The Georges cave: a spectacular lithospheric detachment between mantle and sedimentary cover (Lherz massif, Ariège, France)

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Résumé

The tectonic and thermal evolution of the Pyrenean Cretaceous hyperextensional rift system has attracted substantial interest, particularly in the last decade. Conceptual and numerical models state that after complete thinning, breakup and extraction of the continental crust, the exhumed sub-continental mantle comes in direct contact with the pre-/syn-rift sedimentary cover due to shearing along a detachment, in which the Triassic evaporites are probably involved.
We present a geological section from the Georges cave, located at the western margin of the Lherz Massif (Ariège, France), which has never been described before. In this cavity, we can observe a spectacularly exposed contact between the pre-rift cover at the roof and the Lherz body peridotite at the base. This world-class outcrop shows an exceptional continuity allowing to precisely describe the mantle-cover interface. Field observations in the cave clearly show that this contact, which is oriented ¯N-S, is tectonic. It displays top-to-the-WNW extensional sense of shear, and this from early ductile to late brittle deformation. A metric layer of microbreccia separates the serpentinized peridotite and the brecciated marbles. Texture within carbonate veins/dykes intruding the peridotite and clasts within the microbreccia are indicative of an initial high-temperature (> 500-600∘C?), with dolomite exsolution within calcite. Microstructural and petrographic data suggest that the detachment recorded a thermal evolution from high- to relatively low-temperature conditions in a continuum of extension, in agreement with structural field observations.
No overprint by the Pyrenean tectonic inversion was observed. The Georges cave section could then be interpreted as a world-class example of fossil and preserved extensional lithospheric detachment. The top-to-the-WNW normal sense of shear is consistent with models proposing a transtensional left-lateral regime for the Cretaceous rifting. However, some important questions remain. For example, the contrasted thermal evolution of the detachment footwall and hanging wall, the temperature of serpentinite veins formation being incompatible with the high temperature recorded in the marbles, or the hydrothermal or magmatic nature of the high-temperature carbonate veins/dykes injected in the peridotite and subsequently brecciated within the contact.

Mots-Clés: passive margins, hyperextension, mantle exhumation, Lherz, Pyrenees

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