



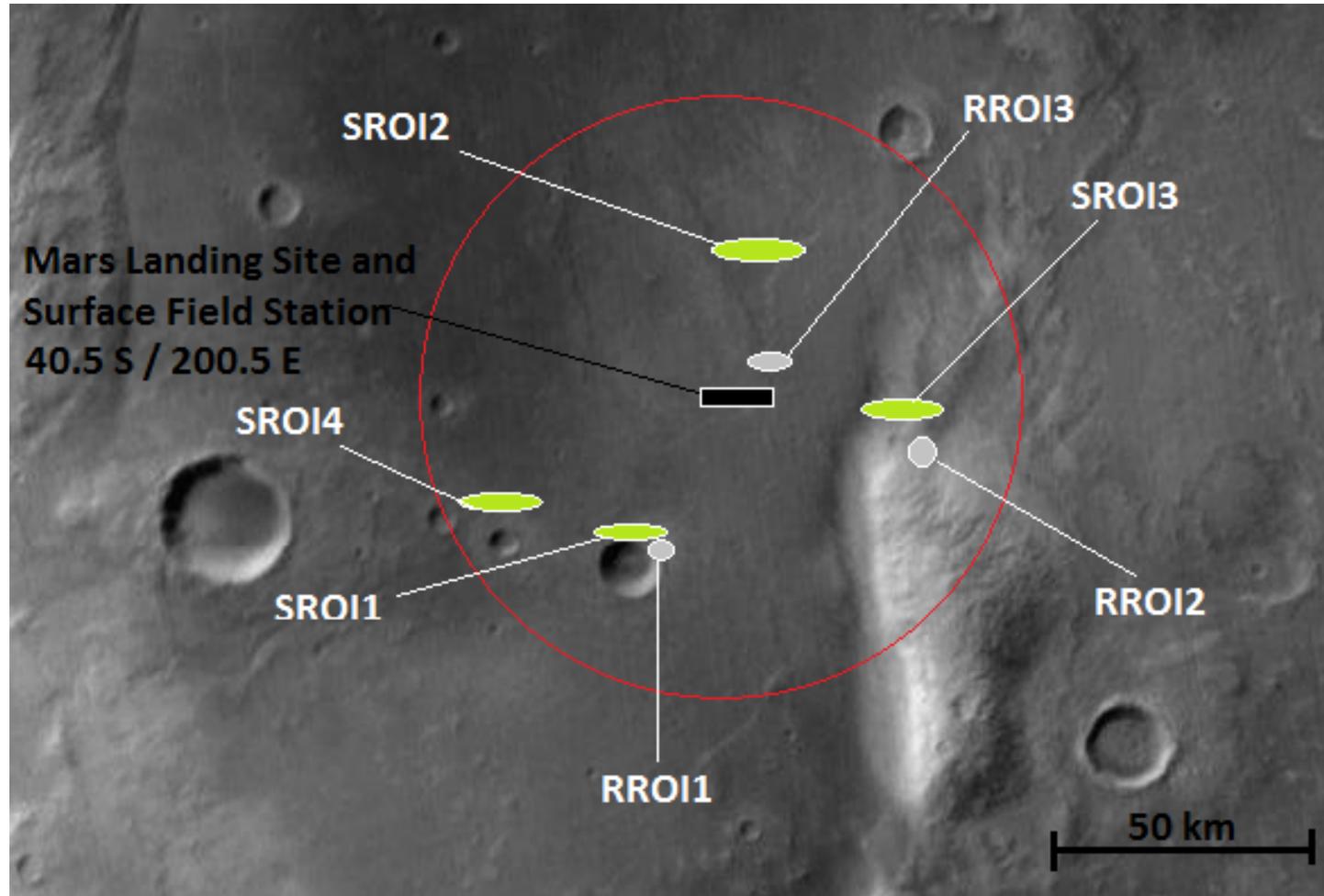
EXPLORATION ZONE IN THE NEWTON  
CRATER

Workshop Abstract #1015

LAINEN P.E. UNIVERSITY OF JYVASKYLA,  
FINLAND

# Exploration Zone Map

1<sup>st</sup> EZ Workshop for Human Missions to Mars



Newton Crater

# Science ROI(s) Rubric

1<sup>st</sup> EZ Workshop for Human Missions to Mars



Site Factors			SROI1	SROI2	SROI3	SROI4	RROI1	RROI2	RROI3	EZ SUM
Astrobio	Threshold	AND/OR								
		Potential for past habitability	○	●	●	○	○	●	○	3,4
		Potential for present habitability/refugia	●	○	○	○	●	○	○	2,5
	Qualifying	Potential for organic matter, w/ surface exposure	○	○	○	○	○	○	○	0,7
Atmospheric Science	Threshold	Noachian/Hesperian rocks w/ trapped atmospheric gases	○	○	○	○	○	○	○	0,7
	Qualifying	Meteorological diversity in space and time	●	●	●	●	●	●	●	7,0
		High likelihood of surface-atmosphere exchange	●	○	○	○	●	○	○	2,5
		Amazonian subsurface or high-latitude ice or sediment	●	○	○	○	●	○	○	2,5
		High likelihood of active trace gas sources	●	?	?	○	●	?	?	2,1
Geoscience	Threshold	Range of martian geologic time; datable surfaces	●	●	●	●	●	●	●	7,0
		Evidence of aqueous processes	●	●	●	○	●	●	●	6,1
		Potential for interpreting relative ages	●	●	●	●	●	●	●	7,0
	Qualifying	Igneous Rocks tied to 1+ provinces or different times	?	?	?	?	?	?	?	
		Near-surface ice, glacial or permafrost	●	○	○	○	●	○	○	2,5
		Noachian or pre-Noachian bedrock units	○	○	○	○	○	○	○	0,7
		Outcrops with remnant magnetization	?	?	?	?	?	?	?	
		Primary, secondary, and basin-forming impact deposits	●			●	●			3,0
		Structural features with regional or global context	●				●			2,0
		Diversity of aeolian sediments and/or landforms		●	●	○		●	○	3,2

Key	
●	Yes
○	Partial Support or Debated
	No
?	Indeterminate

# Resource ROI(s) Rubric

Workshop for Human Missions to Mars



Site Factors			SROI1	SROI2	SROI3	SROI4	RROI1	RROI2	RROI3	EZ SUM		
ISRU and Civil Engineering Criteria	Engineering	Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)		●	●	●	●	●	●	●	7,0	
