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Multiscale analysis of microporosity of deep marine reservoir rocks using hard X-rays zoom microtomography of synchrotron source

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The pre-salt is a geological formation of sedimentary rocks with organic content formed more than 100 million years ago, by the accumulation of organic matter on the south-eastern coast of Brazil during the separation of the American and African continents. The subsequent formation of the Atlantic Ocean led to the subsequent deposition of a layer of salt, which nowadays reaches 2 km in thickness. The salt layer was responsible for trapping the organic content, enabling thermochemical processes that generated oil and natural gas in the pre-salt layer. The latter is currently located 5 km deep below sea level.

The goal is to study the microporosity of reservoir pre-salt rocks in multiple scales using hard X-ray (39 keV) zoom microtomography, at the MOGNO beamline at the Brazilian Synchrotron Light Laboratory. MOGNO's conic beam allows image acquisitions with different pixel sizes by varying the sample position relative to the source and the detector, also enabling the user to image relatively large samples.

Preliminary tests were performed with pre-salt rock plugs of 3 mm diameter. The sample was positioned along the beamline for the acquisition of images at four resolutions, with 2.0, 1.5, 1.0 and 0.5 μm pixel sizes. Different algorithms for image reconstruction and segmentation are currently being studied. The former includes FDK (Feldkamp, Davis and Kress) and EM (Expectation Maximization) algorithms. The latter comprises methods of supervised and unsupervised machine learning algorithms based on image texture.

We expect to be able to correlate micropores and pores throughout the different scales and, by future analysis of other pre-salt reservoir rocks with zoom XR- μCT , to shed light into petrophysical models for a more efficient oil exploitation.

Participation

In-Person

References

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