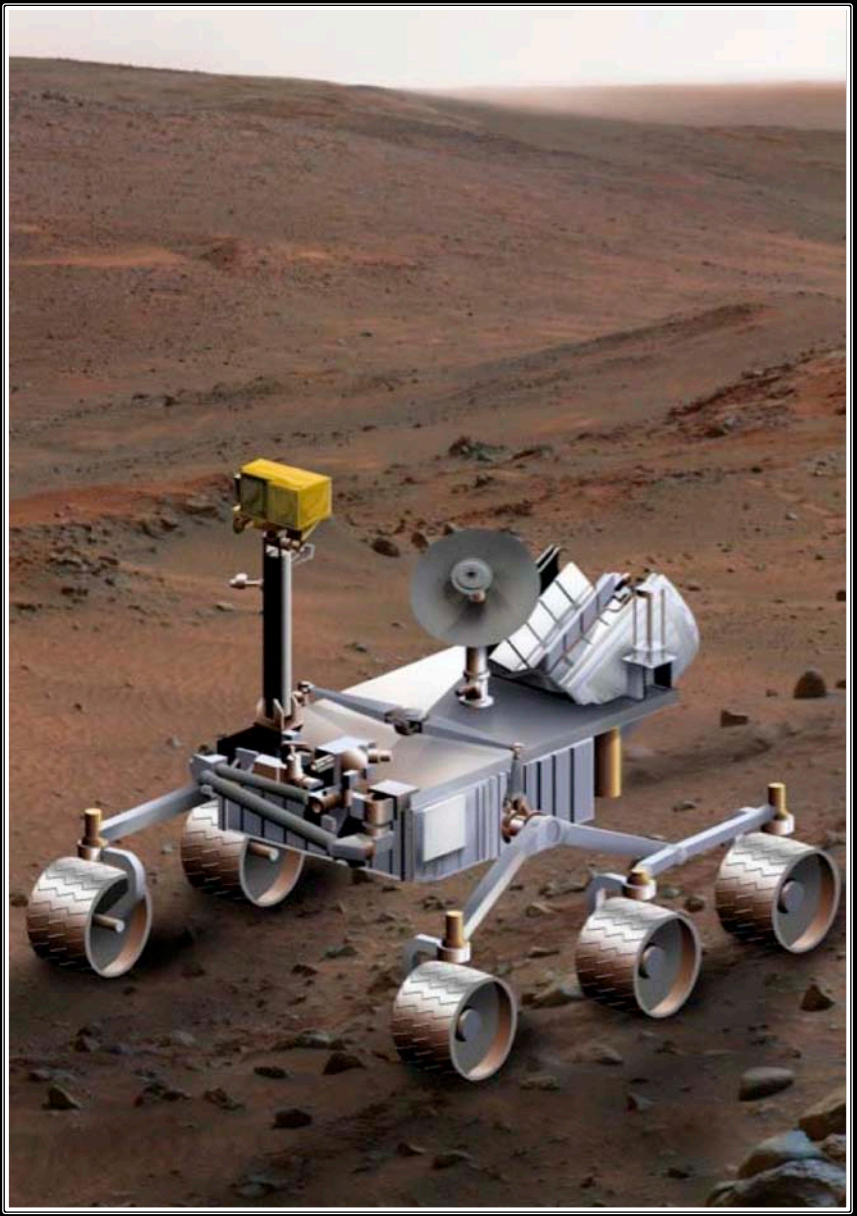
MARS SCIENCE LABORATORY SITE SELECTION

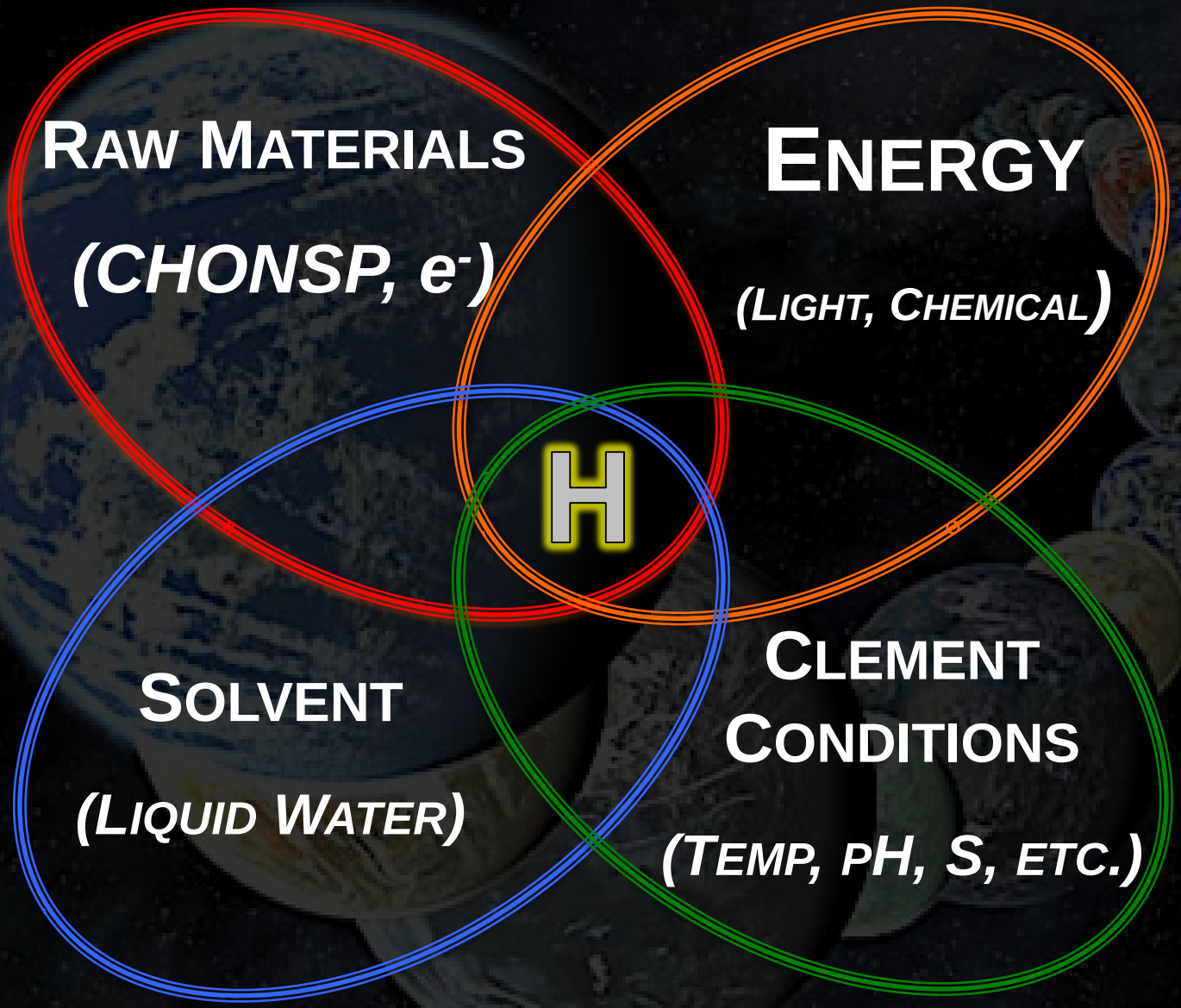
Mission Objectives

MSL's primary scientific goal is to explore a landing site as a potential habitat for life, and assess its potential for preservation of biosignatures.

