GALE CRATER MOUND IN A REGIONAL GEOLOGIC SETTING:

MAPPING AND PROBING THE SURROUNDING OUTCROPS FOR AREAS AKIN TO THE CENTRAL MOUND AT GALE

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Gale Crater and Mt. Sharp:

The Mars Science Laboratory rover, Curiosity, is currently conducting research within Gale Crater as it makes its way towards a channel and layered deposits that will provide insight into the sedimentary history of Gale [1]. Gale Crater is a 155km diameter, Late Noachian/Early Hesperian crater that is located along the dichotomy boundary on Mars [2].

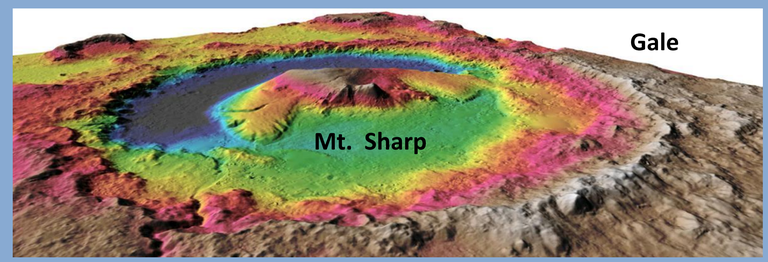
Gale's central mound, Mt. Sharp, is divided into an upper and lower mound which are separated by an erosional unconformity [3] and differ in age [2], erosional patterns [2–4], and mineralogy [1]. Though the age of the upper mound is poorly constrained, the lower mound is Late Noachian/Early Hesperian, like Gale [2].

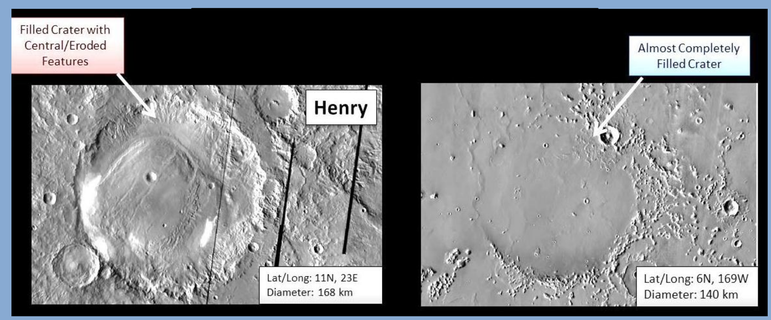
There are several hypotheses on the origin of Mt. Sharp. These include ground water upwelling [2], aeolian, ice, volcanic [2-4], lacustrine [2-4], hydrothermal [2-4], and polar deposits [3].

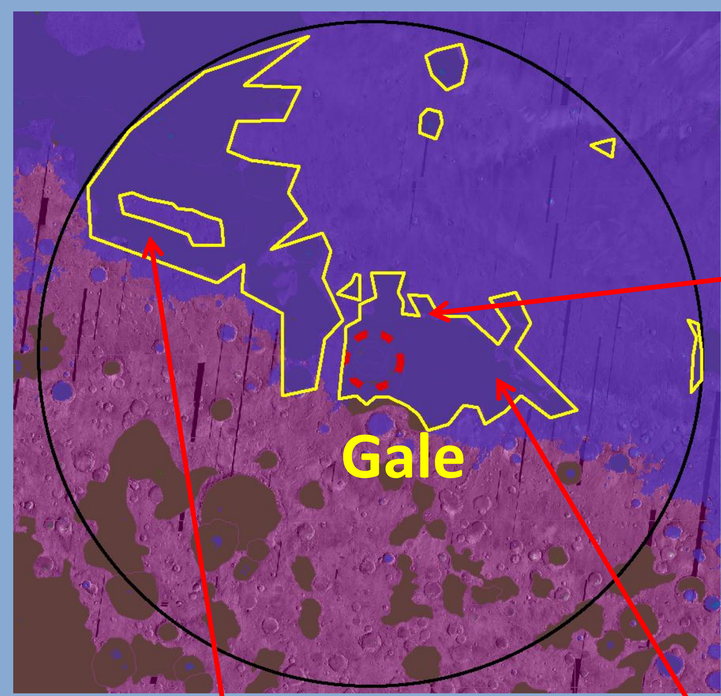
Procedure :

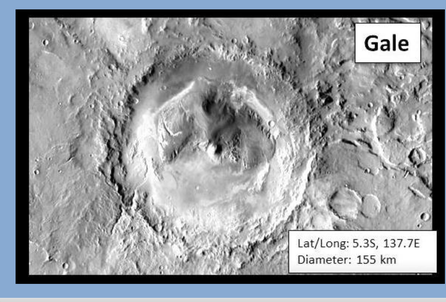
We employed orbital remote sensing data to determine if areas within 1,000km of Gale have features akin to Mt. Sharp.

