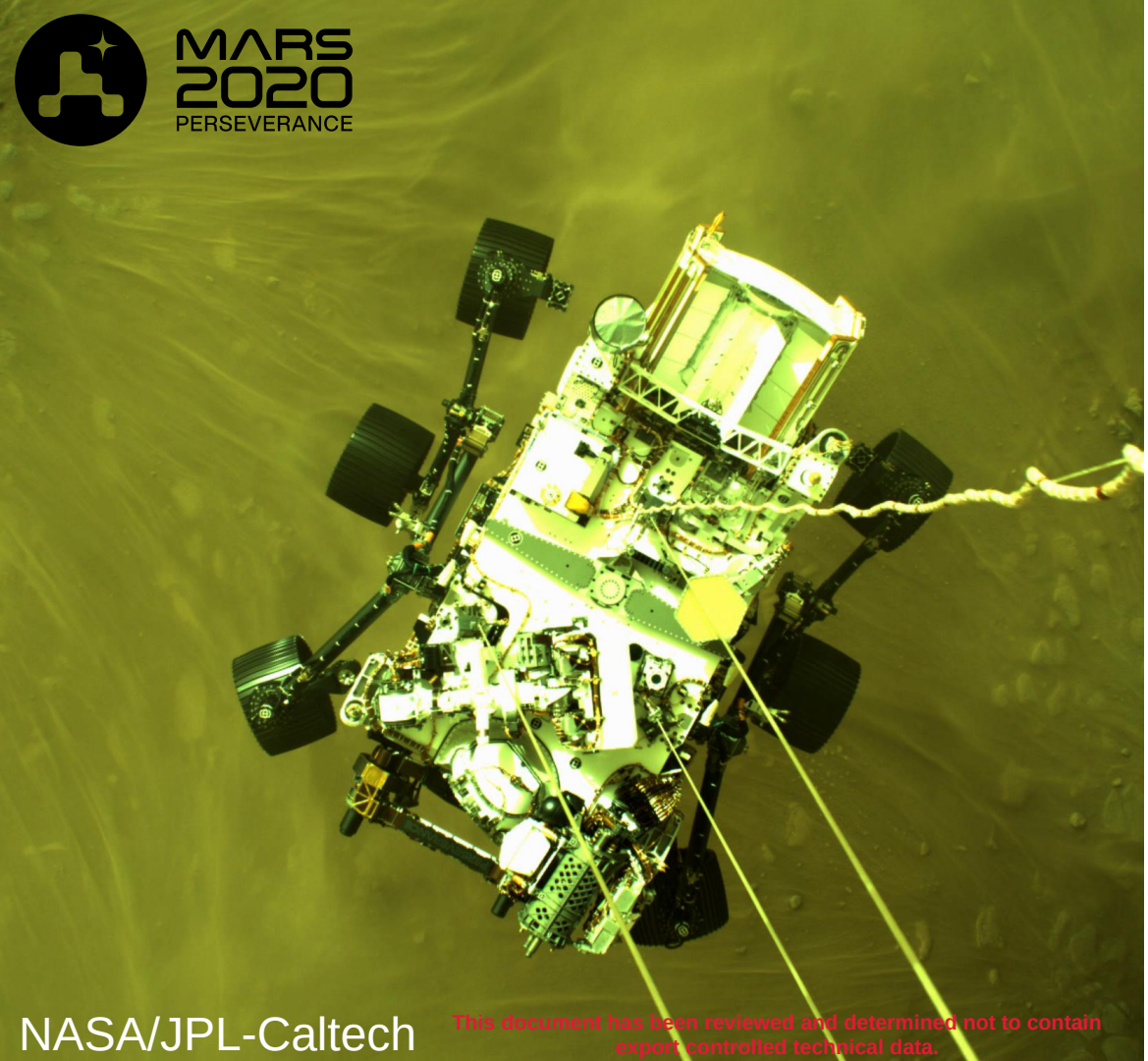


The Mars 2020 Perseverance Rover Mission in Jezero Crater, Mars

Jesse Tarnas

Jet Propulsion Laboratory
California Institute of Technology

NASA/JPL-Caltech

This document has been reviewed and determined not to contain export controlled technical data.


Saturn
Mars
MARS
2020
PERSEVERANCE
NASA


NASA/JPL-Caltech/MSSS/Kevin Gill

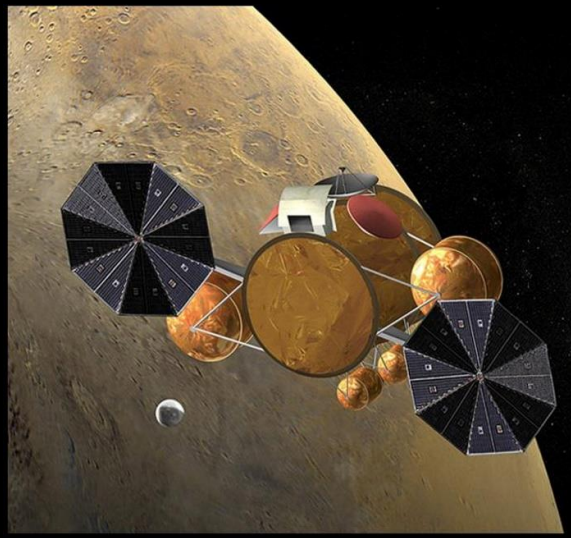

Earth
NASA/JPL-Caltech/MSSS/Kevin Gill

A Notional Three-Mission Mars Sample Return Campaign

Sample Collection
(Mars 2020)

We are here

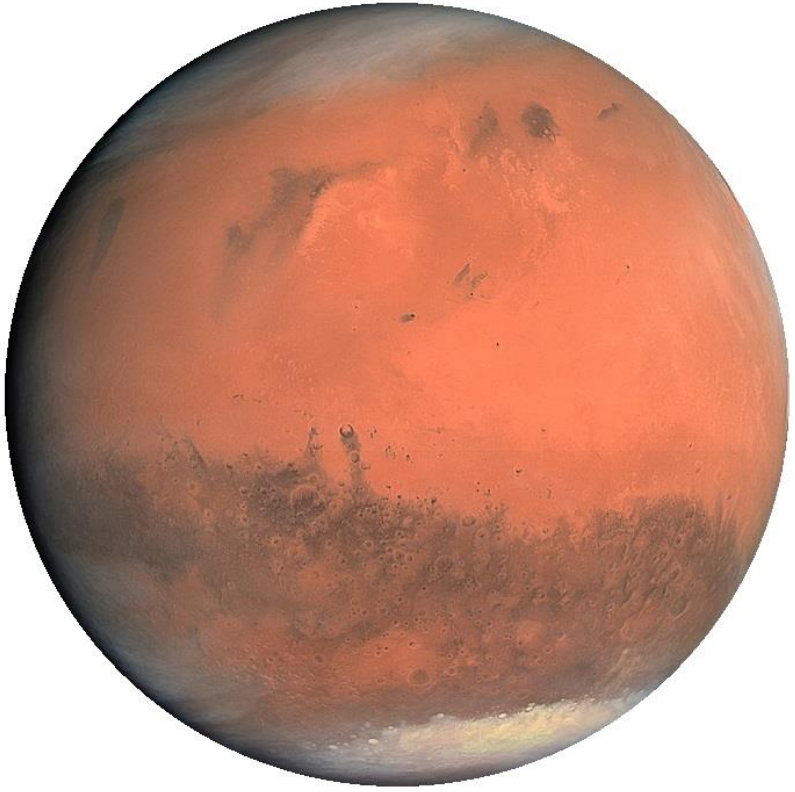
Mars Ascent Vehicle (MAV)
launches Orbiting Sample (OS)



Mars Orbiter captures OS and
brings it back to Earth

MARS 2020 PERSEVERANCE

Martian meteorites



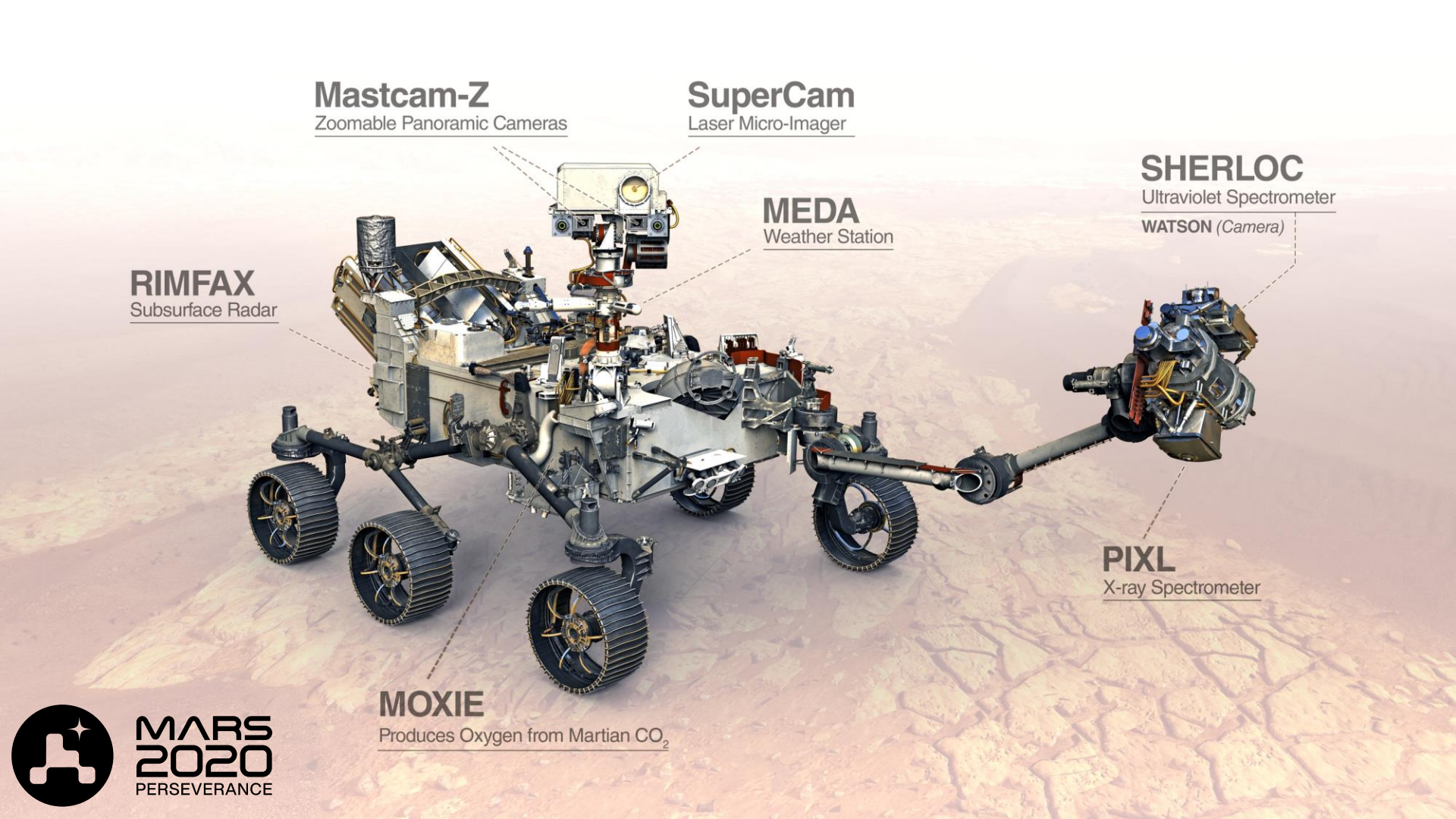
Regolith Breccia

Chassignite

Shergottite

Nakhlite

Mars image credit: NASA
Meteorite Image Credit: David Weir, Meteorite Studies


Mastcam-Z
Zoomable Panoramic Cameras
SuperCam
Laser Micro-Imager
SHERLOC
Ultraviolet Spectrometer
WATSON (Camera)
MEDA
Weather Station
RIMFAX
Subsurface Radar
PIXL
X-ray Spectrometer
MOXIE
Produces Oxygen from Martian CO_2
MARS 2020
PERSEVERANCE


