CHEMICAL STRATIGRAPHY OF APOLLO 17 DRIVE TUBE 73001. J. L. Valenciano[1], C. R. Neal[1], C. K. Shearer[2], and the ANGSA Science Team, [1]Dept. of Civil & Env. Eng. & Earth Sciences, University of Notre Dame, Notre Dame, IN 46556, USA [2]Institute of Meteoritics, University of New Mexico, Albuquerque, NM, USA (jvalenc2@nd.edu)

Introduction: Two vacuum-sealed drive tubes (73001 (lower) & 73002 (upper) (**Fig. 1**) [1] were collected at Apollo 17 Station 3 from the light mantle landslide deposit at the base of the South Massif ~20 m SSE of the rim of Lara Crater. These samples are part of the Apollo Next Generation Sample Analysis (ANGSA) project, which has provided the opportunity to perform analyses of pristine lunar samples with modern instrumentation and techniques. 67 aliquots from 0.5 cm intervals of drive tube 73001 were provided to determine the chemical stratigraphy within the regolith throughout the length of the drive tube. By analyzing the chemical stratigraphy of 73002 and 73001, we can determine if the double-drive tube pierced through this landslide deposit and into underlying material of the South Massif by examining the variations within.

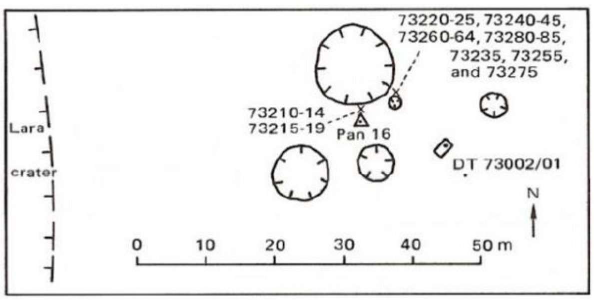

Fig. 1: Schematic showing the location where 73002 and 73001 was collected relative to other station 3 samples [1]

Methods: Pass 1 subsamples of ~50 mg aliquots of 73001 regolith were analyzed for major & trace elements. Samples were ground to a fine powder and digested in a mixture of concentrated HNO_3 and HF at 110°C for 2 days, then concentrated HNO_3 for 3 days.

Data were collected using a process similar to that in [2]. Major and minor element data were collected by ICP-OES (Perkin Elmer Optima 8000 Prep 3) at the Center for Env. Science & Technology (CEST), where a 10-ppm solution of Indium was used as an internal standard for drift correction and an external standard of 1-ppm Thallium solution was used to track the efficiency & consistency of the Prep3 pump as it delivers the sample to the nebulizer. Trace element data were collected using ICP-MS using a Nu Plasma Attom at the Midwest Isotope & Trace Element Research Analytical Center (MITERAC) following the method described in [3]. Samples were analyzed along with USGS reference material (BCR-2 & BHVO-2) to demonstrate accuracy of the data collected. Each aliquot will be measured in duplicate to demonstrate precision.

Results & Discussion: Six intervals were selected for preliminary analysis using ICP-OES [all intervals will be quantified by LPSC 54]. These intervals represent different areas of the core. TiO_2 ranges from 1.4 – 1.6 wt% and FeO from 7.7 – 8.3 wt %. There appears to be a relatively constant abundance of both TiO_2 and FeO down core (**Fig. 2**). Compared to 73002, which had values of TiO_2 ranging from 1.3 – 1.9 wt % and FeO values of 7.6 – 8.7 wt % [4], there is less variation downcore in 73001.

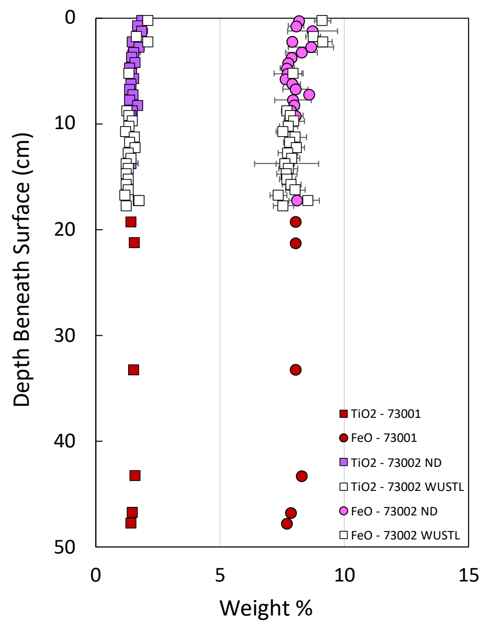

Figure 2: Graph showing the TiO_2 and FeO concentrations in 73001 in relation to those seen in 73002 [4].

