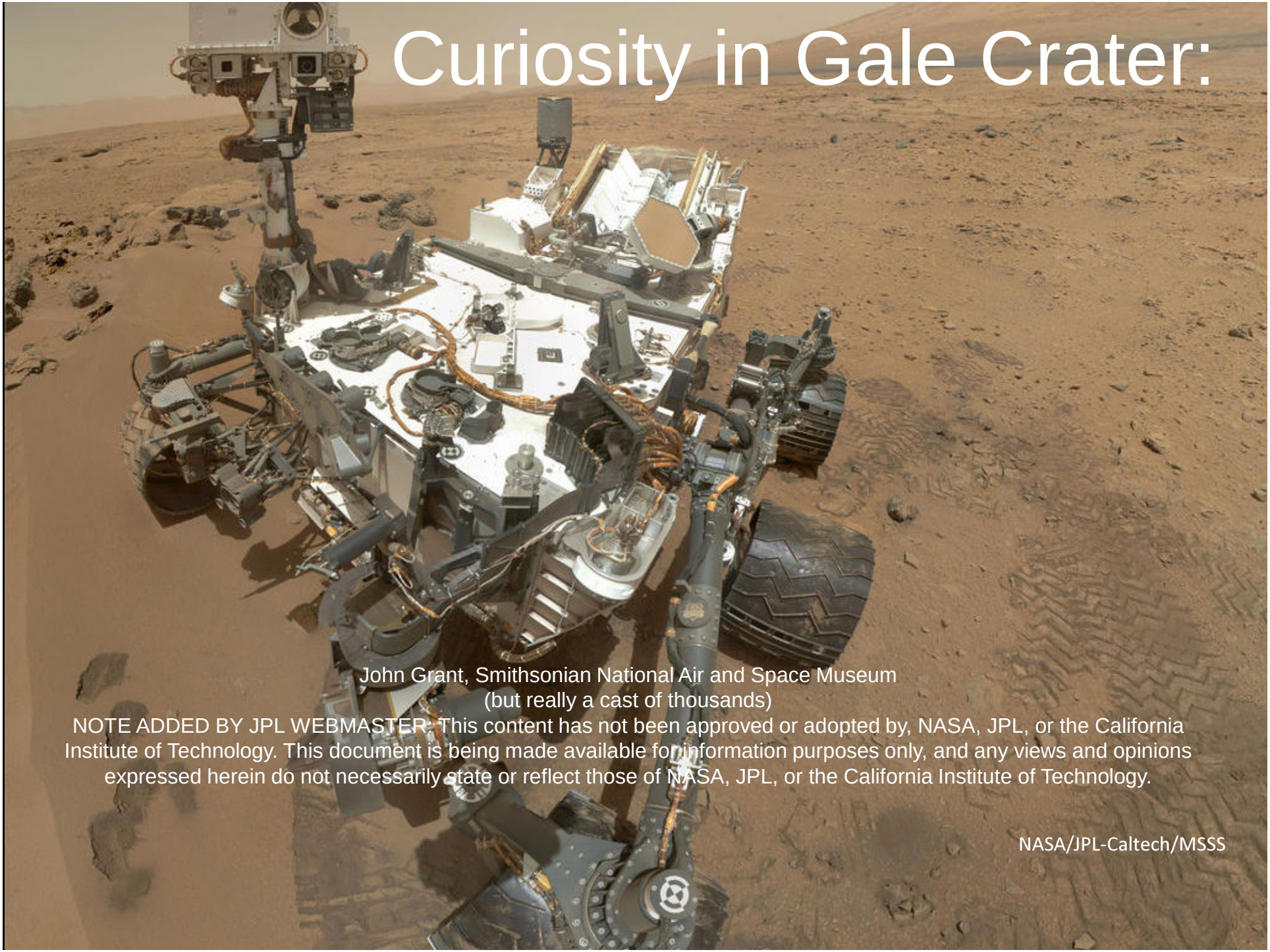
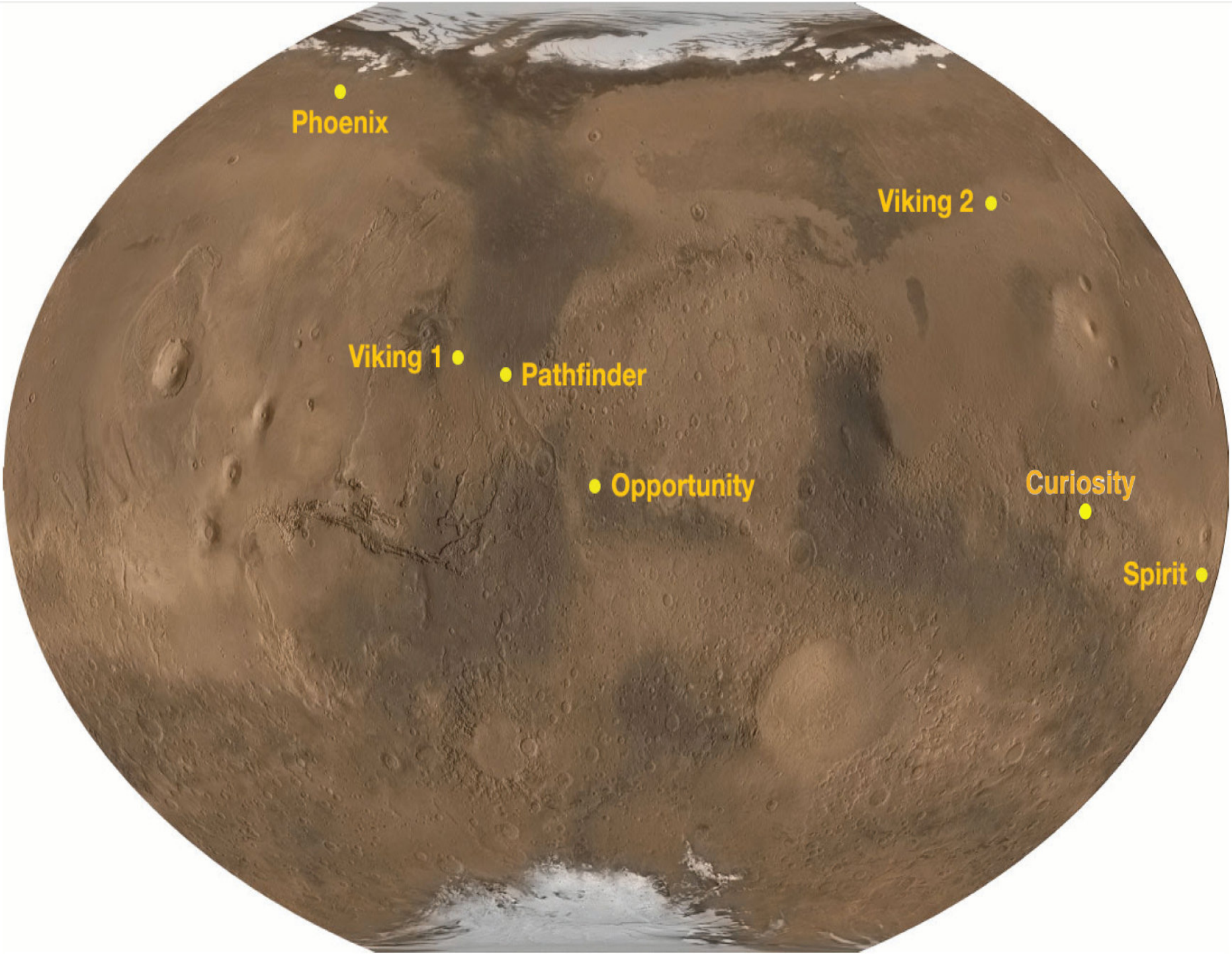
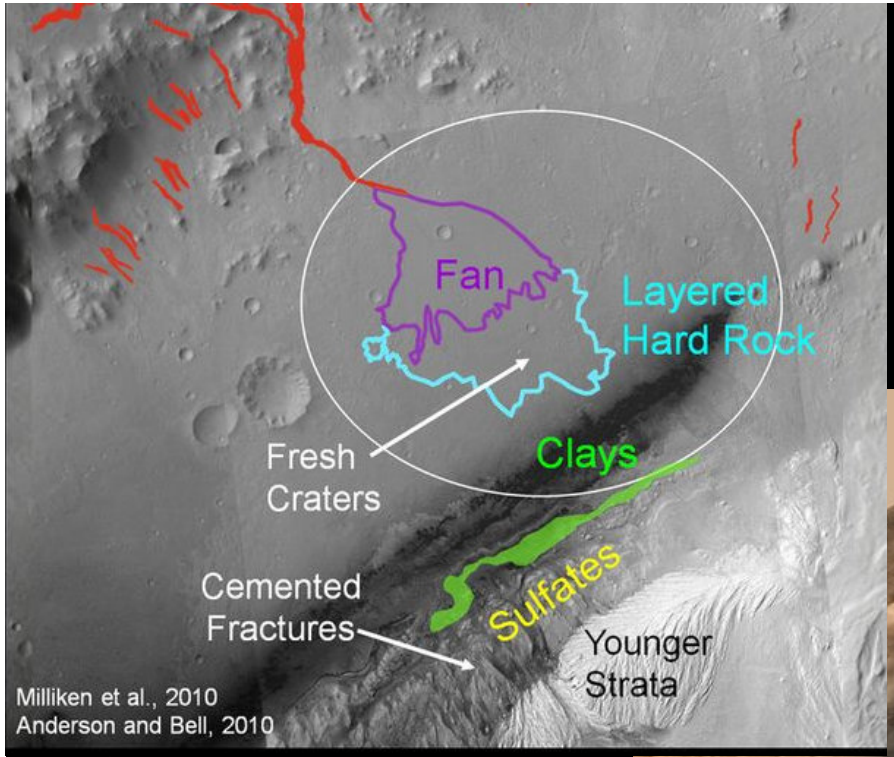