	Water Resource	Threshold	AND/OR	Potential for ice or ice/regolith mix	●	○	○	○	●	○	○	2,5
			Potential for hydrated minerals	●	○	○	○	●	○	○	○	2,5
			Quantity for substantial production	●	○	○	○	●	○	○	○	2,5
			Potential to be minable by highly automated systems	●	○	○	○	●	○	○	○	3,4
			Located less than 3 km from processing equipment site								●	1,0
			Located no more than 3 meters below the surface	○	○	○	○	○	○	○	○	0,7
			Accessible by automated systems		●		●				●	3,0
	Qualifying	Potential for multiple sources of ice, ice/regolith mix <b>and</b> hydrated minerals	○	○	○	○	○	○	○	○	0,6	
		Distance to resource location can be >5 km								●	1,0	
		Route to resource location must be (plausibly) traversable	●	●	●	●	●	●	●	●	7,0	
	Civil Engineering	Threshold	~50 sq km region of flat and stable terrain with sparse rock distribution		●	●	●	●	●	●	●	7,0
			1–10 km length scale: <10°		●	●	●	●	●	●	●	7,0
			Located within 5 km of landing site location								●	1,0
		Qualifying	Located in the northern hemisphere									0,0
	Evidence of abundant cobble sized or smaller rocks and bulk, loose regolith		?	?	?	?	?	?	?	?	0,0	
	Food Production	Qualifying	Utilitarian terrain features		●	●		●	●		●	5,0
			Low latitude									0,0
			No local terrain feature(s) that could shadow light collection facilities		●	●		●	●		●	5,0
			Access to water		●	○	○	○	●	○	○	○
Metal/Silicon Resource	Threshold	Access to dark, minimally altered basaltic sands		?	?	?	?	?	?	?	0,0	
		Potential for metal/silicon		○	○	○	○	○	○	○	0,7	
		Potential to be minable by highly automated systems			●		●				●	3,0
		Located less than 3 km from processing equipment site									●	1,0
		Located no more than 3 meters below the surface		?	?	?	?	?	?	?	?	0,0
	Accessible by automated systems			●		●				●	3,0	
	Qualifying	Potential for multiple sources of metals/silicon		○	○	○	○	○	○	○	○	0,7
Distance to resource location can be >5 km									●	0,1		
Route to resource location must be (plausibly) traversable		●	●	●	●	●	●	●	●	7,0		

