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ELECTRICAL AND MAGNETIC PROPERTIES OF APOLLO 17 SOILS

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PART A. Electrical Properties: The dielectric constant and loss tangent of Apollo 17 lunar soils 74220, 24-1 and 75081,27-1 are shown in Figures 1 and 2 as measured in vacuum better than 5 x 10^{-7} torr at 25°C. Soils 14163 (Strangway et al, 1972) and 15301 (Olhoeft et al, 1972) measured in vacuum, and soils 10084 and 12070 (Katsube and Collett, 1971) measured in dry nitrogen are shown for comparison. The moisture-free dispersion in 74220 near 2 KHz is distinctly noticeable and has not been similarly observed in other lunar samples. Table 1 summarizes the sample data.

Table 1

Sample	Density (gm/cc)	K' [25°C, 1 MHz]	tan δ	TiO_2 (%)	FeO (%)
10084,83	1.94	3.8	0.018	7.56	15.94[1]
12070,107	1.74	3.0	0.025	2.81	16.40[1]
14163,131	1.2	2.3	0.0006	1.79	10.35[1]
15301,38	1.47	3.2	0.0008	1.17	14.05[1]
74220,24-1	1.37	2.6	0.019	8.81	22.04[2]
75081,27-1	2.08	2.4	0.018	9.52	17.41[2]

[1] = 15 PSR
[2] = 17 PET

PART B. Magnetic Properties: Measurement of saturation magnetization (J_S) as a function of temperature (figure 3) for Apollo 17 orange soil 74220 shows that the dominant magnetic mineral in the soil has a Curie point of about 580°C and contributes a room temperature J_S of 0.15-0.20 emu/gm to the soil. Magnetite or a high-nickel FeNi alloy (20% Ni) are the two most probable phases that could account for this. The latter mineral is improbable since it would require that the soil have at least 170 ppm of Ni whereas the measured concentration is 83 ppm (M. Rhodes, private communication). A second experiment was performed in which a sample of the soil was heated in a good vacuum (<10^{-6} torr) after being purged with CO gas. At 500-600°C the magnetic phase reduced to metallic iron (the iron was verified later by its Curie point of 770°C). The quantity of iron produced by the heating to 600°C would have been equivalent to .167 wt% magnetite (the initial J_S of this sample would have been accounted for by .176 wt% magnetite). These observations are in full agreement with

Figure 1

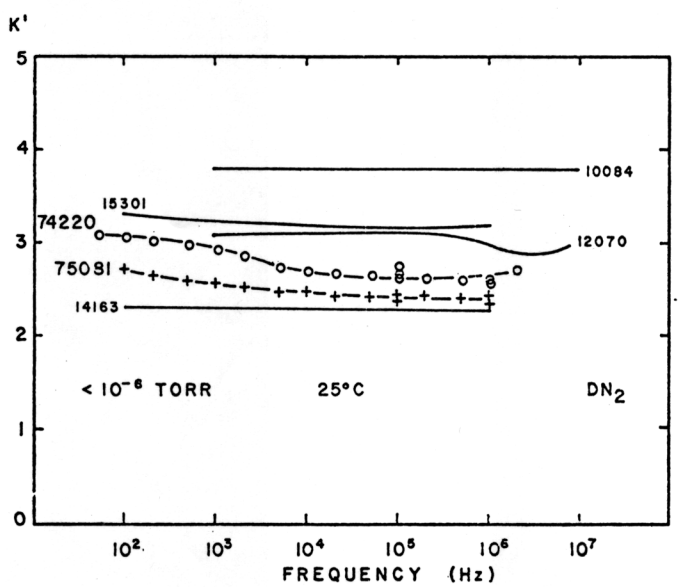


Figure 2

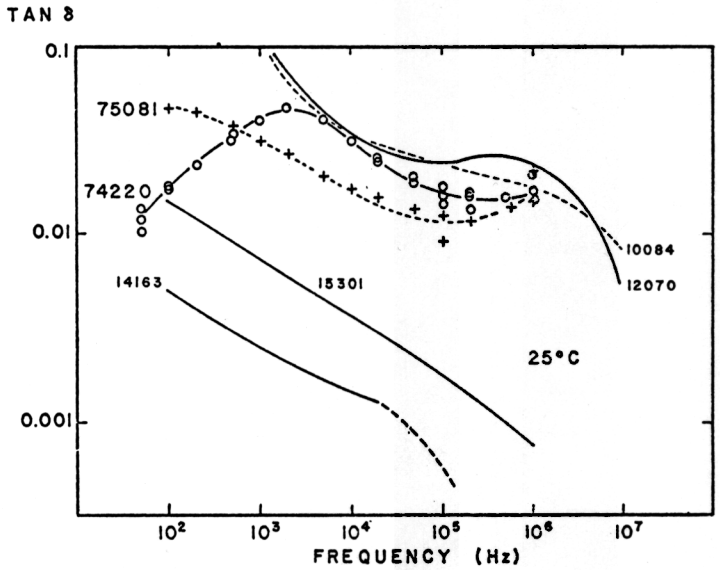
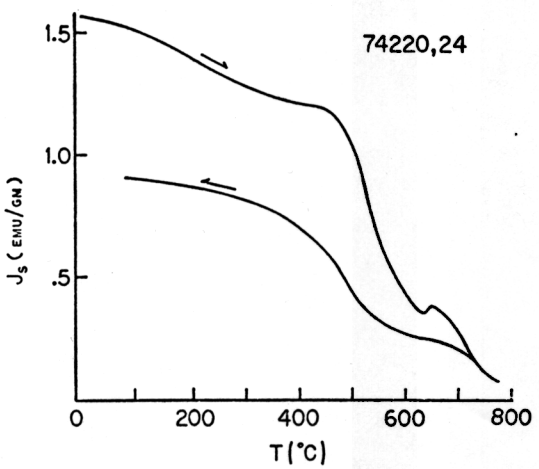


Figure 3: J_S vs T, J_S has been corrected for paramagnetic magnetization.



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