

COMPARISONS OF LONG-WAVELENGTH RADAR
ECHOES OF THE MOON WITH LUNAR SURFACE
COMPOSITIONS

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We examined long-wavelength (70-cm and 7.5-meter) radar scatter from moon in order to gain some insight into the structure and chemical composition of the lunar surface. Radar backscatter values from the lunar maria were compared with models for (1) quasi-specular scattering from the surface-space interface, (2) echoes from a buried substrate, and (3) Mic scattering from surface and buried rocks. The 70-cm echoes agree best with our third model, Mic scattering from buried rocks. Depolarized radar echoes from the moon are likely due to a combination of single and multiple scattering events, although single scattering could account for the observed echo powers, based on a comparison with rocky terrestrial surfaces.

Although lunar radar backscatter strength in the Mic scattering model is controlled by loss tangent, we could not find a clear variation between the 70-cm echo powers and the mineral content of lunar soils. We compared the radar backscatter values with titanium and iron oxide contents inferred from optical observations. Although the radar image correlated well with the unit boundaries defined from optical color differences, the 70-cm backscatter values did not correlate well with [titanium]-oxide abundances derived from earth-based multispectral observations nor from iron abundances derived from Clementine spacecraft observations. However, the 7.5-meter backscatter values did correlate with iron contents suggesting that loss tangent at this wavelength is controlled by the abundance of iron oxide.

All of this suggests that radar and multispectral optical data can provide insights into lunar surface composition. For example, the low-radar echoes associated with cryptomare areas indicate changes in chemical composition with depth. The low-radar echoes associated with radar-dark halo craters indicate changes in chemical composition and/or subsurface rock populations.