MSM68

KNIPAS
Knipovich Ridge Passive Seismic Experiment

Longyearbyen 6.10.1017- Emden 20.10.2017

1. Weekly report

Compared to other science cruises, our cruise MSM68 from Longyearbyen to Emden is really short with only 14 days at sea and so is our research program. We only need to recover 27 ocean bottom seismometers (OBS), that have spent now more than a year on the seafloor recording earthquakes along the Knipovich Ridge. In addition, we will devote some time to improving maps of the rough topography that marks the boundary between the continental plates of North America and Eurasia. A deep rift valley forms the plate boundary. We could detect circular volcanoes on the seafloor and elongate volcanic ridges but also fairly flat terrain in almost 3500 m water depth. The valley is bounded by high mountains partly with steep flanks that tower some 2000 m over the rift valley floor. This landscape that we would love to see with our own eyes without the water layer on top is formed by ocean floor spreading.
The two continents diverge at a slow speed of only 15 mm/y. The gap in between is constantly being filled with magma. In this way new ocean lithosphere is born – in principle. However, Knipovich Ridge belongs to the slowest spreading ridges world-wide. Only very small amounts of melt form, the young ocean lithosphere is very cold and melt freezes so rapidly that it can only make its way to the seafloor at few locations. There, massive volcanoes form, like Logachev Seamount that we examine in detail in this project. At other places, magma cannot reach the surface and rocks of the Earth's mantle are directly exposed at the seafloor. We want to understand, how melt is redistributed along the axis of these particular type of mid-ocean ridges. Small, hardly felt earthquakes occurring in dozens every day along the ridge axis tell us about the temperature regime of the lithosphere, because earthquakes only occur where the rocks are cold enough to break. We suspect that melt can travel along the lower boundary of the lithosphere to the volcanoes provided that the lithosphere is much thinner there. We are interested in the stress regime of the lithosphere and in the deformation zones along which the plates are torn apart. Regions devoid of earthquakes are also very interesting for us, because they point to serpentinite, a very weak type of rock, that forms when mantle rocks get in contact with sea water. From an earlier study we know that at these ultraslowly spreading ridges, an exchange between ocean water and lithosphere can happen down to depths of about 15 km.

For our study, we deployed 27 ocean bottom seismometers along an about 160 km long ridge section from board RV Polarstern last summer. In addition to natural earthquakes from nearby and distant sources we also used artifical seismic rays produced by airguns to image the Earth's crust and mantle along the ridge and to thus get information about their structure. This part of our science program was already accomplished during the preceding cruise MSM67.

We left Longyearbyen on October 6th 2017 in pleasant weather and reached our nearby survey area late on the same day. We spent the night with bathymetric surveying and then, in the morning hours, acoustically released the first OBS. After a little more than half an hour the OBS reaches the sea surface. A radio beacon, a flash light and an orange flag are meant to facilitate spotting the tiny OBS that measures only about 1 m. However, after a year on the sea floor some of these helpful devices fail. In these cases searching the OBS with binoculars is the only option. Sometimes curious birds draw our attention to the OBS. Every single OBS recovery remains therefore really challenging. We managed to recover already 14 OBS thanks to the enormous experience of the ship's crew in spotting the OBS, in manoeuvring the ship towards the tiny OBS and thanks to the decks crew that swiftly fishes the OBS out of the water. Our small group of 4 seismologists and 8 diligent students from the Alfred-Wegener-Institute in Bremerhaven and from the University of Potsdam does great team work such that the OBS are continuously being cleaned, dismantled and stowed away and most importantly, the valuable data are saved. We really look forward to spend next week screening through our exciting data set.

With best regards from the entire science team
Vera Schlindwein

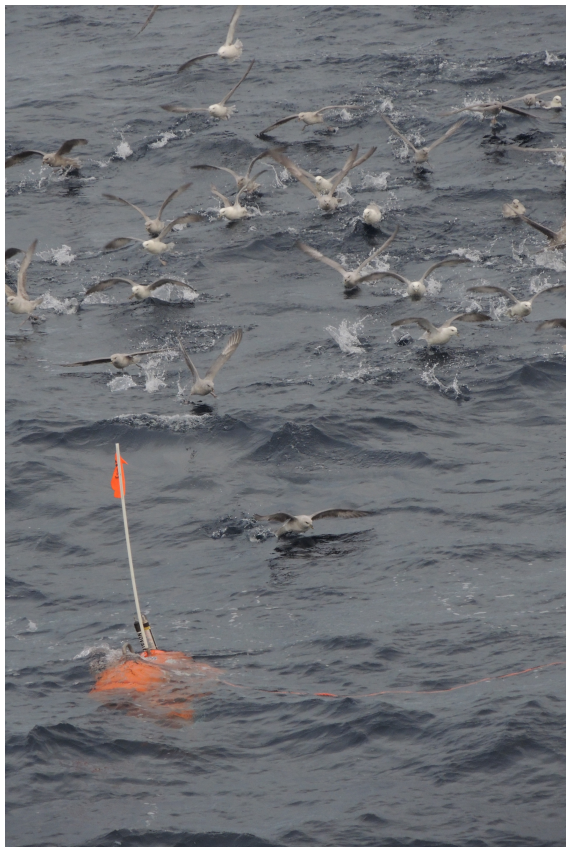

Figure 1: Curious birds inspect our ocean bottom seismometer (Photo: V. Schlindwein)