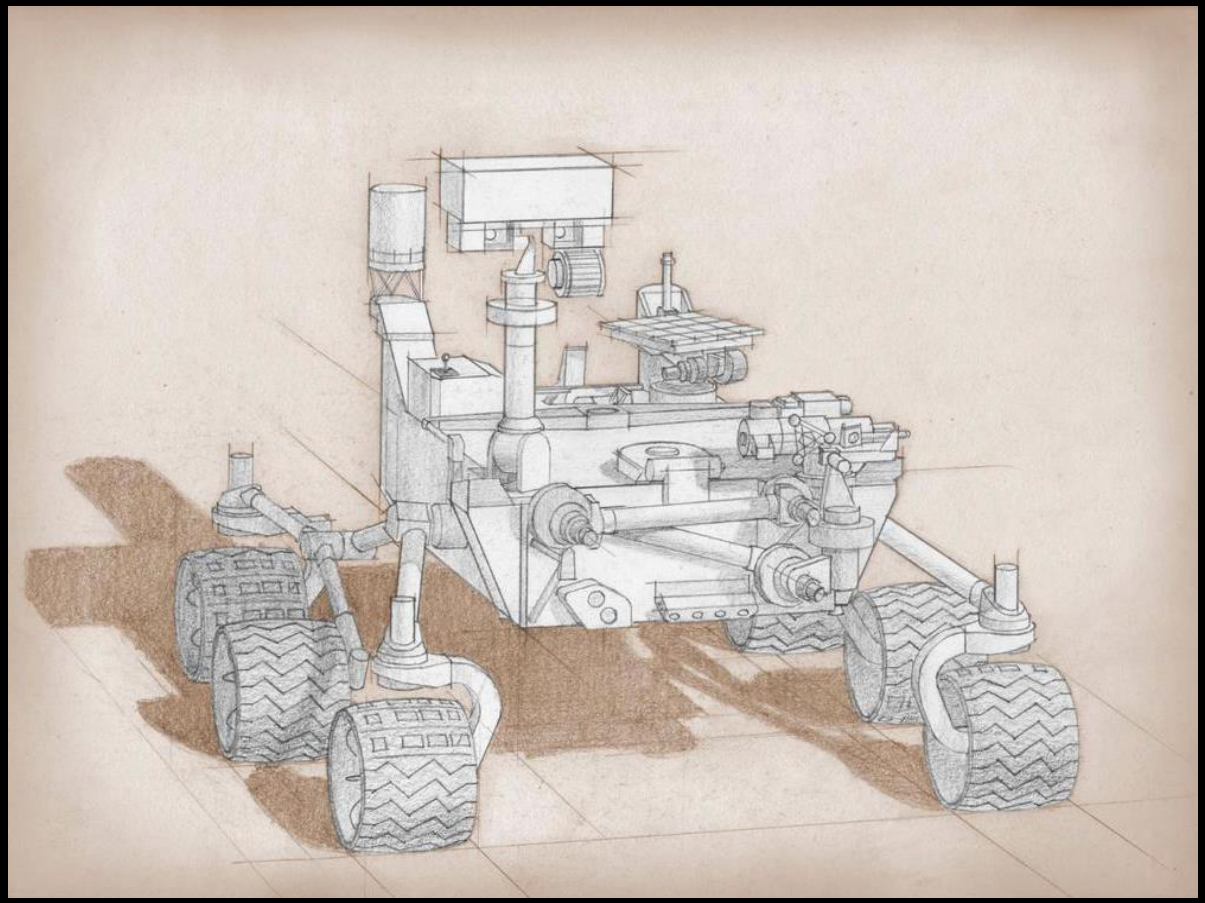
MARS 2020 MISSION
Science Overview

Jet Propulsion Laboratory
California Institute of Technology

MARS 2020 Project



Ken Farley, Project Scientist
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Pre-decisional: for Planning and Discussion Purposes Only

Mars 2020 Science Objectives

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A. Geologic History

Characterize the processes that formed and modified the geologic record within a field exploration area on Mars selected for evidence of an astrobiologically-relevant ancient environment and geologic diversity.

