Group 2 Proposed Landing Site for the Mars Science Laboratory

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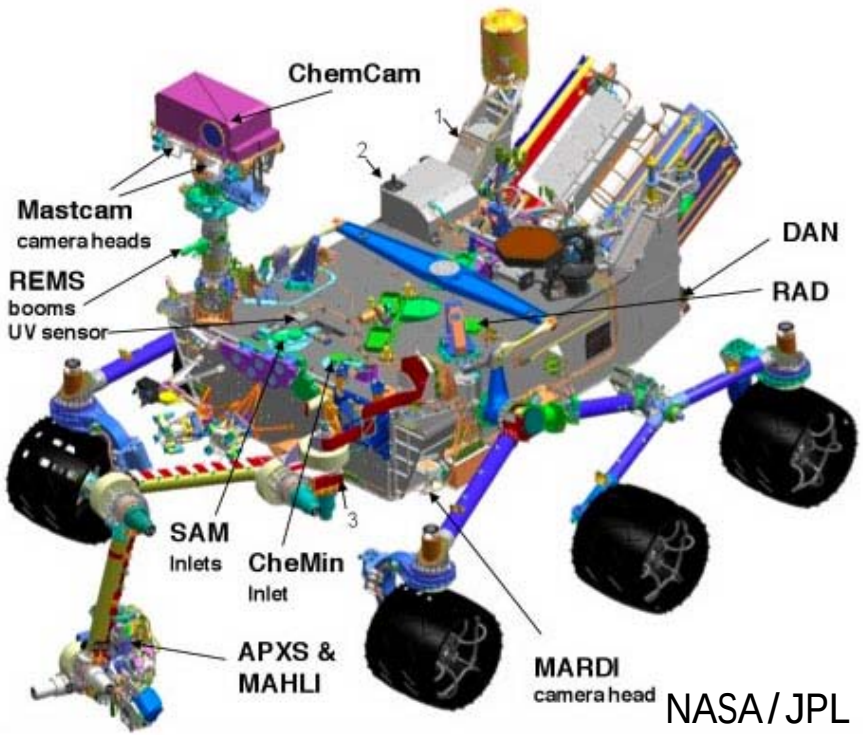
Introduction

MSL Science Mission :

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 .

MSL Science Instrument

Alpha-Particle-X-ray-Spectrometer
CHEMistry CAMera
CHEMIN
Dynamic of Albedo Neutrons
MArs HandLens Imager
MARs Descent Imager
MAST CAMera
Radiation Assessment Detector
Rover Environmental Monitoring Station
Sample Analysis at Mars
Gas Chromatograph
Tunable Laser Spectrometer
The Sample Manipulation System
The Chemical Separation and Processing Laborato
Wide Range Pumps



NASA / JPL

Our landing site selection: **Mawrth Vallis**

Contains mid to late Noachian aged crust

Diverse Assemblage of minerals as detected from multiple orbital datasets

- Directly within landing ellipse:
  - Fe/Mg- Smectites
  - Al- Phyllosilicates
  - Hydrated Silica
- Outside landing ellipse
  - Sulfates
  - Zeolites

