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Mars 2020 Landing Site Considerations

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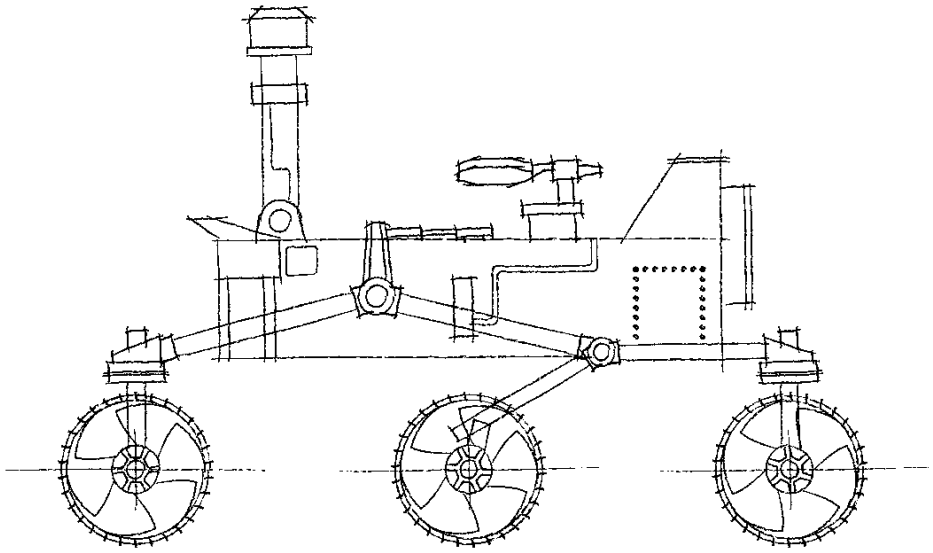

Pre-Decisional: for Planning and Discussion Purposes Only

Mars 2020 Project

Mars 2020 Science Objectives

From SDT Report and Mars 2020 AO

Conduct Rigorous *In Situ* Science

A) Geology - 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) Astrobiology - Determine the habitability of an ancient environment, search for materials with high biosignature preservation potential, and search for potential evidence of past life.

Enable the Future

C) Sample Return Collect samples that are scientifically selected, for which the field context is documented, that contain the most promising samples identified in Objective B and that represent the geologic diversity of the field site.

D) Human Exploration/Technology Contribute to the preparation for human exploration of Mars by making significant progress towards filling at least one major Strategic Knowledge Gap

Landing Site Considerations

From SDT Report

The selected landing site must provide access to geological materials that are sufficient to achieve all 4 objectives (A-B-C-D). Specifically:

1) must permit access to an astrobiologically relevant environment (A)

2) must preserve and allow discovery of information to decipher its geological record, including with respect to habitability and preservation potential. (A)

3) must permit investigation of materials that preserve potential biosignatures. (B)

4) must permit assembly of a sample cache that meets the scientific objectives of Mars sample return. (C)

5) must be consistent with conducting the “technology” elements of the mission. (D)

Mars 2020 Dual Objective

Mars 2020 has dual scientific objectives: *in-situ* exploration and preparation of a scientifically compelling and potentially returnable sample cache.

- The in-situ exploration portion of the mission is focused on geologic characterization of the landing site, and on astrobiology. Mars 2020 instrument selection has not yet been completed, so relating *in-situ* capabilities to applications at potential landing sites can only be done in a generic sense at this time.

- Considerations for site selection for Mars sample return have been investigated previously, e.g., by E2E-ISAG.

Notional MSR Site Selection Characteristics

The following landing site characteristics were noted for MSR by the E2E-ISAG report. Since preparing a potentially returnable cache is just one part of the Mars 2020 mission, these considerations should not be considered definitive.

Required:

- Presence of subaqueous sediments or hydrothermal sediments (equal 1st priority), OR hydrothermally altered rocks or low-T fluid-altered rocks (equal 2nd priority)
- Presence of minerals indicative of aqueous phases (e.g., phyllosilicates, carbonates, sulfates, etc.) in outcrop
- Noachian/Early Hesperian age based on stratigraphic relations and/or crater counts
- Access to unaltered igneous rocks

Desirable:

- Morphological criteria for standing bodies of water and/or fluvial activity (deltaic deposits, shorelines, etc.).
- Assemblages of secondary minerals of any age.
- Presence of former water ice, glacial activity, or its deposits.
- Igneous rocks of Noachian age, of known stratigraphic relation, better if including exhumed megabreccia (?)
- Volcanic unit of Hesperian or Amazonian age well-defined by crater counts and well-identified by morphology and/or mineralogy.
- Probability of samples of opportunity (ejecta breccia, mantle xenoliths, etc.).
- Potential for resources for future human mission

Landing Site Access Capability for M2020

MSR Suggested Criteria vs. MSL Science Criteria vs. 2020 Science Criteria

MSR Suggested Criteria	MSL Science Criteria	2020 Science Criteria
Habitability Biosignature Preservation **In-Place Igneous Rocks**	Search for Habitability	Habitability Biosignature Preservation In-place igneous rocks [*maybe*]

MSR E2E-iSAG (2012)

Columbia Hills – outcropping volcanics

Outcropping igneous rocks are usually found in rocky, uneven locations with scarps, buttes, boulders – obvious landing challenges.

Something to consider: what science objectives are compromised if we have access only to float volcanics?