Event layers within graben-fill deposits in the outer ruse of the Japan Trench

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In the trench outer rises, horst-and-graben structures are formed by normal faulting in response to bending of oceanic plates. Although large outer rise earthquakes tend to occur posterior to large plate boundary earthquakes, no large outer rise earthquakes have been occurred in the Japan Trench after the 2011 Tohoku Earthquake. Therefore, it is important to reveal recurrence history of large outer rise earthquakes in the Japan Trench. However, displacements of outer rise events are likely to be distributed into ~10 normal faults, and activity and seismic/aseismic slip distribution of each fault has not been clarified. In addition to large-scale lithospheric structural analysis, investigations using local sedimentary record is needed to understand activity of specific fault in outer rise fault system.

In this presentation we overview findings of R/V Shinseimaru KS-15-3 and KS-19-14 cruises. During KS-15-3 cruise, we sampled seven piston cores from the outer rise of off-Sanriku Japan Trench. Based on tephrochronology, surface sediments in the outer rise have mean sedimentation rates of ~2-45 cm/kyr, which is high in the graben and low in the horst. Visual core description, X-ray CT image, physical property analysis using multi-sensor core logger, and geochemical analysis using X-ray fluorescence core scanner ITRAX on a graben core revealed that a sedimentary facies characterized by basal parallel lamina enriched in Ca, Fe, Mn and overlying homogeneous mud slightly enriched in Mn, is interbedded with bioturbated mud layer. We interpret the combination of lamina and homogeneous layer as event layers formed by sediment remobilization. Because the studied graben is isolated from the trench axis and no influx of terrigenous sediment is expected, the remobilized event layer would reflect earthquakes rather than flood or landward-based sedimentation event. The recurrence interval of the event layer deposition is in the order of ~1000 years (five layers above To-Cu tephra erupted ~6000 yrs BP), which is sparse than the frequency of subduction-zone earthquakes. Therefore, the event layer might record the history of large outer rise earthquakes occurred in adjacent area. During KS-19-14 cruise, we performed subbottom profiler analysis along the strike of grabens. As a result, we found that graben-fill deposits are limitedly distributed at the deepest portions of grabens, and the thicknesses of graben-fill deposits increase toward the trench. Although analysis of eight cores sampled during the cruise is still on-going, according to core data from KS-15-3, event layers would fill approximately half volume of such graben-fill deposits. By using cores and geophysical data obtained during two cruses, we further aim to understand seismic record of outer rise fault system.

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