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How dry was the Messinian Salinity Crisis? - a molecular study of the Eraclea Minoa (Sicily) section, Italy

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The Messinian Salinity Crisis (MSC; 5.96 - 5.33 Ma) is considered one of the most enigmatic episodes of paleo-oceanographic change. Kilometres thick evaporites were deposited in the Mediterranean basin, during periods when the connections between the Atlantic Ocean and the Mediterranean basin were restricted. The development through time of this crisis is still under debate. Although it is generally accepted that the MSC was a dry period with higher evaporation than precipitation and runoff, how dry climate was and how saline the water, has not yet been quantified accurately. Samples from the Upper Evaporites (MSC stage 3; 5.53 - 5.33 Ma) were collected from the Eraclea Minoa section (Sicily) consisting of cyclic alternations of gypsum and marls. Compound specific hydrogen isotopes, being closely related to the hydrological cycle and build into organic molecules, offer the opportunity to reconstruct past changes in the hydrological cycle and salinity during the MSC. The δD of terrestrial n-alkanes (C25 – C31) mainly records the δD of precipitation, modified by meteoric conditions and evapotranspiration in leaves. The δD of long-chain alkenones, produced by haptophyte algae, depends on the δD of the water, salinity and to some degree growth rate. Both long chain n-alkanes with a high odd over even predominance (higher plants) and long chain alkenones were found, recording heavy (deuterium enriched) hydrogen isotopic values. The very heavy surface water values are in line with exceptional high rates of evaporation. Furthermore, presence of alkenones in the Upper Evaporites suggests that the connections between Atlantic and Mediterranean, despite being reduced, were open also during stage 3 of the MSC.