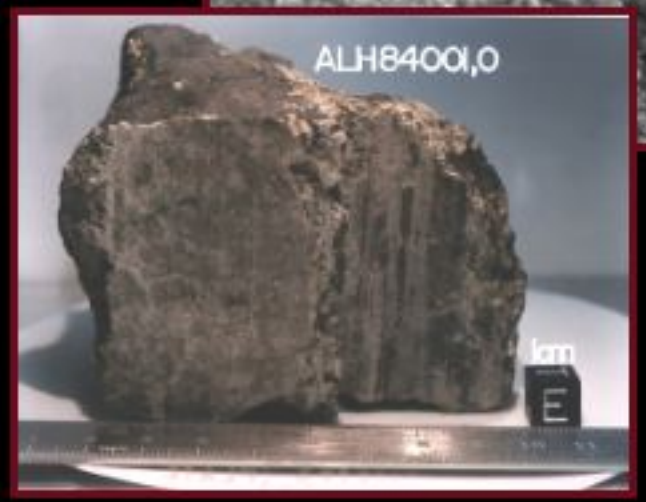
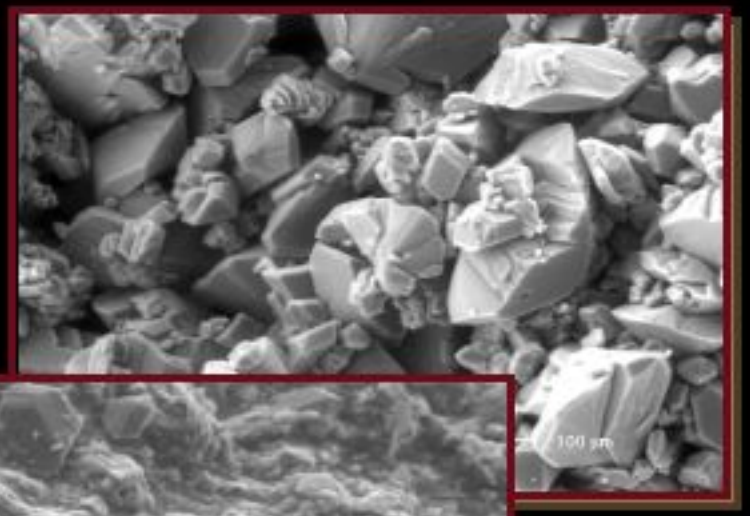
# Curiosity
# The Next Mars Rover

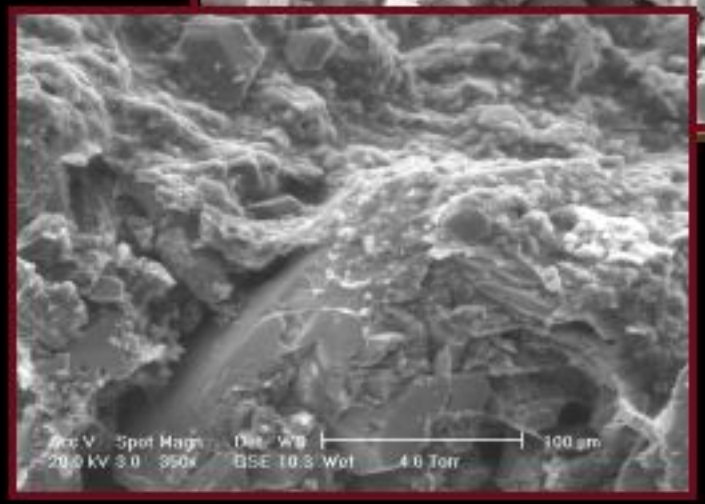
# Sister Planets?

