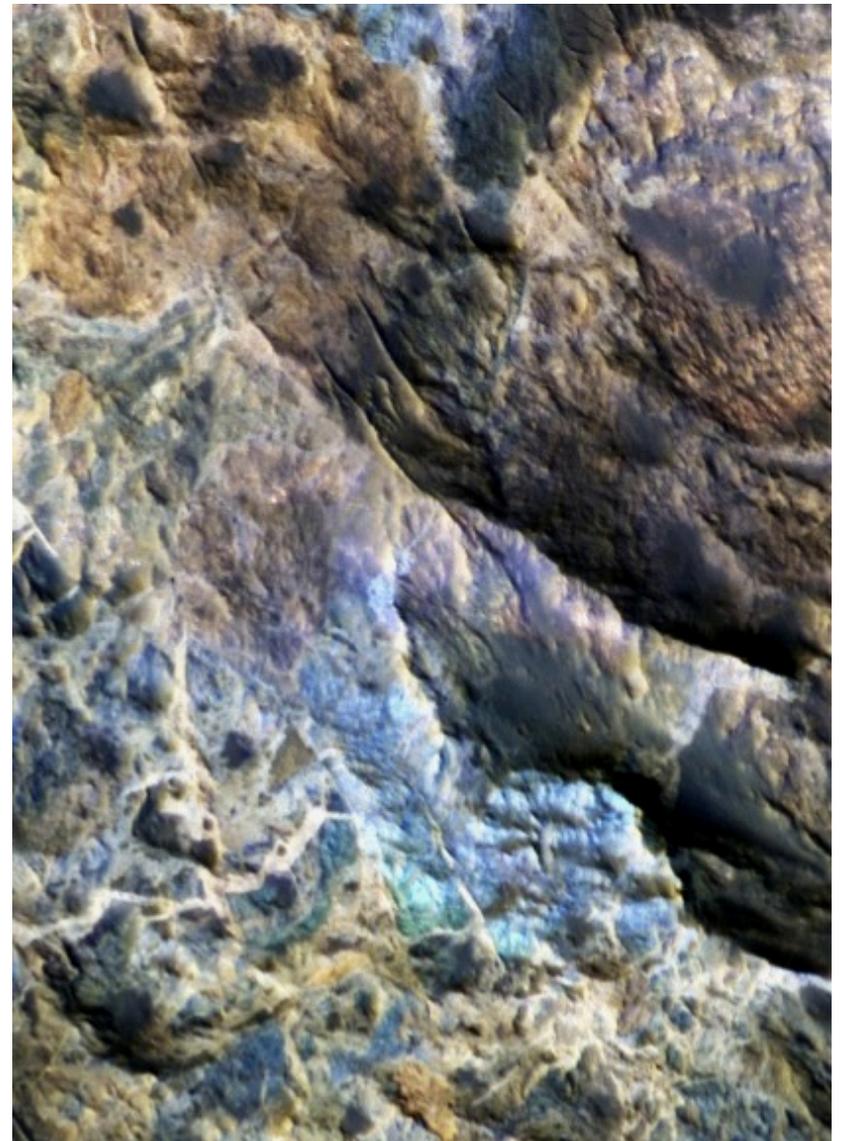
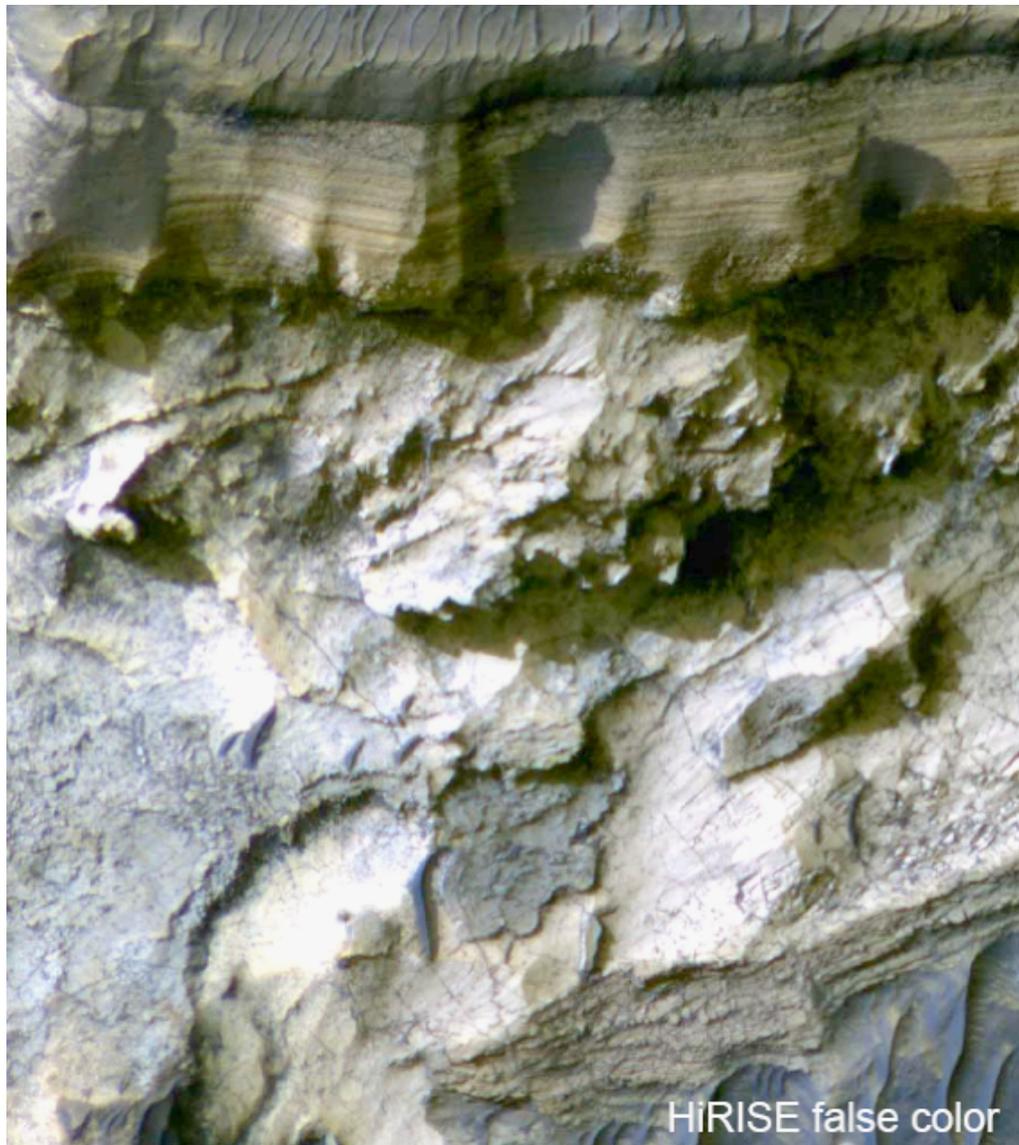
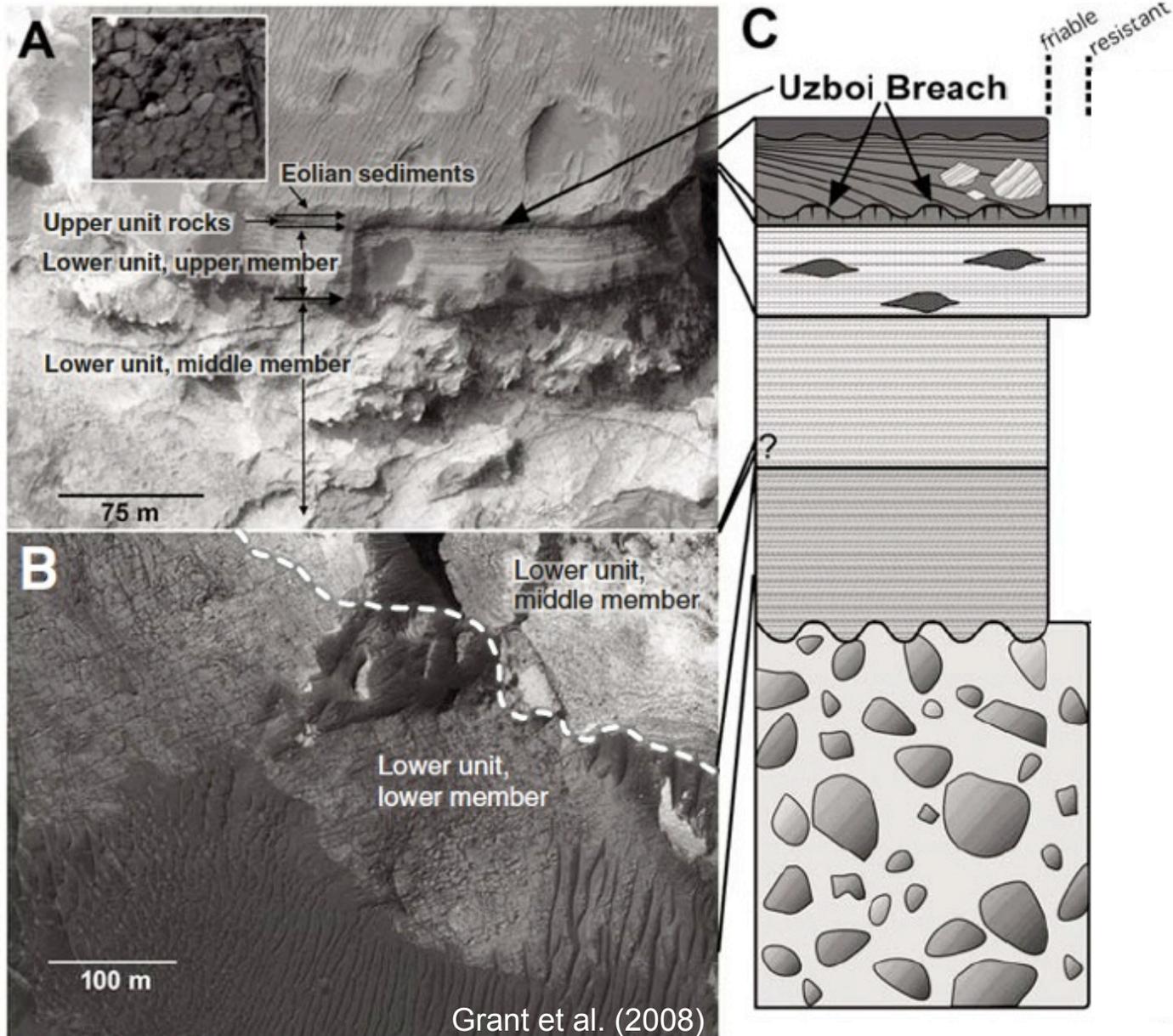


Mineralogic diversity at Holden crater

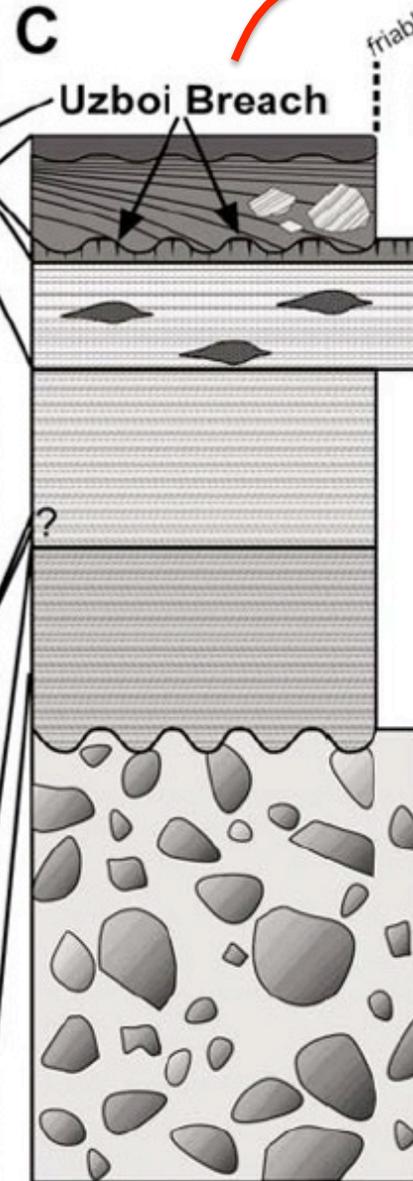
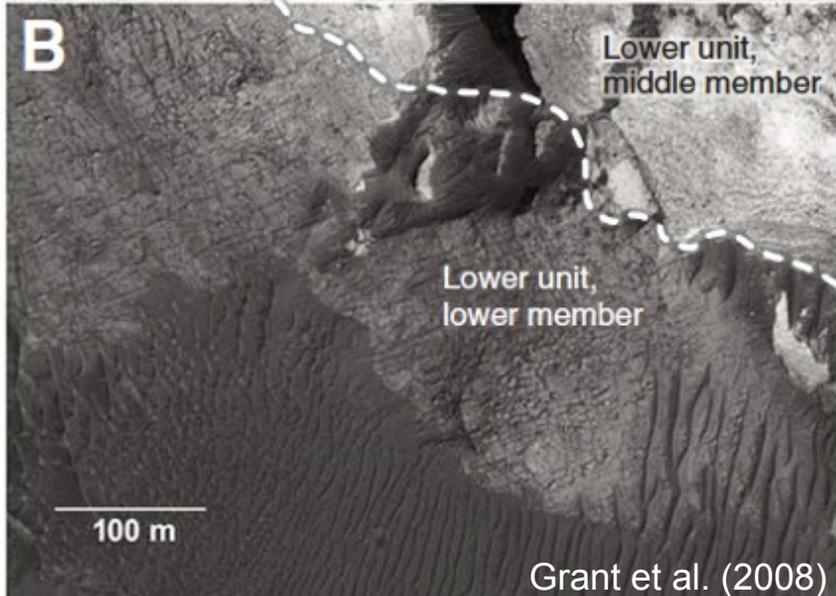
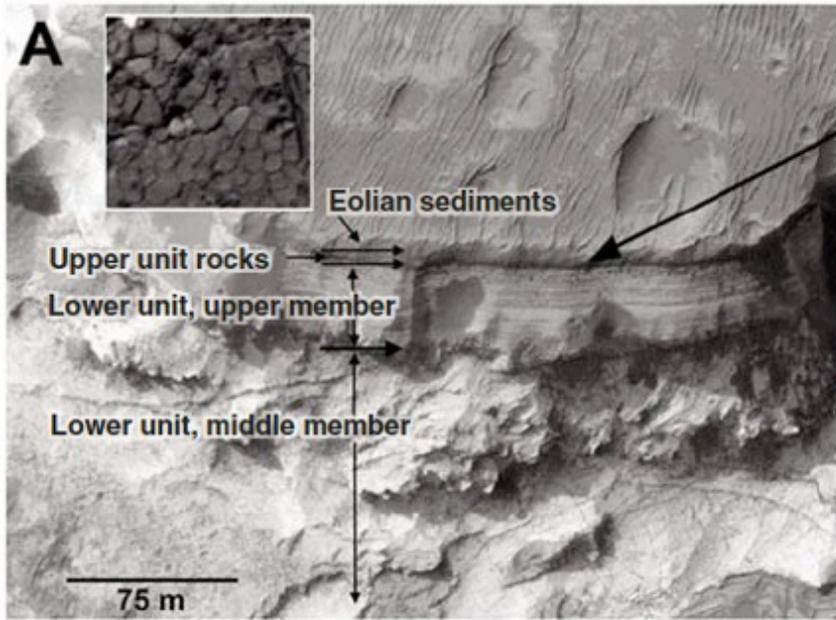


