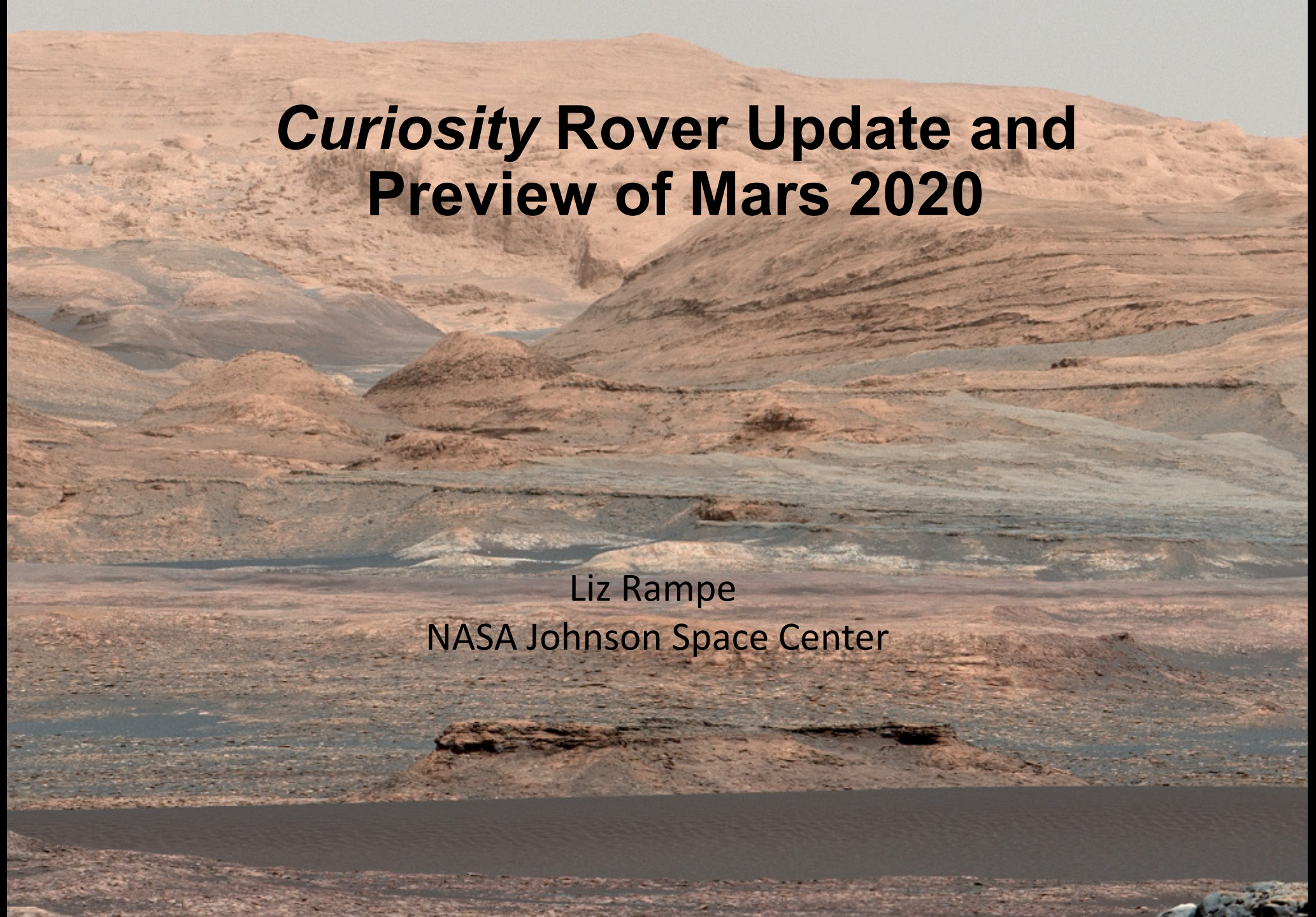
A LITTLE ABOUT ME

NASA Johnson Space Center (JSC), Astromaterials Research & Exploration Science (ARES) Division

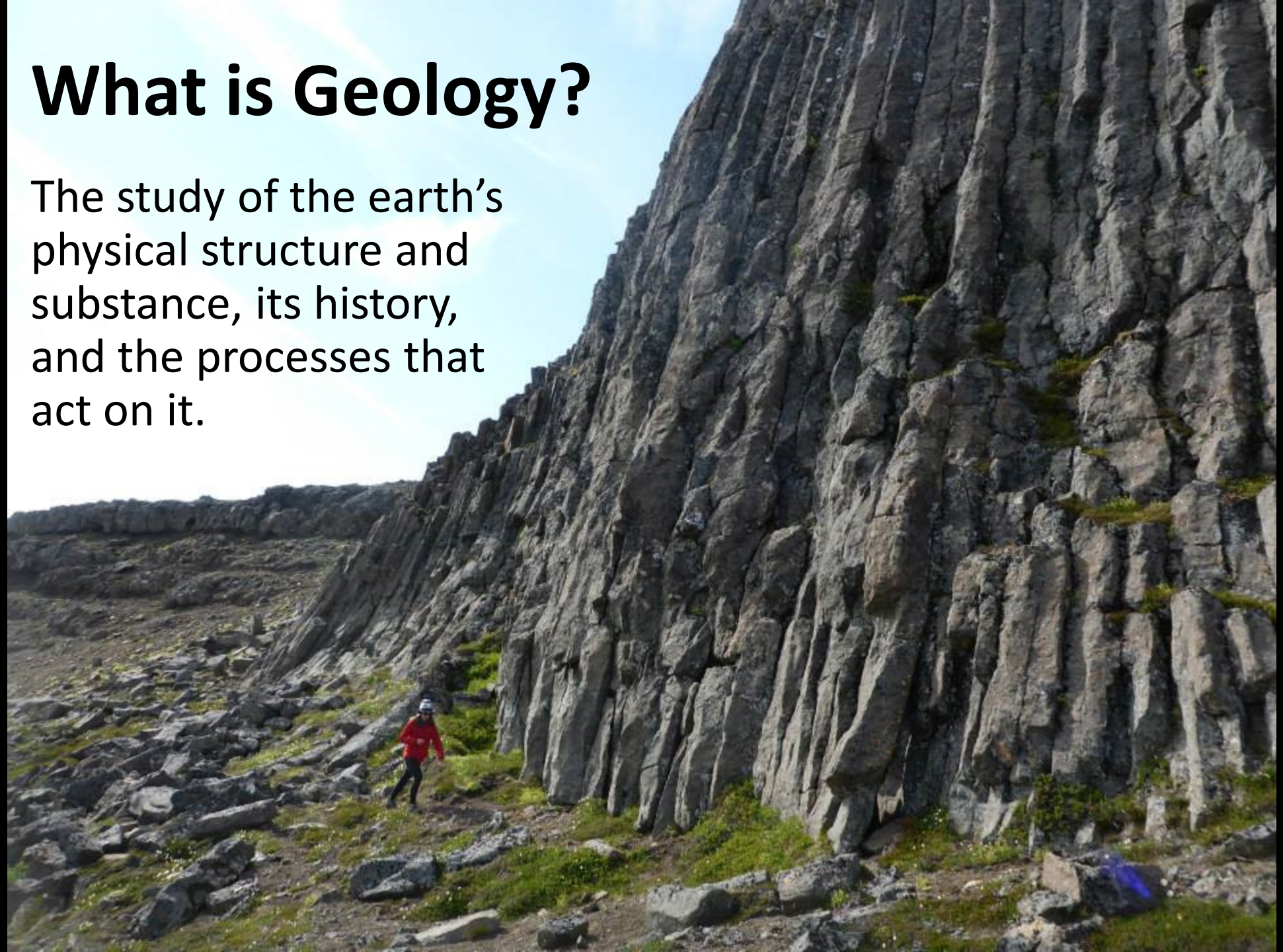


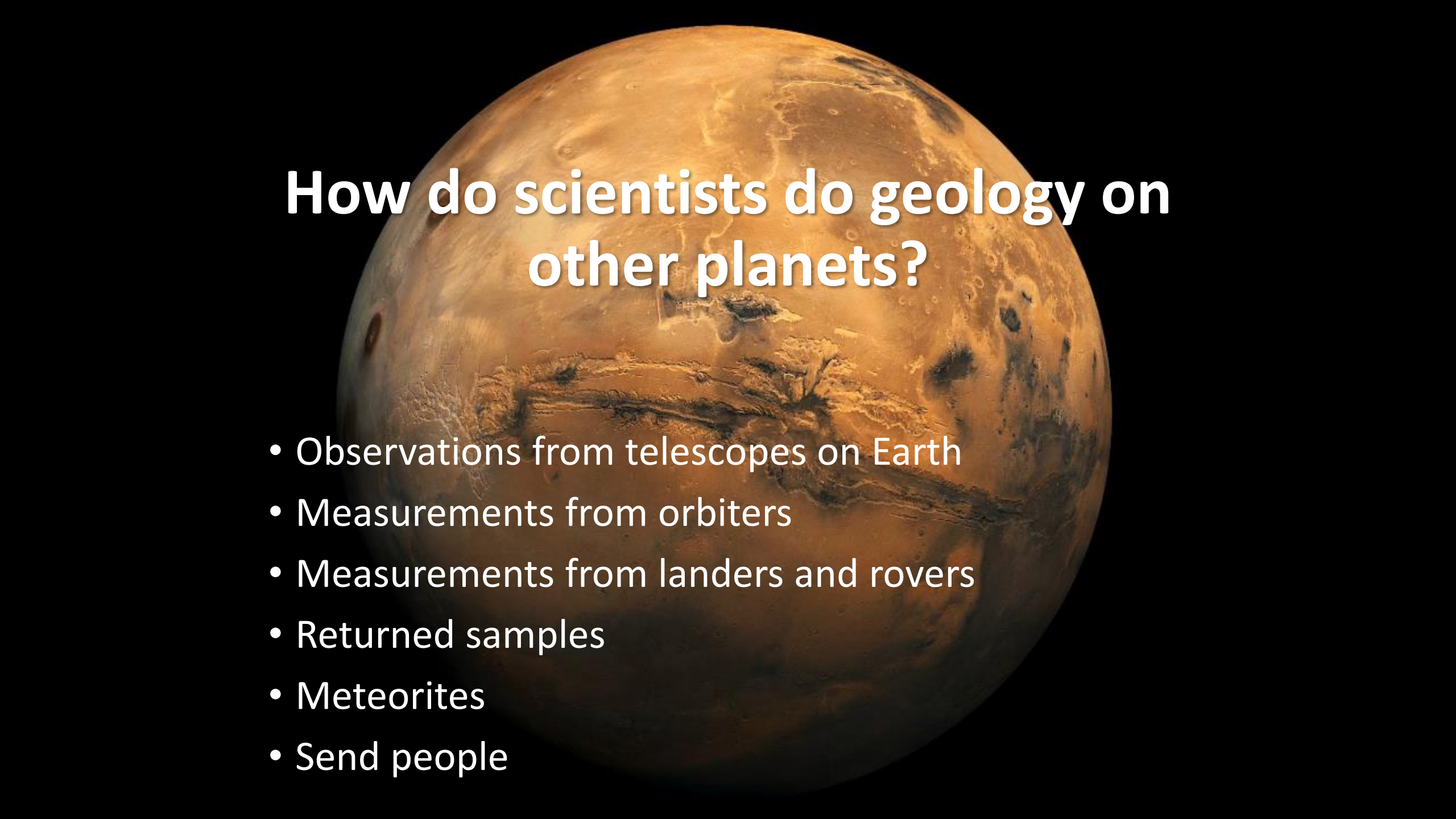
Curiosity Rover Update and Preview of Mars 2020

Liz Rampe
NASA Johnson Space Center

What is Geology?

The study of the earth's physical structure and substance, its history, and the processes that act on it.

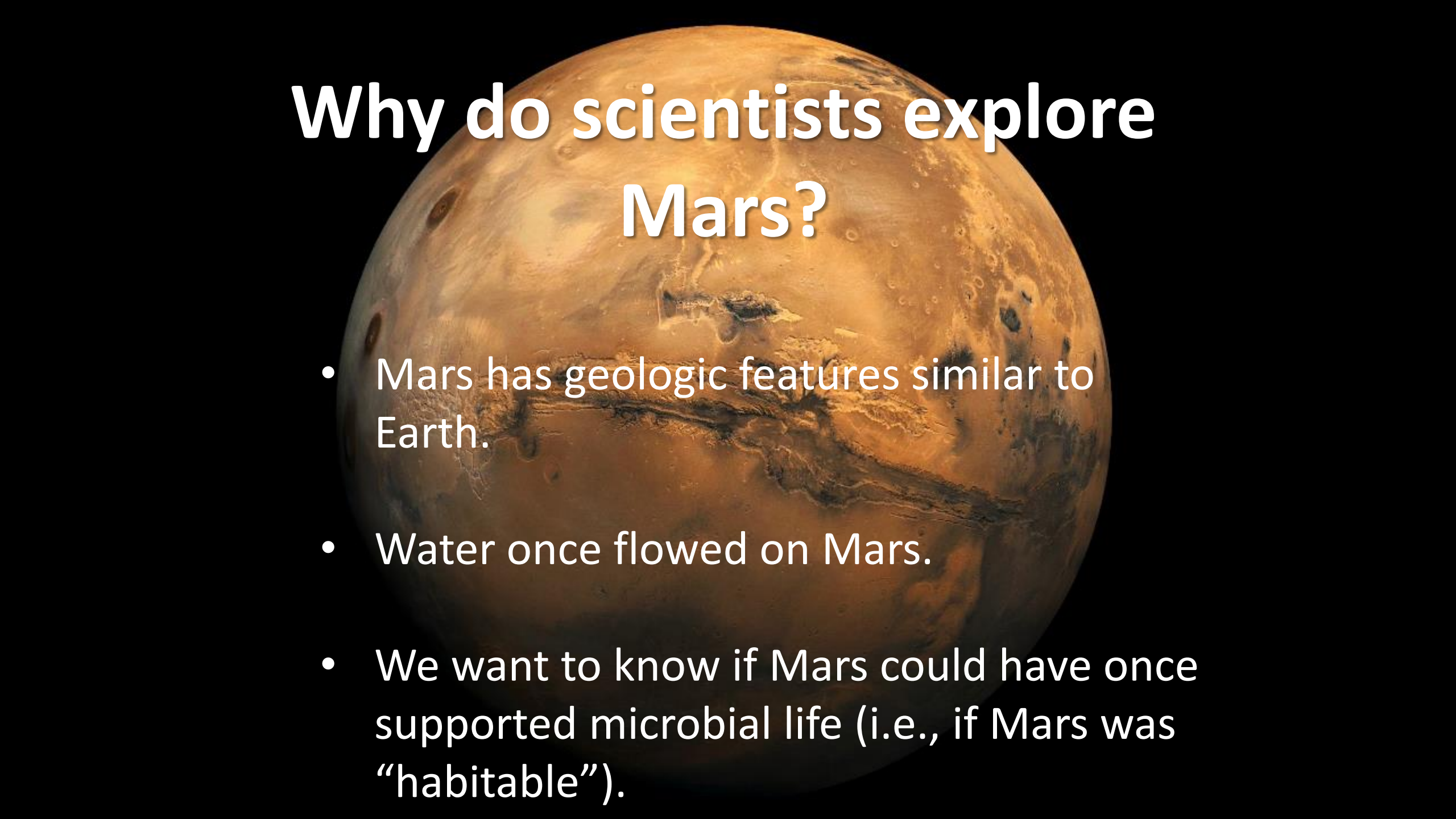




How do scientists do geology on other planets?

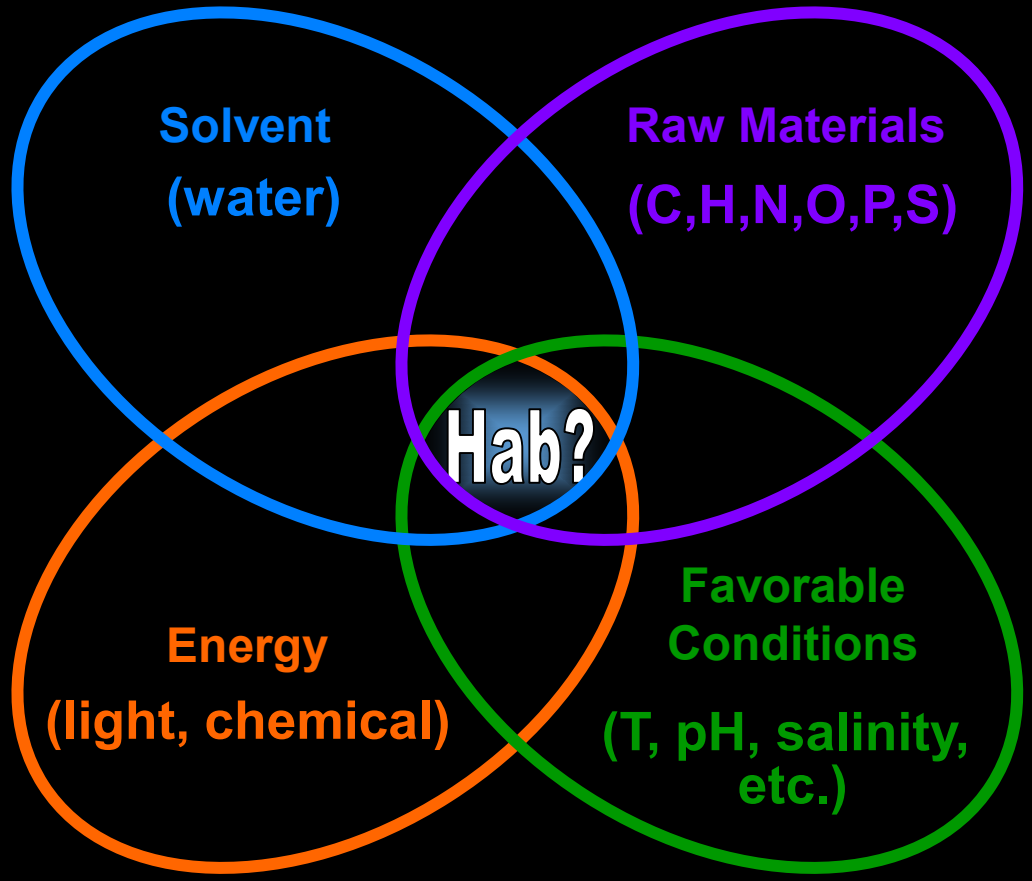
- Observations from telescopes on Earth
- Measurements from orbiters
- Measurements from landers and rovers
- Returned samples
- Meteorites
- Send people

Why do scientists explore Mars?



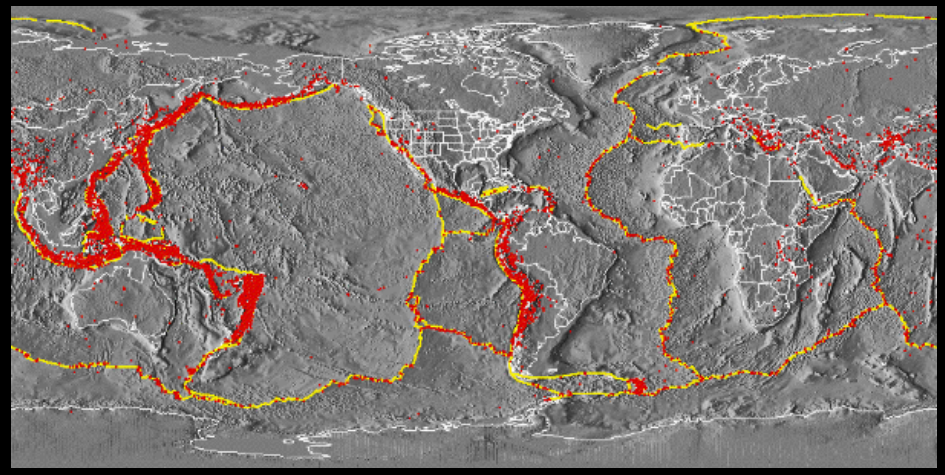
- Mars has geologic features similar to Earth.
- Water once flowed on Mars.
- We want to know if Mars could have once supported microbial life (i.e., if Mars was “habitable”).

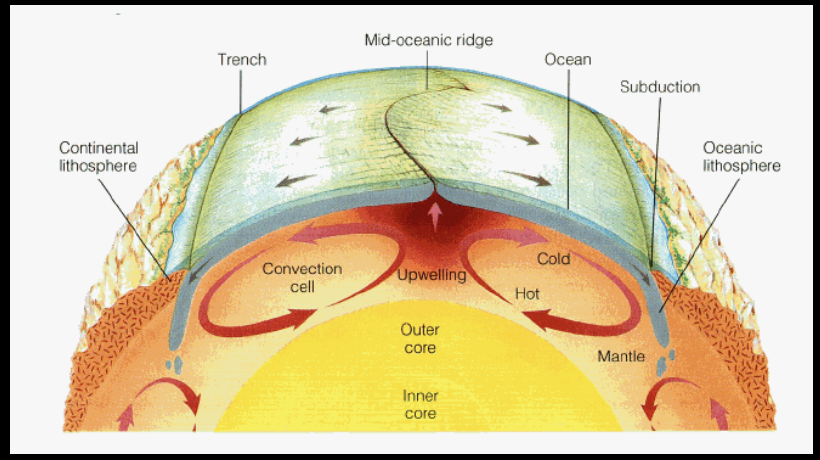
What are the Requirements for Habitability?



adapted from graphic
by Tori Hoehler

Early Earth vs. Early Mars





On Earth, <1% of truly ancient crust is still present – due to plate tectonics.

