BRIGHT-HALOED CRATERS IN CHRYSE PLANITIA AND IMPLICATIONS FOR TARGET PROPERTIES.

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Introduction: We study bright-haloed craters seen in northern Chryse Planitia. We combine imaging data from Mars Odessey, Mars Global Surveyor (MGS) and Viking, and use topographic data from the laser altimeter (MOLA) aboard MGS. We also consider the geological map generated by [1]. The results of this analysis and their implications for the origin of these craters are discussed below.

Bright Haloed Craters: The main defining characteristic of the bright-haloed craters in Chryse Planitia is the presence of a bright debris apron that extends for some distance beyond the crater rim (Fig. 1). Often, the distal edge of these deposits possess a wispy appearance. The bright halos around many of the craters are visible in both the old, low-resolution Viking orbiter visible images and in the more recent 100 m/pixel THEMIS infrared images. Other craters have a distinct bright halo in THEMIS infrared but only a faint halo in visible Viking imagery. All bright-haloed craters in Chryse Planitia are small, ranging in size from approximately 1 to10 km in diameter.

Many of the smaller bright-haloed craters have no other obvious ejecta while the larger bright-haloed craters (>9 km diameter) have interior continuous ejecta that appear fluidized and possess a contiguous rampart surrounding the crater (Fig. 1). All of the craters that have bright halos in both Viking and THEMIS images appear fresh, possessing at THEMIS resolution little or no infill, sharp rims and interior structures. The craters with bright halos only in THEMIS images appear more degraded and perhaps older.

THEMIS images (e.g. Fig. 1) also show that small impacts into the bright-halo materials sometimes excavate dark materials that resemble the surrounding terrain beyond. The sharp contrast between these dark and bright materials essentially produce small "dark" haloed craters.

Topographic Expression: Individual topographic profiles obtained by MOLA indicate that the bright halos are very thin and have little topographic expression. They may be associated with an increase in roughness relative to what is seen beyond the halos, but not typically. They may also possess a small rampart-like feature at their distal ends, but such structures could have existed prior to crater formation and may have simply arrested ejecta flow. It is clear from Figure 2, that a large mound to the north of the crater delineates the edge of the bright apron: no material is deposited beyond it. Such shadowing does not typically occur during ballistic ejecta emplacement [2].

Geologic Setting: Many of the bright-haloed craters are found on the scattered deposits of the Ares Vallis unit (HCa) [1] in Chryse Planitia. HCa is interpreted to be Late Hesperian deposits with with a coarse grained or indurated cap. The halos on these craters tend to be just barely visible in Viking images but are quite prominent in THEMIS.

Six of the haloed craters identified in Chryse Planetia are located in fairly close proximity on a small topographic plateau near its northern boundary (Fig. 3). They are distributed on the Chryse Planitia 3 unit (HCc_3), as defined by [1] and are interpreted as Late Hesperian fluvial deposits; HCc_3 is coeval or perhaps just stratigraphically above the HCa unit. The halos around these craters are bright in both the Viking and THEMIS images. Three very small craters (>1 km) are found directly to the south of this plateau in the HCa unit; they too are bright in both Viking and THEMIS images.

It should be noted that not all craters present in the HCa and HCc_3 units are haloed. However, the unhaloed craters are often degraded in appearance and may be older. Furthermore, while there are large deposits of HCc_3 found to the west in Chryse Planitia, no bright-haloed craters are found in this extensive outcrop; whatever factors are responsible for the formation of the halos in this unit, they seem to be limited to the constrained region of the small eastern plateau.

Aeolian processes are responsible for streak deposits on of the south-west side of many craters and other topographic features in Chryse Planitia. These wind-related processes do not seem to affect the bright-halos in any way, as they seem to extend more or less radially around the craters except when obstructed by local topography.

Implications: The bright-haloed craters in Chryse Planitia possess several characteristics:

1) All are located in two geologic units, implying that target properties may be a contributing factor. It is possible that those craters found in the HCc_3 unit may have bright halos because of underlying HCa.

2) Freshness of craters suggests that they may have formed in recent times, under similar atmospheric conditons. Fresher looking craters have bright halos in both visible and infrared imagery while older craters have obvious halos only in THEMIS images. This may indicate an evolution in the nature of the halos with time.

3) The halos possess a wispy distal character, suggesting that they are not the result of ballistic deposition. Such wispy deposits are often seen at the distal edge of fine ejecta deposited during laboratory impacts in an atmosphere [Schultz, 1992].

