MORPHOLOGY AND MINERALOGY OF LIGHT-TONED LAYERED DEPOSITS ON THE JUVENTAE CHASMA PLATEAU AND THE LOCATION OF A PROPOSED FUTURE LANDING SITE.

J. L. Bishop[1] and C. M. Weitz[2], [1]SETI Institute (Mountain View, CA; jbishop@seti.org), [2]Planetary Science Institute (Tucson, AZ; weitz@psi.edu).

Introduction: Juventae Chasma is a broad 3 km deep depression associated with the Valles Marineris system, but is separated from the main channel by 500 km. The plateau region northwest of Juventae Chasma includes several light-toned layered deposits (LLD) [1-4]. Spectral analyses of these LLD using CRISM images indicate the presence of aqueous units containing opaline silica and $FeSO_4OH$ [2,5]. The unique spectral character of these materials and their layered morphology makes this site of interest for future landed missions. Shown in Fig. 1 is a CTX view of the plateau with a red circle marking a possible landing ellipse.

Spectral Properties of LLD: The strongest spectral signatures for the SiOH and $FeSO_4OH$-bearing layered units are found surrounding a depression shown in Fig. 2. A portion of this image is expanded in HiRISE views of these LLD in Figs. 3-4. Example spectra of the two types of LLD are shown in Fig. 4A. The more abundant LLD contains spectral features near 1.94 and 2.23 μm, plus weak bands at 1.43 and 2.40 μm that vary in intensity indicating some variation in composition. This spectral fingerprint does not fit one known mineral, but is consistent with dehydrated ferric sulfate [2,5,6,7] and is termed $FeSO_4OH$. A similar $FeSO_4OH$-bearing phase has been identified in Aram Chaos [8] and is most similar to dehydrated szomolnokite [7] in that bands are present at 1.49, 1.82, 1.94 and 2.23 μm. The material observed in the LLD on the Juventae Plateau are more consistent with dehydrated copiapite [2,5] or hydronium jarosite [6]. A thinner LLD exhibits bands near 1.39, 1.92, and 2.21 μm and is consistent with opaline silica [2, 5, 9].

Morphology of LLD: The $FeSO_4OH$-bearing unit exhibits a highly stratified, terraced morphology shown in Figs. 3-5. Multiple adjacent layers are observed up to several meters thick [2,10]. These have eroded into swirling patterns with arcing ridges. The hydrated silica component in the plateau west of Juventae Chasma occurs at the geologic contact between the $FeSO_4OH$-bearing material and the older plateau unit and has a broken and blocky texture shown in Fig. 4B. Large cracks 5–10 m long are also present in this hydrated silica-bearing unit. This layer could either be the lowermost stratigraphy in the LLD or the uppermost surface of the plateau. The altered character of the opaline unit and its position underneath the hydroxylated ferric sulfate material (Figs. 3-4) suggest separate aqueous events took place to form these mineralogies. Another possibility is that the opal and $FeSO_4OH$-bearing layers were deposited sequentially during the same hydrothermal event, as silica is less soluble and would have precipitated first. However, the texture of the two materials appears very different in the HiRISE images. This is consistent with a much older opal deposit or a much more friable opal deposit covered by a sulfate layer that is more resistant to erosion.

Extent of LLD: Recent analyses of the extent and composition of the LLD across the plateau indicate that the $FeSO_4OH$-bearing material is widespread. Similar textures and morphologies are found on the plateau bordering Juventae Chasma wherever the darker substrate material has been eroded to reveal

