Investigating the Correlation between Reservoir Electro-Facies and Distinct Geomechanical Units, Iranian Carbonate Gas Reservoir

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Abstract

Geomechanical characteristic of reservoir formations is one of the key factors to propose, design, and operate the almost all reservoir development plans such as directional drilling and reservoir stimulation. Prior to obtaining the geomechanical parameters by experimental tests, taking sufficient plugs which cover most of the mechanical variabilities through the desired investigating interval is crucial. In this regard, making a good linkage between pre-defined reservoir electro-facies and distinct geomechanical units (GMUs) is so advantageous.

The current study has been carried out on an Iranian carbonate gas reservoir with more than 400 meters thickness to evaluate the connection between GMUs and geological facies. First, non-destructive Schmidt hammer test was performed through the whole coring interval (400 meters) by 30 centimeters spacing. Second, reservoir electro-facies initially were defined by conventional well log interpretations and then verified by evaluating more than 1600 prepared thin sections (~25 centimeters spacing). Finally, the linkage between Schmidt hammer readings and defined electro-facies were assessed to obtain the proper number of GMUs.

Based on the extensive thin section studies and well log interpretations, five distinct electro-facies (five classes) are defined through the reservoir carbonate formation. Plotting the Hammer rebound values versus defined electro-facies revealed good concordance between them. In this regard, Hammer rebound values were divided into five groups by cluster analysis. Although a bit of discordances were seen especially in the boundary of some defined groups based on the Hammer rebound with electro-facies classes. The number of groups, the order of group occurrences, and the length of each group have good agreements with electro-facies classes. As a conclusion, defining the electro-facies based on the well logs and thin section studies can be a practical and efficient approach to delineate the distinct geomechanical units (GMUs) which were verified by Schmidt hammer test results in this study.

The key point is, truly defining the individual GMUs through the coring or well logs intervals provides tacking the sufficient and proper samples for geomechanical tests along with saving the time and cost which may be allocated for extra re-sampling. Indeed, making connection between electro-facies and GMUs facilitates defining the distinct geomechanical units through the desired investigating intervals.