**EFFECT OF WIND REGIME ON GEOMORPHOLOGY OF RUSSELL CRATER FLOOR ON MARS.** M. Ju[1,2] and K. Seelos[2], [1]University of Rochester, Rochester, NY (mju2@u.rochester.edu), [2]Johns Hopkins Applied Physics Laboratory, Laurel, MD (kim.seelos@jhuapl.edu).

**Introduction:** Russell crater, a 135-kilometer diameter impact crater located in the Noachis Terra region of Mars's southern hemisphere, possesses a distinctive 35-kilometer "megadune" ridge on its floor, one of the largest in the solar system. A previous study of Russell's megadune examined seasonally defrosting gullies along its SW-facing slip face and concluded that wind from the northeast dominates the morphology of the megadune, and SE and WNW winds shaped the longitudinal crests in the dune field to the south [1]. However, high-resolution imagery of the dune field presents evidence of an original formative wind from the southwest, suggesting a significant directional change in wind regime. Investigating the relationship between the floor material and the dune field provides insight into the geologic and aeolian processes that formed Russell's anomalous megadune.

**Methodology:** JMARS [2] was used in this study to analyze and map geomorphological features in Russell crater and the surrounding region. THEMIS daytime and nighttime infrared datasets at 100 m/pixel were used to examine present-day thermophysical properties of the terrains, and CTX and HiRISE imagery were used to develop an understanding of the geomorphologic characteristics and relationships between units. General elevation patterns were retrieved from MOLA 128 pixels/degree topographic data.

**Observations:** Figure 1 contains a morphologic map of Russell crater (centered at -54.5°N, 12.6°E). In all, nine units were identified and delineated, including large neighboring craters that likely resulted in modification and collapse of several areas of the rim. For example, the ~15 km-diameter impact on the western rim triggered adjacent wall collapse, and a larger impact to the southwest resulted in ejecta settling as far as 25 km inward onto Russell crater floor. Non-fluvial gullies eroded the SW rim, possibly transporting but not formed by low-density ejecta. CTX images reveal dozens of pedestal craters on the floor, though most are smaller than 1 km in diameter. The map outlines craters below the dune field whose rims are distinct in THEMIS data but obscured in CTX images. The dune field, classified by crest-to-crest widths, is characterized by long, megadune-adjacent ridges that decrease in length and inter-crest width as the dune field tapers westward, as well as small dunes to the south and east.

The THEMIS daytime IR data show a prominent warmer region on the western half of the crater. The THEMIS nighttime IR dataset (Fig. 2) indicates that this region has low thermal inertia while the outer edge of the floor has high thermal inertia. The depressions and knobs on the SE floor have distinctly lower thermal inertias than the surrounding floor. CTX images show that most depressions are filled with sand and dust, with abundant dust devil tracks (Fig. 3).

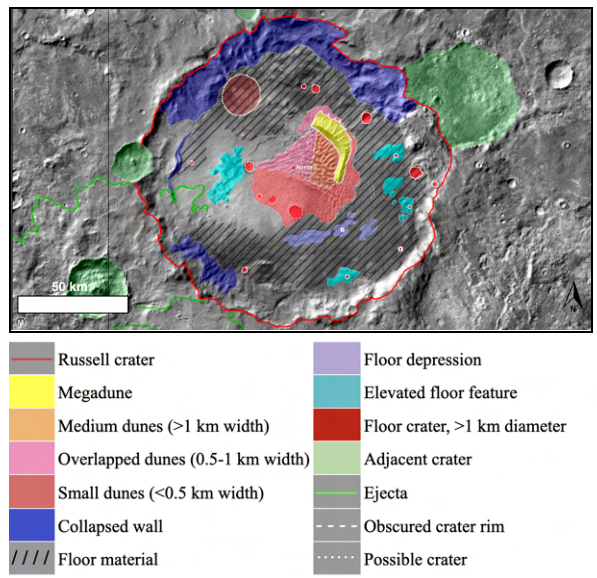


**Fig. 1**. Russell crater feature map over THEMIS daytime IR, constructed using JMARS [2].

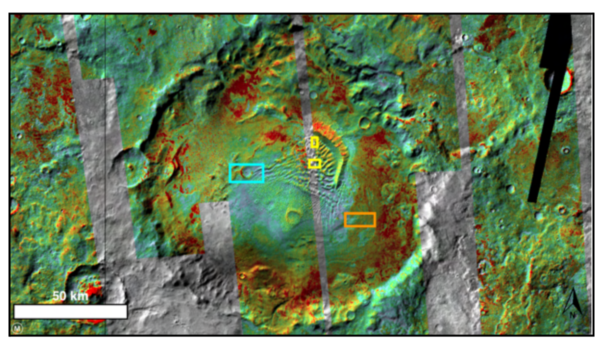


**Fig. 2**. THEMIS daytime IR overlaid with THEMIS colorized nighttime IR. The dataset includes a color scale from low (blue) to high (red). Locations of Fig. 3 (orange), Fig. 4 (yellow), and Fig. 5 (cyan) are marked.