Phyllosilicate stratigraphy similar to other Noachian crust

High astrobiological interest

All sites of interest are within landing ellipse

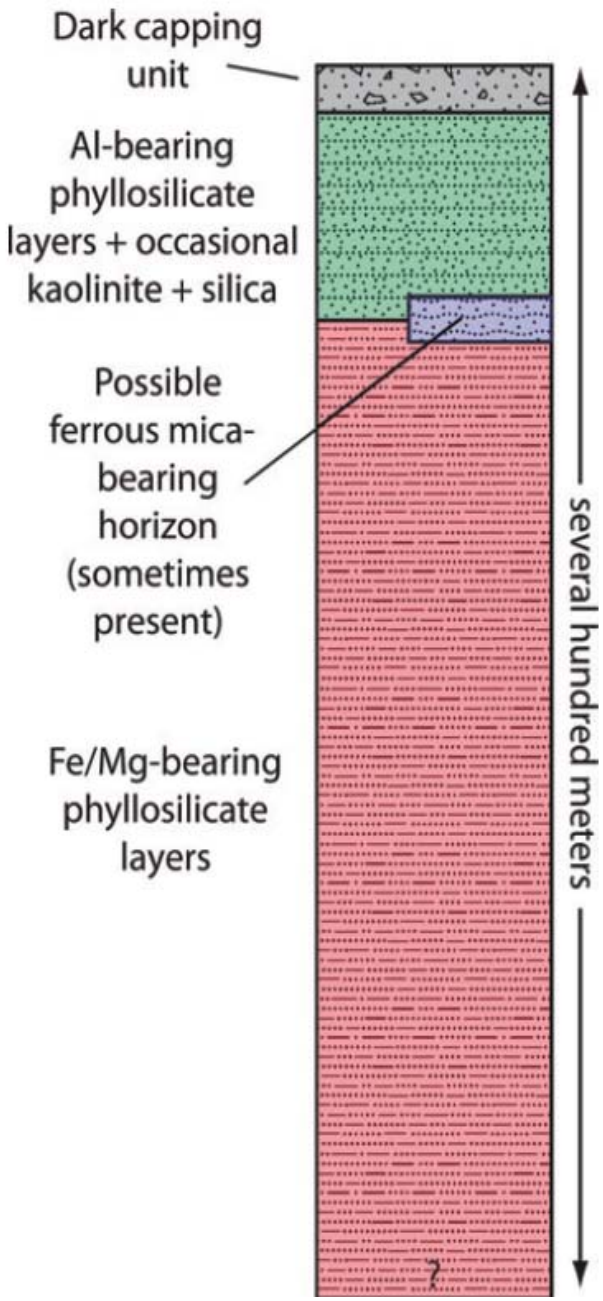
Mawrth Vallis

Maximum Science Return:

- Find organics trapped in smectite layers
- Find a clear cut evidence that Mars had liquid water on surface
- Find indications of subsurface aqueous processes

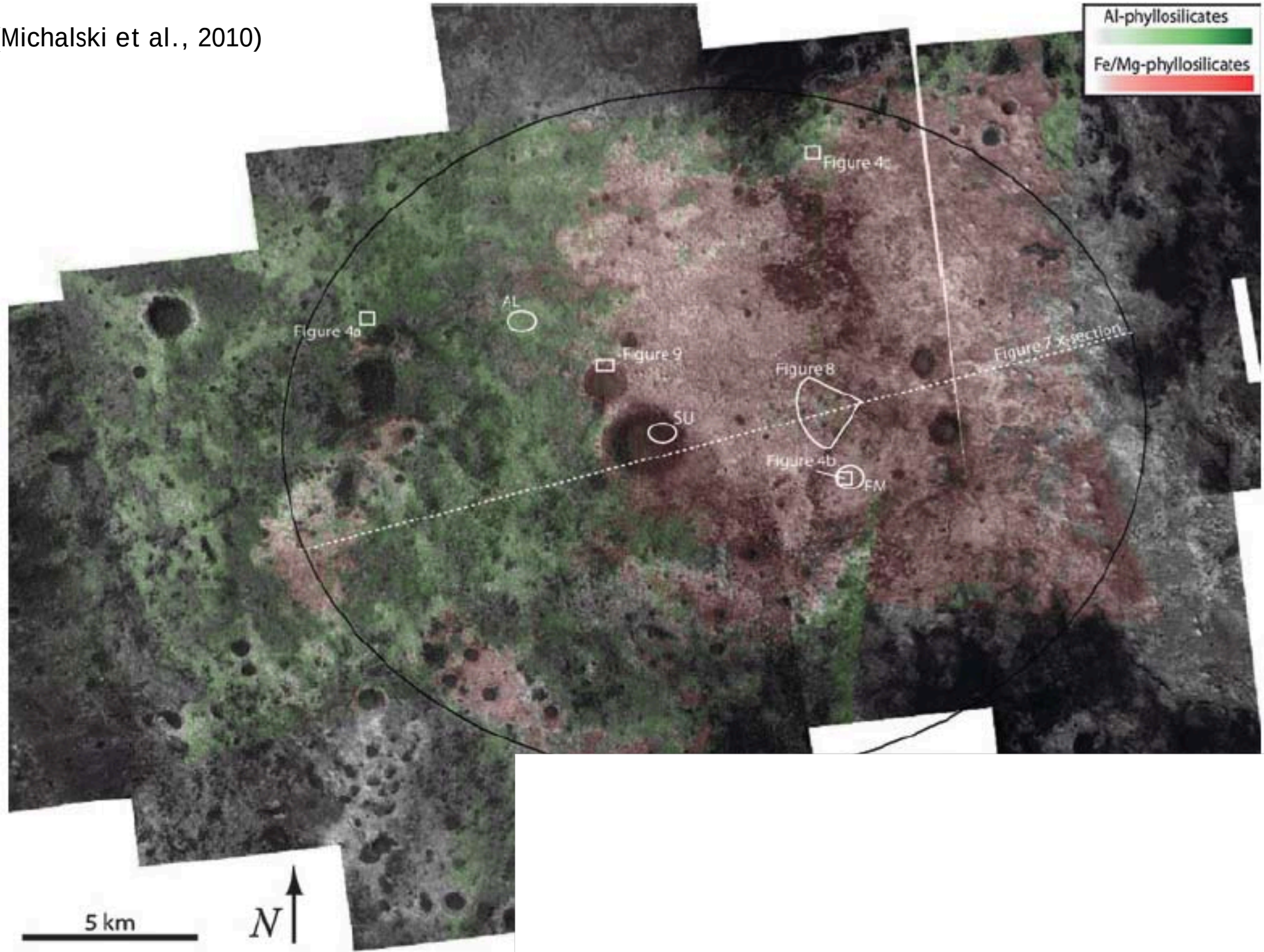
Minimum Science Return:

- Better understand Mars' geological and aqueous history
- Ground truth VNIR and TIR mineralogical observations observations



Michalski et al., 2010

(Michalski et al., 2010)



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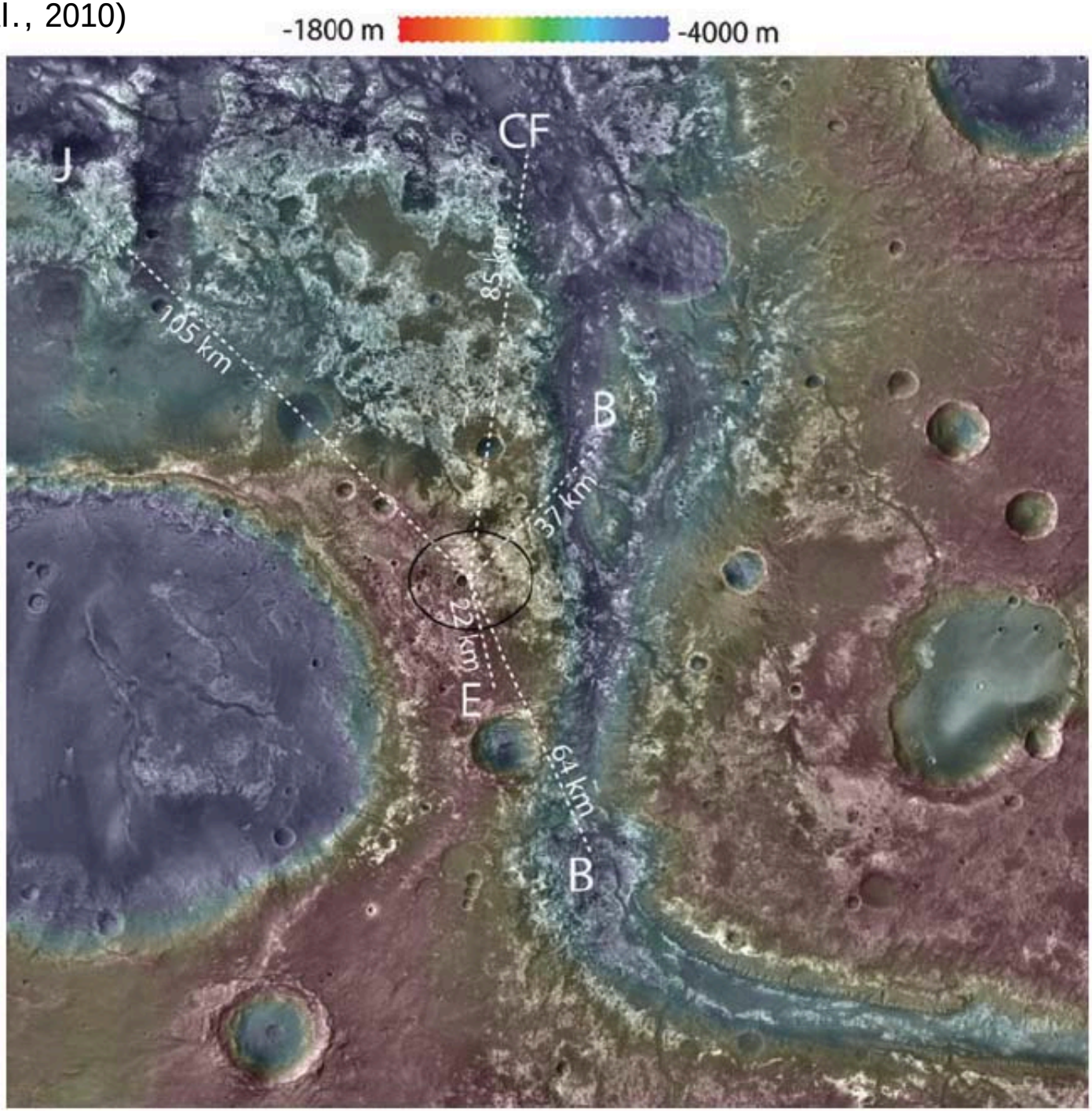


