Object-Based Modeling of Wara Formation (Middle Cretaceous) in Greater Burgan Field (Kuwait): An Innovative Approach for a Better Reservoir Characterization

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ABSTRACT

The Wara formation is one of the main reservoirs of Greater Burgan field, producing under primary depletion since the late 1940s. A major water flood has recently begun and prior to this, a large-scale pilot (Early Wara Pressure Maintenance Project EWPMP), was initiated. As part of the scope of this study, representative geological models were built to capture reservoir heterogeneities, which is crucial in building a dependable simulation model. An innovative workflow combining geological, petrophysical and dynamic data, has been developed to generate a range of geological models that will be selected for dynamic simulation. Five cored wells have been reviewed, to establish the markers used for the geological modeling and to define core-based depositional environments. Six Rock-Types, calibrated on cores, integrating RCA porosity-permeability data have been identified in 56 wells. The Wara Formation has been deposited in fluvio-deltaic to estuarine environments. Six depositional environments have been defined on cores, dominated landward by bay head fluvial delta passing into tidal estuarine mouth bars and sandy estuarine bay. They have been extended to 111 wells based on log signatures. Based on analogs (ancient and modern), aspect ratios for sand body shapes were used in addition to the wells control to constrain the distribution of depofacies. Variations in sand body's size were used to generate poorly, fairly and highly connected sand bodies, with a range of models. The final sand body distributions were validated using pressure data to match some pressure breaks in the reservoir. Then Rock-Types and petrophysical properties distributions were generated in the pre-defined geological framework, using a sequential indicator simulation approach (SIS). The object-based modeling (OBM) approach combines aspect ratios and depositional trends to constrain the petrophysical properties distribution. A range of models has been generated reflecting the geological settings and capturing the reservoir heterogeneities. Modeling complex reservoir heterogeneities in clastic environments is a challenge in the oil industry. An accurate sand body distribution is crucial for a good representation of the reservoir behavior in both static and dynamic models. The proposed modeling workflow combining geological, dynamic and petrophysical data, is a good alternative for geological models of similar depositional environments, to assess the complexity of such reservoirs.