XEROPRESERVATION OF FUNCTIONALIZED LIPID BIOMARKERS IN HYPERARID SOILS IN THE ATACAMA DESERT, CHILE.

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Abstract: The accumulation and preservation of lipid biomarkers was investigated in hyperarid soils in the Yungay region of the Atacama Desert. This region experiences <<2 mm of precipitation annually[1], leading to water activities in the surface soil that are always below the threshold for microbial growth[2], and has experienced continuous hyperaridity for at least the last ~2 Ma[3]. Lipids from seven soil horizons in a 2.5 m vertical soil profile were extracted and analyzed using GC-MS and LC-MS[4]. Diagnostic functionalized lipids and geolipids were detected, and increased in abundance and diversity with depth (*Figure*). Deeper clay units within the soil pit known to have fossil biomass sealed off from exposure to rainwater for the last 2 Ma[5] contained lipids with functional groups and unsaturated bonds in carbon chains. This indicates that minimal degradation of lipids has occurred in these soils since the time of their deposition at least 2 Ma ago. The excellent degree of structural biomarker preservation is likely due to the long-term hyperaridity that led to minimal microbial activity and extracellular enzyme action[6], a taphonomic process that we term xeropreservation (i.e. preservation by drying). The degree of biomarker preservation allowed us to reconstruct major changes in ecology in the Yungay region that reflect a shift in hydrological regime from wet to dry since the Neogene.

Preservation of functionalized lipid biomarkers over million-year timescales in hyperarid terrestrial settings supports potential preservation of lipid-like hydrocarbons under similar conditions elsewhere in the Solar System. This is particularly true for Mars where arid to hyperarid conditions have dominated the environment for approximately the last two billion years and perhaps only geologically recently has the window for habitability closed[7].

References:

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