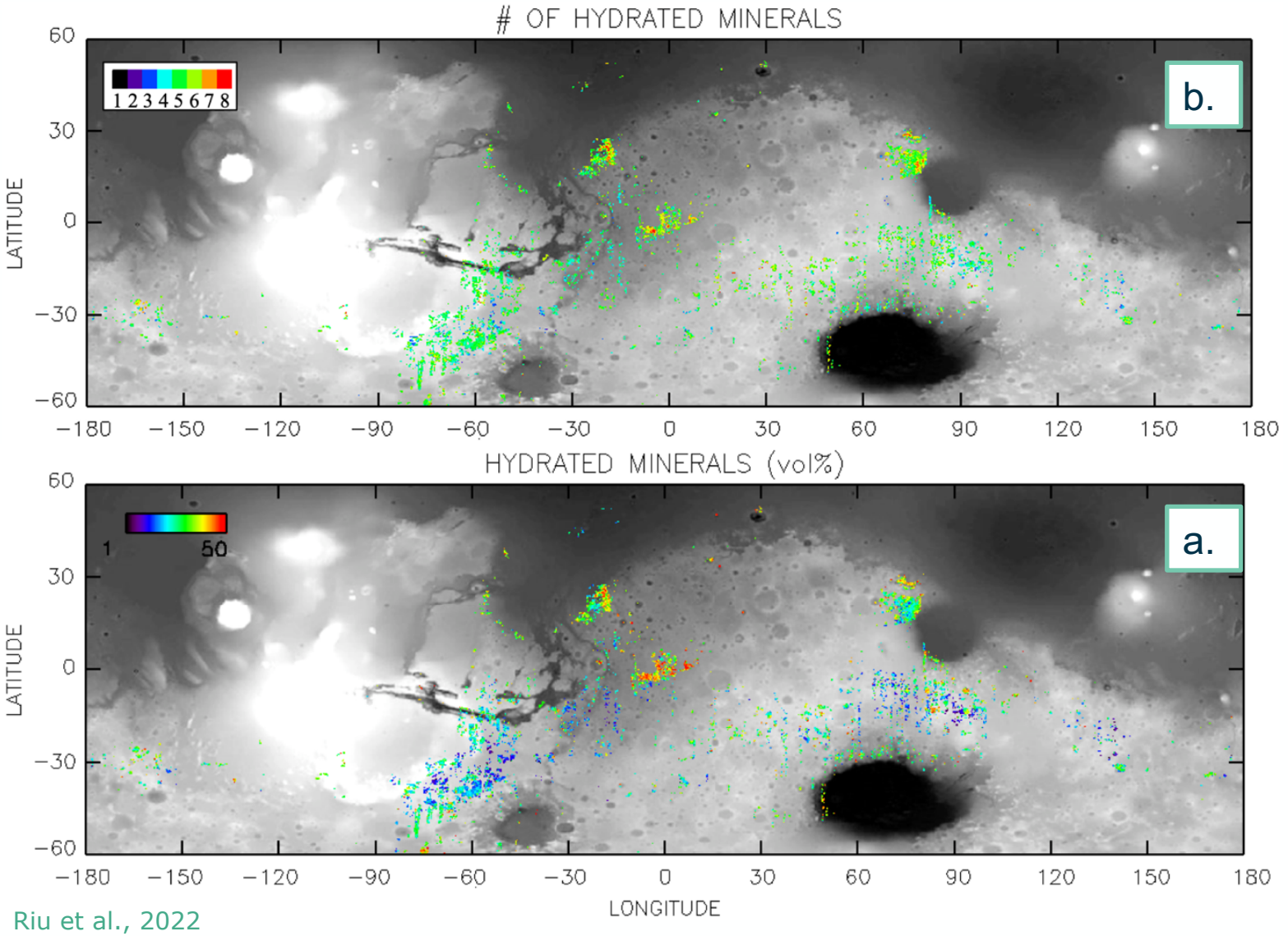
Estimation of H_2O content (in wt%) stored in hydrated silicates at Mars

Lucie Riu, John Carter, François Poulet

EGU2022 – Mars Science and Exploration -- 24/05/2022

Distribution of hydrated silicates from OMEGA/MEx



Riu et al., 2022

Modelling of the abundance of 11 hydrated silicates mixed with anhydrous minerals at the surface of Mars:

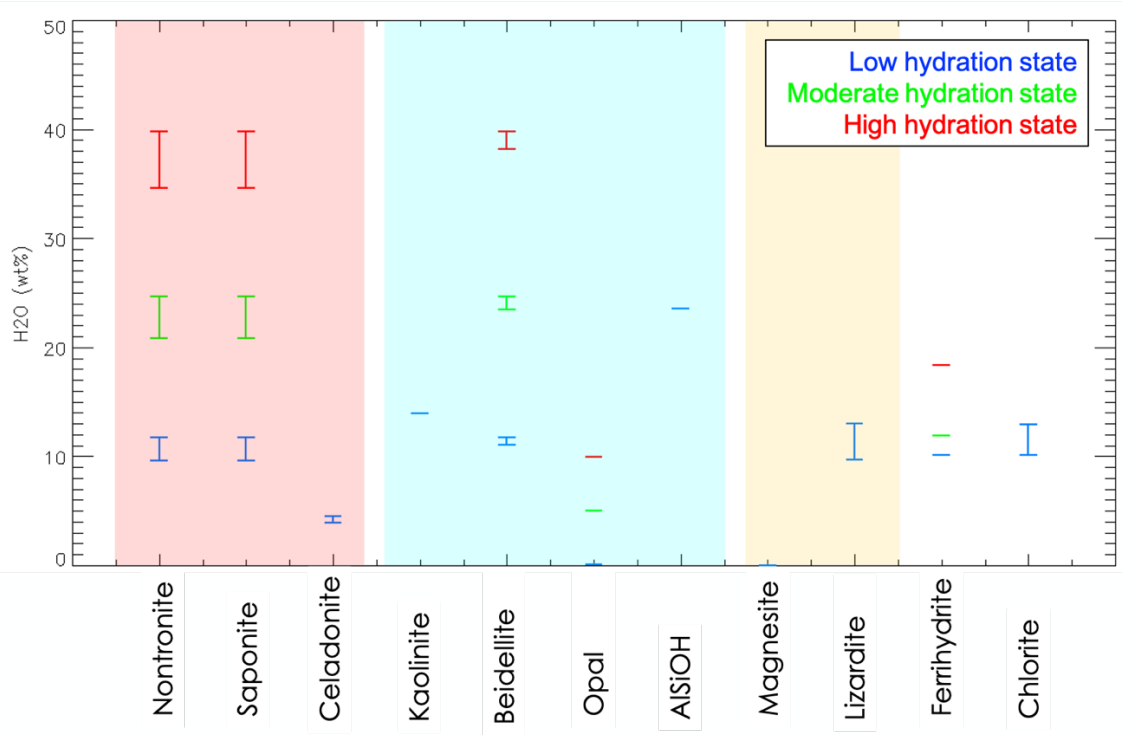
End-member	Average abundance (vol%)	% of detections
Fe-hydroxide	16	96%
Fe-Phyllosilicate	6	64%
Mg-Phyllosilicate	3	30%
Fe/Mg Micas	6	59%
Al-Phyllosilicate	7	45%
Al-Smectite	14	30%
Opal	5	15%
AlSiOH	6	7%
Chlorite	10	21%
Serpentine	6	12%
Mg-Carbonate	1.5	< 1%

