

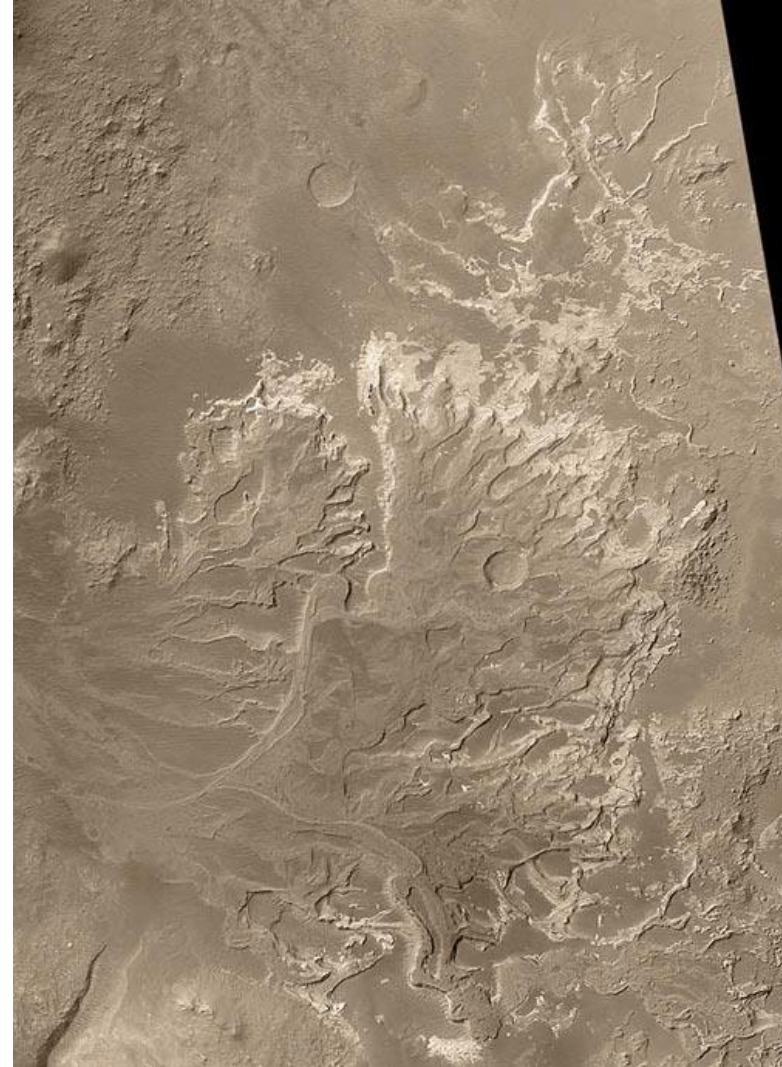
Mars Sample Return

Miguel San Martin (@migonmars)

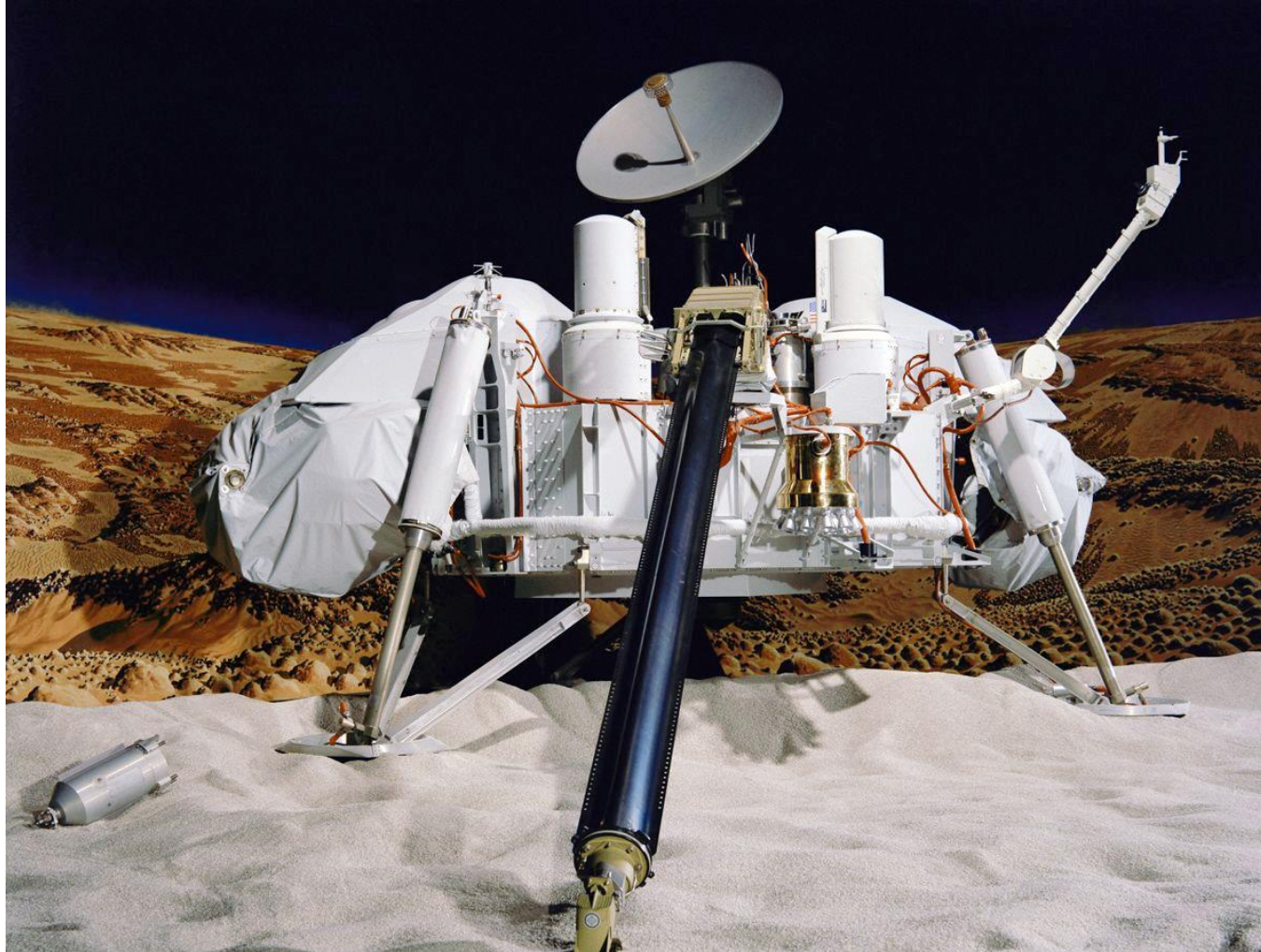
The decision to implement Mars Sample Return will not be finalized until NASA's completion of the National Environmental Policy Act (NEPA) process. This presentation is being made available for information purposes only.

Why Explore Mars?

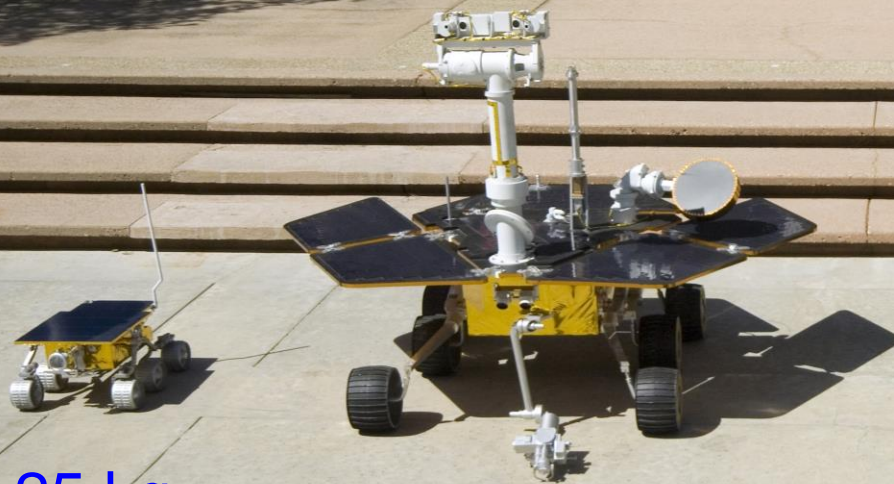
- There is scientific evidence that indicates that in its distant past Mars was a warm and wet planet like Earth, that might have had favorable conditions for the origin of life.
- If we find evidence of microbial life on Mars, past or present, it would be a large leap forward in answering the question of whether we are alone in the universe.



