The idea of visualizing shock wave passage along a dusty (sooty) surface was first proposed and tested by Ernst Mach. High resolution HiRISE images of new impact craters on dusty areas of Mars gave in many cases revealed dark “fresh” halos around craters. In ~7% of cases they have low albedo/color contrasting curved strips near craters referred to as “parabolas” and “scimitars”. We analyze these albedo details as the possible surface footprints of atmospheric shock waves generated during atmospheric passage and shocks from impact cratering by small meteoroids and their fragments. In this approach “parabolas” are the trace of two colliding air shocks propagated from a pair of neighboring craters formed after a meteoroid fragmented during the atmosphere passage. The mechanism of the “scimitar’s” formation is more enigmatic and tentatively could be related to the interaction of the ballistic cone wave and a spherical wave from the point of impact. The study of images is accompanied by numerical modeling of impact of small projectiles at the atmosphere/rock boundary. This modeling constrains the minimum efficiency of an impact to generate the air shock wave in the rarified Martian atmosphere below of 0.1% of the kinetic energy for non-volatile targets. Targets with near surface volatiles could amplified the air blast (if volatiles are presented in the shocked zone). The study is intended to estimate the air-shock wave parameters along the visible surface traces around impact craters. By constraining shock wave parameters opens new possibilities for investigating the mechanical properties of the Martian surface.

The work is supported by RAS program 12 “Universe Origin and Evolution from Earth-based Observations and Space Missions” (BAI), and a grant from the NASA Mars Data Analysis Program, number 80NSSC18K1368.
