Lithospheric velocity structure between the mid-Atlantic ridge and Brazilian passive margin

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Abstract

Brazilian continental margin gained attention in the last decade due to the discovery of very large and deep subsalt structures that were proven to hold extraordinary exploratory potential in hydrocarbon research. To understand their evolution and how they contribute to the salt generation process, it is necessary to develop detailed geodynamics models of the passive margin, that must simulate the whole process associated with the opening of the Atlantic ocean and each involved stage. While many different models could be created, considering different boundary conditions, it is important to bound the best solution by additional known parameters, being one of these, the lithosphere thickness. The oceanic deeper structures in the southern part of the Brazilian margin are poorly investigated by seismological methods, mainly because of the lack of seismic stations in the desired study area. In this work, we proposed to study variations in the lithospheric velocity structure along the Brazilian passive margin using surface waves, generated by mid-Atlantic ridge events, recorded by 23 stations of the Brazilian Seismographic Network, mainly located along the margin. PREM model synthetic tests show that varying the lithosphere thickness between 30 and 220 km, can generate up to 2% velocity variations in the final observed group dispersion, mainly for periods longer than 20 seconds. The most challenging aspect of the proposed work is that we would like to fit those such differences in the dispersion curves between pairs of stations. For that, we collect >350 teleseismic events of magnitude greater than 5.0M that occurred at the mid-Atlantic ridge in the period from 2011 to 2022. All the analyzed stations belong to the National Observatory (in Rio de Janeiro). Comparing initial dispersion curves for periods between 10 and 100 seconds, it is observed a velocity variation, according to the seismic ray paths; those that have propagation paths along young oceanic lithosphere show a greater velocity on lower periods and slightly lower velocities on larger periods, by approximately 3%, while those traveling on aged lithosphere show a dispersion profile close to PREM . More important, comparing the dispersion curves obtained from a set of events at the ridge, traveling parallel to the opening direction, and comparing dispersion curves at stations RIB01 and PET01 (-20°S and -25°S) we did not observe any variation for periods lower than 40s, but station RIB01 show a reduced velocity for periods larger than 40-50 s. Once all the data are processed, we pretend to invert it, taking advantage of the geometry of the mid-ocean ridge where we expect a more homogeneous model close to the ridge, and a differentiation with age. We expect to obtain different 1D velocity models for each pair of events and stations, that will be interpreted and linked with geological and geophysical information already existent. The first results are intended to be shown at the 18th Congress of the Brazilian Geophysical Society.