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The composition of mackinawite

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Abstract

The composition of a mineral is a defining characteristic. The various compositions listed for mackinawite in current mineralogical databases and reference books, such as Fe(Ni)S and $Fe_{1+x}S$, are both wrong and misleading. Statistical analyses of over 100 mackinawite compositions reported over the last 50 years show a mean composition of $Me_{1.0}S$ where Me = Fe + Co + Ni + Cu. Mackinawite is stoichiometric FeS. As with many sulfide minerals, Ni-, Co-, and, possibly, Cu-rich varieties occur in addition to the simple iron monosulfide. These varieties are best referred to as nickelian mackinawite, cobaltian mackinawite, and cupriferous mackinawite. The results confirm that these metals substitute for Fe in the mackinawite structure rather than being contained in the interstices between the Fe-S layers. Most compositional data on mackinawites derive from electron probe microanalyses of small grains in magmatic/hydrothermal associations. The result means that there is no dichotomy between the composition of ambient temperature synthetic mackinawite (which is supposed to be equivalent to sedimentary mackinawite) and mackinawites from higher temperature associations. The correct representation of the composition of mackinawite has implications for a wide swathe of fundamental science, including the origin of life, the genesis of magmatic ore deposits, the provenance of meteorites as well as industrial applications such as water treatment and steel corrosion. The stoichiometric formulation permits the mackinawite formula to be balanced electronically using conventional Fe and S ionic species. It also enables simple, balanced chemical equations involving mackinawite.

Keywords: Mackinawite, iron sulfide, composition, formula, mineralogy