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- Why prospect and explore with lunar robots?
- What can robots do?
- How can robots enable

Science?

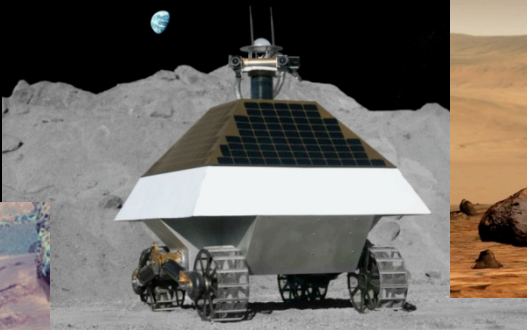
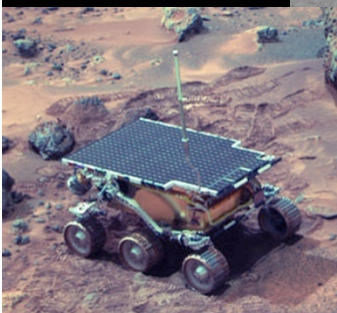
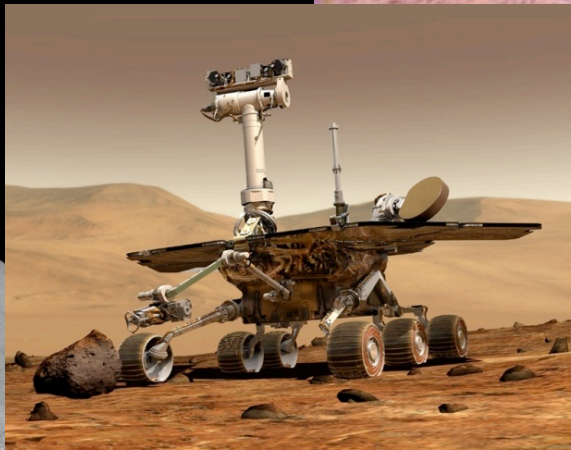
Prospecting?

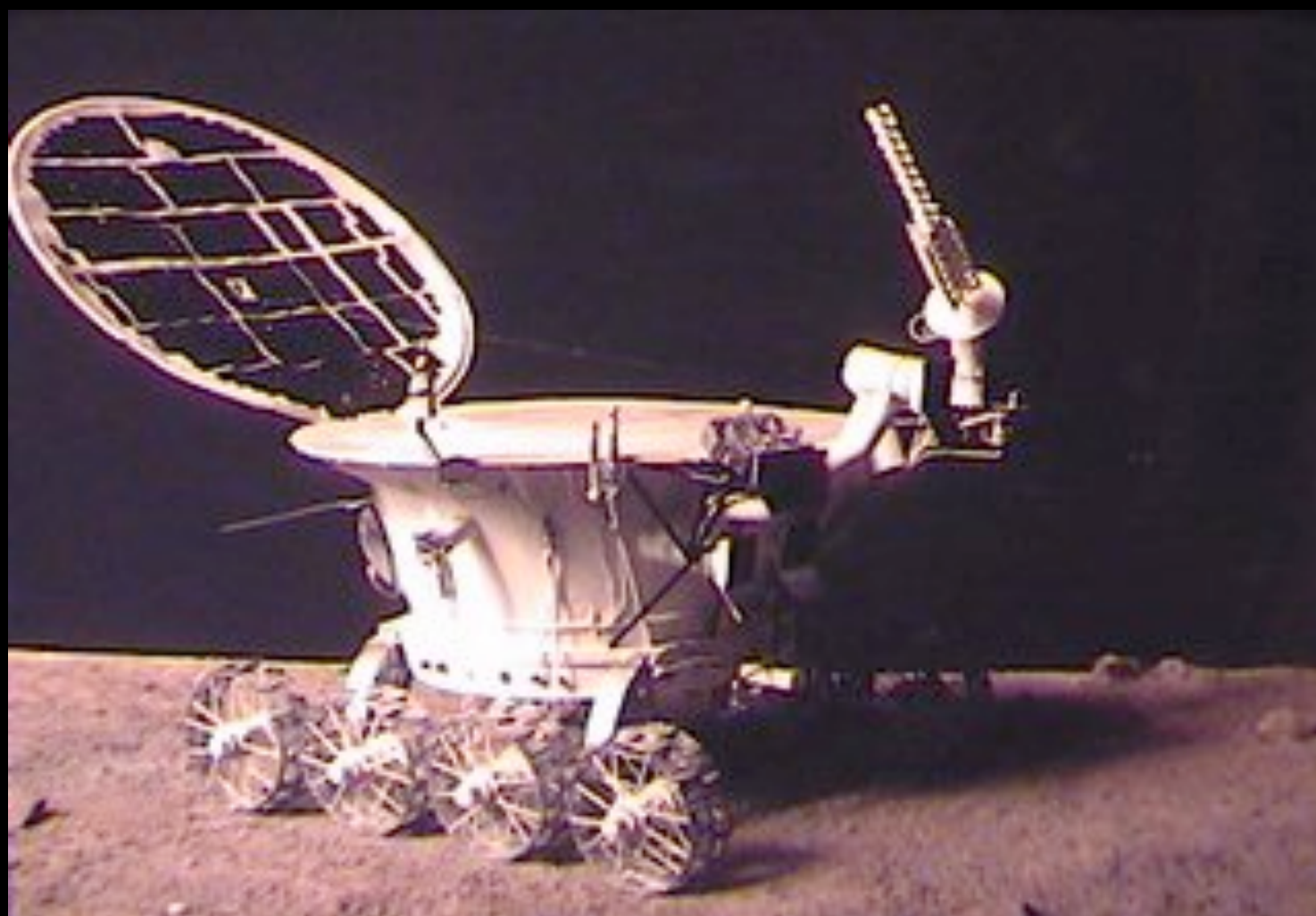
Exploration?

- Appreciable robot capability
- Sustained robot mission duration viz human - only
- Immense map coverage and data volume
- Extensive mission range

