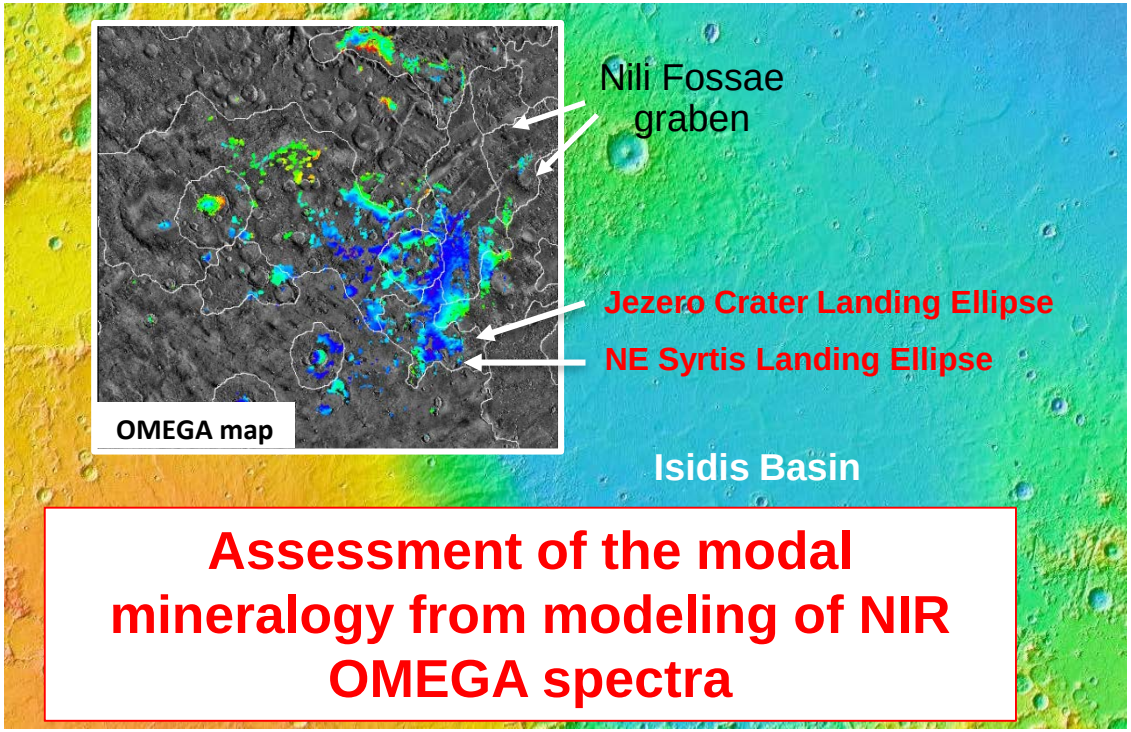
Modal mineralogy of the terrains surrounding the Mars 2020 landing sites in Nili and implications on the past geochemical conditions



Assessment of the modal mineralogy from modeling of NIR OMEGA spectra

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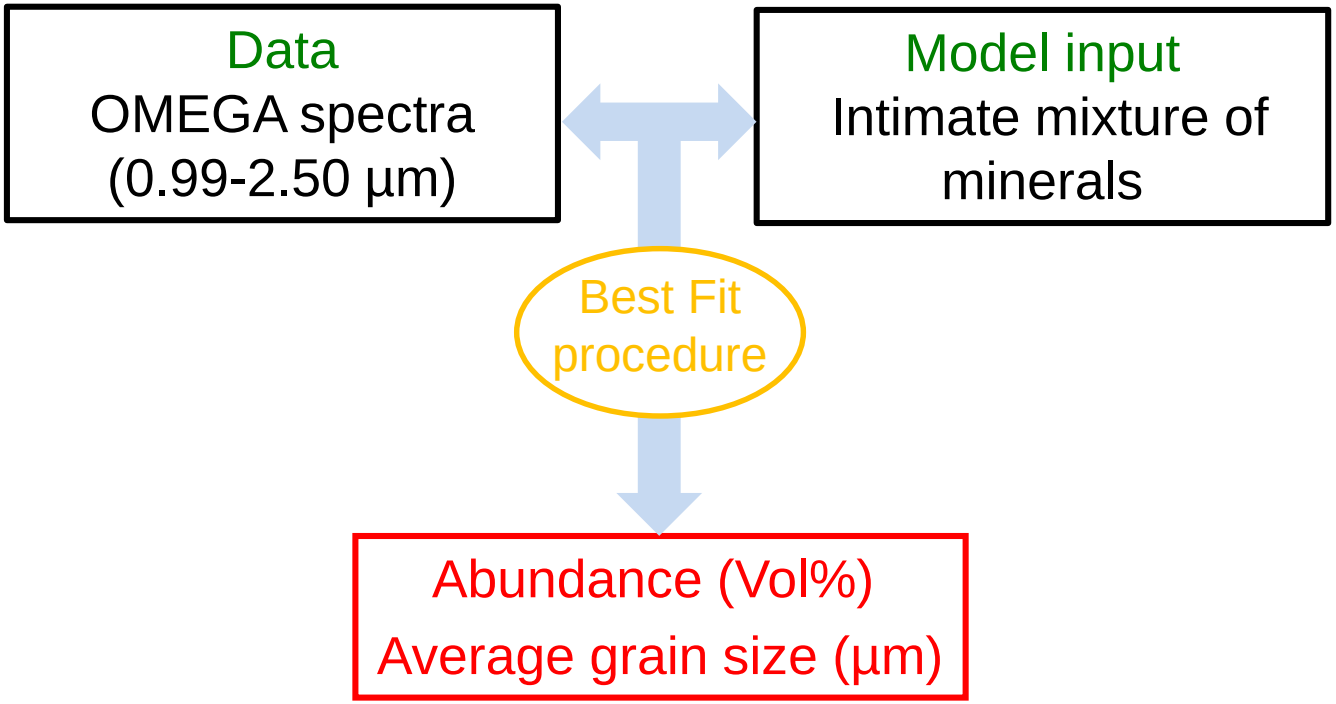
How to derive the modal mineralogy ?

Surface model to fit NIR spectra based on the Shkuratov radiative transfer theory

To simulate the scattering properties of a mineral mixture:

