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Low-temperature thermochronology, exhumation, and long-term landscape evolution in the western Cantabrian Mountains, NW Spain

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The present study aims to quantify the complex post-orogenic history of cooling, denudation, and exhumation of a Variscan crustal segment, exemplified by the Cantabrian Mountains. The substratum of the Cantabrian Mountains, that are located in NW Spain, in the western continuation of the Pyrenees, represents the eroded relict of a mountain range that was built during the Variscan orogeny, and that had been possibly peneplained by Permian-Triassic times. In Mesozoic times, this region was modified by rifting and opening of the Bay of Biscay, while in Paleogene-Neogene times it was affected by the convergence of the Iberian Plate with the Eurasian Plate. The long-term history of formation of the present topography with maximum heights of up to 2,648 m is not well established and is the subject of current research. Low-temperature thermochronology, i.e. apatite fission-track (AFT) dating, and modelling of time-temperature (t-T) paths are used in order to constrain the post-Variscan exhumation history. Furthermore, the thermochronological data will be utilised to determine the long-term landscape evolution by thermokinematic modelling.

The study area is characterized by diverse morphologies. On the one hand there is a sector with long wave length topography and low amplitudes that is used to distinguish the rate of landform evolution, in terms of an increase or a decrease in relief. On the other hand, there is another sector with short wave length topography and abrupt relief, due to deeply incised river valleys, that is used to determine exhumation rates.

The study is based on an overview sampling of 21 samples taken within specified intervals over the entire area. AFT ages range from 270 ($\pm$36) Ma (Permian) to 78 ($\pm$4) Ma (Upper Cretaceous). The age-elevation relationship shows negative slopes that are indicative of a decrease in relief. Mean horizontal confined track lengths vary between 10.4 ($\pm$1.8) μm and 12.8 ($\pm$1.8) μm. C-axis oriented etch pit diameters range from 1.3 ($\pm$0.2) μm to 1.6 ($\pm$0.2) μm. The time-temperature (t-T) paths for selected samples were modelled by applying the computer code HeFTy with independent geological constraints.