# Planetary Protection at NASA: Overview and Status

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NASA Planetary Protection Officer

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# 2014 NASA Strategic Goals



Strategic Goal 1: Expand the frontiers of knowledge, capability, and opportunity in space.

Objective 1.1: Expand human presence into the solar system and to the surface of Mars to advance exploration, science, innovation, benefits to humanity, and international collaboration.

Objective 1.2: Conduct research on the International Space Station (ISS) to enable future space exploration, facilitate a commercial space economy, and advance the fundamental biological and physical sciences for the benefit of humanity.

Objective 1.5: Ascertain the content, origin, and evolution of the solar system and the potential for life elsewhere.

# NASA Planetary Protection Policy



- The policy and its implementation requirements are embodied in NPD 8020.7G *(NASA Administrator)*
  - Planetary Protection Officer acts on behalf of the Associate Administrator for Science to maintain and enforce the policy
  - NASA obtains recommendations on planetary protection issues (requirements for specific bodies and mission types) from the National Research Council's Space Studies Board
  - Advice on policy implementation to be obtained from the NAC Planetary Protection Subcommittee
- Specific requirements for robotic missions are embodied in NPR 8020.12D *(AA/SMD)*
  - Encompasses all documentation and implementation requirements for forward and back-contamination control
- NASA Policy Instruction 8020.7 "*NASA Policy on Planetary Protection Requirements for Human Extraterrestrial Missions*" released in NODIS as of May 28, 2014

# Role of PPS



- Provides expert advice to NASA on planetary protection, as part of the NASA Advisory Council
  - Reviews mission activities and makes recommendations on implementation options
  - Considers and advises on specific points of policy that are below the resolution of international policy set by the Panel on Planetary Protection of the Committee on Space Research
  - Provides guidance regarding programmatic direction and issues of importance/relevance to future missions and implementation of planetary protection requirements
- Serves as a mechanism for interagency coordination within the US Government and internationally
  - Ex Officio membership from a range of US Gov't organizations, as well as other national/regional space agencies

# Recent Recommendations



- Nov. 2012 meeting
  - No formal recommendations
  - Observations and information
    - Concern expressed regarding inclusion of planetary protection issues in the Office of Chief Engineer study on lessons learned from MSL responses ongoing
- Apr. 2013 meeting
  - Recommendations
    - Include PPO early in mission planning and design in work
- Nov. 2013 and May 2014 meetings
  - No formal recommendations; concerns from above reiterated
- Nov. 2014 meeting
  - Recommendations
    - Improve MSL Project Office – Planetary Protection Officer Communications in work
    - Ensure Planetary Protection input to NASA assessment of launch and reentry license applications to the DoT/FAA by Non-Governmental Entities in work
  - Observations and information
    - Pleased by improved communications with InSight, M2020, and HEO
    - Concerned that the reporting line of the PPO be consistent with responsibility to assure continued treaty compliance across programs in multiple directorates
    - Concerned that joint meetings with ESA were not held Lindberg at 4/15 PPWG

