Constraining the composition of basinal brines in the Athabasca basin from individual fluid inclusion analysis in quartz overgrowths

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Constraining the geochemical composition of basinal brines in the Athabasca basin is crucial in understanding the role of diagenetic fluids during the formation of high-grade unconformity-type uranium deposits. In order to characterize the diagenetic fluids before they were involved in mineralization, samples must be collected distally from mineralization or alteration zones. The Rumpel Lake drill core, which is located far away from known mineralization, is an excellent target for this type of analysis.

Isolated and clustered fluid inclusions in quartz overgrowths in the Athabasca Group sandstones (Fig. 1) were selected for analysis. Unlike minerals in veins, quartz overgrowths cannot be separated for bulk fluid inclusion analysis, therefore individual inclusions were analyzed with the heating-freezing, decrepitation SEM-EDS and cryogenic Raman spectroscopic methods [1, 2]. Ice-melting temperatures range from -37.5 to -11.0°C, suggesting that $CaCl_2$ may be present in addition to NaCl. Raman spectra obtained from frozen fluid inclusions show peaks that are comparable to published data for mixed NaCl-$CaCl_2$ systems (Fig. 1) [1]. SEM-EDS analysis shows that the decrepitates of the inclusions are composed of NaCl+KCl+$CaCl_2$±$MgCl_2$. These results are generally consistent with the proposals that the Athabasca basinal brines were derived from seawater evaporation [3], and indicate that some calcium in the basinal fluids found in uranium deposits may have been derived from fluid-rock interactions within the basin, rather than solely from the basement.

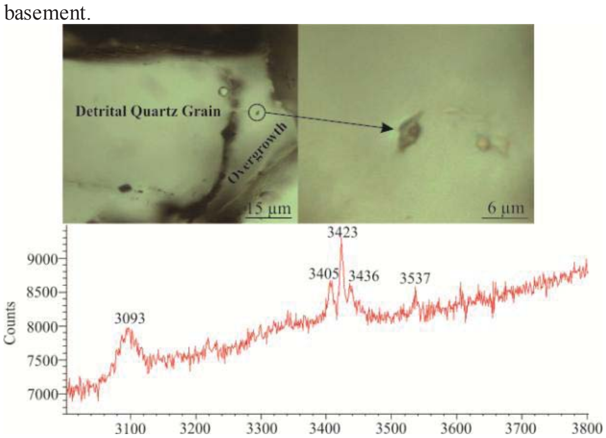

Figure 1: Upper: Isolated fluid inclusion located in the quartz overgrowth. Lower: Raman spectra of the depicted fluid inclusion homogeneously frozen to -185°C.

[1] Samson and Walker (2000) *The Canadian Mineralogist* **38**, 35-43. [2] Savard and Chi (1998) *Economic Geology* **93**, 920-931.
[3] Richard *et al.* (2011) *Geochimica et Cosmochimica Acta* **75**, 2792-2810.

Vegetation collapse on Flores 69,000 years ago: A consequence of the Toba super-eruption, or a volcanic disaster closer to home?

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A large ~8‰ positive $\partial^{13}C$ excursion has been identified at 69,000 years BP in the speleothem archive from Liang Luar cave, Flores, Eastern Indonesia. The excursion, by far the largest in 92,000 years of record, begins abruptly, lasts for over 500 years, and only fully recovers to background $\partial^{13}C$ after 800 years. At its peak the excursion approaches bedrock values and we therefore interpret this event as massive vegetation destruction in western Flores followed by progressive recovery.

The excursion is coeval with the largest spike in concentration of elemental sulphur in the speleothem across this interval, measured using in situ, 30μm scale Sensitive High Resolution Ion Microprobe (SHRIMP) analysis. Atmospheric volcanic sulphate is introduced to the cave system through dissolution in rain and then groundwater. The concentration of sulphate in speleothems serves as a relatively new proxy for volcanic activity.

Taken together, the $d^{13}C$ and sulphur records indicate that this outstanding century-scale event represents massive vegetation loss in western Flores in the aftermath of a major volcanic eruption. Could the Toba super-eruption be the cause of this major event in the history of Flores? We will present $\partial^{18}O$, $\partial^{13}C$ and sulphur concentration records from Flores and nearby Sulawesi detailing the relative timings of the isotopic and concentration changes in order to separate the effects of local eruptions on Flores from the remote volcanic impact of the Toba super-eruption.