



Helmholtz-Zentrum für Ozeanforschung Kiel

RV SONNE Fahrtbericht / Cruise Report SO265

**SHATSKY EVOLUTION:
Evolution of the Shatsky Rise Hotspot System**

Yokohama (Japan) – Kaohsiung (Taiwan)
26.08. – 11.10.2018



Berichte aus dem GEOMAR
Helmholtz-Zentrum für Ozeanforschung Kiel

Nr. 47 (N. Ser.)

December 2018

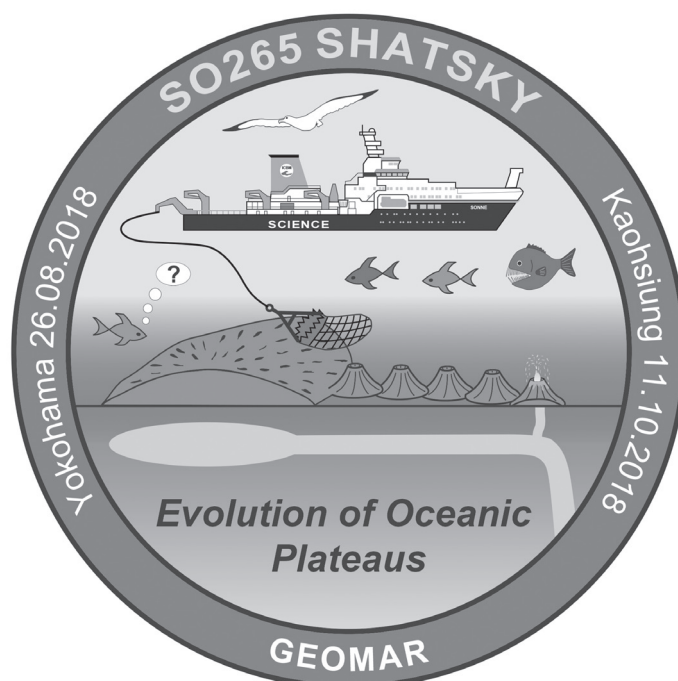


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1.1. SUMMARY

The R/V SONNE expedition SO265 is the central activity of the research project "Shatsky Evolution" that is funded by the Federal Ministry of Education and Research and conducted by the GEOMAR Helmholtz Centre for Ocean Research Kiel in collaboration with international partners. The goal of the project is the investigation of the late stage evolution of Shatsky Rise, a vast, submarine volcanic plateau (Large Igneous Province) in the northwest Pacific. In particular, the project aims to investigate the transition from plateau volcanism (the main body of Shatsky Rise) to postulated hotspot track volcanism (Papanin Ridge and/or Ojin Rise seamounts). Applied methods included bathymetric mapping with the ship's own multi-beam echosounder (KONGSBERG EM 122), sub-bottom profiling (ATLAS PARASOUND DS P70), and rock sampling with chain bag dredges. The main working areas were the Papanin Ridge (the northern extension of Shatsky Rise) and the Ojin Rise Seamount Province (a broad belt of individual seamounts to the east of Shatsky Rise). Dredge hauls were conducted between ~36°N and ~44°N and ~163°E and ~170°E covering the entire geographic extent of both working areas. A third working area, the northern part of Shatsky Rise dominated by its Shirshov Massif, served as a contingency area and only a few dredge hauls were conducted there. In addition, sampling was successfully executed at Hokkaido Trough (45°06'N, 162°27'E), located ~320 km northwest of Papanin Ridge. A total of 72 dredge hauls in average water depths of 4,640 m were carried out during SO265. Of these, 49 (= 68%) delivered *in situ* volcanic rocks samples. No deployed equipment was lost or damaged. Post-cruise investigations at GEOMAR and cooperating institutions will include volcanological/petrological, geochronological, and geochemical studies. Furthermore, macro-benthic organisms were collected from the surfaces of the recovered rocks to study the diversity of deep-sea invertebrates, and sediment sampling (by small sediment traps installed in the dredges) was conducted for meiofauna studies.

1.2. ZUSAMMENFASSUNG

Die FS. SONNE-Expedition SO265 ist die zentrale Aktivität des vom Bundesministerium für Bildung und Forschung finanzierten Projektes "Shatsky Evolution", das vom GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel in Zusammenarbeit mit internationalen Kooperationspartnern durchgeführt wird. Ziel des Projektes ist die geologische Erforschung des Spätstadiums des Shatsky-Rückens, eines großen untermeerischen Vulkanplateaus im Nordwest-Pazifik. Insbesondere soll der Übergang von Plateau-Vulkanismus (der eigentliche Shatsky-Rücken) zu postuliertem Hotspotspur-Vulkanismus (Papanin-Rücken und/oder Ojin Rise Seamounts) untersucht werden. Die angewandten Untersuchungsmethoden umfassten bathymetrische Kartierungen mit dem Fächerecholot (KONGSBERG EM 122) in Verbindung mit Sedimentecholot-Profilierungen (ATLAS PARASOUND DS P70) sowie Gesteinsbeprobung mittels Kettensackdredgen. Die Hauptarbeitsgebiete waren dabei der Papanin-Rücken (die nördliche Verlängerung des Shatsky-Rückens und die Ojin Rise Seamount Provinz (ein breiter Gürtel aus einzelnen Seamounts östlich des Shatsky-Rückens). Die durchgeführten Dredgezüge zwischen ~36°N und ~44°N sowie 163°E und ~170°E und decken daher die Gesamterstreckung der beiden Arbeitsgebiete ab. Ein drittes Gebiet, das vom Shirshov-Massif dominierte nördliche Ende des Shatsky-Rückens, war als alternatives Arbeitsgebiet vorgesehen und dementsprechend wurden dort nur wenige Dredgezüge durchgeführt. Außerdem wurde ein erfolgreicher Dredgezug im 320 km nördlich von Shatsky gelegenen Hokkaido-Graben durchgeführt (45°06'N, 162°27'E). Insgesamt wurden 72 Dredgezüge in durchschnittlich 4.640 m Wassertiefe gefahren. Davon waren 49 (= 68%) erfolgreich, d.h. sie erbrachten *in situ* vorkommende vulkanische Gesteine. Kein eingesetztes Gerät ging verloren oder wurde beschädigt. Die geplanten Untersuchungen der geborgenen Gesteine am GEOMAR und den Partnerinstituten umfassen vulkanologisch-petrologische, geochronologische und geochemische Studien. Zusätzlich wurden auf den geborgenen Gesteinen aufsitzende makrobenthische Organismen sowie die Meiofauna aus an der Dredge angebrachten Sedimentfallen beprobt um die Diversität der in der Tiefsee vorkommenden Invertebraten zu erfassen.

2. PARTICIPANTS

2.1. SHIP'S CREW

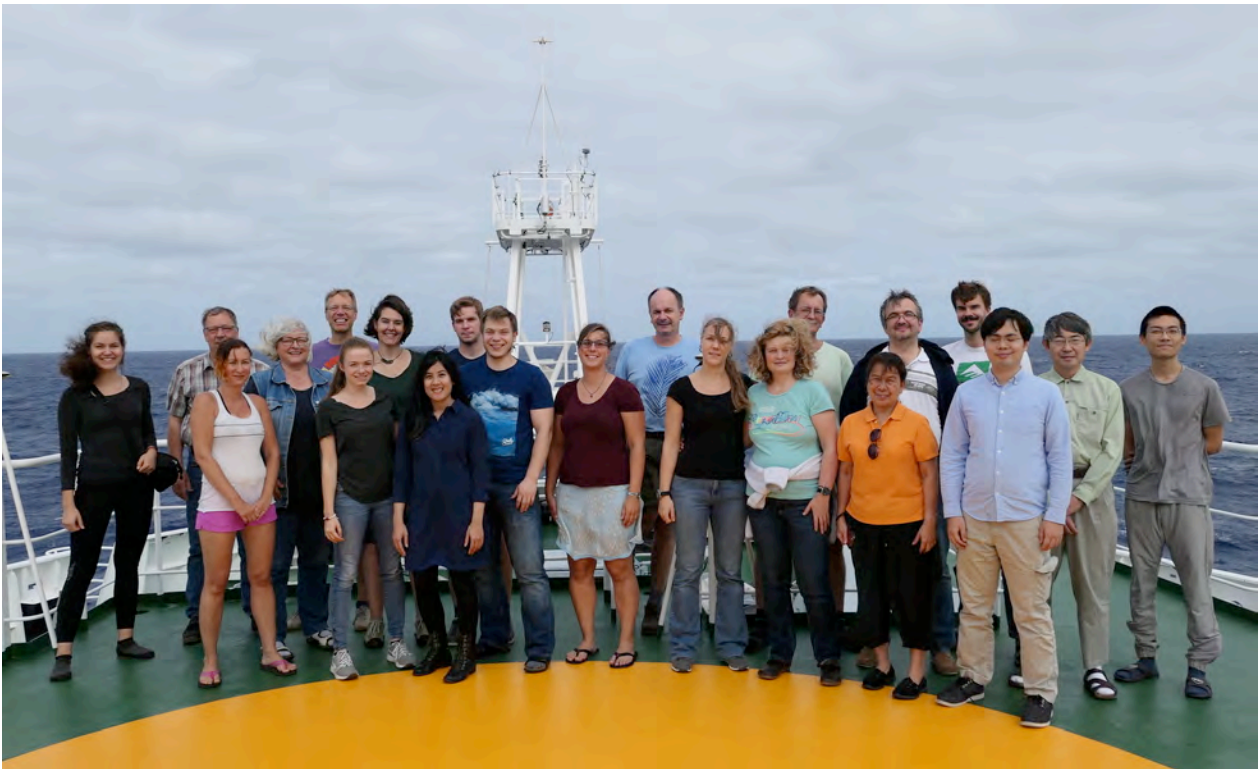
Mallon, Lutz	Master	Schüler, Achim	Chief Engineer
Birnbaum-Feteke, Tilo	Chief Mate	Genschow, Steffen	2 nd Engineer
Büchele, Ulrich	2 nd Mate	Fokken, Johannes	2 nd Engineer
Göbel, Jens	2 nd Mate	Blohm, Volker	Fitter
Leppin, Jörg	Chief Electronician	Langhans, Julian	Motorman
Borchert, Wolfgang	System Operator	Erdmann, Ole	Motorman
Walther, Anke	Surgeon	Lübke, Rene	Motorman
Bierstedt, Torsten	Boatswain	Schlieker, Philipp	Electrician
Eidam, Oliver	A.B.	Adam, Patrick	Electrician
Freitag, Patrick	A.B.	Stöcker, Frank	Chief Cook
Doliwa, Jannik	A.B.	Steep, Maik	2 nd Cook
Schabeck, Henry	A.B.	Lemm, Rene	Chief Steward
Siefken, Tobias	A.B.	Carolino, Bernardo	Steward
Heibeck, Frank	A.B.	Nagel, Jens	Steward
Gieske, Ralf	A.B.		

2.2. PRINCIPAL INVESTIGATORS FOR SO265 SHATSKY EVOLUTION *(in alphabetical order)*

Geldmacher, Jörg (Geology)	GEOMAR
Hoernle, Kaj (Geology)	GEOMAR

2.3. SHIPBOARD SCIENTIFIC PARTY *(in alphabetical order)*

1. Almeev, Renat	Rock Sampling	Univ. Hannover
2. Dürkefälden, Antje	Shift Leader Geology	GEOMAR
3. Geldmacher, Jörg	Chief Scientist	GEOMAR
4. Hampel, Fabian	Rock Sampling	GEOMAR
5. Hauff, Folkmar	Shift Leader Geology	GEOMAR
6. Hauff, Silke	Technician/Rock Sampling	GEOMAR
7. Heitmann-Bacza, Carola	Weather Forecast	DWD
8. Husch, Sabine	Rock Sampling	GEOMAR
9. Kipf, Andrea	Rock Sampling	GEOMAR
10. Nora Krebs	Rock Sampling	GEOMAR
11. Lück, Thorsten	Rock Sampling	GEOMAR
12. Portnyagin, Maxim	Shift Leader Geology	GEOMAR
13. Sano, Takashi	Rock Sampling	NMNS
14. Shimizu, Shoka	Bathymetry	Chiba Univ.
15. Simon, Ina	Rock Sampling	GEOMAR
16. Tejada, Maria Luisa	Rock Sampling	JAMSTEC
17. Truong, Thi Bich	Rock Sampling	OSU
18. Werner, Reinhard	Logistics/Rock Sampling	GEOMAR
19. Witte, Matthias	Rock Sampling	GEOMAR
20. Anne-Christin Zakrzewski	Biological Sampling	MfN
21. Zhou, Hongpu	Rock Sampling	GEOMAR



The SO265 Shipboard Scientific Party. (Photo: Oliver Eidam)

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- DWD** Deutscher Wetterdienst, Seeschiffsberatung, Bernhard Nocht-Straße 76, 20359 Hamburg, Germany, www.dwd.de
- GEOMAR** Helmholtz-Zentrum für Ozeanforschung Kiel, Wischhofstraße 1-3, 24148 Kiel, Germany, www.geomar.de
- JAMSTEC** Japan Agency for Marine-Earth Science and Technology, 2-15, Natsushima-cho, Yokosuka-city, Kanagawa, 237-0061, Japan, www.jamstec.go.jp/e/
- MfN** Museum für Naturkunde Berlin, Leibniz-Institut für Evolutions- und Biodiversitätsforschung, Invalidenstr. 43, 10115 Berlin, Germany, www.museumfuernaturkunde.berlin/
- NMNS** National Museum of Nature and Science, Department of Geology and Paleontology, 4-1-1 Amakubo, Tsukuba 305-0005, Japan, <http://www.kahaku.go.jp/english/>
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- Univ. Hannover** Gottfried Wilhelm Leibniz Universität Hannover, Institut für Mineralogie, Callinstr. 3, 30167 Hannover, Germany, www.mineralogie.uni-hannover.de/mineralogie.html

3. NARRATIVE OF THE CRUISE

(J. Geldmacher)

In the morning of August 26, the SO265 scientific party embarked R/V SONNE in the port of Yokohama (Japan). After all equipment was loaded (including our two containers), the vessel set sail in the afternoon of August 27 with fine weather and begun its 4-day transit to our first planned sampling location on the northern Shatsky Rise (Fig. 3.1). The scientific party consists of 21 scientists (including students) and technicians from six different countries and eight international research institutions.



Fig. 3.1 (upper left): RV SONNE clearing port in Yokohama in the afternoon of August 27.

Fig. 3.2 (upper right): Deteriorating weather conditions on August 31 during the transit to the planned first working area.



Fig. 3.3 (bottom left): Retrieving the CTD probe at night time.

(Photos: J. Geldmacher)

During transit the weather conditions deteriorated and the forecast for our planned first working area (Area I: Papanin Ridge) predicted wind speeds and swell highs that would drastically limit our operational options (Fig. 3.2). Therefore, we decided to switch towards a more southerly located alternative area on the central Shatsky Rise (Working Area II: Ojin Rise Seamount Province) for which the weather forecast looked more promising. After arrival, we first conducted a water sound profile by running the CTD-Probe (conductivity, temperature, depth) down to 2,000 m water depths to calibrate the ship's-own multi-beam echo-sounding system (Fig. 3.3). Thereafter, we successfully conducted two dredge hauls on two prominent seamounts located NE of the Shirshov Summit (DR 2 and DR 3) (Fig. 3.4). Two types of lava rocks were recovered; aphyric and plagioclase-aphyric, similar to the rocks previously dredged by our Japanese colleagues on the southern Ojin seamounts. Afterwards, we continued our transit to northern Shatsky Rise where weather conditions had improved in the meantime. The beginning of Papanin Ridge is marked by the Thompson Trough, a tectonic graben structure (Sager et al. 1999) separating Shatsky Rise with its Shirshov summit in the south and Papanin Ridge to the north (Fig. 3.5). Because this structure provided the rare opportunity to obtain basement samples of both Shirshov Massif and Papanin Ridge, we conducted several dredge hauls at the northern and southern flanks of the trough. From the southern slope (Shirshov side) volcanic rocks could

only be recovered from the lower slope of one seamount (DR 4), but it is currently unclear if this seamount belongs to the Shirshov basement or represents a later feature (e.g. an Ojin seamount?). Two attempts to sample the prominent "Earthwatch Seamount" (named by the R/V Thompson scientific party who dredged this seamount in 1994) failed because the sea state prevented us from dredging its much steeper NE slope. In contrast, sampling the basement of Papanin Ridge (northern slope of Thompson Trough) was successful (DR 7). Another dredge haul up the slope of a seamount which southern flank forms the northern Thompson Trough hillside near its eastern end was also successful (DR 11), yielding well-preserved porphyritic lava rocks.

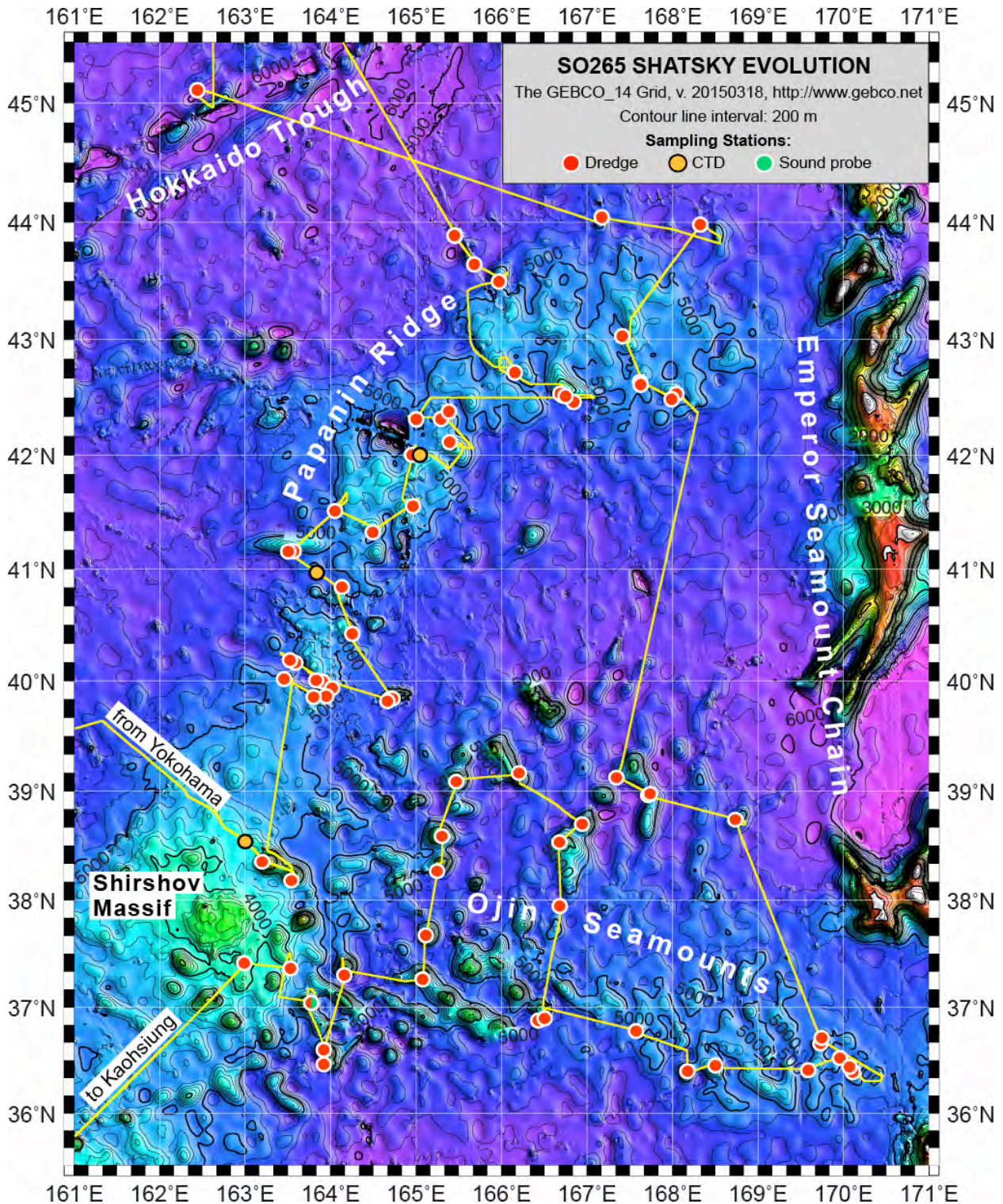


Fig. 3.4: Ship's track and sampling stations (colored dots) of R/V SONNE cruise SO265 (data base for bathymetry: The GEBCO_2014 Grid, version 20150318, <http://www.gebco.net>).

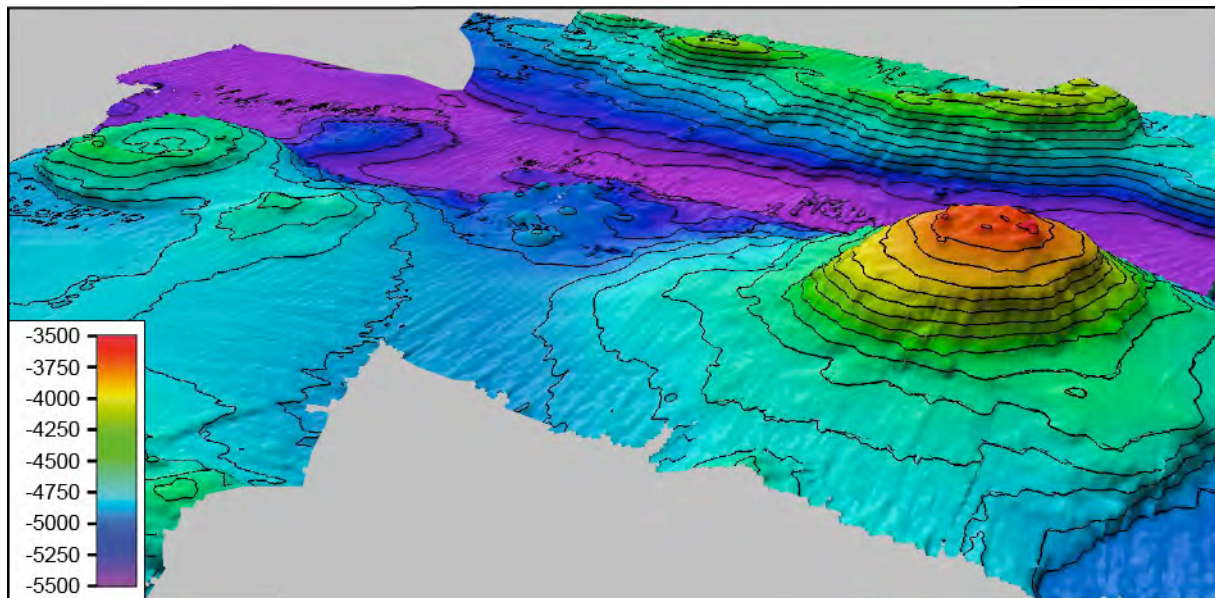


Fig. 3.5: Multi-beam echo-sounding (EM 122 system) data from "Thompson Trough", a 10 km wide canyon that separates Papanin Ridge (upper right side) from the main Shatsky plateau (in the foreground). The large cone in the right was named "Earthwatch Seamount" by the R/V Thompson TN037 expedition scientific party. The three dimensional presentation was processed with "Fledermaus" 7.8.5 software and is shown with 4-times exaggeration.

About 30 nm to the east, a strangely-shaped structure (a pointed, E-W elongated ridge) caught our attention and was given the working name "Sonne Ridge". Because of its form (that differs from the typical roundish Ojin seamounts) we speculated about a possible tectonic origin related to movements at the nearby Thompson Trough. Dredge hauls DR 12 and DR 14 at the deeper and upper slope of Sonne Ridge respectively, recovered well-preserved olivine and plagioclase-phyric pillow lava fragments. Afterwards, the vessel returned to the main body of Papanin Ridge.

By the end of the second week, we had sampled the Papanin Ridge up to a latitude of $42^{\circ}30'$ N which roughly corresponds to one half of its North-South extension. Successfully sampled structures include Shuleykin Seamount (DR 18, 19), which forms a prominent E-W elongated edifice off the eastern edge of Papanin Ridge at $41^{\circ}10'N$ and the deep slope of Papanin Ridge at $41^{\circ}36'$ (DR 20), which we believe to represent the "basement" of Papanin Ridge. Also noticeable, from here on northwards, the dredged rocks also seem to include occasionally ice rafted debris (drop stones), whose origin was quickly revealed by their distinctly fresher appearance and the lack of manganese coating.

At the beginning of the third week we reached the northeastern extension of Papanin Ridge (east of $\sim 165^{\circ}30'$). Sampling this area was of great importance to us because based on paleomagnetic data (Sager et al., 1999) the ridge is here proposed to have no longer formed at a spreading axis, but originated by true intraplate volcanism (i.e. volcanism away from plate boundaries). Accordingly, we expect that the lavas obtained from this area possess a different geochemical composition (compared to the southern part of Papanin Ridge). Initially, our dredging program continued as planned (Fig. 3.6) but in the middle of the week, we had to avoid an approaching storm. After the ship's command and the expedition leadership consultation with the meteorologist from the National Meteorological Service (DWD), who was joining this expedition, the decision was made to northwardly sidestep the storm (by steaming 290 nm to the NE and weather at a position $48^{\circ}N, 162^{\circ}E$) and then safely return on its backside into the working area. This plan worked out well. By Saturday morning, Sept. 15 we found ourselves dredging again on the northern edge of Papanin Ridge in nice weather conditions.

The little unintended excursion to the north, furthermore, enabled us to map and sample the hitherto totally uninvestigated Hokkaido Trough, a 1,000 km long canyon that likely represents an abandoned spreading ridge (Fig. 3.4). Although the sea state did not allow us to dredge the steeper southern side of the trough flank, we managed to obtain pillow fragments from its northern slope (DR 38), which are altered but still suitable for most geochemical analyses and

possibly even age dating (abundant plagioclase microphenocrysts). The recovered samples will hopefully allow us to determine the age of this structure and thus better constrain the plate tectonic history of this little investigated part of the Pacific Ocean.



Fig. 3.6: Upper left: The dredge is hauled on board (Photo: J. Geldmacher). Lower left: Always much excitement! (Photo: F. Hampel) Upper right: Cutting rocks is a messy job! (Photo: J. Geldmacher). Lower right: Cleanup of protective clothing with scientist Takashi Sano inside! (Photo: M.L. Tejada)

Getting samples from the "intraplate" part of Papanin Ridge turned out to be challenging. Many dredges were empty or just returned large numbers of manganese nodules (Fig. 3.7). Moreover, after completing a 40 km long transit to an apparently large volcano (15 km in diameter) that was predicted to exist based on satellite gravimetry data at 188°30'E, the far edge of the working area, the structure could not be found.

We finished our work at the northeastern extension of Papanin Ridge on Sept. 17, in the fourth week of this expedition, and began our long transit to the Ojin Rise seamount province. Overall, however, we managed to get suitable samples for addressing the research objectives for the northeastern tip of Papanin Ridge from five spatially well-distributed locations (DR 30, 35, 39, 42, 44). The transit was also used for celebrating the traditional "Bergfest" (hump day party) indicating that half of the time for this expedition is over. After two weeks of around-the-clock shift work, everyone enjoyed this short break to gain new motivation for the remaining, almost too short, time on board.

The transit was conducted in two legs: The first leg led us 200 nm (about 370 km) southward to the northernmost representatives (at ~39°N) of the broad belt of Ojin seamounts. We managed to get volcanic rocks from two out of three sampled structures. DR 47 returned moderately to strongly altered slightly phyrlic to aphyric, angular lava fragments within manganese nodules. In contrast, DR 49 returned a large number (the chain bag was half full!) of pillow lavas (Fig. 3.8) including some very well-preserved vesicular rocks which contained vesicles still unfilled by secondary material.



Fig. 3.7: Scientist Maxim Portnyagin screening manganese nodules for hidden rocks (Revelation of the picture puzzle: It's the angular block just in the middle of the picture!). (Photo: J. Geldmacher)



Fig. 3.8: Pillow lava fragment with chilled margin (yellowish rim) and elongated pipe vesicles (Photo: GEOMAR).

The second leg of the transit led us another 240 km southeastwards to the eastern termination of the Ojin Seamount province (at $\sim 36^{\circ}\text{N}$ and 170°E). If this widespread belt of seamounts represents an age-progressive hotspot track, this must be its youngest end. Therefore, it was of great importance to us to recover well-preserved rocks suitable for radiometric age dating. The alleged end of the hotspot track turned out to consist of a cluster of medium-sized (c. 10 km \varnothing), pancake-shaped seamounts (Fig. 3.9). We managed to get suitable lava rock material from three out of four sampled pancake volcanoes (DR 52, 53, 54). One of the seamounts features an almost perfectly round, several hundred meters deep "crater" of more than 3 km diameter at its summit. This depression probably represents a caldera instead a classical (explosive) crater. Interestingly, we have frequently detected such caldera structures on medium-sized (pancake-shaped) seamounts in both working areas (Papanin Ridge and Ojin Seamounts). Because of the remarkable steepness of the inner caldera wall of this seamount, we decided to conduct a dredge haul up the caldera wall and we were awarded with exceptionally fresh pillow lava fragments (DR 53). The obtained lava rocks contain phenocrysts of feldspar and we found relicts of fresh glass in the chilled margins! A totally unexpected surprise!

During the following days, we worked our way west in an attempt to retrieve spatially well-distributed samples covering the entire 760 km long E-W extension as well as the up to 350 km wide S-N spread of the Ojin Seamount Province. This approach was successful: In total, 35 dredge hauls were conducted on Ojin seamounts of which 27 returned igneous rocks (Fig. 3, 4), and 24 of those cases yielded quantitatively and qualitatively sufficient material for addressing the project's objectives. Occasionally, the recovered rocks contained well-preserved, large feldspar crystals (e.g. DR 63) and in two instances (DR 69 and DR 73) even fresh volcanic glass was discovered. Therefore, all three research goals for this working area (Do the Ojin volcanoes get younger towards the east? Does the geochemical composition vary with time? Can we see a geographic zonation in the geochemistry?) can be addressed by the planned post-cruise analyses on shore. To avoid duplication of efforts, we did not re-sample those five seamounts that were successfully dredged by T. Sano's R/V KAIREI expedition in 2014.

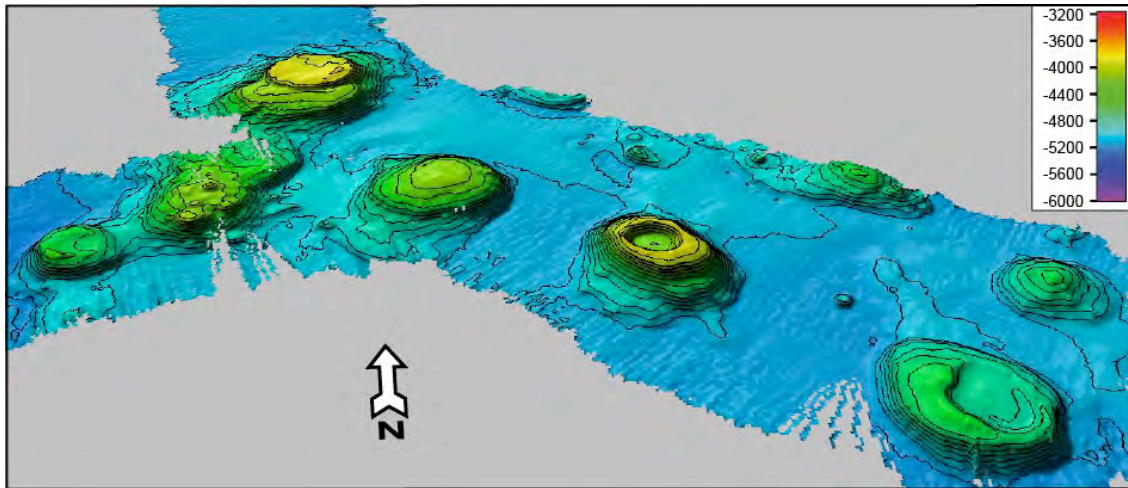


Fig. 3.9: The southeastern termination of the Ojin Rise Seamount Province (at 36°30'N, 170°00'E) is composed by several medium-sized (c. 10 km Ø), pancake-shaped seamounts. A dredge haul conducted within the eye-catching caldera of the seamount in the center of the picture recovered particular well-preserved lava rocks including fresh volcanic glass (DR 53). The three dimensional presentation was processed with "Fledermaus" 7.8.5 software and is shown with 4-times vertical exaggeration.

The last 1.5 days of operational time were dedicated to Working Area III (Northern Shatsky Rise, i.e. the Shirshov Massif). When we lost 3 days of operation time during the third week due to the passing storm (see above), we decided to cut this time out of the 5 days that were originally planned for Northern Shatsky Rise. This Working Area III was at the lowest priority and primarily served as a potential contingency site in case weather conditions would not have allowed us to substantially operate further north (Papanin Ridge) or east (Ojin Seamount Province). Finding suitable dredge sites on Shirshov Massif, however, proved to be difficult. In addition, another approaching storm system (with predicted wave heights up to 12 m) was announced to force us to leave Shatsky Rise earlier than originally planned, thus further reducing the time available to search for better dredge locations (e.g. with steeper slopes). We placed high hopes in dredging a newly discovered 100 m high and >30° steep cliff east of the Shirshov summit, but dredge DR 74 (despite recording a 80 KN bite on the rope tension meter) returned completely empty. Our last attempt targeted a little structure on the eastern Shirshov summit, which could be either a small Ojin seamount or, more likely, a second Shirshov summit that peaks through the thick sediments. DR 75 returned at least one small piece of well-preserved volcanic rock (containing plagioclase microphenocrysts) that could be excavated from a larger Mn crust.

Autumn is quickly approaching in the North Pacific, as evidenced by the increase of heavy storms at these latitudes. Such an approaching storm now forces us to leave our operational area one day earlier as originally planned. Therefore, the last dredge haul was conducted on Friday, September 28 and we set sail for the long transit southward to the port of destination, Kaohsiung in Taiwan. During the transit, the new ships-own OFOS (Ocean Floor Observation System) was successfully tested on the 1,340 m deep summit platform of Katayama Seamount (25°48' N, 147°50' E). In total we have conducted 3 CTD stations and 72 dredge hauls of which 49 (=68%) returned *in situ* volcanic rocks (Fig. 3.4). The SONNE arrived in Kaohsiung on October 9, 2018 and this fantastic cruise came to an end.

4. AIMS OF THE CRUISE

(J. Geldmacher)

IODP Expedition 324 (in 2009) has considerably improved our knowledge about the timing and origin of the Shatsky Rise. Although new evidence has emerged from the drilled samples favoring the origin of the Shatsky Rise through the interaction of a mantle plume with a triple junction of spreading centers, the evidence for the involvement of a mantle plume is not unequivocal. Association of the Shatsky Rise with an age-progressive hotspot track (ages decreasing along a volcanic track extending from the young end of the Shatsky Rise, i.e. Shirshov Massif) could be the “smoking gun” for the involvement of a mantle plume. Interestingly, two different bathymetric features emanate from the Shirshov Massif and could potentially serve as the Shatsky hotspot track. The Papanin Ridge extends to the NE of the Shirshov Massif and has a similar strike as the combined Tamu and Shirshov Massifs; whereas, the Ojin Rise Seamount Province extends ENE from the Shirshov Massif and has a similar strike as the combined Ori and Shirshov Massifs (Fig. 4.1). Both Papanin Ridge and the southern part of the Ojin Seamount Province change strike to the SW at ~167°E longitude. These bathymetric features project eastwards to Hess Rise (intersected only by the mighty Emperor Seamounts hot spot track that formed approximately 50-60 million years later). Demonstrating that one (or both) of the tracks continues the age progression found at Shatsky Rise and has similar geochemistry would provide strong evidence in favor of the plume hypothesis for the origin of the Shatsky Rise. It is also conceivable that both bathymetric anomalies are associated with a Shatsky Plume and represent splitting of the plume into two separate conduits, as has been proposed for the Tristan-Gough plume where the Walvis Ridge bifurcates and then separate plume tracks continue to Tristan da Cunha and Gough Islands (Rohde et al., 2013a,b, Hoernle et al., 2015). Beyond the direct objectives of SO265 lurks the question on the origin of the Hess Rise and whether or not it is also related to the Shatsky hotspot, e.g. represents a second plume pulse from the Shatsky hotspot. A second large pulse of the hotspot could have caused two separate plume conduits (Papanin and Ojin) to merge again (Hess Rise) and thus form a single hotspot track thereafter producing the Liliuokalani Ridge (located north of the Hawaiian seamount chain, see Fig. 4.1) that continues to the Marquesas Islands, which have been proposed to represent a zoned hotspot track (Huang et al. 2011). Since Shatsky Rise, if generated by a mantle plume, formed above the margin of the large-scale, low velocity province (LLSVP) at the base of the lower mantle (Torsvik et al., 2010), it is likely to be a zoned hotspot system. One aim of the postcruise research on the obtained lava samples is therefore to look for evidence for a spatial geochemical zonation within Papanin Ridge and the Ojin Seamount belt.

In particular the following scientific questions and hypotheses shall be addressed:

Working area I: Papanin Ridge (Highest Priority):

- What is the age and geochemical composition of Papanin Ridge? Does this ridge represent the beginning of a Shatsky hotspot track? If so, we would 1) expect ages younger than the main phase of volcanism on the Shirshov Massif and 2) an age progression along the ridge with lavas in the NE being younger than in the SW. Also, we want to test if similar geochemical components and greater heterogeneity are present in the Papanin Ridge compared with the Shatsky Rise, because source heterogeneity is likely to be better preserved at lower-degrees of melting in the plume conduit in an intraplate setting compared to higher degree melting during plume head - ridge interaction.
- Do Papanin Ridge lavas from east of 165°30' (where the Ridge is believed to have formed by pure intraplate volcanism) differ in composition ("lid effect") from lavas that formed west of this longitude (where the ridge followed the trace of the triple junction)?
- Is there evidence for a spatial geochemical zonation across Papanin Ridge? Since two distinct non-MORB source components have been recognized in the plateau lavas and since Shatsky was located at the edge of the lower mantle Pacific superswell in the Early Cretaceous (apparently a precondition for generating zoned hotspots, see Chapter 6.1), it is possible that Papanin Ridge is geochemically zoned as well. Therefore, it shall be tested if dredge samples from the western flank of the ridge have different isotope signatures than samples from the eastern flank. The detection of spatial geochemical

zonation at Papanin Ridge would not only represent the oldest zonation ever recognized in a hotspot track, but would directly link the processes that created Papanin Ridge to many other (zoned) island or seamount chains, for which a hotspot track origin is well established.

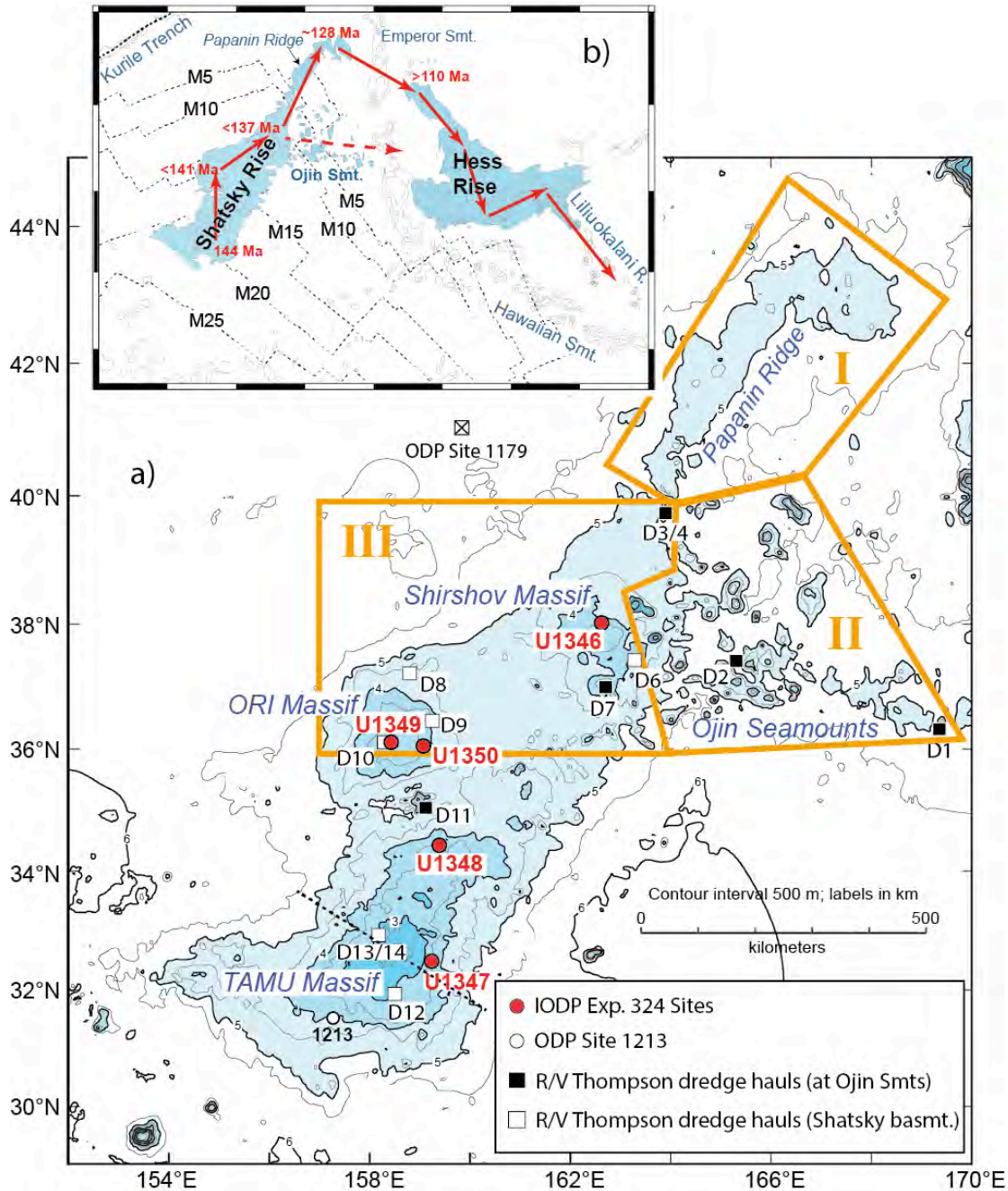


Fig. 4.1: (a) Bathymetric chart of Shatsky Rise with sites of IODP/ODP drill holes and R/V Thompson expedition dredge hauls. Modified after Sager et al. (2010). (b) Regional overview map with selected magnetic lineations (dashed lines) and reconstructed path of volcanism (hotspot track) with assumed ages based on magnetic data (after Sager et al., 1999). The three working areas of expedition SO265 are marked by yellow frames. Stippled line indicates location of seismic profile in Fig. 6.1.

Working area II: Ojin Seamount Province (second highest priority):

- What is the age and geochemical composition of the Ojin Seamount Province and what is their relation to Shatsky Rise? Do they show a west to east younging age progression beginning shortly after formation of the Shirshov Massif, which would provide evidence that they could represent a hotspot track associated with the Shatsky Rise. If both Papanin Ridge and Ojin Seamounts prove to be hotspot tracks related to Shatsky, then an important question is if each track shows a distinct composition, reflecting a spatially

zoned plume, similar to what has been observed for the Tristan-Gough hotspot track system.

- Alternatively, if the Ojin seamounts do not show the proper age-progression to be a hotspot track, what is the origin of this vast seamount province? Do they represent reactivated volcanism associated somehow with the plateau (also discussed for other plateaus in the Pacific, e.g. Ontong Java, Tejada et al., 2013; Hikurangi, Hoernle et al., 2010, based on results from SO168; Manihiki, Timm et al., 2011, based on results from SO193; and Walvis Ridge Homrighausen et al., 2018, based on results of SO233 & SO234) and if so, what are the mechanisms for causing such reactivation. Does it represent melting of recycled subcontinental lithosphere during continental breakup, as proposed for the Christmas Island seamount province (Hoernle et al., 2011; SO199 expedition results), or through the melting of upwelling shallowly recycled ocean lithosphere (e.g. Timm et al., 2010; based in part on SO168 and 169 expedition results). Finally, is the age of the Ojin seamount formation contemporaneous to the oceanic anoxic events (OAE) 1 or 2 implying a causal connection as suggested by Marsaglia (2005)?

Working area: Northern part of Shatsky Rise (lowest priority)

- What is the range of age and geochemical composition across the northern edge of the Shatsky Rise (western, northern and eastern slope of Shirshov Massif)? Can increased geochemical heterogeneity and a decreased degree of melting be detected as suggested by the IODP expedition 324 drilling results?
- Does the geochemical composition of lavas from the northern Shirshov region differs from that of lavas drilled at Site U1346 (see Fig. 4.1)? If so, does this point towards the transition from a more geochemically homogeneous plateau volcanism to a generally more geochemically enriched and heterogeneous hotspot track volcanism? Dredging the outer slopes of Shirshov Massif will also answer the important question how representative the drilled samples from Site U1346 really are, considering that only 53 m of basement was cored at this single site.

In conclusion, we believe that the SHATSKY EVOLUTION project will make significant contributions to solving outstanding questions concerning the origin of oceanic plateaus (Shatsky), submarine ridges (Papanin) and seamount provinces (Ojin). If the plume hypothesis is confirmed and Papanin and/or Ojin are identified as age-progressive volcanic tracks associated with the Shatsky plateau, then our results could also have important implications for the evolution and behavior of mantle plumes in general, including one of the hottest topics in mantle geochemistry at the present, plume zonation.

5. AGENDA OF THE CRUISE

(J. Geldmacher)

To achieve the scientific goals, SO265 should conduct systematic multi-beam mapping, and hardrock sampling by dredging in all the key areas discussed in Chapter 4.

Besides few reconnaissance dredge hauls (see Fig. 4.1a), the northern flanks of Shatsky Rise, the Papanin Ridge and most Ojin seamounts were never sampled by dredging (to our knowledge) before SO265. Therefore, a comprehensive sampling program with maximum spatial coverage was important for these structures to constrain their age and geochemical composition. At Papanin Ridge, sampling should cover the whole crest (from ~40° to ~44°N) to detect a possible age progression, as well as both flanks of the ridge to test a possible axis-parallel spatial geochemical zonation. When sampling the Ojin Seamount Province, priority should be given to structures that were not previously dredged during the R/V Thompson expedition or by the recent R/V KAIREI cruise in 2014. For the goals of the SO265 SHATSKY EVOLUTION project, however, a widespread spatial coverage of the Ojin Seamount Province was required (to detect age progression or zonation). A third working area was the northern edge of Shatsky Rise comprising the flanks of Shirshov Massif. This area, however, should only be sampled if time is left after completing all tasks in the first two working areas. Considering the objectives and goals of this project, the three working areas should be visited in the following order (weather permitted): Papanin Ridge (first priority), Ojin Seamount Province (second priority) and northern part of Shatsky Rise (contingency program, least priority). Based on the Gebco data set (Gebco_08-Grid, <http://www.gebco.net>, see below) and other available information we planned a total of c. 68 dredge stations.

6. BRIEF INTRODUCTION INTO THE WORKING AREA

(J. Geldmacher, T. Sano, M.L. Tejada)

6.1. TWO COMPETING MODELS FOR THE ORIGIN OF SHATSKY RISE

The origin of large igneous provinces (LIPs) is a subject of an ongoing debate. Proposed models range from formation by deep (hot or chemically distinct) mantle upwellings (mantle plumes) to origin by shallow (plate tectonic-related) processes (for overview see: e.g. Farnetani and Samuel, 2005; Foulger, 2007; Campbell and Kerr, 2007). In that respect, the submarine Shatsky Rise, located in the northwest Pacific Ocean c. 1500 km east of Japan (Fig. 4.1), is unique, since it appears to share both plume- and plate-related characteristics. Its spatial extent of $\sim 4.8 \times 10^5$ km² (covering a similar area as Germany, Austria and Denmark combined) makes Shatsky Rise the third largest oceanic plateau (after Ontong-Java and Kerguelen) (Sager et al., 1999). Seismic refraction experiments reveal a maximum crustal thickness of ~ 30 km (Korenaga and Sager, 2012). In contrast to other large oceanic LIPs (e.g., Ontong-Java, Manihiki, Hess Rise), which formed during the Cretaceous normal superchron (121-83 Ma; Cande and Kent, 1995), Shatsky Rise is the only large intraoceanic plateau that formed in the Late Jurassic to Early Cretaceous during a period of frequent reversals of Earth's magnetic field. The magnetic reversals, combined with bathymetric data, allow the reconstruction of the original tectonic setting and temporal evolution of the plateau (e.g. Nakanishi et al., 1999; Sager et al., 2016). Accordingly, Shatsky's three main volcanic edifices (Tamu, Ori and Shirshov) formed by massive volcanism during a short time span along a southwest - northeast trending, rapidly spreading (with frequent ridge jumps) triple junction among the Izanagi, Farallon and Pacific plates (e.g. Sager et al., 1999; Nakanishi et al., 1999). Apparently, the plateau began its formation with the eruption of Tamu Massif (2.5×10^6 km³), located at the southern end of Shatsky Rise. The Tamu Massif preserves magnetic anomaly M19 (~ 144 Ma, Gradstein et al., 1994) (Fig. 4.1b). This is in good agreement with published radiometric ages from Shatsky Rise, that cluster around 143-145 Ma (Mahoney et al., 2005, Geldmacher et al., 2014). This age, when combined with the nearby seafloor magnetic lineations, suggests that Tamu Massif was constructed at a very high rate, with upper estimates of 4.6 km³/a, a value that corresponds to more than a quarter of today's oceanic crust production rate worldwide (Sager et al., 2010). The smaller Ori (0.7×10^6 km³) and Shirshov massifs (0.6×10^6 km³), located to the NE of Tamu, must be younger, because they stand on lithosphere younger than M19 (Fig. 4.1b). The youngest magnetic lineation, identified beneath both Ori and Shirshov massifs, is anomaly M14 (140 Ma). Northeast of Shirshov, the rise connects with the much less voluminous Papanin Ridge (0.4×10^6 km³), which is underlain by anomalies M10 to M1 (134-125 Ma), providing a maximum age range for the ridge. About eighty small- to medium-sized seamounts are located primarily to the east and northeast of Shirshov Massif near the transition to Papanin Ridge, the Ojin Rise seamounts (Sager et al., 1999), hereafter called Ojin Seamounts for simplification (Fig. 4.1a).

The formation along a triple junction, with the three main volcanic massifs having sides that are oriented parallel to spreading ridges and transform faults, implies that the emplacement of Shatsky Rise was controlled by shallow ridge-tectonic processes. On the other hand, the rapid formation of Tamu Massif and the decreasing volume of the three edifices with decreasing age (Fig. 6.1) indicate that the initially voluminous volcanism waned through time and may have continued along the less voluminous Papanin Ridge and/or Ojin seamount province. Such temporal evolution is consistent with classical plume head models and could represent the transition from a plume head (plateau-forming) to plume tail (hotspot track-forming) (e.g. Richards et al., 1989).

In summary, Shatsky Rise shows characteristics of both ridge-controlled formation and involvement of a plume (head). To investigate this apparent contradiction and to address the question of Shatsky Rise's origin, the IODP Expedition 324 was conducted in 2009 (three participants of this IODP expedition also sailed on SO265).

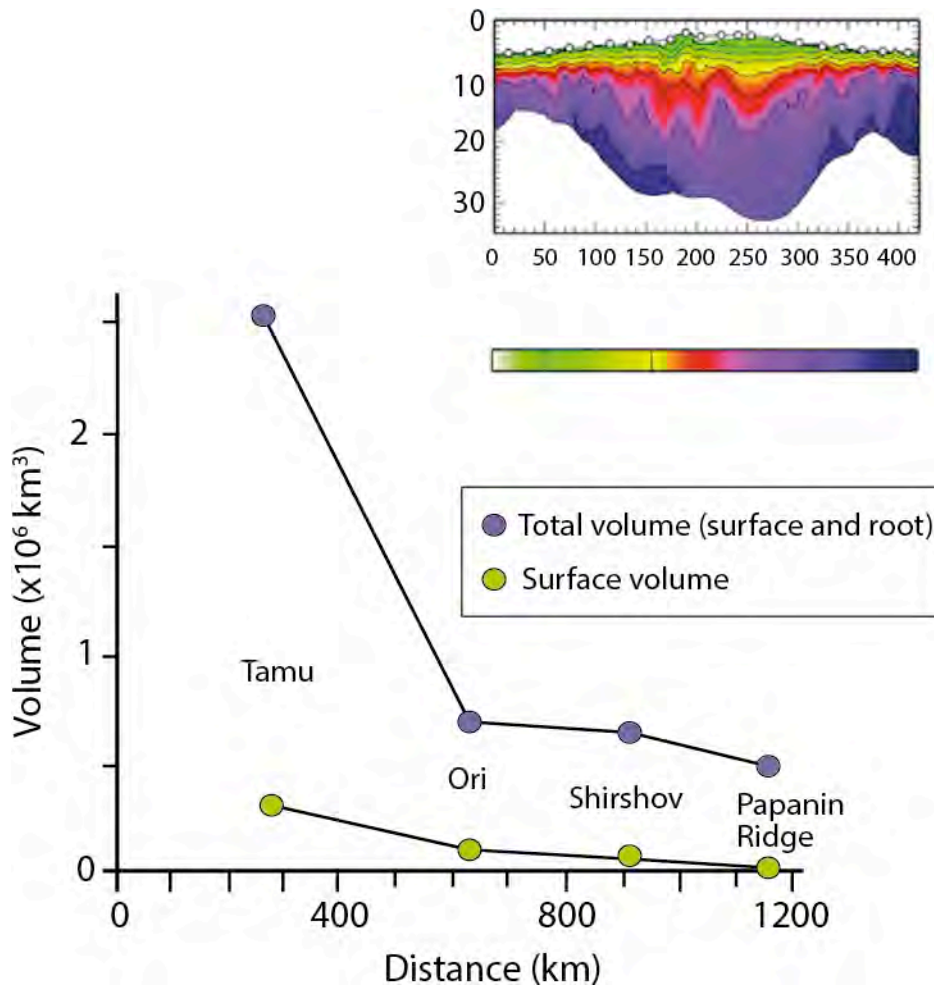


Fig. 6.1: (a) Crustal thickness and velocity model (based on joint refraction and reflection seismic tomography) of Tamu edifice (profile perpendicular to the rise axis which is crossed at c. 220 km, see Fig. 4.1 for orientation of seismic line). Taken from Korenaga and Sager (2012). (b) Estimated volume versus distance along the Shatsky Rise axis (excluding a 7 km thick oceanic crust). Modified from Sager et al. (1999).

Before IODP Expedition 324, very few samples existed from the Shatsky Rise. Igneous rocks (sills or late lava flows) were encountered at the base of the sediment pile at ODP Hole 1213B (Fig. 4.1a) and radiometrically dated and described in Mahoney et al. (2005). In addition, a few dredge hauls were conducted on Shatsky Rise and nearby structures in 1994 during a primarily geophysically-oriented site survey cruise with the US ship R/V Thompson (Fig. 4.1a). Because only light barrel-dredges were used, and only single dredge hauls were conducted at each structure (Klaus and Sager, 2002), most recovered rocks are highly altered and therefore largely unsuitable for geochemical studies. Nevertheless, immobile trace elements and isotope ratios show that these drill and dredge samples have compositions slightly more enriched than Pacific mid-ocean-ridge basalt (MORB) (Tatsumi et al., 1998; Mahoney et al., 2005; Tejada et al., 2016).

6.2. RESULTS FROM IODP EXPEDITION 324

Five sites on the three Shatsky edifices (Site U1346 on Shirshov, U1349 and U1350 on Ori and U1347 and U1348 on Tamu) were drilled and successfully sampled (Fig. 4.1a). Basaltic lava flows were cored at all sites except for Site U1348, at which only a thick sequence of highly altered volcanoclastic sediments was recovered. The cored volcanic sequences consist of packages of pillow basalt and massive sheet flows, frequently interbedded with volcanoclastic sediments (Sager et al., 2010). The most massive inflation flows have a maximum thickness of ~23m and the thickest occur on Tamu Massif, comparable to massive flows cored on Ontong Java Plateau during ODP Leg 192. Fewer massive flows are found at Sites U1349 and U1350 on the Ori Massif summit and flank, respectively, and the individual flow units are generally

thinner than on Tamu Massif. The entire ~50 m succession of igneous rocks penetrated at Site U1346 on the Shirshov Massif summit consists of pillow lavas. The decrease in number and thickness of massive flow units presumably indicates that the average eruptions became smaller and less effusive from Tamu to Ori to Shirshov massifs (Sager et al., 2011).

First $^{40}\text{Ar}/^{39}\text{Ar}$ age determinations on groundmass and plagioclase separates from the drilled flows yield ages between 134-145 Ma (Tamu Massif) and 134 Ma (Ori Massif) (Heaton and Koppers, 2014; Geldmacher et al., 2014) consistent with the earlier published age of 144.6 Ma from Tamu Massif (Mahoney et al., 2005) and supporting the proposed age progression from the SW to the NE as inferred by the magnetic lineations.

Petrological and geochemical studies (based on major and trace element compositions) indicate that Tamu Massif basalts resemble those from the Ontong Java plateau and were produced by 15 to >20% partial melting at depths largely within the garnet stability field (Sano et al., 2012; Husen et al., 2013) (Fig. 6.2). Although the final depth (upper limit) of melting beneath Shatsky Rise (~30 km) is deeper than for MORB magmas (<15 km, Langmuir et al., 1992), the degree of melting is somewhat higher (N-MORB = $\leq 15\%$) and comparable to Ontong Java and Manihiki Plateaus (= 20-30%, Mahoney et al., 1993; Fitton and Godard, 2004; Herzberg, 2004; Timm et al., 2011). This implies that the mantle was hotter and/or more fertile than the MORB source. High crystallization temperatures, however, were not detected thus far (Husen et al., 2013).

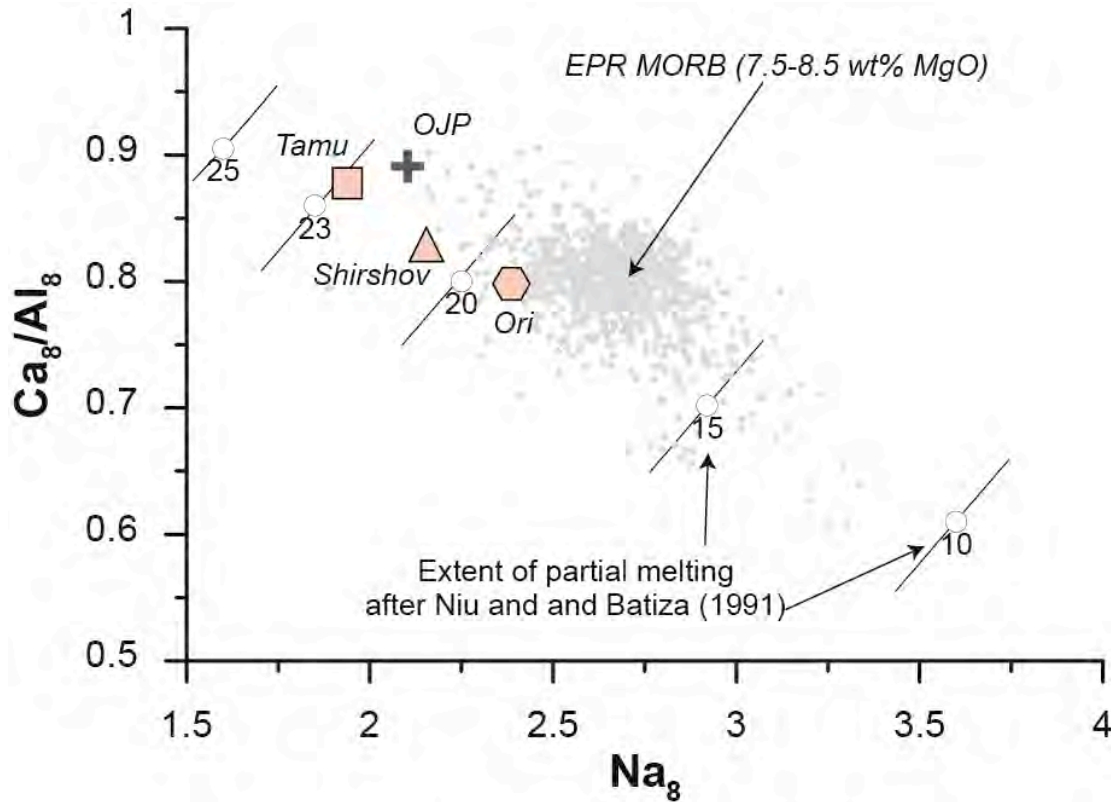


Fig. 6.2: Fractionation corrected average values of Ca_8/Al_8 versus Na_8 for volcanic glass samples drilled from Tamu ($n=41$), Ori ($n=3$), and Shirshov ($n=1$) compared to East Pacific Rise MORB and the Ontong Java Plateau (OJP). Figure slightly modified from Husen et al. (2013). The composition of Tamu Massif lavas indicates higher degree of source melting compared to lavas from the younger edifices. Note that only one glass sample exists for the youngest Shirshov massif (and its low Na_8 value might be therefore not very representative). If Papanin Ridge and/or the Ojin seamounts represent the hotspot track of Shatsky Rise (and if glass samples can be recovered), its elemental composition should plot in the lower right sector of this diagram.

Using immobile (alteration-resistant) trace element ratios (Zr/Ti , Nb/Sc , Nb/Ti), the drilled rocks can be divided into four groups: Normal, Low-Ti, High-Nb and U1349 types, with the Normal type group being the most abundant (Sano et al., 2012). Normal type lavas originated from a relatively depleted mantle source and the low-Ti group is genetically related to the Normal type, which is supported by similar initial Sr-Nd-Pb-Hf isotopic compositions of the two groups

that overlap with the Pacific MORB field (corrected for radiogenic ingrowth to 144 Ma) (Fig. 6.3). Formation of the High-Nb group lavas, however, requires a more enriched source, based on their higher $^{207}\text{Pb}/^{204}\text{Pb}$, $^{208}\text{Pb}/^{204}\text{Pb}$, $^{87}\text{Sr}/^{86}\text{Sr}$ but lower $^{146}\text{Nd}/^{147}\text{Nd}$ and $^{176}\text{Hf}/^{177}\text{Hf}$ ratios that trend towards enriched mantle endmembers such as Enriched Mantle (EM) I or II (Heydolph et al., 2014). The U1349 group lavas yield the most depleted Nd and Hf isotopic compositions that are nearly identical to contemporary, local MORB samples from ODP site 1179 obtained from early Cretaceous oceanic crust just north of Shatsky (Fig. 4.1a). Therefore, U1349 samples could represent the local, upper mantle MORB source (Heydolph et al., 2014).

Although the Normal and Low-Ti basalts possess Nd, Pb and Hf isotope compositions within the MORB range, the $^3\text{He}/^4\text{He}$ ratios of Shatsky's Normal type basalts (the only type from which fresh volcanic glass suitable for He isotope analyses was recovered) is systematically lower than MORB ($<6 \text{ } ^3\text{He}/^4\text{He}_{(\text{Ra})}$, Hanyu et al., 2015), as characteristic for recycled HIMU material (HIMU = high $\mu = ^{238}\text{U}/^{204}\text{Pb}$). The composition of the Normal and Low-Ti lavas also fall within the range of the recently proposed primitive, early depleted (non-chondritic) mantle reservoir defined by the composition of most flood basalts (Fig. 6.3; Jackson and Carlson, 2011). Flood basalts proposed to be fed by this reservoir, however, generally have high $^3\text{He}/^4\text{He}$ ratios (if He isotope data are available) rather than low $^3\text{He}/^4\text{He}$. In contrast, HIMU type hotspot lavas have low $^3\text{He}/^4\text{He}$, due to the production of ^4He through radioactive decay of U and Th in the recycled material. All Shatsky samples (except the enriched High Nb type lavas) form a binary trend in the uraniumogenic Pb isotope diagram that is shallower than the NHRL (Fig. 6.3c), which may indicate a contribution of young ($< 2 \text{ Ga}$) HIMU material consistent with the low $^3\text{He}/^4\text{He}$ of the Normal type lavas. Another line of evidence that the Normal, Low-Ti and High-Nb type lava chemistry is different from the global MORB composition is revealed by their vanadium isotope ratios. The Normal and Low-Ti basalts possess $\delta^{51}\text{V}$ values heavier than MORB, and the only analyzed High-Nb sample shows distinctly lighter values (Prytulak et al., 2013). Since these samples belong to the first ever published set of vanadium isotope data from mafic rocks, the significance of their compositions with respect to mantle source provenance is not clear yet, but it is evident that the analyzed samples from the Normal, Low-Ti and High-Nb type groups are distinct from MORB. In addition, the high-Nb basalts also differ from MORB by their higher $\delta^7\text{Li}$, suggesting the involvement of an enriched component (Sano and Nishio, 2015).

Whereas basalts from all drill sites on Tamu Massif, the oldest edifice, yield fairly uniform isotopic compositions (including ODP Site 1213), a wider isotopic spread is found for basalts erupted on the younger edifices, Ori and Shirshov (Fig. 6.3b). A similar trend is also observed for the magma types defined by Sano et al. (2012) based on trace-element compositions: The Normal type constitutes ca. 94% of the TAMU Massif compared to only 43% of drilled lavas from the younger Ori Massif. Taken together, this evolution suggests that Shatsky's magma has become more heterogeneous with time. According to numerical plume head models (e.g., Farnetani and Richards, 1995; Farnetani et al., 2002), the observed geochemical evolution could reflect decreasing degrees of melting (and therefore less homogenization of inherent plume heterogeneities) or less effective stirring and mixing during the interaction of the spreading center with a waning plume head. As shown in Fig. 6.2, the major element composition of Shatsky basalts indicates the highest degree of melting for Tamu Massif lavas (similar to Ontong Java) and lower degrees of melting for lavas erupted on the younger Ori and Shirshov massifs (more similar to MORB melting) consistent with this model.

In summary, the crustal thickness of the Shatsky plateau, deeper depth of melting and higher degrees of melting compared to MORB, decreasing magma volume and effusion rate with time, existence of isotopically enriched material (in some Shatsky lavas implying involvement of recycled components), $^3\text{He}/^4\text{He}$ values consistently lower than MORB and consistent with recycled source material, vanadium and lithium isotope compositions different from MORB and the evolution towards increasing geochemical heterogeneity with time are consistent with the interaction of a mantle plume with a triple junction for the formation of the Shatsky Rise. The involvement of a mantle plume, however, is not unequivocal. Even the presence of recycled components does not necessarily prove that a mantle plume was involved. This could, for example, simply reflect the presence of shallow recycled ocean crust upwelling beneath a spreading center as has been proposed for Iceland by Foulger et al. (2005). The detection of an age progressive hotspot track would provide the most convincing evidence that the Shatsky Rise was formed by a deep mantle plume. Therefore, getting samples from the transition between

oceanic plateau (northern edge of Shatsky Rise) and a possible hotspot track (Papanin Ridge and/or Ojin Seamount Province,) is crucial (see below) and is one of the main objectives of SO265.

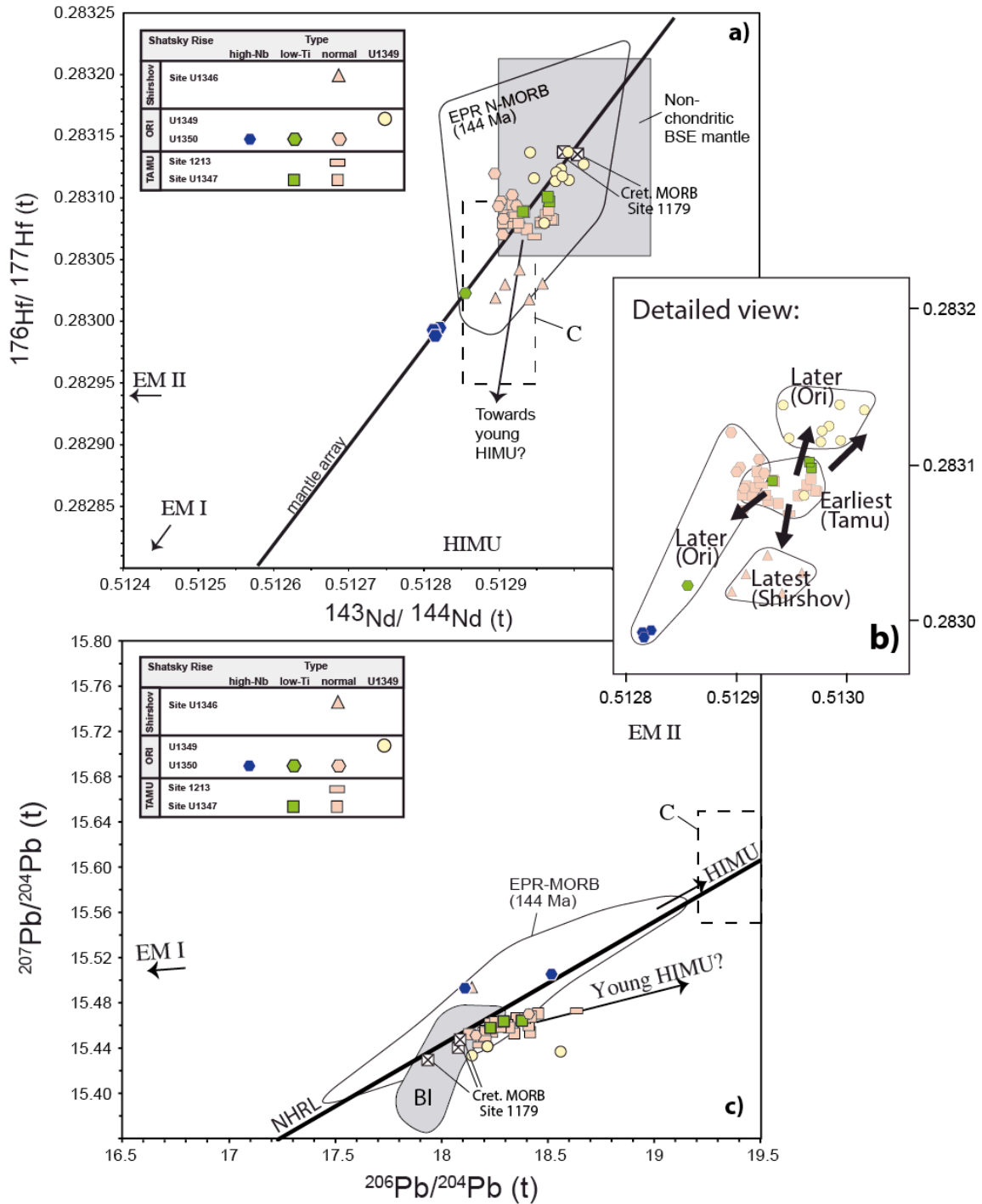


Fig. 6.3: (a) Initial (144 Ma) $^{143}\text{Nd}/^{144}\text{Nd}$ versus $^{176}\text{Hf}/^{177}\text{Hf}$ ratios of Shatsky Rise IODP Exp. 324 drill samples grouped according to Sano et al. (2012) (see Fig. 4.1a for location of drill sites). Data from Heydolph et al. (2014). (b) Close-up of a) indicating that the Shatsky Rise magma source becomes more heterogeneous with time. (c) Initial $^{206}\text{Pb}/^{204}\text{Pb}$ versus $^{207}\text{Pb}/^{204}\text{Pb}$ of Shatsky Rise. Data for non-chondritic bulk silicate Earth (BSE) mantle and Baffin Island (BI) (proposed to originate from the same primitive, non-chondritic reservoir) from Jackson and Jellinek (2013) and Jackson and Carlson (2011). Composition of common mantle endmember „C“ after Hanan and Graham (1996) with Hf isotopic range after Geldmacher et al. (2011).

6.3 THE CRUCIAL TRANSITION FROM PLATEAU TO HOTSPOT TRACK

At most oceanic LIPs, the transition to a hotspot track was either never developed or is no longer preserved (e.g. Ontong-Java, Manihiki, Hikurangi and Caribbean plateaus), or is located on a continent-ocean transition (Tristan/Gough, Reunion, Kerguelen) hampering the interpretation of geochemical and geophysical data about the transition from plume head to plume tail. The Shatsky Rise and surrounding areas, however, have been preserved in the North Pacific and were not significantly modified by later tectonic processes (which happened e.g. at certain areas of the Ontong-Java Plateau). Both the Papanin Ridge and/or the Ojin Seamount Province are morphologically connected with the youngest (northern) part of the Shatsky Rise and could potentially serve as the beginning of the hotspot track (volcanism associated with the "plume tail"). Since Shatsky formed well before the Cretaceous magnetic quiet zone (121-83 m.y.), we can use magnetic data to help reconstruct local tectonic conditions and relationships to the ridge system during this time. Based on currently available magnetic data and bathymetry, a potential hotspot track can be traced through Papanin Ridge or, alternatively, through parts of the Ojin Seamount Province, to the Hess Rise (Verzhbitskii et al. 2006), an oceanic plateau of almost similar size to Shatsky (Fig. 4.1b). From the Hess Rise, the hotspot track is proposed to continue to the SE via the Liliuokalani Ridge (located north of the Hawaiian seamount chain and not sampled or dated thus far) to possibly the Marquesas Islands (Clouard and Bonneville, 2001).

As clearly shown in Fig. 6.1b, the surface and total crustal volume of Shatsky Rise decreases with decreasing age of the volcanic edifices. Although the southern and central parts of Shatsky (consisting of the enormous Tamu Massif and the prominent Ori Massif) have been investigated relatively well (numerous bathymetric, magnetic and seismic studies; 6 dredge sites and 5 ODP/IODP drill sites penetrating basement rocks), much less is known about the less voluminous northeastern part of Shatsky Rise (Shirshov Massif). Only one dredge haul (D6) was conducted in this area (Fig. 4.1a) and the only drill hole near the Shirshov summit (U1346) had to be abandoned after just 53 m basement penetration because of an approaching storm. Therefore, the recovered rocks might not be very representative of this massif, which rises 2300 m above the surrounding abyssal plane. Northeast of the Shirshov Massif, the Shatsky Rise turns into the relatively flat Papanin Ridge and into a cluster of solitary seamounts or isolated seamount groups towards the east (Ojin Seamounts). Both features could represent the transition of the Shatsky Rise into a subsequently formed, age-progressive hotspot track.

Papanin Ridge (Fig. 4.1) has never been drilled or sampled and therefore it is unclear if the observed trends towards greater geochemical heterogeneity as seen in the younger Shatsky drill site lavas (Fig. 6.3b) continue into Papanin Ridge. In addition, as increasingly recognized, several Pacific hotspot tracks (Hawaii, Galápagos, Samoa, Marquesas) show a spatial geochemical zonation (see Rohde et al., 2013, for overview). The respective hotspots seem to be located at the margins of the Pacific large-scale, lower mantle low-velocity province (LLSVP) (Burke et al., 2008). Since Shatsky Rise is calculated to have been located at the edge of the Pacific LLSVP in the Early Cretaceous (Torsvik et al. 2010) and since its composition is heterogeneous, it is possible that its hotspot track(s) may also show a spatial zonation. Based on the available magnetic data, the Papanin Ridge follows the trace of the triple junction up to anomaly M4 (at $\sim 42^\circ\text{N}$) before the ridge axis bends to a southeast trend (Nakanishi et al., 1999). East of $\sim 165^\circ 30' \text{ E}$, the ridge therefore formed by true intraplate volcanism. Accordingly, lavas from this area should show a different geochemical composition because of the deeper average depth of melting ("lid effect" of the lithosphere) as opposed to lavas to the west of this longitude, which were formed under shallow ridge melting conditions.

The about eighty small to medium-size Ojin seamounts are located mainly east to northeast of Shirshov Massif and near the transition to Papanin Ridge (Fig. 4.1a). The seamounts form a very broad, crudely NE-SW elongated field lying along the extensions of a NNE-SSW oriented lineament (parallel to the local fracture zone direction) cutting through the center of the Shatsky Rise (at Dredge Site D11 on Fig. 4.1a). Like Papanin Ridge, this lineament also aligns with the northwest-trending extension of Hess Rise so that alternative models for the path of the Shatsky hotspot track run through the Ojin seamount group (see Verzhbitskii et al., 2006) (Fig. 4.1b). However, highlighting their different morphology (compared to Shatsky) and shallower summit depths (compared to the depth of the basement platform beneath the pelagic cap of Shirshov), Sager et al. (1999) suggest that the Ojin seamounts are younger features formed from a different magma source after Shatsky Rise plateau formation ceased. Only five of these seamounts were

dredged during the R/V Thompson expedition in 1994 (Fig. 4.1a), but most of the recovered material is highly altered making geochemical studies difficult. Based on the few suitable samples, a compositional difference between the westernmost and easternmost Ojin seamounts is indicated: Whereas samples from a western seamount ("D2" see Fig. 4.1a) have Pb isotopic ratios more similar to Shatsky's Shirshov Massif, do samples from one of the easternmost seamounts ("D1") possess more enriched Pb isotope ratios overlapping with the FOZO ("focal zone" Hart et al., 1992) mantle endmember (Fig. 6.4) (Tejada et al., 2016). This geographic variance and the apparent FOZO affiliation, however, need to be confirmed by additional sampling of seamounts from the entire length of the Ojin seamount belt (in addition to obtaining new samples suitable for $^{40}\text{Ar}/^{39}\text{Ar}$ age dating).

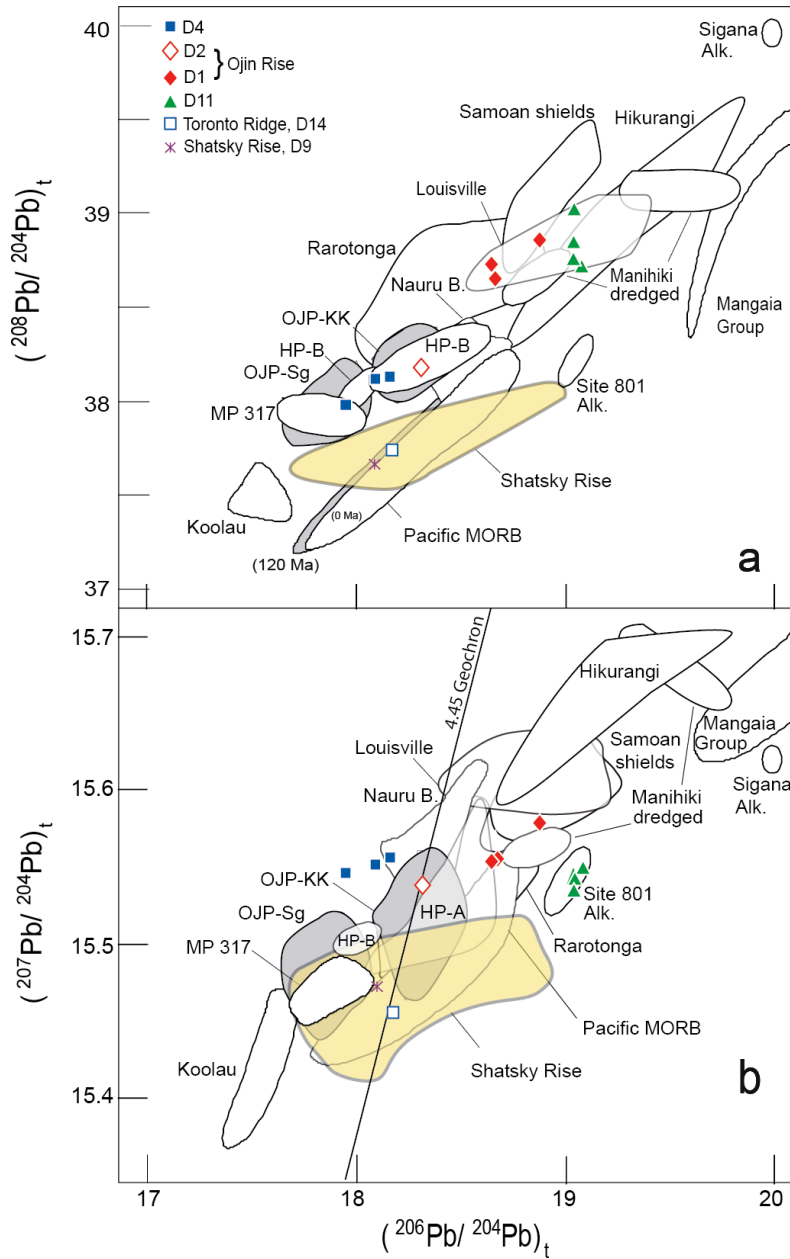


Fig. 6.4 : Initial Pb isotope data (age corrected to 120 Ma) of the few available Ojin Seamount Province samples (dredged during the R/V Thompson cruise in 1994) in comparison to Shatsky Rise (yellow field). Figure modified from Tejada et al. (2016). Filled red diamonds belong to samples from one of the easternmost Ojin seamounts, whereas open red diamond indicates a seamount near Shatsky Rise (see Fig. 6.1 for dredge site locations). Also shown are age-corrected and estimated 120 Ma mantle source fields for other major Pacific intraplate provinces (see Tejada et al. 2016 for data sources). Abbreviations: MP=Manihiki Plateau; HP=Hikurangi Plateau; KK=Kroenke- Kwaimbaita; Sg = Singgalo.

The fundamental question is if Shatsky Rise formed by a mantle plume, which we want to resolve by establishing if the plateau is associated with an age-progressive hotspot track. If so, is the beginning of this hotspot track represented by Papanin Ridge or the Ojin Seamount Province? Alternatively, both areas may reflect part of a bifurcated hotspot track starting at Shirshov Massif and merging again at the Hess Rise (Fig. 4.1b). Recently, it was shown that the bifurcation of the Tristan-Gough hotspot track at the southwestern end of the Walvis Ridge into two subtracks going to Tristan da Cunha and Gough Islands could reflect splitting of the Tristan-Gough plume conduit (Hoernle et al., 2015). It is possible that something similar may have happened with a Shatsky plume. With respect to the proposed plume head - plume tail transition, it can be tested if the Papanin Ridge and/or Ojin Seamount Province rocks have major and trace element composition indicating a lower degree of melting (compared to the drill samples from the Shatsky plateau). If this model is correct, we would expect that lavas formed by a Shatsky hotspot would e.g. have higher ratios of highly incompatible to less incompatible trace elements and also possess higher Na_8 and lower Ca_8/AL_8 values (plotting in the lower right sector of Fig. 6.2).