Curiosity in Gale Crater:

John Grant, Smithsonian National Air and Space Museum
(but really a cast of thousands)

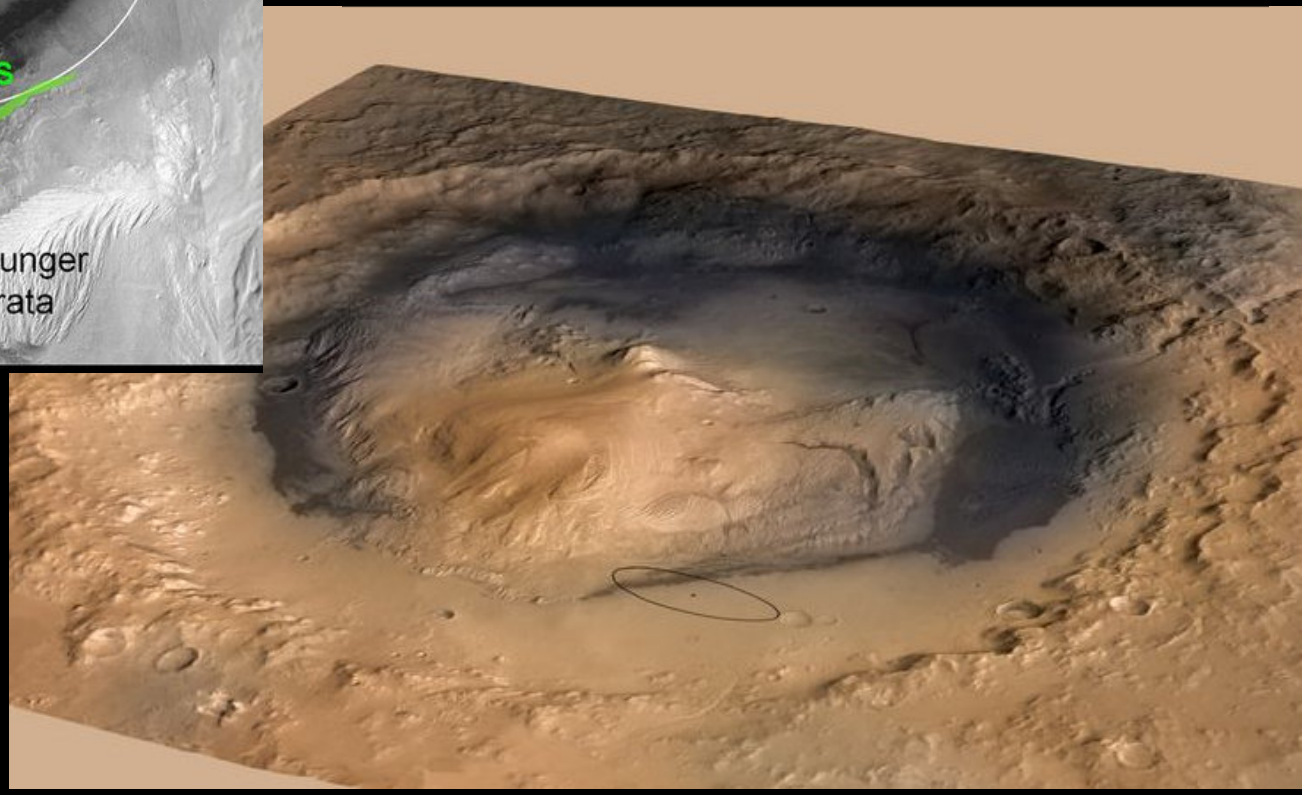
NASA/JPL-Caltech/MSSS


Phoenix
Viking 2
Viking 1
Pathfinder
Opportunity
Curiosity
Spirit



NASA/JPL-Caltech

150-km Gale Crater contains a 5-km high mound of stratified rock. Strata in the lower section of the mound vary in mineralogy and texture, suggesting that they may have recorded environmental changes over time.

