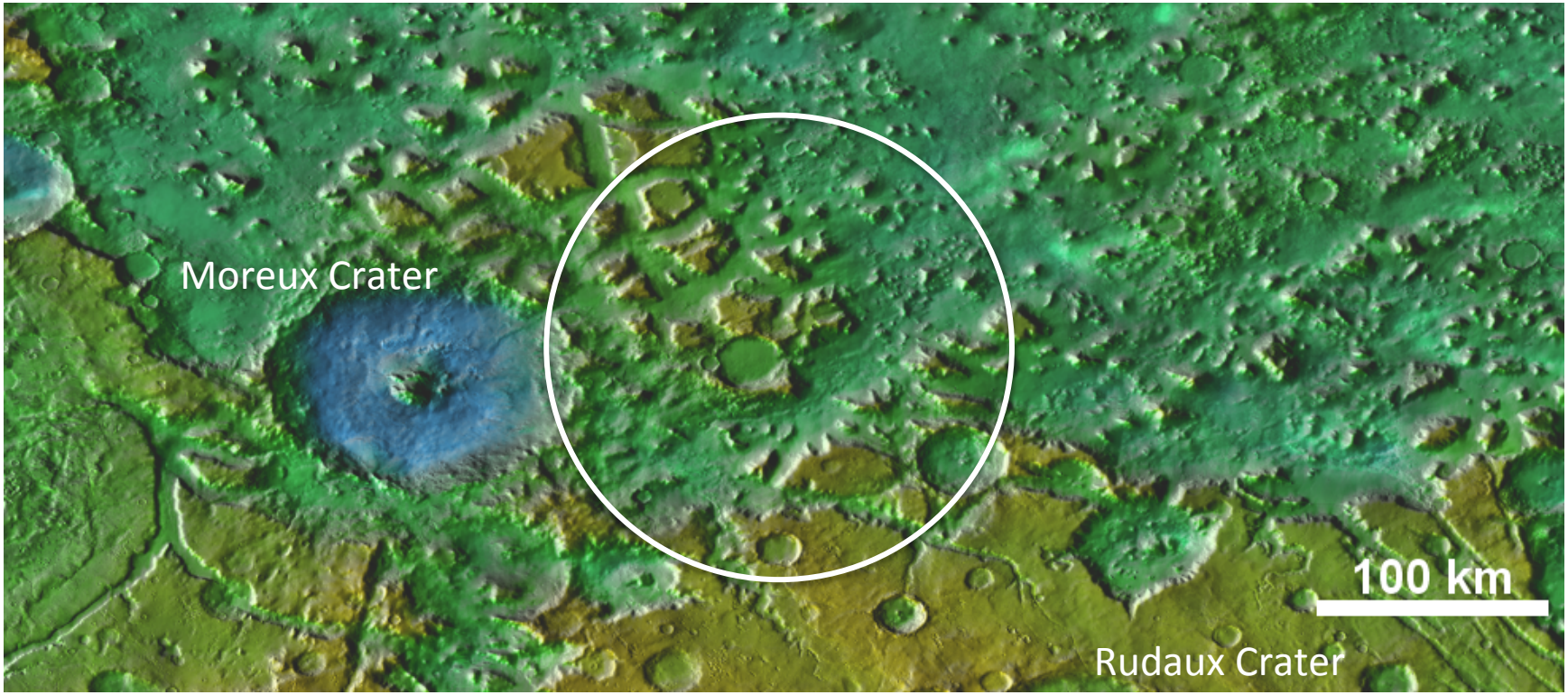
Protonilus Mensae

Abstract #1053

1st EZ Workshop for Human Missions to Mars

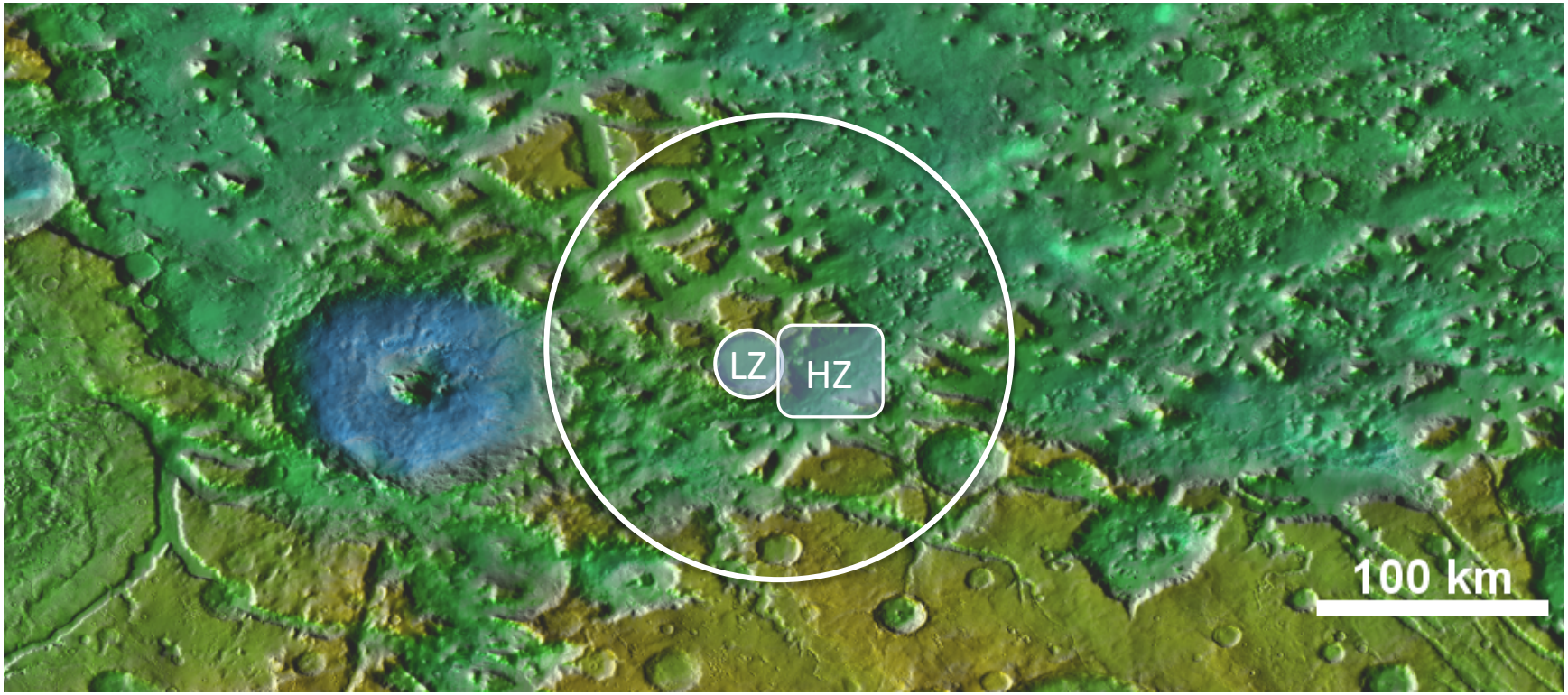
Zachary Gallegos University of New Mexico/Mars One
Horton Newsom University of New Mexico/ChemCam

