BRIGHT-HALOED CRATERS IN CHRYSE PLANITIA. D.L. Buczkowski[1], O.S. Barnouin-Jha[1], F.P. Seelos[1], K.D. Seelos[1], E. Malaret[2], C. Hash[2] and the CRISM team, [1]Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723 (Debra.Buczkowski@jhuapl.edu), [2]Applied Coherent Technology (Herndon, VA 20170)

Introduction: Bright-haloed craters (Fig. 1) have been observed in Chryse Planitia. We study these craters using 1) imaging data from Mars Odyssey, Mars Global Surveyor (MGS) and Viking, 2) spectroscopic data from CRISM, 3) topographic data from the laser altimeter (MOLA) aboard MGS and 4) the geologic map generated by [1]. The results of this analysis 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). The bright haloes are often wispy in appearance and many 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. 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 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 and may possess a small rampart-like feature at their distal ends. A large mound to the north of one 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: Eight bright-haloed craters are located in fairly close proximity on a small topographic plateau near the northern boundary of Chryse Planitia (Figs. 2,3). They are distributed on an outcrop of the Chryse Planitia 3 unit (HCc$_3$) [1], which is interpreted

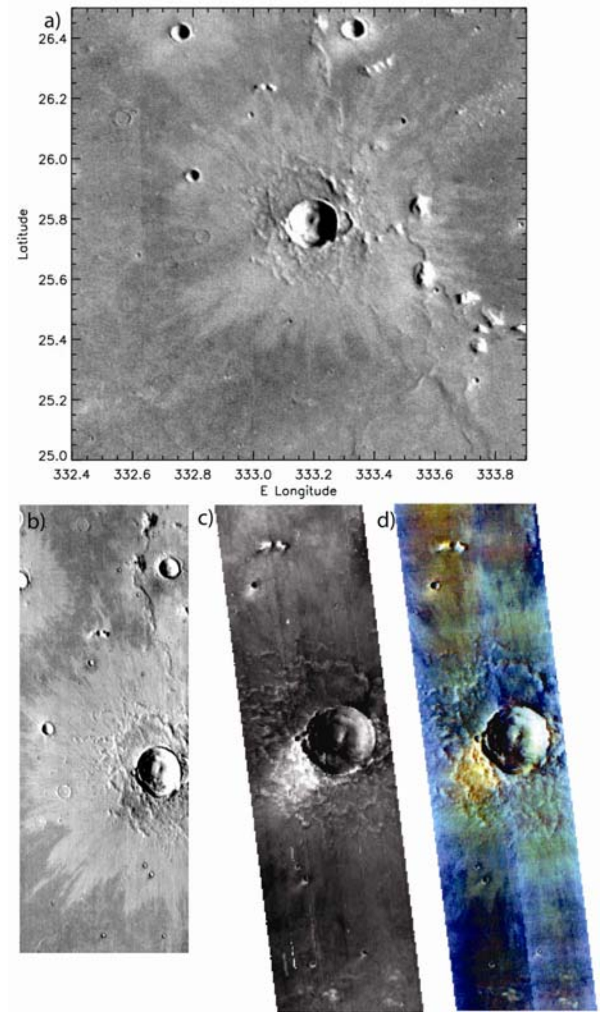

Figure 1. A 9.4 km diameter bright-haloed crater in Chryse Planitia. A fluidized ejecta blanket is interior to the halo. a) Viking image. b) THEMIS daytime infrared image I11235012. c) Mosaic of CRISM infrared albedo (1300 nm I/F) mapping strips 3E6C (left) and 47E7 (right). d) Enhanced RGB composite of CRISM VNIR (red=684 nm; green=534 nm; blue=443 nm) showing significant spectral variability.

as Late Hesperian fluvial deposits. There is also a bright-haloed crater on an outcrop of the HCc$_3$ unit within Ares Vallis (Fig. 2). The halo around this crater is bright in both the Viking and THEMIS images.

Four very small craters (>1 km) are found on the Ares Vallis unit (HCa) [1] directly to the south of the plateau (Figs. 2,3); outcrops of HCa are also found within Ares Vallis near the bright-halo crater. HCa is interpreted to be Late Hesperian deposits with a coarse grained or indurated cap and is coeval to (or perhaps stratigraphically just below) the HCc$_3$ unit. These haloes are bright in both Viking and THEMIS images. However, two other bright-haloed craters are found on HCa deposits in central Chryse Planitia (Fig. 2). The halos on these craters are just barely visible in Viking images but are prominent in THEMIS infrared.

