



Stratigraphic signatures of crustal shortening and central Andean geodynamics in the Altiplano plateau, southern Peru

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The initiation and evolution of hinterland basins along convergent margins has been variably attributed to partitioning of pre-existing flexural foreland basins, drainage closure by uplift of flanking topographic barriers, and/or isolated strike-slip or extensional processes. In the central Andean plateau, the upper Oligocene to middle Miocene basin fill of the northernmost Altiplano in southern Peru preserves a record of orogenesis between the Western Cordillera magmatic arc and the Eastern Cordillera fold-thrust belt. New stratigraphic, provenance, geochronologic and structural datasets from the ~3.7-km-high Ayaviri hinterland basin suggest that upper-crustal shortening was the dominant factor controlling basin evolution. The basin preserves a ~2300 m thick succession (Puno Group and Lower Tinajani Formation) of fluvial sandstone and overbank siltstone capped abruptly by ~400 m of alluvial fan pebble-boulder conglomerate (Upper Tinajani Formation). New U-Pb zircon geochronologic constraints from 8 tuff horizons and the youngest age populations from 10 sandstone horizons constrain the depositional age between 29.6 ± 1.2 Ma and 15.71 ± 0.97 Ma. The resulting ~15 Myr basin record yields sediment accumulation rates between 110 and 660 m/Myr, comparable to those of major lowland foreland basins. A prominent shift in basin provenance is recorded by detrital zircon U-Pb spectra, conglomerate clast compositions, modal sandstone compositions and paleocurrent data. Newly dated growth strata along the two basin-bounding thrust faults highlight the role of Andean shortening on basin evolution. Footwall growth strata along the southwest-directed Ayaviri fault defining the Eastern Cordillera margin suggests deformation at ~28 Ma. Younger footwall growth strata along the northeast-directed Pasani fault defining the Western Cordillera margin demonstrate an episode of out-of-sequence thrusting at ~16.4 Ma. This event is associated with the provenance and depositional shift of the coarse-grained Upper Tinajani Formation. Oligocene to early Miocene basin evolution was controlled by flexural subsidence driven by shortening along the Ayaviri fault and broader Eastern Cordillera. Subsequent basin reorganization was initiated by punctuated out-of-sequence motion along the southwest basin margin (Pasani fault). The record of variable, punctuated shortening and subsidence emphasizes the role of upper-crustal thrusting in driving hinterland tectonics. However, it remains unclear if out-of-sequence thrusting in the northern Altiplano was a localized deformation event indicative of critical wedge dynamics, changing magmatic-arc processes, or a geodynamic response to complex patterns of lithospheric removal and pulses of surface uplift.