The CRISM View of Mars

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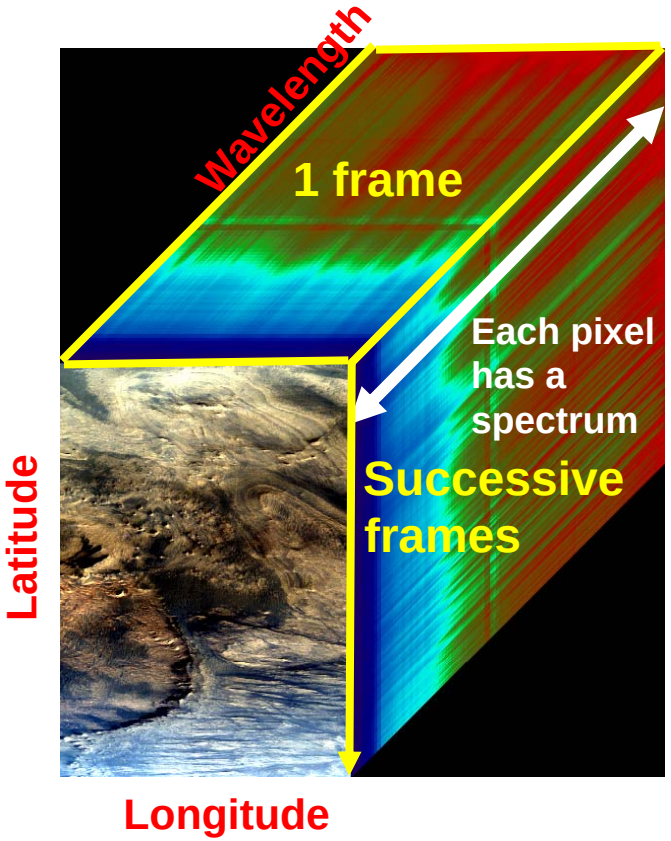
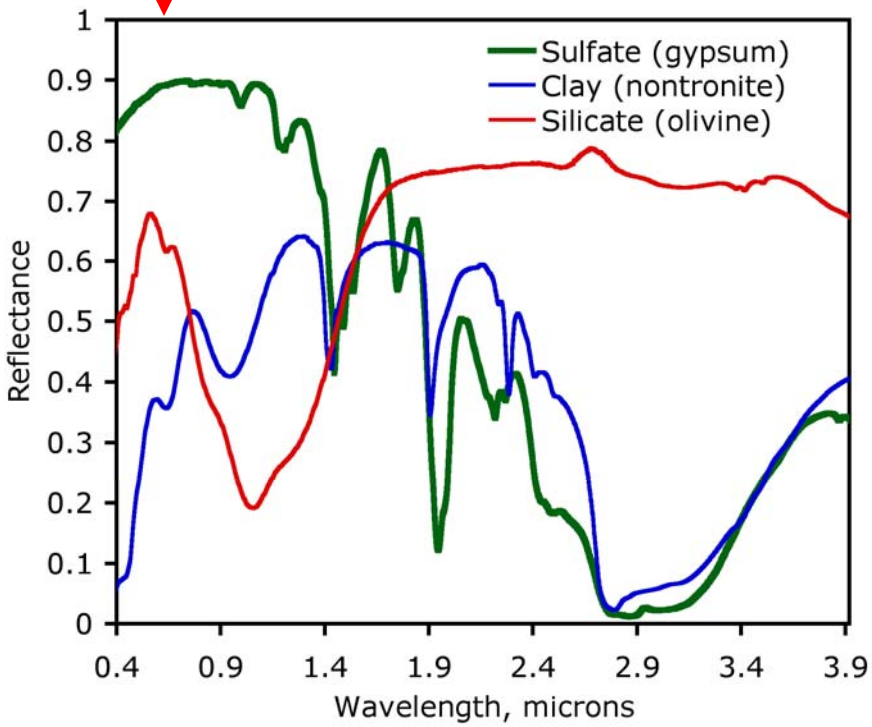
CRISM Detects and Maps Minerals Using Vis-NIR Imaging Spectroscopy

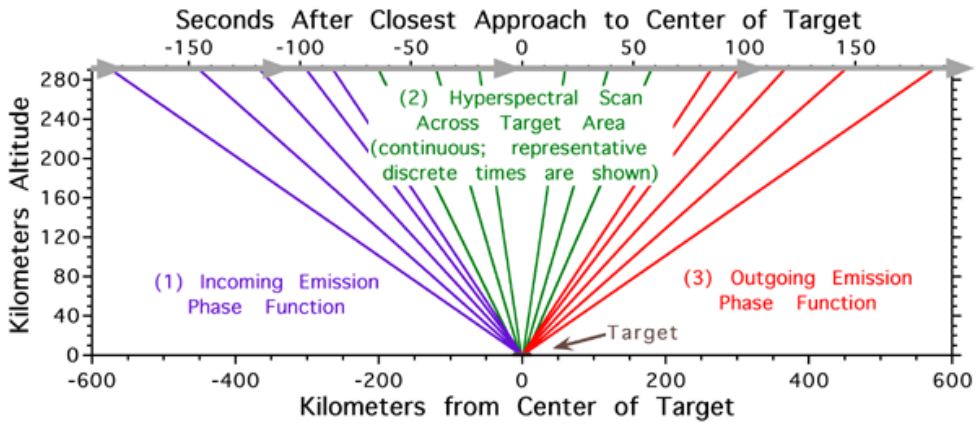




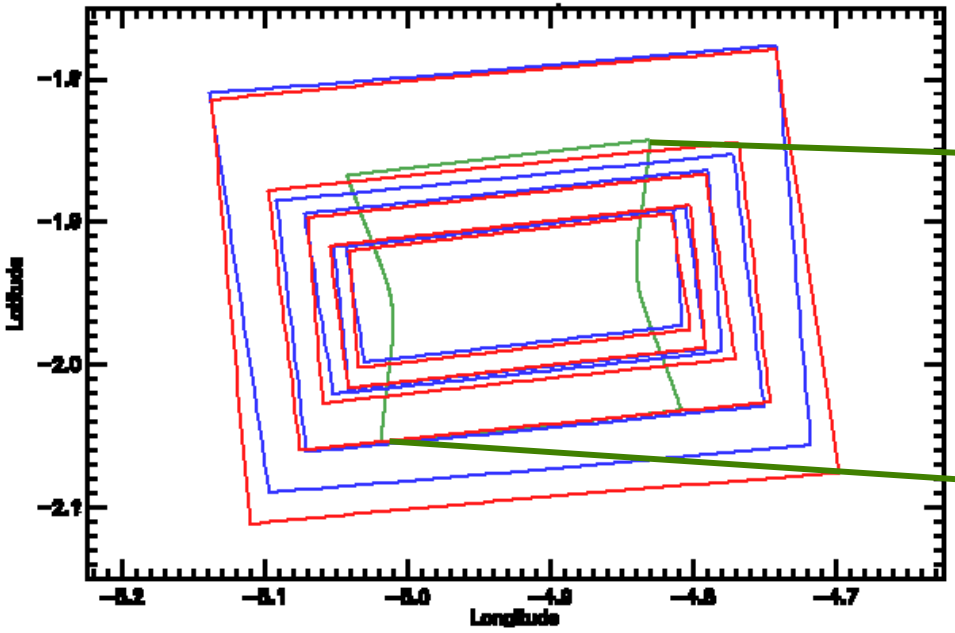
A single image is ~10 km wide, in 544 colors covering 0.36-3.92 μm at 6.55 nm/channel, up to 15 m/pixel

