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Trace element partitioning in sedimentary pyrite: insight from synthesis experiments at ambient temperature

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Authigenic pyrite (FeS_2) is considered a geochemical archive since it records the chemical signature of its precipitating medium, which is of particular use for interpreting past environmental conditions [1] . Although trace element (TE) contents in pyrite are used to reconstruct ancient ocean chemistry and past environmental events [2,3,4], it is expected that TE trapping mechanisms exert a significant control on their solid-solution partitioning. Here, we synthesized pyrites under anoxic conditions at ambient temperature via the polysulfide pathway, in which $FeS_{(s)}$ and elemental $S^{(0)}$ transform into submicron pyrite crystallites over a few weeks. Our experiments aim to mimic early diagenesis conditions under ferruginous to weakly euxinic depositional conditions. Initial aqueous multi-TE (Cr, Mn, Co, Ni, Cu, Zn, As, Se, Sr, Mo, Cd, Ba) concentrations were varied over several orders of magnitude and final solid-solution distribution coefficients were determined from elemental analyses of the supernatants by ICP-MS and AAS (Atomic absorption spectrometry), for trace and major elements, respectively. Combined with synchrotron-based X-ray fluorescence mapping at the nanometer scale, our results suggest various incorporation mechanisms for distinct elements, ranging from non-ideal solid-solution to segregation and nano-inclusion. Despite this complexity, our study provides overall revised average concentration factors and partition coefficients for TE in low-temperature pyrite [5], and thus potentially yields refined constraints for paleoenvironmental reconstructions.

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