

## Rapid and accurate uranium-series dating by MC-ICP-MS, using microdrilling and laser ablation

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Multi-collector inductively-coupled plasma mass spectrometry (MC-ICP-MS) has significantly improved both the ease by which U/Th dating may be undertaken and the sample size required relative to thermal ionisation mass spectrometry, as shown by a number of labs around the world. Here I report further refinement of this technique using a parallel ion counting MC-ICP-MS, to a rapid and accurate method which can produce percent-level age errors from samples containing as little as one nanogram of uranium.

The small sample size and high throughput of the method allows the routine use of high-resolution U/Th studies of small or slow-growing samples. Examples so far from this lab include studies of slow-growing speleothem core samples to constrain the ages of past wildfire events, high-resolution sub-sampling of sub-fossil teeth to produce age diffusion profiles, and the targeting of fine low-Th lamina in fresh water stromatolites to accurately date past periods of high lake levels.

A recently-installed ArF excimer laser system coupled to the same MC-ICP-MS is being used to test the potential of dating high-uranium materials by in-situ laser ablation, capable of producing high-resolution continuous age-distance profiles. Initial indications are that accurate results can be obtained from samples containing as little as 10 ppm uranium, the problem of elemental fractionation being addressed by a combination of external standardisation and anchoring of apparent laser age profiles to results from conventional microdrilling.

Results from a variety of samples and standards will be presented for both microdrilling and laser ablation.

## Geochemical and isotopic (Sr, B, O, H) characterization of groundwater from the Lower Cretaceous sandstone aquifer in the Negev and Arava Valley, Israel

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The Nubian Sandstone (Kurnub) aquifer of the Negev is the largest fossil groundwater reservoirs in Israel and yet due to the relatively high salinity (600 to 3000 mgCl/L) its utilization is limited. Future exploitation will be based upon desalination of the brackish groundwater. The present study aims to delineate the origin of the salinity of groundwater in the Nubian Sandstone and overlying Judea aquifers by investigating their chemical and isotopic (B, Sr, O, H) compositions. The chemical and isotopic data revealed several distinguished water groups that enabled us to reconstruct possible flowpaths and hydrological connections within and between the two aquifers. The salinity is derived from three principle sources: (1) Dissolution of halite (low Br/Cl) and gypsum (high SO<sub>4</sub>/Cl) associated with low <sup>87</sup>Sr/<sup>86</sup>Sr (0.70730 to 0.70775) and δ<sup>11</sup>B (25 to 35‰) values; (2) Mixing with Ca-chloride brines from the Rift valley (low Na/Cl); and (3) mixing with residual seawater and/or formation water with δ<sup>11</sup>B~39‰. The water are a mixture between "true" fossil water characterized by low δ<sup>18</sup>O and δ<sup>2</sup>H values and a slope identical to GMWL, and recent recharged groundwater characterized by higher δ<sup>18</sup>O and δ<sup>2</sup>H values and a slope that is identical to LMWL (i.e., deuterium excess =+22‰). We differentiate between current mixing of the aquifer water with brines from the Rift Valley and a fossil mixing phenomena. The latter is characterized by an inverse relationship between Na/Cl and Br/Cl. Its overall low salinity and its isotopic ratios suggest that dilution by fossil water occurred after the mixing process.