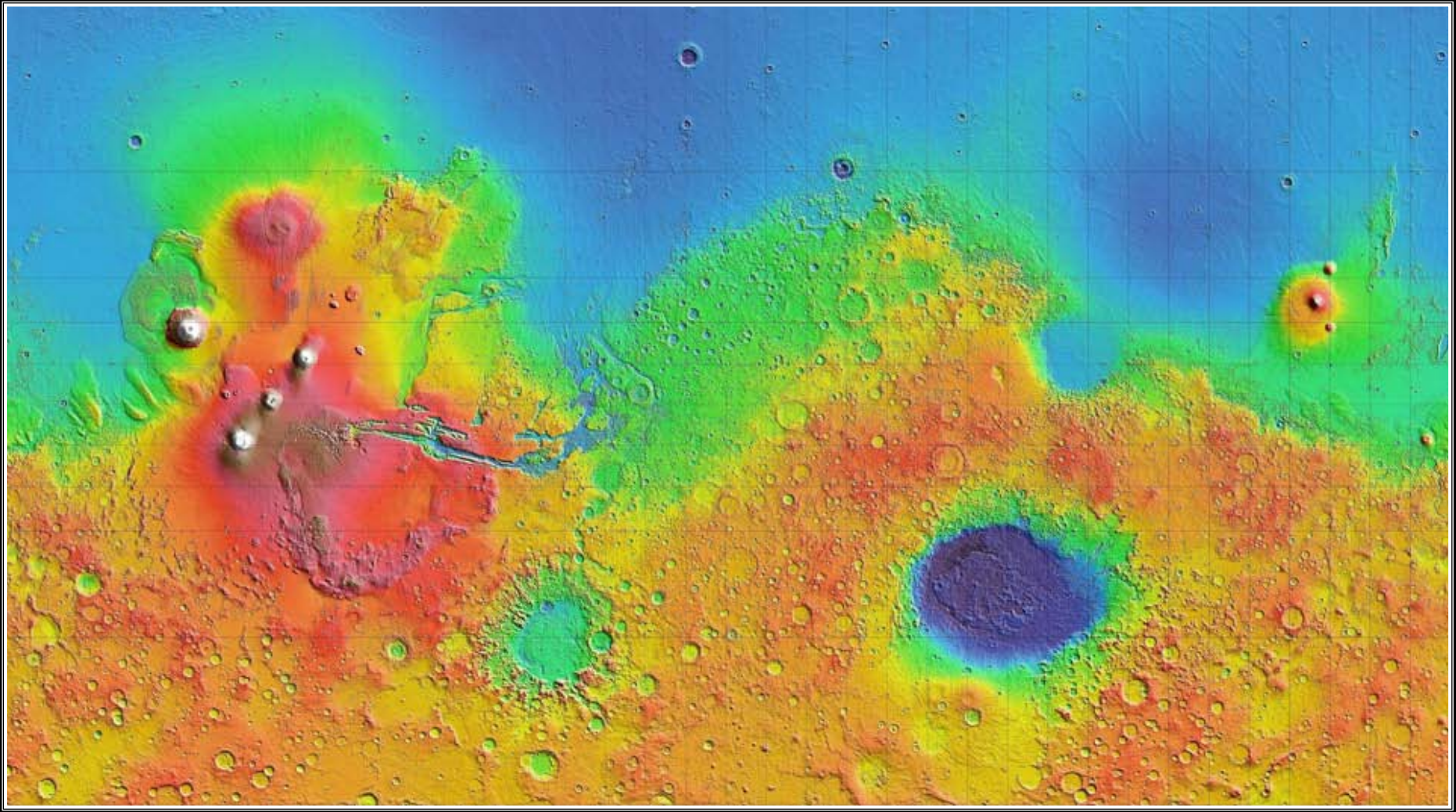
Objectives

- Biological Potential
- Geology and geochemistry
- Water, atmospheric evolution, and climate
- Surface radiation

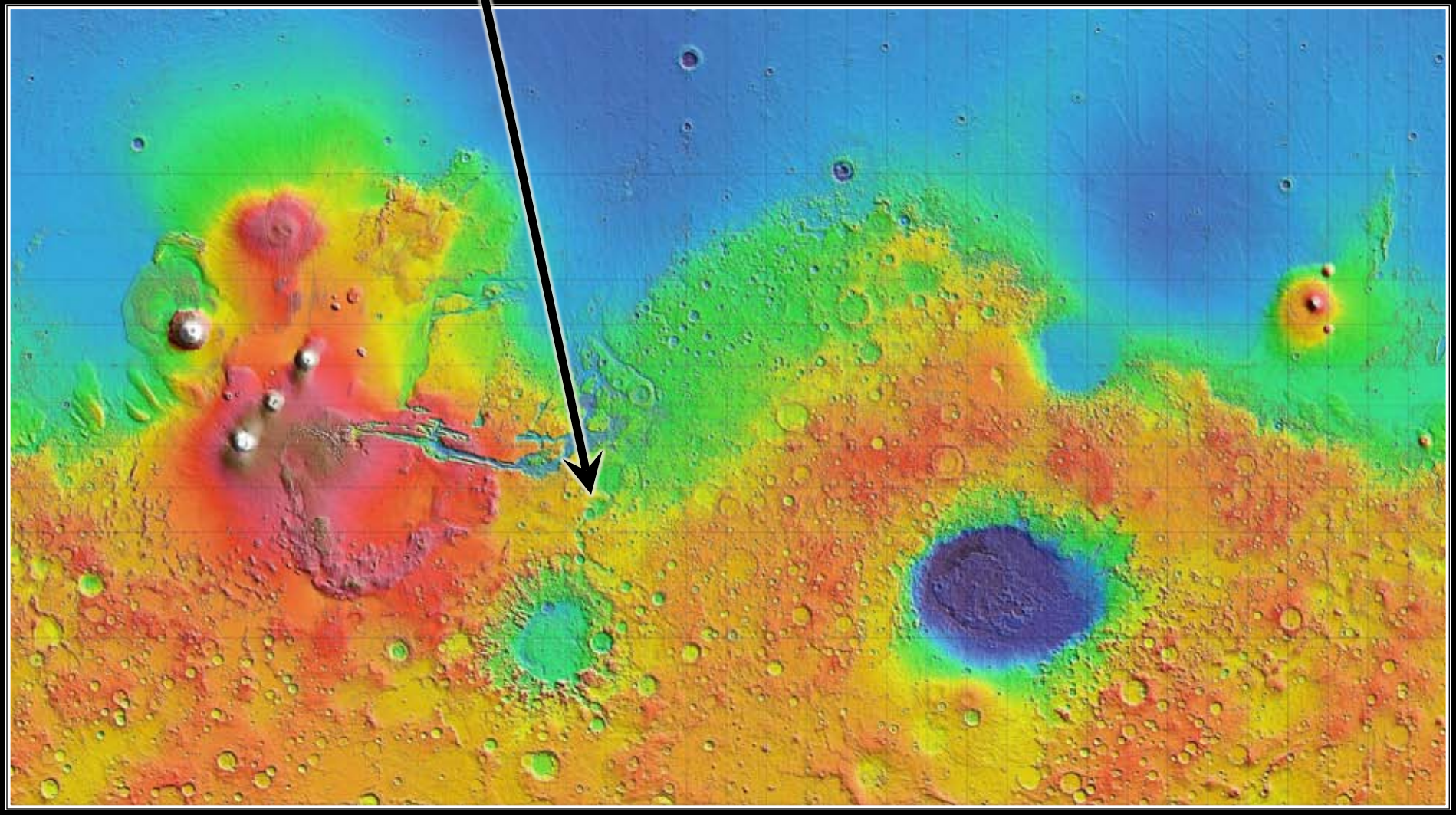



Raw Materials
(CHONSP, e-)
Energy
(Light, Chemical)
H
Solvent
(Liquid Water)
Clement Conditions
(Temp, pH, S, etc.)

