Supplementary materials for "Diverse mineralogies in two troughs of Noctis Labyrinthus, Mars"

CRISM Data Processing

We processed CRISM hyperspectral images using standard procedures developed by the team [Murchie et al., 2007; 2009a]. The CRISM data were converted to I/F by subtracting the instrument background, and dividing by an internal calibration standard and solar irradiance. The resulting I/F was divided by the cosine of the incidence angle (from MOLA) in order to correct the illumination and atmospheric contributions were minimized by dividing by an atmospheric transmission spectrum over Olympus Mons. Finally, a cleaning algorithm was applied to the images to remove noise and large spikes within the data that are due to instrument effects [Parente, 2008].

Within any unit, ~10-100 pixels were averaged and this result was then divided by an average of spectrally neutral pixels along the same column in the CRISM scene. These CRISM ratioed spectra were then compared to laboratory data of pure minerals for potential matches; however, difficulties associated with identifying a perfect match to laboratory spectra can be attributed to subpixel mixing in the CRISM data. Our observations of diverse morphologies within several units based upon HiRISE images supports this subpixel mixing at the CRISM scale (~20 m/pixel).

Parameter maps corresponding to diagnostic mineralogies were generated to map the distribution of minerals such as clays, sulfates, pyroxenes, and olivines [Pelkey et al., 2007; Murchie et al., 2009b] and aid in the selection of spectra. Spectral parameter color maps (Figures 2A, 4A) were produced as follows: the 2.3 μm drop in reflectance, due to Fe/Mg-OH vibrations (D2300), is shown in red; the convexity around 2.3 μm in very hydrated phases due to strong H_2O absorptions at 1.9 and 2.4 μm (SINDEX) is shown in green; and the 1.9 μm band depth, due to combinations of H_2O bending and stretching vibrations (BD1900) is shown in blue.

