New Results from Geologic Mapping of Gusev Crater: Implications for Extended Mission Targets

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New Results From Geologic Mapping of Gusev Crater: Implications for Extended Mission Targets

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Above: MOLA DEM draped over CTX images (~5-6 m/pixel) and THEMIS daytime IR mosaic (100 m/pixel)

GEOLOGIC UNITS

- **h**: Hill material
- **c**: Crater material
- **AHl**: Amazonian-Hesperian landslide material
- **AHMf**: Amazonian-Hesperian Ma'adim debris flow
- **Hrvp1**: Hesperian ridged volcanic plains 1
- **HNrvp2**: Hesperian-Noachian ridged volcanic plains 2
- **NGm**: Noachian Gusev mesa material
- **Ndpl**: Noachian dissected plateau material

Correlation of Map Units

MOLA Topographic Profiles A-A’ and B-B’ (~463 m/pixel resolution)
Ma’adim Vallis Debris Flow
Disintegrating craters

Ndpl
(Friable Material)

1 km
Hesperian-age lava flow

lava flow margins

exposed older flow surface?

lava flow margins

RIMFAX subsurface mapping of lava flow thickness

Elevation (m)

Distance (m)

4 m

3 m

50 m
Dissected Plateau Material (Ndpl): windows into once extensive unit that predates the Gusev plains basalts (HNrvp2)
Gusev Lake and Delta Hypothesis

Mesas

Ma’adim Vallis
**Figure 5 | Topography and mineralogy of Eridania basin.** MOLA topographic data are colourized to show the maximum (1,100 m) and minimum (700 m) level of an ancient sea. Alteration minerals represent phases detected in this study using CRISM data with the exception of ‘chlorides,’ which were detected previously using THEMIS data. Deep basin units are pervasively altered to Fe- and Mg-rich clay minerals, and likely sulphides, which are traced by the occurrence of jarosite.
Ma’adim Vallis Flooding and Gusev Lake Formation Hydraulic Model
May be a telescoping delta complex, eventually dissected into mesas by down-cutting rivers during the fall of water level.

It’s difficult to say if the apparent telescoping of successive delta lobes was due to (see diagrams below):

(A) Exhaustion of delta-plain accommodation space (at a roughly stable water level), which forced the distributary system to seek accommodation at the front (= delta progradation),

(B) Gradual decrease of bulk accommodation by falling water level, which caused headward incision and frontal progradation of the distributary system.

(C) Delta back-stepping due to rising water level (which would mean not true telescoping, but backward stacking of retreating delta lobes).

The height (altitude) of the mesas may be a clue, as it may help distinguish case A from cases B/C. Cases B and C will be difficult to distinguish on this basis, but the former would be more likely since the system’s development ends up with river incision, which suggests a net fall of water level.
Possible network of distributary channels compared to the modern day Wax Lake delta
Possible stratification in hillside, may indicate several phases of delta progradation - parasequences

Mesas very flat topped suggesting bedded sediments

Possible stratification in hillside,
Terraces along mesa scarps
21 km traverse to Mesas (Dissected Delta) will enable investigation of 4 key Geologic Units:
1. Noachian dissected plateau (Ndpl) >3.7 Ga
2. Hesperian/Noachian ridged volcanic plains (HNrvp2) 3.6 Ga
3. Amazonian/Hesperian Ma’adim debris flow (AHMf) 3.4 Ga
4. Noachian Gusev mesas (NGm) 3.7 Ga