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Reevaluation of the origin of overpressure in the inter-salt shale-oil reservoir in Liutun Sag, Dongpu Depression, China

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ABSTRACT

The inter-salt shale-oil reservoir in Liutun Sag of the Dongpu Depression in the Bohai Bay Basin, China, has a strong overpressure and produces abundant heavy oil with little water. The previous researches claimed that the overpressure was mainly a result of disequilibrium compaction, which seemingly contradicts with the little water production. More systematic work is required to understand the origin of the overpressure and the oil/water production. Formation testing, mud weight and wireline-log data were used to recognize overpressure and equivalent depth method and sonic transit time-density crossplot were used to identify the overpressure mechanisms. In addition, the tectonic evolution was included in the analysis, aiming at understanding the oil/water production features. Disequilibrium compaction is considered as the main overpressure mechanism, due to the sealing of salt rocks. Hydrocarbon generation, which mainly generated low maturity heavy oil, contributes to the overpressure feature with the help of tectonic uplift. The overpressure evolution, which corresponds to the tectonic evolution, consists of three phases: early disequilibrium compaction, middle fluid substitution and late disequilibrium compaction. The tectonic uplift in the middle phase, it is proposed, contributes most to the little water production. With the tectonic uplift, a lot of fractures formed, which would promote oil and water drain. However, due to the low mobility of heavy oil, more water tended to be drained away from the region of strong overpressure, and thus the intuitive fluid substitution occurred. The findings above indicate that the exploration of inter-salt shale-oil reservoirs in Liutun Sag or even the other areas of Dongpu Depression may additionally consider some special strategies, including the occurrence of salt rocks and the hybrid overpressure feature of disequilibrium compaction and fluid expansion besides tectonic uplift.

Keywords: abnormal pressure, heavy oil, tectonic evolution, inter salt, shale reservoir

1. Introduction

Overpressure, that is, fluid pressure in excess of hydrostatic pressure, is common in shale-oil reservoirs (Jarvie,

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