Passage of a Deep-Water Transitional Flow Across an Uneven Sea Floor - Implications for Bed-Scale Heterogeneity

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Turbidity currents can evolve or partition into turbulence-suppressed flows as they decelerate. The result is a hybrid event bed, part turbidite, part debrite, that can also show evidence for transitional flow behaviour. Such beds are common in the distal and lateral reaches of many sandy fan systems. The turbulence-suppression means that clays are deposited with sand grains rather than segregated into mud caps (Te division of conventional turbidites). Consequently, the reservoir quality of part of the bed may be compromised. The clay distribution and controls on spatial heterogeneity are currently poorly understood. However, situations where single beds can be followed laterally can help address these issues. Outcrops rarely offer more than a 2D view of lateral variability, and the problem with cores is that it is often difficult to correlate m-scale events bed-for-bed between wells.

The Lower Cretaceous (Aptian) Britannia sandstones in the UK North Sea provide a work-around. The densely-drilled platform area of the Britannia Field includes stacked sheet-like beds that can be followed from well to well due to their unusual scale (>10 m thick), presence of marker horizons, the close well spacing, and abundant core. A thick bed (Bed 78) close to the top of the reservoir is particularly instructive. It can be followed over an area of c. 35 km2 and pinches out laterally against an irregular slope to the N and NW. It blanketed a mass-transport complex returning the sea floor to a smooth surface. The flow responsible for Bed 78 is interpreted to have come from the SW along the base of a SE facing confining slope. It triggered instability on and failure of this slope before passing through a narrow constriction on the basin floor produced by earlier slumping. A very thick (14 m), poorly graded sand-rich bed was deposited in the constriction, and downstream of this the flow expanding laterally to deposit a thinner more heterogeneous graded bed. At the same time, parts of the flow were trapped in re-entrants in the northern slope and dynamically ponded by the body of the flow passing to the south. This produced clay-prone beds with complex banded fabrics. The result is a bed with a relatively narrow central thread of clean sand surrounded by poorer quality argillaceous sand reflecting flow deceleration on leaving a constriction, modification by triggered slope failures and isolation of parts of the flow against uneven slope topography.