Emerging Connections Between TIR and VNIR Observations of Martian Phyllosilicates

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Overview

- Objective: To find correlations between VNIR phyllosilicate detections and TIR observations
- Goal: To reconcile an apparent disconnect between the two spectral regions and provide further insight into Martian phyllosilicate occurrences

Background

REPORTS

A Global View of Martian Surface Compositions from MGS-TES

Joshua L. Bandfield,* Victoria E. Hamilton, Philip R. Christensen

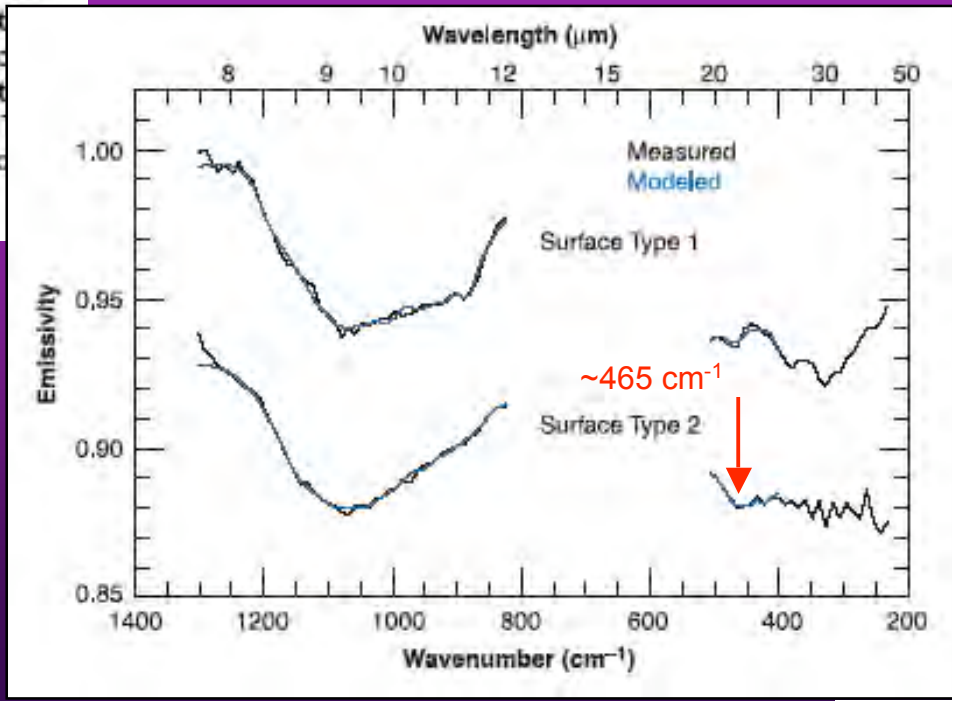
Thermal Emission Spectrometer (TES) data from the Mars Global Surveyor (MGS) are used to determine compositions and distributions of martian low-albedo regions. Two surface spectral signatures are identified from low-albedo regions. Comparisons with spectra of terrestrial rock samples and deconvolution results indicate that the two compositions are a basaltic composit dominated by plagioclase feldspar and clinopyroxene and an andesitic co position dominated by plagioclase feldspar and volcanic glass. The distribut of the two compositions is split roughly along the planetary dichotomy. basaltic composition is confined to older surfaces, and the more silicic co position is concentrated in the younger northern plains.

Science, 2000

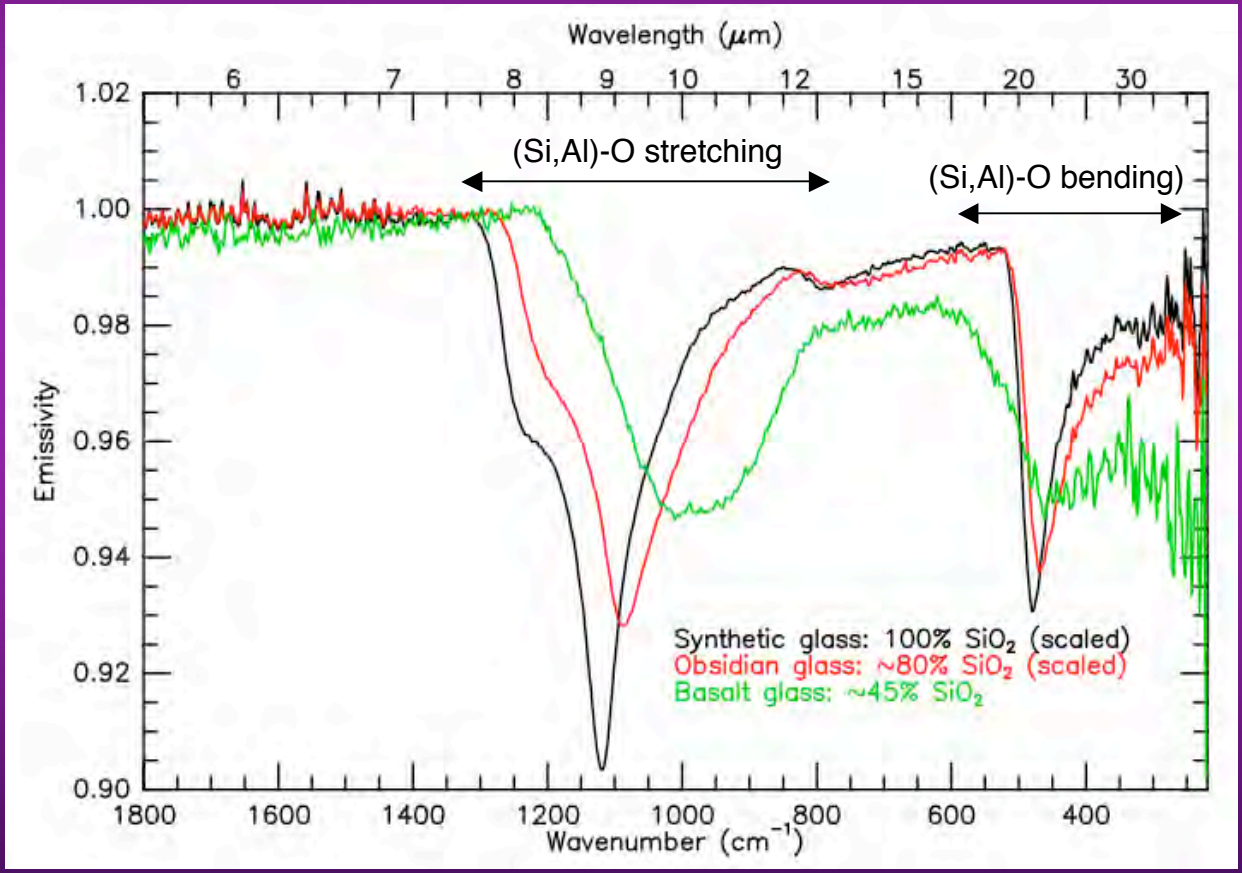
Table 1. Mineral areal percentages retrieved by deconvolution for both surface endmember spectral shapes (23). Minerals in parentheses indicate concentrations at or below detection limit (~10 to 15%).

Surface type 1	Concentration (%)	Surface type 2	Concentration (%)
Feldspar*	50	Feldspar	35
Clinopyroxene†	25	Glass	25
(Sheet silicates)	15	(Sheet silicates)	15
		(Clinopyroxene)	10

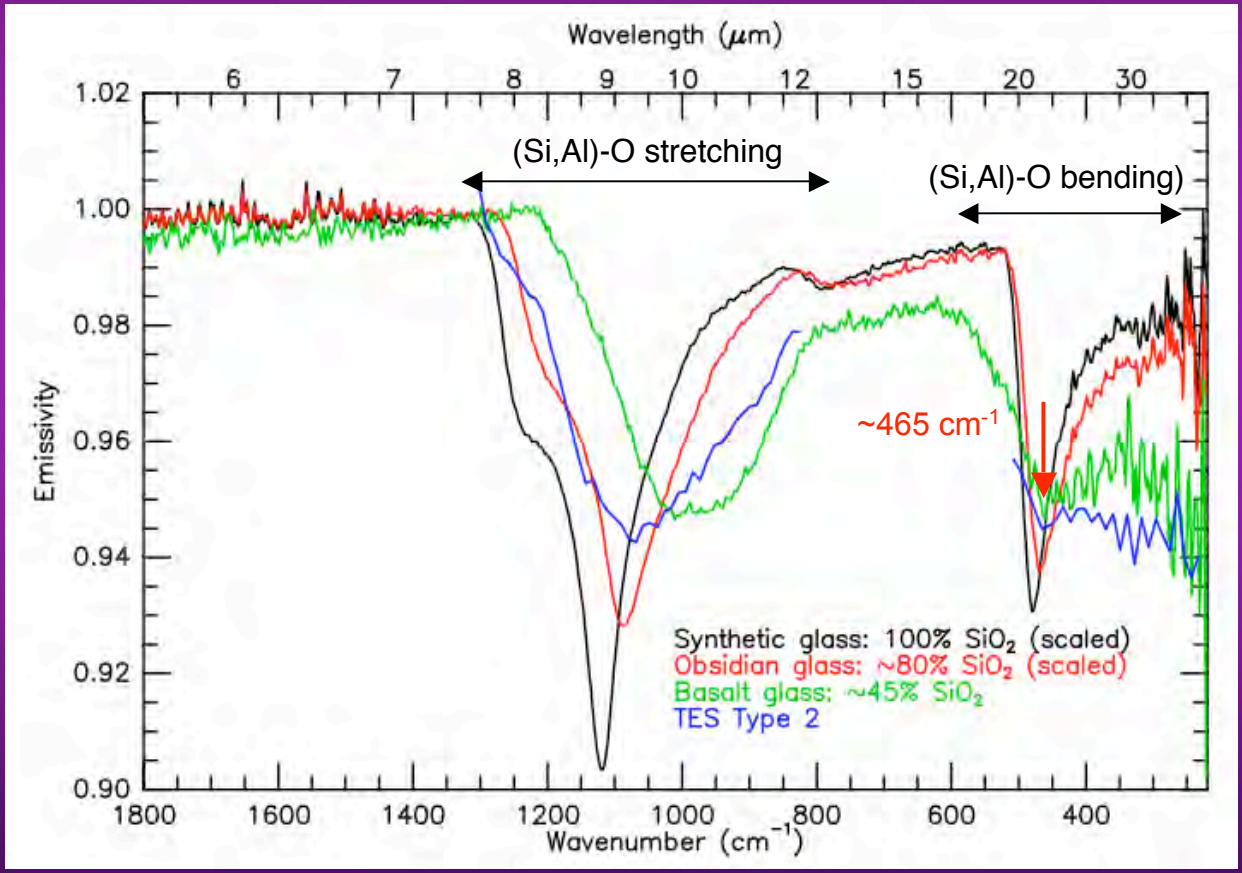
*Plagioclase is the dominant feldspar. †Augite is the dominant clinopyroxene.



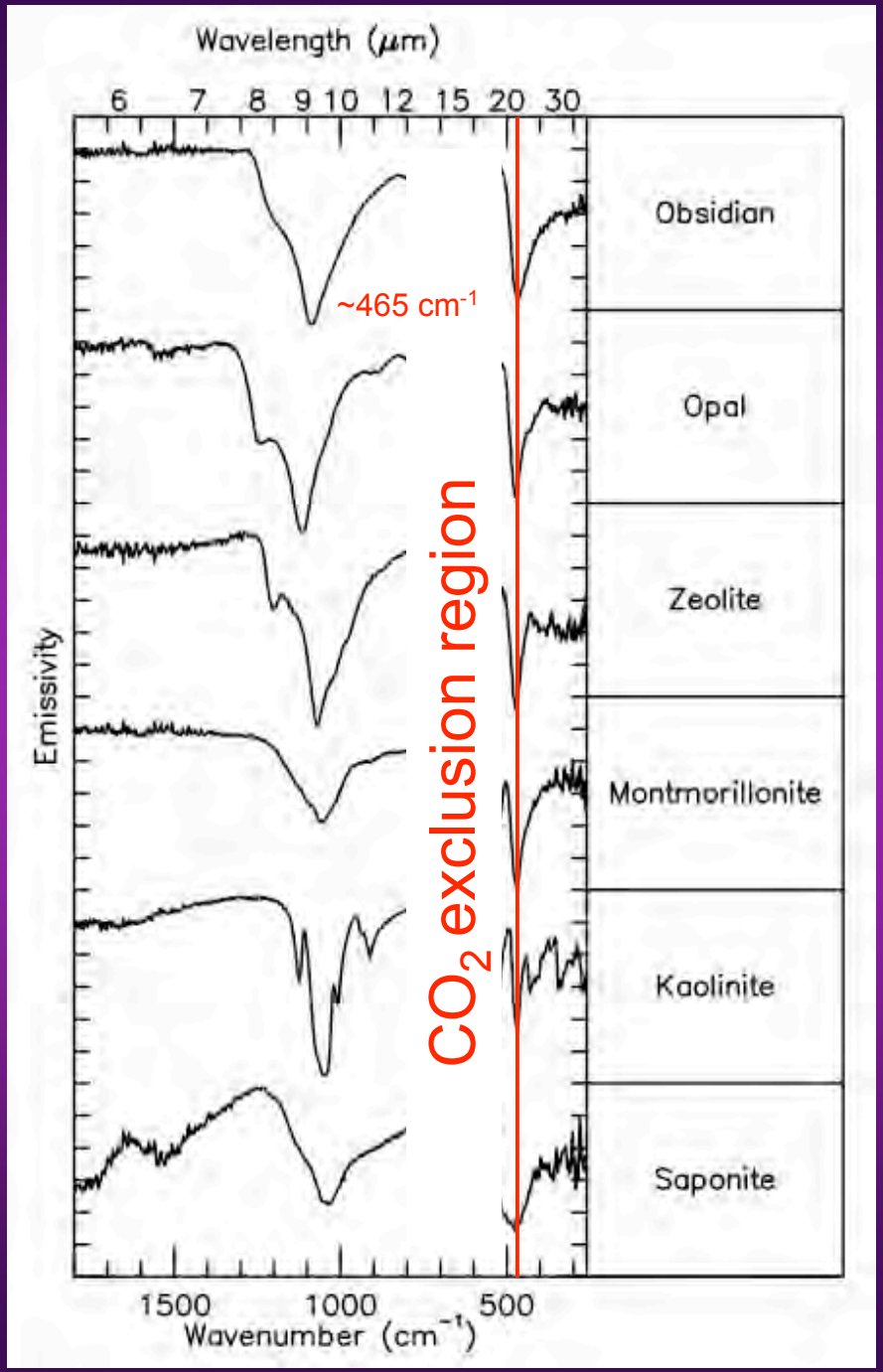
Primary Amorphous Silicates (Glass)



