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Planetary Evolution and Life

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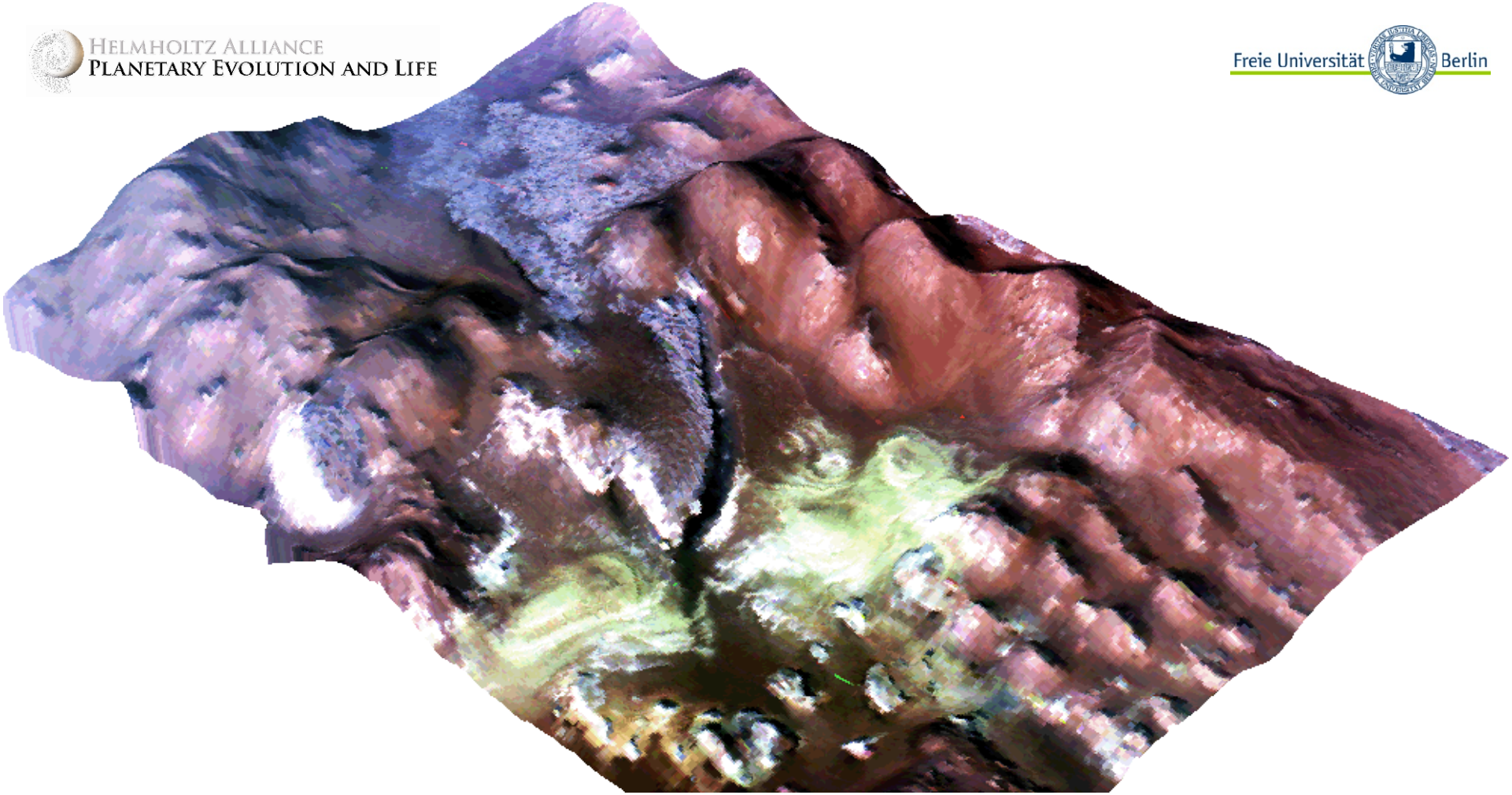

