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Episodic Uplift in Fold-Thrust Belts with Implications for Understanding Anomalous Conglomerate Units in Foreland Basins

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The Central Andes and the adjacent foreland basin represent an excellent analogue that can be used to better understand the development of the Canadian Cordillera and the Western Canadian Sedimentary Basin. This study examines Cenozoic sedimentary units deposited within the interior of the Central Andes in an effort to reconstruct the timing, magnitude, and causes of surface uplift in fold-thrust belts. By constraining these parameters, we can examine how deposition in the foreland basin responds to tectonic activity in fold-thrust belt interiors.

Calcium carbonate nodules from paleosols within a succession of Oligocene and Miocene strata in the hinterland of the Central Andes were sampled and their oxygen isotope ratios analyzed to determine paleoelevation over this time period. Oxygen isotope values from beds with ages of ca. 28-23 Ma indicate the paleoelevation in the region increased from approximately near sea-level at 27 Ma, to a maximum of 2 km above sea-level by 23 Ma. Thrust faulting and folding are not considered likely causes for the elevation increase owing to thermochronology, geochronology, and stratigraphic relationships that indicate upper crustal deformation in the region had ceased by ca. 27 Ma. Importantly, the increase in elevation in the region coincides with the voluminous mafic volcanism. The location of the volcanic centers (200 km behind the arc) and the geochemistry of the volcanic units are interpreted as evidence of a ca. 25 Ma delamination event beneath the region. We interpret the rapid pulse of surface uplift in this area to have resulted from isostatic rebound associated with removal of mantle lithosphere. A similar delamination event with concomitant surface uplift has been previously interpreted to have occurred in the Central Andes between10 and 6 Ma. The removal of dense mantle lithosphere from beneath the orogen results in surface uplift, which in turn should increase sediment influx into the foreland basin. Moreover, the removal of dense material from the region can result in isostatic rebound at a large enough wavelength such that even proximal portions of the foreland basin are affected. The combination of an increase in sediment influx and uplift (or at least diminished subsidence) in proximal portions of the foreland basin provide conditions that can explain how relatively thin, widespread, coarse-grained fluvial units are able to prograde into distal portions of the foreland basin.