7. METHODS AND DESCRIPTION OF STATIONS

7.1. METHODS

(R. Werner, F. Hauff, C. Heitmann-Bacza, A.-C. Zakrzewski, W. Borchert)

7.1.1. Bathymetry (Kongsberg Maritime EM122)

Data Acquisition

R/V SONNE is equipped with Kongsberg Maritime EM122 multi-beam echo sounder systems for continuous mapping of the seafloor. The systems consist of several units. A transmitter/receiver transducer array is fixed in a mills cross below the keel of the vessel. A preamplifier unit contains the preamplifiers for the received signals. The transceiver unit contains the transmitter, receiver electronics, and processors for beam-forming and control of all parameters with respect to gain, ping rate and transmit angles. The system has serial interfaces for vessel motion sensors, such as roll, pitch and heave, external clock and vessel position. The system also include high performance PC workstations. The operator software is the Seafloor Information System (SIS) running under Windows XP or Win7, which processes the collected data, applying corrections, displays the results and logs the data to internal or external disks.

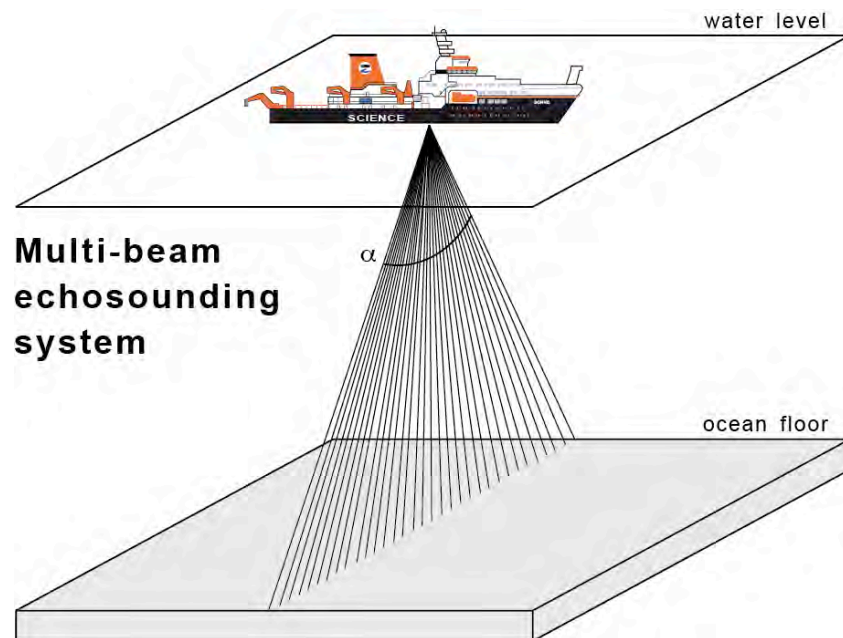


Fig. 7.1: Schematic sketch illustrating the principle mode of operation of multi-beam echo-sounding systems. The whole angular coverage sector (α) of the Kongsberg EM 122 system amounts is up to 150° .

The EM122 system uses a frequency of about 12 KHz with a whole angular coverage sector of up to 150° (75° per port-/starboard side, Fig 7.1). The depth range amounts to 20 - 11,000 m. The system has up to 288 beams and 432 soundings, respectively, per swath with pointing angles automatically adjusted according to achievable coverage or operator defined limits. The ping-rate depends on the water depth and the runtime of the signal through the water column. The variation of angular coverage sector and beam pointing angles was set automatically. This optimizes the number of usable beams. During a survey the transmitter fan is split into individual sectors with independent active steering according to vessel roll, pitch and yaw. This forces all soundings on a line perpendicular to the survey line and enables a continuous sampling with a complete coverage. Pitch and yaw movements within ± 10 degrees and roll movements within ± 15 degrees are automatically compensated by the software. Thus, the EM122 system can map the seafloor with a swath width about up to six times the water depth (to approximately 30 km). The geometric resolution depends on the water depth and the used angular coverage sector and is less than 10 m at depths of 2,000 - 3,000 m.

The accuracy of the depth data obtained from the system is usually critically dependent upon weather conditions and the use of a correct sound velocity profile. During SO265 four sound profiles have been determined using a CTD and a sound probe, respectively, ensuring the use of the correct sound velocity on this cruise. The CTD has been deployed at the northern tip of the Shirshov Massif before dredge operations started (CTD1), directly west of the southern Papanin Ridge (CTD17), on the southern Papanin Ridge (CTD24) and the last sound profile has been measured by a sound probe at the western part of the Ojin Seamounts during dredge haul DR73 (see Appendix I for coordinates). The relatively high number of sound profile measurements required on this cruise is most likely due to the Kuroshio current which affects Shirshov Ridge, the Ojin Seamounts, and the southern part of Papanin Ridge and causes rapid changes in the properties of the water column in those areas. For bathymetric data obtained during the transits from Yokohama to the Shatsky Rise and back to Kaohsiung, sound velocity profiles recorded on a previous cruise have been used.

Data Cleaning and Processing

The data cleaning procedure was accomplished by the QPS Qimera v. 1.7.0 software. After loading the raw data (.all files) from the EM122 and the correct sound velocity profile, a first filtering of failed beams has been conducted. Subsequently a dynamic surface has been created showing the ship's track and the raw data (Fig. 7.2).

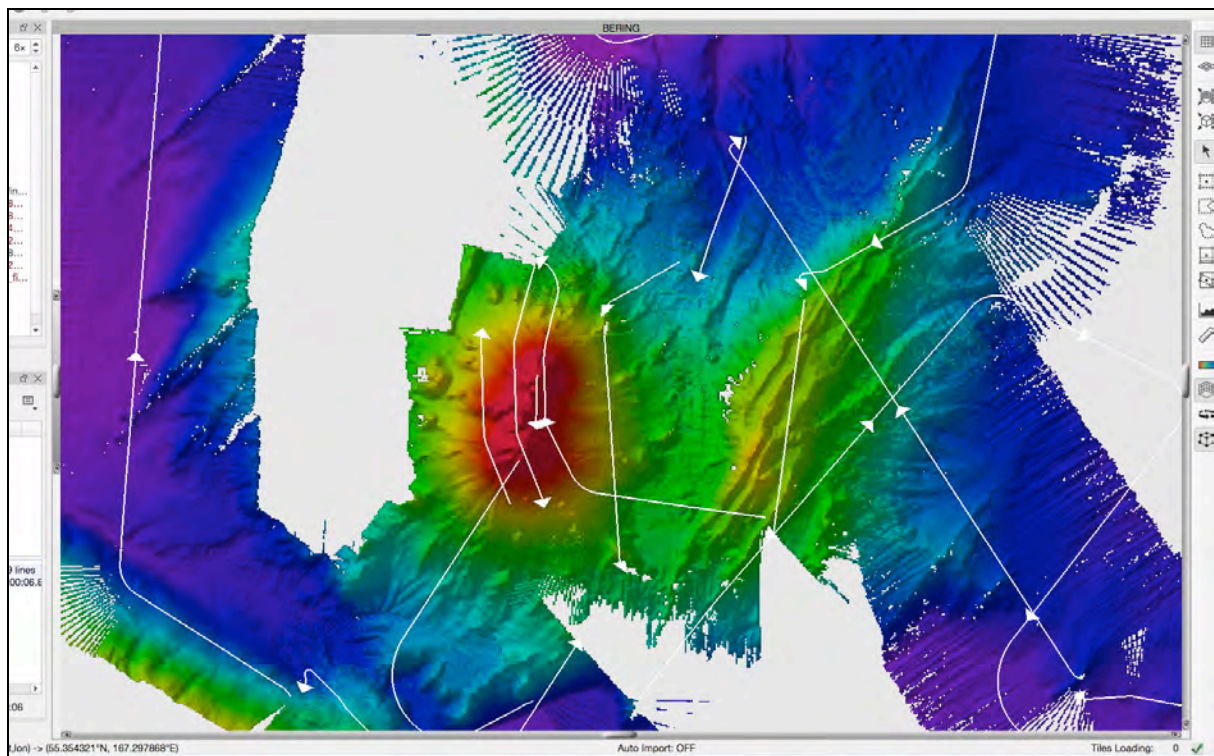


Fig. 7.2: Dynamic surface created with Qimera showing the raw data and the ship's track.

Qimera allows an automatic elimination of major erratic data points using a spine filter. Furthermore there are several tools for detailed elimination of erratic data points, for example a swatch editor, a 2D editor or a 3D editor (Fig. 7.3) which all enable the operator to process each single beam stepwise. All editors display not only the cleaned data but also, if desired, the rejected data points and offer a variety of visualizations of the data (according to files, depth, intensity etc.). Additionally the data can be cleaned and edited using CUBE (Combined Uncertainty and Bathymetry Estimator, by University of New Hampshire).

After data cleaning a static surface has been generated from the dynamic surface, creating a .sd file which can be loaded in the QPS Fledermaus software, allowing 3D visualization of the cleaned data (see chapter 7.2). Furthermore the data can be exported in an ASCII x,y,z file format with header information for assembling, gridding and contouring with the GMT software (Wessel and Smith 1995). All this work was done by the system operator of R/V SONNE and with the help of students.

7.1.2. Sediment Echo-Sounding (Atlas PARASOUND P70)

PARASOUND data have been recorded during selected SO265 bathymetric surveys which covered more or less plain ocean floor and on all transits. During the cruise, however, only online profiles displayed on the screen have been used to identify tectonic features. The data acquisition included PHF and SLF data. All data have been copied on an external hard disk and sorted by the operator into folders according to data type (PHF, SLF / ASD, PS3, SEGY). The entire PARASOUND data set will be transferred to international data banks and may be used by specialists for further shore based processing and analyses.

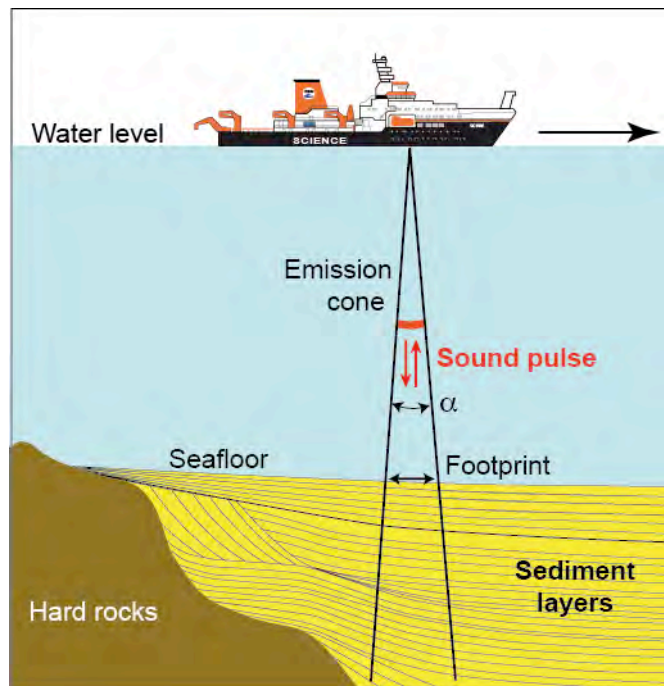


Fig. 7.4: Schematic sketch illustrating the principle mode of operation of sub-bottom profilers. The extremely narrowed beam of the ATLAS PARASOUND system of 4.5° (α) allows to resolve even small-scale bottom structures and offers a deeper penetration of up to ~200 m into the seafloor.

7.1.3. Dredging, Site Selection, and Laboratory Work

Rock sampling on SO265 was carried out using rectangular chain bag dredges. Chain bag dredges are similar to large buckets with a chain bag attached to their bottom and steel teeth at their openings, which are dragged along the ocean floor by the ship's winch.

General station areas were chosen on the basis of a number of existing datasets. These mainly include predicted bathymetry, derived from gravity data and ship depth soundings (etopo by Smith and Sandwell [1997] and "The GEBCO_2014 Grid, version 20150318", <http://www.gebco.net>) as well as published data and maps, and profiles.

The pre-selection of dredge stations at the Shatsky Rise and the Ojin Seamounts was partly based on new, unpublished multi-beam data kindly provided by Masao Nakanishi (Department of Earth Sciences, Chiba University). These new data allowed us to forbear from doing extensive bathymetric surveys before dredging in those areas. Here, only the final positioning of the dredge tracks required short multi-beam mapping by R/V SONNE. The selection of dredge sites in completely unmapped working areas, however, was critically dependent on detailed multi-beam echo-sounding surveys carried out at each site before dredging. Final positioning of the vessel at each dredge station was based on the bathymetric data including considerations of wind, swell and drift conditions. Dredge tracks were usually located - depending on the morphology of the structures - on steep slopes of scarps, canyon walls, fracture zones, and the flanks of cones, ridges, and larger seamounts. This was mainly done to avoid areas of thick sediment cover.

Shipboard Procedure

Once onboard, all rocks collected with the dredge were first scanned for encrusting benthic invertebrates. Afterwards a selection of the rocks were cleaned and cut using a rock saw. They were then examined with a hand lens and binocular microscope, and grouped according to their lithologies and degree of submarine weathering. The immediate aim was to determine whether material suitable for geochemistry and radiometric age dating had been recovered. Best suitable samples have an unweathered and unaltered groundmass, empty vesicles, glassy rims (ideally), and any phenocrysts that are fresh. If suitable samples were present, the ship moved to the next station. If they were not, then the importance of obtaining samples from the respective site was weighted against the required time commitment.

Fresh blocks of representative samples were then cut for post-cruise thin section and microprobe preparation, geochemistry and further procedures to remove manganese and

alteration products and/or to extract glass (if present). Each of these sub-samples, together with any remaining bulk sample, was described, labeled, and finally sealed in either plastic bags or bubble wrap for transportation to GEOMAR or cooperating institutions.

Shore Based Analyses

Magmatic rocks sampled by R/V SONNE from the ocean floor will be analyzed using a variety of different geochemical methods:

Ages of suitable rock samples will be determined by $^{40}\text{Ar}/^{39}\text{Ar}$ laser step-heating dating. Major element geochemistry by X-ray fluorescence (XRF) and electron microprobe (EMP) will constrain magma chamber processes. Trace element data, obtained by inductively coupled plasma mass spectrometry (ICP-MS), will help to define the degree of mantle melting and help to characterize the chemical composition of the source. Phenocryst assemblages and compositions will be used to quantify magma evolution. Petrologic studies of the volcanic rocks will also help to constrain the conditions under which the melts crystallized. The composition of mafic basalts and basaltic glasses, as well as mafic melt inclusions, can be used to assess mantle temperatures at which melting took place, as well as pressures and degrees of melting. Sr, Nd, Hf and Pb (double spike) isotope ratios, determined by Thermal Ionization Mass Spectrometry (TIMS) and multi-collector ICP-MS, reflect the long-term evolution of the magma sources and thus serve as tracers to identify mantle domains and possibly recycled (crustal?) material. O-isotopes provide a powerful tool for evaluating the role of crustal material in the magma source. Morphological and volcanological studies will constrain eruption processes, eruption environment and evolution of the volcanoes.

Non-magmatic rocks and Mn-Fe oxides yielded by dredging can be transferred to co-operating specialists for further shore-based analyses.

7.1.4. Biological Sampling

Shipboard Collecting Procedures

Biological material was also collected by deployment of the chain bag dredge. Additionally, bulk soft sediment was sampled at all stations from the four sediment traps (length 21 cm, diameter 4 cm) installed in the dredges. Upon the dredge's arrival on deck, its contents were visually checked for collected macrofauna and the four sediment traps were removed. After the dredge was emptied, the recovered material (e.g. hard rocks, Mn-crusts) was inspected for encrusting benthic organisms.

Meiofauna

The fine sediment sampled with the sediment traps is in particular relevant for meiofauna studies conducted by the Museum für Naturkunde Berlin (MfN). It was immediately fixed in 6% formaldehyde prepared with buffer tablets for haematology (Merck # 1.09468.0100, pH 7.2). All samples were labeled and separately stored in plastic jars. For shipping, these plastic sediment containers were placed in air-tight heavy duty plastic drums or in aluminum boxes.

Macrofauna

Macrofaunal organisms identifiable either by naked eye or with a stereomicroscope were picked by hand or by using scalpel blades and biological forceps. Depending on the intended investigation methods, specimens were either fixed in 100% ethanol, 4% formaldehyde solution prepared with buffer tablets (pH 7.2), RNAlater (Sigma-Aldrich # R0901) or 4% paraformaldehyde solution (pH adjusted with drops of 1N NaOH to 7.2). All collected specimens were sorted to phylum level or lower and separately stored in plastic vials according to their size. Dead shells or skeletons were air-dried and later transferred to Whirl-Pak sampling bags. In select cases, specimens were photographed using a digital camera. Benthic invertebrates found on the dredged rocks will be further processed and archived at the MfN.

7.1.5. Weather

For the weather forecasts and consulting during the SO265 expedition, observation data and synoptic charts were available; most of these were specially tailored to the specific areas of transit and research. These included, for example:

- wind and sea state data from the ECMWF model with 120 to 240 hours forecast period in 3 to 6 hour time steps for horizontal resolutions of 0.5° and 1.5° for the forecast system MetMaster
- wind and sea state data from the DWD model ICON/GWAM global up to 174 hours forecast period in 3 to 6 hour time steps with a horizontal resolution of 0.5° and 1.5° for the forecast system MetMaster
- NOAA wind and sea state data from GFS Model up to 240 hours forecast period for the presentation in the open source program "ZyGrib" if necessary
- wind and mean sea level pressure charts of the global ECMWF and ICON models up to 168 hours forecast period
- wind, sea state and mean sea level pressure charts of the global ICON/GWAM models up to 72 hours forecast period
- NINJO-Batch products from the ICON model for humidity, pressure and temperatures at different heights, as well as for cloud cover in the three cloud levels up to 72 hours
- Meteograms from the NOAA model GFS for the port Yokohama and Kaohsiung (and also for way points on the transit)
- synoptic weather reports and radiosonde data (TEMPS) of the relevant coastal states as well as ship and buoy reports from surrounding sea areas and adjacent countries
- satellite images of HIMAWARI in infrared and visual range (available every hour or every 3 hours via email or sftp via FileZilla), the Ninjo-Batch satellite images (specially prepared by the German Weather Service Hamburg WV13 for single channels and satellite composites)

The ship's own internet also allowed access to other relevant weather pages, such as the weather forecasts from:

- ECMWF Ensemble Meteograms
- ECMWF charts e.g. for the significant sea state
- and various other weather providers

A presentation and two sea weather forecast in German and English (for the ships and expedition leadership) were prepared daily, based on the information obtained from the sources listed above. These contained, among other things, a detailed description of the weather situation and detailed information about the wind, sea state, weather, and visibility conditions to be expected in the course of the next 3 days. The briefing of the chief scientist took place every day at 08:30 ship's time in the measuring and observation room of the SONNE. In addition, the weather situation and weather development was presented and explained for the ship's command and scientific leaders every Monday and Friday morning on bridge. Furthermore, the officer on duty was informed about current weather forecast and possible changes every evening.

The forecasts were made available to all cruise participants by publishing the presentations and sea weather forecasts on the intranet on board, in the scientists folder on the ships server, and (as hard copy) on the bulletin board. In addition, further information such as current satellite images, analysis maps and information on current typhoons was provided. Additional information and consulting was provided to all interested parties in response to enquiries about weather events.

List of abbreviations used above:

MetMaster	system for routing
zyGRIB	GRIB files viewer
GFS	Global Forecast System Modell NOAA (National Oceanic and Atmospheric Administration US)
GWAM	Global WAVE Model German Modell
ICON Model	ICOsahedral Nonhydrostatic
ECMWF	European Centre for medium-range Weather Forecasting
NINJO	meteorological work station
NINJO-BATCH	system for creation of meteorological graphics

7.2. ROCK SAMPLING REPORT AND BATHYMETRIC MAPPING

(F. Hauff, J. Geldmacher, R. Werner)

The following section gives background information and short summaries of the features sampled and/or mapped on SO265 and on the rock types obtained by dredging but also presents some preliminary interpretations of bathymetric data and rock assemblages. Distances, dimensions and heights given in this chapter are approximate and are only included to give a rough idea of dimensions of morphological features. Distances between seamounts are given between the seamount tops. All photos shown in this chapter are taken by GEOMAR. Refer to Appendix I and II for exact latitude, longitude, and depth of dredge sites and more detailed rock descriptions. Figure 3.4 shows a general overview map with all SO265 sampling sites. Figures 7.5 and 7.17 show more detailed regional overview maps including station numbers for the major working areas at Papanin Ridge and Ojin Seamounts, respectively. All overview maps are based on "The GEBCO_2014 Grid, version 20150318". Refer to Appendix III for detailed 3D-maps of all SO265 dredge tracks, a few selected 3D-maps are also shown in this chapter.

7.2.1. Papanin Ridge

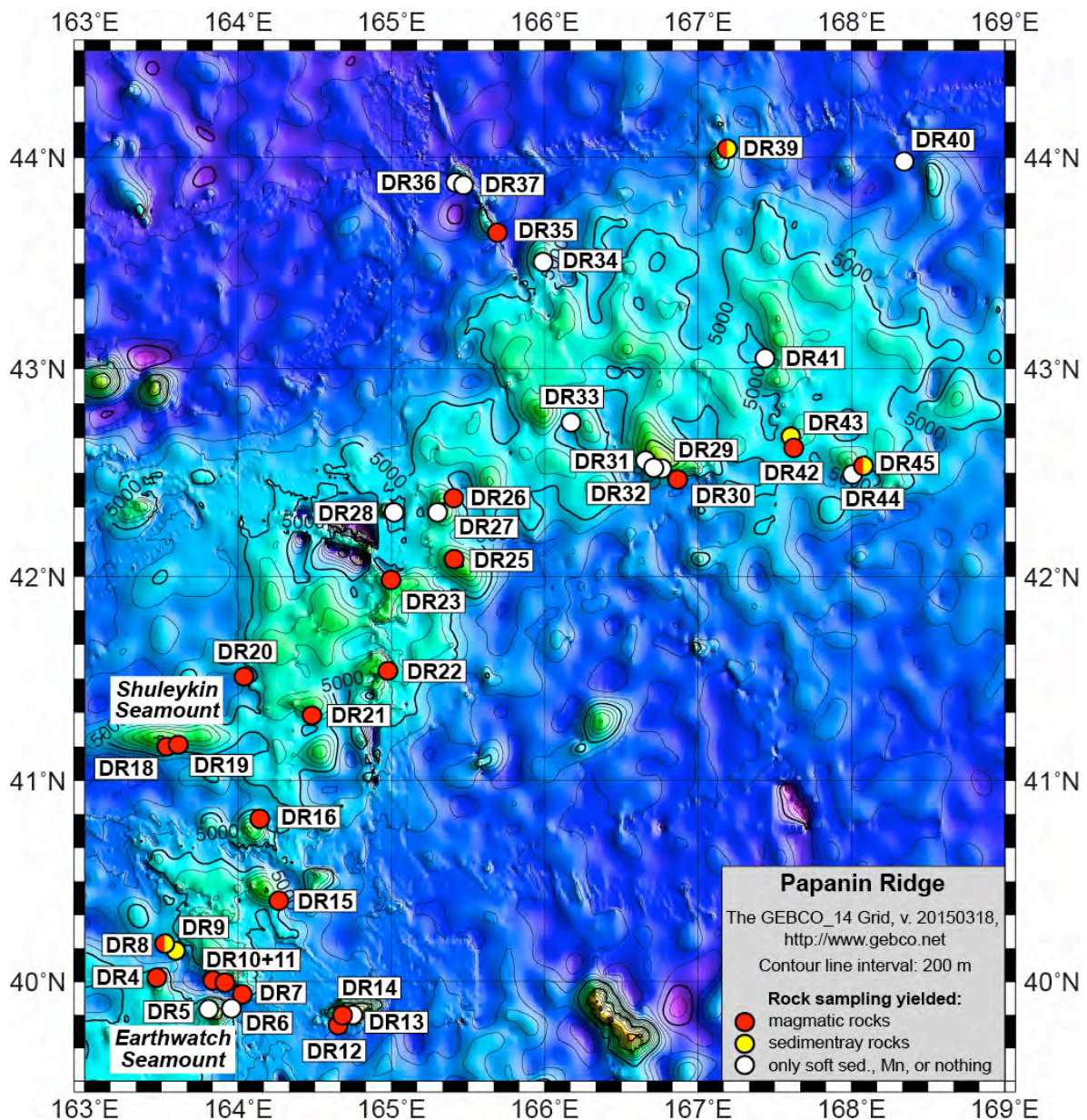


Fig. 7.5: Overview map showing Papanin Ridge and adjacent areas. Dots mark SO265 sampling stations.

The Papanin Ridge is a prominent, \pm SW-NE striking, positive bathymetric feature immediately NE of the Shirshov Massif, the northernmost edifice of the Shastky Rise. It stretches from c. 40°N / 164°E to $42^{\circ}30'\text{N}$ / $165^{\circ}50'\text{E}$ where it bends eastward to morphologically diminish at c. 169°E (Fig. 7.5). While the southern part of Papanin forms a \pm distinct, c. 100 to 150 km wide ridge, the eastern half broadens to a ca. 200 km wide area of elevated seafloor. The morphology of Papanin Ridge can be subdivided into 1) plateau basement, eventually exposed at the margins to the surrounding seafloor including the Thompson Trough and 2) volcanic edifices in the form of seamounts and ridges on top of the plateau basement. The overall geometry of Papanin Ridge is thought to reflect NE migration of a triple junction with a ridge centered Shastky plume that became intraplate when the spreading center migrated in a northward direction after the formation of magnetic anomaly M4 (e.g. Sager et al., 1999; Nakanishi et al., 1999). SO265 dredge operations aimed at full spatial coverage of the Papanin Ridge to obtain the first igneous samples from it. It shall be tested if the lavas reflect the assumed plume-tail transition of Shastky undergoing changing melting conditions from beneath a spreading center to off-axis and intraplate.

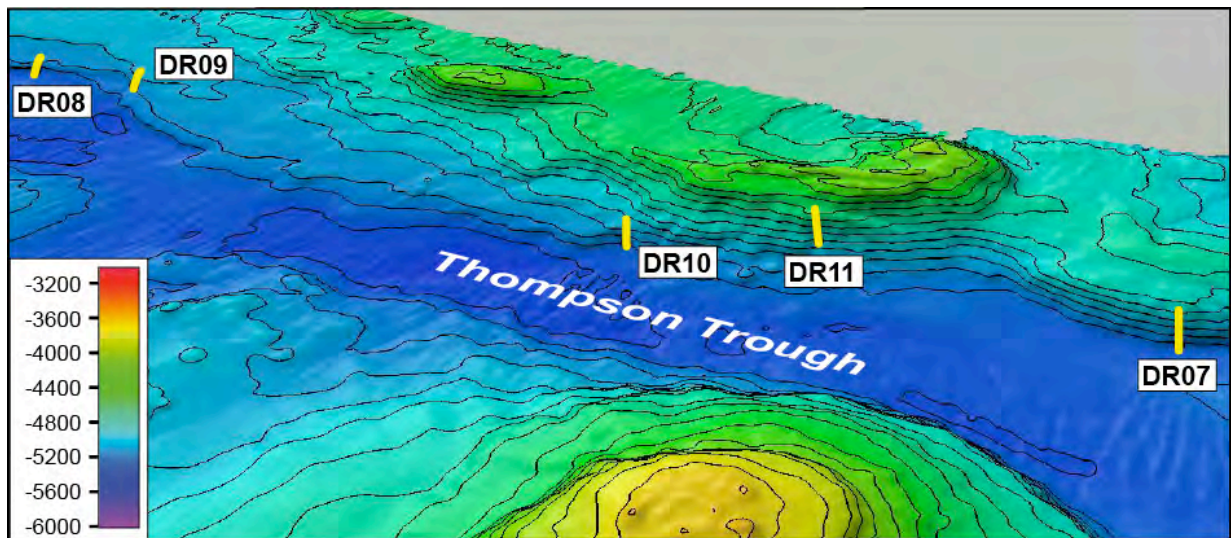


Fig. 7.6: 3D-map of the western and central part of Thompson Trough, representing the faulted southern margin of Papanin Ridge, with dredge tracks DR7 through DR11 shown as yellow lines (view from S to N). The map is based on multi-beam data recorded on SO265 and has been generated using QPS Fledermaus 7.8.5 software (stereo exaggeration: 2x; interval of contour lines: 100 m).

The first series of dredges at Papanin Ridge were conducted at the fault bounded southern end, where the WNW-ESE striking Thompson Trough separates Papanin Ridge from the Shirshov Massif (Figs. 3.5 and 7.6). DR7 through DR9 aimed at the south-facing slopes of terraces without any seamounts, or larger upslope morphology or nearby bathymetric highs in order to exclude unwanted (younger) debris (Fig. 7.6). DR8 and DR9 reflect the deepest tracks along gentle slopes of presumably step-faults in the western half of Thompson Trough. Unfortunately the hauls recovered only Mn nodules with mostly pumice cores. DR7, in the central part of the Thompson Trough, was more successful and obtained aphyric, dense lava fragments with abundant plagioclase microphenocrysts (Fig. 7.7). The samples are variably altered ranging from very fresh (samples DR7-1 to -4) to progressively more altered groundmass oxidation with Mn infiltration. Site DR10 aimed at the very base of the northern flank of Thompson Trough (5,300 m b.s.l.) with a c. 4,000 m b.s.l. seamount in the NE (Fig. 7.6) and returned only two Mn nodules. One of them contains a very small 1cm^3 sized, highly altered lava fragment. Similarly, DR11 along the middle slope (ca. 4,900 to 4,500 m b.s.l.) of the seamount (Fig. 7.6) also returned Mn nodules only but with more abundant, fairly fresh to moderately igneous cores of plagioclase-pyroxene-phyric lava (DR11-1 to -4). In summary, DR7 and DR11 successfully sampled the southern margin of Papanin Ridge. The aphyric lava at DR7 most likely represents the plateau phase and DR11 plagioclase-pyroxene-phyric lava from a later seamount stage.



Fig. 7.7: Fairly fresh, Mn encrusted, aphyric lava fragment from the northern margin of Thompson Trough.



Fig. 7.8: Fresh to moderately altered, aphyric lava fragment from Shuleykin Seamount.

The following stations DR15 and DR16 targeted seamounts in the southern part of Papanin Ridge. DR15 is a circular shaped, \pm flat-topped seamount with three smaller cones in the plateau region. The main edifice has a ca. 20km base diameter, rising \sim 600 m above the surrounding seafloor. The track along the entire SSE-facing slope obtained few Mn nodules with cm-sized cores of slightly to moderately, aphyric lava fragments. DR16 aimed at the NE slope of a morphological similar seamount as DR15 and recovered a $\frac{1}{4}$ full dredge of Mn nodules containing abundant cores of volcanic lava, sediments and pumice. The lava fragments are aphyric throughout and range from fresh to slightly altered (DR16-1 and -2) and moderately to strongly altered. Shuleykin Seamount, an E-W striking ridge west of the main body of Papanin Ridge, was targeted along its southern slope in the 4,800 to 4,200 m b.s.l. depth interval of its steep middle part with DR18 and nearby DR19. Both sites obtained Mn nodules (with igneous cores) but also scarce lava fragments. While DR18 recovered aphyric (DR18-1 and -2, Fig. 7.8) and olivine-plagioclase-phyric lava, gave DR19 olivine and olivine-plagioclase-phyric lava. The overall state of alteration is moderately in DR18 rocks and fresh to moderately in those from DR19. Somewhat unexpectedly for the $\sim 41^\circ\text{N}$ latitude of Shuleykin Seamount a dropstone of unusual fresh olivine-pyroxene-plagioclase-phyric lava (DR19-13) returned in DR19. The stations DR20 through DR23 belong to the central Papanin Ridge and were carried out along the slopes of elongated to circular seamounts (Fig.7.9).

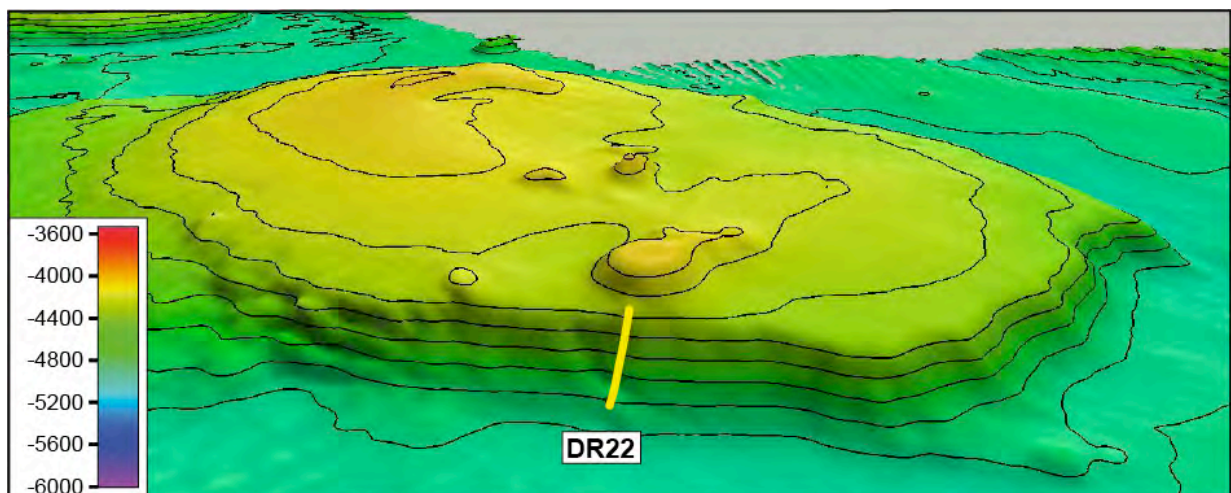


Fig. 7.9: 3D-map of a representative pancake-shaped seamount on the central Papanin Ridge. DR22 was conducted along its east-facing slope beneath a small cone at plateau margin (view from E to W). Vertical exaggeration, contours, data source, and software used are the same as in figure 7.6.

These seamounts elevate 400 - 500 m above seafloor and have large, relatively flat plateaus with occasional cones (DR22, Fig. 7.9). Slightly to mostly moderately altered olivine-phyric lava fragments dominate in DR20 (5,150 to 4,730 m b.s.l.) at the western margin of Papanin. Here, pieces of rafted pumice (-9 & -10) were also sampled. Along the opposite margin of Papanin Ridge at roughly similar latitude, limited quantities of moderately altered, sparsely plagioclase-phyric lava were obtained at DR21 (c. 4,800 to 4,500 m b.s.l.). Nearby DR22 returned angular lava fragments and Mn nodules with sediment cores. Two petrographic groups of igneous material were identified, aphyric lava with rare olivine microphenocrysts ranging from partly fresh to strongly altered (DR22-1 to -8) and highly plagioclase-phyric lava (DR22-9 and -10), but plagioclase being largely altered to clay. Further north at the transition to the northern part of the central Papanin Ridge, an anvil shaped seamount was sampled along its northern flank (DR23, c. 4,750 to 4,450 m b.s.l.) and yielded pillow lava fragments along with Mn nodules. The pillow lava is moderately altered and contains sparsely plagioclase. Overall, the lava is petrographically very similar to those of DR21. The northern part of the central Papanin Ridge was targeted at DR25 to DR28. The dredged structures range from E-W-striking ridges (DR25, c. 4,500 to 4,000 m b.s.l.) to circular features with relatively shallow dipping slopes and cones on the summit (DR26+27; c. 4,700 to 4,000 m b.s.l.) and circular structures with relatively steep slopes and a prominent central caldera (DR28, c. 4,900 to 4,500 m b.s.l.). Only DR25 and DR26 returned *in-situ* igneous rocks. At DR25 moderately to strongly altered, aphyric lava clasts were recovered from a large Mn-crust. Again aphyric pillow lava was obtained at DR26 but overall fresher than at DR25 with possible fresh glass preserved (Fig. 7.10). A few dropstones were also recovered in DR26 and a single plutonic dropstone obtained at DR27. More dropstones along with Mn nodules were delivered by DR28.



Fig. 7.10: Slightly to moderately altered, aphyric lava fragment from central Papanin Ridge.

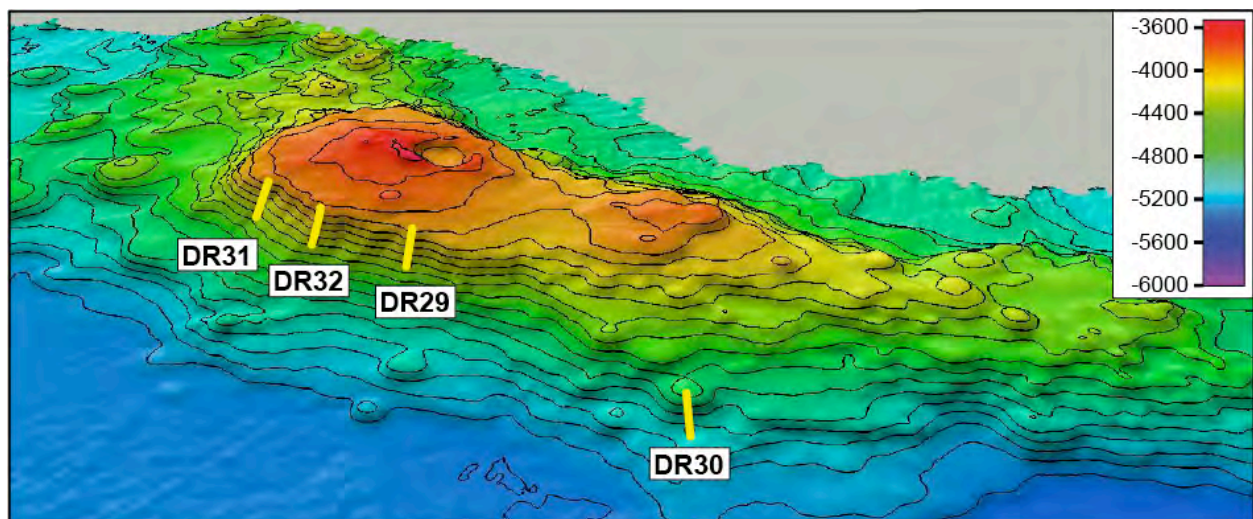


Fig. 7.11: 3D-map of a large E-W-striking seamount in the eastern branch of Papanin Ridge (view from S to N). Vertical exaggeration, contours, data source, and software used are the same as in figure 7.6.



Fig. 7.12: Slightly altered, sparsely plagioclase-phyric lava from base of large seamount in the northeast of Papanin Ridge.

Stations DR29 through DR37 cover the bending of the Papanin ridge into a broad, E-W trending seamount province. Here only two (DR30 and 35) out of nine dredges recovered small amounts of *in-situ* igneous rocks. The others were either empty (DR33 and 37) or contained only dropstones or Mn nodules without igneous cores. DR29 through DR32 aimed at a prominent E-W striking ridge, the largest bathymetric feature of the entire Papanin area (Fig. 7.11). While DR29, DR31, and DR32 unsuccessfully tackled the south-facing slope between 4,300 and 3,800 m b.s.l. just beneath the plateau area, DR30 obtained variably altered, sparsely plagioclase-phyric pillow lava (Fig. 7.12) from the base of the ridge near its eastern termination. In the following, the sampling strategy attempted to obtain a N-S profile across the area where Papanin Ridge bends east. DR33 (c. 4,900 to 4,450 m b.s.l.) aimed at a small ridge between two larger, circular seamounts but returned empty despite the strongest bite (7.4t) thus far recorded during SO265. DR34 is located at the northern termination of Papanin Ridge, a circular seamount with relatively gentle slopes and two small cones in the top area. Only dropstones were recovered from its southern slope. The next two seamounts lie north of Papanin Ridge and rise from the abyssal plain at c. 6,000 m b.s.l. to 4,800 m b.s.l.. Site DR35 consists of two coalesced, WNW-ESE aligned volcanic centers of which the western houses a small central caldera (Fig. 7.13). DR35 carried out along the southeastern slope returned very few and very small fragments of moderately to strongly altered, aphyric lava and similarly altered olivine-plagioclase-phyric lava. DR36 and DR37 targeted the southern slope of another discrete seamount north of the main Papanin body. The first dredge haul delivered a plutonic dropstone while the second was empty.

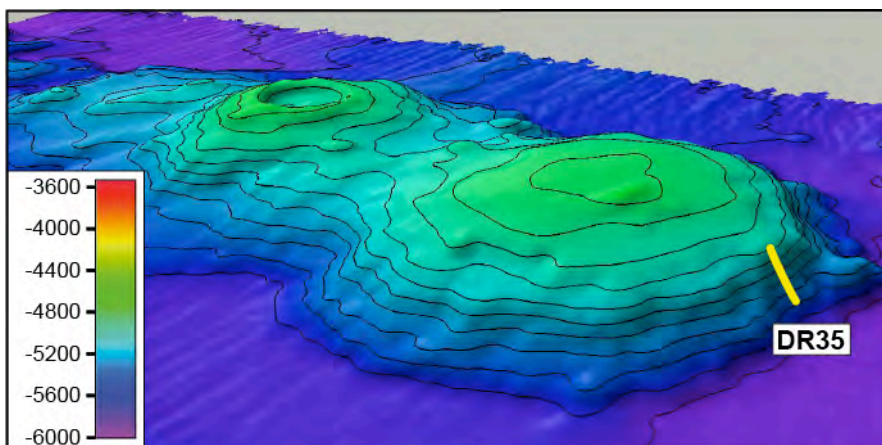


Fig. 7.13: 3D-map of solitaire twin seamounts north of Papanin Ridge, rising from the 6,000 m b.s.l. deep abyssal plain. Note the small depression on the northwestern cone. (view from SSW to NNE). Vertical exaggeration, contours, data source, and software used are the same as in figure 7.6.

A second N-S profile was conducted further east through the center of the Papanin seamount province. Overall the seamount structures elevate less prominent from the surrounding seafloor in this area and they gradually diminish to undredgable structures at the easternmost extension. Stations DR39 and DR40 are again located at solitaire seamounts north of Papanin Ridge and resemble pancake-like (pillow mound?) and oval seamounts, respectively. Track DR39 (c. 5,300 to 4,900 m b.s.l.) was carried out along the eastern flank and returned pillow lava fragments (Fig. 7.14). Initial rock description distinguishes three

moderately altered lithologies 1) slightly plagioclase-phyric, 2) aphyric, non-vesicular and 3) aphyric, slightly vesicular. In addition a greenish / grey sediment (tuff?) was also collected. DR40 returned empty. DR41 (c. 5,044 to 4,700 m b.s.l.) in the center of the profile aimed at a NNW-SSE trending ridge but again returned empty. The southern end of the profile is marked by DR42 through DR45, essentially two pancake-shaped seamounts where repeated dredge hauls were conducted at each. DR42 & DR43 were conducted along the southwest-facing slope from base to the middle part (c. 5,000 to 4,600 m b.s.l.). Only DR42 returned a single, fresh to moderately altered, aphyric lava clast in the core of a Mn nodule along with a plutonic or subvolcanic dropstone. DR43 delivered siltstones and chert. The last two dredges in the eastern Papanin area aimed again at a pancake-shaped seamount with relatively gentle slopes but this time with a small caldera at its northern margin (Fig. 7.16). Tracks DR44 and DR45 were carried out along the eastern and northeastern flanks, respectively, covering 5,150 to 4,600 m b.s.l.. A single dropstone was obtained in DR44, but DR45 finally returned ¼ full, with a large Mn crust (50x40x30 cm) that contained igneous clasts (DR45-7 to -16x) along with loose lava fragments (DR45-1 to -6, Fig. 7.15). The latter consists of olivine-plagioclase- and plagioclase-phyric lava fragments ranging from fairly fresh to strongly altered with most being moderately altered. The cemented fragments from the Mn crust show features of multiple alteration phases that include green-yellow zones of smectite (?) replacing groundmass.



Fig. 7.14: Slightly altered, plagioclase-phyric lava from a solitaire seamount north of the eastern Papanin seamount province.



Fig. 7.15: Relatively fresh, phyric, non-vesicular lava fragment from a seamount at the eastern end of Papanin Ridge.

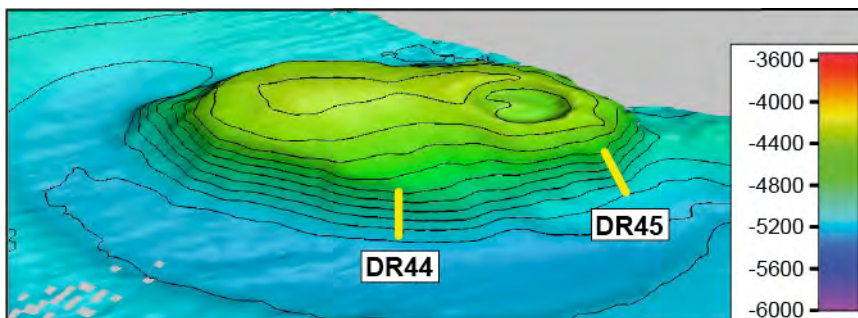


Fig. 7.16: 3D-map of a pancake-shaped seamount with small depression at eastern end of the Papanin seamount province (view from SSE to NNW). Vertical exaggeration, contours, data source, and software used are the same as in figure 7.6.

7.2.2. Ojin Seamounts

The Ojin Seamounts are a vast province of bathymetric highs east of Shatsky's Shirshov Massif (Fig. 7.17). Similar to Papanin Ridge, they are thought to be an expression of post Shatsky plume head volcanism but in contrast to Papanin Ridge, formed in an off-axis to intraplate environment over time. These circumstances may have led to melt extraction of specific mantle portions of the Shatsky plume tail due to the lid effect of the overlying lithosphere in contrast to the more integrated (mixed and diluted) geochemical signal expected from longer melt columns during the early stages of Papanin Ridge when the melting source

was still located beneath a triple junction. To which extend the plume spatially split to deliver material synchronously to Papanin Ridge and Ojin Seamounts is an open question to which SO265 aims to contribute.

The Ojin Seamount Province stretches over 650 km from 163°00'E to 170°20'E and extends over ca. 350 km N-S in their central part (Fig. 7.17). In the easternmost section their N-S spread narrows to <180 km before they morphologically disappear about 70 km west of the later Emperor Seamount chain. SO265 sampling of the Ojin Seamount Province will be described in a roughly clockwise circle beginning at the northeastern boundary of Shirshov Massif (DR2 and DR3), then going east along the northern half of the province (DR12 to DR14, DR67 to DR61 and DR46 to DR49), followed by an E-W profile from DR50 to DR60 along the southern boundary, before finally connecting via DR68 through DR73 with the eastern margin of Shirshov Massif.

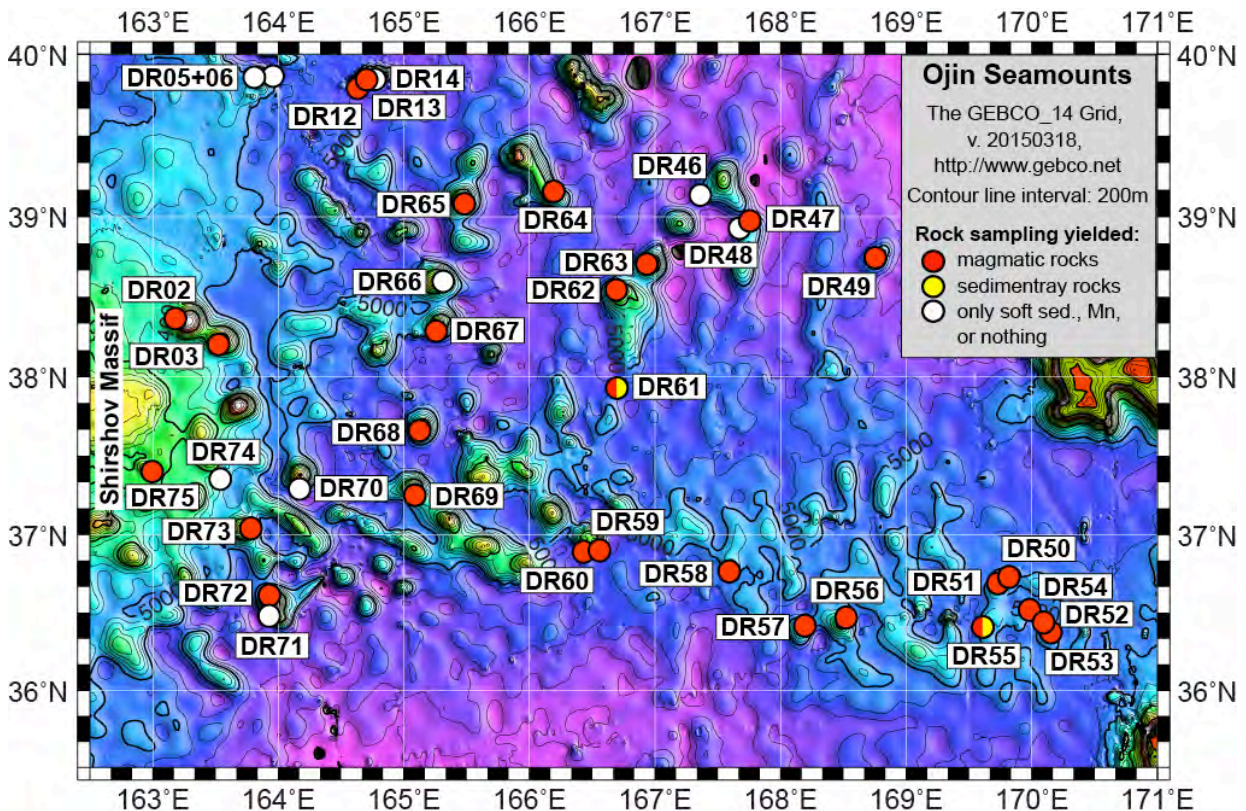


Fig. 7.17: Overview map showing the Ojin Seamounts and the north-easternmost part of the Shirshov Massif. Dots mark SO265 sampling stations.

The loop through the Ojin Seamount Province begins at the northeastern edge of the Shirshov Massif. Here two large circular seamounts with their plateau like summits shallowing to ~2,600 m b.s.l. and thus representing the shallowest features mapped during SO265. DR2 and DR3 sampled their northwestern and southern flanks, respectively, in the depth range of 3,400 to 2,950 m b.s.l. (Fig. 7.18). DR2 yielded highly vesicular aphyric basalt and sparsely plagioclase-phyric basalts with rare up to 1cm, fresh plagioclase (Fig. 7.19). Both lava types are strongly oxidized and may have erupted in shallow water. Rather strongly altered, angular fragments of aphyric to sparsely phyric plagioclase-clinopyroxene-phyric lava clasts cemented by Mn crusts were delivered by DR3 (c. 3,350 to 2,950 m b.s.l.). The plagioclase and clinopyroxene crystals appear, however, fresh.

The geographically northernmost Ojin seamount visited during SO265 was sampled by DR12 through DR14, along a ridge located c. 50 km east of the southern termination of Papanin Ridge and about 200 km northeast of Shirshov Massif. Due to its ± E-W, ridge like elongation and irregular shape of the slopes with abundant valleys and ridges that resemble sunrays (Fig. 7.21), the ridge received the working name “SONNE Ridge” by the SO265 scientific party. DR12 obtained fairly fresh olivine-pyroxene-phyric lava (Fig. 7.20) from the very base (c. 5,200 to 4,750 m b.s.l.) and DR14 slightly to moderately altered olivine-phyric

and olivine-plagioclase-phyric lava fragments from c. 4,100 to 3,700 m b.s.l. near the summit of SONNE Ridge. DR13, located close to DR14 at similar depth, returned empty.

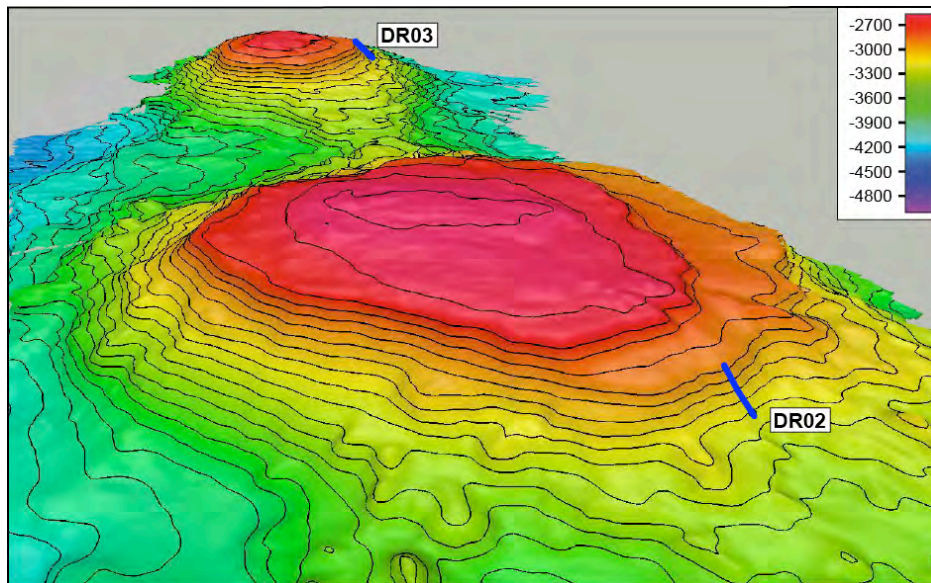


Fig. 7.18: 3D-map of two large circular seamounts with relatively flat plateau summits at the northeastern boundary of Shirshov Massif (view from NW to SE). Vertical exaggeration, contours, data source, and software used are the same as in figure 7.6.



Fig. 7.19: highly vesicular aphyric basalt from the northwestern flank of a seamount at the northeastern edge of the Shirshov Massif.



Fig. 7.20: Fresh to slightly altered olivine-plagioclase-phyric lava from the base of SONNE Ridge, northwestern Ojin Seamount Province.

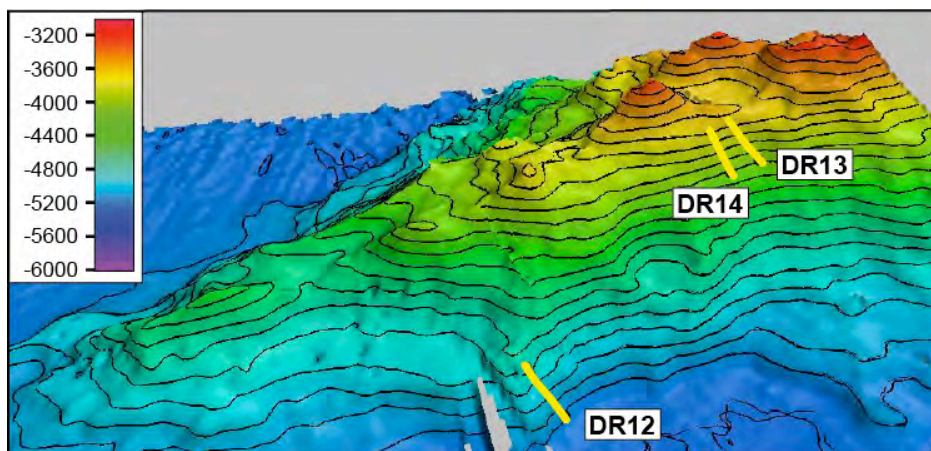


Fig. 7.21: 3D-map of the western part of SONNE Ridge in the northeast peripheral of the Ojin Seamount Province (view from SSW to NNE). Vertical exaggeration, contours, data source, and software used are the same as in figure 7.6.

To the southeast from SONNE Ridge, the northern half of the central Ojin Seamount Province was sampled at stations DR61 to DR67 and DR46 to DR49. DR67 (c. 3,800 to 3,400 m b.s.l.) is located along the southern flank of a N-S elongated seamount with a relatively flat plateau area in the south and a 1km Ø cone at the northern end. A mid-sized pillow (31x30x33

cm) of slightly to moderately altered, sparsely plagioclase-phyric lava was sampled from -1A to -1F. Petrographically similar samples with similar degrees of alteration were obtained as clasts from inside a Mn crust. Finally, aphyric, but highly altered lava fragments were also found. DR66 (c. 3,400 to 3,100 m b.s.l.) along the eastern slope of a flat-topped seamount north of DR67 returned empty. At DR65 a NE-SW elongated seamount with several rib like offsets was targeted over a nose-like structure at its southeastern slope. Several fragments of Mn crust and few larger blocks of Mn crust with abundant lava clasts were recovered. They include fresh to moderately altered plagioclase-phyric and aphyric lava fragments along with volcanoclastics. Further east, a large (10-12 km \varnothing) conical seamount with a small cone in the top region was sampled at DR64 (c. 4,000 to 3,600 m b.s.l.) along its northern flank just beneath the summit plateau. Mostly very well-rounded Mn nodules <10 cm and a very large Mn crust along with a few angular pillow lava fragments were obtained. The igneous rocks are fairly fresh to slightly altered throughout with aphyric and sparsely plagioclase-phyric varieties.

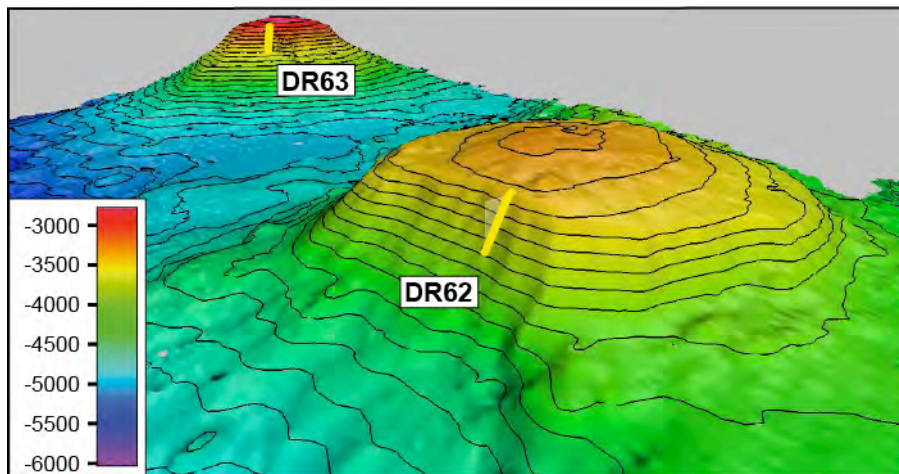


Fig. 7.22: 3D-map of two circular seamounts in the central Ojin Seamount Province. Note the c. 400 m difference in elevation of the plateau margins at their summits (view from WSW to ENE). Vertical exaggeration, contours, data source, and software used are the same as in figure 7.6.

Further southeast DR62 (c. 3,750 to 3,300 m b.s.l.) aimed at the WNW-slope of another flat-peaked seamount built on top of a large, N-S elongated basement structure (Fig. 7.22). A ~40 cm block of strongly altered tuff (Fig. 7.23) and two slightly to moderately altered scoria fragments were obtained. About 20 nm north of DR62 another similarly shaped seamount was targeted during DR63 at its southern slope (Fig. 7.22), which may represent the edge of a possible slope collapse. Overall twenty, variable sized (0.1 to 0.6 m), mostly moderately altered lava fragments were recovered. Most rocks are highly vesicular, fewer dense, some reddish oxidized and all are feldspar-phyric. An exception is sample -9, a dense, slightly altered aphyric lava. A block of highly feldspar-phyric hyaloclastite with xenoliths of highly feldspar-phyric lava was also obtained (DR63-12, Fig. 7.24). The matrix of the hyaloclastite is largely altered but may contain fresh glass.



Fig. 7.23: Strongly altered volcaniclastic sediment, central Ojin Seamount Province.



Fig. 7.24: Highly feldspar-phyric hyaloclastite, central Ojin Seamount Province.

DR61 (ca. 4,550 to 4,150 m b.s.l.) is a small (\varnothing 7 km), solitaire, conical seamount. Its southwestern slope along a scarp slump delivered a $\frac{3}{4}$ full dredge of mostly Mn nodules, rafted pumice and small volcanic rocks. The cores of the Mn nodules occasionally contained aphyric, moderately to strongly altered lava clasts. The next four stations (DR46 to DR49) covered the north-easternmost part of the Ojin Seamount Province. A small conical seamount in a chain of NNE-SSE trending seamounts was aimed along its western slope at DR46 (c. 4,800 to 4,400 m b.s.l.), but returned empty. DR47 and DR48 tackled the northwestern flank of a \pm N-S striking ridge from c. 5,000 to 4,400 m b.s.l. Only DR47 delivered Mn nodules with occasional igneous cores of slightly phyric to aphyric, angular lava fragments. Overall they are moderately to strongly altered. DR48 returned empty. About 50 nm east of DR48 the northwestern flank of a more complex structured seamount was sampled during DR49 along its upper part (c. 4,600 to 4,200 m b.s.l.). The dredge returned $\frac{1}{2}$ full with mostly Mn nodules but igneous fragments also occurred. They are aphyric pillow fragments, ranging from vesicular to non-vesicular. Samples DR49-1 to -8 comprise the vesicular group, with some of them displaying nice pipe vesicles typical of pillow lava (Fig. 7.25). The groundmass ranges from fresh to moderately altered. Samples DR49-9 to -20 are less vesicular, more dense and appear moderately altered throughout. The least altered specimens in this group are number -9, -14, and -20.



Fig. 7.25: Aphyric pillow lava fragment with chilled margin and pipe vesicles, northern margin of central Ojin Seamount Province.

The eastern end of the Ojin Seamount Province was sampled at stations DR50 through DR55. DR50 and DR51 sampled the northern and northwestern slopes of a N-S elongated seamount which houses a smaller, flat, circular plateau in its top region. From DR50 (c. 4,600 to 4,200 m b.s.l.) only two small, highly altered aphyric lava fragments were recovered from the cores of Mn nodules. Repeated station DR51 (c. 4,300 to 3,850 m b.s.l.) also recovered primarily Mn nodules and crusts but with more abundant igneous cores. The lavas from these cores range from slightly altered, plagioclase phyric (Fig. 7.27) to moderately altered, medium grained aphyric lava. After multi-beam mapping, the easternmost Ojin seamount at 36°20'N / 170°30'E turned out to have insufficient steep slopes for dredging. Therefore DR52 and DR53 represent the easternmost Ojin seamount sampled during SO265. At this site, a textbook-like, conical seamount with a base diameter of c. 13 km and a 300 m deep caldera was discovered (Fig. 7.26). DR52 (c. 4,650 to 4,300 m.b.s.l.) along the steep mid section of the northwestern flank obtained only a few Mn-nodules from which a single piece of fairly fresh, aphyric lava was extracted. The extremely steep northwest-facing inner wall of the caldera was the aim of DR53 (c. 4,050 to 3,850 m.b.s.l.) and returned several large Mn crusts that enclosed clasts of pillow lava fragments and hyaloclastites. The sampled igneous material comprises sparsely plagioclase phyric volcanic rocks that range from slightly oxidized to moderately altered. Hyaloclastite samples DR53-7A and -7B seem to possess fresh glass (Fig. 7.28).

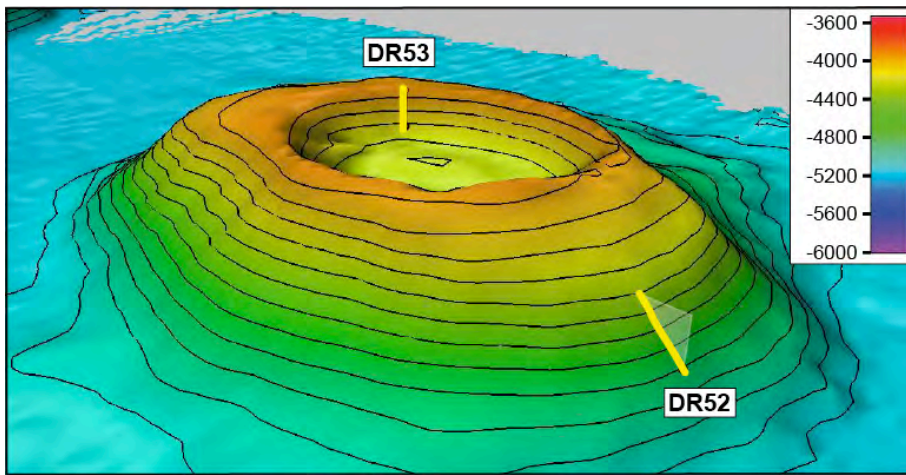


Fig. 7.26: 3D-map of a conical seamount with prominent caldera at the eastern extension of the Ojin Seamount Province. (view from N to S). Vertical exaggeration, contours, data source, and software used are the same as in figure 7.6.



Fig. 7.27: Fairly fresh, aphyric lava recovered from core of a Mn nodule, eastern Ojin Seamount Province.



Fig. 7.28: Altered hyaloclastite with relicts of fresh glass, eastern Ojin Seamount Province.

About 9 nm west of the prominent caldera cone, a circular shaped pillow mound was mapped and sampled along its northeastern flank (DR54, c. 4,850 to 4,400 m b.s.l.). The dredge returned ½ full with pillow lava fragments along with a lot of Mn crusts and nodules. The majority of igneous rocks are aphyric lava fragments with minor occurrences of sparsely plagioclase- and olivine-phyric varieties. Degrees of alteration range from relatively fresh (DR54-1 to -3) to mostly moderately altered in the remaining samples. DR55 is a 8 km Ø pancake-shaped seamount, slightly southwest of the ridge on which stations DR50 and 51 were located at the northern end. Track DR55 is located on the west-facing slope across a small ridge from near base to top (c. 5,000 to 4,550 m b.s.l.). The dredge returned a few rocks and Mn nodules. The aphyric pillow lava fragments are mostly in advanced stages of alteration.

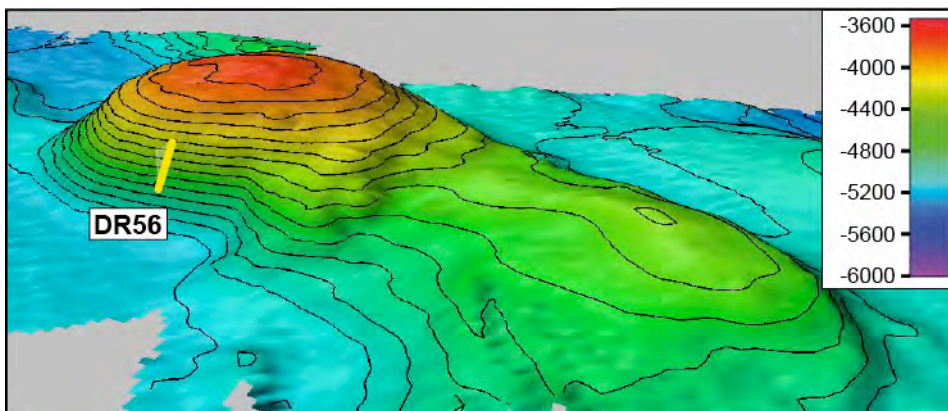


Fig. 7.29: 3D-map of a NW-SE striking ridge with flat topped seamount at its southeastern end (view from NW to SE). Vertical exaggeration, contours, data source, and software used are the same as in figure 7.6.

Stations DR56 through DR60 fill in the southern part of the central Ojin Seamount Province. DR56 is a circular shaped seamount that sits at the southeastern end of a NW-SE striking ridge (Fig. 7.29). The track was carried out along the steep north-facing slope and the dredge returned 1/3 full. It contained volcanic rocks, rafted pumice, Mn nodules, Mn crust and, amongst other biologic material, sponges made of glass fiber. Most lavas are sparsely plagioclase-phyric with minor occurrences of aphyric varieties. The majority of samples are in fairly fresh to slightly altered conditions. About 18 nm further west, a flat topped, slightly E-W elongated seamount with a base diameter of 14 km was sampled along track DR57 (c. 4,450 to 3,950 m b.s.l.) along its northeastern flank. Mn nodules, Mn crusts with semi-consolidated mud, but also igneous rock clasts were recovered. They include fresh to slightly altered, aphyric lava (DR57-1, -2) and more altered varieties (DR57-3, -4). The other lithologies are moderately to strongly altered, sparsely plagioclase-phyric and plagioclase-phyric lava fragments (DR57-5 to -9). Next is DR58 (c. 4,800 to 4,400 m b.s.l.) along the southwestern slope of a circular seamount with relatively steep southern and western slopes. Only few Mn crusts and nodules were obtained but some nodules contained very small clasts of fresh to moderately altered, aphyric lava. DR59 and DR60 aimed at the southern flank (c. 4,650 to 4,200 m b.s.l.) of an E-W elongated seamount with a relatively flat top and a few small cones covering its summit. A 1/3 full dredge with 5-10 cm Ø sized Mn nodules returned. Intense search recovered only two cores of moderately altered, sparsely plagioclase-phyric lava. Repeat station DR60 1 nm further northwest obtained mostly sparsely plagioclase-phyric lava fragments (Fig. 7.30) ranging from slightly to moderately altered (DR60-1, -2, and -4). Aphyric varieties with similar degrees of alteration were sampled in DR60-2E, -6 and -7. Samples -2A through -E are individual clasts from a breccia block.



Fig. 7.30: Sparsely plagioclase-phyric lava from a breccia block, central Ojin Seamount Province.

The following stations DR68 to DR73 cover the western Ojin Seamount Province along its southern margin. Mapping at DR68 revealed a steep (50-60°) sided seamount with a relatively flat summit area at c. 2,800 m b.s.l. (Fig. 7.31) making it the third shallowest seamount (after DR2 & -3) mapped during SO265. At station DR68 the bathymetric features come closest to term this structure a guyot. DR68 (c. 3,500 to 2,900 m b.s.l.) was carried out along the S slope beneath the plateau edge and returned ¼ full. The igneous material comprises relatively fresh to slightly to moderately altered, aphyric, massive lava, (DR68-1 to -6, Fig. 7.32); more vesicular and altered varieties (DR68-7 to -12) and occasional sparsely plagioclase-phyric specimens. Unusual rocks are platy aphyric volcanics or sediment (DR68-13 to -15) generating a characteristic sound when clinked together that resembles phonolite. Finally, a copper green probably hydrothermally altered lava or tuff was also obtained (DR68-16, Fig. 7.33).

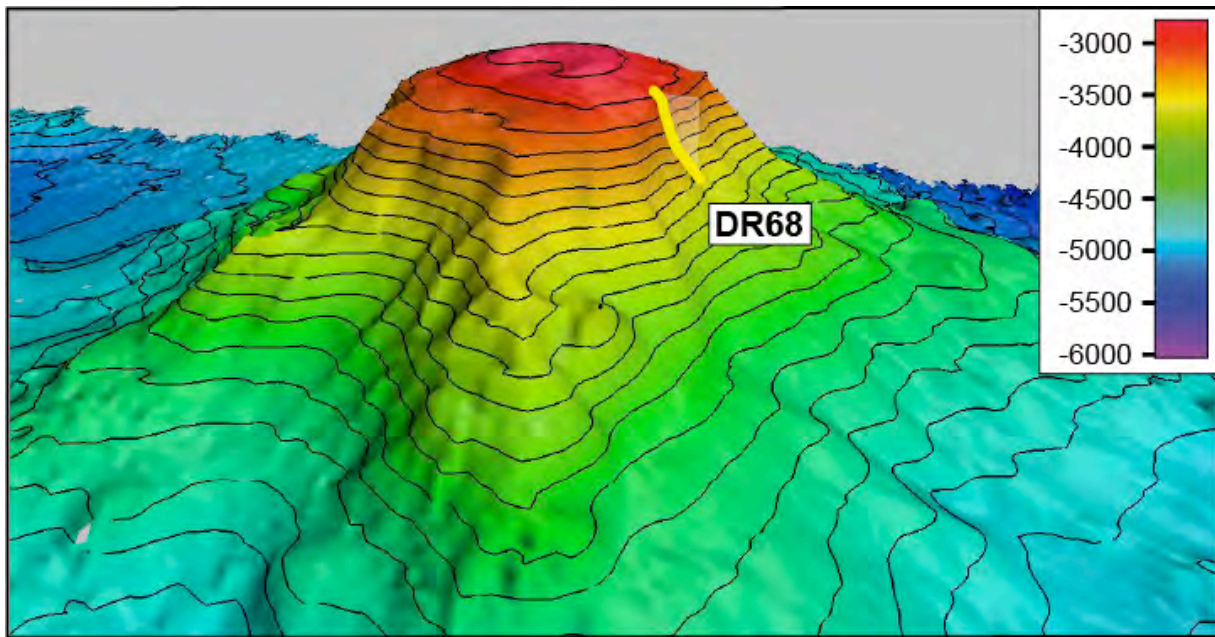


Fig. 7.31: 3D-map of a guyot-type seamount in the western part of the Ojin Seamount Province. The uppermost slope is $\sim 55^\circ$ steep and the summit shallows at $\sim 2,800$ m b.s.l. No direct evidence for subaerial volcanic activity or shallow marine carbonate deposits (reef) were detected (view from ESE to WNW). Vertical exaggeration, contours, data source, and software used as in figure 7.6.



Fig. 7.32: Relatively fresh, massive, aphyric lava fragment, western Ojin Seamount Province.



Fig. 7.33: Green hydrothermally overprinted lava or tuff, western Ojin Seamount Province.



Fig. 7.34: Highly plagioclase-porphyritic lava, fresh to slightly altered, western Ojin Seamount Province.

DR69 is located at the northwestern end of a prominent, ~ 140 km long, NW-SE striking chain of four seamounts of which the three southeastern ones have been successfully sampled during the R/V KAIREI expedition KR14-07 in 2014 (T. Sano pers. comm.). The seamount has a flat top that shallows to c. 2,900 m b.s.l. but the flanks are less steep than DR68. The track was carried out beneath the plateau edge (c. 3,600 to 3,100 m b.s.l.) and the dredge returned $\frac{1}{4}$ full. It contained up to 0.5 m sized lava fragments and a single large pumice bloc along with a few Mn crusts. The igneous material is quite variably and includes fairly fresh, highly plagioclase-phyric lava, (DR69-1 to -4, Fig. 7.34), aphyric, moderately altered and mostly massive lava (-5 to -8). Furthermore, moderately altered, sparsely plagioclase-phyric lava (DR69-9 to -12) and finally strongly altered, mostly aphyric and highly vesicular lava (DR69-13 to -17) were sampled. A pillow breccia and altered hyaloclastite (DR69-18 and -19) may contain relicts of fresh glass. About 40 nm further west, a large, complex shaped seamount delivered only three rafted pumice clasts from the lowermost southern flank during DR70 (c. 5,000 to 4,500 m b.s.l.). The pumice was discarded due to its unknown place of origin. Another complex-shaped seamount consisting of two peaks above a broad basement structure was aimed at DR71 and DR72 (Fig. 7.35).

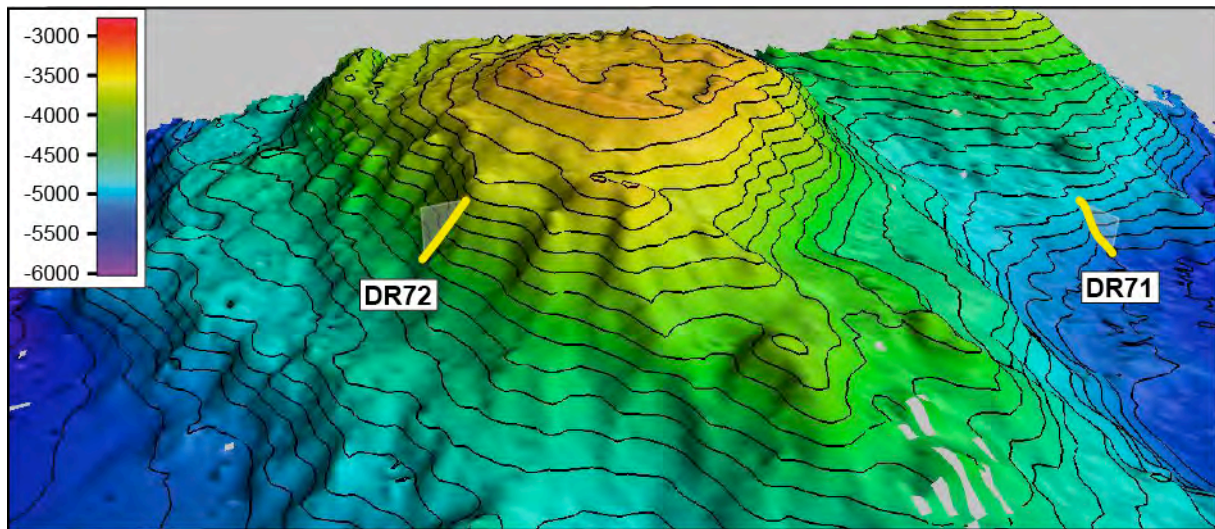


Fig. 7.35: 3D-map of a complex amalgamation of seamounts in the western Ojin Seamount Province (view from W to E). Vertical exaggeration, contours, data source, and software used are the same as in figure 7.6.

DR71 (c. 5,300 to 5,000 m b.s.l.) along the base of the western flank beneath the southern peak returned empty. Repeated station DR72 (c. 4,200 to 3,700 m b.s.l.) along the north-facing flank of the northern summit returned a few rocks of sparsely plagioclase-phyric lava fragments. They were recovered as clasts from breccia blocs (DR72-1 to -3) or were present as loose fragments (DR72-4 and -5). They range from relatively fresh to moderately altered. DR73 marks the last station in the western Ojin Seamount Province during SO265. Along the eastern flank of this, 22 km base diameter-sized seamount with a flat-topped summit, DR73 (c. 3,750 to 3,350 m b.s.l.) returned very few Mn crusts with attached, freshly broken pillow margins. The pillow lavas are aphyric and mostly moderately altered. The chilled margins of -3B, -3C and -3D appear to contain fresh glass (Fig. 7.36).



Fig. 7.36: Moderately altered chilled margins of pillow lava with tiny areas of fresh glass, western Ojin Seamount Province.

7.2.3. Shirshov Massif

The Shirshov Massif is thought to represent the northernmost bathymetric expression of the Shatsky oceanic plateau event. A single IODP drill-hole (Site U1346) penetrated only 53 m into its magmatic basement (e.g. Sager et al. 2010), which therefore remained under-sampled prior to SO265. Attempts to obtain more basement samples were carried out at two seamounts along its northern margin (DR4 to DR6) and possible basement outcrops along the eastern margin of the Shirshov Massif summit (DR74 and DR75).

The northern locations lie ~80 nm NNE of the Shirshov Massif central summit along the southern boundary of the Thompson Trough (Fig. 7.5), which morphologically and structurally (?) separates Shirshov Massif from Papanin Ridge. Based on the E-W narrowing of the 5,000 m depth contour from ~120 nm at central Shirshov Massif to 40-50 nm, the area could, however, also be assigned to Papanin Ridge. Site DR4 aimed at the northwestern slope of a large pillow mound with a large central depression (Fig. 7.37). The seamount is located right on the southern shoulder of the Thompson Trough so that this volcanism may also be associated with formation of the trough and not necessarily represents pre-existing Shirshov / Papanin basement. Haul DR4 recovered basically three *in-situ* igneous lithologies; 1) aphyric lava (DR4-1, -3, -5, -6, -7, 8, -11, -17, Fig. 7.38) varying from slightly to moderately altered, 2) sparsely plagioclase- and olivine-(?) plagioclase-phyric lava (DR4-2, -4, -9, -10) varying from slightly to moderately altered and 3) fluidal textured volcanics (DR4-12 through -16) typical for high K rocks (trachytes?), some containing orange colored pumiceous inclusions. Lastly, pumice blocs most likely derived from pumice rafts were also sampled.

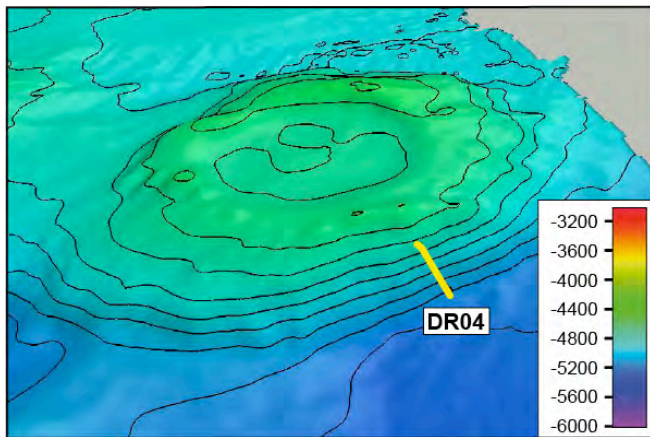


Fig. 7.37: 3D-map of a pancake-shaped pillow mound with a central depression at southern margin of Thompson Trough (view from NNE to SSW). Vertical exaggeration, contours, data source, and software used are the same as in figure 7.6.



Fig. 7.38: Slightly to moderately altered aphyric lava from the pancake-shaped pillow mound at the southern boundary of Thompson Trough.

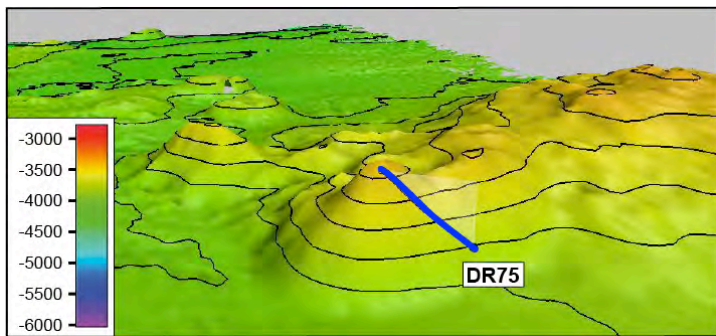


Fig. 7.39: 3D-figure of a small cone 25 nm west of the eastern Shirshov summit interpreted to possibly represent a second, sediment-buried Shirshov summit (view from ENE to WSW). Vertical exaggeration, contours, data source, and software used are the same as in figure 7.6.



Fig. 7.40: Slightly altered, moderately phyric lava from a small cone 25 nm west of the Shirshov summit (cf. Fig. 7.39).

The next two attempts at Earthwatch Seamount east of DR4 were less successful. DR5 (c. 4,400 to 4,000 m b.s.l.) along the northwestern summit retrieved only chunks of Mn crust with attached sediment and a single Mn nodule without igneous core. The deep base of the northwestern flank of Earthwatch Seamount sampled at DR6 (~5,200 to 4,850 m b.s.l.) again only retrieved Mn crusts with occasional, highly altered, very small lava clasts, which appear of limited use for geochemistry and age dating. At the central summit of Shirshov Massif, DR74 (~4,650 to 4,450 m b.s.l.) targeted a small step in the eastern slope of the Shirshov summit.

Despite frequent medium to very strong bites the dredge returned completely empty. The final station of SO265 was carried out along the eastern flank of a small seamount, interpreted to be a sediment-buried second Shirshov summit (Fig. 7.39). Although the dredge DR75 was filled 1/3 with Mn crusts and Mn nodules, a thorough search caught only two clasts of fairly fresh to moderately altered plagioclase phyric lava from the cores of Mn nodules (Fig. 7.40).

7.2.4. Hokkaido Trough

The Hokkaido Trough is thought to be an extinct Cretaceous spreading center about 320 km northwest of the northernmost section of Papanin Ridge. Due to an approaching storm in the Papanin working area, R/V SONNE had to escape northwestward and thus first time ever sampling of the Hokkaido Trough was possible. Since the ocean crust in this area formed during the Cretaceous magnetic quiet zone (c. 120 to 84 Ma) the precise age of the crust in this area and thus the age of the abandoned spreading center is completely unknown. Detailed mapping reveals multiple sets of ENE-WSW striking (fault-bond?) ridges and basins (Fig. 7.41). At DR38 (c. 5,900 to 5,600 m b.s.l.) the southeast facing, gentle slope of such a ridge was dredged and returned moderately altered, aphyric, fine to medium coarse lava (Fig. 7.42).

