
Properties of Iron Oxides in Two Finnish Lakes in Relation to the Environment of Their Formation

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Abstract: Fifteen iron oxide accumulations from the bottoms of two Finnish lakes ("lake ores") were found to contain as much as 50% Fe. Differential X-ray powder diffraction and selective dissolution by oxalate showed that the samples consisted of poorly crystallized goethite and ferrihydrite. The crust ores of one lake had higher ferrihydrite to goethite ratios than the nodular ores of the other lake. The higher ferrihydrite proportion was attributed to a higher rate of Fe²⁺ supply from the ground water and/or a higher rate of oxidation as a function of water depth and bottom-sediment permeability.

Values of Al-for-Fe substitution of the goethites determined from unit-cell dimensions agreed with those obtained from chemical extraction if the unit-cell volume rather than the *c* dimension was used. In very small goethite crystals a slight expansion of the *a* unit-cell dimension is probably compensated by a corresponding contraction of the *c* dimension, so that a contraction of the *c* dimension need not necessarily be caused by Al substitution.

The goethites of the two lakes differed significantly in their Al-for-Fe substitutions and hence in their unit-cell sizes, OH-bending characteristics, dehydroxylation temperatures, dissolution kinetics, and Mössbauer parameters. The difference in Al substitution (0 vs. 7 mole %) is attributed to the Al-supplying power of the bottom sediments: the silty-clayey sediments in one lake appear to have supplied Al during goethite formation, whereas the gravelly-sandy sediments in the other lake did not. The compositions of the goethites thus reflect their environments of formation.

Key Words: Al-substitution • Ferrihydrite • Genesis • Goethite • Iron oxide • Lake environment

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