Trace element and sulfur isotopic evidence for redox changes during formation of the Wallaby gold deposit, Western Australia

JOSEPHINE WARD[1*], JOHN MAVROGENES[2], AMBERLEY MURRAY AND PETER HOLDEN

[1]Research School of Earth Sciences, The Australian National University, Canberra, 0200 ACT, Australia (*Correspondence: jo.ward@anu.edu.au)

[2]Research School of Earth Sciences, The Australian National University, Canberra, 0200 ACT, Australia

Wallaby, WA, is a gold deposit with an estimated resource of 7 million ounces of gold. It has a well-established paragenesis displaying mineral evidence of a redox change across five vein sets, each of which contains pyrite. Pyrite from each vein generation has undergone micro- analysis techniques to show a progressive and gradual change in redox conditions. The sulfur isotope composition has a $\delta^{34}S$ range of -7.7 to +9.8 ‰ using 3 micron spots on the SHRIMP-SI. Negative values indicative of an-oxidized sulfur signature are found in the earliest generation of pyrite which contains high concentrations of As, Ni, Zn, Ag, Sb, Cu and Pb. Conversely, positive values representative of reduced sulfur signatures are found in later generations of pyrite which has lower concentrations of As, Ni, Sb, Cu, Zn and Pb. These later pyrite crystals display higher ratios of As to Ni, As to Sb, and As to Bi, and conversely a lower Cu to Te ratio. The geochemical trends are clearly related to minor and trace elements held within the pyrite that are believed to be redox controlled. Previous suggestions of a single orogenic event, under oxidizing conditions formed the Wallaby gold deposit are supported by the present study. We have demonstrated that pyrite from the Wallaby gold deposit formed via sulfidation and a gradual change in redox conditions within an evolving fluid and did not result by the mixing of two separate fluids as previously advocated. This study also demonstrates the use of pyrite as a valuable mineral tracer in gold-bearing fluid systems.