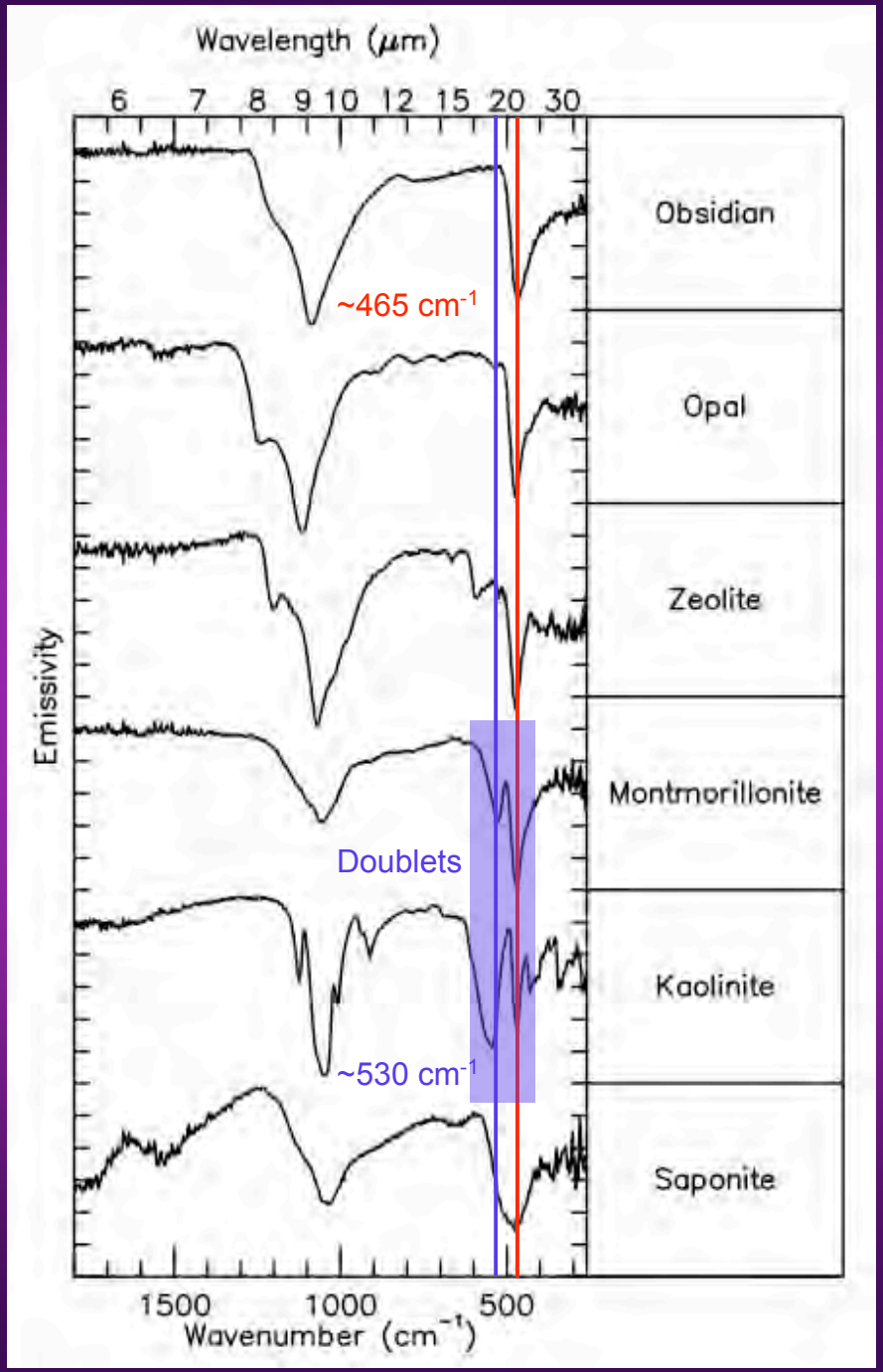
Primary Amorphous Silicates (Glass)



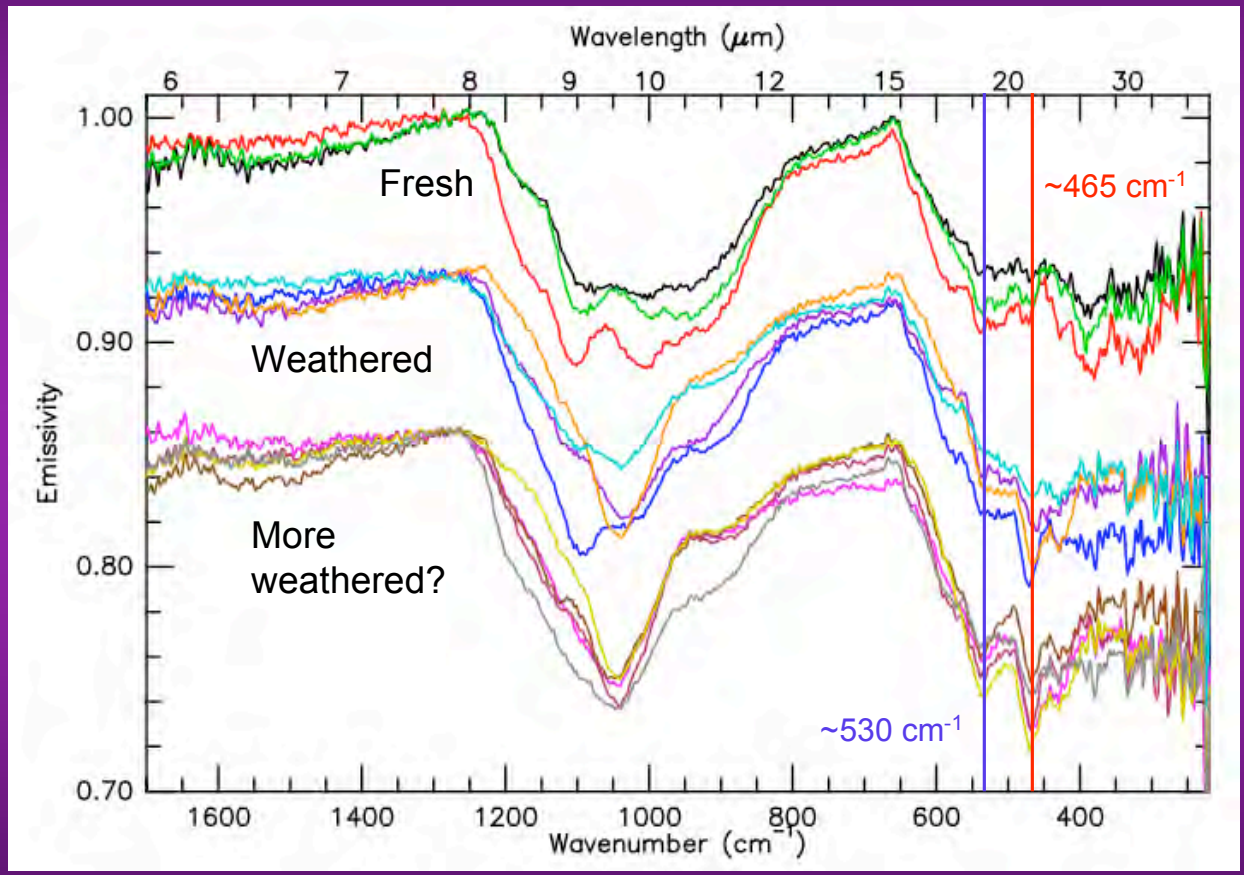
Primary vs. Secondary Amorphous and Crystalline Silicates



Primary vs. Secondary Amorphous and Crystalline Silicates



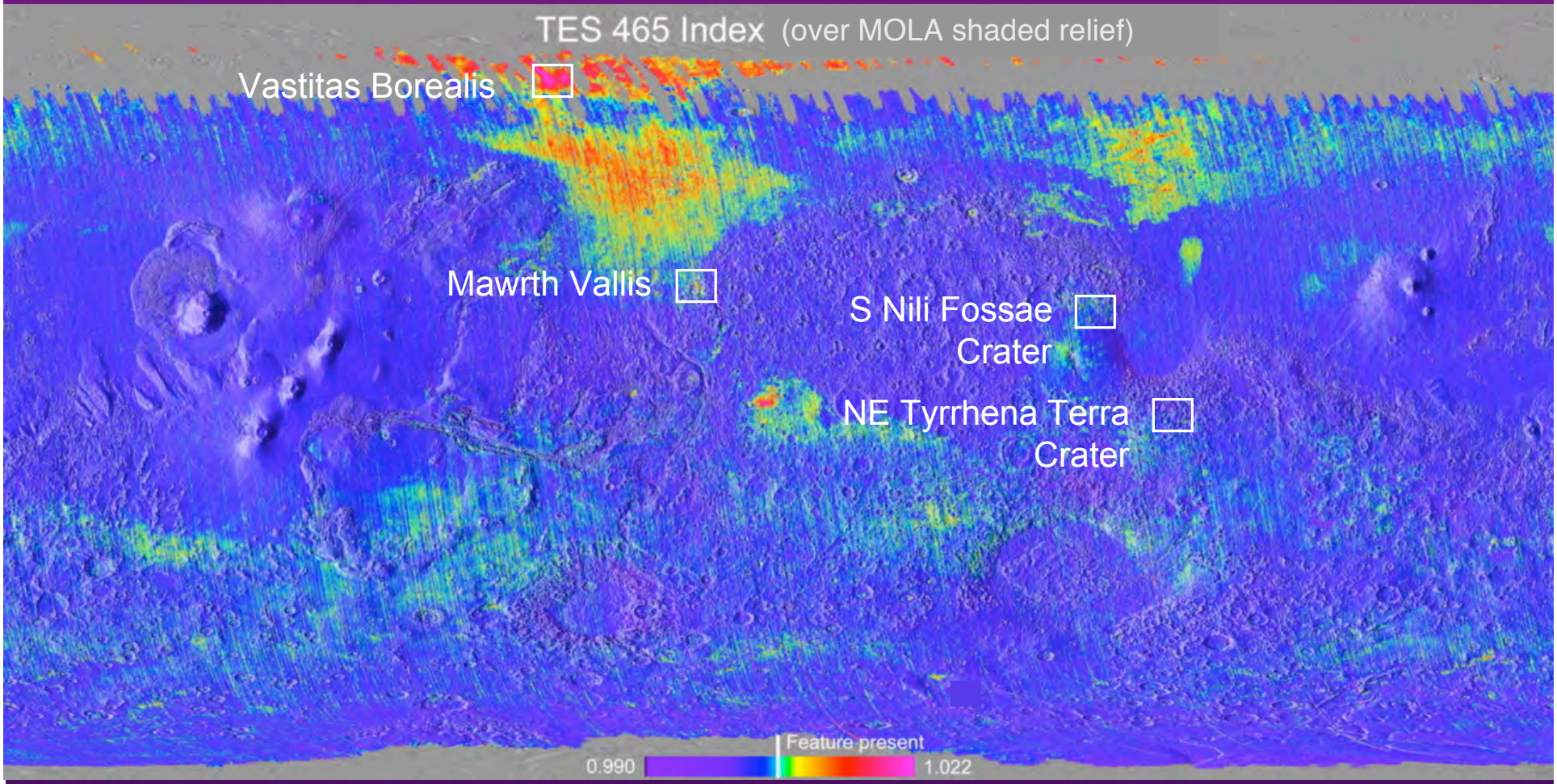
Weathered Basalt



Columbia River Basalts from Joe Michalski

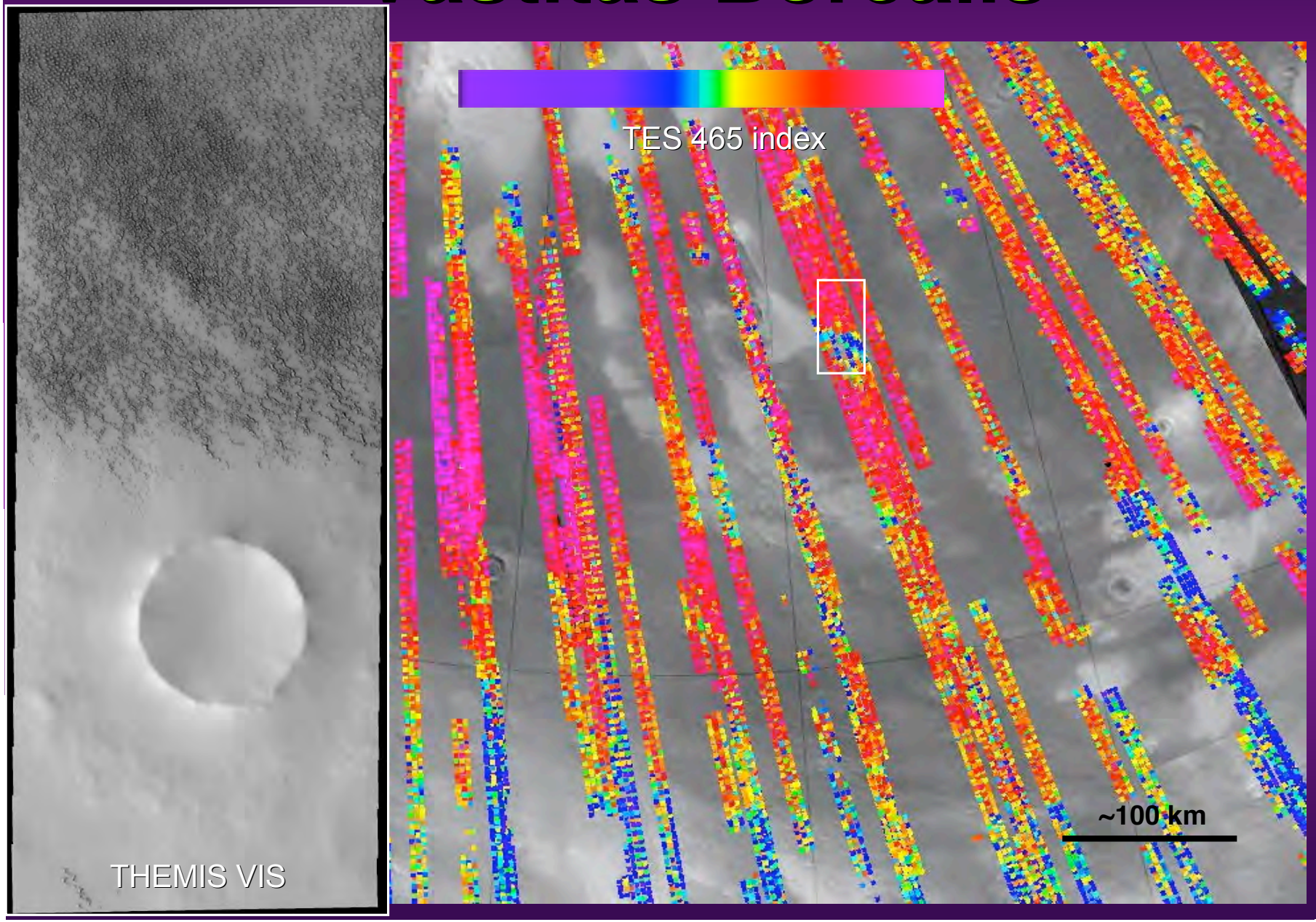
Michalski et al. (2006)

