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Analogue and numerical modelling of the soft point hypothesis

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Observations show that volcanic passive margins display magmatic and tectonic segmentations along-strike with a dominant 50-100 km wavelength. Those margins are punctuated every 50-100 km by long-lived hypovolcanic complexes. The deformation resulting from extension increases gradually towards those igneous centers.

Geoffroy (2001) proposed that this tectonic segmentation could result from the presence of pre-break-up soft points in the continental lithosphere. These would initiate and localize the deformation resulting from extension. In order to test this hypothesis, Callot et al. (2002) developed an analogue model of an extensional continental lithosphere containing soft points. Four layers model were constructed using sand and silicone putties to represent the brittle and ductile layers of both crust and mantle. The soft points were simulated by low-viscosity silicone putty emplaced within the brittle material. The model showed encouraging results but suffered from the limitations of analogue modelling (non temperature-dependent rheology for the ductile crust and ductile mantle, notably). In order to include the temperature-dependence, 3D numerical thermo-mechanical models of an extensional continental lithosphere containing soft points have been developed (Gac and Geoffroy, 2007). The models are constituted with four layers, an upper crust, a lower crust, a mantle lithosphere and the asthenosphere, all of which characterized by temperature-dependent visco-elasto-plastic rheologies. The soft points result from locally higher temperature imposed in the lithosphere. The results of these models will be discussed and compared to the analogue model ones.

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