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Speleothem Reconstruction of Moroccan Climate: from the Strait to the Sahara

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Located at the triple junction of climate regimes associated with the North Atlantic, the Mediterranean and the Sahara desert, Morocco has been subject to fluctuations of climate on multiple time-scales. However, the past temporal and regional variation in climate arising from interplay of these regimes is currently poorly understood. Elucidating where, when and how climate change has occurred holds great importance, not only for understanding how these regimes may respond to a changing climate in future, but also how past changes may have influenced prehistoric populations in the area.

We present speleothem records from highly contrasting climatic regions both north and south of the Atlas Mountains (a major topographic and climatic divide and effectively the northern boundary of the Sahara Desert) to assess the past shifting of climate boundaries, to investigate the impact of such climatic shifts on prehistoric populations, and to elucidate controls on climate at the Atlas/Sahara boundary.

On the Strait of Gibraltar, at the gateway of the Mediterranean and North Atlantic, Ghar Cahal (5˚25′ W, 35˚52′ N) provides palaeoclimate data that is directly comparable to the archaeological record within the site and relevant to the many archaeological sites found along the northern coastline. High-resolution, mid-Holocene stable isotope results reveal multiple large shifts in δ^{18}O ($\sim$1.5 per mil), and a cyclical variation (no shifts) in δ^{13}C. A lack of correlation between the δ^{18}O and δ^{13}C profiles suggests minimal kinetic fractionation and therefore provides greater confidence in the potential for palaeoclimate reconstruction. Ongoing trace element analysis will aid interpretation of the stable isotope data.

South of the Atlas Mountains, we sampled from sites near Ouarzazate (30˚ N) and Er-Rachidia (32˚ N) in the southwest and southeast respectively. Caves from both sites are heavily decorated despite arid (SW) and hyper-arid (SE) modern-day conditions. This presence of past speleothem deposition is itself a robust indicator of significant shifts in regional climate and is assessed here by the U-Th dating of growth periods. Preliminary chronology indicates coeval growth in the N, SE and SW during the mid-Holocene, signifying a potentially widespread pluvial phase. Sample Gar-1 (MegaMite) from the SE shows episodic growth since MIS 10, with deposition occurring predominantly during interglacials. Stable isotope analysis of these samples will enable the investigation of hypotheses regarding potential moisture pathways, providing insight into the source of and controls on precipitation at the currently arid northern fringe of the Sahara.