



InSight

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InSight: Early Operations

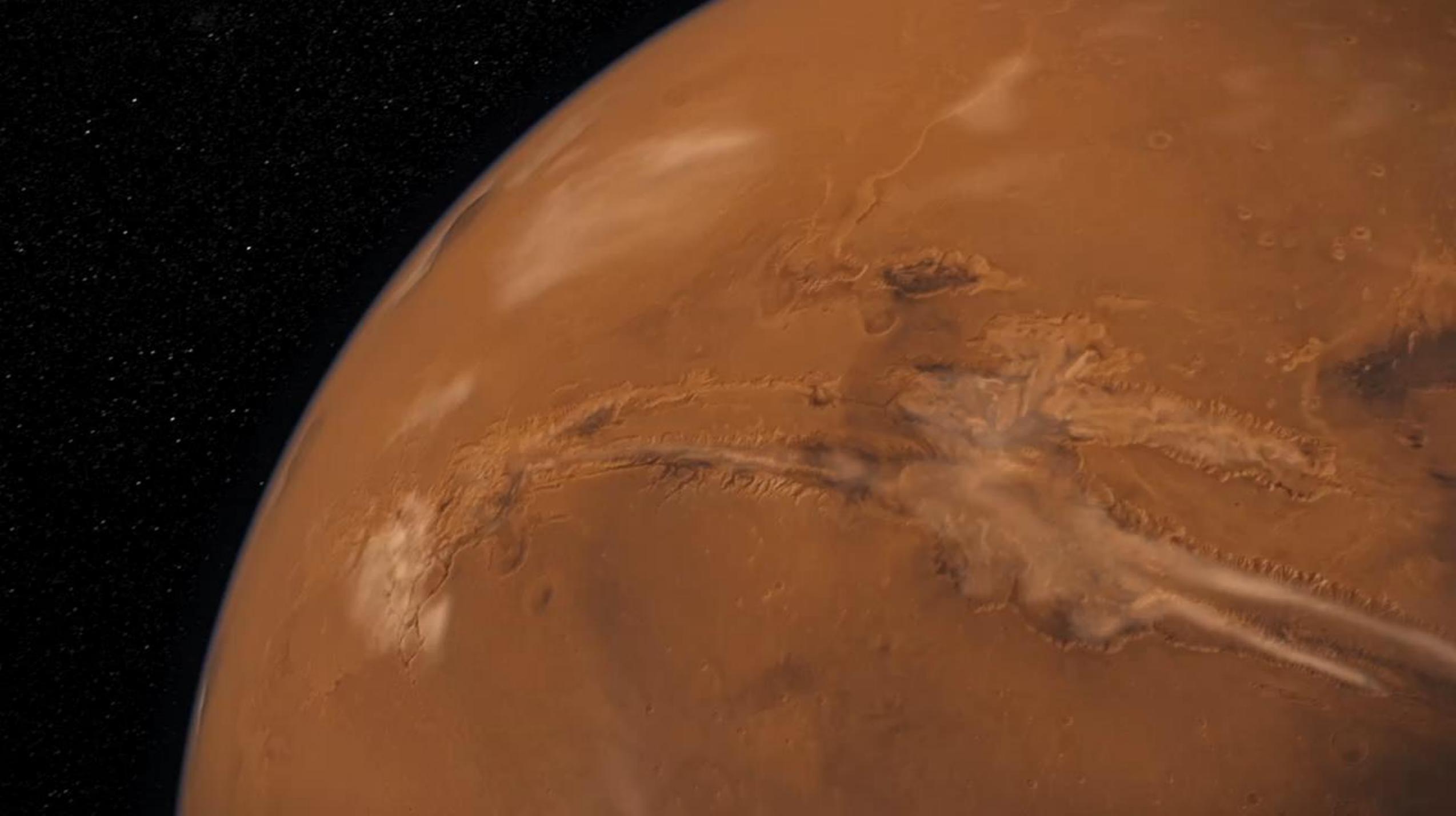
Co-Authors: Jonny Grinblat,
Rob Grover, Allen Halsell,
Travis Imken