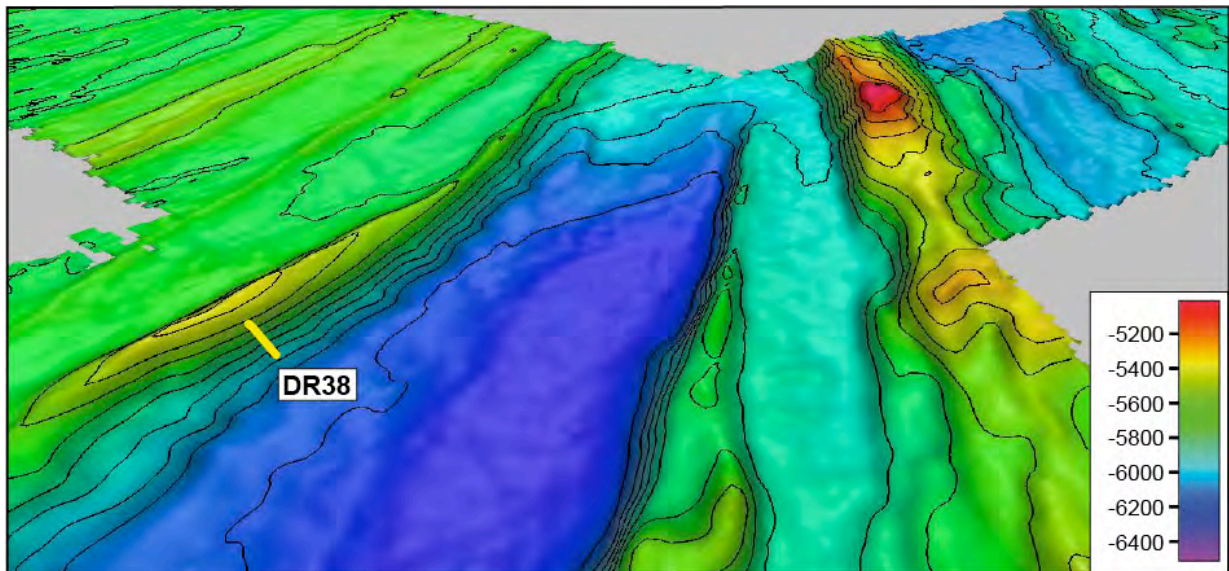


Fig. 7.41: View into Hokkaido Trough composed of multiple ridges and basins that could represent an extinct Cretaceous spreading center about 320 km northwest of Papanin Ridge. Unfortunately, weather conditions did not allow dredging of the much steeper southern flanks (right side) (view from SW to NE). Vertical exaggeration, contours, data source, and software used are the same as in figure 7.6.



Fig. 7.42: Moderately to strongly altered, sparsely plagioclase-olivine-phyric lava from the Hokkaido Trough.

7.2.5. Rock Sampling Summary

As expected, rock dredging proved challenging during SO265, reflecting the 140-110 Ma old structures in combination with sediment cover and strong Mn encrustation in the mostly 4,000 to 5,500 m b.s.l. depth range of dredging. But not only sedimentation / encrustation added to smoothing slope surfaces; their initial steepness is often rather low ($<30^\circ$) as exemplified by the many pancake-shaped seamounts mapped. When successfully sampled, they often returned pillow lavas and confirmed that they are pillow mounds, likely formed over relatively short periods and did not evolve into more complex seamount structures. We note that in other places surveyed by our group such as Afanasy Nikitin (SO258/1, Indian Ocean) or the Eastern Pacific (SO208) morphologically similar seamounts exist, which also return low rock yields when dredged, despite their much younger ages (60-70 Ma and 15 Ma, respectively). Other seamount morphologies in the SO265 working area include ridges, conical seamounts, complex seamounts and guyots. A rough estimate on the distribution of seamount morphologies is shown in Table 7.1. Evidently pancake-shaped seamounts dominate in both areas (Papanin Ridge and Ojin Seamounts) and conical, complex and guyot-shaped seamounts mainly occur in the Ojin Seamount Province. Here, the eastern section appears to be dominated by pancake-type seamounts reflecting lesser eruption volumes and shorter periods of volcanism, most likely caused by diminishing mantle melting. More profound details on seamount morphologies and their spatial distribution, however, await future on-shore analysis. Statements made here are simply first, preliminary impressions. For example, the classification of seamounts as guyots requires more detailed post cruise processing of the collected bathymetry and charting of structural elements such as smoothness / roughness of the plateau surfaces.

Table 7.1: Preliminary estimate on the distribution of seamount morphologies in the three SO265 working areas. Pancake-shaped seamounts prevail in the Papanin and Ojin areas while conical, complex and guyot-types additionally occur in the Ojin Seamount Province.

Morphology	Papanin Ridge	Ojin Smt. Province	Shirshov Massif	Total (50)
Pancake	15	11	1	27
Conical	1	5	1	7
Guyot	0	2	0	2
Complex	0	6	1	7
Ridge	5	2	0	7

Finally, we emphasize that despite prevalent recovery of Mn crusts and Mn nodules, useful igneous material was often present as clasts or cores within these precipitates, rewarding the intense efforts to break up the shells of sometime hundreds of nodules. The dominant recovery of mostly angular igneous clasts also means that slope debris was obtained and only in rare cases igneous rocks were freshly broken off the ground.

In total 72 dredge hauls were conducted during SO265 of which 49 (=68%) recovered *in situ* (= locally occurring) volcanic rocks. No deployed device was lost or damaged. More importantly, we managed to get sample material suitable for the planned geochemical and geochronological analyses from all critical areas/structures and in spatially well-distributed intervals from all working areas to address all the scientific objectives of the project.

Attempts to sample the lower "basement" of both, the Shirshov Massif and Papanin Ridge were made by sampling both sides of Thompson Trough, a tectonic graben structure (Sager et al. 1999). The main body of Papanin Ridge was also densely sampled throughout its SW-NE striking part along with the westerly located Shuleykin Ridge which thus far has an unexplored relation to Papanin Ridge. The north-easternmost extension of Papanin Ridge (east of $165^\circ30'E$), where the ridge was no longer formed at a spreading center but, based on paleomagnetic data, originated by pure intraplate volcanism, proved to be particularly difficult to sample. Only five out of fifteen dredge hauls returned suitable volcanic rocks. Luckily, well-preserved and feldspar-rich lavas (suitable for age determination) were obtained from the easternmost end of the extension. If Papanin Ridge represents a classical hotspot track, the volcanism at this site should have the youngest age. Macroscopically (e.g. in terms of mineral composition), however, no principal difference could be recognized between volcanic rocks

obtained from west and east of 165°30' E. It will be interesting to see, if the geochemical composition of the lavas indicate any difference, i.e. a lower degree of melting compared to Papanin Ridge lavas that formed at the spreading center. Dredge hauls north of 41° frequently recovered ice rafted debris that most likely originates from Kamchatka / Siberia. So far the southernmost limit of such material was thought to lie at ~44°N (John and Krissek 1999). The dropstones, although mostly of volcanic origin were easily identified by unusual freshness, mineralogy and lack of Mn encrustation.

Regarding the second main working area, the Ojin Seamount Province, it can already be concluded, that the number and size of the individual volcanic centers decreases eastwardly going along with the shrinking width of the province. While the province reaches a N-S extension of over 370 km near Shirshov Massif it tapers toward the east and terminates as a small cluster of medium-sized, pancake-shaped seamounts at 170°E. If the planned age dating demonstrates that the ages of the volcanoes become progressively younger towards the east, we have probably found the postulated hotspot track!

Regardless if Papanin Ridge or the Ojin Seamount Belt (or both?) turn out to represent a Shatsky hotspot track, this finding would mean a crucial step forward to solve the riddle of Shatsky Rise plateau formation (to either origin by interaction of a deep mantle plume with a spreading center or exclusive formation by an unusually productive spreading center without mantle plume involvement). Still, if Papanin Ridge and Ojin Seamounts are shown by our post-cruise research to be synchronously related to a single plume source further refinements on the temporal and spatial distribution of such mantle features have to be made.

7.3. BIOLOGICAL INVESTIGATIONS

(A.-C. Zakrzewski)

7.3.1. Collecting Report: Meiofauna

In total, the four sediment trap tubes inside the chain bag of the dredge yielded about 50 kg of sediment. Sediment quantities varied across the 75 stations and not all dredges were successful (see Appendix IV). The sediment samples of each station were fixed in 6% formalin and packed for later extraction and identification at the Museum für Naturkunde (Berlin, Germany).

7.3.2. Collecting Report: Macrofauna

In 44 (60.27%) of the 73 sampled stations, macrofaunal specimens were recovered yielding overall 128 single biological samples (see Appendix IV). This material covers representatives from many different taxa ranging from Foraminifera and Porifera, to Cnidaria, Annelida, Mollusca, Bryozoa, Echinodermata and Tunicata. The majority of specimens was fixed in either Ethanol or formalin. In a few cases, selected material was fixed in paraformaldehyde and/or RNAlater. To illustrate the collected material of SO265, a few selections are shown in the following.

Most of the specimens were of small size ranging from 1mm to 10mm. The most abundant group collected were sponges (Porifera) ranging from small sizes of a few millimeters to several centimeters. The majority of collected sponges belong to the Hexactinellida which are the glass sponges (Fig. 7.43A); but also, representatives of the Demospongia were collected (Fig. 7.43B).

The second most abundant group collected were mainly tube-dwelling worms of the taxon Polychaeta. Many of their calcareous tubes covered the surfaces of the collected rock samples. On one occasion, a representative of the errant polychaetes was collected. This worm belongs to the scale worms (Polynoidae) (Fig. 7.43C).

The echinoderms (Echinodermata) collected during SO265 comprised one sea cucumber (Holothuroidea) and one starfish (Asteroidea) (Fig. 7.43D), but many brittle stars (Ophiuroidea) though they were all collected in only 2 of the 73 dredge stations (Fig. 7.43E).

During SO265, only 2 molluscs (Mollusca) were collected – one gastropod (Gastropoda) and one cephalopod (Cephalopoda). The latter was collected from the pelagic phase rather than the abyssal depths as swarms of *Onychoteuthis* (likely *Onychoteuthis meridiopacifica*) were seen during late hour dredges (Fig. 7.43F).

Another pelagic bycatch collected were colonial tunicates known as salps (Thaliacea). They appeared in long chains on the water surface after sun set (Fig. 7.43G).

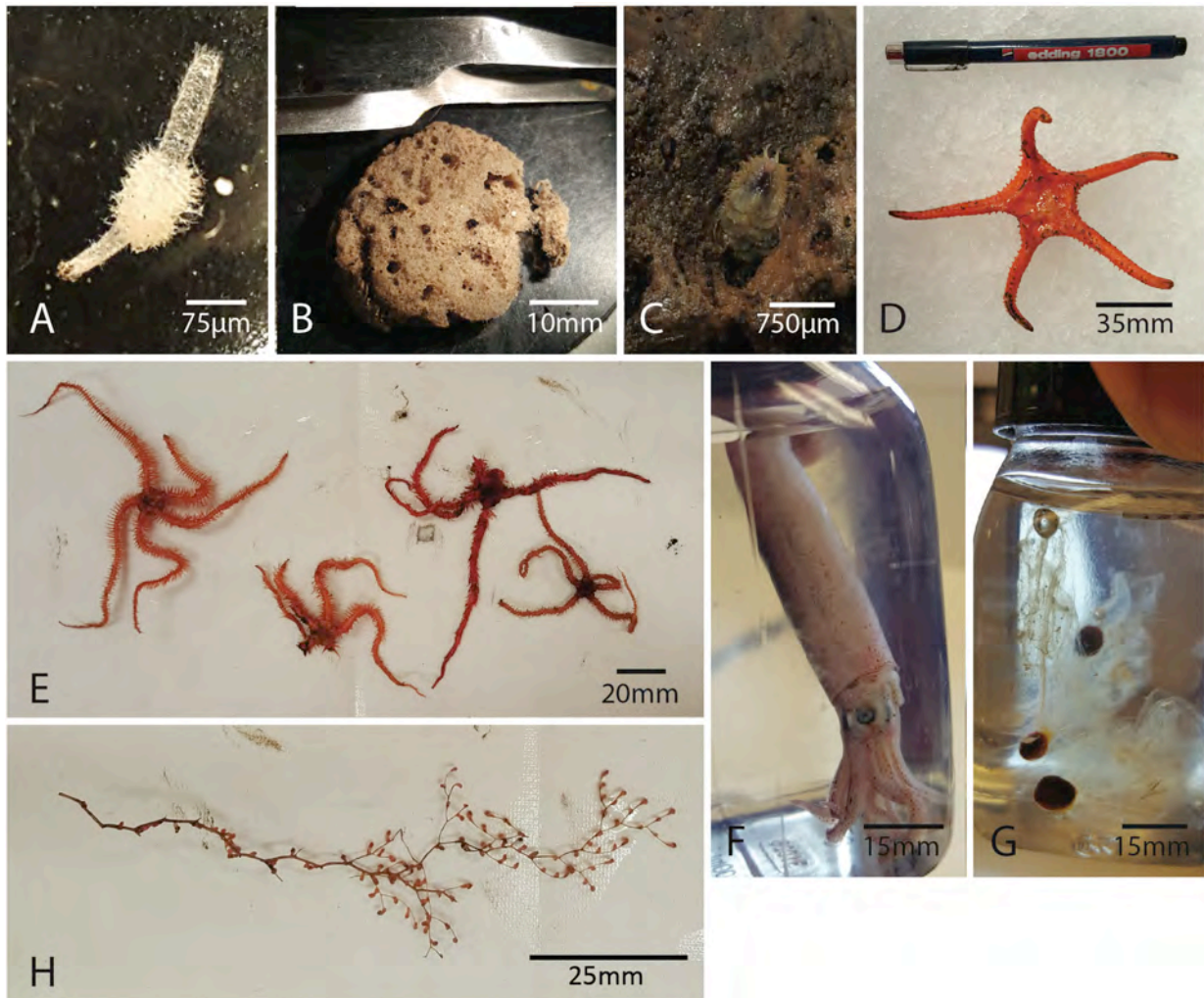


Fig. 7.43: Selection of macrofaunal specimens recovered on cruise SO265.

The cnidarians (Cnidaria) collected during SO265 were mainly from the groups of Anthozoa (e.g., sea anemones, corals) and Hydrozoa (e.g., colonial hydroids). The corals collected in deepest depths were black corals. On one occasion, a branch of golden coral (Fig. 7.43H) was collected together with all sampled ophiuroids.

All macrofaunal specimens collected during SO265 will be transferred to the Museum für Naturkunde (Berlin, Germany), where they will be re-assessed and then distributed to further colleagues for species identification.

7.4. WEATHER DESCRIPTION OF SO265

(C. Heitmann-Bacza)

The research vessel SONNE left the port of Yokohama on August 27th around 03 pm local time with a moderate south to south-easterly wind. The air temperature was about 27°C and water temperature 28°C. During the transit to the northeast, temperatures progressively decreased, especially after leaving the area influenced by the warm Kuroshio Current. Before reaching the first working area (southern Papanin Ridge), the wind strongly refreshed to 6 to 7 Bft at times with gale force gusts and 2 to 3 m of significant wave with swell from northern directions. A developed small-scale low (1012 hPa) at 38°N 150°E moved east. In front of this low, south-easterly winds with 8 Bft and waves of 4 m were expected on August 31st. Due to the deteriorating weather conditions, a switch of the ships course was recommended to start with station work further southeast (eastern Shirshov Massif, at about 39°54'N 164°E). When the ships arrived at the new location, the south-westerly wind weakened to 4 to 5 Bft with a

significant sea of 2 to 3 m and swell from southerly directions allowing to conduct the first dredge hauls. Subsequently, the transit to the northwest was continued at the rear of the low with north-westerly winds of 4 to 5 Bft on September 02nd. The new research area was influenced by alternations of weak high pressure and low troughs with occasional rain or showers and local fog patches. Moderate to strong winds from northwest to northeast prevailed, which turned to the southwest only once.

The super typhoon "JEBI" reached Japan south of Tokyo and then crossed Japan and turned to north-northwest on September 4th. An associated trough with an embedded low centre crossed the working area on September 07th. The air temperatures cooled down to 13°C-16°C, the water temperature that initially was 20°C dropped to 15°C. The wind came from different directions with wind force of 4 to 6 Bft, sea state 2 to 2.5 m, and swell from several directions. Subsequently, temporarily weak high influence dominated again.

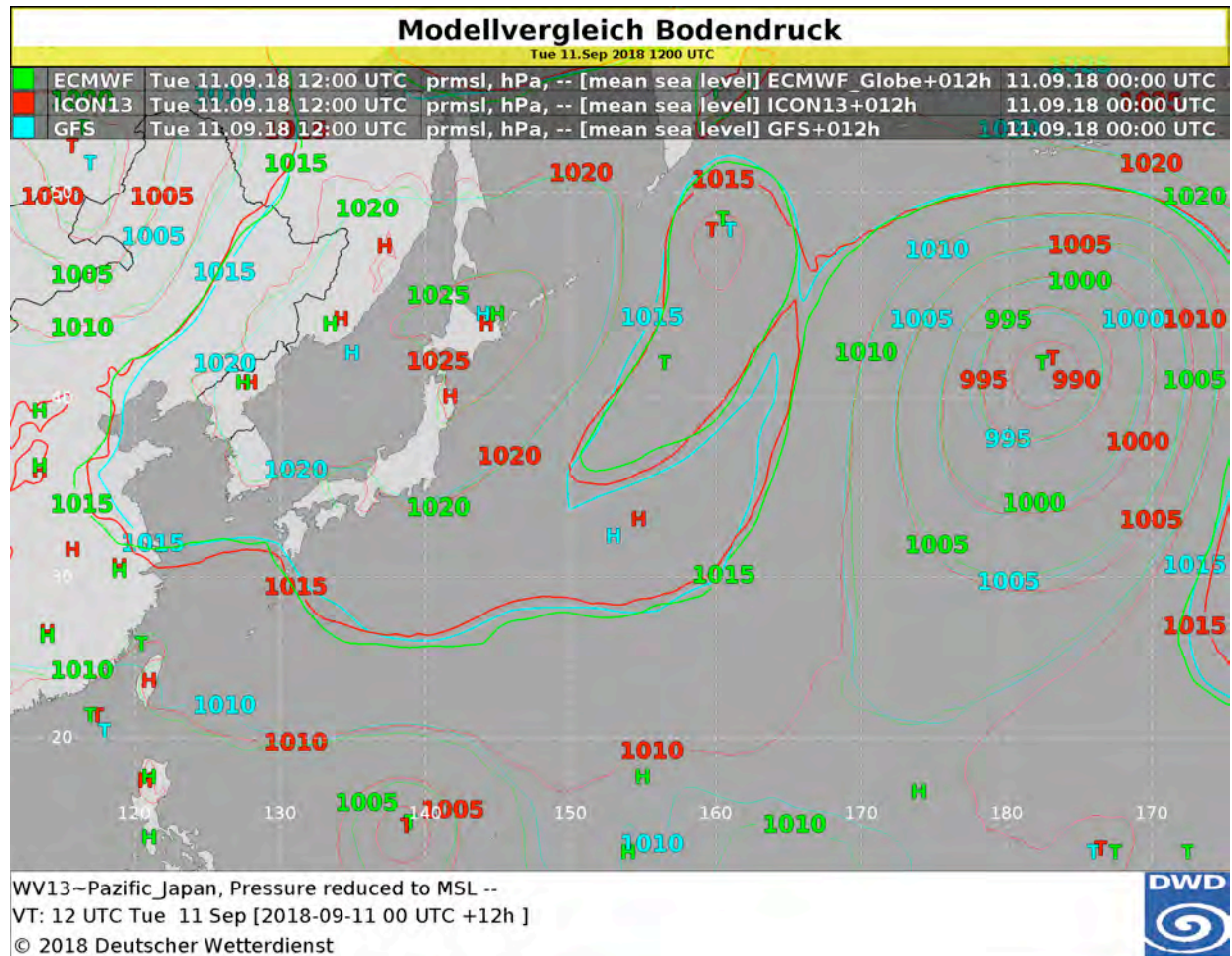


Fig. 7.44: Forecast from September 11th, 2018.

Unfortunately, the crossed gale intensified and was blocked by an extensive high over the Eastern Pacific. The gale was near 43°N, 178°E with 990 hPa on September 10th (00UTC/10LT) and shifted a little to northwest. The research area extended to the west side of this gale, while a high pressure bridge (1020 hPa) was built from west. A strong pressure gradient was supposed to develop between these areas with increasing to 8 to 9 Bft, with gusts of 12 Bft. Significant waves higher than 5 m were expected thus preventing further dredge operations. It was therefore recommended to avoid these conditions by moving towards the northwest and to weather the storm up there. The ship started to sail to this position on September 11th (Fig 7.44.). Another low (TUE 18UTC/04LT 1010 hPa near 47°N 162°E) with rain, later showers, crossed the shelter area eastwards on September 12th. It connected with an extensive gale in the east (994 hPa near 42°N 175°W) and shifted slightly to the northwest on September 13th. Then a strong air pressure gradient formed between an approaching high from the west (12UTC/22LT 1024 hPa near 42°N 145°E), which was

expected to slowly decreased until Friday. A northerly wind with 7 to 8 Bft was still blowing in the shelter area with significant waves of 3 to 4 m on September 12th and 13th. In this northern area temperatures dropped to 11°C. On September 14th wind and swell weakened and the decision was made to return to the working area on a southbound route. Dredging operations could be resumed at night. Water and air temperatures rose slowly to 15° to 20°C again.

The working area at the eastern tip of Papanin Ridge was then influenced by a large high (1032 hPa 40°N 170°E) for the next couple of days, but a swell of 2 to 3 m continued to move into this area. Between a high (1028 hPa) near 45°N 179°E and an increasing north-eastwards moving low (1004 hPa 38°N 152°E) a strong pressure gradient developed again on September 17th. Since the forecast predicted a further interruption of station work, the transit to the next (southerly) working areas was started one day earlier as originally planned. In the afternoon of September 17th, the vessel headed southeast to the southern working area (eastern Ojin Rise Seamount Province). During transit the ship was subjected to a stormy southeast wind with 8 to 9 Bft and some times severe gale force gusts, with an increasing sea of 3 to 4 m and swell from south to southeast. The wind turned eventually to south to southwest and weakened to 5 Bft.

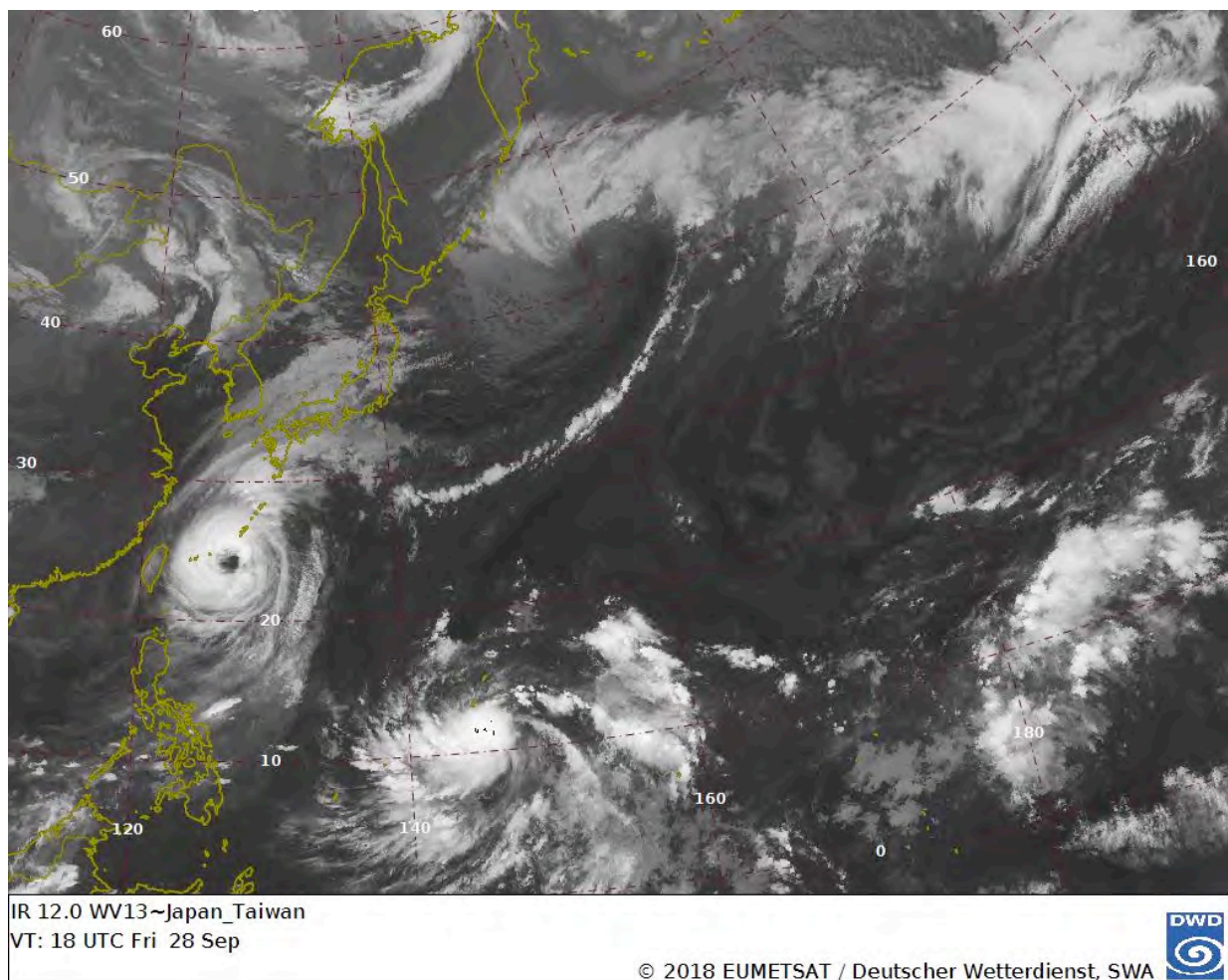


Fig. 7.45: Weather situation with typhoon „TRAMI“ on September 28th, 2018.

After a short period of high influence, the new working area was reached by a zone of low pressure at September 18th, which dominated the weather for the following days. The wind came from different directions and reached force 4 to 6 Bft, with a significant sea around 2 m and swell from southern directions. Subsequently the wind calmed down before another low pressure zone approached from the west, with now south-westerly winds shifting to north and northeast with 5 to 6 Bft. After September 23rd the wind shifted to the southeast to south and increased to 6 to 7 Bft. In the night to September 24th wind force 8 was reached at times. Afterwards, the wind weakened and veered west to northwest and eventually further to the

northeast. The air temperature cooled down to 16°C to 18°C with north-easterly wind and water temperature around 22°C. At times fog patches formed in this low pressure zone.

After a momentary weak high pressure influence the next gale was predicted to arrive on September 28th with two low centers (1008 hPa) near 37°N 154°E and 37°N 145°E moving northeastward and later to the east. Therefore, dredge operations were concluded in the morning of September 28th, before a stormy wind started to blow. The wind rapidly increased to 7 to 8 Bft, coming from south to southwest at noontime. Sea state rose to 3 to 4 m with swell from southeast, and a second swell from west to northwest. Crossing the low troughs also caused rain or showers. After the low pressure area passed, the wind turned northwest to northeast and weakened to 4 to 6 Bft. Sea state was then around 2 m with a swell from southeast, later northwest.

During our southwest transit to Taiwan, the typhoon "Kong-Rey" crossed our direct route to the port of destination, Kaohsiung. Therefore, the course was initially directed to a waypoint at 22°N, 142°E in the south before the ship turned west, following the westwards moving typhoon at a safe distance. A mainly eastern wind blew around 5 Bft, from October 04th on. A more northeast to east wind with 4 to 5 Bft followed. The swell increased to 2 to 3 m caused by the typhoon but slowly weakened with further approximation to Taiwan.

During the SO265 expedition, the earlier typhoons "Mangkut" and "Trami" passed far to the south of the working areas with movements directed to the west before they turned to northerly directions to the northwestern Pacific. Their tracks were daily monitored (Fig 7.45).

8. ACKNOWLEDGEMENTS

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Appendix I (SO265 Station Summary)

Type	Stat.	Location	total volume	Rec. DR	Station summary	start / on bottom		end / off bottom		depth (m)		Rock sampling			
						lat °N	long °	lat °N	long°	begin	end	Mag	VC	Sed	Mn
CTD	1	Northern Shirshov Massif			<i>sound velocity profile for EM122 (2000 m)</i>	38,533	163,000	38,533	162,000						
DR	2	Seamount on northern Shirshov Massif	1/3 full	1	lava fragments, volcanoclastic rocks, Mn-crusts	38,359	163,187	38,357	163,197	3416	2949	yes	yes		yes
DR	3	Seamount on northern Shirshov Massif	1/4 full	1	lava fragments, volcanoclastic rocks, Mn-crusts	38,197	163,529	38,201	163,536	3355	2960	yes	yes		yes
DR	4	Shirshov Massif / Thompson Trough	1/3 full	1	lava fragments, volcanoclastic rocks (pumice), Mn-crusts	40,018	163,467	40,011	163,472	5141	4664	yes	yes		yes
DR	5	Earthwatch Seamount	minor	0	Mn-nodules	39,862	163,813	39,859	163,820	4439	4032				yes
DR	6	Earthwatch Seamount	minor	0	Mn-nodules	39,870	163,962	39,863	163,957	5234	4865				yes
DR	7	Papanin Ridge / Thompson Trough	1/5 full	1	lava fragments, Mn-nodules	39,940	164,030	39,947	164,031	5324	4880	yes			yes
DR	8	Papanin Ridge / Thompson Trough	few rocks	1	Mn-nodules enclosing pumice, lava fragments, and sediment	40,180	163,537	40,185	163,537	5345	5184	yes	yes	yes	yes
DR	9	Papanin Ridge / Thompson Trough	few rocks	0	Mn-nodules enclosing pumice, phosphate, and sediment	40,157	163,598	40,164	163,598	5252	5081		yes	yes	yes
DR	10	Papanin Ridge / Thompson Trough	few rocks	1	Mn-nodules, partly enclosing lava fragments	40,007	163,843	40,014	163,843	5300	5040	yes	yes		yes
DR	11	Papanin Ridge / Thompson Trough	1/6 full	1	lava fragments, volcanoclastic rocks (e.g. pumice)	39,997	163,917	40,004	163,916	4904	4478	yes	yes		
DR	12	"Sonne Ridge" west of Thompson Trough	1/5 full	1	lava fragments, volcanoclastic rocks (pumice), Mn-crusts	39,810	164,653	39,817	164,648	5190	4753	yes	yes	yes	yes
DR	13	"Sonne Ridge" west of Thompson Trough	empty	0		39,849	164,713	39,855	164,708	4080	3650				
DR	14	"Sonne Ridge" west of Thompson Trough	1/4 full	1	lava fragments, volcanocl. rocks (conglomerate), Mn-crusts	39,847	164,705	39,854	164,703	4120	3690	yes	yes		yes
DR	15	Papanin Ridge / southern part	few rocks	1	Mn-nodules, partly enclosing lava fragments	40,407	164,265	40,413	164,261	5103	4671	yes			yes
DR	16	Papanin Ridge / southern part	1/4 full	1	Mn-nodules, partly enclosing lava fragments	40,810	164,144	40,806	164,135	4835	4420	yes			yes
CTD	17	Papanin Ridge / western margin			<i>sound velocity profile for EM122 (2000 m)</i>	40,959	163,850	40,959	163,851						
DR	18	Shuleykin Seamount	minor	1	lava fragment, Mn-nodules, partly enclosing lava fragments	41,174	163,563	41,180	163,561	4602	4200	yes			yes
DR	19	Shuleykin Seamount	few rocks	1	lava fragments, Mn-crusts, dropstone?	41,176	163,579	41,183	163,576	4473	3995	yes			yes
DR	20	Papanin Ridge / southwestern margin	1/3 full	1	lava fragments, volcanocl. rocks, Mn-nodules, dropstones	41,518	164,039	41,525	164,037	5155	4727	yes	yes		yes
DR	21	Papanin Ridge / southern part	few rocks	1	lava fragments, Mn-crusts and -nodules, dropstones	41,320	164,482	41,327	164,484	4822	4480	yes			yes
DR	22	Papanin Ridge / southern part	few rocks	1	lava fragments, Mn-crusts and -nodules	41,542	164,976	41,545	164,967	4672	4241	yes			yes
DR	23	Papanin Ridge / southern part	1/5 full	1	lava fragments, Mn-nodules	41,999	164,973	41,995	164,965	4756	4453	yes			yes
CTD	24	Papanin Ridge / southern part			<i>sound velocity profile for EM122 (2000 m)</i>	41,995	164,965	41,995	164,965						
DR	25	Papanin Ridge / central part	1/5 full	1	<i>Mn-crust with lava fragments</i>	42,103	165,405	42,096	165,403	4488	4017	yes			yes
DR	26	Papanin Ridge / central part	1/4 full	1	lava frag., volcanocl. rocks, Mn-crusts and -nodules, dropst.	42,382	165,396	42,379	165,388	4708	4289	yes	yes		yes
DR	27	Papanin Ridge / central part	one rock	0	dropstone	42,319	165,303	42,326	165,303	4405	4013				
DR	28	Papanin Ridge / central part	few rocks	0	Mn-nodules, dropstones	42,317	165,014	42,320	165,005	4900	4490				yes
DR	29	Papanin Ridge / northeastern part	few rocks	0	Mn-nodules, dropstones	42,527	166,761	42,534	166,760	4309	3843				yes
DR	30	Papanin Ridge / northeastern part	few rocks	1	lava fragments, Mn-nodules	42,479	166,856	42,486	166,854	5044	4669	yes			yes
DR	31	Papanin Ridge / northeastern part	few rocks	0	<i>Mn-crusts and nodules, dropstones</i>	42,548	166,700	42,556	166,702	4330	3890				yes
DR	32	Papanin Ridge / northeastern part	few rocks	0	Mn-crusts and nodules, dropstones	42,534	166,726	42,541	166,727	4235	3857				yes
DR	33	Papanin Ridge / northern part	empty	0		42,742	166,168	42,749	166,168	4915	4450				
DR	34	Papanin Ridge / northern part	minor	0	Mn-crusts and nodules, dropstones	43,503	165,982	43,511	165,979	4756	4484				yes
DR	35	Papanin Ridge / northern part	few rocks	1	lava fragments, Mn-crusts, dropstones	43,646	165,692	43,653	165,690	4467	4987	yes			yes
DR	36	Papanin Ridge / northern part	one rock	0	dropstone	43,888	165,461	43,893	165,462	5543	5180				
DR	37	Papanin Ridge / northern part	empty	0		43,886	165,467	43,892	165,468	5559	5195				
DR	38	Hokkaido Trough	few rocks	1	lava fragments	45,105	162,453	45,110	162,447	5930	5580	yes			
DR	39	Papanin Ridge / northern part	1/8 full	1	lava fragments, sedimentary rocks, Mn-crusts, dropstones	44,041	167,184	44,034	167,178	5300	4900	yes		yes	yes
DR	40	Papanin Ridge / easternmost part	empty	0		43,979	168,336	43,983	168,336	5512	5250				
DR	41	Papanin Ridge / easternmost part	empty	0		43,046	167,424	43,042	167,427	4756	4560				

Appendix I (SO265 Station Summary)

Type	Stat.	Location	total volume	Rec. DR	Station summary	start / on bottom		end / off bottom		depth (m)		Rock sampling			
						lat °N	long °	lat °N	long°	begin	end	Mag	VC	Sed	Mn
DR	42	Papanin Ridge / easternmost part	minor	1	one lava fragment (mn-coated), Mn-crusts, dropstones	42,624	167,616	42,628	167,620	5044	4729	yes			yes
DR	43	Papanin Ridge / easternmost part	minor	0	very small Mn-nodules and dropstones, sediment	42,645	167,608	42,645	167,617	5010	4587				
DR	44	Papanin Ridge / easternmost part	minor	0	one dropstone	42,501	168,002	42,509	167,998	5146	4736				
DR	45	Papanin Ridge / easternmost part	1/4 full	1	lava fragments, Mn-crusts, sediment	42,545	168,057	42,549	168,049	5066	4569	yes			yes
DR	46	Ojin Seamounts / northern part	empty	0		39,128	167,356	39,127	167,364	4779	4379				
DR	47	Ojin Seamounts / northern part	1/6 full	1	Mn-nodules, partly enclosing lava fragments	38,967	167,749	38,961	167,753	5089	4642	yes			yes
DR	48	Ojin Seamounts / northern part	empty	0		38,953	167,728	38,947	167,732	5283	4875				
DR	49	Ojin Seamounts / northern part	1/2 full	1	lava fragments, Mn-crusts and -nodules	38,738	168,747	38,733	168,751	4580	4190	yes			yes
DR	50	Ojin Seamounts / eastern part	1/6 full	1	Mn-crusts and -nodules, enclosing one small lava fragment	36,723	169,758	36,716	169,760	4590	4190	yes			yes
DR	51	Ojin Seamounts / eastern part	1/8 full	1	Mn-nodules, partly enclosing lava fragments	36,690	169,719	36,686	169,727	4280	3862	yes			yes
DR	52	Ojin Seamounts / eastern part	minor	1	Mn-nodules, enclosing one small lava fragment	36,440	170,083	36,436	170,088	4654	4290	yes			yes
DR	53	Ojin Seamounts / eastern part	few rocks	1	lava fragments, volcanoclastic rocks, Mn-crusts	36,391	170,121	36,387	170,121	4057	3835	yes	yes		yes
DR	54	Ojin Seamounts / eastern part	1/2 full	1	lava fragments, Mn-crusts and -nodules	36,520	169,971	36,513	169,970	4865	4383	yes			yes
DR	55	Ojin Seamounts / eastern part	few rocks	1	lava fragments, sedimentary rocks, Mn-nodules	36,410	169,599	36,407	169,608	5029	4579	yes		yes	yes
DR	56	Ojin Seamounts / south-eastern part	1/3 full	1	lava fragments, volcanoclastic rocks, Mn-nodules and -crusts	36,471	168,514	36,464	168,514	4630	4162	yes	yes		yes
DR	57	Ojin Seamounts / south-eastern part	1/5 full	1	lava fragments, Mn-crusts and -nodules	36,419	168,187	36,412	168,183	4451	3954	yes			yes
DR	58	Ojin Seamounts / central part	minor	1	Mn-crusts and -nodules, partly enclosing lava fragments	36,767	167,586	36,774	167,586	4805	4426	yes			yes
DR	59	Ojin Seamounts / central part	1/3 full	1	Mn-nodules, a few enclosing lava fragments, pumice	36,901	166,515	36,907	166,513	4655	4210	yes	yes		yes
DR	60	Ojin Seamounts / central part	missing!	1	lava fragments	36,900	166,488	36,906	166,485	4670	4170	yes			
DR	61	Ojin Seamounts / north-western part	2/3 full	1	Mn-nodules enclosing pumice, lava fragments, and sediment	37,927	166,693	37,935	166,697	4664	4153	yes	yes	yes	yes
DR	62	Ojin Seamounts / north-western part	few rocks	1	lava fragments, volcanoclastic rocks (pumice), Mn-crusts	38,538	166,689	38,534	166,694	3756	3330	yes	yes		
DR	63	Ojin Seamounts / north-western part	1/4 full	1	lava fragments	38,698	166,931	38,702	166,939	3440	2950	yes			
DR	64	Ojin Seamounts / north-western part	1/2 full	1	lava fragments, Mn-crusts and -nodules	39,151	166,192	39,144	166,191	4020	3590	yes			yes
DR	65	Ojin Seamounts / north-western part	1/6 full	1	lava fragments, volcanoclastic rocks (pumice), Mn-crusts	39,075	165,482	39,078	165,480	3906	3650	yes	yes		yes
DR	66	Ojin Seamounts / western part	empty	0		38,590	165,314	38,593	165,310	3391	3088				
DR	67	Ojin Seamounts / western part	1/3 full	1	lava fragments, very large Mn-crust, Mn-nodules	38,280	165,258	38,287	165,257	3822	3373	yes			yes
DR	68	Ojin Seamounts / western part	1/4 full	1	lava fragments	37,660	165,126	37,666	165,129	3520	2885	yes			
DR	69	Ojin Seamounts / western part	1/4 full	1	lava fragments, volcanoclastic rocks (e.g. pumice), Mn-crusts	37,257	165,089	37,263	165,090	3570	3081	yes	yes		yes
DR	70	Ojin Seamounts / western part	minor	0	(three pumice clasts of unclear origin, not sampled)	37,296	164,172	37,303	164,176	5011	4552				
DR	71	Ojin Seamounts / western part	empty	0		36,482	163,932	36,483	163,940	5332	4970				
DR	72	Ojin Seamounts / western part	few rocks	1	lava fragments	36,614	163,932	36,607	163,933	4180	3720	yes			
DR	73	Ojin Seamounts / western part	few rocks	1	Mn-crusts, with pillow margins attached	37,042	163,786	37,042	163,777	3767	3342	yes			yes
DR	74	Shirshov Massif / eastern flank	empty	0		37,358	163,543	37,357	163,536	4666	4460				
DR	75	Shirshov Massif / seamount on plateau	1/3 full	1	two lava fragments, Mn-crusts and -nodules	37,405	163,002	37,397	163,011	3680	3330	yes			yes
OFOS	76	Makarov Seamount			ocean floor observation and technical test (failed)	29,466	153,592	29,466	153,000	1535	1534				

Dredge Stations (DR): 72
CTD Stations (CTD): 3
OFOS Stations (OFOS): 1

Mag: magmatic rocks
 VC: volcanoclastic rocks
 Sed: sedimentary rocks
 Mn: Mn-crusts, - nodules

Appendix 2 (Station Details and Rock Description)

SO265-DR2





Description of Location and Structure: Northern Shirshov Massif. Upper south facing slope of eastern twin guyot on northern Shirshov flank. Probably belongs to Ojin Seamount Province

Dredge on bottom UTC 31/08/18 16:51hrs, lat 38°21.53'N, long 163°11.20'E, depth 3416m





Dredge off bottom UTC 31/08/18 18:21hrs, lat 38°21.43'N, long 163°11.81'E, depth 2949m

total volume: 1/3 full, Mn crusts, some very large blocs contain rock clasts.




Comments: Two major igneous rock types: 1) vesicular aphyric basalt; 2) sparsely Pl phyric basalts with large up to 1cm, fresh Pl. Both lava types are oxidized and were likely erupted in shallow water.

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR2-1	1. Rock Type: slightly to moderately altered aphyric lava 2. Size: 25x17x16cm 3. Shape / Angularity: elongated and rounded 4. Color of cut surface: pale brown 5. Texture / Vesicularity: highly vesiculated (~15%), subequant shape, ~elongated, 0.5-0.8mm ø 6. Phenocrysts: none 7. Matrix: microcrystalline (0.1-0.2mm) 8. Secondary Minerals: brown 9. Encrustations: thick Mn crust 10. Comment:	3	x					single xenocryst present	
SO265-DR2-2	1. Rock Type: slightly to moderately altered aphyric lava 2. Size: 19x9x10cm 3. Shape / Angularity: rounded to subelongated 4. Color of cut surface: pale brown, ~grey 5. Texture / Vesicularity: highly vesiculated (~20%), subequant shape, ~elongated, 0.5-1mm ø 6. Phenocrysts: few pl phenocrysts, ~1mm width 7. Matrix: microcrystalline (0.1-0.2mm) 8. Secondary Minerals: brown 9. Encrustations: white Cc and pink phosphorite 10. Comment:	2	x						
SO265-DR2-3	1. Rock Type: slightly altered and slightly Pl phyric lava 2. Size: 9x9x6cm 3. Shape / Angularity: rounded to subelongated 4. Color of cut surface: grey to pale brown 5. Texture / Vesicularity: moderately vesiculated (~5%) with variable shapes from equant to elongated 6. Phenocrysts: euhedral Pl phenocrysts, ~1mm width 7. Matrix: microcrystalline (0.1-0.2mm) 8. Secondary Minerals: brown secondary minerals present in entire sample 9. Encrustations: none 10. Comment:	2	x						
SO265-DR2-4	1. Rock Type: slightly to moderatley altered, slightly Pl phyric lava 2. Size: 7x8x6cm 3. Shape / Angularity: equant to subrounded 4. Color of cut surface: pale brown 5. Texture / Vesicularity: dense 6. Phenocrysts: some euhedral to subeuhedral Pl phenocrysts, ~0.5mm width 7. Matrix: microcrystalline (0.1-0.2mm) 8. Secondary Minerals: brown secondary minerals distributed throughout sample 9. Encrustations: none 10. Comment:	2	x						






Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR2-5	1. Rock Type: slightly altered aphyric lava 2. Size: 10x6x4cm 3. Shape / Angularity: rounded to subequant 4. Color of cut surface: grey to pale brown 5. Texture / Vesicularity: dense 6. Phenocrysts: none could be confirmed 7. Matrix: microcrystalline (0.1-0.2mm) 8. Secondary Minerals: black patches of 0.5 ø in some. 15 to 20 patches gathered in one place, 0.5-1cm ø 9. Encrustations: none 10. Comment: judging from color this samples appears to be the least altered of DR2 and thus best for geochemistry and possibly dating	2	x						
SO265-DR2-6	1. Rock Type: moderately altered, sparsely Pl phyrlic lava 2. Size: 8x6x6cm 3. Shape / Angularity: subrounded to equant 4. Color of cut surface: brown 5. Texture / Vesicularity: sparsely vesiculated (3%), elongated vesicles 0.2-0.5mm ø 6. Phenocrysts: 1% euhedral / subeuhedral Pl. 0.3-0.5mm width 7. Matrix: microcrystalline (0.1-0.2mm) 8. Secondary Minerals: all parts are altered to brown halo. Some vesicles are filled with white, ~pale brown secondaries (Cc?) 9. Encrustations: none 10. Comment:	2	x						
SO265-DR2-7	1. Rock Type: highly altered, aphyric lava 2. Size: 5x4x3cm 3. Shape / Angularity: rounded to equant 4. Color of cut surface: brown 5. Texture / Vesicularity: highly vesiculated (20%), equant to subequant vesicle shape 6. Phenocrysts: none 7. Matrix: microcrystalline (0.1-0.2mm) 8. Secondary Minerals: completely altered to brown secondary minerals. Some vesicles filled with volcaniclastic material with black and white lithics 9. Encrustations: thin film of Mn crust 10. Comment:	1							
SO265-DR2-8	1. Rock Type: slightly to moderately altered, moderately Pl phyrlic lava 2. Size: 17x12x10cm 3. Shape / Angularity: equant to subangular 4. Color of cut surface: most parts are brown but grey parts are also present 5. Texture / Vesicularity: dense 6. Phenocrysts: two types of Pl phenocrysts. One is euhedral / subeuhedral of 0.5-0.8mm width. The other is anhedral Pl of 2-5mm width. The phenocryst mode is 3%. 7. Matrix: microcrystalline (0.1-0.2mm) 8. Secondary Minerals: many parts are highly altered into brown minerals but some patches of less altered greyish parts are also present. The anhedral Pl pheno or xenocrysts? are partly altered into black secondary minerals (Chl?) 9. Encrustations: thin film of Mn crust 10. Comment: This rock appears to be the best sample for Ar-Ar dating	2	x						





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR2-9	1. Rock Type: moderately to highly altered, sparsely Pl phyric lava 2. Size: 11x10x11cm 3. Shape / Angularity: equant to subhedral 4. Color of cut surface: pale brown to brown 5. Texture / Vesicularity: dense 6. Phenocrysts: <1% euhedral Pl phenocrysts, 0.3-0.5mm width. 2-3% anhedral Pl (xenocrysts?), 3-12mm, some altered to black minerals (Chl?, Smectite) 7. Matrix: microcrystalline (0.1-0.2mm) 8. Secondary Minerals: black halos of 5-10mm width are sparsely present. All parts are altered into brown secondary minerals 9. Encrustations: thin (2-5mm) Mn crust 10. Comment: Outer part of the rock is brecciated, probably pillow breccia or hyaloclastite. All clasts of the breccia are angular to subangular and are highly altered (brown-black to pale green). The size of the clasts is 1-12mm. Matrix composed of white grey minerals (Cc?) and black material (Mn?). The brecciated part is saved as one big slab.	2	x						
SO265-DR2-10	1. Rock Type: moderately to highly altered, sparsely Pl phyric lava 2. Size: 9x9x7cm 3. Shape / Angularity: equant to subangular 4. Color of cut surface: brown 5. Texture / Vesicularity: dense 6. Phenocrysts: subhedral / ~anhedral Pl phenocrysts (xenocrysts?), 0.5-0.8mm wide. Some crystals form crystal cloths. Many parts are altered to black mineral. 2-3% subhedral Augite (ø 1mm) probably present 7. Matrix: microcrystalline (0.1-0.2mm) in inner part and cryptocrystalline (<0.1mm) along the rim 8. Secondary Minerals: brown minerals in the entire rock and black mineral in the Pl (Chl?) 9. Encrustations: thin film of Mn 10. Comment:	2							
SO265-DR2-11	1. Rock Type: slightly to moderately altered, sparsely Pl phyric lava 2. Size: 7x4x6cm 3. Shape / Angularity: subequant to subangular 4. Color of cut surface: grey to brown 5. Texture / Vesicularity: dense 6. Phenocrysts: 1% euhedral / subhedral Pl, 0.2-0.5mm wide. Most parts replaced by black minerals 7. Matrix: cryptocrystalline (<0.1mm) 8. Secondary Minerals: brown minerals are present throughout the rock and black patches (ø 0.2mm) are distributed in some places 9. Encrustations: thin film of Mn 10. Comment:	2	x						






Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR2-12	1. Rock Type: sparsely Pl phyric lava, moderately altered 2. Size: 8x7x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown with small yellow dots 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: 1% Pl up to 0.5mm 7. Matrix: fine grained 8. Secondary Minerals: oxidation, some white filling of cracks 9. Encrustations: thin Mn crust, clay 10. Comment:	2	x	?	rare Pl				
SO265-DR2-13	1. Rock Type: sparsely Pl phyric lava, moderately altered 2. Size: 9x9x6cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: petrographically identical to -12	2	x		Pl				
SO265-DR2-14	1. Rock Type: sparsely Pl phyric lava, moderately altered 2. Size: 8x6x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: reddish brown with white spots 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: rare 1-2% large up to 0.7mm Pl 7. Matrix: aphanitic, very fine crystallized 8. Secondary Minerals: Oxidation, Mn filling of cracks, Pl is fresh 9. Encrustations: thin Mn crust on outer surface 10. Comment:	2	x		Pl				
SO265-DR2-15	1. Rock Type: sparsely Pl phyric lava, moderately altered 2. Size: 7x7x6cm 3. Shape / Angularity: angular 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: very similar to -14	2							
SO265-DR2-16	1. Rock Type: very rare Pl phyric lava, moderately altered 2. Size: 10x7x7cm 3. Shape / Angularity: angular 4. Color of cut surface: brownish grey to brown 5. Texture / Vesicularity: massive 6. Phenocrysts: rare Pl up to 7mm 7. Matrix: fine crystallized to aphanitic / cryptocrystalline 8. Secondary Minerals: oxidation, Mn filling in cracks 9. Encrustations: 5-6mm Mn crust, brecciated material between Mn crust and rock 10. Comment:	2							

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR2-17	1. Rock Type: aphyric lava, moderately altered 2. Size: 5x4x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: reddish brown 5. Texture / Vesicularity: rare vesicles ~2% 6. Phenocrysts: none 7. Matrix: fine crystallized 8. Secondary Minerals: oxidation, light yellow filling in vesicles 9. Encrustations: thin Mn film on outer surface 10. Comment:	2							
SO265-DR2-18	1. Rock Type: aphyric lava, moderately altered 2. Size: 7x6x4cm 3. Shape / Angularity: well rounded 4. Color of cut surface: reddish brown to grey 5. Texture / Vesicularity: ~20% to non-vesicular on one side 6. Phenocrysts: none 7. Matrix: fine crystallized 8. Secondary Minerals: oxidation, clay in vesicles 9. Encrustations: some Mn encrustation 10. Comment: not good for GC except non-vesicular part	2							
SO265-DR2-19	1. Rock Type: sparsely Pl aphyric lava, moderately altered 2. Size: 7x5x3cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown inner part, yellowish brown along outer part 5. Texture / Vesicularity: massive 6. Phenocrysts: 1-2% large Pl 7. Matrix: fine crystallized 8. Secondary Minerals: oxidation, light yellow filling in vesicles 9. Encrustations: Mn crust / film on outer surface 10. Comment:	2							
SO265-DR2-20	1. Rock Type: aphyric vesicular lava, moderately to strongly altered 2. Size: 9x8x4cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: typical of 1) type lava of this dredge. No good for geochemistry	2							

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR2-21	1. Rock Type: aphyric massive lava, moderately to strongly altered 2. Size: 8x7x3cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: type 2) lava of this dredge but has no visible Pl	2							
SO265-DR2-22	1. Rock Type: aphyric vesicular lava, moderately fresh 2. Size: 8x7x5cm 3. Shape / Angularity: well rounded 4. Color of cut surface: 5. Texture / Vesicularity: 20% but empty 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: typical of type 1) lava of this dredge	2							
SO265-DR2-23	1. Rock Type: hyaloclastite, altered 2. Size: 22x15x14cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: volcanoclastic rock composed of angular fragments of former glass and aphyric rocks of type 2). A few chips contain fresh glass!	2			GL		x	glass in air freight box	
SO265-DR2-24Mn	1. Rock Type: Mn crust 2. Size: 17x10x14cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: representative of massive crust								
SO265-DR2-25Mn	1. Rock Type: Mn crust with phosphate core 2. Size: 12x7x7cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SO265-DR3





Description of Location and Structure: Shirshov Massif, two prominent smts at NE end that probably belong to the Ojin Seamount Province. Here the NW guyot is sampled along its NW slope in the mid section 300m below the pleateau edge

Dredge on bottom UTC 01/09/18 00:16hrs, lat 38°11.81'N, long 163°31.72'E, depth 3356m






Dredge off bottom UTC 01/09/18 01:36hrs, lat 38°12.06'N, long 163°32.15'E, depth 2960m

total volume: 1/4 full, lava fragments, altered tuff, Mn




Comments: Aphyric to sparsely phyrlic Pl-Cpx phyrlic lava fragments cemented by Mn crusts. Fragments are all angular and represent fragments in breccia cemented by Mn crust. All rocks are rather strongly altered but Pl and Cpx are fresh

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR3-1	1. Rock Type: aphyric lava, strongly to moderately altered 2. Size: 13x12x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown with some gradation to grey and red 5. Texture / Vesicularity: a few small (<1cm) vesicles 6. Phenocrysts: <1mm Pl and Ol microphenocrysts. Pl is fresh, Ol replaced by Fe-oxides 7. Matrix: fine crystallized but Pl maybe fresh 8. Secondary Minerals: oxidation, strongly altered, concentric zoning 9. Encrustations: thin, <2mm Mn crust 10. Comment: good for geochemistry	2	x						
SO265-DR3-2	1. Rock Type: aphyric lava, strongly to moderately (?) altered 2. Size: 12x9x9cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown 5. Texture / Vesicularity: more vesicular than -1, 3-4% vesicles 6. Phenocrysts: <2%, small Pl and Ol phenocrysts. 7. Matrix: fine crystallized, Pl fresh 8. Secondary Minerals: oxidation, yellow fillings in vesicles 9. Encrustations: 5mm Mn crust 10. Comment: relatively good for geochemistry due to absence of cracks	2	x						
SO265-DR3-3	1. Rock Type: sparsely Pl phyrlic lava, rather strongly altered 2. Size: 23x23x23cm 3. Shape / Angularity: angular, broken apart in several pieces 4. Color of cut surface: brownish-green to grey 5. Texture / Vesicularity: massive 6. Phenocrysts: rare Pl up to 7mm 7. Matrix: very fine crystallized 8. Secondary Minerals: pervasive alteration / oxidation of Gm. Pl is fresg 9. Encrustations: thin Mn crust, crack fillings 10. Comment: not good for Gc but suitable for Ar/Ar	2	x	Pl					
SO265-DR3-4	1. Rock Type: sparsely Pl phyrlic lava, moderately altered 2. Size: 15x12x10cm 3. Shape / Angularity: subangular 4. Color of cut surface: from core to rim: brown, brownish-grey, yellow 5. Texture / Vesicularity: massive 6. Phenocrysts: <1% Pl, 2-3mm 7. Matrix: fine crystallized 8. Secondary Minerals: pervasive alteration / oxidation of Gm 9. Encrustations: some rare cracks filled by Mn penetrate the rock 10. Comment: if Mn from cracks removed, maybe not too bad for Gc	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR3-5	1. Rock Type: aphyric lava similar to -1 2. Size: 4x6x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown 5. Texture / Vesicularity: overall massive with very rare vesicles 6. Phenocrysts: rare microphenocrysts and intergrowths of Pl + Cpx, <0.5mm, 1-2% 7. Matrix: fine crystallized Gm 8. Secondary Minerals: pervasive oxidation and alteration of Gm 9. Encrustations: thin Mn film on outer surface 10. Comment: good for Gc because no cracks with Mn	2	x						
SO265-DR3-6	1. Rock Type: aphyric lava, moderately to strongly altered 2. Size: 13x10x9cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: similar to other rocks of DR3 but has cryptocrystalline texture of Gm. Up to 1cm outer Mn crust	2	x						
SO265-DR3-7	1. Rock Type: aphyric lava similar to -6, moderately to strongly altered 2. Size: 10x8x5cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: see description of -6	2	x						
SO265-DR3-8	1. Rock Type: aphyric lava, moderately to strongly altered 2. Size: 14x7x7cm 3. Shape / Angularity: angular 4. Color of cut surface: brown 5. Texture / Vesicularity: massive outer part of pillow 6. Phenocrysts: rare microphenocrysts of Pl (<0.5mm), 1-2% 7. Matrix: 8. Secondary Minerals: pervasive oxidation / alteration 9. Encrustations: 2-3mm Mn crust 10. Comment:	2	x						
SO265-DR3-9	1. Rock Type: aphyric lava, moderately to strongly altered, identical to -6 & -7 2. Size: 10x10x6cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: Some Mn penetrations along cracks and inside rock. Not good for Gc								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR3-10	1. Rock Type: aphyric to sparsely phyric lava, similar to -6 & -7 2. Size: 9x6x5cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: relatively good for Gc, just a few thin cracks								
SO265-DR3-11Mn	1. Rock Type: breccia cemented by Mn. 2. Size: 17x14x10cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: clasts are aphyric lavas, phosphorite, palagonite. Coarse grained cement between nodules								
SO265-DR3-12Mn	1. Rock Type: Mn nodule with fragment of aphyric basalt inside 2. Size: 6x6x7cm 3. Shape / Angularity: rounded 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: from center to rim; basaltic clast ø 8mm coarse grained, Mn with phosphorite (!) cement, outer 8mm massive Mn								

SO265-DR4

Description of Location and Structure: Northern edge of Shatsky-Shirshov Ridge at Thompson Trough. Circular pillow (?) mound with central depression / caldera. Dredge track along NW margin sloping into Thompson Trough





Dredge on bottom UTC 01/09/18 16:41hrs, lat 40°01.08'N, long 163°28.03'E, depth 5141m

Dredge off bottom UTC 01/09/18 18:07hrs, lat 40°00.67'N, long 163°28.30'E, depth 4664m

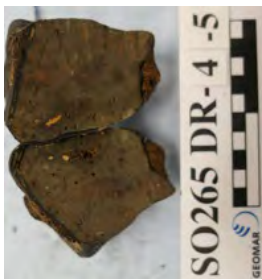
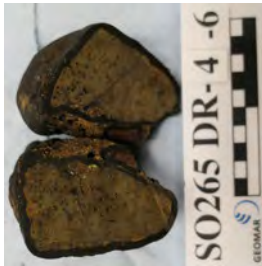


total volume: 1/3 full, Mn nodules, some angular lava fragments, look like pillow

Comments: Basically four igneous lithologies sampled. 1) aphyric lava (-1, -3, -5, -6, -7, 8, -11, -17) varying from slightly to moderately altered. 2) sparsely Pl and Ol?-Pl phyric lava (-2, -4, -9, -10) varying from slightly to moderately altered. 3) fluidal textured volcanics (-12 through -16 typical for high K rocks (trachytes?), some containing orange colored pumiceous inclusions. 4) pumice blocs most likely derived from pumice rafts.





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR4-1	1. Rock Type: aphyric lava, slightly altered 2. Size: 10x8x4cm 3. Shape / Angularity: subrounded and subequant 4. Color of cut surface: grey 5. Texture / Vesicularity: dense, non-vesicular 6. Phenocrysts: none 7. Matrix: microcrystalline (0.1-0.2mm) 8. Secondary Minerals: some black patches (0.5-1mm) 9. Encrustations: thin film of Mn 10. Comment: one of the freshest samples among DR4	2	x				x	GC in air freight box	
SO265-DR4-2	1. Rock Type: sparsely Pl aphyric lava, slightly to moderately altered 2. Size: 9x10x6cm 3. Shape / Angularity: subrounded 4. Color of cut surface: grey to pale brown 5. Texture / Vesicularity: sparsely vesiculated, up to 10mm and elongated shape, filled with pink mineral (phosphorite?), brown (Fe hydroxide), pale green (celadonite?), black (Mn-oxide?) 6. Phenocrysts: 1% Pl, 0.5mm width, some group to crystal cloths 7. Matrix: microcrystalline (0.1-0.2mm) 8. Secondary Minerals: brown minerals are present in all parts, also see 5) for minerals filling vesicles 9. Encrustations: thin film of Mn crust 10. Comment:	2	x						
SO265-DR4-3	1. Rock Type: aphyric lava, slightly altered 2. Size: 18x13x10cm 3. Shape / Angularity: subrounded and elongated (platy) 4. Color of cut surface: grey to pale brown 5. Texture / Vesicularity: 2% sparsely vesiculated, subequant to elongated in shape, ϕ 0.2-2mm 6. Phenocrysts: <1% euhedral Pl, 0.5-0.8mm width 7. Matrix: microcrystalline (0.1-0.2mm) to fine grained (0.2-1mm) 8. Secondary Minerals: brown (Fe-hydroxides) and green (celadonite?) 9. Encrustations: thin film of Mn crust 10. Comment:	2	x						
SO265-DR4-4	1. Rock Type: sparsely Ol?-Pl aphyric lava, slightly altered 2. Size: 10x8x8cm 3. Shape / Angularity: subrounded and elongated 4. Color of cut surface: grey brown band along chilled margin 5. Texture / Vesicularity: ~5% moderately vesiculated are filled with zeolite, Mn-oxide and Fe oxide 6. Phenocrysts: euhedral Ol, 0.5-0.8mm, replaced by iddingsite, euhedral Pl ~0.5mm 7. Matrix: cryptocrystalline (<0.1mm) 8. Secondary Minerals: brown minerals (Fe-hydroxides) and zeolites are present 9. Encrustations: 3mm thick Mn crust 10. Comment:	2	x						






Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR4-5	1. Rock Type: aphyric lava, slightly altered 2. Size: 14x9x7cm 3. Shape / Angularity: subrounded to subequant 4. Color of cut surface: grey 5. Texture / Vesicularity: 7-10% moderately vesiculated, some filled with brown minerals, shape is equant (2-6mm) 6. Phenocrysts: <1% subhedral Pl, 0.5-2mm, mostly fresh 7. Matrix: cryptocrystalline (<0.1mm) 8. Secondary Minerals: a brown alteration halo and vein fills with brown minerals 9. Encrustations: 1mm Mn crust 10. Comment:	2	x						
SO265-DR4-6	1. Rock Type: aphyric lava, moderately altered 2. Size: 11x8x7cm 3. Shape / Angularity: rounded and subequant 4. Color of cut surface: pale brown 5. Texture / Vesicularity: 15% moderately vesiculated, 1-4mm, equant shape, 10% of vesicles filled with brown and white minerals 6. Phenocrysts: <1% subhedral Pl, 0.5mm, fresh 7. Matrix: microcrystalline 8. Secondary Minerals: groundmass Pl, brown minerals in veins 9. Encrustations: 3mm Mn 10. Comment:	2	x						
SO265-DR4-7	1. Rock Type: aphyric lava, moderately altered 2. Size: 10x6x6cm 3. Shape / Angularity: subrounded and subequant 4. Color of cut surface: grey 5. Texture / Vesicularity: 10% moderately vesiculated, 70% of vesicles filled with brown minerals 6. Phenocrysts: <1% euhedral Pl, 1mm, fresh 7. Matrix: cryptocrystalline 8. Secondary Minerals: brown minerals 9. Encrustations: thin film of Mn coating 10. Comment:	2	x						
SO265-DR4-8	1. Rock Type: aphyric lava, slightly altered 2. Size: 19x9x7cm 3. Shape / Angularity: elongated 4. Color of cut surface: grey 5. Texture / Vesicularity: 5% moderately vesiculated, equant vesicles, chilled margin of brown color is present 6. Phenocrysts: <1% euhedral Pl, 0.5-0.8mm, fresh 7. Matrix: fine grained 8. Secondary Minerals: Mn-oxides, Fe-hydroxides, zeolites 9. Encrustations: 2-10 mm thick Mn crust 10. Comment:	2	x						




Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR4-9	1. Rock Type: sparsely Ol-Pl phyric lava, moderately altered 2. Size: 8x6x5cm 3. Shape / Angularity: subrounded 4. Color of cut surface: brownish grey with red and black spots 5. Texture / Vesicularity: porphyritic, vesicular 2-3% 6. Phenocrysts: Ol altered to Fe-oxides <0.5mm, ~1%; Pl fresh <0.5mm, 1% 7. Matrix: fine crystallized, intersertal, fairly fresh 8. Secondary Minerals: red fillings in voids, oxidation, Mn encrustations 9. Encrustations: very thin Mn film on surface 10. Comment:	2							
SO265-DR4-10	1. Rock Type: sparsely Pl phyric lava 2. Size: 10x5x5cm 3. Shape / Angularity: subrounded 4. Color of cut surface: reddish brown with red spots 5. Texture / Vesicularity: vesicular 15%, 1-5mm 6. Phenocrysts: very rare Pl fresh <0.3mm fresh? 7. Matrix: microcrystalline, Px oxidized, Pl fresh 8. Secondary Minerals: oxidation, vesicles filled with secondary minerals 9. Encrustations: very thin Mn film on surface 10. Comment: the sample is from outer part of pillow; not good for Gc	2							
SO265-DR4-11	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 7x6x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: reddish brown 5. Texture / Vesicularity: massive with rare vesicles of irregular shape 6. Phenocrysts: rare Pl subphenocrysts, laths up to 0.5mm, ~1% 7. Matrix: cryptocrystalline, hyalopelitic 8. Secondary Minerals: oxidation, alteration of glass in Gm 9. Encrustations: thin Mn film, clay. Mn along cracks 10. Comment:	2							
SO265-DR4-12	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 8x7x5cm 3. Shape / Angularity: unclear from cut fragments 4. Color of cut surface: brownish grey 5. Texture / Vesicularity: rare vesicles ~5mm of irregular pumiceous shape 6. Phenocrysts: rare Pl microphenocrysts, ≤0.5mm, 1-2%; some Ol possible but unclear 7. Matrix: cryptocrystalline Gm 8. Secondary Minerals: oxidation, glass alteration 9. Encrustations: thin Mn film on surface and vesicles 10. Comment:	2	x						


Appendix 2 (Station Details and Rock Description)


SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR4-13	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 13x7x9cm 3. Shape / Angularity: subangular 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: the rock is similar to -12. A typical feature is fluidal texture and pumiceous vesicles	2	x						
SO265-DR4-14	1. Rock Type: aphyric fluidal textured volcanic rock, similar to -12 & -13 2. Size: 10x6x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: rel massive and might be good for Gc	2							
SO265-DR4-15	1. Rock Type: aphyric, fluidal textured volcanic rock, similar to -12 2. Size: 11x10x5cm 3. Shape / Angularity: subrounded 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:	2							
SO265-DR4-16	1. Rock Type: aphyric volcanic rock, similar to -12 2. Size: 7x5x3cm 3. Shape / Angularity: subangular 4. Color of cut surface: brownish-grey 5. Texture / Vesicularity: aphyric, very few phenocrysts and vesicles 6. Phenocrysts: rare Pl microphenocrysts ≤2mm 7. Matrix: fine grained 8. Secondary Minerals: oxidation 9. Encrustations: thin Mn coating 10. Comment:	2	x						
SO265-DR4-17	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 15x21x10cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown 5. Texture / Vesicularity: aphyric, very few phenocrysts and vesicles 6. Phenocrysts: rare Pl microphenocrysts ≤2mm 7. Matrix: fine grained 8. Secondary Minerals: oxidation 9. Encrustations: thin Mn coating 10. Comment:	2							

Appendix 2 (Station Details and Rock Description)




SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR4-18	1. Rock Type: volcanic rock, pumice, slightly altered 2. Size: 10x9x7cm 3. Shape / Angularity: subrounded 4. Color of cut surface: variable grey to brown 5. Texture / Vesicularity: glassy, highly vesicular 50% up to 5mm 6. Phenocrysts: none 7. Matrix: glassy, layered 8. Secondary Minerals: oxidation?! 9. Encrustations: none 10. Comment: very likely from pumice raft. GL sample taken				GL		x	glass in air freight box	
SO265-DR4-19	1. Rock Type: volcanic rock, pumice, slightly altered 2. Size: 17x12x9cm 3. Shape / Angularity: subrounded 4. Color of cut surface: brownish grey to brown 5. Texture / Vesicularity: glassy, highly vesicular 6. Phenocrysts: none 7. Matrix: glassy, homogeneous 8. Secondary Minerals: 9. Encrustations: 10. Comment: very likely from pumice raft. GL sample taken				GL		x	glass in air freight box	
SO265-DR4-20	1. Rock Type: volcanic rock, pumice, slightly altered, similar to -19 2. Size: 9x6x5cm 3. Shape / Angularity: rounded 4. Color of cut surface: brownish grey 5. Texture / Vesicularity: glassy, highly vesicular 6. Phenocrysts: none 7. Matrix: glassy, homogeneous 8. Secondary Minerals: 9. Encrustations: 10. Comment: very likely from pumice raft. GL sample taken				GL		x	glass in air freight box	

Appendix 2 (Station Details and Rock Description)





SO265-DR5 Description of Location and Structure: Earthwatch Seamount; NW flank along upper section Dredge on bottom UTC 02/09/18 00:55hrs, lat 39°51.74'N, long 163°48.79'E, depth 4439m Dredge off bottom UTC 02/09/18 02:15hrs, lat 39°51.52'N, long 163°49.21'E, depth 4032m <i>total volume: few rocks, small pieces.</i> <i>Comments: Chunks of Mn crust with attached sediment, 1x Mn nodule without rock nucleus. One worm inside Mn crust</i>									
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR5-1	1. Rock Type: Mn nodule 2. Size: ø 5cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: massive 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: a single Mn nodule from this dredge	2	x						

SO265-DR6 Description of Location and Structure: Earthwatch Seamount; NE flank along the lower section Dredge on bottom UTC 02/09/18 06:06hrs, lat 39°52.17'N, long 163°57.72'E, depth 5234m Dredge off bottom UTC 02/09/18 07:26hrs, lat 39°51.78'N, long 163°57.42'E, depth 4865m <i>total volume: very few rocks</i> <i>Comments: just Mn crusts, no volcanic rocks, no biology, almost no sediments</i>									
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR6-1	1. Rock Type: phosphorite, carbonate with very small clasts of basalt in Mn crust. Next description of basaltic clasts: aphyric lava, strongly altered 2. Size: 7x12mm 3. Shape / Angularity: irregular 4. Color of cut surface: brownish with white Cc? spots 5. Texture / Vesicularity: amygdoloidal, filled vesicles 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: red fillings in voids, Cc & zeolites possible 9. Encrustations: several mm thick Mn crust 10. Comment: no good for Gc & dating								





Appendix 2 (Station Details and Rock Description)

SO265-DR7									
Description of Location and Structure: Papanin Ridge SE scarp of Thompson Trough. Eastern part of the scarp, lower step from bottom to top									
Dredge on bottom UTC 02/09/18 06:06hrs, lat 39°52.17'N, long 163°57.72'E, depth 5234m									
Dredge off bottom UTC 02/09/18 07:26hrs, lat 39°51.78'N, long 163°57.42'E, depth 4865m									
total volume: 1/5 full, Mn nodules and some angular lava fragments									
Comments: Aphyric, dense lava fragments throughout with abundant Pl microphenocrysts. Vary in degree of alteration. -1 to -4 grey = very fresh. From -5 onwards reddish - brown Gm. From -10 to -14 cut open reference samples but with lots of Mn patches in Gm									
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR7-1	1. Rock Type: volcanic, aphyric lava, fresh 2. Size: 15x7x9cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey 5. Texture / Vesicularity: 5-10% vesicles filled with brown, some with yellowish material. Few vesicles up to 5mm, most <1mm 6. Phenocrysts: 20% Pl, <1mm 7. Matrix: fine grained 8. Secondary Minerals: brown and yellow vesicle fillings 9. Encrustations: Mn crust up to 1cm 10. Comment: after sawing a volcanic clast appeared. Light grey to slightly brownish, subangular, aphyric, Pl <1mm, 20%	2	x				x	GC in air freight box	
SO265-DR7-2	1. Rock Type: volcanic, aphyric lava, fairly fresh 2. Size: 10x7x8cm 3. Shape / Angularity: subangular to rounded 4. Color of cut surface: grey to brown 5. Texture / Vesicularity: up to 10% vesicles, ø <1mm filled with white or brown material 6. Phenocrysts: euhedral Pl microphenocrysts, 15-20%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: vesicles filled with white material 9. Encrustations: 10. Comment:	2	x						
SO265-DR7-3	1. Rock Type: volcanic, aphyric lava, fairly fresh but moderately altered parts are also present 2. Size: 6x4x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey, kind of intrusion brownish appears more altered 5. Texture / Vesicularity: 10-15% vesicles, ø <1mm filled with white material 6. Phenocrysts: Pl microphenocrysts, 15%, most <1mm, some up to 2mm 7. Matrix: fine grained 8. Secondary Minerals: white mineral in vesicles (Cc?), brownish section contains 30-40% Mn patches 9. Encrustations: 2mm Mn crust 10. Comment:	2	x						





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR7-4	1. Rock Type: volcanic, aphyric lava, altered with some fresher parts 2. Size: 10x5x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey / black to red / brown 5. Texture / Vesicularity: 10-15% vesicles, $\phi < 1\text{mm}$, most filled with white mineral and brown material 6. Phenocrysts: Pl microphenocrysts, 10%, most $< 1\text{mm}$, concentrated in grey black section 7. Matrix: fine grained 8. Secondary Minerals: ~40% of vesicles filled white mineral (Cc?), ~60% of vesicles filled with brown material. Cracks, veins filled with white material. In brown / red section contains up to 30% Mn patches 9. Encrustations: Mn crust up to 5mm 10. Comment:	2	x						
SO265-DR7-5	1. Rock Type: volcanic, aphyric lava, altered 2. Size: 10x7x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: brownish 5. Texture / Vesicularity: ~5% vesicles, $\phi < 1\text{mm}$, few up to 5mm filled with brown materia. Overall veins filled with brown material 6. Phenocrysts: Pl microphenocrysts, 15-20%, most $< 1\text{mm}$, some ~1mm 7. Matrix: fine grained 8. Secondary Minerals: ~10% Mn patches up to 3mm, on average $< 1\text{mm}$ 9. Encrustations: Mn crust up to 4mm 10. Comment:	2	x						
SO265-DR7-6	1. Rock Type: volcanic, aphyric lava, altered 2. Size: 5x5x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown 5. Texture / Vesicularity: 5-10% vesicles, $\phi < 1\text{mm}$, filled with white-yellowish / blueish mineral 6. Phenocrysts: Pl microphenocrysts, 5-10%, few up to 3mm long, some strongly altered 7. Matrix: fine grained 8. Secondary Minerals: see vesicle filling, cracks filled with Mn, ~10% Mn patches 9. Encrustations: 10. Comment:	2	x						
SO265-DR7-7	1. Rock Type: volcanic, aphyric lava, altered 2. Size: 11x8x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown / grey 5. Texture / Vesicularity: 10% vesicles up to 1mm ϕ , filled with brown material 6. Phenocrysts: Pl microphenocrysts, 5%, up to 1mm long 7. Matrix: fine grained 8. Secondary Minerals: few ($< 5\%$) brown patches up to 2cm, veins filled with brown material. Overall Mn patches ~20% 9. Encrustations: Mn crust up to 5mm 10. Comment:	2	x						





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR7-8	1. Rock Type: volcanic, aphyric lava, fairly fresh to slightly altered 2. Size: 15x17x14cm 3. Shape / Angularity: subangular 4. Color of cut surface: light grey to grey brown 5. Texture / Vesicularity: 15-20% vesicles <1mm ø, filled with brown material, few (~5%) larger vesicles 4-10mm not completely filled 6. Phenocrysts: Pl microphenocrysts, 5%, up to 1mm long 7. Matrix: fine grained 8. Secondary Minerals: see vesicle filling, Mn patches often related to cracks 9. Encrustations: Mn crust up to 2-3cm 10. Comment:	2	x						
SO265-DR7-9	1. Rock Type: volcanic, aphyric lava, altered 2. Size: 13x8x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: red / brown 5. Texture / Vesicularity: 15-20% vesicles <1mm ø, filled with brown material 6. Phenocrysts: Pl microphenocrysts, <3%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: single large vesicle filled with yellowish - green material (Cc?). Abundant Mn patches; cracks & veins filled with brown material 9. Encrustations: Mn crust up to 5mm 10. Comment:	2	x						
SO265-DR7-10	1. Rock Type: volcanic, aphyric lava, highly altered 2. Size: 13x7x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: light brown to red brown 5. Texture / Vesicularity: <5% vesicles filled with white material, cracks up to 3mm wide dissecting entire rock 6. Phenocrysts: Pl microphenocrysts, <5%, up to 2mm 7. Matrix: fine grained 8. Secondary Minerals: cracks filled with Mn, Mn patches throughout 9. Encrustations: Mn crust up to 5mm 10. Comment:								
SO265-DR7-11A	1. Rock Type: clast of aphyric lava from breccia 2. Size: 13x11x8cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown, appears to have a more red brown core and grey brown rim (up to 2cm) 5. Texture / Vesicularity: 10-15% vesicles, filled with brown material 6. Phenocrysts: Pl microphenocrysts, <5%, <1mm, seem to be mainly in grey brown rim 7. Matrix: fine grained 8. Secondary Minerals: Mn patches more dominant in core section up to 30%, veins filled with brown material 9. Encrustations: Mn crust up to 5mm 10. Comment:								





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR7-11B	1. Rock Type: clast of aphyric lava from breccia 2. Size: 13x11x8cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown, appears to have a more red brown core and grey brown rim (up to 2cm) 5. Texture / Vesicularity: 10-15% vesicles, filled with brown material 6. Phenocrysts: Pl microphenocrysts, <5%, <1mm, seem to be mainly in grey brown rim 7. Matrix: fine grained 8. Secondary Minerals: Mn patches more dominant in core section up to 30%, veins filled with brown material 9. Encrustations: Mn crust up to 5mm 10. Comment:								
SO265-DR7-12	1. Rock Type: aphyric lava, altered 2. Size: 13x5x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: upper part grey grading into brown 5. Texture / Vesicularity: 5% vesicles, <1mm filled with white mineral 6. Phenocrysts: Pl microphenocrysts, <5%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: Mn patches ~10-15%, cracks up to 4mm filled with Mn 9. Encrustations: Mn crust up to 10mm 10. Comment:								
SO265-DR7-13	1. Rock Type: aphyric lava, altered 2. Size: 9x7x8cm 3. Shape / Angularity: subangular 4. Color of cut surface: light brown 5. Texture / Vesicularity: 10% vesicles, <1mm filled with brown mineral 6. Phenocrysts: Pl microphenocrysts, <3%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: abundant Mn patches, cracks up to 1mm filled with brown material 9. Encrustations: Mn crust up to 10mm 10. Comment:								
SO265-DR7-14	1. Rock Type: aphyric lava, strongly altered pillow lava 2. Size: 18x10x10cm 3. Shape / Angularity: subangular 4. Color of cut surface: red brown 5. Texture / Vesicularity: ~10% vesicles, <1mm filled with brown mineral 6. Phenocrysts: Pl microphenocrysts, <3%, <1mm, few up to 2mm, altered 7. Matrix: fine grained 8. Secondary Minerals: 20% Mn patches 9. Encrustations: Mn crust up to 3mm 10. Comment: overall covered with parallel cracks filled with brown material								





Appendix 2 (Station Details and Rock Description)

SO265-DR8 Description of Location and Structure: Thompson Trough, NW end on Papanin Ridge side. Small SW facing step before slope reaches floor of the trough. Multiple steps visible. Dredge on bottom UTC 02/09/18 21:09hrs, lat 40°10.79'N, long 163°32.21'E, depth 5345m Dredge off bottom UTC 02/09/18 21:58hrs, lat 40°11.12'N, long 163°32.22'E, depth 5184m <i>total volume: few rocks; Mn nodules with cores of pumice, lava and sediment</i> <i>Comments: small worms (polycheten). Pumice maybe rafted from Japan. Comparison with Japanese database may be useful, especially if age of Mn nodule can be determined.</i>									
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR8-1	1. Rock Type: pumice, slightly altered 2. Size: 7x6x3cm 3. Shape / Angularity: subrounded and elongated 4. Color of cut surface: white 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: 7. Matrix: glassy 8. Secondary Minerals: slightly altered to pale brown minerals 9. Encrustations: Mn crust 10mm thick 10. Comment:								
SO265-DR8-2	1. Rock Type: pumice, slightly altered 2. Size: 6x4x4cm 3. Shape / Angularity: subrounded 4. Color of cut surface: white to pale brown 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: 7. Matrix: glassy 8. Secondary Minerals: slightly altered to pale brown minerals 9. Encrustations: Mn crust 10mm thick 10. Comment:								
SO265-DR8-3	1. Rock Type: pumice, slightly altered 2. Size: 6x5x5cm 3. Shape / Angularity: subangular and equant 4. Color of cut surface: white inner and to pale brown outer part 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: 7. Matrix: glassy 8. Secondary Minerals: slightly altered to pale brown minerals 9. Encrustations: Mn crust 10mm thick 10. Comment:								
SO265-DR8-4	1. Rock Type: pumice, slightly altered 2. Size: 7x5x4cm 3. Shape / Angularity: subangular and subequant 4. Color of cut surface: pale green to pale brown 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: 7. Matrix: glassy 8. Secondary Minerals: slightly altered to pale brown minerals 9. Encrustations: Mn crust 10mm thick 10. Comment:								





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR8-5	1. Rock Type: pumice, moderately altered 2. Size: 8x6x3cm 3. Shape / Angularity: subrounded and elongated 4. Color of cut surface: pale brown 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: 7. Matrix: glassy 8. Secondary Minerals: most parts are altered into brown minerals 9. Encrustations: Mn crust 10mm thick 10. Comment:								
SO265-DR8-6	1. Rock Type: pumice, moderately altered 2. Size: 7x5x3cm 3. Shape / Angularity: subrounded and subequant 4. Color of cut surface: brown 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: 7. Matrix: glassy 8. Secondary Minerals: most parts are altered into brown minerals 9. Encrustations: Mn crust 5mm thick 10. Comment:								
SO265-DR8-7	1. Rock Type: pumice, moderately altered 2. Size: 8x5x4cm 3. Shape / Angularity: rounded and equant 4. Color of cut surface: brown 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: 7. Matrix: glassy 8. Secondary Minerals: all parts are altered into brown minerals 9. Encrustations: Mn crust 2mm thick 10. Comment:								
SO265-DR8-8	1. Rock Type: pumice, highly altered 2. Size: 6x5x4cm 3. Shape / Angularity: subrounded to subelongated 4. Color of cut surface: brown 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: 7. Matrix: glassy 8. Secondary Minerals: all parts are altered into brown minerals 9. Encrustations: Mn crust 5mm thick 10. Comment:								


Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR8-9	1. Rock Type: pumice, highly altered 2. Size: 5x4x4cm 3. Shape / Angularity: subrounded and equant 4. Color of cut surface: brown 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: Qz, 0.5-1mm 7. Matrix: glassy 8. Secondary Minerals: except for phenocrysts totally altered into brown minerals 9. Encrustations: Mn crust 13mm thick 10. Comment:								
SO265-DR8-10	1. Rock Type: pumice, moderately altered 2. Size: 4x3x2cm 3. Shape / Angularity: subangular 4. Color of cut surface: pale brown to dark brown 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: 7. Matrix: glassy 8. Secondary Minerals: 9. Encrustations: Mn crust ~1mm thick 10. Comment:								
SO265-DR8-11	1. Rock Type: pumice, slightly altered 2. Size: 4x3x2cm 3. Shape / Angularity: subangular 4. Color of cut surface: white to pale brown 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: Qz, <1%, 0.8-1.5mm 7. Matrix: glassy 8. Secondary Minerals: slightly altered along outer rim 9. Encrustations: Mn crust ~2mm thick 10. Comment:								
SO265-DR8-12	1. Rock Type: pumice, moderately altered 2. Size: 6x4x4cm 3. Shape / Angularity: equant to rounded 4. Color of cut surface: white 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: none 7. Matrix: glassy 8. Secondary Minerals: moderately altered along rim 9. Encrustations: Mn crust 18mm thick 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR8-13	1. Rock Type: aphyric lava or crust, highly altered 2. Size: 8x5x5cm 3. Shape / Angularity: angular and elongated 4. Color of cut surface: grey to pale pink 5. Texture / Vesicularity: massive 6. Phenocrysts: none 7. Matrix: cryptocrystalline (<0.1mm) 8. Secondary Minerals: highly altered in high-Si material 9. Encrustations: Mn crust 30mm thick 10. Comment:							only lava sample from DR8	
SO265-DR8-14	1. Rock Type: pumice, highly altered 2. Size: 6x5x5cm 3. Shape / Angularity: subrounded and subelongated 4. Color of cut surface: black and grey patches 5. Texture / Vesicularity: non vesicular 6. Phenocrysts: none 7. Matrix: highly vesicular 8. Secondary Minerals: highly altered into Mn-oxides 9. Encrustations: Mn crust 23mm thick 10. Comment:								
SO265-DR8-15	1. Rock Type: two pieces of pumice, moderately altered 2. Size: 5x4x4cm 3. Shape / Angularity: subrounded and equant 4. Color of cut surface: pale brown 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: none 7. Matrix: glassy 8. Secondary Minerals: altered into brown mineral along rim 9. Encrustations: Mn crust 16mm thick 10. Comment:								
SO265-DR8-16	1. Rock Type: pumice, highly altered 2. Size: 6x4x4cm 3. Shape / Angularity: subrounded and equant 4. Color of cut surface: black 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: none 7. Matrix: glassy 8. Secondary Minerals: completely altered into Mn-oxides 9. Encrustations: Mn crust 16mm thick 10. Comment: the pumice structure is similar to Sakura flower petals (cherry blossoms)								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR8-17	1. Rock Type: pumice, highly altered 2. Size: 6x4x4cm 3. Shape / Angularity: rounded to subequant 4. Color of cut surface: brown 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: Qz <1% up to 1mm 7. Matrix: glassy 8. Secondary Minerals: completely altered into brown minerals 9. Encrustations: Mn crust 23mm thick 10. Comment: the pumice structure is very similar to chambers of foraminifera								

SO265-DR9




Description of Location and Structure: Papanin Ridge, southern part. Westernmost section of small step at the lower base of southern scarp

Dredge on bottom UTC 03/09/18 02:19hrs, lat 40°09.39'N, long 163°35.85'E, depth 5252m

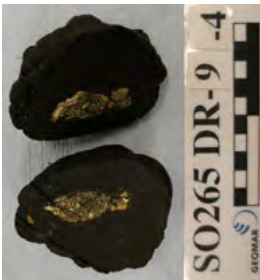


Dredge off bottom UTC 03/09/18 03:30hrs, lat 40°09.83'N, long 163°35.86'E, depth 5081m

total volume: few rocks

Comments: Mn nodules with sedimentary, phosphate and pumice cores. Mn encrusted worm tubes

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR9-1	1. Rock Type: pumice, slightly altered 2. Size: 8x6x4cm 3. Shape / Angularity: rounded 4. Color of cut surface: white 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: 7. Matrix: glassy 8. Secondary Minerals: 9. Encrustations: no Mn on surface 10. Comment: glass?						x	glass in air freight box	
SO265-DR9-2	1. Rock Type: pumice, slightly to moderately altered 2. Size: 7x4x4cm 3. Shape / Angularity: rounded 4. Color of cut surface: pale white 5. Texture / Vesicularity: highly vesicular 6. Phenocrysts: 7. Matrix: still glassy 8. Secondary Minerals: 9. Encrustations: Mn crust up to 9mm 10. Comment:								
SO265-DR9-3	1. Rock Type: phosphorite encrusted by Mn crust up to 1cm thick 2. Size: 7x6x5cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR9-4	1. Rock Type: Mn crust 2-3cm thickness formed on a sample of phosphate. cemented breccia clasts are up to 4mm. No igneous clasts 2. Size: 8x7x6cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								
SO265-DR9-5	1. Rock Type: Mn crust without inclusions 2. Size: 6x5x5cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								
SO265-DR9-6A -B-C-D	1. Rock Type: Mn crust with elongated inclusions (remnants) of the phosphorite cemented breccia (former corals?) 2. Size: 8x8x7cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:							Pics for -C and -D not shown	

SO265-DR10

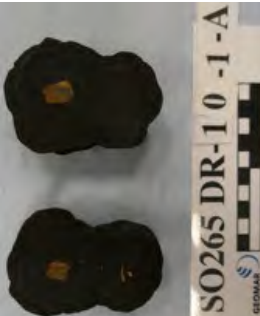
Description of Location and Structure: Papanin Ridge, southern end. Base of central section of northern flank of Thompson Trough

Dredge on bottom UTC 03/09/18 08:20hrs, lat 40°00.42'N, long 163°50.60'E, depth 5300m

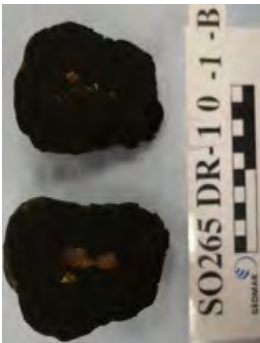



Dredge off bottom UTC 03/09/18 09:28hrs, lat 40°00.86'N, long 163°50.58'E, depth 5040m

total volume: few Mn nodules

Comments: Two Mn nodules contain volcanic clasts, one Mn nodule contains pumice. Some representative samples were selected

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR10-1A	1. Rock Type: volcanic clast inside Mn nodule, core fresher than altered rim 2. Size: 1x1cm 3. Shape / Angularity: slightly rectangular but rounded edges 4. Color of cut surface: brown with grey core 5. Texture / Vesicularity: sparsely phyrlic, vesicles coarser along edge 6. Phenocrysts: rare Pl in core 7. Matrix: cryptocrystalline 8. Secondary Minerals: zeolites? filling vesicles 9. Encrustations: thick Mn crust as sample is inside nodule 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR10-1B	1. Rock Type: volcanic clast inside Mn nodule, moderately altered 2. Size: 2.5x1cm at widest but irregular shape 3. Shape / Angularity: appears like two triangular portions of a single original clast 4. Color of cut surface: brown, some greyish brown 5. Texture / Vesicularity: sparsely Pl phyric, small vesicles, larger are filled 6. Phenocrysts: rare Pl 7. Matrix: cryptocrystalline 8. Secondary Minerals: zeolites or carbonate in same nodule 9. Encrustations: 3cm thick Mn layering make up the nodule 10. Comment:								
SO265-DR10-1C	1. Rock Type: Mn nodule with small pumice clast 2. Size: 1x1cm 3. Shape / Angularity: appears like two triangular portions of a single original clast 4. Color of cut surface: pale brown to white 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 3cm thick Mn layer makes up the nodule 10. Comment:								
SO265-DR10-1D	1. Rock Type: fragments in Mn nodule: 3mm long Pl crystal, altered. Two pumice pieces ~4mm, one hyaloclastite clast 1.5x1.5cm 2. Size: 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 2cm thick Mn layer makes up the nodule 10. Comment:								
SO265-DR10-1E	1. Rock Type: fragments in Mn nodule: hyaloclastite perhaps has secondary phosphate or palagonite a few cm thick 2. Size: 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SO265-DR11




Description of Location and Structure: Papanin Ridge, southern end. Seamount on northern flank of Thompson Trough.

