EARLY HIRISE OBSERVATIONS OF LIGHT-TONED LAYERED DEPOSITS. C. M. Weitz[1], A. S. McEwen[2], C. H. Okubo[1], P. Russell[3], J. A. Grant[4], C. Dundas[2], N. Bridges[5], and the HiRISE Team. [1]Planetary Science Institute, 1700 E. Fort Lowell, Suite 106, Tucson, AZ, 85719 (weitz@psi.edu). [2]Lunar and Planetary Lab, Univ. Arizona, Tucson, AZ 85721. [3]Physikalisches Institut, U. Berne, Switzerland. [4]CEPS, National Air and Space Museum, Smithsonian, Washington, DC 20560. [5] Jet Propulsion Lab, 4800 Oak Grove Drive, Pasadena, CA 91109.

Introduction: HiRISE images are providing a wealth of new information about the non-polar sedimentary light-toned layered deposits on Mars. The HiRISE camera can produce images with a resolution of ~30 cm/pixel, which enables detailed views of the layering in these deposits. False-color information from the three wavelengths is also proving very useful for distinguishing between different types of layered deposits. Finally, stereo images offer a view of the stratigraphy of the deposits that should aid with interpretation of their origin(s).

During the early Primary Science Phase (PSP), many images of the light-toned layered deposits (LTLD) have been analyzed for this study. These images thus far include: Candor Chasma, Melas Chasma, Coprates Chasma, Capri Mensa, Becquerel Crater, Gale Crater, Oudemans Crater, Terby Crater, Holden Crater, Eberswalde delta deposit, Meridiani Planum, Mawrth Vallis, and several unnamed craters.

High-resolution views of the layers: HiRISE images reveal LTLD can consist of stacked, repeating layers with each layer only a few meters thick. The surfaces of many of these layers appear cracked into meter-size blocks, producing a "snakeskin" appearance (Fig. 1). A few light-toned deposits (e.g., PSP_001860_1685 Unamed crater, PSP_002033_1720 White Rock) are fractured and have lineations but don't break into meter-size blocks or have evidence of layered beds. Some LTLD have interbedded layers or smaller lenses (<100 m across) that are unconsolidated with meter-size boulders and limited or no evidence of layering (Fig. 2). Steep cliffs along these more massive units can have meter-size boulders and debris aprons along their bases, although the paucity of loose boulders derived from the LTLD indicates the rocks are friable and easily eroded by winds. Intermixing of finely layered deposits with massive blocky layers/lenses could result from differences in grain size and/or diagenetic history. CRISM observations in Candor [1] suggest mafic, highly altered material, and sulfates in the LTLD, supporting that different compositions may account for some variable morphologies seen in the HiRISE images.

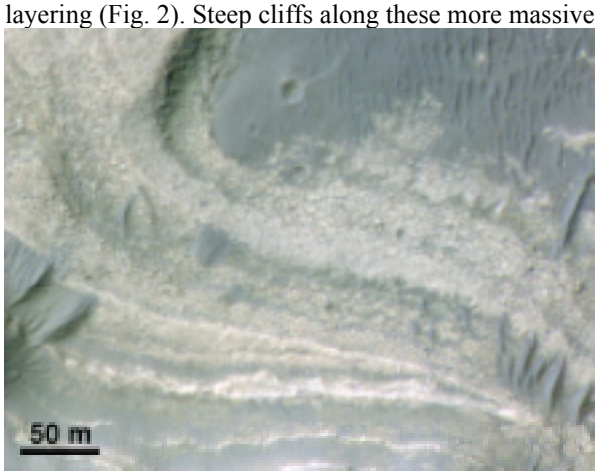

Figure 1. False-color HiRISE subimage of portion of Eberswalde delta layered deposit from PSP_001336_1560.

Figure 2. HiRISE false-color subimage in Melas Chasma showing massive blocky units interbedded with thinly layered, possibly cross-bedded deposits. PSP_1377_1685.

Folds and faults can be seen in some LTLD, with one example shown in Figure 3 for West Candor. The folds and faults indicate that the deposits have experienced disruption after their emplacement. Oudemans Crater has a unique exposure of km-size blocks of LTLD in the central peak that have been brought up from depth and are now tilted and rotated. Joints are

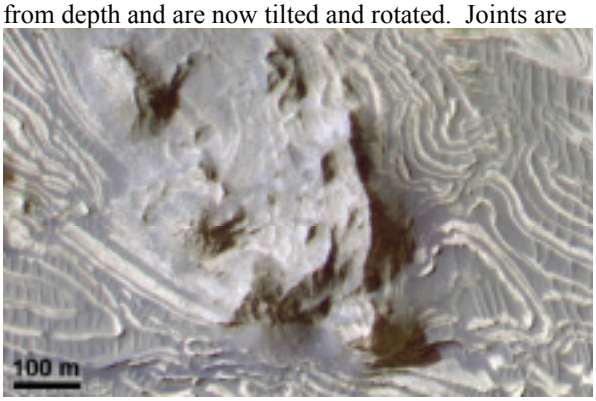

Figure 3. False-color HiRISE subimage of folded and faulted layering in West Candor. PSP_1918_1935.

also evident in some LTLD (Fig. 4), and appear to be sites of localized fluid alterations [2].

