



When using the UVVIS ratio to estimate TiO₂ content, FeO content matters.

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The ultraviolet-visible (UVVIS) color ratio, used to estimate the TiO₂ composition of mature mare basalts, is one of the most widely used spectral parameters in lunar exploration. We combine Clementine, Lunar Prospector, and sample data to evaluate between two models that propose different explanations for the relationship between UVVIS color and TiO₂ content and its limits. The first model attributes the correlation between TiO₂ and UVVIS color to spectrally neutral opaques (i.e. ilmenite), while the other emphasizes the effect of Fe-Ti charge-transfer in lunar glasses and dual scattering mechanisms between high- and low-Ti basalts. Examination of the remotely sensed data reveals that the correlation between UVVIS ratio and TiO₂ composition is best represented by a sigmoidal trend rather than the canonical linear or curvilinear correlation. Interpretation of the sample data suggests that in addition to ilmenite/TiO₂ content, factors such as bulk FeO content, ilmenite grain size, modal abundance of plagioclase, and the olivine-to-pyroxene ratio in a mare soils can influence the UVVIS continuum. We do not find evidence in the spectral data to support the occurrence of Fe-Ti charge-transfer in lunar glass as the principal cause for color in high-Ti basalts. The data also do not substantiate the existence of different scattering mechanisms (e.g., volume v. surface scattering) between high and low TiO₂ basalts. These findings point to promising avenues of research that future UVVIS spectral techniques can exploit in order to yield more accurate TiO₂ estimates and potentially additional petrologic information.