

SOLAR WIND-INDUCED SECONDARY IONS AND THEIR RELATION TO LUNAR SURFACE COMPOSITION; R. C. Elphic, H. O. Funsten III, Space Plasma Physics Group and Geology and Geophysics Group, Los Alamos National Laboratory, Los Alamos, NM 87545, R. L. Hervig, Center for Solid State Science, Arizona State University, Tempe, AZ 85287

Based on previous laboratory experiments simulating solar wind sputtering of lunar surface materials, it appears that solar wind ions sputter secondary ions in sufficient numbers to be measured from low-altitude lunar orbit. Solar wind protons are hundreds of times less efficient than those used in standard secondary ion mass spectrometry; nevertheless secondary ions of Na, Mg, Al, Si, K, Ca, Mn, Ti and Fe were observed sputtered from sample simulants of mare and highland soils. These secondary ion fluxes depend both on concentration in the soil and on probability of ionization; yields of easily ionized elements such as K and Na are relatively much greater than those for the more electronegative elements and compounds. The principal geochemical indicator elements Na, Mg, Al, Si, K, Ca, Ti, Mn and Fe are nevertheless detectable. However, it has not been shown that the observed secondary ions vary strictly one-to-one with their concentrations in the geochemically distinct soil simulants used here.

While we have a first order understanding of secondary ion sputtering, it is not clear that the observed ion yields can be linked with great accuracy to the simulant's composition. The simulants were analyzed by electron microprobe to establish their detailed composition. The observed secondary ion fluxes can then be compared with the microprobe results. For example Ti^+ fluxes from the three simulants correspond to the true composition with accuracies of better than 10% for the high-Ti basalt, and about 20% for the low-Ti simulant. The highlands simulant produced a statistically insignificant Ti^+ count rate.

Similar results were obtained for the elements Al, Fe, Ca, and K. However, the response of Mg ions did not correlate well with composition under any circumstances. Na content did not vary enough between samples to do the comparison. We suspect that cross-contamination and/or profound surface effects contributed to the lack of correlation between the microprobe results and the hydrogen sputtering results.

Here we discuss the results of further SIMS experiments using the ASU/Center for Solid State Science facility. With careful isolation and preparation of samples, we avoid the problems of the previous experiments. In particular, we will make use of ground-up sample to mimic the sputtering behavior of regolith, and will avoid charging by placing the soil on a conducting indium substrate. We report the results of a blind test of the SIMS technique using a sample of unknown composition.