The topographic high in the outer trench wall of the Kuril Trench

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From the oceanic trench, the oceanic plate is subducting beneath the overlying plate. Prior to subduction, the oceanic plate changes its dip angle, resulting in the plate flexure. In the outer trench area, a topographic high called the outer rise is formed due to the flexure of the incoming oceanic plate. Although the flexure depends on factors such as the density and mechanical thickness of the oceanic plate, the height and width of the outer rise are considered to be good criteria of the plate bending.

At the outer trench area of the Kuril Trench, there is a prominent topographic high called "Hokkaido Rise". Conventionally, the Hokkaido Rise is considered as one of the most developed outer rises in the world. The water depth at the peak of the Hokkaido Rise is about 5,300 meter, which is about 700 meter shallower than the oceanic basin next to the Hokkaido Rise. In the trench side of the Hokkaido Rise, we can observe half graben structure on the seafloor, which is formed by the plate bending-related faulting. However, strangely, the development of the half grabens is not so remarkable in comparison with the prominent scale of the Hokkaido Rise.

In 2009, we conducted a 2-D controlled-source seismic survey across the Hokkaido Rise with the aim of the understanding of the subduction inputs to the north-eastern Japan arc. We found that the systematic velocity changes within the incoming oceanic plate prior to subduction due to bend-related faulting. In addition, we found that the oceanic crust beneath the Hokkaido Rise was significantly thicker than that in the oceanic basin to the south of the Hokkaido Rise (Fujie et al., 2013, 2018). This observation suggests that the relative height of the Hokkaido Rise, several hundred meters above the oceanic basin, can be mostly, at least partly, explained by the simple isostacy by assuming standard density for the oceanic crust and oceanic mantle.
However, as our survey line was only one and it did not reach the trench axis, the overall structure of the Hokkaido Rise is still not well resolved.

In 2019 and 2020, we JAMSTEC conducted multi-channel seismic (MCS) reflection survey across the Kuril Trench along eight 2-D lines. Although the new survey lines covered the northern half of the Hokkaido Rise because the primary aim of these surveys was mainly revealing the detailed seismic structure in the outer trench wall and the subduction zone, these new data enable us to discuss the variations in the crustal thickness beneath the Hokkaido Rise.

All the obtained MCS data were processed using Prestack time and Prestack depth migration techniques and we succeeded in imaging Moho in most areas except for the area beneath the seamounts. Defining the crustal thickness by the depth (two-way time) difference between the top of the oceanic crust (igneous basement) and the Moho, we found that the crustal thickness beneath the Hokkaido Rise is basically uniform except for the seamount area. In this presentation, we will discuss the nature of the Hokkaido Rise based on the crustal thickness variations in the Kuril Trench, the Japan Trench, and the neighboring oceanic basins.

Keywords: Hokkaido Rise, oceanic crust, crustal thickness