- Macroscopic Level
- Microscopic Level ⇔ composition, grain size



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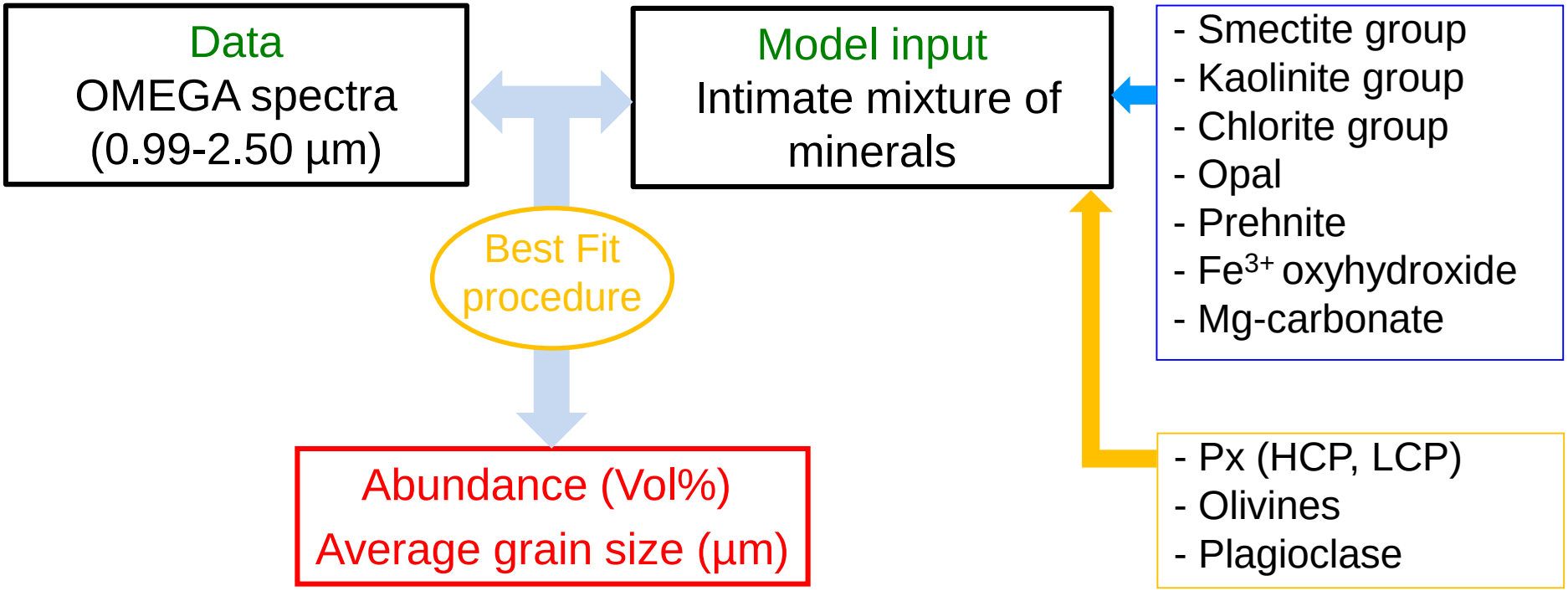
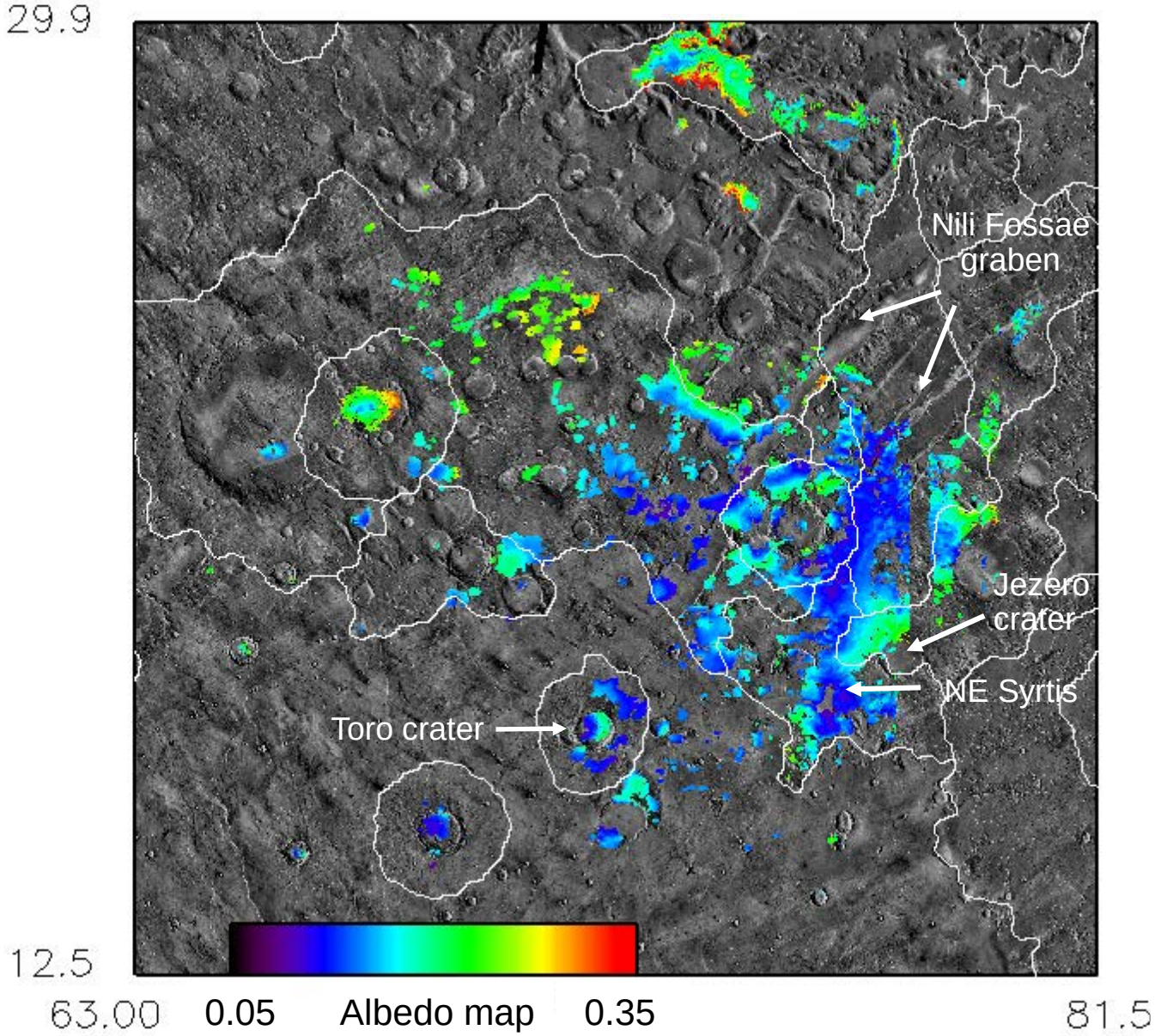
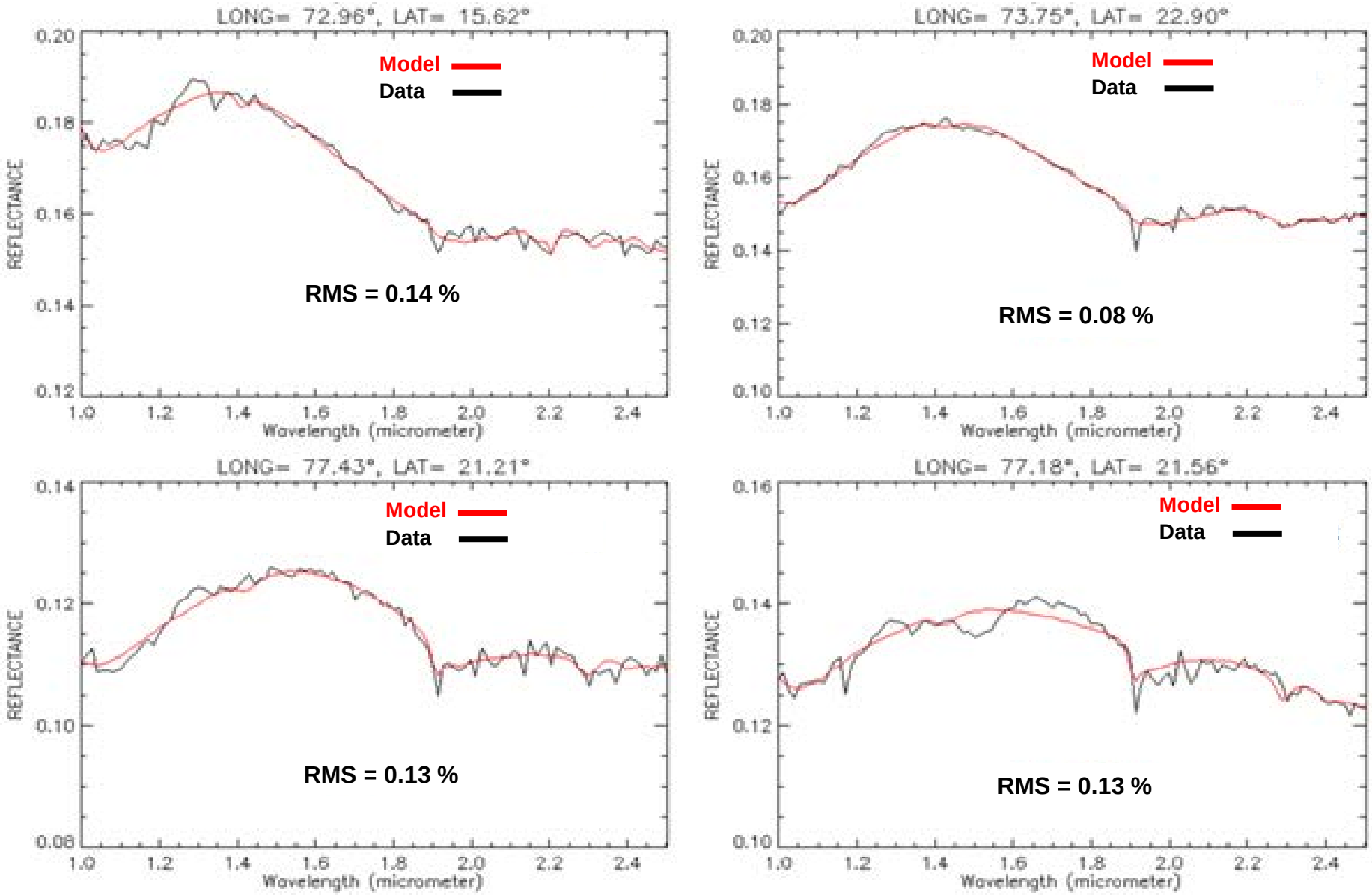