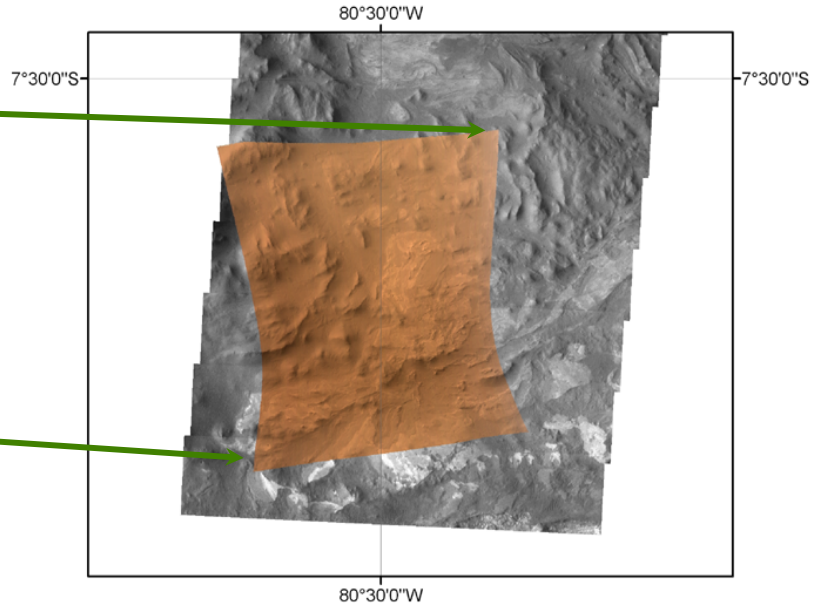
Each pixel has a spectrum that can be compared with mineral spectra

Operating Mode 1: Targeted Observations

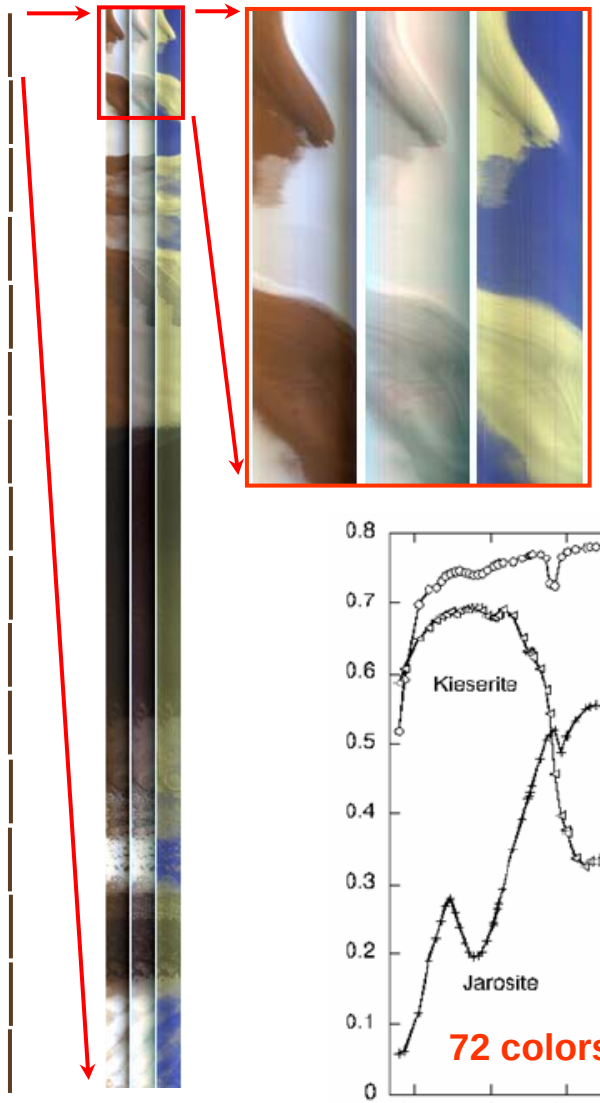


- For selected sites
- 11 images per observation, 360-3920 nm, all 544 wavelengths
- Central image is unbinned (18 m/pixel) or 2x binned (36 m/pixel); main geology product
- 1st 5 and last 5 are 10x binned spatially (~180 m/pixel); to separate surface/ atmosphere



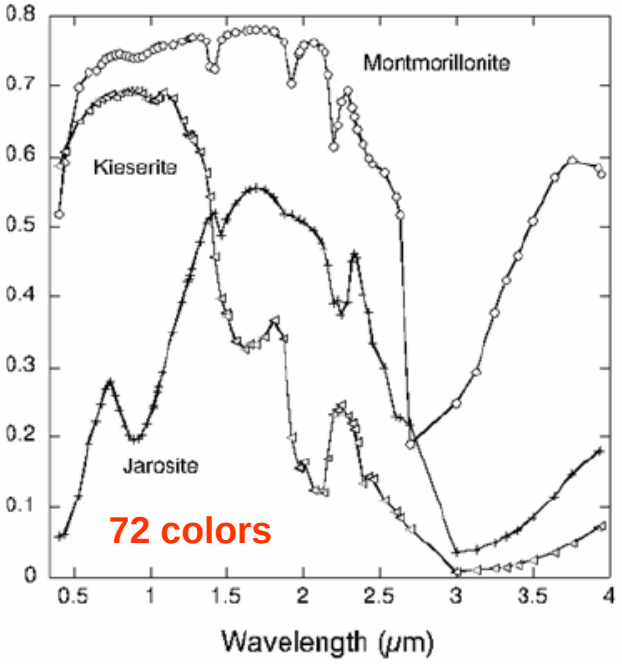


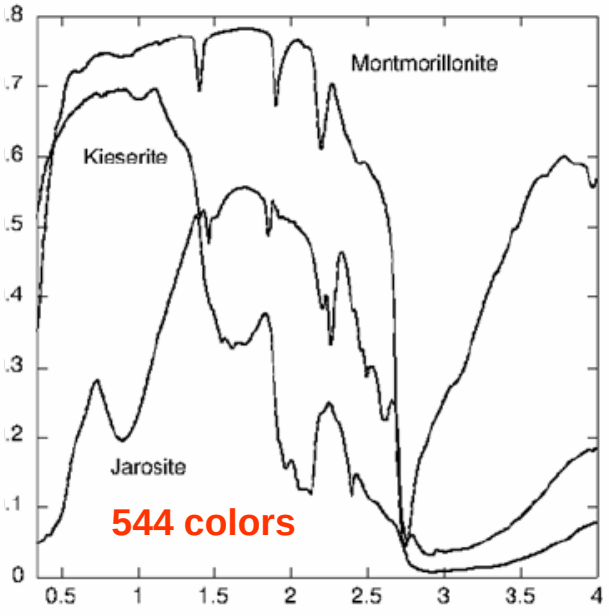
Operating Mode 2: Multispectral Survey



1 orbit 3-min segment

- Lower-resolution global map to provide context and to find new targets
- 72 programmable wavelengths at full spectral resolution, 10x-binned spatially to 200 m/pixel
- Multispectral "noodles" mosaicked to create global map

