

Constraining depositional age of tsunami deposit using rip-up clast

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Depositional ages of tsunami deposits are important for estimating recurrence interval of tsunamis. Correlation of tsunami deposits in the wide area are usually conducted based on dating results of tsunami deposits in many area. The ¹⁴C dating method is commonly used for dating of tsunami deposit. In general, ¹⁴C dating are conducted using organic matters in the sediments from above and below the tsunami deposit. The depositional age of the tsunami deposit is assumed to be within these ages. However, the estimated depositional age of the tsunami deposit may be older than the actual age by this method because tsunami can erode bottom sediment. If we identify any materials that were eroded by the tsunami and incorporated into the tsunami deposit, the depositional age may be further constrained by the dating result of such materials.

In case of dating using materials within the tsunami deposit, shells and plant fragments are commonly selected (e.g., Bondevik et al., 1997; Clark et al., 2011). However, ¹⁴C dating results of individual materials often have large statistical errors due to wiggles in the calibration curve. Instead, rip-up clast, which is considered to have been eroded from the ground sediment by the tsunami and incorporated into the tsunami deposit, has an advantage because sequential ¹⁴C dating can be performed. In this study, we tested sequential measurement of ¹⁴C dating of rip-up clast to better constrain the depositional age of tsunami deposit.

Study area is the Rikuzentakata City, Iwate prefecture. In this area, we observed a tsunami deposit with abundant rip-up clasts in few centimeters in size. Presence of rip-up clasts indicates strong basement erosion during the tsunami flow. We performed ¹⁴C dating using samples taken from above and below the tsunami deposit and rip-up clasts within the tsunami deposit. Results of sequential measurement of ¹⁴C dating were constrained by the stratigraphic order and depth information using OxCal ver.4.2.4 (Bronk Ramsey, 2008; Bronk Ramsey and Lee, 2013). The depositional age of the tsunami deposit is AD 681-1184 if we only use dating results from sediments above and below the tsunami deposit. On the other hand, the age of the youngest part of the rip-up clast was AD 776-887. The age obtained from the rip-up clast can be used to constrain the limiting maximum age of the tsunami deposit. In this case, depositional age of the tsunami deposit is AD 776-1184.

As stated above, rip-up clast can further constrain the depositional age of the tsunami deposit. This results in turn suggest that the depositional age of the tsunami deposit sometimes be older than few tens to hundreds of years due to the basement erosion by the tsunami flow if we only use dating results from sediments above and below the tsunami deposit.

Keywords: tsunami deposits, rip-up clasts, OxCal