CORRELATION OF THE SPECIFIC INTENSITY OF THE FMR OF FINES WITH PARTICLE SIZE*

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It has been suggested[1] that ferric oxide phases could be produced in lunar fines and not in crystalline rocks or strongly consolidated and recrystallized breccias by the base surge of a cometary impact in which oxidizing gases from the comet and the heat of impact oxidize the fines, by fumarolic activity, or by carbonaceous meteorite impact (remanents of which supply a trace of ferric oxide particles). The site dependence of ΔH and its correlation (albeit not a strong correlation) with the abundance of TiO_2[2] indicate that local soil chemistry may be an important parameter. Hence, the first two mechanisms are preferable, since the ferric oxide phases produced by these processes would be determined by soil chemistry. Ferric oxides produced by such events would be expected to be intermixed intimately with major mineral components of the soil and increase in concentration with an increase in surface-to-volume ratio. The first expectation would make detection by optical and microprobe techniques difficult. The second expectation can be tested by measuring the specific intensity of the "characteristic" FMR component as a function of particle size, since the surface-to-volume ratio increases with decreasing particle size.

Samples of 12001-15 and 14163-50 were each divided into 10 size fractions: < 0.2, 0.2 - 0.5, 0.5 - 0.75, 0.75 - 1, 1 - 2, 2 - 5, 5 - 10, 10 - 20, 20 - 30, and > 30 μm in diameter. In addition, the particles from a given fraction of one sample, 12001-15, were separated on the basis of specific gravity.

Size segregation was by centrifugation and by use of a settling column of 200-proof ethanol. Each sample was first ultrasonified to insure disaggregation. A settling column was then used to separate the fractions greater than 10 μ in diameter, settling times being calculated from Stokes Law. Reproducibility of size separations was typically within 10 percent of the reported amount; sample loss was about 5 percent. The particles in the 5 - 10 μ fraction of sample 12001-16-1 were separated on the basis of their specific gravity by means of density-gradient centrifugation.[3] The 5 - 10 μ fraction yielded four different density portions, one with a specific gravity of 1.89 - 1.93, a second 2.24 - 2.35, a third 2.72 - 2.86, and a fourth > 2.86. The portions were recovered from the gradient and washed with ethanol before resonance measurements.

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The specific intensity of the "characteristic" resonance as a function of particle size is shown in Fig. 1. The specific intensity of the Apollo 12 sample shows a correlation with particle size, increasing with decreasing particle size, with the exception of the smallest (0.2 - 0.5 μm) size. A correlation for the Apollo 14 sample is not apparent. This data base is not sufficient to determine if there is an enhancement in specific intensity with decrease in particle size, but does indicate that the probability of such an enhancement is at least 0.5. Additional measurements are required.

The specific intensity of density fractions of the 5 - 10 μm fraction of the Apollo 12 sample is shown in Fig. 2. For this size fraction, there is an approximately linear dependence of specific intensity upon density. The result is expected since, whatever the source of the "characteristic" component, it must be due to minerals in which the primary element is iron and thus is associated with those minerals whose densities > 3.0.

Since the size fractions were obtained by a technique other than sieving, it is useful to compare the weight fractions of each size fraction with data obtained from sieving techniques. The weight of each size fraction and the fraction of the total sample weight in each size are shown in Fig. 3. Both samples have approximately the same distributions of weight fractions in each size range. A bimodal distribution is resolved with the weight fraction of the 5 - 10 μm fraction exceeding the weight fractions of sizes either less than or greater than the 5 - 10 μm fraction. The second peak in the distribution occurs at sizes > 30 μm and is not resolved in our data. The weight fraction of the < 30 μm size of our sample of 14163 is approximately the same as that reported by King et al.[4] for their sample of 14163. In the case of our two samples, the weight fractions in the range 5 to 30 μm are similar, and hence the differences in particle size distributions upon which King et al.[4] base their exposure age determinations do not appear for particles < 30 μm, at least in these two cases. Our data on the size fractions < 10 μm are similar to the data of King et al.[4] It should be noted that our losses in preparing the fractions are relatively high, and there may be a larger fractional loss for the smaller (< 5 μm) particle sizes.

