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Integration of MICP Data with Logs, as a Means to Improve Reservoir and Seal Characterization

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Abstract

The importance of MICP is widely recognized as a means to characterize the porous network of reservoir formations and to understand how it controls the fluids flow and its use for a quantitative evaluation of the sealing capacity of a rock. This poster proposes a flowchart for the integration of MICP data into multi-well projects at field or basin scale in order to characterize rock facies in terms of porous network and to model their sealing efficiency in terms of the maximum hydrocarbon column height needed to overcome the Capillary pressure forces. The modeling takes into account the type of Hydrocarbons and the pressure and temperature conditions prevailing during migration. The Purcell method is the core of the process, by which the pore throat size distribution (PSD) of a rock sample is derived from the MICP measurements; it is devoid of any user bias and does not requires any assumption about the distribution; its results can be confidently benchmarked against permeability measurements. The integration of PSD together with regularly sampled logs allows its prediction over the complete logged interval of any well, even the uncored ones. The predicted PSD is the foundation for modeling the sealing capacity of the varied rock facies; it is also an invaluable input for advanced facies characterization. A field example illustrates the flowchart of the process of MICP, how the resulting PSD is integrated with the logs, upscaled at log resolution and how the sealing efficiency is modelled.

In order to evaluate the sealing potential of the rocks, it is critical to determine the pressure required to form a connecting filament of non‐wetting fluid through the largest connected pore apertures of the rock. The objective of the method proposed here is to derive, from MICP drainage curves, the pore aperture at which porous network is fully connected and to predict it, at basin scale, over the entire logged (cored and uncored) intervals of a possibly very large number of wells. Sealing efficiency is the height of the Hc. column needed to overcome this pressure.

The proposed methods are:

1. Loading and presenting MICP curves in the format of well logs. Performing QC and conformance correction.
2. Extracting the Pore Throat Size Distribution and the contribution to permeability of each class of pore size, by PURCELL method,
3. Extracting the critical pore aperture (and all other characteristics of Porous Network known to be derivable from MICP)
4. Integrating PSD with core measurements and log data and predicting the PSD over uncored intervals, by means of k‐NN algorithm.
5. Upscaling, from plug scale to Log scale and Bed scale, the results of prediction
6. Simulating Fluid properties (interfacial tension and density) as a function of subsurface Pressure and temperature conditions.
7. Computing the height of the hydrocarbon column which may be trapped by a given rock facies.