ORIGIN OF THE LOW-ALBEDO MOUND SKIRTING UNIT IN THE REGION OF THE MSL LANDING ELLIPSE, AND IMPLICATIONS FOR THE RELATIVE AGE OF GLENELG STRATA. L.C. Kah,[1] D.M. Rubin[2], S. Gupta[3], K.W. Lewis[4], G.A. Kocurek[5] , J.P. Grotzinger[6]. [1]University of Tennessee (Department of Earth & Planetary Sciences, 1412 Circle Drive, Knoxville, TN 37996, lckah@utk.edu); [2]USGS Pacific Coastal and Marine Science Center, Santa Cruz, CA; [3]Imperial College, London, UK; [4]Princeton University, Princeton, NJ; [5]University of Texas, Austin, TX; [6]California Institute of Technology, Pasadena, CA

Introduction: On August 5, 2012, NASA's Mars Science Laboratory (MSL) Curiosity rover landed in Gale Crater. The primary goal of mission's first 90 sols was to commission the analytical equipment that comprises Curiosity's payload, while exploring the nearby region for evidence of past or present, potentially habitable environments.

One of the most exciting features of the landing ellipse is the Peace Vallis fan, which drains an extensive network of channels along the margin of Gale Crater . The main main body of the Peace Vallis fan lies to the north-northwest of the landing ellipse and extends into the landing ellipse. The Peace Vallis fan is a composite fan with well-preserved topographic contours, and only minor cratering and local deflation in distal fan regions [1]. The fan represents a relatively late-stage hydrologic event and is potentially the source the fluvial-to-alluvial gravels found within the landing ellipse [2]. Ultimately, the Peace Vallis fan drains into a topographically closed basin just north of Glenelg, that is characterized by distinct light-toned strata [3].

In order to better understand the relationships between Glenelg strata and units skirting Mount Sharp, here we provide an analysis, from CTX and Hi-Rise Images, of a distinctlow-albedo unit that caps Glenelg strata (Fig 1), and relate it to strata units that Skirt Mount Sharp.

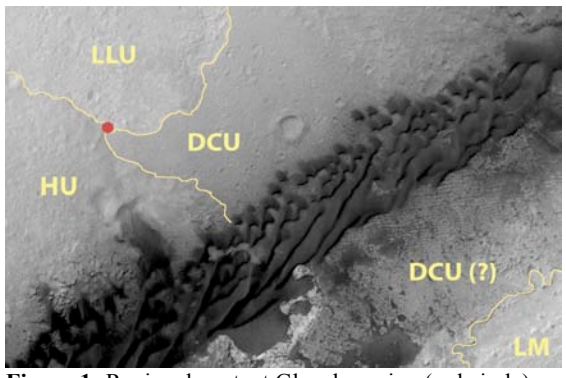

Figure 1: Regional context Glenelg region (red circle), including the Hummocky Unit (HU), with surficial deposits from the Peace Vallis Fan; the Light-toned Layered Unit (LLU); and the Dark Cratered Unit (DCU) which extends underneath current dunes and is potentially equivalent to units that skirt Mount Sharp (LM).

Dark Cratered Unit (DCU): The Dark Cratered Unit comprises a distinct, multi-layered unit that consists of a well-indurated (i.e. crater retaining), low albedo strata. It is similar in albedo, and may be depositionally related to a similarly well-indurated interval that, when exposed near the base of Mount Sharp, displays a conspicuous "washboard structure" composed of subparallel ridges oriented ENE (Fig. 2). Combined, these two intervals range from <1 meter in thickness (where thinned by erosion) to a maximum of nearly 6 meters in thickness.

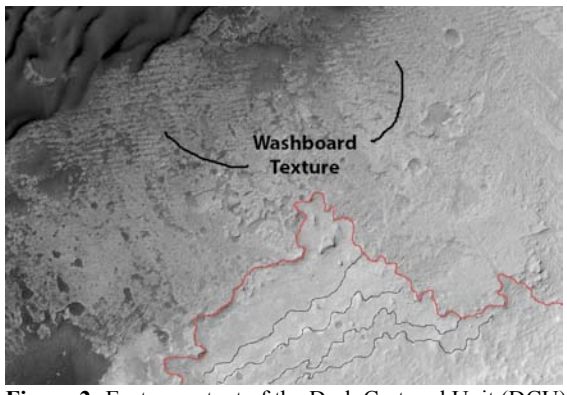

Figure 2: Eastern extent of the Dark Cratered Unit (DCU) displaying prominent, polsitive-relief lieaner features (i.e., "washboard texture". Red line shows eastern, erosional extent of the DCU; thin black lines trace prominent bedding of unconformably underlying, lower mound strata.

Stratigraphic Position of low albedo units: A key question is whether the DCU can be traced, via a series of windows, underneath the modern, low-albedo dunes that encircle Mount Sharp into similarly low-albedo, well-indurated strata that skirts Mount Sharp. Across the Glenelg region, the DCU shows little change in topography, showing a regional dip of the surface of <0.4°. Near the eastern edge of the low-albedo dune field, well-indurates, low-albedo mound skirting strata abruptly change to a relatively uniform dip between of 5.0-5.5°. This dip is retained through the eastern extent of the mound skirting unit, and corresponds to the regional incline of lower Mount Sharp. Abrupt change in dip beneath the current dune field suggests that the position of the dune field is, in part, controlled by a change in regional topography near the base of Mount Sharp; change in expression of low albedo units also suggests the potential for a potentially complex transition between units that is largely obscrured by the current dune field.