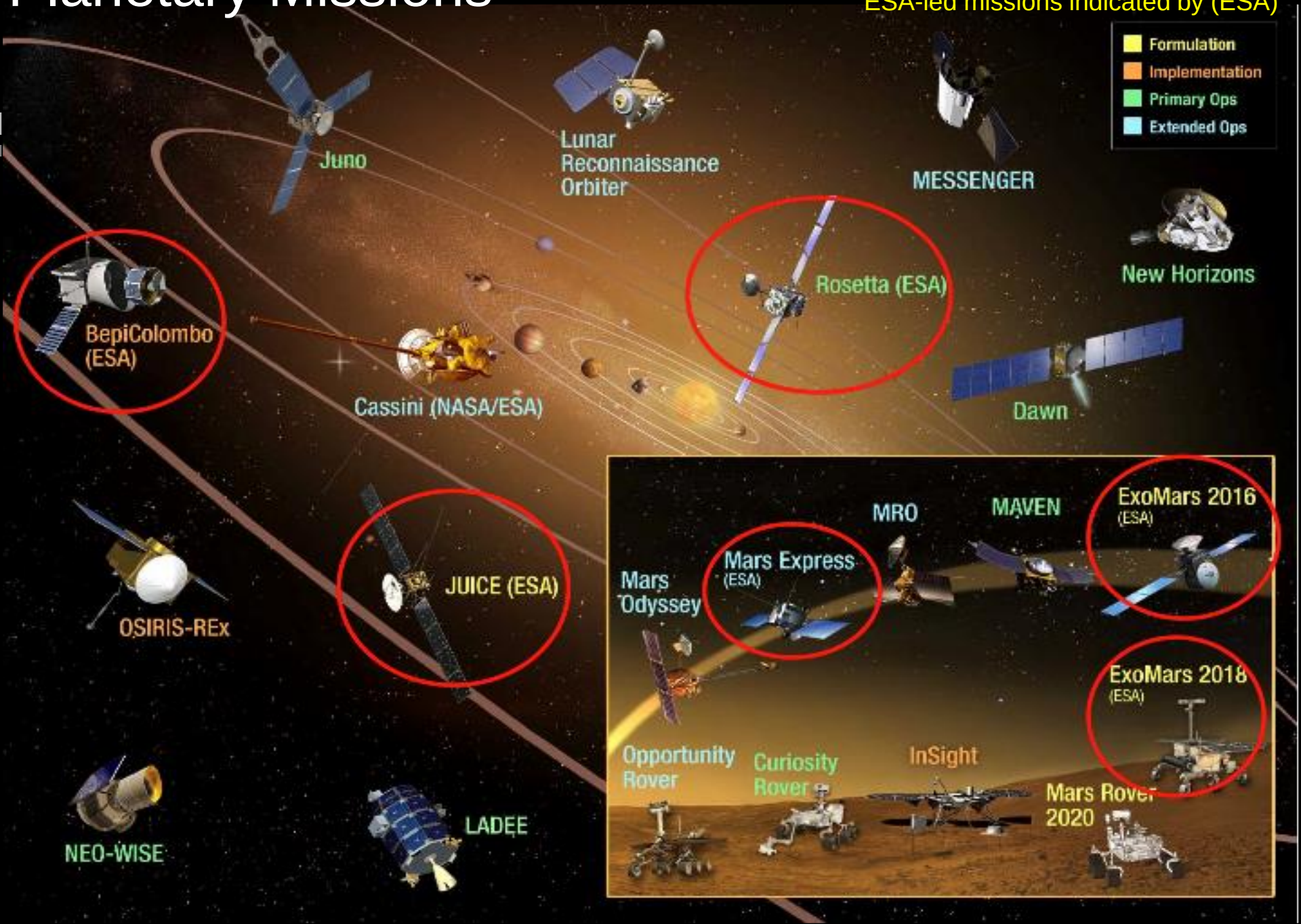
# Ongoing Actions



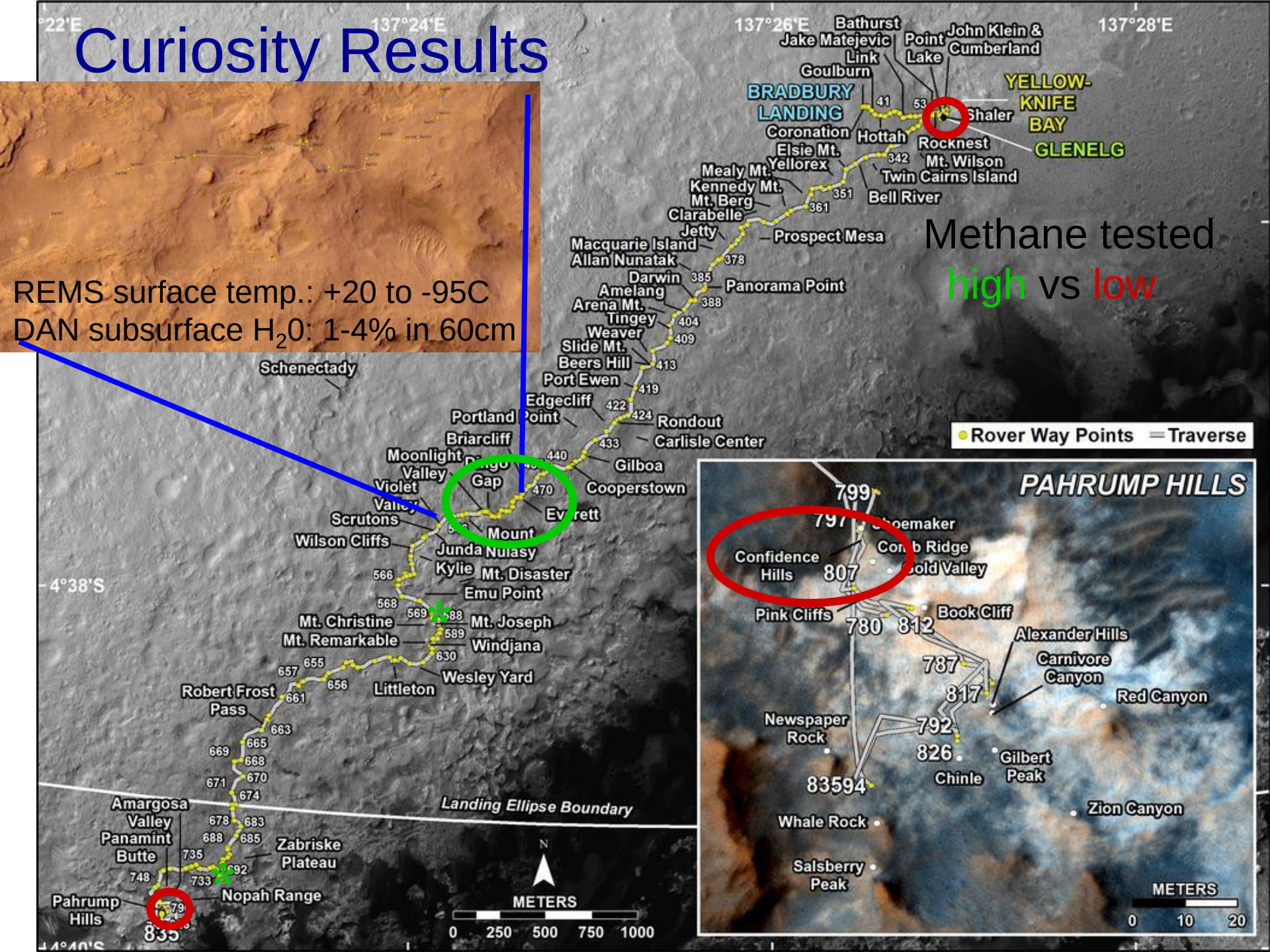
- Responses to prior findings
  - SMD lead on responses to Lessons Learned initiated
    - Ensure appropriate requirements flowdown in discussions with M2020
    - Revise/coordinate planetary protection documentation A-M Novo-Gradac
    - Expand training options A. Spry and A-M Novo-Gradac
    - Continue cross-directorate coordination A-M Novo-Gradac
  - Exploring opportunities for interaction with SMA
- Internal SMD activities
  - Ensure appropriate separation of implementation activities in PSD from regulatory/oversight activities of PPO
  - Develop and support Office of Planetary Protection operating plan
    - Anne-Marie Novo-Gradac assigned to support OPP
    - Include planetary protection in Launch Services Contract
  - Work closely with missions, active and in development B. Pugel
    - MSL, M2020, InSight; MAVEN, MOM, MRO
    - Cassini, Dawn,  New Horizons, Juno,
    - Europa Concept, Discovery and New Frontiers AOs
    - missions supporting HEO – e.g. ARM