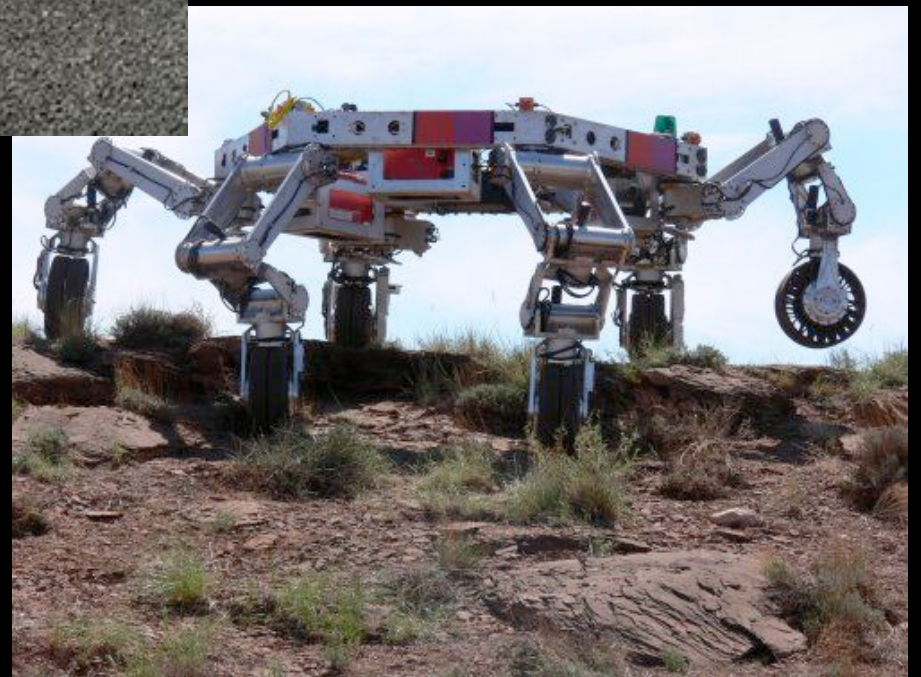


# Lunar- Relevant prospecting





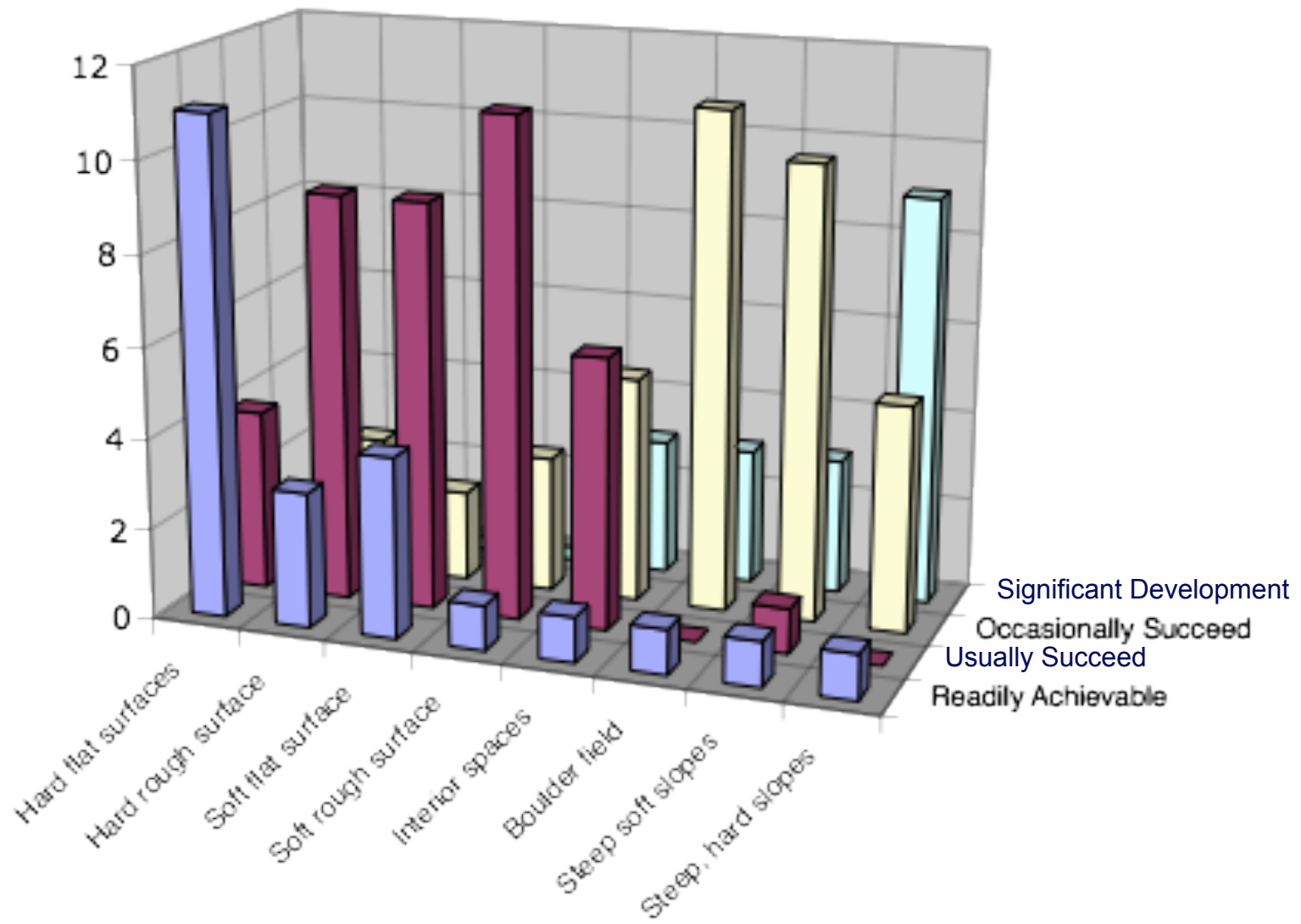








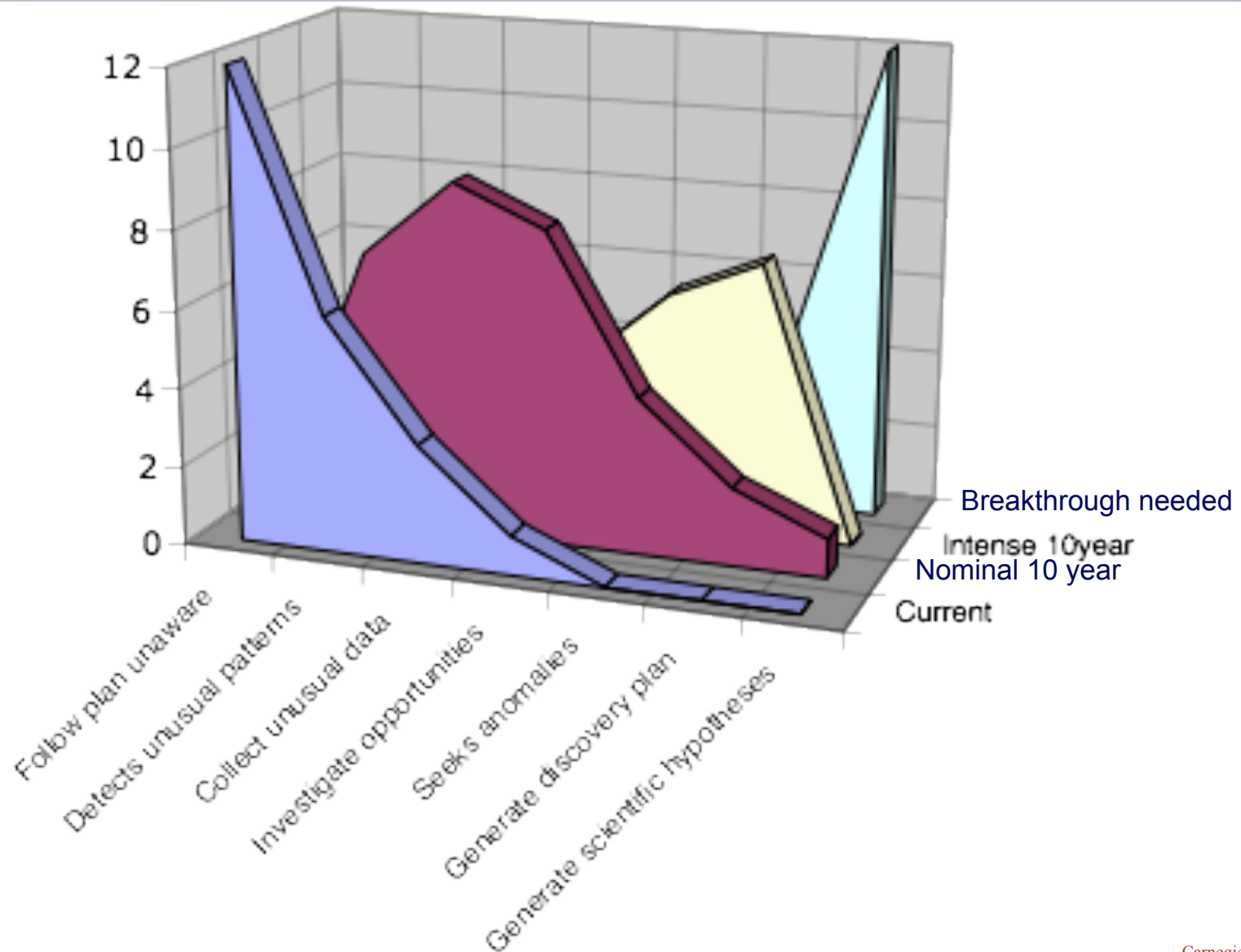
# Surface Mobility Challenges







