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Temperature variations during the last 140 kyr in the Eastern Mediterranean based on alkenones and speleothem fluid inclusions

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The high resolution oxygen isotopic record ($\delta^{18}O$) of *Globigerinoides ruber* (*Gr)* from two cores off the Israeli coast shows an excellent correlation with the well-dated $\delta^{18}O$ record of speleothems from caves, located ~40 km inland in Israel. Sea surface temperatures (SST) based on alkenones and land temperatures based on fluid inclusions (FI) trapped in speleothems [1] were calculated from these records for the last 140 kyr. Maximum FI temperatures during interglacial MIS 5.5 are ~ 20°C and gradually decrease to ~16°C at MIS 5.1. During most of the last glacial, temperature varied between 16°C and 13°C, reaching a minimum of about 8°C during the LGM. A maximum temperature of 20°C occurred during the Holocene at ~ 1.0 kyr (Fig. 1). Alkenone SST values are usually 1-2°C higher compared to FI temperatures. The similar trends of $\delta^{18}O_{Gr}$ and $\delta^{18}O_{speleothems}$ on one hand, and the corresponding similar alkenone-SST and FI temperatures trends on the other hand, clearly demonstrate that the sea-land connection through heat and vapour transfer was always from a single source, i.e., the Eastern Mediterranean Sea. The slightly higher alkenones SST most probably reflect a larger seasonal signal whereas the FI temperatures reflect the average yearly temperature of the land surroundings.

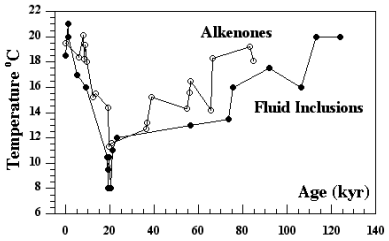

Fig. 1. A comparison between alkenone-SST and FI land temperatures in the Eastern Mediterranean.

References

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Holocene climate history of the SW USA from speleothem chronology

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The Holocene is generally viewed as a time of stable climate. However, it was the time of human expansion and large faunal overturns in North America. A changing cultural and faunal history through the Holocene may indicate important climate variability. Few proxies are sensitive enough to provide continuous absolutely datable records of climate change over this time period. Speleothems, which can be dated precisely using U-series chronology, provide the possibility of producing high-resolution (annually-resolved) records of climate change, even during periods thought to have minor climate variability.

In moisture-limited regions, such as the southwestern United States, band thicknesses, changes in mineralogy – from calcite to aragonite during periods of aridity, and frequency and duration of hiatuses may be directly related to available moisture. Our results, so far, show that the transition from the Pleistocene to the Holocene was a time of rapid climate change, similar in frequency to those seen in the ice records from the Northern Hemisphere, although not synchronous. The middle Allerød to early Younger Dryas, which corresponds to Clovis occupation, was a time of drought. Wetter conditions were established starting 12,500 YBP, well after the start of the Younger Dryas, and persisted for about 2,000 years, about 1,000 years past the termination of the Younger Dryas, consistent with regional lake level data.

Lack of any significant growth, and no growth in most of our samples, indicate that the early (after 10,500 years BP) through middle Holocene was a very arid interval. Wetter conditions started to get established by about 4,000 YBP and have persisted to the present, although interrupted by periods of aridity. In the southwestern USA, many of the climate transitions coincide with major cultural changes and faunal extinctions. Although not conclusive that climate was the dominant factor in all of these changes, a role for climate is strongly suggested by our data.