Olympic Dam Cu-U-Au deposit: $^{87}Sr/^{86}Sr$ in carbonate gangue documents long formation history

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The Olympic Dam supergiant Cu-U-Au-Ag-(REE) deposit, South Australia, is hosted in hematite-rich breccia within 1590 Ma granite. Initially linked exclusively to the 1590 Ma Gawler Range Volcanic LIP and associated mafic/ultramafic magmatism, mineralization is now known to have a complex multi-stage history. Here we use Sr isotope ratios in gangue minerals to constrain the history of this complex deposit.

Carbonate (chiefly siderite, dolomite-ankerite, calcite with diverse settings and textures) forms a prominent component of the Olympic Dam Breccia Complex. $^{87}Sr/^{86}Sr$ in a set of 58 carbonate samples (most with Rb/Sr<0.05) vary from 0.7077 to 0.7524, clustering at 0.715-0.725, and there is little correlation with mineralogy, paragenesis, texture or host lithology. Similar results were obtained for barite and fluorite [1,2]. Existing models involving 'single-stage' mineralization at ~1590 Ma propose two main sources of ore-forming fluids, the host granite and near-coeval mafic-ultramafic magmatism. In this scenario, carbonate, fluorite and barite gangue would have formed with $^{87}Sr/^{86}Sr$ of ≤0.7090 [3], and given their low Rb/Sr, such minerals would be expected to largely preserve this fluid signature. In contrast, the high and variable $^{87}Sr/^{86}Sr$ observed in low-Rb/Sr gangue minerals requires that much of the carbonate-sulfate-fluorite gangue formed substantially post-1590 Ma, after build-up of radiogenic Sr within the high-Rb/Sr granitic host rock. Alternatively, high $^{87}Sr/^{86}Sr$ may be inherited from pre-1590 Ma, possibly sedimentary components within the breccia complex. Our preferred explanation involves multiple episodes of ore/gangue formation at 1590, 1300-1100, 820 and ~500 Ma, as a response to large-scale geological events [4].

[1] Wawryk (1989) Hons Thesis, Univ.of Adelaide [2] Maas et al. (2011) Min. Mag. Goldschmidt Abstracts 1375 [3] Creaser & Gray (1992) *GCA* **56**, 2789-2795 [4] Kamenetsky et al. (2015) SEG abstract, Hobart