**LAYERING IN THE UPPER WALLS OF VALLES MARINERIS, MARS: A DIAGENETIC ORIGIN.** Kelly H. Fuks[1], Allan H. Treiman[2], and Scott Murchie[3]. [1]Department of Geology, Georgia State University, Atlanta GA 30303. [2]Lunar and Planetary Institute, 3600 Bay Area Blvd. Houston TX 77058. [3]Applied Physics Laboratory, Johns Hopkins Rd., Laurel MD 20723.

A packet of resistant layers, totaling ~400m thick, is present at tops of the chasma walls throughout Valles Marineris. The packet consists of an upper darker layer (~50 m), a central brighter layer (~250 m) and a lower dark layer (~100 m). The packet appears to be continuous and of nearly constant thickness over the whole Valles system (4000 km E-W and 600 km N-S), independent of elevation (3-10 km) and age of plateau surface (Noachian through upper Hesperian). The genetic mechanism most consistent with the observed properties of the layers is that they formed *in situ* by diagenesis of pre-existing materials.

**Introduction.** The uppermost walls of the Valles Marineris show layering in color and material strength that are continuous over tens to hundreds of km [1,2], which have been interpreted as lava flows or other "resurfacing units" [2,3]. To better understand the origin of the upper wall layering, we mapped its lateral extent and determined elevations, thicknesses, and stratigraphies for different exposures of the layering using Viking orbiter and Mariner 9 images and elevation data. Images of <60 m/pixel were emphasized. At each examined section of wall, layering was described, and layer thickness was estimated from height of the wall exposure (from mapped topography [4,5]) and the fraction of the wall occupied by the layering.

**Results.** The type example of upper wall layering is taken as the south-east wall of Hebes Chasma, in the head scarp of a large landslide (2°S, 74°W). An upper dark layer, ~50 m thick, forms a "cliff" at the wall top. Beneath is a brighter, slope-forming layer ~260 m thick, followed by a dark, more resistant layer ~ 65 m thick. The rest of the 2 km scarp is bright material (talus?) lacking obvious lithologic boundaries. Layers like these appear within 50 m of the tops of chasma walls throughout the Valles system from central Noctis Labyrinthus (103°W) through eastern Eos (40°W). The layers are best exposed on planar walls, and are commonly not evident on walls with spur-and-gully morphology. Layer thicknesses vary little (Figure 1), and the layering can be traced continuously for ~200-300 km in many places (Hebes, N. Ius, S. Coprates to Eos).

The character of the layering in remarkably unaffected by the physiography of the overlying plateau surface. Layering thicknesses and structure show no relationship with elevation (from 1.5 to 10 km above the datum, Figure 1) or with surface age (from Noachian through upper Hesperian). The layering packet remains at effectively zero depth, even though thicknesses of the post-Noachian Tharsis volcanic sequence varies from zero to > 500 m [7,8]. The layering also continues uninterrupted beneath impact craters up to 30 km diameter (S wall of Ganges chasma, Noachian age).