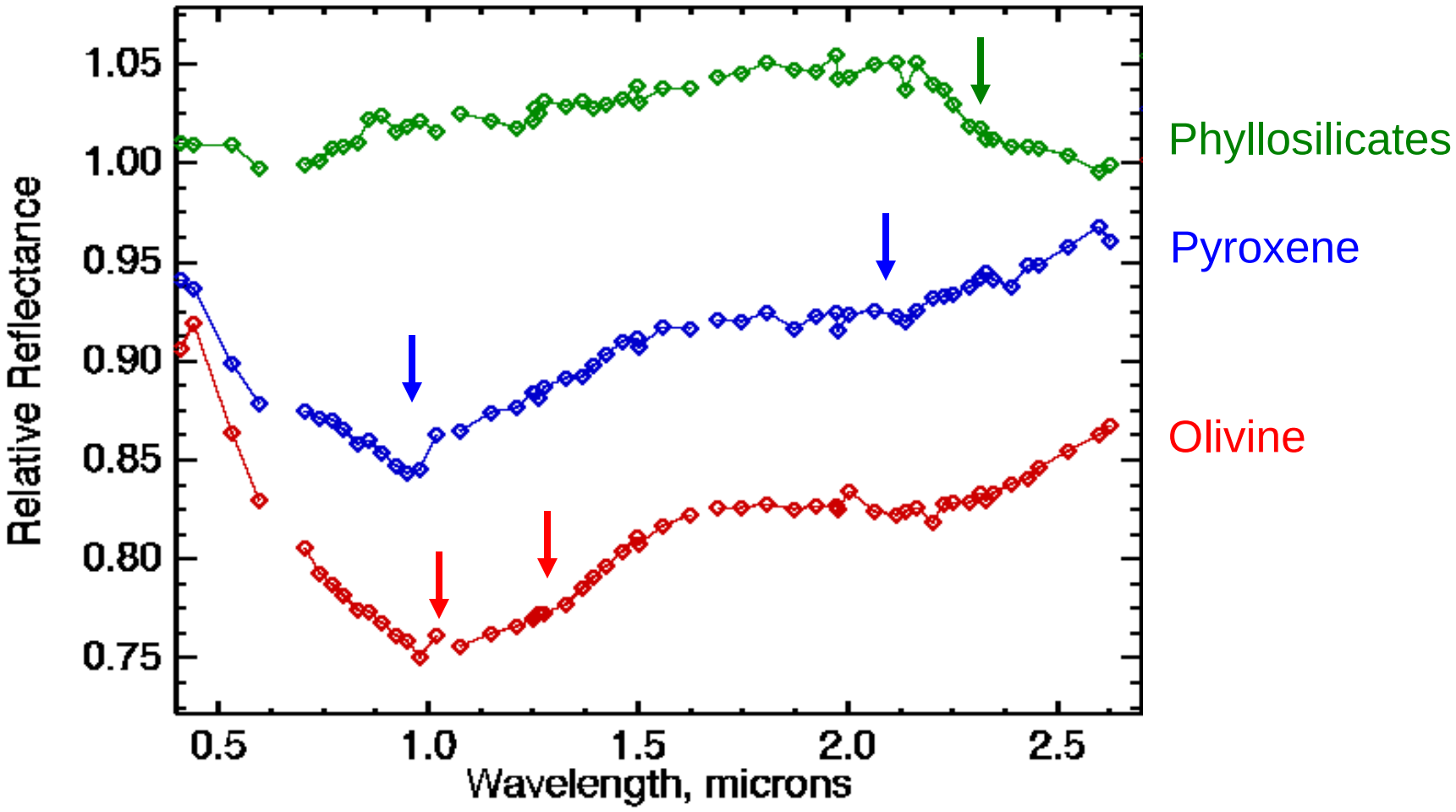


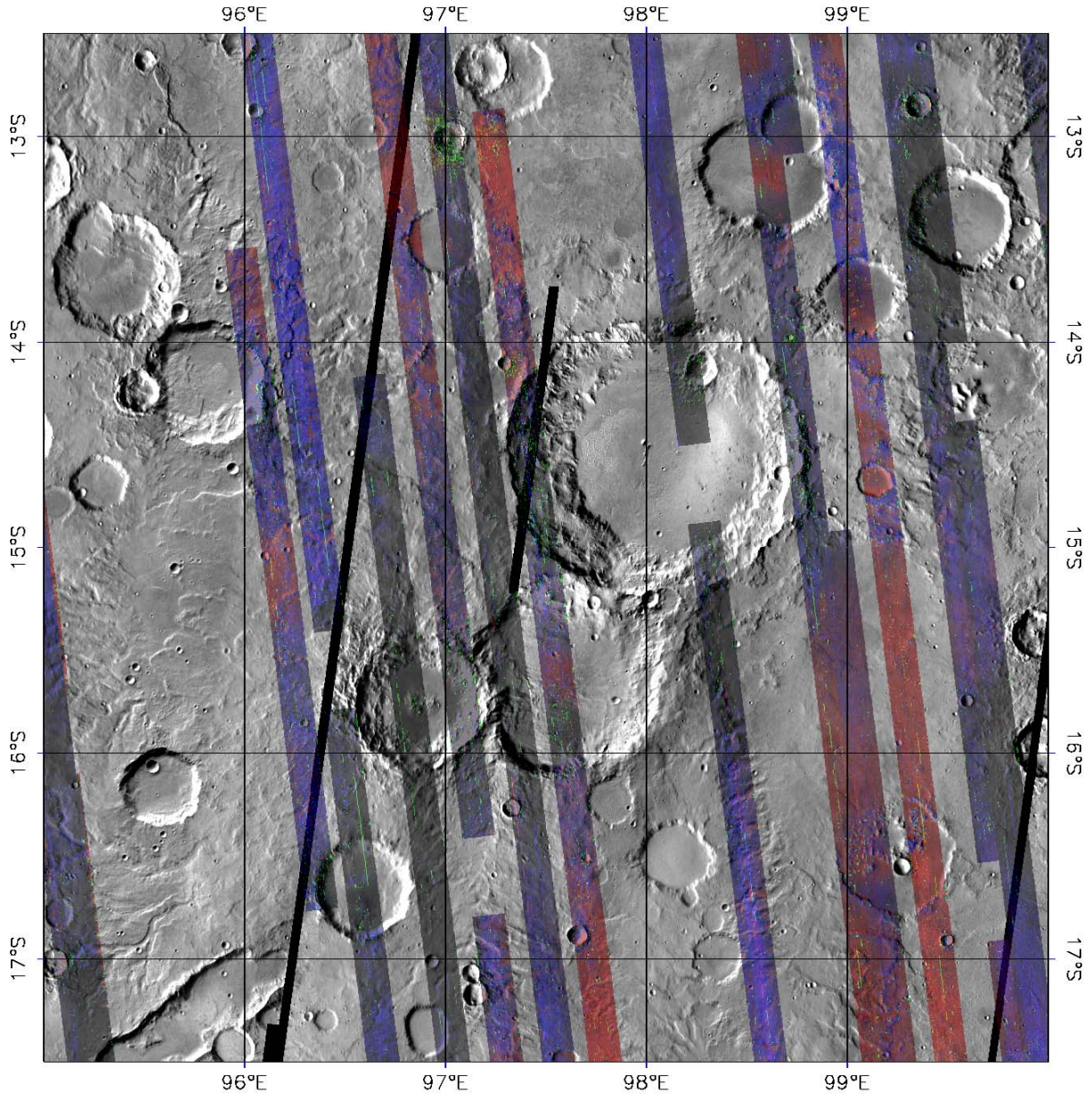


Standard Processing

- Calibration to radiance
  - Reference against internal integrating sphere
- Correction to I/F
  - Divide by solar spectrum
- Derivation of photometric angles
  - SPICE
- Atmospheric / photometric correction
  - Normal method: divide by *cos i*, scaled ratio spectrum of base/summit of Olympus Mons
- Calculation of spectral summary products
