Challenging Intraplate Orogens: from geomorphology to lithospheric dynamic. The French Massif Central Case study

Oswald Malcles\textsuperscript{1}, Philippe Vernant\textsuperscript{1}, Jean-François Ritz\textsuperscript{1}, David Fink\textsuperscript{2}, Gaël Cazes\textsuperscript{3}, Toshiyuki Fujioka\textsuperscript{4}, Régis Braucher\textsuperscript{5}, Jean Chéry\textsuperscript{1}, and Pierre Camps\textsuperscript{1}

\textsuperscript{1}Geosciences Montpellier, University of Montpellier, Montpellier, France
\textsuperscript{2}Australian Nuclear Science and Technology Organisation, Lucas Heights, Australia
\textsuperscript{3}SEES, University of Wollongong, Wollongong, Australia
\textsuperscript{4}Centro Nacional de Investigación sobre la Evolución Humana, Burgos, Spain
\textsuperscript{5}Centre Européen de Recherche et d’Enseignement des Geosciences de l’Environnement, Aix-en-Provence, France

In the 60's, the formulation of the plate tectonic theory changed our understanding of the Earth dynamics. Aiming at explaining the earth first order kinematics, this primary theory of plate tectonic assumed rigid plates, a necessity to efficiently transfer stress from one boundary to another.

If successful to explain, at first order, the plate-boundary evolutions, this theory fails when compared to the unpredicted but identified deformation located inside the plate-domains: the intraplate orogens. Indeed, the intraplate regions are thought to be slowly, if at all, deforming. Therefore, it is expected that intraplate regions do not show important finite deformation, that is to say, no mountains. Some intraplate regions, however, have important relief: the Snowy Mountains (Australia), the Ural Mountains (Russia) or the Massif Central (France) for examples. Traditionally, such regions are interpreted as old structures that are slowly eroded, interpretations that are most of the time weakly constrained.

Our study is aiming at providing stronger constraints and then a better understanding of such challenging area that are the intraplate orogen domains. Because direct measurements of deformations (e.g. GNSS: Global Navigation Satellite System or InSAR: Interferometric Synthetic Aperture Radar) are most of the time below the precision level, it is necessary to derive this information from the landscape evolution. To do so, terrestrial cosmogenic nuclide (TCN) technics are a key method, allowing to constraint the temporal landscape evolution. Classically, two TCN-based approaches are used to quantify the landscape evolution rate: burial ages and watershed-wide denudation rates, based on measurement in quartz sediment of 10Be and 26Al concentrations, two radioactive cosmogenic isotopes.
Using the Massif Central (France) as study area, we show that this region is currently deforming.

From new geochronological constraints and a geomorphometric study, we propose that the region undergoes an active uplift encompassing the last c.a. 4 Ma. It can be explained by the combination of at least two phenomena: the first one is the uplift triggering event, that has yet to be clearly identified, and the second one: the erosional isostatic adjustment enhancing the first one and possibly continuing after the end of the first one.