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Tortuosity Physical Investigation and Modelling Using 2D & 3D Technologies

Mohammad S. Al-Dosary[1], Waleed H.Al-Bazzaz[1], Swerga Sunil[1], Ahmad Al-Farhan[1]

[1]Petroleum Research Center, Kuwait Institute for Scientific Research, Safat, KUWAIT

ABSTRACT

Tortuosity in five Kuwaiti reservoirs is characterized and investigated by 2D and 3D technologies. A deterministic tortuosity physical model is developed. Then detailed and rigorous quantifications of the deterministic tortuosity approach that have utilized 2D and 3D image capturing and then image processing, which applied on these Kuwaiti reservoirs. Mercury pore size 3D approach is also utilized in this study for validation purpose. The imaging model developed is to mathematically quantify as well as physically describe tortuosity rock physics trends in each reservoir rock sample. And, then, compare/ validate pore tortuous paths with 3D mercury pore-sizing derived data. The main objective for this study is tortuosity quantification utilizing 2D & 3D imaging tools and validation results with deterministic systems and novel approach.

Recent improvements in reservoir petrology have brought about by the need for more realistic detailed reservoir models. Characterizing rock physics as well as prediction petrophysical properties are crucial for reservoir development and management. Since tortuosity initial state is captured and it will be well described, per se, measurement will no longer be random or follow stochastic solutions. In this study, heterogeneity prediction model is also studied by constructing mathematical model based on tortuosity quantifications for each selected rock sample. only Previously, tortuosity was only based on fractal assumptions and its direct quantification is vaguely established. In this study, quantifying tortuosity follows morphological approach that has greater confidence.

This study considers securing five samples from different formations (sandstone, Oolite limestone, tight carbonate, and shale). Preliminary data is collected and then data generated from image processing are used to create experimental designs to calculate Tortuosity. Further, physical models are developed based on integrating data collected and analyzed. Physical model involves interpretation and comparative studies and development of a novel approach to quantify tortuosity and to predict heterogeneity.

General summary of results suggest that investigation of actual flow length (tortuosity), quantification can be strongly useful into future unconventional programs using novel approach of 2D and 3D imaging technology and modelling.