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Integrative Study of Sedimentological and Geomechanical Properties of Wajid Group Sandstone, SW Saudi Arabia

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SUMMARY

This study focused on the sandstones of Wajid Group in the outcrop in Wadi Al-Dawaser and Tathalith areas as an analogue of the groundwater aquifers and hydrocarbon reservoirs in Wajid and Rub' Al-Khali Basins. Wajid Group in the outcrop divided into four formations from the bottom up, Dibsiyah, Sanamah, Khussyayan, and Juwayl. The geomechanical and sedimentological properties of studied sandstones have been determined, and the relationship between these properties has been defined. The geomechanical properties of the studied sandstones were measured in the field using the Schmidt rebound hammer and in laboratories by the uniaxial compression test. And, the sedimentological characteristics of studied sandstones also described in the field and laboratories (thin section analysis). The uniaxial compressive strength (UCS) and the static Young's modulus of 81 sandstone samples were obtained. The result showed that Wajid Group can be divided into 27 mechanical units (Dibsiyah(18), Sanamah(2), Khussyayan(3) and Juwayl (4)). The geomechanical result revealed that the Dibsiyah and Khussyayan Formation display a similar geomechanical behavior, however, the Sanamah and Juwayl Formations are similar with mechanical properties values higher than Dibsiyah and Khussyayan Formations. Thus, this geomechanical similarity corresponding with similarity in depositional environments, where, the Dibsiyah and Khussyayan Formation deposited in fluvial to shallow marine environment, whereas, the Sanamah and Juwayl Formation deposited in glacial to the glacio-fluvial environments. the integrated results showed that the variation of the geomechanical behavior of studied sandstone mainly controlled by the percent of cemented materials. Thus, the increasing in the geomechanical values of studied sandstone is corresponding with increasing in cement materials percentage, and vice versa. The findings of this study will help to understand the geomechanical behavior of studied sandstone that hosting groundwater and hydrocarbon in Wajid and Rub' Al-Khali basins. Moreover, the results of this study can be used to predict the relative geomechanical behavior of studied sandstone in the subsurface based on their sedimentological characteristics. thus, This study will help to enhance the groundwater and hydrocarbon exploration in Wajid and Rub' Al-Khali Basins.

Abstract

This study focused on the outcrop of Wajid Group sandstone in Wadi Al-Dawaser and Tathalith areas. Wajid Group is the main groundwater aquifer in Wadi Al-Dawaser and Najran areas, and it serves as reservoirs for oil and natural gas in Rub' Al-Khali Basin. In the study area, Wajid Group divided into four formations from the bottom up, Dibsiyah, Sanamah, Khussyayan and Juwayl. The aim of this study is to characterize the geomechanical properties of the sandstone of Wajid Group and define their relationship with sedimentological characteristics. The geomechanical properties of the studied sandstone were measured in the field using the Schmidt rebound hammer and in laboratories by the uniaxial compression test. Moreover, the sedimentological characteristics of studied sandstone also described in the field and laboratories (thin section analysis). The uniaxial compressive strength (UCS) and the static Young's modulus of 81 sandstone samples were obtained. The result showed that Wajid group can be divided into 27 mechanical units (Dibsiyah(18), Sanamah(2), Khussyayan(3) and Juwayl(4)). The geomechanical result revealed that the Dibsiyah and Khussyayan Formation display a similar geomechanical behaviour, however, the Sanamah and Juwayl Formations are similar with mechanical properties values higher than Dibsiyah and Khussyayan Formations. Thus, this geomechanical similarity correspond with similarity in depositional environments, where, the Dibsiyah and Khussyayan Formation deposited in fluvial to shallow marine environment, whereas, the Sanamah and Juwayl Formation deposited in glacial to the glacio-fluvial environments. The integrated results showed that the variation of geomechanical behaviour of studied sandstone mainly controlled by the percent of cemented materials. Thus, the increasing in the geomechanical values of studied sandstone is corresponding with increasing in cement materials percentage, and vice versa. The findings of this study will help to understand the geomechanical behaviour of studied sandstone that hosting groundwater and hydrocarbon in Wajid and Rub' Al-Khali basins. Moreover, the results of this study can be used to predict the relative geomechanical properties of studied sandstone in the subsurface based on their sedimentological characteristics. Thus, This study will help to enhance the groundwater and hydrocarbon exploration in Wajid and Rub' Al-Khali Basins.