Dredge on bottom UTC 03/09/18 13:39hrs, lat 39°59.80'N, long 163°54.99'E, depth 4904m




Dredge off bottom UTC 03/09/18 15:04hrs, lat 40°00.26'N, long 163°54.94'E, depth 4478m

total volume: 1/6 full

Comments: Mostly large Mn nodules or Mn encrusted rock fragments, some containing fairly fresh, subangular fragments of Pl-Px phyric lava (-1 to -4). -5 is a Mn encrusted breccia clast and -6 a pumice from a raft. Three larger blocs (A, B, C) were all Mn covers and consisted of platy sediment (A), volcanic sediment (B) and a Mn nodule. No igneous rocks inside, thus discarded.

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR11-1	1. Rock Type: Pl-Px phyric lava, fairly fresh 2. Size: 9x6x5cm original size of Mn nodule 3. Shape / Angularity: subangular (lava clast) 4. Color of cut surface: grey Gm 5. Texture / Vesicularity: <5% up to 4mm filled with yellow brown material 6. Phenocrysts: Pl 7-10%, 1-2mm, clear white; Px? <5%, <1mm, black 7. Matrix: fine grained 8. Secondary Minerals: see vesicle filling 9. Encrustations: Mn crust up to 5mm 10. Comment:	2	x					x GC in air freight box	
SO265-DR11-2	1. Rock Type: Pl-Px phyric lava, fresh to moderately altered 2. Size: 10x8x5cm original size of Mn nodule 3. Shape / Angularity: subangular (lava clast) 4. Color of cut surface: greyish to brownish 5. Texture / Vesicularity: <5% up to 4mm filled with yellow brown material 6. Phenocrysts: Pl 7-10%, up to 3mm, clear white; Cpx ~5%, up to 5mm, green to black 7. Matrix: fine grained 8. Secondary Minerals: see vesicle filling, cracks filled with yellow / brown material 9. Encrustations: <1mm Mn crust 10. Comment:	2	x						
SO265-DR11-3	1. Rock Type: Pl-Px phyric lava, fresh to moderately altered 2. Size: 14x12x15cm original size of Mn nodule, 8x4 lava clast 3. Shape / Angularity: subangular (lava clast) 4. Color of cut surface: greyish to brownish, more brown than -2 5. Texture / Vesicularity: similar to -2 6. Phenocrysts: Pl 10%, up to 2mm, sometimes brownly altered, most clear white; Px <5%, up to 5mm, green to black 7. Matrix: fine grained 8. Secondary Minerals: similar to -2 9. Encrustations: Mn crust up to 6cm 10. Comment:	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR11-4	1. Rock Type: Pl-Px phyric lava, moderately altered 2. Size: 14x12x16cm original size of Mn nodule, ø 9cm lava clast 3. Shape / Angularity: rounded (lava clast) 4. Color of cut surface: grey dark brown 5. Texture / Vesicularity: <1mm, <5% 6. Phenocrysts: Pl 5-10%, up to 2mm, white transparent; Px 5%, up to 4mm, black-green; <2% iddingsite?, up to 2mm, brown altered 7. Matrix: fine grained 8. Secondary Minerals: Mn patches, cracks with Mn 9. Encrustations: Mn crust up to 3cm 10. Comment:								
SO265-DR11-5	1. Rock Type: breccia, heavily altered 2. Size: 13x9x12cm original size of Mn nodule 3. Shape / Angularity: rounded to subangular 4. Color of cut surface: red-brown-green 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: reddish to brown matrix with clay minerals in pores 8. Secondary Minerals: clay minerals, probably smectite greenish; Fe-oxides, Mn patches 9. Encrustations: Mn crust up to 1cm 10. Comment:								
SO265-DR11-6	1. Rock Type: pumice 2. Size: 22x9x11cm 3. Shape / Angularity: rounded 4. Color of cut surface: light grey 5. Texture / Vesicularity: 15-20% vesicles, up to 5mm, empty 6. Phenocrysts: Amphibole black up to 1cm 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SO265-DR12




Description of Location and Structure: E of Thompson Trough "Sonne Ridge", irregular shaped, elongated seamount with numerous ridges and valleys, appears of tectonic origin. Western end along S facing flank at the very base.

Dredge on bottom UTC 03/09/18 22:37hrs, lat 39°48.57'N, long 164°39.17'E, depth 5190m





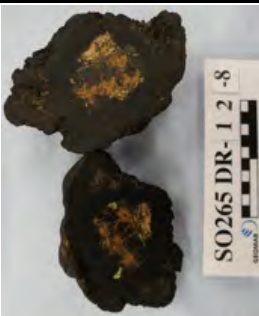
Dredge off bottom UTC 04/09/18 00:00hrs, lat 39°48.99'N, long 164°38.87'E, depth 4753m

total volume: ~1/5 full



Comments: two pieces of Ol-Pl phyric lava, fairly fresh (-1 & -2), rafted pumice (-3, -4 and -6), sediment (-7 & -8), scoria (-5) and Mn-oxide crust (-9 & -10)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR12-1	1. Rock Type: 10-15% Ol-Pl phyric lava, fresh to slightly altered 2. Size: 14x10x8cm 3. Shape / Angularity: angular and equant 4. Color of cut surface: grey 5. Texture / Vesicularity: massive, slightly vesiculated 6. Phenocrysts: euhedral Ol 10%, 0.5-1mm, completely altered to brown and green minerals; euhedral / subhedral Pl 5-7%, 0.5-1mm, fresh 7. Matrix: microcrystalline 8. Secondary Minerals: Cc filling of vesicles and cracks 9. Encrustations: 7cm thick Mn crust 10. Comment: Half of the piece is Ol rich, the other half Pl rich. Mixing? Check Gc for homogeneous distribution of phenocrysts	2	x		Pl fresh, Ol altered			x GC in air freight box	
SO265-DR12-2	1. Rock Type: sparsely Ol-Pl phyric lava, slightly altered 2. Size: 12x7x6cm 3. Shape / Angularity: angular, equant 4. Color of cut surface: grey to brown 5. Texture / Vesicularity: chilled margin present, dense 6. Phenocrysts: euhedral / subhedral Ol 3%, 0.5-1mm, completely altered to brown and green minerals (iddingsite?); euhedral Pl <1%, 0.2-0.8mm, fresh 7. Matrix: crypto to microcrystalline 8. Secondary Minerals: cracks are filled with white, black and pale green minerals 9. Encrustations: 1cm thick Cc surrounds the lava and 1cm Mn crust covers lava and Cc 10. Comment: lava piece too small for TS / GC								
SO265-DR12-3	1. Rock Type: pumice, fresh 2. Size: 8x6x5cm 3. Shape / Angularity: rounded, subequant 4. Color of cut surface: pale grey 5. Texture / Vesicularity: highly vesicular 50% 6. Phenocrysts: 2% Qz 0.5-1mm, 1% black mineral (dark mica) 0.5mm 7. Matrix: glassy 8. Secondary Minerals: pale brown minerals in the vesicles 9. Encrustations: 10. Comment: pumice raft, glass?						x	glass in air freight box	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR12-4	1. Rock Type: pumice, slightly altered 2. Size: 10x8x4cm 3. Shape / Angularity: subrounded, elongated 4. Color of cut surface: white to light grey 5. Texture / Vesicularity: highly vesicular 50%, vesicles aligned parallel to each other 6. Phenocrysts: <1% Qz 0.5mm, fresh; biotite 0.2-0.5mm, fresh 7. Matrix: glassy 8. Secondary Minerals: black and brown minerals fill the vesicles 9. Encrustations: 1mm thick Mn crust 10. Comment:								
SO265-DR12-5	1. Rock Type: scoria; could be highly altered pumice 2. Size: 14x9x6cm 3. Shape / Angularity: subrounded, elongated 4. Color of cut surface: black 5. Texture / Vesicularity: highly vesicular 40-50% 6. Phenocrysts: <1% Qz 0.5-1mm, fresh 7. Matrix: glassy 8. Secondary Minerals: too dark to identify the alteration 9. Encrustations: 10. Comment: pumice raft, glass?						x	glass in air freight box	
SO265-DR12-6Mn	1. Rock Type: pumice; moderately altered 2. Size: 9x8x5cm 3. Shape / Angularity: subrounded, subequant 4. Color of cut surface: white to dark grey 5. Texture / Vesicularity: highly vesicular 30% 6. Phenocrysts: <1% Qz 0.5mm, fresh 7. Matrix: glassy 8. Secondary Minerals: central part is altered to dark grey 9. Encrustations: 10. Comment: 1cm thick Mn crust							Mn Box	
SO265-DR12-7Mn	1. Rock Type: sediment 2. Size: 6x6x5cm 3. Shape / Angularity: rounded 4. Color of cut surface: black with pink grey interior 5. Texture / Vesicularity: core is highly vesicular with ~20% vesicles that are highly elongated and stretched 6. Phenocrysts: aphyric 7. Matrix: microcrystalline matrix 8. Secondary Minerals: pink clay, Fe-Mn 9. Encrustations: encrusted with 10-15mm Mn-oxide 10. Comment:							Mn Box	
SO265-DR12-8Mn	1. Rock Type: sediment 2. Size: 14x15x10cm 3. Shape / Angularity: subangular, irregular surface 4. Color of cut surface: black with multi-colored core. black-yellow-orange mosaic 5. Texture / Vesicularity: colloform, banded 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: clay, Fe-Mn oxide, sulfur? yellow 9. Encrustations: 2-4cm Mn-oxide 10. Comment:							Mn Box	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR12-9Mn	1. Rock Type: Mn oxide with phosphorite + Cc core 2. Size: 8x6x5cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:							Mn Box	
SO265-DR12-10Mn	1. Rock Type: Mn oxide similar to -7 & -8 but core is granule size only 2. Size: 10x8x7cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:							Mn Box	

SO265-DR13

Description of Location and Structure: "Sonne Ridge", upper section of southern flank at western part of ridge

Dredge on bottom UTC 04/09/18 03:32hrs, lat 39°50.94'N, long 164°42.78'E, depth 4080m

Dredge off bottom UTC 04/09/18 04:45hrs, lat 39°51.33'N, long 164°42.49'E, depth 3610m

total volume: empty

SO265-DR14


Description of Location and Structure: "Sonne Ridge", upper part of southern flank, 0.5nm W of DR13

Dredge on bottom UTC 04/09/18 07:39hrs, lat 39°50.84'N, long 164°42.30'E, depth 4120m





Dredge off bottom UTC 04/09/18 08:49hrs, lat 39°51.22'N, long 164°42.15'E, depth 3690m

total volume: one large bloc of Mn crust and several small rock fragments


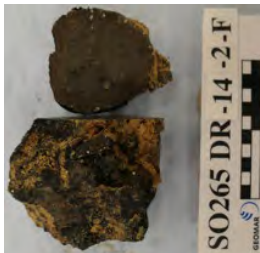


Comments: numerous fragments of Ol phyric basaltic pillow lavas cemented by Mn crust. Loose fragments of the same rock type

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR14-1	1. Rock Type: Ol phyric lava, slightly altered 2. Size: 11x10x9cm 3. Shape / Angularity: angular 4. Color of cut surface: grey to pale grey 5. Texture / Vesicularity: vesicular, up to 20% 6. Phenocrysts: Ol up to 5%, 0.4mm, completely replaced by secondary minerals 7. Matrix: fine grained 8. Secondary Minerals: Ol replaced by red to orange iddingsite, some vesicles filled by oolites 9. Encrustations: Mn crust 2-3mm 10. Comment: the best sample in the dredge, good for Gc, selected for air-freight	2	x				x	Gc in air-freight box	


Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR14-2A	1. Rock Type: OI phyric lava clast from bloc A, moderately altered 2. Size: 20x13x10cm, part of bloc A (64x65x37cm) 3. Shape / Angularity: subangular 4. Color of cut surface: brownish grey with red dots 5. Texture / Vesicularity: vesicular, up to 10% 6. Phenocrysts: OI 5-7%, up to 1mm ø, altered; PI 2-3%, ≤1mm 7. Matrix: fine grained 8. Secondary Minerals: OI replaced by Fe-oxides, glass alteration in Gm, some vesicles filled with Mn, some with white material 9. Encrustations: Mn crust 1cm 10. Comment: rel. fresh rock but highly vesicular, Mn must be picked out	2	x						
SO265-DR14-2B	1. Rock Type: OI-PI phyric lava clast from bloc A, moderately altered 2. Size: 11x9x10cm 3. Shape / Angularity: subangular to rounded 4. Color of cut surface: brownish grey 5. Texture / Vesicularity: vesicular, 10-15%, some filled with white material 6. Phenocrysts: OI 5-10%, 4-5mm ø, altered to iddingsite; PI <3%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: OI replaced by Fe-oxides, some vesicles filled with white material 9. Encrustations: <1mm Mn crust 10. Comment:	2	x						
SO265-DR14-2C	1. Rock Type: OI-PI phyric lava clast from bloc A, moderately altered 2. Size: 11x10x8cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to light grey 5. Texture / Vesicularity: vesicular, 10%, up to 5mm, some filled with white material 6. Phenocrysts: OI 5-10%, 4-5mm ø, altered to orange iddingsite; PI <1%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: OI replaced by Fe-oxides, some vesicles filled with white material (zeolite?) 9. Encrustations: <1mm Mn crust 10. Comment:	2	x						
SO265-DR14-2D	1. Rock Type: OI-PI phyric lava clast from bloc A, moderately altered 2. Size: 13x8x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: light grey 5. Texture / Vesicularity: vesicular, 10-15%, up to 4mm, some filled with white material 6. Phenocrysts: OI ~10%, up to 4mm ø, altered to orange iddingsite; PI 2-3%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: OI replaced by Fe-oxides, some vesicles filled with white material (zeolite?) 9. Encrustations: <1mm Mn crust 10. Comment:	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR14-2E	1. Rock Type: OI-PI phyric lava clast from bloc A, moderately altered 2. Size: 13x7x8cm 3. Shape / Angularity: subangular 4. Color of cut surface: light grey 5. Texture / Vesicularity: vesicular, 15-20%, up to 3mm, some filled with white material 6. Phenocrysts: OI 10-15%, up to 2mm ϕ , altered to orange iddingsite; PI 2-3%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: OI replaced by Fe-oxides, some vesicles filled with white material (zeolite?) 9. Encrustations: <1mm Mn crust 10. Comment:	2	x						
SO265-DR14-2F	1. Rock Type: OI-PI phyric lava clast from bloc A, moderately altered 2. Size: 14x11x8cm 3. Shape / Angularity: not visible after sawing 4. Color of cut surface: light grey 5. Texture / Vesicularity: vesicular, 15-20%, up to 7mm, mostly 1-2mm, some filled with white material 6. Phenocrysts: OI, up to 5mm, altered to orange iddingsite; PI 2-3%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: OI replaced by Fe-oxides, some vesicles filled with white material (zeolite?) 9. Encrustations: <1mm Mn crust 10. Comment:	2	x						
SO265-DR14-2G	1. Rock Type: OI-PI phyric lava clast from bloc A, moderately altered 2. Size: 11x12x8cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey - brownish 5. Texture / Vesicularity: vesicular, ~15%, up to 4mm, avrg 1-2mm, some filled with white material 6. Phenocrysts: OI 5-10%, 1-2mm, altered to orange iddingsite; PI <3%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: OI replaced by Fe-oxides, some vesicles filled with white material (zeolite?) 9. Encrustations: Mn crust up to 1cm 10. Comment:	2	x						
SO265-DR14-2H	1. Rock Type: OI-PI phyric lava clast from bloc A, moderately altered 2. Size: 16x10x9cm 3. Shape / Angularity: subangular to rounded 4. Color of cut surface: grey - brown 5. Texture / Vesicularity: vesicular, 10-15%, up to 3mm, avrg 1mm, some filled with white material 6. Phenocrysts: OI 10%, 1-2mm, altered to orange iddingsite; PI <5%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: OI replaced by Fe-oxides, some vesicles filled with white material (zeolite?) 9. Encrustations: Mn crust up to 4cm 10. Comment:	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR14-3	1. Rock Type: sediment, coarse grained breccia 2. Size: 12x8x6cm 3. Shape / Angularity: rounded 4. Color of cut surface: grey blueish, clasts multicolored brown, black, red, grey 5. Texture / Vesicularity: polymict, various clasts 6. Phenocrysts: clasts up to 1cm, some appear to be basaltic 7. Matrix: fine grained 8. Secondary Minerals: 9. Encrustations: Mn crust <1mm 10. Comment:								

SO265-DR15



Description of Location and Structure: Papanin Ridge, Southern area; circular shaped, ± flat topped seamount with ca 20km ø, rises ca 600m above abyssal plane. Small volcanoes on flat top, unlikely to be a guyot based on overall shape. Track along S flank, SSE facing slope from bottom to edge

Dredge on bottom UTC 04/09/18 16:36hrs, lat 40°24.39'N, long 164°15.90'E, depth 5103m



Dredge off bottom UTC 04/09/18 17:51hrs, lat 40°24.76'N, long 164°15.67'E, depth 4671m

total volume: 1/10 full; Mn nodules only, all of very similar 10-15cm diameter

Comments: few nodules contain larger (cm sized) lava fragments as cores. -1 is largest clast, a fairly fresh aphyric lava with grey Gm, altered Ol and fresh Pl in Gm, possibly Px

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR15-1	1. Rock Type: aphyric lava, slightly to moderately altered 2. Size: 14x10x9cm nodule, clast 3x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: light grey to grey 5. Texture / Vesicularity: 2-3% <1mm, some filled with black some filled with white material 6. Phenocrysts: Ol 2-3%, <1mm, altered orange; Pl needles 2-3%, <1mm; greenish Px? <3% <1mm 7. Matrix: fine grained 8. Secondary Minerals: Ol replaced by iddingsite, vesicles filled with (Mn?) and white (zeolite?) material 9. Encrustations: Mn crust 2cm 10. Comment: freshest sample of dredge, not much material but good for GC and possibly Ar-Ar Gm dating	2	x						
SO265-DR15-2	1. Rock Type: aphyric lava, slightly to moderately altered 2. Size: 7x5x4.5cm nodule, clast 1x2cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown to grey 5. Texture / Vesicularity: 1-2% <1mm, filled with black material 6. Phenocrysts: Ol 5-10%, <1mm, altered orange in Gm; Pl <5%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: Ol replaced by iddingsite, black material (Mn?) in vesicles 9. Encrustations: Mn crust 2cm 10. Comment: very small sample; serves only as back up								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR15-3	1. Rock Type: aphyric lava, strongly altered 2. Size: 7x7x6cm nodule, volcanic clast 1x2cm 3. Shape / Angularity: subangular 4. Color of cut surface: brownish rim (~2mm), grey brown core 5. Texture / Vesicularity: 5%, up to 1mm, some filled with white material 6. Phenocrysts: Ol 3-5%, <1mm, altered orange in Gm; Pl <5%, <2mm, altered 7. Matrix: fine grained 8. Secondary Minerals: Ol replaced by iddingsite, white material (zeolite?) in vesicles 9. Encrustations: Mn crust 3cm 10. Comment:								
SO265-DR15-4	1. Rock Type: aphyric lava, strongly altered 2. Size: 6x6x6cm nodule, volcanic clast 1x2cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown 5. Texture / Vesicularity: 2-3%, up to 1mm, filled with grey / black material 6. Phenocrysts: Ol ~5%, <1mm, altered orange in Gm; Pl needle up to 1mm, <5% 7. Matrix: fine grained 8. Secondary Minerals: Ol replaced by iddingsite, white material (zeolite?) in vesicles 9. Encrustations: Mn crust 2cm 10. Comment:								

SO265-DR16


Description of Location and Structure: Papanin Ridge, flat topped Smt SE of Shuleykin Smt, NE slope from bottom to top

Dredge on bottom UTC 05/09/18 00:16hrs, lat 40°48.57'N, long 164°08.65'E, depth 4835m

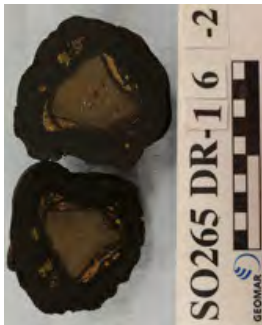



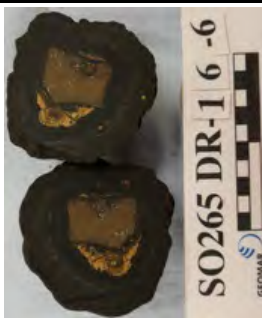
Dredge off bottom UTC 05/09/18 01:42hrs, lat 40°48.37'N, long 164°08.12'E, depth 4420m

total volume: 1/4 full; Mn nodules, cores: volcanic rocks, Cc, breccias, pumice





Comments: Mn cores made of some fairly fresh to altered volcanic rocks

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR16-1	1. Rock Type: aphyric lava, fresh to slightly altered 2. Size: 9x5x5cm, from bloc E (18x13x12cm) 3. Shape / Angularity: angular 4. Color of cut surface: grey 5. Texture / Vesicularity: massive, non-vesicular 6. Phenocrysts: euhedral Pl microphenocrysts <1%, 0.5-0.8mm 7. Matrix: microcrystalline 8. Secondary Minerals: black patches (Fe-hydroxide?) are present. Oxidized brown halo along rim 9. Encrustations: nodule has 8cm Mn layering 10. Comment: freshest sample of DR, good for Gc and possibly Ar/Ar	2	x		Pl			x	GC in air-freight box 





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR16-2	1. Rock Type: aphyric lava, slightly altered, similar to -1 2. Size: 5x5x4cm core, nodule 10x8x7cm 3. Shape / Angularity: angular 4. Color of cut surface: brownish grey 5. Texture / Vesicularity: aphyric, massive, slightly vesicular 6. Phenocrysts: rare Pl microphenocrysts <1%, ~1.5mm 7. Matrix: fine grained, microcrystalline 8. Secondary Minerals: Mn patches, vesicles filled with sediment / Cc 9. Encrustations: 2cm Mn crust 10. Comment: similar to -1	2	x						
SO265-DR16-3	1. Rock Type: aphyric lava, moderately altered, similar to -1 & -2 but more altered 2. Size: core 6x5x4cm; nodule 11x9x9cm 3. Shape / Angularity: angular 4. Color of cut surface: brownish grey, brown patches 5. Texture / Vesicularity: aphyric, massive, rare vesicles <1%, ~1mm 6. Phenocrysts: rare Pl microphenocrysts <1%, <1mm 7. Matrix: fine grained, microcrystalline 8. Secondary Minerals: Mn patches, altered brown patches 9. Encrustations: 2.5cm Mn crust 10. Comment:	1						only TS to GEOMAR	
SO265-DR16-4	1. Rock Type: aphyric lava, moderately altered, similar to -3 2. Size: core 12x8x8cm; bloc B 25x16x9cm 3. Shape / Angularity: angular 4. Color of cut surface: greyish brown 5. Texture / Vesicularity: see -3 6. Phenocrysts: see -3 7. Matrix: see -3 8. Secondary Minerals: larger Mn patches 9. Encrustations: 1.8cm Mn coating 10. Comment:	1	x					only TS to GEOMAR	
SO265-DR16-5	1. Rock Type: aphyric lava, moderately altered, similar to -3 & -4 2. Size: core 8x4x3cm; nodule 10x8x5cm 3. Shape / Angularity: angular 4. Color of cut surface: brown 5. Texture / Vesicularity: see -3 6. Phenocrysts: see -3 7. Matrix: see -3 8. Secondary Minerals: rare Mn patches 9. Encrustations: 1.8cm Mn coating 10. Comment:	1						only TS to GEOMAR	
SO265-DR16-6	1. Rock Type: aphyric lava, moderately altered, similar to -3 to -5 2. Size: core 8x4x3cm; nodule 11x8x8cm 3. Shape / Angularity: angular 4. Color of cut surface: brownish-grey 5. Texture / Vesicularity: see -3 6. Phenocrysts: see -3 7. Matrix: see -3 8. Secondary Minerals: some Mn patches, vesicle filling sediment 9. Encrustations: 1.5cm Mn crust 10. Comment:	1						only TS to GEOMAR	





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR16-7	1. Rock Type: aphyric lava, strongly altered, similar to -3 to -6 2. Size: core 7x5x3cm; nodule 9x8x7cm 3. Shape / Angularity: angular 4. Color of cut surface: brown 5. Texture / Vesicularity: aphyric, massive, non-vesicular 6. Phenocrysts: rare Pl in Gm <1%, <1mm 7. Matrix: fine grained, dense, microcrystalline 8. Secondary Minerals: Mn patches 9. Encrustations: 2cm Mn crust 10. Comment:	1						only TS to GEOMAR	
SO265-DR16-8	1. Rock Type: aphyric lava, strongly altered, similar to -7 2. Size: core 7x5x4cm; nodule 11x9x8cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown 5. Texture / Vesicularity: see -7 6. Phenocrysts: see -7 7. Matrix: see -7 8. Secondary Minerals: Mn patches, vesicle fillings 9. Encrustations: 3cm Mn crust 10. Comment:	1						only TS to GEOMAR	
SO265-DR16-9	1. Rock Type: aphyric lava, strongly altered 2. Size: core 5x4x3cm; nodule 7x6x6cm 3. Shape / Angularity: angular 4. Color of cut surface: brown 5. Texture / Vesicularity: aphyric, massive, non-vesicular 6. Phenocrysts: rare Pl in Gm <0.5mm, <1% 7. Matrix: fine grained, microcrystalline 8. Secondary Minerals: Mn patches 9. Encrustations: 1.8cm Mn crust 10. Comment:								
SO265-DR16-10	1. Rock Type: aphyric lava, strongly altered similar to -9 2. Size: core 6x5x4cm; nodule 7x6x5cm 3. Shape / Angularity: angular 4. Color of cut surface: brown 5. Texture / Vesicularity: aphyric, massive, rare vesicles <0.5mm, <1% 6. Phenocrysts: rare Pl in Gm <1mm, <1% 7. Matrix: fine grained, microcrystalline 8. Secondary Minerals: Mn patches, fillings 9. Encrustations: 1cm Mn crust 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR16-11	1. Rock Type: aphyric lava, strongly altered similar to -9 & -10 2. Size: core 3x3x2cm; bloc A 34x23x14cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 5cm Mn crust 10. Comment:								
SO265-DR16-12	1. Rock Type: breccia with sediment matrix (clay) and volcanic clasts (fragments and altered glass) 2. Size: 14x10x9cm 3. Shape / Angularity: rounded 4. Color of cut surface: brown matrix, brown and green clasts 5. Texture / Vesicularity: brecciated, clastic 6. Phenocrysts: clast with thin Mn coating 7. Matrix: sediment ---> clay 8. Secondary Minerals: palagonite 9. Encrustations: 1cm Mn crust 10. Comment:								
SO265-DR16-13	1. Rock Type: breccia large hyaloclastite clast, few volcaniclasts, similar to -12 2. Size: 11x9x8cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 1.8cm Mn crust 10. Comment:								
SO265-DR16-14	1. Rock Type: breccia, hyaloclastite clast, similar to -13 2. Size: 8x6x6cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 1.9cm Mn crust 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR16-15	1. Rock Type: pumice, slightly altered 2. Size: 9x9x6cm 3. Shape / Angularity: rounded 4. Color of cut surface: brownish grey, pale 5. Texture / Vesicularity: glassy, highly vesicular 6. Phenocrysts: rare Qz <1%, ~2mm 7. Matrix: glassy 8. Secondary Minerals: 9. Encrustations: 5mm Mn crust 10. Comment:								
SO265-DR16-16	1. Rock Type: pumice / scoria, slightly altered 2. Size: 7x5x4cm 3. Shape / Angularity: subrounded 4. Color of cut surface: dark brown 5. Texture / Vesicularity: glassy, highly vesicular 6. Phenocrysts: few Qz crystals? 7. Matrix: glassy 8. Secondary Minerals: 9. Encrustations: no Mn crust 10. Comment:								
SO265-DR16-17	1. Rock Type: sediment with some palagonite fragments 2. Size: 11x11x6cm 3. Shape / Angularity: subrounded 4. Color of cut surface: brown 5. Texture / Vesicularity: dense sediment --> clay 6. Phenocrysts: palagonite fragments ~1%, ≤1mm 7. Matrix: fine grained 8. Secondary Minerals: palagonite (altered glass), Mn patches 9. Encrustations: 2mm Mn crust 10. Comment:								
SO265-DR16-18	1. Rock Type: sediment with few palagonite + volcanic fragments, similar to -17 2. Size: 7x5x9cm 3. Shape / Angularity: subrounded 4. Color of cut surface: brown 5. Texture / Vesicularity: see -17 6. Phenocrysts: see -17 7. Matrix: see -17 8. Secondary Minerals: see -17 9. Encrustations: 5mm Mn crust 10. Comment:								

SO265-CTD17

Description of Location and Structure: Transit to Shuleykin Smt




CTD to water UTC 05/09/18 05:06hrs, lat 40°57.56'N, long 163°51.01'E, depth 4900m

CTD on deck UTC 05/09/18 06:39hrs, lat 40°57.55'N, long 164°51.03'E, depth 4895m



total volume:

Comments: CTD lowered to 2000 mbsl to record sound profile for EM122

Appendix 2 (Station Details and Rock Description)

SO265-DR18									
Description of Location and Structure: Shuleykin Smt, middle part of S slope. Middle steepest part of the ridge slope									
Dredge on bottom UTC 05/09/18 10:49hrs, lat 41°10.43'N, long 163°33.78'E, depth 4602m									
Dredge off bottom UTC 05/09/18 12:10hrs, lat 41°10.79'N, long 163°33.64'E, depth 4200m									
total volume: very few rocks; mostly Mn nodules, few angular rock fragments.									
Comments: Mn cores made of some fairly fresh to altered volcanic rocks									
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR18-1	1. Rock Type: rel. aphyric lava, fresh to moderately altered 2. Size: 8x5x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: light grey 5. Texture / Vesicularity: fairly massive, vesicles 5-10%, ≤1mm, some filled white and light green material 6. Phenocrysts: Pl needles ~10%, ≤1mm, white to transparent, altered Ol <2%, <1mm, orange / brown 7. Matrix: rel. coarse grained to medium grained 8. Secondary Minerals: see vesicle filling, Ol altered to Fe-oxide 9. Encrustations: ≤1mm Mn crust 10. Comment:	2	x				x	GC in air freight box	
SO265-DR18-2	1. Rock Type: rel. aphyric lava, fresh to moderately altered 2. Size: 5x3x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: light grey 5. Texture / Vesicularity: fairly massive, vesicles 3-5%, up to 1mm, some filled white / transparent to slightly yellowish material 6. Phenocrysts: Pl ~5%, ≤1mm, altered Ol 5-10%, <1mm, orange / brown 7. Matrix: medium grained 8. Secondary Minerals: see -1 9. Encrustations: ≤2mm Mn crust 10. Comment: freshest sample of dredge, however, not much material but sufficient for Gc	1	x					TS only for GEOMAR	
SO265-DR18-3	1. Rock Type: slightly Ol-Pl phyrlic lava, moderately altered 2. Size: clast 4.5x3; nodule 5x3x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: mostly brown, small part light grey 5. Texture / Vesicularity: vesicles 5-10%, up to 4mm, filled with white / yellowish material 6. Phenocrysts: Pl needles 2-3%, up to 3mm, transparent, altered Ol 5%, up to 2mm, orange 7. Matrix: fine to medium grained 8. Secondary Minerals: see -1 9. Encrustations: Mn crust up to 2cm 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR18-4	1. Rock Type: slightly Ol-Pl phyric lava, moderately to strongly altered 2. Size: 10x4x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown to slightly grey 5. Texture / Vesicularity: rel aphyric, vesicles 3-5%, up to 1mm, filled with white / brownish material 6. Phenocrysts: Pl needles 5-10%, up to 2mm, altered Ol 5%, ~1mm, brown 7. Matrix: medium to coarse grained 8. Secondary Minerals: see -1 9. Encrustations: Mn crust <1mm 10. Comment:	2	x						
SO265-DR18-5X	1. Rock Type: slightly Ol-Pl phyric lava, moderately to strongly altered 2. Size: three pieces 5x3.5x3cm; 5x3.5x2cm; 7x5.5x4.5cm 3. Shape / Angularity: subangular 4. Color of cut surface: see -3 & -4 5. Texture / Vesicularity: see -3 & -4 6. Phenocrysts: see -3 & -4 7. Matrix: see -3 & -4 8. Secondary Minerals: see -3 & -4 9. Encrustations: see -3 & -4 10. Comment: back up samples								

SO265-DR19


Description of Location and Structure: Shuleykin Ridge / Smt, Repeat of DR18 ~1nm E at similar depth range. Middle part of S slope.

Dredge on bottom UTC 05/09/18 15:33hrs, lat 41°10.56'N, long 163°34.72'E, depth 4473m





Dredge off bottom UTC 05/09/18 16:53hrs, lat 41°10.96'N, long 163°34.53'E, depth 3995m

total volume: few rocks; surprisingly scarce Mn nodules






Comments: After cutting abundant fragments of Ol-phyric lava, some with rare Pl. Vary from moderately to strongly altered. Many still have grey Gm. Sample -13 has large Px? phenocrysts, is very fresh and was unusually hard to saw almost like a metamorphic rock; this is a suspect dropstone (!)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR19-1	1. Rock Type: Ol phyric lava, fresh to moderately altered 2. Size: 8x4.5x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey 5. Texture / Vesicularity: porphyric; vesicles 5-10%, ≤1mm, filled with white and light green material 6. Phenocrysts: altered Ol 10%, ≤2mm, orange 7. Matrix: fine grained 8. Secondary Minerals: zeolites? filling vesicles filling, Ol altered to iddingsite 9. Encrustations: ≤1mm Mn crust 10. Comment:	2	x				x	GC in air-freight box	


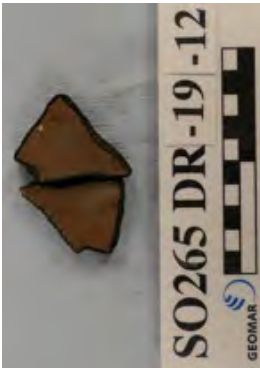

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR19-2	1. Rock Type: Ol phyric lava, fresh to moderately altered 2. Size: 4x5x3cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to grey brownish 5. Texture / Vesicularity: porphyric; vesicles $\leq 1\%$, $\leq 1\text{mm}$, filled with white and light green material 6. Phenocrysts: altered Ol 10%, $\leq 2\text{mm}$, orange, Pl $< 2\%$, $\leq 1\text{mm}$ 7. Matrix: fine grained 8. Secondary Minerals: similar to -1 + Mn patches 9. Encrustations: $\leq 2\text{mm}$ Mn crust 10. Comment:	2	x						
SO265-DR19-3	1. Rock Type: Ol-Pl phyric lava, fresh to moderately altered 2. Size: 8x10x4.5cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to grey 5. Texture / Vesicularity: porphyric; vesicles 5%, $< 3\text{mm}$, partially filled rusty-orange mineral (Fe-oxide); remark: probably mistaken as altered 6. Phenocrysts: altered Ol 20-30%, $\leq 1\text{mm}$, orange, Pl needles $< 5\%$, $\leq 1\text{mm}$; remark: Ol appears overestimated 7. Matrix: fine grained 8. Secondary Minerals: iddingsite replacing Ol 9. Encrustations: $\leq 1\text{mm}$ Mn crust 10. Comment:	2	x						
SO265-DR19-4	1. Rock Type: Ol-Pl phyric lava, fresh to moderately altered 2. Size: 6x5x2cm 3. Shape / Angularity: subangular 4. Color of cut surface: dark grey 5. Texture / Vesicularity: porphyric; vesicles 10%, filled with orange material 6. Phenocrysts: altered Ol $< 5\%$, $\leq 1\text{mm}$, orange, Pl 5%, up to 1mm 7. Matrix: fine grained 8. Secondary Minerals: iddingsite replacing Ol 9. Encrustations: up 1mm Mn crust 10. Comment:	1	x					TS only for GEOMAR	
SO265-DR19-5	1. Rock Type: Ol-Pl phyric lava, moderately altered 2. Size: 5x5.5x3cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to orange brown 5. Texture / Vesicularity: porphyric; vesicles $< 1\%$, $< 1\text{mm}$, filled with white-yellowish material 6. Phenocrysts: altered Ol $< 10\%$, up to 2mm, orange, Pl $< 1\%$, $< 1\text{mm}$ 7. Matrix: fine grained 8. Secondary Minerals: iddingsite replacing Ol 9. Encrustations: $< 1\text{mm}$ Mn crust 10. Comment:	2	x						

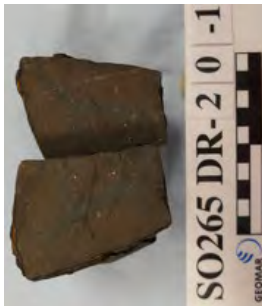


Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR19-6	1. Rock Type: Ol-Pi phyric lava, moderately altered 2. Size: 9x5x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: similar to -5 5. Texture / Vesicularity: similar to -5 6. Phenocrysts: similar to -5 7. Matrix: similar to -5 8. Secondary Minerals: similar to -5 9. Encrustations: similar to -5 10. Comment:	2	x						
SO265-DR19-7	1. Rock Type: Ol-Pi phyric lava, moderately altered 2. Size: 8x3x3cm 3. Shape / Angularity: similar to -5 4. Color of cut surface: similar to -5 5. Texture / Vesicularity: similar to -5 6. Phenocrysts: similar to -5 7. Matrix: similar to -5 8. Secondary Minerals: similar to -5 9. Encrustations: similar to -5 10. Comment:								
SO265-DR19-8	1. Rock Type: Ol-Pi phyric lava, moderately altered 2. Size: 3.5x3x5cm 3. Shape / Angularity: similar to -5 4. Color of cut surface: similar to -5 5. Texture / Vesicularity: similar to -5 6. Phenocrysts: similar to -5 7. Matrix: similar to -5 8. Secondary Minerals: similar to -5 9. Encrustations: similar to -5 10. Comment:								
SO265-DR19-9	1. Rock Type: Ol-Pi phyric lava, moderately altered 2. Size: 7x2.5x7cm 3. Shape / Angularity: similar to -5 4. Color of cut surface: similar to -5 5. Texture / Vesicularity: similar to -5 6. Phenocrysts: similar to -5 7. Matrix: similar to -5 8. Secondary Minerals: similar to -5 9. Encrustations: similar to -5 10. Comment:								
SO265-DR19-10	1. Rock Type: Ol-Pi phyric lava, moderately altered 2. Size: 9x7x4cm 3. Shape / Angularity: similar to -5 4. Color of cut surface: similar to -5 5. Texture / Vesicularity: similar to -5 but vesicles up to 3mm, mostly filled with white material 6. Phenocrysts: similar to -5 7. Matrix: similar to -5 8. Secondary Minerals: similar to -5 9. Encrustations: similar to -5 10. Comment:								

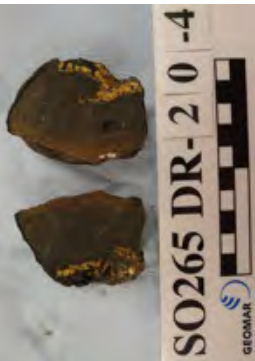



Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR19-11	1. Rock Type: Ol-Pi phyric lava, moderately to strongly altered 2. Size: 6x9x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to orange brown 5. Texture / Vesicularity: vesicles 1%, up to 2mm, mostly filled with white-yellow material 6. Phenocrysts: altered Ol <1%, ≤1mm, Pl <1%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: iddingsite replacing Ol, Mn patches, vesicle filling white-yellow material 9. Encrustations: 3cm Mn crust 10. Comment:								
SO265-DR19-12	1. Rock Type: Ol-Pi phyric lava, strongly altered 2. Size: 5x5x3cm 3. Shape / Angularity: subangular 4. Color of cut surface: orange brown 5. Texture / Vesicularity: vesicles <1%, <1mm, filled with white material 6. Phenocrysts: altered Ol <5%, ≤1mm, Pl <1%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: iddingsite replacing Ol, Mn patches, vesicle filling white material 9. Encrustations: ≤3mm Mn crust 10. Comment:								
SO265-DR19-13	1. Rock Type: Ol-Px-Pl phyric lava lava, very fresh, hard to saw, probably a dropstone 2. Size: 3x3x5cm 3. Shape / Angularity: subangular to rounded 4. Color of cut surface: grey blueish 5. Texture / Vesicularity: dense 6. Phenocrysts: altered Ol <2%, ≤2mm; Px 3-5% black, <3mm; Pl ~5%, <2mm white transparent 7. Matrix: fine grained 8. Secondary Minerals: iddingsite replacing Ol 9. Encrustations: ≤1mm Mn crust 10. Comment: alkali basalt? possibly metamorphosed, contains light patches up to 6mm of unknown mineral. Suspect dropstone!							dropstone	





Appendix 2 (Station Details and Rock Description)

SO265-DR20									
Description of Location and Structure: Papanin Ridge at W margin, S flank of small Smt from base to top									
Dredge on bottom UTC 06/09/18 00:36hrs, lat 41°31.05'N, long 164°02.36'E, depth 5155m									
Dredge off bottom UTC 06/09/18 01:59hrs, lat 41°31.48'N, long 164°02.24'E, depth 4727m									
total volume: 1/3 full									
Comments: altered volcanic rocks, pumice, Mn nodules with cores of breccias, carbonate and unusually fresh rock which are probably dropstones									
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR20-1	1. Rock Type: moderately Ol phyric lava, fresh to slightly altered 2. Size: 14x8x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey, ~brownish 5. Texture / Vesicularity: massive, non-vesicular 6. Phenocrysts: euhedral / subhedral Ol 5-7%, 0.3-1mm, some are fresh(!) but most are altered 7. Matrix: fine grained, accicular Pl, 0.1-0.2mm width 8. Secondary Minerals: brown mineral replaces Ol and Gm in many places. Pores filled by white & pale brown mineral 9. Encrustations: 1.5cm Mn crust 10. Comment: this rock has Pl in Gm but -2 has no Pl in Gm	2	x						
SO265-DR20-2	1. Rock Type: moderately Ol phyric lava, fresh but some parst are altered 2. Size: 10x8x7cm 3. Shape / Angularity: subrounded 4. Color of cut surface: grey 5. Texture / Vesicularity: massive, non-vesicular 6. Phenocrysts: euhedral / subhedral Ol 7%, 0.5-0.8mm, some are fresh(!) 7. Matrix: cryptocrystalline 8. Secondary Minerals: brown mineral replace Ol and Gm in some places. 9. Encrustations: thin film of Mn crust 10. Comment: freshest rock of the dredge	2	x						
SO265-DR20-3	1. Rock Type: Ol phyric lava, moderately altered, some portions fresher 2. Size: 9x8x7cm 3. Shape / Angularity: subrounded 4. Color of cut surface: grey - brown, some reddish brown 5. Texture / Vesicularity: massive, non-vesicular 6. Phenocrysts: subhedral, red-brown Ol occurs in aggregates 5-10%, also altered to pale green 7. Matrix: cryptocrystalline, rare Pl needles 8. Secondary Minerals: brown-red mineral, perhaps recrystallized Ol plus pale green mineral in contact with some alteration 9. Encrustations: 1.5 thick Mn crust 10. Comment:	1	x						





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR20-4	1. Rock Type: Ol phyric lava, moderately altered, rusted red fine grained edge to fresher interior 2. Size: 5x6x5cm 3. Shape / Angularity: subrounded 4. Color of cut surface: grey - brown, some red brown 5. Texture / Vesicularity: generally non-vesicular, but there are a few empty spherical voids up to 5mm length, possible material to occupy space. <1% vesicles <1mm 6. Phenocrysts: subhedral Ol, some forming aggregates in fresher portions of rock 7. Matrix: cryptocrystalline with needle like Pl up to 2-3mm. A few have swallow tail shape 8. Secondary Minerals: pale green minerals fills some void. Ol altered to brown red product. Fe or Mn-oxide fractures also exist 9. Encrustations: thin Mn crust 10. Comment:	1	x					only TS to GEOMAR	
SO265-DR20-5	1. Rock Type: Ol phyric lava, moderately altered 2. Size: 5x5x4cm 3. Shape / Angularity: angular 4. Color of cut surface: dark grey to brown 5. Texture / Vesicularity: massive non-vesicular 6. Phenocrysts: subhedral Ol ~1mm form clusters with Pl laths. Some pl occurs on glomerocrysts with Ol (maybe former Px) 7. Matrix: cryptocrystalline appears to have an formation of Pl with devitrified former glass 8. Secondary Minerals: brown red mineral replacing Ol 5-10%, occurrence minor <5% pale green alteration in separate clusters 9. Encrustations: 1cm Mn crust 10. Comment:								
SO265-DR20-6	1. Rock Type: Ol phyric lava, highly altered 2. Size: 5x3x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: rusted red rim to dark brown to dark grey interior, overall mostly brown 5. Texture / Vesicularity: massive non-vesicular 6. Phenocrysts: subhedral Ol up to 1mm 7. Matrix: cryptocrystalline 8. Secondary Minerals: brown red mineral replacing Ol. Phosphate near Mn-oxide crust and pale green mineral on exterior, once in interior, ~5mm length 9. Encrustations: 5mm Mn crust 10. Comment:								
SO265-DR20-7	1. Rock Type: Ol phyric lava, highly altered 2. Size: 5x5x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: reddish brown with some grey spots 5. Texture / Vesicularity: massive, non-vesicular 6. Phenocrysts: subhedral Ol <5%, 0.5mm 7. Matrix: cryptocrystalline, rare Pl ~0.5mm, thin 8. Secondary Minerals: brown red mineral replacing Ol. White filling of some voids 9. Encrustations: 1cm Mn crust 10. Comment:								


Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR20-8	1. Rock Type: Ol phyric lava, slightly altered 2. Size: 11x4x3cm 3. Shape / Angularity: angular 4. Color of cut surface: salt and pepper, grey-black to light grey brown 5. Texture / Vesicularity: non-vesicular 6. Phenocrysts: Ol most <0.5mm, some up to 1.5mm 7. Matrix: cryptocrystalline, with possibly abundant Pl 8. Secondary Minerals: brown-red mineral replacing Ol and a few pale green minerals present. Phosphate along fracture 9. Encrustations: 5mm Mn crust 10. Comment:	2	x	Gm looks possible					
SO265-DR20-9	1. Rock Type: pumice or scoria 2. Size: 11x4x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: pale grey and medium grey spots 5. Texture / Vesicularity: 30-50% vesicles, elongated vesicles up to 15mm, most < 0.5mm 6. Phenocrysts: rare Pl, possible Mt or other dark oxide 7. Matrix: glassy 8. Secondary Minerals: some phenocrysts present in voids, where matrix tends to be darker 9. Encrustations: no Mn crust 10. Comment: rafted pumice				GL		x	glass in air freight box	
SO265-DR20-10	1. Rock Type: pumice or scoria 2. Size: 9x4x2cm 3. Shape / Angularity: angular, elongated 4. Color of cut surface: pale tan grey 5. Texture / Vesicularity: highly vesicular ~50%, open; some 1% elongated up to 20mm 6. Phenocrysts: dark oxide <5mm, 1% 7. Matrix: glassy 8. Secondary Minerals: some in vesicle walls but not identifiable 9. Encrustations: no Mn crust 10. Comment: rafted pumice				GL		x	glass in air freight box	
SO265-DR20-11	1. Rock Type: scoria, darker than -9 & -10 2. Size: 6x4x5cm 3. Shape / Angularity: subrounded 4. Color of cut surface: dark brown grey 5. Texture / Vesicularity: highly vesicular 30-40%, open; some 1% elongated up to 75mm but comprise <50% of the vesicles, some filled with Qz along walls 6. Phenocrysts: Qz 0.5-1.5mm, a few appear fresh 7. Matrix: glassy 8. Secondary Minerals: some reddish brown patches near edge and along vesicles 9. Encrustations: thin 2mm Mn crust 10. Comment: rafted pumice				GL		x	glass in air freight box	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR20-12	1. Rock Type: breccia with sediment core, highly altered 2. Size: 10x6x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: black rind, pale tan rind, brown interior 5. Texture / Vesicularity: dense, clasts are subrounded with rind of black oxide, sediment in spaces between clasts 6. Phenocrysts: none 7. Matrix: fined grained sediment 8. Secondary Minerals: palagonite clasts up to 1.5cm, 20% of sample, some brown portions in clasts, phosphate rind 9. Encrustations: thin Mn crust 10. Comment:								
SO265-DR20-13	1. Rock Type: Pl-Hbl phyric volcanic rock, fresh; dropstone! 2. Size: 13x8.5x7cm 3. Shape / Angularity: subrounded 4. Color of cut surface: dark grey with white and black spots 5. Texture / Vesicularity: porphyritic, dense, no vesicles 6. Phenocrysts: Hbl up to 5mm, ~2%; Pl up to 5mm, ~2% 7. Matrix: fully crystallized, medium grained <1mm, Gm composed of Cpx, Opx, Pl, Fe-oxides 8. Secondary Minerals: none 9. Encrustations: 10. Comment: very likely dropstone of island arc origin	1	x					dropstone	
SO265-DR20-14	1. Rock Type: Ol-Cpx phyric volcanic rock, fresh; Ol slightly altered, dropstone! 2. Size: 7x4x7cm 3. Shape / Angularity: subrounded 4. Color of cut surface: dark grey with light dots 5. Texture / Vesicularity: massive, porphyritic 6. Phenocrysts: Cpx ~1-2% up to 3mm; Ol ~5%, 1-2mm 7. Matrix: fine crystallized with Pl laths ~0.2mm in cryptocrystalline matrix 8. Secondary Minerals: serpentine after Ol 9. Encrustations: very thin Mn film on surface 10. Comment: dropstone!	1						dropstone	
SO265-DR20-15	1. Rock Type: Pl-Px phyric volcanic rock, slightly altered, dropstone! 2. Size: 10x5.5x2cm 3. Shape / Angularity: subrounded 4. Color of cut surface: light grey with white spots 5. Texture / Vesicularity: porphyritic 6. Phenocrysts: Pl 20%, 1-2mm; Cpx(?) ~1%, ~1mm 7. Matrix: fine crystallized 8. Secondary Minerals: minor chloritization on Pl 9. Encrustations: <2mm Mn crust 10. Comment: dropstone!	1						dropstone	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR20-16	1. Rock Type: aphyric volcanic (?) rock, dropstone! 2. Size: 8x7x5cm 3. Shape / Angularity: perfectly rounded pebble 4. Color of cut surface: dark grey 5. Texture / Vesicularity: massive 6. Phenocrysts: 7. Matrix: medium to coarse grained, fully crystallized 8. Secondary Minerals: 9. Encrustations: very thin Mn film on surface 10. Comment: dropstone!	1	x					dropstone	

SO265-DR21

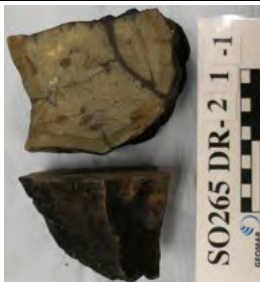

Description of Location and Structure: Papanin Ridge, Southern Area, flat topped seamount near eastern margin of Papanin Ridge, SW flank from base to top

Dredge on bottom UTC 06/09/18 08:22hrs, lat 41°19.18'N, long 164°28.93'E, depth 4822m


Dredge off bottom UTC 06/09/18 09:48hrs, lat 41°19.60'N, long 164°29.06'E, depth 4480m

total volume: few rocks

Comments: two pillow lava fragments and Mn nodules and crust fragments. A few pebbles -dropstones-. Sample -1 & -2 are aphyric, vesicular basalts

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR21-1	1. Rock Type: Sparsely Pl phyric volcanic rock, moderately altered 2. Size: 14x13x13cm 3. Shape / Angularity: angular pillow fragment 4. Color of cut surface: dark grey with white spots to reddish grey at margin 5. Texture / Vesicularity: vesicular, 8-10%, 0.2-0.8mm ø 6. Phenocrysts: very rare Pl, ~2mm long, fresh 7. Matrix: fine crystallized, looks fresh 8. Secondary Minerals: oxidation at margins, glass altered 9. Encrustations: Mn crust ~2mm and penetration along cracks, white fillings in vesicles 10. Comment: good for Gc but Mn must be picked out	2	x						
SO265-DR21-2	1. Rock Type: aphyric volcanic rock, similar to -1 2. Size: 8x6x6cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: the rock has more cracks, green fillings in vesicles. Not as good for Gc as -1								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR21-3	1. Rock Type: Mn nodule, representative fro DR21 2. Size: 10x9x8cm 3. Shape / Angularity: rounded :O) 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								

SO265-DR22



Description of Location and Structure: Papanin Ridge, Southern Area, NE-SW elongated pan-cake like Smt; 30x16km. Track along E margin from bottom to edge where slope flattens. Above edge small cone.

Dredge on bottom UTC 06/09/18 16:20hrs, lat 41°32.51'N, long 164°58.57'E, depth 4672m





Dredge off bottom UTC 06/09/18 17:43hrs, lat 41°32.72'N, long 164°57.00'E, depth 4241m

total volume: few rocks





Comments: some angular lava fragments, mostly Mn nodules with sediment cores. -1 to 8 aphyric lava with rare Ol microphenocrysts ranging from moderately to partly fresh to strongly altered, -9 & -10 are highly Pl phytic lava fragments but Pl is to a large extend altered to clay.

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR22-1	1. Rock Type: aphyric lava, fresh to moderately altered 2. Size: 9x6.5x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey-blueish to grey brownish 5. Texture / Vesicularity: aphyric, 10% vesicles up to 3mm, some filled with brown and white greenish material 6. Phenocrysts: 2% Ol microphenocrysts, altered; but could also be vesicle filling 7. Matrix: fine grained 8. Secondary Minerals: Mn patches, filled vesicles 9. Encrustations: Mn crust <1cm 10. Comment:	2	x				x	GC in air freight box	
SO265-DR22-2	1. Rock Type: aphyric lava, fresh to moderately altered 2. Size: 6x5.5x2.5cm 3. Shape / Angularity: subangular 4. Color of cut surface: see -1 5. Texture / Vesicularity: see -1 6. Phenocrysts: see -1 7. Matrix: see -1 8. Secondary Minerals: Mn patches related to cracks 9. Encrustations: Mn crust <1mm 10. Comment:	2	x						



Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR22-3	1. Rock Type: aphyric lava, fresh to moderately altered 2. Size: 8x9x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey-blueish with brownish sections 5. Texture / Vesicularity: aphyric, 10-15% vesicles up to 6mm, avrg <1mm, filled with brownish-orange material 6. Phenocrysts: 2-5% Ol microphenocrysts, ≤1mm, altered; but could also be vesicle filling 7. Matrix: fine grained 8. Secondary Minerals: ~2-3% Mn patches, filled vesicles 9. Encrustations: Mn crust up to 2-3mm 10. Comment:	2	x						
SO265-DR22-4	1. Rock Type: aphyric lava, fresh to moderately altered 2. Size: 8x8x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey-blueish with brownish sections 5. Texture / Vesicularity: aphyric, 10-15% vesicles up to 6mm, avrg <1mm, a few filled with brownish-orange material 6. Phenocrysts: see - to -3 7. Matrix: see - to -3 8. Secondary Minerals: see - to -3 9. Encrustations: Mn crust up to 2cm 10. Comment:	2	x						
SO265-DR22-5	1. Rock Type: volcanic, moderately altered 2. Size: 10x10x5cm 3. Shape / Angularity: angular 4. Color of cut surface: green-grey to light grey 5. Texture / Vesicularity: aphyric, 2% small vesicles <1mm, ± filled 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: clay, Fe-Mn filling of vesicles 9. Encrustations: Mn crust up to 3cm, removed 10. Comment: moderately altered, can be used for Gc; some fresh crystalline Pl in Gm	?	?						
SO265-DR22-6	1. Rock Type: volcanic, moderately to strongly altered 2. Size: 6x6x5cm 3. Shape / Angularity: angular 4. Color of cut surface: green-grey with brown patches 5. Texture / Vesicularity: aphyric, sparsely vesicular 2%, ± filled, mostly rounded, few stretched +irregular 6. Phenocrysts: 7. Matrix: finer grained than -5 8. Secondary Minerals: Mn in vesicles and veinlets, cutting through and forming dendritic network, clay in vesicles 9. Encrustations: Mn crust up to 1cm, removed 10. Comment: recommend to replace with -5 instead for TS and GC.	2	x						




Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR22-7	1. Rock Type: volcanic, moderately to strongly altered 2. Size: 6x5.5x2.5cm 3. Shape / Angularity: subangular 4. Color of cut surface: green-grey with brown +black veinlets 5. Texture / Vesicularity: microcrystalline, 2% vesicles, ± filling 6. Phenocrysts: aphyric, fresh PI in Gm 7. Matrix: microcrystalline 8. Secondary Minerals: Mn dendrites along veinlets, altered margin 9. Encrustations: Mn crust up to 1cm, removed 10. Comment: similar to -6	2	x						
SO265-DR22-8	1. Rock Type: volcanic, moderately altered with some fresh areas 2. Size: 6x6x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: light grey (fresh) with dark grey alteration margins 5. Texture / Vesicularity: aphyric, finely vesicular, 5% rounded vesicles, ± filled with white clay / zeolite? 6. Phenocrysts: aphyric, fresh PI in Gm 7. Matrix: microcrystalline 8. Secondary Minerals: Mn dendrites along veinlets cut through rock; Mn dissemination along dark grey alteration margin 9. Encrustations: Mn rind up to 2cm, removed 10. Comment:	2	x						
SO265-DR22-9	1. Rock Type: volcanic, moderately to strongly altered 2. Size: 5.5x4.5x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown to light grey (fresher) 5. Texture / Vesicularity: porphyritic, few vesicles <1%, some with white clay, Mn filling 6. Phenocrysts: PI phenocrysts 2-10mm, with preserved species, 3% of total phenocrysts 7. Matrix: GM is microcrystalline 8. Secondary Minerals: clays mostly in PI + some vesicle filling, Fe-Mn with clay in PI and vesicles. Mn veinlets and dendrites in Gm 9. Encrustations: thin Mn crust 1-2cm 10. Comment: maybe possible to find sufficient fresh PI for Ar-Ar dating	2	x						
SO265-DR22-10	1. Rock Type: volcanic, moderately to strongly altered 2. Size: 5x8x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: light grey with brown stains 5. Texture / Vesicularity: porphyritic with few amygdules 6. Phenocrysts: PI phenocrysts 2-5mm, some with fresh cores but most altered to clay + Cc + Mn. Clusters of altered OI? 7. Matrix: microcrystalline Gm 8. Secondary Minerals: Mn disseminated + replacing PI, clay + Cc replacing PI 9. Encrustations: Mn crust up to 1cm 10. Comment: similar to -9; may have fewer of the fresh PI for dating	2	x						




Appendix 2 (Station Details and Rock Description)

SO265-DR23 Description of Location and Structure: Papanin Ridge, Southern to Central Area, irregular, anvil-like shaped Smt on E side of Papanin Ridge; track along N flank Dredge on bottom UTC 07/09/18 00:48hrs, lat 41°59.96'N, long 164°58.35'E, depth 4756m Dredge off bottom UTC 07/09/18 02:07hrs, lat 41°59.69'N, long 164°57.90'E, depth 4453m total volume: 1/5 full Comments: lava fragments, Mn nodules. Fragements of pillow lava. Sparsely Pl phyric, petrographically identical to DR21									
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR23-1	1. Rock Type: sparsely Pl phyric pillow lava, moderately altered with fresh (grey areas) 2. Size: 9x6x5cm 3. Shape / Angularity: angular 4. Color of cut surface: dark grey to reddish grey with white spots 5. Texture / Vesicularity: 10-12% vesicles 0.2-1mm, filled with zeolite? 6. Phenocrysts: ~1% Pl 2-3mm long 7. Matrix: fine crystallized, white visible Pl microlites 8. Secondary Minerals: oxidation along margin and also spots in the inner part. Glass replaced by palagonite 9. Encrustations: Mn crust 2mm on outer surface, incrustations along cracks 10. Comment: after picking good for Gc. This rock is petrographically identical to those from DR21	2	x						
SO265-DR23-2A	1. Rock Type: rare Pl phyric lava, moderately altered 2. Size: 12x6x8cm clast from bloc B (48x24x26cm) 3. Shape / Angularity: angular 4. Color of cut surface: dark grey with reddish brown spots around core 5. Texture / Vesicularity: 15-20% vesicles, filled with green material (zeolite?). Does not fizz with HCl, possibly former glass altered to palagonite 6. Phenocrysts: spongey altered mineral. perhaps Pl 3mm long, rare orange replaced mineral <1%, <0.5mm 7. Matrix: fine grained with Pl microlites 8. Secondary Minerals: similar to -1, oxidation along margin and also penetrates into the fresher core, especially near vesicles. 9. Encrustations: Mn crust pervades along fractures into rock 10. Comment:	2	x						


Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR23-2B	1. Rock Type: rare Pl phyric lava, moderately altered 2. Size: 11x9x8cm clast from bloc B (48x24x26cm) 3. Shape / Angularity: angular 4. Color of cut surface: rusted red outer rind, abot 2.3cm thick, dark brown red interior with 2cm grey areas with brownish grey matrix 5. Texture / Vesicularity: 10-15% vesicles, 50% filled with green yellow infill, tend to be 0.1-0.5 mm. Larger vesicles mostly unfilled about 1mm ø. There are empty voids where minerals perhaps were plugged or dissolved, ~2mm length 6. Phenocrysts: single spongy Pl 2mm. Altered phenocrysts not identifiable as they are chalky substance with no form, white to green 7. Matrix: finely crystalline, ≤10% very fine needle like Pl. Rusted rind fine grained, grades into coarser grained core. Typical for pillow lava. 8. Secondary Minerals: vesicles filled with white yellow green infill which appears spherical. Former minerals seem to be pale green to orange 9. Encrustations: thin Mn crust pervades some fractures. Dark oxide spots 5% present in rock 10. Comment:	2	x						
SO265-DR23-2C	1. Rock Type: rare Pl phyric lava, moderately altered 2. Size: 12x12x10cm clast from bloc B (48x24x26cm) 3. Shape / Angularity: subangular 4. Color of cut surface: similar to -2B but most vesicles filled 5. Texture / Vesicularity: similar to -2B 6. Phenocrysts: similar to -2B 7. Matrix: similar to -2B 8. Secondary Minerals: similar to -2B 9. Encrustations: 1.5cm thick Mn crust 10. Comment:	1	x						
SO265-DR23-3	1. Rock Type: rare Pl phyric lava, moderately altered 2. Size: 15x10x7cm 3. Shape / Angularity: angular 4. Color of cut surface: greyish-brown with dark brown edges 5. Texture / Vesicularity: vesicular, ~5%, ~0.5mm, most have green infill 6. Phenocrysts: Pl, ~1mm, <1% 7. Matrix: fine grained, Pl microlites 8. Secondary Minerals: similar to -2A through -2C. Thin 0.5mm palagonite rind 9. Encrustations: 0.5cm thick Mn crust, some encrustations in fractures 10. Comment:	1	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR23-4	1. Rock Type: sparsely Pl phyric lava, moderately altered 2. Size: 10x8x6cm 3. Shape / Angularity: angular 4. Color of cut surface: dark grey with brown oxidized edges, brown alteration halo in core as well 5. Texture / Vesicularity: vesicular, ~5%, ~0.5mm, about 80% infill with pale green-white material 6. Phenocrysts: single glomerocrystic cluster of spongy, anhedral Pl, ~2mm 7. Matrix: fine grained with thin Pl microlites 8. Secondary Minerals: similar to -2A through -2C, -3 9. Encrustations: 2cm thick Mn crust with some dark oxides in interior, but no cracks with encrustations 10. Comment:	1	x						
SO265-DR23-5	1. Rock Type: sparsely Pl phyric lava, moderately altered 2. Size: 12x9x6cm 3. Shape / Angularity: angular 4. Color of cut surface: brown grey with reddish outer edge, ~1cm thick 5. Texture / Vesicularity: vesicular, ~5%, usually ~0.5mm or less, about 80% with white green infill 6. Phenocrysts: two glomerocrystic clusters of spongy, subhedral Pl, 2-4mm. Individual Pl <1% of rock, ~1mm , equant 7. Matrix: fine grained with some Pl microlites, <0.5mm 8. Secondary Minerals: similar to -3 with very thin palagonite rind? 9. Encrustations: thin Mn crust. Mn near fractures but not pervasively inside cracks 10. Comment:	1							
SO265-DR23-6	1. Rock Type: phyric lava, highly altered 2. Size: 16x10x11cm 3. Shape / Angularity: angular 4. Color of cut surface: dark brown 5. Texture / Vesicularity: vesicular, 5-10%, on 25mm, most have infill 6. Phenocrysts: altered and not able to identify, <5%, anhedral, ≤1mm 7. Matrix: fine grained altered to brown 8. Secondary Minerals: vesicles possibly filled with palagonite or other pale green mineral 9. Encrustations: thin Mn crust, pervades a few fractures 10. Comment:	1							

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR23-7	1. Rock Type: rare Pl phyric lava, moderately altered 2. Size: 16x14x14cm 3. Shape / Angularity: subangular 4. Color of cut surface: very altered parts are reddish brown, fresh portions dark grey with brown spots 5. Texture / Vesicularity: vesicular, 5%, less than half are filled 6. Phenocrysts: single spongy Pl, anhedral, 3mm with possibly dissolved core. Brown red altered mineral also present (Ol?), <1% 7. Matrix: fine grained altered to brown, rare Pl microlites 8. Secondary Minerals: brown red altered mineral <1%, palagonite possibly filled vesicles, rusted red very fine grained 9. Encrustations: thin Mn crust 10. Comment:	1	x						

SO265-CTD24

Description of Location and Structure: at end of DR23

CTD in water UTC 07/09/18 03:51hrs, lat 41°59.69'N, long 164°57.91'E, depth 4446m

CTD on deck UTC 07/09/18 05:21hrs, lat 41°59.69'N, long 164°57.91'E, depth 4444m

SO265-DR25


Description of Location and Structure: Papanin Ridge, Central Area, N slope of E-W striking ridge

Dredge on bottom UTC 07/09/18 11:41hrs, lat 42°06.16'N, long 165°24.28'E, depth 4488m



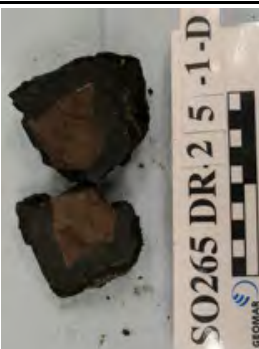
Dredge off bottom UTC 07/09/18 13:04hrs, lat 42°05.73'N, long 165°24.17'E, depth 4017m

total volume: 1/5 full

Comments: large Mn crust (bloc A; 55x20x75cm) with very scarce lava clasts (pillow fragments). Moderately to strongly altered, some grey areas, aphyric, all samples taken are from bloc A and labelled -1A through -1D. Other recovered material were 3-4 Mn nodules without igneous cores and thus were discarded.

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR25-1A	1. Rock Type: aphyric lava, moderately to strongly altered 2. Size: 6x5x3cm 3. Shape / Angularity: subangular 4. Color of cut surface: red brown 5. Texture / Vesicularity: 10% vesicles, <1mm, partially filled with white material, but mostly open 6. Phenocrysts: <1% altered Ol, <1mm 7. Matrix: fine grained 8. Secondary Minerals: Ol replaced by iddingsite, some Mn patches, see also vesicle filling 9. Encrustations: 10. Comment:	1	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR25-1B	1. Rock Type: aphyric lava, moderately to strongly altered 2. Size: 11x11x6cm; pillow fragment 3. Shape / Angularity: subangular 4. Color of cut surface: red brown to grey brown 5. Texture / Vesicularity: 10-15% vesicles, ≤ 1 mm, mostly empty, some filled with white green material 6. Phenocrysts: 1-2% altered Ol, < 1 mm 7. Matrix: fine grained 8. Secondary Minerals: Ol replaced by iddingsite, see also vesicle filling 9. Encrustations: up to 5mm Mn crust 10. Comment:	2	x						
SO265-DR25-1C	1. Rock Type: aphyric lava, strongly altered 2. Size: 12x10x9cm nodule within Mn crust; 5.5x4cm core 3. Shape / Angularity: subangular 4. Color of cut surface: red brown 5. Texture / Vesicularity: 5-10% vesicles, up to 1mm, mostly empty, rarely filled with white material 6. Phenocrysts: 1-2% altered Ol, < 1 mm 7. Matrix: fine grained 8. Secondary Minerals: Ol replaced by iddingsite, see also vesicle filling 9. Encrustations: 2-3cm Mn crust 10. Comment:	1							
SO265-DR25-1D	1. Rock Type: aphyric lava, very strongly altered 2. Size: 8x8x8cm nodule within Mn crust; 4x4cm core 3. Shape / Angularity: subangular 4. Color of cut surface: dark red brown 5. Texture / Vesicularity: 5% vesicles, < 1 mm, empty or rarely filled with white green material 6. Phenocrysts: 1-2% altered Ol, < 1 mm 7. Matrix: fine grained 8. Secondary Minerals: Ol replaced by iddingsite, see also vesicle filling 9. Encrustations: 2-3cm Mn crust 10. Comment:	1							

SO265-DR26

Description of Location and Structure: Papanin Ridge, Central Area, Smt 20nm NNE of DR25. ENE faulted? flank near base. Smt NNW and connects with DR25 Smt along NNW-SSE striking, elevated sea floor





Dredge on bottom UTC 07/09/18 20:54hrs, lat 42°22.89'N, long 165°23.73'E, depth 4708m

Dredge off bottom UTC 07/09/18 22:02hrs, lat 42°22.72'N, long 165°23.29'E, depth 4289m



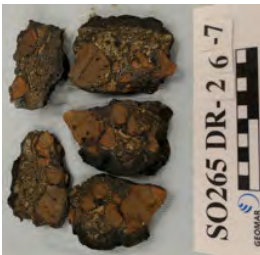

total volume: 1/4 full

Comments: few rocks, large Mn crust, Mn nodules. Numerous fragments of pillow lava and altered glass in Mn crust, a few dropstones. Aphyric fluidal pillow lava fragments, some are fairly fresh



Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR26-1	1. Rock Type: aphyric lava, slightly to moderately altered 2. Size: 5x4x4cm 3. Shape / Angularity: equant, subangular 4. Color of cut surface: grey to pale brown 5. Texture / Vesicularity: slightly vesicular, ~1%, filled with white minerals 6. Phenocrysts: very rare Pl, <1%, ~0.5mm, fresh 7. Matrix: microcrystalline, Pl and dark minerals 8. Secondary Minerals: white brown minerals, vesicle filling, brown halo present (chilled margin?) 9. Encrustations: 6mm thick Mn crust 10. Comment:	2	x				x	GC in air freight box	
SO265-DR26-2	1. Rock Type: aphyric lava, fresh to slightly altered 2. Size: 6x5.5x5.5cm 3. Shape / Angularity: angular 4. Color of cut surface: brown chilled margin, grey inner part 5. Texture / Vesicularity: chilled margin with pipe vesicles; overall sparsely vesicular <1% 6. Phenocrysts: accicular Pl, <1%, ~0.5mm, fresh 7. Matrix: glassy chilled margin, cryptocrystalline inner part 8. Secondary Minerals: brown minerals along chilled margin, vesicles filled with white and black minerals, black patches ~1mm distributed in some places 9. Encrustations: inner part of bloc A (43x24x18cm) 10. Comment: this piece is from bloc A	2	x					from bloc A	
SO265-DR26-3	1. Rock Type: aphyric lava, fresh to slightly altered 2. Size: 6x5.5x5cm 3. Shape / Angularity: angular 4. Color of cut surface: similar to -2 5. Texture / Vesicularity: similar to -2 6. Phenocrysts: similar to -2 7. Matrix: similar to -2 8. Secondary Minerals: similar to -2 9. Encrustations: similar to -2 10. Comment: inner part of bloc A, marble cake of brown color is present, glass? in margin	1	x				x	from bloc A glass in air freight box	
SO265-DR26-4	1. Rock Type: aphyric lava, slightly to moderately altered 2. Size: 7.5x5x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: similar to -2 5. Texture / Vesicularity: similar to -2 6. Phenocrysts: similar to -2 7. Matrix: similar to -2 8. Secondary Minerals: similar to -2 9. Encrustations: similar to -2 10. Comment: inner part of bloc A, marked marble cake structure, with dark and bright parts separated by brown film	1	x					from bloc A	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR26-5	1. Rock Type: aphyric lava, moderately altered 2. Size: 7x5x4cm 3. Shape / Angularity: angular 4. Color of cut surface: similar to -2 5. Texture / Vesicularity: similar to -2 6. Phenocrysts: similar to -2 7. Matrix: similar to -2 8. Secondary Minerals: similar to -2 9. Encrustations: similar to -2 10. Comment: inner part of bloc A, marble cake structure, possibly spherulitic texture	1	x					from bloc A	
SO265-DR26-6	1. Rock Type: aphyric lava, moderately to highly altered 2. Size: 6x7x8cm 3. Shape / Angularity: highly angular, irregular 4. Color of cut surface: brown, small grey cores 5. Texture / Vesicularity: brecciated, sparsely vesiculated, 1-5%, white-greenish fillings with black minerals, elongated pipe vesicles 6. Phenocrysts: replaced Ol, 1mm, <1% 7. Matrix: glassy to cryptocrystalline 8. Secondary Minerals: brown, greenish white and white minerals replaced everywhere 9. Encrustations: from inner part of bloc A 10. Comment: inner part of bloc A, matrix of the breccia is cemented by white (calsite?), black (Mn-oxide) and pale green (replaced glass?) minerals							from bloc A	
SO265-DR26-7	1. Rock Type: aphyric volcanic breccia, moderately to highly altered 2. Size: 7x7x9cm 3. Shape / Angularity: angular 4. Color of cut surface: similar to -6 5. Texture / Vesicularity: similar to -6 6. Phenocrysts: similar to -6 7. Matrix: similar to -6 8. Secondary Minerals: similar to -6 9. Encrustations: similar to -6 10. Comment: similar to -6							from bloc A	
SO265-DR26-8	1. Rock Type: moderately Pl-Px phyric lava, fresh 2. Size: 9x6x4cm 3. Shape / Angularity: subangular, elongated 4. Color of cut surface: grey 5. Texture / Vesicularity: sparsely vesiculated, 5%, some are filled by white to pale pink minerals 6. Phenocrysts: subanhedral Pl, ~1mm, <3%, fresh, some are altered; anhedral Px, ~1mm, 1%, fresh 7. Matrix: fine grained 8. Secondary Minerals: white and pale pink minerals fill vesicles 9. Encrustations: ~1mm thick Mn coating 10. Comment: this is probably a dropstone	1	x					dropstone	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR26-9	1. Rock Type: volcanic breccia, moderately to highly altered 2. Size: 6.5x6x4cm 3. Shape / Angularity: subangular, elongated 4. Color of cut surface: pale, green, pale pink 5. Texture / Vesicularity: volcanic breccia, filled by altered ash 6. Phenocrysts: none 7. Matrix: volcanic breccia filled by green tuff 8. Secondary Minerals: green and pale pink minerals replace original minerals or glass 9. Encrustations: Mn coating 10. Comment: three lithic fragments are identified 1) vesiculated round shaped, grey lithic; 2) non vesicular, pale pink, angular lithic; 3) non-vesicular, greenish, subrounded lithic, filled by green ash							dropstone	
SO265-DR26-10	1. Rock Type: Mn nodule 2. Size: 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								

SO265-DR27


Description of Location and Structure: Papanin Ridge, Central Area, Same Smt as of DR26, small cone on SW flank in top area, track along S to SW flank

Dredge on bottom UTC 08/09/18 02:24hrs, lat 42°19.13'N, long 165°18.29'E, depth 4405m

Dredge off bottom UTC 08/09/18 03:44hrs, lat 42°19.58'N, long 165°18.19'E, depth 4013m

total volume: single rock

Comments: plutonic dropstone

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR27-1	1. Rock Type: granite, frsh to slightly altered 2. Size: 10.5x7.5x5cm 3. Shape / Angularity: rounded 4. Color of cut surface: white & black 5. Texture / Vesicularity: holocrystalline 6. Phenocrysts: coarse grained, Qz, Fsp, Mica 7. Matrix: 8. Secondary Minerals: fresh 9. Encrustations: thin Mn coating 10. Comment: dropstone							dropstone	

SO265-DR28

Description of Location and Structure: Papanin Ridge, Central Area, Smt 10nm W of DR26+27. Circular Smt with prominent depression in top area, most likely a caldera, Track along SE flank of main edifice in the middle part of the slope.


