

## Application of Borehole Micro-Imagery Logs for Lithofacial Association Interpretation of Carbonate Reservoirs

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### ABSTRACT

Geomodelling of carbonate reservoirs comprises two major steps, namely identification and correlation of sequence boundaries between cored and uncored wells, and propagation of the reservoir properties based on core data and core-calibrated well logs. Distribution of reservoir properties in the sequence stratigraphic framework is considerably controlled by the depositional environments (diagenesis effect is out of scope of this paper). Thus, inter-well correlation and trend mapping of lithofacial associations, accumulated in similar depositional environments are essential parts of any carbonate reservoir study.

Number of cored wells is usually very limited and thus extension of depositional environments to uncored wells, containing only log data, becomes unavoidable and often very difficult task, considerably defining the quality of the reservoir model and the economics of the field. In this respect, available high resolution borehole micro imaging (BHMI), performed in both cored and uncored wells provides a unique repository of secondary core data, which can yield additional information to complement the environmental classification and improve reliability of lithofacial association interpretation in uncored wells.

Depositional interpretation of BHMI consists of two steps: calibration of the BHMI image on core and interpretation of BHMI images of uncored wells. At the first step, an atlas of the 'typical' image character (and combinations thereof) for each depositional environment class is produced. It is important to emphasize that BHMI logs in carbonates cannot yield particular lithofacies, however can yield sedimentological information *e.g.* bioturbation, bedding and large fauna. The BHMI atlas allows at the second step extending depositional environments interpretation to uncored wells, based on visual comparison of the BHMI images with characteristic patterns, identified for the variety of the environments and consistently documented in the atlas.

It is important to emphasise that applying the BHMI scheme to uncored wells contains a number of important uncertainties that can lead to incorrect lithofacies association and properties propagation on the reservoir level. The interpretation comprises lower risk, where one image motif directly matches one lithofacies association and higher risk, where one motif matches with multiple lithofacies associations. The latter uncertainty can often be resolved through analysis of position of the layer in the sequence stratigraphic framework, defining the depositional cycles.

It is also likely that there will be a range of conductive and resistive values (and hence colour) for each motif in different wells due to lithological, physical, electrical and processing variables. This uncertainty can partly be resolved by applying proper image processing techniques and integrated analysis of all available logs. The article presents a case study of applying BHMI data for lithofacies interpretation at one of the major carbonate reservoir in the Middle East.