



A low-temperature thermochronology of denudation, crustal uplift and canyon incision in the Western Cordillera of southern Peru

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In Peru, the western edge of the 4–4.5 km-high Altiplano is cut by the >3 km-deep Cotahuasi–Ocoña canyon. To understand river incision and regional uplift history, 26 granite samples were collected for low-temperature thermochronology from vertical profiles parallel and perpendicular to the canyon at elevations between 3.8 and 0.6 km. Whereas 90–130 Ma zircon fission-track (FT) ages are consistent with rock formation ages, apatite FT ages range between ~100 and 60 Ma and show no systematic relationship to elevation. Samples from the shallower crustal levels, however, exhibit longer mean track lengths ($MTL > 14 \mu\text{m}$) and constrain pre-canyon burial temperatures since Cretaceous times at ~40–60 °C. Given that the low-relief Altiplano topography extends at <1 km above the most elevated sample, and assuming a minimum geothermal gradient of 30 °C/km due to the likelihood of compressed isotherms in the canyon, we conclude that the Altiplano has barely suffered 1 km of denudation since ~60 Ma. Apatite (U–Th)/He ages confirm that most denudation had occurred prior to ~15 Ma. Within the more deeply incised area, (U–Th)/He ages range between 15 and 3 Ma, indicating that accelerated incision began after middle Miocene times. Incision was driven by vertical rock uplift, but the fact that denudation rates away from the canyon system were far outpaced by rock uplift rates is explained by long-term aridity. Gorge cutting has thus focused most of late Cenozoic denudation, with high stream power conditions having been ensured by a range of processes despite low mean runoff.