Dredge on bottom UTC 08/09/18 08:58hrs, lat 42°18.99'N, long 165°00.82'E, depth 4900m

Dredge off bottom UTC 08/09/18 10:23hrs, lat 42°19.19'N, long 165°00.29'E, depth 4490m

total volume: few rocks

Comments: Mn nodules and dropstones

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR28-1	1. Rock Type: Mn-nodule 2. Size: 11x10x8cm 3. Shape / Angularity: rounded 4. Color of cut surface: black 5. Texture / Vesicularity: massive 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: very thin phosphorite layer 9. Encrustations: 10. Comment: tiny palagonite (?) clast in center								

SO265-DR29



Description of Location and Structure: Papanin Ridge, Central Area at transition to E Smt Province. E-W elongated, large Smt, 15x10nm with \pm flat topped area. S facing slope in W section of Smt. Track along uppermost slope beneath edge

Dredge on bottom UTC 08/09/18 23:05hrs, lat 42°31.60'N, long 166°45.63'E, depth 4309m






Dredge off bottom UTC 09/09/18 00:20hrs, lat 42°32.06'N, long 165°45.62'E, depth 3843m

total volume: few rocks


Comments: Mn nodules and dropstones

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR29-1	1. Rock Type: volcanic, fresh to weakly altered 2. Size: 5x4x4cm 3. Shape / Angularity: subrounded 4. Color of cut surface: light grey to grey 5. Texture / Vesicularity: porphyritic, non-vesicular 6. Phenocrysts: 5-7% Pl 1-3mm, larger Pl altered to clay (white-green), small Pl white clayey; 2-3% Px 0.5-1mm, black tabular. Large ones 5mm replaced by black oxide along rims (pseudomorph) 7. Matrix: Gm is microcrystalline 8. Secondary Minerals: oxide + clay replacing Px and Pl 9. Encrustations: 10. Comment: dropstone	1	x					dropstone	
SO265-DR29-2	1. Rock Type: clastic sediment, moderately altered 2. Size: 7x6x4cm 3. Shape / Angularity: subrounded 4. Color of cut surface: greenish - grey 5. Texture / Vesicularity: clastic, medium to coarse grained, poorly sorted 6. Phenocrysts: 7. Matrix: clast supported, very little matrix, coarse grained clasts 8. Secondary Minerals: 9. Encrustations: <1mm Mn coating 10. Comment: dropstone	1						dropstone	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR29-3	1. Rock Type: clastic suppoorted sediment, moderately altered 2. Size: 6x5x4.5cm 3. Shape / Angularity: subrounded 4. Color of cut surface: greenish - grey 5. Texture / Vesicularity: clastic, medium to coarse grained, poorly sorted 6. Phenocrysts: 7. Matrix: clast supported, very little matrix, coarse grained clasts 8. Secondary Minerals: 9. Encrustations: <1mm Mn coating 10. Comment: dropstone	1						dropstone	
SO265-DR29-4	1. Rock Type: metamorphic rock?, hornfels? 2. Size: 8x6.5x3cm 3. Shape / Angularity: subrounded 4. Color of cut surface: dark grey 5. Texture / Vesicularity: massive 6. Phenocrysts: 7. Matrix: cryptocrystalline 8. Secondary Minerals: 9. Encrustations: <<1mm Mn coating 10. Comment: dropstone							dropstone	
SO265-DR29-5	1. Rock Type: mud-siltstone 2. Size: 9x6x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: pale brown, white 5. Texture / Vesicularity: sparsely vesiculated 6. Phenocrysts: 7. Matrix: microcrystalline 8. Secondary Minerals: pale brown halo inner parts 9. Encrustations: 1mm Mn crust 10. Comment: possibly a highly, hydrothermally altered, aphyric, volcanic rock. To be verified by TS. dropstone	1						dropstone	
SO265-DR29-6	1. Rock Type: sediment, colloform layered structure 2. Size: 9x9x9cm 3. Shape / Angularity: subangular 4. Color of cut surface: black with light brown core 5. Texture / Vesicularity: colloform texture 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: Mn nodule 10. Comment:								
SO265-DR29-7	1. Rock Type: Mn nodule with core of pink altered material (phosphorite?) 2. Size: 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR29-8	1. Rock Type: Mn nodule with core of coral / sponge like structure 2. Size: 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								

SO265-DR30




Description of Location and Structure: Papanin Ridge, Central Area at transition to E Smt Province. Same E-W elongated, large Smt as DR29 but E section of S facing slope, 300m deeper than DR29 near base.

Dredge on bottom UTC 09/09/18 03:58hrs, lat 42°28.71'N, long 166°51.34'E, depth 5044m



Dredge off bottom UTC 09/09/18 05:14hrs, lat 42°29.17'N, long 166°51.22'E, depth 4669m

total volume: a few rocks

Comments: pillow lava fragments, Mn nodules <8cm ø

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR30-1	1. Rock Type: Pl phyric pillow lava fragment, slightly altered 2. Size: 11x9x9cm 3. Shape / Angularity: angular 4. Color of cut surface: brownish grey 5. Texture / Vesicularity: phyric, rare vesicles <1%, filled 6. Phenocrysts: 1-2% Pl 5mm 7. Matrix: fine grained, dense 8. Secondary Minerals: palagonite rim, few Mn patches, oxidation along cracks 9. Encrustations: chilled margin 5mm, palagonite 3mm, Mn coating 2mm 10. Comment: good for Gc and Ar/Ar, some picking required	2	x	x	Pl		x	GC in air freight box	
SO265-DR30-2	1. Rock Type: sparsely Pl phyric lava, slightly altered 2. Size: 6x6x5cm 3. Shape / Angularity: see -1 4. Color of cut surface: see -1 5. Texture / Vesicularity: see -1 6. Phenocrysts: see -1 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: see -1 10. Comment: good for Gc and Ar/Ar, some picking required	2	x	x	Pl				
SO265-DR30-3	1. Rock Type: sparsely Pl phyric pillow lava fragment, slightly altered 2. Size: 7x7x5cm 3. Shape / Angularity: see -1 4. Color of cut surface: see -1 5. Texture / Vesicularity: see -1 6. Phenocrysts: see -1 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: see -1 10. Comment: good for Gc and Ar/Ar, some picking required	2	x	x	Pl				

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR30-4	1. Rock Type: sparsely PI phyric pillow lava fragment, moderately altered 2. Size: 8x6x5cm 3. Shape / Angularity: see -1 4. Color of cut surface: see -1 5. Texture / Vesicularity: see -1 6. Phenocrysts: see -1 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: see -1 10. Comment: more altered, oxidized than -1 to -3	1			PI				
SO265-DR30-5	1. Rock Type: sparsely PI phyric lava, slightly to moderately altered 2. Size: 7x4x2cm 3. Shape / Angularity: see -1 4. Color of cut surface: see -1 5. Texture / Vesicularity: see -1 6. Phenocrysts: see -1 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: see -1 10. Comment: somewhat more altered and small				PI				

SO265-DR31

Description of Location and Structure: Papanin Ridge, Central Area at transition to E Smt Province. Same E-W elongated, large Smt as DR30, again W section of S facing slope, upper part accross small canyon

Dredge on bottom UTC 09/09/18 09:00hrs, lat 42°32.90'N, long 166°42.34'E, depth 4330m

Dredge off bottom UTC 09/09/18 10:28hrs, lat 42°33.34'N, long 166°42.11'E, depth 3890m

total volume: a few rocks

Comments: Mn crusts, dropstones (dunite, sandstone, tuffs, PI-CPx-OI basal). No samples taken

SO265-DR32

Description of Location and Structure: Papanin Ridge, Central Area at transition to E Smt Province. Same E-W elongated, large Smt as DR31 but 1.5nm SE. S facing slope, mid section to top

Dredge on bottom UTC 09/09/18 13:54hrs, lat 42°32.01'N, long 166°43.57'E, depth 4235m

Dredge off bottom UTC 09/09/18 15:13hrs, lat 42°32.45'N, long 166°43.62'E, depth 3857m

total volume: few rocks & mud

Comments: Mn crusts & one clearly identified dropstone. At closer inspection a disk like Mn crust contained an igneous core that was first thought to be a highly Fsp phyric rock (-1) but under the binocular turned out as plutonic rock and thus classifies for being a dropstone.

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR32-1	1. Rock Type: plutonic, moderately altered, dropstone 2. Size: 5x4.5x0.7cm 3. Shape / Angularity: flat / round ----> disk like 4. Color of cut surface: light grey to brownish 5. Texture / Vesicularity: dense, non-vesicular 6. Phenocrysts: 30% Fsp <1-2mm, altered; 5% Qz, 60% dark mineral, unable to identify, 2-5mm. At first glance looks like Gm but under binocular mineral shapes visible 7. Matrix: coarse grained, holocrystalline 8. Secondary Minerals: Fsp altered to clay 9. Encrustations: <<0.5 mm Mn coating all over piece 10. Comment: dropstone, first it was thought to be a volcanic due to grey Gm, which however are dark minerals							dropstone	no pic

SO265-DR33

Description of Location and Structure: Papanin Ridge, Central Area ca 25nm WNW of DR32. Small ridge connecting two large circular Smts, steepest slope in the entire mapped area. S-facing slope from bottom to top. All three Smts on a single WNW striking line.

Dredge on bottom UTC 09/09/18 23:30hrs, lat 42°44.50'N, long 166°10.07'E, depth 4915m

Dredge off bottom UTC 10/09/18 00:54hrs, lat 42°44.95'N, long 166°10.07'E, depth 4450m

total volume: empty despite single 7.4t bite. The strongest bite thus far on SO265

SO265-DR34


Description of Location and Structure: Papanin Ridge, Central Area at transition to E Smt Province. Smt ø 6nm at base. S slope along mid section. Due to wind directions restriction from 340° to 360°. Therefore steeper W slope not possible.

Dredge on bottom UTC 10/09/18 11:58hrs, lat 42°30.16'N, long 165°58.90'E, depth 4756m


Dredge off bottom UTC 10/09/18 13:33hrs, lat 43°60.97'N, long 165°58.71'E, depth 4484m

total volume: few rocks

Comments: dropstones, Mn nodules and crust. Single volcanic rock but dropstone

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR34-1	1. Rock Type: sparsely phyric volcanic rock, dropstone 2. Size: 5x4x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to dark grey 5. Texture / Vesicularity: massive 6. Phenocrysts: subhedral Px, 3%, 1-3mm, replaces by white & black minerals 7. Matrix: cryptocrystalline 8. Secondary Minerals: pale brown minerals along rim 9. Encrustations: thin Mn coating 10. Comment: dropstone	1						dropstone	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR34-2	1. Rock Type: phyric volcanic rock, relatively fresh, dropstone 2. Size: 15x15x9cm 3. Shape / Angularity: subangular 4. Color of cut surface: dark grey, several white veins 5. Texture / Vesicularity: non-vesicular 6. Phenocrysts: Px 15%, 3-8mm, rel. fresh, Pl 1%, 1-2mm, some are altered 7. Matrix: cryptocrystalline 8. Secondary Minerals: white minerals (not Cc) filling veins 9. Encrustations: 2mm Mn coating 10. Comment: dropstone	1						dropstone	

SO265-DR35



Description of Location and Structure: Papanin Ridge, NW section of N part. Elongated Smt, S slope

Dredge on bottom UTC 10/09/18 19:22hrs, lat 43°38.76'N, long 165°41.52'E, depth 4467m


Dredge off bottom UTC 10/09/18 20:41hrs, lat 43°39.20'N, long 165°41.42'E, depth 4987m

total volume: a few rocks

Comments: small rock fragments of lavas, Mn crusts

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR35-1	1. Rock Type: aphyric volcanic rock, moderately to strongly altered 2. Size: 6x5x4cm 3. Shape / Angularity: angular 4. Color of cut surface: alternating rings red core, yellow, greenish, brown 5. Texture / Vesicularity: massive 6. Phenocrysts: maybe small Pl subphenocrysts, not clear 7. Matrix: microcrystalline 8. Secondary Minerals: strong oxidation, palagonitization 9. Encrustations: outer Mn crust 10. Comment: the sample is strongly oxidized like all three samples from DR35 but maybe not too bad for Gc. Red parts should be most suitable	1	x						
SO265-DR35-2	1. Rock Type: aphyric - sparsely Pl-Ol phyric volcanic rock, moderately to strongly altered 2. Size: 7x5.5x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: alternating purple to orange, yellow rings 5. Texture / Vesicularity: dense, perhaps slightly vesicular 6. Phenocrysts: Pl-Ol subphenocrysts <2%, <0.5mm 7. Matrix: microcrystalline 8. Secondary Minerals: strong oxidation, palagonitization 9. Encrustations: 0.5mm Mn crust 10. Comment: Gc maybe not too bad for red / purple parts	1	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR35-3	1. Rock Type: aphyric volcanic rock, strongly oxidized, altered 2. Size: 5x6x5cm 3. Shape / Angularity: angular 4. Color of cut surface: core is purple red, rim orange 5. Texture / Vesicularity: mostly massive, vesicles <0.5mm, ~5% 6. Phenocrysts: 7. Matrix: microcrystalline 8. Secondary Minerals: oxidation, palagonitization 9. Encrustations: 2-3mm Mn crust 10. Comment:	1	x						

SO265-DR36


Description of Location and Structure: Papanin Ridge, northern most edge. The northernmost Smt in a chain of \pm N-S striking Smts; lower part of S slope

Dredge on bottom UTC 11/09/18 02:45hrs, lat 43°53.27'N, long 165°27.66'E, depth 5543m

Dredge off bottom UTC 11/09/18 03:47hrs, lat 43°53.59'N, long 165°27.69'E, depth 5180m

total volume: single dropstone

Comments: dropstone of angular, mafic plutonic rock

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR36-1	1. Rock Type: plutonic rock, fresh 2. Size: 14x6x6cm 3. Shape / Angularity: angular 4. Color of cut surface: black grey to dark green 5. Texture / Vesicularity: massive, holocrystalline 6. Phenocrysts: Qz or Fsp 40-50%, ~60% dark minerals, ~5% green minerals Px or Amph?, ore 7. Matrix: medium grained 8. Secondary Minerals: 9. Encrustations: 10. Comment:							dropstone	

SO265-DR37

Description of Location and Structure: Papanin Ridge, northern most edge. The northernmost Smt in a chain of \pm N-S striking Smts; lower part of S slope. Repeat of DR36, 0.5nm further E

Dredge on bottom UTC 11/09/18 07:43hrs, lat 43°53.16'N, long 165°28.01'E, depth 5559m

Dredge off bottom UTC 11/09/18 08:49hrs, lat 43°53.53'N, long 165°28.10'E, depth 5195m

total volume: empty

SO265-DR38

Description of Location and Structure: Hokkaido Trough; SE facing slope of ENE-WSW trending ridge






Dredge on bottom UTC 14/09/18 00:30hrs, lat 45°06.27'N, long 162°27.16'E, depth 5930m

Dredge off bottom UTC 14/09/18 01:46hrs, lat 45°06.59'N, long 162°26.81'E, depth 5580m


total volume: few volcanic rocks

Comments: aphyric lavas with fine to medium crystallized Gm

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR38-1	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 9x5x4cm clast extracted from 20x10x10cm Mn crust 3. Shape / Angularity: angular 4. Color of cut surface: dark grey to brownish grey 5. Texture / Vesicularity: aphyric massive 6. Phenocrysts: 7. Matrix: fine grained (<1mm), Pl is fresh 8. Secondary Minerals: oxidation, palagonite 9. Encrustations: Mn coating and penetration inside sample 10. Comment: good for Gc and possibly Ar-Ar dating. The samples has the largest sized Pl in Gm of all samples in DR38	2	x	±	Pl			x	GC in air freight box 
SO265-DR38-2	1. Rock Type: aphyric volcanic rock, moderately altered pillow lava fragment 2. Size: 8x7x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: orange along chilled margin (former glass) to grey and light dark in core 5. Texture / Vesicularity: aphyric to sparsely, massive 6. Phenocrysts: Pl subphenocrysts ≤1mm, ~2% 7. Matrix: fine grained 8. Secondary Minerals: palagonite, oxidation etc low T alteration 9. Encrustations: ~1mm Mn crust and along cracks 10. Comment: maybe good for Gc, possibility of Ar-Ar dating questionable	2	x	-					
SO265-DR38-3	1. Rock Type: aphyric / sparsely aphyric pillow lava fragment 2. Size: 9x5x4cm 3. Shape / Angularity: see -2 4. Color of cut surface: see -2 5. Texture / Vesicularity: see -2 6. Phenocrysts: see -2 7. Matrix: see -2 8. Secondary Minerals: see -2 9. Encrustations: see -2 10. Comment: see -2	2	x						
SO265-DR38-4	1. Rock Type: aphyric pillow lava fragment, moderately altered 2. Size: 9x5x5cm 3. Shape / Angularity: see -2 4. Color of cut surface: see -2 5. Texture / Vesicularity: see -2 6. Phenocrysts: see -2 7. Matrix: see -2 8. Secondary Minerals: see -2 9. Encrustations: see -2 10. Comment: see -2	2	x						
SO265-DR38-5	1. Rock Type: aphyric pillow lava fragment, moderately altered 2. Size: 9x4x4cm 3. Shape / Angularity: see -2 4. Color of cut surface: see -2 5. Texture / Vesicularity: see -2 6. Phenocrysts: see -2 7. Matrix: see -2 8. Secondary Minerals: see -2 9. Encrustations: see -2 10. Comment: see -2	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR38-6	1. Rock Type: aphyric pillow lava fragments, moderately altered, for archive & backup 2. Size: A) 8x5x5cm, B) 8x4x6cm, C) 7x5x4cm, D) 7x5x4cm, E) 7x6x3cm, F) 6x4x4cm, G) 5x5x5cm, H) 6x4x3cm, I) 6x4x3cm 3. Shape / Angularity: see -2 4. Color of cut surface: see -2 5. Texture / Vesicularity: see -2 6. Phenocrysts: see -2 7. Matrix: see -2 8. Secondary Minerals: see -2 9. Encrustations: see -2 10. Comment: see -2. All samples are in separate bags stored in one bag -6								

SO265-DR39



Description of Location and Structure: Papanin Ridge / Smt Province, Eastern Section at northern margin. Circular Smt with caldera like depression at summit. Probably a pillow mound. Lower part of NE flank

Dredge on bottom UTC 14/09/18 23:09hrs, lat 44°02.46'N, long 167°11.01'E, depth 5300m






Dredge off bottom UTC 15/09/18 00:43hrs, lat 44°02.02'N, long 167°10.70'E, depth 4900m

total volume: 1/8 full






Comments: pillow lava fragments, Mn crusts with lava fragments, a few dropstones. Pl phyric and aphyric lavas, moderately altered with fresh Pl

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR39-1	1. Rock Type: Pl phyric volcanic rock (lithology 1), slightly altered 2. Size: 10x10x8cm clast from bloc A (45x25x20cm) 3. Shape / Angularity: angular 4. Color of cut surface: grey with brownish rind 5. Texture / Vesicularity: phyric, massive, non-vesicular 6. Phenocrysts: Fsp 5-10%, ≤5mm fresh, interior altered 7. Matrix: fine grained (<1mm), Pl is fresh 8. Secondary Minerals: Mn patches, encrustations on fractures, altered Ol (red) 9. Encrustations: Mn coating 10. Comment: lithology 1, best sample	2	x					clast from bloc A x GC in air freight box	
SO265-DR39-2	1. Rock Type: Pl phyric volcanic rock (lithology 1), moderately altered throughout 2. Size: 14x8x7cm 3. Shape / Angularity: angular 4. Color of cut surface: brownish grey 5. Texture / Vesicularity: phyric, massive, non-vesicular 6. Phenocrysts: Fsp 5%, ≤3mm fresh, sparse Ol, altered 7. Matrix: fine grained 8. Secondary Minerals: altered Ol 9. Encrustations: 2mm Mn coating 10. Comment: lithology 1	2	x						






Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR39-3	1. Rock Type: Pl phyric volcanic rock (lithology 1), moderately altered 2. Size: 9x6x6cm 3. Shape / Angularity: angular 4. Color of cut surface: brown to reddish brown 5. Texture / Vesicularity: phyric, massive, non-vesicular 6. Phenocrysts: Fsp 1-3%, up to 4mm fresh but commonly ~1mm 7. Matrix: fine grained 8. Secondary Minerals: altered Ol, some glomeritic clusters of Pl 9. Encrustations: 2mm Mn coating, slight fracture encrustations 10. Comment: lithology 1	2	x						
SO265-DR39-4	1. Rock Type: Pl phyric volcanic rock (lithology 1), moderately altered 2. Size: 10x8x6cm 3. Shape / Angularity: angular 4. Color of cut surface: brown to slightly grey 5. Texture / Vesicularity: phyric, massive, non-vesicular 6. Phenocrysts: Fsp 1-3%, up to 4mm but mostly 1-2mm 7. Matrix: fine grained 8. Secondary Minerals: altered Ol 1-3%, Mn patches 9. Encrustations: up to 3mm Mn crust 10. Comment: lithology 1	2	x						
SO265-DR39-5	1. Rock Type: Pl phyric volcanic rock (lithology 1), moderately altered 2. Size: 8x8x6cm 3. Shape / Angularity: angular 4. Color of cut surface: brownish grey 5. Texture / Vesicularity: phyric, massive, non-vesicular 6. Phenocrysts: Fsp ~5%, 1-2mm 7. Matrix: fine grained 8. Secondary Minerals: Mn patches 9. Encrustations: ≤1mm Mn crust 10. Comment: lithology 1	2	x						
SO265-DR39-6	1. Rock Type: Pl phyric volcanic rock (lithology 1), moderately altered 2. Size: 10x6x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown, greyish 5. Texture / Vesicularity: phyric, massive, non-vesicular 6. Phenocrysts: Fsp 1-3%, ≤1mm 7. Matrix: fine grained 8. Secondary Minerals: altered Ol ≤2%, ≤1mm 9. Encrustations: ≤1mm Mn crust 10. Comment: lithology 1	2	x						
SO265-DR39-7	1. Rock Type: aphyric volcanic rock (lithology 2), moderately altered 2. Size: 11x9x9cm clast from bloc C (25x20x15cm) 3. Shape / Angularity: subangular 4. Color of cut surface: brown to grey 5. Texture / Vesicularity: aphyric, massive, non-vesicular 6. Phenocrysts: none 7. Matrix: fine grained 8. Secondary Minerals: altered Ol ≤1%, ≤1mm 9. Encrustations: ≤1mm Mn crust 10. Comment: lithology 2	2	x						


Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR39-8	1. Rock Type: aphyric volcanic rock (lithology 2), moderately altered 2. Size: 10x10x7cm clast from bloc A (45x25x20cm) 3. Shape / Angularity: angular 4. Color of cut surface: similar to -7 5. Texture / Vesicularity: similar to -7 6. Phenocrysts: v 7. Matrix: similar to -7 8. Secondary Minerals: similar to -7 9. Encrustations: similar to -7 10. Comment: lithology 2	2	x						
SO265-DR39-9	1. Rock Type: aphyric volcanic rock (lithology 2), moderately altered 2. Size: 15x7x6cm 3. Shape / Angularity: angular 4. Color of cut surface: brown 5. Texture / Vesicularity: aphyric, massive, non-vesicular 6. Phenocrysts: none 7. Matrix: fine grained 8. Secondary Minerals: Mn patches 9. Encrustations: ≤1mm Mn crust 10. Comment: lithology 2	2	x						
SO265-DR39-10	1. Rock Type: aphyric volcanic rock (lithology 2), moderately altered 2. Size: 11x6x6cm 3. Shape / Angularity: angular 4. Color of cut surface: red-brown rim; blue grey greenish core 5. Texture / Vesicularity: aphyric, massive, non-vesicular 6. Phenocrysts: none 7. Matrix: fine grained 8. Secondary Minerals: Mn patches 9. Encrustations: ≤1mm Mn crust 10. Comment: lithology 2	2	x						
SO265-DR39-11	1. Rock Type: aphyric volcanic rock (lithology 2), moderately altered 2. Size: 13x8x5cm 3. Shape / Angularity: angular 4. Color of cut surface: dark to light brown 5. Texture / Vesicularity: aphyric, massive, non-vesicular 6. Phenocrysts: none 7. Matrix: fine grained 8. Secondary Minerals: few (<1%) altered Ol 9. Encrustations: ≤1mm Mn crust 10. Comment: lithology 2	2	x						
SO265-DR39-12	1. Rock Type: aphyric volcanic rock (lithology 2), moderately altered 2. Size: 9x8x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to reddish brown 5. Texture / Vesicularity: aphyric, massive, non-vesicular 6. Phenocrysts: Fsp <1% <1mm 7. Matrix: fine grained 8. Secondary Minerals: few (<1%) altered Ol, Mn patches 9. Encrustations: ≤1mm Mn crust 10. Comment: lithology 2	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR39-13	1. Rock Type: aphyric volcanic rock (lithology 3), moderately altered 2. Size: 15x9x5cm clast from bloc A (45x25x20cm) 3. Shape / Angularity: subangular 4. Color of cut surface: grey to dark brown 5. Texture / Vesicularity: aphyric, <1% vesicles filled with white material <1mm 6. Phenocrysts: Fsp <1-2% <1mm 7. Matrix: medium grained, Gm contains Ol >Fsp 8. Secondary Minerals: altered Ol <1mm, along cracks Fe-oxides, Mn patches 9. Encrustations: ≤1mm Mn crust, vesicles filled with white material 10. Comment: lithology 3	2	x						
SO265-DR39-14	1. Rock Type: aphyric volcanic rock (lithology 3), moderately to strongly altered 2. Size: 11x10x5cm clast from bloc B (30x20x15cm) 3. Shape / Angularity: subangular 4. Color of cut surface: brown 5. Texture / Vesicularity: aphyric, <1% vesicles filled with white material <1mm 6. Phenocrysts: Fsp <1% <1mm 7. Matrix: coarse grained, Gm contains altered Ol, Fsp 8. Secondary Minerals: vesicles filled with white material 9. Encrustations: ≤1mm Mn crust 10. Comment: lithology 3	2	x						
SO265-DR39-15	1. Rock Type: aphyric volcanic rock (lithology 3), moderately altered 2. Size: 16x8x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to brown 5. Texture / Vesicularity: aphyric, 2-3% vesicles filled with brown-orange material 6. Phenocrysts: Fsp <1% <1mm 7. Matrix: coarse grained, Gm contains altered Ol, Fsp 8. Secondary Minerals: 1-2% altered Ol <1mm, Mn patches 9. Encrustations: ≤2mm Mn crust 10. Comment: lithology 3	2	x						
SO265-DR39-16	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 9x8x5cm clast from bloc B (30x20x15cm) 3. Shape / Angularity: subangular 4. Color of cut surface: dark brown rim, core grey to brown 5. Texture / Vesicularity: aphyric, non-vesicular 6. Phenocrysts: Fsp <1% <1mm 7. Matrix: coarse grained, Gm contains altered Ol, Fsp 8. Secondary Minerals: <1% altered Ol <1mm, Mn patches 9. Encrustations: ≤2mm Mn crust 10. Comment: lithology 3	2	x						
SO265-DR39-17	1. Rock Type: aphyric volcanic rock (lithology 3), moderately to strongly altered 2. Size: 9x8x5cm clast from bloc B (30x20x15cm) 3. Shape / Angularity: rounded 4. Color of cut surface: brown 5. Texture / Vesicularity: aphyric, <1% vesicles filled with white material ø <1mm 6. Phenocrysts: Fsp 1-2% <1mm 7. Matrix: medium grained 8. Secondary Minerals: <1% altered Ol <1mm, Mn patches 9. Encrustations: ≤2mm Mn crust 10. Comment:	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR39-18	1. Rock Type: sediment / tuff 2. Size: 9x7x6cm clast from bloc A (45x25x20cm) 3. Shape / Angularity: subangular 4. Color of cut surface: greenish-grey 5. Texture / Vesicularity: 6. Phenocrysts: Qz? 7. Matrix: fine grained 8. Secondary Minerals: Mn patches 9. Encrustations: ≤5mm Mn crust 10. Comment:	1							

SO265-DR40

Description of Location and Structure: Papanin Ridge, easternmost area. Ø 2.5km cone with rel. steep S-flank. The large Smt at 168°30'E; 43°50'N according to predicted map did not exist, therefore DR40 represents the only dredgable structure nearby

Dredge on bottom UTC 15/09/18 12:42hrs, lat 43°58.75'N, long 168°20.17'E, depth 5512m

Dredge off bottom UTC 15/09/18 13:31hrs, lat 43°59.00'N, long 168°20.16'E, depth 5250m

total volume: empty

SO265-DR41

Description of Location and Structure: Papanin Ridge, NE area. Southern of two closely spaces Smts at the end of a NNW-SSE trending ridge, N slope of a small cone

Dredge on bottom UTC 16/09/18 01:30hrs, lat 43°02.74'N, long 167°25.42'E, depth 4756m

Dredge off bottom UTC 16/09/18 02:22hrs, lat 43°02.52'N, long 167°25.60'E, depth 4560m

total volume: empty

SO265-DR42


Description of Location and Structure: Papanin Ridge, northeasternmost area. Smt at southern termination of NNW-SSE striking chain of Smts and ridges. SW facing flank from near base to mid-section

Dredge on bottom UTC 16/09/18 07:02hrs, lat 42°37.42'N, long 167°36.93'E, depth 5044m


Dredge off bottom UTC 16/09/18 09:30hrs, lat 42°37.68'N, long 167°37.20'E, depth 4729m

total volume: very few rocks + biology.

Comments: small Mn-nodules + one dropstone. Core of one Mn-nodule contains an angular fragment of fairly fresh to moderately altered lava

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR42-1	1. Rock Type: aphyric lava clast, fresh to moderately altered 2. Size: 2x2x1cm clast in 6x5x4cm Mn nodule 3. Shape / Angularity: angular 4. Color of cut surface: grey 5. Texture / Vesicularity: aphyric, non-vesicular 6. Phenocrysts: Gm minerals Pl ~10%, ≤1mm fresh, Ol 5-10% <1mm, altered 7. Matrix: fine grained 8. Secondary Minerals: xenomineralic Qz? associated with reddish and / or black minerals; <1%, up to 2mm 9. Encrustations: up to 3mm Mn crust 10. Comment: due to Mn crust and angularity this lava piece is considered in-situ. Gc slab to be carefully picked to avoid Mn penetration	tiny fragment to be used for TS; packed with sample	x					clast from Mn nodule	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR42-2	1. Rock Type: plutonic or subvolcanic rock, porphyric, fresh 2. Size: 8x7x3cm 3. Shape / Angularity: angular 4. Color of cut surface: dark grey 5. Texture / Vesicularity: holocrystalline, dense, massive 6. Phenocrysts: Fsp >20%, ≤2mm fresh; Qz >20%, <2mm; Px-Amph <5%; Mica <1%, <1mm, 50% grey Gm or dark minerals 7. Matrix: coarse grained 8. Secondary Minerals: 9. Encrustations: <1mm Mn crust 10. Comment: very likely a dropstone	2	x					dropstone	

SO265-DR43



Description of Location and Structure: Papanin Ridge, northeasternmost area. Repeat of DR42 at same , 1nm further NW along W facing slope from near base to almost top

Dredge on bottom UTC 16/09/18 13:37hrs, lat 42°38.68'N, long 167°36.46'E, depth 5010m



Dredge off bottom UTC 16/09/18 14:37hrs, lat 42°38.67'N, long 167°37.04'E, depth 4587m

total volume: almost nothing, 15 brittle chunks

Comments: small Mn-nodules embedded in sediment, dropstones (sediments?), sedimentary rocks. One bigger animal

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR43-1	1. Rock Type: fine sand, siltstone 2. Size: 7x5x3cm 3. Shape / Angularity: angular 4. Color of cut surface: grey 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: 9. Encrustations: 2mm Mn crust 10. Comment: dropstone							dropstone?	
SO265-DR43-2	1. Rock Type: fine sand, siltstone 2. Size: 4x4x2cm 3. Shape / Angularity: subrounded 4. Color of cut surface: grey 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: 9. Encrustations: thin film of Mn 10. Comment:							dropstone?	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR43-3	1. Rock Type: chert 2. Size: 4x3x3cm 3. Shape / Angularity: subrounded 4. Color of cut surface: grey - blueish 5. Texture / Vesicularity: highly cracked and non-clastic 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: 9. Encrustations: 0.5mm Mn coating 10. Comment:							dropstone?	
SO265-DR43-4	1. Rock Type: sediment 2. Size: 5x3x3cm 3. Shape / Angularity: subrounded and elongated 4. Color of cut surface: white and brown (banded) 5. Texture / Vesicularity: laminated, clastic 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: 9. Encrustations: 2mm Mn crust 10. Comment:							dropstone?	

SO265-DR44


Description of Location and Structure: Papanin Ridge, northeasternmost part. Elongated, flat-topped Smt with depression on top in NE part, dredge track along S-SSE slope

Dredge on bottom UTC 16/09/18 20:24hrs, lat 42°30.08'N, long 168°00.10'E, depth 5146m

Dredge off bottom UTC 16/09/18 21:37hrs, lat 42°30.50'N, long 167°59.87'E, depth 4736m

total volume: one dropstone

Comments: andesite dropstone

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR44-1	1. Rock Type: dropstone, andesite 2. Size: 6x4x3cm 3. Shape / Angularity: angular 4. Color of cut surface: grey 5. Texture / Vesicularity: porphyritic 6. Phenocrysts: Px, Pl which is possibly metamorphosed 7. Matrix: cryptocrystalline, fresh, appears to be glassy 8. Secondary Minerals: 9. Encrustations: none 10. Comment: dropstone!							dropstone	

Appendix 2 (Station Details and Rock Description)

SO265-DR45





Description of Location and Structure: Papanin Ridge, easternmost area. Repeat of DR44 at elongatded (oval), flat-topped Smt, NE slope, ~2nm N of DR44

Dredge on bottom UTC 17/09/18 01:37hrs, lat 42°32.68'N, long 168°03.41'E, depth 5066m






Dredge off bottom UTC 17/09/18 03:02hrs, lat 42°32.96'N, long 168°02.94'E, depth 4569m

total volume: 1/4 full, 1x large Mn crust and loose rock fragments





Comments: Ol-Pl and Pl phyric lava fragments, either as loose fragments (-1 to -6) or cemented fragments (-7 to -16X) in bloc A (50x40x30cm). Both sets range from fairly fresh to strongly altered with most being moderately altered. The cemented fragments show features of multiple alteration phases that include green-yellow zones of smectite? replacing Gm.

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR45-1	1. Rock Type: aphyric volcanic rock, relativley fresh 2. Size: 13x7x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: Fsp ~1%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: green round minerals; some dark black minerals (Mn?) 9. Encrustations: Mn crust <1mm 10. Comment: loose lava fragment in dredge	2	x				x	GC in air freight box	
SO265-DR45-2	1. Rock Type: aphyric volcanic rock, medium altered 2. Size: 12x9x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey core, brown rim (5-10mm) 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: Fsp 1-3%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: some Mn patches 9. Encrustations: Mn crust up to 1.5cm 10. Comment: loose lava fragment in dredge	2	x						
SO265-DR45-3	1. Rock Type: sparsely phyric volcanic rock, medium altered 2. Size: 8x7x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey core, brown rim (up to 10mm) 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: altered Ol 1-3%, <1mm; Fsp 1-3%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: Mn patches, some green round minerals 9. Encrustations: Mn crust <1mm 10. Comment: loose lava fragment in dredge	2	x						
SO265-DR45-4	1. Rock Type: moderately phyric volcanic rock, medium altered 2. Size: 5x5x3cm 3. Shape / Angularity: angular 4. Color of cut surface: small grey core, brown rim (1-2cm) 5. Texture / Vesicularity: massive, slightly vesiculated 6. Phenocrysts: altered Ol 1-3%, <1mm; Fsp 1-3%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: Mn patches, some green round minerals 9. Encrustations: Mn crust <1mm 10. Comment: loose lava fragment in dredge	2	x						




Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR45-5	1. Rock Type: moderately phyrific volcanic rock, slightly altered 2. Size: 6x4x4cm 3. Shape / Angularity: angular 4. Color of cut surface: greenish core to brown rim 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: altered Ol 1-3%, <1mm; Fsp <3%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: Mn patches 9. Encrustations: Mn crust <1mm 10. Comment: loose lava fragment in dredge	2	x						
SO265-DR45-6	1. Rock Type: phyrific volcanic rock, medium altered 2. Size: 7x9x6cm 3. Shape / Angularity: angular 4. Color of cut surface: grey core to brown rim (~2cm) 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: altered Ol 1-3%, <1mm; Fsp <3%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: yellow-green patches (smectite?), Mn patches 9. Encrustations: Mn crust <1mm 10. Comment: loose lava fragment in dredge	2	x						
SO265-DR45-7A	1. Rock Type: phyrific volcanic rock, slightly altered 2. Size: 10x9x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey core to slightly brown rim 5. Texture / Vesicularity: similar to -6 6. Phenocrysts: similar to -6 7. Matrix: similar to -6 8. Secondary Minerals: similar to -6 9. Encrustations: similar to -6 10. Comment: lava fragment from bloc A	2	x						
SO265-DR45-8A	1. Rock Type: moderately phyrific volcanic rock, slightly altered 2. Size: 10x8x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey core to brown rim (1-2cm) 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: altered Ol ~3%, <1mm; Fsp <5%, 1mm 7. Matrix: fine grained 8. Secondary Minerals: some yellow green patches (smectite?), Mn patches 9. Encrustations: Mn crust <1mm 10. Comment: lava fragment from bloc A	2	x						
SO265-DR45-9A	1. Rock Type: moderately phyrific volcanic rock, slightly altered 2. Size: 10x7x10cm 3. Shape / Angularity: angular 4. Color of cut surface: grey core to slightly brownish rim 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: altered Ol 1-2%, <1mm; Fsp ~3%, 1mm 7. Matrix: fine grained 8. Secondary Minerals: some yellow green patches (smectite?) 9. Encrustations: Mn crust <1mm 10. Comment: lava fragment from bloc A	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR45-10A	1. Rock Type: phyrific volcanic rock, medium altered 2. Size: 9x7x8cm 3. Shape / Angularity: angular 4. Color of cut surface: grey core to slightly brownish rim (up to 1cm) 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: altered Ol ~1%, <1mm; Fsp ~5%, 1mm 7. Matrix: fine grained 8. Secondary Minerals: yellow-green patches (smectite?), Mn patches 9. Encrustations: Mn crust <1mm 10. Comment: lava fragment from bloc A	2	x						
SO265-DR45-11A	1. Rock Type: moderately phyrific volcanic rock, medium altered 2. Size: 8x7x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey core to brownish rim 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: altered Ol <1%, <1mm; Fsp 1-3%, 1mm 7. Matrix: fine grained 8. Secondary Minerals: some yellow-green patches (smectite?), Mn patches 9. Encrustations: Mn crust <1mm 10. Comment: lava fragment from bloc A	2	x						
SO265-DR45-12A	1. Rock Type: moderately phyrific volcanic rock, medium to strongly altered 2. Size: 12x9x9cm 3. Shape / Angularity: subangular 4. Color of cut surface: reddish to brown 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: see -7 to -11 7. Matrix: fine grained 8. Secondary Minerals: some yellow-green patches (smectite?), Mn patches 9. Encrustations: Mn crust <1mm 10. Comment: sample taken to investigate multiple phases of alteration	2						TS for MP to study alteration phases	
SO265-DR45-13A	1. Rock Type: moderately phyrific volcanic rock, medium to strongly altered 2. Size: 10x9x9cm 3. Shape / Angularity: subangular 4. Color of cut surface: reddish to brown 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: see -7 to -11 7. Matrix: fine grained 8. Secondary Minerals: some yellow-green patches (smectite?), Mn patches 9. Encrustations: Mn crust <1mm 10. Comment: sample taken to investigate multiple phases of alteration	2						TS for MP to study alteration phases	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR45-14A	1. Rock Type: moderately phyrific volcanic rock, medium to strongly altered 2. Size: 10x7x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: reddish to brown 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: see -7 to -11 7. Matrix: fine grained 8. Secondary Minerals: some yellow-green patches (smectite?), Mn patches 9. Encrustations: Mn crust <1mm 10. Comment: sample taken to investigate multiple phases of alteration. core piece has parallel stripes of different alteration zones	1						TS for MP to study alteration phases	
SO265-DR45-15X	1. Rock Type: 4x lava fragments 2. Size: 8x8x4cm, 9x8x5cm, 10x7x8cm, 10x6x5cm 3. Shape / Angularity: angular 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: backup samples, representative for lava fragments from bloc A								
SO265-DR45-16X	1. Rock Type: 2x lava fragments 2. Size: 6x4x3cm, 5x5x3.5cm 3. Shape / Angularity: subangular 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: backup samples, representative for loose lava fragments in DR45								

SO265-DR46

Description of Location and Structure: Northern Ojin Smts, a small Smt in a chain of NNE-SSE trending Smts. 2nd Smt from N. W slope, middle part

Dredge on bottom UTC 18/09/18 00:45hrs, lat 39°07.69'N, long 167°21.36'E, depth 4779m

Dredge off bottom UTC 18/09/18 02:05hrs, lat 39°07.61'N, long 167°21.86'E, depth 4379m

total volume: empty

SO265-DR47

Description of Location and Structure: Northern Ojin Smts, ~18nm SSE of DR46. NW flank of ±N-S striking ridge. From slightly above base to break in slope in top region





Dredge on bottom UTC 18/09/18 08:22hrs, lat 38°58.02'N, long 167°44.96'E, depth 5089m

Dredge off bottom UTC 18/09/18 09:36hrs, lat 38°57.67'N, long 167°45.20'E, depth 4642m


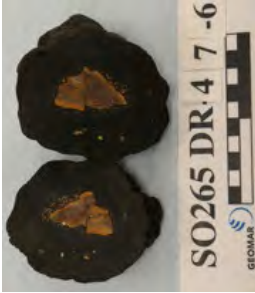
total volume: 1/6 full, with Mn nodules

Comments: Rarely cores of Mn nodules are igneous. They are mostly slightly phyrific to aphyric, angular lava fragments. Moderately to strongly altered

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR47-1	1. Rock Type: phyric volcanic rock, moderately altered 2. Size: 5x2cm clast in ø9cm nodule 3. Shape / Angularity: subangular 4. Color of cut surface: grey core, brownish rim 5. Texture / Vesicularity: massive, 1% vesicles unfilled with white material 6. Phenocrysts: altered OI 3%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: iddingsite, vesicle filling, Mn patches 9. Encrustations: 10. Comment: Gc requires carfull picking (separation) of freshest material possible	2	x					GC not trimmed due to size	
SO265-DR47-2	1. Rock Type: aphyric volcanic rock, moderately to strongly altered 2. Size: 4x3cm clast in ø7cm nodule 3. Shape / Angularity: angular 4. Color of cut surface: light brown rim, red brown core 5. Texture / Vesicularity: massive, 1% vesicles some filled with white and brown material 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: vesicle filling, Mn patches 9. Encrustations: 10. Comment: Gc requires carfull picking (separation) of freshest material possible	2	x					GC not trimmed due to size	
SO265-DR47-3	1. Rock Type: aphyric volcanic rock, moderately to strongly altered 2. Size: 2.5x1.5cm clast in ø6cm nodule 3. Shape / Angularity: angular 4. Color of cut surface: reddish brown 5. Texture / Vesicularity: 5-7% vesicles <1mm mostly filled with greenish or white material 6. Phenocrysts: <3% altered OI <1mm 7. Matrix: fine grained 8. Secondary Minerals: vesicle filling, Mn patches, iddingsite 9. Encrustations: 10. Comment:	1							
SO265-DR47-4	1. Rock Type: phyric volcanic rock, strongly altered 2. Size: 2.5x2.5cm clast in ø6.5cm nodule 3. Shape / Angularity: angular 4. Color of cut surface: red brown 5. Texture / Vesicularity: 2-3% vesicles <1mm some filled white material 6. Phenocrysts: 3-5% altered OI <1mm 7. Matrix: fine grained 8. Secondary Minerals: vesicle filling, Mn patches, iddingsite 9. Encrustations: 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR47-5	1. Rock Type: aphyric volcanic rock, strongly altered 2. Size: 2.5x1cm clast in ø5cm nodule 3. Shape / Angularity: angular 4. Color of cut surface: orange brown 5. Texture / Vesicularity: <5% vesicles <2mm some filled white greenish material 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: vesicle filling, Mn patches 9. Encrustations: 10. Comment:								
SO265-DR47-6	1. Rock Type: aphyric volcanic rock, strongly altered 2. Size: 3.5x2.5cm clast in ø10cm nodule 3. Shape / Angularity: angular 4. Color of cut surface: orange brown 5. Texture / Vesicularity: 1-2% vesicles <1mm filled white greenish material 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: 9. Encrustations: Mn along cracks 10. Comment:								

SO265-DR48

Description of Location and Structure: Northern Ojin Smts. Repeat of DR47 at same structure, 1nm SW of previous location at same slope

Dredge on bottom UTC 18/09/18 13:26hrs, lat 38°57.16'N, long 167°43.66'E, depth 5283m

Dredge off bottom UTC 18/09/18 14:48hrs, lat 38°56.80'N, long 167°43.91'E, depth 4875m

total volume: empty

SO265-DR49


Description of Location and Structure: Northern Ojin Smts. ~50nm E of DR48. NW flank of Smt, upper part of slope

Dredge on bottom UTC 18/09/18 23:15hrs, lat 38°44.27'N, long 168°44.80'E, depth 4580m





Dredge off bottom UTC 19/09/18 00:29hrs, lat 38°43.97'N, long 168°45.07'E, depth 4190m

total volume: 1/2 full, mainly Mn nodules but also igneous fragments





Comments: Pillow fragments, aphyric lava ranging from vesicular to non-vesicular. -1 to -8 belong to vesicular group, some with pipe vesicles, Gm ranges from fresh to moderately altered. -9 to -20 are less vesicular, more dense and massive but most are moderately altered. Least altered in this group appear -9, -14 and -20.

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR49-1	1. Rock Type: aphyric volcanic rock, pillow lava fragment, slightly altered 2. Size: 11x9x7cm 3. Shape / Angularity: angular 4. Color of cut surface: dark grey, orange at former chilled margin 5. Texture / Vesicularity: vesicular, 10-15%; two generations of vesicles, large elongated towards margin (pipe like) up to 3.4 cm long, small 0.5-1mm rounded vesicles 6. Phenocrysts: none 7. Matrix: fine grained, fresh Gm 8. Secondary Minerals: palagonite after glass 9. Encrustations: 0.5cm Mn crust, brown-yellow fillings of vesicles, some Mn gfilling along minute cracks near margin 10. Comment: good for Gc and possibly Ar-Ar dating; alteration products to be picked out	2	x				x	GC in air freight box	





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR49-2	1. Rock Type: aphyric volcanic rock, pillow lava fragment, slightly altered 2. Size: 14x10x6cm 3. Shape / Angularity: see -1 4. Color of cut surface: see -1 5. Texture / Vesicularity: see -1 6. Phenocrysts: see -1 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: see -1 10. Comment: see -1	2	x						
SO265-DR49-3	1. Rock Type: aphyric volcanic rock, pillow lava fragment, slightly altered 2. Size: 12x6x6cm 3. Shape / Angularity: see -1 4. Color of cut surface: see -1 5. Texture / Vesicularity: see -1 6. Phenocrysts: see-1 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: see -1 10. Comment: see -1	2	x						
SO265-DR49-4	1. Rock Type: aphyric volcanic rock, pillow lava fragment, slightly altered 2. Size: 10x9x7cm 3. Shape / Angularity: see -1 4. Color of cut surface: see -1 5. Texture / Vesicularity: see -1 6. Phenocrysts: see-1 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: see -1 10. Comment: see -1 Note: vesicles filled with pumiceous material, perhaps glass segregation after eruption and slow cooling inner pillow parts (?)	2	x						
SO265-DR49-5	1. Rock Type: aphyric volcanic rock, pillow lava fragment, slightly altered 2. Size: 9x6x6cm 3. Shape / Angularity: see -1 4. Color of cut surface: see -1 5. Texture / Vesicularity: see -1 6. Phenocrysts: see-1 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: see -1 10. Comment: see -1 Note: vesicles empty or filled with pumiceous material	1	x						



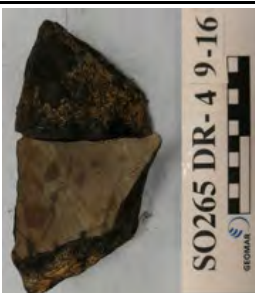


Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR49-6	1. Rock Type: aphyric volcanic rock, pillow lava fragment, moderately altered overall with grey areas 2. Size: 18x9x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: light grey, brownish along pipe vesicles 5. Texture / Vesicularity: vesicular, 10-15% pipe vesicles ø5mm up to 4cm long, often lined with orange material, some filled with beige stuff (punice like) 6. Phenocrysts: none 7. Matrix: fine grained Gm with mostly open <0.5mm vesicles 8. Secondary Minerals: see filling of pipe vesicles, some Gm oxidation 9. Encrustations: 0.5mm Mn crust 10. Comment: Gc requires careful, labor extensive picking to avoid large vesicles	1	x						
SO265-DR49-7	1. Rock Type: aphyric lava fragment, moderately altered 2. Size: 16x15x7cm from bloc C (17x13x12cm) which broke into two fragments 3. Shape / Angularity: angular 4. Color of cut surface: light brown to patchy grey 5. Texture / Vesicularity: see -6 6. Phenocrysts: see -6 7. Matrix: see -6 8. Secondary Minerals: see -6 9. Encrustations: see -6 10. Comment: see -6	2	x						
SO265-DR49-8	1. Rock Type: aphyric lava fragment, fairly fresh(!) 2. Size: 12x9x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: dark grey 5. Texture / Vesicularity: 3% large pipe-like vesicles ø5-7mm, 50% filled with Fe-oxides, others open, lined with yellow and black material. 1-3% small vesicles <<0.5mm, open 6. Phenocrysts: none 7. Matrix: fine grained, Fsp in Gm 8. Secondary Minerals: Fe-oxides in large vesicles, few cracks with little Mn 9. Encrustations: up to 2cm Mn crust 10. Comment: fairly fresh Gm, good for Gc and Ar-Ar dating	2	x						
SO265-DR49-9	1. Rock Type: aphyric lava fragment, fresh to slightly altered. Belongs to group of less vesicular, medium grained lava 2. Size: 12x9x6cm 3. Shape / Angularity: angular 4. Color of cut surface: light grey to faint brownish oxidized areas 5. Texture / Vesicularity: 3-4% Gm vesicles <0.5mm, mostly open; <1% vugs up to 5mm, filled with yellow (smectite?) material 6. Phenocrysts: none 7. Matrix: fine to medium grained, Gm Fsp and Px <0.2mm, ±fresh, some areas slightly oxidized 8. Secondary Minerals: Fe-oxides in large vesicles, few cracks with little Mn 9. Encrustations: 5mm Mn crust 10. Comment: group of less vesicular lava with medium grained Gm starts here. Sample looks reasonable good fro Gc and possibly Ar-Ar	2	x						



Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR49-10	1. Rock Type: aphyric lava fragment, moderately altered 2. Size: 14x10x9cm 3. Shape / Angularity: angular 4. Color of cut surface: greyish but with strong transition to greenish-brown discoloration 5. Texture / Vesicularity: fairly dense with <3%, <1mm vesicles, mostly open, lined with Mn; lots of very small vesicles in Gm, open 6. Phenocrysts: none 7. Matrix: medium to fine grained, Fsp and Px make up Gm, possibly also Ol, altered to red oxidized dots 8. Secondary Minerals: minor cracks with Mn, Gm oxidation, Mn lining of vesicles 9. Encrustations: 1.5cm Mn crust 10. Comment: Gc possible but sample is definitely more altered than previous samples of dredge	2	x						
SO265-DR49-11	1. Rock Type: aphyric lava fragment, moderately altered 2. Size: 16x10x7cm 3. Shape / Angularity: angular 4. Color of cut surface: grey to slightly brown with some brown patches 5. Texture / Vesicularity: 3-4% vesicles up to 2mm ø, mostly filled with yellow-greenish material, a few with Fe-oxides; some bigger vesicles 4-5mm 6. Phenocrysts: none 7. Matrix: fine grained, Fsp and Px in Gm, some red dots (iddingsite) 8. Secondary Minerals: occasional Fe-oxides in vesicles, some cracks filled with Mn 9. Encrustations: 1cm Mn crust 10. Comment:	1	x						
SO265-DR49-12	1. Rock Type: aphyric lava fragment, moderately altered 2. Size: 12x8x7cm 3. Shape / Angularity: angular 4. Color of cut surface: grey to slightly brown at rim and along cracks 5. Texture / Vesicularity: 3-5% vesicles up to 2mm ø, mostly filled with yellow-greenish material, a few with Fe-oxide? 6. Phenocrysts: none 7. Matrix: fine grained, Fsp and Px in Gm, some red dots (iddingsite) 8. Secondary Minerals: some Mn patches, Gm oxidation 9. Encrustations: up to 1cm Mn crust 10. Comment:	1	x						
SO265-DR49-13	1. Rock Type: aphyric lava fragment, slightly altered 2. Size: 12x7x7cm 3. Shape / Angularity: angular 4. Color of cut surface: grey with some brown patches 5. Texture / Vesicularity: 5-7% vesicles up to 2mm ø, mostly are open, some filled with yellow-greenish material others with Fe-oxide 6. Phenocrysts: none 7. Matrix: fine grained to microcrystalline, Gm Fsp + Px + iddingsite 8. Secondary Minerals: some Mn patches, Gm oxidation 9. Encrustations: 0.5cm Mn crust 10. Comment:	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR49-14	1. Rock Type: aphyric lava fragment, slightly altered 2. Size: 9x9x6cm 3. Shape / Angularity: angular 4. Color of cut surface: grey with some brown patches 5. Texture / Vesicularity: 1-2% vesicles with mostly 0.5mm ϕ , few with 3-4mm ϕ , majority filled with yellow-greenish material 6. Phenocrysts: none 7. Matrix: fine grained to microcrystalline, Gm Fsp + Px + iddingsite 8. Secondary Minerals: some Mn patches, Gm oxidation 9. Encrustations: 0.5cm Mn crust 10. Comment:	2	x						
SO265-DR49-15	1. Rock Type: aphyric lava fragment, moderately altered 2. Size: 14x14x8cm 3. Shape / Angularity: angular 4. Color of cut surface: grey-reddish to greenish-brown 5. Texture / Vesicularity: 2-3% vesicles with ϕ max 1mm ϕ , mostly open, some filled with yellow-greenish material 6. Phenocrysts: none 7. Matrix: fine grained to microcrystalline, Gm Fsp + Px + iddingsite 8. Secondary Minerals: some Mn patches, Gm oxidation 9. Encrustations: 0.5cm Mn crust 10. Comment:	1	x						
SO265-DR49-16	1. Rock Type: aphyric lava fragment, moderately altered 2. Size: 15x8x7cm 3. Shape / Angularity: angular 4. Color of cut surface: grey to grey-reddish / brown 5. Texture / Vesicularity: 3-5% vesicles with ϕ max 1mm ϕ , some filled with Fe-oxide or yellow-greenish material 6. Phenocrysts: none 7. Matrix: fine grained, Gm Fsp + Px + iddingsite 8. Secondary Minerals: some Mn patches, Gm oxidation 9. Encrustations: none 10. Comment:	1	x						
SO265-DR49-17	1. Rock Type: aphyric lava fragment, moderately altered 2. Size: 14x9x8cm 3. Shape / Angularity: subrounded 4. Color of cut surface: grey to brownish at rim 5. Texture / Vesicularity: 2-3% vesicles with ϕ max 1mm ϕ , some bigger with 3-4mm ϕ , most open, some with Fe-oxide 6. Phenocrysts: none 7. Matrix: fine grained, Gm Fsp + Px + iddingsite 8. Secondary Minerals: some Mn patches, Gm oxidation 9. Encrustations: 1cm Mn crust 10. Comment:	1	x						
SO265-DR49-18	1. Rock Type: aphyric lava fragment, moderately altered 2. Size: 12x10x6cm 3. Shape / Angularity: angular 4. Color of cut surface: grey to grey brown 5. Texture / Vesicularity: 7-10% vesicles with ϕ max 1.5mm ϕ , most are open, rarely filled with red-brown material 6. Phenocrysts: none 7. Matrix: fine grained, Gm Fsp + Px + iddingsite 8. Secondary Minerals: some Mn patches and along cracks, Gm oxidation 9. Encrustations: none 10. Comment:	1	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR49-19	1. Rock Type: aphyric lava fragment, moderately altered 2. Size: 12x12x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey-red to brown, oxidized rim 5. Texture / Vesicularity: 5-7% vesicles with ϕ max 3mm, mostly 1mm ϕ , some filled with grey soft material 6. Phenocrysts: none 7. Matrix: fine grained, Gm Fsp + Px + iddingsite 8. Secondary Minerals: some Mn patches and along cracks, Gm oxidation 9. Encrustations: none 10. Comment:	1	x						
SO265-DR49-20	1. Rock Type: aphyric lava fragment, slightly altered 2. Size: 11x9x6cm 3. Shape / Angularity: angular 4. Color of cut surface: grey to brownish along rim 5. Texture / Vesicularity: 2-3% vesicles mostly <1mm ϕ , some 1-2mm, open 6. Phenocrysts: none 7. Matrix: fine grained, Gm Fsp + Px + iddingsite 8. Secondary Minerals: some Mn patches and along cracks, Gm oxidation 9. Encrustations: 5mm Mn crust 10. Comment:	1	x						

SO265-DR50



Description of Location and Structure: Ojin Smts, Eastern part. N-S elongated Smt topped by smaller circular flat topped plateau, northern slope at nose-like prominence

Dredge on bottom UTC 19/09/18 16:06hrs, lat 36°43.39'N, long 169°45.46'E, depth 4590m

Dredge off bottom UTC 19/09/18 17:22hrs, lat 36°42.96'N, long 169°45.59'E, depth 4190m

total volume: 1/6 full

Comments: Mn crusts and nodules. Two, small igneous cores recovered from nodules. Both are highly altered aphyric lava fragments

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR50-1	1. Rock Type: aphyric volcanic rock, highly altered 2. Size: 2x1.5x1.5cm core of Mn nodule 3. Shape / Angularity: angular 4. Color of cut surface: brown 5. Texture / Vesicularity: slightly vesiculated <1% 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: brown minerals throughout; oxidation? 9. Encrustations: 2.5cm Mn crust 10. Comment: Gc questionable								
SO265-DR50-2	1. Rock Type: aphyric volcanic rock, highly altered 2. Size: 8x5x5cm Mn nodule, dimensions of igneous core not provided 3. Shape / Angularity: angular 4. Color of cut surface: brown at core, pale yellow at rim 5. Texture / Vesicularity: sparsely vesiculated 6. Phenocrysts: none 7. Matrix: cryptocrystalline to glassy 8. Secondary Minerals: brown and yellow minerals 9. Encrustations: 2cm Mn crust 10. Comment: Gc questionable								

Appendix 2 (Station Details and Rock Description)

SO265-DR51




Description of Location and Structure: Ojin Smts, Eastern part. Repeat of DR50 at same Smt, but 2sm SW of DR50 along W-flank; upper part of slope

Dredge on bottom UTC 19/09/18 20:46hrs, lat 36°41.42'N, long 169°43.16'E, depth 4280m





Dredge off bottom UTC 19/09/18 22:02hrs, lat 36°41.17'N, long 169°43.63'E, depth 3862m

total volume: 1/8 full

Comments: Mn crusts and nodules, a few with igneous cores ranging from slightly altered Pl phyric (-1 and -5) to moderately altered, medium grained aphyric lava (-2). -3 is similar to -2 but with Mn filled vesicles. Remaining are highly oxidized, vesicular pillow lava fragments (-4, -6 -7)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR51-1	1. Rock Type: Pl phyric lava fragment, fairly fresh 2. Size: 5.5x5x3cm free clast with thick Mn crust 3. Shape / Angularity: angular 4. Color of cut surface: dark grey 5. Texture / Vesicularity: phyric, non-vesicular 6. Phenocrysts: 5-10% Pl, 1-3mm, some altered yellow, larger species intergrown with black minerals Px? 7. Matrix: fine grained Gm 8. Secondary Minerals: some Pl oxidized, small cracks, oxidation along outer half of GC slab 9. Encrustations: 1.5cm Mn crust 10. Comment: good for Gc after careful picking, Ar-Ar Gm appears possible, Pl questionable	2	x					x	GC in air freight box 
SO265-DR51-2	1. Rock Type: aphyric lava fragment in core of Mn-nodule, moderately altered 2. Size: 4x2cm clast, nodule 9x6.5x6.5cm 3. Shape / Angularity: subangular 4. Color of cut surface: dark grey with spotty greenish discoloration from secondaries replacing Gm 5. Texture / Vesicularity: <1% vesicles <0.5mm filled with white material 6. Phenocrysts: none 7. Matrix: medium grained 8. Secondary Minerals: a few oxidized areas 9. Encrustations: clast from Mn-nodule 10. Comment: usable for Gc after intense picking	2	x						
SO265-DR51-3	1. Rock Type: aphyric, highly vesicular lava fragment, moderately altered 2. Size: 3x2cm clast, nodule 7cm ø 3. Shape / Angularity: subangular to round 4. Color of cut surface: greyish brown 5. Texture / Vesicularity: 15% vesicles 1-4mm, largely unfilled, a few partly filled with orange material 6. Phenocrysts: none 7. Matrix: cryptocrystalline to glassy 8. Secondary Minerals: Gm oxidation, Mn infill of vesicles 9. Encrustations: Mn-nodule ø7cm 10. Comment: Attention! Mn mud filled vesicles during sawing, carefully ultrasonify chips to make sample somewhat useable for Gc	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR51-4	1. Rock Type: aphyric, highly vesicular lava fragment, moderately altered 2. Size: 3.5x3.5cm clast with 5mm Mn crust housed in 20x16x15cm Mn nodule 3. Shape / Angularity: triangular pillow shape, angular 4. Color of cut surface: light brown overall with some greyish areas 5. Texture / Vesicularity: 15% vesicles up to 5mm, mostly open with some lining, along outer rim filled with yellow-white material 6. Phenocrysts: none 7. Matrix: fine grained 8. Secondary Minerals: Gm oxidation, vesicle lining and filling 9. Encrustations: initial 5mm crust before integration into larger nodule 10. Comment: Gc questionable, Mn has been trimmed off	1	x						
SO265-DR51-5	1. Rock Type: Pl phyric lava fragment in core of Mn nodule, fairly fresh 2. Size: 5x1cm clast in 7.5x8.5x4.5cm Mn nodule 3. Shape / Angularity: see -1 4. Color of cut surface: see -1 5. Texture / Vesicularity: see -1 6. Phenocrysts: see -1 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: see -1 10. Comment: only GC slab, no TS due to limited size		x						
SO265-DR51-6	1. Rock Type: aphyric lava fragment, very strongly altered / oxidized 2. Size: 3x3.5cm clast in 8x6.5x6.5cm Mn nodule 3. Shape / Angularity: subangular 4. Color of cut surface: brown 5. Texture / Vesicularity: 5% vesicles <1mm, mostly filled with yellowish green material 6. Phenocrysts: none 7. Matrix: fine grained 8. Secondary Minerals: severe Gm oxidation, vesicle filling 9. Encrustations: core clast from nodule 10. Comment: no good for GC	1							
SO265-DR51-7	1. Rock Type: aphyric lava fragment, very strongly altered / oxidized, similar to -6 2. Size: 2.5x2.5cm clast from ø7cm Mn nodule 3. Shape / Angularity: see -6 4. Color of cut surface: see -6 5. Texture / Vesicularity: see -6 6. Phenocrysts: see -6 7. Matrix: see -6 8. Secondary Minerals: see -6 9. Encrustations: see -6 10. Comment: no good for GC								

Appendix 2 (Station Details and Rock Description)

SO265-DR52


Description of Location and Structure: Ojin Smts, Eastern Section. Ø13km Smt with prominent caldera. Track along NW flank in steep mid section


Dredge on bottom UTC 20/09/18 07:04hrs, lat 36°26.37'N, long 170°04.94'E, depth 4654m

Dredge off bottom UTC 20/09/18 08:13hrs, lat 36°26.13'N, long 170°05.27'E, depth 4290m





total volume: few rocks

Comments: Mn nodules, single piece of fairly fresh, aphyric lava as core inside a Mn-nodule





SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE	
SO265-DR52-1	1. Rock Type: aphyric lava fragment, fresh to slightly altered 2. Size: 5x4x4cm clast with 3.5cm Mn crust 3. Shape / Angularity: subangular 4. Color of cut surface: grey 5. Texture / Vesicularity: sparsely vesiculated, 2% 6. Phenocrysts: none 7. Matrix: fine grained Gm 8. Secondary Minerals: brown minerals / oxidation sparsely present 9. Encrustations: 3.5cm Mn crust 10. Comment: appears good for Gc	1	x					x	entire sample in air freight box	

SO265-DR53										
Description of Location and Structure: Ojin Smts, easternmost section. Same Smt as DR52 but along NW facing caldera inner wall at SE crater rim										
Dredge on bottom UTC 20/09/18 11:32hrs, lat 36°23.48'N, long 170°07.25'E, depth 4057m										
Dredge off bottom UTC 20/09/18 12:25hrs, lat 36°23.22'N, long 170°07.28'E, depth 3835m										
total volume: 3 large and several small Mn crusts										
Comments: pillow lava fragments and hyaloclastites. Sparsely Pl phyric volcanic rocks, slightly oxidized to moderately altered. Hyaloclastite -7A and -7B may possess fresh glass										
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE	
SO265-DR53-1	1. Rock Type: sparsely PI phyric volcanic rock, moderately altered 2. Size: 13x14x11cm, part of bloc C (20x14x11); Mn crust removed during processing 3. Shape / Angularity: angular 4. Color of cut surface: reddish grey with white spots 5. Texture / Vesicularity: rare vesicles, <1%, mostly massive 6. Phenocrysts: PI <1% up to 7mm ø, fresh 7. Matrix: medium grained, PI fresh, glass devitrified 8. Secondary Minerals: oxidation, glass alteration, outer rims of PI maybe altered 9. Encrustations: thick ~5cm Mn crust removed, some fractures with Mn 10. Comment: good for Gc and dating	2	x	x				x	GC in air freight box	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR53-2	1. Rock Type: sparsely Pl phyric volcanic rock, moderately altered 2. Size: 8.5x5.5x5cm 3. Shape / Angularity: angular, no Mn crust 4. Color of cut surface: see -1 5. Texture / Vesicularity: see -1 6. Phenocrysts: see -1 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: see -1 10. Comment: see -1	2	x	x					
SO265-DR53-3	1. Rock Type: sparsely Pl phyric volcanic rock, moderately altered 2. Size: 7x7x4.5cm 3. Shape / Angularity: angular, no Mn crust 4. Color of cut surface: see -1 5. Texture / Vesicularity: see -1 6. Phenocrysts: see -1 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: see -1 10. Comment: see -1	2	x	x					
SO265-DR53-4	1. Rock Type: aphyric volcanic rock, slightly to moderately altered with <u>fresh glass</u> fragments + altered hyaloclastite 2. Size: 9.5x6x6cm, rock clast is 3cm ø 3. Shape / Angularity: angular 4. Color of cut surface: light grey to yellowish grey, brown palagonite along margin with black spots of fresh glass 5. Texture / Vesicularity: massive, no vesicles 6. Phenocrysts: none 7. Matrix: fine crystallized, glassy 8. Secondary Minerals: palagonite, and typical low-T alteration 9. Encrustations: Mn crust cementing rock fragments and hyaloclastite 10. Comment: fresh glass, small GC	2	x		GL		x	glass in air freight box	
SO265-DR53-5	1. Rock Type: rare Pl phyric volcanic rock, slightly to moderately altered 2. Size: 9x9.5x8cm 3. Shape / Angularity: subangular with 0.5cm Mn crust 4. Color of cut surface: see -1 5. Texture / Vesicularity: see -1 6. Phenocrysts: see -1 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: see -1 10. Comment: more vesicular, 5%, 3-5mm irregular shape; Gm is less crystallized than -1	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR53-6	1. Rock Type: sparsely Pl phyric volcanic rock, slightly to moderately altered 2. Size: 10.5x8x4.5cm 3. Shape / Angularity: angular with thin Mn crust 4. Color of cut surface: see -1 5. Texture / Vesicularity: see -1 6. Phenocrysts: see -1 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: see -1 10. Comment: see -1	2	x						
SO265-DR53-7A	1. Rock Type: rare Pl phyric volcanic rock, slightly to moderately altered 2. Size: 18x17x11cm, part of bloc B (26x21x12), lava fragments covered with 5cm Mn crust 3. Shape / Angularity: angular 4. Color of cut surface: pinkish pale to grey 5. Texture / Vesicularity: 5% vesicles, marginal part of pillow 6. Phenocrysts: Pl 1-2%, <5mm, fresh 7. Matrix: fine to cryptocrystalline 8. Secondary Minerals: oxidation, low-T alteration 9. Encrustations: thick Mn crust, removed; fractures with Mn 10. Comment: good for Gc likely some glass in margin. Two bags for glass 1) glass box and 2) with main sample bag				GL		x	glass in air freight box	
SO265-DR53-7B	1. Rock Type: hyaloclastite, altered with glass relicts 2. Size: 13x14x8cm, part of bloc B (26x21x12) 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: fresh glass fragments in palagonitized hyaloclastite. Two glass bags with "glass box" and main sample box				GL				
SO265-DR53-8	1. Rock Type: breccia composed of small pillow lava fragments cemented by Mn and light, fine grained material 2. Size: 22x17x11cm 3. Shape / Angularity: angular fragments 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: same type of rocks throughout, fine crystallized, some fragments can be picked for Gc if necessary								

Appendix 2 (Station Details and Rock Description)

SO265-DR54




Description of Location and Structure: Ojin Smts, easternmost section. Flat topped Smt 9nm W of DR52+53 Smt. Track along NE facing slope from valley across small ridge

Dredge on bottom UTC 20/09/18 16:35hrs, lat 36°31.22'N, long 169°58.25'E, depth 4865m





Dredge off bottom UTC 20/09/18 18:02hrs, lat 36°30.79'N, long 169°58.22'E, depth 4383m

total volume: 1/2 full




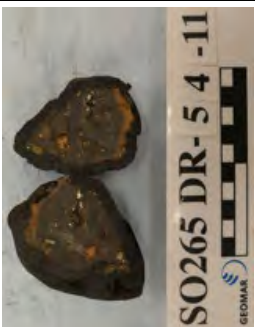
Comments: pillow lava fragments, a lot of Mn crusts and Mn nodules. Aphyric to sparsely Pl and Ol phyric lava fragments, ranging from relatively fresh (-1 to -3) to mostly moderately altered in the remaining samples

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR54-1	1. Rock Type: aphyric volcanic rock, relatively fresh 2. Size: 11x11x7.5cm nodule 3. Shape / Angularity: angular 4. Color of cut surface: grey; brownish along fractures and cracks 5. Texture / Vesicularity: 5-7% vesicles, <1mm, some filled with white material, 1-3% vesicles ø 5mm filled with sediment and Mn 6. Phenocrysts: Pl <1%, <1mm 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: Mn crust 1cm 10. Comment:	2	x				x	GC in air freight box	
SO265-DR54-2	1. Rock Type: aphyric volcanic rock, fairly fresh to moderately altered 2. Size: 12x17x13cm nodule 3. Shape / Angularity: subrounded 4. Color of cut surface: grey 5. Texture / Vesicularity: 5-10% vesicles, up to 1cm long, mostly ≤3mm, filled with white / brown / yellow material 6. Phenocrysts: Pl 3-5%, up to 2mm, white to ± transparent, Ol 1%, ≤1mm, altered 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: Mn crust <7mm 10. Comment:	2	x						
SO265-DR54-3	1. Rock Type: aphyric to sparsely phyric volcanic rock, rel. fresh to moderately altered 2. Size: 8x6x5.5cm nodule 3. Shape / Angularity: subrounded 4. Color of cut surface: mostly grey with brownish areas 5. Texture / Vesicularity: 3-5% vesicles, 2-6mm, mostly filled with white and greenish soft material, 1-3% vesicles <1mm, filled 6. Phenocrysts: Ol up to 3%, ≤1mm, altered 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches and Mn along cracks 9. Encrustations: Mn crust <2mm 10. Comment:	2	x						




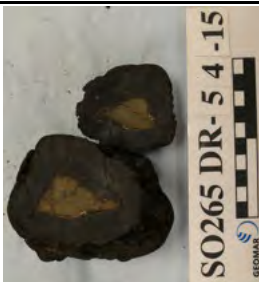
Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR54-4	1. Rock Type: sparsely phyric volcanic rock, moderately altered 2. Size: 14x11x9.5cm nodule 3. Shape / Angularity: subrounded 4. Color of cut surface: grey to brown 5. Texture / Vesicularity: 1-3% vesicles, <1mm, mostly open, few with white material 6. Phenocrysts: Fsp ≤3%, ≤2mm 7. Matrix: fine to medium grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: Mn crust <2cm 10. Comment:	2	x						
SO265-DR54-5	1. Rock Type: aphyric volcanic rock, fresh to moderately altered 2. Size: 11x10x9cm nodule 3. Shape / Angularity: subangular 4. Color of cut surface: grey to brown-grey 5. Texture / Vesicularity: 7-10% vesicles up to 1cm, mostly filled with mineral or empty 6. Phenocrysts: Fsp 1-2%, ≤2mm 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: Mn crust <1cm 10. Comment:	2	x						
SO265-DR54-6	1. Rock Type: aphyric volcanic rock, overall moderately altered 2. Size: 18x11x10cm nodule 3. Shape / Angularity: subangular 4. Color of cut surface: mostly brown-grey, in parts grey 5. Texture / Vesicularity: 1-2% vesicles, ≤1mm, filled with white mineral or empty 6. Phenocrysts: Fsp <1%, ≤1mm, 2% Ol, ≤1mm, altered 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches, iddingsite 9. Encrustations: Mn crust <0.5cm 10. Comment:	2	x						
SO265-DR54-7	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 10x10x9cm nodule 3. Shape / Angularity: angular 4. Color of cut surface: brown-grey 5. Texture / Vesicularity: 7-10% vesicles up to 5mm long, empty or filled with white material 6. Phenocrysts: Ol, 1-2%, ≤1mm, altered 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches, iddingsite 9. Encrustations: Mn crust <0.5cm 10. Comment:	2	x						


Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR54-8	1. Rock Type: aphyric volcanic rock, fresh to moderately altered 2. Size: 8.5x7.5x6cm nodule 3. Shape / Angularity: angular 4. Color of cut surface: mostly grey 5. Texture / Vesicularity: 7-10% vesicles, ≤ 3 mm long, filled with white or brown orange material 6. Phenocrysts: Ol, 2%, ≤ 1 mm, altered 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches, iddingsite 9. Encrustations: Mn crust < 0.5 cm 10. Comment: only TS and GC, no remaining material	2	x						
SO265-DR54-9	1. Rock Type: sparsely Ol phyric volcanic rock, moderately altered 2. Size: 11x8x6cm nodule 3. Shape / Angularity: angular 4. Color of cut surface: grey to brown grey 5. Texture / Vesicularity: 3-5% vesicles, ≤ 2 mm long, empty or filled with white or brown orange material 6. Phenocrysts: Ol, $< 3\%$, ≤ 1 mm, altered 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, iddingsite 9. Encrustations: Mn crust < 0.5 cm 10. Comment:	2	x						
SO265-DR54-10	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 13x13x10.5cm nodule 3. Shape / Angularity: angular 4. Color of cut surface: brown-grey 5. Texture / Vesicularity: 5-7% vesicles, ≤ 3 mm long, empty or filled with white or brown orange material 6. Phenocrysts: Ol, $< 2\%$, ≤ 1 mm, altered 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, iddingsite, Mn patches 9. Encrustations: Mn crust < 4 mm 10. Comment:	1							
SO265-DR54-11	1. Rock Type: aphyric volcanic rock, moderately to strongly altered 2. Size: 7.5x8x6cm nodule 3. Shape / Angularity: subrounded 4. Color of cut surface: dark grey to brown 5. Texture / Vesicularity: $< 3\%$ vesicles up to 8mm long, if filled then with white or brown or green material 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: Mn crust < 4 mm 10. Comment:	1							

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR54-12	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 8.5x5.5x4.5cm nodule 3. Shape / Angularity: angular 4. Color of cut surface: dark grey to brown 5. Texture / Vesicularity: 5-10% vesicles <1mm small but many, empty or filled with white - green material 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: Mn crust <2cm 10. Comment:	1							
SO265-DR54-13	1. Rock Type: aphyric volcanic rock, fresh to moderately altered 2. Size: 9.5x6x6cm nodule 3. Shape / Angularity: angular 4. Color of cut surface: mostly grey 5. Texture / Vesicularity: 7% vesicles, mostly <1mm, some up to 3mm, empty or filled with white - green material 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: Mn crust 1-2cm 10. Comment:	1							
SO265-DR54-14	1. Rock Type: aphyric volcanic rock, moderately to strongly altered 2. Size: 8x8.5x6.5cm nodule 3. Shape / Angularity: angular 4. Color of cut surface: light grey-brown 5. Texture / Vesicularity: <3% vesicles, up to 2mm, empty or filled with brown or white material 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: Mn crust <5mm 10. Comment:	1							
SO265-DR54-15	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 12x9x7cm nodule 3. Shape / Angularity: angular 4. Color of cut surface: grey to brown 5. Texture / Vesicularity: <1% vesicles, but abundant veins, filled with black-red material, more irregular veins in the stronger altered part 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: vein fillings, Mn patches & Mn dots 9. Encrustations: Mn crust <2cm 10. Comment:	1							

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR54-16	1. Rock Type: aphyric volcanic rock, fresh to moderately altered 2. Size: 10x7x6cm nodule 3. Shape / Angularity: subangular 4. Color of cut surface: grey 5. Texture / Vesicularity: 5-7% vesicles, up to 3mm, empty or filled with white, white-green or brown material 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: vein fillings 9. Encrustations: Mn crust <1cm 10. Comment:	1							

SO265-DR55




Description of Location and Structure: Ojin Smts, easternmost section. Pancake shaped Smt, ø 8km, SW of ridge with stations DR50 & 51. W-facing slope across small ridge, from near base to top

Dredge on bottom UTC 20/09/18 23:49hrs, lat 36°24.61'N, long 169°35.93'E, depth 5029m






Dredge off bottom UTC 21/09/18 01:21hrs, lat 36°24.43'N, long 169°36.47'E, depth 4579m

total volume: few rocks & Mn nodules




Comments: aphyric pillow lava fragments, most in advanced stages of alteration. -1 & -2 have grey areas while -3 to -7 are more altered; -8 to -10 are strongly altered with multiples stages / phases of alteration; taken to study these phases in more detail; -11 mud stone.