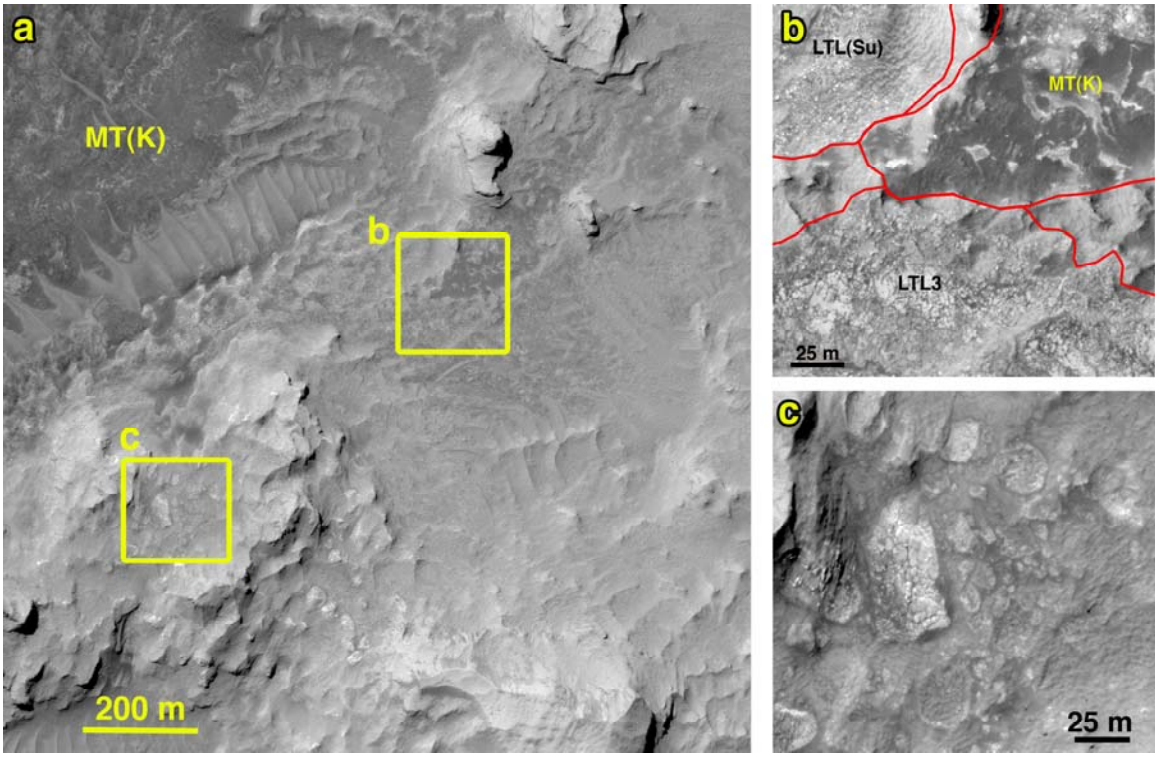

Figure DR1. (a) Portion of HiRISE image ESP_015975_1695 showing (b) blowup views of Trough 1 units LTL(Su), LT(K), and LTL3. (c) Rounded blocks of LTL(Su) mixed into material of unknown lithology along the southeastern portion of the trough.

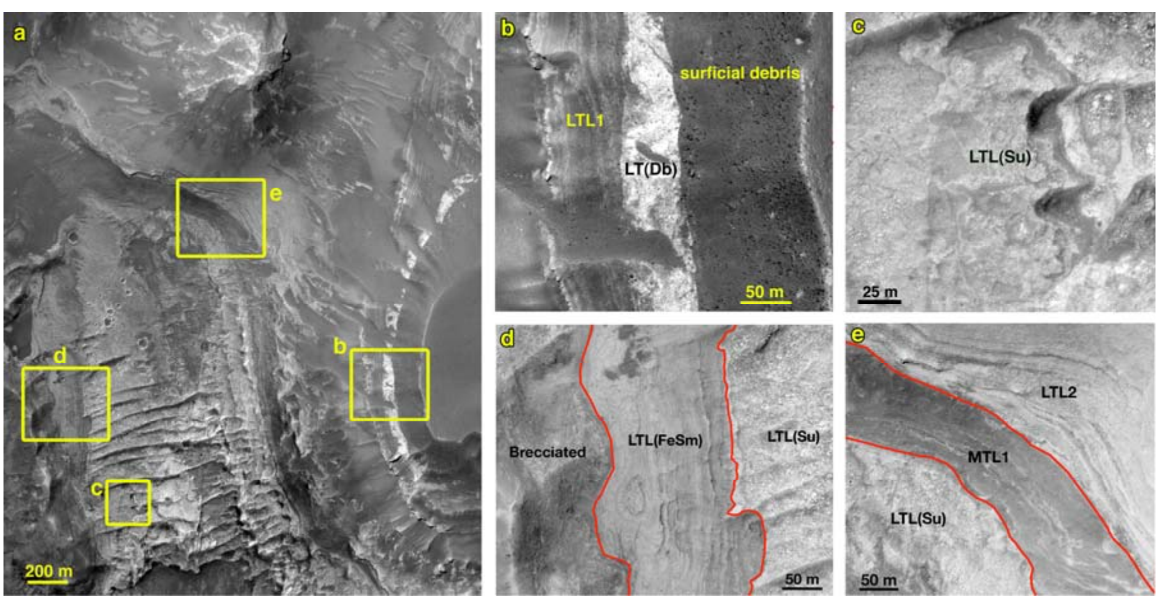

Figure DR2. (a) Portion of HiRISE image ESP_015975_1695 showing blowup views (b-e) of Trough 1 units LT(Db), LTL1, LTL2, MTL1, LTL(Su), LTL(FeSm) and Brecciated.

