# Does One Model Fit All? Exploring Factors that Influence the Stratigraphic Evolution of a Deep-Water Channel-Levee Complex System

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## Abstract

At the Castle Creek study area (British Columbia, Canada), a superbly exposed leveed-channel system (Isaac channel complex set 1; ICC1) crops out. ICC1 overlies a sequence boundary that separates a mixed carbonate-siliciclastic succession (FIC) from siliciclastic strata of ICC1, which is 220 m-thick and exposed 5 km along strike. ICC1 consists of two vertically-stacked complexes (LC and UC), the latter being subdivided into three channel units (UC1-3). Detailed documentation of lithological attributes and stratigraphic relationships of inter- and intra-channel fills allows for an examination of the complex history of erosion and deposition in a leveed slope-channel system. Additionally, these data can test the generally held concept that deep-marine slope channels show a systematic temporal evolution from lateral channel accretion to aggradation ("hockey-stick" model). Siliciclastic strata of LC are confined to the southeast part of the study area where it overlies an erosion surface incised at least 30 m into older FIC strata. LC comprises nested channel fills, each about 15 m thick with well-developed upward and lateral fining and thinning. UC, in contrast, is 95 m thick and crops out across the entire study area. UC1 and UC2 are, respectively, 50 m and 25 m thick, bounded by levee deposits, and exhibit common cut and fill features suggesting multiple erosively juxtaposed channel fills. UC1 is dominated by coarse-grained, graded, massive and cross-stratified sandstone with little upward or lateral change in facies. UC2, on the other hand, comprises nested channel fills (10 m thick) of coarse-grained

sandstone that progressively fine and thin upward and laterally. In turn, UC3 (30 m thick) comprises laterally-offset-stacked channels (10-15 m thick) filled with coarse-grained strata that show only minor vertical or lateral change in grain size. Channel bases are flat except on one side where they erosionally onlap outer bend levee deposits. LC through UC2 consist of a disorganized stack of aggradational channel fills exhibiting negligible lateral accretion of individual channels. In contrast, single UC3 channels show well-developed lateral accretion with an organized lateral-offset-stacking channel pattern and noticeable aggradation. Collectively, these observations contrast the pattern predicted by the hockey-stick model and illustrate the need for a better understanding of the spatial and temporal sedimentary variables that control channel and associated levee sedimentation.