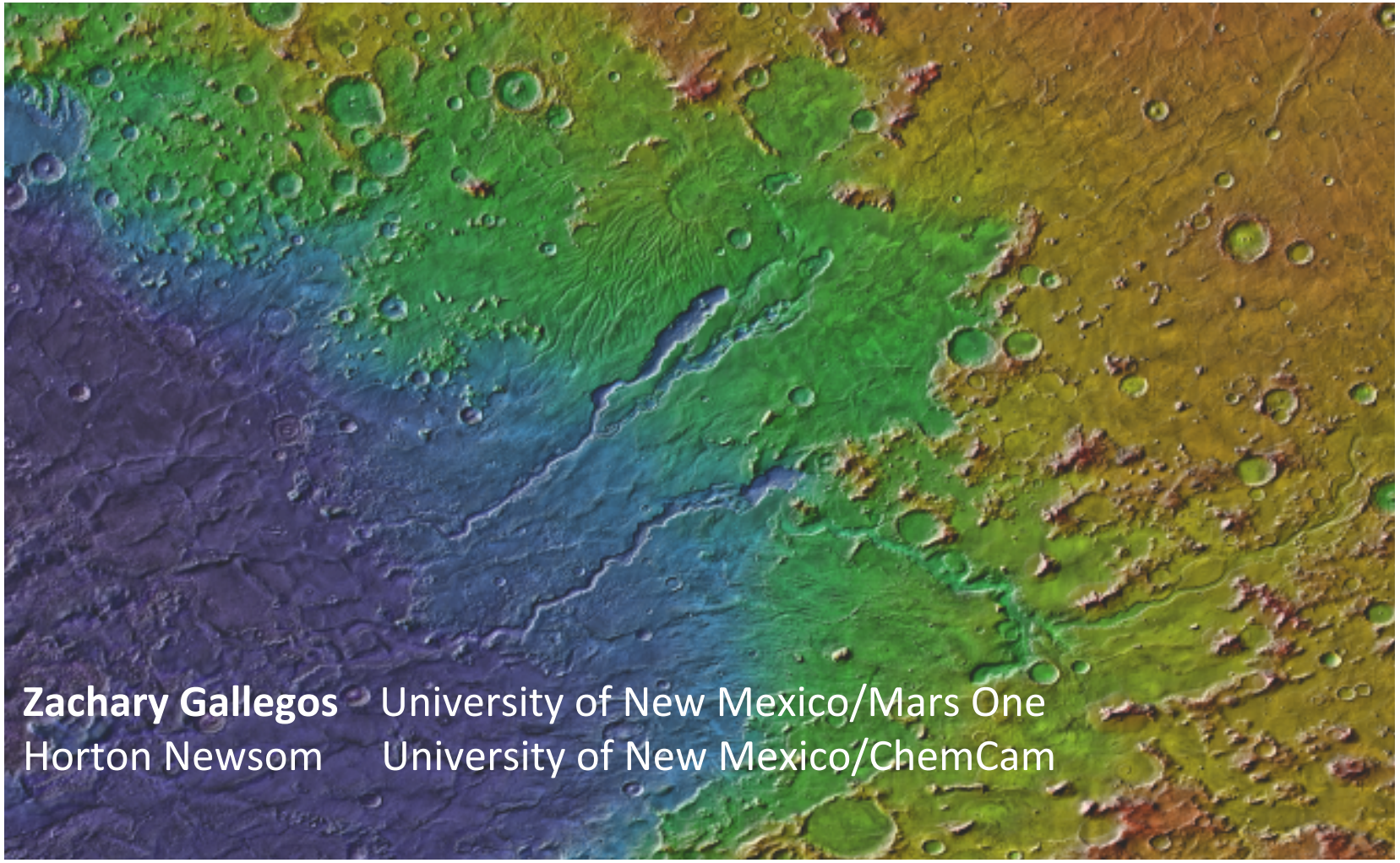
The East Rim of Hellas: Mars' Mesopotamia

Abstract #1035

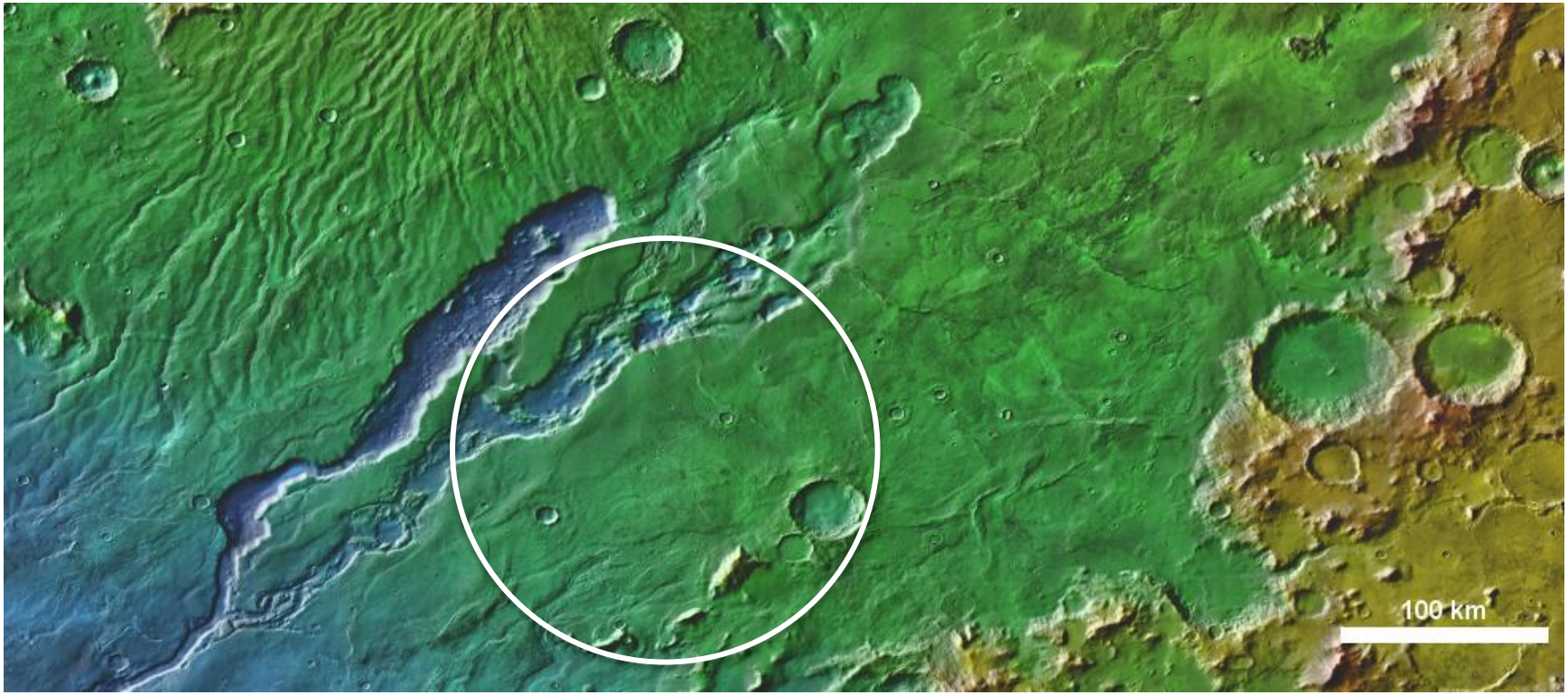
1st EZ Workshop for Human Missions to Mars



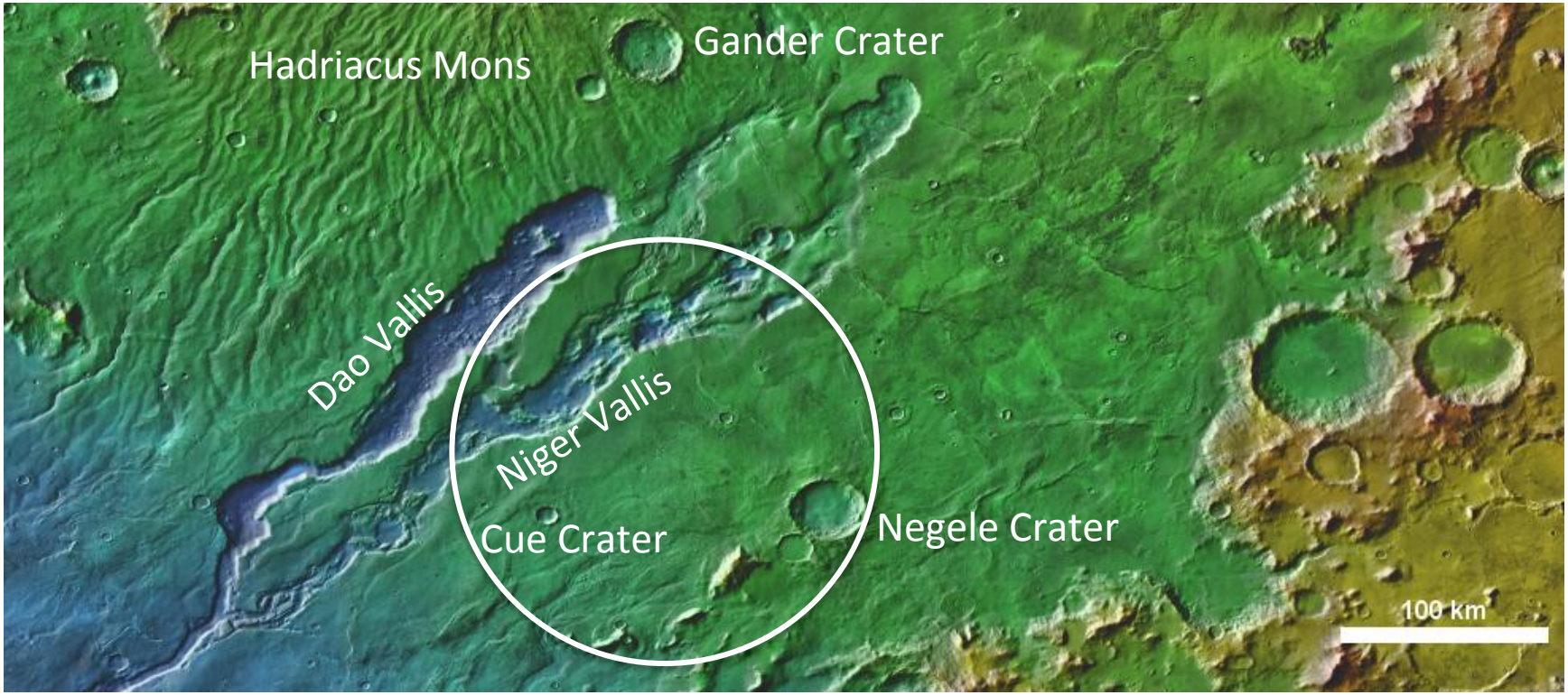
Zachary Gallegos University of New Mexico/Mars One
Horton Newsom University of New Mexico/ChemCam