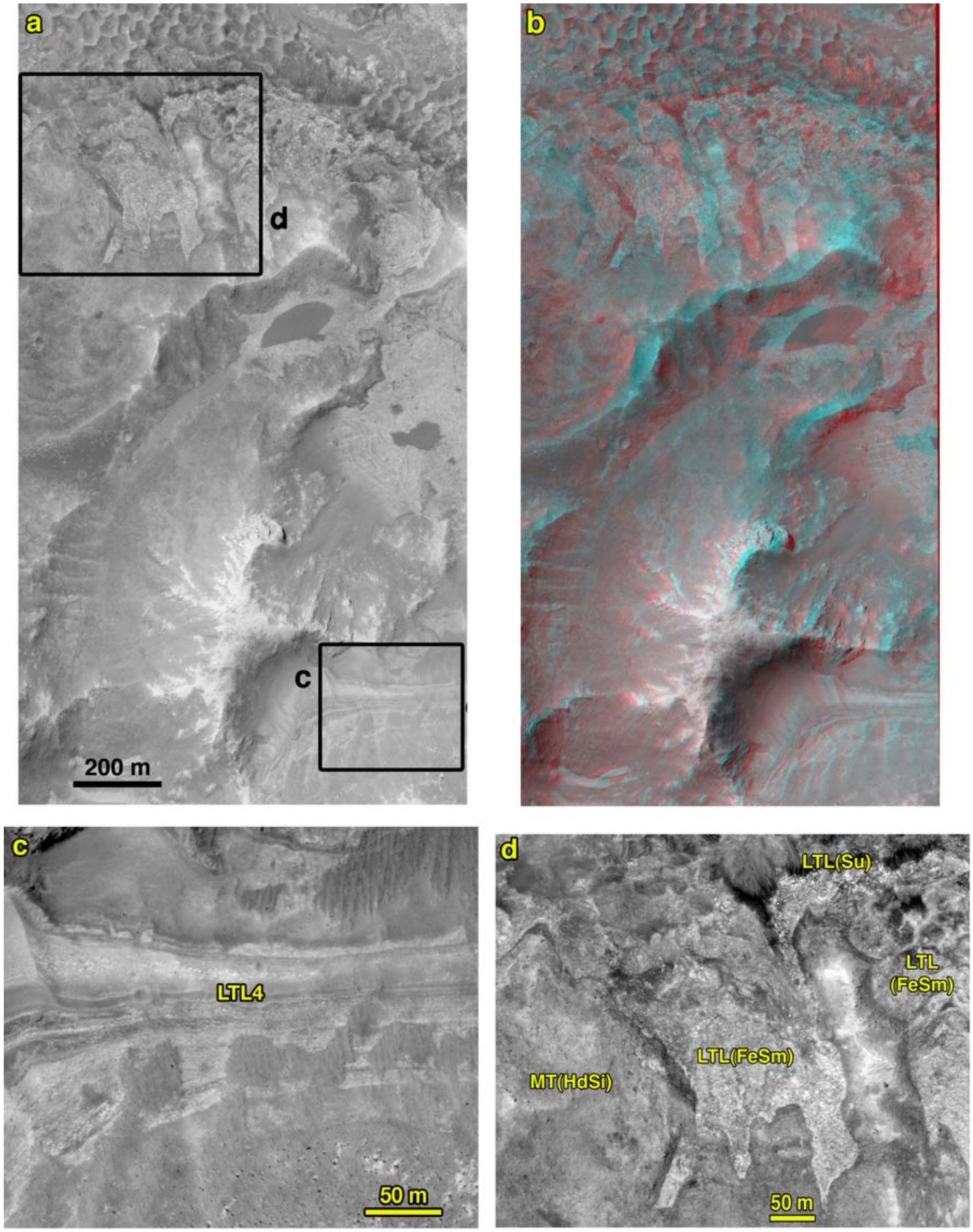

Figure DR3. (a) Portion of HiRISE image ESP_016898_1695 showing blowup views of Trough 1 units. (b) HiRISE stereo anaglyph of same region shown in a. (c) Blowups of LTL4 and (d) LTL(Su), LTL(FeSm), and MT(HdSi). Notice the finger-like extensions of LTL(FeSm) filling topographic lows upslope along unit MT(HdSi).

