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Fine Scale 3D Architectural Model of a Submarine Slope Channel Complex Projected onto a High-Resolution Seismic Image

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ABSTRACT

Ten channel-fill sandstones comprise a 255ft thick stratigraphic succession in the deepwater Dad Sandstone Member, Lewis Shale, Wyoming. This succession has been characterized by measuring 121 closely-spaced outcrop stratigraphic sections, decimeter-scale GPS-tracing (Global Positioning System) of bed boundaries, drilling and gamma-logging of 8 shallow boreholes, ground-penetrating radar (GPR), and electro-magnetic induction (EMI) behind the outcrops. A 3D facies and architectural model was built using GOCAD TM. In addition, high-resolution, shallow seismic has been shot behind outcrop to capture the sinuous geometry of the meandering slope channels. This paper hopes to capture the nature of each channel's sinuosity and describes the process and workflow carried out to do so properly.

Each channel-fill sandstone is separated by thin-bedded, very fine sandstone/mudstone strata. Channel facies include structureless sandstone with fluid escape structures, structureless sandstone without fluid escape structures, rippled to climbing rippled sandstone, parallel to subparallel laminated sandstone, cross-bedded sandstone, shale-clast conglomerate, thin-bedded sandstone/mudstone, and slumped beds. In separate channel-fill sandstone, these facies can be complexly interbedded, but there is a tendency for shale-clast conglomerates to comprise the base and one side of a channel-fill, whereas cross-bedded sandstones comprise the opposite side. Massive/fluid escape structured sandstones typically occupy the top of these successions. Proximal to distal levee beds occur adjacent to some of the channel sandstones.

This distribution of facies, coupled with GPR data, suggests the sandstones filled sinuous channels. The shale-clast conglomerates are thought to be the product of slumping of adjacent levee walls from the steeper channel margin, and the cross-bedded sandstones are interpreted to be in-channel bar or dune forms. These channels probably fed sand into the deeper basin contemporaneously with levee formation; the channel-fill sandstones represent the product of later backfilling episodes. The slumped and erosive nature of some channel margins support this interpretation.

This 3D outcrop characterization provides an excellent, scaled analog for leveed channel reservoirs. The complex vertical stratigraphy indicates individual channel sandstones can be mutually isolated reservoirs. The complex internal channel sandstone distribution indicates internal reservoir fluid flow will also be complex. A figure illustrating the relation of channel-fill sandstone sinuosity relative to one another in outcrop has also been created.