  - Images of strengths of key absorption bands
- Extracted spectra are commonly ratioed to nearby "dusty" regions to cancel out systematic artifacts

Spectral Signatures in Global Mapping Data (tile 750)



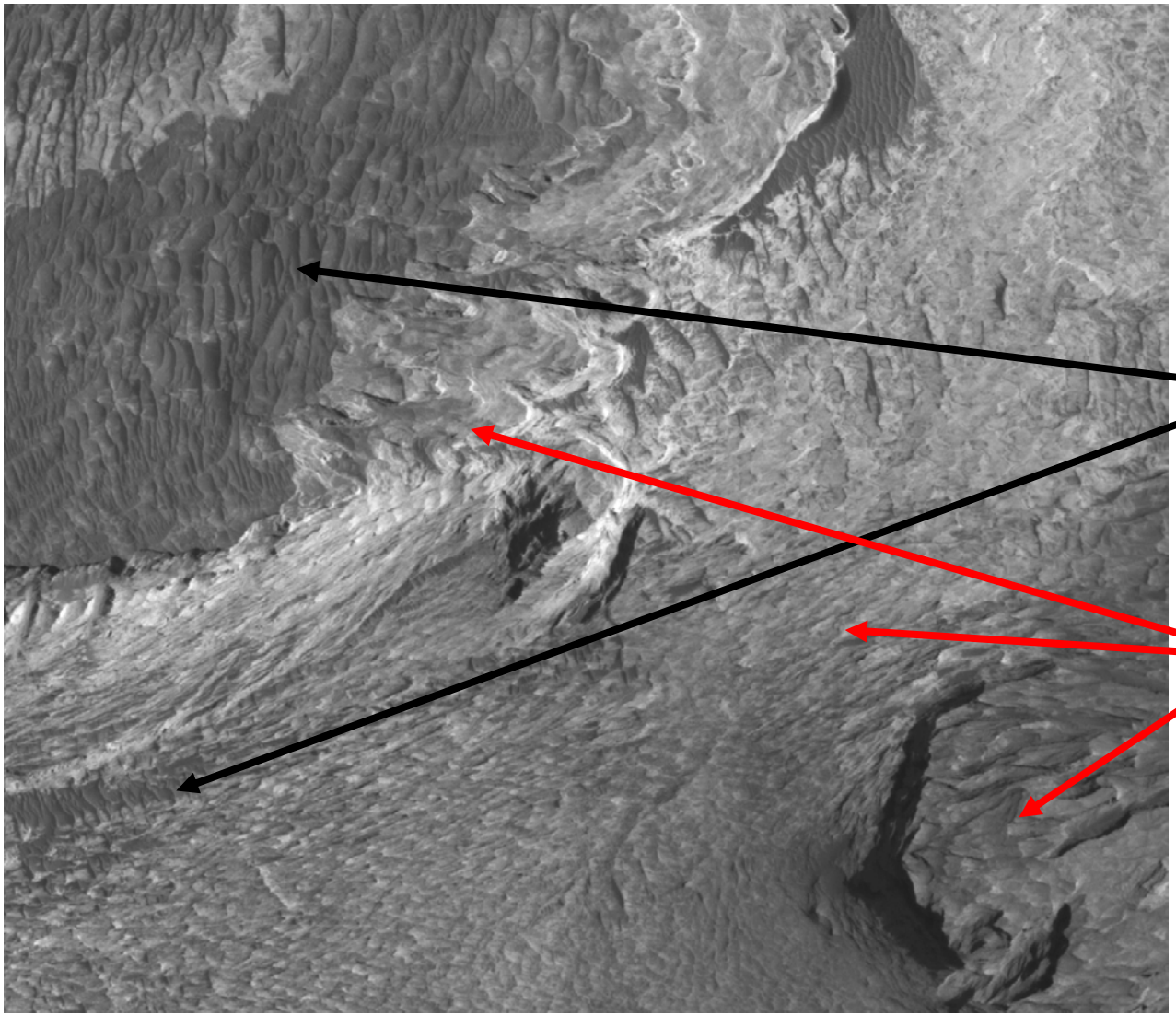


Summary Products

- 45 total products showing known or potential variations in surface spectra
- See Pelkey et al. 2007, Aug. 2007 *JGR-Planets*
- This view shows local compositional variations in part of tile 750 in Tyrrhena Terra:

R = olivine index
G = 2.3-µm phyllosilicate absorption
B = pyroxene index

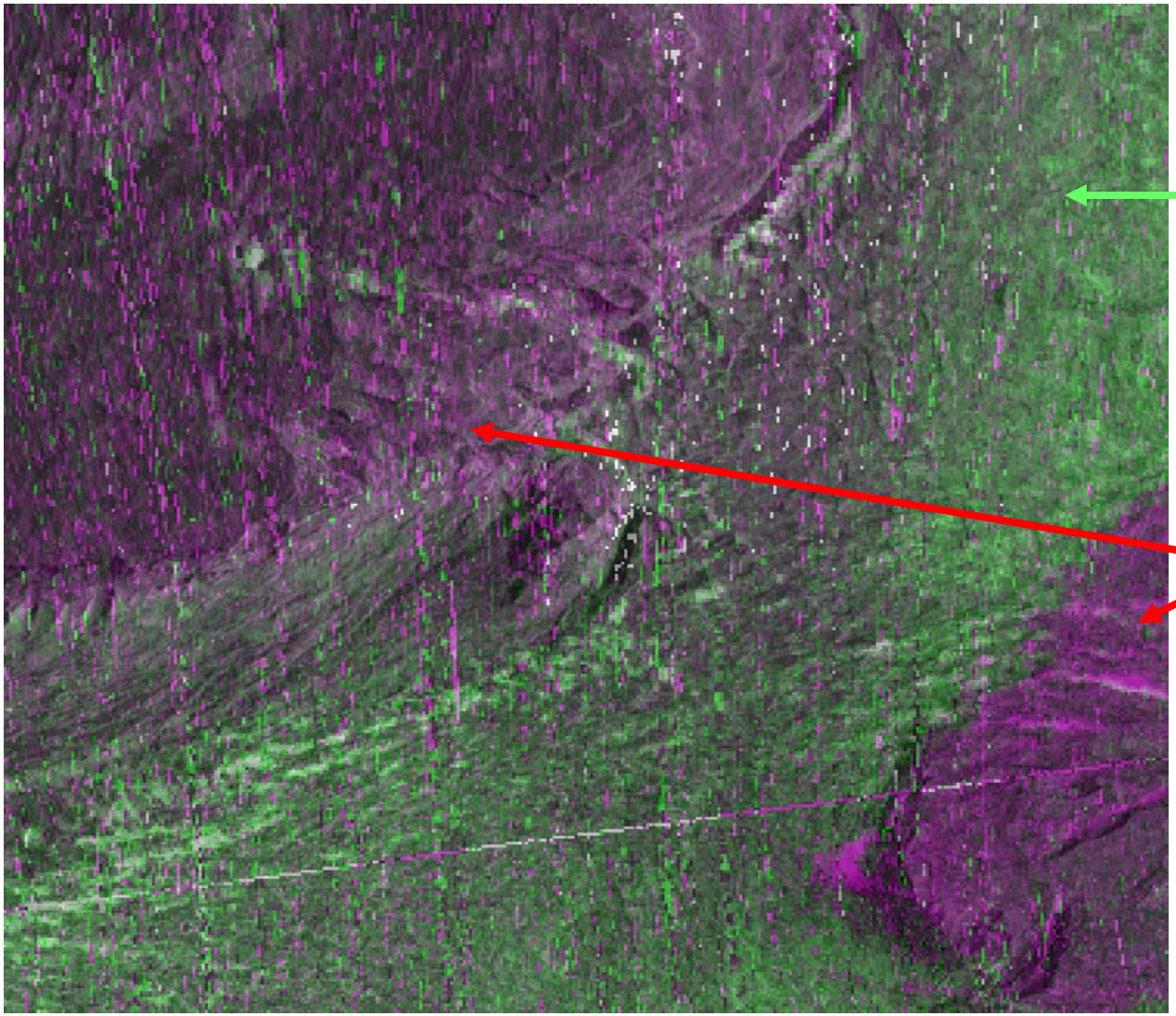
Sulfates in Hesperian Layered Deposits



- Interior layered deposits in W Candor Chasma

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

Composition varies between layers at the 10's-m scale



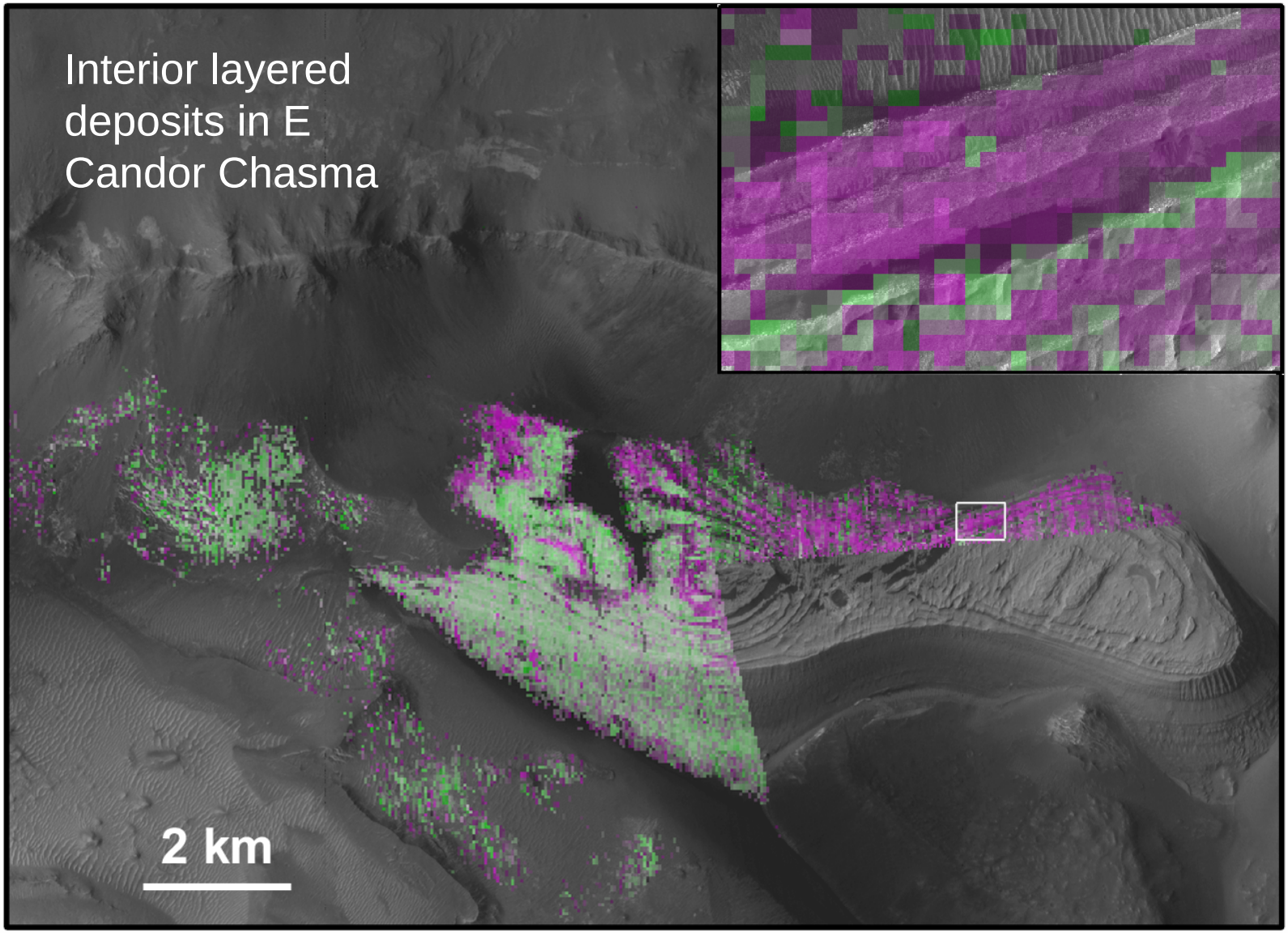
Light-toned layered rock with monohydrate signature

