Geophysical Research Abstracts
Vol. 18, EGU2016-10806, 2016
EGU General Assembly 2016

Deformation Processes Along the Moyagee Fault, Western Australia - a Subtle Interplay of Fracture, Flow and Mineralizing Fluids

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Within the Archean Yilgarn Craton of Western Australia, crustal-scale shear zones accompanied emplacement of large crustal batholiths. The dextral transpressional Cundimurra Shear Zone (CMSZ) was active for >20 Ma, during the incremental emplacement of the Cundimurra Pluton. Displacement along the CMSZ continued after pluton assembly, during the syndeformational cooling and exhumation of the granite-greenstone system. The Moyagee Fault occurs within the northern portion within the NEtrending segment of the CMSZ during the latter stages of pluton emplacement. The fault network comprises sequentially developed discrete shear fracture, cataclasis and ductile shear localized along pre-existing zones of high ductile shear. The distinct deformation components have been examined by SEM, TEM and EDSB in order to establish the grain-scale deformation processes.

Discrete fault/shear zone segments are highlighted by ultra-fine-grained tourmaline having all the aspects of pseudotachylyte that requires at least thin sectioning for definitive identification. In the earliest stages of fault development, tourmaline veins are a common, but not ubiquitous component, consistent with stress-driven, as opposed to fluid-pressure driven rupture. Subsequent displacement occurs by cataclasis that transitions rapidly into ductile flow and formation of ultramylonite. The ultramylonite is dominated by tourmaline, plagioclase and K-feldspar with grains only rarely larger than 1μm. All mineral phases are heavily dislocated with evidence of dynamic recrystallization. During this phase of deformation, the presence of tourmaline is critical to establishing a polyphase material in which grain pinning and grain boundary sliding enable substantive macroscopic strain. Overall, the grain-scale fabrics demonstrate the complexity and possibility of multiple brittle-ductile transitions throughout the continental crust.