The ICDP Dead Sea Deep Drill Core: Chronology and implications for Levant climate change

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The ICDP Dead Sea Deep Drilling Project recovered the longest paleoclimate record in the Middle East, including a ~450m long core in the deepest basin, and extending to MIS 7, based on the overall glacial vs interglacial lithology. Here we report the detailed chronology from ^{14}C of organic material, stable isotopes and U-series of aragonite, changing lithology, stratigraphic correlation with subaerial deposits, XRF-scanning, and layer counting.

The Levant climate conditions are recorded in detail in the sediment layering. During wetter climate intervals varve-like alternating aragonite and detritus (aad) reflect summer and winter seasons, respectively. Less runoff means less aragonite (more mud). Gypsum layers indicate more arid climate, and halite indicates hyper-aridity.

The new chronology shows that major lithological changes coincide with the timing of MIS boundaries; for example, at MIS 2/1 there is substantial gypsum interval (during Heinrich 1) is followed by halite, and interestingly, MIS 6/5 shows a similar transition. Throughout the core, the lithological sequence in detail strongly reflects changes observed in marine and polar records. For example, full glacials (MIS 2, 4, 6) are reflected by thicker aad sequences, while strong interglacial intervals show substantial halite, gypsum, and mud, but little aad. Halite and gypsum are prominent during the warmer intervals of MIS 5 (5e,c,a), while the cooler intervals (5d,b) are characterized by mud and even aad. Short unstable intervals such as the MIS 3 D-O cycles are reflected by short sequences of aad, mud, gypsum.

The most dramatic discovery is a major desiccation event, more extreme than anything during the Holocene, now constrained to occur during MIS 5c, and indicated by an interval of rounded pebbles resembling on-shore beach deposits, overlying ~45 meters of mainly salt. The obvious question arises, why did it happen during MIS 5c rather than 5e? Possible explanations include a more intense southern monsoon during 5e that contributed runoff in the basin, or low enough P/E during both 5e and 5c. In any case, its occurrence has implications for the water-starved Middle East today, with GCM models indicating a more arid future.

Multi-element pedogeochemical prospecting in the Agrochão-Murçós area (NE Portugal)

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Total concentrations of chemical elements in soils of the Agrochão-Murçós area (NE Portugal) were determined in order to define potential spatial anomalies which have economic value based on a multivariate analysis and a geostatistical approach. In the area networks of quartz veins mineralized with scheelite, wolframite and rare cassiterite cut metamorphosed silurian rocks near the ceiling of small apophyses of biotite granodiorite and granite.

Soil samples were collected at 421 locations (20–30 cm depth from the surface) and were taken at intervals of 50 m within parallel sampling lines and spaced 500 m. The total concentrations were determined in each sample after being disaggregated and sieved in a 180 mesh sieve. The solutions were analysed by ICP-OES for a suite of 45 elements.

Principal component analysis and factorial kriging analysis were used to map the spatial distribution of chemical elements in soil. The analysis of the plane of the first three principal components revealed three groups of elements. A group showed a positive correlation with the first principal component and included Al, Na, Ca, Li, Ga, P, Zr, Rb, Sr, Th, U and Rare Earth Elements (REE- Y, La, Ce), while a second group of 11 elements (Fe, Sc, V, Co, Ni, Ti, Cr, Nb, Mn, Ba and Zn) showed a positive correlation with the second component. The third group included As, Cu, W and Pb. Sulfur, K and Sn are better explained isolated respectively by the axes 4, 5 and 7.

Then, the elements were analyzed separately by factorial kriging analysis. In the study area, six anomalies of W, Sn and REE were defined. Tungsten anomalies are spread across an area which coincides not only with the Rebordelo granitic massif but also to some extent with other smaller granite outcrops to the east and the surrounding metasediments. In addition there is a clear correlation with the calculated anomalies and several old Sn/W concessions in the area. The Sn distribution is such that most of the samples fall below percentile 95 and only scattered samples show small concentrations of Sn. The Sn anomaly is restricted and even this represents values of approximately 100 ppm only.

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