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

5 km

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

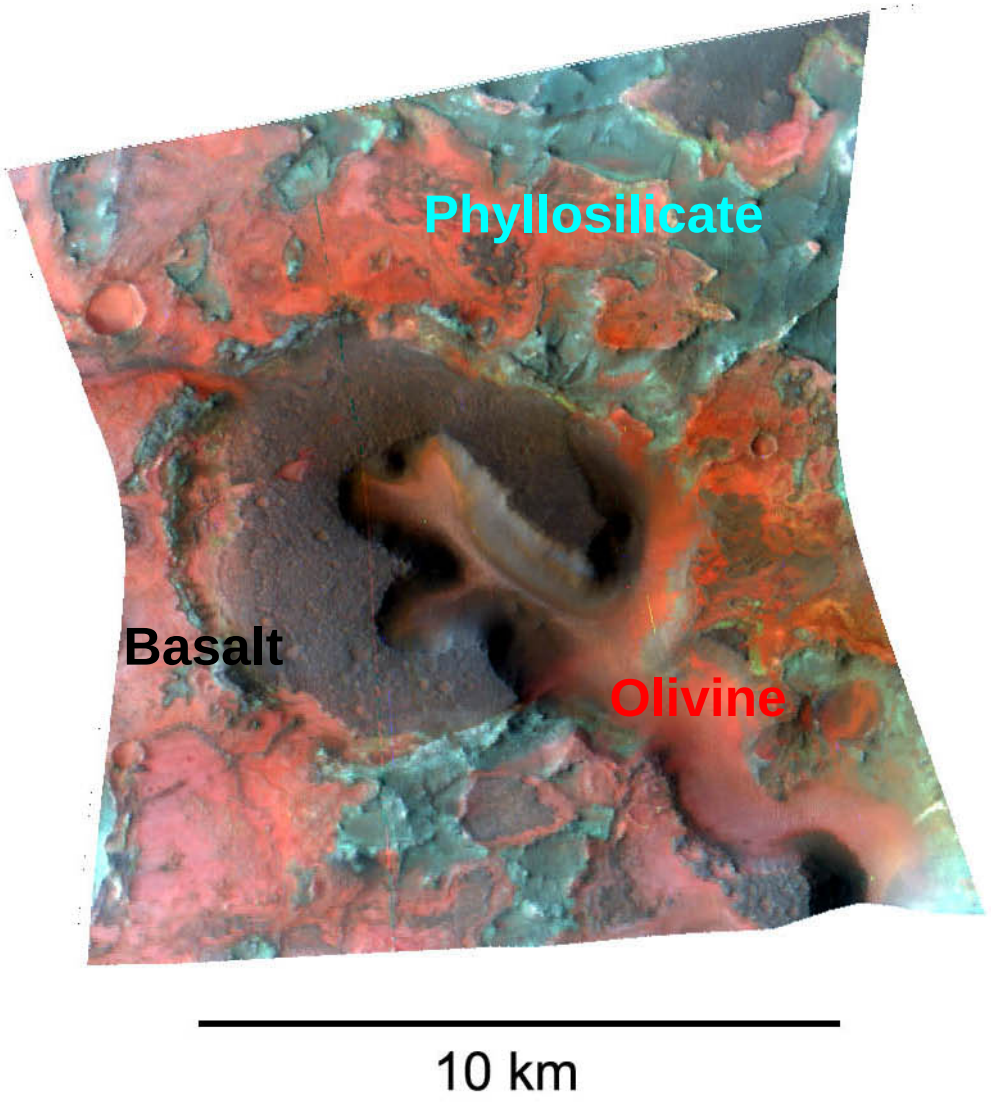
Composition varies between layers at the 10's-m scale



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

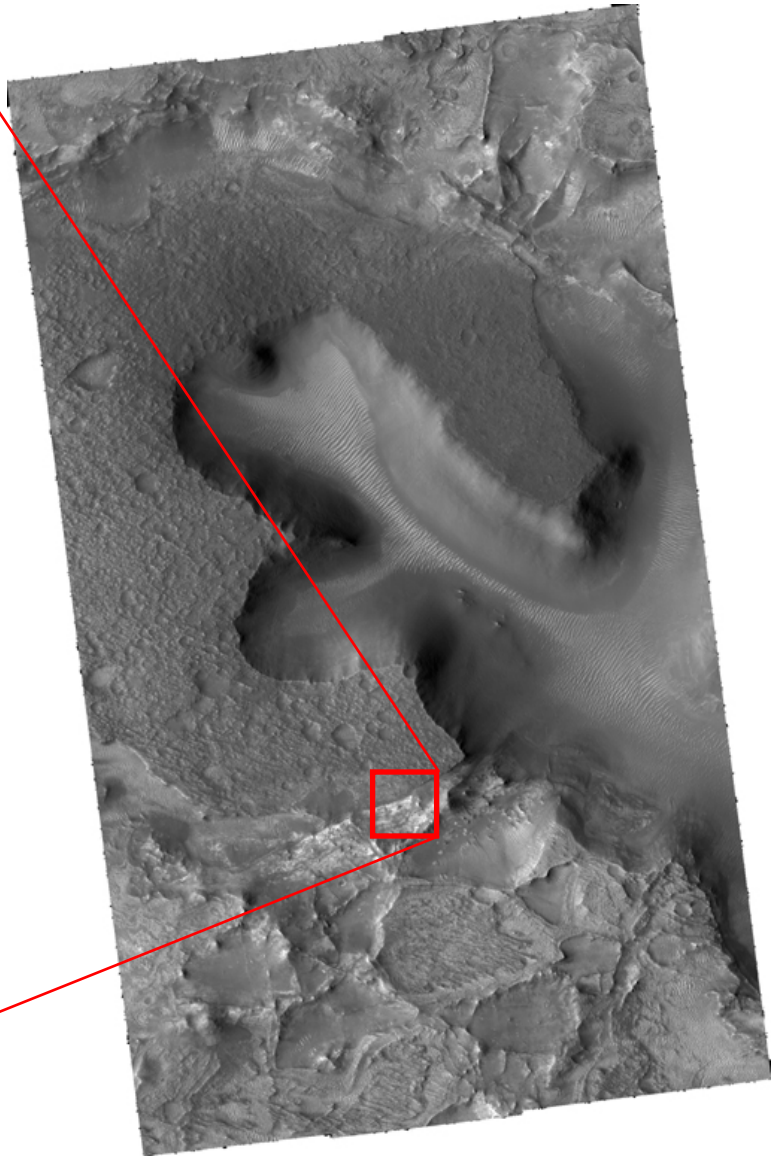
Noachian crust exhibits dramatic compositional layering