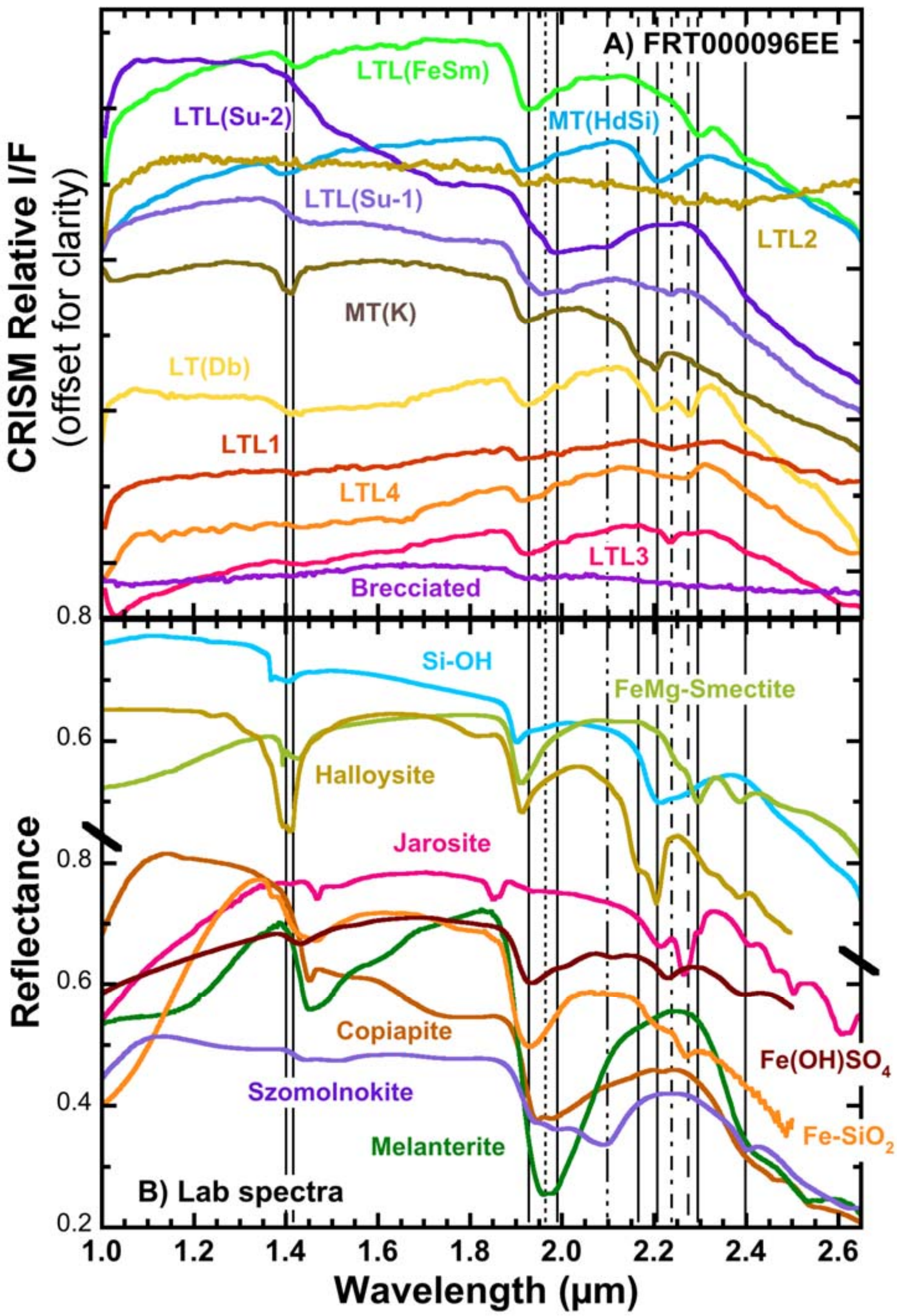

Figure DR4. (A) CRISM spectra of all units in Trough 1 that display hydration absorptions. (B) Selected laboratory spectra that have similar features and absorptions to the units in Trough 1. The FeMg-smectite sample is from Flagstaff Hill, CA, and the spectrum is from Bishop et al. [2008]. The hydrated silica spectrum is from Bishop et al. [2005a] and the sample is an altered ash near S vents inside Kilaeau and contains a large amount of opal-A. The halloysite spectrum is from the USGS spectral library [Clark et al., 1993; http://speclab.cr.usgs.gov/]. The jarosite spectrum is from Bishop and Murad [1996], the ferricopiapite and szomolnokite spectra are from Lane et al. [2004] and the spectrum of $FeOHSO_4$ created through dehydration of ferricopiapite is from Bishop et al. [2009].

