THE MARTIAN CRATERING RECORD AND ITS IMPLICATIONS FOR THE EARLY HISTORY OF THE PLANET. N.G. Barlow, Lunar and Planetary Institute, 3303 NASA Road One, Houston, TX 77058.

Mars, unlike the Earth, displays terrain units which retain the scars from the period of high impact rates occurring early in solar system history. The Relative crater size-frequency distribution plotting technique not only provides a means for determining relative ages of terrain units with respect to each other, but also allows determination of whether a unit pre- or post-dates the end of heavy bombardment based on the shape of the distribution curve (1). Terrains displaying a multi-sloped distribution curve, typical of those seen in the heavily cratered regions of the moon, Mercury, and Mars, date from the period of heavy bombardment, whereas those units with a distribution curve following a power law of -3 differential slope index have formed since the end of heavy bombardment. Using this technique for craters ≥8-km diameter, the relative chronology for Mars has recently been revised based on whether units date from the period of heavy bombardment, the end of heavy bombardment, or the post heavy bombardment period (2, 3).

This revised chronology indicates that 60% of all martian terrain units retain the cratering record from the period of heavy bombardment. These units are primarily located in the southern highlands, but also include the ridged plains regions near the equator and several of the small volcanic constructs located in the Tharsis and Elysium regions. The location of these heavy bombardment-aged volcanoes within the northern plains indicates that the formation of the hemispheric dichotomy occured very early in martian history, contemporaneously if not prior to the formation of the oldest terrain units in the southern highlands (4). The average age of the fretted and dissected terrains along the highlands/plains boundary is younger than the age of most of these small volcanoes, indicating that in general these terrains cannot be used to date the formation of the hemispheric dichotomy, particularly if the dichotomy was caused by a single event (5).

Many of the impact craters within the southern highlands appear to have undergone substantial amounts of degradation since their formation. The degraded appearance of these craters together with the almost exclusive occurance of small valley networks within the highlands has been cited as evidence for a thicker martian atmosphere and higher erosion rates early in martian history (6). Since ejecta blankets are among the first crater features to show the effects of erosion, the shapes of the size-frequency distribution curves of craters with intact ejecta blankets can provide information on whether or not erosion rates decreased substantially prior to the end of heavy bombardment (Fig. 1). Preliminary analyses of relative plots for ejecta craters superposed on the intercrater plains, ridged plains, and northern plains suggest that the curves for the intercrater and ridged plains show a shape and crater density indicative of emplacement prior to the end of heavy bombardment. This suggests that the population of impactors responsible for the period of heavy bombardment still dominated the cratering record when obliteration rates decreased on Mars. The average relative age of the intercrater plains ejecta crater population supports the contention that atmospheric conditions on Mars are substantially different today than they were prior to the formation of the Argyre Basin (7).

References: (1) Woronow, A., R.G. Strom, and M. Gurnis (1982). In Satellites of Jupiter, Univ. Az Press, 237-276. (2) Barlow, N.G. and R.G. Strom (1986). LPS XVII, 24-25. (3) Barlow, N.G. (1987). PhD Dissertation, Univ. Az. (4) Barlow, N.G. (1987). LPS XVIII, 44-45. (5) Wilhelms, D.E. and S.W. Squyres (1984). Nature, 309, 138-140. (6) Chapman, C.R. and K.L. Jones (1977). Ann. Rev. Earth Planet. Sci., 5, 515-540. (7) Schultz, P.H. (1986). NASA TM 88383, 188-189.

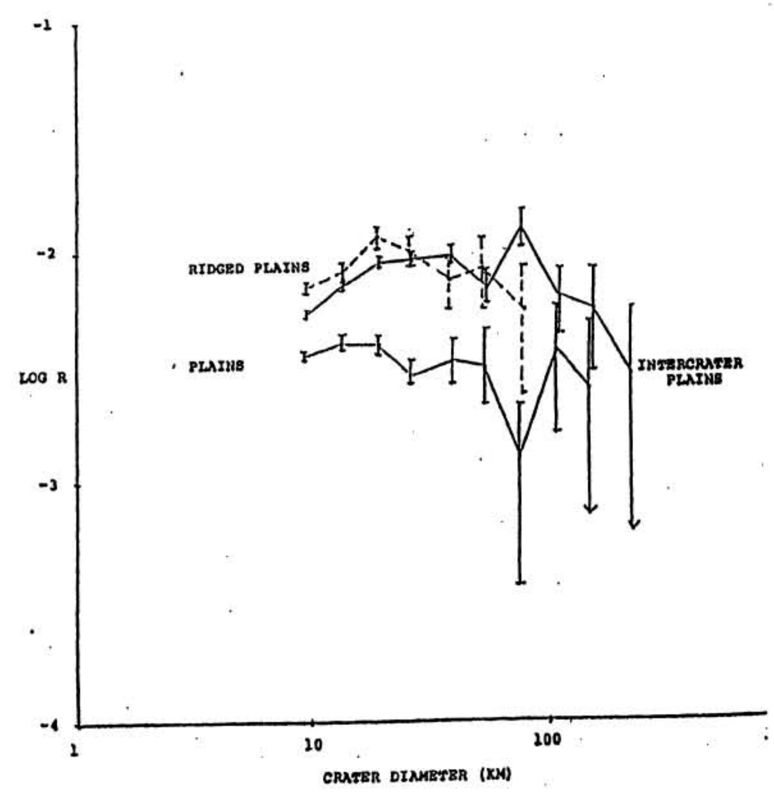

FIGURE 1