**RESTORATION OF APOLLO DATA BY THE NSSDC AND PDS LUNAR DATA NODE.** David R. Williams[1], H. Kent Hills[2], Edward A. Guinness[3], Patrick T. Taylor[4], and Marie J. McBride[5], [1]NSSDC, Code 690.1, Goddard Space Flight Center, Greenbelt, MD, 20771, david.r.williams@nasa.gov, [2]ADNET, NSSDC, Code 690.1, Goddard Space Flight Center, Greenbelt, MD 20771, howard.k.hills@nasa.gov, [3]Department of Earth and Planetary Sciences, Washington University, St. Louis, MO, 63130, guinness@wustl.edu, [4]Code 698, Goddard Space Flight Center, Greenbelt, MD 20771, patrick.t.taylor@nasa.gov, [5]Florida Institute of Technology, 150 W. University, Box 6647, Melbourne, FL 32901, mmcbride2009@my.fit.edu

The Apollo Lunar Surface Experiment Packages (ALSEPs), suites of instruments deployed by the Apollo 12, 14, 15, 16 and 17 astronauts on the lunar surface, still represent the only *in-situ* measurements of the Moon's environment taken over long time periods. Most instruments operated successfully until they were turned off on 30 September 1977, having returned 5 to 7 years worth of data. The Apollo missions also returned critical data from orbit and from experiments performed by the astronauts during their brief stays on the surface. Much of these data are housed at the National Space Science Data Center (NSSDC) at Goddard Space Flight Center but are in forms that are not readily usable, such as microfilm, hardcopy, and magnetic tapes with older, obsolete formats.

The Lunar Data Node (LDN) has been formed under the auspices of the Planetary Data System (PDS) Geosciences Node to put relevant, scientifically important Apollo data into accessible digital form for use by researchers and mission planners. The LDN has prioritized the restoration of these data based on their scientific and engineering value and the level of effort required. We will report on progress made and plans for future data restoration.

Data from four ALSEP experiments, the Apollo 14 and 15 Cold Cathode Ion Gage (CCIG), and the Apollo 12 and 15 Solar Wind Spectrometer (SWS), comprising six unique data sets, have been restored and delivered to the PDS for archiving and distribution to the science community. The CCIG and SWS datasets are available online through the PDS Geosciences Node website (pds-geosciences.wustl.edu/missions/apollo/).

The Apollo 15 and 16 Soil Mechanics data, handwritten charts and plots from the Lunar Penetrometer, have been digitized from the archival microfilm and put into PDS format for review and validation. These data sets include information on the traverses and sampling sites, as well as video of the astronauts performing the experiments.

Heat flow data from the Apollo 15 and 17 ALSEPs has been read from magnetic tapes at NSSDC, reformatted, documented and are now available online at the NSSDC Lunar Data Project website (see below). These data have been converted to PDS format and are being reviewed and will be archived with the PDS Geosciences Node. These data are incomplete, Patrick Taylor headed a LASER (Lunar Advanced Science and Exploration Research) funded effort to retrieve further heat flow data. This effort has included a trip to the Lamont-Doherty Earth Observatory to review data tapes and notebooks from the heat flow experiment.

The Traverse Gravimeter Experiment was carried on the lunar rover and deployed at various sites by the Apollo 17 astronauts over the three day mission. The purpose of the experiment was to profile the local gravity field. These data were stored on microfilm and hard copy documents at NSSDC and have been transcribed into digital tables, put into PDS format, and are now under review.

The Dust Thermal Radiation Environment Monitor (DTREM), more commonly known as the Dust Detector, was deployed on Apollos 11, 12, 14, and 15 and returned data on the effect of dust deposition, temperature, and radiation on solar cells mounted on the central stations. The data for the Apollo 14 and 15 experiments, consisting of raw and calibrated voltages and temperatures, was saved to microfilm from computer printouts at NSSDC. The microfilm has been scanned and saved to a data set as digital images. These data are now under review and will be validated and archived as a PDS data set. Recently the raw housekeeping telemetry containing the output from the Dust Detectors became available to NSSDC. We are converting the telemetry to raw and calibrated voltages and temperatures for the Apollo 14 and 15 DTREMs using information from the archived microfilm, and are producing tables of raw counts from the Apollo 11 and 12 output. When completed, they will be archived as fully digital datasets through the PDS.