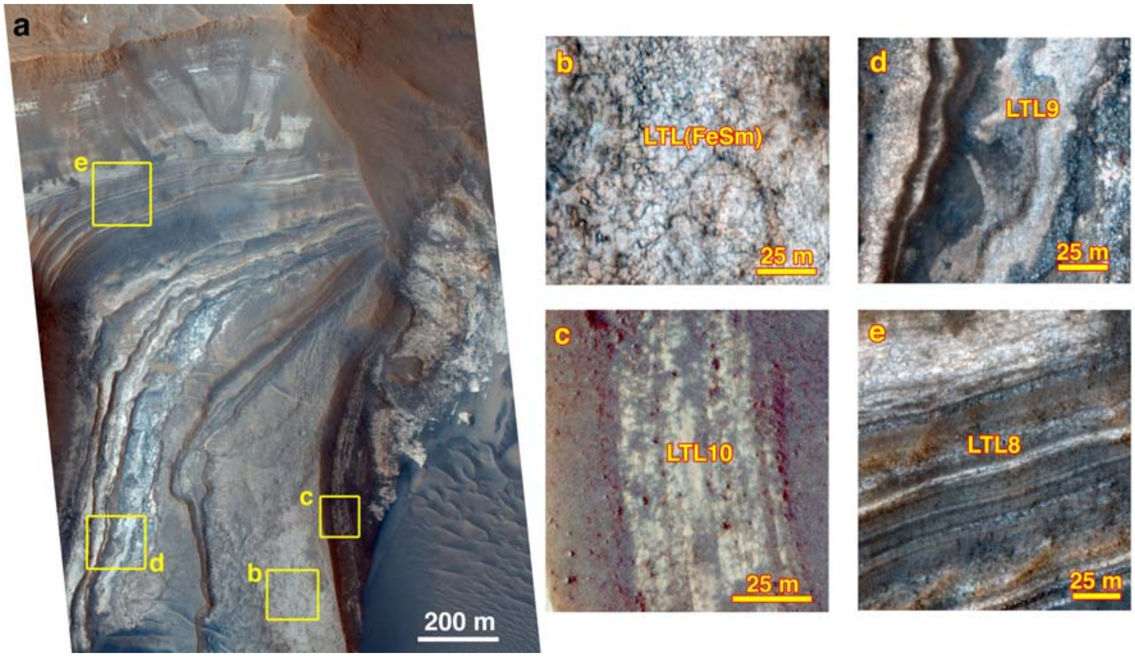

Figure DR5. (a) Portion of false-color HiRISE image PSP_005400_1685 showing blowup views (b-e) of Trough 2 units LTL10, LTL9, LTL8, and LTL(FeSm).