MSL Instrumentation specifically in Mawrth Vallis

ChemCam, **CheMin** and **APXS** –

Confirm Fe/Mg-smectite mineralogy,
Estimate smectite abundance
Determine remaining composition of rock
Will likely also identify additional clay minerals associated with dominant smectites

SAM- Identify trapped organics in smectites

These identifications will assist in understanding the formation mechanisms and potential habitability conditions

SAM and APX – Characterize C, H, N, O, P, S in clay rich rocks

All these can be used to assess the changes in geochemical environment – the transition from the extremely old Fe/Mg smectite rich rocks to the younger Al phyllosilicates and hydrated silica

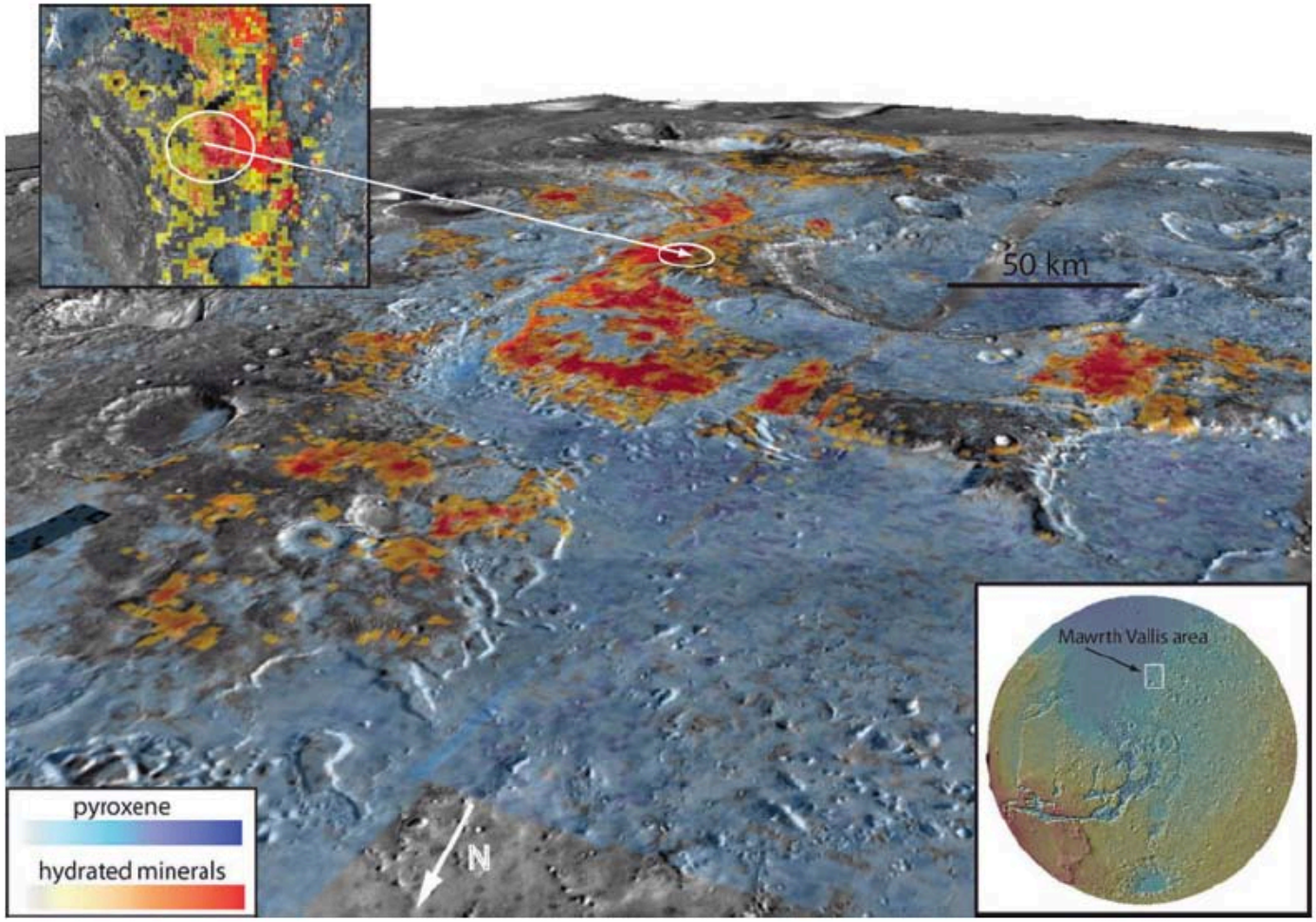
- Inventory of biomass building materials on Mars' surface (Spec, SAM, X-ray)
- Potential habitability and past habitability (Camera, Spec, SAM)
- Amount and assemble of minerals of interests (Camera, Spec, X-ray)
- Subsurface hydrate materials (neutron)

