

ISMENIUS CAVUS: ANCIENT LAKE DEPOSITS AND CLAY MINERALS SURROUNDED BY AMAZONIAN GLACIERS

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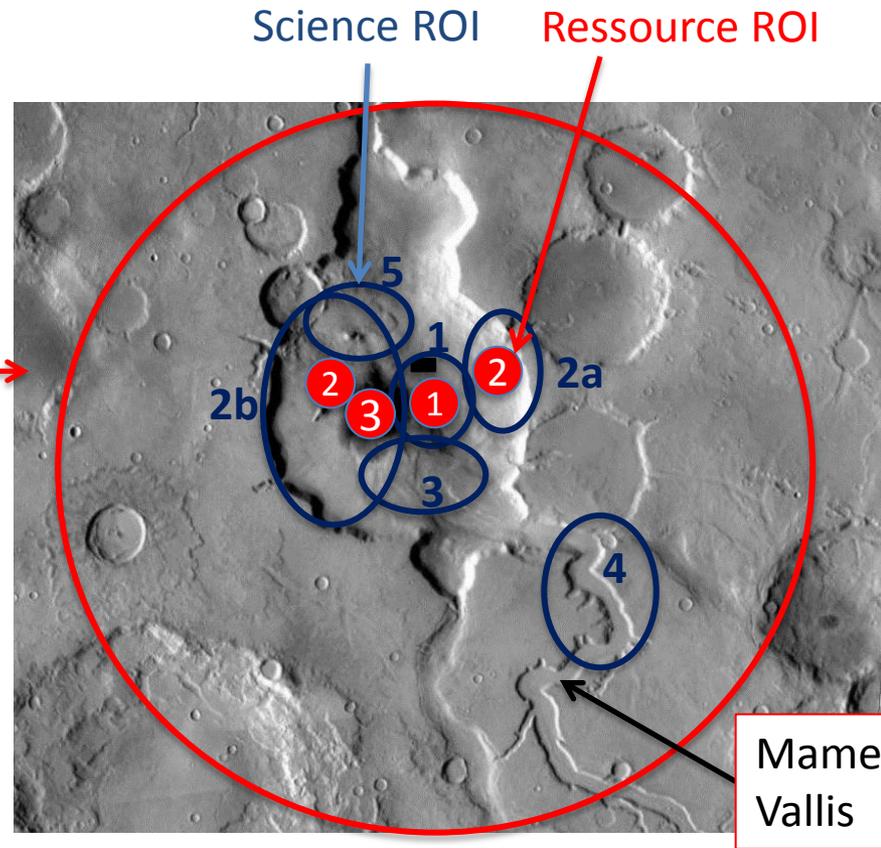
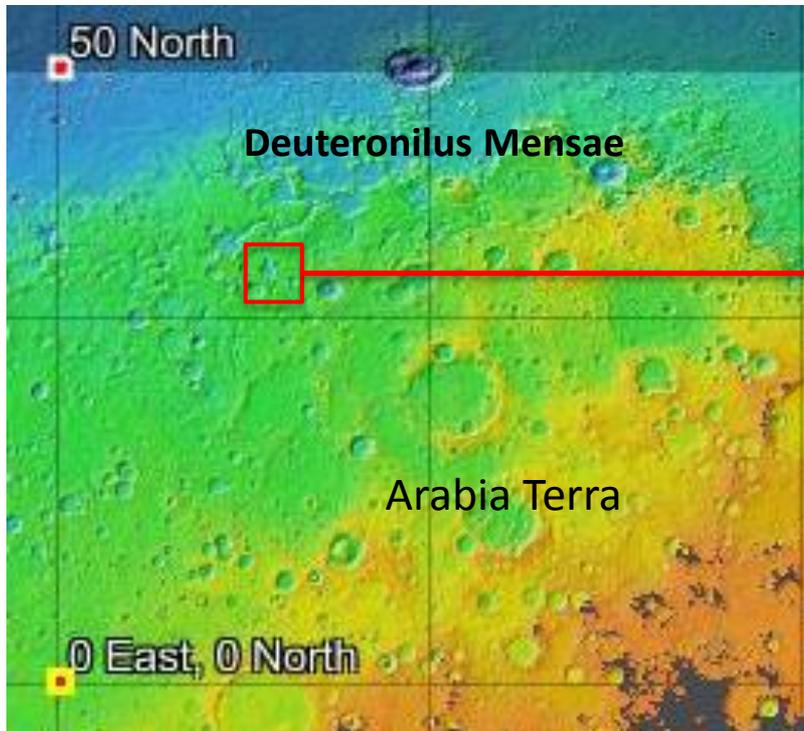
A biking trip through Mars history!!

Geographic and geologic context



Ismenius Cavus: Coord: 33.5°N, 17°E,
Elevation: -3.5 to -1.5 km

At the junction between current mid-latitude ice deposits and low latitude clay minerals



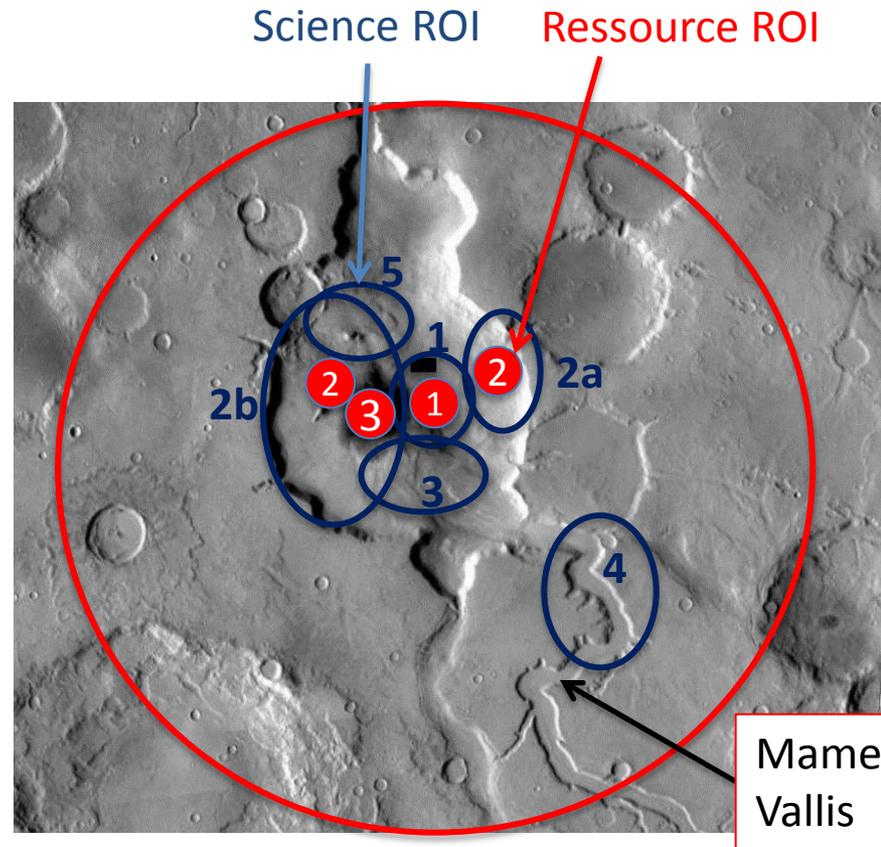
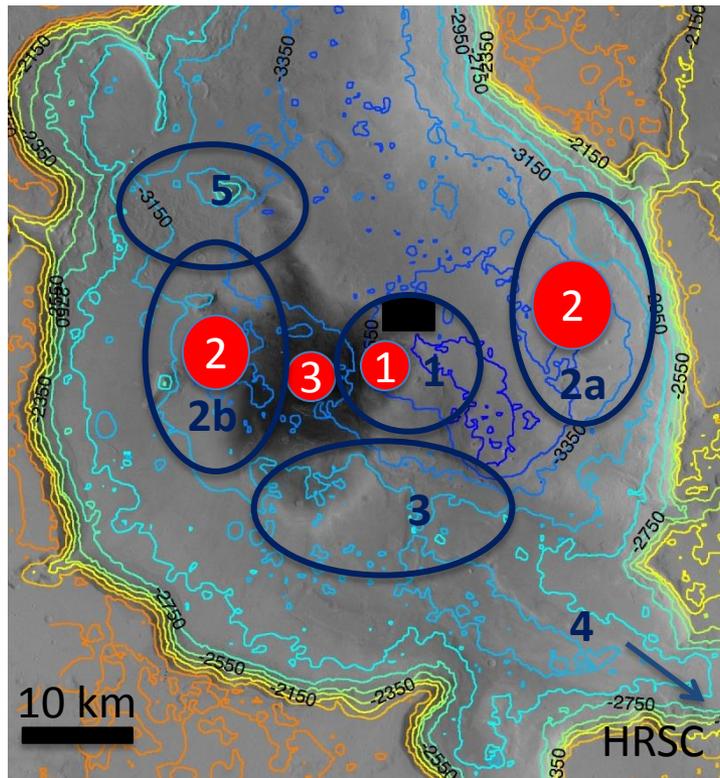
Exploration Zone Map