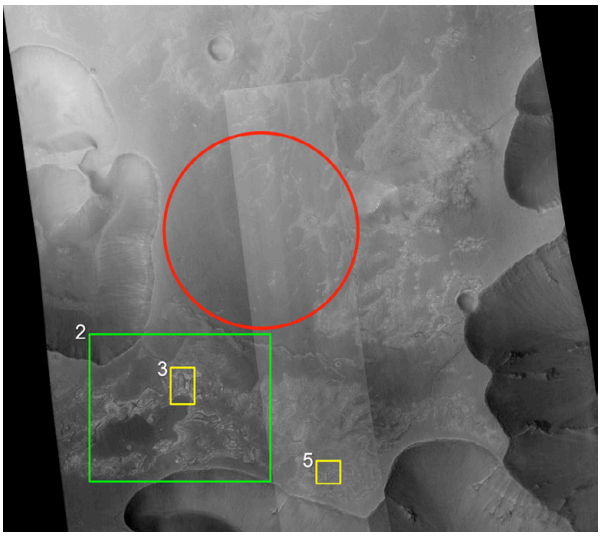

Figure 1: CTX image mosaic of Juventae Plateau region [from 2] with a 10 km diameter circle marked in red for a possible landing site. Green and yellow boxes mark locations of Figures 2, 3, and 5.

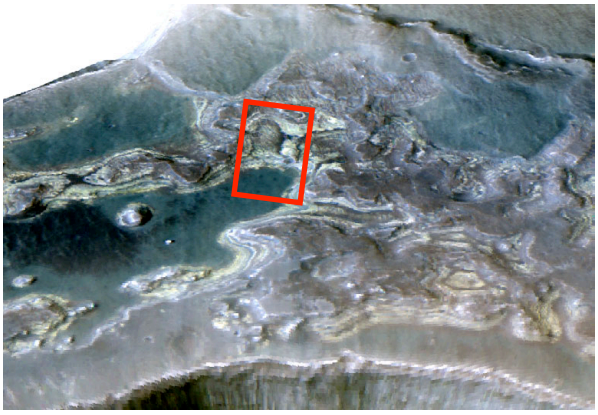

Figure 2: CRISM FRT00005814 3D image showing layered units mapped with R 1080 nm, G 1500 nm, B 2500 nm.

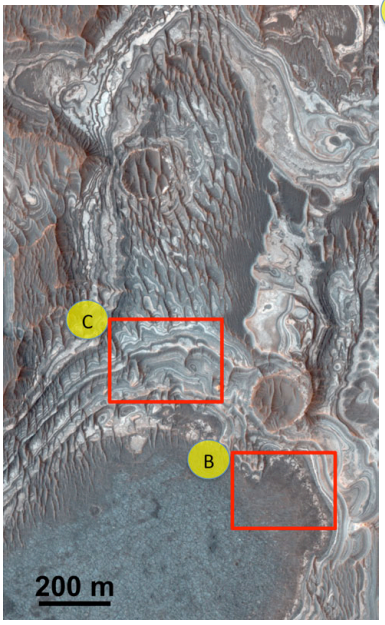

Figure 3: HiRISE image PSP_003434_1755 showing layered units in CRISM image from Figure 2 (red box).

