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Sedimentological and Stratigraphic Controls on Natural Fracture Distribution in Wajid Group, SW Saudi Arabia

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The Cambro-Permian Wajid Group, SW Saudi Arabia, is the main groundwater aquifer in Wadi Al-Dawasir and Najran areas. In addition, it has a reservoir potentiality for oil and natural gas in Rub' Al-Khali Basin. Wajid Group divided into four formations, ascending Dibsiyah, Sanamah, Khussyayan and Juwayl. They are mainly sandstone and exposed in an area extend from Wadi Al-Dawasir southward to Najran city and deposited within fluvial, shallow marine and glacial environments. This study aims to investigate the sedimentological and stratigraphic controls on the distribution of natural fractures within Wajid Group outcrops. A scanline sampling method was used to study the natural fracture network within Wajid Group outcrops, where the natural fractures were measured and characterized in 12 locations. Four regional natural fracture sets were observed with mean strikes of 050o, 075o, 345o, and 320o. Seven lithofacies characterized the Wajid Group at these locations and include fine-grained sandstone, coarse to pebbly sandstone, cross-bedded sandstone, massive sandstone, bioturbated sandstone, conglomerate sandstone, and conglomerate lithofacies. We found that the fine-grained and small scale cross-bedded sandstones lithofacies are characterized by high fracture intensity. In contrast, the coarse-grained sandstone and conglomerate lithofacies have low fracture intensity. Therefore, the relative fracture intensity and spacing of natural fractures within Wajid Group in the subsurface can be predicted by using the lithofacies and their depositional environments. In terms of stratigraphy, we found that the bed thickness and the stratigraphic architecture are the main controls on fractures intensity. The outcomes of this study can help to understand and predict the natural fracture distribution within the subsurface fractured sandstone hosting groundwater and hydrocarbon in Wajid and Rub' Al-Khali Basins. Hence, the finding of this study might help to explore and develop the groundwater and hydrocarbon resources in the subsurface.