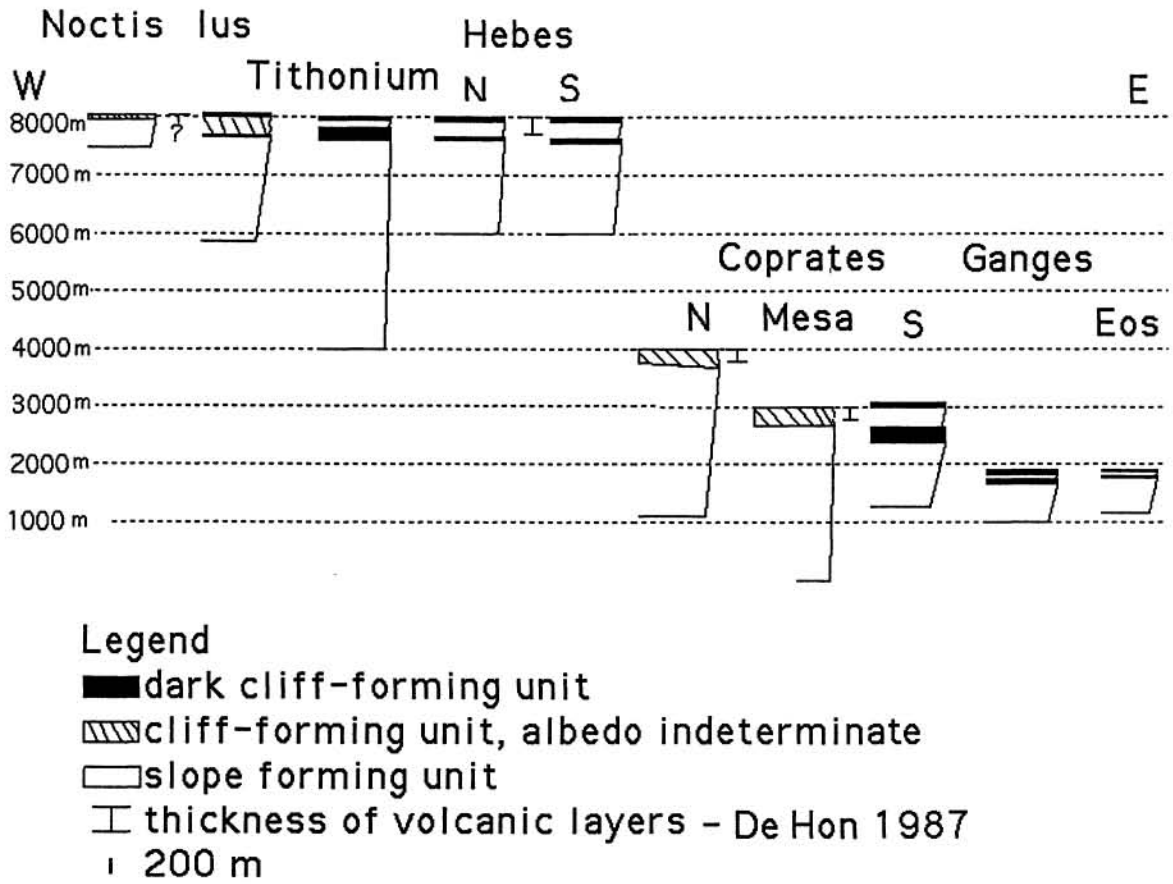
**Interpretations.** The stratigraphy and thicknesses of the layers at the wall tops are relatively constant throughout the Valles Marineris, an area of 4000 km by 600 km; the packet of layers is visible on uncovered, ungullied walls wherever viewing geometry and resolution are adequate. This lateral continuity suggests that the layering packet represents a single geologic feature. It seems unlikely that the layering packet represents a depositional unit, sedimentary or volcanic, because the packet transgresses a time-stratigraphic marker horizon, the base of the Hesperian-age Tharsis volcanic sequence. The plateau surface above the central and western chasma system is of Hesperian age, and is interpreted as volcanic units related to Tharsis. The volcanic sequence ranges to > 500 m thick [7,8], and thins eastward to zero, exposing the underlying Noachian-aged plains units. If the packet were a Noachian-age depositional unit, it would dip beneath the Tharsis volcanic units; it does not. If the packet were a Hesperian-age depositional unit, it should not be present beneath Noachian surfaces nor craters; it is.

A diagenetic origin for the upper wall layering can explain its structure-transgressions, time-transgressions, and lateral extent. Diagenesis controlled by the proximity to the ground surface would transgress subsurface structures. Given similar compositions and permeabilities, all earlier materials might be similarly affected by diagenesis. And diagenetic layers can be of regional

extent, like hardpans or caliches on Earth (though none so extensive as described here). Diagenesis has been invoked to explain 'rock' shapes at VL sites and clodding of near-surface sediment [9,10], but neither for such an extent and thickness as required by the upper wall layers in Valles Marineris.

A diagenetic origin for the upper wall layers has significant implications for the geologic history of Mars. The diagenetic event, suggesting widespread activity of aqueous solutions near the martian surface, affected an enormous portion of the planet relatively recently (upper Hesperian or younger). The diagenesis was controlled by proximity to the ground surface, independent of its elevation, and so could not directly reflect a long-term groundwater table [11]. And, aqueous solutions are not stable at the Martian surface today, so a significantly different pressure / temperature environment must have prevailed at the Valles Marineris at the time of the diagenetic event.

Figure 1. Stratigraphic columns of wall exposures throughout Valles Marineris, emphasizing layering in the uppermost wall. Elevations are relative to the datum [4,5].

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