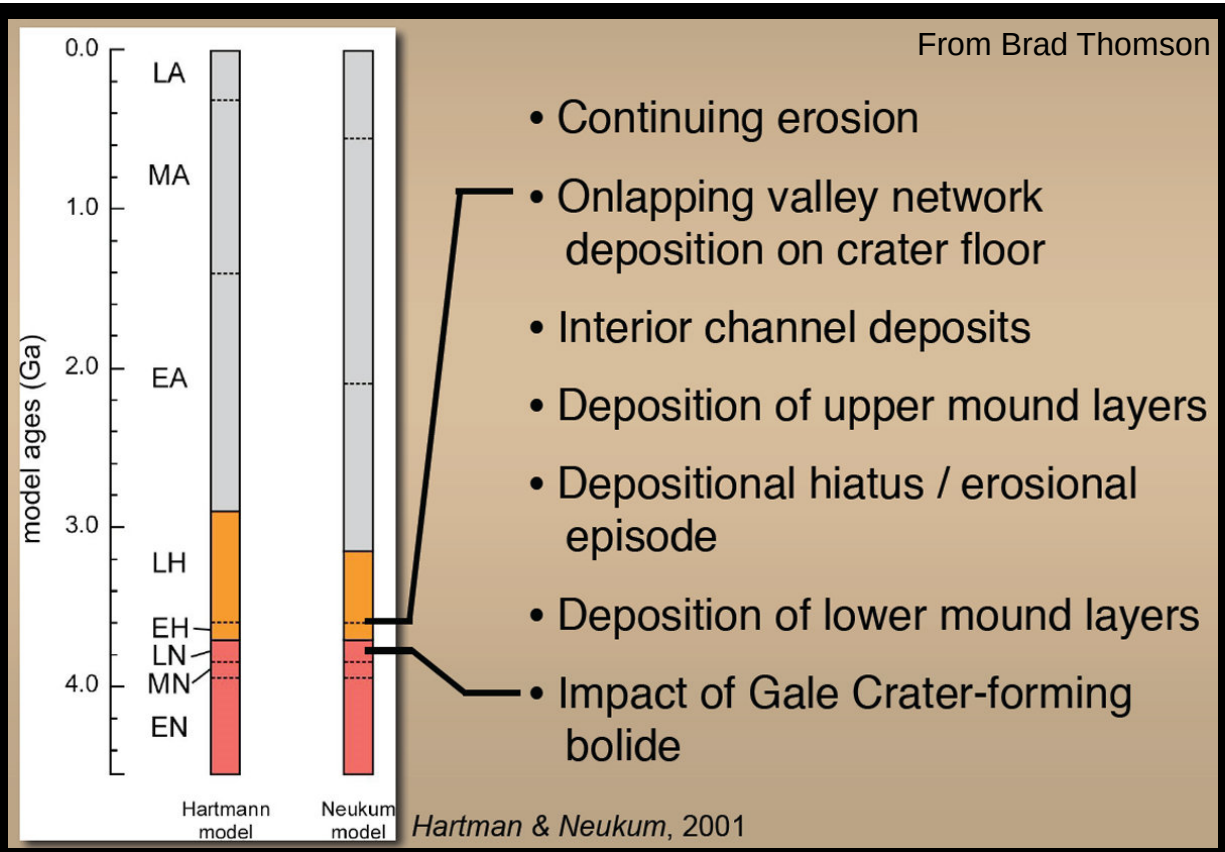


NASA/JPL-Caltech/ESA/DLR/FU Berlin/MSSS

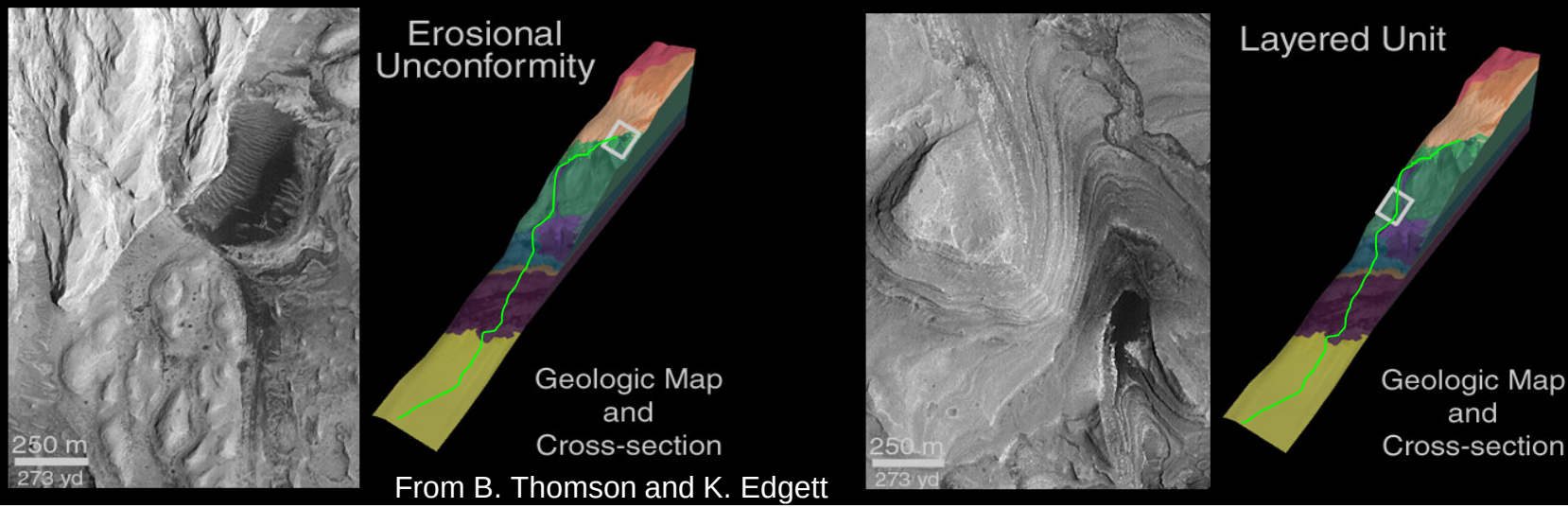
CURIOSITY

Target: Gale Crater and Mount Sharp

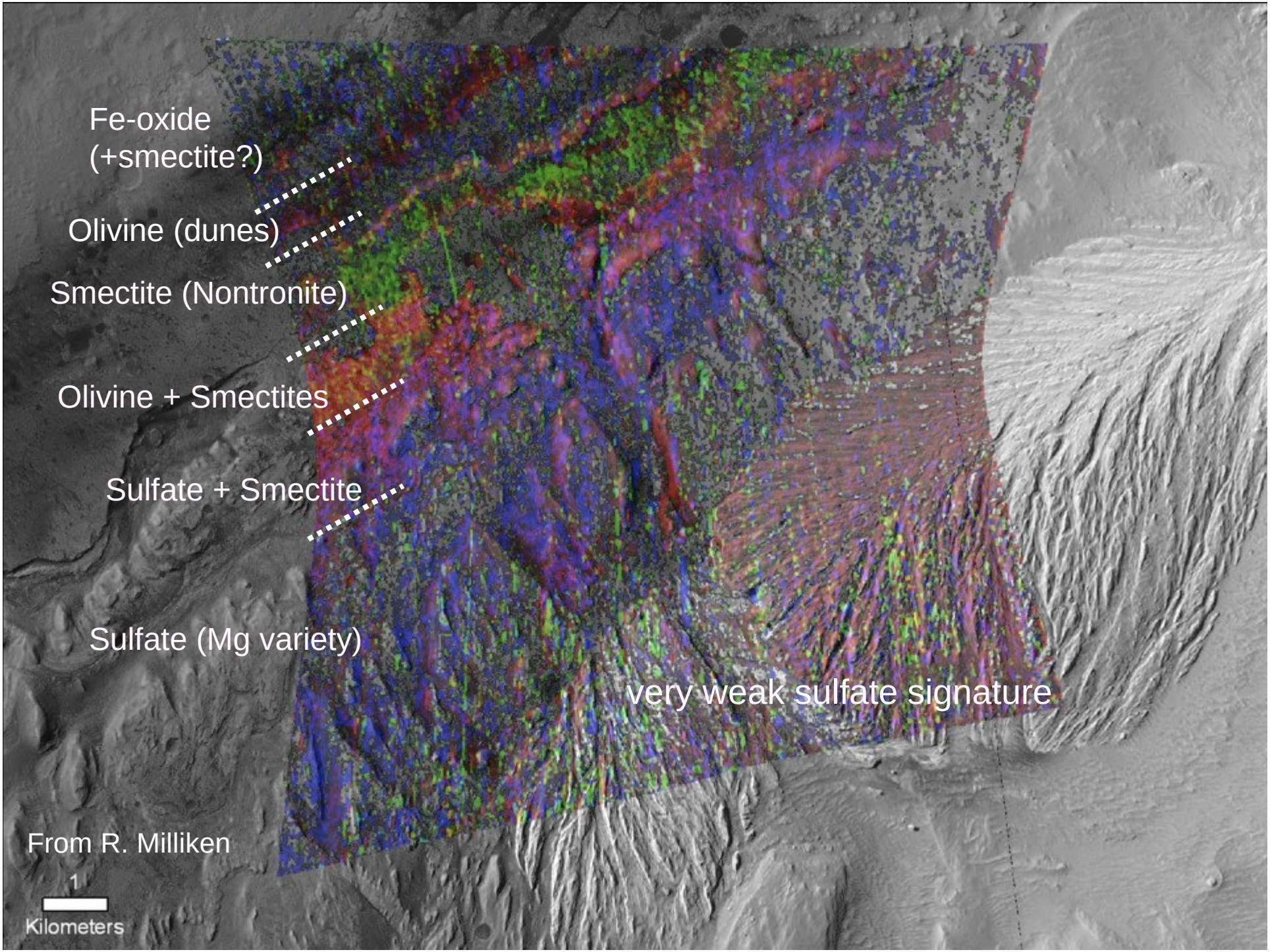
Gale Crater:

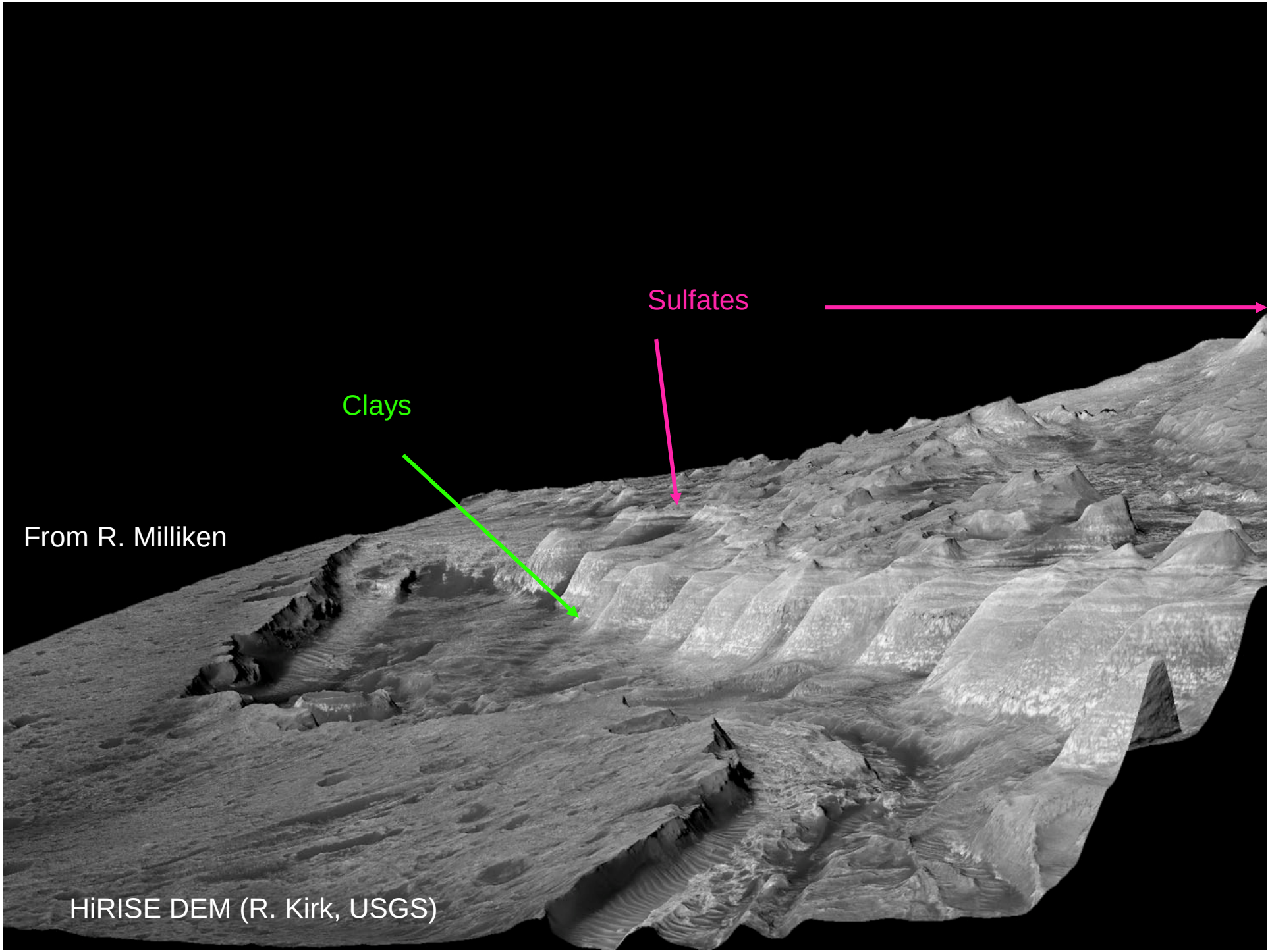


Origin of fill, Composition, Mode of deposition, Depositional Environments, Timing, Mineralogy, Role of water

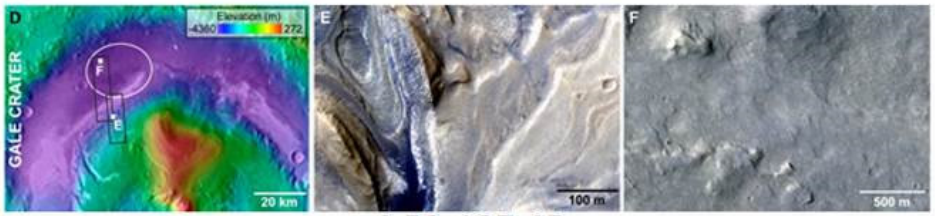


From B. Thomson and K. Edgett


Fe-oxide
(+smectite?)
Olivine (dunes)
Smectite (Nontronite)
Olivine + Smectites
Sulfate + Smectite
Sulfate (Mg variety)
very weak sulfate signature
From R. Milliken
1
Kilometers


Sulfates
Clays
From R. Milliken
HiRISE DEM (R. Kirk, USGS)

Gale Crater Site



4.5S, 137.4E

Overarching Hypothesis:

- Strata within the 5 km thick mound of layered sediments within Gale crater record a sequence of aqueous habitable environments over an extended period. These strata contain multiple hydrous minerals (sulfates, phyllosilicates) that indicate varying aqueous environmental conditions.

