Architectural Analysis and Evolution of a Deep-Marine Channel-Levee Complex: The Lower Isaac Formation, Southwestern Canadian Cordillera

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Channel 3 of the Issac Formation in the southern Canadian Cordillera is a deep-water leveed channel system that is up to 90 m thick and extends laterally for at least 1.6 km. It overlies an extensive debrite, which in turn is locally overlain by an incipient overbank lobe. These underlying deposits helped focus subsequent flows that ultimately localized and promoted the development of Channel 3. This channel complex comprises four channel-fill units bounded on both sides by genetically-related levee deposits. Field observations suggest that each channel-levee unit developed in three stages. The first stage of channel formation was characterized by low channel confinement that enabled the lower, higher concentrated part of turbidity currents to overspill. This resulted in relatively sand-rich levee deposition especially on the outer-bend proximal levee. Within the channel, the majority of sediment was transported further basinward leaving behind bypass deposits (i.e. thin-bedded or coarse lags). The second stage was distinguished by continued levee growth, and as a consequence only the upper, more dilute fraction of flows were able to overspill. These dilute overbanking flows deposited fine-grained, thin-bedded strata on both the outer- and inner-bend levees. Moreover, the onset of channel filling occurred during this stage and generally consists of highly-amalgamated, thick-bedded conglomerate and dispersed pebbly sandstone. The third and last stage was marked by significant channel aggradation along with decreased levee aggradation. Channel-fill deposits throughout this stage are commonly composed of amalgamated sandstone in the channel axis that change laterally to less amalgamated, more interbedded sandstone and thin-bedded, fine-grained turbidites toward the channel margins.

Stages 1, 2 and 3 form a depositional continuum that was repeated at least 3 times in connection with the lateral shifting of the channel axis. Cut bank erosion, associated with the shifting of the channel axis, along with channel aggradation produced a composite terraced geometry along the outer-bend channel margin sharply separating levee and channel-fill deposits. Furthermore, a change in channel configuration is inferred by the upward change in stratal architecture of the inner-bend levee. For example, the lower part of the inner-bend levee is truncated by the channel margin suggesting an association with an earlier, more erosive braided nature of the channel. In contrast, the upper part, wherein channel fill deposits interfinger with fine-grained levee deposits, suggests deposition on the lower-energy inner-bend levee of a sinuous channel.