Diagenetic Controls on the Fracture Distribution within Sandstone Reservoir: A Case Study from Wajid Group, Southwestern Part of Saudi Arabia

Mohammed H. Benaafi[1], Mustafa M. Hariri[1], Abdulaziz Al-Shaibani[1], M Makkawi[1], and Osman M. Abdullatif[1]

[1]Geosciences Department, College of Petroleum Engineering & Geosciences, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia.

ABSTRACT

The distribution of natural fractures within sandstone reservoir depends on the variability in the sandstone properties. The diagenesis history of sandstone plays a key role in its mechanical behavior (rock strength and brittleness), and then the deformation pattern. This study aims to define the diagenetic controls on the spacing of the natural fractures within Wajid Group. Wajid Group is a groundwater aquifer in Wadi Al-Dawasir and Najran areas, and it is a potential hydrocarbon reservoir in Rub' Al-Khali Basin. 82 sandstone samples were collected from Wajid Group outcrops for petrographic analyses. Thin section, XRD, and SEM-EDX analyses have been conducted to define the diagenetic features of the studied sandstone. The fracture spacing was directly measured from outcrops by using the scanline method in five outcrop stations. The major diagenetic features of the Wajid Group sandstone include cementation (calcite and clay minerals), and dissolution of the feldspars and calcite cement. The result showed that the highly cemented sandstone displays small fracture spacing than the poorly cemented sandstone. Increasing in cement content lead to increase the sandstone strength and then decrease the fracture spacing. The result showed that the calcite-cemented sandstone displays high strength and small fracture spacing than the clay-cemented sandstone. The fracture spacing correlated with matrix porosity of studied sandstone, and the result showed that the sandstone with low porosity displays small fracture spacing than sandstone with high porosity. The dissolution of calcite cement and feldspars grains leads to increase the porosity of the studied sandstone and then increase the fracture spacing. Understanding the diagenetic history of the studied sandstone will help to predict the relative abundance of fractures within the equivalent hydrocarbon reservoirs in Rub' Al-Khali Basin. Therefore, this will help to enhance hydrocarbons exploration and production from the sandstone reservoirs in Rub' Al-Khali Basin.