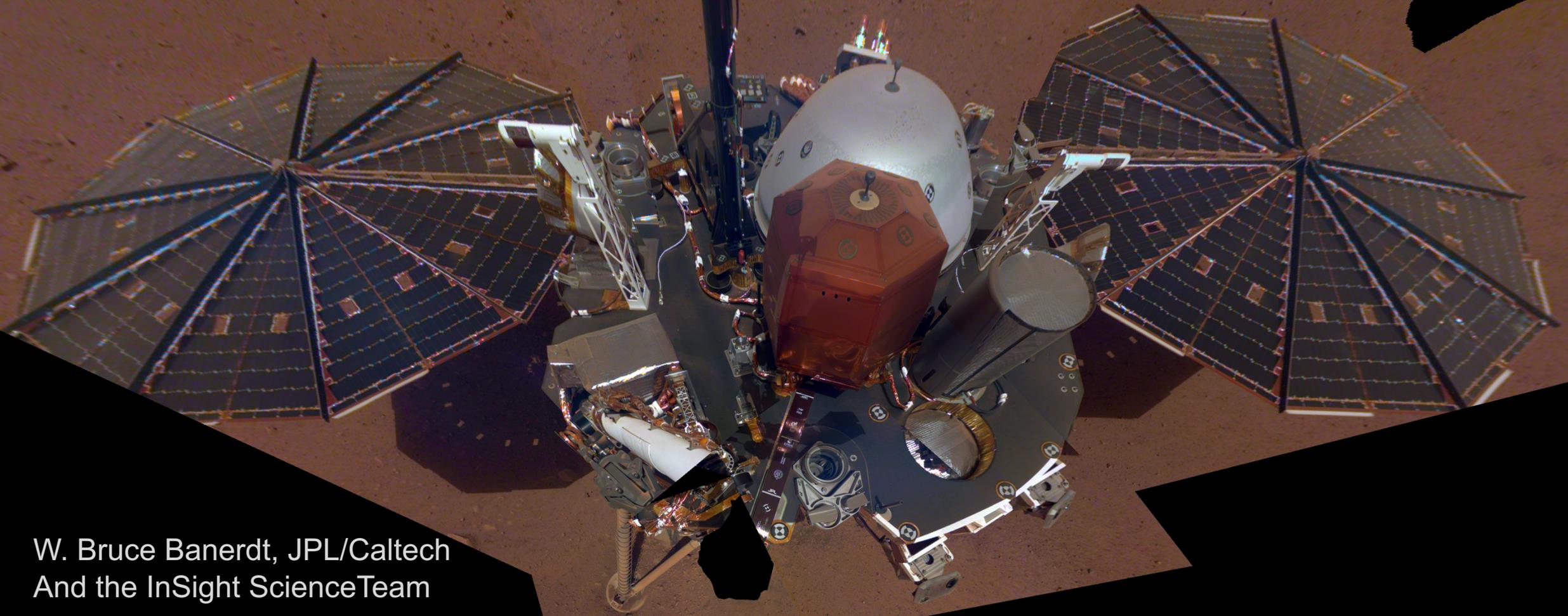


Insight — The First Three Months (or 100 sols) on Mars



W. Bruce Banerdt, JPL/Caltech
And the InSight Science Team

18 March, 2019

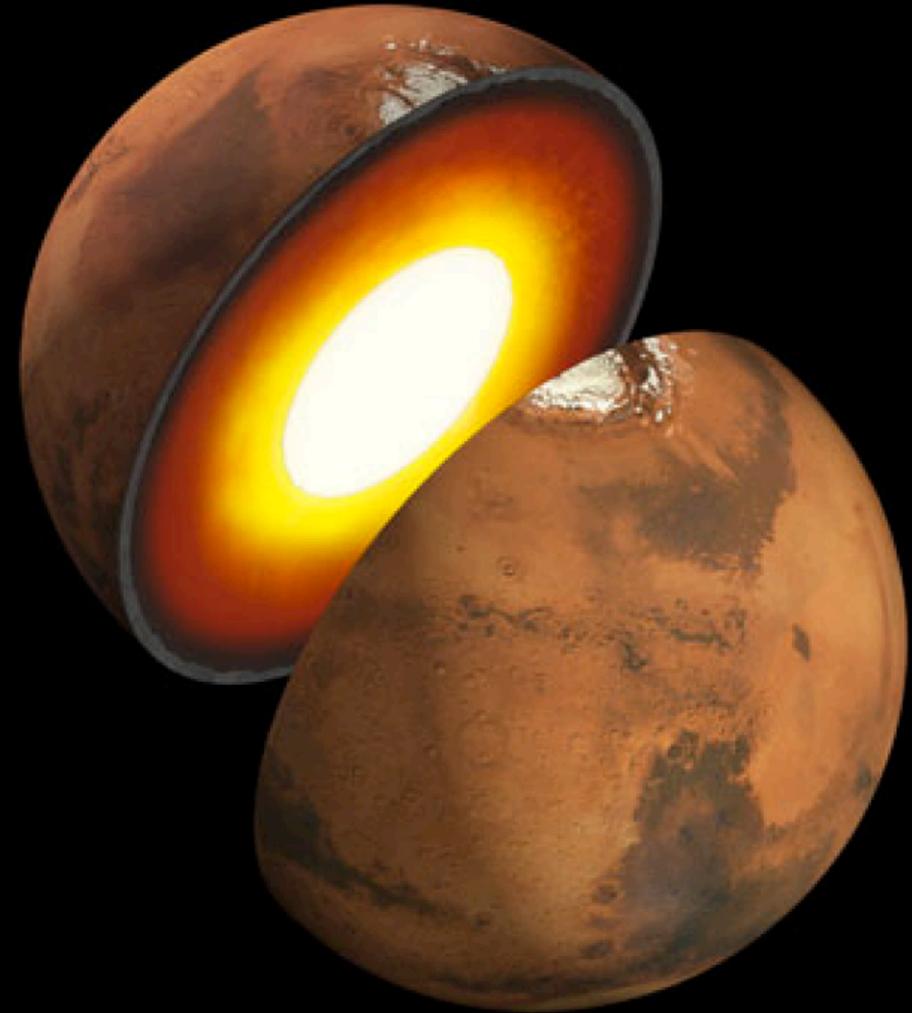


Mission Objectives

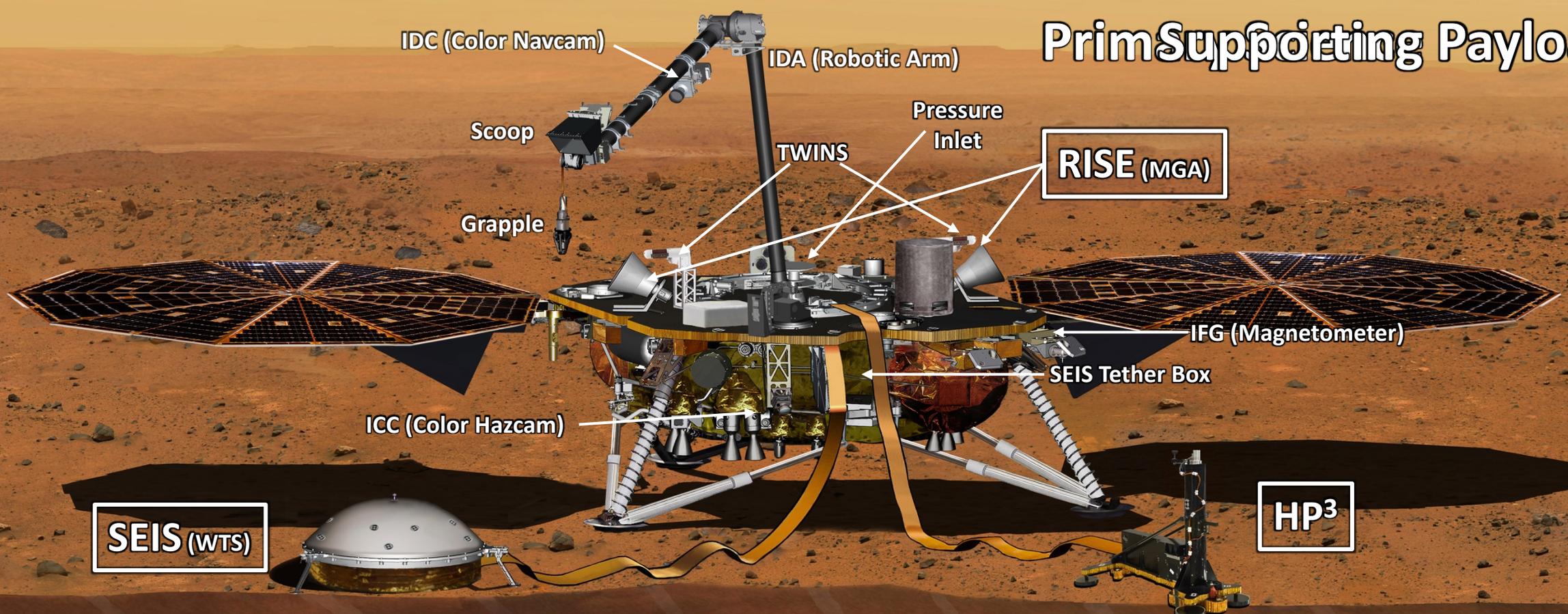
Goal: Provide constraints on the formation and early evolution processes of terrestrial planets by studying the internal structure of Mars.

In order to address this goal, InSight will determine, through geophysical measurements:

- Crustal thickness and large-scale layering
- Mantle structure
- Core size and density
- Global heat flux
- Rate and distribution of seismic activity
- Rate of meteorite impacts



Primary Supporting Payload



SEIS (WTS)

