AAPG Annual Convention
Salt Lake City, Utah
May 11-14, 2003

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Fine-Scale 3-D Architecture of a Deepwater Channel Complex

Twelve channel sandstones comprise a 78m thick stratigraphic succession in the deepwater Dad Sandstone Member, Lewis Shale, Wyoming. This succession was characterized by 128 closely-spaced detailed measured sections, dm-scale GPS-tracing of bed boundaries, drilling/gamma-logging of 8 shallow boreholes, and ground-penetrating-radar (GPR) behind outcrop. A 3-D facies/architectural model was built using GOCAD TM.

Channel sandstones are separated by thin-bedded, very-fine sandstone/mudstone strata. Channel facies include massive-sandstone, rippled-sandstone, cross-bedded sandstone, sandstone with fluid-escape structures, shale-clast conglomerate, and thin-bedded sandstone/mudstone. These facies can be complexly interbedded, with a tendency for shale-clast conglomerates to comprise the base and one side of a channel-fill, whereas cross-bedded sandstones comprise the other. Massive/fluid escape structured sandstones occupy the top of successions. Proximal to distal levee beds occur adjacent to some channel sandstone outcrops.

This facies distribution, coupled with GPR, suggests the sandstones filled sinuous channels. Shale-clast conglomerates form by adjacent levee walls slumping from steep channel margins, while cross-bedded sandstones are interpreted as in-channel bar forms. These channels fed sand into the deeper basin contemporaneously with levee formation; channel sandstones were deposited during later backfilling. The slumped/erosive nature of some channel margins support this interpretation. In some locations, sandstones grade into thin-bedded facies over short distances, suggesting sinuosity into the outcrop. GPR has confirmed one such channel bend.

This 3-D outcrop characterization provides an excellent analog for leveed-channel reservoirs. The complex vertical stratigraphy creates mutually isolated reservoirs. Channel-fill and adjacent levee thin-bed discontinuities may lead to tortuous fluid flow paths and create differential pressures in analog reservoirs.