# Speculations about signs of Martian life are currently being studied by scientists.



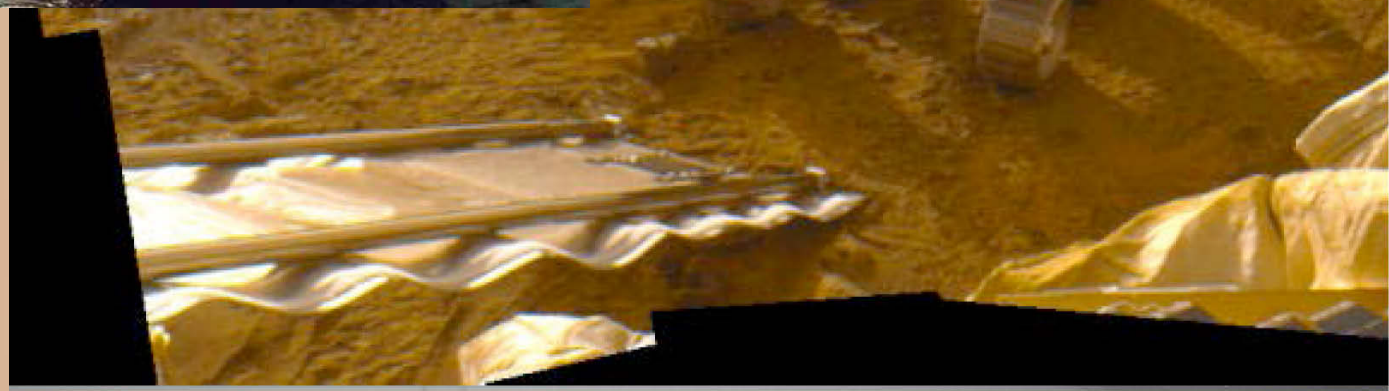

Rock structure without life

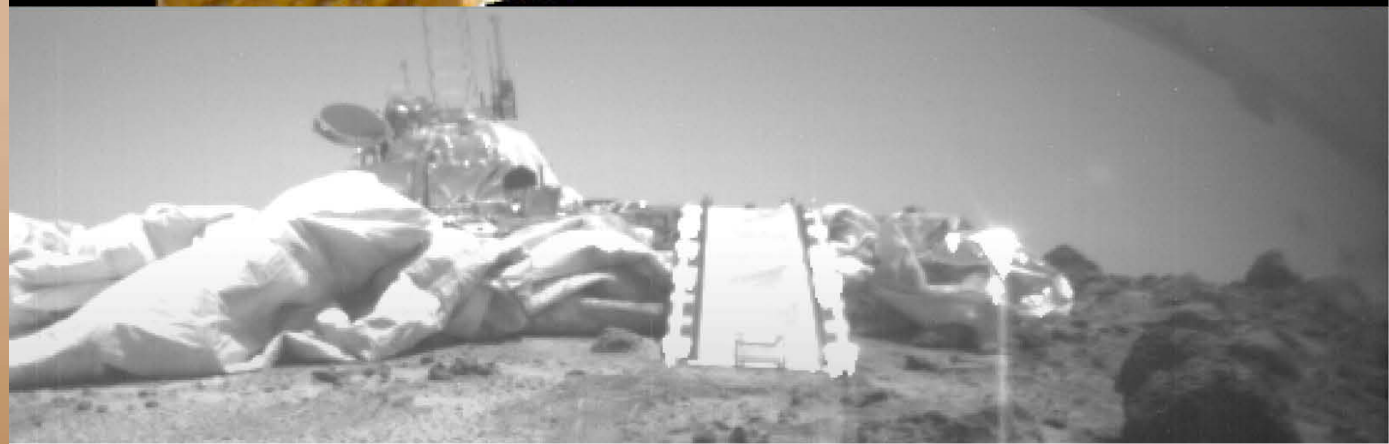




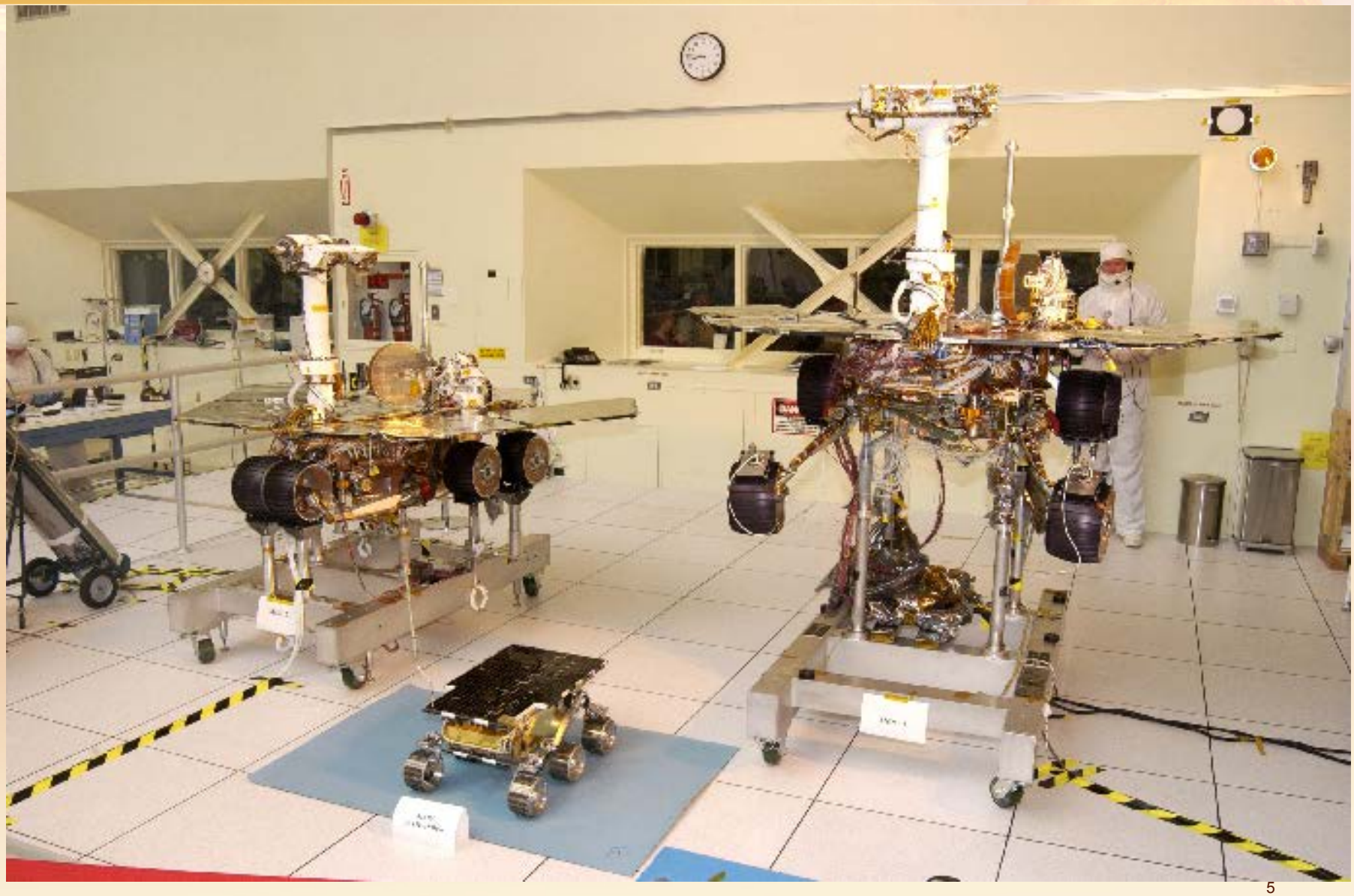
Rock structure with life

# Mars Pathfinder

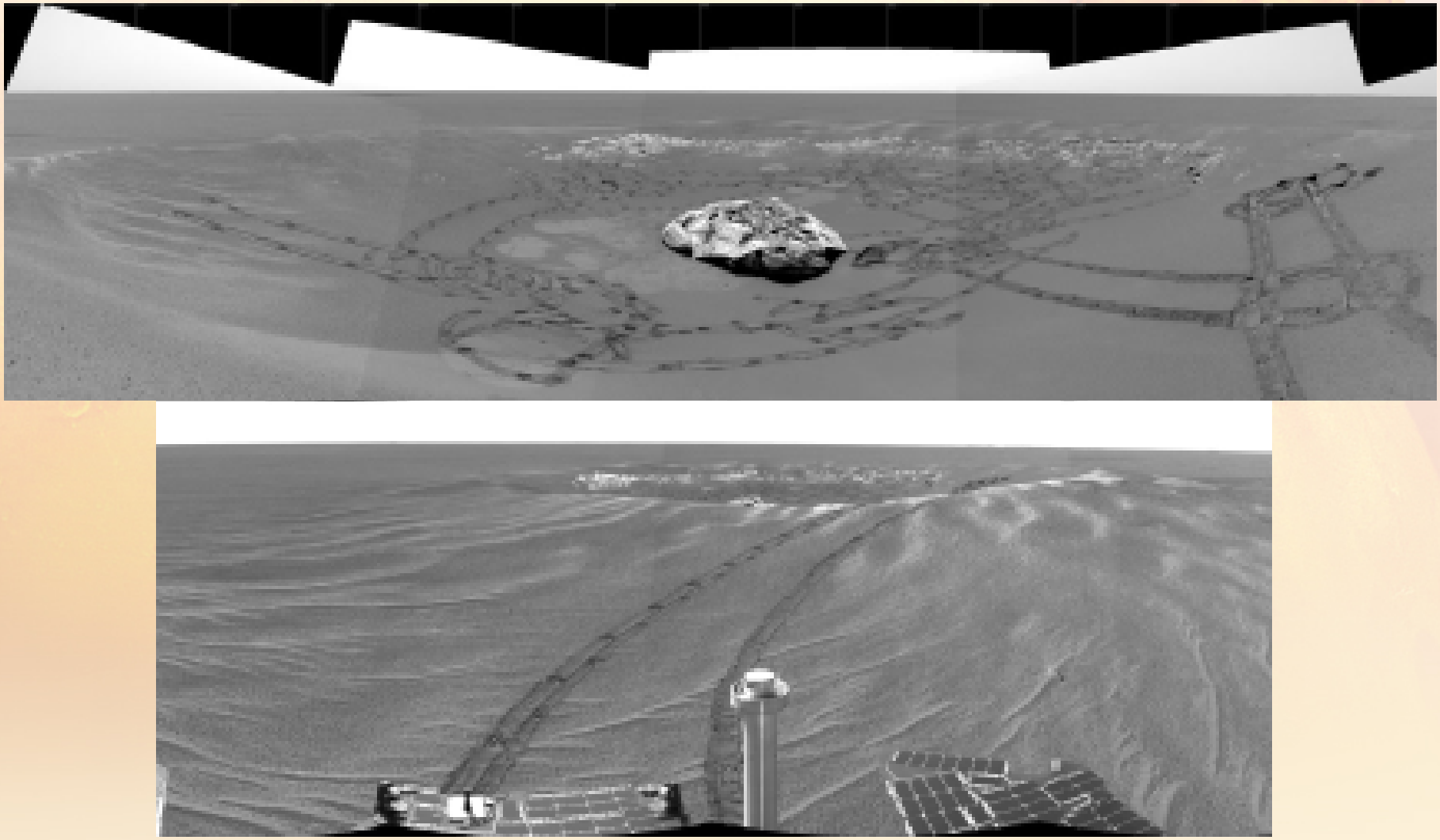