HP3

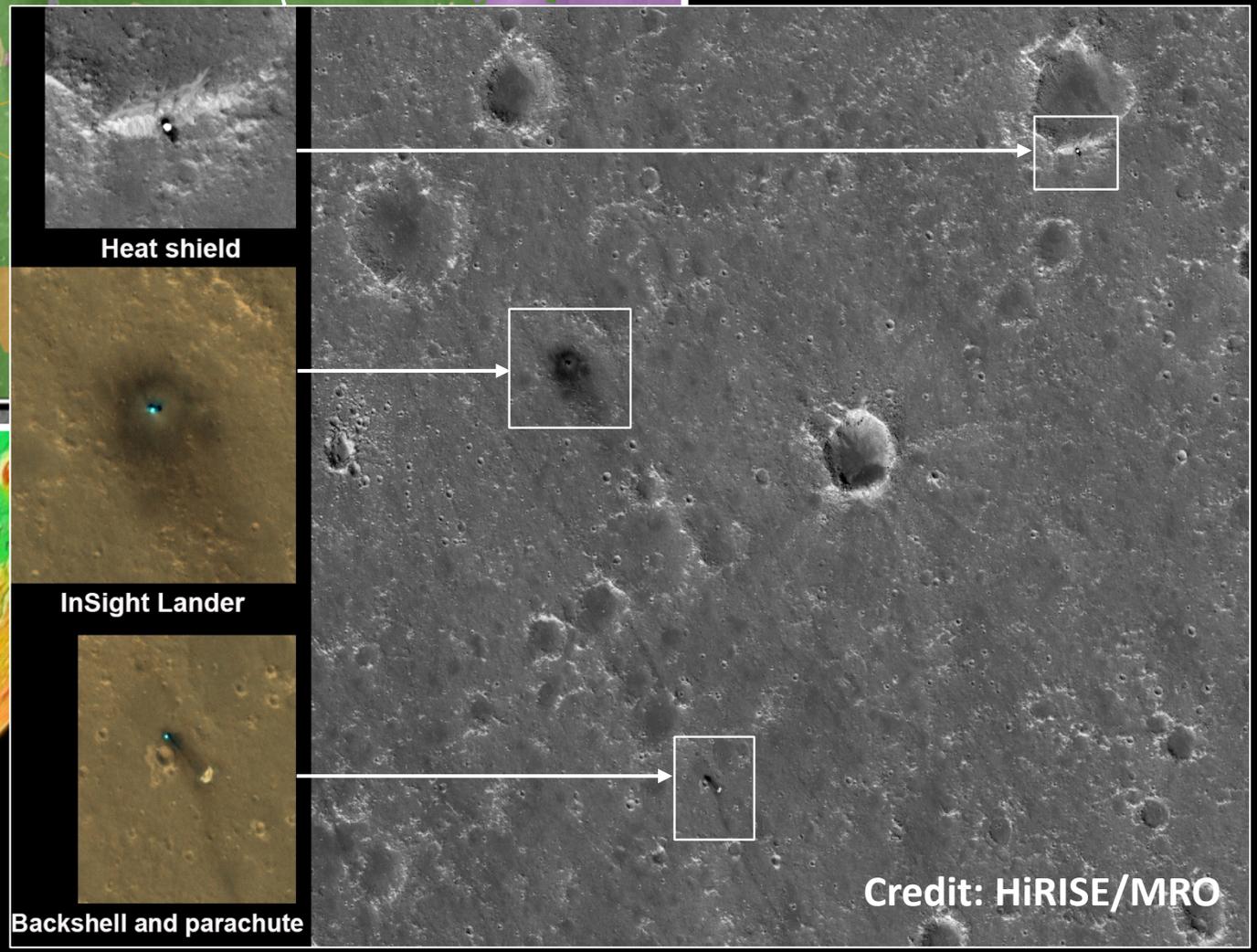
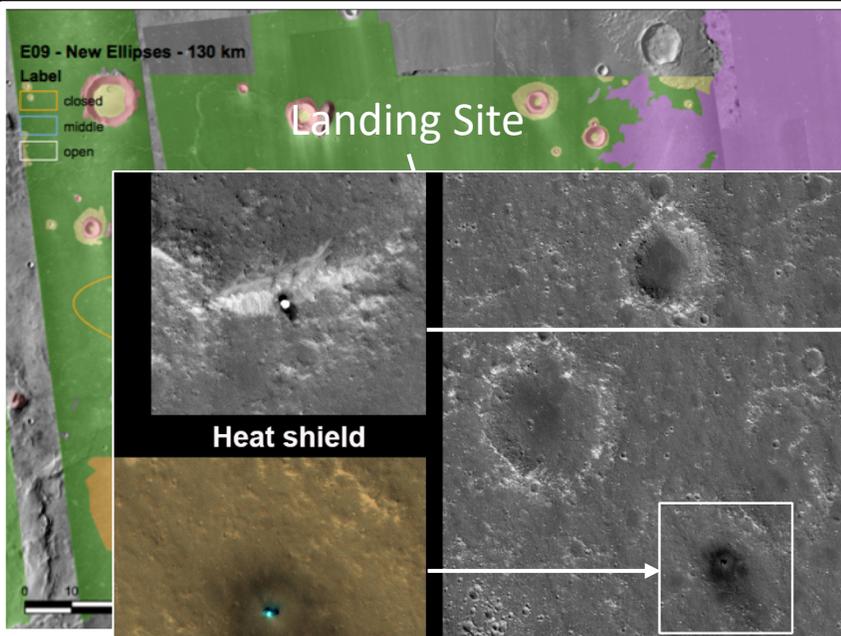
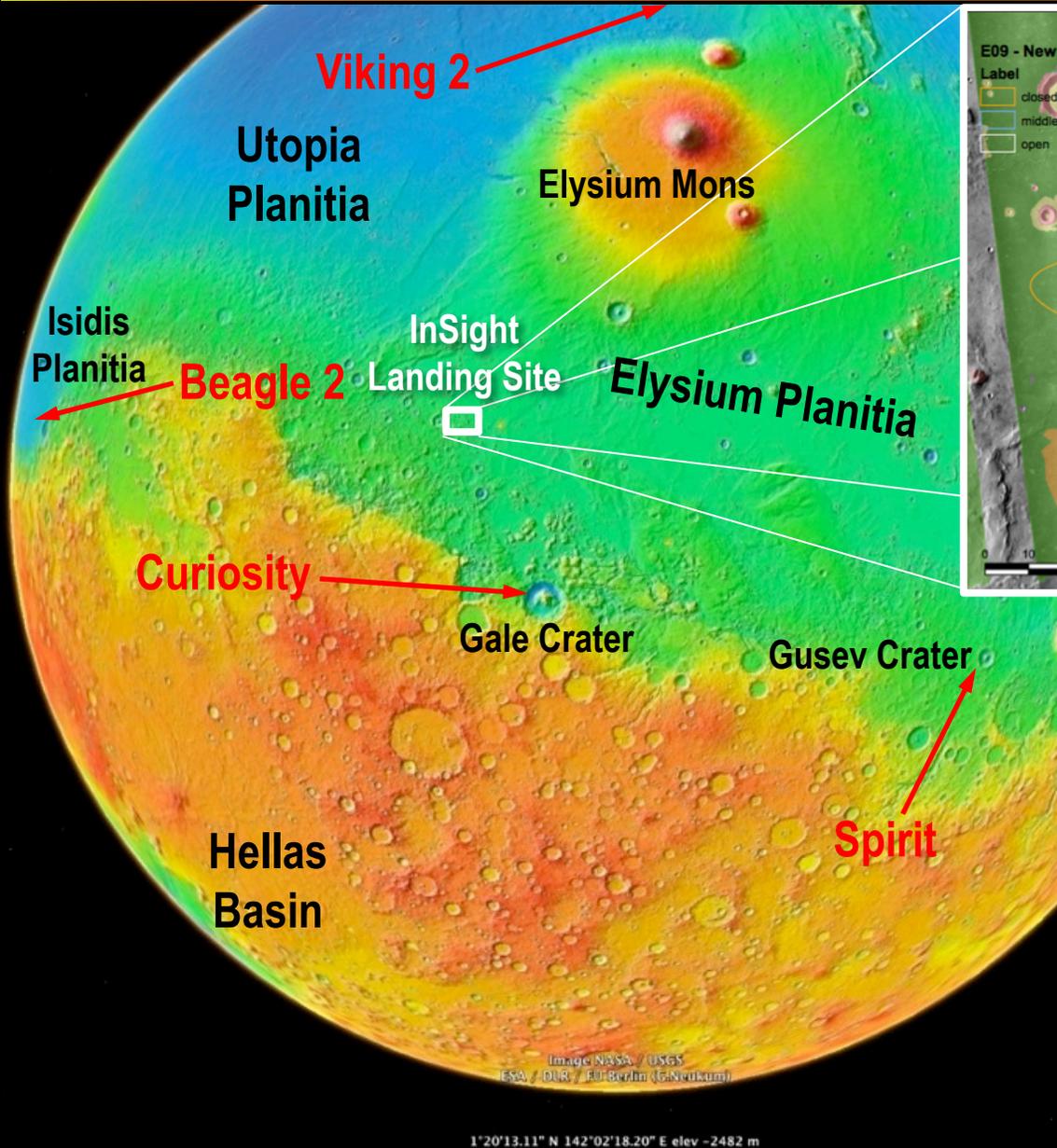
- Instrument Electronics – Inside S/C
- Pressure Sensor – Inside S/C
- Radiometer – Other side of S/C
- Camera Calibration Target – Other side of deck
- LaRRI (Laser Retroreflector) – Other side of deck
- Names to Mars Chips – Other side of deck

Science Tether

Mole

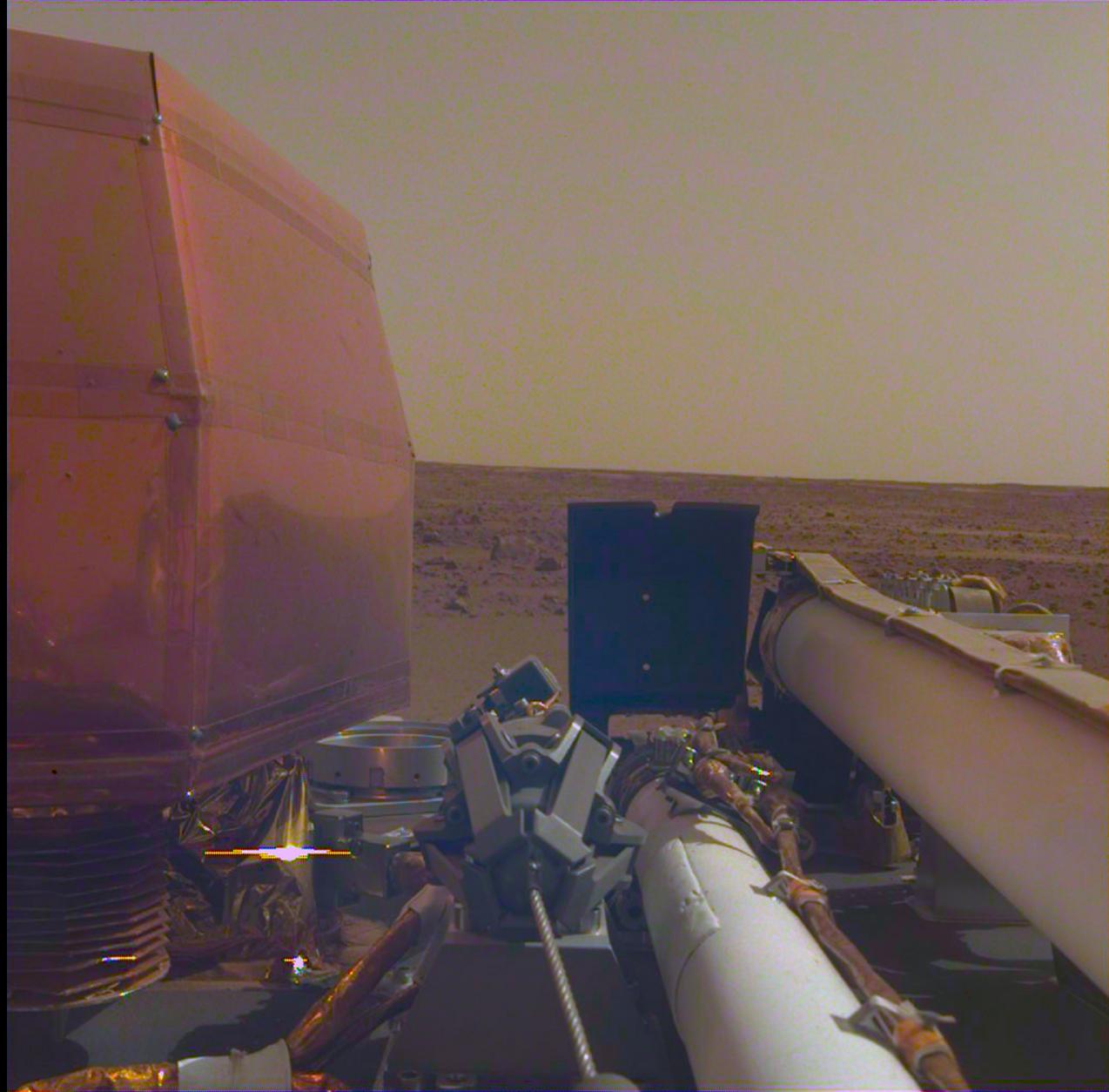
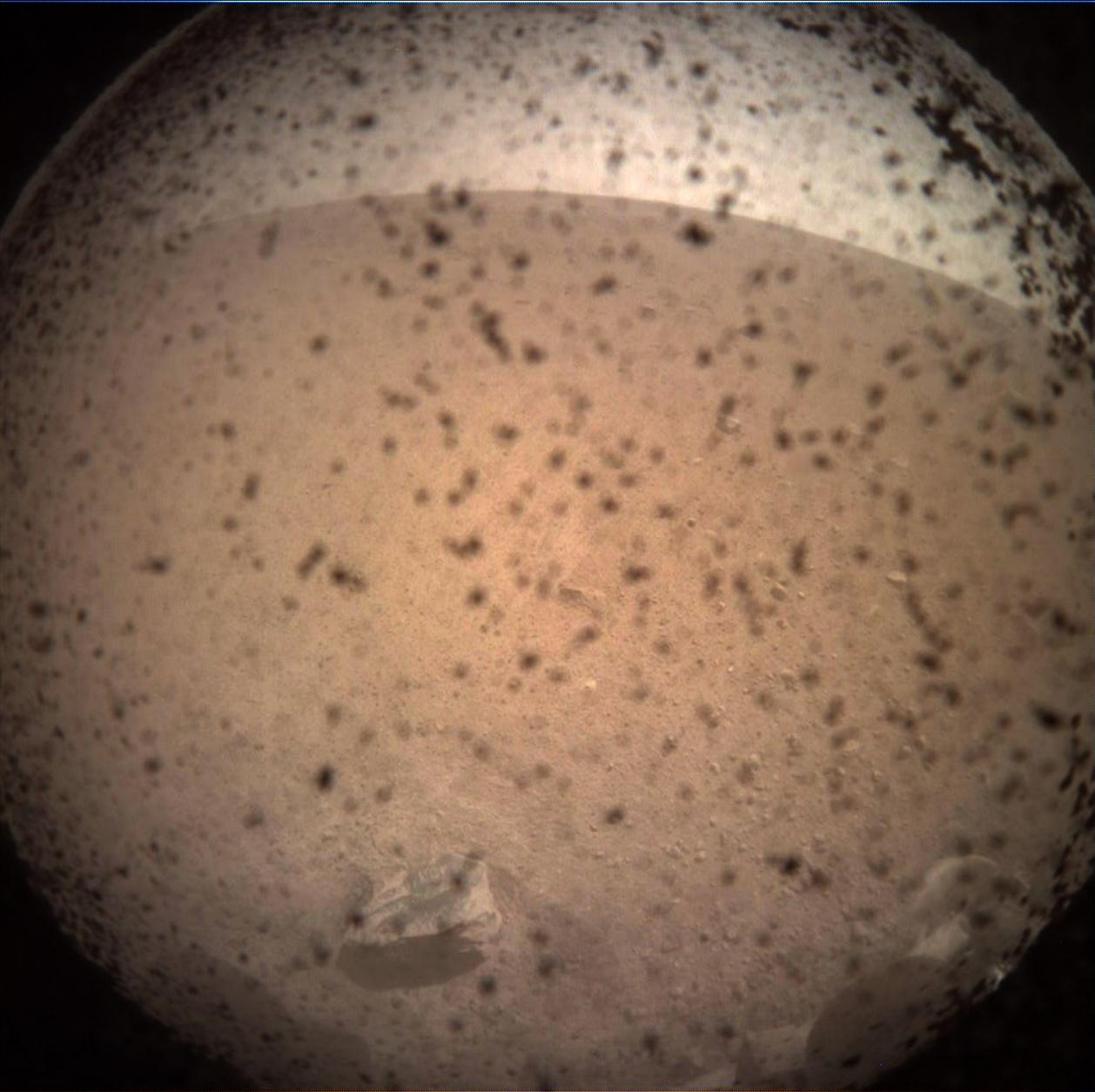