# Exploration Challenges







# Mobility innovation for prospecting



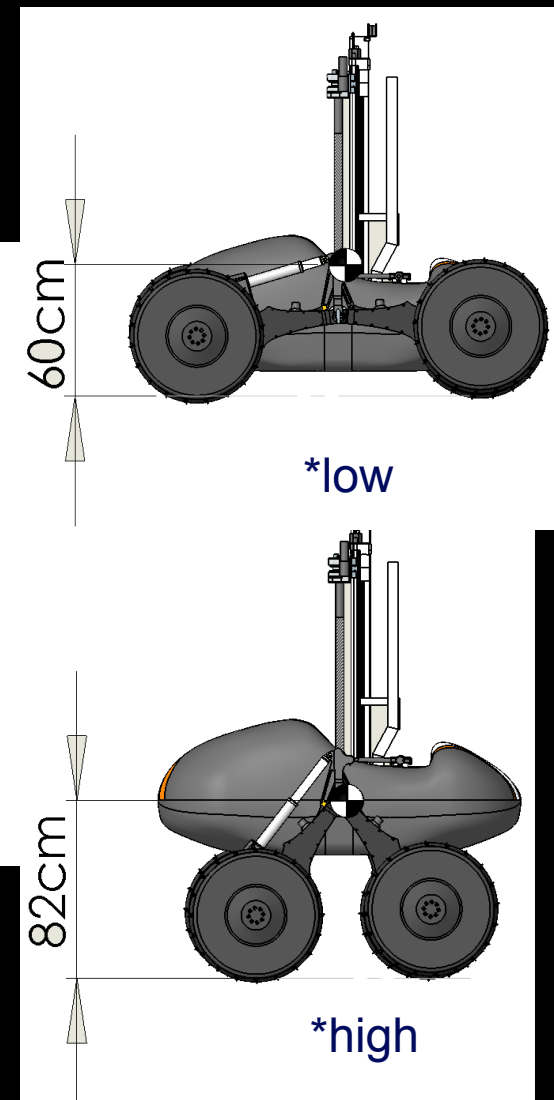
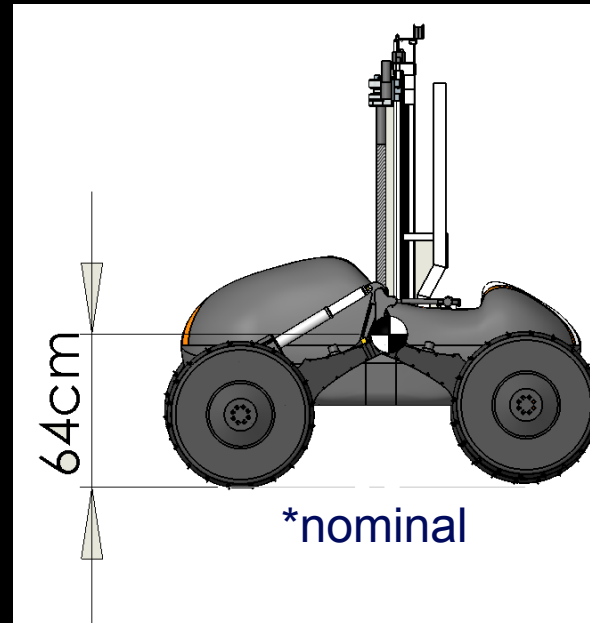
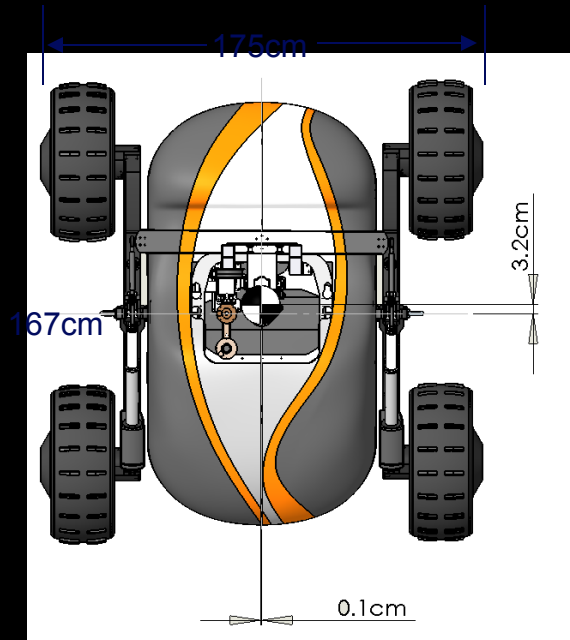




