LUNAR DUST EFFECTS ON SPACESUIT SYSTEMS: INSIGHTS FROM THE APOLLO SPACESUITS.
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Systems and components of selected Apollo A7L/A7LB flight-article spacesuits worn on the lunar surface have been studied to determine the degree to which they suffered contamination, abrasion and wear or loss of function due to effects from the dust size fraction of the lunar soil (<10 μm diameter). The study materials included the outermost soft fabric layers on Apollo 12 and 17 Lunar Module Pilot (LMP) Integrated Thermal Micrometeoroid Garments (ITMG), and the wear surfaces of the Apollo 16 LMP Pressure Glove Assembly (PGA) wrist rotation bearings. The Apollo 17 ITMG is notable for having a high level of residual dust contamination due to the duration and nature of the EVA, and the relative lack of post-mission cleaning. A Scanning Electron Microscopy (SEM) study of particles sampled from the Apollo 17 ITMG outer fabric using adhesive tape shows about 70% lunar grains and 30% terrestrial contaminants. Plagioclase feldspar (25-30%) and glass (30-35%) are dominant in the particle count with lesser amounts of pyroxene, ilmenite and olivine. Although pyroxene is minor in the particle count, the grains are large, so that pyroxene dominates the modal abundances, and has a much higher mode on the fabric than in the lunar soil at the Apollo 17 site, especially relative to lunar soil glass. We attribute this to the higher friability of the glass grains, which makes them more likely to comminute and leave the fabric when it is brushed or rubbed. SEM examination of the bearing race surface on the Apollo 16 EVA PGA shows no evidence of increased wear relative to the bearings on intravehicular gloves used on the same mission. This suggests that, at least for the relatively short lunar exposure of the Apollo 16 EVA, the glove gauntlet and bearing designs were sufficient to prevent dust from entering the bearing.