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Better reservoir characterisation in uncored intervals using mineralogical and sedimentological data from core and cuttings samples: application to petrophysical models in conventional and unconventional hydrocarbon reservoir case studies.

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ABSTRACT

An increase in operational costs coupled with decreasing oil and gas prices in recent times has created the need for greater efficiency, integration and optimisation of workflows used in the understanding of reservoir models. Integration of geological and petrophysical datasets allows for enhanced reservoir characterisation compared with standard wireline-based evaluation. Innovative techniques such as automated mineralogy can supply quantitative mineralogical and textural data to streamline these workflows, with a positive impact that ranges from improved regional exploration understanding to better reservoir models.

We present applications of this approach with examples from both conventional and unconventional hydrocarbon reservoir studies. Standard sedimentological analyses were applied to core and ditch cuttings samples. Additionally, automated mineralogical analysis and high resolution SEM were carried out. A geologically constrained petrophysical assessment of the non-cored intervals was then obtained by integrating these data with wireline logs.

Routine petrophysical analysis was applied to the wireline log data in order to predict lithology, effective porosity and water saturation. Shear velocity modelling was necessary to obtain mechanical properties in some cases. Detailed core description was carried out and rock samples (both cores and ditch cuttings) were collected and analysed to obtain quantitative mineralogical and textural information (grain and pore fabric). The resulting data were used to improve the initial petrophysical models. Electrofacies were created by assigning typical log responses (gamma ray, density, neutron and sonic logs) to interpreted intervals from the core descriptions. Furthermore electrofacies were linked with TOC, from samples and logs, and mechanical rock properties available from the petrophysical analysis, to establish rock types in the intervals and wells for which no rock sample data was available.
The integrated method results show distinct improvements over initial petrophysical predictions of key reservoir quality parameters, such as water saturation, effective porosity, TOC and elastic moduli. These parameters directly impact rock-typing analysis, risk mapping and drilling and completion designs. Therefore, by employing this integrated workflow and recognising geological heterogeneities, reservoir characterisation is materially improved, resulting in increased production and profitability.