James Wray

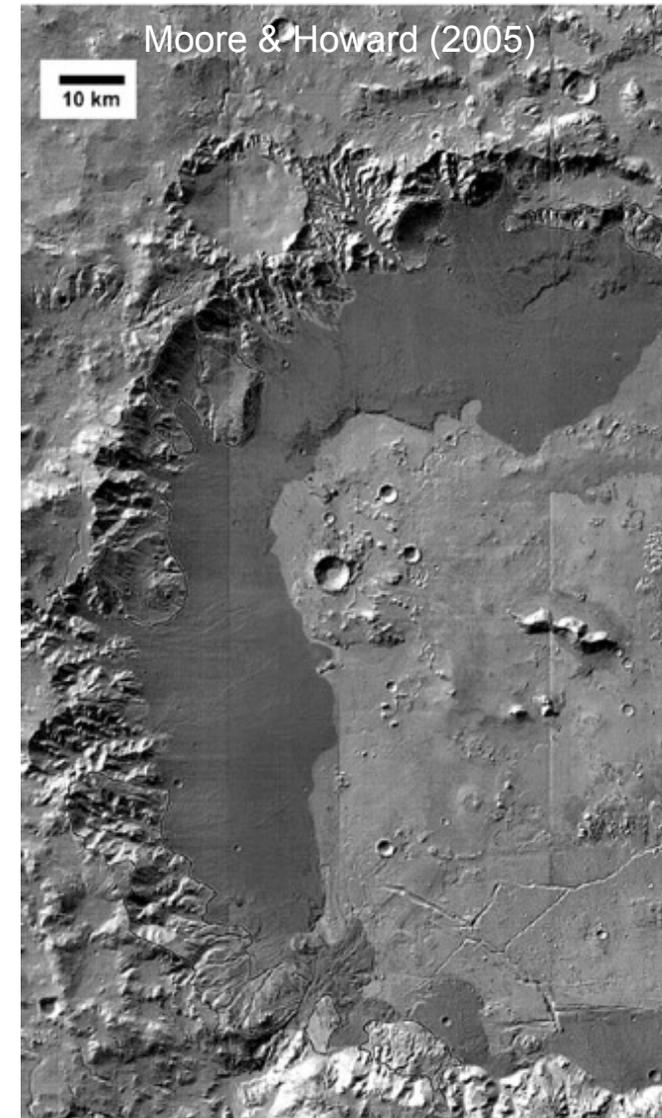
Holden stratigraphy review

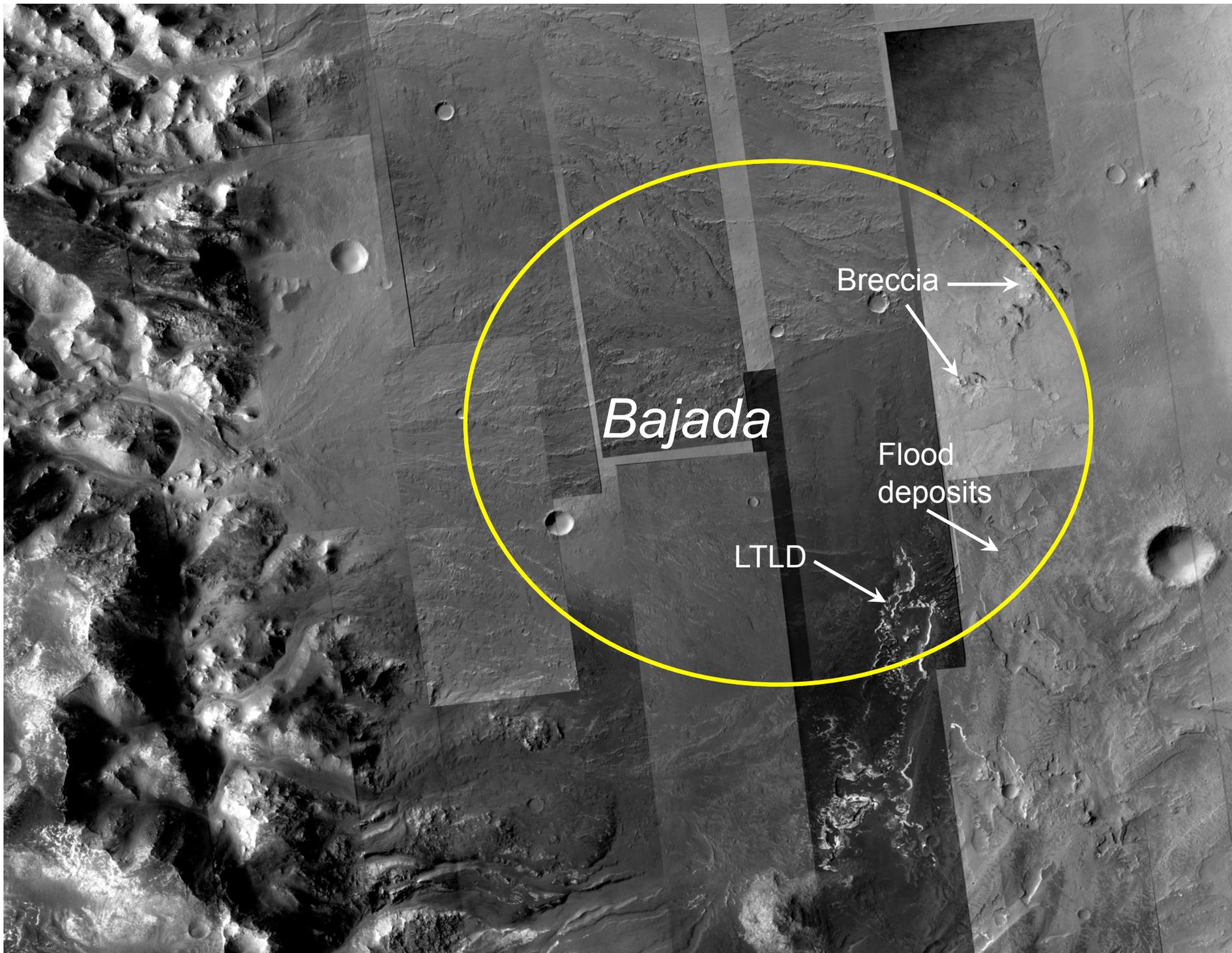


Holden stratigraphy review



All overlain by the fans...





Bajada

Breccia →

Flood
deposits →

LTL D →



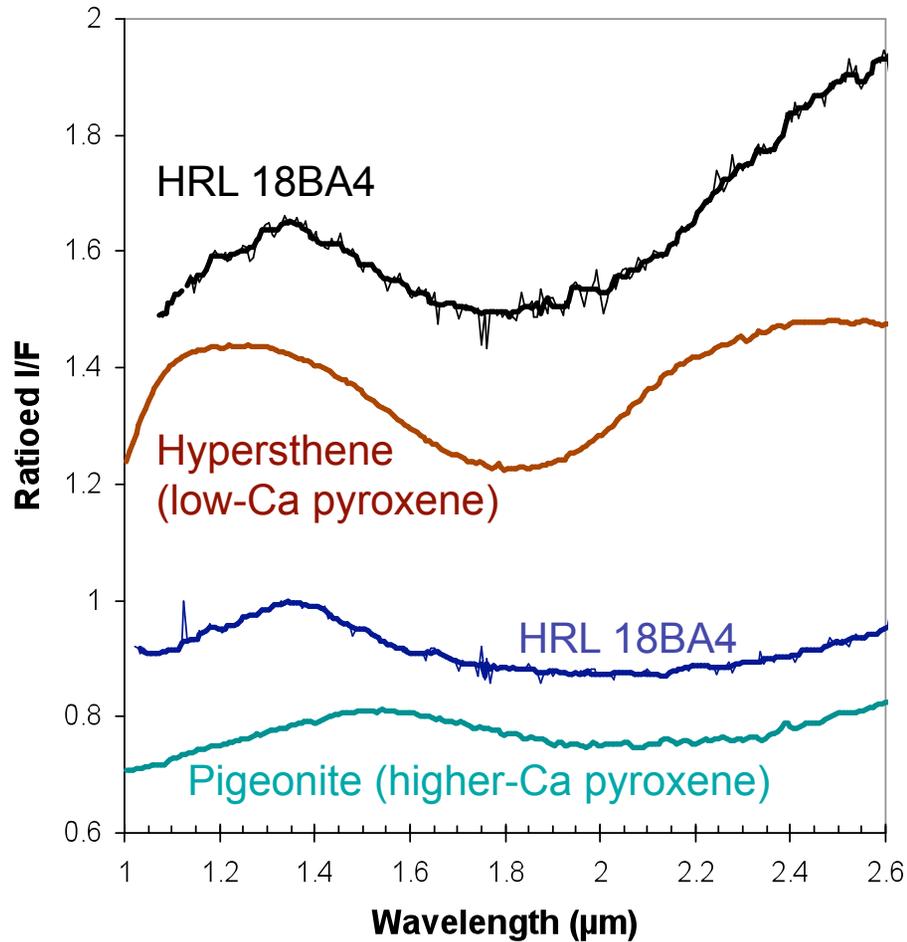
Holden fan composition likely homogenized, obscured by soils ...

but what's up here?

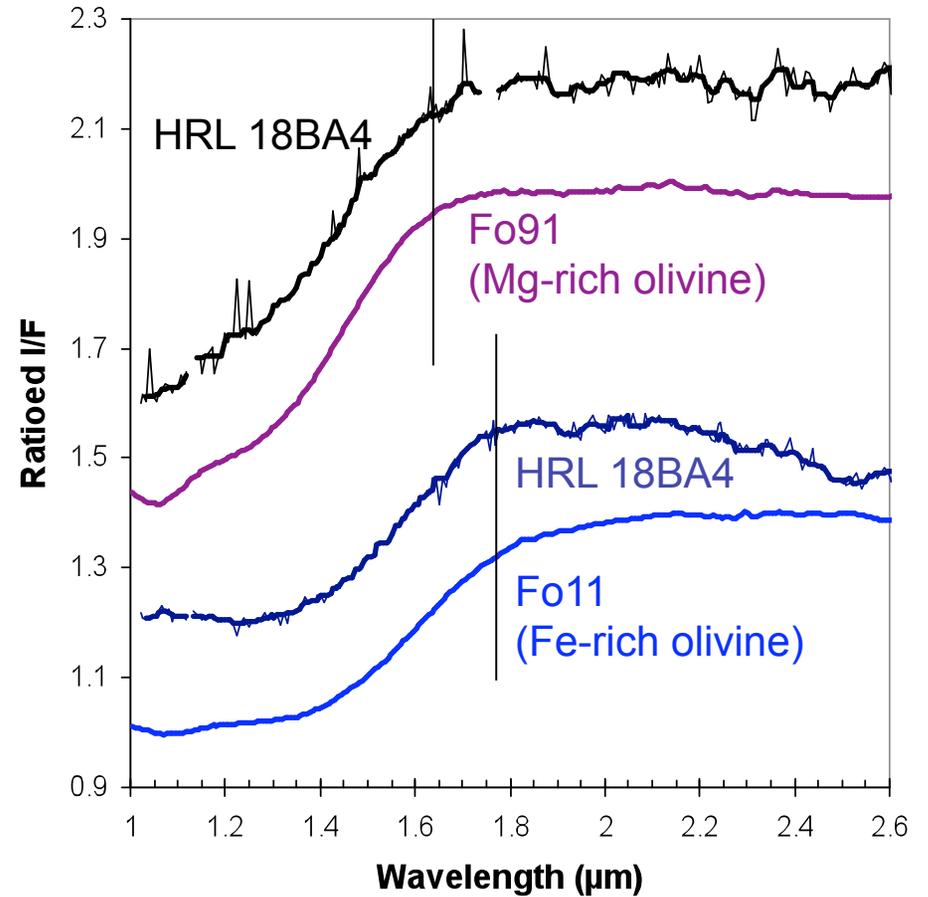
Credit: Marli Bryant Miller

Mafic minerals in Holden fan source rocks

Two pyroxenes



Two olivines(?)

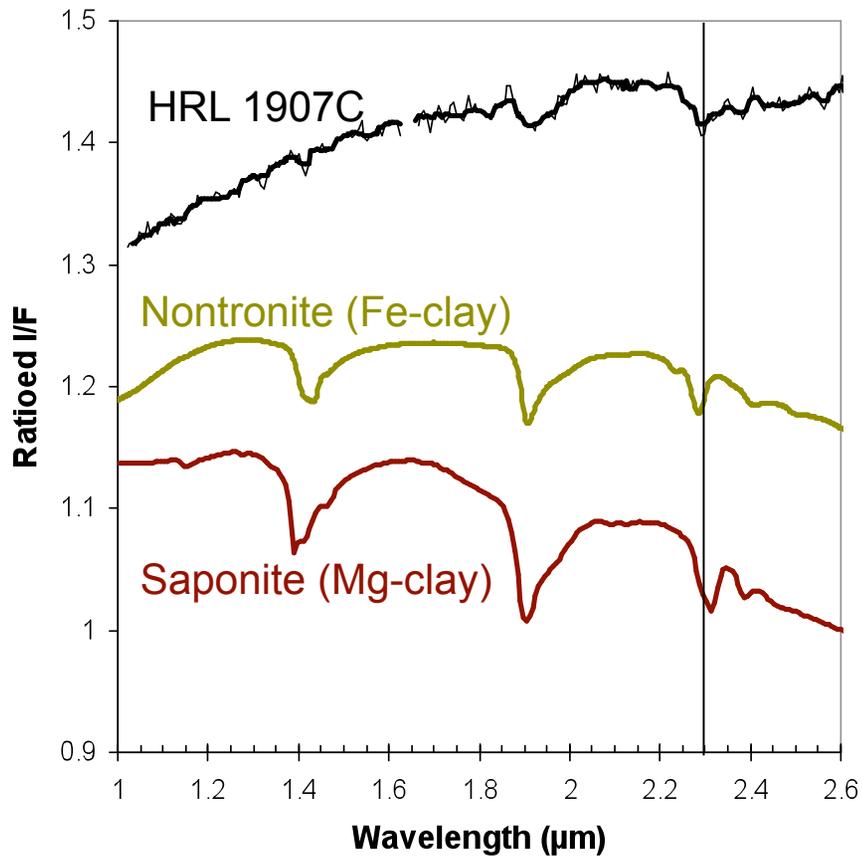


Lower spectrum could be another ferrous phase

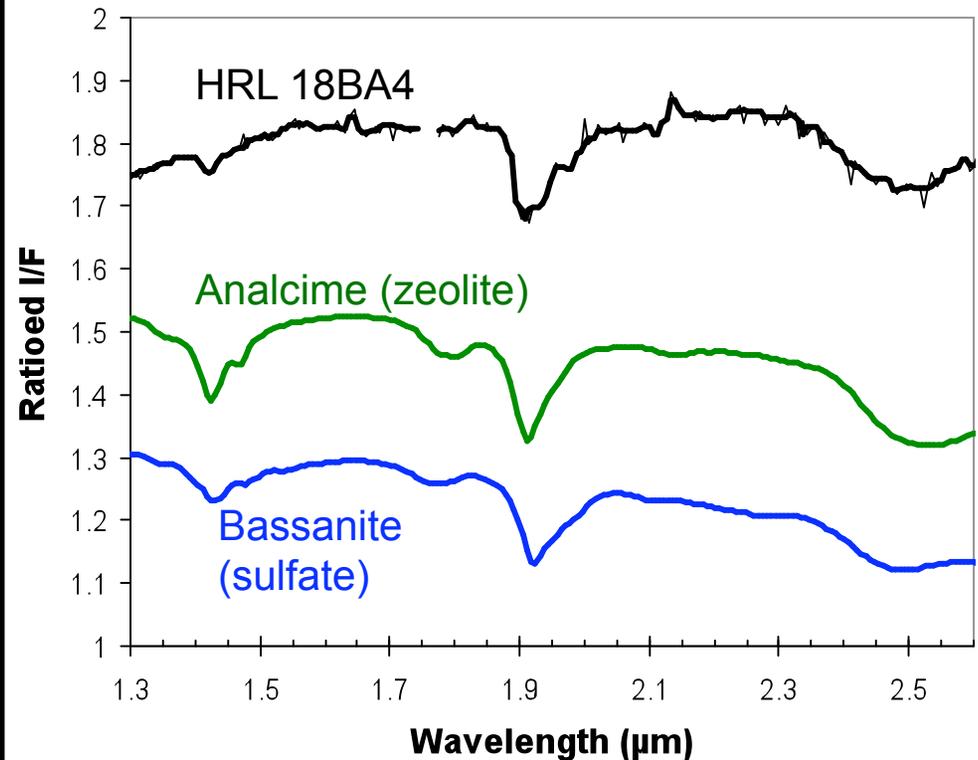
(example lab spectra scaled for comparison)

