Geophysical Research Abstracts
Vol. 20, EGU2018-8984, 2018
EGU General Assembly 2018

From foreland to intermontane basin: Surface uplift and orographic barrier formation in the Eastern Cordillera by means of volcanic glass stable isotopes (Quebrada del Toro).

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A major challenge in deciphering the uplift history of orogens is the common lack of surface-uplift markers of individual mountain ranges. Episodic deformation within intermontane basins and diachronous foreland uplifts, associated with the reactivation of inherited basement structures, make a thorough assessment of the spatiotemporal uplift patterns difficult. The Andes constitute one of the most important orographic barriers in the southern hemisphere, which impacts atmospheric circulation, the amount and distribution of rainfall, and resulting surface processes. In the Central Andes of NW Argentina the Puna Plateau and the intermontane basins within the adjacent Eastern Cordillera constitute archives that furnish spatiotemporal information on the uplift of the orogen and ensuing paleo-environmental changes. Presently, rainfall in NW Argentina is focused along the windward flanks of the Eastern Cordillera, while its intermontane basins and the Puna constitute high-elevation regions with decreasing rainfall and steep topographic and environmental gradients. The influence of topography on hydrologic conditions are reflected in the stable isotope composition of meteoric water. Importantly, in light of these systematic present-day isotope characteristics, proxy materials retrieved from basin strata may record analogous conditions in the past and provide insight concerning topographic growth through time. Here, we present isotopic signatures of volcanic glass (δDg), extracted from volcanic ash deposits interbedded with the sedimentary basin record of the Quebrada del Toro Basin (24.5°S). Combined with published ages and more 27 new U-Pb zircon dates, our data show clear variations in δDg that can be correlated with topographic growth and associated orographic effects during the late Miocene and Pleistocene. For example, early δDg values from the Quebrada del Toro (ca. –80‰ suggest similar conditions than in the foreland prior to 7 Ma, followed by a significant negative shift in δDg between 7 and 6 Ma. The latter is interpreted to represent surface and enhanced rainout along a paleo-Andean front. Finally, our data records a strong positive shift towards modern δDg values (–80‰ after ca. 800 ka, associated with aridification due to range uplift to the east and orographic shielding.