Anisotropy of the Upper Mantle South American Intraplate

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Abstract

A seismic anisotropy study is an investigation into how a physical property changes depending on the direction in which it interacts with a body. In the upper mantle, this concept relates to how seismic wave propagation speeds vary when interacting with different materials. This particular study focuses on understanding upper mantle anisotropy in Brazil, particularly in relation to the flow patterns of the asthenosphere around the Amazonian craton. By employing advanced seismic analysis techniques and utilizing regional data, the study aims to uncover the relationship between geological structures and seismic wave properties. The findings reveal a significant correlation between upper mantle anisotropy and asthenospheric flow patterns. In the Amazonian craton, the study found average values of φ (phi) and δt (delay time) to be 90.23 ± 10.78 and 0.76 ± 0.15, respectively. For the São Francisco craton, these values were 109.17 ± 14.25 and 0.67 ± 0.16. In the Paraná Basin, the values were φ of 84.52 ± 12.23 and δt of 0.88 ± 0.23, while the Ribeira Fold Belt presented values of φ of 85.26 ± 6.89 and δt of 1.02 ± 0.4. The Tocantins Province showed values of φ of 89.33 ± 1.95 and δt of 1.28 ± 0.09. The Chaco-Paraná Basin exhibited φ of 102.45 ± 12.59 and δt of 0.97 ± 0.19, and the Paranaíba Basin had φ of 94.62 ± 18.17 and δt of 0.71 ± 0.35. Visualization of variations in primary waves at the Moho (Hess et. al, 1964) demonstrated that the analysis of shear wave splitting has significant potential for investigating past events and visualizing current asthenospheric flow patterns. The data for this study were obtained from the University of São Paulo (USP) network through the FDSN request, with stations available in the Brazilian Seismographic Network (RSBR). A total of 72 stations and over 1700 data points were analyzed, providing new parameters for seismic anisotropy studies and updated maps. The results indicate that the stable South American plate exhibits fast polarization in the East to NNW-SSE direction, while the cratons maintain a more NNW-SSE orientation. The Chaco-Paraná Basin reflects the influence of the stable part of the basin. In terms of delay time, fold belts exhibit higher values compared to cratons, which have lower values.