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Palaeothermicity investigation in the Variscan southern external domain: the case of the Montagne Noire (France)

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The Montagne Noire, located in the southern part of the French Massif Central represents the meridional part of the Variscan belt external area. It is subdivided in three parts. The granite-migmatite Axial Zone dome is surrounded by non- or weakly metamorphosed Palaeozoic sedimentary series. Both northern and southern flank of the Montagne Noire dome are deformed by km-scale, south-verging, recumbent folds, and thrusts. A foreland turbiditic basin develops in the southern part of the Montagne Noire. The Raman Spectroscopy of Carbonaceous Material (RSCM) method has been carried out in the sedimentary or low-grade metamorphic rocks of the South side of the Montagne Noire. The measured temperatures, comprised between 400°C near the dome, and 230°C in the southern domain, constrain isotherms to cut across the different nappe contacts and to lie parallel to the Axial dome limit. This temperature distribution supports the idea that the thermal structure was acquired as a result of the emplacement of the Axial Zone dome.

Our precise measurements comply with previous studies on illite crystallinity, conodont colour alteration, and fluid inclusions carried out in the Montagne Noire south flank that documented a low grade-metamorphism increasing towards the dome. The thermal structure acquired during nappe emplacement and burial of the sedimentary series has been totally overprinted by the doming, and cannot be deciphered in this multiply deformed zone. However, several areas present high temperatures that contrast with the bulk N-S gradient. This may suggest the presence of hidden intrusive bodies beneath the sedimentary rocks of the foreland basin. The temperature discrepancy between RSCM on the one hand, and illite crystallinity and conodont colour alteration on the other hand, in a domain relatively remote from the dome, points to a contrasting record of short-lived thermal pulses by the different methods. RSCM recorded the effect of the Axial Dome heat pulse over a much broader area and longer time span than the other methods, probably as a result of more efficient kinetics of graphitization reaction. For thermal events with a short lifetime, in the low temperature range, the different geothermometers available provide therefore complementary results.