Presentation by Janice Bishop at 5th Landing Site Workshop

Mawrth Vallis Challenge

There is no consensus on the depositional environment for this site

We see this as a compelling reason to investigate



(Michalski et al., 2010)

Final Quad Charts for 5th MSL Workshop 5 - Marsoweb

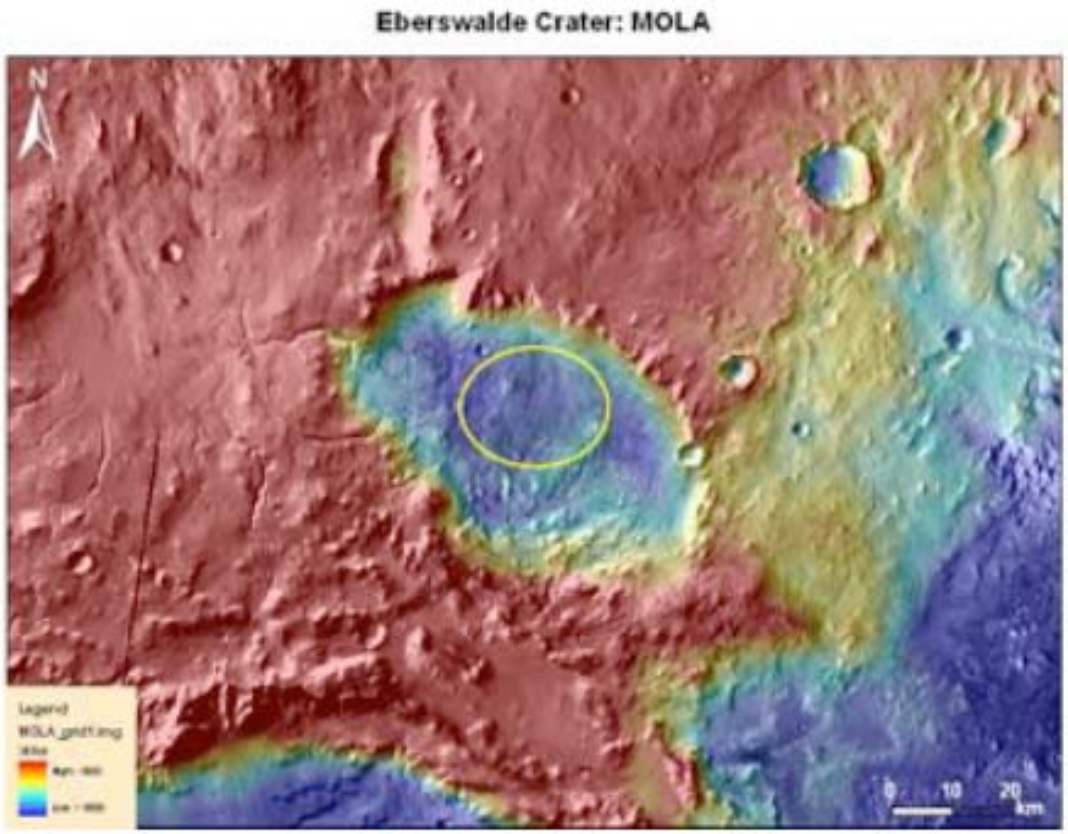
Fine print and disclaimer

All sites are of obvious intellectual merit and contain varying benefits toward exploration and comprehension of Mars.

The following list of cons is meant to address the perceived difficulties and strains that would be placed upon the mission as understood as the members of this committee.

The sites are similar in regards to their potential depositional environments and mineralogical information, but the choice of Mawrth Vallis is based primarily on what can be perceived as the least amount of difficulties with the best chance of learning something new about this planetary system.

