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Low-temperature dielectric measurements of confined water in porous granites

Hugo Gonçalves da Silva (1), Pedro Prezas (2), Ana Vinagre (3), Manuel F. Graça (2), Jorge H. Monteiro (2), Mouhaydine Tlemçani (1,4), Patrícia Moita (1,3), António Pinho (3,5), Mourad Bezzeghoud (1,4), Sushil K. Mendiratta (2), Rui N. Rosa (1,4)

(1) Geophysics Centre of Évora, University of Évora, Portugal, (2) University of Aveiro, I3N-Physics Departament, Portugal, (3) University of Évora, Geosciences Departament, Portugal, (4) University of Évora, Physics Departament, Portugal, (5) GeoBioTec Research Centre, University of Aveiro, Portugal

Three different granitic rocks extracted from Évora (in the south of Portugal) where used to perform dielectric measurements in the frequency range from 100 Hz to 1 MHz and temperatures $100 - 350$ K. Thin cylindrical samples were prepared and circular electrodes were established using silver conductive paint. A clear anomaly appears, for T $\sim 200 - 220$ K, in the dielectric measurements of the samples studied. This anomaly occurs in different materials and coincides with a phase transition of supercooled water. Tightly bounded water confined in the pores of the rock do not crystallize at 273 K, but form a metastable liquid down to $200-220$ K increasing water polarization. Below this temperature water molecules solidify and polarizability decreases. The rock presenting the most sizeable anomaly has a very low specific surface area, ~ 0.09 m^2g^{-1}, and connected porosity, ~ 1.10 %. In addition, geochemical analyses reveal almost inexistence of water molecules in its structure confirming the role of confined water in the anomaly. Comparison between saturated, oven dried, and vacuum dried samples is done. Finally, a logarithmic dependency of the critical temperature for the supercooled water phase transition with the measuring frequency is found.

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