Geophysical Research Abstracts
Vol. 18, EGU2016-4570, 2016
EGU General Assembly 2016

Reconstructing mantle heterogeneity with data assimilation based on the back-and-forth nudging method: Implications for mantle-dynamic fitting of past plate motions

Petar Glišović and Alessandro Forte
GEOTOP, Université du Québec à Montréal, Montréal, Canada (pglisovic@gmail.com)

The paleo-distribution of density variations throughout the mantle is unknown. To address this question, we reconstruct 3-D mantle structure over the Cenozoic era using a data assimilation method that implements a new back-and-forth nudging algorithm. For this purpose, we employ convection models for a compressible and self-gravitating mantle that employ 3-D mantle structure derived from joint seismic-geodynamic tomography as a starting condition. These convection models are then integrated backwards in time and are required to match geologic estimates of past plate motions derived from marine magnetic data. Our implementation of the nudging algorithm limits the difference between a reconstruction (backward-in-time solution) and a prediction (forward-in-time solution) on over a sequence of 5-million-year time windows that span the Cenozoic. We find that forward integration of reconstructed mantle heterogeneity that is constrained to match past plate motions delivers relatively poor fits to the seismic-tomographic inference of present-day mantle heterogeneity in the upper mantle. We suggest that uncertainties in the past plate motions, related for example to plate reorganization episodes, could partly contribute to the poor match between predicted and observed present-day heterogeneity. We propose that convection models that allow tectonic plates to evolve freely in accord with the buoyancy forces and rheological structure in the mantle could provide additional constraints on geologic estimates of paleo-configurations of the major tectonic plates.