Hydrated minerals in Holden fan source rocks

Fe/Mg-phyllsilicate

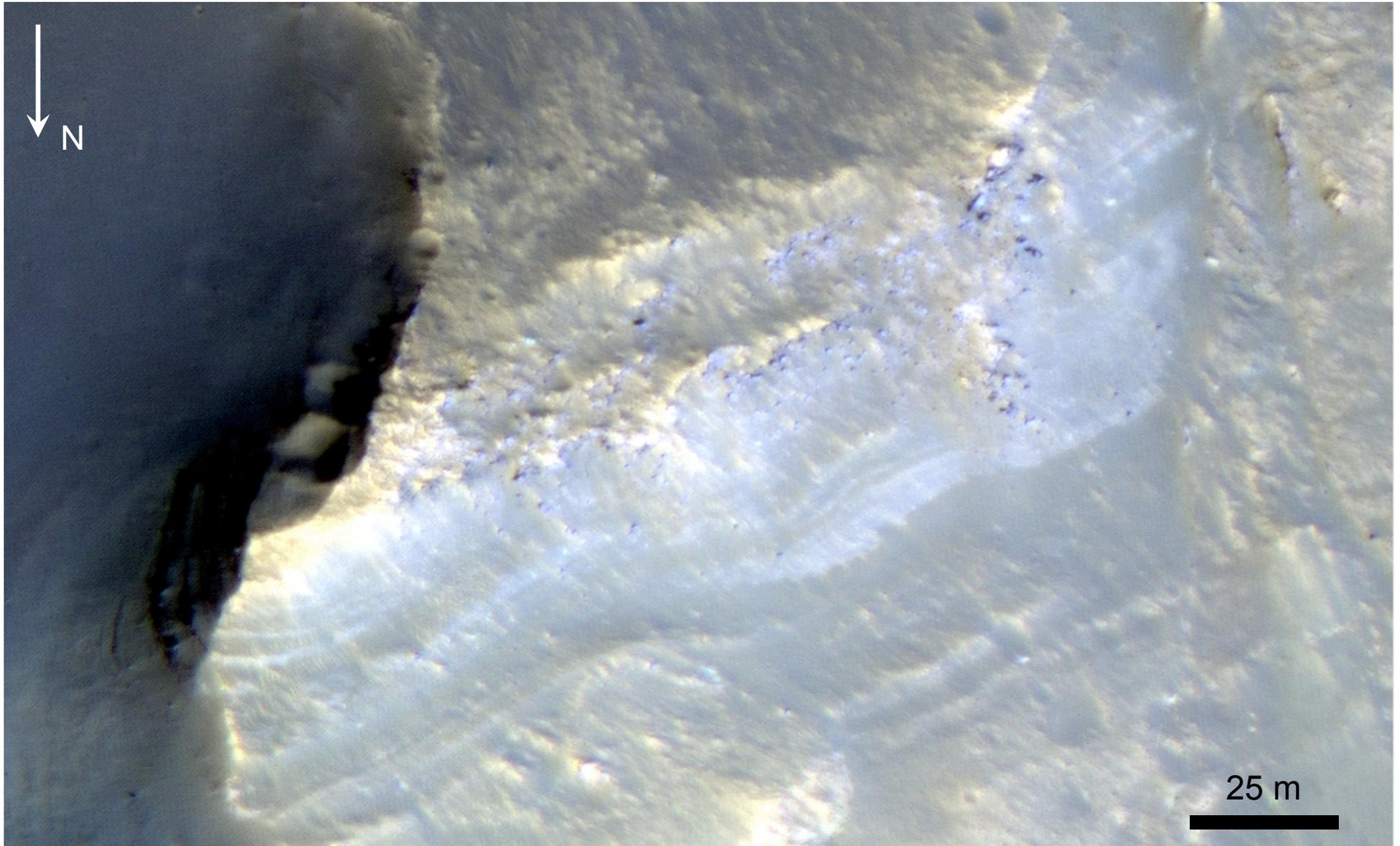


Hydrated salt / zeolite



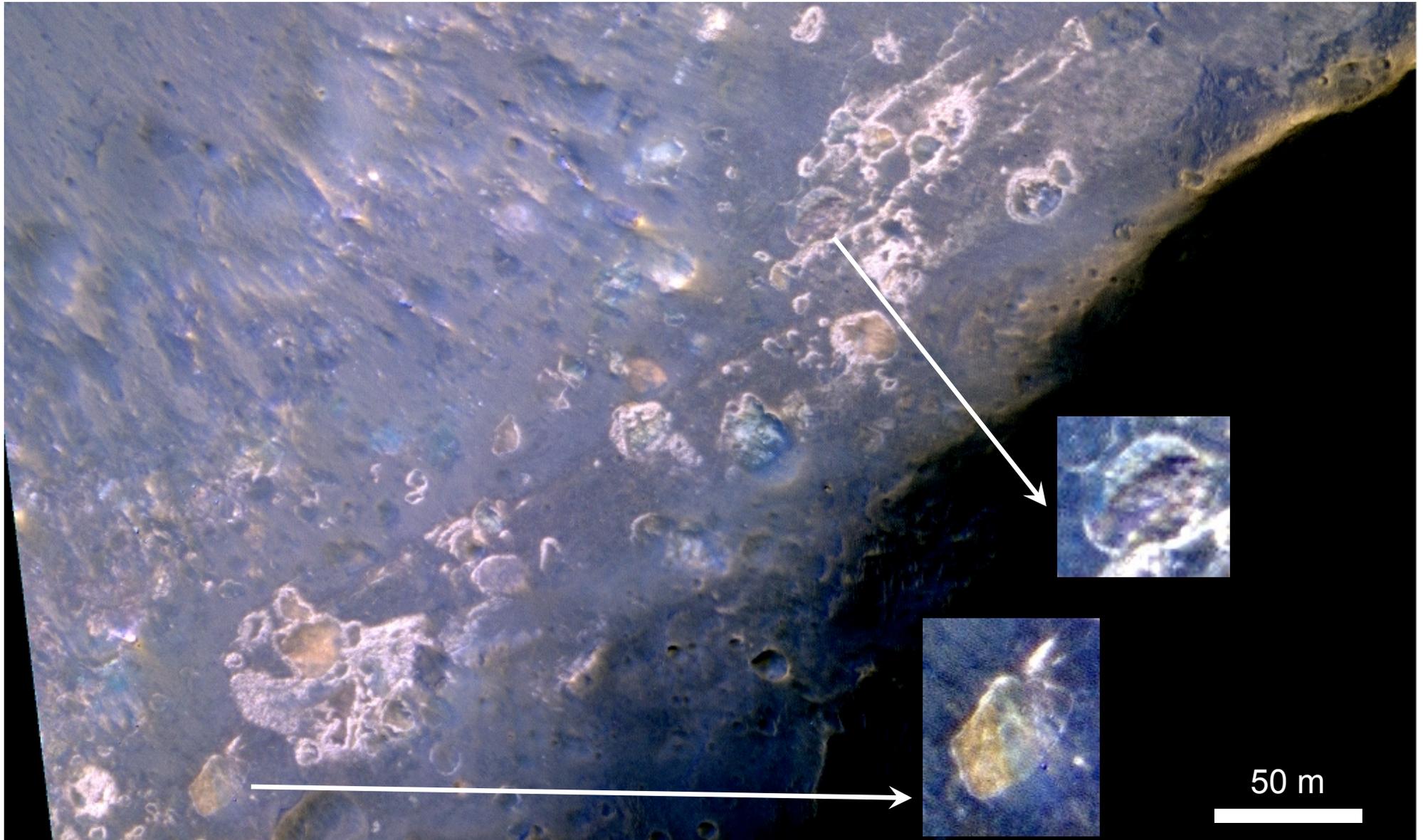
MSL can look for compositional differences between layers/distributaries across the fan

