Microbial iron reduction in iron ore

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Most studies on bacterial Fe(III) reduction focused on synthesized Fe(III) oxides (e.g.: ferrihydrite, goethite or hematite) while a few were done on natural iron ores. However, many differences subsist between synthesized and natural Fe(III) oxides such as impurities, surface area or iron oxide crystallinity. Thus far, the identification of the secondary iron minerals resulting from the iron ore bioreduction remains poorly documented. The impact of iron-metabolizing bacteria on the degradation of iron ore constituting the pillars in iron mines in Lorraine (France) could be helpful to understand the post-mining underground collapses. The fundamental purpose of this study is to identify the bioreduced and biogenerated phases that may have occurred after mining under reducing conditions (iron mines are under the water-table). The results of the reduction by *Shewanella putrefaciens* are analyzed.

The iron ore samples were taken from iron ore pillars in underground mines of Lorraine (France). Two different oolithic iron ores: intact and healthy, oxidized and aged (i.e., exposed to the oxidizing mine atmosphere conditions during a century of mining). Intact iron ore is made of oolithes of goethite. The inter-oolithic cement is made up of calcite, siderite, ankerite, magnesite, iron oxides and berthierine in varied proportions. TEM-EDS, FTIR and Mössbauer analysis were performed to obtain the mineralogy of the bioreduced ores. Within the « aged » iron ore, 13% of goethite (% Fe) were reduced in siderite, which is higher than what we expected from previous studies [1]. Within the «intact» iron ore, 20% of goethite were reduced but only 5% of siderite were formed. A new amorphous Fe(II) phase appeared, probably ankerite. Hence, up to 20% of reduction was obtained with natural iron ore whereas only 10% of reduction is usually obtained with synthetized goethite [e.g. : 2]. Our results showed that the Fe(III) reducing bacteria could use over time the Fe(III) within the iron pillars which support overburdens. Because of the new iron ore mineralogy, the impact of bacteria on mechanical properties will be investigated to assess the long-term stability of iron mines.

[1] Roden & Urrutia (2002) *Geomicrobiol J* **19**, 209-251 [2] Liu *et al* (2001) *Environ Sci Technol* **35**, 2482-2490