Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.10705

Changes in magnetic properties of magnetite nanoparticles upon microbial iron reduction

PENGCONG WANG[1], TAIHENG SHI[2], NEHA MEHTA[3], SHANSHAN YANG[4,5], HONGMEI WANG[4,5], DENG LIU[4,5] AND ZONGMIN ZHU[2,5]

[1]China University of Geosciences
[2]Hubei Key Laboratory of Critical Zone Evolution, School of Earth Sciences, China University of Geosciences, Wuhan
[3]IMPMC CNRS/Sorbonne Université/MNHN
[4]School of Environmental Studies, China University of Geosciences, Wuhan
[5]State Key Laboratory of Biogeology and Environmental Geology, China University of Geosciences, Wuhan

Presenting Author: Pengcongwang@163.com

The magnetic signals of magnetite nanoparticles (NPs) preserved in rocks, soils, and sediments are effective index for paleoenvironmental reconstruction. It has been demonstrated that magnetite NPs can serve as a terminal electron sink for the microbial respiration (i.e., microbial iron reduction). The magnetic properties of magnetite NPs may be altered by microbial iron reduction, which is a critical but often overlooked process in paleomagnetism. In this study, three magnetite NPs with different particle sizes were reduced by a dissimilatory iron-reducing bacterium (*Shewanella oneidensis* MR-1) under a non-growth condition mimicking that of the early Earth and modern oligotrophic environment. The changes in magnetic, chemical as well as crystallographic properties of the magnetite NPs during the microbial reduction process were examined. Our results showed that the bioreduction rate of magnetite NPs was mainly controlled by their particle size and redox state. In addition, the microbial iron reduction could affect both the crystallographic and magnetic properties of three types of magnetite NPs used herein. After bioreduction, the crystal lattice parameters and magnetic susceptibility of the magnetite NPs increased, while their remanence recording capability and coercivity decreased (i.e., "softer" magnetism). Furthermore, bioreduced magnetite NPs had a larger remanence loss near the Verwey transition region with low-temperature magnetic analysis. These results indicate that the microbial reduction of magnetite NPs deserves attention when sedimentary magnetites are used in paleoenvironment reconstruction.