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# Physically consistent viscosity of polyphase rocks: a new method and its validation

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Metamorphic reactions constitute one of the major processes inducing strain localisation and influencing the strength of the lithosphere. However, this process has seldom been explicitly taken into account in large-scale thermomechanical models so far. Such a development requires the calculation of the strength of any rock knowing its mineralogical composition and the strength of its components. Most of the existing polyphase rocks strength models are empirical. Those that are physically consistent provide strength bounds and/or lead to long and complex calculations, which is not suitable for large scale modelling.

Here, we present a new method to calculate the bulk viscosity of a polyphase rock knowing the fraction and the creep parameters of each phase constituting the rock. This analytical method uses a minimization procedure of the power dissipated in the polyphase rock with the Lagrange multiplier technique. This method is simple and quickly leads to values of the bulk viscosity as well as partitioning of stress and strain rate between phases. It allows us to revaluate the classical bounds and to compute a close approximate of bulk viscosity and bulk creep parameters, that are physically consistent. Then, this method is tested and validated against experimental data and numerical models under simple shear condition. Finally, we present an application of this method to the evolution of strength in a subducting slab.