Ferromagnetic resonance spectroscopy and rock magnetism of coral skeletons

*Yuho Kumagai[1], Norihiro Nakamura[2], Toshitaka Oka[2], Tetsuro Sato[1], Kaede Ino[3]

1. Graduate school of Earth Science, Tohoku University, 2. Institute for Excellence in Higher Education, Tohoku University, 3. Department of Earth Science, Tohoku University

Deceased coral skeletons, especially annual banded skeletons of hermatipic corals (e.g., *Porites*), possess an enormous potential as environmental proxies if they show an enough magnetization above sensitivity limits of magnetometers. Sato et al. (2014) found that coral boulders reworked from reef edge by tsunamis showed a measurable remanent magnetization with spinner magnetometer. However, the origin of magnetic minerals in coral skeletons is poorly constrained between detrital and biogenic magnetic minerals. To determine the magnetic mineralogy of coral skeletons, we conducted ferromagnetic resonance (FMR) spectroscopy, first-order reversal curve (FORC) measurements, and scanning electron microscopy observations of acid-treated residuals of coral skeletons collected from Ishigaki Island, Miyako Island, and Tonga. FORC diagrams of the boulders with coral skeletons and microbial mats showed a narrow ridge along the *H*c axis with negligible vertical spread, being called as "central ridge" which indicates the presence of intact magnetosomes (Egli et al., 2010). FMR spectra of the same boulders represented an obvious secondary absorption peak on lower field side of main peak, which are explained as result from uniaxial anisotropy of magnetosome (e.g., Weiss et al., 2004; Charilaou et al., 2011). Although the FORC diagrams from single *Porites* skeletons also had the central ridge feature, the FMR spectra represented multiple lower field absorption peaks which is different from the signature of magnetosome-bearing coral skeletons. This suggests that coral boulders with microbial mats showed the presence of magnetites aligned in magnetosome chain structures like those produced by the magnetotactic bacteria, whreas single *Porites* coral skeletons showed the higher contribution of detrital magnetite with trace amount of biogenic magnetites.

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