

Integrating depositional facies and sequence stratigraphy in characterizing reservoirs potential of Chichali and Lumshiwal formations, Northwest Indus Basin, Pakistan

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Abstract

The early to middle Cretaceous Chichali and Lumshiwal formations are investigated for lithofacies and sequence stratigraphy to understand the relationship between strata deposition and reservoir quality in time and space. The study revealed that Chichali Formation consists of glauconitic sandstone, ferruginous sandstone and carbonaceous shale lithofacies and occasional limestone facies. Based on which a middle to outer ramp depositional environment is suggested for Chichali Formation. The overlying Lumshiwal Formation consists of white quartz arenitic lithofacies, bioclastic limestone facies and glauconitic sandstone lithofacies which resulted from delta front to inner ramp depositional setting. The XRD, SEM and EDS data revealed that hematite, illite, goethite and ferroan dolomite cement filled the intergranular pores in the Chichali Formation. Grain fracture porosity and dolomitization may have resulted into an increase in secondary porosity and thus adds to the reservoir potential of the Chichali Formation.

For Lumshiwal Formation, both physical and chemical compaction, authigenic mineralization, cementation, and late stage dissolution are commonly observed, that included calcite, ferroan dolomite, kaolinite, illite and quartz overgrowth cements. Dissolution porosity and late diagenetic dolomitization may have enhanced the secondary porosity to a greater level.

The sequence stratigraphic analysis revealed that Chichali Formation is deposited during Transgressive System Tract of 2nd order depositional cycle which is preserved in the form of carbonaceous shale and glauconitic sandstone lithofacies of middle to outer ramp depositional setting which is interpreted to have negative impact on reservoir quality of the formation, while the Low Stand System of 2nd order cycle is responsible for the deposition of Lumshiwal Formation, which in turn is subjected to marine flooding surfaces, within this LST that resulted in delta front depositional setting which has contributed to the formation of main reservoir unit of the Lumshiwal Formation.