U-series isotopes of travertine deposits near the Santa Fe fault in Laguna, New Mexico: Reconstruction of paleo flow paths and hydrodynamics

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Fault zones in the shallow crust are intimately linked with a variety of geological processes governing fluid storage and flow patterns. Fluid flow systems can be highly influenced by tectonic and climatic events, both of which occur at short and long timescales. Determining the relative influences of tectonic and climate activity on fluid flow in fault systems is therefore a great challenge. Travertine deposits that are associated with active normal faults in the central portion of the Rio Grande rift near Los Lunas, New Mexico preserve an invaluable record of past and current fluid flow and provide an opportunity to investigate the relative roles of tectonic vs. climatic forces responsible for fluid flow in the shallow crust.

The goal of this study is to reconstruct spatial and temporal patterns in travertine deposition to test the main hypothesis that glacial to interglacial transitions control formation of travertine in the Rio Grande rift. An equally important task will be to investigate how fluid sources change through time. To do this, we will investigate multiple glacial-interglacial transition zones in order to build links between tectonic and climatic forcing's at regional and global scales.

Thirty preliminary solution-based U-series ages from 12 samples have been obtained as well as 100 LA-MC-ICPMS U-series ages from two samples, at spatial resolutions of 3 ages per sample (1-2 cm apart) and ~50 ages per sample (0.464 mm apart), respectively. Travertine ages range from 0.944 ± 0.014 ka to outside of U-series range (>600 ka). This large spread in ages suggests that these deposits span multiple glacial-interglacial transitions. Travertine precipitation rates calculated from solution-based and LA-MC-ICPMS ages range from ~0.10 mm/ka to ~8mm/ka. Faster travertine precipitation rates coincide with interglacial periods, higher $\delta^{13}C$, and lower $\delta^{18}O$ isotope compositions.

Current results suggest that travertine precipitation rates are highly influenced by interglacial periods due to the increased availability of fluids near the surface. This study contributes to our growing understanding of the relationship between travertine precipitation rates and past fluid flow conditions, that are influenced by tectonic and climatic events, at an unprecedented scale.