EZ Close-up

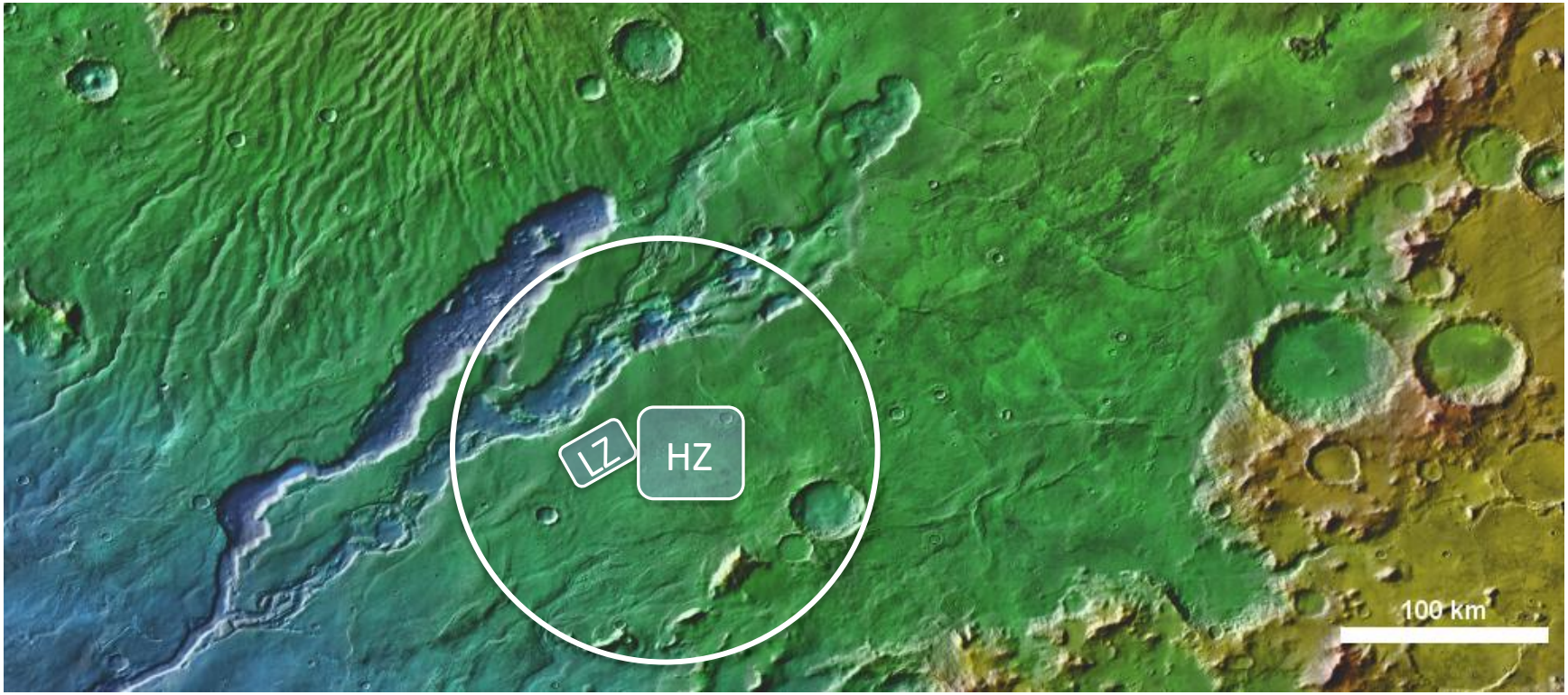
- 94.02E, 35.352S



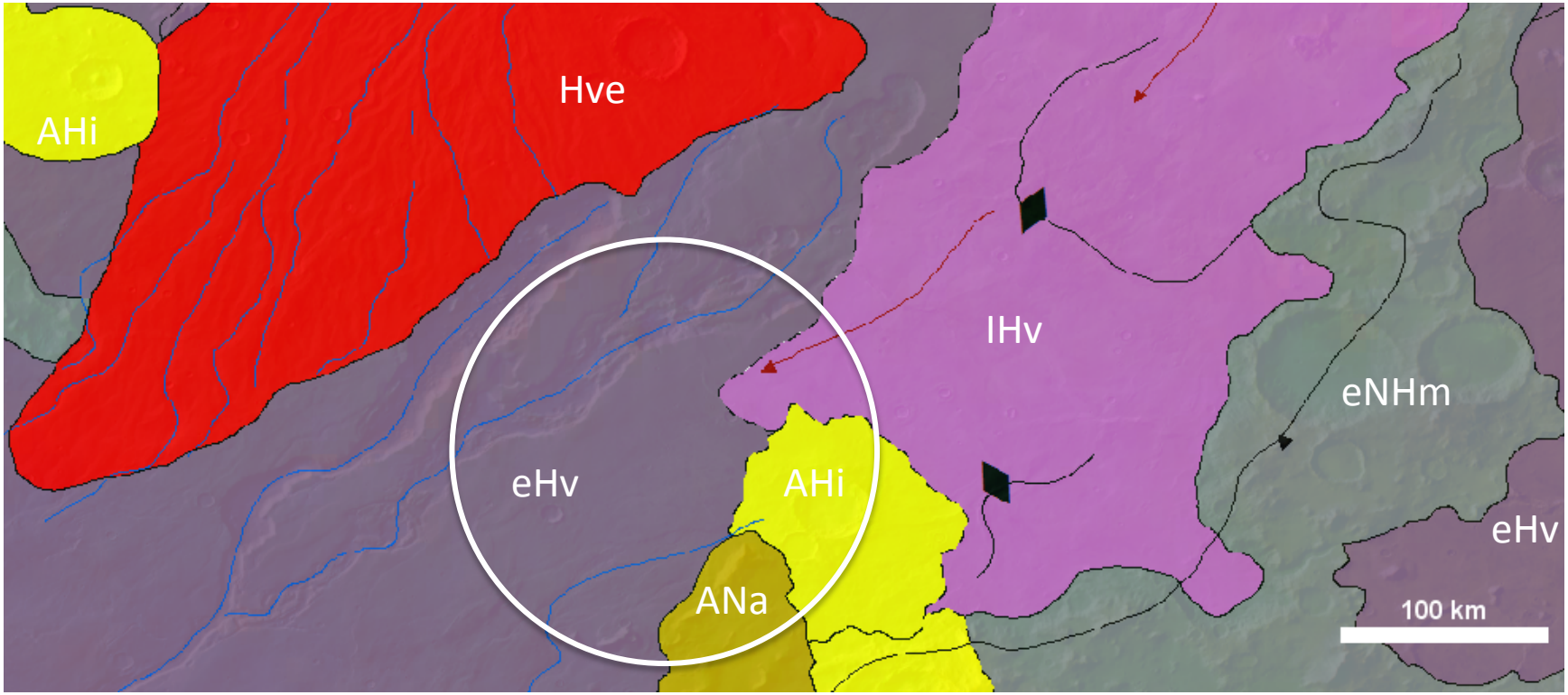
Local Features



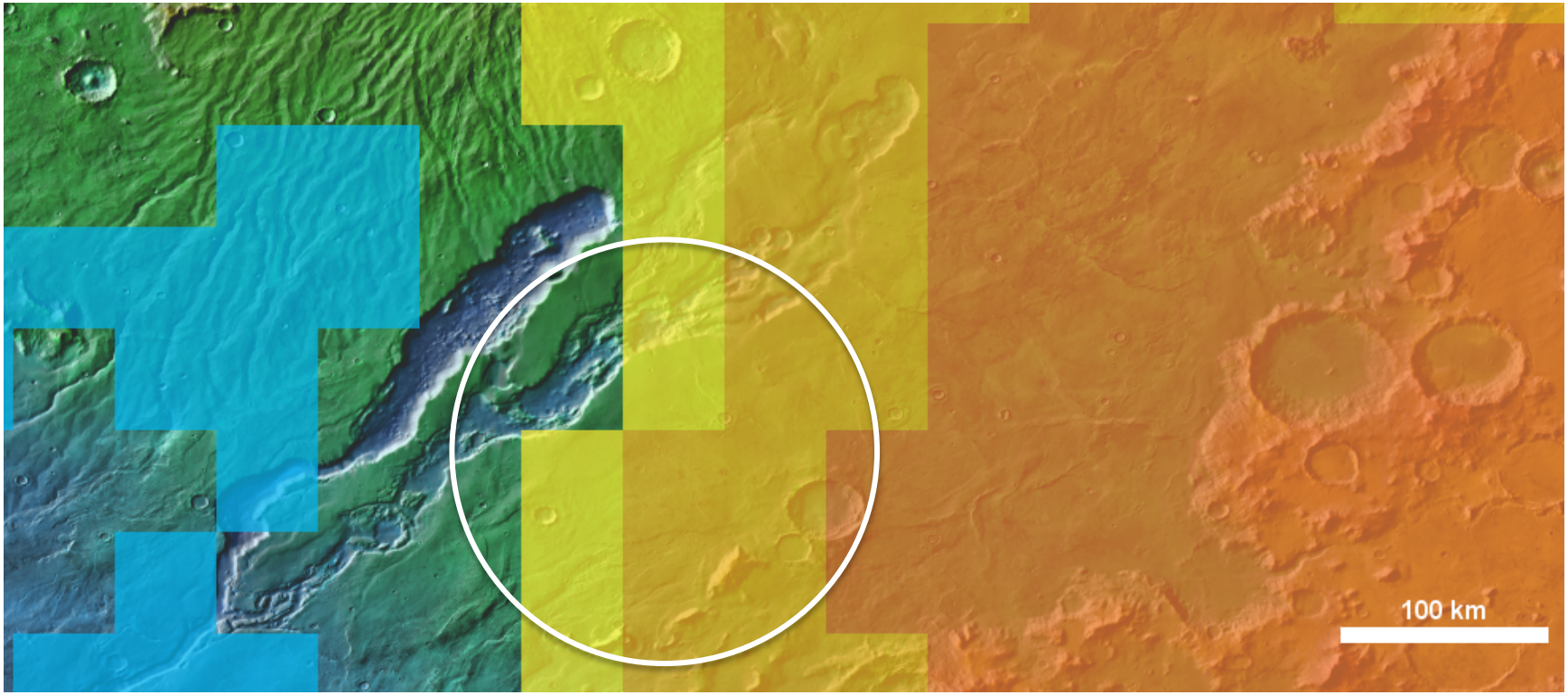
EZ Close-up



Geologic Context

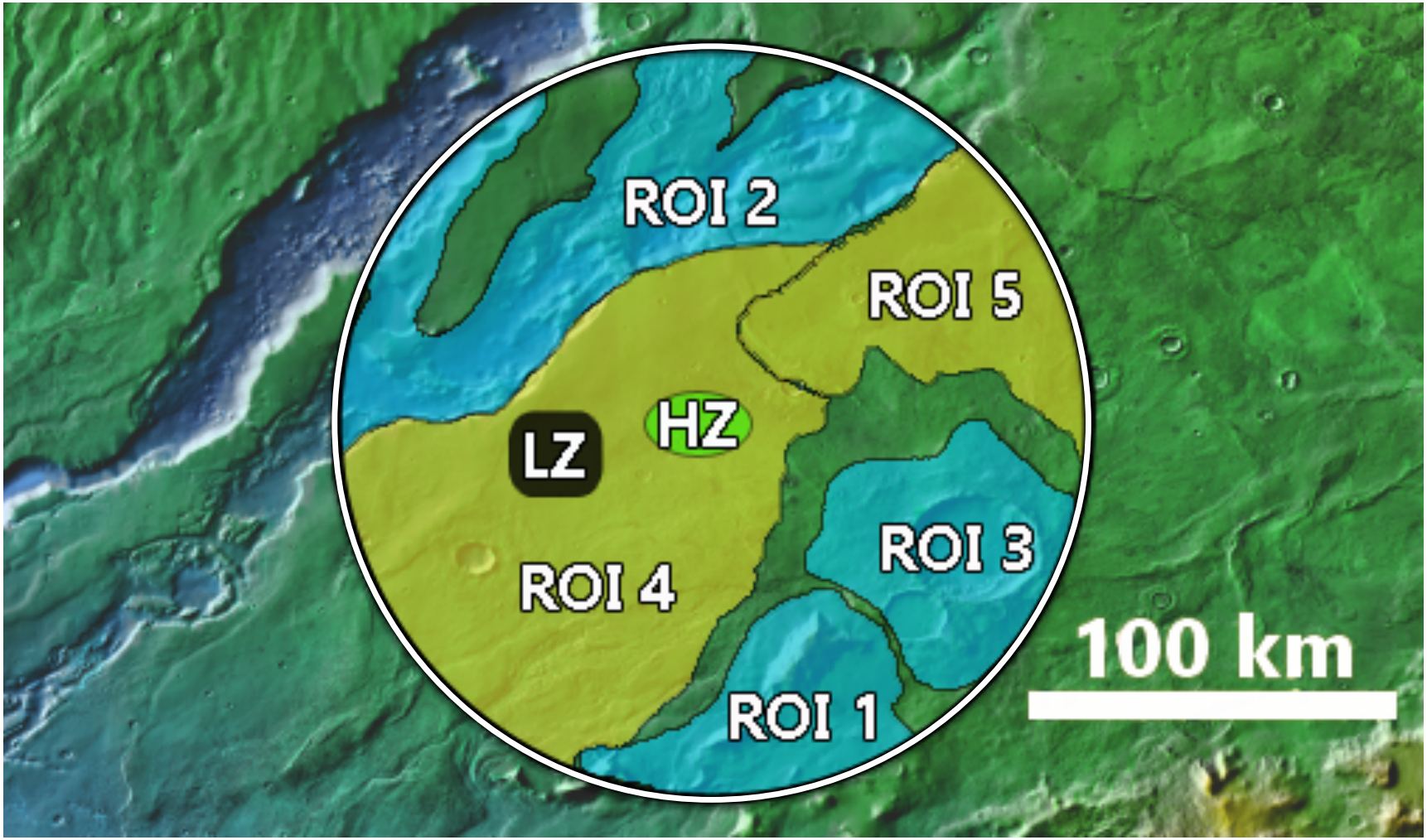


Remnant Magnetism



East Hellas: Mesopotamia

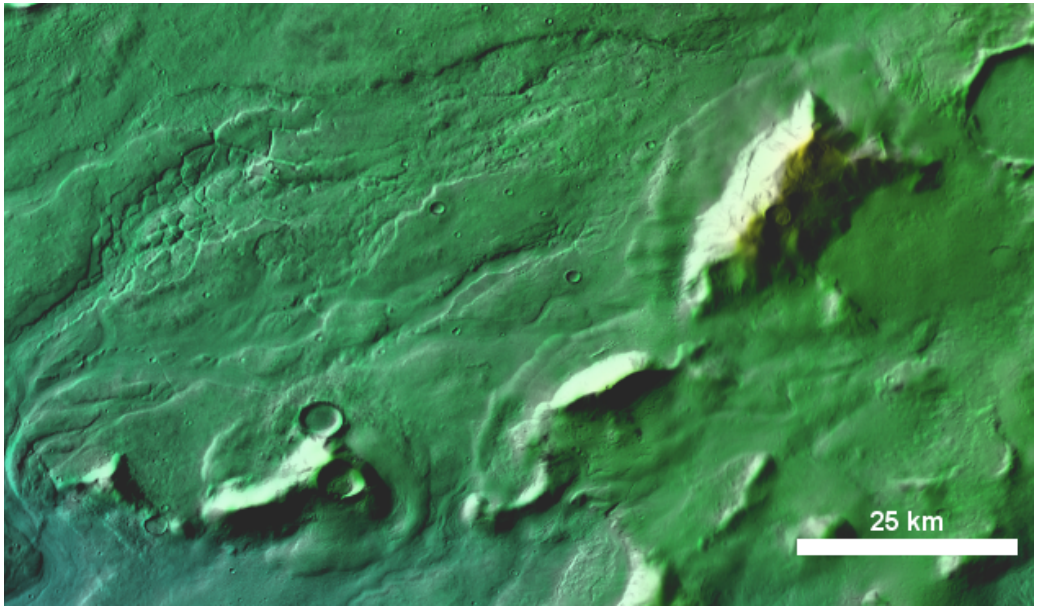
Exploration Zone Map



SCIENCE ROIs

Science ROI1

Amazonian-Noachian apron unit (ANa)