MSL Candidate Sites

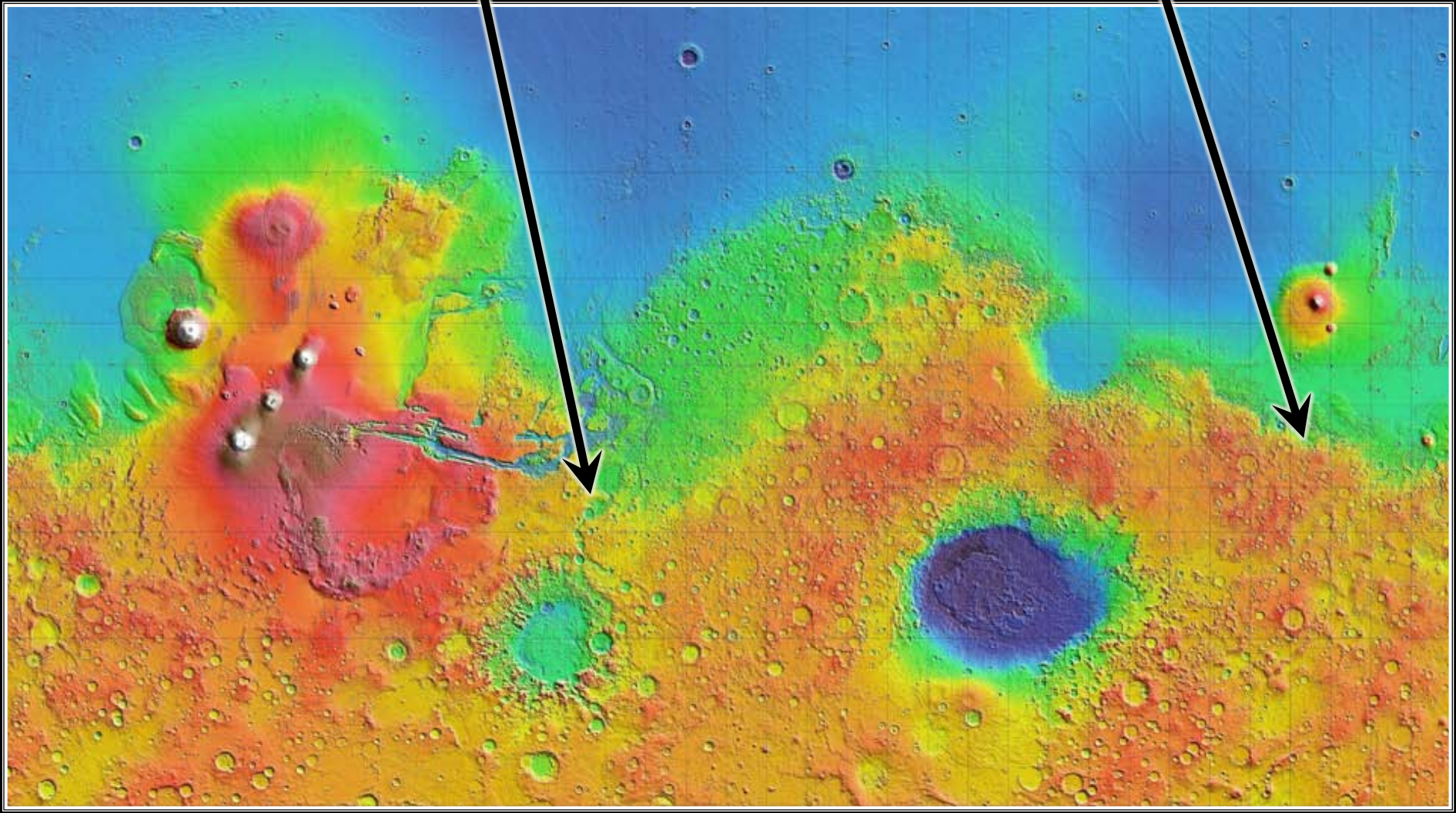


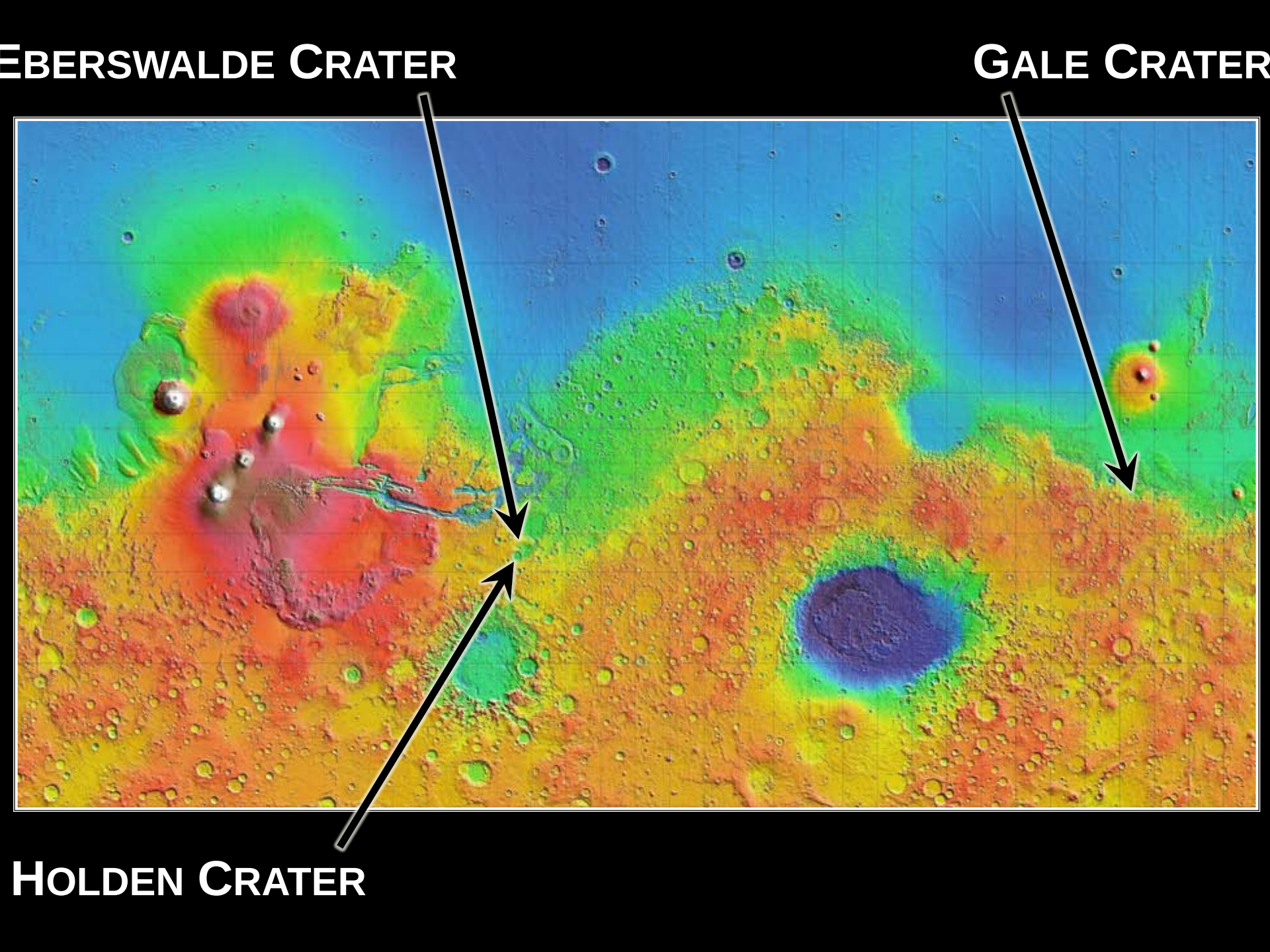
Eberswalde Crater

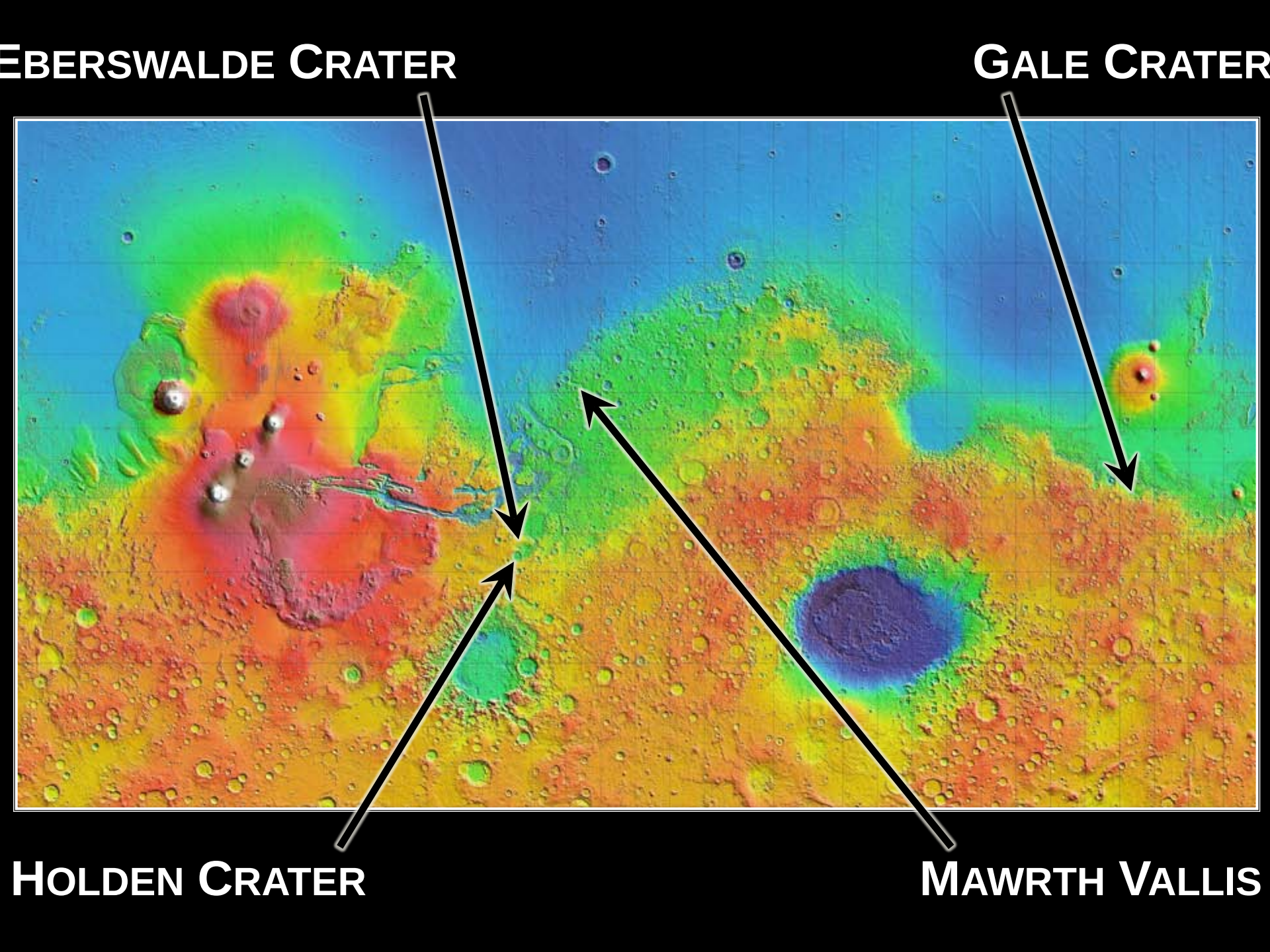


EBERSWALDE CRATER

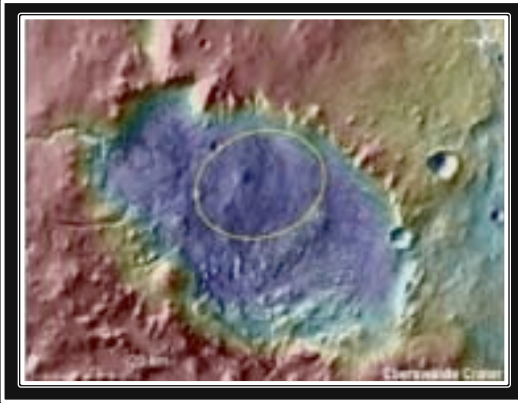
GALE CRATER




EBERSWALDE CRATER
GALE CRATER
HOLDEN CRATER

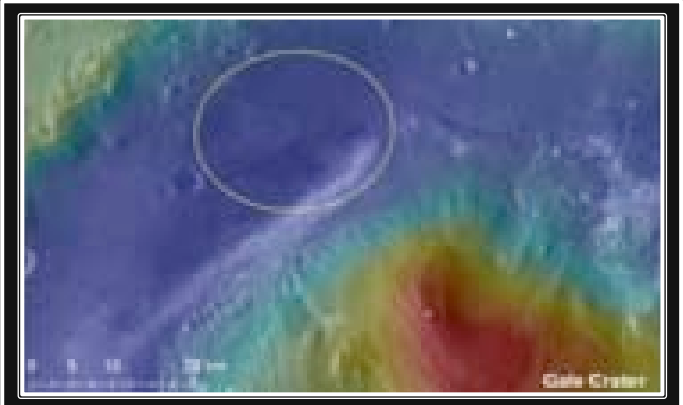

EBERSWALDE CRATER
GALE CRATER
HOLDEN CRATER
MAWRTH VALLIS

Final Four MSL Candidate Sites



Eberswalde Crater

- Fan delta located within a crater possibly representing deposition for several hundred thousand years