Local Features

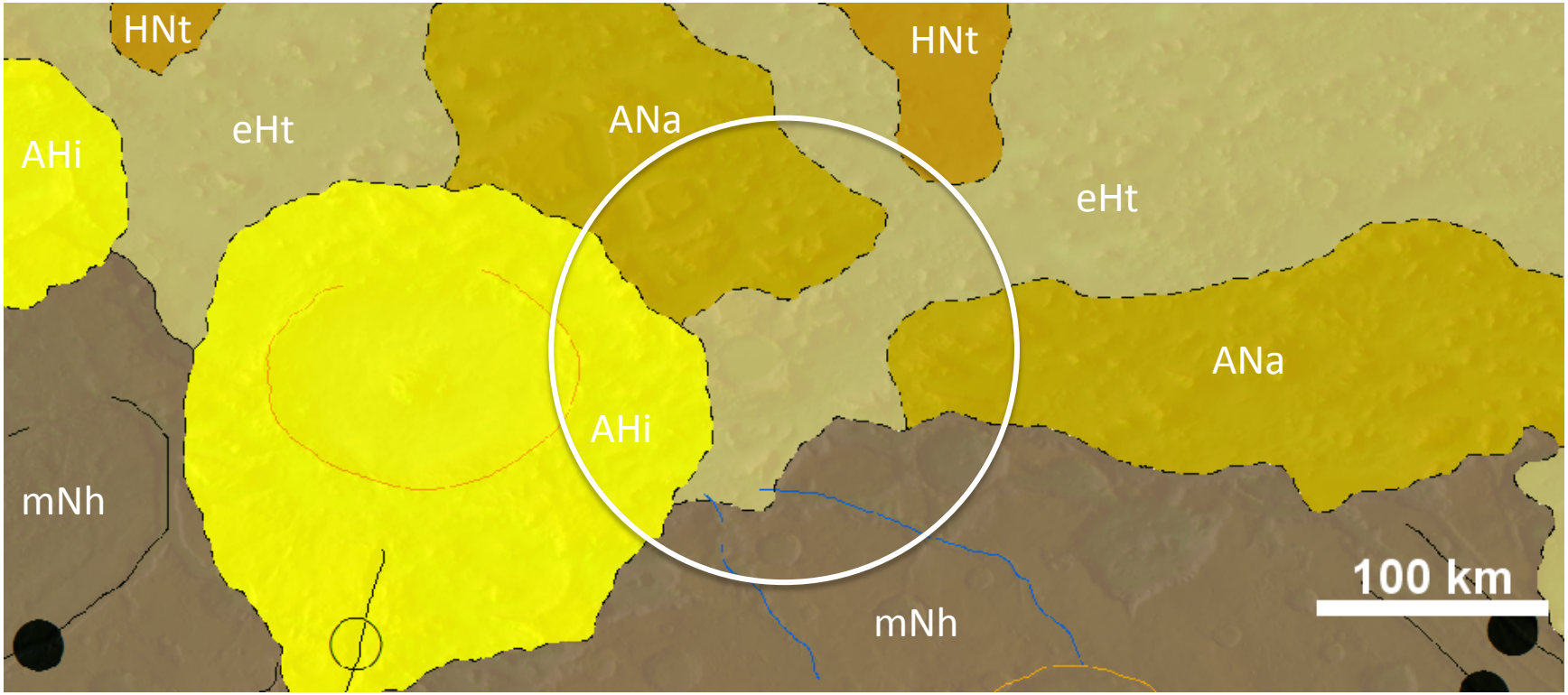


EZ Close-up

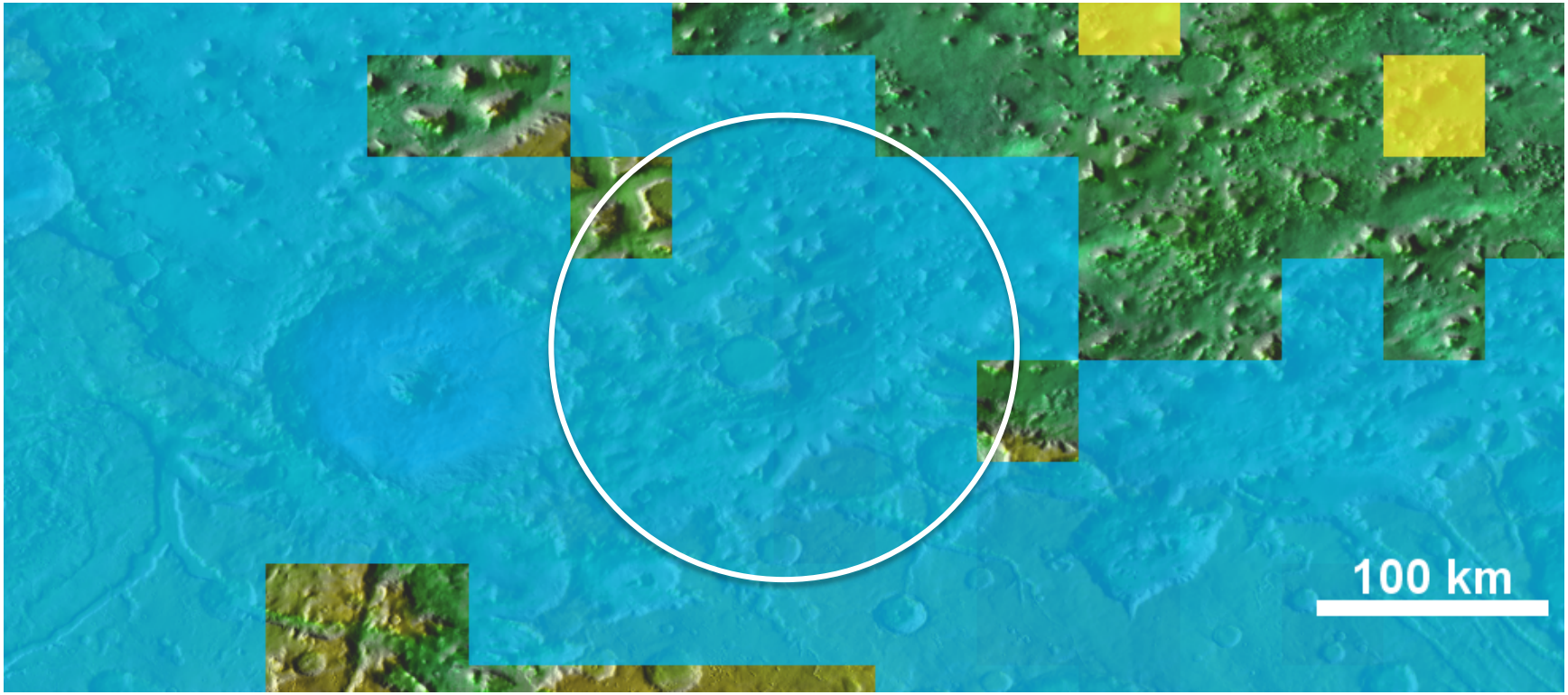
- 48.062E, 42.187N



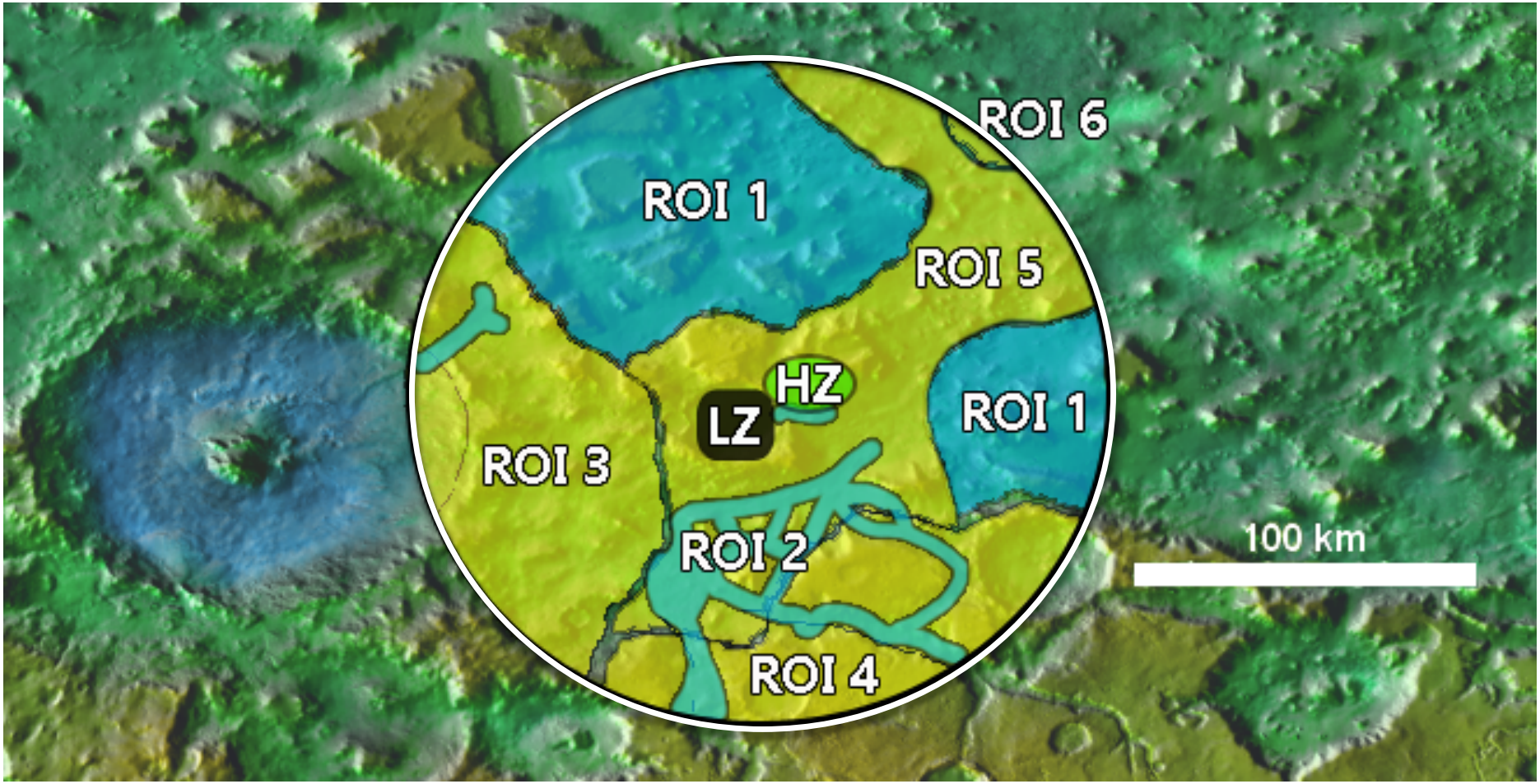
Geologic Context



Remnant Magnetism



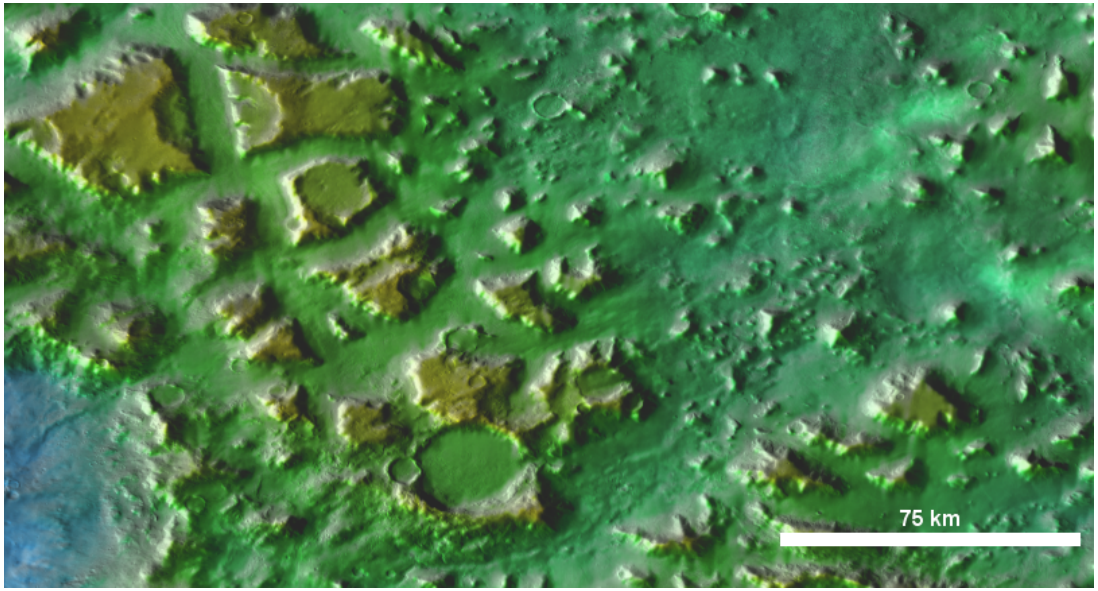
Exploration Zone Map



SCIENCE ROIs

Science ROI1

Amazonian-Noachian apron unit (ANa)



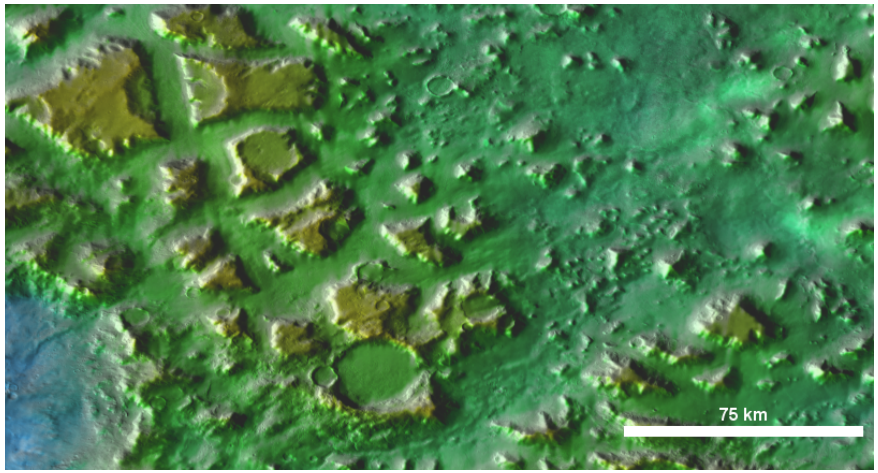
- 46.961E, 43.555
- 50.141E, 42.109

- Fretted terrain
- Amazonian water ice
- Noachian bedrock

Science ROI1 Rubric

1st EZ Workshop for Human Missions to Mars

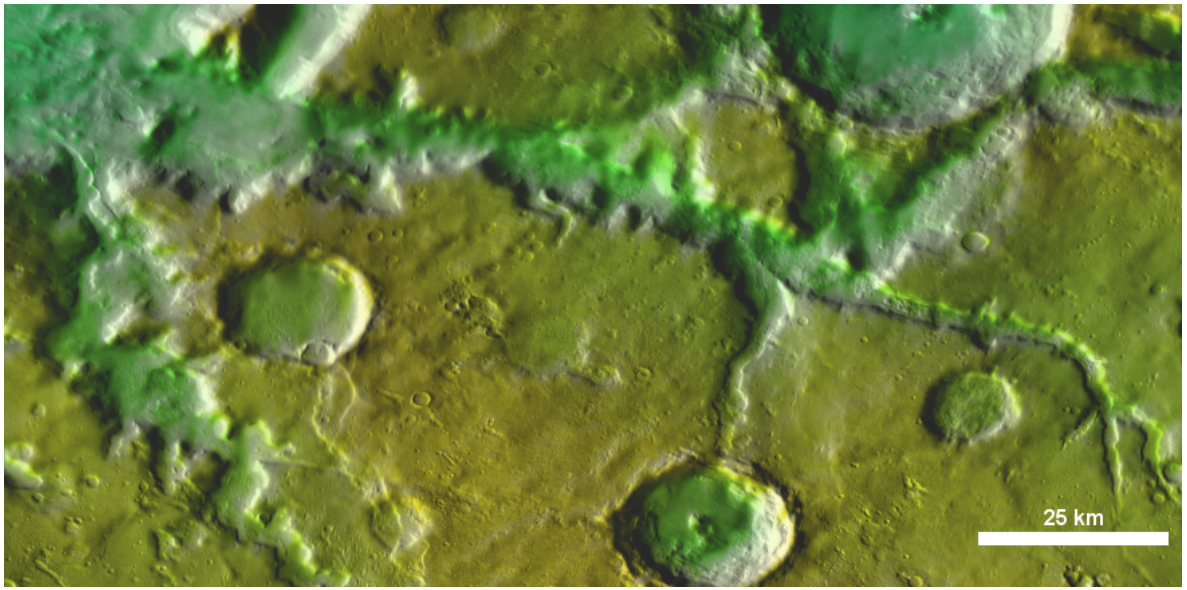
Science Site Criteria				Site Factors	SROI1
	Astrobio	**Threshold**	AND/OR	**Potential for past habitability**	●
				Potential for present habitability/refugia	●
		Qualifying		Potential for organic matter, w/ surface exposure	?
	Atmospheric Science	**Threshold**		**Noachian/Hesperian rocks w/ trapped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



Key	
●	**Yes**
○	**Partial Support or Debated**
	No
?	**Indeterminate**

Science ROI2

Outflow channels



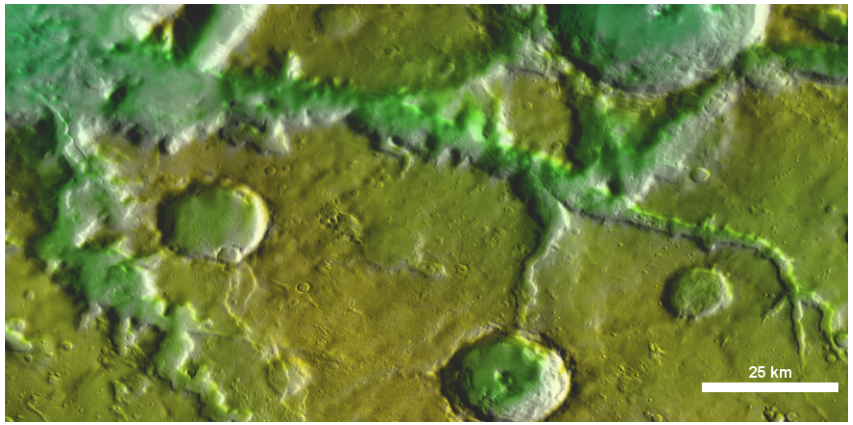
- 47.527E, 40.305
- 49.336E, 40.32

- Aqueous processes
- Past habitability
- Water ice

Science ROI2 Rubric

1st EZ Workshop for Human Missions to Mars

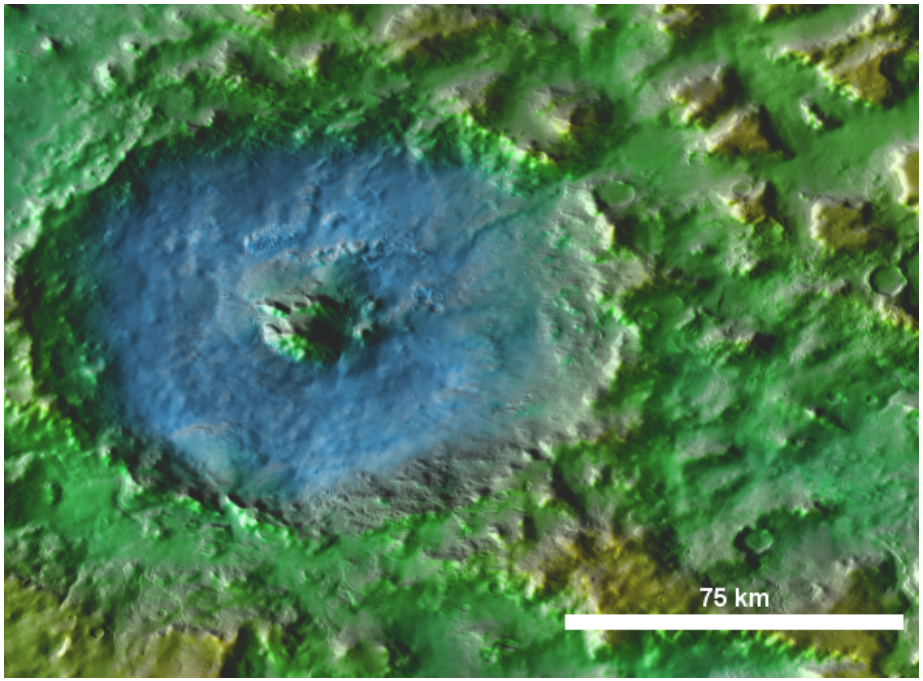
Site Factors					SROI2
Science Site Criteria	Astrobio	Threshold	AND/OR	**Potential for past habitability**	●
				Potential for present habitability/refugia	●
		Qualifying		Potential for organic matter, w/ surface exposure	?
	Atmospheric Science	Threshold		**Noachian/Hesperian rocks w/ trapped atmospheric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



