CENOZOIC CLIMATE AND TOPOGRAPHIC CHANGE IN THE SOUTHERN ANDES (35°-47°S): A COMPARISON OF ORGANIC MOLECULAR AND INORGANIC ISOTOPIC RECORDS

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The Andes Mountains form the world's longest continental mountain belt and their evolution has shaped global climate, weathering and biological systems. Numerous studies have quantified the topographic evolution of this range, yet there remains considerable debate over the timing and magnitude of change along the orogen. We analyzed the δ^2H of plant-derived organic biomarkers, the δ^2H of volcanic glass and the distribution of soil-derived glycerol dialkyl glycerol tetraethers from Cenozoic sediments preserved in basins between ~35° and 47°S. These data were analyzed to reconstruct spatiotemporal changes in precipitation isotopes and temperature on the eastern flank of the Southern Andes. Both variables (precipitation isotopes and temperature) are strongly related to the topography of an orogen through isotopic distillation of precipitation during rainout and changes in temperature with elevation. Importantly however, molecular biomarkers can also provide key information about climate and aridity, informing interpretation of isotope and temperature data through time. We show that organic biomarker and volcanic glass δ^2H from the Malargüe basin (~35°S) in Argentina and several basins around ~47°S show comparable shifts in precipitation δ^2H (~15-20‰) from the early to late Cenozoic followed by an increase in δ^2H values in the Mid-late Miocene associated with increased vapor pressure deficit and indicators of increased aridity. These independent records attest to the fidelity of the isotopic signals in organic and inorganic proxies and demonstrate that the observed change in hydrogen isotopes through the Cenozoic dominantly reflects a change in ambient water composition, not secondary processes that bias a single proxy. Large negative precipitation isotope values observed for early Cenozoic sedimentary basins between 35° and 47°S are consistent with isotopic distillation associated with a high orographic barrier along the Southern Andes at this time. Increases in reconstructed precipitation δ^2H values on the eastern side of the orogen through the Cenozoic can be explained almost entirely by a change in the isotopic composition of precipitation related to Cenozoic changes in global climate and ocean temperature. In total, organic molecular and inorganic data indicate long-standing high topography in the Southern Central Andes since the beginning of the Cenozoic with evidence for mid-late Miocene drying, increased plant stress and a positive shift in precipitation isotopes.