A ROCK RECORD OF COMPLEX HESPERIAN AEOLIAN BEDFORMS IN GALE CRATER, MARS.

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Introduction: The history of the Martian climate is recorded in Mars’ fragmentary rock record. By understanding the processes in which these rocks were deposited and the conditions required to preserve them, the environment of deposition and the regional climate can be inferred. The Stimson formation, Gale crater, Mars is dominated by an aeolian sandstone facies that accumulated on an erosional unconformity stratigraphically above the lacustrine Murray formation. By reconstructing the ancient dunes represented by the Stimson formation, insight can be gained to the size of the ancient dune field and the regional climate at the time of deposition.

Between Sols 987 and 1454, the Mars Science Laboratory rover Curiosity was used to examine outcrops of the Stimson formation; the team documented the nature and distribution of facies within this aeolian sandstone to determine the origin, depositional processes, stratigraphic relationships, and the regional palaeoclimate at time of deposition.

Figure 1: Map of the distribution of Stimson outcrops.

Emerson Plateau: The northern most outcrops (Sols 987-1055) occur within the Emerson plateau area (Figure 1). They are characterized predominantly by simple metre-scale cross sets, up to 1 m thick (Figure 2). These sets are bounded by decametre-length sub-horizontal bounding surfaces, which are interpreted to be interdune surfaces [1] (1st order bounding surface [2,3]). No fine-grained interdune deposits were observed in this region. Internally, these cross sets consist of uniform laminations with thicknesses up to 4 mm which are interpreted as grain fall and windripple strata, with no evidence for grainflow strata observed. Textural analysis of grains using the Mars Hand Lens Imager showed bimodally-sorted, well rounded grains, suggesting aeolian processes. Cross set dip-azimuths across the Emerson Plateau record a dominant sediment transport direction toward the north east.

Murray Buttes: The southern outcrops, in the Murray Buttes (Figure 1) are characterized by compound cross sets (cosets), with measured thicknesses up to 4 m (Figure 2). Coset bounding surfaces are formed by sub-horizontal bounding surfaces, which can be traced laterally across the width of many of the buttes; these are interpreted to be interdune surfaces. Bounding surfaces which are inclined relative to the interdune surfaces, which bound cross sets ~1 m thick can be identified; these are interpreted to be superposition surfaces (2nd order surfaces [2,3]. These smaller cross sets contain cross laminations with a similar visual expression and apparent uniform thickness as those observed in the Emerson Plateau. No evidence of fine-grained interdune deposits, or damp aeolian processes were recorded in the Murray Buttes. Interdune surfaces are interpreted to have formed by passage of a scour pit preceding a migrating draa-scale bedform (a complex or compound dune), with superposition surfaces formed by scouring.
as transiting superimposed dunes crossed the lee slope of the draa. The superposition surfaces record the orientation of the draa’s lee slope, and can be used to determine migration direction for the draas, while the cross lamination dip-azimuth can be used to determine sediment transport direction in the superimposed bedforms. In the Murray Buttes, draas migrated toward the north-north-west, while superimposed bedforms migrated to the north east.

**Reconstruction:** The traverse across and among the outcrops of the Stimson formation using the Curiosity rover records a transect from the margin to the centre of a dry aeolian dune field. The outcrop at Emerson Plateau represents a more distal section of the erg, characterized by simple dunes approximately 10 m high, with wavelengths of ~160 m. The outcrops at the Murray Buttes represents a central part of an erg, where draas with heights upto 60 m, and wavelengths up to 900 m were present. Superimposed bedforms migrated obliquely across the lee slope of the draas indicating a complex wind regime.