- Detection of phyllosilicates within the delta with potential for containing organics

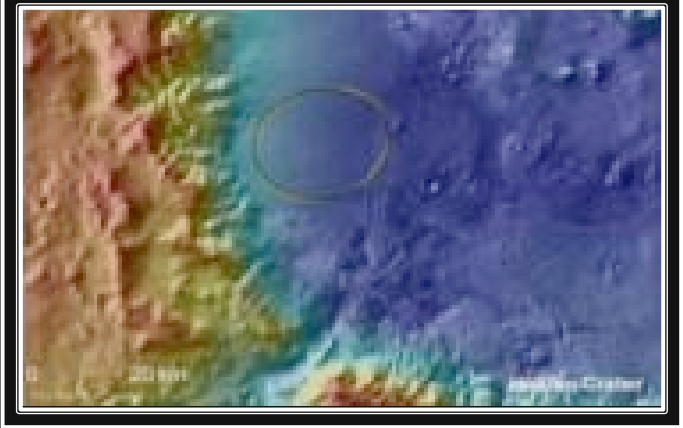


Gale Crater

- A five kilometer mound containing phyllosilicates and sulfates
- Unique stratigraphy present in mound represents changing environments on Mars

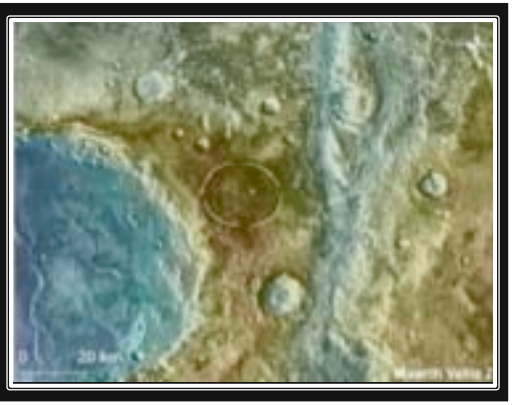
Holden Crater

- Contains a well-preserved fluvial system with the presence of phyllosilicates
- Megabreccia also present from early impacts



