

## **From Petrophysical to Depositional Facies in a Middle Upper Jurassic Carbonate Sequence of the Arabian Plate (Northern Iraq)**

**Raffaele Di Cuia<sup>1</sup>, Enrica Battara<sup>1</sup>, Angelo Ricciato<sup>1</sup>, Stefano Borello<sup>1</sup>, N. Chikina<sup>2</sup>, Olga Grobushkina<sup>2</sup>, Alexey Mazarovich<sup>2</sup>, Andrei Murashka<sup>2</sup>, and R. Ismagilov<sup>3</sup>**

<sup>1</sup>GEPlan Consulting

<sup>2</sup>RN-Middle East company LLC

<sup>3</sup>Saudi Aramco

### **Abstract**

This study focuses on the sedimentological and stratigraphic analysis of Jurassic sequence in the norther sector of the Kurdistan region (Iraq) within in the Arabian plate. The scope of this study was to define depositional facies within this sequence, by integrating data at different scales: from cm (thins section) to meter (core and wireline logs), through an accurate work of observations and calibration of these data aided by petrophysical analysis and image logs.

The description of 450m of cores from the Jurassic sequence from 15 wells in the study area allowed the definition of lithofacies and lithofacies associations and the gross depositional environments. A further attempt to identify different order and resolution cycles using a sequence stratigraphic approach was also made.

The key aspects analysed by observing the thin sections are the lithological & textural description, but also focuses on the internal organisation of the sample, the textural/lithological variations, the different skeletal types, the matrix and cements habit and properties, the existing visual porosity, the fracture network characteristics, the pressure solution features, the paragenetic evolution and associated products, the reservoir quality and the related uncertainties and open points. Some wells had RCA data that can be used as support for the lithological and the pore system characterisation.

Using the petrophysical model available and the results of lithofacies associations deriving from the integration and calibration of thin sections and cored intervals, a refine lithofacies zonation was obtained and correlated to un-cored intervals. Using a multi-step approach 12 facies have been identified: 5 facies define various types of limestone, 5 facies define different dolostone, 1 facies was created for intervals with borehole caving and 1 facies describes no-reservoir units (includes anhydrite and evaporitic intervals but also limestone and dolomites with no porosity). About the 60% of the datapoints are considered “no reservoir” facies, and about the 10% are in caverns/rubble zones. Between the remaining 30% of the dataset, 14% are dolomite facies, whereas 16% are limestone facies.

The work on the image logs resulted in 20 Borehole Image log facies, classified based on their internal organisation, ultimately reduced to five groups (structureless/massive facies, poorly/faintly bedded facies, vuggy/nodular facies, bedded/laminated facies, fractured/brecciated facies).

The wireline log response was useful for validate the interpreted BHI log facies, and for adjusting some uncertain boundaries between facies. The final integration of the petrophysical analysis (also including the outcomes from thin section and cores) with the BHI interpretation resulted into 27 facies that were grouped in lithofacies association and used in the classification and correlation of depositional environments in a carbonate platform setting from interior (sabkha) to proximal environments (lagoonal).