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THE SECOND CONFERENCE ON THE LUNAR HIGHLANDS CRUST AND NEW DIRECTIONS

Revised mineral and Mg# maps of the Moon from integrating results from the Lunar Prospector neutron and gamma-ray spectrometers with Clementine spectroscopy†

Sarah T. Crites[1,*] and Paul G. Lucey[1]

[1]Hawai'i Institute of Geophysics and Planetology, University of Hawai'i at Mānoa, 1680 East West Road, POST 602, Honolulu, Hawaii 96822, U.S.A.

Abstract

Mineralogical measurements from spectral remote sensing and remote geochemical measurements from gamma-ray and neutron spectrometers are complementary data sets that have been used together successfully to study the distributions of iron, titanium, and rare earth elements on the Moon. We compare neutron and gamma-ray data sets from Lunar Prospector and find them in good agreement with each other within the errors of previously developed equations that relate neutron flux with geochemistry, but find small adjustments to the nominal values are warranted. We used the neutron-validated LP GRS oxides to improve Clementine-based global mineral maps. The comparison was enabled by converting the minerals of Lucey (2004) to oxides using stoichiometry and assumptions about Mg#, calcium content of clinopyroxenes, and An#. We find that FeO and Al_2O_3 derived from the maps of Lucey (2004) do not follow the expected negative correlation seen in lunar samples, but can be brought into agreement with samples and with LP GRS oxides by increasing plagioclase in proportion with orthopyroxene abundance, while simultaneously decreasing Mg#. We interpreted this to mean that plagioclase and orthopyroxene exist in rocks together (as in a noritic rock) with the spectrally difficult to detect plagioclase being masked by the strong spectral signature of the orthopyroxene. We generated a revised set of maps of the major lunar minerals and a map of Mg# for the mafic minerals that are consistent with Lunar Prospector neutron and gamma-ray spectrometer results and show greatly improved agreement with lunar soil samples over previous global mineral maps from Clementine.

Keywords: Remote sensing, mineralogy, lunar magma ocean, neutron spectroscopy, gamma-ray spectroscopy, visible spectroscopy