On Mars, plate tectonics didn't resurface the planet. We can look at 3-4 Gyr sedimentary rocks with little alteration since they were deposited.

Therefore, we can study the habitability of early Mars.

How do we know that water once flowed on Mars?

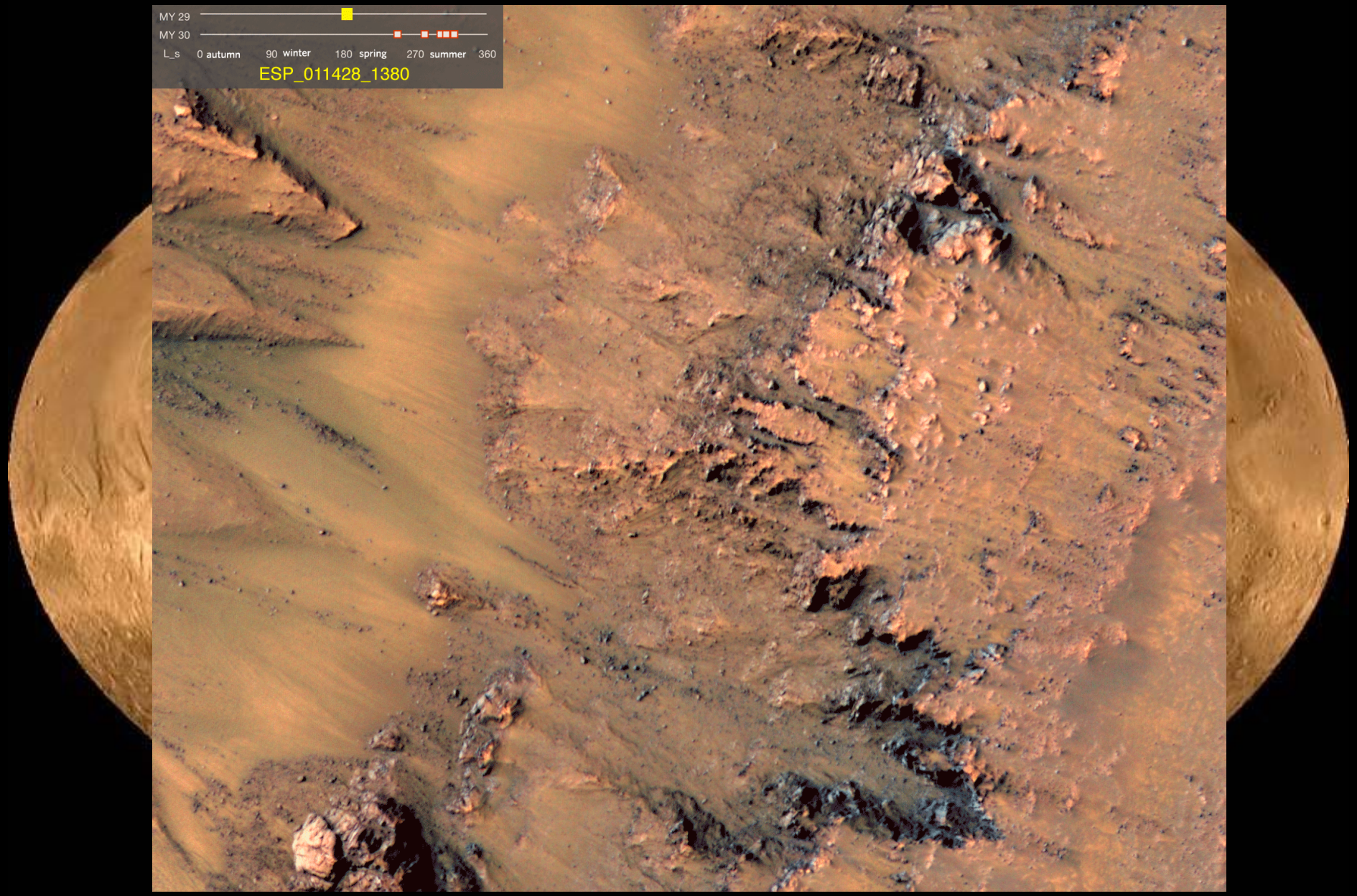
A. We see water on the surface today.
B. Surface features provide evidence of water that once flowed across the surface.
C. Remote sensing instruments detect minerals on the surface that form in water.

Put your answer(s) and any supporting information in the chat.

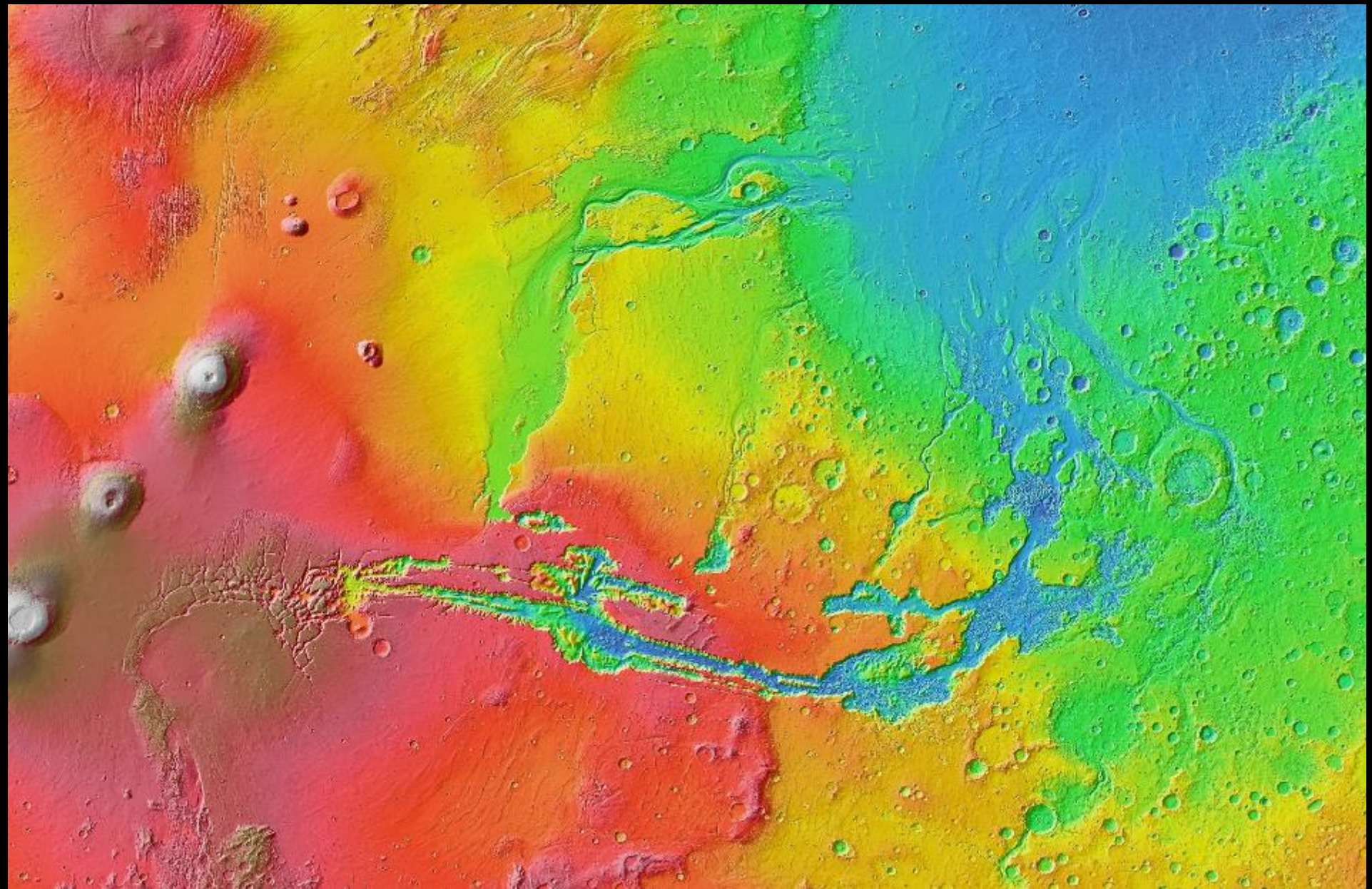
How do we know that water once flowed on Mars?

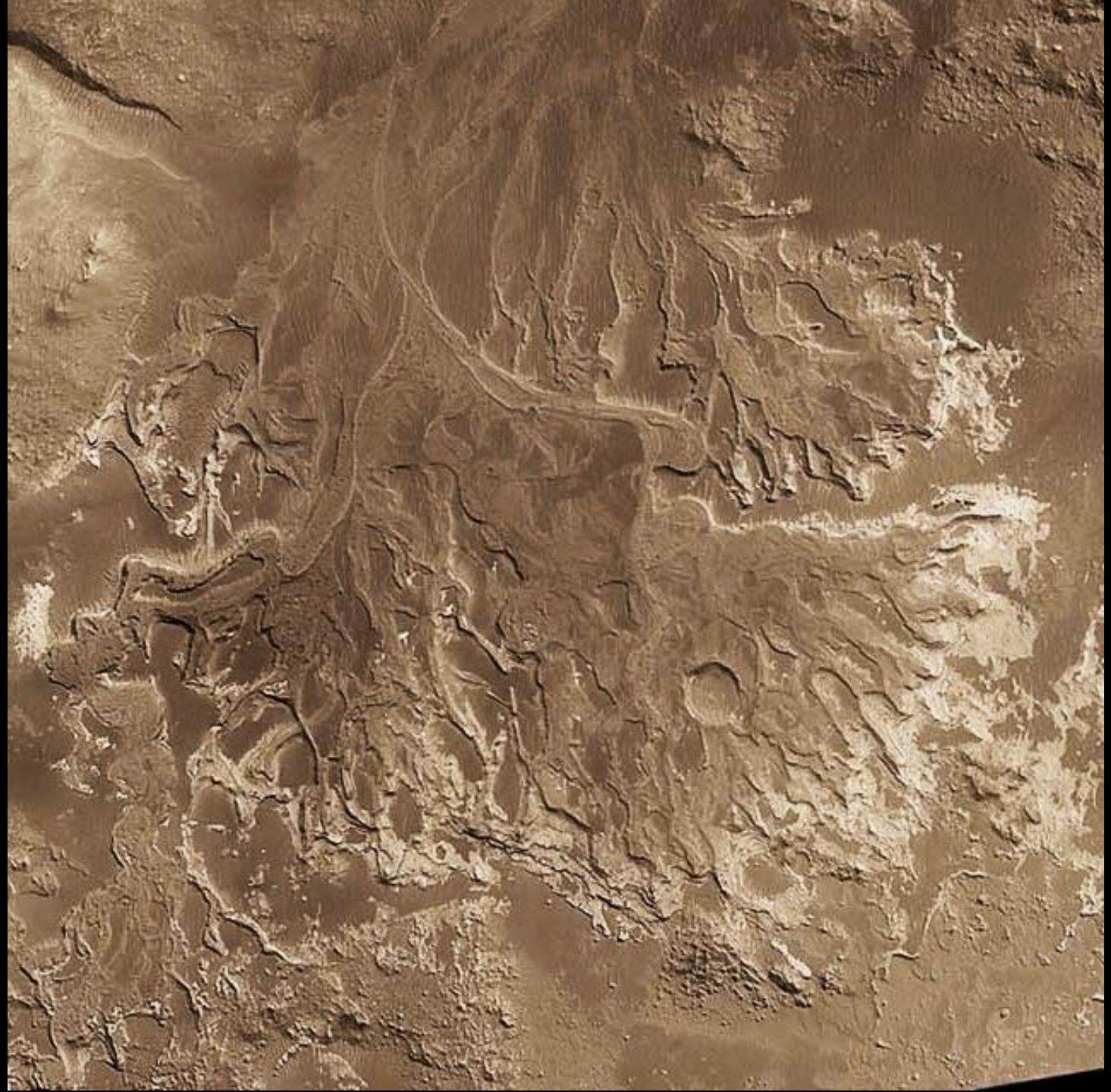
A. We see water on the surface today. Dark slope streaks?
B. Surface features provide evidence of water that once flowed across the surface. River and lake deposits
C. Remote sensing instruments detect minerals on the surface that form in water. Clay minerals and salts

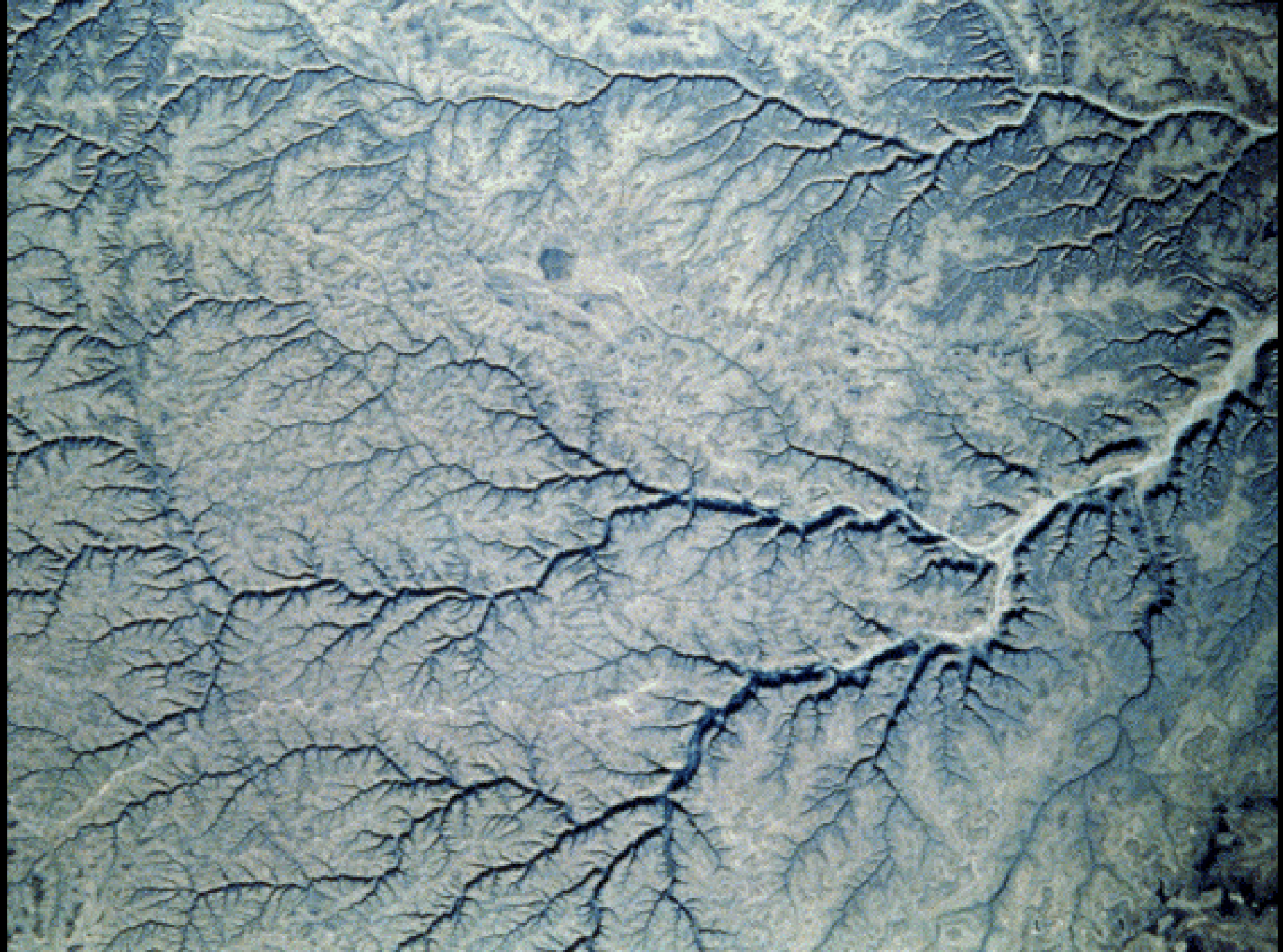
Water on Modern Mars?



