Classification and Logging Identification of Diagenetic Facies of a Cretaceous Carbonates Formation in Southern Iraq: Implication for Reservoir Quality Prediction

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Abstract

Diagenesis is the geological process that controls the petrofacies of carbonate rocks after their deposition. Understanding diagenetic heterogeneity in carbonates is crucial for reservoir characterization. The carbonates of Middle Cretaceous Mishrif Formation is one of the richest oil-bearing strata in southern Iraq. It was deposited in a warm, humid climate, and between the shallow basin to supratidal belts. The Mishrif carbonates are characterized by complicated porosity types and poor correlation between porosity and permeability because various types of rock texture modified by multistage and multiple diageneses. Results from observation of thin sections, scanning electron microscopy and cathodoluminescence, and measurement of MICP and NMR demonstrate that the major diagenetic process affecting the petrofacies of the Mishrif carbonates are micritization, cementation and dissolution, followed by the mechanical and chemical compaction and weak dolomitization. Six diagenetic facies assemblages were classified according to comprehensive analyses of the primary rock texture, diagenetic types, sequences and end products. The diagenetic facies assemblage was up-scaled by correlation with wire-line log responses and a model based on cross plots of well logs was built. For example, Bioclastic dissolution, micritization and fragmentation facies in grainstones contributed to the formation of interparticle porosity with

porosity ranging from 24.2%-29.8%, and permeability ranging from 62 mD-1618 mD, and macro size of pore-throat. It can be identified by low bulk density (RHOB), high acoustic travel-time differences (DT) and low gamma-ray (GR). The logging model is validated by blind testing log-predicted diagenetic facies against petrographic features from core samples of the Mishrif Formation, which indicates it is a helpful predictive model. which can facilitate prediction of reservoir quality at a field-scale. This study suggested that diagenesis facies assemblages have good correspondence with reservoir quality. Classification and logging identification of the diagenetic facies is of great significance to reservoir quality prediction at a field scale.

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