Landing – November 26, 2018, Western Elysium Planitia



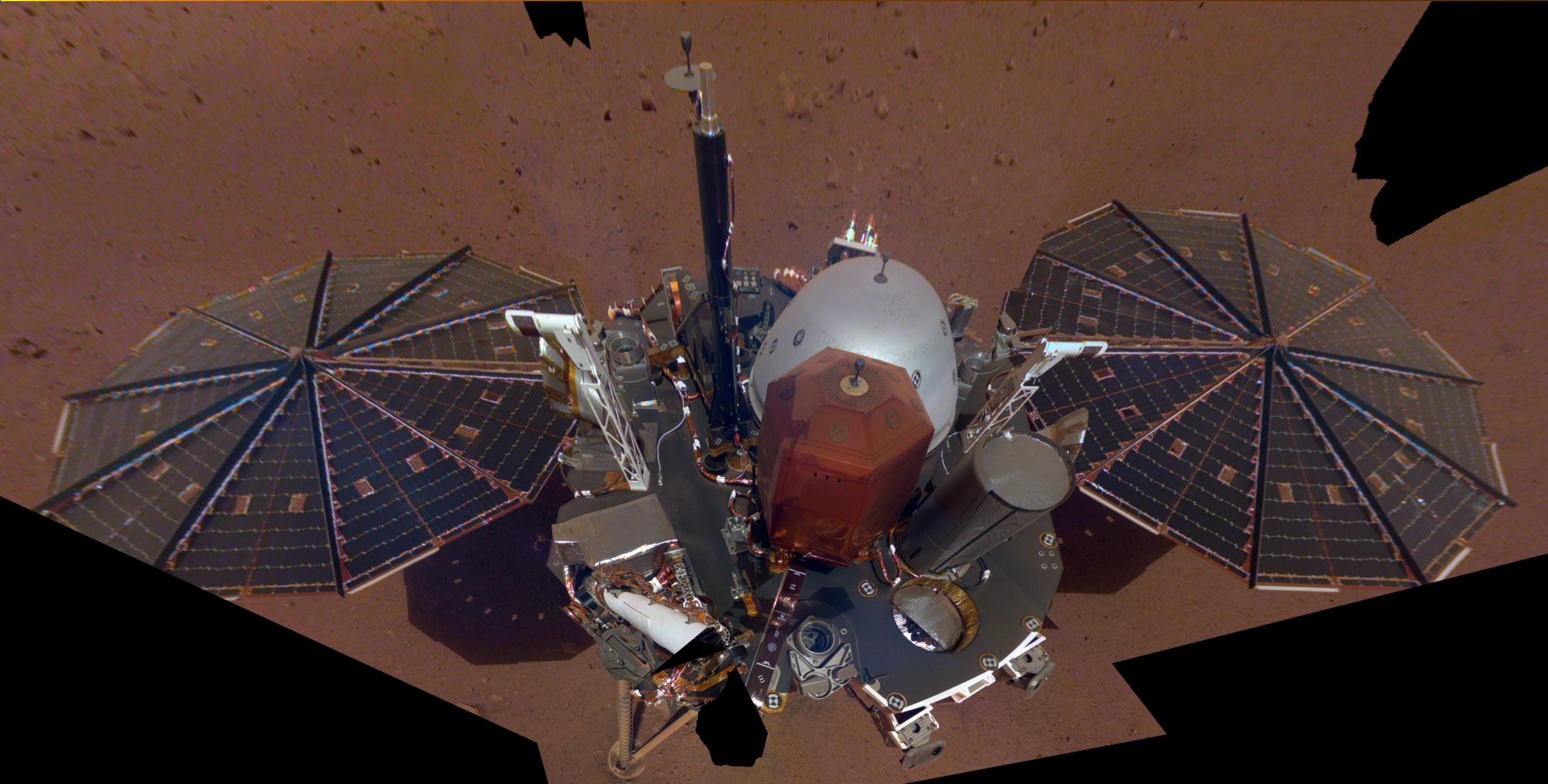


First InSight Images from Mars – Sol 0





Deployment Phase – Landing Through Sol 87

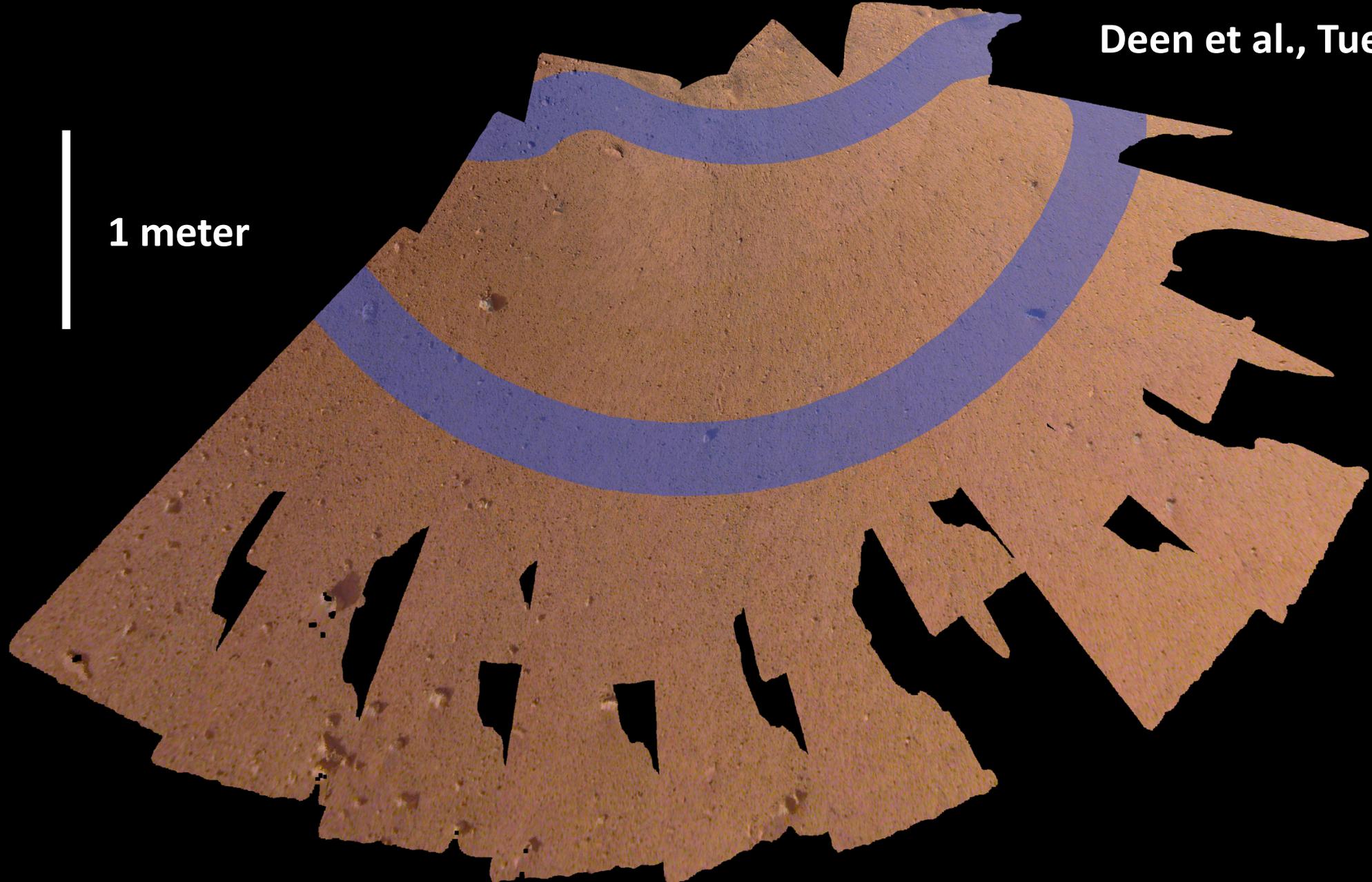




IDA (Instrument Deployment Arm) Workspace

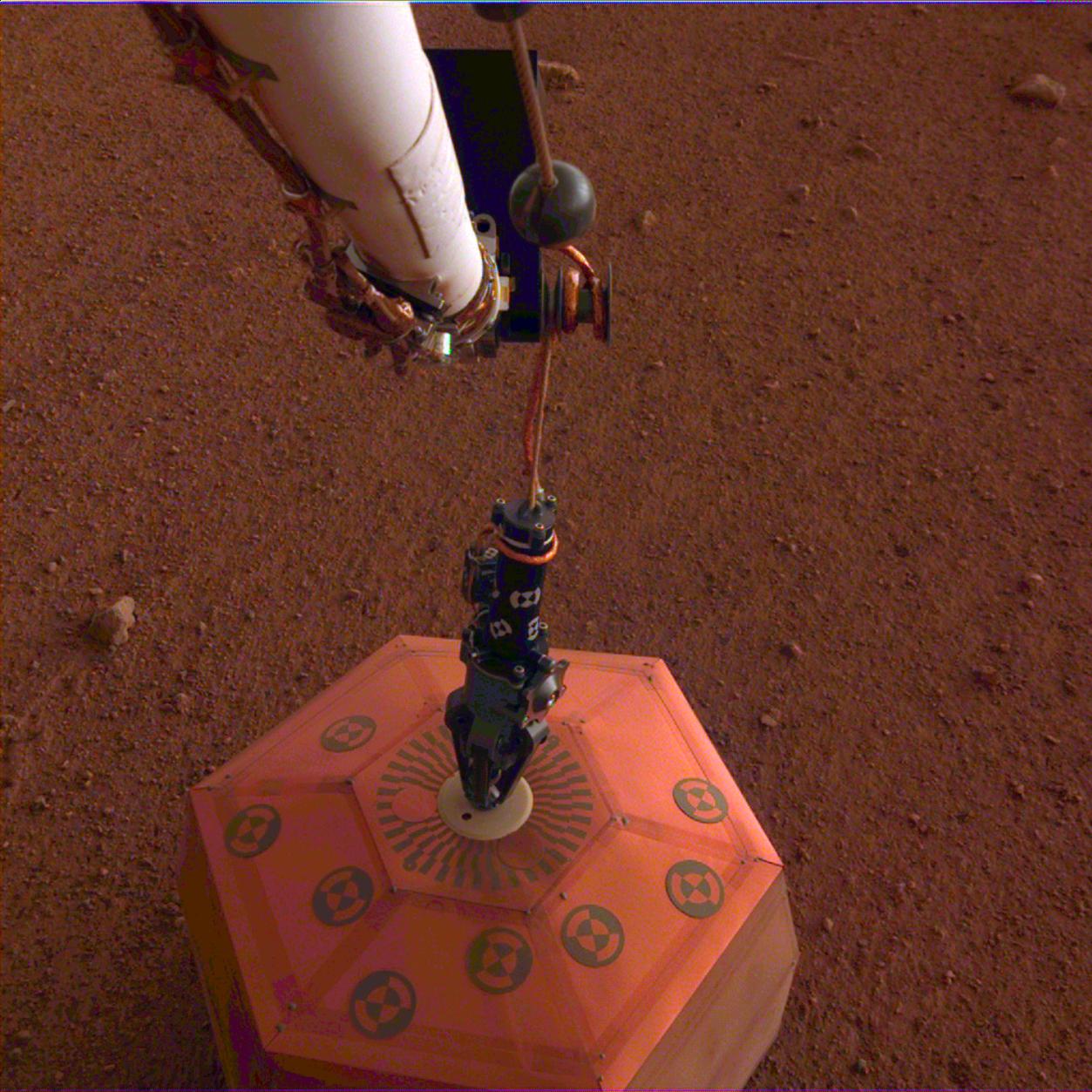
Deen et al., Tuesday Poster

1 meter

A vertical white scale bar representing 1 meter.