Key	
●	**Yes**
○	**Partial Support or Debated**
	No
?	**Indeterminate**

Science ROI3

Moreux Crater (AHi)



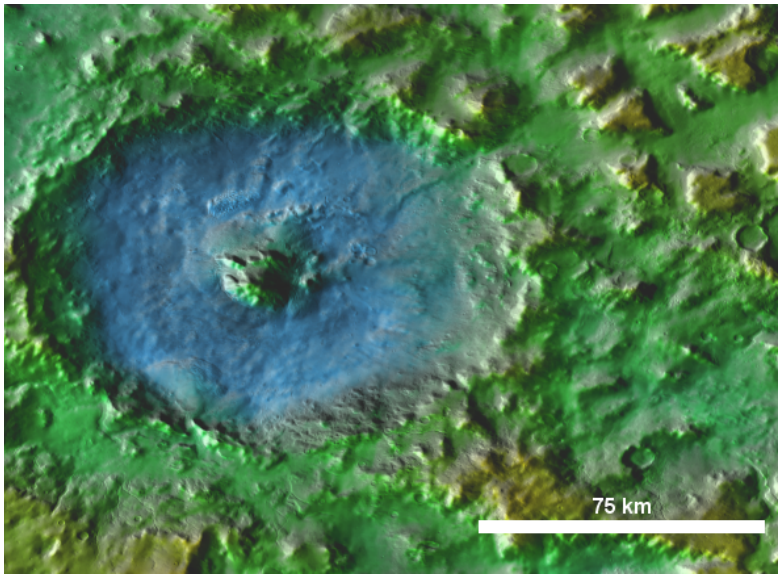
- 46.727E, 41.703

- Impact deposits
- Datable surfaces
- Trapped gasses
- Water ice

Science ROI3 Rubric

1st EZ Workshop for Human Missions to Mars

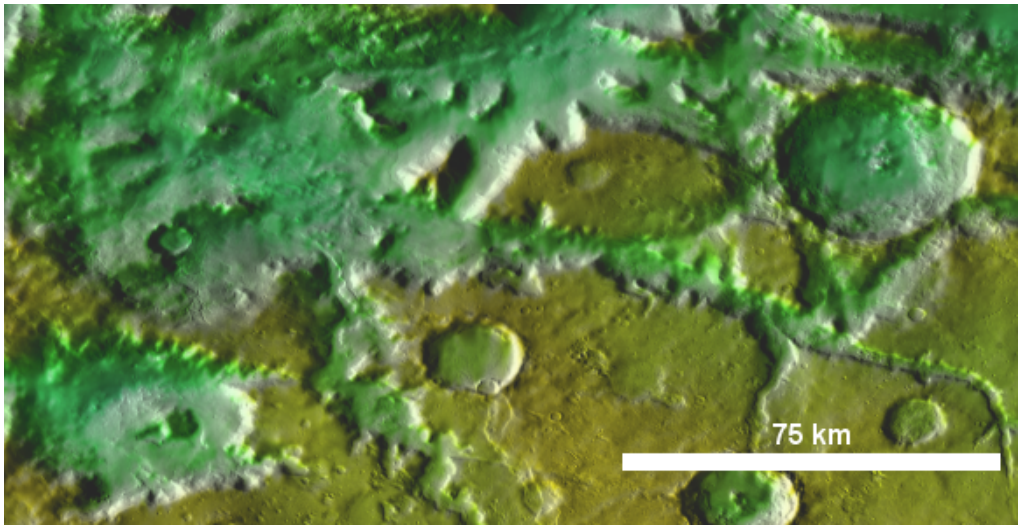
Science Site Criteria				Site Factors	SROI3
	Astrobio	Threshold	AND/OR	**Potential for past habitability**	●
				Potential for present habitability/refugia	●
		Qualifying		Potential for organic matter, w/ surface exposure	?
	Atmospheric Science	Threshold		**Noachian/Hesperian rocks w/ trapped atmospheric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



Key	
●	**Yes**
○	**Partial Support or Debated**
	No
?	**Indeterminate**

Science ROI4

Noachian Highlands (mNh)



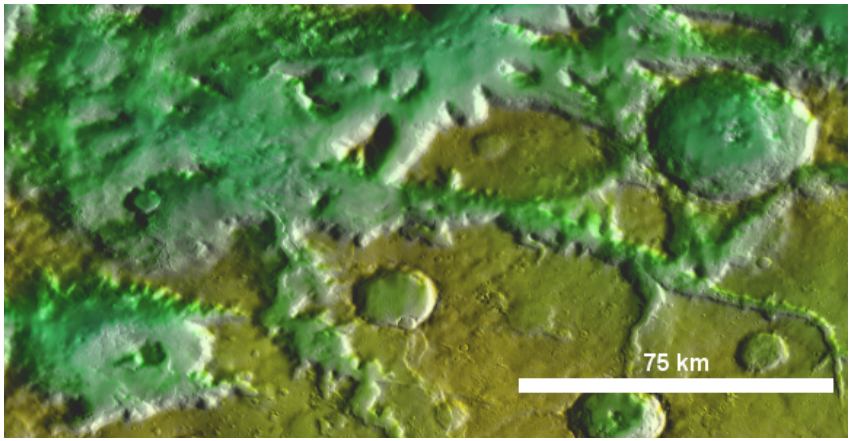
- 48.766E, 39.977

- Igneous rocks
- Datable surfaces
- Trapped gasses

Science ROI4 Rubric

1st EZ Workshop for Human Missions to Mars

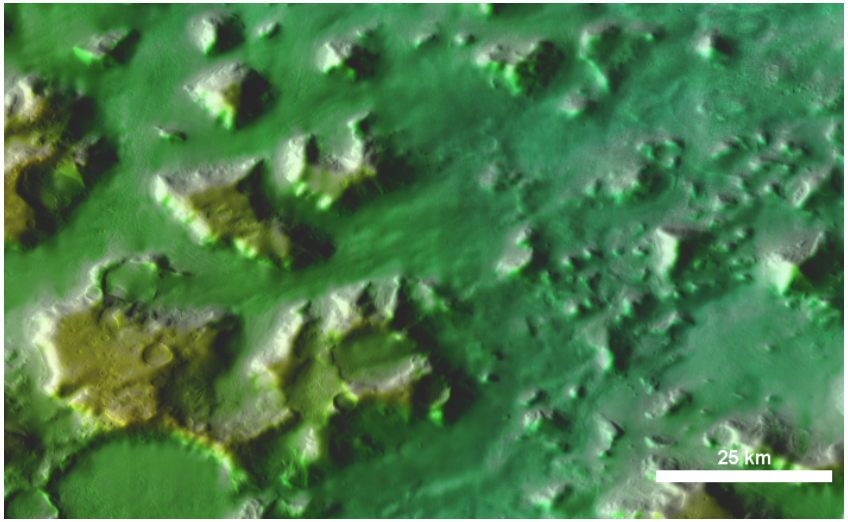
Site Factors					SROI4
Science Site Criteria	Astrobio	Threshold	AND/OR	Potential for past habitability	
				Potential for present habitability/refugia	
		Qualifying		Potential for organic matter, w/ surface exposure	?
	Atmospheric Science	Threshold		Noachian/Hesperian rocks w/ trapped atmospheric gases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



Key	
●	Yes
○	Partial Support or Debated
	No
?	Indeterminate

Science ROI5

Early Hesperian transition unit (eHt)



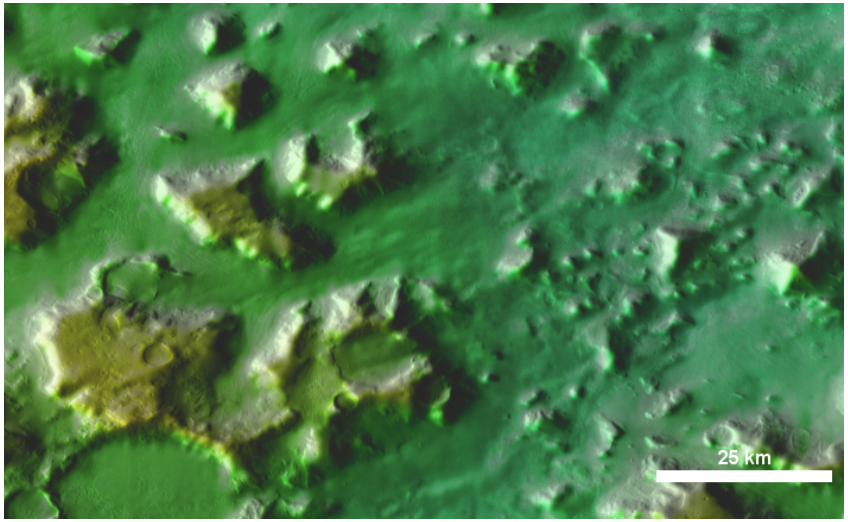
- 49.312E, 42.898

- Igneous rocks
- Datable surfaces
- Trapped gasses

Science ROI5 Rubric

1st EZ Workshop for Human Missions to Mars

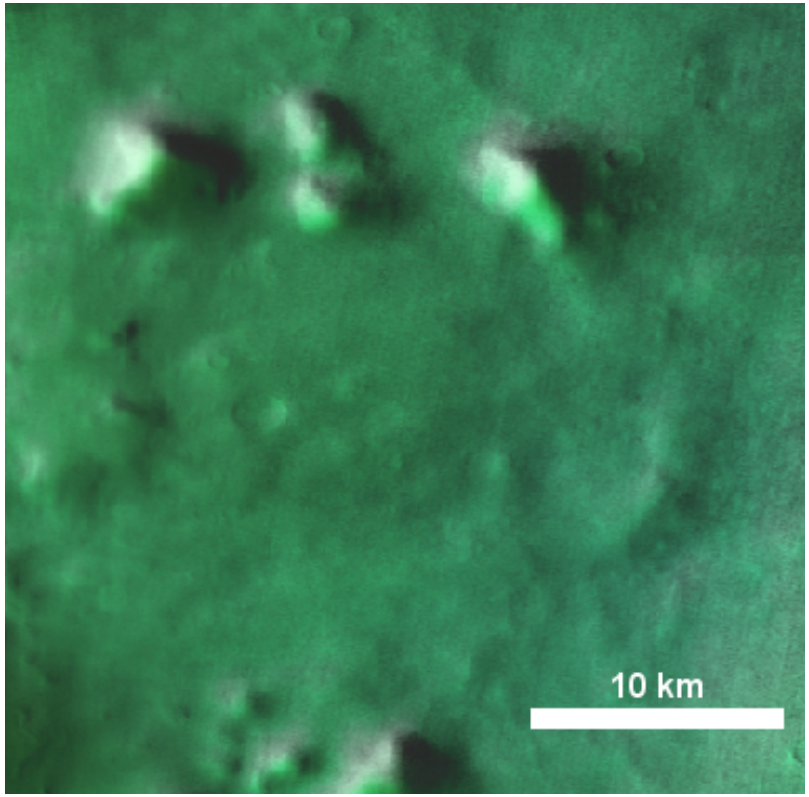
Site Factors					SROI5
Science Site Criteria	Astrobio	Threshold	AND/OR	Potential for past habitability	
				Potential for present habitability/refugia	
		Qualifying		Potential for organic matter, w/ surface exposure	?
	Atmospheric Science	Threshold		Noachian/Hesperian rocks w/ trapped atmospheric gases	●
		Qualifying		Meteorological diversity in space and time	●
				High likelihood of surface-atmosphere exchange	●
				Amazonian subsurface or high-latitude ice or sediment	●
				High likelihood of active trace gas sources	?
	Geoscience	Threshold		Range of martian geologic time; datable surfaces	●
				Evidence of aqueous processes	●
				Potential for interpreting relative ages	●
		Qualifying		Igneous Rocks tied to 1+ provinces or different times	●
				Near-surface ice, glacial or permafrost	●
				Noachian or pre-Noachian bedrock units	●
				Outcrops with remnant magnetization	○
				Primary, secondary, and basin-forming impact deposits	
				Structural features with regional or global context	
				Diversity of aeolian sediments and/or landforms	?