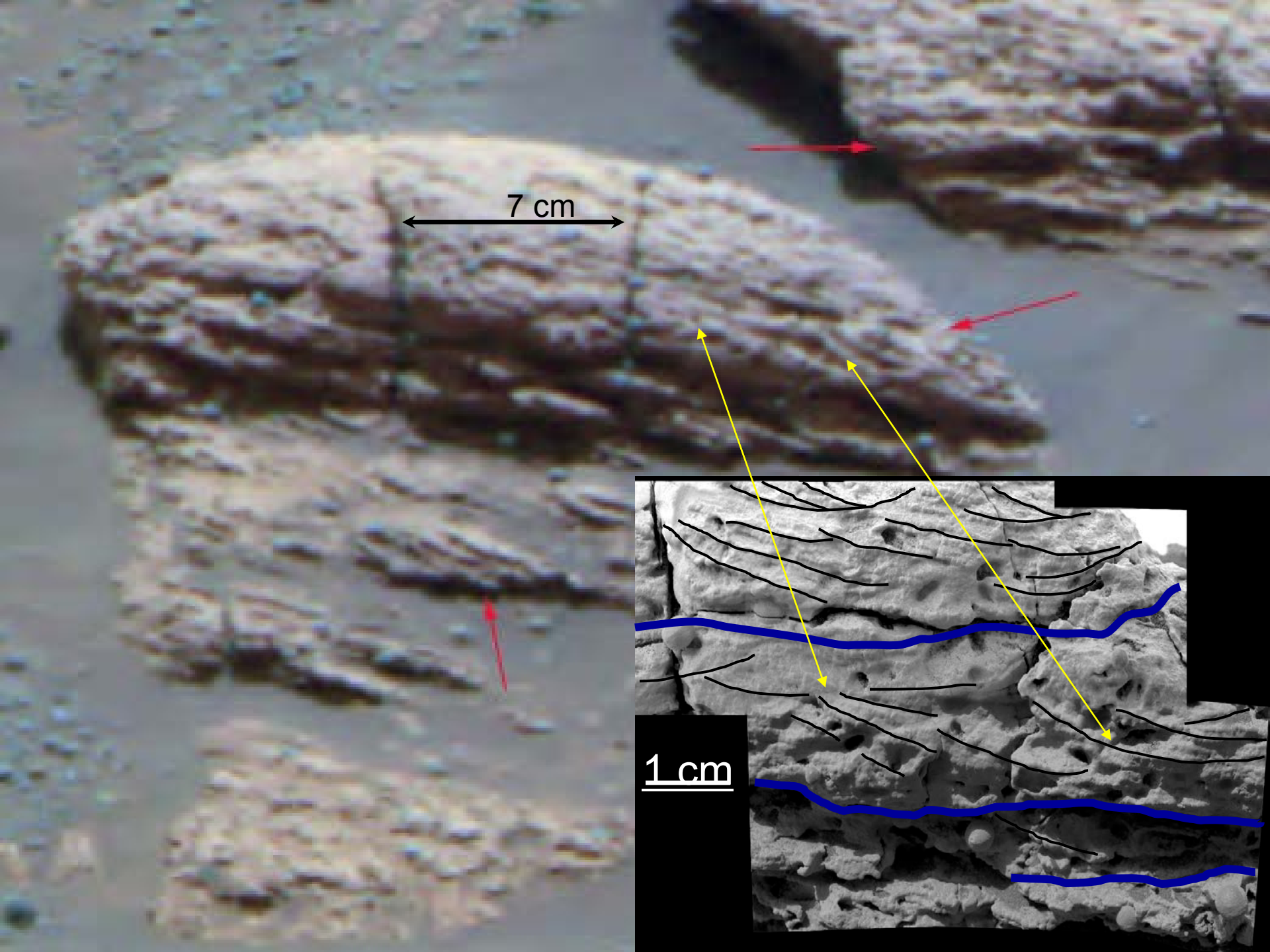


# *Mars Exploration Rovers in test with 1997 Sojourner rover*

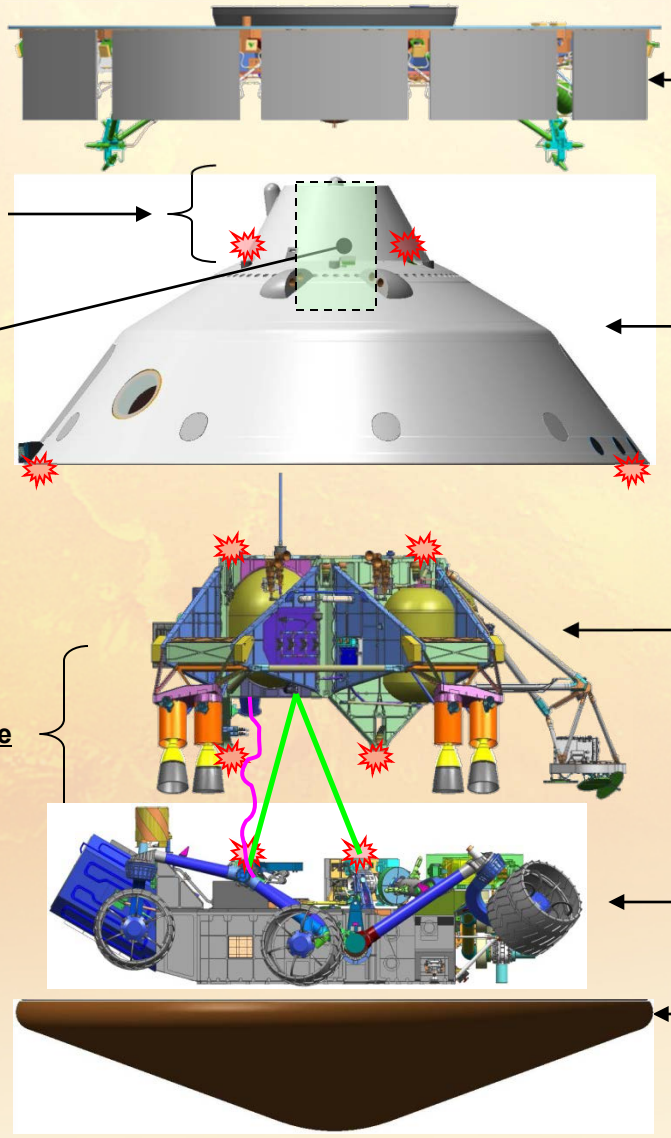


# Opportunity in Meridiani Planum

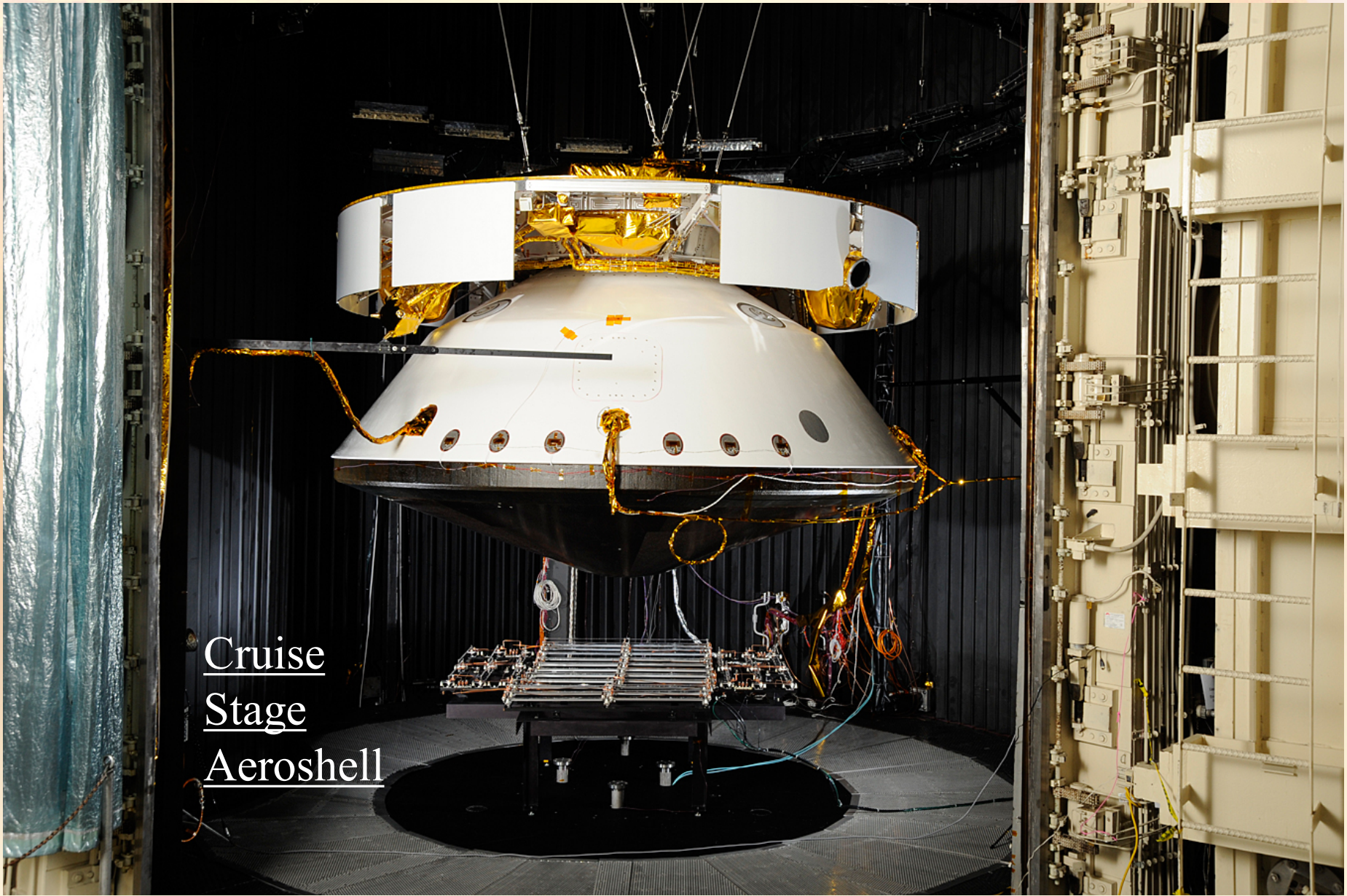



7 cm
1 cm