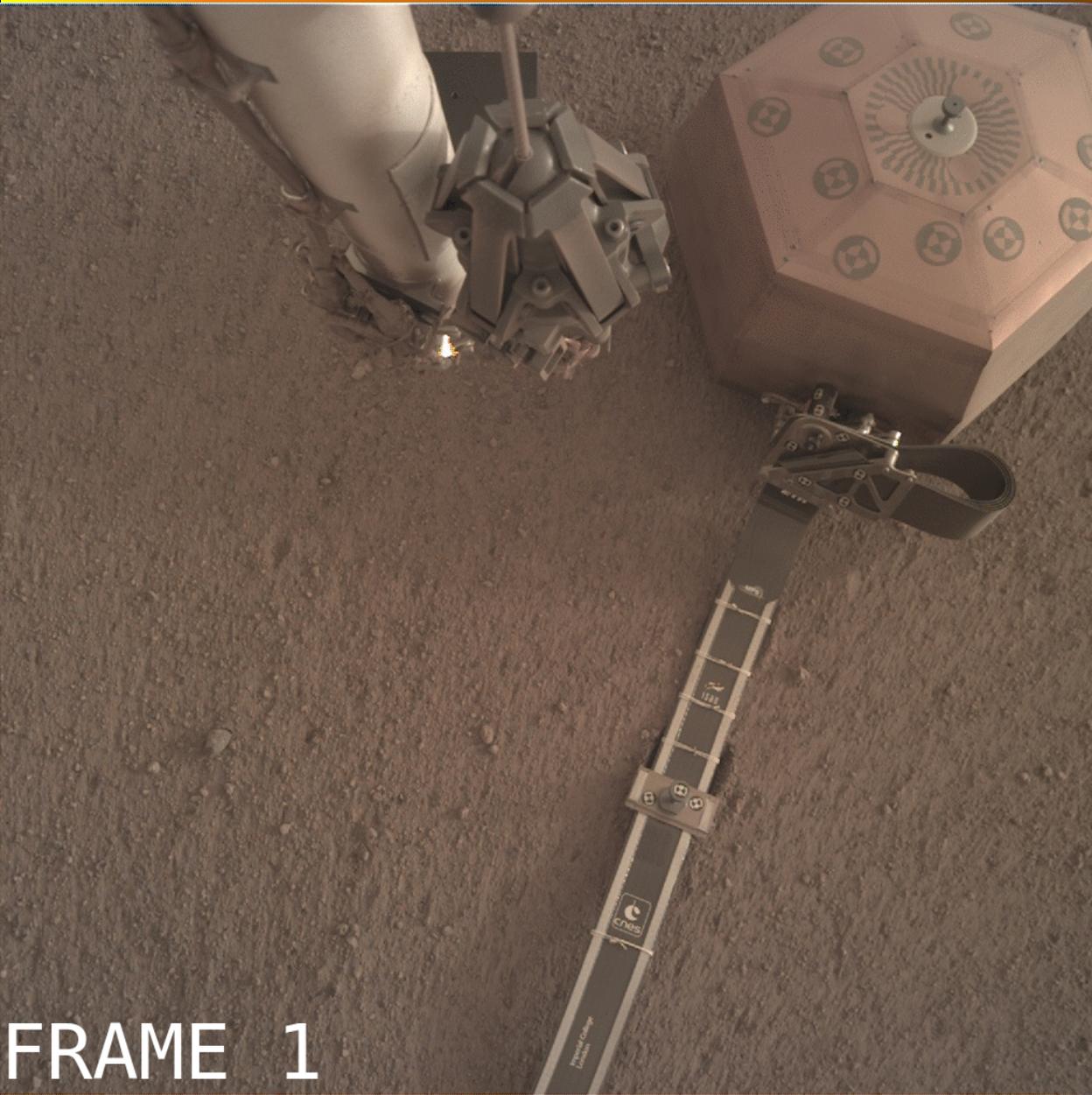


Sol 22 –SEIS Deployment

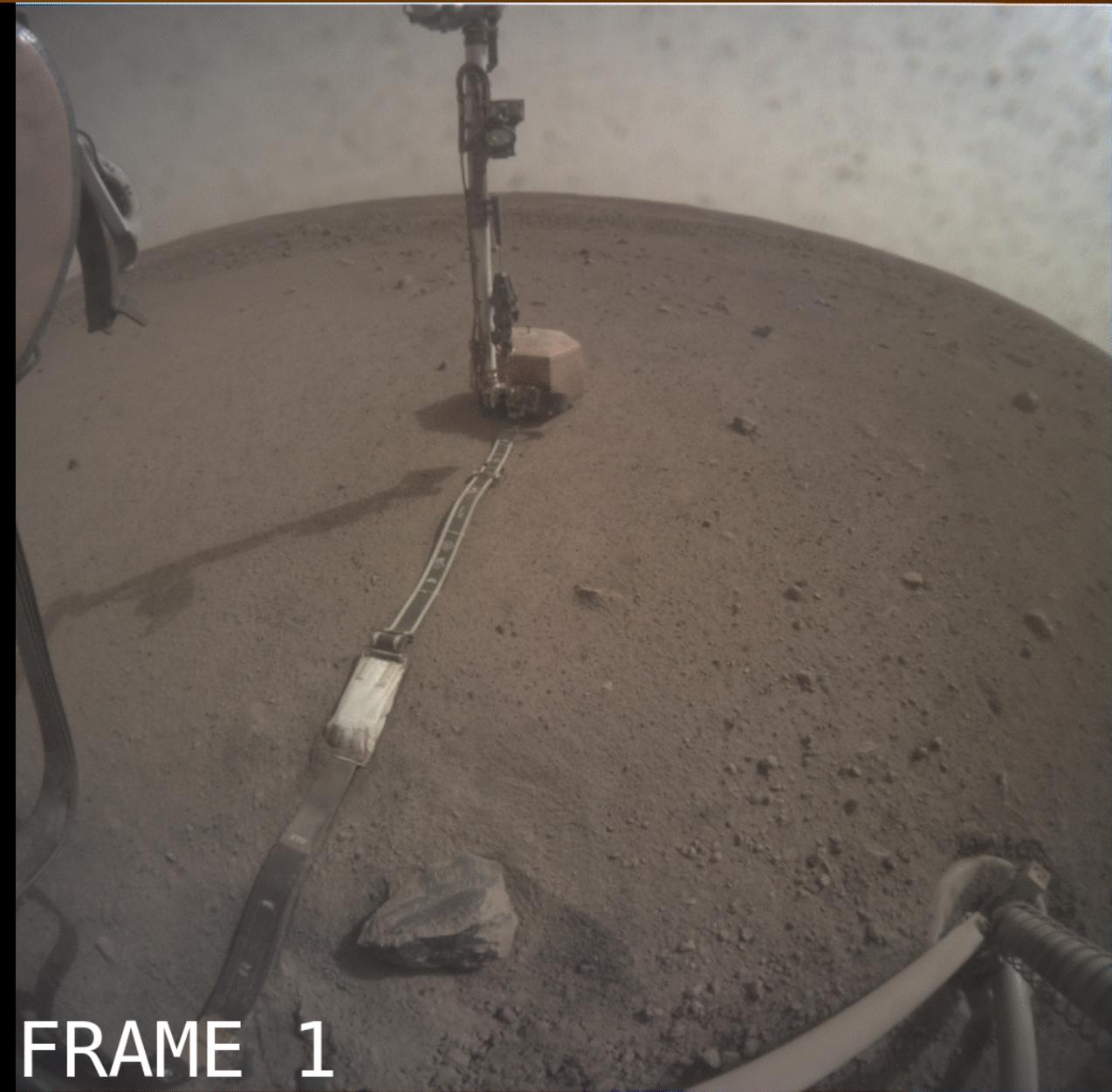




Sol 61 – Final Step of SEIS Preparation: Tether Adjustment



FRAME 1

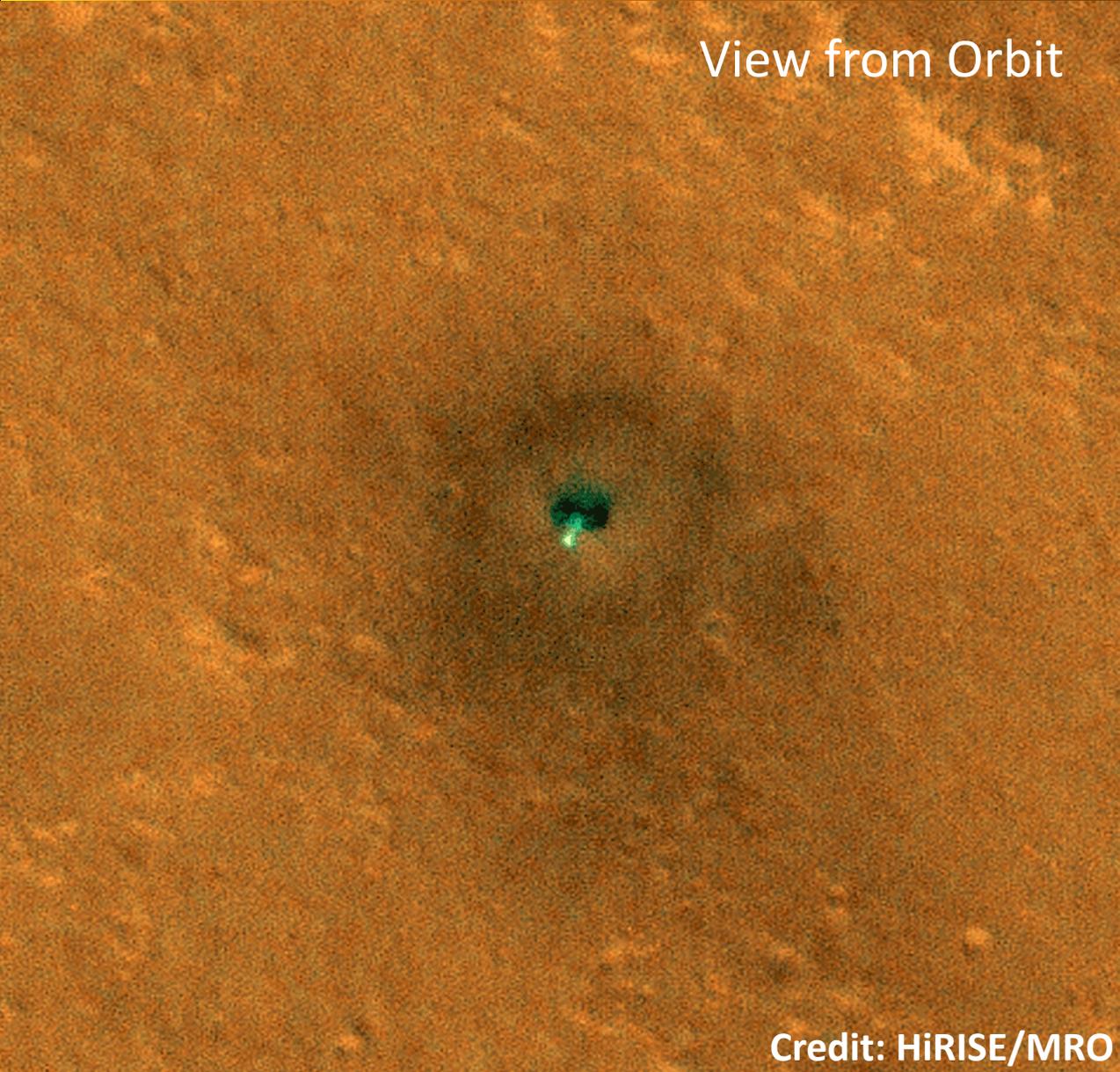


FRAME 1



Sol 66 – Wind and Thermal Shield Deployment

View from Orbit



Credit: HiRISE/MRO

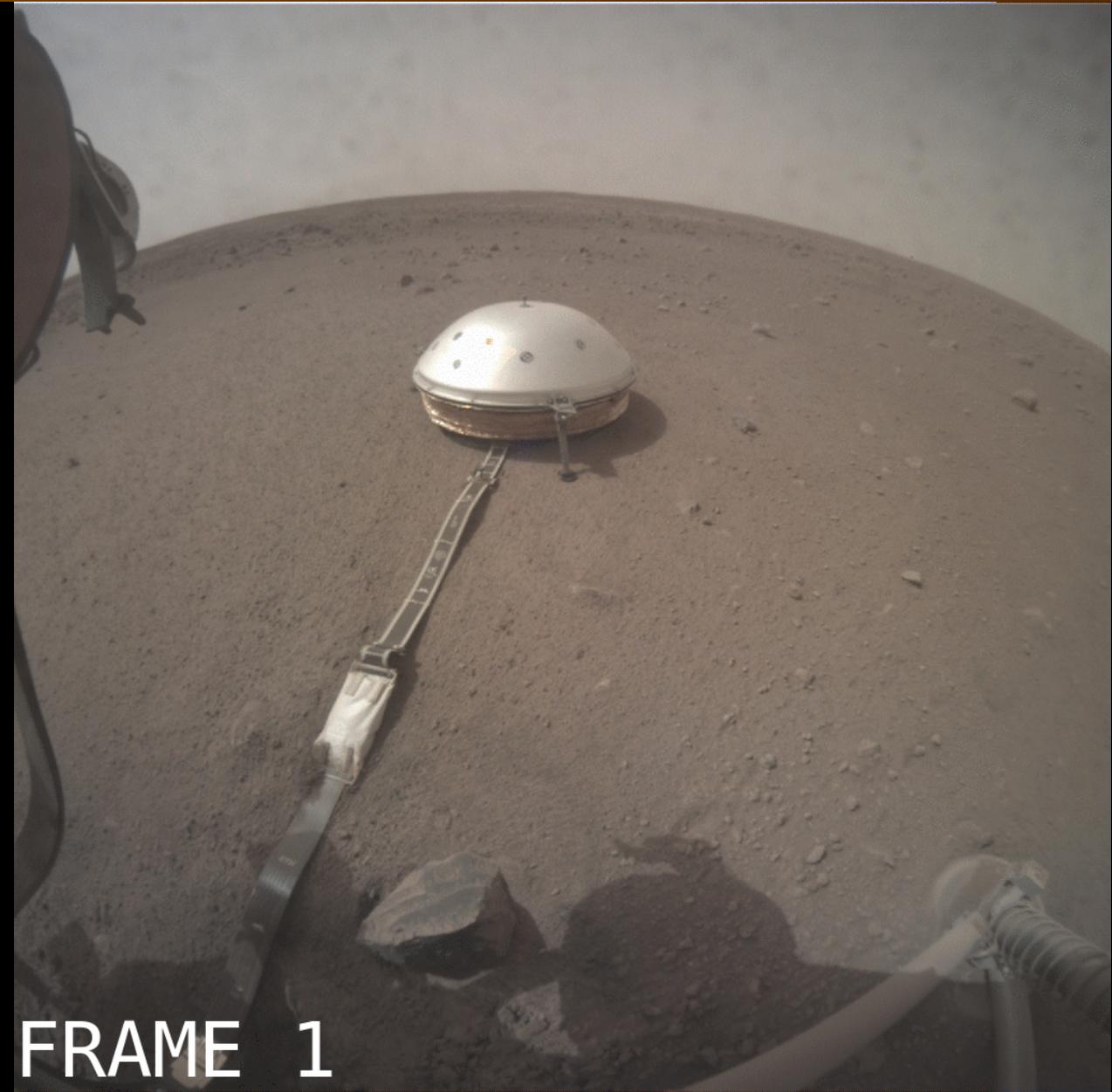