Studied area



80k spectra with a 1.9 µm band to be modeled

Spectral diversity well reproduced



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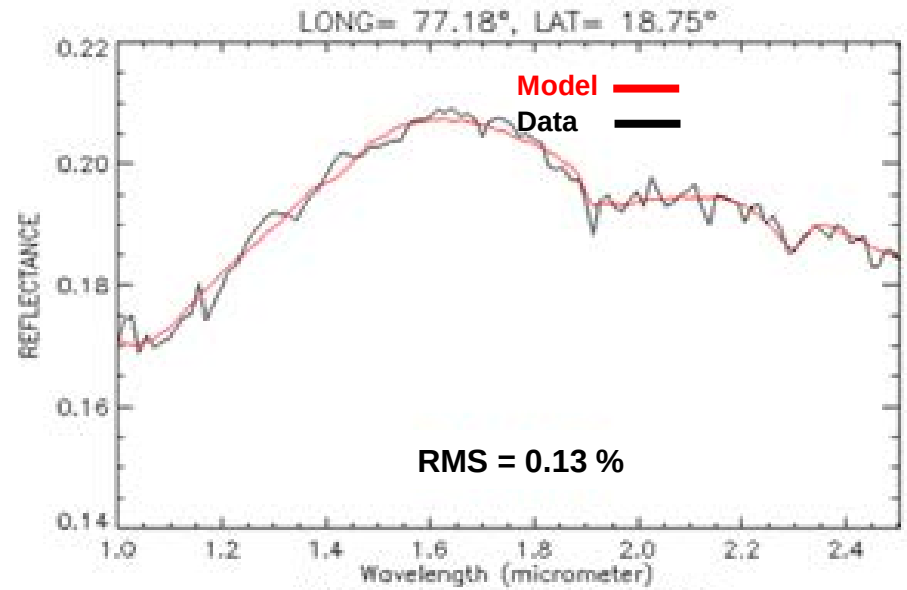
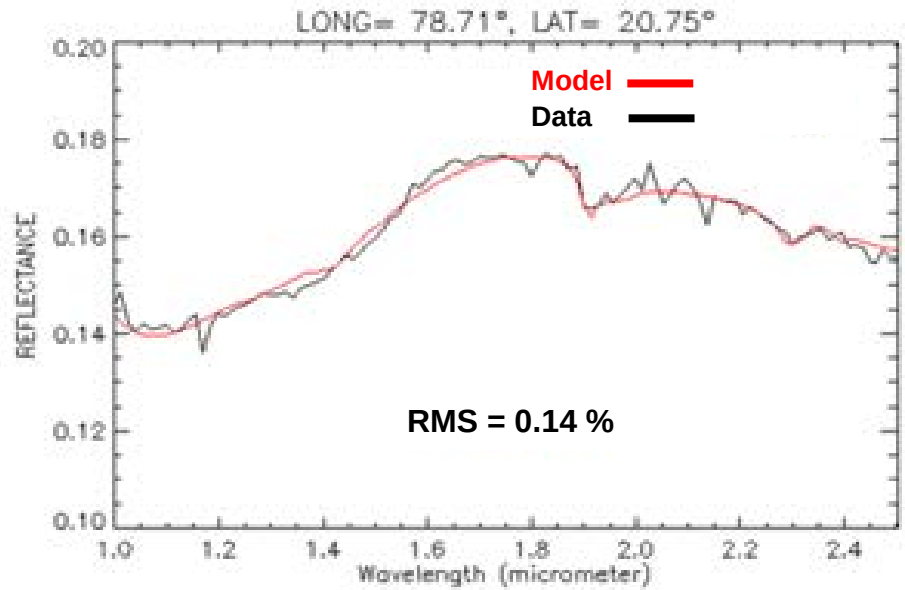
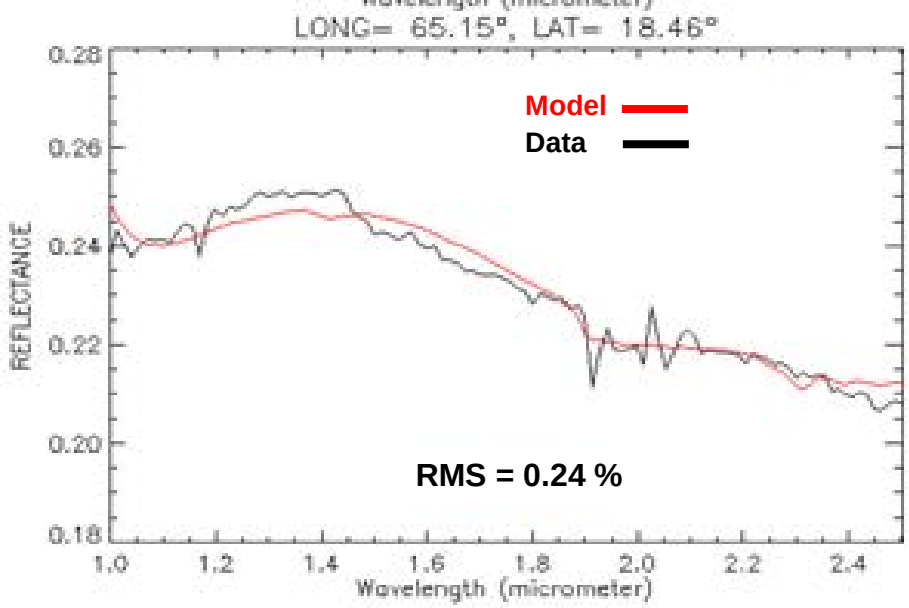
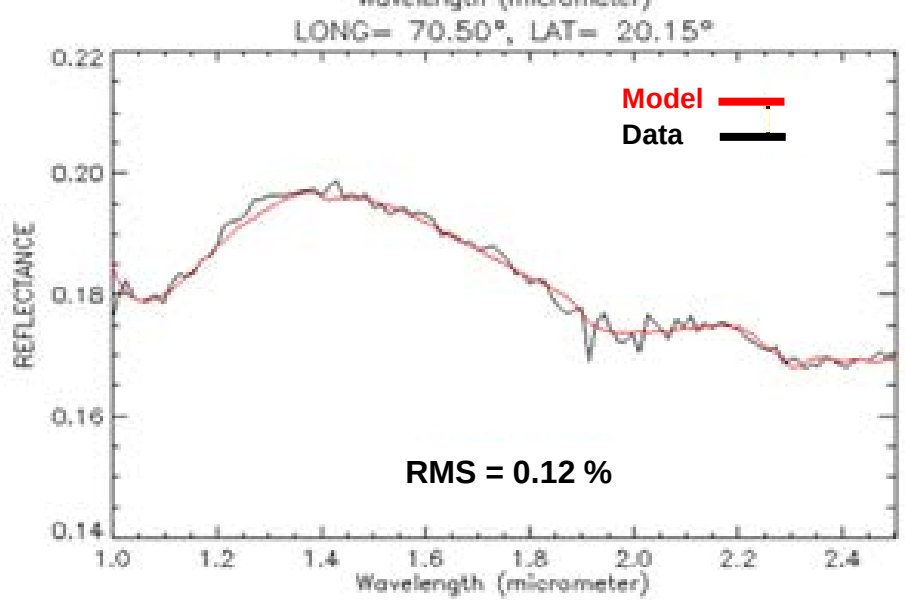
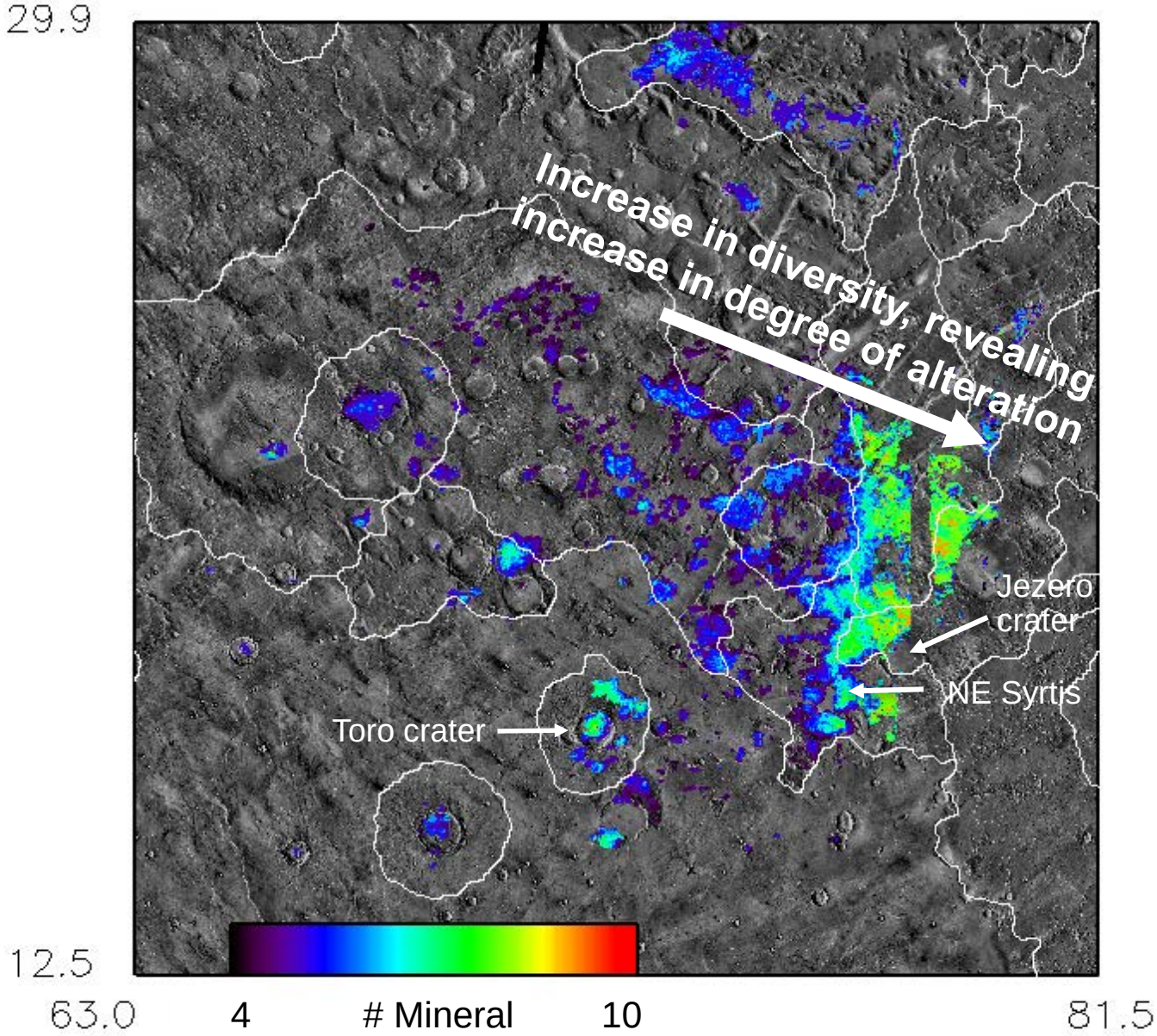






