Linking depositional environments and diagenetic processes to porosity evolution and destruction in the Arab Formation reservoirs, Offshore oilfields of Qatar

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Abstract

Using a multi-proxy approach based on core analysis, thin sections and log data from the Jurassic Arab reservoirs in selected wells in the offshore area of Qatar, the reservoir has been divided into a set of distinctive petrographic units. The Arab Formation consists of oolitic sediments of oolitic grainstone/packstone, foramifera-bearing packstone/wackestone, lagoonal mudstone and dolomite, alternating with anhydrite. The sediments underwent a series of diagenetic processes such as leaching, micritization, cementation, dolomitization and fracturing. The impact of these diagenetic processes on the different depositional fabrics created a complex porosity system. So, in some cases there are preserved depositional porosity such as the intergranular porosity in the oolitic grainstone, but in other cases, diagenetic cementation blocked the same pores and eventually destroyed the pores. In other cases, diagenesis improved the texture of non-porous depositional texture such as mudstone through intergranular cementation creating inter-crystalline porosity. Dissolution created new and old secondary porosity in otherwise non-porous foraminifera-bearing packstone and packstone. Therefore, creating a matrix of depositional fabrics versus diagenetic processes enabled the identification of different situations in which porosity was either created or destroyed. By correlating such petrographic data with logs, it will become possible to identify certain “facio-diagenetic” signatures on logs which will be very useful in both exploration and production studies.

1. The Jurassic Arab Formation reservoirs in the offshore oilfields of Qatar show a wide variation in the depositional environments in a relatively small area.
2. These rocks were subjected also to varied diagenetic processes that destructed partially or totally the original fabrics of the rocks and created new fabrics.
3. A matrix is developed between the depositional environments and diagenetic processes.
4. It is found that diagenesis was constructive in most of the time creating secondary porosity as it is the cases with bioturbation, dolomitization, and fracturing and destructive in the case of cementation.
5. By cross-plottting depositional fabrics versus diagenetic facio-diagnostic units can be recognized.
6. These units can be imposed on logs and used for exploration and production purposes.

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Conclusions

1. The Jurassic Arab Formation reservoirs in the offshore area of Qatar show a considerable variation in the depositional environments and the rock types of the Arab Formation. While the Well A and C show similar development of intertidal flats and lagoons, the Well B shows a more varied lithologies with the development of buildups formed of stromatoporoids and coral-agg association. Development of such buildups may be induced by the presence of some sub-marine highs resulted from the upward movement of the Hormuz Salt. This correlation on such a relatively small area gives indication about the scale of variation in both depositional environments and diagenetic process of the Formation.

2. Depositional cycles of the Arab Formation

3. Typical lithologies of the Arab Formation

4. Depositional environments of the Arab Formation (Stephens et al., 2009)