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Digital Rock Characterization of Glacial Deposits to Refine Pore Systems

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This paper presents the results of the pore system digital characterization of glacial Upper Paleozoic clastic rocks in Saudi Arabia by employing high-resolution X-ray microscopy (XRM) and digital rock analysis workflows. Glacial sediments in this study are essentially devoid of clays and have undergone a complex burial history that manifests itself as a composite pore system. The objective of this study was to carry out detailed scans of selected plugs to better understand reservoir properties, i.e., porosity, permeability and pore throat sizes distributions.

Careful sample selection of representative facies was based on the screening of associated petrographic thin-section scans and X-ray diffraction mineralogy data of the main geological units. The digital rock physics (DRP) workflow deployed in this study includes high-resolution (10 microns) scanning of the rock samples with XRM, segmentation of the tomograms to identify pores and grain fabrics, building the pore network model and calculation of petrophysical properties. This workflow was used, not only to predict rock properties, but also for the spatial distribution of the rock features and pore network assemblages causing these properties. The end products of the workflow were verified with conventional core analysis data.

XRM revealed that grain dissolution vugs were fairly common in the bulk of the plugs, with very few clues of these features found on visual inspection on the surface of the plug. A feature of the vugs that could only be extracted from the MicroCT images were that they usually appeared flattened or deformed, but display well formed edges of the precursor clasts. This suggests induration of sediment before dissolution of clasts. The DRP demonstrated that the plugs exhibiting vuggy porosity are free of cement and have better porosity and permeability that make vuggy intervals prioritized exploration and development targets as they would contribute to extra storage capacity in zones where they occur. Fine grained sections of the plugs were associated to glacial flour which is an indicative texture and brings with it an influx of heavy minerals. This study was able to supply evidence of how the stratigraphy could be resolved using XRM.

As the glacial flour is made up of fine particles, these particles may be mobile when a well is put on production, which may reduce permeability and cause productivity issues. Identification of the glacial flour helps to refine well testing and production mechanisms. As yielded by DRP, vugs associated with studied rocks may also be a way of distinguishing glacial sediments, and impact storage capacity of the formation.

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Country

Saudi Arabia

References

Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

In person

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