Light-toned layered rock, fan source valley wall



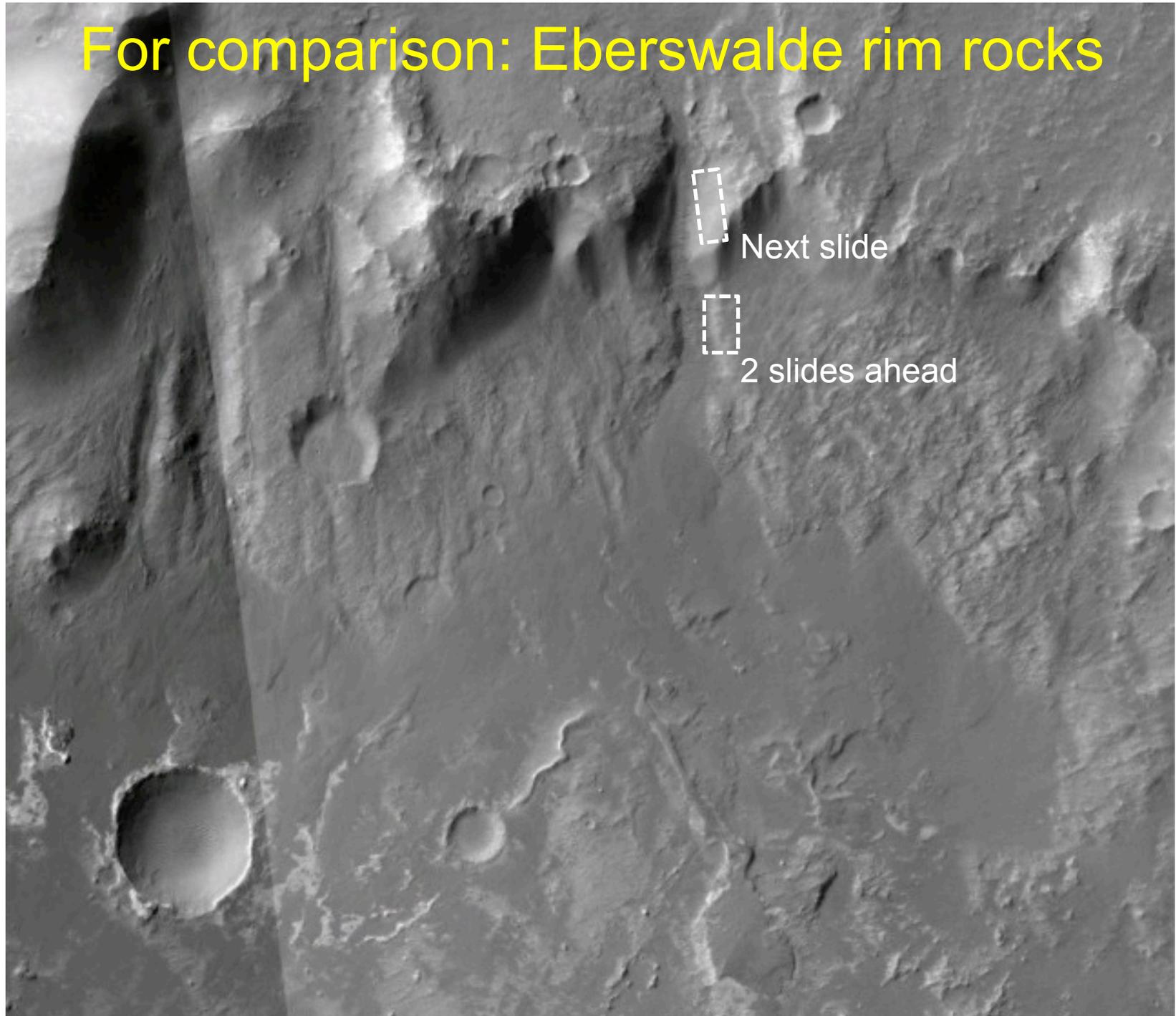
HiRISE ESP_017766_1535

Breccia blocks on Holden fan source valley wall

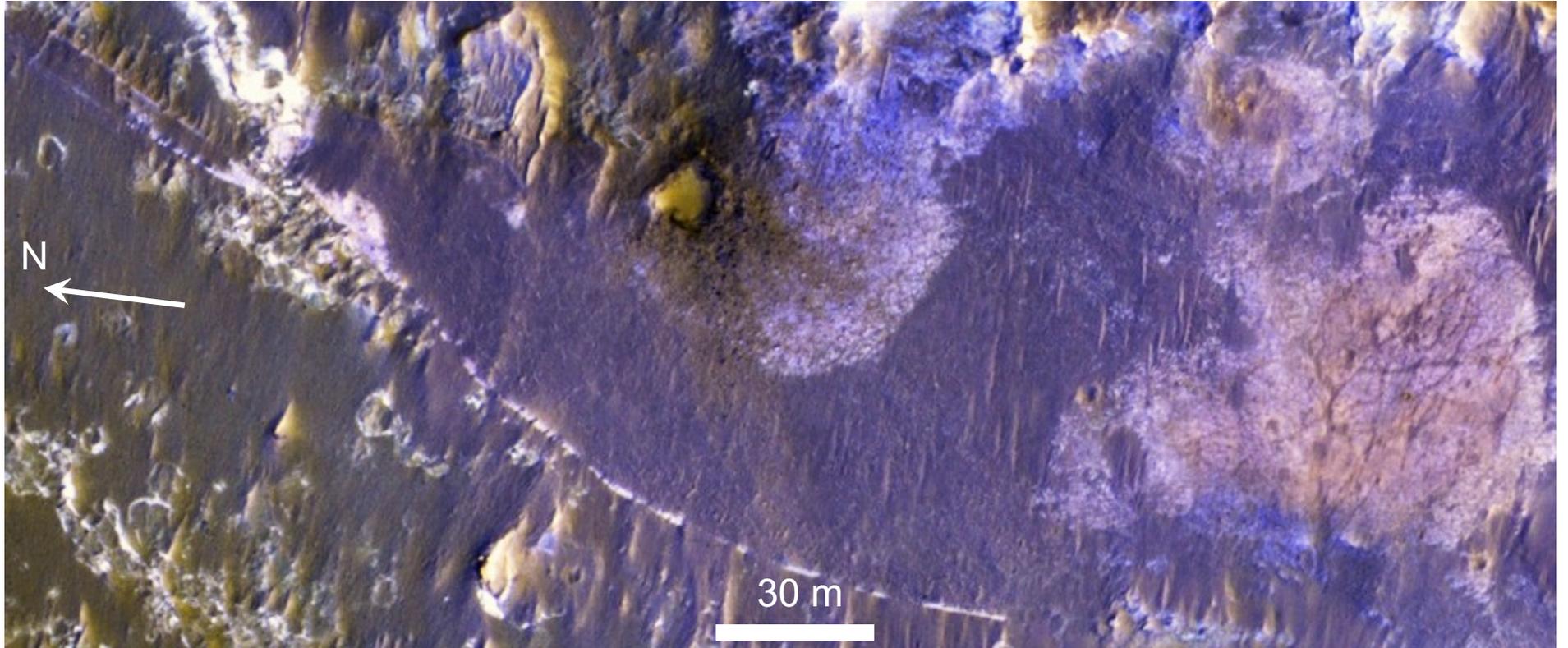


HiRISE ESP_017766_1535

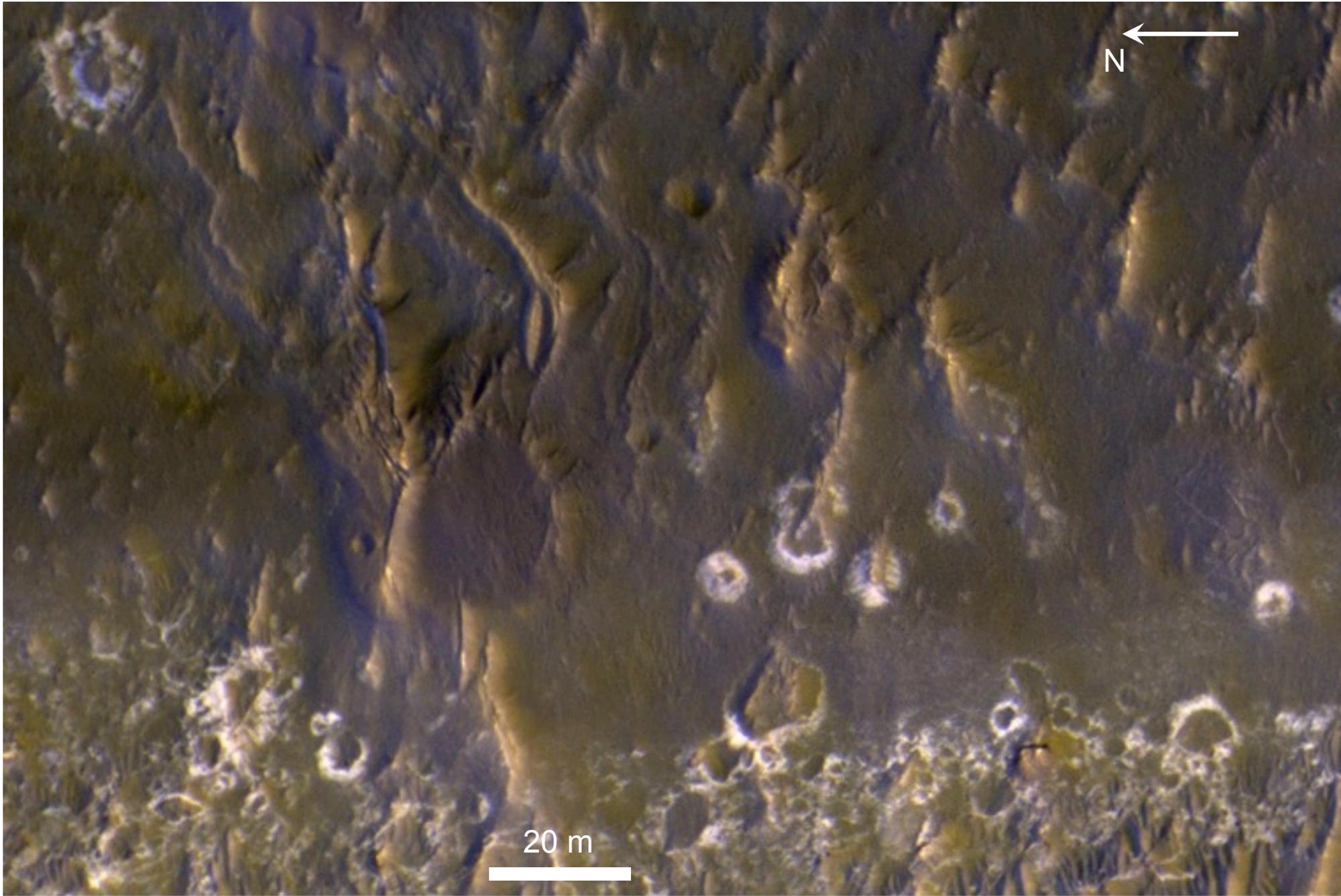
For comparison: Eberswalde rim rocks



Diverse rocks in eroded Eberswalde crater rim

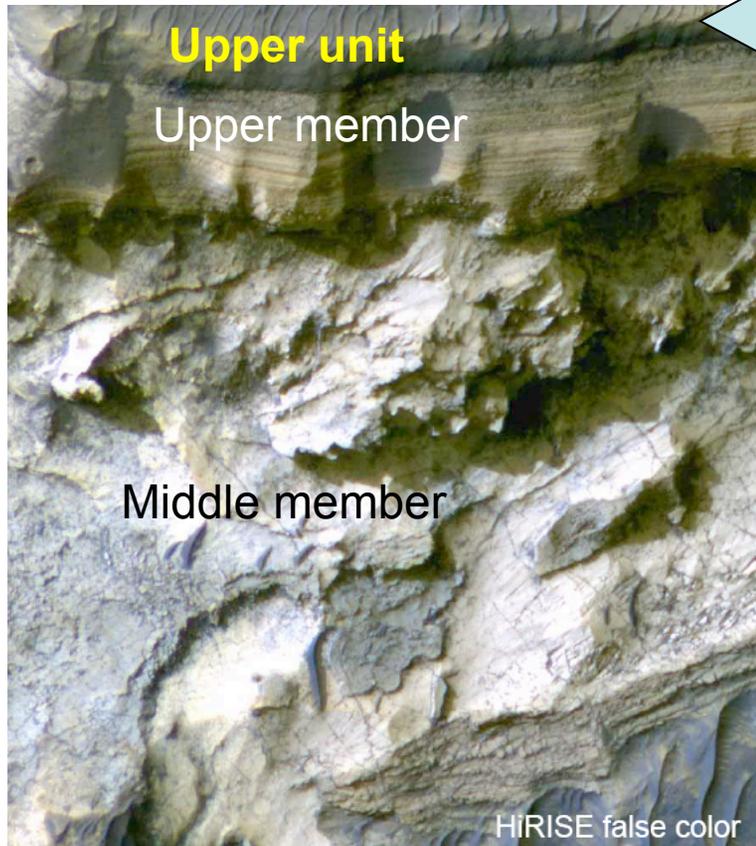


HiRISE ESP_021669_1560

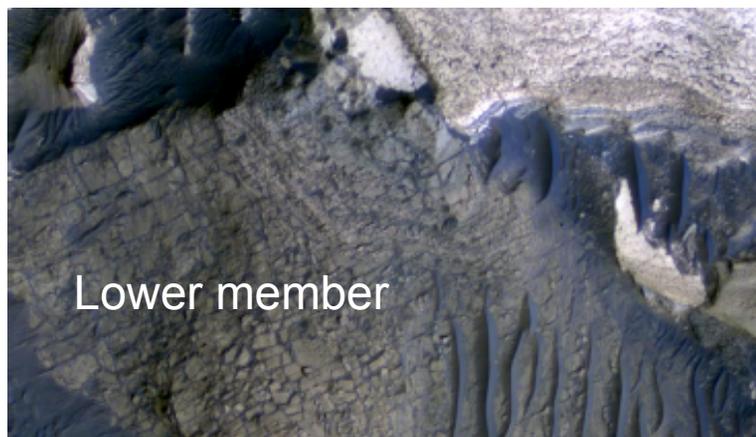
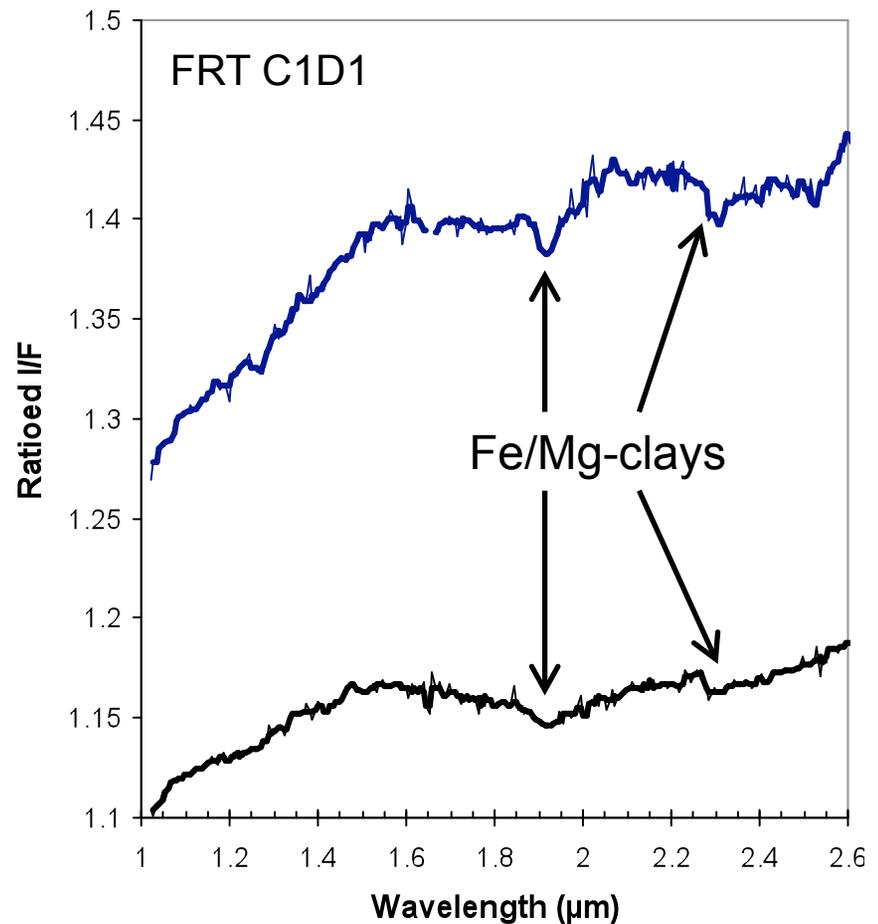


HiRISE ESP_021669_1560

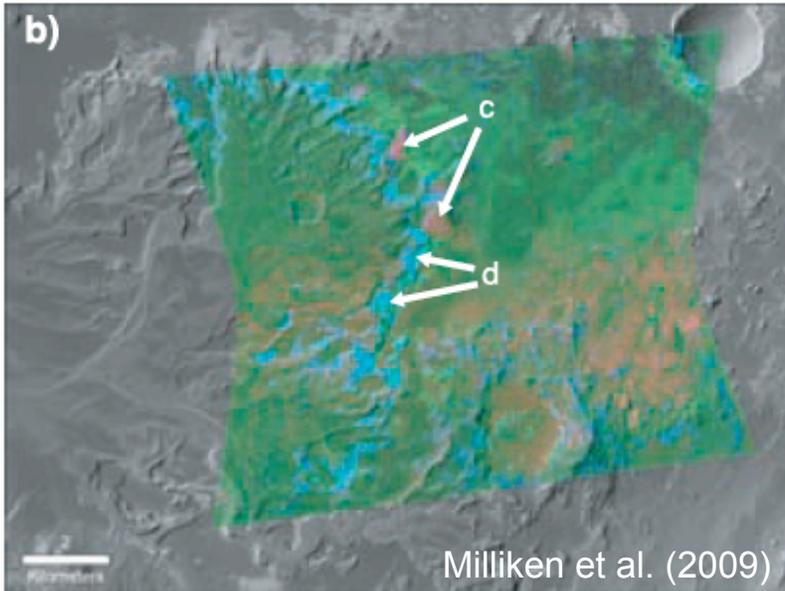
Holden upper unit (flood deposits)



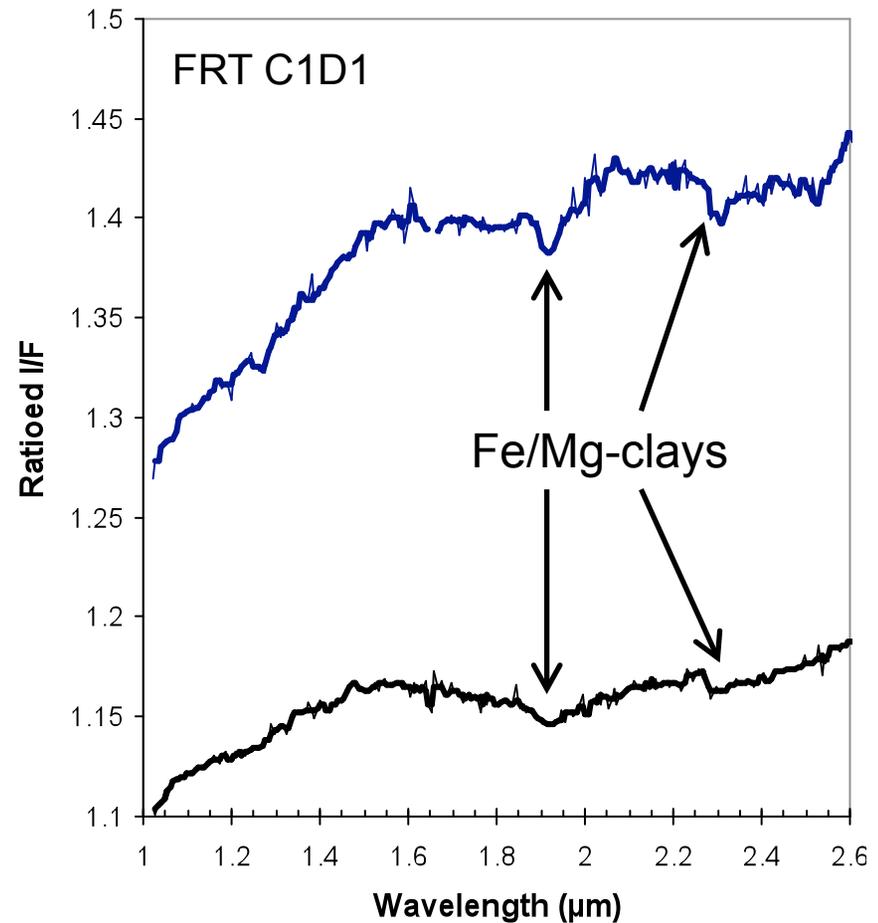
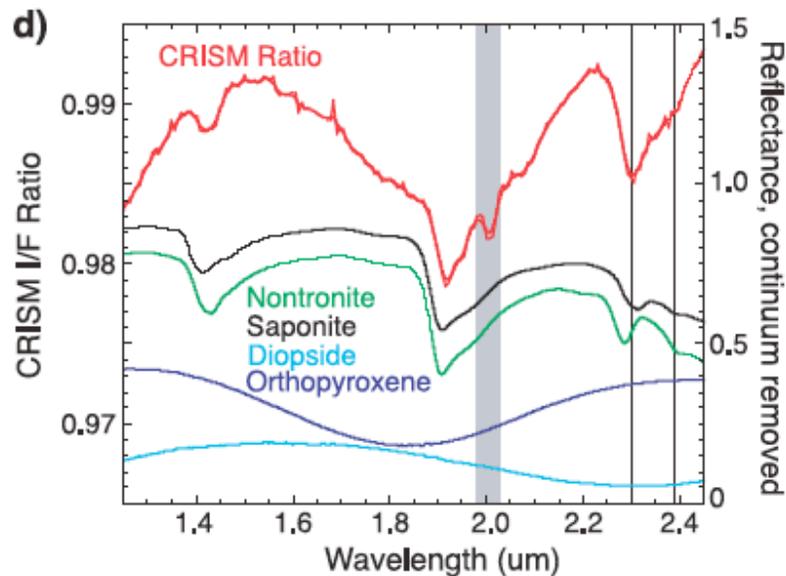
- Pyroxene/olivine spectral shape *and* Fe/Mg-clay
- Consistent w/ mixed-layer smectite/chlorite (Milliken et al., LPSC 2011)



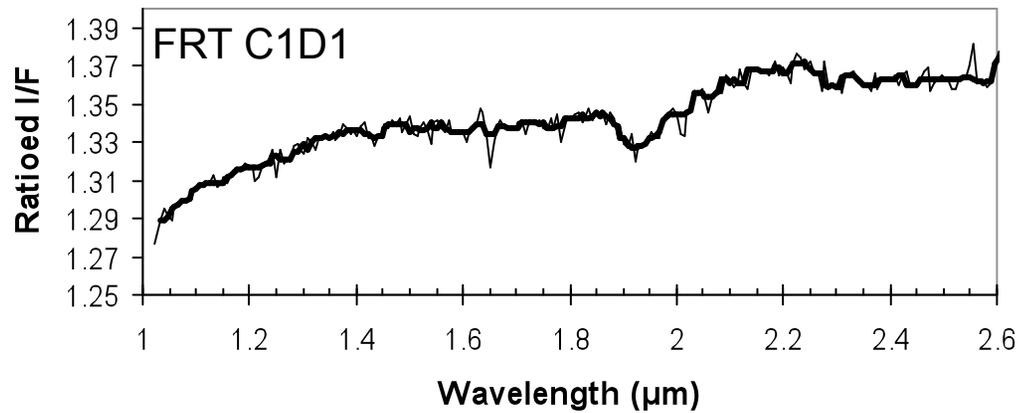
Holden upper unit (flood deposits) vs. Eberswalde delta front beds



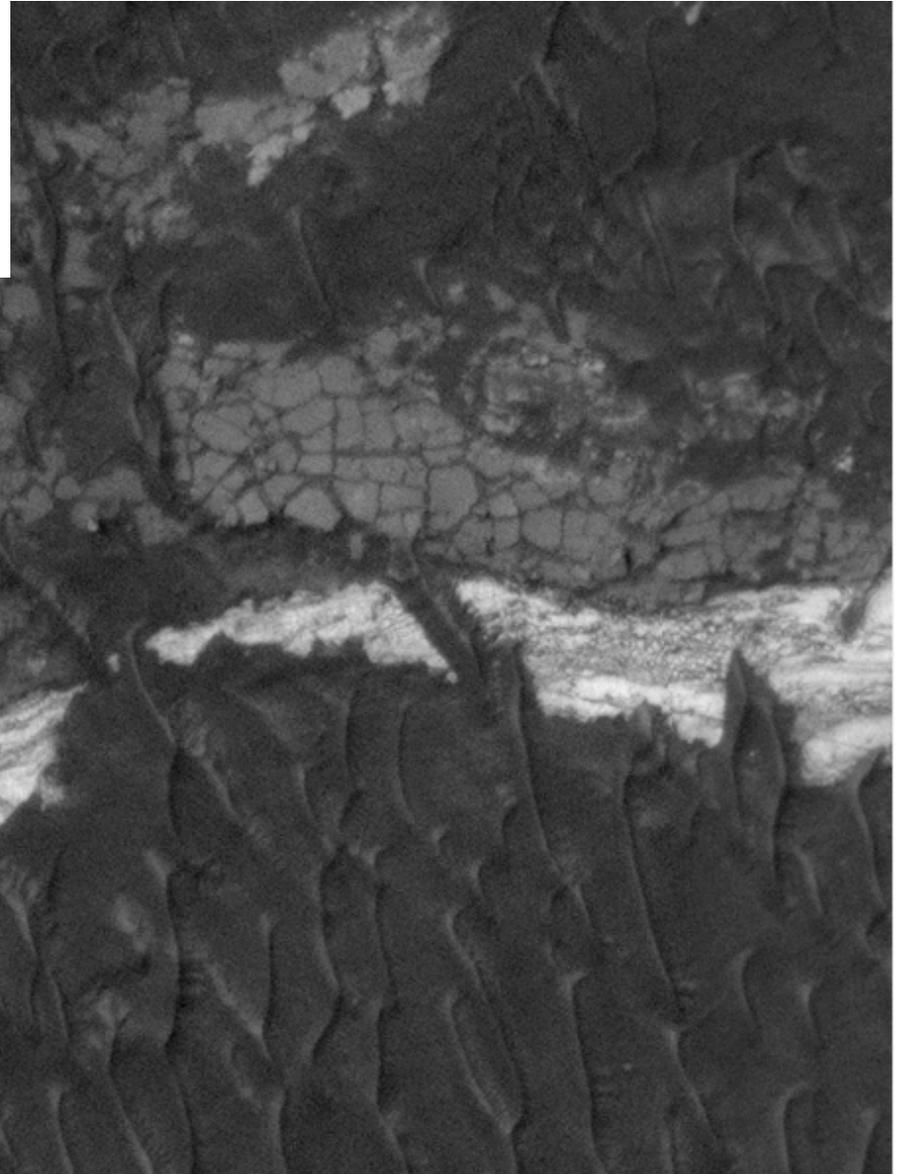
Basaltic spectral shape *and* Fe/Mg-clay signatures