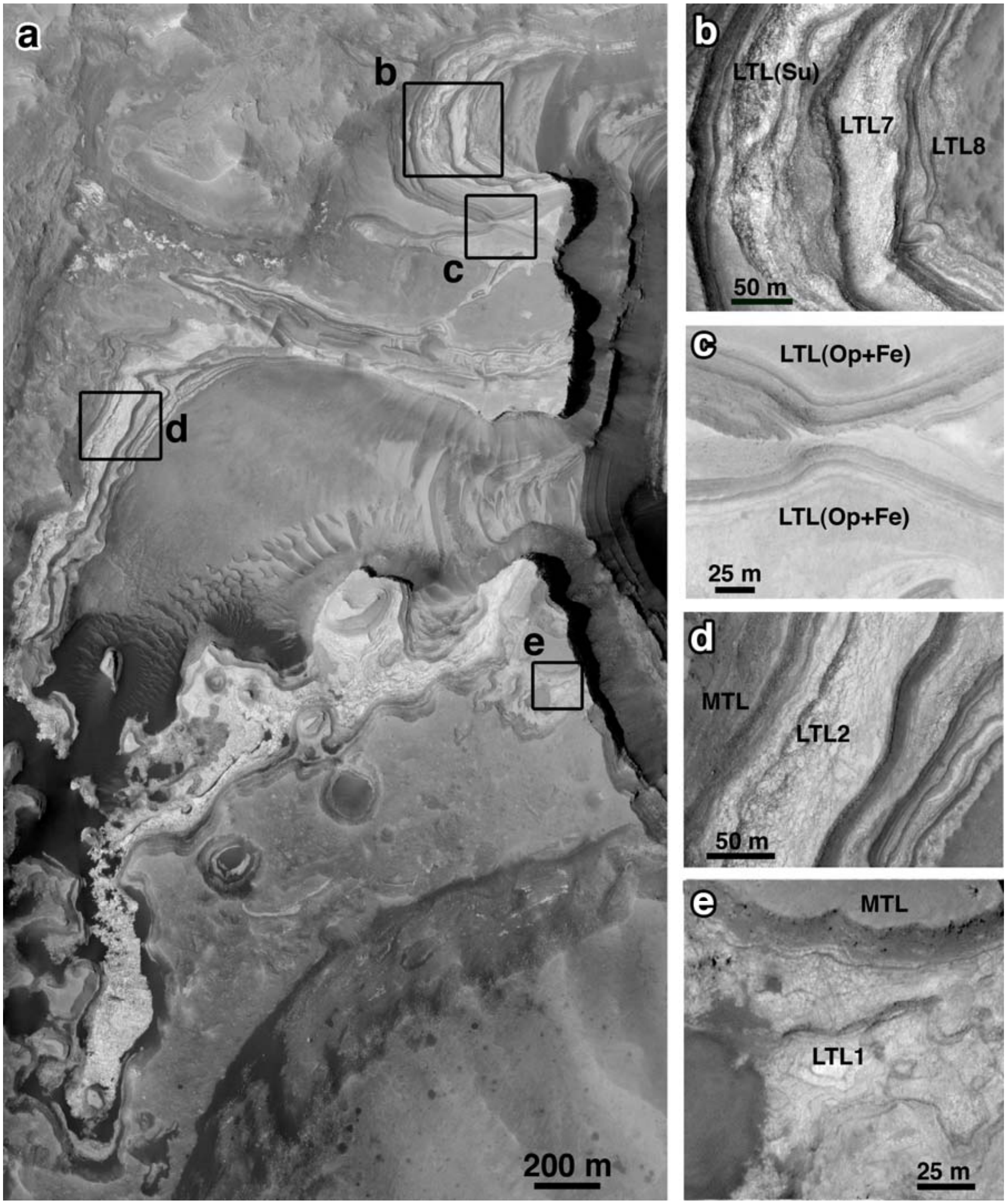

Figure DR6. (a) Portion of HiRISE image PSP_005400_1685 showing blowup views (b-e) of Trough 2 units LTL8, LTL7, LTL(Su), LTL(Op+Fe), LTL2, LTL1, and MTL.

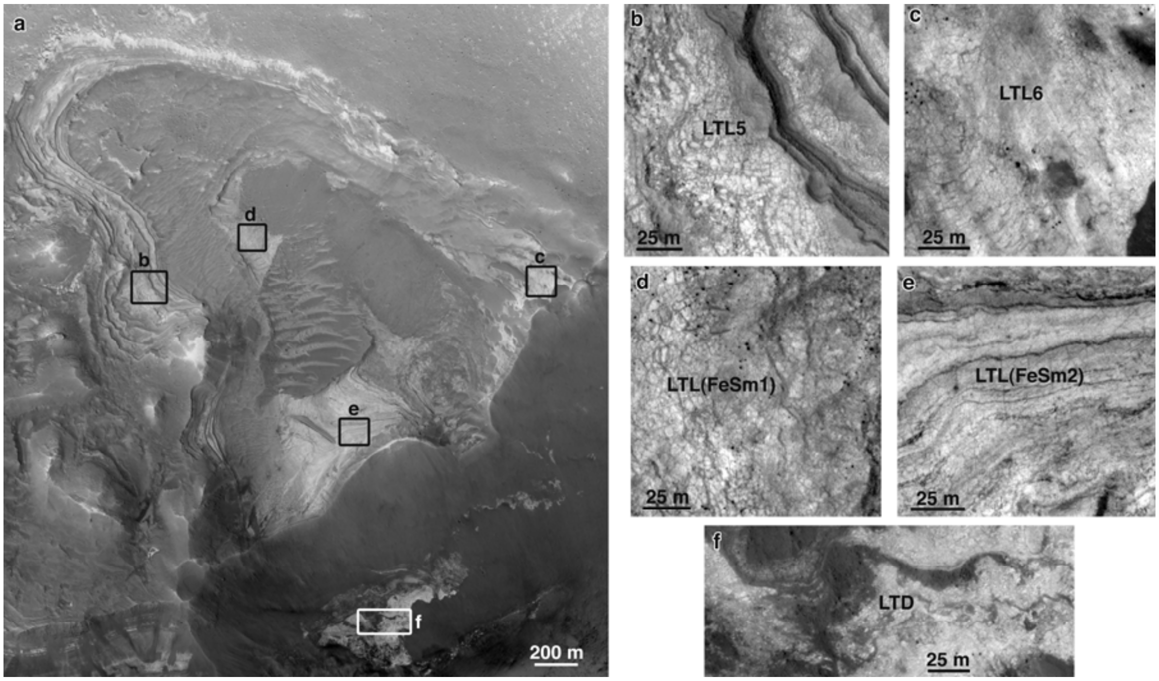

Figure DR7. (a) Portion of HiRISE image PSP_005400_1685 showing blowup views (b-f) of Trough 2 units LTL5, LTL6, LTL(FeSm1), LTL(FeSm2), and LTD.