Global Map of Amorphous Silicate/Clay/Zeolite Candidates

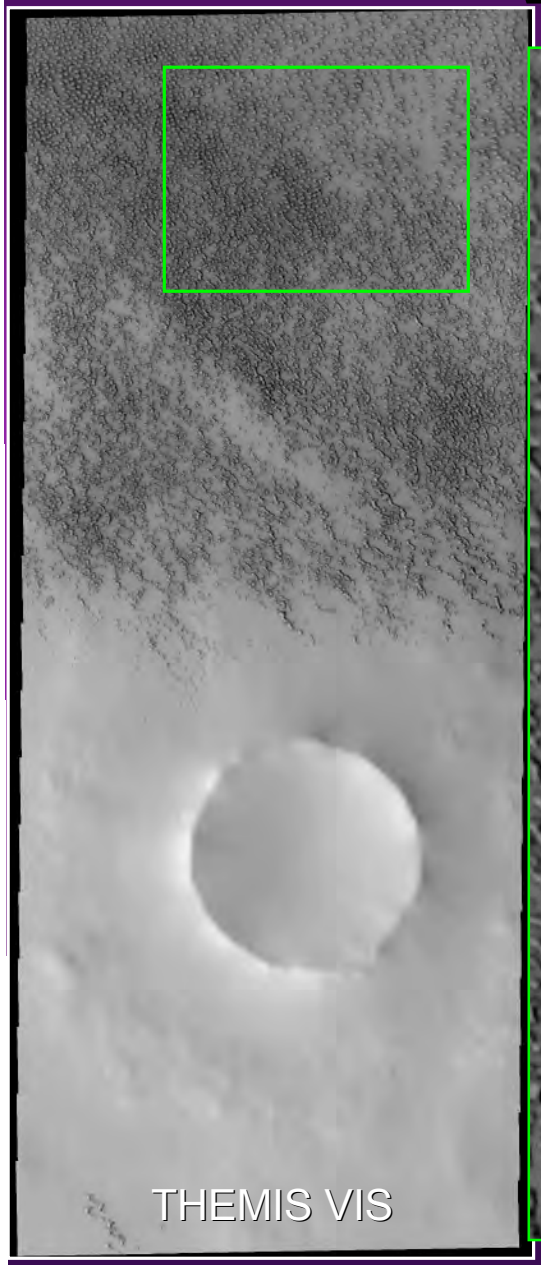


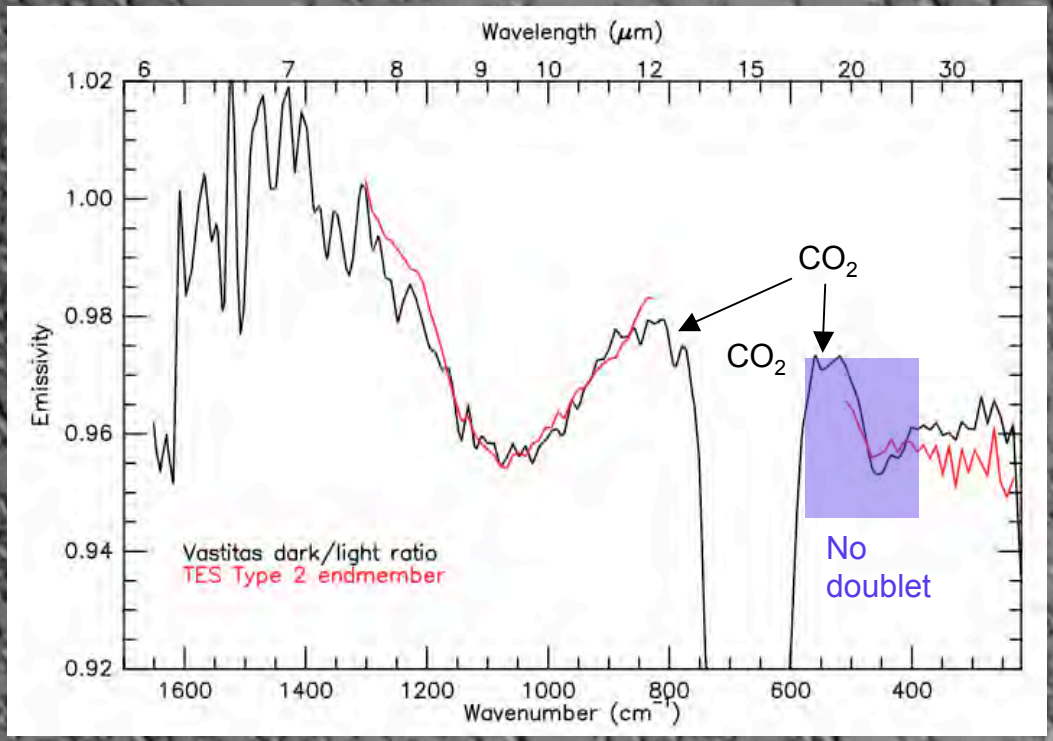
Ruff and Christensen (2007)

