Ages and distribution of paleo-tsunami deposits since 6 ka at Koyadori, Yamada Town, Iwate Prefecture, northeast Japan

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Long-term paleo-seismic history is significant for the understanding of earthquake mechanisms and the assessment of earthquake and related hazards (e.g., tsunami). Especially, tsunami deposits research progressed after the devastating large tsunamis (e.g., the 2004 Indian Ocean earthquake and 2011 Tohoku-oki earthquake) and paleo-tsunami deposits have been identified all over the world. In the terrestrial environment, it is generally difficult to find an appropriate site for revealing the long-term paleo-tsunami history and such appropriate sites were limited due to landform development and artificial modification. It is true along the Pacific coast area in the Tohoku region, northeast Japan. However, the authors found the most appropriate site for the reconstruction of long-term paleo-tsunami history on the Sanriku Coast. This is the Koyadori site, where organic fine sediments accumulated continuously since Towada-Chuseri (To-Cu) tephra (ca. 6 ka; Mclean et al., 2018) and sediments supply from surrounding are small except for tsunami deposits. In this study, we show the ages of paleo-tsunami deposits since 6 ka and their subsurface distribution in Koyadori lowland based on dense and many excavation and drilling surveys.

From 2012 to 2015, we conducted trench excavation survey (Ishimura and Miyauchi, 2015), outcrop survey (Ishimura and Miyauchi, 2015), drilling survey (Ishimura et al., 2014), short Geoslicer survey (Ishimura et al., 2015), and long Geoslicer survey from 200 m to 400 m distance from the coastline and used these samples to this study. In the laboratory, we conducted the radiocarbon dating, tephra analysis, μXRF analysis, and gravel roundness analysis for lateral correlations of sediments. In this study, we mainly used five long Geoslicer samples. All samples reached To-Cu tephra and, that is, they record a continuous 6 thousand years history. From these samples, we confirmed that there are 14 tsunami deposits including the 2011 event after To-Cu tephra and the average recurrence interval is estimated to be 300-400 years.

Subsurface distribution of them was revealed by sedimentary facies, geochemical signature, gravel roundness, and radiocarbon dates of long Geoslicer, short Geoslicer, and drilling cores. As a result, the most appropriate site in Koyadori for tsunami deposits research is limited only 300 m to 350 m area distance from the coastline. On the other hand, in the seaside area behind the 5-m-high beach ridge (200 m to 300 m distance from the coastline), large erosion occurred a few times after To-Cu tephra and these erosions were not expected from the present topography. This indicates that we need to care buried topography and to conduct a multi drilling survey. Takeda et al. (2018) pointed out a similar thing.

This study gives us clues for tsunami deposits identification and accurate lateral correlation of sediments. Dense drilling surveys and/or continuous outcrops tell us an accurate number of tsunami deposits. Tephra layers give us robust ages and correlative layers in sediments. A geochemical signature can be used to correlate background sediments and gravel roundness is useful to identify tsunami deposits and correlate them. Radiocarbon dating gives us confirmation of the lateral correlation of sediments. We thought that this is an efficient procedure for paleo-tsunami deposits research.

Keywords: Tsunami deposits, Sanriku Coast, Towada-Chuseri (To-Cu) tephra, Roundness, Itrax, Lateral correlation of tsunami deposits

