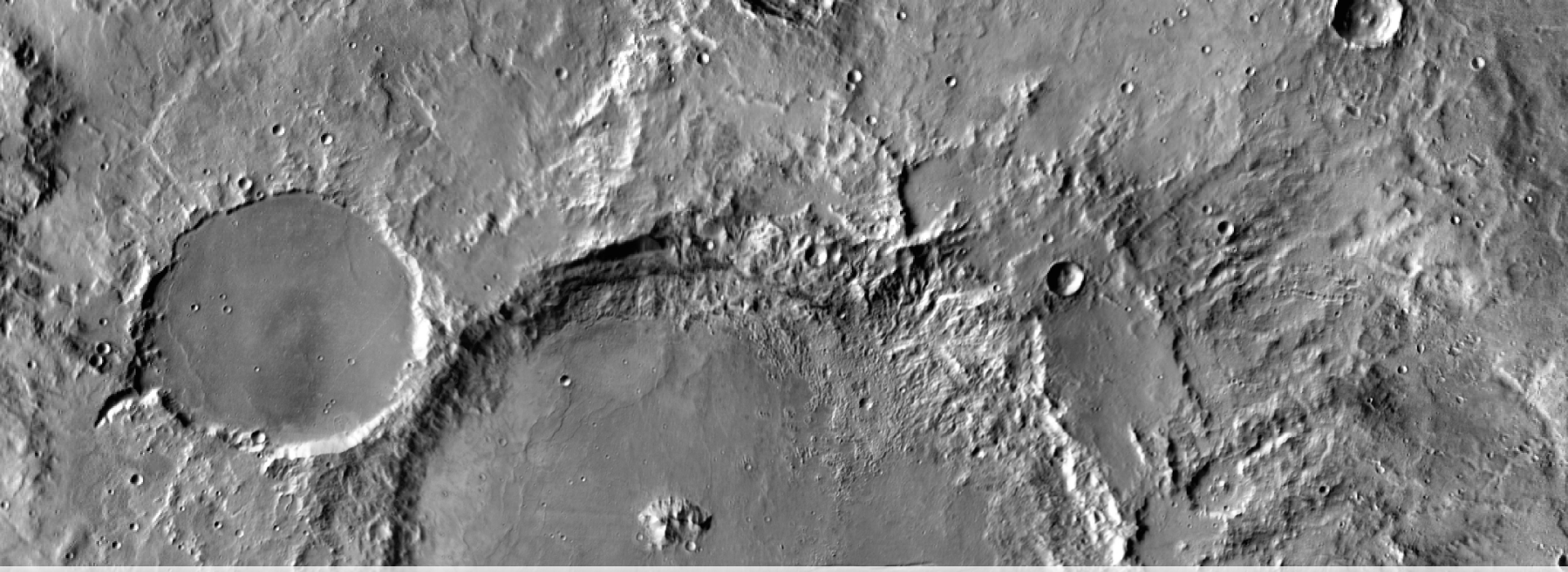


Exploring Habitability, Hydrology, and Climate Change on Mars at Columbus Crater

Abstract #1041

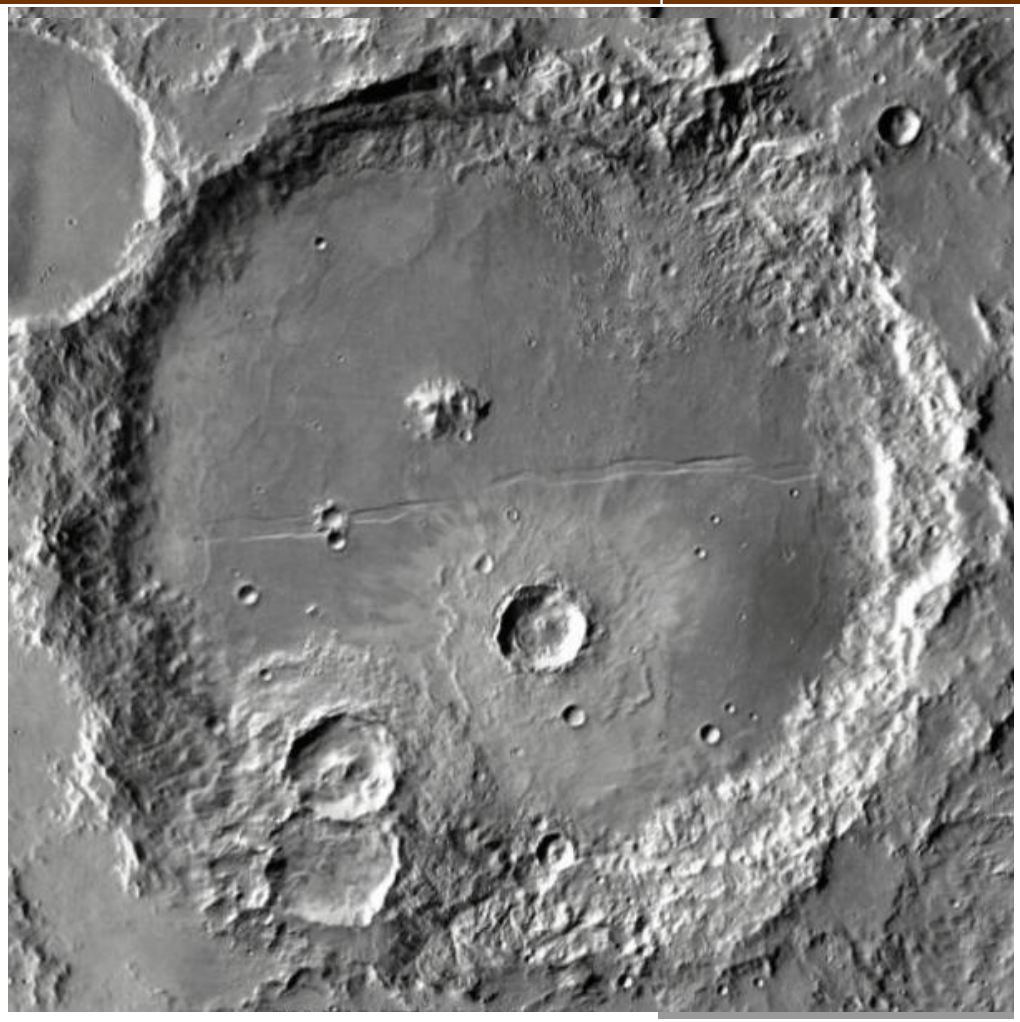
Kennda Lynch[1] and James Wray[2]

