Two-dimensional convection with a two-phase damage rheology lithosphere

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Plate tectonics is the unifying theory of geology, yet much remains to be understood about its development on Earth and absence on other planets. The generation of plate tectonics from mantle convection requires shear localization in order to form narrow, weak zones that separate the broad, strong plate interiors. Two-phase damage theory provides a theoretical framework to describe the failure and weakening that leads to shear localization. Two-phase damage theory allows for the development of damage to be manifested in two distinct ways: void generation associated with dilation of the matrix and increasing the fineness of the mixture (e.g. pulverization). This work will examine the application of two-phase damage theory to the problem of generating plate behavior from mantle convection. Our model will consist of a thin plate obeying a two-phase damage rheology overlaying a Newtonian mantle that is undergoing simple thermal convection in two dimensions. Our objective is to determine how successful the different manifestations of damage are at producing plate-like behavior in a more sophisticated simulation than previously examined.