Application of Resistivity and Acoustic Images to Characterize Fractured Reservoirs, Middle East Case Histories

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ABSTRACT

Resistivity and acoustic images are typically used to build standard geological and reservoir models especially for naturally fractured reservoirs. Also, the information and outputs from the images can be used to build geomechanical models to predict wellbore instability during drilling, identify the hydraulically most conductive natural fractures, and optimized perforations design.

The performance of low permeability, fractured, and often overpressured reservoirs is controlled by the in situ state of stress and by the distribution and orientation of natural fractures and faults. Only a subset of the total number of fractures is likely to be permeable, and the orientation of this subset is controlled by the state of stress. Maximizing productivity in fractured reservoirs requires intersecting the greatest number of permeable fractures.

Drilling-induced wellbore failures provide critical constraints on the in situ state of stress. Knowledge of the relationship between natural fracture systems and tectonic stresses has direct application to problems of reservoir performance, hydrocarbon migration and wellbore stability. Resistivity and acoustic images provide the means to detect and characterize natural fracture systems and discriminate these from induced wellbore failures.

In most carbonate reservoirs, oil and gas deliverability to the well bore and the productivity of hydrocarbon reserves are directly linked to the diagenetic fabric of carbonate rocks. Understanding the distribution of vugs and fractures in such reservoirs greatly enhances the correctness of any proposed flow modeling and, through better plans for drilling and completion, improves reservoir recoverability.

The texture and internal structure of the diagenetic fabric of the carbonate reservoirs which are dominated by features of secondary porosity are best resolved by borehole imagers integrated with acoustic imagers. The vug-like conductive patches, often several centimeters in size, coalesce to produce complex networks of permeability pathways.

Some case histories will be presented for fractured Basement, clastic and carbonate reservoirs in Yemen, Algeria, Libya, Egypt and Kuwait to elucidate the importance and the valuable output of resistivity and acoustic images in characterizing these different fractured reservoirs.