[1] Depart of Civil & Environmental Engineering, Colorado School of Mines

[2]School of Earth and Atmospheric Sciences, Georgia Tech

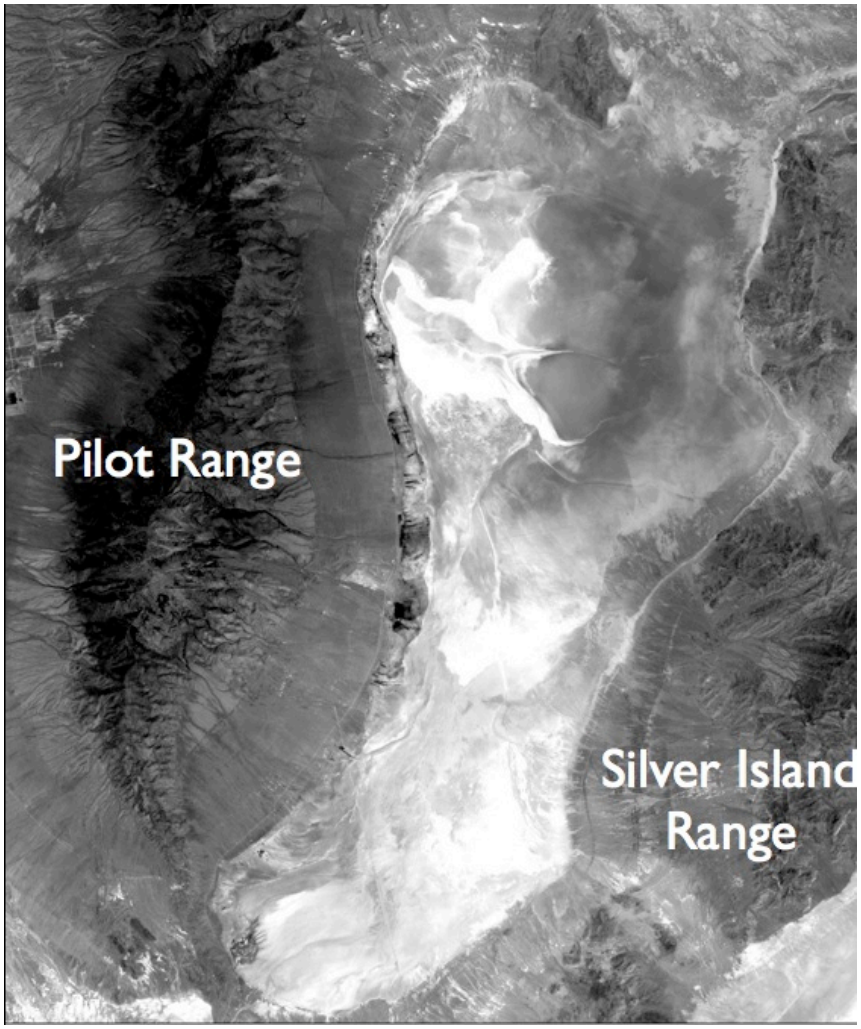
Columbus Crater: Overview

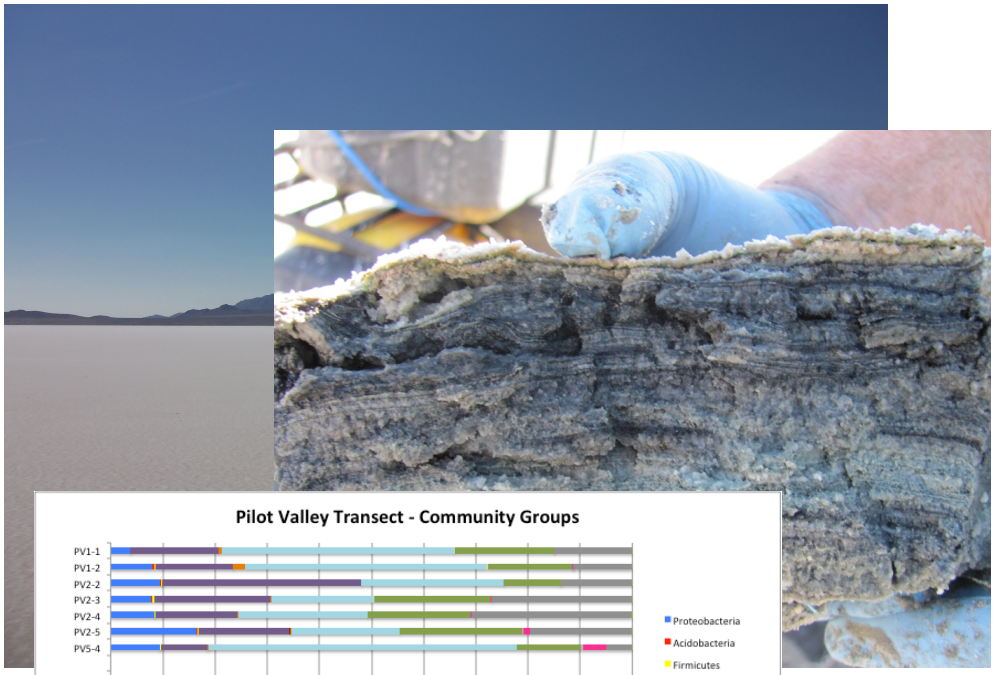
- Ground-water filled paleolake basin
- ~110 km in diameter
- Estimated 1.5 km depth of sedimentary and/or volcanic infill
- Excellent crater retention for age dating
- Diversity of Noachian & Hesperian aged deposits and outcrops
- High diversity of aqueous mineral deposits

