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Testing a new approach to differentiate oxidation degree from the primitive composition of titanomagnetites from oceanic basalts

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Low-field magnetic susceptibility as a function of temperature – χ(T) is one of the most powerful techniques to assess the main magnetic mineralogy of rocks from distinct geological settings. For the specific case of titanomagnetite solid solution, the dependence of Curie temperature (Tc) on their composition and oxidation degree imposes limits to the application of thermomagnetic methods as a tool to assess independently one of the variables, i.e. the pristine composition and/or quantification of the oxidation degree. In order to overcome this ambiguity several authors resorted to independent methods, like microprobe, scanning electron microscopy (SEM) and transmission electron microscopy (TEM) analyses. The study here presented seeks to establish a new approach able to correlate the oxidation degree with Tc variations of partially oxidized submarine basalts, only supported by the thermomagnetic analyses conducted between -190ºC and 650ºC. 40 thermomagnetic signatures were evaluated along cross-section profiles of four pillow-lavas, sampled from the Mid-Atlantic Ridge and from the Terceira Rift (Azores plateau). For each one a lamellae with a thickness of 2 to 3 mm was collected along each centimeter of the profile. All the experiments were made using the same experimental conditions (atmosphere, heating rate). Our thermomagnetic curves of partially oxidized oceanic basalts are characterized by a peak of susceptibility between 300-350ºC and 520-550ºC, which mostly results from the inversion of the thermally metastable titanomaghemite into a complex multiphase intergrowth. From our experiments, we were able to obtain a good linear correlation (positive) between the amplitude of this peak and the Tc for each sample profile. Moreover, these results are well correlated with the oxidation degree determined by Mössbauer Spectroscopy analyses and with microscopic observations, which show an increase of oxidation degree towards the margins of the pillow lavas. Therefore, these results indicate that the method here conducted could provide an important approach to assess more accurately the main pristine composition of basalts Fe-Ti oxides and permit a qualitative inference of oxidation degree. The author wish to acknowledge REGENA (PTDC/GEO-FIQ/3648/2012) project for its major contribution without which this work wouldn't be possible. Publication supported by project FCT UID/GEO/50019/2013 - Instituto Dom Luiz.