Guiding Principles for Landing Site Selection:

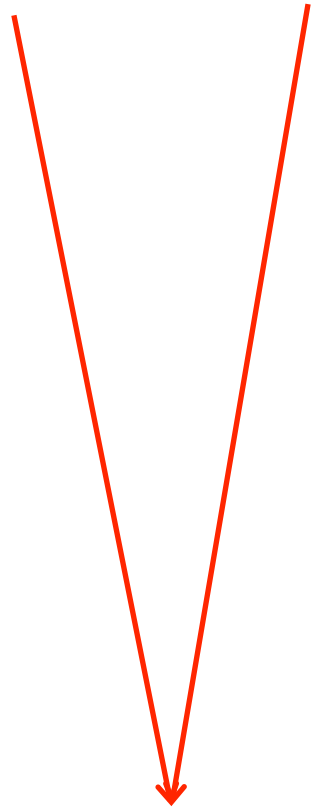
- Landing site selection is critical to all aspects of 2020 mission and program success (no landing, no science)
- Final site recommendation and selection/approval is the job of the 2020 Science Team, Project, and NASA HQ, respectively.
- The broad expertise of the science community is crucial to the identification and evaluation of optimal sites.
- Process is open to all and has no predetermined outcome

Basis for 2020 Site Selection:

- Site Must Meet **All** Engineering Requirements
- Selected Sites Are Best Suited to Achieving 2020 Mission Science Objectives:
  - ✓ Astrobiologically Relevant Environment
  - ✓ Preserve Information to Understand Geological Record – Including Habitability and Preservation Potential
  - ✓ Preserve Materials Preserve Potential Biosignatures
  - ✓ Assemble Sample Cache – Include Igneous Rocks
  - ✓ Consistent with “Technology” Elements

Participants in 2020 Landing Site Selection:

- **Science Community Input**
  - Broad e-mail distribution, Workshop Attendance, Websites
- **Additional Members**
  - Blend Experience and Mission Involvement
  - Provides for Feed-back on Process
- **NASA-Appointed Landing Site Steering Committee**
  - Co-chairs Grant and Golombek
  - Other Members Appointed by NASA HQ
- **Mars Characterization Investigators** (MDAP, MFRP, CDP)
  - Insight into Landing Site Science and Safety
- **2020 Science Team and Project:**
  - Science Team helps identify and evaluate merits of sites
  - Engineering teams define the engineering constraints and help analyze aspects of the surface and atmospheric environments.
  - Project management and the PSG review scientific analyses of sites.
- **Headquarters and Other Ex-Officios**
  - Ensures broad, relevant MEP participation
  - Access to Ongoing Mission Data
  - Planetary Protection Compliance



- **All Landing Site Selection Activities Documented at:**
  - http://marsnext.jpl.nasa.gov/announcements/index.cfm

Draft 2020 Landing Site Selection Timeline

4-5 Workshops, 4-5 Years, Possible Selection L-2 or L-1 yr

Date	Title	Comments/Description	# of Sites
7/13	SDT report	• Preliminary engineering constraints	
5/14	LSW 1	• Sites prioritized into thirds by science merit • Top 3rd to be characterized for safety and TRN need by LSW 2	~28
6/15	LSW 2	• Identify 8 selectable sites – Are there enough non-TRN sites of sufficient science merit? – If not, is TRN required?	~8
1/17	LSW 3	• ~Middle of Phase C	~4
6/18	LSW 4	• Final planned workshop	~1
7/18	Site selection	• Decision dependent on number of high priority sites, clustering of sites, programmatic factors	
7/19	LSW 5, if necessary	• Opportunity for LSW 5 if final site wasn't selected in 2018	
7/20	Launch		

Status of 2020 Sites Requesting HiRISE Images (Aug 20, 2015)

