
Hisingerite: A Ferric Kaolin Mineral with Curved Morphology

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Abstract: Hisingerite, first described in 1810, has been variously regarded as noncrystalline, as a septechnorite, as ferric allophane, as ferric halloysite and as poorly crystalline nontronite. Hisingerite from the original localities of Gillinge and Riddarhyttan in Sweden has a composition close to $\text{Fe}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$. X-ray diffraction (XRD) analysis of Riddarhyttan hisingerite yields very broad maxima at 7.7, 4.44, 3.57, 2.56, 2.26, 1.69 and 1.54 Å, and that from Gillinge is similar. Cation exchange capacities are 2.2 meq/100 g (Riddarhyttan) and zero (Gillinge). Transmission electron microscopy (TEM) shows a fabric of concentric spheres and part spheres, with diameters of about 140 Å and walls up to six 7-Å layers thick. High-resolution images of the sphere walls reveal a 2-layer structure similar to that of kaolinite. A calculated diffraction pattern based on a model of 4 concentric shells of ferric kaolinite structure matches the observed pattern quite closely; Some other hisingerites, notably that from Bellevue King Mine, Idaho, show 10-Å layers as well as 7-Å layers, and this hisingerite has a CEC of 32 meq/ 100 g and a weak 15.5-Å X-ray reflection in addition to a pattern similar to Riddarhyttan hisingerite. It is concluded that hisingerite is a curved ferric 7-Å 1:1 layer silicate analogous to halloysite, and that many of the hisingerites reported in the literature contain admixed nontronite.

Key Words: Cation Exchange Capacity • Halloysite • Hisingerite • Kaolinite • Nontronite • Transmission Electron Microscopy • X-ray Powder Diffraction

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