

# Fractures Identification and Modeling of an Unconventional Reservoir Using Advanced Petrophysics

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## Abstract

Unconventional reservoirs are becoming more and more known throughout the world following the huge experience gained in the last years. It is necessary to provide a major boost to the development of unconventional reservoirs due to the high potential of future hydrocarbon. In this study, we carried out advanced petrophysics studies in one of the gas-producing tight sandstone reservoirs in North Africa. The reservoir is located in a highly fractured area with an anticline trap for gas accumulation. Due to the fractures and extreme tightness, we are unable to obtain fluid samples from their wells. Introducing new advanced techniques is needed to extract the fluids and overcome this challenge.

**Objectives & Procedure:** The main purpose is to deploy an integrated workflow of borehole images, sonic scanner logs, and core data in order to optimize the sampling and create a fractures network to best locate the hydraulic fracturing site. To accomplish this, multiple data were integrated into this study to perform a successful operation.

The methodology consists of the combination of acoustic and borehole images as well as injecting core data to conduct a complete and detailed natural fractures characterization, namely: type of fracture, orientation, density, and the exact location of the fracture, and most importantly, study the continuity of the fracture far from the well-wall by analyzing anisotropy using sonic scanner tool.

This study represents the first step in fracture identification to establish fracture network modeling in a multi-well to optimize the hydraulic fracturing site.

**Results & Discussion:** Results obtained from borehole images and core data helped us to highlight different types of fractures (both natural and induced), multiple breakouts, and in-situ stress orientations in the reservoir section.

Based on the time anisotropy, the slowness anisotropy, and the maximum and minimum energy parameters, we could define the anisotropy intervals within our crossed section.

When integrating the data, we observed a large split of fast/slow shear slowness at low frequencies in the dispersion plot which indicate a far field anisotropy related to the natural opening of fractures which led us to confirm the extension of these fractures.

This enabled us to select preferable depths for the formation fluid sampling. We find that the acoustic combined with the borehole image and core data are valuable inputs to target open fractures, understand the anisotropy and select the favorable depths for the fluid sampling.

These results constituted an added value for better characterizing the reservoir and overcoming the tightness challenge in the area. The results of this study lead us to recommend a similar approach in fracture identification and modeling of other unconventional reservoirs.