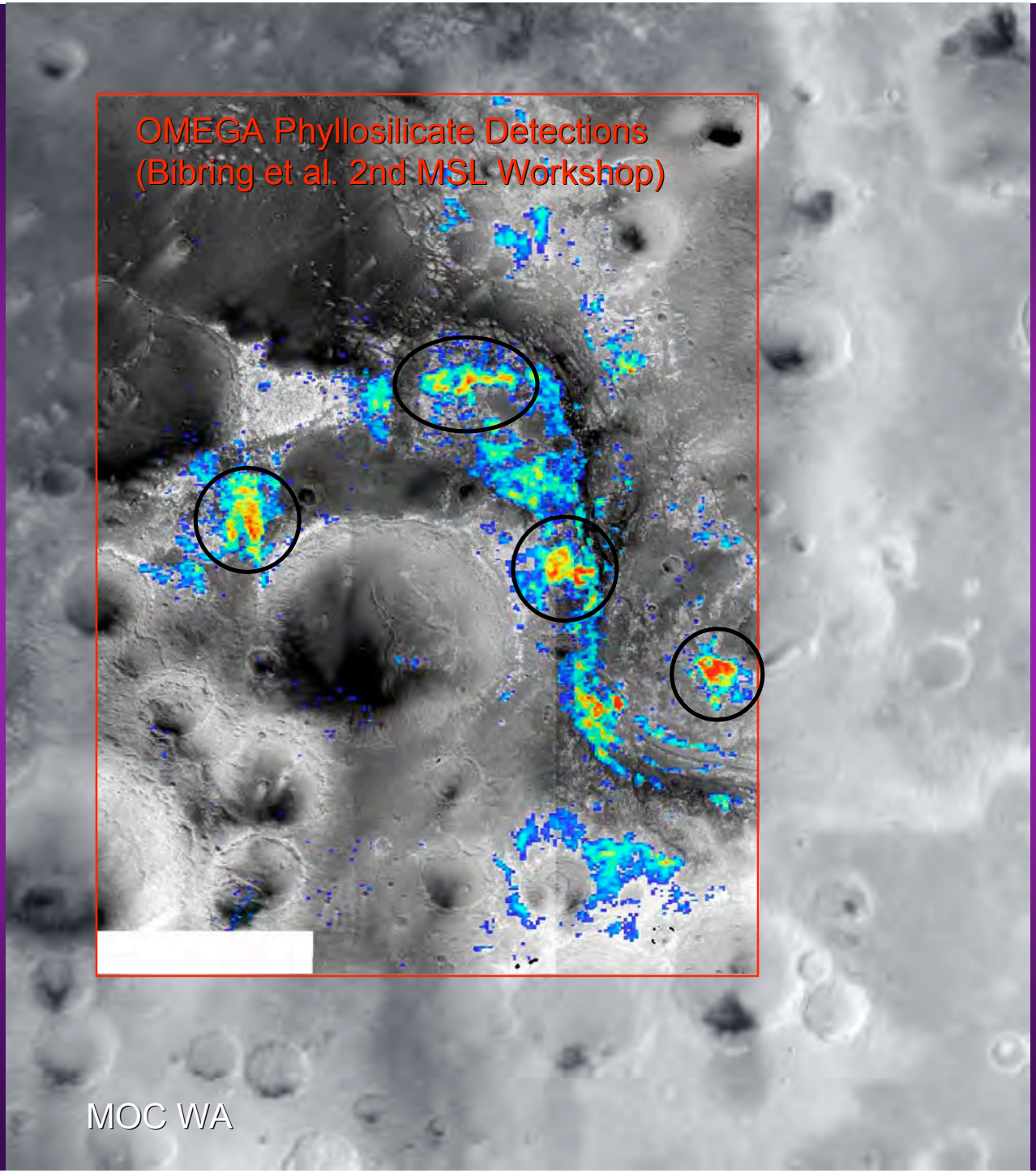
Vastitas Borealis

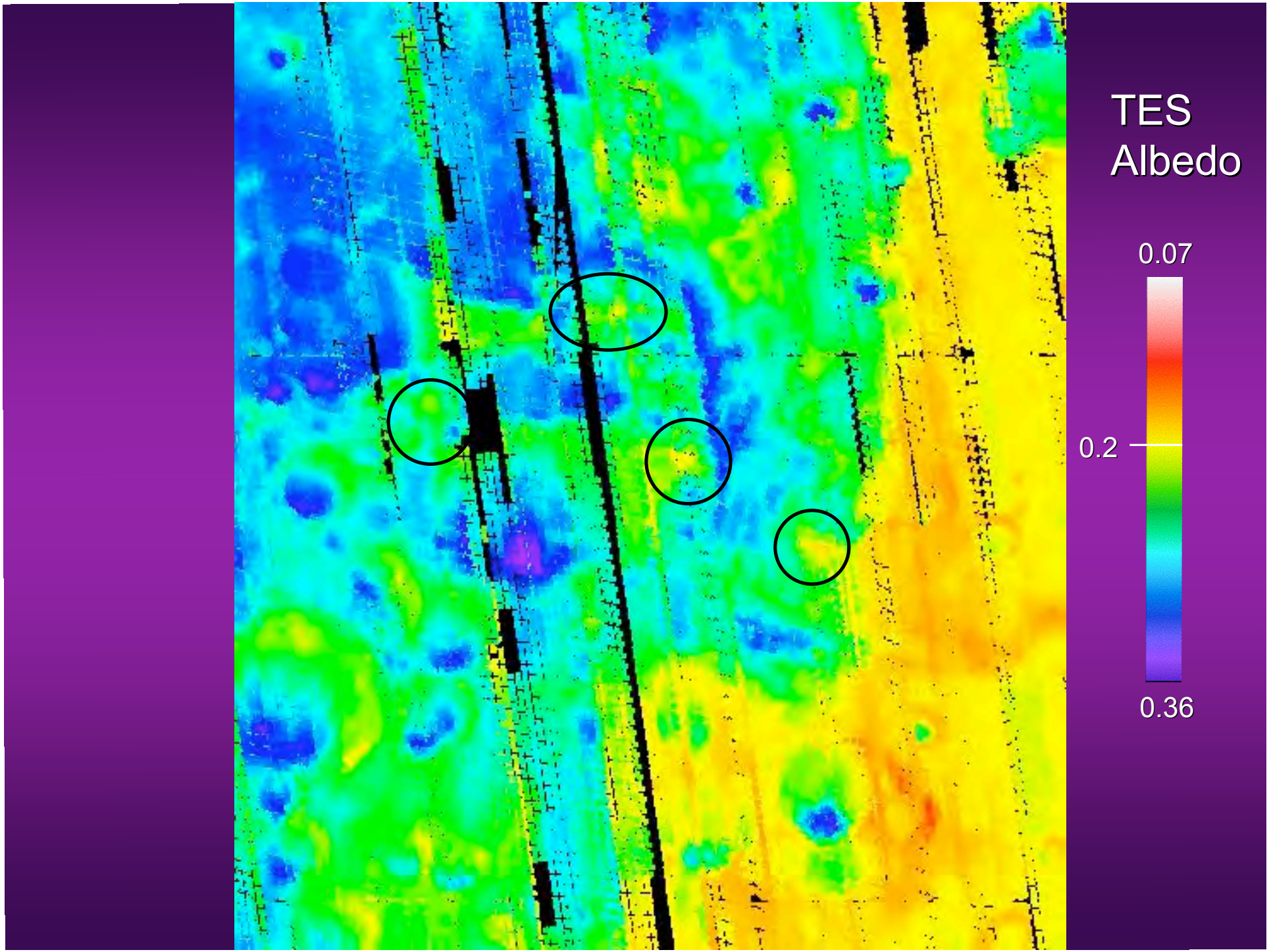


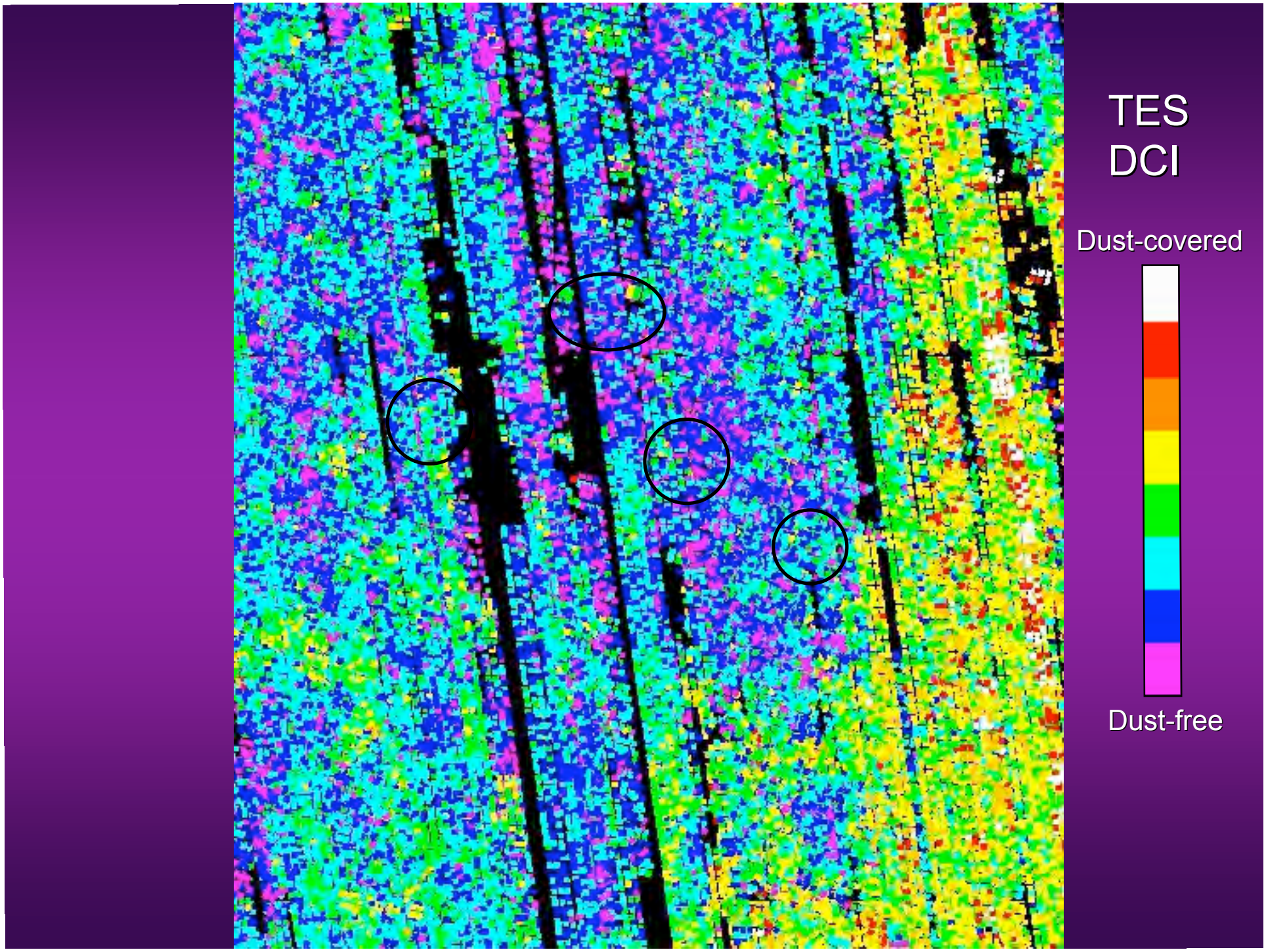
Vastitas Borealis

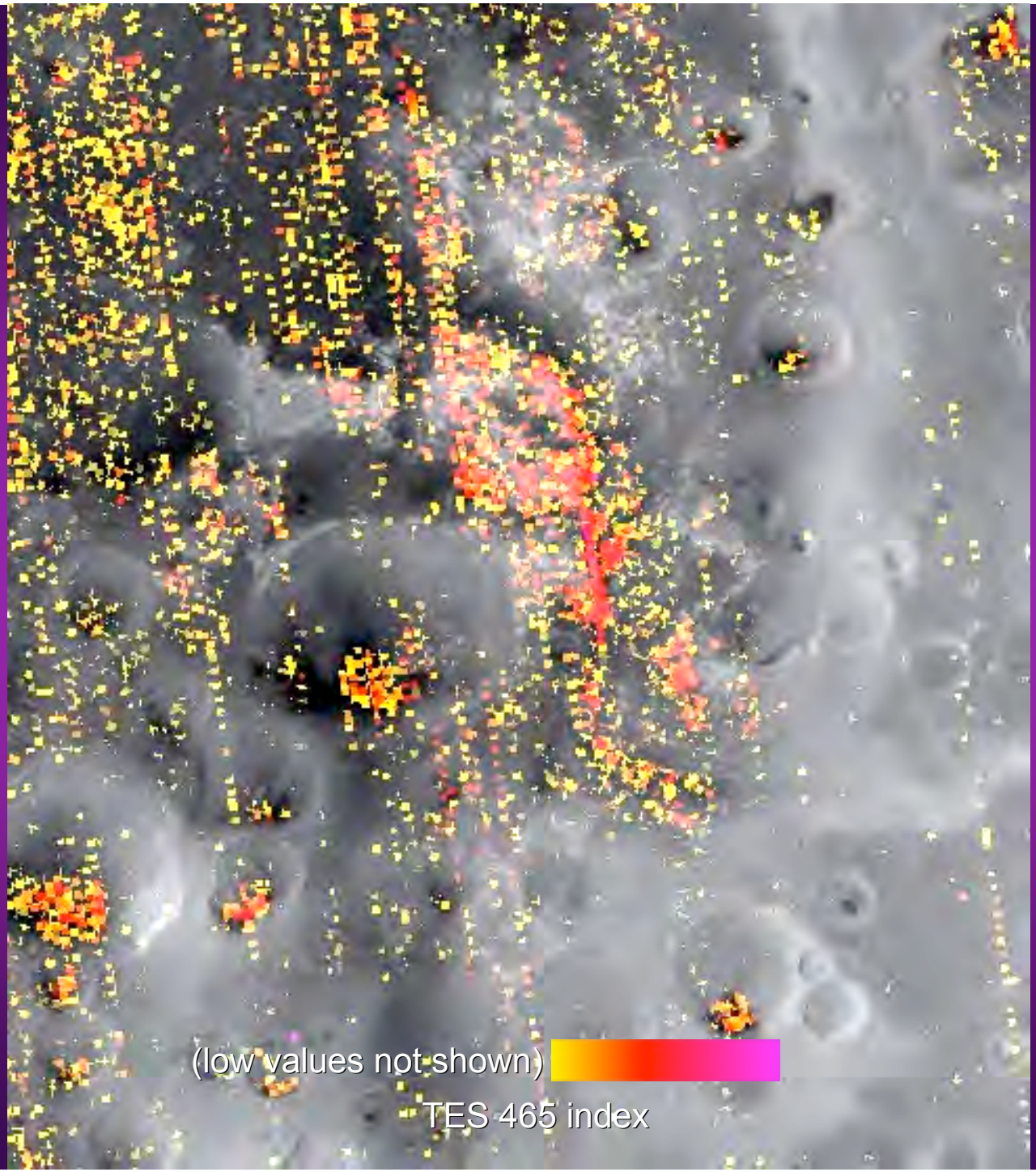


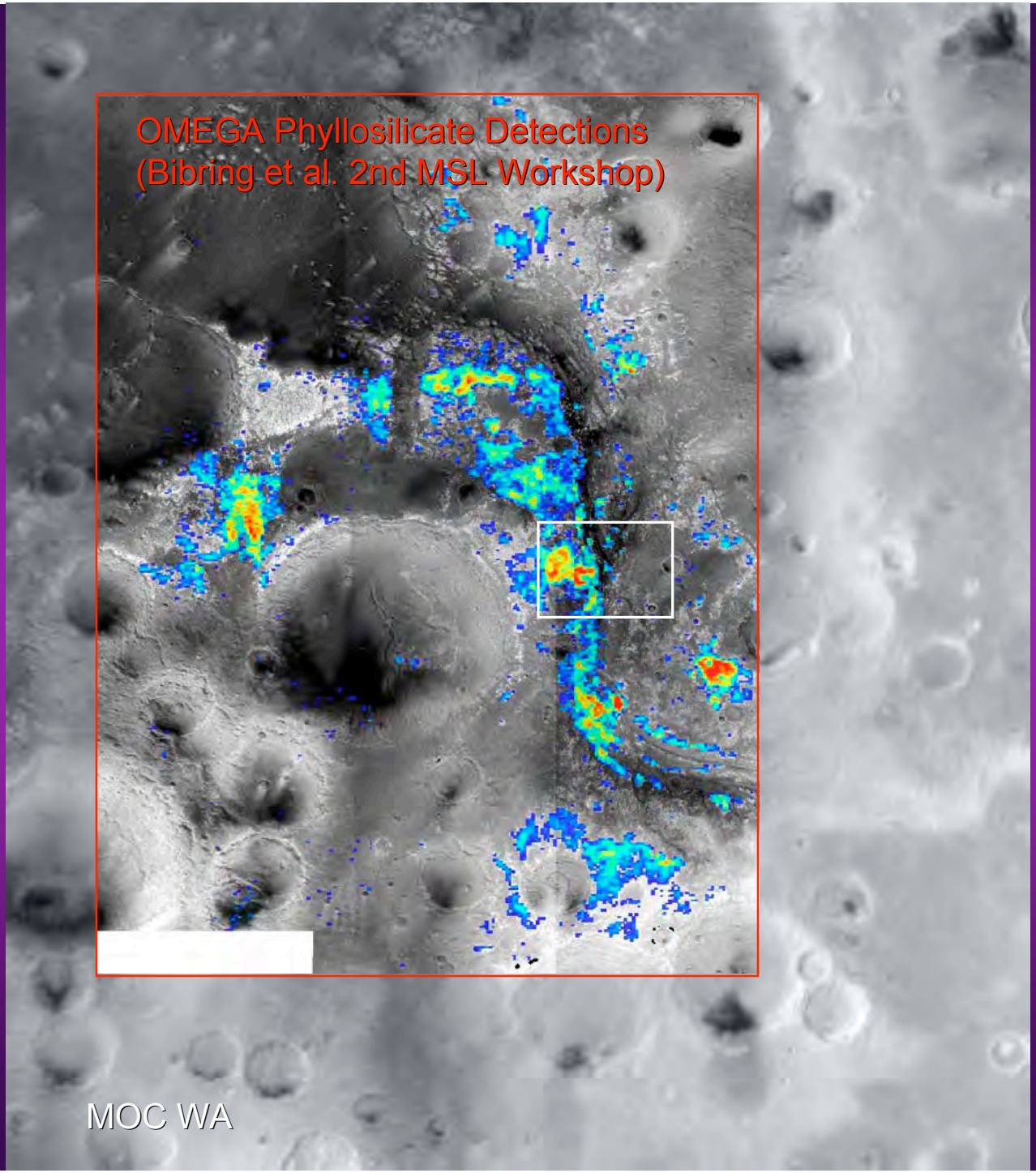



OMEGA Phyllosilicate Detections
(Bibring et al. 2nd MSL Workshop)
MOC WA


TES
Albedo
0.07
0.2
0.36


TES
DCI
Dust-covered
Dust-free


(low values not shown)
TES 465 index


OMEGA Phyllosilicate Detections
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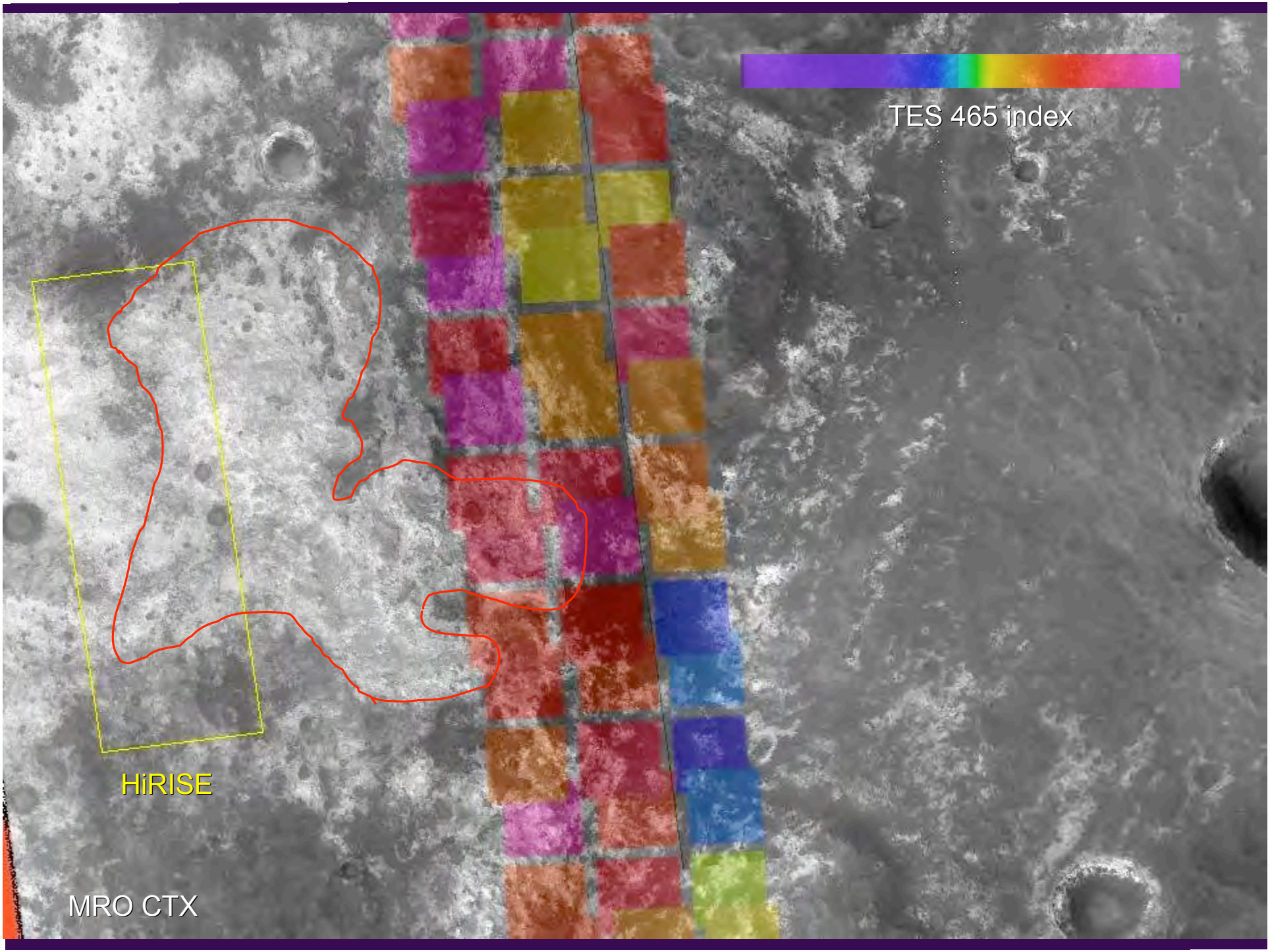
