AEOLIAN PROCESSES AND DUNE MORPHOLOGY IN GALE CRATER. S. W. Hobbs[1], D. J. Paull[2], M. C. Bourke[3]
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Introduction: Seven aeolian dune fields within Gale Crater follow the low lying areas around the 5.1 km high central mound. These include a large sand sea situated between the western crater wall and the central mound and dune fields north, east and south of the central mound. The extent of these features indicates that aeolian dune field construction and migration has been a significant process in the most recent geomorphology of Gale Crater.

The aim of this work is to provide an estimate of formative wind directions derived from dune morphology and to compare those with mesoscale model results. This data is used to show the importance of topographical features in influencing dune morphology [1]. Most previous intra crater dune field studies have focused on craters with relatively flat interiors [2]. Additionally this work will determine the composition and probable source of the aeolian dune sediment. This will enhance understanding of sediment pathways between intercrater dune fields.

Datasets and Methods:

Thermal Inertia. Thermal inertia measurements on the dune fields and the central mound were performed using THEMIS data (100m/pixel) in order to estimate grain size.

Dune slip-face measurements. Measurements of 467 dune slip-faces were undertaken from HIRISE and CTX images. Slip-faces orientation is used to indicate formative wind directions [3].

Mesoscale modeling. Small scale topographic effects on wind direction were also assessed using mesoscale modelling of the Gale Crater region by Mars Atmospheric Model System (MRAMS) previous. MRAMS was set up by NASA AMES to simulate a Martian dust storm as these conditions are ideal for generating wind velocities high enough to saltate Martian sand [4]. The MRAMs data comprised a two dimensional near surface simulation of 144 time intervals, with a horizontal grid spacing of 3.75 km.

Results and Discussion: Analysis of the Gale Crater dune fields has revealed a complex topographically driven wind regime. Our thermal inertia analysis has detected a wider range of aeolian sediment sizes for discrete dune fields in Gale Crater than have been previously determined. Thermal inertia studies of the dune sediment indicated they comprise material that is predominantly coarse to very coarse sand (330 - 530 $Jm^{-2}K^{-1}s^{-1/2}$). Although a significant deposit of smaller size particles (240-330 $Jm^{-2}K^{-1}s^{-1/2}$), was found, all analysed particle sizes fall within ranges typical of intracrater dunes [5]. By contrast thermal inertia values for the central mound range from very fine sand at the top of the peak to very coarse sand at the base. Granules and pebble particle size ranges from a sharp delineation around the peak, correlating with the rough terrain in this region.

Slip face orientation mapping of the dune fields revealed a dominant prevailing north-north-west wind that has been accelerated and channeled by a regional topography which includes features such as the crater wall and central mound. This topographically influenced wind acts to transport sediment from a probable source external to the crater, over the crater wall and around the central mound to coalesce into the western sand sea and other topographic lows. A southerly wind direction has also modified dunes to the south of Gale Crater, particularly at a channel mouth located adjacent to the western sand sea.

Mesoscale modeling generated northern and southern winds, as well as the topographically diverted winds. The correlation between dune orientation and the mesoscale model suggest that that the dune morphologies could be developed under the present Martian climatic conditions. The central mound, while providing a key role in shaping wind flows in the crater is unlikely to have been a source of the aeolian sediment.

Conclusions

1. A wider range of aeolian sediment sizes for discrete dune fields in Gale Crater have been identified than previously determined. Most dunes are composed of coarse to very coarse sand. One southern dune field is composed of medium sand.
2. Thermal inertia values for the central mound suggest grain sizes that range from very fine sand at the top to very coarse sand at the base.
3. The central mound is unlikely to have been a source of the aeolian sediment. A source external to the crater is more likely.
4. The wind regime in Gale Crater is dominated by topographic influences.
5. The correlation between dune slip face orientation and the mesoscale model results suggest that that the dune fields could be developed under the present Martian climatic conditions.

