The Aggregation and Dispersal of Supercontinents In Global Mantle Convection Models

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In 1966 J. Tuzo Wilson suggested that the Atlantic Ocean basin had closed and then reopened, a process now commonly termed the Wilson Cycle. Since then, numerous paleomagnetic studies have shown that Wilson's original idea may be extended to describe a global cycle, punctuated by the periodic formation of supercontinents such as Pangea, Rodinia, and Columbia, separated by time scales of several hundred million years (Myr) (e.g. Hoffman, 1991; Rogers & Santosh, 2002). It is generally accepted that these motions are coupled to large scale mantle convection. Early two dimensional (2D) mantle convection models demonstrated the dynamic feasibility of such supercontinent cycles (e.g. Gurnis 1988; Lowman & Jarvis, 1993). Here we present the first ever high resolution, 3D spherical mantle convection models with multiple mobile continents. We study models incorporating three to six continents in a predominantly radiogenically heated mantle with radially stratified viscosity. The results of these models reinforce the plausibility of a supercontinent cycle with a period of a few hundred Myr. Underlying mantle temperatures vary by up to 100 K over ∼100 Myr. Continental velocities fluctuate in concert, ranging from ∼0–7 cm/yr. These results agree well with geologic and geophysical observations, and place dynamic constraints on global mantle flow models.

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