Geophysical Research Abstracts
Vol. 20, EGU2018-9253-1, 2018
EGU General Assembly 2018

New improvements on LitMod package: A tool for integrated geophysical-petrological modelling of the lithosphere and upper mantle

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LitMod is a combined geophysical-petrological 2D forward modelling tool developed ten years ago at ICTJA-CSIC to study the thermal, compositional, density and seismological structure of lithosphere and sublithosphere domains by combining data from petrology, mineral physics and geophysical observables within a self-consistent framework. Here, we present a set of improvements on the different modules of the current version of the LitMod package focused on the graphic user interface (GUI), the average composition of the upper mantle, and the incorporation of anomalous sublithospheric bodies in terms of composition, temperature and seismic velocities. A new GUI has been developed under Python programming language to gain versatility and compatibility with the different operative systems and platforms. We tested several changes in the sublithospheric mantle composition (DMM instead PUM) and in the attenuation parameters (grain size and period) to fit the calculated seismic velocities with those from the ak135 global reference model. None of these changes produce significant variations in the calculated velocity values below 200 km depth and hence, the calculated synthetic tomography from LitMod shows a red shift below this depth. The most interesting improvement is the possibility to incorporate sublithospheric bodies with different chemical compositions, and either anomalous velocities (Vp or Vs) or temperatures, which can be imposed from independent studies for each target region. To this end we increased the range of temperatures up to 2200 ºC in calculating the mineral assemblages and we incorporated anelasticity in calculating the bulk rock seismic velocities and their partial derivatives, such that we can translate temperature anomalies into seismic velocities and vice-versa. Additionally, this new tool permits to calculate coupled-uncoupled elevation to estimate the effects of density anomalies on topography giving an upper bound for dynamic topography under isostatic equilibrium.

This research is supported by project SUBITOP (MSCA-ITN-2015-ETN-674899).