B. *In Situ* Astrobiology

Perform the following astrobiologically relevant investigations on the geologic materials at the landing site:

- Determine the habitability of an ancient environment.
- Search for materials with high biosignature preservation potential.
- Search for potential evidence of past life

C. Sample Return

Assemble rigorously documented and returnable cached samples for possible future return to Earth.

Mission Level 1 Requirements and Success Criteria Relevant to Landing Site Selection

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Capabilities

- MSL+ landing capabilities (possibly including TRN)

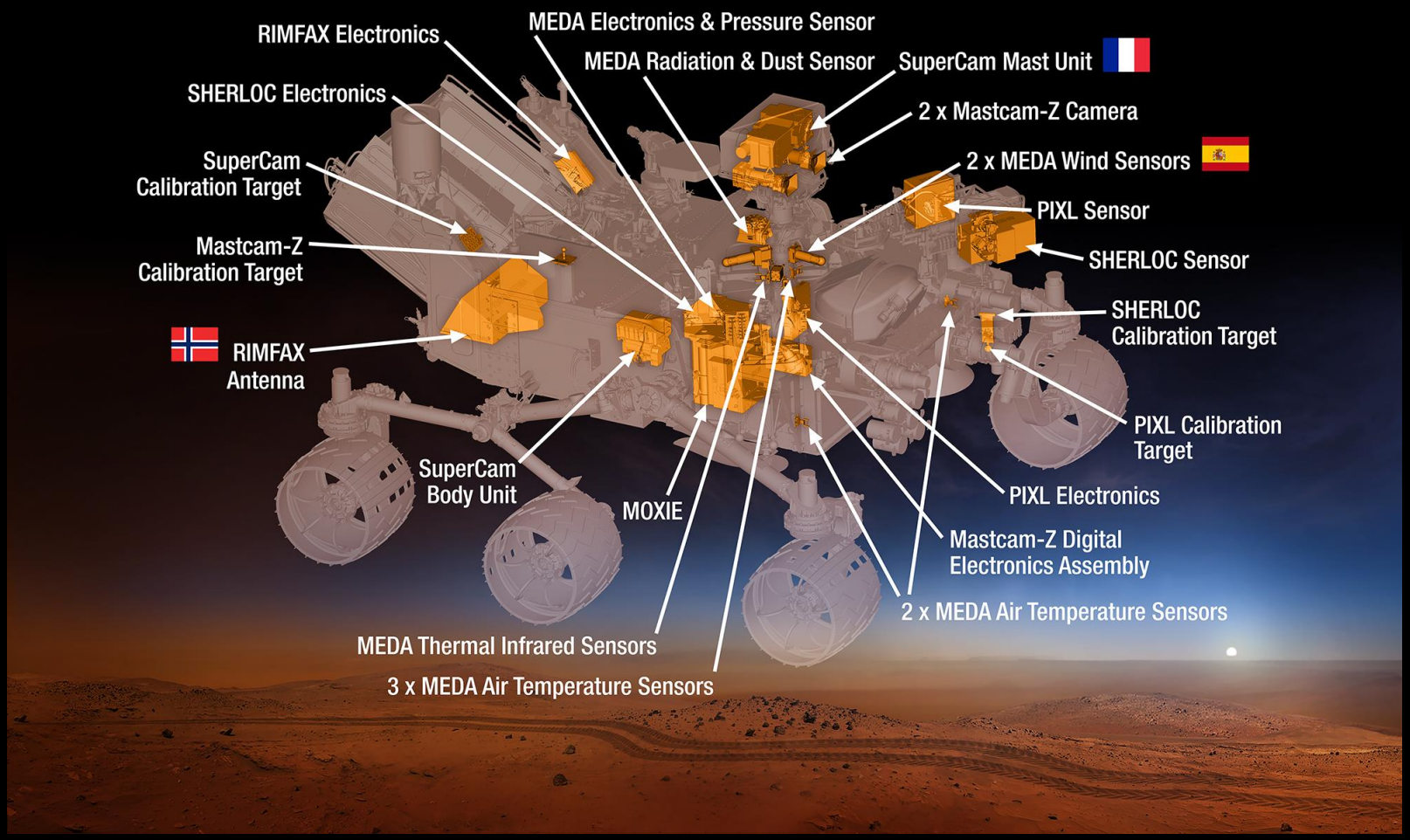
- In the Prime Mission, the rover must be able to do the following at two regions of interest (ROIs):
    1) undertake the investigations required to fulfill science objectives A and B
    2) acquire and cache a minimum of 20 returnable samples/blanks (total)

Success Criteria

- Operate the instrument suite so as to meet the science objectives as well as program objectives related to future Mars exploration

- Acquire and place on the surface of Mars a suite of scientifically selected and documented samples of Martian materials and standards / blanks adequate to address the mission objectives.

