CRISM and OMEGA-based intercomparisons of mineral absorption strengths for the four final 2020 rover candidate landing sites

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(with atmospheric input from Mike Wolff and Mike Smith)

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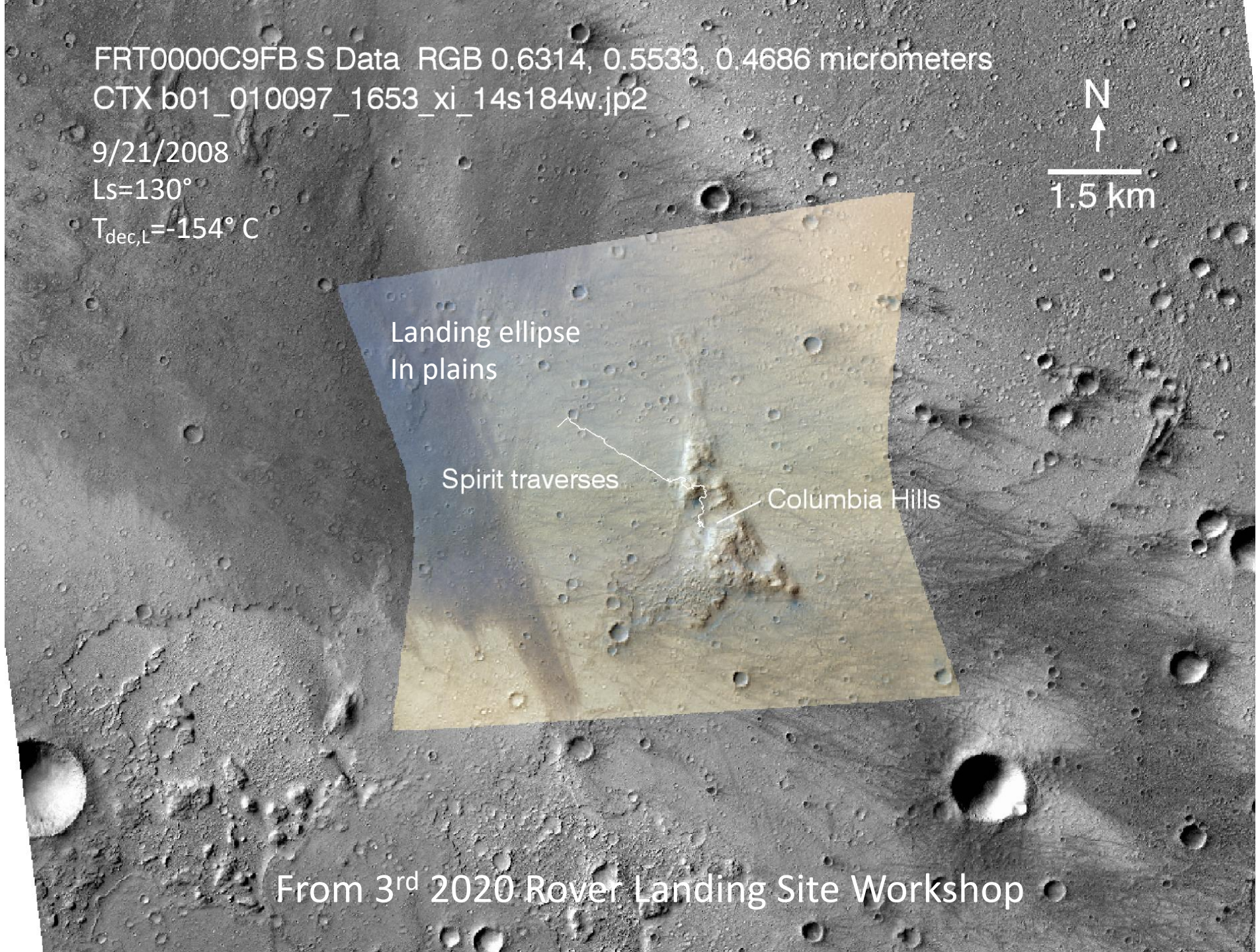
NASA 2020 Rover 4th Landing Site Workshop

Overview

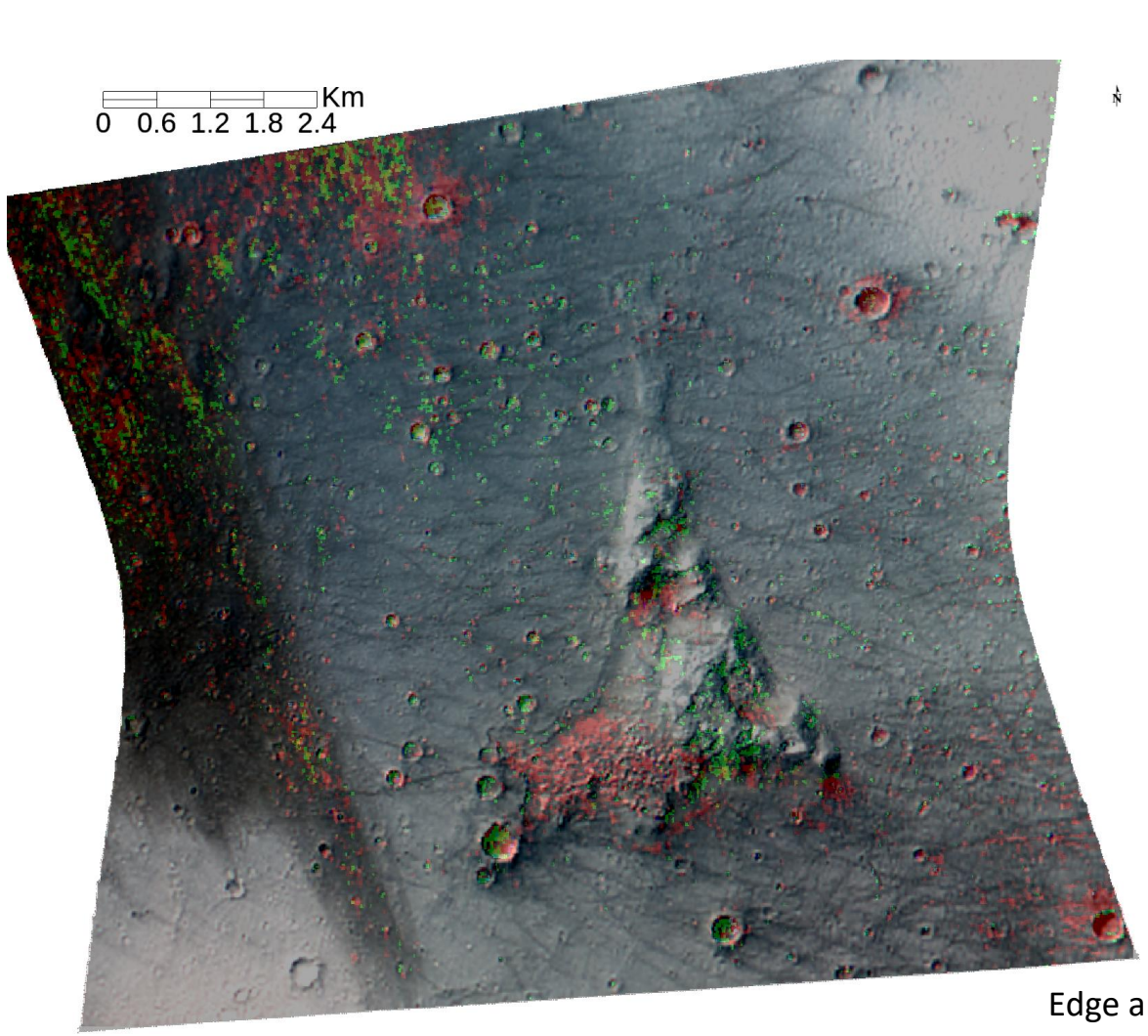
- Process CRISM and OMEGA data to retrieve best estimate of surface reflectance in presence of noise:
  - DISORT modeling of gas and aerosols with Hapke surface function to retrieve surface single scattering albedo (SSA) spectra, which are independent of atmospheric conditions and lighting and viewing conditions, thereby facilitating direct comparisons scene to scene
  - Neural network approaches employing training spectra and synthetic scenes using DISORT results to retrieve surface kinetic temperatures and SSA spectra for wavelengths longer than ~2.7 µm, where mixed solar and thermal radiative streams start
  - Log maximum likelihood recursive regularization (remove spatial and spectral transfer functions) with penalties to retrieve best estimate ofCRISM-based SSAs in presence of Poisson-dominated noise
  - Compare CRISM and OMEGA-based mineral inferences for four final candidate landing sites
  - Use olivine, pyroxene, 1.9 µm hydration, 2.3 µm smectite parameters as baselines
  - *TODAY FOCUS ON COLOR VARIATIONS AND CRISM-BASED SPECTRAL PARAMETERS*

