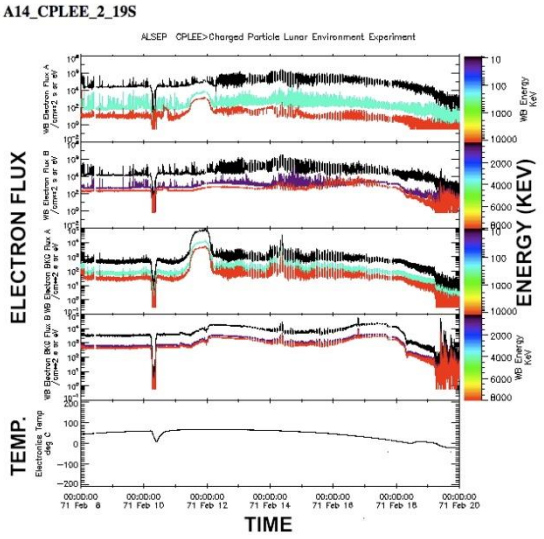
RESTORATION OF APOLLO DATA BY THE LUNAR DATA PROJECT / PDS LUNAR DATA NODE: AN UPDATE. David R. Williams[1], H. Kent Hills[2], Patrick T. Taylor[3], Edwin J. Grayzeck[1], Edward A. Guinness[4], [1]Code 690.1/NSSDCA, NASA Goddard Space Flight Center, U.S.A. (david.r.williams@nasa.gov), [2]Code 690.1/NSSDCA, Adnet Systems Inc., U.S.A., [3]Code 698/Planetary Geodynamics, NASA Goddard Space Flight Center, U.S.A., [4]Dept. of Earth and Planetary Sci., Washington University in St. Louis, U.S.A.

Introduction

The Apollo 11, 12, and 14 through 17 missions orbited and landed on the Moon, carrying scientific instruments that returned data from all phases of the missions, included long-lived Apollo Lunar Surface Experiments Packages (ALSEPs) deployed by the astronauts on the lunar surface. Much of these data were never archived, and some of the archived data were on media and in formats that are outmoded, or were deposited with little or no useful documentation to aid outside users. This is particularly true of the ALSEP data returned autonomously for many years after the Apollo missions ended. The purpose of the Lunar Data Project and the Planetary Data System (PDS) Lunar Data Node is to take data collections already archived at the NASA Space Science Data Coordinated Archive (NSSDCA) and prepare them for archiving through PDS, and to locate lunar data that were never archived, bring them into NSSDCA, and then archive them through PDS. Preparing these data for archiving involves reading the data from the original media, be it magnetic tape, microfilm, microfiche, or hard-copy document, converting the outmoded, often binary, formats when necessary, putting them into a standard digital form accepted by PDS, collecting the necessary ancillary data and documentation (metadata) to ensure that the data are usable and well-described, summarizing the metadata in documentation to be included in the data set, adding other information such as references, mission and instrument descriptions, contact information, and related documentation, and packaging the results in a PDS-compliant data set. The data set is then validated and reviewed by a group of external scientists as part of the PDS final archive process. We present a status report on some of the data sets that we are processing.

Charged Particle Lunar Environment

The Charged Particle Lunar Environment Experiment (CPLEE) was deployed on the surface as part of the Apollo 14 ALSEP. CPLEE consisted of two electrostatic analyzers that measured ions and electrons at the lunar surface over a spectrum of directions and energies. The original data were archived at NSSDCA on magnetic tape in binary format. They have been read and converted to CDF, from which they are converted to ASCII tables. The metadata are being prepared to accompany these data tables and a PDS data set will be ready for review and validation this calendar year. Below is a sample of CPLEE data generated from the CDF files.



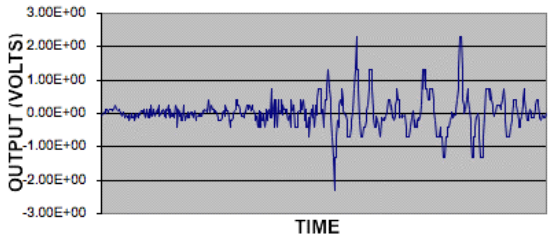
X-Ray Spectrometer

Apollo 15 and 16 carried X-ray spectrometers in the orbiting service module. These instruments took measurements of the lunar X-ray flux from near-equatorial orbit in order to constrain the surface composition. The original data were on magnetic tape archived at NSSDCA, consisting of time-ordered count rates from three proportional counters and a solar x-ray monitor. These have been converted into digital tables and have undergone PDS validation and review. The last of the liens has been resolved, and these data should be available through PDS before the LPSC meeting in March, 2016.