Key	
●	Yes
○	Partial Support or Debated
	No
?	Indeterminate

Science ROI6

Hesperian and Noachian transition unit (HNt)



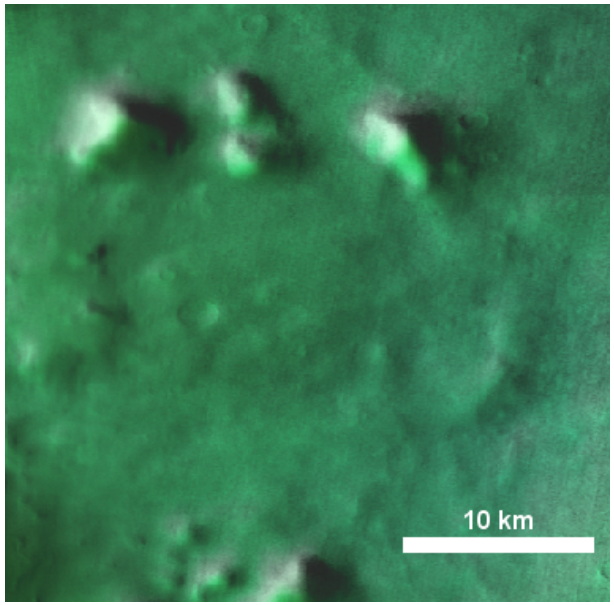
- 49.383E, 43.937

- Igneous rocks
- Datable surfaces
- Trapped gasses

Science ROI6 Rubric

1st EZ Workshop for Human Missions to Mars

Science Site Criteria				Site Factors	SROI5
	Astrobio	**Threshold**	AND/OR	**Potential for past habitability**	
				Potential for present habitability/refugia	
		Qualifying		Potential for organic matter, w/ surface exposure	?
	Atmospheric Science	**Threshold**		**Noachian/Hesperian rocks w/ trapped atmospheric gases**	●
		Qualifying		Meteorological diversity in space and time	
				High likelihood of surface-atmosphere exchange	
				Amazonian subsurface or high-latitude ice or sediment	●
				High likelihood of active trace gas sources	?
	Geoscience	**Threshold**		**Range of martian geologic time; datable surfaces**	●
				Evidence of aqueous processes	●
				Potential for interpreting relative ages	●
		Qualifying		Igneous Rocks tied to 1+ provinces or different times	●
				Near-surface ice, glacial or permafrost	●
				Noachian or pre-Noachian bedrock units	●
				Outcrops with remnant magnetization	○
				Primary, secondary, and basin-forming impact deposits	●
				Structural features with regional or global context	
				Diversity of aeolian sediments and/or landforms	?

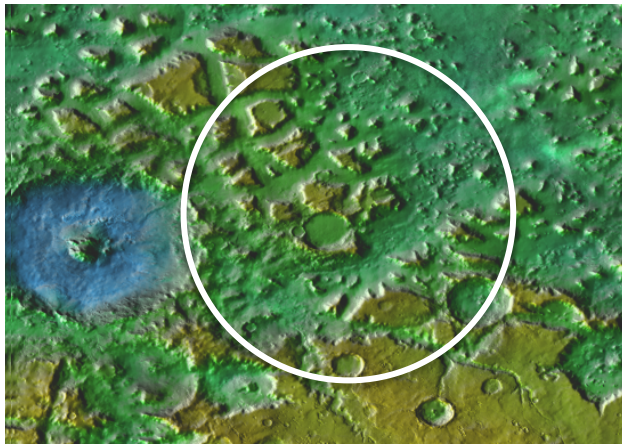


Key	
●	**Yes**
○	**Partial Support or Debated**
	No
?	**Indeterminate**

Science Rubrics

1st EZ Workshop for Human Missions to Mars

Site Factors					SROI1	SROI2	SROI3	SROI4	SROI5	SROI6	EZ SUM
Science Site Criteria	Astrobio	Threshold	AND/OR	**Potential for past habitability**	●	●	●				(3,0)
				Potential for present habitability/refugia	●	●	●				(3,0)
		Qualifying		Potential for organic matter, w/ surface exposure	?	?	?	?	?	?	
	Atmospheric Science	Threshold		**Noachian/Hesperian rocks w/ trapped atmospheric gases**	●	●	●	●	●	●	(6,0)
		Qualifying		Meteorological diversity in space and time	●	●	●		●		(4,0)
				High likelihood of surface-atmosphere exchange	●	●	●		●		(4,0)
				Amazonian subsurface or high-latitude ice or sediment	●	●	●		●	●	(5,0)
				High likelihood of active trace gas sources	?	?	?	?	?	?	
	Geoscience	Threshold		**Range of martian geologic time; datable surfaces**	●	●	●	●	●	●	(6,0)
				Evidence of aqueous processes	●	●	●	●	●	●	(6,0)
				Potential for interpreting relative ages	●	●	●	●	●	●	(6,0)
		Qualifying		Igneous Rocks tied to 1+ provinces or different times	●	●	●	●	●	●	(6,0)
				Near-surface ice, glacial or permafrost	●	●	●		●	●	(5,0)
				Noachian or pre-Noachian bedrock units	●	●	●	●		●	(5,0)
				Outcrops with remnant magnetization	●	●	●	●	○	○	(4,2)
				Primary, secondary, and basin-forming impact deposits	●	●	●	●		●	(5,0)
				Structural features with regional or global context	●	●	●	●			(4,0)
				Diversity of aeolian sediments and/or landforms	?	?	?	?	?	?	

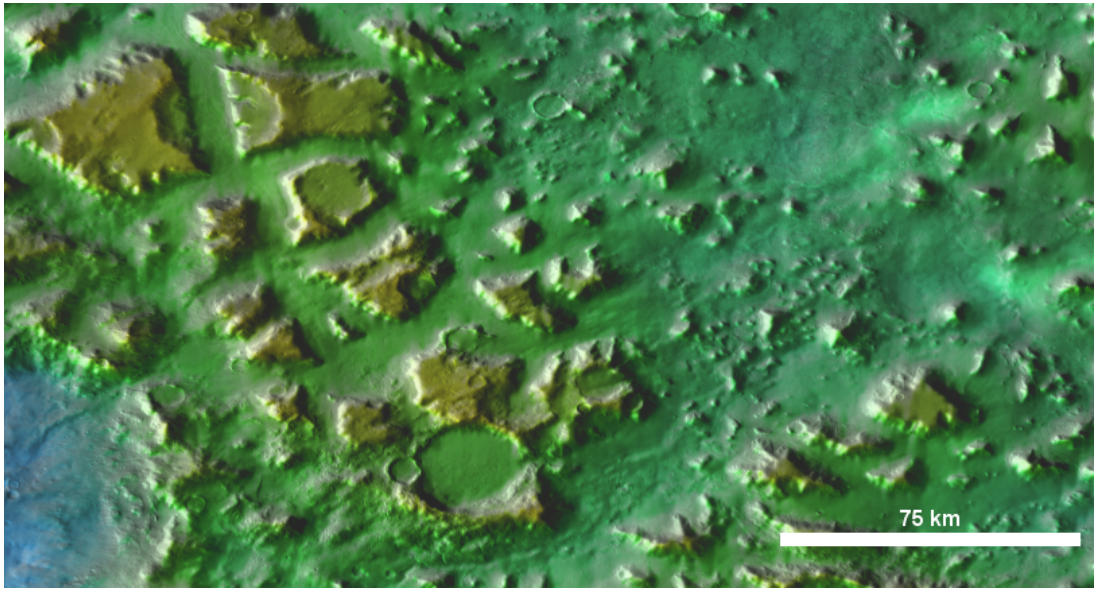


Key	
●	**Yes**
○	**Partial Support or Debated**
	No
?	**Indeterminate**

RESOURCE ROIs

Resource ROI1

Amazonian-Noachian apron unit (ANa)



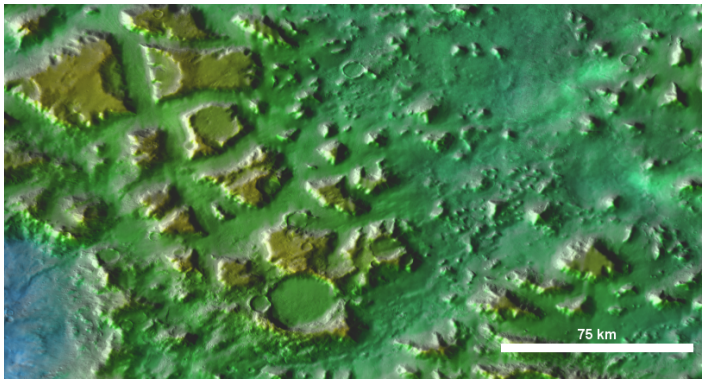
- 46.961E, 43.555
- 50.141E, 42.109

- Amazonian water ice

Resource ROI1 Rubric

1st EZ Workshop for Human Missions to Mars

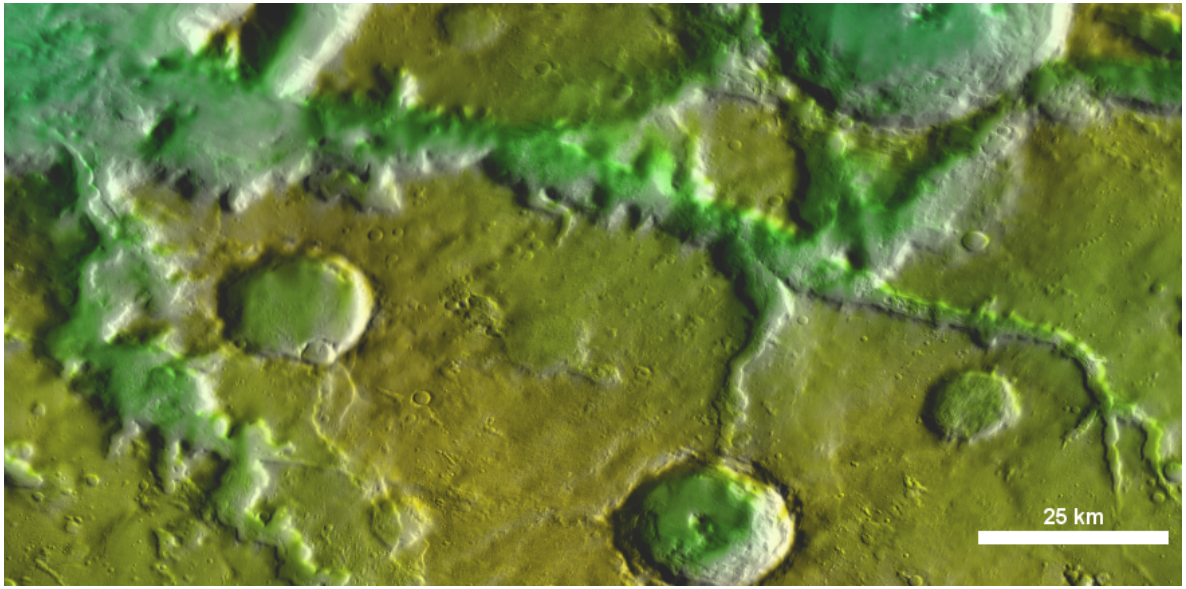
Site Factors					RROI1
ISRU and Civil Engineering Criteria	Engineering			Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)	●
	Water Resource	**Threshold**	AND/OR	**Potential for ice or ice/regolith mix**	●
				Potential for hydrated minerals	
				Quantity for substantial production	●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



