Temporal variation of crustal accretion along the Vulcan Transform, the Southern Ocean

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Long oceanic transform faults (TFs) are the places where whole crustal section is exposed in chronological order. This is the best place to obtain a comprehensive understanding in diversity of crustal structure and mid-ocean ridge process, and its spatio-temporal variation. We started the project MOWALL (Moho Observation along transform fault WALLs) since 2018. The project aims to investigate the temporal variation of mid-ocean ridge process and the relationship with mantle heterogeneity by systematic rock sampling along long TF.

The Vulcan transform is a 120 km long, east-west trending strike-slip boundary between the Antarctic and Sur plates. The ridge axis offsets right-stepped, and the Sur plate moves westward at 15-16 mm/yr. relative to Antarctic plate (MORVEL, DeMets et al., 2010). R/V Hakuho-maru KH-19-6 cruise conducted geophysical mapping along this transform and conducted five dredge hauls along Antarctic side of TF wall from the present-day ridge axis to 120 km off axis, that is roughly corresponds 15 Ma crust assuming global plate motion model.

The axial valley of the southern ridge segment shows an asymmetric structure. In the western part of the axial valley, ridge-parallel, inward-facing fault scarps develop to ridge flank. In the eastern part, contrary, relatively smooth, doomed highs form the deeper part of the axial wall, and large volcanic peak continues eastward. A steep and oblique lineament develops about 20 km east of the axis. The abyssal hills are well-ordered east of 17°W. The magnetic profiles along the TF were also collected, to obtain exact history of spreading rate. Our preliminary forward modeling (2D, assuming constant thickness magnetization layer draped the observed bathymetry) provide two possible scenarios of spreading. We also calculated mantle Bouguer anomaly (MBA) using newly collected multibeam bathymetry. Density contrasts among water/crust/mantle and crust thickness are assumed as 1665, 600 kg/m3 and 6km. Anomalous high positive MBA appears around eastern axial wall, suggesting the exposure of high-density material. MBA also shows million-years order fluctuation, likely suggesting the temporal variation of melt supply at this ridge segment.