Large areas (marked in yellow) match Gale Crater's Mt. Sharp in age (Late Noachian/Early Hesperian) [5], altitude (-4,600m to + 400m), and nighttime infrared brightness (proxy for thermal inertia) [6-7]. Data were taken from the Thermal Emission Imaging System (THEMIS) [6], Mars Orbital Camera (MOC), Mars Orbiter Laser Altimeter (MOLA), Context Camera (CTX), and High Resolution Imaging Science Experiment (HiRISE).

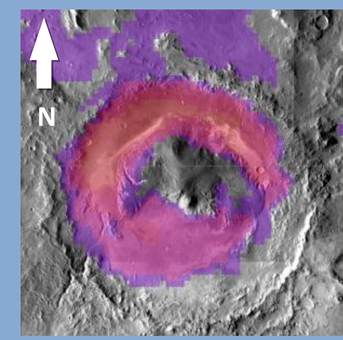




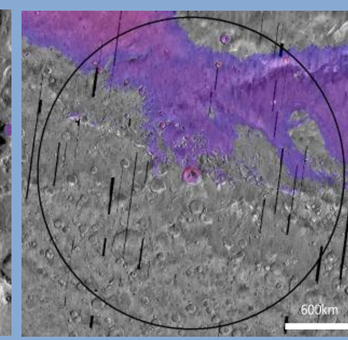




Could Gale have been filled? Many large (140 – 170km in diameter) Martian craters contain layered deposits, some of which have been eroded. The volume of fill in Gale is approximately 10% of the total crater volume, a smaller ratio than for any other crater of similar size

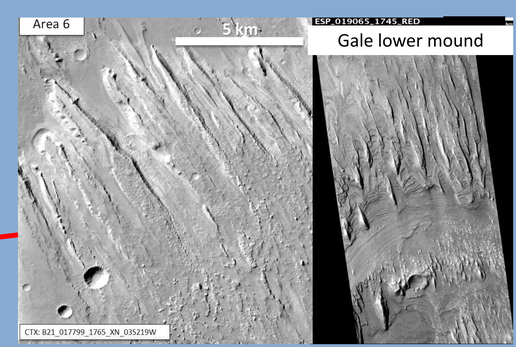


-2,300m contour in Gale Crater



-2,300m contour in the northern lowlands

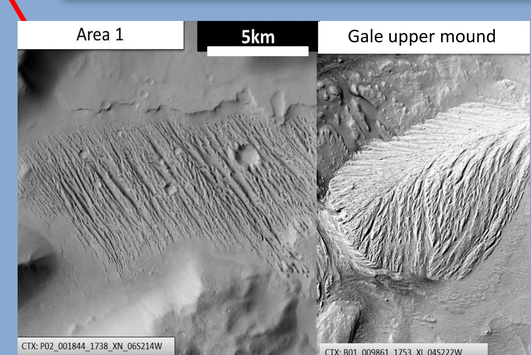
Was there an ocean? Multiple channels in Gale that open at the same altitude suggest that the crater once hosted a lake with a surface at -2,300m [8-9] If so, the lower units of Mt. Sharp could have been formed or altered under water [8-9]. If a lake stood at -2,300m and the crater rim was in its present configuration, the lake would have been in contact with a much larger body of water in the northern lowlands.



Yardangs in finely-layered unit
Altitude - 2,000 to -2,650 m

Specific outcrops within the larger areas show analogous morphology and erosional characteristics, with similar layering, altitude, age, and brightness as Mt. Sharp's upper and lower mound.

Layers ~ 100 m thick
Altitude - 380 to - 750 m



Yardangs in un-layered unit
Altitude - 2,400 to - 2,500 m

Conclusions:

Our observations are consistent with the hypothesis that the sedimentary units in both the upper and lower sections of Mt. Sharp are related to nearby regional units. This relationship supports a geologic history that includes episodes of widespread sedimentary deposition and erosion. In this model, Mt. Sharp is the remnant of these regional sedimentary deposits that partially or completely filled the crater and were later deeply eroded. The history of Gale Crater and its mound may also include a sizable lake that could have been connected to a much larger body of water. The *in situ investigations by Curiosity over the next several years will directly address the origin and history of Mt. Sharp and its surroundings.*

References: [1] Andrews-Hanna et al. (2012) 3rd Conf. on Early Mars, Abs 7038. [2] Thomson et al. (2011) *Icarus,* 214, 413-432. [3] Milliken et al. (2010) *GRL,* 37, L040201. [4] Anderson, Bell (2010) *Mars*, 5, 76-128. [5] Greeley and Guest (1987) *USGS*, I-1802-B. [6] THEMIS Daytime IR mosaic http://www.mars.asu.edu/data/thm_dir/. [7] Jakosky et al. (2000) *JGR* 105, 9643-9652. [8] Sumner et al. (2011) 5th MSL Landing Site Workshop. [9] Parker (2010) 5th MSL Landing Site Workshop.