Evaluation of the potential of in-situ cosmogenic ^{14}C to date Holocene marine terraces on Yakushima, Japan

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Exposure dating, by measuring in situ cosmogenic nuclides, is an important method in Quaternary geochronology (e.g., Gosse and Philipps, 2001; Yokoyama et al., 2005; 2019). While ^{10}Be has been widely used for dating, in-situ ^{14}C has the potential to reach higher temporal resolution for studying Holocene and late Pleistocene surface processes (Yokoyama et al., 2004) due to its shorter half-life (5,730 years). Because of its relatively rapid decay, in situ ^{14}C is especially sensitive to short-term shielding and inheritance, which often complicate the ^{10}Be dating of clastic marine terraces. However, in-situ ^{14}C application is still limited by analytical difficulties, including the extraction of very small amounts of carbon from quartz and uncertainties in production rate scaling. To overcome these limitations, we use the newly developed in-situ cosmogenic ^{14}C extraction system (e.g., Shimizu et al., 2023) at the Atmosphere and Ocean Research Institute (AORI), The University of Tokyo. A key objective of this study is to establish a reliable long-term background calibration for the AORI system in order to improve the precision of low-concentration measurements. The background will be compared with other in-situ ^{14}C lab and early research of this system (e.g., Shimizu et al., 2023).
The second part of this study focuses on the high-precision reconstruction of Holocene tectonic uplift on Yakushima. At present, estimates of uplift rates for the coastal marine terraces of Yakushima mainly rely on Kikai-Caldera eruption, occurred at 7,300 years ago, tephra in marine terraces on Yakushima and other adjacent island. However, due to the erosional degradation of terrace surfaces, uplift rates derived from these conventional approaches are often coarse and lack sufficient resolution. To improve precision, this study introduces *Spirobranchus akitsushima* as a high-resolution paleo–sea-level indicator. The upper growth limit of its colonies corresponds closely to mean sea level, with a measurement uncertainty constrained within ±0.1 m, substantially improving the accuracy of traditional sea level reconstruction. By determining the radiocarbon ages of these biological remains, we establish a depth profile with independent chronological control.
By comparing the background of the new developed extraction system in AORI with independent age constraints from *Spirobranchus akitsushima*, we aim to discuss the feasibility of in-situ ^{14}C dating of Quaternary geochronology.

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