MARS
2020
PERSEVERANCE
NASA/JPL

NASA/JPL

Perseverance loaded into heat shield

URS CL#20-4730

National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

Rover, heat shield, cruise stage

URS CL#20-4730

National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

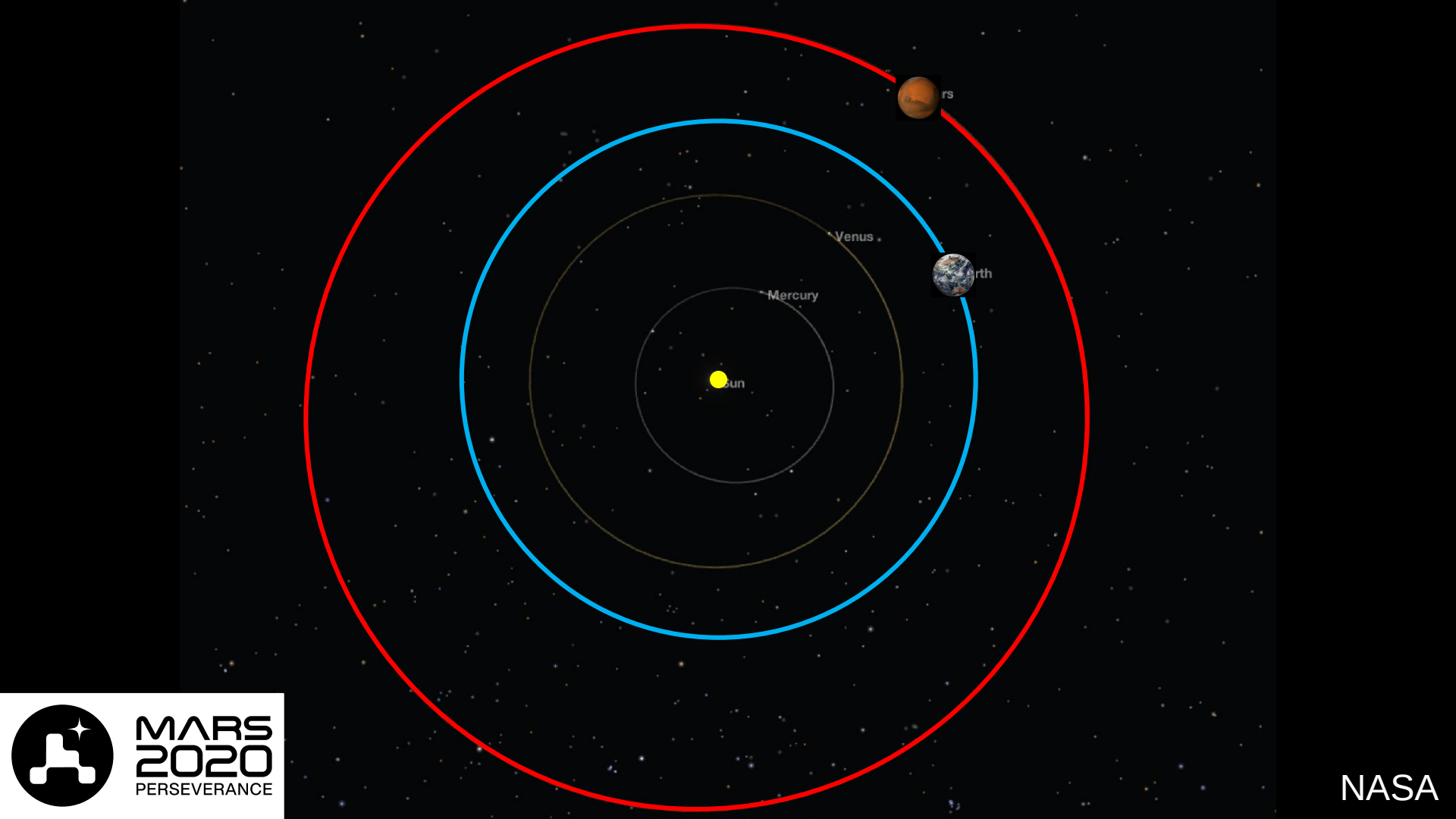
Rover, heat shield, cruise stage

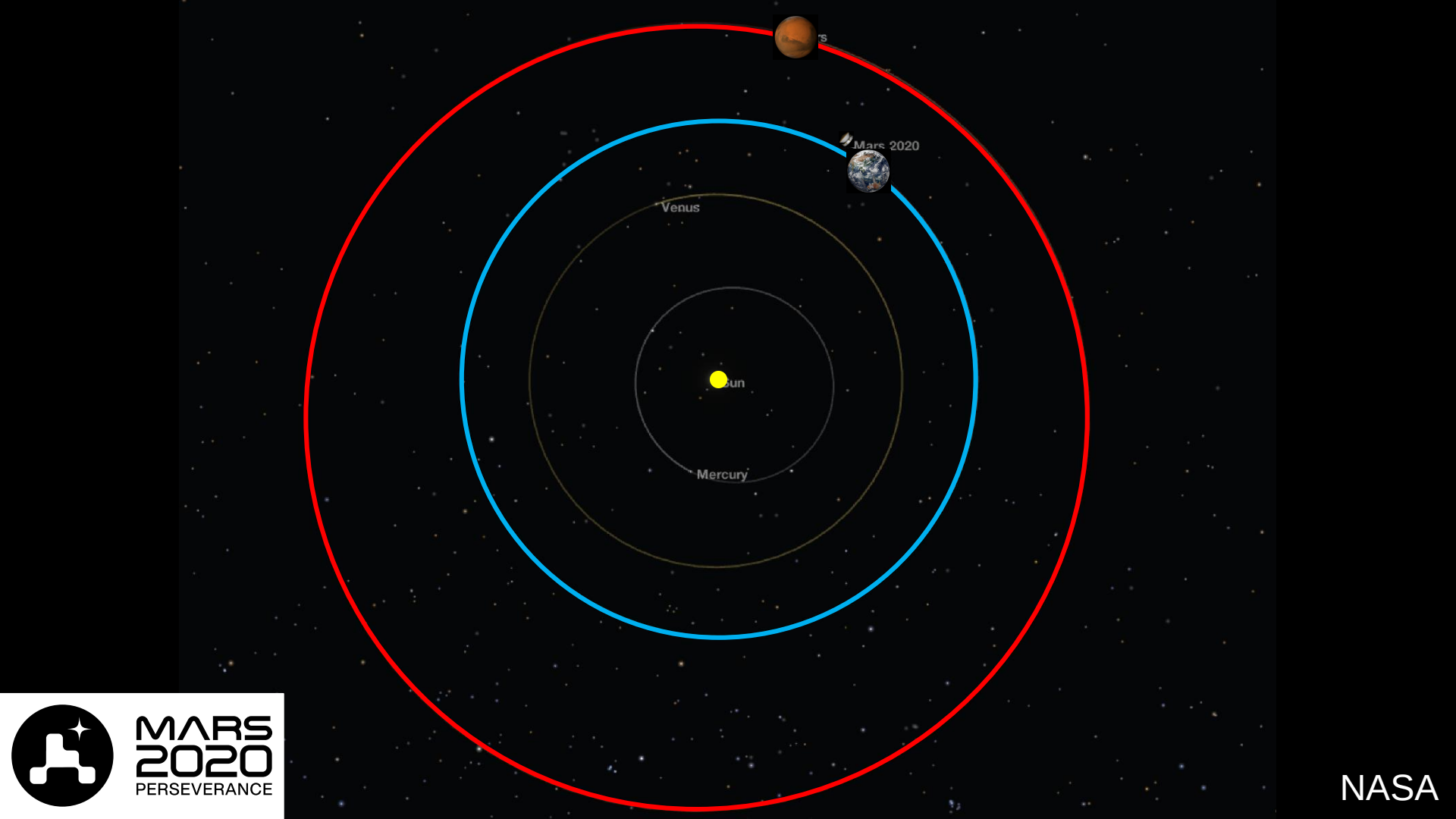
URS CL#20-4730

Transport to rocket

URS CL#20-4730

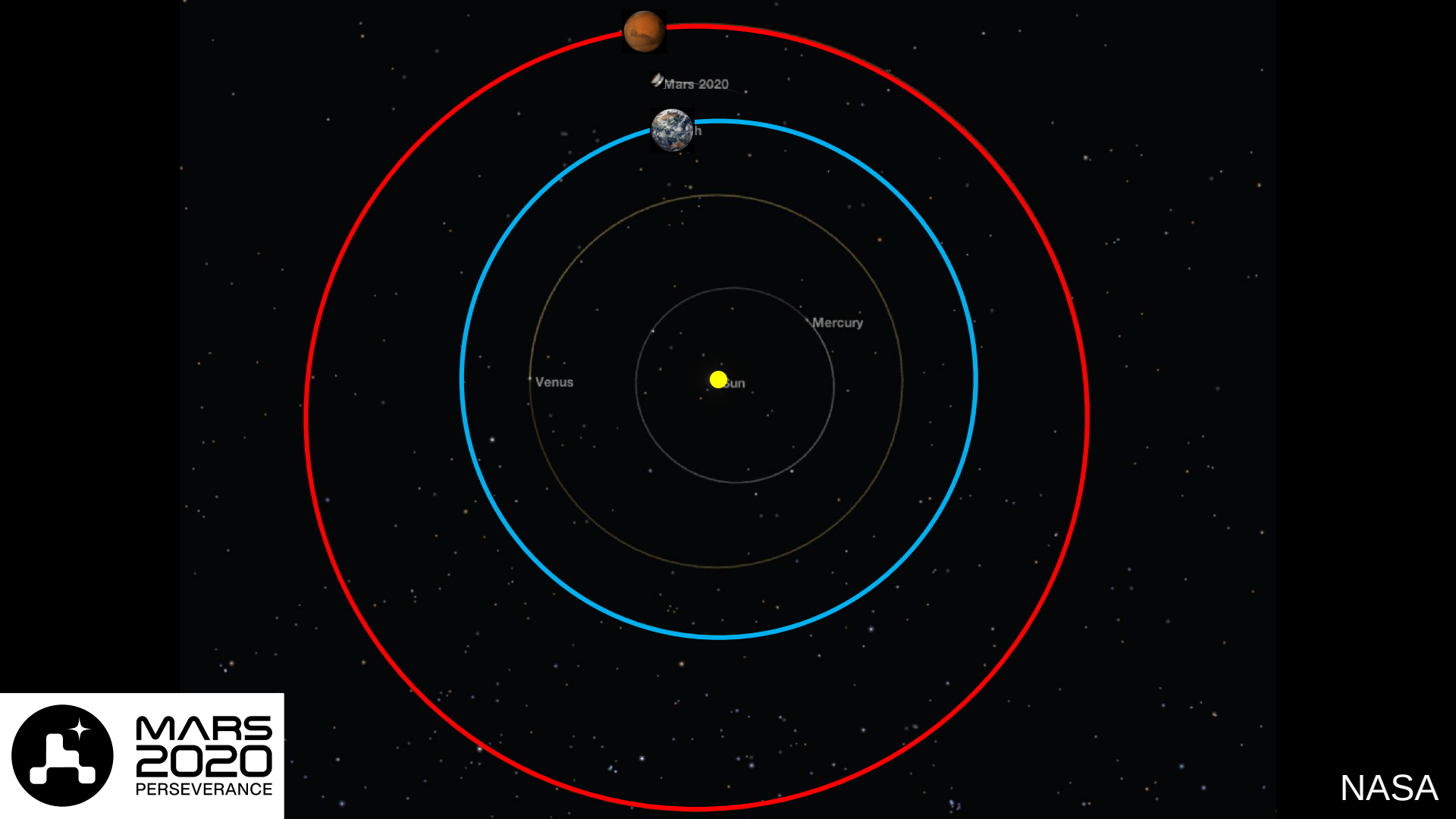

MARS
2020
PERSEVERANCE
Launched July 30, 2020
NASA


Venus
Mercury
NASA



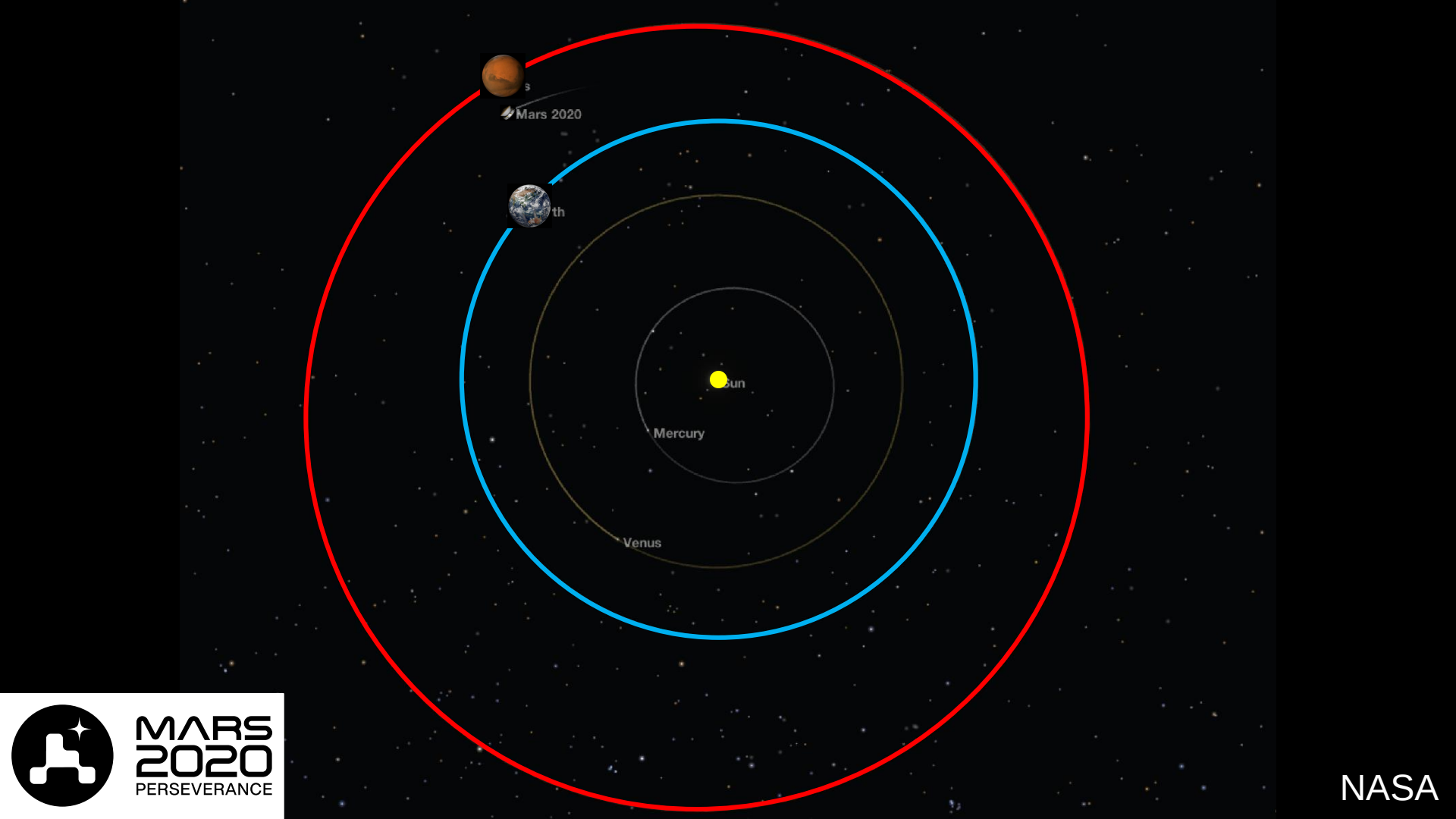
MARS 2020 PERSEVERANCE

NASA



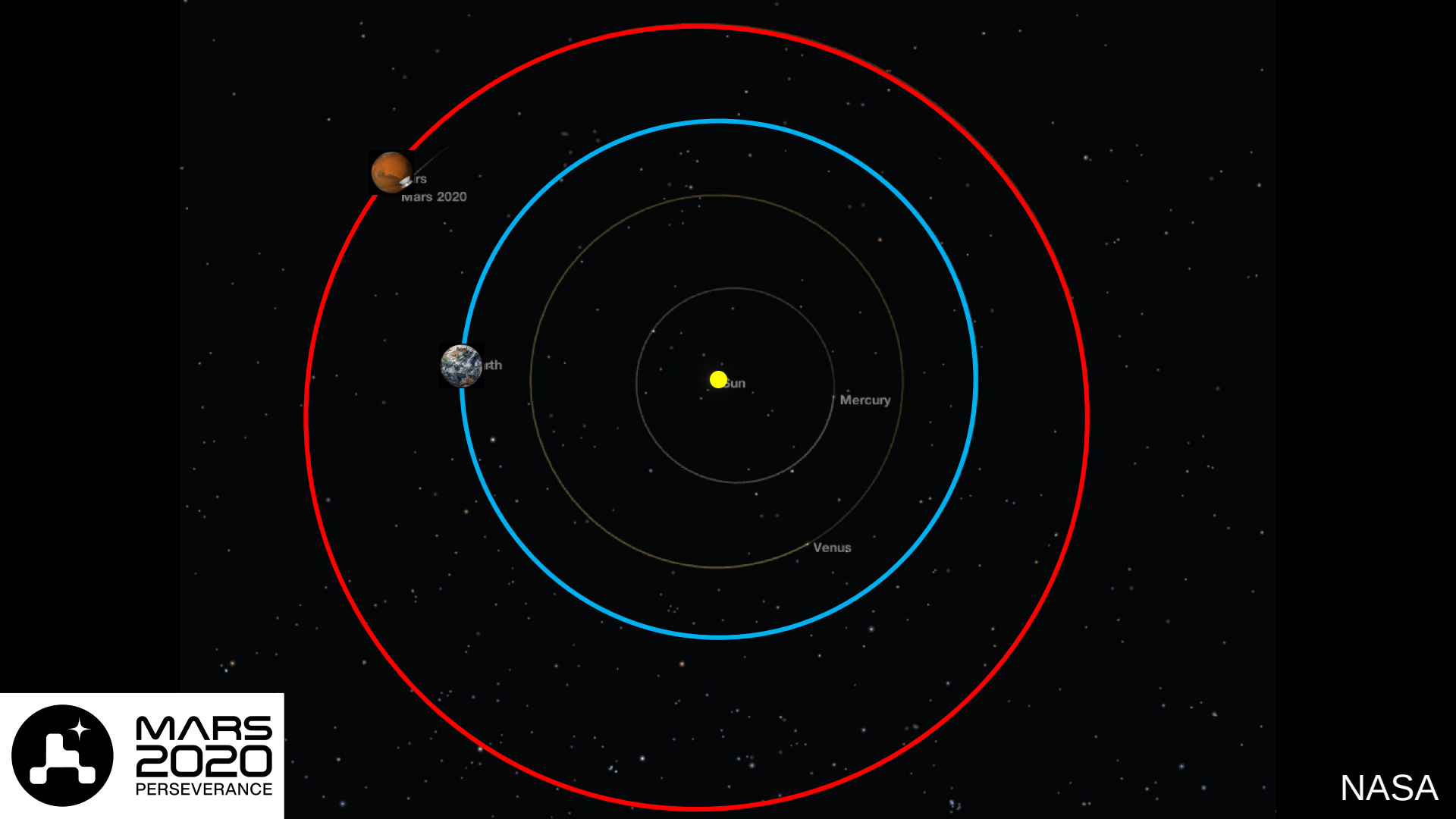
MARS 2020 PERSEVERANCE

NASA



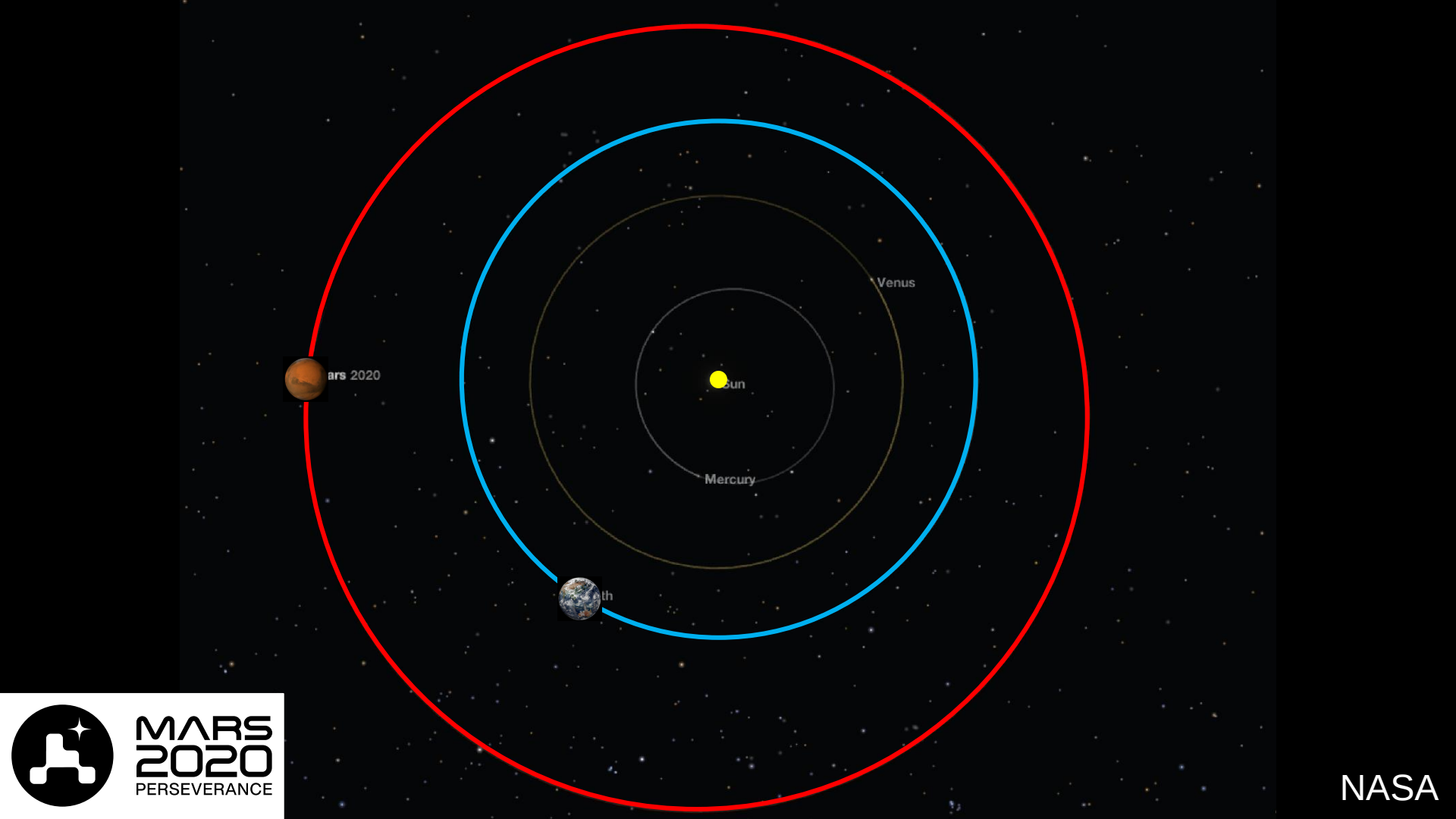
MARS 2020 PERSEVERANCE

NASA



MARS 2020 PERSEVERANCE

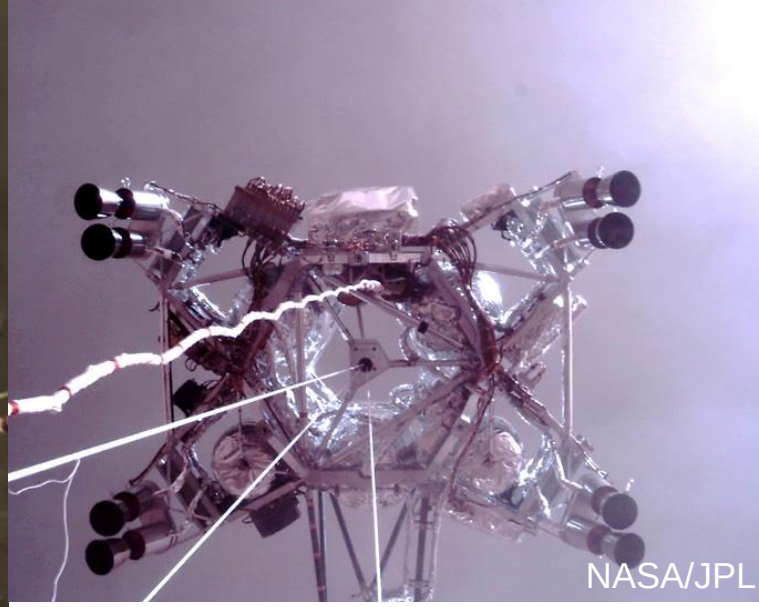
NASA



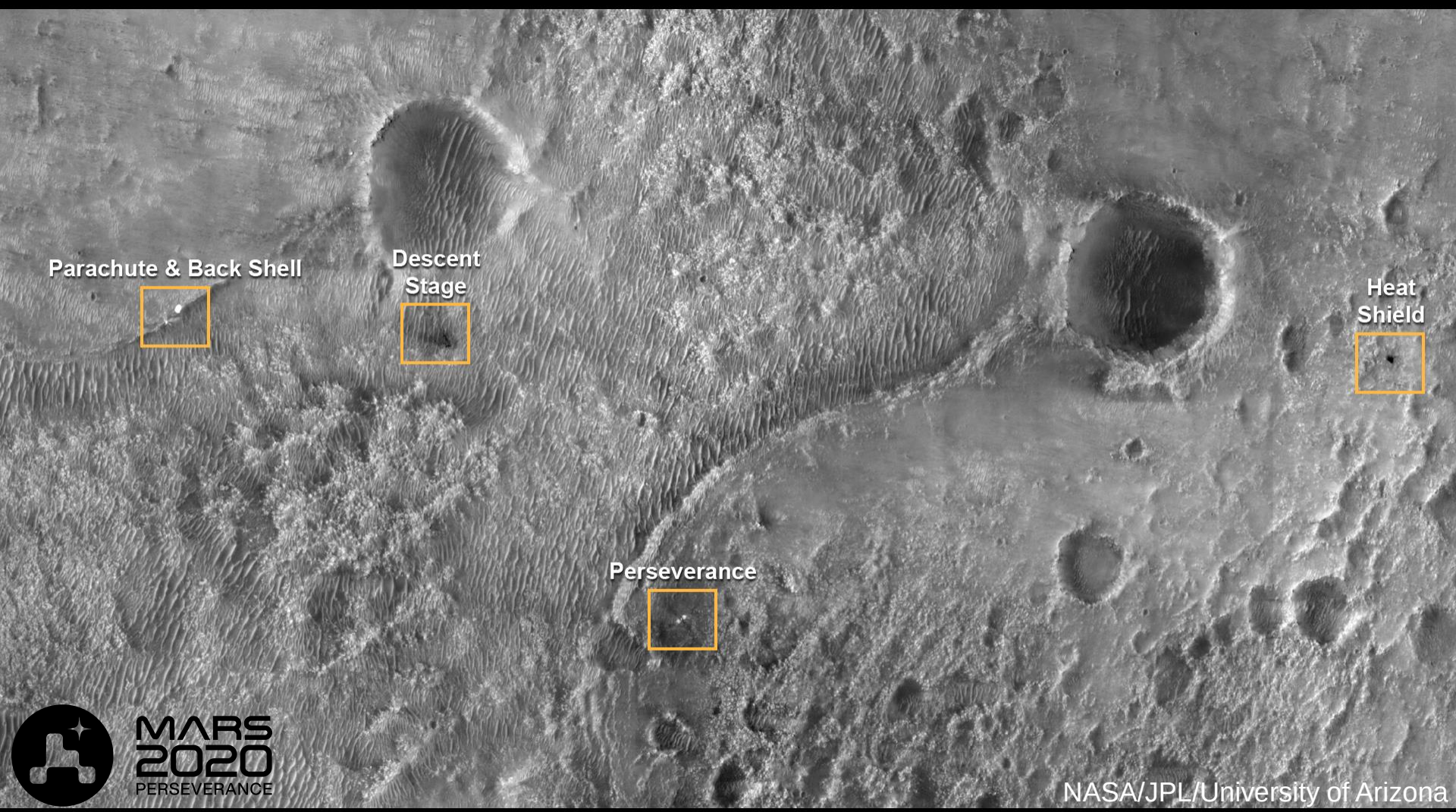
MARS 2020 PERSEVERANCE

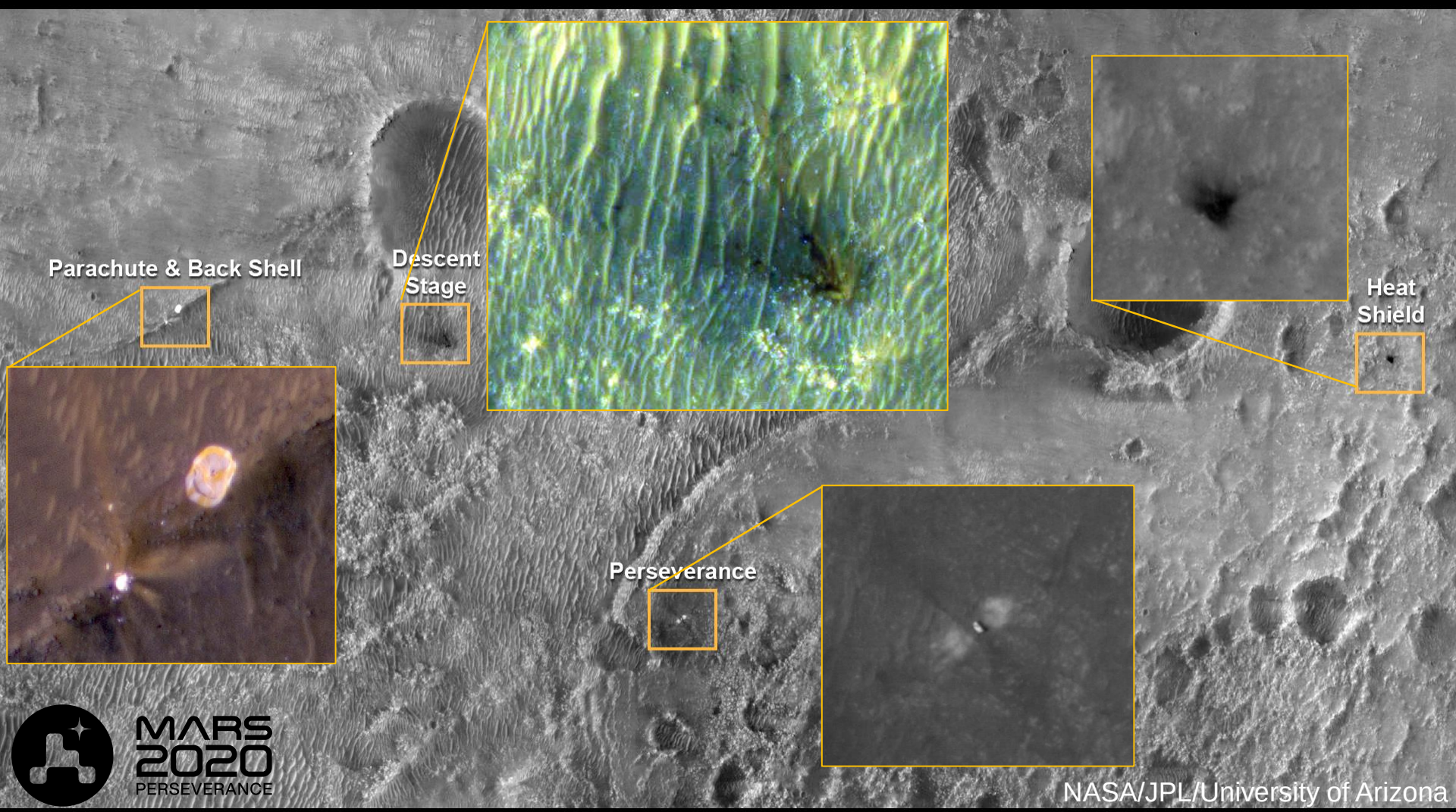
NASA

Landfall on Mars




MARS
2020
PERSEVERANCE
URS CL#20-4730
NASA/JPL/University of Arizona


Parachute & Back Shell
Descent Stage
Heat Shield
Perseverance
MARS 2020
PERSEVERANCE
NASA/JPL/University of Arizona


Parachute & Back Shell
Descent Stage
Heat Shield
Perseverance
MARS 2020
PERSEVERANCE
NASA/JPL/University of Arizona


