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# Stable isotope paleoaltimetry: Tectonics and the evolution of landscapes and life

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Stable isotope paleoaltimetry exploits systematic changes in the oxygen ($\delta$18O) or hydrogen ($\delta$D) isotopic composition of precipitation when lifting of moist air masses over topography induces orographic precipitation. The past 10 years have witnessed rapidly expanding research activities in stable isotope paleoaltimetry that resulted in a broad array of fascinating tectonic studies many of which concentrated on the elevation histories of continental plateau regions. Stable isotope based reconstructions of topography, therefore, have greatly expanded what used to be very sparse global paleoaltimetric information. The topography of mountain ranges and plateaus, however, not only reflects the geodynamic processes that shape the Earth's surface; it also represents a key element in controlling continental moisture transport, atmospheric circulation and the distribution of biomes and biodiversity. The challenge now lies in disentangling the surface uplift component from the inevitable impact of climate change on long-term records of $\delta$18O and $\delta$D in precipitation that accompanies surface uplift. The robustness of stable isotope paleoaltimetry reconstructions can be greatly enhanced when high-elevation $\delta$18O or $\delta$D proxy data are referenced against low-elevation records that track climate-modulated $\delta$18O or $\delta$D of precipitation through time. In addition, evaluating $\delta$18O or $\delta$D of precipitation upstream of the orogen/continental plateau region reduces commonly encountered complexities such as topographic threshold conditions to atmospheric circulation, variable moisture recharge to the atmosphere through evapotranspiration over the continents or the impact of hemispheric-scale atmospheric teleconnections; all of which may conspire in setting $\delta$18O or $\delta$D of precipitation.
Here, I present examples where stable isotope paleoaltimetry data successfully track topographic thresholds to changes in atmospheric circulation and precipitation with a particular focus on the effect of plateau-bounding ranges and document how a) spatially distributed proxy data permit the reconstruction of atmospheric circulation (and precipitation) patterns and b) how differences in $\delta$18O between high and low-elevation sites may enhance the robustness of stable isotope paleoaltimetry data. Future advances in stable isotope paleoaltimetry will greatly benefit from addressing topographically-induced teleconnections in the global climate system that affect $\delta$18O or $\delta$D of precipitation and from interfacing with evolutionary biology/phylogenetic techniques to evaluate competing hypotheses with respect to the timing of surface uplift.