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Electric transport in different granitic rocks

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Many studies are being done to understand acoustic to electromagnetic conversion in rocks, [1], mainly because of the so-called seismo-electromagnetic phenomena (SEMG). Nevertheless, to our knowledge, most of them disregard a preliminary analysis of the electrical transport occurring in these rocks. These are, in fact, crucial to understand any electromagnetic process occurring in the materials since they clarify the transport mechanism (typically in rocks it is ionic, but it could also be tunnelling, among others), the energies involved (typically $\sim$1-100 meV), charge accumulation effects, and many other aspects. Thus, we believe that it deserves more attention by researchers.

The objective of this work is, indeed, to initiate a detailed analysis of the electrical transport in various rocks using our experience with other materials [2]. As a start three different granitic samples with different mineralogical content have been studied: the first is a coarse grained biotitic granite, yellow coloured and characterized by an abundance of large feldspar megacrystals usually showing poorly defined shapes, the second is a quartz diorite grey coloured and medium grained rock with homogeneous appearance, dominantly biotitic, and the third is a medium grained homogeneous pophyroid granite, with light rosy colour determined by the tonality of the feldspar crystals that stand out from a greyish with matrix containing dark grains. Moreover, granites are abundant in the lithosphere and should, in principle, play a fundamental role in (SEMG).

Circular samples with approximately 24 mm diameter and 2-4 mm in thicknesses were prepared. Once cut and carefully polished (with a 15μm polishing disc) the samples here heated from room-temperature up to $\sim$400 K and after cooled down again. Circular electrodes with a diameter of 20 mm were then established using silver conductive paint. The samples were submitted again to a heat treatment at $\sim$400 K to evaporate the silver paint solvent. After this preparation procedure the samples were attached to a sample holder and inserted in a bath cryostat.

Moreover, the focus of this work is to elucidate the effect of confined water in the electrical transport properties for temperatures ranging from 80 K up 400 K. The presence of confined water was observed through an anomaly in the dielectric behaviour near T $\sim$ 220K. This temperature is typical of the super-cooled phase transition of strongly confined water affecting electronic devises [3]. Thus, in this work we explore this anomaly in the three different natural rock samples mentioned above. Other techniques used in the literature can also be considered like thermal stimulated depolarization current [4] to characterize transport mechanisms.

References

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