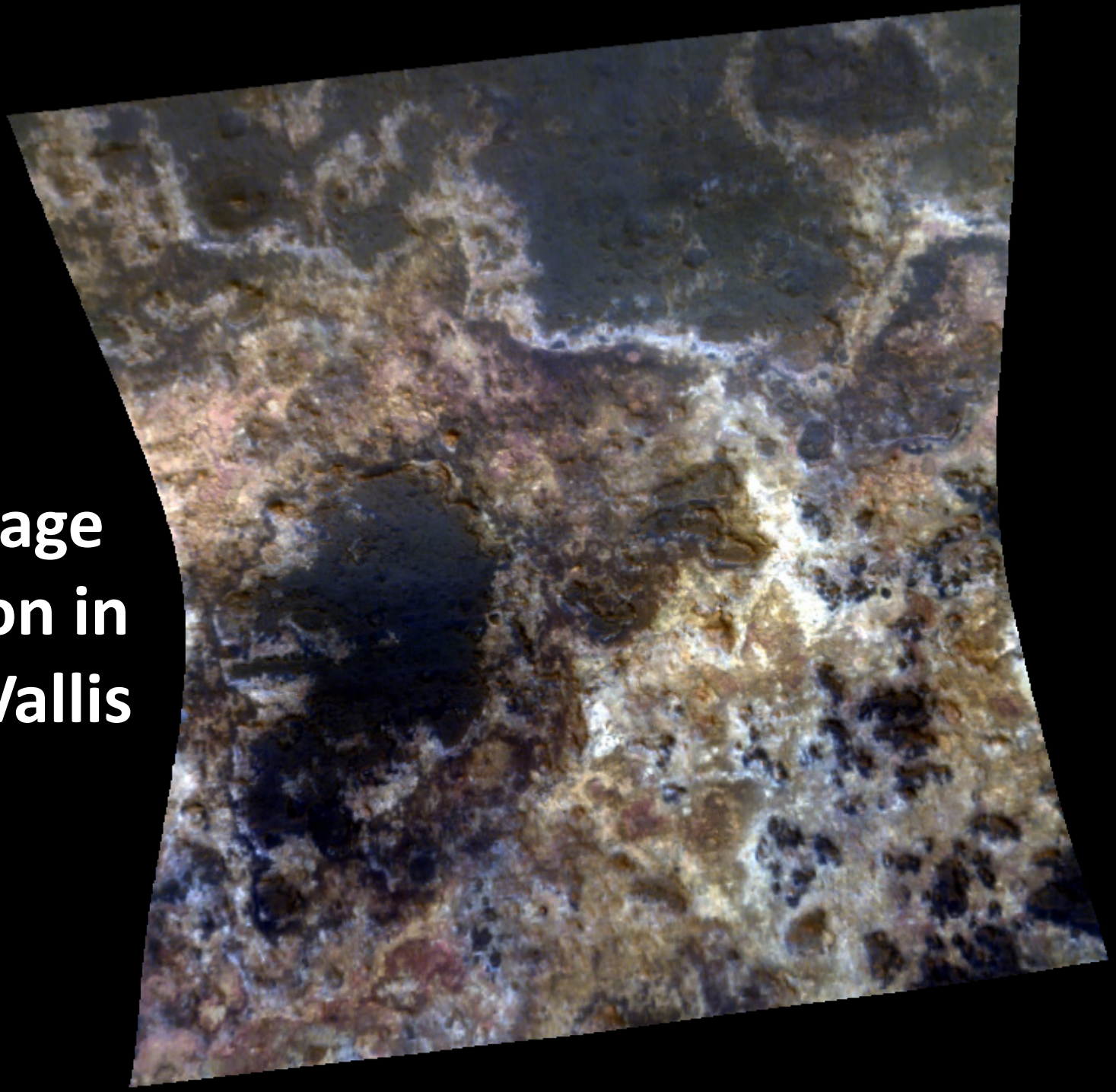
Water on Ancient Mars







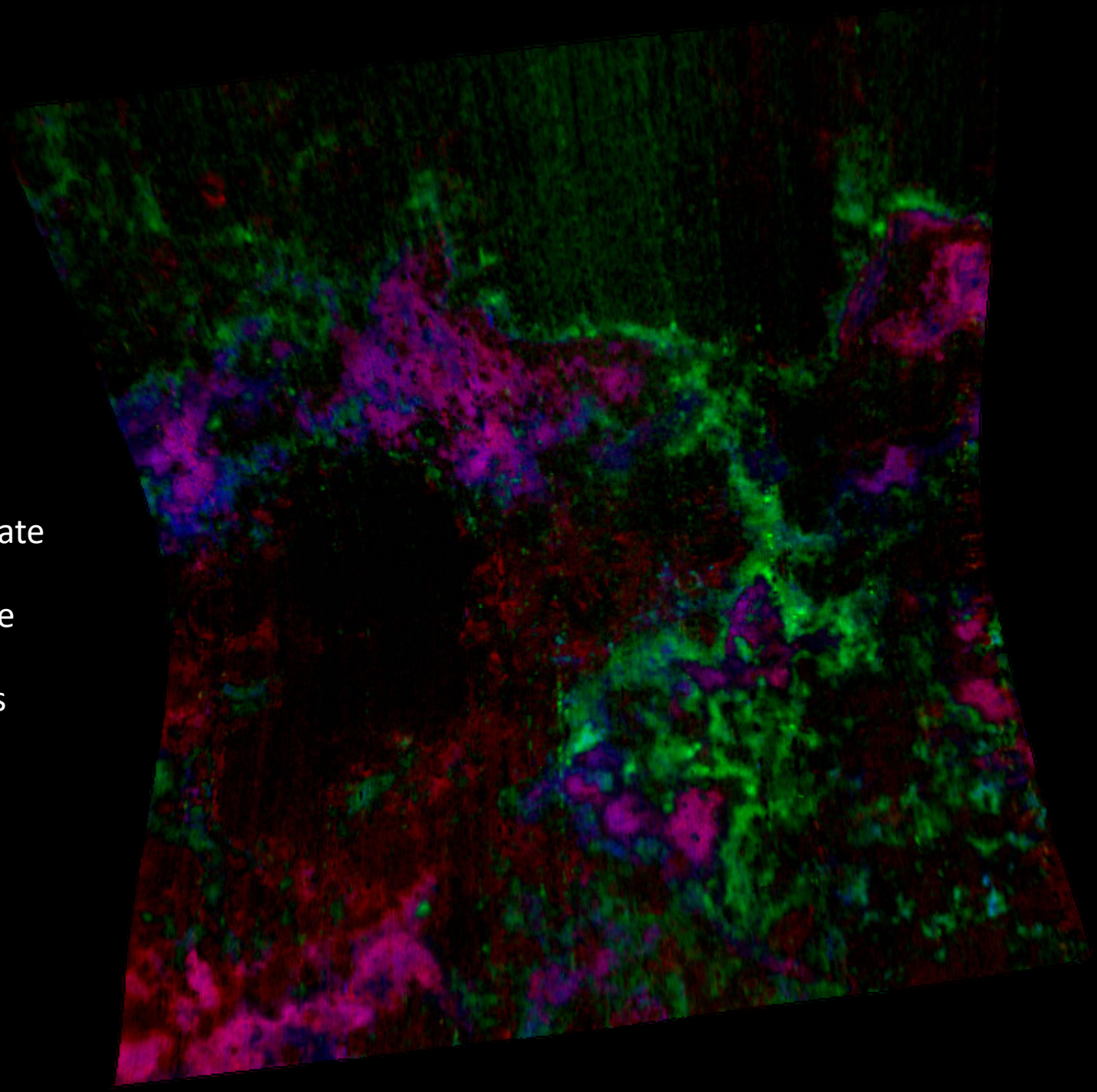
Color Image of a Region in Mawrth Vallis



Red – Fe/Mg phyllosilicate

Green – Al phyllosilicate

Blue - hydrated sulfates

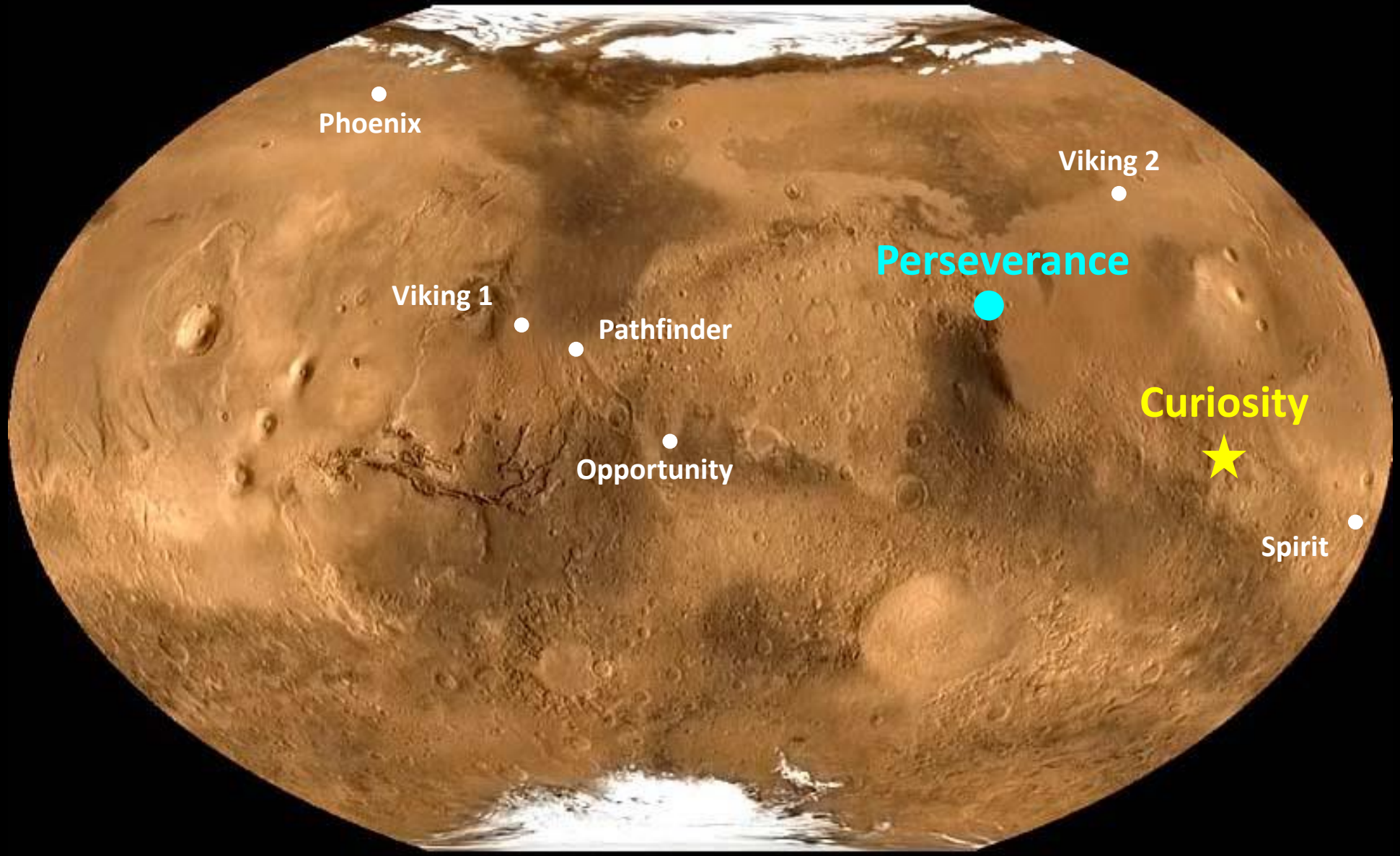


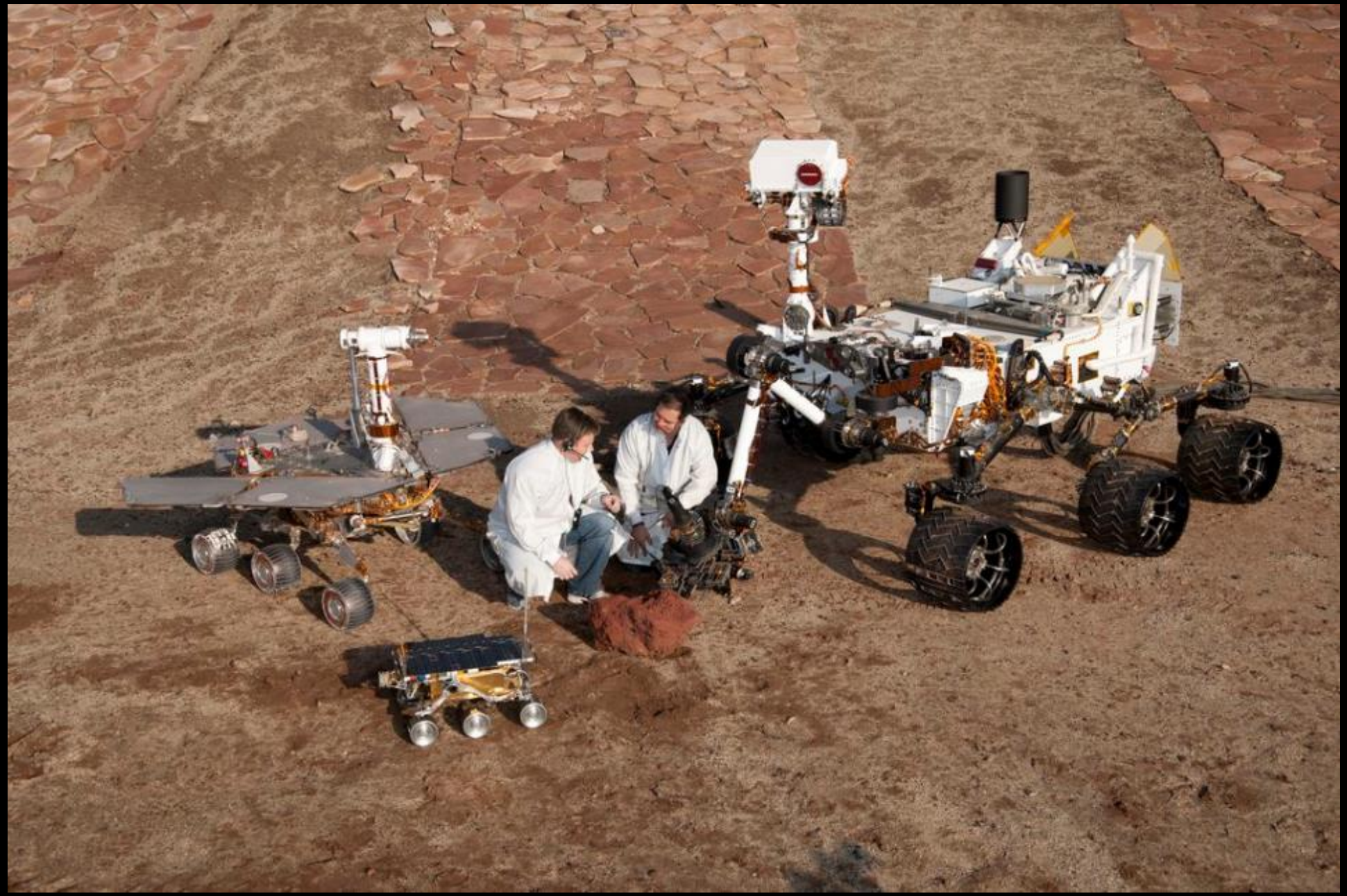
What happened to Mars' Water?

This video is an artist's concept showing the transition from an ancient, habitable Mars capable of supporting liquid water on its surface to the cold desert world of today.

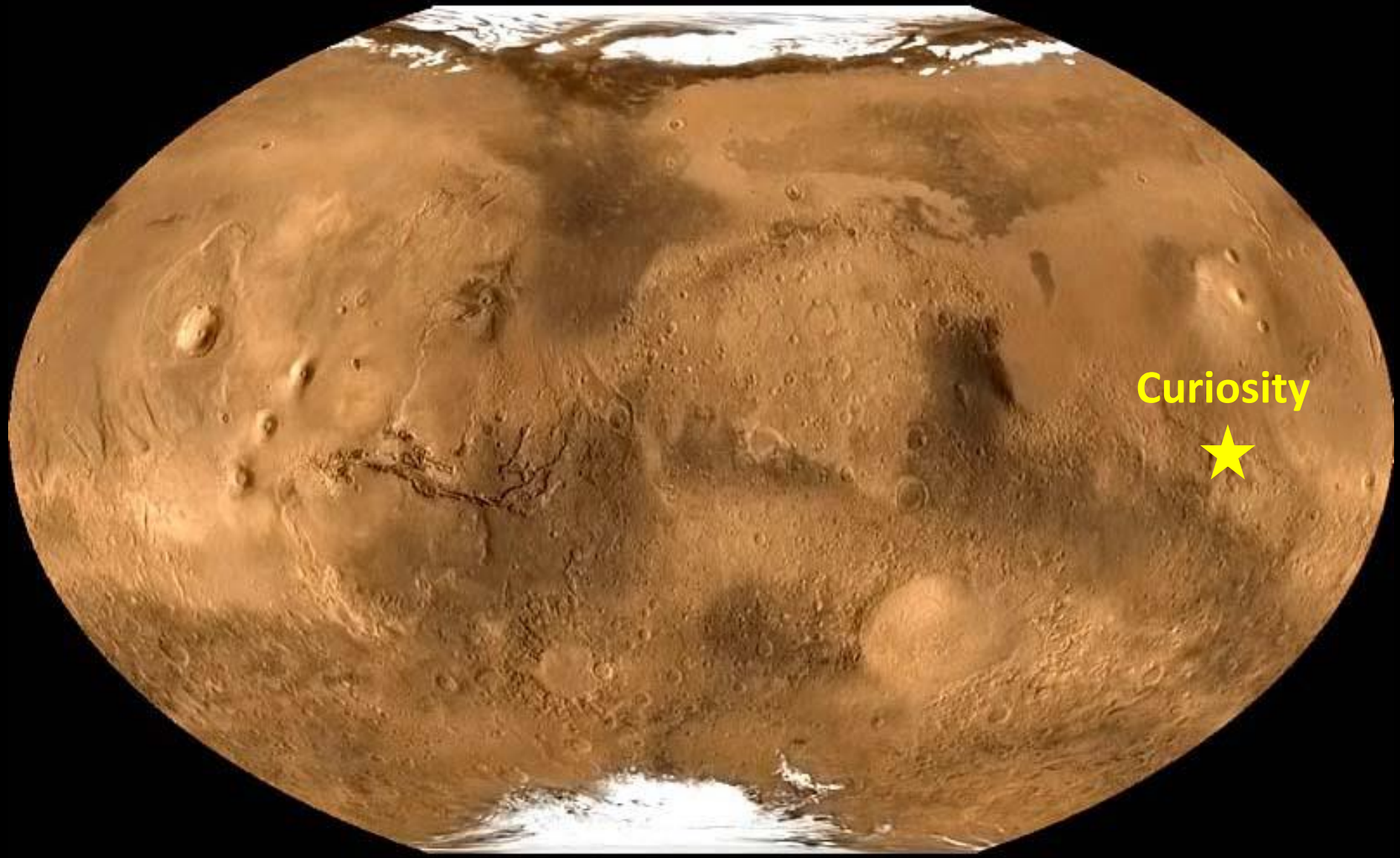
Credits: Michael Lentz/NASA Goddard Conceptual Image Lab

Where did we land?

