ELECTRICAL PROPERTIES AT 450 MHz OF APOLLO 15 AND 16 DEEP DRILL CORE SAMPLES AND SURFACE SOIL SAMPLES AT THE SAME SITES. T. Gold, E. Bilson and R. L. Baron, Center for Radiophysics & Space Res., Cornell University, Ithaca, N.Y., 14853.

Measurements were made on four core samples from different depths below the surface: 15003,645 (from 139 cm depth); 15001,338 (from 229 cm depth); 60002,319 (from 185 cm depth); 60005,97 (from 55-73 cm depth) and also on a surface sample, 60501,81 from the site of the Apollo 16 deep drill core.

The dielectric constant and the loss tangent were determined by the same method as used for numerous samples from all the Apollo missions (1,2). In Figure 1 an average dielectric constant vs. density Rayleigh curve is plotted for all the Apollo 15 and 16 surface soil samples examined by us. (All these Rayleigh curves lie very close to each other.) The data points for the core samples and the Apollo 16 surface soil from the site of the deep drill core are shown in this figure as well. The behavior of the core samples conforms to that of the surface samples with the exception of 15001. The deviation of the data points of this sample from the average Rayleigh curve exceeds the error limits of the determination ($\pm 5\%$).

The voltage absorption length, l_a, in wavelengths ($l_a = \frac{1}{\pi (k')^{1/2} \tan\delta}$, where k' is the real part of the relative permittivity or dielectric constant and $\tan\delta$ is the loss tangent) vs density Rayleigh curves for the core samples are shown in Figures 2 and 3 along with the most and least absorbent surface samples. The absorption length in 15003,645 is similar to that in the most absorbent Apollo 15 surface sample which originated from the vicinity of the collection site of the core. Sample 15001,338, which originates deeper below the surface, is much less absorbent. The absorption lengths in the two Apollo 16 core samples examined are very similar to that in the surface sample collected at the site of the core.

These results indicate significant variations in the electrical properties in the Apollo 15 deep core and virtually no variation in the Apollo 16 deep core. We have had the opportunity of measuring only very few samples so far. The results parallel the chemical data (3): the major elemental abundances are the same, within 1%, in our Apollo 16 core samples and the surface sample from the site of this core, whereas there are significant differences between the composition of 15001,338 and that of 15003,645.

Recently (2) we have shown a correlation between the bulk iron + titanium concentration in the soil samples and their absorbency. Interestingly, the iron concentration is approximately 20% higher in 15001,338 than in 15003,645, however the former is much less absorbent (the titanium concentration is the same in both samples). 15001,338 also has an anomalously high albedo for an iron rich soil sample and surface chemical analysis by Auger spectrometry shows only a slight average iron enrichment on the surface of the grains (3). All these observations may be taken to indicate that this sample represents a soil layer that has suffered particularly little surface exposure, and has therefore not obtained the modifications of the optical and electrical properties that would be common for soils of similar bulk composition. It would be interesting to examine cosmic ray track density data and other maturity indices for this sample.

These measurements show that subsurface samples, down to a depth of 229 cm, have also very low values of the radio absorption, within the same range as surface samples. The significance for the interpretation of radar results lies in the fact that no material has been sampled so far that could give a radar obscuration of an interface, at a shallow depth, to coarsely broken rock; yet no radar signal from such an interface is observed (2). Unless an enormously more absorbent material is widespread on the Moon, we have to conclude that coarsely broken rock is not a usual constituent of the subsurface, down to a depth of at least 100 meters.

References

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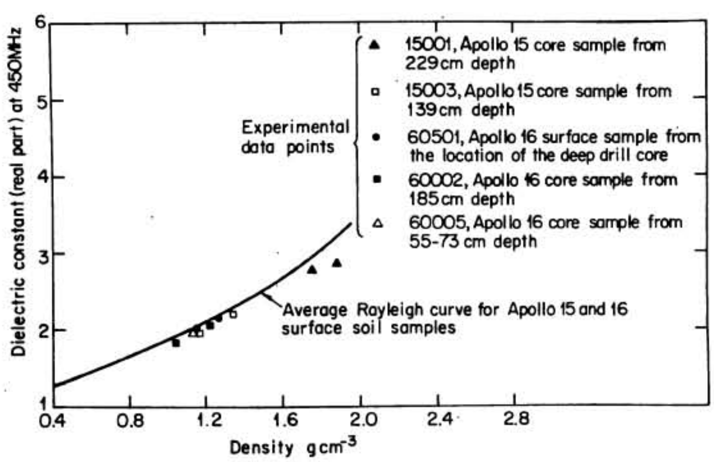

Fig. 1

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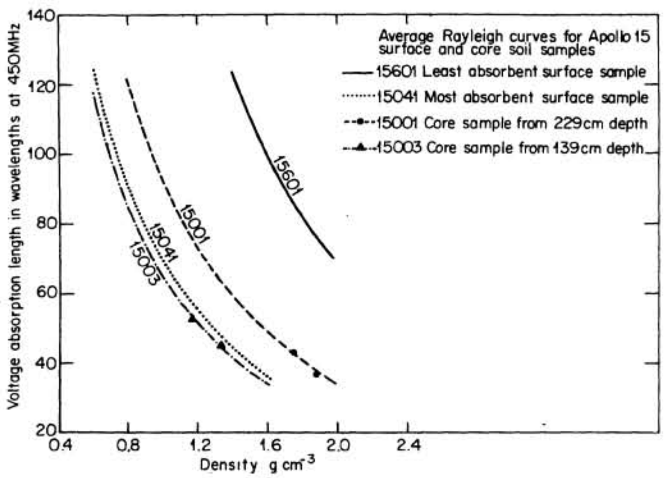

Fig. 2

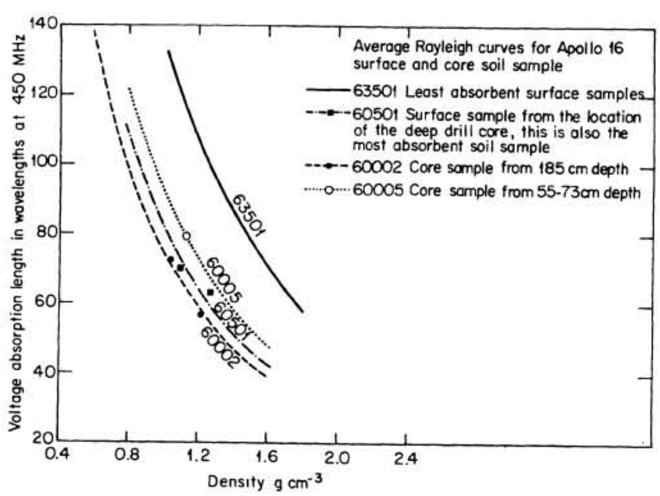

Fig. 3