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Electrical properties of gabbroic and troctolitic rocks from IODP Hole U1309D, Mid-Atlantic Ridge, 30

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Laboratory measurements were carried out to explore the electrical properties of gabbroic and troctolitic samples from Integrated Ocean Drilling Program (IODP) Hole U1309D, in the Atlantis Massif, an oceanic core complex located at 30°N along the Mid-Atlantic Ridge. Oceanic core complexes are presumably localized in portions of heterogeneous oceanic crust that are relatively rich in igneous rocks and are the locus of significant hydrothermal activity. Electrical properties are used in igneous rocks to discuss their porosity structure as a function of mineralogy, alteration processes, and deformation. Electrical properties of the gabbroic suites sampled during IODP Expeditions 304 and 305 can contribute to the understanding of these processes in the Atlantis Massif. Electrical properties are obtained from a suite of resistivity measurements at variable salinity of the saturating fluid.
We present the electrical data together with density and porosity measurements for 109 samples taken from the entire core recovered in IODP Hole U1309D. These include 7 oxide gabbros (oxide content > 2%), 72 gabbros and olivine gabbros, 14 troctolitic gabbros and troctolites, 16 olivine-rich troctolites (olivine > 70%). The linear decrease of the electrical formation factor, as well as an increase of surface conductivity with porosity, often observed for igneous rocks, is obtained here. However, this pattern is somewhat disturbed by samples that tend to have higher electrical surface conductivity and lower formation factor at fairly constant porosity (around 1 %). As a consequence, the electrical tortuosity tends to be more scattered, especially when abundant olivine and/or serpentine is present. Higher degrees of serpentinization do not significantly change the sample porosity, and tend to generate a simpler geometry of the porous network. 25 samples show a deflection at low pore fluid salinity, a behaviour ascribed to the occurrence of zeolites in previous studies. Small-scale downhole trends in electrical formation factor and electrical surface conductivity are larger than the calculated standard errors, and then correspond to actual downhole variations of some first-order controlling parameter(s) such as porosity or alteration.