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Aeolian sedimentary processes at the Bagnold Dunes, Mars: Implications for modern dune dynamics and sedimentary structures in the aeolian stratigraphic record of Mars

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Wind-blown sand dunes are ubiquitous on the surface of Mars and are a recognized component of the martian stratigraphic record. Our current knowledge of the aeolian sedimentary processes that determine dune morphology, drive dune dynamics, and create aeolian cross-stratification are based upon orbital studies of ripple and dune morphodynamics, rover observations of stratification on Mars, Earth analogs, and experimental and theoretical studies of sand movement under Martian conditions. In-situ observations of sand dunes (informally called the Bagnold Dunes) by Curiosity Rover in Gale Crater, Mars provide the first opportunity to make observations of dunes from the grain-to-dune scale thereby filling the gap in knowledge between theory and orbital observations and refining our understanding of the martian aeolian stratigraphic record. We use the suite of cameras on Curiosity, including Navigation Camera (Navcam), Mast Camera (Mastcam) and Mars Hand Lens Imager (MAHLI), to make observations of the Bagnold Dunes. Measurements of sedimentary structures are made where stereo images are available. Observations indicate that structures generated by gravity-driven processes on the dune lee slopes, such as grainflow and grainfall, are similar to the suite of aeolian sedimentary structures observed on Earth and should be present and recognizable in Mars' aeolian stratigraphic record. Structures formed by traction-driven processes deviate significantly from those found on Earth. The dune hosts centimeter-scale wind ripples and large, meter-scale ripples, which are not found on Earth. The large ripples migrate across the depositional, lee slopes of the dune, which implies that these structures should be present in Mars' stratigraphic record and may appear similar to compound-dune stratification.The Mars Science Laboratory Curiosity Rover Team is acknowledged for their support of this work.