Silician magnetite from the Archean/Paleoproterozoic Transition from the Pilbara Craton, Western Australia: Characterization and Bio-environmental Implications

JULIE CARLUT[1], AUDE ISAMBERT[1], HÉLÈNE BOUQUEREL[1], FRANCOIS GUYOT[2], PASCAL PHILLIPOT[1], ERNESTO PECOITS[1], EMMANUELLE VENNIN[3], MAGALI ADER[1], CHRISTOPHE THOMAZO[3] , JEAN-FRANÇOIS BUONCRISTIANI[3]

[1]Institut de Physique du Globe de Paris, UMR 7154 CNRS, 75005 Paris, France, carlut@ipgp.fr
[2]IMPMC, UMR 7590 CNRS, MNHN, Paris France
[3]UMR CNRS 6282, Université de Bourgogne, 21000 Dijon, France.

The formation of iron oxides in Archean and Paleoproterozoic Banded Iron Formations is still a matter of debate. We report here a detailed rock magnetic study (susceptibility, isothermal remanent magnetization, Curie and Verwey transition temperatures) coupled with scanning and transmission electron microscopy (SEM and TEM) and electron microprobe analyses (EPMA) along a 60 meters section which encompasses the uppermost Archean Boolgeeda Iron Formation and its transition into the lower Paleoproterozoic Kungarra Formation in the Pilbara Craton, Western Australia. Treatment of the remanence acquisition curves by cumulative log-Gaussian functions allowed to quantify the relative magnetic contribution of magnetite and hematite throughout the section. Magnetite is identified as the main magnetic carrier in all iron-rich layers including hematite-bearing jasper beds. A sharp decrease in magnetization at the Archean-Proterozoic transition attest for the almost complete disappearance of magnetite/hematite in the section at the onset of the Paleoproterozoic. Chemically impure silician magnetite is specifically reported from a 2 meter-thick interval lying within the late Archean section of the core. High resolution TEM observations reveal nano-domains of Si-rich magnetite associated with crystal defects caused by cation exchange mechanism. Solid-solution models based on EPMA measurements are discussed. The detection of nano carbon phases, joined with an overall increase in Total Organic Carbon (TOC) in the same interval attest for a close association of organic carbon with Si-rich magnetite.