Key	
●	**Yes**
○	**Partial Support or Debated**
	No
?	**Indeterminate**

Resource ROI2

Outflow channels



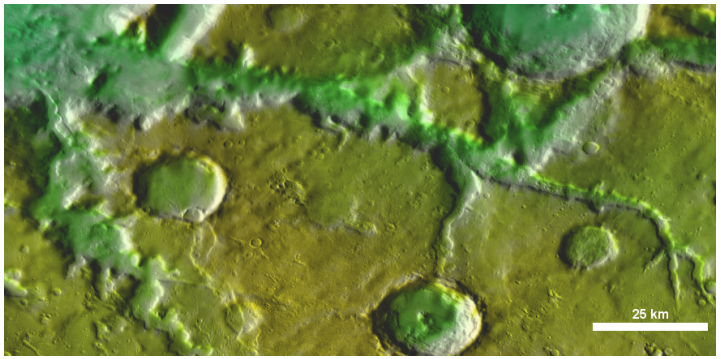
- 47.527E, 40.305
- 49.336E, 40.32

- Water ice
- Hydrated minerals

Resource ROI2 Rubric

1st EZ Workshop for Human Missions to Mars

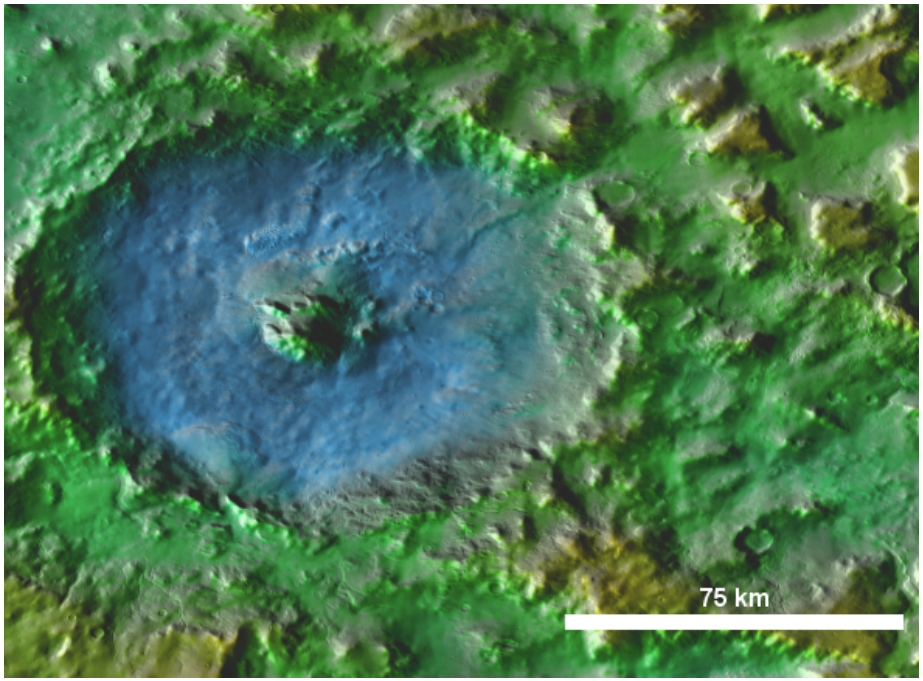
Site Factors				RROI2
ISRU and Civil Engineering Criteria	Engineering		Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)	●
	Water Resource	Threshold	AND/OR: **Potential for ice or ice/regolith mix**	●
			AND/OR: **Potential for hydrated minerals**	●
			Quantity for substantial production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



Key	
●	**Yes**
○	**Partial Support or Debated**
	No
?	**Indeterminate**

Resource ROI3

Moreux Crater (AHi)



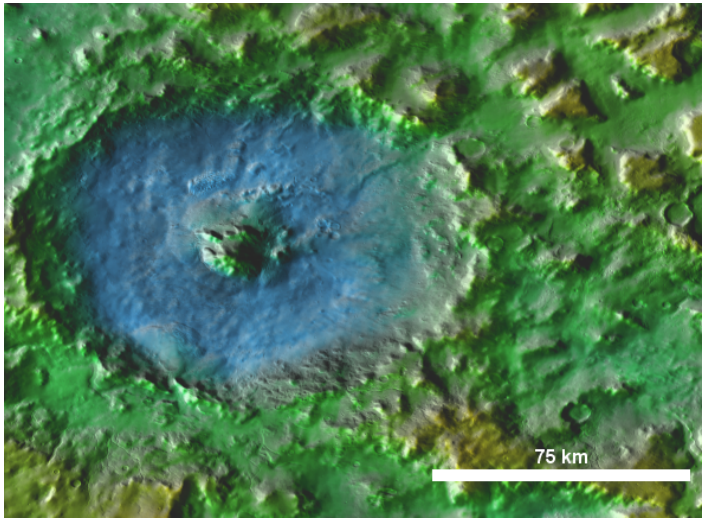
- 46.727E, 41.703

- Impact glass
- Water ice

Resource ROI3 Rubric

1st EZ Workshop for Human Missions to Mars

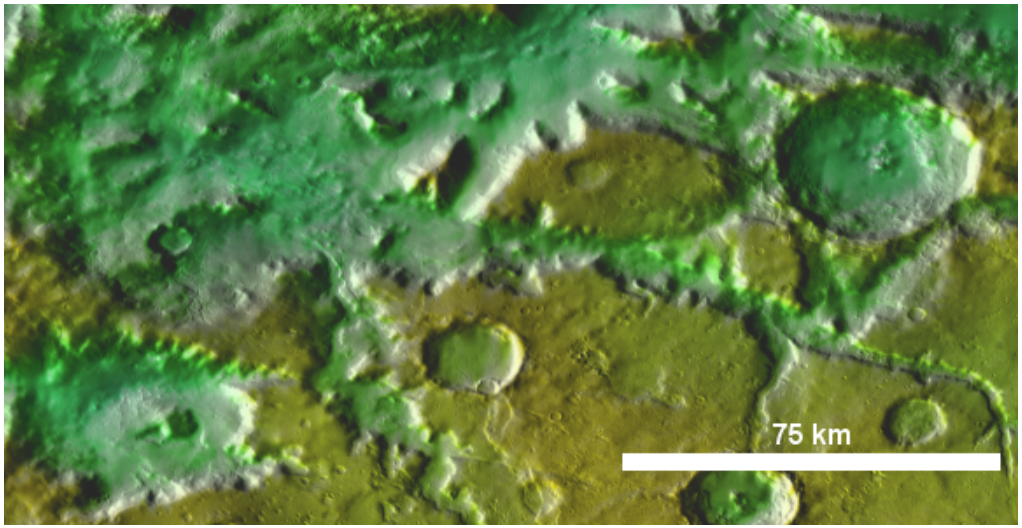
Site Factors					RROI3
ISRU and Civil Engineering Criteria	Engineering			Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)	●
	Water Resource	**Threshold**	AND/OR	**Potential for ice or ice/regolith mix**	●
				Potential for hydrated minerals	●
				Quantity for substantial production	●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



Key	
●	**Yes**
○	**Partial Support or Debated**
	No
?	**Indeterminate**

Resource ROI4

Noachian Highlands (mNh)

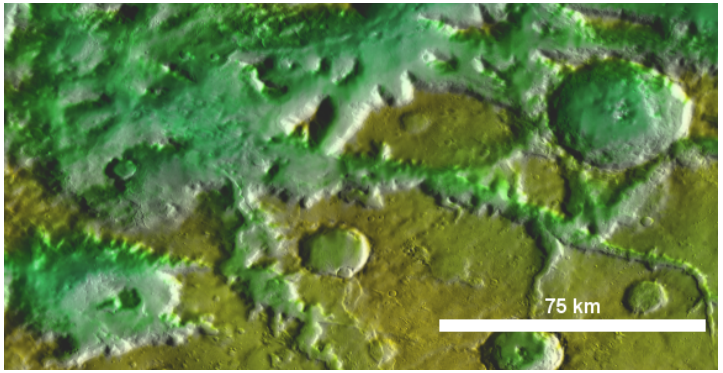


- 48.766E, 39.977
- Cobbles, rocks, regolith
- Metals?

Resource ROI4 Rubric

1st EZ Workshop for Human Missions to Mars

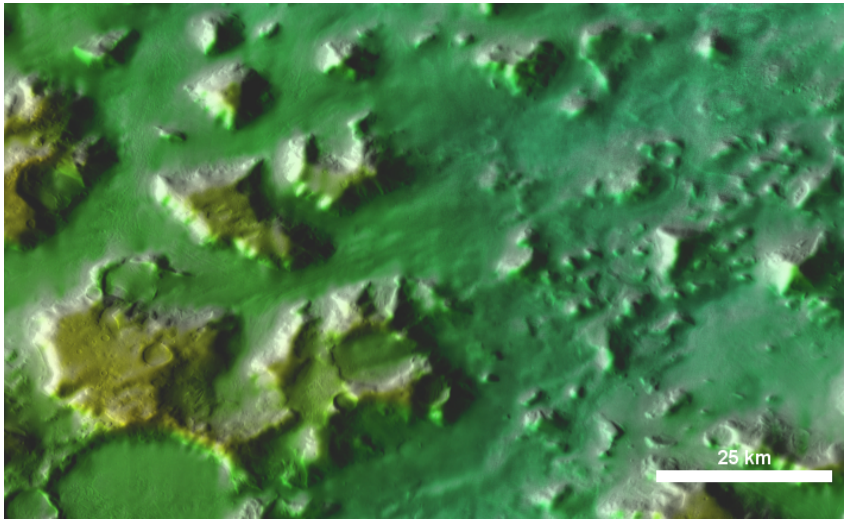
ISRU and Civil Engineering Criteria			Site Factors	RROI4
	Engineering		Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)	●
	Water Resource	Threshold	AND/OR: **Potential for ice or ice/regolith mix**	
			AND/OR: **Potential for hydrated minerals**	
			Quantity for substantial production	
			Potential to be minable by highly automated systems	
			Located less than 3 km from processing equipment site	
			Located no more than 3 meters below the surface	
			Accessible by automated systems	
		Qualifying	Potential for multiple sources of ice, ice/regolith mix **and** hydrated minerals	
			Distance to resource location can be >5 km	
			Route to resource location must be (plausibly) traversable	
	Civil Engineering	Threshold	**~50 sq km region of flat and stable terrain with sparse rock distribution**	
			1–10 km length scale: <10°	
			Located within 5 km of landing site location	
		Qualifying	Located in the northern hemisphere	
			Evidence of abundant cobble sized or smaller rocks and bulk, loose regolith	●
			Utilitarian terrain features	
	Food Production	Qualifying	Low latitude	
			No local terrain feature(s) that could shadow light collection facilities	
			Access to water	
			Access to dark, minimally altered basaltic sands	
	Metal/Silicon Resource	Threshold	**Potential for metal/silicon**	●
			Potential to be minable by highly automated systems	●
			Located less than 3 km from processing equipment site	○
			Located no more than 3 meters below the surface	○
			Accessible by automated systems	●
		Qualifying	Potential for multiple sources of metals/silicon	●
			Distance to resource location can be >5 km	●
			Route to resource location must be (plausibly) traversable	●



Key	
●	**Yes**
○	**Partial Support or Debated**
	No
?	**Indeterminate**

Resource ROI5

Early Hesperian transition unit (eHt)

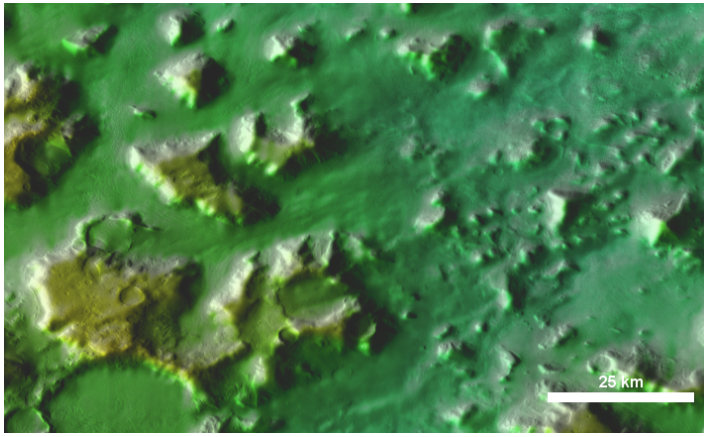


- 49.312E, 42.898

- Cobbles, rocks, regolith
- Metals?

Resource ROI5 Rubric

			Site Factors	RROI5
ISRU and Civil Engineering Criteria	Engineering		Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)	●
	Water Resource	Threshold	AND/OR **Potential for ice or ice/regolith mix**	●
			AND/OR **Potential for hydrated minerals**	●
			Quantity for substantial production	●
			Potential to be minable by highly automated systems	●
			Located less than 3 km from processing equipment site	●
			Located no more than 3 meters below the surface	●
			Accessible by automated systems	●
		Qualifying	Potential for multiple sources of ice, ice/regolith mix **and** hydrated minerals	●
			Distance to resource location can be >5 km	●
			Route to resource location must be (plausibly) traversable	●
	Civil Engineering	Threshold	**~50 sq km region of flat and stable terrain with sparse rock distribution**	●
			1–10 km length scale: <10°	●
			Located within 5 km of landing site location	●
		Qualifying	Located in the northern hemisphere	
			Evidence of abundant cobble sized or smaller rocks and bulk, loose regolith	●
			Utilitarian terrain features	
	Food Production	Qualifying	Low latitude	
			No local terrain feature(s) that could shadow light collection facilities	
			Access to water	●
			Access to dark, minimally altered basaltic sands	
	Metal/Silicon Resource	Threshold	**Potential for metal/silicon**	
			Potential to be minable by highly automated systems	
			Located less than 3 km from processing equipment site	
			Located no more than 3 meters below the surface	
			Accessible by automated systems	
		Qualifying	Potential for multiple sources of metals/silicon	
			Distance to resource location can be >5 km	
			Route to resource location must be (plausibly) traversable	

