

Surface exposure dating on marine terraces at Samuraihama along the Sanriku coast in Iwate prefecture

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Crustal deformation along the Pacific coast of the Tohoku region is thought to be caused by the accumulation of strain due to plate subduction and repeated strain-releasing events such as superearthquakes (Ikeda et al., 2012). The Great East Japan Earthquake of 11 March 2011 is considered to be one of these strain-releasing events. Marine terraces that are estimated to have formed around Marine isotope stages (MIS) 5e, and MIS 7 are known to be widely distributed along the Sanriku coast (e.g., Miyazaki & Ishimura, 2018). These are topographic features that suggest long-term uplift, contrary to geodetic observations suggesting subsidence over the past 100 years. An accurate reconstruction of the tectonic history of the Tohoku region is needed to better understand such contradictory crustal deformation.

Tephrochronology based on volcanic ash in sediments on marine terraces has been used to reconstruct tectonic history in coastal areas of the Tohoku region, but it is difficult to apply to marine terrace surfaces where sediments are sparse. In the Sanriku coast, the thickness of sedimentary layers decreases southwards along the coastline, which is one of the obstacles to the accurate reconstruction of tectonic history in the Sanriku area. Surface exposure dating is a dating method that uses radionuclides produced in rocks exposed to cosmic rays. This method is widely used in studies of Earth's surface processes (e.g. Yokoyama et al., 2005). Studies include the evaluation of uplift rates based on the exposure ages of marine terrace surfaces (e.g. Saillard et al., 2009; Yokoyama et al., 2023).

However, surface exposure dating has been applied mostly to old topography, or high latitude and high-altitude areas with high cosmic ray irradiance, where sufficient radionuclide accumulation can be achieved for measurement. In mid-latitude areas and areas at lower altitudes, such as near the sea surface, analysis is often difficult due to low cosmic ray intensity and low radionuclide accumulation caused by atmospheric attenuation. Because the Tohoku coastal area is located near sea level in the mid-latitude region, it is expected to be difficult to date using conventional surface exposure dating methods. Therefore, in this study, we attempted Be isotope analysis by surface exposure dating of samples with low nuclide accumulation using blank samples with low background carriers and long-term AMS measurements (Yokoyama et al., 2019). The study area, Samuraihama, is located along the southern part of the Sanriku coast in Iwate Prefecture, where quartz-rich granitic basement rocks are exposed as a flight of terraces for about 15 m above present sea level. In addition, there is an area of volcanic ash deposits a few kilometres to the north at a similar elevation, so the surface exposure dating at Samuraihama can be used to check the accuracy of the dating by comparison with tephrochronology. Samples were collected by drilling at five points at different elevations ranging from 1 m to 12 m above sea level on the marine terraces of Samuraihama. AMS measurements using low background carriers showed that the $^{10}\text{Be}/^9\text{Be}$ ($\times 10^{-12}$) values of the samples were significantly different between the lower and higher elevations, indicating higher accumulation at the higher elevations. This suggests the possibility of using surface exposure dating to investigate the age of emergence from seawater in this

area. This study was carried out as part of the Nuclear Regulation Authority's 2020 and 2021 project on disaster prevention measures for nuclear facilities (study on the evaluation of the age of uplifted coastal landforms using cosmogenic nuclides).

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