

Tsunami deposits of the 863 (Jogan 5) earthquake in Junicho Lagoon Swamp, along the western Toyama Bay, central Japan

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No large earthquake tsunami has not been recorded in recent years in Toyama Bay. However, earthquake tsunamis have sometimes occurred in the eastern margin of Japan Sea and the most recent historical example attacked the Toyama Bay is the 1-2 m tsunami in Himi City, which was raised by the source fault of the 1833 offshore Yamagata Prefecture earthquake. In order to search for the pre-historical evidences for tsunamis, marine event deposits (tsunami deposits) transported by the earthquake tsunami were deciphered.

Firstly, we analyzed core samples from the southern Toyama Bay coast of the former Houjozu Lagoon and discovered benthic foraminiferal shell in tsunami deposits. From microscopic observations, it became clear that sample No. 5-2 from the Hojozu Lagoon is a tsunami deposit and that the tsunami hit after 2974-2834 calBC and before 1910-1754 calBC. Sedimentological characteristics of sample No. 5-2 indicate that tsunami deposits around Toyama Bay, might offer an index evidence for determining tsunami deposits. The major features are aggregated sand, allochthonous shells, and benthic characteristic foraminiferal shells derived from greater depth [*Ammonia ketienziensis* (Ishizaki)], and abundant coastal benthic foraminiferal shells (*Ammonia beccarii*).

Along the western Toyama Bay coast, a layer of strange event-deposits containing miscellaneous materials (fossil shells, wood and earthen ware pieces, etc) derived from both land and sea were found in the Junicho Lagoon Swamp in Himi City. The strange assemblage in the deposits was already reported by Matsushima (1981) who pointed out that an earthquake and/or paleocurrent from tsunami could be responsible. In order to identify the factor responsible for these event deposits, the University of Toyama Tsunami Mitigation project carried out drilling surveys at Kubo and Iseomachi in Himi City where core samples (sampleNo.901-1) and (sampleNo.145) respectively were collected. As a result, it was found that the event deposits consist of coarse sand layer which apparently corresponds to the above the Junicho deposits.

This study aimed to make the description and correlation of the core samples, and to reveal the factors and timing of formation of these event deposits. In order to determine the formation age of the event deposits recovered from drilling point of sample No.145, analyses of benthic foraminiferal shells using stereoscopic microscope were conducted as well as radiocarbon dating and an appraisal of pottery pieces.

From the results, the event deposit has been established to be in a marine origin, although no foraminiferal shells of deep-sea origin was detected yet. Based on the dating data, the stratigraphy of the Junicho event deposits was correlated to that of the drill-core sample No.145 and the marine event was found to have been occurred at a time between 1700 BP (calendar year AD315) from 826 BP (AD1190). As for the historical records during this period, the only earthquake tsunami that might bring a great damage to the ancient Toyama was found to correspond to the Jogan 5 (July 10 AD863) Etchu and Echigo earthquake.

As future challenges, it is necessary to find any benthic foraminiferal shells derived from the deep-sea bottom of Toyama Bay to exclude the probability of tidal swell origin for marine event deposits.

Keywords: earthquake tsunami, Toyama Bay, event deposits

