AMS studies in “Foz do Douro metamorphic complex" (N Portugal): preliminary insight

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Introduction

The “Foz do Douro Metamorphic Complex” (FDMC) is situated on the shoreline of Porto extending along a series of small beaches between the Douro river mouth and the “S. Francisco Xavier” Fort. The geology of this zone is marked by the presence of Porto-Tomar-Fereira do Alentjo, NNW-SSE dextral, shear zone and by magnificent outcrops of a thin band of Precambrian metamorphic rocks intruded by Variscan granites [1,2]. The metamorphic band is represented by outcrops of metasedimentary rocks, spatially associated to orthogneisses of different types and ages (606±17 to 567± 6 Ma) and amphibolites that constitute the FDMC [3]. The granites belong to a late-Variscan granite group (298±11Ma) [4].

A Anisotropy of magnetic susceptibility (AMS) study is being carried out in these several types of orthogneisses. In this work we present the first data obtained with 49 samples of leucocratic gneisses, some with garnet, and augen gneisses (Group 1) and with 15 samples of biotite-rich orthogneisses (Group 2).

Results and Discussion

Magnetic susceptibility (K) ranges between 20.0 and 72.3 x 10^{-6} SI in Group 1 orthogneisses which indicates a paramagnetic behaviour of this lithology, due to ferromagnesian minerals, such as biotite. However in Group 2 orthogneisses, K presents values > 10^{-3} SI (0.12 x 10-3 SI, in average) which enhance the presence of magnetite. These two distinct behaviours indicate two different types of Precambrian magmatism: a oxidized type (magnetite type) (Group 2) and a reduced type (Group 1).

Magnetic anisotropy, expressed by the ratio Kmax/Kmin, ranges from 1.052 to 1.144 in Group 1 orthogneiss and is higher (1.204) in the Group 2 gneisses. These values are typical of deformed rocks but the high anisotropy of the Group 2 orthogneisses also reflects the presence of magnetite. In both lithologies, magnetic fabric is characterised by subvertical magnetic lineations associated to subvertical E-W to ESE-WNW and NW-SE trending magnetic foliations, related to a shear deformation.

[1] Chaminé *et al*. (2003) *Cadernos Lab. Xeolóxicos de Laxe* **28**, 37-78. [2] Ribeiro *et al*. (2009) *C. R. Geoscience* **341**, 127-139. [3] Noronha & Leterrier (2000) *Revista Real Academia Galega de Ciências* **XIX,** 21-42. [4] Martins *et al*. (2011) *C. R. Geoscience* **343**, 387-396.

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The Role of Metal Redox Coupling Processes in Carbon Cycling and Stabilization

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The association of carbon with mineral phases has been increasingly recognized as a major stabilizing mechanism for protecting organic matter against microbial degradation in soils. Iron (Fe) and manganese (Mn) oxides are of particular importance because of their abundance in soils and high reactive surface area. Both Fe and Mn are susceptible to redox variability along landscape gradients. Reductive dissolution and transformation of Fe and Mn minerals governs the amount, form and transport of sequestered C. We have investigated Fe speciation as well as the composition of organic matter and its molecular interaction with soil minerals across hillslope transects within the Christina River Basin Critical Zone Observatory (CRB-CZO) to link iron-redox coupling processes with soil C cycling. Selective chemical extractions, X-ray absorption spectroscopy (XAS), micro-XAS techniques, and Mossbauer spectroscopy were employed to characterize soil Fe speciation. Applying scanning transmission X-ray microscopy (STXM) and carbon near edge X-ray absorption fine structure (CNEXAFS) spectroscopy, we mapped the spatial distribution of carbon and carbon forms, and imaged the association of organic functional groups with specific minerals in the soils. Ferrihydrite, because of its ubiquitous occurrence in the environment and its high surface area, contributes significantly to the sorption of organic matter and protects it against microbial degradation in soils and sediments. In addition, ferrihydrite often forms in the presence of dissolved organic matter in the natural environment, which leads to coprecipitation of organic matter with ferrihydrite. However, the extent and mechanisms of organic matter adsorption to or coprecipitation with ferrihydrite, and the consequences of such reactions for the properties of sorbed versus coprecipitated organic matter remain largely unknown. In this presentation, we compare adsorption and coprecipitation with dissolved organic matter from a forest litter layer. To examine the chemical fractionation of the organic matter and the mechanisms of organo-ferrihydrite complex formation associated with these two processes CNEXAFS and Fourier transform infrared (FTIR) spectroscopic techniques were employed. To study spatial distribution, macromolecular structure, and chemical composition of sorbed and coprecipitated OM at the nanometer-scale we used STXM. Data on the role of Mn in C cycling will also be presented. Such studies will enhance our understanding of OM stabilization mechanisms on soil mineral surfaces and will provide new insights on the metal-redox coupling processes affecting carbon cycling at soil/sediment-water interfaces.