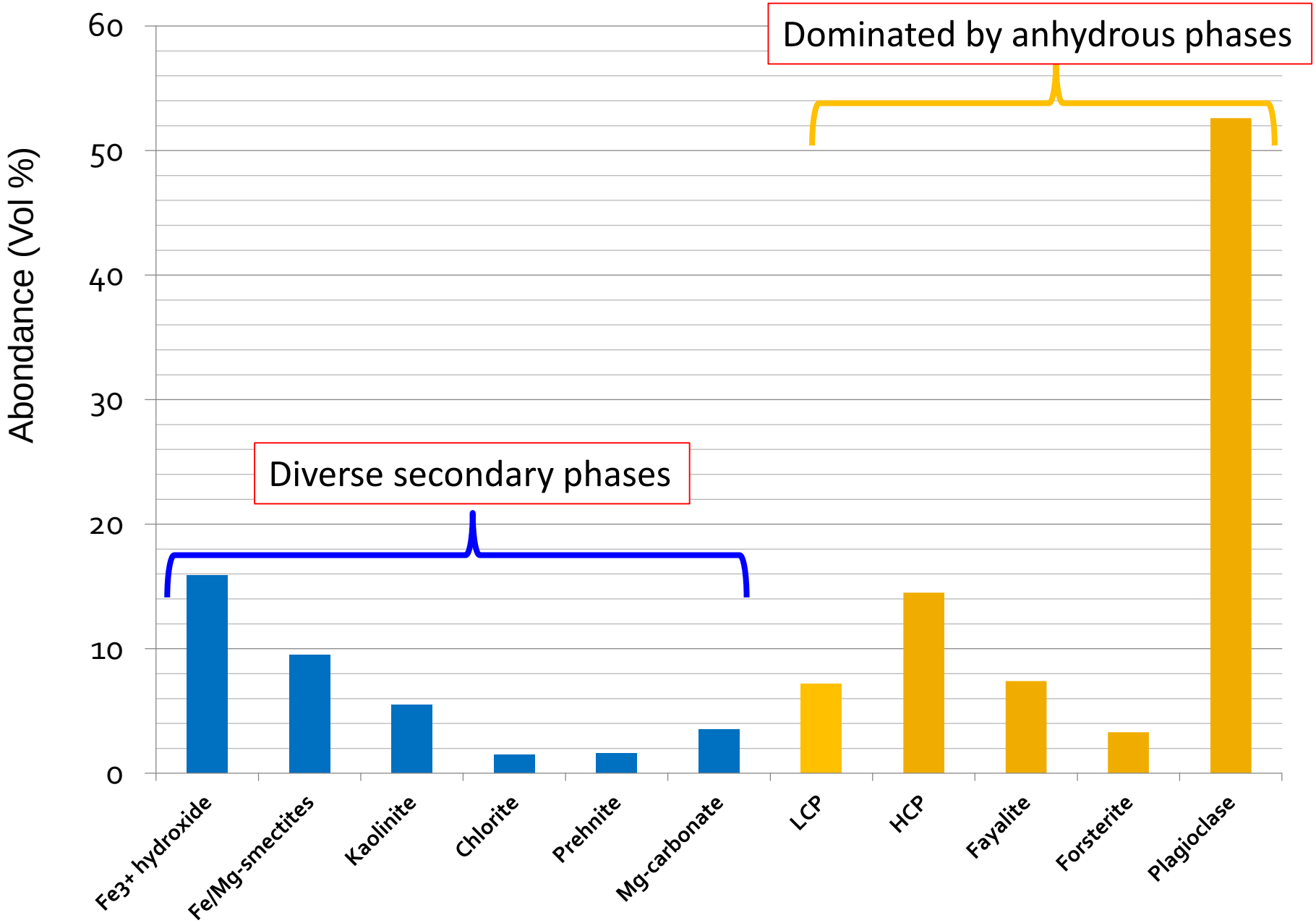


Number of end-members

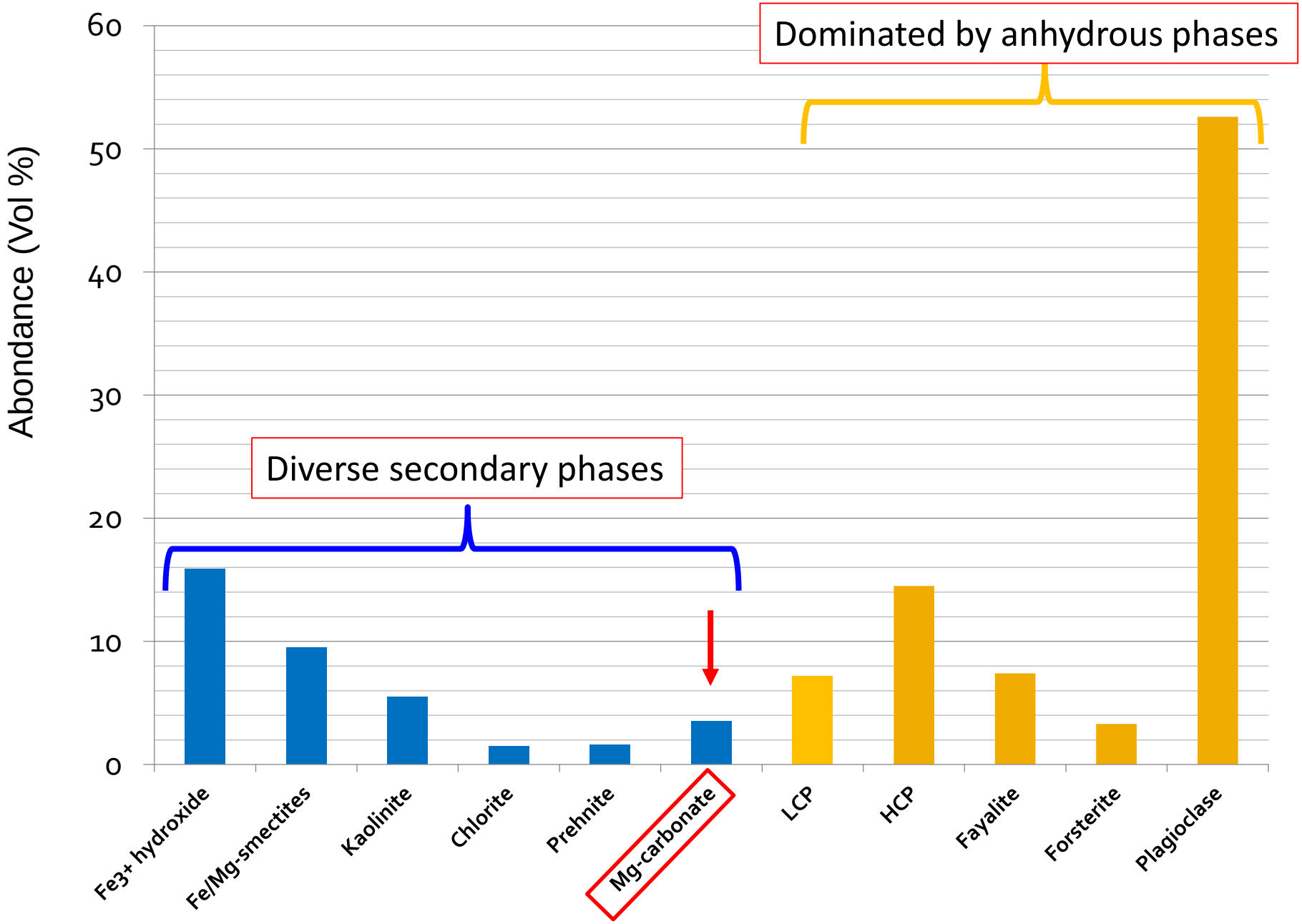


Mineralogical assemblage is more complex towards eastern parts

Averaged modal mineralogy

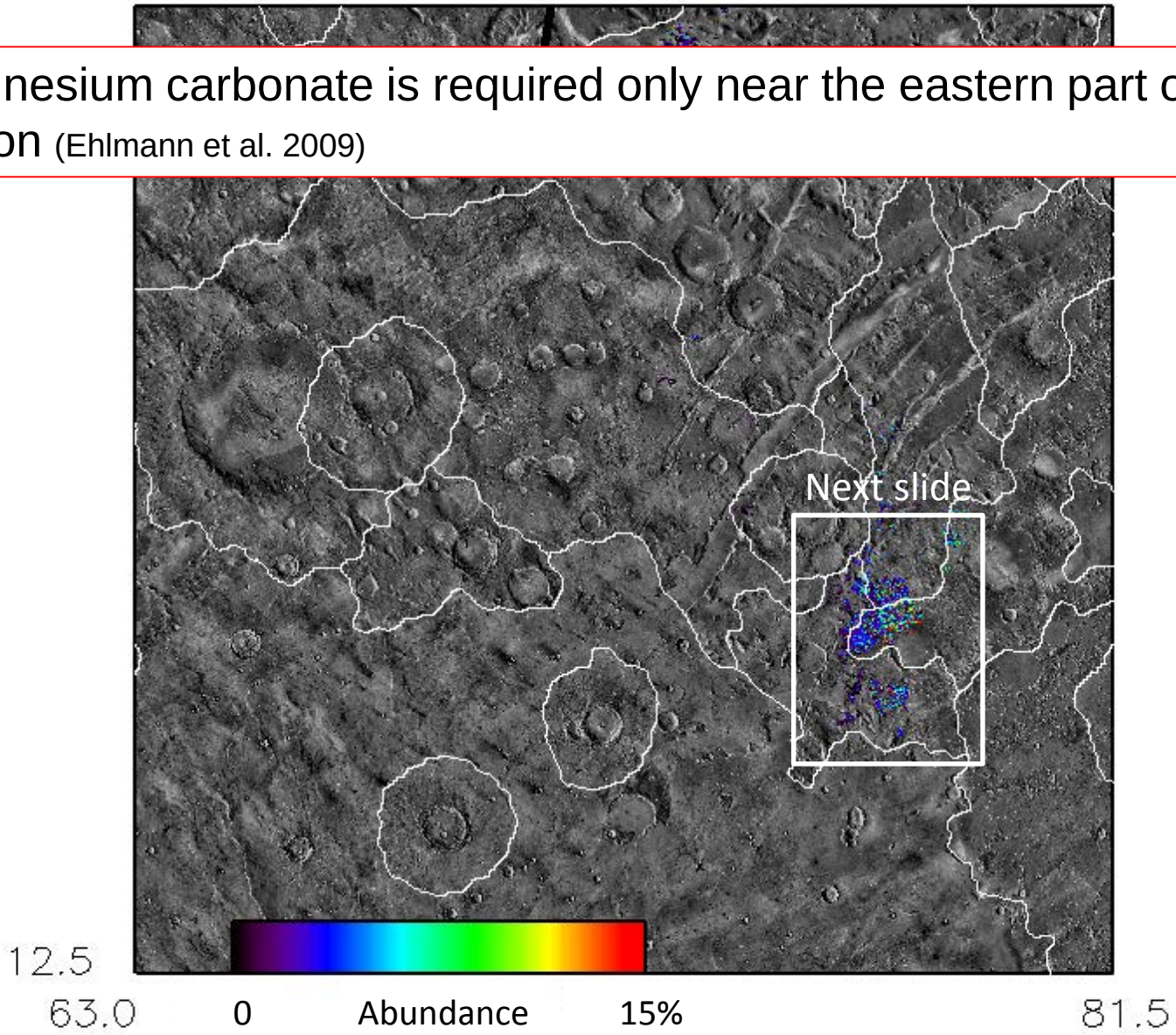


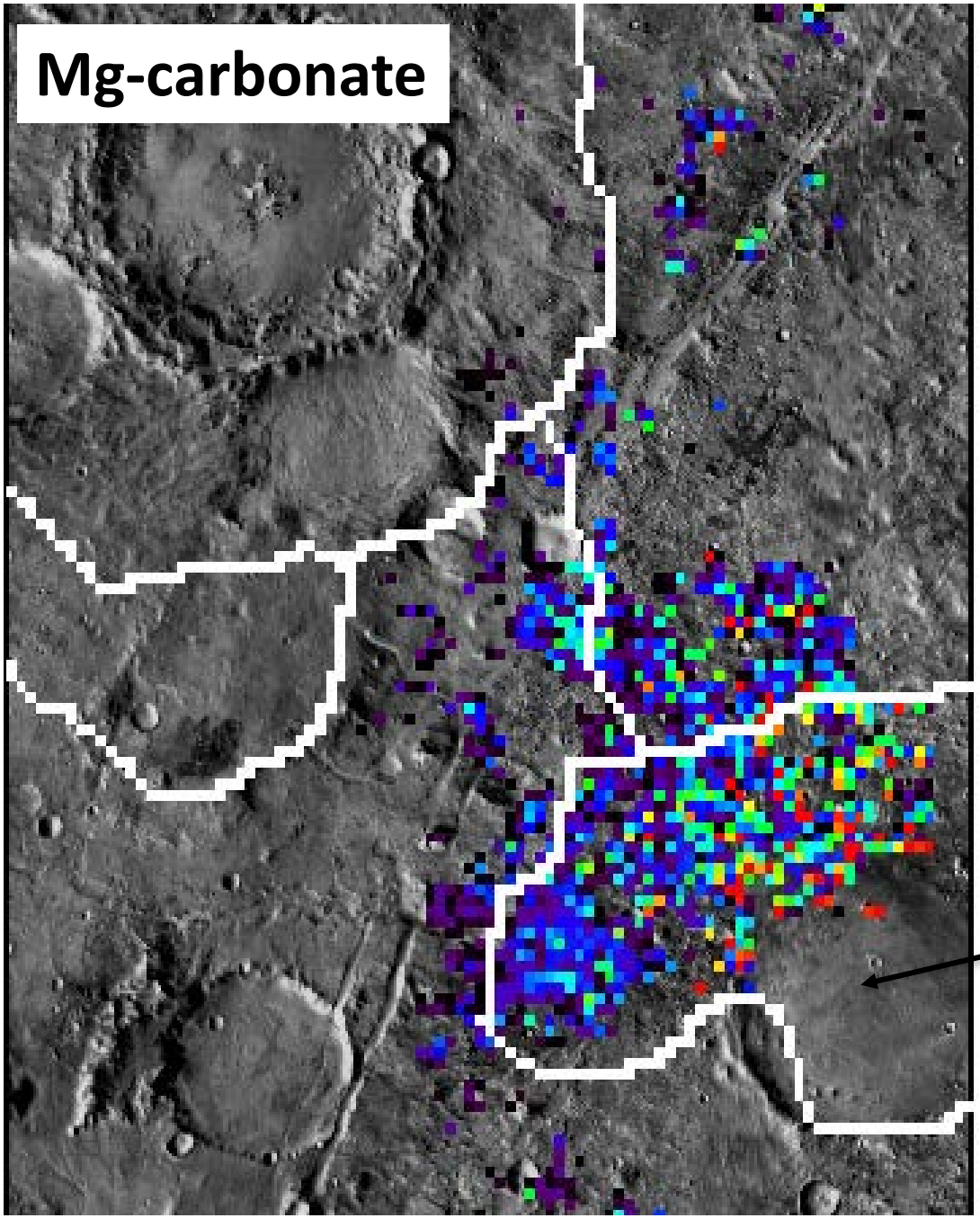
Averaged modal mineralogy



Map of Mg-carbonate abundance

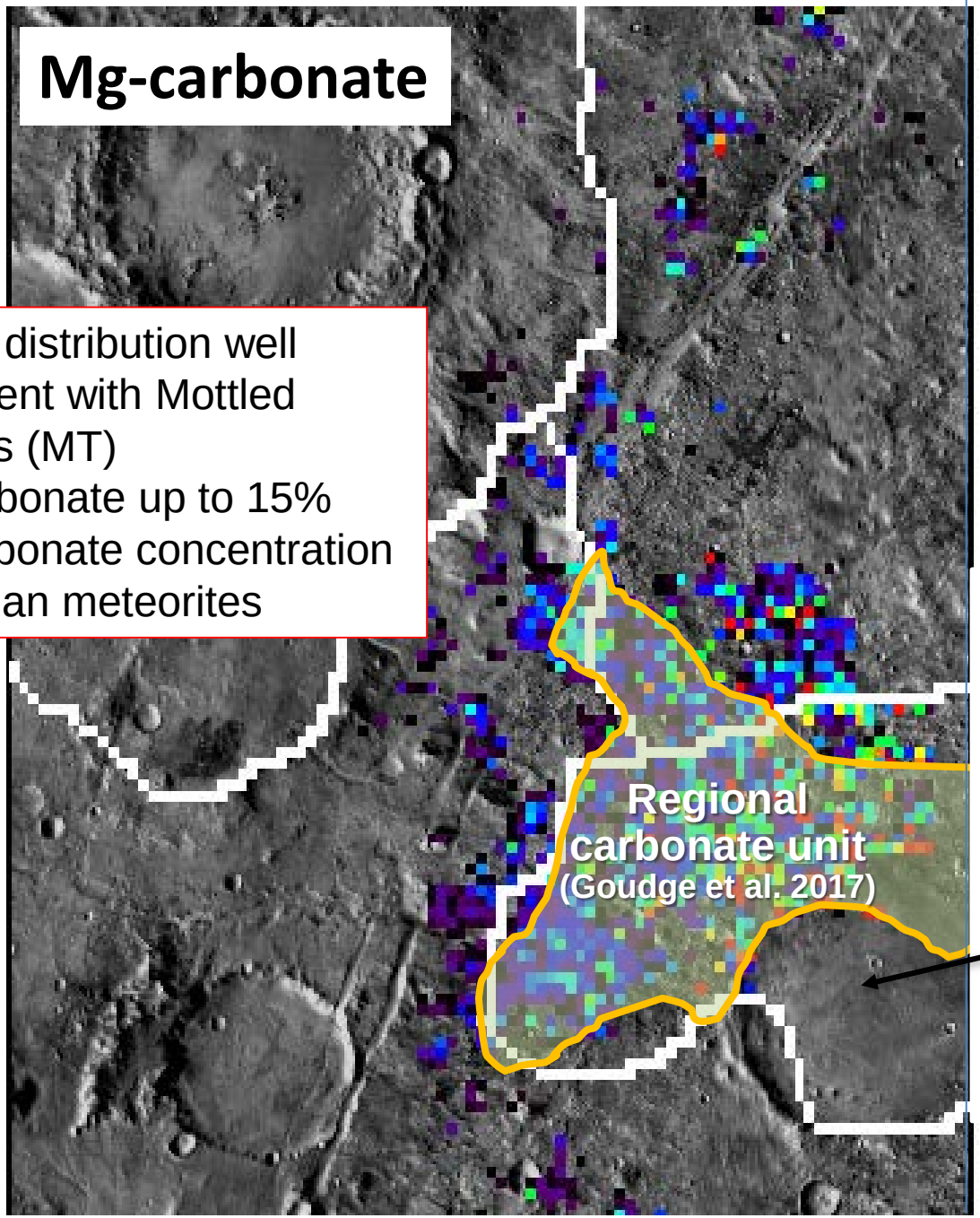