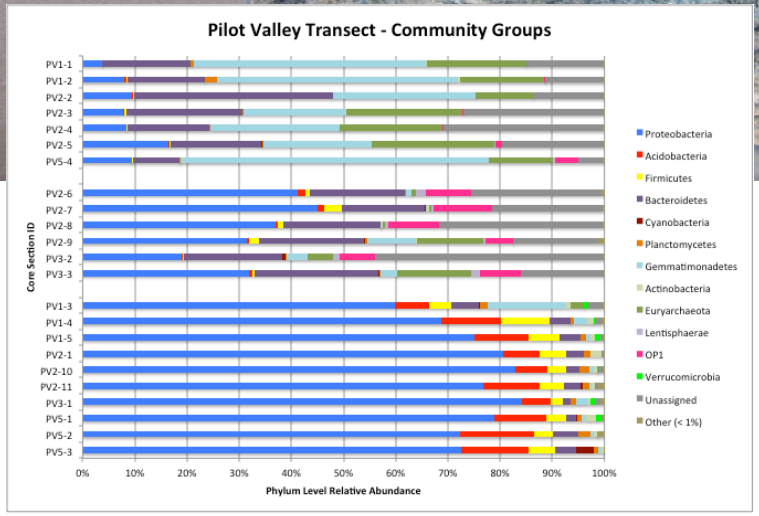


Wray et al., 2011

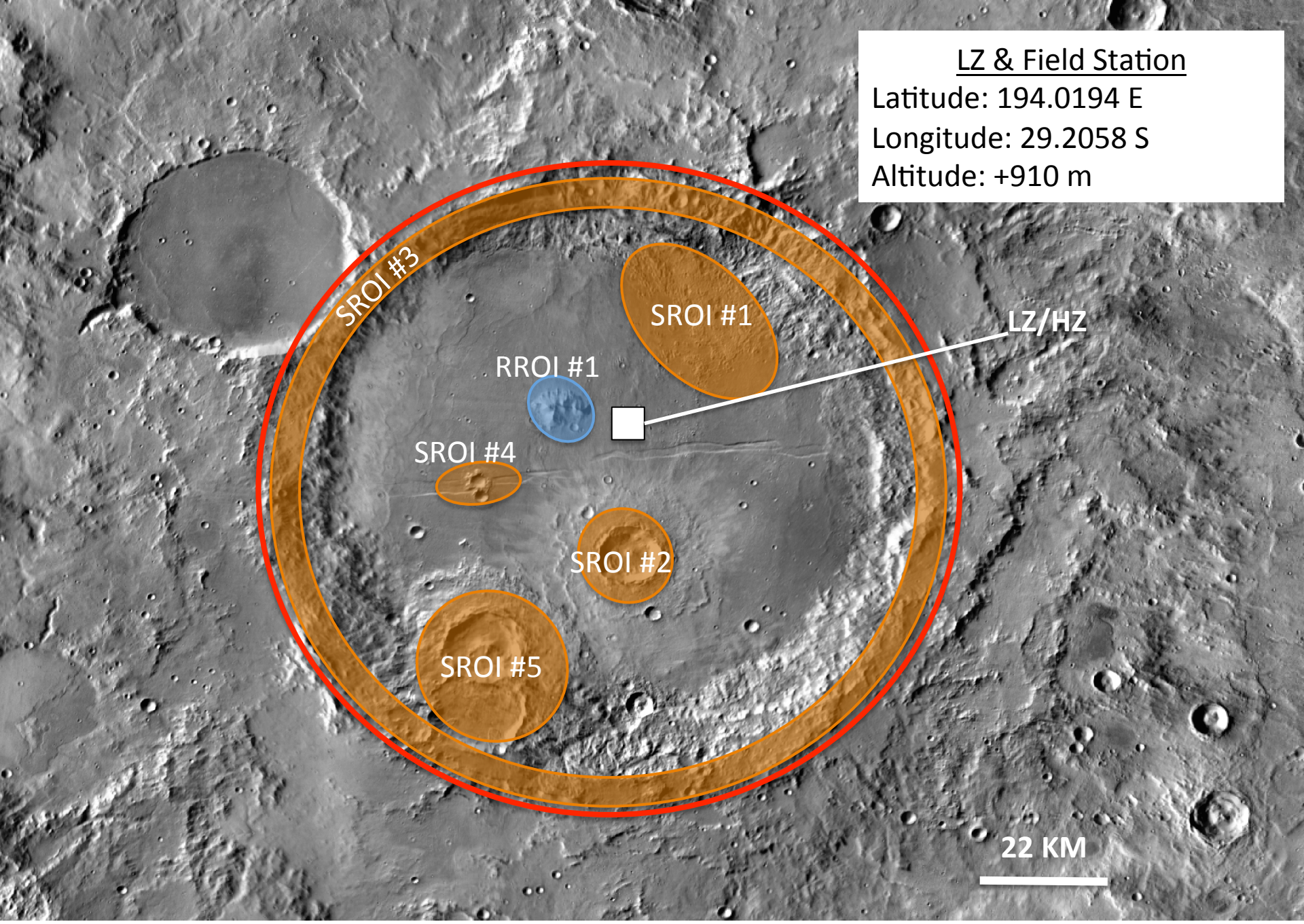
Analog Studies







Lynch et al., 2015


LZ & Field Station
Latitude: 194.0194 E
Longitude: 29.2058 S
Altitude: +910 m
SROI #3
SROI #1
LZ/HZ
RROI #1
SROI #4
SROI #2
SROI #5
22 KM

Science ROI(s) Rubric

1st EZ Workshop for Human Missions to Mars

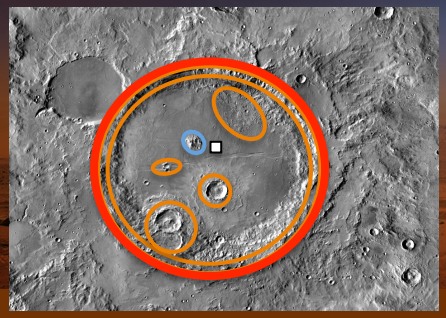
Science Site Criteria		Site Factors			SROI1	SROI2	SROI3	SROI4	SROI5	RROI1	EZ SUM
	Astrobio	Threshold	AND/OR	**Potential for past habitability**	●	●	●	●	●	●	(6,0)
				Potential for present habitability/refugia		?	?	?	?	?	(0,0)
		Qualifying		Potential for organic matter, w/ surface exposure	●	○	●	●	●	●	(5,1)
	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	●		●		●		(3,0)
				Amazonian subsurface or high-latitude ice or sediment	○	○	○	○	○	○	(0,6)
				High likelihood of active trace gas sources	?	?	?	?	?	?	(0,0)
	Geoscience	Threshold		**Range of martian geologic time; datable surfaces**	●	●	●		●	●	(5,0)
				Evidence of aqueous processes	●	●	●	●	●	●	(6,0)
				Potential for interpreting relative ages	●	●	●	●	●	●	(6,0)
		Qualifying		Igneous Rocks tied to 1+ provinces or different times	●	●		●			(3,0)
				Near-surface ice, glacial or permafrost	?	?	?	?	?	?	(0,0)
				Noachian or pre-Noachian bedrock units			○			○	(0,2)
				Outcrops with remnant magnetization			○			○	(0,2)
				Primary, secondary, and basin-forming impact deposits		●		●	●		(3,0)
				Structural features with regional or global context				●			(1,0)
				Diversity of aeolian sediments and/or landforms	●	●	●				(3,1)

