An attempt to estimate high-precision 14C dating of tsunami deposits based on the Bayes theorem

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One of the most important issues to estimate recurrence interval of subduction zone earthquakes and tsunamis is precise determination of depositional ages of tsunami deposits (Komatsubara et al., 2006). However, a common technique, which is usually dating organic materials from above and below the candidate deposits, often has large statistical errors ranging from few tens to few hundreds of years. Furthermore, erosion of bottom soil during the tsunami inundation may lead large bracketing age of the event (Goto et al., 2014).

These statistical errors arise during calibration of ^{14}C date. Because of the fluctuations in the calibration curve, calibration will often result in widened and multi-peaked calendar age uncertainties (Blaauw, 2010). To solve this problem, the Bayes theorem is useful to constrain the calibration results. The purpose of this study is to conduct millimeter-scale high resolution radiocarbon dating and to estimate precise determination of the depositional age of tsunami deposits based on the Bayes theorem. In this study, we use deposition model of Oxcal ver. 4.2.4 (Ramsey, 2009). An age-depth model can be made using this model based on the information of the stratigraphic order of deposition and depth information (Ramsey, 2008).

As examples, here we show results of high-resolution radiocarbon dating of soil samples below the paleo tsunami deposits at Urahoro, Hokkaido (Nanayama et al., 2002) and those at Noda Village, Iwate. For example, tsunami deposit at Urahoro is considered to have been formed in the 17th century (Nishimura and Nakamura, 2010), because it lies just below the Ta-b tephra that erupted A.D. 1677. However, it is difficult to estimate the age using ^{14}C dating method, because this age has wiggles in calibration curve. In spite of these wiggles, high resolution measurement allows us to make age-depth model using Bayes theorem and to estimate the precise age of this deposit as early to middle 17th century.

Keywords: tsunami deposits, 14C dating, Bayes theorem