245-20 - UNDERSTANDING FAULT-FLUID INTERACTION THROUGH STABLE ISOTOPE ANALYSIS OF TOURMALINE-COATED BRITTLE FAULTS OF THE WEST ANTARCTIC RIFT SYSTEM

Wednesday, 12 October 2022

9:00 AM - 1:00 PM

Colorado Convention Center - Exhibit Hall F

Booth No. 144

Abstract

Brittle faults in the southern Ford Ranges of Marie Byrd Land, West Antarctica, provide unique opportunity to study fluid-rock interactions in the West Antarctic Rift System (WARS) and the role of crustal fluids during regional-scale faulting. This fault array contains steep, NNW-striking, normal-oblique slip faults and sub-vertical WNW-ESE strike-oblique faults. Faults at Mt. Douglass, Mt. Dolber, and Lewissohn Nunatak display strongly aligned tourmaline, indicating syntectonic mineralization; surfaces in one location feature distinctive mirrors, suggestive of formation during seismic slip. Tourmaline has been demonstrated to resist chemical re-equilibration during even high-temperature metamorphism, and to maintain a record of conditions during formation, therefore oxygen isotope compositions of tourmaline and quartz pairs may elucidate crustal conditions (e.g., temperatures and fluid-rock ratios) and fluids sources.

Analyzed tourmaline and quartz were separated from the upper ~2mm of the fault surfaces; host rocks are tourmaline-free. Tourmaline $\delta^{18}O$ ratios (n=4) fall within a range of +9.2 to +10.4 ± 0.1 ‰ VSMOW (average 9.7‰, StDev = 0.7). Paired quartz yield $\delta^{18}O$ values of +11.1 to +10.3 ± 0.1 ‰; $\Delta_{Qtz\text{-}Trm}$ values between 1.3 and 2.0‰ may reflect an inability of quartz to equilibrate during tourmaline crystallization. Equilibrium between quartz and tourmaline would suggest temperatures of formation in excess of 550°C. Relative isotopic homogeneity suggests similar fluid conditions were present for all samples and supports field evidence for their association in a regional fault array.

Geometric and kinematic relationships suggest a link to deeper level shears hosting muscovite, and sillimanite with garnet. On-going investigation includes oxygen isotope analyses of these shears, as well as analysis of hydrogen and boron isotopes in tourmaline, which will better characterize the relationship between the deeper crustal shears with the brittle fault array, and the fluid sources and metasomatic processes in regional fault systems. Furthermore, temporal constraints on tourmaline mineralization will establish whether faulting is associated with Cretaceous intracontinental extension of the WARS (*Siddoway 2008*) or a crustal response to Neogene mantle delamination (*Shen et al 2018*).

Geological Society of America Abstracts with Programs. Vol. 54, No. 5, 2022
doi: 10.1130/abs/2022AM-383864

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