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Continental transform margins : state of art and future milestones

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Transform faults were defined 45 years ago as 'a new class of fault' (Wilson, 1965), and transform margins were consequently individualized as a new class of continental margins. While transform margins represent 20 to 25 % of the total length of continent-ocean transitions, they were poorly studied, especially when compared with the amount of data, interpretations, models and conceptual progress accumulated on divergent or convergent continental margins.

The best studied examples of transform margins are located in the northern part of Norway, south of South Africa, in the gulf of California and on both sides of the Equatorial Atlantic. Here is located the Côte d'Ivoire – Ghana margin, where the more complete data set was acquired, based on numerous geological and geophysical cruises, including ODP Leg 159.

The first models that encompassed the structure and evolution of transform margins were mainly driven by plate kinematic reconstructions, and evidenced the diachronic end of tectonic activity and the non-cylindrical character of these margins, with a decreasing strike-slip deformation from the convex to the concave divergent-transform intersections. Further thermo-mechanical models were more specifically designed to explain the vertical displacements along transform margins, and especially the occurrence of high-standing marginal ridges. These thermo-mechanical models involved either heat transfer from oceanic to continental lithospheres across the transform faults or tectonically- or gravity-driven mass transfer in the upper crust. These models were far from fully fit observations, and were frequently dedicated to specific example, and not easily generalizable.

Future work on transform continental margins may be expected to fill some scientific gaps, and the definition of working directions can benefit from the studies dedicated to other types of margins.

At regional scale the structural and sedimentological variability of transform continental margins has to be emphasized. There is not only one type of transform margins, but as for divergent margins huge changes from one margin to another in both structure and evolution. Multiple types have to be evidenced together with the various parameters that should control the variability. As for divergent margins, special attention should be paid to conjugated transform margins as a tool to assess symmetrical / asymmetrical processes in the oceanic opening. Attention should also be focused on the three-dimensional structure of the intersections between transform and divergent margins, such as the one where the giant oil field Jubilee was recently discovered. There is almost no 3D data available in these area, and their structures still have to be described.

An other key point to develop is the mechanical behavior of the lithosphere in and in the vicinity of transform margins. The classical behaviors (isostasy, elastic flexure) have be tested extensively. The localization of the deformation by the transform fault, and the coupling of continental and oceanic lithosphere across the transform fault have to be adressed to understand the evolution of these margins. Again as for divergent margins, new concepts are needed to explain the variations in the post-rift and post-transform subsidence, that can not always be explained by classical subsidence models.

But the most remarkable advance in our understanding of transform margins may be related to the study of interactions between the lithosphere and adjacent envelops : deep interactions with the mantle, as underplating, tectonic erosion, or possible lateral crustal flow ; surficial interactions between structural evolution, erosion and sedimentation processes in transform margins may affect the topography and bathymetry, thus the oceanic circulation with possible effects on regional and global climate.