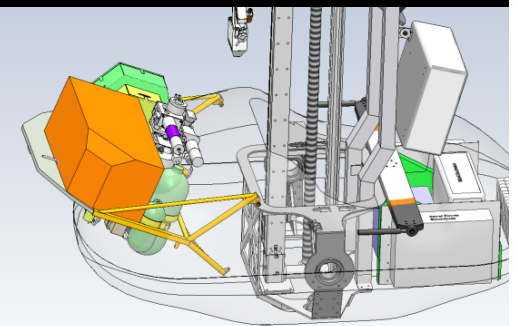
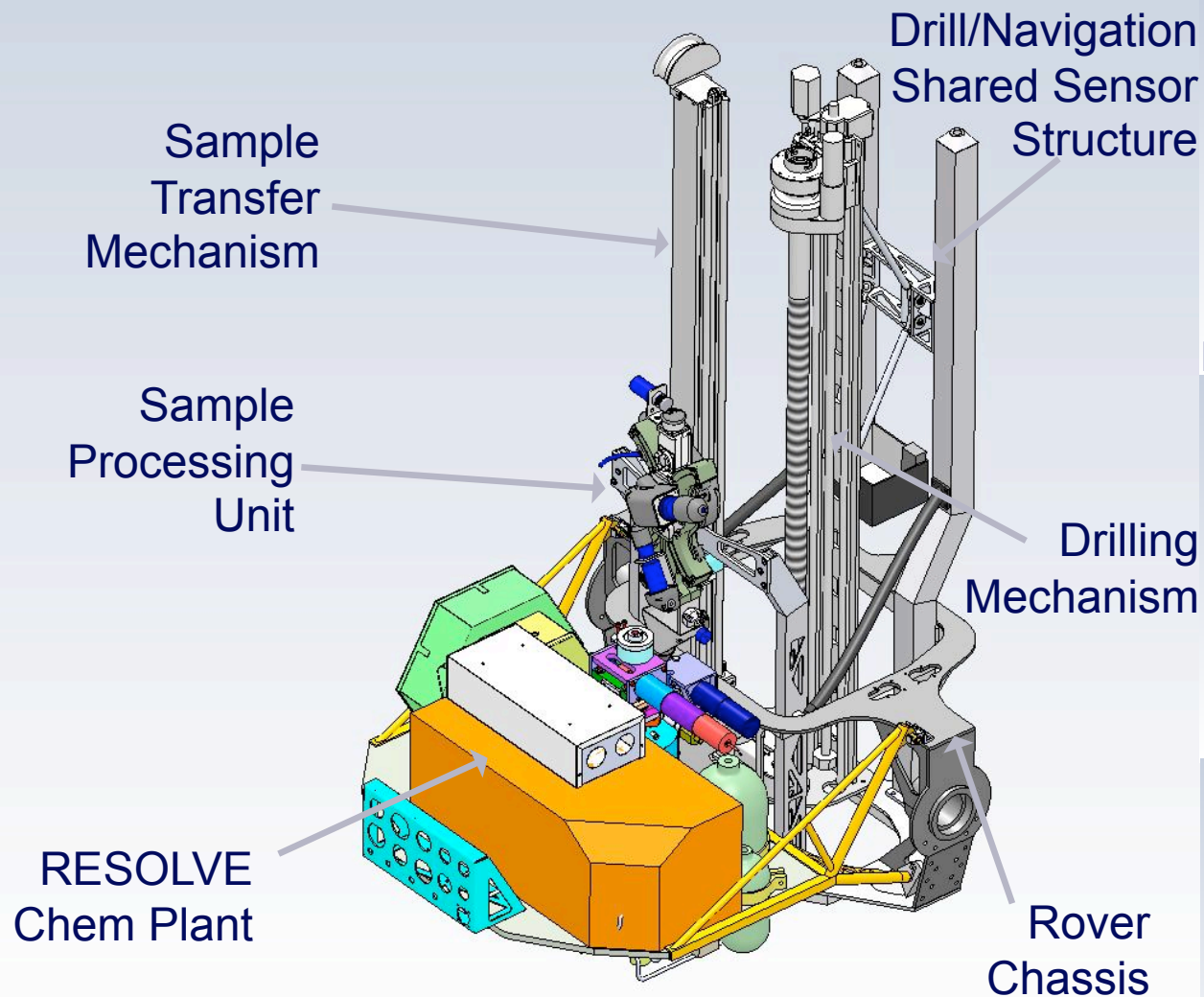
# Scarab Specifications

Mass (w/o payload):	280 kg
Weight:	460 N $\mathcal{D}$ 2750 N $\oplus$
Power (driving):	200 W (peak) $\oplus$
Power (posing):	380 W (peak) $\oplus$
Power (idle):	78 W
Speed:	5.0 cm/s (6.0 cm/s max)
Height (with drill tower):	2.2 m high stance, 1.6 m low stance
Width (wheelbase):	1.4 m
Length (wheelbase):	0.8 - 1.4 m
Aspect (track/wheelbase):	1:1 low, 1:1.2 nom, 1:1.7 high
Wheel diameter:	60 cm
Straddle:	57 cm max, 0 cm min
Height (Center of Mass):	0.64m, 0.60m low, 0.72m high

