Thermochemistry of poorly crystalline iron oxides

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Poorly crystalline iron oxides – ferrihydrite ($\sim FeOOH \cdot 1.8H_2O$), schwertmannite ($\sim Fe_8O_8(OH)_5(SO_4)_{1.5}$), and feroxyhyte ($\delta$-FeOOH) – precipitate readily from iron-rich aqueous solutions at sites with acid mine drainage or in underground water reservoirs. Because of their large surface area, they often act as scavengers and transport media of toxic and radioactive metals (Jambor and Dutrizac 1998). In some cases, these iron oxide precipitates are life-threatening to aquatic fauna even in the absence of metals other than Fe (Nordstrom et al. 1999). In this study, we have used acid solution calorimetry to determine enthalpies of formation of these phases. The goal of this work is to put tighter constraints on thermodynamic properties, including solubility, of these compounds.

A series of ferrihydrite samples was prepared by titration of 1 M $Fe(NO_3)_3$ solution with NaOH solution at variable rates. The products are 2 to 6 line ferrihydrites. These samples are 13-16 kJ/mol metastable in enthalpy with respect to hematite and water at ambient temperature. The samples become slightly more stable with increasing crystallinity.

The preparation and characterization of the well and poorly crystalline feroxyhyte samples was described previously by Koch et al. (1995). Well-crystalline feroxyhyte is metastable with respect to hematite and water by ~5 kJ/mol at 298 K. The poorly crystalline feroxyhyte, similar to naturally occurring feroxyhyte samples, is metastable by 9 kJ/mol. In terms of enthalpy, feroxyhyte very similar to lepidocrocite (γ-FeOOH) and akaganeite (β-FeO(OH,Cl)).

The study will be completed by measurement of enthalpy of formation of schwertmannite. We anticipate that the measured enthalpies of formation will allow discrimination among the published estimates of solubility products of these phases. The outcome of this work will be a set of much more reliable thermodynamic data for the poorly crystalline iron oxides.

Jambor J.L. and Dutrizac J.E. (1998) Chem.Rev. 98, 2549-2585.

Koch C.B., Oxborrow C.A., Morup S., Madsen M.B., Quinn A.J. and Coey J.M.D. (1995) Phys.Chem.Min. 22, 333-341.

Nordstrom D.K., Alpers C.N., Coston J.A., Taylor H.E., McClesley R.B., Ball J.W., Ogle S., Cotsifas J.S. and Davis J.A. (1999) Water-Res. Inv. - USGS Report: WRI 99-4018-A, 289-296.

Fe-Mg silicate strings on the Earth.

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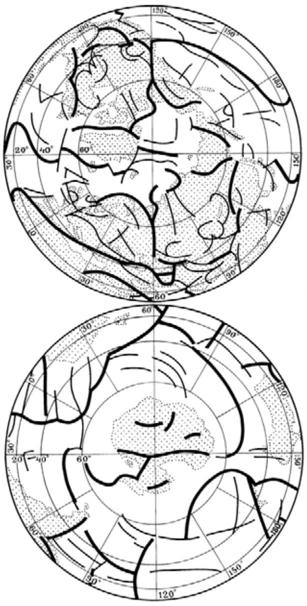
The Figure is author's symbol of earlier unknown phenomenon: axial structural symmetry of outer earthen shell. On the grounds of geochemistry the coarse lines on this ring are the greenrock seams – central zones of planetary fold geosynclinal (GS) zones. On the upper and lower scheme-map the Earth from the N and S poles) there are W.Indic and W.Pacific ridges. They stretch northward to Urals (variscan GS) and Cordilleras (laramian GS) with the edge of Bear zone (PE GS) in America. Other structures are obvious.



In the evolution of all fold zones there were: grooves, then young island arcs, then mature volcanic island mountains with orogenic fold basements, then taphrogenic rifts above the cover basalt fields (final magmatites) with basic or more differentiate volcanics, then (may be) – second-orogenic or above-rifts revised volcanic ridges.

In author's position (books 1978,1983,1986,1993 in [1], in www.gpi.ru/~mkrn/lpsr) the mid-oceanic ridges are the axis of fold GS belts. Common continent-oceanic dislocated zone net is axial-symmetric on our planet. This new knowledge permits to make comparison between earthen and otherplanet structures. The planets have similar design [1]. The plate tectonics is delusion.

References

[1] Makarenko G.F., 1997 Periodicity of basalts, biocrisises, axial symmetry of the Earth. Moscow, Geoinformmark N 3, 95 p. (Russian)