Reconstruction of paleoenvironment and paleo-geohazard recorded in Porites coral boulders cast ashore in Ishigaki Island

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A large number of massive coral boulders are scattered on the shore and in the reef of eastern Ishigaki Island, Japan. Many of these boulders were likely cast ashore by the 1771 Meiwa earthquake tsunami, which was one of the largest tsunami disasters in Japanese history, resulting in the deaths of 12,000 people in the region. According to the previous study, ^{14}C ages of well-preserved surface parts of these coral boulders, particularly focused on Porites spp. corals, were analyzed with the aim of confirming that they had been transported by the Meiwa tsunami. However, the calibrated ^{14}C age distribution showed a relatively wide range, and the events transporting these boulders onshore could not be entirely clear, although it was revealed that massive Porites coral boulders had not been caused by a single event.

Precise and accurate dating of coral sample is now possible by [230]Th dating. To confirm when coral boulders had been cast ashore and dead, we applied high-precision [230]Th dating to well-preserved surface parts of massive Porites coral boulders.

Coral skeletons are composed of calcium carbonate, and the stable isotope ratios and trace elements in the skeleton can provide insight into environmental information. Therefore, modern and fossil Porites corals have been used for paleoenvironmental reconstructions to reveal past oceanographic and climatic changes. By using [230]Th dating for Porites coral boulders and splicing paleoenvironmental data reconstructed from coral skeletons of several these boulders dying at various dates, it has a potential to reconstruct paleoenvironment at high-resolution for several centuries, continuously.

Another aim of this study is to determine the ages of past tsunamis and/or severe storm events by high-precision [230]Th dating of youngest part of Porites coral boulders. In addition, identifying coral boulders cast ashore by the 1771 Meiwa tsunami has scientific merit for constraining their tsunami models to apply these boulders. It is important to determine the seismic recurrence period for long-term assessment of future earthquake and tsunami risk in this region, and, if the boulders were cast onshore by large typhoons, the frequency of such events should also be known for future disaster mitigation. Our study demonstrated that Porites boulders are useful for studies of not only paleoenvironment but also paleo-geohazrd such as tsunamis and extreme storms.

Keywords: Porites sp. coral, Tsunami boulder, 230Th dating, 14C dating, paleo-geohazard, paleoenvironment