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KNIPAS – exploring active seafloor spreading processes at segment-scale

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Knipovich Ridge passive seismic experiment (KNIPAS) is a state-of-the-art seismological project that studies on segment scale the active spreading processes of an ultraslow mid-ocean ridge. The generation of new ocean floor is accompanied by characteristic seismicity that reflects ongoing spreading events and the physical state of the young lithosphere, and differs widely depending on spreading rate. While fast spreading ridges hardly show earthquakes that are large enough to be recorded on land, magmatic spreading events at the slowest spreading centres seem to be regularly preceded by earthquakes larger than M 5. The depth limit of earthquakes and their presence and absence reveal along-axis variations in the thermal and mechanical regime of the lithosphere. Therefore, it is necessary to record earthquakes locally with ocean bottom seismometers (OBS). Such surveys, however, typically have limited spatial extent and cannot reveal segment-scale spreading processes like along-axis melt flow, while spatially more extended data sets of hydro-acoustically recorded earthquakes yield no information on focal depth and can therefore not constrain lithospheric thickness or temperature.

The project KNIPAS instrumented for the first time an entire ridge segment with OBS. During Polarstern cruise PS100 in July-September 2016 we deployed 23 OBS of the German Instrument Pool for Amphibian Seismology (DEPAS) along a 160 km long ridge section that covers Logachev Seamount and a neighbouring volcanic centre. An additional 3 OBS of the Institute of Geophysics, Polish Academy of Sciences, were deployed around Logachev Seamount. The instruments recorded seismicity until July-October 2017 depending on capacity. Cruise MSM67 of Maria S. Merian acquired wide-angle seismic profiles across Logachev Seamount and the subsequent cruise MSM68 successfully recovered all OBS.

We now have a comprehensive seismological dataset at hand that will contain despite partly high noise levels in the vicinity of Logachev volcano an expected 9000 earthquakes M>1 and several dozens of well-recorded teleseismic events to study spatial variations of seismicity, thermal structure and lithospheric thickness of an ultraslow spreading ridge. In a joint project we will combine the expertise of our work groups to study seismicity pattern, analyse the large-scale lithospheric structure with modern passive seismic methods to be adapted for the special conditions of marine seismic surveys and to image at high resolution the structure of a volcanic centre.