

Environmental Signatures for Habitability: What to Measure and How to Rank the Habitability Potential of Mars

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What to Measure

CHEMICAL

Elements

Inorganic compounds

Water (abundance & state)

Organic chemicals

Phase state volatiles

Redox

PHYSICAL

Temperature

Radiation (eg, cosmic, radionuclide decay)

Solar radiation (λ and intensity)

Mass

Wind speed, direction & variability

Humidity

Dynamics

MORPHOLOGICAL

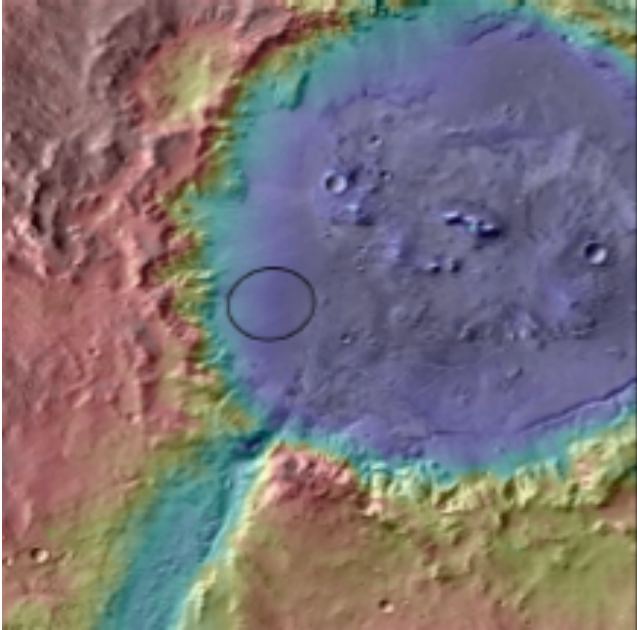
Large scale process indicators (volcanism, seismicity, impact & rebound, etc)

Sedimentary structures

Finer scale textures

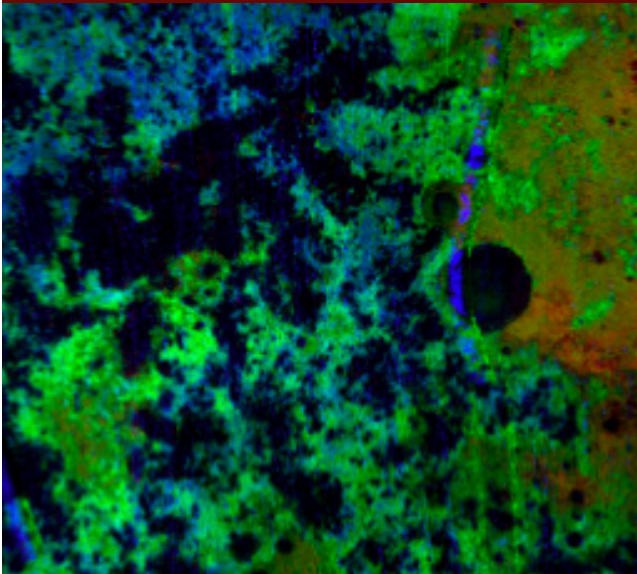
Mechanical stability

Candidate MSL Landing Sites



Holden crater:

