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Textural and microstructural development of the Barro Alto Complex: implications for seismic anisotropy

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Crustal rheology is associated with the behavior of its constituents in response to stress and strain, while the seismic anisotropy is a property that can correlate these parameters. Seismic properties are strongly related to the microstructures and crystallographic preferred orientation (CPO) of the rocks. In this work, we study CPO-derived seismic anisotropy of metamorphosed gabbro-norites from the Barro Alto (Brazil central) layered complex. The EBSD technique was employed to analyze the crystallographic orientation of the main mineral assembly, diopside and feldspar. The Barro Alto complex belongs to the Tocantins Structural Province, developed between the Amazon and São Francisco cratons, during the Neoproterozoic Brasiliano orogenic cycle. This complex was formed by a mafic-ultramafic layered intrusion mylonitized and metamorphosed under granulite facies conditions. The mylonitic foliation shows compositional segregation into felsic and mafic bands. The samples are composed of porphyroclasts of plagioclase and diopside in a fine matrix of plagioclase, clinopyroxene, orthopyroxene and, less commonly, amphibole and biotite. The plagioclase porphyroclasts exhibit undulose extinction and core-mantle structure. In fine matrix samples the poles to a(100), b(010) and c(001) are randomly distributed in both phases. However, for increasing matrix grain size plagioclase grains shows maxima of a(100) poles sub-parallel to the foliation and b(010) normal to the foliation. The low value of the J index (2.4 for plagioclase and 1.8 for diopside) indicates poorly developed fabric. Misorientation profiles showing high frequency of small angle boundaries are typical of recrystallization by subgrain rotation mechanisms. The microstructural and CPO analyses suggest deformation controlled by diffusive processes. The CPO models were compared to models described in the literature, based on the anorthite + diopside assembly, since these are the major phases, and thus control the seismic properties of the aggregate. The CPO of plagioclase can then be classified as Type P, intermediate between plastic deformation and magmatic flow. The seismic anisotropy patterns presented low value of P-wave velocity (Vp), being the fast velocity direction perpendicular to the foliation, while the S wave anisotropy is extremely low (1.1 to 3%). The mineral assembly and the deformation mechanisms played a major role in the resulting patterns of seismic propagation by reducing the anisotropic behavior of these rocks, creating patterns similar to those found in an isotropic media.