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In search of signs of life on Mars with China's sample return mission Tianwen-3

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Supplementary Materials for

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Supplementary Table 1 The types of samples expected to fulfill the scientific objectives of the Tianwen-3 mission, along with the corresponding scientific goals outlined in the iMOST report.

	Scientific questions of Tianwen-3 mission	Expected types of samples to fulfill these questions	Corresponding scientific goals outlined in the iMOST report[21]
(1)	Characteristics, preservation, and significance of possible signs of life in different samples	All rock types and Soil	Assess and interpret the potential biological history of Mars, including assaying returned samples for the evidence of life.
(2)	Development of the aqueous surface environments	Soil, evaporites, paleosols, rocks/veins representing water-rock interactions, hydrothermal fluid-formed/altered rocks	Interpret the primary geologic processes and history that formed the Martian geologic record, with an emphasis on the role of water.
(3)	Atmospheric dust and water activity on Mars	Soil, evaporites	
(4)	Solar wind and the Martian atmospheric escape	Orbital data	None
(5)	Spatio-temporal evolution of water and volatiles on Mars	Ancient rocks or minerals (bound Martian atmosphere, ancient Martian atmosphere and minerals or rocks in equilibrium)	Constrain the inventory of Martian volatiles as a function of geologic time and determine the ways in which these volatiles have interacted with Mars as a geologic system.

(6)	Nature of the Martian crust	Igneous rock, sedimentary rock (possibly magnetic), impact-generated samples	Reconstruct the history of Mars as a planet, elucidating those processes that have affected the origin and modification of the crust, mantle, and core.
(7)	Composition and evolution of the ancient Martian mantle		
(8)	The impact fluxes and geological activities in the history of Mars	Ancient igneous rocks that bound critical stratigraphic intervals or correlated with crater-dated surfaces	Determine the evolutionary timeline of Mars.
(9)	The differentiation of the Martian core and mantle and the internal evolution of ancient Mars	Igneous rocks	Reconstruct the history of Mars as a planet, elucidating those processes that have affected the origin and modification of the crust, mantle, and core.

Supplementary Table 2 Coordinates and geological units of the 86 candidate landing ellipses on Mars.

Landing ellipses ID	Center latitude (°E)	Center longitude (°N)	Geological Units[73]		
			Noachian	Hesperian	Amazonian
A01	21° 54′ 30″	-22° 25′ 53″	eNh		
A02	23° 54′ 49″	-20° 01′ 57″	eNh		
A03	24° 50′ 59″	-19° 17′ 49″	mNh		
A04	22° 07′ 37″	-8° 15′ 46″	INh		
A05	27° 48′ 40″	-52° 13′ 55″	Nhu		
A06	26° 14′ 33″	-56° 12′ 02″	Nhu		
B01	23° 25' 26"	-20° 07' 40"	eNh		
B02	21° 53' 3"	-022° 28' 49"	eNh		
B03	24° 17' 52"	-018° 55' 42"	eNh		
B04	19° 59' 57"	079° 22' 58"	HNt		
B05	25° 12' 42"	-034° 06' 50"		IHI/IHt	
B06	25° 59' 55"	-062° 04' 21"	Nhu		
C01	26° 15' 16"	-056° 01' 3"	Nhu		
C02	26° 52' 28"	-053° 19' 15"	Nhu		
C03	27° 49' 27"	-053° 28' 45"	Nhu		
C04	29° 30' 12"	-052° 38' 19"	Nhu		
C05	23° 12' 0"	-020° 17' 24"	eNh		
C06	21° 43' 48"	-022° 17' 24"	eNh		
C07	22° 57' 48"	-033° 39' 10"		AHI	AHI
C08	23° 48' 11"	-031° 11' 0"		Hto	

