Stalagmite records of Pleistocene and Holocene climate from the Sierra Nevada, California

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Stalagmites from caves developed on the western slope of the central Sierra Nevada, California (38°N), exhibit abrupt isotopic and elemental changes over the past 75kyr that track changes in climate in the North Atlantic region, suggesting an atmospheric linkage between the two regions. Abrupt shifts to more negative $\delta^{18}O$ and $\delta^{13}C$ values, lower trace element concentrations, and less radiogenic $^{87}Sr/^{86}Sr$ in a $^{230}Th/U$-calibrated stalagmite (Moaning Cave) are coeval to within the dating uncertainty with the Older and Younger Dryas and Inter-Allerød Cold Period, indicating shifts to wetter conditions coincident with the onset of Northern Hemisphere cool periods.

Conversely, Northern Hemisphere warm periods (Bølling, early and late Allerød) are represented by increases in $\delta^{18}O$ and $\delta^{13}C$, elevated trace element concentrations, and more radiogenic, host rock dominated $^{87}Sr/^{86}Sr$ values suggesting shifts to drier conditions above Moaning Cave. Preliminary data from a stalagmite, collected from a cave developed within the same Sierran marble pod, documents decreased $\delta^{18}O$ and $\delta^{13}C$ during the transition out of interstadial 20 at ~ 69ka, indicating wetter conditions during earlier cool periods. These results suggest that changes in water-soil-rock interactions, driven by past changes in precipitation, occurred in the Sierra Nevada in synch with Northern Hemisphere warmings and coolings.

Raman spectroscopic identification of phthalic and mellitic acids in mineral matrices

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The possibility of life on Mars has fascinated mankind for centuries. The 1976 Viking missions failed to detect organic molecules on the Martian surface, even those expected from meteoritic bombardment. Since then, it is believed that the Martian regolith is highly oxidative and converts all organic molecules to metastable intermediates, which might be embedded in soils and rocks. Several types of organic compounds are known to have come to Mars via meteorites. Naphthalene, phenanthrene and anthracene all convert to phthalic acid in the generic oxidation process, and higher polycyclic aromatic hydrocarbons and kerogen transform into benzenecarboxylic acid products (e.g., mellitic acid) during oxidation [1].

In this study, we compare 785 nm and 514 nm excitation wavelengths of Raman spectroscopy to test this nondestructive method as a means to determine the presence of these two carboxylic acids (phthalic and mellitic acids) in experimentally prepared mineral matrices. This approach was first tested using beta-carotene [2] and usnic acid [3]. Samples consisting of carboxylic acid mixed one by one with powdered minerals (gypsum, epsomite and halite) were studied. Various concentrations of carboxylic acids (25, 10, 5, 1wt%) in the mineral matrices were studied to determine the detection limits of Raman spectroscopy for the detection of these biomarkers. Carboxylic acids mixed with mineral powders were then covered by a UV-transparent crystal of the same minerals, thereby creating a type of artificial inclusion. If a similar concentration of these acids exists in Martian samples, then Raman spectroscopy will be able to identify it.

[1] Benner *et al*. (2000) *PNAS* **97**, 2425-2430. [2] Vitek *et al*. (2009) *PSS* (in press, doi:10.1016/j.pss.2008.06.001). [3] Osterrothova and Jehlicka (2009) *SAA* (in press, doi:10.1016/j.saa.2008.09.005).