Study of physical and petrophysical properties of Hamra Quartzites formation (Hassi Messaoud field, Algeria)

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In the Ordovician reservoir, the formation of Hamra quartzites is considered as a productive reservoir of oil around Hassi Messaoud field (Boudjema, 1987). This formation is little studied compared to Cambro-Ordovician sandstones. The Hamra quartzites, presented as a clean massive sandstone, are well developed, but the the reservoir quality is variable because of the diagenetic effects, their position with respect to the Hercynian unconfomity and the presence of fractures (Askri et al., 1995). In this work we studied the physical and petrophysical properties of core samples taken from Hamra quartzites formation in different oil wells located in Hassi Messaoud field.

The analysis of different types of fractures obtained by UBI and CBIL well imaging tools and well cores show the existence of three types of fractures (open, partially open and closed), with the dominance of partially open fractures. The global orientation of these fractures is NE-SW and NW-SE. These fractures are almost at the same direction as that found on rocks outcopping at Tassili des Ajjers. This type of fractures is considered to be of tectonic origin (Massa et al., 1972). Magnetic measurements were performed, such as (i) magnetic susceptibility vs. temperature giving information on magnetic phases, their thermal and mineralogical carriers, (ii) hysteresis loops and (iii) isothermal remanent magnetization at saturation (ARIs) showing that the high magnetic susceptibility areas are related to several magnetic minerals such as hematite, magnetite and pyrrhotite.

The thermal conductivity (TC) of the studied samples was measured using the optical scanning method (Popov et al., 1999). The studied core samples are cut into two parts: one for thermal conductivity, porosity and permeability measurements, the other for thin section preparation. The samples are dried for 72 hours in an electric oven at 37°C. The plane polarized light microscopy analysis is used to classify samples on cemented and uncemented grain sets. The first set contains 13 samples and the second includes 15 samples. The relation between thermal conductivity and physical parameters shows that the porosity increases with the decrease of the thermal conductivity. These results confirm that the porosity is the main factor controlling the thermal conductivity. Weak correlation coefficients are found between thermal conductivity, permeability and density. The cementation of grains has low effect on the relation between TC and physical parameters. The correlation coefficient between TC, porosity and density increases slightly in uncemented set.

The Radial Basis Function (RBF) neural network proves to be a successful tool to estimate the thermal conductivity from physical parameters. The high value of the correlation coefficient (R=0.983) between the thermal conductivity measured in laboratory and that estimated by RBF neural network shows the nonlinear relation between these parameters.

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