1st EZ Workshop for Human Missions to Mars



Ismenius Cavus: Coord: 33.5°N, 17°E,
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At the junction between current mid-latitude ice deposits and low latitude clay minerals



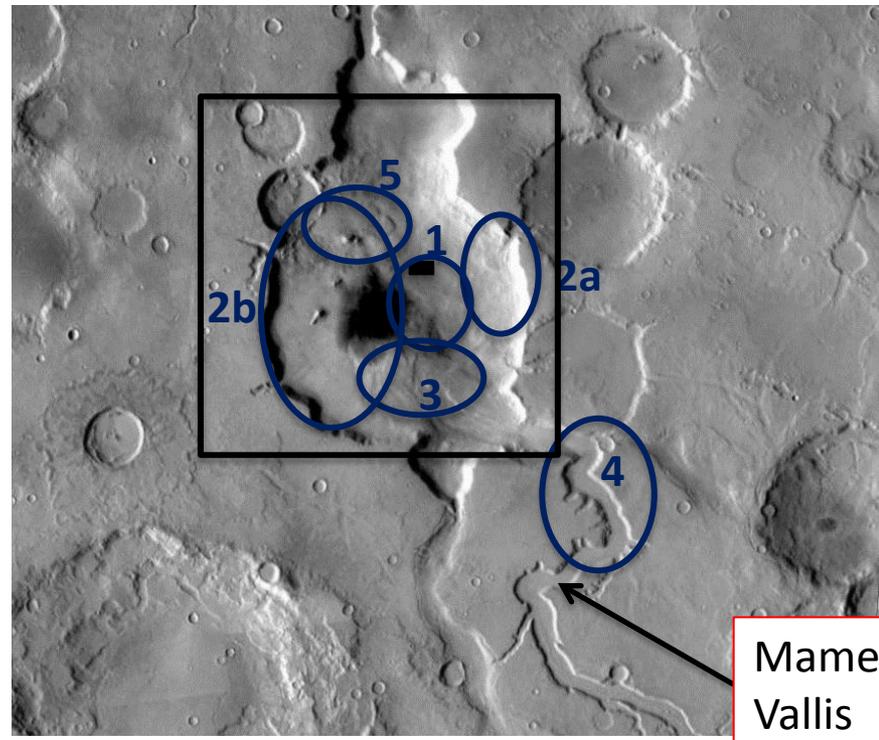
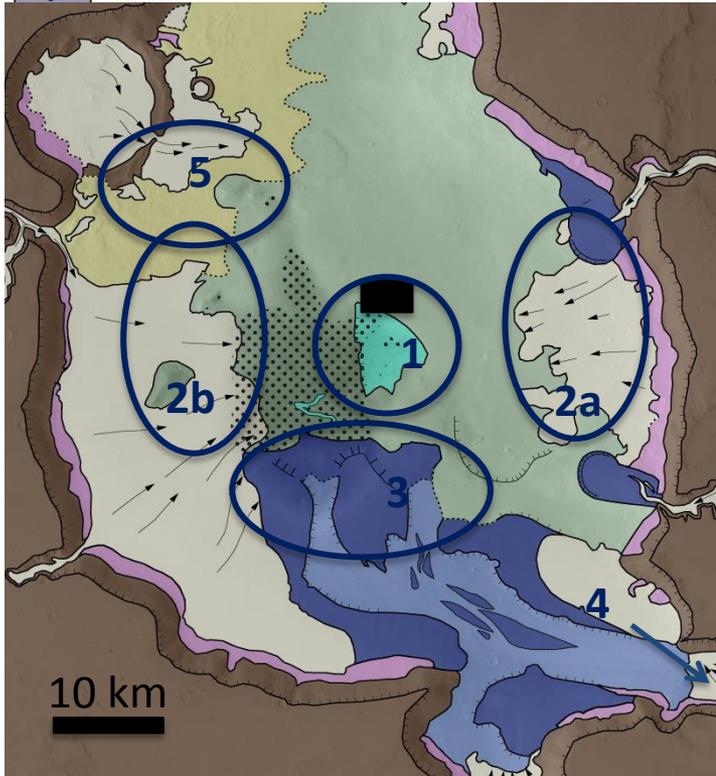
Scientific objectives

1st EZ Workshop for Human Missions to Mars



- | | |
|--|--|
| 2 Glacial landforms | Geologic map caption |
| 5 Modified ejecta blanket |  Depression floor |
| 3,4 Channel in the delta deposits | 1  Phyllosilicate-bearing unit |
| 3,4 Delta deposits |  Noachian plateau |

At the junction between current mid-latitude ice deposits and low latitude clay minerals



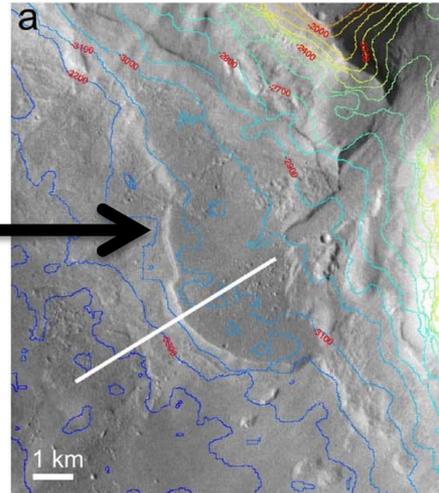
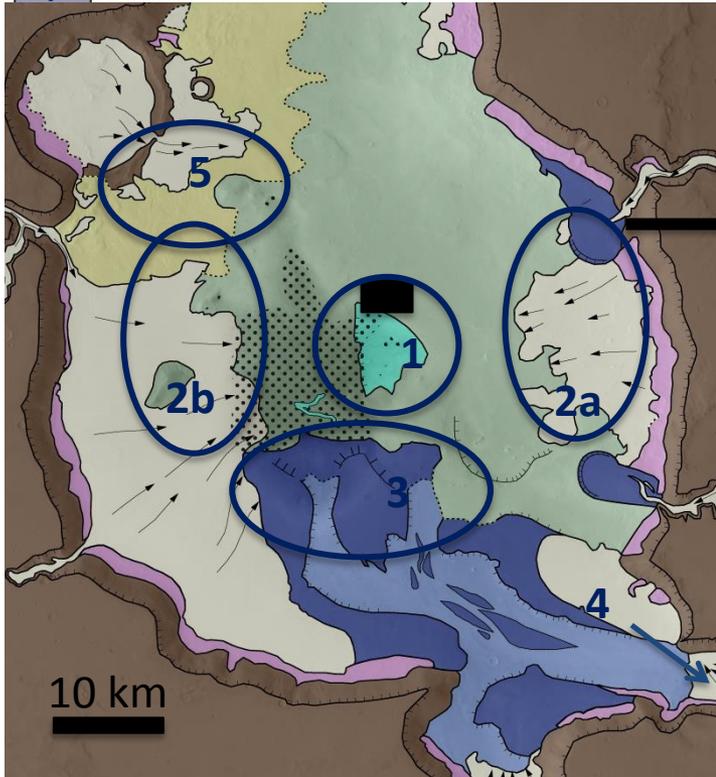
Mamers Vallis

Scientific objectives



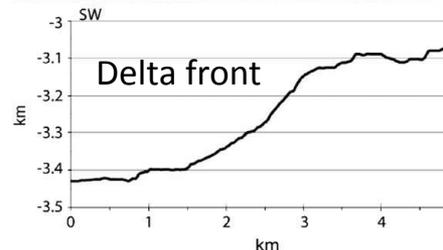
Number	Geologic map caption	Geologic map caption
2	Glacial landforms	Depression floor
5	Modified ejecta blanket	1 Phyllosilicate-bearing unit
3,4	Channel in the delta deposits	Noachian plateau
3,4	Delta deposits	

A paleolake with clay minerals in lake sediments



- Three delta fans (blue on map) (*Ori et al, 2000*)
- HRSC topography consistent With a delta plain and a steep front
- The three fans have a plateau at the same elevation (-3100 m)