# Habitability and its correlation with hydrated minerals – Evidence from Aureum Chaos

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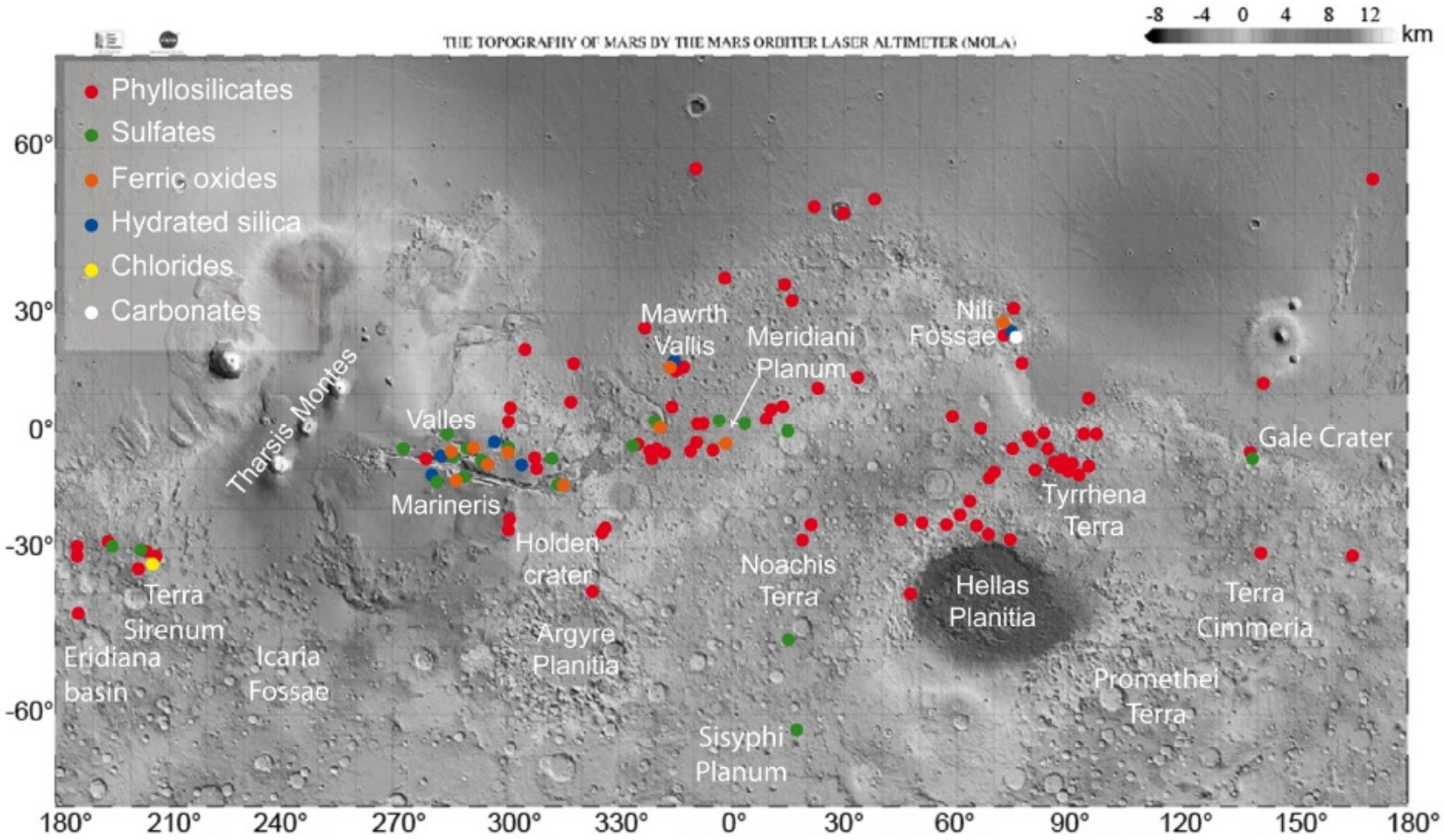
Exploring Mars Habitability, Lisbon, June 13-15, 2011

# Aqueous Minerals on Mars





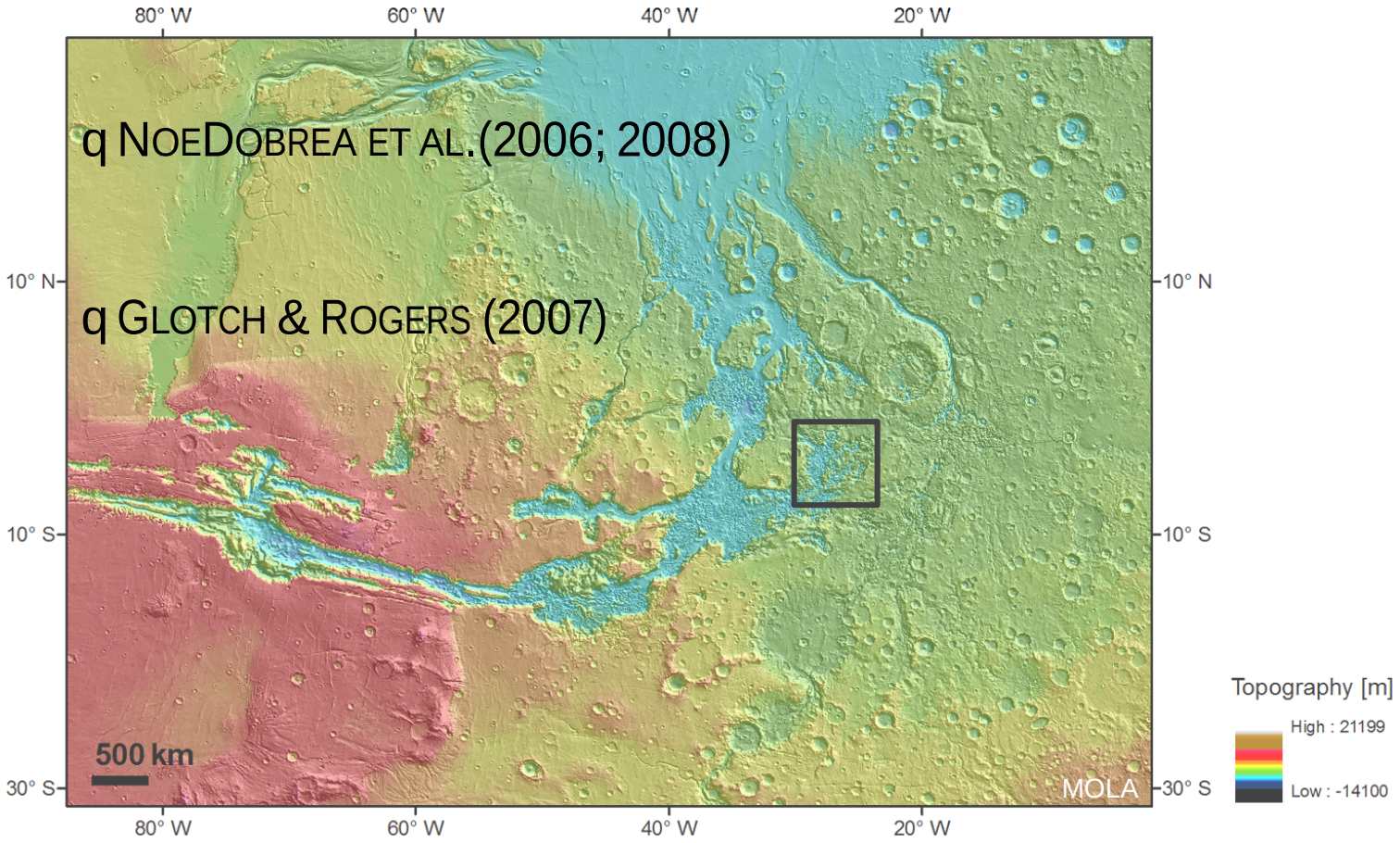

detected by OMEGA, CRISM, THEMIS

(e.g. Gendrin et al. 2005, Poulet et al. 2007, Carter et al. 2009, Murchie et al. 2009, Wray et al. 2009, Osterloo et al. 2010)

