AN INTEGRATED PETROPHYSICAL CHARACTERIZATION OF A SILICICLASTIC TIGHT GAS RESERVOIR IN NEUQUEN BASIN, WESTERN ARGENTINA

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Abstract:

The Río Neuquén field is located thirteen miles north west of Neuquén city, between Neuquén and Río Negro provinces, Argentina. Historically it has been a conventional oil producer, but some years ago it was converted to a tight gas producer targeting deeper reservoirs. The targeted geological formations are Lajas, which is already a known tight gas producer in the Neuquén basin, and the less known overlaying Punta Rosada formation, which is the main objective of the current work. Punta Rosada presents a diverse lithology, including shaly intervals separating multiple stacked reservoirs that grade from fine-grained sandstones to conglomerates. The reservoir pressure can change from the normal hydrostatic gradient to up to 50% of overpressure, there is little evidence of movable water.

The key well in this study has a comprehensive set of open hole logs, including NMR and pulsed-neutron spectroscopy data, and it is supported by a full core study over a 597ft section in Punta Rosada. Additionally, data from several offset wells were used, containing sidewall cores and complete sets of electrical logs. This allowed to develop rock-calibrated mineral models, adjusting the clay volume with X-ray diffraction data, porosity and permeability with confined core measurements, and link the logs interpretation to dominant pore throat radius models from MICP Purcell tests at 60,000 psi. Several water saturation models were tested attempting to adjust the irreducible water saturation with NMR and Purcell tests at reservoir conditions. As a result, three hydraulic units were defined and characterized, identifying a strong correlation with lithofacies observed in cores and image logs. A cluster analysis model allowed the propagation of the facies to the rest of the wells (50). Finally, lithofacies were distributed in a full-field 3D model, guided by an elastic seismic inversion.

In the main key well, in addition to the open hole logs and core data, a cased hole pulsed neutron log (PNL) was also acquired, which was used to develop algorithms to generate synthetic pseudo open hole logs such as bulk density and resistivity, integrated with the spectroscopy mineralogical information and other PNL data to perform the petrophysical evaluation. This enables the option to evaluate wells in contingency situations where open hole logs are not possible or are too risky, and also in planned situations to replace the open hole data in infill wells, saving considerable drilling rig time to reduce costs during this field development phase. Additionally, the calibrated cased hole model can be used in old wells already drilled and cased in the Punta Rosada formation.

This paper explores the integration of different core and log measurements and explains the development of rock calibrated petrophysical and rock types models for open and cased hole logs addressing the characterization challenges found in tight gas sand reservoirs. The results of this study will be crucial to optimize the development of a new producing horizon in a mature field.

Bio:

Nicolas Carrizo is a geologist and petrophysicist who started in 2007 in YPF S.A. as a operational development geologist, then development petrophycisist, regional petrophysics specialist, currently he is a Principal petrophysicist working as company petrophysics specialist at YPF S.A. Professor of subjects Petrophysics & logging and Oil and gas geology at Universidad Nacional del Comahue since 2012, Neuquén, Argentina.

Emiliano Santiago started in 2002 in Schlumberger company supporting geological and petrophysical software, in 2009 joined YPF S.A. as a development geologist, currently he is working as senior geologist at YPF S.A., last years mainly committed in tight sand reservoirs. Professor of subjects related to the oil industry at Universidad Nacional del Comahue since 2012, Neuquén, Argentina.

Pablo Saldungaray is a petrophysicist working for Schlumberger providing support for the planning, execution and interpretation of open and cased hole logs, with a focus on wireline services and petrophysical applications. He is currently based in Buenos Aires, providing support to several countries in Latin America south region. Since joining Schlumberger as a Wireline engineer in 1989, he has held various positions in the field and data processing centers in Africa, Europe, Latin America and the Middle East. He has also worked and consulted for oil companies operating in Argentina, Uruguay and Chile. He holds a degree in Electrical Engineering from the Universidad Nacional del Sur (1987), Argentina, and an executive MBA degree from Universidad Austral (1995), Argentina.