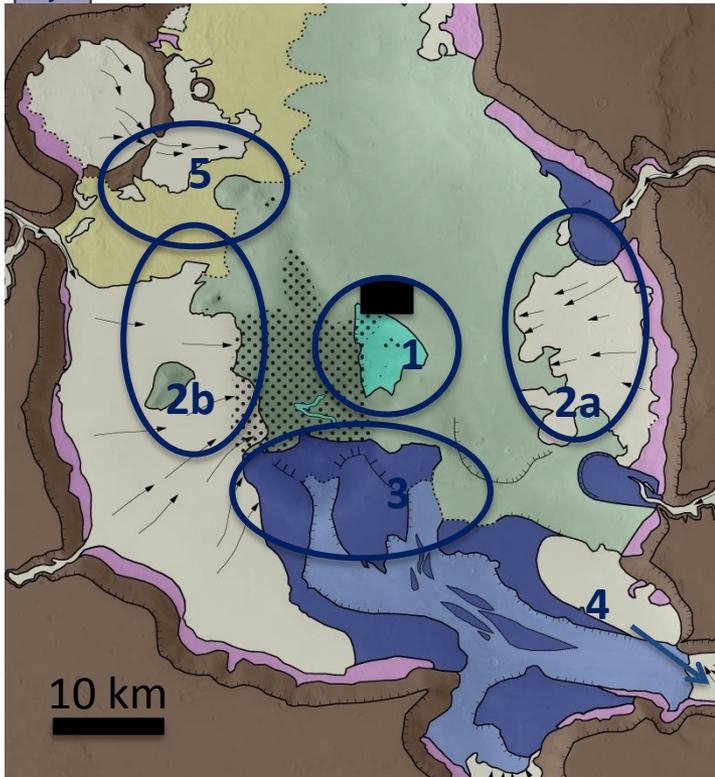
⇒ **Consistent with coeval activity in a past lake (>400 m deep)**



Scientific objectives

1st EZ Workshop for Human Missions to Mars

- | | |
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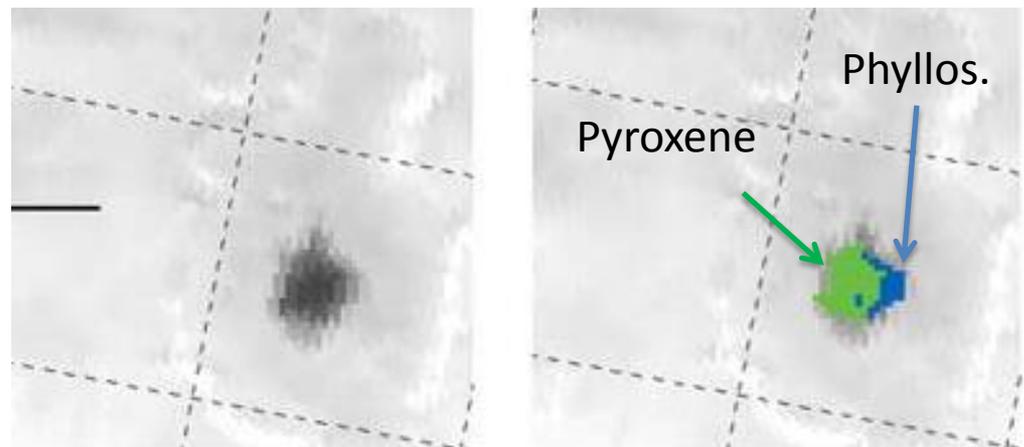


Dehouck et al., Planet. Spa. Sci., 2010

A paleolake with clay minerals in lake sediments

Specific type of clay minerals on dark terrains
(Poulet et al, 2005, OMEGA/Mars Express)

Actually just darker than the surroundings
No high resolution images at that time



Scientific objectives

1st EZ Workshop for Human Missions to Mars



2 Glacial landforms

5 Modified ejecta blanket

3,4 Channel in the delta deposits

3,4 Delta deposits

Geologic map caption

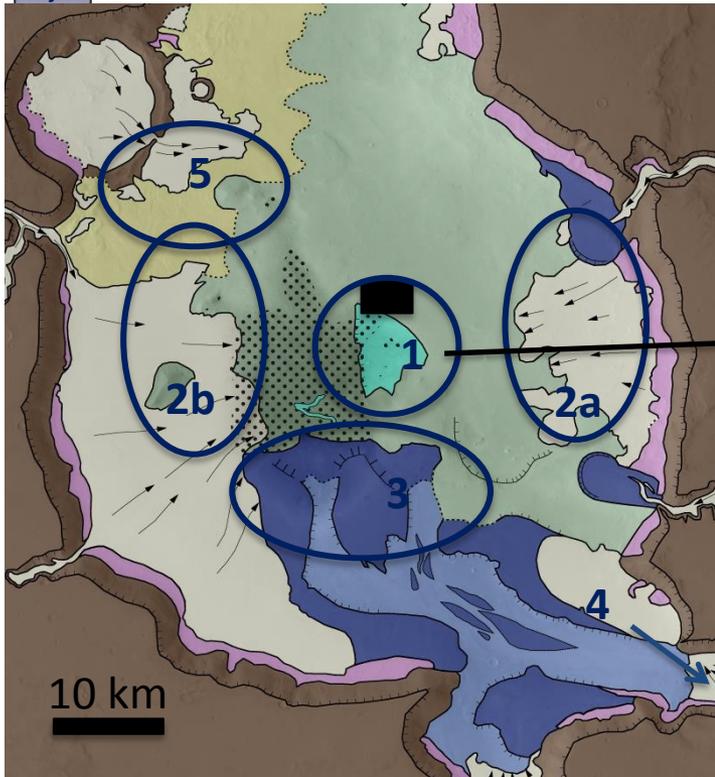
 Depression floor

 **1** Phyllosilicate-bearing unit

 Noachian plateau

A paleolake with clay minerals in lake sediments

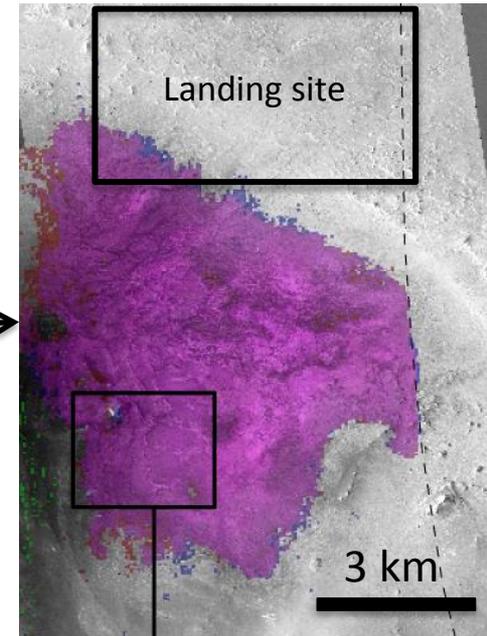
CRISM spectral map (Dehouck et al, 2010)



Fe-Mg phyllosilicates (likely smectites)