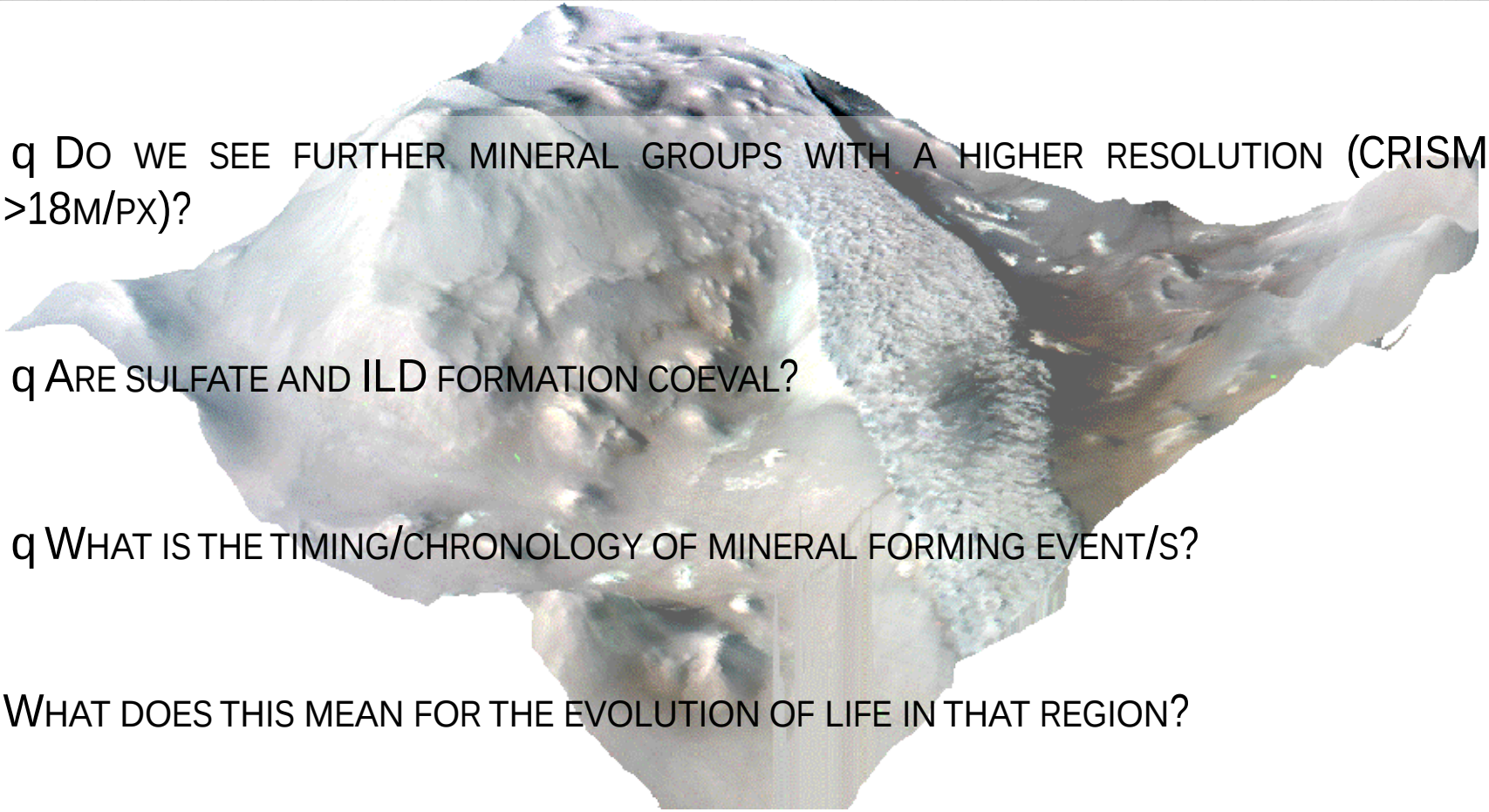
*Le Deit et al. 2011, HGF Midterm review*

