Effect of Chain Transform fault on the Lithosphere-Asthenosphere Boundary

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Keywords: Tectonics, Lithosphere, Asthenosphere

The Lithosphere – Asthenosphere boundary (LAB) is an elusive boundary in that it can be defined in terms of differences in mechanical, thermal, rheological and compositional properties of lithosphere and asthenosphere. The LAB is at Moho depth near ridge axis and deepens with age, but the actual depth of the boundary is still a topic of debate. Previous results using multi-channel seismic (MCS) reflection data at St. Paul fracture zone have revealed a melt-rich sub-lithospheric low velocity channel that deepens from 72 km at 40 Ma to 88 km at 70 Ma, thins from 18 to 12 km respectively and roughly corresponds to 1300 ℃ isotherm. But the LAB is unconstrained in the areas where the lithosphere is influenced by the three dimensional thermal structure of transform faults and plate boundaries. We present the results of reflection events observed on ocean-bottom seismometers (OBS) along 800 km long profile 40 km south of Chain Transform fault that we interpret to be the upper bounds of the LAB. These events have offsets of 200 km up to 450 km indicating sub-moho reflector depths. We also present the velocity structure of the crust and upper mantle along the whole profile obtained from the first arrival travel time tomography. In the region close to the transform fault, sea floor is almost flat and the usual half-space cooling model could not explain the observed lack of subsidence which indicates that the region is influenced by deeper thermal anomalies. The sea floor then becomes more rugged and uplifted at the edge of the transform fault probably due to the ridge-transform intersection. We observe that the Moho depth suddenly decreases from ~5.5 km to 3.5 km starting from 23 Ma and attribute this crustal thinning to the presence of a propagator which intersects our profile around 30 Ma. There is a low velocity anomaly in the crust and Mantle near the Ridge-Transform intersection (RTI) which could explain the topography in the region. We have used travel-time mapping method to migrate the reflection events and find that the events roughly correspond to 1250℃ isotherm and interpret them to be the upper bound of the LAB. We discuss the effect of thermal structure of Chain transform fault on the crustal and upper mantle velocity structure and implications of unusual LAB observed in the region.