



# Western Candor Chasma Candidate Landing Sites

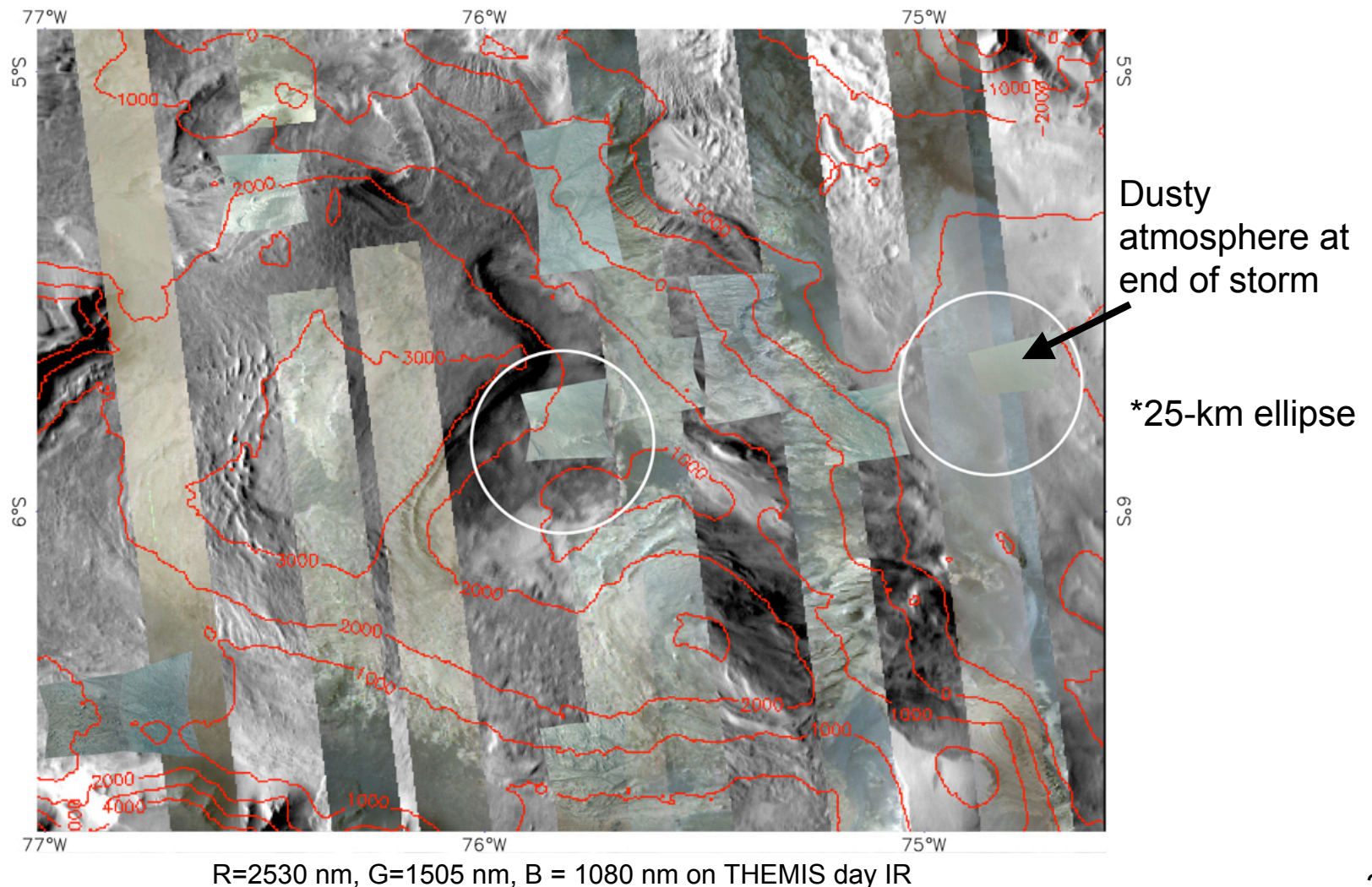
Scott Murchie

(on behalf of many on the CRISM team,  
especially Frank Seelos, Leah Roach,  
Ralph Milliken, and Eldar Noe Dobrea)

24 Oct 2007

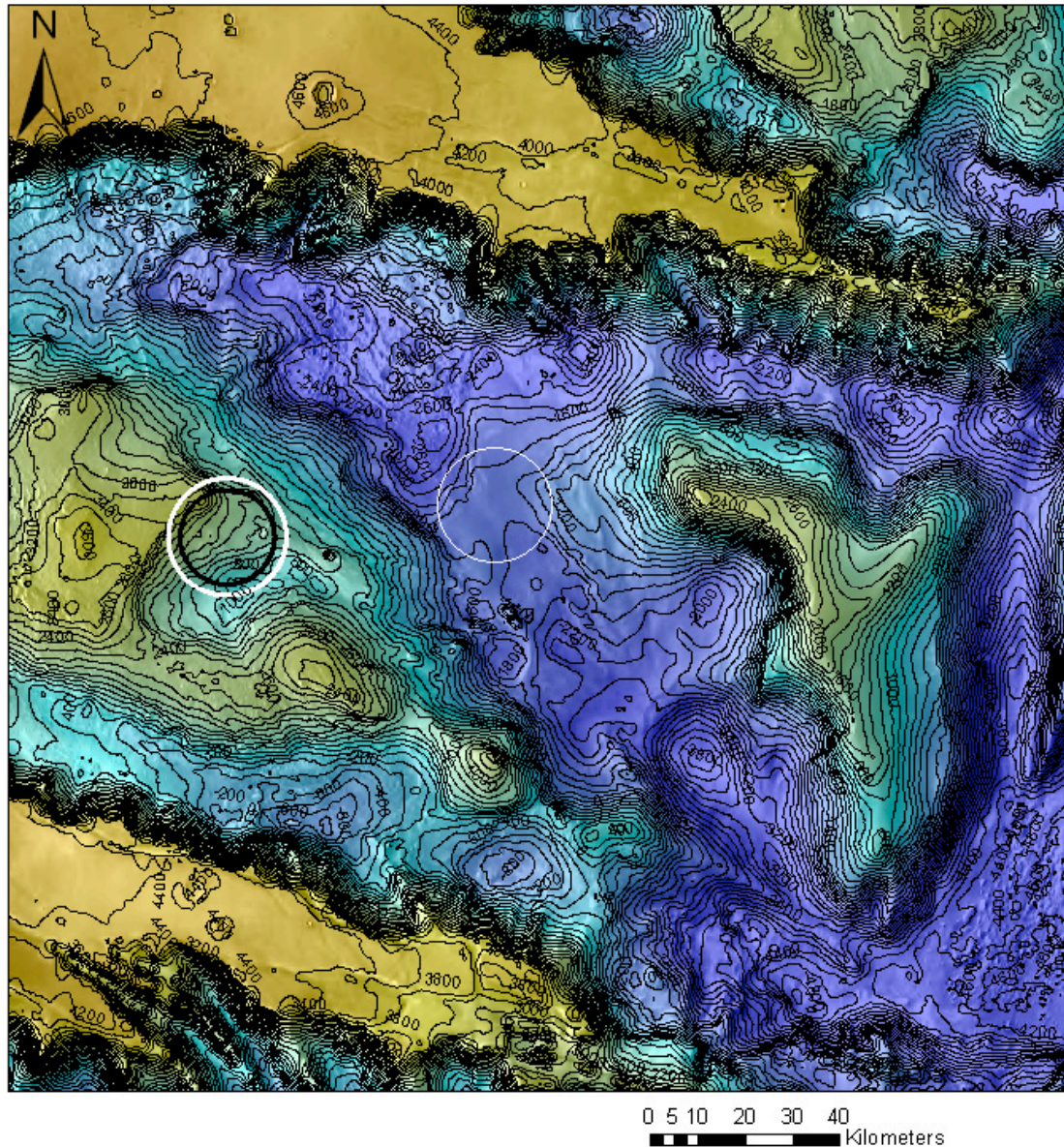


- TES, OMEGA: ILDs contain poly-, monohydrated sulfates, locally ferric oxide
- 3-km thick Hesperian deposit is among the youngest with evidence for an aqueous mineral record
- 2 sites, originally proposed and a safer alternate
- Regional coverage about 50% by CRISM mapping, 11 targeted observations





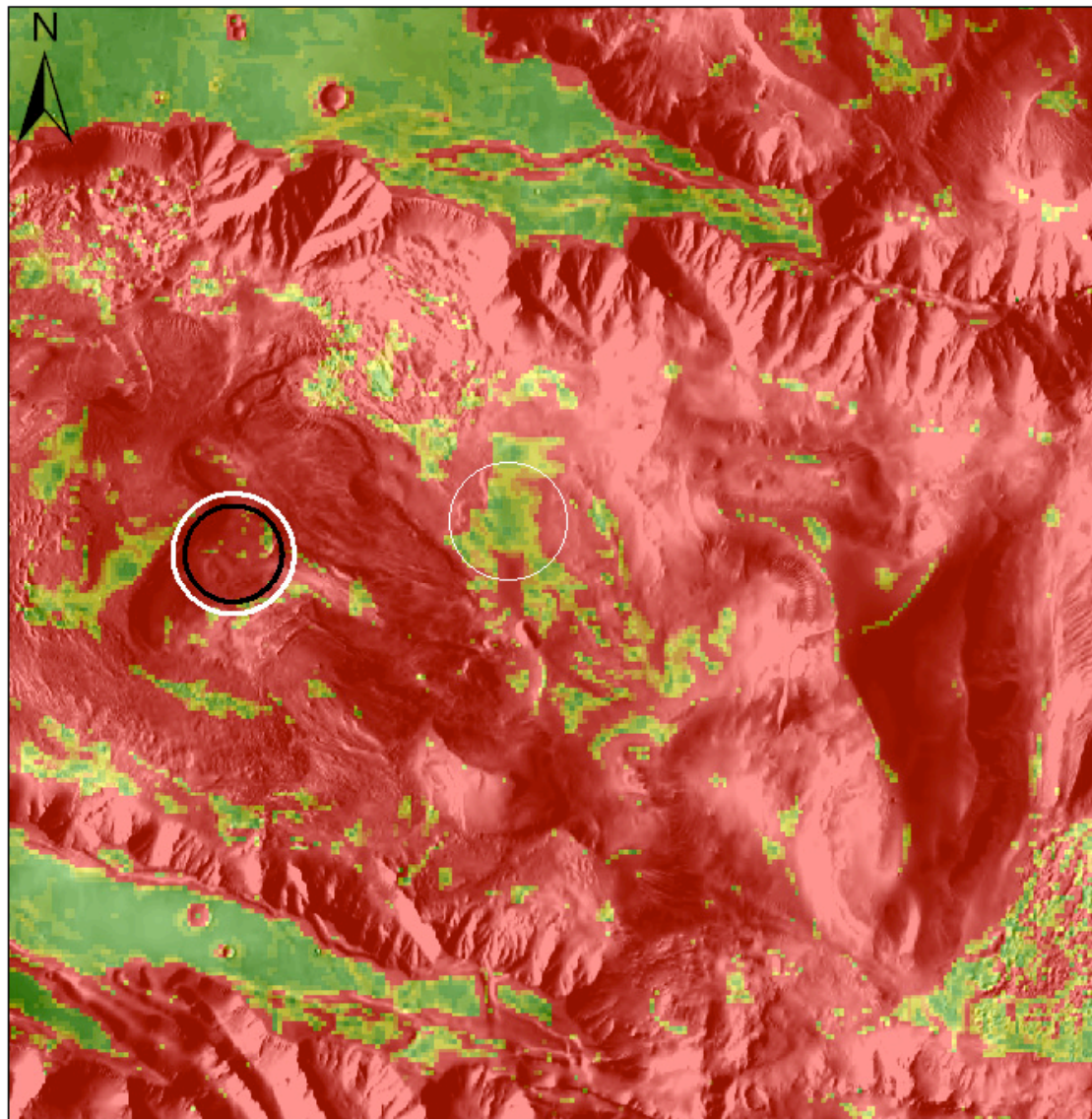
# Engineering Constraints: Elevation



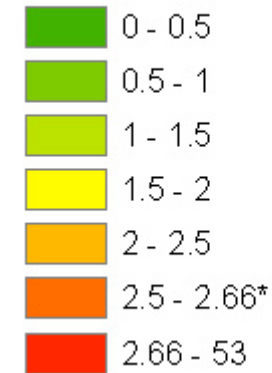
- 2/3 of original ellipse is above +1 km elevation constraint
- Alternate ellipse -1.2 to -2.4 km elevation