Near Glenelg, the DCU is parallel to, and appears to conformably overlie, strata of the Light-toned Layered Unit (LLU). Potentially equivalent strata of the-washboard-bearing unit, however, can be shown to cross-cut numerous stratal boundaries within the lowermost strata (i.e. Lower Member of [4]) of the Mount Sharp mound (Fig. 2). These strata correspond, to the southeast of the landing ellipse, to massive, light-toned, fractured strata that display mineralogical (CRISM) signatures of sulfate [4]. Cross-cutting relationships at the eastern extent of the outcrop demonstrates that the washboard unit was deposited after both deposition, and erosion, of lower Mount Sharp strata.

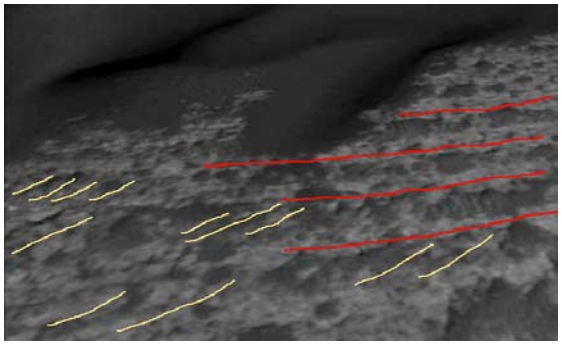

Figure 3: Google Mars image highlighting the orientation of the "crests" of linear, positive-relief, dune-like features within the DCU (red), which show a distinct gentle northerly dip; also highlighted are internal, angular lamination (yellow) exposed along south-facing flanks.

Origin of "washboard features" in low-albedo, well-indurated strata: Washboard features comprise a series of linear, positive-relief features with relatively straight, largely parallel parallel crests, similar to linear eolian dunes. Wavelength of these features ranges from 35-50 m and, in the region of the landing ellipse have strong, ENE orientations. Previous studies have considered these features to be preserved bedforms or truncated strata cropping out on a planar surface [5,6].

HiRISE imagery, when draped over topography, and viewed in three dimensions, highlights two additional observations. First, washboard features appear asymmetric, with gentle flanks dipping northward and steeper flanks dipping southward. Second, steeper south-facing flanks sometimes preserve evidence of westward-dipping, internal stratification (Fig. 3).

One model that can account for both the dune-like geometry and these tantalizing hints of internal stratification is that northward-dipping planes represent relatively more-lithified bounding surfaces between successive generation of eolian dunes migrating southward along the margin of Mount Sharp, whereas internal stratification represents along-crest migration of secondary bedforms toward the west (as appears to the the case for some of the nearby active linear dunes). In this interpretation, the washboard-bearing strata would represent a lithified remnant of a mound-skirting dune field that existed prior to the current, low albedo dunes.

Such interpretation of the this strata as a remnant low-albedo dune field along the edge of the eroded relief of Gale mound may also be consistent with with a transition to a planar sand sheet (potentially the DCU) as mound topography flattened to the west. Furthermore, the low-albedo of these units suggests a composition potentially similar to the olivine-bearing composition of current low-albedo dunes.

Implications for the age of Glenelg strata: The unconformable relationship between the mound skirting strata and underlying strata of lower Gale mound clearly indicates that deposition occurred after deposition and erosional exhumation of the oldest strata exposed at Mount Sharp. The age of these strata relative to stratigraphically higher units within Gale mound cannot, at present, be constrained.

The superposition of the DCU over the LLU exposed in the region of Glenelg, however, demands that the DCU is *also* younger than the LLU. At its western extent, strata of both the DCU and the LLU are essentially flat-lying, making it difficult to determine whether or not this relationship is conformable.

If the DCU and mound skirting units represent elements of the same depositional package, we propose two possible scenarios for the timing of LLU deposition in the region of Glenelg. In the first, LLU strata represent the lowermost strata of Gale mound, potentially penecontemporaneous with the lowermost strata exposed east of the current low-albedo dune field. Within Gale mound, the depositional dips of strata appear to decrease outward from the central portion of the mound, which is consistent with flat-lying strata of the LLU. In this case, closer inspection of this contact by the Curiosity rover might show evidence of disconformity between the LLU and overlying DCU. In a second scenario, the LLU represents strata of unknown origin, unrelated to Gale mound strata. In either case, it is unlikely that the LLU represents strata directly related to the Peace Vallis fan, as gravels attributed to this relatively young feature have been found—and are potentially widespread—throughout the hummocky unit (HU; [2]), which topographically and stratigraphically overlies the DCU in the region of Glenelg.

References: [1] Palucis, M., et al. (2013) *LPSC 44,* this volume. [2] Williams, B., et al. (2013) *LPSC 44,* this volume. [3] Sumner, D.Y., et al. (2013) *LPSC 44,* this volume. [4] Milliken, R.E., et al. (2010) *Geophysical Research Letters*, 37:L04201. [5] Edgett, K.S., Malin, M.C. (*2005) GSA Abstracts*, 249-1. [6] Anderson, R.B., Bell, J.F., III (2010) *Mars*, 5:76-128.