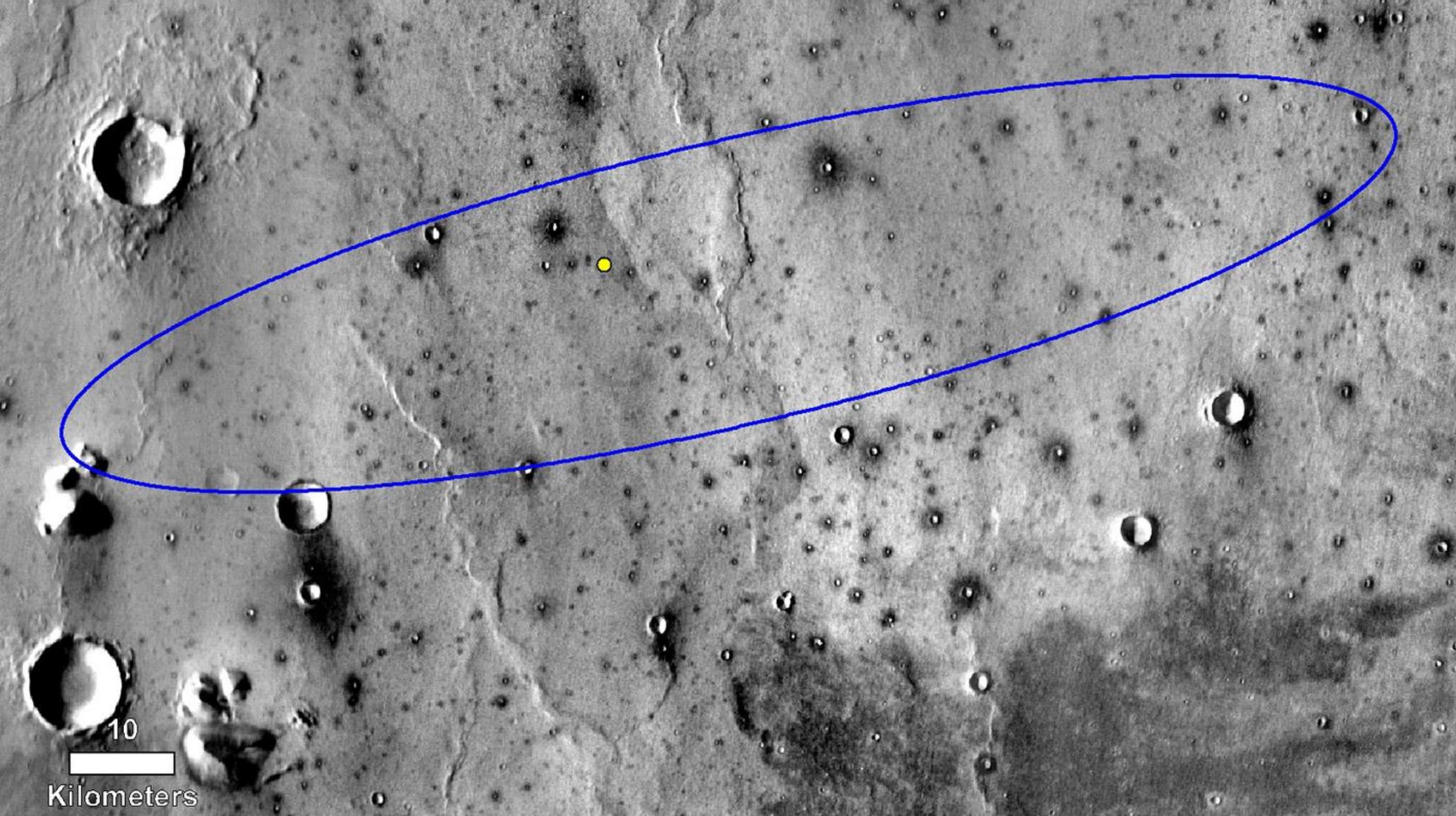






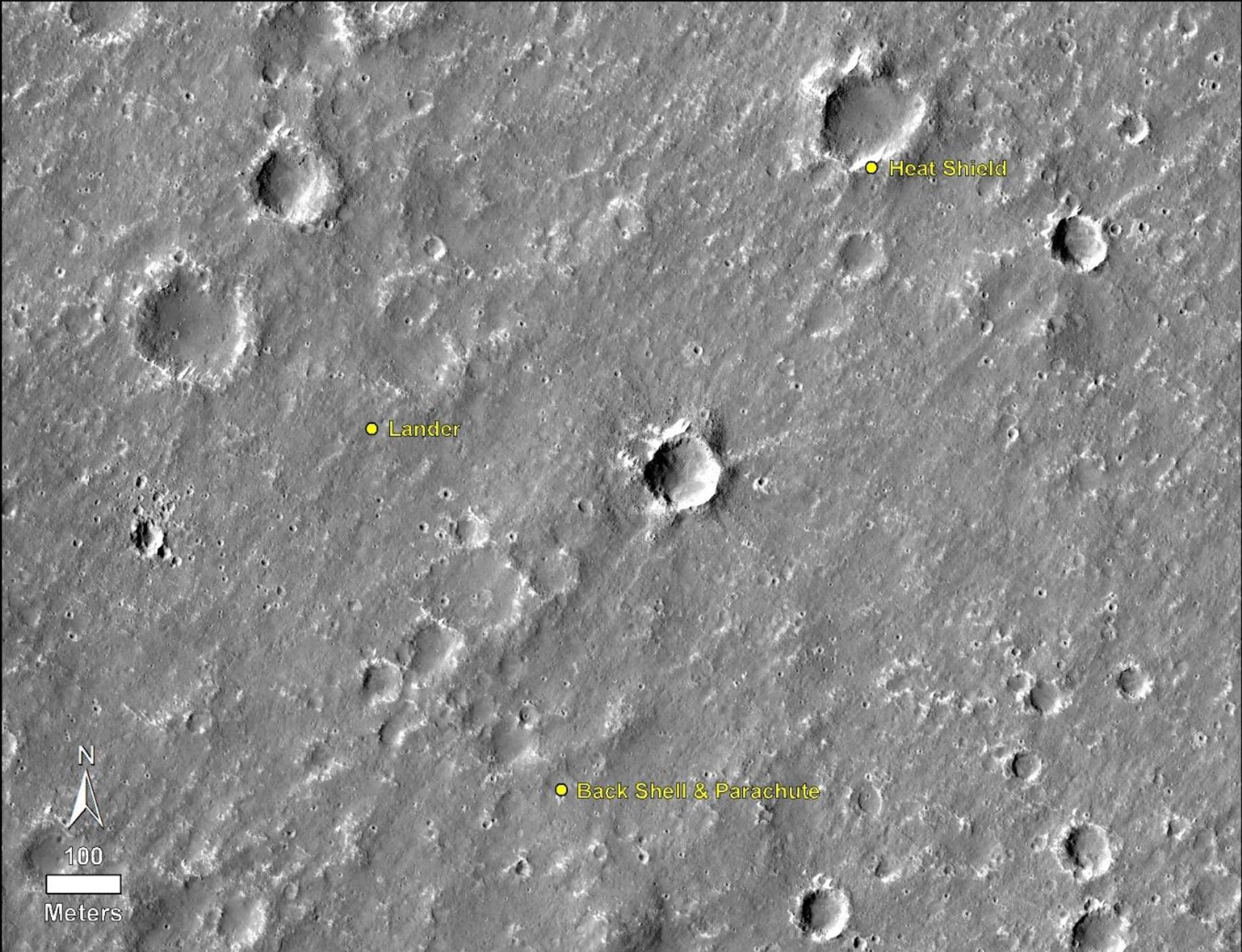






10

Kilometers



● Heat Shield

● Lander

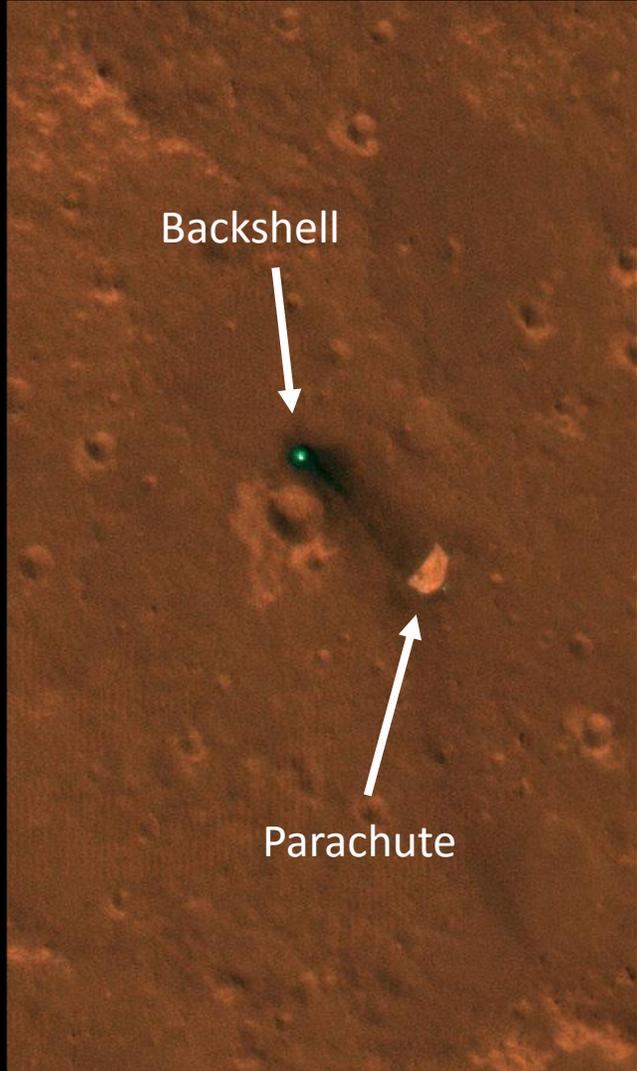
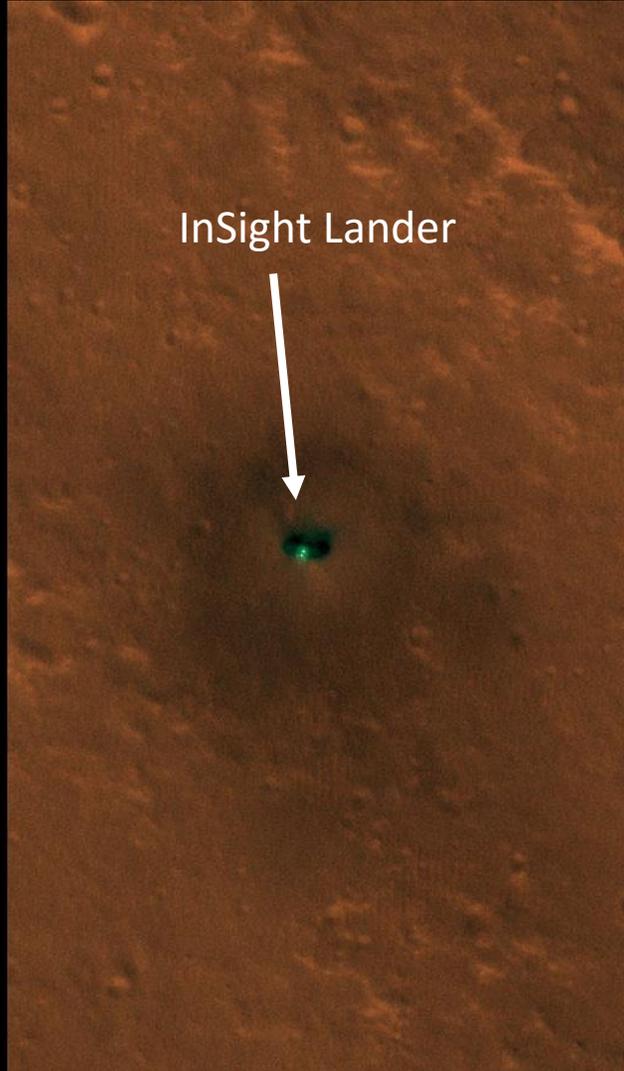
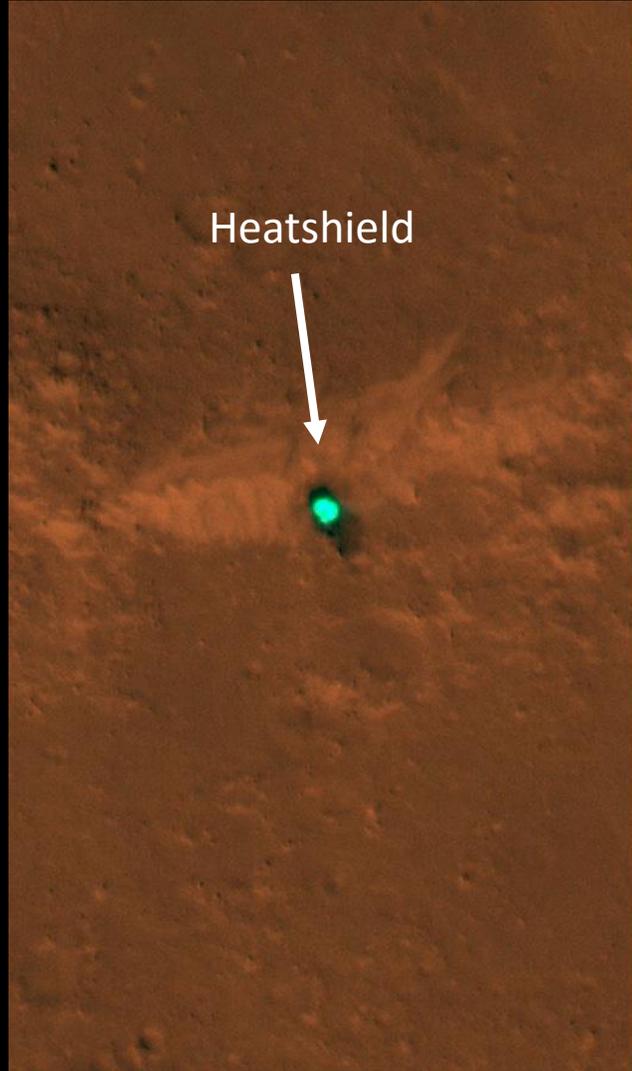
● Back Shell & Parachute