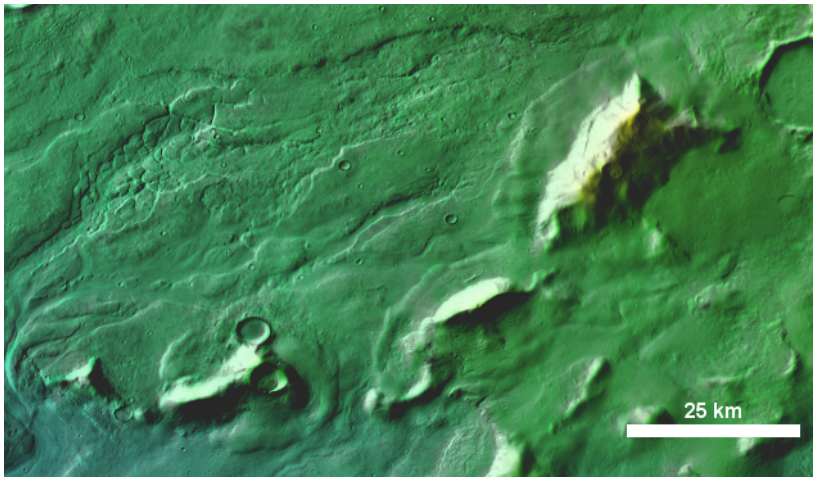
- 94.812E, -36.422

- Amazonian water ice
- Aqueous processes
- Noachian bedrock
- Remnant mag
- Impact processes

Science ROI1 Rubric

1st EZ Workshop for Human Missions to Mars

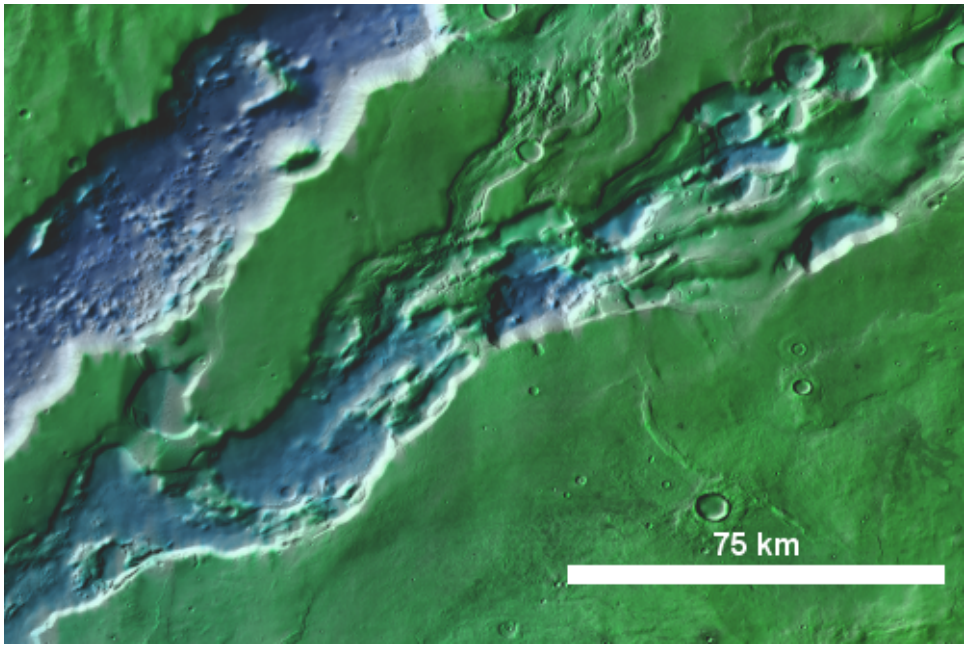
Site Factors					SROI1
Science Site Criteria	Astrobio	Threshold	AND/OR	Potential for past habitability	●
				Potential for present habitability/refugia	●
		Qualifying		Potential for organic matter, w/ surface exposure	?
	Atmospheric Science	Threshold		Noachian/Hesperian rocks w/ trapped atmospheric gases	●
		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 ROI2

Niger Vallis



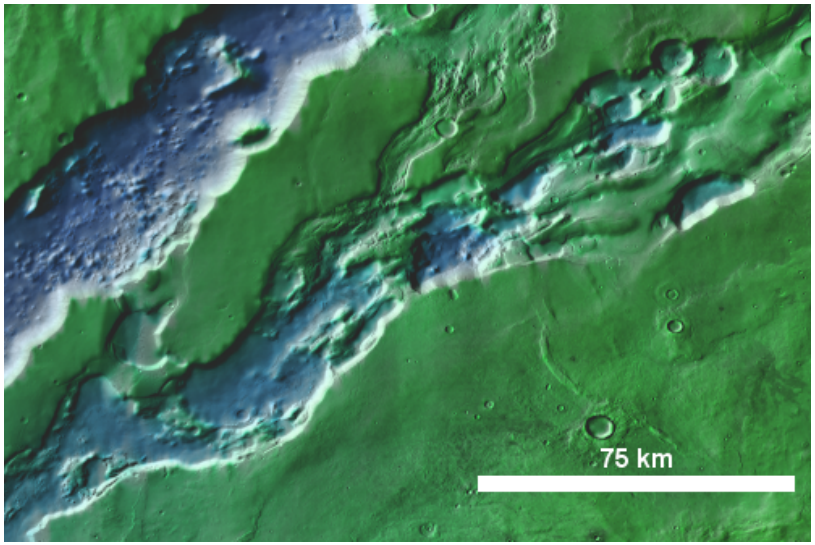
- 94.422E, -33.813

- Aqueous processes
- Hydrated minerals
- Potential habitability
- Water ice

Science ROI2 Rubric

1st EZ Workshop for Human Missions to Mars

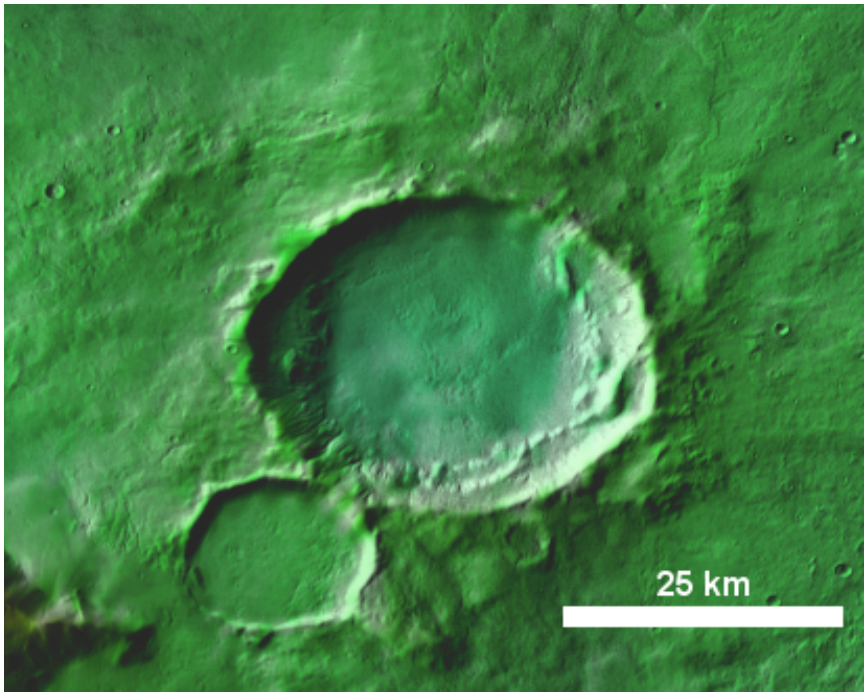
Site Factors					SROI2
Science Site Criteria	Astrobio	Threshold	AND/OR	Potential for past habitability	●
				Potential for present habitability/refugia	●
		Qualifying		Potential for organic matter, w/ surface exposure	?
	Atmospheric Science	Threshold		Noachian/Hesperian rocks w/ trapped atmospheric gases	●
		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

Negele Crater – Amazonian Hesperian impact (AHi)

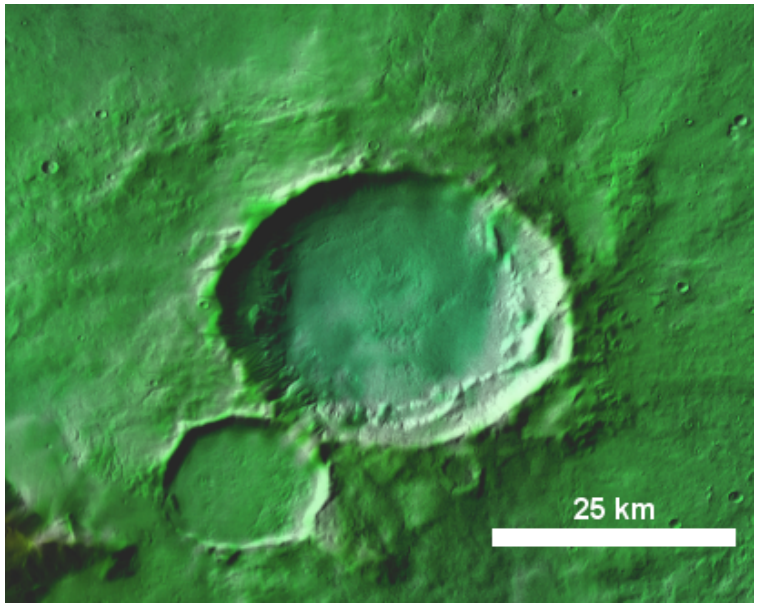


- 95.875E, -35.688

- Impact deposits
- Trapped atmospheric gasses
- Water ice

Science ROI3 Rubric

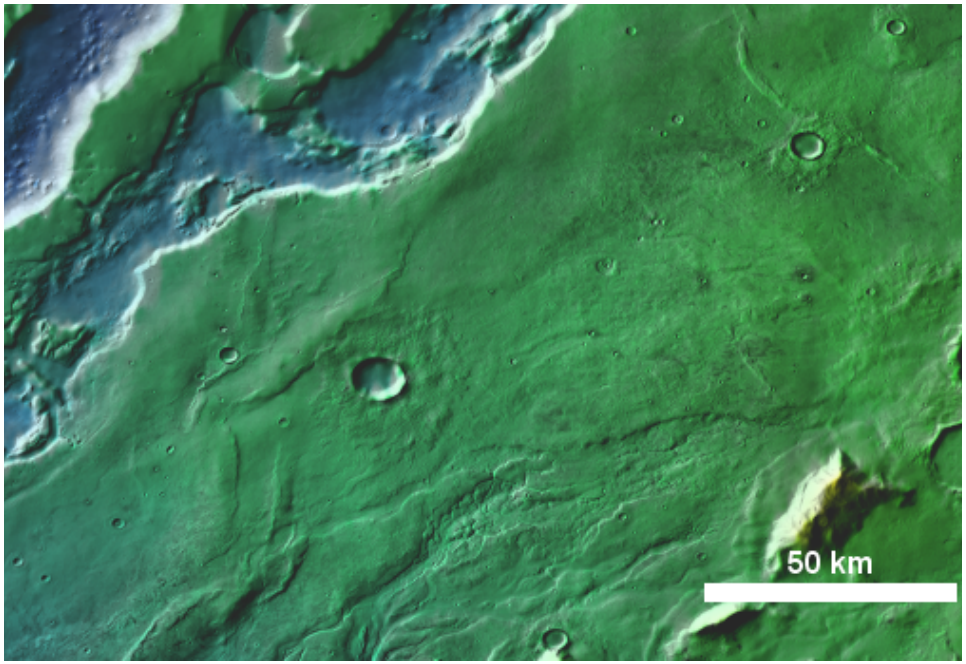
Site Factors					SROI3
Science Site Criteria	Astrobio	Threshold	AND/OR	Potential for past habitability	●
				Potential for present habitability/refugia	●
		Qualifying		Potential for organic matter, w/ surface exposure	?
	Atmospheric Science	Threshold		Noachian/Hesperian rocks w/ trapped atmospheric gases	●
		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 ROI4

Early Hesperian volcanic unit (eHv)



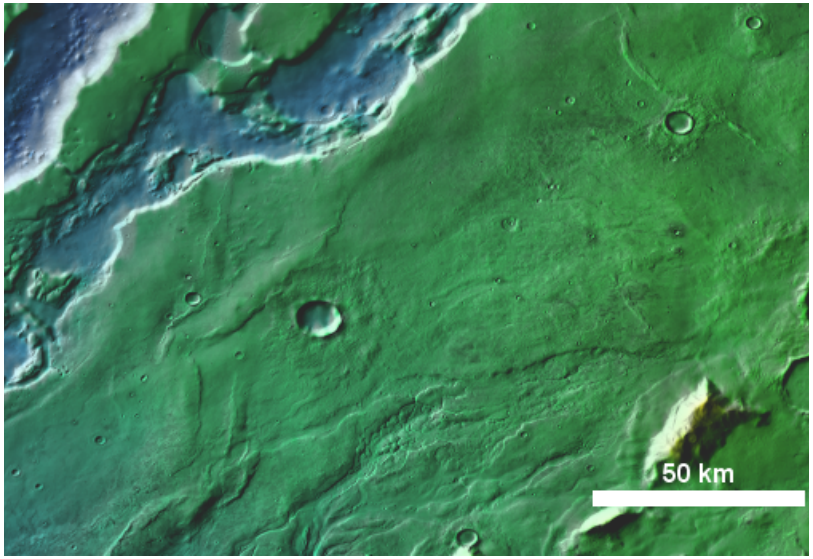
- 94.141E, -35.594

- Igneous rocks
  - Wrinkle ridges
- Datable surfaces
- Trapped gasses
- Impact deposits

