DEPOSITIONAL AND REWORKING HISTORY OF CORE 74001/2. Richard V. Morris[1], Wulf A. Gose[2] and H.V. Lauer, Jr.[3] ([1]NASA-JSC, Houston, TX 77058; [2]Univ. of Texas Marine Science Inst., Galveston, TX; [3]Lockheed Electronics Co., Inc., Houston, TX 77058).

Introduction

The double drive tube core 74001/2 was driven into the lunar regolith on the rim of Shorty Crater near the trench where 74220 (orange soil) and 74241 and 74261 (grey soils) were collected [1]. The core contains mainly orange and black droplets, which are generally considered to be pyroclastic in origin [2]. The black droplets are apparently the crystallized equivalent of the orange droplets [2], and [3] propose two models of fire fountaining which account for the presence of both orange and black droplets. In an earlier paper [4], we reported maturity, FeO and metallic iron profiles for the lower core section 74001. We found that the FeO and Fe° concentrations were quite uniform and that the maximum value of the FMR maturity index I_s/FeO was about 0.2 units so that the 74001 soils are very immature. The uniformly low maturity implies rapid deposition. In this paper we report maturity, FeO, and Fe° profiles for the upper section 74002. We also report on FMR and magnetic studies of grain-size separates of 8 samples from 74002 and 5 samples from 74001. Grain size and petrographic, chemical, and rare gas studies of the same grain-size separates are reported elsewhere in this volume [5,6,7].

Profiles

The FeO, I_s/FeO, and Fe°_{VSM} profiles for 74002 are shown in Fig. 1 along with the range of those parameters for 74001. The core units of [8] are also shown. The FeO content is very uniform and, as expected, there are apparently no large variations in major element concentrations in 74001/2. (The values of FeO reported by [4] all should be lowered by ∿5% due to a new procedure to calculate FeO from the paramagnetic susceptibility.) Below 5 cm, the maturity of 74002 is ∿0.2 units of I_s/FeO and is a continuation of that observed for all of 74001. From ∿5 cm to the surface there is a sharp increase in maturity which we feel is probably due to <u>in situ</u> reworking (see below). All of the soil in 74001/2 is immature; the soil below 5 cm is exceptionally immature [9]. Distinct variations are also observed in the Fe°_{VSM} profile. (Fe°_{VSM} includes metal grains $\gtrsim$ 20-40 Å in diameter.) We believe these variations are due to some extent to variations in the ratio of orange to black droplets (see below). The soils with low values of Fe°_{VSM} would tend to have a higher proportion of orange droplets.

<u>In Situ</u> Reworking

As is discussed by [10], this is the fourth core in which we have observed a marked increase in maturity as the lunar surface is approached. [10] argues that these zones are due to <u>in situ</u> reworking (gardening) of the lunar surface. For 74001/2, this means that after final emplacement, the entire core had a maturity of ∿0.2 units I_s/FeO; subsequently, <u>in situ</u> reworking raised the maturity in the zone from 0 to 5 cm to give the observed profile. We will

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consider evidence not discussed by [10] which supports the in situ reworking interpretation for the upper 5 cm of 74001/2.

Fig. 2 is a log-log plot of the grain-size dependence of I_s (relative concentration of fine-grained metal) for the four soils located above 5 cm and the average grain-size dependence of I_s for 9 soils located below 5 cm. The value of I_s/FeO (<250) is given in parentheses for each soil. Note that as maturity (I_s/FeO) increases, the linear-least-squares slopes of the data would become less negative. According to [11], this is the proper direction for in situ reworking, but the magnitude of the change is much more rapid than expected from the data of [11]. We suggest this results from an inherent difference between the droplet soils and bedrock-derived soils, upon which the data of [11] is based. The droplet soils have very little ($\lesssim$5 wt. % [5]) material >250 μm in diameter compared to bedrock-derived soils (typically 20-30 wt. % in the size range 250 μm-1 cm [12]). The smaller reservoir of larger particles for the droplet soils means that with maturation the fraction of constructional particles (agglutinates) in the coarser sieve fractions will increase faster in the droplet soil, producing the observed more rapid rate of change of the slope. Thus, we conclude that the data in Fig. 2 supports the in situ reworking interpretation. It is worthwhile to point out that if the maturity in the upper 5 cm of 74002 were due to the mixing of droplet soil having I_s/FeO $\sim$ 0.2 units with variable amounts of a soil matured prior to the time of implacement of 74001/2 (i.e., the maturity is not due to in situ reworking), the arguments given by [11] predict that the variation of slope with maturity would be opposite to that observed in Fig. 2.

