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Improving Turbidite Geological Models with Borehole Imaging: An Integrated FMI, Cores, and Outcrop Study, Tanqua Karoo, South Africa

In an analogue study of Permian turbidites in the Tanqua Karoo Basin, South Africa, digital outcrop data was compared and integrated with cores and logs obtained from wells. The geological fieldwork resulted in a 3-D digital model that was complemented by three large-diameter wells and four small-diameter wells. These were fully cored and logged with wireline tools. The large-diameter wells include a complete logging suite of standard petrophysical logs (PEX and DSI), as well as geochemical logs (ECS and NGS) and borehole imager (FMI).

Analysis of the FMI borehole images reveals a great variety of sedimentary structures such as cross bedding, ripple lamination, debris flows, slumps, and rip-up clasts. These are found to compare well with core observations and additionally provide directional information, notably on paleocurrent directions. The zonation into turbidites, overbank deposits and shales is also early made and can be performed with an automated computational procedure into which geochemical and petrophysical logs can be integrated. Subtle dip differences reveal stacking patterns within and between fans that reflect progradation and shifting of the depositional system. These findings are integrated into the outcrop model, resulting in a detailed reservoir architecture of very high resolution. Such analogue models can greatly help in understanding turbidite reservoirs and increasing the success rates of development wells.