Origin of deep-sea turbidite by stratigraphic variations of terrigenous organic carbon ratio, examples from the off Kii and Boso peninsulas

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Origin of turbidite are important for paleoseismic studies by using deep-sea turbidite, because turbidity currents are caused not only by slope failure during submarine earthquakes, but also by flood and storms. In this study, we try to recognize origin of each turbidite with stratigraphic patters of terrigenous organic carbon (TerOC) ratio by stable organic carbon isotope analyses of deep-sea sediments. Several stratigraphic patterns of TerOC ratio were recognized in turbidite mud deposited by the modern natural disasters, such as the 1596 Keicho-Bungo earthquake, the 1889 Totsukawa Flood, the 1959 Isewan Typhoon, the 2003 flood by Typhoon no.10, the 2004 off-Kii Peninsula earthquakes, and the 2011 Kumano flood by Typhoon no.12 (Omura et al., 2014). Flood-induced turbidite mud have two stratigraphic patterns of TerOC ratio as follows, 1) high and stable TerOC ratio, and 2) low TerOC ratio in lower part and high TerOC ratio in upper part. Slope failure sediments have two stratigraphic patterns of TerOC ratio as follows, 3) low and stable TerOC ratio, and 4) upward decrease of TerOC ratio (Omura et al. 2014). In this study, origin of past deep-sea turbidite are examined by correlation with modern stratigraphic variations of TerOC ratio.

Sediment cores were acquired from the off Kii Peninsula (KT-12-34-PC01, 5.2 m long) at about 2,000 m water depth and the off Boso Peninsula (KS-13-T5-PC02, 9.2 m long) at about 2,500 m water depth by using piston corer. The coring sites of KT-12-34-PC01 and KS-13-T5-PC02 were not directly affected by the submarine canyon. These sediments are composed mainly of olive black clayey silt layers, but includes numerous turbidite layers. Nine intervals of turbidite mud and hemipelagic mud were examined by stable organic carbon analyses. Turbidite mud layers were distinguished from hemipelagic mud by visual examination of soft X-radiographs, on which they show weaker X-ray transmission. Continuous sub-samples were collected at one centimeter intervals from turbidite mud and hemipelagic mud. Total organic carbon contents and stable organic carbon isotope ratio were measured by using an elemental analyzer (Flash EA and Flash 2000) and a mass spectrometer (MAT 253) at the National Museum of Nature and Science, Tokyo. The terrigenous and marine fractions of the organic carbon in the sediment were calculated from the measured stable organic carbon isotope ratio.

In sediment core KT-12-34-PC01, the stable organic carbon isotope ratio was between −19.1‰ and −22.6‰, and the estimated terrigenous fraction was between 0% and 40%. Stratigraphic variations of both flood-induced and slope failure sediments are recognized in TerOC ratio. These results indicate that deep-sea turbidite off the Kii Peninsula were deposited by flood or slope failure. In sediment core KS-13-T5-PC02, the stable organic carbon isotope ratio was between −20.4‰ and −21.7‰ and the estimated terrigenous fraction was between 11% and 28%. Stratigraphic variations of slope failure sediments are recognized in TerOC ratio. These results indicate that deep-sea turbidite off the Boso Peninsula were mainly deposited by slope failure.

The stratigraphic variations of TerOC ratio might be important information for paleoseismic studies by using deep-sea turbidites.

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