N
100
Meters



InSight Viewed from Mars Reconnaissance Orbiter

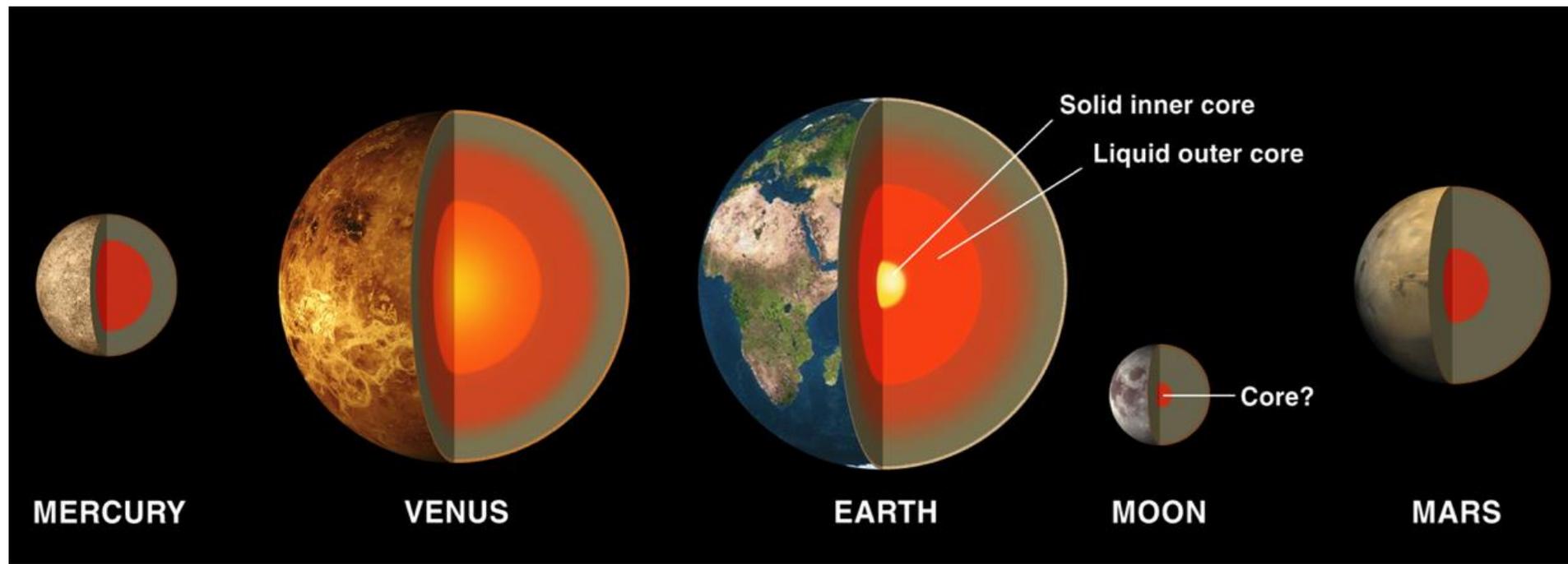
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THE SCIENCE

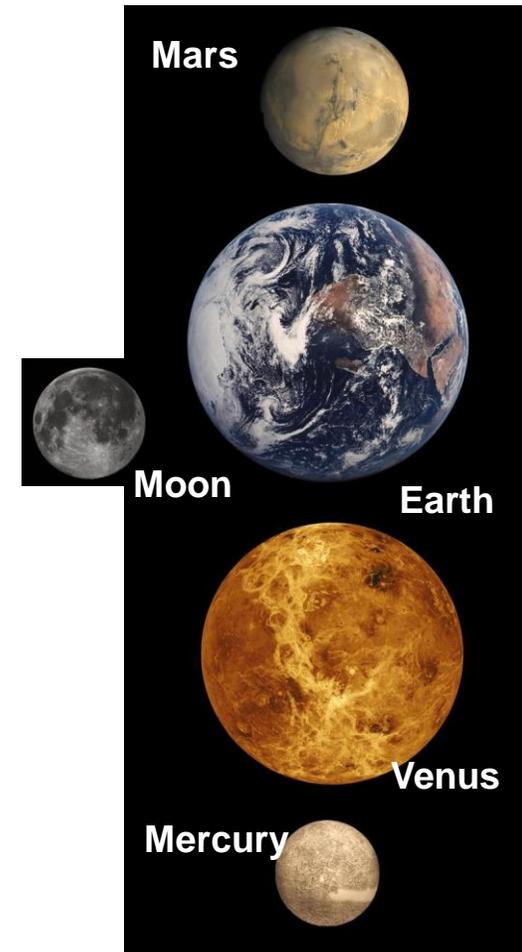
Science Goal

Understand the formation and evolution of **all** terrestrial planets through investigation of the interior structure and processes of Mars.



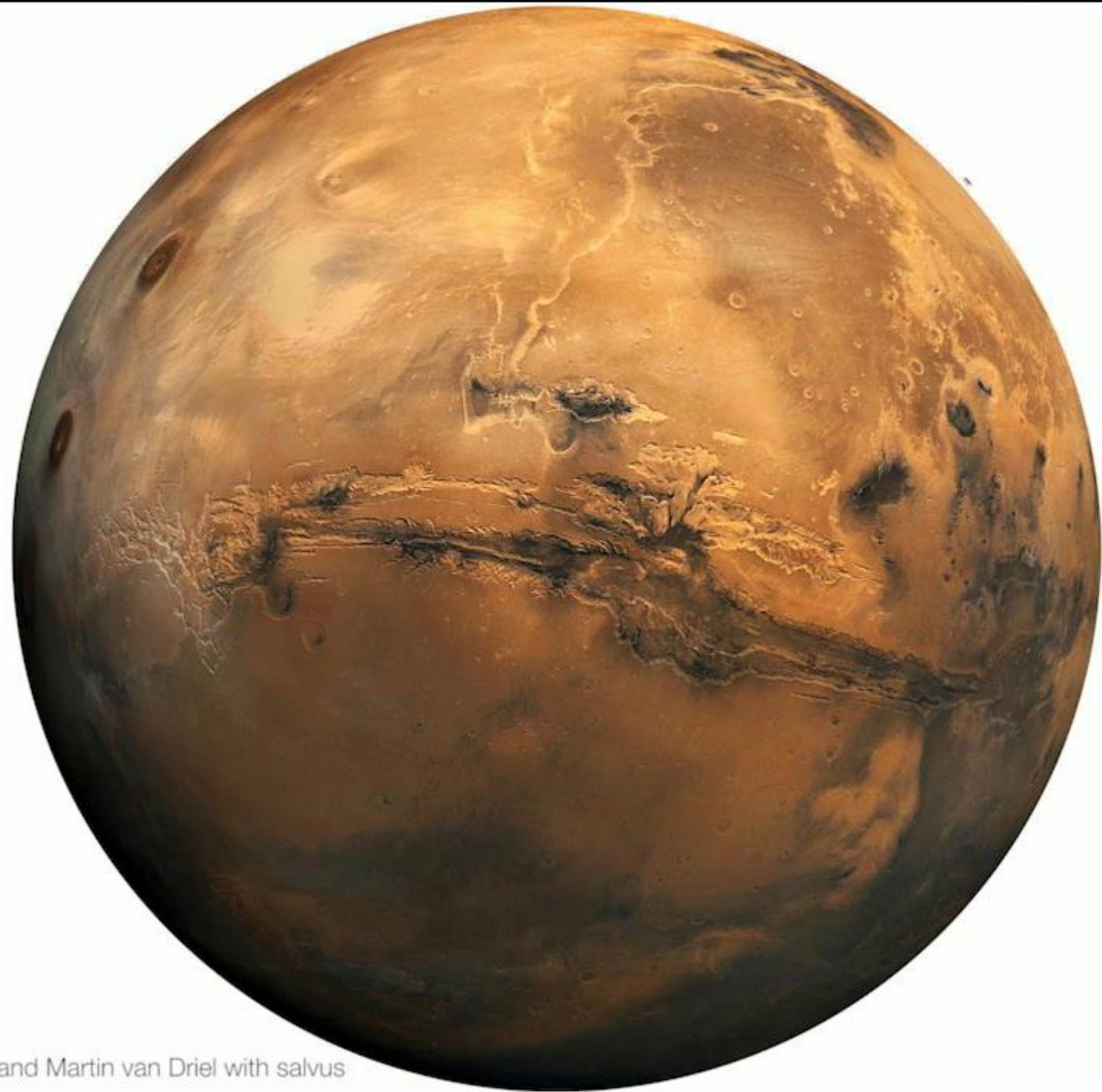
Terrestrial Family Photo

- All of the terrestrial planets have a three-part layered structure:
 - At the center is a metallic, iron-rich **core**, part of which may be molten
 - Above the core is a thick middle layer called the **mantle**, rich in silicon, making up most of the bulk of the planet
 - Above the mantle is a relatively thin **crust** of less-dense rocky material
- *InSight*, short for **I**nterior exploration using **S**eismic Investigations, **G**eodesy and **H**eat **T**ransport
 - Will determine the structure of Mars
 - Address why Mars evolved so differently than Earth
 - Aid in understanding fundamental geophysical questions on Planet formation



Why Mars?





