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Seismic modeling of the lithosphere structure under Logachev Seamount on Knipovich Ridge (Greenland Sea)

Dariusz Wójcik (1), Wojciech Czuba (1), Tomasz Janik (1), Vera Schlindwein (2), and Florian Schmid (3)

(1) Institute of Geophysics Polish Academy of Sciences, Warszawa, Poland (dwojcik@igf.edu.pl), (2) Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany, (3) GEOMAR, Helmholtz Centre for Ocean Research, Kiel, Germany

To better understand the lithospheric structure beneath the ultraslow-spreading ridges the active seismic survey within the Knipovich Ridge Passive Seismic Experiment (KNIPAS) was carried out. The aim of this work was to provide a segment-scale image of lithosphere structure, velocity field and its boundaries beneath the Logachev Seamount on the Knipovich Ridge.

Active seismic profiles were acquired during cruise no. MSM67 in September 2017. On the ocean floor at depths from 2.3 to 3.3 km seismic energy was recorded by 8 ocean bottom seismometers (OBS). In total 320 km of seismic data was collected along 6 profiles with lengths varying from 30 to approximately 60 km covering the area of around 2200 km2. The profiles are crossing each other over the center of the Logachev Seamount. High resolution bathymetric data acquired during the cruise combined with previous bathymetry data sets were utilized as an ocean bottom layer within the seismic model. Our intention underlying this work is to provide evidence of crustal thickness variation beneath the Logachev Seamount and therefore substantially contribute to an understanding of this type of ridges. For the 2D modeling process only data from OBSs near the profiles were used. Seismic model was prepared for each seismic line by iterative trial-and-error ray tracing.

After preparation and initial processing of the acquired data, picking of visible first breaks on all seismic sections had been done. Layers of the model were added to assume the best fit between calculated travel times and picks. Five lithospheric layers for the longest profiles were separated with substantial velocity contrasts at the boundaries. Besides first arrivals, later phases and multiples were used. Water wave and its multiples allowed estimation of the velocity in the sea water. Available non-linear information from all profiles will be used for further 3D tomography modeling.

By combining the available observables from all seismic profiles we draw the following conclusions. The resulting 2D lithosphere models show relatively high velocity gradients especially for the middle oceanic crust. High velocities 5.3 – 5.8 km/s are observed just below the surface over the seamount center. We found ca. 1.5 km uplift of the lower oceanic crust layer to the East of the Logachev Seamount. For the longest profile layer with velocity above 8 km/s was distinguished at depth of approximately 10 km which can suggest presence of the Moho discontinuity.