Viking I & II (1976)

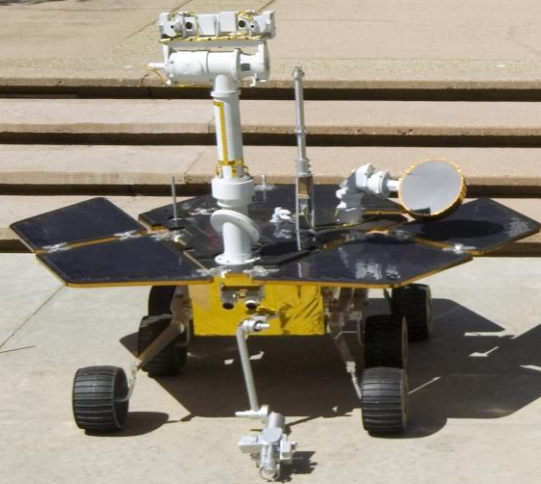


*Mars
Pathfinder
1997*



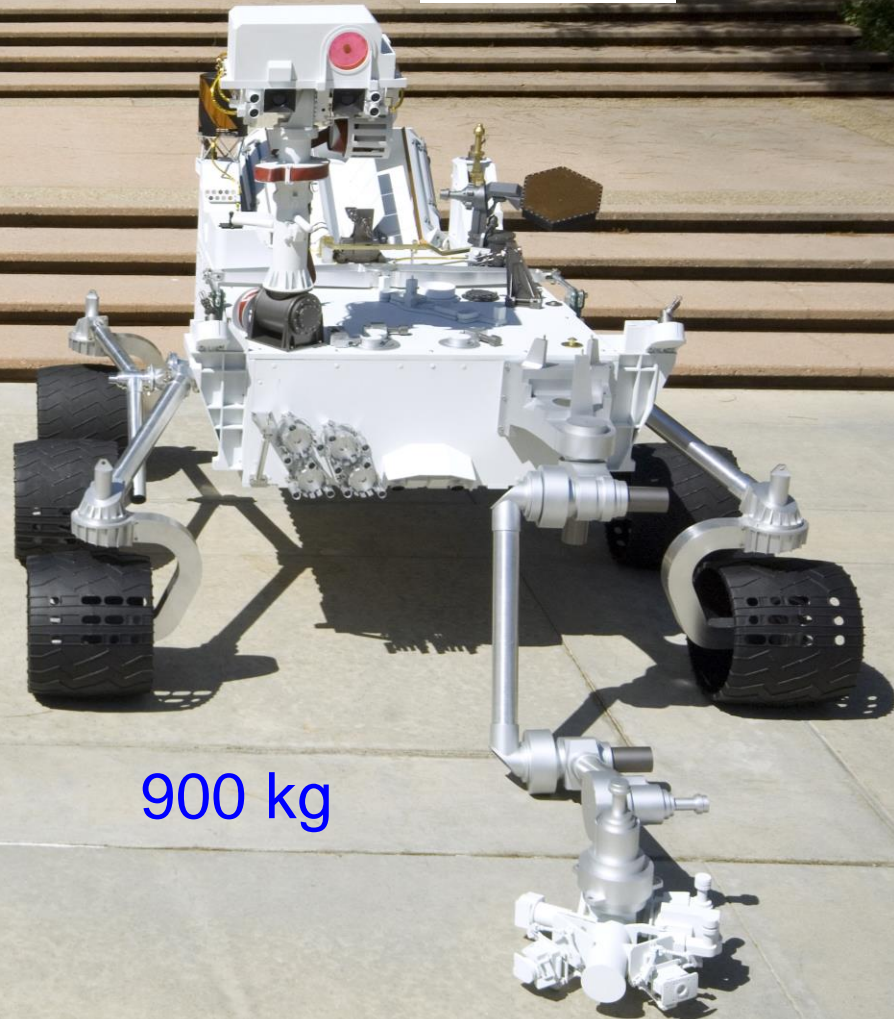
25 kg

*Mars
Exploration
Rovers
2004*



175 kg

*Mars
Science
Laboratory
2012*



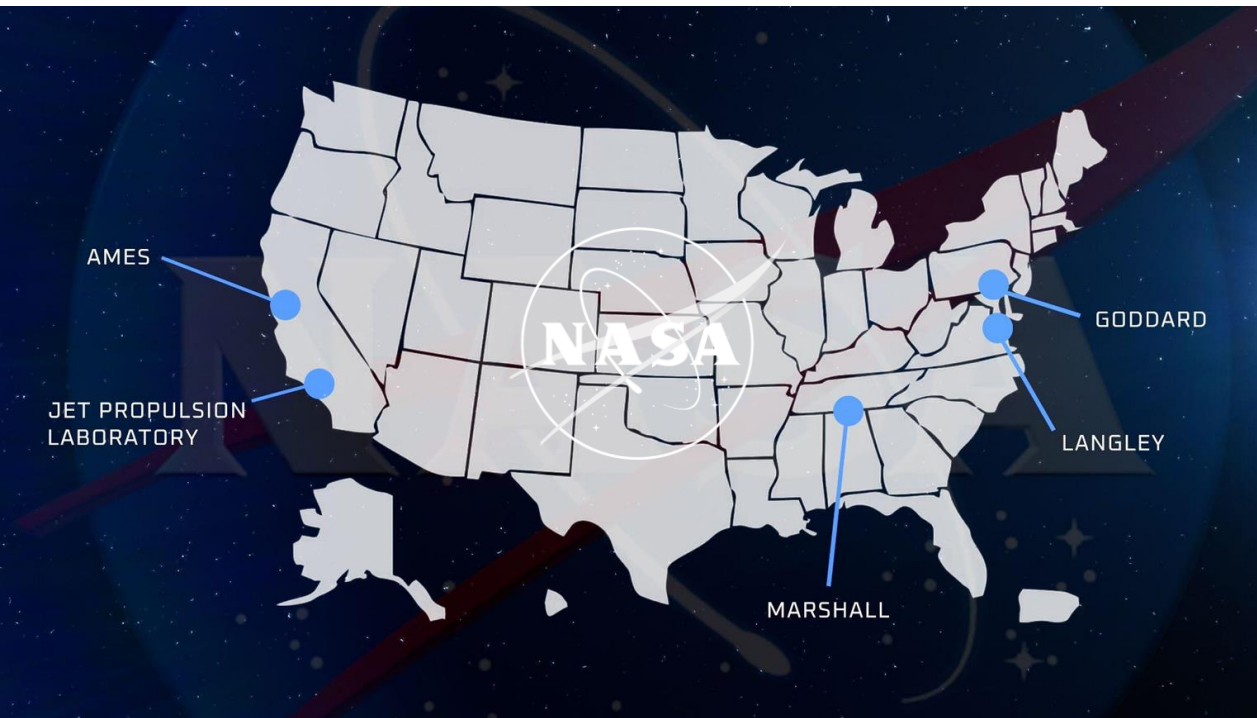
900 kg

An artistic rendering of the Mars Sample Return mission. In the foreground, a Mars rover is on the left and a lander with three large rock samples is on the right. In the sky, a sample return vehicle is ascending with a bright plume, and a Mars orbiter is visible in the upper left. The background shows the reddish, hilly landscape of Mars.

The Mars Sample Return program is an ambitious plan to bring back samples of Mars rocks and soil to Earth for study.

