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The northern Chile coastal morphology: an interplay between recent tectonic uplift of the west andean margin and precipitation gradient

A. Coudurier Curveur, R. Armijo, and R. Lacassin

Institut de Physique du Globe de Paris, Laboratoire de Tectonique et Mécanique de la Lithosphère, 1 rue Jussieu, 75238 Paris, France (coudurier@ipgp.fr)

The western topography of the Andes is marked by the large flat surface of the Pampa Del Tamarugal basin, hanging 1 km above sea level, limited to the West by a 1-km-high cliff - the Coastal Scarp - nearly continuous over a distance of 700 km. These features form a coastal topographic step in the morphology at the foot of the Altiplano plateau and are deeply incised by steep canyons descending from the plateau to the Pacific Ocean. Whether these morphologies result from recent tectonic uplift or not remains under debate. The Coastal Scarp is interpreted as a cliff continuously formed by wave action on an Early Oligocene topographic high [5] or as a Late Miocene fault scarp related to a marine normal fault system secondary retreated by marine erosion [2, 6, 1]. River incision would have been triggered by overspill of the Pampa Del Tamarugal basin over the topographic high during the Late Miocene [4] or resulted from a recent land surface uplift associated with tectonic processes that may take place beneath, at the subduction zone [1]. We address this problem using a landscape evolution model (APERO) [3]. We use an initial lower topography with a constant uplift rate, producing a morphology similar to the coastal step over a 7 My period, and precipitation values derived from present day precipitation rates. These latest are non-uniform over the studied area. Annual precipitation rates are higher in the northern studied area (18˚30'S) where rivers are exoreic than in the southern area (22˚S) where rivers are endoreic, which corresponds to one of the most arid desert on Earth: the Atacama Desert. Our results show that (1) a drainage system very similar to the northern Chile one is developed with modelling tectonics and climatic conditions and that (2) precipitation rates variations influence the endoreic or exoreic behaviour of rivers towards the ocean on an uplifting topography, as observed in North Chile. The morphology (Coastal Scarp and Pampa Del Tamarugal hanging surface) and the drainage systems of the northern Chile area can therefore be well explained by recent tectonic surface uplift of the topography associated with present day precipitation rates distribution over the last 10 My. These results imply that the deformation of the western margin is still active and that the Andes are growing towards the subduction zone.

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