# Engineering Constraints: Slopes



Slope (degrees) at 926m



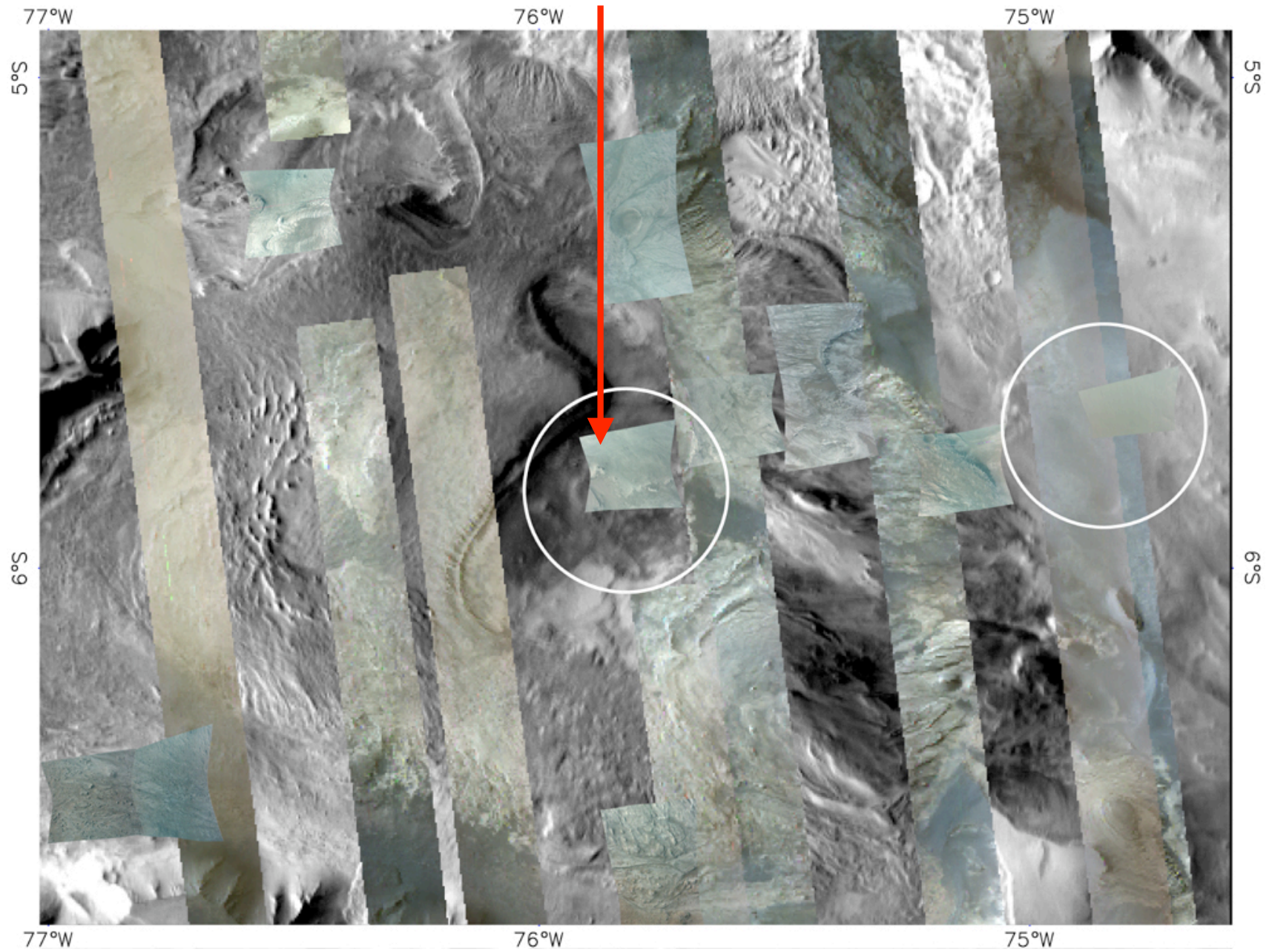
- Virtually all of original ellipse above  $2.5^\circ$  over 1 km slope constraint
- Half of alternate ellipse is within slope constraint; the smoothest region with access to West Candor's ILDs

Leg

0 5 10 20 30 40  
Kilometers



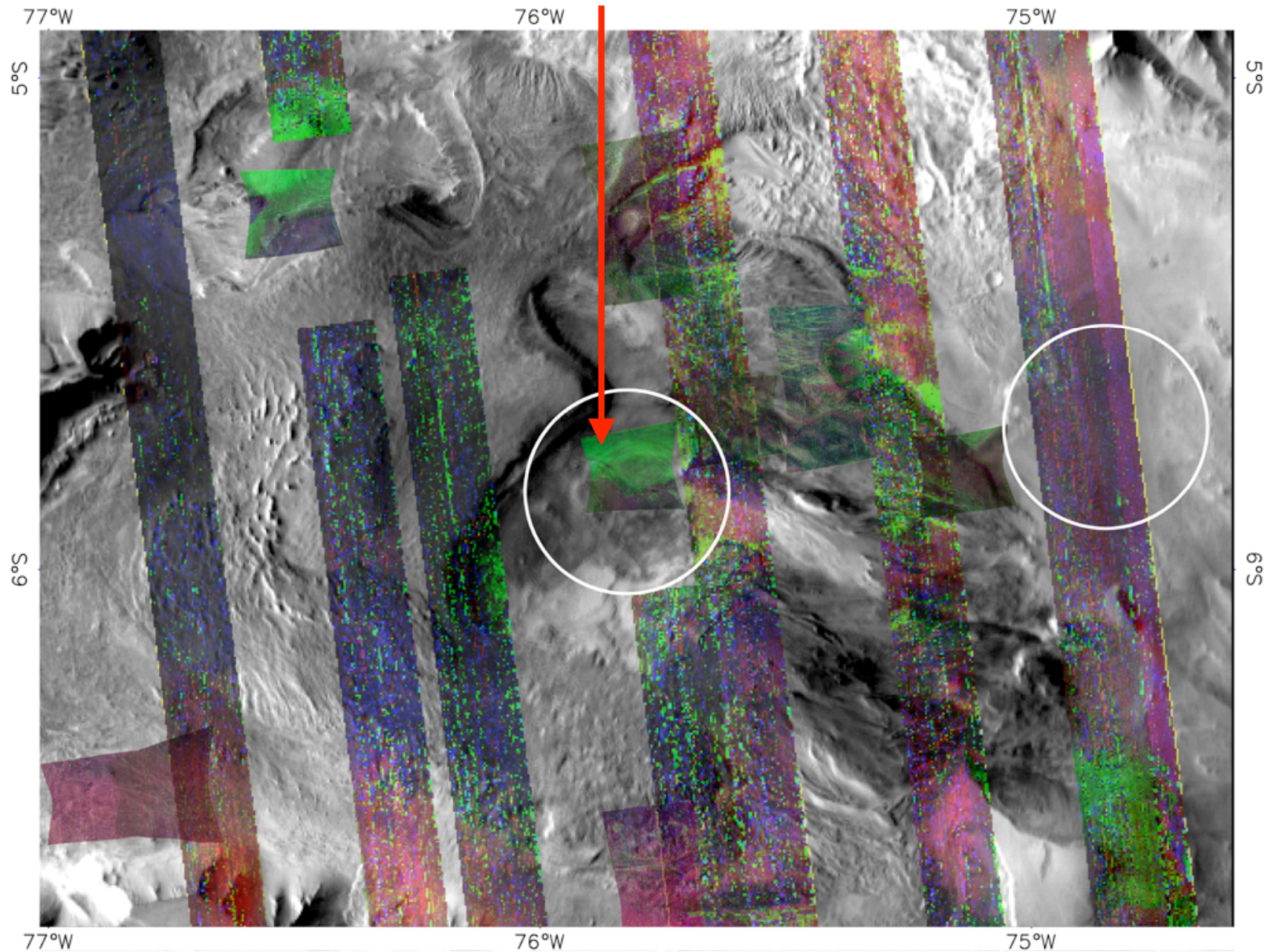
1) High-albedo layers with signature of monohydrated sulfate



R=2530 nm, G=1505 nm, B = 1080 nm on THEMIS day IR



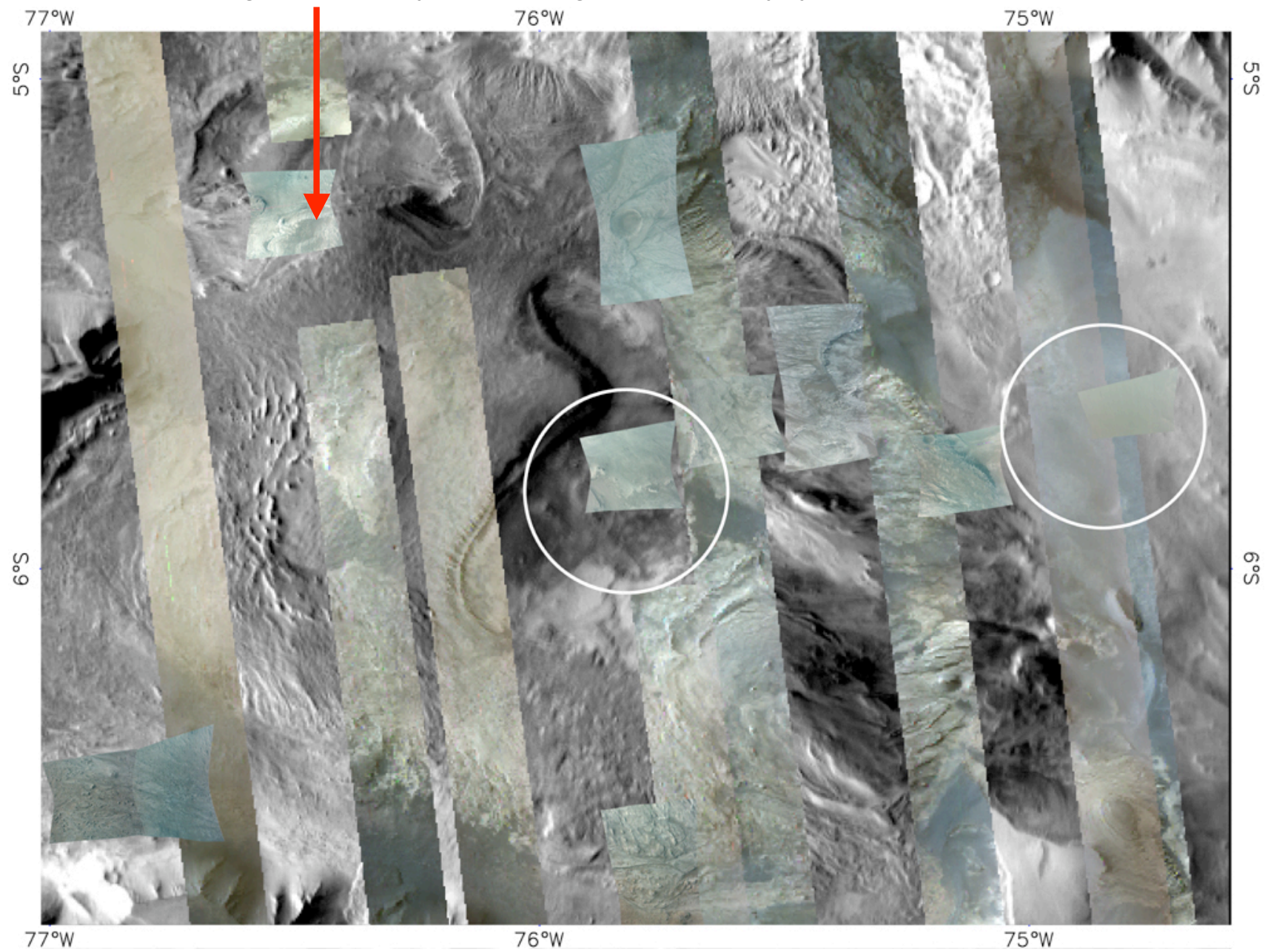
1) High-albedo layers with signature of monohydrated sulfate



R=BDI1000IR (1-μm mafic mineral band), G = BD2100 (monohyd sulf), B = BD1900 (polyhyd sulf) on THEMIS day IR