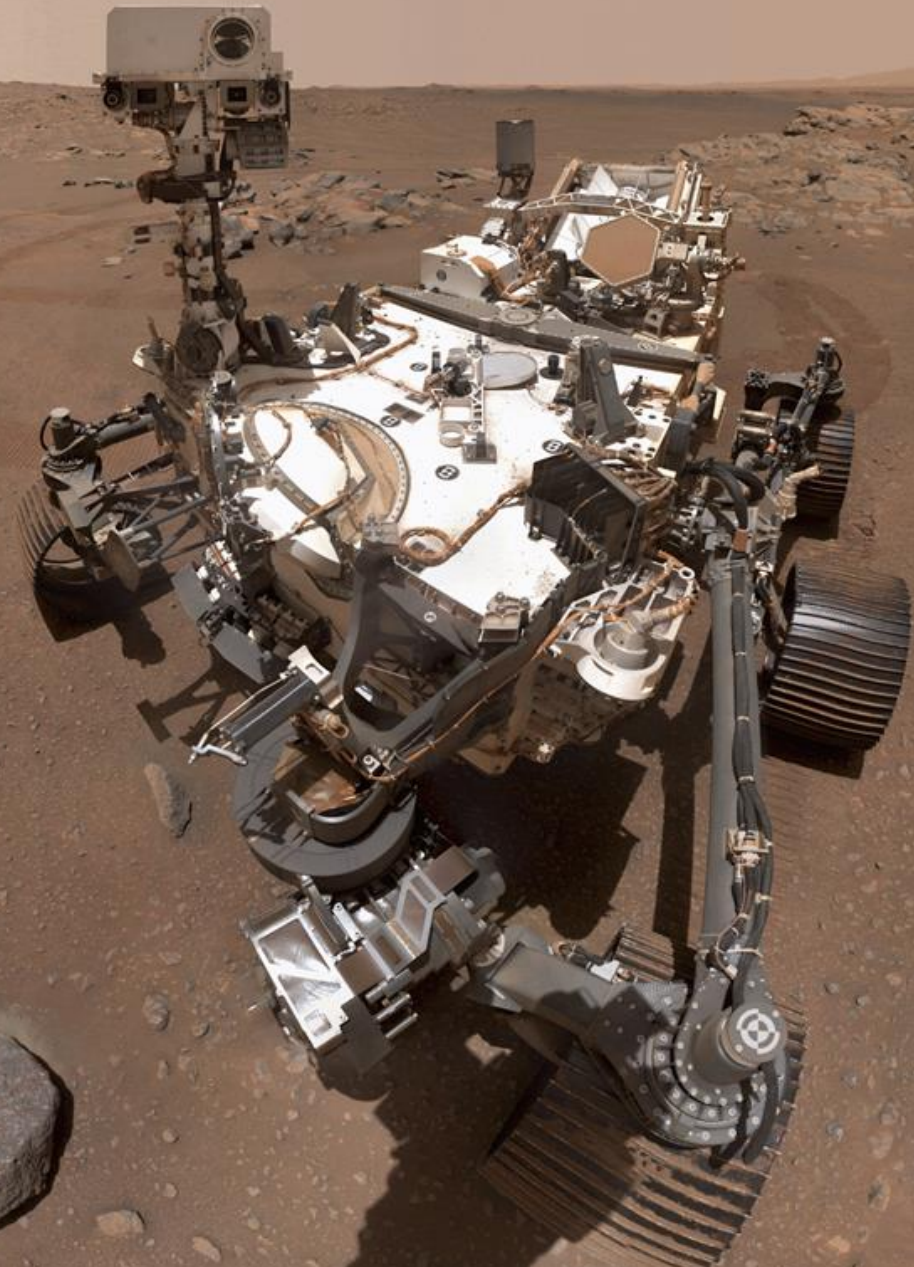
These samples might answer whether ancient life ever arose on Mars.

This is an international effort being pursued in collaboration with ESA, using multiple NASA centers around the country.



Now is the right time to bring samples back from Mars.

The process is underway! The Perseverance rover is collecting and storing rock and soil samples in Jezero Crater.