# Planetary Missions

Nearly all NASA missions have multiple-agency contributions; ESA-led missions indicated by (ESA)

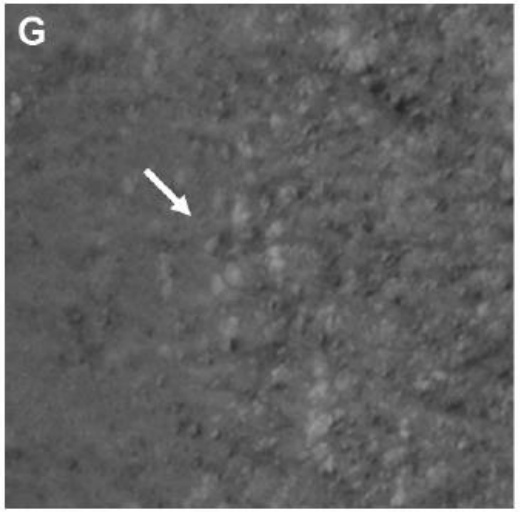


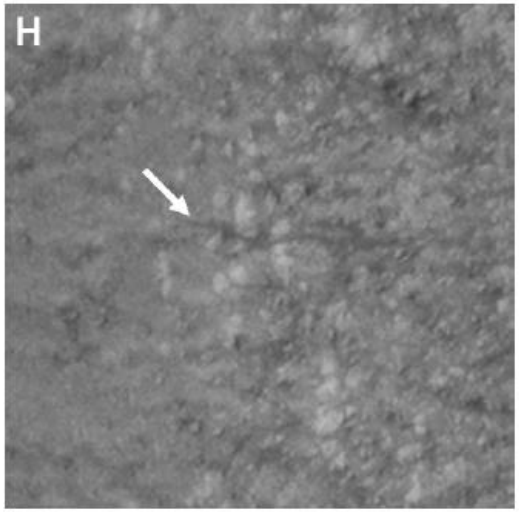
# Curiosity Results



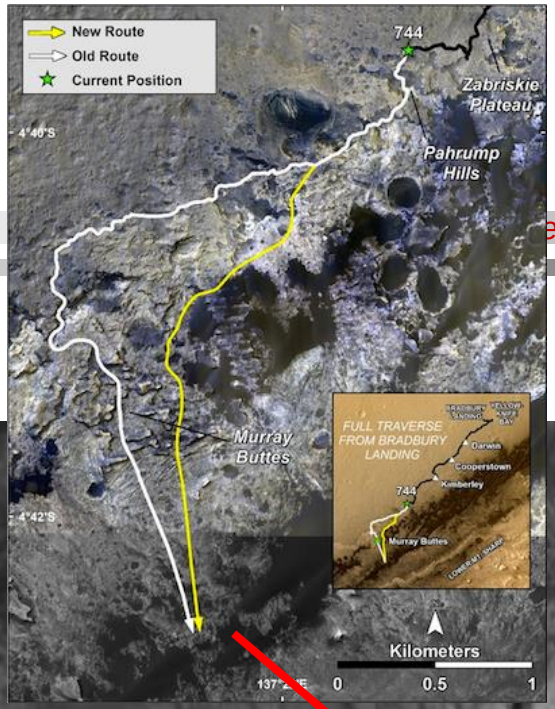
# Curiosity
# New Traverse

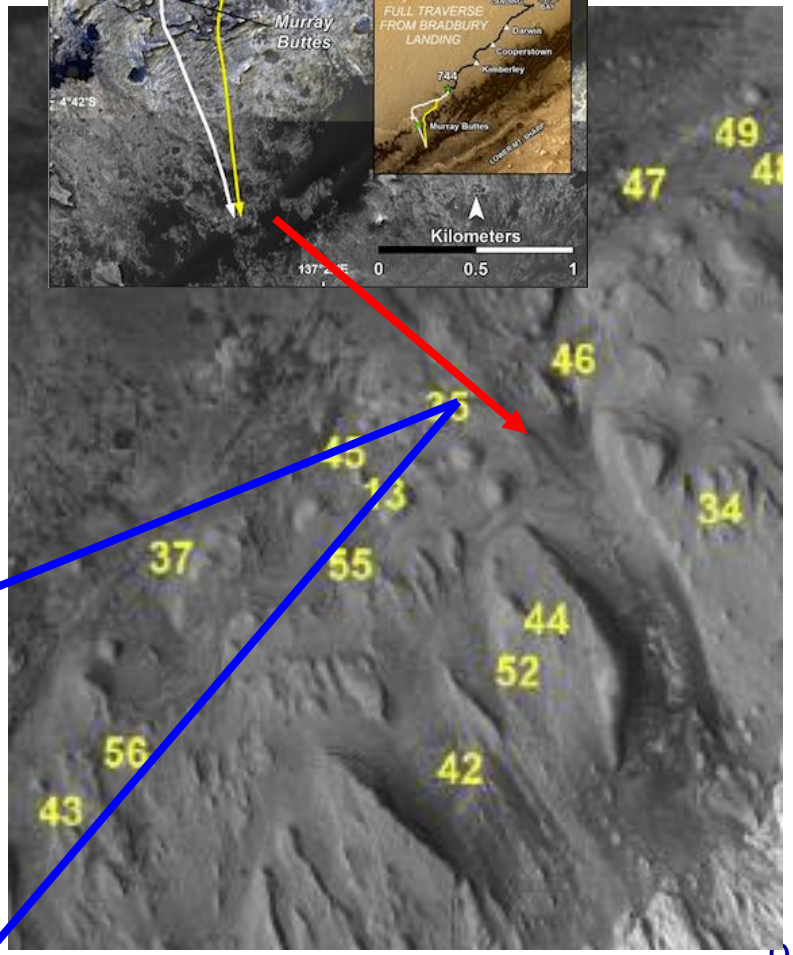
## Many Dark Streaks, Possible RSLs....