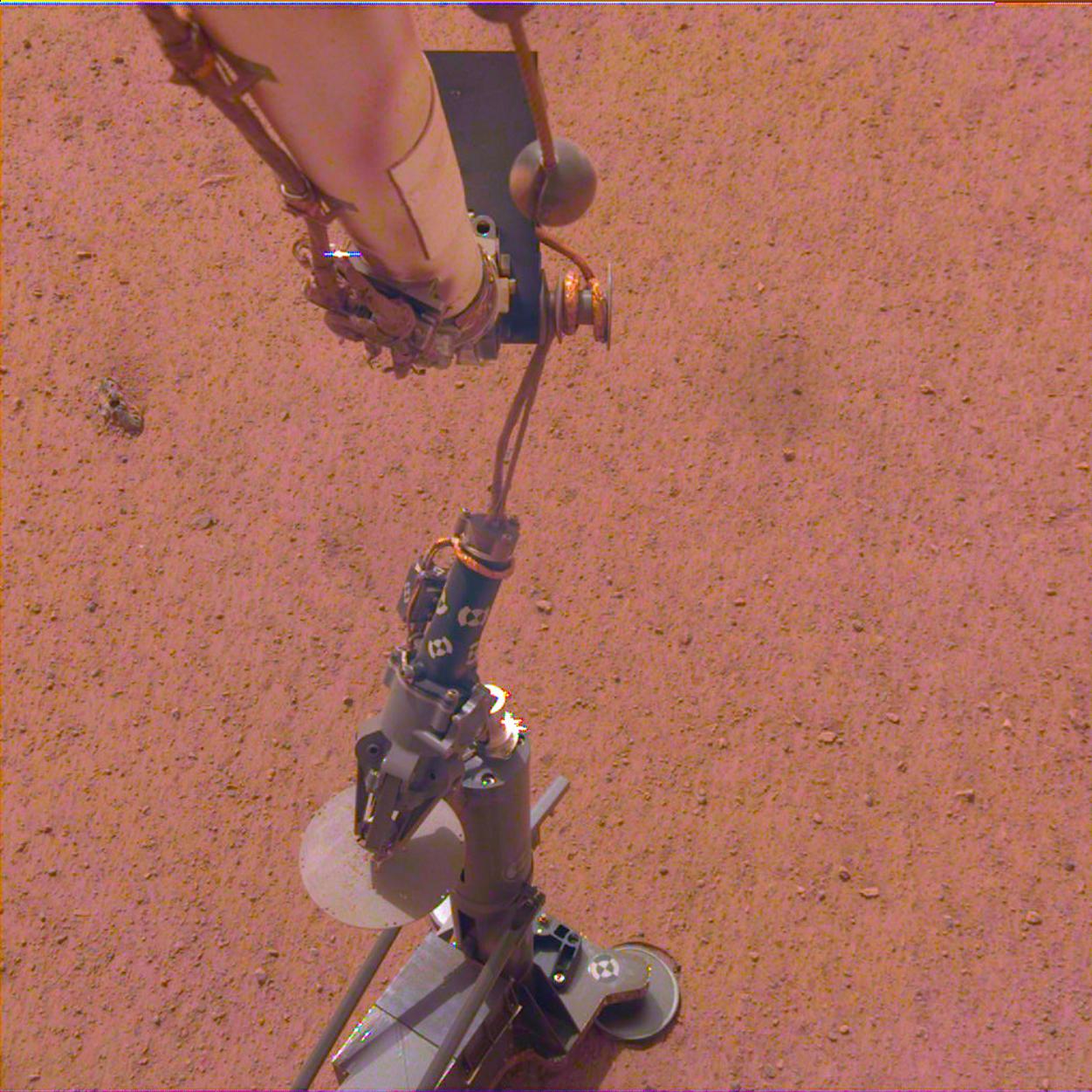
View from the Ground



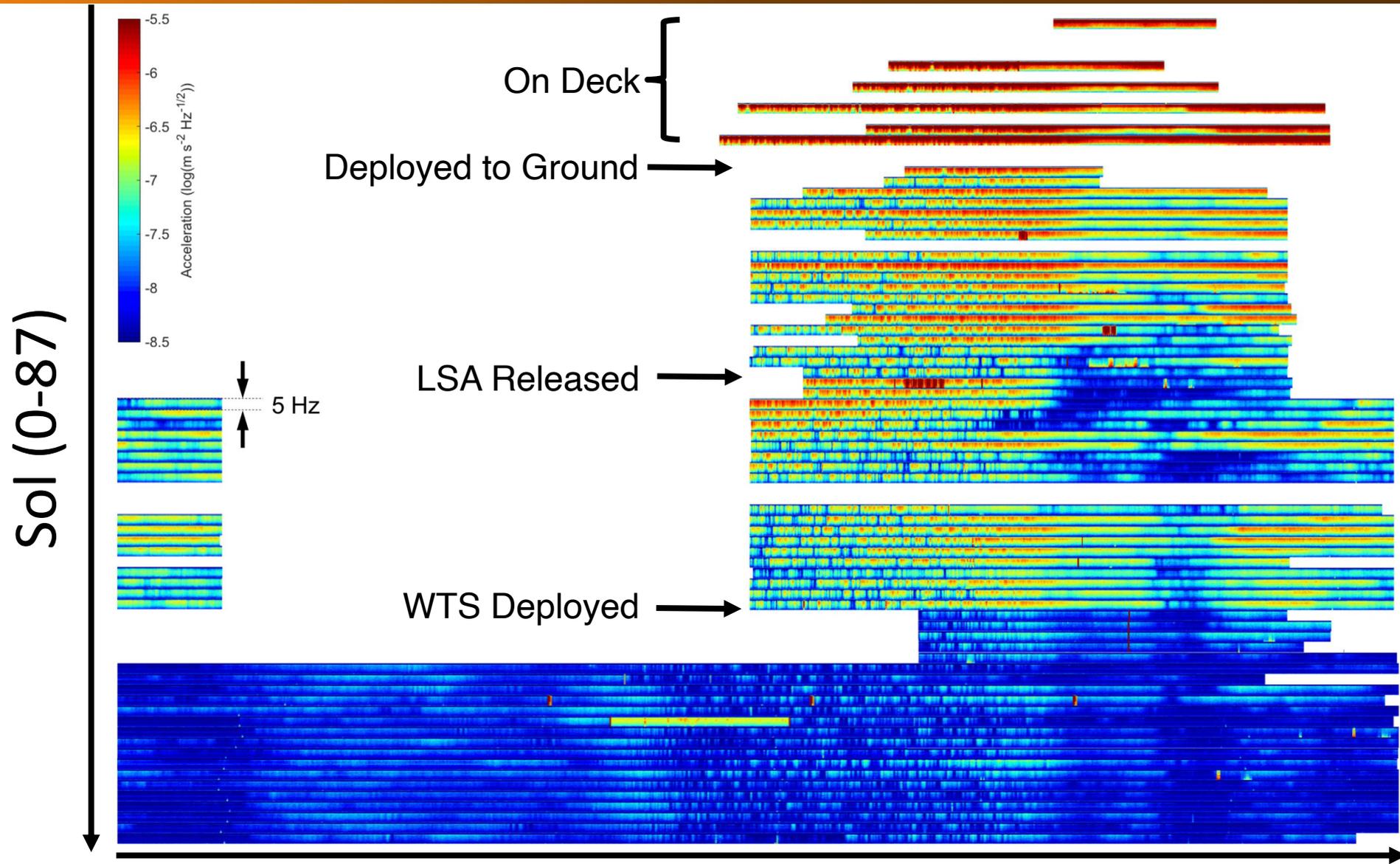
FRAME 1



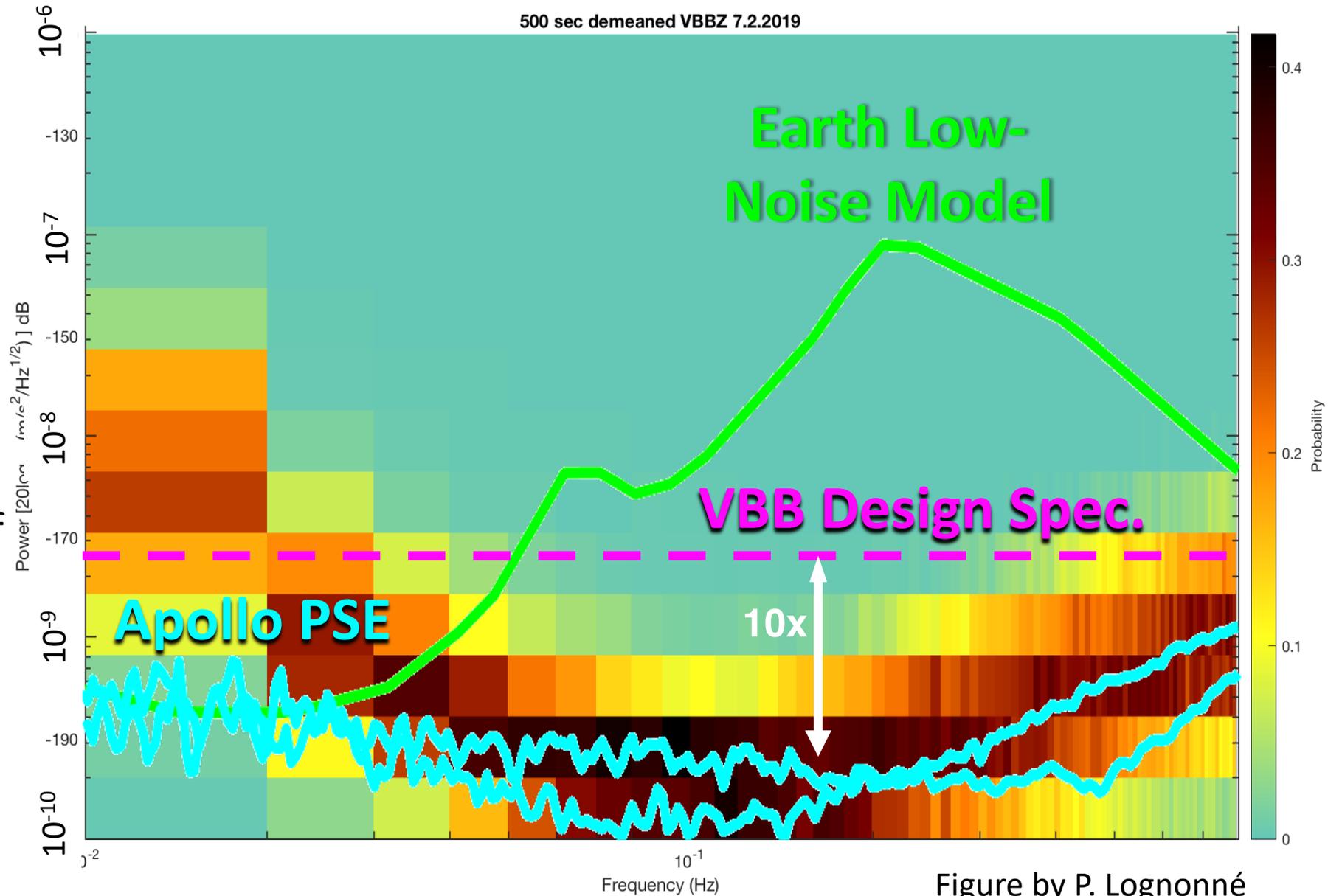
Sol 76 – HP³ Deployment



FRAME 1



For scale, the inferred displacement sensitivity at the bottom of this plot is of order 25 pm, or ~20% the diameter of a hydrogen atom.



