

Historical natural disasters that remain in the stone pillars on the seafloor at Tosashimizu city, Japan

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Several tens of stone pillars were lay on the seafloor at shallow depth (5-10m) near Tsumajiro beach at Tosashimizu city, Kochi prefecture, Japan. However, no information was provided about the origin of the submerged pillars and the proof that the pillars are artifact. The Tsumajiro area has been repeatedly hit by big tsunami waves by Nankai earthquakes and great water flood by typhoons, therefore, the submerged pillars might be connected with the historical natural disasters. Moreover, a historical tale about “Kurodagori” village which was probably submerged during the Hakuho Nankai earthquake of 684 CE implies the connection with the underwater pillars. In this study, geomorphological, geophysical, and geochemical characteristics of the pillars were investigated, and these characteristics were compared with those of sedimentary rocks and stone works at nearby villages, which give a hint for the provenance of the pillars.

Our results revealed that the underwater pillars were made from sandstone of Tatsukushi formation in Misaki group (Miocene). The brocks for the pillars were probably collected from the old quarry at Misaki village, and then the pillars were used as stone works (stone steps and building foundation) at Tsumajiro area. Moreover, these stone works were transferred to sea bottom near the coast by tsunami wave 1707 Hokei Earthquake.

Our study is based on destructive (porosity, density, XRD) and non-destructive (X-ray CT image, pXRF, magnetic susceptibility) measurements, and non-destructive measurements have a great advantage for underwater geoarchaeological study. Surface roughness measurements of the pillars by X-ray CT image, and the multivariate statistical analysis based on chemical components measured by pXRF contributed strongly on the determination of the provenance of the pillars. However, the measurements were conducted at surface (under dry condition), therefore it is necessary to develop the tools to measure them in seawater. On the other hand, it was difficult to determine the timing of submergence of the pillars based on the radiocarbon dating.

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