Geophysical Research Abstracts
Vol. 20, EGU2018-18943, 2018
EGU General Assembly 2018

Impact of topography, climate and moisture sources on isotopic composition (δ18O & δD) of small rivers in the Pyrenees: implications for topographic reconstructions in low-elevated orogens

Damien Huyghe (1,2), Frédéric Mouthereau (1), Mathieu Sébilo (3), Arnaud Vacherat (1), Loïc Ségalen (4), Patricia Richard (3), Philippe Biron (3), and Thierry Bariac (3)

(1) Géosciences Environnement Toulouse (GET), Université Paul Sabatier Toulouse 3, 14 Avenue Edouard Belin, 31400 Toulouse, France, (2) Sorbonne Universités, UPMC-Paris 06, UMR 8222, Lab. Ecogéochimie des environnements benthiques (LECOB), Observatoire Océanologique, F-66650, Banyuls-sur-mer, France (damien.huyghe@obs-banyuls.fr), (3) Sorbonne Université UPMC Université Paris 06, Institut d'Ecologie et des Sciences de l'Environnement de Paris (IEES Paris), CNRS, Campus INRA, AgroParisTech, Bâtiment EGER, 78550 Thiverval-Grignon, France, (4) Sorbonne Universités, UPMC-Paris 06, UMR CNRS 7193, ISTeP, F-75005, Paris, France

Topography of continents is the expression of the coupling processes between geodynamics that govern exhumation, loading and unloading of the continental crust and earth surface processes. These processes control ways in which sediments are stored and transported from mountainous areas to sink domains. The elevation of mountain ranges exerts a direct control on atmospheric circulation and thus on precipitation and climate, and has strong implications on topics as broad as geodynamics, tectonics, sedimentology, paleoclimatology or paleontology. Documenting the evolution of Earth's surface elevation is a critical question for understanding the tectonic evolution of collisional domains, and to investigate tectonics vs climate interactions and their relative influence on erosion and sedimentation. Paleoelevation has been successfully reconstructed for high elevated mountain ranges like the Tibetan Plateau or the Bolivian Plateau from stable isotope measurements of minerals formed from meteoric water. In comparison low elevated orogens remain poorly investigated and it is a main question to determine if these small orogens are able to exert an orographic effect on isotope composition of precipitation or not?

Thus, before estimating paleoaltitudes, it is first required to document the local modern isotopic lapse rate from which assumptions can be formulated regarding a possible orographic effect on precipitation. Here, we determine the isotopic composition (δ18O and δD) of 82 small rivers and springs from small catchments in the Pyrenees sampled during the dry season (July to Septembre). Calculation of the deuterium excess (d-excess) parameter allows the distinction of four distinct isotopic provinces with d-excess values of between 15 and 22 ‰ in the northwest, between 7 and 14 ‰ in the central northern Pyrenees and between 3 and 11 ‰ in the northeast. The southern Pyrenees have a homogenous d-excess signature ranging from 7 to 14 ‰Our results show significant local moisture recycling and/or rain amount effect in the northwestern Pyrenees, and control by evaporation processes during rainfall events in the southern Pyrenees and for low elevated samples of the northeast of the range. Based on the distribution of d-excess values, we estimate contrasting isotope lapse rates of -2.9/-21.4 ‰km (δ18O/δD) in the northwest, -2.7/-21.4 ‰km (δ18O/δD) in the north central and -3.7/-31.7 ‰km (δ18O/δD) in the northeastern Pyrenees. The southern Pyrenees show distinctly higher lapse rates of -9.5/-77.5 ‰km (δ18O/δD), indicating that in this area the altitudinal effect in not the only parameter driving isotopic composition of rivers. Despite their relatively low topographic gradient, the Pyrenees exert a direct control on the isotopic composition of river waters, especially on their northern side. The variations in isotopic composition-elevation relationships documented along the strike of the range are interpreted to reflect an increasing continentality effect driven by wind trajectories parallel to the range, and mixing with Mediterranean air masses. Despite these effects, the measurable orographic effect on precipitation in the Pyrenees proves that the isotopic composition approach for reconstructing past topography is applicable to low-elevation orogens.