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Characterization of magmatism and deformation in "Foz do Douro Metamorphic Complex" (N Portugal): insights from AMS studies

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The "Foz do Douro Metamorphic Complex" (FDMC) is situated on the shoreline of Porto extending along ∼3km series of small beaches. The geology of this zone is marked by magnificent outcrops of a thin band of Precambrian metamorphic rocks intruded by Variscan granites and by the effects of Porto-Tomar-Ferreira do Alentejo, N330º a N340º, dextral, shear zone [1,2]. The metamorphic band is represented by outcrops of metasedimentary rocks, spatially associated to different types of orthogneisses and amphibolites that constitute the FDMC [3]. The granites belong to a late-Variscan granite group (298±11Ma) [4]. Studies of Anisotropy of Magnetic Susceptibility (AMS) were carried out on several types of orthogneisses and amphibolites from the FDMC, as well as on the Variscan granites and tonalites. The results presented here are related to 218 samples collected on 21 sampling sites: 6 sites (n=67) on leucocratic orthogneisses (Group 1), 10 sites (n=99) on biotite orthogneisses (Group 2), 1 site (n=11) on amphibolite (Group 3), 1 site (n=11) on biotite granite (Group 4), 2 sites (n=20) on biotite porphyritic granites (Group 5) and 1 site (n=10) on tonalite (Group 6). Magnetic anisotropy, expressed by the ratio Kmax/Kmin, ranges from 1.045 to 1.144 in Groups 1, 3, 4 and 5 and from 1.139 to 1.297 in Groups 2 and 6. The magnetic fabric is characterized by subvertical magnetic foliations in all lithologies with directions varying from N41º to N86º in Groups 1 and 2, N0º to N10º in Group 3, N80º to N90º in Group 6 and N130º to N140º in Groups 4 and 5, and mainly subvertical magnetic lineations dipping 50º to 86º in Groups 1 and 2, 77 to 80º in Group 3, 75º to 80º in Group 5 and 65º to 70º in Group 6, with the exception of 3 orthogneisses (one belonging to Group 1 and two from Group 2) and two granites (one belonging to Group 4 and one to Group 5) which reveal subhorizontal (04º to 36º) magnetic lineations. Magnetic susceptibility (K) ranges between 20.0 and 74.3 x 10-6 SI in Groups 1 and 4, which indicates a paramagnetic behaviour of these lithologies due to the presence of minerals, such as biotite and ilmenite. In Groups 2, 3, 5 and 6, K present values > 10-3 SI which indicates the presence of magnetite (0.12 to 1.49 x 10-3 SI in Group 2 and averages of 0.58 x 10-3 SI in Group 3, 0.22 x 10-3 SI in Group 5 and 1.0 x10-3 SI in Group 6). The anisotropy and magnetic fabric of the FDMC formations and of the granitic rocks are clear indicators of different styles of deformation on these rocks. The results confirm the field observations pointing out that this area was affected by intense deformation probably subjected to deformation partioning. K values indicate distinct types of magmatism: a oxidized type (magnetite type) (Groups 2, 3, 5 and 6) and a reduced type (Groups 1 and 4).

References

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