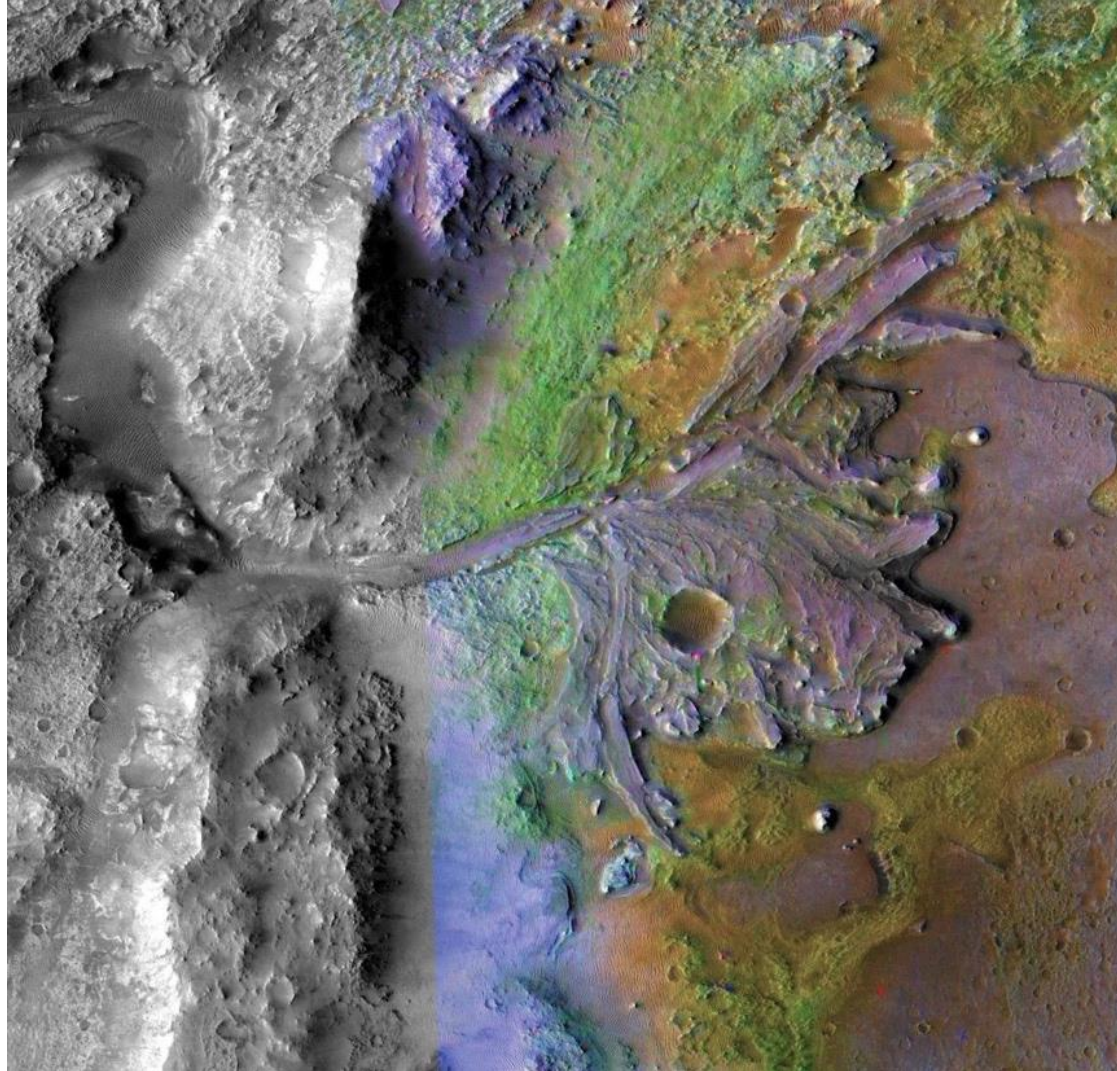


JEZERO CRATER

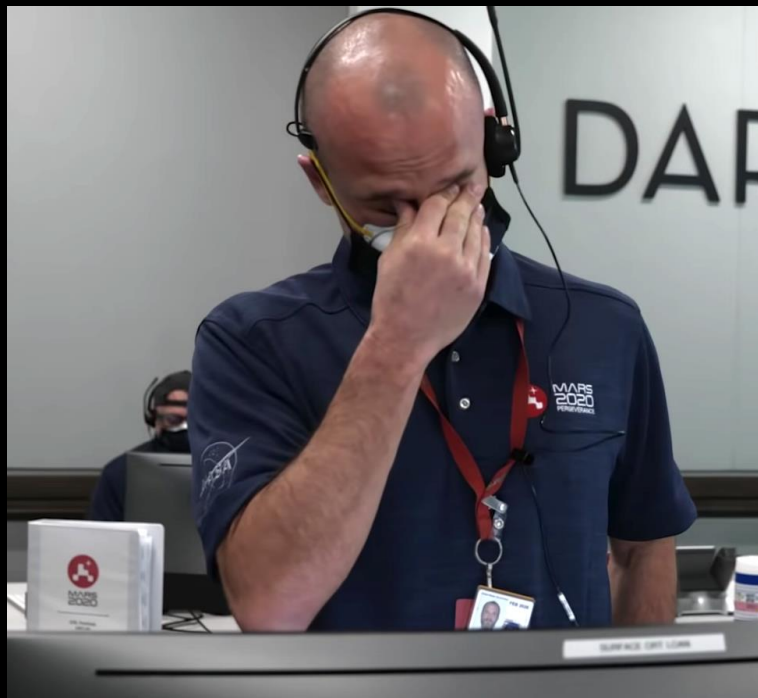




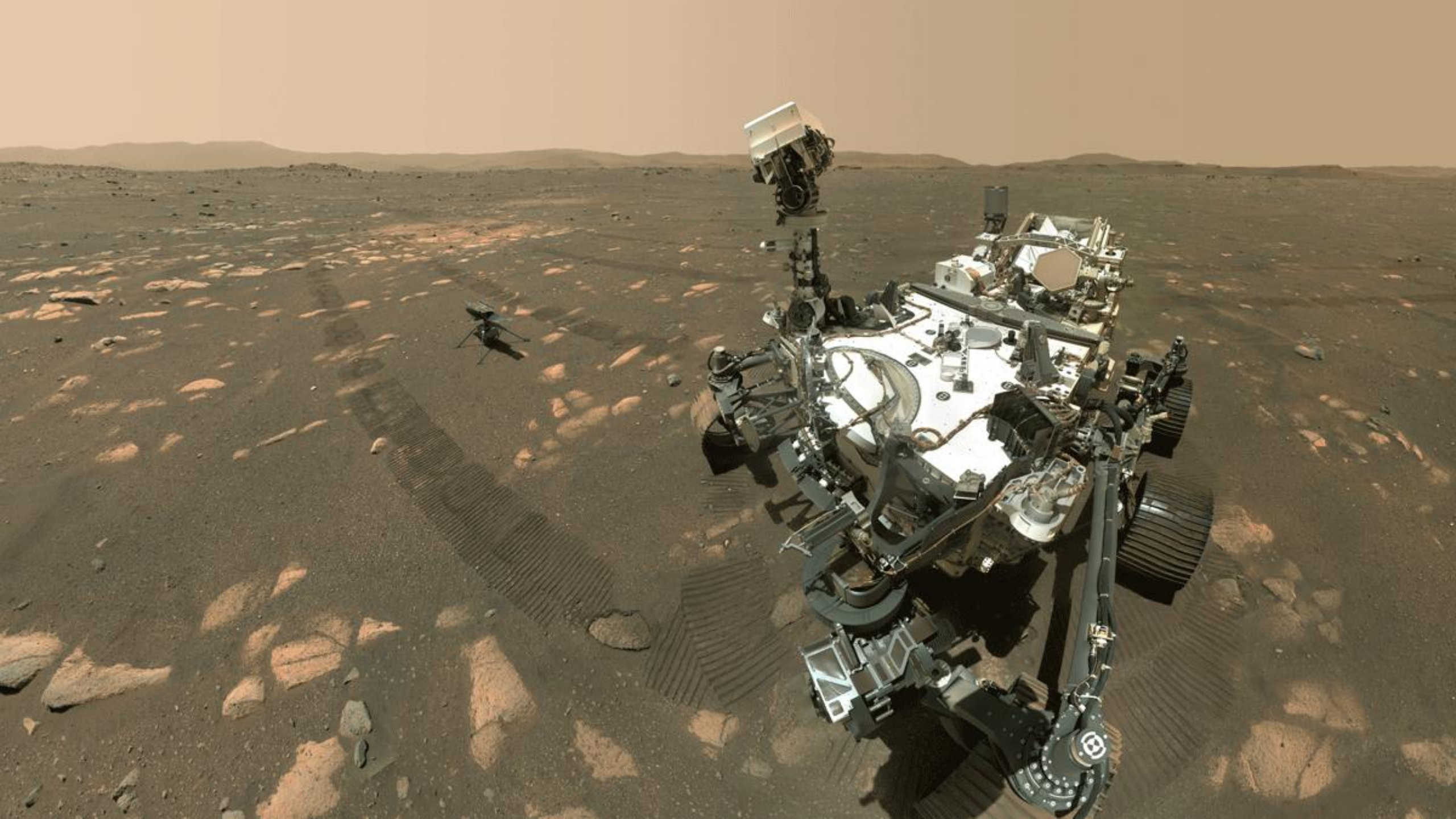
Jezero Crater Delta

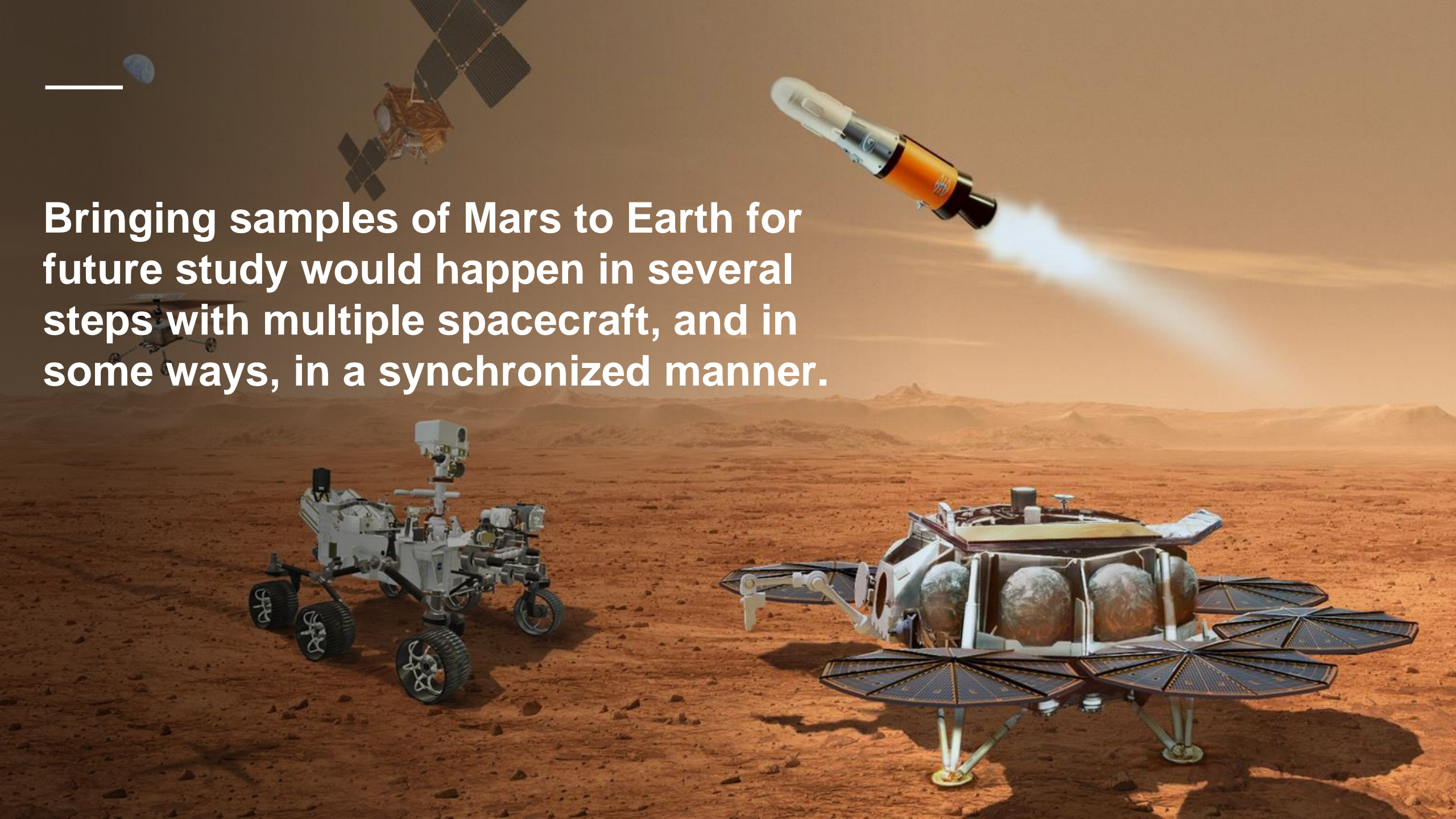


February 18, 2021



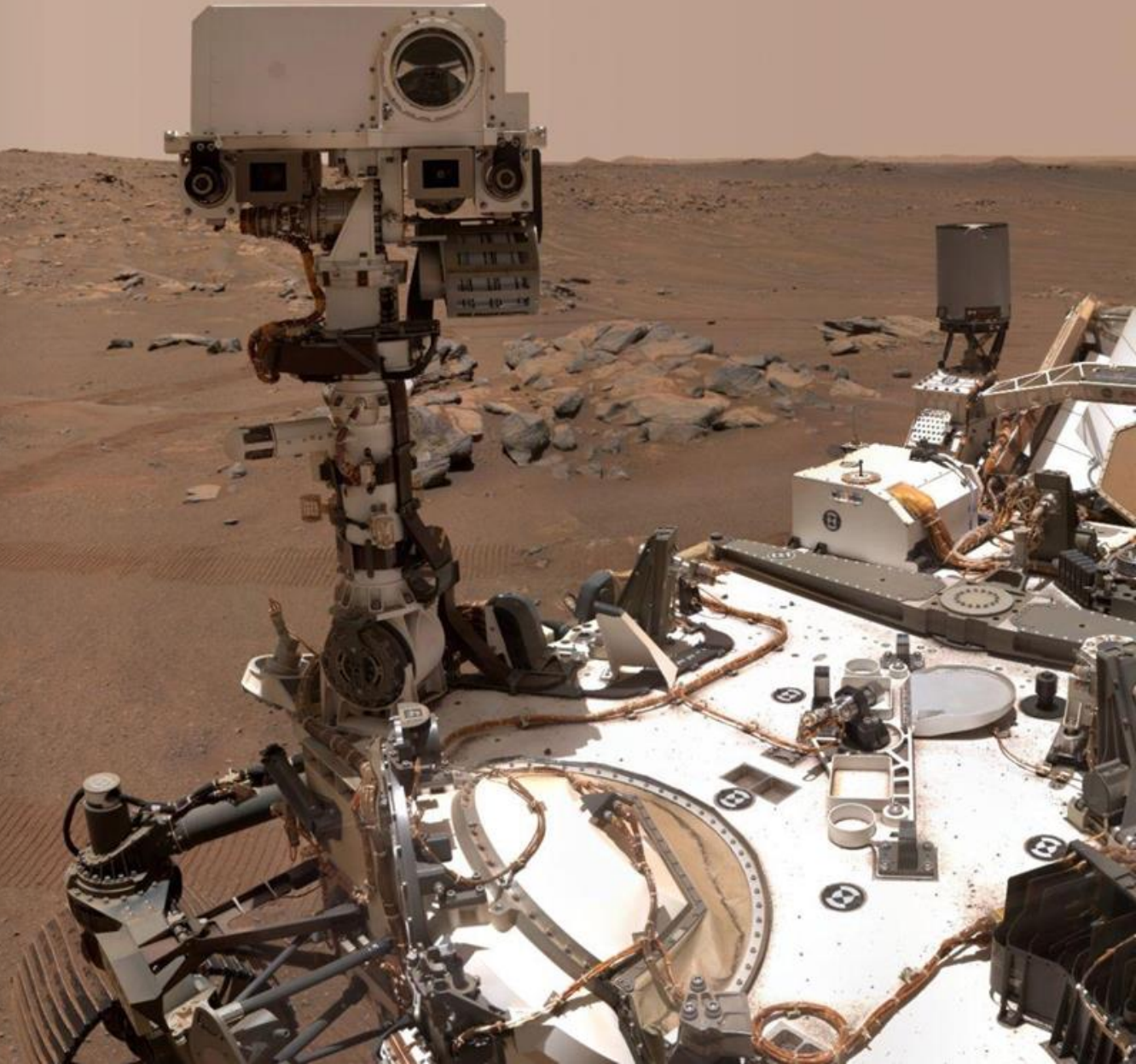
Success!!!



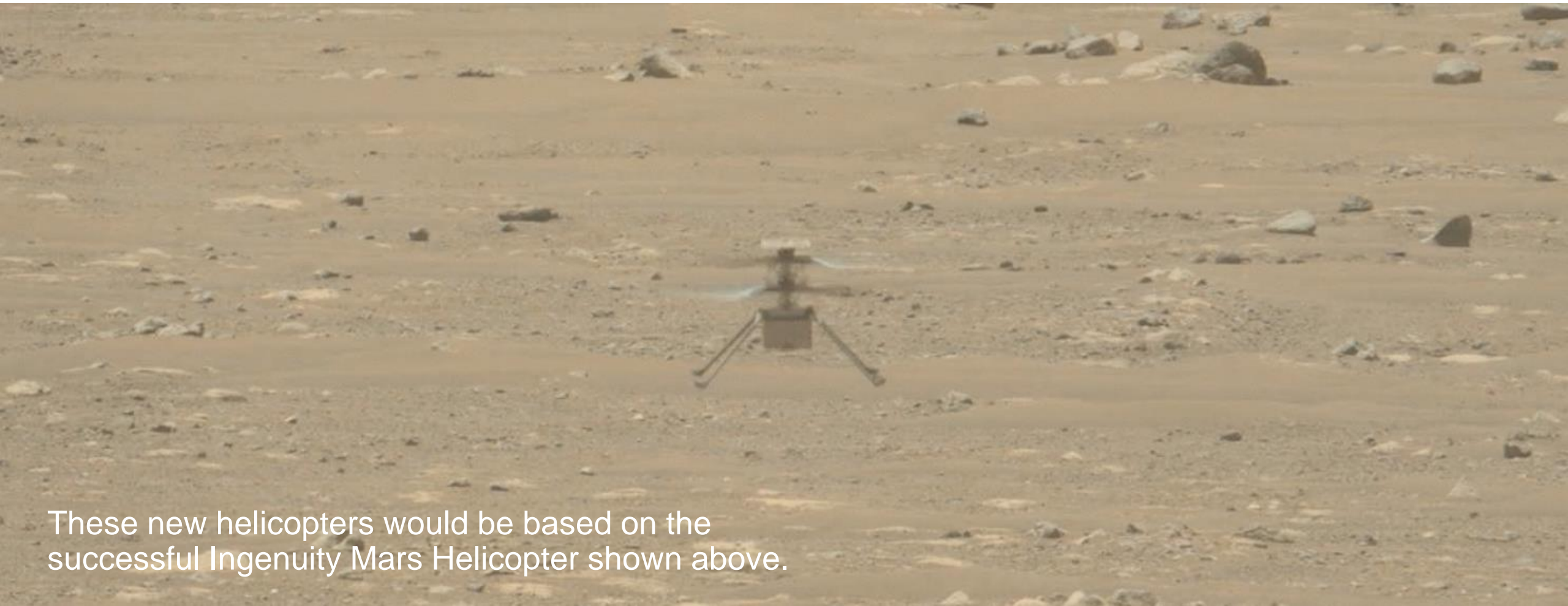


Bringing samples of Mars to Earth for future study would happen in several steps with multiple spacecraft, and in some ways, in a synchronized manner.

**Perseverance would
bring a set of stored
samples to the lander
where they would be
transferred into a
container inside the
Mars Ascent Vehicle.**



As a backup, Sample Recovery Helicopters could locate other sample tubes stashed by Perseverance and bring them to the lander.