# PREVIOUS WORK

à TES, THEMIS VIS, OMEGA



# Motivation



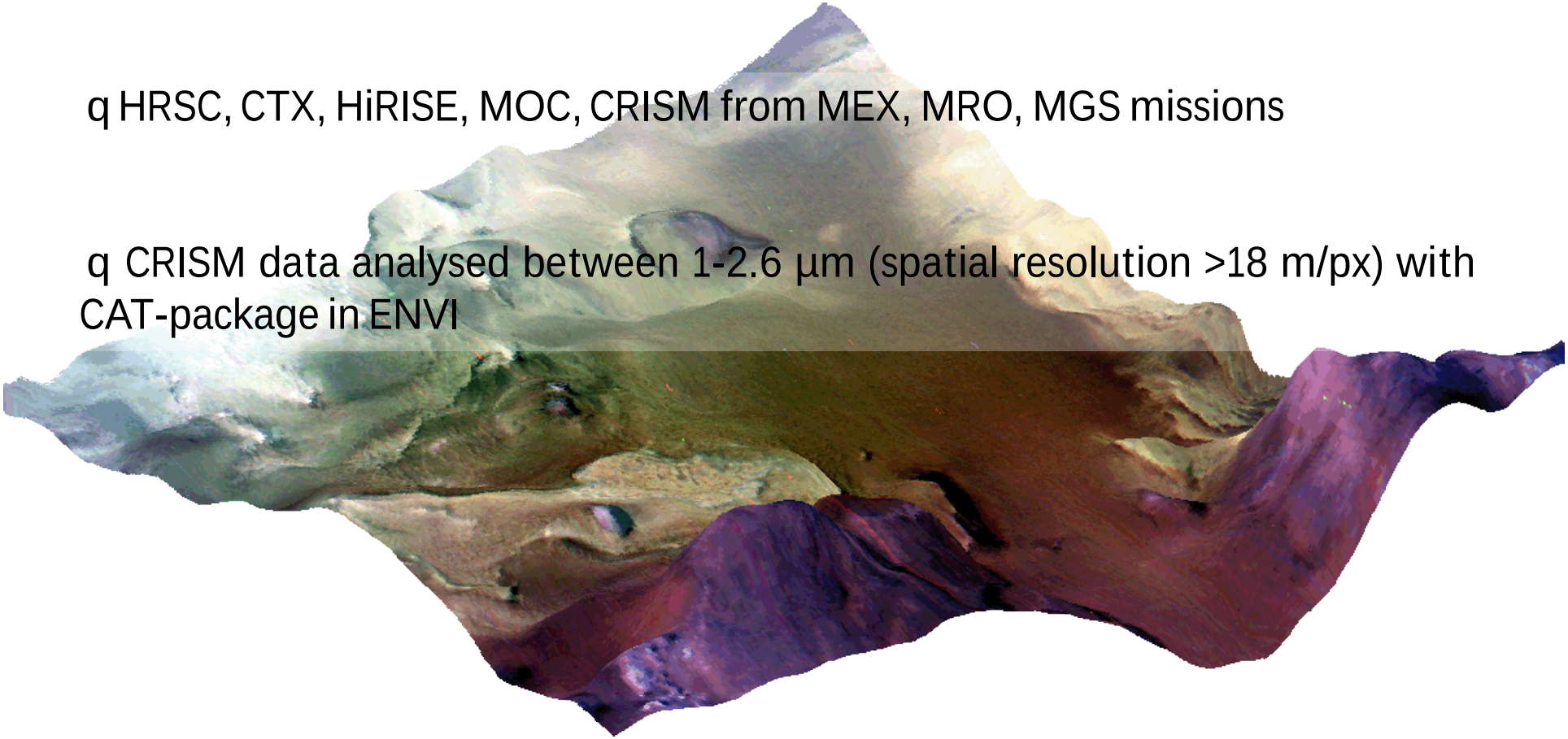
- Do we see further mineral groups with a higher resolution (CRISM, >18m/px)?
- Are sulfate and ILD formation coeval?
- What is the timing/chronology of mineral forming event/s?

What does this mean for the evolution of life in that region?

# DATASETS

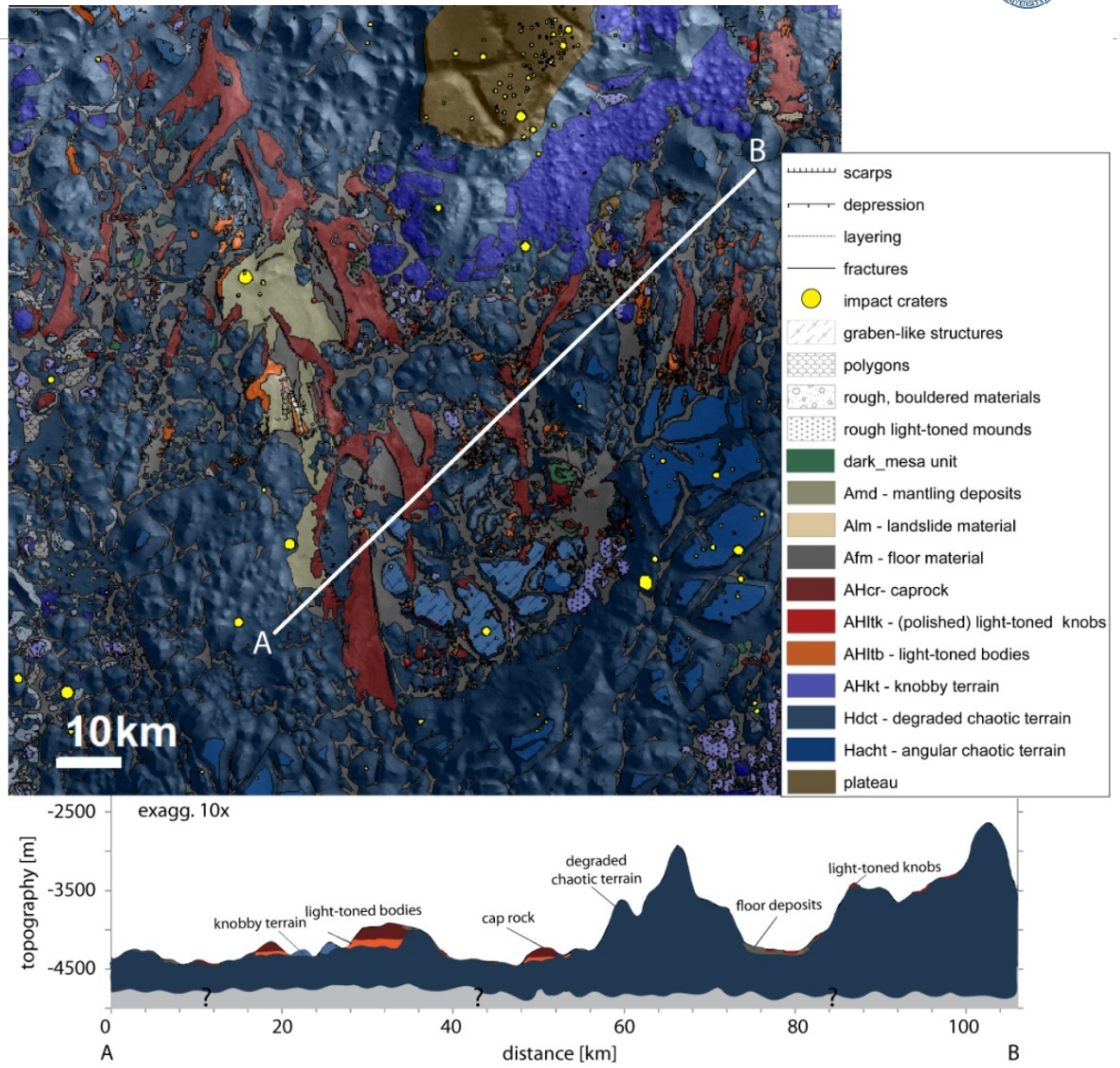
q HRSC, CTX, HiRISE, MOC, CRISM from MEX, MRO, MGS missions

