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Braided river deposit geometry and the morpho-dynamics of confluences

J.T. Gardner (1,2) and P. Ashmore (1)

(1) Department of Geography, University of Western Ontario, London, Canada (pashmore@uwo.ca), (2) Stantec Consulting, 4370 Dominion Street , Burnaby BC, Canada

River bed deposit (set) thickness reflects the river bed topography and the rate of sediment deposition relative to the transport rate. In the case of non-aggrading rivers the frequency distribution of bed elevation is the primary control on set thickness and preserved deposit geometry will reflect the amplitude of the river topography and the channel morpho-dynamic processes. However, in braided rivers, data on the geometry of the deposit bounding surfaces, and their relationship to channel morphology and processes, remains limited. Scour at channel confluences is likely to exert strong control on deposit thickness because confluences are the areas of greatest erosion depth and may migrate to form extensive scour surfaces. A more general consequence is that confluence deposits may comprise a large proportion of the preserved river deposits overall.

Analysis of three-dimensional deposit geometry, its development over time, and its relation to channel morpho-dynamics requires monitoring of the evolution of river deposit geometry in relation to the fluvial processes forming the deposit. This has proved difficult because of the length of time over which the deposit forms and the absence of methods for monitoring deposit geometry as it develops. The limitations of the time of development can be overcome by using small-scale physical models. However, many physical model experiments have been done in net-depositional environments and consequently the relationship between river morpho-dynamics and deposit geometry has not been assessed for the lower (limiting) condition of no net aggradation. Close-range photogrammetric techniques are a cost-effective approach to acquiring high-resolution digital elevation models (DEMs). The combination of physical modeling and close-range photogrammetry makes it possible to acquire high temporal resolution 3-D data for analysis of a sequence of DEMs which yields new information on deposit geometry in relation to river morphology. We use 3-D photogrammetry and image analysis to re-create the deposit geometry of a braided river over geomorphologically significant time scales. We show the topography and time-development of the upper and lower bounding surfaces of the river deposit and the river bed as a whole. The morphology and kinetics of confluences are mapped to illustrate their spatial influence as well as their contribution to the geometry of the minimum surface and to the deposit thickness and geometry. The DEMs can also be used to characterize river bed kinetics, and volumetric rates and patterns of erosion and deposition