Correlation with erosional window of layered deposits

Clay minerals consistent with fine-grained deposits at lake bottom



Science ROI 1

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2 Glacial landforms

5 Modified ejecta blanket

3,4 Channel in the delta deposits

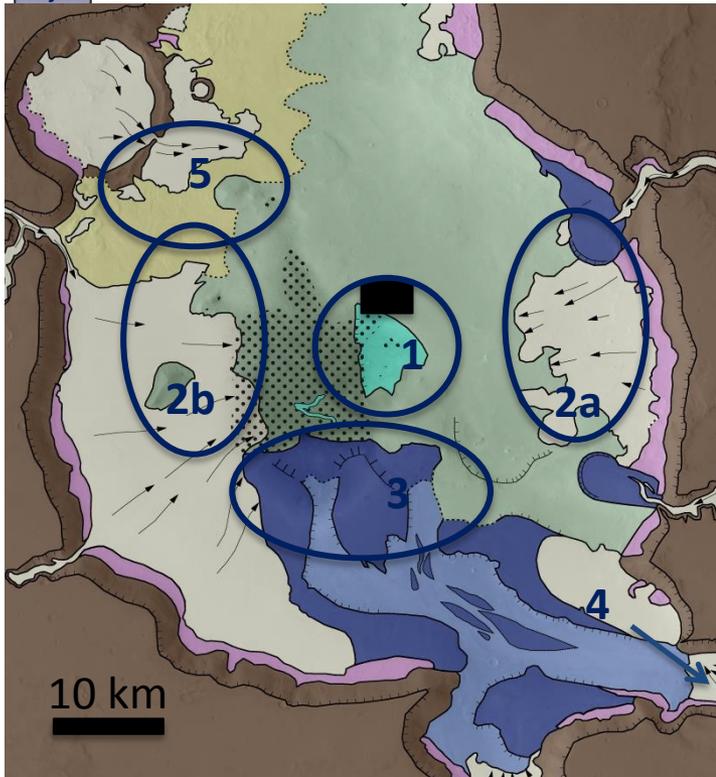
3,4 Delta deposits

Geologic map caption

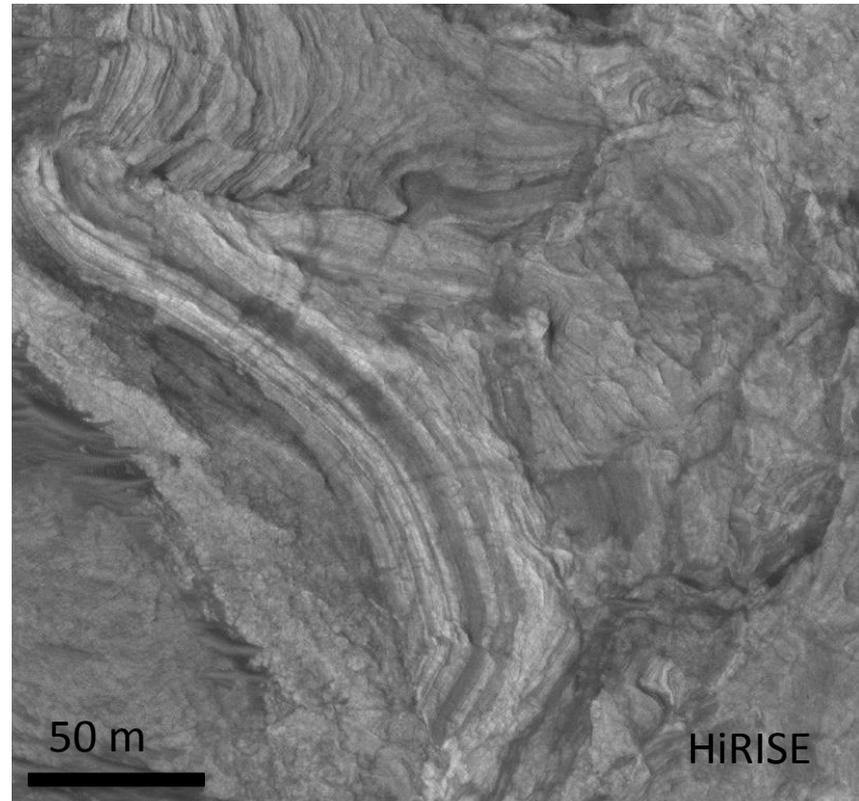
 Depression floor

 **1** Phyllosilicate-bearing unit

 Noachian plateau



Close-up on clay-rich layered deposits



Science ROI 2a

1st EZ Workshop for Human Missions to Mars



2 Glacial landforms

Geologic map caption

5 Modified ejecta blanket

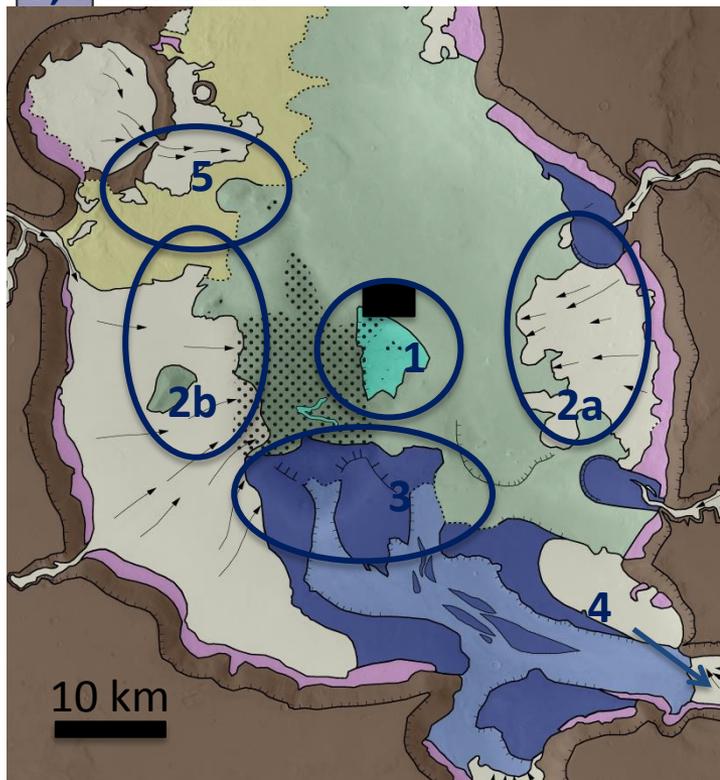
Depression floor

3,4 Channel in the delta deposits

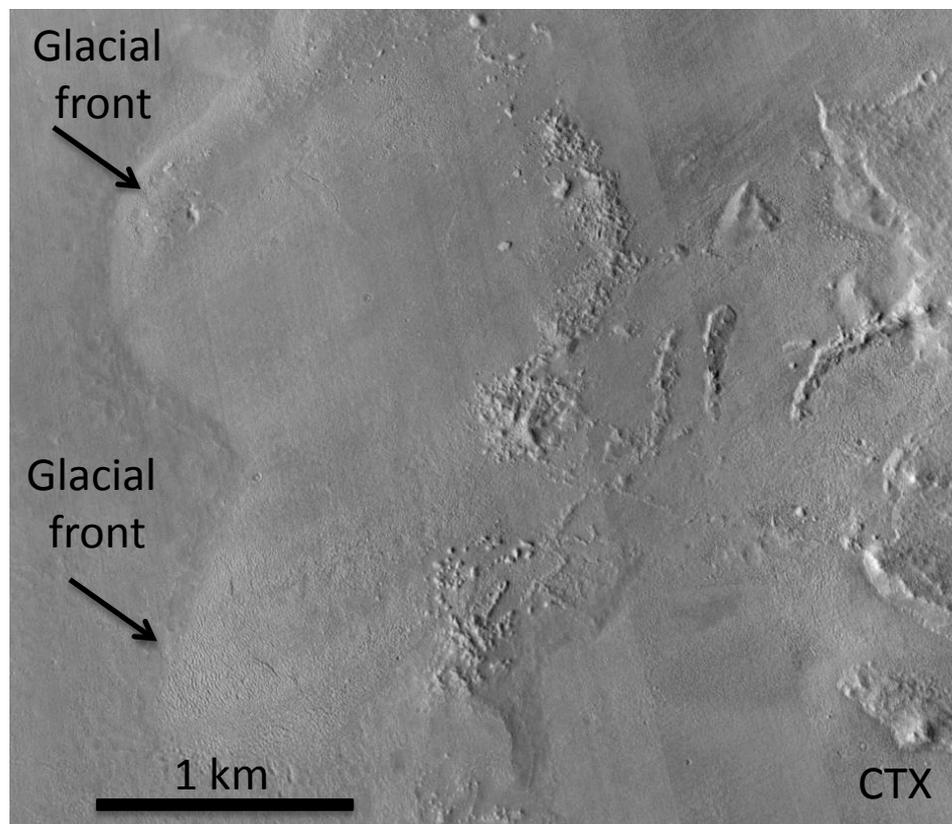
1 Phyllosilicate-bearing unit

