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Excavation of sand by impinging jets of gas, with application to lunar landings PHILIP METZGER, NASA Kennedy Space Center, CHRISTOPHER IMMER, ASRC Aerospace, MATTHEW DEYO-SVENDSEN, Stetson University, CARLY DONAHUE, Berry College, ROBERT LATTA, Embry-Riddle Aeronautical University, BRUCE VU, ROBERT YOUNGQUIST, NASA Kennedy Space Center — The erosion of sand by jets of gas is dominated in many cases by an interesting bulk flow of the granular material beneath the surface that occurs when the volumetric drag of gases diffusing through the porous medium produces a shear stress sufficient to unjam the material. Prior studies of rocket-induced cratering of a planetary surface had failed to identify this type of granular flow, which we are calling "diffusion-driven shearing" (DDS). It explains the simple observation that a crater is deepest in the center, despite the fact that the gases are stagnant directly beneath the center of the jet so that the traditional erosion mechanisms cannot possibly occur there, and despite the fact that the stagnation pressure under the jet is generally insufficient to cause the material to unjam. This study has also worked out a number of the scaling laws for the observed logarithmic growth of crater depth and width, and has explained the feedback mechanisms that govern that growth. The results are applied to controlling the blast effects of landing rockets on the Moon.

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