

Hydrothermal synthesis of cubanite under conditions relevant to the CI-chondrite parent body

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The low temperature form of CuFe_2S_3 , cubanite, has been identified in the CI chondrites and in samples returned from Comet Wild 2 by the Stardust Mission [1]. We report the first synthesis of this mineral under aqueous conditions consistent with predictions for the CI-chondrite parent body.

An aqueous system can be described as the interplay between pH, temperature, oxygen and sulfur fugacities [2]. We form cubanite at 150 and 200°C (fig. 1) by controlling oxygen fugacity (f_{O_2}), pH and T. Oxygen isotope measurements and modeling of aqueous conditions on asteroidal bodies [3, and ref. therein] predict: T of 20-150°C, pH of 7-10 and $\log f_{\text{O}_2} > 10^{-55} - 10^{-70}$.

EMPA and FIB-TEM techniques are used to determine composition and crystal structure.

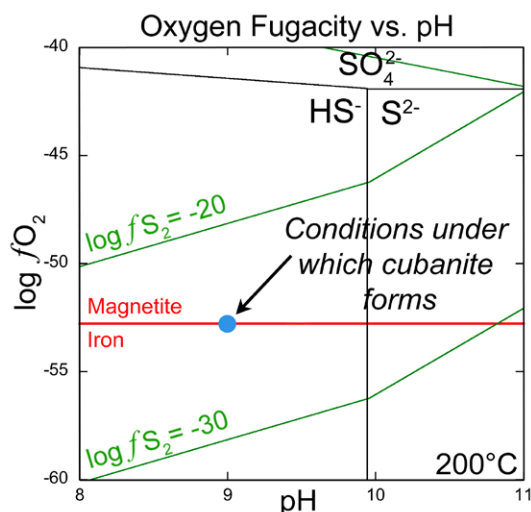


Figure 1: Oxygen fugacity vs. pH for an aqueous system containing 0.025M S. Major S species (aq), lines of constant sulfur fugacity and the iron-magnetite buffer are indicated.

[1] Berger *et al.* (2011) *GCA* doi:10.1016/j.gca.2011.03.026.

[2] Barnes and Kullerud (1961) *Econ. Geol.* **56**, 648-688. [3]

Brearley (2006) in *MESS-II*, 587-624.

Fluoride patterns in a boreal stream influenced by bedrock and hydrology

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The spatial and temporal variation of fluoride in the Kärsvik catchment (27 km²) in SE Sweden has been monitored monthly for up to 6 years (2002 - 2009). The bedrock is characterized by 1.8 Ga old granite to quartz monzodiorite. However, in the lower reaches the F-rich, 1.45 Ga old, Götömar granite crops out.

Fluoride increased significantly at this intrusion and showed a strong negative relationship with flow, ranging between 0.6 and 4.2 mg L⁻¹ (median 1.04 mg L⁻¹). In the upper reaches the concentrations were lower, <0.20 - 0.85 mg L⁻¹ (median ~0.4 mg L⁻¹). The spatial concentration pattern of fluoride in well waters was concordant with that of the surface waters within the catchment.

On a continental scale, European streams (n=808, 25 countries) have median fluoride concentrations of 0.1 mg L⁻¹ [1]. The Kärsvik catchment is therefore an area with anomalous fluoride concentrations. Stream waters can be major sources of drinking water and the World Health Organization guideline value is set to 1.5 mg L⁻¹.

The fluoride pattern can be explained by three main sources associated with weathering processes in the lower reaches of the catchment: 1, glacial deposits partially enriched in weathering products from the Götömar granite, 2, larger input of baseflow water (longer interaction time with F-bearing minerals) and 3, intrusion-related fractures strongly enriched in fluorite.

Detailed studies of near-surface groundwaters in the region will further increase the understanding of the dynamics of this element in these kinds of environments.

[1] Salminen *et al.* (2005) *Geochemical Atlas of Europe. Part 2*, 161-162.