

RECENT ACHIEVEMENT BY THE SSERVI ALSEP DATA RECOVERY FOCUS GROUP. S. Nagihara¹, Y. Nakamura², D. R. Williams³, P. T. Taylor³, S. A. McLaughlin³, H. K. Hills⁴, W. S. Kiefer⁵, R. C. Weber⁶, J.-L. Dimech⁶, D. Phillips⁷, C. Nunn⁸, and G. K. Schmidt⁹. ¹Department of Geosciences, Texas Tech University, Lubbock, TX 79409 (seiichi.nagihara@ttu.edu), ²Institute for Geophysics, University of Texas at Austin, Austin, TX 78758, ³Goddard Space Flight Center, Greenbelt, MD 20711, ⁴ADNET Systems, NSSDC, Greenbelt, MD 20711, ⁵Lunar and Planetary Institute, Houston, TX 77058, ⁶Marshall Space Flight Center, Huntsville, AL 35805, ⁷Department of Physics and Astronomy, University of Alabama in Huntsville, Huntsville, AL 35899, ⁸Department of Earth and Environmental Sciences, Ludwig Maximilian University of Munich, ⁹Solar System Exploration Virtual Research Institute, Ames Research Center, Moffett Field, CA 94035.

Introduction: The ALSEP Data Recovery Focus Group was founded in 2010 under NASA's Lunar Science Institute and continues under the Solar System Exploration Research Virtual Institute (SSERVI). ALSEP (Apollo Lunar Surface Experiment Package) is a collective name for the ground-based science instruments deployed by the astronauts at the Apollo 12, 14, 15, 16, and 17 sites. The ALSEP instruments operated from November 1969 to September 1977, and 15 types of experiments were carried out [1]. At the conclusion of the ALSEP program, only portions of the data were archived at the National Space Science Data Center (NSSDC). The ALSEP Focus Group's primary mission is to recover/restore the missing data and metadata, and make them available in formats that are user-friendly to contemporary researchers. The Focus Group (FG) also serves as a forum for communication between the original ALSEP investigators and contemporary researchers who want to use/re-analyze the data. Here we summarize some of the group members' recent achievement made possible by the support from NASA's Planetary Data Archiving, Restoration, and Tools program.

Recovery of Raw ALSEP Data: From April 1973 to September 1977, raw ALSEP data received from the Moon were recorded on digital open-reel magnetic tapes for archival purpose at Johnson Space Center (JSC) and University of Texas at Galveston. However, these tapes were not delivered to NSSDC in 1977, and many of them were later lost. When the ALSEP FG was founded, only copies of the tapes generated in March 1976 to September 1977 had been archived. In 2010, we recovered at the Washington National Records Center 440 original archival tapes generated in April through June of 1975. We recently finished extracting data from these tapes (*Level-0* Data). Because of degraded quality of the tapes, the extracted binary files contained numerous bit errors. We have cleaned up most of such errors and have recovered more usable data. The raw data and cleaned-up raw data (*Level-0* and *Level-0a* Data) for April through June 1975 are now available from the National Space Science Data Coordinated Archive (NSSDCA). The raw data files from March 1976 through September 1977 are also available.

Higher Order Data and Derivative Products:

The files from the archival tapes contain data from various experiments intermeshed [2], and thus they do not readily conform to the specifications of the Planetary Data System (PDS). We are now extracting individual data packets, experiment by experiment, from our *Level-0* and *-0a* products for archiving with PDS (*Level-1* Data). Some of these products are now available from NSSDCA.

Because *Level-1* data are not readily usable for scientific data analysis, they are now being further processed according to the scheme and the instrument calibration data used by the original ALSEP investigators (*Level-2* Data).

Derivative data products are also being generated from *Level-1* and *-2* data. For example, the currently used lunar seismic event catalog, compiled in 1981 [3], is now being updated and expanded with additional moonquake information extracted from the recently restored data for the Lunar Seismic Profiling and the Lunar Surface Gravimeter experiments [4].

Digital Metadata Catalog: The *Level-2* data processing requires metadata, most of which were never published by the original ALSEP investigators. At the conclusion of the Apollo program, voluminous documents containing important information on the data processing, instrument design, and calibration experiments were moved from JSC to the Lunar and Planetary Institute (LPI) in Houston, TX and the National Archives storage facility in Fort Worth, TX. Our group has been conducting an inventory and optical scanning of these documents. Digital copies of these documents are being made available through LPI's web portal:

<https://repository.hou.usra.edu/handle/20.500.11753/2>

References: [1] Bates, J.. et al. (1979) *NASA Reference Pub.*, #1036, 165p. [2] Lockheed Electric Co. (1975) *ALSEP Archive Tape Description Document*, JSC-09652. [3] Nakamura, Y. et al. (1981) *Univ. Texas Inst. Geophys. Tech. Rept.*, #18. [4] Dimech, J.-L. et al. (2017) *LPSC 48*, Abstract #2675.