Active Seismic

Active seismic experiments were conducted on the Apollo 14 and 16 missions, and a seismic profiling experiment was performed on Apollo 17. The active seismic experiments consisted of a set of three geophones, a "thumper" (a handheld device to generate a seismic signal), and a mortar and grenades. The thumper was operated at various points along the seismic line by the astronauts

during their EVAs, and the mortar (which was not operated on Apollo 14) fired grenades to different distances after the astronauts departed. The original data were on magnetic tape archived at NSSDCA. Matt Brzostowski converted the tape data into digital tables of time and geophone readings. The appropriate metadata is now being prepared and the data sets will be packaged, reviewed, and validated before archive with PDS. Below is shown a sample output from one of the geophones.



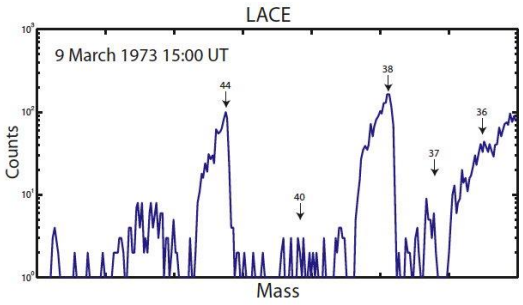
The Apollo 17 seismic profiling experiment comprised a set of geophones deployed by the astronauts in a triangular pattern and a set of charges emplaced at different distances from the site during the EVAs. These charges were timed to detonate a few days after the astronauts left. These data were archived at NSSDCA on magnetic tape and the original binary readout was converted by Matt Brzostowski (Schlumberger) into digital tables which are now being prepared for archive with PDS. All these seismic experiments had a passive listening mode that was exercised at various periods during the ALSEP operations and these data are included.

Dust, Thermal, and Radiation Degradation

Apollo 11, 14, and 15 carried Dust, Thermal and Radiation Environment Monitors (DTREM) and Apollo 12 carried a Dust Detector, small packages that tracked the output of solar cells over time in the lunar environment. The degradation of the cells with time, measured by diminishing output, was used to estimate the effects of dust deposition, radiation, and extreme temperatures. The original data at NSSDCA consisted of reels of microfilm with raw and reduced output data. Additionally, the Apollo housekeeping data, saved by Yosio Nakamura (Univ. Texas, Austin) as part of the Apollo passive seismic data, contained the raw counts from the dust detectors. The microfilm has been scanned and gone through PDS review and is now awaiting lien resolution and updating of the metadata. The raw counts have been tabulated and are being prepared for archive with PDS. Additionally, the microfilm has allowed us to convert the raw counts into actual voltage output for Apollo 14 and 15, and these data will be archived with PDS as well.

Lunar Atmospheric Composition

The Apollo 17 Lunar Atmospheric Composition Experiment (LACE) comprised a magnetic deflection mass spectrometer deployed on the lunar surface. It operated for about 10 months, measuring the composition of the tenuous lunar gases as part of the ALSEP package. The original data were archived at NSSDCA on magnetic tape in the form of mass spectra. These data have been read from the tapes and reformatted. The metadata are now being assembled to complete the data set for review and validation by PDS. Below is shown an example of one spectral sweep.



Completed Data Sets

Previously completed data sets are available at http://pds-geosciences.wustl.edu/missions/apollo/. These include the Apollo 14 and 15 Cold Cathode Ion Gage (CCIG) data, which consist of scans of microfilm plots of the number of neutral gas particles near the surface, measured by the ALSEP CCIG sensor. The Traverse Gravimeter, used by the Apollo 17 astronauts, measured the lunar gravity along a Lunar Rover. These original data were on microfilm and hardcopy documents, and now consist of a table of results from the experiment. The Solar Wind Spectrometer, part of the Apollo 12 and 15 ALSEPs, measured plasma parameters at the lunar surface. Originally archived on magnetic tape, these data are now in the form of digital tables. Portions of the Heat Flow Experiment data, from the Apollo 15 and 17 ALSEPs, originally on magnetic tape at NSSDCA, are now available through PDS as digital tables of the outputs of the thermistors. Soil Mechanics Penetrometer data, originally archived by NSSDCA on microfilm and as hardcopy documents, have been scanned and are available through PDS as image files and digital tables. The Lunar Data Project is online at http://nssdc.gsfc.nasa.gov/planetary/lunar/lunar_data