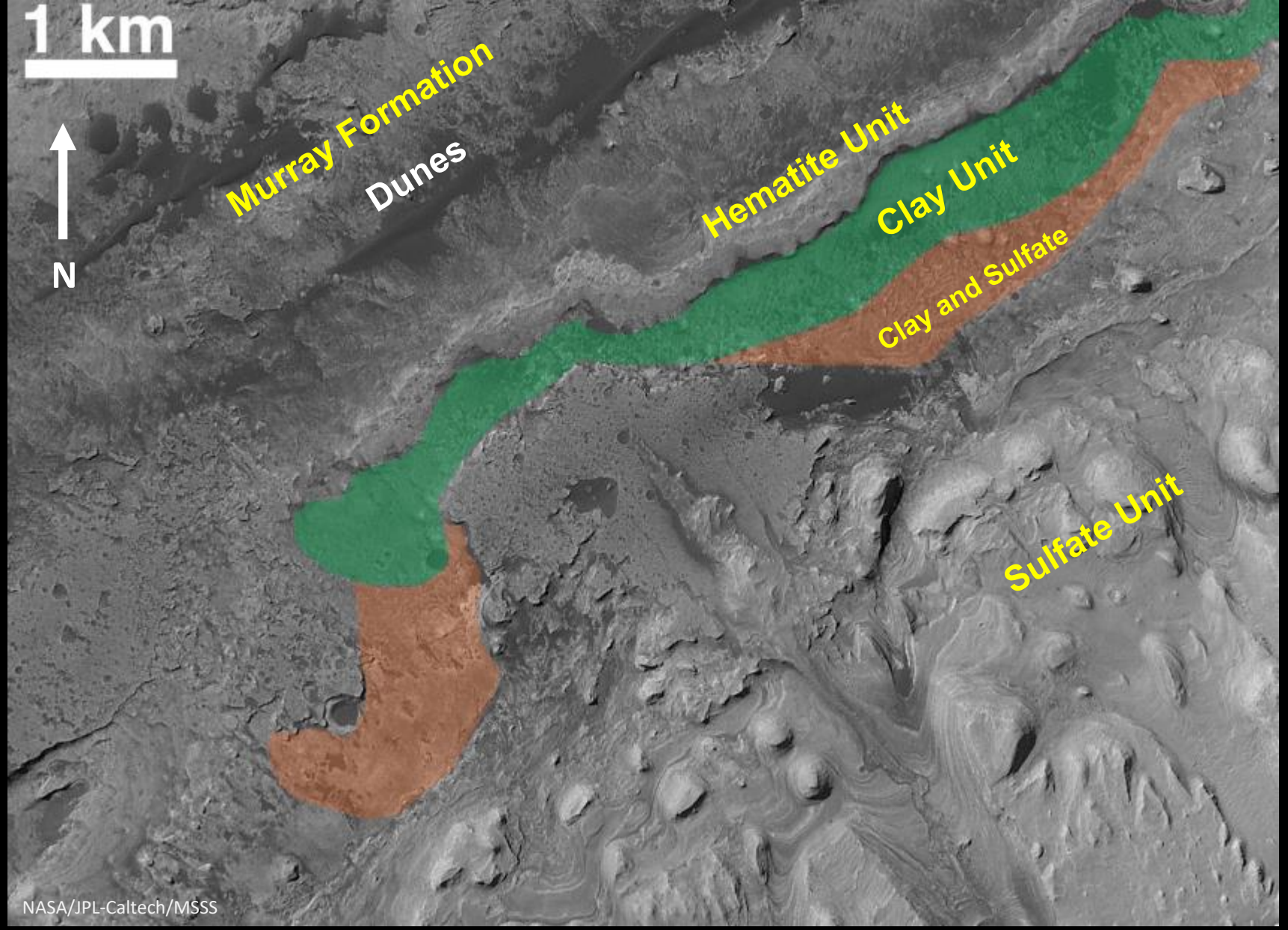




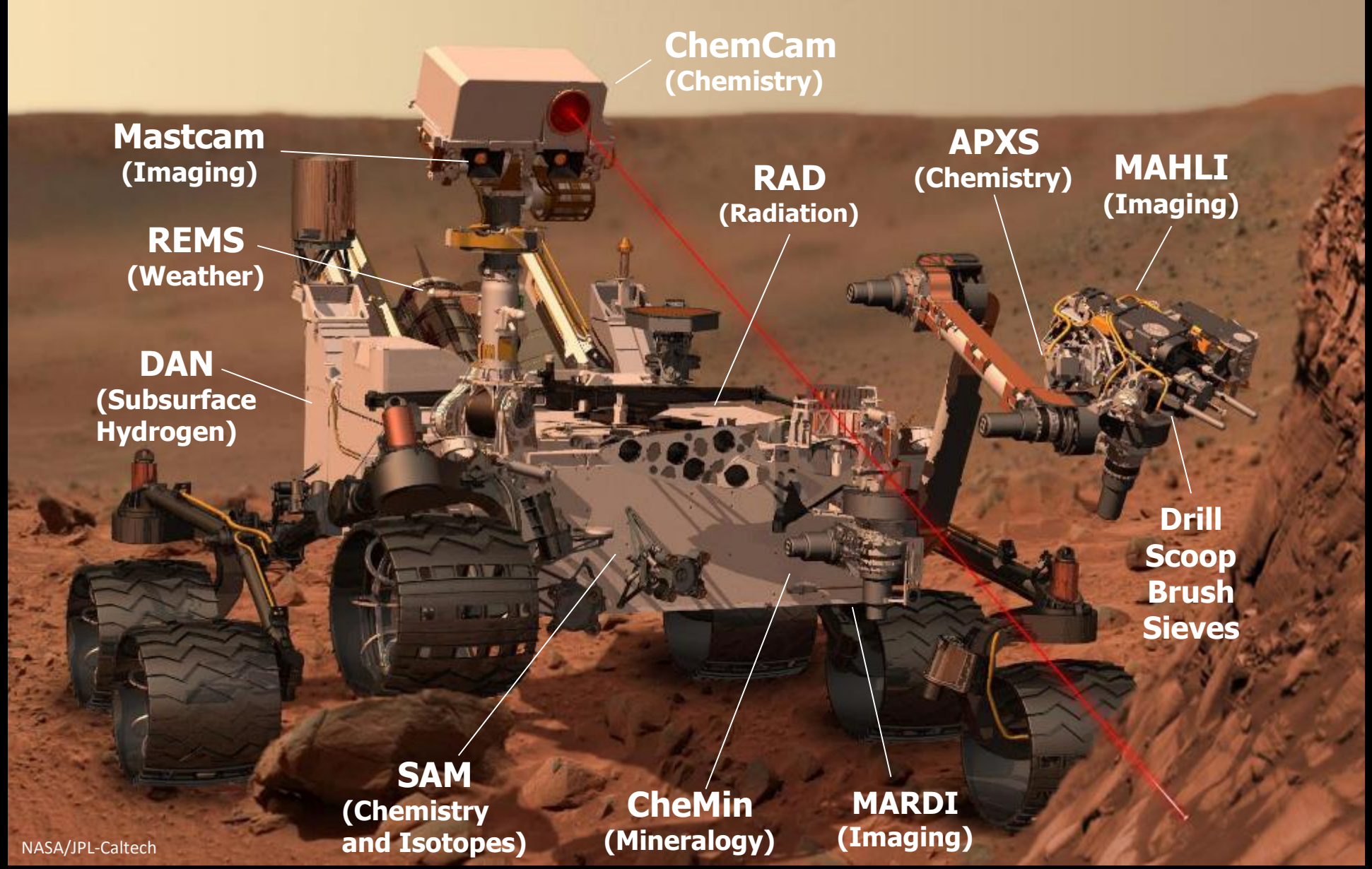
Curiosity at Gale Crater



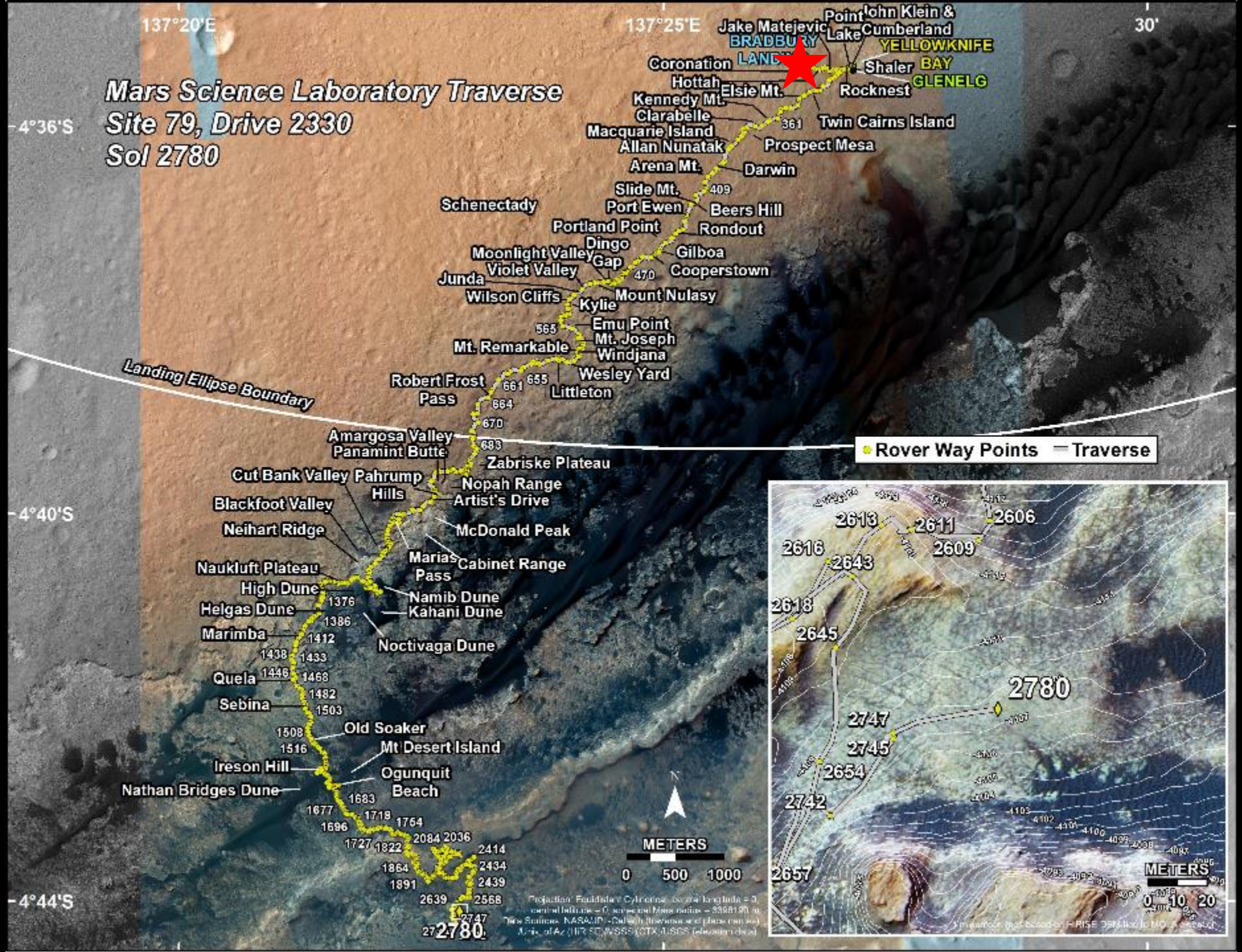
150-km Gale Crater contains a 5-km high mound of stratified rock. Strata in the lower section of the mound vary in mineralogy and texture, suggesting that they may have recorded environmental changes over time.



- What were these ancient climates like?
- Were they habitable?

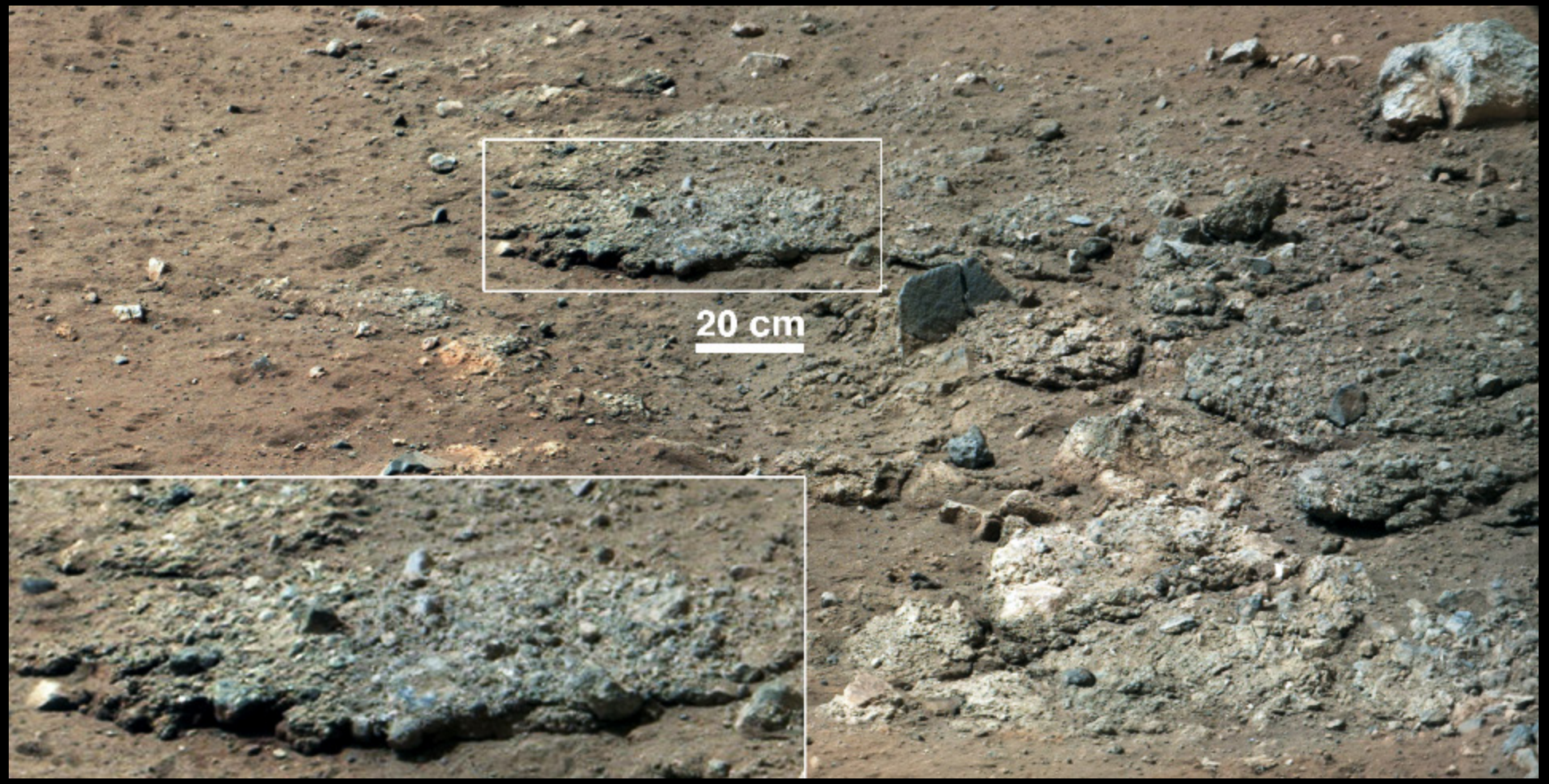


Curiosity's Science Payload


Mars Science Laboratory Traverse
Site 79, Drive 2330
Sol 2780
137°20'E
137°25'E
30'
4°36'S
4°40'S
4°44'S
Jake Matejevic
Point Lake
John Klein & Cumberland
BRADBURY LANDING
YELLOWKNIFE BAY
GLENELG
Coronation
Shaler
Hottah
Elsie Mt.
Rocknest
Kennedy Mt.
Clarabelle
361
Twin Cairns Island
Macquarie Island
Allan Nunatak
Prospect Mesa
Arena Mt.
Darwin
Slide Mt.
409
Schenectady
Port Ewen
Beers Hill
Portland Point
Rondout
Dingo Gap
Moonlight Valley
Violet Valley
Gilboa
470
Cooperstown
Junda
Wilson Cliffs
Kylie
Mount Nulasy
565
Emu Point
Mt. Joseph
Mt. Remarkable
Windjana
Wesley Yard
Robert Frost Pass
661
655
Littleton
664
670
Landing Ellipse Boundary
Amargosa Valley
Panamint Butte
683
Zabriske Plateau
Cut Bank Valley
Pahrump Hills
Nopah Range
Artist's Drive
Blackfoot Valley
Neihart Ridge
McDonald Peak
Marias Pass
Cabinet Range
Naukluft Plateau
High Dune
Namib Dune
Helgas Dune
1376
Kahani Dune
1386
Marimba
1412
Noctivaga Dune
1438
1433
Quela
1446
1468
1482
Sebina
1503
1508
Old Soaker
1516
Mt Desert Island
Ireson Hill
Ogunquit Beach
Nathan Bridges Dune
1683
1677
1718
1754
1696
1727
1822
2084
2036
2414
1864
2434
1891
2439
2639
2568
2747
2780
Rover Way Points
Traverse
N
METERS
0
500
1000
2613
2611
2606
2616
2609
2643
2618
2645
2780
2747
2745
2654
2742
2657
METERS
0
10
20

NASA/JPL-Caltech/MSSS

Mastcam mosaic of Mount Sharp, descent rocket scours, and rover shadow



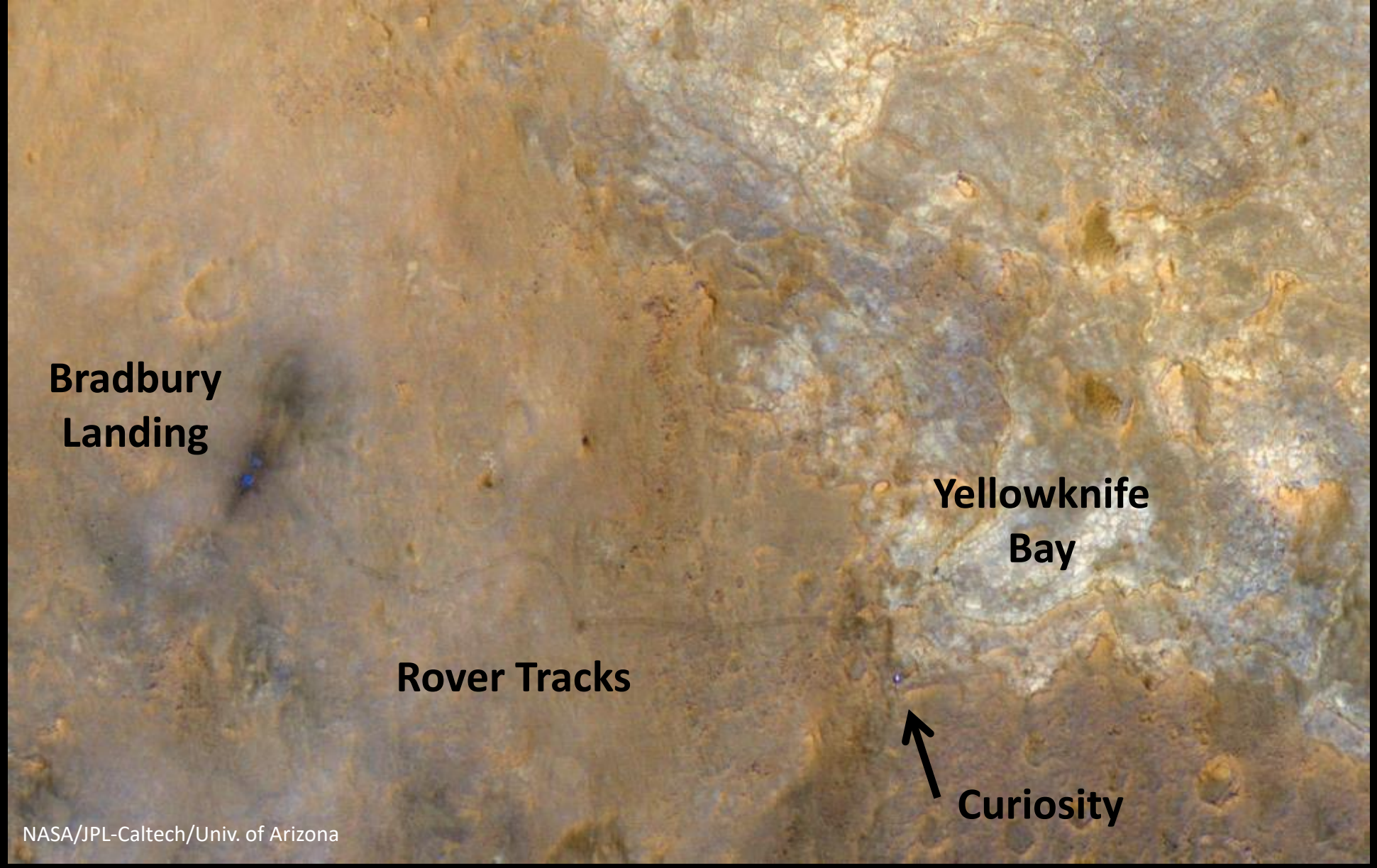
NASA/JPL-Caltech/MSSS

Rocks uncovered by Curiosity's descent rockets

NASA/JPL-Caltech/MSSS

CURIOSITY

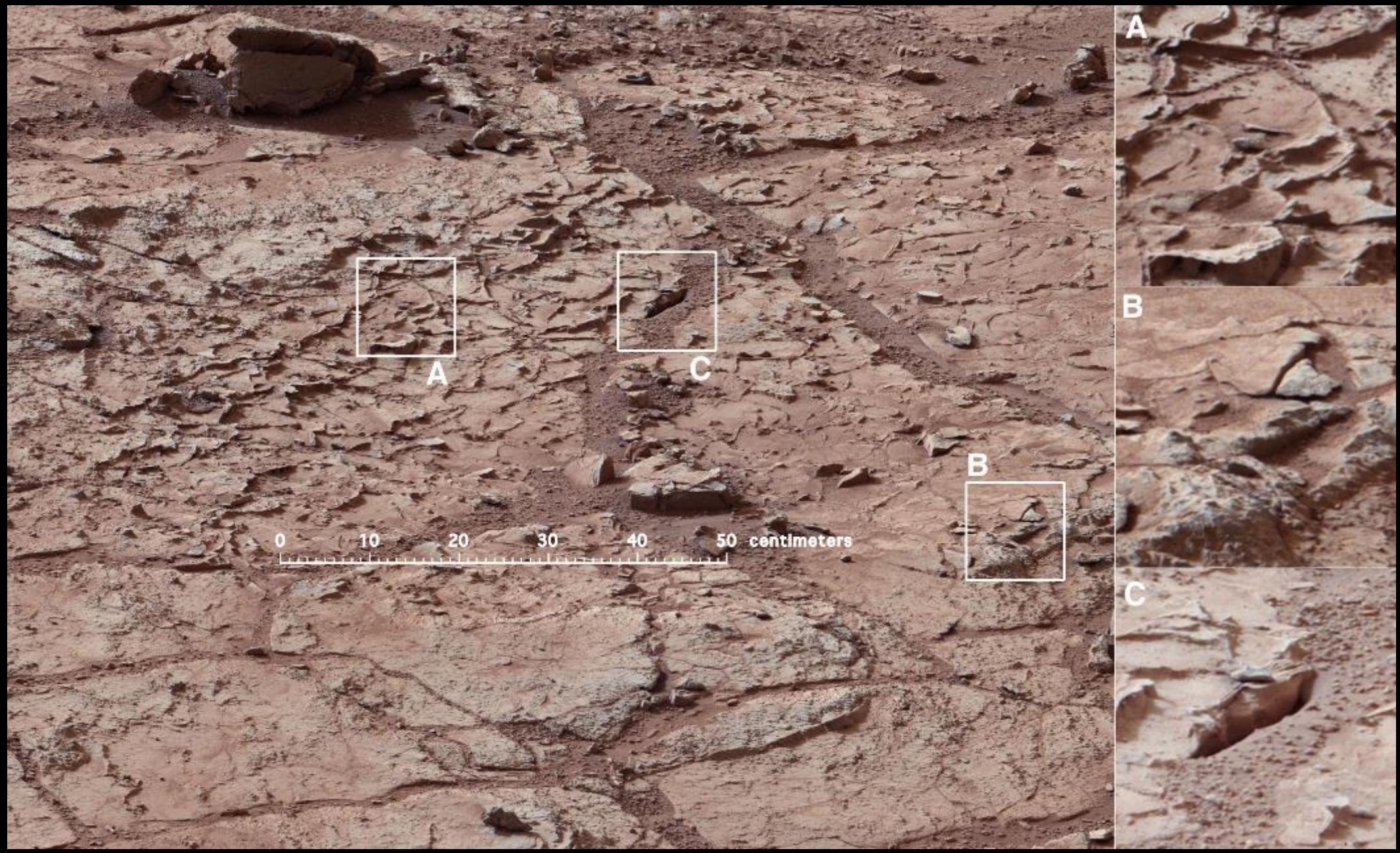
Rounded pebbles and sand in the conglomerate indicate water flowed ankle to hip deep



CURIOSITY

Curiosity and its tracks captured by HiRISE on the Mars Reconnaissance Orbiter

Yellowknife Bay



NASA/JPL-Caltech/LANL/CNES/IRAP/IAS/LPGN

NASA/JPL-Caltech/MSSS

How is the drilled sample from beneath the surface different from what we see on the surface?

