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渤海湾盆地黄骅坳陷应力场的三维数值模拟分析

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Numerical modeling on the stress field in the Huanghua depression, Bohai Bay basin

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摘要

采用有限元方法模拟了渤海湾盆地黄骅坳陷的现今应力场特征.模型的构建主要基于黄骅坳陷精细三维地震数据体,包括了七个主要层序底面及近真实的断层产状.根据模拟结果,对比已知油气藏的分布位置和断裂的展布方向,定量分析了黄骅坳陷第一主应力、第三主应力、应力强度以及主应力方向的分布特征,并探讨了影响黄骅坳陷构造特征的主要因素.据此,得出以下认识:1)通过改变模型的边界条件发现,在右旋剪切作用下模型中压性应力场低值区的分布特征及主应力方向分别与黄骅坳陷中已知油藏的分布及断裂展布方向具有较好的对应关系.2)黄骅坳陷内构造样式及其构造应力场方向自北向南存在一定的差异,而造成这种差异的原因与地形的变化、沧东断层空间形态的变化、断层组合样式的变化以及滑脱面的变化密切相关.

关键词 黄骅坳陷, 构造应力场, 有限元数值模拟, 现今, 渤海湾盆地

Abstract:

The present-day stress field of the Huanghua Depression is anlysized using finite element modeling (FEM). The models are constructed based on 3D seismic data, which consists of bottom surfaces of seven sequences and near-real spatial occurrences of faults in the depression. Comparing with the distribution of oil-gas reserviors and fault patterns around the area of the reservoirs, we quantitatively explain the distribution characteristics of the first/third principal stresses, stress intensity and direction of principal stresses. Then, the main factors influencing the structural features of the Huanghua Depression are discussed accordingly. The faults in the model are introduced as Coulomb-type frictional zones that refer to contact analysis of FEM. The results are as followed: 1) by adjusting the boundary conditions of the models, we find out that under the left-lateral shearing, the third principal stresses and the orientations of principal stresses show certain correlation with the position of five oil-gas reserviors and fault strikes in the Huanghua Depression, respectively. 2) There are differences in the structural patterns and the directions of structural stress field of the the Huanghua Depression from north to south, which closely relate to the spatial occurrences of the Cangdong Fault, fault pattern, types and the spatial change of detachment fault.

Keywords The Huanghua Depression, Structural stress field, FEM, Present-day, Bohai Bay Basin

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