

Rock magnetism of the black shale in the Mt. Roe Basalt, Pilbara Craton, Western Australia

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We conducted preliminary paleo- and rock magnetic study on the early Archean rocks in Pilbara Craton, Western Australia. Archean Biosphere Drilling Project had drilled a continuous 300 m core from the Mt. Roe basalt (2770 Ma; Arbdt et al. 1990) in the Whim Creek region. Lithofacies of the drilled core are divided into Basalt Zone and Black Shale Zone (upper zone 72-124 m; lower zone 258-280 m). The Black Shale Zone contains iron sulfide nodule, which are divided into (1) ca. 10-20 mm radius rounded shape, (2) ca. 10 mm radius amoebic shape, and (3) ca. 5 mm thickness layer.

Initial measurements of whole core by the Multi Scanner Core Logger (MSCL) and the pass-through cryogenic magnetometer indicate that the lower Black Shale Zone correspond to high magnetic susceptibility and intensity interval. Curie temperature and hysteresis loop of the black shale and iron sulfide nodule by Vibrating Sample Magnetometer (VSM) indicate to contain ferrimagnetic iron sulfide. A moment of the iron sulfide nodule is 100 times stronger than black shale. Curie temperatures at 320 and 340 degrees correspond to monoclinic pyrrhotite (Fe_7S_8) and greigite (Fe_3S_4). Increments of moment at ca. 270 degrees suggest that the black shale contains hexagonal pyrrhotite (Fe_9S_{10}). A constricted hysteresis loop of the nodule may be produced by mixture of high and low coercivity. Including the evidence of the black shale rich in organic carbon, the occurrence of ferrimagnetic iron sulfide minerals suggests that microorganisms such as methanogen had created a strongly euxinic environment. Further, paleomagnetic measurements are going to reveal the relationship between the deposition of the black shale and formation of the iron sulfide.