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Quantification and Prediction of Braided Fluvial Systems using Digital Outcrop Models

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The application of UAV-collected digital outcrop model investigation is quantitatively evaluated using a set of fluvial case studies to produce predictive braided fluvial system metrics. Data collection techniques are examined to demonstrate their utility for collating meaningful and reliable statistical information needed to build process-controlled reservoir models. Quantifiable accuracies are required to build a large geostatistical dataset and evaluate the common metrics of braided fluvial system deposits, derived from a suite of case studies. Typical data collection methods are largely restricted by ease of access, or to using remote observations with limited accuracy, such as photographic methods. Digital data collection techniques such as LiDAR (Light Detection and Ranging), differential GPS and UAV-mounted Structure from Motion photogrammetry allow more accurate measurements, also from previously inaccessible locations, to be taken of sedimentary architectures. High-density, classified point clouds and photogrammetric models were generated in Agisoft Photoscan Pro, before being statistically interrogated in Virtual Reality Geoscience (VRGS). This generates many more measurements, as the area from which accurate data can be extracted is increased, providing a more meaningful statistical dataset and reducing uncertainty in the final reservoir model. Case studies of the Carboniferous Millstone Grit Group, UK, Triassic Sherwood Sandstone Group, UK and Late Triassic Wolfville Formation, Canada are well developed braided fluvial systems, widespread within basinal depocenters. Quantitative data comparisons of system architectures and relative facies proportions across an entire braided fluvial system provide robust metrics for reservoir model population, and inter-well prediction. In all cases, periods of deposition are concentrated within ‘intra-belt’ zones, reducing statistical probabilities of finding similar strata elsewhere in the braidplain at that given time. The results provide a statistical, three-dimensional framework to interrogate braided fluvial systems more quantitatively, to guide subsequent reservoir modelling processes based on metrics and processes, rather than architectural geometries. These case studies show how UAV data collection is invaluable to more completely assess reservoir intervals, at greater speed, with more accurate results for quantifying and predicting facies distribution within a braided fluvial system.