Key	
●	Yes
○	Partial Support or Debated
	No
?	Indeterminate

[in order of priority: addressing threshold first, then qualifying]

# **SCIENCE ROIs**

# Science ROI 1

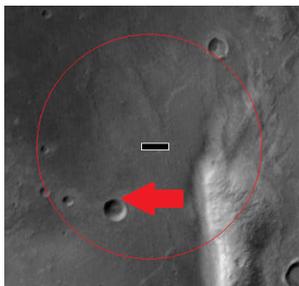
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## Image of SROI 1



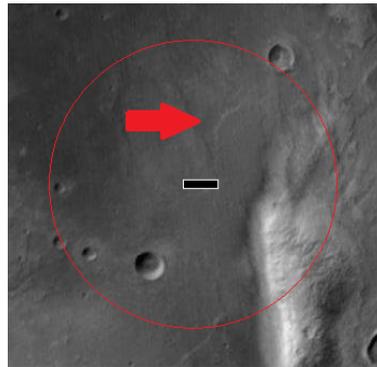
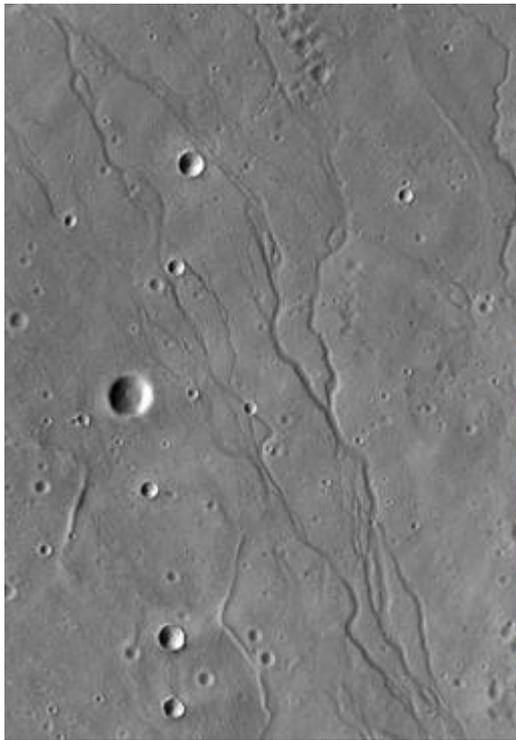
- 40.7° S / 200.3° E, altitude ~ -2 km, MOC, HiRISE
- Visible gullies: Evidence of present aqueous processes -> Potential for present habitability/refugia