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR55-1	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 11x11x7.5cm Mn-nodule, clast 3x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown chilled margin with grey part on one side towards pillow interior 5. Texture / Vesicularity: 1-3% vesicles, <1mm, filled with white - yellowish material 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: Mn crust ≤1cm 10. Comment:	2	x						
SO265-DR55-2	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 8x8x6cm Mn-nodule, clast 4x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: greenish - grey 5. Texture / Vesicularity: <1% vesicles, <1mm, filled with white material 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: Mn crust ≤1cm 10. Comment:	2	x						
SO265-DR55-3	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 10x4x7cm clast 3. Shape / Angularity: angular 4. Color of cut surface: greenish - grey 5. Texture / Vesicularity: 1-3% vesicles, <2mm, filled with brown and white material 6. Phenocrysts: ≤1% Fsp ≤1mm 7. Matrix: fine grained 8. Secondary Minerals: white vesicle fillings, Mn patches 9. Encrustations: Mn coating 10. Comment:	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR55-4	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 6x6x7cm nodule, 5x4cm clast 3. Shape / Angularity: rounded 4. Color of cut surface: grey to brown 5. Texture / Vesicularity: 3-5% vesicles, some up to 0.7cm long, some filled with white or brown material 6. Phenocrysts: $\leq 1\%$ Fsp $\leq 1\text{mm}$ 7. Matrix: fine grained 8. Secondary Minerals: white vesicle fillings, Mn patches 9. Encrustations: Mn 10. Comment:	1	x						
SO265-DR55-5	1. Rock Type: aphyric volcanic rock, slightly to moderately altered 2. Size: 9x6x7cm nodule, 6x4cm clast 3. Shape / Angularity: angular 4. Color of cut surface: brownish grey 5. Texture / Vesicularity: dense, non-vesicular 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: Mn patches 9. Encrustations: Mn crust $\leq 1\text{cm}$ 10. Comment:	1							
SO265-DR55-6	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 6x6x4cm clast 3. Shape / Angularity: angular 4. Color of cut surface: brownish 5. Texture / Vesicularity: 1-3% vesicles, $\leq 1\text{mm}$ filled with white material 6. Phenocrysts: 1-2% Fsp $\leq 1\text{mm}$; 1-2% Ol $\leq 1\text{mm}$, altered 7. Matrix: fine grained 8. Secondary Minerals: altered Ol, vesicle fillings, Mn patches 9. Encrustations: Mn coating 10. Comment:	1							
SO265-DR55-7	1. Rock Type: aphyric volcanic rock, moderately to strongly altered 2. Size: 7x7x10cm clast 3. Shape / Angularity: pillow fragment 4. Color of cut surface: brownish to grey / green 5. Texture / Vesicularity: 1-2% vesicles, $\leq 1\text{mm}$ filled with white material 6. Phenocrysts: 1-2% Fsp $\leq 1\text{mm}$ 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: Mn crust $< 0.5\text{mm}$ 10. Comment: orange / brownish rim on upper side up to 2mm --> palagonite	1							
SO265-DR55-8	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 7x7x7cm clast 3. Shape / Angularity: angular 4. Color of cut surface: mostly brownish with a prominent 2mm wide ring of dark grey discoloration 5. Texture / Vesicularity: non-vesicular 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: Mn crust $< 0.5\text{cm}$ 10. Comment: seems to have undergone three alteration events, 0.5cm brown rim, ~2mm grey ring, brownish core containing white patches	1							

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR55-9	1. Rock Type: aphyric volcanic rock, moderately altered, simialr to -8 2. Size: 7x4x5cm clast 3. Shape / Angularity: angular 4. Color of cut surface: mostly brownish with a prominent 2mm wide ring of dark grey discoloration 5. Texture / Vesicularity: similar to -8 6. Phenocrysts: similar to -8 7. Matrix: similar to -8 8. Secondary Minerals: similar to -8 9. Encrustations: 1-2cm Mn crust 10. Comment:	1							
SO265-DR55-10	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 7x4x5cm clast 3. Shape / Angularity: angular 4. Color of cut surface: grey, core light grey 5. Texture / Vesicularity: 1% vesicles <1mm filled with white material 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: Mn patches, vesicle filling 9. Encrustations: up to 1cm Mn crust 10. Comment:	1							
SO265-DR55-11	1. Rock Type: mudstone 2. Size: 8x6x5cm clast 3. Shape / Angularity: angular 4. Color of cut surface: orange-brown 5. Texture / Vesicularity: 1% vesicles <1mm filled with white material 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: 9. Encrustations: Mn coating 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SO265-DR56

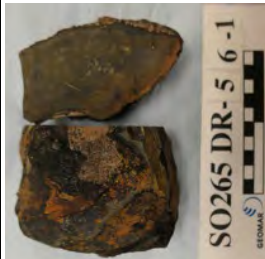


Description of Location and Structure: Ojin Smts, southern part of eastern section. circiular shaped Smt on top of elongated NW-SE striking plateau base, track along steep N slope

Dredge on bottom UTC 21/09/18 09:56hrs, lat 36°28.27'N, long 168°30.84'E, depth 4630m





Dredge off bottom UTC 21/09/18 11:20hrs, lat 36°27.83'N, long 166°30.85'E, depth 4162m

total volume: 1/3 full





Comments: volcanic rocks, pumice, Mn nodules, Mn crust, biology mainly sponges made of glass fibre. Most lava is sparsely Pl phyric with minor occurences of aphyric varieties. Majority are fairly fresh to slightly altered. TS and GC prepared for -1 to -7. Remaining without, in contrast to initial preparation protocol, probably due to size.

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR56-1	1. Rock Type: sparsely Pl phyric volcanic rock, slightly altered 2. Size: 12x11x9cm 3. Shape / Angularity: angular 4. Color of cut surface: yellowish-grey along edge, dark grey interior with some yellow-grey spots 5. Texture / Vesicularity: mostly massive, rare 1% vesicles 6. Phenocrysts: rare Pl 1-1.5mm, subhedral , slightly altered with spongy interior 7. Matrix: fine grained, has brown alteration halo with more pervasive Mn fractures 8. Secondary Minerals: white-yellow vesicle fillings, oxidation of Pl to yellow-green 9. Encrustations: 2mm Mn crust, some patches and encrustations along fractures 10. Comment:	2	x						
SO265-DR56-2	1. Rock Type: sparsely Pl phyric volcanic rock, fresh to slightly altered 2. Size: 20x19x8cm 3. Shape / Angularity: angular 4. Color of cut surface: dark grey to yellow grey 5. Texture / Vesicularity: mostly massive, rare 1% vesicles, filled with white material, infill up to 0.5mm 6. Phenocrysts: rare Pl up to 2mm, edges appear altered 7. Matrix: fine grained, fresh, feathery microlites 8. Secondary Minerals: brown altered mineral (Pl?), white vesicle infill 9. Encrustations: 1cm Mn crust, some patches in rock 10. Comment: good for Gc	2	x				x	GC in air freight box	
SO265-DR56-3	1. Rock Type: sparsely Pl phyric volcanic rock, slightly to moderately altered 2. Size: 10x8x8cm 3. Shape / Angularity: angular 4. Color of cut surface: grey with brown patches 5. Texture / Vesicularity: mostly massive, rare, <1% vesicles, 0.2mm ø, open 6. Phenocrysts: rare Pl 0.5mm, some up to 2mm, altered to feathery, spongy appearance 7. Matrix: fine grained, appears to have microlites, some intersertal 8. Secondary Minerals: Pl often altered, white-pale yellow orange patches and some Mn spots 9. Encrustations: no Mn crust but some patches 10. Comment:	2	x						


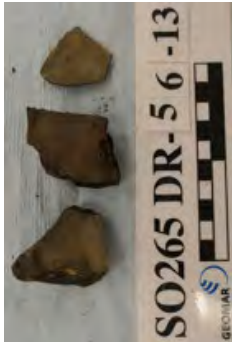



Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR56-4	1. Rock Type: sparsely Pl phyric volcanic rock, fresh to slightly altered 2. Size: 8x7x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to dark grey 5. Texture / Vesicularity: mostly massive, rare vesicles 6. Phenocrysts: none 7. Matrix: fine grained, fresh, slightly oxidized along rims with more abundant secondary minerals 8. Secondary Minerals: brown red near edges, white vesicle infill, Pl altered to yellow staining 9. Encrustations: very thin Mn crust with a few patches near edge, original 1.5cm Mn crust chipped off 10. Comment:	2	x						
SO265-DR56-5	1. Rock Type: rare Pl phyric volcanic rock, slightly to moderately altered 2. Size: 12x9x8cm 3. Shape / Angularity: angular 4. Color of cut surface: grey with dark brown / grey spots 5. Texture / Vesicularity: sparsely vesiculated, 1%, 30% unfilled up to 0.5mm ø bust mostly 0.1 to 0.25mm mostly 6. Phenocrysts: rare Pl 1%, up to 1mm, subhedral, altered 7. Matrix: fine grained, fresh to oxidized near edges 8. Secondary Minerals: white-green vesicle infill, brown alteration product probably from Pl 9. Encrustations: 1cm Mn crust has been chipped off 10. Comment:	2	x						
SO265-DR56-6	1. Rock Type: sparsely Pl phyric volcanic rock, slightly altered 2. Size: 15x13x10cm 3. Shape / Angularity: angular 4. Color of cut surface: grey with brown rim 5. Texture / Vesicularity: fine grained outer rim, slightly vesiculated slightly, mostly massive interior vesiculated, ~1% vesicles 0.1-0.5mm with white infill 6. Phenocrysts: rare Pl up to 0.4mm, altered spongy interior 7. Matrix: fine grained, fresh appearance with fine laths of Pl 8. Secondary Minerals: similar to -2 9. Encrustations: 2.2cm Mn crust has been removed 10. Comment: texture suggests pillow lava	2	x						
SO265-DR56-7	1. Rock Type: rare Pl phyric volcanic rock, fresh to moderately altered 2. Size: 6.5x5x5cm 3. Shape / Angularity: angular 4. Color of cut surface: dark grey to reddish brown 5. Texture / Vesicularity: overall massive, 1-3% vesicles 0.1-0.3mm, most with white infill 6. Phenocrysts: <1% Pl up to 3mm, majority ~1mm subhedral, rectangular 7. Matrix: fine grained to cryptocrystalline in places, heavily oxidized along edges 8. Secondary Minerals: similar to -2, Pl particularly altered when large 9. Encrustations: 0.5cm Mn crust has been removed 10. Comment:	2	x						



Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR56-8	1. Rock Type: rare Pl phyric volcanic rock, fresh to slightly altered 2. Size: 9x7x5.5cm 3. Shape / Angularity: angular 4. Color of cut surface: dark grey to brownish grey 5. Texture / Vesicularity: slightly vesiculated, <1%, majority <0.1mm, a few up to 0.5mm. Small vesicles have green-white infill, larger yellow or none 6. Phenocrysts: single Pl 3.5mm, subhedral, spongy 7. Matrix: fine grained, fresh 8. Secondary Minerals: vesicle infill 9. Encrustations: 1.2cm Mn crust has been removed 10. Comment:								
SO265-DR56-9	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 8x8x6cm 3. Shape / Angularity: angular 4. Color of cut surface: dark grey to dark brown 5. Texture / Vesicularity: overall massive, <1% vesicles, see - 8 for infill 6. Phenocrysts: none 7. Matrix: fine grained, oxidized - patchy 8. Secondary Minerals: similar to -8 9. Encrustations: 0.5cm Mn crust, Mn along fractures 10. Comment:								
SO265-DR56-10	1. Rock Type: sparsely Pl phyric volcanic rock, slightly altered 2. Size: 9x9x9cm 3. Shape / Angularity: angular 4. Color of cut surface: dark grey brown to brownish-red, oxidation, possibly former pillow margin 5. Texture / Vesicularity: overall massive, <<1% vesicles 0.1-0.2mm ø, most with green-white infill 6. Phenocrysts: <1% Pl up to 2mm, subhedral 7. Matrix: fine grained, oxidized - patchy 8. Secondary Minerals: similar to -8, Mn encrustation 9. Encrustations: 1cm Mn crust, Mn along fractures 10. Comment: pillow structure								
SO265-DR56-11	1. Rock Type: near aphyric volcanic rock, mostly fresh with alteration halo and fresher core 2. Size: 5.5x4x3cm 3. Shape / Angularity: subangular 4. Color of cut surface: dark grey with brownish grey halo along edge 5. Texture / Vesicularity: overall massive, slightly vesiculated <<1%, most ~0.3mm ø with white-green infill 6. Phenocrysts: <<1% Pl(?) up to 1mm, feathery 7. Matrix: cryptocrystalline, fairly fresh some oxidation 8. Secondary Minerals: vesicle infill 9. Encrustations: very thin Mn crust, Mn along fractures 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR56-12	1. Rock Type: Mn crust with two volcanic clasts. 1) altered volcanic similar to -6 (2x1cm, angular), 2) altered volcanic (3x2cm, subrounded) similar to -7 2. Size: 9.5x6x5cm Mn crust 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 0.5cm Mn crust 10. Comment:								
SO265-DR56-13	1. Rock Type: aphyric volcanic rock, altered 2. Size: 9.5x6x5cm 3. Shape / Angularity: angular 4. Color of cut surface: yellowish grey to brown grey 5. Texture / Vesicularity: overall massive, slightly vesiculated <1%, white-green infill 6. Phenocrysts: none 7. Matrix: cryptocrystalline, oxidized 8. Secondary Minerals: chalky white maybe former Pl ~0.25mm 9. Encrustations: thin 2.5mm Mn crust 10. Comment:								
SO265-DR56-14	1. Rock Type: rare Pl phyric volcanic rock, fresh to slightly altered 2. Size: 5.5x5.5x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: dark grey 5. Texture / Vesicularity: overall massive, slightly vesiculated <1%, 0.1-0.3mm, filled 6. Phenocrysts: one Pl, 0.4mm, altered, chalky 7. Matrix: fine grained some patches are oxidized 8. Secondary Minerals: brown red minerals <<1% 9. Encrustations: no Mn crust 10. Comment:								
SO265-DR56-15	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 8.5x8x7.5cm 3. Shape / Angularity: angular 4. Color of cut surface: grey-brown with red brown edges 5. Texture / Vesicularity: overall massive, slightly vesiculated <1%, 0.1-0.3mm, few open 6. Phenocrysts: none 7. Matrix: fine grained maybe feathery Pl microlites, oxidized 8. Secondary Minerals: Mn oxide patches, white green alteration in streaks 9. Encrustations: 1.5cm Mn crust removed, pervasive fractures 10. Comment:								
SO265-DR56-16X	1. Rock Type: remnants of bloc A (55x44x24cm); six fragments total, see -1 for description 2. Size: 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR56-17X	1. Rock Type: eight small rock samples, former Mn crust chipped off, two have been taped together 2. Size: 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								
SO265-DR56-18X	1. Rock Type: pumice, four pieces, rounded without any crust, grey color 2. Size: 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								

SO265-DR57


Description of Location and Structure: Ojin Smts, eastern section. Flat topped Smt, ~18nm W of DR56. Slightly E-W elongated, ø14km Smt with flat topped Smt. Track along NE flank below plateau edge

Dredge on bottom UTC 21/09/18 17:04hrs, lat 36°25.12'N, long 168°11.22'E, depth 4451m





Dredge off bottom UTC 21/09/18 18:32hrs, lat 36°24.74'N, long 168°10.95'E, depth 3954m

total volume: 1/5 full





Comments: Mn nodules with some rock clasts, Mn crusts with mud. Fresh to slightly altered, aphyric lava (-1 & -2), more altered (-3 & -4). Sparsely Pl phyr to Pl phyr lava, moderately to strongly altered (-5 to -9)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR57-1	1. Rock Type: aphyric volcanic rock, fairly fresh 2. Size: 9x7x7cm 3. Shape / Angularity: initial not visible after cutting 4. Color of cut surface: grey with some brown parts 5. Texture / Vesicularity: massive, <1% vesicles ≤1mm filled with white material 6. Phenocrysts: 1% Pl <1mm 7. Matrix: fine grained 8. Secondary Minerals: white vesicle fillings, Mn patches 9. Encrustations: Mn crust ≤1.2cm 10. Comment:	2	x				x	GC in air freight box	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR57-2	1. Rock Type: aphyric volcanic rock, rel. fresh to slightly altered 2. Size: 6x5.5x5.5cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey including brown parts 5. Texture / Vesicularity: massive, <1% vesicles, ≤1mm, unfilled 6. Phenocrysts: none 7. Matrix: fine grained 8. Secondary Minerals: few Mn patches 9. Encrustations: Mn crust ≤0.7cm 10. Comment:	2	x						
SO265-DR57-3	1. Rock Type: aphyric volcanic rock, slightly to moderately altered 2. Size: 7.5x5x5.5cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey with brown parts 5. Texture / Vesicularity: massive, 3% vesicles up to 2mm, unfilled; others 1-3%, <1mm filled with white material 6. Phenocrysts: 1-2% Fsp ≤1mm 7. Matrix: fine grained 8. Secondary Minerals: Mn patches, vesicle fillings 9. Encrustations: Mn crust ≤3mm 10. Comment:	2	x						
SO265-DR57-4	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 3x3.5x2cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown to red brown 5. Texture / Vesicularity: massive, 1-3% vesicles, mostly ≤1mm up to 1cm long, filled with white material 6. Phenocrysts: 1% Fsp ≤1mm 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: from Mn nodule 10. Comment:	1							
SO265-DR57-5	1. Rock Type: sparsely phyric volcanic rock, moderately altered 2. Size: 8.5x6.5x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey / brownish; brown-orange rim ranging from 10 to 1mm 5. Texture / Vesicularity: massive, 3-5% vesicles, ≤2mm, some filled with white material 6. Phenocrysts: ~2% Fsp up to 2mm 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings 9. Encrustations: 10. Comment:	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR57-6	1. Rock Type: aphyric volcanic rock, slightly to moderately altered 2. Size: 4.5x4x3.5cm 3. Shape / Angularity: subangular 4. Color of cut surface: light grey to brownish 5. Texture / Vesicularity: 1-2% vesicles 2-5mm, unfilled, some filled with drak brown material; 1-2% vesicles \leq 2mm mostly unfilled, few filled with white material 6. Phenocrysts: none 7. Matrix: fine grained 8. Secondary Minerals: few Mn patches 9. Encrustations: from Mn nodule 10. Comment:	2	x						
SO265-DR57-7	1. Rock Type: sparsely Fsp phyric volcanic rock, moderately altered 2. Size: 8x4x3cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey / brown 5. Texture / Vesicularity: 1-2% vesicles \leq 4mm, mostly filled with red / brown material; 2-3% vesicles \leq 1mm, few filled with white material 6. Phenocrysts: 2-3% Fsp <1mm 7. Matrix: fine grained 8. Secondary Minerals: Mn patches, vesicle fillings 9. Encrustations: from Mn nodule 10. Comment:	2	x						
SO265-DR57-8	1. Rock Type: Pl phyric volcanic rock, moderately altered 2. Size: 5.5x3x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: blueish grey to brown 5. Texture / Vesicularity: 3-5% up to 2mm, mostly unfilled, some with white-greenish material 6. Phenocrysts: 5-10% Fsp <2mm 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings 9. Encrustations: from Mn nodule 10. Comment:	2	x						
SO265-DR57-9	1. Rock Type: Pl phyric volcanic rock, moderately to strongly altered 2. Size: 4.5x4x3cm 3. Shape / Angularity: subangular 4. Color of cut surface: light brown, dark brown rim up to 5mm 5. Texture / Vesicularity: 1-3% \leq 1mm, mostly unfilled, some with white material 6. Phenocrysts: 10-15% Fsp <1mm, altered 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, few Mn patches 9. Encrustations: from Mn nodule 10. Comment:	1							

Appendix 2 (Station Details and Rock Description)

SO265-DR58




Description of Location and Structure: Ojin Smts, central section. Circular Smt with rel. steep S and W slope. Track along SW slope from within small gully across ridg to top region

Dredge on bottom UTC 22/09/18 02:02hrs, lat 36°46.00'N, long 167°35.13'E, depth 4805m

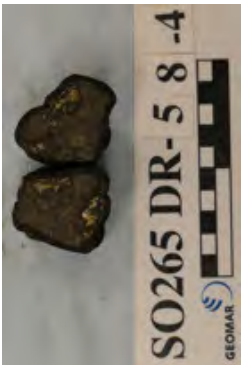

Dredge off bottom UTC 22/09/18 03:17hrs, lat 36°46.46'N, long 167°35.16'E, depth 4426m

total volume: very few Mn crusts & nodules

Comments: Mn nodules with some rock clasts, Mn crusts with mud. Very small clasts of aphyric lava fresh to moderately altered. With some effort Gc possible, Ar-Ar questionable. Not sufficient material for multiple TS. This is however a strategic location between Western and Eastern Ojin Smt province. Do not use up all material for Gc if Ar-Ar is feasible after TS inspection

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR58-1	1. Rock Type: aphyric volcanic rock, slightly to moderately altered 2. Size: 8.5x6x4.5cm nodule; 2.5x1cm clast 3. Shape / Angularity: angular 4. Color of cut surface: grey to pale brown 5. Texture / Vesicularity: sparsely vesiculated 3% 6. Phenocrysts: none 7. Matrix: microcrystalline, Pl + Px 8. Secondary Minerals: white to pale greenish minerals in vesicles, patches & spots of brown minerals 9. Encrustations: 1.5cm Mn crust 10. Comment: very tiny TS, no GC slab due to size, try to abrade Mn with steel brush	1							
SO265-DR58-2	1. Rock Type: aphyric volcanic rock, moderately altered, similar to -1 2. Size: 6x4x3.5cm nodule; 1x2cm clast 3. Shape / Angularity: angular 4. Color of cut surface: grey to pale brown, core more greyish 5. Texture / Vesicularity: sparsely vesiculated 1-2% 6. Phenocrysts: none 7. Matrix: microcrystalline, Pl + Px 8. Secondary Minerals: brown minerals in vesicles 9. Encrustations: 1.5cm Mn crust 10. Comment: very tiny TS, no GC slab due to size, try to abrade Mn with steel brush, quite similar to -1	1							
SO265-DR58-3	1. Rock Type: aphyric volcanic rock, inner part slightly to moderately altered, outer part highly altered 2. Size: 7x5x5cm nodule; 3.5x4cm clast 3. Shape / Angularity: subangular 4. Color of cut surface: inner part grey to pale brown, outer part brown 5. Texture / Vesicularity: sparsely to moderately vesiculated 5% 6. Phenocrysts: none 7. Matrix: microcrystalline, Pl + Px 8. Secondary Minerals: white minerals in vesicles (zeolites?), dendritic Mn along cracks 9. Encrustations: 5mm Mn crust 10. Comment: quite similar to -1	1	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR58-4	1. Rock Type: aphyric volcanic rock, slightly to moderately altered 2. Size: 6x4.5x4.5cm nodule; 3.5x3cm clast 3. Shape / Angularity: subangular 4. Color of cut surface: greyish parts with lighter grey areas along with pale greenish to pale brownish parts 5. Texture / Vesicularity: sparsely to moderately vesiculated 5% 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: white minerals in vesicles (zeolites?) 9. Encrustations: 5mm Mn crust 10. Comment:	1	x						
SO265-DR58-5	1. Rock Type: volcanic core of Mn nodule, moderately altered 2. Size: 4.5x6.5x5cm nodule; 3.5x2cm clast 3. Shape / Angularity: subrounded 4. Color of cut surface: brown-grey to brown 5. Texture / Vesicularity: aphyric, 2% vesicles, especially along margin, tiny, rounded 6. Phenocrysts: none 7. Matrix: microcrystalline 8. Secondary Minerals: white minerals in vesicles (zeolites?), oxidation 9. Encrustations: 1.5cm Mn crust 10. Comment: too small fro TS but can be picked for Gc								

SO265-DR59


Description of Location and Structure: Ojin Smts, western section, easternmost Smt. E-W elongated Smt with relatively flat top and few small cones on top, upper part of steep S slope beneath plateau edge.

Dredge on bottom UTC 22/09/18 12:16hrs, lat 36°54.07'N, long 166°30.91'E, depth 4655m



Dredge off bottom UTC 22/09/18 13:30hrs, lat 36°54.42'N, long 166°30.80'E, depth 4210m

total volume: 1/3 full

Comments: Mn nodules 5-10cm ø. Two cores of moderately altered, sparsely Pl phyrlic lava recovered

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR59-1	1. Rock Type: sparsely Pl phyrlic volcanic rock, moderately altered 2. Size: 4x2x2cm clast in 12cm ø; Mn nodule 3. Shape / Angularity: angular 4. Color of cut surface: brown - grey 5. Texture / Vesicularity: mostly massive, slightly vesicular <1% up to 0.5mm 6. Phenocrysts: microphenocrysts of Pl, 0.1-0.2mm fine fraction size, 1-5% 7. Matrix: cryptocrystalline 8. Secondary Minerals: vesicles filled with brown red alteration product 9. Encrustations: clast originates from ø12 cm nodule, all Mn removed 10. Comment: Pl may be datable picked from fine fraction 100-250µm	1	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR59-2	1. Rock Type: Pl phyric volcanic rock, moderately altered 2. Size: 4.5x3x2cm clast in 10cm ø; Mn nodule 3. Shape / Angularity: angular to subangular 4. Color of cut surface: brown - grey 5. Texture / Vesicularity: mostly massive, slightly vesicular <1%, 0.1-0.25mm, mostly filled 6. Phenocrysts: 1-3% Pl, up to 2mm, subhedral, altered 7. Matrix: cryptocrystalline, finer grained edge more oxidized / brown 8. Secondary Minerals: vesicles filled with green-white infill, chalky white altered mineral (former Pl?) 9. Encrustations: clast originates from ø10 cm nodule, all Mn removed, patches of Mn inside rock 10. Comment:	1	x						
SO265-DR59-3	1. Rock Type: pumice, fresh 2. Size: 9x8x6cm 3. Shape / Angularity: rounded 4. Color of cut surface: tan 5. Texture / Vesicularity: 50% vesicles 6. Phenocrysts: coarse Hbl, Opx, Qz 7. Matrix: glassy 8. Secondary Minerals: none 9. Encrustations: none 10. Comment: rafted pumice				GL		x	glass in air freight box	

SO265-DR60


Description of Location and Structure: Ojin Smts, western section, easternmost Smt. Repeat of DR60 1nm further NW along same slope beneath plateau edge

Dredge on bottom UTC 22/09/18 17:01hrs, lat 36°54.01'N, long 166°29.27'E, depth 4670m





Dredge off bottom UTC 22/09/18 18:12hrs, lat 36°54.36'N, long 166°29.12'E, depth 4170m

total volume: missing!





Comments: mostly sparsely Pl phyric lava fragments ranging from slightly to moderately altered (-1, -2 and -4). Aphyric varieties with similar degrees of alteration sampled in 2E, -6 and -7. Samples 2A through E are individual clasts from a breccia bloc

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR60-1	1. Rock Type: sparsely Pl phyric volcanic rock, fresh to slightly altered 2. Size: 10x7x7cm 3. Shape / Angularity: angular 4. Color of cut surface: grey, some brown along edges 5. Texture / Vesicularity: 3-5% sparsely vesicular, 25% filled up to 0.75mm, most are 0.1-0.2mm, others are unfilled up to 1mm ø 6. Phenocrysts: <1% Pl, up to 4mm appears subhedral-anhedral but maybe fresh looking in some parts, more altered near oxidized edge 7. Matrix: cryptocrystalline, fresh with some mottled brown patches 8. Secondary Minerals: white-green vesicle infill and chalky white mineral <1% 9. Encrustations: very thin Mn crust 10. Comment: rinds to be examined for glass	2	x		Pl+Gl?		x	GC in air freight box	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR60-2A	1. Rock Type: sparsely Pl phyric volcanic rock, moderately altered 2. Size: 12x7x6cm, clast from bloc B (30x30x20cm) 3. Shape / Angularity: angular 4. Color of cut surface: grey in core, grey-brown along edges 5. Texture / Vesicularity: 3-5% vesicles overall, 1/3 are ϕ 0.5mm and majority <0.3mm. 20% filled have white-green infill and occur mostly along edges. In core they are mostly open. 6. Phenocrysts: <<1% Pl, tend to be angular, euhedral to subhedral, some spongy, feathered edges on altered Pl 7. Matrix: fine grained, possible Pl microphenocrysts 8. Secondary Minerals: vesicle infill, brown-red oxidation of minerals 9. Encrustations: bloc B originally had Mn crust (removed), some Mn patches near fractured edges 10. Comment:	2	x					from bloc B	
SO265-DR60-2B	1. Rock Type: sparsely Pl phyric volcanic rock, fresh to slightly altered 2. Size: 9x7x3.5cm, clast from bloc B (30x30x20cm) 3. Shape / Angularity: subangular 4. Color of cut surface: grey with some oxidized brown-grey 5. Texture / Vesicularity: massive, non-vesicular 6. Phenocrysts: <1% Pl up to 4mm, fresh 7. Matrix: fine grained, Pl microlites, intersertal texture 8. Secondary Minerals: some chalky white, altered mineral 9. Encrustations: bloc B originally had Mn crust (removed), 0.5cm Mn crust 10. Comment: Gm looks very good for dating	2	x	x			x	GC in air freight box	
SO265-DR60-2C	1. Rock Type: sparsely Pl phyric volcanic rock, relatively fresh 2. Size: 11x10x10cm, clast from bloc B (30x30x20cm) 3. Shape / Angularity: angular 4. Color of cut surface: grey with some brown areas along rim 5. Texture / Vesicularity: massive, ~5% vesicles \leq 1mm, mostly open; 1-2% filled with white material 6. Phenocrysts: 1% Pl \leq 3mm, subhedral 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: bloc B originally had Mn crust (removed), <0.5cm Mn crust 10. Comment:	2	x						
SO265-DR60-2D	1. Rock Type: sparsely Pl phyric volcanic rock, relatively fresh 2. Size: 13x9x8cm, clast from bloc B (30x30x20cm) 3. Shape / Angularity: angular 4. Color of cut surface: grey with few slightly brownish parts 5. Texture / Vesicularity: massive, 5-10% vesicles \leq 1mm, 2/3 filled with white / greenish material, some with light brown 6. Phenocrysts: 1% Pl \leq 3mm, subhedral, 1-2% altered Ol?, brown \pm rounded 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches, altered Ol? 9. Encrustations: bloc B originally had Mn crust (removed), <1mm Mn crust 10. Comment:	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR60-2E	1. Rock Type: aphyric volcanic rock, slightly altered 2. Size: 14x10x7cm, clast from bloc B (30x30x20cm) 3. Shape / Angularity: angular 4. Color of cut surface: grey to brown 5. Texture / Vesicularity: 10-15% vesicles ≤ 1 mm, mostly filled with brownish or transparent grey blueish material, infill distribution 50:50 6. Phenocrysts: 1% PI ≤ 1 mm 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches along cracks 9. Encrustations: bloc B originally had Mn crust (removed), < 2.5 cm Mn crust 10. Comment:	2	x						
SO265-DR60-3	1. Rock Type: sparsely phyric volcanic rock, relatively fresh 2. Size: 13x6x6cm 3. Shape / Angularity: angular 4. Color of cut surface: blueish grey core, up to 1cm brownish oxidation halo along rim 5. Texture / Vesicularity: 5-10% vesicles ≤ 1 mm, up to 1/3 filled with white soft material and yellowish green material 6. Phenocrysts: 1-2% PI up to 3mm, subhedral 7. Matrix: fine grained, possible PI microphenocrysts 8. Secondary Minerals: vesicle fillings, Mn patches and Mn in cracks 9. Encrustations: < 2 mm Mn crust 10. Comment:	2	x						
SO265-DR60-4	1. Rock Type: sparsely to moderately phyric volcanic rock, slightly to moderately altered 2. Size: 11x9x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey, transgressive brown towards rim 5. Texture / Vesicularity: 3-5% vesicles ≤ 2 mm, $\sim 2/3$ filled with white soft material and transparent to yellowish material 6. Phenocrysts: 1-2% PI < 1 mm, appears altered 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: < 1.5 cm Mn crust 10. Comment: one side made of brown layer / rim up to 2mm (palagonite?)	1							
SO265-DR60-5	1. Rock Type: sparsely phyric volcanic rock, moderately altered 2. Size: 6x6x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: orange brown to grey 5. Texture / Vesicularity: $\sim 10\%$ vesicles ≤ 2 mm on average, mostly filled with white soft material and transparent to yellowish material 6. Phenocrysts: $\sim 1\%$ PI < 1 mm, subhedral to anhedral 7. Matrix: fine grained, appears altered 8. Secondary Minerals: vesicle fillings, Mn patches 9. Encrustations: < 1 cm Mn crust 10. Comment: one side made of brown layer / rim up to 2mm (palagonite?)	1							

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR60-6	1. Rock Type: sparsely phyric to aphyric volcanic rock, slightly altered to fairly fresh 2. Size: 6x5x5cm 3. Shape / Angularity: angular 4. Color of cut surface: grey core, up to 1cm oxidized, brown rim 5. Texture / Vesicularity: 5-10% vesicles \leq 1mm on average, few up to 3-4mm, ~1/2 filled with soft material 6. Phenocrysts: 1-2% Pl up to 1mm, subhedral 7. Matrix: fine grained 8. Secondary Minerals: Mn along cracks 9. Encrustations: Mn crust removed 10. Comment: chilled margin, 3mm red brown layer, palagonite along pillow margin	1							
SO265-DR60-7	1. Rock Type: aphyric volcanic rock, rel. fresh to slightly altered 2. Size: 7x6x5cm 3. Shape / Angularity: angular 4. Color of cut surface: blueish grey to brown core, up to 3mm brown rim 5. Texture / Vesicularity: 5-10% vesicles \leq 1mm, ~1/2 filled with soft white material 6. Phenocrysts: none 7. Matrix: 8. Secondary Minerals: Mn along cracks, Mn patches 9. Encrustations: Mn crust \leq 2cm 10. Comment:	1							

SO265-DR61


Description of Location and Structure: Ojin Smts, western section, northern part. Small ø7km conical Smt, steep SW slope (scrap of slump), uppermost part below top region

Dredge on bottom UTC 23/09/18 03:30hrs, lat 37°55.62'N, long 166°41.56'E, depth 4564m

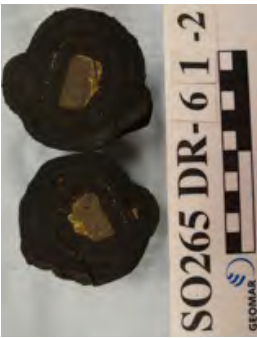



Dredge off bottom UTC 23/09/18 04:58hrs, lat 37°56.07'N, long 166°41.80'E, depth 4153m

total volume: 3/4 full!






Comments: mostly Mn nodules, pumice, small pieces of volcanic rocks and sediment inside nodules. Small, moderately to highly altered aphyric volcanic rocks, some are highly vesicular

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR61-1	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 3x2.5x1.5cm clast in ø7cm Mn nodule 3. Shape / Angularity: angular 4. Color of cut surface: grey, ~brown 5. Texture / Vesicularity: 15%, moderately vesiculated, some vesicles are filled white, brown, yellow material 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: vesicle filling, brown patches in Gm 9. Encrustations: 2.5cm Mn crust 10. Comment:								




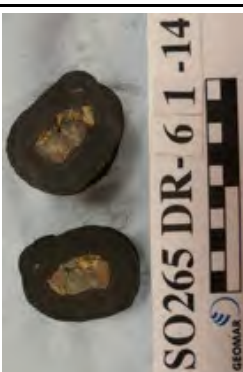

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR61-2	1. Rock Type: aphyric volcanic rock, moderately to highly altered 2. Size: 2.5x2x1.5cm clast in ø8cm Mn nodule 3. Shape / Angularity: subangular 4. Color of cut surface: grey, ~brown, ~pale yellow 5. Texture / Vesicularity: 25%, highly vesiculated, most vesicles filled with white, pale yellow and black material 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: mosaic-like distribution of brown minerals throughout the rock, yellow staining along cracks and vesicles 9. Encrustations: 2.5cm Mn crust 10. Comment:								
SO265-DR61-3	1. Rock Type: aphyric volcanic rock, moderately to highly altered 2. Size: 2.5x2x1.5cm clast in ø7cm Mn nodule 3. Shape / Angularity: subrounded 4. Color of cut surface: grey, ~brown, ~pale yellow 5. Texture / Vesicularity: 20%, moderately vesiculated 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: similar to -2 9. Encrustations: 2.2cm Mn crust 10. Comment:								
SO265-DR61-4	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 4.5x3x1.5cm clast in ø7cm Mn nodule 3. Shape / Angularity: angular and platy 4. Color of cut surface: grey, ~pale yellow 5. Texture / Vesicularity: 30%, highly vesiculated, many filled with white, pale yellow and black material 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: vesicle filling 9. Encrustations: 1.5cm Mn crust 10. Comment:	1							
SO265-DR61-5	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 3x3x1.5cm clast in ø8cm Mn nodule 3. Shape / Angularity: subangular and platy 4. Color of cut surface: grey, ~pale yellow, ~pale brown 5. Texture / Vesicularity: see -4 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: vesicle filling 9. Encrustations: 1.5cm Mn crust 10. Comment:	1							



Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR61-6	1. Rock Type: aphyric volcanic rock, highly altered 2. Size: 3x2x2cm clast in ø11cm Mn nodule 3. Shape / Angularity: subangular 4. Color of cut surface: brown, ~pale yellow 5. Texture / Vesicularity: 40%, highly vesiculated, filled with pale yellow material, some with brown, white and black minerals 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: brown minerals replaced most of the rock (remark: probably Gm oxidation is meant), vesicle filling 9. Encrustations: 2.5cm Mn crust 10. Comment:								
SO265-DR61-7	1. Rock Type: aphyric volcanic rock, highly altered 2. Size: 2x2x2cm clast in ø8cm Mn nodule 3. Shape / Angularity: subrounded 4. Color of cut surface: pale brown core, pale yellow rim 5. Texture / Vesicularity: 30%, highly vesiculated, filled with pale yellow and white material 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: thorough Gm oxidation, vesicle filling 9. Encrustations: 1.8cm Mn crust 10. Comment:								
SO265-DR61-8	1. Rock Type: aphyric volcanic rock, highly altered 2. Size: 4x3x3cm clast in ø7cm Mn nodule 3. Shape / Angularity: subangular 4. Color of cut surface: pale brown 5. Texture / Vesicularity: 5%, sparsely vesiculated, filled with brown material 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: brown clay replacing Gm 9. Encrustations: 1.5cm Mn crust 10. Comment:	1							
SO265-DR61-9	1. Rock Type: aphyric volcanic rock, highly altered 2. Size: 5x3x3cm clast in ø8cm Mn nodule 3. Shape / Angularity: angular 4. Color of cut surface: pale brown 5. Texture / Vesicularity: 3%, sparsely vesiculated, filled with brown and black material 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: brown clay replacing Gm 9. Encrustations: 2.2cm Mn crust 10. Comment:								
SO265-DR61-10	1. Rock Type: aphyric volcanic rock, highly altered 2. Size: 3x1.5x1cm clast in ø7cm Mn nodule 3. Shape / Angularity: subangular, platy 4. Color of cut surface: pale brown 5. Texture / Vesicularity: massive, non-vesicular 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: brown clay replacing Gm 9. Encrustations: 2.2cm Mn crust 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR61-11	1. Rock Type: aphyric volcanic rock, highly altered, brown 2. Size: 2x1.5x1.5cm clast in ø7cm Mn nodule 3. Shape / Angularity: subangular 4. Color of cut surface: brown 5. Texture / Vesicularity: 1% vesicles, fractured, zeolite, oxide, phosphate filling 6. Phenocrysts: none 7. Matrix: microcrystalline 8. Secondary Minerals: phosphate, clay, zeolite, Mn-oxide 9. Encrustations: 2cm Mn crust 10. Comment:								
SO265-DR61-12	1. Rock Type: aphyric volcanic rock, highly altered, brown 2. Size: 6x7x5.5cm clast in ø7cm Mn nodule 3. Shape / Angularity: subrounded 4. Color of cut surface: brown with cream colored alteration rind 5. Texture / Vesicularity: non vesicular 6. Phenocrysts: aphyric 7. Matrix: microcrystalline 8. Secondary Minerals: phosphate, clay, zeolite, Mn-oxide 9. Encrustations: 2cm Mn crust 10. Comment:								
SO265-DR61-13	1. Rock Type: Mn nodule with alteration products of basalt in core 2. Size: 6x7x5cm clast in ø8cm Mn nodule 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								
SO265-DR61-14	1. Rock Type: volcanoclastic breccia in core of Mn nodule 2. Size: 5x5x5cm clast in ø7cm Mn nodule 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: clasts are aphyric basalt, brown, microcrystalline Gm. Matrix is altered material + phosphoritic crust								
SO265-DR61-15	1. Rock Type: Mn nodule with brown aphyric volcanic core, highly altered 2. Size: 7x6x5cm clast in ø8cm Mn nodule 3. Shape / Angularity: subrounded 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR61-16	1. Rock Type: pumice, moderately altered 2. Size: 12x9x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: dirty white, blackish, brownish 5. Texture / Vesicularity: porphyritic, vesicular 20% 6. Phenocrysts: Qz, Mica 7. Matrix: fine grained 8. Secondary Minerals: Mn in some vesicles 9. Encrustations: thin Mn coating / film and patches of Mn oxide 10. Comment:								
SO265-DR61-17X	1. Rock Type: several fragments of volcanic rocks from Mn nodules. 2. Size: 6x1.5x3cm largest, others <2cm 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:								

SO265-DR62


Description of Location and Structure: Ojin Smts, western section, northern part. Flat topped Smt on top of large N-S elongated basement structure, upper part of WNW slope

Dredge on bottom UTC 23/09/18 11:44hrs, lat 38°32.25'N, long 166°41.32'E, depth 3756m



Dredge off bottom UTC 23/09/18 12:48hrs, lat 38°32.05'N, long 166°41.64'E, depth 3330m

total volume: few rocks

Comments: ~40cm bloc of tuff, several small tuff fragments, two clasts of scoria and vesicular volcanic rock

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR62-1	1. Rock Type: vesicular volcanic rock, scoria, slightly to moderately altered 2. Size: 7x6x4cm 3. Shape / Angularity: angular 4. Color of cut surface: dark brown 5. Texture / Vesicularity: 30% vesicles, partly filled with Mn 6. Phenocrysts: none 7. Matrix: cryptocrystalline, very fine grained 8. Secondary Minerals: minor low-T alteration 9. Encrustations: 0.5cm Mn crust 10. Comment: the rock is basically good for Gc but Mn fillings in fillings are difficult to avoid	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR62-2	1. Rock Type: vesicular volcanic rock, scoria, slightly altered 2. Size: 11x10x8cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown 5. Texture / Vesicularity: 20% vesicles, majority are partly filled with Mn 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: minor low-T alteration 9. Encrustations: none, thin Mn film 10. Comment:	2	x						
SO265-DR62-3	1. Rock Type: volcanoclastic sediment, tuff, strongly altered 2. Size: one of several up to 40cm blocs; specimen taken 25x13x7cm 3. Shape / Angularity: freshly broken 4. Color of cut surface: green / brown 5. Texture / Vesicularity: clastic layered, fine to coarse grained 6. Phenocrysts: some fresh Pl crystals 7. Matrix: palagonitized glass particles, basaltic scoria fragments 8. Secondary Minerals: pervasive palagonitization 9. Encrustations: none 10. Comment: Pl can be picked	2			Pl?				

SO265-DR63


Description of Location and Structure: Ojin Smts, western section, northern part. Flat topped Smt ~20nm N of DR62. S slope at edge of a possible slope collapse site

Dredge on bottom UTC 23/09/18 17:31hrs, lat 38°41.89'N, long 166°55.86'E, depth 3440m




Dredge off bottom UTC 23/09/18 18:50hrs, lat 38°42.09'N, long 166°56.32'E, depth 2950m

total volume: 1/4 full





Comments: 20 lava fragments 0.1 to 0.6m. Most are highly vesicular, fewer dense, some reddish oxidized, bloc is a highly Fsp phryic hyaloclastite with xenoliths of Fsp phryic lava; matrix mostly altered but may contain fresh glass

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR63-1	1. Rock Type: aphyric, highly vesicular volcanic rock, moderately altered 2. Size: 31x26x17cm original size of Bloc D 3. Shape / Angularity: angular 4. Color of cut surface: grey to brown along rim 5. Texture / Vesicularity: 20-30% vesicles, mostly ø 3-7mm and open, some filled with Mn? 6. Phenocrysts: none 7. Matrix: fine grained 8. Secondary Minerals: minor vesicle filling and Mn patches 9. Encrustations: up to 1cm Mn crust 10. Comment:	2	x					bloc D	





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR63-2	1. Rock Type: aphyric, highly vesicular volcanic rock, moderately altered 2. Size: 17x11x9cm 3. Shape / Angularity: subrounded 4. Color of cut surface: grey to brown 5. Texture / Vesicularity: 15-20% vesicles, 2-8mm ϕ , mostly open, sometimes filled with Mn? 6. Phenocrysts: 1-2% Fsp, <1mm; 1-2% altered Ol?, <1mm 7. Matrix: fine grained 8. Secondary Minerals: some Mn patches 9. Encrustations: 3-4mm Mn coating 10. Comment:	2	x						
SO265-DR63-3	1. Rock Type: aphyric, highly vesicular volcanic rock, slightly altered 2. Size: 9x5x5cm 3. Shape / Angularity: subrounded 4. Color of cut surface: light grey to brownish at cracks 5. Texture / Vesicularity: 15-20% vesicles, 2-4mm ϕ , some elongated to up to 1cm, mostly open, sometimes filled with brown material 6. Phenocrysts: 1-2% Fsp, <1mm; 1% altered Ol?, <1mm 7. Matrix: fine grained 8. Secondary Minerals: Mn patches and Mn in cracks 9. Encrustations: thin Mn coating 10. Comment: too small for 2nd TS (OSU). Check TS if groundmass is ok for Ar-Ar. Do not use up entire sample for Gc	1	1						
SO265-DR63-4	1. Rock Type: aphyric, highly vesicular volcanic rock, moderately altered 2. Size: 11x5x7cm 3. Shape / Angularity: subrounded 4. Color of cut surface: grey - greenish to brownish around cracks and vesicles 5. Texture / Vesicularity: 15-20% vesicles, 2-4mm ϕ , some elongated to up to 1cm, open 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: Mn patches 9. Encrustations: Mn coating 10. Comment:	1	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR63-5 & SO265-DR63-5X	1. Rock Type: aphyric, highly vesicular volcanic rock, moderately altered 2. Size: 45x33x28cm original size of bloc E 3. Shape / Angularity: angular 4. Color of cut surface: grey - greenish to slightly brown 5. Texture / Vesicularity: 20% vesicles, 1-4mm ø, unfilled along outside (Cc dissolution?), filled in center with brownish-yellowish material and Cc 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: few Mn patches 9. Encrustations: Mn coating 10. Comment: -5X backup sample in separate bag along with other samples. TS and GC from rim and core. Along rim vesicles are open (Cc dissolution below CCD?) and in core they are filled. Likely that rim samples is better for Gc; suggested to prepare both GC slabs.	4	x					bloc E	
SO265-DR63-6 & SO265-DR63-6X	1. Rock Type: sparsely phyric, highly vesicular volcanic rock, moderately altered 2. Size: 28x23x18cm original size of bloc B 3. Shape / Angularity: angular 4. Color of cut surface: brown - reddish to greenish in places 5. Texture / Vesicularity: 15-20% vesicles, 1-4mm ø, vesicles filled with brown or green material 6. Phenocrysts: 7. Matrix: fine to medium grained with Fsp needles 8. Secondary Minerals: Mn patches, greenish vesicle filling / lining resembles malachite (Cu?) 9. Encrustations: Mn coating 10. Comment: -6X backup sample in separate bag along with other samples	2	x						
SO265-DR63-7	1. Rock Type: Fsp phyric, vesicular volcanic rock, moderately altered 2. Size: 14x10x4cm 3. Shape / Angularity: subrounded 4. Color of cut surface: dark reddish brown 5. Texture / Vesicularity: 5-10% vesicles, 1-5mm ø, some filled with Mn 6. Phenocrysts: 15% Fsp <1mm; ~10% altered Ol? 7. Matrix: fine grained 8. Secondary Minerals: Mn patches 9. Encrustations: Mn coating 10. Comment:	1							
SO265-DR63-8	1. Rock Type: Fsp phyric, vesicular volcanic rock, moderately altered 2. Size: 12x6x8cm 3. Shape / Angularity: subrounded 4. Color of cut surface: brown reddish 5. Texture / Vesicularity: 15-20% vesicles, 1-3mm ø, open 6. Phenocrysts: ~15% Fsp up to 3-4mm; most are ~1mm needles 7. Matrix: fine grained with Fsp needles 8. Secondary Minerals: Mn patches 9. Encrustations: Mn coating 10. Comment:	1							

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR63-9 & SO265-DR63-9X	1. Rock Type: Fsp aphyric volcanic rock, slightly altered 2. Size: 33x20x18cm original size of bloc C 3. Shape / Angularity: subrounded 4. Color of cut surface: grey with some brown, oxidized patches 5. Texture / Vesicularity: ~1% vesicles, 1-2mm ϕ , filled with brown material 6. Phenocrysts: ~1% Fsp, ϕ 1mm; 1-2% altered Ol, ϕ 1mm 7. Matrix: fine grained with Fsp needles 8. Secondary Minerals: Mn patches and along cracks 9. Encrustations: Mn coating 10. Comment: -9X backup sample in separate bag along with other samples	2	x				x	bloc C GC in air freight box	
SO265-DR63-10	1. Rock Type: Fsp sparsely phyric volcanic rock, strongly altered 2. Size: 9x9x4cm 3. Shape / Angularity: subrounded 4. Color of cut surface: light brown to brown 5. Texture / Vesicularity: ~10% vesicles, 1-4mm ϕ , some filled with yellow-green or brown material 6. Phenocrysts: 2-3% altered Ol?, ϕ 1mm; 1% Amph?, \leq 1mm 7. Matrix: fine grained with Fsp needles 8. Secondary Minerals: Mn patches 9. Encrustations: Mn coating 10. Comment:	1	x						
SO265-DR63-11	1. Rock Type: aphyric volcanic rock, strongly altered 2. Size: 15x11x7cm 3. Shape / Angularity: subrounded 4. Color of cut surface: grey to dark 5. Texture / Vesicularity: ~10% vesicles, 1-3mm ϕ , some filled with white material 6. Phenocrysts: 1-2% Fsp?, ϕ \leq 1mm; 1-2% altered Ol? \leq 1mm 7. Matrix: fine grained 8. Secondary Minerals: Mn patches 9. Encrustations: Mn coating 10. Comment:	1							
SO265-DR63-12	1. Rock Type: highly Fsp phyric hyaloclastite, overall strongly altered, maybe some fresh glass preserved 2. Size: 20x16x14cm original size of bloc A 3. Shape / Angularity: angular 4. Color of cut surface: olive green to black 5. Texture / Vesicularity: massive, non-vesicular 6. Phenocrysts: ~20% large Fsp phenocrysts up to 1cm, altered Gl 7. Matrix: glassy, rounded xenoliths of Fsp phyric lava with similar texture as hyaloclastite but crystallized Gm. 8. Secondary Minerals: glass altered to smectite 9. Encrustations: Mn coating 10. Comment: Fsp to be checked for Ar-Ar and matrix if some fresh Gl is preserved. Entire bloc A sampled. GEOMAR TS are 1x xenolith, 1x hyaloclastite, OSU 1x hyaloclastite for Fsp inspection, and Hannover 1x hyaloclastite	4						bloc A	

Appendix 2 (Station Details and Rock Description)

SO265-DR64




Description of Location and Structure: Ojin Smts, western province, northern part. Ø10-12km Smt with cone on top. N-facing flank beneath top area of cone.

Dredge on bottom UTC 24/09/18 02:24hrs, lat 39°09.07'N, long 166°11.53'E, depth 4020m





Dredge off bottom UTC 24/09/18 03:39hrs, lat 39°08.64'N, long 166°11.45'E, depth 3590m

total volume: 1/2 full





Comments: Mostly Mn nodules <ø10cm very well rounded, 1x very large Mn crust (bloc A), a few angular pillow lava fragments, pumice. Several fairly fresh aphyric volcanic rocks sampled. All highly vesicular, some have rare Pl phenocrysts

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR64-1	1. Rock Type: aphyric lava, fresh to slightly altered 2. Size: 11x6x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to pale brown 5. Texture / Vesicularity: 20% moderately vesiculated, two types 1) pipe vesicles ø5-8mm and 2) small ø1mm. Pipe vesicles filled with brown material, others with grey white material 6. Phenocrysts: none 7. Matrix: fine grained, fresh Pl microphenocrysts in Gm 8. Secondary Minerals: vesicle filling 9. Encrustations: 2mm Mn crust 10. Comment:	2	x						
SO265-DR64-2	1. Rock Type: very sparsely Pl phyric lava, fresh to slightly altered 2. Size: 12x7x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to pale brown 5. Texture / Vesicularity: see -1 6. Phenocrysts: <1% Pl, 0.5-1mm, euhedral 7. Matrix: fine grained 8. Secondary Minerals: see -1 9. Encrustations: thin film of Mn 10. Comment:	2	x		Pl				
SO265-DR64-3	1. Rock Type: very sparsely Pl phyric lava, fresh to slightly altered 2. Size: 9x6x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to pale brown 5. Texture / Vesicularity: 3% vesicles, some filled with pale yellow, pale green, pale brown material 6. Phenocrysts: <1% Pl, <0.5mm, subhedral 7. Matrix: microcrystalline 8. Secondary Minerals: pale brown halo covering 1/3 of sample, vesicle fillings 9. Encrustations: thin film of Mn 10. Comment: the freshest of all DR64 rocks	2	x				x	GC in air freight box	

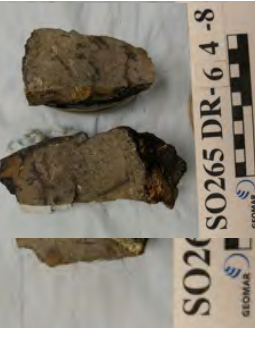



Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR64-4	1. Rock Type: very sparsely Pl phyric lava, fresh to slightly altered 2. Size: 11x8x7cm; clast from bloc A (85x60x25cm) 3. Shape / Angularity: subangular 4. Color of cut surface: grey core, brown middle part, pale yellow pillow rim 5. Texture / Vesicularity: see -1 6. Phenocrysts: <1% Pl, 0.5-1mm, euhedral to subhedral, fresh 7. Matrix: microcrystalline 8. Secondary Minerals: brown to pale brown material fills pipe vesicles, brown to pale yellow along pillow margin 9. Encrustations: 5cm Mn crust 10. Comment: a piece of from bloc A	2	x		Pl			from bloc A	
SO265-DR64-5	1. Rock Type: very sparsely Pl phyric lava, fresh to slightly altered 2. Size: 12x8x8cm; clast from bloc A (85x60x25cm) 3. Shape / Angularity: angular 4. Color of cut surface: see -4 5. Texture / Vesicularity: see -4 6. Phenocrysts: <1% Pl, 0.5-2mm, euhedral to subhedral, fresh, in places altered into pale-brown mineral 7. Matrix: see -4 8. Secondary Minerals: see -4 9. Encrustations: see -4 10. Comment: a piece of from bloc A	2	x		Pl			from bloc A	
SO265-DR64-6	1. Rock Type: very sparsely Pl phyric pillow lava, fresh to slightly altered 2. Size: 10x9x7cm; clast from bloc A (85x60x25cm) 3. Shape / Angularity: angular 4. Color of cut surface: see -4 5. Texture / Vesicularity: see -1 6. Phenocrysts: <1% Pl, 0.5-2mm, subhedral to anhedral, fresh to altered pale-brown mineral, some form crystal cloths 7. Matrix: microcrystalline 8. Secondary Minerals: brown, pale brown material fills pipe vesicles, white pale brown material along cracks and some vesicles. Oxidation halo covering 1/4 of sample 9. Encrustations: see -4 10. Comment: a piece of from bloc A	2	x		Pl			from bloc A	
SO265-DR64-7	1. Rock Type: very sparsely Pl phyric pillow lava, fresh to slightly altered 2. Size: 12x7x6cm; clast from bloc A (85x60x25cm) 3. Shape / Angularity: angular 4. Color of cut surface: see -4 5. Texture / Vesicularity: see -1 6. Phenocrysts: <1% Pl, 0.5-2mm, euhedral to anhedral, fresh 7. Matrix: see -6 8. Secondary Minerals: see -6 9. Encrustations: see -6 10. Comment: a piece of from bloc A	2	x		Pl			from bloc A	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR64-8	1. Rock Type: very sparsely PI phyric pillow lava, slightly altered 2. Size: 13x11x15cm 3. Shape / Angularity: angular 4. Color of cut surface: grey to pale brown 5. Texture / Vesicularity: see -1 6. Phenocrysts: <1% PI, 1-3mm, euhedral to subhedral, altered to grey - pale brown mineral 7. Matrix: microcrystalline 8. Secondary Minerals: brown minerals are scattered everywhere in the rock and pipe vesicles. Pale-yellow minerals fill small vesicles 9. Encrustations: thin Mn crust 10. Comment:	2	x		PI				
SO265-DR64-9	1. Rock Type: very sparsely PI phyric pillow lava, fresh to slightly altered 2. Size: 13x11x15cm 3. Shape / Angularity: angular 4. Color of cut surface: grey to pale brown 5. Texture / Vesicularity: see -1 6. Phenocrysts: see -8 7. Matrix: fine grained 8. Secondary Minerals: see -8 9. Encrustations: see -8 10. Comment:	2	x						
SO265-DR64-10	1. Rock Type: very sparsely PI phyric pillow lava, fresh to slightly altered 2. Size: 7x6x4cm clast from bloc B (15x15x18cm) 3. Shape / Angularity: subangular 4. Color of cut surface: grey to brown 5. Texture / Vesicularity: see -1 6. Phenocrysts: <1% PI, 0.5-1.5mm, fresh 7. Matrix: microcrystalline 8. Secondary Minerals: oxidation halo, pale brown minerals fill pipe vesicles, white brown minerals fill small vesicles 9. Encrustations: 5cm Mn crust 10. Comment: from bloc B	2	x					from bloc B	
SO265-DR64-11	1. Rock Type: very sparsely PI phyric pillow lava, fresh to moderately altered 2. Size: 7x6x6cm clast from bloc C (19x17x8cm) 3. Shape / Angularity: angular 4. Color of cut surface: grey to brown 5. Texture / Vesicularity: see -1 6. Phenocrysts: <1% PI, 0.5-2mm, subhedral to anhedral, some partially replaced by grey mineral 7. Matrix: microcrystalline 8. Secondary Minerals: see -10 9. Encrustations: 4cm Mn crust 10. Comment: from pillow bloc C	2	x					from bloc C	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR64-12	1. Rock Type: very sparsely Pl phyric pillow lava, fresh to moderately altered 2. Size: 7x6x6cm clast from bloc C (19x17x8cm) 3. Shape / Angularity: angular 4. Color of cut surface: grey to brown 5. Texture / Vesicularity: see -1 6. Phenocrysts: see -11 7. Matrix: see -11 8. Secondary Minerals: see -11 9. Encrustations: see -11 10. Comment: from pillow bloc C							from bloc C	
SO265-DR64-13	1. Rock Type: very sparsely Pl phyric pillow lava, fresh to moderately altered 2. Size: 9x8x6cm clast from bloc A (85x60x25cm) 3. Shape / Angularity: angular 4. Color of cut surface: grey to pale pink to brown 5. Texture / Vesicularity: see -1 6. Phenocrysts: <1% Pl, 0.5-3mm, euhedral / subhedral, fresh to slightly altered into pale yellow mineral 7. Matrix: fine grained 8. Secondary Minerals: see -10 9. Encrustations: 5cm Mn crust 10. Comment: from bloc A							from bloc a	
SO265-DR64-14	1. Rock Type: very sparsely Pl phyric pillow lava, moderately to highly altered 2. Size: 13x11x7cm clast from bloc A (85x60x25cm) 3. Shape / Angularity: angular 4. Color of cut surface: pale brown to brown 5. Texture / Vesicularity: highly vesicular 30%, filled with brown, pale yellow, pale green and white material 6. Phenocrysts: <1% Pl, 0.5-3mm, euhedral / subhedral, fresh to slightly altered into pale yellow mineral 7. Matrix: cryptocrystalline 8. Secondary Minerals: suffered from hydrothermal alteration to pale, brown minerals 9. Encrustations: 5cm Mn crust 10. Comment: from bloc A							from bloc A	
SO265-DR64-15	1. Rock Type: volcanic rock, pumice, moderately altered 2. Size: 13x11x17cm clast from bloc A (85x60x25cm) 3. Shape / Angularity: elongated, subangular 4. Color of cut surface: dirty white with black patches / spots 5. Texture / Vesicularity: highly vesicular 30%, stretched in one direction, bubble wall texture 6. Phenocrysts: aphyric 7. Matrix: microcrystalline 8. Secondary Minerals: largely replaced / disseminated with Mn-oxide 9. Encrustations: Mn coating 10. Comment:								

SO265-DR65

Description of Location and Structure: Ojin Smts, western province, northern part. NE-SW elongated Smt with several rib like offsets, track along nose-like structure at SE slope





Dredge on bottom UTC 24/09/18 10:02hrs, lat 39°04.47'N, long 165°28.89'E, depth 3906m

Dredge off bottom UTC 24/09/18 10:53hrs, lat 39°04.69'N, long 165°28.79'E, depth 3650m





total volume: 1/6 full

Comments: several fragments of Mn crust, few larger blocs of Mn crust, one larger bloc which is probably tuff





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR65-1	1. Rock Type: sparsely Pl phyric volcanic rock, fresh to slightly altered 2. Size: 8x6x4cm clast from bloc B (20x18x12cm) 3. Shape / Angularity: angular, equant 4. Color of cut surface: grey 5. Texture / Vesicularity: 20% vesicles, ~0.2mm, up to 1mm, majority openbut 1/2 are lined with yellow-brown product 6. Phenocrysts: <1% Pl up to 2mm, bladed, euhedral, appears fresh 7. Matrix: cryptocrystalline, some fine acicular Pl, 0.5-1mm 8. Secondary Minerals: vesicle walls lined with brown mineral. Gm may have experienced low-T alteration in some portions 9. Encrustations: 2mm Mn crust 10. Comment: from bloc B, freshest sample of DR65	2	x	x				x from bloc B GC in air freight box	
SO265-DR65-2A	1. Rock Type: sparsely Pl phyric volcanic rock, fresh to slightly altered 2. Size: 6x5x4cm clast from bloc E (22x11x10cm) 3. Shape / Angularity: angular sample, subangular bloc E 4. Color of cut surface: grey 5. Texture / Vesicularity: 30% vesicles, most abundant (3/4) are ≤0.5mm, open; other 25% are up to 5mm but lined with secondaries along walls 6. Phenocrysts: <1% Pl up to 2mm, does not appear fresh, feathery edges, appear corroded 7. Matrix: cryptocrystalline, fine Pl microlites, some mesotaxis, appears slightly oxidized 8. Secondary Minerals: some Pl altered to chalky white - yellow 9. Encrustations: 2cm Mn crust on bloc E, on sample removed during preparation 10. Comment: from bloc E	1	x					from bloc E	
SO265-DR65-2B	1. Rock Type: sparsely Pl phyric volcanic rock, fresh to slightly altered 2. Size: 3x3x3cm clast from bloc E (22x11x10cm) 3. Shape / Angularity: angular sample, subangular bloc E 4. Color of cut surface: grey 5. Texture / Vesicularity: see -2A, except no large vesicles, max ø 1mm, unfilled 6. Phenocrysts: <1% Pl but smaller than -2A 7. Matrix: see -2A 8. Secondary Minerals: see -2A 9. Encrustations: see -2A 10. Comment: from bloc E							from bloc E	
SO265-DR65-3	1. Rock Type: aphyric lava, fresh to slightly altered 2. Size: 4x4x4cm clast from bloc A (30x24x20cm) 3. Shape / Angularity: angular sample, subangular bloc A 4. Color of cut surface: dark grey to dark brown 5. Texture / Vesicularity: 30-40% vesicles, 80% ≤0.3mm, mostly open, others up to 4mm, spherical or slightly oblate 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: some white green coloration along outer sufaces. Gm appears reddish in places and possibly recrystallized 9. Encrustations: <1mm Mn on bloc A, on sample removed during preparation 10. Comment: from bloc A	1	x					from bloc A	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR65-4A	1. Rock Type: aphyric lava, fresh to slightly altered 2. Size: 14x11x6cm clast from bloc C (33x25x17cm) 3. Shape / Angularity: angular sample, subrounded bloc C 4. Color of cut surface: grey 5. Texture / Vesicularity: 30-40% vesicles, 0.2-6mm, spherical, majority open, some filled with yellow-brown material 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: minor vesicle infill 9. Encrustations: 1.5cm Mn on bloc C, on sample removed during preparation 10. Comment: from bloc C	1	x					from bloc C	
SO265-DR65-4B	1. Rock Type: volcaniclastic breccia 2. Size: 10x8x9cm from bloc C (33x25x17cm) 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment: representative portion of volcaniclastic breccia of bloc C. Contains angular volcanic clasts up to 2.5cm. They range from grey to brown, are aphyric and vesicular							matrix of bloc C	
SO265-DR65-5A	1. Rock Type: aphyric lava, fresh to slightly altered 2. Size: 6x5x5cm clast from bloc D (33x25x17cm) 3. Shape / Angularity: subangular 4. Color of cut surface: grey 5. Texture / Vesicularity: 30% vesicularity, max ø 2.5mm, less vesicle wall lining 6. Phenocrysts:similar to -4A 7. Matrix: similar to -4A 8. Secondary Minerals: similar to -4A 9. Encrustations: 0.5cm Mn crust 10. Comment: from bloc D	1	x					from bloc D	
SO265-DR65-5B	1. Rock Type: aphyric lava, moderately altered, sparsely Pl aphyric 2. Size: 4x4x4cm clast from bloc D (33x25x17cm) 3. Shape / Angularity: subangular 4. Color of cut surface: brown to dark grey brown 5. Texture / Vesicularity: 10-20% vesicularity, most <0.25mm, majority open. Seem to form bands of massive lava and then vesicles 6. Phenocrysts: rare Pl <1% up to 1.5mm, euhedral, appear fresh 7. Matrix: cryptocrystalline, oxidized, some Mn patches. Gradation of Gm color from edge to core 8. Secondary Minerals: some vesicle filling, brown Gm oxidation along edge 9. Encrustations: 1cm Mn crust 10. Comment: from bloc D, same as 5B but different clast	1						from bloc D	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR65-6	1. Rock Type: aphyric lava, slightly altered 2. Size: 6x5x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: brown grey 5. Texture / Vesicularity: similar to -4A 6. Phenocrysts: similar to -4A 7. Matrix: similar to -4A 8. Secondary Minerals: similar to -4A but Gm may have suffered more intense low T alteration, vesicle have more infill 9. Encrustations: 1cm Mn crust 10. Comment:	1							
SO265-DR65-7	1. Rock Type: sparsely Pl aphyric lava, moderately altered 2. Size: 10x7x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: similar to -5B 5. Texture / Vesicularity: similar to -5B 6. Phenocrysts: similar to -5B, except Pl more subhedral and ~1mm 7. Matrix: similar to -5B 8. Secondary Minerals: similar to -5B 9. Encrustations: 1cm Mn crust 10. Comment:	1							
SO265-DR65-8	1. Rock Type: pumice, fresh 2. Size: 13x10x9.5cm 3. Shape / Angularity: rounded 4. Color of cut surface: white to tan 5. Texture / Vesicularity: 50% vesicles 6. Phenocrysts: Qz + Hbl 7. Matrix: glassy 8. Secondary 9. Encrustations: 10. Comment:				Gl				
SO265-DR65-9	1. Rock Type: pumice, fresh 2. Size: 13x10x9.5cm 3. Shape / Angularity: rounded 4. Color of cut surface: white to tan 5. Texture / Vesicularity: 50% vesicles 6. Phenocrysts: Qz + Hbl 7. Matrix: glassy 8. Secondary 9. Encrustations: 10. Comment:						x	glass in air freight box	

SO265-DR66

Description of Location and Structure: Ojin Smts, western province. Flat topped Smt, S of DR65, small scarp along E slope, track along upper part

Dredge on bottom UTC 24/09/18 17:18hrs, lat 38°35.41'N, long 165°18.84'E, depth 3391m

Dredge off bottom UTC 24/09/18 18:16hrs, lat 38°35.57'N, long 165°18.57'E, depth 3088m

total volume: empty

Appendix 2 (Station Details and Rock Description)

SO265-DR67




Description of Location and Structure: Ojin Smts, western province, NW corner. N-S elongated Smt with flat topped area in S and ø1km cone at N end. Track along S flank of the main edifice beneath plateau edge

Dredge on bottom UTC 24/09/18 23:05hrs, lat 38°16.82'N, long 165°15.47'E, depth 3822m





Dredge off bottom UTC 25/09/18 00:33hrs, lat 38°17.24'N, long 165°15.39'E, depth 3373m

total volume: very large Mn crust, Mn nodules and pillow






Comments: mid sized pillow (bloc B, 31x30x33cm) of sparsely Pl phyric lava, slightly to moderately altered (1A - 1F). Samples -2 through -4 are from bloc A (133x80x33cm) and moderately altered lava similar to -1. Samples -5 & -6 are highly altered, aphyric lava fragments while -7 is another piece of sparsely Pl phyric lava.

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR67-1A	1. Rock Type: sparsely Pl phyric pillow fragment, slightly to moderately altered. -1A through -1F are all from same pillow (bloc B) 2. Size: 9x8x5cm from bloc B (31x30x33cm) 3. Shape / Angularity: subangular 4. Color of cut surface: reddish brown 5. Texture / Vesicularity: 3-5% vesicles, ≤3mm, mostly ≤1mm, filled with white-green material 6. Phenocrysts: 3-5% Pl <2mm, subhedral to anhedral, <1% Px? greenish ≤1mm 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings; Mn patches 9. Encrustations: ≤1mm Mn crust 10. Comment:	2	x					from pillow bloc B	
SO265-DR67-1B	1. Rock Type: sparsely Pl phyric pillow fragment, moderately altered. From pillow bloc B 2. Size: 6x5x5cm from bloc B (31x30x33cm) 3. Shape / angularity: subangular 4. Color of cut surface: partly grey but mostly reddish brown 5. Texture / Vesicularity: 1-3% vesicles, mostly ≤2mm, filled with white-green material, few up to 7mm, open 6. Phenocrysts: 5% Pl <3mm, subhedral to anhedral, <1% Px? greenish ≤1mm 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings; Mn patches 9. Encrustations: 10. Comment:	1	x					from pillow bloc B	
SO265-DR67-1C	1. Rock Type: sparsely Pl phyric pillow fragment, moderately altered. From pillow bloc B 2. Size: 8x9x6cm from bloc B (31x30x33cm) 3. Shape / angularity: subangular 4. Color of cut surface: similar to -1B 5. Texture / Vesicularity: similar to -1B 6. Phenocrysts: 5% Pl <3mm, subhedral to anhedral 7. Matrix: similar to -1B 8. Secondary Minerals: similar to -1B 9. Encrustations: similar to -1B 10. Comment:	1	x					from pillow bloc B	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR67-1D	1. Rock Type: sparsely Pl phyric pillow fragment, moderately altered. From pillow bloc B 2. Size: 6x8x6.5cm from bloc B (31x30x33cm) 3. Shape / angularity: subangular 4. Color of cut surface: small part grey, mostly orange brown 5. Texture / Vesicularity: similar to -1B but larger vesicles absent 6. Phenocrysts: similar to -1B 7. Matrix: similar to -1B 8. Secondary Minerals: similar to -1B 9. Encrustations: similar to -1B 10. Comment:	1						from pillow bloc B	
SO265-DR67-1E	1. Rock Type: sparsely Pl phyric pillow fragment, moderately altered. From pillow bloc B 2. Size: 6x8x6cm from bloc B (31x30x33cm) 3. Shape / angularity: subangular 4. Color of cut surface: very small grey part, rest orange brown 5. Texture / Vesicularity: 1-3% vesicles, ≤2mm, most filled with sediment or white / greenish material 6. Phenocrysts: similar to -1B 7. Matrix: similar to -1B 8. Secondary Minerals: similar to -1B 9. Encrustations: similar to -1B 10. Comment:	1						from pillow bloc B	
SO265-DR67-1F	1. Rock Type: sparsely Pl phyric pillow fragment, moderately altered. From pillow bloc B 2. Size: 16x14x11cm from bloc B (31x30x33cm) 3. Shape / angularity: subangular 4. Color of cut surface: grey part but mostly orange brown 5. Texture / Vesicularity: to -1B 6. Phenocrysts: 7% Pl ≤4mm 7. Matrix: similar to -1B 8. Secondary Minerals: similar to -1B 9. Encrustations: similar to -1B 10. Comment:	1						from pillow bloc B	
SO265-DR67-2	1. Rock Type: sparsely Pl phyric lava fragment, moderately altered. From Mn crust bloc A 2. Size: 4.5x6x5.5cm 3. Shape / angularity: subangular 4. Color of cut surface: pale brown to brown 5. Texture / Vesicularity: massive, slightly vesiculated, filled with green clay 6. Phenocrysts: 1% Pl ≤0.5mm, euhedral to subhedral, fresh 7. Matrix: cryptocrystalline 8. Secondary Minerals: most parts are altered / oxidized to brown discoloration, Mn along cracks and dendritical growth 9. Encrustations: 4mm Mn crust 10. Comment: clast from Mn crust	1	x					clast from Mn crust bloc A	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR67-3	1. Rock Type: sparsely Pl phyric lava fragment, moderately altered. From Mn crust bloc A 2. Size: 5.5x4.5x4.5cm 3. Shape / angularity: angular 4. Color of cut surface: similar to -2 5. Texture / Vesicularity: similar to -2 6. Phenocrysts: similar to -2 7. Matrix: similar to -2 8. Secondary Minerals: similar to -2 9. Encrustations: 3mm Mn crust 10. Comment: clast from Mn crust bloc A	1						clast from Mn crust bloc A	
SO265-DR67-4	1. Rock Type: sparsely Pl phyric lava fragment, moderately altered. From Mn crust bloc A 2. Size: 8x8x5.5cm 3. Shape / angularity: subangular 4. Color of cut surface: pale brown 5. Texture / Vesicularity: massive 6. Phenocrysts: 1% Pl <0.5mm, euhedral to subhedral, almost fresh 7. Matrix: cryptocrystalline 8. Secondary Minerals: Gm oxidation to brown, dendritic Mn infiltration 9. Encrustations: thin Mn coating 10. Comment: clast from Mn crust bloc A	1						clast from Mn crust bloc A	
SO265-DR67-5	1. Rock Type: aphyric lava fragment, highly altered 2. Size: 7x6x5.5cm 3. Shape / angularity: angular 4. Color of cut surface: greyish brown 5. Texture / Vesicularity: massive 6. Phenocrysts: 1% Pl ~1mm, subhedral, altered to clay, replaced by Mn 7. Matrix: cryptocrystalline 8. Secondary Minerals: dissemination of Mn in Gm, severe Gm oxidation 9. Encrustations: thin Mn coating 10. Comment:	1							
SO265-DR67-6	1. Rock Type: aphyric lava fragment, highly altered 2. Size: 8x6.5x5cm 3. Shape / angularity: angular 4. Color of cut surface: brown 5. Texture / Vesicularity: massive 6. Phenocrysts: similar to -5 7. Matrix: cryptocrystalline 8. Secondary Minerals: similar to -5 9. Encrustations: thin Mn coating 10. Comment:	1							
SO265-DR67-7	1. Rock Type: sparsely phyric lava fragment, moderately to highly altered 2. Size: 6.5x6x7cm 3. Shape / angularity: angular 4. Color of cut surface: gry with light brown spots 5. Texture / Vesicularity: massive 6. Phenocrysts: ~1% Pl similar ~1mm, euhedral to subhedral, altered to clay, replaced by Mn, few fresh 7. Matrix: cryptocrystalline 8. Secondary Minerals: similar to -5 9. Encrustations: thin Mn coating 10. Comment:	1							

Appendix 2 (Station Details and Rock Description)

SO265-DR68





Description of Location and Structure: Ojin Smts, western province, central part. Extremely steep sloped, guyot shaped Smt, S-flank up to 56° steep

Dredge on bottom UTC 25/09/18 07:07hrs, lat 37°39.57'N, long 165°07.55'E, depth 3520m





Dredge off bottom UTC 25/09/18 08:54hrs, lat 37°39.95'N, long 165°07.75'E, depth 2885m

total volume: 1/4 full



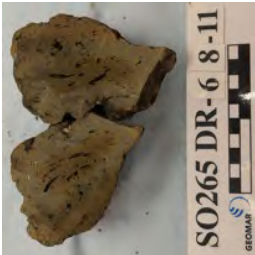

Comments: Aphyric, massive lava, relatively fresh to slightly-moderately altered (-1 to -6); more vesicular varieties -7 to -12, more altered and sparsely Pl aphyric. Platy volcanics or sediment -13 to -15, aphyric, sound like phonolite. -16 copper green hydrothermally altered lava or tuff.

