The Impact of Lithology in the use of the Nuclear Magnetic Resonance to Evaluate the Tuffaceous Formations of the Golfo San Jorge Basin, Argentina.

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The evaluation of the formations in the highly tuffaceous sand intervals of the Golfo San Jorge basin is very difficult due to the variable lithology, the uncertainties in the clay volume, the rock relative permeabilities and the variable formation water salinity.

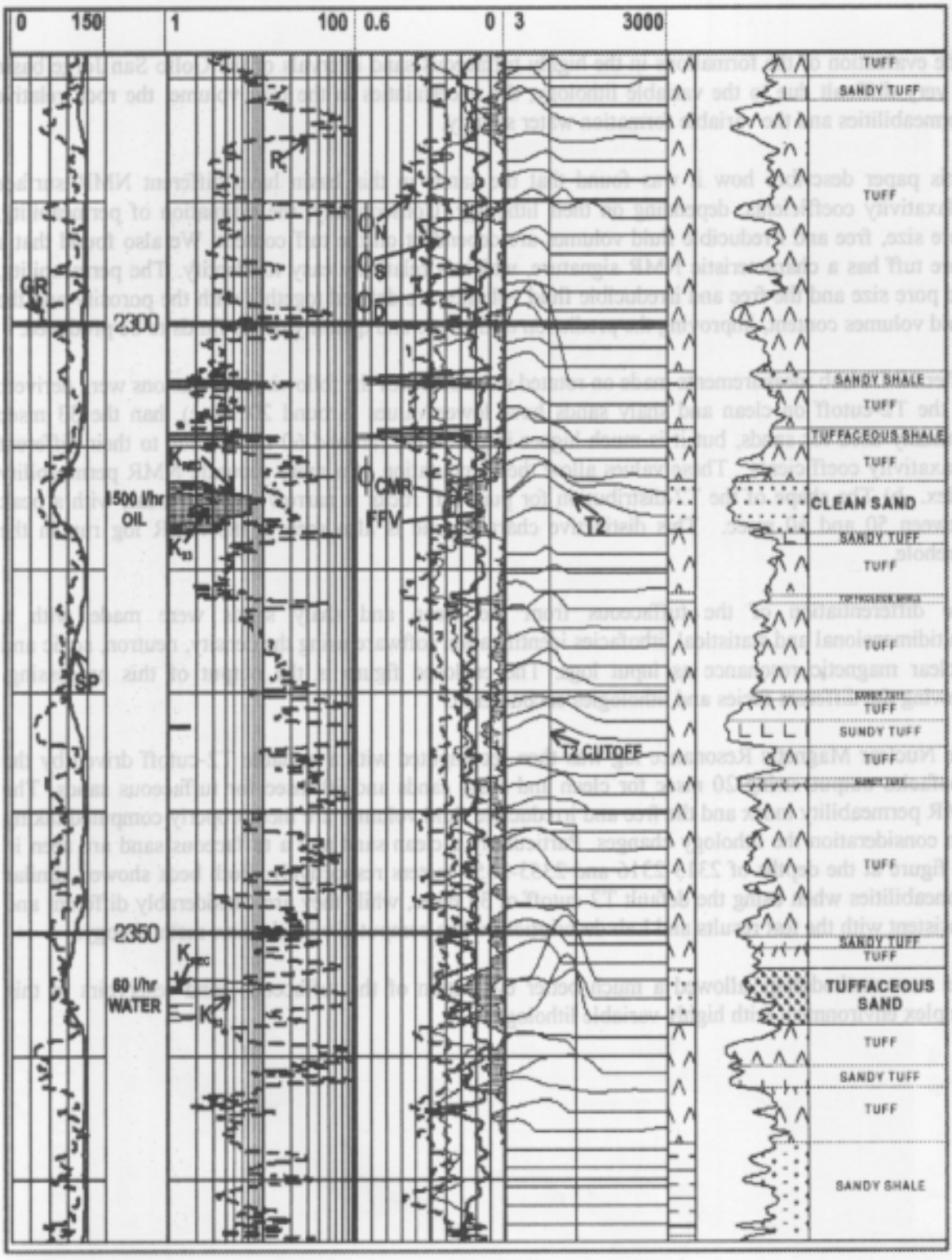
This paper describes how it was found that the sands in this basin have different NMR surface relaxativity coefficients, depending on their lithology. Consequently, the estimation of permeability, pore size, free and irreducible fluid volumes are dependent on the tuff content. We also found that a pure tuff has a characteristic NMR signature, which is relatively easy to identify. The permeability, the pore size and the free and irreducible fluid volumes are defined together with the porosity and the fluid volumes content, improving the prediction of the type and quantity of the fluids to be produced.

After NMR Lab measurements made on rotated sidewall cores the following conclusions were derived: a) the T2-cutoff on clean and shaly sands have lower values (around 20 msec) than the 33 msec normally used for sands, but it is much higher in pure tuff, (around 60 msec), due to their different relaxativity coefficients. These values allow the computation of a more accurate NMR permeability index. b) The shape of the T2-distribution for pure tuff rocks is narrow and unimodal, with a peak between 50 and 60 msec. This distinctive characteristic is also seen in the NMR log run in the borehole.

The differentiation of the tuffaceous from the clean and shaly sands were made with a multidimensional and statistical lithofacies identification software using the density, neutron, sonic and nuclear magnetic resonance as input logs. The enclosed figure is the output of this processing, showing the different facies and lithologies encountered.

The Nuclear Magnetic Resonance log was then recomputed with a variable T2-cutoff driven by the lithofacies output, using 20 msec for clean and shaly sands and 60 msec for tuffaceous sands. The NMR permeability index and the free and irreducible fluid volumes are then properly computed taking into consideration the lithology changes. Particularly a clean sand and a tuffaceous sand are seen in the figure at the depths of 2313-2316 and 2353-2357 meters respectively. Both beds showed similar permeabilities when using the default T2-cutoff of 33 msec, while they are considerably different and consistent with the test results and Lab descriptions when computed with the new methodology.

This new methodology allowed a much better evaluation of the tuffaceous sand reservoirs in this complex environment with highly variable lithology.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