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Climate change towards more arid conditions in SW Iberia during the Holocene

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During Holocene, a limestone tuff system developed in the SW Iberia near the town of Tavira (Portugal). The system is characterized by a set of three dams built up by the precipitation of layered limestones. Each dam has a low-energy pond system upstream where fine grained detrital sediments accumulated. The stable isotopic composition (oxygen and carbon) of the limestone tuffs were studied in detail with the aim of deciphering the paleo-climatic conditions prevailing onshore in this area during the Holocene.

The more relevant results can be summarized as follow: (i) ^{14}C age determinations constrained de carbonate sedimentation to the period between 10.2 ka and 2.6 ka; (ii) X-ray diffraction shows that the mineralogical composition of the limestone tuffs is dominated by calcite although some minor amounts of detrital quartz and clay minerals are present in some of the samples; (iii) the oxygen stable isotope data of the limestone layers shows δ^{18}O values ranging between -5.52 and -2.79 per mil for the time interval under consideration; (iii) the possibility of a contribution of the surrounding Mesozoic formations to the isotopic composition of the limestone tuffs was discarded by the lack of correlation between the ^{87}Sr/^{86}Sr values and the oxygen and carbon isotope ratios; (iv) after decomposition of the time series the change of the δ^{18}O values throughout the Holocene is characterised by an initial stage with δ^{18}O values ranging between approximately -5.1 and -4.5 per mil which ends around 3.7 ka and is followed by a late stage with stronger differences between the minimum and the maximum of the oxygen isotope ratio values (-4.8 to -3.9 per mil); (v) during the time interval under consideration the values of δ^{18}O of the limestone tuffs exhibit a trend of slow and regular increase.

The data on present day precipitation and isotopic composition of meteoric waters supports that the balance between evaporation and precipitation is the main factor controlling the fractionation of oxygen stable isotopes of the meteoric water in this region. The observed increase in δ^{18}O values throughout most of the Holocene can then be interpreted as the result of an increase in the amount of evaporation and/or a decrease on the amount of precipitation with the consequent change in the local climate conditions towards a more arid environment. This increase in the evaporation is most likely related to the increase in the atmospheric temperature during the climatic recovery following the Younger Dryas.

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