Silician magnetite from the Dales Gorge Banded Iron Formation

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We report silician magnetite from Banded Iron Formation (BIF) in the Dales Gorge Member of the Brockman Iron Formation, Hamersley Group, Western Australia. Magnetite mesobands in the Dales Gorge BIF are typically composed of individual ~100 µm laminae. Previous studies have identified these laminae as magnetite overgrowths on hematite. Backscatter electron scanning electron microscopy, orientation contrast imaging and electron backscatter diffraction reveal that these magnetite lamellae are actually composed of silician magnetite overgrowths on magnetite. Electron probe microanalysis (EPMA) shows the silician magnetite contains up to 2 wt% SiO_2. Three distinct textures of silician magnetite are seen in the Dales Gorge BIF: (1) Sinuous internal lamellae of magnetite with overgrowths of silician magnetite, (2) recrystallized magnetite with a core of silicon-poor magnetite and a rim of silician magnetite, and (3) a complex intergrowth at the µm-scale of magnetite and silician magnetite. All three textures are found within mm-thick layers of magnetite in macrobands DB4-5, and DB12-16 of drill core DDH-44 from Paraburdoo [1].

High-resolution transmission electron microscopy (HR-TEM) and spatially-resolved chemical analyses verify that silicon is present in the magnetite crystal structure in solid solution and in some cases as Guinier-Preston Zone-like textures. We exclude the possibility that silicon is present as an admixture of quartz and magnetite in these samples. *In situ* micro X-ray diffraction (XRD) using a 30 µm spot size shows that the lattice parameters for silician magnetite are smaller, a=8.388 (2) Å, than for Si-poor magnetite, a=8.394 (2) Å and pure synthetic magnetite, a=8.3967 (3) Å [2].

Silician magnetite has been reported from a limited number of skarns using XRD and EPMA, but this is the first confirmed report of silician magnetite using HRTEM and the first report of silician magnetite for banded iron formations. It has been proposed that silica readily adsorbs to ferrihydrite during BIF deposition [3]. Silician magnetite may form by recrystallization of a silica-adsorbed ferrihydrite precursor phase and may be characteristic of oxide facies BIFs that underwent low-temperature metamorphism or diagenesis.

[1] Ewers and Morris (1981) *Econ. Geo.*, **76**, 7, 1929-1953. [2] Bosi *et al.* (2009) *Am. Min.*, **94**, 1, 181-189. [3] Fischer and Knoll (2009) *GSA Bull.*, **121**, 222-235.

Arsenic pollution of groundwater in Lahore City, Pakistan

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Good quality water is essential for human survival. Many anoxic groundwaters that are used as drinking water sources throughout the world are polluted with naturally-occurring arsenic. In urbanised areas, this natural pollution can be exacerbated by anthropogenic activities that include irrigation, canalisation, industrial and agricultural activity, and disposal of human sewerage. We have examined the chemistry of groundwater sampled from 52 wells in 9 Towns of Lahore City, Pakistan, to determine natural and anthropogenic processes responsible for arsenic enrichment and depletion.

Only three samples were taken from tubewells < 30 m depth; all but one of the rest were from wells between 125 and 250 m depth. Five of the 52 wells sampled (i. e., c. 10%) contain < 10 µg L^{-1} of arsenic, 39 wells (i. e., 75%) contain < 50 µg L^{-1}, and the remaining 13 wells contain up to 1760 µg L^{-1} of arsenic. The geochemical data suggest that some of the high amounts of arsenic are due to the natural processes of evaporation and hydrous iron-manganese oxide reduction. Spatial data suggest that the latter may have been aggravated by local inputs of sewerage or industrial effluent, as found for other areas in Pakistan [1]. All of the wells are also polluted with nitrate (up to 205 mg L^{-1}), likely due to use of NO_3 fertilizer for intensive agriculture. That some arsenic concentrations are weakly correlated to those of nitrate suggests either an anthropogenic source for this arsenic, or mixing of separate sources. Further work is needed in Lahore City and other urban areas affected by arsenic pollution in order to develop strategies for aquifer management and remediation.

[1] Nickson *et al* (2005) *Appl. Geochem.* **20**, 55-68.