Conversion of the abundance in water content

Wernicke & Jakosky, 2021

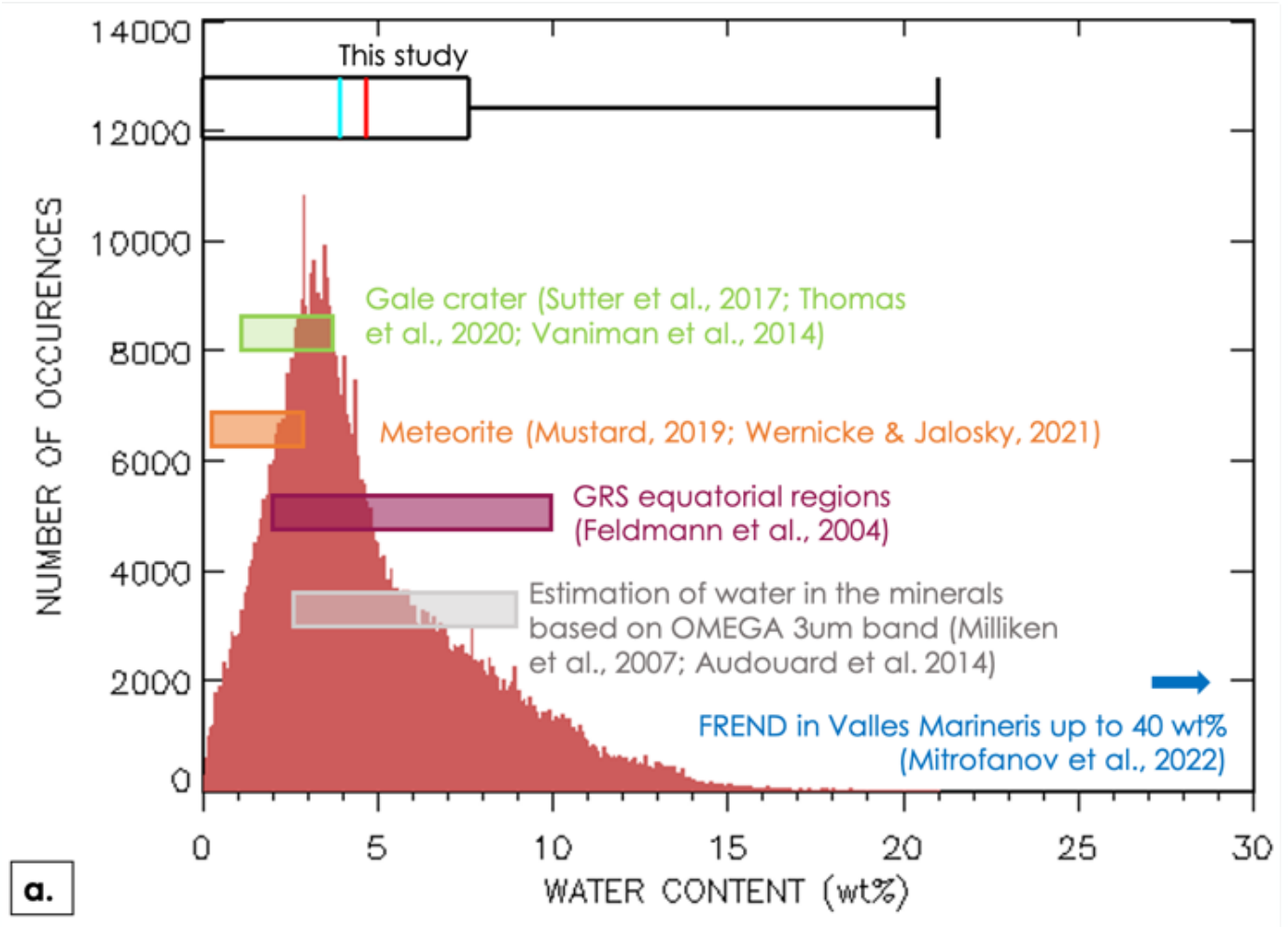
End-Member	Chemical composition
Fe-phyllosilicates Nontronite[1]	$(Na,Ca)_{0.3-0.5}(Fe,Mg,Al)_{2-3}(Al,Si)_4O_{10}(OH)_2 \cdot nH_2O$
Mg-phyllosilicates Saponite[1]	$(Na,Ca)_{0.3-0.5}(Fe,Mg,Al)_{2-3}(Al,Si)_4O_{10}(OH)_2 \cdot nH_2O$
Fe/Mg Micas Celadonite	$K(Mg,Fe^{2+})(Fe^{3+},Al)(Si_4O_{10})(OH)_2$
Al-phyllosilicates Kaolinite[1]	$Al_2Si_2O_5(OH)_4$
Al-smectites Beidellite[1]	$(Na,Ca)_{0z.3-0.5}(Al,Mg)_2(Al,Si)_4O_{10}(OH)_2 \cdot nH_2O$
Chlorite[1]	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$
Opal[1]	$SiO_2 \cdot nH_2O$
AlSiOH	AlSiOH
Fe-hydroxide Ferrihydrite[3]	$5(Fe_2O_3) \cdot nH_2O$
Mg-carbonates Magnesite	$MgCO_3$
Serpentine Lizardite	$(Mg,Fe)Si_2O_5(OH)_4$

Estimation of the individual water content for each end-member, depending of the chemical formula and/or the hydration state:



Riu et al., in prep

Distribution of water content at the surface (1/2)



Overall we find on average ~5 wt% of water in the studied locations.

The majority of regions (75%) present water content from 0 to 7 wt%.

