MICROMETEORITE CRATERS ON LUNAR ROCK SURFACES

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ABSTRACT

Detailed optical stereomicroscope study of seven lunar rocks (12006, 12017, 12021, 12038, 12047, 12051, 12073) has been made. Common microcraters on crystalline rock surfaces consist of a central glass-lined "pit" surrounded by a crush-zone or "halo" of microfractured crystalline material both of which lie within a "spall" area produced by the impact event. Crater diameters measured range from smaller than .1 mm up to several millimeters. The ratios of halo diameter to pit diameter and spall diameter to pit diameter average 2.3 and 4.5 respectively. The glass lining of most pits is melted host rock. Based on laboratory cratering experiments which yield glass-lined pits, at least 95% of the microcraters observed are interpreted as the impacts of primary cosmic particles moving at relative velocities greater than 10 km/sec. A sharp demarcation line between cratered and completely uncratered rock surfaces indicates that parts of some rocks were buried in the lunar soil. The presence of "ropy splashes" and "welded" dust near the soil line of the rock is evidence of secondary impacts related to primary impacts occurring in the soil near the rock. Microcratering on the millimeter scale is the dominant process causing erosion of rock surfaces exposed to the lunar environment.

Microcrater populations on glass-covered rock surfaces are not "equilibrium" populations, otherwise the cratering process would have removed the glass coatings entirely. The size distribution of these microcraters corresponds with the interplanetary particle mass distribution and indicates that on the log cumulative flux versus log particle mass curve a negative slope of greater than one exists down to masses in the $10^{-7} - 10^{-8}$ gm range. Using currently accepted particle flux data based on satellite-borne experiments a minimum exposure time for the glass surface on rock 12073 is $10^3$ years.

The populations of millimeter-sized microcraters on the most cratered surfaces of all rocks examined are "equilibrium" populations. The minimum time required to achieve the state of equilibrium on the rocks studied is about $10^5$ years.

The mean survival times of the seven rocks are calculated to .5-3.5x$10^6$ years using empirical data on rock destruction by meteroid impact. A similar approach is used to derive a minimum erosion rate of .2 -.4 mm in $10^6$ years. However all these data are heavily dependent on the interplanetary particle flux applied and thus highly tentative.