MIXING OF MAJOR SOIL COMPONENTS IN THE APOLLO 16 DRILL CORE

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Two major processes are thought to act on lunar soils, maturation and mixing. Petrologic data(1), inert gas data(2), and magnetic data(3) show <u>convincingly</u> that mixing of at least three major soil types is a significant contribution to the gross stratigraphy of this core. The evidence, however, does not <u>exclude in situ</u> maturation. The soil types are:

Component α : coarse, immature, PLAG-poor, high reflectivity, low trapped gas, high Ar-40/Ar-36 (2-5), FeO about 5%, rich in light matrix breccia(LMB), abundant in modal petrologic unit A.

Component β : fine, mature, PLAG-poor, low reflectivity, high in trapped gas, low Ar-40/Ar-36 (about 1.0), FeO 8% or greater, rich in agglutinates(AGG), dark matrix breccia(DMB), norite and troctolite(N+T). Similar to the dark surface soils(4).

Component γ ; fine to coarse, mature to submature, PLAG-rich, high reflectivity, intermediate Ar-40/Ar-36 (about 1.5), FeO 3% or less, abundant in modal unit C. There are strong hints (3) that component γ is submature to immature in segment 60005 (unit C) for which no petrologic data are available. Hence, γ may be identical to the PLAG-rich, immature soils in 60009 (5).

<u>MODAL UNIT A.</u> Avg. LMB 25%, range 8-65%. Avge. PLAG 15%, range 4-39%(1). Dark clasts or lithologies definitely more mature than light ones(3). Inert gas contents and isotopic ratios strongly variable. Contains abundant α , but also γ and probably β . 1.Unit A was deposited as a "single slab"(3). Requires inhomogeneity of arriving ejecta. Similarity of component α to surface soils 61220 and 61240 suggests large Eden Valley impact (6) providing unmixed α (below end of drill core?), while secondary impacts nearer to the core site provide mixed and unmixed α , γ ,and perhaps β for the section of unit A actually seen in the core. 2. Unit A was deposited by "dribs and drabs". Possible. Raises puzzle why α became "exhausted" in the environment(it is much less abundant in units C and D). Interface between A and B has been termed short-lived(3). However, track(7) and inert gas (2) data show that the interface could have been a "surface" for extended time periods. The resolution of the magnetic data (3), upon which the "instanteneous" deposition-of-B-theory is based is definitely insufficient at the A-B interface. The question of the nature of this interface remains unresolved.

<u>MODAL UNIT B</u>. It has been suggested that unit B has been deposited <u>in toto</u> on top of A, perhaps simultaneously(3). There is no clear-cut evidence from petrologic, inert gas, and magnetic data which rule this out. Much depends on the interpretation of the laminated and marbled zones in segment 60003, loca-

ted in unit B, some 20-40 cm above the A-B contact. If these zones represent long periods of maturation and mixing (reworking), then unit B has not been deposited in toto. Actually, Unit B almost certainly consists of several sub-units, which are most clearly seen in the magnetic data. The following gross division can be made: a. dissection unit 13=mature; dissection units 14-17 are submature,; dissection units 18-26=mature, dissection units 27,28 =submature, dissection units 29-31=mature, dissection unit 32=submature, dissection units 33-37= mature. the petrologic and inert gas data are not perfectly consistent with the magnetic trends, but show roughly similar trends. Most of unit B is a mixture of components α, β and γ in proportions which are difficult to give accurately. Certainly, it is the first part of the core, going from bottom to top, where the FeO-rich α component makes its appearance (3). If one tries to imagine what the regolith surface near the core site was like when the deposition of unit A was completed, one is inclined to "believe" that this surface contained principally the light α and γ components down to some tens of centimeters at least and for tens if not hundreds of meters away from the core site. What was it that caused the transgression of the dark, mature, FeO-rich soils seen in unit B? Today, such soils are abundant at the surface near the core site and on Stone Mountain. All available evidence suggests that they were not abundant near the core site when dissection unit 12 was in place. This suggests very strongly that unit B has not been "accreted" by very small "dribs and drabs" from the near-environment. Our preferred theory is that a large secondary from the Eden Valley event emplaced dark soils from relatively far away: 1. immediately on top of modal unit A, but probably only dissection units 13 and 14, a relatively dark portion of the core which straddles the break between 60003 and 60002, 2. in the general environment of the core (the transgression). The oscillations in petrology, maturity and gas signature in unit B has then come about by the tapping of these two sources: the old $(\alpha+\gamma)$ and the new (β).

MODAL UNIT C. Petrologic data are only available for the portion in segments 60006-7. Gas data are scarce. The B-C contact is not known. The magnetic data suggest emplacement of the entire unit in toto (3) followed by maturation, mixing and reworking of long duration and to significant depth at the top. All available information is consistent with this idea. The mixing model explains the petrologic data elegantly, because the new arrival, γ, is clearly mixed with the older soils $\alpha+\gamma$ and β. In fact, the upper portion of Unit C can be comfortably thought of as a derivative of the immature, plagioclase-rich soil in 60009. What has happened is that the parent soil has become more fine-grained, I_s/Fe^o has increased and the parent has become contaminated with soils which were already abundantly present nearby.

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MODAL UNIT D. Of all the modal units, this one shows the strongest imprimatur of soil component β. Logically, it is also the last unit emplaced in the column.

INTERFACE UNITS C AND D. One of the most puzzling aspects of the drill core is that the soils in 60006 become increasingly more mature from base to top, but the FeO content decreases(2). The first observation sugggests extensive maturation and reworking of the top of unit C during long times(2). The second observation is not necessarily in conflict with that idea, but it seems to tell us that the deeper portions of unit C, i.e. nearer the base of 60006 and into 60005(3) are less pure γ than the top portions of unit C. If one tries to *imagine* again what the surface of the regolith was like at the time of "maturation"(or rather during the era of maturation), one cannot escape the "belief" that the"transgression" of γ -rich soils was significant, blanketing as it did much of the immediate environment of the core site. In terms of I_s/Fe^o, dissection unit 38(all of 60005) is not very different from the average of unit B. Assume that, for unknown reasons, the γ -rich blanket was much thinner than average at the core site. One can then understand the trends in 60006 as mixing and maturation, but with the maturation of the γ -rich soils occuring in the near environment, not strictly *in situ*.

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