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Abrupt change in the rate of hemipelagic sedimentation at the Late Miocene in the Shikoku Basin (Sites C0011 & C0012)

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Hemipelagites are muddy deposits that are produced mainly by terrestrial weathering, transported into oceans by river flows, and left the shelf by various processes such as stirring of the bottom by strong waves. Generally, they form even-thickness drapes of the deep-sea basins with nearly constant rate of sediment accumulation. However, we discovered that there is a substantial decrease in the rate of hemipelagic sedimentation at the Late Miocene (11 Ma) in the Shikoku Basin (IODP Sites C0011 & C0012).

Expedition 322 drilled Sites C0011 and C0012 at offshore the Kii Peninsula, SW Japan, to document the characteristics of incoming sedimentary strata and igneous basement prior to their arrival at the subduction front of Nankai Trough. The subducting sediments of the Nankai Trough were accumulated in the Shikoku Basin that formed during the middle Miocene by sea-floor spreading along the back-arc side of the Izu-Bonin volcanic chain. Both in Sites C0011 and C0012, five lithologic units were identified. Unit I is Holocene to late Miocene, and is composed of hemipelagic mud with thin interbeds of volcanic ash. Unit II is late Miocene, and consists of hemipelagic silty claystone with interbeds of volcaniclastic turbidites with minor amount of mud turbidites. Lithologic Unit III is middle to late Miocene in age, and the dominant lithology of this interval is hemipelagic silty claystone. Lithologic Unit IV is middle Miocene in age, and the dominant lithology is hemipelagic silty claystone with abundant interbeds of mud turbidites and sandstone turbidites. Lithologic Unit V is early to middle Miocene in age, and the main lithologies in Unit V are hemipelagic silty claystone alternating with tuff beds and volcaniclastic turbidites.

An abrupt change in the rate of hemipelagic sedimentation occurs in the Unit III of Site C0011 at about 11 Ma, which is evident from both biostratigraphic and paleomagnetic age constraints. Although it is relatively subtle, the rate change of hemipelagic sedimentation observed also in the Unit III of Site C0012. Rates of sediment accumulation for each lithofacies were analyzed, and it was revealed that Units II and IV were characterized by high rates of sediment accumulation for the turbiditic deposits. The result of this analysis suggests that the rate of sediment accumulation for the hemipelagic deposits was constant (7.7 cm/kyr) from Unit V to the lower part of Unit III through the lithologic unit boundaries, but in the middle part of Unit III, there appears to have been a significant decrease to 3.9 cm/kyr. The rate of sediment accumulation was also constant into Unit II.

This significant decrease in the rate of sediment accumulation for the hemipelagites, along with the observed changes in physical properties recorded for the same depth interval at Site C0011,

suggests the possibility of some fundamental paleoenvironmental change in the Shikoku Basin and /or the significant tectonic event that occurred in the SW Japan Arc. Previous studies indicate that this change of rate of hemipelagic sedimentation also occurred at about 11 Ma in the another site of the Nankai Trough (ODP Site 1174) and the Miura Group that is exposed in the Boso Peninsula, Japan, suggesting that the rate of clay mineral production decreased in the widespread regions in the SW Japan Arc. This abrupt change in the sediment accumulation rate in Unit III is coincident with the cessation of voluminous forearc volcanism at ~ 11 Ma. Therefore, although there are various ways to explain this abrupt change in the rate of sediment accumulation, a possibility is that this change might have been due to a change from anomalous near-trench volcanism to forearc cooling.

Keywords: Nankai Trough, IODP, hemipelagic mud, SW Japan Arc