Mars 2020 Rover



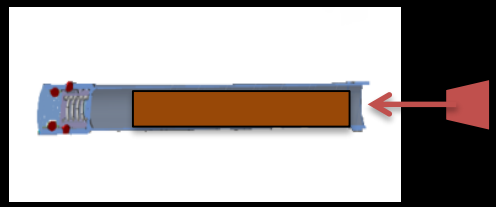
Details of instrument payload available on NASA's Mars 2020 website

Sample Acquisition Approach

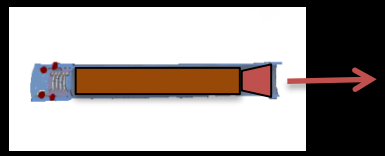
1. Locate and adequately characterize sample to be drilled

2. Acquire sample, roughly as follows:

1) Rover drills a core of pencil-like thickness, 5 cm long, directly into a clean tube



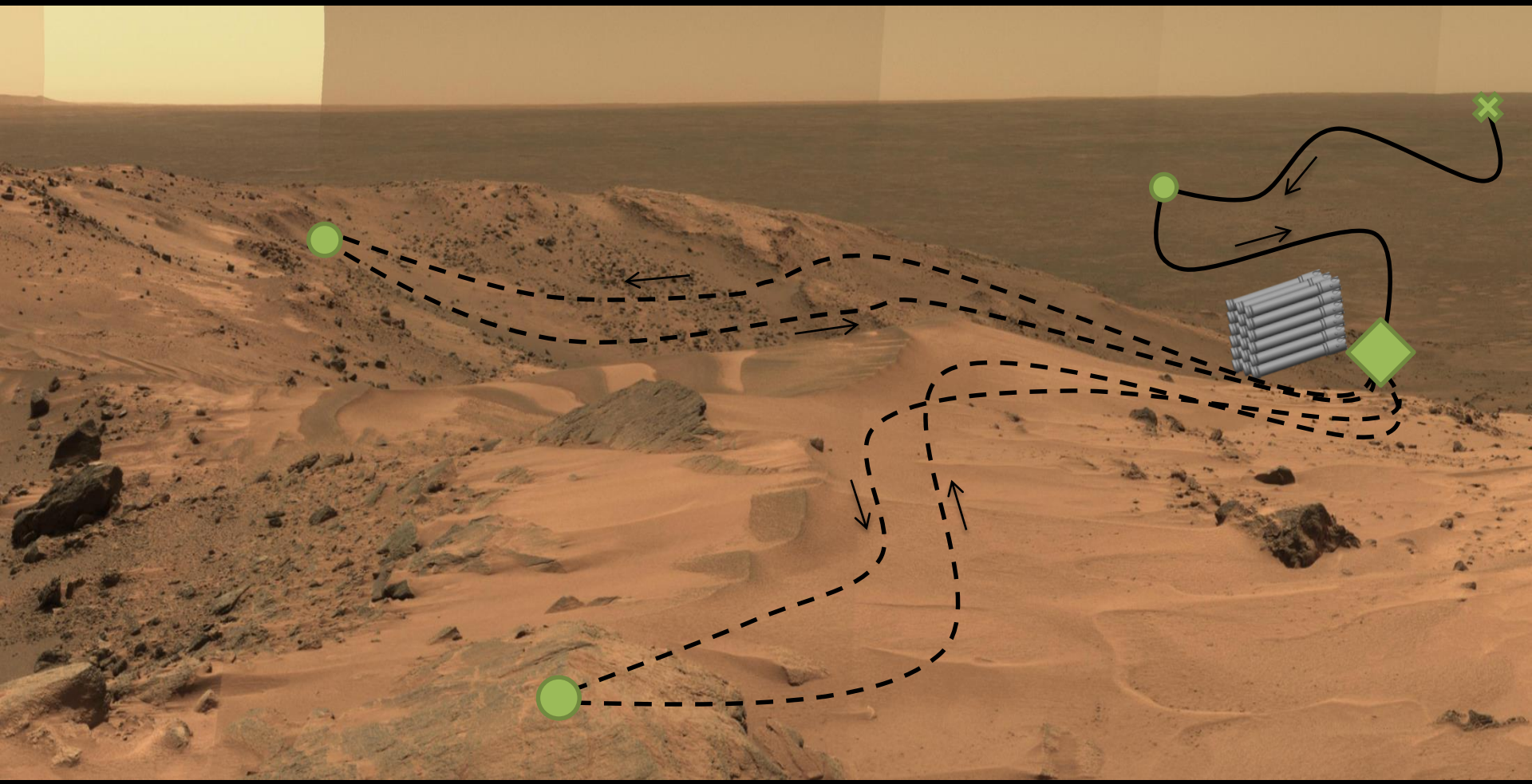
2) Tube is hermetically sealed



3) Sealed tube is stored/transported on rover and ultimately cached

Note: core not visible to science instruments; no proxy core capability but science access to both drill hole and tailings

Mars 2020 Baseline Approach: Depot Caching on Mars Surface



Further discussion of depot caching is available on the landing site workshop website

Potential Landing Site Criterion Related to Depot Caching: Tube Temperature

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- sample tubes subjected to solar heating on surface

- maximum temperature of untreated tubes may cause science value degradation at some landing sites
  - tubes may get hotter at southern compared with northern latitude sites

- tube design and caching strategy currently in work on project
  - coating or abrading tube surface can substantially reduce the heating effect
  - depot site characteristics may also offer some mitigation

- preliminary work suggests heating can be fairly well-mitigated

Not considered appropriate to apply this criterion to landing site selection at the present time

Broadening the Input to Mars 2020 Landing Site Selection

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Mars 2020 has stakeholders beyond those most familiar with Mars missions. To gain input from these stakeholders, the following steps have been taken:

1. Creation of Returned Sample Science (RSS) Board
   - board of ~8 experts, appointed by NASA Headquarters to provide input from a diversity of disciplines interested in the returned samples
   - board should be in place and operating by end of August

2. Direct solicitation of input from broader community through workshops and presentations at major national conferences (AGU, GSA, AbSciCon, MetSoc)