MARS
2020
PERSEVERANCE
NASA/JPL

Welcome to Jezero Crater

Octavia E. Butler Landing

NASA/JPL

MARS 2020 PERSEVERANCE

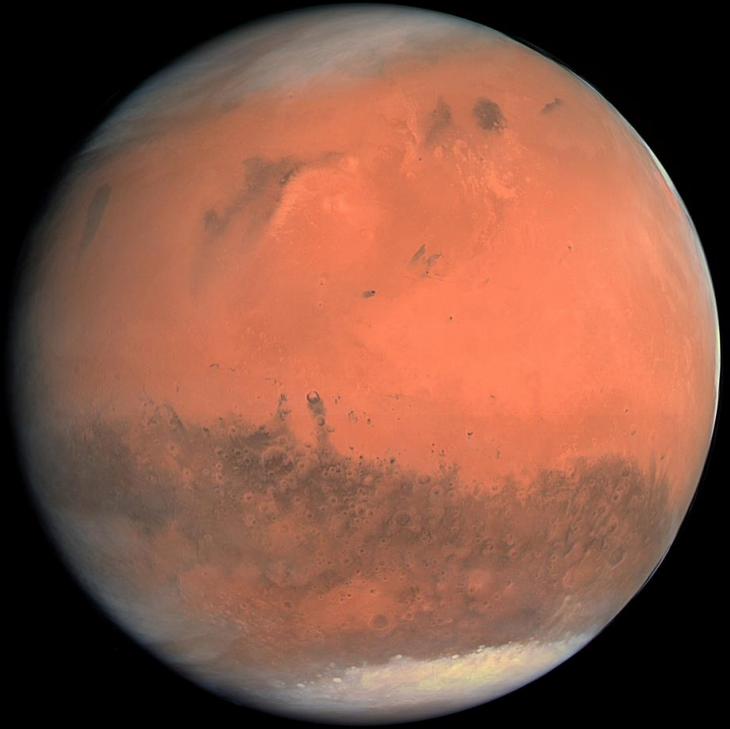
MARS 2020 PERSEVERANCE

Hubble

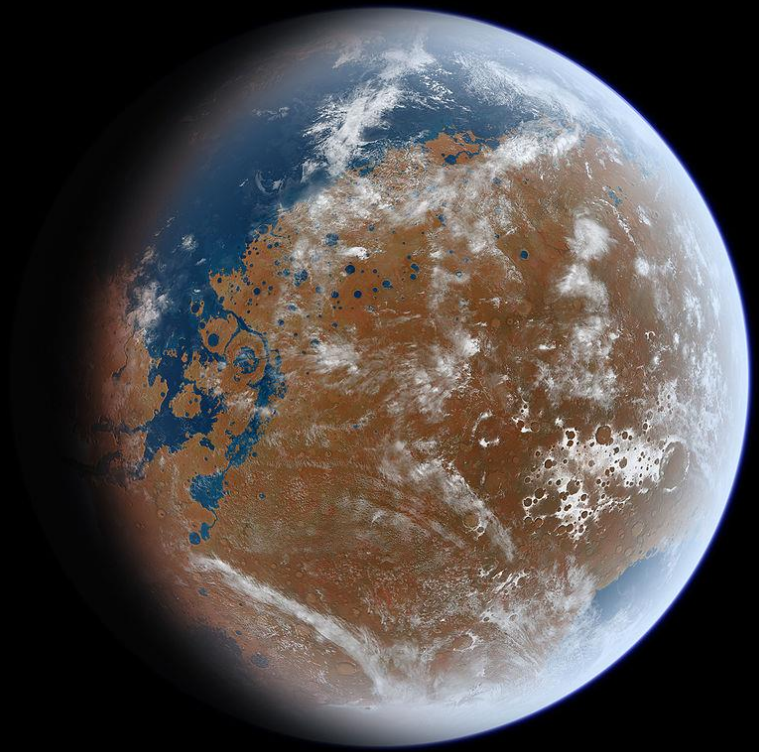
VIIRS

NASA

Ancient Mars: Surface Liquid Water

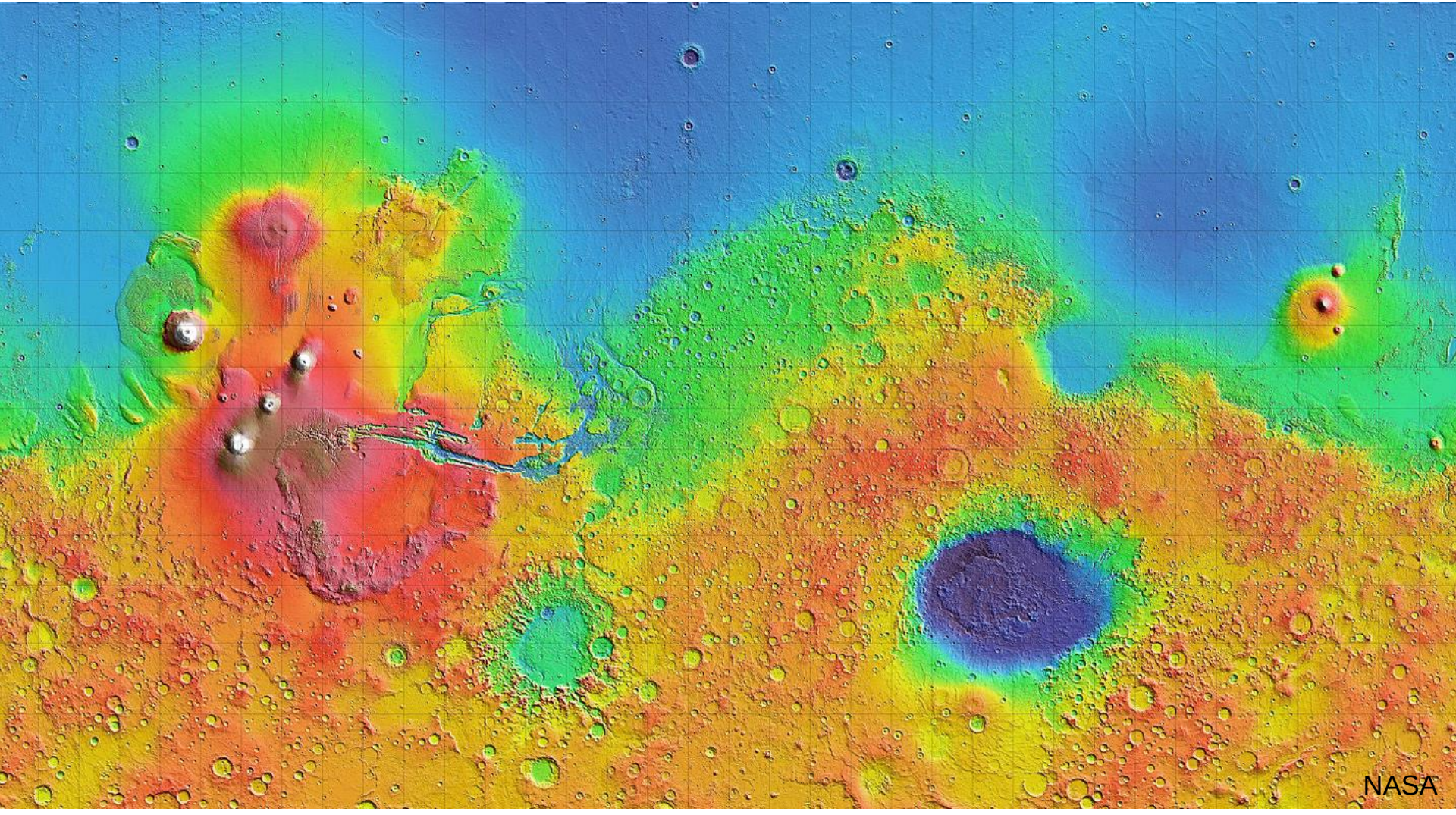


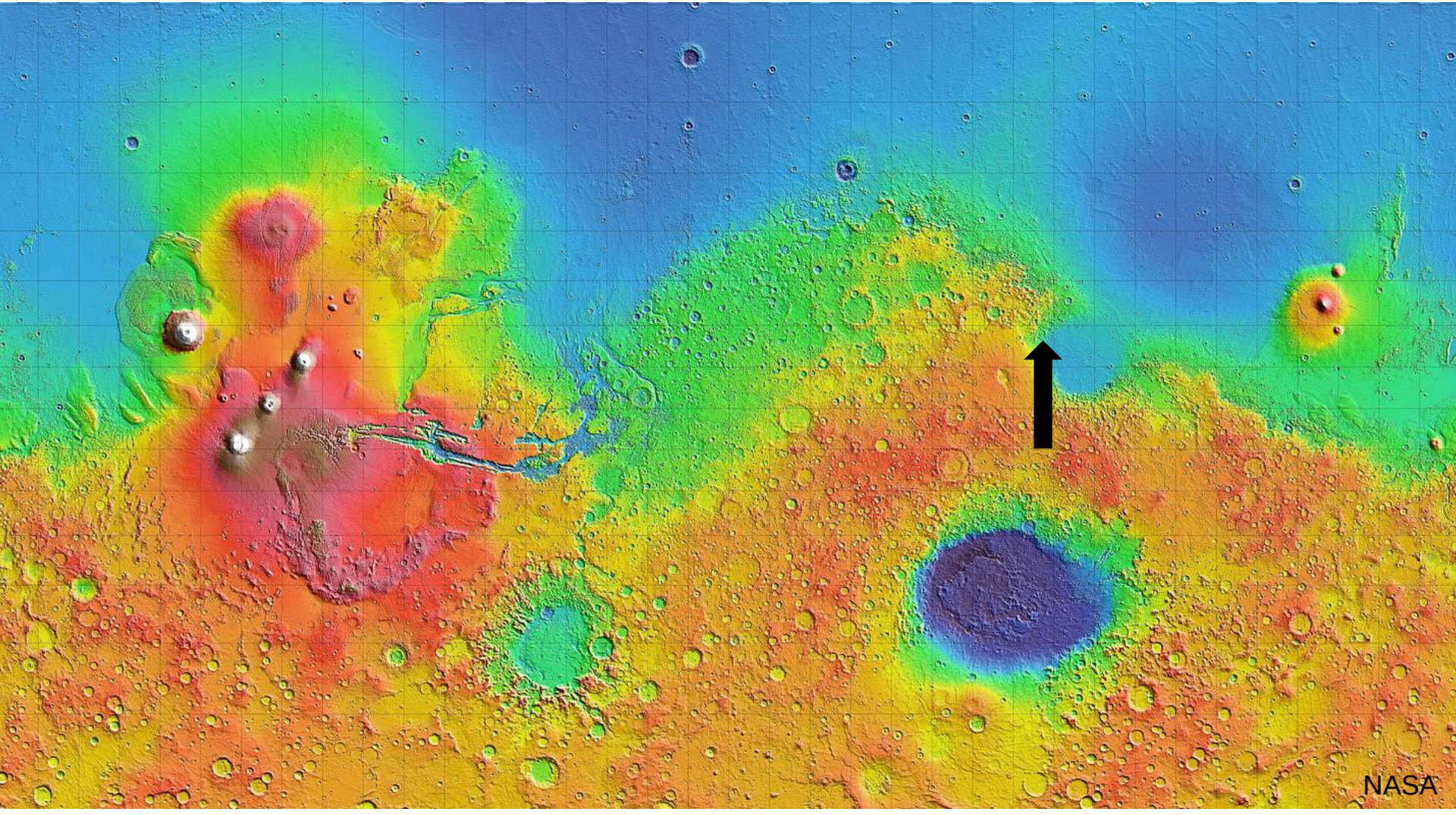
Modern Mars

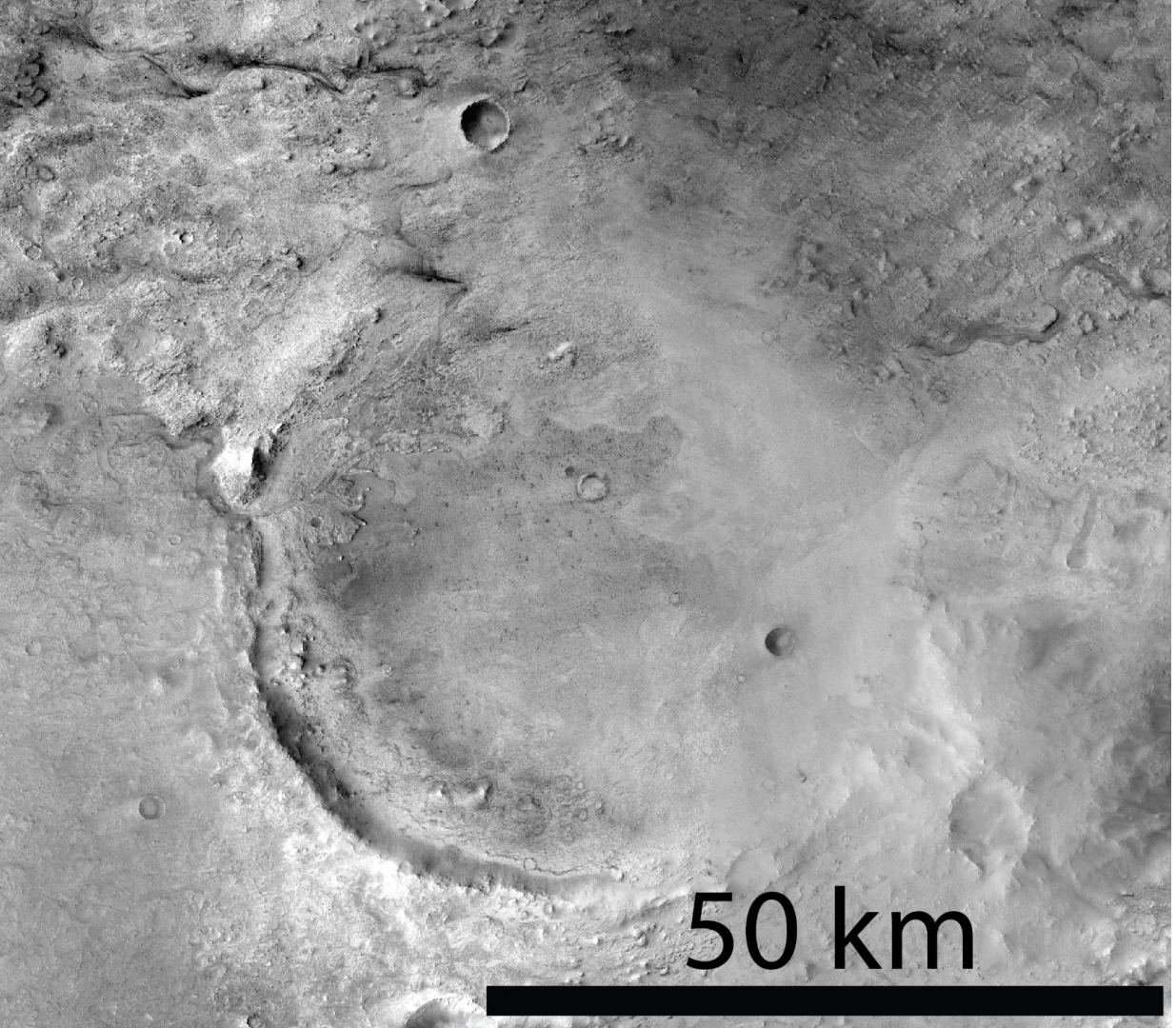


Mars ~ 3.6 billion years ago (?)