3,4 Delta deposits

Noachian plateau



Lobate debris aprons 10 km east of the landing zone



Science ROI 2a

1st EZ Workshop for Human Missions to Mars



2 Glacial landforms

5 Modified ejecta blanket

3,4 Channel in the delta deposits

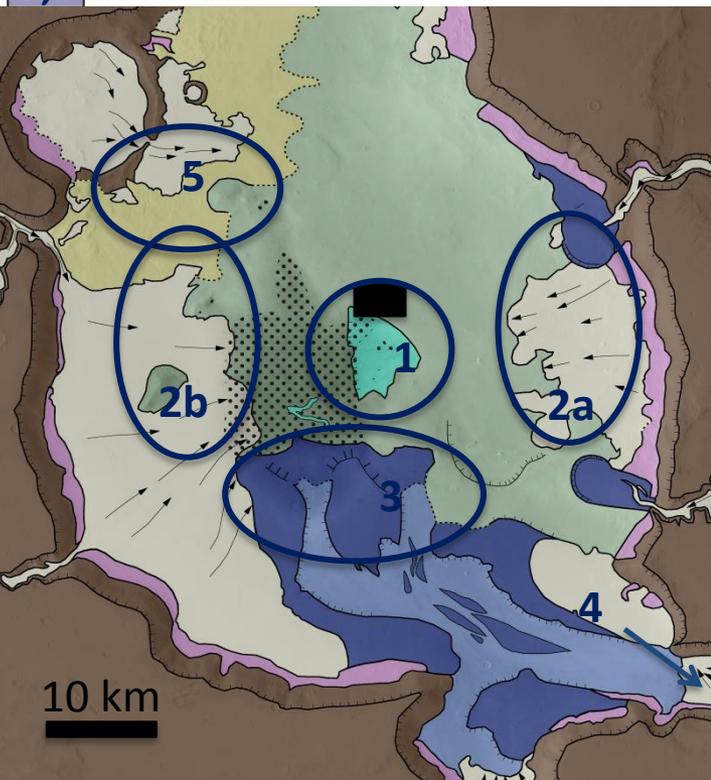
3,4 Delta deposits

Geologic map caption

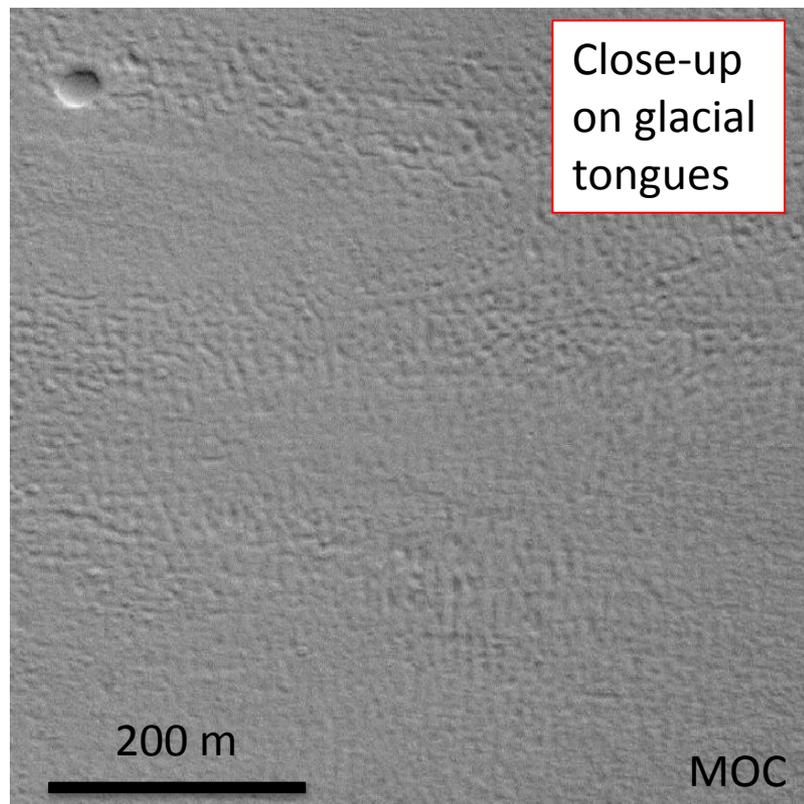
 Depression floor

 **1** Phyllosilicate-bearing unit

 Noachian plateau



Pitted texture typical of sublimation of ice (Mangold, 2003)
Similar to Deuteronilus glaciers (Head et al., this morning)

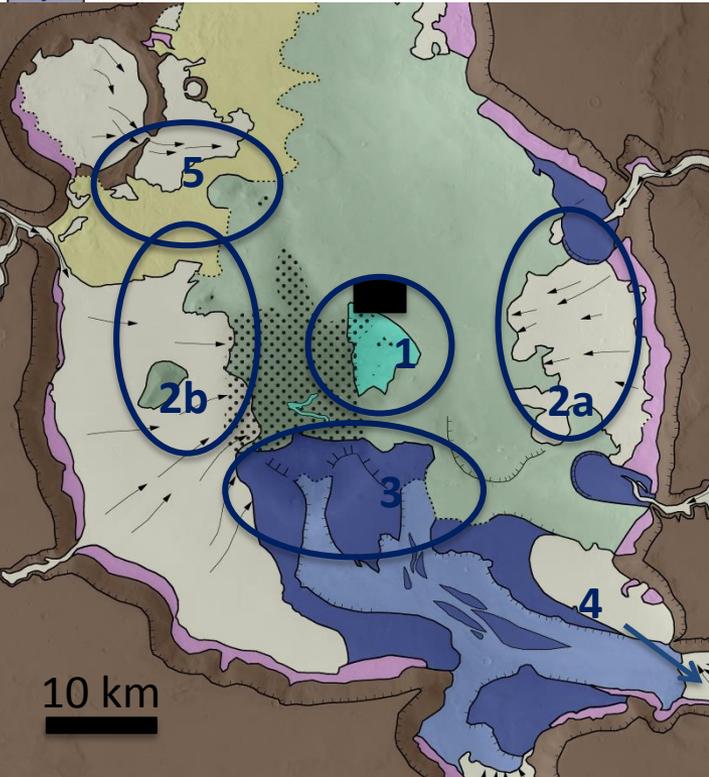


Science ROI 2b

1st EZ Workshop for Human Missions to Mars

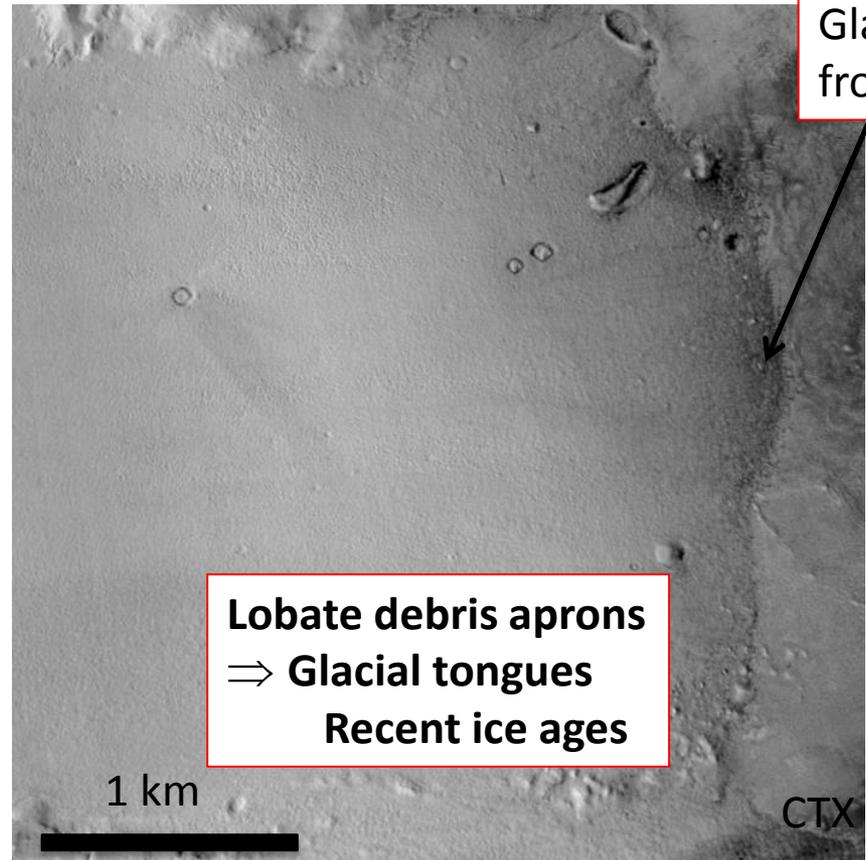


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Dehouck et al., Planet. Spa. Sci., 2010

