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 well controls 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.
The Wulaia field is located in the southwestern part of the Greater Burgan Field in Figure 1, as shown in a structural map of field's different reservoirs. As can be seen the study area is relatively extensive and contains a significant number of reservoir intervals. The study area consists of the southwestern part of the Burgan field in the State of Kuwait. The Wulaia field is one of the four main reservoirs in Greater Burgan Field. II 2.6 Transgressive Channel low; ~< 30-32 API cross-over; low density 1 & 2 highest; >20 ... high neutron, low density 5 & 6 none commonly present in WL and WU; distinguished by high neutron and separation Cross-overs in 1D strike direction as well as 2D dip direction have been generated for it to quality check the sand body shapes and distribution.

**ABSTRACT**

The Wulaia field is one of the main reservoirs of Greater Burgan Field, producing under a single separator since the late 1970s. A large water flood has been on-going prior to this, a large-scale pilot (Early Water Pressure Maintenance Project DMP), was initiated. As part of the scope of the study, representative geological models were built to capture reservoir heterogeneities, which is crucial in understanding reservoir behavior.

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 optimization. The workflow has been reviewed, to establish the maturity used for the geological modeling and to define conceptual depositional environments. Six Rock-Types, calibrated as cores, integrating field petrophysical data have been identified in the field.

The Wulaia field has been deposited in fluvial to deltaic environments. Six depositional environments have been defined in core, dominated by low to high sand bodies passing into tidal fluvial packages and sand and sandy estuarine lobe. They have also been extended in 1D wells based on seismic signatures. Based on an analysis of ancient and modern, expert ratios for sand body shapes were used in the study area to connect to the sedimentary distribution. Variations in sand body size and shape were used to generate poorly and highly connected sand bodies, with a focus on sand body distribution and to match some pressure break in the reservoir.

The Wulaia reservoir is a complex reservoir characterized by low to high sand bodies passing into tidal fluvial packages and sand and sandy estuarine lobe. They have also been extended in 1D wells based on seismic signatures. Based on an analysis of ancient and modern, expert ratios for sand body shapes were used in the study area to connect to the sedimentary distribution. Variations in sand body size and shape were used to generate poorly and highly connected sand bodies, with a focus on sand body distribution and to match some pressure break in the reservoir.

**OBJECTIVE MODELING**

The objectives of the study are to discriminate between the depositional environments and to predict the porosity distribution through the use of field and well data. The approach is to create various alternative reservoirs, to test the models in the field and to assess the permeability distribution, a key parameter for reservoir characterization.

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