bedrock
outcrops, alluvial fans,
rich history of aqueous
processing

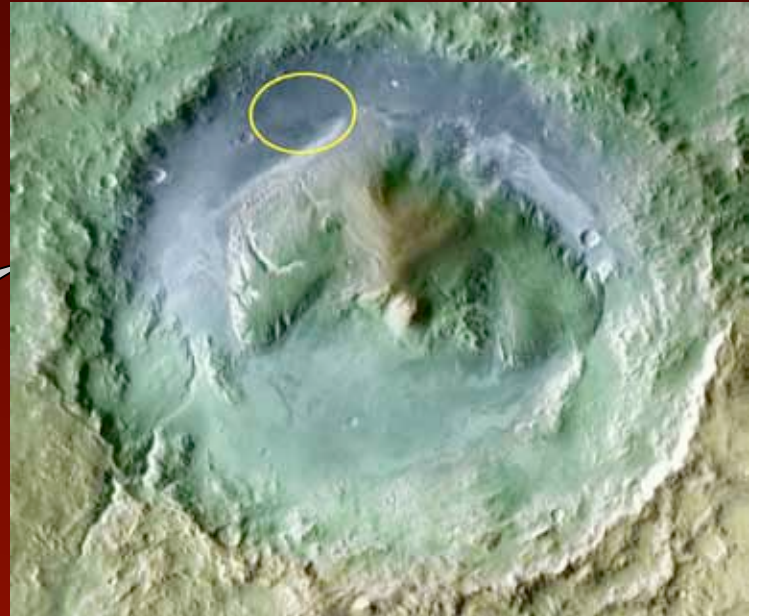
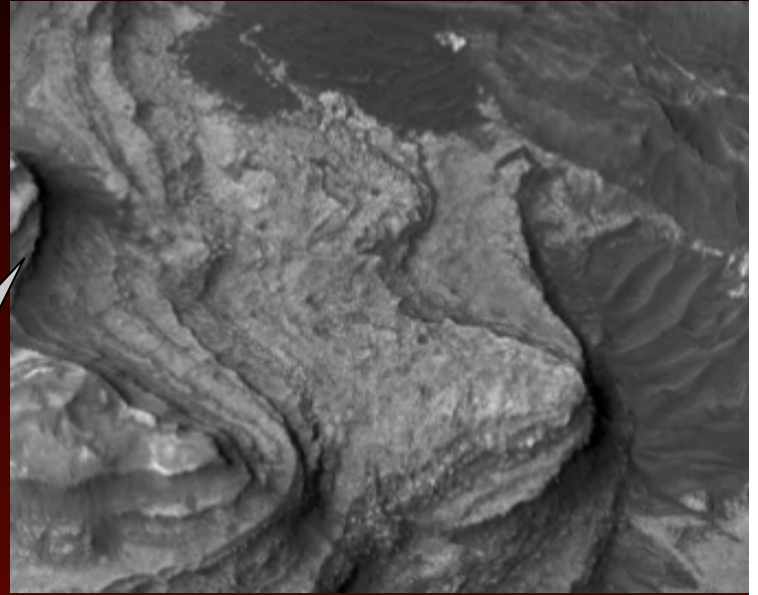


Eberswalde crater:

well defined delta
suggests long duration
water flow

Mawrth: strong CRISM and
OMEGA signatures of Fe/
Mg and Al phyllosilicates –
may be good preservation
environment for organics

Gale crater: diversity of
mineralogy in well defined
layered sequences that
could be traversed by MSL



General Approach on Earth and Mars

1. First, study remote sensing data, maps, etc.
2. Decide how big an area to measure.
 - Science driven
 - Technology, safety, finance and time constrained
3. Determine the spatial sampling rate.
 - Science driven
 - Technology, finance and time constrained
4. Determine the temporal sampling rate.
 - Science driven
 - technology, safety, finance and time constrained
5. Determine the order of measurements
 - Primarily technology constrained, but also by safety and time
6. Decide where to begin measurements
7. Randomly select locations and proceed (not on Mars)

What to Use on MSL

Structural & Morphological Signatures

MASTCAM

MAHLI

CHEMCAM (RMI)

CHEMIN

What to Use on MSL

Chemical Signatures

MASTCAM

DAN

CHEMCAM (LIBS)

APXS

CHEMIN

SAM

What to Use on MSL

Physical Signatures

REMS

RAD

MASTCAM

CHEMCAM

Ranking Scale for Planetary Habitability

CLASS	CRITERIA
CLASS ONE	Uninhabitable and likely has never been habitable
CLASS TWO	Has a high potential but no confirmed observation of life (as defined above)
CLASS THREE	Inhabited (we find life)
A	Globally inhabited
B	Primitive life; early in its evolution, but not yet globally established
C	Exists only in refugia—planet heading toward class four
CLASS FOUR	Post-habitable (there once was life, but now it's gone)