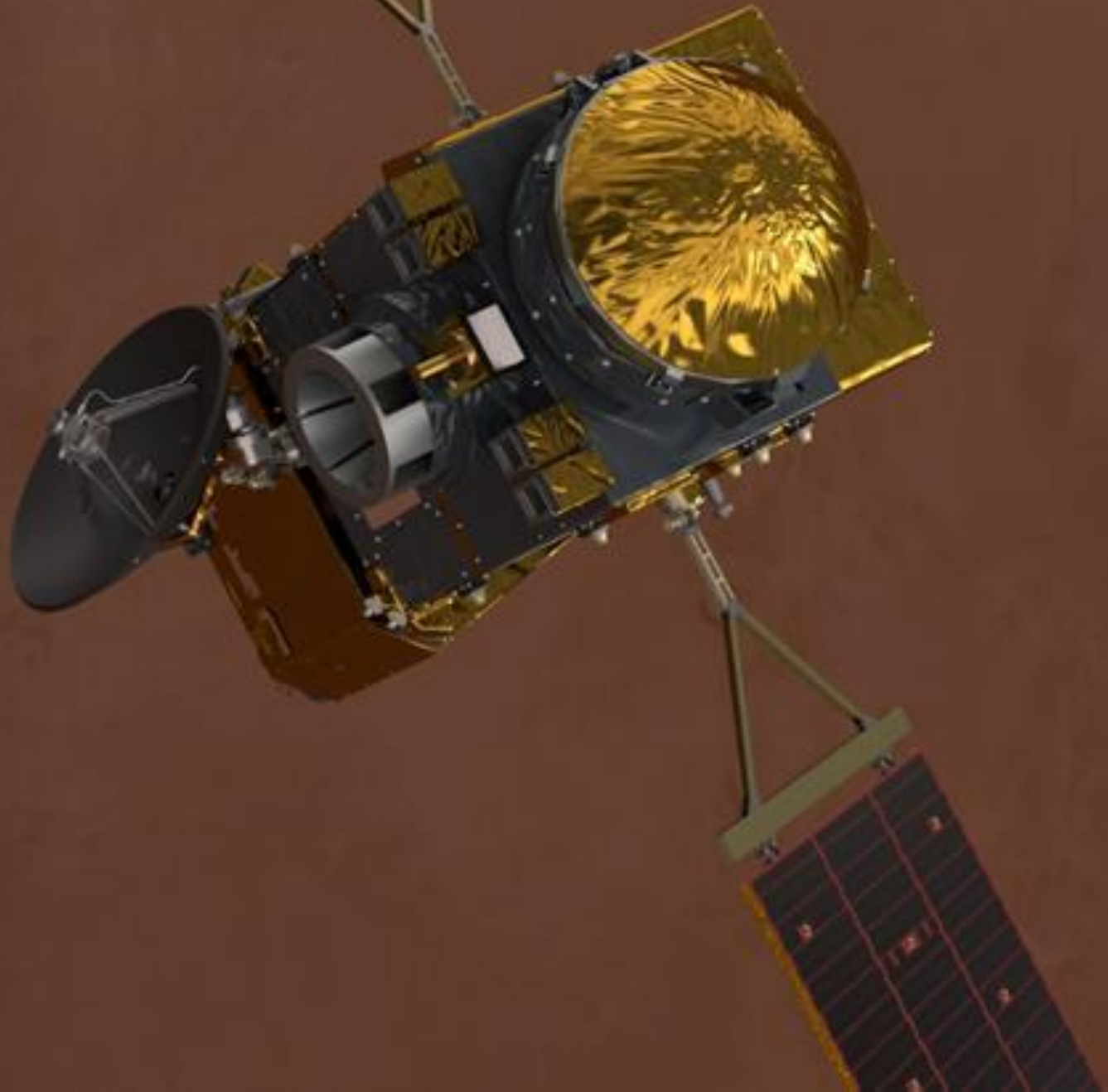


These new helicopters would be based on the successful Ingenuity Mars Helicopter shown above.

With samples in hand, the Mars Ascent Vehicle would be the first rocket ever to launch from the surface of another planet.



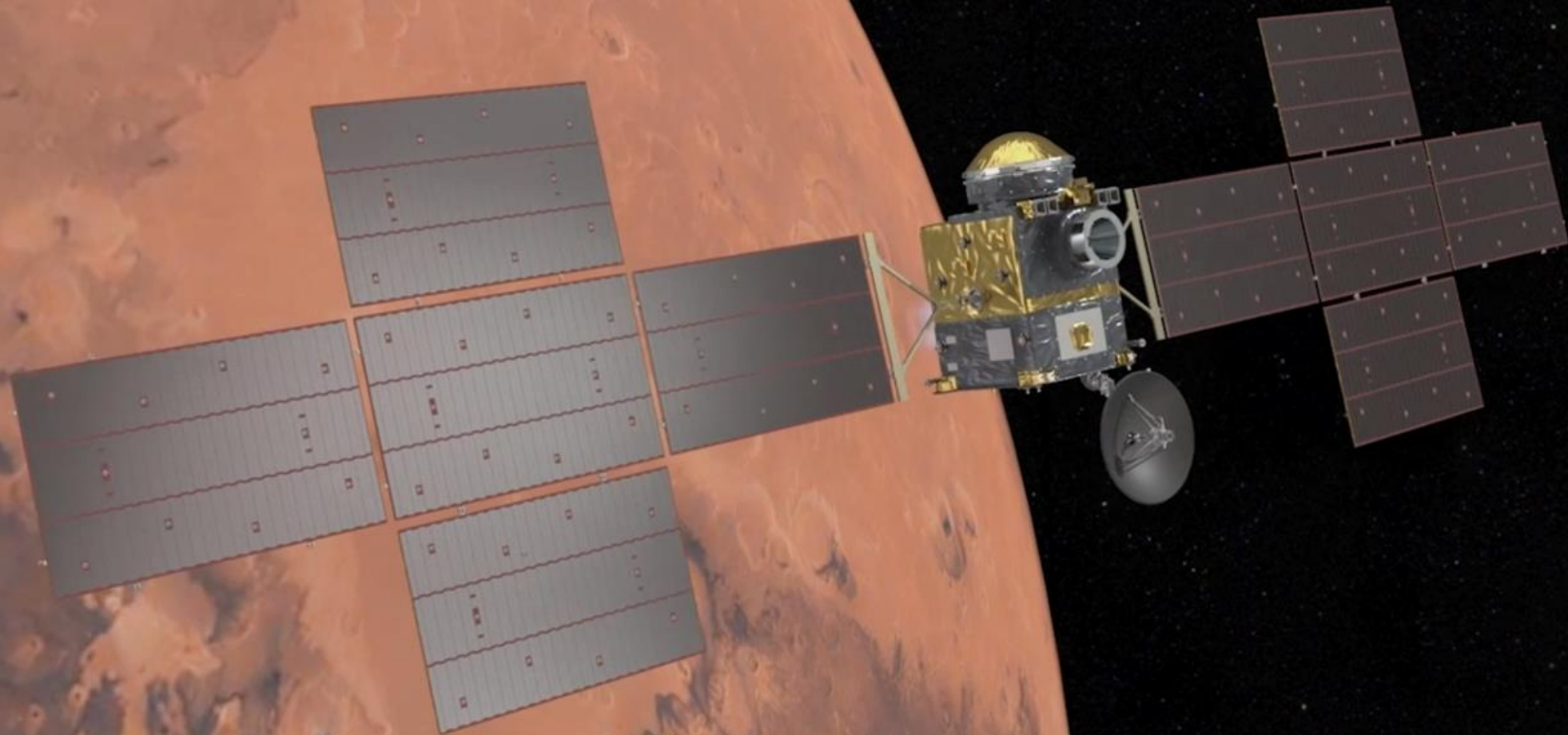
**Another spacecraft,
the Earth Return
Orbiter, provided by
ESA, would be
waiting in orbit to
collect the samples.**



Inside the orbiter would be the NASA-provided Capture, Containment and Return System, which would securely contain the sealed samples, then prepare them for the return to Earth inside the Earth Entry System.



The Earth Return Orbiter would use solar electric propulsion to depart Mars orbit, headed for Earth.