- Magnesium carbonate is required only near the eastern part of the region (Ehlmann et al. 2009)




Mg-carbonate
Jezero crater

Mg-carbonate

- Spatial distribution well consistent with Mottled Terrains (MT)
- Mg-carbonate up to 15%
- >> Carbonate concentration in Martian meteorites



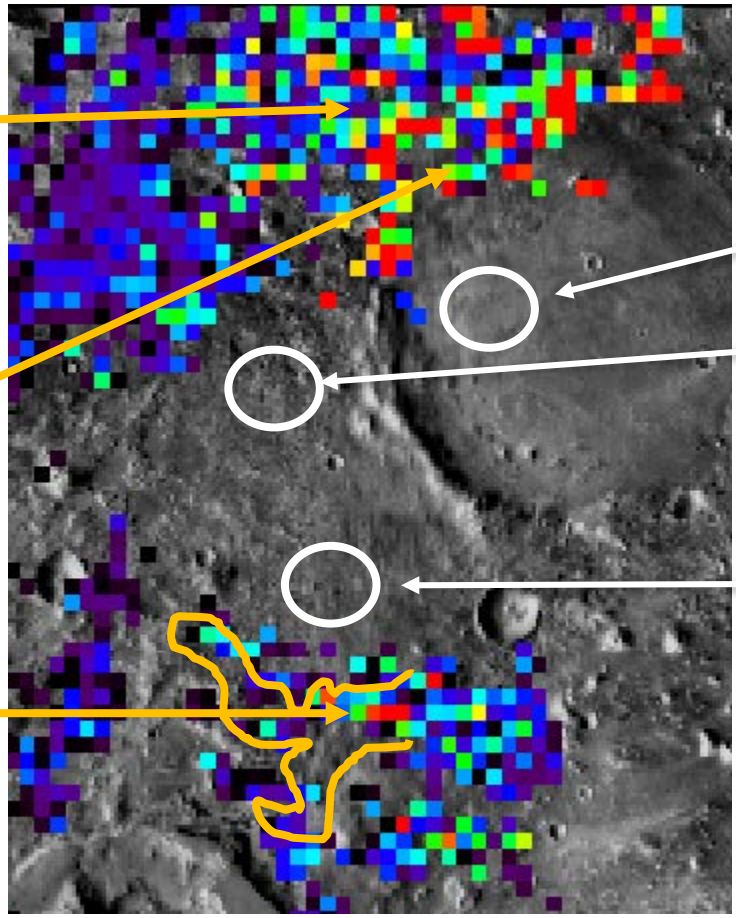
Modal mineralogy over Mars2020 LS

Comparable amount of carbonates

Carbonate outside the crater

Carbonate basin rim and floor

