We have analyzed over 500 particles from the 2-4 mm splits of three Apollo 17 soils, 76503, 72503 and 72443, in order to determine the diversity and proportions of rock types recorded within the soils, to compare the relative diversity of North and South Massif soils, and to compare lithologic diversity within the soils to that of large-rock samples. In this abstract, we compare the known distribution of rock types at the Apollo 17 site to what we have found in the soil particles. The floor of the Taurus Littrow Valley, located on the southeastern rim of the Serenitatis Basin, is underlain by high-Ti mare basalt and covered by a thick regolith which is intermixed with pyroclastic orange-glass deposits. The valley is bordered by tall massifs consisting of Serenitatis impact-melt-breccia and pre-Serenitatis ANT-suite materials; many samples of impact-melt breccia were obtained from boulders near the base of the massifs. Most melt-breccias fall into two compositionally similar groups: the more pyroclastic we have found in the soil particles. The floor of the Taurus Littrow Valley, located on the southeastern rim of the Serenitatis Basin, is underlain by high-Ti mare basalt and covered by a thick regolith which is intermixed with pyroclastic orange-glass deposits. The valley is bordered by tall massifs consisting of Serenitatis impact-melt-breccia and pre-Serenitatis ANT-suite materials; many samples of impact-melt breccia were obtained from boulders near the base of the massifs. Most melt-breccias fall into two compositionally similar groups: the more pyroclastic
from this soil, in this case, 72503, is predominantly melt breccia: 65% noritic breccia matrix, 17% ITE-poor highlands rock types, 12% agglutinates and regolith breccias, and 5% others. In contrast, North Massif soil, represented by 76503, has a much greater portion of ITE-poor highlands rocks and mare basalt fragments: 29% ITE-poor highlands, 24% melt-breccia matrix, 13% mare basalt, 30% agglutinates and regolith breccias, and 4% orange-glass breccia and others. The greater percentage of melt breccia in the South Massif light-mantle soil is due to stratigraphy and poor mixing; the light mantle, from the noritic top portion of the massif, did not mix well with the pre-existing regolith of the lower massif slopes, which is presumably similar to that of North Massif. Additional differences between the massif soils include (1) compositions of poikilitic melt breccias from the two massifs differ slightly [2]; (2) North Massif regolith contains magnesian troctolitic anorthosite and possibly other magnesium-rich, ITE-poor components that are not represented in South Massif soils.

Mare basalts. At least three compositionally distinct groups of high-Ti basalts are distinguished on the basis of geochemical parameters such as Ba/Rb or Sr/Rb (groups A-C, [5]), and further subdivisions have been based on REE ratios (B1 & B2, [6]). A chemically distinct type D basalt has also recently been characterized [7]. Samples of groups A and B are abundant and come from many location on the valley floor; however, the few group C samples are all from Shorty Crater (Sta. 4). The type D basalt sample is from the Van Serg drive tube. Of the 2-4 mm particles from sample 76503, 13% by mass are basalt. A third of the particles belong to Gp. A and another third, to Gp B2. One coarse-grained basalt particle is compositionally similar to Gp. C and two fine-grained particles have tentatively been assigned to Gp D. Remaining basalt particles are too coarse-grained to be representative and cannot be assigned to one of the known groups without further petrographic study.

Very-low-Ti basalt (VLT) has been found only as small fragments in the deep drill core [8] and as clasts in impact melt breccias [9] and 72215 and 72235 [10], although spectral reflectance data indicate that a VLT type basalt flow may cover the central Serenitatis basin [8]. In addition to TiO₂ concentrations less than 2%, VLT basalts have low REE concentrations and distinctive REE patterns. Among the particles in 76503, there is VLT basaltic breccia (hypabyssal?) rich in augite and with ~0.8% K₂O. Its relationship to other VLT basalts is uncertain and merits further investigation.

Orange Glass. Spheres and broken fragments of orange and black glass were found in and around Shorty Crater and in some places constitute entire soil horizons (e.g., 74220) within the gray soil that otherwise characterizes the valley floor. The compositions and morphologies of these glasses are consistent with an origin by fire-fountaining of primary, mantle-derived magma [11, 12]. All of the regolith breccias found in sample 76503 contain orange-glass as well as mare-basalt components and four of the particles consist almost entirely of orange and black-glass breccia. Two of the particles from sample 72503 are rich in orange-glass. Presumably, these samples have been delivered to the massif soil by small impacts on the valley floor.

