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The North African margin: a field laboratory for future climate change. Reconstructing paleo-wind circulations using dust provenance

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The North African desert margin is under the influence of the dry Saharan and the wet Atlantic and Mediterranean air masses. It is one of the areas most sensitive to the ongoing climate change. Models predict a decrease of precipitation leading to hyper-aridity. However, uncertainties remain large with a predicted precipitation decrease ranging from -4.5 to -22.9% for the latest CMIP6 simulations. Better reconstructions and understanding of the mechanisms that drove past changes of air-mass trajectories under the Holocene warm conditions could help reduce these uncertainties.
We present new data from a sediment core recovered from Lake Sidi Ali (Middle Atlas, Morocco) aiming at reconstructing variations in dust provenance using radiogenic isotopes (Lead (Pb), Neodymium (Nd), and Strontium (Sr)) on the <10µm detrital fraction of the sediment. The Pb, Nd and Sr isotopic compositions variations are coherent over the Holocene. In particular, there is a marked variation centered around 8.2 ka. Between ca. 7.5 and 4.5 ka the Nd (Pb and Sr) isotope ratios decrease (increase), then values are more stable. Using the radiogenic isotopes, we show that local inputs from the recent and highly erodible Moroccan volcanism are negligible in the fine fraction of the sediment. We also show that, although considered a major North African dust source, the Bodélé depression does not contribute to the Sidi Ali lake area. We have identified three potential dust contributors: the distal Mauritania-Senegal and the Southern Algeria-Northern Mali areas, and the more proximal Moroccan Atlas surface sediments.
The 8.2 ka abrupt event has been identified in numerous climate archives. At Lake Sidi Ali oxygen isotopes of ostracod valves and Cedrus pollen records both show significant changes around this event and have been attributed to enhanced spring rains compared to that of winter and cooler summers. The new radiogenic isotopes records show that a change in either dust provenance and/or the relative contribution of dust sources occurred at the same time. Hence, these results show that an abrupt change in air-mass circulation over the North African desert margin occurred around 8.2 ka.