

Iron reduction and accumulation in oxygen minimum zones

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Dissolved Fe and Fe(II) has been measured in the Arabian Sea, Eastern tropical Pacific and Peru Upwelling, which are the three main regions of denitrification in the world's oceans, on 4 cruises between 2004 and 2007. Maxima in Fe(II) coincides with the secondary nitrite maxima (where denitrification rates are highest) in all three major denitrification zones. Fe(II) can be up to 50% of total dissolved Fe, but is at detection limits above and below this zone. There is no enrichment of Fe(II) in the primary nitrite maximum. Fe(II) maxima are always associated with local maxima in total dissolved Fe, reflecting the higher solubility and longer residence time of Fe(II).

Fe(II) is observed under conditions where its oxidation rates are slow; sub-micromolar oxygen and $\text{pH} > 7.7$, but it is unfavored thermodynamically even in the presence of slight oxygen. Most likely, it is maintained through active microbial mediation. It is not possible to determine if this is associated with dissimilatory reduction or a high-affinity Fe transport system. There are high Fe requirements associated with denitrification, and most likely, with anamox, and high Fe(II) levels undoubtedly influence these processes. Fe(II) may influence the relative abundance of bacteria containing the Cu vs. Fe nitrite reductase, with the latter being favored in the presence of Fe(II).

Elevated dissolved Fe within nitrite maxima may be important in the offshore transport of Fe. Recently, it has been argued that nitrogen fixation may be important in areas where surface waters have excess phosphate, reflecting a nearby, nitrate-depleted OMZ source. Elevated dissolved Fe in the OMZ may also be an important Fe source for diazotrophs, since many of these regions have low dust inputs. Fe reduction by denitrifiers may be an important component of the coupling of nitrogen fixation and denitrification, providing a source of "recycled" Fe in the absence of external sources. On geological timescales, it may lead to a significant amount of nitrogen fixation that is decoupled from changes in dust fluxes.

Geochemistry of rare earth elements in iron oxide and apatite in Chadormalu iron ore deposit, Bafq district, Iran

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Chadormalu iron ore deposit is located in the Bafq district, central Iran. The Chadormalu iron oxide ores were emplaced along regional faults and associated with sub-alkaline magmas related to an extensional setting where rifting was important.

Rare earth elements in iron oxide, apatite and host rocks were analyzed by ICP-MS, using the lithium metaborate fusion preparation method.

The iron oxide of the studied area shows a pattern with 86.5-578 ppm REE, a strong LREE/HREE fractionation and negative Eu anomalies. The apatite of the Chadormalu iron ore deposit has a content of 13685-15610 ppm REE with a strong LREE/HREE fractionation and negative Eu anomalies (Figure 1). Apatite in sedimentary phosphorites has lower content of REE (<1000 ppm) with Ce depletion which excludes a sedimentary origin of the studied ore deposit. The REE distribution in the intermediate to felsic host rocks is similar to that of iron oxide and apatite but shows moderate LREE/HREE fractionation. The host rocks, the apatite and the iron oxide of the studied area have a similar REE pattern which indicates a probable common genesis. Geochemistry of apatite and iron oxide of the Chadormalu iron ore deposit is similar to other iron oxide-apatite ores of the world including those of Kiruna in Sweden.

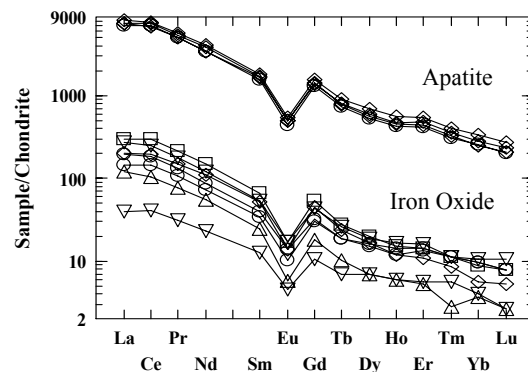


Figure 1: Condorite-normalized REE pattern of iron oxide and apatite from Chadormalu iron ore deposit.