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Analysis of the Metre-Scale Depositional Architecture of the Montney Fm. in Outcrop using UAV Technology: Implications for Sedimentology and Fracture Stratigraphy

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Summary

Although the Montney Fm. hosts one of Canada's largest unconventional plays, the depositional architecture of this formation remains poorly understood. The formation consists of approximately 300 metres of siltstone to very-fine sandstone that is highly uniform in both grain size and composition, making it difficult to correlate in the subsurface using cores and well logs. The outcrop used in this study is an exceptional exposure of the Triassic Montney-equivalent Sulphur Mountain Fm., exhibiting over 150 metres of stratigraphy and up to 2 kilometres of lateral exposure. The outcrop was analyzed using drone photography and photogrammetry to study the depositional fabric of the various sedimentary environments preserved at this outcrop. Images of the outcrop have been captured using a Phantom 4 Pro UAV (unmanned aerial vehicle), and a 3D point cloud model of the outcrop was created using Pix4D software. Orthomosaic images were created by projecting the outcrop on to a flat plane perpendicular to bedding and are used to create detailed line drawings of the formation's depositional architecture (Figure 1). Sedimentological sections have been measured on the outcrop, and both spectral gamma ray and samples for XRF have been collected on the section. The outcrop displays sediments deposited in basin floor, slope, shelf, and shoreface environments. Although the consistently fine-grained nature of this formation can make these environments difficult to differentiate in core or well logs, differences in the bedding geometry and meter-scale facies architecture can be readily identified on the orthomosaic images. The various bedding geometries observed, including tabular bedding, undulose/scoured bedding, and channel-form sands, imply differences in water depth, accommodation, or energy source (current vs. oscillatory), and are combined with observed smaller-scale bedforms (current ripples, wave ripples, hummocky-swaley cross stratification, convolute bedding) to better constrain the depositional model. The implications of this study include a detailed understanding the architecture of the different depositional systems, which in turn allow us to better evaluate and constrain the sequence stratigraphic framework of the formation. This work may also serve to inform subsurface reservoir models as to the typical dimensions and lateral continuity of flow units, and how natural fracture networks and mechanical stratigraphy is affected by the depositional fabric.

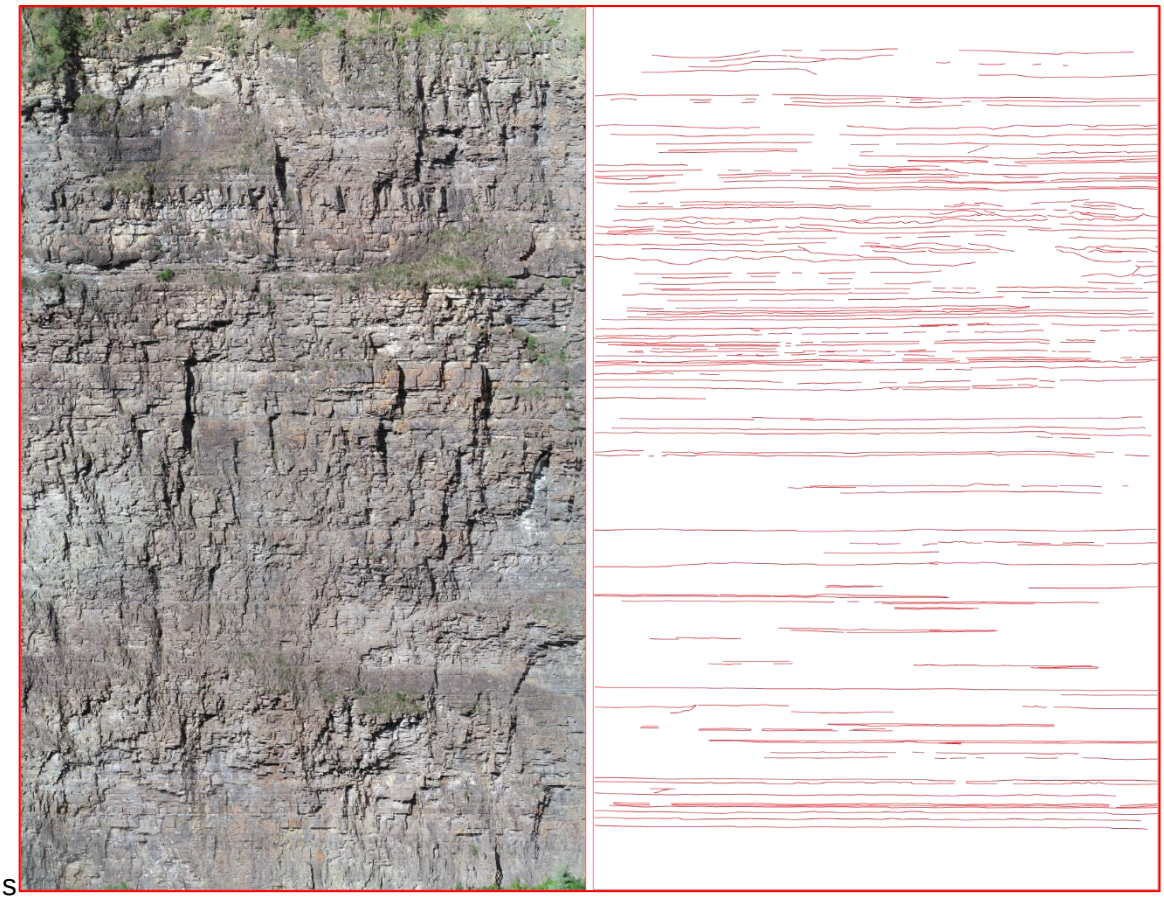
s 

Figure 1. Left: Outcrop orthomosaic of the Sulphur Mountain Formation. Right: Stratigraphic line drawing of the outcrop shown to the left, demonstrating the variable bedding geometries within the section.

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