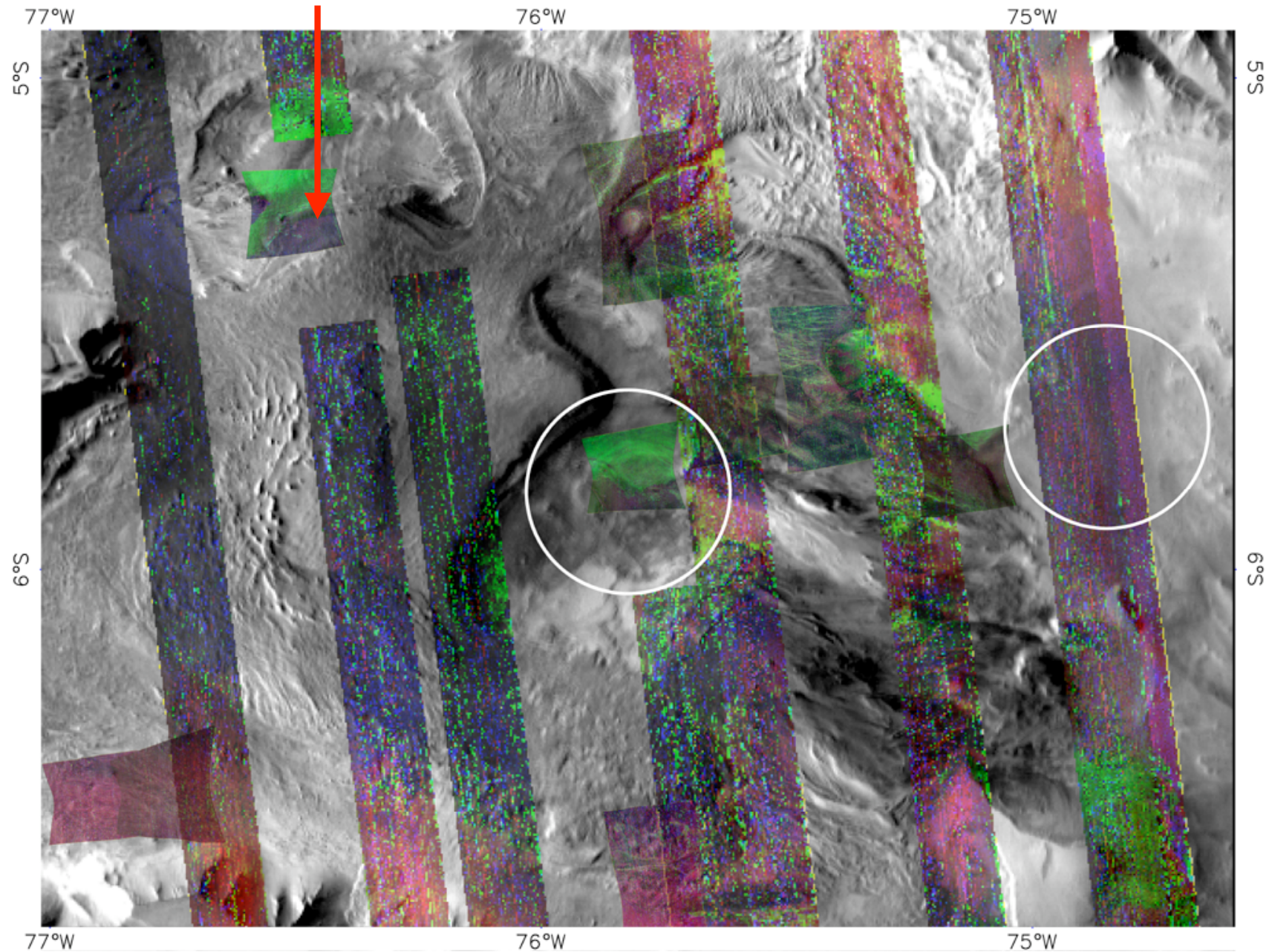
2) Medium- to high-albedo layers with signature of polyhydrated sulfate



R=2530 nm, G=1505 nm, B = 1080 nm on THEMIS day IR



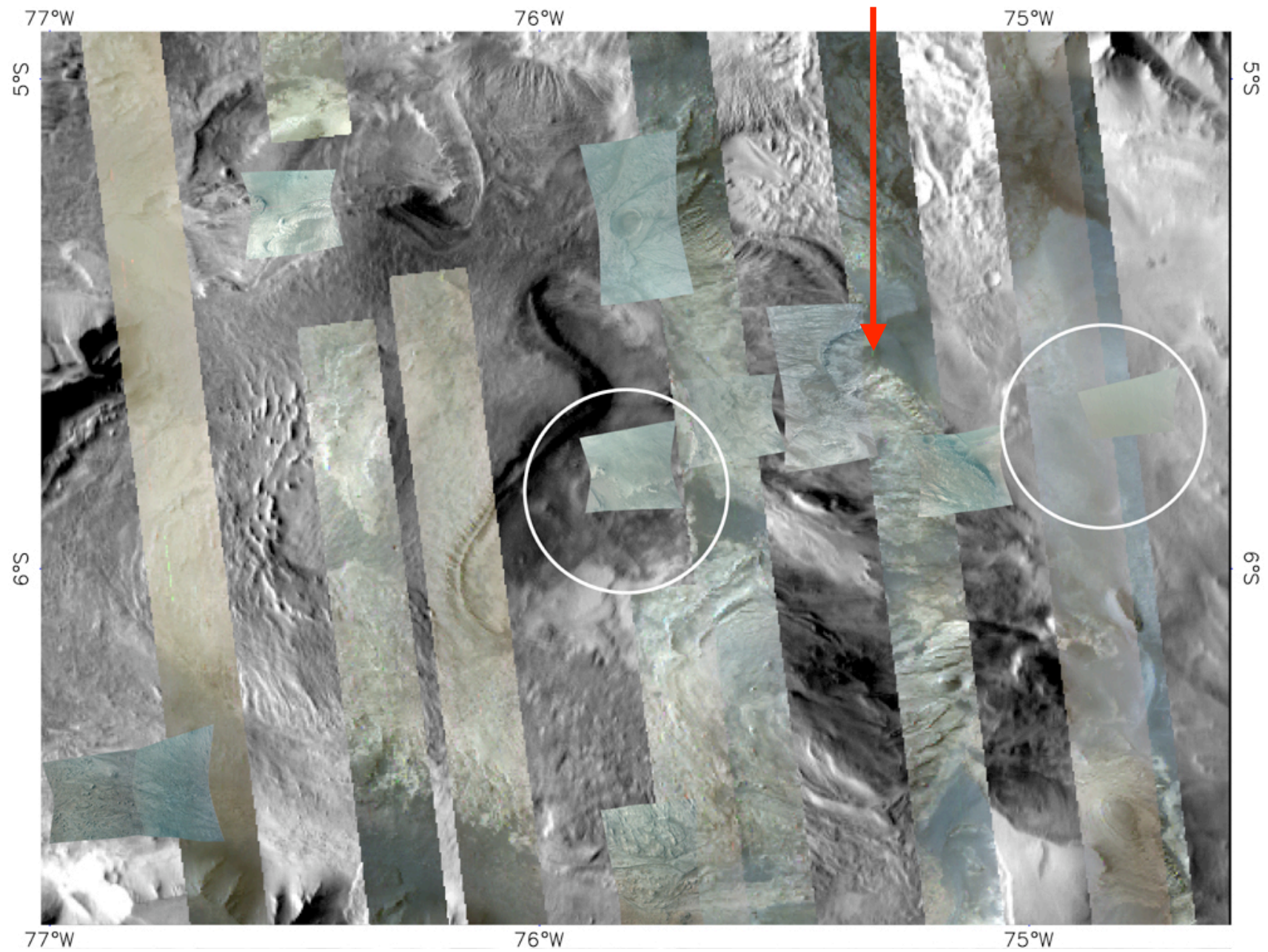
## 2) Medium- to high-albedo layers with signature of polyhydrated sulfate



R=BDI1000IR (1- $\mu$ m mafic mineral band), G = BD2100 (monohyd sulf), B = BD1900 (polyhyd sulf) on THEMIS day IR



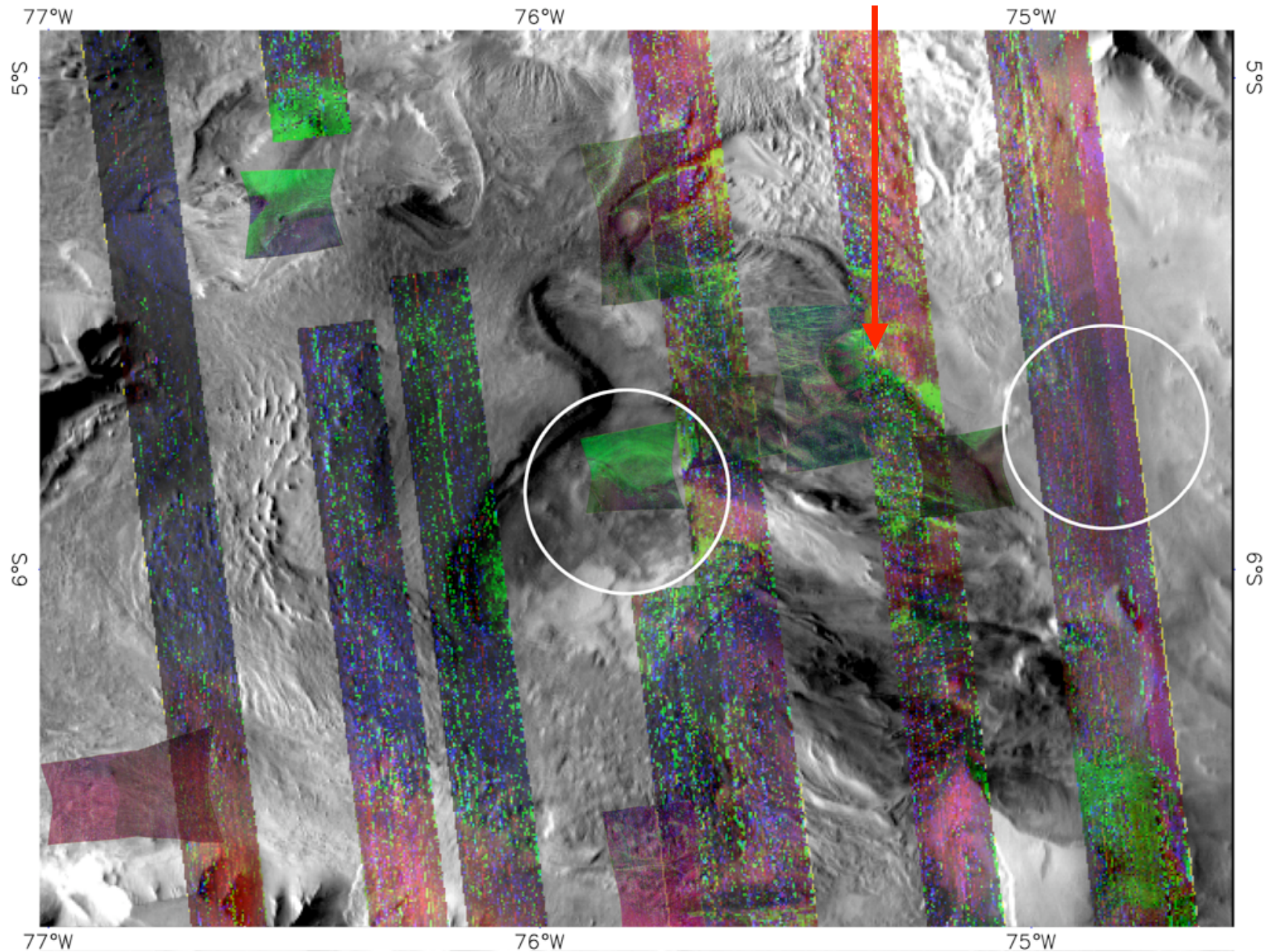
3) Lower-albedo, friable material with monohydrated sulfate, sometimes ferric oxide



R=2530 nm, G=1505 nm, B = 1080 nm on THEMIS day IR

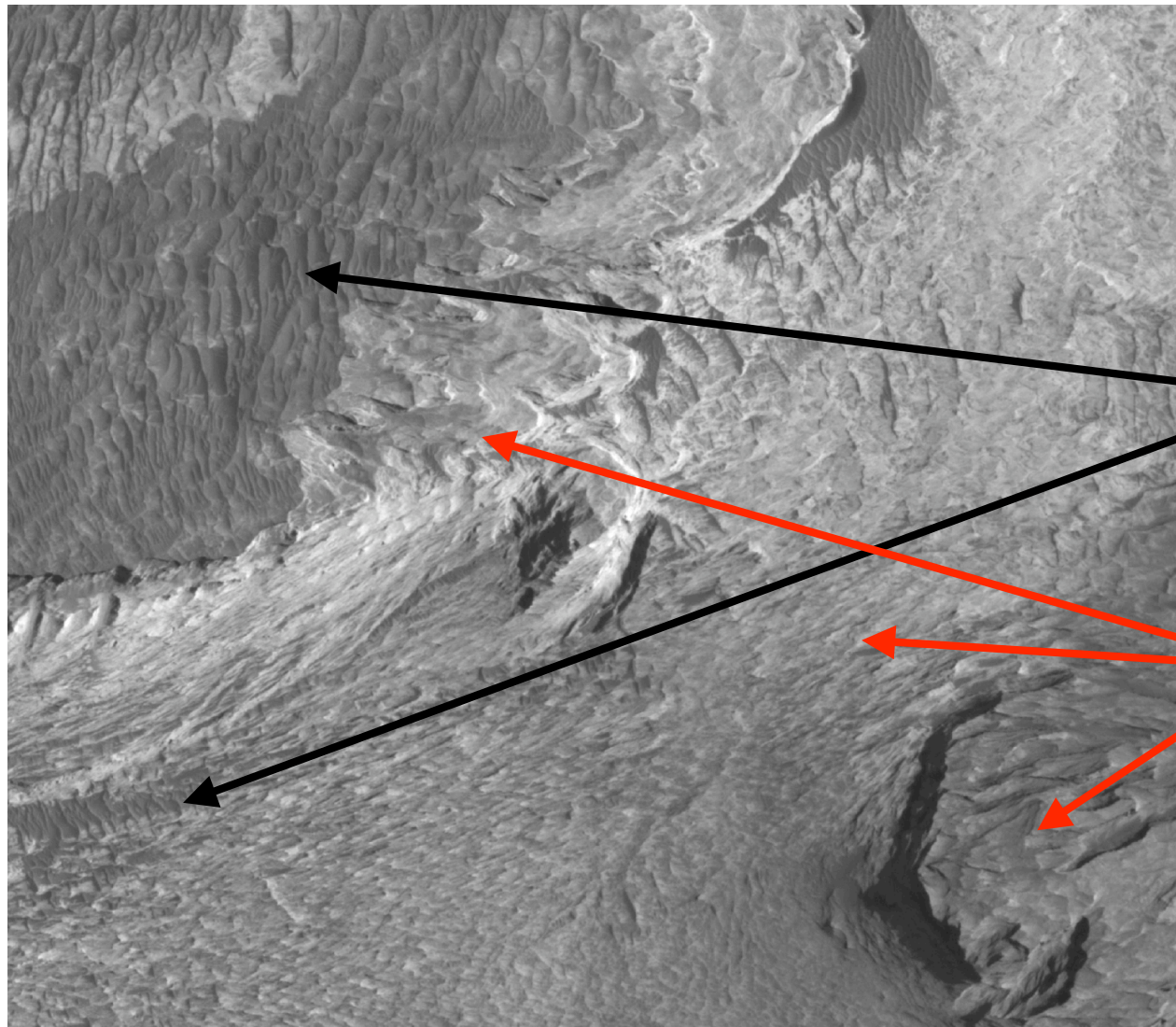


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## Layers and Debris, NW Candor