Possible Cons of Site:

- The original extent and timing of processes responsible for the present mound morphology needs better definition and the regional and global stratigraphic context of the mound is not firmly established and it is unlikely that all depositional aspects of the mound will be understood in advance of landing.
- Science in landing ellipse on and near an alluvial fan is secondary to that outside of the ellipse and observations within the ellipse may be encumbered by dust.

Specific Pros of Site:

Setting -

•Diverse stratigraphy in a 5 km mound within a 5 km deep Late Noachian crater. Stratigraphy includes well-defined beds of hydrated minerals and the lower mound includes contributions by fluvial processes and likely reflects deposition during changing and possibly global scale wetter-to-drier environmental conditions.

•Alluvial materials and inverted channels in the ellipse record hydrologic conditions when they were emplaced and provide the opportunity to sample materials weathered and eroded from the crater walls.

Diversity -

•Multiple mineralogical and stratigraphic units within the 5 km thick mound sequence with alternating inter-bedded phyllosilicate and sulfate bearing beds in the lower mound. Stratigraphy comprising the mound is continuous over many km and well characterized in places.

•Alluvium in the landing ellipse enables sampling crater rim materials that may record environmental conditions during their emplacement and from before the formation of the north-south dichotomy on Mars.

Preservation –

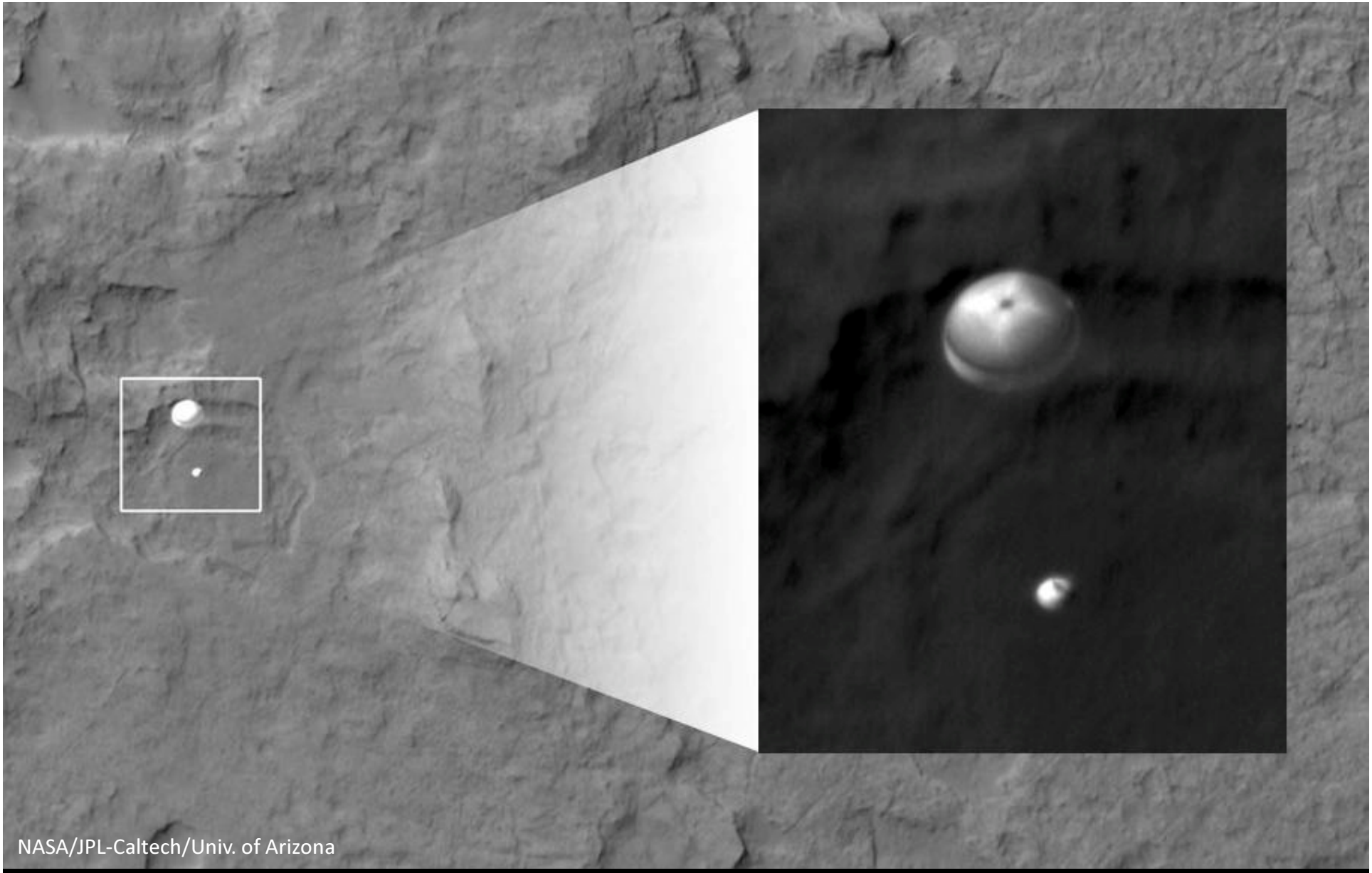
•The phyllosilicate-bearing units in the lower mound and moat include smectites that would help preserve organics if present. Biosignatures may be best preserved in the sulfate bearing strata in the mound.

Exploration Targets –

•The specific distribution of science targets within and outside of the ellipse is well defined. Preserved organics could occur in a high thermal inertia unit in fan in ellipse, in clay rich layers that may not have sulfates, and in the sulfates.

Remaining Uncertainties:

- Although several testable models for mound formation exist, uncertainty remains about the depositional setting for much of the stratigraphy despite a better understanding of the constituent mineralogy. Nevertheless, bed continuity and morphology implies origin of lower section involved deposition onto a wet surface or into standing water and there is evidence for fluvial redistribution of mound materials.
- •The source of water associated with deposition remains uncertain, but if sediments were deposited in a lake, the relative paucity of associated valleys suggests groundwater as opposed to meteoric sources.
- The source of the lower mound sediments is unknown but likely from outside of the crater and it is uncertain whether the mound is part of a larger deposit (though it is morphologically similar to deposits seen elsewhere on Mars). Valleys breaching the rim at a stratigraphic level now lost to erosion may have contributed fill to the crater and/or in lake.
- Crater statistics suggest Gale is Late Noachian, whereas floor deposits onlapping the lower mound and including the fan in ellipse are interpreted to be Early Hesperian, thereby bracketing the age of the lower mound. Age of upper mound and total time recorded in the mound is uncertain.
- •Preservation potential of organics in the sulfate units may be compromised by the known presence of iron oxides.



