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Development of a Conceptual Fluid Flow Model Based on the Tanqua Karoo Turbidites, South Africa

Textural and mineralogical variations within submarine fan systems can strongly influence fluid flow. Exposures of the Permian submarine fan complex in the Tanqua Karoo Basin, South Africa, allow detailed analysis of grain size distribution and mineralogical variations. Samples were studied within one of five submarine fan complexes from erosive channel to sheet lobe facies. Fan 3 consists of four separate high-frequency low-stand system tracts, separated by condensed intervals. These sand-rich intervals are traceable for over 20 km down dip within the fan complex. With the aid of the high-quality correlations panels and logs, over 50 rock samples have been collected within one interval along the whole outcrop area.

Mineral analyses of the field samples were carried out with an electron microprobe and petrographic image analysis used to obtain relevant textural parameters and their regional distribution. The results show that all rock samples are tight fine-grained arkosic sandstones in which mineralogy changes are minor. The dominant grain equivalent diameter varies between 70 µm in the overbank deposits and 160 µm in the channels. In the sand-rich amalgamated sheet deposits, grain size variations are small.

The grain size and sorting distributions thus obtained are used to reconstruct relative porosities and permeabilities at a given stage in the compaction process. A number of such layers are stacked upon each other in a manner that conceptually resembles the field observations. This composite permeability model of a turbidite fan serves as a basis to perform fluid flow simulations to test various reservoir development scenarios.