Overpressure Generation Mechanisms and Its Distribution in the Paleocene Shahejie Formation in the Linnan Sag, Huimin Depression, Eastern China

Chao Li[1], Xiaorong Luo[2], Likuan Zhang[3], Lei Yuhong[1], Ming Cheng[4], Luo Hongmei[5]
[1]Institute of Geology and Geophysics, Chinese Academy of Science; [2]Chinese Academy of Sciences; [3]Institute of Geology and Geophysics; [4]Institute of Geology and Geophyisics, CAS; [5]Geological Science Research Institute, SINOPEC Shengli Oilfield Company

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

The Linnan Sag is one of the main oil-producing units in the Huimin Depression, Eastern China, and the pore pressure gradients obtained from drill stem tests (DSTs) range from 9.0 to 16.0 MPa/km. Uncertainty about the origin and distribution of abnormally high pressures in the Linnan Sag has caused different interpretations of the hydrocarbon accumulation and resource assessments, and interferes with safe drilling. In the Linnan Sag, mudstone compaction curves are gravely affected by several non-compaction factors, and the normal trend of the compaction curve is difficult to determine, which makes it difficult to determine the origin and distribution of overpressure. In this paper, the factors that may affect mudstone compaction, such as shale volume, higher calcareous and organic matter content, are carefully checked out and processed. The decontaminated mudstone compaction curves, compiled from acoustic, density and neutron logs, are used to estimate the pressures in the mudstones, and calibrated by DST and mud weight data. The log response-vertical effective stress and acoustic velocity-density crossplots are used to identify the characteristics and generation mechanisms of the overpressure. The comprehensive compaction curve shows that the mudstones in the overpressured layer appear clearly undercompaction characteristics. The analyses of the acoustic velocity/density-vertical effective stress and acoustic velocity-density crossplots demonstrate that the overpressured points consistent with the

loading curve. So, the disequilibrium compaction of the thick Paleocene mudstones is the fundamental mechanism resulting in overpressures. Hydrocarbon generation and vertical transfer may be the main unloading mechanisms, that correspond to the overpressure points that deviate from the loading curves. Since organic matter cracking may occur in formations at depths deeper than 3800m, the contribution of hydrocarbon generation to overpressuring should be limited. The transfer of overpressure via opening faults is therefore considered as the main cause of higher overpressure in local sandstones. The overpressures in the mudstones show the characteristic that gradually decreases from the center to the margin in the Linnan Sag. The pressure in the isolated sandstone body is generally similar to that in the surrounding mudstones, whereas it can be lower or higher when the overpressure in the sandstone body is vertically transferred by faults to other pressure systems. The results of this analysis provide an indication of the magnitude, mechanism and distribution of the overpressure. This understanding will help to guide further exploration activities in the Linnan Sag and similar geological basins.