

EGU21-5417, updated on 27 Jan 2022

<https://doi.org/10.5194/egusphere-egu21-5417>

EGU General Assembly 2021

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Climate and land-use effects on hydrological and vegetation signals during the last three millennia in southwestern Morocco

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The southwest of Morocco is considered to be an area of refuge within the Mediterranean region, hosting the endemic tropical Argan tree. This region is presently subject to severe droughts, desertification, and land degradation, and likely facing increased climate variability and socio-economic stress in the future. Here, we use the stable hydrogen and carbon isotope composition (δD and $\delta^{13}C$) of plant-waxes in a high-resolution marine sediment core (GeoB8601-3) collected off Cape Ghir in southwestern Morocco, in combination with published data on pollen and XRF element ratios from the same archive. We aim to reconstruct the hydroclimate and vegetation history during the last 3000 years. Stable carbon isotope compositions of leaf waxes ($\delta^{13}C_{wax}$) show that natural vegetation in southwestern Morocco consists of C3 plants. Minor variations in $\delta^{13}C_{wax}$ were positively correlated to changes in stable hydrogen isotope compositions of leaf waxes (δD_{wax}) before 700 CE. Changes in rainfall amounts and water use efficiency indicate a clear vegetation response to precipitation changes and thus to climate forcing. After 700 CE, δD_{wax} and $\delta^{13}C_{wax}$ became de-coupled suggesting that the plant wax discharge and their isotope signals were no longer solely controlled by climate; the waxes likely mainly originate from the lowlands and carry an enriched (dry) δD signal but a depleted ^{13}C signature. The depletion of $\delta^{13}C_{wax}$ correlates with the increase of Argan pollen concentration in the record. The period between ~700 and 900 CE coincides with the Arabization of Morocco which had an impact on the demographic composition of the country leading to new agricultural habits and, as a result, on the land-use triggering a higher erosion of lowland material by the Souss River.