NASA Scientific Visualization Studio


NASA

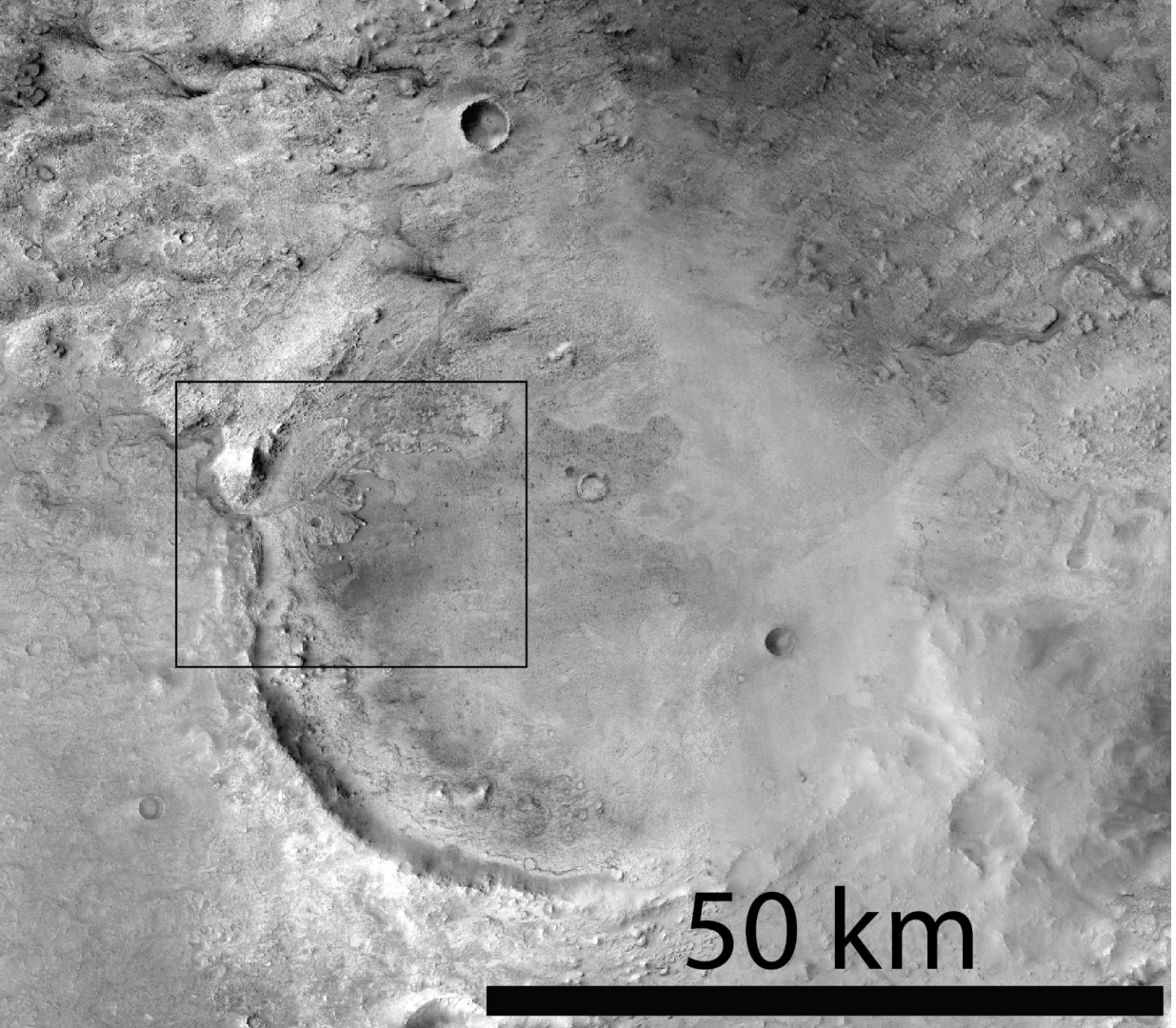

NASA



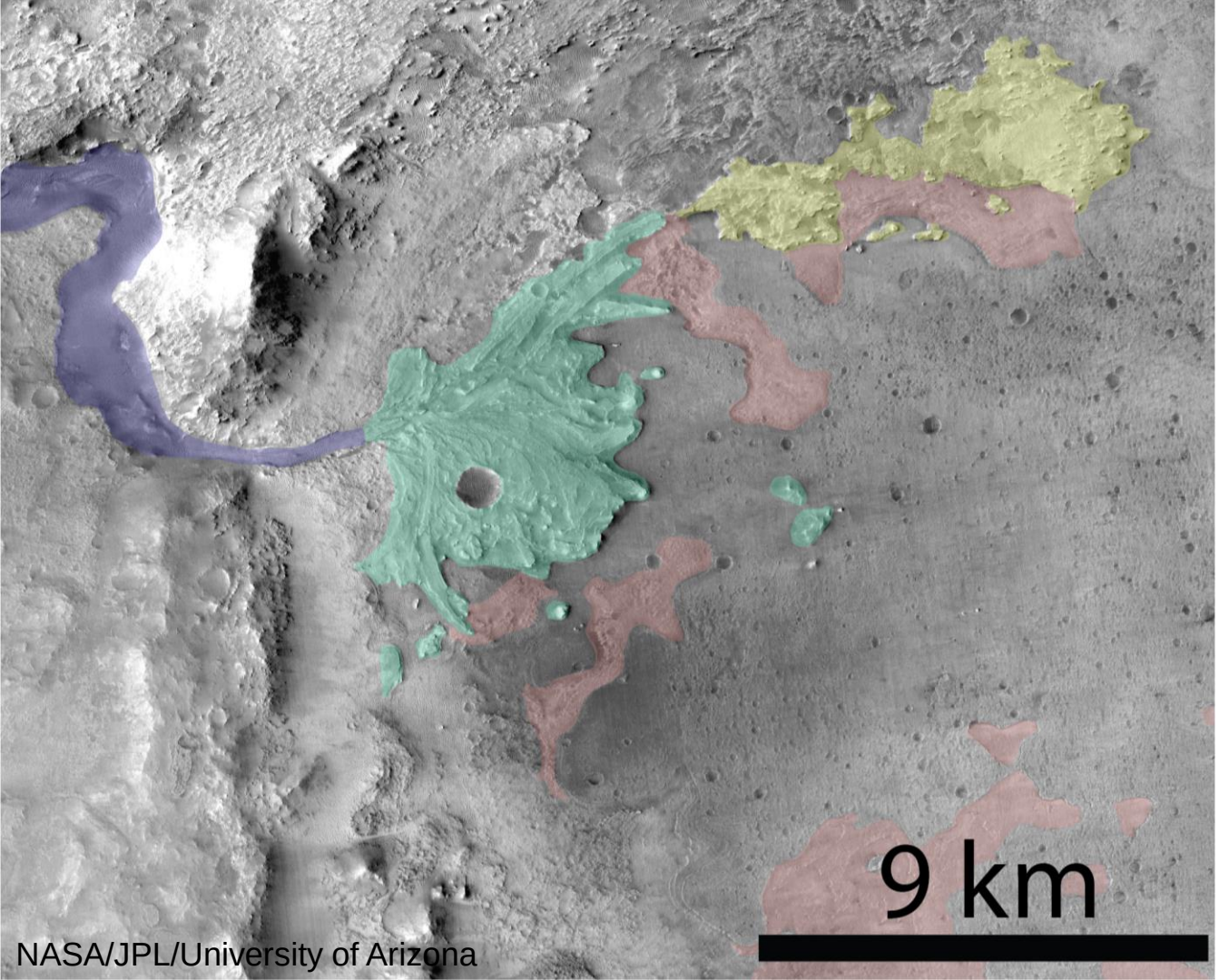
Jezero crater, a former martian lake

CTX Mosaic by The Murray Lab, Caltech
Dickson et al. (2019), 49th LPSC

Jezero crater, a former martian lake



CTX Mosaic by The Murray Lab, Caltech
Dickson et al. (2019), 49th LPSC

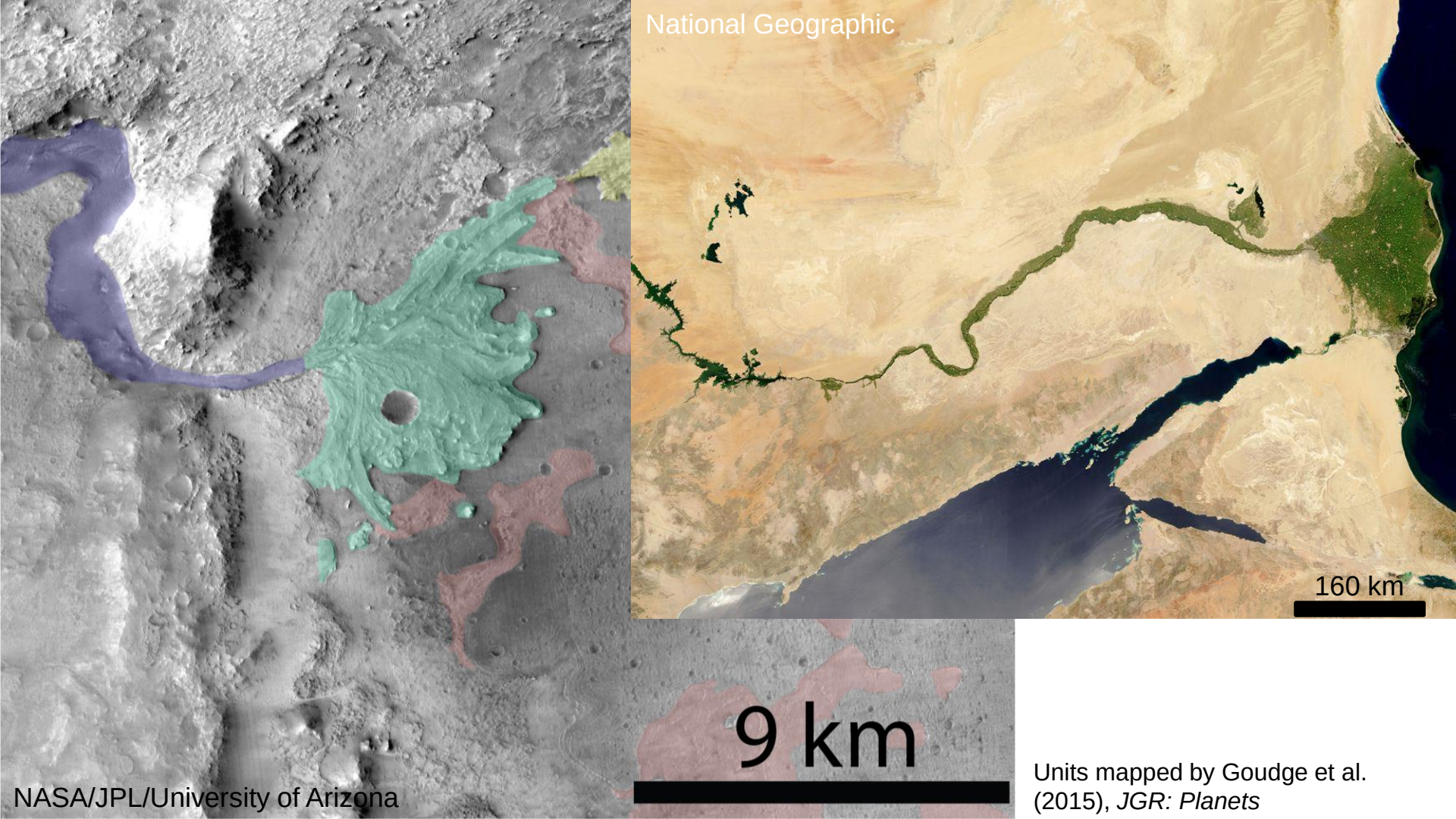


Western delta

Northern delta

NASA/JPL/University of Arizona

Units mapped by Goudge et al. (2015), *JGR: Planets*



Units mapped by Goudge et al. (2015), *JGR: Planets*


NASA/JPL

Modern Stromatolites: Shark Bay

Ancient Stromatolites: Pilbara Region, Western Australia

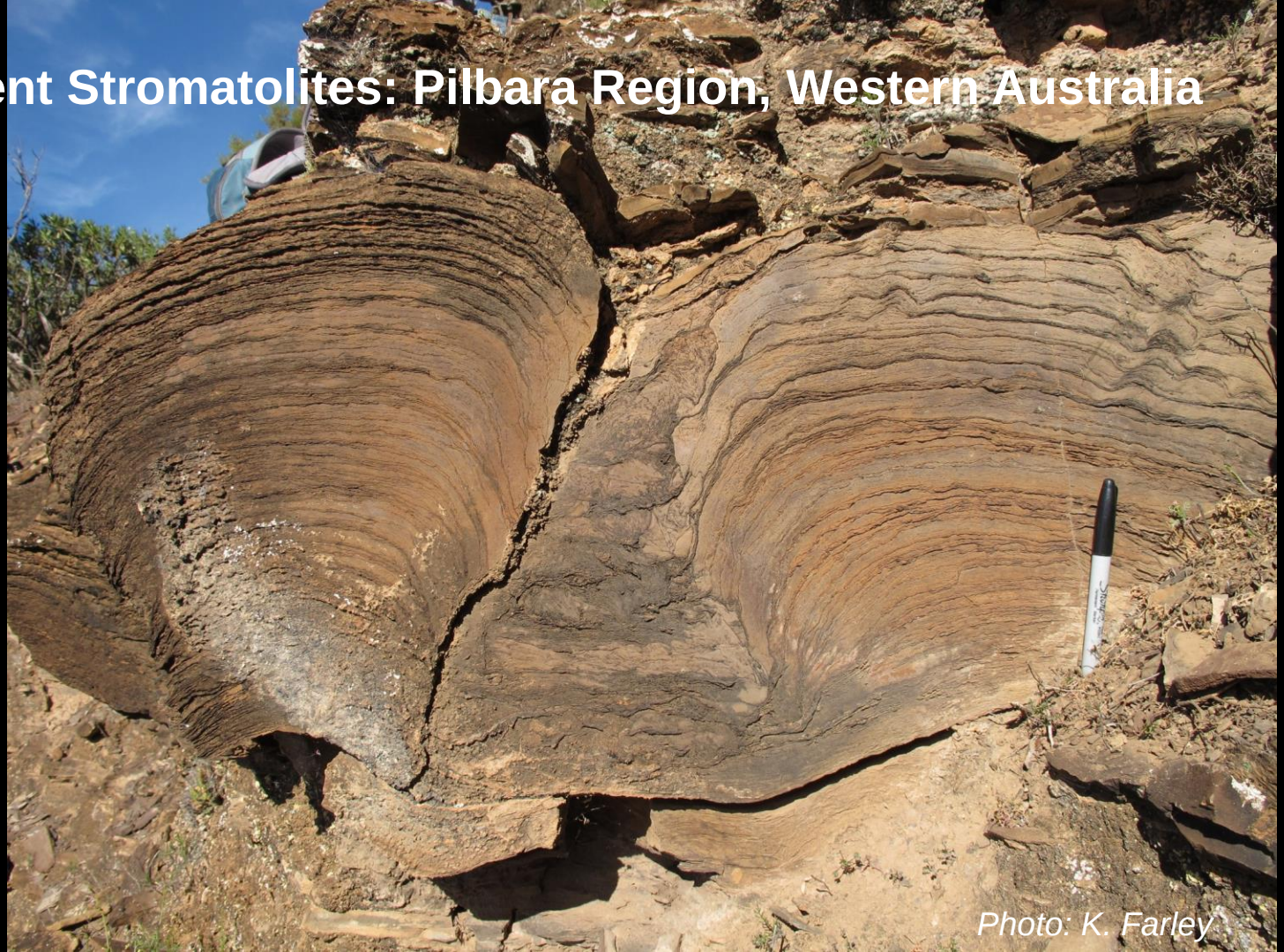
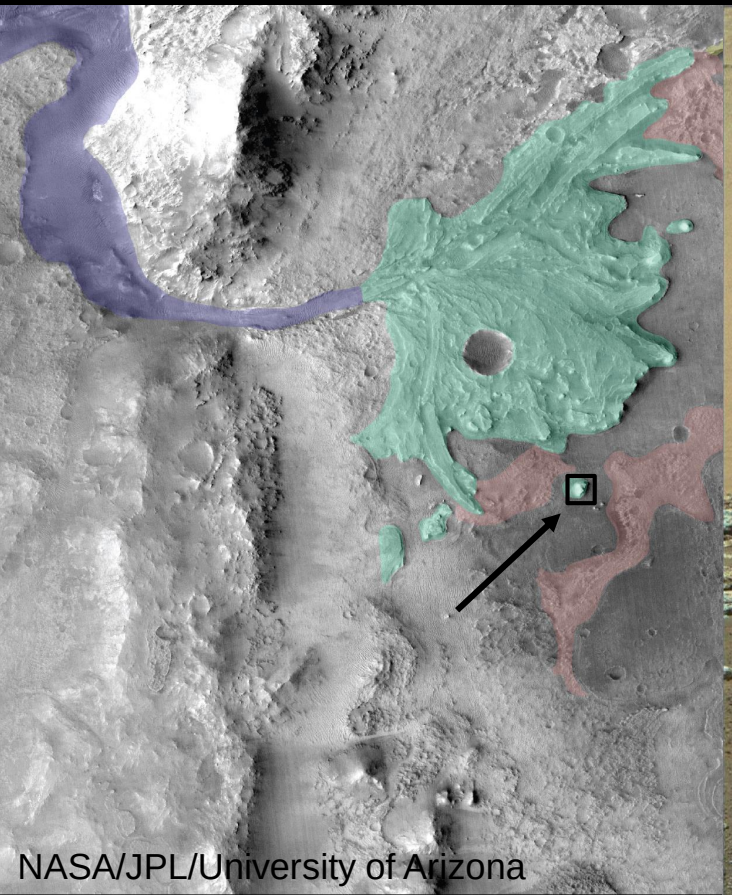


Photo: K. Farley

River Deltas Are Habitable Environments

Alaska runoff, NOAA

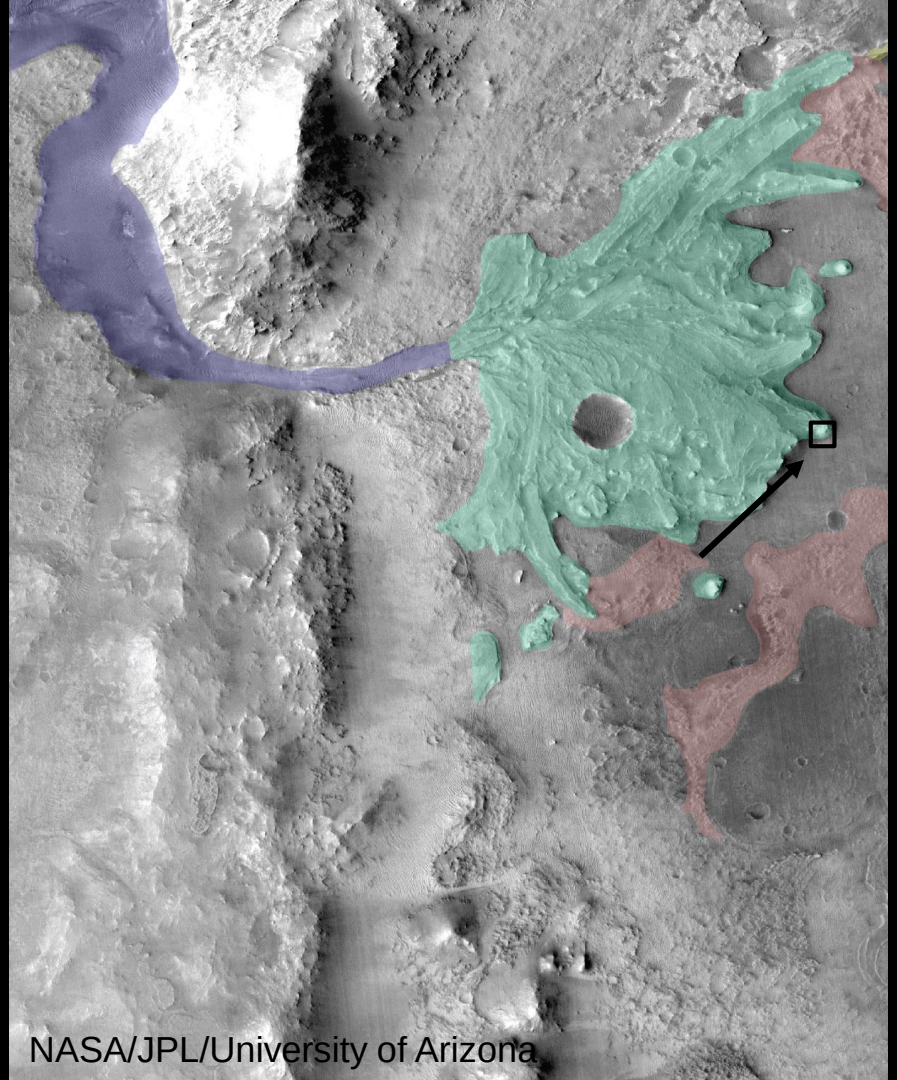
Analyzing the delta from the ground



NASA/JPL/University of Arizona

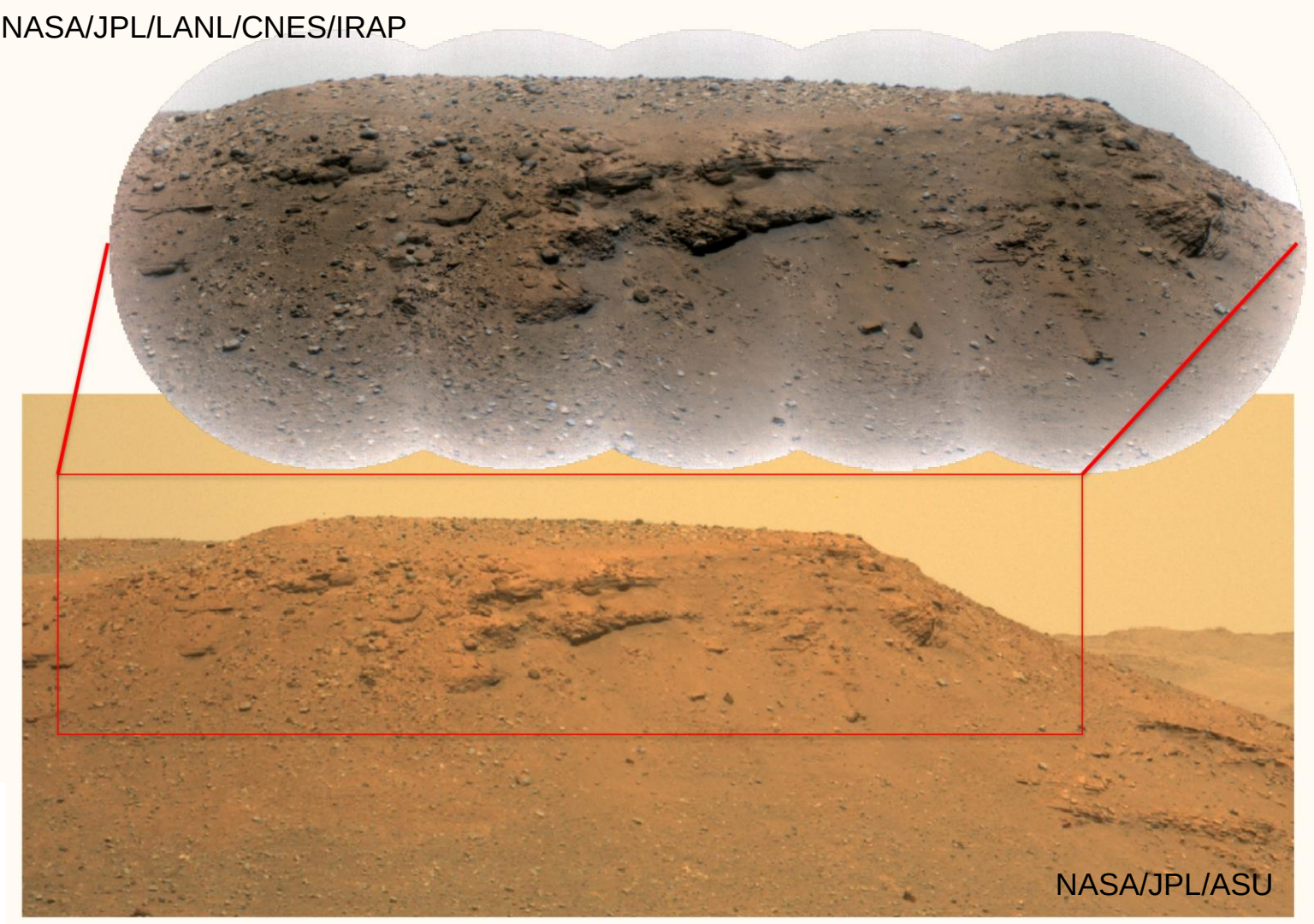
NASA/JPL/ASU

Seeing from afar



NASA/JPL/University of Arizona

Beautiful bedrock exposures



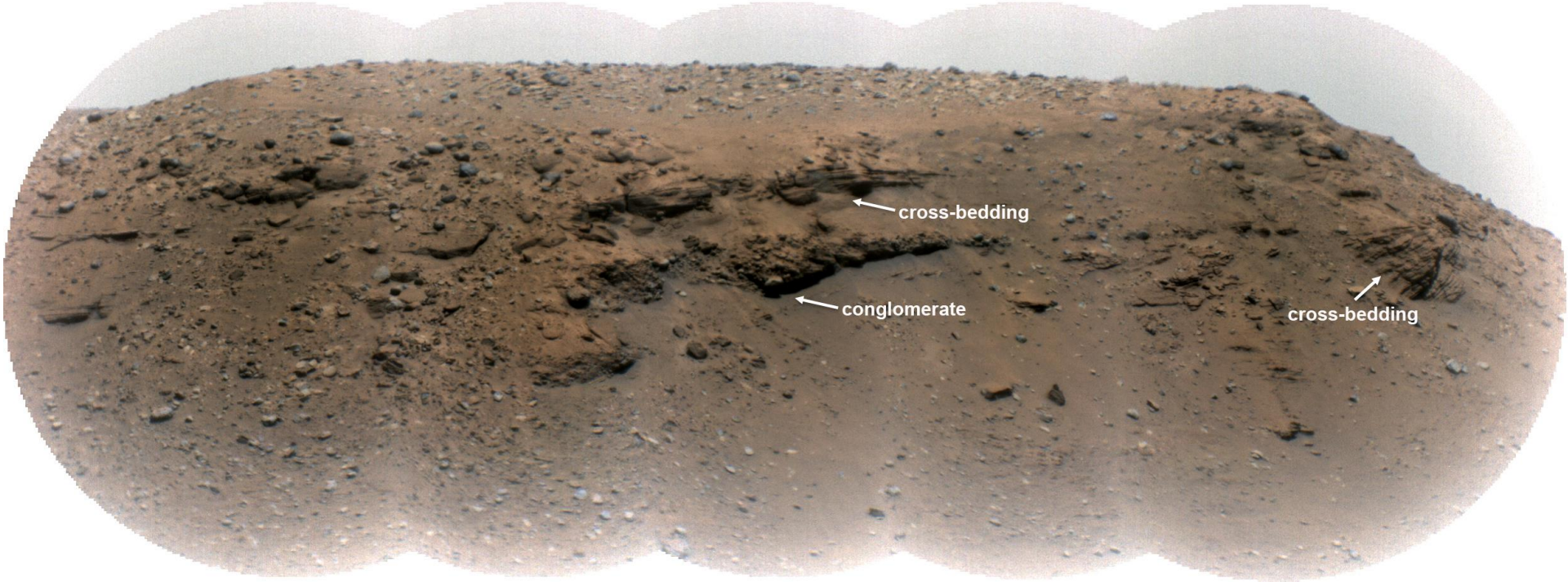
MARS 2020 PERSEVERANCE

Characterizing past environments on Mars from afar

MARS 2020 PERSEVERANCE

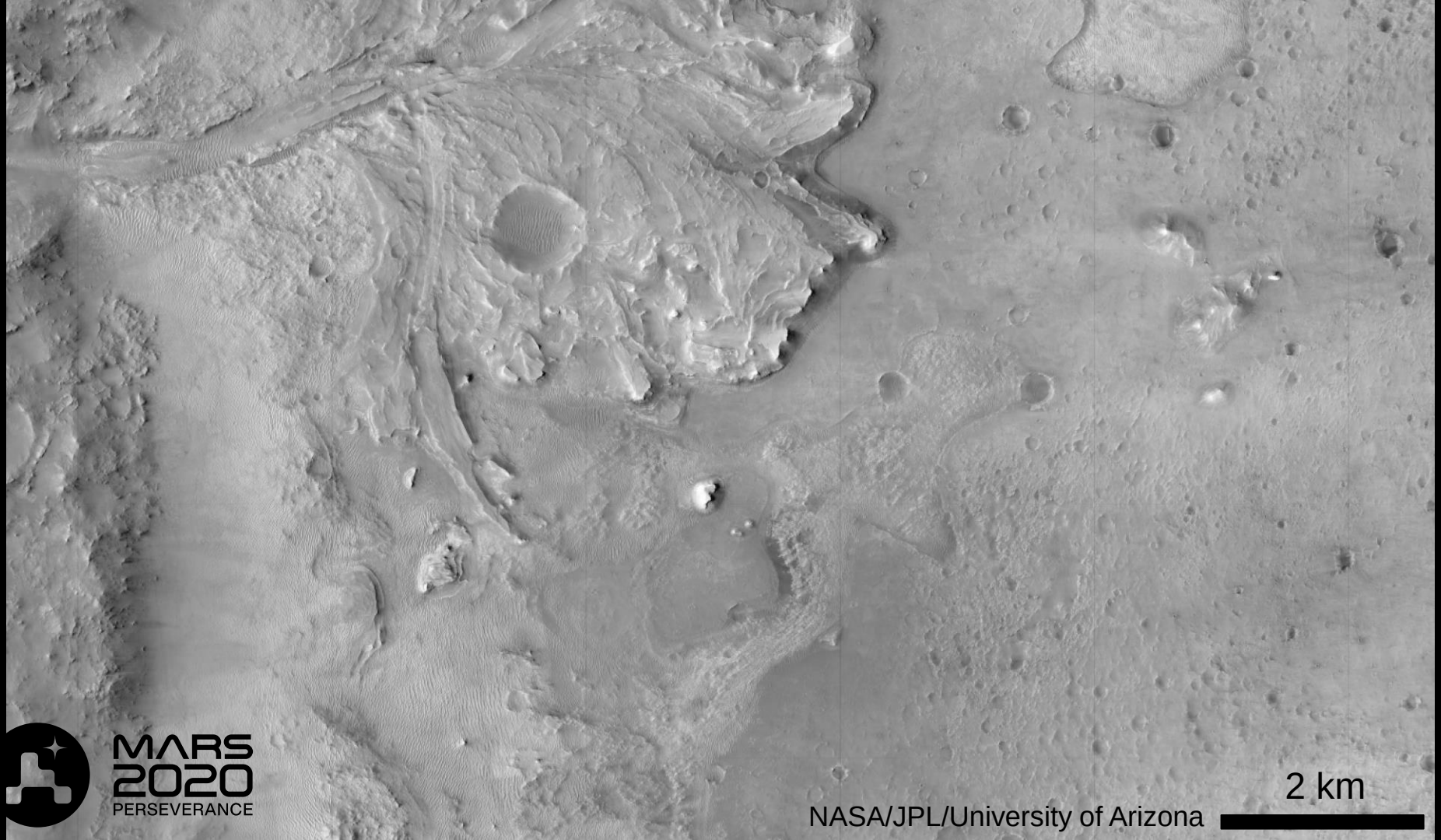
NASA/JPL/LANL/CNES/IRAP

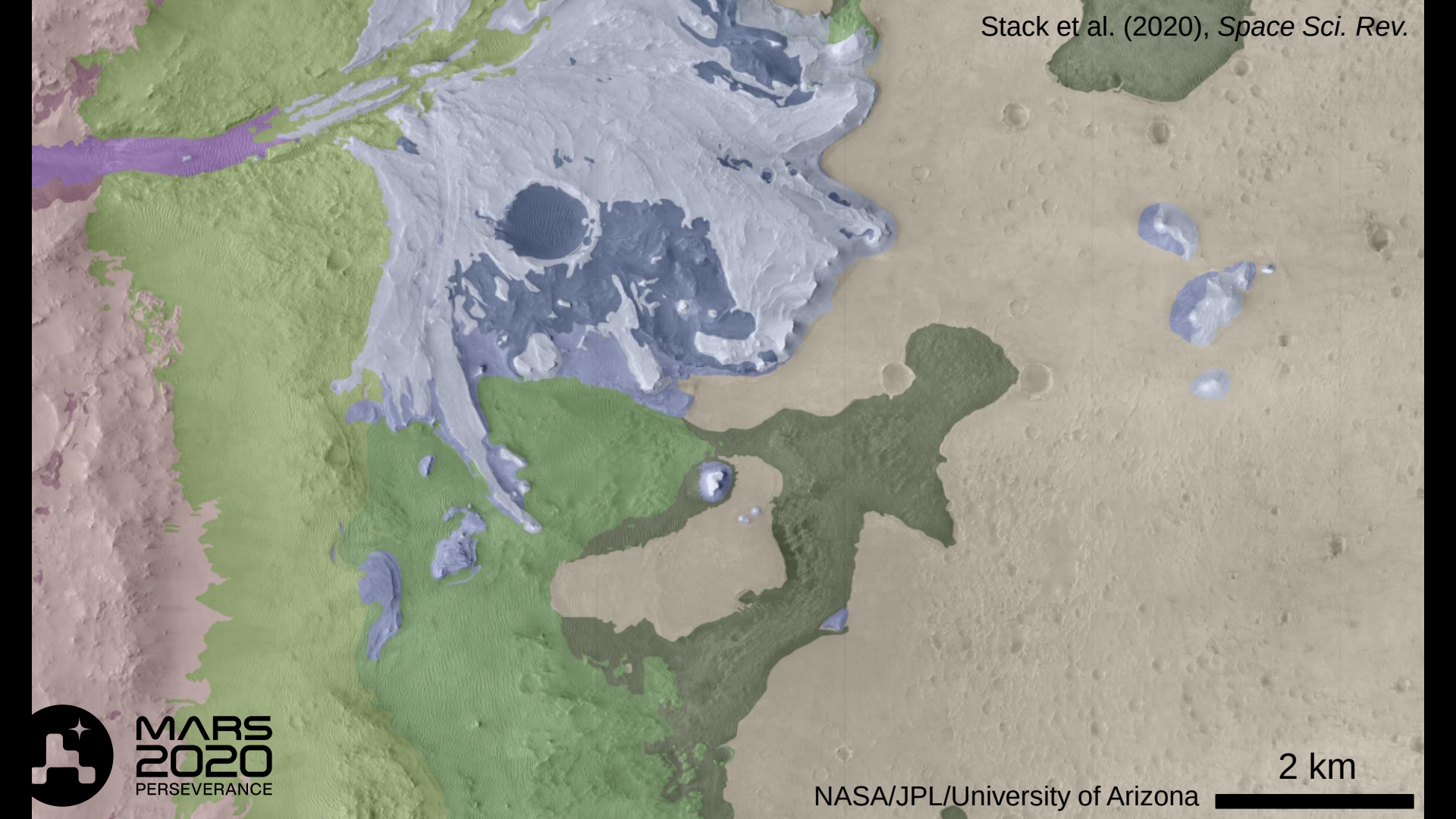
Characterizing past environments on Mars from afar



