

**RESTORATION OF APOLLO DATA BY THE PDS LUNAR DATA NODE.** David R. Williams<sup>1</sup>, Alfred B. Schultz<sup>1</sup>, H. Kent Hills<sup>2</sup>, Edward A. Guinness<sup>3</sup>, Paul D. Lowman<sup>4</sup>, and Patrick T. Taylor<sup>4</sup>, <sup>1</sup>PDS, Code 690.1, Goddard Space Flight Center, Greenbelt, MD, 20771, [david.r.williams@nasa.gov](mailto:david.r.williams@nasa.gov), [alfred.b.schultz@nasa.gov](mailto:alfred.b.schultz@nasa.gov), <sup>2</sup>ADNET, NSSDC, Code 690.1, Goddard Space Flight Center, Greenbelt, MD 20771, [howard.k.hills@nasa.gov](mailto:howard.k.hills@nasa.gov), <sup>3</sup>Department of Earth and Planetary Sciences, Washington University, St. Louis, MO, 63130, [guinness@wustl.edu](mailto:guinness@wustl.edu), <sup>4</sup>NASA Code 698, Goddard Space Flight Center, Green Belt, MD 20771, [paul.d.lowman@nasa.gov](mailto:paul.d.lowman@nasa.gov), [patrick.t.taylor@nasa.gov](mailto:patrick.t.taylor@nasa.gov)

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 [1]. We will report on progress made since last year and plans for future data restorations.

The Apollo lunar missions returned a wealth of information, including long-term (1969-1977) surface data collected by autonomous ALSEP (Apollo Lunar Surface Experiment Package) stations emplaced by the crews of the Apollo 12, 14, 15, 16, and 17 missions, surface point measurements, and orbital data. The data, meant primarily for evaluation of the engineering aspects of human sorties to the Moon and eventual establishment of lunar bases, represent the only long-term information on the lunar surface environment, and as such are ideal for studying the lunar domain and planning future lunar exploration.

Much of the ALSEP and other surface and orbital data housed at National Space Science Data Center (NSSDC), GSFC are in forms that are not readily usable, such as microfilm, hardcopy, and magnetic tapes with older, obsolete formats. The LDN is prioritizing these data based on their scientific and engineering value for hazard and resource assessment and the level of effort required for restoration.

Data from three experiments, Apollo 15 and 16 X-Ray Spectrometer (XRS), Apollo 14 and 15 ALSEP Cold Cathode Ion Gage (CCIG), and the Apollo 12 and 15 Solar Wind Spectrometer (SWS), comprising eight unique data sets, have been restored, prepared for archiving, and completed PDS peer review. The CCIG and SWS datasets have been delivered to the PDS Geosciences Node for archiving and distribution to the science community. The XRS dataset is awaiting the addition of SOLRAD data before

this dataset is submitted for archiving. The CCIG and SWS datasets are available online through the PDS Geosciences Node website ([pds-geosciences.wustl.edu/missions/apollo/](http://pds-geosciences.wustl.edu/missions/apollo/)). Figure 1 shows examples of restored data sets.

The Apollo 15 and 16 Soil Mechanics data, handwritten charts and plots from the Lunar Penetrometer, were also evaluated at the PDS peer review. These have been digitized from the archival microfilm, put online at NSSDC, and are being prepared for submission to the PDS. Additional information about where the measurements were made is being added to this dataset.

The Apollo 14 and 15 Dust, Thermal, and Radiation Engineering Measurements data, comprising tables of solar cell voltages over time, which give information on the degradation of solar cells and the lunar dust environment, are being scanned from microfilm. The Apollo 14 data have been scanned and optical character recognition software is being used to produce digital tables of this data for the PDS. The scanning of Apollo 15 microfilm should be completed by late Spring 2009.

The Apollo 14 Charged Particle Lunar Environment Experiment data, energy spectra of charged particles striking the lunar surface, have been read from magnetic tape and are being converted into CDF for addition to the online CDAWeb system and prepared for archive with the PDS.

Future plans include restoration of the Apollo 15 and 16 Alpha Particle Spectrometer, Apollo 17 Far-Ultraviolet Spectrometer, Apollo 12, 14, and 15 Suprathermal Ion Detector Experiment, Apollo 15 and 16 Gamma-Ray Spectrometer, Apollo 16 Active Seismic Experiment, and the Apollo 15 and 16 Subsatellite Lunar Particle and Boundary Layer Experiment data sets. NSSDC is also supporting restoration of the Apollo Metric and Panoramic Photography [2], and the

Lunar Data Node is involved in other concurrent data restoration efforts, including the Apollo Heat Flow [3], Apollo Surface and Orbital Magnetic Fields [4], and Apollo 17 Lunar Atmospheric Composition Experiment [5]. Other datasets being examined include Apollo 17 Traverse Gravimeter, Surface Gravimeter, and Lunar Sounder. We are still soliciting external feedback and suggestions on useful future data sets for restoration.

Metadata, ancillary information to aid in the use and understanding of the data, have been compiled and are included in these online data collections. The documentation covers complete descriptions of the data sets, formats, processing history, and relevant references and contacts, as well as descriptions of the instruments used to collect the data and mission history. At the end of this multi-year effort we will have the

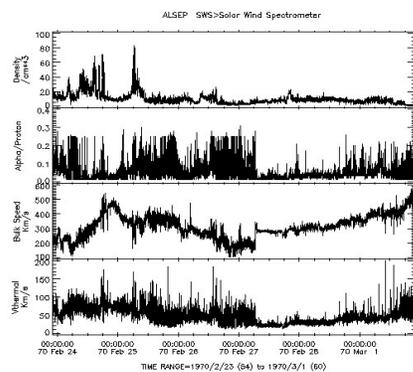
relevant data and associated metadata online and easily accessible to interested users from the lunar scientific and exploration communities.