The Apollo 17 Lunar Atmosphere Composition Experiment (LACE) returned data for just under a year on the mass spectrum of particles in the tenuous lunar atmosphere. These data were stored on magnetic tape and have been read and converted to ASCII. They will be reformatted, appropriate ancillary data will be added, and they will be put through PDS review.

The Lunar Ejecta And Meteorites (LEAM) experiment on Apollo 17, led by Otto Berg, was designed to measure the direction and energy of particles striking the Moon's surface. It took measurements for 3 years

but unfortunately the data were lost before they could be archived. However, Berg did keep detailed notes on these data, he loaned his notebooks to NSSDC where they have been scanned and will be put online. It is possible the calibration data will allow use of the raw data from the instrument which are held on telemetry tapes and may be recoverable as mentioned below.

The Apollo 15 and 16 X-Ray Spectrometer data, measurements of the lunar surface from orbit, have been read from magnetic tape and put in digital tabular format and will be provided as a PDS data set when supporting SOLRAD data have been added.

Interactions with the P.I. of the Apollo 17 Infrared Spectrometer, Wendell Mendell (NASA/JSC), have led to an agreement to archive a documented digital version of that data set as well.

Other instrument data being restored by the Lunar Data Node include the Apollo 14 and 16 Active Seismic Experiment, the Apollo 14 Charged Particle Lunar Environment Experiment, and the Apollo 17 Lunar Surface Gravimeter

Concurrently, related work in a separate LASER proposal led by Peter Chi is being done to recover tapes with magnetic field data from Apollo 15 and 16 Orbital and Surface Magnetometers. These data are planned for recovery, reformatting, and archive with PDS through the LDN.

The raw telemetry returned to Earth by the ALSEPs was saved on what were called ARCSAV tapes. The last year and a half of these tapes were archived at NSSDC, but the disposition of the earlier tapes is not known. Work led by Seiichi Nakamura (Texas Tech University) has uncovered a collection of these tapes at the National Records Center. We plan to recover the data from these tapes, reformat and archive the resulting raw data, and then for cases in which we have sufficient information, (e.g. LEAM) apply the appropriate corrections and calibrations to create restored instrument data sets.

The ALSEPs also produced a collection of housekeeping and engineering tapes which have been read by Yosio Nakamura (University of Texas, Austin). These data, which include instrument status, central station power information, and other pertinent general data on each ALSEP instrument suite, would be reformatted and archived to serve as an ancillary data set for use with the instrument data.

A visit to the Lunar and Planetary Institute Library yielded a collection of ALSEP Summary reports, weekly reports detailing the operational status and anomalies of each instrument over its lifetime. The library staff has scanned all the reports and we have started the process of pulling out the history for each instrument for reformatting.

Lynn Lewis, in conjunction with the Apollo Lunar Surface Experiments Package Data Recovery focus group of the NASA Lunar Science Institute, has been spearheading an effort to collect information on ALSEP history and relevant references and contacts for all the experiments. This information will be used for understanding, describing and formatting the data. Also included with the data will be the necessary metadata, ancillary information to aid in the use and understanding of the data, including complete descriptions of the data sets, formats, processing history and descriptions of the instruments used to collect the data and the mission histories. At the end of this multi-year effort we will have the relevant data and associated metadata online and easily accessible to interested users from the lunar scientific and exploration communities. We are still soliciting external feedback and suggestions on useful future data sets for restoration.

In addition to those mentioned in the author list and referenced above, the other LDN team members are: Ray Arvidson, Pam Clark, Jay Friedlander, Jim Garvin, Danny Hoag, Howard Leckner, Michael Liu, Allison Lopez, Stephanie McLaughlin, and Jeff Plescia.

The data sets and more information can be found at the NSSDC Lunar Data Project website nssdc.gsfc.nasa.gov/planetary/lunar/lunar_data/ and the PDS Geosciences Node website pds-geosciences.wustl.edu/.