COMPOSITION OF APOLLO 17 DOUBLE DRIVE TUBE 73001 / 73002. M. Neuman[1], P. Koefoed[1], K. Wang[1], B.L. Jolliff[1], R.L. Korotev[1], R.V. Morris[2], M. Broussard[1], and the ANGSA Science Team[3], [1]Department of Earth & Planetary Sciences and the McDonnell Center for the Space Sciences, Washington University in St. Louis, MO 63130, [2]ARES, NASA Johnson Space Center, Houston, TX 77058, [3]www.lpi.usra.edu/ANGSA/teams/ (mdneuman@wustl.edu)

Introduction: A significant focus of the Apollo Next Generation Sample Analysis (ANGSA) program is on 73001/2, the double drive tube collected on the "light mantle" at Station 3 during Apollo 17 [1]. The light mantle is thought to represent a landslide deposit off the South Massif, presumably caused by impacting ejecta from the formation of Tycho Crater [2]. Exposure ages of rocks from Stations 2 and 3 indicate that the formation of Tycho crater and resulting deposition of the light mantle likely occurred ~100 m. y. ago [3, 4]. Analysis of the Station 3 double drive tube, through ANGSA, provides a unique opportunity to study the light mantle using advancements in technology and knowledge since the early Apollo sample investigations. In this work, we determined the major--, minor-, and trace-element composition of every 0.5 cm interval of the entire drive tube and used the chemical compositions to model the proportions of the major Apollo 17 lithologic components that contribute to the drive-tube materials.

Methods: We received a total of 104 subsamples of 73001/2 for this work. Samples were approximately 50 mg of the <1 mm size fraction (dry sieved) from each 0.5 cm increment of dissection Pass 2. Ferromagnetic resonance (FMR) and magnetic measurements were conducted at Johnson Space Center on the samples prior to analyses at Washington University in St. Louis [5]. Samples were then split into two aliquots: 45 mg for quadrupole inductively-coupled-plasma mass spectrometry (ICP-MS), and 5 mg for fused-bead electron-probe microanalysis (FB-EPMA) (see [6] for details).

Results: Overall chemical compositions are similar to those of nearby Station 2 and 3 soils. For example, FeO ranges between 7 and 9 wt.%, and TiO_2 ranges between ~1 and 2 wt.% (Fig. 1). Concentration variations with depth are significant for many elements (e.g., Al_2O_3, FeO, TiO_2), whereas others are relatively constant (e.g., SiO_2, MgO, P_2O_5). For many of the elements with affinity for mafic minerals, especially pyroxene and ilmenite (e.g., FeO, TiO_2, Sc, Cr, and V), elevated concentrations are present at the surface of the core in the 0-4 cm intervals (e.g., Fig. 1). Several spikes in concentrations of these elements occur in specific intervals that correspond for geochemically similar elements (e.g., 12.5–13.0 cm depth, Fig. 1).

The rare earth elements (REE) have consistent trends of small variations on the scale of the entire core, with slight enrichments of HREEs (heavy-REE) near the surface compared to more uniform LREE (light-REE) values elsewhere These variations are expected as the HREE are elevated relative to LREE in the basaltic components as noted within 10 cm of the surface. Patterns of the REEs (3 cm averages) are distinct between the upper and lower portions of 73002 (Fig. 2). The near surface composition is simlar to that of 73261, a Station-3 trench-sequence soil, and the bottom is similar to 73131, a disaggregated soil breccia clod from Station 2a.

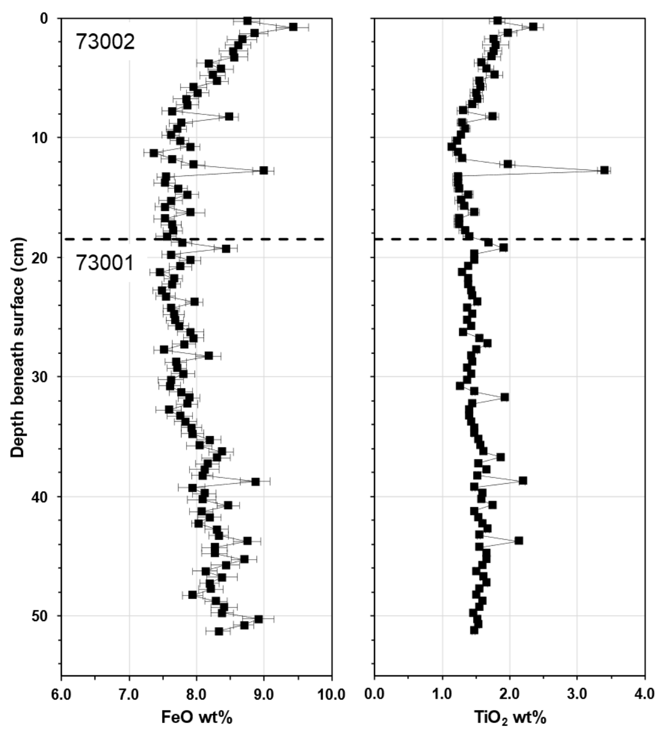

Figure 1. FeO and TiO_2 concentrations of each 73001/2 core interval from dissection Pass 2.

