



Estimate Borehole Fracture Density Based on Image Logs: A Case Study on Presalt Carbonate Reservoirs of the Santos Basin

Tuany Younis Abdul Fatah^{*1}; Antonio Fernando Menezes Freire¹, Luiz Antonio Pierantoni Gamboa¹ and Wagner Moreira Lupinacci¹

¹GIECAR-UFF

Copyright 2021, SBGf - Sociedade Brasileira de Geofísica.

This paper was prepared for presentation during the 17th International Congress of the Brazilian Geophysical Society held in Rio de Janeiro, Brazil, 16-19 August 2021.

Contents of this paper were reviewed by the Technical Committee of the 17th International Congress of the Brazilian Geophysical Society and do not necessarily represent any position of the SBGf, its officers or members. Electronic reproduction or storage of any part of this paper for commercial purposes without the written consent of the Brazilian Geophysical Society is prohibited.

The carbonate reservoirs of the presalt of the Santos Basin formed during the Gondwana break-up were deposited during the Barremian and the Aptian ages and extend along the marginal basins of Brazil since Santa Catarina to Sergipe states. The well analyzed in this study is located in the northeast portion of the Santos Basin and the stratigraphical interval comprises the Itapema and the Barra Velha formations. The Barra Velha Formation representing the main presently producing reservoir and is composed by limestones: shubs, spherulites, laminites and reworked facies. The Itapema Formation is composed mainly by rudstones composed of bivalves (coquinas), present in the structural highs, and dark shales in the distal portions. Borehole image logs provide good quality information regarding reservoirs and are widely used for fractured reservoir characterization. They are used in the recognition of the structural trends of natural fractures and are the key to understand paleo and present stress regimes once the geometry of fractures and their internal architecture are controlled by them. With the use of borehole images, it is also possible to identify high fractured zones and how the fractures interact with reservoir properties. This study analyzes and classifies the interaction of fracture density by the interpretation of resistive and acoustic borehole images in a well that crosses the Barra Velha and the Itapema formations. We measured and classified the directions and dip angles of natural fractures and breakouts. Five types of fractures were classified and named as open, mixed, closed (resistive), non-classified and partial fractures. The main target was the calculation of fracture densities and the fracture distribution to better understand the reservoirs characteristics in this area. It was possible to observe that both formations show partial fractures occurring in a NW/SE trend. These partial fractures occur with a low density of fractures and with very well-defined preferential trends, exhibiting a fracturing pattern that is common for both formations. These results were integrated with spectroscopy logging tool, magnetic resonance porosity and data from sidewall core samples to comprehend the relationship between fractures, lithology, and the porosity of these reservoirs. The interpretation of borehole images and the integration with other logs helped in the understanding of fractures impact in the reservoir properties. In this well, there is a directly proportional relationship between the high density of fractures and the silica content due to the higher brittleness. This is an important observation and may indicate that possible fractured oil reservoirs are related to silicified carbonates. This silicified carbonates by the way shows a reservoir behavior, where once increasing the silica the porosity goes down.

Keywords: presalt; fracture density; Santos Basin; Borehole images.