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Denudation rates across the seaward side of a juvenile orogenic topography, western Cantabrian Range

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The Cantabrian Range in northern Spain reaches average elevations above 1500 m a.s.l. (up to 2700 m). This topography grew by uplift of Variscan basement rocks along the North Spanish coast during minor Iberia-Eurasia convergence since Eocene times. The convergence also caused limited subduction along the margin. The generation of this obvious topography has not coincided with significant exhumation; apatite fission track and He thermochronology suggests that less than 1.5 km has been removed since 80 Ma. Despite this, the landscape in the seaward side of the mountain belt shows features consistent with it not being in equilibrium. Relict landforms, in particular low relief surfaces, are preserved above 600 m in the interfluves of the incised fluvial system. These surfaces are interpreted to have evolved from a pre-Eocene palaeo-landscape. The low relief surface in the Oscos area is perhaps the best example. It covers an area of ∼450 km2 at 600 to 1000 m, and is composed of broad, rolling hills and hillslopes that never exceed 15º. The river catchments draining these surfaces drop up to 500 m along short bedrock canyons to join the surrounding incised rivers. Small river basins that flow northwards and drain the lowest ∼1000 m topography have incised into the 1.5 Ma old wave-cut platform that rises several tens of metres above sea-level along the coast.

In order to investigate the distribution of erosion throughout this seemingly inefficient erosional system, in situ cosmogenic nuclides have been analysed in bedrock and alluvial sediment samples. Cosmogenic 21Ne concentrations in sediments from the river mouths imply that basin-average denudation rates are at least a few tens of mm/kyr. These rates are similar to those measured in active Alpine areas elsewhere in Europe. However, denudation rates measured from bedrock quartz in the Oscos paleosurface are significantly lower (1-5 mm/kyr) similar to rates determined in cratonic areas. This heterogeneous distribution of denudation rates is consistent with erosion being concentrated in incised areas as the system accommodates base-level lowering and narrow steep valley slopes developed on resistant bedrock. Ongoing cosmogenic 21Ne and 10Be measurements will provide more precise understanding of the erosional response to landmass uplift during juvenile stages of evolution in a slow-growing coastal orogen.