HYDROGEN ABUNDANCES IN APOLLO 16 AND 17 DEEP DRILL CORE AND 79001/79002 CORE SAMPLES. Everett K. Gibson, Jr.[1], Roberta Bustin[2] and Patricia Mannion[3]. 1) SN4, Expt. Planetology, NASA JSC, Houston, TX 77058, 2) Chemistry Department, Arkansas College, Batesville, AR, and 3) Earlham College, Richmond, IN (LPI Summer Intern, 1987).

Future space activities will be enhanced if an extraterrestrial source of hydrogen for propellants and consumables becomes available. Hydrogen has been implanted in lunar materials through solar wind bombardment. In order to determine the feasibility of utilizing this solar wind hydrogen, it is necessary to know not only hydrogen abundances in a variety of locations but also the distribution of hydrogen within a given material. Over the past several years we have been studying hydrogen abundances in a variety of samples. The hydrogen abundances in soils from the Apollo 16 and 17 deep drill cores along with the recently open Apollo 17 double drive tube 79001/2 are given in this report. Hydrogen was extracted from lunar soil by vacuum pyrolysis using the technique of Carr et al. (1).

Apollo 16 Deep Drill Core 60002-60007. The core was collected from the Cayley Plains near the ALSEP site. The area surrounding the core site was covered by ejecta from South Ray Crater. Some of the core samples may represent materials from nearby older craters such as Palmetto, Spook, and Gator (2). The profile of hydrogen abundances matches the I_s/FeO profile for surface maturity fairly closely for approximately the lower two-thirds of the core (Fig. 1). Gose and Morris (3) suggested the upper 13 cm of the core was emplaced much later than the bottom portion. The unit below 190 cm contained the most immature soils found in the core. This unit consisted of coarse-grained material (2) and probably was not exposed to the lunar surface for any significant time period (3). As would be expected, the hydrogen abundances for this unit were low.

Apollo 17 Deep Drill Core 70002-70009. The core was taken about 400 meters SE of Camelot Crater and was the deepest soil column (295 cm) returned from the moon. The I_s/FeO profile for the entire core shows a wide range of soil maturities. The correlation between hydrogen abundance determined in this study and soil maturity as measured by the I_s/FeO index is striking (Fig. 2). One of the distinctive features of the core is the immature zone between 20 and 60 cm. As expected, we found very low hydrogen concentrations in this zone. Proceeding down the core, soils became more mature, and larger hydrogen abundances were found. Both of these results are expected from the grain size distributions in the core (4). The section of the core where hydrogen is depleted (bottom of 70009 through 70008) consisted of coarse-grained basaltic material. Gas concentrations are usually lower in larger grain sizes. The largest hydrogen abundances were found in the middle of 70006 down to the middle of 70005. These enrichments are associated with the finer grained materials which have had a longer surface exposure (4).

Stoenner et al. (5) measured hydrogen and helium on nine samples from the same core. They found unusually high H/He ratios for the samples. It is believed that the hydrogen abundances reported by (5) represent a component of terrestrial water contamination. Using our hydrogen abundances and the helium values from (5), the average $^1H/^4He$ for this core was 8.5. This is in the expected range of 7 to 10 for the solar wind $^1H/^4He$ atom ratio.

Apollo 17 Double Drive Tube 79001/2. The drive tube was collected about 70 meters south of Van Serg Crater at the Apollo 17 site. The striking feature of this core was a distinct dark-light boundary inclined 25 to 30 degrees from approximately 8.5 to 11 cm below the surface. Morris (6) showed that the upper dark portion was distinctly more mature than the underlying light material. The distinct change in both soil maturity and hydrogen abundances at approximately the interface between the dark and light layers can be seen in Fig. 3. Schwarz (7) observed that in the upper dark-gray portion, soil breccias and soil clods were the dominant particle types. In the lower light-gray end of the core, basalt and glass particles were noticeably more prevalent. As we have reported previously (8) soil breccias typically have higher hydrogen abundances and basalts and glassy particles are very low in hydrogen. The correlation between hydrogen and soil maturity as measured by the I_s/FeO index is excellent.

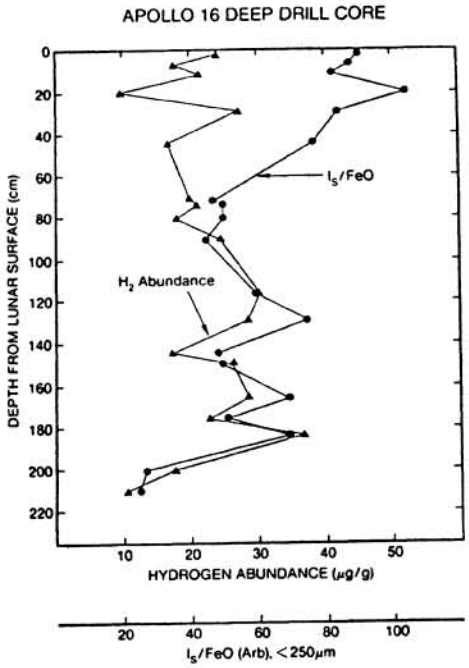

Fig. 1. Depth profiles of hydrogen abundances and I_s/FeO for the Apollo 16 Deep Drill Core 60002-60007.

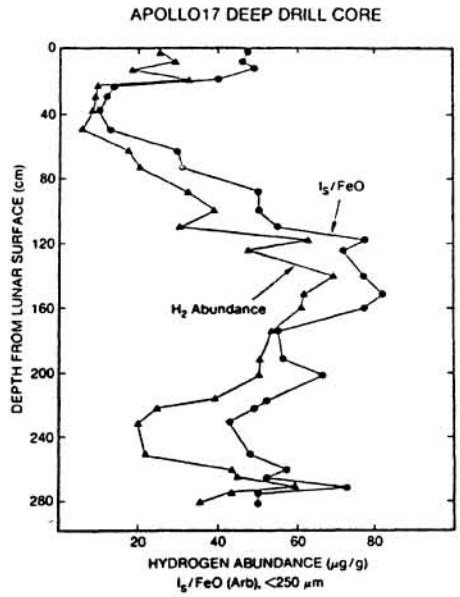

Fig. 2. Depth profiles of hydrogen abundances and I_s/FeO for the Apollo 17 Deep Drill Core 70002-70009..

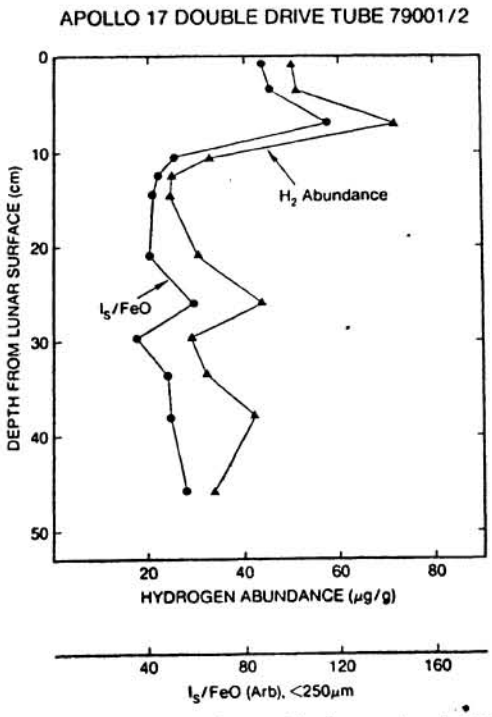

Fig. 3. Depth profiles of hydrogen abundances and I_s/FeO for the Apollo 17 Double Drive Tube 79001-79002.

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