The other LDN team members are: Ray Arvidson, Pam Clark, Jay Friedlander, Jim Garvin, Danny Hoag, Howard Leckner, Michael Liu, Allison Lopez, Stephanie McLaughlin, Bruce Milam, 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/](http://nssdc.gsfc.nasa.gov/planetary/lunar/lunar_data/) and the PDS Geosciences Node website [pds-geosciences.wustl.edu/](http://pds-geosciences.wustl.edu/).

References: [1] Slavney et al. (2008), LPSC XXXIX. [2] Robinson et al. (2008), LPSC XXXIX. [3] Nakamura et al. (2008), LPSC XXXIX. [4] Chi et al. (2008), LPSC XXXIX, [5] Hodges et al. (1973), LPSC IV, 2855.

APOLLO12\_SWS\_28S



TIME RANGE=1970/2/25 (64) to 1970/3/1 (66)  
Please acknowledge data provider, Conway W. Snyder  
at Jet Propulsion Laboratory and CDAWeb when using these data.  
Generated by CDAWeb on Thu Mar 1 14:52:53 2007

144	309073.69	6.70	1.81	-79.24	82.74	-175.55	0.46	-38.31
71	28	41	38	33	42	34	105	2403
6	8	5	81	2553	50	10	10	3
55	92	32	18	20	21	34	724	18
144	309081.98	6.70	1.87	-79.66	83.04	-175.56	0.46	-38.30
49	32	33	18	28	28	20	96	2482
6	7	12	80	2486	16	7	8	4
54	95	34	23	29	17	23	738	99
144	309089.75	6.70	1.94	-80.06	83.33	-175.58	0.46	-38.29
61	33	32	17	35	20	10	94	2326
3	3	11	91	2434	13	7	8	10
55	76	36	19	20	24	26	692	96
144	309097.75	6.70	2.00	-80.47	83.62	-175.59	0.46	-38.28
38	10	30	28	22	26	24	96	2417
5	12	7	88	2474	24	10	11	5
58	93	25	21	24	25	29	735	98
144	309105.69	6.70	2.06	-80.87	83.91	-175.59	0.47	-38.28
38	29	36	29	28	23	29	91	2279
8	3	10	53	2394	18	10	5	12
45	95	28	15	25	30	23	754	99
144	309113.56	6.70	2.13	-81.27	84.20	-175.60	0.47	-38.27
47	26	44	10	22	24	22	103	2325
3	9	11	71	2462	13	6	7	4
63	93	29	20	31	31	26	754	99
144	309121.75	6.70	2.19	-81.69	84.50	-175.61	0.47	-38.27
46	24	27	32	26	32	28	98	2314
6	11	12	61	2436	13	7	8	11
50	100	28	18	26	25	33	732	98
144	309129.75	6.70	2.25	-82.09	84.79	-175.62	0.47	-38.27
34	20	36	32	25	29	19	102	2279
4	5	11	73	2388	17	8	6	7
63	73	24	20	26	22	29	755	98
144	309137.69	6.70	2.32	-82.50	85.07	-175.62	0.47	-38.26
52	26	28	30	20	33	30	98	2346
8	4	10	65	2483	8	12	11	9
48	89	46	22	37	24	33	710	99
144	309145.56	6.70	2.38	-82.90	85.35	-175.63	0.47	-38.26
41	25	24	20	25	29	27	107	2333
6	7	13	70	2423	9	16	6	7
64	86	34	20	16	16	21	787	99
144	309153.75	6.70	2.44	-83.32	85.65	-175.63	0.48	-38.26
51	22	39	28	27	27	23	113	2296
4	5	12	67	2400	14	10	13	8
65	75	35	22	27	20	30	766	102
144	309161.75	6.70	2.50	-83.72	85.93	-175.63	0.48	-38.26
50	12	37	29	43	24	19	99	2358
7	7	12	63	2532	18	7	7	12
55	84	32	26	17	24	32	727	99

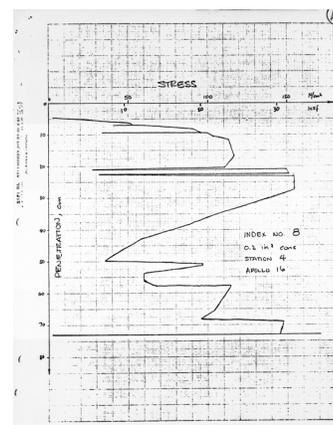
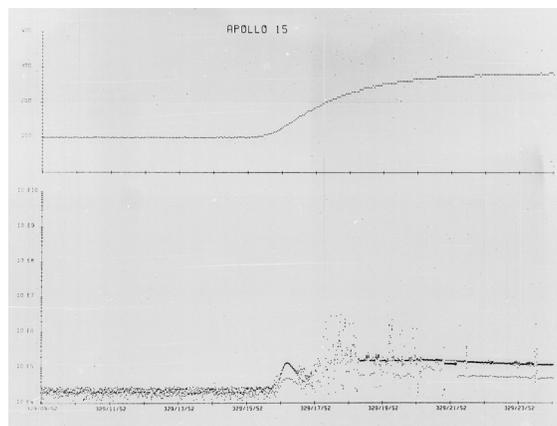


Figure 1: Examples of restored data (clockwise from upper left): SWS (CDAWeb plots), CCIG (top temperature, bottom density), Soil Mechanics Penetrometer (stress), X-Ray Spectrometer (time, position angles, and counts)