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A short notice on the importance of the Young's modulus on the interpretation of crustal strength

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Flexural rigidity (D) and elastic thickness (Te) are commonly estimated in order to investigate crustal architecture. It is often stated that elastic thickness is a measure of lithosphere rigidity, and therefore, a proxy for its strength. However, this is not necessarily true. We argue that the mechanical properties of the crustal plate, and its interpretation in terms of strength, primarily are a function of the Young's modulus, not of elastic thickness. Elastic thickness is commonly estimated by the spectral method, which prevents insight to the role and significance of the internal parameters to the 4th order differential equation from which elastic thickness is derived. A sensitivity analysis of the analytical solution of the equation reveals a strong dependence between lithospheric rigidity and the Youngs modulus; it can vary by several orders of magnitude. Particular large discrepancies are to be expected in the case of hyperextended crust underlain by partially serpentinized mantle, i.e. the case for many of the World's outer margins. Such settings will typically be overestimated in terms of the elastic thicknesses when estimated by the spectral method and hence generate misleading interpretations of strength; results will typically be interpreted as representing strong crust, whereas it in reality is weak. The reason for this lies in inability to properly include the Young's modulus representative of serpentinite in the spectral method. We provide the theoretical basis for the above. An example from a hyperextended rifted margin is presented in a companion paper (Lundin & Doré).