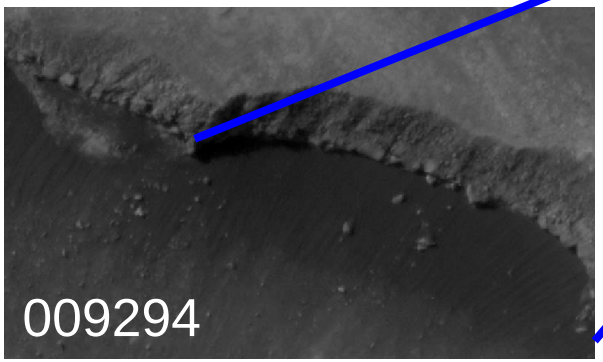


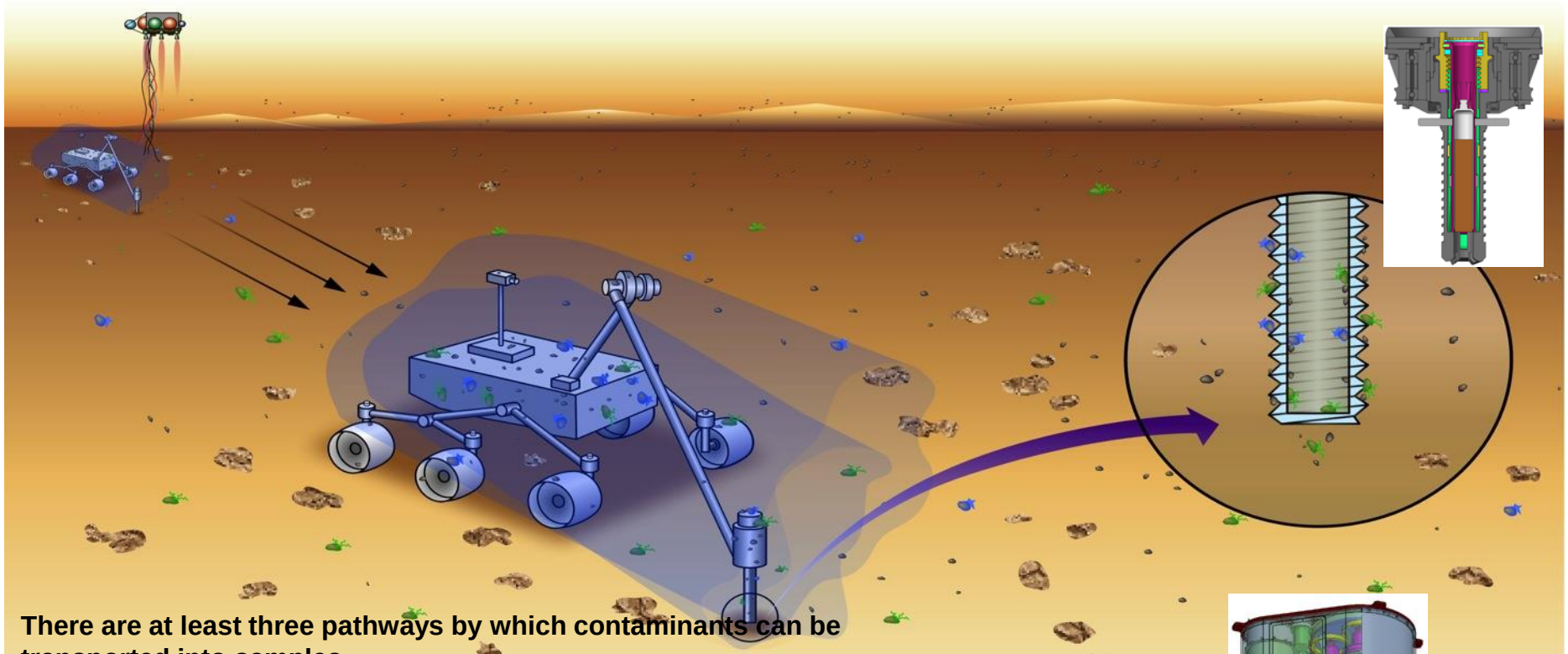

CM Dundas & AS McEwen, (2015) Icarus 213–218



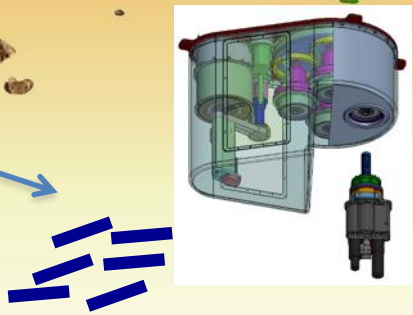



# M2020: Evolving Concepts for Sampling



**There are at least three pathways by which contaminants can be transported into samples:**

- Direct contact – microbial and molecular contaminants are transferred from the hardware surfaces to samples by direct contact.
- Particle transport – Microbes and molecular contaminant-containing particles are dislodged from spacecraft hardware surfaces by wind or by mechanical forces and are then carried by wind to the sampling ground or into the sample tube.
- VOC transport – outgassed volatile organic compounds from nonmetallic parts will diffuse or be carried by wind to condense on the sampling ground, sample contacting hardware, and samples.



Deposit cache or individual sample tubes

# SSB Meeting of Experts Process (PPS participation)

**HQ/Mars Exploration Program-convened**

**Organic Contamination Panel**

*Start: March 2014*
*Draft Report: May 16, 2014*

**PPS Review of MEP–convened Organic Contam Panel Report**

*Finalized late 2014, minority report released early 2015*

**NRC-convened Meetings of Experts**

*May 2014 and May 2015, additional meetings in planning*

**Provide feedback to NASA: support inputs to Earth Safety Analysis**

*Pending final report from MEP Science Org. Contam Science Study Lead*

**Ongoing PPS Review**

**Provided to Mars 2020**

**Goals:**
- Single PP/Science cleanliness requirement
- Recorded in L1 Requirements

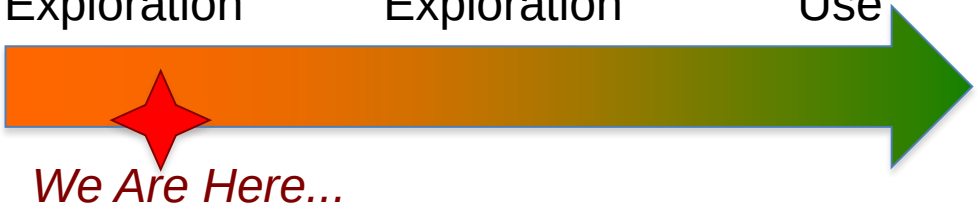
# Planetary Protection for Humans on Mars

**Outer Space Treaty:**

Protect the Earth, Avoid Harmful Contamination

International (COSPAR) Policy:

*Adding humans. policy has the same intent but different implementation*



**Phased Approach:** Be careful early; tailor later constraints using knowledge gained

- Humans have many interests at Mars; understanding potential hazards supports all of them
- Searching for Mars life becomes more difficult, the more Earth contamination is introduced
- Future colonization could be challenged, if unwanted Earth invasive species are introduced
  - Blocking aquifers
  - Consuming resources
  - Interfering with planned introductions

NASA Policy Instruction in place: Human mission requirements under development by HEO and SMD

