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Imaging passive margins: a petrological perspective

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While several tectonic models (e.g., simple shear, detachment or mantle exhumation) are proposed to explain the formation of extensive basins and passive margins; a single thermal model (McKenzie, 1978), as a kind of dogma, is used to model the formation and evolution of sedimentary basins. The thermal evolution of such basins, coupled with other tectonic models, have been scarcely studied in detail. For instances, petrological changes (i.e. phase tranisitions), related to temperature changes, affect rock density and thus influence the subsidence history of the basin. Recent studies of continental passive margins collectively describe a great number of processes accounting for the extreme thinning of the continental crust. Among all the parameters that may act during crustal stretching, the thermal state of the system and the temporal evolution of the heat distribution during thinning appear of major importance.

We explore the effect of different thermal evolution models on petrological changes and their consequences on the geophysical signature of rifted zones.

We will present computed geodynamic models quantifying mineralogical and physical changes in the lithosphere during rifting processes and early margin formation. In the light of these high temperature evolution models supported by new field data from the north Pyrenean basins, we discuss the effect on subsidence as well as on gravimetric and seismic velocities signatures of passive margins.

Consequently, we are able to distinguish two types of margins according to their thermal evolution:

- An Alpine-type basin in which the temperature increase is 50 to 100 Ma older than the tectonic extension, leading to the "cold" opening of the ocean.
- A Pyrenean type basin where heating is coincident with basin formation, leading to a crustal boudinage and formation of an “anomalous” geophysical layer at the OCT