

Stratigraphic Relationship Between Tide Dominated Valley Fill Successions & Wave Dominated Deltaic Strata Upper McMurray – South Athabasca, Alberta

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ABSTRACT

Upper McMurray strata are a complex assemblage of wave-influenced deltaic and tidally-influenced channel sediments. Three regionally mappable stratigraphic units comprise the Upper McMurray. Transgressive brackish marine mudstones (marine flooding events) and overlying progradational deltaic successions comprise both the upper and lower stratigraphic units, McMurray A and McMurray C respectively (McMurray A and McMurray B2 EUB designations). The middle stratigraphic unit of the Upper McMurray; the McMurray B (McMurray B1 – EUB designation) is a retrogradational, shallow water, wave influenced deltaic assemblage.

The top of the McMurray C is an unconformity marked locally by well-developed soils and regionally by truncation of progradational deltaic sediments (Upper McMurray unconformity). Valleys, incised from this boundary, are filled with tidally influenced meandering channel sediments. Meandering channel sedimentation, in some paleovalleys, terminated with onset of McMurray B deltaic sedimentation, while in others, meandering channel sedimentation continued into and was, at least in part, coeval with McMurray B sedimentation. The upper boundary of the McMurray B is a ravinement surface at the base of lower shoreface to shallow shelf sediments of the McMurray A flooding event. Progradational deltaic sediments, forming the upper portion of the McMurray A, are truncated regionally by an unconformity at the base of the Wabiskaw Formation.

Wave influenced deltaic sediments of the McMurray C are highstand progradational deposits that overlie a maximum flooding surface (McMurray C mudstone). The unconformity at the top of the McMurray C is a sequence boundary. Estuarine valley fill sediments and back-stepping deltaic strata that comprise the McMurray B overlie this sequence boundary. During the early stages of transgression, tidal currents were amplified in paleovalleys resulting in tidally influenced channel sedimentation. Continued base level rise resulted in expansion of deposition beyond paleovalleys onto interfluves. Morphological expansion resulted in an increase in wave energy relative to tidal energy. Wave dominance on sedimentation was expressed as McMurray B wave influenced deltaic sedimentation that onlaps the Upper McMurray sequence boundary. Channels, no longer confined to paleovalleys, acted as conduits for sediment delivered to the deltaic flood plain and shoreline. Channels seaward of the back-stepping shoreline were capped by prodelta deposits. Landward of the deltaic

shoreline, channels abandoned prior to McMurray B flooding were capped by floodplain sediments. McMurray B sediments represent an initial flooding prior to the maximum flooding recorded by the McMurray A mudstone. Deltaic sediments, above the McMurray A mudstone, are a progradational package that downlaps onto the McMurray A mudstone. A regional unconformity at the base of the overlying Wabiskaw Formation (Wabiskaw unconformity) truncates McMurray A sediments.

The McMurray C is the upper regressive portion of a T-R sequence. The basal McMurray C brackish marine mudstone records maximum flooding while overlying deltaic sediments represent highstand progradation. The unconformity capping the McMurray C is a sequence boundary formed as a result of base level fall. McMurray B strata, above the unconformity, comprise the transgressive portion of the succeeding T-R sequence. McMurray B sediments accumulated in response to an initial flooding event within an overall transgression that culminated in the maximum flooding event recorded by the McMurray A mudstone. The regressive portion of this T-R sequence (McMurray A wave dominated deltaic sediments) record highstand progradation. Base level lowering following highstand progradation produced the Wabiskaw unconformity, the upper boundary of the T-R sequence.