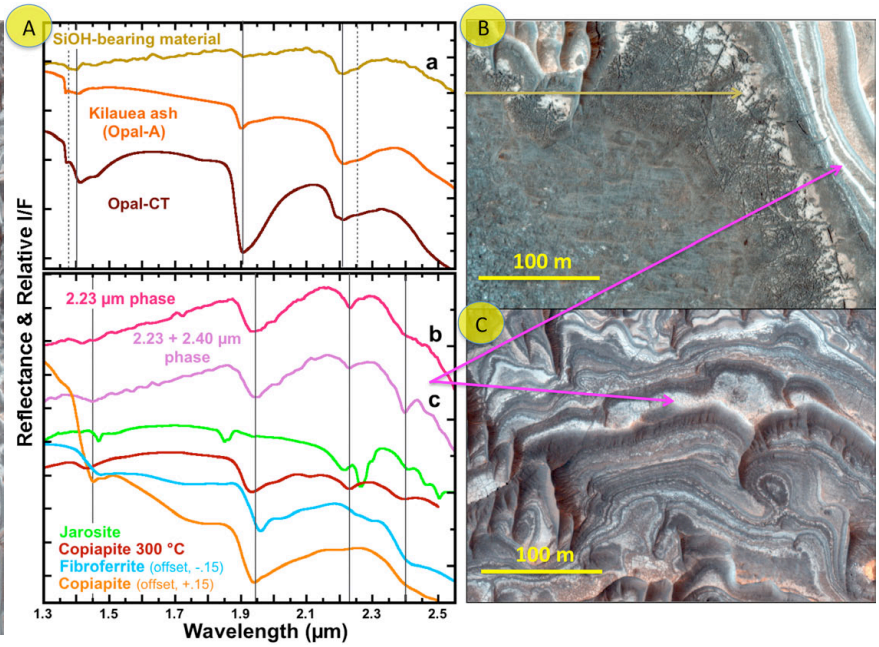

Figure 4: A) CRISM spectra of Si-OH bearing material (a) compared to lab spectra of Opal-A and Opal-CT, and the $FeSO_4OH$ phases (b,c) compared with lab spectra of ferric sulfates. B & C) expanded HiRISE views of opaline silica material and Fe-SO_4OH phases.

bedrock below. One example is shown in Fig. 5. Bright mesas of blocky eroded material consistent with the opaline silica are also observed in many regions of the LLD. However, the LLD are insufficiently thick across most of the plateau to provide a CRISM signature (at 18 m/pixel). The only region exhibiting detectable CRISM features (using TRR2 calibration) is shown in Fig. 2. As the TRR3 versions of the images in this area become available, we will extend this investigation and hope to observe CRISM signatures of the opaline and $FeSO_4OH$-bearing units elsewhere on the plateau.

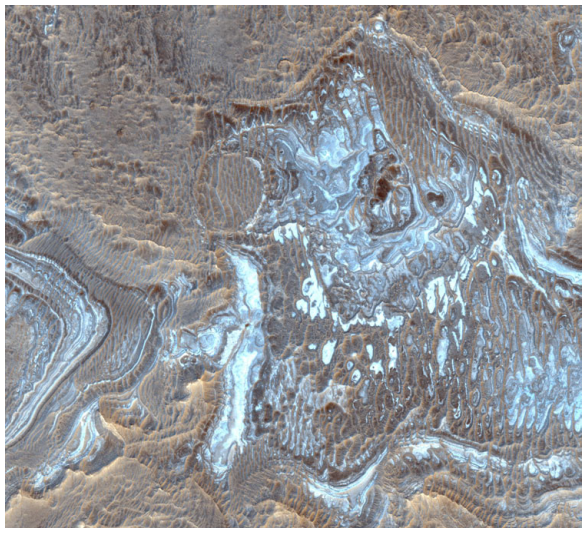

Figure 5: HiRISE color image PSP_006981_1760 showing layered units similar to those featured in Figures 2-4. Image ~300 m across.

Potential Landing Site Activities: The best landing site would be in the flat region marked by the red circle in Fig. 1. There is a rift towards the south that would be difficult for a rover to climb towards the LLD exhibiting the strongest CRISM signatures (Figs. 3-4). However, the LLD to the east of the potential landing area would be readily accessible and appear to contain the same hydroxylated ferric sulfate and opaline material. The LLD are likely less exposed here as they do not exhibit detectable CRISM signatures to date. Landing at this plateau region neighboring Juventae Chasma would enable characterization of this enigmatic $FeSO_4OH$ in the LLD. Other occurrences of this uniquely Martian mineral would likely be too difficult for rover access.

Acknowledgements: We are grateful for CDP funding for study of this region as a potential future landing site.

References: [1] Mangold N. et al.(2008) *JGR, 113,* doi:10.1029/2007JE002985. [2] Bishop J.L. et al. (2009) *JGR,114,*doi:10.1029/2009JE003352. [3] Weitz C.M. et al. (2010) *Icarus, 205,* 73-102. [4] Le Deit L. et al. (2010) *Icarus, 205,* 73-102. [5] Milliken R.E. (2008) *Geology*, *36*, 847-850. [6] Desborough G.A. (2006) *ICARD 7, St. Louis*, abs. [7] Morris R.V. et al. (2009) *LPS VI,* #2317. [8] Lichtenberg K.A. (2010) *JGR, 115,* doi:10.1029/2009JE003353. [9] Anderson J.H. and K.A. Wickersheim (1964) *Surface Science, 2,* 252–260. [10] Weitz C.M. et al. (2008) *GRL, 31,* doi:10.1029/2008GL035317.