Anisotropy of magnetic susceptibility field-dependence in Portuguese granites and gabbros

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Low-field Anisotropy of Magnetic Susceptibility (AMS) is one of the most adopted petrophysical properties in geology studies and is usually measured at field of 300 A/m. The Kappabridge KLY-4S (Agico) equipment is used to make an adjustment of the field amplitude and allows the magnetic susceptibility field-dependence to be researched. In this study the AMS field-dependence was investigated by undertaking measurements in ac-fields, from 2 A/m to 450 A/m in 21 steps, at 875 Hz, on standard cylinders (2.5 cm diameter and 2.2 cm height). The studied rocks samples belong to the Lavadores variscan granites (298±12, 3 Ma [1]) and to Sines late cretaceous gabbros (72-75 Ma [2]), both having magnetite.

The average magnetic susceptibility obtained at 300 A/m was $13.42\text{x}10^{-3}$ SI and $86.53\text{x}10^{-3}$ SI respectively for granites and gabbros. When using the field-dependence parameter χHd (%)=$[(k_{300}\text{A/m}-k_{30}\text{A/m})/k_{300}\text{A/m}]\text{x}100$ [3], our results show a weak field-dependence, 0.6% and 0.8% for granites and for gabbros. However the magnetic anisotropy factor $((k_{max}/k_{int}-1)\text{x}100)$ was increased at higher fields in both rocks and a strong linear relation existed between the two parameters. Comparing the anisotropy factor obtained at 2 and at 450 A/m there is a difference of 3% which can be significant when one establishes the relation between the intensity of rock deformation and the magnetic anisotropy factor. It was also observed that the orientation of the three main axes of the AMS ellipsoid and its shape are insensitive to the different applied fields. Our results point out the influence of the magnetic fabric on the field-dependence as some authors have already demonstrated [4]. Magnetic anisotropy which is due to the magnetic grains alignment may interfere with the field-dependence, depending on the orientation of the applied field relatively to the main axes of the AMS ellipsoid.

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Geochemical analysis of altered seafloor lavas hosting extensive microbial communities

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Young lavas exposed at the seafloor harbor diverse and abundant microbial communities [1]. The supply of labile organic carbon sources is seemingly limited in this cold, light-deprived environment, prompting questions regarding the energetic underpinnings of these communities [2]. Redox reactions involving reduced, inorganic compounds provided by volcanic lavas and by distant hydrothermal venting could theoretically support a substantial biomass [3]. Indeed, a recent study [4] demonstrated that a microbial biome exists in ferromanganese crusts coating unaltered, seafloor lavas – linking biomass production to hydrothermally-derived energy sources. Communities supported directly by basalt alteration processes are difficult to establish because the initial processes and mechanisms controlling low-temperature alteration in the environment are not fully elucidated

Here we present the results of spatially-resolved, micrometer-scale geochemical analyses of young, slightly-altered seafloor lavas from the East Pacific Rise at 9°N. We employed synchrotron-based techniques including: (1) X-ray fluorescence (XRF) to map the chemical distribution and co-occurrence of several geochemically relevant elements (e.g. Fe, Mn, Ca, Si, and K), and (2) extended X-ray absorption fine structure (EXAFS) to identify the structure and speciation of alteration products and mineral accumulations. Our data show the presence of Fe-rich clays lining the surfaces of fresh glass in the alteration rind. Additionally, we observed isolated patches of Fe-oxides and oxyhydroxides and Mn-oxide minerals both filling the fractures and accumulating on the surfaces exposed directly to seawater. These spectroscopy data will allow us to better understand the processes involved in low-temperature alteration of basalt glasses, a process which could support a significant microbiological community.

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