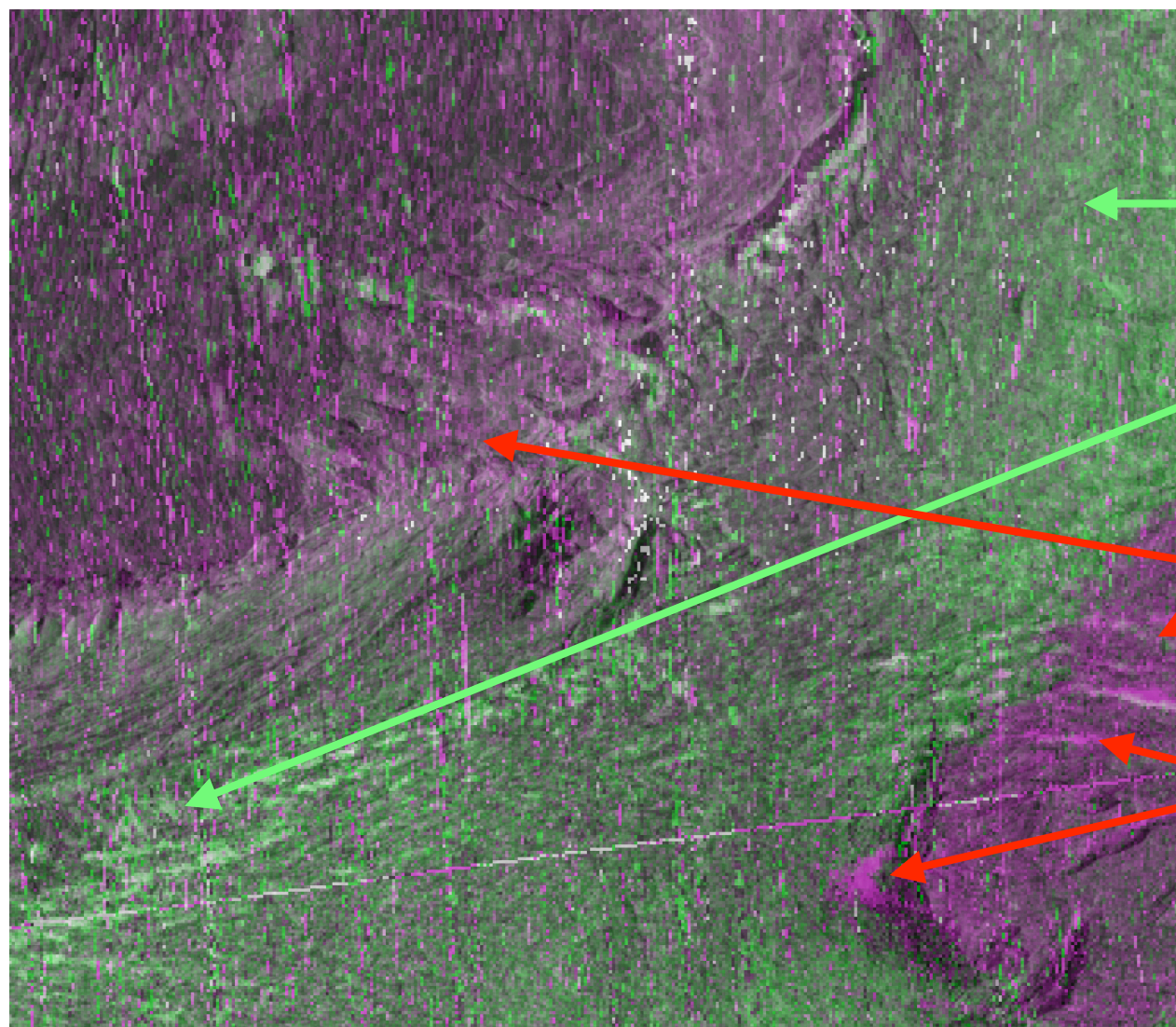
Dunes

Yardangs

CTX image shows  
exposures of eolian-  
sculpted layered  
rocks with eolian  
debris

5 km





Light-toned layered  
rock with monohydrate  
signature

Dark-toned dune-  
forming material with  
monohydrate signature

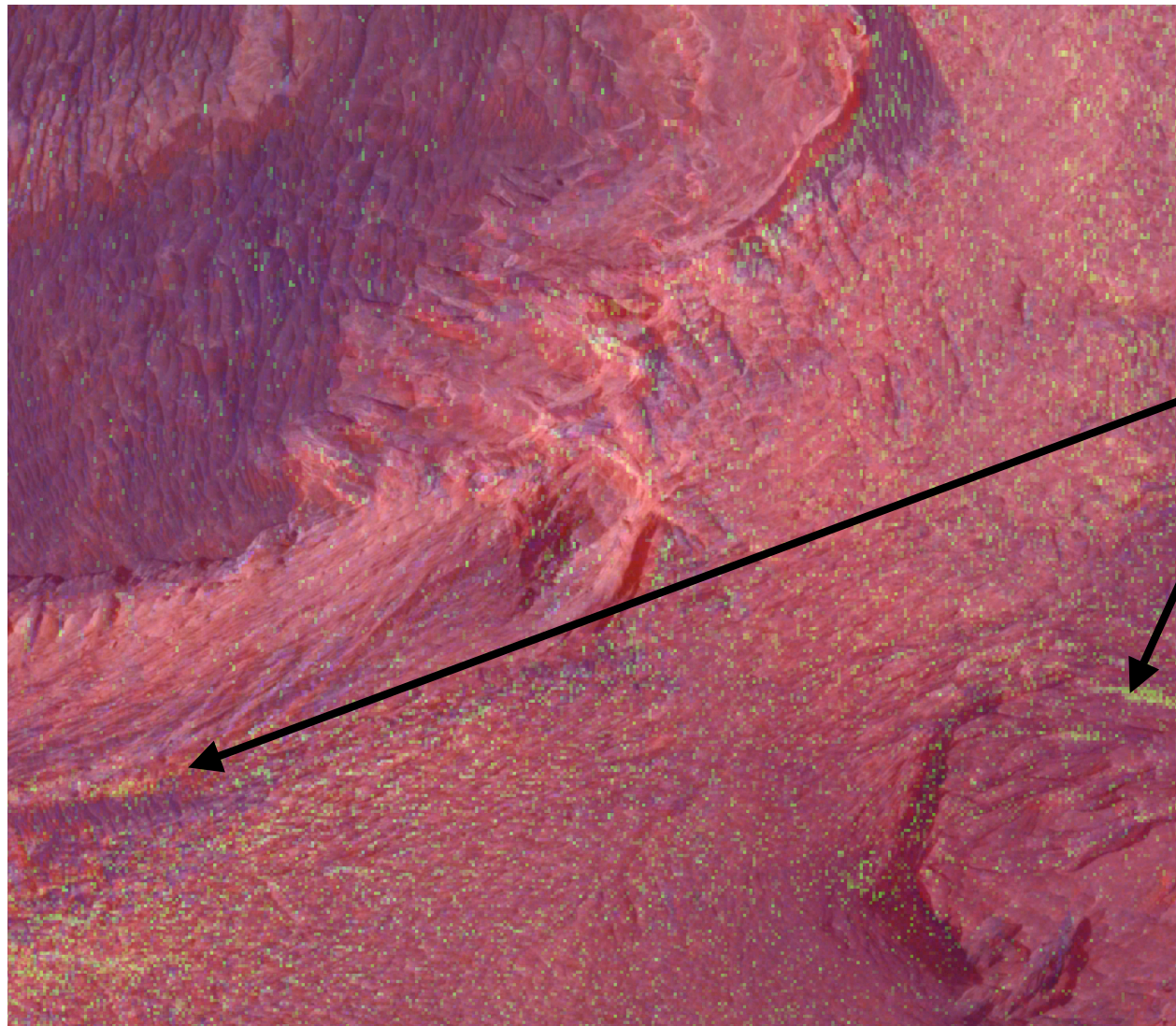
Light- and medium-  
toned cap-forming  
layered rock with  
polyhydrate signature

Dark-toned dune-  
forming material with  
polyhydrate signature

5 km

R,B = BD1900 (polyhydrate); G = BD2100 (monohydrate)