# MSL Spacecraft Major Elements



# Cruise Thermal Vacuum



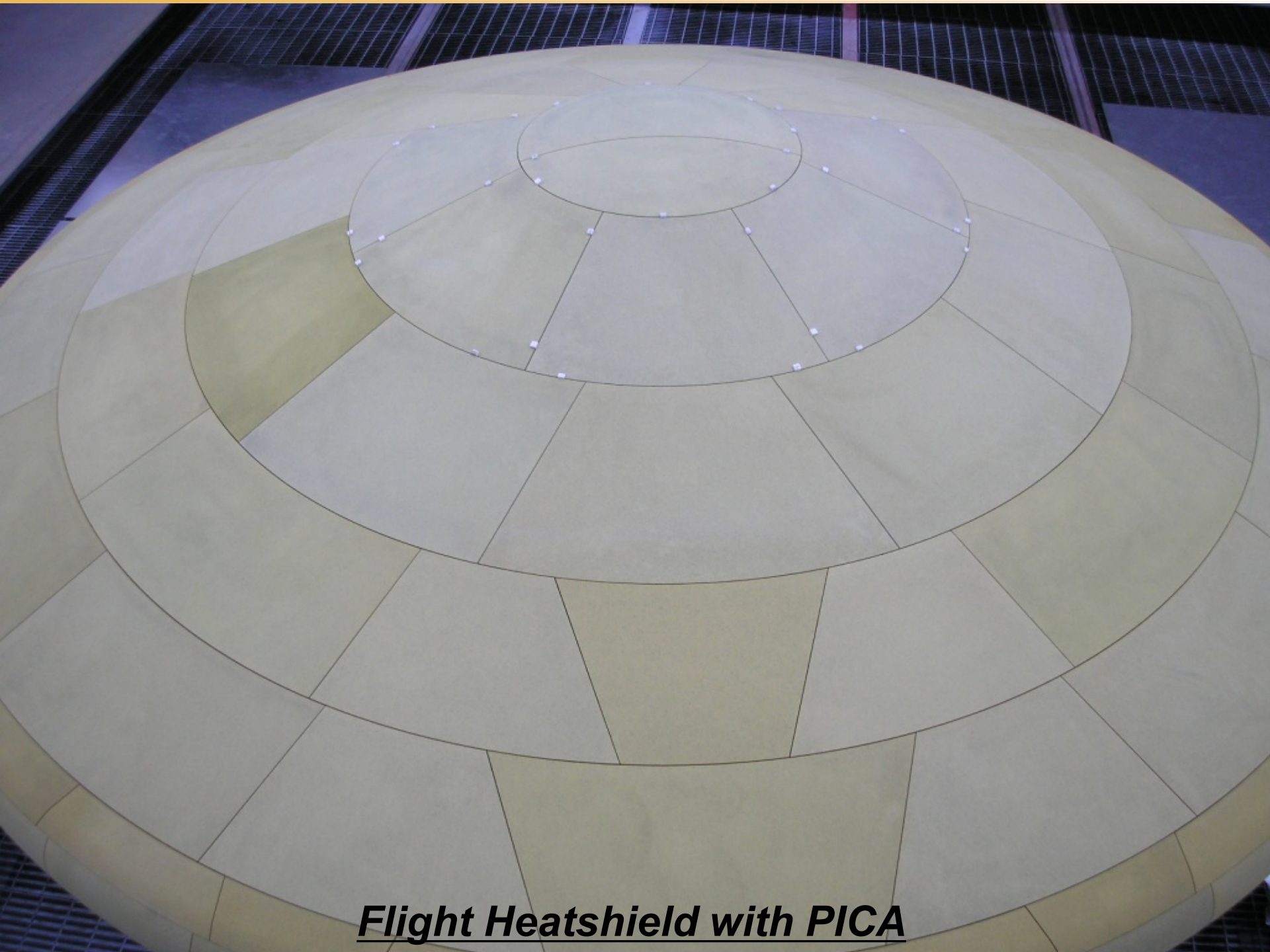

DANGER
Cruise Solar Array
Cruise Structure

***HRS Radiators***
***Propulsion Thrusters***

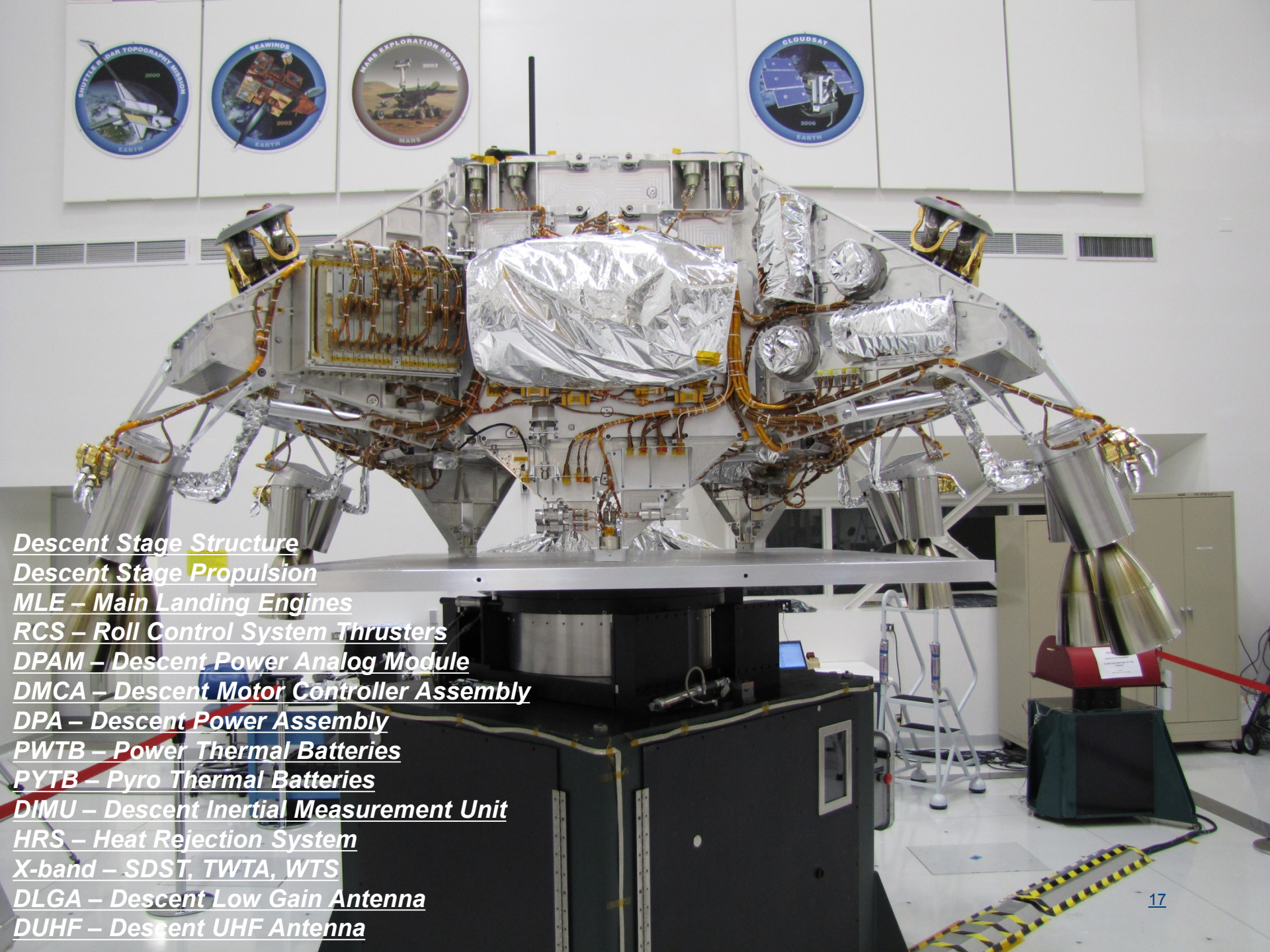

Star Scanner
Sun Sensors & Heads
Propulsion System
CPAMs
CPA
Thermal Hardware
Shunt Radiators
CIPAs