Discussion: Compositions of 73001/2 with depth show clear trends and many elements with similar geochemical behavior are closely correlated. Given that regolith is a mixture of different lunar materials, we quantitatively determined the proportions of several classes of lithologic components and their variations with depth. We used an error-weighted, linear-least-squares approach that determines the proportions of a set of input lithologic components for each interval composition by minimizing the sum of squares of residuals, similar to previous studies of Apollo 17 soils [7, 8, 9]. Of all of the components used by [8], we selected high-Ti mare basalt (HT), orange glass (OG), noritic breccia (NB), anorthositic norite (AN), and a volatile-free CI chondrite (CI) to model the compositions of 730012 intervals. We used a CM chondrite composition in place of CI, as CM chondrites have been shown to be the major source of meteoritic material at the lunar surface [e.g., 10].

Results of the mixing analysis reveal that the main components are noritic impact-melt breccia (NB) and anorthositic norite (AN), both of which are themselves composed of related materials (e.g., AN is an average of a variety of components with generally anorthositic norite, with minor proportions of high-Ti basalt, orange glass, and CM chondrite (Fig. 3). Proportions of An range from 42–63 wt%. NB components make up 33–48 wt%, and high-Ti basalt, 0–13 wt% of the soils. Orange and/or black glass was indicated in 26 of 104 intervals, in proportions up to 7 wt%. In cases where the model returned negative results for OG/BG, we excluded this component from the mix. Approximately 0–2.3 wt% (0.5 wt% average) of the volatile-free CM-chondrite component accounts for excesses of siderophile elements. Low proportions of the basalt component at the bottom of 73001 indicate the drive tube did not penetrate the light mantle deposit to sample the underlying basaltic valley floor regolith.

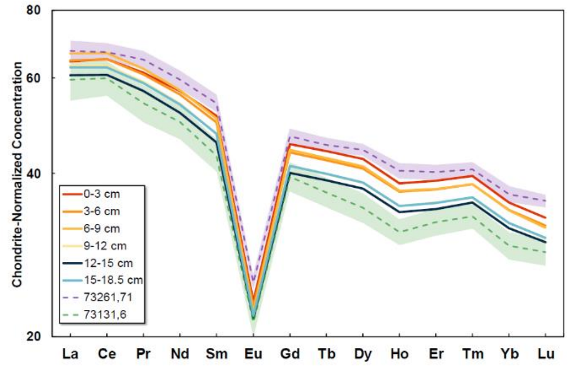

Figure 2. REE patterns for 3-cm-averaged sections of 73002. Nearby soils 73261 and 73131 are shown for comparison.

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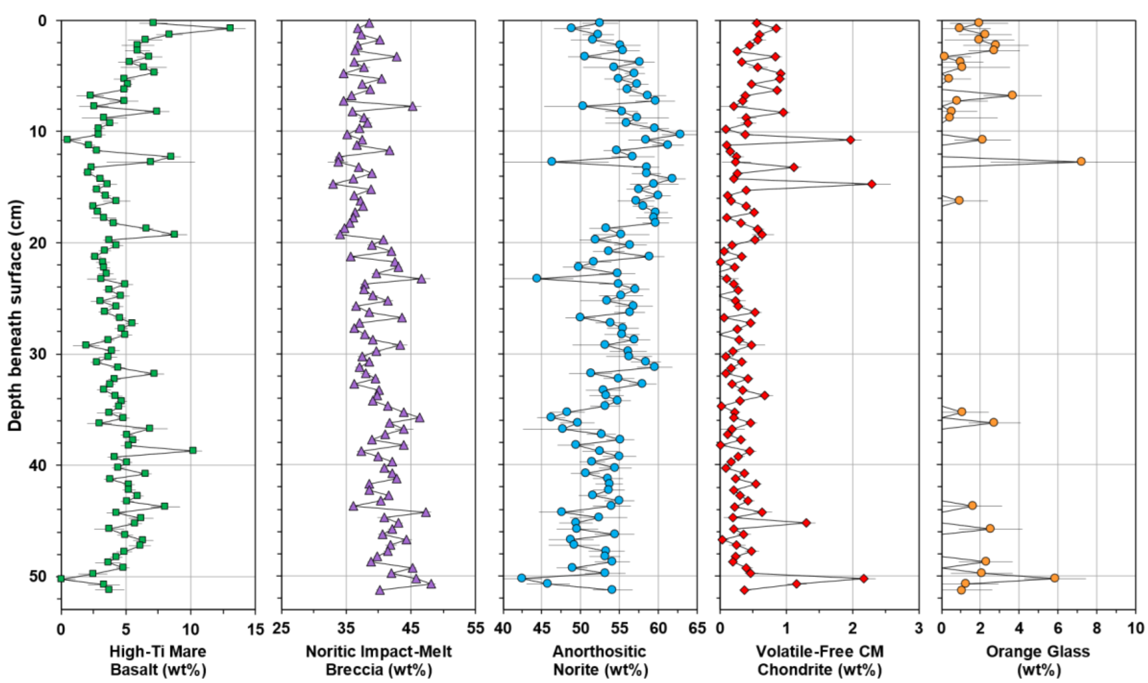

Figure 3. Results of lithologic component mixing calculations.