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Using helicopter-based laser scanning to analyse controls on fluvial channel belt architecture in the Blackhawk Formation, eastern Utah, USA

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During the last decade terrestrial lidar (laser scanning) has become a standard tool in sedimentology for the collection of accurate, geometrically constrained, spatial information on small (c. 1-5 km) outcrops. To investigate controls on larger scale fluvial sandbody architecture, oblique helicopter-mounted lidar combined with a very high resolution digital camera has been used to collect data from two very large outcrops (each >10 km in extent). These outcrops include the fluvial parts of the Blackhawk Formation in eastern Utah, USA that are otherwise inaccessible. The resulting photorealistic and georeferenced virtual outcrops have then been used to interpret fluvial stacking patterns and their controls.

The investigated part of the non-marine Blackhawk Formation was deposited on a coastal plain during an overall regression of the Cretaceous Western Interior Seaway. To allow for down-dip comparison, two intervals from either side of the San Rafael Swell were studied. The Wasatch Plateau section is $\sim$250 m thick and was deposited in the fore-deep c. 60 km from the contemporaneous Sevier thrust front which is the source of the sediments deposited in the area. The second section represents a depositional-strike section of the Beckwith Plateau (part of the Book Cliffs), 70 km further east (down dip), with a thickness of 40-50 m, much thinner than the Wasatch section.

A series of datums (i.e. underlying shorefaces) have been used to enable comparison of sandbodies at various stratigraphic levels. Dimensions of several hundred individual single- and multistory channels have been measured in order to empirically investigate lateral and vertical controls on large scale geometry and stacking patterns. The measured values have then been corrected for flow direction. Analysis of the corrected data shows that systematic changes exist both vertically and laterally over very large distances. Channels become smaller and more ordered down depositional dip, while vertical trends show an upward widening of individual channels and channel belts in both sections. This is interpreted to be the stratigraphic record of a very large scale DFS (distributary fluvial system).

The numerical results of this study can now readily be used as robust input data for reservoir modeling for analogous oil and gas reservoirs, while for valid predictions of reservoir behaviour and performance, understanding the sedimentary controls of a depositional area is critical. The data presented from this study represent an important step towards that major goal.