Ejecta Deposits of Large Martian Impact Basins: A Useful Geologic Tool and Window to Early Martian History? ***Kenneth S. Edgett,*** *Department of Geology, Arizona State University, Tempe, AZ 85281.*

The recognition of basin ejecta deposits is considered to be an important key to the interpretation of martian cratered highlands geology [1]. Because most of the basins are very ancient (Early and Middle Noachian [2]), they are important to understanding the nature and composition of the early martian crust. If recognized, basin ejecta deposits could be used as stratigraphic tools to correlate the timing of early events in the martian cratered highlands, as was done on the Moon [3,4] and Mercury [5,6]. Basin ejecta are also considered to be desirable materials to return to Earth for study, because they permit the sampling of deep, ancient crustal materials and can aid in the absolute dating of the martian stratigraphic record [7,8].

The main problem with the study of impact basin ejecta on Mars is that the deposits are generally not recognized through photogeologic study. Features characteristic of basin ejecta (radial valleys, troughs, grooves, and secondary crater chains) are not observed near most basins. Although King [8] has reported to the contrary, this is particularly true of Hellas Basin and the other large basins, Argyre and Isidis.

A survey of martian basins ≥ 200 kilometers in diameter has been completed, in order to assess the preservation state of their ejecta deposits. The very ancient and highly degraded basins descibed by Schultz *et al.* [9] are not included here, because they were treated in that earlier study. There are about 19 basins ≥ 200 km in diameter, excluding those of [9]. Three of these are Hellas, Isidis, and Argyre. For the most part, their ejecta are not recognized. A fourth is tentatively labeled "South Polar" (82.5°S, 267°W; 850 km diam.) [10], and it, too, shows no ejecta deposit. The remaining basins of concern in this study are those 200 - 500 km in diameter. Of these 15 basins, only two have significant observable ejecta deposits. One of these is the youngest basin on Mars, Lyot (50°N, 331°W; 200 km diam.), considered to be Early Amazonian in age [2]. The other basin is Herschel (14°S, 230°W; 300 km diam.), which has at least 95,000 km^2 of preserved continuous ejecta; and it is older (Middle Noachian) than Lyot [11]. The basins Newton (41°S, 157°W; 300 km diam.), Huygens (14°S, 304°W; 460 km diam.), and Schiaparelli (3°S, 344°W; 470 km diam. [1]) are the only others which definitely show the types of radial features which are landforms associated with the emplacement of ejecta. The other basins ≥ 200 km in diameter show a range of states of preservation, but most seem to lack ejecta material. Some notes on these basins are listed below.

Consequently, the use of martian basin ejecta as a photogeologic stratigraphic tool is impractical for two reasons. The first is that the basins are widely separated from each other [12]. Even in Arabia, where there are five basins with diameters ≥ 200 km, the continuous ejecta deposits could not overlap. Secondly, most of the ejecta deposits have been greatly modified by depositional and erosional processes [13, 14, 15]. Subsequent meteorite impacts and aeolian processes have probably dominated the erosion of ejecta. Fluvial or sapping processes have also operated (*eg.* radial channels in Herschel Basin ejecta [11]). Much of the ejecta of these basins has probably been *buried* by volcanic and aeolian deposits [13, 16, 17].

As a potential material for unmanned sample return, basin ejecta may be a poor candidate. There are three reasons for this: (1) basin ejecta deposits are largely buried or eroded, as stated above, (2) an ejecta deposit would not likely provide a smooth, safe site for robotic landers and rovers, and (3) because these basins are mostly very ancient (Early-Middle Noachian, 3.85 or 4.2 to 4.6 billion years old [2]), the ancient crustal rocks they have exposed will likely be chemically altered and weathered.

The potential for using martian basin ejecta deposits as windows to martian geologic history is not diminished, however. A careful study of the erosional and depositional processes which have acted upon them may reveal clues to local, global, and historical climatic conditions. Study of weathered samples of ejecta will provide additional insight to these issues, as well as information about the crustal composition and age. Careful field studies of buried ejecta deposits by geologists *on* the surface of Mars will eventually make it possible to correlate the timing of basin-forming events, and to study early crustal materials exposed in basin ejecta and within the basin walls and central peaks.

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MARTIAN BASIN EJECTA MODIFICATION: PRELIMINARY NOTES FOR BASINS ≥200 KM, ≤500 KM (Except Lyot)

Schmidt (-72°, 79°) Diam. ~200 km [MC-30-D]
- -some radial texture preserved
- -appears to be buried by (layered?) mantling deposits
- -also has several superimposed craters

"Unnamed" (-42°, 123°) Diam. ~200 km [MC-24-NE]
- -tectonically disturbed in NE
- -volcanics in NE, SE
- -channeled 'ejecta'? in SE

Secchi (-58°, 258°) Diam. ~205 km [MC-28-SE]
- -radial "fluvial" channels
- -lies in heavily fractured Hellas Mts. material
- -some smooth materials mantle area

Kepler (-47°, 219°) Diam. ~210 km [MC-29-NC,SW]
- -modified by impacts, some radial channels
- -tectonic disturbances in SE and E?
- -might be partly buried in N,NE
- -possible secondary chain to NW

Flaugergues (-19°, 341°) Diam. ~220 km [MC-20-SW,NW]
- -some radial grooves, valleys
- -burial and tectonic disturbance to SE
- -ejecta difficult to recognize

Galle (-51°, 31°) Diam. ~220 km [MC-26-SW,SE]
- -located in Argyre Mts. material
- -some radial features (ie. grooves to E)
- -much ejecta may be eroded
- -probably mantled, as well

Koval'skiy (-30°, 141°) Diam. ~280 km [MC-24-NC, MC-16-SE]
- -greatly modified by volcanic materials from S. Tharsis area

Copernicus (-40°, 169°) Diam. ~290 km [MC-24-SW,NW]
- -tectonically disturbed in NE
- -no 'ejecta' visible?

Herschel (-14°, 230°) Diam. ~300 km [MC-22-NE,SE]
- -ejecta preverved in NW,N,NE,SE
- -channels radial to basin
- -possible burial ? in SW
- -several superimposed impacts
- -(see Edgett *et al.*, 1988)

Newton (-41°, 157°) Diam. ~300 km [MC-24-NW,NC]
- -some radial features
- -secondary chains to SE, N
- -tectonic disturbance in W
- -channels in E

IMPACT BASIN EJECTA
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Cassini (24°, 328°) Diam. ~400 km [MC-12-NE]
-numerous superimposed impacts
-burial by volcanics (?) in SW,W,NE

Antoniadi (22°, 299°) Diam. ~400 km [MC-13-NW]
-buried by volcanics in SE
-disrupted by impact (Baldet Crater) in NE
-radial grooved to S,N
-S,W,N- hard to distinguish ejecta from surrounding terrain

Huygens (-14°, 304°) Diam. ~460 km [MC-21-NW,SW]
-numerous radial grooves, channels
-some burial by volcanics in N,NE,W?

Schiaparelli (-3°, 344°) Diam. ~470 [MC-20-NW, MC-12-SW]
-radial grooves ESE, SSW (some ejecta present?)
-burial in SE, SW, N, NW(?) by volcanics
-radial channels evident
-(see Mouginis-Mark *et al.*, 1981)

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