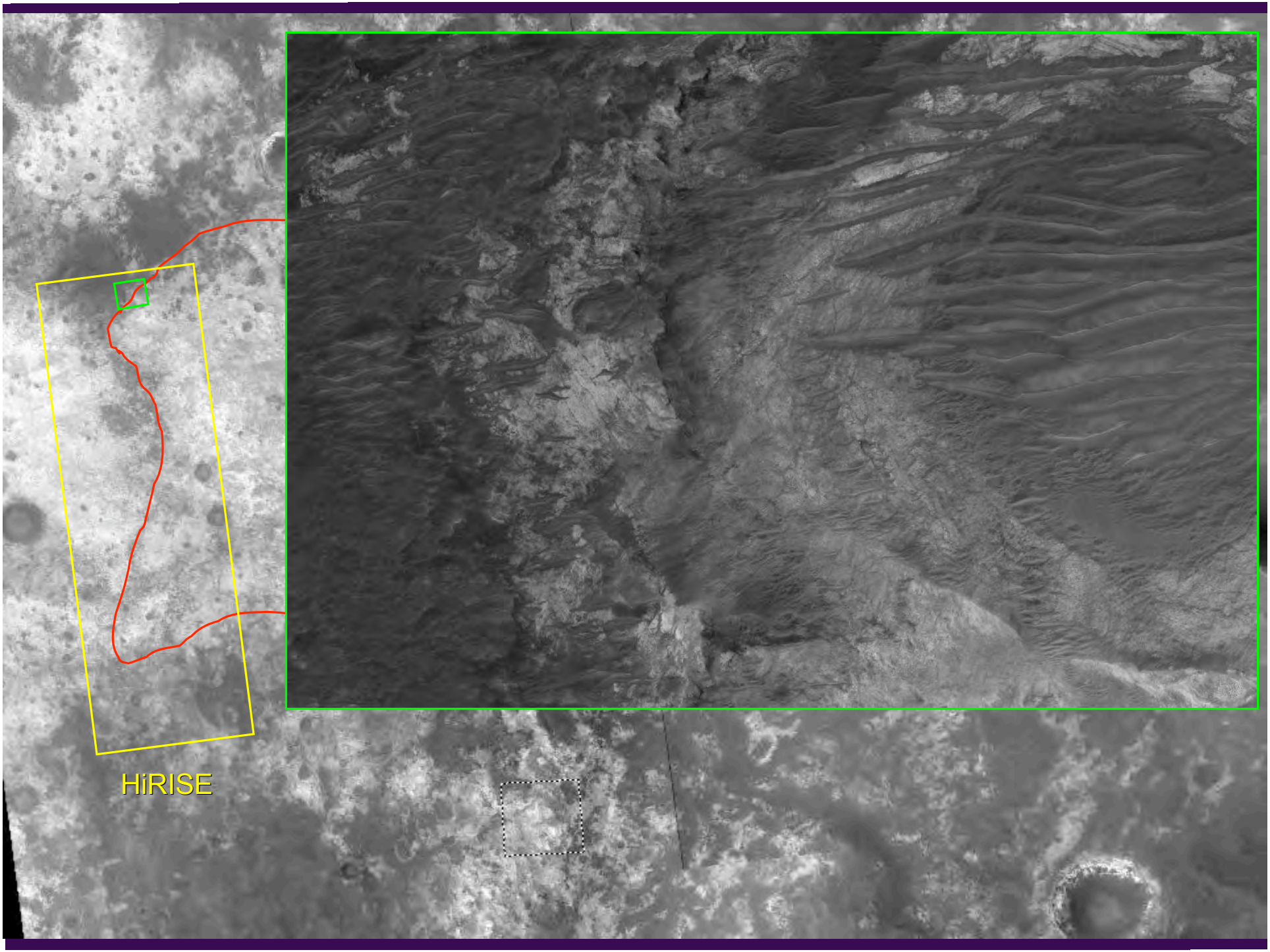
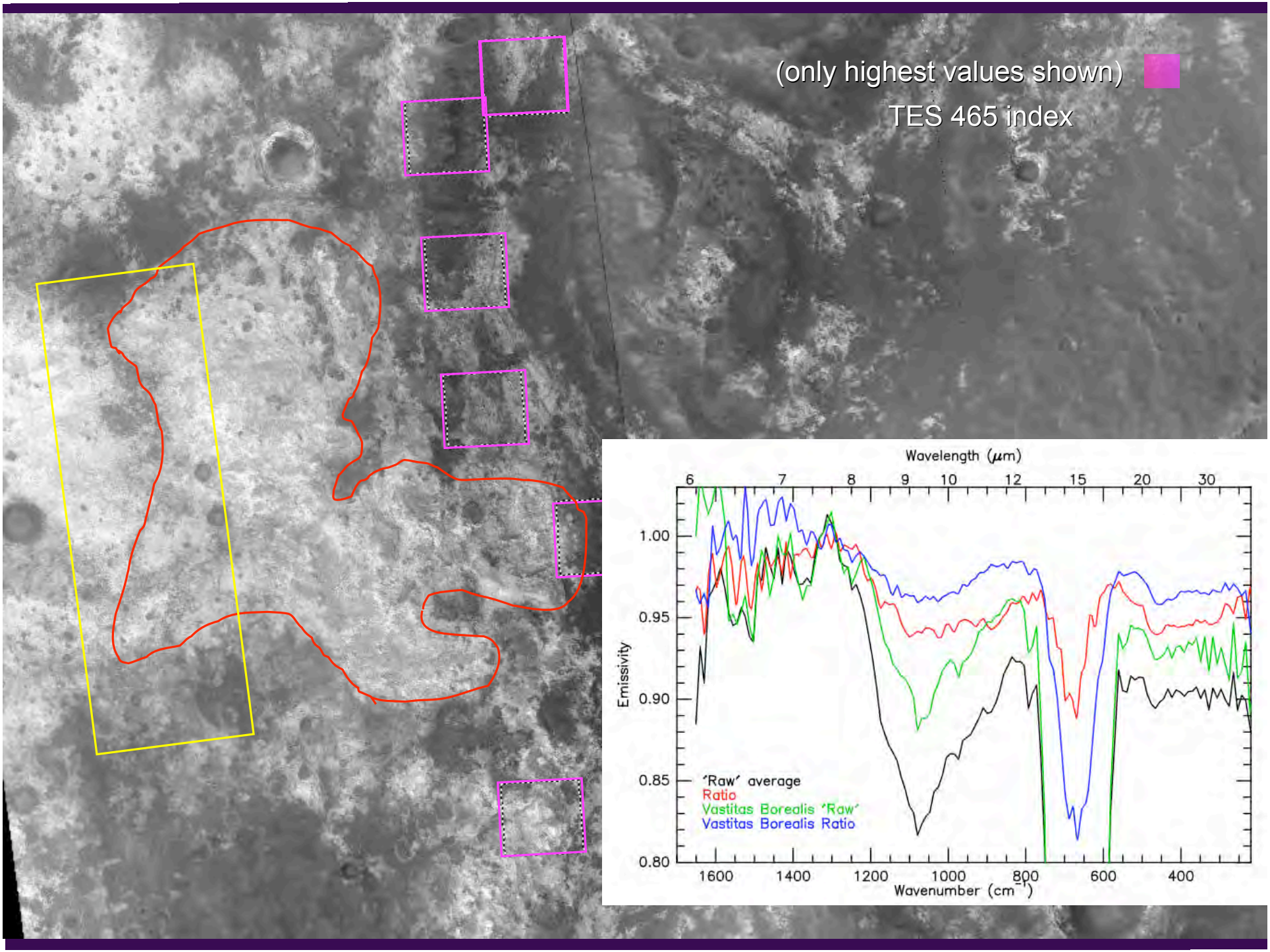
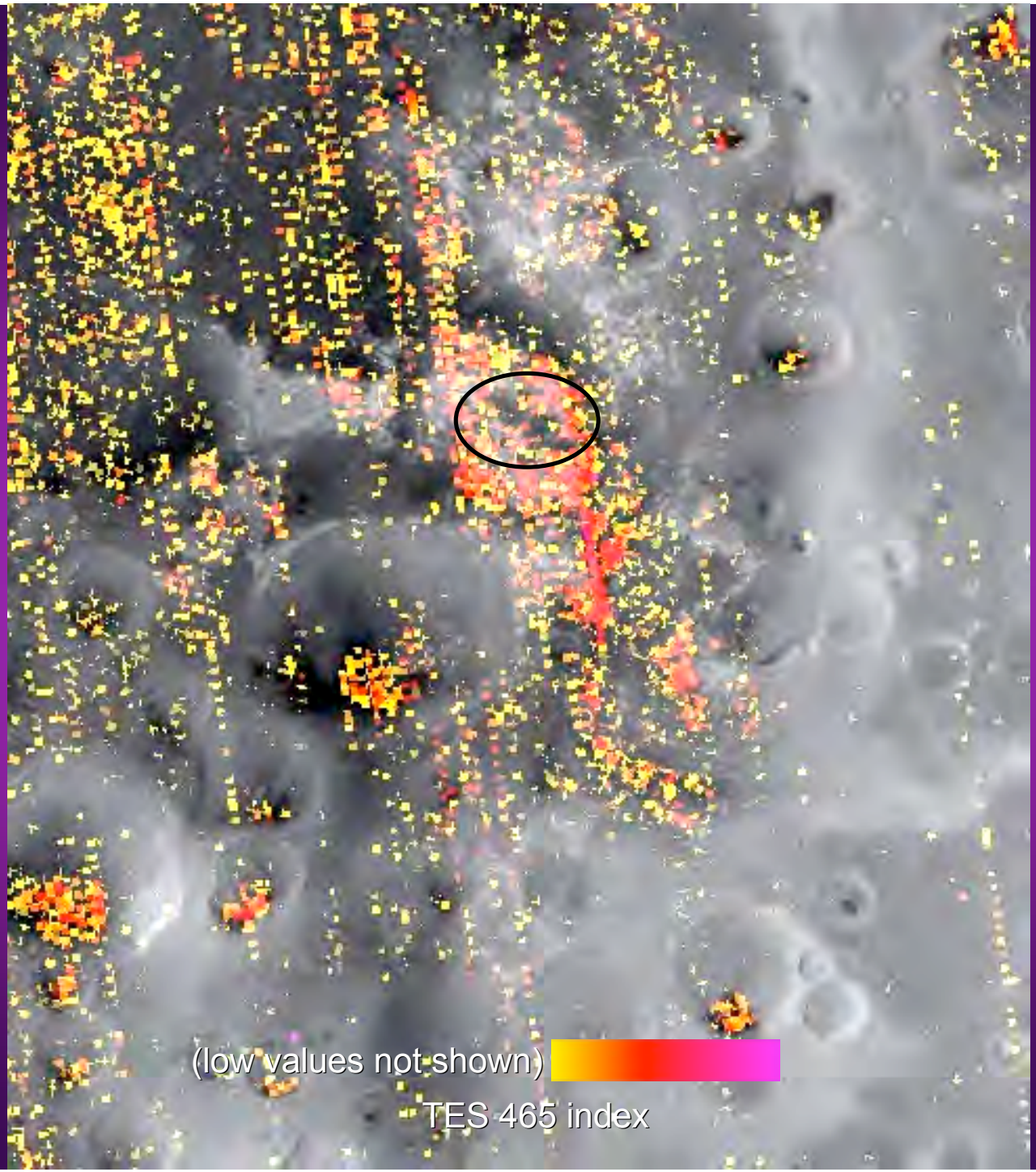
MOC WA


TES 465 index
HiRISE
MRO CTX


HiRISE


(only highest values shown)
TES 465 index
Wavelength (μm)
6
7
8
9
10
12
15
20
30
1.00
0.95
0.90
0.85
0.80
Emissivity
'Raw' average
Ratio
Vastitas Borealis 'Raw'
Vastitas Borealis Ratio
1600
1400
1200
1000
800
600
400
Wavenumber (cm-1)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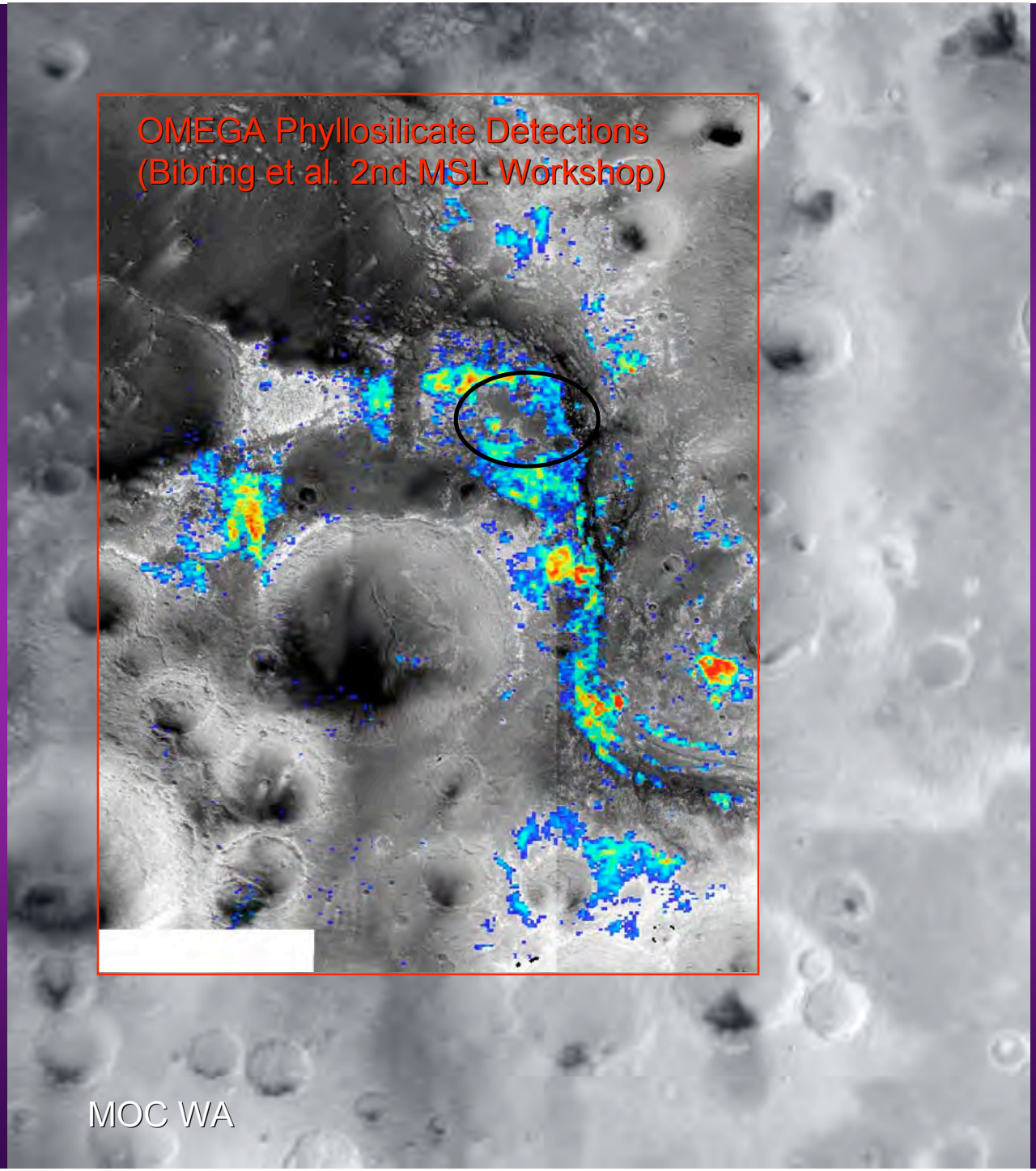
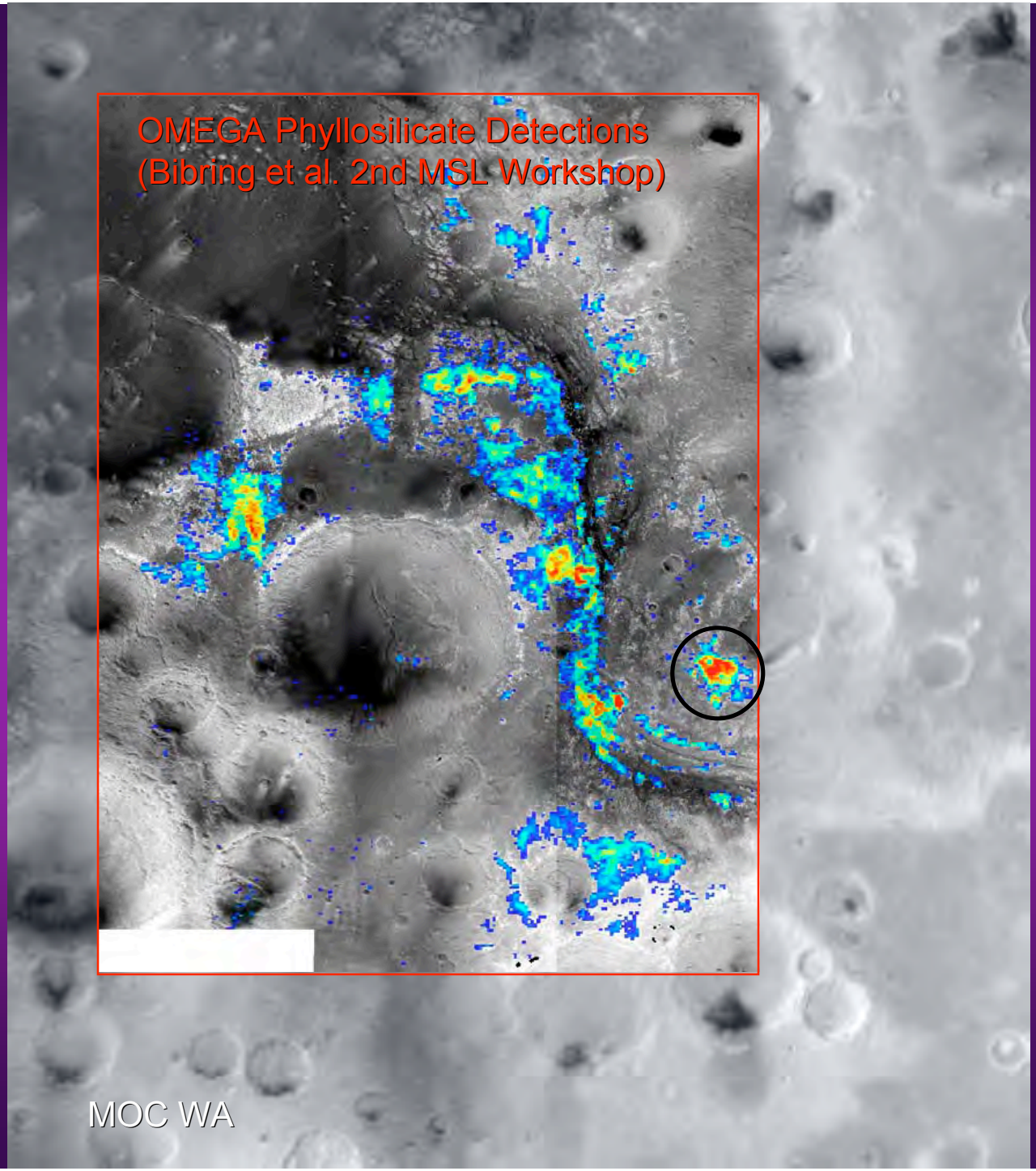
TES 465 index