# Science ROI 2

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## Image of SROI 2

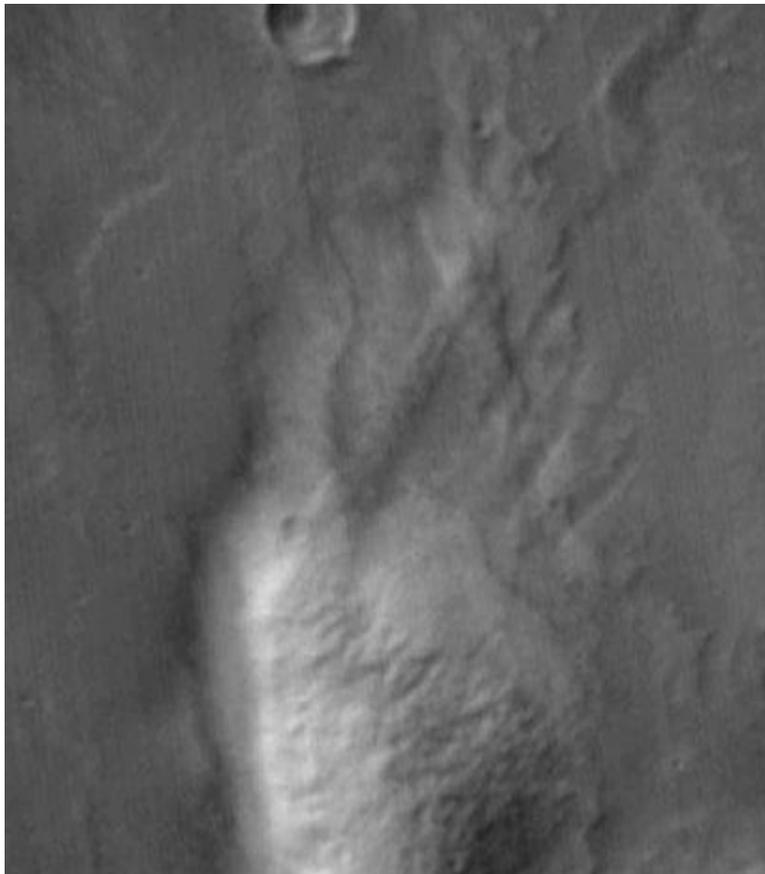


- 40.2° S / 200.8° E, altitude ~ -2 km, THEMIS
- Channels: Evidence of aqueous processes -> Potential for past habitability

# Science ROI 3

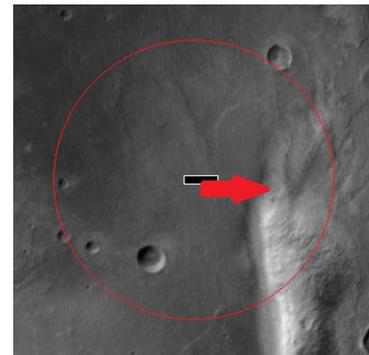
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## Image of SROI 3



Newton Crater

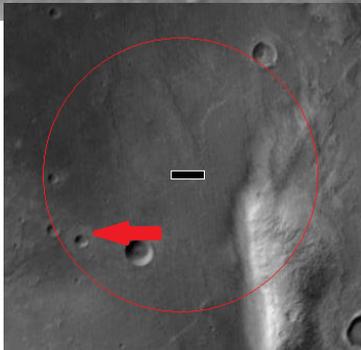
- 40.3° S / 201 E, altitude ~ -2 km, THEMIS
- Bulge, probable sediment from aqueous processes -> Potential for past habitability



# Science ROI 4

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## Image of SROI 4



- 40.5° S / 199.6 E, altitude ~ -2 km, THEMIS
- Three craters of different age in the slide of the Newton Crater, revealing layers from different eras -> Potential for interpreting relative ages

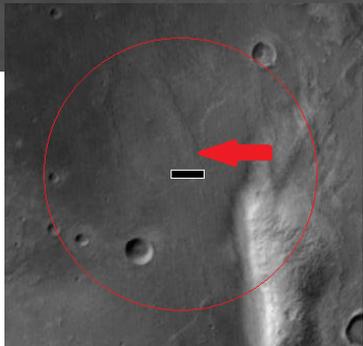
[in order of priority: addressing threshold first, then qualifying]