C09	24° 19' 13"	-032° 41' 43"		IHt/IHl	
C10	17° 11' 46"	-031° 49' 57"		Hto	
D01	21° 53' 51"	-022° 23' 56"	eNh		
D02	24° 35' 23"	-021° 18' 33"	mNh	eHh	
D03	24° 11' 31"	-019° 02' 39"	eNh	eHh	
D04	23° 23' 9"	-019° 58' 46"	eNh	eHh	
D05	22° 36' 3"	-018° 25' 0"	eNh	eHh	
D06	18° 19' 27"	-024° 39' 53"	lNh		
D07	17° 28' 36"	077° 58' 14"	mNhm		
D08	19° 07' 42"	-035° 23' 51"		Hto	
D09	21° 25' 6"	-008° 29' 31"	LNh		
D10	27° 47' 57"	134° 18' 37"			Av
E01	08° 21' 53"	-049° 26' 23"		AHi	
E02	29° 23' 20"	073° 14' 40"	HNt		
E03	21° 02' 29"	033° 16' 32"	eNh		
E04	07° 30' 18"	-034° 51' 10"		Hto	
E05	10° 51' 20"	-030° 31' 50"	mNh		
F01	24° 46' 19"	109° 58' 5"		lHl	
F02	20° 22' 24"	109° 44' 22"		lHl、lHt	
F03	22° 45' 41"	129° 43' 33"		lHl、lHt	AHv
F04	28° 51' 42"	-048° 45' 9"	Nhu	Hto	
F05	17° 44' 44"	-035° 18' 0"		Hto	
F06	21° 42' 21"	089° 29' 50"		lHl	
F07	17° 55' 21"	093° 10' 14"		eHt、lHt	
G01	11° 58' 44"	-045° 14' 7"	mNh		
G02	23° 28' 3"	-019° 53' 24"	eNh		
G03	20° 45' 24"	-072° 39' 9"	Nhu		
G04	22° 35' 15"	-068° 27' 10"	Nhu		
G05	28° 37' 3"	091° 00' 45"		lHl	
G06	27° 52' 50"	111° 26' 14"		lHl	
G07	21° 31' 56"	123° 26' 48"		lHl	
G08	27° 47' 57"	011° 23' 15"		AHi	
G09	07° 05' 10"	150° 44' 6"	lAav		
G10	11° 56' 10"	-046° 33' 49"		lNh	
G11	32° 36' 29"	021° 53' 15"	MNh		
H01	24° 01' 33"	-018° 51' 5"	eNh		
H02	24° 26' 29"	-018° 52' 10"	eNh, mNh		
H03	24° 49' 55"	-019° 17' 34"	mNh		
H04	21° 47' 44"	-022° 18' 43"	eNh		
H05	17° 59' 43"	-024° 11' 25"	lNh		

H06	18° 25' 6"	-024° 27' 57"	lNh		
H07	25° 41' 13"	-055° 22' 14"			AHi
H08	25° 47' 52"	-054° 50' 14"	Nhu		AHi
H09	20° 20' 56"	079° 24' 26"	HNt	HNt	
H10	17° 38' 30"	077° 00' 17"	mNhm		
I01	24° 14' 47"	109° 58' 43"		lHl	
I02	25° 53' 37"	-040° 13' 31"		Hto	
I03	21° 06' 51"	-043° 09' 33"		Hto	
I04	26° 24' 53"	-045° 17' 8"		Hto	
I05	27° 08' 59"	-022° 26' 53"		Hto	
I06	21° 48' 26"	-022° 36' 13"	eNh		
I07	23° 24' 25"	-020° 20' 53"	eNh		
J01	29° 31' 42"	-070° 19' 6"			AHv
J02	29° 38' 6"	133° 43' 47"			Av
J03	23° 21' 16"	121° 44' 48"		lHl	
J04	20° 45' 51"	132° 54' 20"			AHv
J05	17° 20' 48"	-031° 20' 35"	Nhu		
J06	23° 44' 1"	-098° 59' 47"			AHv
J07	19° 40' 14"	024° 45' 54"	mNh		
J08	19° 16' 14"	024° 58' 11"	mNh		
J09	16° 18' 39"	013° 00' 15"	mNh		
K01	23° 47' 28"	-152° 02' 39"			AHi
K02	19° 10' 36"	-037° 29' 26"		Hto	
K03	21° 49' 9"	121° 58' 39"		IHI	
K04	25° 13' 7"	-059° 17' 47"	Nhu		
K05	20° 04' 4"	079° 19' 34"	HNt	HNt	

Reference

[21] Beaty, D. W. et al. The potential science and engineering value of samples delivered to Earth by Mars sample return: International MSR Objectives and Samples Team (iMOST). *Meteorit Planet Sci* **54**, S3-S152 (2019).

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