Dynamic properties of a porous Martian soil simulator under shock compression conditions at pressures of 0.5–1.7 GPa

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As part of the creation of rheological models of the dynamic properties of porous, loose and foamed materials, an experimental study of porous geological materials similar to some types of Martian regolith under conditions of one-dimensional shock compression was carried out. The initial density of the samples and the average grain size are 1.30 g/cm^3 and 95 μm, respectively. The velocity profiles of the free surface of the samples when a compression shock wave arrives on them were obtained by an unequal-arm laser Doppler interferometer. The shock adiabatic of the Martian sand simulator was obtained $U_s = a + bU_p$, where U_s is the wave velocity, U_p is the particles velocity, $a = 0.33$ km/s, $b = 1.64$. It was found that the rise time of the compression wave front decreased from tens of microseconds to hundreds of nanoseconds with an increase in compression pressure from 0.5 to 1.7 GPa. The value of 1.91 of the exponent of the degree of dependence between the rise time and pressure $\tau \propto P^{-m}$ was found. The data obtained are analyzed in comparison with similar ones for granular and silica-rich systems studied earlier. It is shown that in the pressure range of 0.5–1.1 GPa, this parameter can be related to the average grain size. At higher pressures, the data obtained correspond to those for granular systems with an average particle size of about 20 μm, which may be due to the destruction of regolith particles at high pressures.