DEFORMATION MECHANISMS AND SEISMIC ANISOTROPY IN GABRO-NORITES FROM THE BARRO ALTO COMPLEX

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ABSTRACT: Crustal rheology is associated with the behavior of its constituents on relation to stress and strain, while the seismic anisotropy is a property that can correlate these parameters. The seismic properties are strongly related to the microstructures and the crystallographic preferred orientation (CPO). In this work, we analyzed metamorphosed gabbro-norites from the Barro Alto (Brazil central) layered complex, by optical and scanning electron microscopy means, aiming to characterize the microstructures of those rocks. The EBSD technique was employed in order to analyze the crystallographic preferred orientation of the main mineral assembly, diopside and feldspar. The Barro Alto complex belongs to the Tocantins Structural Province, developed between two stable areas, the Amazonic and the São Francisco Cratons, during the Neoproterozoic Brasiliano Orogenic Cycle. This complex was formed by a mafic-ultramafic layered intrusion millonitized and metamorphosed under granulite facies. The MTEX toolbox for MATLAB™ software was used to analyze the CPO and seismic profiles. We analyzed the pole figures, misorientation histograms and index of texture intensity (J index) aiming to better describe the resulting CPO patterns. The seismic profile was calculated by the Voigt method, given by the equation:

$C_{ijkl} \approx C_{Voigt} = [\Sigma_i V_i\ C\ (_{gi})]$

This method assumes that the strain field is constant, therefore the local stiffness (C_{ijkl}) can be calculated using the crystallographic orientations (gi), the elastic constants of the single crystal and the volume fraction (V_i) for each phase.The mylonitic foliation shows compositional segregation in felsic and mafic bands. The samples are composed by porphyroclasts of plagioclase and diopside in a fine matrix of plagioclase, clinopyroxene, orthopyroxene and, less commonly, amphibole and bioitite. The plagioclase porphyroclasts exhibit undulose extinction and core-mantle structure. The CPO models were compared to the 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. In the fine matrix samples the poles normal to a(100), b(010) and c(001) are distributed randomly in both minerals. However, for increasing grain size in the matrix, 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 to plagioclase and 1.4 to diopside) indicates poorly developed fabric. Misorientation profiles showing large number 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 of plagioclase can then be classified as the Type P, intermediary pattern 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 2.4%). 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.

KEY WORDS: PLAGIOCLASE, DEFORMATION, EBSD.