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR68-1	1. Rock Type: aphyric volcanic rock, relatively fresh 2. Size: 15x12x9cm 3. Shape / Angularity: subangular 4. Color of cut surface: blueish grey 5. Texture / Vesicularity: 1-2% vesicles, ≤1mm, filled with white material 6. Phenocrysts: none 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings; Mn patches 9. Encrustations: ≤1mm Mn crust 10. Comment:	2	x				x	GC in air freight box	
SO265-DR68-2	1. Rock Type: aphyric volcanic rock, relatively fresh to slightly altered 2. Size: 21x16x12cm 3. Shape / Angularity: subangular 4. Color of cut surface: blueish grey; appears to have a slightly darker ≤1cm rim 5. Texture / Vesicularity: 1% vesicles, ≤1mm, open 6. Phenocrysts: none 7. Matrix: fine grained 8. Secondary Minerals: 9. Encrustations: ≤1mm Mn crust 10. Comment:	2	x						
SO265-DR68-3	1. Rock Type: sparsely Pl aphyric volcanic rock, slightly altered 2. Size: 13x11.5x6.5cm 3. Shape / Angularity: subangular 4. Color of cut surface: light grey, partly blueish grey 5. Texture / Vesicularity: 1-3% vesicles, open or filled with Mn 6. Phenocrysts: ≤2% Fsp, ≤1mm, subhedral to euhedral 7. Matrix: fine grained 8. Secondary Minerals: Mn as vesicle fillings and along cracks 9. Encrustations: ≤1mm Mn crust 10. Comment:	2	x						
SO265-DR68-4	1. Rock Type: sparsely Pl aphyric volcanic rock, relatively fresh to slightly altered 2. Size: 10x8x8cm 3. Shape / Angularity: subangular 4. Color of cut surface: light grey and blueish grey, appears to be some kind of layering 5. Texture / Vesicularity: 20% vesicles, up to 4mm, mostly elongated, open, aligned parallel to color layering 6. Phenocrysts: 1-2% Fsp, ≤1mm, subhedral to euhedral 7. Matrix: fine grained 8. Secondary Minerals: few Mn patches 9. Encrustations: ≤1mm Mn crust 10. Comment:	2	x						





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR68-5	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 14x11x8cm 3. Shape / Angularity: subangular 4. Color of cut surface: light grey 5. Texture / Vesicularity: overall <1% vesicles, ≤5mm, filled with white brown material, in a small area 20-30% vesicles, ≤1mm 6. Phenocrysts: none 7. Matrix: fine grained; 15-20%, black minerals ~0.2mm 8. Secondary Minerals: vesicle filling 9. Encrustations: Mn coated 10. Comment:	2	x						
SO265-DR68-6	1. Rock Type: aphyric volcanic rock, fresh to moderately altered 2. Size: two pieces 12x11x5.5cm & 12x12x9cm from bloc C (25x18x12cm) 3. Shape / Angularity: subrounded 4. Color of cut surface: grey 5. Texture / Vesicularity: 3% elongated vesicles, up to 9mm, mostly empty or yellow mineral filling 6. Phenocrysts: <1% altered OI?, <1mm 7. Matrix: fine grained 8. Secondary Minerals: yellow vesicle filling; Mn patches, altered OI? 9. Encrustations: Mn coated 10. Comment:	2	x						
SO265-DR68-7	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 7x8.5x9cm 3. Shape / Angularity: subangular 4. Color of cut surface: light grey 5. Texture / Vesicularity: 5-10% vesicles, up to 10mm, elongated, mostly empty 6. Phenocrysts: <1% Fsp, <1mm 7. Matrix: fine grained 8. Secondary Minerals: a few Mn patches 9. Encrustations: Mn coated 10. Comment:	2	x						
SO265-DR68-8	1. Rock Type: sparsely phyric volcanic rock, fresh to moderately altered 2. Size: 15x12x12cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey 5. Texture / Vesicularity: 20-25% vesicles, up to 4mm, mostly empty or filled brown 6. Phenocrysts: <1% altered OI, <1mm; 1-2% Fsp, <1mm 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings 9. Encrustations: coated with Mn and white-yellow or copper-green minerals 10. Comment:	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR68-9	1. Rock Type: aphyric volcanic rock, slightly altered 2. Size: 3 pieces of Bloc B (29x22x11cm); 14x10x7cm, 11.5x10x5.5cm; 9.5x8x9 3. Shape / Angularity: pieces subangular, bloc angular 4. Color of cut surface: light grey 5. Texture / Vesicularity: 20-25% vesicles, up to 5mm, mostly empty, some lined with yellowish or green film, a few with Mn or dark greenish material 6. Phenocrysts: <1% Fsp, <1mm 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, dark green looks like malachite 9. Encrustations: 10. Comment:	2	x						
SO265-DR68-10	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 3 pieces of Bloc G (22x12x10cm); 13x12x7cm, 6.5x8.5x7cm; 9x10x6 3. Shape / Angularity: pieces subrounded to subangular, subrounded 4. Color of cut surface: brown to light brown to greyish brown 5. Texture / Vesicularity: 20-25% vesicles, from <1mm up to 12mm, mostly elongated, empty, few vesicles lined with Mn 6. Phenocrysts: <1% Fsp, <1mm 7. Matrix: fine grained 8. Secondary Minerals: Cc in 3% of vesicles 9. Encrustations: none 10. Comment:	2	x						
SO265-DR68-11	1. Rock Type: aphyric volcanic rock, slightly altered to fairly fresh 2. Size: 16x12x7cm 3. Shape / Angularity: subangular to subrounded 4. Color of cut surface: light grey; partly light brown stained 5. Texture / Vesicularity: 15-20% vesicles, elongated up to 2cm, overall range 1 to 20mm, mostly open, 5% with light green infill 6. Phenocrysts: none 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings, Mn along cracks 9. Encrustations: ≤1mm crust 10. Comment:	2	x						
SO265-DR68-12	1. Rock Type: aphyric volcanic rock, layered, elongated vesicles parallel to layering, moderately to strongly altered, reddish oxidized Gm 2. Size: 13x8x5cm 3. Shape / Angularity: subrounded 4. Color of cut surface: brownish - red 5. Texture / Vesicularity: platy, 5% elongated vesicles parallel to layering, more viscous lava? 6. Phenocrysts: none 7. Matrix: fine grained 8. Secondary Minerals: Gm red oxidized 9. Encrustations: Mn coating 10. Comment: not too promising for bulk rock Gc	2	x						

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR68-13	1. Rock Type: platy volcanic rock fragment, makes characteristic noise when pieces are pushed against each other ----> phonolite?; moderately altered 2. Size: 14.5x12x4.5cm 3. Shape / Angularity: angular 4. Color of cut surface: dark green with brownish patches 5. Texture / Vesicularity: massive, 7-10% <<0.5mm, open with yellow lining 6. Phenocrysts: none 7. Matrix: fine grained, no Gm minerals visible 8. Secondary Minerals: yellowish patchy discoloration 9. Encrustations: oxidized exterior, Mn coating 10. Comment: maybe this is a more evolved alkaline rock; phonolite?	2	x						
SO265-DR68-14	1. Rock Type: very fine grained, layered, fluidal textured rocks, not clear if sediment or volcanic 2. Size: clasts from bloc J (25x13x5cm) 17x8x3.5cm, 9x14x5.5cm, 9x15.5x3.5 3. Shape / Angularity: platy, angular 4. Color of cut surface: dark red brown 5. Texture / Vesicularity: massive, shisty, non-vesicular, possibly small elongated vugs parallel to layering, filled with orange material 6. Phenocrysts: none 7. Matrix: very fine grained, no individual grains or minerals visible 8. Secondary Minerals: Mn and oxidation along shist plane 9. Encrustations: 1mm Mn crust 10. Comment: check TS if volcanic or sediment (tuff?)	1							
SO265-DR68-15	1. Rock Type: very fine grained, layered rock, unclear if sediment or viscous volcanic 2. Size: clasts from bloc I (30x16x10cm) 8x8x4.5cm, 11x10x5cm, 11.5x8x5cm 3. Shape / Angularity: platy, angular 4. Color of cut surface: light grey to light brown 5. Texture / Vesicularity: sub 0.1mm porosity, open, massive with 2-5mm layering. Mn along cracks 6. Phenocrysts: none 7. Matrix: fine grained, appears to be made of similar sized grains ----> more likely to be sediment 8. Secondary Minerals: Mn filling along layering planes 9. Encrustations: minor Mn coating 10. Comment: check TS if volcanic or sediment (more likely)	1							
SO265-DR68-16	1. Rock Type: hydrothermally overprinted lava or tuff 2. Size: clasts from bloc E (25x17x12cm) 8.5x9x7cm, 13x12x15cm, 4x8x6cm, 16x9x7.5cm 3. Shape / Angularity: subrounded 4. Color of cut surface: grass-green, Cu-oxides? 5. Texture / Vesicularity: massive, possibly layered 6. Phenocrysts: none 7. Matrix: medium grained 8. Secondary Minerals: appears thoroughly altered to green discoloration 9. Encrustations: <<0.5 Mn coating 10. Comment: TS to check if volcanic or sediment, bulk Gc in case hydrothermalism is of interest	1	x						

Appendix 2 (Station Details and Rock Description)

SO265-DR69




Description of Location and Structure: Ojin Smts, western province. Flat topped Smt, 20nm S of DR68, track along S facing flank beneath plateau edge

Dredge on bottom UTC 25/09/18 16:53hrs, lat 37°15.43'N, long 165°05.32'E, depth 3570m





Dredge off bottom UTC 25/09/18 18:02hrs, lat 37°15.78'N, long 165°07.40'E, depth 3081m

total volume: 1/4 full





Comments: lava fragments up to 0.5m, single large pumice bloc (defragmented), few Mn crusts. Highly PI phyric lava, fairly fresh (-1 to -4), aphyric, moderately altered, mostly massive lava (-5 to -8). Sparsely PI phyric lava (-9 to -12), moderately altered. -13 to -17 mostly aphyric, highly vesicular lava, strongly altered. -18 & 19, pillow breccia with possibly fresh glass and altered hyaloclastite respectively

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR69-1	1. Rock Type: highly PI phyric volcanic rock, fresh to slightly altered 2. Size: 17x9x8cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to pale brown 5. Texture / Vesicularity: 10% vesicles, some filled with brown-black minerals 6. Phenocrysts: 30% PI, 2-5mm, subhedral to anhedral, many parts replaced 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings; Mn patches 9. Encrustations: ≤1mm Mn crust 10. Comment:	2	x		PI		x	GC in air freight box	
SO265-DR69-2	1. Rock Type: highly PI phyric volcanic rock, fresh to slightly altered 2. Size: 15x12x9cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to pale brown 5. Texture / Vesicularity: 10% vesicles, ≤2mm, filled with brown minerals 6. Phenocrysts: 30% PI, 2-5mm, subhedral to anhedral, many parts replaced 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings; Mn patches 9. Encrustations: ≤2mm Mn crust 10. Comment:	2	x		PI				
SO265-DR69-3	1. Rock Type: highly PI phyric volcanic rock, slightly altered 2. Size: 14x11x8cm 3. Shape / Angularity: subangular 4. Color of cut surface: grey to pale brown 5. Texture / Vesicularity: see -1 6. Phenocrysts: see -1 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: ≤4mm Mn crust 10. Comment:	2	x		PI				





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR69-4	1. Rock Type: moderately Pl phyric volcanic rock, slightly to moderately altered 2. Size: 14x11x8cm 3. Shape / Angularity: angular 4. Color of cut surface: brownish grey to brown 5. Texture / Vesicularity: 5% vesicles, some filled with brown material 6. Phenocrysts: 10%, Pl, 1.3mm, euhedral to anhedral, many parts replaced by dark white, creamy white secondary minerals 7. Matrix: see -1 8. Secondary Minerals: see -1 9. Encrustations: ≤5mm Mn crust 10. Comment:	2	x		Pl				
SO265-DR69-5	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 18x13x11cm 3. Shape / Angularity: highly angular 4. Color of cut surface: green grey with brown patches 5. Texture / Vesicularity: non-vesicular 6. Phenocrysts: none 7. Matrix: microcrystalline Gm 8. Secondary Minerals: Gm oxidation, Mn oxide in cracks and as dissemination 9. Encrustations: thin Mn-oxide coating 10. Comment:	2	x						
SO265-DR69-6	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 10x10x7cm 3. Shape / Angularity: highly angular, equant 4. Color of cut surface: green grey with lighter shade along 1cm thick alteration halo 5. Texture / Vesicularity: non-vesicular 6. Phenocrysts: none 7. Matrix: microcrystalline Gm 8. Secondary Minerals: oxidation, bleaching of rim, infiltration of Mn oxide along margin 9. Encrustations: thin film of Mn-oxide and inside 10. Comment:	2	x						
SO265-DR69-7	1. Rock Type: aphyric volcanic rock, moderately altered, highly oxidized 2. Size: 11x7x5cm 3. Shape / Angularity: highly angular, oblong 4. Color of cut surface: brownish grey 5. Texture / Vesicularity: sparsely vesiculated along margin, 1-5%, roundish with Mn & clay filling 6. Phenocrysts: traces of Pl, <1%, ≤0.5mm, altered 7. Matrix: microcrystalline Gm 8. Secondary Minerals: oxidation, infiltration of Mn oxide along margin, dissemination of Mn 9. Encrustations: ~1mm Mn coating 10. Comment:	1	x						





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR69-8	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 9x7x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: light brown 5. Texture / Vesicularity: slightly vesiculated along margin, ≤1%, zeolite? filling 6. Phenocrysts: none 7. Matrix: microcrystalline Gm 8. Secondary Minerals: infiltration of Mn oxide along margins, dissemination into Gm 9. Encrustations: ~0.5 mm Mn coating 10. Comment:	1							
SO265-DR69-9	1. Rock Type: sparsely Pl phyric volcanic rock, moderately altered 2. Size: 9x7x9cm 3. Shape / Angularity: angular 4. Color of cut surface: pale brown 5. Texture / Vesicularity: moderately vesiculated, 2-10%, variable density of vesicle occurrence 6. Phenocrysts: 1% Pl, 1-3mm, euhedral to subhedral, in places replaced by dark white minerals 7. Matrix: microcrystalline Gm 8. Secondary Minerals: pale brown minerals throughout rock, dark white minerals replacing Pl 9. Encrustations: ~2mm Mn crust 10. Comment:	1	x		Pl				
SO265-DR69-10	1. Rock Type: moderately Pl phyric volcanic rock, moderately altered 2. Size: 13x8x6cm 3. Shape / Angularity: angular 4. Color of cut surface: pale green 5. Texture / Vesicularity: sparsely vesiculated, <1% 6. Phenocrysts: 3% Pl, 0.5-3mm, euhedral to anhedral, some form crystal cloths, partly replaced by dark white minerals 7. Matrix: microcrystalline Gm 8. Secondary Minerals: pale green minerals along (halo) in the whole rock 9. Encrustations: thin film of Mn crust 10. Comment:	1	x		Pl				
SO265-DR69-11	1. Rock Type: moderately Pl phyric volcanic rock, moderately altered 2. Size: 19x10x9cm piece from bloc G (16x21x10cm) 3. Shape / Angularity: angular 4. Color of cut surface: pale yellow to pale green 5. Texture / Vesicularity: sparsely vesiculated, <3%, most elongated and aligned in one direction, some filled with cream white and brown minerals 6. Phenocrysts: 3% Pl, 1-3mm, subhedral to anhedral, partly replaced by dark white and black minerals 7. Matrix: cryptocrystalline Gm 8. Secondary Minerals: pale yellow to pale green halo throughout rock, vesicle filling and Pl replacing 9. Encrustations: thin film of Mn crust 10. Comment: from bloc G	1	x		Pl			piece from bloc G	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR69-12	1. Rock Type: very sparsely Pl phyric volcanic rock, fresh to moderately altered 2. Size: 15x13x7cm piece from bloc D (18x15x12cm) 3. Shape / Angularity: subangular 4. Color of cut surface: grey 5. Texture / Vesicularity: moderately vesiculated, 15%, 1-3mm, mud & Mn filling along margin, oxidation 6. Phenocrysts: <1% Pl, 1mm, replaced clay 7. Matrix: microcrystalline Gm 8. Secondary Minerals: clay minerals, pelagic sediment infill, Fe-oxides, Mn infiltration 9. Encrustations: ~1cm Mn crust 10. Comment: from bloc D	1	x					piece from bloc D	
SO265-DR69-13	1. Rock Type: aphyric volcanic rock, moderately fresh 2. Size: 15x14x10cm 3. Shape / Angularity: subangular 4. Color of cut surface: dark grey with brown tint 5. Texture / Vesicularity: moderately vesiculated, 10%, <0.5mm to 1cm along axis, mostly open, some with clay filling 6. Phenocrysts: none 7. Matrix: cryptocrystalline Gm 8. Secondary Minerals: clay zeolites in some vesicles 9. Encrustations: some Mn patches on surface 10. Comment:	1	x						
SO265-DR69-14	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 17x10x10cm piece of subangular bloc E (28x15x10cm) 3. Shape / Angularity: angular 4. Color of cut surface: brownish with some light grey 5. Texture / Vesicularity: aphyric, moderately vesiculated, 15%, 1-10mm 6. Phenocrysts: none 7. Matrix: cryptocrystalline Gm 8. Secondary Minerals: some Mn infiltration along margin, clear crystals in two vesicles observed, do not fizz with HCl, Qz?, Mn lining of vesicles, oxidation patches in Gm 9. Encrustations: Mn patches on surface 10. Comment: from bloc E	1	x					piece from bloc E	
SO265-DR69-15	1. Rock Type: aphyric volcanic rock, highly altered 2. Size: 28x14x17cm piece of subangular bloc A (46x33x22cm) 3. Shape / Angularity: subangular 4. Color of cut surface: reddish brown 5. Texture / Vesicularity: aphyric, moderately vesiculated, 20%, some vesicles filled with greenish minerals and brown mud 6. Phenocrysts: none 7. Matrix: microcrystalline Gm 8. Secondary Minerals: brown and reddish brown minerals present throughout rock. Greenish minerals in vesicles 9. Encrustations: 1mm thick Mn crust 10. Comment: from bloc A	2	x					piece from bloc A	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR69-16	1. Rock Type: sparsely PI phyric volcanic rock, highly altered 2. Size: 16x14x10cm piece of subangular bloc B (26x15x15cm) 3. Shape / Angularity: subrounded 4. Color of cut surface: brown 5. Texture / Vesicularity: aphyric, moderately vesiculated, 20%, vesicles partly filled with pale green and brown minerals 6. Phenocrysts: 2% PI, 0.5-2mm, subhedral to anhedral, replaced by dark white and black minerals 7. Matrix: cryptocrystalline Gm 8. Secondary Minerals: brown minerals inside and pale green mineralization outside 9. Encrustations: 3mm thick Mn crust 10. Comment: from bloc B	1	x		PI			piece from bloc B	
SO265-DR69-17	1. Rock Type: aphyric volcanic rock, highly altered 2. Size: 18x13x12cm piece of subrounded bloc F (23x20x10cm) 3. Shape / Angularity: subrounded 4. Color of cut surface: pale green, dark brown 5. Texture / Vesicularity: aphyric, moderately vesiculated, 20%, rarely filled by green minerals 6. Phenocrysts: <1% PI, 0.5-2mm, euhedral to subhedral, completely replaced by dark white and black minerals 7. Matrix: microcrystalline Gm 8. Secondary Minerals: dark brown minerals throughout 9. Encrustations: 1mm thick Mn crust 10. Comment: from bloc F	1			PI			piece from bloc F	
SO265-DR69-18	1. Rock Type: aphyric volcanic breccia, pillow breccia or hyaloclastite, fresh to moderately altered 2. Size: 10x10x15cm 3. Shape / Angularity: angular 4. Color of cut surface: black, pale brown, brown 5. Texture / Vesicularity: brecciated, fragmented glass shards 6. Phenocrysts: none 7. Matrix: glassy 8. Secondary Minerals: most parts are replaced by pale brown and brown minerals (palagonite), but possible fresh glass present in some cores 9. Encrustations: 1mm thick Mn crust 10. Comment: check for fresh glass	1			PI			glass in air freight box	
SO265-DR69-19	1. Rock Type: volcanoclastic rock 2. Size: 11x7x13cm 3. Shape / Angularity: subrounded 4. Color of cut surface: green, with some yellow and clear transparent minerals 5. Texture / Vesicularity: slightly vesiculated ≤1%, open 6. Phenocrysts: none 7. Matrix: glassy 8. Secondary Minerals: brown material replacing glassy Gm (palagonite), pale yellow minerals replace PI 9. Encrustations: 4mm thick Mn crust 10. Comment: glass (up to 7mm) and PI (up to 3mm) fragments make up rock	1			GI? PI?				

Appendix 2 (Station Details and Rock Description)

SO265-DR70

Description of Location and Structure: Ojin Smts, western province, western area. E-W elongated Smt, 40nm W of DR69, S flank lowermost section

Dredge on bottom UTC 26/09/18 02:22hrs, lat 37°17.78'N, long 164°10.33'E, depth 5011m

Dredge off bottom UTC 26/09/18 03:51hrs, lat 37°18.19'N, long 164°10.56'E, depth 4552m

total volume: three rafted pumice clasts

Comments: no samples taken

SO265-DR71

Description of Location and Structure: Ojin Smts, western province, western area. Large Smt with two peaks and broad basement structure, track along western flank at the very basement beneath the southern peak.

Dredge on bottom UTC 26/09/18 12:25hrs, lat 36°28.90'N, long 163°55.89'E, depth 5332m

Dredge off bottom UTC 26/09/18 13:45hrs, lat 36°28.98'N, long 163°56.37'E, depth 4970m

total volume: empty

SO265-DR72



Description of Location and Structure: Repeat of DR71 along the northern flank of the northern peak of the large Smt structure. Track along the middle part of the N facing slope

Dredge on bottom UTC 26/09/18 17:37hrs, lat 36°36.81'N, long 163°55.94'E, depth 4180m





Dredge off bottom UTC 26/09/18 18:55hrs, lat 36°36.42'N, long 163°55.98'E, depth 3720m

total volume: a few rocks





Comments: sparsely Pl phyric lava fragments recovered as clasts from breccia blocs (-1 to -3) or as loose fragments (-4 & -5). Range from relatively fresh to moderately altered

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR72-1A	1. Rock Type: aphyric volcanic rock, relatively fresh 2. Size: 21x15x9cm clast from bloc A (35x21x15cm) 3. Shape / Angularity: subangular 4. Color of cut surface: grey 5. Texture / Vesicularity: 10-15% vesicles, <1mm, mostly open, 2-3% filled with white material 6. Phenocrysts: 7. Matrix: fine grained 8. Secondary Minerals: vesicle fillings 9. Encrustations: Mn coating, bloc A 3-5cm Mn crust 10. Comment:	2	x						
SO265-DR72-1B	1. Rock Type: sparsely phyric volcanic rock, moderately altered 2. Size: 11x7x4cm clast from bloc A (35x21x15cm) 3. Shape / Angularity: subangular 4. Color of cut surface: grey to brownish 5. Texture / Vesicularity: ~5% vesicles, <2mm, open 6. Phenocrysts: 3% Fsp, ≤1mm; ≤1% altered Ol?, ≤1mm 7. Matrix: fine grained 8. Secondary Minerals: altered Ol?, Mn patches 9. Encrustations: Mn coating, bloc A 3-5cm Mn crust 10. Comment:	2	x						





Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR72-2	1. Rock Type: sparsely Pl phyric volcanic rock, relatively fresh 2. Size: 22x20x8cm clast from bloc B (23x18x12cm) 3. Shape / Angularity: clast subangular 4. Color of cut surface: grey 5. Texture / Vesicularity: 10-15% vesicles, <2mm, open 6. Phenocrysts: 1-3% Fsp, ≤2mm, subhedral 7. Matrix: fine grained 8. Secondary Minerals: 9. Encrustations: bloc C 3-5cm Mn crust 10. Comment:	2	x						
SO265-DR72-3	1. Rock Type: sparsely Pl phyric volcanic rock, relatively fresh 2. Size: 10x7x5cm 3. Shape / Angularity: subrounded 4. Color of cut surface: grey 5. Texture / Vesicularity: 10% vesicles, up to 2mm, open 6. Phenocrysts: 1-3% Fsp, ≤2mm, subhedral 7. Matrix: fine grained 8. Secondary Minerals: 9. Encrustations: 0.5cm Mn crust 10. Comment:	2	x						
SO265-DR72-4	1. Rock Type: sparsely Pl phyric volcanic rock, slightly altered 2. Size: 15x13x7cm clast from bloc B (26x21x13cm) 3. Shape / Angularity: clast subrounded 4. Color of cut surface: partly grey, partly brown 5. Texture / Vesicularity: 10% vesicles, ≤1mm, open 6. Phenocrysts: similar to -2 & -3 7. Matrix: similar to -2 & -3 8. Secondary Minerals: similar to -2 & -3 9. Encrustations: 1cm Mn crust bloc B 10. Comment:	2	x						
SO265-DR72-5	1. Rock Type: aphyric volcanic rock, moderately altered 2. Size: 10x6x3cm 3. Shape / Angularity: angular 4. Color of cut surface: brown, small parts grey 5. Texture / Vesicularity: 15-20% vesicles, ≤1mm, 50% filled with white material 6. Phenocrysts: similar to -2 to -4 7. Matrix: similar similar to -2 to -4 8. Secondary Minerals: vesicle filling 9. Encrustations: ≤1cm Mn crust 10. Comment:								





Appendix 2 (Station Details and Rock Description)

SO265-DR73									
Description of Location and Structure: Ojin Smts, western section. Ø22km Smt, flat topped, E-flank, maybe a scarp. Track along E-flank, upper section									
Dredge on bottom UTC 27/09/18 02:37hrs, lat 37°02.54'N, long 163°47.14'E, depth 3767m									
Dredge off bottom UTC 27/09/18 03:57hrs, lat 37°02.54'N, long 163°46.59'E, depth 3342m									
total volume: very few rocks									
Comments: Mn crusts, some with freshly broken pillow margins attached. Aphyric pillow lava, mostly chilled margin, moderately altered. -3B, -3C and 3D contain fresh glass									
SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR73-1	1. Rock Type: aphyric pillow lava, moderately altered 2. Size: 9x8x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: pale brown 5. Texture / Vesicularity: massive 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: pale brown minerals, replace Gm, traces of black minerals along cracks 9. Encrustations: >5mm Mn crust 10. Comment:	2	x						
SO265-DR73-2	1. Rock Type: aphyric pillow lava, highly altered 2. Size: 6x6x5cm 3. Shape / Angularity: subrounded 4. Color of cut surface: brown, pale yellow 5. Texture / Vesicularity: massive 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: pale yellow, brecciated particles along rim (palagonite) and small vesicles 9. Encrustations: >5mm Mn crust 10. Comment:	2							
SO265-DR73-3A	1. Rock Type: aphyric pillow lava, moderately altered 2. Size: 9x9x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: pale yellow 5. Texture / Vesicularity: similar to -1 6. Phenocrysts: similar to -1 7. Matrix: similar to -1 8. Secondary Minerals: similar to -1 9. Encrustations: >5mm Mn crust 10. Comment: a piece of bloc A (25x20x14cm)							from bloc A	
SO265-DR73-3B	1. Rock Type: aphyric pillow lava, fresh glass, moderately altered Gm 2. Size: 9x7x6cm 3. Shape / Angularity: subangular 4. Color of cut surface: black, fresh glass; pale brown Gm 5. Texture / Vesicularity: massive, brecciated 6. Phenocrysts: none 7. Matrix: glassy cryptocrystalline 8. Secondary Minerals: thorough Gm oxidation, pale yellow brecciated particles along rim; pale brown minerals (altered glass?), filled veins, traces of Mn 9. Encrustations: >3mm Mn crust 10. Comment: a piece of bloc A (25x20x14cm)				fresh Gl?			glass in air freight box	

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR73-3C	1. Rock Type: aphyric pillow lava, fresh glass, fresh to moderately altered Gm 2. Size: 11x9x8cm 3. Shape / Angularity: subangular 4. Color of cut surface: black, fresh? part; pale brown to brown Gm 5. Texture / Vesicularity: massive to brecciated 6. Phenocrysts: none 7. Matrix: glassy - cryptocrystalline 8. Secondary Minerals: pale brown rim with alteration in core, Mn dissemination & along cracks. Green to pale green secondary minerals in the brecciated parts 9. Encrustations: >1cm Mn crust 10. Comment: a piece of bloc A (25x20x14cm)				fresh Gl?		x	glass in air freight box	
SO265-DR73-3D	1. Rock Type: aphyric pillow lava, fresh glass?, fresh to moderately altered Gm 2. Size: 11x6x7cm 3. Shape / Angularity: subangular 4. Color of cut surface: similar to -3C 5. Texture / Vesicularity: similar to -3C 6. Phenocrysts: similar to -3C 7. Matrix: similar to -3C 8. Secondary Minerals: brown alterations, Mn dissemination, green to dark brown minerals in the brecciated part 9. Encrustations: >0.5cm Mn crust 10. Comment: a piece of bloc A (25x20x14cm)				fresh Gl?		x	glass in air freight box	
SO265-DR73-3E	1. Rock Type: aphyric pillow lava, moderately altered Gm 2. Size: 9x7x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: pale brown 5. Texture / Vesicularity: massive 6. Phenocrysts: traces of Pl <1%, acicular to euhedral, fresh 7. Matrix: cryptocrystalline 8. Secondary Minerals: pale brown secondaries throughout rock, Mn along cracks 9. Encrustations: 10. Comment: a piece of bloc A (25x20x14cm)								
SO265-DR73-3F	1. Rock Type: aphyric pillow lava, altered Gm 2. Size: 5x4x4cm 3. Shape / Angularity: subrounded 4. Color of cut surface: brown, a few grey patches 5. Texture / Vesicularity: massive 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: yellow mud fill in cracks 9. Encrustations: 5mm Mn crust 10. Comment: a piece of bloc A (25x20x14cm)								

Appendix 2 (Station Details and Rock Description)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR73-3G	1. Rock Type: aphyric pillow lava, altered Gm 2. Size: 7x5x4cm 3. Shape / Angularity: subangular 4. Color of cut surface: pale brown 5. Texture / Vesicularity: massive 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: Mn and yellow mud fill in cracks 9. Encrustations: Mn crust 10. Comment: a piece of bloc A (25x20x14cm)								
SO265-DR73-3H	1. Rock Type: aphyric pillow lava, altered core and highly altered rim 2. Size: 7x5x5cm 3. Shape / Angularity: subangular 4. Color of cut surface: pale brown 5. Texture / Vesicularity: massive 6. Phenocrysts: none 7. Matrix: cryptocrystalline 8. Secondary Minerals: Mn and yellow mud fill in cracks 9. Encrustations: Mn crust 10. Comment: a piece of bloc A (25x20x14cm)								
SO265-DR73-4	1. Rock Type: aphyric volcanic rock in core of Mn nodule, highly 2. Size: 8x5x5cm 3. Shape / Angularity: subrounded; elongated, feet shaped inside 4. Color of cut surface: on cut surface feet shaped; outline has brown core and orange to yellow rim; the background colors are green brown and black mosaic 5. Texture / Vesicularity: aphyric 6. Phenocrysts: none 7. Matrix: cryptocrystalline Gm 8. Secondary Minerals: oxidation, palagonitization of Gm, bleaching of rim into yellowish tint. Granule sized volcanic fragments altered to green mineral 9. Encrustations: thin <1mm Mn coating 10. Comment: museum piece / cover page photo							happy feet	
SO265-DR73-5	1. Rock Type: sedimentary rock, Mn nodule 2. Size: ø5cm 3. Shape / Angularity: round, equant 4. Color of cut surface: black 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:					Mn-nodule			

Appendix 2 (Station Details and Rock Description)

SO265-DR74

Description of Location and Structure: Shirshov Ridge, Eastern flank. Eastern slope of Shirshov Ridge, small break in slope between two Smts on top of Shirshov basement

Dredge on bottom UTC 27/09/18 11:16hrs, lat 37°21.46'N, long 163°32.56'E, depth 4666m

Dredge off bottom UTC 27/09/18 12:19hrs, lat 37°21.41'N, long 163°32.13'E, depth 4460m

total volume: empty, despite frequent medium to strong bites

SO265-DR75




Description of Location and Structure: Shirshov Massif Eastern flank. A small cone on E flank of Smt, 25nm W of plateau margin. Smt interpreted to be the top of a sediment buried Shirshov volcano

Dredge on bottom UTC 27/09/18 18:16hrs, lat 37°24.31'N, long 163°00.10'E, depth 3680m

Dredge off bottom UTC 27/09/18 19:40hrs, lat 37°23.81'N, long 163°00.13'E, depth 3330m

total volume: 1/3 full

Comments: Mn crusts, Mn nodules, two large Mn crusts. Recovered a clast of relatively fresh, Pl phyric lava as core of a Mn nodule (-1) and a sparsely Pl phyric, moderately altered lava as core of a Mn nodule (-2). Four Mn nodules ø 7cm also sampled (-4)

SAMPLE #	SAMPLE DESCRIPTION	TS	CHEM	Ar/Ar	GL/MIN	SED	REF	NOTES	PICTURE
SO265-DR75-1	1. Rock Type: moderately Pl phyric volcanic rock, slightly altered 2. Size: 9x5x6cm 3. Shape / Angularity: subrounded 4. Color of cut surface: grey 5. Texture / Vesicularity: massive, 1% vesicles, up to 1mm, some filled with white / green material, a few larger vesicles up to 5mm filled with brown material 6. Phenocrysts: 1-3% Fsp, 1mm 7. Matrix: microcrystalline 8. Secondary Minerals: Mn patches, vesicle fillings 9. Encrustations: 10. Comment: core of Mn nodule	2	x					x	GC in air freight box 
SO265-DR75-2	1. Rock Type: sparsely Pl phyric volcanic rock, medium altered 2. Size: 6x5x4cm 3. Shape / Angularity: subrounded 4. Color of cut surface: grey - brown 5. Texture / Vesicularity: 10% vesicles, 1-3mm, filled with yellow - greenish material 6. Phenocrysts: 1-3% Fsp, 1mm 7. Matrix: fine grained, altered 8. Secondary Minerals: Mn patches, vesicle fillings 9. Encrustations: 10. Comment: core of Mn nodule	1							
SO265-DR75-3Mn	1. Rock Type: four Mn nodules, ø7cm 2. Size: 3. Shape / Angularity: 4. Color of cut surface: 5. Texture / Vesicularity: 6. Phenocrysts: 7. Matrix: 8. Secondary Minerals: 9. Encrustations: 10. Comment:	1				Mn-nodule			

Appendix 2 (Station Details and Rock Description)

Abbreviations in Table Header:

TS: thin section billet

CHEM: chemistry slab to prepare materials for geochemical analysis

Ar/Ar: estimate of sample quality for $^{40}\text{Ar}/^{39}\text{Ar}$ dating

GL/MIN: potential glass and / or mineral separates

SED: sediment

REF: reference sample for immediate transport to home institution after cruise

Abbreviations for Minerals and Materials:

Apt: Apatite

Bi: Biotite

Cc: clacite

Chl: Chlorite

Cpx: clinopyroxene

Fsp: feldspar

Gc: Geochemistry

Gm: Groundmass

Ilm: Ilmenite

MI: Melt Inclusions

Mn: manganese

Mt: Magnetite

Ol: olivine

Opx: orthopyroxene

Pl: plagioclase

Px: pyroxene

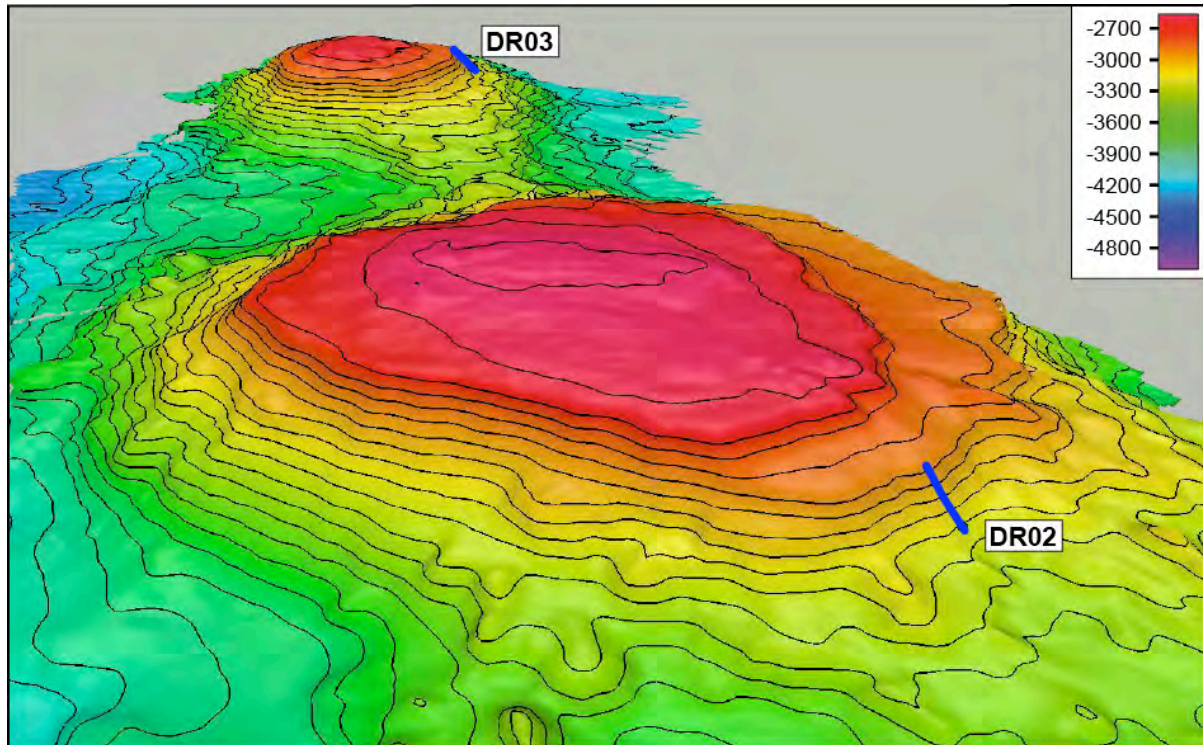
Qz: Quartz

Zr: Zircon

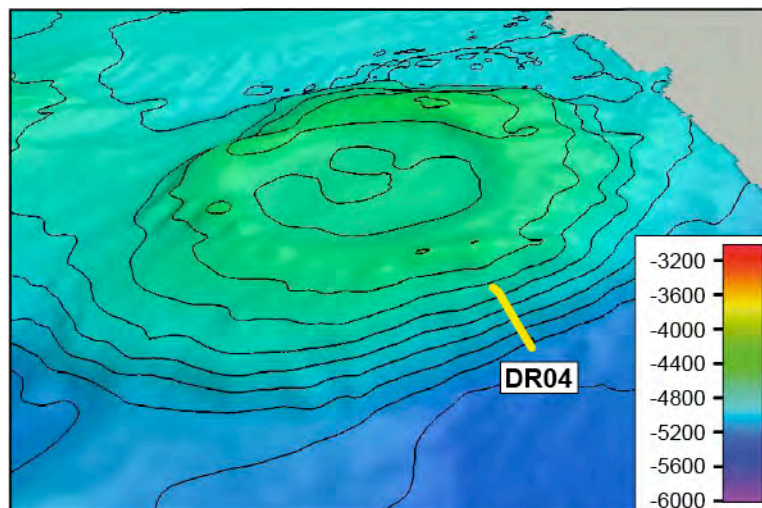
Appendix III (3D-Maps of SO265 Dredge Tracks)

The 3D-maps shown in this appendix are based on multi-beam data recorded on SO265 using a Kongsberg EM122 multi-beam echo-sounder and have been generated with QPS Fledermaus 7.8.5 software. Exaggeration is 2x for all maps, the interval of contour lines is 100 m.

(Station 1: CTD)

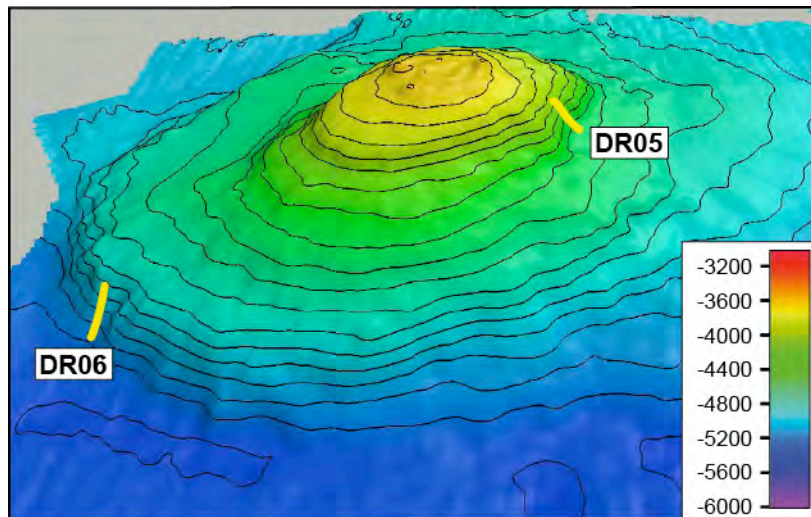


DR2 and 3 at the northeastern boundary of Shirshov Massif (view from NW to SE).

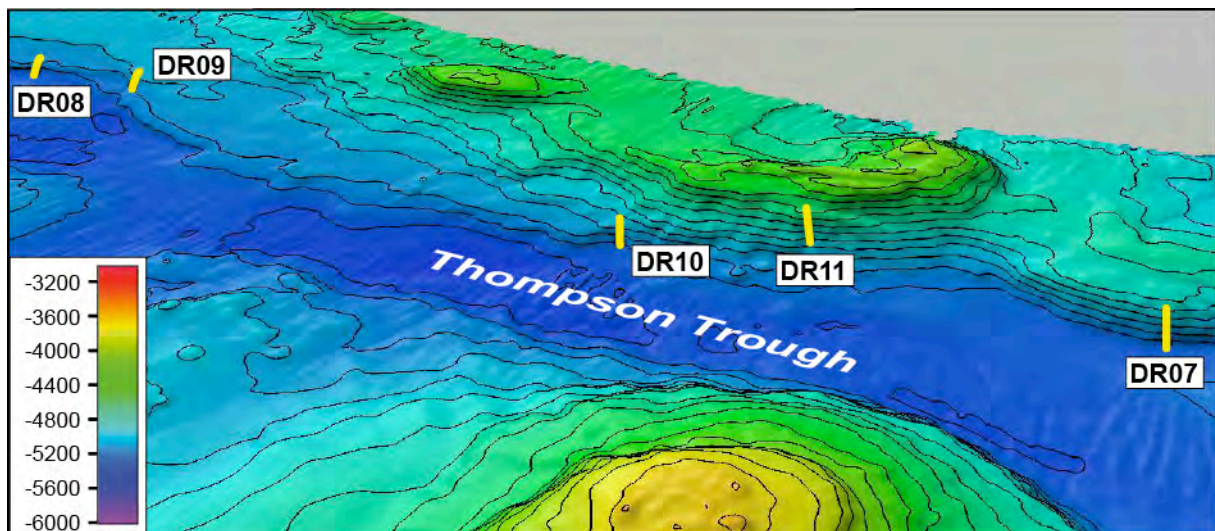


DR4 at southern margin of Thompson Trough (view from NNE to SSW).

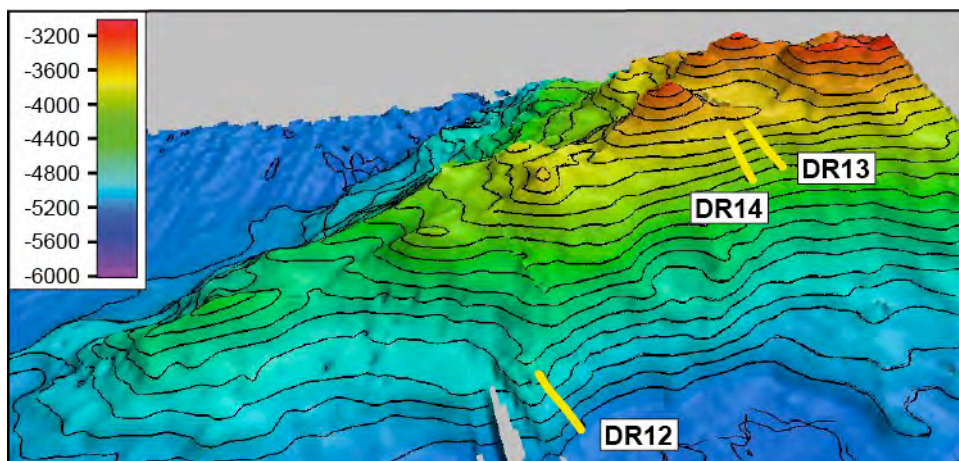
Appendix III (3D-Maps of SO265 Dredge Tracks)



DR5 and 6 at Earthwatch Seamount at southern margin of Thompson Trough (view from NNE to SSW).

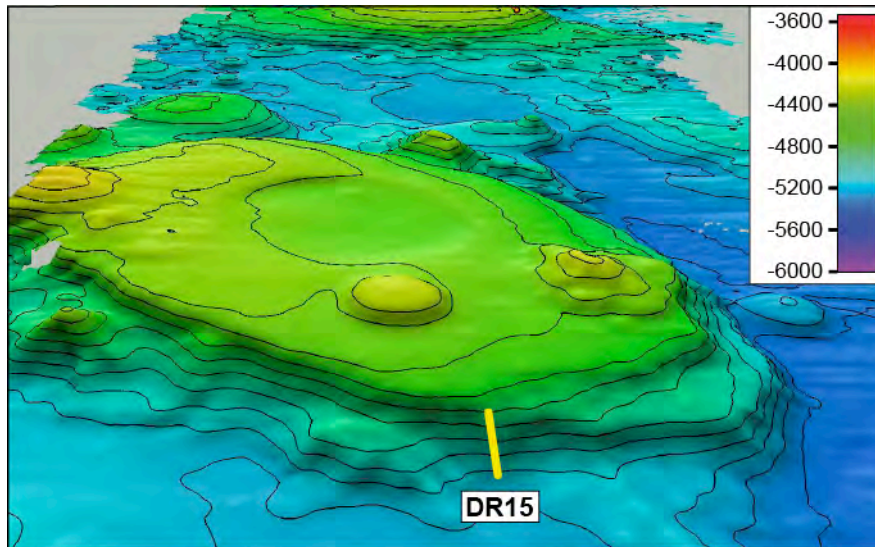


DR7 through 11 at the northern flank of Thompson Trough, representing the faulted southern margin of Papanin Ridge (view from S to N).

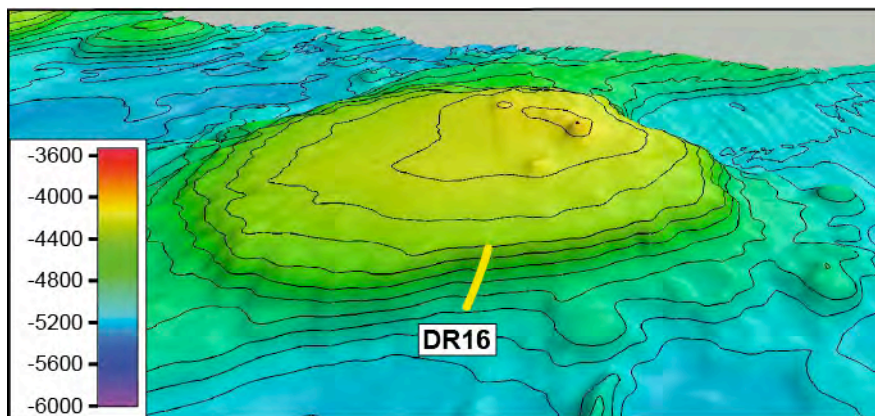


DR12 through 13 at SONNE Ridge (working name) in the northeastern part of the Ojin Seamount Province (view from SSW to NNE).

Appendix III (3D-Maps of SO265 Dredge Tracks)

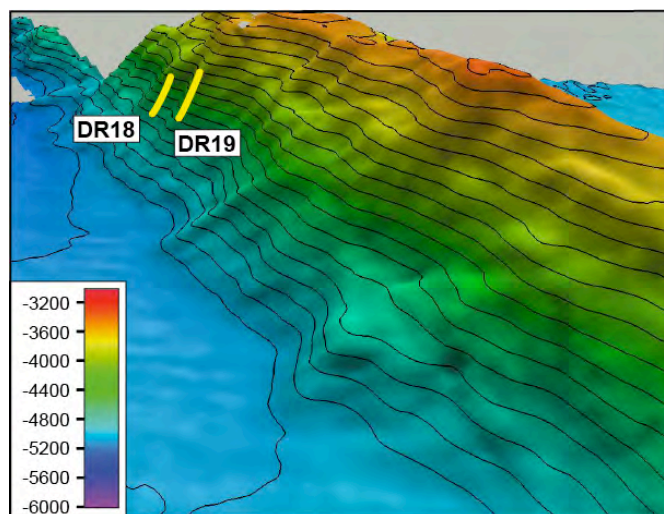


DR15 at a "pancake" seamount on the southern Papanin Ridge (view from SSE to NNW).



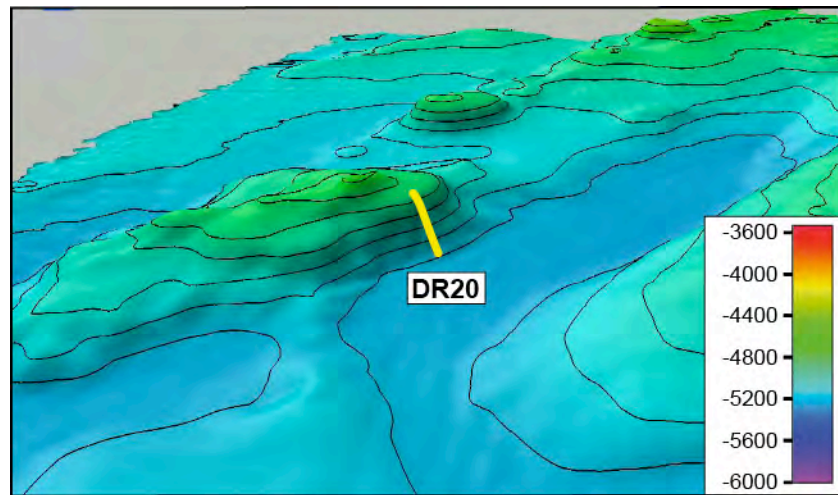
DR16 at a "pancake" seamount on the southern Papanin Ridge (view from NNE to SSW).

(Station 17: CTD)

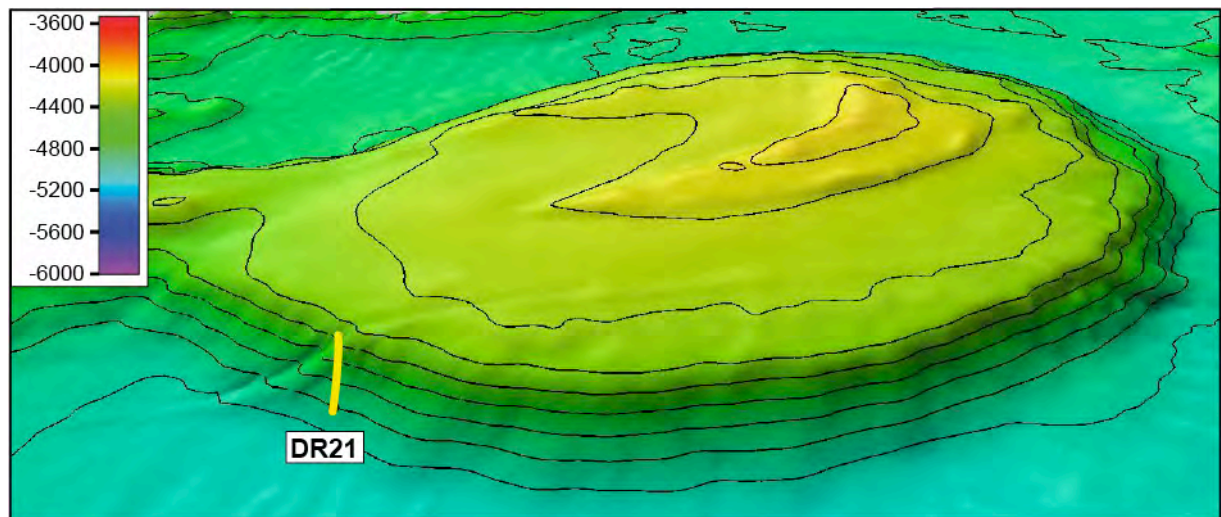


DR18 and 19 at the southern flank of Shuleykin Seamount east of Papanin Ridge (view from NE to SW).

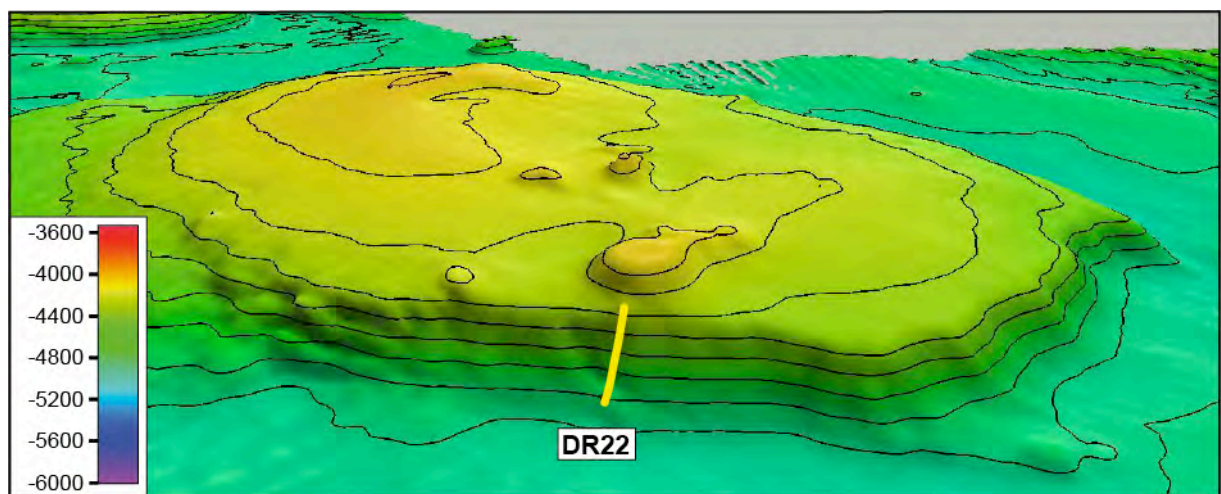
Appendix III (3D-Maps of SO265 Dredge Tracks)



DR20 at the western edge of the central Papanin Ridge (view from SSW to NNE).

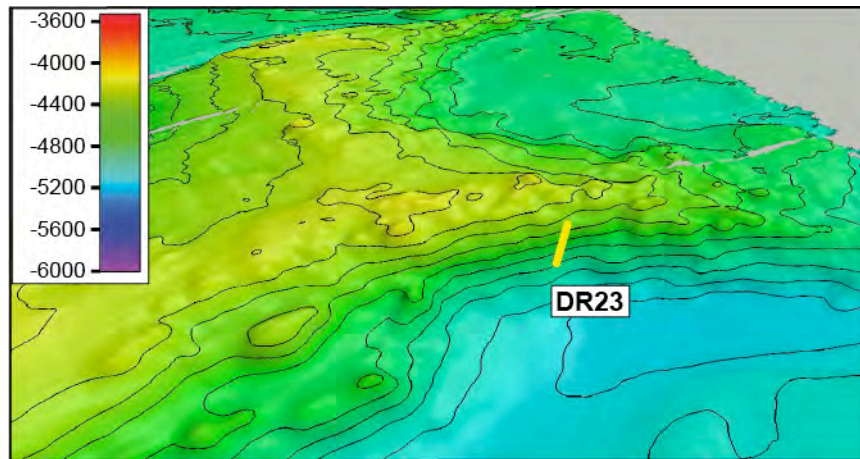


DR21 at a "pancake" seamount on the central Papanin Ridge (view from SSW to NNE).



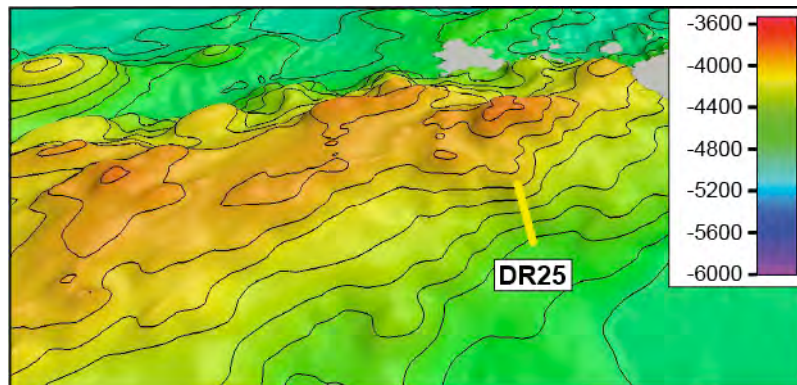
DR22 at another "pancake" seamount on the central Papanin Ridge (view from E to W).

Appendix III (3D-Maps of SO265 Dredge Tracks)

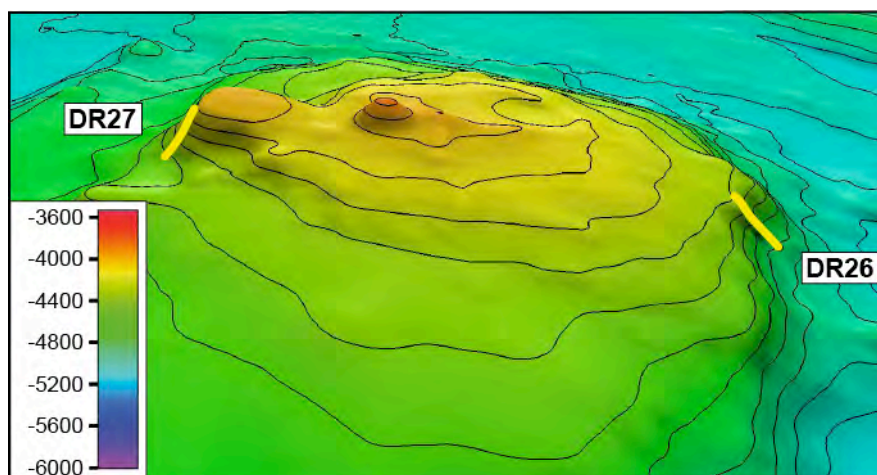


DR23 at an anvil-shaped seamount on the central Papanin Ridge (view from NE to SW).

(Station 24: CTD)

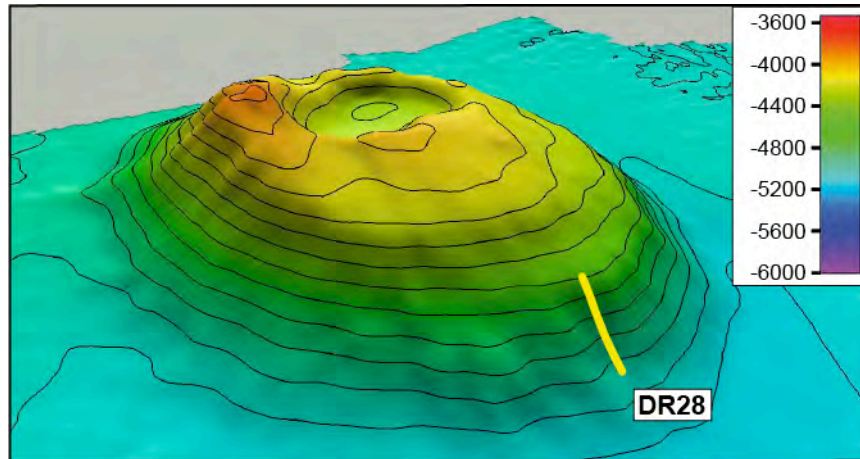


DR25 at an E-W-striking ridge on the central Papanin Ridge (view from NE to SW).

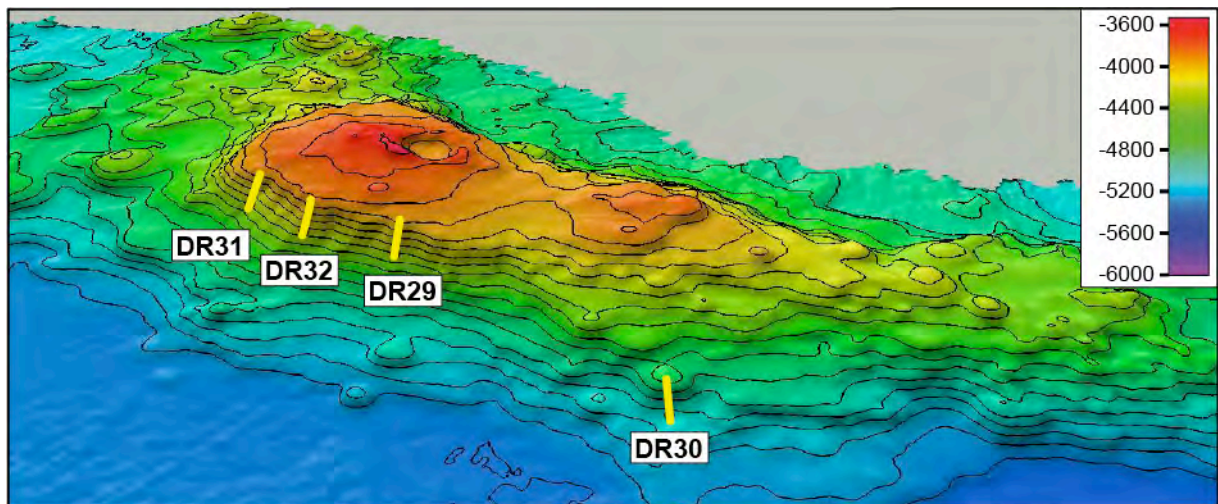


DR26 and 27 at a circular seamount with cones on the summit on the central Papanin Ridge (view from SE to NW).

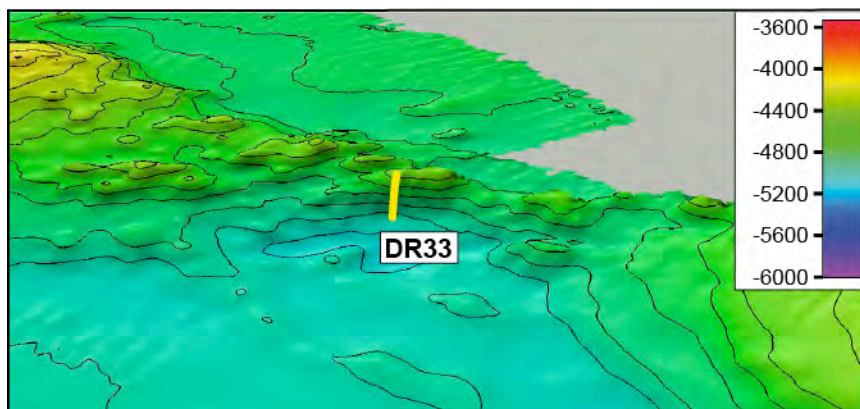
Appendix III (3D-Maps of SO265 Dredge Tracks)



DR28 at a small circular seamount on the central Papanin Ridge (view from SE to NW)

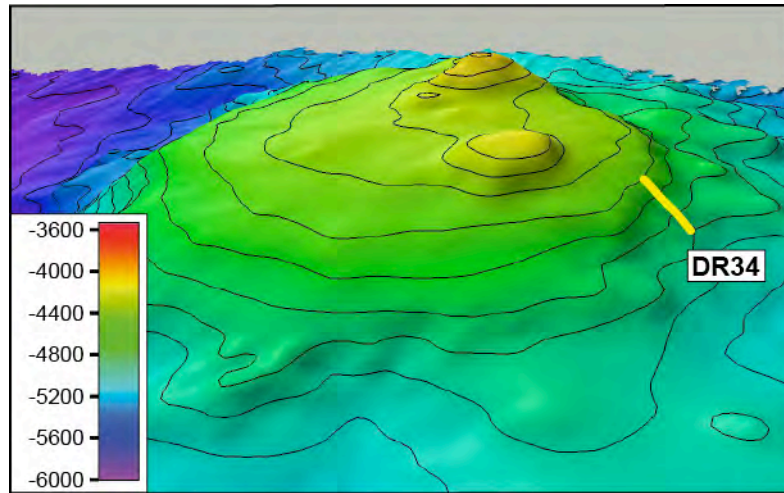


DR28 through 32 at a large E-W-striking seamount in the eastern branch of Papanin Ridge (view from S to N).

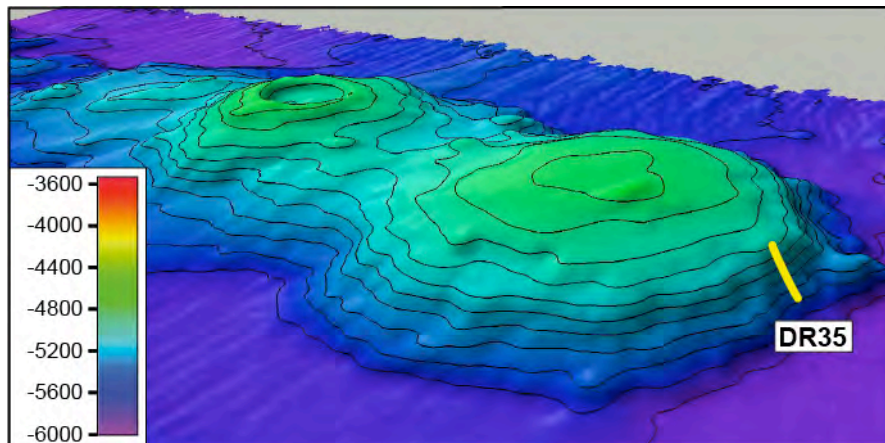


DR33 at a small ridge between two circular seamounts on the eastern Papanin Ridge (view from S to N).

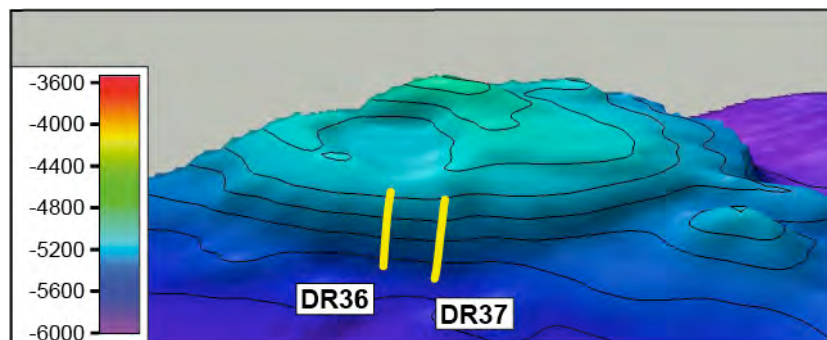
Appendix III (3D-Maps of SO265 Dredge Tracks)



DR34 at a circular seamount at the northern termination of Papanin Ridge (view from SSW to NNE).

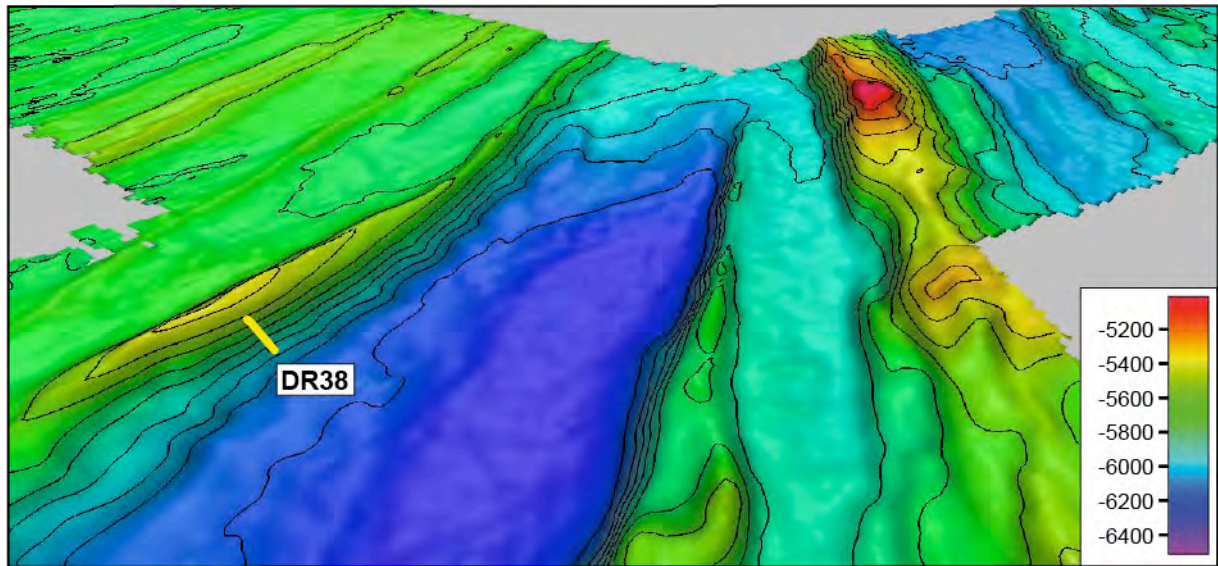


DR35 at solitaire twin seamounts on the abyssal plain north of Papanin Ridge (view from SSW to NNE).

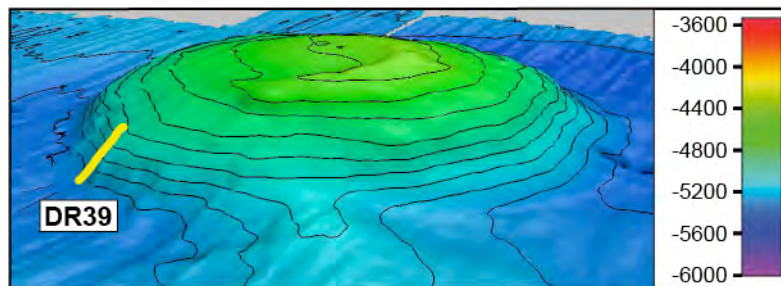


DR36 and 37 at the southern slope of another discrete seamount on the abyssal plain north of Papanin Ridge (view from S to N).

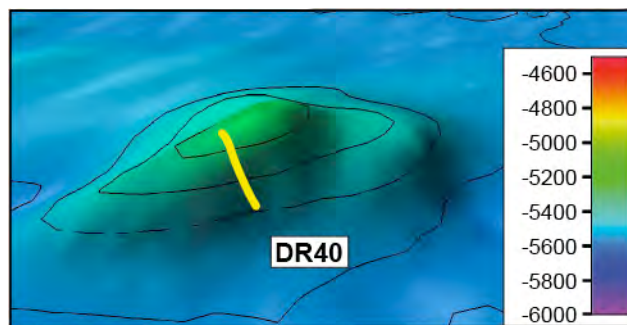
Appendix III (3D-Maps of SO265 Dredge Tracks)



DR38 at the southeast-facing slope of Hokkaido Trough (view from SW to NE).

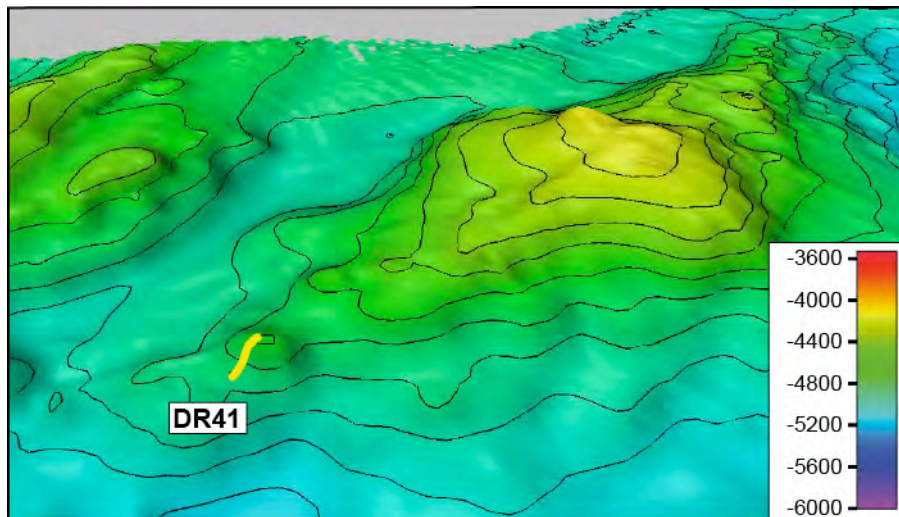


DR39 at a solitary "pancake" seamount on the abyssal plain north of Papanin Ridge (view from NNW to SSE).

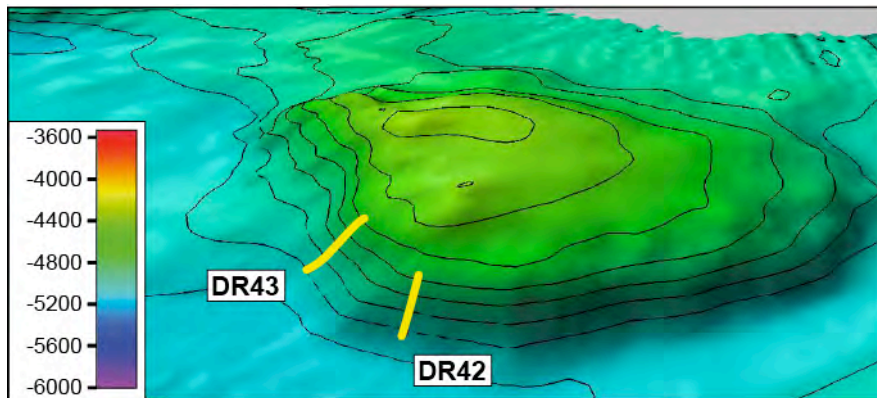


DR40 at a small solitary seamount on the abyssal plain north of Papanin Ridge (view from SW to NE).

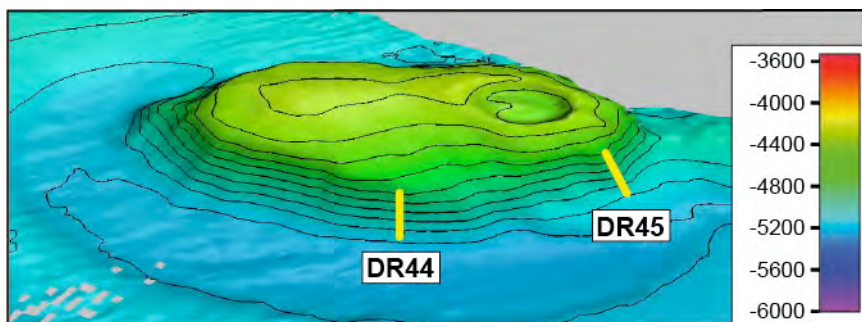
Appendix III (3D-Maps of SO265 Dredge Tracks)



DR41 at a NNW-SSE-trending ridge-type seamount at the eastern end of Papanin Ridge (view from WNW to ESE).

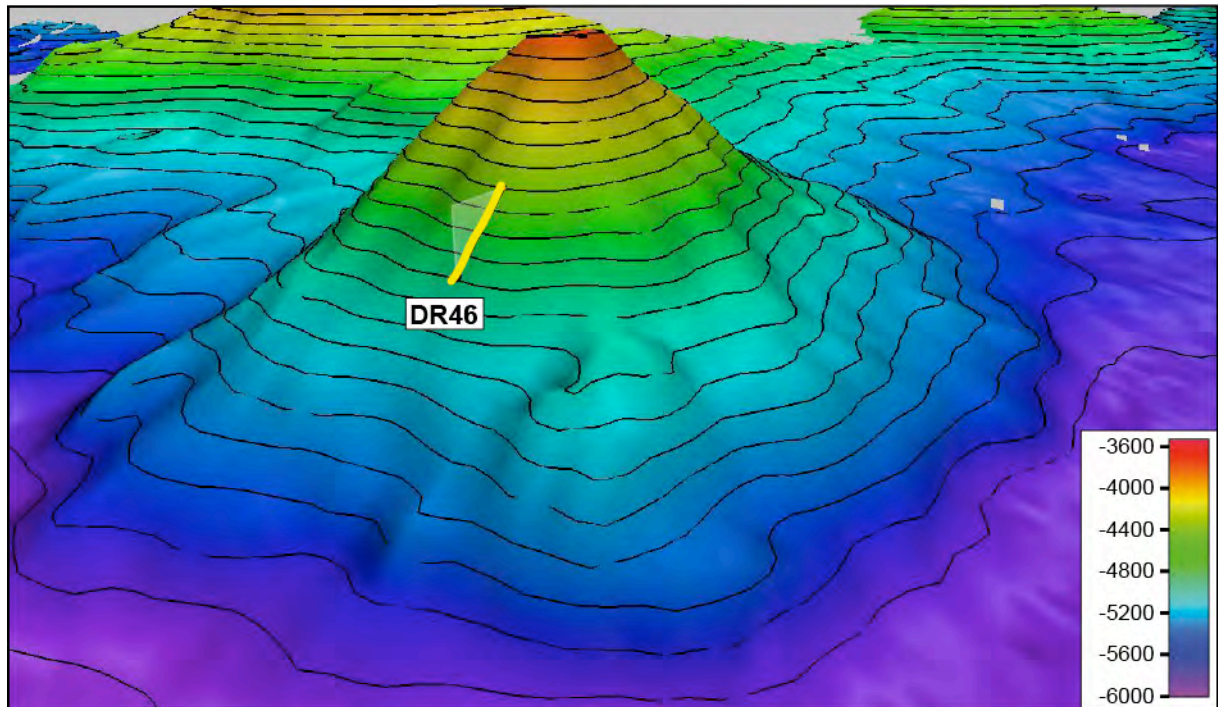


DR42 and 43 at a "pancake" seamount at the eastern end of Papanin Ridge (view from SSW to NNE).

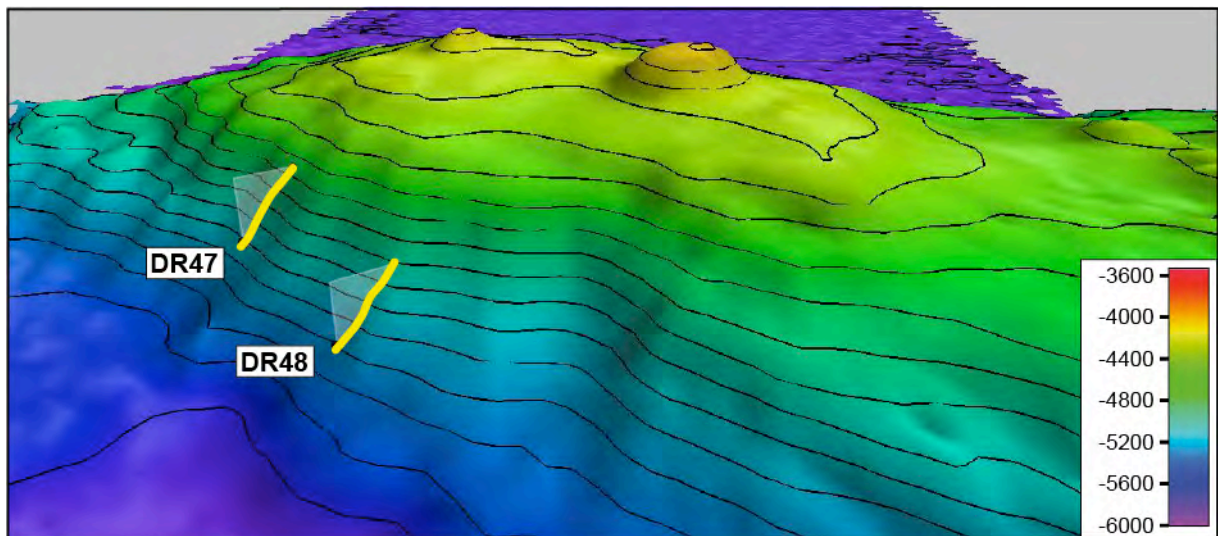


DR44 and 45 at another "pancake" seamount at the eastern end of Papanin Ridge (view from SSE to NNW).

Appendix III (3D-Maps of SO265 Dredge Tracks)

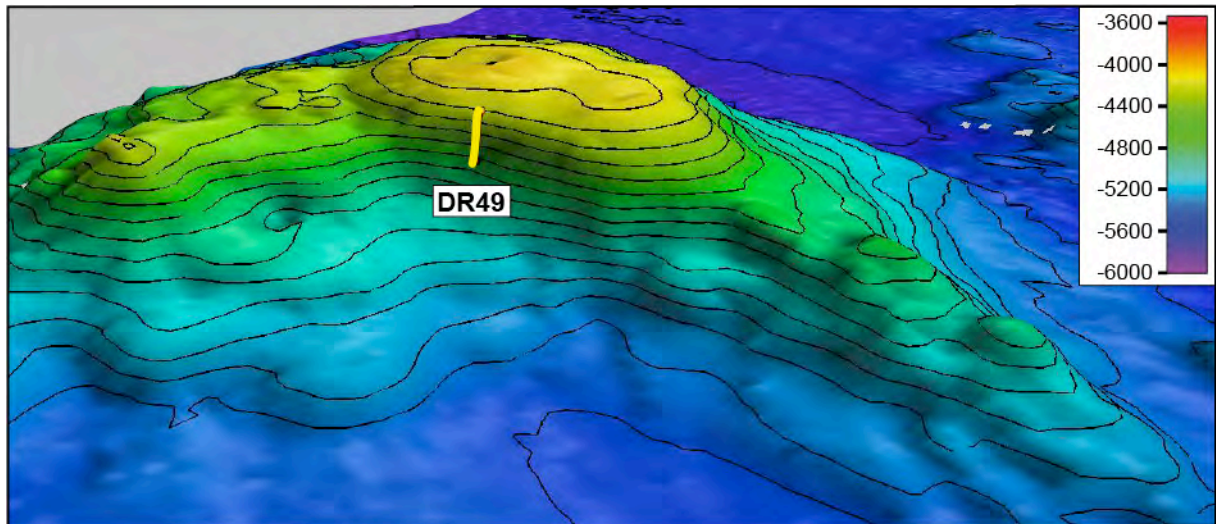


DR46 at a conical seamount in the north-easternmost part of the Ojin Seamount Province (view from WSW to ENE).

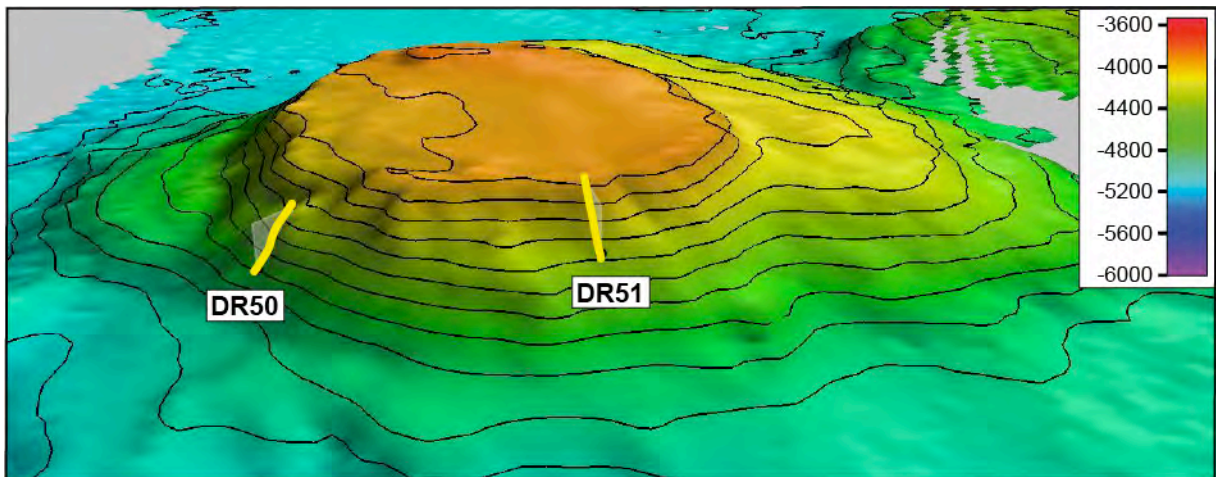


DR47 and 48 at the northwestern flank of a \pm N-S-striking ridge in the north-easternmost part of the Ojin Seamount Province (view from W to E).

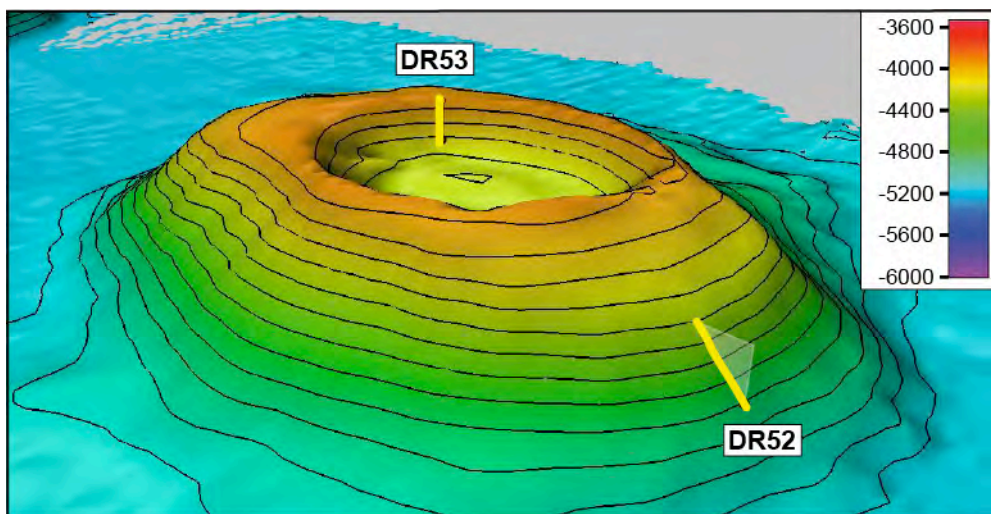
Appendix III (3D-Maps of SO265 Dredge Tracks)



DR49 at a complex structured seamount in the north-easternmost part of the Ojin Seamount Province (view from NW to SE).

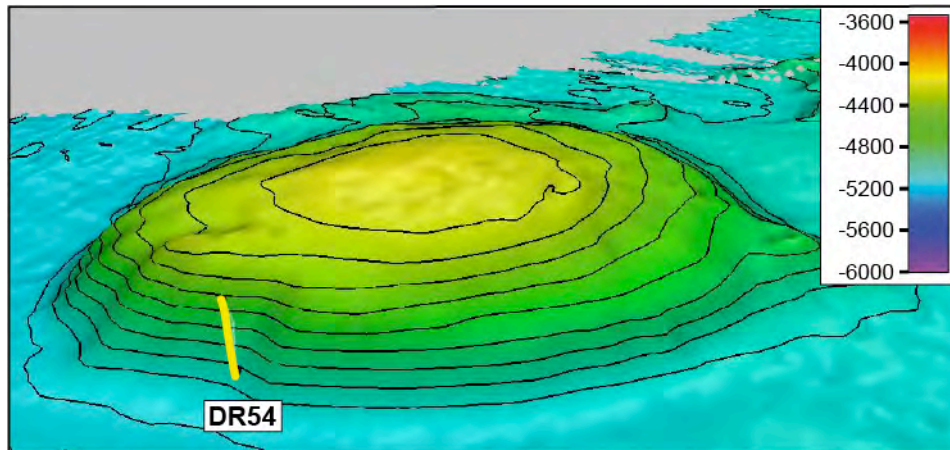


DR50 and 51 at a N-S-elongated flat-topped seamount at the eastern end of the Ojin Seamount Province (view from NW to SE).

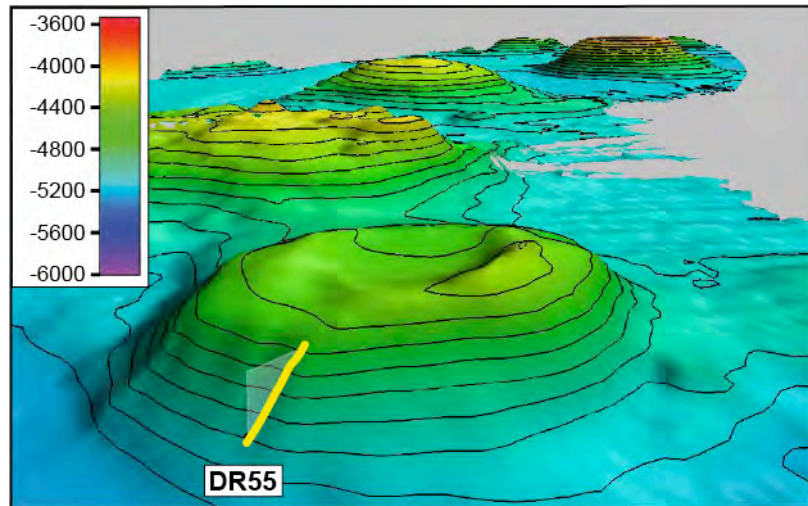


DR52 and 53 at a conical seamount with a prominent caldera at the eastern end of the Ojin Seamount Province (view from N to S).