Flight Backshell
PCC Hardware / PUHF
PSS Telecom Hardware

# Flight Heatshield – no PICA

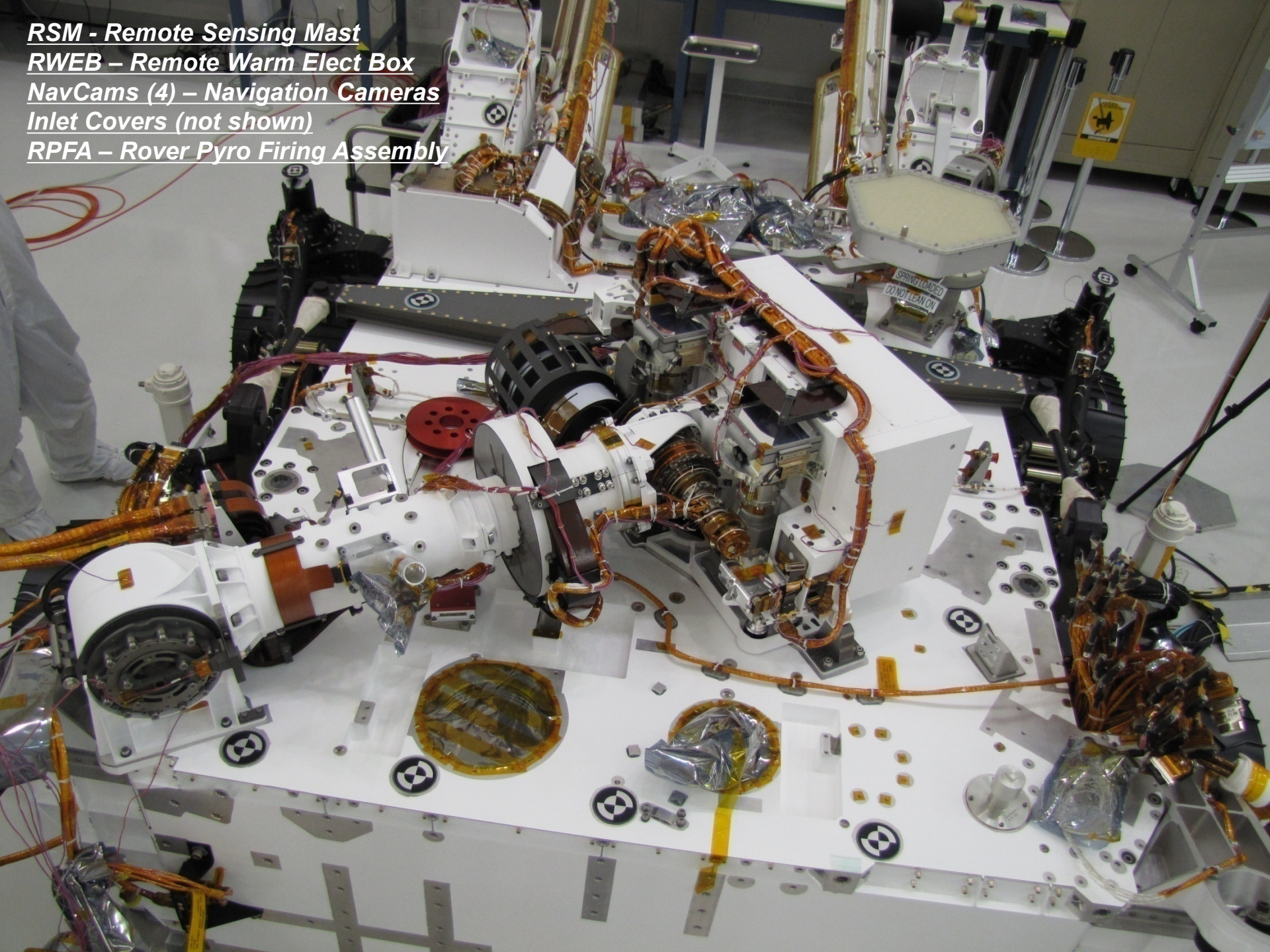


***Flight Heatshield with PICA***

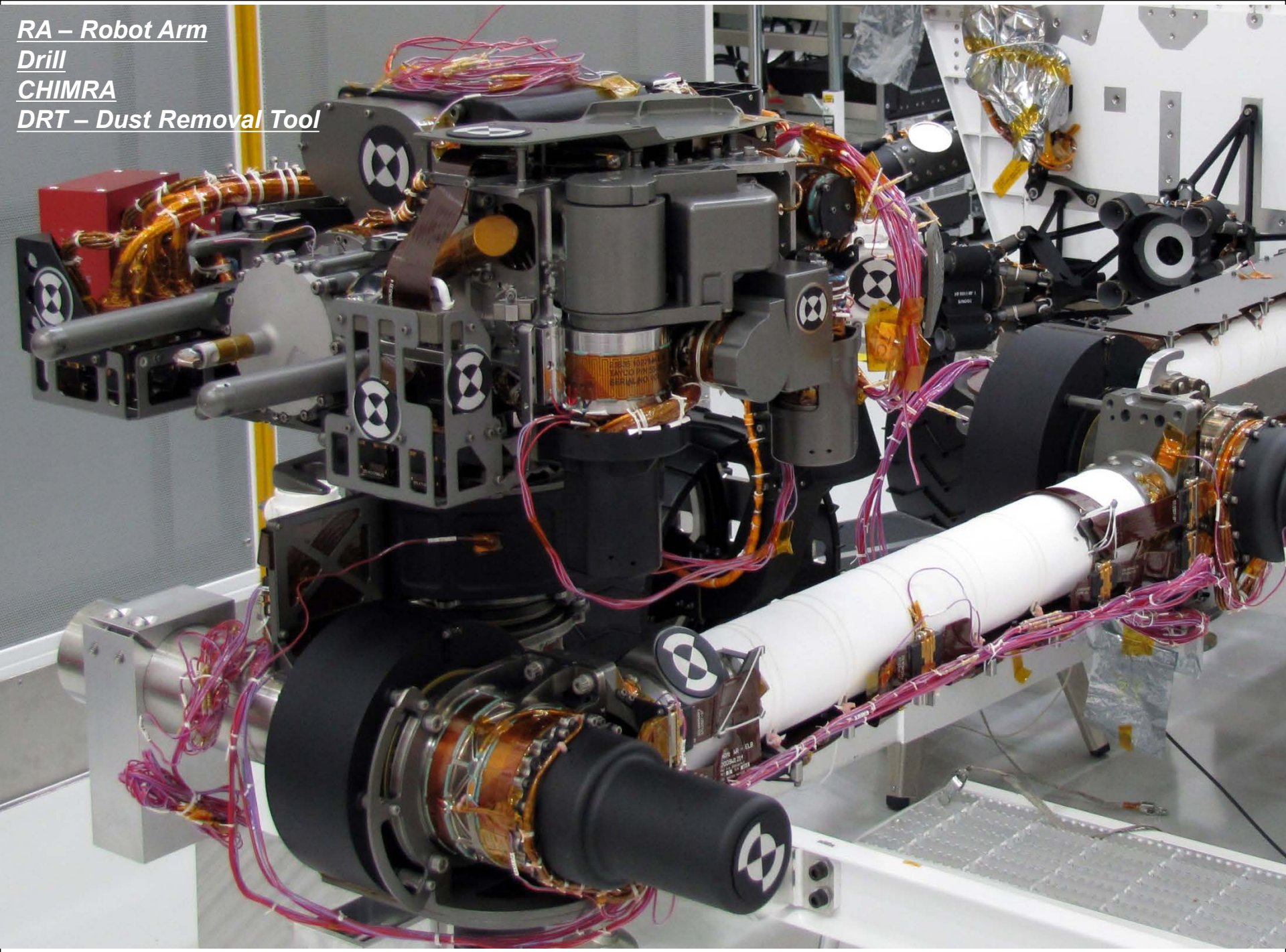

Descent Stage Structure
Descent Stage Propulsion
MLE – Main Landing Engines
RCS – Roll Control System Thrusters
DPAM – Descent Power Analog Module
DMCA – Descent Motor Controller Assembly
DPA – Descent Power Assembly
PWTB – Power Thermal Batteries
PYTB – Pyro Thermal Batteries
DIMU – Descent Inertial Measurement Unit
HRS – Heat Rejection System
X-band – SDST, TWTA, WTS
DLGA – Descent Low Gain Antenna
DUHF – Descent UHF Antenna


TDS – Terminal Descent System (Radar)
BUD – Bridle Umbilical Device

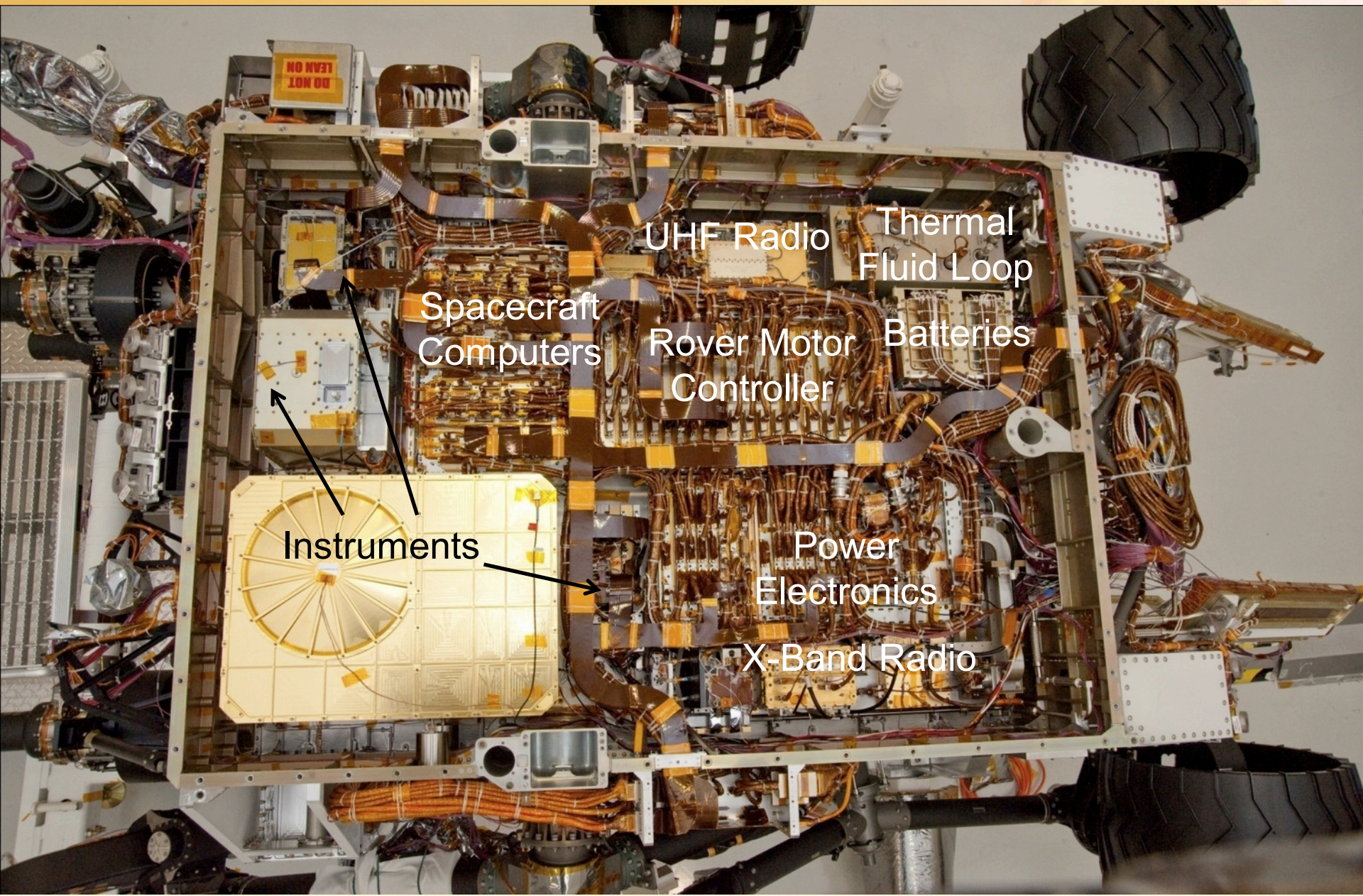

***Rover Chassis***
***Mobility***
***HRS – Heat Rejection System***
***HGA – High Gain Antenna***
***RUHF – Rover UHF Antenna***
***RLGA – Rover Low Gain Antenna***
***Widgets – Sample Playground, Poker, Windguard***
***Bitboxes/DBA – Drill Bit Assemblies***
***OCM – Organic Check Material***
***HazCams (8) – Hazard Avoidance Cameras***



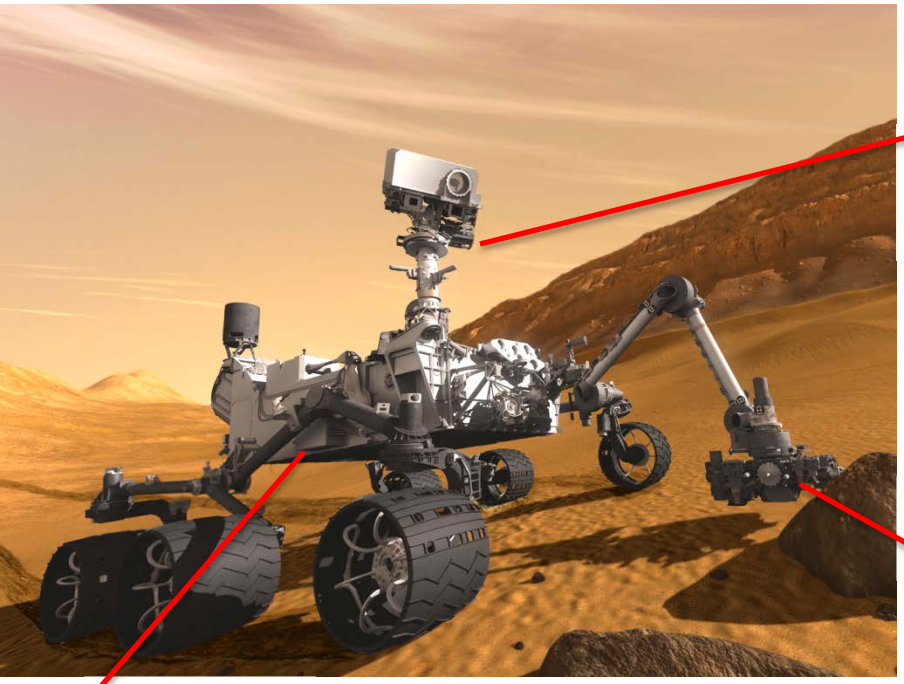

***RSM - Remote Sensing Mast***
***RWEB – Remote Warm Elect Box***
***NavCams (4) – Navigation Cameras***
***Inlet Covers (not shown)***
***RPFA – Rover Pyro Firing Assembly***


