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Pore space orientation and anisotropy of different lithologies

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Knowledge about physical rock properties are vital for a broad field of engineering applications within the construction industry, reservoir engineering or geothermal projects. For this study numerous methods had been used to derive information about the orientation of the pore space for different lithologies. Laboratory measurements of directional dependent parameters (permeability, electric resistivity, elastic properties and thermal conductivity) and other petrophysical properties had been carried out on plugs with 25 mm diameter and 22 mm length in dry and brine saturated conditions. Overall the data can be divided into four sample groups (carbonate, sandstone, igneous- and metamorphic rocks). In general the data can be divided into porous and non-porous rocks which are carbonate, sandstone and igneous and metamorphic respectively (with some outliers).

In addition for a broad range of samples measurements of the anisotropy of magnetic susceptibility (AMS) (Tarling and Hrouda, 1993) had been carried out. AMS data together with other petrophysical data was used to select suitable samples for the Ferrofluid (FF, magnetic fluid) impregnation method (Pfleiderer and Halls, 1990). This method uses magnetic properties of FF within the rocks pore space, to reveal information about the degree of anisotropy and the orientation of the pore space by AMS measurements. The magnetic properties of specific minerals within our samples can be divided into low susceptibilities ($< 10^{-3}$ SI) for diamagnetic- (quartz, calcite) and paramagnetic minerals (phyllosilicate) and high susceptibilities ($\geq 10^{-1}$ SI) for ferromagnetic minerals (e.g. hematite, goethite, magnetite; sensu lato including antiferromagnetic and ferromagnetic minerals). Usable for the FF impregnation method within our samples are those with reasonable porosities and low susceptibilities. Therefore suitable are bulk of carbonate and sandstone samples and some metamorphic quartzite samples. – Anisotropy indications from FF impregnation method are compared with anisotropy derived from directional measurements of prior permeability and specific electrical resistivity.

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