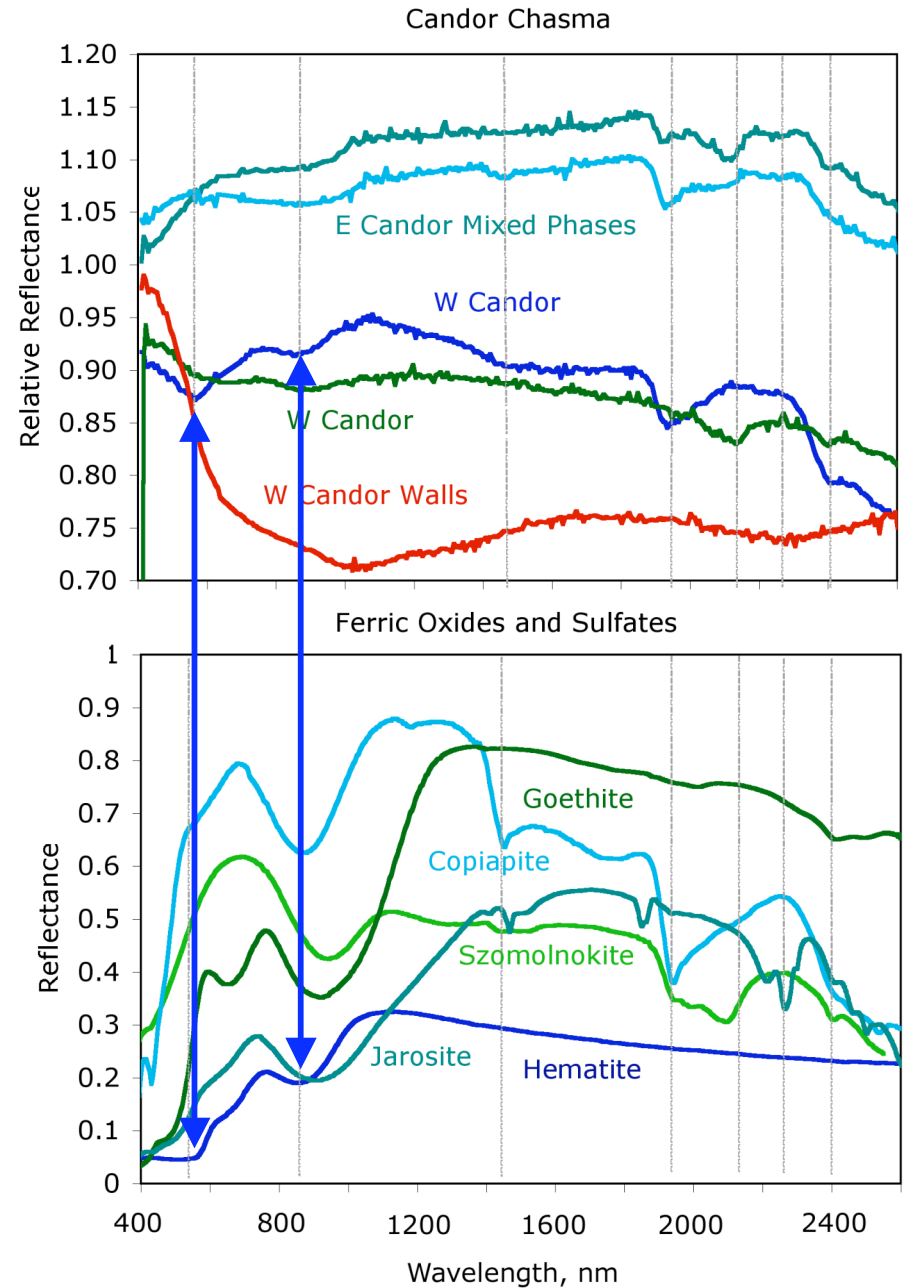
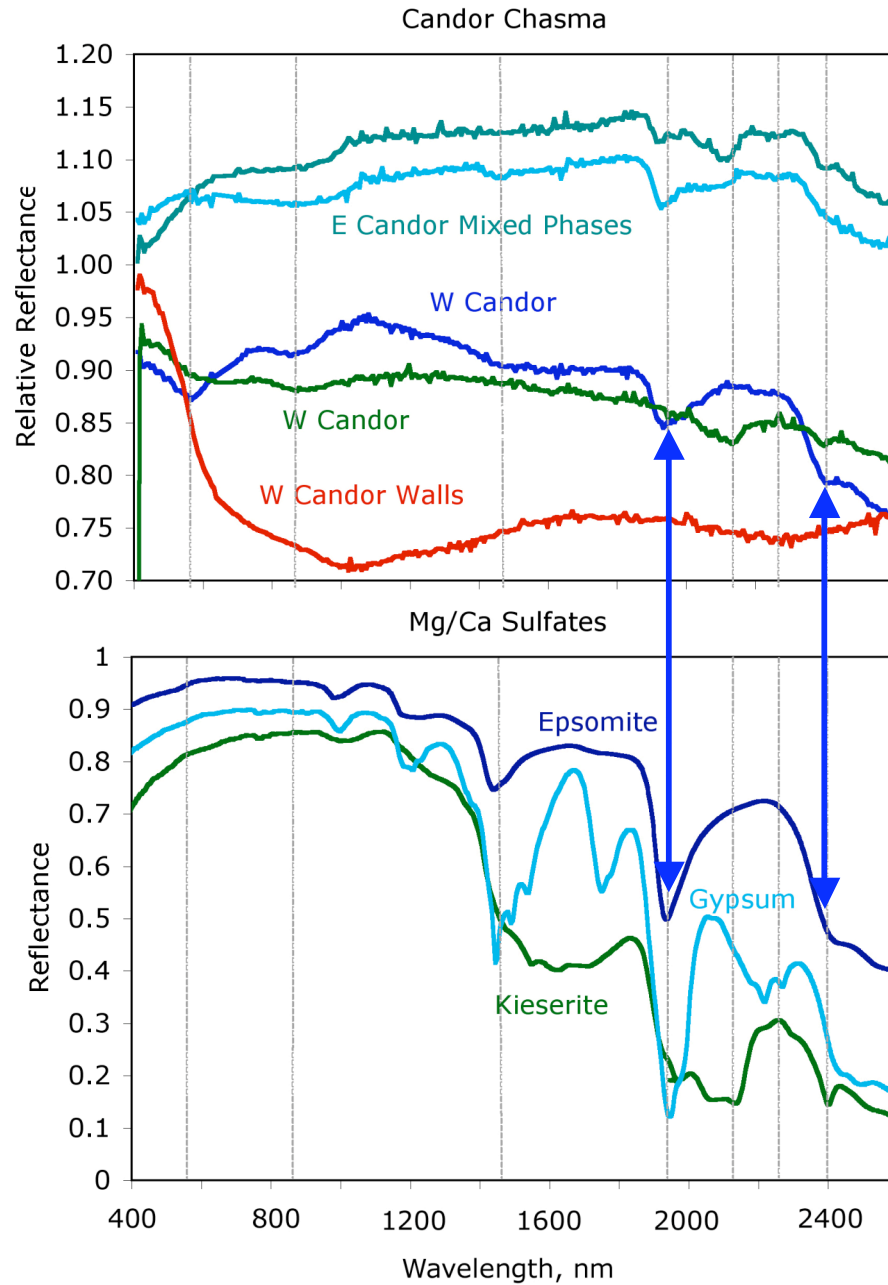
Dark-toned debris has crystalline ferric signature; interpreted as abraded gray hematite-containing, sulfate-bearing rock

5 km

R = BD530 (ferric)  
G = BD860 (crystalline ferric)  
B = BD1000 (mafic)

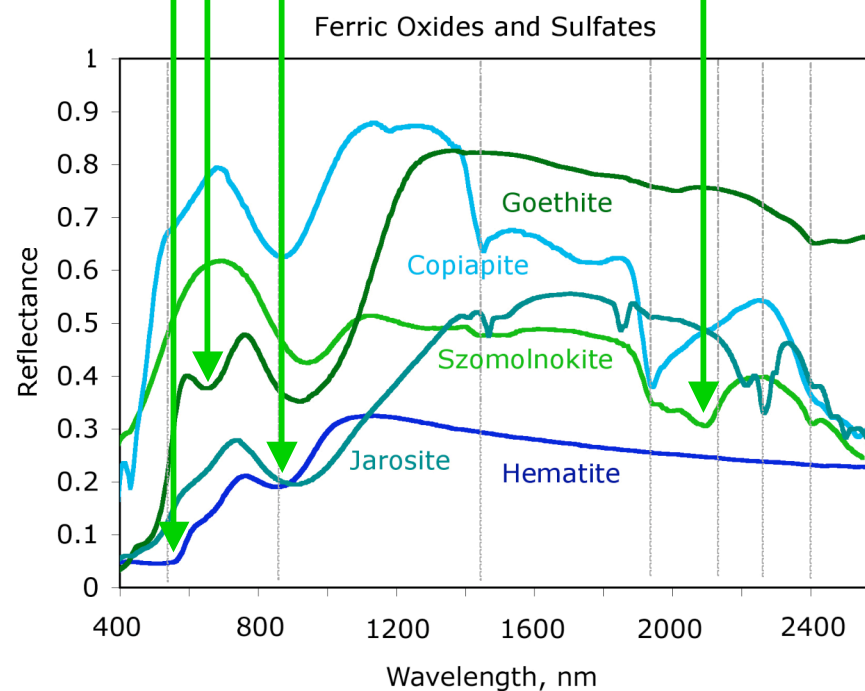
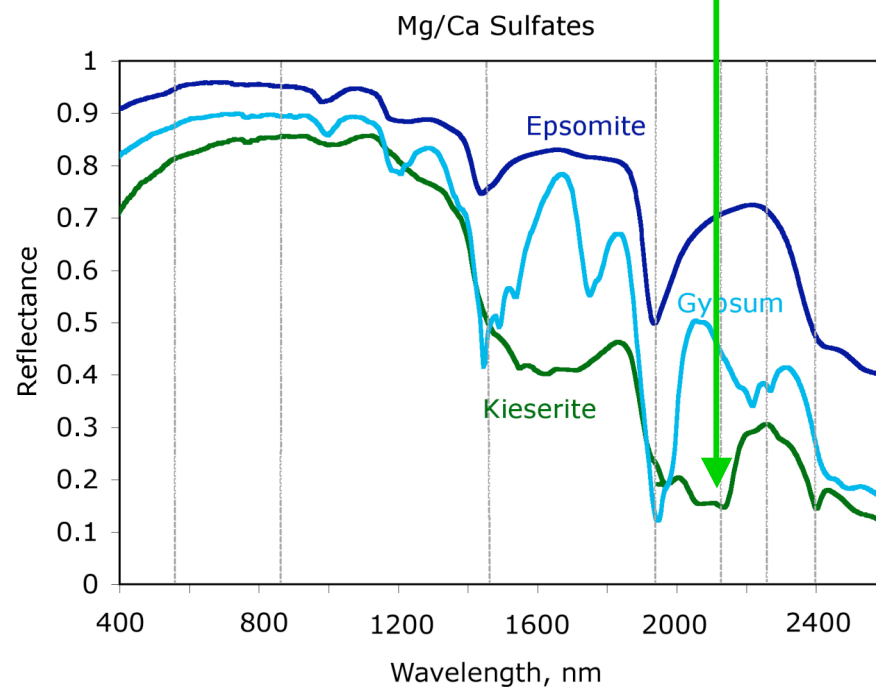
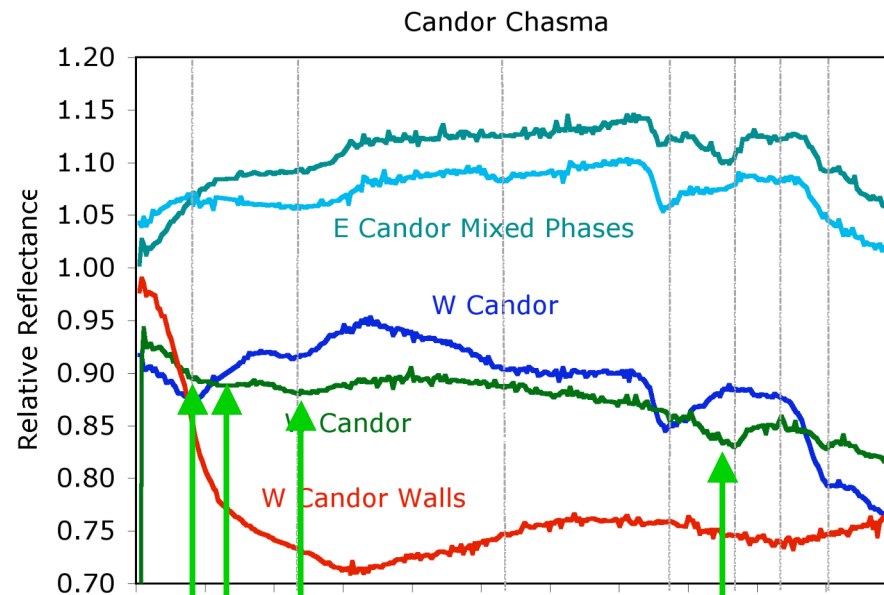
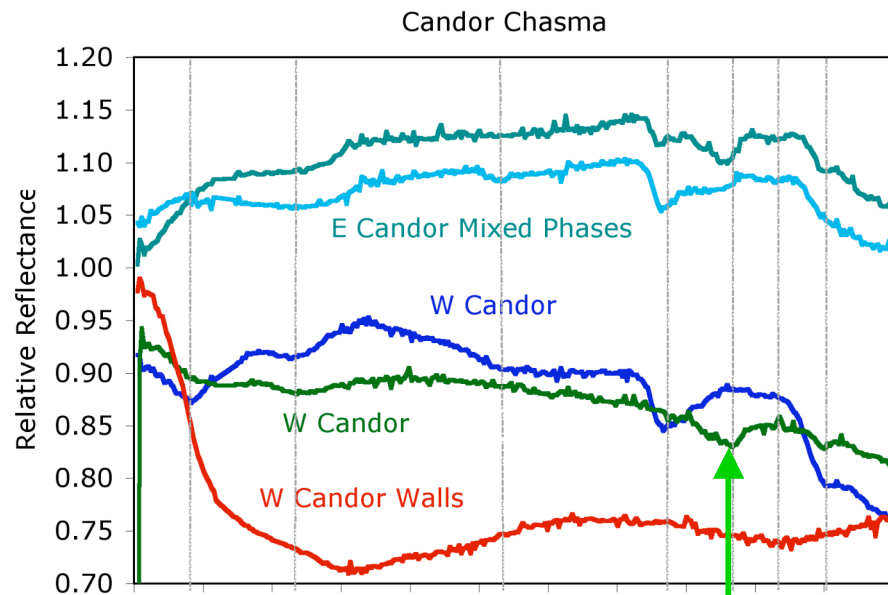


