Stalagmite reconstruction of Moroccan climate from geographically spaced records

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Located at the boundary between Mediterranean and Saharan climates and within the southern limit of the North Atlantic storm tracks, Morocco is strategically placed for studying glacial to sub-millennial timescale shifting of climate boundaries. There is a specific lack, however, of high-resolution terrestrial records with high-precision, absolute chronology. Consequently, climate variation arising from interplay between climate systems is poorly understood and IPCC (2007) predictions of rainfall are presently uncertain. Precisely-dated, high-resolution, records of palaeoclimate linked with Morocco's extensive, rich archaeological records will also provide valuable insight into the potential effects of rapid climate change on pre-historic communities.

This study provides high-resolution and precisely dated U/Th records from speleothems discretely sampled from six caves in three sites (Ghar Cahal on the NW Mediterranean coast [5°3 W, 35°5 N]; 3 caves near Ouarzazate close to [7°3 W, 30°2 N]; and 2 caves in the SE close to Errachidia [4°2 W, 32°0 N]). Continuous growth and more negative $\delta^{18}O$ values in northern Morocco concurrent with abundant speleothem growth in the currently arid area south of the Atlas mountains suggests overall wetter conditions during the mid-Holocene and allow assessment of the pattern of rainfall and air-masses. We investigate the temporal and spatial relationships between these sites and compare them with existing records from the Holocene Climatic Optimum period, and with archaeological records in the region.

Comparison of oil sands process waters and natural water using Fourier transform ion cyclotron resonance mass spectrometry

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As the demand for petroleum has continued to rise, it has become necessary to increasingly turn to previously non-viable sources of oil, such as the oil sands in the Athabasca region of Canada. Using an alkaline hot water extraction process, the bitumen can be extracted from the oil sands prior to being upgraded to synthetic oil. Approximately three barrels of fresh water are required during the process to produce one barrel of synthetic oil. The exploitation of the Athabasca oil sands is therefore placing a burden upon the aquatic ecosystem in particular.

Fourier transform ion cyclotron resonance (FTICR) mass spectrometry has played a key role in the advent of the field of "petroleomics." The inherent ultra-high resolving power and mass accuracy is unrivalled within mass spectrometry, making the technique highly-suitable for the analysis of complex mixtures.

A 12 T Bruker solariX FTICR has been used to characterize a range of samples from the Athabasca region of Canada. The samples originate from natural water sources, such as rivers and lakes, and industrial sources, such as tailings ponds. High field FTICR mass spectrometry affords the ability to characterize the thousands of components present within the samples, which create characteristic signatures. Subsequent usage of principal component analysis (PCA) has demonstrated that these profiles can be used to determine the origins of samples, including distinguishing between industrial sources. There is potential for FTICR mass spectrometry to delineate between naturally-occurring profiles and anthropogenic sources.