OMEGA Phyllosilicate Detections
(Bibring et al. 2nd MSL Workshop)
MOC WA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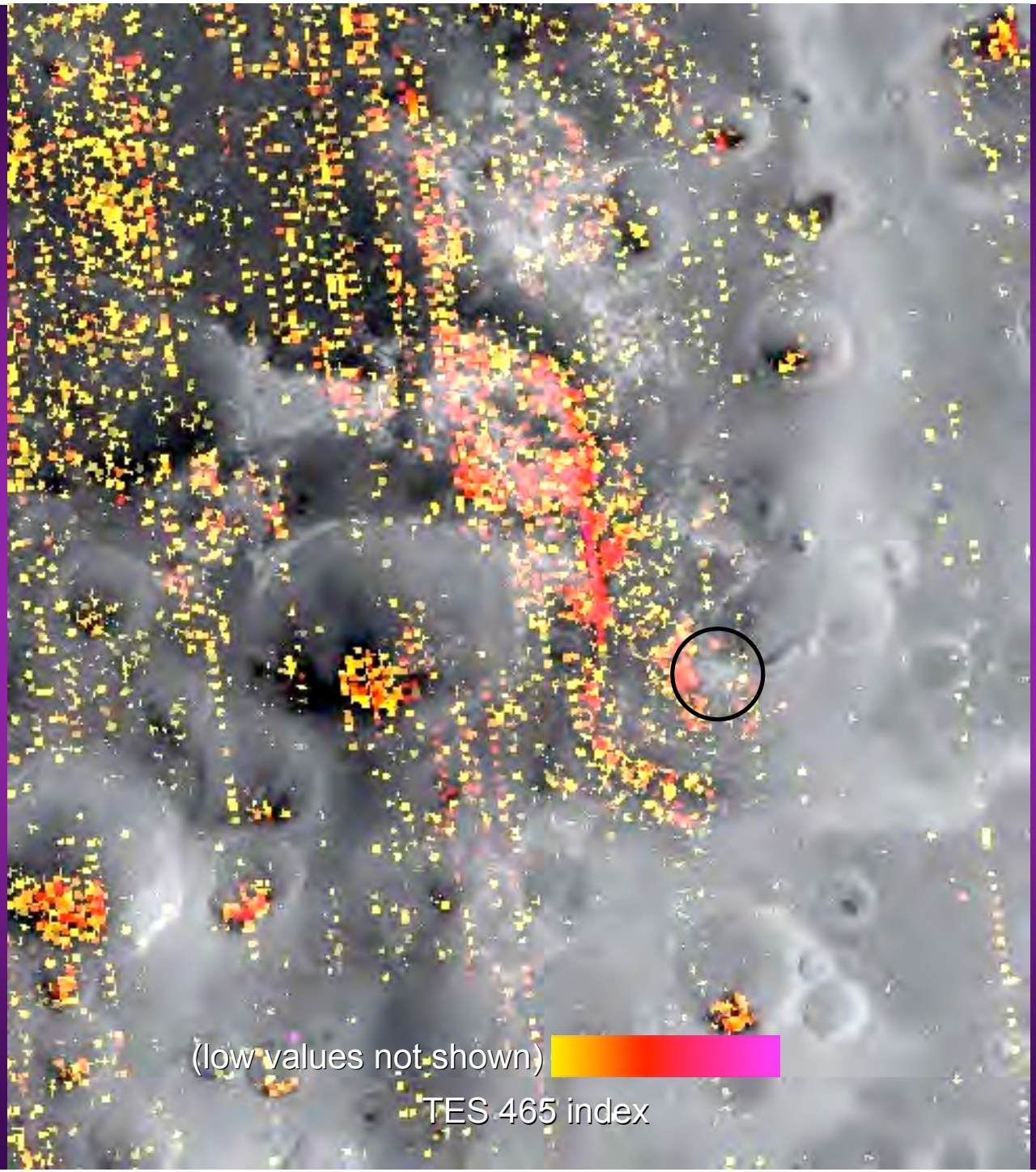
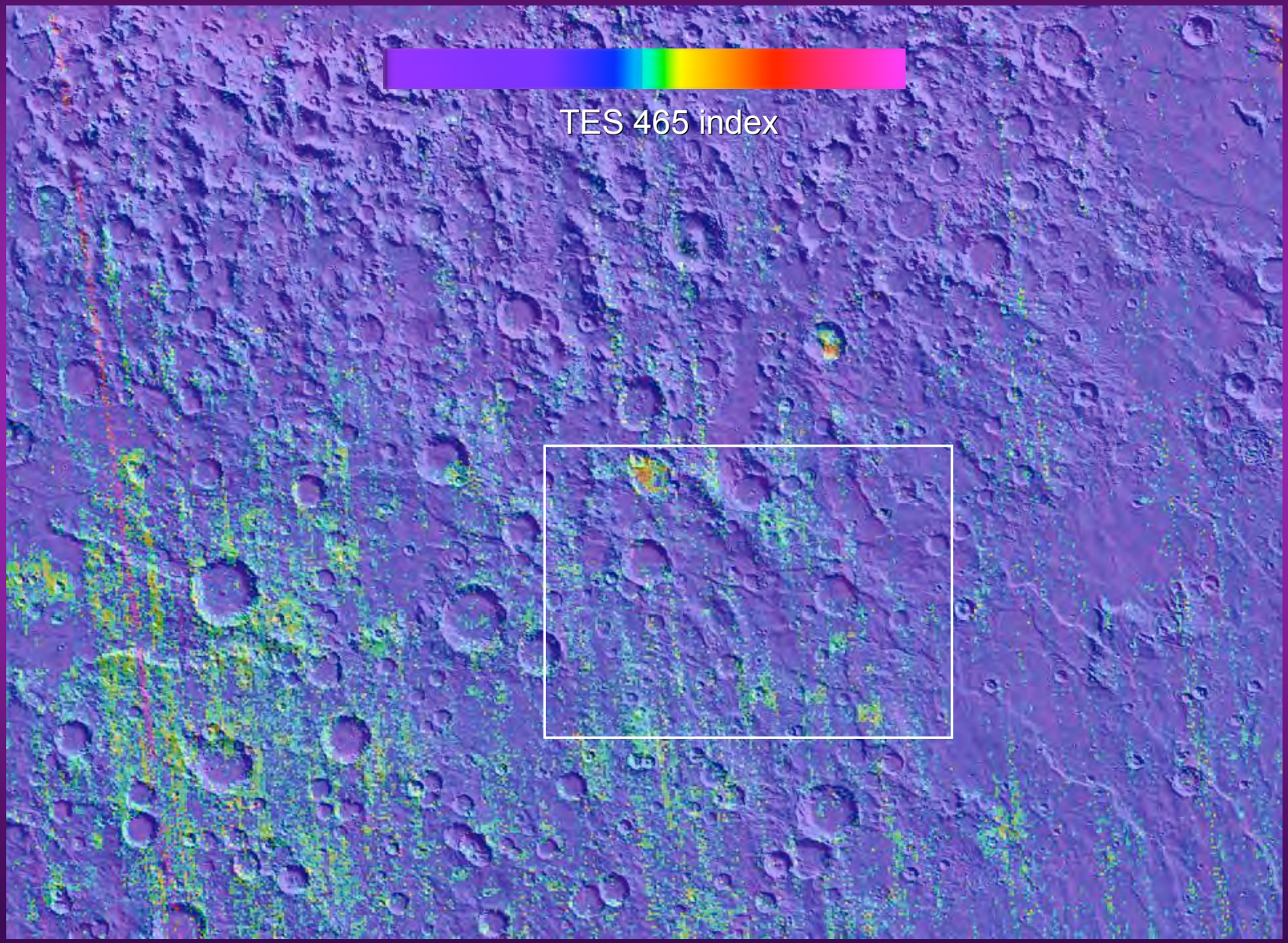
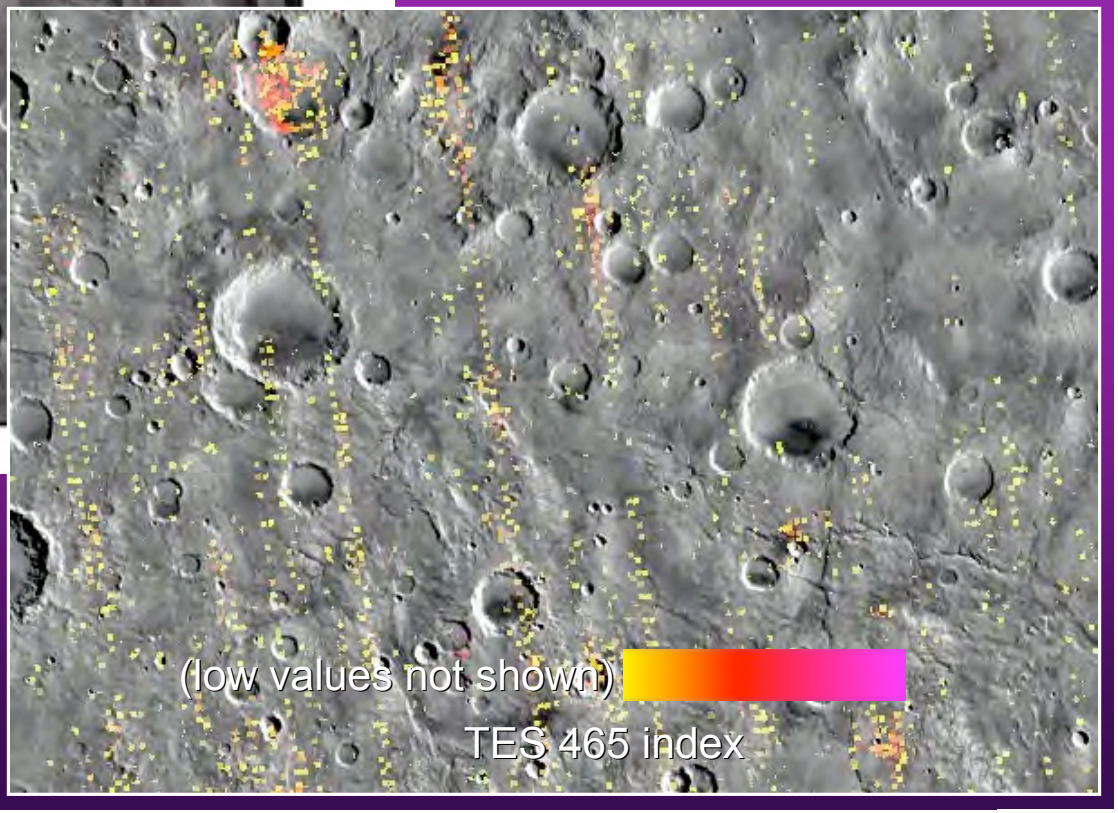
MOC WA