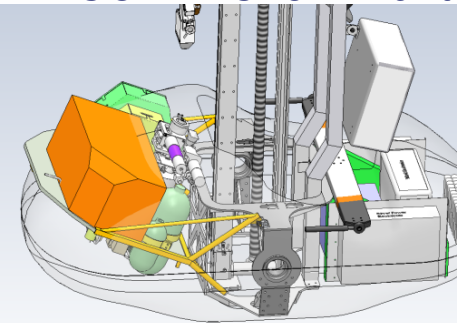
# Scarab Dimensions



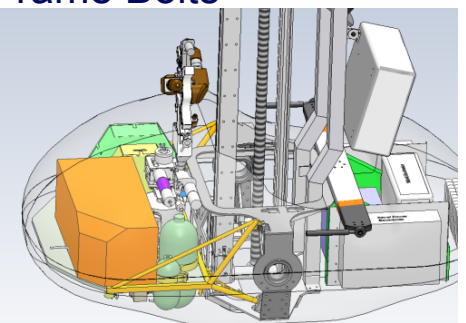
# ISRU/RESOLVE Integration



Drop In RESOLVE Chem Plant



Sinch Frame Bolts



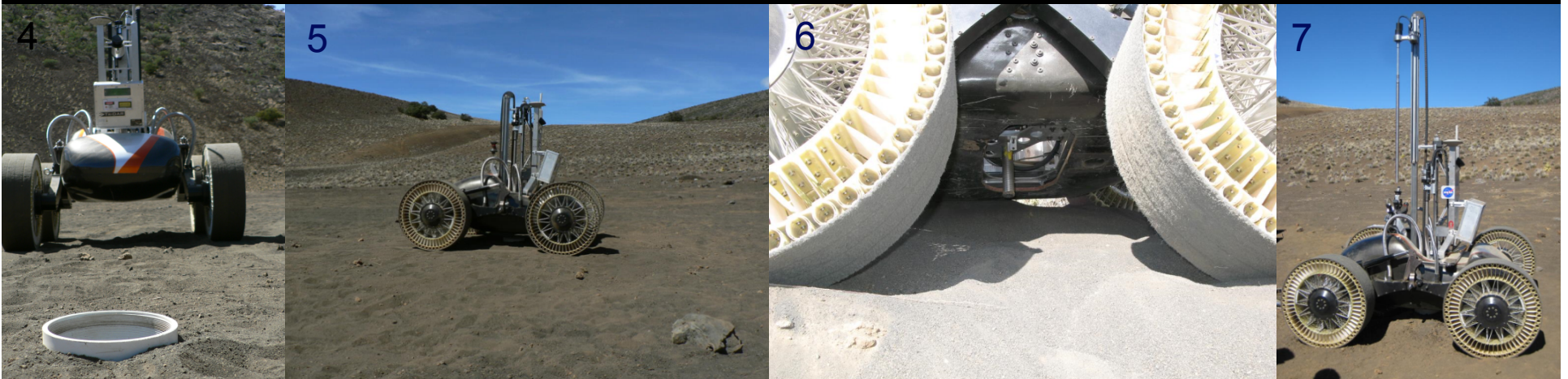
Install Sample Processing Unit



# ISRU/RESOLVE Support



- Steep Slope Ascent, 20 ° ash
- Crater access for assay



# TWeel





# Robotic Capability

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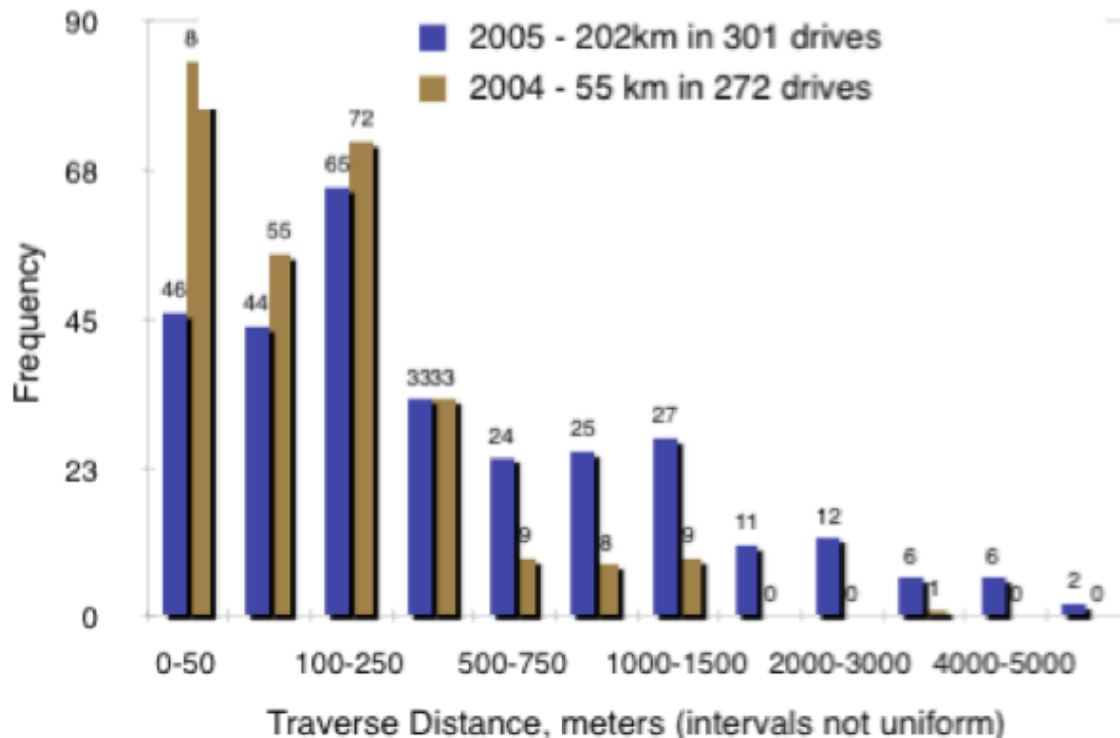
## What can robots do?

- Drive
- Extricate
- Navigate
- Determine position
- Perform procedural tasks
- Power, thermal and comm services
- Work, not just watch
- Take risks
- Tolerate physical exposures
- Operate early without extensive infrastructure