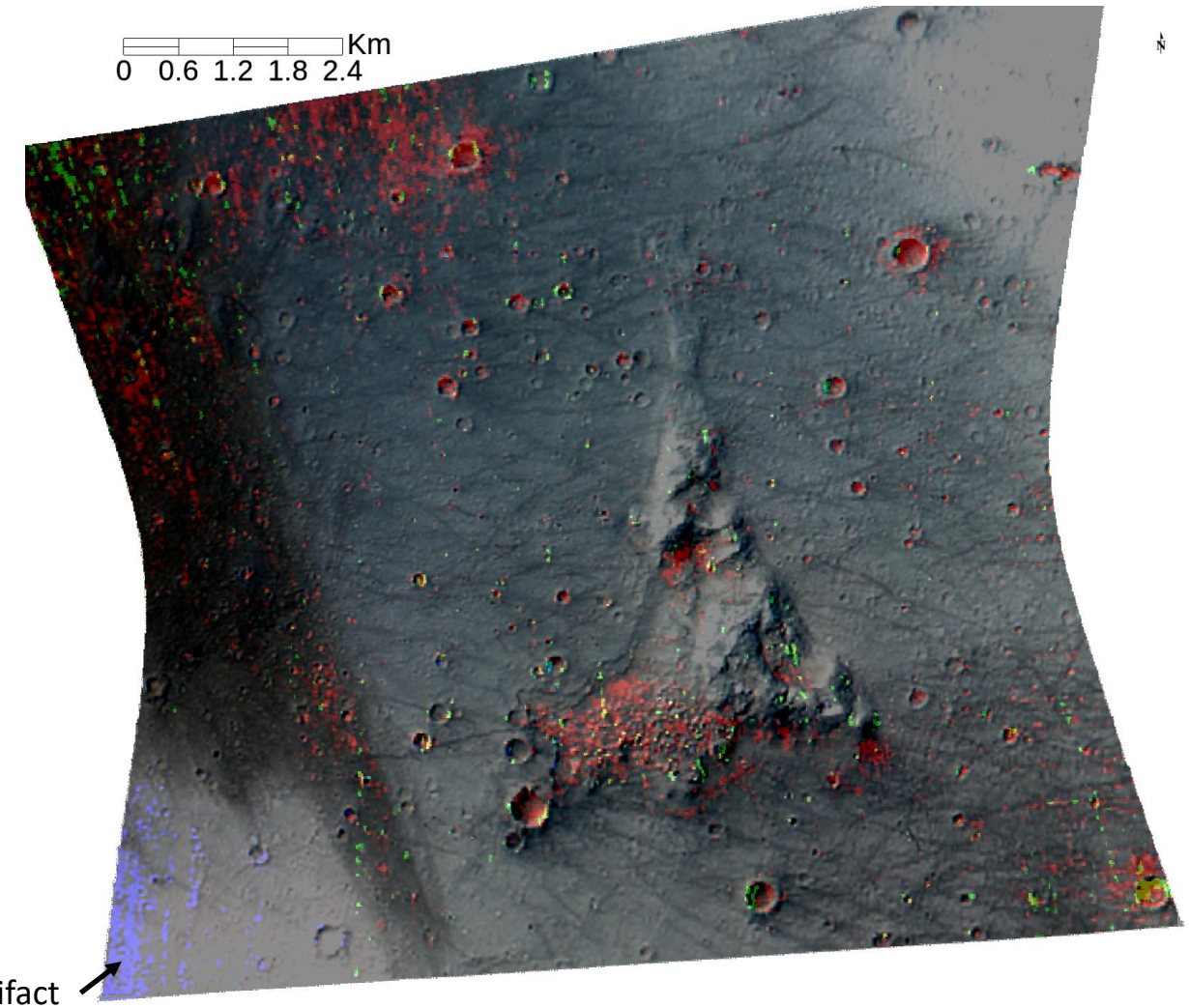
Approach

- Gusev results presented at 3rd Landing Site Workshop, so will only briefly review
- Concentrate on NE Syrtis, Midway, and Jezero, particularly landing ellipse locations
- Use combination of CRISM Full Resolution Targeted (FRT), Full Resolution Short (FRS), Half Resolution Long (HRL), Multispectral Survey (MSP) data, together with OMEGA 32 pixel wide coverage over NE Syrtis, Midway, and Jezero sites
- No CRISM full resolution long wavelength “L” data over Midway, thus bootstrap from NE Syrtis full resolution data using MSP and OMEGA data over both sites



From 3rd 2020 Rover Landing Site Workshop





RGB: Olivine; Low Ca Pyroxene; High Ca Pyroxene

Olivine; 1.9 µm Hydration; 2.3 µm Fe,Mg-OH smectites

Quantitative Comparisons of Parameter Values on Summary Slide for Four Sites

FRT0003192 L Data
RGB 2.5194, 1.5065, 1.0601 µm

Spirit traverses

What Spirit Found
Independence and Voltaire
(glasses, phyllosilicates?)

West spur
(geothite)

CRISM-based carbonate spectra

Comanche
(Fe-Mg carbonates)

El Dorado
(wind-blown basaltic ripples)

Inner Basin

Home plate
(Fe, Mg, Ca sulfates, gypsum, hematite, opaline silica)

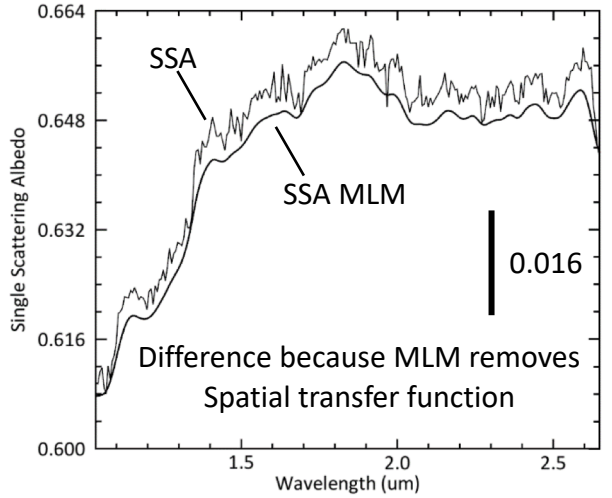
Columbia Hills

N

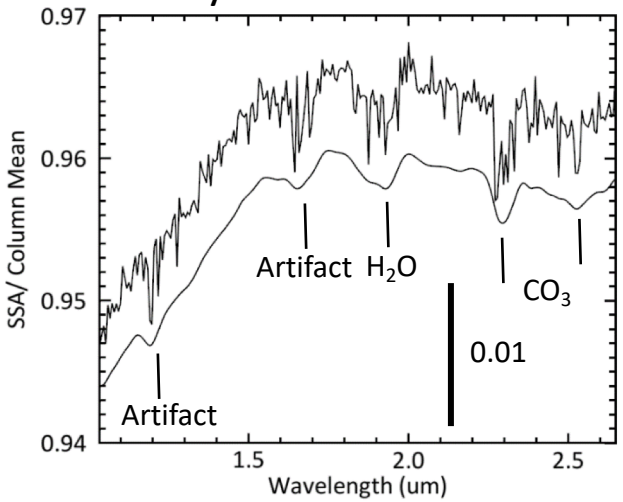
1 km

Very shallow absorption features indeed. Consistent with bland nature of the false color composite.

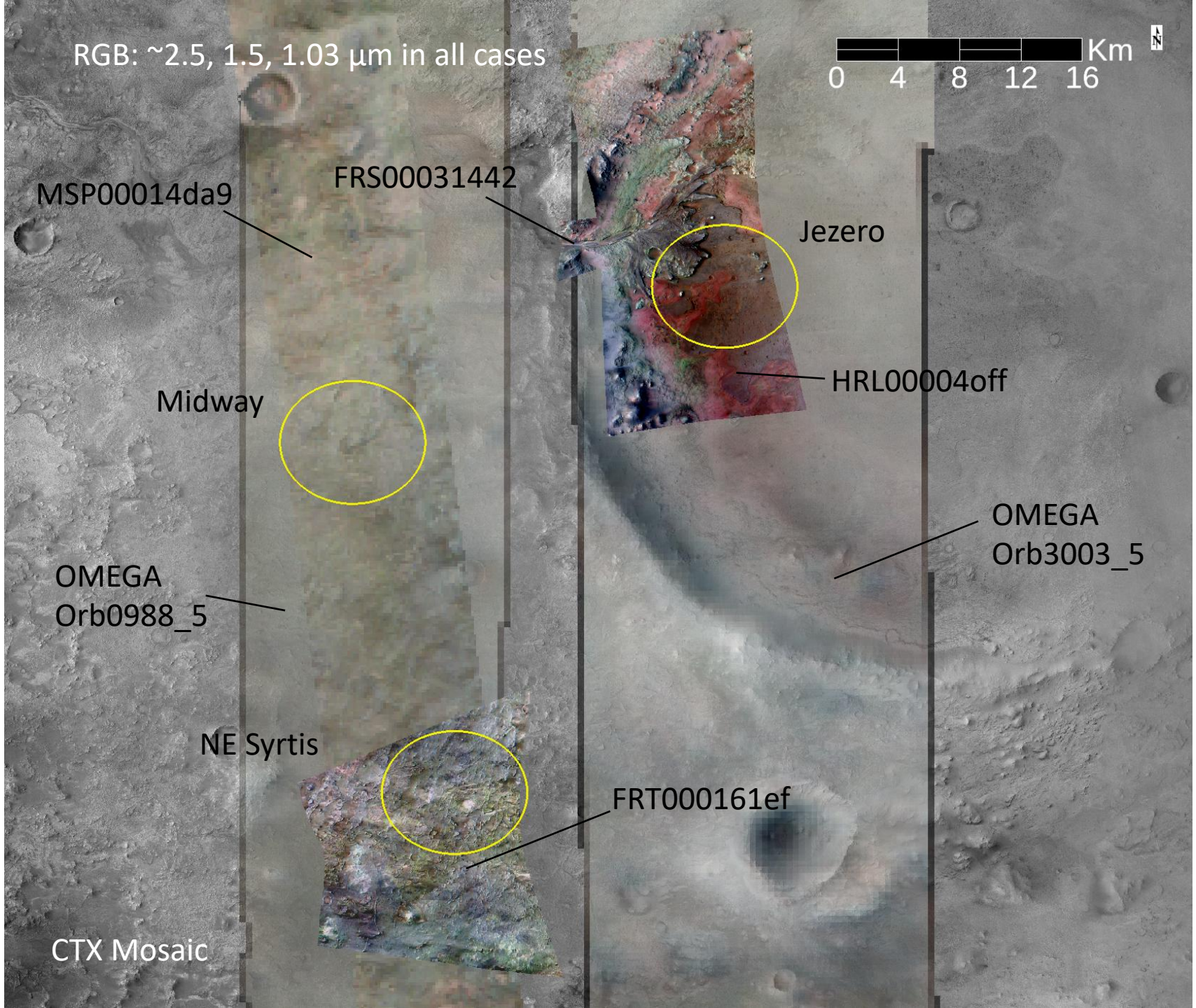
Five pixel means of area around Comanche and downhill in SSA and SSA/column means

