Process and Architectural Evolution During Deltaic Cross-Shelf Transits - Fox Hills Deltas, Washakie Basin, Wyoming

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The topset compartments of two Maastrichtian clinothem complexes (C9 and C10) are characterized for the role they played in constructing the Lance-Fox Hills-Lewis shelf-margin prism and infilling of the Washakie and Great Divide basins. About 800 well logs have been used to map the deltaic complexes on the Fox Hills shelf and to detail their dimensions, orientation and facies as they autogenically shifted during repeated cross-shelf transits. The regressive transits of the deltas initiated up to 50 km back from the shelf edge and preserved river and wave-dominated deltaic deposits that thicken and concentrate sand on the outer shelf. At the shelf edge, tidally influenced deltas are also present. Sand isopach maps of the topset deposits show that (1) there are coeval delta lobes suggesting multiple rivers, (2) delta complexes have a likely autogenic compensational stacking pattern, and (3) wave-dominated deltas become more common closer to the shelf edge.

Several deltaic complexes have been mapped within the regressive segment of clinothem 9. The inner shelf deltas are progradational with a rising shoreline trajectory, downlap onto older marine mudstones on the shelf, and pinch out before reaching the outer shelf. Sand isopach maps display a lobate-elongate geometry suggesting fluvial and/or tidal dominated deltas. In contrast, the mid-to-outer shelf deltas have a strike-elongate pattern suggesting a wave-dominated control. The youngest deltaic complex reaches the shelf edge and is top truncated by a tidal ravinement surface. The thickness of the mapped deltaic compartments varies from 19 to 26 m and in general the deltas thicken towards the shelf edge. The delta overall progradation rate, based on a duration estimate of about 100 ky/clinothem was some 55 km/ky, significantly higher than the 4.7 km/100 ky of shelf-edge progradation.

Such dynamics of the depositional environments was also observed in extended outcrops where the dominant depositional processes change over a distance of a few kilometers from river to wave dominated. Outcrops (C10) also show the presence of tidally influenced shelf-edge deltas in areas where wave influence is reduced and there may be confinement at the shelf edge. Our results support the idea that there are predictable process and architectural changes as deltas transit from the inner to the outer shelf, as well as along strike, and therefore delta reservoirs are highly dynamic in their external shape and internal character.