Rock Type Analysis of 1000 Wells Using Computational Classification Techniques. A Case Example in the Lower Cretaceous Centenario Formation, Neuquén Basin, Argentina*

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Abstract

The Lower Cretaceous Centenario Formation is a conventional shallow clastic reservoir developed close to the northeastern border of the Neuquén Basin, Argentina. This unit has only been recognized in the subsurface, and is composed of thick-bedded sandstones and conglomerates interbedded with shales. Its depositional model has not been deeply studied, and has been interpreted as fluvial, deltaic and shelfal deposits. Recently, a revision of the sedimentology of this unit was conducted throughout the study of 200.11 meters of cores corresponding to eight wells in the Rialto, Colorado Area. The deposits are dominated by m-thick massive sandstone beds with minor cross-bedded intervals and shales, which have been interpreted as shallow shelf sediments accumulated as channel-fills and lobes by hyperpycnal flows. Facies analysis allowed the recognition of twelve sedimentary facies suggesting traction and fallout processes from turbulent suspensions with limited bedload, and fallout deposits in an offshore marine/prodelta setting. Sedimentary facies were physically characterized by a number of conventional analyses and calibrated with logs, aimed to determine the main correlation between sedimentary facies and electrical well logs. In this case, GR (Gamma Ray) and SP (Spontaneous Potential) logs were selected as the best describing metrics. Using the selected registers, an electrofacies classification was independently performed taking into account SP and GR cut-off values in the eight studied wells. Four electrofacies were recognized from the aforementioned classification. The population of these electrofacies with facies and facies associations allowed the definition of four rock types. Based on the calibrated rock properties and cut-off values of rock types, an automated computational classification was applied to a larger available well database composed of more than 1000 wells, using in-house developed software. The results not only show an accurate correspondence between manual and automated classification, but also allow the construction of detailed reservoir maps focused in the understanding of sandbodies and properties distribution along the entire area.
**Rock Type Analysis of 1000 Wells Using Computational Classification Techniques.**

A Case Example in the Lower Cretaceous Centenario Formation, Neuquén Basin, Argentina.

**1. Introduction**
The Lower Cretaceous Centenario Formation is a conventional shallow-clastic facies developed close to the northeastern border of the Neuquén Basin, Argentina. This unit has only been recognized in the subsurface, and is composed of thick bedded sandstones and conglomerates interbedded with shales. Its depositional model has not been deeply studied, and has been interpreted as fluvial, deltaic, and shelfal deposits. Recently, a revision of the sedimentology of this unit was conducted throughout the study of 200.1 meters of cores corresponding to eight wells in the Rio Colorado Area. The deposits are dominated by thin, massive sandstone beds with minor cross-bedded intervals, and shales, which have been interpreted as shallow shelf sediments accumulated as channel fills and lobs by hyperpycnal flows.

**2. Sedimentary Facies Analysis**
Facies analysis allowed the recognition of Middle Neocolombian paleo-estuarine fan. Five different hydraulic processes from erosion of bedload deposits, to sedimentation with limited bedload, and fallout deposits in an offshore marine/palustrine setting. Sedimentary facies were physically characterized by a number of conventional analysis and calibrated with log analysis and core data. The main correlation between sedimentary facies and electrical logs. In this case, GR (Gamma Ray) and SP (Spontaneous Potential) logs were selected as the best describing metrics. Using the selected registers, an electrofacies classification was independently performed taking into account SP and GR cutoff values in the eight studied wells.

**3. Electrofacies Analysis**
Four electrofacies were recognized from the above methods based on conventional interpretation of these electrofacies with facies and facies associations allowed the definition of four rock types.

**First manual approach on cores**

**What does Electrofacies can see?**

**Cross plot showing the response of sedimentary facies according to Gamma Ray and SP logs.**

**Finding the best classificator**

**Comparison manual vs. automatic classificator**

**Testing (8 wells)**

**4. Applying the classificator to 1000 wells**
Based on the calibrated rock properties and cutoff values of rock types, an automated computational classification was applied to a larger available well database composed of more than 1000 wells, using an inhouse developed software.

**5. Electrofacies vs Sedimentary Facies associations**
Correspondence between architectural elements and electrofacies: key points for pattern-environmental analysis.

**6 Results**
The results not only show an accurate correspondence between manual and automated classification, but also allow the construction of detailed reservoir models focused in the understanding of sands bodies and properties distribution along the entire area.

**7 Conclusions**
The automatic electrofacies definition allowed to manage and process a large log database with very high efficiency purposes. The calibration of electrofacies with the main architectural elements provides a powerful tool to obtain multiple detailed reservoir maps at a whole field scale.