(low values not shown)
TES 465 index

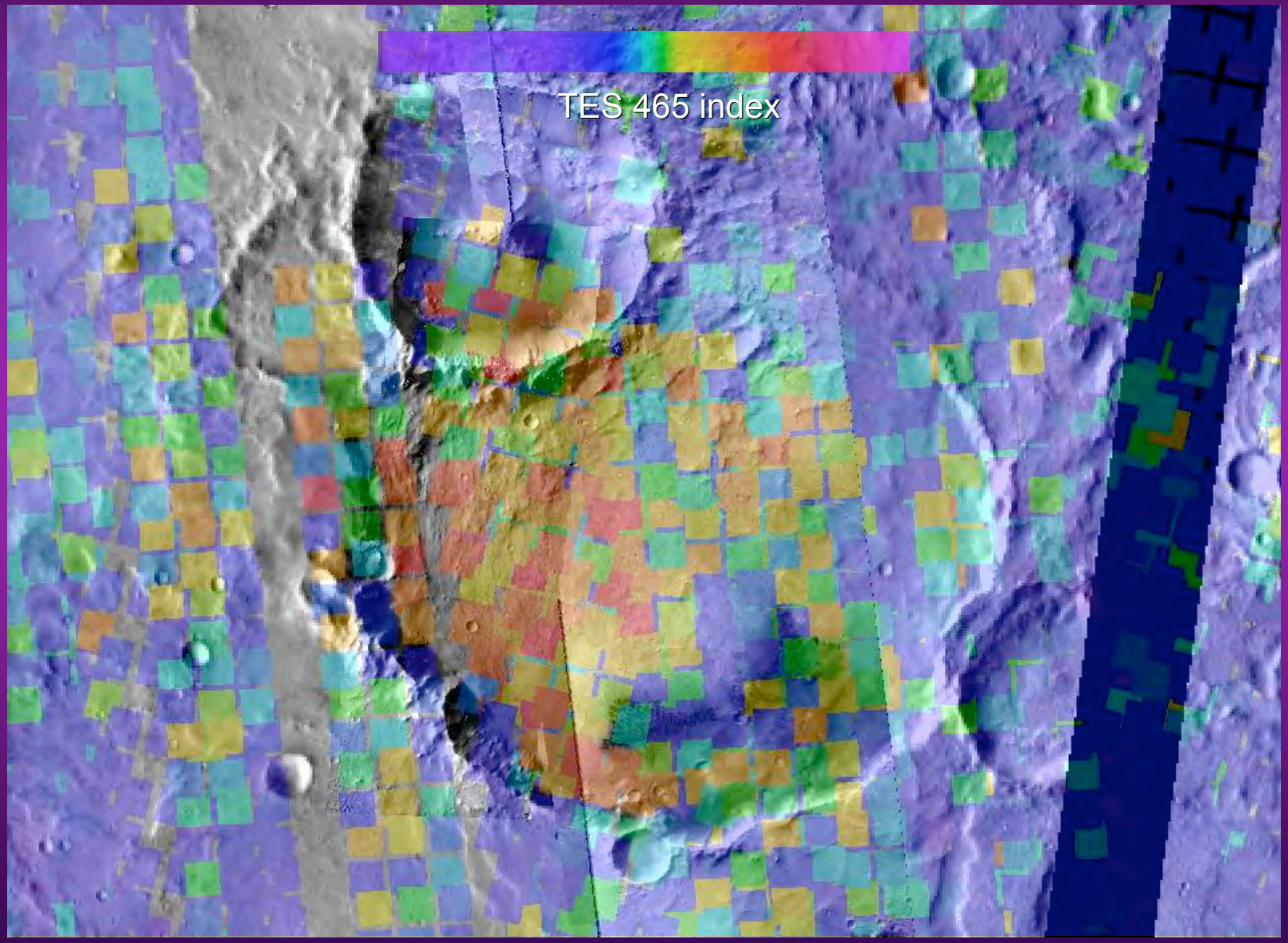
NE Tyrrhena Terra Crater



NE Tyrrhena Terra Crater



NE Tyrrhena Terra Crater



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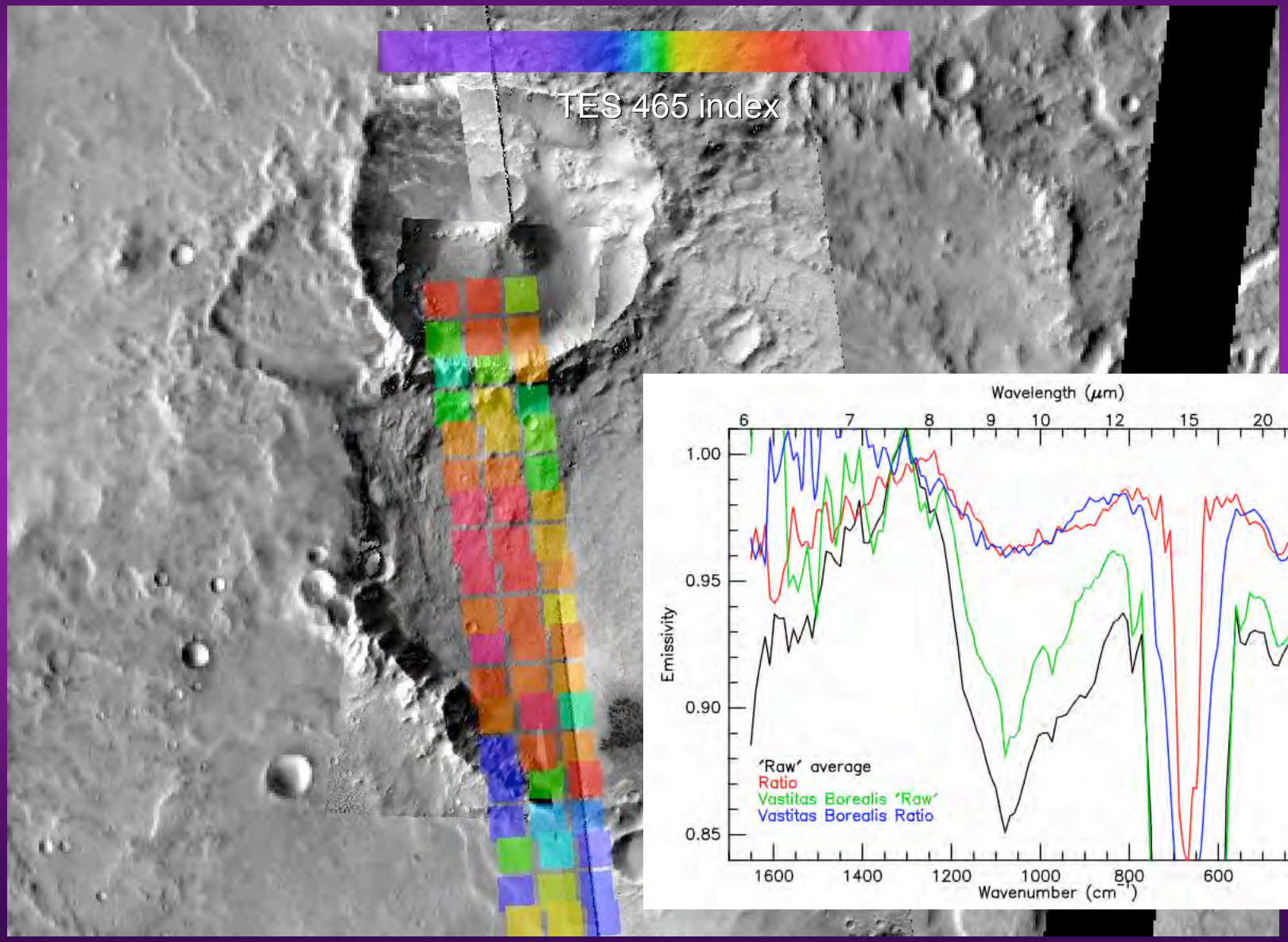
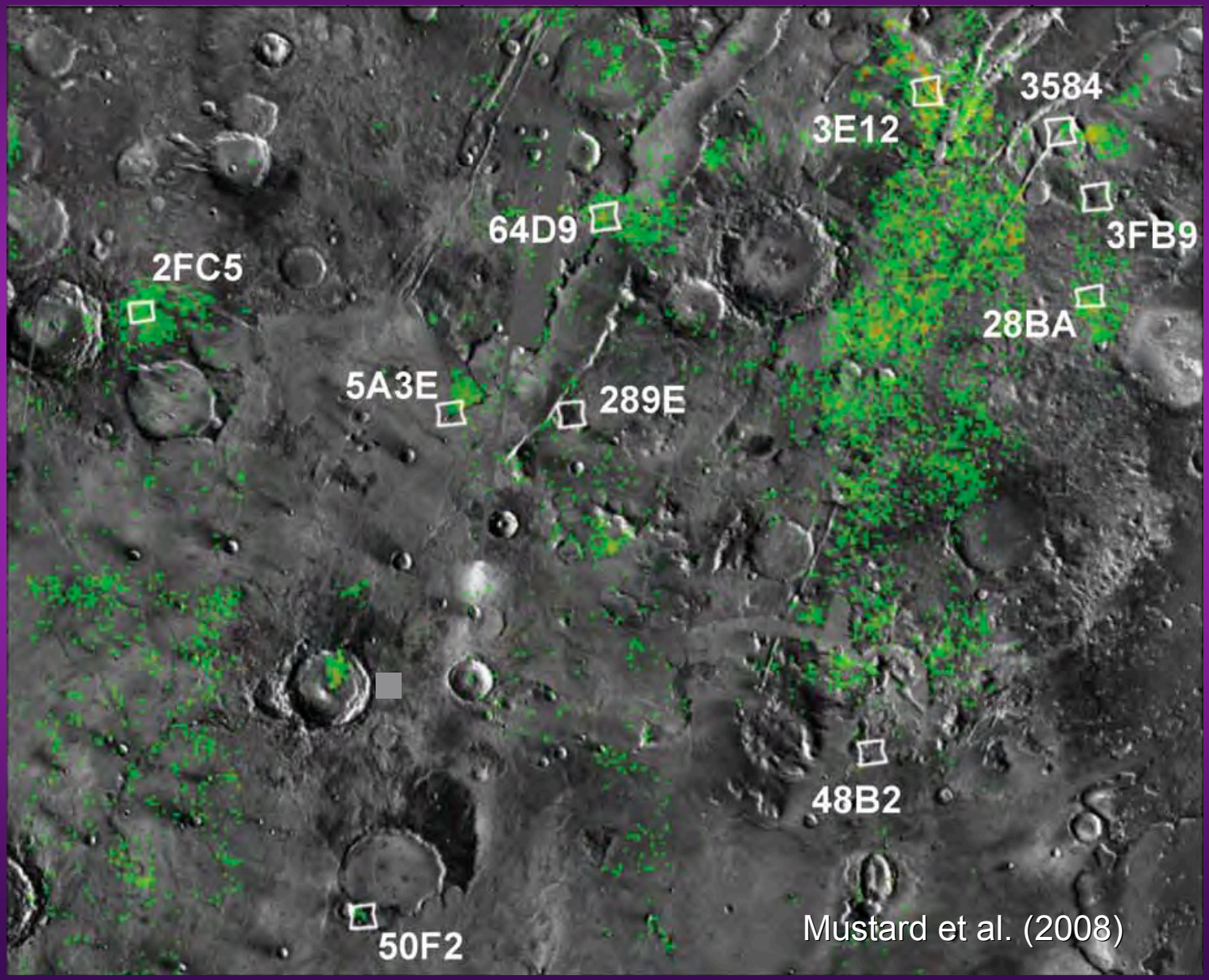
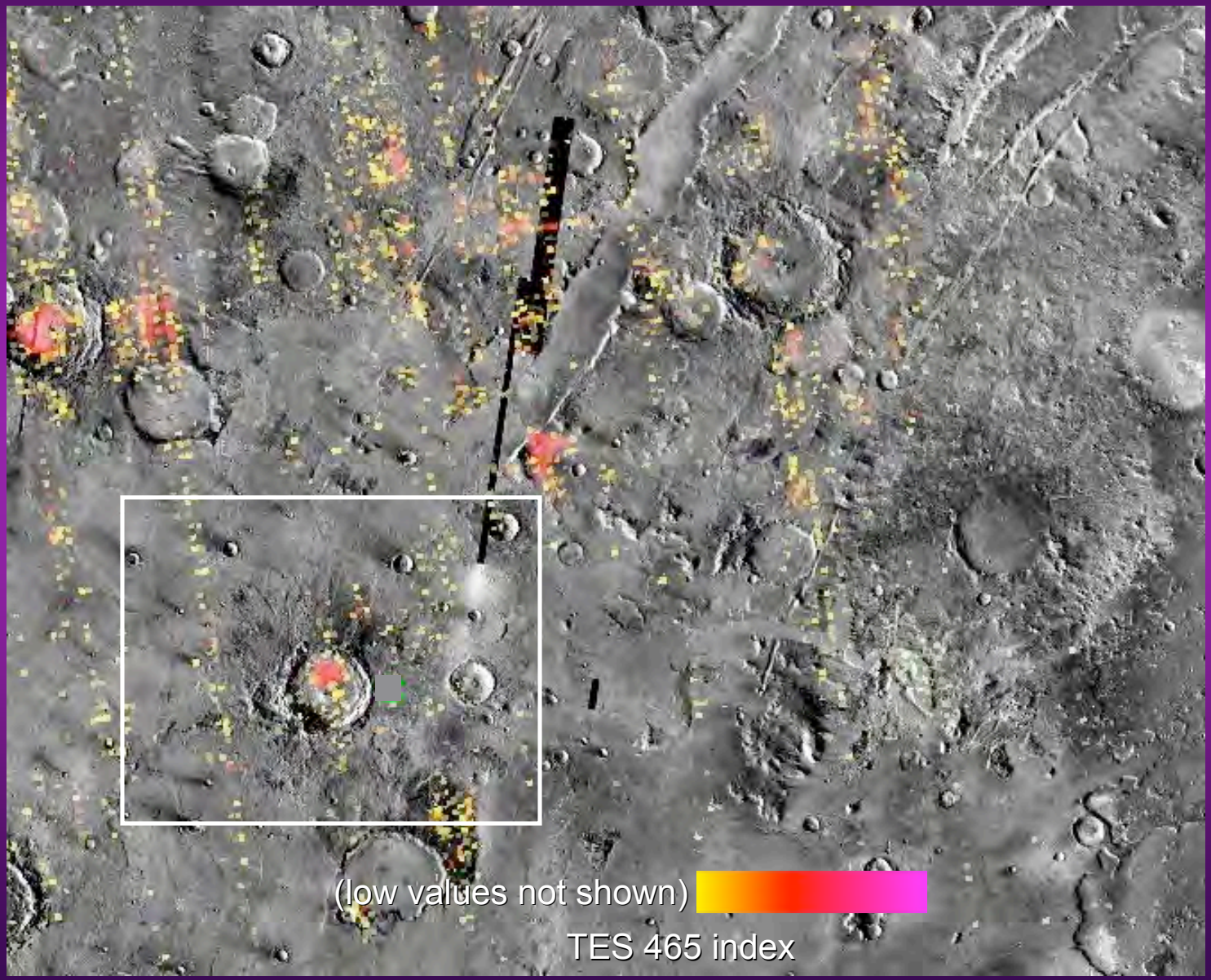


