

The use of radiogenic isotopes for identifying the mineralising fluid source at the Wallaby Gold Deposit, Northeastern Goldfields, Western Australia.

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The source of mineralising fluids in Archaean load-gold deposit genesis is controversial. Hypotheses invoke either metamorphic or magmatic processes in the generation of mineralising fluids. The most widely accepted hypotheses is the crustal continuum model of Groves (1993) which proposes fluids generated by metamorphic dewatering are focused along structural conduits before deposition in favourable host rock packages. The alternative is that gold is deposited from magmatic fluids derived from igneous intrusions. The Wallaby gold deposit, located in the Northeastern Goldfields Province of Western Australia, which is intimately associated with a suite of monzonite-syenite-carbonatite dykes, provides an ideal opportunity to test this hypothesis.

The radiogenic isotopic systems used to test for a possible link between mineralisation and magmatism were Sr, Nd and Pb, which were analysed by a combination of isotope dilution TIMS and LA-MC-ICP-MS. The dyke suite gave a range of $3\epsilon\text{Nd}$ units (3.5 to 0.5), $^{87}\text{Sr}/^{86}\text{Sr}_{(t)} = 0.7014$ to 0.7016, and a range of $^{206}\text{Pb}/^{204}\text{Pb} = 13.598$ to 14.263, $^{207}\text{Pb}/^{204}\text{Pb} = 14.794$ to 14.934, $^{208}\text{Pb}/^{204}\text{Pb} = 33.370$ to 36.068. The range in isotopic data found is larger than would be expected from a single magma source, which suggests mixing between two isotopic sources. The first with high ϵNd and low $^{87}\text{Sr}/^{86}\text{Sr}_{(t)}$, indicating a period of LREE and Rb/Sr depletion, whereas Pb isotopes show that the first source had history of high U/Pb and Th/Pb. The ore isotopic ratios are indistinguishable from the carbonate veins lithology, which can be shown to be the final phase of magmatic intrusion associated with the carbonatite magma. The close match between magmatic units and mineralisation provides strong evidence for a genetic relationship between the two events.

References

[1] Groves, D.I. (1993) The crustal continuum model for late-Archaean load-gold deposits of the Yilgarn Block, Western Australia. *Mineralium Deposita*, **28**(6), 366-374.