# Sulfate / Ferric Minerals: W Candor Polyhydrated Debris



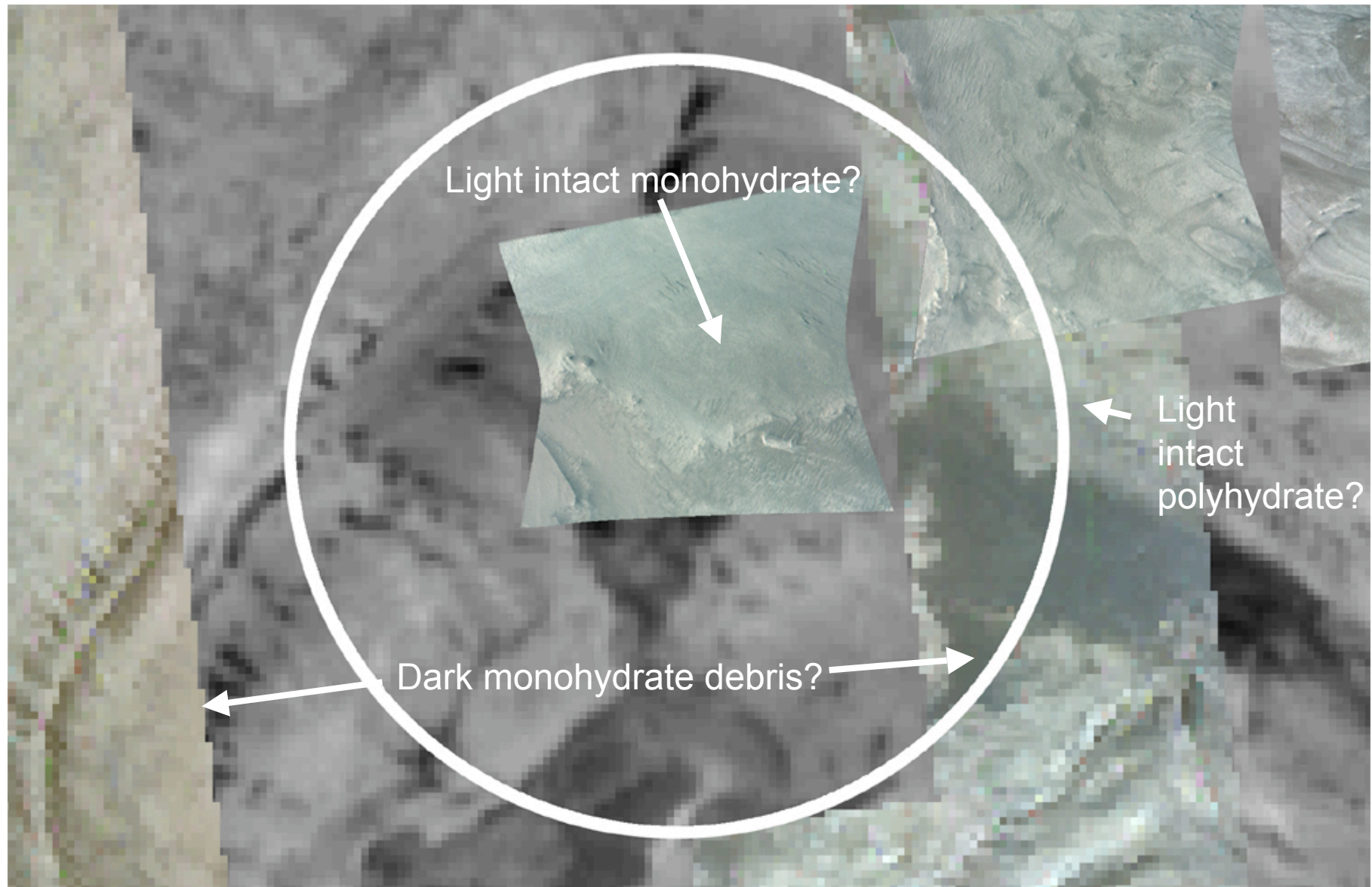


# Sulfate / Ferric Minerals: W Candor Monohydrated Debris





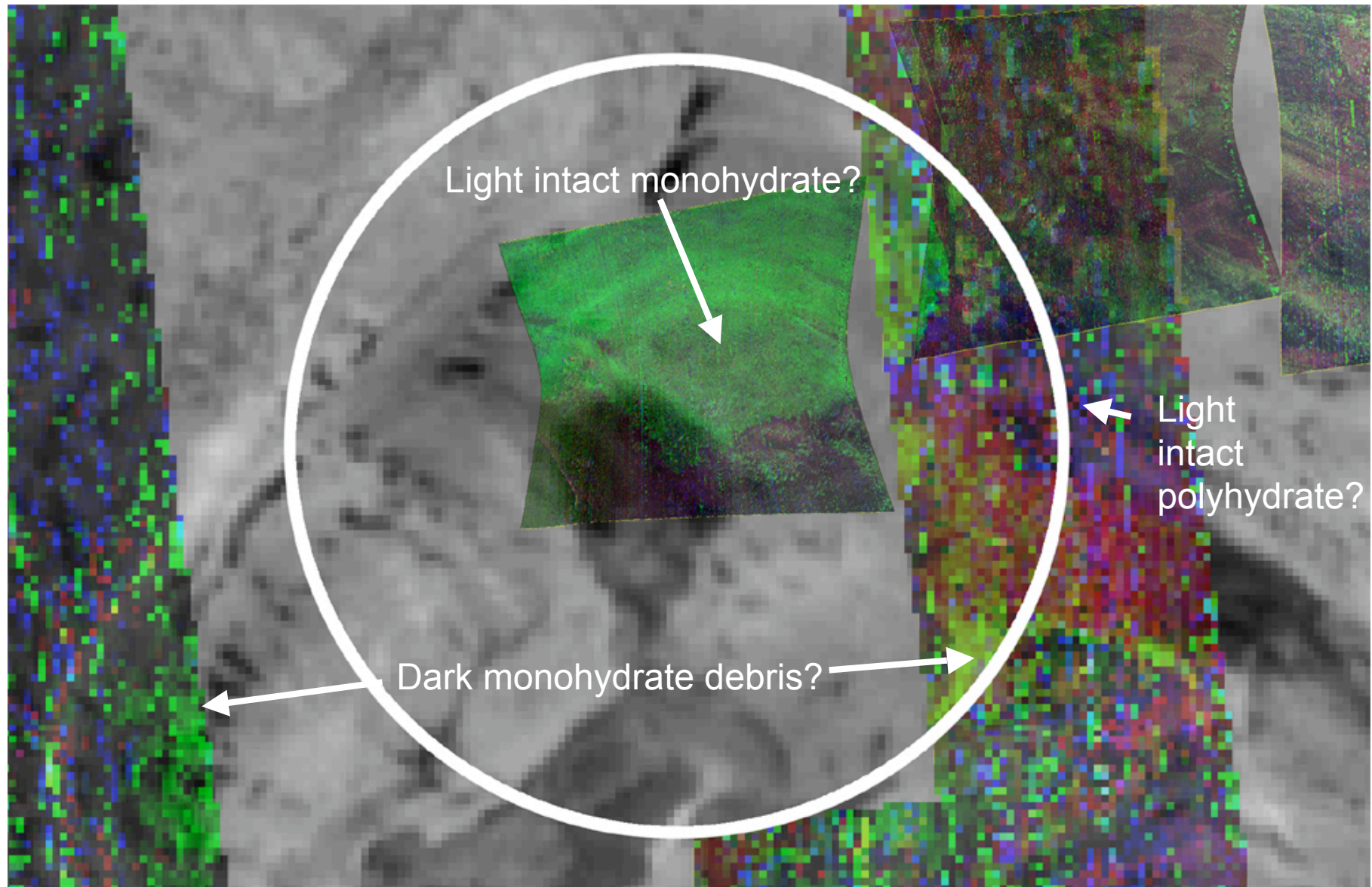
## Original Site, CRISM on THEMIS Night IR



R=2530 nm, G=1505 nm, B = 1080 nm on THEMIS night IR



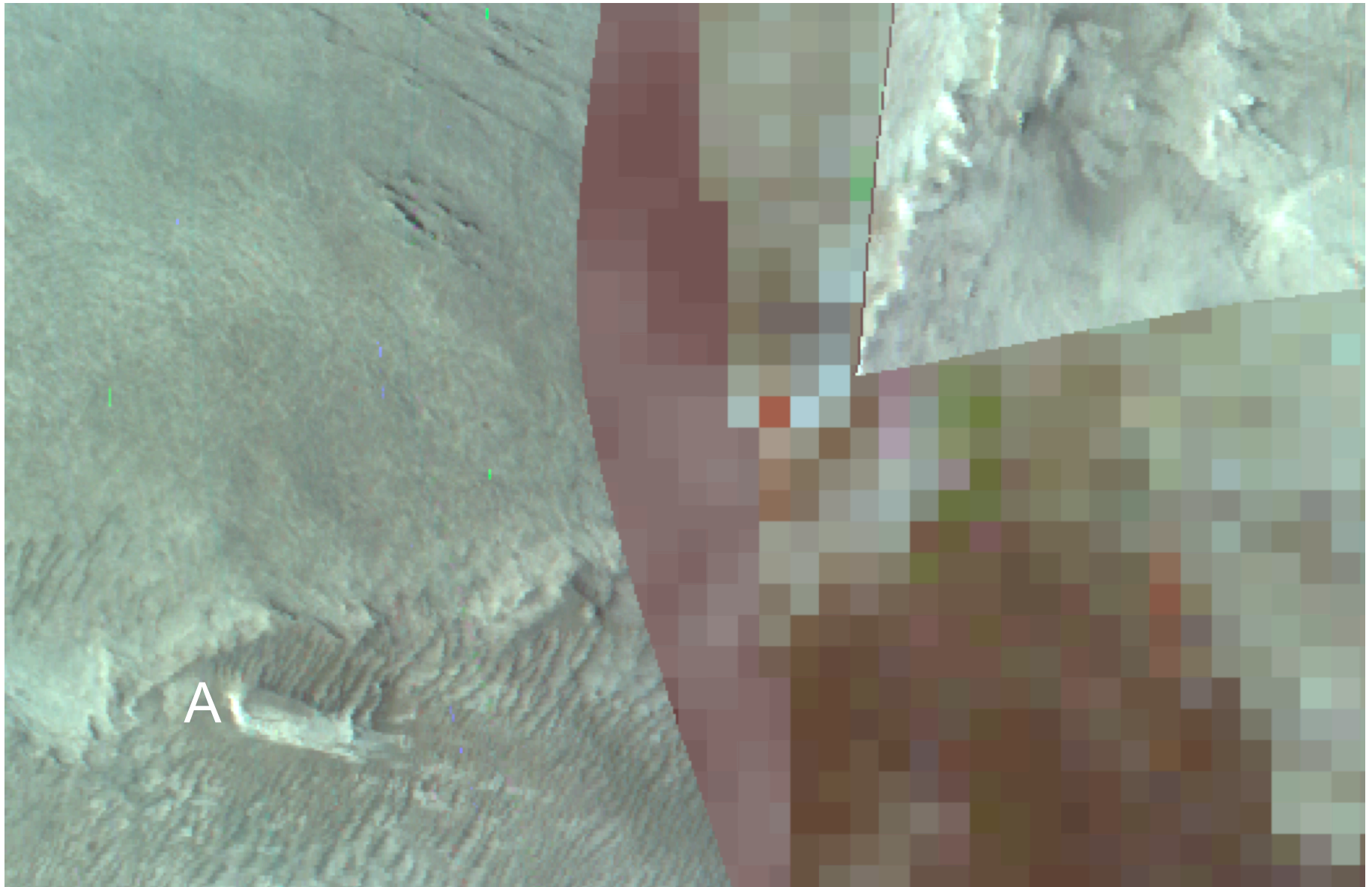
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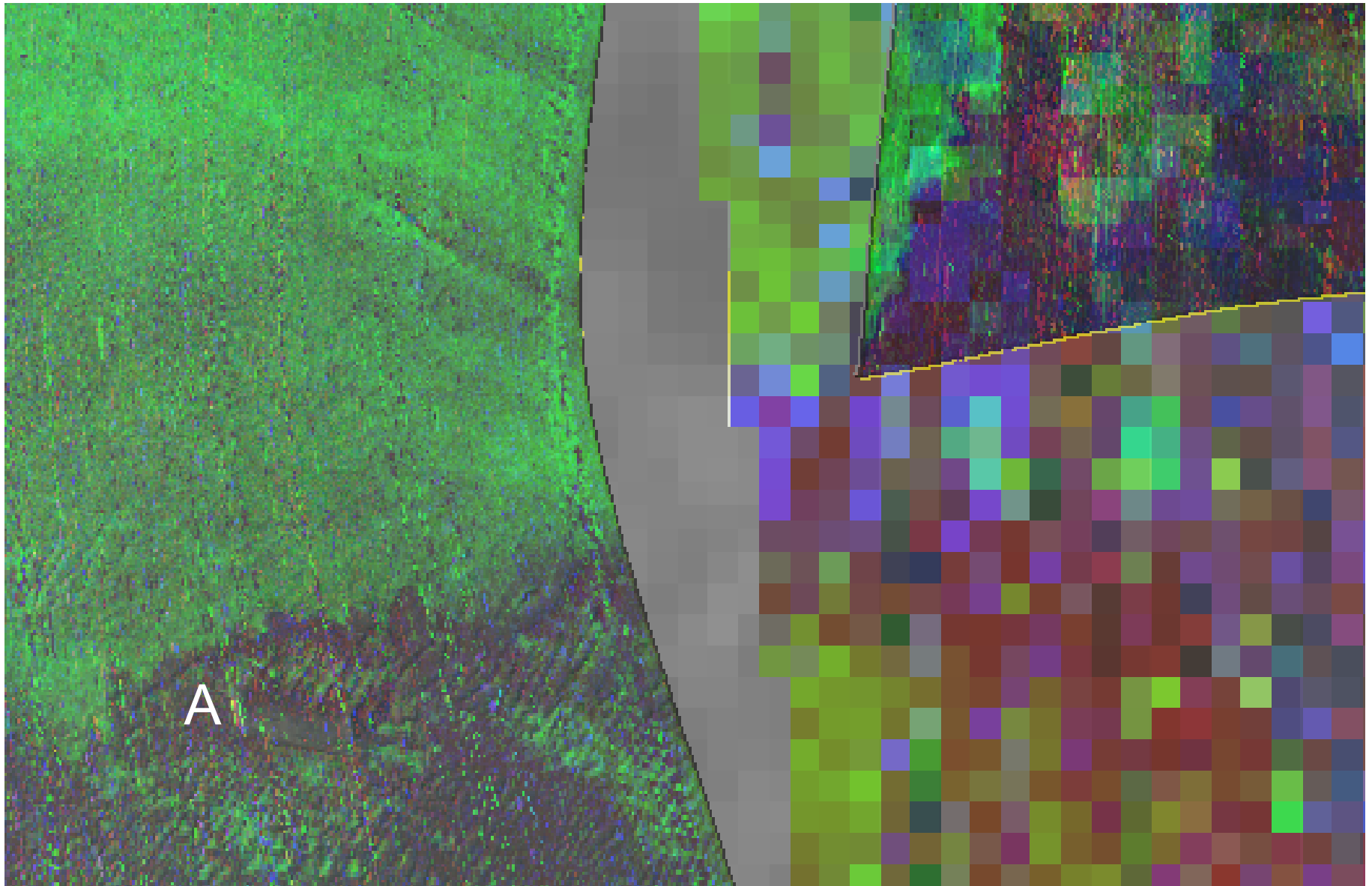
## Zoom on Edge of Light Monohydrate Layer



