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Viscosity and thickness of Earth's asthenosphere: inferred from Kyr-long processes, applicable to Myr-long dynamics

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Viscosity and thickness of Earth's asthenosphere are typically inferred from observations of postglacial rebound of the lithosphere. Parameter values deduced from studies of these observations serve a wide range of geodynamic models that simulate processes evolving over time periods of hundred Myr - much longer than the duration of the rebound process itself. The question remains whether inferences derived from the kyr-long rebound process hold over Myr-long periods. The record of past motions of non-subducting plates may help address such a question, because these motions are necessarily driven by asthenospheric Poiseuille-type flow, which is sensitive to viscosity and thickness of the asthenosphere. Here I show how a simple model for the dynamics of non-subducting plates may be used to address the question whether parameter values derived from the kyr-long rebound hold over the longer time-scales of plate motions. By interrogating the reconstructed records of past motions of three non-subducting plates, I find that indeed this is the case. Furthermore, including also constraints on the asthenosphere thickness from seismic tomography narrows down the range of plausible values of asthenosphere viscosity to [1, 3]*10^19 Pa*s.