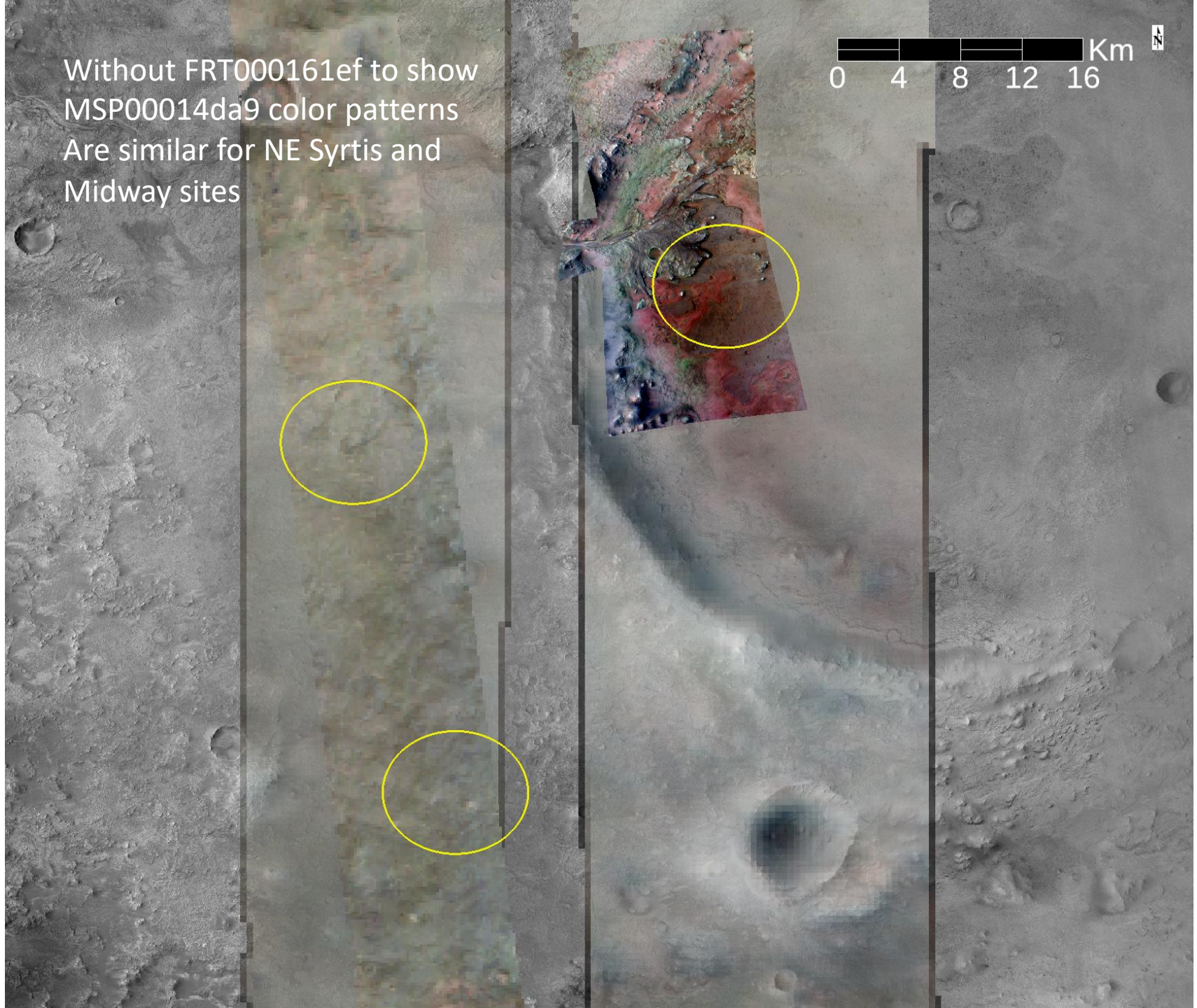


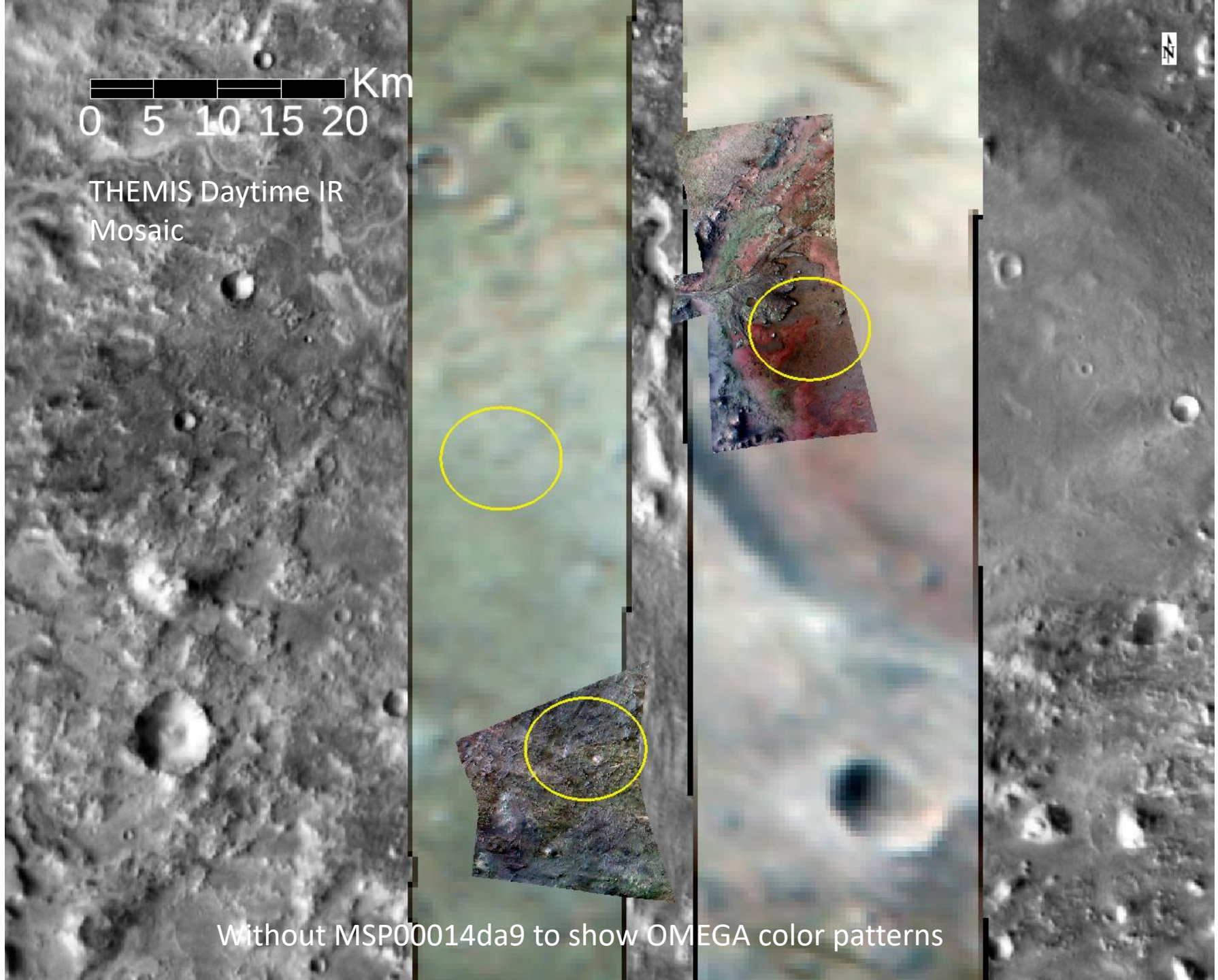
Very shallow features



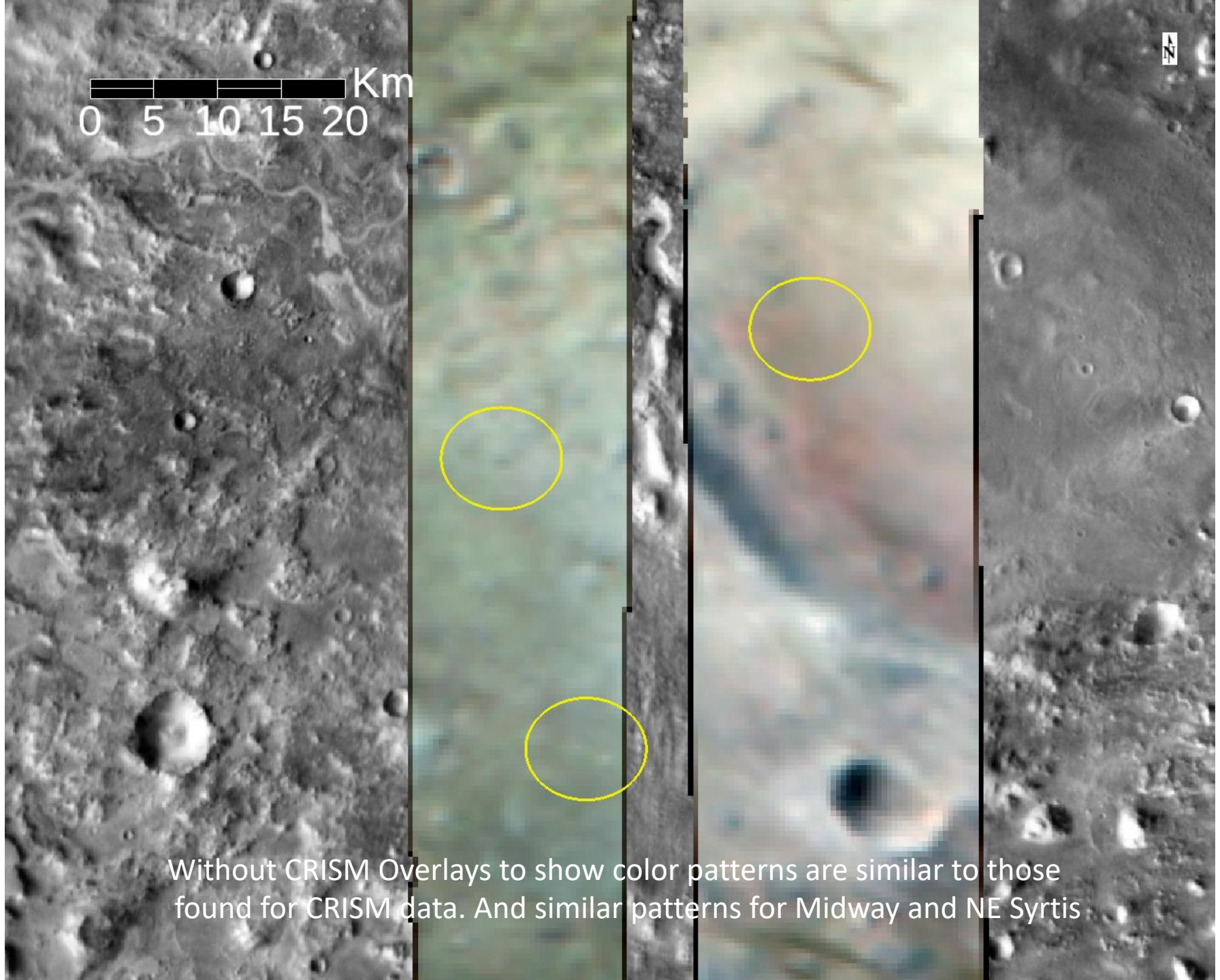
Similar to what Carter and Poulet (2012) reported


RGB: ~2.5, 1.5, 1.03 µm in all cases
0 4 8 12 16 Km
MSP00014da9
