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Preliminary shear-wave splitting analysis in the Carajás Mineral Province area

André Nascimento (Observatório Nacional), Marcelo Rocha (University of Brasília), Marcelo Assumpção (Universidade de São Paulo), Giuliano Sant'Anna Marotta, Estevão Tadeu (University of Brasília), Paulo Azevedo (Federal University of Western Pará), Cintia Trindade (Federal University of Western Pará), Meijian An (Chinese Academy of Geological Sciences), Mei Feng (Chinese Academy of Geological Sciences)

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Shear-wave splitting provides unambiguous evidence for the existence of anisotropy within the Earth. Measurements of upper-mantle anisotropy, in turn, provide some of the best constraints on both past and present deformation and flow inside the Earth. The inherent difficulty in deploying seismic stations in the Amazon rainforest makes the Amazonian craton one of the worst seismologically sampled areas in stable South America, despite its mineral significance. However, this situation is now improving in the eastern Amazonian craton thanks to a temporary network (7A) deployed in the Carajás Mineral Province (CMP) between October 2021 and March 2024, funded by Vale S. A.. Here, we analyze teleseismic core-refracted shear-wave phases (XKS phases) at 30 stations from the 7A network to determine fast polarization directions and delay times for the upper mantle beneath the CMP and neighboring tectonic provinces. The XKS phases are measured from earthquakes with magnitudes greater than 5.8 Mw and epicentral distances between 85º and 180º. Overall, our results show fast polarization directions in the CMP are roughly E-W, parallel to the absolute plate motion direction given by the hotspot reference model HS3-NUVEL-1A. Moreover, we find that the fast polarization direction beneath station VL29, located in the western portion of the Parnaíba basin, differs the most from the general pattern observed below the other stations, which might be indicative of mantle flow deviation around the keel of the Amazonian craton, as suggested by previous studies. Finally, we also notice that the average delay time (i.e., anisotropy strength) is around 0.7 s, lower than the average continental delay time of 1 s. The mechanism behind this seemingly weak anisotropy in the mantle beneath the CMP remains to be investigated, although a possible explanation could be that the symmetry axis representing the aggregate of anisotropic minerals is subvertical, hence reducing the observed amplitude of azimuthal anisotropy.