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Mars surface dust activation at small meteoroid's impacts

Boris Ivanov
Russian Academy of Scineces, Institute for Dynamics of Geospheres, Moscow, Russian Federation (boris_a_ivanov@mail.ru)

We continue the analysis of HiRISE high resolution images of Mars to understand properties of dust covering the surface. The data on dust devils observed with Mars landers and surface traces of dust devils could be expanded with elongated albedo features imaged near "new" impact sites ("new" means that we have orbital images before and after the meteoroid impact, which give us an estimate of the impact date and the age of a feature). The age of these features is from 0.5 to 12 terrestrial years. From geometric reasons we could assume that the most possible mechanism of this elongated albedo details is the "footprint" of two or more colliding air shock waves, generated at the impact site. Of ~1200 "new" impacts known today, in 18 cases crater pairs or clusters, created with fragments of the same "parent" meteoroid, we recognize 24 thin "parabolas" with a width of 1 to 10 m (0.2 to 10 main crater diameters, *D*), extended to 100 – 400 m (3 to 100 *D*) from the impact site. In ~30 cases near a single crater we observe a curved albedo feature nick-named "scimitar". These features have width, growing with a distance from the impact point. The length varies from 10 to 100 *D*, the width varies from 1 to 10 *D*. Our working hypothesis is that "scimitars" are footprints of ballistic and spherical air shock wave collision at the surface. Both "parabolas" and "scimitars" have an exact bilateral symmetry, which allows us to reconstruct the flight direction of projectiles.

We estimate the equivalent energy of spherical air blasts with two different assumptions for "parabolas" and "scimitars" formation. For parabolas we assume a mechanism, similar to dust devil track formation – the negative pressure excurse uplifts the upper fine dust layer. The main assumption is that the dark parabolic strip width corresponds the wave length of the negative pressure phase in the air shock wave. It gives us the minimum energy estimate as in reality the negative phase could be longer. The negative pressures here along the parabola length decay from about 10 to 5 Pa with the phase duration of a few milliseconds. Such a suction pulse is able to mobilize dust particles 50 to 100 microns in size.

For scimitars, which in contrast to "dark" parabolas are typically "brighter" than surrounding area, we have no a good mechanical explanation of origin. However, with limits of our current model, the spherical "explosion" air blast should be enough energetic, to overrun the ballistic shock wave. From non-linear motion of the shock wave front we can estimate the fraction of meteoroid's kinetic energy, converted to the air blast energy. The model is able to reproduce approximately the scimitar's curvature.