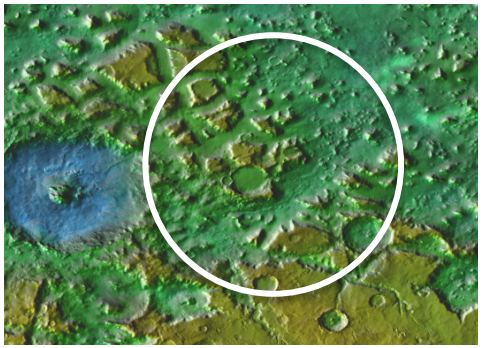


Key	
●	**Yes**
○	**Partial Support or Debated**
	No
?	**Indeterminate**

Resource Rubrics

1st EZ Workshop for Human Missions to Mars

ISRU and Civil Engineering Criteria				Site Factors	RROI1	RROI2	RROI3	RROI4	RROI5	EZ SUM
	Engineering			Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)	●	●	●	●	●	(5,0)
	Water Resource	Threshold	AND/OR	**Potential for ice or ice/regolith mix**	●	●	●		●	(4,0)
				Potential for hydrated minerals		●	●		●	(3,0)
				Quantity for substantial production	●	●	●		●	(4,0)
				Potential to be minable by highly automated systems	●	●	●		●	(4,0)
				Located less than 3 km from processing equipment site	○	○	○		●	(1,3)
				Located no more than 3 meters below the surface	○	○	○		●	(1,3)
				Accessible by automated systems	●	●	●		●	(4,0)
		Qualifying		Potential for multiple sources of ice, ice/regolith mix **and** hydrated minerals	●	●	●		●	(4,0)
				Distance to resource location can be >5 km	●	●	●		●	(4,0)
				Route to resource location must be (plausibly) traversable	●	●	●		●	(4,0)
	Civil Engineering	Threshold		**~50 sq km region of flat and stable terrain with sparse rock distribution**	●				●	(2,0)
				1–10 km length scale: <10°	●				●	(2,0)
				Located within 5 km of landing site location	●				●	(2,0)
		Qualifying		Located in the northern hemisphere						
				Evidence of abundant cobble sized or smaller rocks and bulk, loose regolith	○	●	●	●	●	(4,1)
				Utilitarian terrain features	●	●				(2,0)
	Food Production	Qualifying		Low latitude						
				No local terrain feature(s) that could shadow light collection facilities						
				Access to water	●	●	●		●	(4,0)
				Access to dark, minimally altered basaltic sands						
	Metal/Silicon Resource	Threshold		**Potential for metal/silicon**			●	●		(2,0)
				Potential to be minable by highly automated systems			●	●		(2,0)
				Located less than 3 km from processing equipment site			○	○		(0,2)
				Located no more than 3 meters below the surface			○	○		(0,2)
				Accessible by automated systems			●	●		(2,0)
		Qualifying		Potential for multiple sources of metals/silicon			●	●		(2,0)
				Distance to resource location can be >5 km			●	●		(2,0)
				Route to resource location must be (plausibly) traversable			○	●		(1,1)



Key	
●	Yes
○	Partial Support or Debated
	No
?	Indeterminate

EZ Rubrics

1st EZ Workshop for Human Missions to Mars

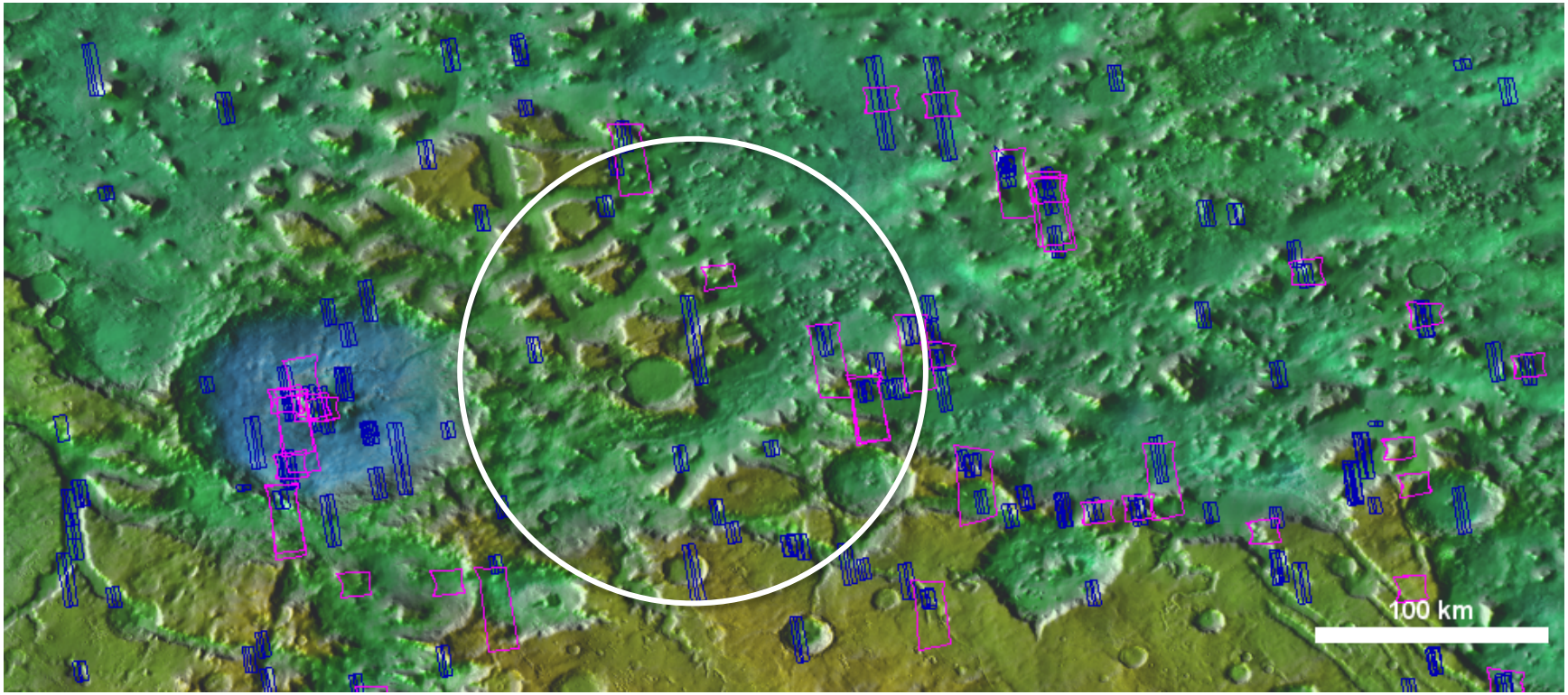
Science Site Criteria

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

ISRU and Civil Engineering Criteria

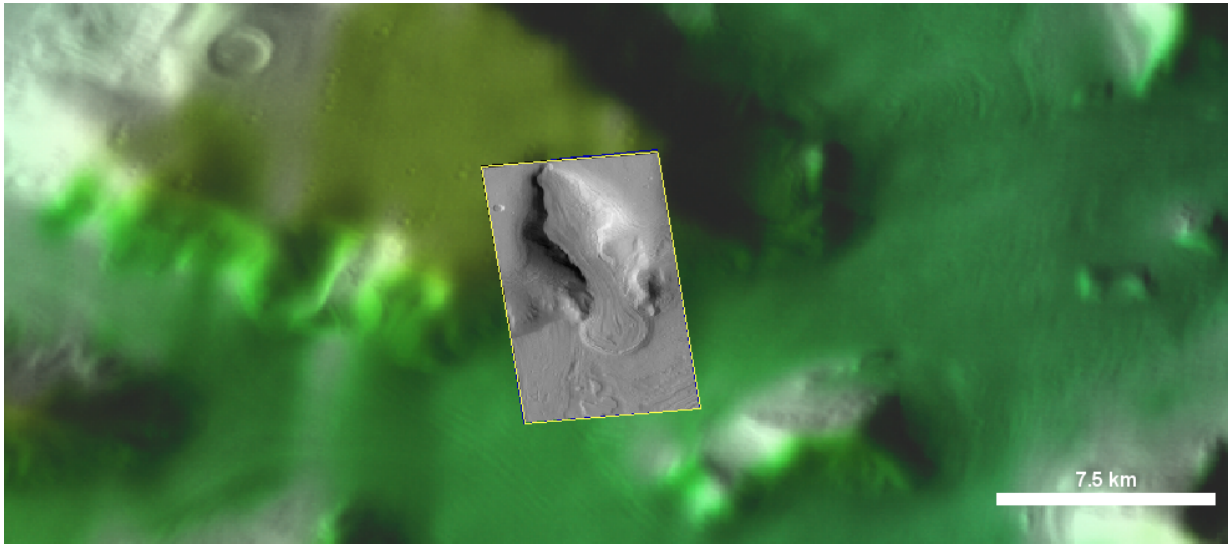
			Site Factors	EZ
Engineering			Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)	●
Water Resource	Threshold	AND/OR	**Potential for ice or ice/regolith mix**	●
			Potential for hydrated minerals	●
			Quantity for substantial production	●
			Potential to be minable by highly automated systems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