4) Topography delineates the edge of the flow, and confirms that the bright halos are the result of a

ground-hugging flow. Scouring of the target by a shock is probably not the cause of these deposits [4].

5) Some bright halos have been impacted with small craters that have formed dark halos around them. The dark halo material is similar to the surrounding terrain. This indicates that the dark haloed impacts have excavated to the terrain underlying the bright halo deposits.

6) Wind erosion of surrounding terrain but not of the halos implies that the halo material is either very fine or quite coarse. This conclusion is based on wind threshold analysis [e.g. 5] that indicate that extremely fine-grained materials or coarse grains will not be entrained by common winds.

References: [1] Tanaka K.L., Skinner J.A. and Hare T.M. (2005) USGS Sci. Inv. Series Map 2888. [2] Barnouin-Jha O.S. and Buczkowski D.L. (2007) LPSC XXXVIII, abs. 1304. [3] Schultz P.H. (1992) JGR 97, 11623. [4] Wrobel K., Shultz P.H. And Crawford D.A. (1996) Met. Plan. Sci. 41, 1539-1550. [5] Greeley and Iversen (1997)

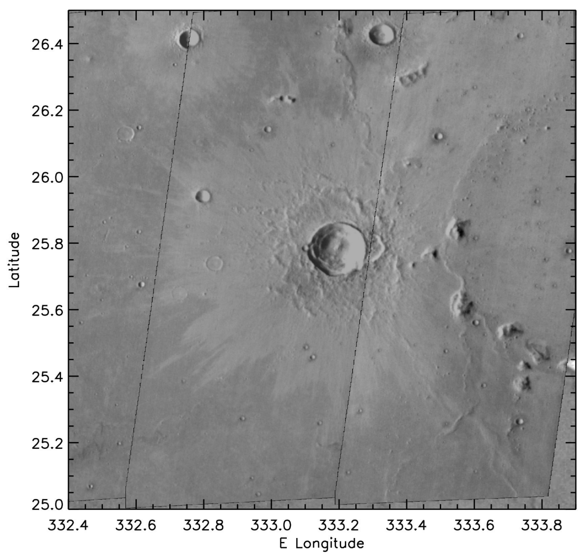

Figure 1. Bright-haloed crater (9.4 km) in Chryse Planitia. A Fluidized ejecta blanket is interior to the halo.

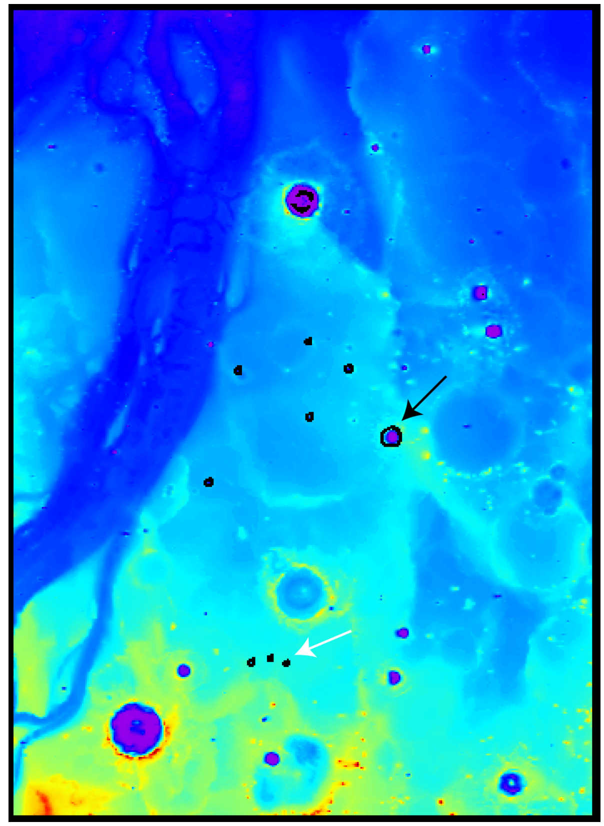

Figure 2. MOLA DTM showing the location of bright-haloed craters (black circles) on a small plateau of the HCc$_3$ unit to the north-east in Chryse Planitia. The plateau has a elevation between that of Chryse Planitia proper to the southwest and the lowland plains to the north. Black arrow points to the crater in figure 1. White arrow points to three bright-haloed craters are in the HCa unit.