8th International Symposium
on Andean Geodynamics
(ISAG)

Crustal shortening and removal of mantle lithosphere in the geodynamics of the Andes

P. Molnar[1]

[1]*Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado*

The Nazca and South America plates have converged for the entire Cenozoic Era, and during that time crustal shortening and thickening of crust has obviously played a crucial role in the construction of the high Andean belt. Yet, twenty-first Century estimates of Andean paleoaltimetry suggest that portions of the Central Andes rose 2000 m, if not 3000 m, abruptly since ~10 Ma. Concurrently, the Andes seem to have grown wider, when the sub-Andes emerged, and deep river incision into the eastern and western Cordillera began. Moreover, the convergence rate between the Nazca and South American plates slowed by 30-40%, presumably in response to an increased force per unit length that a high Andes applies to the surrounding plates. If the rise of the Andean surface and the decreased convergence rate occurred as abruptly as some data suggest, between ~10 and 6 Ma, then removal of some mantle lithosphere must have occurred, for crustal shortening could not have raised the surface and increased the gravitational potential energy per unit area of the Andes so quickly. This simple view – removal of mantle lithosphere and surface uplift – does not imply that entire Andean high terrain rose at 10 Ma. Abundant evidence of crustal shortening predating 10 Ma implies that elevated terrain existed before that time. Moreover, some paleoaltimetric estimates call for pre-10-Ma surface uplift. A remaining challenge is to determine where along the Andes surface uplift to present-day elevations occurred before or after 10 Ma. A simultaneous surface uplift along the entire chain would challenge our understanding of how mantle lithosphere has been removed, and might suggest that removal of mantle lithosphere does not explain the surface uplift.