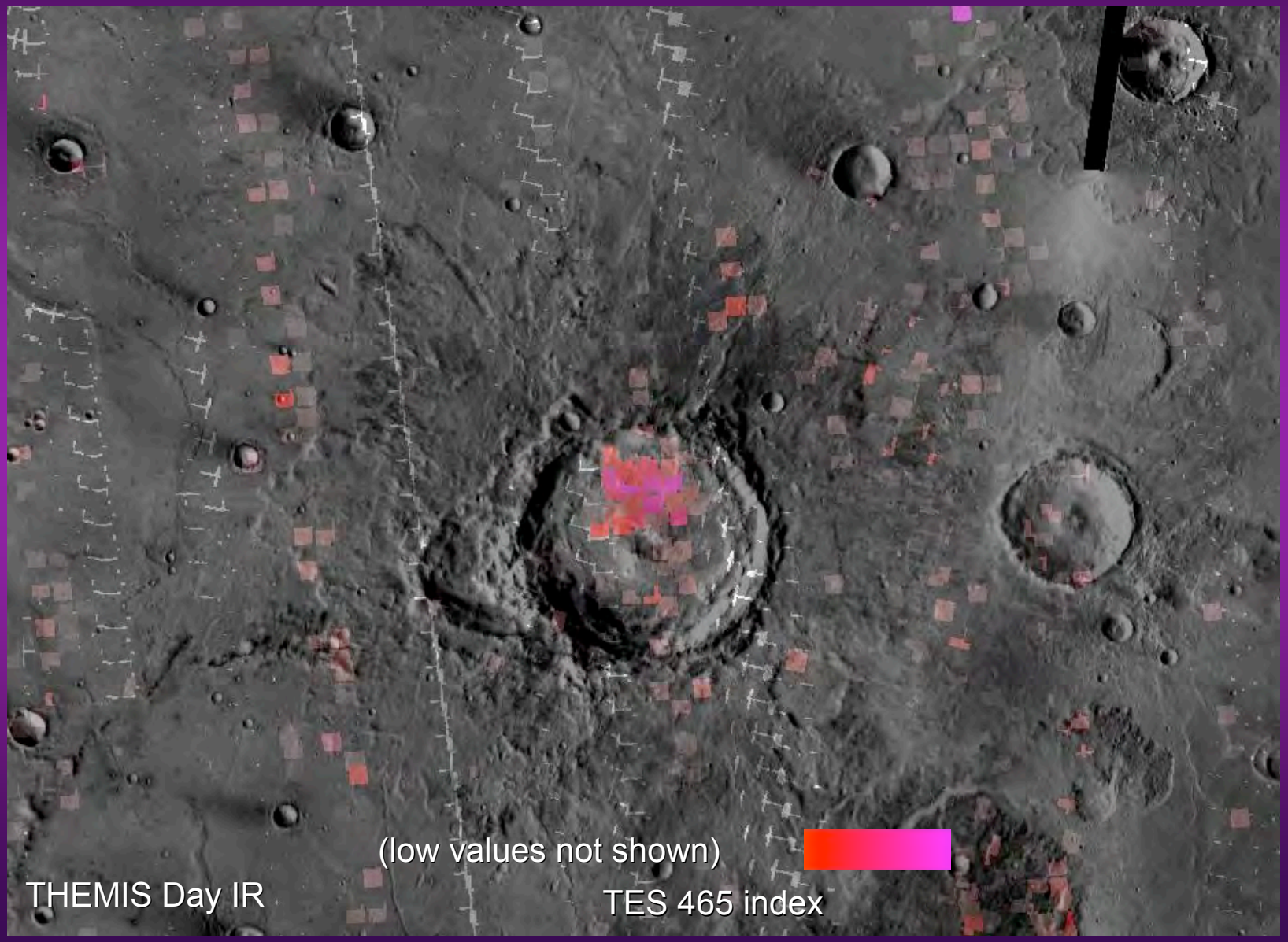
South Nili Fossae



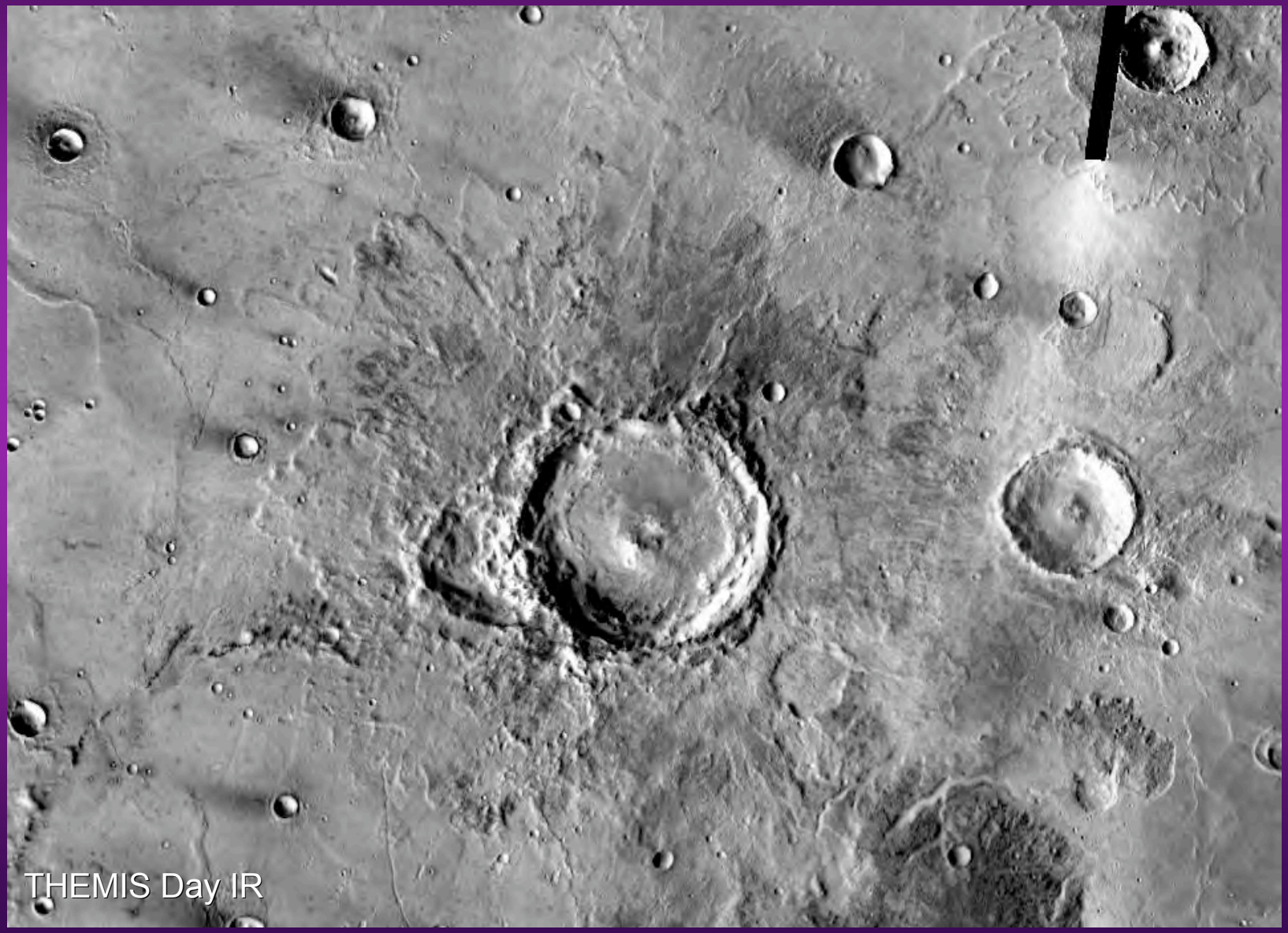
South Nili Fossae



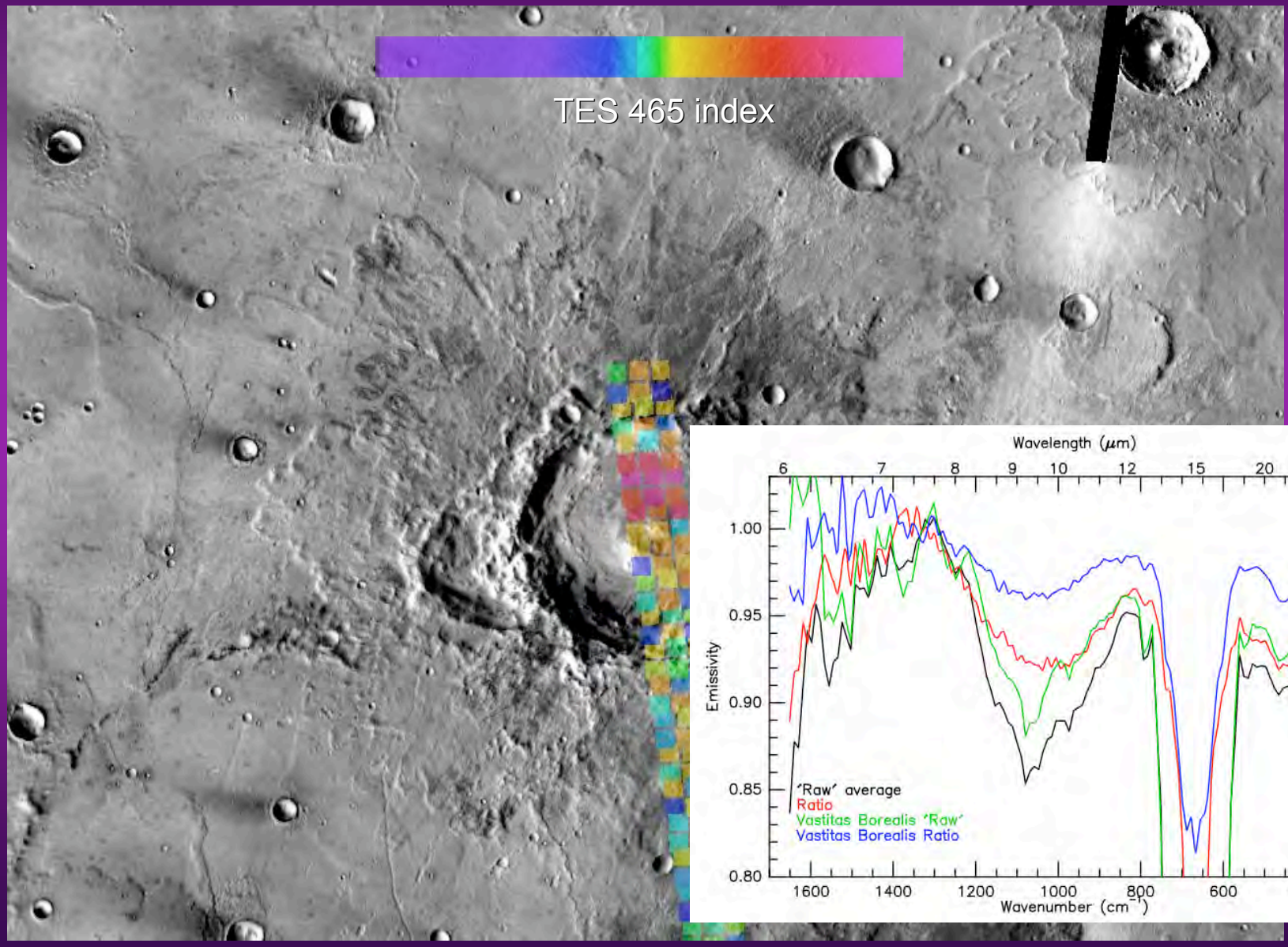
S. Nili Fossae Crater



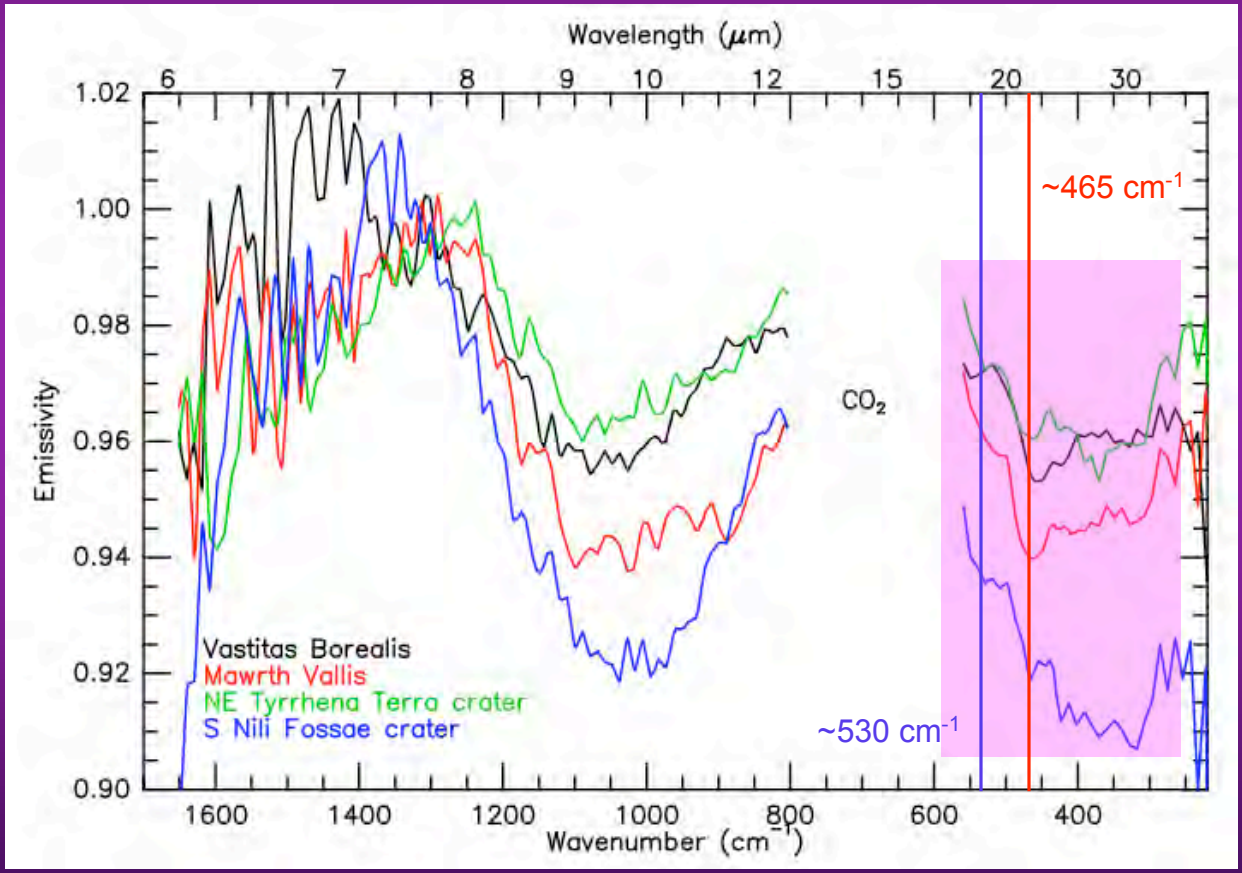
S. Nili Fossae Crater



S. Nili Fossae Crater



TES Type 2 Revisited: Emerging View



Conclusions

- TES 465 cm^{-1} index provides a useful reconnaissance tool for comparing to VNIR phyllosilicate (and other phases?) observations
- Some locations show unambiguous correlations between TIR and VNIR indicators of phyllosilicates
- Other locations lack such correlations; may represent places with primary (unaltered) silicate glass
- Pairing of TIR and VNIR observations provides a broader perspective on the geologic environments in which phyllosilicates have been found
- Future work will incorporate Mini-TES spectra and other rover data for indirect ground truth