Intra- and inter- speleothem variability of bacterial communities in Kartchner Caverns

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Kartchner Caverns is a wet living carbonate cave located in the Whetstone Mountains in Benson, Arizona, USA. It was added to the National Science Foundation's Microbial Observatories (MO) in 2006. This cavern is considered one of the top ten caves in the world in terms of its mineral and speleothem diversity. It contains minerals from six different chemicals classes; carbonates, sulfates, oxides, nitrates, silicates and phosphates [1]. Kartchner Caverns is an extremely oligotrophic environment with high CO_2 and high humidity. One goal of the MO is to determine the heterogeneity of bacterial communities and mineral composition of speleothems in the cave. This study examined nine different speleothems and one flowstone that were in an area of 10 m (length) x 2 m (width) located in a single room of the cave. The objective was to explore both, intra- (on the same speleothem) and inter- (different speleothems) speleothem variability in bacterial community structure and mineral composition. Bacterial community fingerprints were generated from each speleothem by denaturing gradient gel electrophoresis (DGGE) analysis of 16S rRNA gene fragments. An elemental profile of each speleothem was also performed using inductively coupled plasma mass spectrometry (ICP-MS) analysis. The intra-speleothem analysis revealed that the community profiles from the same formation are more similar than the ones from different speleothems. For the inter-speleothem analysis, four clusters were observed which were primarily associated with the spatial location of the formations. Elemental analysis revealed differences in the trace mineral content of the ten formations. These are being explored for correlations with the DGGE bacterial community profiles. In a further study, pyrosequencing of the 16S rRNA gene fragment from the bacterial community DNA of the ten formations will be initiated Summer 2009.

[1] Hill and Forti (1997) *2nd Edition of cave minerals of the world.* 350-354.

^{129}I and Sr isotopes as tracers of large-scale fluid migration in the northern Appalachian Basin (USA)

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Results from previous studies of ore deposits, fluid inclusions, clay mineral assemblages, and hydrologic modelling suggest that brines and hydrocarbons have migrated long distances across the Appalachian basin, driven by topographic gradients and tectonic forces. This pilot study uses iodine and strontium isotopes of basinal fluids as tracers of brine migration in the northern Appalachian basin (W. NY and N.W. PA).

Ten brine samples were collected from oil and gas wells producing from Mississippian, Devonian, and Silurian age formations and analyzed for ^{129}I/I, ^{87}Sr/^{86}Sr, stable isotopes (O,H, and C), and elemental composition. Measured ^{129}I/I values (28-1890X10^{-15}) are 5 to 9 orders of magnitude greater than expected cosmogenic values (10^{-19} to 10^{-21}), given the depositional age (>350 Ma) of the source organic matter. Fissiogenic ^{129}I/I values (50-100X10^{-15}) in Devonian shales were estimated from published ^{238}U (spontaneous fission to ^{129}I) data and can account for only 7 of the high ^{129}I/I values. Large ^{238}U deposits in S.E. PA represent a regional fissiogenic iodine source (calculated ^{129}I/I up to 17,000X10^{-15}) that may have been mobilized during the Alleghanian orogeny (~315 Ma). Strontium isotope results show a mixing trend between a radiogenic (0.7210) end-member (consistent with exchangeable ^{87}Sr/^{86}Sr on smectite-illite clay assemblages), with a low ^{87}Sr/^{86}Sr (0.7100) end-member (within the range of Paleozoic marine carbonates in the Appalachian Basin). K^+/Cl^- ratios, less than the evaporated seawater trend, have a weak correlation with radiogenic Sr values and may provide evidence for punctuated clay diagenesis (illitization) by high temperature fluids expelled basinward, likely during orogenic events.