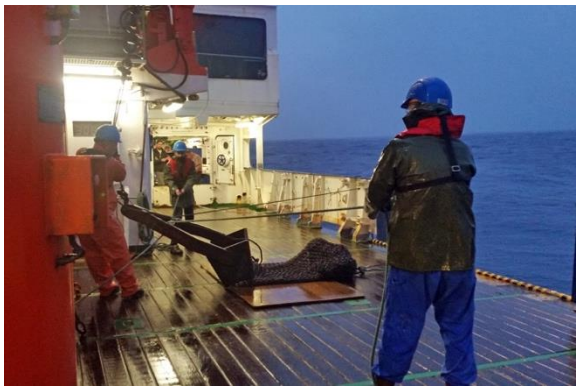
R/V METEOR
Cruise M168 (GPF 20-3_080)
08.11.2020 – 08.12.2020
Emden – Emden

3. Weekly report, 16. – 22.11.2020

This week we reached the next section of our working area: King's Trough, after which we named our expedition. King's Trough is a canyon-like structure that is about 350 km long and up to 80 km wide with a relief of more than 4 km. To get a better idea of the dimensions, it is helpful to compare it with the famous Grand Canyon in the USA, which is somewhat longer, but not even half as wide and less than half as deep. However, King's Trough is not only a huge trough in the ocean floor, but interestingly, it is flanked by elongated ridges and seamounts. Up to now, hardly anything is known about the origin and evolution of King's Trough. Few investigations, most of which had been undertaken several decades ago, and plate reconstructions suggest that it may have been formed by extensional processes, when the boundary between two tectonic plates was temporarily (probably about 36-28 million years ago) located in this area. It is further assumed that the flanking ridges and seamounts may have been formed by volcanic activity caused by an underlying so-called mantle plume. A mantle plume is characterized by hot material that rises from the deep mantle, probably even from the core-mantle boundary, melts partially and then extrudes as lava at the earth's surface. However, it is not clear whether the volcanic activity took place before, during or after the formation of the trough. We aim to reconstruct the evolution of the trough and the flanking ridge structures more precisely including their temporal relation. This week we thus have extensively mapped and sampled the northeastern flank of King's Trough including some of the flanking ridges. The mapping suggests that the trough must have been tectonically very active, which is also confirmed by some rocks showing areas of striation and recrystallization typically caused by stress during tectonic movements. Sampling revealed a wide variety of rocks. In addition to pillow lava, aphyric (without large crystals) and porphyric (with larger feldspar, pyroxene and sometimes astonishingly fresh olivine crystals) layered lavas, subvolcanic



Top: The Dredge arrives on deck and two scientists are supporting the crew. Bottom: Large rocks are broken into smaller pieces on deck (pictures by Antje Dürkefälden).

rocks and volcaniclastics, the dredges also contained plutonic (intrusive) rocks such as granites, diorites and gabbros, although these are probably so-called "dropstones", which do not originally belong to this region. Dropstones are rocks, which were transported by icebergs during the last ice age. The icebergs drifted across the ocean and eventually melted, releasing the rocks which then gradually fell to the ocean floor.
In the meantime, we became used to the workflows on board and the processing of the recovered samples in the labs is routine. After the rocks have been brought from the dredge to the lab, they are cut into half with a rock saw set up in the lab. In this way we can get an overview of how fresh the rocks are inside, what kind of rocks they represent, e.g. volcanic (effusive) or plutonic (intrusive) rocks, sediments or pure manganese crusts, and whether the volcanic rocks solely consist of a fine-grained matrix or also contain larger crystals. Based on this characterization, we can sort the rock samples and assign consecutive numbers. We then measure the rocks, take pictures and saw off the outer crust, leaving only the inner part, which is usually least altered by seawater and therefore most suitable for our geochemical analyses, age dating and for making thin sections. Afterwards, the individual samples are described macroscopically and microscopically and finally packed for transport back to GEOMAR.

Upper left: Rocks recovered from one dredge haul. Upper right: Working at the rock saw is so dirty that only rainwear helps. Lower left: Blocks as fresh as possible are sawn out of the individual rocks for further analysis. Lower right: Rock description at the microscope (pictures by Fabian Hampel, Antje Dürkefälden).

We finish this week with the “Bergfest”, which is traditionally celebrated together with the crew when half of the expedition time has passed. Since we are working around the clock, several scientists have agreed to take over the dredging in the evening and at night.

All cruise participants are doing well and send their best greetings to everybody at home!

Antje Dürkefälden and the scientific party of M168
(GEOMAR Helmholtz Centre for Ocean Research Kiel)