q CRISM data analysed between 1-2.6 µm (spatial resolution >18 m/px) with CAT-package in ENVI



# Map 1:40k

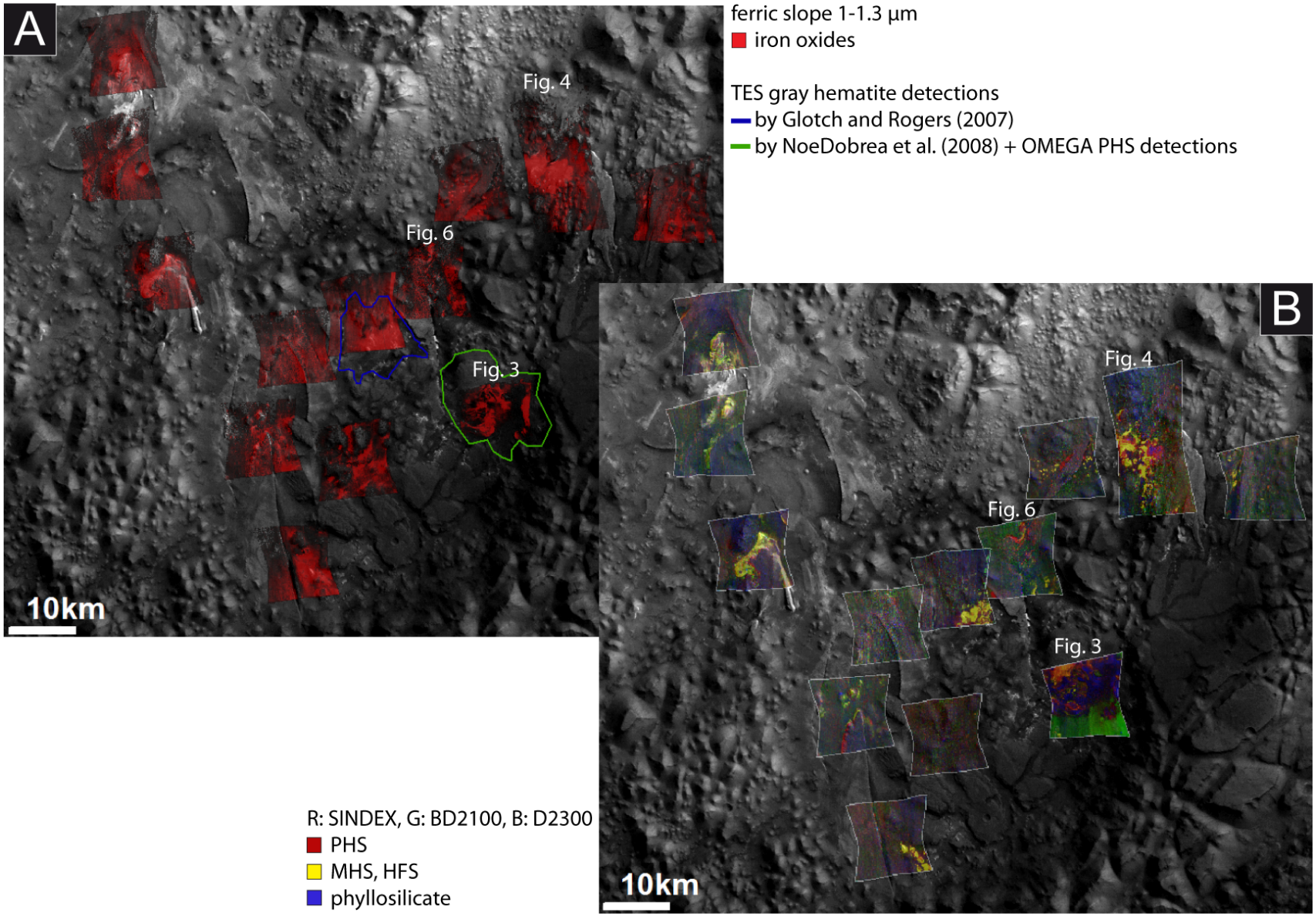
- ILDs area ~1600km²
- 3.3 km below datumn



