SEG 2023 Conference: Resourcing the Green Transition

Tracing the Sources of Rare Earth Elements in IOCGs

Antony D. Burnham[1, 3], Jonathan Cloutier[2, 3], Vickie C. Bennett[1], Ross Chandler[1], John A. Mavrogenes[1]
1. Research School of Earth Sciences, Australian National University, Canberra, ACT, Australia, 2. Centre for Ore Deposit and Earth Sciences, University of Tasmania, Hobart, TAS, Australia, 3. Geoscience Australia, Symonston, ACT, Australia

Developing reliable mineral potential and exploration models depends on understanding the formation histories and source characteristics of different ore types. Iron oxide-copper-gold deposits have multiple models proposed for their formation, and their link to magmatism as a source of heat and metals is contentious. Fortunately, many IOCGs host abundant rare earth element (REE) minerals that are amenable to radiometric dating and Nd isotope microanalysis. We examined the REE-rich SWAN IOCG in the Mount Isa Inlier, Australia, and assessed its potential link to local magmatism. Drilling shows that SWAN and the neighbouring Mt Elliott IOCG deposit sit in the contact with a mafic intrusion. Using laser ablation ICP-MS, we measured εNd of REE-bearing minerals (allanite, apatite, and titanite) within ore samples ranging from highly mineralized to distal disseminated mineralization; these values were compared to the bulk-rock εNd as measured by ID-TIMS.

The SWAN deposit contains abundant allanite with a TIMS ^{207}Pb-^{206}Pb age of 1519.6 ± 1.1 Ma. The $εNd_{1520}$ of the mafic intrusion is 3.2 (± 0.4; 1σ), in contrast to the ore samples, which consistently had $εNd_{1520}$ = –4.7 (± 0.1; 95% CI) regardless of mineral type or location within the deposit. Most of the local granites have values of $εNd_{1520}$ ~ –3, whereas the local siliciclastics have typically $εNd_{1520}$ ~ – 8. Thus, a juvenile mafic source cannot have contributed chemically, though may have provided a driving heat source. The oxygen isotope composition ($δ^{18}O$) of allanite at SWAN is +7.6 (± 0.5; 1σ)‰, indicating that the host marble (typical $δ^{18}O$ > +20) has not contributed significantly to the oxygen in allanite. Hence, the REEs in the SWAN IOCG deposit were possibly sourced from a combination of the local granites and clastic metasediments, with brines as the transport vector.