Hydraulic Jump Controls Deep Water Sandstone Reservoir Quality in the Channel Lobe Transition Zone

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Abstract

The prediction of reservoir quality of the deepwater channel lobe transition (CLTZ) is challenging, as where depositional and bypass process alternatively occur. This study investigated the morphology and the grain size composition of the deposit over the analogical CLTZ in the flume experiment. The flume is ten-centimeters wide and four meters long slope flume having a flexing point from 17° to 8.6°. We conducted experiments of 164 surge-type turbidity currents. A surge of the current was generated by opening the valve for five seconds. Sediment used has broad grain size distribution ranging from silty fine to medium sands. The result showed that the occurrence of hydraulic jumps significantly controlled the resultant geomorphology and grain size segregation of deposits. Hydraulic jumps occurred sequentially from the flexing point of the slope situated in the flume. The fraction of silt to fine-grained sediment significantly decreased at around the locations of hydraulic jumps, and grain-size distribution fines downstream. Comparison between the experimental results and more than a few kilometer long CLTZ outcrops (e.g., Permian Karoo Basin) exhibits similarity in morphological and sedimentological features. This suggests that the hydraulic jumps play a similar role also in natural environments. We also compare with the sandstone reservoir of the Ichthys gas-condensate field, North West Shelf of Australia. The deposition partly occurs in the CLTZ. The sedimentary facies of the core is dominated by amalgamation with scour and fill structures, which implies the dominance of the hydraulic jump process under Froude supercritical flow regime. The reservoir petrography shows the spatial and temporal variabilities of the fraction of clay minerals, which is interpreted as one of the controlling

factors of the quartz overgrowth. Our study potentially explains that the CLTZ could result in the sequential occurrence of hydraulic jumps of turbidity currents, producing coarser and less fine-grain deposits leading to the variability of the deepwater sandstone reservoir quality.

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