

Trench fill and graben fill sediments on the incoming plate around the Japan trench

*Yasuyuki Nakamura¹, Shuichi Kodaira¹, Gou Fujie¹, Seiichi Miura¹, Koichiro Obana¹, Mikiya Yamashita²

1. Japan Agency for Marine Earth Science and Technology, 2. National Institute of Advanced Industrial Science and Technology

The input material to the subduction trench is one of the key elements to the subduction zone processes like megathrust earthquakes and tsunamis. In the Japan Trench where the 2011 Tohoku earthquake occurred, the variation of the incoming sediment thickness correlates with the extent of the large shallow coseismic slip during the 2011 Tohoku earthquake (Fujie et al. 2020). We present the complete map of the incoming sediments in the Japan Trench and discuss characteristics of the seismic structure focusing on the trench and graben fill sediments.

Since the 2011 Tohoku earthquake, extensive seismic surveys have been conducted in the Japan Trench. More than 100 reflection seismic profiles were obtained in the vicinity of the trench axis off Ibaraki to the south and off Aomori to the north with 4-8 km survey line separation. The incoming sediments show generally weak semicontinuous reflections which parallel to the strong basement reflections. The seafloor reflection also generally parallels that of the basement, gently inclined landward. However, we also observe sediments which cover or onlap the inclined “original” sediments on the Pacific plate. These sediments are mostly distributed at the trench axis and trench-ward end of the grabens. Two types of seismic characters are observed on these fill sediments; one is chaotic, the other is horizontally stratified. The graben fills mostly show the stratified characters, but chaotic graben fills are also observed in some locations. These chaotic graben fills seem to be brought from the failure of the sediments on the horst edge located east of the graben. The trench fill sediments show chaotic character in many cases, which should be related to the failure of the slope immediately landward of the trench. In some locations, the stratified units are interbedded in the chaotic units in the trench fills. These trench fills and graben fills are identified in the southern and northern part of the Japan Trench, but not dominant in the central part where the shallow slip occurred during the 2011 Tohoku earthquake. The fill sediments increase the thickness of the input sediments to the subduction zone and could increase the water content of the input materials, which could be related to the plate boundary slip behavior.

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