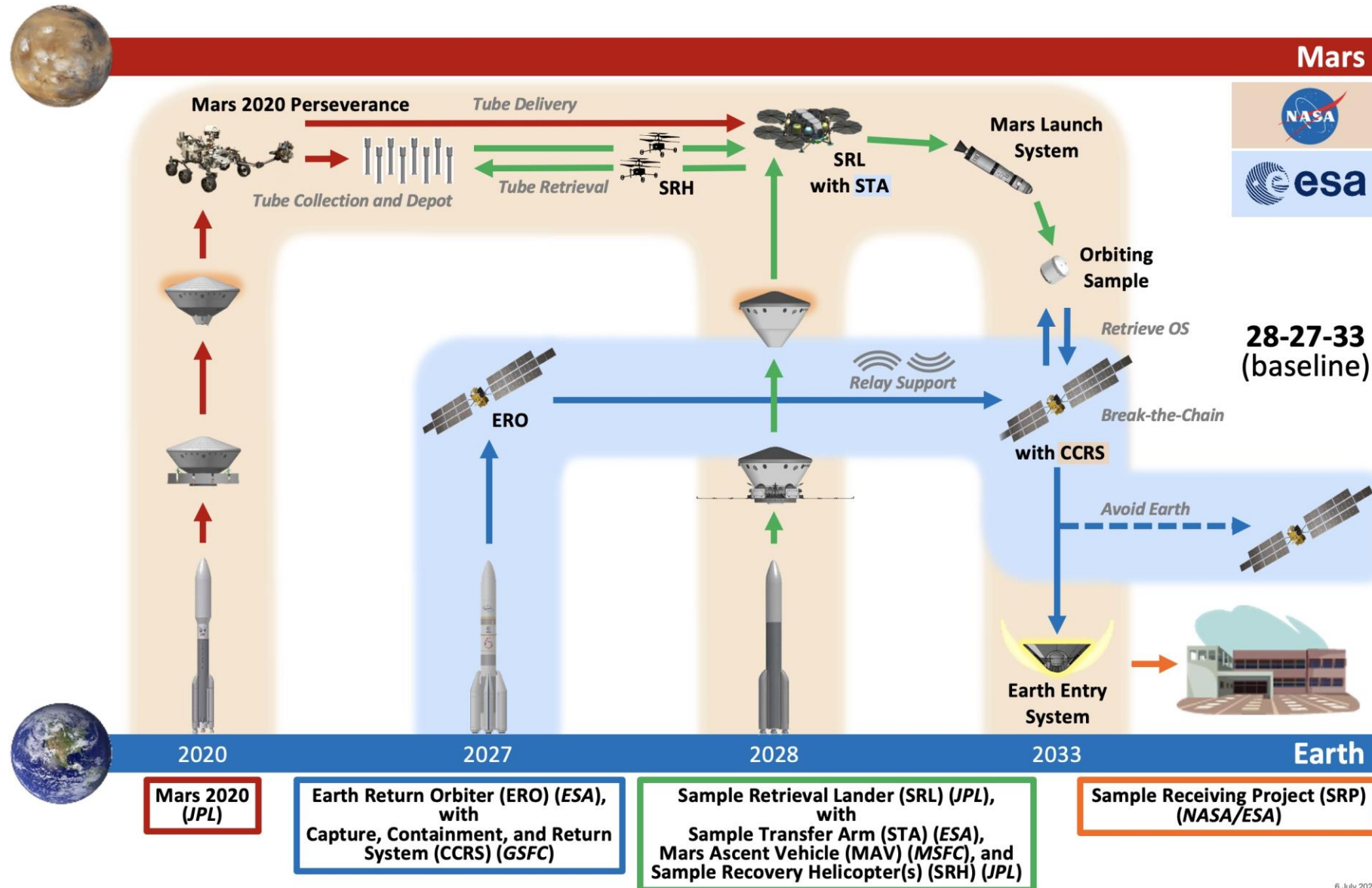
When flying past Earth, the Earth Return Orbiter would release the Earth Entry System.



The Earth Entry System would be targeted for a safe place to land.

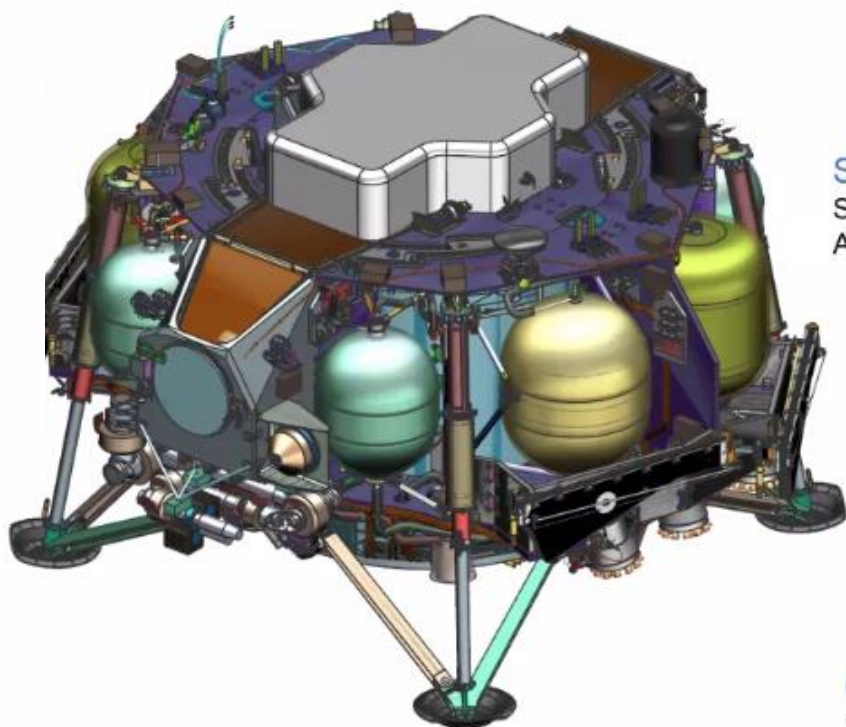
Its heat shield would protect it during its entry through Earth's atmosphere.

Planned MSR Campaign Architecture Overview



Surface Deployments

MLV Landed Configuration



MAV Bay Door Deployment

Sol 1XX, Just Prior to MLS/MAV Launch
Actuator Driven one-time deployment

Debris Shield & SRH Deployment

Sol 1-10, during Lander Commissioning
Actuator Driven one-time deployments (x3)

Solar Array Deployments x 5

Sol 0, shortly after landing
Actuator Driven one-time deployment

Surface Deployments

Exterior Hazcam Cover Deploy x 4

Sol 0, shortly after landing
Spring driven one-time deployment

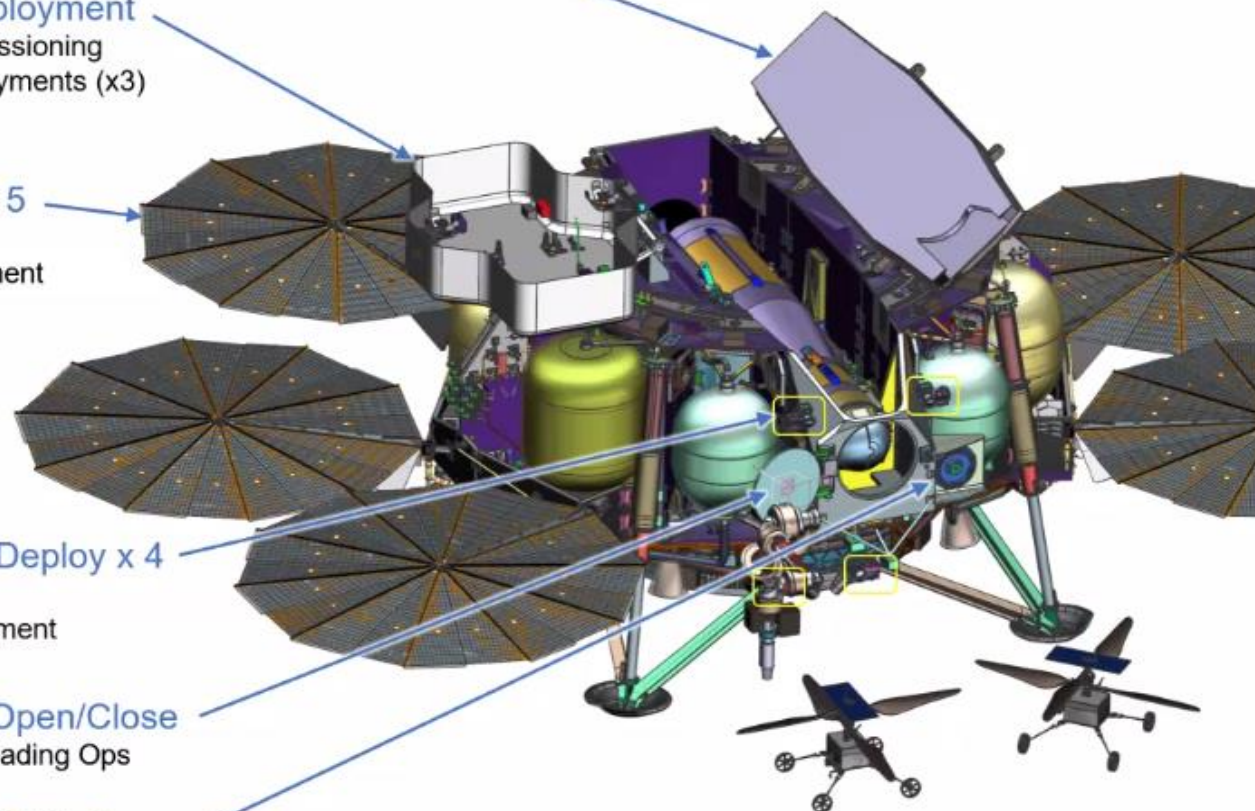
OS Sample Access Door Open/Close

Sol 5 - 1XX, Opened for Tube Loading Ops
Actuator Driven

OS Lid Cover

Sol 1XX, After completion of Tube Transfer Ops
Removed by STA, one time deployment

