Geophysical Research Abstracts
Vol. 19, EGU2017-12985-1, 2017
EGU General Assembly 2017

Controls on sublithospheric small-scale convection on Curie depths

Jeremias Likerman (1), Sergio Zlotnik (2,3), Li Chun-Feng (3,4)

(1) Universidad de Buenos Aires. CONICET. Instituto de Estudios Andinos (IDEAN), Buenos Aires, Argentina., (2) LaCaN, Universitat Politècnica de Catalunya (UPC), Barcelona, Spain, (3) School of Ocean Sciences, Tongji University, Shanghai, China, (4) College of Ocean Sciences, Zhejian University, Zhoushan, China

As the ocean lithosphere cools and thickens, its bottom layer goes unstable leading to sub-lithospheric small-scale convection (SSC). Since SSC was originally proposed, there have been considerable efforts regarding the understanding of the physics that rules the thermal instabilities of the SSC (e.g. Dumoulin et al, 1999; Solomatov and Moresi, 2000). Over the last several years, it is understood that the interaction between the plate movement and the SSC tends to form longitudinal (LRs or also called 'Richter rolls') and transverse rolls (TRs), of which the axis is parallel and perpendicular to the plate motion, respectively. The geometry of these rolls have been been recently inferred by Li et al (2013) using Curie depths from the North Atlantic as proxies for plates temperatures. They showed that Curie depths have a large oscillating and heterogeneous patterns that could be related to SSC. In the North Atlantic transverse rolls seem predominant.

In this work we analyze, by means of 3D dynamical numerical simulations, the influence of SSC on the Curie depths patterns observed in the North Atlantic and Pacific plates. We investigate the behaviour of the Curie isotherms trying to determine if SSC is able to reproduce the observed data, and the influence of several poorly constrained rheological parameters.

Our numerical simulations show that: a) using realistic laboratory-constrained rheologies and temperature it is possible to modify temperatures as low as those at Curie depths; b) transverse rolls are generated as well as longitudinal rolls on those isotherms; c) the spreading rate is a first order control on the developing of transverse rolls.

References

Dumoulin, C., Doin, M. P., & Fleitout, L. (1999). Heat transport in stagnant lid convection with temperature- and pressure-dependent Newtonian or non-Newtonian rheology. Journal of Geophysical Research: Solid Earth, 104(B6), 12759-12777.

Li, C. F., Wang, J., Lin, J., & Wang, T. (2013). Thermal evolution of the North Atlantic lithosphere: new constraints from magnetic anomaly inversion with a fractal magnetization model. Geochemistry, Geophysics, Geosystems, 14(12), 5078-5105.

Solomatov, V. S., & Moresi, L. N. (2000). Scaling of time-dependent stagnant lid convection: Application to small-scale convection on Earth and other terrestrial planets. Journal of Geophysical Research: Solid Earth, 105(B9), 21795-21817.