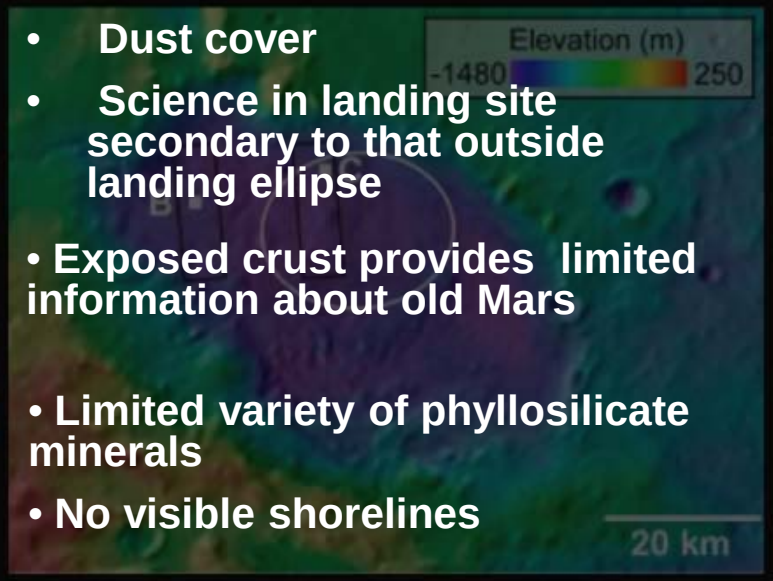
Mawrth Vallis

- Prominent stratigraphy layers representing an early, neutral, wetter phase on Mars
- Contains the oldest rock layers of the four sites (Noachian)



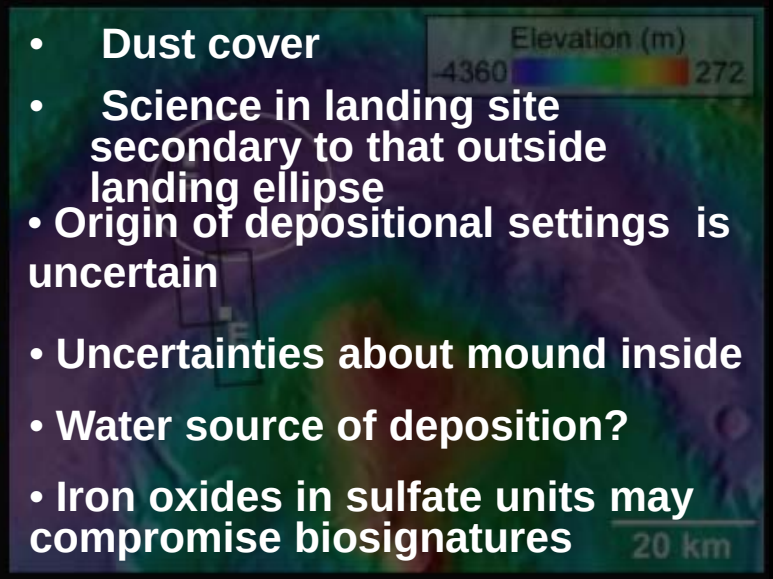
Cons of the MSL Landing Sites

Eberswalde



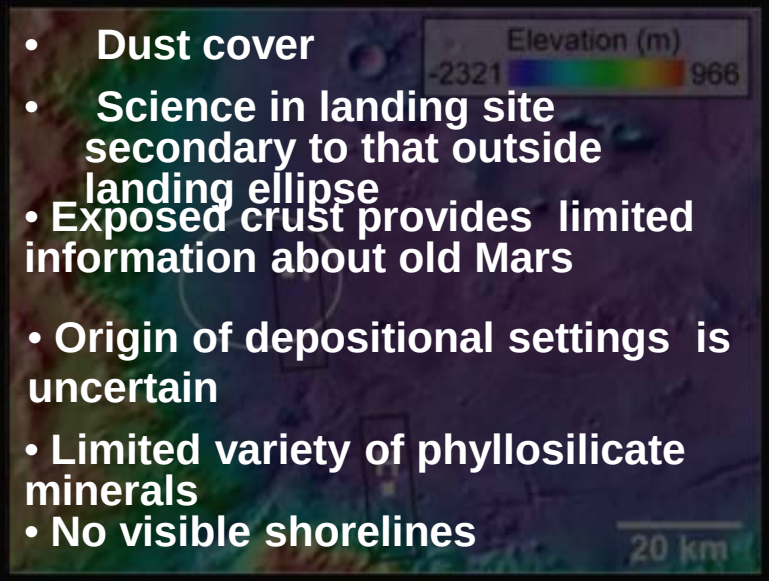
- Dust cover
- Science in landing site secondary to that outside landing ellipse
- Exposed crust provides limited information about old Mars
- Limited variety of phyllosilicate minerals
- No visible shorelines

Gale Crater



- Dust cover
- Science in landing site secondary to that outside landing ellipse
- Origin of depositional settings is uncertain
- Uncertainties about mound inside
- Water source of deposition?
- Iron oxides in sulfate units may compromise biosignatures

Holden Crater



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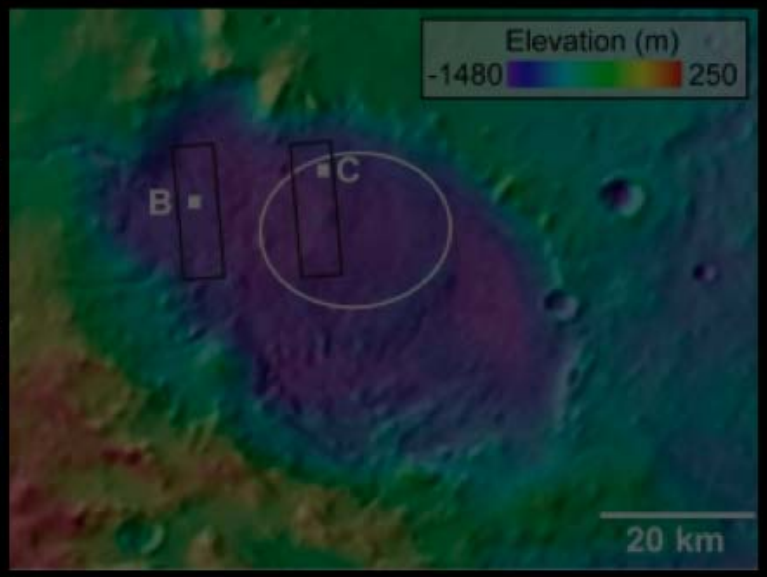

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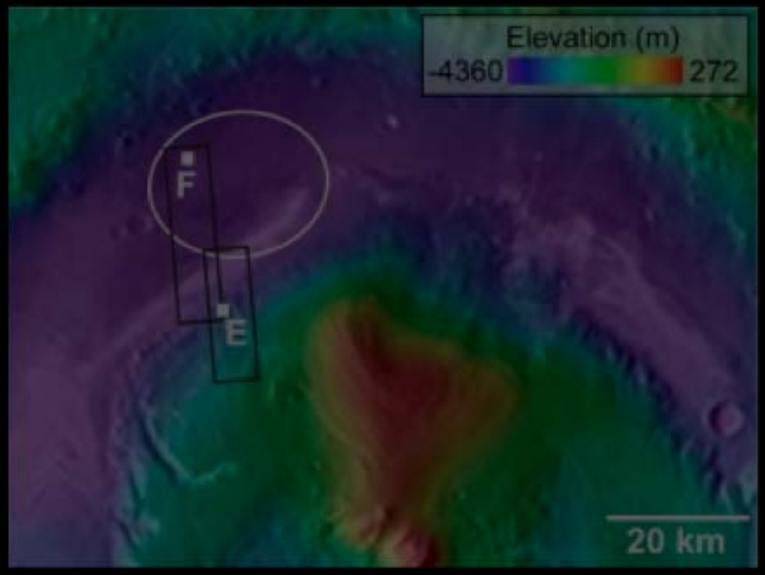