# Detected Minerals -Overview-



## à CRISM+HRSC



# DETECTED MINERALS

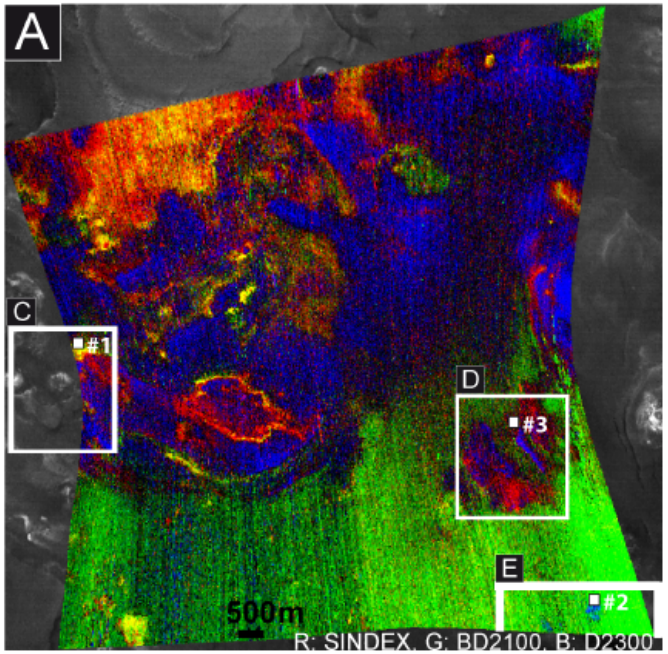
## -SULFATES AND PHYLLOS I-

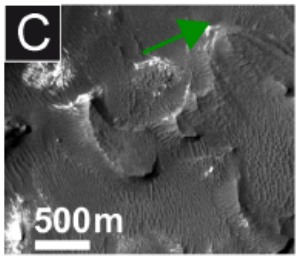
à CRISM+CTX

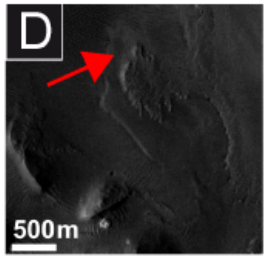
- MHS, MHS: monohydrated sulfate
  à kieserite

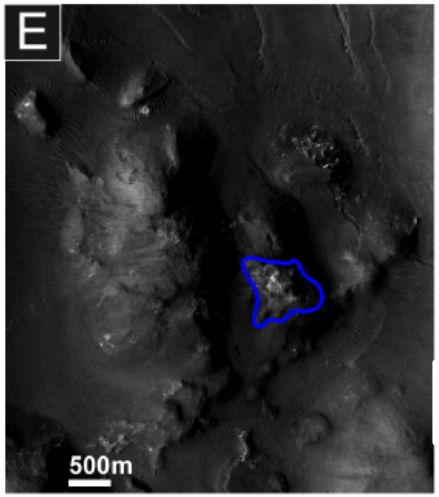
- PHS: polyhydrated sulfate, oxyhydroxysulfate?

