Pressure-Temperature-time constraints for undercover exhumation of sub-continental mantle in a distal evaporite-rich passive margin (Lherz detachment, Pyrenees, France)

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Résumé

Recent studies have shown the crucial impact that pre-rifting evaporites may have on the tectonic, thermal and metasomatic evolution of rifted and passive margins. These rocks promote mantle exhumation in the distal part of passive margins under a thick allochthonous cover of pre- and syn-rift sedimentary units. Also, in these settings, major detachment faults may place subcontinental mantle (in the footwall) in direct contact with sediments (in the hanging wall) following crustal breakup as a result of crustal thinning. Despite numerous investigations on the thermal evolution of evaporite-rich passive margins, the thermobarometric evolution of such detachments remains poorly understood.

To address this gap, we present new data from the Lherz Detachment exposed underground in the Gouffre Georges (Lherz Massif, Pyrenees, France). The new results show that carbonate vein/dikes that intruded the exhumed peridotite along the detachment were sourced in

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the overlying Jurassic carbonate units. We also performed 39Ar/40Ar dating and thermobarometric modeling based on the chemistry of pargasite and phlogopite, both in equilibrium with the mineral assemblage of the vein/dikes. Temperature estimates indicate slightly higher maximum temperatures ($\geq 600\circ$ C) than those previously suggested for the base of the sedimentary stack. Pressures are compatible with the lithostatic load inferred from the known thickness of the pre- and syn-rift cover in the area at the time of crustal breakup. Amphibole ages indicate crystallization of the vein/dikes and hence crustal breakup in the latest Albian (ca. 101-102 Ma), while phlogopite 39Ar/40Ar ages reflect cooling of the system below ca. 400-500$\circ$ C, during Cenomanian/Turonian times in the post-rift stage.
These new ages provide the first direct dating of crustal breakup in the Pyrenees (and possibly in similar settings) and are consistent with ages inferred from the tectono-stratigraphic evolution of the North Pyrenean basins. Furthermore, as the carbonate vein/dikes are cataclastically deformed during extension, their cooling below the temperature of the brittle/ductile transition must be younger than Turonian. Our preliminary observations could question existing age models for the onset of the post-rift phase in the North Pyrenean Zone.

Mots-Clés: Pyrenees, mantle exhumation, detachment, evaporite, rich passive margins