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Thermochronological and structural constraints for alpine exhumation in the Axial Zone, Pyrenees

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The Pyrenean belt was formed by the convergence between European and Iberian plates, which followed the Mesozoic rifting. The deformation in the Axial Zone is accommodated by a stacking of several tectonic units characterized by a complex pre-collisional history especially associated to the Variscan orogeny and possibly to the Mesozoic rifting. Published data allow to characterize the first order exhumation pattern (mainly from the AFT data, exhumation peak around 30 Ma) but not discuss the thermal and structural evolution in details. Is there an early phase of distributed shortening before the initiation of the crustal thrusts? Is there a thermal influence of the Mesozoic rifts in the Axial Zone? When did the exhumation start in the Axial Zone?

We performed a multiscale analysis of Pyrenean structures (Alpines), particularly near the ECORS profile in the Axial Zone. Low temperature thermochronological (ZFT, ZHe, including laser ablation depth profile from surface of grain coupled to AFT from the literature) are coupled to a chlorite-phengite thermobarometric analysis. Their relative intercalibration will help us to constrain and model the exhumation in the plutonic massifs and deformation in paleozoic metasediments.

Preliminary results show the Alpine shortening is distributed in the Axial Zone, while it seems more localized in the West. In the western part, the deformation is particularly clear in plutonic massifs, while along the ECORS profile it seems restricted to metasediments. Geochronological data will help us to date the deformation which has been recently described as mainly Variscan.

Thermochronological data on zircon fission track highlight a complex exhumation story with Cretaceous ages in several units of the Axial Zone, which could be associated to the rifting in the North Pyrenean Zone. In the northern part of the Axial Zone, the Gavarnie unit, late Paleocene/early Eocene ZFT ages are obtained, which is significantly older than previously thought but more consistent with the foreland basins record. Moreover, ZFT ages also suggest fast exhumation rates during Eocene times.

Thermal inverse modelling with QTQt provide the first complete and detailed results on the exhumation pattern of the Axial Zone, which is much more complex than previously thought. Such new data will allow new estimations of the (sequential) Cenozoic denudation, a discussion of the wedge thermicity and of its rheology.

This study is included to the Orogen research project, a tripartite partnership between academy and industry (Total, BRGM, CNRS).