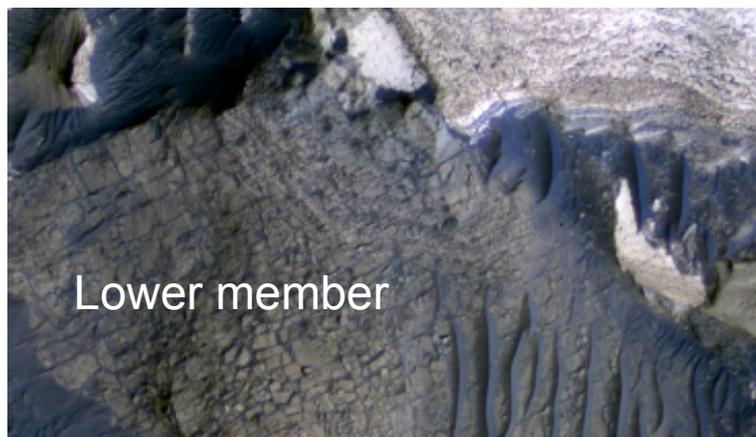
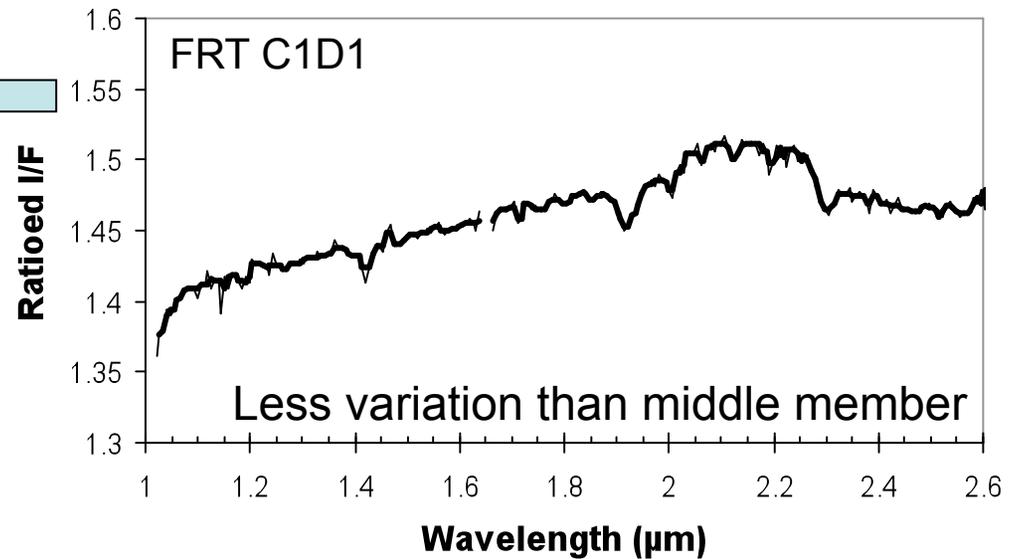
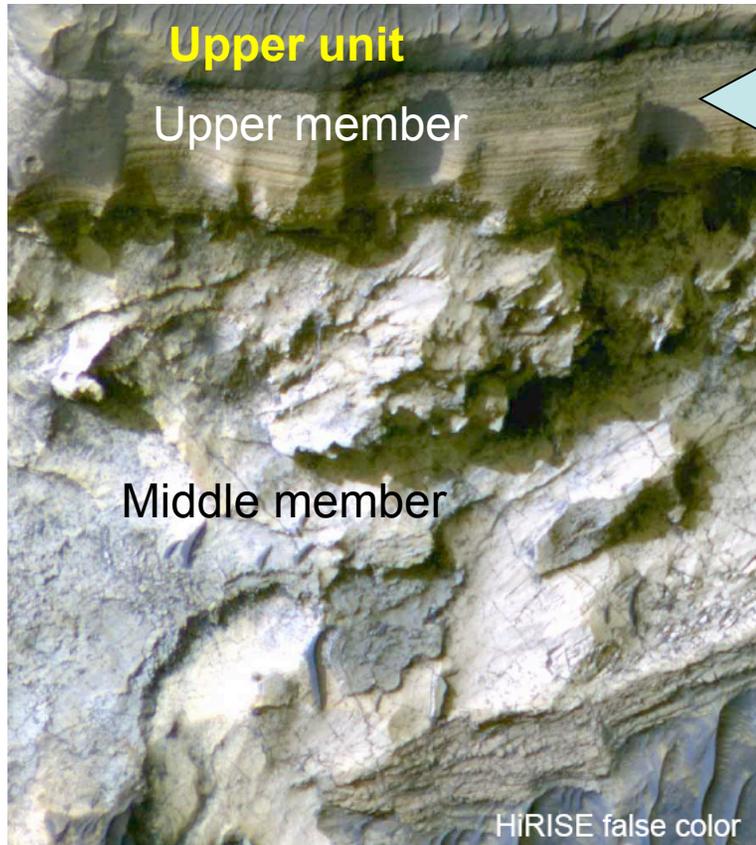
Polygonal surface overlying light-toned layers



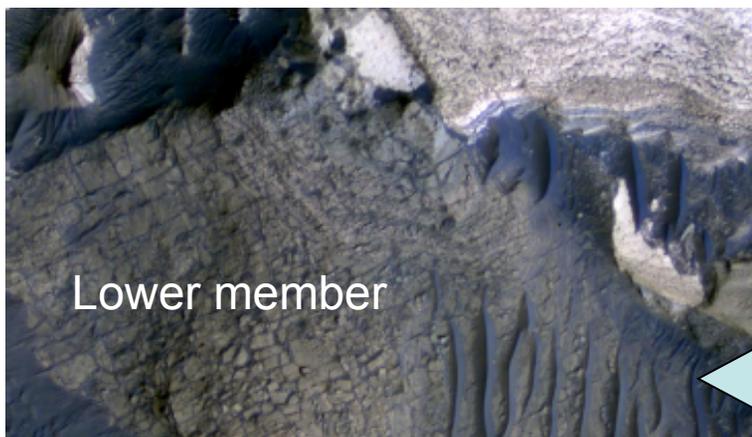
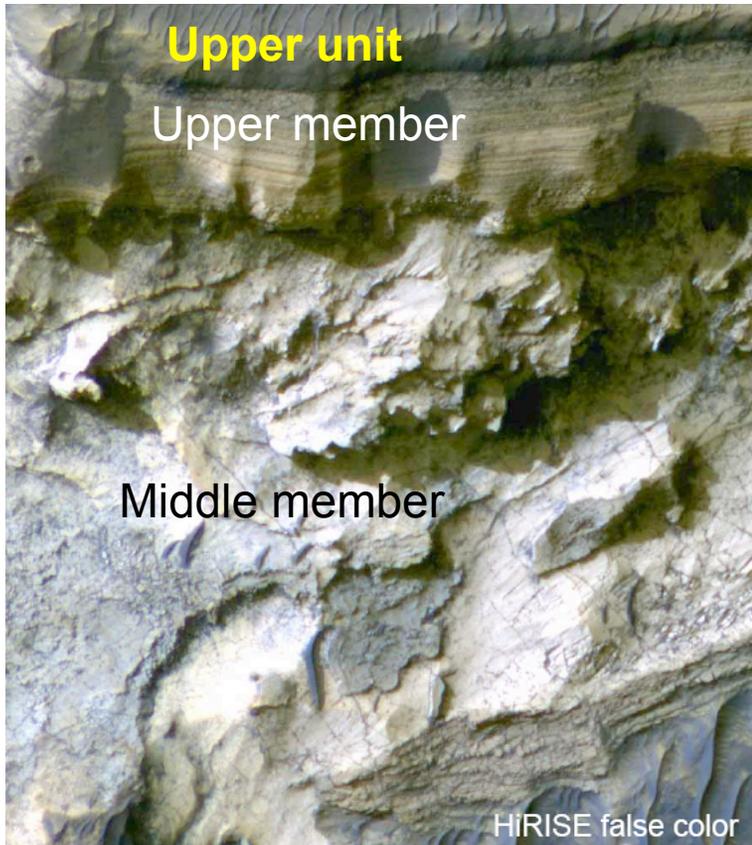
Rare strongly hydrated material seen on polygonal (evaporite??) surface



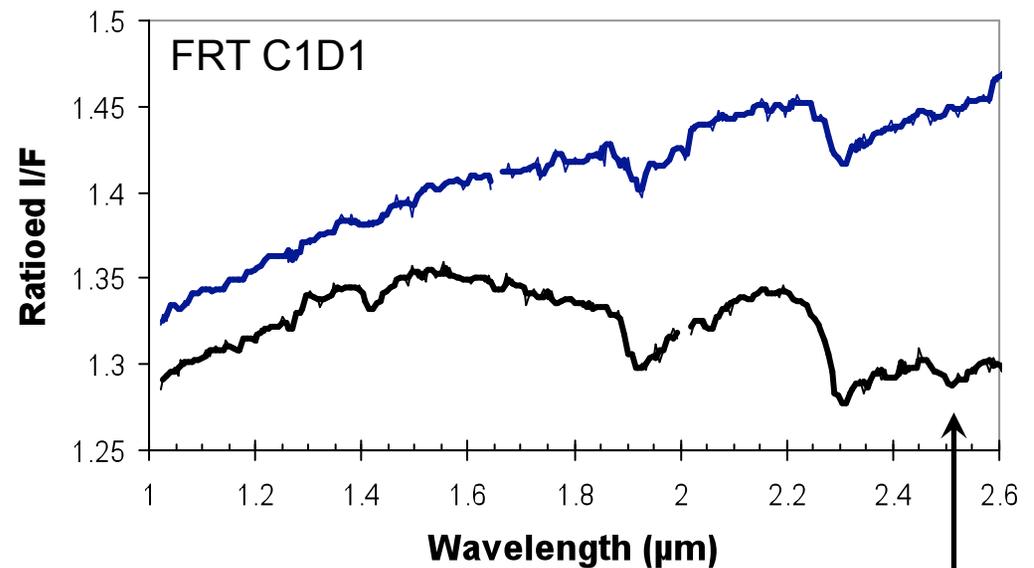
Holden light-toned layered deposits



Holden light-toned layered deposits

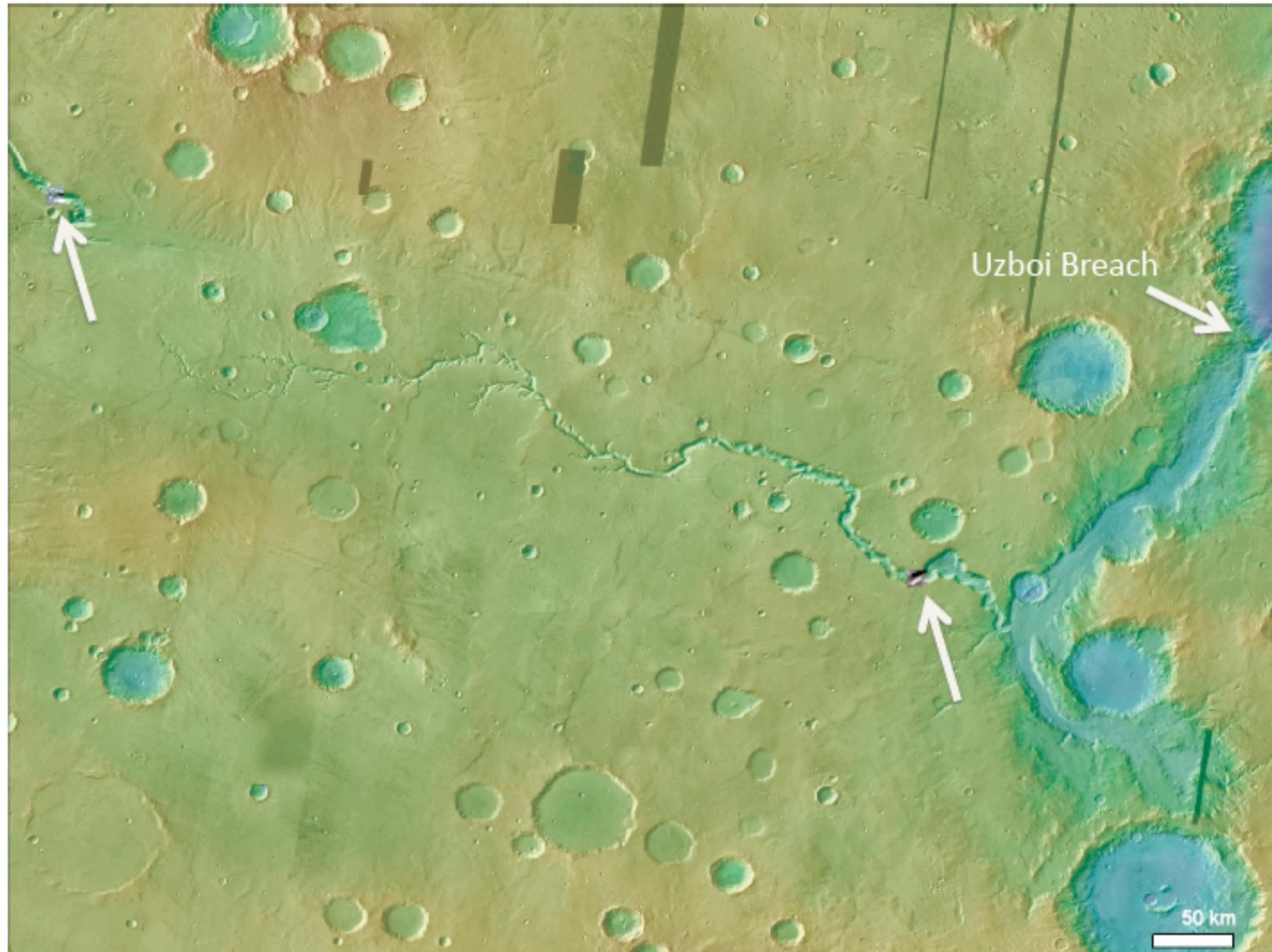


Lower member of lower unit may have
~25–45% clays (Poulet's talk yesterday)



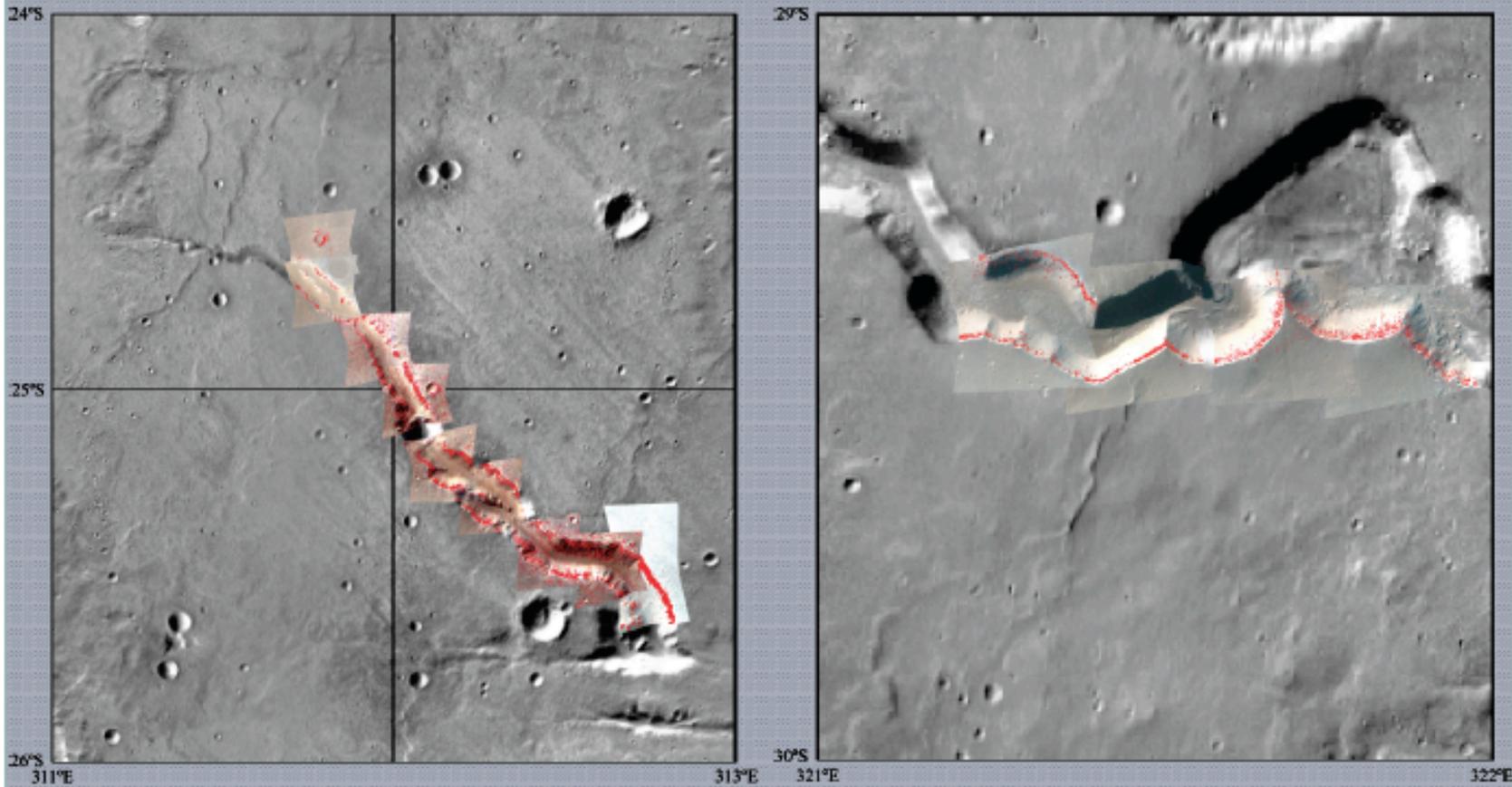
Additional phase,
varying in abundance?