Olv-carbonate in fractured unit (mapped by Bramble et al. 2017)



Jezero crater ellipse

Midway ellipse

NESyrtis ellipse

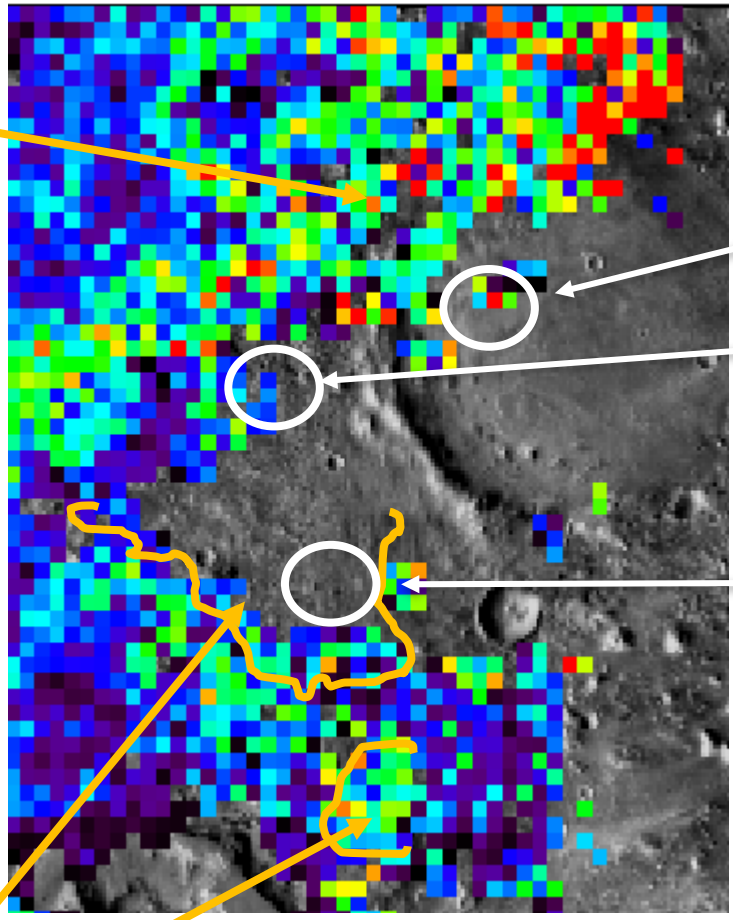
Mg-carbonate abundance

0 Abundance 15%

Modal mineralogy over Mars2020 LS

Fe/Mg smectites mixed with carbonates in mottled terrains

- Variations => compositional heterogeneity ?
- Size and quality of exposures + presence (or absence) of mantling materials



