Temperature controlled trace element variations in pyrite within the Skouriotissa sulfide deposit, Troodos ophiolite, Cyprus

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The Troodos ophiolite represents one of the best-preserved fossil analogs of modern oceanic crust including numerous volcanic-hosted massive sulfide deposits. Most of the largest sulfide deposits are located at the northern flank of the Troodos ophiolite associated with graben structures that represent fossil spreading axes [1]. One of these is the actively operating Skouriotissa mine that can be separated in a stockwork ore zone and an overlying massive sulfide lens that is covered by metalliferous sediments representing the former sulfide–seawater interface. Pyrite is the dominant sulfide mineral within these ores. The trace element composition of pyrite varies systematically with stratigraphic depth probably reflecting variable hydrothermal fluid temperatures during precipitation. Elements such as Co, Ni, Se, Te and Bi that are associated with high fluid temperatures [2] are enriched within stockwork pyrite. In contrast, Zn, Sb, Pb and Mo that preferentially precipitate at low temperature conditions [2] are concentrated in pyrite of the massive sulfide lens. Temperature estimations based on massive sulfide-hosted sphalerite [3] yield average paleo-fluid temperatures of 411 °C ± 25 °C for the upper most part of the massive sulfide lens. Investigations on $\delta^{18}O$ variations of stockwork quartz revealed important insights on ore-forming processes within the underlying high temperature hydrothermal upflow zone.

Textural and chemical similarities, including $\delta^{34}S$, between massive pyrite from the Skouriotissa deposit and from the active Sisters Peak smoker on the Mid-Atlantic Ridge (5°S) [4] imply that the fossil hydrothermal system has a modern analog. These results indicate that in situ trace element analyses of pyrite yield important insights on the formation and internal zonation of massive sulfide deposits.

[1] Bettison-Varga *et al*. (1992) *Geology*, **20**, 987-990. [2] Maslennikov *et al*. (2009) *Econ Geol*, **104**, 1111-1141. [3] Keith *et al*. (2014) *Geology*, **42**, 699-702. [4] Keith *et al*. (submitted manuscript)