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Coastal paleo-environment changes and tsunami deposits from Kanto earthquakes in Ena bay, during the past 4000 years

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Interplate earthquakes and subsequent tsunamis often leave geological evidence such as tsunami deposits in coastal regions, therefore studies of coastal paleo-environment changes and tsunami deposits from paleo-earthquake by microfossil analysis are important for long-term earthquake forecast because these data provide information on earthquake occurrence time and environmental changes during co-seismic and inter-seismic periods.

The average recurrence interval of the great interplate earthquakes along the Sagami Trough, Taisho-type Kanto earthquake, is estimated to be 200-400 years. However, earthquake histories prior to the 1703 Genroku Kanto earthquake have not been revealed from historical literature although some candidates were proposed. Miura Peninsula has been uplifted during the previous Kanto earthquakes and attacked by the tsunamis (Hatori et al., 1973). Shimazaki et al. (2011) conducted Geo-slicer surveys in Koajiro Bay of Miura Peninsula and suggested that the 1293 earthquake causing destructive damage in and around Kamakura was the Kanto earthquake prior to the 1703 Genroku earthquake. On the other hand, Kaneko (2012) reported the possibility that the tsunami accompanied by the Kanto earthquake in 1495AD might strike Ito on the east coast of Izu Peninsula from archeological and historical records. However, geological evidences and historical records of Kanto earthquake are still not enough to reveal the recurrence interval. Also, there are hardly natural coastal wetlands that would preserve tsunami deposits, because the natural environments were collapsed by revetments in Kanto.

The object of this study is to reveal the histories of Kanto earthquakes through identification of tsunami deposits and a reconstruction of paleo-sea depth changes using diatom, grain size and C/N analysis in Ena bay. Ena bay is a small bay on the south coast of Miura Peninsula and salt marsh is formed innermost of the bay. In May and November, 2009, and February, 2011, we conducted 3 m length handy Geo-slicer surveys at Ena bay. We have basically analyzed 5 cores (ENA-C, ENA-E, ENA-F, ENA-I and ENA-2a) and some modern surface sediment samples collected in the bay.

As a result, three (in ENA-C), four (in ENA-E and ENA-I), five(in ENA-F) or six (in ENA-2a) coarse layers including shell fragments and gravels are recognized. Each of these event deposits have sharp lower contact indicating that they accompanied with a strong current. Rarity and poor preservation of diatoms are recognized from these event deposits, indicating long-distance transport by a high-energy flow. On the other hand, changes in diatom assemblage show an increase or a decrease of relative abundance of marine species, suggesting a paleo-sea depth changes. Namely, marine benthic species gradually decrease prior to the deposition of tsunami deposits indicating coastal subsidence, and benthic species increase above tsunami deposits indicating coastal uplift. It is revealed that Miura Peninsula uplifted about 1.4 m at the time of the 1923 Kanto earthquake and now subsides with a rate of about 3.7 mm/year from tide gauge record at Aburatsubo. The diatom analysis suggests that environmental changes corresponding to these co-seismic and inter-seismic crustal movements. Based on the sedimentological features and environmental changes, we conclude that the event deposits, named as T1, T2, T3, T4, T5 and T6 unit from the top to the bottom, are transported by tsunami from the previous Kanto earthquakes. The T1 unit is the tsunami deposit from the 1923 Taisho Kanto earthquake based on Pb-210 dating. Radiocarbon ages indicate that the T2, T3, T4, T5 and T6 unit deposited about 2000, 3000, 3300, 3700, and 4000 cal. BP, respectively. These dates are consistent with records of previous Kanto earthquakes inferred from marine terraces in Boso Peninsula (Shishikura, 2003). In addition, it is revealed that geological records during 1000-2000 cal. BP are hardly remained in Ena bay.

Keywords: Kanto earthquake, Tsunami deposit, Diatom analysis, Paleosea depth, Ena bay