Science ROI4 Rubric

1st EZ Workshop for Human Missions to Mars

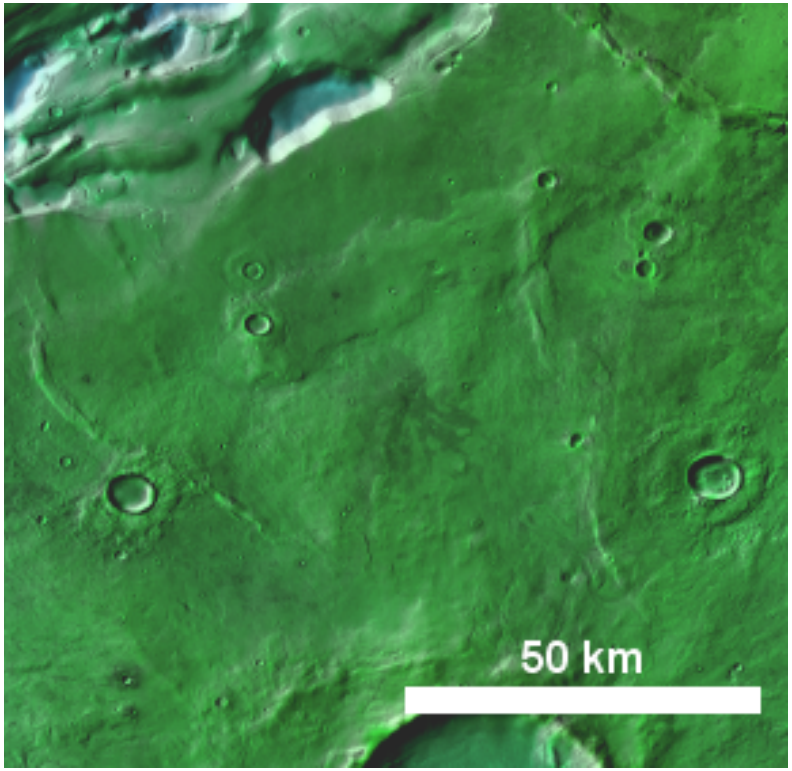
Site Factors					SROI4
Science Site Criteria	Astrobio	Threshold	AND/OR	**Potential for past habitability**	
				Potential for present habitability/refugia	
		Qualifying		Potential for organic matter, w/ surface exposure	
	Atmospheric Science	Threshold		**Noachian/Hesperian rocks w/ trapped atmospheric 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

Late Hesperian volcanic unit (lHv)

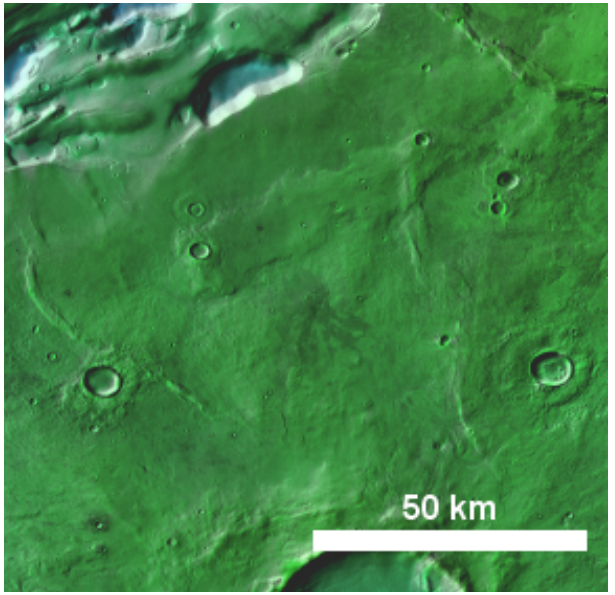


- 95.266E, -34.406

- Igneous rocks
  - Wrinkle ridges
- Datable surfaces
- Trapped gasses
- Impact deposits

Science ROI5 Rubric

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	?

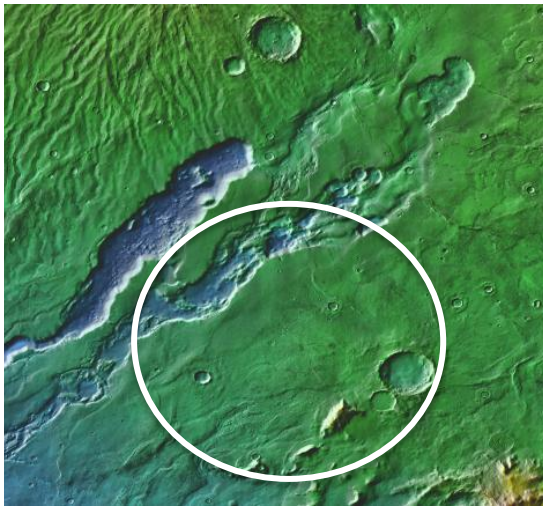


Key	
●	**Yes**
○	**Partial Support or Debated**
	No
?	**Indeterminate**

Science Rubrics

1st EZ Workshop for Human Missions to Mars

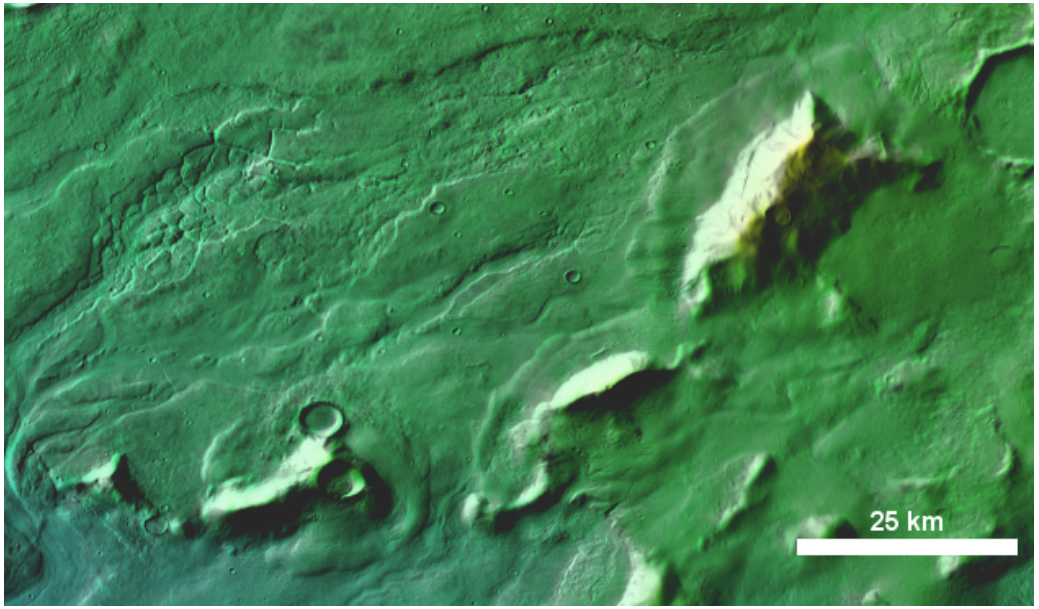
Science Site Criteria				Site Factors	SROI1	SROI2	SROI3	SROI4	SROI5	EZ SUM
	Astrobio	Threshold	AND/OR	Potential for past habitability	●	●	●			(3,0)
				Potential for present habitability/refugia	●	●	●			(3,0)
		Qualifying		Potential for organic matter, w/ surface exposure	?	?	?	?	?	
	Atmospheric Science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



Key	
●	Yes
○	Partial Support or Debated
	No
?	Indeterminate

RESOURCE ROIs

Amazonian-Noachian apron ice (ANa)

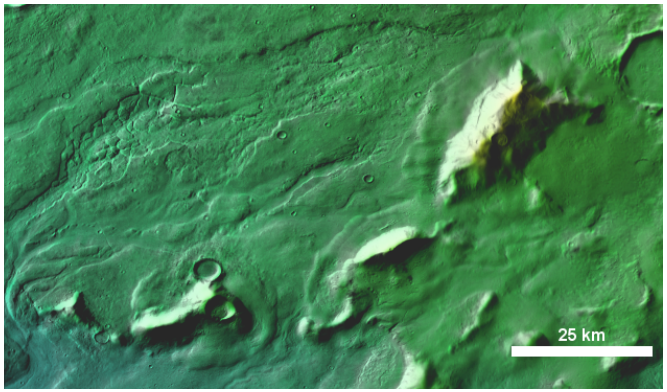


- 94.812E, -36.422

- Amazonian water ice
- Glacial till

Resource ROI1 Rubric

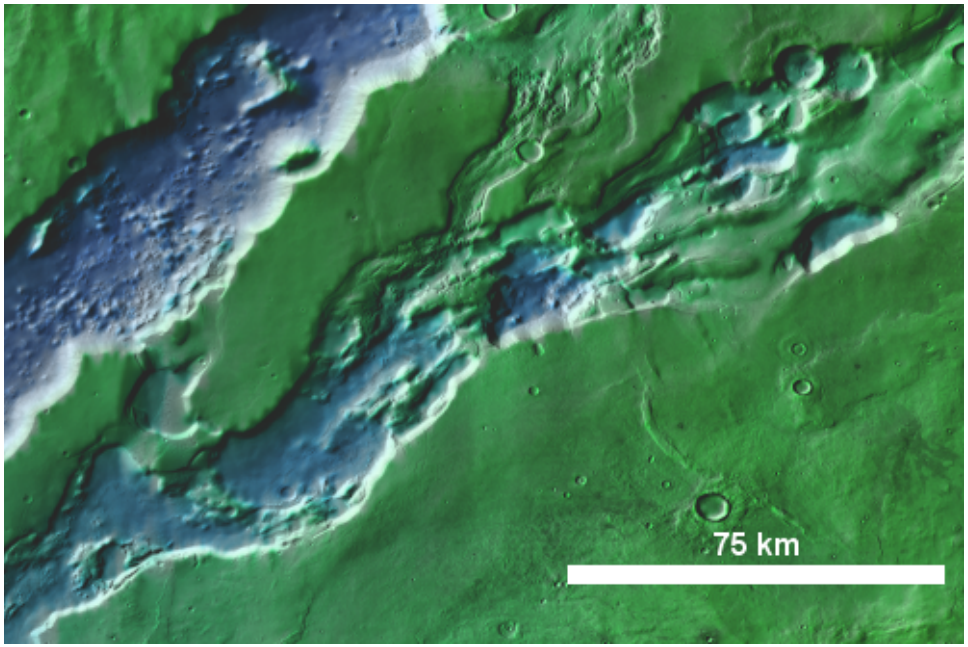
					RROI1
Site Factors					
ISRU and Civil Engineering Criteria	Engineering			Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)	●
	Water Resource	**Threshold**	AND/OR	**Potential for ice or ice/regolith mix**	●
				Potential for hydrated minerals	●
				Quantity for substantial production	●
				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

Niger Vallis

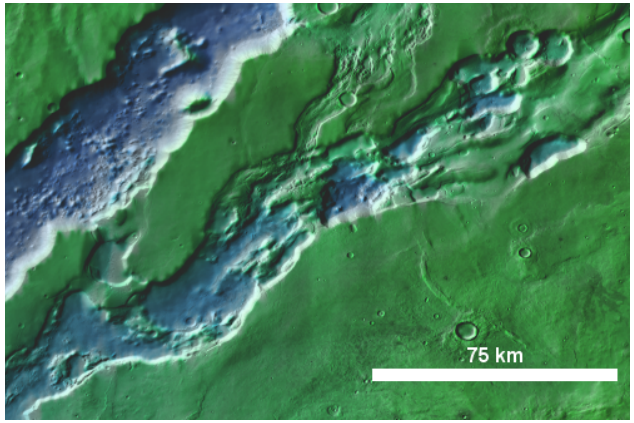


- 94.422E, -33.813

- Water ice
- Hydrated minerals

Resource ROI2 Rubric

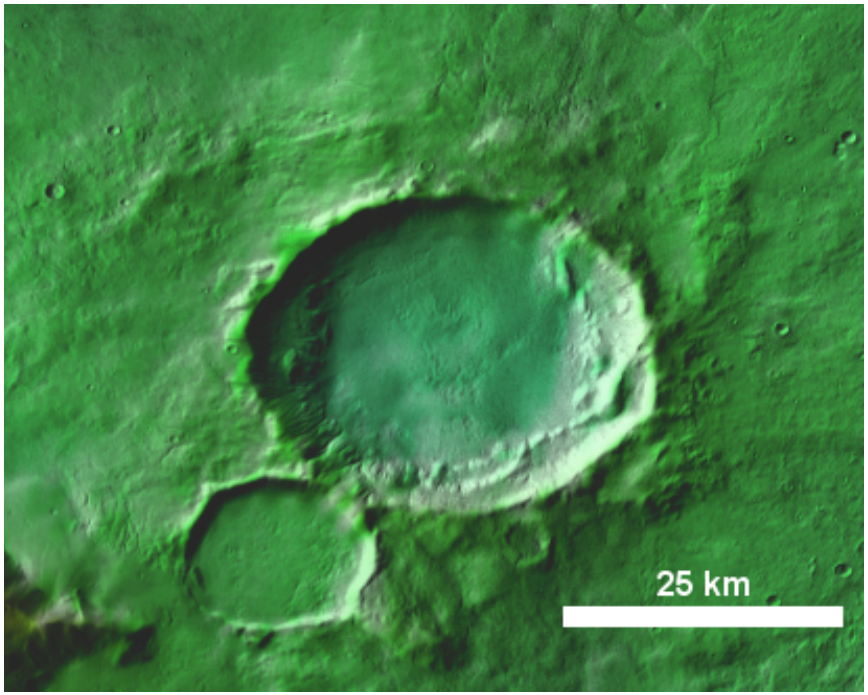
			Site Factors	RROI2
ISRU and Civil Engineering Criteria	Engineering		Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)	●
	Water Resource	Threshold	AND/OR **Potential for ice or ice/regolith mix**	●
			AND/OR **Potential for hydrated minerals**	●
			Quantity for substantial production	○
			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