Regional context for Holden/Eberswalde clays



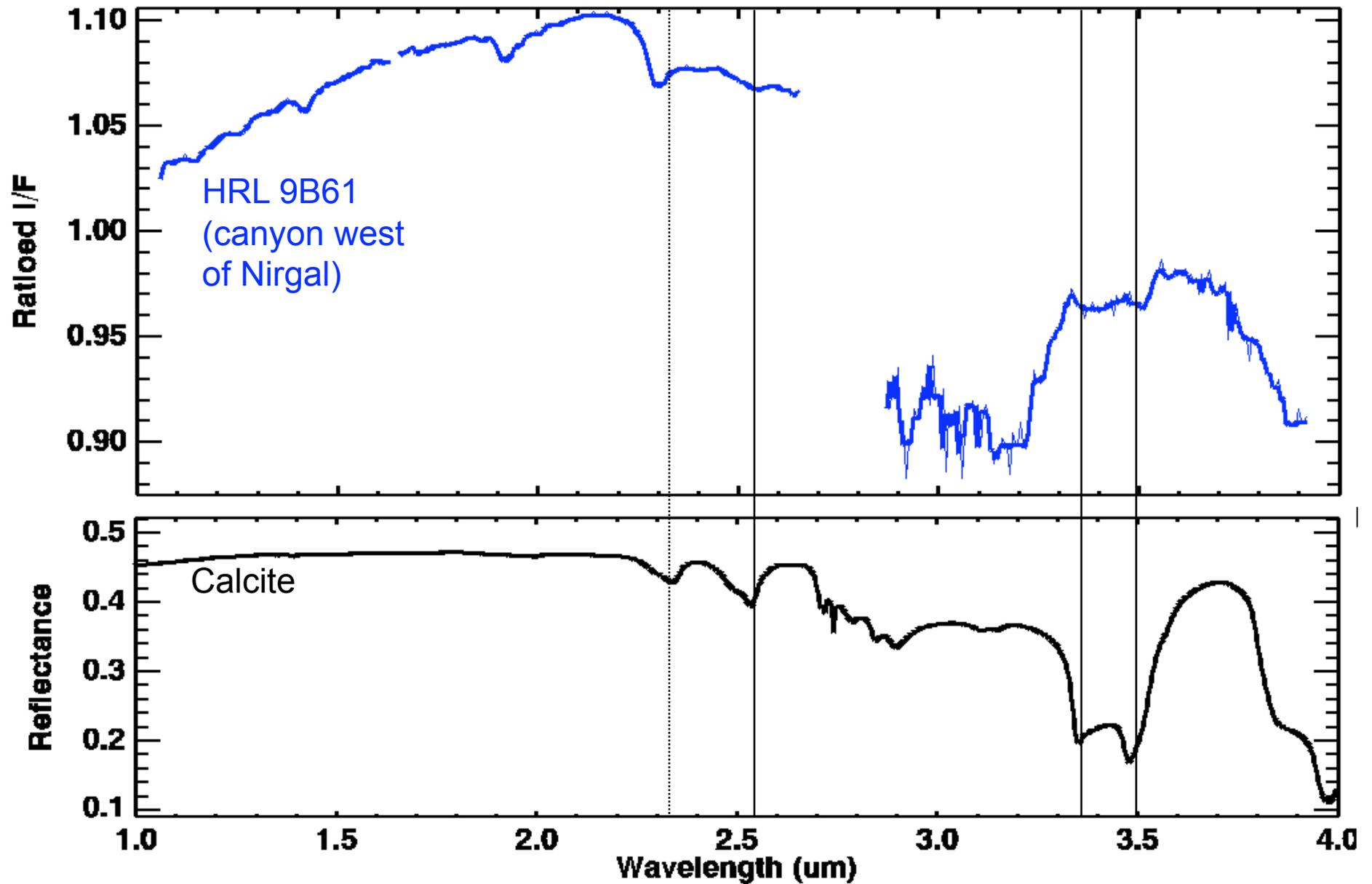
From R. Milliken presentation at 4th landing site workshop

CRISM Observations of Valleys

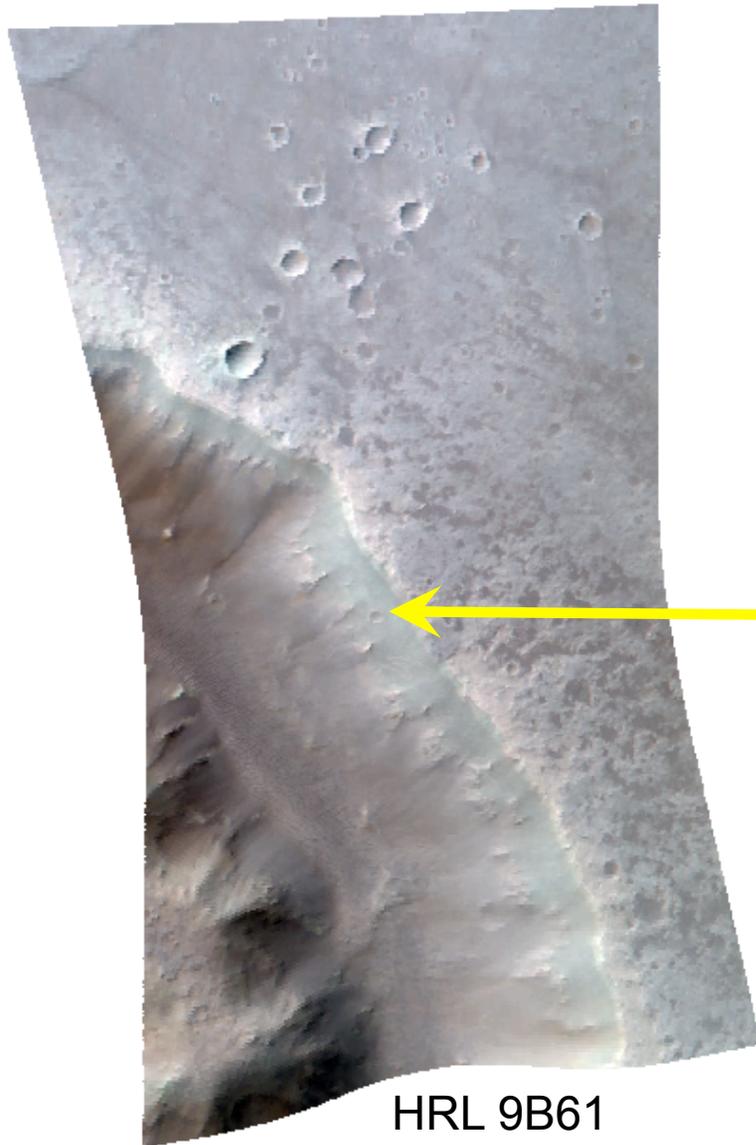


From D. Buczkowski presentation at 4th landing site workshop

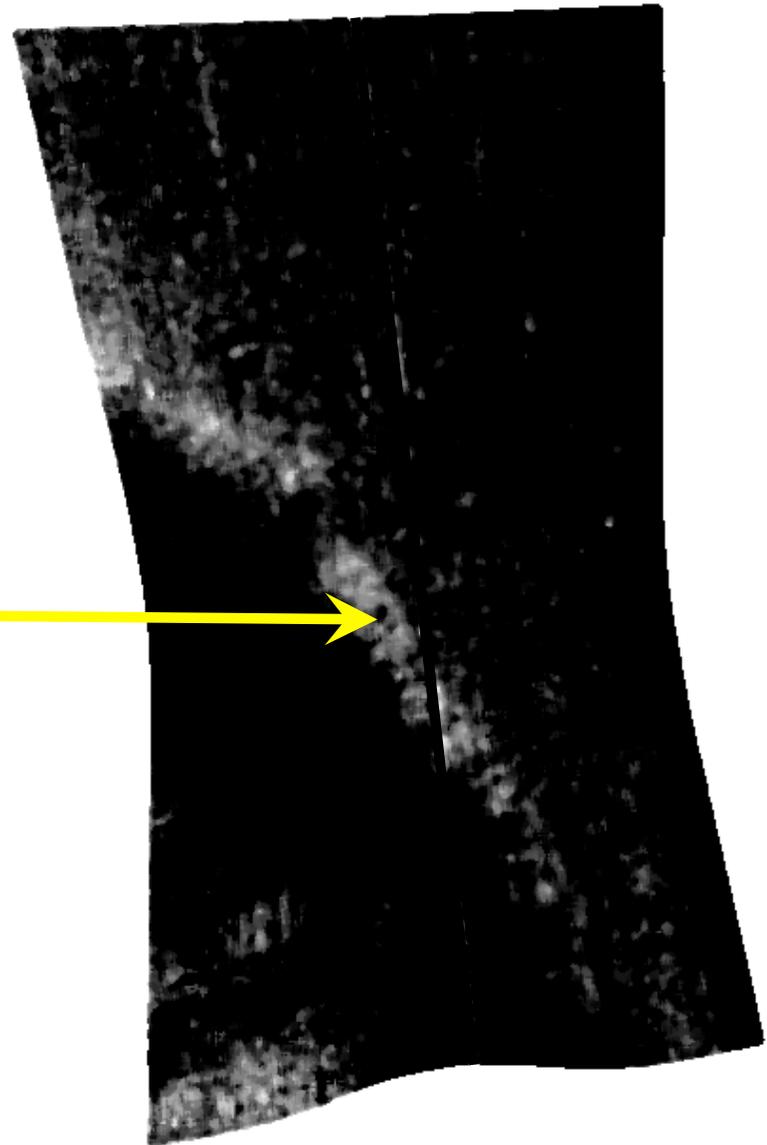
The 2.5 μm band: evidence for carbonates?



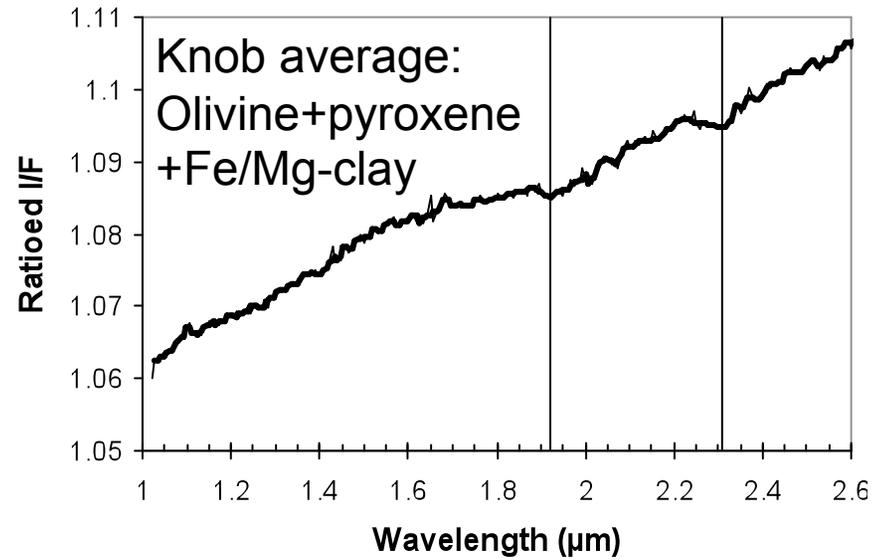
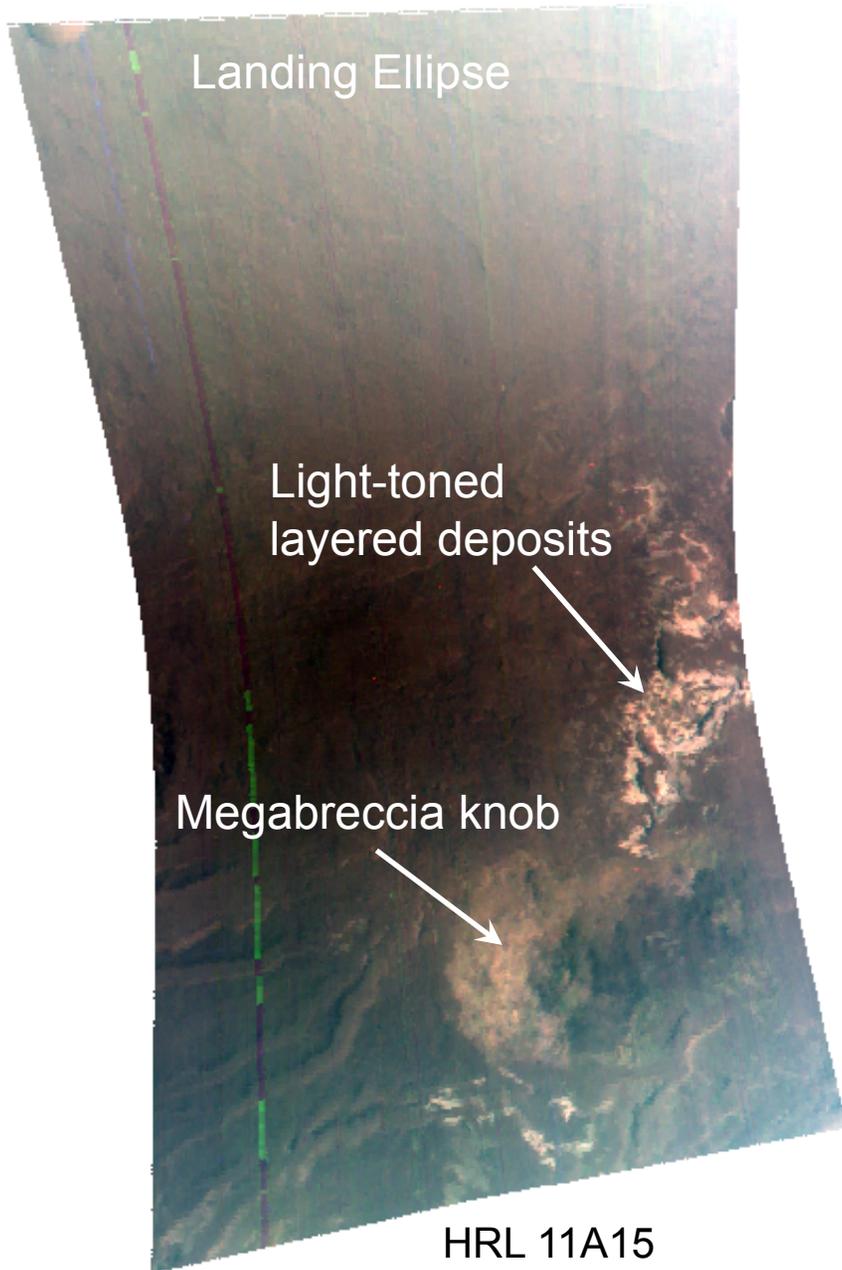
Mapping the 3.9 μm band