# Long-Range Traverse

**Autonomous Traverse by Distance**



**Autonomous Traverse  
Experiments: 573**

**Total Distance: 257 km**

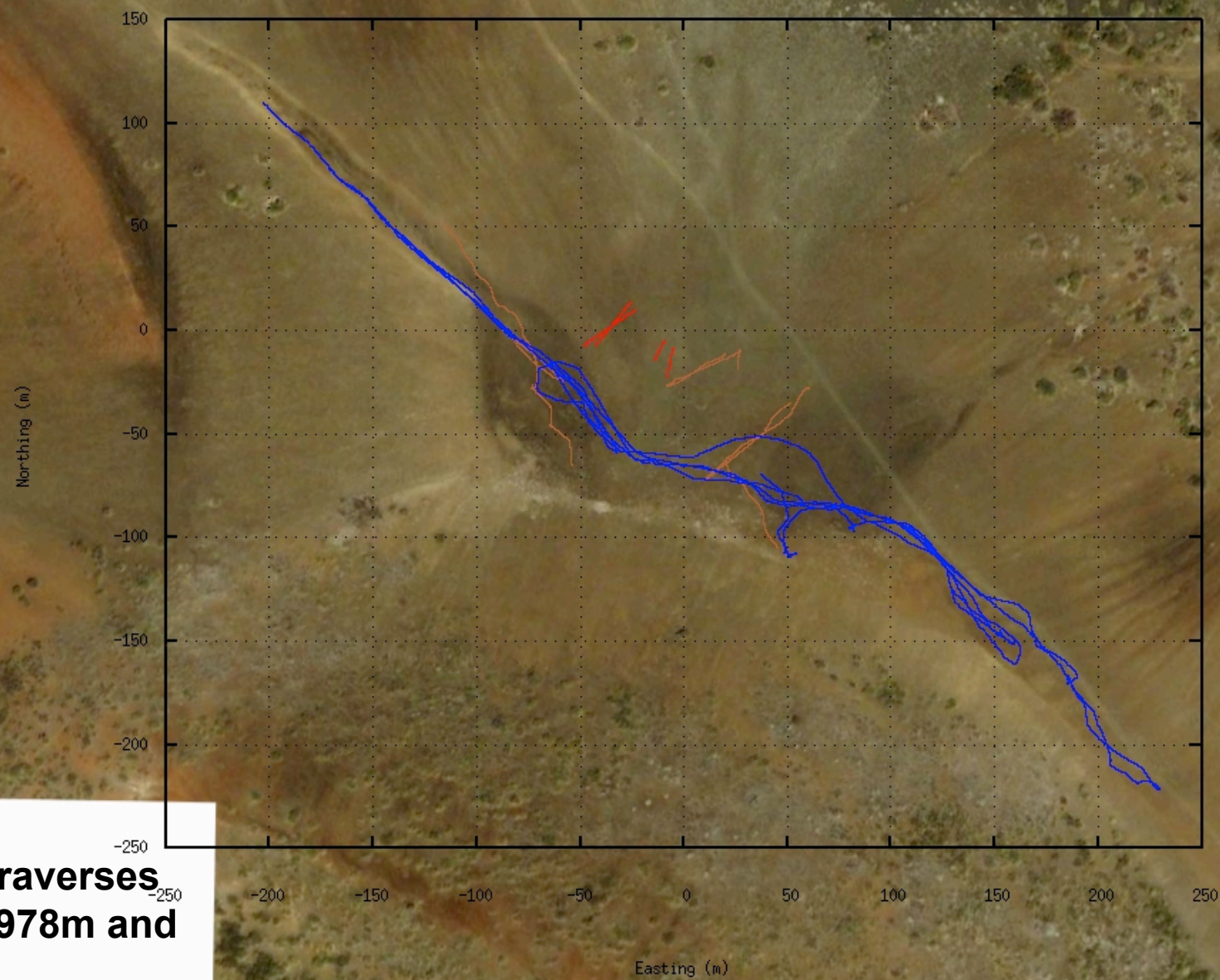
**Single-command Traverse:**

**Over 2000m: 26**

**Over 1000m: 75**

**Over 100m: 343**

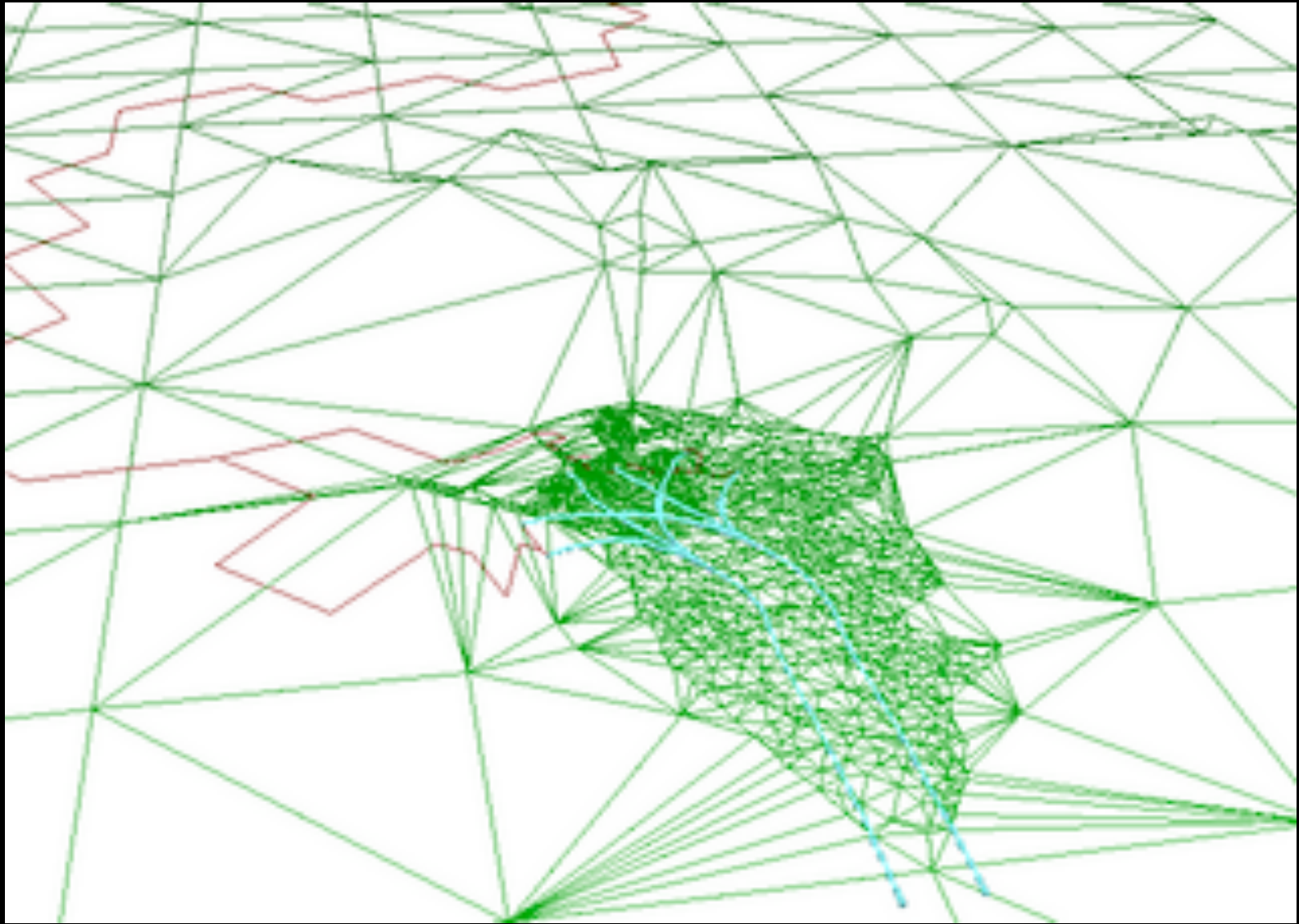
Note: Some traverses were intentionally limited in length.



**Long traverses  
(blue) 978m and  
1302m**



# Dark Navigation





# How do Robot Prospectors enable science and exploration?

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- Deploy tools, not toys
- Generate power
- Deliver vast coverage
- Automate repetitive tasks
- Deploy instruments and sensors
- Capture context and televise scene awareness
- Sustain prospecting/exploration & science
- Undertake initiatives beyond human risk threshold
- Reason, classify, plan, react

# Ultralight prospectors

60kg

120W Solar

273Wh Battery

HD Stereo

HD Telephoto

1.0 Mbps

Skid Steering

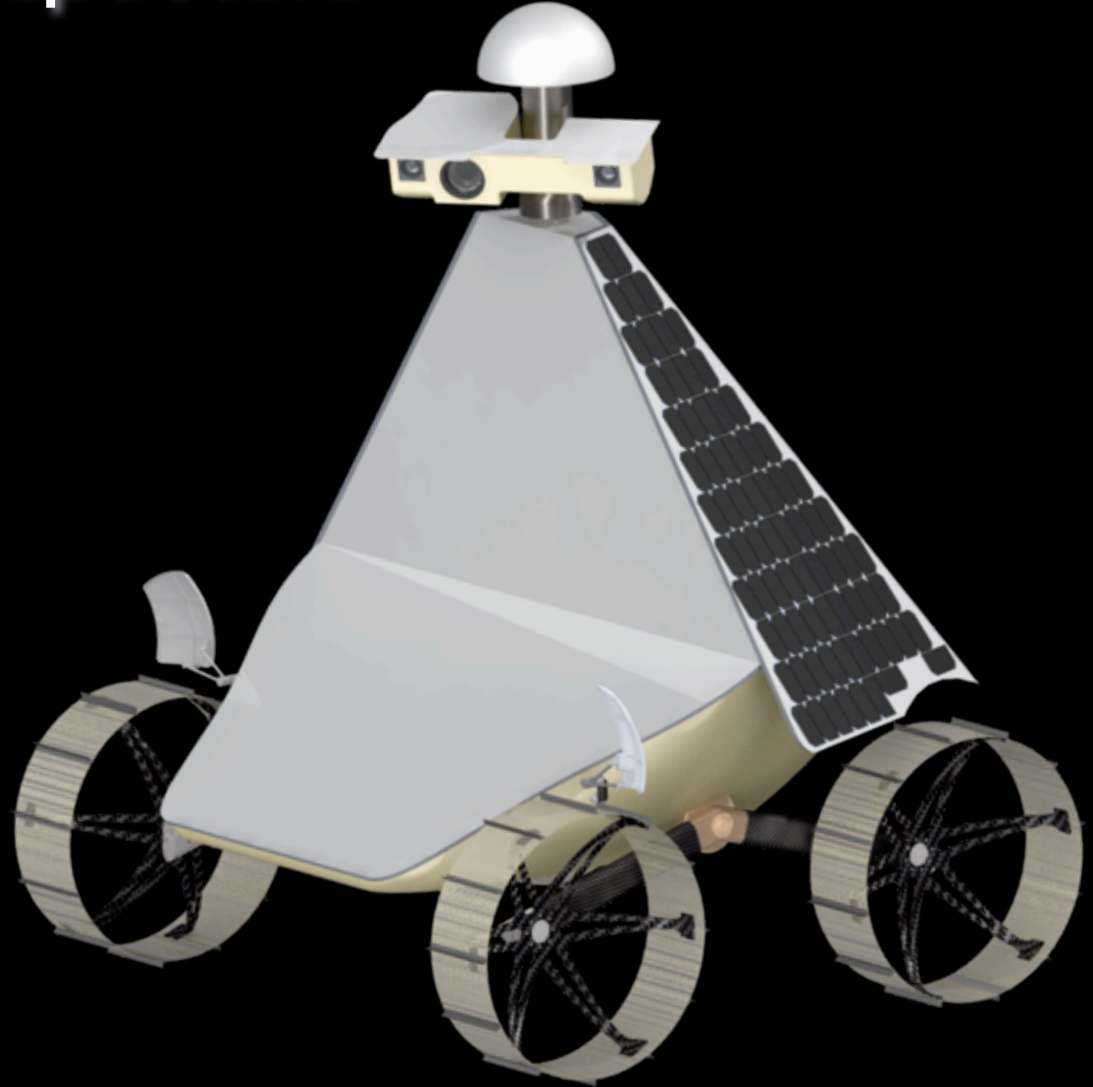
10 cm/s

Motorized Actuators:

