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Reconstructing Ancient Fluvial Environments at the Balmville and Dingo Gap Outcrops, Gale Crater, Mars

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Abstract:

Since leaving Yellowknife Bay, the Mars Science Laboratory (MSL) Curiosity rover has investigated a number of sedimentary outcrops along the traverse. Here we present the depositional history of two outcrops known as Balmville and Dingo Gap, investigated during sols 508 to 538. Balmville represents the first opportunity for close-range imaging of a unique geologic unit that was identified in orbital mapping, characterized by northeast-southwest trending striations. At Balmville the beds that produce the striated appearance dip towards the north. We use both orbital observations and in-situ observations from Curiosity to compare the orientation, spacing and dip direction of the striations at Balmville to the Kimberley outcrop, where this unit was investigated in detail, and we present several hypotheses for the origin of the striations. Shortly after Balmville, the MSL drive strategy shifted from driving on the topographic high areas to the topographic low areas. The result was a unique vantage point while driving through a valley with several meters of stratigraphy on either side of the rover, revealing approximate cross-sections. Dingo Gap and Moonlight Valley expose ~3 m of stratigraphic section. We explore the diversity of facies exposed here, including coarse-grained conglomerates, cross-stratified sandstones, fine-grained evenly laminated sandstones and massive fining upward facies. However, the stratigraphy on north and south walls of the valley are not the same, despite being separated by only a couple 10s of m. We explore several depositional models to account for these differences. The stratigraphy exposed at Dingo Gap can also be compared to other stratigraphic sections taken at waypoints known as Darwin, Cooperstown, Kylie, and Kimberley for regional correlations.

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