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Relationships between petrophysical, sedimentological and microstructural properties of the Oolithes Blanche formation, a saline aquifer in the Paris Basin.

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The Paris Basin appears to be appropriate in terms of CO2 capture and storage when considering both the amount of CO2 produced and the availability of depleted fields and deep saline aquifers. The purpose of this study is to investigate the petrophysical properties in relation with the sedimento-diagenetic environment of the "Oolithe Blanche" formation (Dogger), a deep saline aquifer considered as a potential candidate for CO2 storage. Regarding the scarcity of the core data in the Paris Basin, our investigation was firstly based on the study of field analogs in the south-east of the Paris Basin.

The Oolithe Blanche Formation is composed of very shallow marine oolitic and bioclastic limestones, mainly grainstones. Three main sedimentological fabrics were defined: tide-dominated, wave-dominated (oolitic shoal) and prograding oolitic shoal fabrics. These three fabrics show subtle variations in composition (ooliths vs bioclasts) and in the distribution of the carbonate textures.

The Oolithe Blanche Formation (Bathonian) is 70-80 meters thick and water salinity ranges from 1 to 4 g NaCl/l. 18 oriented blocks were collected on outcrops selected for the different sedimentological facies recognised in the formation: 9 blocks in the Bierry Lès Belles Fontaines quarry (Yonne), 5 blocks in the Ravières quarries (Côte d'Or) and 4 blocks in the Massangis quarry (Yonne). On each block, several petrophysical properties were measured on three perpendicular plugs: porosity, pore size distribution derived from mercury injection tests, permeability, capillary imbibition parameters, electrical conductivity and acoustic velocities. The sedimento-diagenetic fabric and microstructural analysis was defined by using optical microscope and scanning electron microscopy, coupled with image analysis on thin sections.

The porosity measured using the water saturation triple weight method ranges from 6% to 34%. The permeability values are low, between 0.1 mD and 9 mD. The data from the mercury intrusion porosimetry show that the distribution of the pore-throat diameter is either unimodal (microporosity only) or bimodal (macro- and microporosity). The microporosity is intraparticles (intraoolitic) and macroporosity is interparticles and is related to processes of dolo-dedolomitization. Variations of the capillary imbibition parameters acoustic velocities and electric conductivity can be explained by the microstructure. So, our investigations show a relationship between the sedimento-diagenetic fabrics and the petrophysical fabrics. The variation of reservoir properties are mainly controlled by two microstructural characters : the cement (type, quantity and distribution) and the microporosity distribution inside the oolithe grains.
Now, these latter results calibrated by studying field analogs must be extended to bore-hole data and core data to optimize our knowledge of the deep saline aquifer of the Oolithe Blanche. Without these investigations, it will be impossible to estimate the good or poor quality of this deep saline aquifer with respect to CO2 storage.