IR False Color (2528, 1505, 1078 nm)



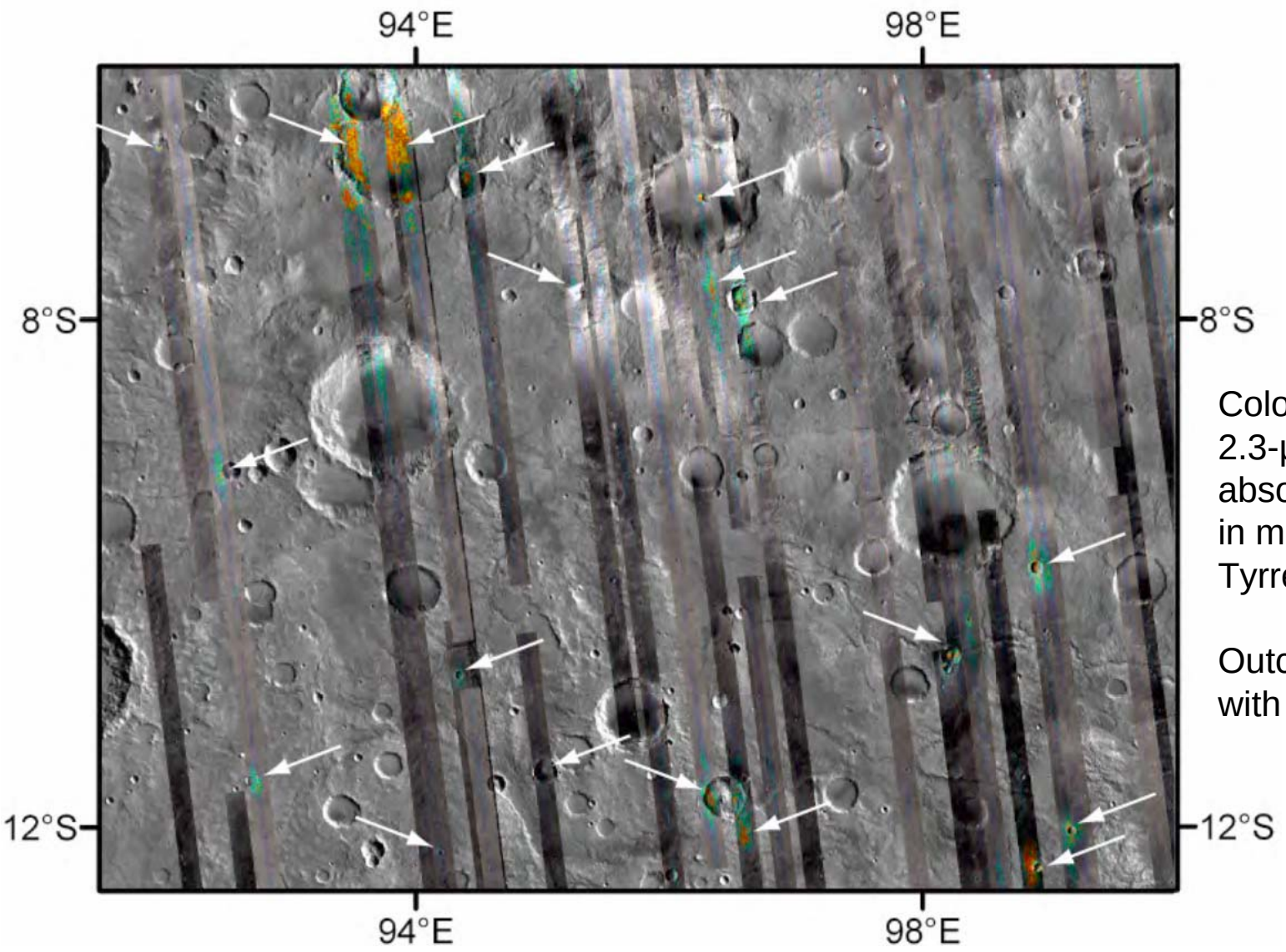
- Nili Fossae reveals a section of Noachian rocks with a wide range of compositions
- These data suggest that Mars was wet about 4 billion years ago but became much colder and dryer by the latter stage of valley network formation (~3.7 billion years ago)

Close-up from HiRISE



400 meters

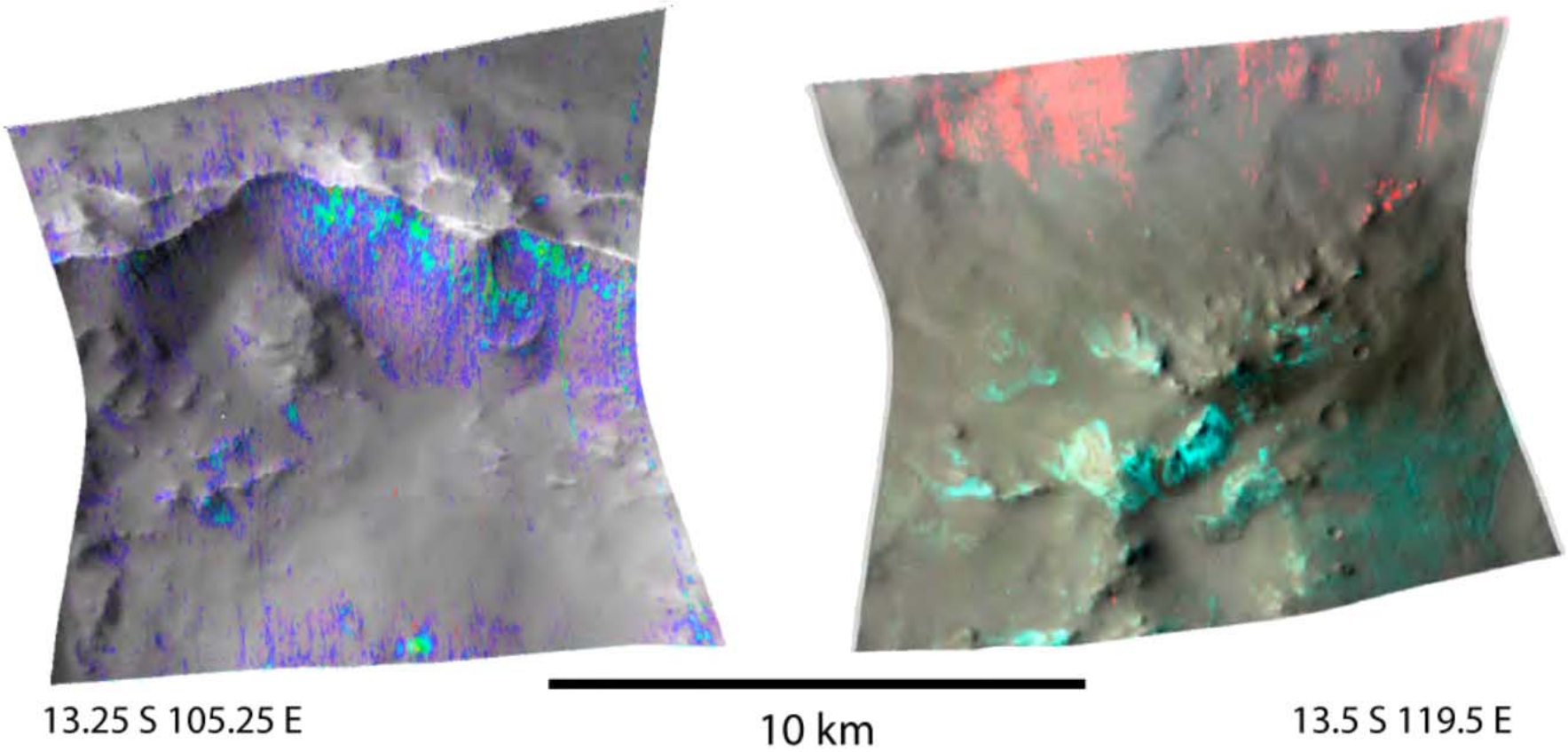
Phyllosilicates are widespread in the Noachian crust



