Granite metasomatism in IOCG systems: feldspars at the nanoscale

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Recent studies of granite-hosted Fe-oxide Cu-Au (IOCG) systems within the Olympic Cu-Au Province, South Australia, show mineralogical complexity at the nanoscale which can be attributed to distinct alteration stages associated with evolution of an IOCG system [1, 2]. Here we show aspects illustrative of the magmatic-hydrothermal transition within Roxby Downs Granite (RDG), host of the Olympic Dam deposit. A change from deuteric to hydrothermal alteration, discerned from feldspar textures and geochemistry, likely represents the earliest stage of Fe-REE metasomatism in the IOCG system. Nanoscale observations support coupled dissolution-reprecipitation (CDR) mechanisms for replacement of deuteric perthite and igneous plagioclase by hydrothermal albite. High-resolution HAADF STEM imaging also reveals the presence of co-precipitate minerals such as Fe-oxides, epidote and sericite, many of which concentrate along porous grain boundaries at the reaction interface. Subsequent Fe metasomatism, widespread throughout the RDG, is expressed by increasing intensity of nm-scale Fe-oxide staining within K-feldspar and REE-minerals, which increase in abundance with proximity to the Olympic Dam deposit. This coincides with a systematic decrease of ΣREE in feldspars [3], indicating local remobilization of REE from the feldspar crystal lattice; similar to other major phases within the RDG. These insights show how mineral reactions and macroscale features of metasomatized granite are traceable by linking micron- to nanoscale observations in rocks that otherwise would appear 'fresh'. Moreover, results further highlight the ability of CDR reactions to remobilize elements at the grain-scale and facilitate subsequent stages of alteration. Mineral precipitation via transient porosity can locally plumb the evolving IOCG system and may be critical in the formation of large deposits such as Olympic Dam.

[1] Kontonikas-Charos *et al.* (2018) *Min Mag,* https://doi.org/10.1180/minmag.2017.081.040. [2] Ciobanu *et al.* (2017) *Minerals* **7**, 227. [3] Kontonikas-Charos *et al.* (2018) *Mineral Petrol* **112**, 145-172.