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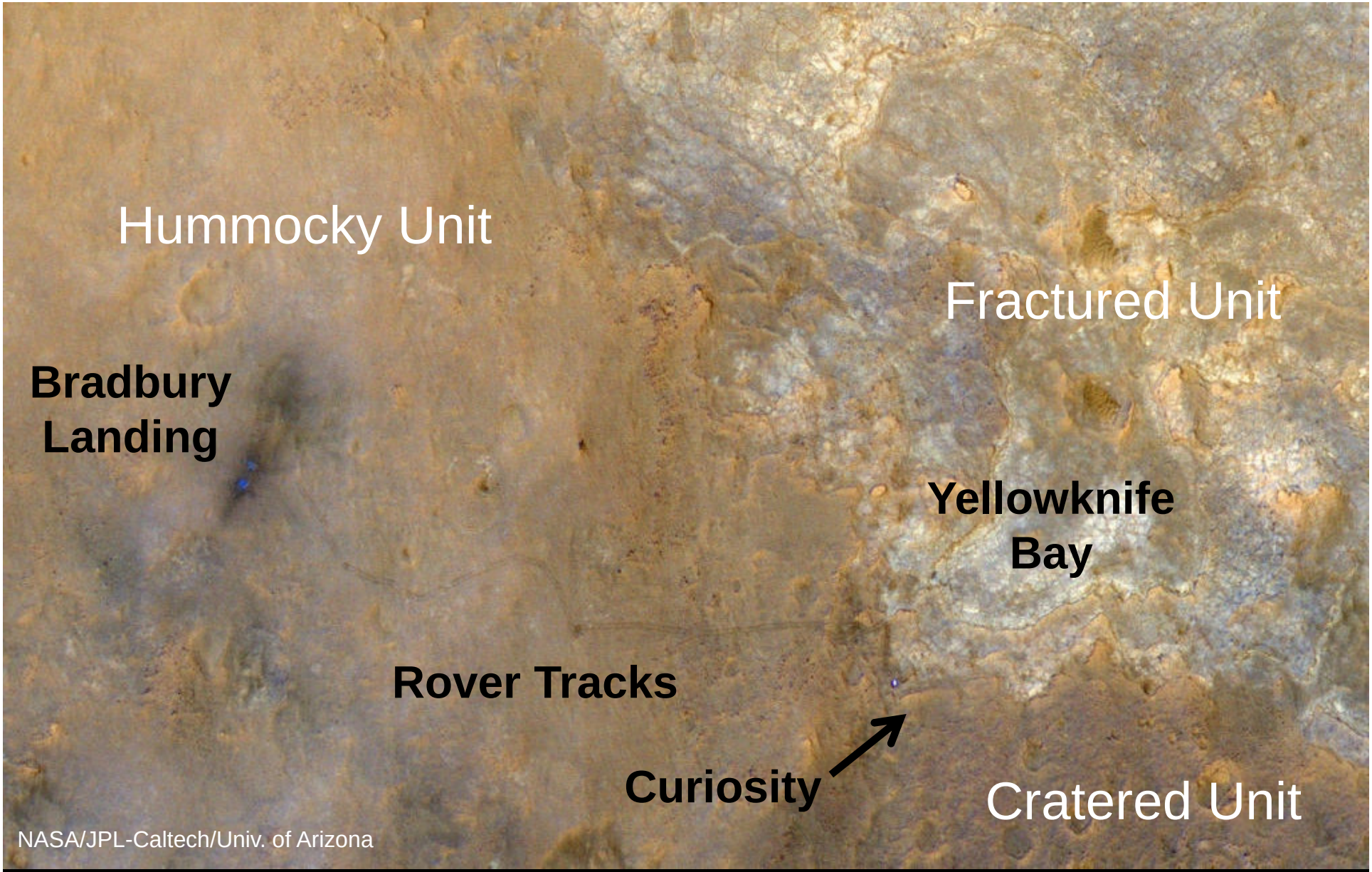
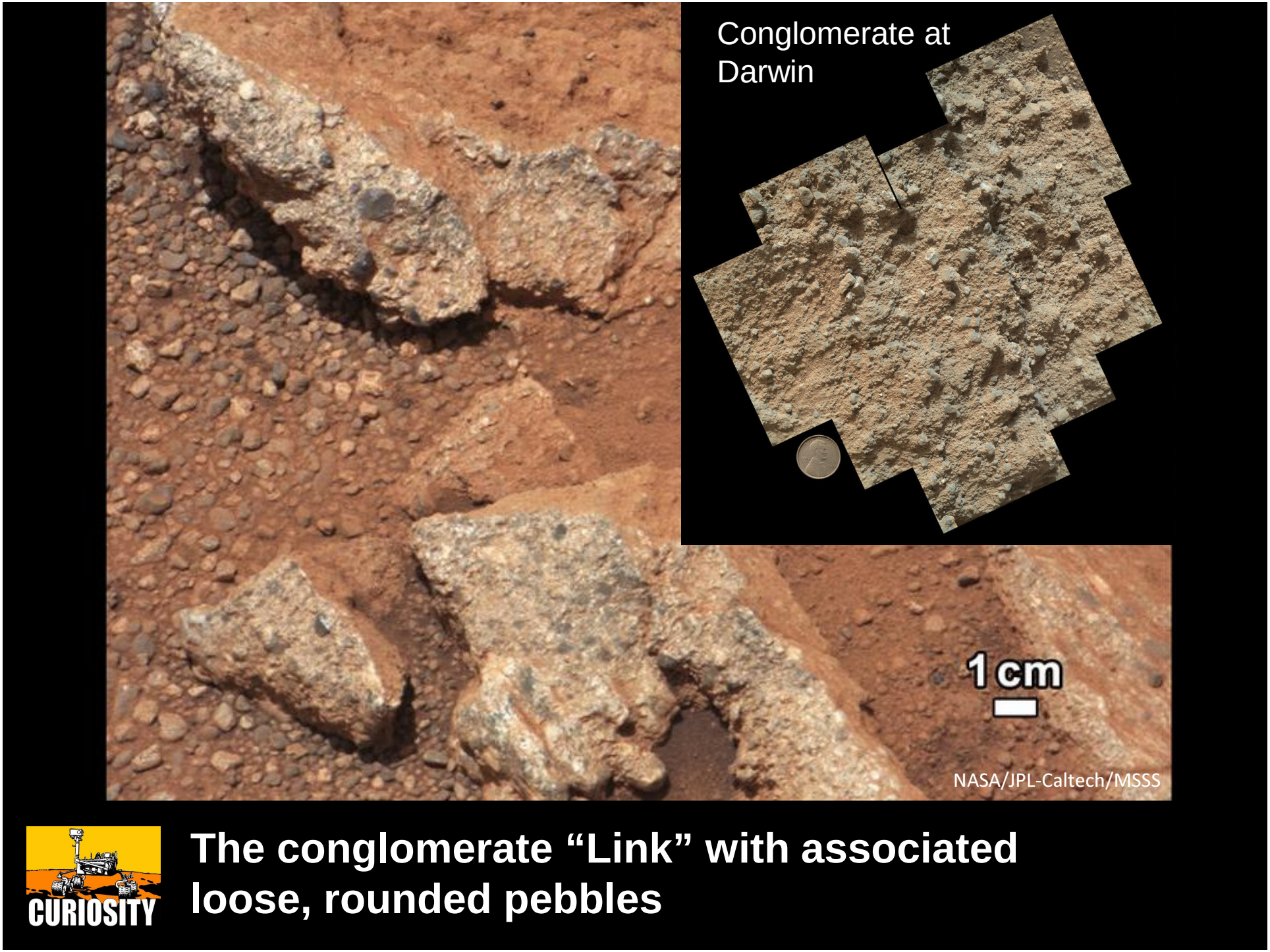
Curiosity on parachute, imaged by HiRISE on the Mars Reconnaissance Orbiter

