37-7 - INVESTIGATION OF TOURMALINE-MINERALIZED MIRRORED BRITTLE FAULTS FROM WEST ANTARCTICA USING ∂^{18}O (QZ-TUR), TOURMALINE ^{40}AR/^{39}AR THERMOCHRONOLOGY, AND BRITTLE KINEMATIC ANALYSIS

Friday, 17 May 2024

9:00 AM - 1:30 PM

Grand Ballroom (Davenport Grand Hotel)

Booth No. 7

Abstract

Brittle faults are widespread but rarely exposed in Marie Byrd Land, a part of the West Antarctic rift system, owing to enhanced erosion of zones of cataclasis by the regional ice sheet. Tourmaline-mineralized faults discovered at three locations in the Ford Ranges constitute a new record of fluid-rock interactions in this region of extended crust. Tourmaline resists re-equilibration, even during metamorphism, thus strongly aligned tourmaline from high-angle faults at Mt. Douglass, Mt. Dolber, and Lewissohn Nunatak likely contain direct records of fault-hosted fluids and timing of fault movements. The faults form an array oriented NNW-SSE and WNW-ESE, which displays brittle kinematic criteria indicating normal-oblique and strike-oblique displacement. Mirrored fault surfaces suggest formation during seismic slip.

Tourmaline is concentrated within a 2 to 4 mm zone bordering the fault planes. Petrography and EMPA analyses show unzoned tourmaline , with the dravite variety at Lewissohn Nunatak and schorl at the other two sites. Fluid inclusions in dravite are tubular (A-axis-parallel), 10 to 15 um, and up to 25 um, in length, containing gas and fluid phases. Fluid inclusions in schorl are C-axis-parallel and breached. Tourmaline ∂^{18}O ratios (n=4) range from 9.2 to 10.4 ± 0.1 ‰ VSMOW (average 9.7‰, s.dev. = 0.7). Paired quartz yield ∂^{18}O values of 11.1 to 10.3 ± 0.1 ‰, and ΔQtz-Trm values between 1.3 and 2.0. Brittle microfractures in parallel arrays, evident in thin section, indicate tensile opening along ENE- WSW axes, in accordance with outcrop evidence.

The strong preferred orientation and uniform mineral composition of tourmaline indicate syntectonic growth of tourmaline along fault planes. ΔQtz-Trm values suggest equilibration between host-rock quartz and tourmaline was not achieved, likely due to rapid tourmaline precipitation. Relative isotopic homogeneity between sites suggests similar fluid conditions across the region, for crust underlying a minimum area of 2000 km^2. Preliminary results of tourmaline ^{40}Ar/^{39}Ar dating indicate broadly Cretaceous timing for fault-related fluid flow. Ongoing work seeks to determine the temperature of mineralizing fluids and evaluate whether the brittle array localizes geothermal heat beneath the contemporary icesheet.

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