

The Rhaetian fluvial-dominated deltaic system in the North German Basin: facies, controls and geothermal reservoir characteristics

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The Rhaetian in the North German Basin (NGB) is characterized by widespread semi-arid to arid continental conditions until the diachronous “Middle Rhaetian transgression” led to the formation of a shallow marine to brackish deltaic system. This comprehensive study is based on existing facies maps of Rhaetian deltaic sandstone complexes in the eastern part of the NGB and focuses on facies variations and control factors within the deltaic system. Twelve wells (1750 m of core samples) and more than a dozen outcrops in northern Germany have been investigated. Ten lithofacies types have been established and grouped into five lithofacies associations: (I) upper deltaic plain with stacked distributary channels, (II) upper deltaic plain with terminal distributary channels, comprising both well-sorted, medium- to coarse-grained ripple cross-laminated and cross-bedded sandstones as well as sheet sands, swamps and heterolithic tidal strata, (III) delta-front proximal mouth bars, comprising well-sorted, medium-grained ripple- and horizontally-bedded sandstones, (IV) distal equivalents of I-III, and (V) prodelta deposits represented by dark bioturbated pelites. For basin-wide correlation and construction of new facies maps, Gamma-Ray, Self Potential, and Resistivity logs of approximately 200 randomly distributed wells have been interpreted. The facies maps invoke a distributary channel-dominated upper deltaic plain with 20 to 30 m thick and 5 to 10 km wide channels oriented N-S. Deltaic front deposits are characterized by up to 15 m thick mouth bar associations. The petrophysical properties of these facies types are exploited for geothermal energy (e.g. Waren, Neustadt-Glewe). The facies maps also indicate that a fluvial-dominated shallow marine to brackish deltaic system was established from the Upper Exter Formation to the Liassic transgression. Sediment was transported from the Scandinavian High to the south by wide fluvial channels prograding over a 300 km broad deltaic front stretching from Hamburg to Poland. Distributary deltaic plain channels were dominant in northeast Germany, becoming prodelta in the west around Hamburg.