MARS 2020 PERSEVERANCE

NASA/JPL/LANL/CNES/IRAP

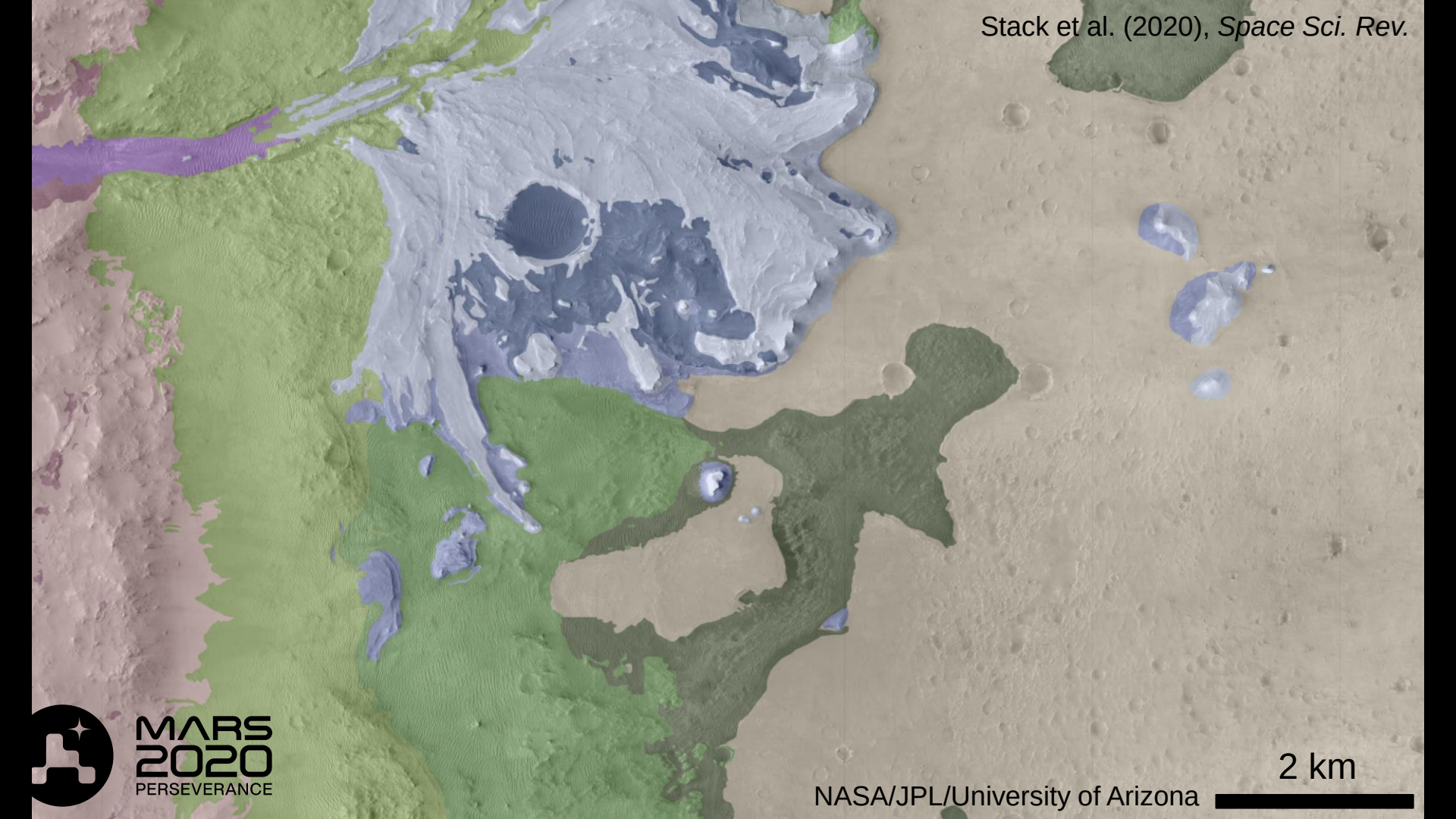

MARS
2020
PERSEVERANCE
2 km
NASA/JPL/University of Arizona


Stack et al. (2020), *Space Sci. Rev.*
MARS 2020
PERSEVERANCE
NASA/JPL/University of Arizona
2 km

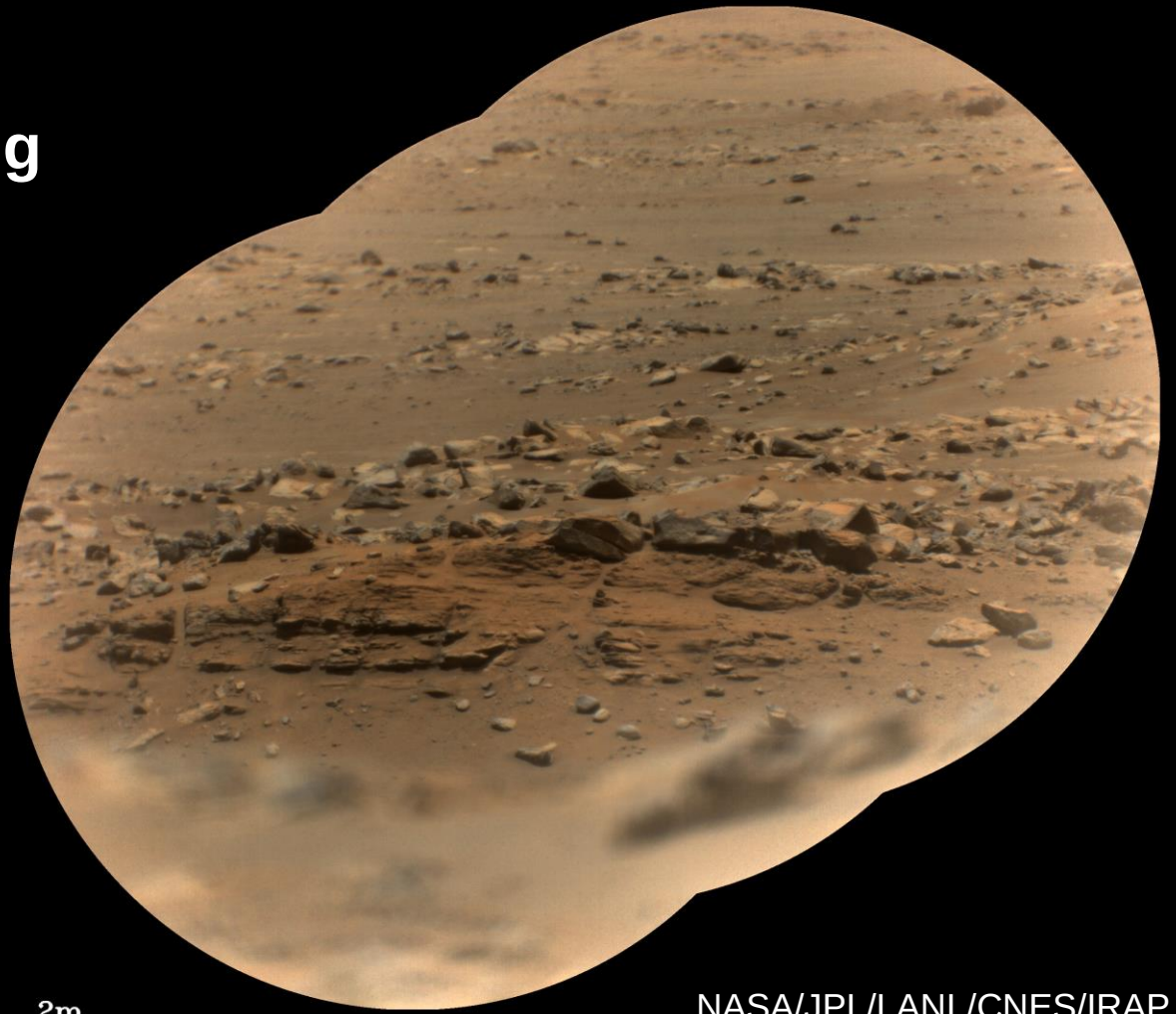
Helicopter scouting shows limited traversibility in Séítah

MARS 2020 PERSEVERANCE

NASA/JPL

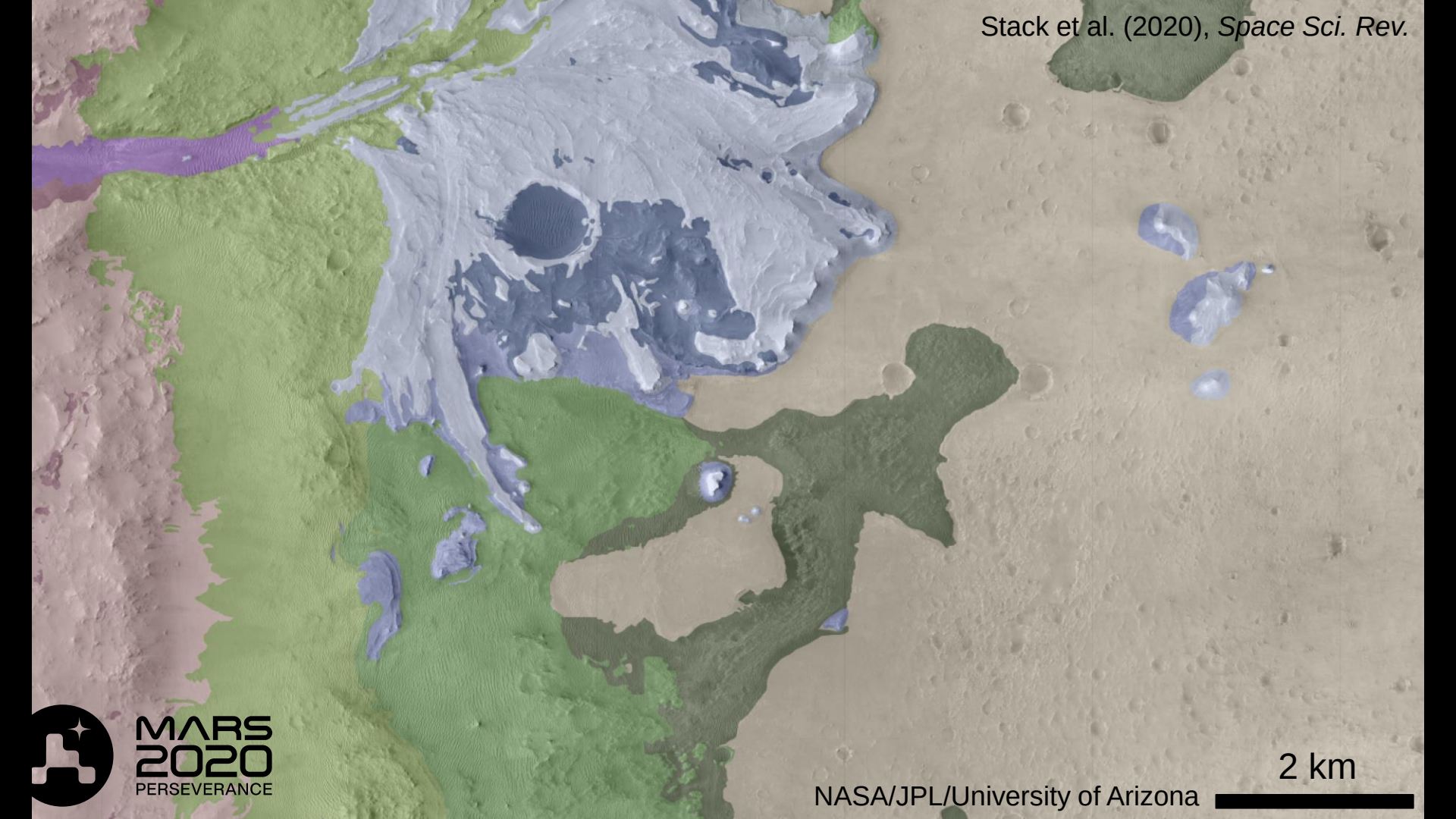

Stack et al. (2020), *Space Sci. Rev.*
MARS 2020
PERSEVERANCE
NASA/JPL/University of Arizona
2 km

Séítah shows geologically intruiging layered rocks

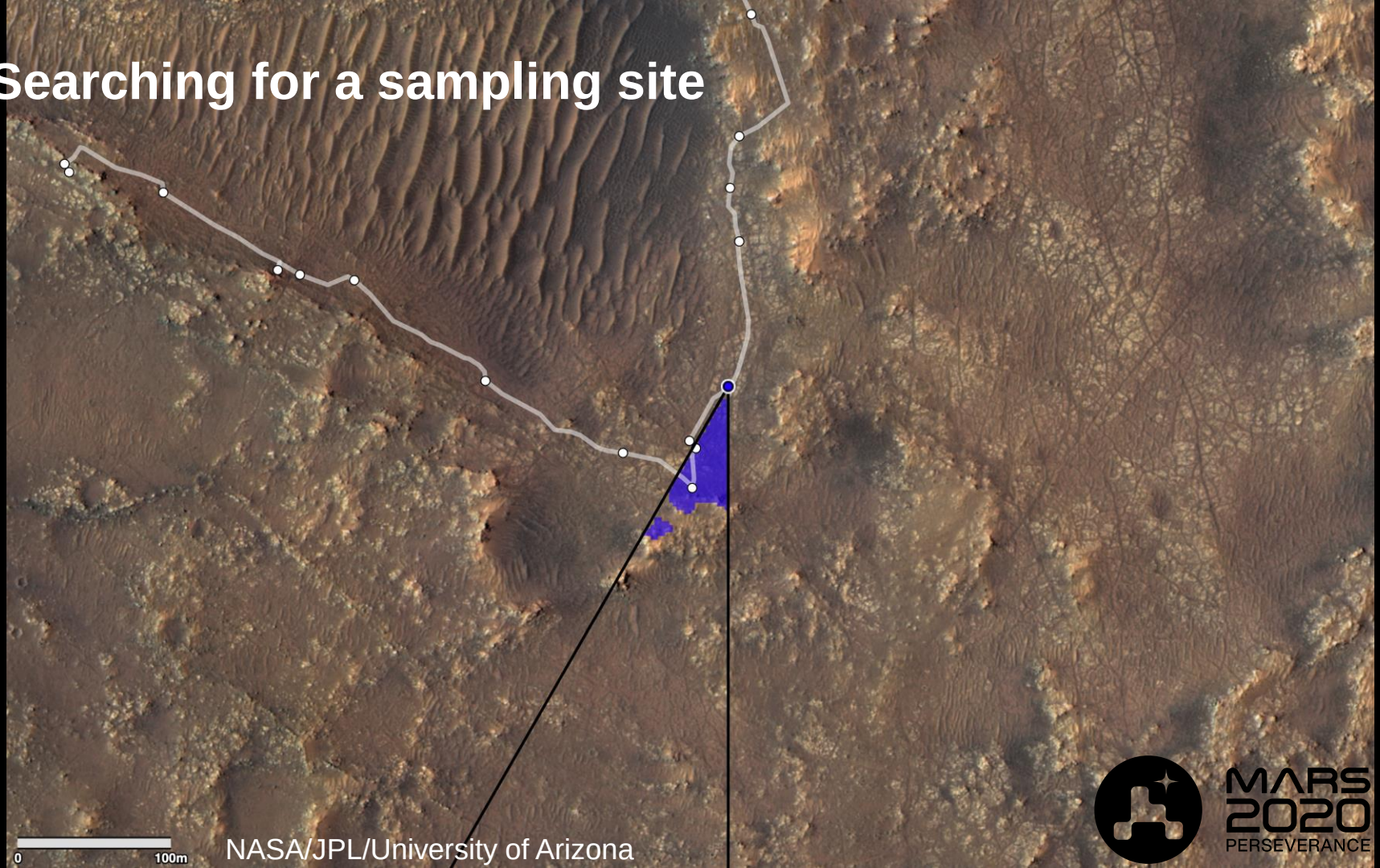


MARS 2020 PERSEVERANCE

NASA/JPL/LANL/CNES/IRAP


Stack et al. (2020), *Space Sci. Rev.*
MARS 2020
PERSEVERANCE
NASA/JPL/University of Arizona
2 km

Searching for a sampling site



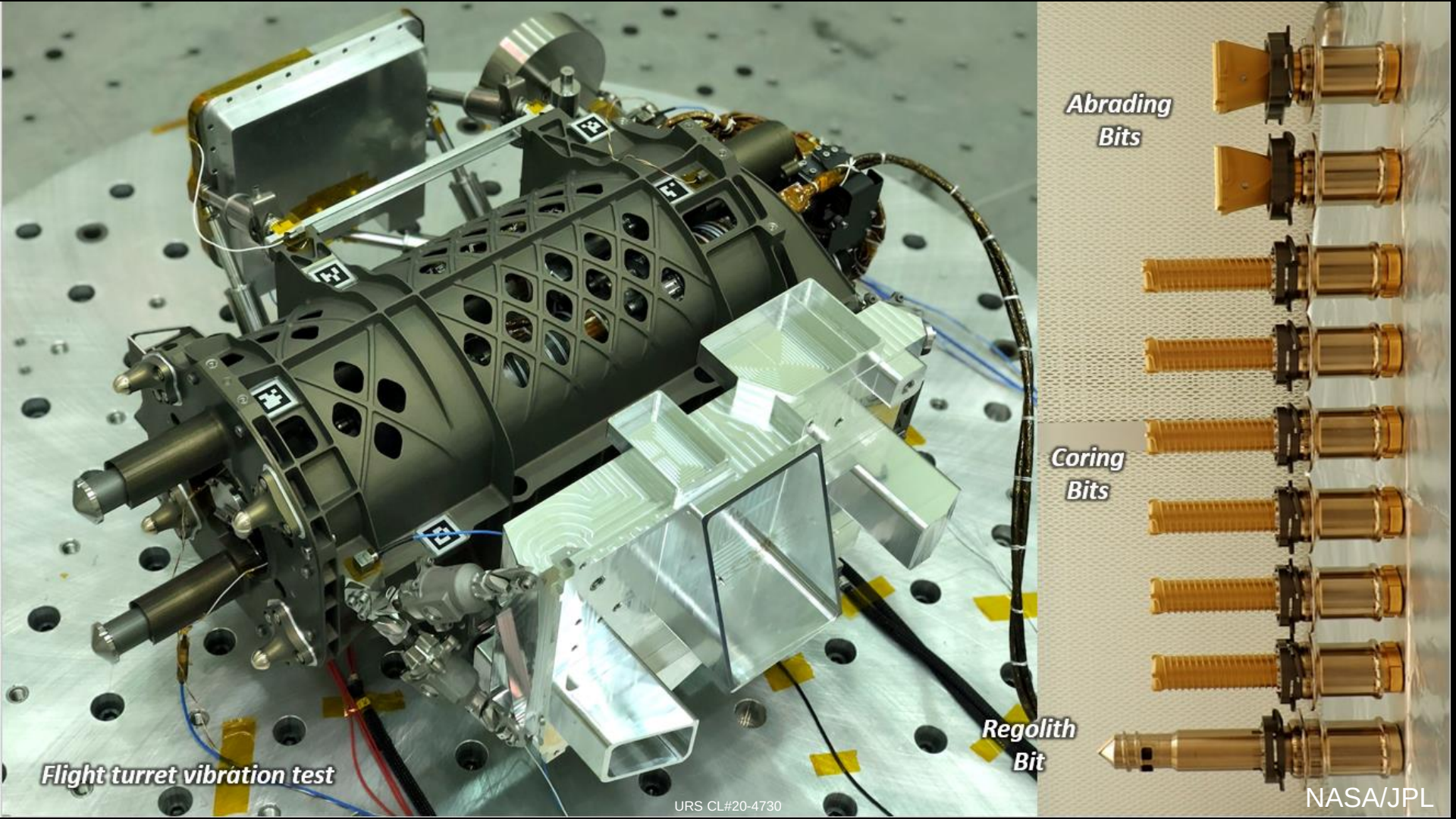
Searching for a sampling site

MARS 2020 PERSEVERANCE

NASA/JPL/ASU

Searching for a sampling site

NASA/JPL/ASU

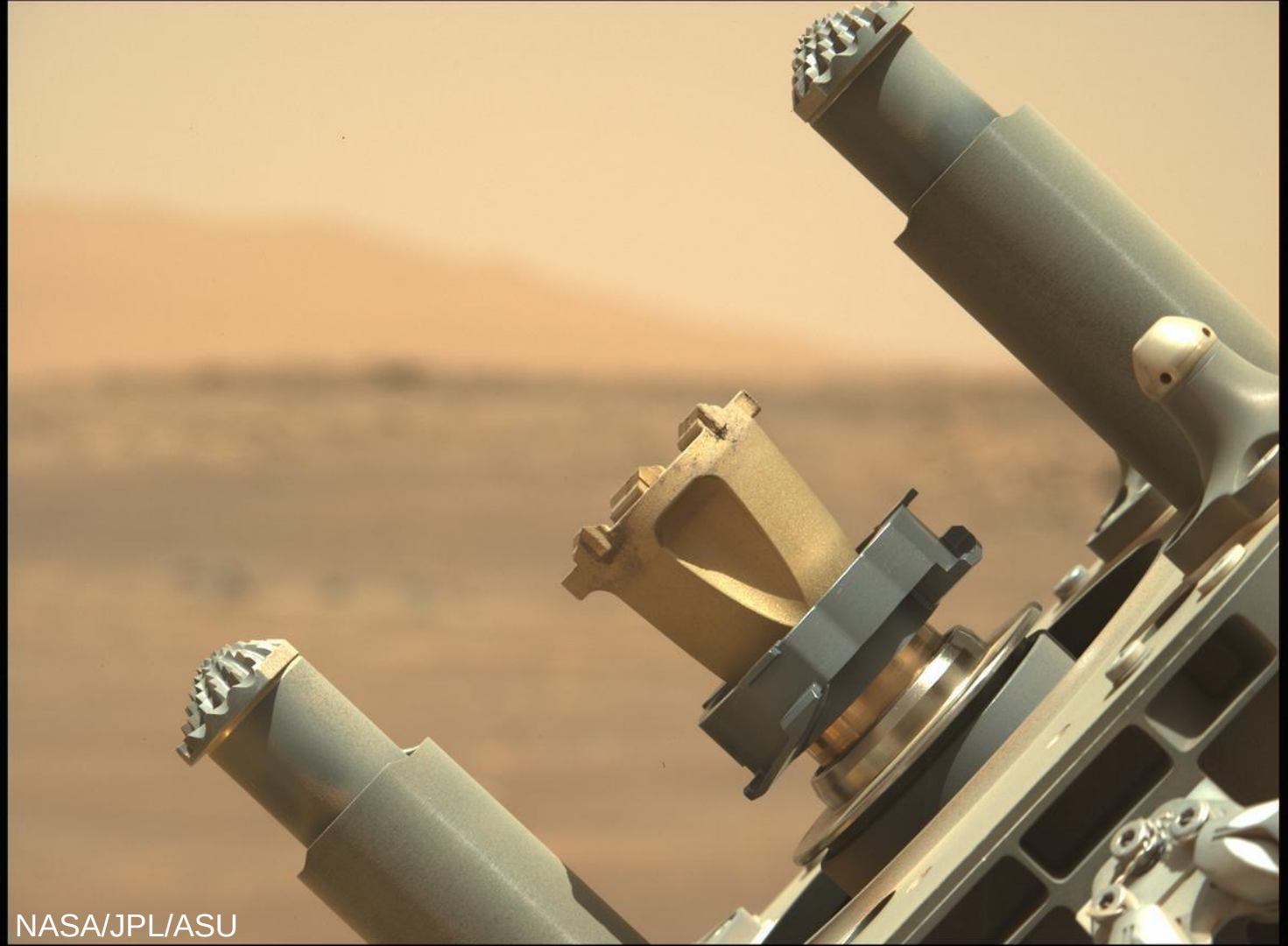

Abrading Bits
Coring Bits
Regolith Bit
Flight turret vibration test
URS CL#20-4730
NASA/JPL