Impact melt breccias. The melt breccias from Apollo 17 have been classified mainly into two groups, anaphonitic and poikilitic, based on a combination of petrographic and compositional characteristics [1]. The majority of analyzed melt breccias belong to the compositionally tight poikilitic group and it is generally accepted that this group formed during the Serenitatis basin-forming impact [1,4,15,23]. The anaphonitic melt-breccia group is compositionally more variable and is distinguished from the poikilitic group by lower Ti, Na, Eu, Ni/Co and...
more variable Sc [1, 2]. The aphanitic melt breccias also tend to be more aluminous [13]. It has also been noted that the clast content of the two groups of melt breccias are different [1]; clasts of the poikilitic melt breccias are dominantly of the ANT suite, commonly granulites and plutonic norites and troctolites [14, 15]. In addition to ANT suite lithologies, aphanitic melt breccias contain clasts of felsite, basalt, feldspathic breccia, and more abundant shocked mineral clasts [10, 16, 17, 18]. The Apollo 17 impact melt breccias are very coherent and form the boulders that have rolled or slid down the massif slopes. The station 6 boulders came from the lower third of North Massif whereas those at the base of South Massif are from near the top [4]. All of the large aphanitic melt breccia samples are from the South Massif, but poikilitic melt breccias were found at the base of both massifs.

Roughly one fourth of the particles from 76503 are fragments of melt breccias, whereas the majority of those from 72443 and 72503 are fragments of melt breccia. Most of these are of the poikilitic type based on compositional characteristics and limited petrography. This group generally forms a compositional trend between a mafic ITE-rich melt and incompatible-trace-element (ITE) poor highlands rock types. The low ITE component does not appear to be dominated by any one particular type of clast. There appear to be subtle differences between poikilitic melt breccias from North Massif and those from South Massif [2]. Four particles from 76503 appear to belong to the aphanitic group and are the first of this group found in a North Massif sample. Approximately 13% of the station 2 melt-breccia particles appear to be of the aphanitic type. In addition to the aphanitic and poikilitic breccias, we have found a third compositional group of melt breccias among the soil particles. They are dominantly of the ANT suite, commonly granulites and plutonic fragments. These melt-breccia particles appear to be of the aphanitic type. They are characterized by higher REE concentrations and a lower Cr/Si ratio than either the poikilitic or aphanitic breccias, but a Eu/Sr ratio similar to that of the aphanitic breccias. Some of these breccias were visually observed to bear notable feldspathic clasts.

ITE-poor highlands rock types. Highlands granulitic breccias and monomict igneous rock types occur in the station collection as small rocks, clasts in melt breccias, and as fragments in the soils. Less than ten of these among the returned rocks have masses exceeding 50g. The majority of the igneous rocks belong to the magnesian suite; only a few small samples have ferroan or alkaline mineral compositions [e.g. 19], although some of the well-studied lunar granitites were found as clasts in Station 2 [20] and Station 3 [18] boulders. Of the igneous rock types, troctolites and norites are most abundant and about equally represented. Granulitic breccias with compositions ranging from noritic/gabbroic anorthosite to anorthositic gabbro are also abundant. Among the 2-4 mm fragments, granulitic breccias are found in samples from both massifs, although they are more abundant in North Massif sample 76503. Magnesian and ferroan granulitic breccias are present at Station 2 whereas Station 2 appears only to have magnesian granulitic breccias. Lithic fragments of igneous magnesian-suite samples are scarce in the Station 2 samples, but there are several that have ferroan compositional characteristics. Lithic fragments of magnesian-suite igneous rocks are found in the station 6 sample, but they are dominated by crystalline fragments of plagioclase, plagioclase plus olivine, and brecciated equivalents, which, taken as a group, indicate a troctolitic anorthosite precursor [21]. Another compositionally distinct group of samples found in soil particles from both stations 2 and 6 are regolith breccias that lack mare basalt and noritic impact melt clasts. These we consider to be samples of the pre-Serenitatis surface [22].

Sample 76503, from a immature soil, reflects the lithologic diversity of the Taurus Littrow Valley and the surrounding highlands massifs better than rock particles from the mature station 2 soils. Thus, more important than a soil's maturity in this regard is the length of time it is exposed to the effects of small-scale lateral mixing from impacts coupled with its proximity to lithologically diverse geologic units. The lithic fragments in these soils, particularly 76503, do not simply reflect comminuted products of the newest boulders or large rocks.

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