Discovery of contourite drifts at the Japan and Kuril Trenches and its significance: Study of rapid depositional and erosional processes along a convergent margin

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Contourites are sediments that are deposited and/or reworked by the persistent action of bottom currents (Stow et al., 2002). They are important for palaeoceanographic and palaeoclimatological analysis, especially around active margins where they are associated with the formation of bottom water (Rebesco et al., 2014). A recent study by Nicholson et al. (2020) suggested that the instability of contourite drift, with its well-selected fine-grained sediments and slope-parallel sedimentary structures, is involved in the mechanism of tsunamigenic submarine landslides. In other words, their study highlights the importance of studying contourites in convergent margins, which have not been well studied in the past. The Discovery of new contourite drift and clarification of depositional processes in convergent margins, which have different component particles and topographic characteristics from active margins, has been one of the challenges in recent contourite studies.

The Japan Trench and Kuril Trench are convergent margins where northward bottom currents originating from the Lower Circumpolar Deep Water (LCDW) flow along the outer slope (Ando et al., 2013). However, contourites deposited by bottom currents have been not found in this area. Therefore, in this study, we were observed and analyzed piston core samples and interpreted seismic profiles to discover contourite drift on the oceanic plate of this area. In this paper, we will discuss the depositional process using PC01 samples collected during the cruise KH-20-8 by the “R/V Hakuho-Maru” at 144°53'E, 39°24'N in the graben structure which is developed on the subducting Pacific plate in the Japan Trench.

When bottom currents are flowing, particles are selectively deposited. This is because the upward shear stress caused by friction between the turbulence and the seafloor surface acts the drag on the settling particles. Therefore, contourite develops generally an upward coarsening structure during a period of increased flow velocity and an upward fining structure during a period of decreased flow velocity along the bottom current axis. This trend in grain size change is most clearly seen in the Sortable Silt range (McCave, 1995).

To identify sedimentary facies and deposition processes based on grain size, we analyzed the KH-20-8 PC01 sample at 2 cm intervals and calculated the mean Sortable Silt for classifying its distribution using nomenclature.

As a result, KH-20-8 PC01 sample was identified two types of contourites as siliceous bioclastic contourite facies that are characterized by unimodal grain size distribution with mode diameters from 8 to 20 μm and volcaniclastic contourite facies that are characterized by unimodal with low kurtosis or bimodal grain size distribution with mode diameters from 18 to 30 μm.

The sedimentary facies observed in this study showed significant changes in mean Sortable Silt, corresponding to both upward coarsening and upward fine-grained structures. Additionally, the grain size distribution exhibited decreasing skewness with increasing mode diameter and increasing skewness with decreasing mode diameter, which is consistent with previous observations of contourite sedimentology (Brackenridge et al., 2018). However, the mean Sortable Silt values for the studied contourites were higher than those reported for contourites deposited by bottom currents with similar velocities in the Atlantic. This may be attributed to enhanced flow velocities resulting from localized changes in the flow axis caused by topographical features such as seamounts, petit-spots, and Horst Graben. Furthermore,

the presence of coarse pyroclastic materials may have contributed to the higher mean Sortable Silt, which remains unaffected by sorting effects.
This study shows new evidence of contourite deposits in the Japan Trench and the Kuril Trench, but our understanding of their depositional processes and structures is still limited. We plan to conduct topographic interpretation and laboratory experiments using pyroclastic materials to advance our knowledge of deep-sea sediments in this area and to contribute to our understanding of contourites at convergent boundary margins.

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