Arm mobility tests at Octavia E. Butler Landing Site

MARS 2020 PERSEVERANCE

NASA/JPL/ASU

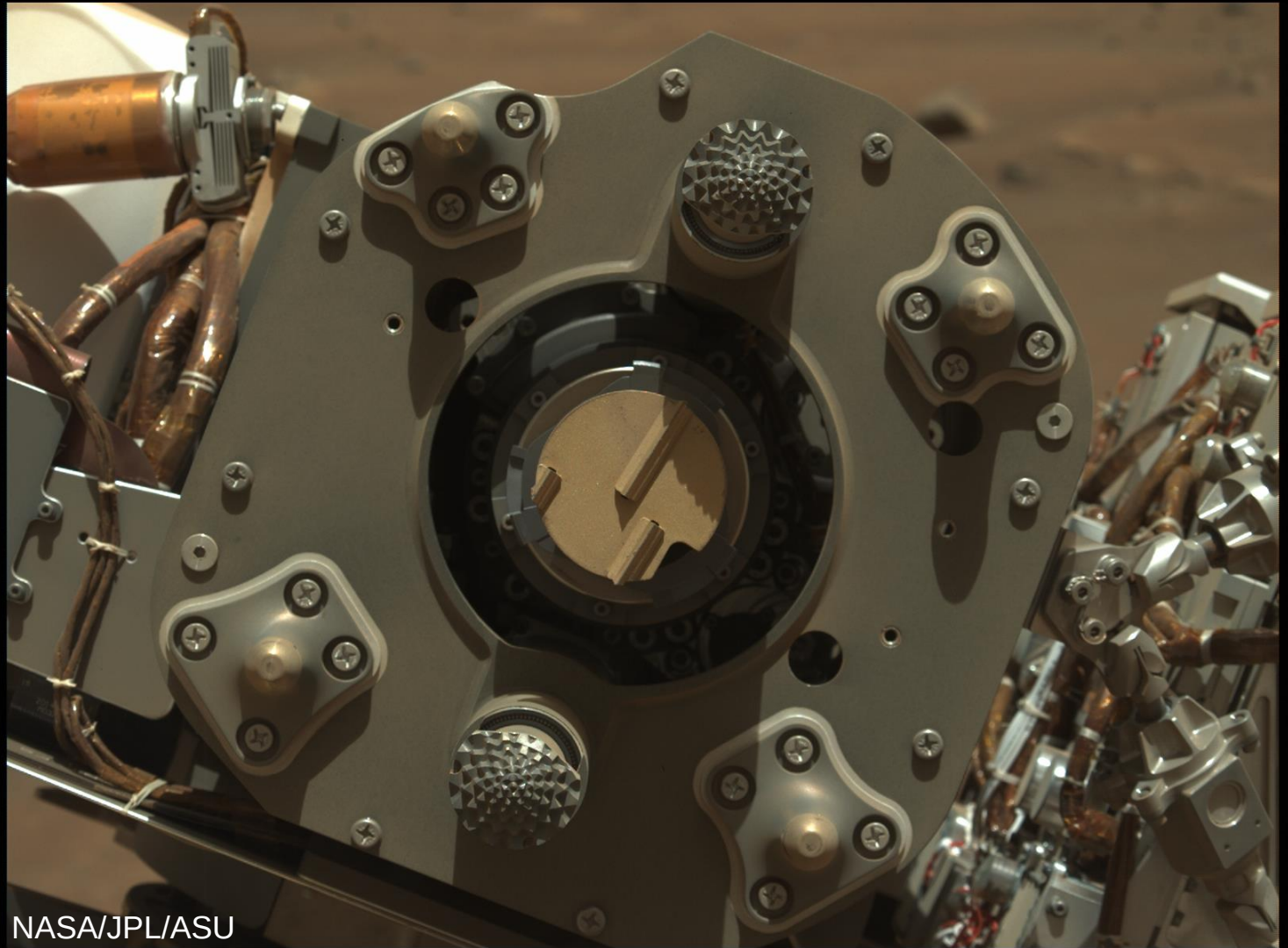
Abrading bit



NASA/JPL/ASU

MARS 2020 PERSEVERANCE

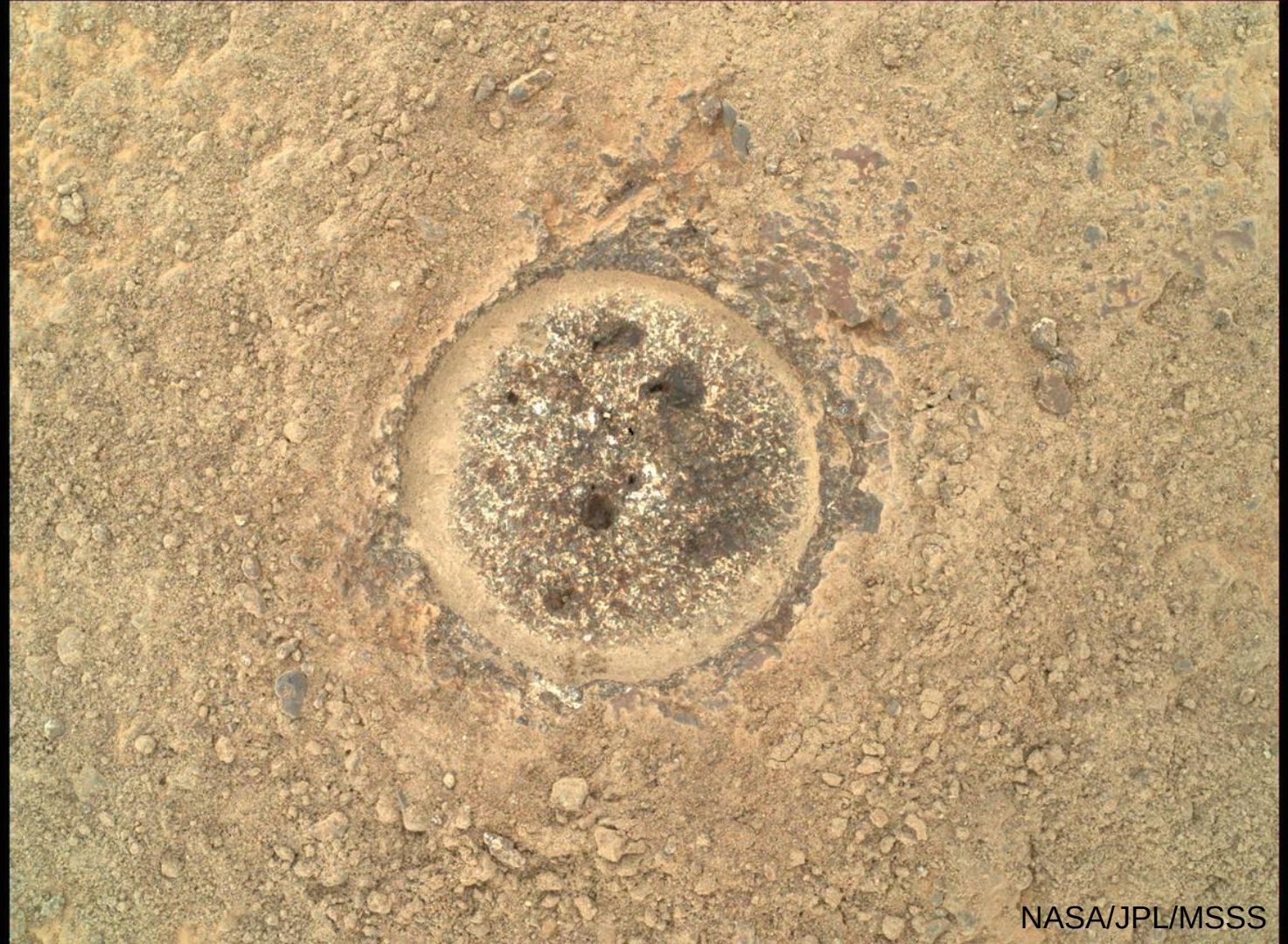
Abrading bit



NASA/JPL/ASU

MARS 2020 PERSEVERANCE

Abraded rock patch



MARS 2020 PERSEVERANCE

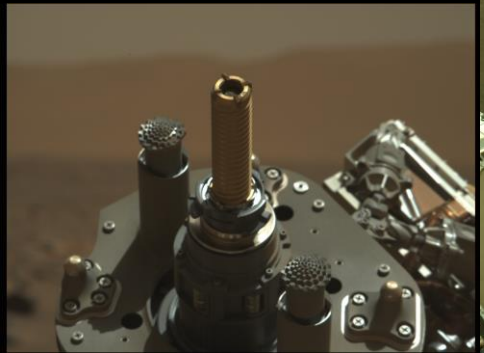
NASA/JPL/MSSS

Getting an up-close look using X-ray Fluorescence (PIXL) and Raman Spectroscopy (SHERLOC)

NASA/JPL

MARS 2020 PERSEVERANCE

Drilling bit



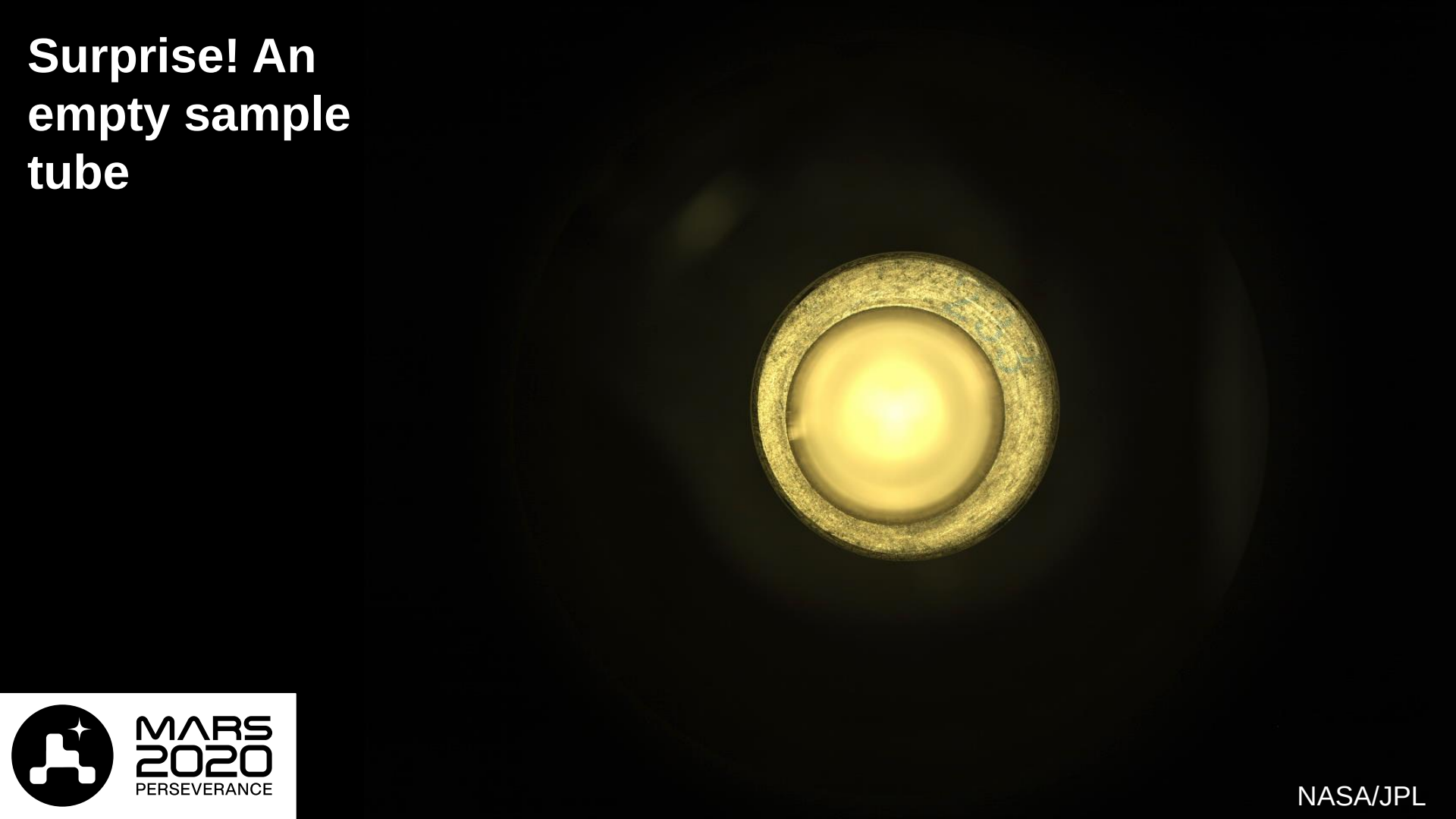
NASA/JPL/ASU

Abraded patch next to borehole

NASA/JPL/ASU

MARS 2020 PERSEVERANCE

Surprise! An empty sample tube



MARS 2020 PERSEVERANCE

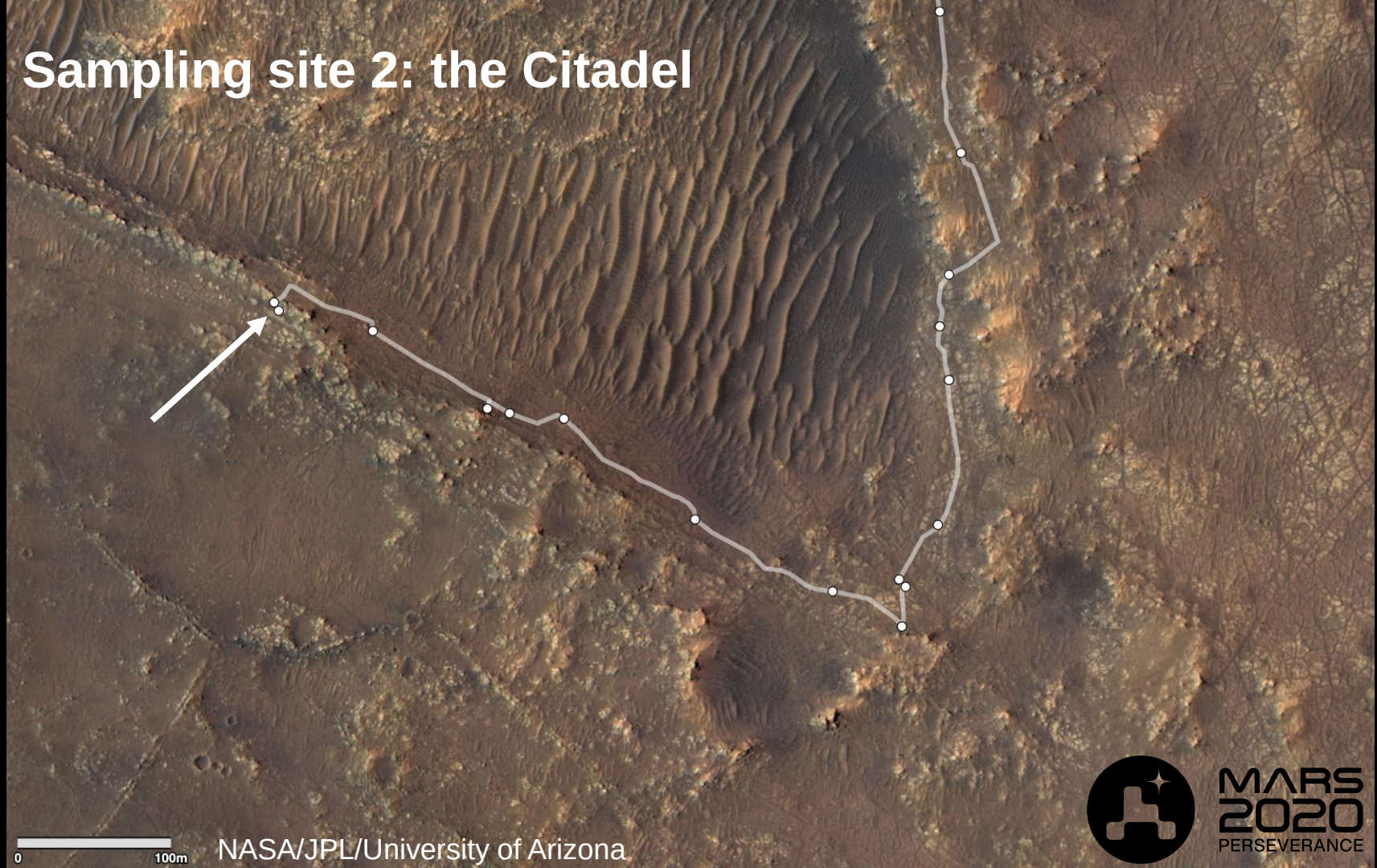
NASA/JPL

Disintegrated remains of the rock core

MARS 2020 PERSEVERANCE

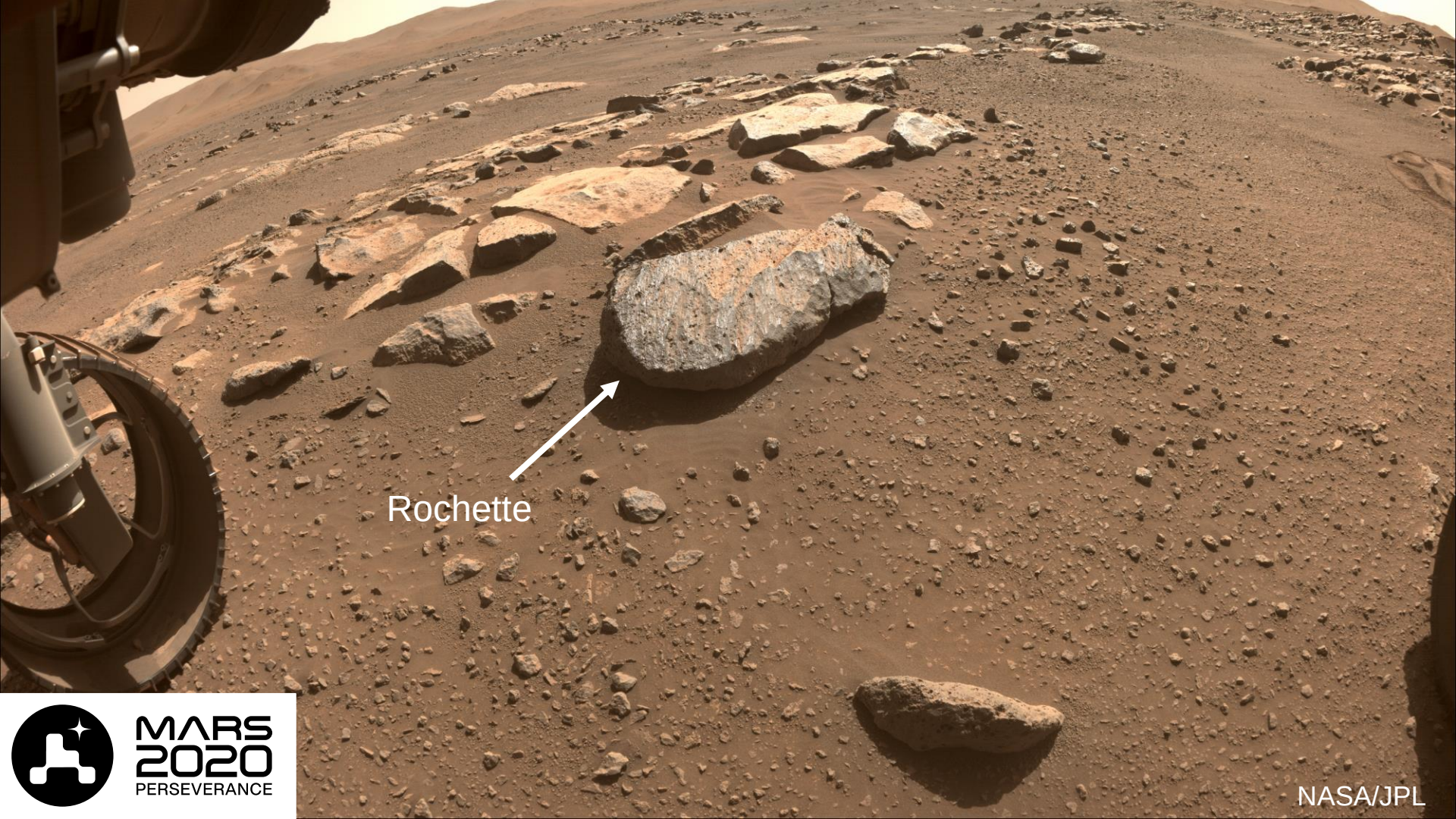
NASA/JPL/MSSS

Sampling site 2: the Citadel



NASA/JPL/University of Arizona

MARS 2020 PERSEVERANCE


Rochette
MARS
2020
PERSEVERANCE
NASA/JPL

Abraded rock patch: round 2

MARS 2020 PERSEVERANCE

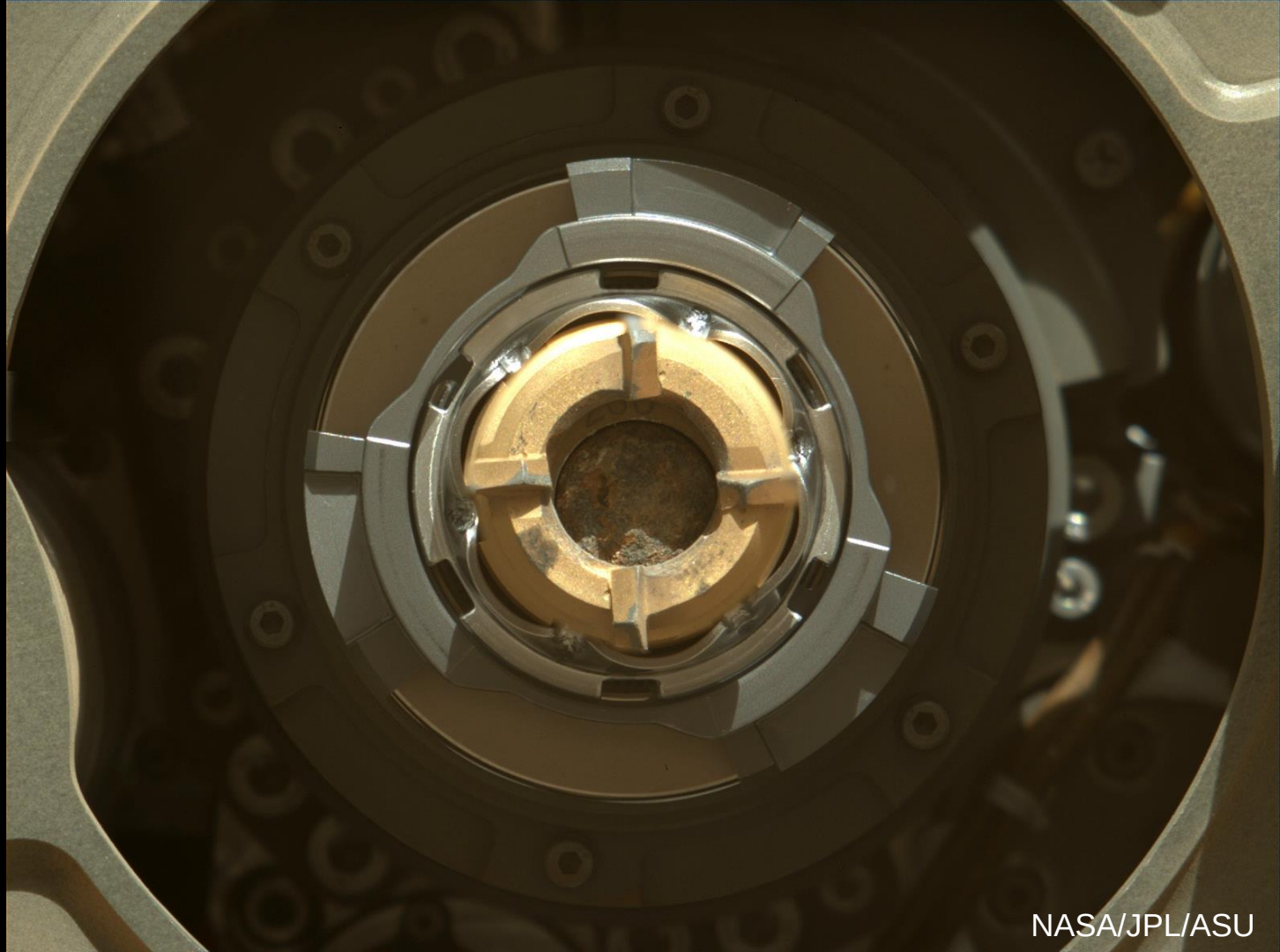
NASA/JPL/MSSS

Abraded patch (covered by tailings) and borehole

MARS 2020 PERSEVERANCE

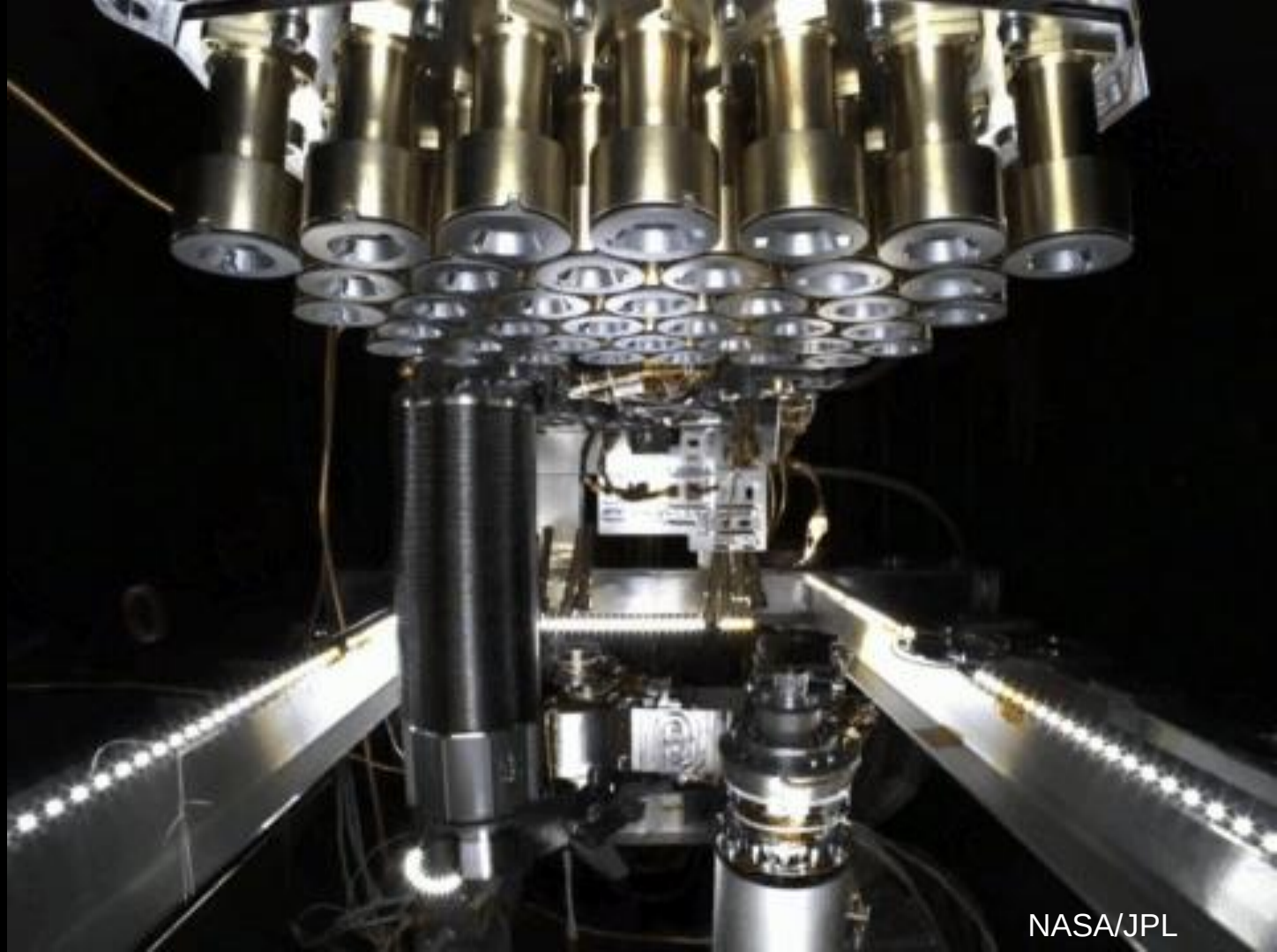
NASA/JPL/ASU

Success! A rock core in the sample tube!



