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Analysis of geomechanical properties of an Indian unconventional shale reservoir using well logs

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The study of geomechanics is receiving substantial importance recently in the petroleum industry as various problems, encountered during drilling a well to the completion stage of the extraction of hydrocarbon from the reservoir, can be addressed and mitigated with the knowledge of geomechanics. Particularly, for unconventional shale reservoirs, where challenges are more to have well stability and to extract a significant amount of production from the reservoir with ultra-low permeability, geomechanics plays a key role. Well logs can be used to analyze and estimate various parameters related to geo-mechanical properties of the rock formations in a time-efficient and cost-effective manner. The present work is aimed to study geomechanical properties of Cambay Shale, Jambusar-Broach block, Cambay Basin, India, with the application of basic and advanced well logs like Sonic Scanner, Elemental Capture Spectroscopy (ECS) and Formation Micro Imager (FMI).

Sonic Scanner log, with state-of-art sonic measurements, has been utilised to obtain a quantitative estimation of parameters related to elastic and geomechanical properties of the formation like Poisson's ratio, VPVS ratio, Young's modulus, Bulk modulus, Shear modulus and strength of the rock. These parameters are useful for manipulating drilling programmes with lesser complications, analysing wellbore stability and designing an effective hydro-fracture operation for optimum production. Analysis of FMI log has been used to get information on drilling-induced features like breakouts and drilling-induced fractures (DIFs) which are indicators of the orientation of horizontal stresses and provide useful information in controlling wellbore stability.

Brittleness index (BI) is commonly used as a key geomechanical parameter in evaluating fracturability of the formation. Two log-based methodologies have been used in the present study to evaluate continuous BI. In one method, Sonic Scanner measurements have been used to estimate elastic moduli-based BI. The other method of BI estimation is based on the mineral composition of the formation. ECS log has been used to obtain the continuous mineralogical composition of the formation. As both of the methods for BI estimation are having intrinsic limitations, a combination of the two methods will provide more realistic information for brittle regions in the shale formation. The advantage of evaluation of the geomechanical properties of the studied shale formation using advanced well logs will be beneficial to the petroleum industry to reduce the cost and to have continuous information for targeting potential regions for

hydrocarbon extraction with fewer complications.

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