An 11.5 Ma paleoclimate record from travertine deposits at Barrancas Blancas in the eastern Atacama Desert, Chile

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Here we survey the potential of spring-related, surface and sub-surface carbonates as an archive of paleoenvironmental change at Barrancas Blancas, located in the broadest and driest sector of the Atacama at 24˚S in Chile. From these deposits we present a new stable isotopic record of paleoenvironmental conditions over portions of the past ~11.5 Ma. U-Pb dates from the carbonates, both surface and sub-surface, demonstrate that springs have discharged at this location over much of the last 11.5 Ma, attesting to the exceptional geomorphic stability of the central Atacama. Many of the sampled vein systems line vertical fissures, and formed within the aquifer before ground water discharged at the surface. Carbonates in such circumstances should not undergo off-gassing and kinetic fractionation prior to formation, simplifying the interpretation of their isotopic composition. Oxygen isotopic compositions of carbonates are genrally high (>-1‰VPDB), and using paleospring water temperatures reconstructed from clumped isotopes, point to strongly (up to 20-30%) evaporated water oxygen isotope values, like those associated with hyperarid conditions in recharge areas today. Carbon isotopic compositions are also high (+3‰ PDB) reflecting a recharge area essentially devoid of plants and dominated by volcanic CO_2, as is the case today. Our isotopic results are very similar to those from the Calama Basin to the north, suggesting that the western face of the Andes between 21-25˚S has been highly evaporative and plantless for much of the last 11.5 Ma. The spring carbonates at Barrancas Blancas strongly resemble those found at Devils Hole and Furnace Creek in Death Valley, USA, and as such warrant further exploration as potential archives of climate change.

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