Computed by Lion Krischer and Martin van Driel with salvus

Time: 0 sec



Computed by Martin van Driel with AxiSEM

THE INSTRUMENTS

Checking the Health of Mars

InSight will be using its science instruments to take the “vital signs” of Mars



its pulse (seismology),

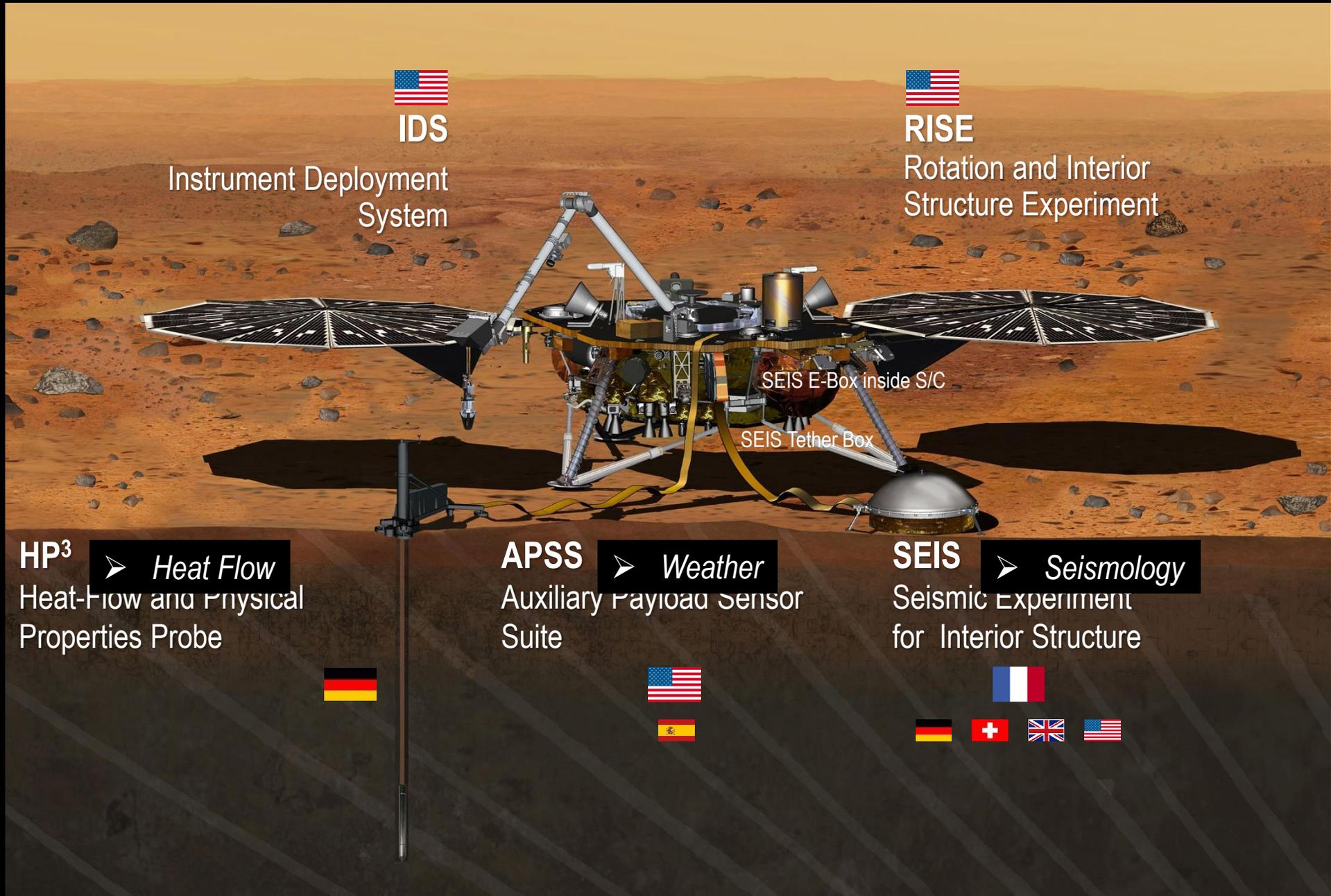


its temperature (heat flow)



its reflexes (radio science)

InSight Payloads



IDS

Instrument Deployment System



RISE

Rotation and Interior Structure Experiment

SEIS E-Box inside S/C

SEIS Tether Box

HP³

➤ *Heat Flow*
Heat-Flow and Physical Properties Probe



APSS

➤ *Weather*
Auxiliary Payload Sensor Suite



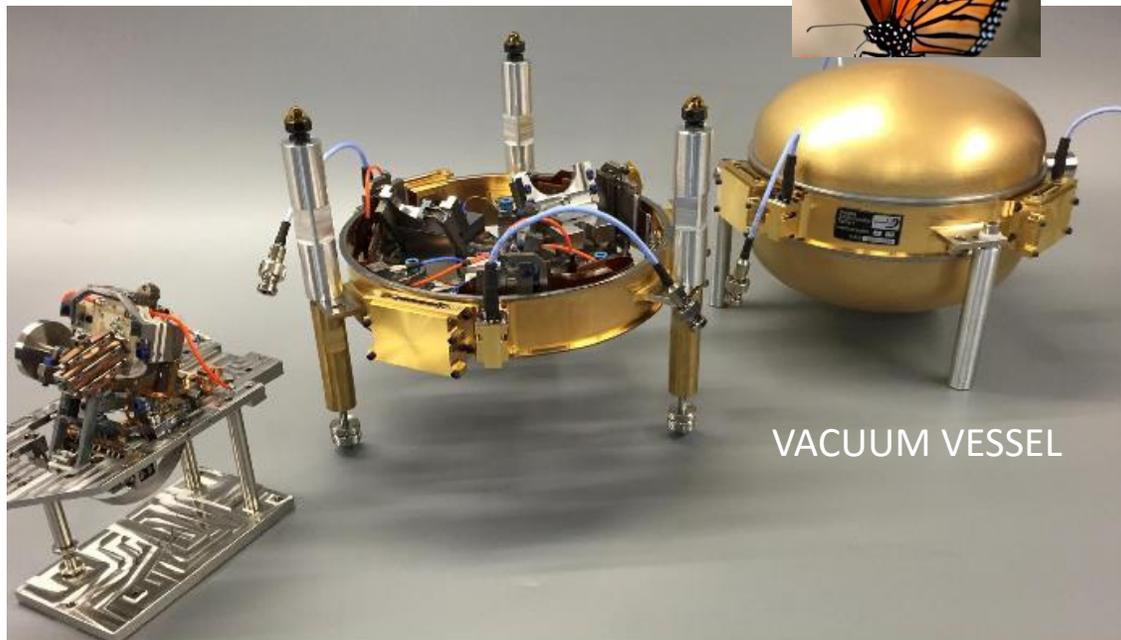
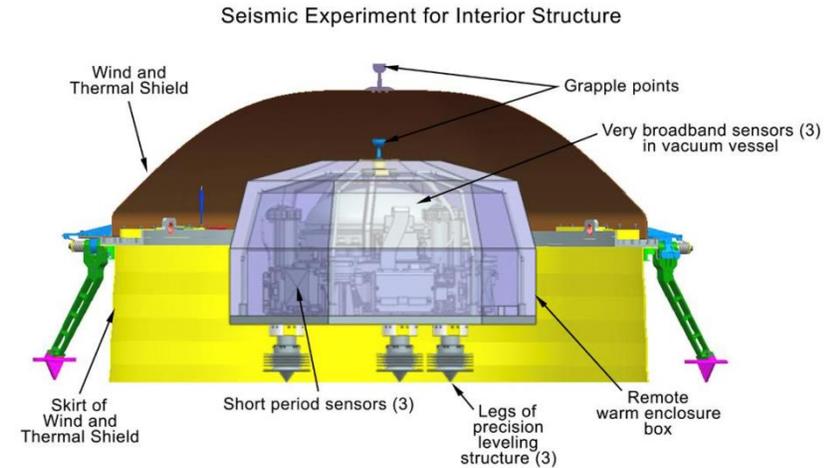
SEIS

➤ *Seismology*
Seismic Experiment for Interior Structure



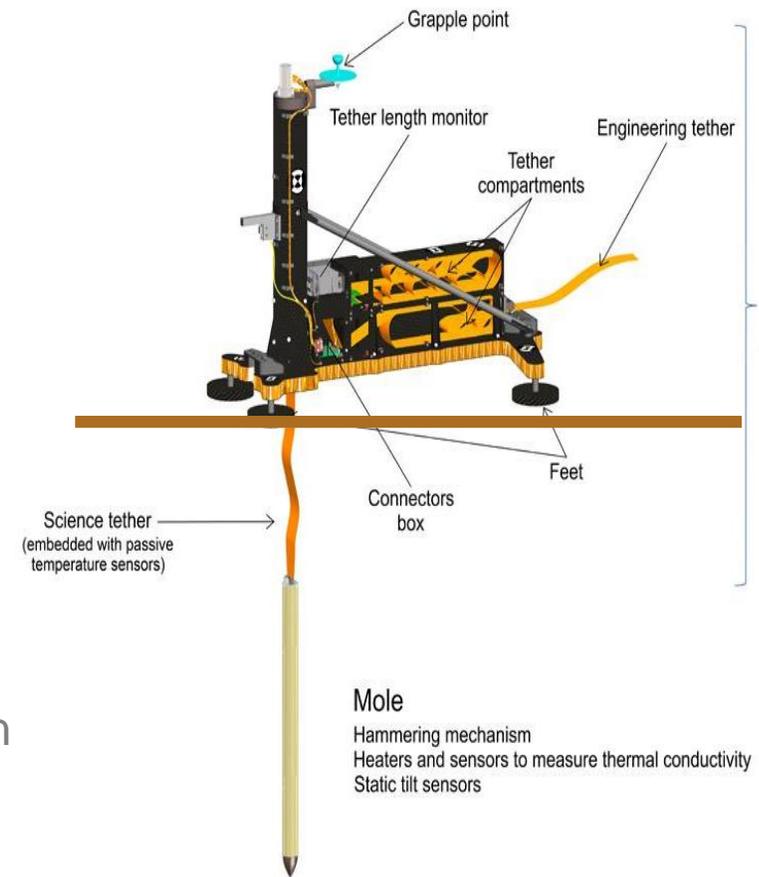
InSight Seismometer

- InSight seismometer combines two types of sensors
 - 3 is an ultra-sensitive "very broad band"
 - 3 is a short-period instrument, adding capability for higher-frequency vibrations.



