Atom probe analysis of isotopically-distinct nanoscale Pb reservoirs in Witwatersrand pyrite

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The Witwatersrand gold deposits are characterised by an heterogeneous Pb isotopic composition. This has been interpreted as mixing between an old (~3 Ga) common Pb component and a more recent (~2 Ga) radiogenic Pb component [1]. However, the interpretation of such mixing arrays is complex and relies on a number of assumptions.

In this work we present new atom probe microscopy (APM) in combination with electron backscaterred diffraction (EBSD) and electron microprobe (EPMA) results [2] to refine our understanding of Pb mobility and metallogenesis in this area. The results indicate heterogeneous trace element composition in microstructures, with enrichement in As, Ni, Co, SB, Bi and Pb in a high angle boundary, and Ni, Sb, Cu, Tl and Pb in individual dislocations. The isotopic composition of the Pb reservoirs indicate that Pb ingressed into the pyrite through deformation microstructures, changing its isotopic signature during the ~2 Ga metamorphic event. Our data illustrate the need for nanoscale isotope measurements to isolate the distribution of isotopically-distinct Pb reservoirs. The trace element distribution also indicates important element mobility. The data presented here are consistent with the modified placer model [3, 4].

[1] Large, R.R., et al. Economic Geology, 2013. 108(6): p. 1215-1241. [2] Reddy, S. M. & Hough, R. M. Contributions to Mineralogy and Petrology, 2013. 166, 1269-1284. [3] Frimmel, H. and V. Gartz. Mineralium Deposita, 1997. 32(6): p. 523-530. [4] Robb, L.J. and F.M. Meyer. Ore Geology Reviews, 1995. 10(2): p. 67-94.