Historical tsunami deposits and storm deposits from western Shizuoka Prefecture, central Japan

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1. Introduction

Pacific coast of southern Japan, along the Nankai Trough, has been suffered from subduction zone earthquakes and tsunamis. Sandy or gravelly deposits settled from tsunami currents sometimes remain in stratigraphic records. The investigation that correlate tsunami deposits with historical subduction zone earthquakes, and the attempts to recover prehistorical tsunamis have increased recently. However, it is sometimes difficult to distinguish tsunami deposits from other event deposit, especially where the tsunami inundation area is also inundated by storm surges due to the small width of the coastal plain.

The Pacific coast of Kosai City, Shizuoka Prefecture has known to experienced both tsunami disasters and storm surges. Historical tsunamis in literature are associated with 1498 Meio, 1605 Keicho, 1707 Hoei, 1854 Ansei earthquakes. The Shirasuka Town and the Nagaya Village along the coast were deadly damaged by the 1707 Hoei tsunami beyond recovery, resulted in removing onto the top of the marine terrace behind. On the other hand, eight records of storm surges that caused damage to this area from Meio era are found in literature (Saita, 1942; Arakawa et al., 1961; Tsuji, 1979), but damage of these storms seems smaller than 1707 Hoei tsunami.

In this study we took cores by geoslicer samplers in the coastal lowland half way between the places of old Shirasuka Town and old Nagaya Village, and tried describing characteristics of tsunami and storm surge deposits based on sedimentary facies and 14C age determination.

2. Result

The study area is an elongated basin, located between a beach ridge and a Pleistocene marine terrace, with a width of about 100 m. It does not have a clastic supply system such as a fluvial valley, except for small fans from the terrace. We used 2 and 6-m long geoslicer to take thirteen core samples, which consist of gravelly beach deposits overlain by coastal marsh deposit from 13th century. Seven layers of event deposits at most are found in the marsh deposit, which named here as A to F in an ascending order. A and G become thick and coarse-grained to include subangular gravels, implying a derivation from the terrace cliff behind. Layer C can be traced to the margin of the lowland with relatively constant thickness, composed of well-sorted, medium-grained massive marine sand including mud breccias, muscovite-rich fine sand with current ripples showing seaward paleocurrent directions, and draping white clay between them.

Layer B, E and F are similar to the lower sandy part of C, composed of marine sand with mud breccia, massive or parallel laminated, traceable as a single sand sheet in the lowland. D is not a one layer but a group of thin discontinuous sand layers, less than several centimeters each, sometimes with current ripples landward.

3. Interpretation

The characteristics of layer C indicate that sand was derived into the lowland as a single event, followed by a complete stop of the current, subsequently water come out to the sea making current ripples. This kind of sedimentary structures are unlikely to be formed by wind waves, which has several to twenty seconds period. Meanwhile, tsunami waves, which has running-up and returning currents with a long period, can explain this sedimentary structures reasonably. This tsunami deposit is well agree with the tsunami event caused by 1605 Keicho earthquake, based on 14C ages of plant fragments from above/below the layer.

The difference of sedimentary facies between layers BEF and D is attributed to the difference of current conditions, therefore it may provide a clue to discriminate tsunamis from storm surges. But at this moment other evidence such as sedimentary facies change across the event deposits implying seismic subsidence/uplift, or a trace of liquefaction suggesting strong ground motions are necessary to separate these two deposits, except for the obvious case like layer C.