EGU22-8441
https://doi.org/10.5194/egusphere-egu22-8441
EGU General Assembly 2022

Detailed Structure of the South American Cratons Using Waveform Tomography

Bruna Chagas de Melo[1], Sergei Lebedev[1,2], Nicolas Celli[1], and Marcelo Assumpção[3]
[1]Dublin Institute for Advanced Studies, Cosmic Physics, Dublin, Ireland (bmelo@cp.dias.ie)
[2]Department of Earth Sciences, University of Cambridge, Cambridge, United Kingdom
[3]Instituto de Astronomia, Geofísica e Meteorologia, Universidade de São Paulo, São Paulo, Brasil

South America presents a diverse tectonic set-up, with an active subduction margin on the western border and a stable continental interior to the east. In the ancient stable part, two main cratonic domains can be separated. The Amazonian, consolidated in Archean-Paleoproterozoic times, and the Brasiliano, marked by Neoproterozoic events related to the West Gondwana assembly. In each domain, geology and geophysical methods separate different cratonic nuclei. However, some nuclei's detailed lateral and vertical extent and even existence are debated.

In seismic tomography, we can define regions of cratonic lithosphere due to the shear wave sensitivity to temperature and composition. However, until recently, seismic data sampling in South America was highly scarce and uneven. Here, we assembled all freely available seismic data globally, with the addition of the FAPESP "3-Basins Thematic Project" temporary network. After selecting all paths crossing the hemisphere centred at South America and performing an automatic outlier rejection, we obtain a massive dataset of ~1 million waveform fits, constraining our final model.

We compute a new S-velocity tomographic model of the upper mantle of South America and surrounding oceans using the Automated Multimode Inversion of surface, S- and multiple S-waves. The increase in the data coverage of the model combined with the optimized tuning of the inversion parameters on the continent allows us to identify for the first time the fine details present in the cratonic structure. We observe that regions of thinner lithosphere inside cratons correspond to areas of rifting in previous tectonic cycles. Inside the boundaries of the Amazon craton, we image two cratonic blocks, separated by the Amazon basin. In this area, an aborted rift system preceded the formation of the Amazon basin in the Neoproterozoic, and rift reactivation occurred with the break-up of Pangea in the Mesozoic. Similarly, in the São Francisco Craton, we image a significantly thinner lithosphere in the Paramirim Aulacogen area, a Paleoproterozoic intracontinental rift system. These observations show that the continental lithospheric topography is closely related to upper mantle dynamic processes. We also image high-velocity lithospheric blocks under sedimentary basins. East of the Amazon craton, we image a high-velocity anomaly beneath the Parnaíba block, and under the Paraná basin the fragmented Paranapanema block lithosphere. Finally, by imaging the boundary of the cratonic units in detail, we can observe that

magmatic events and large igneous provinces are distributed around the thick roots of the cratons, where the lithosphere is thinner.