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Integrated Modeling of Fractured Low Permeability Reservoir, Sangonghe Formation, Baolang Oilfield, Northwest China

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Abstract

This paper integrated Flow Zone (FZ), single sandstone sequence, with the study of fracture, and gave a fine characterization and modeling of fractured low permeability reservoir. It pointed out that calculating the porosity and permeability for low permeability reservoir based on FZ and building the 3D discrete fracture network (DFN) distribution model integrated with the static fracture character and the density distribution of high angle fracture (HAF) and low angle fracture (LAF) are efficient methods for fractured low permeability reservoir. This brings forward the use of FZ and considerable sequence stratigraphy controlled modeling method, and brings forward to build fracture surface from point which controlled by the density distribution of HAF and LAF. The result shows the efficiency of a modeling approach for a fractured low permeability reservoir by integrating low permeability characterization and fracture study.

Introduction

It is still a challenge to model fractured low permeability reservoirs, such as characterizing the low permeability matrix, 3D fracture distribution, fracture character, fracture and matrix coupling character.¹⁻⁵ From the onset of development of Baobei Block, Baolong oilfield in 1994, the detailed sand architecture, flow zone and possible reservoir performance were known. Based on reservoir performance from exploitation, the low productivity could not be characterized by flow zone only and hence the need for an integrated characterization and modeling of the low permeability matrix and fracture is very important.

This paper is based on detailed core analysis, characterization of low permeability matrix, and model build up of the low permeability matrix controlled by multi-surface and flow zone, and construction of 3D discrete fracture network (DFN) distribution model integrated with the 2D fracture distribution, predicted by well-log response and structural curvature, and the fracture occurrence.

Geological Setting

Baobei Block belongs to the Baolang Sumu structure zone, which is situated in the mid section of the north depression in Bohu sag, Yanqi basin (Figure 1(a)). The oil trap is a multi-stage structure formation made up of a long anticline axis, situated in local shear stress field. The long anticline axis spreads along the NW-SE direction, divided into three sections: SE and NW sections are wider than the mid section, which is contrary to normal mid section been wider than the ends of the anticline. This dumbbell shape anticline is formed by a strong extrusion at the mid section (Figure 1(b)).

The reservoir is of a coarse grain and low permeability reservoir developed from braided delta. The sand thickness varies from 1m to 6m, with distinct multi-interlayer. The change in channel path is relatively high, hence the strong anisotropic character of the reservoir. The average porosity range is 12% to 14%, and that of permeability is 2.97 md to 27.3 md in different oil groups, within Sangonghe formation.