Geophysical Research Abstracts,
Vol. 11, EGU2009-9740, 2009
EGU General Assembly 2009

Inverse Retrospective Problem of Thermal Evolution of the Earth Interior

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I consider an inverse (time-reverse) problem of thermal evolution of a viscous inhomogeneous incompressible heat-conducting fluid describing dynamics of the Earth's mantle. Present observations of geophysical fields (temperature, velocity) are incorporated in a three-dimensional dynamic model to determine the initial conditions of the fields. I present and compare numerical techniques for assimilation of geophysical and geodetical data into the geological past: backward advection, variational (adjoint), and quasi-reversibility methods. The methods are applied to restore the evolution of the mantle structures such as rising plumes and descending lithospheric plates.