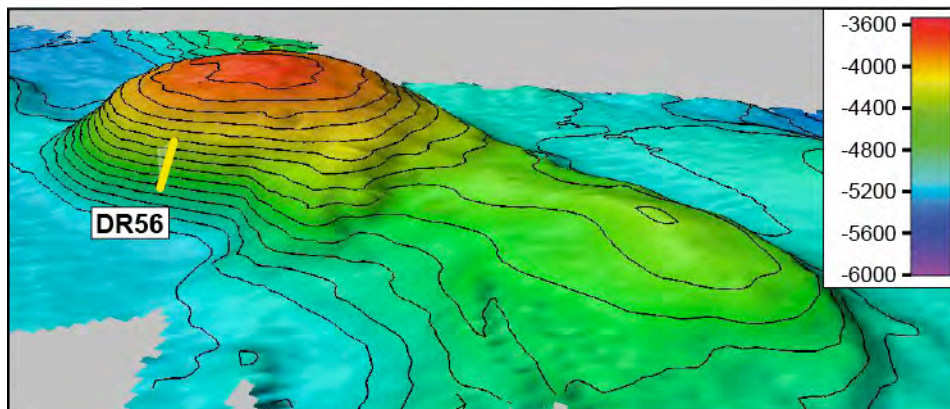
Appendix III (3D-Maps of SO265 Dredge Tracks)



DR54 at a "pancake" seamount at the eastern end of the Ojin Seamount Province (view from NNE to SSW).

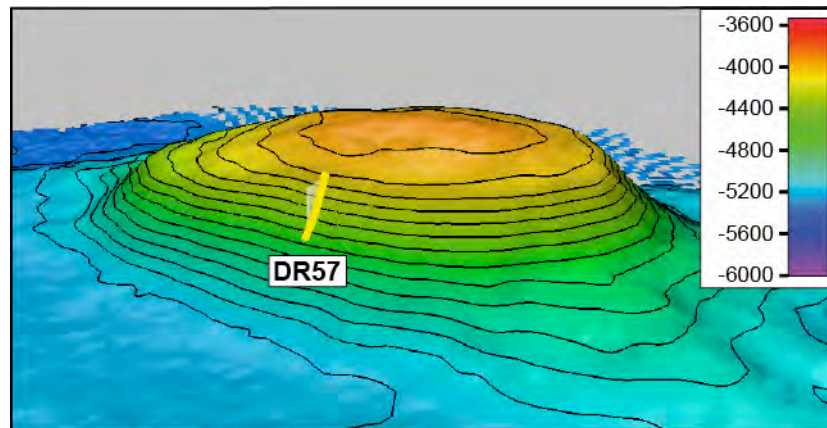


DR55 at another "pancake" seamount at the eastern end of the Ojin Seamount Province (view from WSW to ENE).

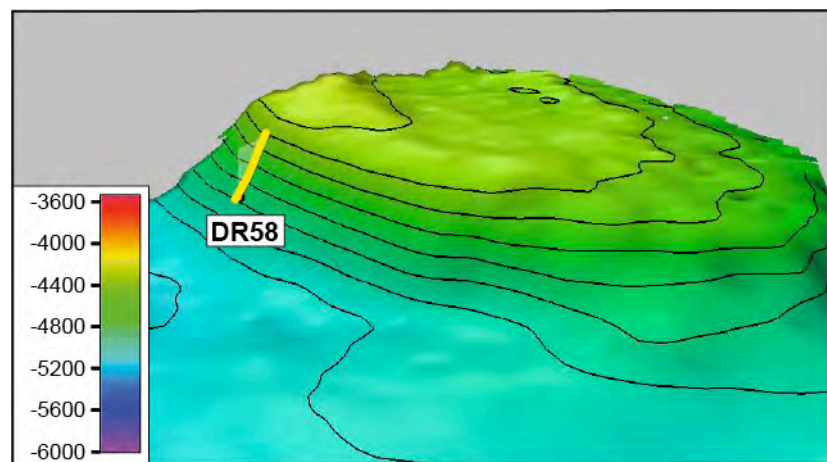


DR56 at NW-SE-striking ridge with flat topped seamount at its southeastern end in the southern part of the central Ojin Seamount Province (view from NW to SE).

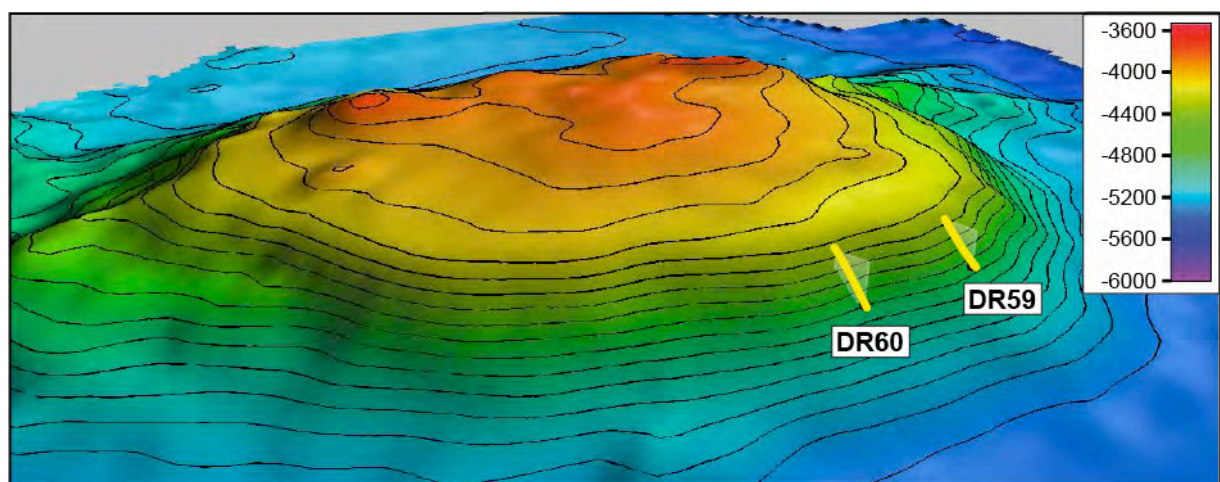
Appendix III (3D-Maps of SO265 Dredge Tracks)



DR57 at a flat-topped, slightly E-W-elongated seamount in the southern part of the central Ojin Seamount Province (view from N to S).

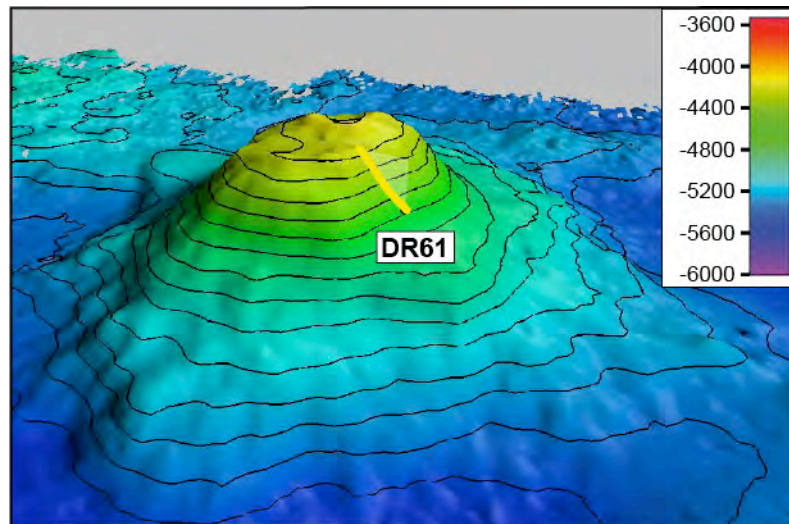


DR58 at a circular seamount in the southern part of the central Ojin Seamount Province (view from SE to NW).

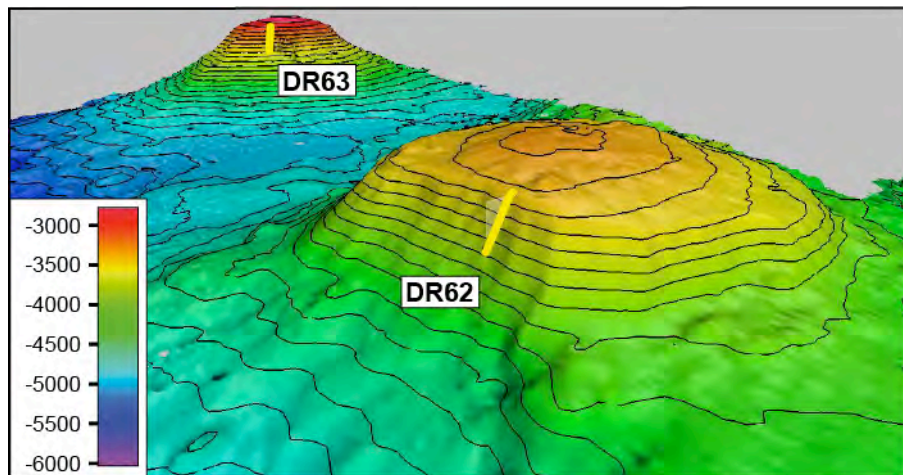


DR59 and 60 at the southern flank of an E-W-elongated seamount in the southern part of the central Ojin Seamount Province (view from SSW to NNE).

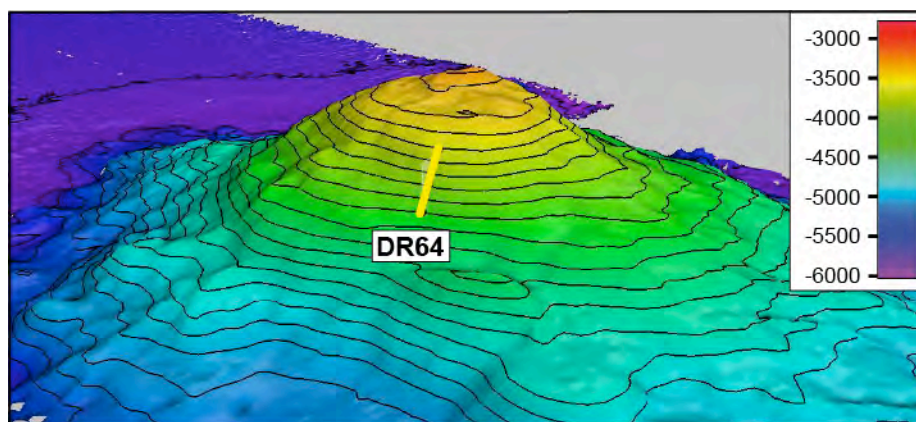
Appendix III (3D-Maps of SO265 Dredge Tracks)



DR61 at a solitary conical seamount in the northern half of the central Ojin Seamount Province (view from WSW to ENE).

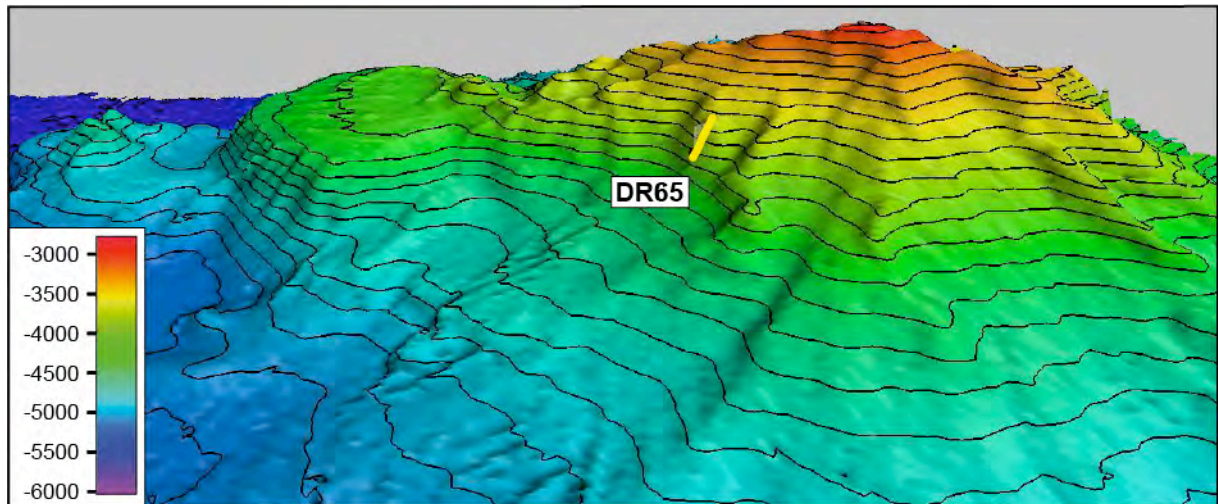


DR62 and 63 at two circular seamounts in the northern half of the central Ojin Seamount Province (view from WSW to ENE).

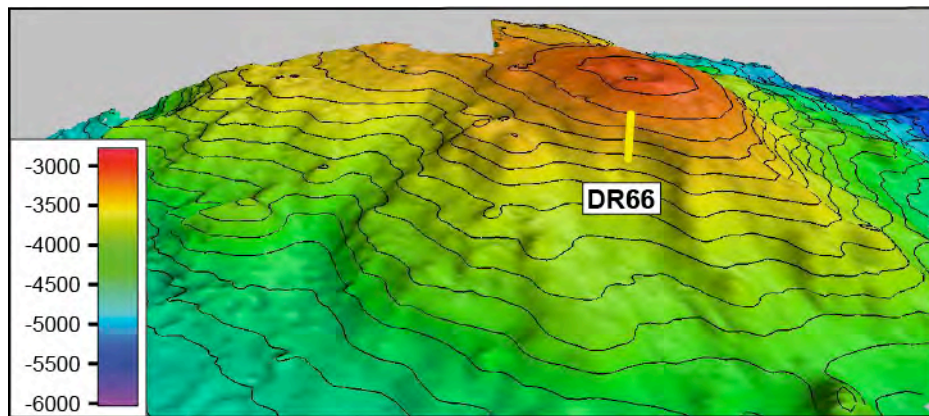


DR64 at the northern flank of a large conical seamount in the northern half of the central Ojin Seamount Province (view from NNW to SSE).

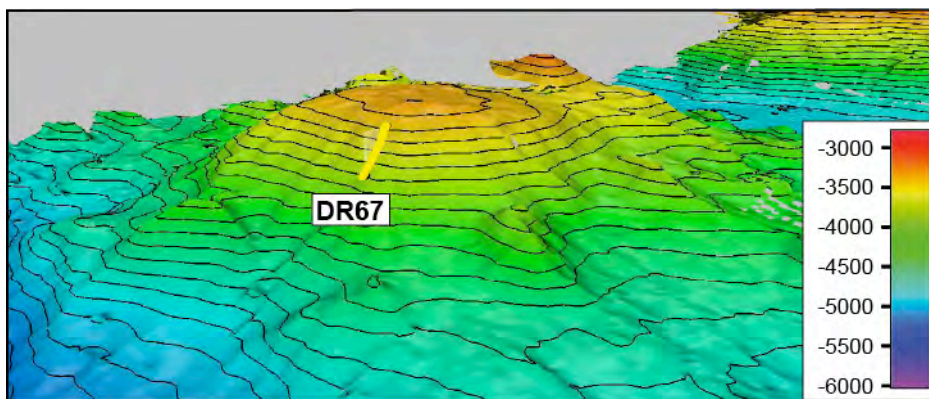
Appendix III (3D-Maps of SO265 Dredge Tracks)



DR65 at a NE-SW-elongated seamount with several rib-like offsets in the northern half of the central Ojin Seamount Province (view from ESE to WNW).

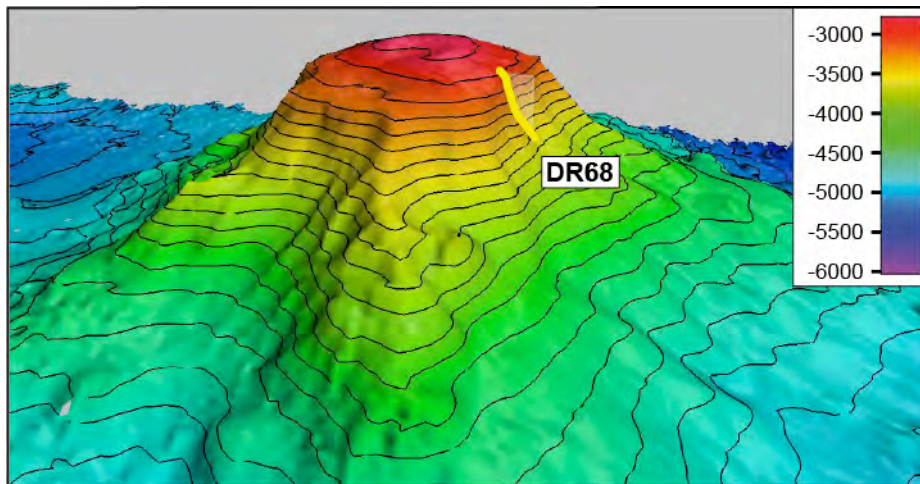


DR66 at the upper eastern slope of a flat-topped seamount in the northern half of the central Ojin Seamount Province (view from ESE to WNW).

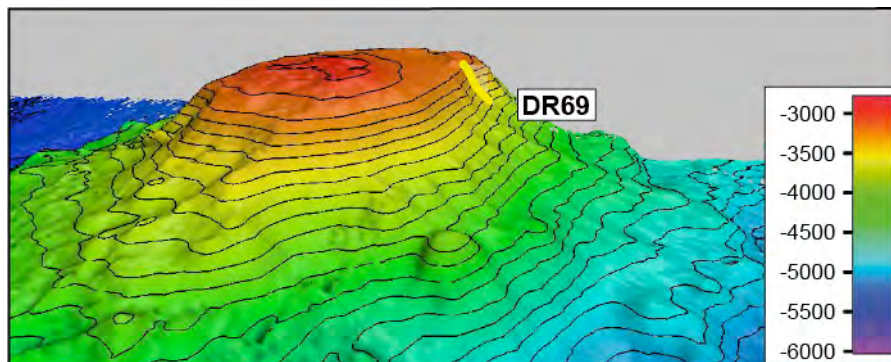


DR67 at the southern flank of a flat-topped seamount in the northern half of the central Ojin Seamount Province (view from ESE to WNW).

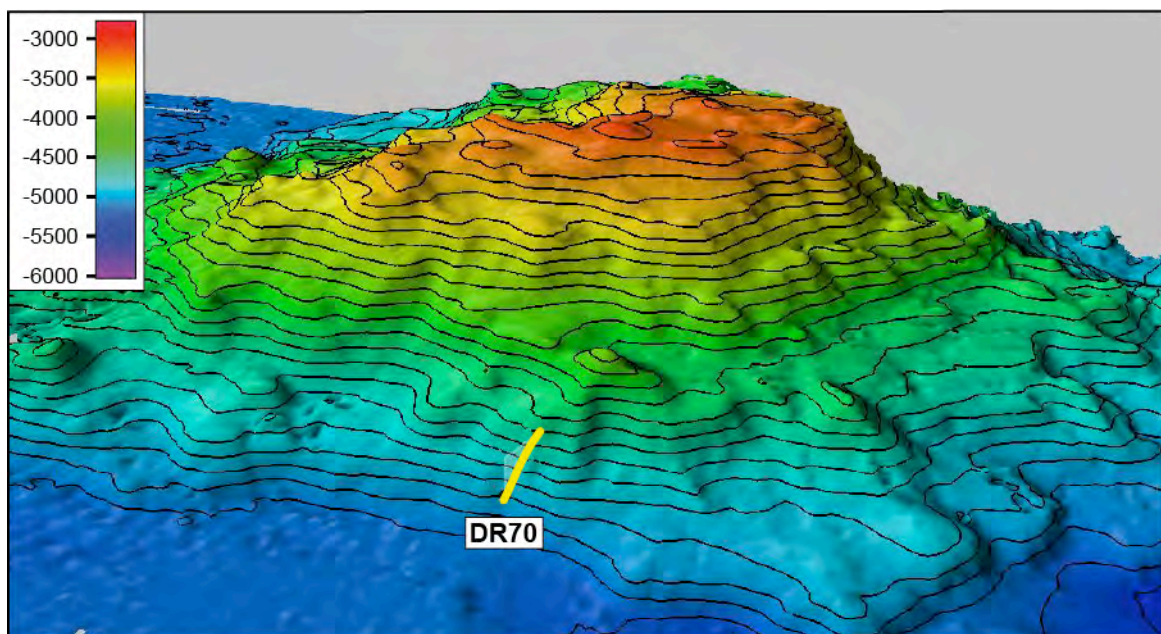
Appendix III (3D-Maps of SO265 Dredge Tracks)



DR68 at a guyot-type seamount in the western part of the Ojin Seamount Province (view from ESE to WNW).

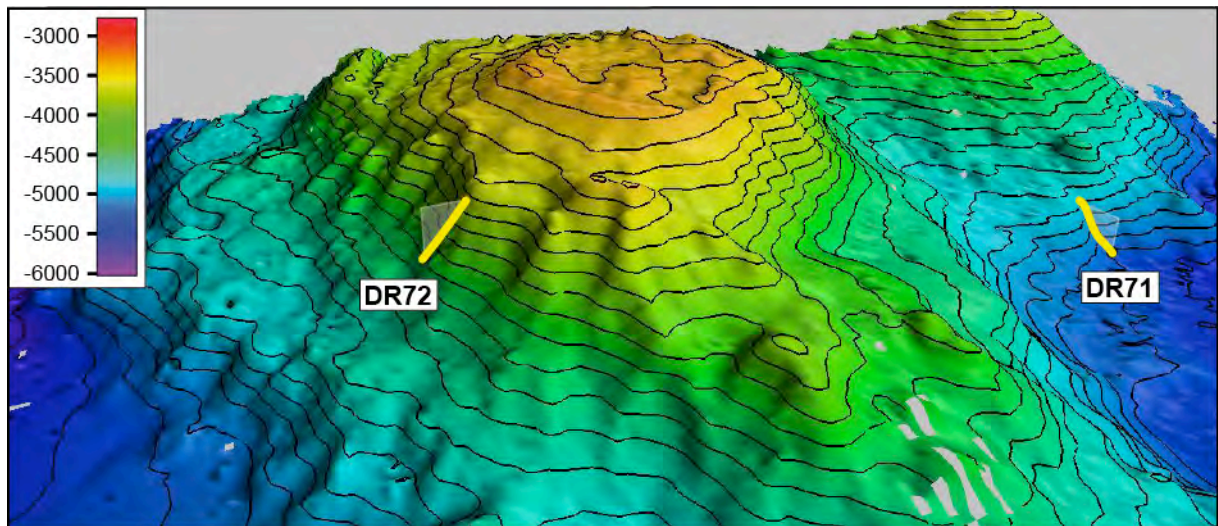


DR69 at a flat-topped seamount at the northwestern end of a prominent, ~140 km long, NW-SE striking chain of four seamounts of which the three southeastern ones have been successfully sampled during the R/V KAIREI expedition KR14-07 in 2014 (view from W to E).

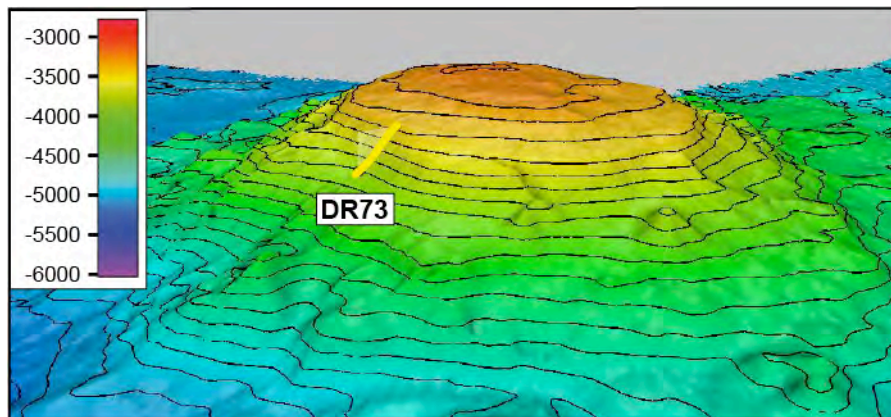


DR70 at a large, complex-shaped seamount in the western part of the Ojin Seamount Province (view from SSE to NNW).

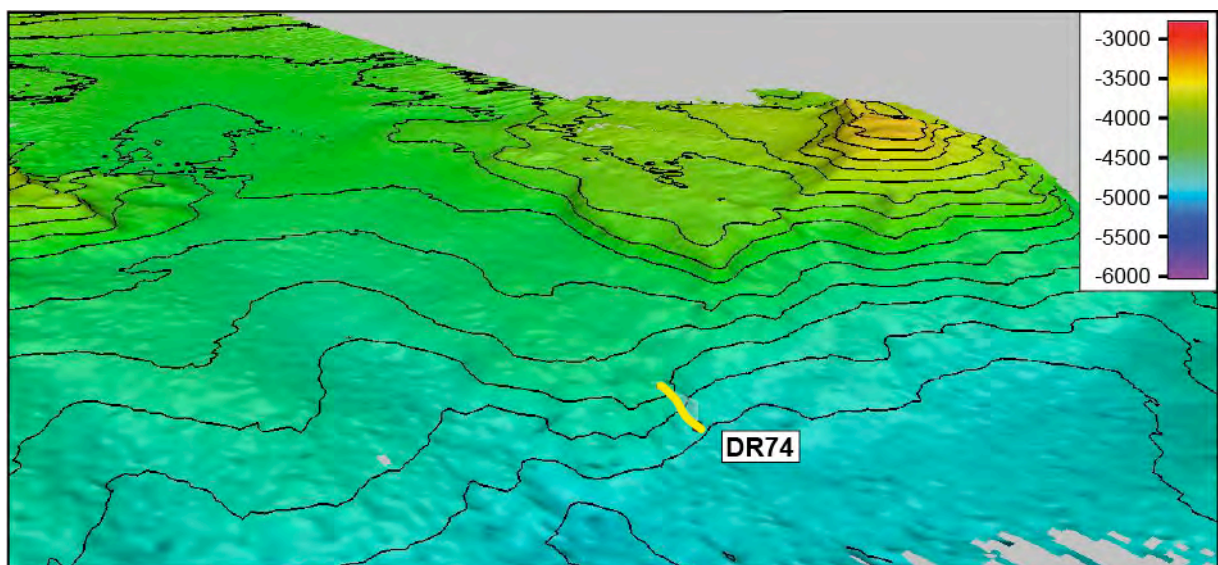
Appendix III (3D-Maps of SO265 Dredge Tracks)



DR71 and 72 at a complex amalgamation of seamounts in the western Ojin Seamount Province (view from W to E).

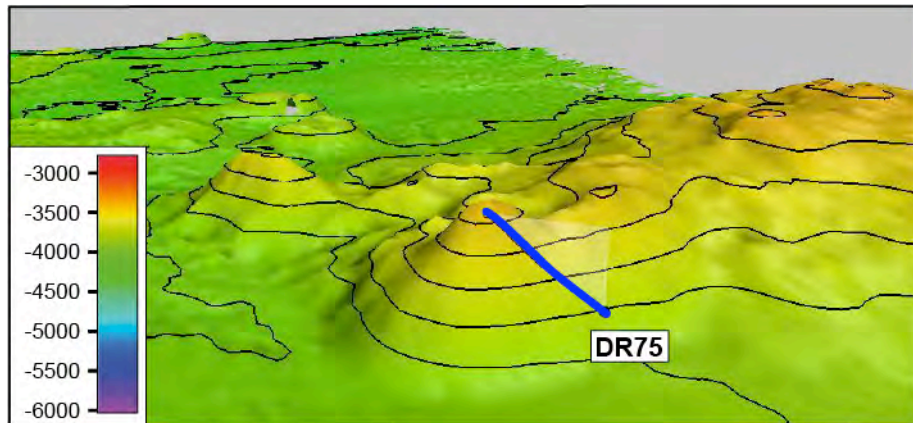


DR73 at a flat-topped seamount in the western Ojin Seamount Province (view from NE to SW).



DR74 at a small step in the eastern slope of the summit of the Shirshov Massif (view from SE to NW).

Appendix III (3D-Maps of SO265 Dredge Tracks)



DR75 at small cone 25 nm west of the summit of the Shirshov Massif interpreted to possibly represent a second, sediment-buried Shirshov summit (view from ENE to WSW).

Appendix IV: Biological Sampling

Abbreviations: n = number of collected samples, FIX = fixative, F4 = 4% formaldehyde solution, F6 = 6% formaldehyde solution, EtOH = 100% ethanol, AM = acetone/methanol, PFA = 4% paraformaldehyde solution, RNA = RNAlater, WP = Whirl-Pak, smt = seamount, DR = dredge, FZ = fracture zone, CTD = conductivity + temperature + pressure probe
The numbers 2, 5, 50, 100, 200, 500, and 1,000 refer to the size of the vials in ml

SO265-CTD1

CTD, no biological sampling

SO265-DR02 *label reads SO265-DR01*

Description of Location and Structure: Northern Shirshov Massif. Upper south facing slope of eastern twin guyot on northern Shirshov flank

Dredge on bottom UTC 31/08/18 16:51hrs, lat 38°21.53'N, long 163°11.20'E, depth 3416m

Dredge off bottom UTC 31/08/18 18:21hrs, lat 38°21.43'N, long 163°11.81'E, depth 2949m

total volume: 1/3 full, Mn crusts, some very large blocs contain rock clasts.

Comments: Two major igneous rock types: 1) vesicular aphyric basalt; 2) sparsely Pl phyric basalts with large up to 1cm, fresh Pl. Both lava types are oxidized and were likely erupted in shallow water.

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	unknown (possibly Echiura)	1	x								F4	From sediment traps

SO265-DR03 *label reads SO265-DR02*

Description of Location and Structure: Shirshov Massif, two prominent smts at NE end. Here the NW guyot is sampled along its NW slope in the mid section 300m below the plateau edge

Dredge on bottom UTC 01/09/18 00:16hrs, lat 38°11.81'N, long 163°31.72'E, depth 3356m

Dredge off bottom UTC 01/09/18 01:36hrs, lat 38°12.06'N, long 163°32.15'E, depth 2960m

total volume: 1/4 full, lava fragments, altered tuff, Mn

Comments: Aphyric to sparsely phyric Pl-Cpx phyric lava fragments cemented by Mn crusts. Fragments are all angular and represent freagments in breccia cemented by Mn crust. All rocks are rather strongly altered but Pl and Cpx are fresh

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Serpulidae	2	x								EtOH	Tubes with and without worms
	Sedentaria	4	x								EtOH	Tubes with and without worms

Appendix IV: Biological Sampling

SO265-DR04

Description of Location and Structure: Northern edge of Shatsky-Shirshov Ridge at Thompson Trough. Circular pillow (?) mound with central depression / caldera. Dredge track along NW margin sloping into Thompson Trough

Dredge on bottom UTC 01/09/18 16:41hrs, lat 40°01.08'N, long 163°28.03'E, depth 5141m

Dredge off bottom UTC 01/09/18 18:07hrs, lat 40°00.67'N, long 163°28.30'E, depth 4664m

total volume: 1/3 full, Mn nodules, some angular lava fragments, look like pillow lava.

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna												

SO265-DR05

Description of Location and Structure: Earthwatch Seamount; NW flank along upper section

Dredge on bottom UTC 02/09/18 00:55hrs, lat 39°51.74'N, long 163°48.79'E, depth 4439m

Dredge off bottom UTC 02/09/18 02:15hrs, lat 39°51.52'N, long 163°49.21'E, depth 4032m

Comments: Chunks of Mn crust with attached sediment, 1x Mn nodule without rock nucleus. One worm inside Mn crust

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Unknown (branched polychaet?)	1	x								F4	was growing inside a whole --> branched posterior

SO265-DR06

Description of Location and Structure: Earthwatch Seamount; NE flank along the lower section

Dredge on bottom UTC 02/09/18 06:06hrs, lat 39°52.17'N, long 163°57.72'E, depth 5234m

Dredge off bottom UTC 02/09/18 07:26hrs, lat 39°51.78'N, long 163°57.42'E, depth 4865m

total volume: very few rocks

Comments: just Mn crusts, no volcanic rocks, no biology, almost no sediments

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1				x					F6	From sediment traps --> almost empty
Macrofauna	-											

Appendix IV: Biological Sampling

SO265-DR07

Description of Location and Structure: Papanin Ridge SE scarp of Thompson Trough. Eastern part of the scarp, lower step from bottom to top

Dredge on bottom UTC 02/09/18 06:06hrs, lat 39°52.17'N, long 163°57.72'E, depth 5234m

Dredge off bottom UTC 02/09/18 07:26hrs, lat 39°51.78'N, long 163°57.42'E, depth 4865m

total volume: 1/5 full, Mn nodules and some angular lava fragments

Comments: Aphyric, dense lava fragments throughout with abundant Pl microphenocrysts. Vary in degree of alteration. -1 to -4 grey = very fresh. From -5 onwards reddish - brown Gm. From -10 to -14 cut open reference samples but with lots of Mn patches in Gm

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Unknown	1	x								EtOH	"stalked" egg"?
	Unknown	1	x								EtOH	
	Polychaeta	1	x								EtOH	tube (Serpulidae)?

SO265-DR08

Description of Location and Structure: Thompson Trough, NW end on Papanin Ridge side. Small SW facing step before slope reaches floor of the trough. Multiple steps visible.

Dredge on bottom UTC 02/09/18 21:09hrs, lat 40°10.79'N, long 163°32.21'E, depth 5345m

Dredge off bottom UTC 02/09/18 21:58hrs, lat 40°11.12'N, long 163°32.22'E, depth 5184m

total volume: few rocks; Mn nodules with cores of pumice, lava and sediment

Comments: small worms (polycheten). Pumice maybe rafted from Japan. Comparison with Japanese database may be useful, especially if age of Mn nodule can be determined.

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Porifera	1	x								F4	

Appendix IV: Biological Sampling

SO265-DR09

Description of Location and Structure: Papanin Ridge, southern part. Westernmost section of small step at the lower base of southern scarp

Dredge on bottom UTC 03/09/18 02:19hrs, lat 40°09.39'N, long 163°35.85'E, depth 5252m

Dredge off bottom UTC 03/09/18 03:30hrs, lat 40°09.83'N, long 163°35.86'E, depth 5081m

total volume: few rocks

Comments: Mn nodules with sedimentary, phosphate and pumice cores. Mn encrusted worm tubes

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR10

Description of Location and Structure: Papanin Ridge, southern end. Base of central section of northern flank of Thompson Trough

Dredge on bottom UTC 03/09/18 08:20hrs, lat 40°00.42'N, long 163°50.60'E, depth 5300m

Dredge off bottom UTC 03/09/18 09:28hrs, lat 40°00.86'N, long 163°50.58'E, depth 5040m

total volume: few Mn nodules

Comments: Two Mn nodules contain volcanic clasts, one Mn nodule contains pumice. Some representative samples were selected

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR11

Description of Location and Structure: Papanin Ridge, southern end. Seamount on northern flank of Thompson Trough.

Dredge on bottom UTC 03/09/18 13:39hrs, lat 39°59.80'N, long 163°54.99'E, depth 4904m

Dredge off bottom UTC 03/09/18 15:04hrs, lat 40°00.26'N, long 163°54.94'E, depth 4478m

total volume: 1/6 full

Comments: Mostly large Mn nodules or Mn encrusted rock fragments, some containing fairly fresh, subangular fragments of Pl-Px phyric lava (-1 to -4). -5 is a Mn encrusted breccia clast and -6 a pumice from a raft. Three larger blocs (A, B, C) were all Mn covers and consisted of platy sediment (A), volcanic sediment (B) and a Mn nodule. No igneous rocks inside, thus discarded.

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Polychaeta	1	x								EtOH	tubes
	Polychaeta	1	x								F4	tubes
	Polychaeta	1	x								F4	tubes

Appendix IV: Biological Sampling

SO265-DR12

Description of Location and Structure: E of Thompson Trough "Sonne Ridge", irregular shaped, elongated seamount with numerous ridges and valleys, appears of tectonic origin. Western end along S facing flank at the very base.

Dredge on bottom UTC 03/09/18 22:37hrs, lat 39°48.57'N, long 164°39.17'E, depth 5190m

Dredge off bottom UTC 04/09/18 00:00hrs, lat 39°48.99'N, long 164°38.87'E, depth 4753m

total volume: ~1/5 full

Comments: two pieces of OI-PI phyric lava, fairly fresh (-1 & -2), rafted pumice (-3, -4 and -6), sediment (-7 & -8), scoria (-5) and Mn-oxide crust (-9 & -10)

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR13

Description of Location and Structure: "Sonne Ridge", upper section of southern flank at western part of ridge

Dredge on bottom UTC 04/09/18 03:32hrs, lat 39°50.94'N, long 164°42.78'E, depth 4080m

Dredge off bottom UTC 04/09/18 04:45hrs, lat 39°51.33'N, long 164°42.49'E, depth 3610m

total volume: empty

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

Appendix IV: Biological Sampling

SO265-DR14

Description of Location and Structure: "Sonne Ridge", upper part of southern flank, 0.5nm W of DR13

Dredge on bottom UTC 04/09/18 07:39hrs, lat 39°50.84'N, long 164°42.30'E, depth 4120m

Dredge off bottom UTC 04/09/18 08:49hrs, lat 39°51.22'N, long 164°42.15'E, depth 3690m

total volume: one large bloc of Mn crust and several small

Comments: numerous fragments of Ol phyric basaltic pillow lavas cemented by Mn crust. Loose fragments of the same rock type

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1	x						x		F6	From sediment traps
Macrofauna	Porifera, Hexactinellida	1	x								F4	
	Porifera	1	x								F4	
	Porifera	1	x								EtOH	
	Porifera	1	x								F4	
	Porifera	1			x						EtOH	Base of a sponge
	Cnidaria, Hydroidea	1	x								EtOH	skeleton of the colony
	Brachiopoda?	1	x								EtOH	pouch with several small double-shelled individuals
	Polychaeta, Serpulidae	1	x								EtOH	tube without worm
	Polychaeta	1	x								EtOH	tube with worm but incomplete
	Gastropoda	1	x								F4	

SO265-DR15

Description of Location and Structure: Papanin Ridge, Southern area; circular shaped, ± flat topped seamount with ca 20km ø, rises ca 600m above abyssal plane. Small volcanoes on flat top, unlikely to be a guyot based on overall shape. Track along S flank, SSE facing slope from bottom to edge

Dredge on bottom UTC 04/09/18 16:36hrs, lat 40°24.39'N, long 164°15.90'E, depth 5103m

Dredge off bottom UTC 04/09/18 17:51hrs, lat 40°24.76'N, long 164°15.67'E, depth 4671m

total volume: 1/10 full; Mn nodules only, all of very similar 10-15cm diameter

Comments: few nodules contain larger (cm sized) lava fragments as cores. -1 is largest clast, a fairly fresh aphyric lava with grey Gm, altered Ol and fresh Pl in Gm, possibly Px

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

Appendix IV: Biological Sampling

SO265-DR16

Description of Location and Structure: Papanin Ridge, flat topped Smt SE of Shuleykin Smt, NE slope from bottom to top

Dredge on bottom UTC 05/09/18 00:16hrs, lat 40°48.57'N, long 164°08.65'E, depth 4835m

Dredge off bottom UTC 05/09/18 01:42hrs, lat 40°48.37'N, long 164°08.12'E, depth 4420m

total volume: 1/4 full; Mn nodules, cores: volcanic rocks, Cc, breccias, pumice

Comments: Mn cores made of some fairly fresh to altered volcanic rocks

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Unknown	1	x								F4	Tube was growing on top of manganese crust like seaweed
	Octocorallia, Pennatulidae	1			x						EtOH	
	Octocorallia, Pennatulidae	1			x						F4	

SO265-DR17

Description of Location and Structure: Transit to Shuleykin Smt

CTD to water UTC 05/09/18 05:06hrs, lat 40°57.56'N, long 163°51.01'E, depth 4900m

CTD on deck UTC 05/09/18 06:39hrs, lat 40°57.55'N, long 164°51.03'E, depth 4895m

Comments: CTD lowered to 2000 mbsl to record sound profile for EM122

SO265-DR18

Description of Location and Structure: Shuleykin Smt, middle part of S slope. Middle steepest part of the ridge slope

Dredge on bottom UTC 05/09/18 10:49hrs, lat 41°10.43'N, long 163°33.78'E, depth 4602m

Dredge off bottom UTC 05/09/18 12:10hrs, lat 41°10.79'N, long 163°33.64'E, depth 4200m

total volume: very few rocks; mostly Mn nodules, few angular rock fragments.

Comments: Mn cores made of some fairly fresh to altered volcanic rocks

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

Appendix IV: Biological Sampling

SO265-DR19

Description of Location and Structure: Shuleykin Ridge / Smt, Repeat of DR18 ~1nm E. Middle part of S slope.

Dredge on bottom UTC 05/09/18 15:33hrs, lat 41°10.56'N, long 163°34.72'E, depth 4473m

Dredge off bottom UTC 05/09/18 16:53hrs, lat 41°10.96'N, long 163°34.53'E, depth 3995m

total volume: few rocks; surprisingly scarce Mn nodules

Comments: After cutting abundant fragments of Ol-phyric lava, some with rare Pl. Vary from moderately to strongly altered. Many still have grey Gm. Sample -13 has large Px? phenocrysts, is very fresh and was unusually hard to saw almost like a metamorphic rock; this is a suspect dropstone (!)

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Polyplacophora	1	x								EtOH	

SO265-DR20

Description of Location and Structure: Papanin Ridge at W margin, S flank of small Smt from base to top

Dredge on bottom UTC 06/09/18 00:36hrs, lat 41°31.05'N, long 164°02.36'E, depth 5155m

Dredge off bottom UTC 06/09/18 01:59hrs, lat 41°31.48'N, long 164°02.24'E, depth 4727m

total volume: 1/3 full

Comments: altered volcanic rocks, pumice, Mn nodules with cores of breccias, carbonate and unusually fresh rock which are probably dropstones

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Ophiuroidea	1	x								F4	
	Unknown	1	x								F4	possible remnant from hatching event
	Unknown	1	x								EtOH	possible remnant from hatching event

SO265-DR21

Description of Location and Structure: Papanin Ridge, Southern Area, flat topped seamount in western section of Papanin Ridge, SW flank from base to top

Dredge on bottom UTC 06/09/18 08:22hrs, lat 41°19.18'N, long 164°28.93'E, depth 4822m

Dredge off bottom UTC 06/09/18 09:48hrs, lat 41°19.60'N, long 164°29.06'E, depth 4480m

total volume: few rocks

Comments: two pillow lava fragments and Mn nodules and crust fragments. A few pebbles -dropstones-. Sample -1 & -2 are aphyric, vesicular basalts

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

Appendix IV: Biological Sampling

SO265-DR22

Description of Location and Structure: Papanin Ridge, Southern Area, NE-SW elongated pan-cake like Smt; 30x16km. Track along E margin from bottom to edge where slope flattens. Above edge small cone.

Dredge on bottom UTC 06/09/18 16:20hrs, lat 41°32.51'N, long 164°58.57'E, depth 4672m

Dredge off bottom UTC 06/09/18 17:43hrs, lat 41°32.72'N, long 164°57.00'E, depth 4241m

total volume: few rocks

Comments: some angular lava fragments, mostly Mn nodules with sediment cores. -1 to 8 aphyric lava with rare Ol microphenocrysts ranging from moderately to partly fresh to strongly altered, -9 & -10 are highly Pl phyric lava fragments but Pl is to a large extent altered to clay.

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR23

Description of Location and Structure: Papanin Ridge, Southern to Central Area, irregular, anvil-like shaped Smt on E side of Papanin Ridge; track along N flank

Dredge on bottom UTC 07/09/18 00:48hrs, lat 41°59.96'N, long 164°58.35'E, depth 4756m

Dredge off bottom UTC 07/09/18 02:07hrs, lat 41°59.69'N, long 164°57.90'E, depth 4453m

total volume: 1/5 full

Comments: lava fragments, Mn nodules. Fragments of pillow lava. Sparsely Pl phyric, petrographically identical to DR21

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Porifera	1			x						F4	
	Porifera	1			x						EtOH	
	Porifera	1	x								F4	
	Porifera	1	x								EtOH	
	Porifera	1	x								F4	
	Porifera	1	x								EtOH	
	Polychaeta, Serpulidae	1	x								EtOH	
	Hydroidea	1	x								F4	
	Unknown	1	x								F4	
	Unknown/Cnidaria	1					x				F4	likely Cnidaria, Octocorallia

SO265-CTD24

CTD, no biological sampling

Appendix IV: Biological Sampling

SO265-DR25

Description of Location and Structure: Papanin Ridge, Central Area, N slope of E-W striking ridge

Dredge on bottom UTC 07/09/18 11:41hrs, lat 42°06.16'N, long 165°24.28'E, depth 4488m

Dredge off bottom UTC 07/09/18 13:04hrs, lat 42°05.73'N, long 165°24.17'E, depth 4017m

total volume: 1/5 full

Comments: large Mn crust (bloc A; 55x20x75cm) with very scarce lava clasts (pillow fragments). Moderately to strongly altered, some grey areas, aphyric, all samples taken are from bloc A and labelled -1A through -1D. Other recovered material were 3-4 Mn nodules without igneous cores and thus were discarded.

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Tunicata	1				x					F4	
	Porifera	1	x								EtOH	

SO265-DR26

Description of Location and Structure: Papanin Ridge, Central Area, Smt 20nm NNE of DR25. ENE faulted? flank near base. Smt NNW and connects with DR25 Smt along NNW-SSE striking, elevated sea floor

Dredge on bottom UTC 07/09/18 20:54hrs, lat 42°22.89'N, long 165°23.73'E, depth 4708m

Dredge off bottom UTC 07/09/18 22:02hrs, lat 42°22.72'N, long 165°23.29'E, depth 4289m

total volume: 1/4 full

Comments: few rocks, large Mn crust, Mn nodules. Numerous fragments of pillow lava and altered glass in Mn crust, a few dropstones.

Aphyric fluidal pillow lava fragments, some are fairly fresh

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Cnidaria, Pennatulidae	1							x		F4	
	Cnidaria, Pennatulidae	1	x								EtOH	part of F4 fixed sample
	Porifera	1	x								EtOH	
	Porifera	1			x						EtOH	

Appendix IV: Biological Sampling

SO265-DR27

Description of Location and Structure: Papanin Ridge, Central Area, Same Smt as of DR26, small cone on SW flank in top area, track along S to SW flank

Dredge on bottom UTC 08/09/18 02:24hrs, lat 42°19.13'N, long 165°18.29'E, depth 4405m

Dredge off bottom UTC 08/09/18 03:44hrs, lat 42°19.58'N, long 165°18.19'E, depth 4013m

total volume: single rock

Comments: plutonic dropstone

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR28

Description of Location and Structure: Papanin Ridge, Central Area, same Smt as of DR26, small cone at SW side in the top area, track along S to SW slope

Dredge on bottom UTC 08/09/18 08:58hrs, lat 42°18.99'N, long 165°00.82'E, depth 4900m

Dredge off bottom UTC 08/09/18 10:23hrs, lat 42°19.19'N, long 165°00.29'E, depth 4490m

total volume: few rocks

Comments: Mn nodules and dropstones

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Cnidaria?	1	x								EtOH	
	Polychaeta	1	x								F4	
	Polychaeta	1	x								F4	

SO265-DR29

Description of Location and Structure: Papanin Ridge, Central Area at transition to E Smt Province. E-W elongated, large Smt, 15x10nm with ± flat topped area. S facing slope in W section of Smt. Track along uppermost slope beneath edge

Dredge on bottom UTC 08/09/18 23:05hrs, lat 42°31.60'N, long 166°45.63'E, depth 4309m

Dredge off bottom UTC 09/09/18 00:20hrs, lat 42°32.06'N, long 165°45.62'E, depth 3843m

total volume: few rocks

Comments: Mn nodules and dropstones

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

Appendix IV: Biological Sampling

SO265-DR30

Description of Location and Structure: Papanin Ridge, Central Area at transition to E Smt Province. Same E-W elongated, large Smt as DR29 but E section of S facing slope, 300m deeper than DR29 near base.

Dredge on bottom UTC 09/09/18 03:58hrs, lat 42°28.71'N, long 166°51.34'E, depth 5044m

Dredge off bottom UTC 09/09/18 05:14hrs, lat 42°29.17'N, long 166°51.22'E, depth 4669m

total volume: a few rocks

Comments: pillow lava fragments, Mn nodules <8cm ø

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR31

Description of Location and Structure: Papanin Ridge, Central Area at transition to E Smt Province. Same E-W elongated, large Smt as DR30, again W section of S facing slope, upper part accross small canyon

Dredge on bottom UTC 09/09/18 09:00hrs, lat 42°32.90'N, long 166°42.34'E, depth 4330m

Dredge off bottom UTC 09/09/18 10:28hrs, lat 42°33.34'N, long 166°42.11'E, depth 3890m

total volume: a few rocks

Comments: Mn crusts, dropstones (dunite, sandstone, tuffs, Pl-CPx-Ol basal). No samples taken

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR32

Description of Location and Structure: Papanin Ridge, Central Area at transition to E Smt Province. Same E-W elongated, large Smt as DR31 but 1.5nm SE. S facing slope, mid section to top

Dredge on bottom UTC 09/09/18 13:54hrs, lat 42°32.01'N, long 166°43.57'E, depth 4235m

Dredge off bottom UTC 09/09/18 15:13hrs, lat 42°32.45'N, long 166°43.62'E, depth 3857m

total volume: few rocks & mud

Comments: Mn crusts & one clearly identified dropstone. At closer inspection a disk like Mn crust contained a igneous core that was first thought to be a highly Fsp phyric rock (-1) but under the binocular turned out as plutonic rock and thus classifies for being a dropstone.

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

Appendix IV: Biological Sampling

SO265-DR33

Description of Location and Structure: Papanin Ridge, Central Area ca 25nm WNW of DR32. Small ridge connecting two large circular Smts, steepest slope in the entire mapped area. S-facing slope from bottom to top. All three Smts on a single WNW striking line.

Dredge on bottom UTC 09/09/18 23:30hrs, lat 42°44.50'N, long 166°10.07'E, depth 4915m

Dredge off bottom UTC 10/09/18 00:54hrs, lat 42°44.95'N, long 166°10.07'E, depth 4450m

total volume: empty despite single 7.4t bite. The strongest bite thus far achieved on SO265

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR34

Description of Location and Structure: Papanin Ridge, Central Area at transition to E Smt Province. Smt ø 6nm at base. S slope along mid section. Due to wind directions restriction from 340° to 360°. Therefore steeper W slope not possible.

Dredge on bottom UTC 10/09/18 11:58hrs, lat 42°30.16'N, long 165°58.90'E, depth 4756m

Dredge off bottom UTC 10/09/18 13:33hrs, lat 43°60.97'N, long 165°58.71'E, depth 4484m

total volume: few rocks

Comments: dropstones, Mn nodules and crust. Single volcanic rock but dropstone

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Polychaeta	1	x								F4	

SO265-DR35

Description of Location and Structure: Papanin Ridge, NW section of N part. Elongated Smt, S slope

Dredge on bottom UTC 10/09/18 19:22hrs, lat 43°38.76'N, long 165°41.52'E, depth 4467m

Dredge off bottom UTC 10/09/18 20:41hrs, lat 43°39.20'N, long 165°41.42'E, depth 4987m

total volume: a few rocks

Comments: small rock fragments of lavas, Mn crusts

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

Appendix IV: Biological Sampling

SO265-DR36

Description of Location and Structure: Papanin Ridge, northern most edge. The northernmost Smt in a chain of \pm N-S striking Smts; lower part of S slope

Dredge on bottom UTC 11/09/18 02:45hrs, lat 43°53.27'N, long 165°27.66'E, depth 5543m

Dredge off bottom UTC 11/09/18 03:47hrs, lat 43°53.59'N, long 165°27.69'E, depth 5180m

total volume: single dropstone

Comments: dropstone of angular, mafic plutonic rock

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Cnidaria	1			x						EtOH	
	Cnidaria	1					x				F4	

SO265-DR37

Description of Location and Structure: Papanin Ridge, northern most edge. The northernmost Smt in a chain of \pm N-S striking Smts; lower part of S slope. Repeat of DR36, 0.5nm further E

Dredge on bottom UTC 11/09/18 07:43hrs, lat 43°53.16'N, long 165°28.01'E, depth 5559m

Dredge off bottom UTC 11/09/18 08:49hrs, lat 43°53.53'N, long 165°28.10'E, depth 5195m

total volume: empty

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR38

Description of Location and Structure: Hokkaido Trough; N facing slope of \pm W-E trending ridge

Dredge on bottom UTC 14/09/18 00:30hrs, lat 45°06.27'N, long 162°27.16'E, depth 5930m

Dredge off bottom UTC 14/09/18 01:46hrs, lat 45°06.59'N, long 162°26.81'E, depth 5580m

total volume: few volcanic rocks

Comments: aphyric lavas with fine to medium crystallized Gm

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

Appendix IV: Biological Sampling

SO265-DR39

Description of Location and Structure: Papanin Ridge / Smt Province, Eastern Section at northern margin. Circular Smt with caldera like depression at summit. Probably a pillow mound. Lower part of NE flank

Dredge on bottom UTC 14/09/18 23:09hrs, lat 44°02.46'N, long 167°11.01'E, depth 5300m

Dredge off bottom UTC 15/09/18 00:43hrs, lat 44°02.02'N, long 167°10.70'E, depth 4900m

total volume: 1/8 full

Comments: pillow lava fragments, Mn crusts with lava fragments, a few dropstones. Pl phyrlic and aphyric lavas, moderately altered with fresh Pl

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Unknown	1			x						EtOH	growing on rock

SO265-DR40

Description of Location and Structure: Papanin Ridge, easternmost area. Ø 2.5km cone with rel. steep S-flank. The large Smt at 168°30'E; 43°50'N according to predicted map did not exist, therefore DR40 represents the only dredgable structure nearby

Dredge on bottom UTC 15/09/18 12:42hrs, lat 43°58.75'N, long 168°20.17'E, depth 5512m

Dredge off bottom UTC 15/09/18 13:31hrs, lat 43°59.00'N, long 168°20.16'E, depth 5250m

total volume: empty

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR41

Description of Location and Structure: Papanin Ridge, NE area. Southern of two closely spaces Smts at the end of a NNW-SSE trending ridge, N slope of a small cone

Dredge on bottom UTC 16/09/18 01:30hrs, lat 43°02.74'N, long 167°25.42'E, depth 4756m

Dredge off bottom UTC 16/09/18 02:22hrs, lat 43°02.52'N, long 167°25.60'E, depth 4560m

total volume: empty

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Tunicata, Ascidiacea	1								2000	F4	still attached to rock

Appendix IV: Biological Sampling

SO265-DR42

Description of Location and Structure: Papanin Ridge, northeasternmost area. Smt at southern termination of NNW-SSE striking

Dredge on bottom UTC 16/09/18 07:02hrs, lat 42°37.42'N, long 167°36.93'E, depth 5044m

Dredge off bottom UTC 16/09/18 09:30hrs, lat 42°37.68'N, long 167°37.20'E, depth 4729m

total volume: very few rocks + biology.

Comments: small Mn-nodules + one dropstone. Core of one Mn-nodule contains an angular fragment of fairly fresh to moderately altered lava

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Tunicata, Thaliacea, Salpa maxima	1					x				EtOH	caught in the dredge from water surface
	Tunicata, Thaliacea, Salpa maxima	1					x				F4	caught in the dredge from water surface
	Tunicata, Thaliacea, Salpa maxima	1			x						EtOH	caught in the dredge from water surface
	Tunicata, Thaliacea, Salpa maxima	1			x						EtOH	caught in the dredge from water surface

SO265-DR43

Description of Location and Structure: Papanin Ridge, northeasternmost area. Repeat of DR42 at same , 1nm further NW along W facing slope from near base to almost top

Dredge on bottom UTC 16/09/18 13:37hrs, lat 42°38.68'N, long 167°36.46'E, depth 5010m

Dredge off bottom UTC 16/09/18 14:37hrs, lat 42°38.67'N, long 167°37.04'E, depth 4587m

total volume: almost nothing, 15 brittle chunks

Comments: small Mn-nodules embedded in sediment, dropstones (sediments?), sedimentary rocks. One bigger animal

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Tunicata, Thaliacea, Salpa maxima	1					x				F6	pelagic
	Porifera	1	x								EtOH	tiny sponge (1-2mm)

SO265-DR44

Description of Location and Structure: Papanin Ridge, northeasternmost part. Elongated, flat-topped Smt with depression on top in NE part, dredge track along S-SSE slope

Dredge on bottom UTC 16/09/18 20:24hrs, lat 42°30.08'N, long 168°00.10'E, depth 5146m

Dredge off bottom UTC 16/09/18 21:37hrs, lat 42°30.50'N, long 167°59.87'E, depth 4736m

total volume: one dropstone

Comments: andesite dropstone

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Tunicata, Thaliacea, Salpa maxima	1				x					F4	pelagic

Appendix IV: Biological Sampling

SO265-DR45

Description of Location and Structure: Papanin Ridge, easternmost area. Repeat of DR44 at elongated (oval), flat-topped Smt, NE slope, ~2nm N of DR44

Dredge on bottom UTC 17/09/18 01:37hrs, lat 42°32.68'N, long 168°03.41'E, depth 5066m

Dredge off bottom UTC 17/09/18 03:02hrs, lat 42°32.96'N, long 168°02.94'E, depth 4569m

total volume: 1/4 full, 1x large Mn crust and loose rock fragments

Comments: Ol-Pi and Pi phyric lava fragments, either as loose fragments (-1 to -6) or cemented fragments (-7 to -16X) in bloc A (50x40x30cm). Both sets range from fairly fresh to strongly altered with most being moderately altered. The cemented fragments show features of multiple alteration phase that include green-yellow zones of smectite? replacing Gm.

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR46

Description of Location and Structure: Northern Ojin Smts, a small Smt in a chain of NNE-SSE trending Smts. 2nd Smt from N. W slope, middle part

Dredge on bottom UTC 18/09/18 00:45hrs, lat 39°07.69'N, long 167°21.36'E, depth 4779m

Dredge off bottom UTC 18/09/18 02:05hrs, lat 39°07.61'N, long 167°21.86'E, depth 4379m

total volume: empty

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR47

Description of Location and Structure: Northern Ojin Smts, ~18nm SSE of DR46. NW flank of ±N-S striking ridge. From slightly above base to break in slope in top region

Dredge on bottom UTC 18/09/18 08:22hrs, lat 38°58.02'N, long 167°44.96'E, depth 5089m

Dredge off bottom UTC 18/09/18 09:36hrs, lat 38°57.67'N, long 167°45.20'E, depth 4642m

total volume: 1/6 full, with Mn nodules

Comments: Very occasional cores of Mn nodules are igneous. They are mostly angular, slightly phyric to aphyric, angular lava fragments. Moderately to strongly altered

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

Appendix IV: Biological Sampling

SO265-DR48

Description of Location and Structure: Northern Ojin Smts. Repeat of DR47 at same structure, 1nm SW of previous location at

Dredge on bottom UTC 18/09/18 13:26hrs, lat 38°57.16'N, long 167°43.66'E, depth 5283m

Dredge off bottom UTC 18/09/18 14:48hrs, lat 38°56.80'N, long 167°43.91'E, depth 4875m

total volume: empty

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	-											
Macrofauna	Cnidaria	1							x		F6	

SO265-DR49

Description of Location and Structure: Northern Ojin Smts. ~50nm E of DR48. NW flank of Smt, upper part of slope

Dredge on bottom UTC 18/09/18 23:15hrs, lat 38°44.27'N, long 168°44.80'E, depth 4580m

Dredge off bottom UTC 19/09/18 00:29hrs, lat 38°43.97'N, long 168°45.07'E, depth 4190m

total volume: 1/2 full, mainly Mn nodules but also igneous fragments

Comments: Pillow fragments, aphyric lava ranging from vesicular to non-vesicular. -1 to -8 belong to vesicular group, some with pipe vesicles, Gm ranges from fresh to moderately altered.

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR50

Description of Location and Structure: Ojin Smts, Eastern part. N-S elongated Smt topped by smaller circular flat topped plateau, northern slope at nose-like prominence

Dredge on bottom UTC 19/09/18 16:06hrs, lat 36°43.39'N, long 169°45.46'E, depth 4590m

Dredge off bottom UTC 19/09/18 17:22hrs, lat 36°42.96'N, long 169°45.59'E, depth 4190m

total volume: 1/6 full

Comments: Mn crusts and nodules. Two, small igneous cores recovered from nodules. Both are highly altered aphyric lava fragments

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Anthozoa	1	x								EtOH	
	Cnidaria, Anthozoa	1			x						EtOH	found while cracking open manganese crust

Appendix IV: Biological Sampling

SO265-DR51

Description of Location and Structure: Ojin Smts, Eastern part. Repeat of DR50 at same Smt, but 2sm SW of DR50 along W-flank; upper part of slope

Dredge on bottom UTC 19/09/18 20:46hrs, lat 36°41.42'N, long 169°43.16'E, depth 4280m

Dredge off bottom UTC 19/09/18 22:02hrs, lat 36°41.17'N, long 169°43.63'E, depth 3862m

total volume: 1/8 full

Comments: Mn crusts and nodules, a few with igneous cores ranging from slightly altered PI phyric (-1 and -5) to moderately altered, medium grained aphyric lava (-2). -3 is similar to -2 but with Mn filled vesicles. Remaining are highly oxidized, vesicular pillow lava fragments (-4, -6 -7)

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Cnidaria, Anthozoa	1	x								F4	same as DR50 stored in 50ml EtOH

SO265-DR52

Description of Location and Structure: Ojin Smts, Eastern Section. Ø13km Smt with prominent caldera. Track along NW flank in steep mid section

Dredge on bottom UTC 20/09/18 07:04hrs, lat 36°26.37'N, long 170°04.94'E, depth 4654m

Dredge off bottom UTC 20/09/18 08:13hrs, lat 36°26.13'N, long 170°05.27'E, depth 4290m

total volume: few rocks

Comments: Mn nodules, single piece of fairly fresh, aphyric lava as core inside a Mn-nodule

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	-											
Macrofauna	-											

SO265-DR53

Description of Location and Structure: Ojin Smts, easternmost section. Same Smt as DR52 but along NW facing caldera inner wall at SE crater rim

Dredge on bottom UTC 20/09/18 11:32hrs, lat 36°23.48'N, long 170°07.25'E, depth 4057m

Dredge off bottom UTC 20/09/18 12:25hrs, lat 36°23.22'N, long 170°07.28'E, depth 3835m

total volume: 3 large and several small Mn crusts

Comments: pillow lava fragments and hyaloclastites. Sparsely PI phyric volcanic rocks, slightly oxidized to moderately altered. Chilled margin with fresh at -3, Hyaloclastite -7A and -7B also possess fresh glass

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	-											
Macrofauna	-											

Appendix IV: Biological Sampling

SO265-DR54

Description of Location and Structure: Ojin Smts, easternmost section. Flat topped Smt **xy** nm W of DR52+53 Smt. Track along NE facing slope from valley across small ridge

Dredge on bottom UTC 20/09/18 16:35hrs, lat 36°31.22'N, long 169°58.25'E, depth 4865m

Dredge off bottom UTC 20/09/18 18:02hrs, lat 36°30.79'N, long 169°58.22'E, depth 4383m

total volume: 1/2 full

Comments: pillow lava fragments, a lot of Mn crusts and Mn nodules

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Polychaeta, Sedentaria	1	x								EtOH	
	Polychaeta, Sedentaria	1	x								EtOH	
	Polychaeta, Sedentaria	1	x								EtOH	

SO265-DR55

Description of Location and Structure: Ojin Smts, easternmost section. Pancake shaped Smt, ø 8km, SW of ridge with stations

Dredge on bottom UTC 20/09/18 23:49hrs, lat 36°24.61'N, long 169°35.93'E, depth 5029m

Dredge off bottom UTC 21/09/18 01:21hrs, lat 36°24.43'N, long 169°36.47'E, depth 4579m

total volume: few rocks & Mn nodules

Comments: aphyric pillow lava fragments, most in advanced stages of alteration. -1 & -2 have grey areas while -3 to -7 are more altered; -8 to -10 are strongly altered with multiples stages / phases of alteration; taken to study these phases in more detail; -11 mud stone.

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Sipunculidea	1	x								F4	inside a hole on manganese crust

Appendix IV: Biological Sampling

SO265-DR56

Description of Location and Structure: Ojin Smts, southern part of eastern section. circular shaped Smt on top of elongated NW-SE striking plateau base, track along steep N slope

Dredge on bottom UTC 21/09/18 09:56hrs, lat 36°28.27'N, long 168°30.84'E, depth 4630m

Dredge off bottom UTC 21/09/18 11:20hrs, lat 36°27.83'N, long 166°30.85'E, depth 4162m

total volume: 1/3 full

Comments: volcanic rocks, pumice, Mn nodules, Mn crust, biology mainly sponges made of glass fibre. Most lava are sparsely PI phyric lava with minor aphyric varieties. Majority are fairly fresh to slightly altered. TS and GC prepared for -1 to -7. Remaining without, in contrast to initial preparation protocol, probably due to size.

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Porifera	1	x								EtOH	
	Porifera	1	x								EtOH	
	Porifera	1	x								EtOH	
	Porifera	1	x								EtOH	
	Polychaeta	1	x								EtOH	tubes with/-out worms
	Polychaeta	1	x								EtOH	tubes with/-out worms
	Hydrozoa or Bryozoa?	1	x								EtOH	Hydrozoa or Bryozoa?

SO265-DR57

Description of Location and Structure: Ojin Smts, eastern section. Flat topped Smt, ~18nm W of DR56. Slightly E-W elongated, ø14km Smt with flat topped Smt. Track along NE flank below plateau edge

Dredge on bottom UTC 21/09/18 17:04hrs, lat 36°25.12'N, long 168°11.22'E, depth 4451m

Dredge off bottom UTC 21/09/18 18:32hrs, lat 36°24.74'N, long 168°10.95'E, depth 3954m

total volume: 1/5 full

Comments: Mn nodules with some rock clasts, Mn crusts with mud. Fresh to slightly altered, aphyric lava (-1, -2), more altered (-3, -5).

Sparsely PI to PI phyric lava, moderately to strongly altered (-6 to -9)

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Cephalopoda	1					x				F4	

Appendix IV: Biological Sampling

SO265-DR58

Description of Location and Structure: Ojin Smts, central section. Circular Smt with rel. steep S and W slope. Track along SW

Dredge on bottom UTC 22/09/18 02:02hrs, lat 36°46.00'N, long 167°35.13'E, depth 4805m

Dredge off bottom UTC 22/09/18 03:17hrs, lat 36°46.46'N, long 167°35.16'E, depth 3426m

total volume: very few Mn crusts & nodules

Comments: Mn nodules with some rock clasts, Mn crusts with mud. Very small clasts of aphyric lava fresh to moderately altered. With some effort Gc possible, Ar-Ar questionable. Not sufficient material for multiple TS. This is however a strategic location between Western and Eastern Ojin Smt province. Do not use up all material for Gc if Ar-Ar is feasible after TS inspection

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Hydrozoa, Siphonophorae	1					x				F4	

SO265-DR59

Description of Location and Structure: Ojin Smts, western section, easternmost Smt. E-W elongated Smt with relatively flat top

Dredge on bottom UTC 22/09/18 12:16hrs, lat 36°54.07'N, long 166°30.91'E, depth 4655m

Dredge off bottom UTC 22/09/18 13:30hrs, lat 36°54.42'N, long 166°30.80'E, depth 4210m

total volume: 1/3 full

Comments: Mn nodules 5-10cm ø

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Cnidaria	1	x								EtOH	
	Polychaeta	1	x								EtOH	tube with worm

SO265-DR60

Description of Location and Structure: Ojin Smts, western section, easternmost Smt. Repeat of DR60 1nm further NW along same slope beneath plateau edge

Dredge on bottom UTC 22/09/18 17:01hrs, lat 36°54.01'N, long 166°29.27'E, depth 4670m

Dredge off bottom UTC 22/09/18 18:12hrs, lat 36°54.36'N, long 166°29.12'E, depth 4170m

total volume: ??

Comments: mostly sparsely Pl aphyric lava fragments ranging from slightly to moderately altered (-1, -2 and -4). Aphyric varieties with similar degrees of alteration sampled in 2E, -6 and -7. Samples 2A through E are individual clasts from a breccia bloc

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

Appendix IV: Biological Sampling

SO265-DR61

Description of Location and Structure: Ojin Smts, western section, northern part. Small ø7km conical Smt, steep SW slope (scrap of slump), uppermost part below top region

Dredge on bottom UTC 23/09/18 03:30hrs, lat 37°55.62'N, long 166°41.56'E, depth 4564m

Dredge off bottom UTC 23/09/18 04:58hrs, lat 37°56.07'N, long 166°41.80'E, depth 4153m

total volume: 3/4 full!

Comments: mostly Mn nodules, pumice, small pieces of volcanic rocks and sediment inside nodules. Small, moderately to highly altered aphyric volcanic rocks, some are highly vesicular

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Holothuriidea	1					x				F4	
	Polychaeta	1				x					F4	scale worm
	Polychaeta	1	x								EtOH	

SO265-DR62

Description of Location and Structure: Ojin Smts, western section, northern part. Flat topped Smt on top of large N-S elongated basement structure, upper part of WNW slope

Dredge on bottom UTC 23/09/18 11:44hrs, lat 38°32.25'N, long 166°41.32'E, depth 3756m

Dredge off bottom UTC 23/09/18 12:48hrs, lat 38°32.05'N, long 166°41.64'E, depth 3330m

total volume: few rocks

Comments: ~40cm bloc of tuff, several small tuff fragments, two clasts of scoria and vesicular volcanic rock

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR63

Description of Location and Structure: Ojin Smts, western section, northern part. Flat topped Smt ~20nm N of DR62. S slope at edge of a possible slope collapse site

Dredge on bottom UTC 23/09/18 17:31hrs, lat 38°41.89'N, long 166°55.86'E, depth 3440m

Dredge off bottom UTC 23/09/18 18:50hrs, lat 38°42.09'N, long 166°56.32'E, depth 2950m

total volume: 1/4 full

Comments: 20 lava fragments 0-1 to 0.6m. Most are highly vesicular, fewer dense, some reddish oxidized, bloc is a highly Fsp phyric hyaloclastite with xenoliths of Fsp phyric lava; matrix mostly altered but may contain fresh glass

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Bryozoa	1		x							EtOH	

Appendix IV: Biological Sampling

SO265-DR64

Description of Location and Structure: Ojin Smts, western province, northern part. Ø10-12km Smt with cone on top. N-facing flank beneath top area of cone.

Dredge on bottom UTC 24/09/18 02:24hrs, lat 39°09.07'N, long 166°11.53'E, depth 4020m

Dredge off bottom UTC 24/09/18 03:39hrs, lat 39°08.64'N, long 166°11.45'E, depth 3590m

total volume: 1/2 full

Comments: Mostly Mn nodules <Ø10cm very well rounded, 1x very large Mn crust (bloc A), a few angular pillow lava fragments, pumice.

Several fairly fresh aphyric volcanic rocks sampled. All highly vesicular, some have rare Pl phenocrysts

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Unknown	1				x					F4	
	Gastropoda	1		x							F4	
	Bryozoa?, Cnidaria?	1	x								EtOH	

SO265-DR65

Description of Location and Structure: Ojin Smts, western province, northern part. NE-SW elongated Smt with several rib like offsets. track along nose-like structure at SE slope

Dredge on bottom UTC 24/09/18 10:02hrs, lat 39°04.47'N, long 165°28.89'E, depth 3906m

Dredge off bottom UTC 24/09/18 10:53hrs, lat 39°04.69'N, long 165°28.79'E, depth 3650m

total volume: 1/6 full

Comments: several fragments of Mn crust, few larger blocs of Mn crust, one larger bloc which is probably tuff

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Bryozoa	1	x								EtOH	
	Polychaeta?	1	x								EtOH	tube no worm
	Porifera	1	x								EtOH	
	Porifera	1	x								EtOH	

SO265-DR66

Description of Location and Structure: Ojin Smts, western province. Flat topped Smt, S of DR65, small scarp along E slope, track

Dredge on bottom UTC 24/09/18 17:18hrs, lat 38°35.41'N, long 165°18.84'E, depth 3391m

Dredge off bottom UTC 24/09/18 18:16hrs, lat 38°35.57'N, long 165°18.57'E, depth 3088m

total volume: empty

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

Appendix IV: Biological Sampling

SO265-DR67

Description of Location and Structure: Ojin Smts, western province, NW corner. N-S elongated Smt with flat topped area in S and ø1km cone at N end. Track along S flank of the main edifice beneath plateau edge

Dredge on bottom UTC 24/09/18 23:05hrs, lat 38°16.82'N, long 165°15.47'E, depth 3822m

Dredge off bottom UTC 25/09/18 00:33hrs, lat 38°17.24'N, long 165°15.39'E, depth 3373m

total volume: very large Mn crust, Mn nodules and pillow

Comments: mid sized pillow (bloc B, 31x30x33) of sparsely Pl phyric lava, slightly to moderate altered (1A - 1F). Samples -2 through -4 are from bloc A (133x80x33cm) and moderately altered lava similar to -1. Samples -5 & -6 are highly altered, aphyric lava fragments while -7 is another piece of sparsely Pl phyric lava.

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Hexacorallia	1					x				F4	"Golden Coral"
	Hexacorallia	1				x					EtOH	"Golden Coral"
	Porifera	1			x						EtOH	
	Porifera	1			x						EtOH	
	Porifera	1			x						EtOH	
	Porifera	1			x						EtOH	
	Porifera	1			x						EtOH	
	Porifera	2	x								EtOH	
	Polychaeta	1	x								EtOH	
	Hexacorallia	1	x								EtOH	"Golden Coral"
	Cnidaria?, Bryozoa?	1	x								EtOH	
	Cnidaria?, Bryozoa?	1	x								EtOH	
	Foraminifera	1	x								EtOH	
	Porifera	1	x								EtOH	
	Polychaeta	1	x								F4	tube
	Unknown	1	x								EtOH	
	Cnidaria	1	x								EtOH	
	Polychaeta	1	x								EtOH	
	Crustacea	1	x								EtOH	Cirripedia

Appendix IV: Biological Sampling

SO265-DR68

Description of Location and Structure: Ojin Smts, western province, central part. Extremely steep sloped, guyot shaped Smt, S-flank up to 56°

Dredge on bottom UTC 25/09/18 07:07hrs, lat 37°39.57'N, long 165°07.55'E, depth 3520m

Dredge off bottom UTC 25/09/18 08:54hrs, lat 37°39.95'N, long 165°07.75'E, depth 3885m

total volume: 1/4 full

Comments: Aphyric, massive lava, relatively fresh to slightly-moderately altered (-1 to -6); more vesicular varieties -7 to -12, more altered and sparsely Pl phyr. Platy volcanics or sediment -13 to -15, aphyric, sound like phonolite. -16 copper green hydrothermally altered lava or tuff.

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Asteroidea	1							x		F4	cut tips of the 3 arms
	Asteroidea	1		x							PFA	arm tips
	Ophiuroidea	1									F4	species 1 (s1)
	Ophiuroidea	1									EtOH	species 1 (s1)
	Ophiuroidea	1									RNAlat	species 1 (s1)
	Ophiuroidea	1									er	
	Cnidaria	1			x						F4	specimen 1 (s1)
	Cnidaria	1			x						F4	specimen 1 (s1)
	Cnidaria	1			x						EtOH	specimen 1 (s1)
	Cnidaria	1	x								RNAlat	specimen 1 (s1)
	Ophiuroidea	1				x					er	
	Ophiuroidea	1					x				F4	species 2 (s2)
	Ophiuroidea	1						x			EtOH	species 2 (s2)
	Ophiuroidea	1				x					EtOH	species 2 (s2); adult with cut arm tips
	Ophiuroidea	1		x							PFA	arm tips
	Ophiuroidea	1		x							PFA	arm tips
	Ophiuroidea	1			x						RNAlat	fragmented arms
	Ophiuroidea	1									er	
	Ophiuroidea	1				x					F4	species 3 (s3); adult with fragmented arms
	Ophiuroidea	1	x								EtOH	species 3 (s3); arm fragment
	Ophiuroidea	1	x								RNAlat	species 3 (s3); arm fragment
	Ophiuroidea	1									er	
	Ophiuroidea	1						x			F4	species (s4);arm tips cut and fixed for PFA
	Ophiuroidea	1		x							PFA	arm tips
	Polychaeta	1	x								EtOH	tube
	Porifera	1							x		EtOH	spicules

Appendix IV: Biological Sampling

SO265-DR69

Description of Location and Structure: Ojin Smts, western province. Flat topped Smt, 20nm S of DR68, track along S facing flank beneath plateau edge

Dredge on bottom UTC 25/09/18 16:53hrs, lat 37°15.43'N, long 165°05.32'E, depth 3570m

Dredge off bottom UTC 25/09/18 18:02hrs, lat 37°15.78'N, long 165°07.40'E, depth 3081m

total volume: 1/4 full

Comments: lava fragments up to 0.5m, single large pumice bloc (defragmented), few Mn crusts. Highly PI phyric lava, fairly fresh (-1 to -4), aphyric, moderately altered, mostly massive lava (-5 to -8). Sparsely PI phyric lava (-9 to -12), moderately altered. -13 to -17 mostly aphyric, highly vesicular lava, strongly altered. -18 & 19, pillow breccia with possibly fresh glass and altered hyaloclastite respectively

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Polychaeta	1	x								EtOH	
	Polychaeta	1	x								F4	
	Unknown	1	x								EtOH	
	Unknown	1			x						F4	
	Polychaeta	1			x						EtOH	

SO265-DR70

Description of Location and Structure: Ojin Smts, western province, western area. E-W elongated Smt, 40nm W of DR69, S flank lowermost section

Dredge on bottom UTC 26/09/18 02:22hrs, lat 37°17.78'N, long 164°10.33'E, depth 5011m

Dredge off bottom UTC 26/09/18 03:51hrs, lat 37°18.19'N, long 164°10.56'E, depth 4552m

total volume: three rafted pumice clasts

Comments: no samples taken

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

SO265-DR71

Description of Location and Structure: Ojin Smts, western province, western area. Large Smt with two tops and broad basement

Dredge on bottom UTC 26/09/18 12:25hrs, lat 36°28.90'N, long 163°55.89'E, depth 5332m

Dredge off bottom UTC 26/09/18 13:45hrs, lat 36°28.98'N, long 163°56.37'E, depth 4970m

total volume: empty

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	-											

Appendix IV: Biological Sampling

SO265-DR72

Description of Location and Structure: Repeat of DR71 along the northern flank of the northern peak of the large Smt structure.

Track along the middle part of the N facing slope

Dredge on bottom UTC 26/09/18 17:37hrs, lat 36°36.81'N, long 163°55.94'E, depth 4180m

Dredge off bottom UTC 26/09/18 18:55hrs, lat 36°36.42'N, long 163°55.98'E, depth 3720m

total volume: a few rocks

Comments: sparsely Pl phyric lava fragments recovered as clasts from breccia blocs (-1 to -3) or as loose fragments (-4 & -5). Range from relatively fresh to moderately altered

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Polychaeta	1	x								EtOH	tube

SO265-DR73

Description of Location and Structure: Ojin Smts, western section. Ø22km Smt, flat topped, E-flank, maybe a scarp. Track along E-flank, upper section

Dredge on bottom UTC 27/09/18 02:37hrs, lat 37°02.54'N, long 163°47.14'E, depth 3767m

Dredge off bottom UTC 27/09/18 03:57hrs, lat 37°02.54'N, long 163°46.59'E, depth 3342m

total volume: very few rocks

Comments: Mn crusts, some with freshly broken pillow margins attached. Aphyric pilliow lava, mostly chilled margin, moderately altered. - 3B, -3C and 3D contain fresh glass

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Cnidaria	1			x						F4	

SO265-DR74

Description of Location and Structure: Shirshov Ridge, Eastern flank. Eastern slope of Shirshov Ridge, small break in slope between two Smts on top of Shirshov basement

Dredge on bottom UTC 27/09/18 11:16hrs, lat 37°21.46'N, long 163°32.56'E, depth 4666m

Dredge off bottom UTC 27/09/18 12:19hrs, lat 37°21.41'N, long 163°32.13'E, depth 3460m

total volume: empty, despite frequent medium to strong bites

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Polychaeta	1								2000	F4	

Appendix IV: Biological Sampling

SO265-DR75

Description of Location and Structure: Shirshov Massif Eastern flank. A small cone on E flank of Smt, 25nm W of plateau margin.

Smt interpreted to be sediment covered Shirshov volcano

Dredge on bottom UTC 27/09/18 18:16hrs, lat 37°24.31'N, long 163°00.10'E, depth 3680m

Dredge off bottom UTC 27/09/18 19:40hrs, lat 37°23.81'N, long 163°00.13'E, depth 3330m

total volume: 1/3 full

Comments: Mn crusts, Mn nodules, two large Mn crusts. Recovered a clast of relatively fresh, Pl phyric lava as core of a Mn nodule (-1) and a sparsely Pl phyric, moderately altered lava as core of a Mn nodule (-2). Four Mn nodules ø 7cm also sampled (-4)

	TAXA	n	2	5	50	100	200	500	1000	other	FIX	NOTES
Meiofauna	Unsorted	1							x		F6	From sediment traps
Macrofauna	Polychaeta	1	x								EtOH	tube
	Polychaeta	1	x								EtOH	tube
	Polychaeta	1	x								EtOH	tube

Abbreviations in Table Header:

TS: thin section billet

CHEM: chemistry slab to prepare materials for geochemical analysis

Ar/Ar: estimate of sample quality for 40Ar/39Ar dating

GL/MIN: potential glass and / or mineral separates

SED: sediment

REF: reference sample for immediate transport to home institution after cruise

Abbreviations for Minerals and Materials:

Fsp: feldspar Gm: Groundmass

Pl: plagioclase Mt: Magnetite

Ol: olivine Zr: Zircon

Px: pyroxene Apt: Apatite

Cpx: clinopyroxene Chl: Chlorite

Opx: orthopyroxene Bi: Biotite

Cc: clacite Ilm: Ilmenite

Mn: manganese Gc: Geochemistry

Qtz: Quartz Hbl: Hornblende

MI: Melt Inclusions Amph: Amphibole

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