HP³ (Heat Flow and Physical Properties Package)

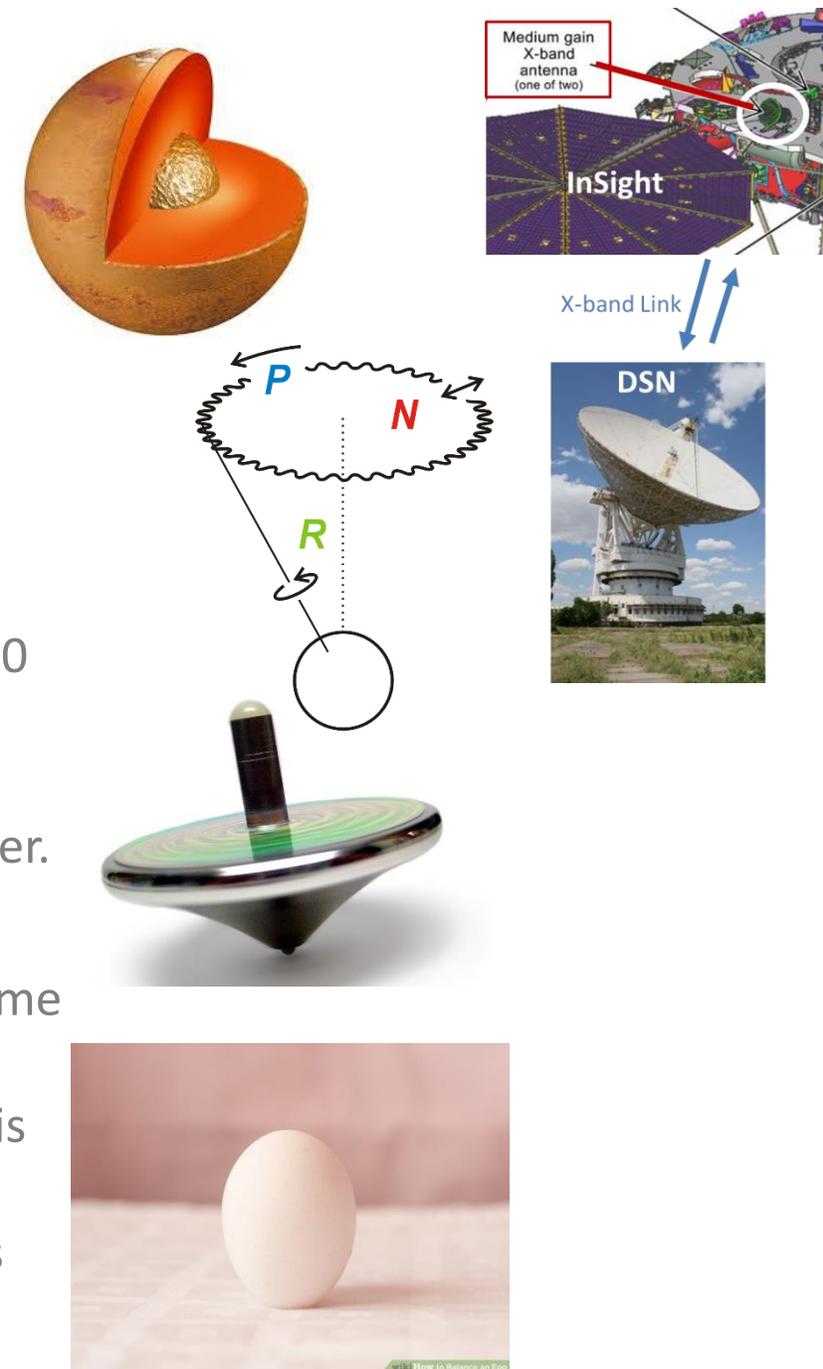
- The instrument's mole is expected to use between 5,000 and 20,000 hammering strokes, over at least 45 days, to reach 10-16 feet depth
- The mole carries sensors and heaters to determine the thermal conductivity of the ground around it.
- The science tether contains precise temperature sensors every ~1 foot to measure the temperature changes with depth (thermal gradient)
- When combined with the conductivity information determines the heat flux



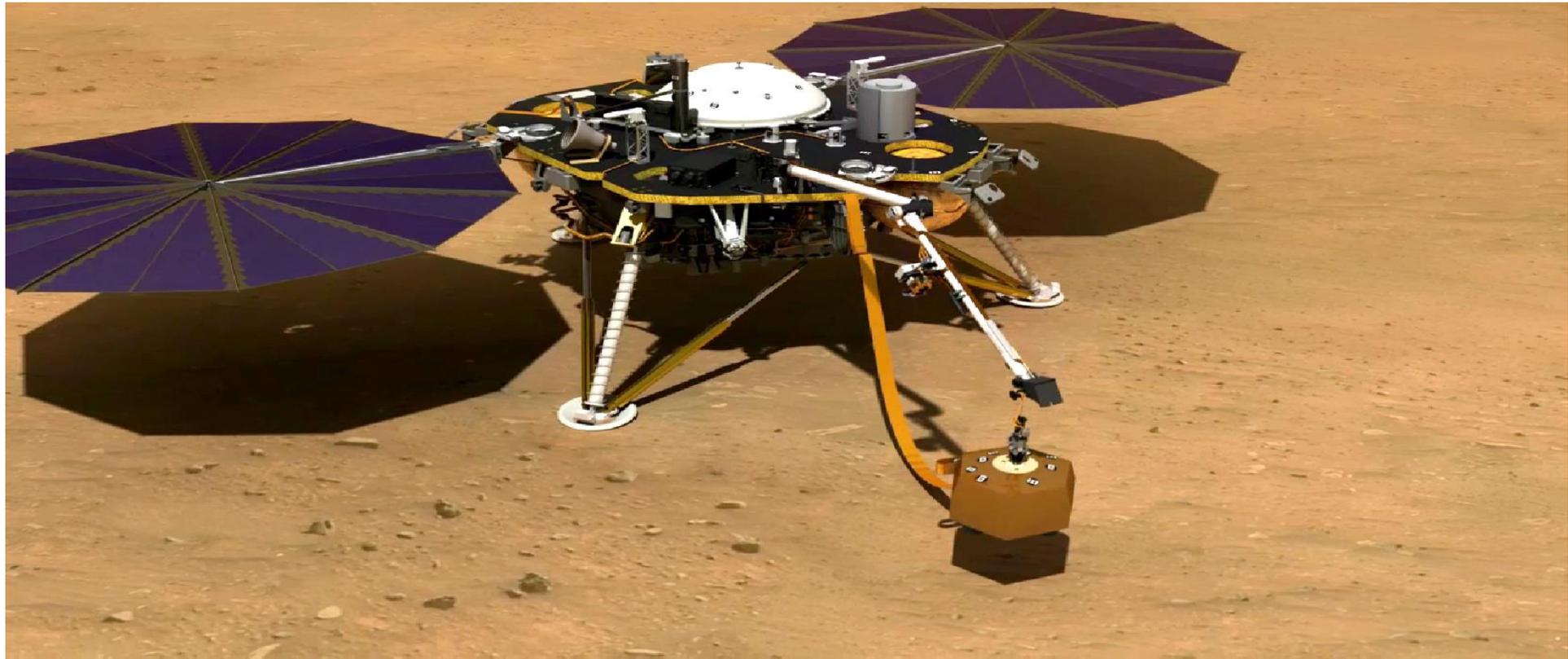
The mole is about a U.S. quarter in diameter and the length of a forearm.

Sizing Up the Core of Mars

- Perturbations of a planet rotation axis can provide information about the planet's core. The perturbations resemble the wobble of a spinning top, and occur on two time scales.
- The longer wobble, called precession, takes about 165,000 years and is the same as the process that makes a top wobble. The speed of this precession is directly related to the proportion of the body's mass that is close to the center.
- The shorter-period wobbles, called nutation, occurs on time scales of less than a year and are extremely small. Their cause is unrelated to a toy top's wobble. A closer analogy is the traditional method for determining whether an egg is hard-boiled by spinning it. An egg with a solid center spins easily. The liquid center of a raw egg perturbs the spin.



