

## Rock magnetism of Tsunami boulders and its implication to emplacement history.

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In Ishigaki Island of Japan, there are several tens of erratic boulders, consisted of hermatypic coral. They had been emplaced due to the 1771 Meiwa Tsunami and/or prehistorical Tsunamis, called Tsunami boulder. These boulders that originally had attached to the reef edge emplaced to the shoreline or reef flat. To reveal the age of ancient Tsunami attacks, recent studies have conducted radiocarbon dating to Tsunami boulders and the result showed the population of five tsunamis since about 2000 years ago. Therefore, each Tsunami event might have transported or rotated Tsunami boulders more than once. However, radiocarbon dating cannot discriminate subsequent rotations. To solve this problem, we propose the paleomagnetic strategy. When coral grows, the coral magnetized parallel to the Earth's magnetic field due to the presence of magnetosome or detrital magnetite. If boulder have fine-grained magnetite, it is easy to acquire the secondly magnetization. Thus, the boulder obtains the new magnetization as it moves and rotates. This new magnetization is called viscous remanent magnetization (VRM) and increases progressively with age like vector composition. Using progressive thermal demagnetization (PTD), these vector components are erased young to old. Therefore, PTD can visualize the point of magnetic vector component changed and this point indicates the presence of Tsunami event. Furthermore, Neel's theory gives the formula that natural VRM acquired at low temperature over a long time disappears at a high temperature in a short time. This formula predicts multiple Tsunami age is determined from rotation record of each boulder. Our result showed multiple points of vector component changed during 383K to 413K. This result consist with emplacement mode of "Bari-ishi" which have been emplaced by 1771 Meiwa Tsunami. Our paleomagnetically-dated ages agree well with the population of radiocarbon dating. Furthermore, the ages calculated by the demagnetization temperature of VRM are close to ages of radiocarbon dating, although remanence-carrying mineral should be a single domain magnetite. To reveal the magnetic mineralogy, we conducted Lowrie-Fuller test, X-ray diffraction, high-temperature hysteresis to determine the Curie point. These allow us that the magnetic mineral of Tsunami boulder is of single domain magnetite. Therefore, our paleomagnetic strategy is valid for revealing the multiple transportation history of Tsunami boulder at Ishigaki Island.

Keywords: Tsunami boulder, paleomagnetism, viscous remanent magnetization, Neel's theory, single domain