Color-coded map of 2.3-µm phyllosilicate absorption strength in mapping data for Tyrrena Terra

Outcrops correlated with craters

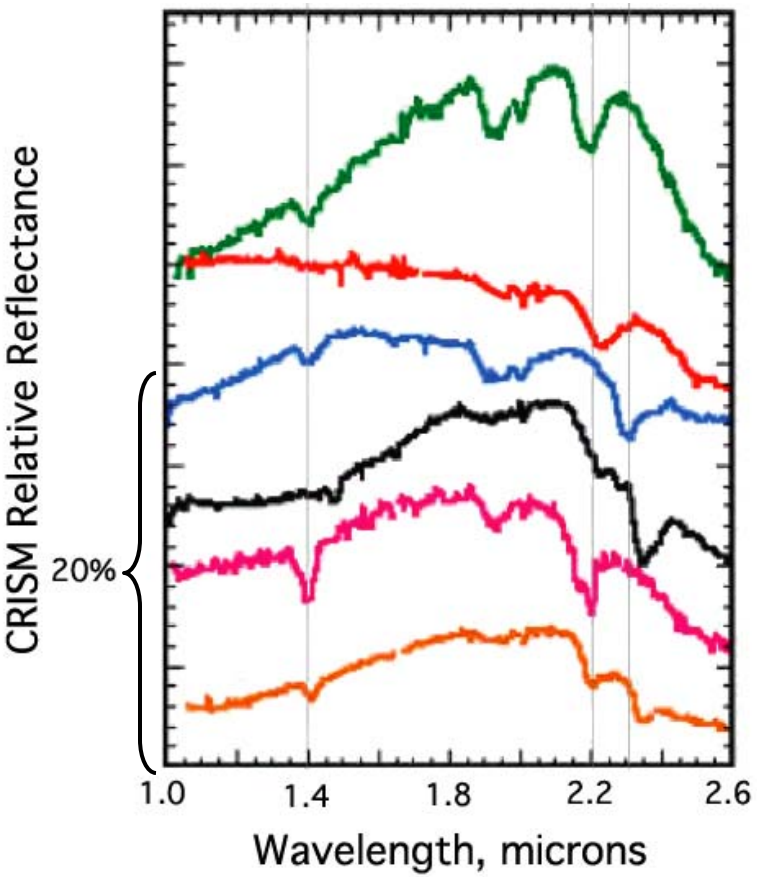
Follow-up Observations with Full Resolution

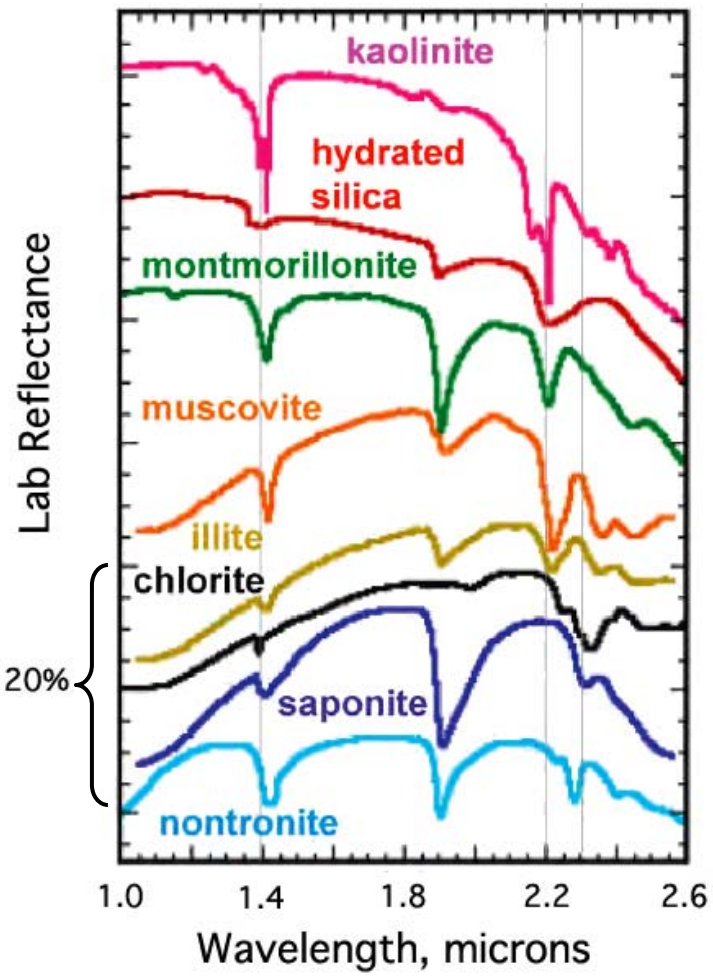


(R = pyroxene index, B = 2.3-μm phyllosilicate absorption, on 1.3-μm albedo)

- Exposures are on crater walls, ejecta, and central peaks, also eroded highland remnants
- Absent from comparable sized craters in Hesperian and Amazonian units
- Indicates exposures from 100's of meters to kilometers depth in Noachian units; early to middle Noachian

A wide range of hydroxylates silicates is present





- Identifications are preliminary
- Restricted to Noachian rocks
- Saponite is most common
- If the unaltered composition was basaltic, a wide range of temperatures and amount of leaching are implied