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Marine geophysical measurements in the northernmost part of the Emperor Seamount Chain in the Northwest Pacific

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In spring 2009 the research cruise SO-201 Leg 1a was carried out with RV SONNE in the framework of the KALMAR project which is funded by the German Ministry of Education and Research. During the cruise marine geophysical data were acquired including multi-channel seismic (MCS), magnetic and gravimetry. In addition the shipboard systems swath and sediment echo sounder were used. The main survey area was located in the northernmost part of the Emperor Seamount Chain were 11 profiles with a total length of 2283 km were acquired. The data give evidence of the structural build-up of the seamounts and the adjacent sediments. The focus of the contribution lies on the presentation and the interpretation of the gravity data. The shipboard free-air gravity anomalies were compared with different free-air gravity data sets derived from satellite altimetry. The comparison resulted in the usage of the DNSC08 data set in areas where no shipboard data are available. A combined map of the free-air gravity anomalies was compiled.

The Emperor Seamounts with an elevation of up to 5000 m are reflected in a chain of free-air gravity maxima of up to 300 mGals with a width of 30 to 70 km. The NNW-SSE striking maxima are adjoined on both sides by gravity minima with a width of 80 to 100 km resulting from the flexure of the rigid lithosphere due to the additional volcanic load. To the East another elongated gravity minimum reflects the Emperor Trough which represents a fault zone on the oceanic crust striking in an acute angle to the seamount chain. To the North the seamount chain passes on to the broad Meji Plateau. Maps of the Bouguer gravity anomalies and the isostatic residual anomalies were calculated showing further features.

Based on the gravity data along several profiles density models were developed taking into account the stacked and time-migrated MCS data. The models show that the seamounts have roots with thicknesses about two times of their respective elevation. The roots are mostly asymmetric with a deeper part in the East. The seamount tops have an almost flat morphology that appears to be erosional. The sediment basins bordering the seamounts show a thickness of 1.5 to 3 km. According to the MCS data three sequences could be distinguished. The lowermost represents basaltic flows associated with the formation of the seamounts. The following hanging sequence of continuous reflectors reflects the erosional debris deposited during the erosive subaerial period. The youngest sequence consists of pelagic sediments which increase in thickness towards the seamounts and compensate thus partly for the bathymetric depression due to the flexure of the oceanic lithosphere.