Feldspar Reequilibration Reactions in Hiltaba Suite Granites from the Olympic Dam IOCG-(U) Deposit, South Australia

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Our reconnaissance study investigates textural relationships and geochemical signatures of feldspars from "fresh" to variably sericite- and hematite-altered ~1.595 Ga Hiltaba suite granites at Olympic Dam. The sample suite is representative of the Horn Ridge Granite (HRG), a quartz monzonite, and the Roxby Downs Granite (RDG) distal and proximal to, as well as within, the Olympic Dam Breccia Complex (ODBC). Microscopic observations and quantitative analyses indicate the presence of feldspar reequilibration and replacement reactions prior to deposition of mineralization within the RDG.

Alkali feldspars at the earliest preserved stage display characteristic fine-grained cryptoperthite and microperthite exsolution textures, which have been pervasively recrystallized by circulation of deuteric fluids in the form of patch perthite, consisting of Ab-rich and Or-rich subgrains. Igneous feldspar in both granites, oligoclase (An_{11} in RDG, An_{24} in HRG), is commonly observed as rims surrounding alkali feldspar phenocrysts (Rapakivi texture), which are partially and completely replaced by albite ± sericite. Whereas sericite commonly forms an intergrowth texture with replacive albite, other mineral inclusions also nucleate in association with feldspar replacement phases. Sub-µm sized hematite inclusions form within and, most commonly, near the reaction boundary of patch perthite and replacive albite, respectively, while fluorite is a frequent accessory in oligoclase. In addition, synchysite (REE-fluoro-carbonate) is occasionally observed in replacive albite. Irrespective of source, the presence of such inclusions indicates the remobilization of these elements during early feldspar reequilibration reactions. Quantitative LA-ICP-MS spot analyses of the various feldspar phases may provide insight into the behavior of these trace elements during fluid-rock interaction.

A sharp reaction-interface, the generation of pores (± inclusions) in the product phase, and pseudomorphic textures associated with both deuteric coarsening and albitization are strongly supportive of coupled dissolution re-precipitation reaction. Electron microprobe mapping is in accordance with these textural observations. The Rapakivi texture may have also formed via a similar dissolution re-precipitation mechanism. Following early deuteric coarsening and incipient albitization, hydrothermal alteration progresses, particularly in the ODBC, and results in widespread sericitization at the expense of igneous plagioclase and albite. Red-stained K-feldspar (attributed to dusty sub-µm hematite inclusions) is the only persisting alkali feldspar, however, albite and rare alkali feldspar microtextures are preserved at depth or on the peripheries of the ODBC.

Given the abundance of alkali and plagioclase feldspars in the RDG (>65 vol %), such textural features, in particular the generation of transient porosity, may have greatly increased the overall permeability of the rocks during fluid-rock interaction. Therefore, sustained flow of an oxidized (hematite-stable) fluid may have led to significant redistribution of major, minor and trace elements, including rare-earth elements and yttrium, within the RDG prior to subsequent mineralizing stages. Feldspar re-equilibration and replacement reactions would thus represent the circulation of fluid(s), at least locally, accounting for overlapping alteration styles during the initial stages of IOCG genesis.