Trace element partitioning during the pyrite to pyrrhotite reduction

SEAN C. JOHNSON[1], ROSS R. LARGE[1],
SEBASTIEN MEFFRE[1] AND TIMOTHY D. RAUB[2]

[1]CODES, Centre for Ore Deposits, University of Tasmania, Hobart, Australia, 7001. Sean.Johnson@utas.edu.au
[2]Department of Earth Sciences, Unversity of St. Andrews, St. Andrews, Fife, United Kingdom, KY16 9AJ

Pyrite and pyrrhotite are commonly associated minerals in many economic deposits and black shales across the world. The metamorphic reduction of diagentic pyrite into pyrrhotite is known to result in the release of sulfur, thereby enabling further formation of other metal- sulfide clusters.

We discuss here the various geochemical and and physiochemical transitions that result during this reduction. We observe that diagenetic pyrite has the ability to encorporate a range of trace elements (T.E.), likely sourced from seawater and intertitial pore waters [1] [2], of which, a large majority (e.g. Zn, Cu, Ag, Au and Pb) are liberated during the conversion. We also present preliminary work on a magnetic study of these two sulfide phases where we observe that pyrite has a distinct magnetic characteristic, akin to that of pyrrhotite, at temperatures far below the published phase transition [3] [4]. We present a series of case studies utilising, real-world examples of this transition and compare them to published work. In this context we discuss aspects of this transition and its applications to paleoceanography, ore genesis and exploration.

[1] Large, et.al., (2014), Trace element content of sedimentary pyrite as a new proxy for deep-time ocean-atmosphere evolution: *Earth and Planetary Science Letters*, v. **389**, p. 209-220. [2] Lehmann, et al., (2007), Highly metalliferous carbonaceous shale and Early Cambrian seawater: *Geology*, v. **35**, p. 403–406. [3] Tomkins et al., (2007), On the initiain of metamorphic sulfide anatexis: *Jornal of Petrology*, v. **48**, p. 511-535. [4] Craig & Vokes, (1993), The metamorphism of pyrite and pyritic ores: an overview. *Mineral Mag*. v. **57**, p. 3-18.