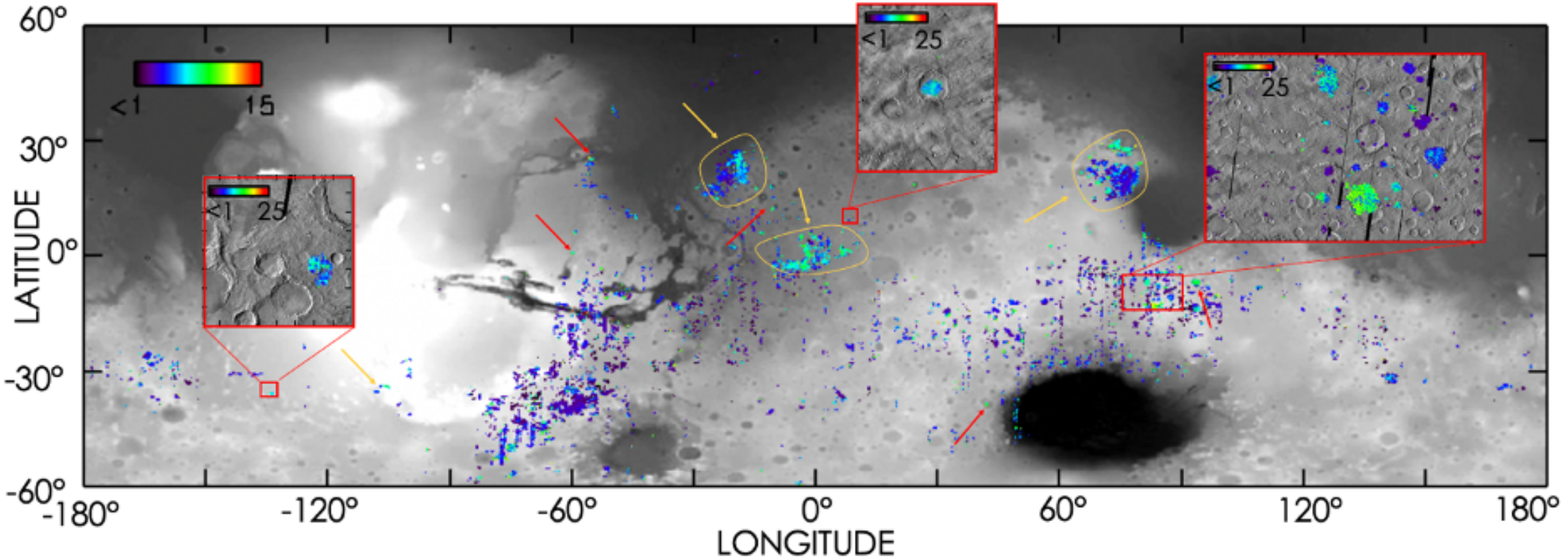
Locally, we can find detections with more than 10 wt% of water.

Riu et al., in prep

Distribution of water content at the surface (2/2)

The largest regions with water content >10wt% are Nili Fossae, Marwth Vallis and Meridiani Planum.

About ~10 other regions where identified as bearing > 10wt% of water consistently on 100s of km² (a majority of which corresponds to crater floors in the southern highlands).



Riu et al., in prep

Global Equivalent Layer (m)

The water content can be converted to GEL (m) and provide an estimate of the amount of water that was lost in the hydrated silicates at the surface of Mars.

Hypothesis on:

- the Martian density
- the depth of deposits (vertical distribution)
- the extent of the deposits (horizontal distribution)

Global Equivalent Layer (m)

The water content can be converted to GEL (m) and provide an estimate of the amount of water that was lost in the hydrated silicates at the surface of Mars.

Hypothesis on:

- the Martian density
- the depth of deposits (vertical distribution)
- the extent of the deposits (horizontal distribution)

WORK IN PROGRESS

Conclusions and future work

- From the overall OMEGA/MEx near-infrared dataset, we have been able to build abundance maps of anhydrous and aqueously hydrated minerals at the surface of Mars with a resolution < 1 km/px (Riu et al., 2022) → local analysis of landing sites / prospective landing sites, support for MSR, local analysis of new regions of interest.

- The individual abundance of the hydrated minerals has been converted onto an estimate of the water content stored at the surface: on average the water content in hydrated silicates is about ~5wt% with higher content in localized regions. These results are consistent with previous / various orbital studies and *in situ* measurements → implications for ISRU.

- When converted into GEL (m), the water content represents a lower bond to the potential water that has been lost in the surface during Mars history (~3.10^{-4} m) → better estimation of the overall extent of the deposits.