Out of 100 Sols on Mars, we have 40 sols with excellent SEIS data quality.

During this time we have observed NO clear signal identified as a marsquake.

This excludes Earth-like activity levels.

Pre-landing estimates (e.g. Golombek, 1992) are still within the allowed range of activity rates.

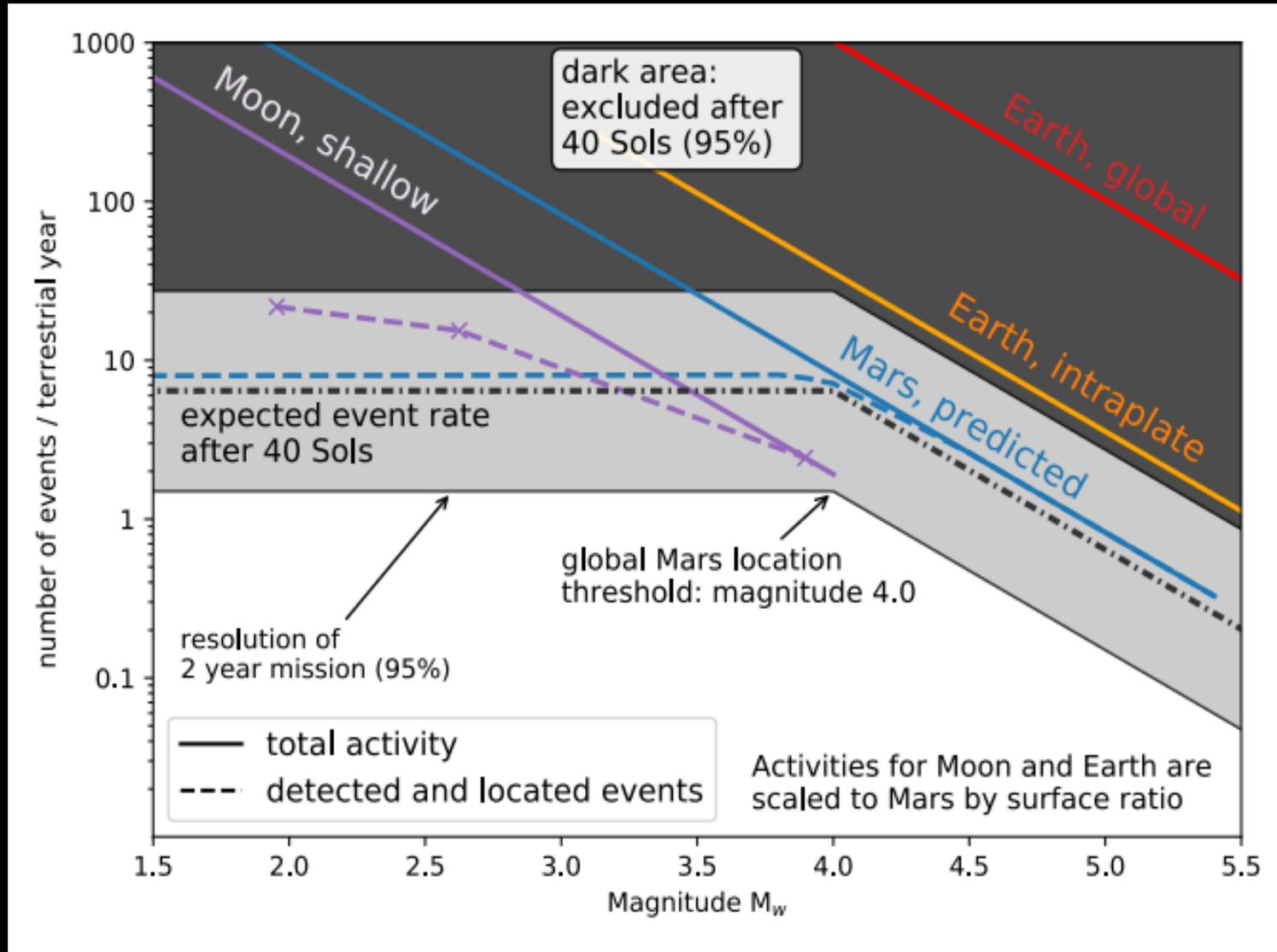
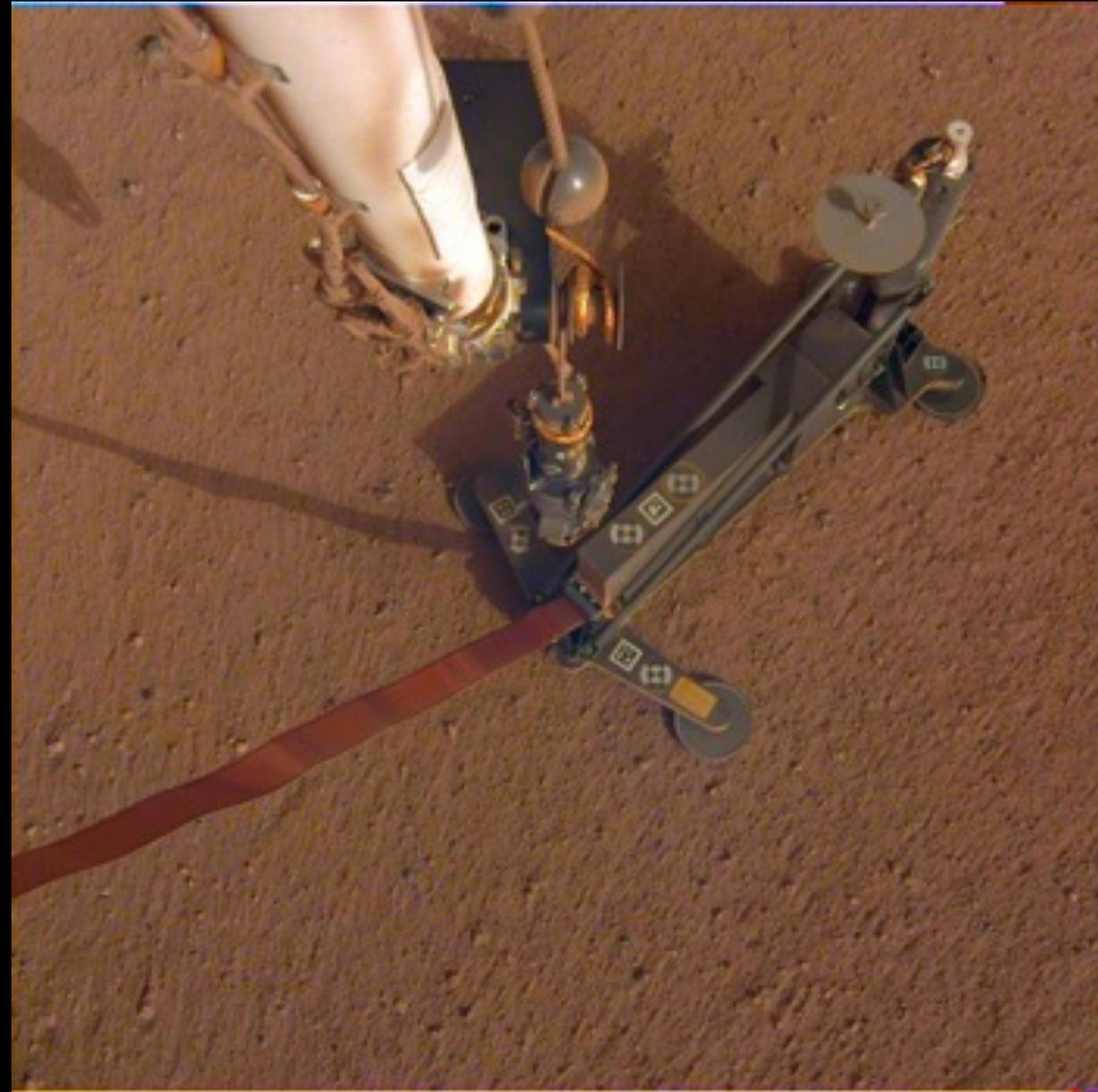
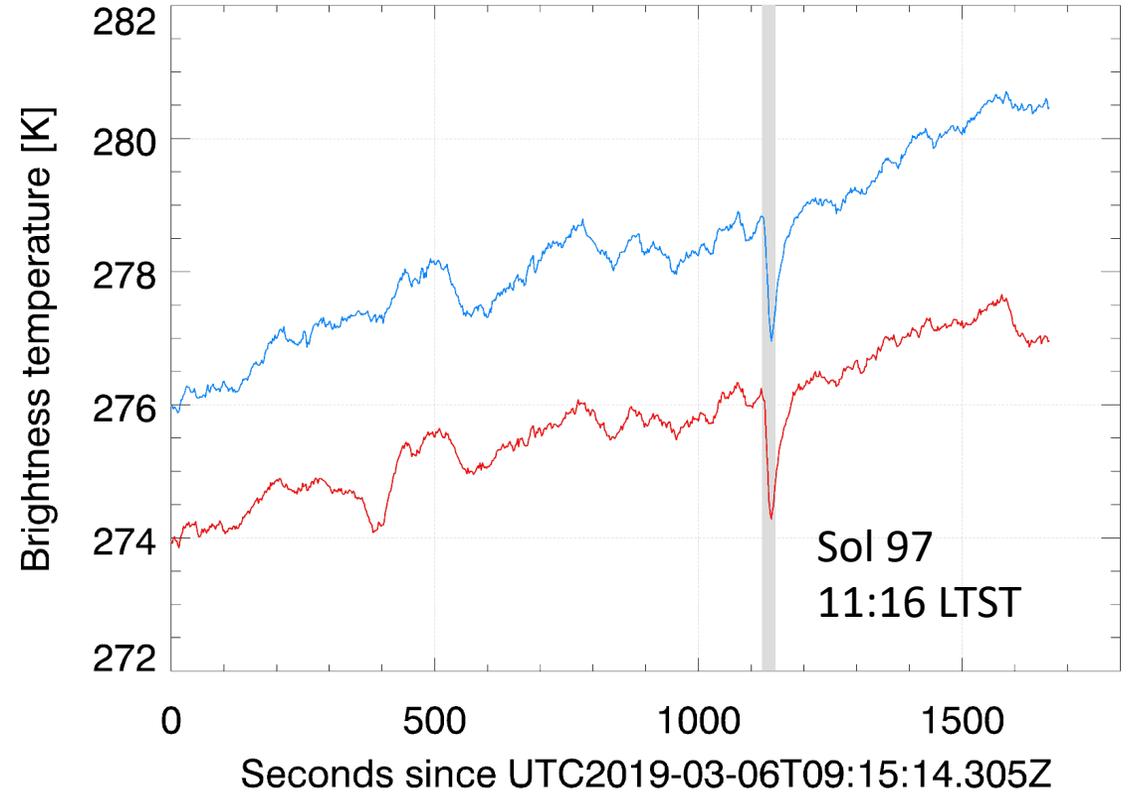
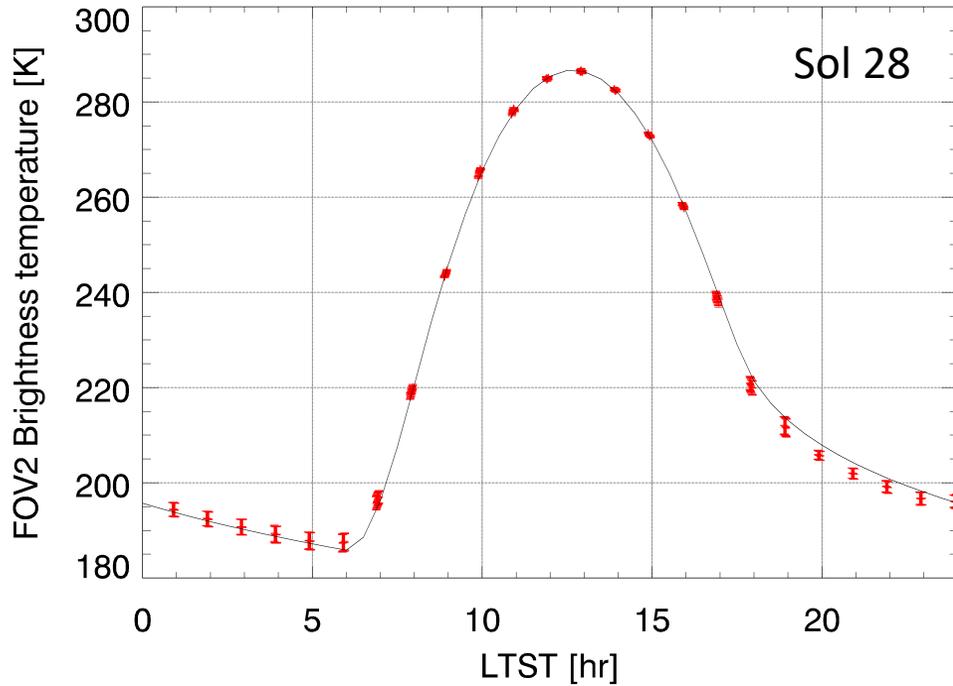


Figure by S. Stähler and D. Giardini

- HP³ has been on the surface since 2/12.
- First hammering session on 2/28 for 4h
 - Only reached a depth of between 18cm and 55cm; likely ~30cm
- Second hammering session on 3/4 for 5h resulted in no measurable further progress.
- At that point we paused for further analysis using imaging, seismic, tilt measurement and thermal along with dynamic CAD modeling, and testing using spare hardware.
- Analysis is ongoing.





