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ILMENITE DETECTION ON THE MOON BY REMOTE SENSING: AN INTEGRATION OF MULTISENSOR DATASETS OVER MARE AUSTRALE AND MARE INGENII REGIONS

Abstract

Ilmenite (FeTiO3), the fourth most abundant mineral on the Moon, is a valuable resource because the titanium and oxygen it contains can be extracted for in situ resource utilization. Mapping lunar ilmenite concentrations would thus help in the establishment of a permanent base on the Moon. Attempts to map ilmenite concentrations by remote sensing have not led to conclusive solutions, which, in part, is because the ultraviolet (UV) portion of the spectrum (i.e. <415 nm) that would detect the distinctive reflectance properties of ilmenite has not been used. The goal of this study is to develop a reliable method to map ilmenite on the lunar surface using the UV portion of the spectrum. This study focuses on the Mare Australe and Mare Ingenii regions on the far side of the Moon. Hapke radiative transfer theory was used to compute spectra for different proportions of minerals on the Moon (i.e. orthopyroxene, clinopyroxene, plagioclase, olivine, and ilmenite), with varying chemistry, and degree of maturity. These spectra were then compared to those from the Lunar Reconnaissance Orbiter's Wide Angle Camera (LROC-WAC) multispectral dataset (320-690 nm) integrated with the Clementine UVVIS/NIR multispectral dataset (415-2000 nm). Our results were evaluated using the "maximum possible" ilmenite content, which was calculated by dividing the abundance of titanium in a pixel (i.e. values taken from the most accurate titanium map derived from Clementine data) by the abundance of titanium in stoichiometric ilmenite. The most accurate titanium map derived from Clementine data was calculated using the algorithm of Shkuratov et al. 2005 because it gave the best correlation with Lunar Prospector data compared with two other titanium algorithms. With the titanium data obtained using the Shkuratov et al. 2005 algorithm, we calculated that the maximum ilmenite content is up to 6-8 % for the Mare Australe region and up to 3-5 % for the Mare Ingenii region. Their average ilmenite content is respectively 1.92 % and 1.49 %. Our preliminary results showed that the maximum ilmenite content found in the two regions of our study is 8 %. The maximum possible ilmenite content will subsequently be compared to the mineral mapping results using LROC-WAC data integrated with Clementine UVVIS/NIR datasets.