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Return to the Moon (02)
Scientific Highlights and Lessons from Recent Lunar Missions (1)

Author: Prof. Brian J. O'Brien
The University of Western Australia, Australia

RETURN TO INESCAPABLE STICKY DUST ON THE SURFACE OF THE MOON

Abstract

Future robotic and human expeditions to the surface of the Moon will face inescapable sticky lunar dust, as fine as talcum powder but more abrasive than sandpaper. Gene Cernan, last astronaut on the Moon, said "one of the most aggravating, restricting facets of lunar surface exploration is the dust and its adherence to everything no matter what kind ... and its restrictive friction-like action to everything it gets on." Harrison Schmitt, second-last, said "Dust is the Number 1 environmental problem on the Moon." Such expert judgements even after 30 months of 6 Apollo missions, prove that return missions to the Moon will only be cost-effective, productive and successful if they pre-plan and instrument their management and mitigation (MM) of lunar dust. This report by the inventor and PI of the minimalist matchbox-sized 270g Apollo Dust Detector Experiments (DDEs), reviews knowledge of precursor dust basics essential to MM. Basic direct measurements of movements and characteristics of lunar dust were made only by Apollo 11, 12, 14 15 DDEs, with a dozen discoveries since 2007 when 30 million measurements were revisited. Apollo 11 DDE proved jet exhausts of Lunar Module ascent 17m away contaminated the 47kg Passive Seismometer with dust, causing it to overheat by 30C0 and be terminated early. Apollo 12 DDE showed LM ascent at 130m caused cleansing, with different effects on vertical and horizontal surfaces. Radiation effects including extremely intense Solar Proton events of August 1972 were measured by Apollo 12, 14 and 15 DDEs, monitoring almost two-thirds of a solar cycle. The NASA Thermal Degradation Surface (TDS) experiment by Alan Shepard on Apollo 14 tested effects of brushing and tapping of plates with 12 different test surfaces. TDS was lost after quarantine in Houston, and preliminary analyses by Gold in 1971 remained little known until 2011. TDS photos prove cohesive forces among lunar dust particles can bunch them, overcoming adhesive forces or stickyness, vital information for MM. Funding and technological issues for getting to the Moon are extremely challenging. Yet once on the Moon, the inescapable basic challenge before success remains MM of lunar dust, vitally important for thermal control and mechanical movements. Knowledge for MM is progressing from new analyses of Apollo data and laboratory discoveries.