INSTRUMENT DEPLOYMENT AND OPERATIONS

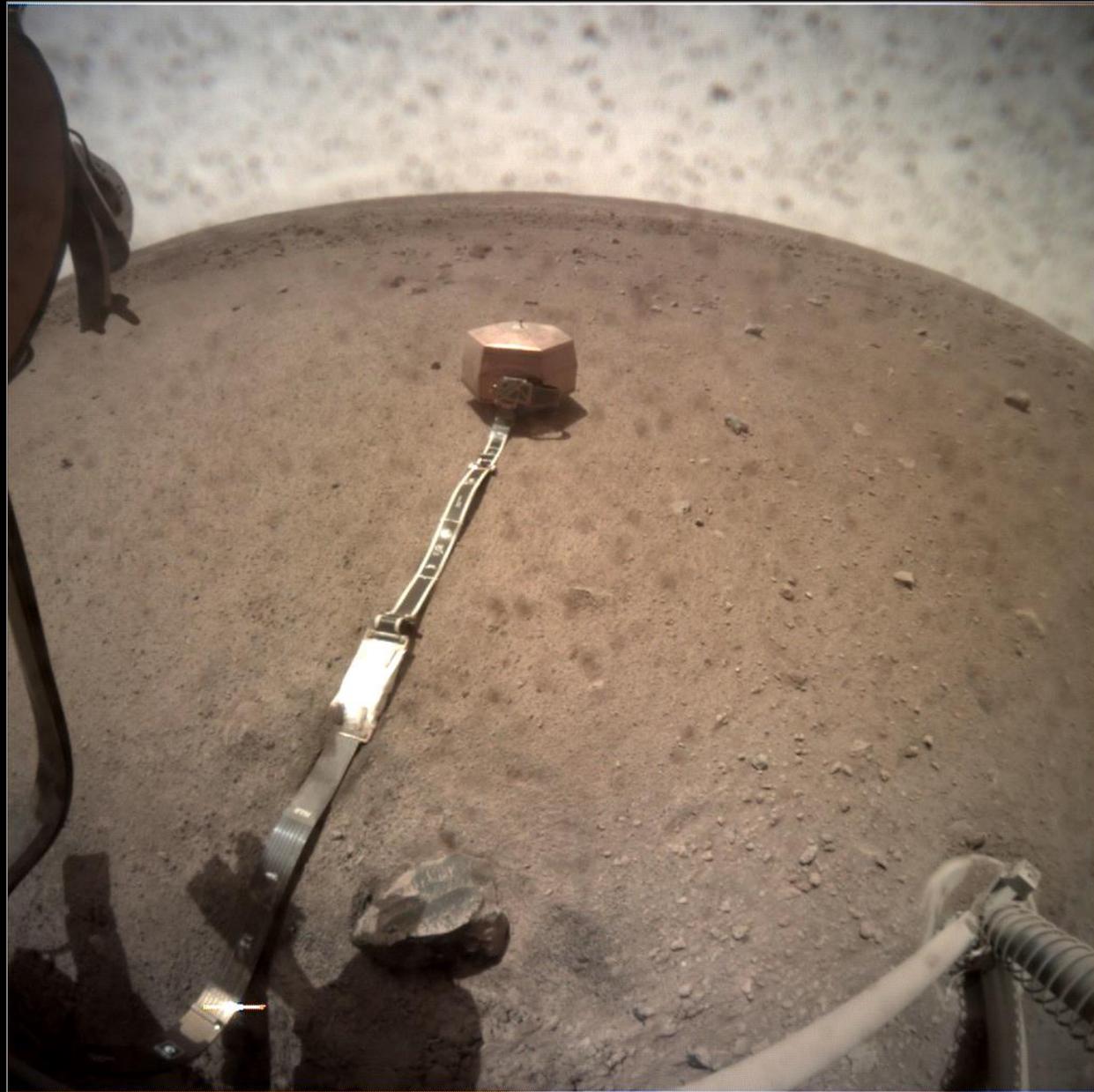




Post-touchdown Image





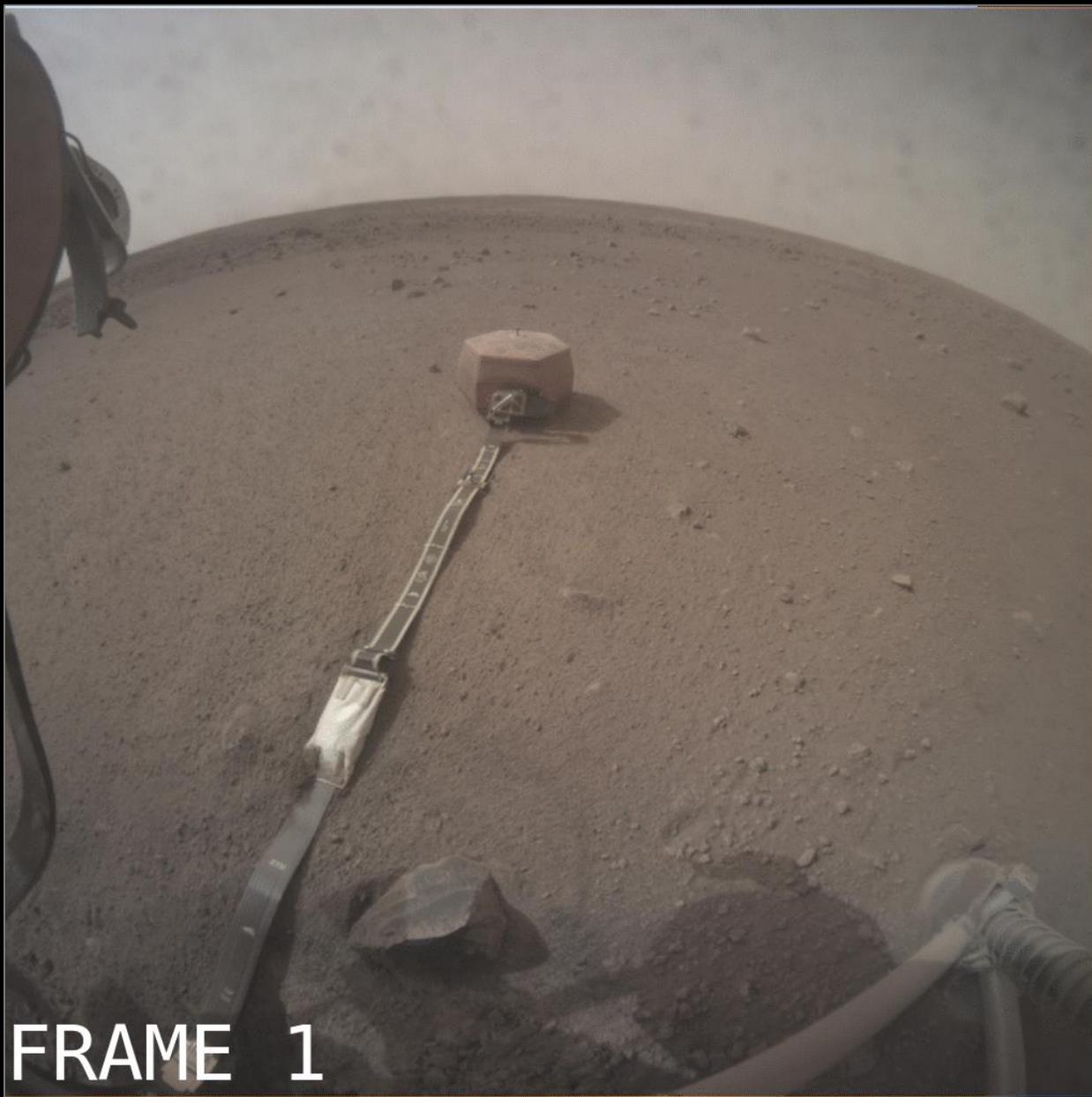




InSight

Wind & Thermal Shield Deployment Sequence

1



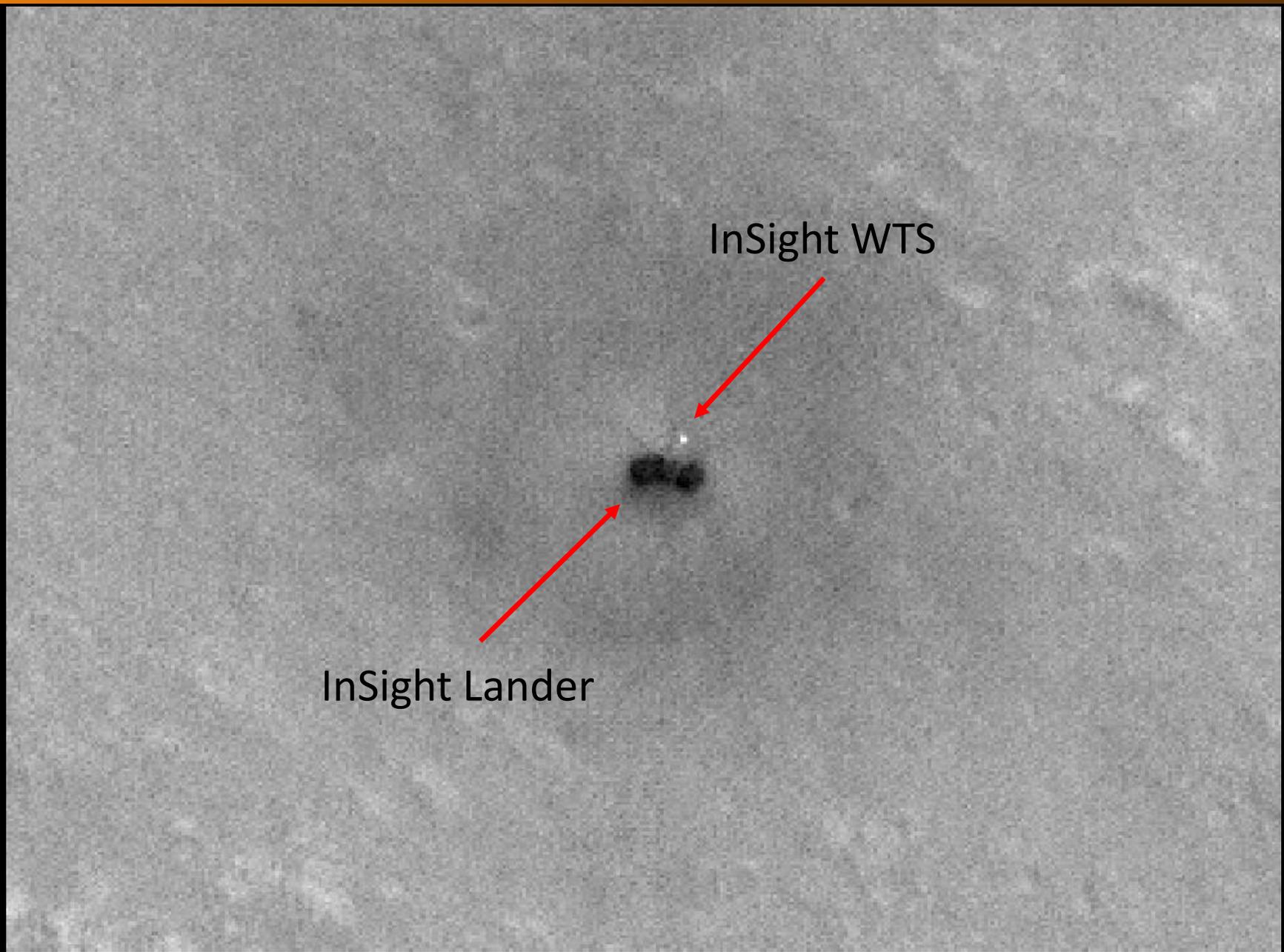
FRAME 1



InSight