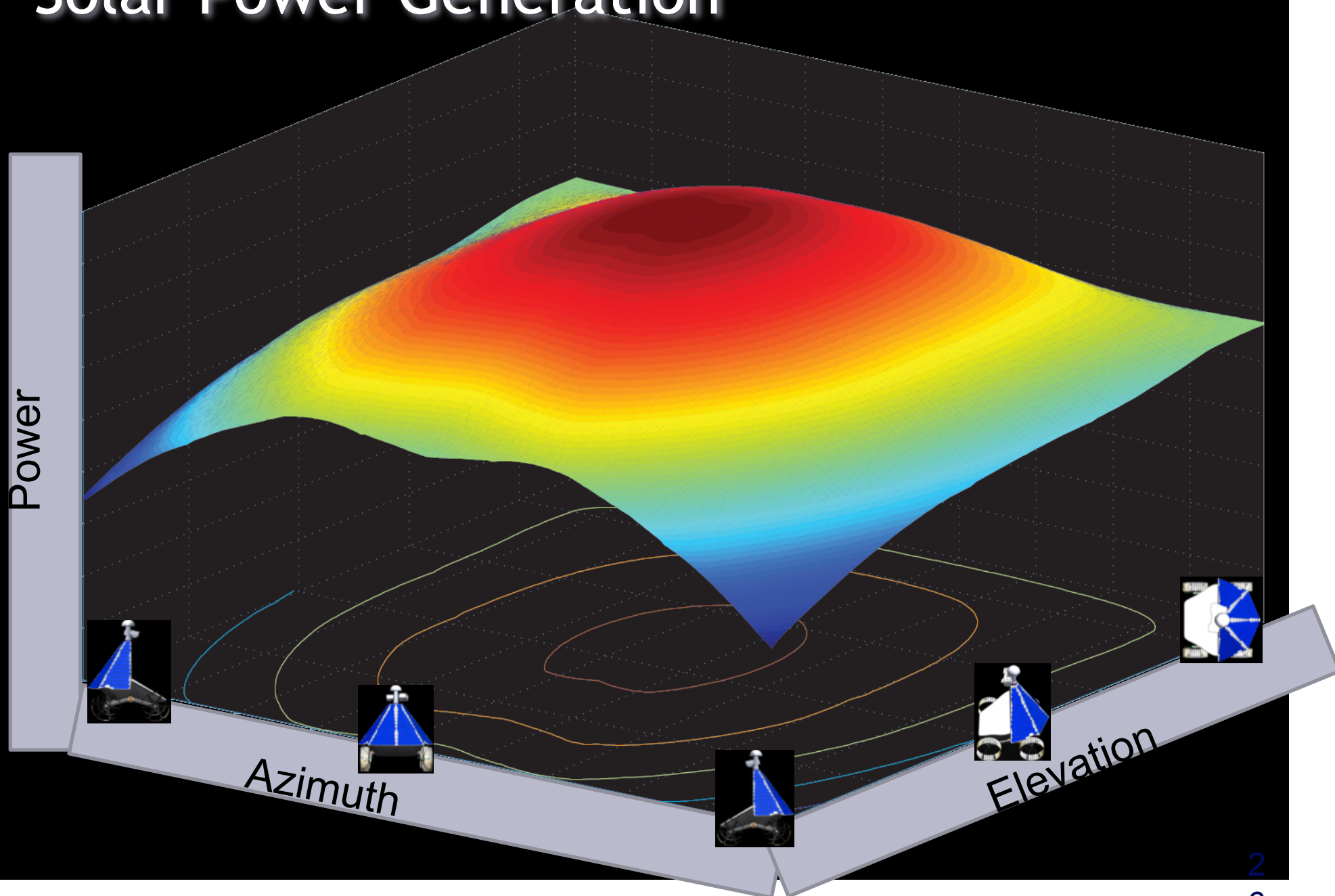
- 2 drive

- 2 mast pan/tilt

- 3 Zoom Camera

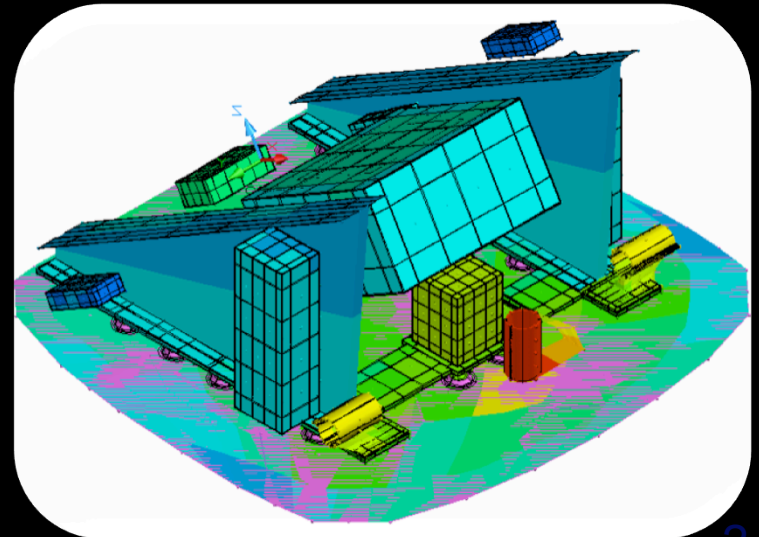
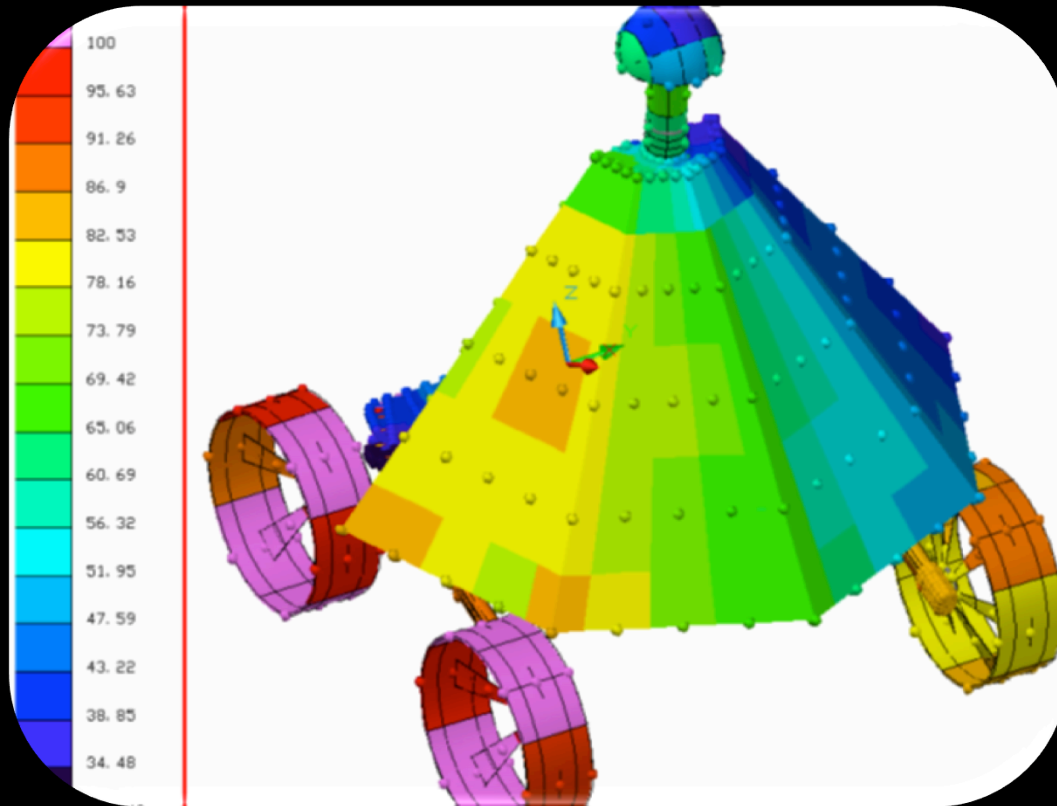