# **RESOURCE ROIs**

# Resource ROI 3

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## Image of RROI 3

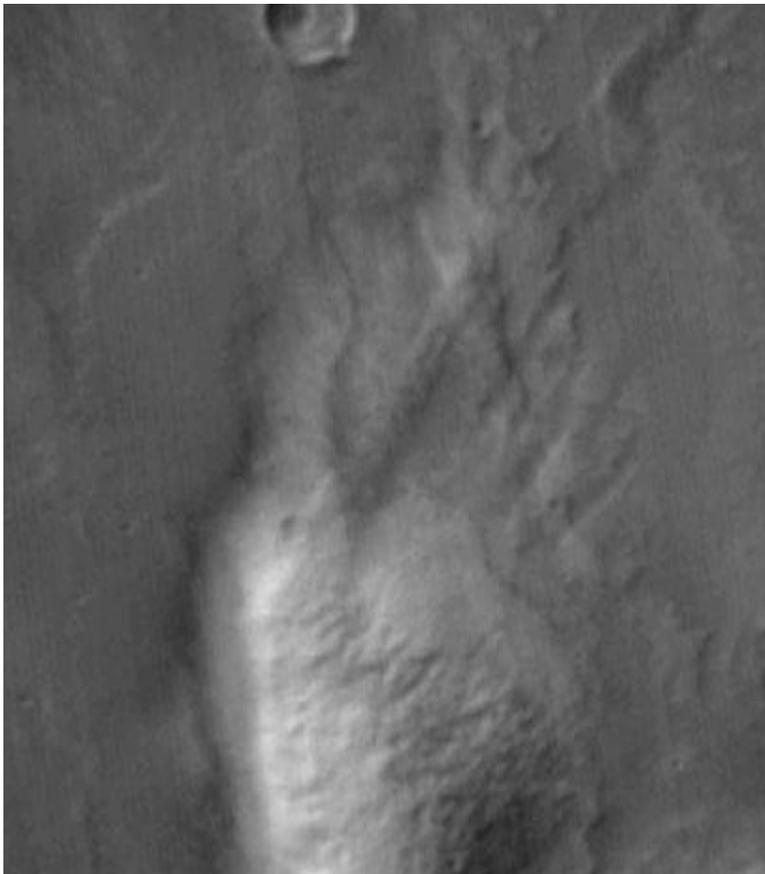


- 40.4° S / 200.5 E, altitude ~ -2 km, THEMIS
- Channels: Evidence of aqueous processes -> Potential for ice or ice/regolith mix & potential for metal/silicon, located less than 3 km from processing equipment site and accessible by automated systems

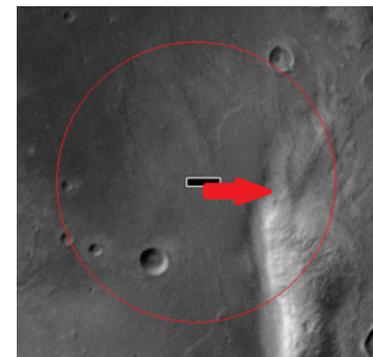
# Resource ROI 2



## Image of RROI 2



- 40.3° S / 201 E, altitude ~ -2 km, THEMIS
- Bulge, probable sediment from aqueous processes -> Potential for ice or ice/regolith mix & potential for metal/silicon



Newton Crater

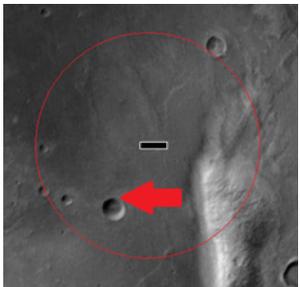
# Resource ROI 1

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## Image of RROI 1



- $40.7^{\circ}$  S /  $200.4^{\circ}$  E, altitude  $\sim$  -2 km, MOC, HiRISE
- Visible gullies: Evidence of present aqueous processes -> Potential for ice or ice/regolith mix for substantial production



# RUBRICS

# Highest Priority EZ Data Needs

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- Science potential
  - Noachian/Hesperian rocks that have likelihood of containing trapped atmospheric gases: Only threshold criterion for Atmospheric Science
- Resource potential
  - Potential for usable metal/silicon: metal/silicon concentration poorly known

# BACKUP SLIDES

# Prioritization List of EZ Data Needs

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- Orbiter/rover data to be collected to assess the science potential of the EZ:
  - More high resolution imaging (HiRISE) of EZ to assess all ROIs' threshold criteria
- Orbiter/rover data to be collected to assess the resource potential of the EZ:
  - More accurate gamma ray spectroscopy (GRS) to assess metal/silicon concentrations of resource ROIs