Lakehead University | Department of Geology

SEMINAR SERIES 2022-2023

Seminar Presented by:

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10:00 AM – CB 3031

CAN CO-SEISMIC PORE PRESSURE OF ANCIENT CONTINENTAL EARTHQUAKES BE ESTIMATED FROM FAULT-RELATED INJECTION VEINS?

Developing tools for estimating paleo-pore fluid pressure in faults is essential for understanding how the properties of fault rocks evolve during an earthquake cycle and over the lifetime of a fault. High pore pressure represents a weakening mechanism needed for fault slip, earthquake triggering, heat transport, and fluid / chemical cycling. It is also potentially a key to understanding the mechanical behavior of low-angle thrusts, which remains a great paradox in tectonics and fault mechanics. The Muddy Mountain Thrust in southern Nevada, USA, is part of the regional mid-late Cretaceous Sevier orogenic front and exposes evidence of paleoseismic slip. The thrust juxtaposed an imbricated Paleozoic carbonate sequence above Jurassic and Cretaceous sandstones, molasse, and conglomerates. The thrust displays injections of gouge and breccia from the fault core into fractures in the hanging wall rocks. Crosscutting relations between principal slip surfaces and injections indicate multiple seismic pressurization events. Field observation and microstructure of the injection materials revealed the presence of poorly sorted assorted remnant clasts of quartz, microcline, foliated gouge, breccia, and cement. The mixed lithology clasts were sourced from the fault core below and pushed upward into the hanging wall injection site, possibly implying rapid emplacement through the injection of materials by thermal pressurization and fluidization during seismic slip. Microstructural observations of cement and solution features will be used to infer the chemical characteristics and constrain density estimates and clast carrying capacity of the driving fluid. These observations will be used as boundary conditions to model the velocity and pressure of the driving fluid and the pore pressures required to drive injections. The modelled velocities and pressures will be related to co-seismic stress conditions associated with large earthquakes in the continental fold and thrust settings. Our model attempts to understand the pore pressure limits on the fault, which we will compare to the pressurization required to propel thrust slip on the low angle fault and potentially provide the first quantitative observational constraints of paleo-pore pressure from a low angle thrust.

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