FRS00031442
Jezero
HRL00004off
Midway
OMEGA
Orb3003_5
OMEGA
Orb0988_5
NE Syrtis
FRT000161ef
CTX Mosaic

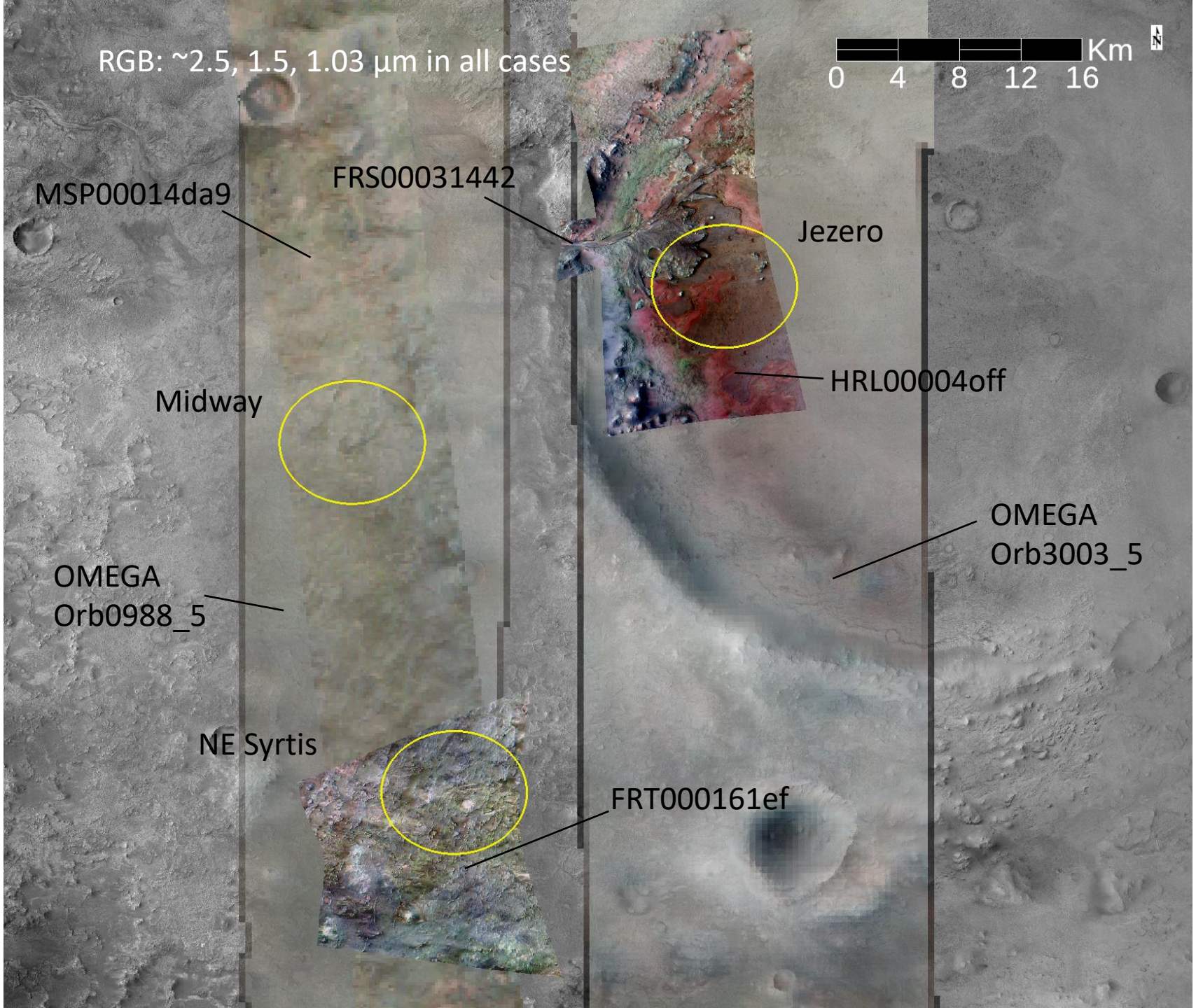

Without FRT000161ef to show
MSP00014da9 color patterns
Are similar for NE Syrtis and
Midway sites
0 4 8 12 16
Km
N