Negele Crater (AHi)



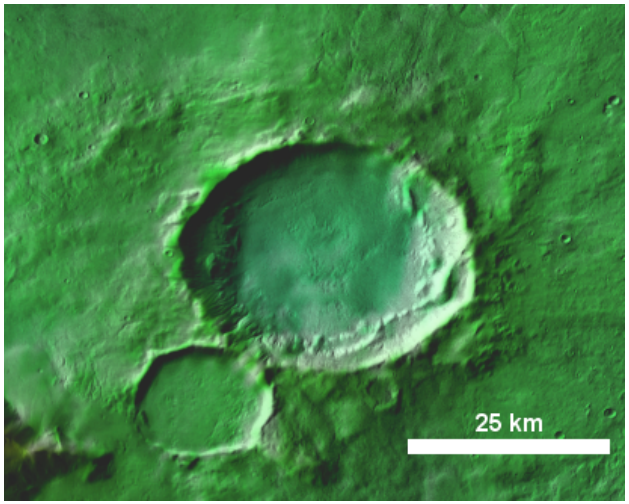
- 95.875E, -35.688

- Impact glass
- Water ice

Resource ROI3 Rubric

1st EZ Workshop for Human Missions to Mars

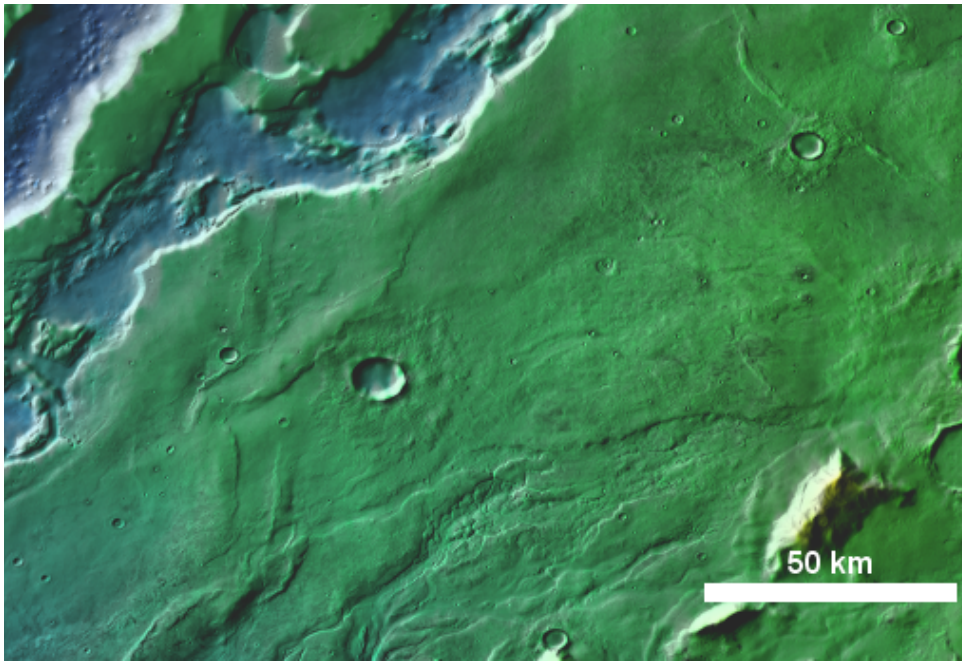
ISRU and Civil Engineering Criteria			Site Factors	RROI3
	Engineering		Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)	●
	Water Resource	Threshold	AND/OR: **Potential for ice or ice/regolith mix**	●
			AND/OR: **Potential for hydrated minerals**	○
			Quantity for substantial production	●
			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 ROI4

Early Hesperian volcanic unit (eHv)



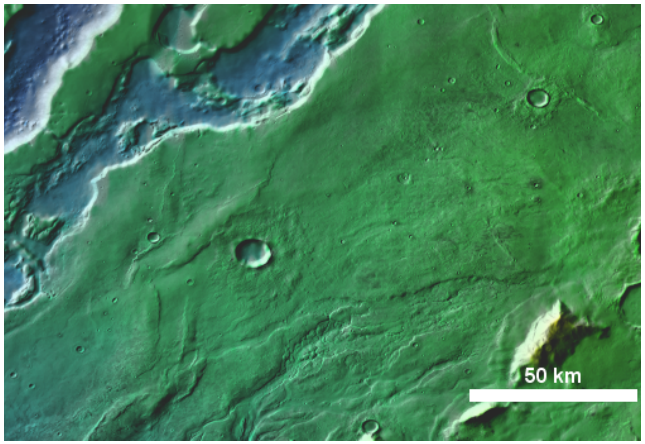
- 94.141E, -35.594

- Cobbles, rocks, regolith
- Metals?

Resource ROI4 Rubric

1st EZ Workshop for Human Missions to Mars

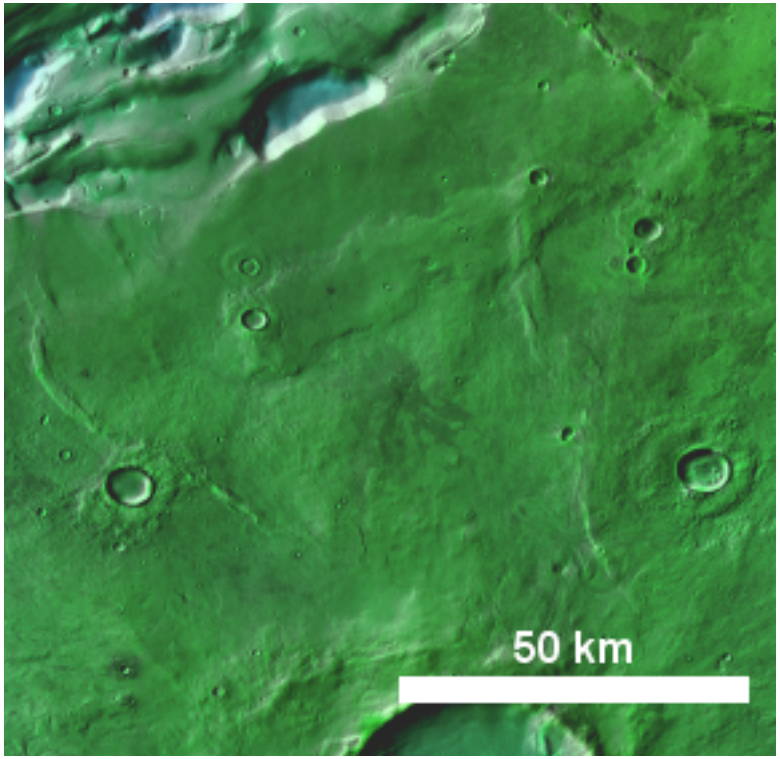
Site Factors					RROI4
ISRU and Civil Engineering Criteria	Engineering			Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)	●
	Water Resource	Threshold	AND/OR	**Potential for ice or ice/regolith mix**	●
				Potential for hydrated minerals	?
				Quantity for substantial production	?
				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 ROI5

Late Hesperian volcanic unit (lHv)



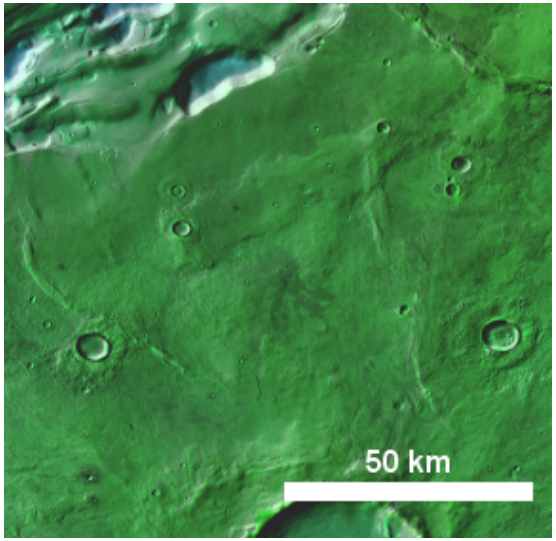
- 95.266E, -34.406

- Cobbles, rocks, regolith
- Metals?

Resource ROI5 Rubric

1st EZ Workshop for Human Missions to Mars

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**	●
				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	●

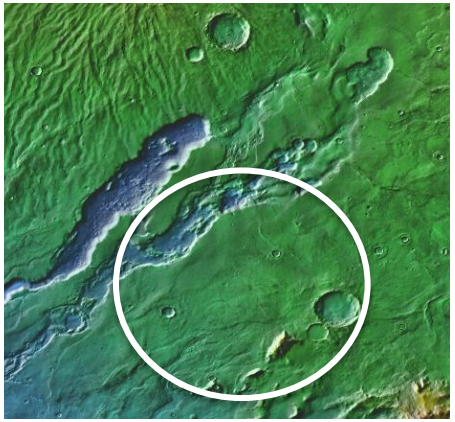


Key	
●	**Yes**
○	**Partial Support or Debated**
	No
?	**Indeterminate**

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**	●	●	●	●	●	(5,0)
				Potential for hydrated minerals	●	●	○	?	?	(2,1)
				Quantity for substantial production	●	●	●	●	●	(5,0)
				Potential to be minable by highly automated systems	●	●	●	●	●	(5,0)
				Located less than 3 km from processing equipment site	○	○	○	○	○	(0,5)
				Located no more than 3 meters below the surface	○	○	○	○	○	(0,5)
				Accessible by automated systems	●	●	●	●	●	(5,0)
		Qualifying		Potential for multiple sources of ice, ice/regolith mix **and** hydrated minerals	●	●	●	●	●	(5,0)
				Distance to resource location can be >5 km	●	●	●	●	●	(5,0)
				Route to resource location must be (plausibly) traversable	●	●	●	●	●	(5,0)
	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	○	○	●	●	●	(3,2)
				Utilitarian terrain features				●		(1,0)
	Food Production	Qualifying		Low latitude						
				No local terrain feature(s) that could shadow light collection facilities	●	●	●	●	●	(5,0)
				Access to water	●	●	●	●	●	(5,0)
				Access to dark, minimally altered basaltic sands				●	●	(2,0)
	Metal/Silicon Resource	Threshold		**Potential for metal/silicon**			●	●	●	(3,0)
				Potential to be minable by highly automated systems			●	●	●	(3,0)
				Located less than 3 km from processing equipment site			○	○	○	(0,3)
				Located no more than 3 meters below the surface			○	○	○	(0,3)
				Accessible by automated systems			●	●	●	(3,0)
		Qualifying		Potential for multiple sources of metals/silicon			●	●	●	(3,0)
				Distance to resource location can be >5 km			●	●	●	(3,0)
				Route to resource location must be (plausibly) traversable			○	●	●	(2,1)



