Dark Material on Valles Marineris Plateaus: A Preliminary Report. M. G. Chapman[1], G. Neukum[2], A. Dumke[2], G. Michael[2], and T. Kneissl[2], [1]Planetary Science Institute, 1700 E. Fort Lowell, Tucson, AZ 85719; mchapman@psi.edu, [2]Institute of Geosciences, Freie Universitaet Berlin, Germany.

Introduction: Dark material could be a key to determining the evolution of the surface of Mars, as it is a discrete material that can be found across the entire globe. Understanding dark material also plays a role in unraveling the climatic history on Mars, as non-lithified sand seas and dunes of dark material are widely considered to be aeolian deposits formed during recent climate episodes.

On red Mars, dark areas were first observed by Schiaparelli using a telescope in 1877, and were shown to be surface materials in the 1965 flyby images of Mariner 4. Numerous publications document that the dark material's windblown grains accumulate in relatively young, non-lithified, surficial sand seas and aeolian dunes [1-6]. Although an alternate origin as impact-melt spherules for some fraction of the material was suggested [7], dark grains are generally thought to be mostly basaltic fragments that the wind recycled from volcanic deposits, either primary volcanic ash, or a combination of ash and lavas [3-5,8-10]. Suggested possible parental sources for local deposits include erosion of lithic-rich (rock fragment-rich) dust beds in the north polar layered deposits for the north polar dark erg [1,11,12], young pyroclastic eruptions from Valles Marineris margin faults for some of the canyon's dark floor deposits [8,13], and erosion of in-situ dark layers from within crater walls to form dark crater floor deposits [9] and within the Medusae Fossae Formation to form sediments along its southwest margin [14]. However because there has been no definitive identification of widespread parental surface rocks, dark materials have almost become synonymous with non-lithified aeolian deposits.

Some newly published articles mention dark materials on the plateau near Valles Marineris [15,16,10,17]; however, most of these articles provide few details of the dark deposits and briefly note that they may be mostly basaltic in composition and likely aeolian debris, with a possible component of impact regolith [16]. The lack of detail is not surprising as the focus of these articles is the light-toned layered deposits (LLDs), a unit of heightened interest associated with CRISM-detected opaline silica, Fe-sulfate, and jarosite deposits [10,15]. The dark material uncomformably overlies much of the LLDs in the region, preventing correlation of LLDs outcrops [16]. CRISM multispectral mapping data show the dark material to be relatively homogenous surface with absorption consistent with pyroxene and olivine [10].

This preliminary abstract suggests that the dark materials about Valles Marineris form distinct mapable lithologies on the plateau surrounding several chasmata (Fig. 1). Although observable in gray scale imagery, the dark deposits are best identified and studied using color and high-resolution imagery and topography data. These data sets demonstrate that rather than being just young, non-lithified aeolian deposits, these materials about Valles Marineris are local, eroded outcrop remnants of in-situ, lithified dark-toned layered rocks (DLDs) that range in total thickness from <10 to >100 meters.

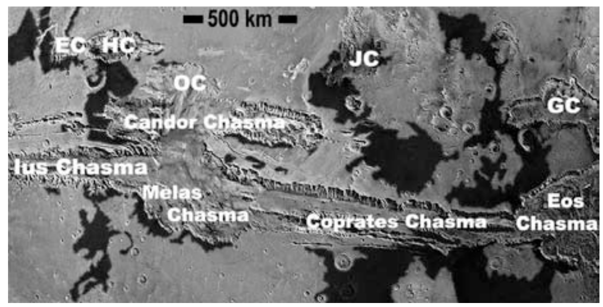

Figure 1. Viking mosaic with black areas on plateau showing outcrops of dark material; chasmata labeled in white (EC=Echus, HC=Hebes, OC=Ophir, JC= Juventae, GC=Ganges).

DLD Attributes: On the plateau west of Echus Chasma, most of the local DLD outcrops reside within a newly interpreted middle member (unit Hsm) of the Syria Planum Formation [18] that is thinly layered, very dark in tone, and cut by narrow valley networks [18,19,20]. The exposed middle member materials are wind eroded. For example, dark aeolian dunes whose grains were likely recycled from the eroded middle member can be found on proximal surfaces and eroded dark material can be traced from the middle member to alluvial cascades that flowed down the slope of wallrock into Echus Chasma (Fig. 2A). The DLDs appear to be confined to in-situ beds that alternate with some thinner variably toned layers. Because this dark material is within a discrete layered unit on the plateau surrounding Echus, it was interpreted to be a poorly indurated, but lithified rock unit. These attributes and the unit's sharp contacts with the lower and upper members of the Syria Planum Formation and Echus Chasma wallrock (Fig. 2C) justified a designation as a middle member. In this area the dark middle member is beautifully observed on HRSC perspective views as a fairly thick caprock on the plateau, demonstrating the strength of the camera's color and topographic data (Fig. 2A,B). HiRISE images of this middle member caprock appear to show the internal layering of DLDs alternating with lighter-toned beds above a sharp basal contact (Fig. 2C).