	LOCATION	# TARGETS	REQUESTED STEREO PAIRS	COMPLETE IMAGES	REQUESTED IMAGES	REMAINING IMAGES
1	Nilosytris crater	2	2	4	4	COMPLETE
2	Intercrater W. Arabia	3	3	6	6	COMPLETE
3	Vistula Valles/Chryse	3	3	5	6	1 (S2)
4	Farthest W. Meridiani	3	3	6	6	COMPLETE
5	Nili Patera	3	2 (+1 stereo 2)	5	5	COMPLETE
6	Hadriacus Palus	3	3	5	6	1 (S2)
7	Oyama crater	6	2 (+1 stereo 2)	7	8	1 (S2)
8	Firsoff crater	5	3	7	8	1 (S2)
9	Jezero crater	4	4	8	8	COMPLETE
10	Magong/Sabrina Vallis	3	2 (+1 stereo 2)	4	5	1 (S2)
11	Nili Carbonate	1	0	1	1	COMPLETE
12	Kashira crater	7	5	11	12	1 (S2)
13	NE Syrtis	9	4 (+ 1 stereo 2)	10	13	3 (S2)
14	Hypanis	2	2	3	4	1 (S2)
15	Melas Chasma/East Melas	4	3 (+ 1 stereo 2)	5	5	COMPLETE
16	Capri	1	0	1	1	COMPLETE
17	Coprates Chasma	2	0	2	2	COMPLETE
18	Oxia Planum	6	1	6	7	1 (S2)
19	Gusev	6	5	10	11	1 (S2)
20	Nili Fossae Trough	4	2	6	6	COMPLETE
21	McLaughlin crater	3	3	5	6	1 (S2)
22	Ladon Vallis	1	1	2	2	COMPLETE
23	Eridania	5	3	8	8	COMPLETE
	TOTAL	86	56 (+ 5 stereo 2s)	127	140	13 (S2)

Second 2020 Landing Site Workshop Summary:

- Held in Monrovia, CA, August 4-6, 2015
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- 21 Sites presented (one new: S. Nili Trough)
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Rubric Employed at 2020 Workshop

Landing Site Factor	Mars 2020 Mission and Decadal Priority Science Factors																							
	Environmental Setting for Biosignature Preservation and Taphonomy of Organics								Type 1A & 1B Samples: Aqueous Geochemical Environments indicated by Mineral Assemblages									Type 2 Samples: Igneous		Context: Martian History Sampled, Timing Constraints				
	Deltaic or Lacustrine (perennial)	Lacustrine (evaporitic)	Hydrothermal (<100°C) surface	Hydrothermal (<100°C) subsurface	Pedogenic	Fluvial/Alluvial	No diagenetic overprinting	Recent exposure	Crustal phyllosilicates	Sedimentary clays	Al clays in stratigraphy	Carbonate units	Chloride sediments	Sulfate sediments	Add sulfate units	Silica deposits	Ferric Ox./Ferrous clays	Igneous unit (e.g, lava flow, pyroclastic, intrusive)	2nd Igneous unit	Pre- or Early-Noachian Megabreccia	Oldest stratigraphic constraint	Youngest stratigraphic constraint	Stratigrapy of units well-defined	Dateable surface, volcanic (unmodified crater SFD)
Colum. Hills (14.4S, 175.6E)	○	~	●		~	○	●	~	●	○	?	●		●	●	●	●	●	●		LN	EH	~	●
Holden (26.4S, 325.1E)	●			●		●	●	●	●	●		~				~				●	EH	EA	●	
Eberswalde (23S, 327E)	●			~		●	~	●	~	●						●		~		~	LN	EA	●	
Magong/Sabrina (11.7N, 313.1E)	○					○		○		○								~	~		MN	LA	○	~
Jezero (18.5N, 77.4E)	●	~	~	~		●		~		●		●						●			LN	EA	●	●
Eridania(28.5S, 181.3E)	●	~			●	○		●	~	●	●			●			●	●			EH	LH	●	●
Ladon(20.5S, 329.9E)	●	●	~	?	~	●		●	?	●								○	?	?	MN	EA	●	○
Hadriacus Pal (26.9S, 78E)	~	●	~	~		●		~	○									~		●	LN	LH	●	
Coprates (12.6S, 296.1E)	~	~		●		●	●	●	●			~		●	?			●	?	●	EN?	H	●	?
Melas Basin(12.2S, 290E)	●	●		~	~	●	●	●			?			○		●	?				?	EH	●	?
Nili Trough N(21N, 74.5E)			~	●		~			●	●	○	○						●	~	~	MN	EH	●	●
Nili Trough S (19.7N, 286.2E)				~	~	~		●	●	~	○	○						●	●	○	EN	EH	○	●
Nili Carb.(21.9N, 78.9E)		~	~	~	~			●	○		○	●					○	●	●		EN	EH	●	~
NE Syrtis(17.8N, 77.1E)			~	~	●	○	~	●	●		●	●		○	○			●	○	●	LN	H	●	●
Nili Patera(9.0N, 67.43E)			○					○								○		●	●		LH	EA	●	●
Mawrth(24.0N, 341.1E)		○		~	●	●	●	●	~	●	●			○	●	●	●	●	○		EN	EH	●	●
Oyama Cr (23.4N, 340.2E)	~	?		?	●	●	~	●		●	●			?	?	?	?	●	●		LN	EH	●	●
McLaughlin Cr (21.9N, 337.8E)	●	~	~	~		○		~	~	●		●				~	~	●	~		LN	?	●	●
Oxia Planum(17.8N, 336E)			?		~	●	?	●		●	~	~				●	●	●	~		MN	EA	●	●
E. Marg. Chlor. (5.64S, 353.9E)	~	●				○	●			●			●					●	~		MN	?	●	●
Hypanis(11.8N, 314.6E)	●	~	~			●		~		○								~			LN	EA?	●	~