**Discussion:** Despite the current wind regime [1], the shape and position of the megadune in the NE quadrant of Russell is consistent with wind from the southwest, analogous to that of the Great Sand Dunes National Park in Colorado [3]. However, the dune ridges on the megadune's stoss are perpendicular to its curvature, strongly indicative of swirling wind within the crater. The medium-width dunes bordering the megadune have long, reversing ridges shaped by eastward and westward winds (Fig. 4a). The complexity of the wind regime increases toward the center of the crater: SW-facing windward slopes interrupt the longitudinal crests, and star dunes compose the south of the medium-width dune region (Fig. 4b). Rocky, light-toned material between the dunes appears similar to some floor units (Fig. 3). Albedo and THEMIS relationships between the severely weathered pedestal crater, deposited sand, and rocky material in Fig. 3 suggest that dune material may be sourced from old floor material. HiRISE observations of the star dunes between MY 28 and MY 34 show migration of ripples but no dune migration, consistent with the strength of present-day surface winds [4]. Russell crater's latitude limits its dune migration potential; $CO_2$ frost inhibits mobility while seasonal defrosting restores sand availability [5].

Since THEMIS data is sensitive to 1-2 cm dust layers [6], the region of low thermal inertia is likely dust deposited downwind by the same process that shaped the megadune. Dust coverage of the Russell floor may continue to grow due to ice blocks on the megadune lofting dust plumes as they defrost in early southern spring [7]. Dust deposits are visible on NE-facing crevices of a rocky, elevated low-albedo feature west of the dune field (Fig. 5). The feature borders an unnamed 5-km crater whose rim in the THEMIS nighttime IR dataset suggests that it impacted into the same rocky material. The erosion and faint dunes on the NE rim of the crater suggests a NE-ward wind. Sand grains that were too large to saltate over the rim likely accumulated northeast of the central peak and formed the single dune on its floor, shaped by the same SE and WNW winds that influenced smaller dunes outside the crater's eastern rim.

**Future Work:** The abundance of pedestal craters and other differentially eroded landforms in Russell crater may be a result of local aeolian erosion of the floor materials. Our next step is to use HRSC DTM data to determine the extent and magnitude of this erosion, and CRISM multispectral visible-near IR data to determine the mineralogic relationship between floor and dune materials. Understanding the provenance of the sediments composing Russell crater dunes, i.e. locally sourced or transported from outside, could help to explain its anomalous size and extent.

**Acknowledgments:** All THEMIS, HiRISE, CTX, and MOLA data used are publicly available on the Planetary Data System. ASU/JMARS was used to create composite graphics.

**References:** [1] Gardin, E. et al. (2010) *JGR*, 115, E06016. [2] Christensen, P. R. et al. (2009) *AGU*, Abstract #IN22A-06. [3] Madole, R.F. et al. (2016) *USGS*, Scientific Investigations Map 3362. [4] Silvestro, S. et al. (2010) *GRL*, 37, L20203. [5] Banks, M. E. et al. (2018) *JGR: Planets*, 123, 3205– 3219. [6] Fergason, R. L. et al. (2006) *JGR*, 111, E12004. [7] Dinwiddie, C. L., and Titus, T. N. (2021) *GRL*, 48, e2020GL091920.

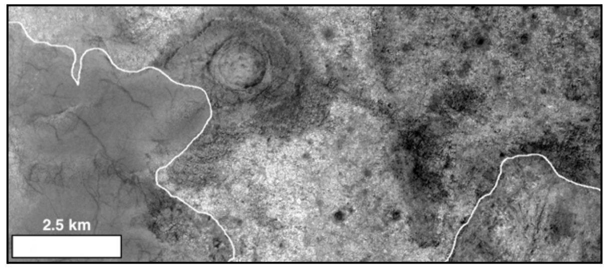


**Fig. 3**. Stretched CTX mosaic demarcating the light-toned rocky floor material from topographic depressions in the region southeast of the dune field. See also Fig 1. CTX IDs: P12_005805_1252_XI_54S347W, D10_031043_1259_XN_54S346W.

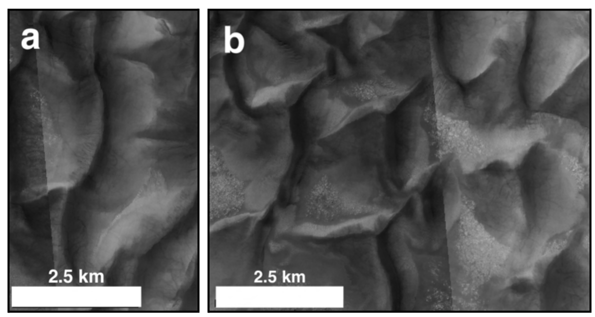


**Fig. 4**. HiRISE mosaic of complex dunes near the center of Russell: (a) linear to wavy ridge crests (b) star dunes suggest multi-directional winds. Locations are indicated in Fig. 2. HiRISE IDs: PSP_006161_1250_RED, ESP_065381_1255_RED.

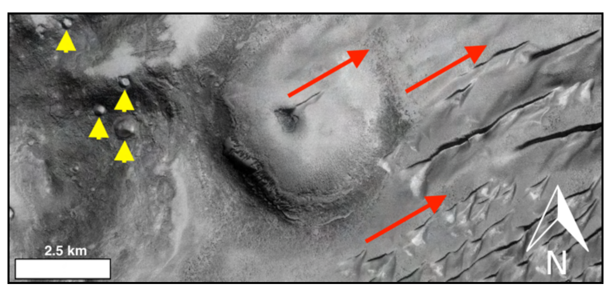


**Fig. 5**. CTX image of Russell crater floor units, including an elevated floor feature, eroded crater, and dunes in the far western side of the erg. Small, distinct crater rims (yellow arrows) in the elevated feature indicate rocky material. Dunes show evidence of NE-ward wind (red arrows). CTX ID: K04_054884_1227_XN_57S347W.