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Accumulation process of earthquake-induced turbid layer in the Nankai Trough accretionary prism

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While massive seafloor turbid layers were observed at slope basin of Nankai Trough off Kumano in the proximity of an epicenter of the 2004 Earthquake (Mw 7.4) during submersible observation immediately after the earthquake, they were not recognized at the same observation site after 6 years of the event. This phenomenon is considered to have been resulted from rapid deposition of large amounts of sediments within a relatively short time. We can investigate paleoearthquakes based on estimations of sedimentation age after careful assessment of whether the depositions are caused by earthquakes or not. It is inferred that these deep-sea turbid phenomena are accompanied by relatively high sedimentation rate and characterized by a typical accumulation processes, but the picture remains unsolved. We aim to investigate the possible mechanism of suspended layers generated just after an earthquake and their accumulation and sedimentation processes, which also contribute to evaluation of samples studied for paleoenvironment and paleooceanography.

We used the data derived during KY04-11, KH-10-3 and KH-11-9, and the data on ROV NSS (Navigable Sampling System). We also used high-resolution images obtained from a chirp subbottom profiler (SBP) surveys, and interpreted geological structure of the basin in detail.

Based on the result of the SBP profiles acquired at the slope basin, we classified the deposition structure into acoustic transparent layers and the acoustical high amplitude layer. The thickness of upper transparent layer is 2 m. The layer is considered to have been originated from earthquake-induced turbid layer. A ripple-like structure was observed on the seafloor of the slope basin from the NSS deep sea video footage. The crest of the ripple-like structure is considered to have been developed parallel to the bathymetry, which suggests that it seems to be an evidence of traveling down of sediment gravity flows along the slope. In addition, since the ripple-like crest structure originates from two directions in NE-SW and NW-SE, several basin-wards incoming sediment flows from surrounding slope basin areas are presumed. Moreover considering the slope basin, the sediment source region that could supply sediments based on the bathymetrical map, deposition rate and seismogenic interval, the acoustic transparent layer observed in this basin is considered to have been deposited during single earthquake event. In addition, clay fabrics of the sediment samples obtained during KT-06-7 Cruise observed by a scanning electron microscope (SEM) were characterized by a ”granular structure” formed by high-concentrated mud fluids, which suggests that the occurred suspended layer is composed of high-concentrated state substances. Thus, thick sediment layer is eventually expected after completed settling of suspended layer. The comparison of the measured water depth in 2004 and 2010/2011 resulted that the suspended layer was estimated to be at least 2.5 m. Since no significant differences exist between the thickness of the acoustic transparent layer recognized in SBP profile and the one of coseismic turbid deposit layer derived from the results of particle settling experiments and seafloor observations, the transparent layer is considered to have been originated from turbid layer.

From these results, the upper acoustic transparent layer in the slope basin is considered to have been formed by the 2004 event, which suggests that sediment layer with the thickness of 2 m can be deposited after M7 class earthquake. Moreover, this study proposes the possibility for determining the presence and absence of turbid sediment in the sedimentary basin based on high-resolution SBP data, which contribute to reconstruct the histories of paleoearthquakes.

Keywords: earthquake-induced sediment, gravity flow, slope basin, turbid layer