NASA/JPL/ASU

MARS 2020 PERSEVERANCE

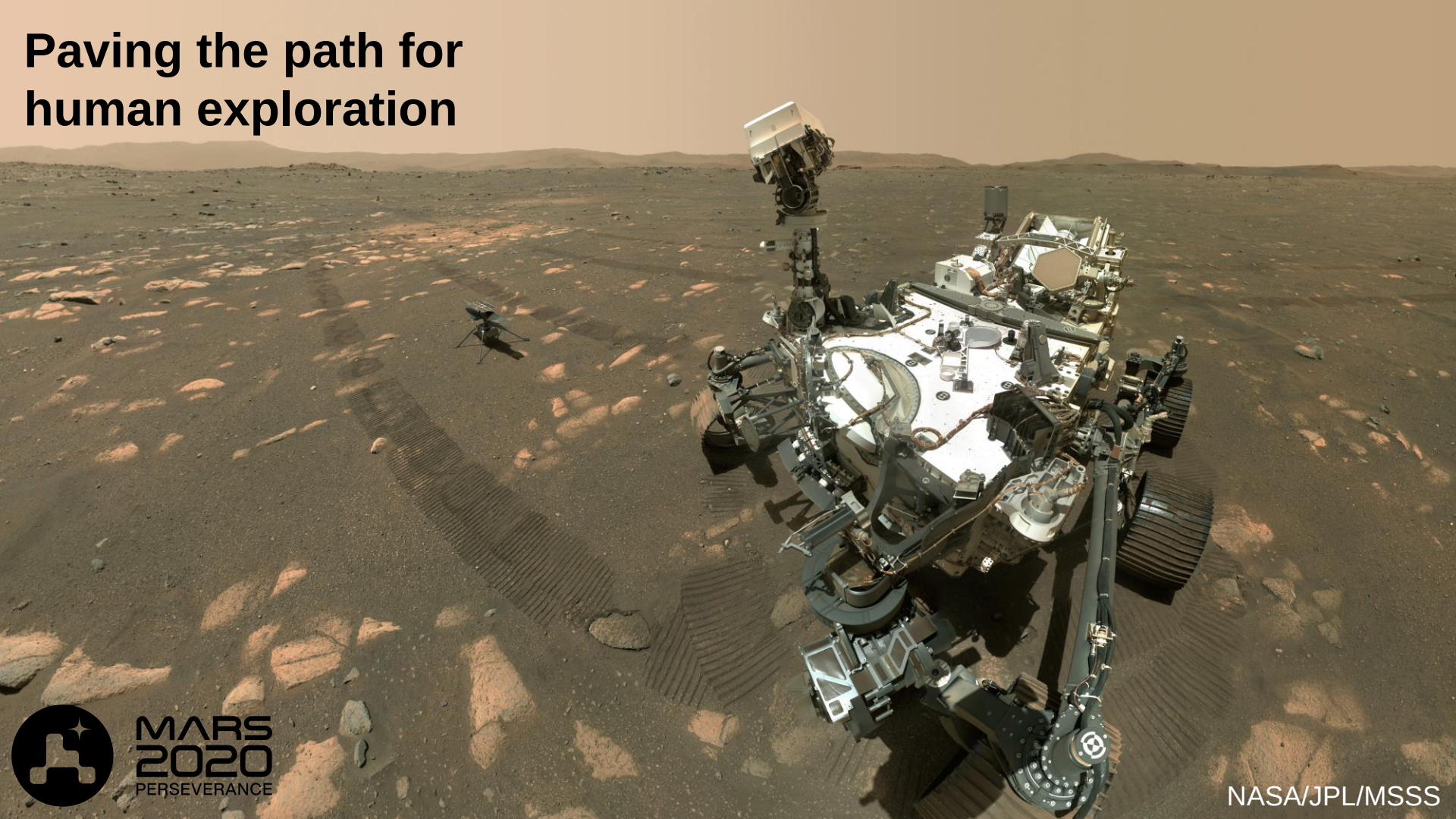


Flight sample tube handling during TVAC testing

MARS 2020 PERSEVERANCE

NASA/JPL

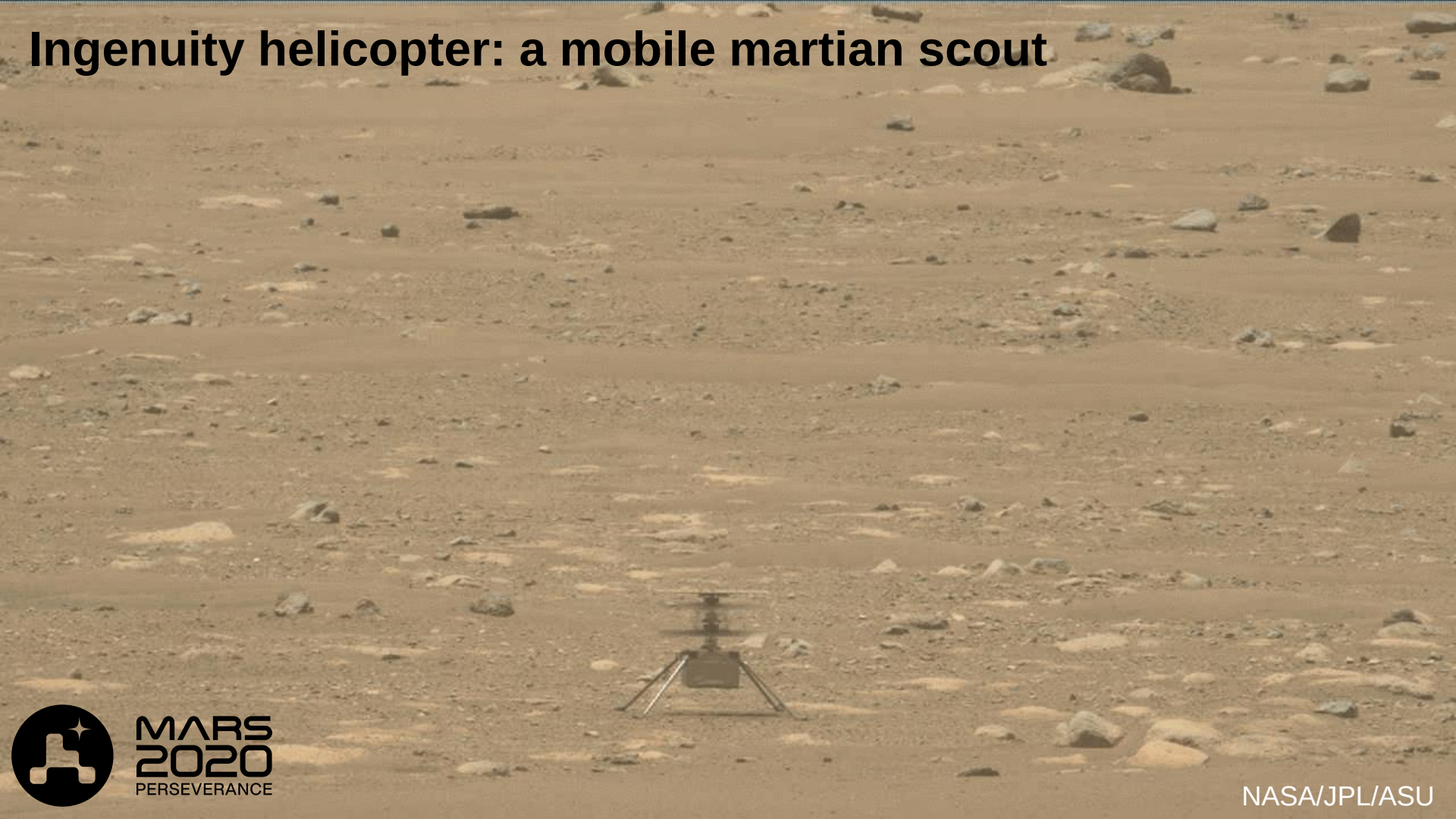
Paving the path for human exploration



MARS 2020 PERSEVERANCE

NASA/JPL/MSSS

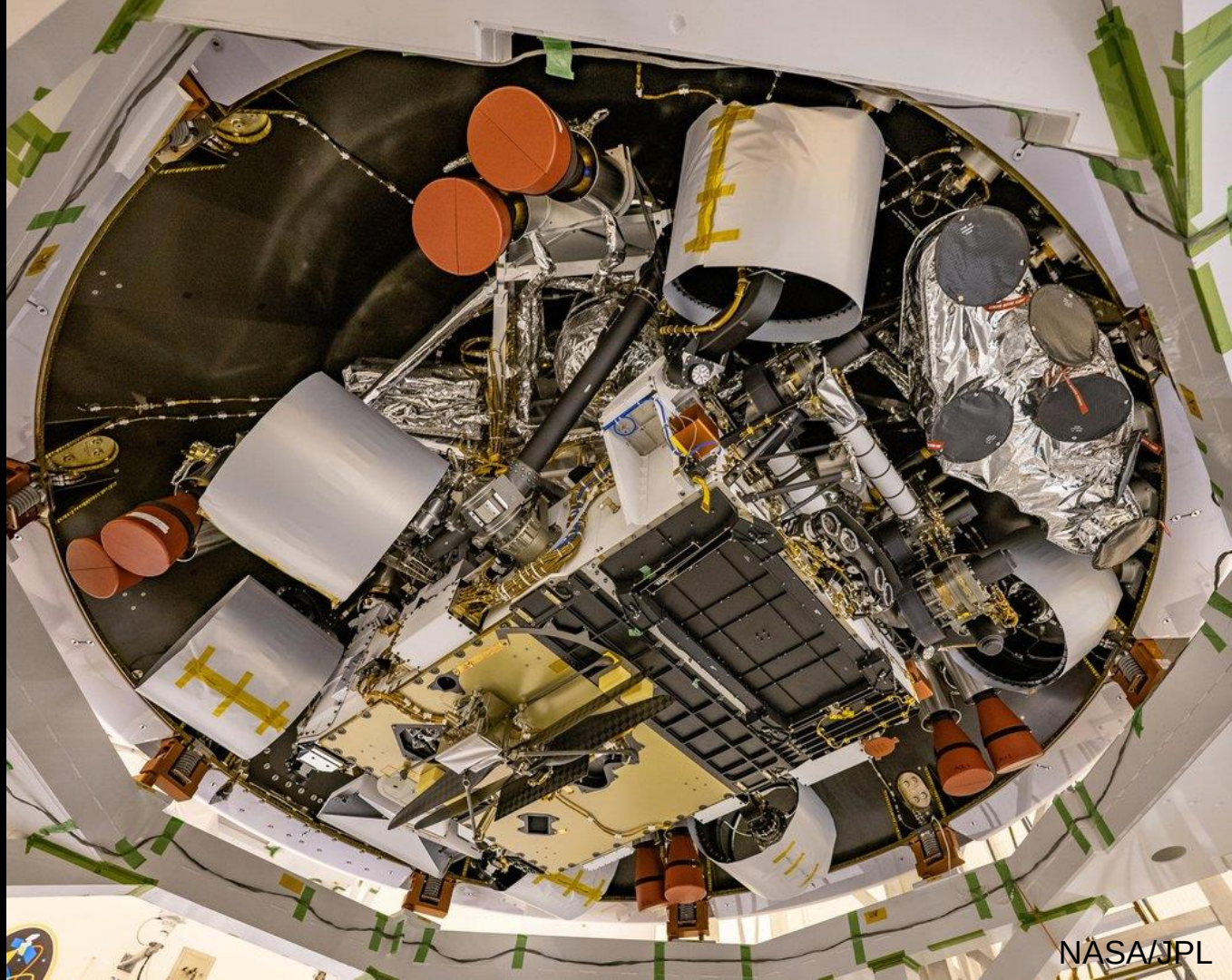
Ingenuity helicopter: a mobile martian scout



MARS 2020 PERSEVERANCE

NASA/JPL/ASU

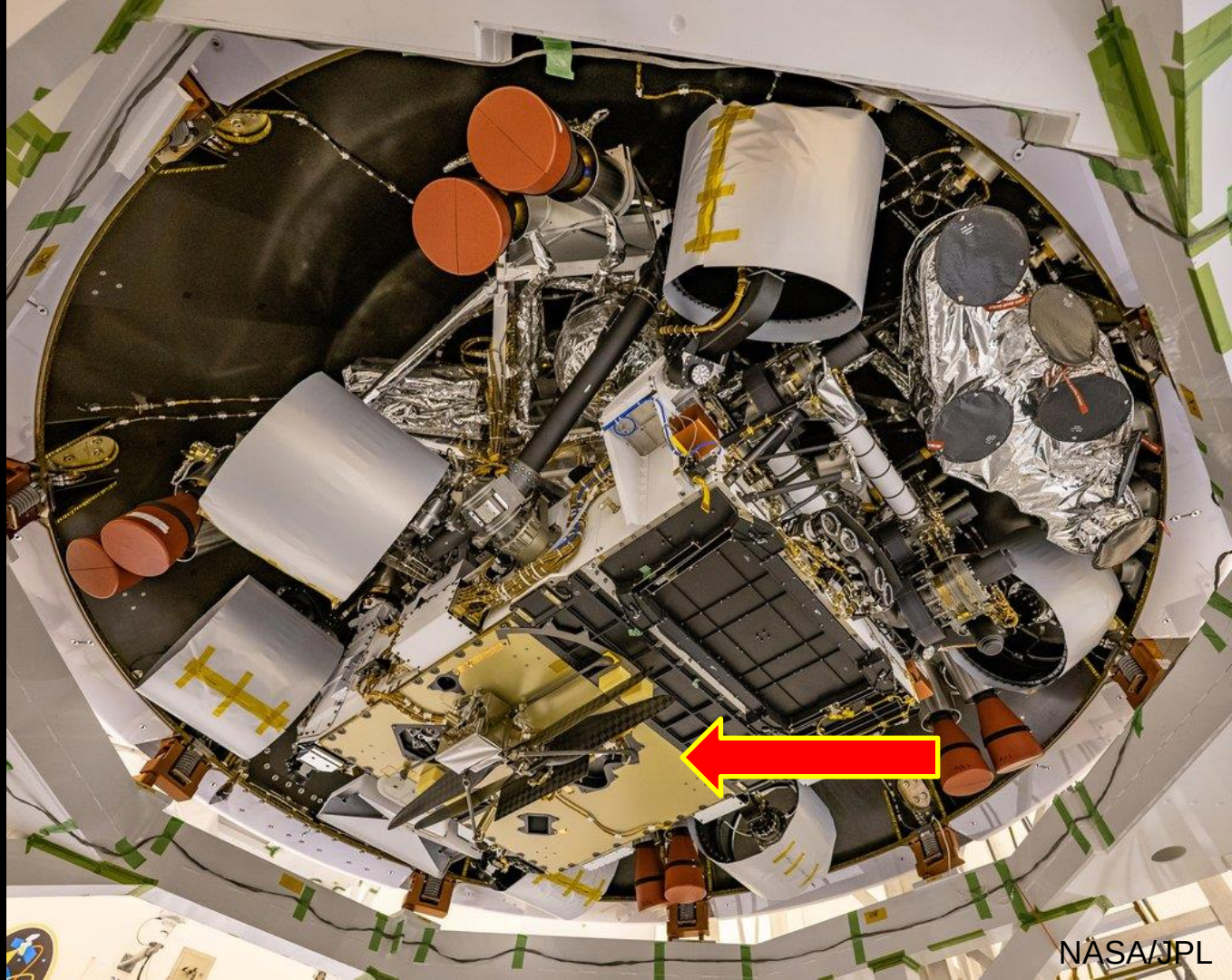
Ingenuity's location on the ride to Mars