○	Yes (out of ellipse)
●	Yes (in-ellipse)
~	Partial Support or Debated
?	Indeterminate
	questions raised, to be resolved
	No or Unknown

Scientific Selection Criteria:

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

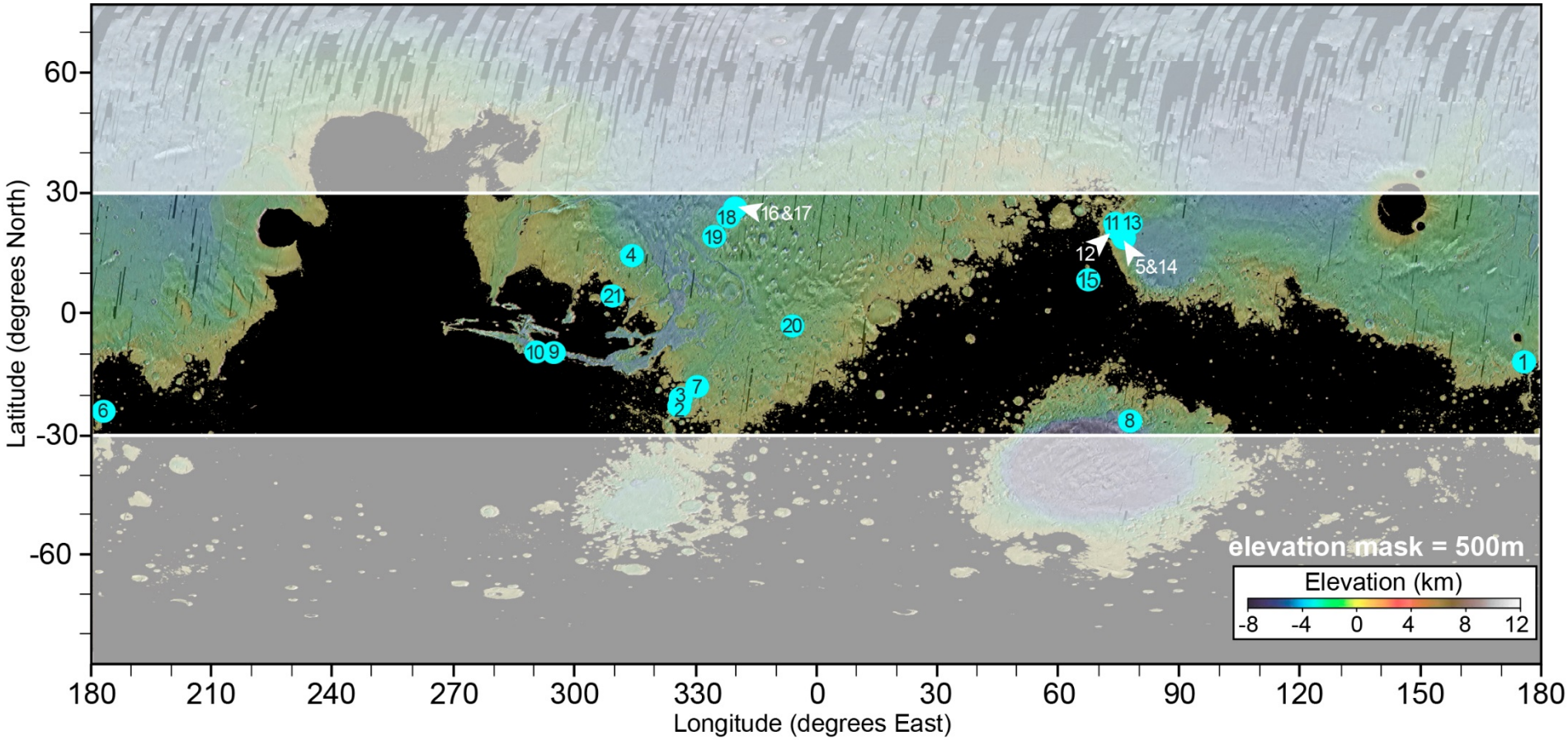
- 2a. The landing site offers an ancient habitable environment.
- 2b. Rocks with high biosignature preservation potential are available and are accessible to investigation for astrobiological purposes with instruments on board the rover.