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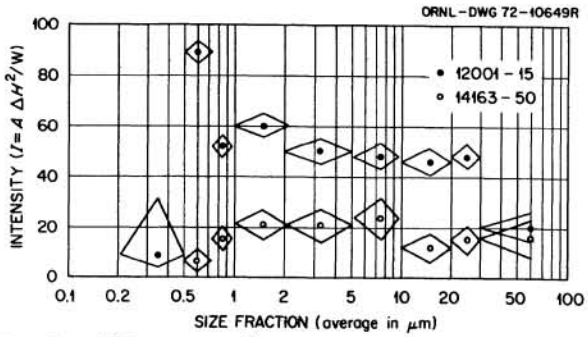
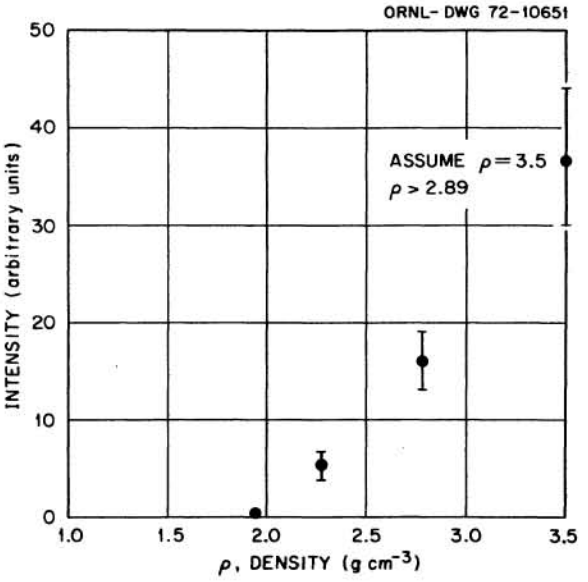


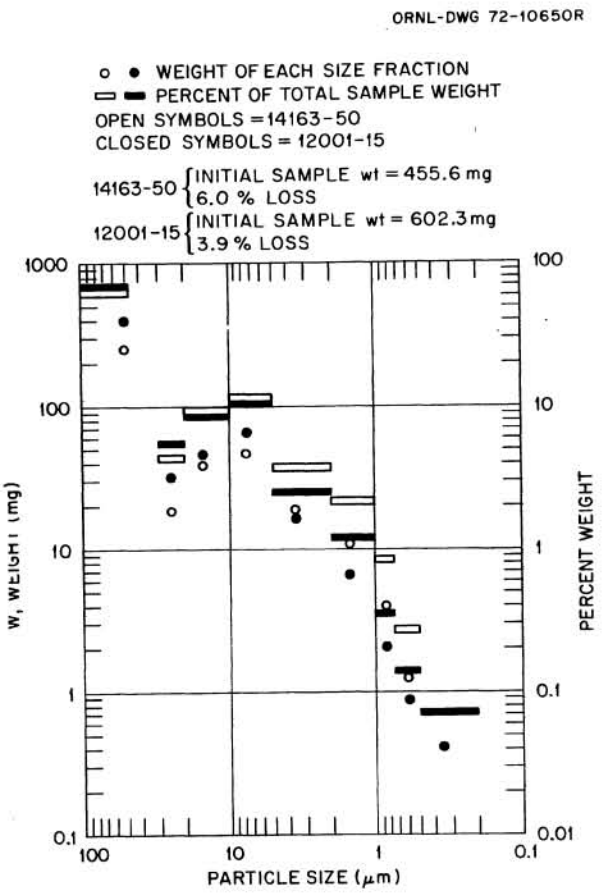
Intensity of "Characteristic" Resonance of Lunar Soils vs Size Fractions.

FIGURE 1



Intensity of Characteristic Resonance vs Density of 5-10 μm Fraction.

FIGURE 2



Size Fractions of 12001-16. and 14163-50.

FIGURE 3

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