# WORKSHOP

**Planetary Protection Knowledge Gaps for**

## Human Extraterrestrial Missions

Website:
www.nasa.gov/ames/ppw2015workshop/

Registration:
www.hou.usra.edu/meetings/ppw2015/

MARCH 24–26, 2015

NASA AMES RESEARCH CENTER, CA

# Planetary Protection Support



- Increased staffing
  - B. Pugel and T. Errigo, detailee/support from GSFC
  - A.-M. Novo-Gradac, assigned from SMD
- Frequent interactions with SMD Deputy AA
  - regular constructive meetings with MEP and M2020 project
  - clarification of roles/responsibilities leading to improved communication and interfaces
- Strengthening interfaces with HEO and STMD
  - identifying Center points of contact beyond HQ
- Budget increasing to accommodate expanded responsibilities
  - improved programmatic support
  - PPR research program selected 6 proposals from ROSES14

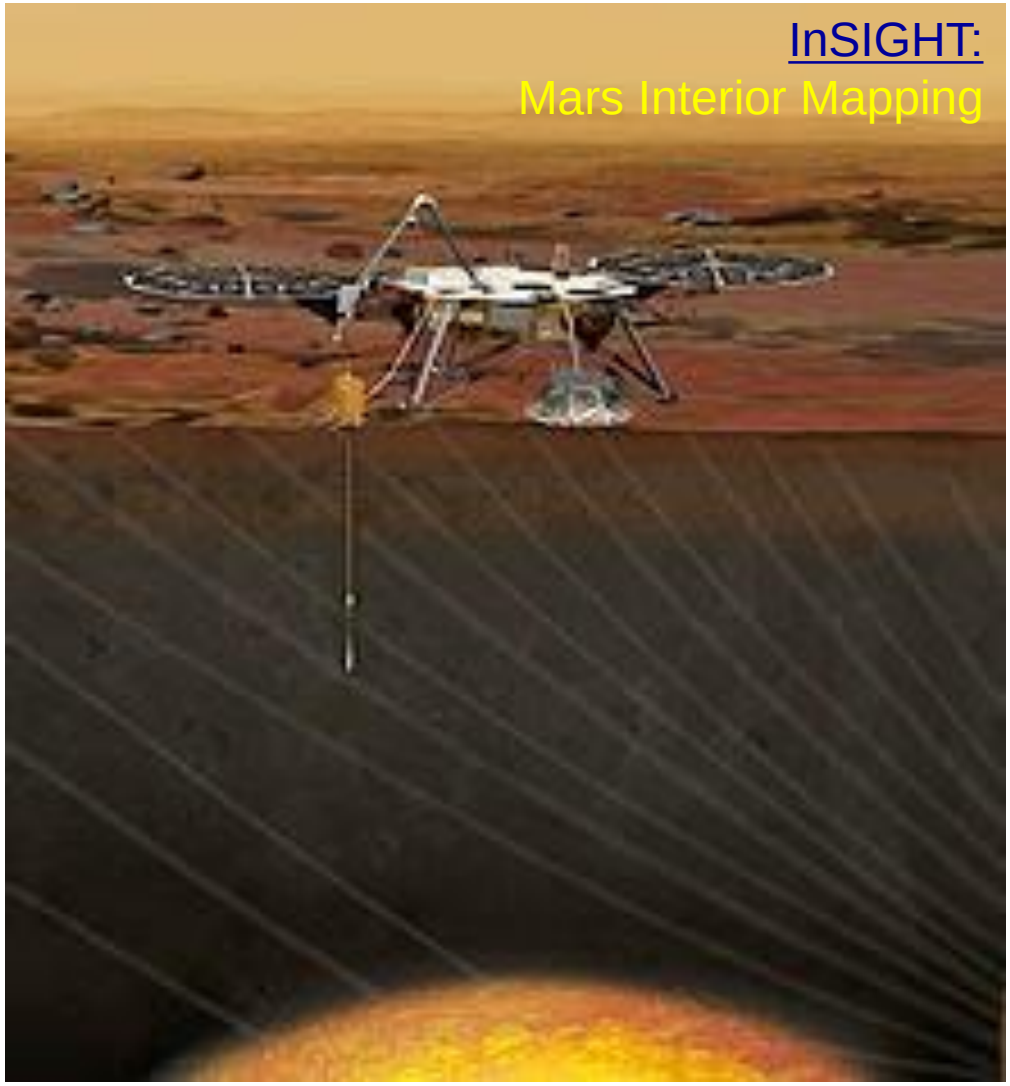
# Questions?

KEEP YOUR
HELP FIGHT NECK ROT
FUTURAMA™
R.U.R.
REHABILITATE UNSANITARY ROBOTS
ROBOT CLEAN

DON'T LET THE
HUMAN RACE
DESTROY
OUTER SPACE!