Ratio of orange to black droplets

The values of Fe^{o}_{VSM} for the sieve fractions of the eight soils from >15 cm depth (high-Fe^{o}_{VSM} group) were systematically larger than the values for corresponding sieve fractions for the five soils from <10 cm depth (low-Fe^{o}_{VSM} group). For each group and sieve fraction the values were averaged and plotted on Fig. 2; the uncertainties are standard deviations. Corresponding data for the orange soil 74220 is also shown and it overlaps the low-Fe^{o}_{VSM} group. We believe this implies that the variation in Fe^{o}_{VSM} in Fig. 1 reflect at least in part the ratio of orange to black droplets, the low Fe^{o}_{VSM} soils having the highest proportion of orange droplets. Detailed comparison with petrography and grain-size analysis is necessary to determine the extent to which, for this core, Fe^{o}_{VSM} is an index of the ratio of orange to black droplets.

Summary and Depositional History

Our data indicate that the 74001/2 core was implaced, probably by an impact (Shorty Crater?) in its present location with a maturity of about 0.2 units I_s/FeO. The implacement may have occurred either about 3 my [13] or about 30 my [7] ago. Subsequently, in situ reworking progressed to a depth of about 5 cm giving the observed increase in maturity to that depth. In the period between final emplacement and the original formation of the orange and black droplets around 3.5 by ago [14], our data only loosely constrain the evolution of the soil in 74001/2. The uniformly low maturity of the soils below $\sim$5 cm shows: (1) that none of the soils were present at the surface for an appreciable

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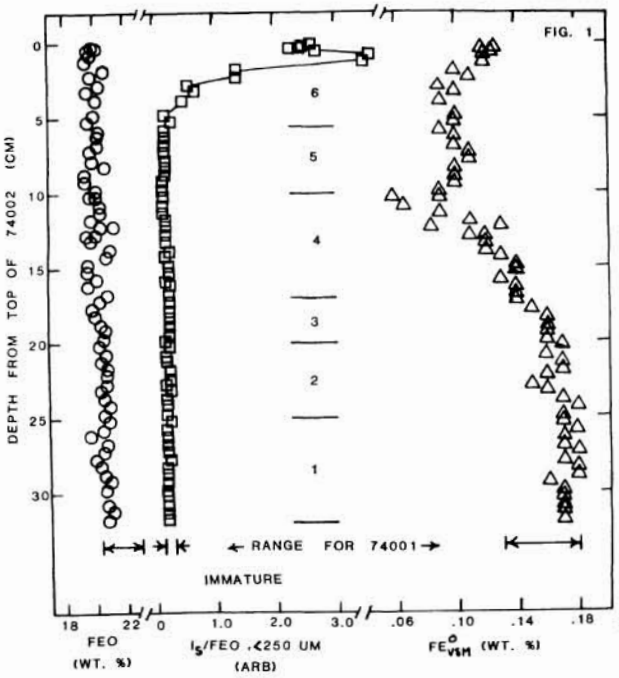
length of time (maximum about 0.5 my [4]) during original deposition from the fire fountain, and (2) that between original deposition and final implacement the 74001/2 soils (within the resolution of our data) did not see any surface exposure and have not been mixed with a matured soil. With respect to point (1), our data are not incompatible with a time on the order of a day for the original deposition of the core because of the uncertainty regarding the origin of the small amount of fine-grained metal. In agreement with other workers [2,7,15], point (2) indicates the 74001/2 core was covered by a significant amount of material in order to isolate it from in situ reworking for 3.5 by.



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