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.

Votes will be made on each candidate site using each of the criteria listed above. Each person will vote once per site per criteria, with Green=5 points, Yellow=3 points, Red=1 point

Landing Sites Presented (in order)



Listed in order presented at Mars 2020 Workshop 2 (August, 2015):

1. Columbia Hills/Gusev crater
2. Holden crater
3. Eberswalde crater
4. Sabrina Vallis/Magong crater
5. Jezero crater
6. Eridania basin
7. Ladon Valles
8. Hadriacus Palus
9. Coprates Chasma
10. Melas Chasma
11. Nili Fossae trough (N)
12. Nili Fossae trough (S)
13. Nili Fossae carbonates
14. NE Syrtis Major
15. Nili Patera
16. Mawrth Vallis
17. Oyama crater
18. McLaughlin crater
19. Oxia Planum
20. Eastern Margaritifer
21. Hypanis delta, Xanthe Terra

And the community votes are in!

rankings	Site	Landing Site Scientific Selection Criteria											
		CHARACTERIZABLE GEOLOGIC SETTING & HISTORY		ANCIENT HABITABLE ENVIRONMENT		HIGH BIOSIGNATURE PRESERVATION POTENTIAL		ASTROBIOLOGICAL QUALITY OF RETURNED SAMPLES		PETROLOGICAL QUALITY OF RETURNED SAMPLES		AVERAGE	
		mode	average	mode	average	mode	average	mode	average	mode	average	mode	average
1	Jezero	5	4.9	5	4.7	5	4.4	5	4.4	5	4.3	5	4.5
2	Columbia Hills	5	4.7	5	4.3	5	4.3	3	3.8	5	4.1	4.6	4.2
3	NE Syrtis	5	4.7	5	3.8	3	3.3	5	3.8	5	4.8	4.6	4.1
4	Eberswalde	5	5.0	5	4.5	5	4.3	3	3.4	3	3.0	4.2	4.0
5	SW Melas	5	4.5	5	4.1	5	3.9	3	3.6	3	3.1	4.2	3.9
6	Nili Fossae Trough (N)	5	4.4	3	3.4	3	3.2	3	3.4	5	4.7	3.8	3.8
7	Nili Fossae Carbonate	5	4.2	3	3.4	3	3.2	3	3.2	5	4.3	3.8	3.7
8	Mawrth	5	4.3	3	3.7	3	2.9	3	3.4	5	3.9	3.8	3.6
9	Holden Crater	5	4.4	3	3.4	3	3.2	3	3.2	3	3.4	3.4	3.5
10	McLaughlin	3	3.6	3	3.9	3	3.0	3	3.5	3	3.5	3	3.5
11	Hypanis	3	3.8	3	3.6	3	3.1	3	3.0	3	2.8	3	3.2
12	Nili Fossae Trough (S)	3	3.8	3	2.9	3	2.6	3	2.9	3	3.9	3	3.2
13	Ladon Valles	3	3.8	3	3.3	3	3.1	3	2.7	3	2.7	3	3.1
14	E. Margaritifer	3	3.7	3	3.1	3	3.5	3	2.7	3	2.7	3	3.1
15	Coprates Chasma	5	4.1	3	2.7	3	2.3	3	2.5	3	3.7	3.4	3.1
16	Oyama Crater	3	3.3	3	3.2	3	2.8	3	2.7	3	3.1	3	3.0
17	Eridania	3	3.2	3	2.8	3	2.5	3	2.3	3	2.4	3	2.6
18	Nili Patera	5	4.6	3	2.4	3	2.5	1	1.4	3	2.2	3	2.6
19	Oxia Planum	3	3.0	3	2.4	1	2.1	1	2.1	3	2.7	2.2	2.5
20	Sabrina/Magong Crater	3	3.1	3	3.0	3	2.2	1	1.8	1	2.0	2.2	2.4
21	Hadriacus Palus	3	3.2	3	2.5	1	1.5	1	1.6	3	2.8	2.2	2.3