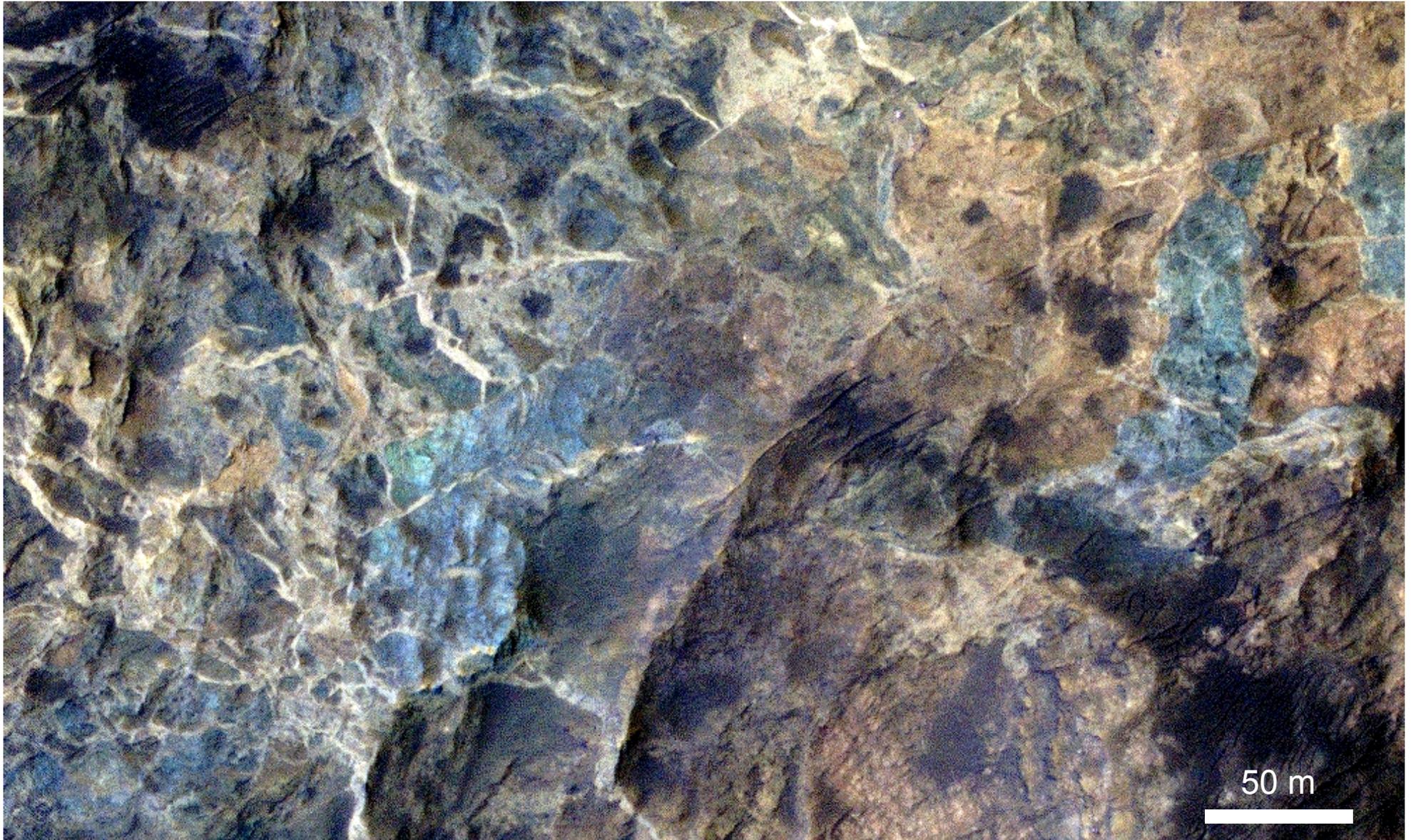
HRL 9B61



Holden megabreccia knob

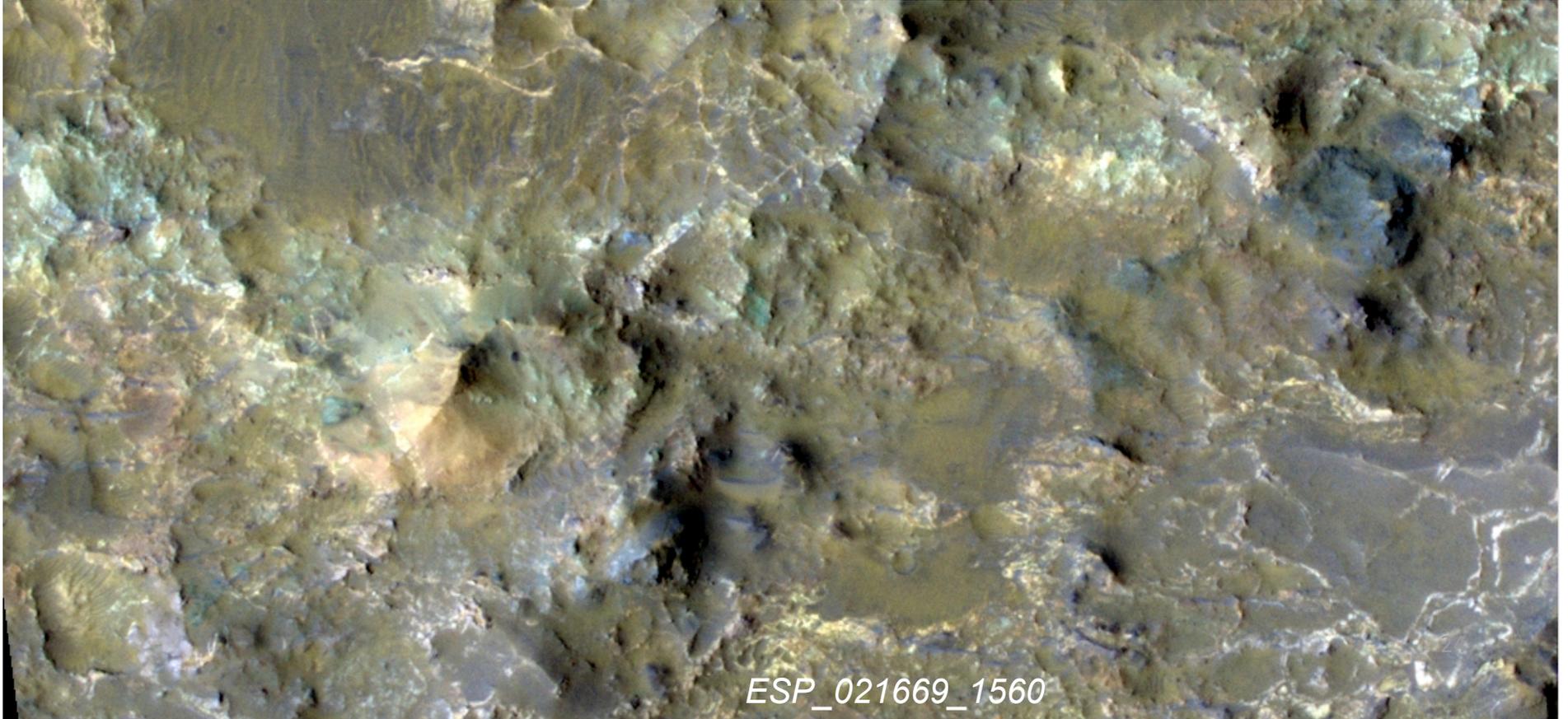
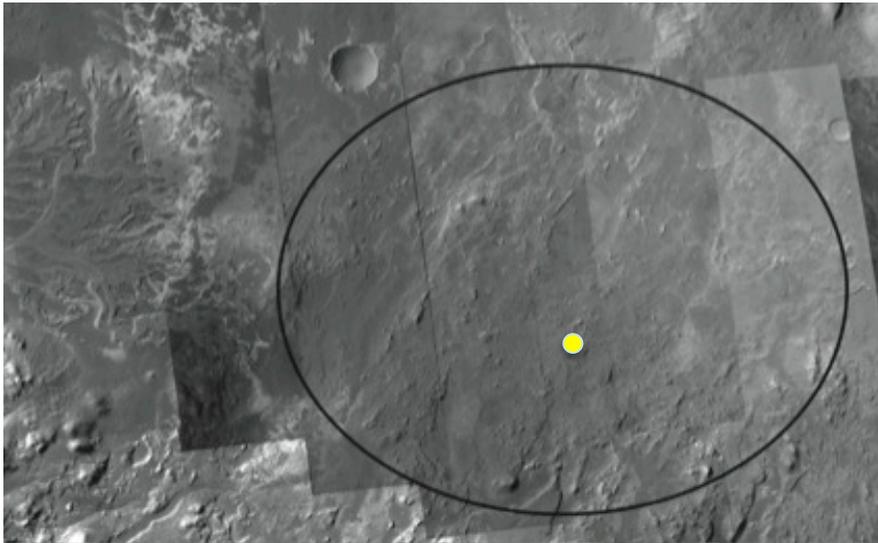


Megabreccia knob (extended mission target)



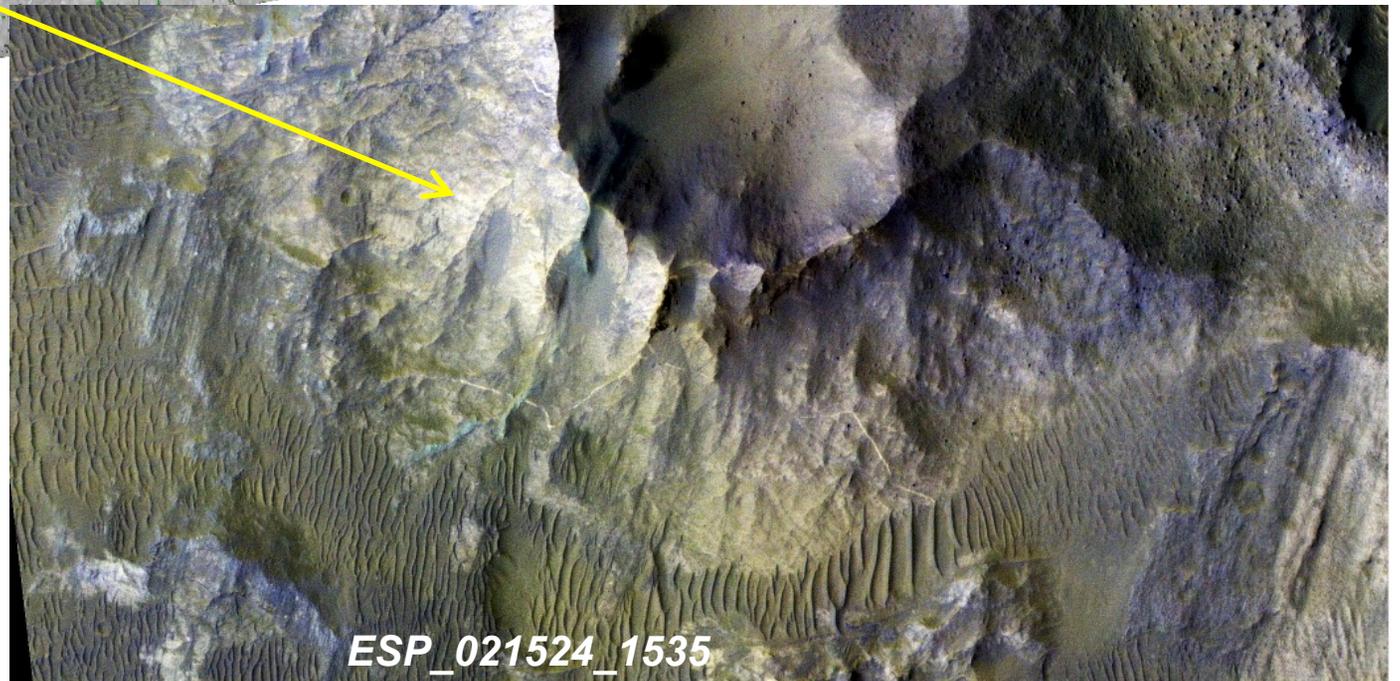
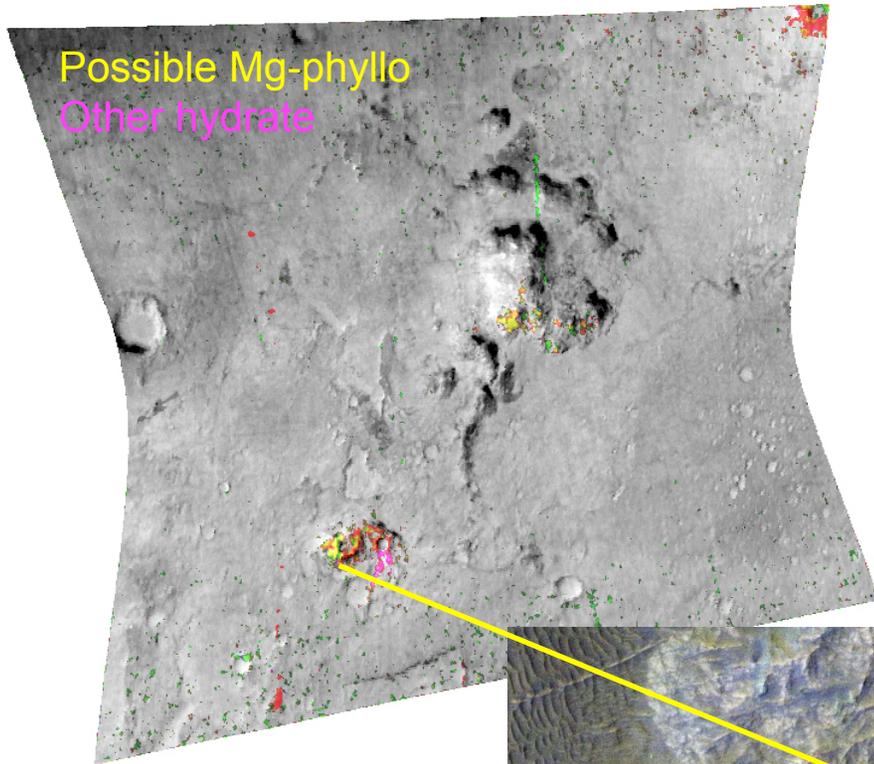
HiRISE ESP_012386_1530