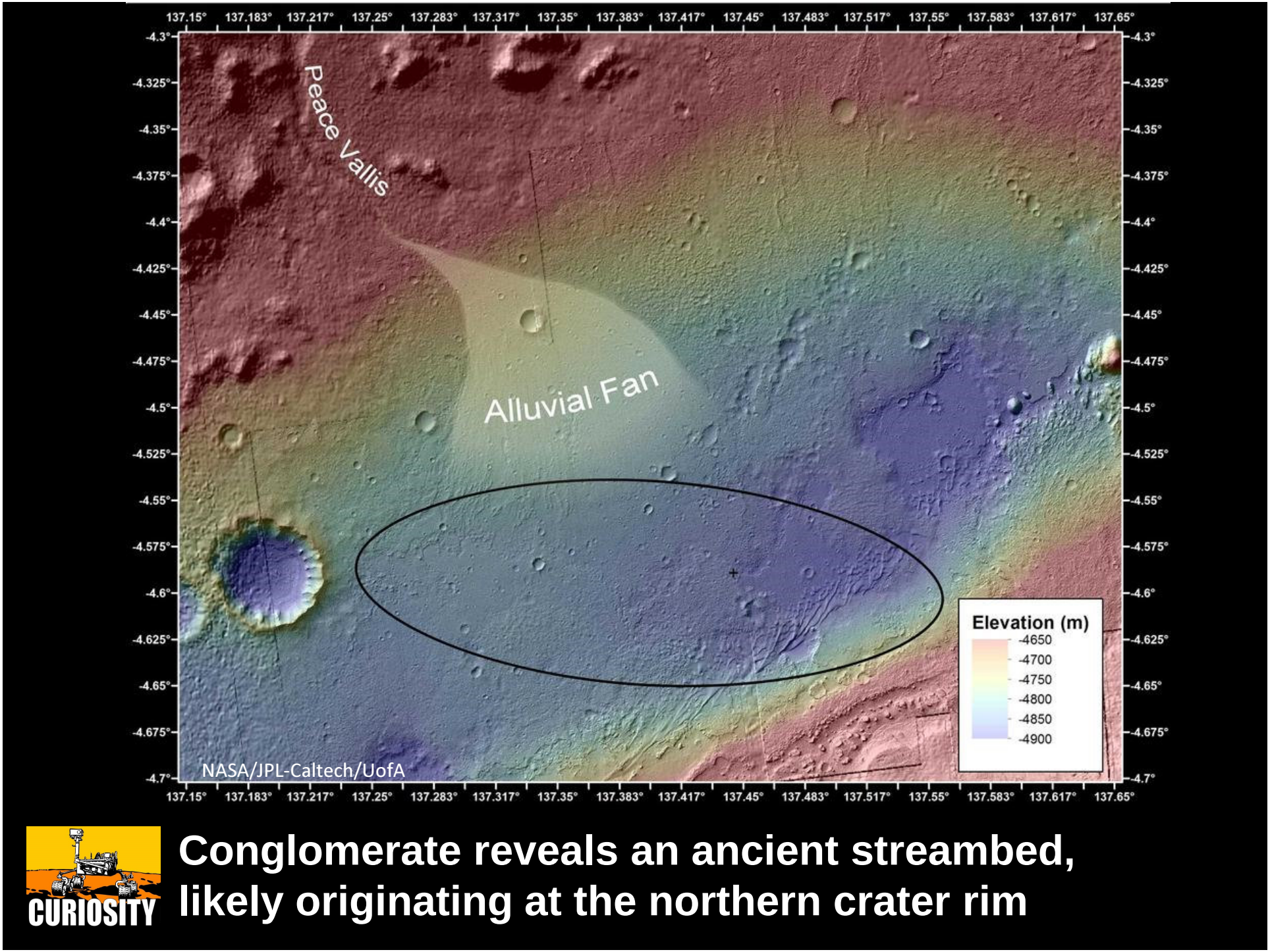


Curiosity's Traverse to Glenelg: Jake M. and Conglomerates



CURIOSITY

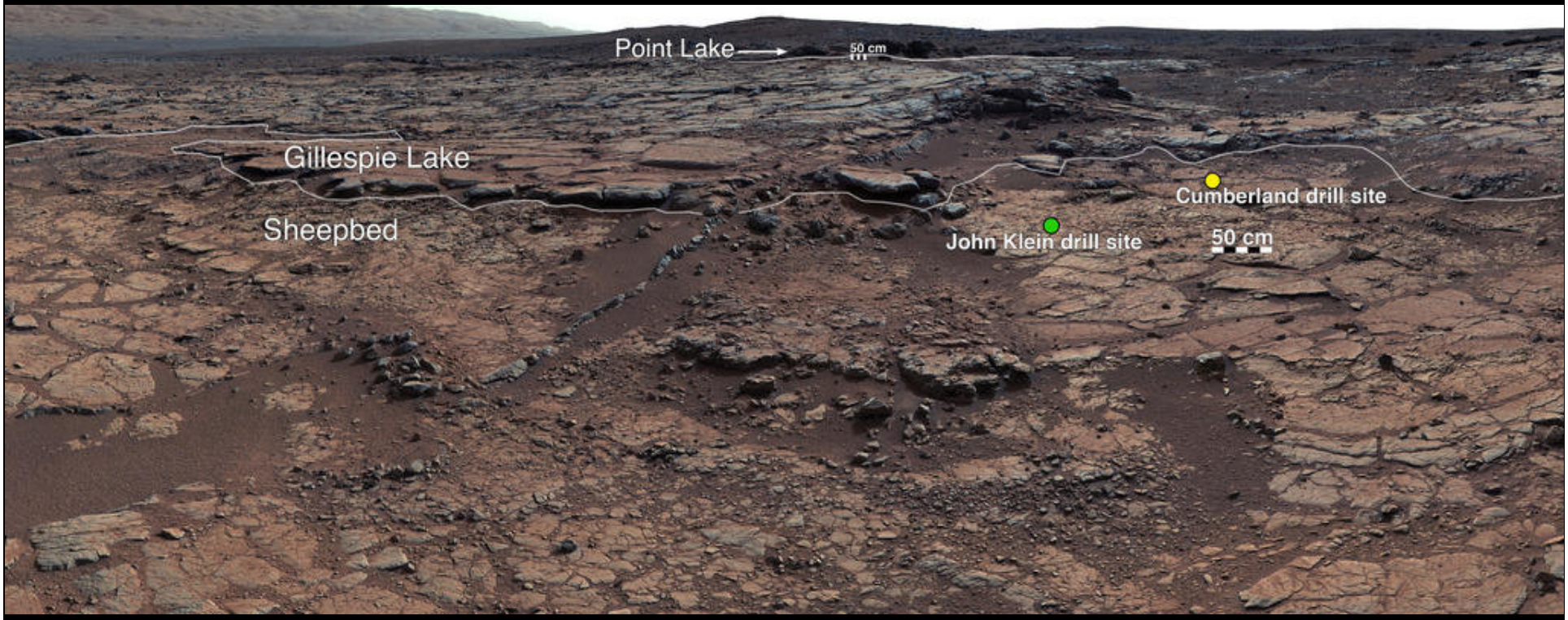
The conglomerate “Link” with associated loose, rounded pebbles



CURIOSITY

Conglomerate reveals an ancient streambed, likely originating at the northern crater rim

Rock Units in Yellowknife Bay:



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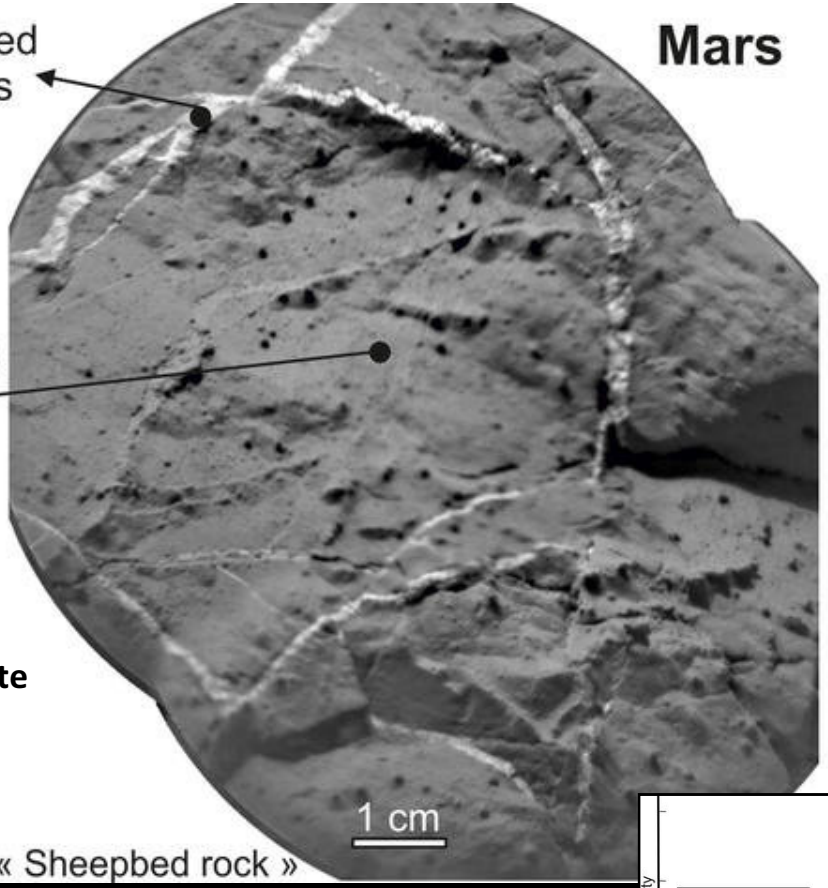
CURIOSITY

“Sheepbed” rocks also contain many spherules suggesting that water percolated though pores

Veins of hydrated calcium sulfates

Sediments with basaltic composition

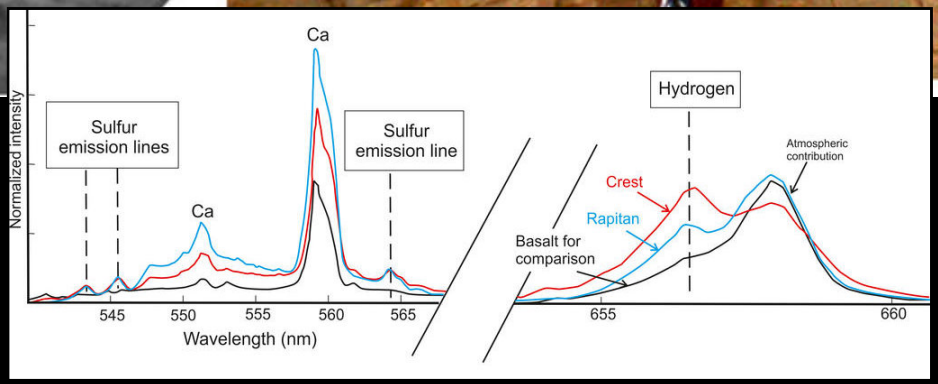
ChemCam Remote Micro-Imager



Earth

NASA/JPL-Caltech/LANL/CNES/IRAP/
LPGNantes/CNRS/LGLyon/Planet-Terre

ChemCam spectra from sol 125 "Crest" and 135 "Rapitan"