RA – Robot Arm
Drill
CHIMRA
DRT – Dust Removal Tool

# What's under the Hood



# CURIOSITY CRRIES TEN (10) INSTRUMENTS



**There are 3 on the mast:**

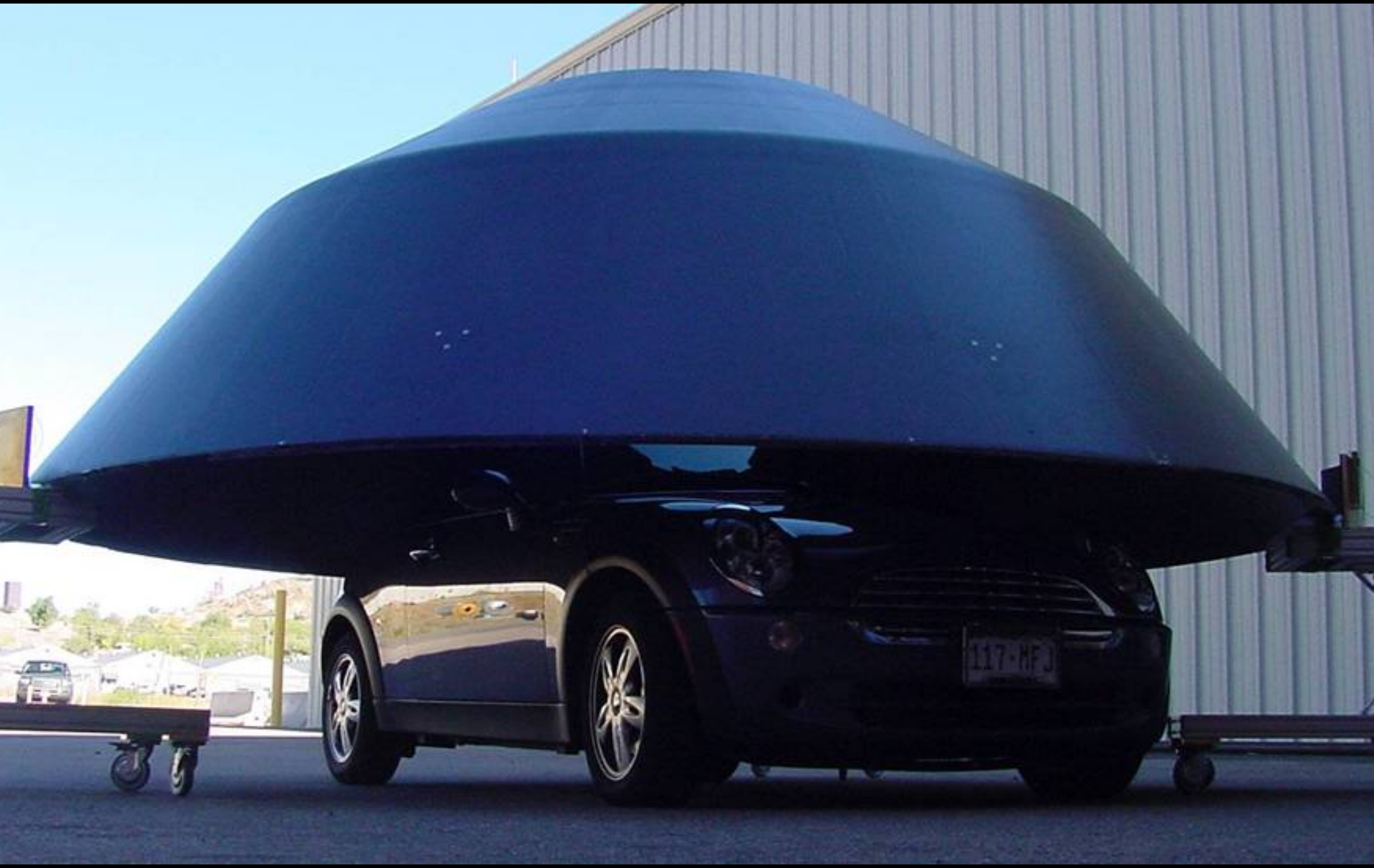
1. Mastcam imager
2. ChemCam laser
3. REMS metrology

**There are 2 on the arm:**

1. MAHLI microscope
2. APXS elemental spectrometer

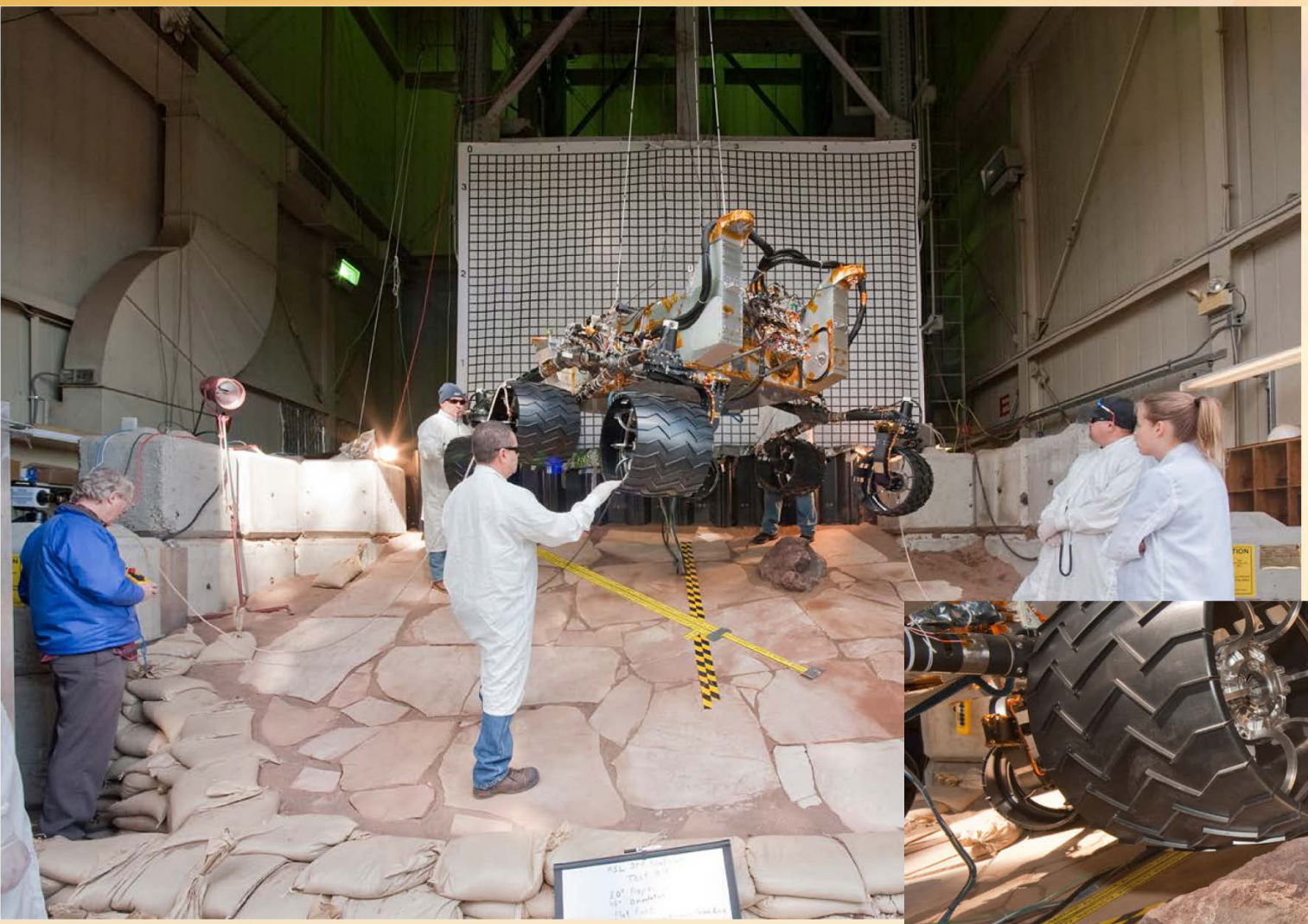
**There are 5 on/in the body:**

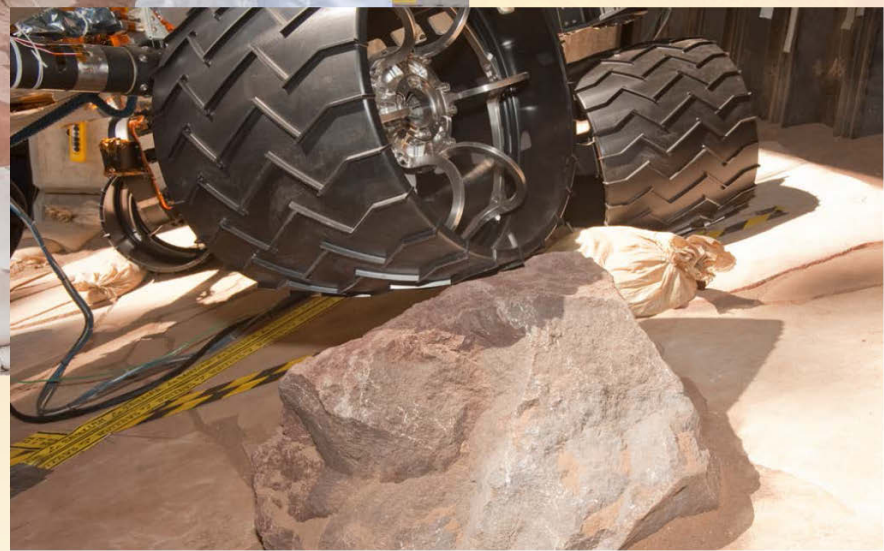
1. MARDI descent imager
2. RAD radiation detector
3. DAN neutron detector
4. CHEMIN chemical spectrometer
5. SAM analytical laboratory




