Msc. intern project

Towards better understanding of the highly overpressured Lower Triassic Bunter reservoir rocks in the Terschelling Basin

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Abstract

Large lateral variations in pore fluid formation pressures and associated overpressures occur in the Lower Triassic Bunter reservoir rocks in the Terschelling Basin. This study describes in detail the main controlling factors on the distribution of these overpressures in the Terschelling basin by combining structural interpretations based on seismic data with pressure data. Insight in these controlling factors also makes it possible to estimate the pore fluid overpressures in the Bunter compartments that haven't been drilled (yet). Furthermore, this study aims to gain insight into the overpressure generating mechanisms that are responsible for the observed overpressures. Additionally, a prospectivity analysis for the presence of gas in the Bunter strata in the Terschelling Basin is performed in this study.

Regarding the controlling factors on the distribution of overpressure in the Lower Triassic bunter strata, it is found that the most important controlling factor on the distribution of overpressures is the presence of both lateral and vertical permeability barriers. Lateral permeability barriers are formed by Zechstein salt and faults. The most important vertical permeability barrier is the Upper Triassic Röt evaporite. In the Bunter compartments where the Röt evaporite is continuously present, high overpressures of around 30MPa and higher are observed. In areas where the Röt evaporite is absent due to Mid-Kimmerian uplift and subsequent erosion, overpressures are lower than 15MPa. The timing of the formation of the lateral permeability barriers (Zechstein salt and faults) has been of great importance for the generation of the high pore fluid overpressures in the compartments, as overpressures could have build up after hydraulic closure of the compartments. Based on structural interpretations, by making use of seismic data, it is concluded that the compartments where the Röt evaporite is continuously present became hydraulically restricted in three phases; starting with Middle Triassic faulting (phase 1) followed by the activity of Zechstein salt walls, diapirs and domes during the Middle and Late Triassic (phase 2). Subsequently, the compartments became fully hydraulically restricted during Late Jurassic and Early Cretaceous faulting (phase 3). Calculations show that the subsequent sedimentary loading during the Cretaceous and Cenozoic could largely explain the observed overpressures in the hydraulically restricted Lower Triassic Bunter reservoirs. Hence, it is concluded that sedimentary loading during the Cretaceous and Cenozoic is the main pressure generating mechanism for the Lower Triassic Bunter reservoir rocks in the Terschelling Basin. Additionally, the local presence of natural gas contributes at some places to the pore fluid overpressures. Secondary salt cementation (salt plugging) in the Bunter reservoir rocks is not likely to have contributed to the generation of overpressures because it predates the build up of overpressures. However, secondary salt cementation does pose a major risk for the presence of gas in the Bunter reservoir rocks, as it presumably predates the main phase of gas-generation.

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