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Quantifying the strain localization potential of metamorphic reactions in the rifted mantle

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Experimentally determined flow laws of rheologically important monophase aggregates and polyphase rocks have been published by many authors. These provide good constraints on lithology-controlled lithospheric strength variations. However, since the whole range of mineralogical and chemical rock compositions cannot be experimentally tested, variations in reaction-controlled rock strength cannot be systematically and fully characterized.

We here present the results of a study coupling thermodynamical and mechanical modeling aiming at predicting the mechanical impact of metamorphic reactions on the strength of the mantle. Thermodynamic modeling is used for calculating the mineralogical composition of a typical peridotite as a function of pressure, temperature and water content. The calculated modes and flow laws parameters for monophase aggregates are then used as input of the Minimized Power Geometric model for predicting the polyphase aggregate strength. Hence, by considering P-T evolutions characteristic of exhumed mantle, we quantify the strength of the mantle as a function of pressure, temperature and water content in a rift zone. We, therefore, quantify the mechanical impact of metamorphic reactions and highlight their importance as an active process for localizing plate boundaries.