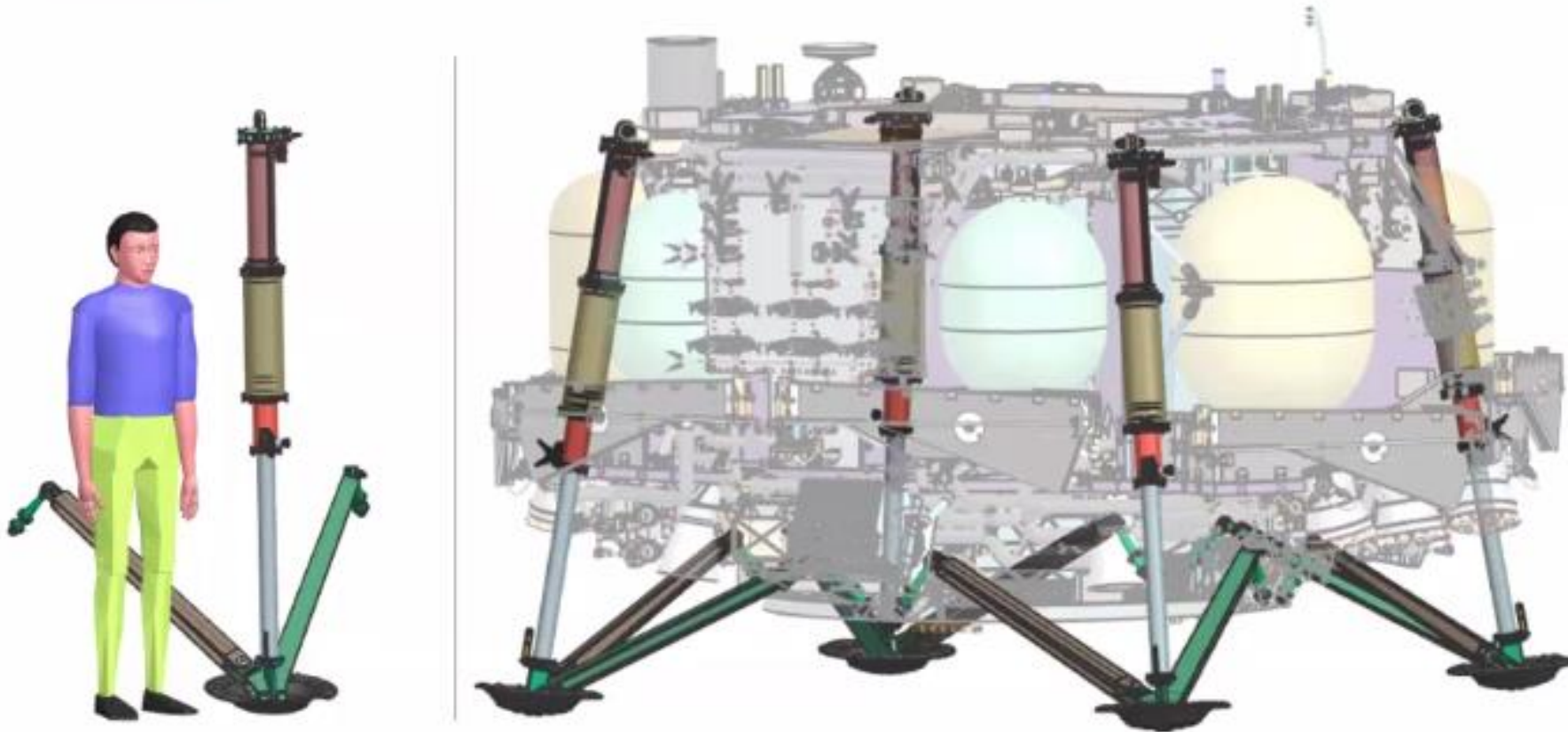
MLV Ready for MLS/MAV Launch



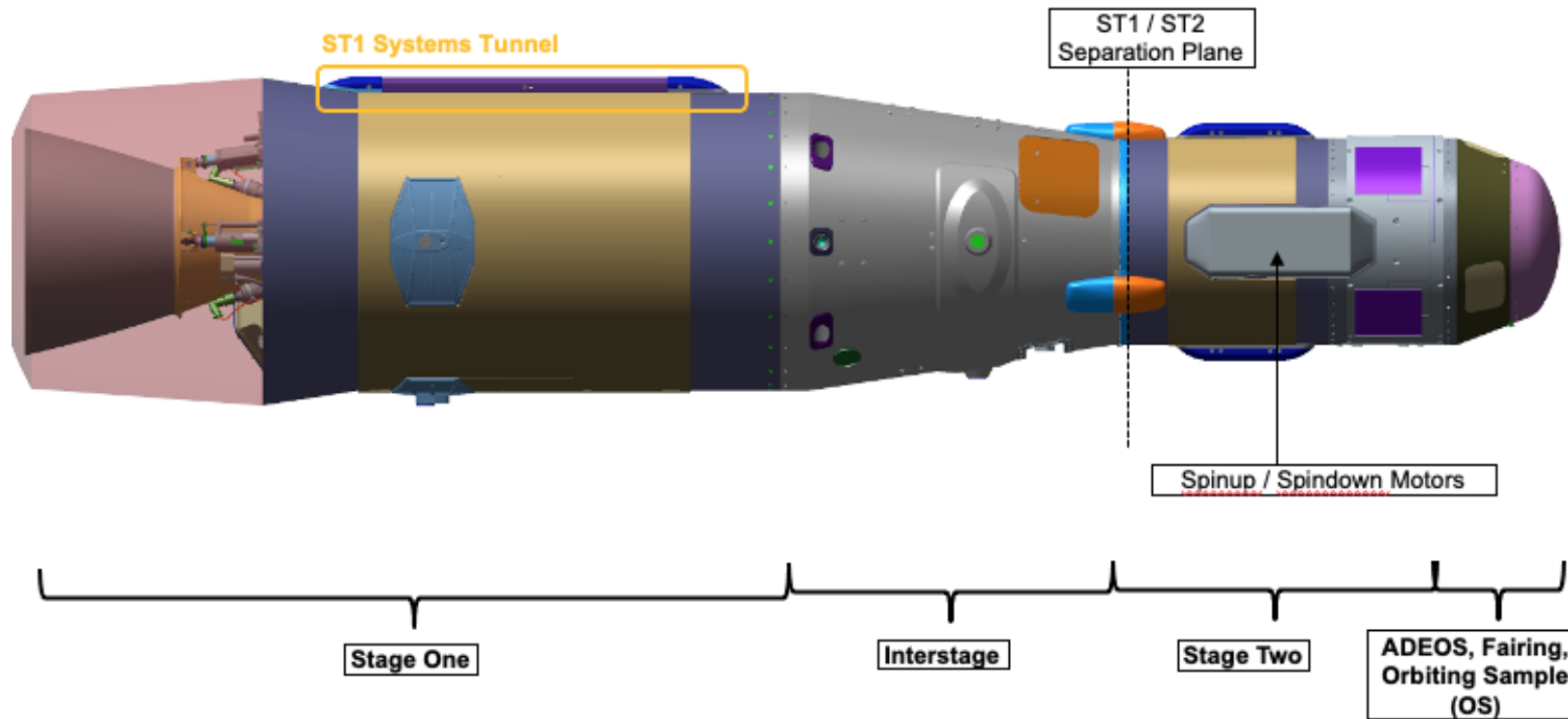
Helis shown in this view for scale reference only.
Helis will not be near Lander during MLS Launch



Landing Gear



Mars Ascent Vehicle



Sample Recovery Helicopter Concept



- Helicopter is close descendent of Ingenuity
 - 1.2m diameter blades (some discussion of possible growth to 1.4m)
 - ~2kg flight mass (some discussion of possible growth to 2.5kg)

