

Rise of the Andes & the Geodynamics of Orogenic Plateaus

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(ABSTRACT)

Paleoelevation and incision histories provide important constraints on the timing and magnitude of regional surface uplift of mountain belts that point to specific processes that led to surface uplift. Multiple elevation proxies including paleoleaf physiognomy, $\delta^{18}\text{O}$ paleoaltimetry, and $\delta^{47}\text{Ti}$ paleothermometry, indicate that the Altiplano basin had attained no more than ~2 km of elevation by ~10 Ma. Both $\delta^{18}\text{O}$ paleoaltimetry and $\delta^{47}\text{Ti}$ paleothermometry show that the northern Altiplano was raised to its current elevation by ~6.4 Ma, suggesting that surface rise on the order of ~2 km or more took place between ~10 and 6 Ma. Geomorphic constraints on the incision history of widespread, low-relief paleosurfaces on both the eastern and western flanks of the Andes also suggest that deep incision began between ~10 and ~6 Ma over the entire width of the mountain belt and over at least 5° latitude, associated with ~1 to 2 km of surface uplift of the eastern and western margins of the plateau. Also coincident with regional surface uplift is the cessation of shortening across the plateau, a decrease in sedimentation rates within the Altiplano basin, the widespread eruption of ignimbrites, and eruption of asthenosphere-derived lavas in the southern Altiplano and Puna. Regional surface uplift of the Andean plateau in the late Miocene predicts a decrease in the horizontal deviatoric stress in the plateau that is consistent with the observed histories of shortening, sedimentation, and volcanism. The combination of geodynamic processes that appear to have occurred in the Andes during the Cenozoic, including Eocene to middle Miocene upper crustal shortening, late Miocene removal of high density lower lithosphere, and redistribution of crustal material by lower crustal flow and erosion/sedimentation are likely mechanisms for building broad, flat, high elevation plateaus in convergent tectonic settings.