SMALL SATELLITE MISSIONS SYMPOSIUM (B4)
Hitchhiking to the Moon (8)

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LUNACHEM–AN INSTRUMENT TO DETERMINE THE CHEMICAL REACTIVITY OF LUNAR DUST

Abstract

The chemical reactivity of lunar dust may be one of its most important properties, of relevance to pulmonary toxicity for astronauts, and of relevance to lunar dust interaction with other biological systems. From studies of terrestrial materials, we know that water reacts with chemically active minerals to produce hydroxyl radicals and other reactive oxygen species, associated with potent biological effects. We seek to understand the chemical reactivity of lunar dust in similar terms. Indeed, the recent success of LCROSS, which discovered water on the Moon, underscores the importance of defining lunar dust chemical reactivity in the context of interaction with aqueous environments. Ground-based studies using Apollo era specimens provide the foundation of our lunar dust chemical reactivity studies. Although each of the unique features of the Moon-—micrometeorite bombardment, UV radiation, particle radiation, and extreme vacuum—-can be duplicated in the laboratory, combinations of these features can be difficult to accurately reproduce. A further limitation of ground-based studies using Apollo era specimens is the fact that the lunar surface is heterogeneous, elegantly demonstrated by the recent Selene (Kaguya) and LRO missions. Currently available lunar specimens, therefore, may not be representative of future landing sites. These considerations argue strongly for the development of an instrument to measure the chemical reactivity of lunar dust in situ, to be included aboard one or more robotic precursor missions to the Moon. One such instrument, "LunaChem," is a conceptual design that has been under development at NASA Ames Research Center. As envisioned, LunaChem is a compact instrument, with the capability of acquiring a lunar dust sample, delivering the sample to the interior of the instrument, and performing one or more aqueous tests of chemical reactivity. A key feature of LunaChem is the ability to provide environmental control, so that lunar dust specimens are subjected to defined conditions of humidity and oxygen concentration over a period of time, so the decay of chemical reactivity can be measured. An understanding of the decay of the chemical reactivity of lunar dust, once it enters a habitat-like environment, is necessary for designing safe habitats, and for understanding how lunar dust may interact with materials present in the habitat. A variant of LunaChem could include a hand-held device, to be used by astronauts to evaluate lunar dust properties as new regions of the Moon are explored.