References: [1] Breed C. S. et al. (1979) *JGR, 84,* 8183–8204. [2] Fenton, L.K., (2006) *JGR Let, 33,* L20201. [3] Fenton L.K., (2003) *Calif Inst Tech*. [4] Sullivan R. and Bandfield D. (2005) *AGU*, Abstract #H31G-02. [5] Tirsch D. and Jaumann R (2008) *LPS XXIX*, Abstract #7006.

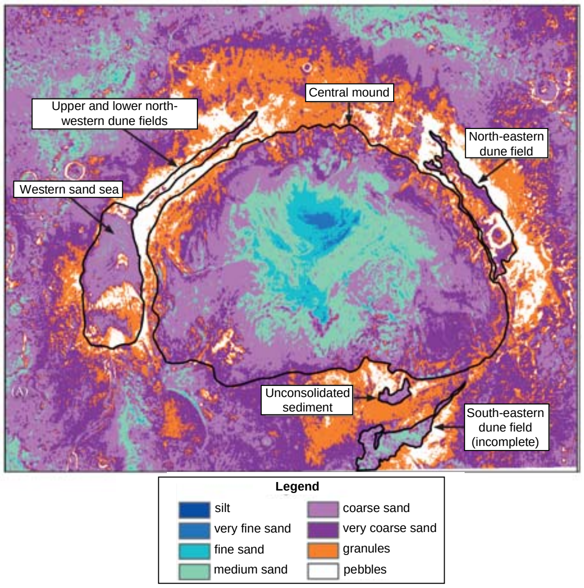

Figure 1: *Thermal inertia measurements of Gale Crater, including the aeolian features and the central mound. Note the coarse – very coarse sand values of most of the dune fields and medium sand values of the south-eastern dune field. Thermal inertia coverage wasn't present for dune fields to the south and south-west of the central mound.*

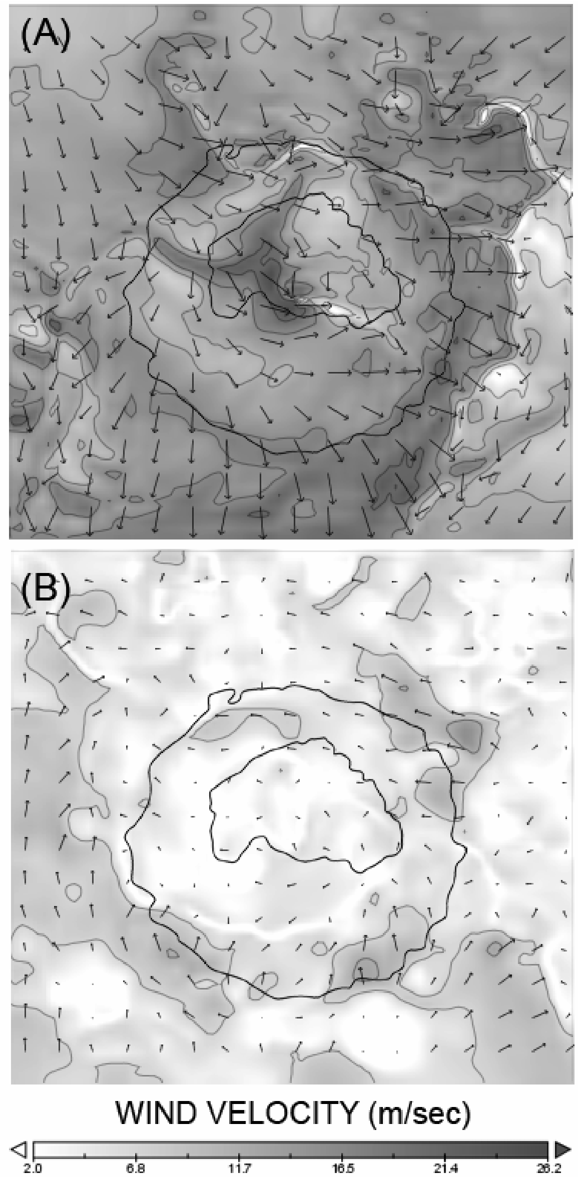

Figure 2: *Mesoscale modeling of Gale Crater showing the two major wind directions acting on the crater.* ***(a)*** *north-north-west trending winds* ***(b)*** *south trending winds*