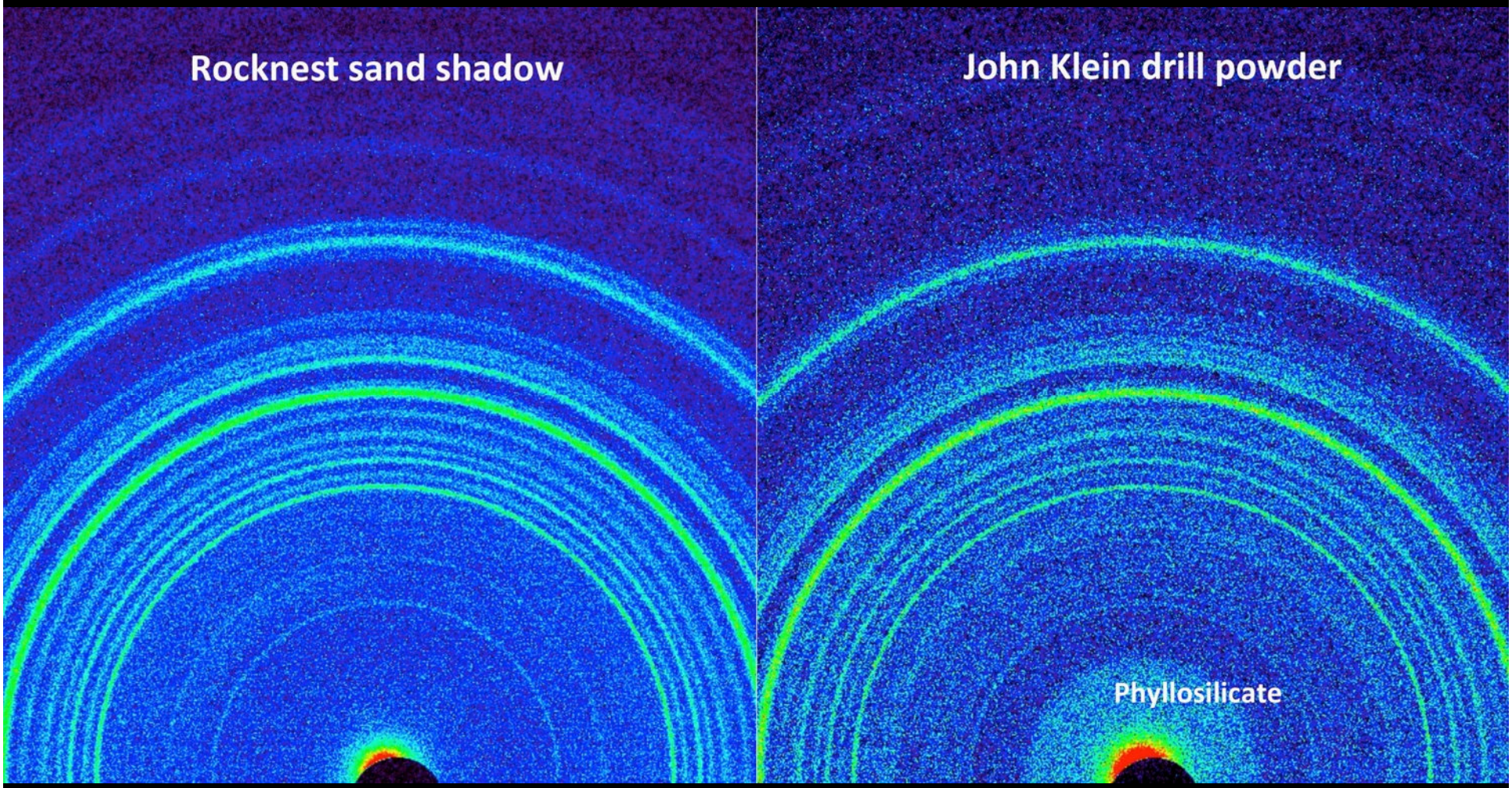
"Sheepbed" rocks contain 1 to 5-mm fractures filled with calcium sulfate minerals that precipitated from fluids at low to moderate temperatures

CURIOSITY

NASA/JPL-Caltech/D. Bouic

CURIOSITY

Arm deployed at John Klein



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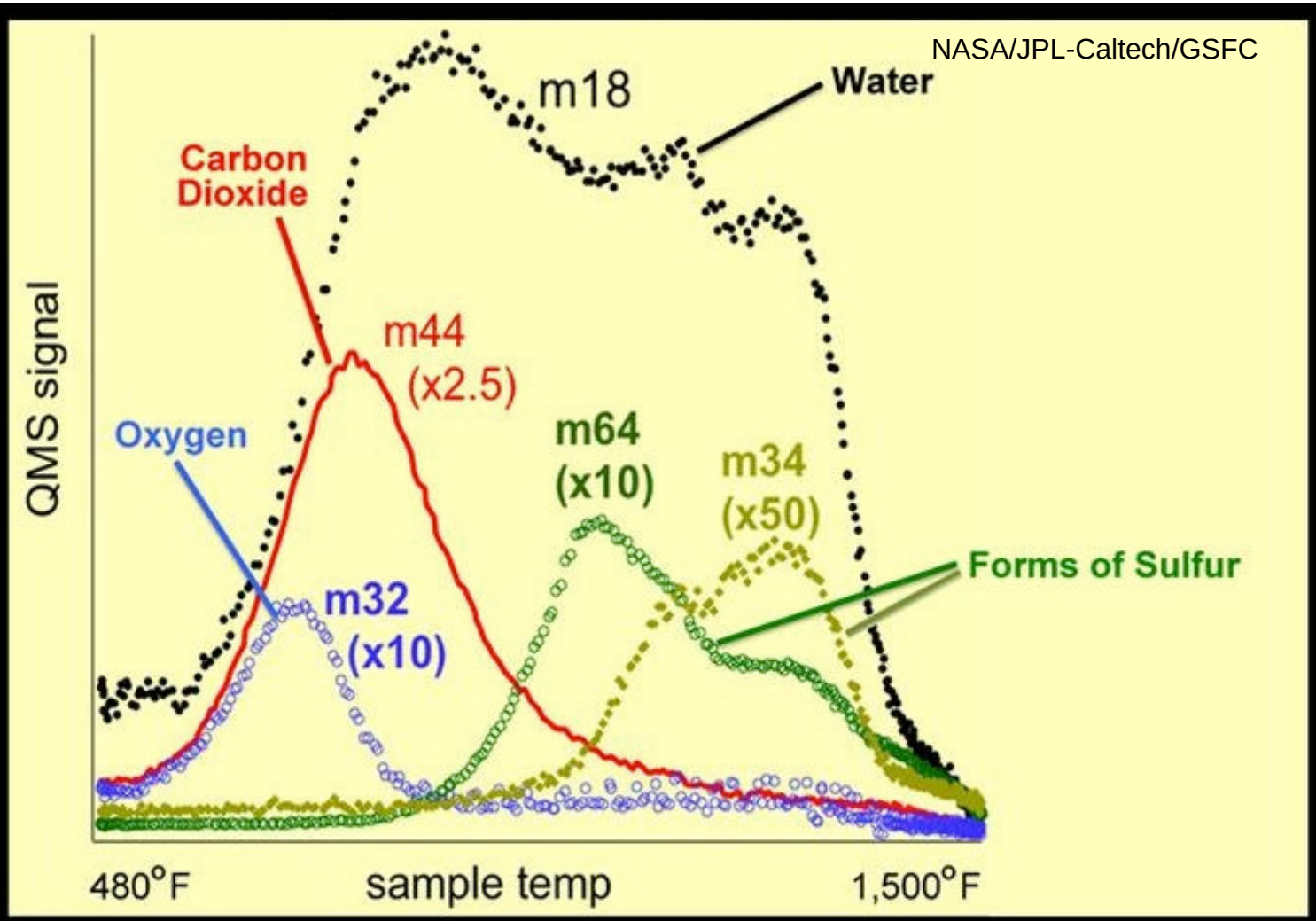
The drill powder contains abundant phyllosilicates (clay minerals), indicating sustained interaction with water

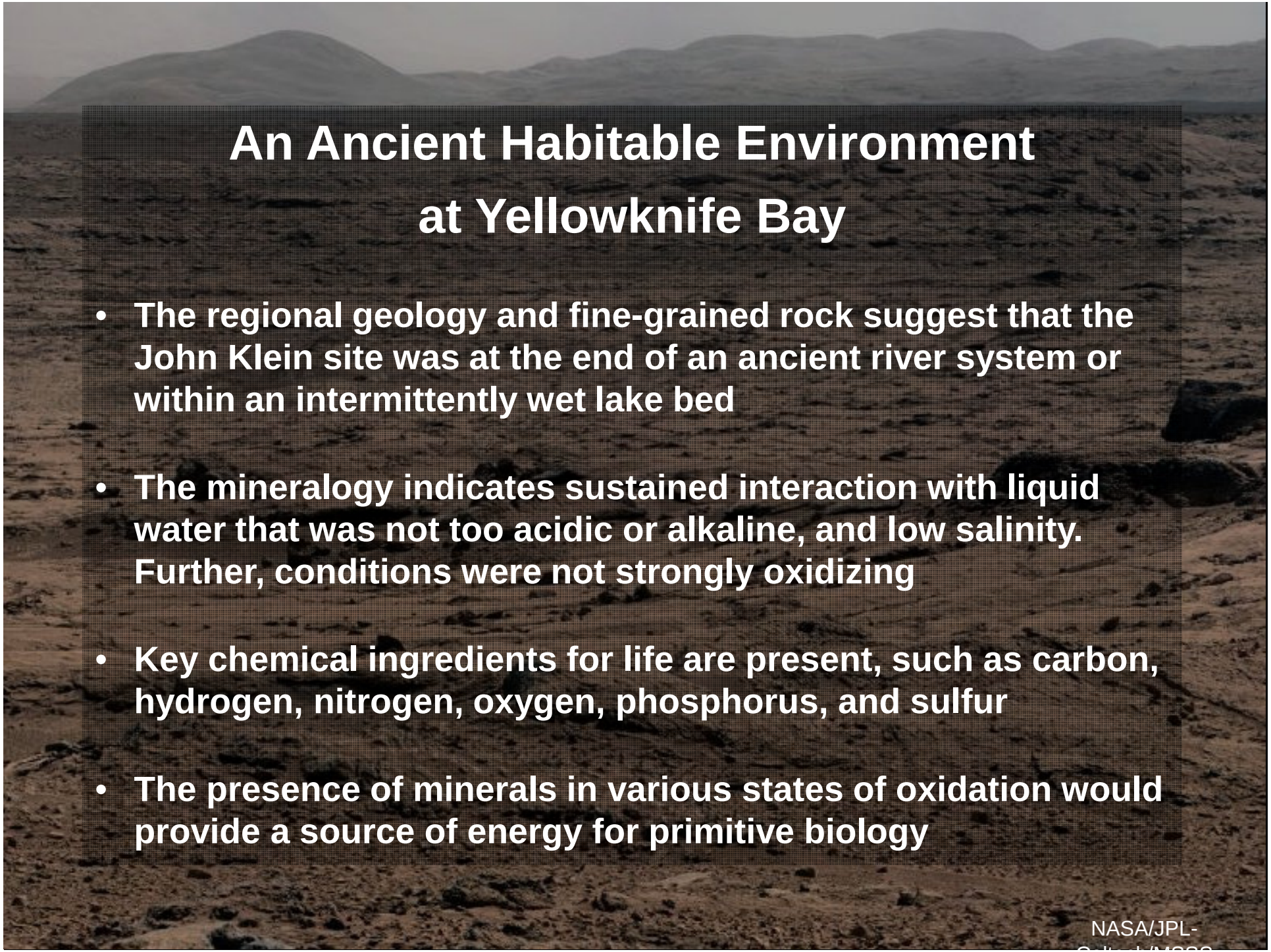
X-ray diffraction patterns from Rocknest (left) and John Klein (right)



SAM analysis of the drilled rock sample reveals water, carbon dioxide, oxygen, sulfur dioxide, and hydrogen sulfide released on heating. The release of water at high temperature is consistent with smectite clay minerals.