R=2530 nm, G=1505 nm, B = 1080 nm on THEMIS night IR



## Zoom on Edge of Light Monohydrate Layer



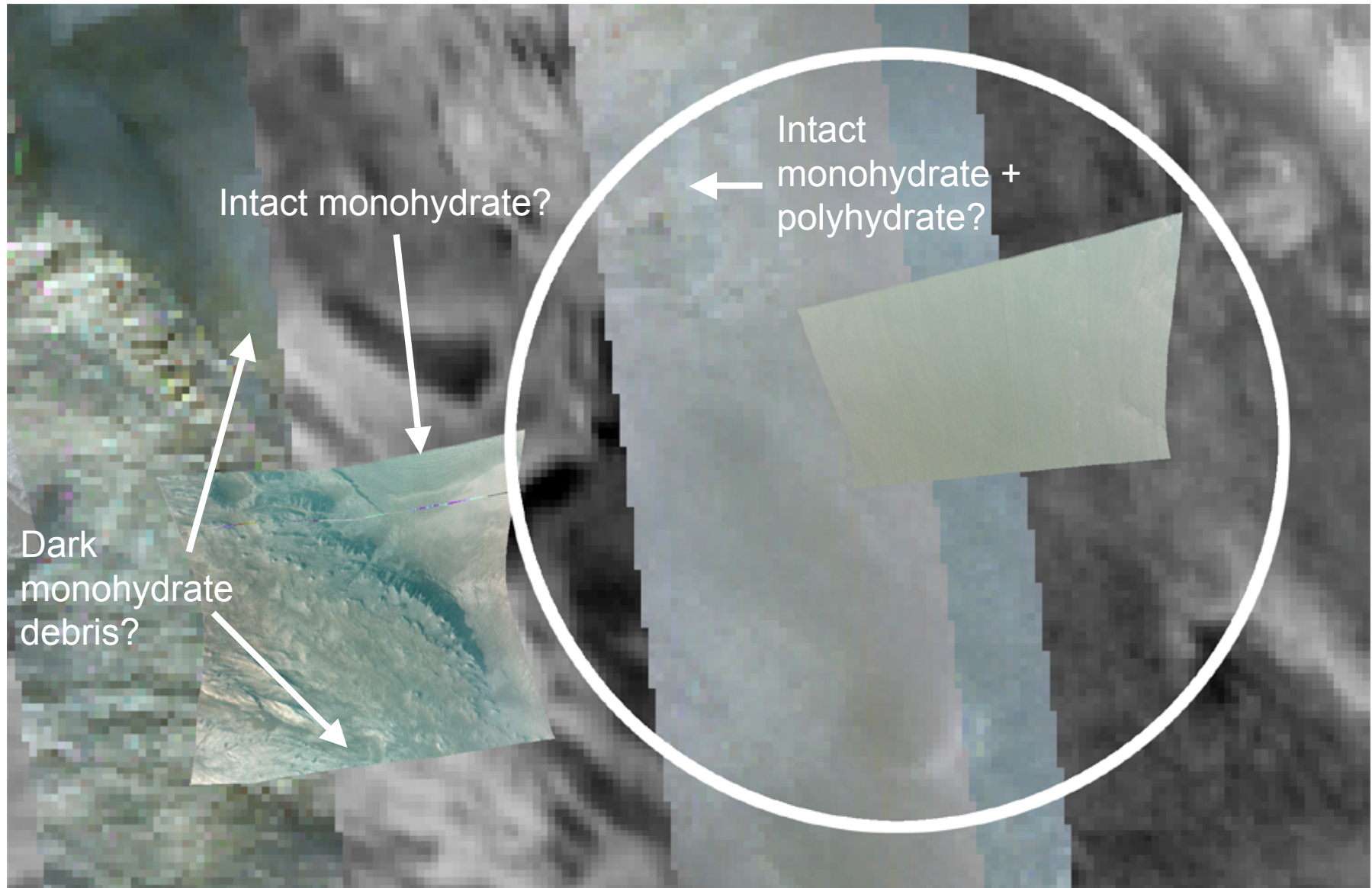
R=BDI1000IR (1- $\mu$ m mafic mineral band), G = BD2100 (monohyd sulf), B = BD1900 (polyhyd sulf) on THEMIS night IR



Zoom on "A" (HiRISE, 1 km wide)



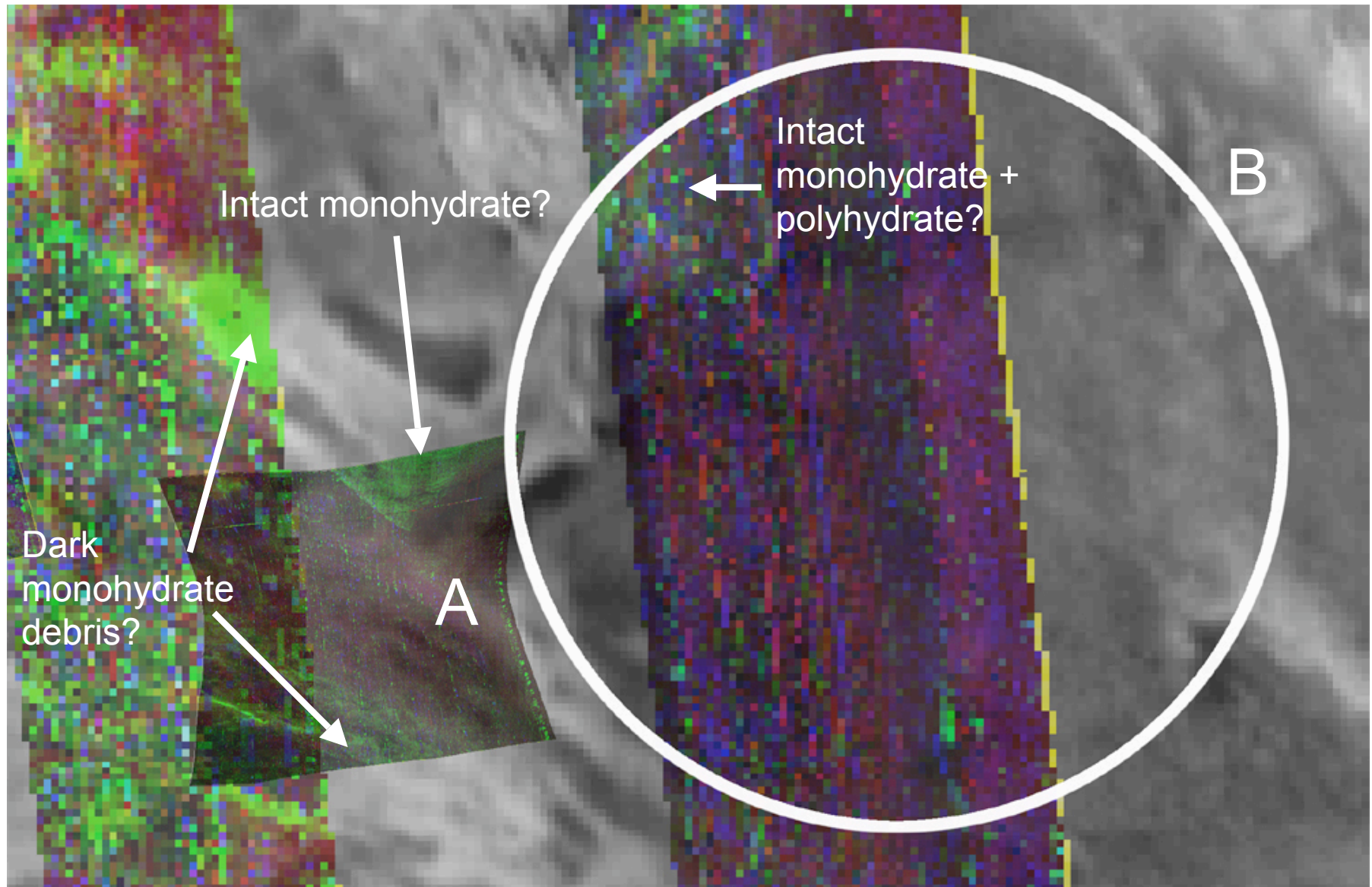
## Alternate Site, CRISM on THEMIS Night IR



R=2530 nm, G=1505 nm, B = 1080 nm

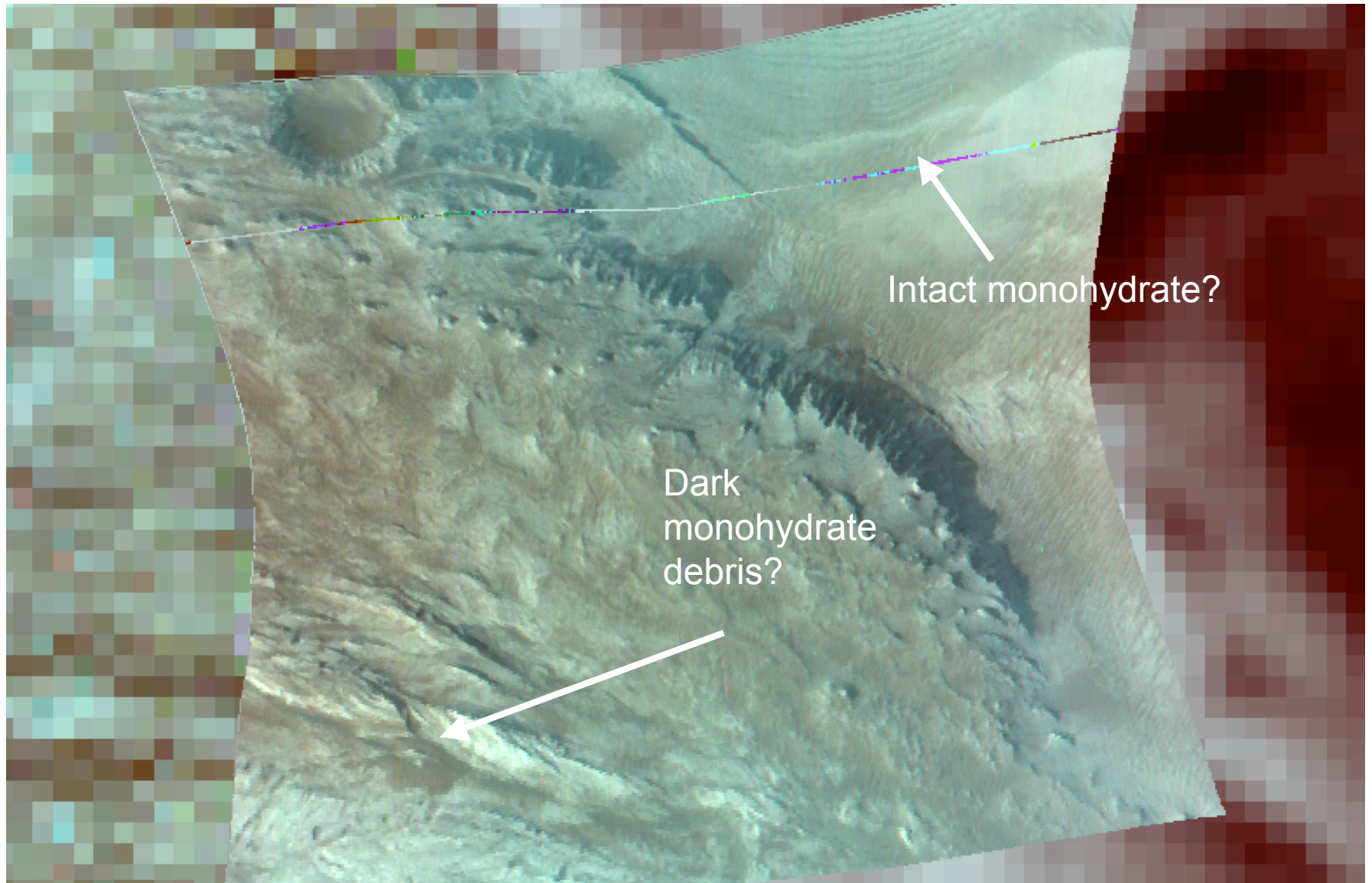


## Alternate Site, CRISM on THEMIS Night IR



R=BDI1000IR (1- $\mu$ m mafic mineral band), G = BD2100 (monohyd sulf), B = BD1900 (polyhyd sulf)