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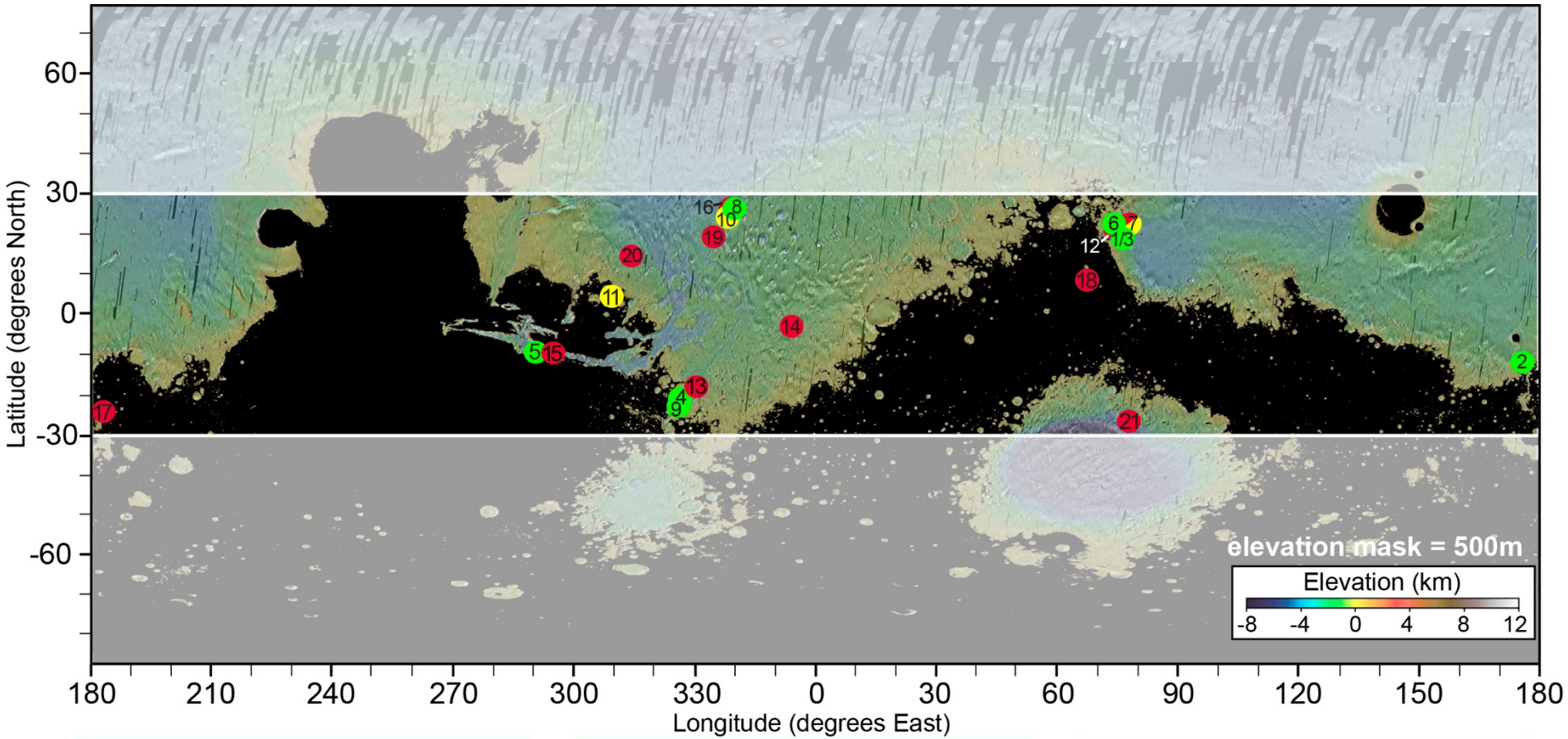
Map of location/ranking of all sites:



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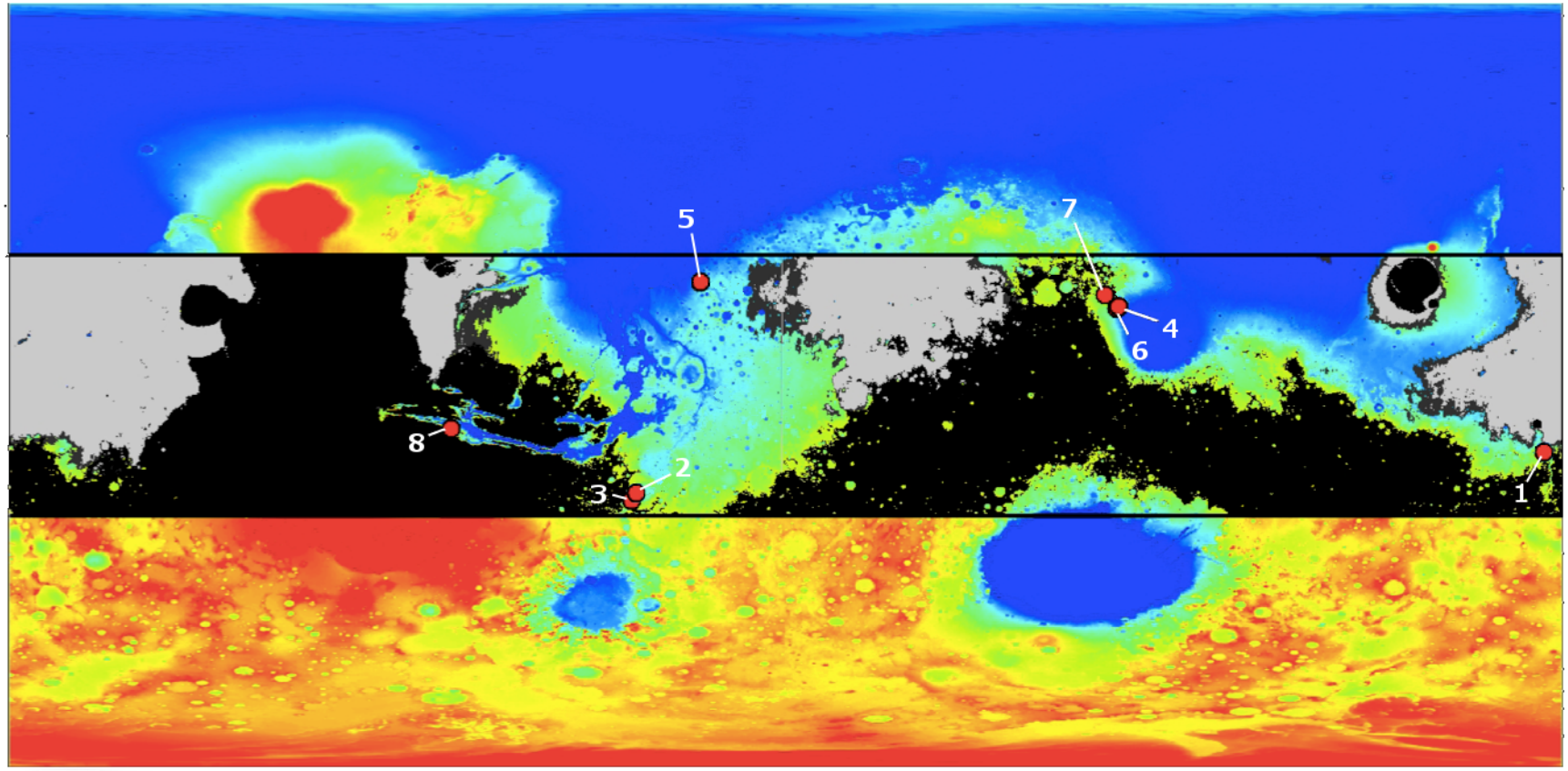
Tabular View of Sites and Status:

Rank	Landing Site	Latitude (°N)	Longitude (°E)	Approx. Elev. (km)
1	Jezero crater	18.5	77.4	-2.0
2	Columbia Hills/Gusev crater	-14.4	175.6	-1.94
3	NE Syrtis Major	17.8	77.1	-2.0
4	Eberswalde crater	-23.0	327.0	-1.4
5	Melas Chasma	-12.2	290	-5.0
6	Nili Fossae trough (N)	21.0	74.5	0.6
7	Nili Fossae carbonates	21.9	78.9	1.5
8	Mawrth Vallis	24	341.1	
9	Holden crater	-26.4	325.1	-2.2
10	McLaughlin crater	21.9	337.8	-5.0
11	Hypanis delta in Xanthe Terra	11.8	314.6	-2.7
12	Nili Fossae Trough (S)	19.7	74.5	
13	Ladon Valles	-20.5	329.9	-2.05
14	E. Margaritifer	-5.6	353.8	-1.25
15	Coprates Chasma	-12.6	296.1	-5.0
16	Oyama crater	23.4	340.2	-3.89
17	Eridania basin	-28.5	181.3	
18	Nili Patera	9.0	67.43	0.2
19	Oxia Planum	17.8	336	-3.0
20	Sabrina Vallis/ Magong crater	11.7	313.1	-2.5
21	Hadriacus Palus	-26.9	78.0	-2.66

2020 Project Top Eight Sites:



(alphabetical order)

1- Columbia Hills (Gusev)
2- Eberswalde
3- Holden
4- Jezero
5- Mawrth
6- NE Syrtis
7- Nili Fossae
8- SW Melas

Elevation above MOLA Geoid (m)

High: 4000 Low: -5000

Black elevation mask > 0.5 km
Thermal Inertia masks:
< 150 = Dark Gray
< 100 = Light Gray

From Al Chen and 2020 Project

Candidate Sites for Science and Engineering Evaluation (in alphabetical order)

Site	Approximate Locations	Elevation	Geologic Process
Columbia Hills (Gusev)	14.4S, 175.6E	-1.9 km	Hydrothermal Crustal
Eberswalde	23S, 327E	-1.4 km	Fluvial/Deltaic
Holden (original MSL target)	26.4S, 325.1E	-2.1 km	Fluvial/Deltaic
Jezero	18.5N, 77.4E	-2.5 km	Fluvial/Deltaic
Mawrth	24N, 341.1E	-2.3 km	Pedogenic
NE Syrtis	17.8N, 77.1E	-2.2 km	Hydrothermal Crustal
Nili Fossae	21N, 74.5E	-0.6 km	Hydrothermal Crustal
SW Melas	12.2S, 290E	-1.9 km	Fluvial/Deltaic

Two sites for additional science investigation (not engineering evaluation):

- Hypanis (11.8N, 314.6E; -2.6 km)
- McLaughlin (21.9N, 337.8E; -5.0 km)

Mars 2020 Returned Sample Science Board

RSS Board - represents interests of future scientists who would analyze samples collected by Mars 2020

- provides guidance to the project on full range of RSS-related issues
- contributes to landing site selection.
- NASA HQ sponsored member selection process.

Membership:

Hap McSween and Dave Beaty (co-chairs);
Andrew Czaja; Elisabeth Hausrath; Christopher Herd; Munir Humayun;
Scott McLennan; Lisa Pratt; Mark Sephton; Andrew Steele; Ben Weiss

Ex-officio:
Francis McCubbin (JSC Mars curation)
Yulia Goreva (RSS investigation scientist)

Ex-officio observers:
NASA HQ planetary protection;
NASA HQ Mars program;
Mars Program Formulation Office science liaison