Small-scale convection under mid-oceanic ridges: influence of transform faults

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Small-scale convection develops at the base of oceanic lithospheres during their cooling history. This small-scale convection has often been mentioned to be responsible for seafloor topographic flattening (Stein and Stein, 1992; Dumoulin et al., 2001), although other phenomena have been invoked (Zhong et al, 2007). In any case, the development of small-scale convection might have an impact on the thermal structure of oceanic lithospheres, seismic anistropy, partial melting, gravity anomalies...

In this study, we focus on the influence of a transform fault (TF) on the initiation, development and geometry of small-scale convection. 3-D numerical models, using a multigrid code (Choblet and Parmentier, 2001) are performed over a wide range of parameters (Rayleigh number, viscosity temperature-dependence, spreading rate...). We observed that advection schemes seem to have a strong influence on the onset and on the geometry of thermal instabilities. Different schemes are therefore tested and discussed.

Former 2D studies tend to show that topography of lithospheric isotherms (ie, lateral thermal heterogenities) induce smaller onset times (Huang and Zhong, 2003; Dumoulin et al., 2005). Here, the third direction allows material to flow inside the lower part of the lithosphere, in a direction depending on the topographic step (created by the coexistence of two lithospheres of different ages) and on the spreading. This flow moves the topographic step ("TF trail" on figure) farther and farther from the initial position of the TF, in the older part of the lithosphere, during ageing. Furthermore, the onset time of small-scale convection, on both sides of the TF, does not seem smaller than for a case without TF.

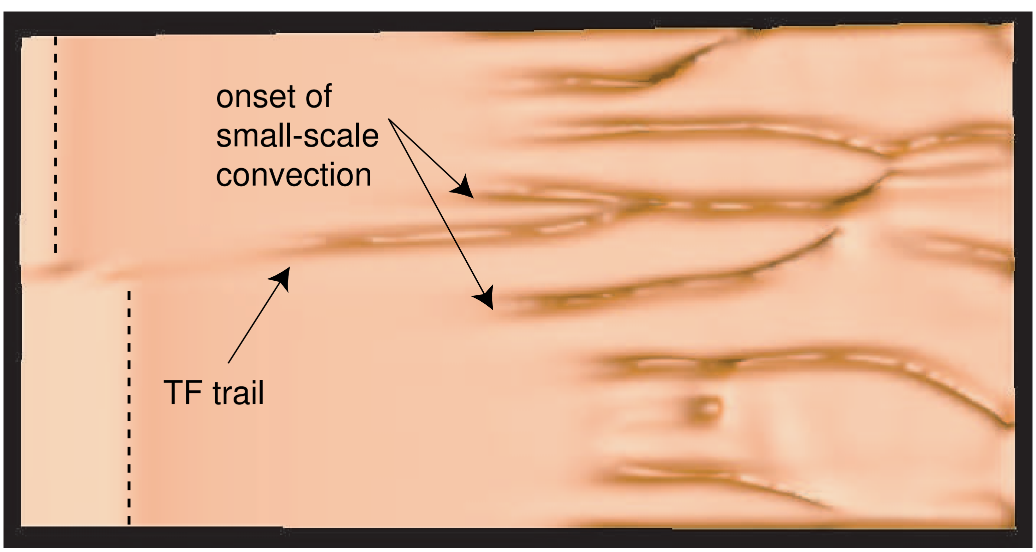

Figure 1: Isotherm of the base of the lithosphere.