Geophysical Research Abstracts
Vol. 14, EGU2012-12290, 2012
EGU General Assembly 2012

Quantifying active tectonic processes in orogenic belts from river analysis of the Sierra Nevada (Spain)

A. Carracedo (1), R. Beucher (1), C. Persano (1), J. Jansen (2), A. Codilean (3), T. Hoey (1), and P. Bishop (1)

(1) School of Geographical and Earth Sciences, University of Glasgow, Glasgow, UK (cristina.persano@glasgow.ac.uk), (2) Department of Physical Geography and Quaternary Geology, Stockholm University, Stockholm, Sweden, (3) Deutsches GeoForschungsZentrum GFZ, Potsdam, Germany

The landscape of active orogenic belts is the result of the interaction between tectonic and surface processes. This interaction can be quantified by analysing bedrock river profiles, as they are the first features to respond to active tectonics. Sierra Nevada is an E-W oriented, ∼80 km long, ∼40 km wide young mountain chain in southern Spain which is seismically active. The western and southern margins of the chain are defined by normal faults with some strike-slip components, which have been active at least since the Pleistocene. Seismicity is less pronounced in the north where sedimentary basins now in exhumation are exposed.

The geographical location of Sierra Nevada in the southern Mediterranean; its E-W orientation and pronounced elevation (highest peak, Mulhacen, 3,480m) result in a climate contrast between the west, with higher elevation, and the eastern flanks of the mountain. Precipitation occurs mainly as snowfall during winter; in the west, where peaks have elevations of more than 3,000 m, snow is present for up to 4 months per year.

The difference in tectonic activity and climate is reflected in the river profiles. Analysing those we have divided the Sierra Nevada in three main areas: the northern flank, where rivers show predominantly concave profiles; the western flank, where rivers show tendencies towards non equilibrium; and the southern flank where rivers are not in equilibrium and often show convex profiles. The contribution climate makes in shaping these profiles is, however, unknown.

We have analysed 16 longitudinal river profiles along the Sierra Nevada; quantified their morphological parameters and identified the presence of knickpoints. These results show a strong correlation between river disequilibrium and active seismicity in the southern flank; this correlation is not as clearly defined in the western area, where, despite the high tectonic activity, rivers are closer to equilibrium. The results observed in the northern rivers show that they are in equilibrium. We used stream power maps to model the effects of tectonics and climate on river profiles to provide insight on the erosion and exhumation of the Sierra Nevada. We suggest that the presence of snow and, probably water condensation, increase the erosional power of the rivers in the western flank hence we observe river profiles closer to equilibrium in a highly active tectonic area.