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Characterizing ferrofluid properties for a more reliable and quantitative interpretation of magnetic pore fabric studies

Andrea Regina Biedermann[1], Michele Pugnetti[1], Yi Zhou[1], and Josep M Parés[2]
[1]University of Bern, Institute of Geological Sciences, Bern, Switzerland (andrea.regina.biedermann@gmail.com)
[2]CENIEH, Burgos, Spain

Magnetic anisotropy is a time-efficient and powerful tool to characterize the anisotropy of pore space in ferrofluid-impregnated rocks. Empirical correlations exist between magnetic pore fabrics and the shape preferred orientation of pores, as well as between magnetic pore fabrics and permeability anisotropy. Up to now, quantitative interpretation has been challenging, and one reason is the variability of ferrofluids and their properties that have been used in different studies. Namely, the susceptibility of the ferrofluid largely controls the degree of measured magnetic anisotropy. Being a colloidal solution of superparamagnetic particles, ferrofluid displays magnetic properties that are both frequency- and time-dependent. This in turn affects the quantitative interpretation of magnetic pore fabrics. This study sheds light on the magnetic properties of the ferrofluids used in pore fabric studies, with a particular focus on processes such as particle aggregation and sedimentation, and how these affect ferrofluid impregnation as well as the measured pore fabrics. Further, interactions between the ferrofluid and the rock that lead to changes in magnetic properties are studied. These results will form the basis for future quantitative interpretation of magnetic pore fabric studies in groundwater, CO2 or hydrocarbon applications.