CURIOSITY

Major gases released from John Klein sample and analyzed by SAM

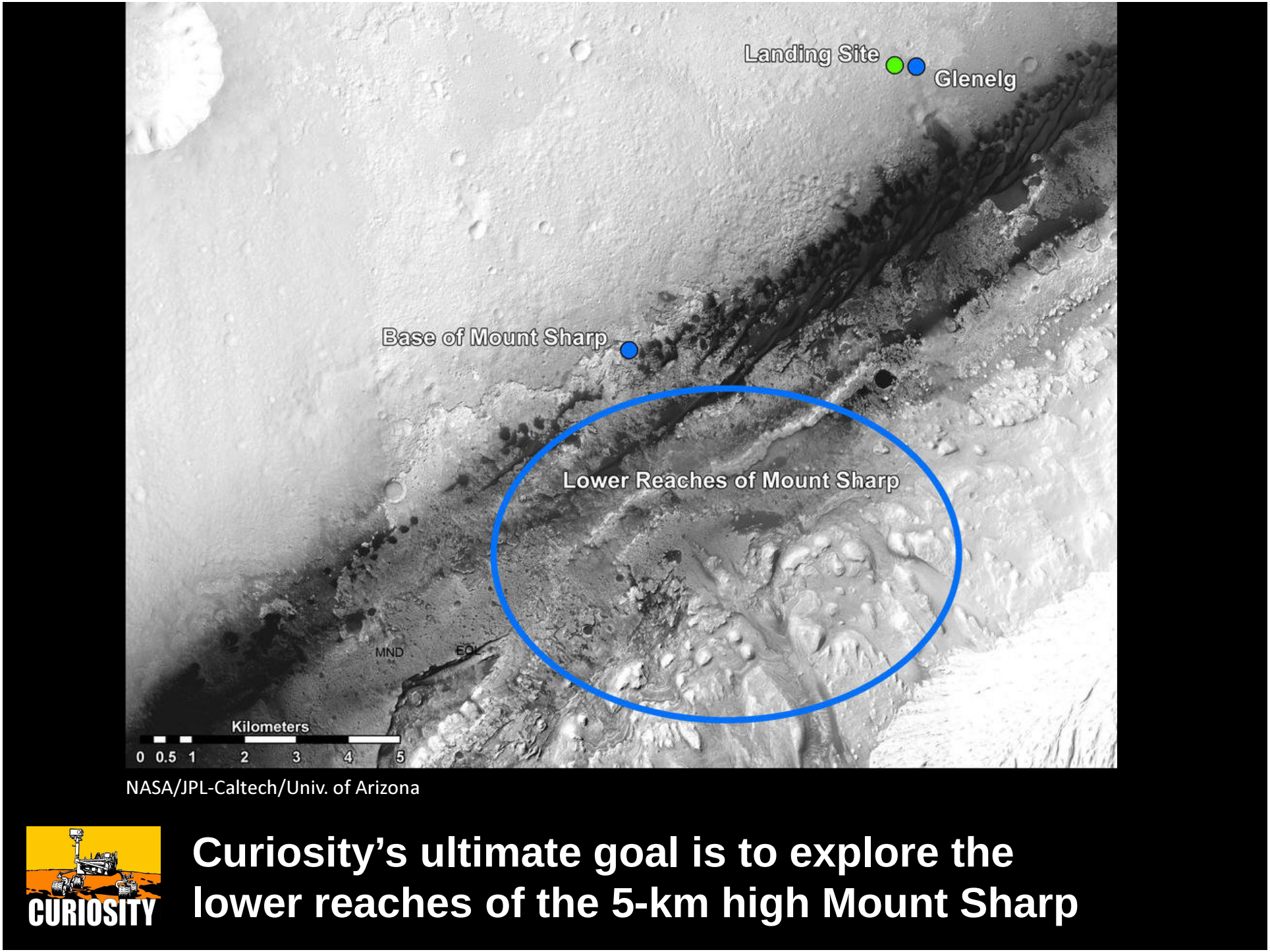


An Ancient Habitable Environment at Yellowknife Bay

- The regional geology and fine-grained rock suggest that the John Klein site was at the end of an ancient river system or within an intermittently wet lake bed
- The mineralogy indicates sustained interaction with liquid water that was not too acidic or alkaline, and low salinity. Further, conditions were not strongly oxidizing
- Key chemical ingredients for life are present, such as carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur
- The presence of minerals in various states of oxidation would provide a source of energy for primitive biology

NASA/JPL-


NASA/JPL-Caltech/MSSS



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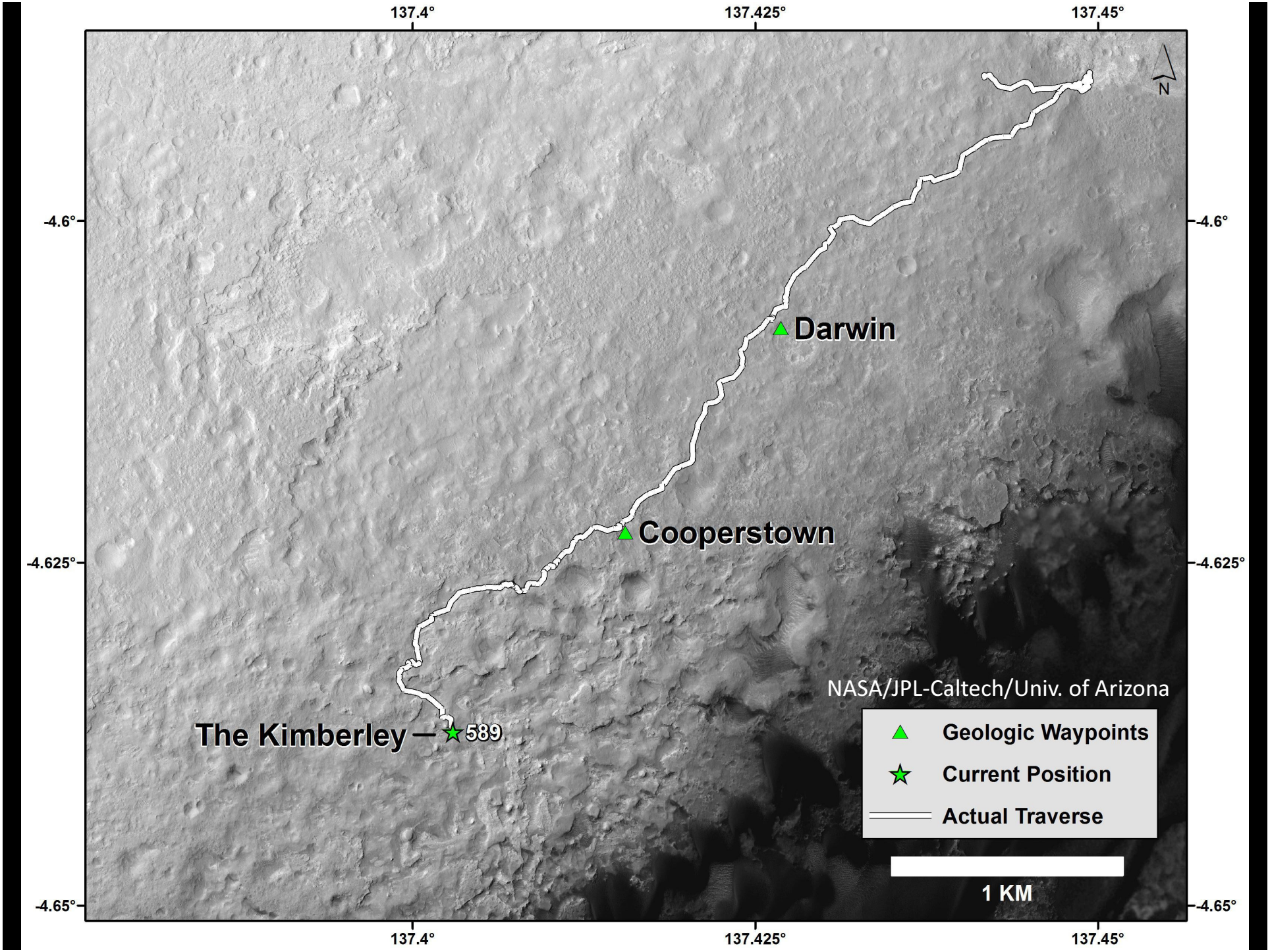
CURIOSITY

Curiosity's ultimate goal is to explore the lower reaches of the 5-km high Mount Sharp


137.4°
137.425°
137.45°
-4.6°
-4.625°
-4.65°
N
Darwin
Cooperstown
The Kimberley
589
NASA/JPL-Caltech/Univ. of Arizona
Geologic Waypoints
Current Position
Actual Traverse
1 KM