MARS 2020 PERSEVERANCE

NASA/JPL

Ingenuity's location on the ride to Mars



MARS 2020 PERSEVERANCE

NASA/JPL

Swinging down to the surface

MARS 2020 PERSEVERANCE

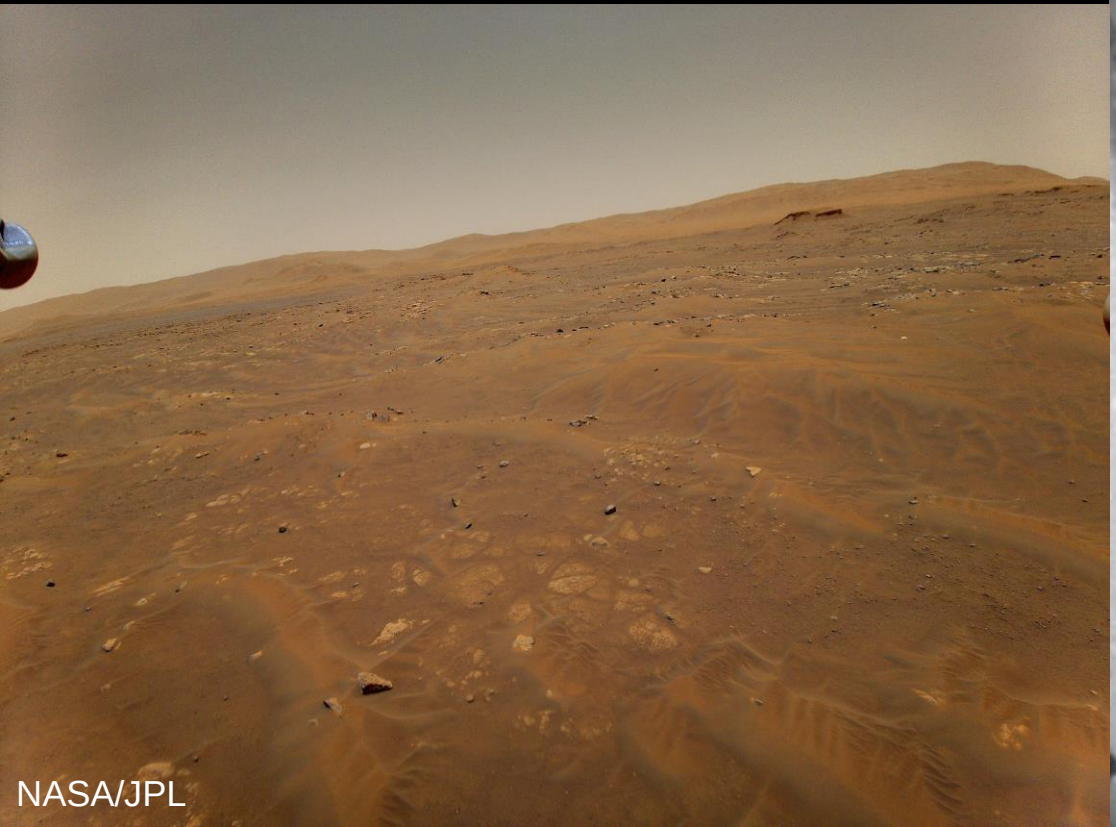
SOL 35

Rotor blade testing

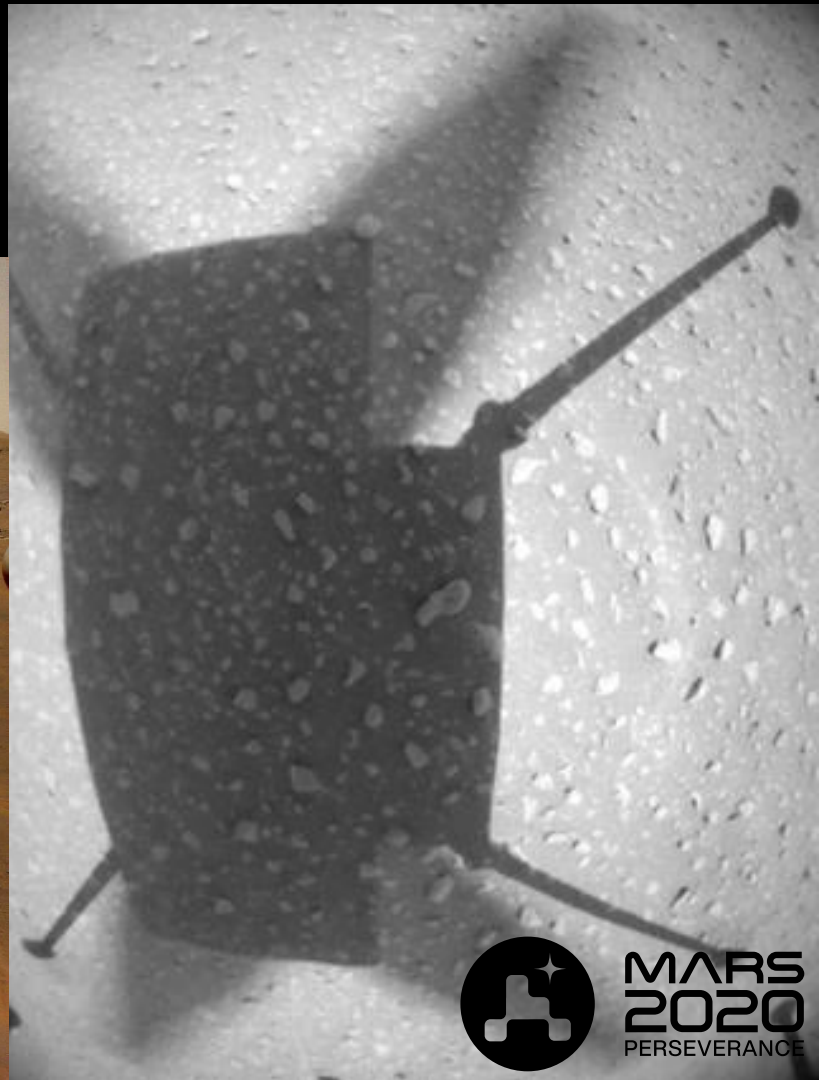
MARS 2020 PERSEVERANCE

NASA/JPL/ASU

Ingenuity covers and maps difficult terrain



NASA/JPL

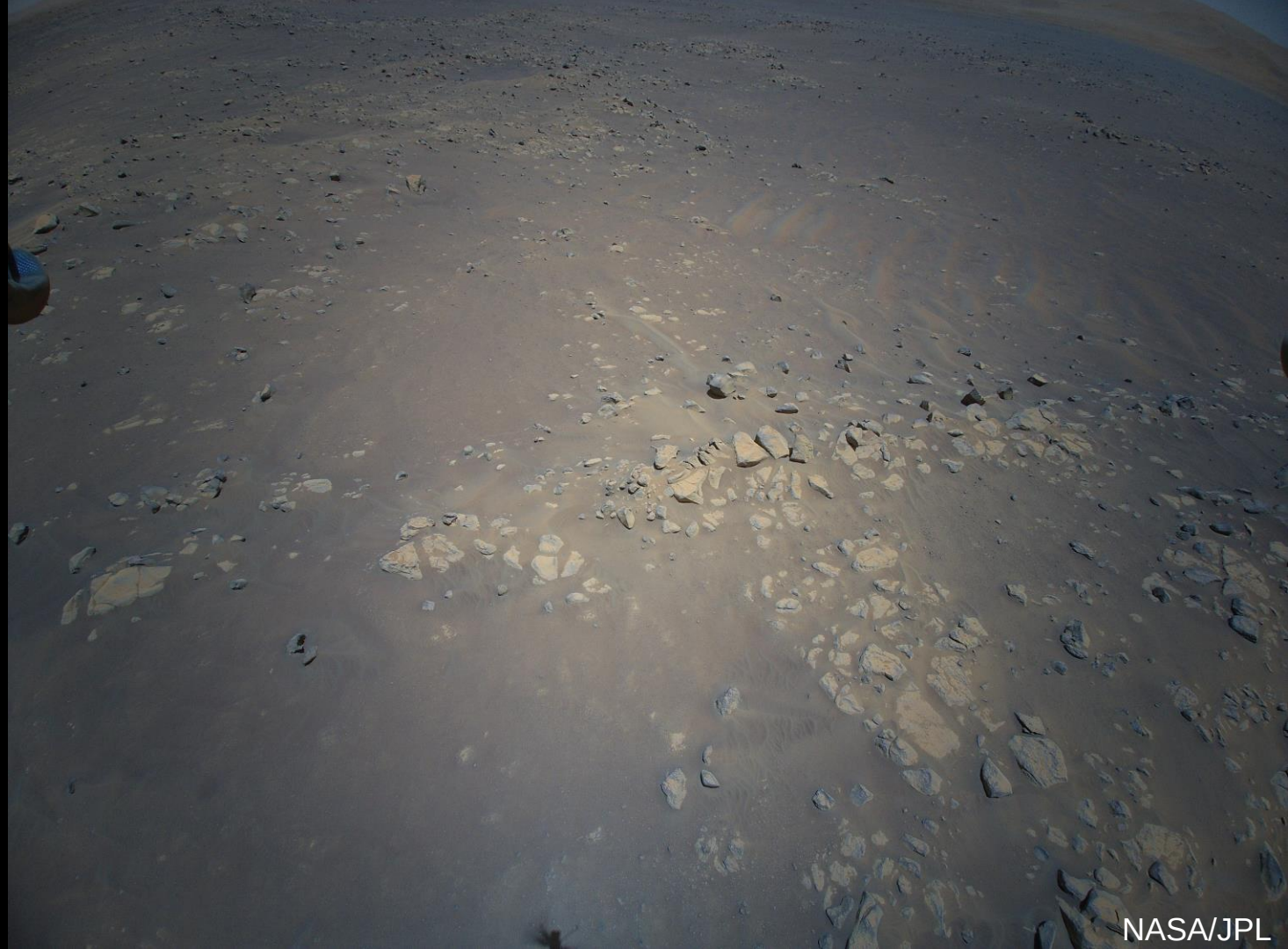


Ingenuity covers and maps difficult terrain

NASA/JPL

MARS 2020 PERSEVERANCE

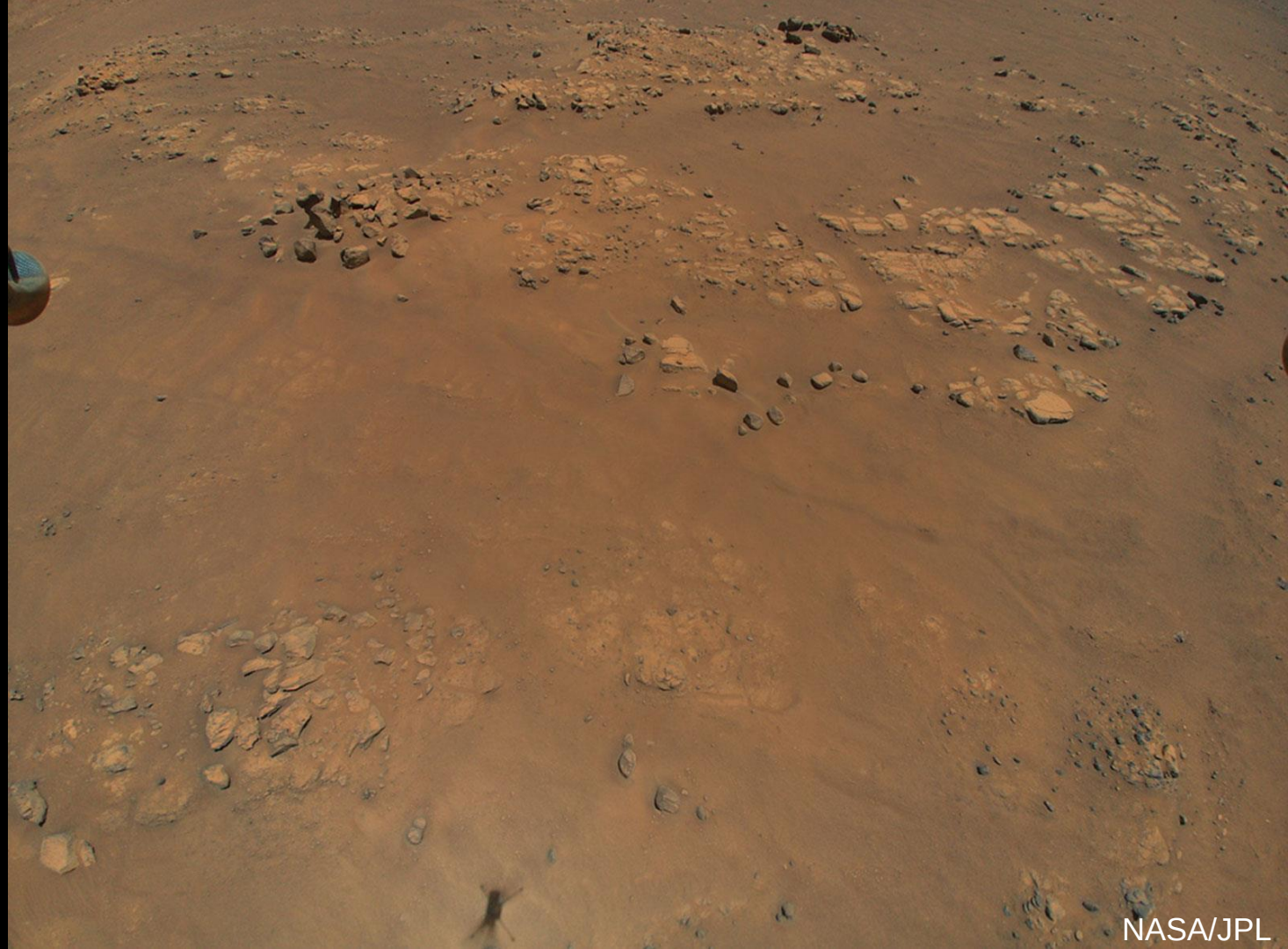
Ingenuity covers and maps difficult terrain



MARS 2020 PERSEVERANCE

NASA/JPL

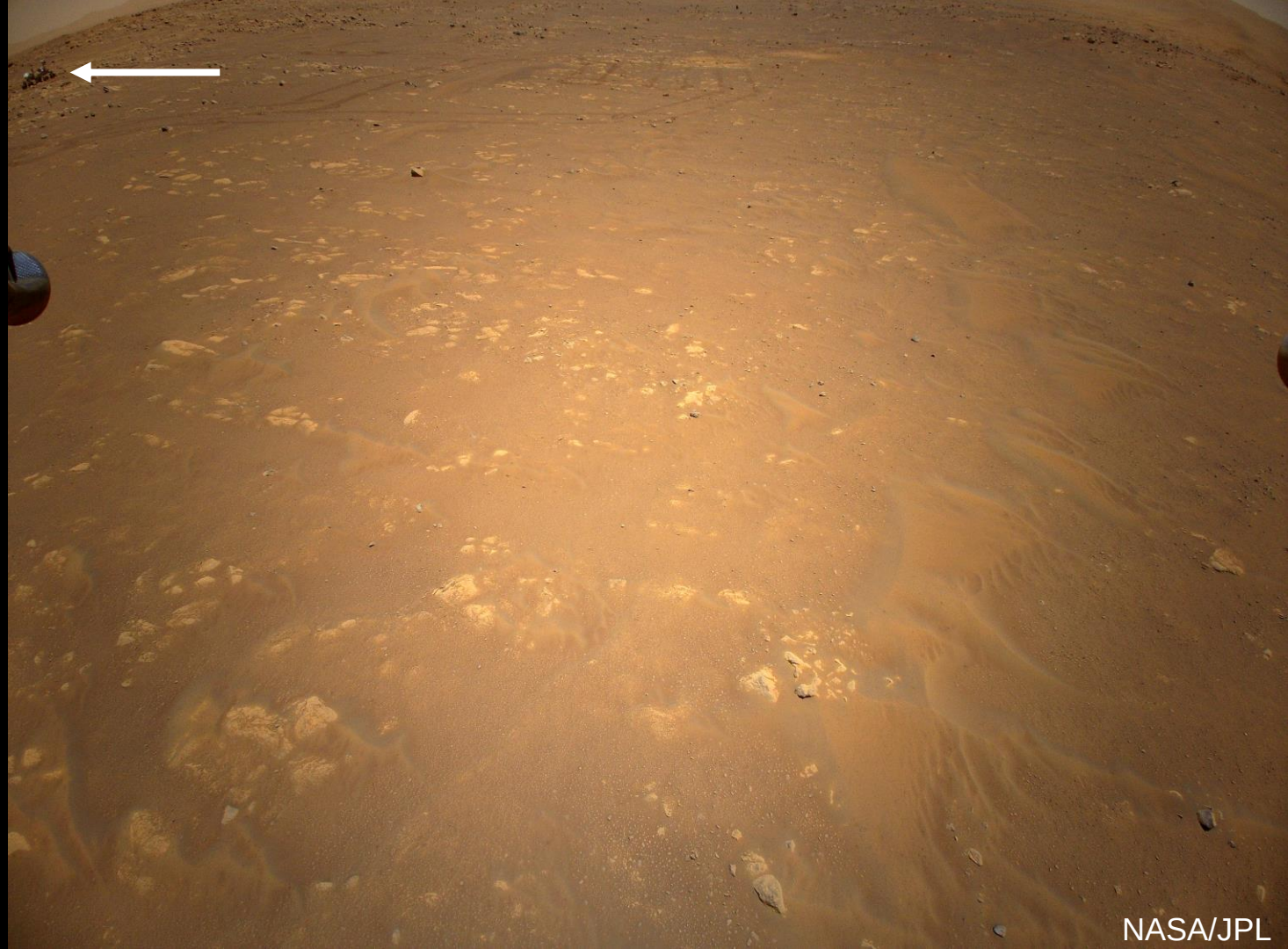
Ingenuity covers and maps difficult terrain



MARS 2020 PERSEVERANCE

NASA/JPL

Photo of Perseverance by Ingenuity



NASA/JPL

MARS 2020 PERSEVERANCE

Photo of Ingenuity by Perseverance

Martian helicopters can be used for future human and robotic exploration

NASA/JPL

MARS 2020 PERSEVERANCE

Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE) makes O_2 from the CO_2 in the martian atmosphere

MARS 2020 PERSEVERANCE

NASA/JPL

MARS 2020 PERSEVERANCE

NASA/JPL/MIT/Forrest Meyen

Dust is everywhere!

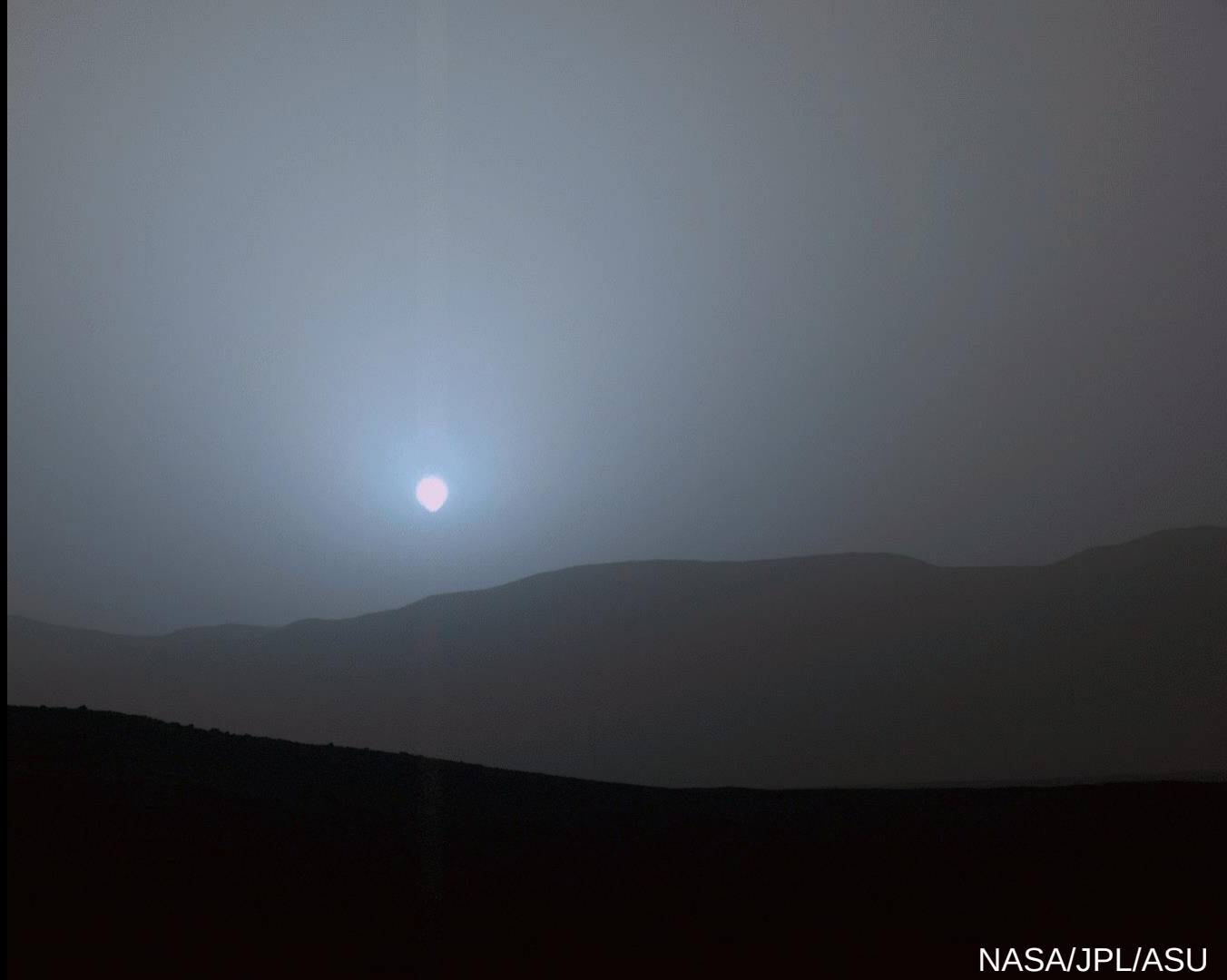
NASA/JPL/MSSS

Observations of dust constrain the processes controlling martian weather

MARS 2020 PERSEVERANCE

NASA/JPL

Martian sunset captured by the Curiosity rover

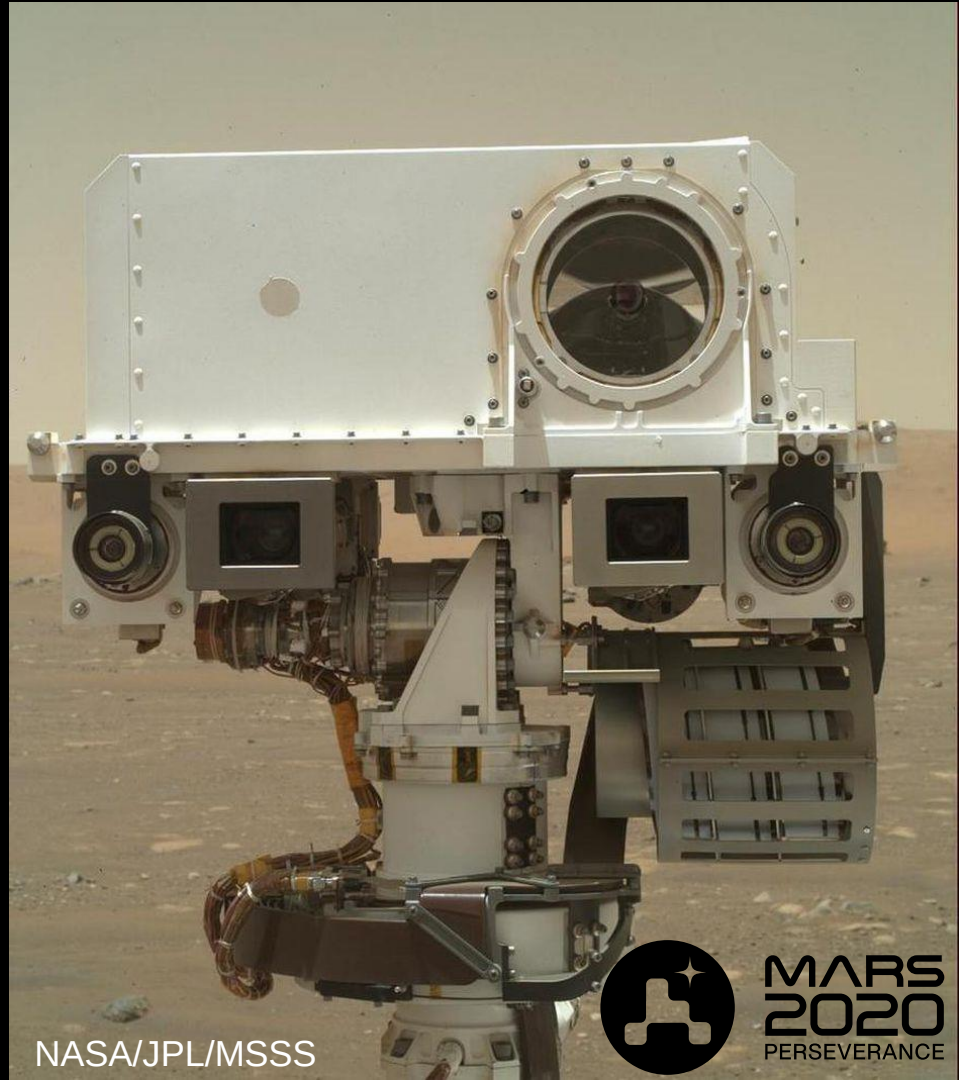


NASA/JPL/ASU

Perseverance rover mission: first 200 sols

Science highlights:

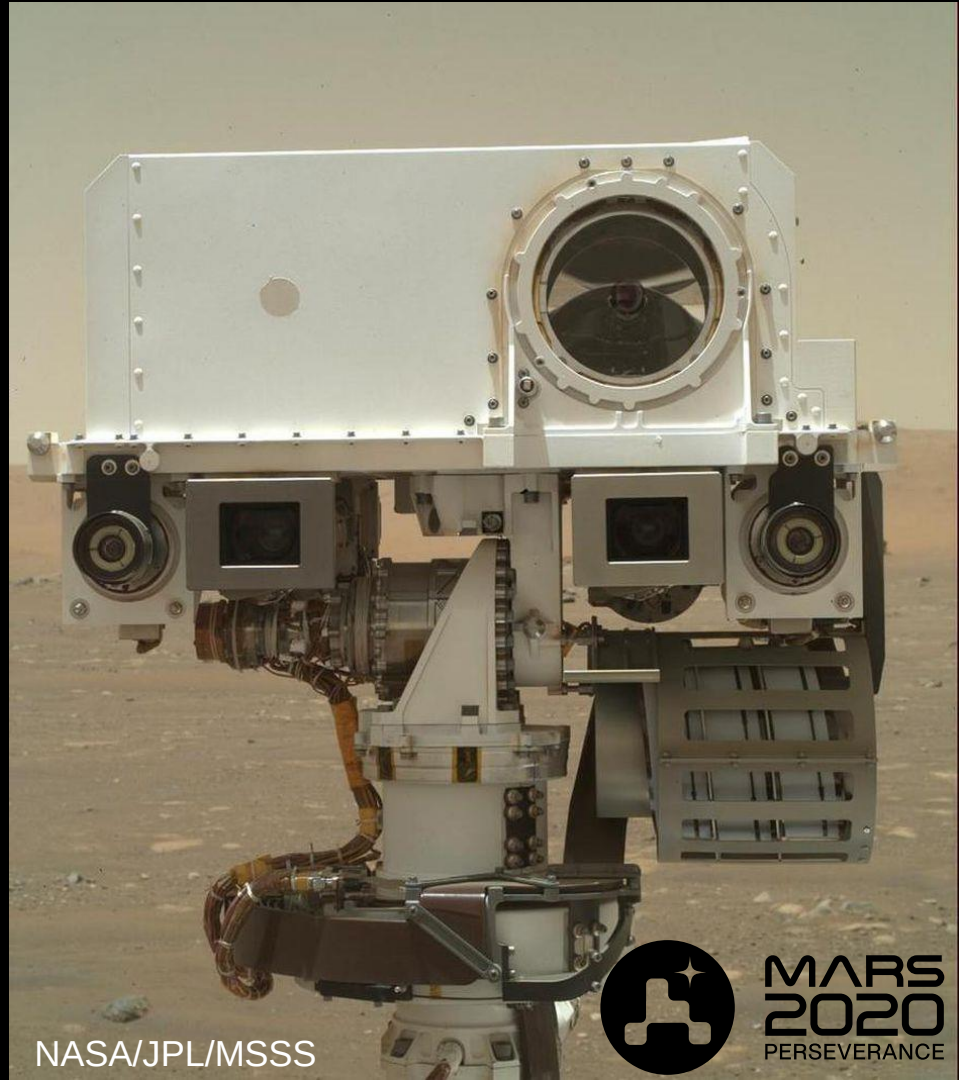
1. Collection of the first rock and atmospheric samples for return to Earth
2. Confirmation of a paleolacustrine environment in Jezero crater
3. Characterization of multiple deltaic units, constraining past aqueous environments on Mars
4. Investigation of multiple crater floor units, leading towards determination of their origins
5. Observations to constrain Mars dust cycling and weather patterns



Perseverance rover mission: first 200 sols

Exploration highlights:

1. First flight by an aircraft off Earth, unlocking new exploration strategies for robotic and human space missions
2. First in-situ production of oxygen from the martian atmosphere (MOXIE)
3. First footage captured of landing on Mars
4. Multiple records set for autonomous navigation driving distance
5. Characterization of seasonal dust cycling and dust devil activity, which affects power production by solar panels



Jet Propulsion Laboratory
California Institute of Technology

jpl.nasa.gov