Styles of Compartmentalization of Deepwater (Turbidite) Reservoirs and Associated Performance Issues

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The three major architectural elements of deepwater (turbidite) reservoirs are sheet sandstones, channel-fill sandstones, and levee/overbank deposits. Each of these elements exhibits a different style of internal compartmentalization, leading to separate issues of reservoir performance.

Sheet sandstones comprise good reservoirs because individual sandstones exhibit long-distance lateral continuity, and usually, relatively good reservoir quality. Packages of sheet sandstones are often separated by laterally continuous, thick shales. These shales---in addition to thinner shales within sandstone packages---vertically compartmentalize a reservoir, and may give rise to multiple fluid contacts. Development wells may be widely spaced owing to the good continuity of sandstones.

Channel-fill sandstones comprise reservoirs of variable performance owing to a high degree of internal complexity. Sandstones are often lenticular, elongate, and are associated with discontinuous shale drapes and multiple scour surfaces. If shale drapes are not abundant, sandstones may be interconnected; but if shale drapes are abundant, internal connectivity will be poor. Fluid flow paths in these rocks are probably tortuous, and there may be multiple fluid contacts. Thus, reservoir performance is difficult to predict and wells might have to be relatively closely spaced.

Levee/overbank deposits are thinly interbedded sandstones/siltstones and mudstones, often referred to as ‘’low resistivity/low contrast pay’ because individual bed thicknesses are beneath the resolution of conventional well logs (but not borehole image logs). Individual thin beds may or may not be laterally continuous for long distances, and they may or may not be truncated by scour surfaces. Thus, fluid flow rates will be variable, and difficult to predict. The boundary between levee/overbank, thin-bedded sequences and adjacent channels is often quite complex, and consists of slides and scoured beds, giving rise to either total lack of, or only partial communication between the channel and adjacent thin-beds. Spacing of development wells will be dependent upon the continuity of the thin-bed packages, as well as their reservoir quality.

Examples are presented of each style of compartmentalization to illustrate the performance issues. Acquisition of quantitative bed continuity and connectivity data on appropriate reservoir analog outcrops provides a means of improving subsurface well performance prediction.