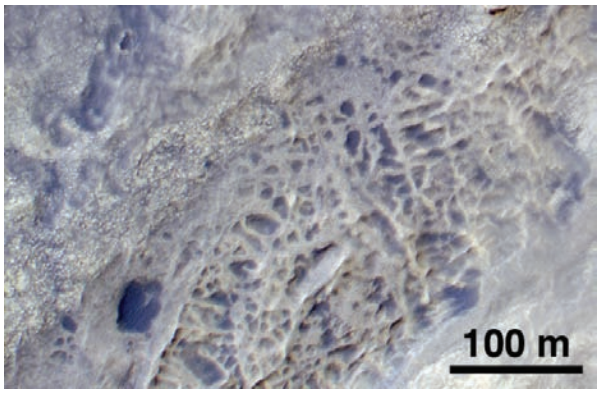

Figure 4. False-color HiRISE subimage showing joints in Gale Crater LTLD. PSP_001488_1750.

Color details in the layers: HiRISE acquires images in three wavelengths, providing color coverage for the central portion of the swath width [3]. These color images have been used to distinguish between different units in the layered deposits, such as those seen in Mawrth Vallis (Fig. 5). Most of the layers in LTLD appear to differ more in morphology than they do in color. The LTLD have thin mantles of darker debris which could be eroded fines derived from the layered material or basaltic grains eroded from nearby lava flows and later deposited on the LTLD by winds. Mantling by darker debris on flatter portions of the LTLD produces a dark-bright "zebra" banding in many instances (Figs. 2 and 3). Although stratigraphically younger in age, dark mantles have more impact craters, indicating that the LTLD have had removal of cratered surfaces by the wind or the deposits were quickly buried beneath these darker mantles to prevent higher numbers of impact craters from forming.

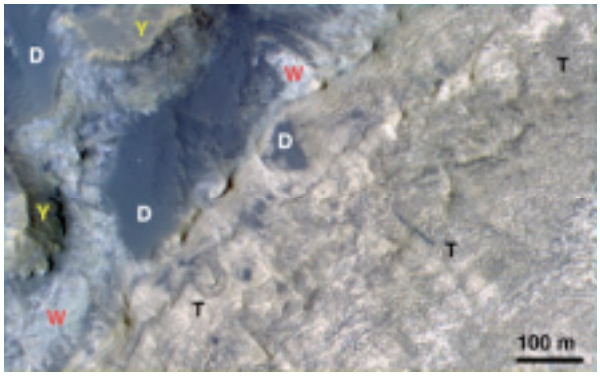

Figure 5. HiRISE false-color subimage of Mawrth Vallis. A dark mantle (D) overlies an upper yellow unit (Y), a middle white unit (W), and a lower tan layered unit (T). PSP_1929_2050.

Stratigraphy from stereo images: Stereo images obtained by two HiRISE images taken at different roll angles can be used to produce red-green anaglyphs. For the LTLDs, the stereo images provide valuable insight into whether layered deposits are horizontal or tilted, which can be used to support origins for the deposits or determine post-deposition displacement of formerly horizontal layers. In Figure 6 from Becquerel crater, upper layers appear tilted relative to underlying horizontal layers. In Figure 7, many of the layers in West Candor appear tilted. There are also resistant hills in Figure 7 that could represent joints where fluids from underlying sediments moved upwards under pressure from overlying layers, depositing chemical precipitates along these vertical joints that are now more resistant than the adjacent LTLD, although other origins are also being evaluated.

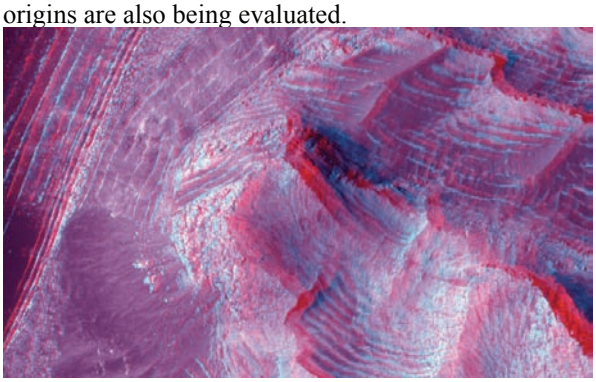

Figure 6. Stereo anaglyph of angular unconformity in Becquerel crater, with upper layers tilted relative to more horizontal lower layers. PSP_1546_2015 and PSP_1955_2015. Image is 0.46 km across.

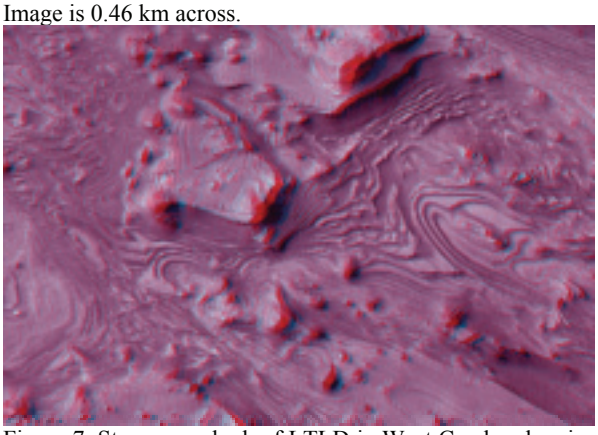

Figure 7. Stereo anaglyph of LTLD in West Candor showing that many of the layers are not horizontal. PSP_1918_1735 and PSP_1984_1735. Image is 3.4 km across.

Conclusions: The LTLD display a range of morphologies that likely reflect differences in their orign and post-emplacement modification.

References: [1] Murchie et al., *LPSC XXXVIII*, this volume, 2007. [2] Okubo, C.H., and A.S. McEwen, *Science*, in press, 2007. [3] McEwen, A.S.., et al., *JGR, 111*, in press, 2007.