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

EZ Rubrics

1st EZ Workshop for Human Missions to Mars

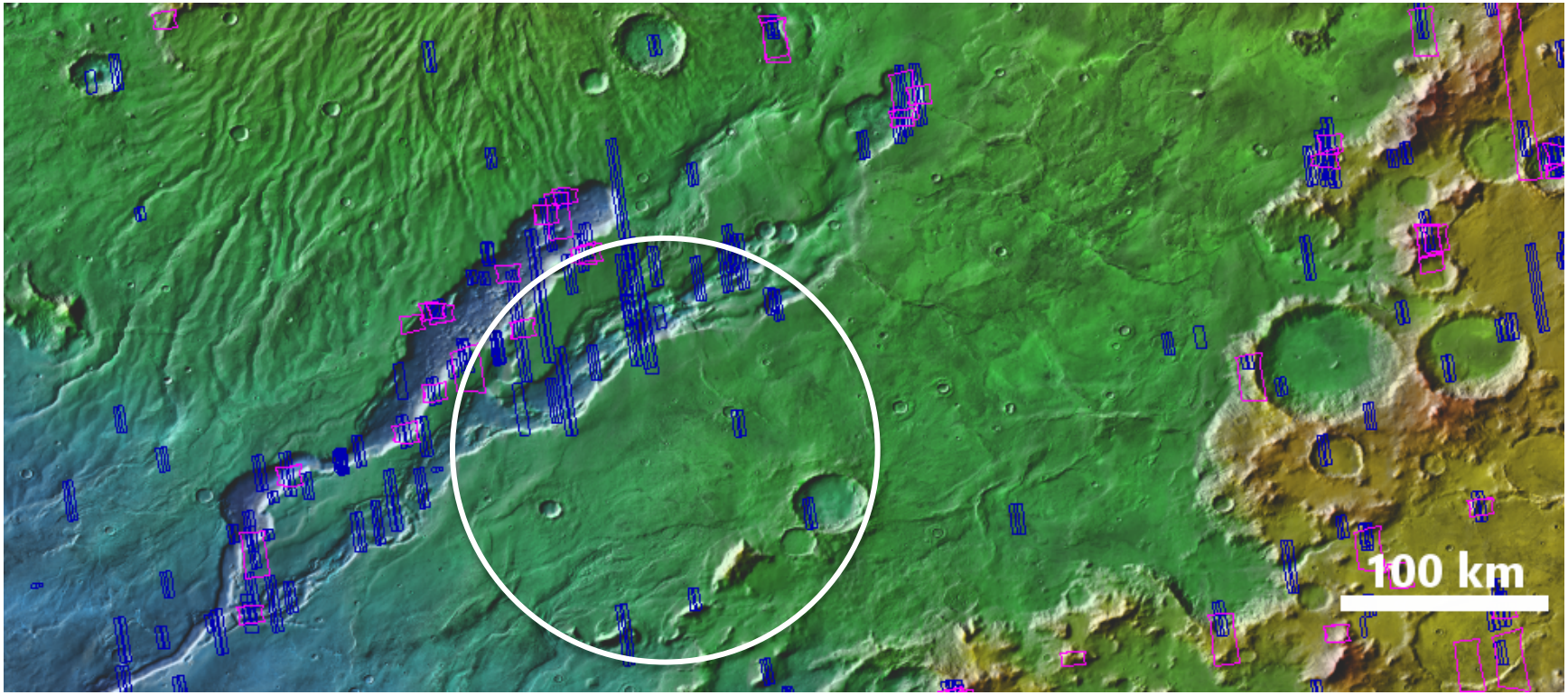
Science Site Criteria

				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

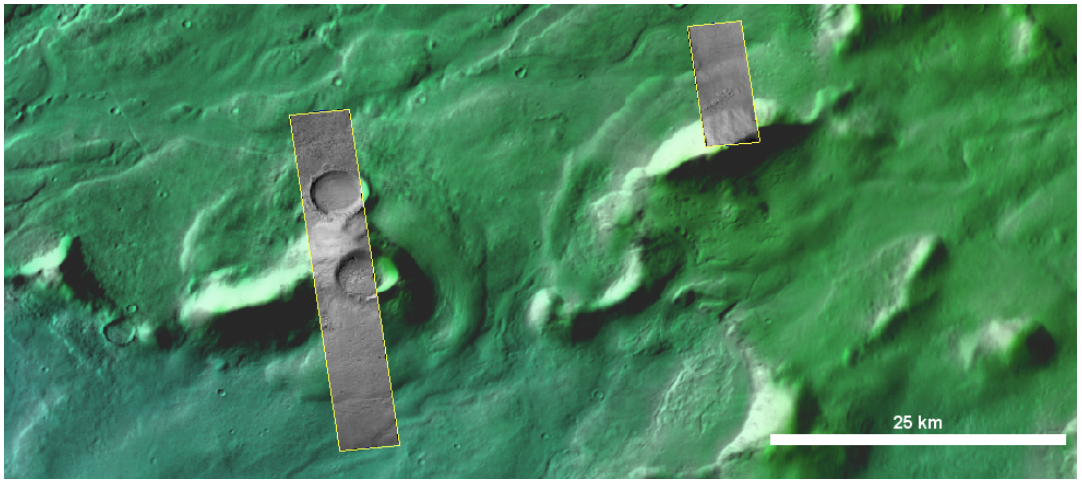
			Site Factors	EZ
Engineering			Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)	●
Water Resource	Threshold	AND/OR	**Potential for ice or ice/regolith mix**	●
			Potential for hydrated minerals	●
			Quantity for substantial production	●
			Potential to be minable by highly automated systems	●
			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	●

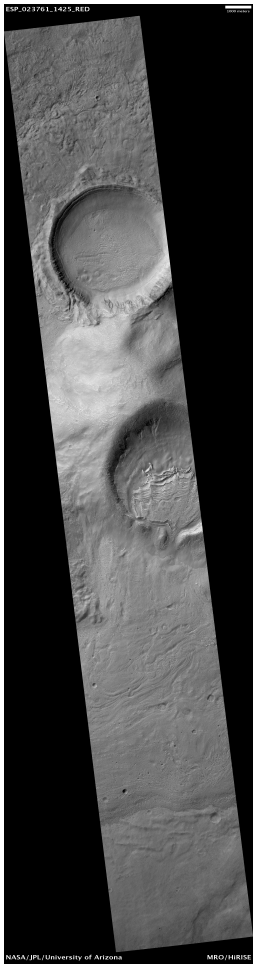
Current HIRISE and CRISM coverage

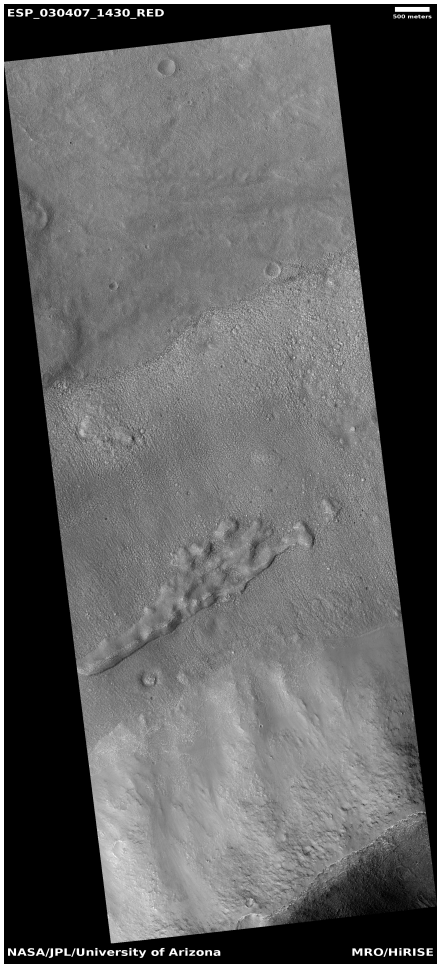


HIRISE and CRISM

- Amazonian Noachian apron unit

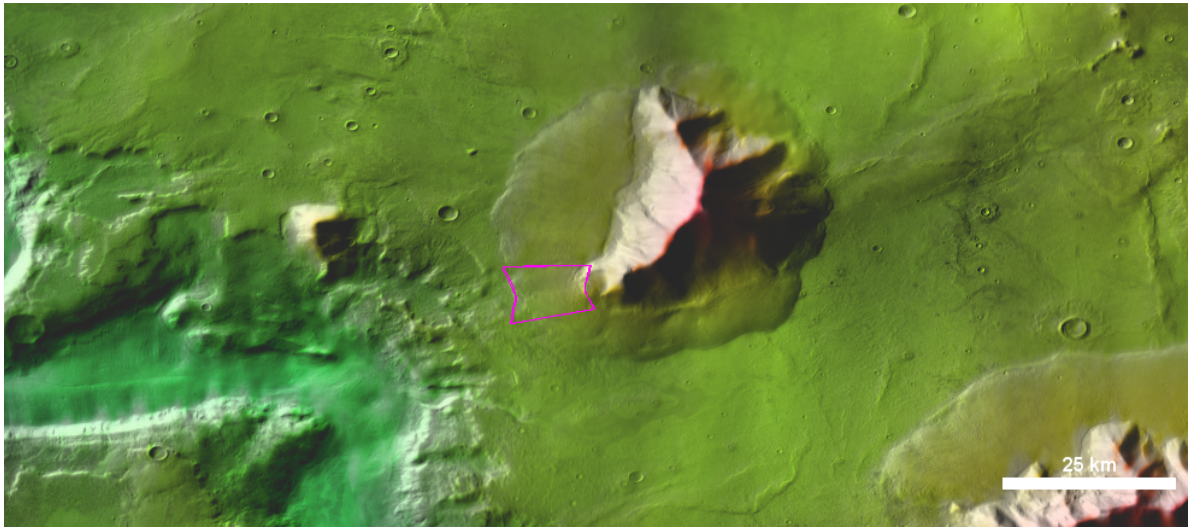


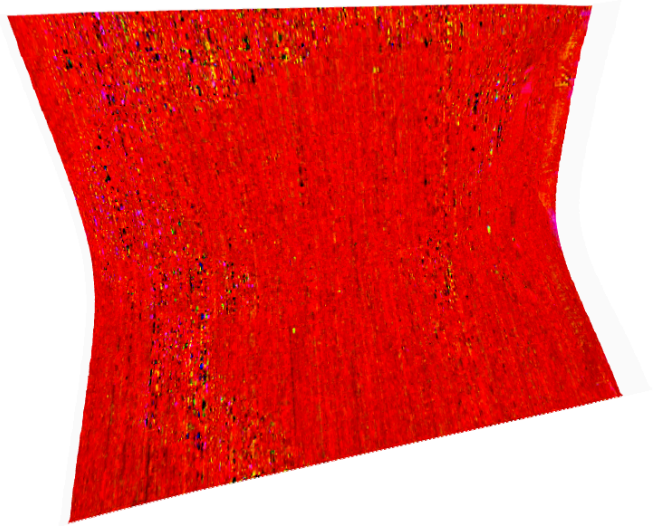




HIRISE and CRISM

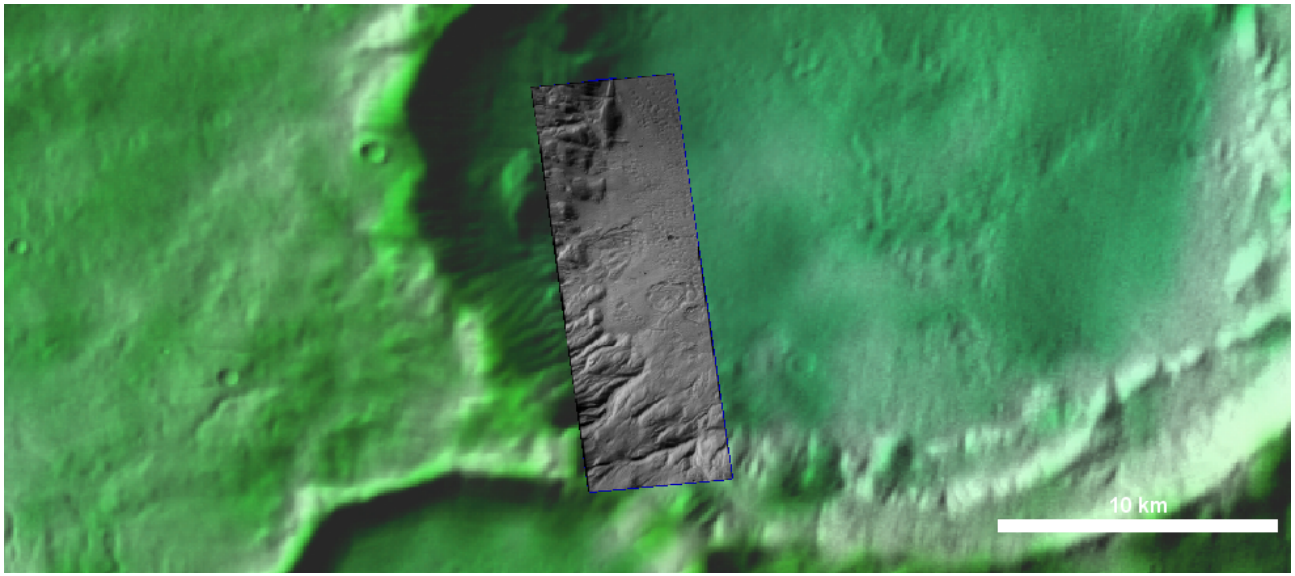
- Amazonian Noachian apron unit, south of EZ
- Bound water