Jezero crater ellipse

Midway ellipse

NESyrtis ellipse

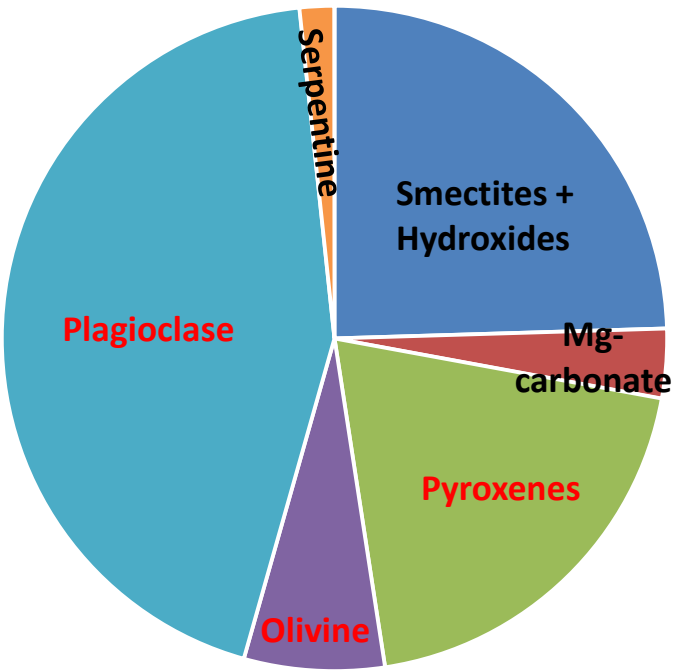
Fe/Mg smectites abundance

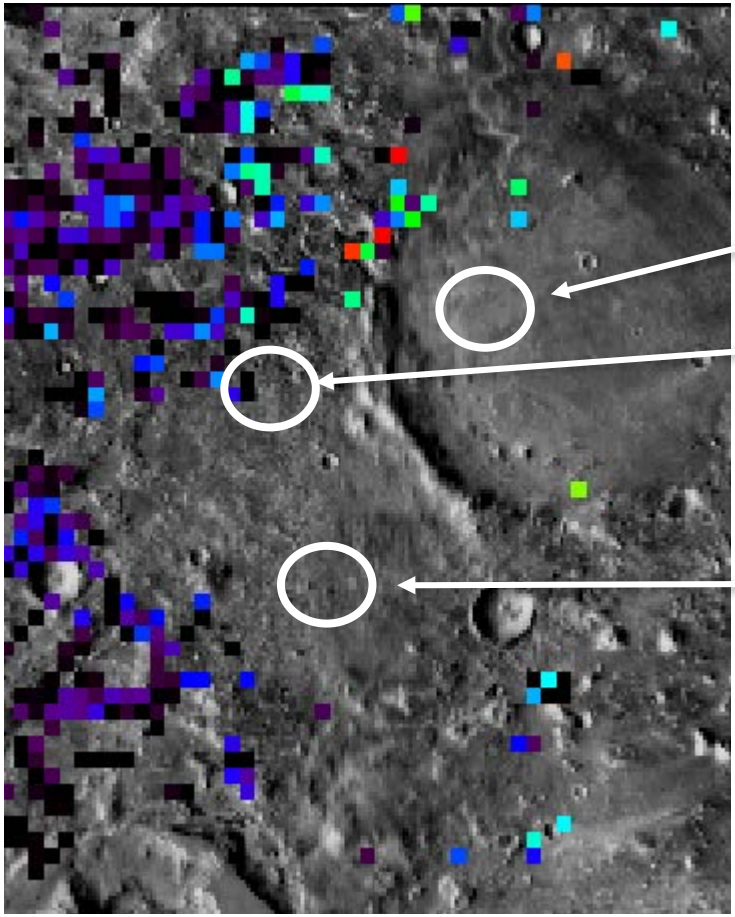
0 Abundance 30%

Fe/Mg-smectite basement unit (mapped by Bramble et al. 2017)

Modal mineralogy over Mars2020 LS

Averaged abundance (Vol%)

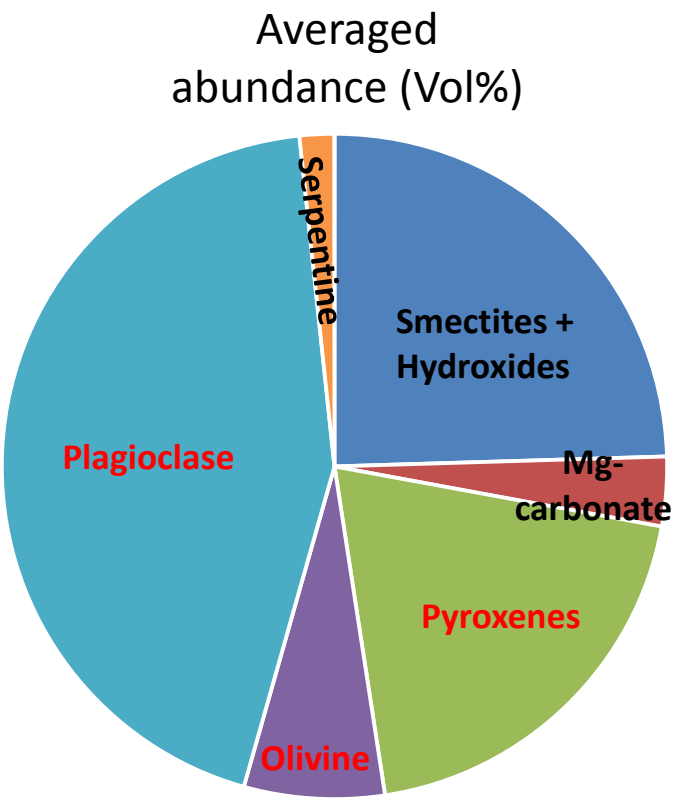




Serpentine (lizardite) abundance

0 Abundance 20%

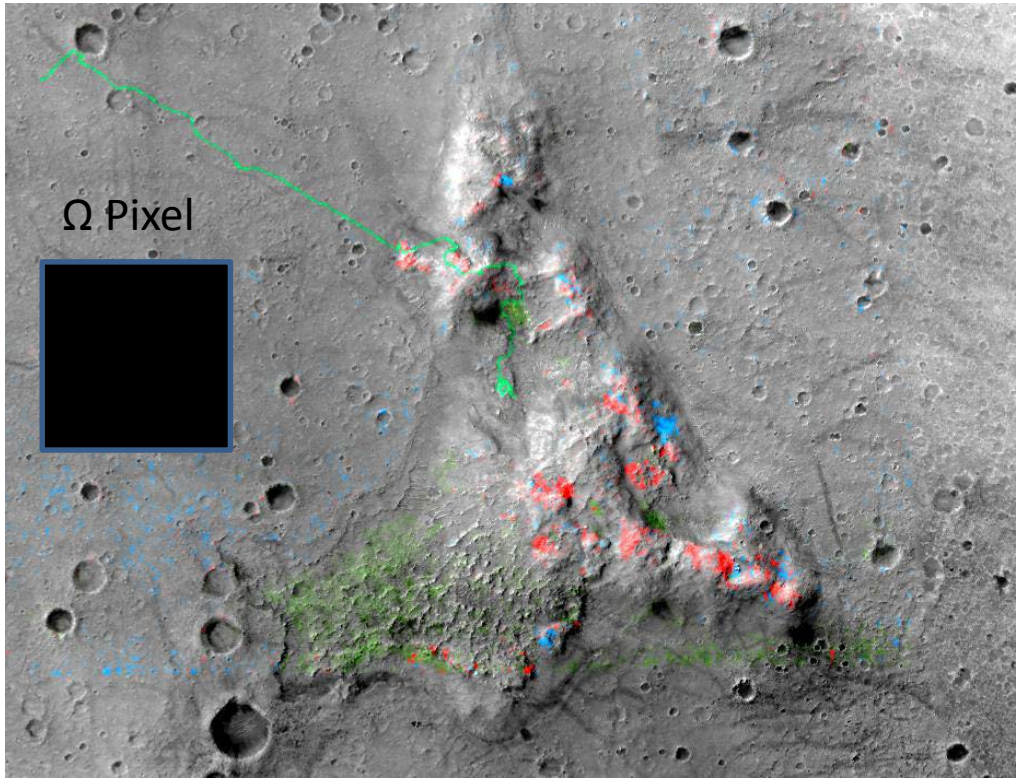
Modal mineralogy over Mars2020 LS



- Dominated by basaltic composition (consistent with TES-based modeling, Salvatore et al. 2018)
- Local enrichments of smectites and carbonates well consistent with geological units (BaU, FrU, MT)
- Olivines and pyroxenes abundances larger than 10 % in altered terrains => aqueous alteration was limited
- Mottled Terrains composition similar inside and outside Jezero crater