Lobate debris apron 15 km west of the landing zone



Glacial front

Lobate debris aprons
⇒ Glacial tongues
Recent ice ages

Science ROI 3, 4

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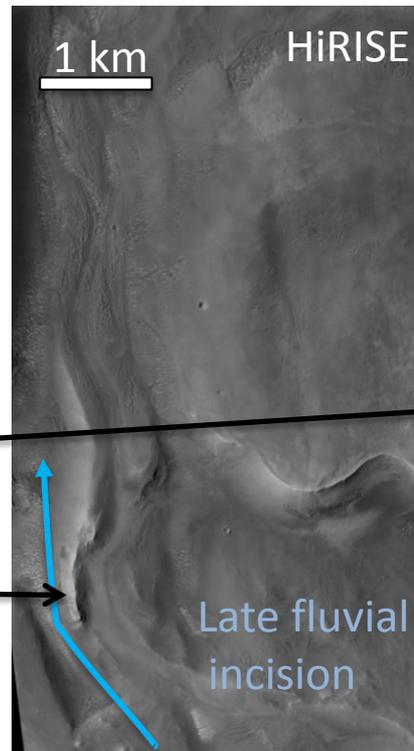
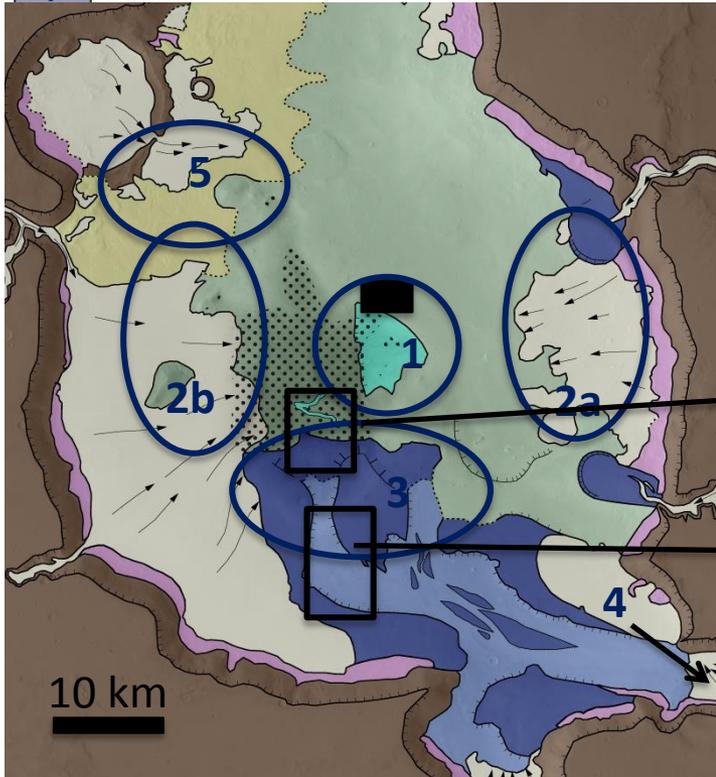


- | | | |
|------------|-------------------------------|--|
| 2 | Glacial landforms | Geologic map caption |
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| 3,4 | Delta deposits |  Noachian plateau |