Key	
●	Yes
○	Partial Support or Debated
	No
?	Indeterminate

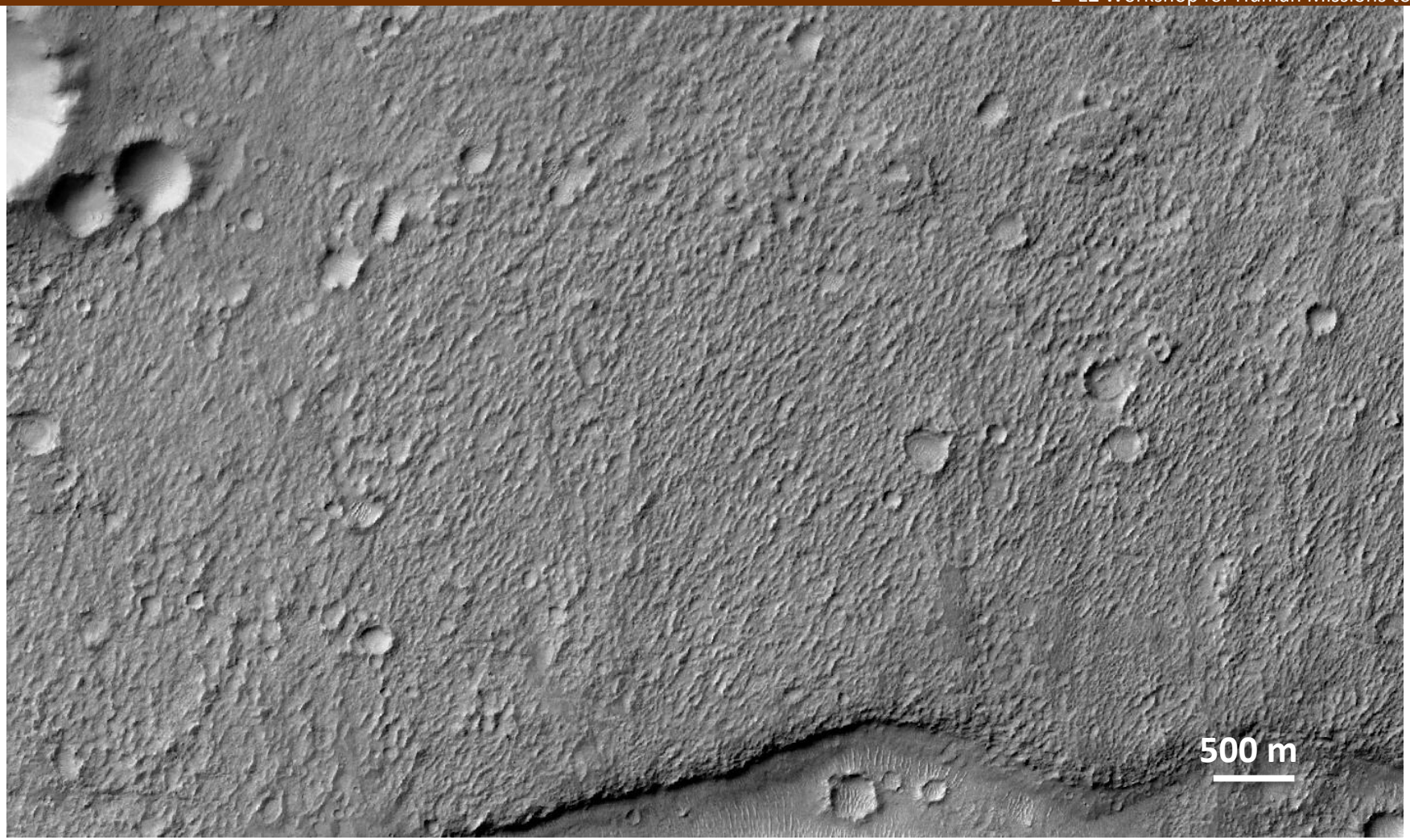
Resource ROI(s) Rubric

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

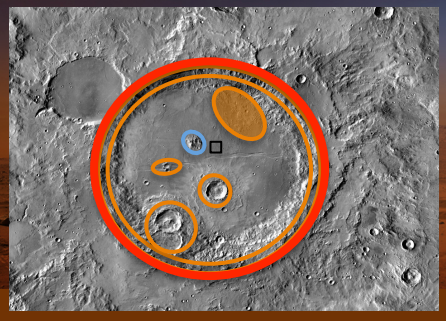
Key	
●	**Yes**
○	**Partial Support or Debated**
	No
?	**Indeterminate**



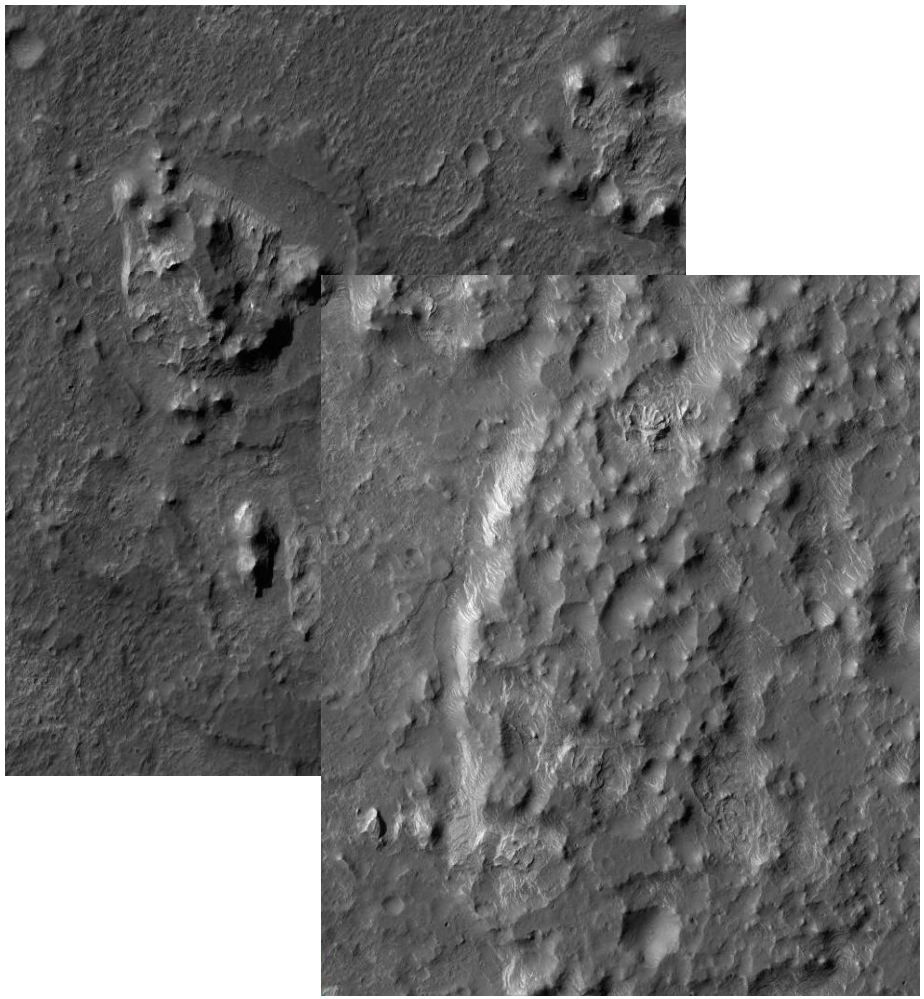
LZ & Field Station



Columbus Crater

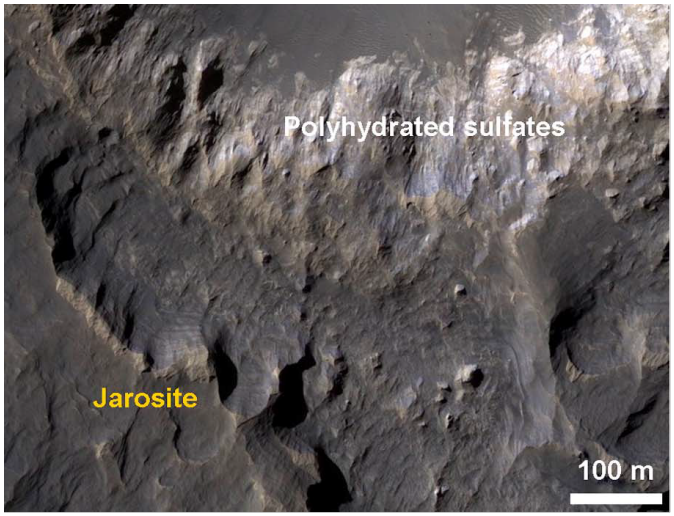


Science ROI 1



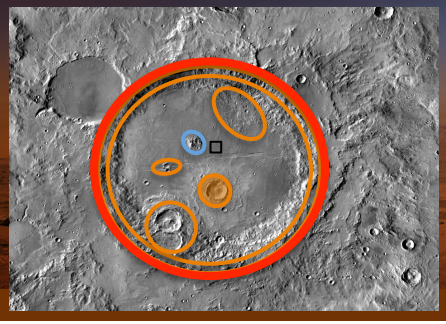
Northeastern Shore

- 194.2591° E, -28.883° N
- Most exposed light toned units & highest diversity of aqueous mineral deposits