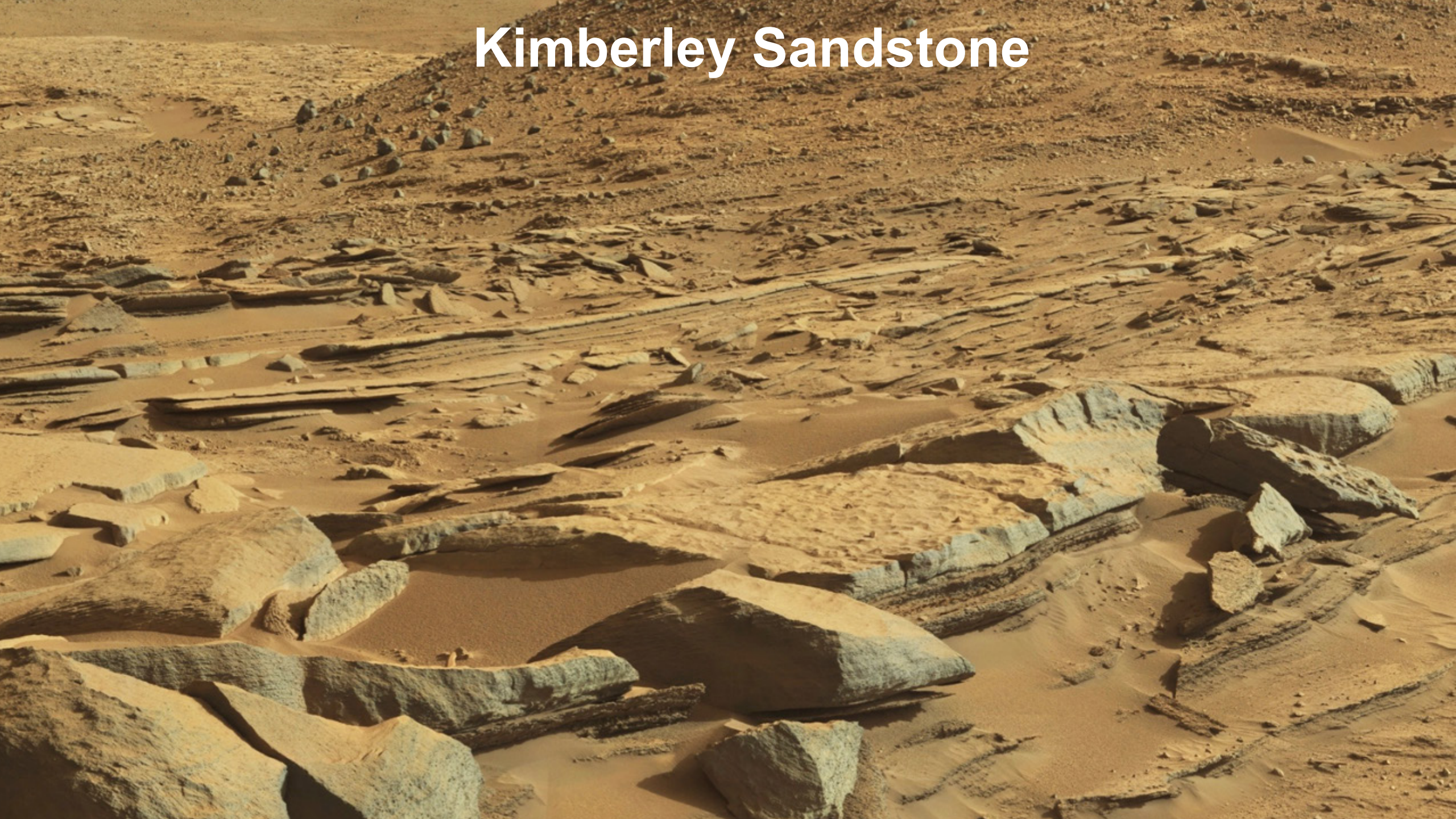
Put your answer(s) in the chat.

The drilled sample is **GRAY**!

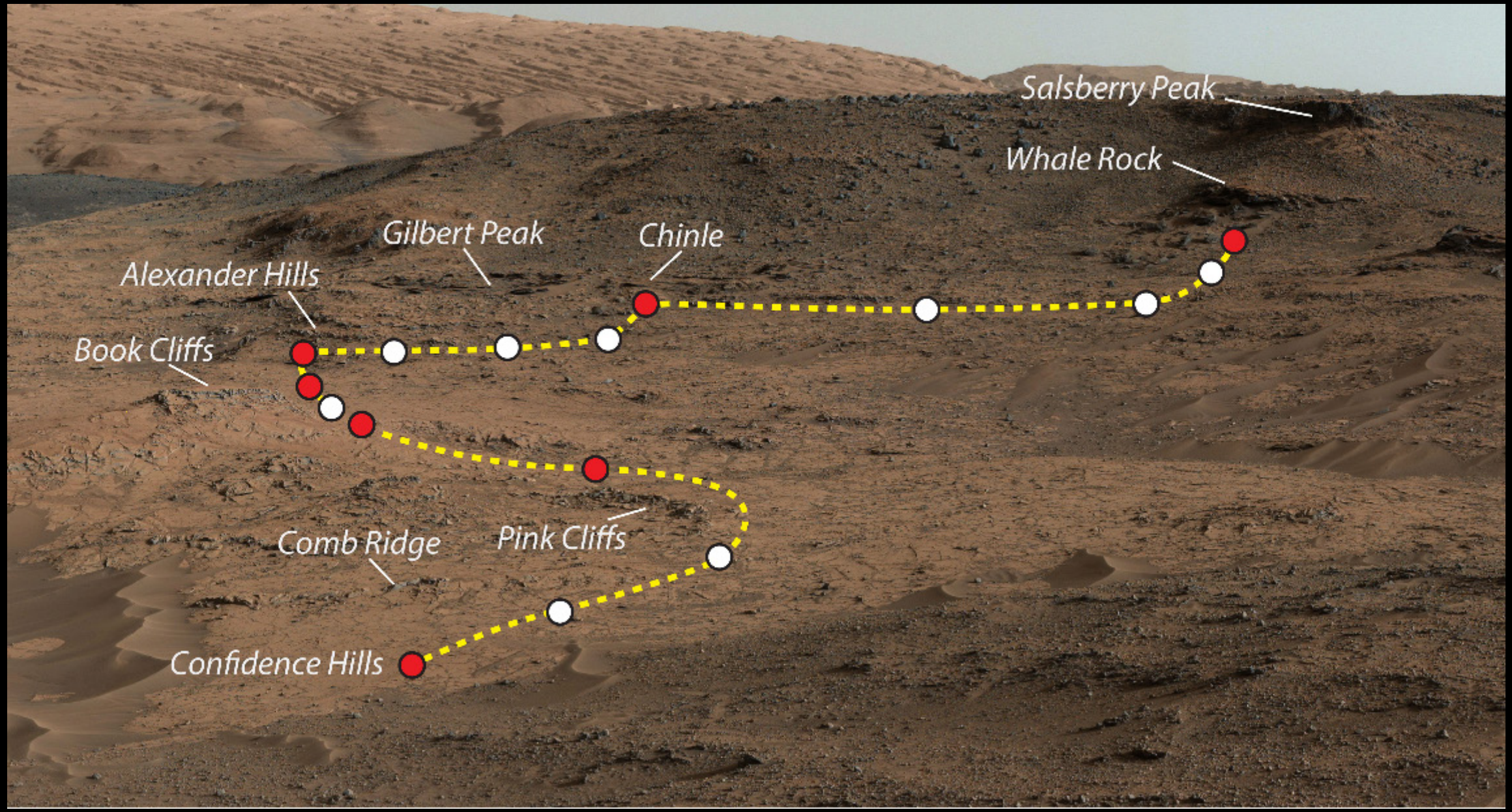
NASA/JPL-Caltech/MSSS

Curiosity's 1.6-cm drill bit, drill and test holes, and scoop full of acquired sample