Fluvial and deltaic deposits from Mamers Vallis

Fluvial bars

Clay minerals in some layers



Flow direction

Layers at delta front

Dehouck et al., Planet. Spa. Sci., 2010

Science ROI 5



2 Glacial landforms

5 Modified ejecta blanket

3,4 Channel in the delta deposits

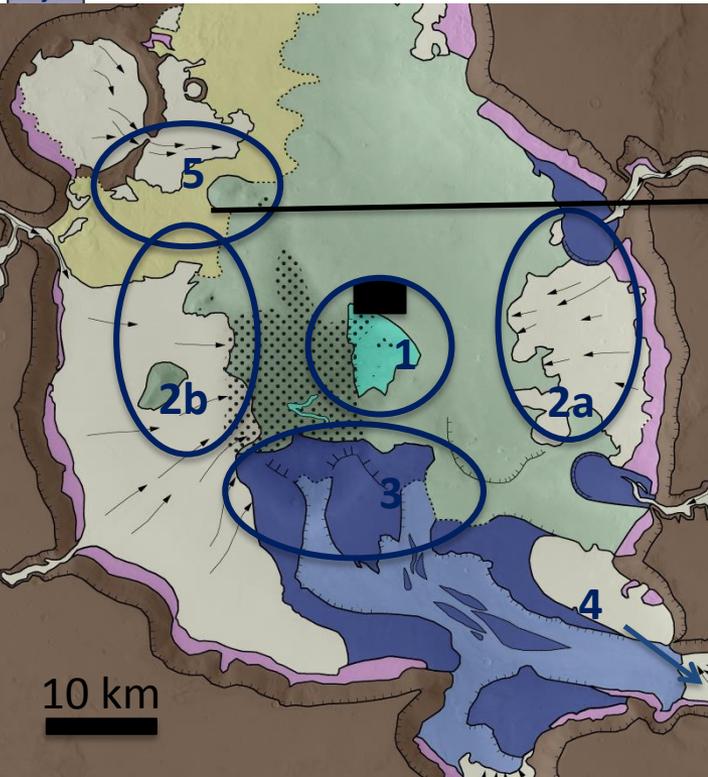
3,4 Delta deposits

Geologic map caption

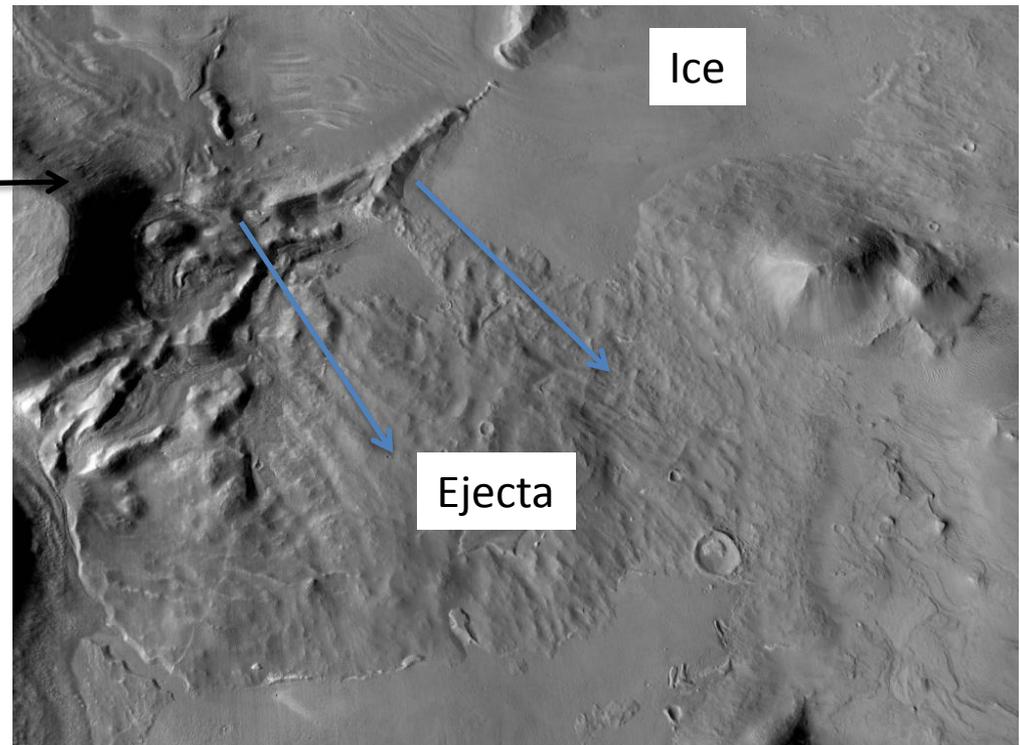
 Depression floor

 **1** Phyllosilicate-bearing unit

 Noachian plateau

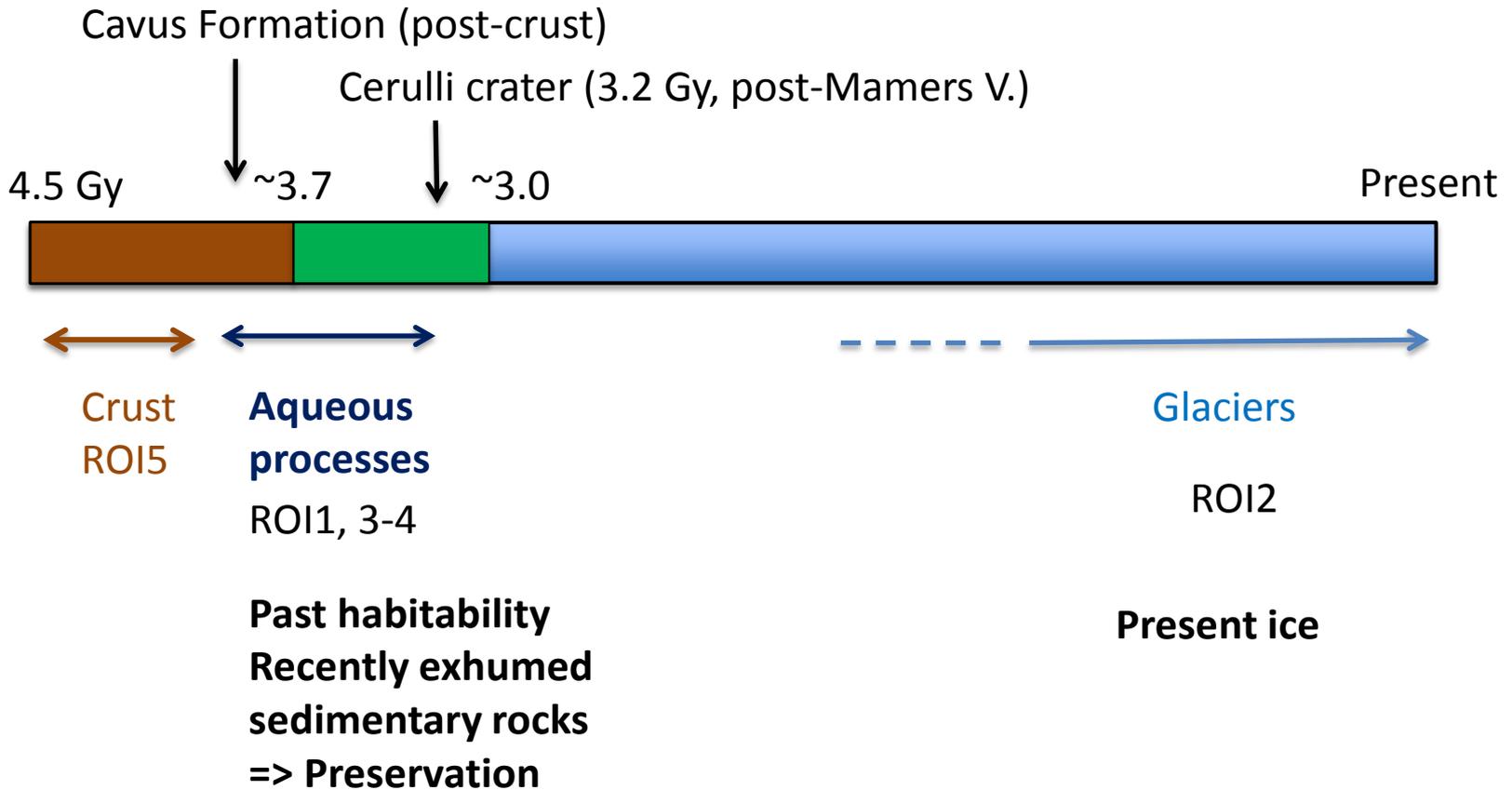


Ejecta from craters: Access to Noachian crustal rocks
Limitation: Maybe covered by ice



Science ROIs Summary: Range of geologic time

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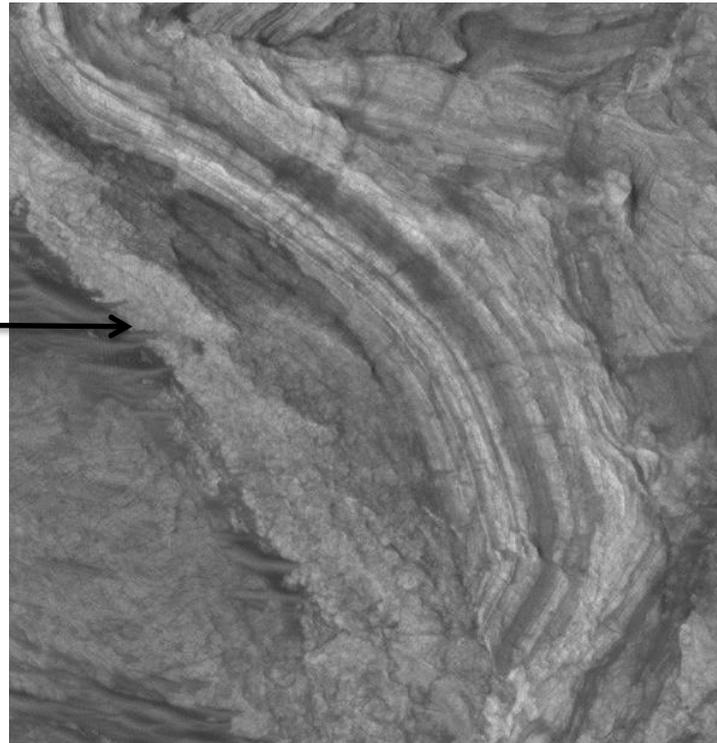
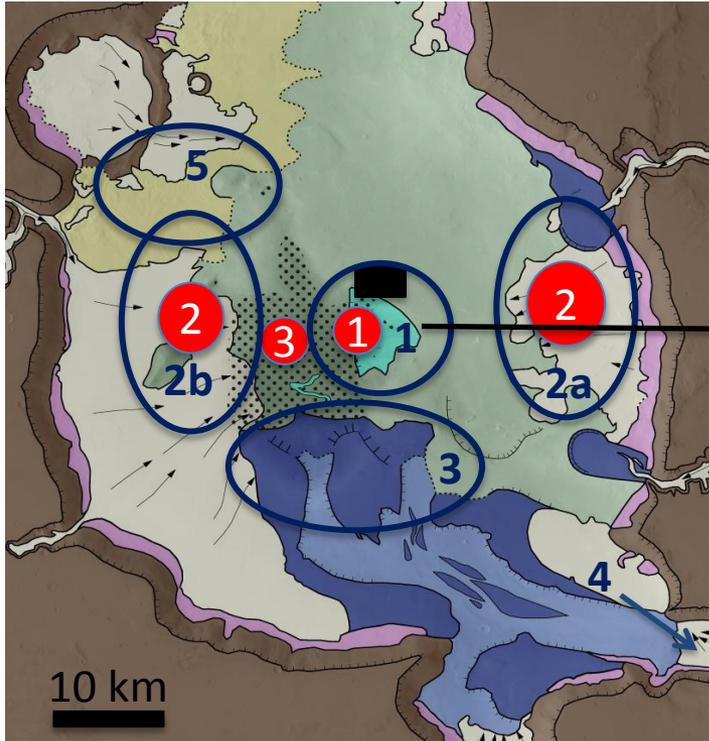


Resource ROI 1



Clay rich deposits contain water

e.g., saponite:

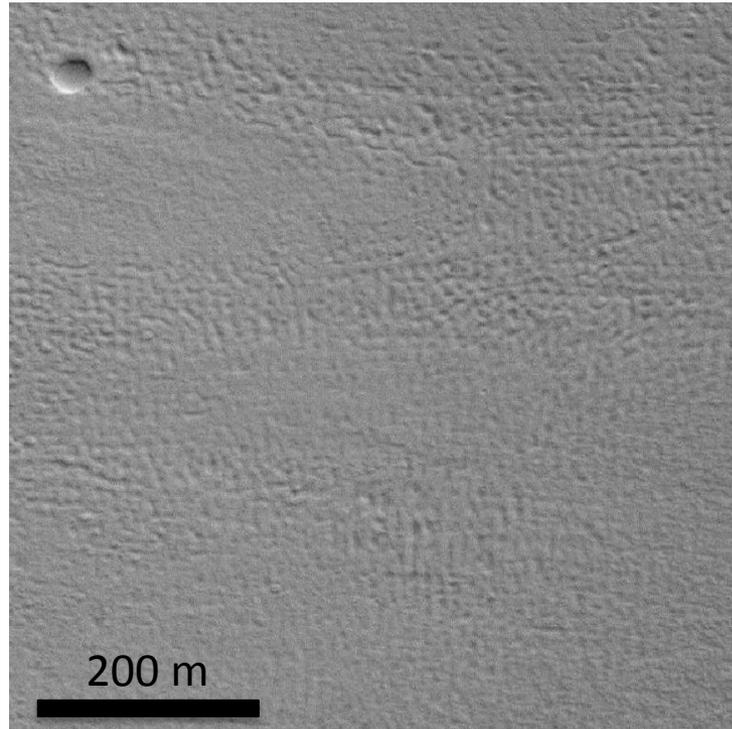
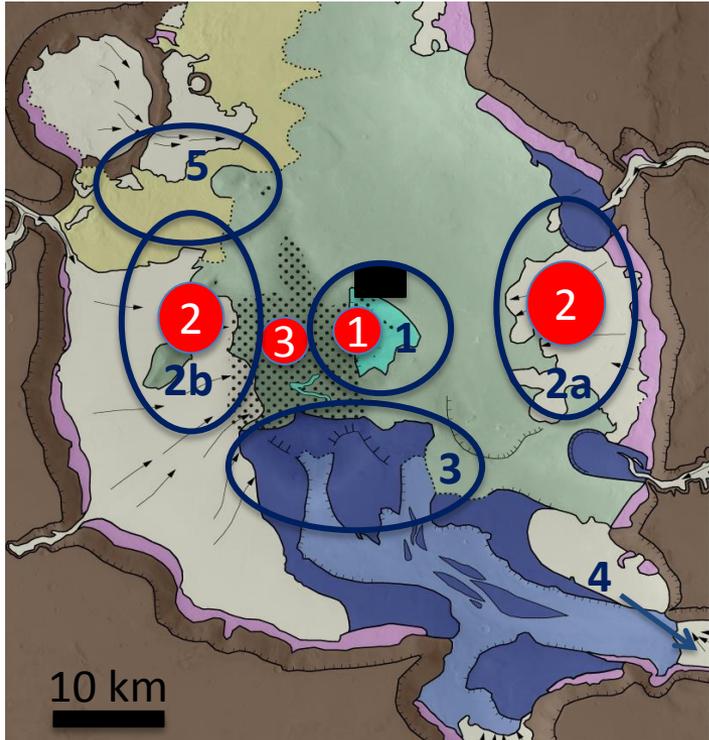