Without MSP00014da9 to show OMEGA color patterns



Without CRISM Overlays to show color patterns are similar to those found for CRISM data. And similar patterns for Midway and NE Syrtis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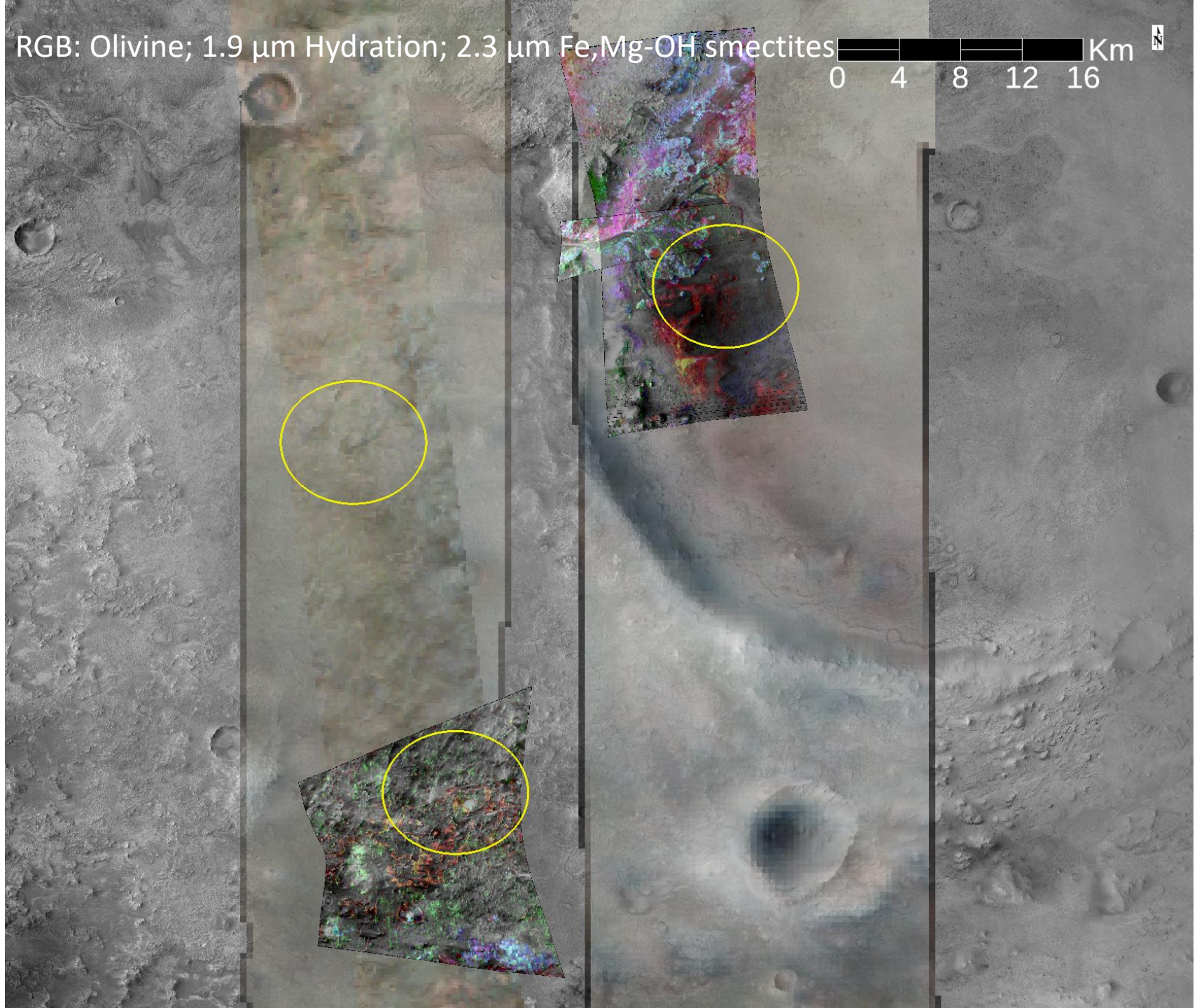
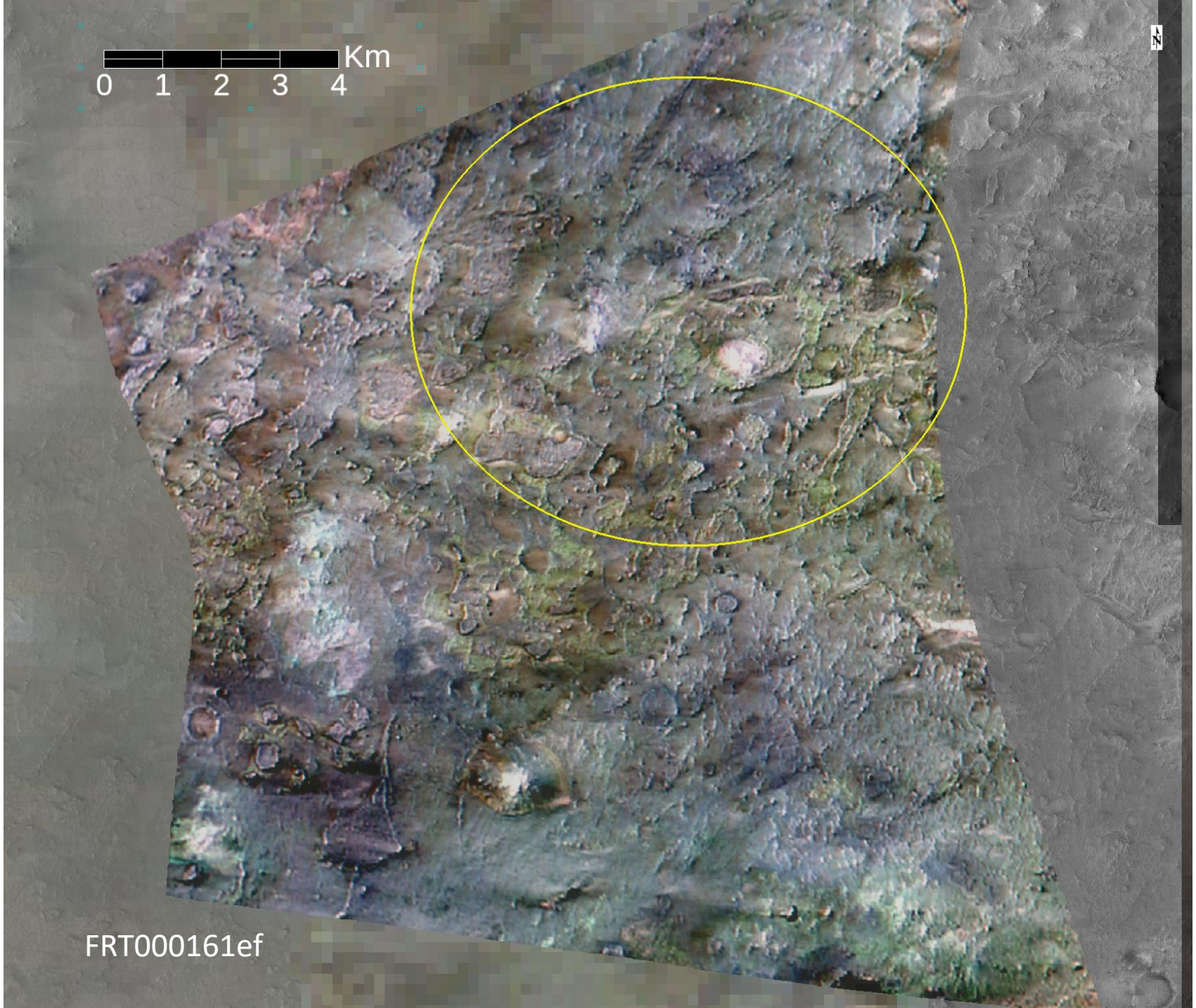
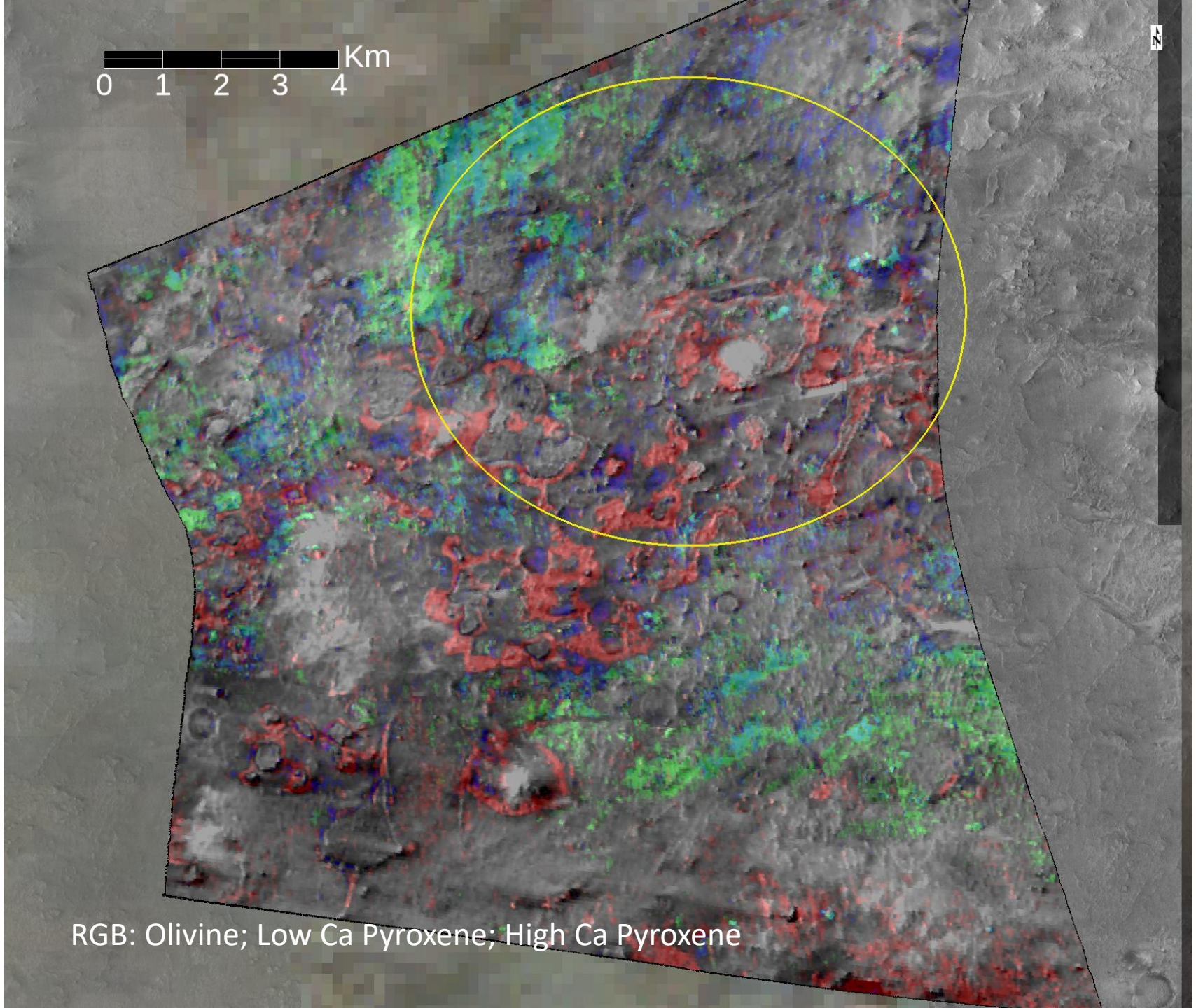
Km
0 4 8 12 16
MSP00014da9
FRS00031442
Jezero
HRL00004off
Midway
OMEGA
Orb3003_5
OMEGA
Orb0988_5
NE Syrtis
FRT000161ef

