

A prehistoric tsunami inundation and associated environmental change on the north coast of Beppu Bay

*Masaki Yamada¹, Takashi Chiba², Catherine Chagué³, Tetsuya Shinozaki⁴, Shigehiro Fujino⁵

1. Earthquake Research Institute, The University of Tokyo, 2. Maritime Disaster Prevention Center, 3. School of Biological, Earth and Environmental Sciences (BEES), UNSW Australia, 4. Center for Research in Isotopes and Environmental Dynamics (CRIED), University of Tsukuba, 5. Faculty of Life and Environmental Sciences, University of Tsukuba

Submarine active faults are widely distributed in Beppu Bay, eastern Kyushu, Japan. Historical written records document that the tsunami generated by the AD1596 Keicho-Bungo intraplate earthquake ($M=6.9$) affected the entire coastal area of the bay. While results of earlier acoustic and coring surveys suggest that active faults in the bay have ruptured five times in the past 7000 years, there is no geological record about past tsunami inundations. This study aims to establish a detailed chronology of tsunamigenic intraplate earthquakes that occurred in Beppu Bay before AD1596 using data from land sediment cores. Here we present findings from a study carried out in the Nokinoi lowland located on the north coast of the bay. The water height of AD1596 tsunami was estimated to be 4–5 m in Kitsuki City, 5 km northeast from the study area, based on historical documents.

A sediment core obtained 700 m from the shoreline reveals a 12-cm-thick sand layer between an upper non-marine organic-rich mud and a lower non-marine organic-poor mud. Plant material collected from the organic-rich mud just above the sand layer is dated to 1880–2000 cal. yr BP. The sand layer exhibits sharp upper and lower contacts with the surrounding muds, implying that it was deposited by a sudden event. It is characterized by higher magnetic susceptibility associated with higher counts of Ti and Fe, as well as Si, S, K, Ca, Mn, Sr, and Ba than in the overlying and underlying muds, suggesting that the sand grains were supplied from a source different from the freshwater marsh. Moreover, the occurrence of brackish-marine and marine diatoms in the sand layer, as opposed to their absence in the surrounding muds, implies that the sand grains were transported from the sea bottom and shore.

The depositional environment of the lowland is reconstructed using the sedimentary facies in association with elemental profiles and fossil diatom assemblages. The facies change between the mud layers below and above the sand layer suggests that the depositional environment at the study site changed after the deposition of the sand layer. This is also supported by differences in chemical components and fossil diatom assemblages between both mud layers. However, it is uncertain whether this environmental change was affected by a local crustal movement associated with an intraplate earthquake in the bay.

Keywords: Tsunami deposit, Submarine active fault, Intraplate earthquake