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Benchmark study using a multi-scale, multi-methodological approach for the petrophysical characterization of reservoir sandstones

Peleg Haruzi et al.

Correspondence to: Regina Katsman (rkatsman@univ.haifa.ac.il) and Matthias Halisch (matthias.halisch@leibniz-liag.de)

This Supplementary material contains two sections: S.1 – A link to a data repository with datasets related to the samples S1, S2, S3 explored in the paper; S.2 - Definition and explanations regarding Euler characteristic

Supplement Sect. S.1 - A link to a data repository with datasets related to the samples S1, S2, S3 explored in the paper

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Description:

The datasets contain:

1. One file with data for grain size analysis: grain_size_S1_S2_S3.xls. It includes data for samples S1, S2, S3 in 3 tabs.
2. Three files for mercury intrusion porosimetry: MIP_S1.TXT, MIP_S2.TXT, MIP_S3.TXT.
3. Three files for XRD analysis: XRD_S1.doc, XRD_S2.doc, XRD_S3.doc.
4. Data for porosity and permeability measurements for three samples: por_perm_S1_S2_S3.xlsx.
5. Three micro micro-CT image stacks for S1, S2, S3: S1_CT.zip, S2_CT.zip, S3_CT.zip

Supplement Sect. S.2 - Definition and explanations regarding Euler characteristic

The Euler characteristic is a number that describes the structure of a topological space. The most intuitive way to think about the Euler characteristic is in terms of its Betti numbers (β_i):

$$\chi = \beta_0 - \beta_1 + \beta_2$$

For a 3D object, β_0 is the number of components, β_1 is the number of inequivalent loops and β_2 is the number of cavities (enclosed voids). In describing the topology of the pore space of a porous rock, it can be assumed that the solid matrix is connected such that $\beta_2 = 0$. In this case, the Euler number reduces to the difference between the number of discrete components and the number of inequivalent loops. If all pore spaces are connected via one pathway or another and assuming that there are no isolated pore spaces, then $\beta_0 = 1$. In a pore network of sandstone that can be modeled as a bundle of tubes, the number of loops β_1 is large, and χ is negative. Therefore, the Euler number, χ, is related to the connectivity of the pore space. As the number of loops decreases, the Euler number becomes less negative and eventually becomes positive, where the system will no longer percolate, according to Vogel (2002).

Vogel, H.: Topological characterization of porous media, Morphology of Condensed Matter, 600, 75–92, **2002**.