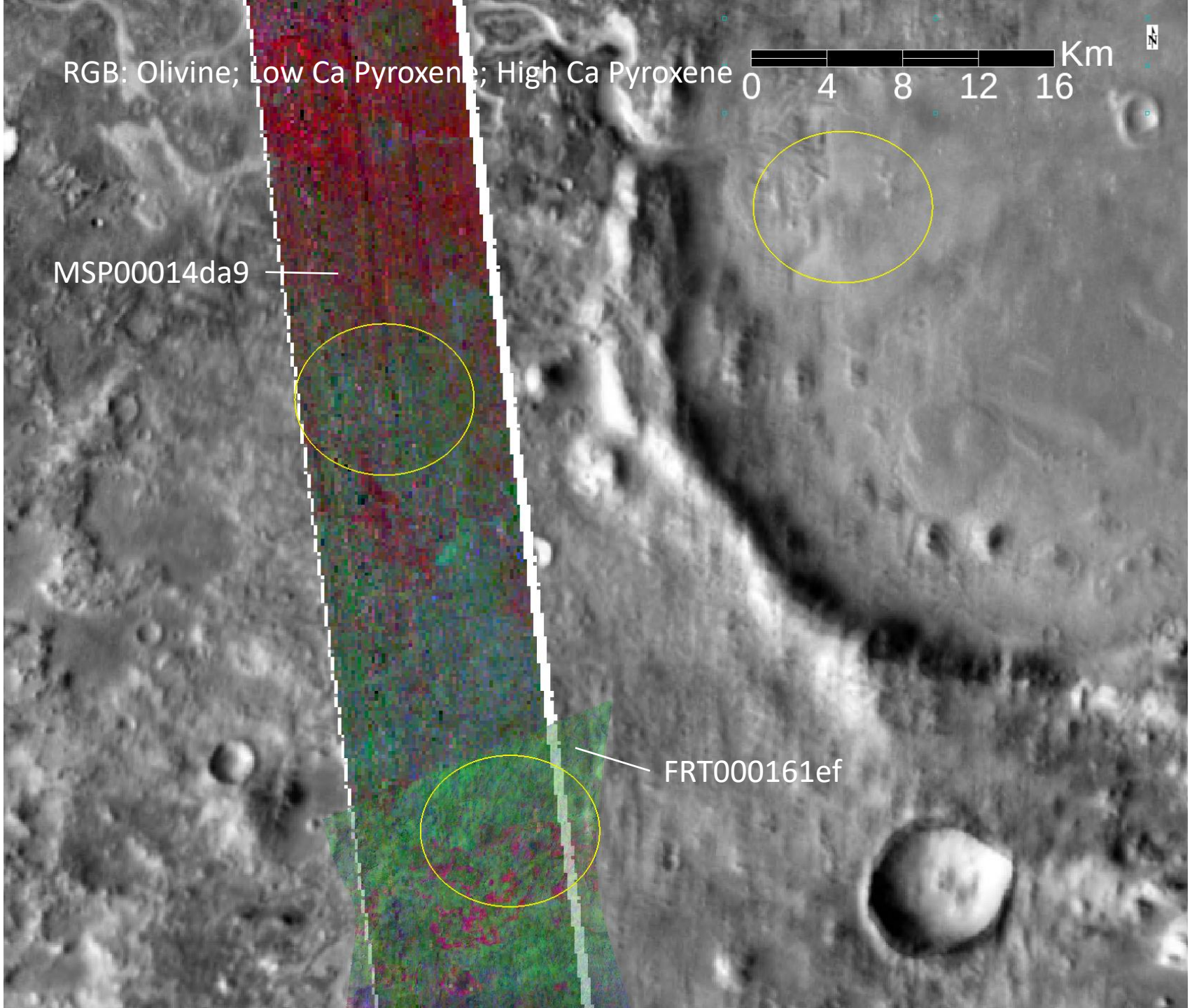

RGB: Olivine; Low Ca Pyroxene; High Ca Pyroxene
0 4 8 12 16
Km
N

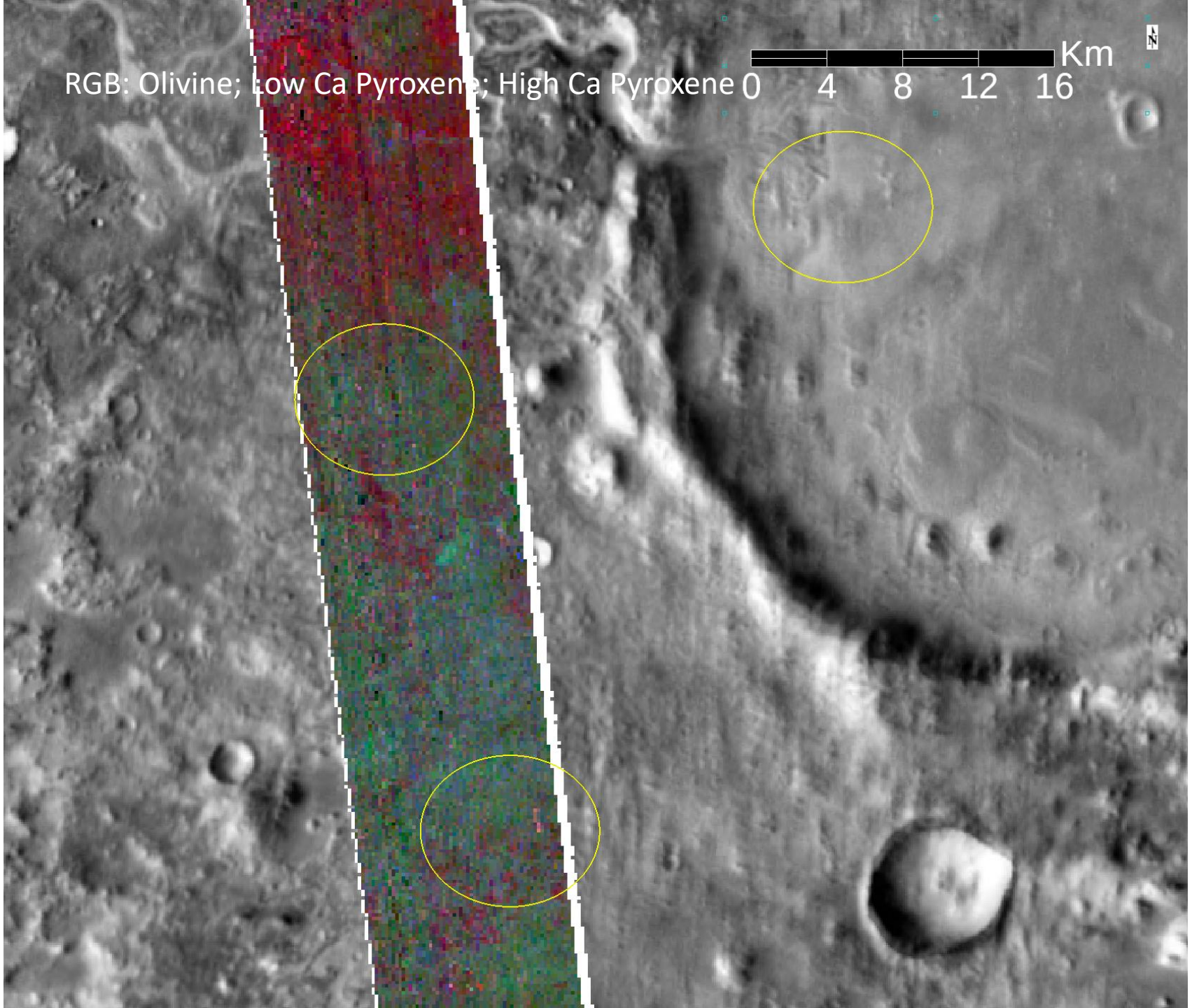

RGB: Olivine; 1.9 µm Hydration; 2.3 µm Fe,Mg-OH smectites
0 4 8 12 16
Km
N

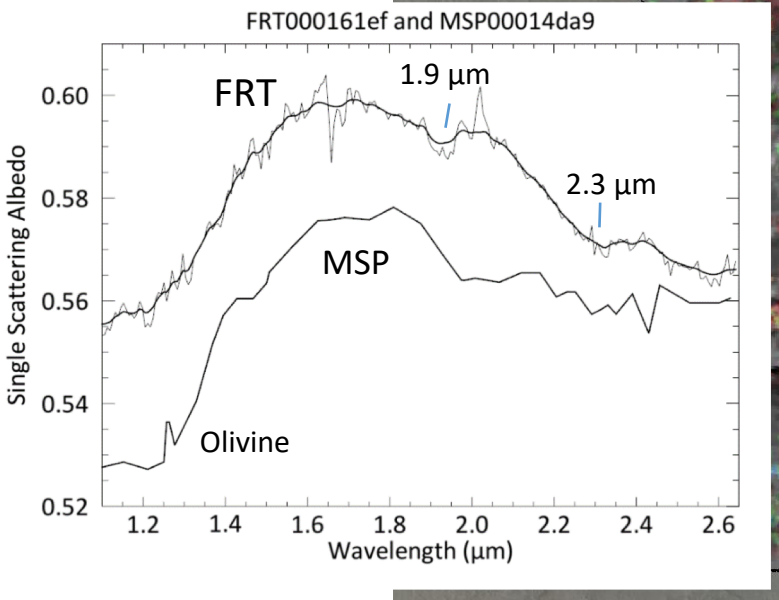

Km
0 1 2 3 4
N
FRT000161ef



RGB: Olivine; Low Ca Pyroxene; High Ca Pyroxene


RGB: Olivine; Low Ca Pyroxene; High Ca Pyroxene
0 4 8 12 16 Km
MSP00014da9
FRT000161ef


