GLOBAL DISTRIBUTION OF ON-SET DIAMETERS OF RAMPART EJECTA CRATERS ON MARS: THEIR IMPLICATION TO THE HISTORY OF MARTIAN WATER. Joseph M. Boyce, NASA Headquarters, Washington, DC 20546, David J. Roddy (Scientist Emeritus), Lawrence A. Soderblom, and Trent Hare, US Geological Survey, Branch of Astrogeology, Flagstaff, AZ. 86001.

It has been suggested that Martian fluidized ejecta craters hold historical information about subsurface water on Mars (1, and numerous others), because they most likely result from volatiles in the target materials (2, 3), though atmosphere effects have been proposed as an explanation for these craters (4, 5). As a result, their onset diameters have been used to map the depth to the volatile-rich layer in the Martian crust (6,7,8,9,10,11,12, 13, 14). Most of these maps show a general pole ward decrease in size; reflecting the increased pole ward stability of ice in the regolith. However, these maps lump all types of fluidized craters together. We have extended this concept (6, 7, 13, 14), proposing that the major morphologic types (pedestal vs. rampart) of fluidized ejecta reflect differences in the phase of water in the target materials, and differences within each types (e.g., multiple layer vs. single layer ejecta) are the result of such factors as gravity, or size (6,7, 13, 14). Based on crater formation and emplacement mechanics, we have suggested that rampart ejecta craters are produced by water-rich target materials while the other major types of fluidized ejecta craters are mainly produced by ice in the target.

In this study, we have extended our earlier regional mapping (13,14) of rampart craters onset diameters (Dr) globally in an effort to provide information about the historical presence of water in the Martian subsurface (Figure 1). There are numerous pit falls using this general approach (15,16) and are considered in this study. The resultant map is based on rampart crater onset-size measured in 5x5 degrees grid cells. The onset sizes range from sub-Km to nearly 30 Km and are recorded in 1 km bins for preliminary analysis. Some cells contain no rampart craters, which may result from the absence of such craters in an area (i.e., no subsurface water ever existing in that area, or young age surface with no craters large enough to excavate to water), image resolution too poor to support data collection (1-2% of the areas) or terrain types that prevent reliable identification (e.g., extreme rough). The greatest concentration of these zero cells is above 30 N, below 60 S, and the central Tharsis region.

A preliminary evaluation of the map suggests that are global and regional units or trends that correlate with geographic and geologic features (correlation does not necessarily mean causation or connection). There is a global latitudinal symmetry of values center on about 20-30 S latitude, with Dr values generally increasing pole ward. North of about 30 N. to the pole, Dr values generally contains large values of Dr (from 12 to 30 KM) that continuously increase in value with increasing latitude. The region from about 30 N. to the equator, and from about 45-50 S. to the South Pole contains mostly intermediate (5-11 KM) Dr values, though there is considerable local variation in the southern most region. The smallest values of Dr (1-5 KM) are mainly cluster in regions from the equator to about 45-50 S.

In the polar regions, onset diameter of undifferentiated fluidized ejecta crater show a progressive decreases in size from about 30 latitude pole ward, consistent with the stability of ground ice. In contrast, in the northern hemisphere , rampart craters show an inverse relationship where Dr increases continuously to the pole - consistent with that expected for the freeze/thaw isotherm in the subsurface. But, in the southern polar regions the mirror image of this trend is not observed. This could reflect the differences in age and geologic historical of the two polar regions (e.g., differences in climate and crustal thermal histories recorded by each region since its formation). Areas containing the smallest Dr values are concentrated in the old cratered highlands southerly of Tharsis region, and northwest of the Argyre basin. This distribution of small Dr values may reflect a connection with the Tharsis uplift or conditions in a global groundwater system.

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Figure 1