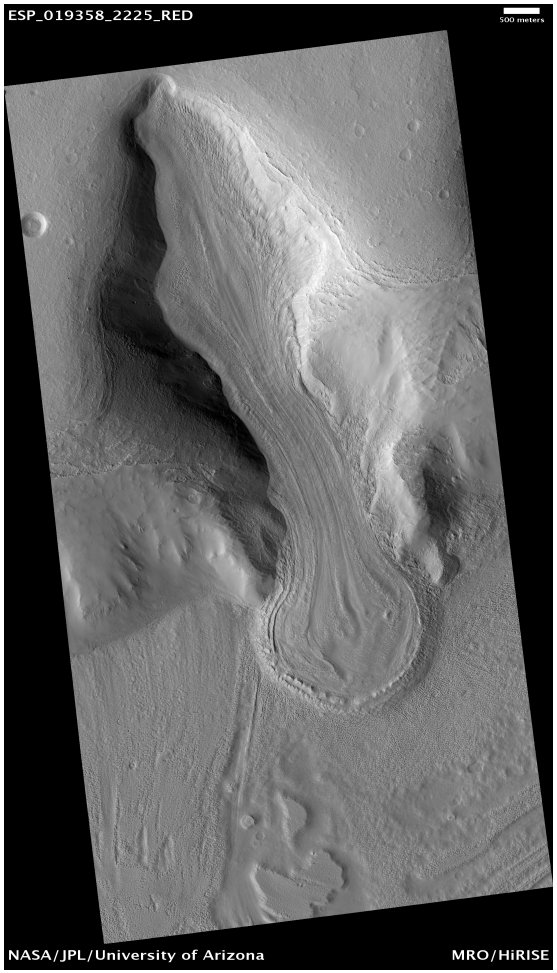
Current HIRISE and CRISM coverage



HIRISE and CRISM

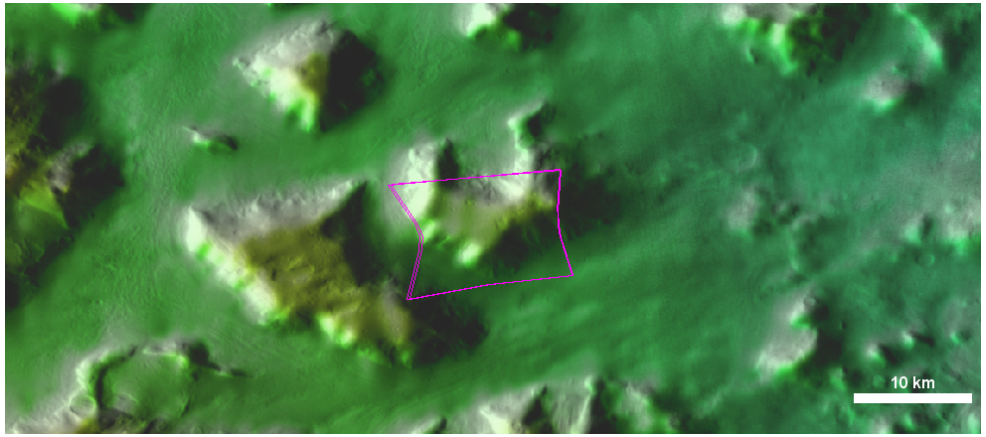
- Amazonian Noachian apron unit

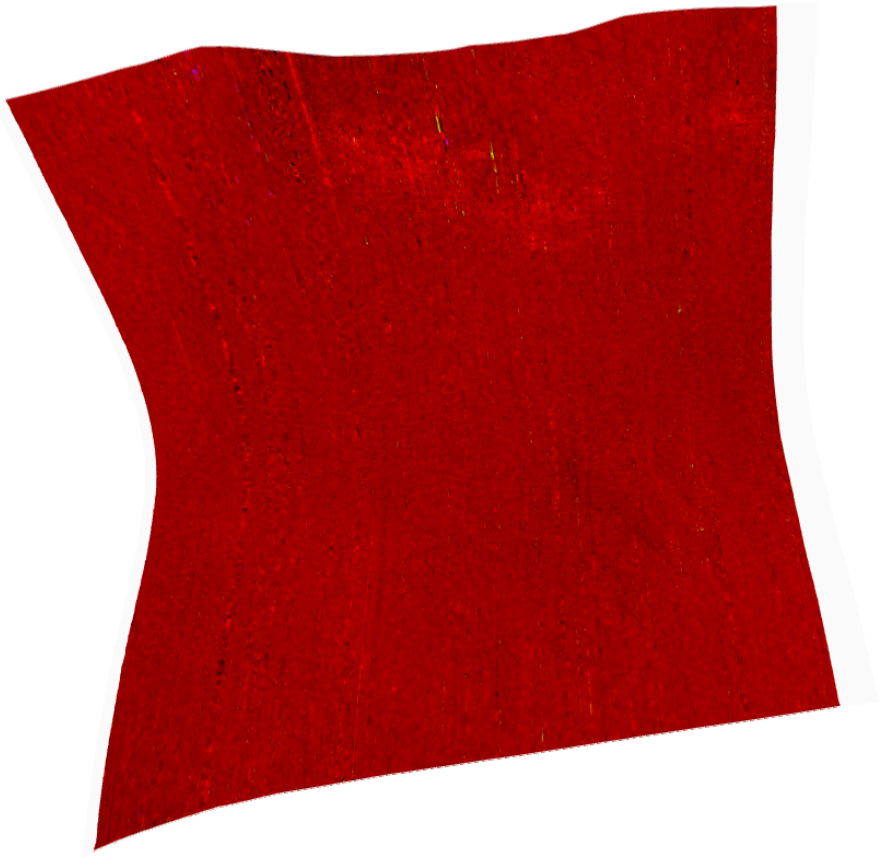




HIRISE and CRISM

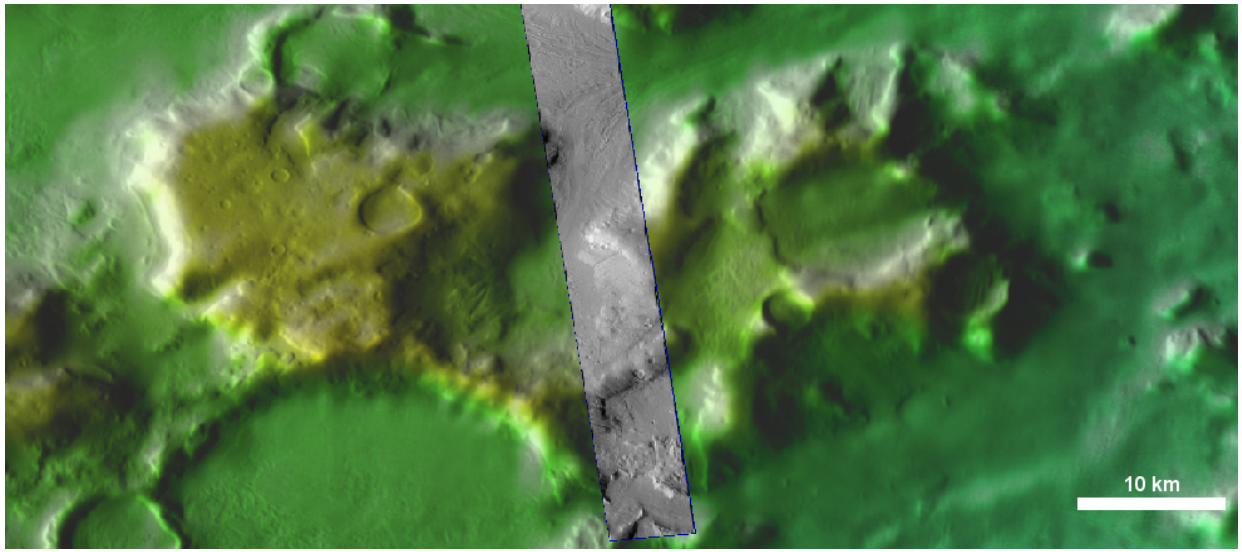
- Amazonian Noachian apron unit
- Bound water

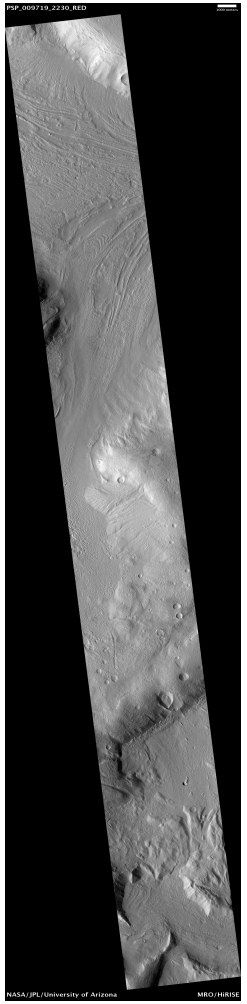




HIRISE and CRISM

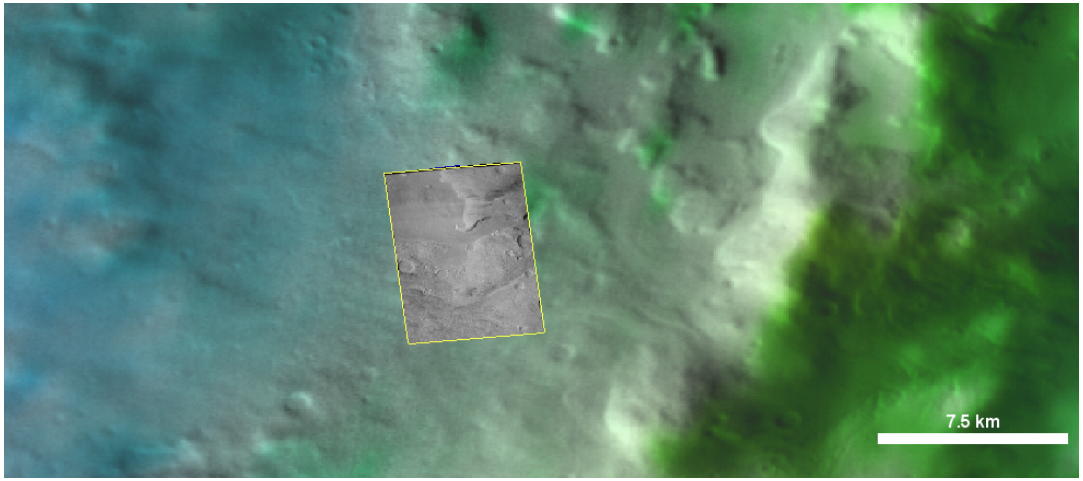
- Landing site crater outlet
- Amazonian Noachian apron unit





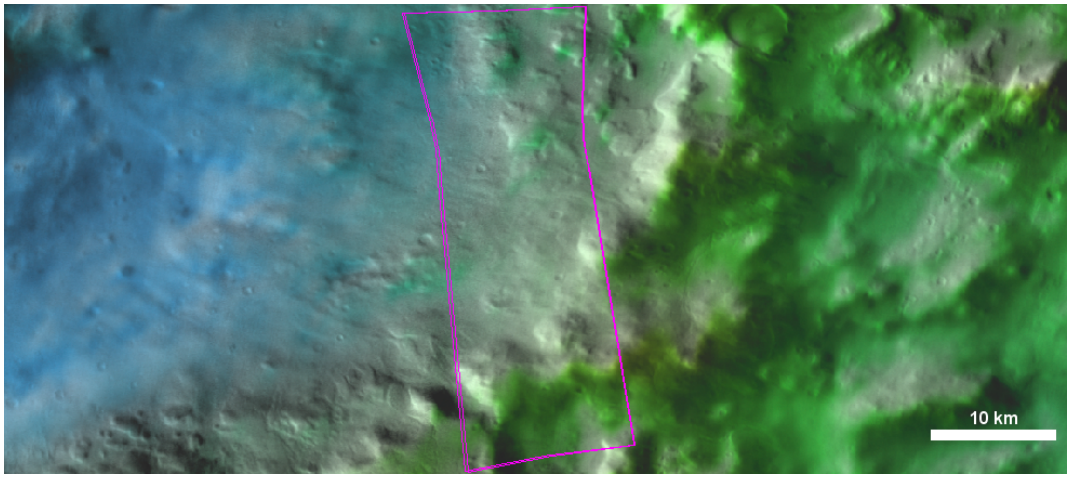
HIRISE and CRISM

- Inside Moreux Crater



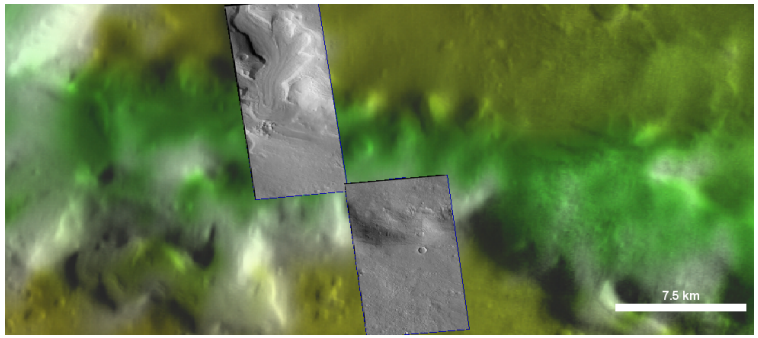
HIRISE and CRISM

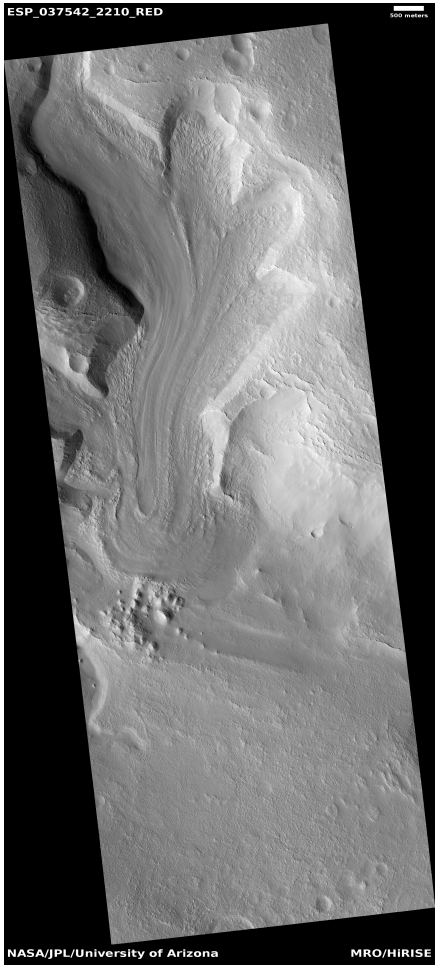
- Inside Moreux Crater
- Bound water

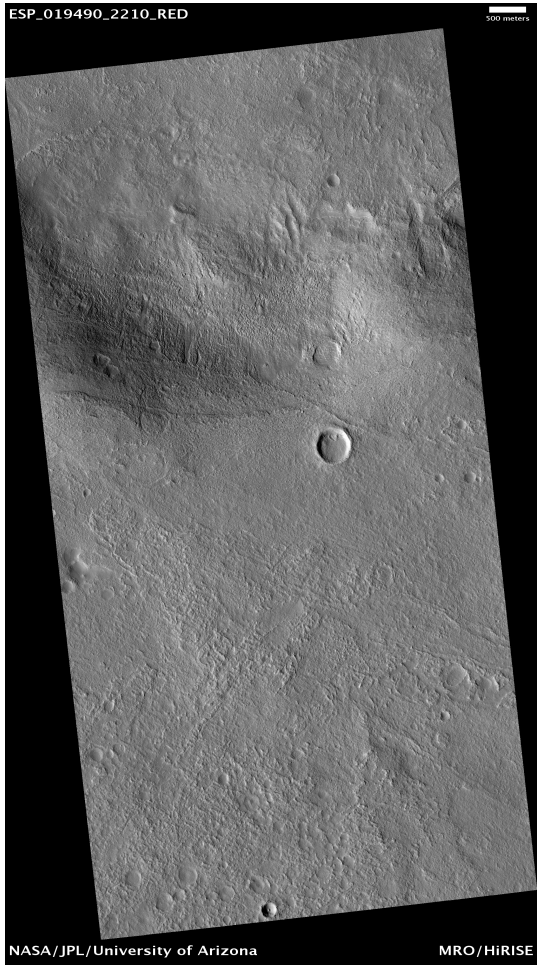


HIRISE and CRISM

- Highlands outflow channel







EZ Science Data Needs

1. Orbital data
   - High-resolution imagery
   - Spectroscopy

2. MSL class rover
   - Science reconnaissance

EZ Resource Data Needs

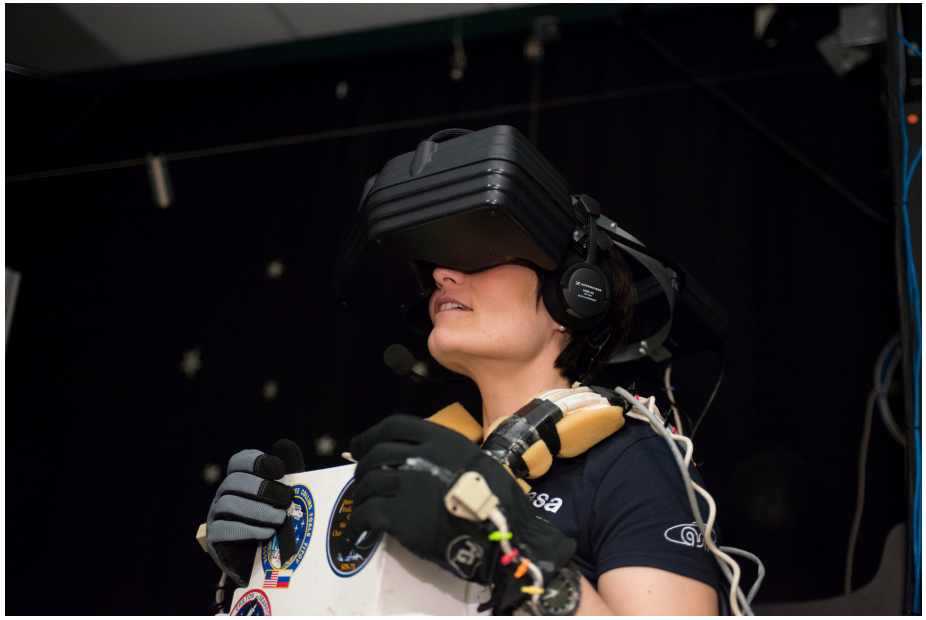
1. MSL class rover
   - Resource reconnaissance
     - ANa ice (sell the mission as exploring Mars glaciers!)
     - Impact glass and metals