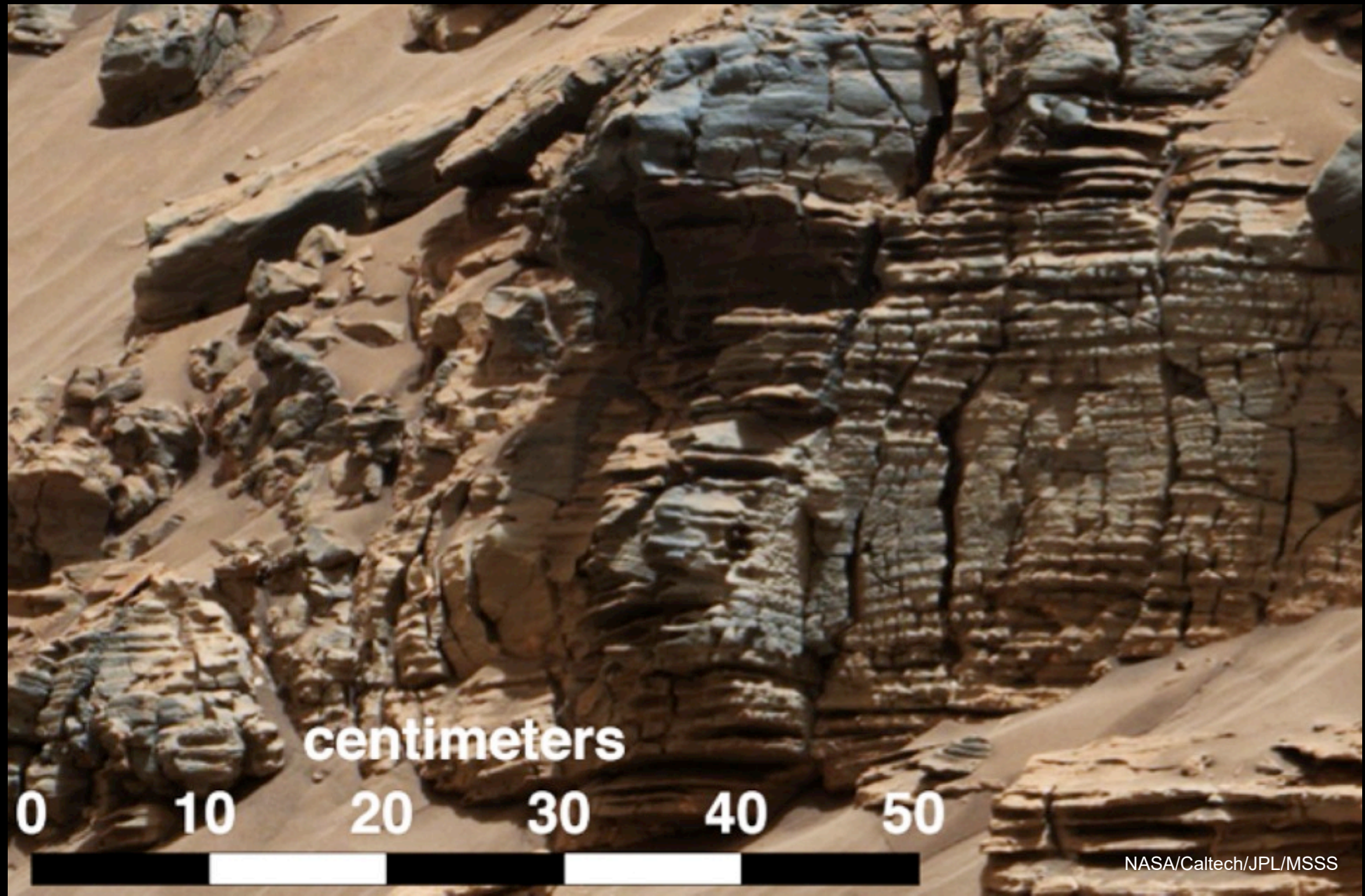
Kimberley Sandstone



Pahrump Hills



Thickly Laminated Mudstone at Pahrump Hills

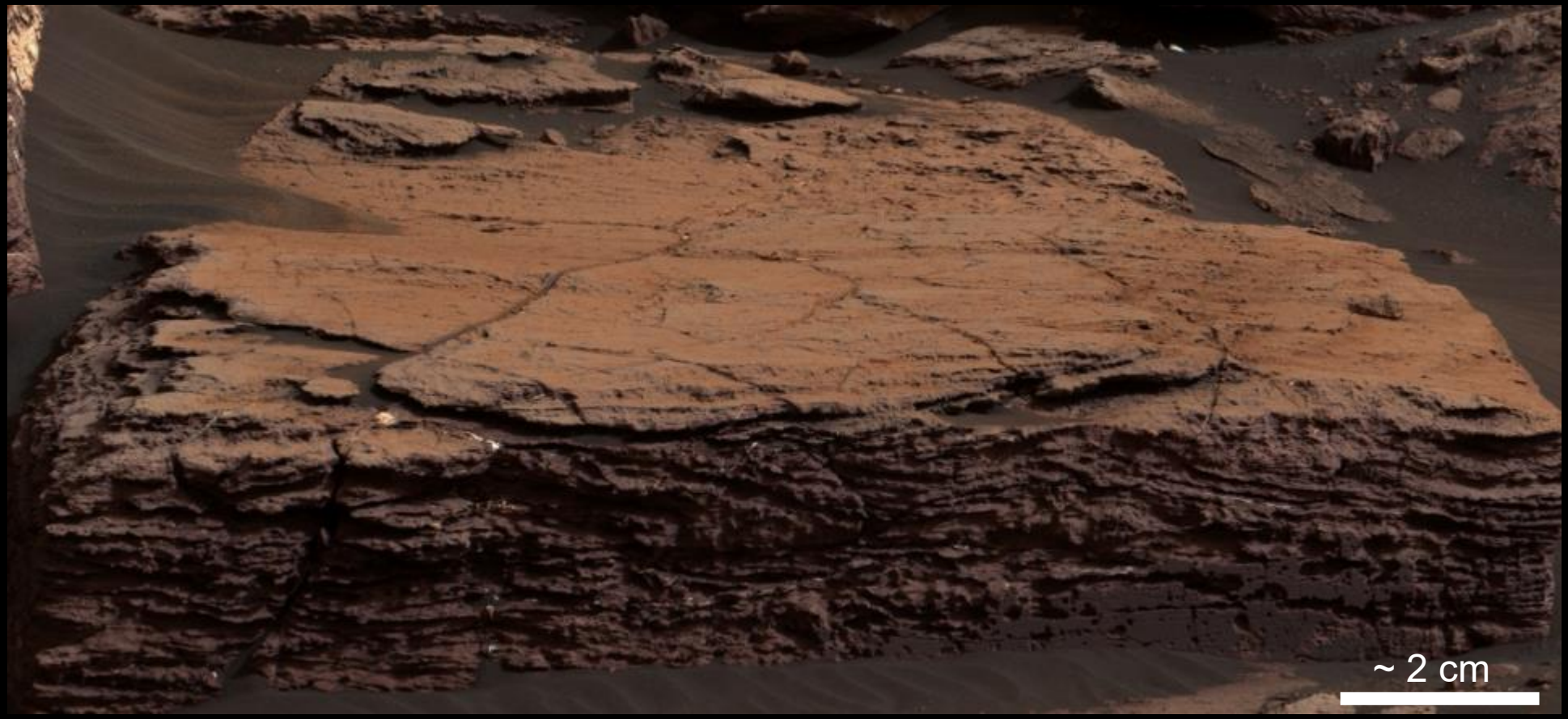


Thinly Laminated Mudstone at Pahrump Hills

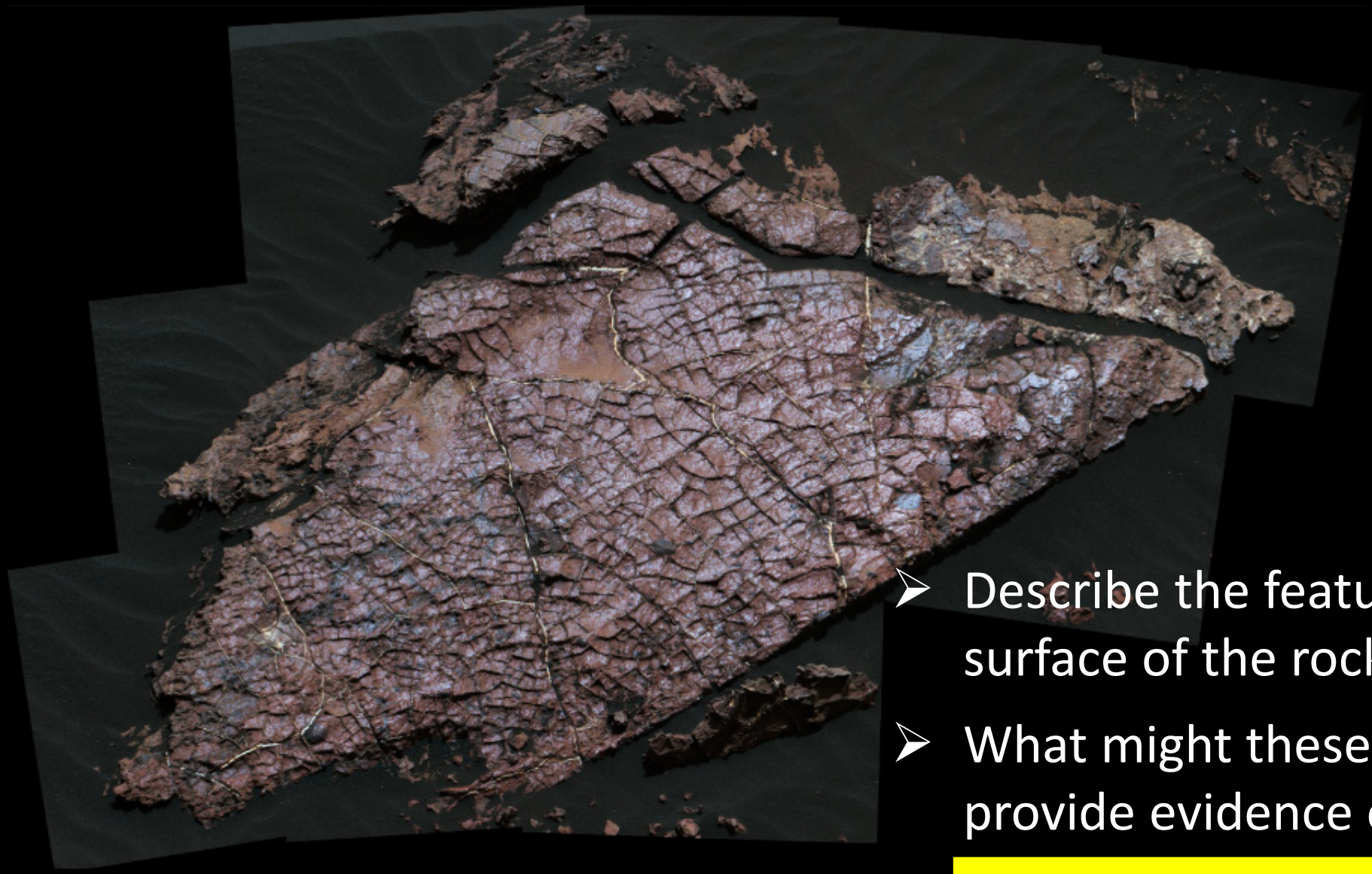
NASA/Caltech/JPL/MSSS

Marias Pass

Fossilized Ripples



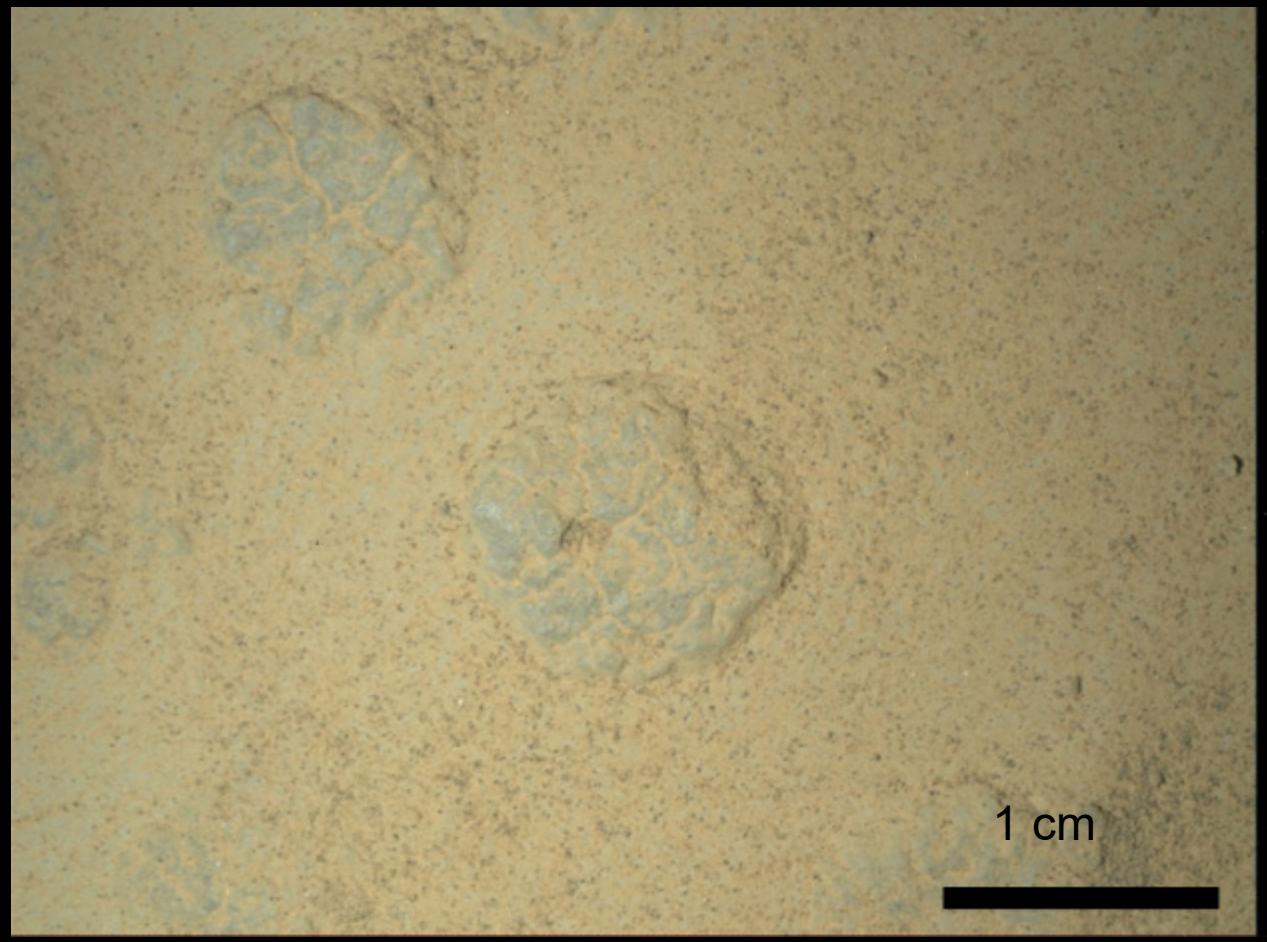
“Old Soaker” Target

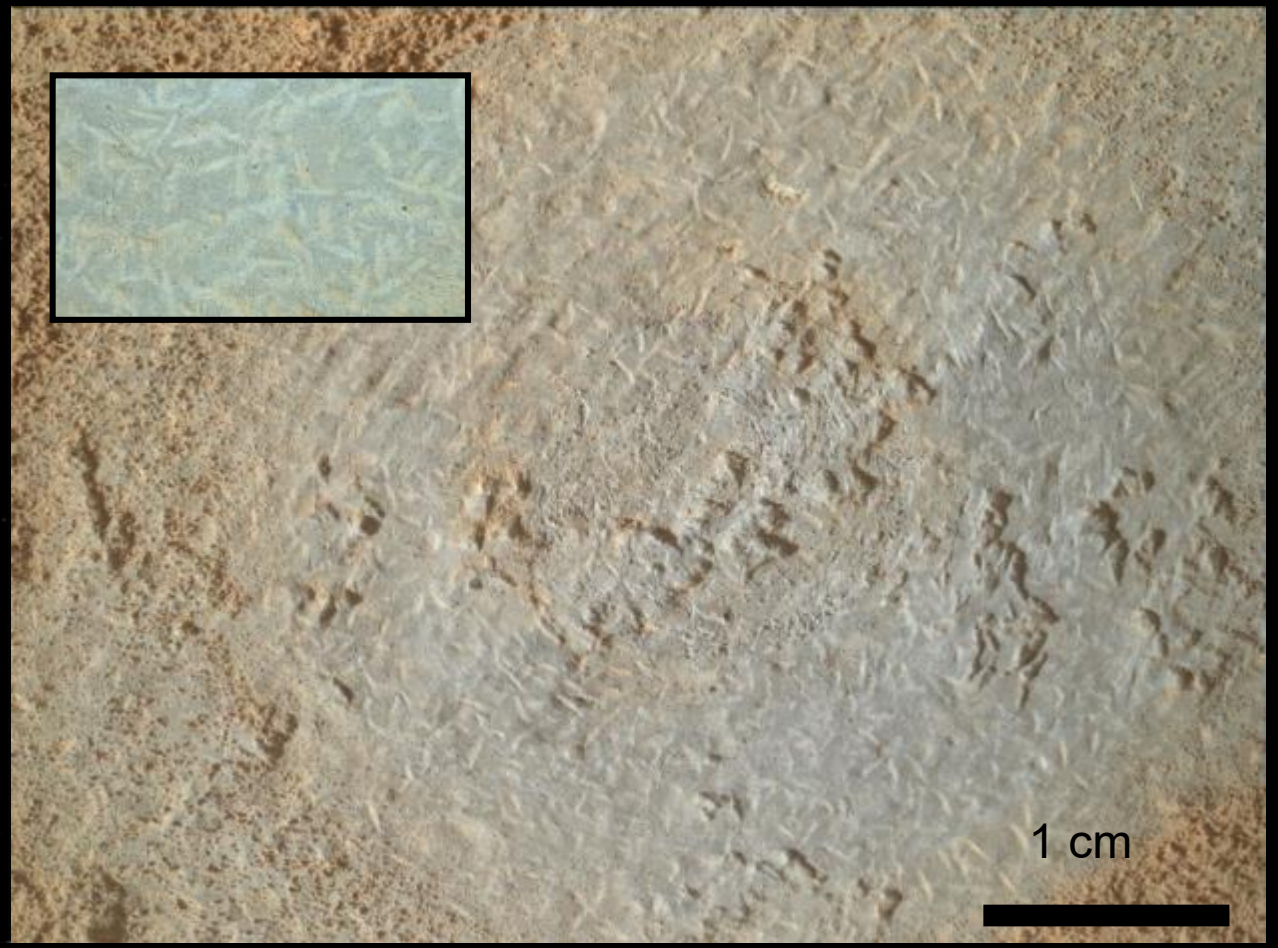


- Describe the features on the surface of the rock?
- What might these features provide evidence of?

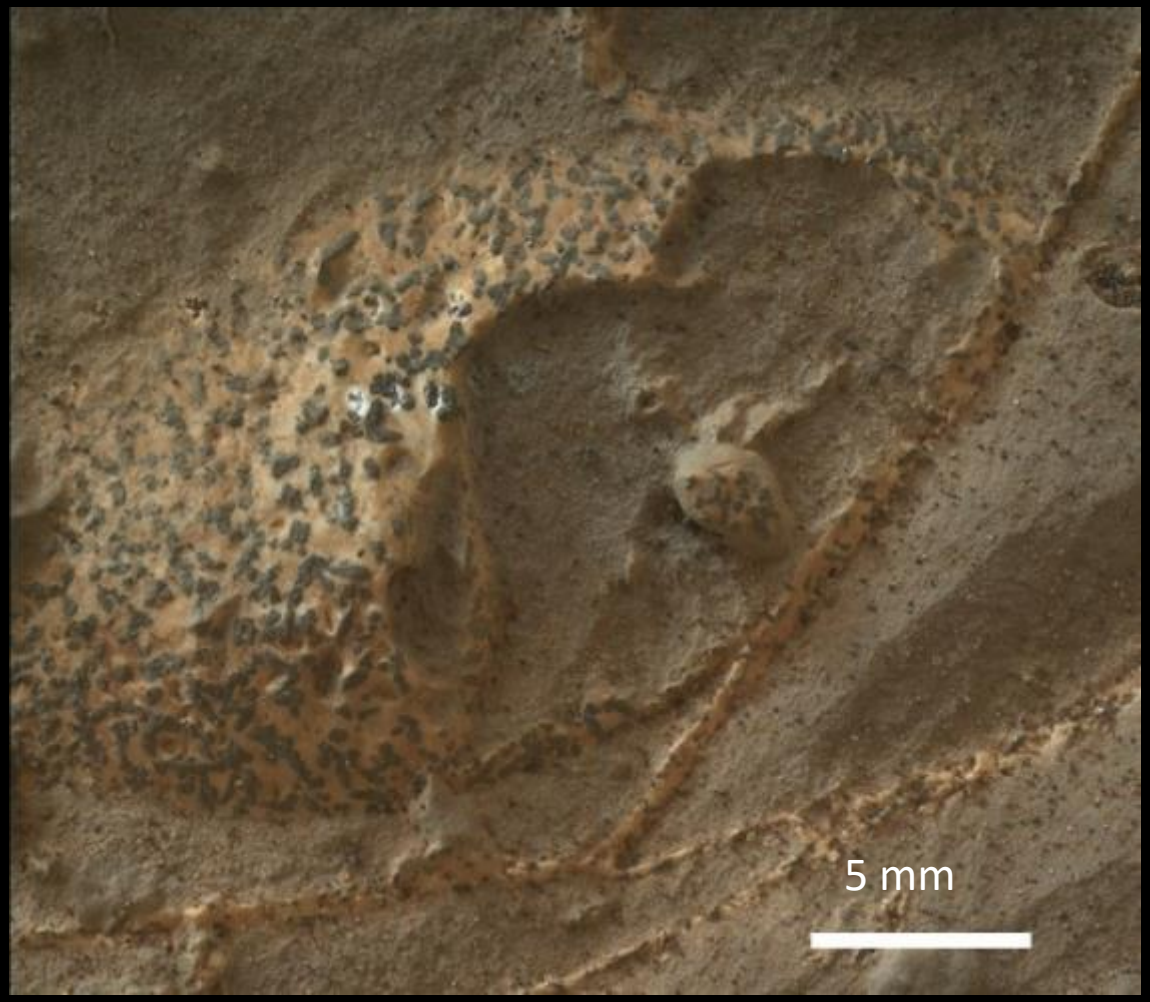
Put your answers in the chat.

