Geophysical Research Abstracts
Vol. 21, EGU2019-15730, 2019
EGU General Assembly 2019

The Global Consequences of a Weaker Asthenospheric Sub-Layer on Plate and Trench Motions at Subduction Zones.

Roberta Carluccio, Louis Moresi, Fabio Capitanio, Boris Kaus, and Ting Yang
The University of Melbourne, Australia (rcarluccio@student.unimelb.edu.au)

A range of recent geophysical studies report the presence of a thin layer at the lithosphere-asthenosphere boundary (LAB) underneath subducting oceanic plates at some of the edges of the Pacific plate. At these localities seem to correspond a of ultra-low seismic velocity and high electrical conductivity zone. This has been interpreted as being weaker and thinner than the underlying asthenospheric mantle. Despite these observations, the role of a sub-asthenospheric layer on the dynamics of subducting oceanic plates has remained unclear, as well as deciphering information on its later extent. The ability to detect and distinguish whether these narrow channels constitute a global or a regional feature at the base of the lithosphere has been hindered by the complicated nature of this boundary and by a trade-off that exists between resolving power and regional extent of seismic studies. Further, reproducing the dynamics of fast moving plates and slow moving trenches, such as those at the edge of the Pacific plates, have also proven numerical difficulties. With the aim of reconciling observations and numerical models, we use 2D and 3D visco-elastic-plastic numerical models of subduction to explore the implications of the asthenospheric structure on the evolution and deformation of slab morphology, dip angles, plate and trench motions. In our models, we vary the physical properties and the geometrical extent of the weaker asthenospheric layer at the base of the oceanic lithosphere. Our results show that the presence of weaker asthenospheric sub-layer has the potential to affect the dynamics of subducting oceanic plates and it also improves our numerical ability to match with natural observations at the global scale. We use these results to build a regime diagram that shows the relationship between the relative effective stiffness of the lithsophere, the pattern of deformation for the slab and the subduction partitioning. These effects are maintained in a 3D geometry, which suggest that this mechanism has also the potential to affect subduction dynamics at the global scale.