# 2012 Discovery Selection





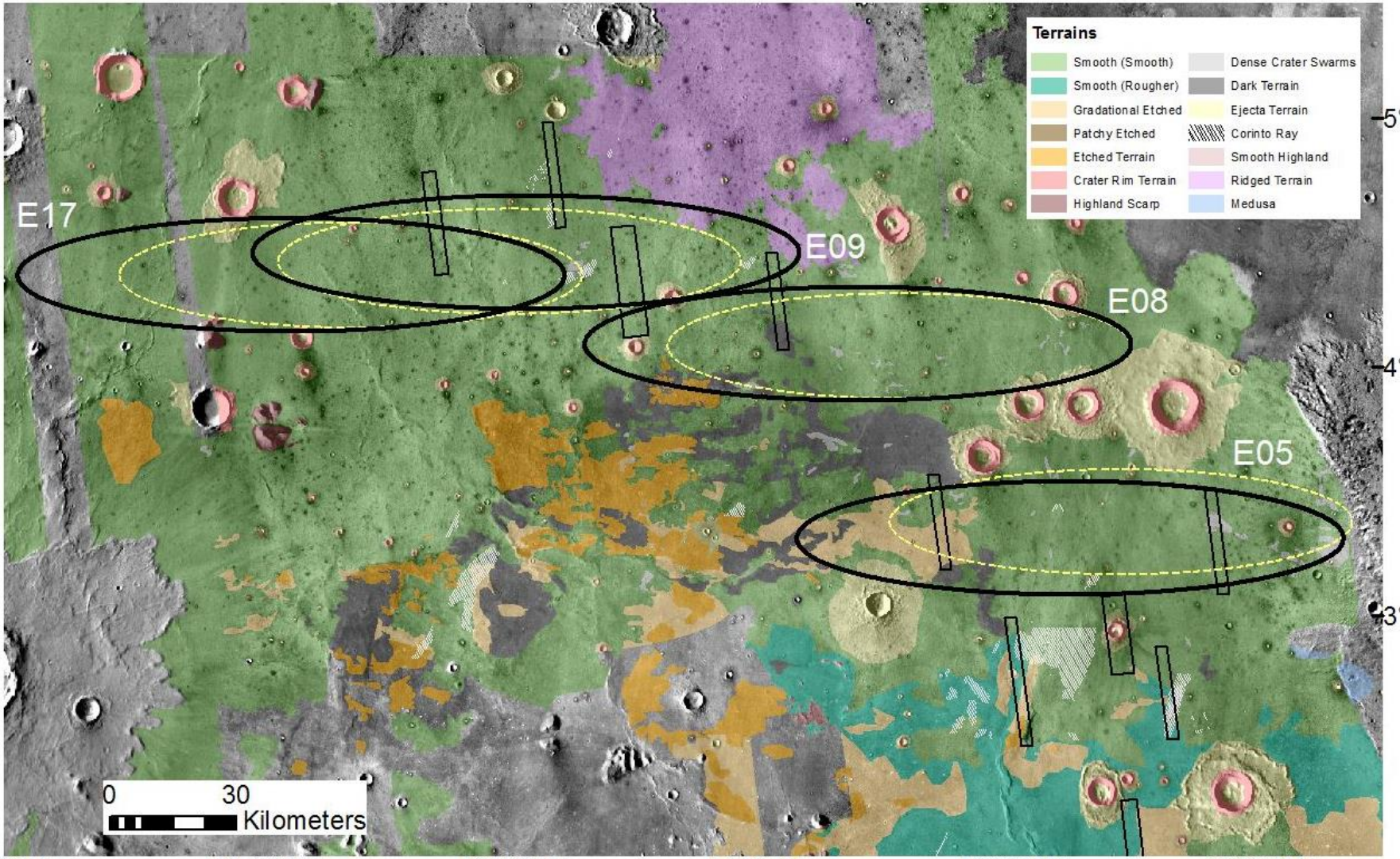

Category IVa
Launch March 2016

- Demonstrate, by observation and analysis, that mole will not access Mars special regions