cf. Eberswalde breccia

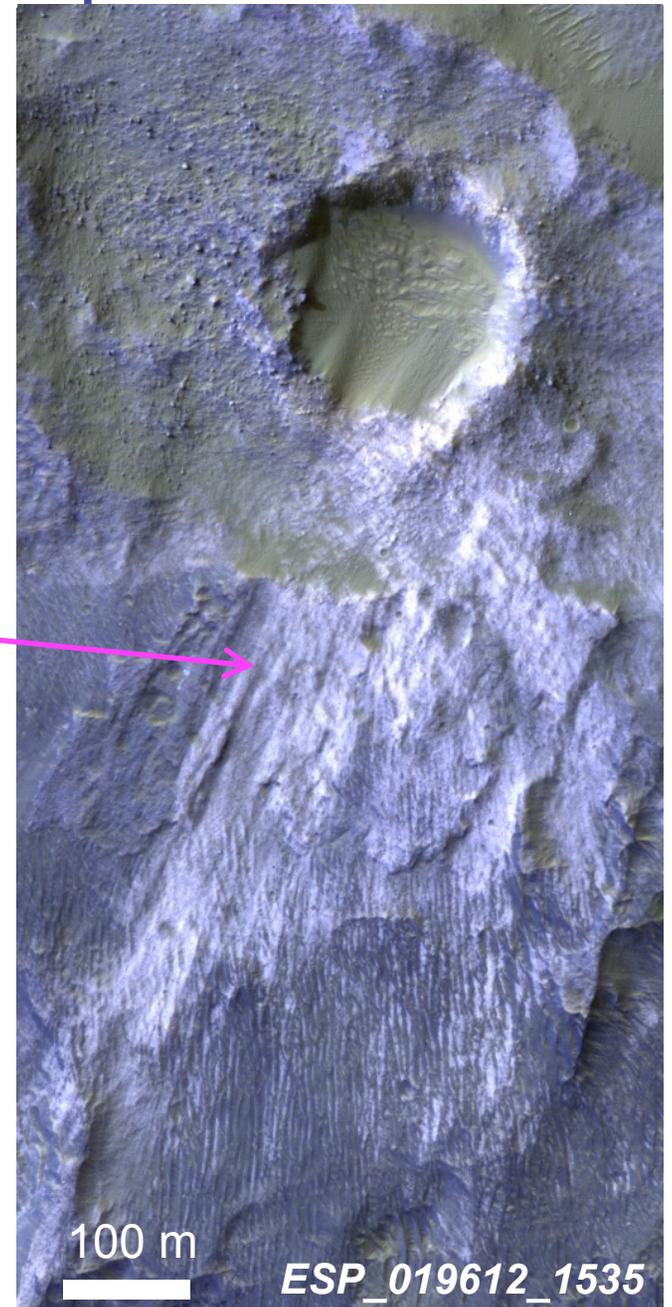
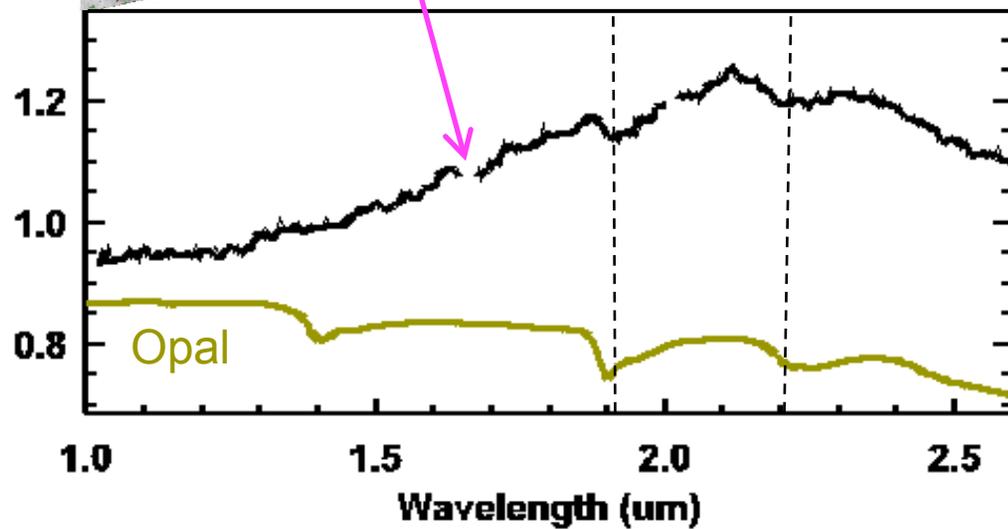
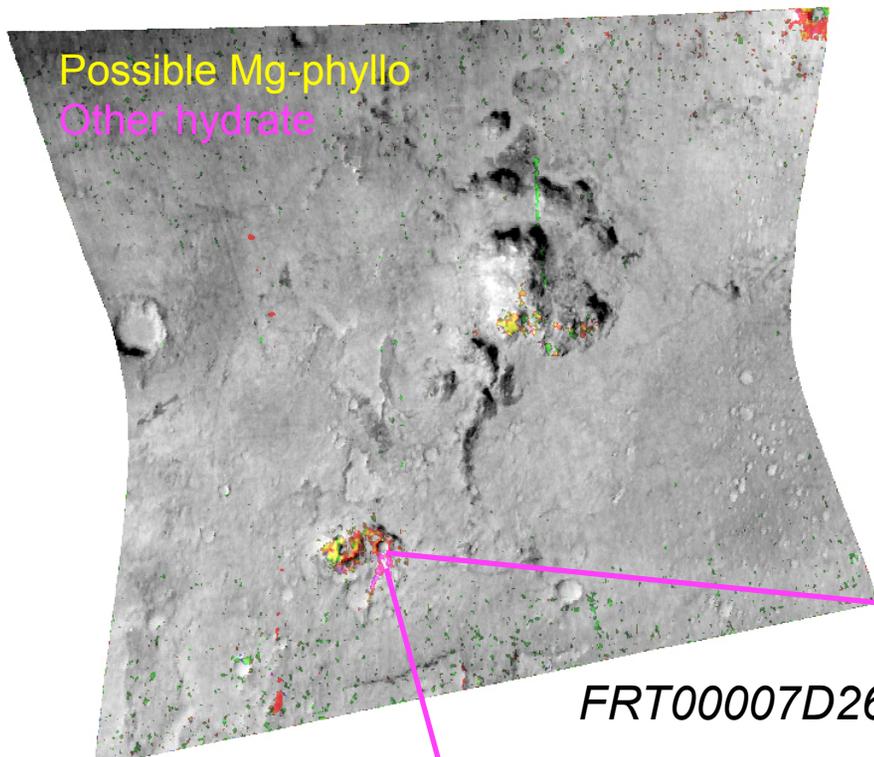


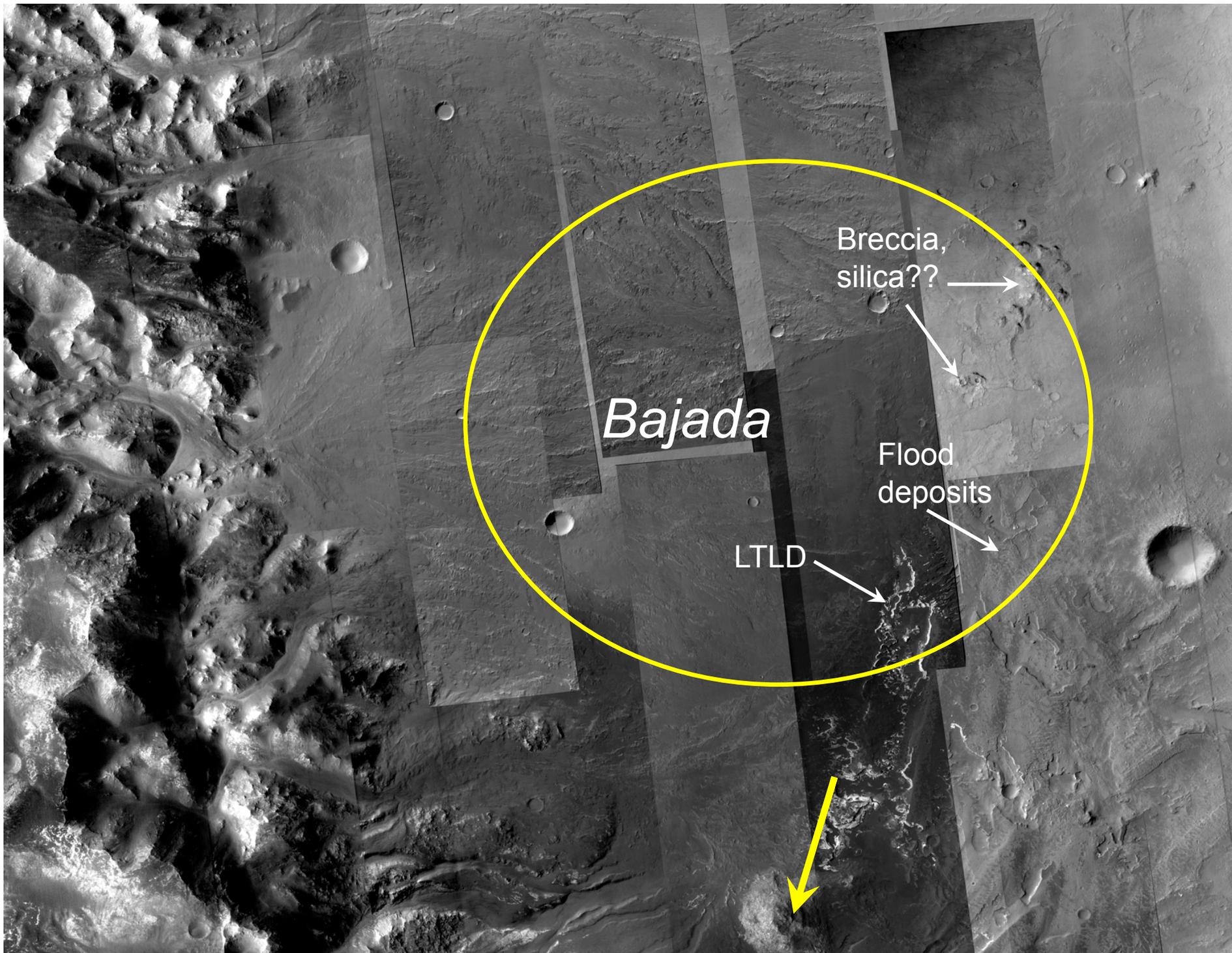
ESP_021669_1560

Eastern ellipse outcrops



Eastern ellipse outcrops



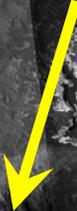


Bajada

Breccia,
silica??

Flood
deposits

LTL D



Summary

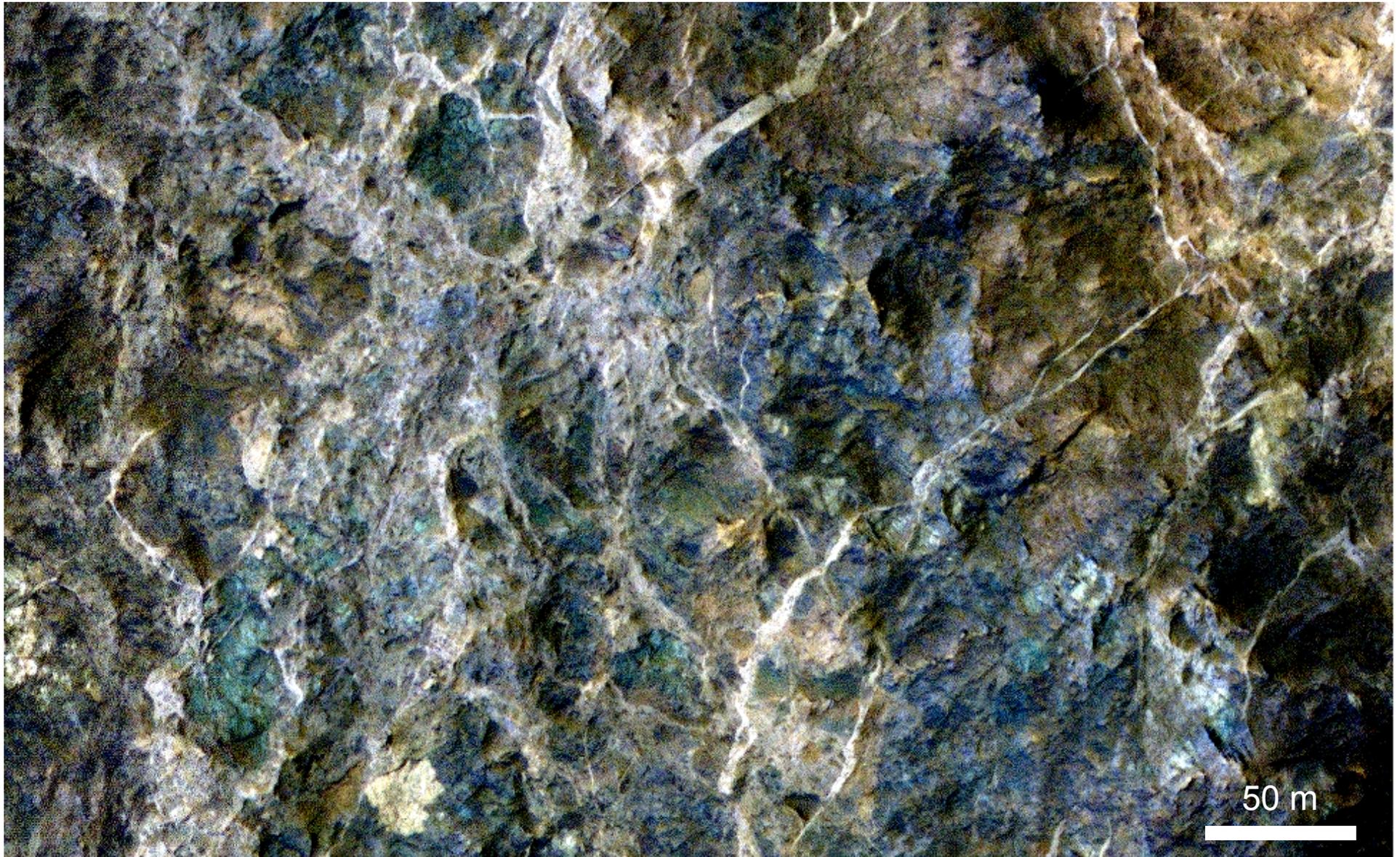
- **Holden's mineralogy is diverse!**

Fan source area:	Ellipse:	Layered deposits:	Megabreccia:
<i>Low-Ca pyroxene</i>	<i>Hydrate: silica?</i>	Strong <i>Fe/Mg-clays</i>	<i>Fe/Mg-clay</i>
<i>High-Ca pyroxene</i>	<i>Fe/Mg-clay</i>	<i>Hydrated phase</i>	<i>Much more!</i>
<i>Mg-rich olivine</i>		<i>2.5 μm phase?</i>	
<i>Fe-rich olivine?</i>			
<i>Fe/Mg-clay</i>			
<i>Hydrated salt/zeolite</i>			

- Diverse minerals and strong clay signatures ***with geologic context***
- Alluvial/lacustrine deposits remain the primary science target for MSL, but mineralogic/astrobiologic characterization of diverse Noachian rocks (altered and unaltered) by MSL would feed forward to MSR

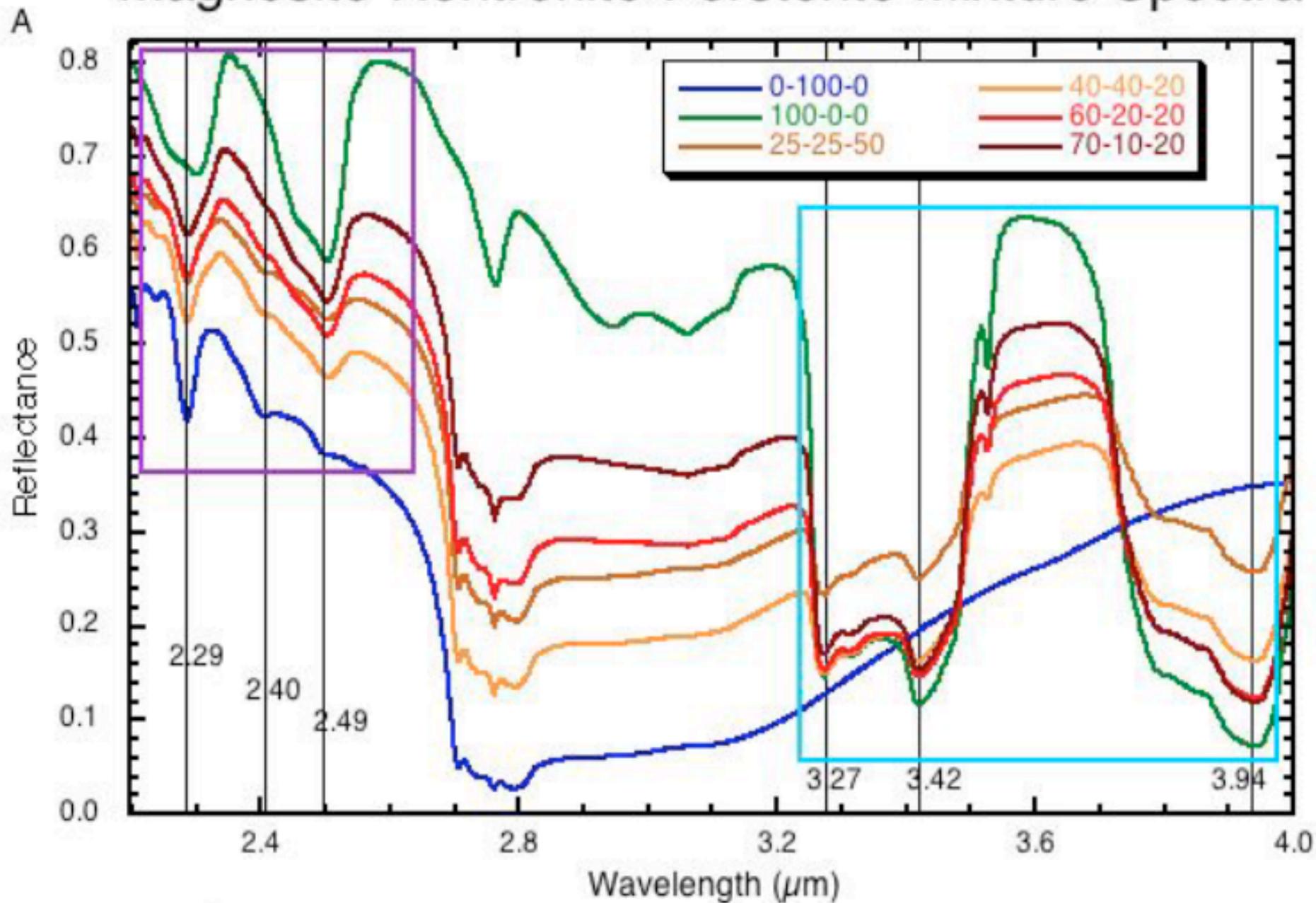
Extras

Megabreccia knob (extended mission target)



HiRISE ESP_012320_1530

Magnesite-Nontronite-Forsterite Mixture Spectra



Perry et al. (LPSC 2011)