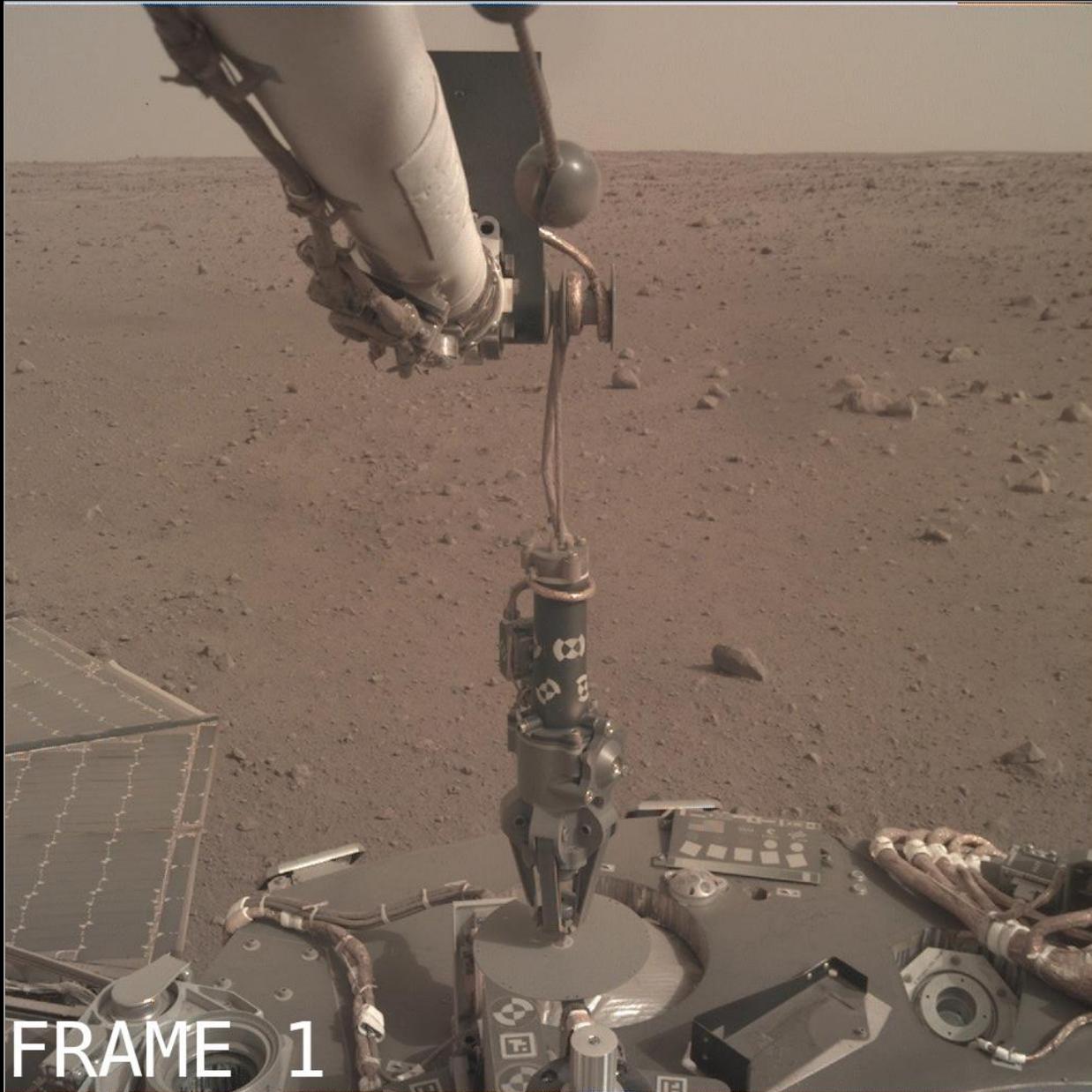
Wind & Thermal Shield on Mars







Heat Probe Grappling Sequence



FRAME 1



Heat Probe Deployment Sequence

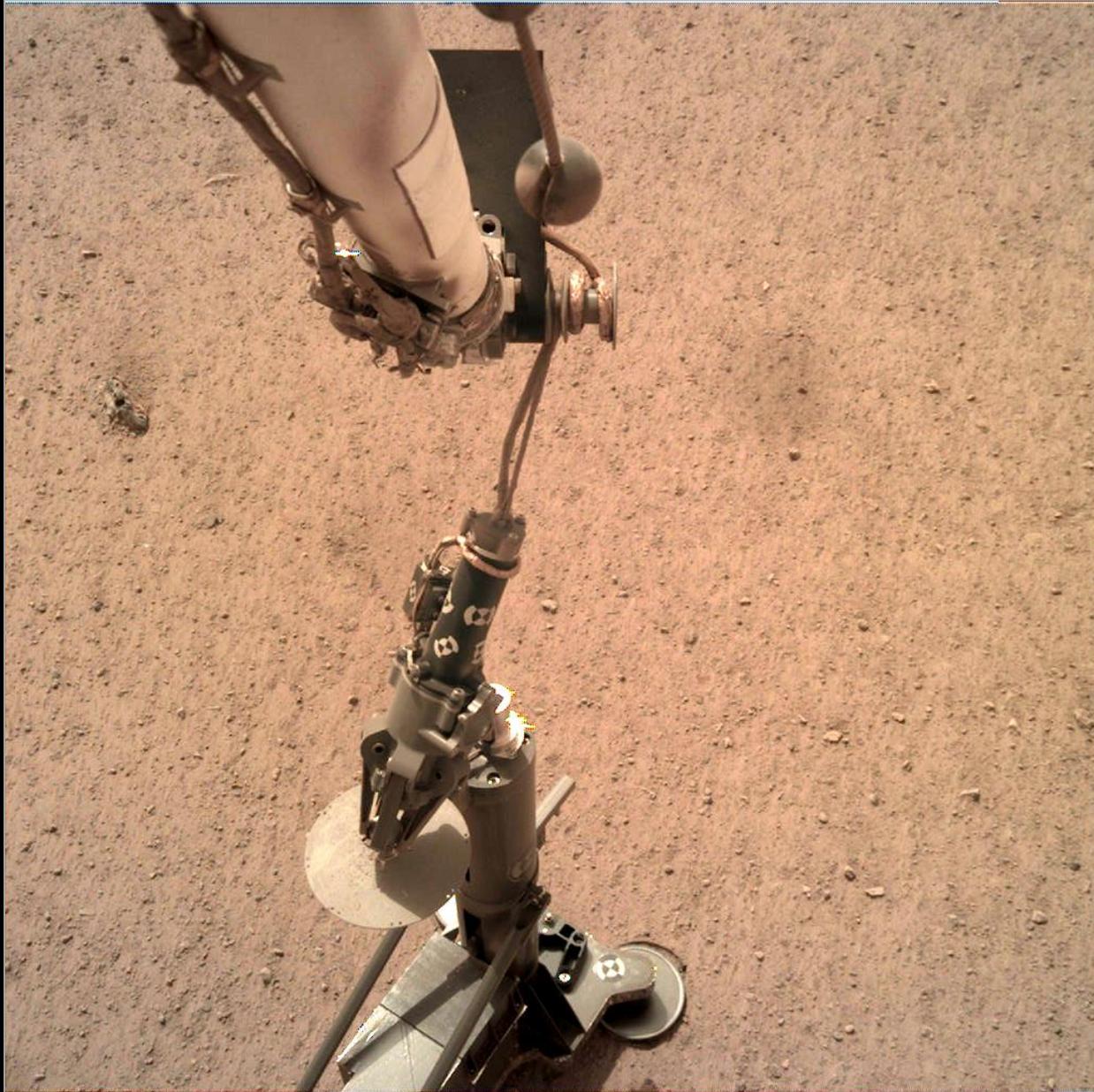
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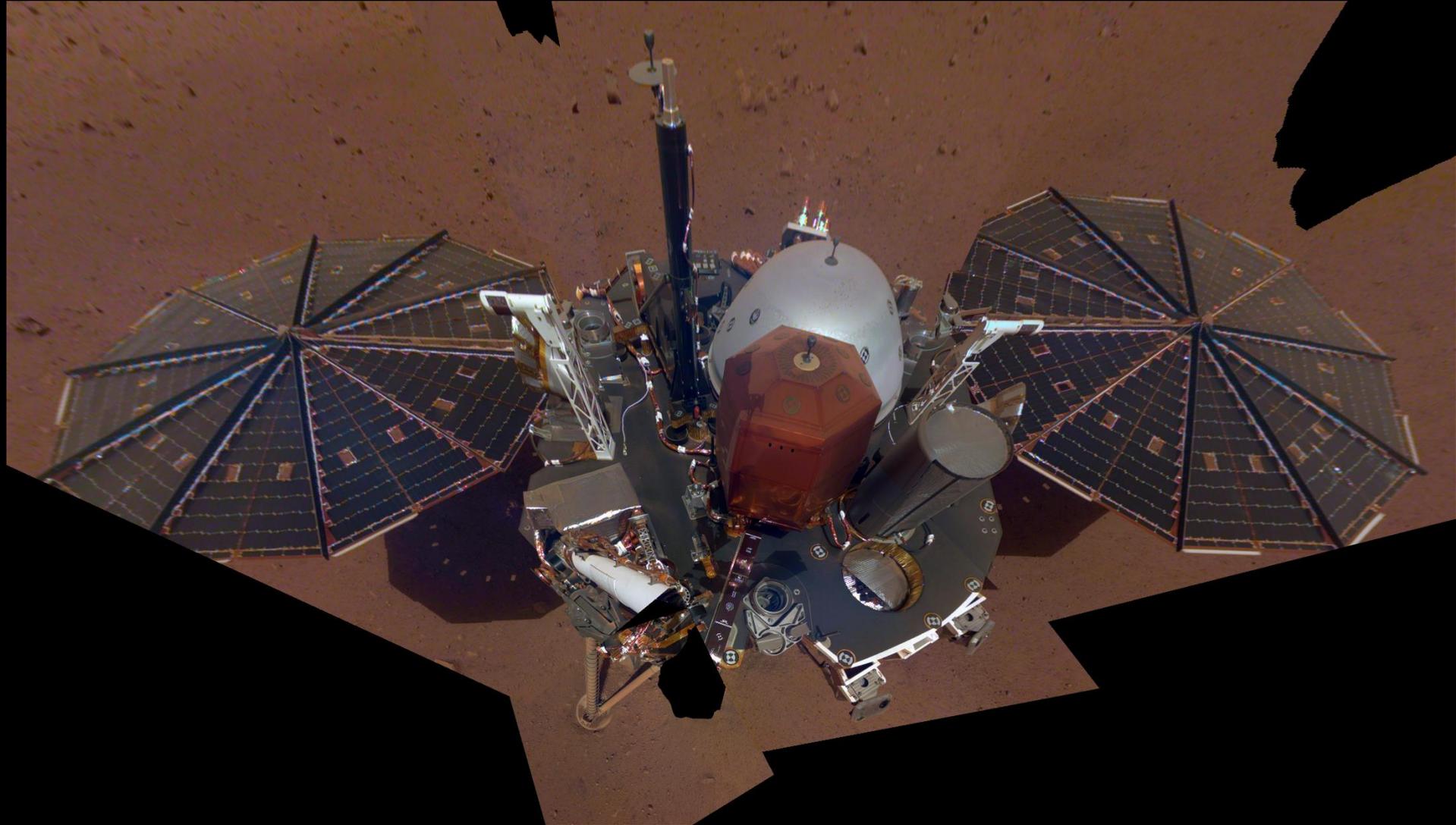


FRAME 1