Resource ROIs 2a and 2b



Glacial deposits contain ice

Texture with some sublimation but
no intense sublimation
suggests ice likely near surface ($\ll 10$ m)

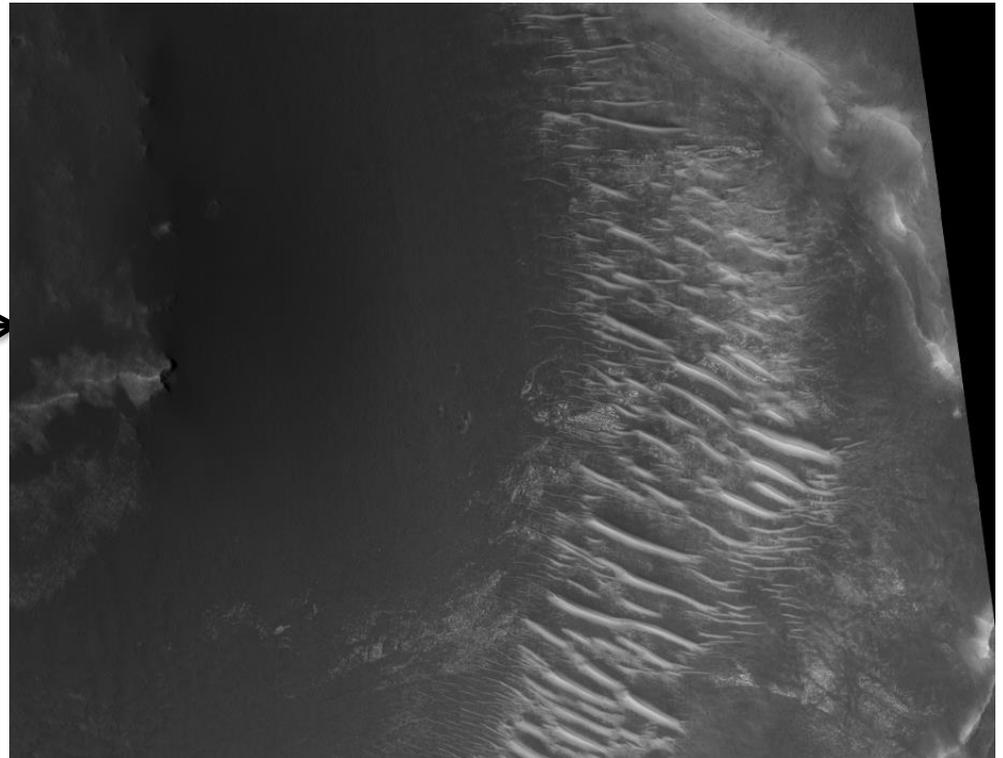
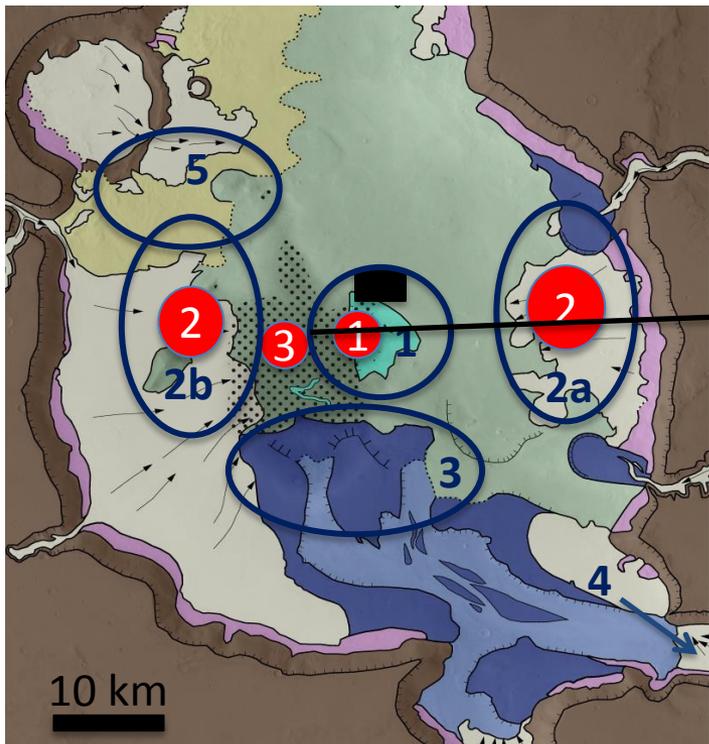


Resource ROI 3



Area of sand few kms west of the landing zone

Mobile material for construction (composition is pyroxene rich from spectral data)



Resource ROIs Summary

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- Two main resources for water:
 - Clay minerals near the landing site proposed
 - Water ice 10 km of potential landing site
- Mobile material for constructions close to landing site

Science ROI(s) Rubric

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Site Factors				SROI1	SROI2	SROI3	SROI4	SROI5	RROI1	RROI2	RROI3	EZ SUM
Astrobio	Threshold	AND/OR	Potential for past habitability	●		●	●		●			4,0
			Potential for present habitability/refugia		?					?		0,2
	Qualifying		Potential for organic matter, w/ surface exposure	●		●	○		●			3,1
Atmospheric Science	Threshold		Noachian/Hesperian rocks w/ trapped atmospheric gases	●		●		○	●			3,1
			Meteorological diversity in space and time	?	?	○			?	?		0,5
	Qualifying		High likelihood of surface-atmosphere exchange		●					●	●	3,0
			Amazonian subsurface or high-latitude ice or sediment		●					●		2,0
			High likelihood of active trace gas sources									
Geoscience	Threshold		Range of martian geologic time; datable surfaces	●		?			●			2,1
			Evidence of aqueous processes	●		●	●		●			4,0
			Potential for interpreting relative ages	●	?			○	●	?		2,3
	Qualifying		Igneous Rocks tied to 1+ provinces or different times									
			Near-surface ice, glacial or permafrost		●					●		2,0
			Noachian or pre-Noachian bedrock units	○				●	○			1,2
			Outcrops with remnant magnetization									
			Primary, secondary, and basin-forming impact deposits									
	Structural features with regional or global context		?					?			0,2	
	Diversity of aeolian sediments and/or landforms		●					●	●		3,0	

Key	
●	Yes
○	Partial Support or Debated
	No
?	Indeterminate

Science Site Criteria

Resource ROI(s) Rubric

1st EZ Workshop for Human Missions to Mars



Site Factors			SROI1	SROI2	SROI3	SROI4	SROI5	RROI1	RROI2	RROI3	EZ SUM				
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													
	Food Production	Qualifying	Utilitarian terrain features												
			Low latitude												
			No local terrain feature(s) that could shadow light collection facilities												
			Access to water												
Metal/Silicon Resource	Threshold	Access to dark, minimally altered basaltic sands													
		Potential for metal/silicon													
		Potential to be minable by highly automated systems													
		Located less than 3 km from processing equipment site													
	Qualifying	Located no more than 3 meters below the surface													
		Accessible by automated systems													
		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

Highest Priority EZ Data Needs

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- High resolution **stereo** imagery on glacial flows (both for Resource and Science ROI2)
- High resolution imagery on Mammers Vallis outlet (for Science ROI4 and for navigation)

Conclusion:

A unique location on Mars with both present ice and past lake sediments with clay minerals

BACKUP SLIDES

Prioritization List of EZ Data Needs

1st EZ Workshop for Human Missions to Mars



- Provide a prioritized list of orbiter/rover data to be collected to assess the science potential of the EZ.
- Provide a prioritized list of orbiter/rover data to be collected to assess the resource potential of the EZ.
- This data could be either from a current or future asset.
- If data to be collected are from existing assets please indicate:
 - HiRISE
 - CRISM
 - THEMIS
 - other

Provide a short justification as to what questions this will address.