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Quantifying valleys incision rates with low-temperature thermochronology in the flat slab subduction segment of the western Andes slope (29ºS)

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The timing and rate of uplift and topographic evolution in many parts of the Andes is still under debate. One of these areas is the segment of flat slab subduction of the Central Andes (28-34ºS) attributed to the subduction of the aseismic Juan Fernández Ridge during the Neogene. Geomorphology at 29°S appears as a good scenario to study timing and magnitude of incision linked to the Andes uplift. The incision onset of the Miocene Low-Relief Surfaces (12.5 Ma) and erosion rates recorded by morpho-stratigraphic analysis agree with the rock exhumation rates assess by 4He/3He thermochronometry measurements in apatite. Individual ages show a systematic topographic distribution. In the valley bottoms ages are late Oligocene and Miocene, whereas ages are Eocene and early Oligocene when samples approach to the low relief surfaces of the interfluves. Calculated exhumation rates by thermal models show very slow rates prior to 15-10 My, ~ 20 m/My, and then increase to ~ 50 m/My from ~10 My to present. Therefore, both, the topographic evolution and the rock exhumation was controlled by the onset of valley incisions ca. 12.5 My. This incision may be a consequence of deformation and uplift linked to the subduction onset of the Juan Fernández Ridge at 12-10 My. Subduction of this aseismic ridge lead to flat-slab subduction, decrease of convergence rates and increase the shortening of the mountain's core, and which finally uplift the Frontal Cordillera. New topographic, hydrographic and local climatic reconfigurations increase the incision capability by the rise of elevation of the mountain and the increase capture area of the western Andes slope, and both, can explain the rock exhumation and topographic change by valleys incision. The valleys incision was favored by the increase of aridity in the western Andes slope with the preservation of Miocene Low-Relief Surface between incised valleys. Incision acceleration linked to intensification of the Westerlies and the beginning of the Andes glaciations during the Pliocene was not recorder by individual thermochronological ages or by thermal model because climate signals are coupled with the tectonic signals and local climate change.