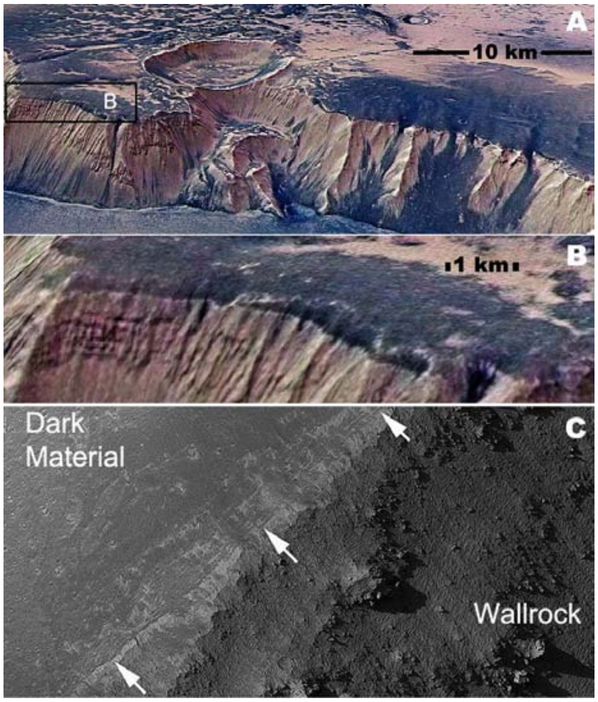

Figure 2. Echus Chasma west wall showing caprock of DLDs; (A) HRSC perspective view, box denotes location of 'B', view to west; (B) Enlarged view of boxed area in 'A'; (C) HiRISE image PSP_007654_1805_red showing sharp basal contact of DLDs above wallrock (arrows) and possible internal layering, field of view about 0.3 km.

Like the Echus Chasma plateau site, in all of the other outcrop areas the DLDs overlie (and hence are younger than) the Hesperian ridged plains (Unit Hr), and locally there are intervening deposits (such as the LLDs) that appear to occur between the DLDs and ridged plains. Unlike the Echus site, some other local areas can also show different weathering styles and erosional patterns that suggest a more indurated, less friable nature (Fig. 3). DLDs can be observed to unconformably overlie crater rims of brighter material (Fig. 3A), and have thicknesses that range from an eroded featheredge of only a few meters to more than 100 meters (Fig. 3). Thicknesses were measured using HRSC topography, as the instruments along-track spatial resolution of 10 m makes it a better dataset than MOLA to measure such small fine features (Fig. 3). Study of the nature of Valles Marineris plateau DLDs is ongoing preliminary research submitted for MDAP funding. The central hypothesis of the proposal is that these eroded outcrops could be the remains of an extremely widespread, somewhat friable, internally layered rock unit that may have been eroded to form dark aeolian dunes.

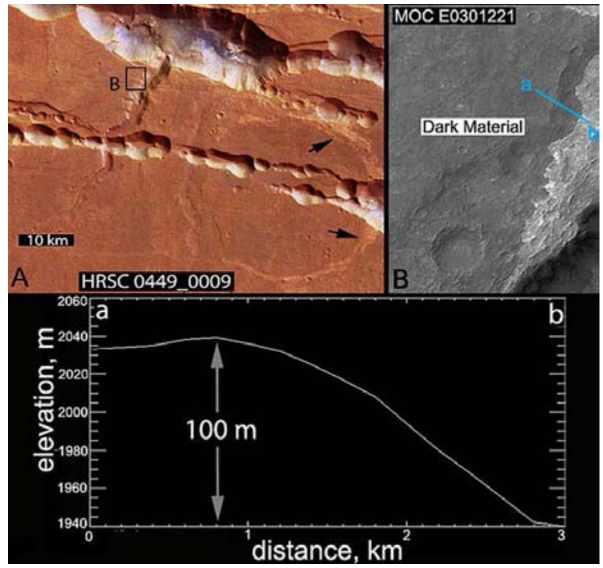

Figure 3. Mars-like colored HRSC view showing DLD on plateau south of Coprates Catena, note dark material embayment of large bright crater rim (arrows), box denotes location of Fig. 3B; (B) MOC image shows DLDs overlying brighter deposit, blue line marks HRSC topographic profile below.

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