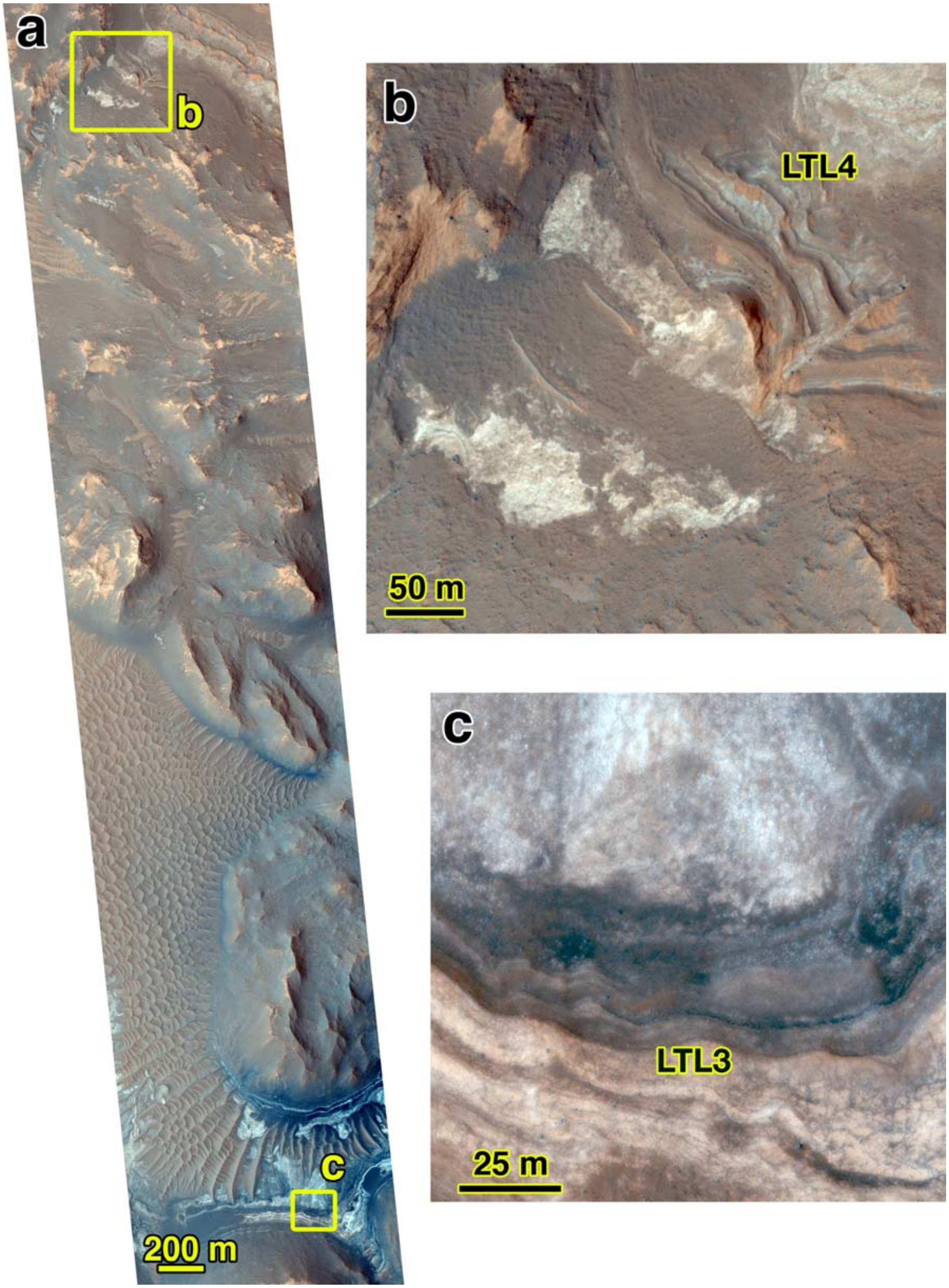

Figure DR8. (a) Portion of false-color HiRISE image ESP_014353_1685 showing blowup views (b,c) of Trough 2 units LTL3 and LTL4.