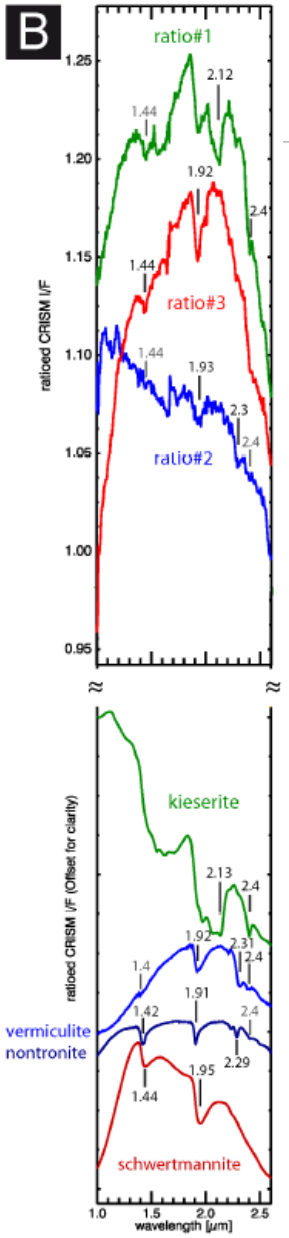
- Phyllosilicate
  à nontronite



# DETECTED MINERALS

## -SULFATES AND PHYLLOS II-

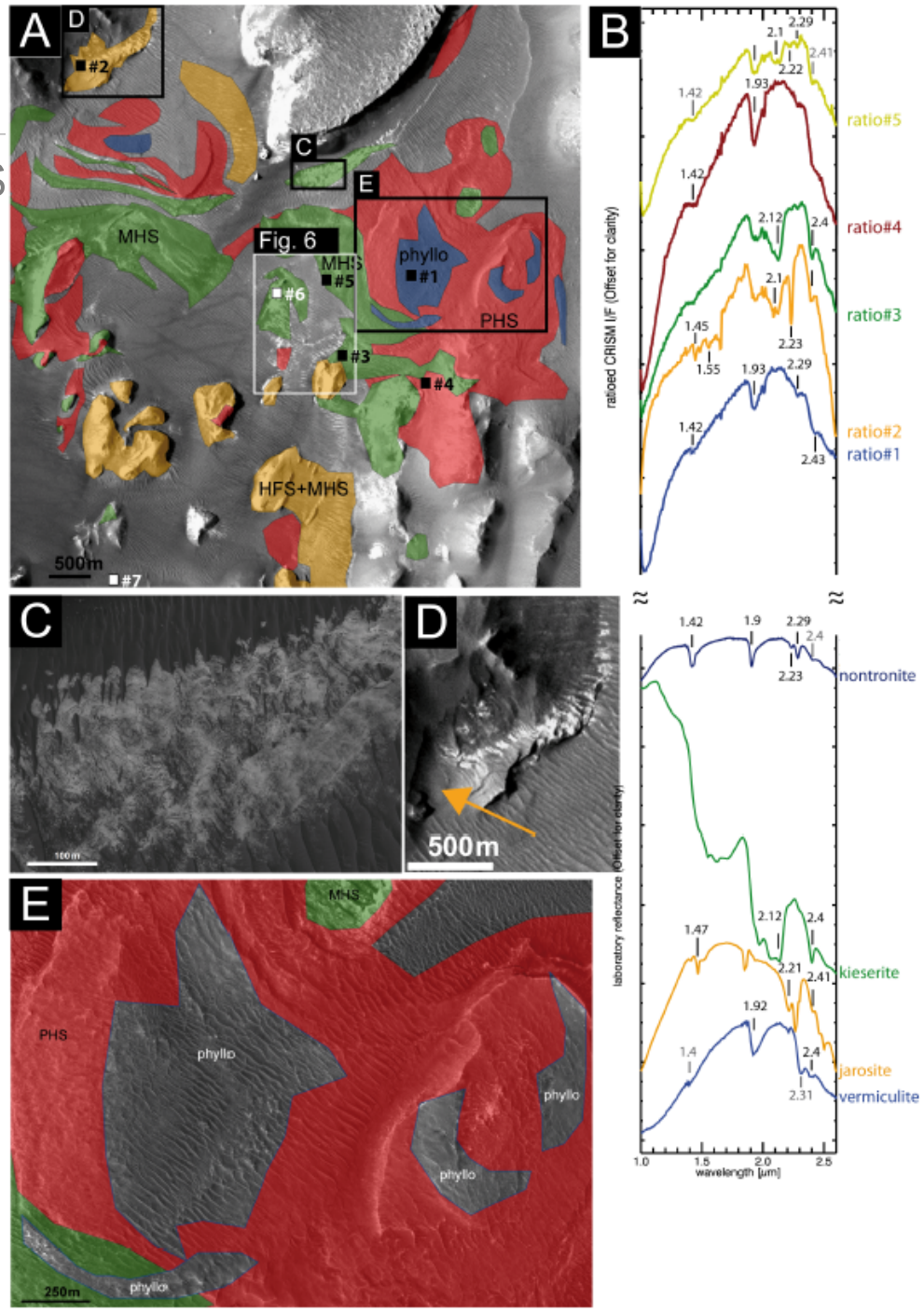
à CRISM+HiRISE

§comparable to Aram Chaos (Lichtenberg et al. 2010): and Juventae Chasma (HFS

à jarosite ?

*dehydrated PHS/ copiapite?*

(Bishop et al. 2009)



# STRATIGRAPHY



Mantling deposits: phyllo-bearing

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ILD cap rock: spectrally bland

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ILD, layered or massive: PHS

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ILD, layered or massive: MHS, MHS+HFS

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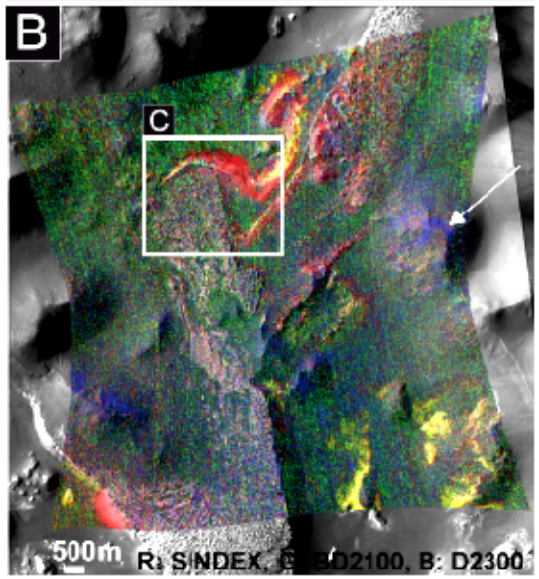
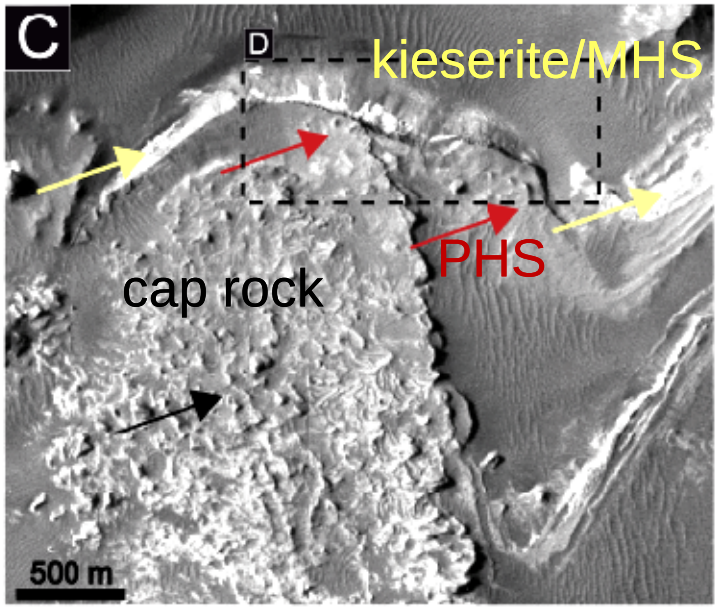
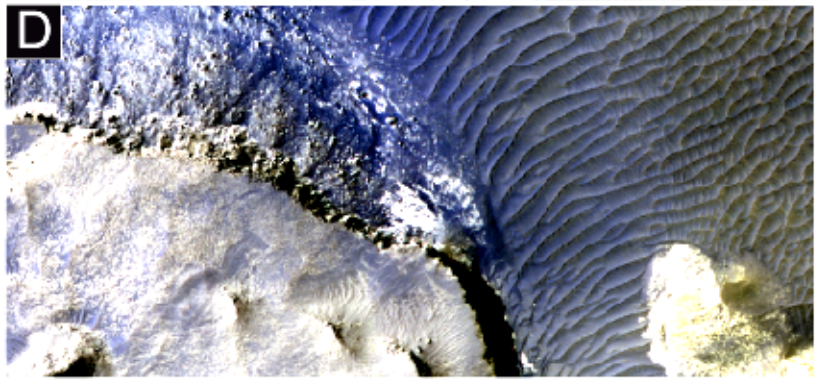
Chaotic terrain: Phyllo-bearing