Both measurements are consistent with a thermal inertia of $190 \text{ J m}^{-2} \text{ s}^{-1/2} \text{ K}^{-1}$.
 This is also consistent with both orbiter observations and direct conductivity measurements by the mole in the regolith

Timescale	Associated Phenomena	Status
Secular	CO ₂ cap mass budget	Coming Soon
Interannual	Global dust storms	Coming Soon
Seasonal	CO ₂ cycle, atmospheric dynamics	Beginning...
Synoptic	Regional dust storms	✓
Day-to-day	Baroclinic waves	✓
Diurnal	Thermal tides, slope winds	✓
Hour-to-hour	Gravity waves, slope winds	✓
Minute-to-minute	Boundary layer convection	✓
Second-to-second	Convective vortices & cells	✓
Sub-second	Infrasound, small-scale turbulence	✓

Timescale	Associated Phenomena	Status
Secular	CO2 cap mass budget	Coming Soon
Interannual	Global dust storms	Coming Soon
Seasonal	CO ₂ cycle, atmospheric dynamics	Beginning...
Synoptic	Regional dust storms	✓
Day-to-day	Baroclinic waves	✓
Diurnal	Thermal tides, slope winds	✓
Hour-to-hour	Gravity waves, slope winds	✓
Minute-to-minute	Boundary layer convection	✓
Second-to-second	Convective vortices & cells	✓
Sub-second	Infrasound, small-scale turbulence	✓

Seasonal Pressure Variation

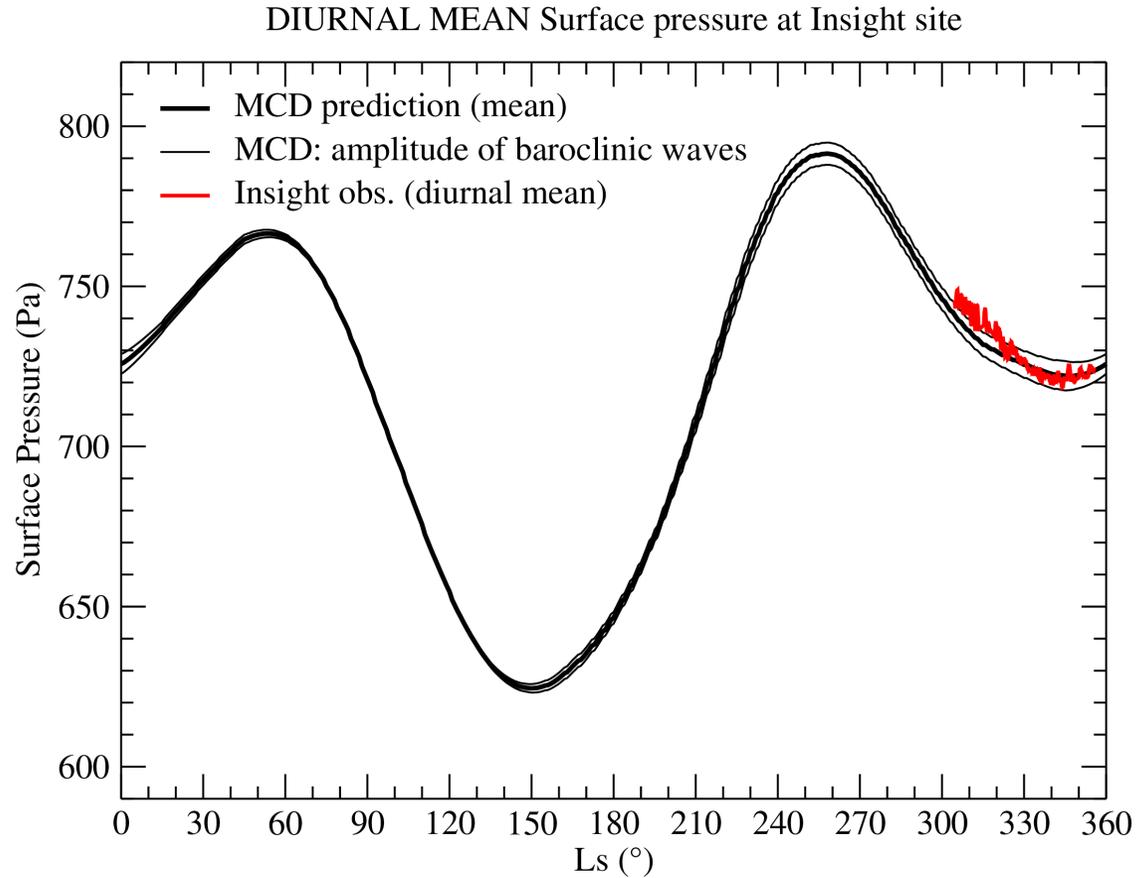


Figure by F. Forget

Convective Vortices (Dust Devils)

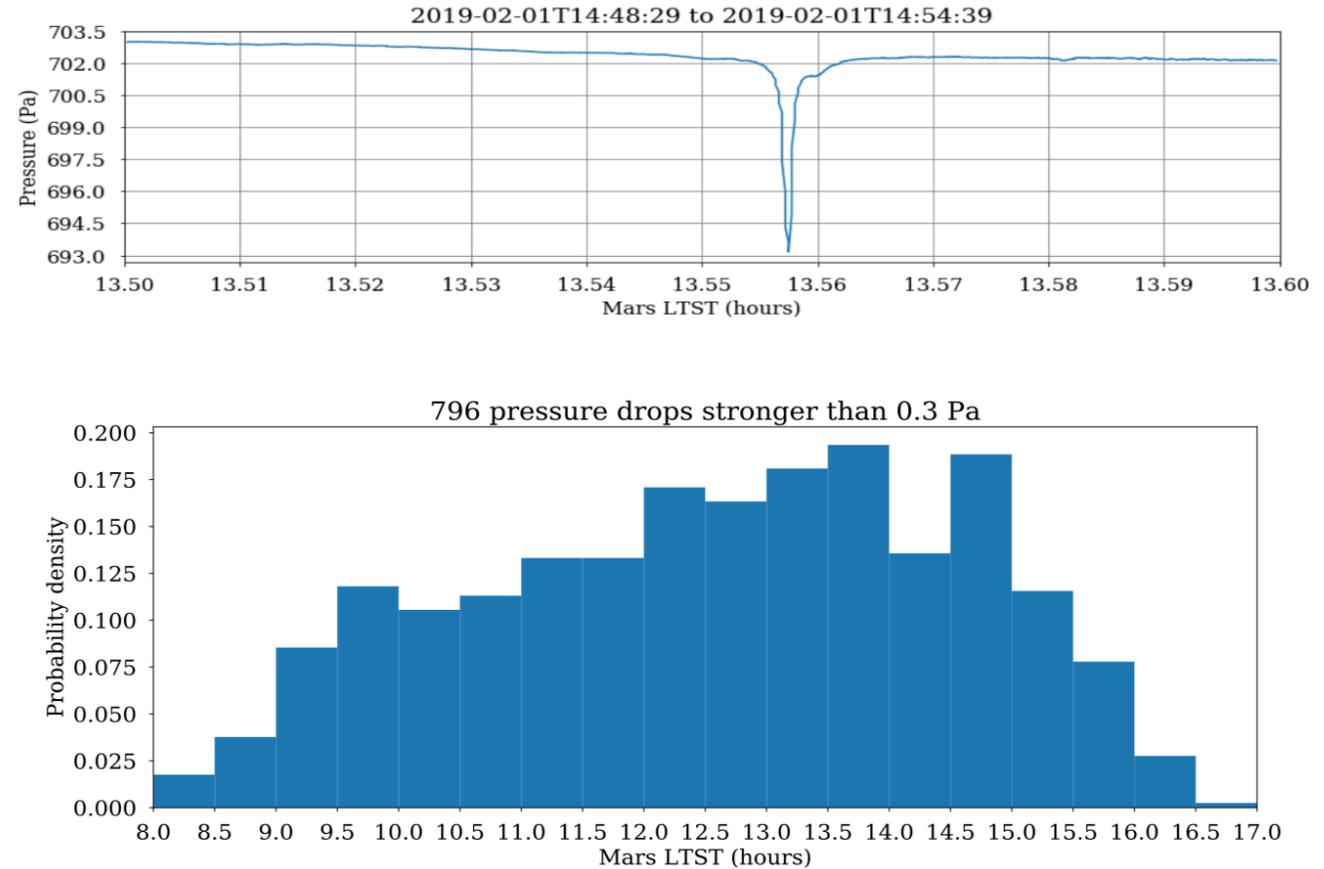
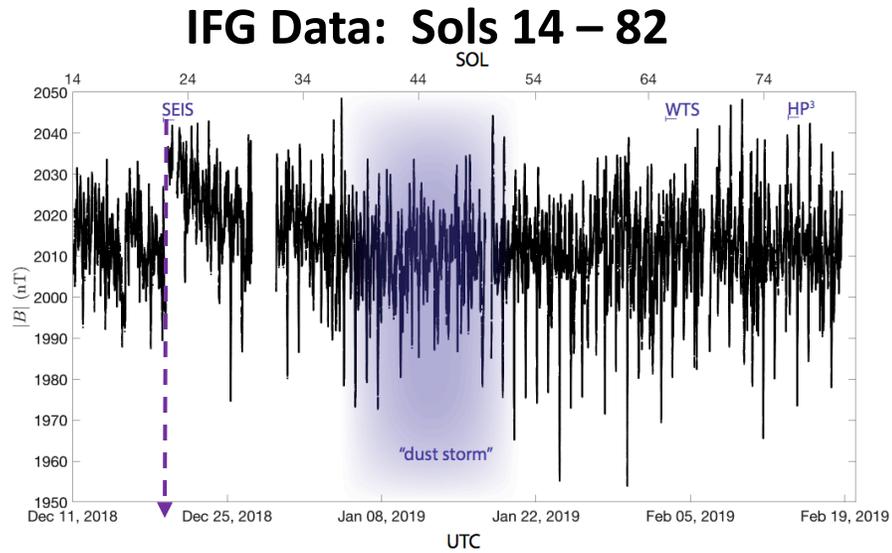


Figure by A. Spiga; See also Murdoch et al., poster #134, and Warren et al., poster #135