2. Orbital data
   - High-resolution imagery
   - Spectroscopy
   - More radar data?

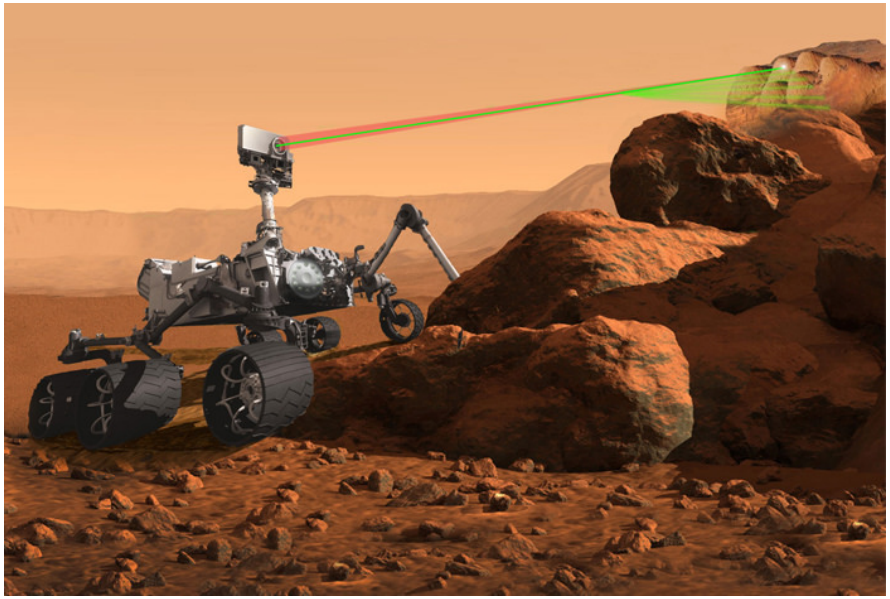
EZ Engineering Data Needs

1. High-resolution orbital imagery
   - Landing site conformation
   - Traverse capabilities
   - Rock abundance

Rover Tele-operations

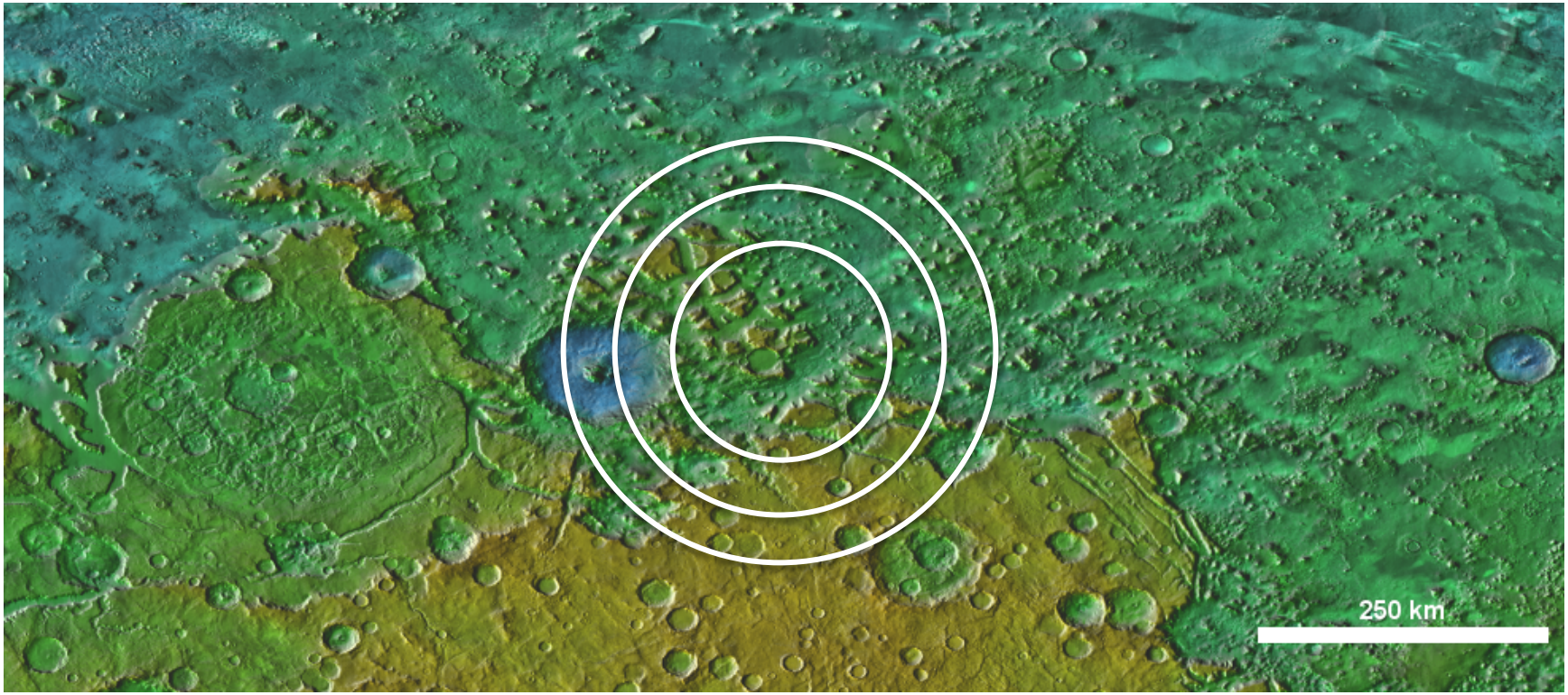


- Gives astronauts something to do
- Faster, more capable than Earth-based operation



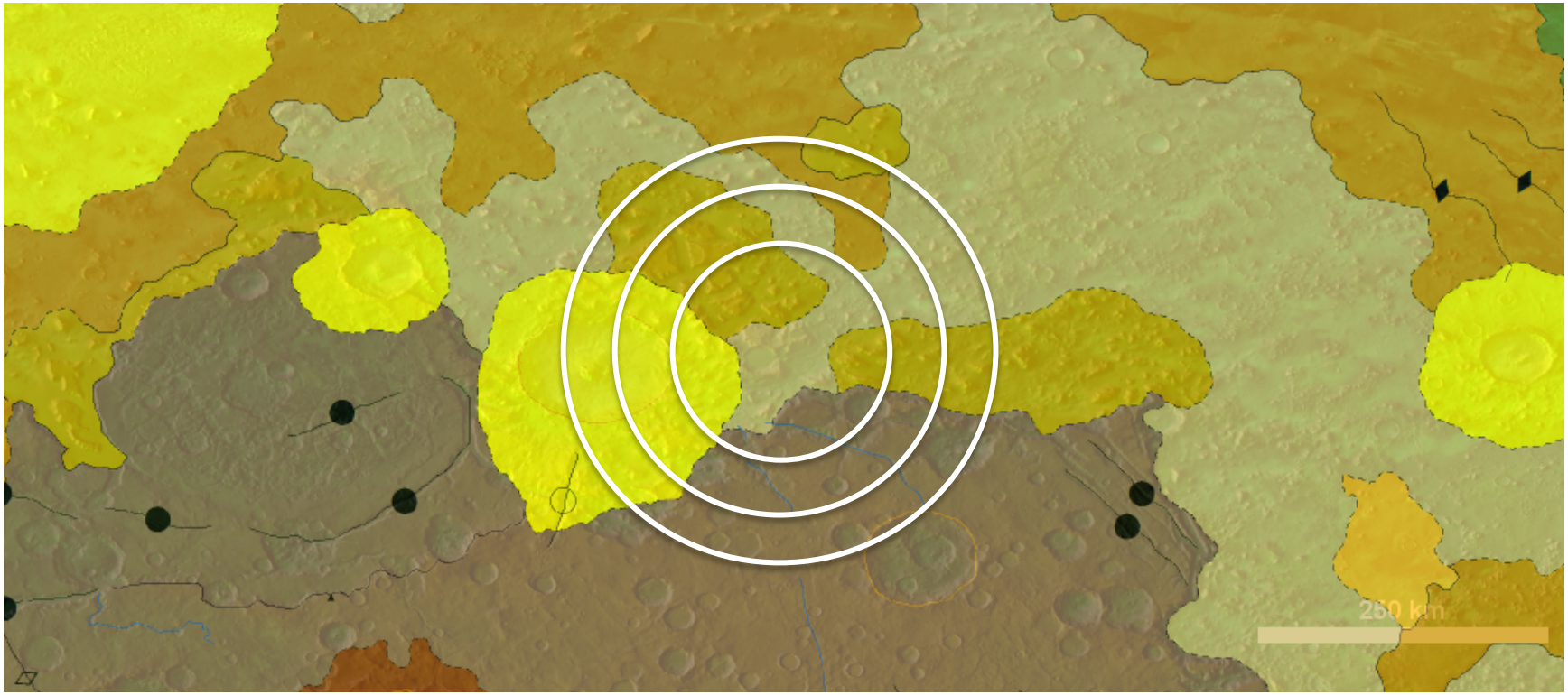
- Increases EZ area/radii
- More science potential for every site

Extended Rover EZ



Protonilus Mensae

Extended Rover EZ



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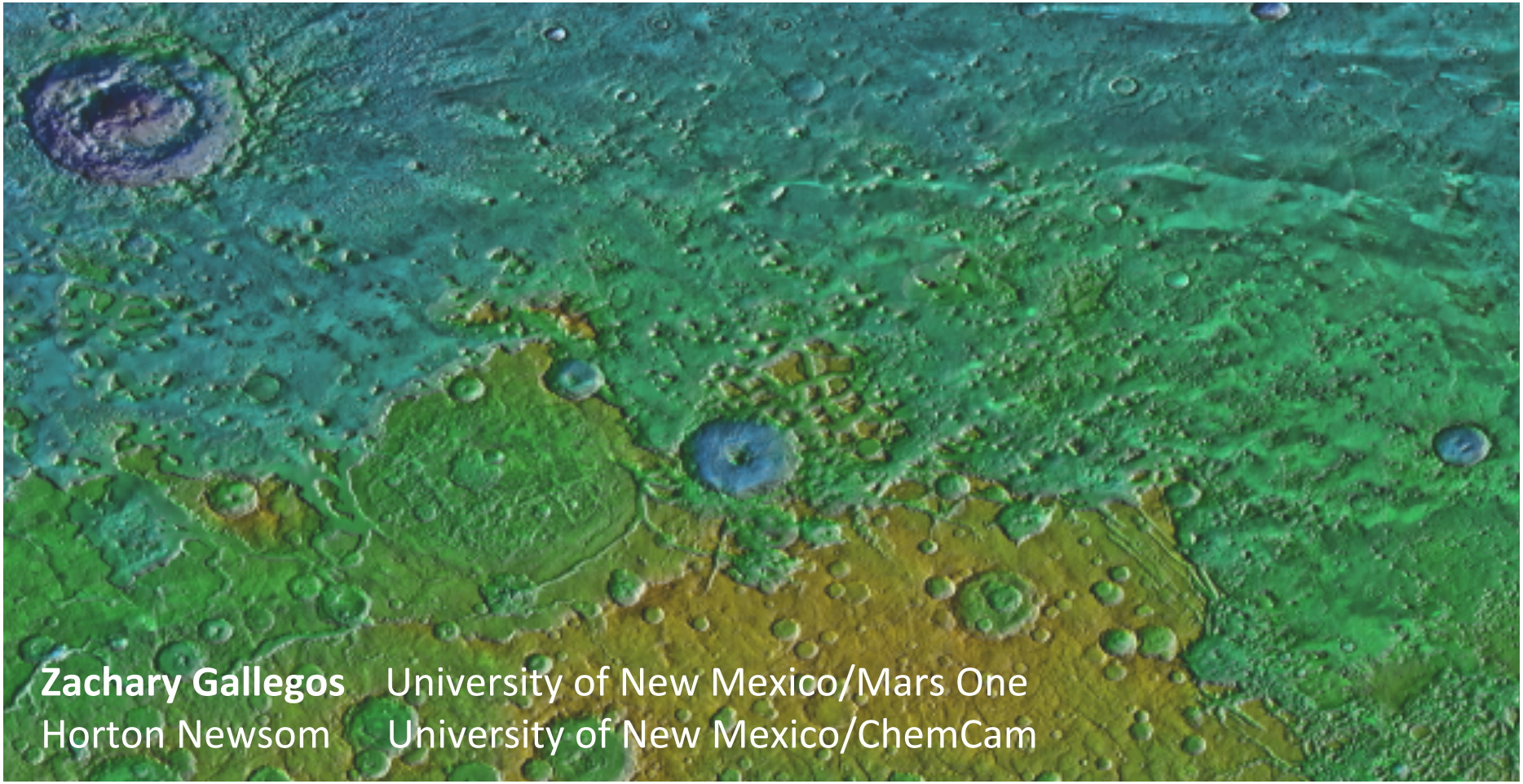
Abstract #1053

1st EZ Workshop for Human Missions to Mars



Zachary Gallegos University of New Mexico/Mars One
Horton Newsom University of New Mexico/ChemCam

Extra Slides

Communications Blimp