Modern Carbonate Depositional Systems of the Arabian Gulf in Saudi Arabia; Great modern analog for the Ancient Giant Reservoirs in the Middle East

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Abstract

The present Arabian Gulf is one of the best modern analogs of an arid climate carbonate system in the world. It represents a gentle homoclinal ramp that passes gradually into a relatively deep-water environment at the eastern part of the Gulf. The Arabian Gulf also represents a great modern example of an active foreland basin setting, where the Arabian Plate is collided and subducted underneath the Eurasian plate, forming Zagros mountains and the Arabian basin. Although the Arabian Gulf has been studied extensively in the region, little work has been done on this area, particularly along the shoreline of eastern Saudi Arabia. This paper aims to shed light on some of the key examples of modern carbonate and evaporite systems and compare them with the subsurface reservoirs. This comparison should lead to better understanding of the process that created these successions, thus will help on building more robust depositional systems and facies anatomies for building 3-D geological models and enhancing the reservoir characterization studies. Four main locations were investigated and studied, including the shoreline of Half-Moon Bay, Qurrayah peninsula, Uqair and Ras Tanurah beaches. Each location exhibits distinctive depositional and facies anatomies that are different from the other locations. For example, Half-Moon Bay is interpreted here as a semi-restricted lagoon with low energy beach sediment that passes landward into sabkhas and large sand dunes without tidal flat systems. The shoreline of Qurrayah peninsula is interpreted as a tidal flat complex system that changed basinward into an agitated lagoon first and then to a high energy grainstone barrier and finally into a deep-water environment. The landward side of the Qurrayah has some of the best examples of flat sabkha with evaporite systems that are surrounded by sand dunes and beach ridges. The Ras Tanurah shoreline shows different settings with a pronounced high energy that is directly open to the sea without a barrier or lagoon. This shoreline is dominated by modern ooids sands and grainstone beachrock. This grainstone is characterized by medium-sized, well-rounded, well-sorted grains associated with skeletal fragments. On the mainland, there are several sabkhas and patchy salt lakes that are not attached to the shoreline and extend North all the way to the Jubail Area. In this study, the modern Half-Moon Bay is defined as a good analog for the Late Jurassic Formations; the Qurrayah shoreline is interpreted to be an analog for the Permian Formation; and the Ras Tanurah shoreline is interpreted as an analog for the Middle Jurassic Formation. The Cretaceous analog, on the other hand, was not defined in the study area; however, there may possibly be a potential analog for it along the coral reef/barrier banks that are developed in the proximal offshore marine environments several kilometers away from the shoreline of Eastern Saudi Arabia.