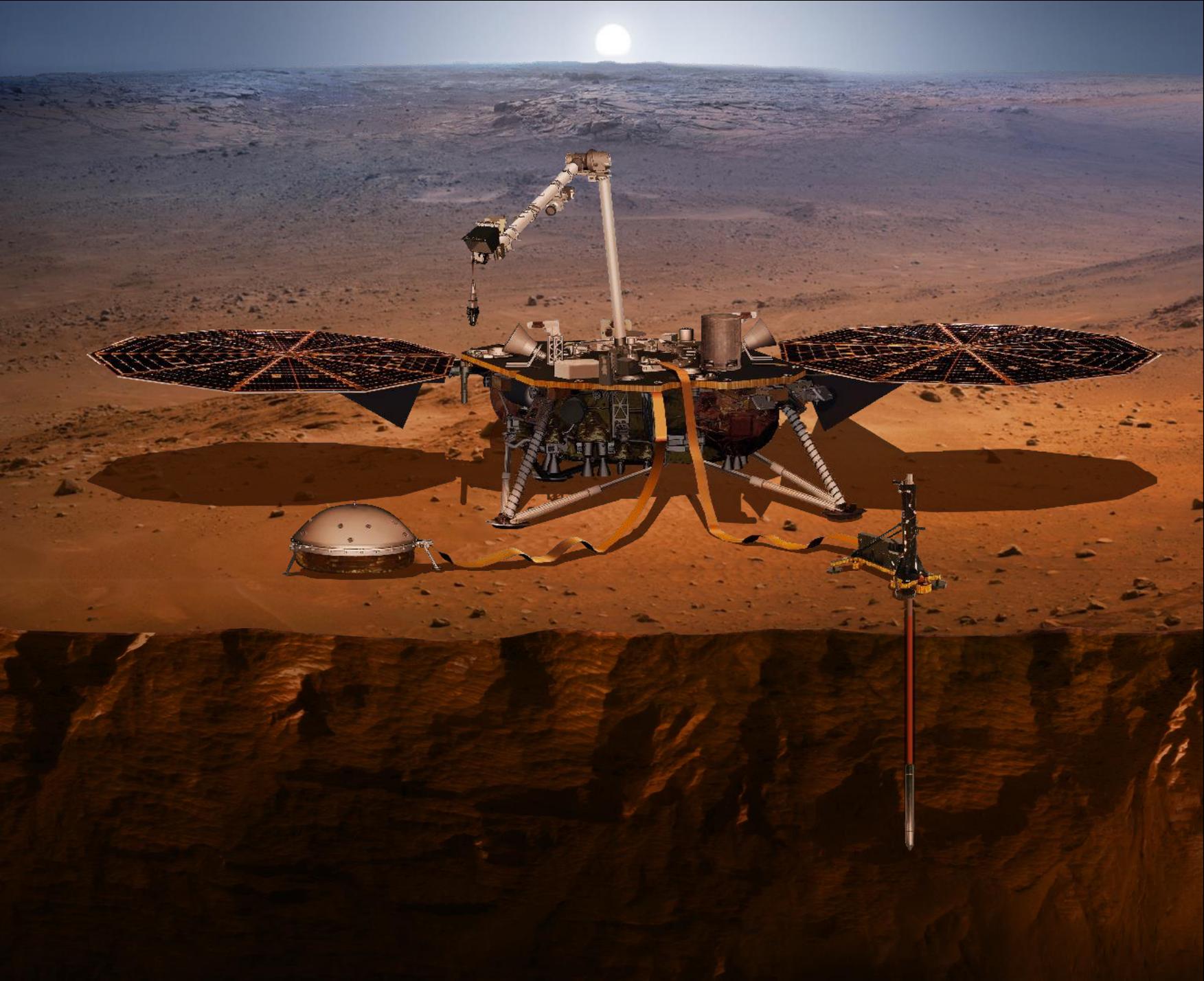
Heat Probe on Mars (with grapple)







InSight Project Team
January 2019



Join the InSight team on Mars:

- <https://mars.nasa.gov/insight/>
 - Interact with Lander
 - “On a mission” Podcast
 - Lots of cool mission information

- Thanks to my co-authors!