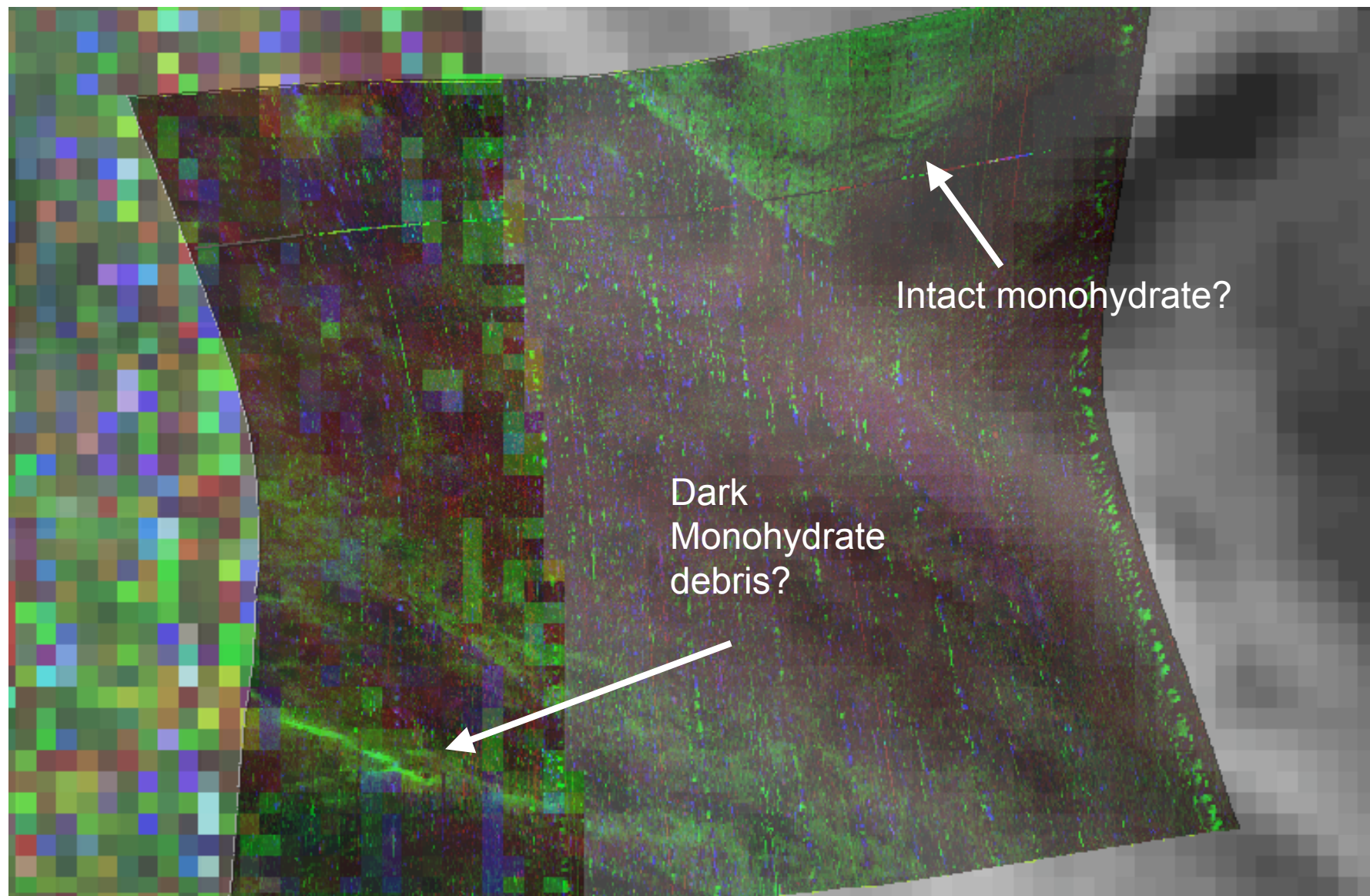
## Zoom on "A"



R=2530 nm, G=1505 nm, B = 1080 nm

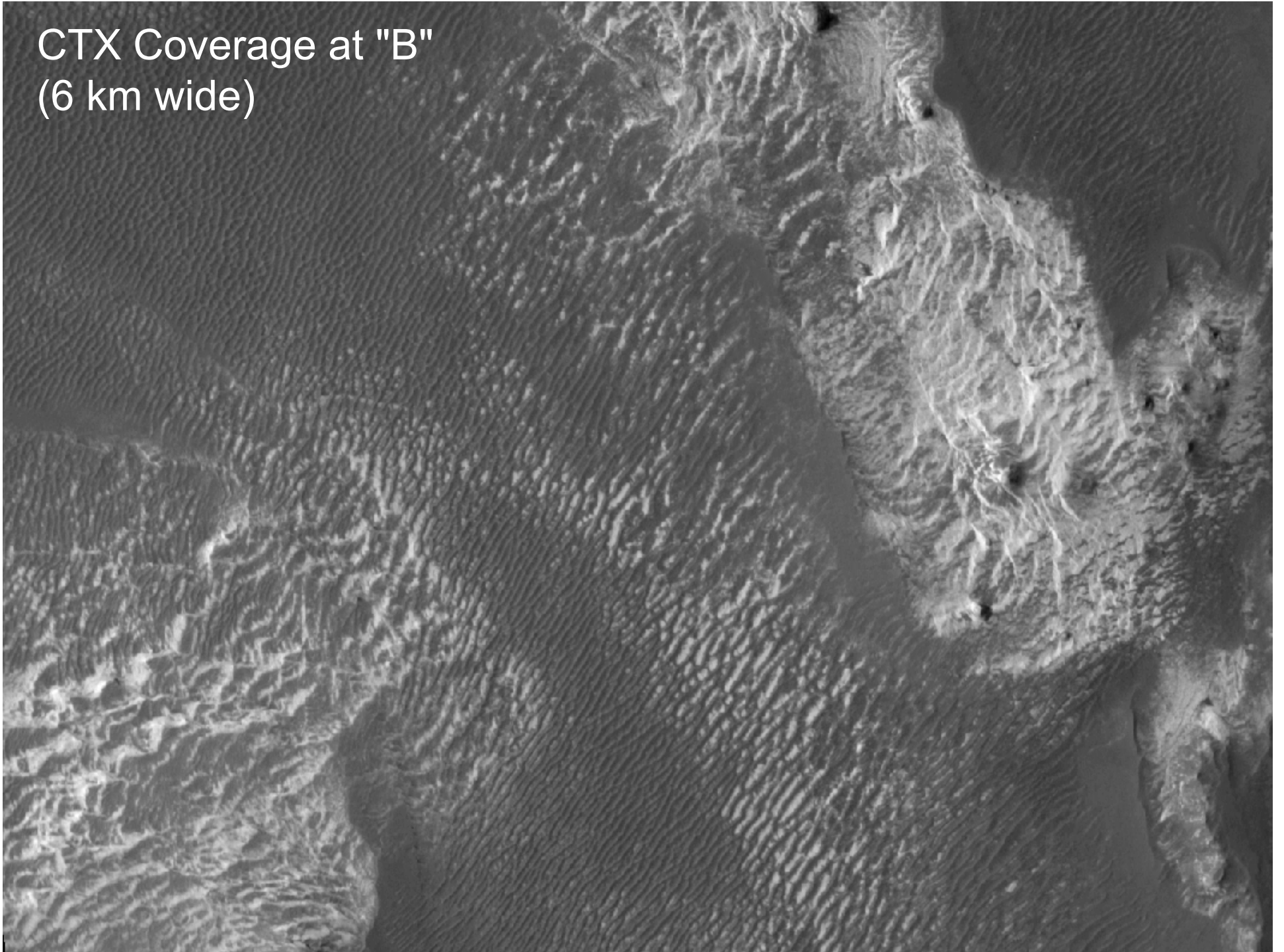


## Zoom on "A"



R=BDI1000IR (1- $\mu$ m mafic mineral band), G = BD2100 (monohyd sulf), B = BD1900 (polyhyd sulf)

CTX Coverage at "B"  
(6 km wide)

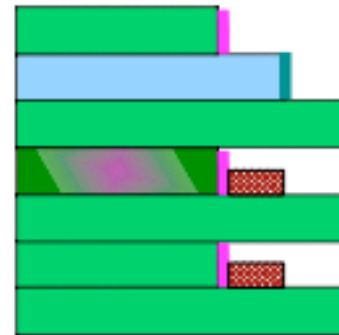




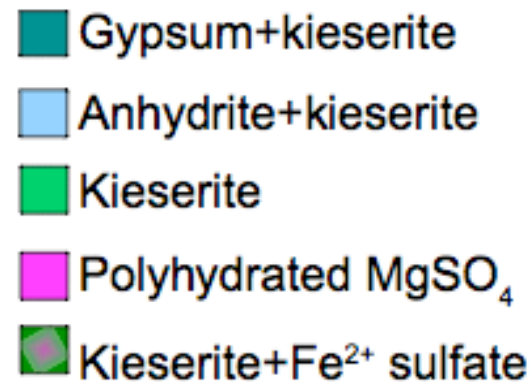
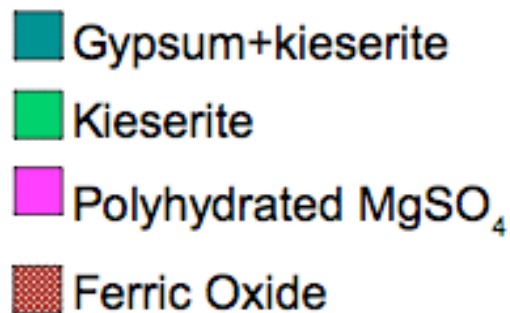
## Possible Significance of Multiple Layered Sulfates



**Evaporite sequence** of closed basin with periodic recharge



**Groundwater evaporation** creates mostly uniform mineralogy across layers which **weathers** to another assemblage **upon exposure**



## West Candor Site Summaries

	Original Site	Alternate Site
<b>Exposed compositions</b>	Intact layered monohydrated and polyhydrated sulfate-bearing ILDs, with partial cover by dunes	Mostly dune covered with exposures of intact monohydrated (and possibly polyhydrated) sulfate-bearing ILDs
<b>Science Pro's</b>	<ul style="list-style-type: none"> <li>• Some of the best sulfate exposures</li> <li>• At least periodically wet into the Hesperian</li> <li>• Excellent investigation of sulfate depositional environment</li> <li>• Allows testing of genetic relationship between sulfate phases</li> </ul>	
<b>Science Con's</b>	<ul style="list-style-type: none"> <li>• Acidic environment</li> <li>• Extensive dune cover</li> </ul>	
<b>Elevation</b>	Mostly exceeds +1 km limit	Entirely below + 1 km limit
<b>Slopes</b>	All of +25 km ellipse exceeds 2.5° at 1-km scale	Part of +25 km ellipse exceeds 2.5° at 1-km scale
<b>Safe haven</b>	No	No
<b>Other issues</b>	<ul style="list-style-type: none"> <li>• Trafficability / accessibility due to dunes</li> </ul>	<ul style="list-style-type: none"> <li>• Trafficability / accessibility due to dunes</li> <li>• Winds?</li> </ul>



# Assessment of Biologic Potential

- **Y** Ability to characterize geologic record
  - Layering is clearly exposed, with intact sections
  - However overage by dunes / eolian debris presents an issue to accessing the record
- **G** Evidence for habitability
  - Sulfates provide definitive evidence for liquid water
  - It occurs over 3 km of ILDs
  - However it's not clear that water was long-lasting; some interpretations of compositional layering imply intermittent water
- **R** Preservation potential for biologic materials
  - Acidic + hematite = unfavorable to preserving organics
- **R** Assessment of biologic potential with MSL instruments
  - Geochemistry and dunes are significant challenges