GSA DATA REPOSITORY 2011217 Li et al.

Item DR1.

The details of magnetite samples shown in Figs.DR1, DR2 and DR. Biogenic magnetite crystals were named after the name of DIRB induced the precipitation of magnetite. The magnetite of BrY-b, EX-37, W-3, TOR39-a, and M-3 were stored in IRB media in strict anaerobic condition for more than 8 years, these magnetite crystals degenerated from Fe²⁺-excess to a cation-deficient stoichiometry, as described in Li et al. (2009).

Sample	DIRB or Source of Magnetite Degenerated or Reference Oxidized		Reference		
Magnetite in Fig. DR1					
Shewanella BrY-a	Shewanella algae strain BrY	No	Li et al. (2009)		
Shewanella BrY-b	Shewanella algae strain BrY	Yes	Li et al. (2009)		
Shewanella PV1-b	Shewanella putrefaciens strain BrY	No	This study		
Shewanella EX37-b	Shewanella putrefaciens strain BrY Yes		This study		
Shewanella W3-b	Shewanella pealeana strain BrY Yes		This study		
Geobacter GS-15-a1	Geobacter metallireducens strain GS-15	No	This study		
Geobacter GS-15-a2	Geobacter metallireducens strain GS-15	Unknown	Re-calculated from Sparks et al. (1990)		
<i>Thermoanaerobacter</i> TOR39-a	Thermoanaerobacter spp. strain TOR39	Yes	This study		
<i>Thermoanaerobacter</i> TOR39-b	Thermoanaerobacter spp. strain TOR39	No	This study		
Thermoanaerobacter M3-b	Thermoanaerobacter spp. strain TOR39	Yes	This study		
Magnetotactic MV1	Magnetotactic bacteria strain MV-1	Unknown	Re-calculated from Sparks et al. (1990)		
Frio-B	Frio Formation, Daytown, Texas, USA		Kharaka et al. (2006)		
Ideal	Ideal magnetite		Zhang & Satpathy (1991)		
Syn Series (1-5)	Cation-excess magnetite experienced continuous oxidations	1, 2 (cation-excess), 3,4,5 (oxidized)	Zhang et al. (2000)		
Syn@ 90°C	Thermal chemically synthesized at 90°C		This study		
Banded iron formation	Dales Gauge, Hamersley, Australia		This study		
Magnetite in Fig. DR2 and Fig. DR3					
The biogenic magnetite from the cultures of <i>Shewanella</i> and <i>Geobacter</i> were prepared from those in Fig.1. M3 and C1 were					
Sun 1 Sun 2 Sun 3	Thermochemically synthesized at 25°C		This study		
Syli-1, Syli-2, Syli-5	60°C and 90°C				
Dabie China	Magnetite separated from gneiss of the ultrahigh pressure metamorphic belts of Eastern China		This study		

Table DR1.

Figure DR1. The Mössbauer spectroscopy and hyperfine parameters of BIF sample from Dales Gauge, Hamersley. TETR indicates tetrahedral coordinated site; OCT indicates octahedral coordinated site.



Mössbauer spectroscopic profile of Dales Gorge BIF.

δ (mm/s)	Δ (mm/s)	Magnetic field (kOe)	Site		
0.27	-0.04	489.2	^{TETR} Fe ³⁺ -Magnetite		
0.68	0.04	467.1	^{OCT} Fe ^{2.5+} -Magnetite		
0.36	-0.16	520.3	^{OCT} Fe ³⁺ -Hematite		
1.23	1.75		Fe ²⁺ -Siderite		
0.15	0.57		Acetate salt of Fe(III)		
1.13	2.74		^{OCT} Fe ²⁺ -Minnesotaite		

Hyperfine parameters of Dales Gauge BIF sample

Item DR2

Pretreatment of samples for enzymatic analysis of acetate in magnetite-rich iron oxide bands of BIF and magnetite-assemblages from bacterial iron-reducing cultures. The magnetite was extracted and purified by using a magnet. Weighted sample was dissolved in 6M HCl overnight in bottle sealed by the butyl rubber stopper. The solution was then titrated with K_2 HPO₄ solution to remove iron as white precipitate of Fe(II)- and Fe(III)-phosphates. The solution was then filtered by 0.22 µm filter to remove precipitates. The enzymatic analysis of acetate followed the protocol provided by R-BIOPHARM AG (www.r-biopharm.com). Acetate was converted to acetyl-CoA by adding enzyme acetyl-CoA synthetase and ATP and coenzyme A (CoA). The determination of the existence of acetate by spectrophotometer is based on the formation of NADH which has strong absorbance at 340 nm.

Figure DR2. The laboratory synthesis of Fe(III)-acetate. 10g of $FeCl_3 \cdot 6H_2O$ was dissolved in 150 ml distilled water. The solution was then titrated with 28% NH₃·H₂O until the pH reached 9.0 with dark, brown color precipitation. The precipitate was washed by pure water to get rid of redundant chlorine. The pure ferric hydroxyl was dried at 40°C for 6 hours. The dried powder was dispersed in 10 ml acetate and kept stirring for 4, 8, 16 hours. The products were dried in vacuum oven at 40°C for 12 hours. FTIR spectra (Left) show vibrations of functional groups of Fe(III)-acetate salt. Transmission electron microscopic observation indicated its amorphous state (Right panel).



Figure DR3. The electron dispersive X-ray spectroscopy (EDS) and more Images of apatite aggregates. A presents the intergrowth of magnetite and aggregates of apatite, images from **B** to **D** show more of apatite aggregates, and **E** shows EDS spectrum of the chemical composition of an apatite aggregate.

