Detached Fine-Grained Shelf Edge Wedges Within Shale Dominated Successions, Depositional Model and Reservoir Significance

Pedersen, Per K.[1]; Macquaker, Joe H.[2]; Hart, Bruce [3] (1) Department of Geoscience, University of Calgary, Calgary, AB, Canada. (2) Department of Earth Sciences, Memorial University of Newfoundland, St. John's, NF, Canada. (3) ConocoPhillips, Houston, TX.

Detailed mapping of markers and flooding surfaces using well logs and cores within thick shale-dominated shelfal successions reveals a complex internal architecture. Within the shale succession, detached wedges of relative steeply dipping clinoforms form distinct units. These wedges are characterized by offlap onto the shelf break of older clinoforms, and an internal architecture of relative steeply to slightly aggrading basinward prograding clinoforms. Cores of these wedges show them to be variably sandy or silty within a shale dominated succession. Bioturbation can be pervasive, essentially destroying all primary sedimentary structures while mixing all available grain sizes. Alternatively, silt and very fine grained sandstone may be present as laminae and very thin (<2 cm thick) beds. In these latter cases, bedforms are dominated by current ripples, often forming discontinuous starved ripples, with minor wave ripples and wavy laminae, suggesting deposition above storm wave base but below fair weather base. These sand- or silt-rich units are sharply overlain by more clay-rich strata. We propose that these wedges of fine grained strata were essentially deposited as wedges that were detached from the coeval shoreline. Under some combinations of shelf physiography, sea level and other variables, the inner shelf can become a sediment bypass zone. Modern analogs are generally developed in shelf-margin settings, whereas the Western Interior Seaway is generally assumed to have been a ramp, without a well-developed shelf margin. In this and other cases, the requisite seafloor topography to generate prograding detached wedges could be associated with basement structural features, differential compaction over underlying strata, or some other mechanism.

These shoreline detached fine grained wedges form several shallow gas pools in southern Alberta and Saskatchewan, where wedges of thin bedded silt and very fine grained sand form prolific reservoir intervals with a thick upper Cretaceous shale dominated succession. Similar geometries are observed in the Cretaceous Lewis Shale of the San Juan Basin. In that case, pervasively bioturbated clinoforming strata of the Lewis form the most productive strata. In both cases, the production trends are perpendicular to the direction of clinoform progradation. Identification of clinoforms in detached fine-grained wedges can be an important exploration and development tool for stratigraphically controlled, fine-grained reservoirs.