Electrofacies characterization of a giant North African petroleum reservoir

Presenting author: John C. Davis, Heinemann Oil GmbH
Authors: Stefan Egger, Heinemann Oil GmbH

Abstract: "Electrofacies" are unique combinations of petrophysical log responses that reflect specific physical and compositional characteristics of a rock interval cut by a borehole. An important advantage of electrofacies over alternative types of facies classifications of rocks in the subsurface is that electrofacies can be defined solely on the basis of log responses, without reliance on cores, cuttings or outcrops. Although electrofacies are empirical, they also are objective; no subjective interpretations of sediment genesis or inferences about depositional environments are required. Electrofacies were used to characterize Late Cretaceous rocks of a giant oil field in North Africa. The reservoir included lithologies ranging from sandstone and breccia to carbonates to altered igneous rocks. Sediments were laterally discontinuous, reflecting rapid lateral differences in depositional environments. Only a few cores were available, making interpretations of lithologies and depositional environments difficult. Open-hole logs were available, so an unsupervised classification procedure based on responses of five petrophysical logs was used to place intervals in the reservoir into five electrofacies. Although the electrofacies could not be related to specific lithologies or depositional environments, they produced classes that reflected reservoir properties. Compared to conventional petrophysical interpretations, electrofacies improved the match between (1) core porosity to log porosity, (2) vertical well inflow profiles from production logs to log permeabilities, and (3) productivity indices to cumulative permeabilities per well. Dynamic simulations confirmed that a geocellular model based on electrofacies reproduced the observed dynamic behavior of 85% of the wells in the field. This demonstrates that electrofacies can produce a superior reservoir characterization; can contribute substantially to understanding reservoir dynamics; and may improve the predictive power of geological simulation models. Although electrofacies may not be directly interpretable in conventional lithological terms, this does not limit their utility.