Classification of tsunami flows on Ria coast based on 'source-deposit' contained in tsunami deposit

*Tomoko GOTO[1], Kenji Satake[2], Toshihiko Sugai[1], Takeo Ishibe[2], Tomoya Harada[2], Aditya Gusman[2]

1.Graduate School of Frontier Science, University of Tokyo, 2.Earthquake Research Institute, University of Tokyo

Tsunami deposit sometimes includes land-originated particles that were eroded and transported by tsunami. We can reveal the tsunami behavior of erosion and deposition, and reconstruct the behavior of past tsunamis by investigating the source deposits contained in tsunami deposit layers. To reveal the characteristic sedimentary features of tsunami deposits in rocky coast, we first mapped source deposit of the 2011 Tohoku tsunami deposits in Numanohama, Miyako City in Iwate Prefecture. High tsunami run-ups (>30 m) of the 2011 Tohoku tsunami were measured in this valley (Tsuji *et al*., 2011, 2014). On the basis of these source deposits, we then tried to reconstruct the flow of past tsunamis using particle components of event layers in geological samples.

The sedimentary features of the 2011 Tohoku tsunami deposit in a narrow valley along the Sanriku coast (e.g., Yamada *et al*., 2014) were quite different from those of sandy layer which was observed at Sendai plain, Miyagi Prefecture (e.g., Fujiwara and Tanigawa, 2015). The difference is attributed to the topographical conditions. We examined the depositional conditions in a valley, and classified source deposit into beach, riverbed, and slope. We focused on gravels with the diameter of > 2mm and investigated their features such as rock type, diameter, roundness, and sphericity. We found that the combination of rock type and roundness was the best indicator to represent the characteristic features of each source deposit. 'Source deposit [marine]'; marine beach-originated source deposit, has a high roundness (0.8-0.9) regardless of rock types. 'Source deposit [slope]'; slope-originated source deposit, is composed of angular particles with a low roundness (0.1-0.2) regardless of rock types, and is distributed in slope area with altitudes of >5 m. 'Source deposit [riverbed]'; riverbed-originated source deposit, is composed of granite with an intermediate (0.4-0.5) roundness, which was originated from mother rock in the upper stream.

In order to understand the behavior of past tsunamis, we classified each event layer into four types. Type A; the layer which includes all of the above source deposits, Type B; the layer which includes source deposit [marine] and [slope], Type C; the layer which includes source deposit [riverbed] and [slope], Type D; the layer which includes none of the above source deposits. We used these four types as an indicator of water flow during the event. Type A suggests the high inundation and strong run-up and return currents. Type B shows high inundation and strong run-up current which transport marine pebbles landward. Type C shows high inundation and characterizes strong return flow.

We have identified 12 event layers (S1-S12 from top to bottom) from a 5.7m-long geological sample at the survey site (Goto *et al*., 2015; the 2015 SSJ Fall Meeting). The S1 layer is probably the trace of the 2011 Tohoku tsunami. The sedimentation ages of the other layers were estimated as follows; S2 (AD1961-), S3 (AD1947-1997), S4 (AD1910-1950), S5 (AD1769-1904), S6 (AD1713-1889), S7 (AD1682-1852), S8 (AD1609-1820), S9 (AD1476-1728), S10 (AD1469-1617), S11 (AD 1461-1600), and S12 (AD271-1390).

Among these, layers S1, S4, S5, S7, S8 and S12 were classified into Type A, two layers (S2 and S10) were Type B, the only one (S3) layer was Type C, and three layers (S6, S9 and S11) were Type D. On the basis of their sedimentary ages and historical records, other five layers of Type A (S4, S5, S7, S8, and S12) can be correlated with historical tsunamis as follows; the 1933 Sanriku-Oki, 1896 Sanriku-Oki, 1763 Aomori-Oki, 1611 Sanriku-Oki, and 869 Jogan tsunamis. In a similar way, we

could construct the behavior of past tsunamis for the other types; hence, source deposits are useful as an indicator reconstructing behavior of each tsunami.

Keywords: tsunami deposit, Ria coast, Sanriku coast, historical tsunami, source deposit

