ON THE RATE OF FORMATION OF SEDIMENTARY DEBRIS ON MARS; Raymond E. Arvidson, McDonnell for the Space Sciences, Department of Earth and Planetary Sciences, Washington University, St. Louis, MO 63130

We now have enough information to place rather meaningful constraints on the current rates of aeolian redistribution of fine grained debris on Mars. For example, from the three years of Viking Lander 1 observations, typical values of sediment redistribution are micrometers per year, although centimeters of loose, disturbed material were removed during a brief interval in the third year (1). Rates of erosion of rocks were too small to be observed, either by tracking changes in morphologies or by tracking changes in rock photometric properties. Consideration of the large number of pristine-looking, small bowl-shaped craters at the Lander 1 site suggests a rate of rock breakdown and removal of only meters over the lifetime of the surface. Thus, averaged over the lifetime of the Chryse Plains, rock breakdown and removal has been meters per billions of years, orders of magnitude lower than the micrometers per year for soils (2). Most of the equatorial regions of Mars likewise preserves ancient surfaces, with craters even at small sizes seemingly in production. Thus, rock breakdown and removal over the equatorial terrains has been quite small for much of geological time. Even the fretted terrains have probably been inactive for a long while, considering that the crater abundances in much of fretted terrain are second in abundance only to the cratered terrains (3). The younger fretted areas seem to be embayed by younger deposits (4) or to be in areas of relatively recent tectonic activity, such as the chaotic terrains. By areal extent, most of the equatorial terrains of Mars have been subjected to very low erosion rates, significantly less than the debris redistribution rates witnessed by Viking Lander 1. Thus, as noted by (2), differential aeolian erosion on Mars is a major geological process, with debris deposits accumulating and eroding to depths of hundreds of meters over geological time, while rock breakdown has been occurring in most regions at vanishingly small rates. Given the low rates of production of new debris, one is forced to conclude that Mars has had a decidedly non-linear history of debris production. In particular, most sedimentary debris must have been produced relatively early, perhaps in the first billion years of geological time. Impact cratering, production of volcanic ash, and chemical corrosion may all have been important debris-forming processes. Given that the mineralogy of martian debris has apparently not come into equilibrium with the present ambient conditions (5), we may have some chance of deciphering the relative importance of various debris forming processes. For example, if analyses of Mars Observer Imaging Spectrometer data show a dominance of palagonitic materials, then early volcanism would be indicated.

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