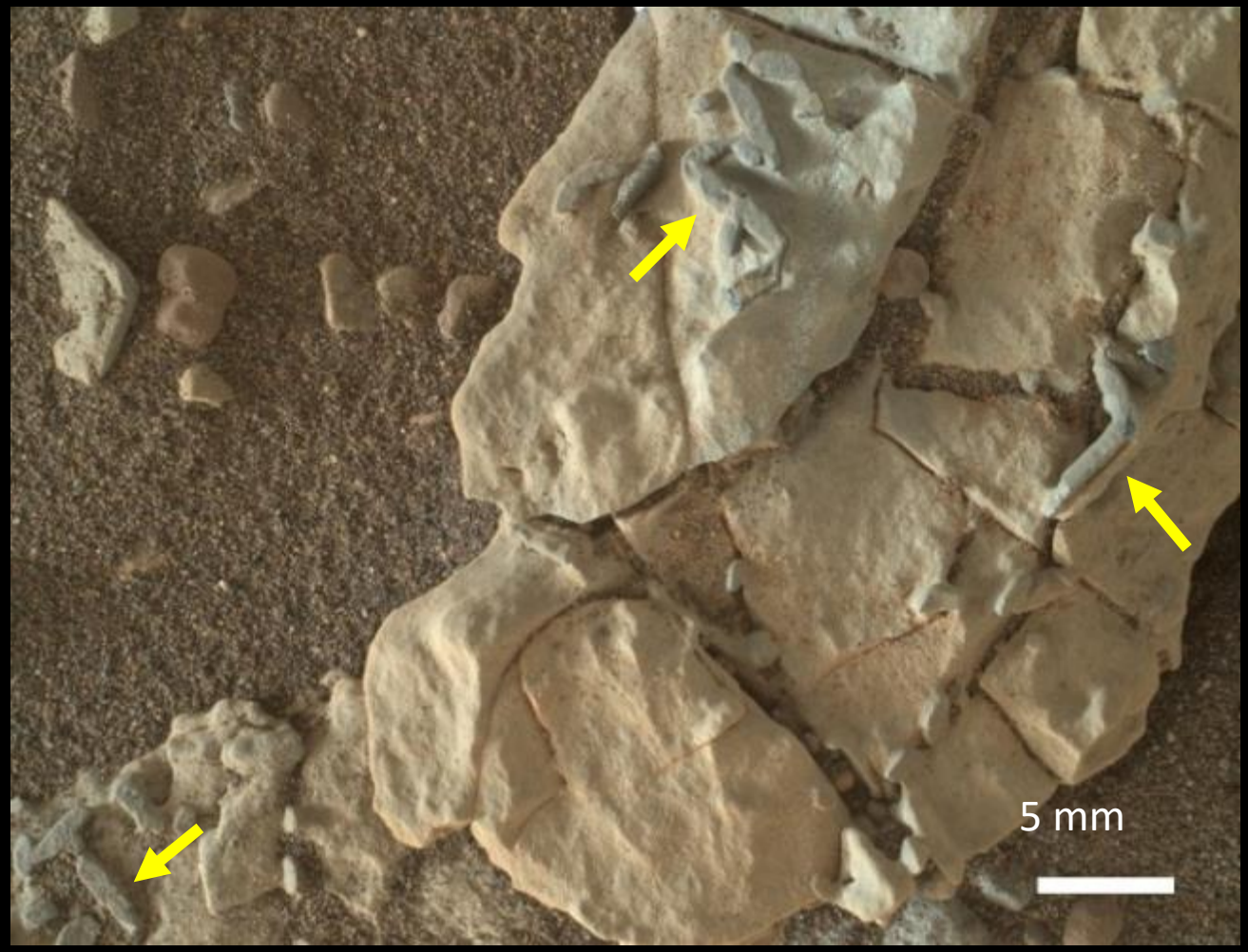
Evidence for Groundwater

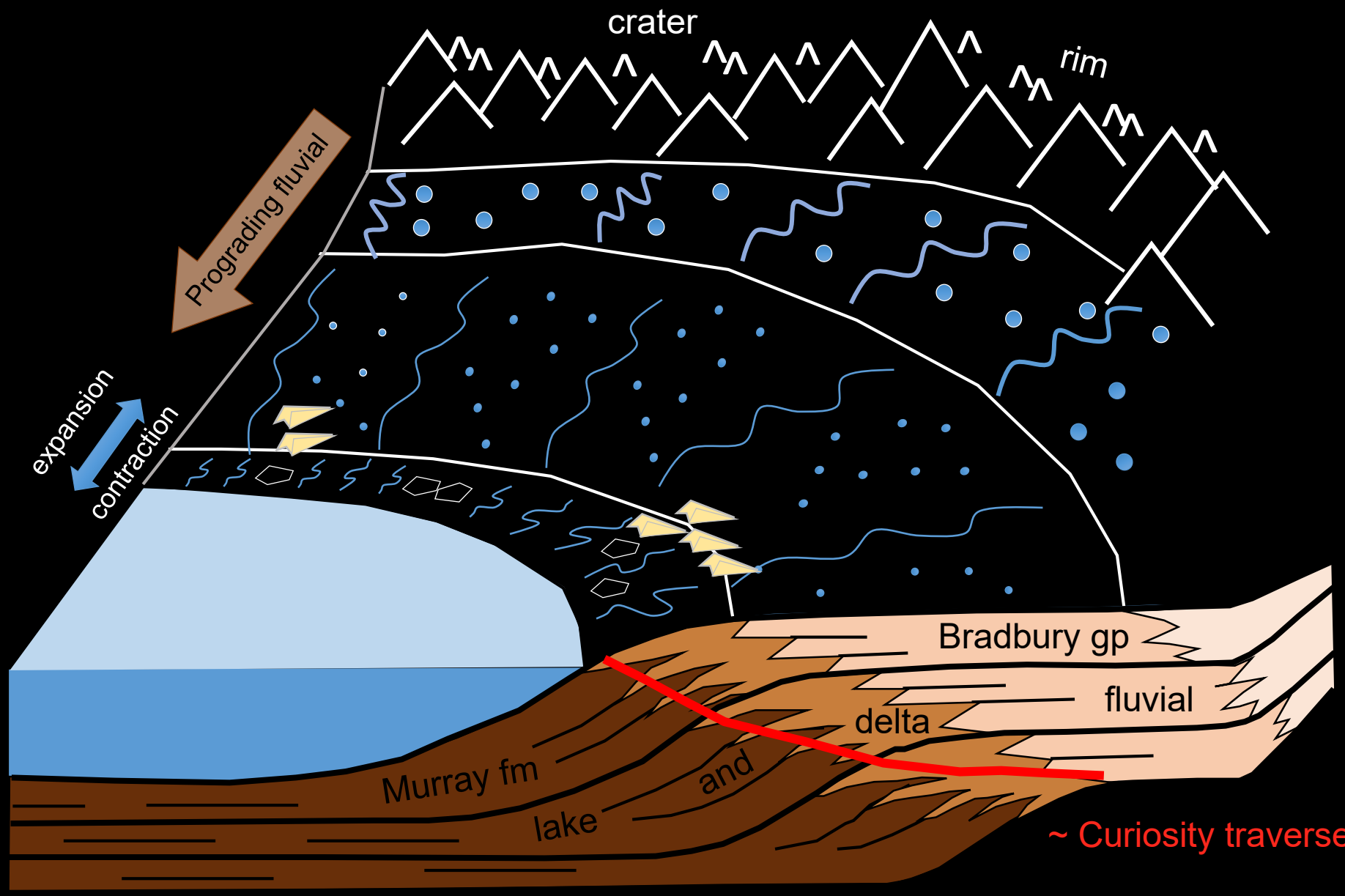




Evidence for Groundwater

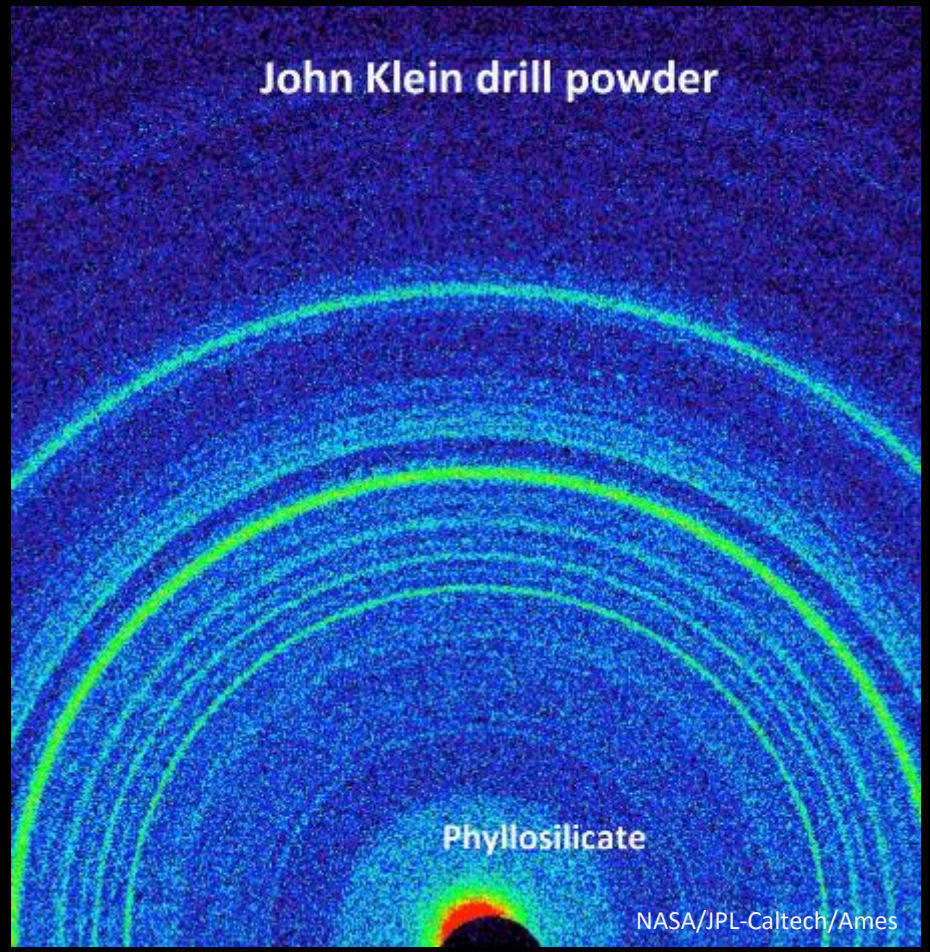






Credit: Chris Fedo

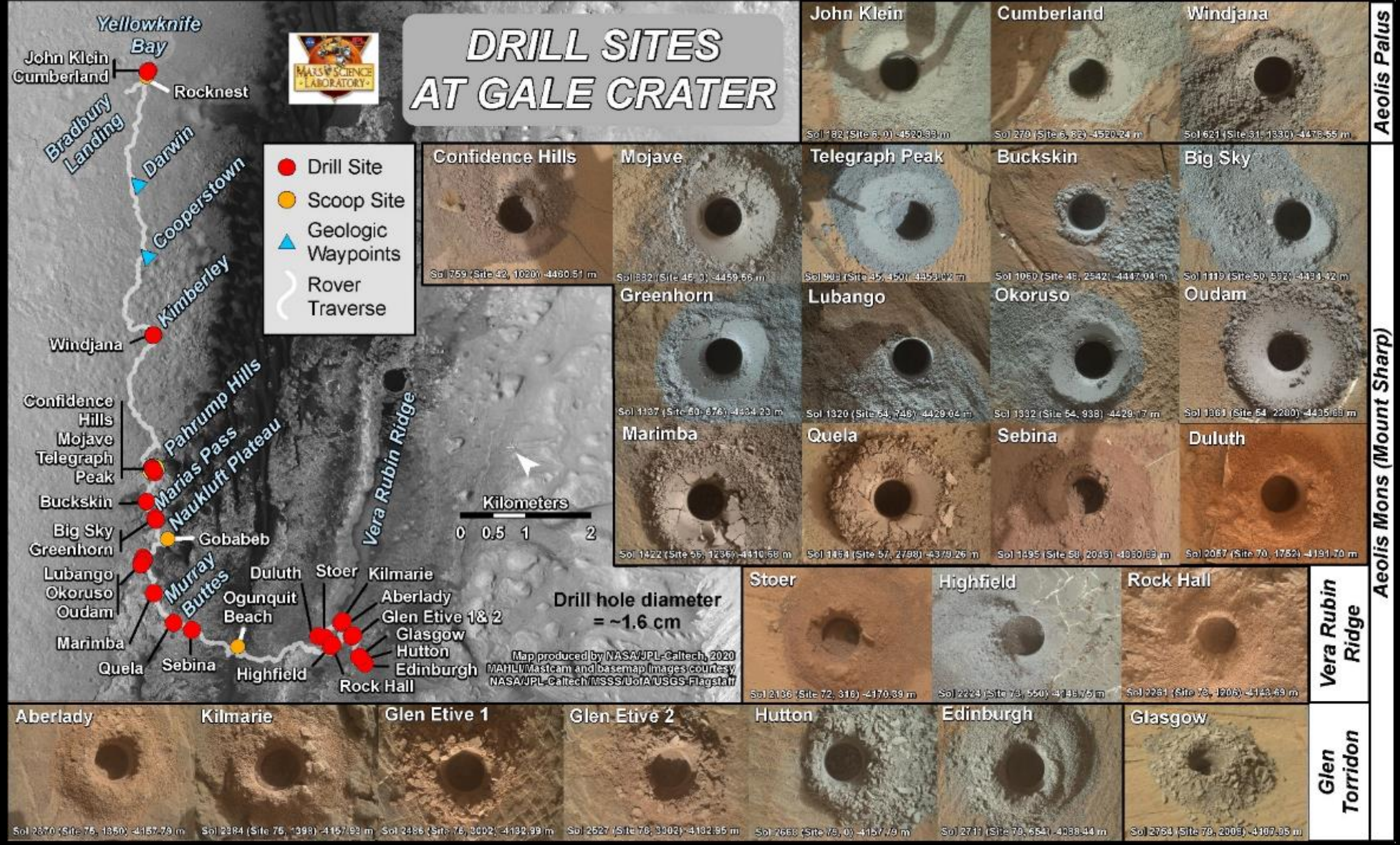
Animation of CheMin



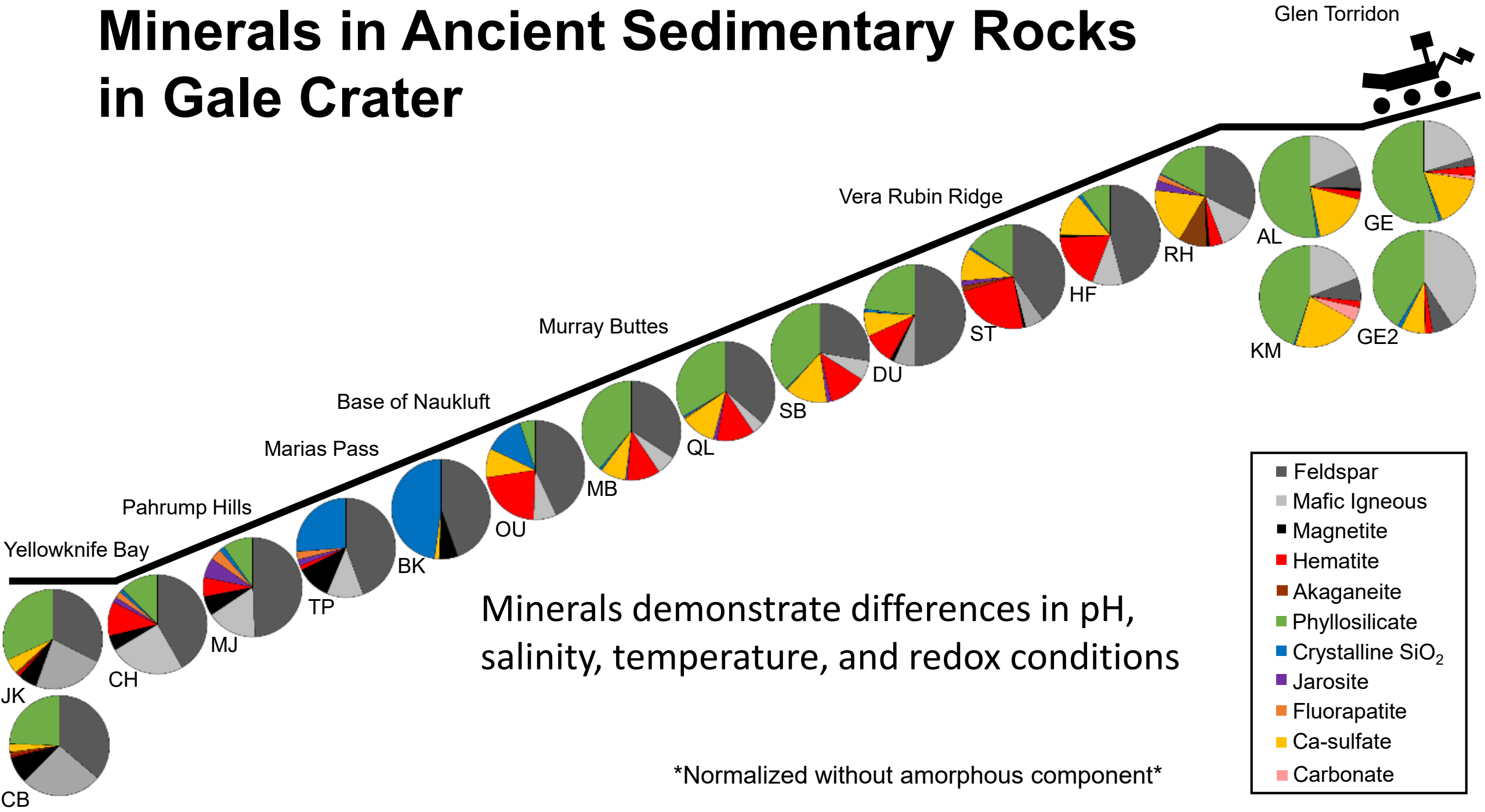
The drill powder contains abundant phyllosilicates (clay minerals), indicating sustained interaction with water

X-ray diffraction pattern from John Klein

DRILL SITES AT GALE CRATER



Minerals in Ancient Sedimentary Rocks in Gale Crater



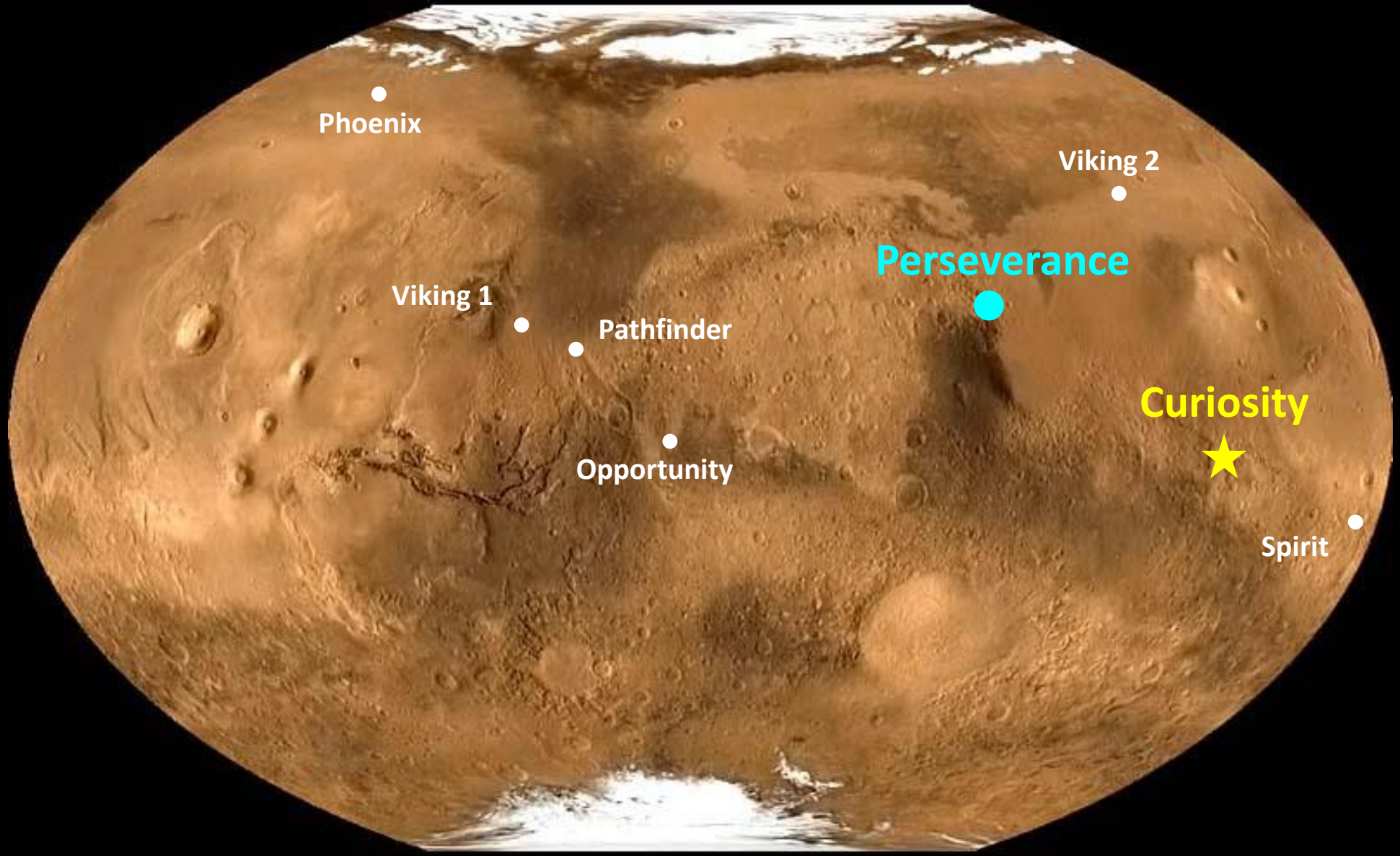
Minerals demonstrate differences in pH, salinity, temperature, and redox conditions

Normalized without amorphous component

Ancient Gale Crater

- Gale crater had a system of rivers, lakes, and deltas ~3.5 Ga
- Groundwater moved through sediments
- Mineralogy and geochemistry suggest many different environments, which would have been habitable to ancient microbial life

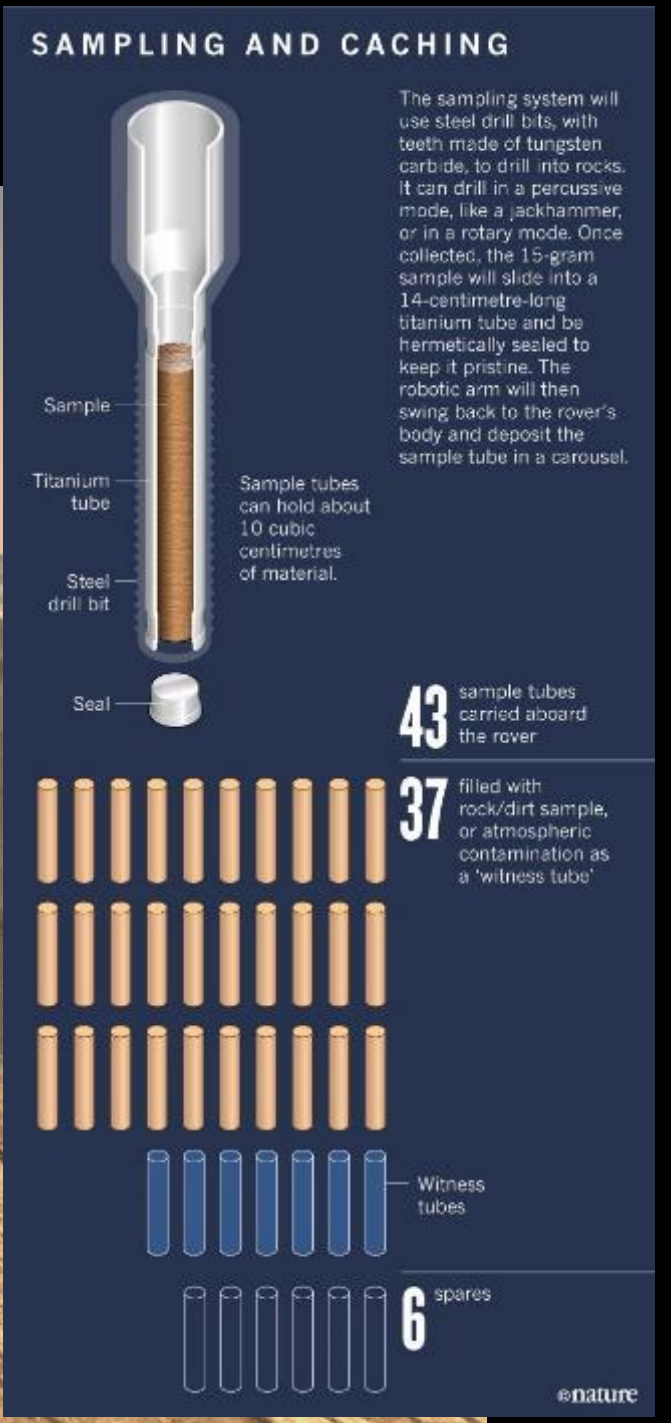
Perseverance in Jezero Crater



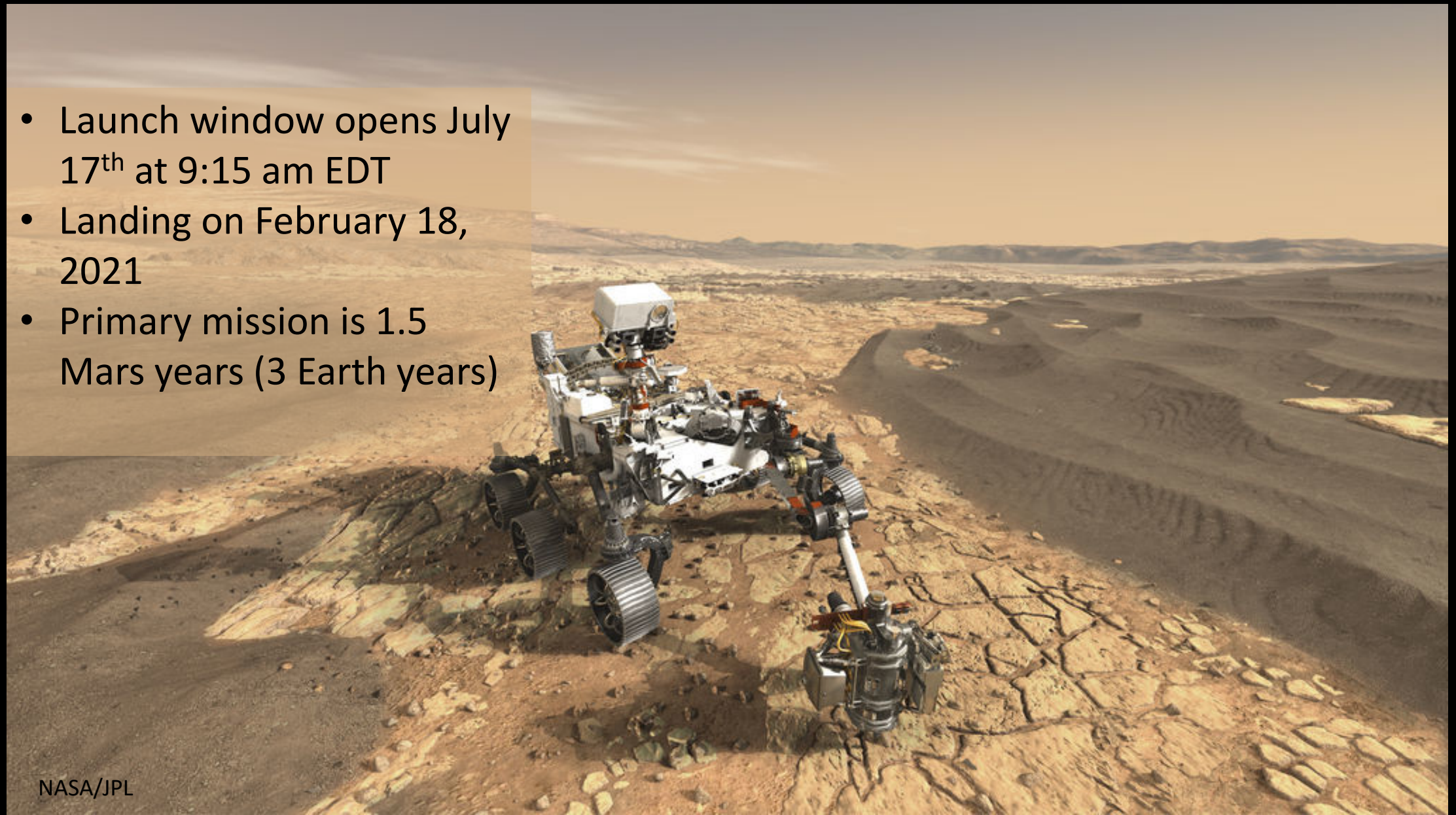
Perseverance Goals

- Identify past environments capable of supporting microbial life
- Seek signs of possible past microbial life in those habitable environments
- Collect core rock and “soil” samples and store them on the martian surface
- Test oxygen production from the martian atmosphere

NASA/JPL



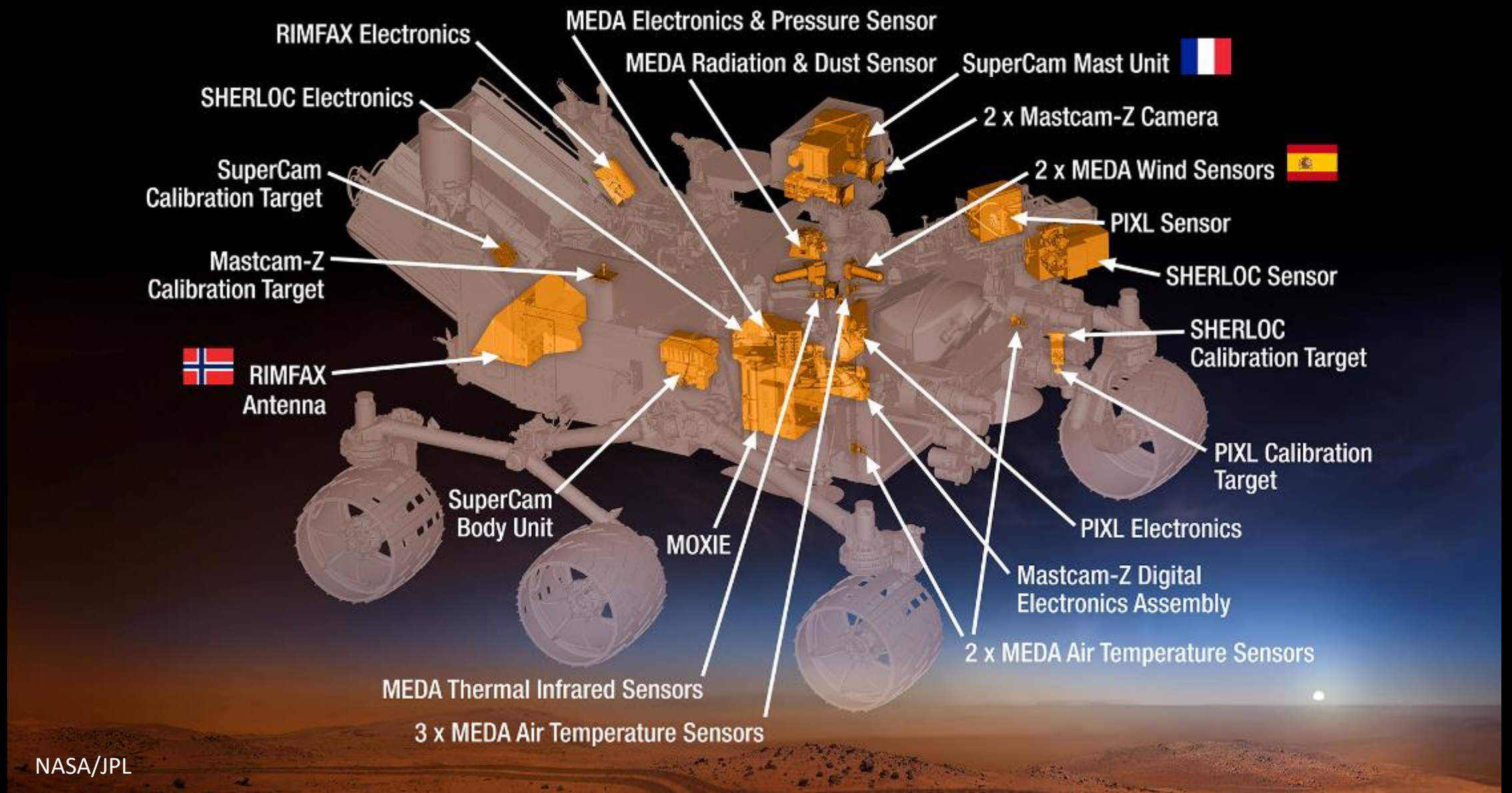
Perseverance Mission



- Launch window opens July 17th at 9:15 am EDT
- Landing on February 18, 2021
- Primary mission is 1.5 Mars years (3 Earth years)

