Continental rifting and hyperextended passive margin formation controlled by ductile strain localization in the lithosphere mantle

Frédéric Gueydan*[1] and Etienne Van Broecke*[2]

[1]Géosciences Montpellier – Université Montpellier - CNRS – France
[2]Géosciences Montpellier – Institut National des Sciences de l'Univers, Centre National de la Recherche Scientifique, Université des Antilles, Université de Montpellier – France

Résumé

In extension, the presence or absence of a high-strength brittle mantle respectively leads to localized or distributed rifting. However, several geological and geophysical data question the existence of such a brittle mantle. Natural processes such as grain size reduction, fluid circulation, viscous shear heating, and metamorphic reactions - suggest ductile weakening as an alternative to the brittle mantle. However, the complexity of such small-scale mechanisms poses a problem in integrating such processes in large-scale models.

Using small-scale finite element models has enabled ductile weakening to be quantified as a function of strain and temperature. The weakening function reflects the complexity at the grain scale of metamorphic reactions in the crust or grain size reduction by grain boundary sliding creep in the mantle. Such simple weakening functions can be then simply imported into lithosphere-scale models. Using the ASPECT code, we show that ductile weakening is efficient, leading to strain localization in the lithosphere mantle. Narrow rift and hyper-extended continental margin can be numerically reproduced, without a brittle mantle.

Mots-Clés: Lithosphere extension

*Intervenant