Possible Landing Capability Enhancement: Terrain Relative Navigation (TRN)

- this capability permits deflection away from ~ 100 meter hazards in the landing ellipse during powered descent

- the project is holding resources for this capability, awaiting a final decision on its inclusion
  - decision required by Preliminary Design Review (PDR) in early 2016

- for this workshop: <u>consider TRN a derived variable</u>

  - *rank sites on the basis of scientific merit independent of whether TRN is required*
  - *sensible trades can then be considered between science value and cost/risk of TRN*

LSW2 Scientific Site Selection Criteria

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The following criteria are directly mappable to the mission's science objectives

Objective A.

1. The geologic setting and history of the landing site can be characterized and understood through a combination of orbital and in-situ observations.

Objective B

2a. The landing site offers an ancient habitable environment.

2b. Rocks with high biosignature preservation potential are available and are accessible to investigation for astrobiological purposes with instruments on board the rover.

Objective C

3a. The landing site offers an adequate abundance, diversity, and quality of samples suitable for addressing key astrobiological questions if and when they are returned to Earth.

3b. The landing site offers an adequate abundance, diversity, and quality of samples suitable for addressing key planetary evolution questions if and when they are returned to Earth.

LSW2 Rubric

Rubric - "*an evaluation tool or set of guidelines used to promote the consistent application of a set of standards*"

LSW2 rubric designed to systematically document site characteristics. Not a scorecard.

- the characteristics of each proposed landing site will be documented through use of a single rubric circulated to proposers and recommended by the Mars 2020 PSG

- the rubric contains documentation explaining/justifying the specific site characteristics included

- will be described by Bethany Ehlmann and Briony Horgan