Eberswalde Crater



Golombek et al., 2011

Engineering disadvantages:

- Highest elevation landing site of possible sites
- Go-to site

Scientific disadvantages:

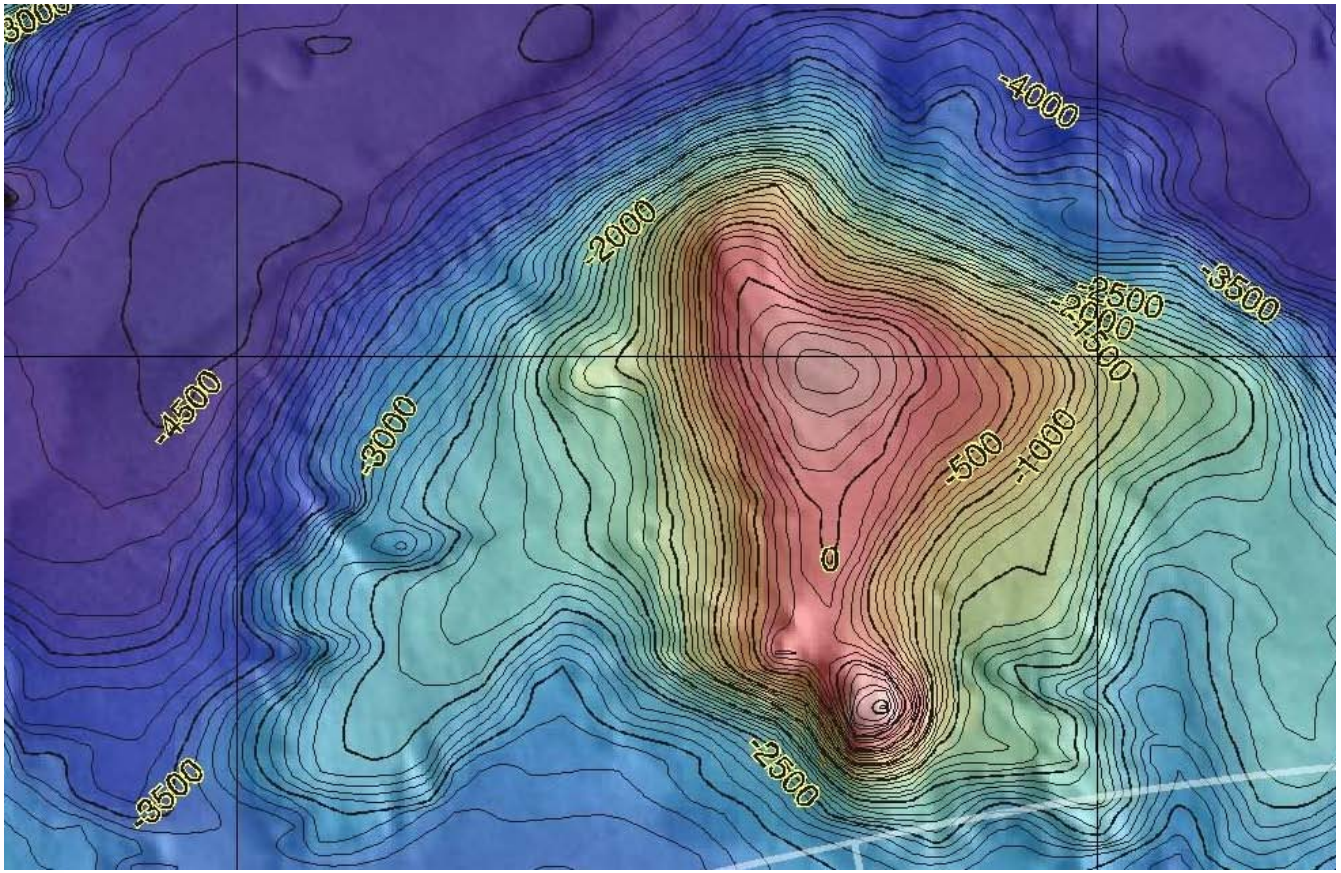
- Emplacement of delta may be as young as the Early Amazonian and therefore does not provide contextural information for a time period no longer available on Earth.
- Least variety and amount of phyllosilicates compared to the other sites.

Gale Crater

Engineering difficulties such as:

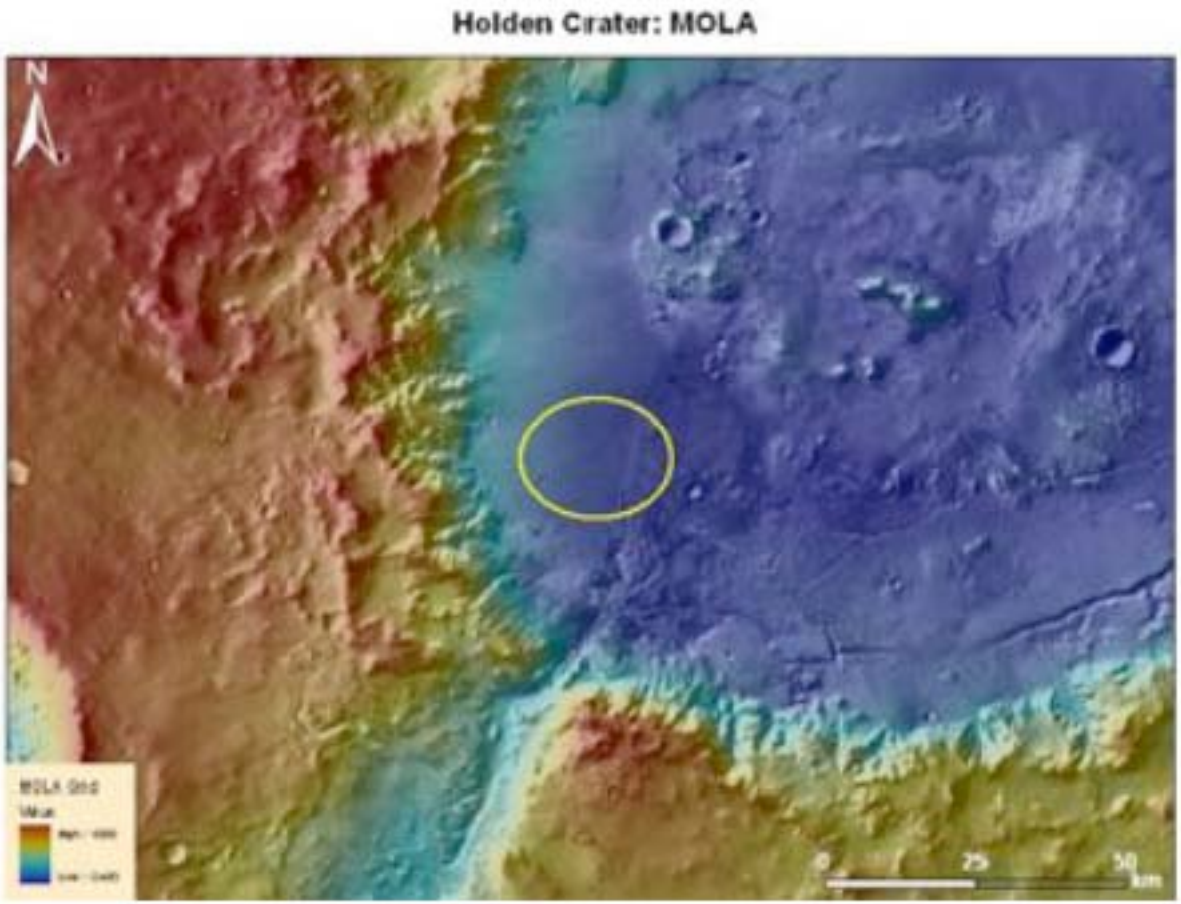
- Go-to site, distance and difficulty of climbing central mound
- Most dust in area compared to all other landing sites

Mound source and deposition not well understood



NASA/Scott Anderson

Holden Crater



Golombek et al., 2011

Scientific disadvantages:

- Low amount of phyllosilicates known to preserve organic material detected from orbit
- Source of deposits in fans not entirely understood
- Go-to site, lots of dunes in the landing ellipse might make traversing across the dunes time-consuming.

