

EXPERIMENTAL SULFUR ISOTOPE STUDIES OF THE PYRITE TO PYRRHOTITE  
CONVERSION IN A HYDROGEN ATMOSPHERE

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Abstract

Sulfur isotope effects associated with the conversion of pyrite to pyrrhotite in a dry hydrogen atmosphere were measured at temperatures from 500° to 600°C. H<sub>2</sub>S was the primary fluid species produced, although at temperatures of 500° and 525°C native sulfur in amounts up to 30 percent of the total liberated sulfur condensed in the collection system. At temperatures of 550°, 575°, and 600°C, more than 90 percent of the liberated sulfur was in the form of H<sub>2</sub>S. At all temperatures pyrrhotite was the only residual iron sulfide. Native sulfur was characterized by a  $\delta^{34}\text{S}$  value of -0.1 per mil relative to the starting pyrite, whereas H<sub>2</sub>S varied from -0.2 to +0.1 per mil (most values were within analytical error of 0‰). The produced pyrrhotite ranged from 0.3 per mil at 500° and 525°C, to 0.2 per mil at all higher temperatures. Pyrrhotite-H<sub>2</sub>S fractionation factors are near equilibrium values for these temperatures and suggest that potential kinetic isotope effects are suppressed at low  $f_{\text{O}_2}$  conditions where H<sub>2</sub>S is the principal fluid species. Both experimental and empirical studies suggest that very little sulfur isotope fractionation accompanies the conversion of pyrite to pyrrhotite in carbon-rich metapelites. For this reason the isotopic composition of pyrrhotite in graphitic metapelites may serve as a reliable indicator of the isotopic composition of sulfur that was available for assimilation by magmas or hydrothermal fluids, and that may have been involved in later ore genesis.