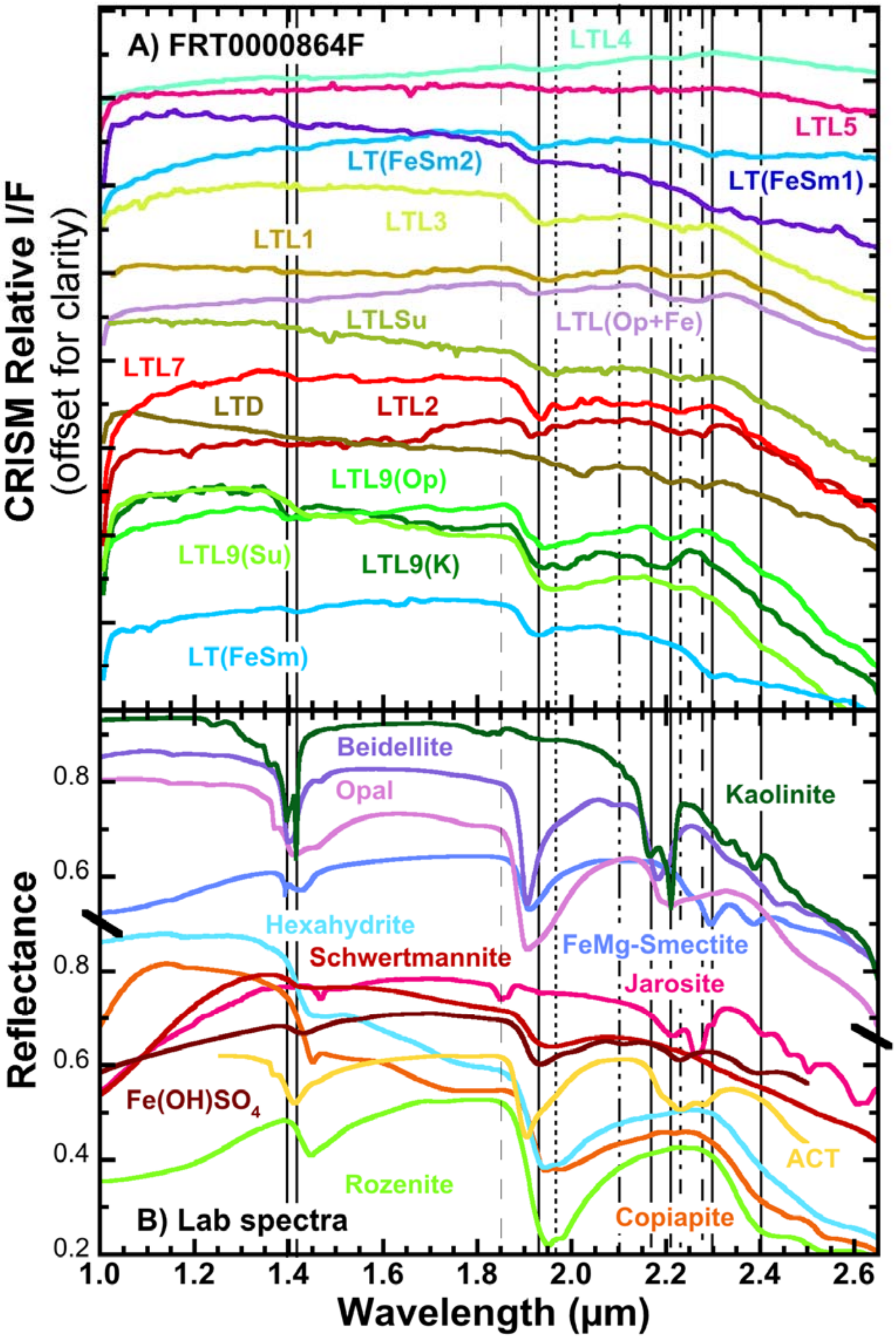

Figure DR9. (A) CRISM spectra of all units in Trough 2 that display hydration absorptions. (B) Selected laboratory spectra that have similar features and absorptions to the units in Trough 2. The FeMg-smectite spectrum is from Bishop et al. [2008] and the beidellite spectrum is from Bishop et al. [2011]. The SBCa-1 beidellite sample is a Casaturated <0.2 μm sediment extraction of a natural sample from CA [Gates, 2005]. The opal spectrum is from McKeown et al. [2011] and is opal-CT from Virgin Valley, NV. The kaolinite KGa-1 is from Washington County, GA and the spectrum is from Bishop et al. [2008b]. The hexahydrite spectrum is from Cloutis et al. [2006], the schwertmannite and jarosite spectra are from Bishop and Murad [1996], the ferricopiapite spectrum is from Lane et al. [2004] and the rozenite spectrum is from Bishop et al. [2005b].

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