Parachute Testing @ Ames

# DTM Rover Touchdown Testing



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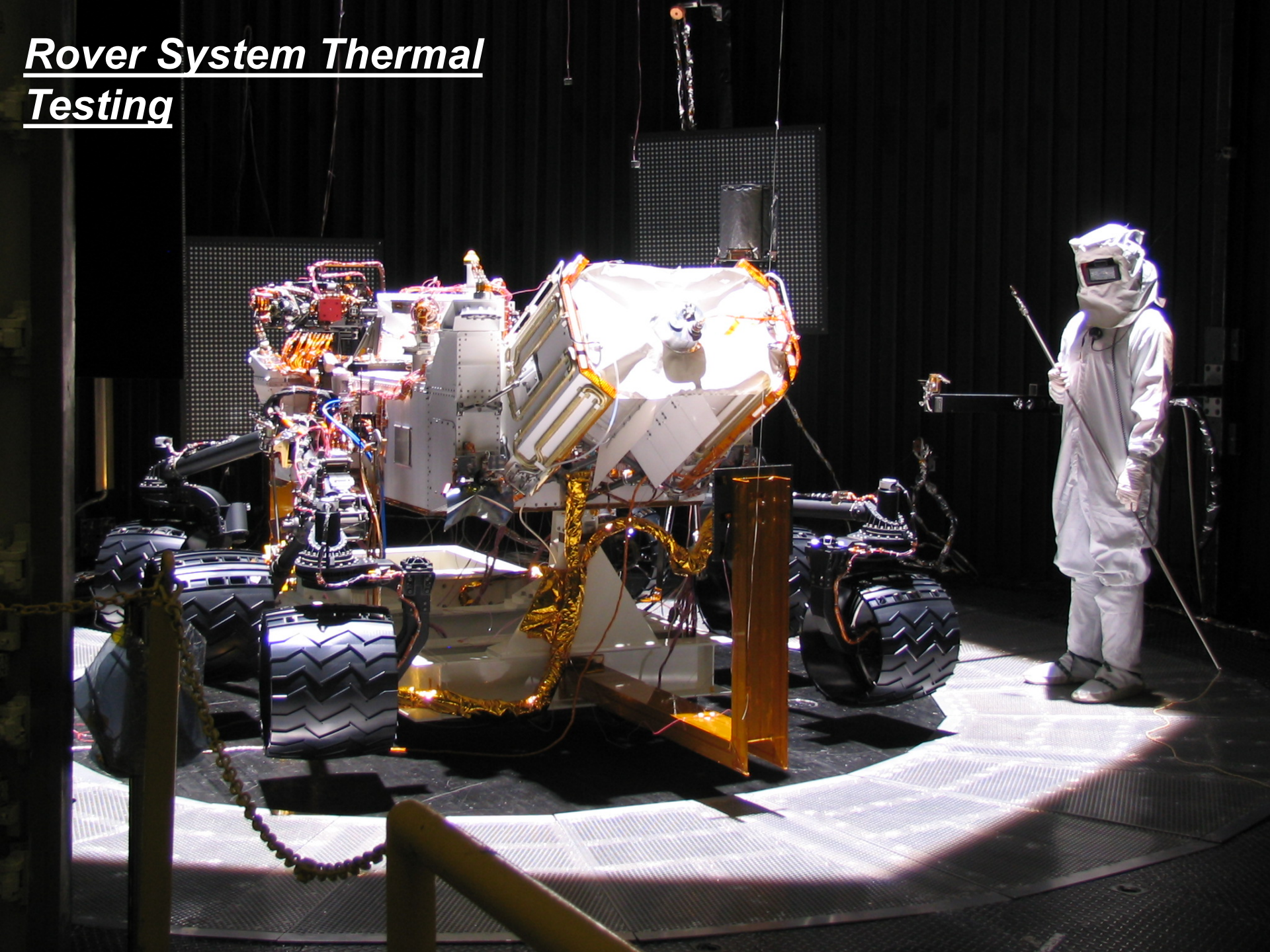
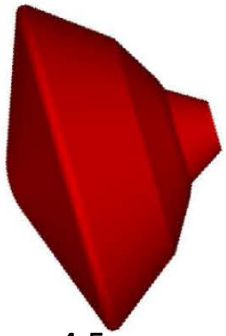
# Rover System Thermal Testing



