SOME SURFACE CHARACTERISTICS AND GAS INTERACTIONS OF APOLLO 14 FINES AND ROCK FRAGMENTS, by D. A. Cadenhead (Principal Investigator), N. J. Wagner, B. R. Jones and J. R. Stetter, Department of Chemistry, State University N.Y. at Buffalo, Buffalo, N.Y. 14214.

Over the past six months a surface study of Apollo 14 fines and rock fragments have been carried out with the following objectives: (1) A correlation of geologic features and lunar events with surface area (2) The observation of internal pore structure (3) An evaluation of the adsorption characteristics of these materials to gases such as nitrogen, hydrogen and water vapor. Objectives 1 and 2 were realized by the observation, through both optical and electron (scanning and transmission) microscopy, of the surface features of the samples, while obtaining the surface area (and co-incidentally the helium density). Helium densities were obtained using a classical B.E.T. volumetric system. Typical density values ranged from 2.7 to 3.1 g/cc, and were used to provide accurate taring of samples for gravimetric adsorption. Surface area were determined by gravimetrically measuring nitrogen adsorption at liquid nitrogen temperatures, using an area/adsorbed nitrogen molecule of 16.2 Å. Surface areas of 0.2 to 1.0 m²/g were found for fines (< 1 mm) and for breccia surface fragments, with considerably lower values for surface crystalline fragments. Preliminary observations indicate that geode and pressure fusion breccia formation enhance surface area, while the formation of glass lined pits through micrometeorite impact reduces surface area.

The electron microscopy in particular reveals that the measured surface areas arise in large part from small particle size (fines), from pressure fusion of small particles to form larger ones (fines and breccia) and from surface roughness. So far we have not observed internal pore structure which arises through rock crystallization accompanied by gas evolution.

Physical adsorption of molecular hydrogen on lunar fines was observed at low temperatures (–197°C) but not at higher temperatures. Possible chemisorption of molecular hydrogen at higher temperatures (up to 130°C) and atomic hydrogen at both low and high temperatures will be studied. Adsorption of water vapor on lunar fines at room temperatures takes place with typical capillary condensation hysteresis at high relative pressures but with complete reversibility at low pressures. This behavior as well as good reproducibility is considerably dif-
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Different from previously reported behavior on lunar fines. These differences could arise through the different nature of the samples, their different pretreatment prior to adsorption studies, difficulties in the calibration of the gravimetric system, or a combination of all three.

Our observations, so far, are that those factors which most increase surface area or roughness are the fracturing of rocks to fine particles as well as the accompanying light pressure fusion processes. The formation of geodes and glass lined micrometeorite pits in crystalline rock materials appear to produce only small increases or decreases in surface area. Molecular hydrogen will have no effect on the chemical composition of exposed materials at low temperatures (-130 to 0°C) but may do so at higher temperatures (0°C to 130°C). A more likely candidate is atomic hydrogen. Exposure of lunar materials to water vapor has not shown any rapid weathering effects, hence brief accidental exposures to an earth-like atmosphere is not likely to be harmful. Under lunar conditions, any water vapor to which these materials might be exposed, would rapidly be lost.

References


Water Adsorption $T = 37.5^\circ C$

$\Delta \mu$ in $\mu g$

$P$ in torr

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