à CTX, HiRISE + CRISM

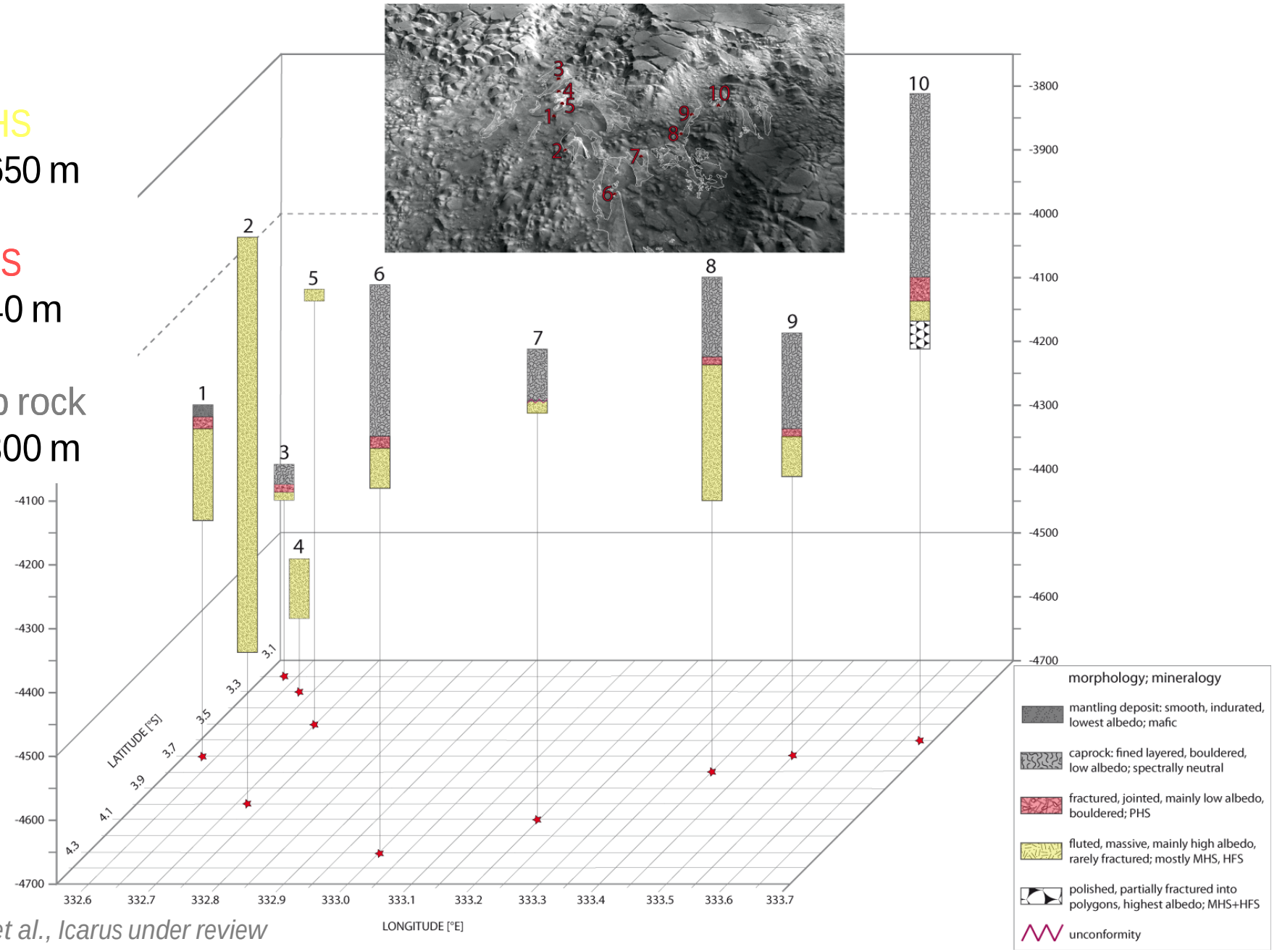
# Extent of ILD spectral units



- MHS
20-650 m

- PHS
20-40 m

- cap rock
40-300 m




*Sowe et al., Icarus under review*

# Sulfates

q Associated with ILDs (post-chaos)

q Subsequent fm of ILD and sulfates: Groundwater Alteration

ØWater intruding into pre-existing sulfate-free ILDs?

q Coeval fm: Evaporation in a lake

ØFormation of PHS-rich ILDs by evaporation in a lake à alteration by diagenesis producing MHS and ferric oxides (Roach et al., 2010)?

# Phyllosilicate

q Associated with chaotic terrain and mantling deposits (in situ and allochthonous fm.;pre-, post-chaos)

à local conditions allowed clay formation even after the well-accepted global "phyllosian" era?

q in-situ and contemporaneous with sulfate formation? (e.g. Baldrige et al., 2009):

# TIMING OF MINERAL FORMATION



1. Chaotic terrain formation (late Hesperian<3.6 Ga ago; Scott & Tanaka, 1986),
   a) accompanied phyllo formation (or phyllo fm already in Noachian or in Hesperian/Amazonian? with sulfates)
2. Formation of ILDs <late Hesperian
   a) coeval formation with PHS
   b) subsequent sulfate formation
3. Conversion of sulfates , ferric oxide
4. Deposition of mantling of ILD units (with allochthonous phyllos), calculated surface age mid-late Amazonian (0.5-0.2 Ga)

## HABITABILITY?

§ If life requires water for prolonged periods to evolve, then it conditions would have been given during in situ phyllo fm

Ø preserved smectites, HFS/jarosite indicate dry conditions with short-lived wetting events after deposition (Tosca & Knoll, 2009)


THANK YOU!!
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