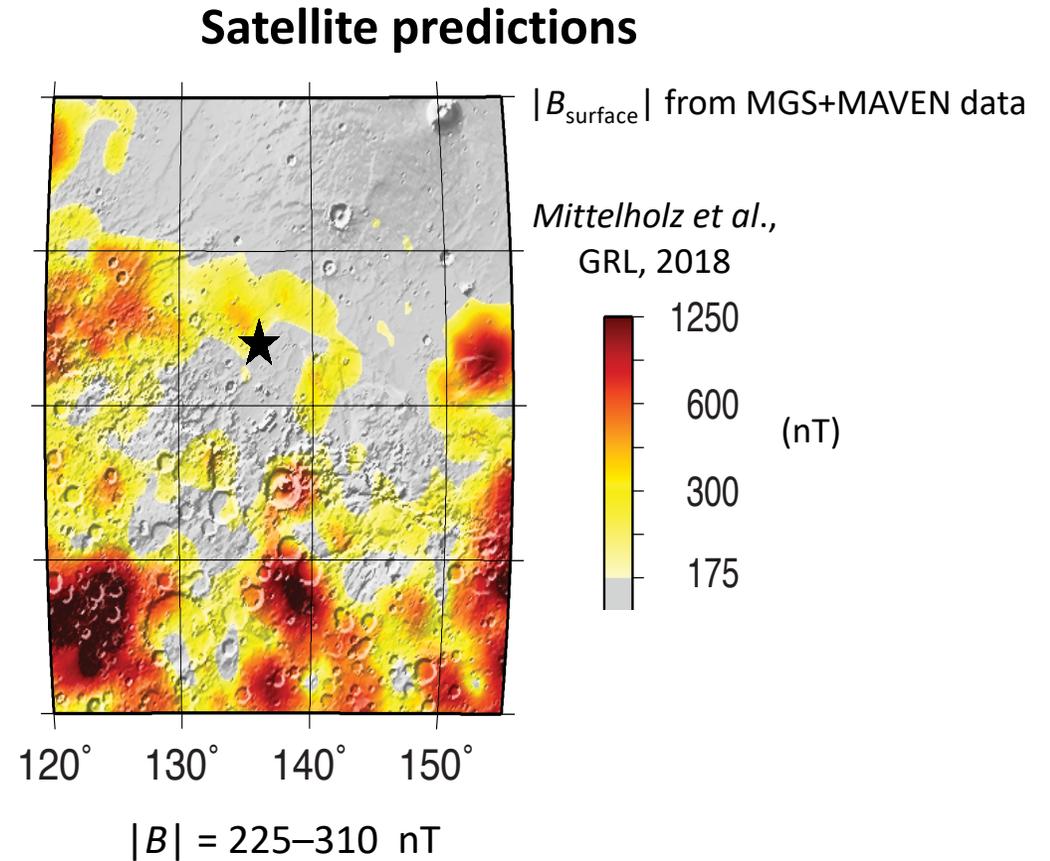


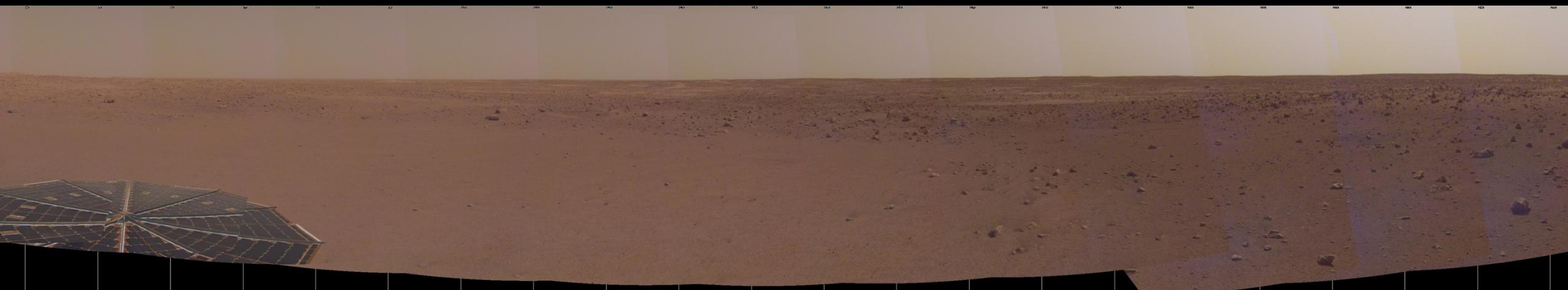
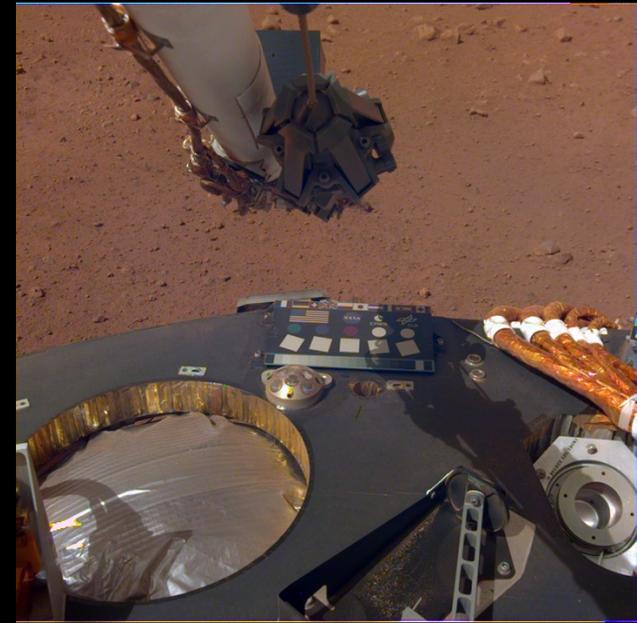
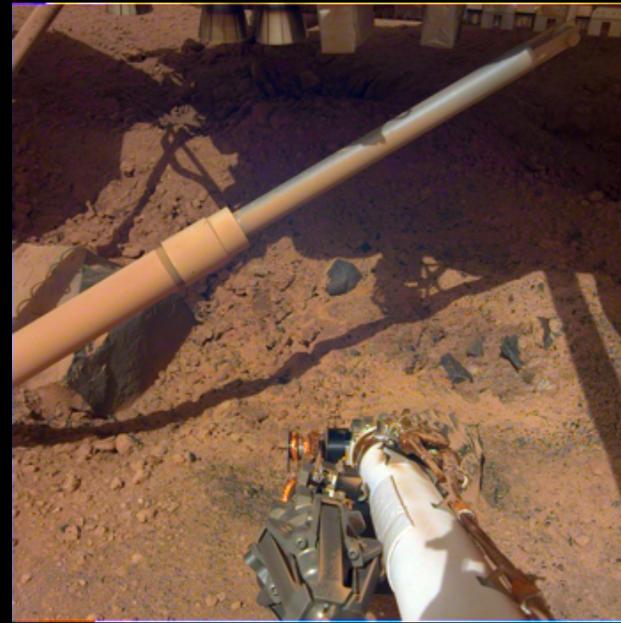
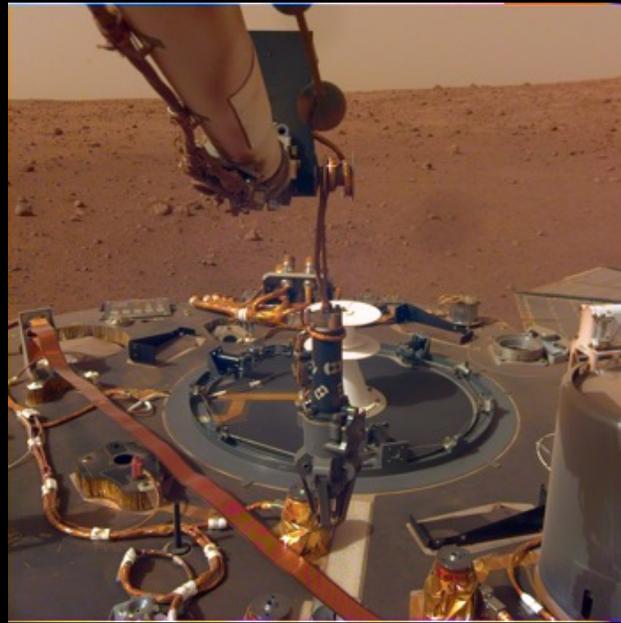
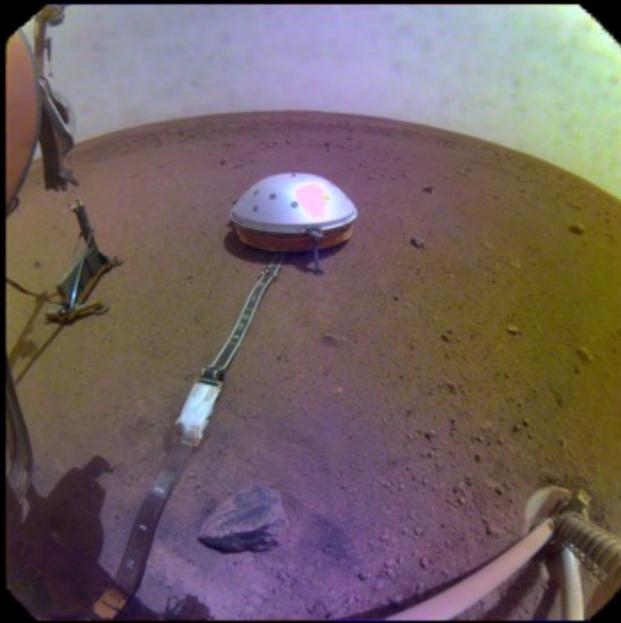
DC field → estimate of crustal field.

$$|B| = 2013 \pm 13 \text{ nT}$$

Declination = 138° , Inclination = -28°
 i.e., SE and upward pointing

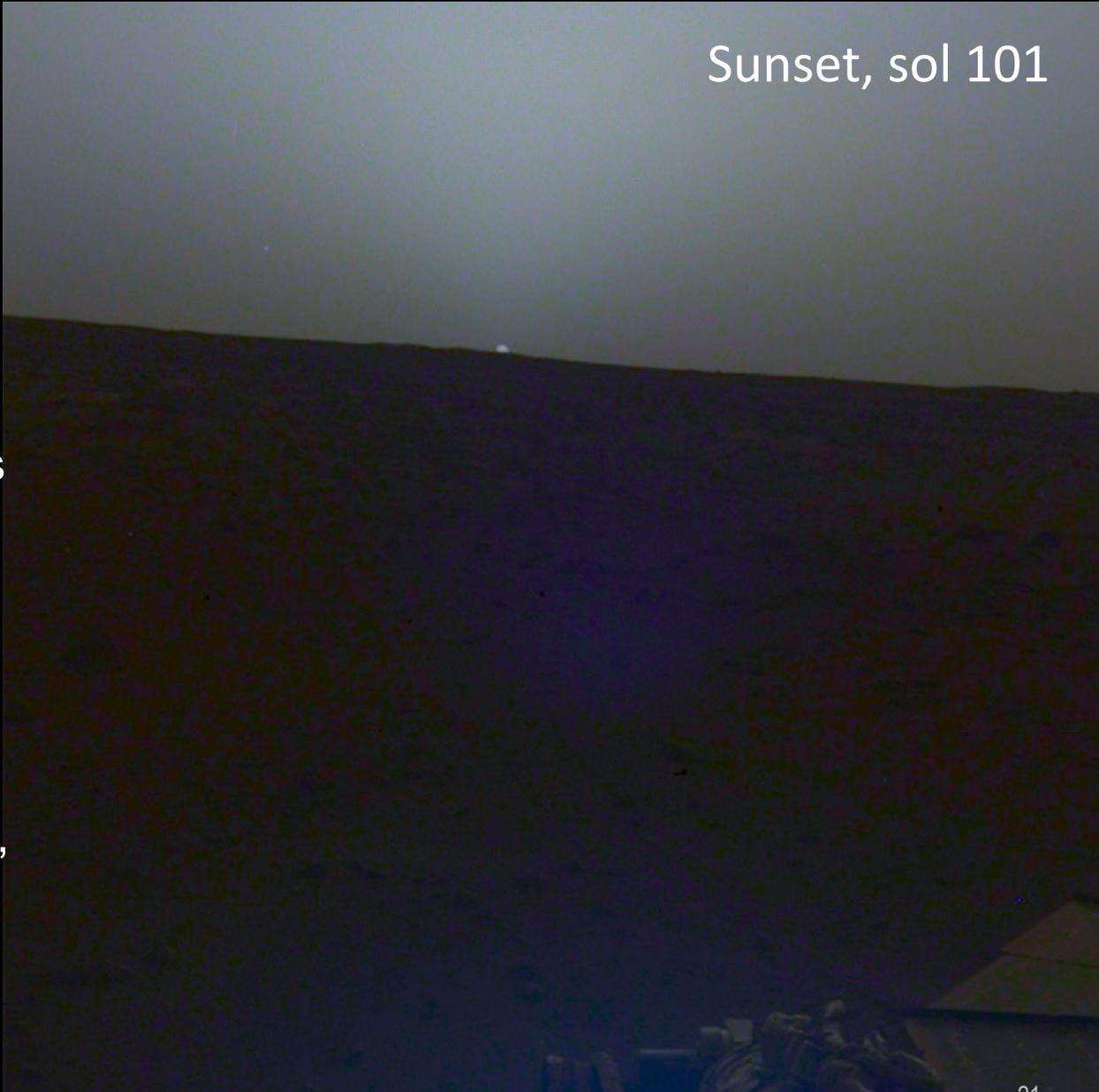
Ground-based estimate ~ 10x satellite estimate
 → contributions from magnetizations with scale lengths $< \sim 150 \text{ km}$





See Golombek et al., this session; Image Showcase and posters #147-#166 on Tuesday

- InSight landed safely and has completed instrument deployment and SEIS commissioning activities.
- The InSight lander is operating virtually perfectly, and ground operations are proceeding smoothly.
- SEIS is working remarkably well and is exceeding its pre-launch performance goals.
 - No marsquakes have yet been detected; this is consistent with pre-landing estimates.
- HP³ has encountered an obstruction after ~30 cm of penetration.
 - We are in the process of evaluating the next steps to continue penetration.
- The environmental sensors are making continuous, around-clock observations of the atmosphere and magnetic field, and the geological characterization of the landing area is well underway.

A photograph of a sunset on Mars. The sky is a deep, dark blue, and the horizon is a dark, silhouetted line. The sun is a small, bright white dot just above the horizon. The foreground is dark and indistinct, showing the silhouette of the lander's structure.

Sunset, sol 101