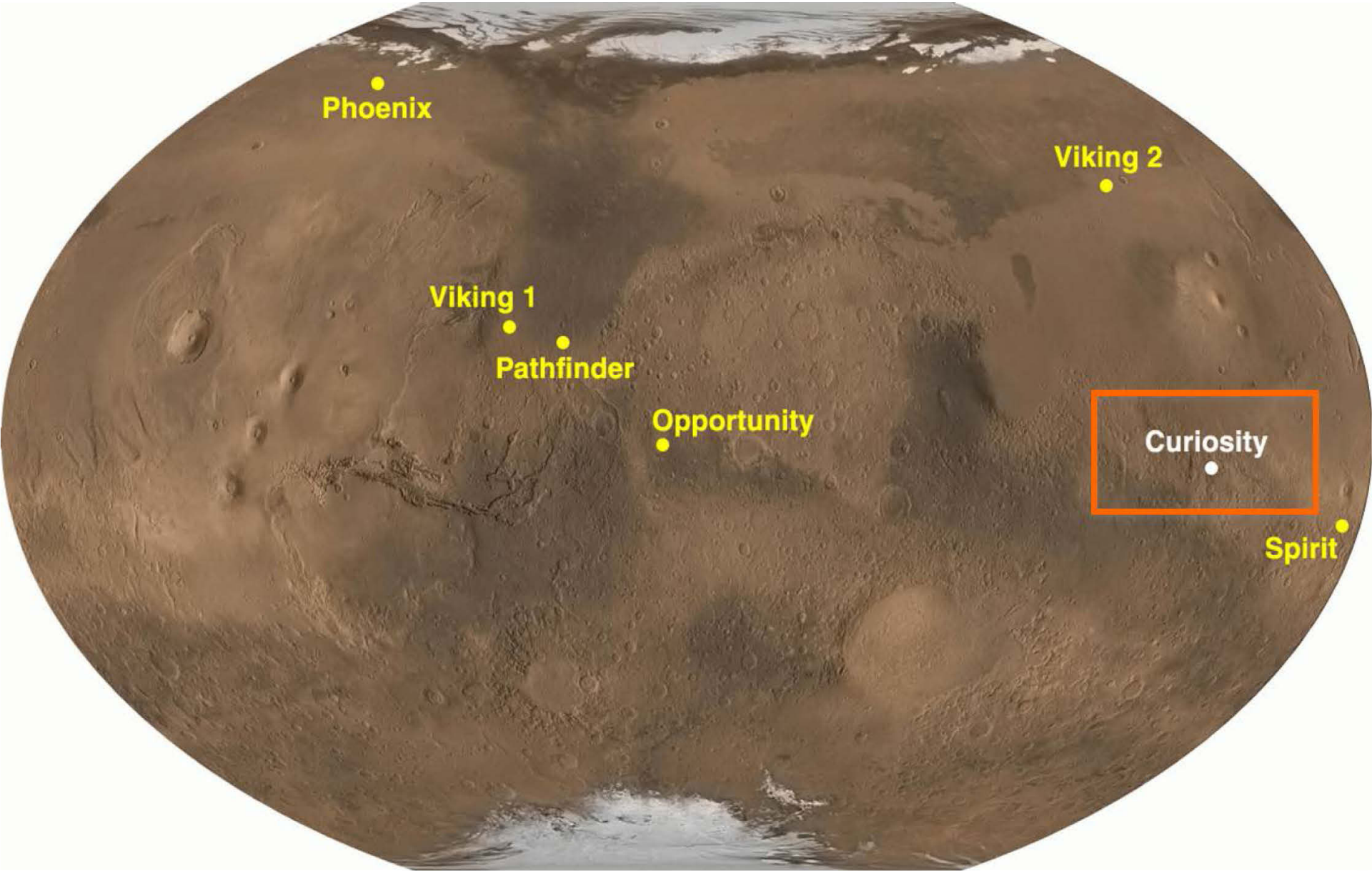
# ATLO EDL Sky Crane Testing

# A COMPARISON

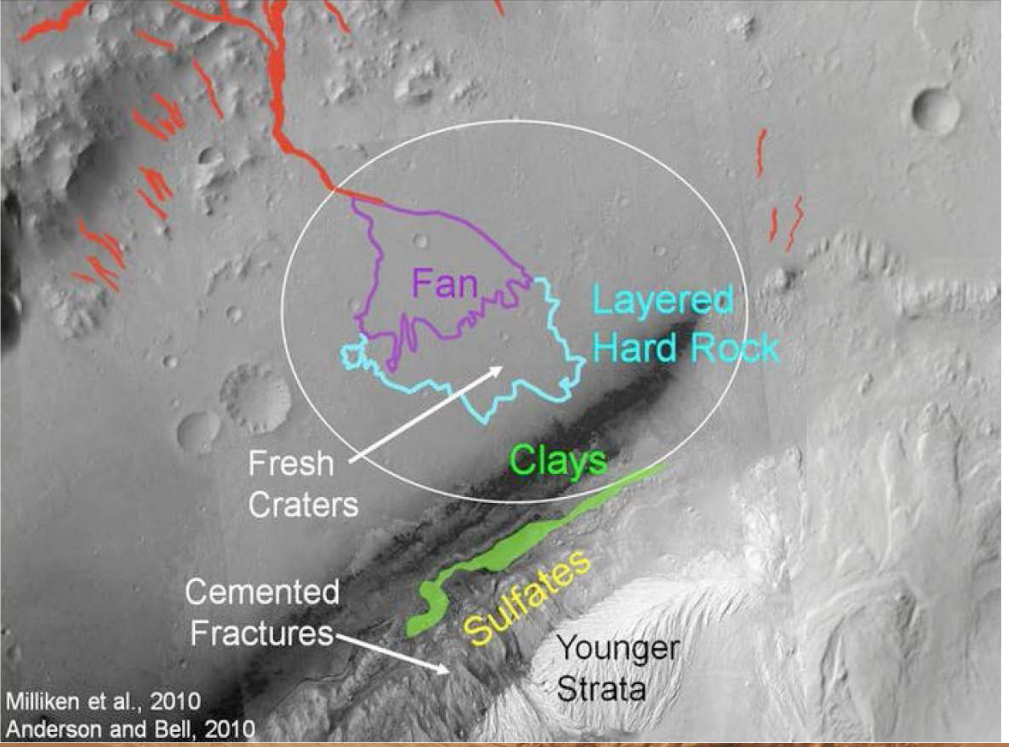
| | Viking 1/2 | Pathfinder | MER A/B | Phoenix | MSL |
|---|---|---|---|---|---|
| |  |  |  |  |  |
| Aeroshell Diameter, m | 3.50 | 2.65 | 2.65 | 2.65 | 4.5 |
| Entry Mass, kg | 930 | 585 | 840 | 602 | 3,152 |
| Landed Mass, kg | 603 | 360 | 539/173 | 364 | 1561/900 |
| Landing Altitude, km MOLA | -3.5 | -1.5 | -1.3 | -3.5 | -4.4 (capability: -0.5) |
| Landing Accuracy, km | 300 x 300 | 200 x 100 | 150 x 20 | 100 x 20 | 25 x 20 (21 x 7) |
| Lift/Drag Ratio | 0.18 | 0 | 0 | 0 | 0.24 |
| Entry Guidance/Control | Lift Up RCS Control | None Spinning | None Spinning | None Non-Spinning | Guided RCS Control |
| Parachute Diameter, m | 16.15 | 12.7 | 14.1 | 11.8 | 21.5 |
| Touchdown System | Legs | Airbags | Airbags | Legs | Sky Crane/Wheels |


AIR FORCE
5141

# WHERE HAVE ALL THE LANDERS GONE?

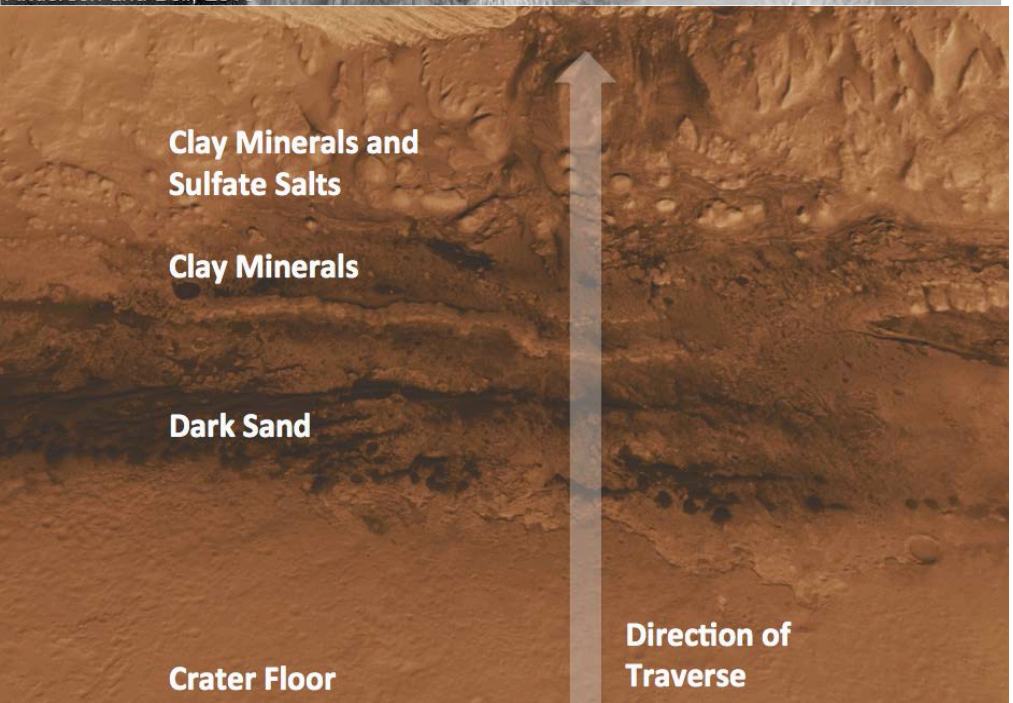


Curiosity is targeted to land within the black ellipse, on flat terrain near Gale's central mound and explore the basin floor, making it's way up Mt Sharp.




The landing ellipse allows access to a fan at the base of a fluvial channel that begins on the crater wall. Other science targets include fresh craters that expose bedrock, and small channel features.

# Science Targets at Gale Crater



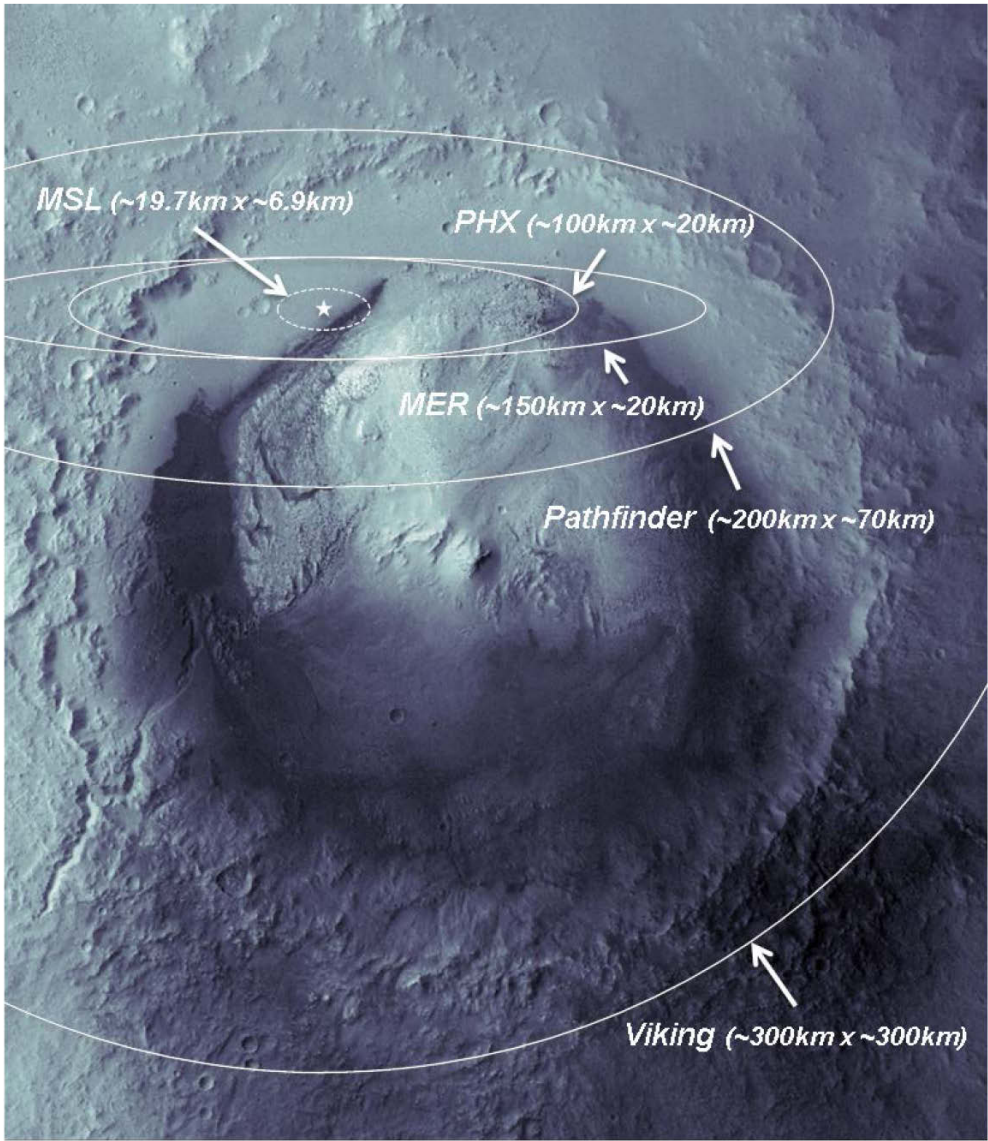

The primary science targets are the lower strata of the central mound, where orbital mapping indicates the presence of clay minerals near the base of the section, transitioning to sulfates higher up.

# WHY CAN'T WE LAND ON A DIME

MSL lands more accurately than its predecessors. That is great but why not better?

There are 4 primary sources of error:

1. **Spacecraft knowledge at entry.** The navigation during cruise is very good, but not perfect. This propagates into a 2-3 km miss (down range and cross range).
2. **Attitude knowledge during hypersonic guidance.** The mechanical alignment of the Descent Stage IMU relative to the Star Scanner on the Cruise Stage is not perfect. This translates into guided entry errors of 4-6 km miss (down range and cross range)
3. **Atmospheric and aerodynamic variability.** To maximize altitude, the final 75-100 km to the target are flown open-loop with respect to the downrange target. As a result, error due to atmospherics and aerodynamics are introduced resulting in a 5-7 km miss (down range)
4. **Winds.** Once on the parachute, winds will impact the landing precision resulting in a 1-2 km miss (down range and cross range)



*From our family to yours …..*

# Enjoy the show 8/5/12