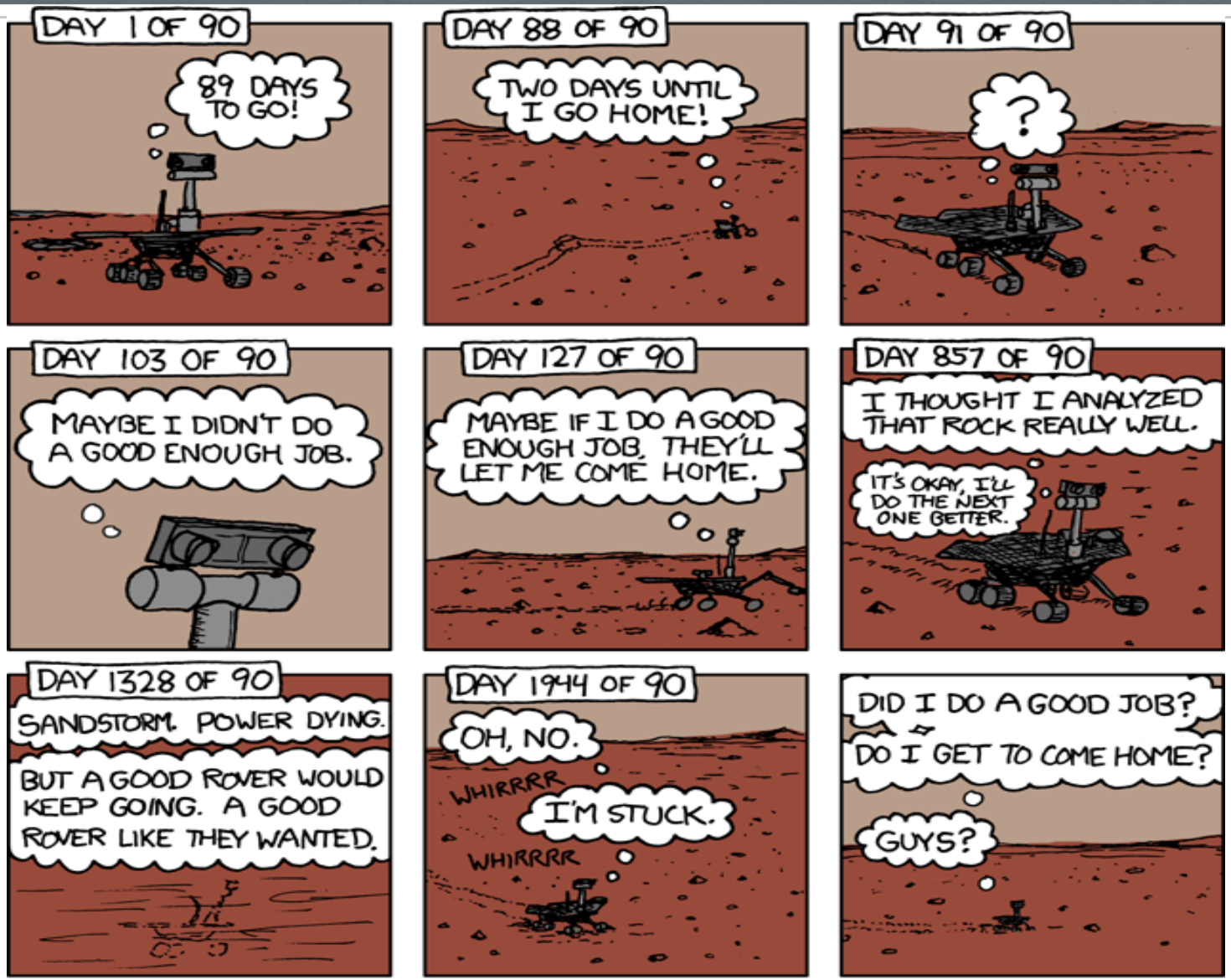
Conclusions

In Mawrth Vallis, MSL will elucidate the past habitability of the region and subsequently Mars as a planet.

MSL will evaluate:

✓Potential evidence of past life preserved in organics
✓Noachian (> 4Gyr) crust
✓Abundant ancient phyllosilicates
✓Phyllosilicate stratigraphy, which is comparable to many other locations across the planet
✓Evidence for early wet Mars and ability to sample diverse aqueous environments

We select Mawrth Vallis as a landing site because it has maximum scientific potential, with study sites for every MSL mission objective within the specified landing ellipse.



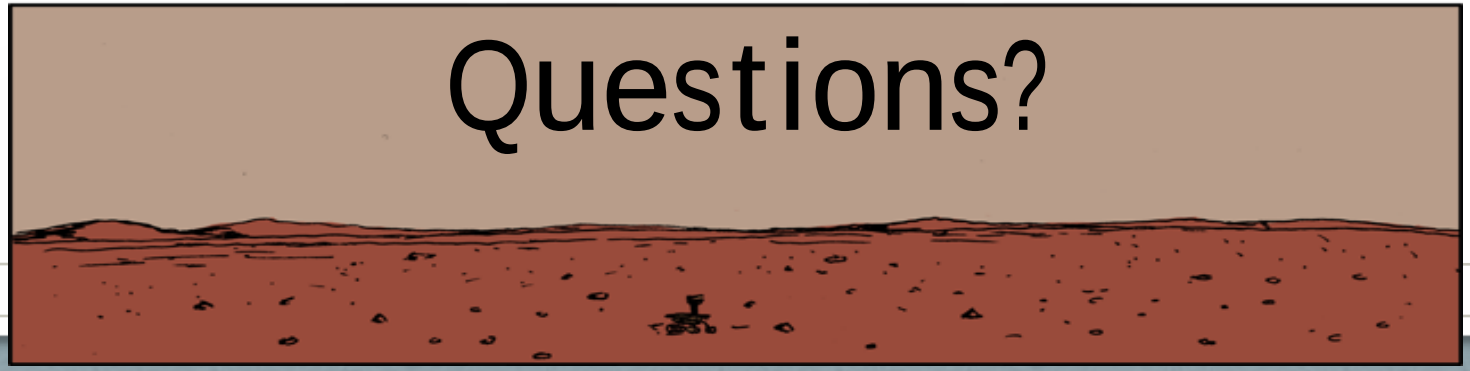


Image credit: Randall Munroe, xkcd