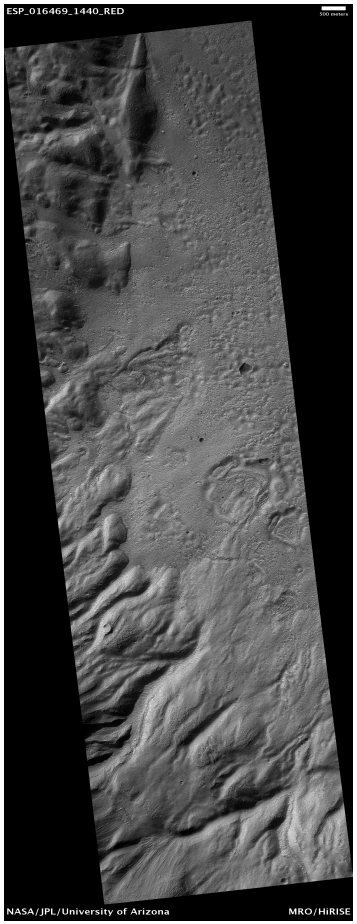




HIRISE and CRISM

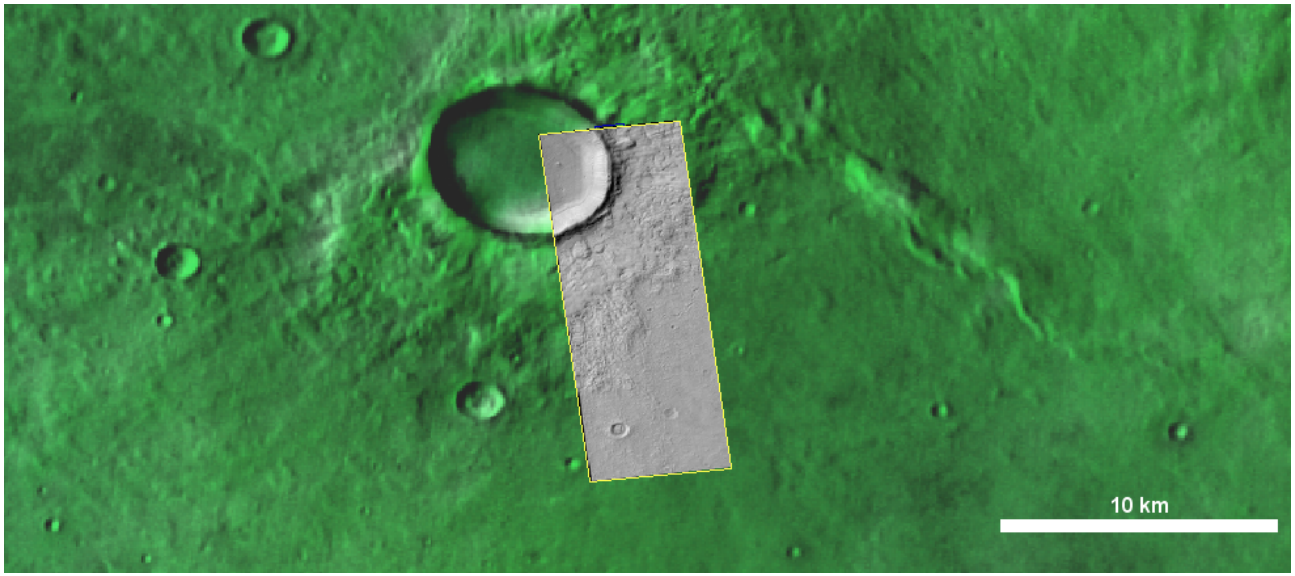
- Negele Crater

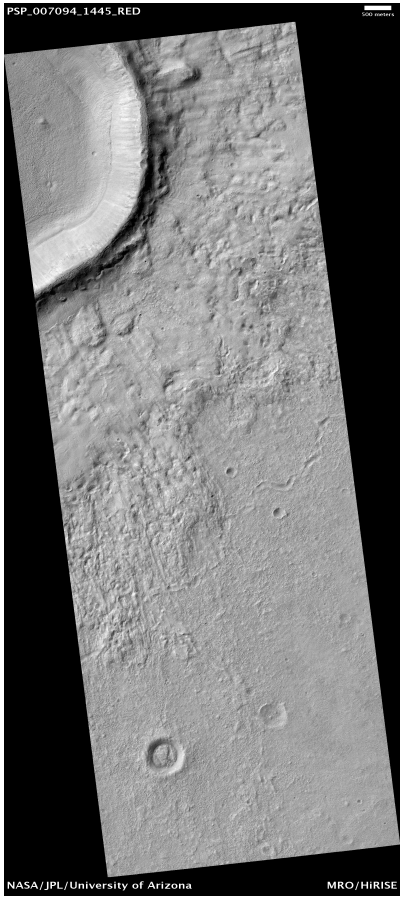




HIRISE and CRISM

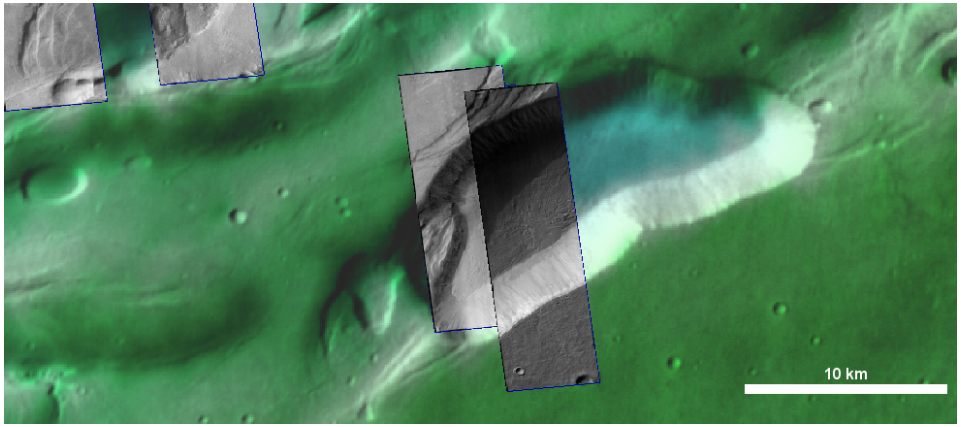
- Crater near habitation zone

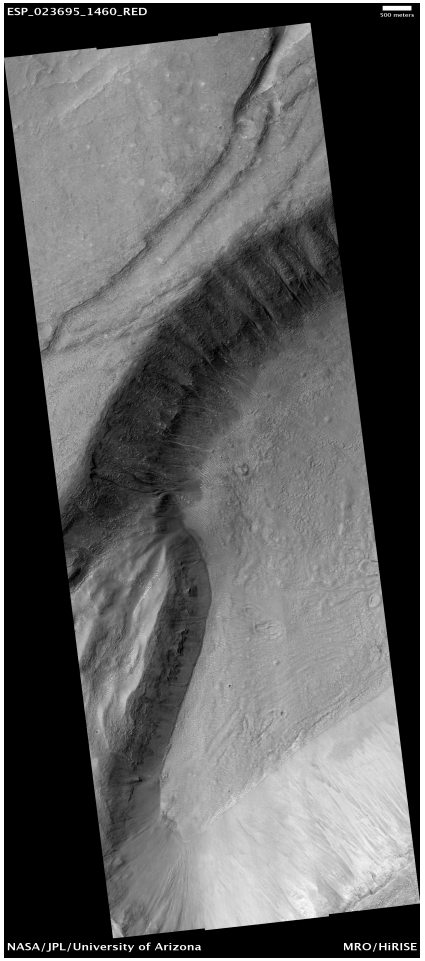


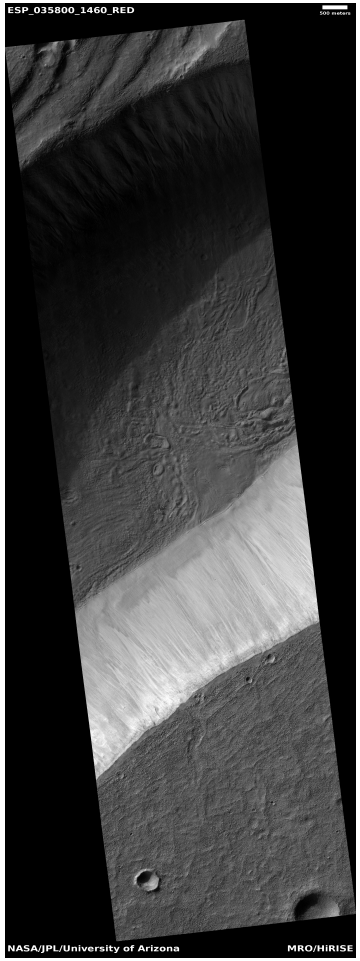


HIRISE and CRISM

- Niger Vallis, east

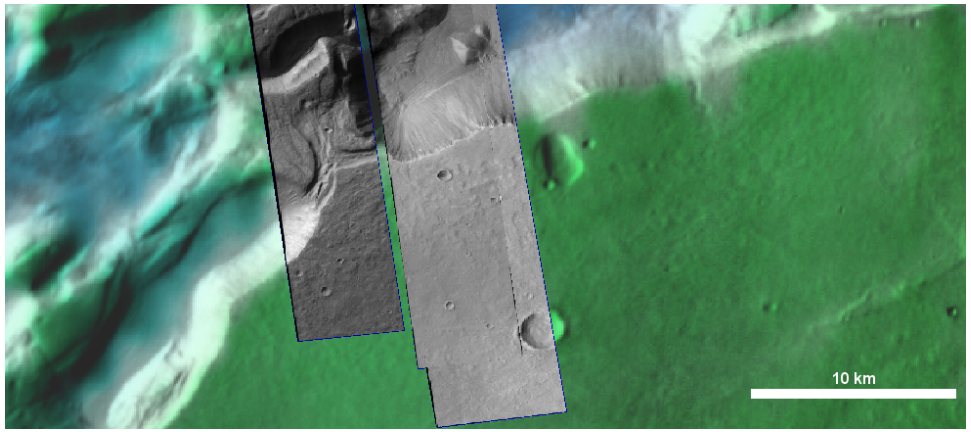


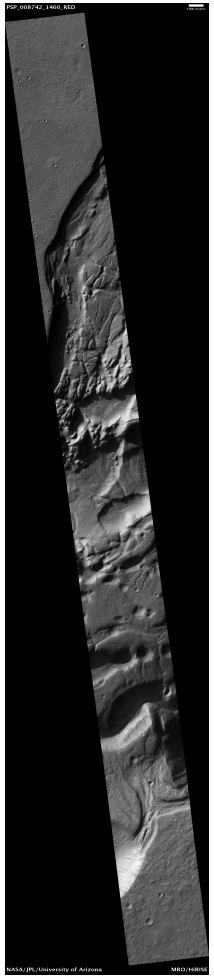


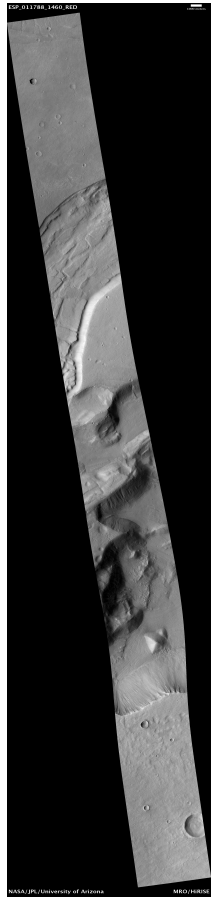


HIRISE and CRISM

- Niger Vallis, west

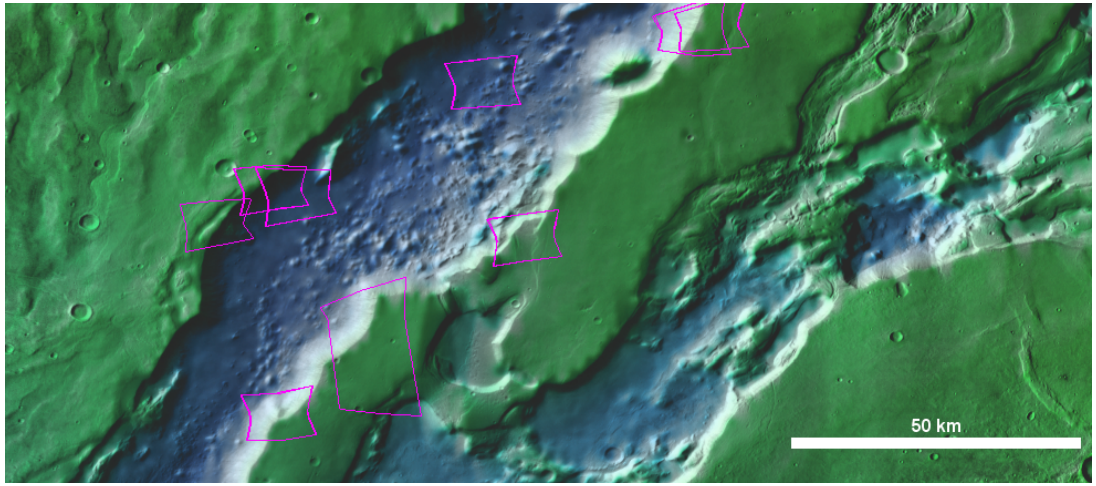


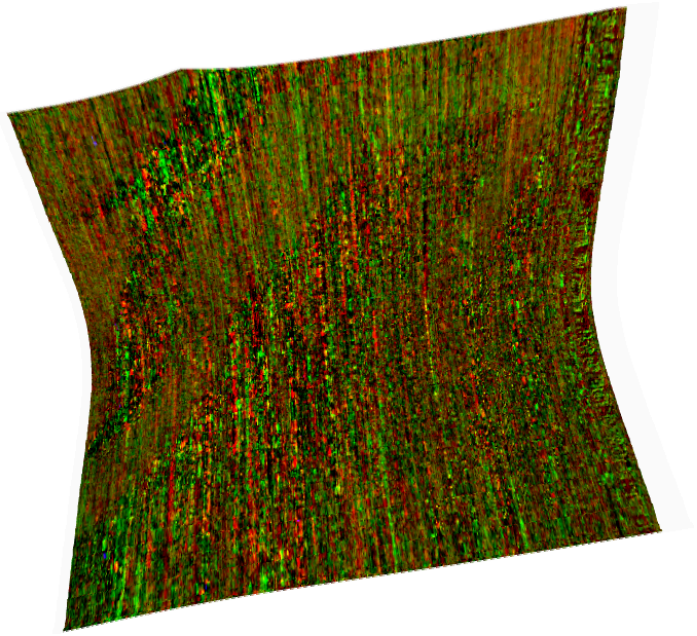




HIRISE and CRISM

- Niger Vallis
- Bound water





EZ Science Data Needs

1. Orbital data
   - High-resolution imagery
   - Spectroscopy

2. MSL class rover
   - Science reconnaissance

EZ Resource Data Needs

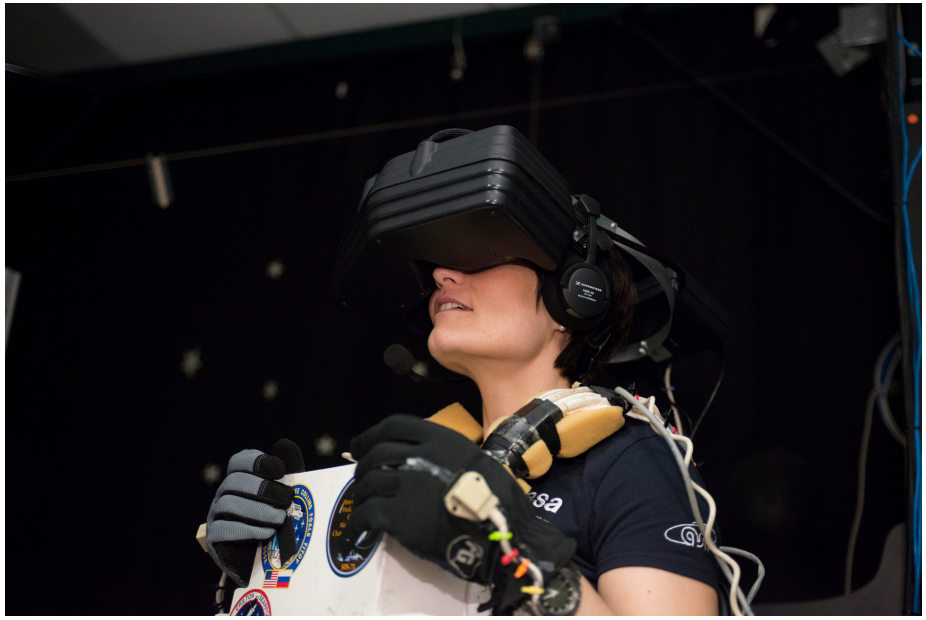
1. MSL class rover
   - Resource reconnaissance
     - ANa ice (sell the mission as exploring Mars glaciers!)
     - Impact glass and metals