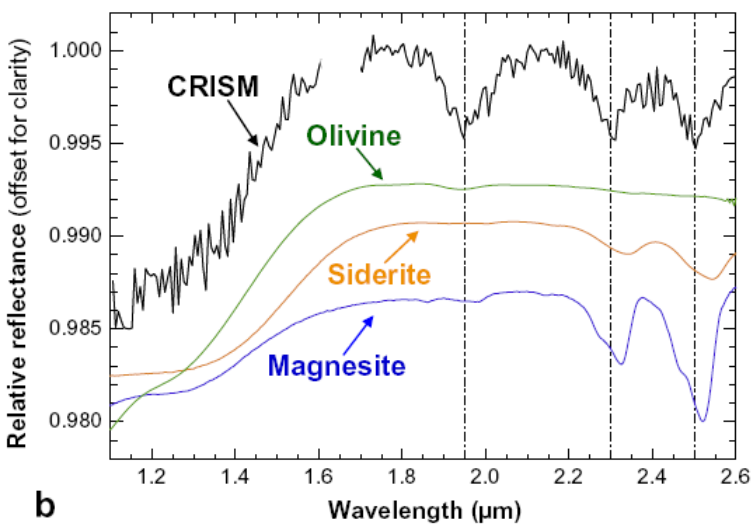
Comparison with Columbia Hills

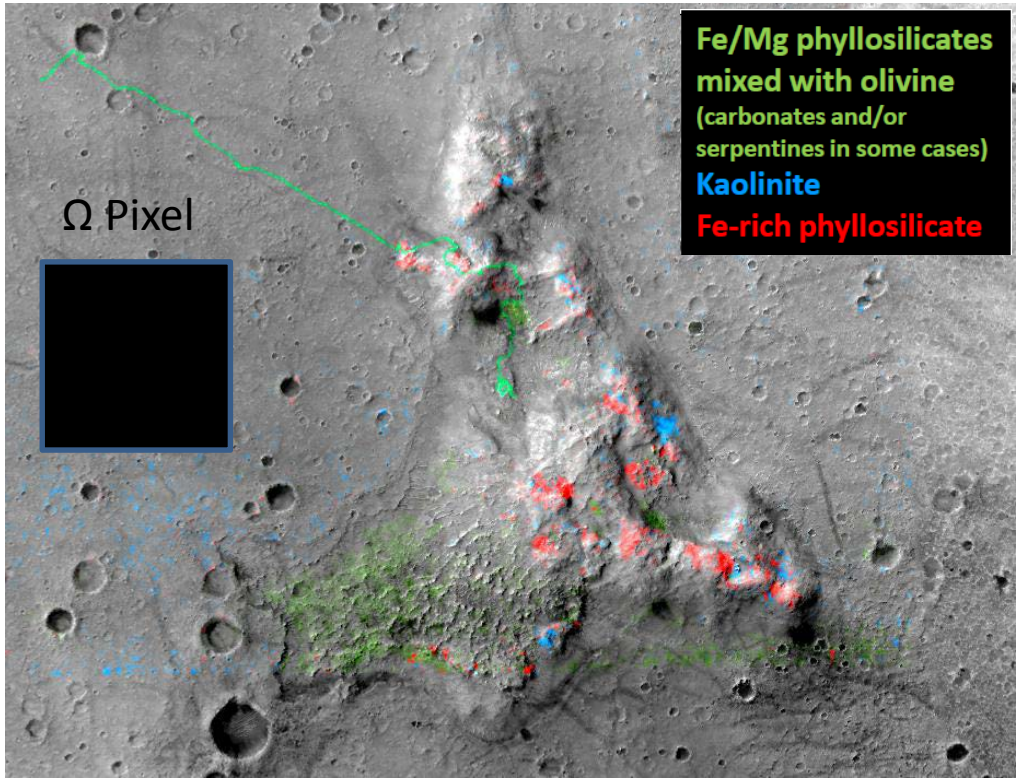
- OMEGA: No detection



Comparison with Columbia Hills

- OMEGA: No detection
- In situ (Morris et al. 2010): larger amount of olivine (>20-30 %) and carbonate (15-30 %) <u>but no smectite</u>
- CRISM (Carter & Poulet, 2012): Mg-carbonate + olivine + hydrated phase(s)





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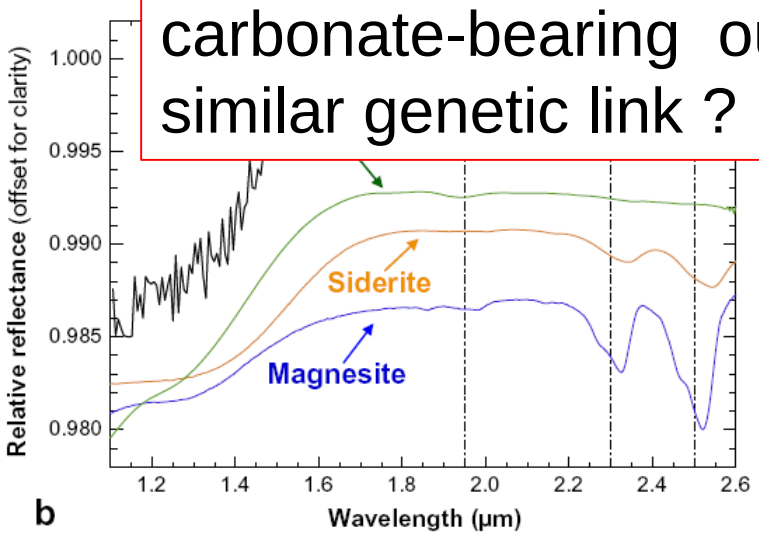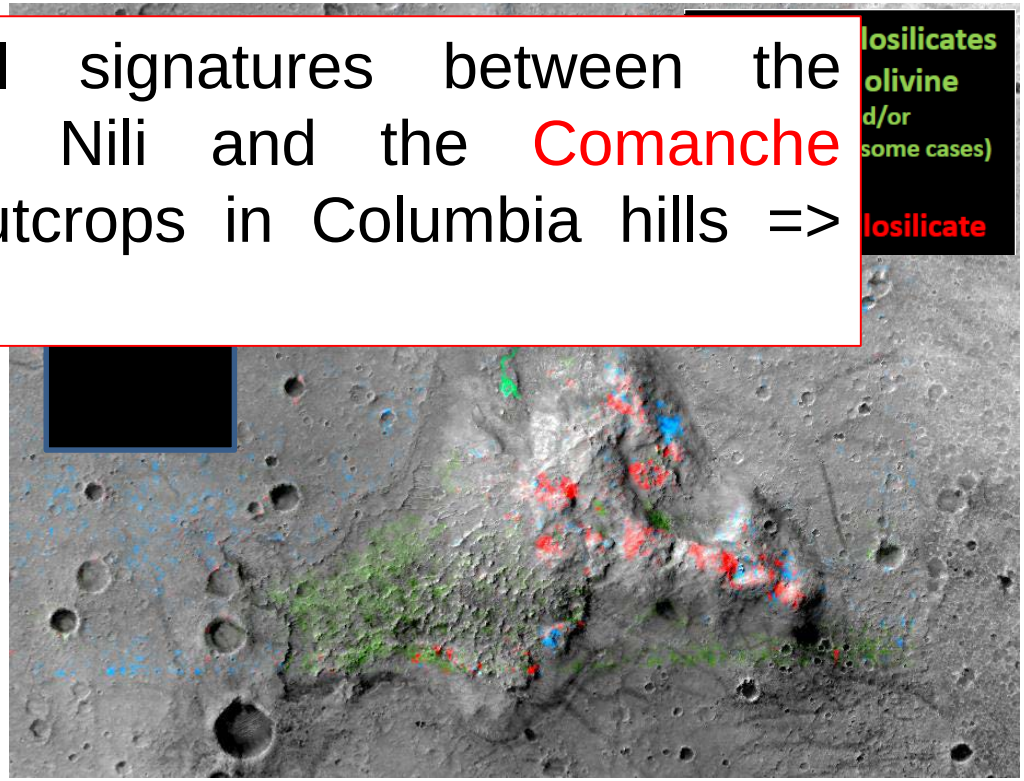
Comparable mineral signatures between the Mottled Terrains in Nili and the Comanche carbonate-bearing outcrops in Columbia hills => similar genetic link ?