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Fluid induced microstructures in granulites from the Reynolds Range, central Australia

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Fluids play a major role in the evolution of the Earth's crust, driving metamorphic reactions, facilitating transport of mass and heat, and changing the physical properties of rock. Shear zones present in intraplate orogens are ideal natural laboratories to study the relationship of fluid-driven rock weakening to deformation, and thus the impact of fluid availability on the tectonic reworking of continental interiors. Here we present preliminary observations from the Aileron Shear Zone (ASZ), Reynolds Range, central Australia, a major crustal-scale thrust of the Palaeozoic Alice Springs Orogen (ASO).

This study focuses on the effects of fluids on the mineralogy and mineral chemistry of deep crustal rocks collected from a transect running through the ASZ. The ASZ is thought to have been of major importance during exhumation of the ASO, and exhumes a partly retrogressed suite of felsic and metasedimentary granulite facies gneisses. Hydration reactions associated with retrogression resulted in the partial replacement of orthopyroxene and numerous myrmekite textures associated with plagioclase and mica. In undeformed samples, orthopyroxene (En56 Fer44) rims are partly replaced by a zoned sequence of biotite (Phl70 Ann30), sub-parallel rims of magnetite, biotite and K-feldspar (Or87). Deformed samples gradually show an increase in dynamic recrystallization of quartz, with fully recrystallized bands of foam texture quartz defining the foliation together with biotite. Quartz and minor biotite replacement then dominates the mineral assemblage with increasing strain.

The presence of fluid-driven mineral replacement reactions in undeformed samples suggests that hydration predates shearing and exhumation, and furthermore, that strain may have been localised in areas of intense hydration and rock weakening. Retrograde reactions and myrmekite textures suggest the availability of a silica-saturated fluid. Additional mass-balance calculations will be applied to constrain the composition of the alteration fluid, and to gain further insight into mass-transport related to rock weakening and shear localisation.