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Understanding deformation of cratons in presence of mid-lithospheric discontinuity

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The recent discovery of mid-lithospheric discontinuity (MLD) within most cratons has added a new dimension in the understanding of cratonic survival. The MLD shows up as a seismic discontinuity at ~80-160 km depth. However, there is controversy regarding the strength of this layer. While some studies suggest that this layer is as strong as the craton itself, others advocate that under some special conditions (e.g. metasomatism) MLD can become weak and aid in the delamination of cratons. In this study, we develop 3-D full spherical mantle convection models to understand the effect of MLD in the survival of cratons. In our models, we incorporate MLDs of variable strength, depth and thickness. Along with varying the strength of MLDs, we use different combinations of craton and asthenosphere viscosity to quantitatively estimate how deformation pattern varies. Results obtained from the models suggest that in the presence of a weak MLD stress magnitudes decrease but strain-rates increase ~2-3 times. This could potentially lead to delamination of cratons. To constrain the present-day strength of MLDs, we predict deviatoric stresses from these different models and compare them to the observed SH_{max} directions obtained from the World Stress Map. The deviatoric stress pattern changes as the viscosity, depth and thickness of MLD changes.