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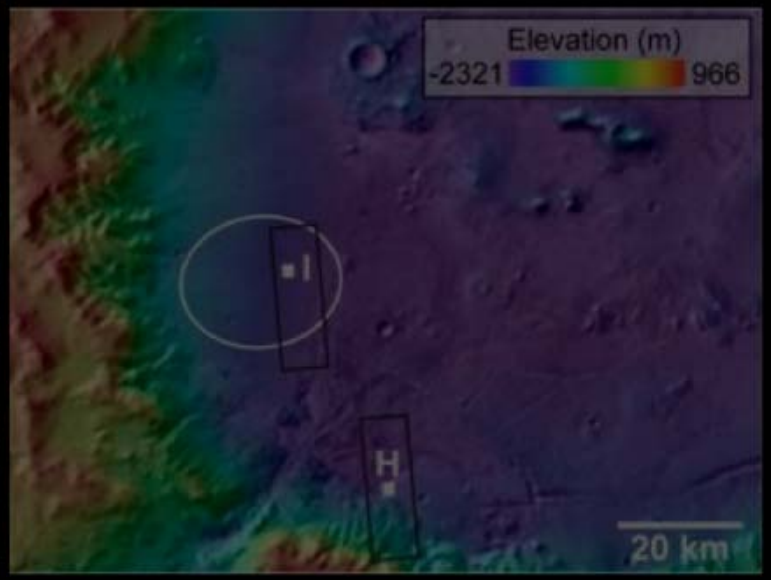

Mawrth Vallis

Pros of the MSL Landing Sites

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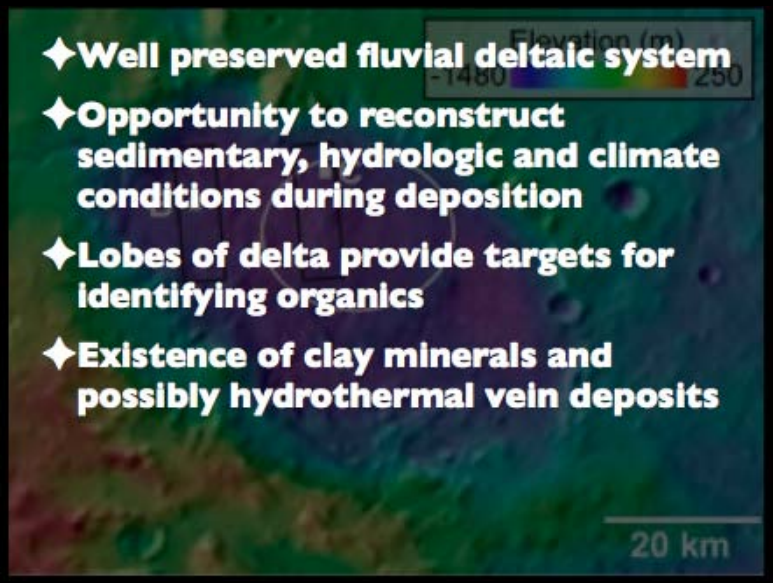

- ✦Well preserved fluvial deltaic system
- ✦Opportunity to reconstruct sedimentary, hydrologic and climate conditions during deposition
- ✦Lobes of delta provide targets for identifying organics
- ✦Existence of clay minerals and possibly hydrothermal vein deposits

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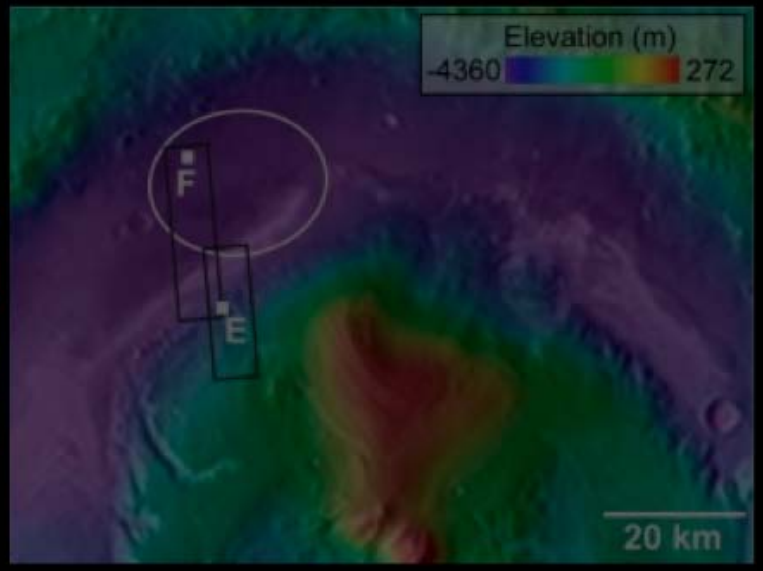

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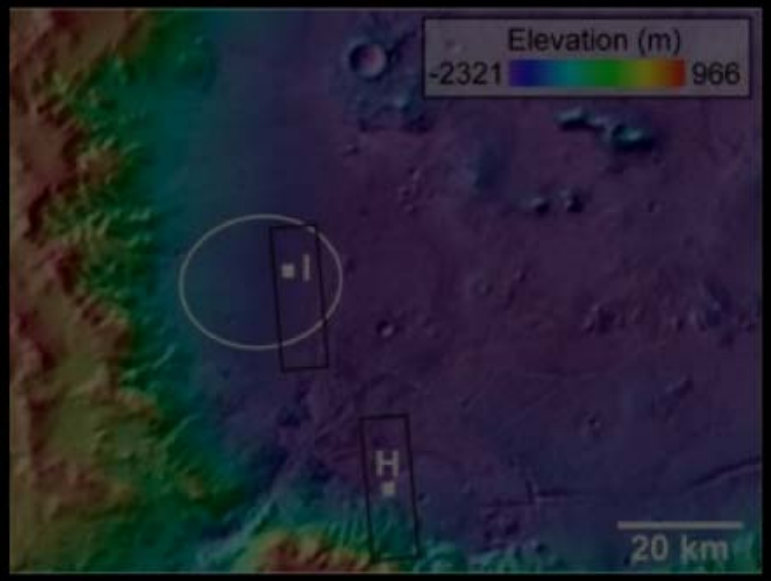

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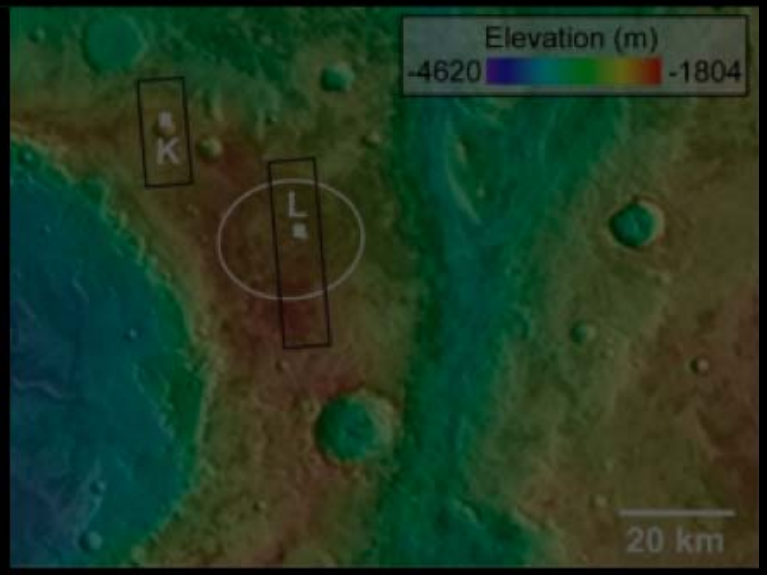