RGB: Olivine; Low Ca Pyroxene; High Ca Pyroxene
0 4 8 12 16
Km
N

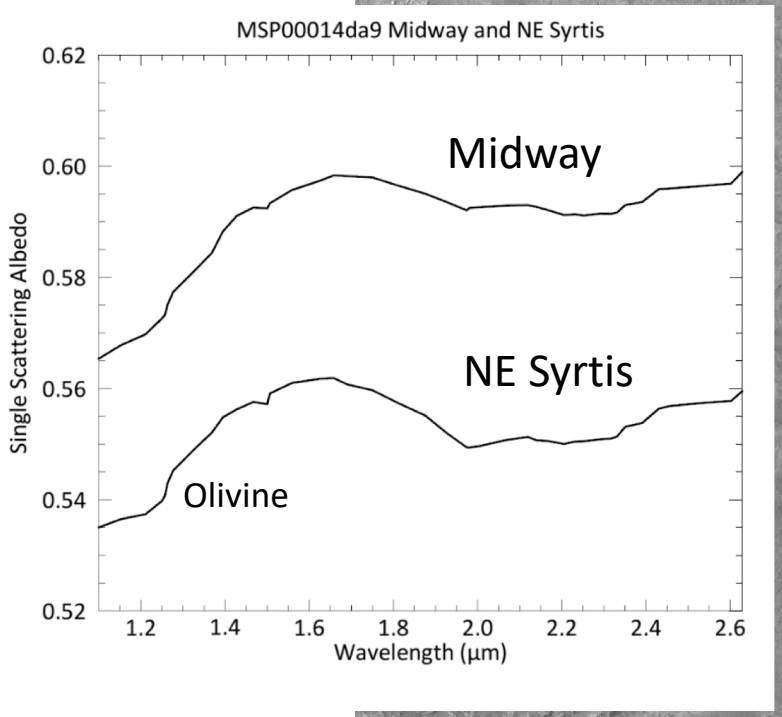


RGB: Olivine; 1.9 µm Hydration; 2.3 µm Fe,Mg-OH smectites

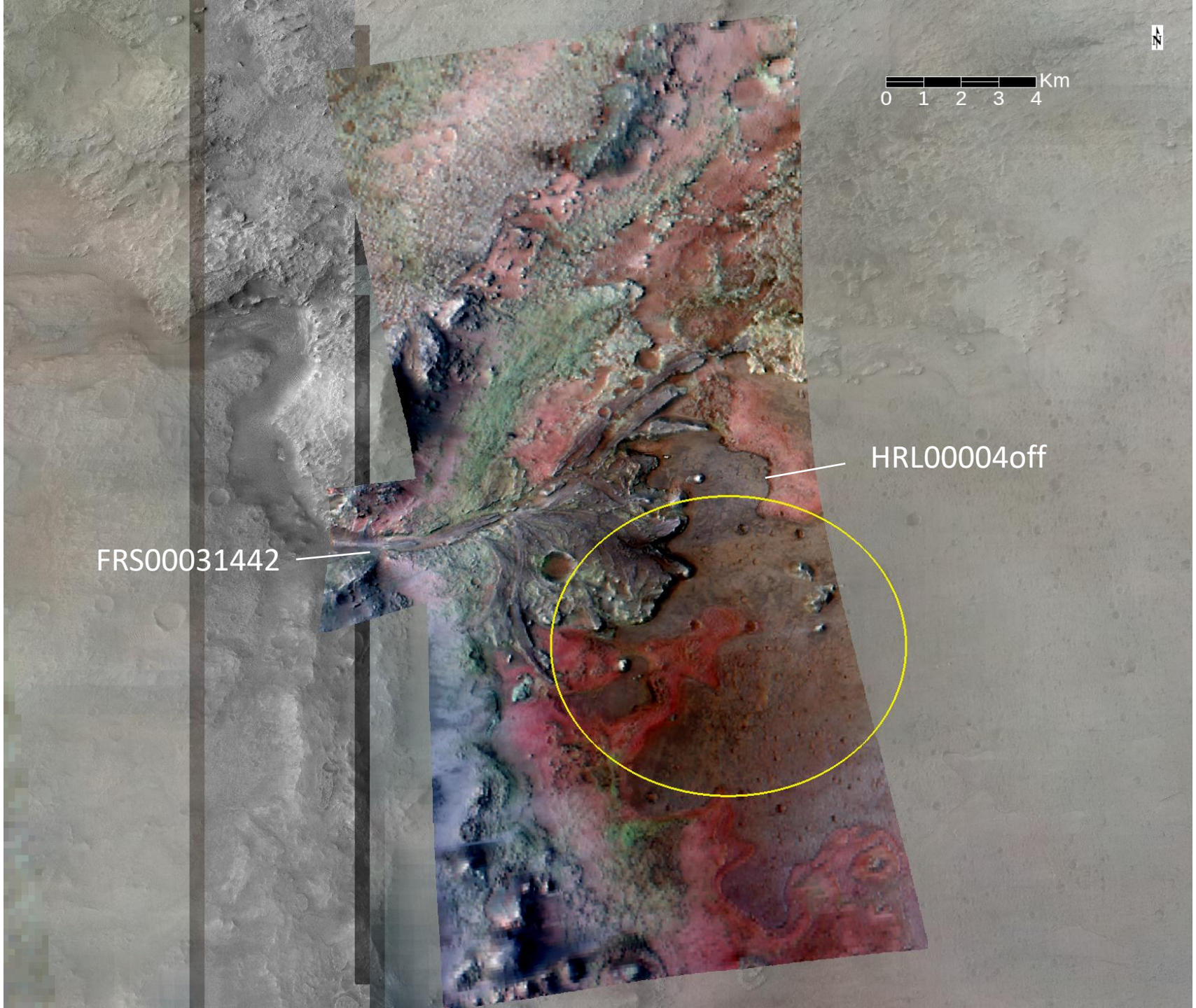
Midway

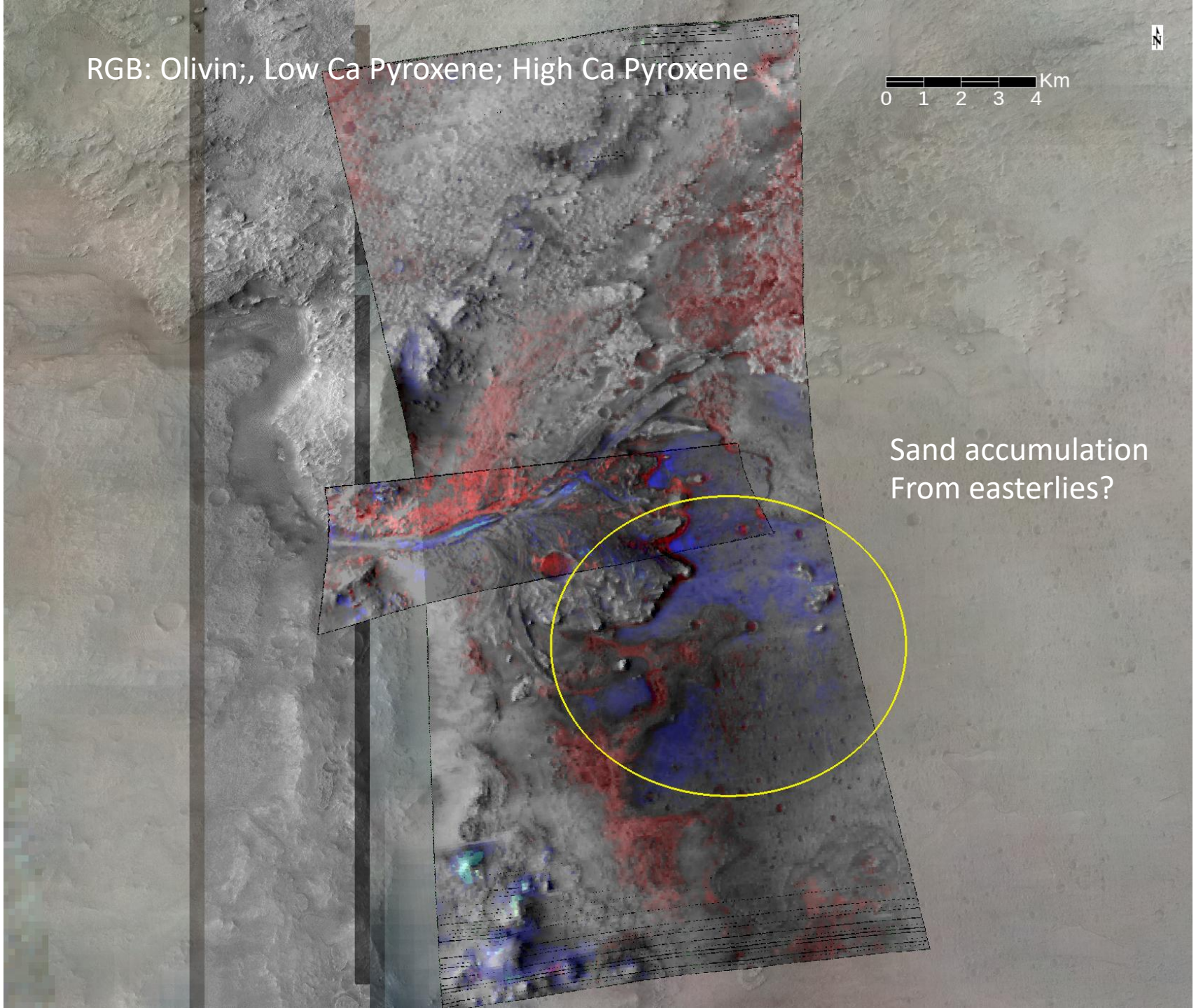
Km
0 1 2 3 4

Pixel means within ellipses

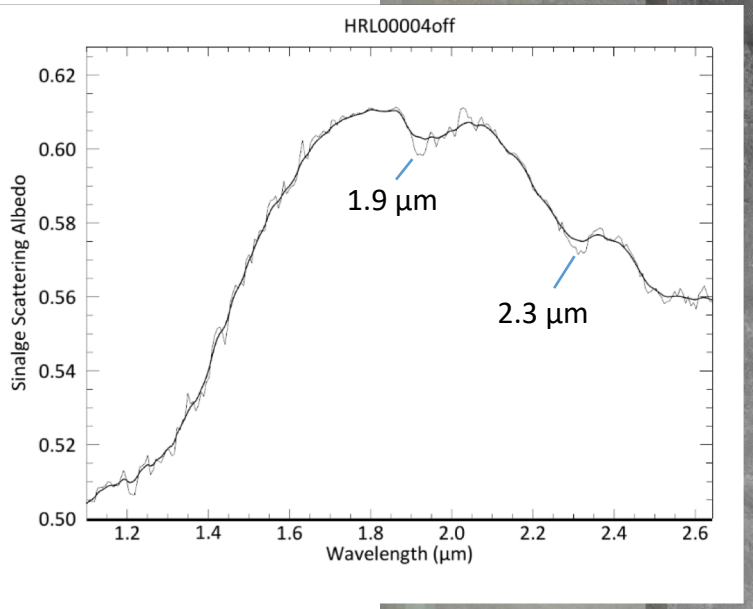


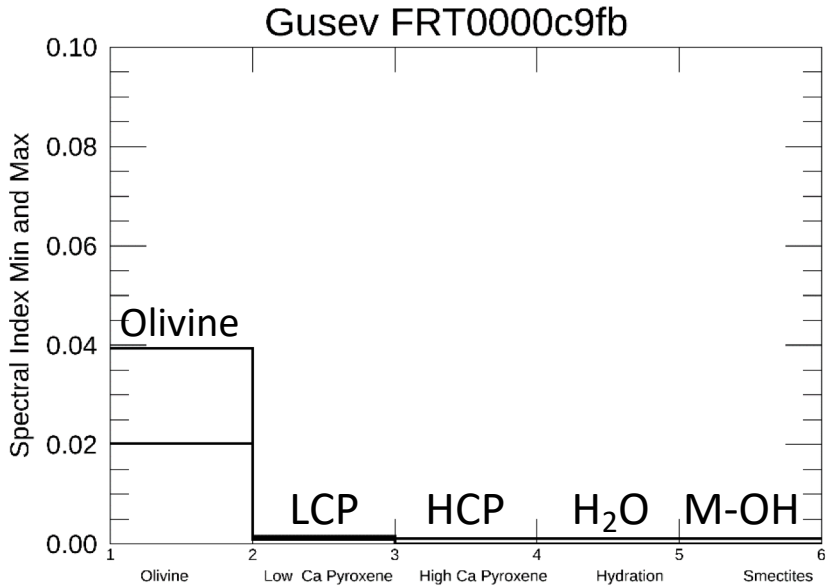
Brighter, likely dustier than
NE Syrtis (Jezero wind shadow?)


Km
0 1 2 3 4
HRL00004off
FRS00031442

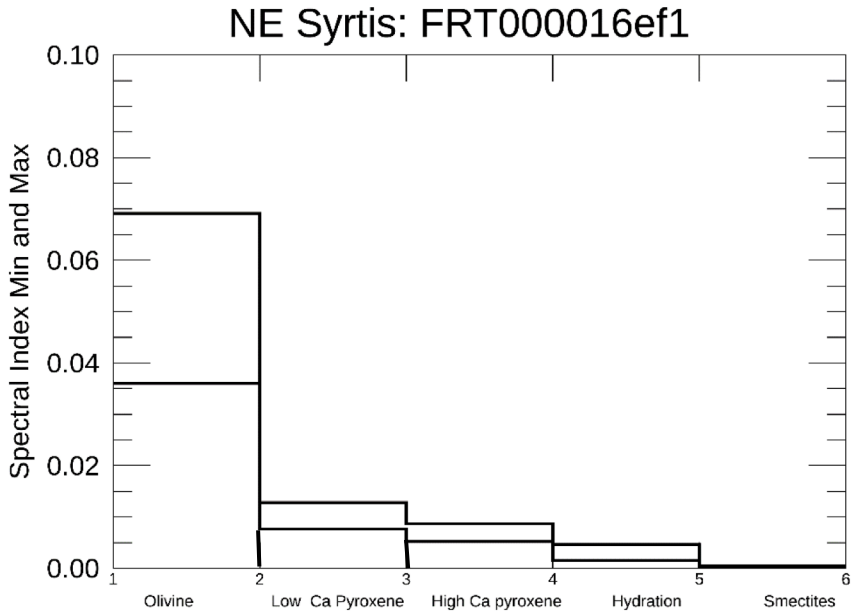

RGB: Olivin;, Low Ca Pyroxene; High Ca Pyroxene
Km
0 1 2 3 4
Sand accumulation
From easterlies?

RGB: Olivine; 1.9 µm Hydration; 2.3 µm Fe,Mg-OH smectites





Lower setting: upper quartile or greater if still negative.
Upper setting to keep color ranges constant scene to scene.



Spectral Summary:

- Gusev: Dusty, ferrous silicate dominated
- NE Syrtis: Clear evidence for aqueous alteration phases
- Midway: Similar to NE Syrtis, but subdued, likely more dust cover
- Jezero: Areally most extensive evidence for aqueous alteration phases, with deepest absorptions

Will follow-up with full CRISM and OMEGA-based analyses for delivery to Project Scientist