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Relationships between microstructure and composition in enargite and luzonite

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ABSTRACT

$Cu_3(As,Sb)S_4$ minerals commonly contain structurally disordered crystals of intergrown enargite and the luzonite-famatinite series (Pósfai and Sundberg 1998). Here we discuss the relationships between the fine-scale structural variations and the Sb/As ratios of these minerals. Although luzonite typically contains more Sb than enargite, individual layers of luzonite within Sb-bearing enargite are not associated with higher Sb/As ratios. Defect-free enargite can also contain Sb. We develop a ''structure-composition'' diagram in which both the structural enargite-luzonite and the compositional luzonite-famatinite solid solutions can be represented. Compositions plotted in this diagram reveal that Sb-bearing enargite and luzonite contain only a relatively small number of defects, whereas Sb-free crystals can be heavily disordered. Coexisting enargite and famatinite and zoning in luzonite-famatinite indicate fluctuations in the Sb-content of the fluid during ore deposition. On the other hand, assemblages of Sb-free enargite and luzonite probably reflect thermal oscillations; heavily disordered, intermediate structures may have formed near the transition temperature of low-temperature luzonite to high-temperature enargite. Our results suggest that characteristic microstructures in enargite, luzonite, and famatinite can be useful for constraining fluid composition and temperature during ore deposition.