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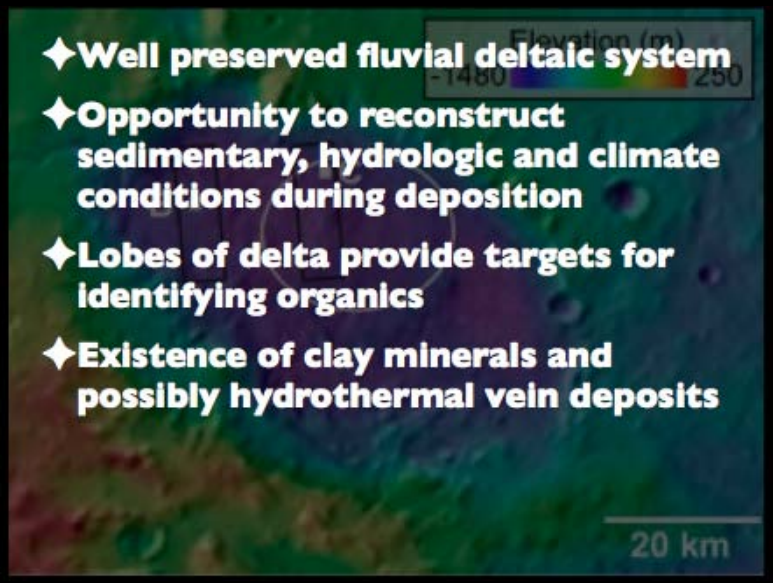

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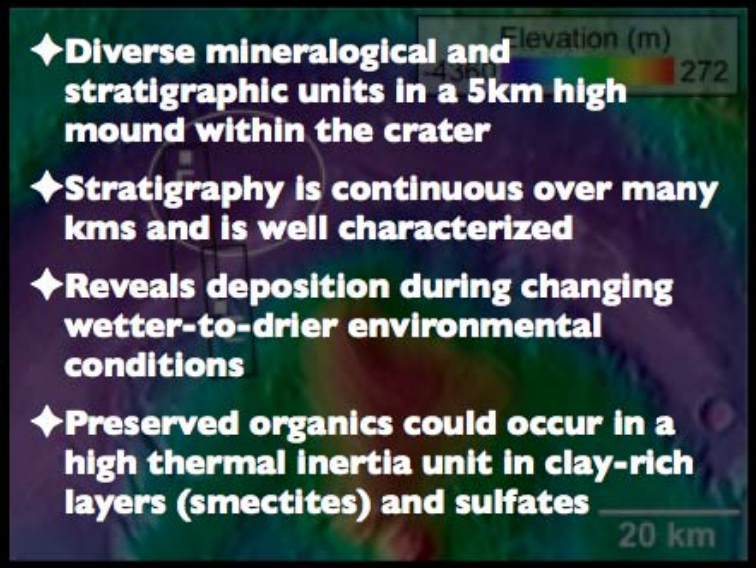
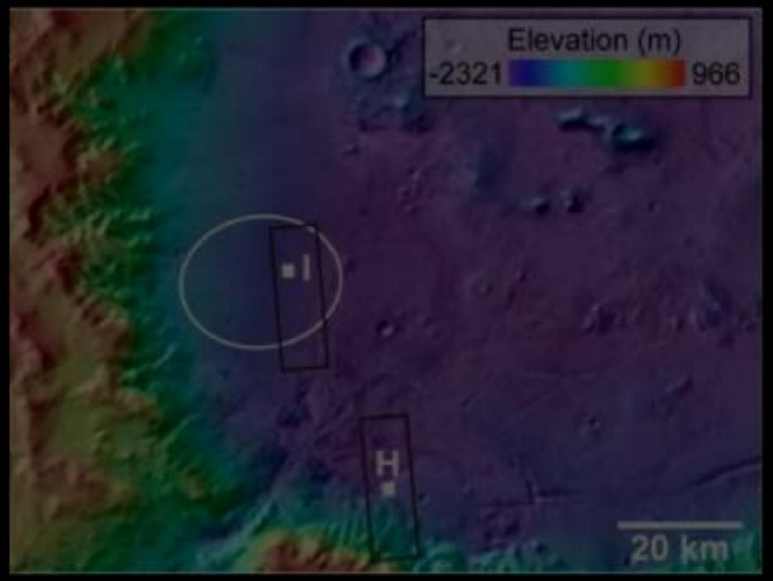


- Diverse mineralogical and stratigraphic units in a 5km high mound within the crater
- Stratigraphy is continuous over many kms and is well characterized
- Reveals deposition during changing wetter-to-drier environmental conditions
- Preserved organics could occur in a high thermal inertia unit in clay-rich layers (smectites) and sulfates

Holden Crater



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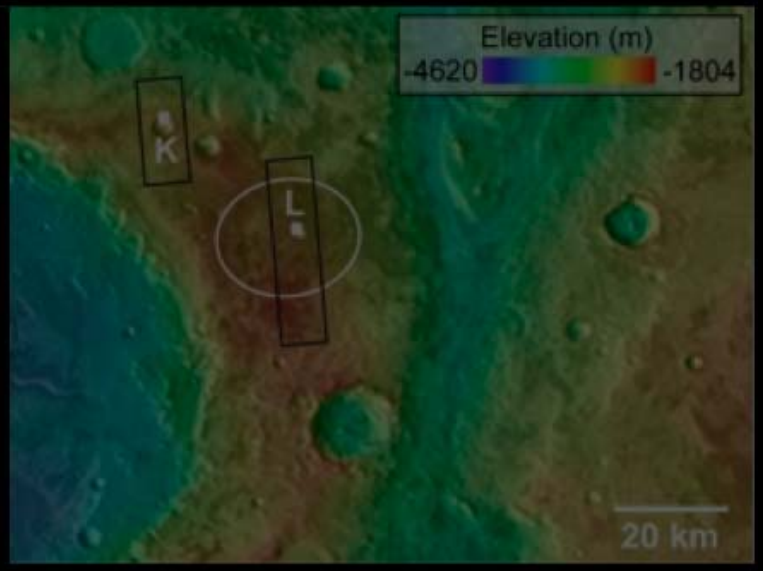

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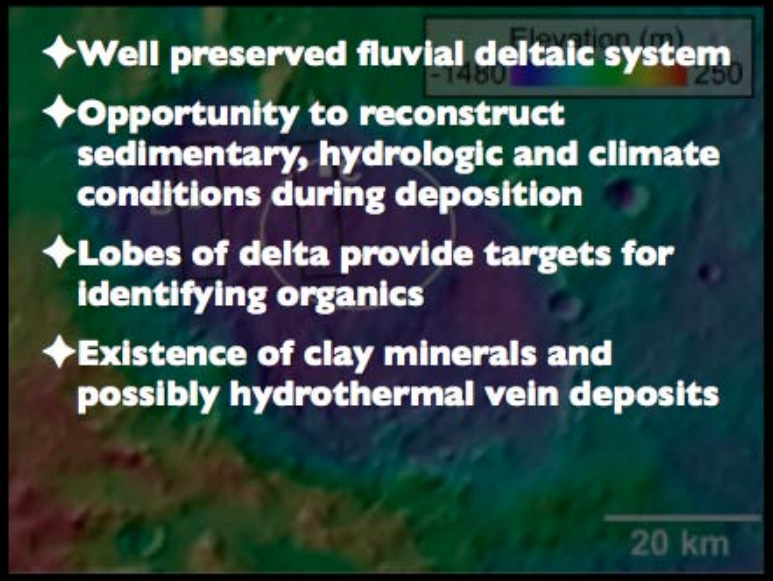

