RELATIVE AGES OF MARTIAN TERRAIN UNITS; N.G. Barlow and R.G. Strom, Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona 85721

Lunar, mercurian, and martian craters larger than 8km in diameter have crater size/frequency distributions which display two distinct crater populations. These two populations have different slopes and crater densities. A Chi-square statistical test indicates that the two populations are different at the 99% confidence interval. The heavily cratered regions of the terrestrial planets show the same highly structured curve which cannot be represented by a single-slope distribution function at all crater diameters. This crater population was emplaced during the period of heavy bombardment, which ended about 3.8BY ago on the moon. The origin of the objects responsible for the period of heavy bombardment is uncertain: left-over accretional remnants (Ref.1), asteroids (Ref.2), or comets (Ref.3) have all been suggested. Most of these origins have orbital dynamics which suggest that the end of heavy bombardment occurred essentially contemporaneously within the inner solar system, although for accretional remnants the period of heavy bombardment may have been extended at Mars by Mars-crossing objects (Ref.1,4). A younger crater population, which shows an approximately -3 slope over the diameter range 8 to 70km, is retained on the plains regions of Mars and the moon. Thus, at about 3.8BY ago, at least in the Earth-Moon vicinity, the family of objects responsible for the period of heavy bombardment became extinct, and the subsequent cratering record was caused by a second family of objects (probably asteroids and comets) which has impacted up to the present time.

Mars exhibits a number of terrain units with various crater densities. These units can be dated relative to the end of heavy bombardment depending on whether they show a highlands crater size/frequency distribution or a plains distribution. Furthermore, the relative ages of the units within these two time divisions can be determined by crater densities.

Relative age dating of the various Martian terrain units was last done on a global basis using Mariner 9 data. The more detailed Viking data has not yet been used for a planetwide analysis, primarily because the data was not in a convenient form for mapping until recently. In an attempt to update the Martian relative age chronology, we have divided the surface of Mars into approximately 25 terrain units, based on existing Mariner 9 geologic maps and extensive remapping using the USGS Viking 1:2M photomosaic series. We have mapped and measured all craters greater than 8km in diameter across the entire Martian surface. Use of this large crater population minimizes the problems associated with the use of smaller craters (<5km in diameter), such as erosion and inclusion of secondary and endogenic craters. We have classified all the measured craters by terrain type, ejecta and interior structure, relationship to tectonic features, and whether the crater pre- or post-dates the surrounding terrain.

All regions of a particular terrain type across the planet have been combined and crater size/frequency distributions have been determined using relative plots. Average ages relative to the end of heavy bombardment have been obtained based on the shape of the crater distribution curve, and average ages among the different terrains have been obtained by crater densities. Since only large craters have been

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used, large areas have been utilized to make these results statistically significant. These dates should therefore be considered as average ages only, since individual units may contain smaller areas that are either older or younger than the average age of the unit. Localized units of large enough extent have begun to be studied in detail to provide a more complete chronolgy.

In general, about 60% of the Martian surface, located predominantly in the southern hemisphere, dates from the period of heavy bombardment. This includes the floors of the Hellas and Argyre Basins, the volcanic plains near Hellas, and the ridged plains regions of Lunae Planum, Syrtis Major, and Chryse Planitia. The remaining 40% of Mars is situated primarily in the northern hemisphere and has formed since the end of heavy bombardment. The Elysium volcanic region, the outflow channels, and the chaotic terrain are about the same age as the average northern plains. The youngest regions on the planet are the canyons, the polar and equatorial layered deposits, and the volcanic plains and large volcanic constructs of the Tharsis region. Several other localized regions are being studied in order to obtain a more detailed and updated Martian chronology.

References:(1)Wetherill, G.W. (1977) Proc. Lunar Planet. Sci. Conf. 8, p.1-15; (2)Öpik, E. (1951) Proc. Roy. Irish Acad. 54A, 165-199; (3)Shoemaker, E. (1980) Satellites of Jupiter, U. of Ariz. Press, p.277; (4)Wetherill, G.W. (1975) Proc. Lunar Sci. Conf. 6, p.1539-1561.

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