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Martin Grecula[1], Danny Soo Kwong Yin[1] (1) Nederlandse Aardolie Maatschappij, Assen, Netherlands

Climatic Control on Vertical Diagenetic Zonation in Permian Eolian-Fluvial Reservoirs, Northern Netherlands

Uncertainty in the reservoir quality prediction is a major risk associated with the exploration and production of Lower Permian Rotliegende sandstones in the southern North Sea and onshore Netherlands. The deposition along the southern margin of the Variscan foreland basin occurred in alluvial environments, eolian desert plain and wet flats of the desert lake margin occupying the basin center. Three major cycles of lake progradation and retreat have been recognized in the reservoir sequence, which coincide with the vertical permeability zonation in the wells. The reservoir quality is controlled both by facies characteristics and the type of diagenetic phase, especially authigenic clays. Antithetic pattern in abundance of kaolinite and illite, or illite and chlorite through the stratigraphy seems to depend on the relative paleogeographic position and the related composition of groundwater fluids during early diagenesis. While kaolinite tends to dominate early grain-coating phase in the proximal areas, illite is abundant in the damp facies of the lower desert plain. Chlorite developed preferentially in the areas influenced by lake brines. As the later diagenetic clays grew mainly as an extension of the early grain coats, progressive burial led to the enhanced growth of different clay types in different palaeogeographic provinces, depending on the abundance of pre-cursors. Due to climatic cyclicity, variable degree of late diagenetic impairment is encountered in different stratigraphic units of the reservoirs. Structural and burial history modelling is crucial for the prediction of large-scale diagenetic effects in different parts of the basin; however, stratigraphic modeling is essential to predict the vertical reservoir quality distribution in a field.