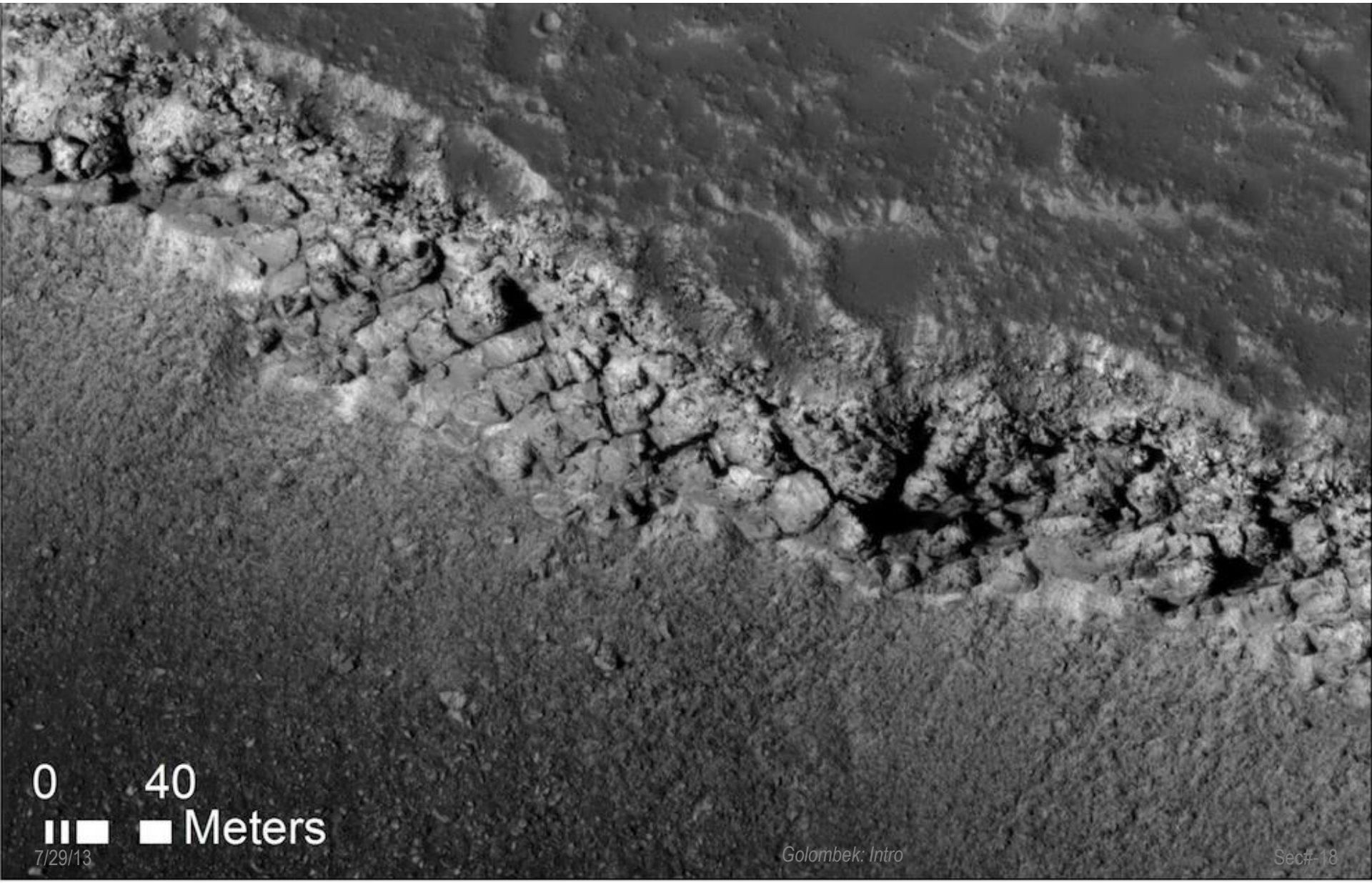
Discovery ’14
Released

# InSight Landing Selection: Elysium Planitia



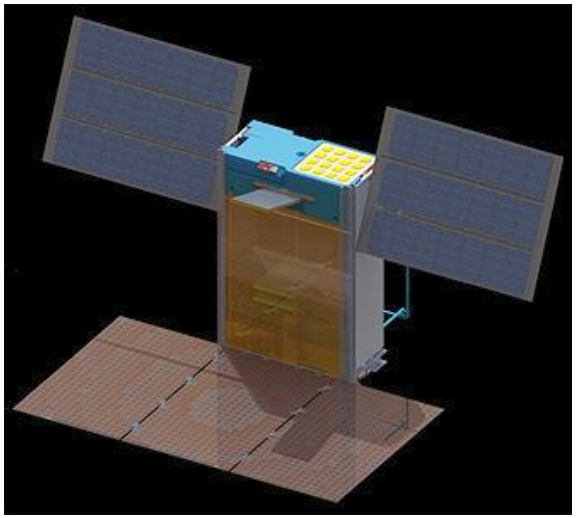


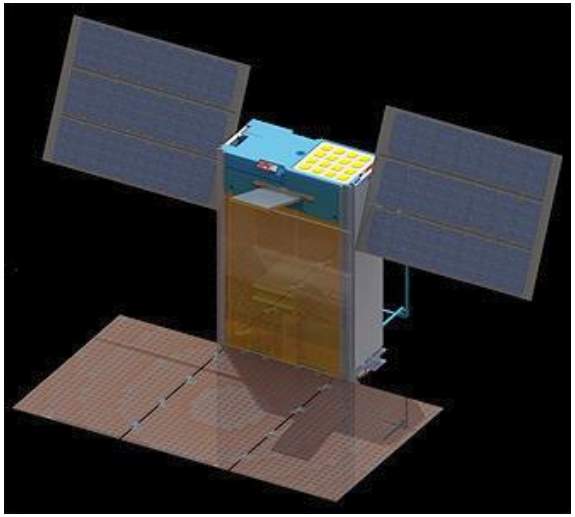
# Cross Section of Regolith



# MarCo CubeSat Secondary Payload







- Two Cubesats to follow InSight to Mars and provide communications during EDL.
- Nominal mission is a flyby: Cubesats continue in heliocentric orbit.
- Cubesat launcher is mounted at the base of the upper stage: requires Mars impact avoidance at $<1x10^{-4}$, or Burn-up and Break-up analysis.
- Good communication between all payloads and the launch vehicle providers are essential, to ensure that planetary protection requirements on the primary payload are not violated.