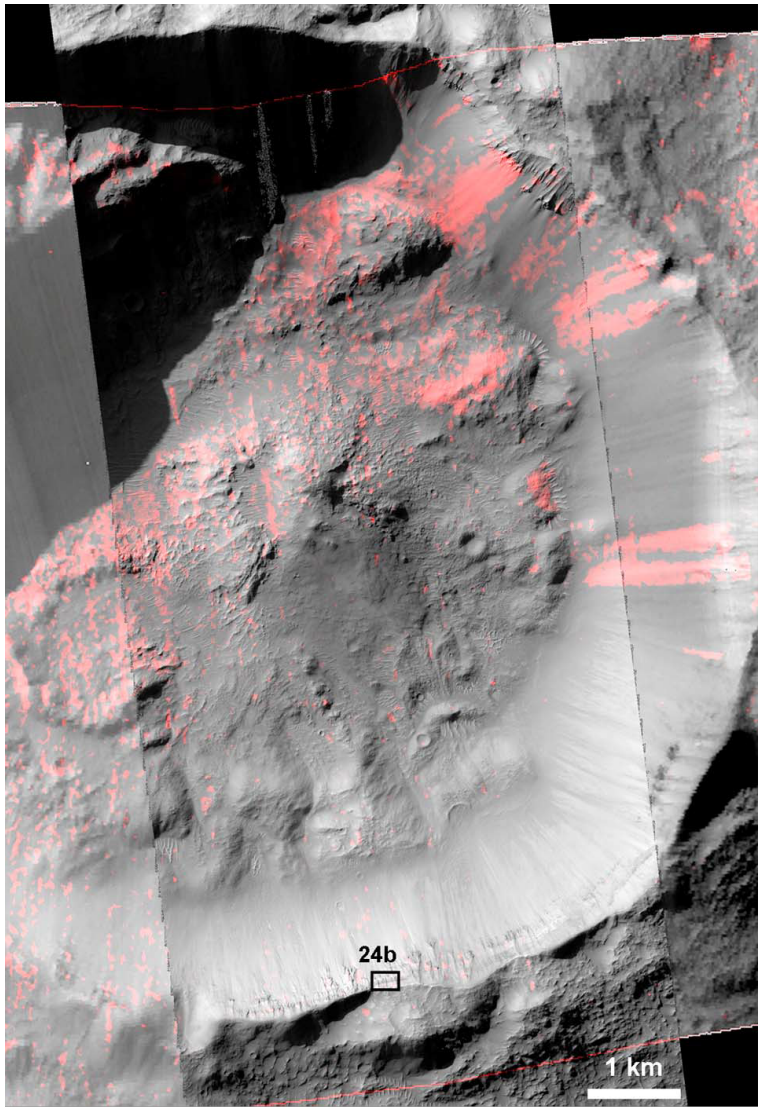


Columbus Crater

Wray et al., 2011

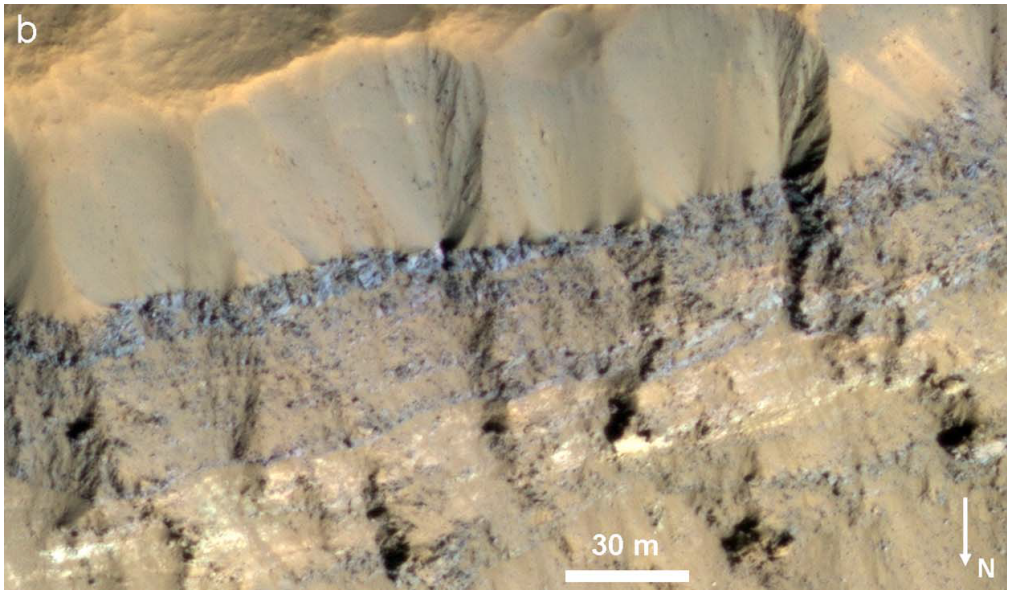


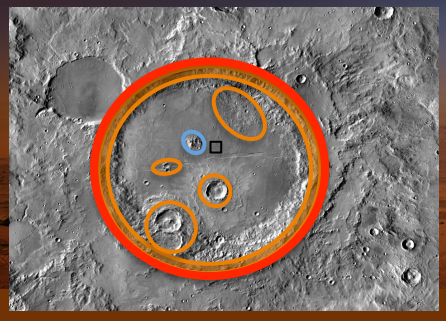
Science ROI 2



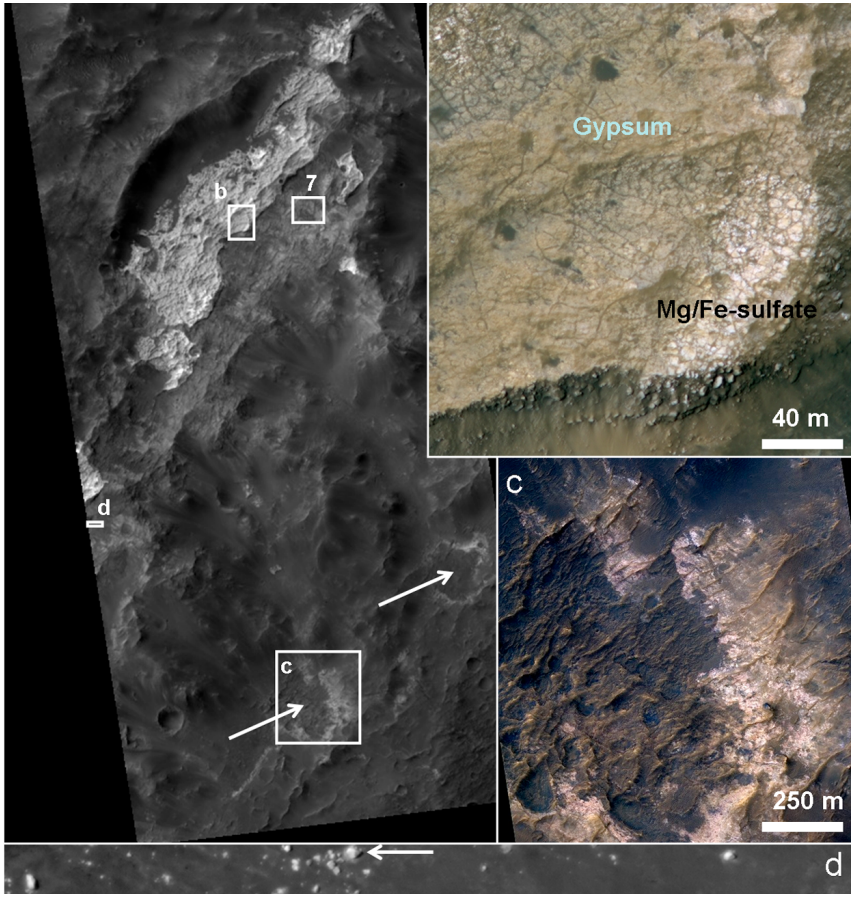
D11 Crater

- 194.2591° E, 29.581° S
- Stratigraphic context
- Possible RSL