# Solar Power Generation

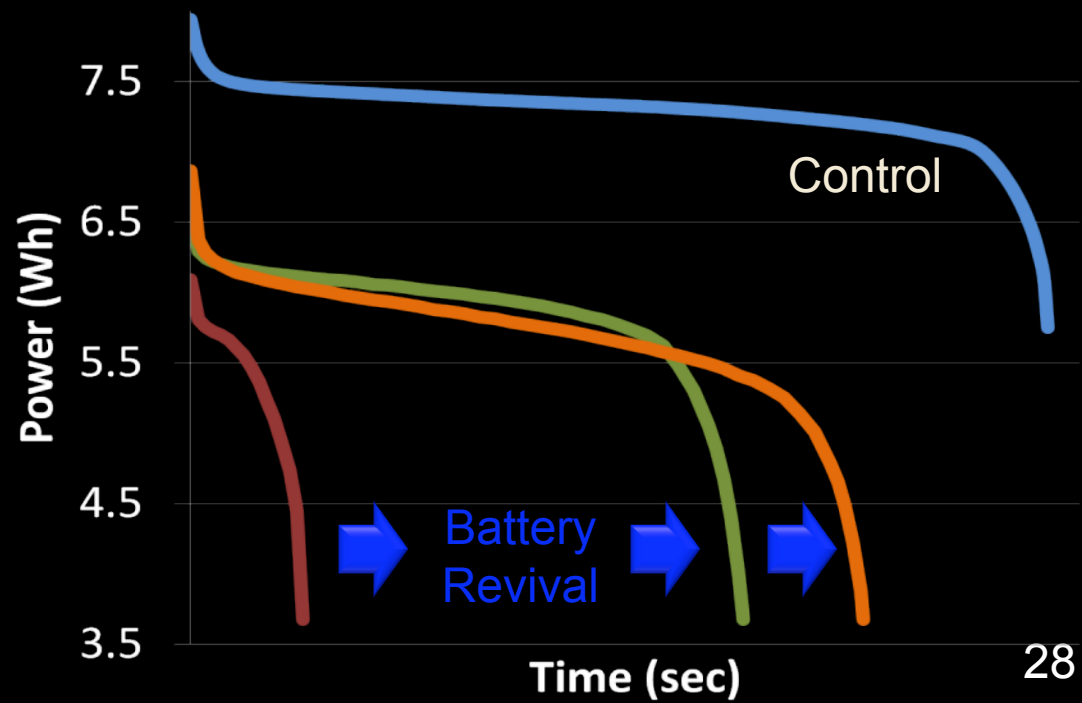
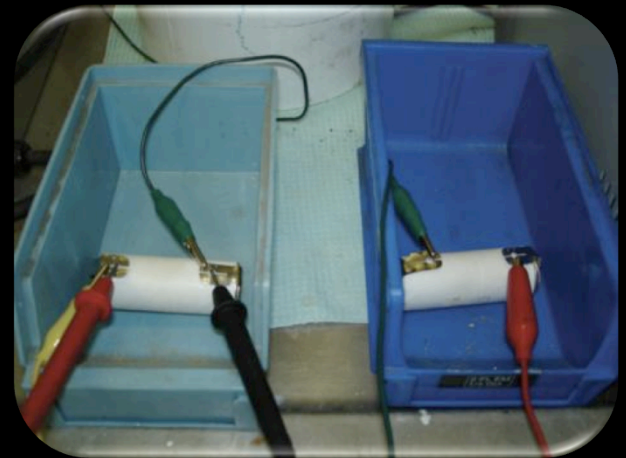




# Continuous Daytime Operation



# Overnight Survival



# Fulfillment of Robotic Lunar Prospecting

- Thermal management
- Longevity
- High Performance
- High Payload ratio
- Productivity
- Generality for diverse prospecting

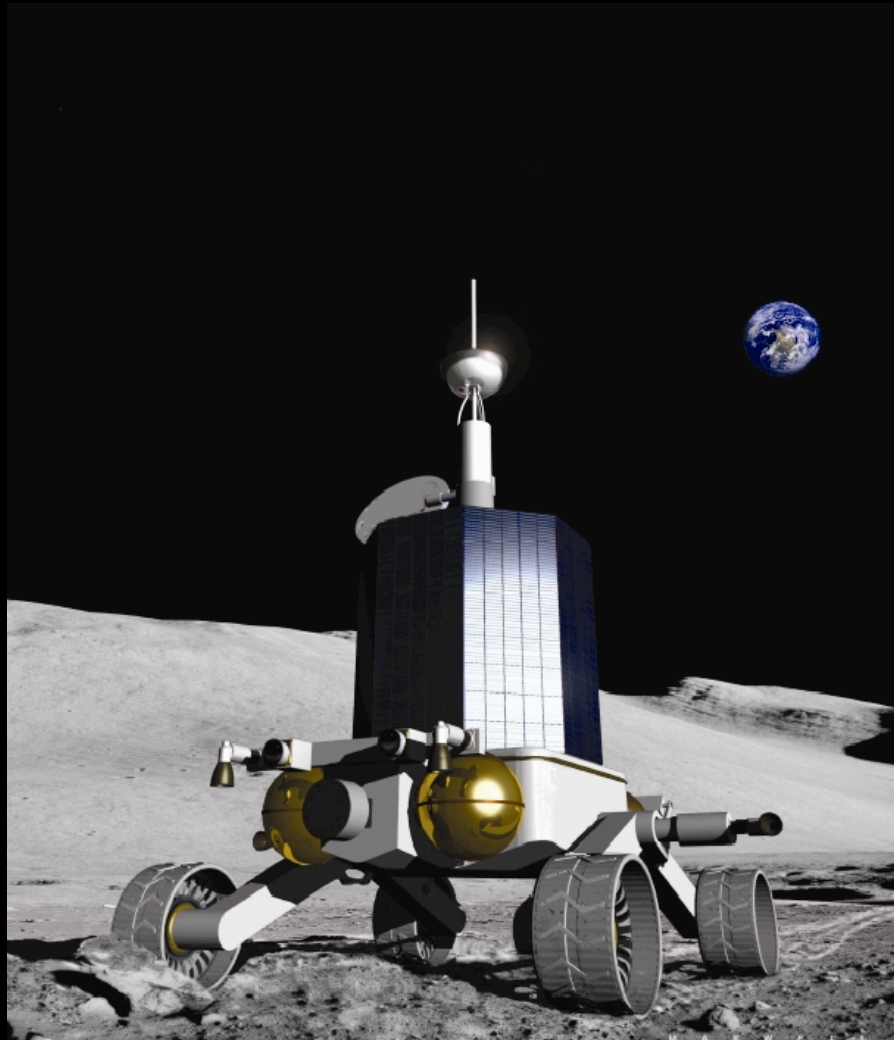


# Robotic Prospecting in Lava Tubes





# Polar Solar Robotic Prospecting





# Material handling for ISRU and sitework

