

Estimation of the atmospheric effect on the formation process of Martian fluidized ejecta

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Many Martian craters possess distinctive ejecta morphologies that are probably the result of flow which somehow reflect the uniqueness of the Martian environment. Pedestal craters are known as a subclass of Martian crater with fluidized ejecta. The ejecta of these craters typically possess two layers: a thick inner one and faint outer one. Many grooves extend over both layers. In addition, no boulders at the termination region of the grooves are visible. Depositional features of the inner and the outer layers are so different that two processes of ejecta sedimentation could be possible during a single impact event. This morphology could be the result of high-speed atmospheric winds that scour the ejecta surface to produce the grooves after the deposition of the inner lobes, which are probably initially deposited ballistically.

In order to evaluate whether or not an atmosphere could effect on the emplacement of ejecta on Mars, we have conducted a series of experiments using water and granular particles in which we simulate the Martian atmosphere and its surface, respectively. We generated a vortex ring using a piston and a cylinder and observed the interaction between the vortex ring and the particles with high-speeded digital video camera.

We find three modes of interactions between the vortex ring and the particle:

Mode 1: The vortex ring does not only sweep away the particles but also lifts them up as it expands radially outwards. The depositional morphology represents petal-like shape, radial lineations and other small structures.

Mode 2: This threshold mode is where the vortex ring just barely displaces the particles, generating radial lineations and other small structures. Petal-like deposition features as observed in Mode 1 do not occur.

Mode 3: The vortex ring is too weak and nothing happens.

Two dimensionless number, θ and Reynolds number define when the different modes occur. The θ is the ratio of inertial resistance of the surrounding fluid to negative buoyancy of a particle. It is likely that small vortices known as Görtler instabilities generate the radial lineations and other small structures seen in Mode 1 and 2.

We will also show the beautiful movies of the interaction between the vortex ring and the particles.