The impact of secular cooling on Earth's geodynamics: insights from global scale numerical models

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Résumé

Secular cooling of the Earth exerts a first-order control on the mantle dynamics which drives changes in the tectonic regime and the nature of the geological record through time. Various flavors of geodynamic scenarios based on field observations, petrological and geochemical models have been proposed to explain the nature and origin of Archean rocks and the progressive changes in tectonic fabrics observed between craton and younger surrounding orogenic belts. Here we use 3D spherical thermomechanical numerical models of mantle convection (StagYY; Tackley, 2008) to investigate the influence of decreasing radiogenic heat production driving the long-term cooling of the Earth on the surface geodynamics. Different models with varying lithospheric strength are considered. All the models incorporate rigid cratonic cores and solve the conservation of mass, energy, and momentum for an incompressible fluid. Spatial-temporal analysis of the modelling results based on factors like plate size distribution, active plate margin type evolution, lifespan of tectonic features, and supercontinent cycles allow us to propose a new vision of the changing geodynamics of the Earth and the transition from Archean to modern-style plate tectonics.

Mots-Clés: Numerical modeling, Radiogenic heat, Secular cooling, Archean, Plate tectonics

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