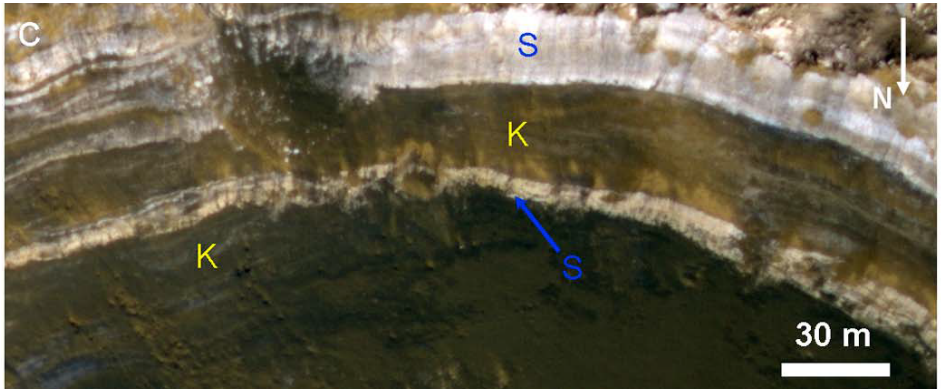


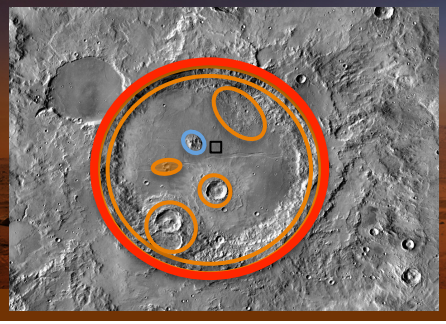
Science ROI 3



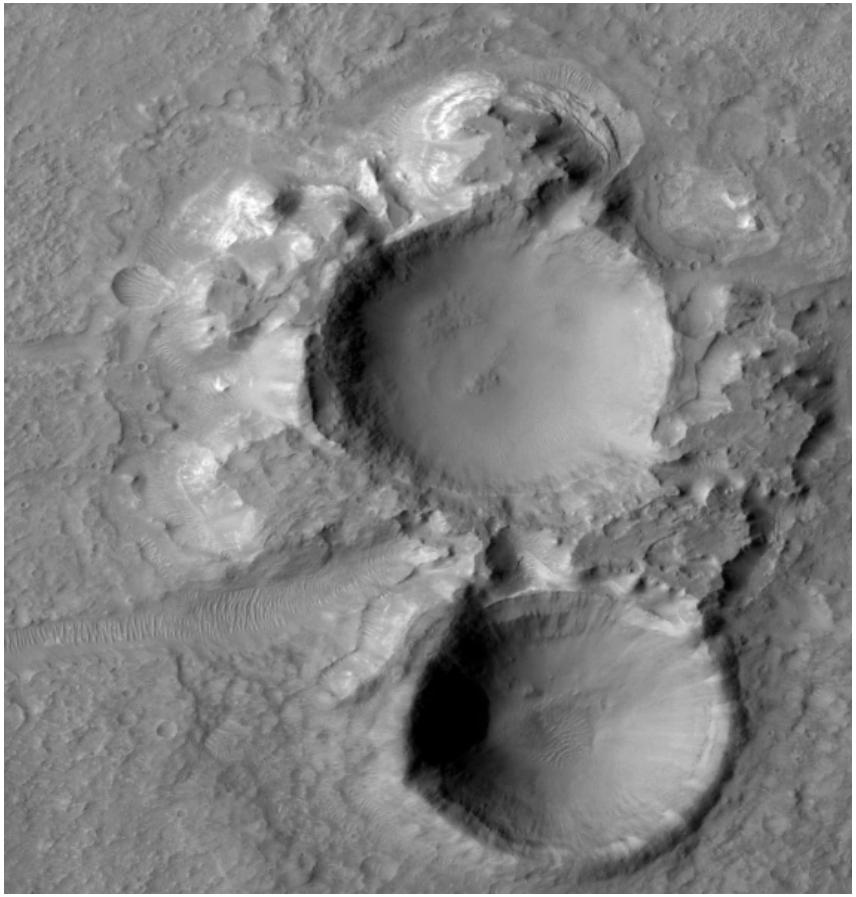
Wray et al., 2011

Bathtub Ring



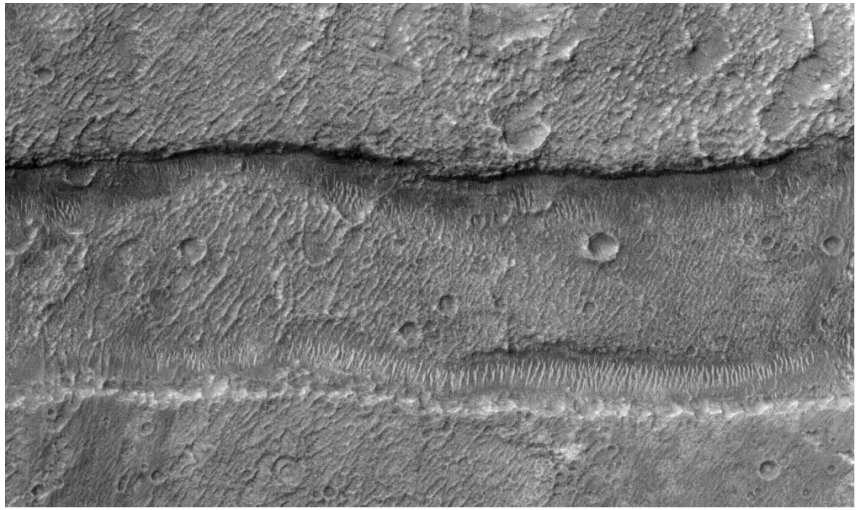


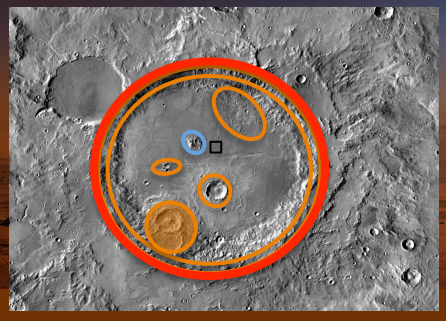
Science ROI 4



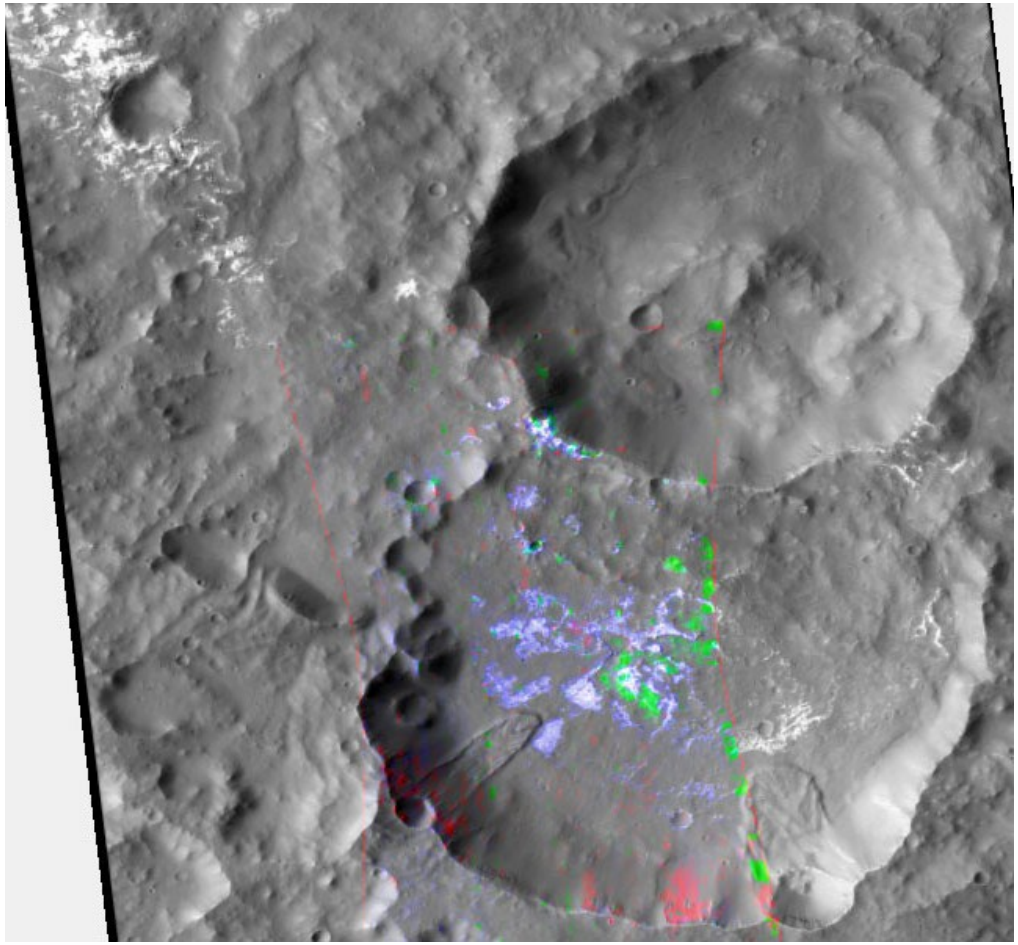
Pedestal Crater