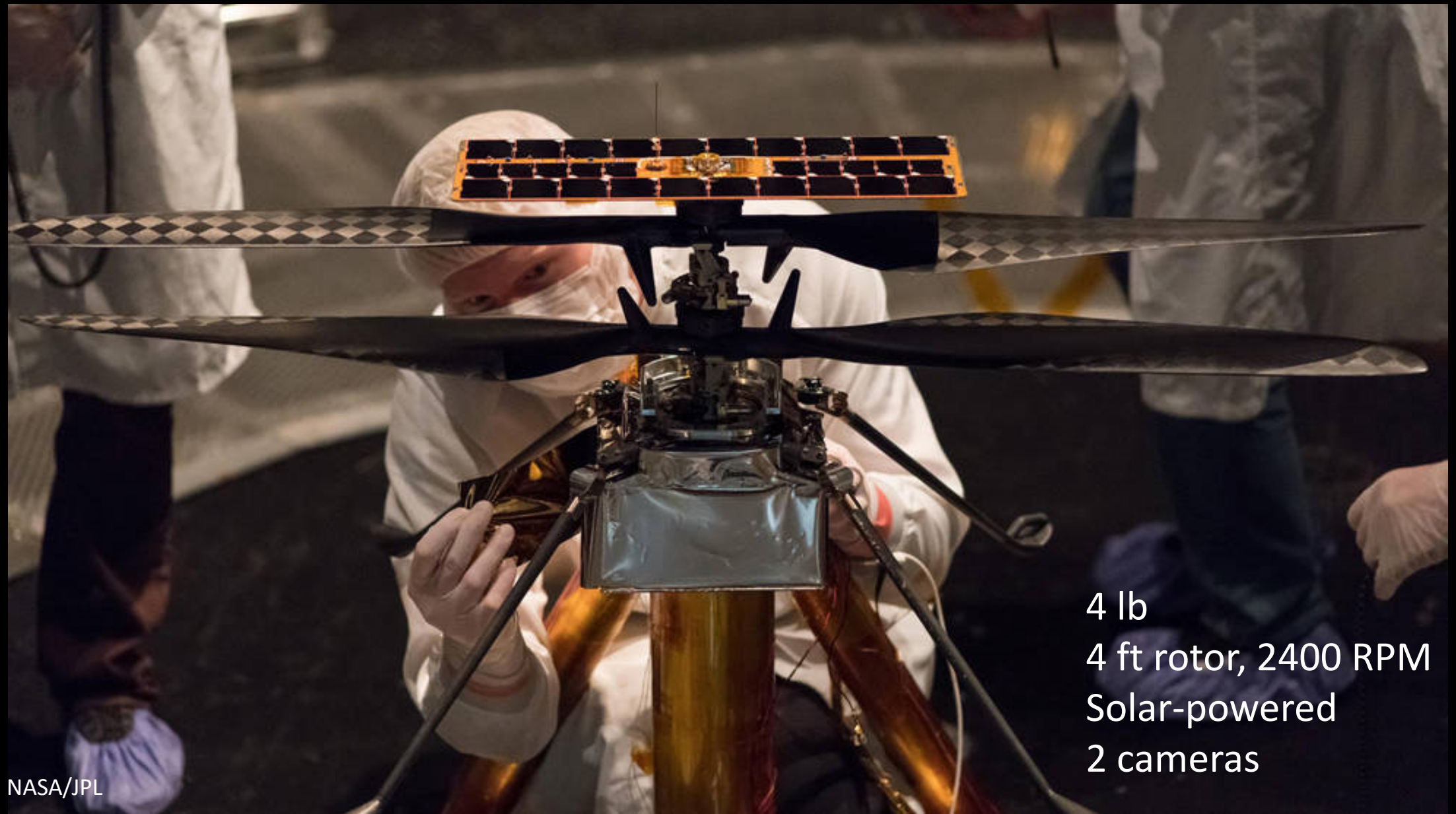
NASA/JPL

Perseverance Instruments



NASA/JPL

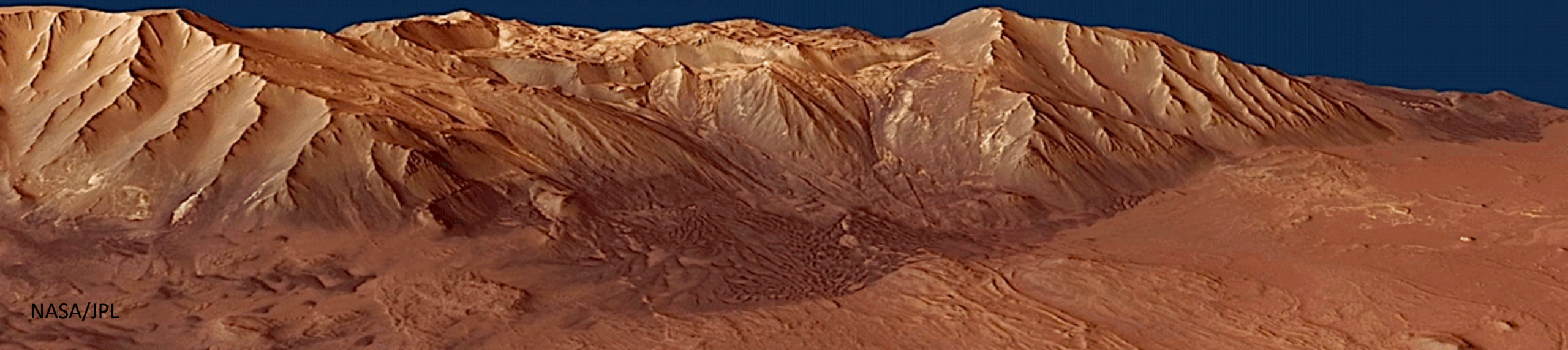
“Ingenuity” Helicopter



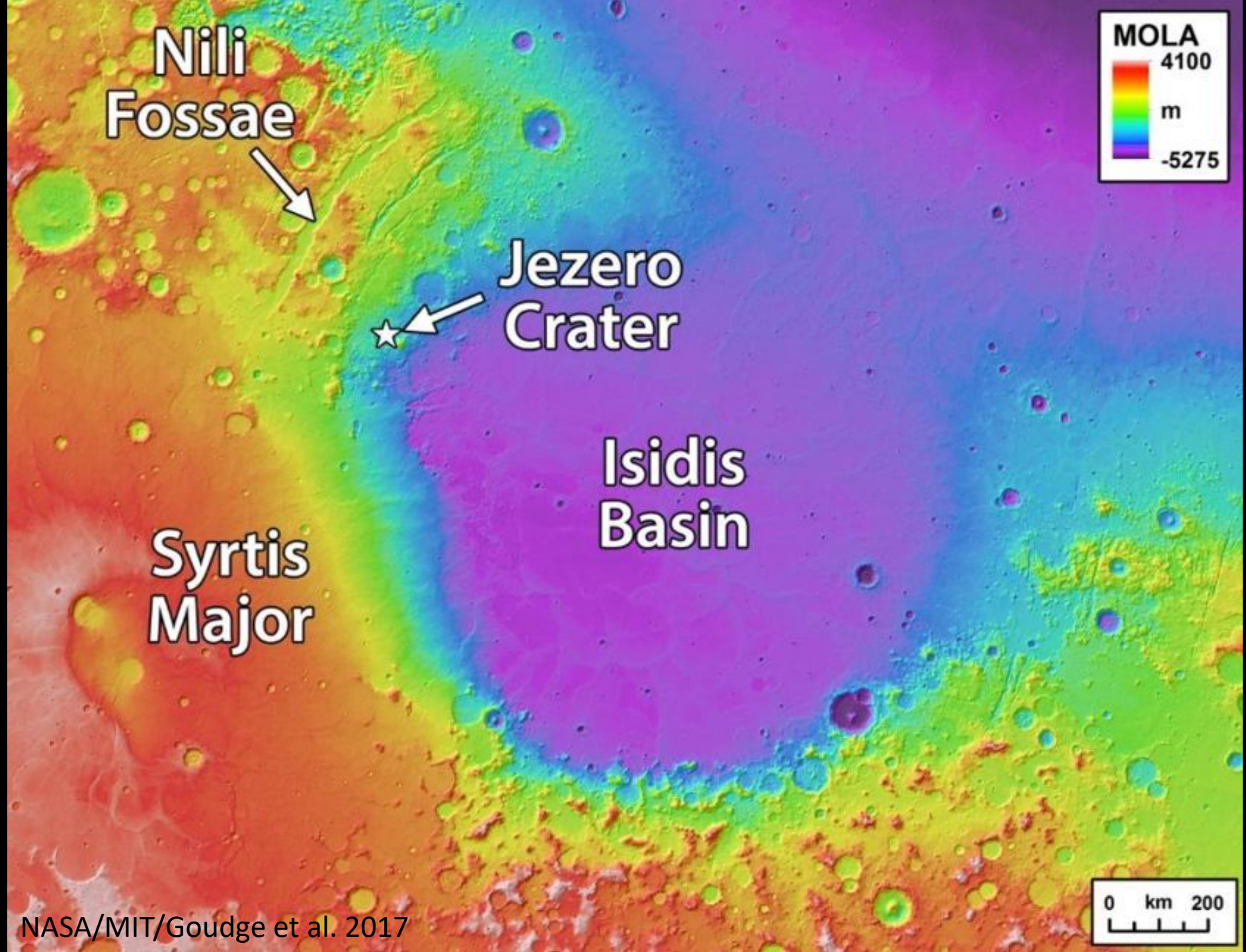
4 lb
4 ft rotor, 2400 RPM
Solar-powered
2 cameras

NASA/JPL

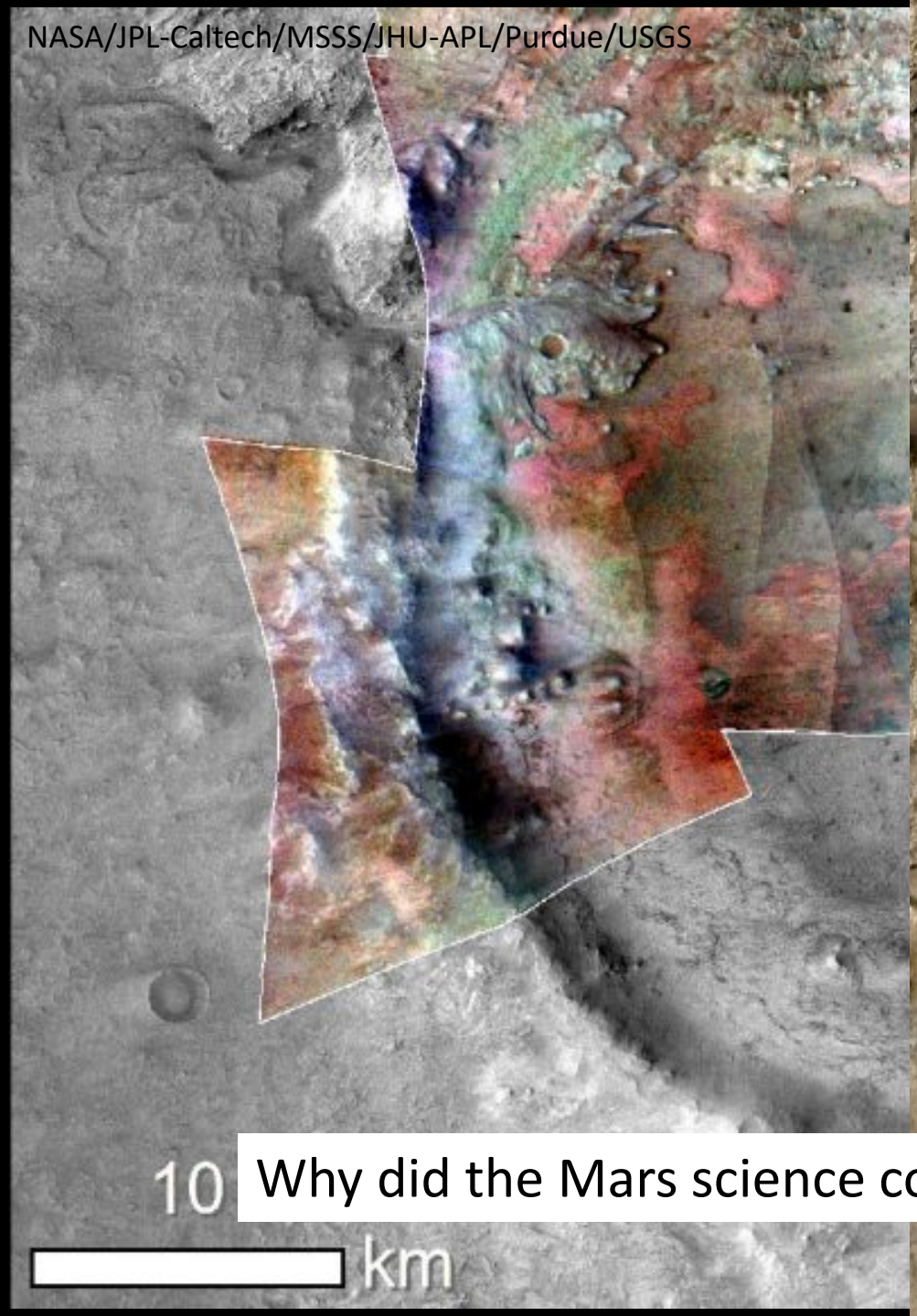
MARS 2020 ROVER
TERRAIN RELATIVE NAVIGATION



NASA/JPL



NASA/MIT/Goudge et al. 2017

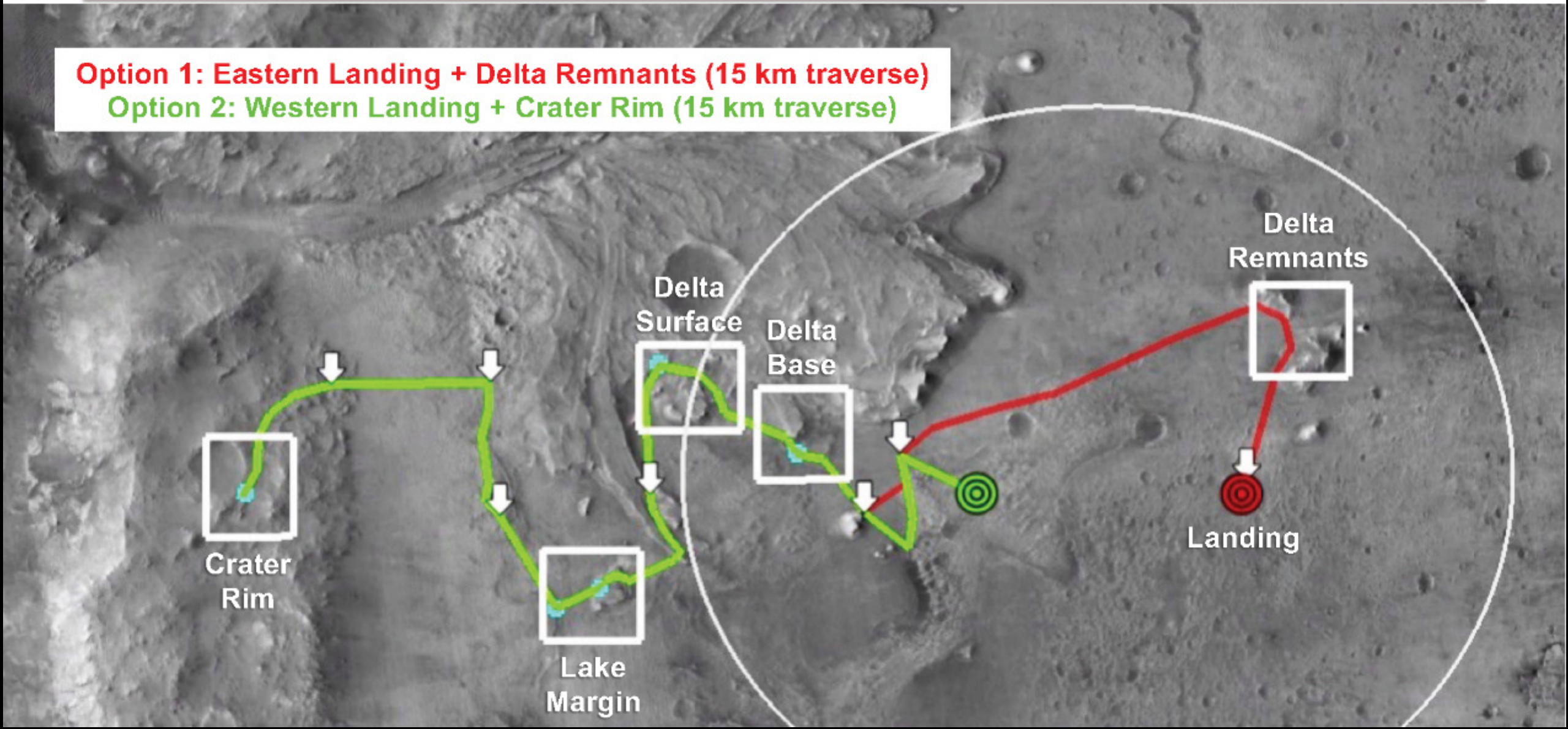


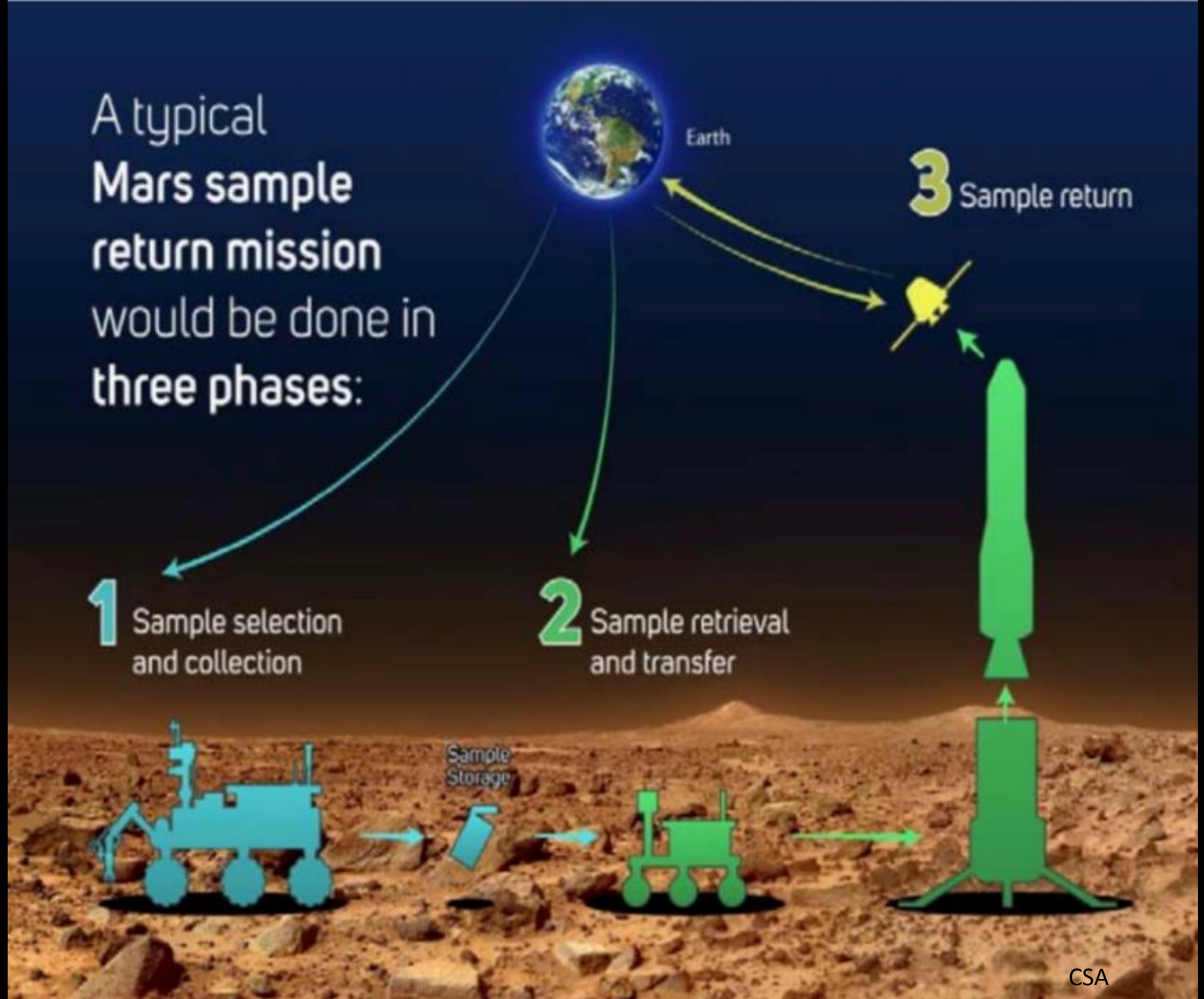
Why did the Mars science community decide to send Perseverance to Jezero crater?

Put your answer in the chat.

Notional Mission Scenario for Jezero crater

Jet Propulsion Laboratory
California Institute of Technology




A typical
Mars sample
return mission
would be done in
three phases:
Earth
3 Sample return
1 Sample selection
and collection
2 Sample retrieval
and transfer
Sample
Storage
CSA