



Rapid hydrological response to central Andean Plateau uplift, NW-Argentina

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The response of the regional and global hydrological cycle, vegetation and erosion to tectonic surface uplift and topographic growth of the world's largest orogenic plateaus and their flanking ranges is subject to ongoing debate. During the last decade reconstructions of paleo-environmental conditions and the topographic evolution of mountain belts have increasingly relied on stable isotope proxies retaining the oxygen ($\delta^{18}\text{O}$) or hydrogen (δD) isotopic composition of ancient meteoric waters or carbon ($\delta^{13}\text{C}$) of vegetation. Intermontane basin sediments along the Puna of NW Argentina, the southern extension of the Altiplano-Puna Plateau and the world's second largest plateau, record the eastward-directed lateral growth of the central Andes and the spatiotemporal impact of tectonism on hydrologic, sedimentary, and ecological changes through time. Here we reconstructed paleo-hydrological changes during a phase of major Andean uplift and orographic barrier formation (10-2 Ma) along the eastern flank of the Puna Plateau from a sedimentary sequence within the intermontane Angastaco basin of NW Argentina (25°45 S, 66 W). We use a unique array of stable water-isotope proxies in leafwaxes, pedogenic carbonates and hydrated volcanic glass. In addition we use vegetation-cover proxies based on stable C isotopes obtained from leafwaxes and pedogenic carbonates. Lipid biomarker leafwax δD values range between -95 and -160 ‰ (VSMOW), and $\delta^{13}\text{C}$ values from -23 to -36 ‰ (PDB). Pedogenic carbonate $\delta^{18}\text{O}$ values range from 18 to 31 ‰ (VSMOW) and $\delta^{13}\text{C}$ values vary between -4 to -17 ‰ (PDB), whereas volcanic glass δD values range from -71 to -95 ‰ (VSMOW). In combination, these proxies provide a precipitation – evapotranspiration record, which reveals the onset of the South American Low Level-Jet in NW Argentina at ~ 9 Ma and the presence of seasonally humid foreland conditions until 7 Ma, followed by orographic barrier formation upwind of the basin and rapid creation of sediment accumulation space in an early intermontane setting. After 6.5 Ma the presence of an efficient orographic barrier is compatible with the inference of rapid (~ 0.5 Ma) basin aridification and a gradual shift to semi-arid vegetation and upward sediment coarsening. Our new high-resolution multi-proxy isotope approach reconstructs the response of the hydrologic cycle, ecosystem, and surface processes to the eastward advance of Mio-Pliocene Andean mountain building in unprecedented detail.