- 193.603° E, 29.345° S



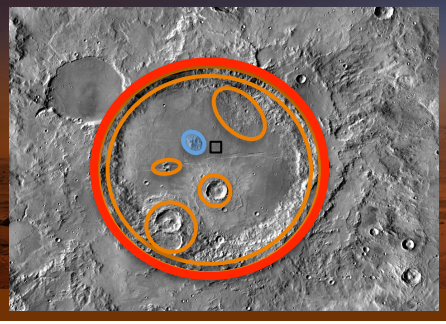


Science ROI 5

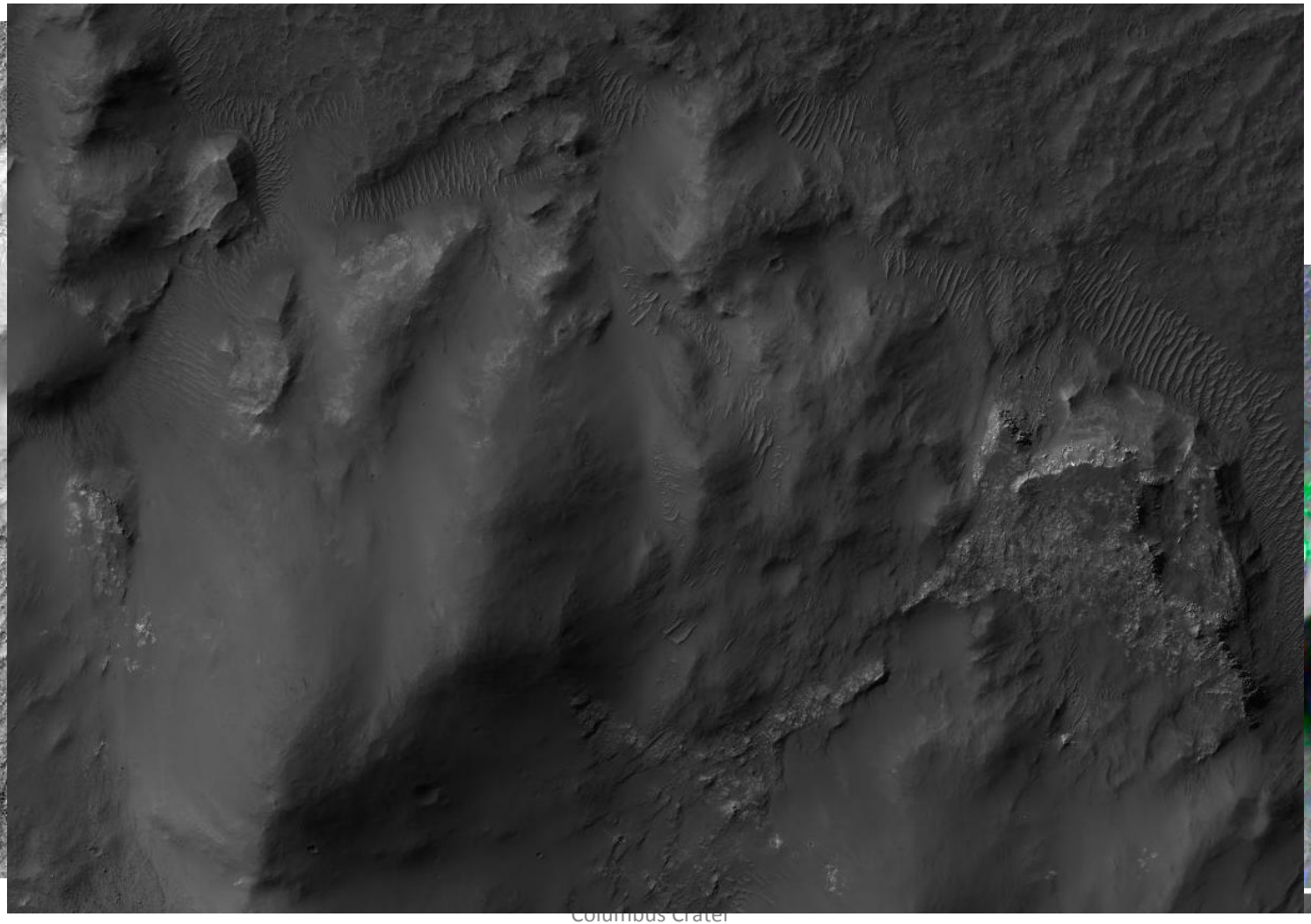


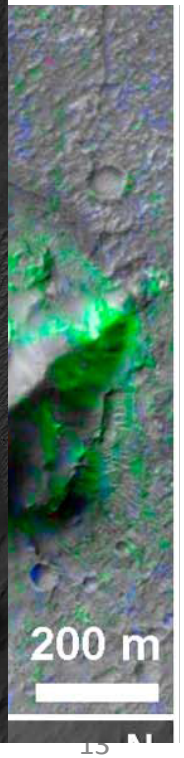
Dual Craters

- 193.599° E, 29.973° S

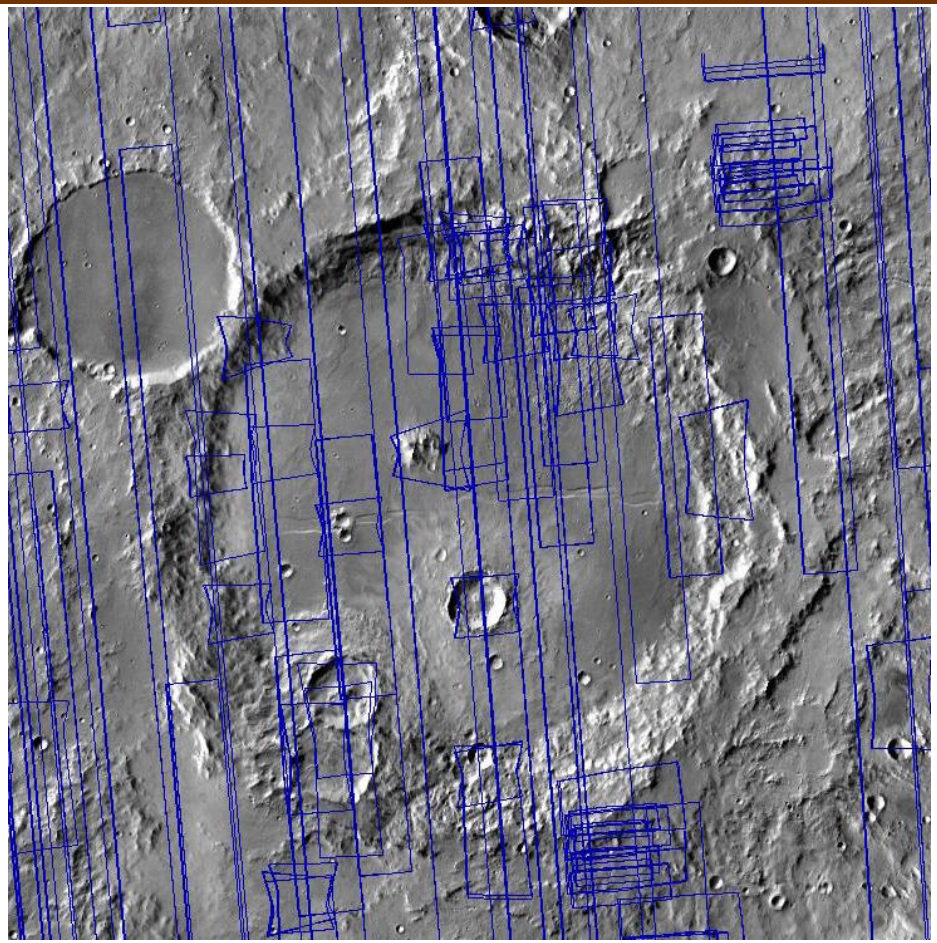


Resource ROI 1

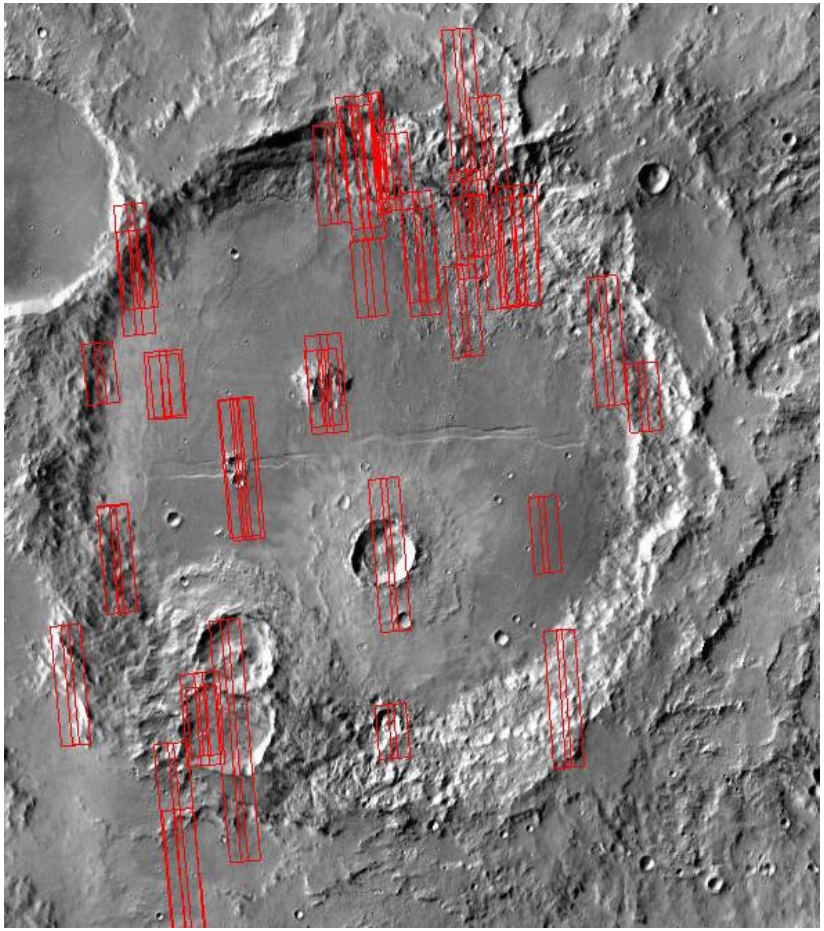




Data Coverage



CRISM Coverage



HiRISE Coverage

Highest Priority EZ Data Needs

- Science Coverage
  - HRSC coverage of crater rim & basin floor
  - CRISM coverage of the Northwest crater Rim
  - General HiRISE coverage of the crater rim and basin floor
- Resource Coverage
  - General HiRISE coverage of basin floor