Twenty-one intervals were selected throughout different horizons of the core for preliminary trace element analysis using ICP-MS. These data show that the regolith is light (L)REE-enriched throughout the core (**Fig. 3**), with variable REE abundances that decrease down to ~20.5 cm and then increase at ~25 cm. Ce, Yb, and Nb display similar downcore variations in 73001 (**Fig. 4**). At the top of 73001 there is a slight increase in Ce, Yb, and Nb relative to the base of 73002 (**Fig. 4**), which decrease to constant values at 22-30 cm. At 30 cm there is a decrease in Ce (~40 ppm to ~36 ppm), Yb (~7 ppm to ~5 ppm), and Nb (~18 ppm to ~16 ppm).at ~44 cm there appears to be an increase in all elements to ~38 ppm Ce, ~6 ppm Yb, and ~17 ppm Nb, but these decrease back to the levels immediately above this interval towards the bottom of core 73001 (**Fig. 4**).

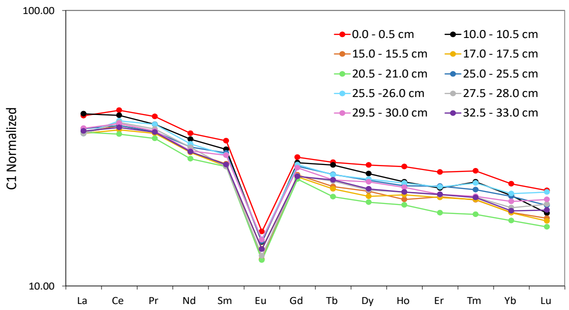

Figure 3: Graph showing values of rare earth element (REE) concentrations seen in selected intervals throughout 73001.

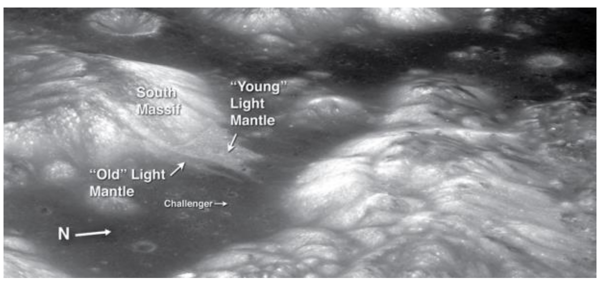

Figure 5: LROC image showing the landslide deposit from which double-drive tube 73002/73001 was collected [6].

The selected trace elements in Figure 4 suggest there are potentially 5 layers represented in 73002-73001. This initial finding will be refined with the complete data set for major and trace elements. Layer 1 could represent a package of South Massif regolith that slumped as a unit with layer 2 representing a mixture of South Massif and underlying mare regolith that could extend into the top of 73001. FeO and TiO_2 (Fig. 2) display some variability in Layer 1 (0-9 cm), but are relatively in Layer 2 (9-19 cm). Major element analyses are in progress for the majority of intervals below 19 cm, but the data currently available exhibit little variation. The 73001 trace elements in Figure 4 show similar variability to those in 73002, but extend to lower abundances in Layer 4 before an increase at the top of Layer 5 to values intermediate between Layers 3 and 4. Layer 3 has Ce and Yb abundances higher than in the Apollo 17 high-Ti mare basalts, but lower than the Apollo 17 KREEP basalts. However, this layer could be a mixture of mare and highlands Mg- and/or Alkali Suite materials. This hypothesis will be tested with the complete major & trace element data sets. A major question that will be addressed is do the materials in ANGSA samples 73002 & 73001 contain materials from both the Young and the Old Light Mantle deposits (**Fig. 5**).

Future Work: Analyses of the remaining 73001 regolith aliquots are in progress. Results will be presented at LPSC 54. Comparisons in elemental compositions between 73002 and 73001 will also be included, as well as mixing calculations to determine lithologies that comprise 73001.

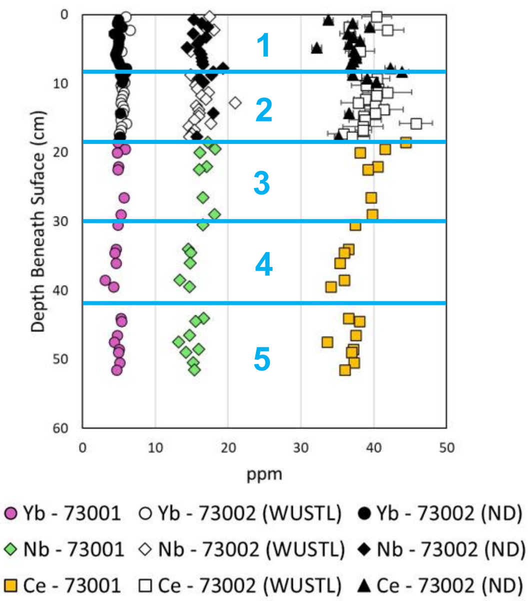

Figure 4: Variation of Ce (LREE), Yb (HREE), and Nb downcore in 73002 and 73001. Initial interpretation of the chemical stratigraphy indicates there are potentially 5 layers represented.

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References: [1] Wolfe, E.W. et. al. (1981) *USGS Professional Paper*, 1080. [2] Fagan, A.L. and Neal, C.R. (2016) *GCA 173*, 352-372. [3] Neal C.R. (2001) JGR 106, 27,865-27,885. [4] Valenciano, J.L. et al. (2022) *LPSC 52*, #2818. [5] Salpas et al. (1987) *PLPSC 17*, E340-E348. [6] Schmitt H.H. et al. (2017) *Icarus* 298, 2-33.