There is also one bright-halo crater on unit HCc$_4$ (debris flows and fluvial sediments from Simud and Tiu Valles) in western Chryse; this halo is moderately bright in both Viking and THEMIS images. It should be noted that not all craters present in the HCa, HCc$_3$ and HCc$_4$ units are haloed. However, the un-haloed craters are often degraded in appearance and may be older.

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) Target properties may be a contributing factor in the formation of bright haloes. It is possible that those craters found on the HCc$_3$ and HCc$_4$ units may have bright halos because of the excavation of underlying HCa. Craters on the HCa unit may have less bright halos because there is less color contrast between the excavated ejecta and the surface material.

2) Freshness of bright-halo craters suggests that they may have formed in recent times, possibly under similar atmospheric conditions. Many older appearing craters have no bright deposit of any type, either halos or streaks.

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 [3].

4) Topography often delineates the edges 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 dark-haloed smaller craters. The dark halo material is similar to the surrounding terrain. This indicates that the dark haloed impacts have excavated the terrain underlying the bright halo deposits.

6) The size of the bright-halo particles can be constrained. THEMIS and CRISM images show that the halos are bright in daytime IR and dark in nighttime IR, indicating that the particles are fine. However, wind erosion of surrounding terrain but not of the halos implies that the halo material is coarser than 20 nm. This constraint is based on wind threshold analyses [eg. 5] that indicate that coarse grains will not be entrained by common winds but could be by stronger, impact-generated winds or other types of flow.

7) Preliminary CRISM analyses show that there is significant spectral variability between the bright halos and the surrounding terrain (ex. Fig. 1), indicating differences in chemical properties.

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., Schultz P.H. And Crawford D.A. (1996) Met. Plan. Sci. 41, 1539-1550. [5] Greeley and Iversen (1997)

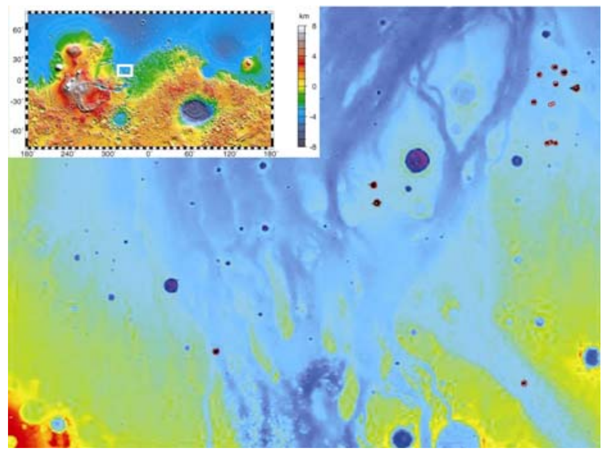

Figure 2. Mars topography from Mars Orbiter Laser Altimeter (MOLA) of Chryse Planitia. Red circles show the locations of bright-haloed craters.

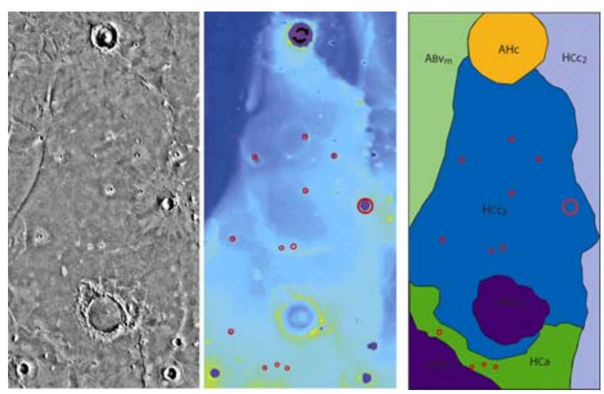

Figure 3. a) Viking image of 23.5°- 29.5°N, 26.5°- 30.5°W, showing the location of bright-haloed craters on a small plateau of HCc$_3$ unit in NE Chryse Planitia. b) MOLA DEM of the region; bright haloed craters are marked by red circles. c) Geologic map of the region, adapted from [1].