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

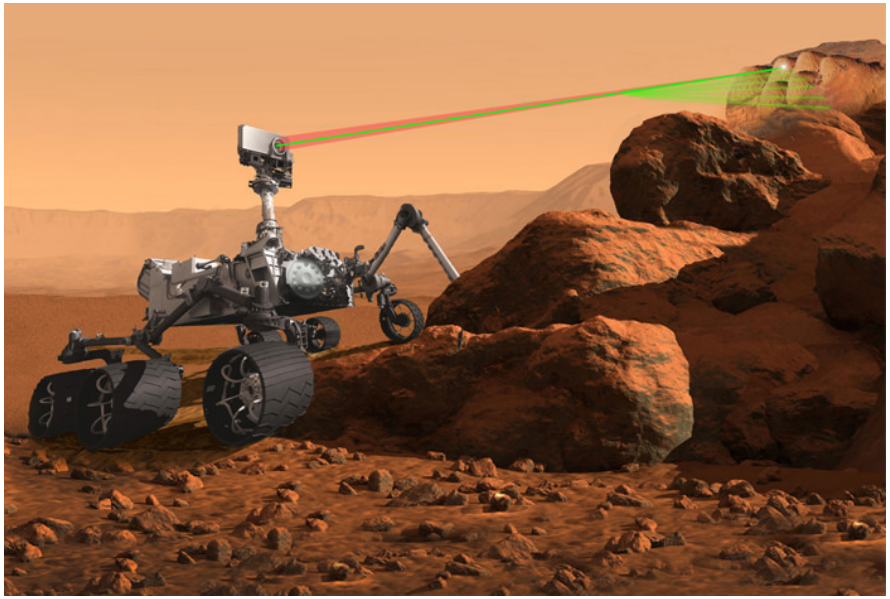
EZ Engineering Data Needs

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

Rover Tele-operations

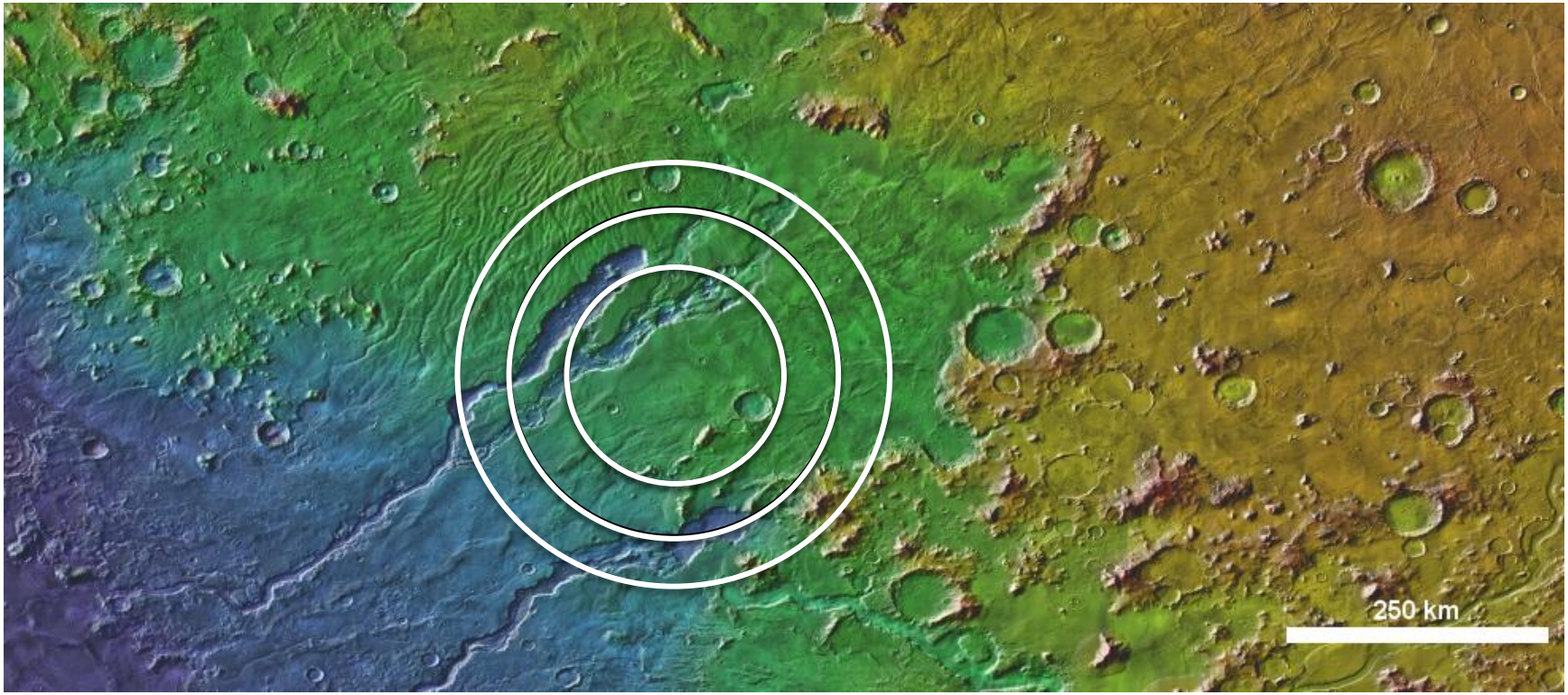


- Gives astronauts something to do
- Faster, more capable than Earth-based operations



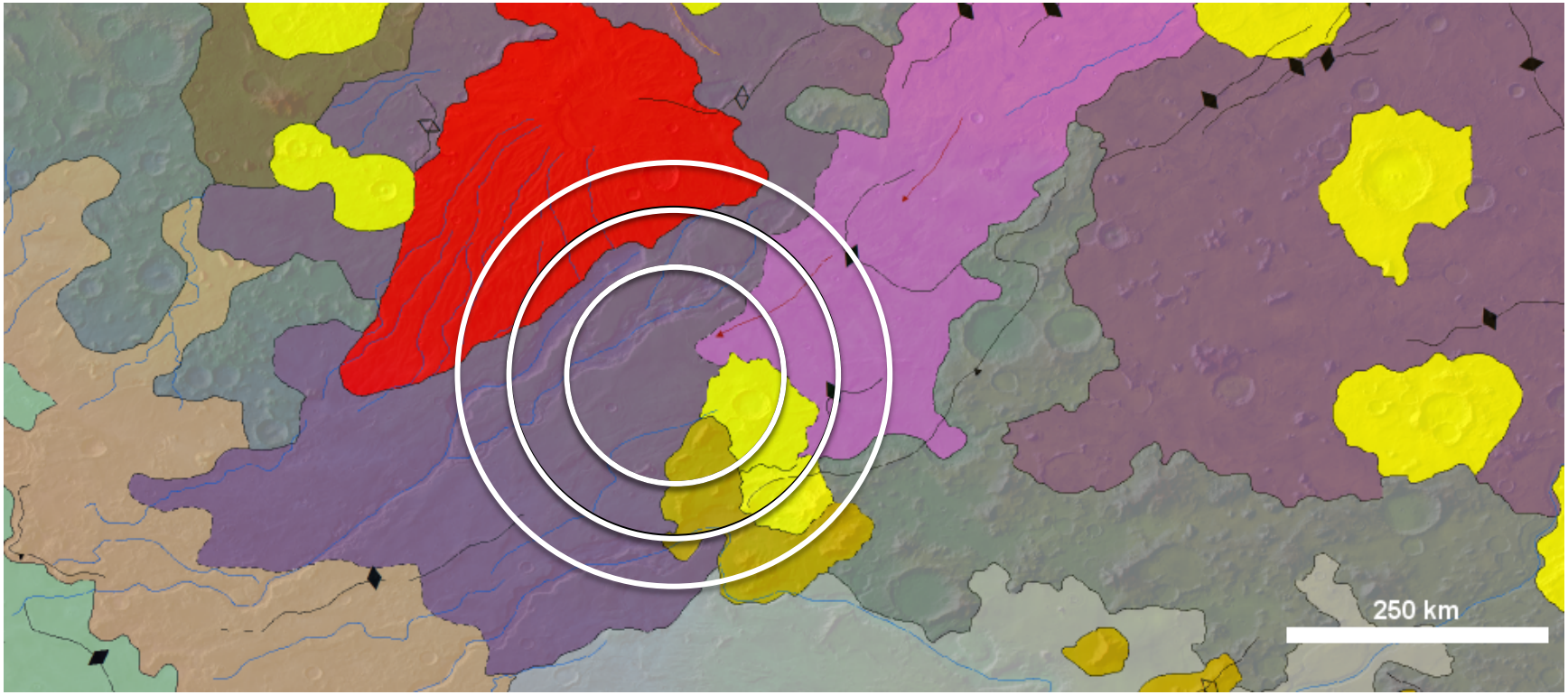
- Increases EZ area/radii
- More science potential

Extended EZ



East Hellas: Mesopotamia

Extended EZ

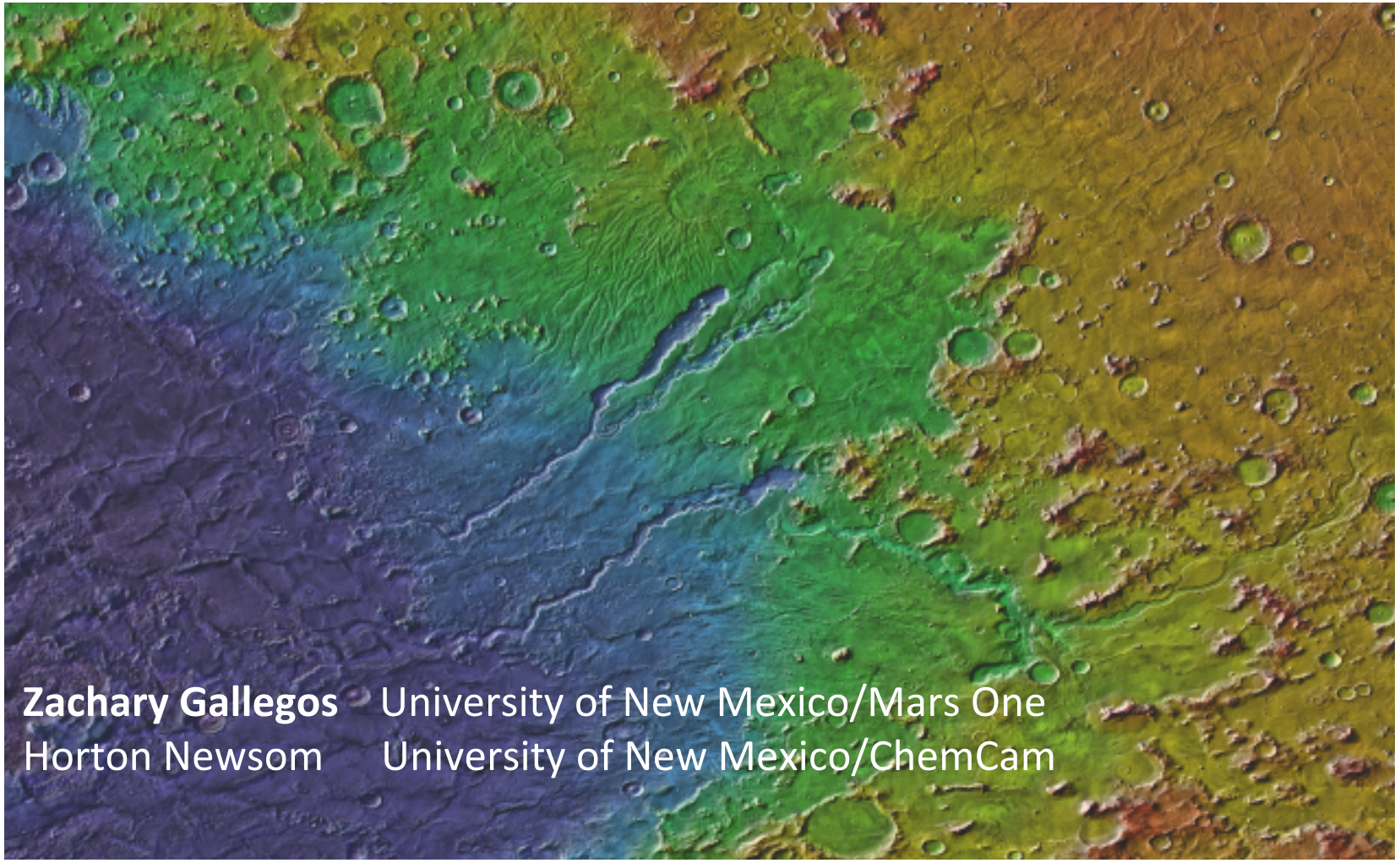


East Hellas: Mesopotamia

The East Rim of Hellas: Mars' Mesopotamia

Abstract #1035

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