

Weekly Report POS 510 (12.03.17-19.03.17)

The week of 12.03.17-19.03.17 was devoted to continued mapping and sampling along the Kolumbo Line and in the Anydros Basin. Unsettled weather meant that operations had to be moved several times during the week to gain shelter inside Santorini. Highlights were i) a gravity coring and heat flow survey of the northern flank of the Anydros Basin, ii) the completion of the sidescan survey of the Anydros Basin west of Kolumbo, iii) a complete map and heat flow (plus gravity coring) survey of the low-temperature vents inside Santorini along the extension of the Kolumbo Fault, and iii) the first AUV dives at Kolumbo. The developing map of the Kolumbo-Santorini corridor is one of the largest contiguous mapping projects of a volcanic complex ever conducted by Abyss (approaching 50 km²).

Sunday, March 12: The AUV Abyss was recovered from an overnight dive in the NE part of the Santorini caldera at the intersection with the Kolumbo Fault. During the day, gravity coring was conducted in the area of low-temperature venting near the fault. Nine (9) gravity cores were taken in an area of 500 m x 500 m at 200 to 300 m depth. All cores contained Fe-oxide crusts, which attained a thickness of at least 3 m in several locations, and 3 cores had bottom temperatures of 19-21 °C (3-5 °C above ambient). The survey confirmed the areal extent of the low-temperature upflow in this part of the caldera and also showed the considerable thickness of the Fe-oxide deposits. In the late afternoon of Sunday, March 12, wind inside the caldera increased to force 8, preventing the safe launch of the AUV for its overnight dive. Operations were suspended until the morning of Monday, March 13.

Monday, March 13: Conditions outside Santorini improved and the regional survey of the Anydros Basin resumed. Four (4) heat flow stations, approximately 10-15 km apart, were occupied on the west side of the basin from 36 34' N to 36 45' N. The objective was to establish background heat flow in the oldest part of the rift adjacent to the basin-bounding Los Fault Zone, where basin fill is at least 500 m thick. However, insufficient penetration of the probe prevented triggering of a heat pulse. All bottom thermistors recorded ambient temperatures in the mud of 15-16° C. In the evening of March 13, a fourth AUV dive was conducted in the western part of the rift, completing the sidescan survey of the Anydros basin. The data show at least one major fault trace in the basin sediments, ~1 km long, marked by a series of collapse pits, each 30-50 m in diameter. The orientation, which is oblique to the basin, probably reflects the regional dextral transtension on the basin-bounding faults. It appears to be a secondary fracture pattern that is now developing in the post-Kolumbo volcanoclastic sediments, subparallel to the dikes that intrude the Kolumbo Line. A distinct "pinnacle" emerging from the sediment in the center of the rift may be an extension of one of these dikes.

Tuesday, March 14: A series of gravity cores were attempted along the Los Fault. Only sediment in the core catcher was retrieved, consisting mainly of clay-rich mud. In the evening of March 14, the first deployment of the AUV was made at Kolumbo Seamount on the eastern flank and including the dike-like feature extending from the summit area in the southwest. The volcano has a youthful appearance with pyroclastic deposits covering the eastern flank; however, the dike-like feature outside the caldera has a very smooth surface compared to the volcano, most likely due to a blanket of ash from a very recent eruption (possibly the 1650 AD eruption recorded at Kolumbo).

Wednesday, March 15: After recovery of the AUV in the morning, operations were moved again into Santorini Caldera to avoid deteriorating weather at Kolumbo. During the day, a complete heat flow survey was conducted in the area of low-temperature venting along the extension of the Kolumbo Fault. Eight (8) penetrations of the heat flow probe were made with 5 successful heat flow measurements. As in Kolumbo, the softest sediments are mainly amorphous Fe-oxides with finely laminated crusts, closest to the vents. Temperatures in the lower thermistors corresponded closely to those measured in the earlier gravity cores (19-21 °C). The maximum calculated heat flow was 1496 mW/m² in the area of the thickest Fe-oxide deposits. Outside this area, with a few hundred meters,

heat flow decreases to between 500 and 700 mW/m² but is still very high compared to background values.

Thursday, March 16: With improved weather outside Santorini, we resumed heat probe deployments in the Anydros Basin along the northernmost volcanic cones of the Kolumbo Line. Unlike the area surrounding Kolumbo, where pumice-rich sediment prevented penetration of the heat probe, the sediments in the northern part of the Kolumbo Line and adjacent to the Anydros Fault were clay-rich and very stiff. This also prevented enough penetration to trigger a heat pulse and no heat flow measurements were made. Bottom thermistors recorded background temperatures of 15-16 °C. The first AUV dive inside the steep-walled Kolumbo crater was launched in the evening but terminated 2 hours early following a collision. No damage to the AUV resulted, and normal AUV operations were continued the following day.

Friday, March 17: Heat flow stations in the northern part of the Kolumbo Line and adjacent to the Anydros Fault were revisited with the 3-m gravity corer. 10 cores penetrated variably reduced clay-rich mud (maximum 3 m). In one core at the summit of one of the small volcanic cones, fractures in the mud were lined by Mn-oxide, but no other signs of hydrothermal activity were observed. A number of ash layers were found in several of the cores, including one layer with fresh mafic clasts (including unaltered olivine). In the evening the AUV was deployed for its third dive at Kolumbo.

Saturday, March 18: Following recovery of the AUV, we targeted several features observed in the sidescan survey in the west of the Anydros Basin opposite Santorini and Kolumbo. Cores were attempted along the fault trace observed in the sidescan, in dark patches adjacent to the fault, and at the location of several pinnacles in the middle of the basin. Traces of Fe-oxides were found near the pinnacles, but basalt fragments in the sediment confirmed that these structures are likely part of a protruding dike. Dive 8 of the AUV was launched in the evening, focussing on the saddle between Kolumbo and Santorini. Preliminary data from the AUV dives suggest that the Kolumbo Fault is occupied by a complex of dikes, probably similar to those observed in the wall of the Santorini Caldera where it is cut by the Kolumbo Fault.

To date (ending 19.03.17): 8 AUV dives, 10 deployments of the heat probe (30 penetrations), 37 gravity core stations, 150 sediment samples and 110 pore fluid samples.

On behalf of the Research Team

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Photo: RV Poseidon in the caldera of Santorini Volcano.