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Unraveling the contribution of the western margin of the Altiplano plateau in North Chile (20°S) to Andean mountain-building

The Andes are the case example of an active Cordilleran-type orogen. It is generally admitted that, in the Central Andes (~20°S), mountain-building started ~50-60 Myr ago, close to the subduction margin, and then propagated eastward. Though suggested by some early geological cross-sections, the structures sustaining the uplift of the western flank of the Altiplano have been largely dismissed, and the most common view theorizes that the Andes grow only by east-vergent deformation along its eastern margin. However, recent studies emphasize the significant contribution of the West Andean front to mountain-building and crustal thickening, in particular at the latitude of Santiago de Chile (~33.5°S). The contribution of similar structures elsewhere along the Andes to the kinematics of the orogen is still poorly solved, because not yet well synthesized nor quantified. Here, we focus on the western margin of the Altiplano at 20°S, in the Atacama desert of northern Chile. We focus our work on two sites where structures are well exposed.

Our results confirm two main structures: (1) a major west-vergent thrust placing Andean Paleozoic basement over Mesozoic strata, and (2) a west-vergent fold-and-thrust-belt involving Mesozoic units. Once restored, we calculate a minimum of ~4 km of shortening across the sole ~10 km-wide outcropping fold-and-thrust-belt. Further west, structures of this fold-and-thrust-belt are unconformably buried under slightly deformed Cenozoic units, as revealed from seismic profiles. By comparing the scale of these buried structures to those investigated previously, we propose that the whole fold-and-thrust-belt has most probably absorbed ~15-20 km of shortening, sometime between ~68 Ma (youngest folded Mesozoic layers) and ~29 Ma (oldest unconformable Cenozoic layer). Preliminary (U-Th)/He thermochronological data suggest that basement exhumation by thrusting happened at the beginning of this ~30 Ma time span. Minor shortening affecting the mid-late Cenozoic deposits indicates that deformation continued after 29 Ma along the western Andean fold-and-thrust-belt, but remained limited compared to the more intense deformation during the Paleogene. Altogether, the data presented here will provide a quantitative evaluation of the contribution of the western margin of the Altiplano plateau to mountain-building at this latitude.

Category: Earth exterior envelops

Indicative keywords: Tectonics (keyword missing in your list), Geodynamics, Geomorphology