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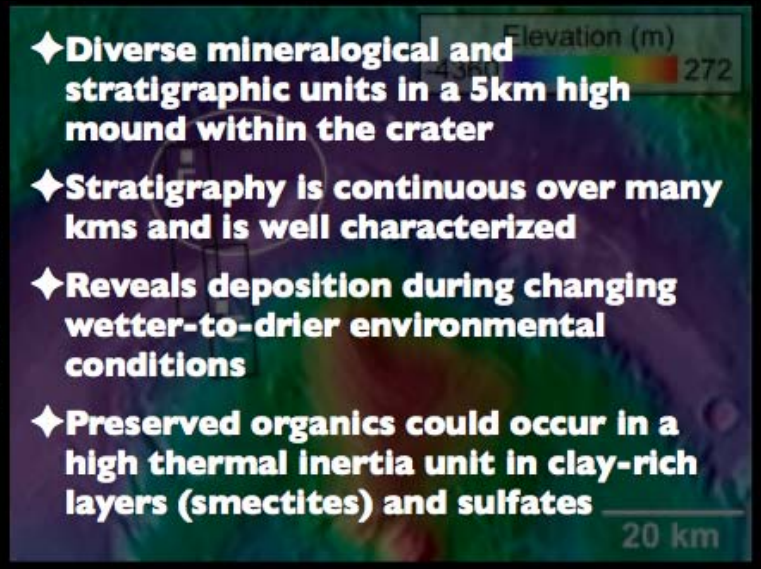
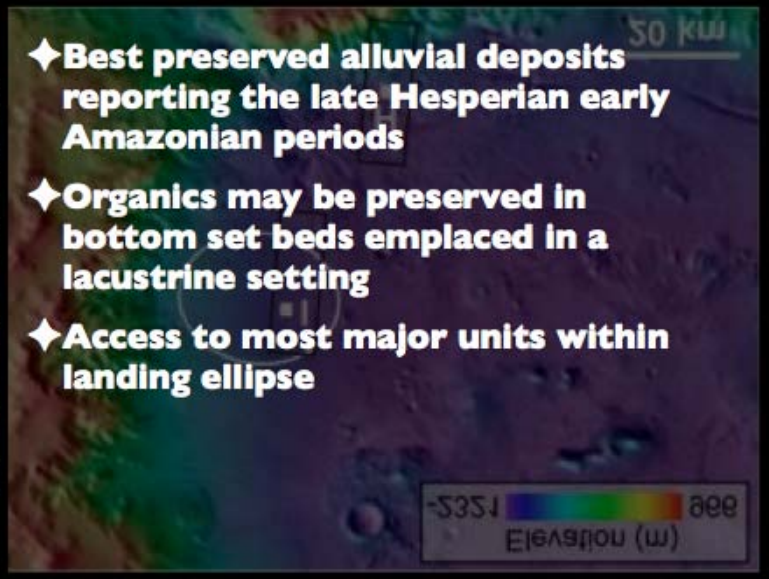


Holden Crater

- ✦Best preserved alluvial deposits reporting the late Hesperian early Amazonian periods
- ✦Organics may be preserved in bottom set beds emplaced in a lacustrine setting
- ✦Access to most major units within landing ellipse



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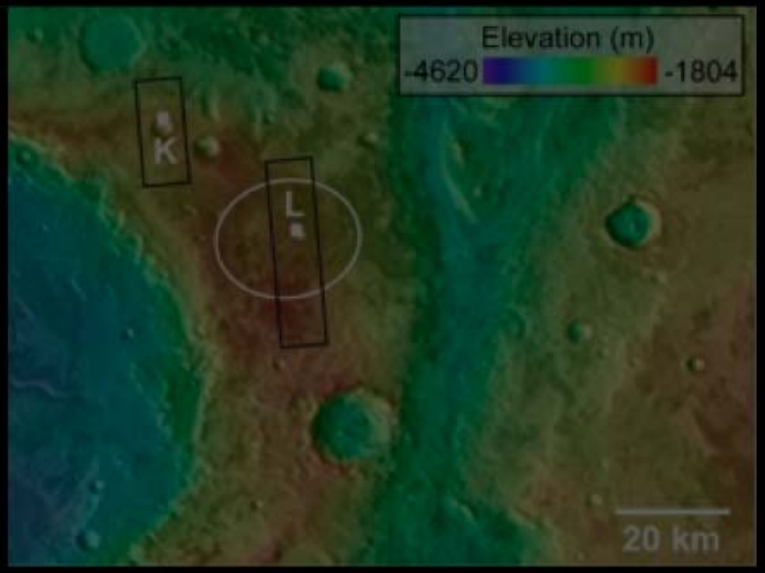

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Mawrth Vallis

- ✦Oldest preserved rocks (Noachian crust) and mineralogically representative of widespread processes on early Mars
- ✦Hydrated minerals present (~10% of rock volume)
- ✦Ellipse encompasses a diverse mineralogical rock sequence (including multiple phyllosilicates and sulfates)

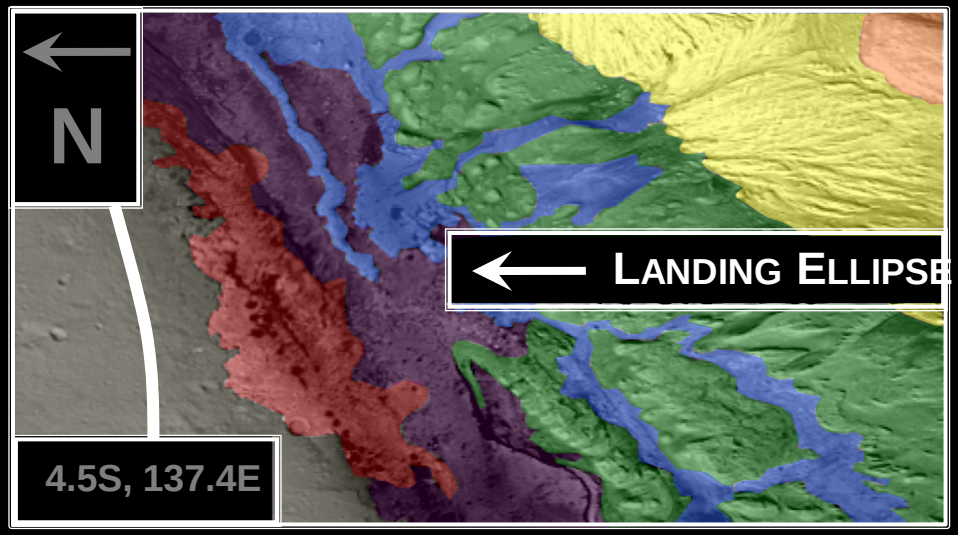
Gale Crater Summary

Diverse Sampling and Observational Opportunities

- **Mineralogical** – Phyllosilicates (Mg,Fe), Sulfates (mono- and poly-hydrated), Olivine, Pyroxene (LCP/HCP), Crystalline red Hematite, and Martian dust.
- **Morphological** – Sedimentary Layers, Bedding, Fans, etc…
- **Biosignatures** – Potential Preservation of Organic Molecules in Clays or Salts, Habitability Suggested by Smectites/Sulfates

Long-time-ordered record of Martian history

- Noachian to Hesperian in Age, Amazonian Processing
- Sedimentary Units May Record Climate Change Over Time



Multiple depositional environments which may allow constraint of:

- *Fluvial vs. Subaqueous vs. Subaerial* Depositional Processes on Mars

Multiple Geologic, Mineralogical and Morphological targets of interest near landing ellipse!