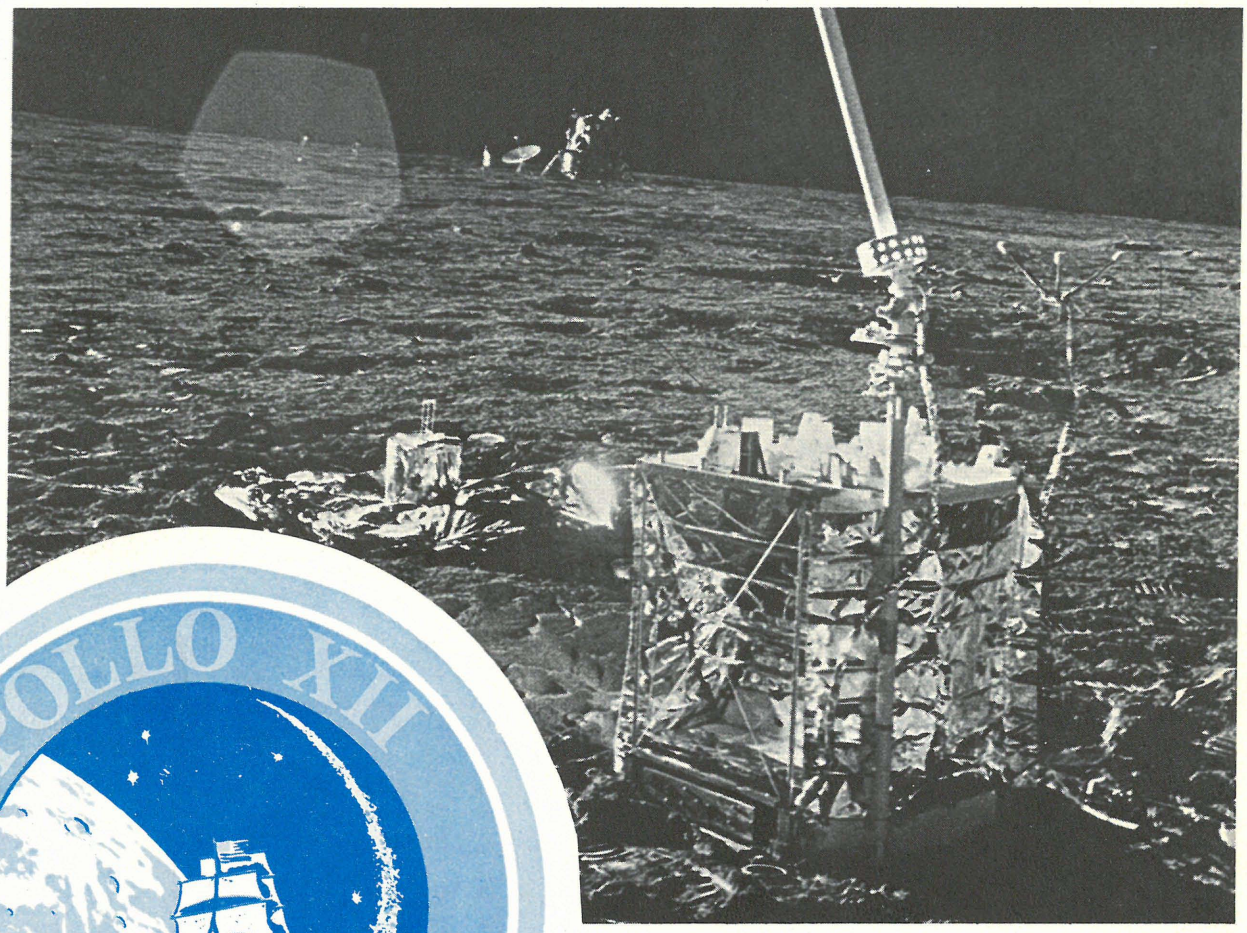
Apollo Lunar Surface Experiments Package (ALSEP)

Five Years of Lunar Science and Still Going Strong



Apollo 12 ALSEP Deployed on the Moon

Unprecedented Reliability Achievement

Although only required to operate one year, the Apollo 12 ALSEP system has transmitted an uninterrupted stream of science and engineering data for five years. ALSEP has survived more than 60 lunations (28 earth days per lunation) while being subjected to temperatures as low as minus 300°F at lunar night and as high as 250°F during lunar day.

Bendix Aerospace Systems Division

Experiment Mission Assignments

Experiment	Principal Investigator[a]	Mission, Array, Deployment Date, and Landing Site					
		Apollo 11 EASEP 20 July 1969 Mare Tranquillitatis	Apollo 12 ALSEP A 19 November 1969 Oceanus Procellarum	Apollo 14 ALSEP C 5 February 1971 Fra Mauro	Apollo 15 ALSEP A-2 31 July 1971 Hadley Rille	Apollo 16 ALSEP D 21 April 1972 Descartes	Apollo 17 ALSEP E 12 Dec 1972 Taurus Littrow
Passive Seismic Experiment	Gary Latham U. of Texas	•	•	•	•	•	
Laser-Ranging Retroreflector . 100 Corner	J. E. Faller Wesleyan University	•		•			
. 300 Corner					•		
Lunar Surface Magnetometer	Palmer Dyal Ames Research Center Charles Sonett University of Arizona		•		•	•	
Solar Wind Spectrometer	Conway W. Snyder Jet Propulsion Laboratory		•		•		
Suprathermal Ion Detector Experiment	John Freeman Rice University		•	•	•		
Heat Flow Experiment	Mark Langseth Lamont-Doherty Geological Observatory, Columbia Univ.				•	•	•
Charged-Particle Lunar Environment Experiment	D. Reasoner Rice University			•			
Cold-Cathode Gage Experiment	Francis Johnson University of Texas		•	•	•		
Active Seismic Experiment	Robert Kovach Stanford University			•		•	
Lunar Seismic Profiling Experiment	Robert Kovach Stanford University						•
Lunar Surface Gravimeter	Joseph Weber University of Maryland						•
Lunar Mass Spectrometer	John H. Hoffman University of Texas						•
Lunar Ejecta Meteoroid Experiment	Otto Berg Goddard Space Flight Center						•
Dust Detector	James Bates Manned Spacecraft Center	•	•	•	•		

[a]For most experiments, a team of co-investigators is responsible for definition of experiment requirements and interpretation of science data; only the principal investigator is listed here.

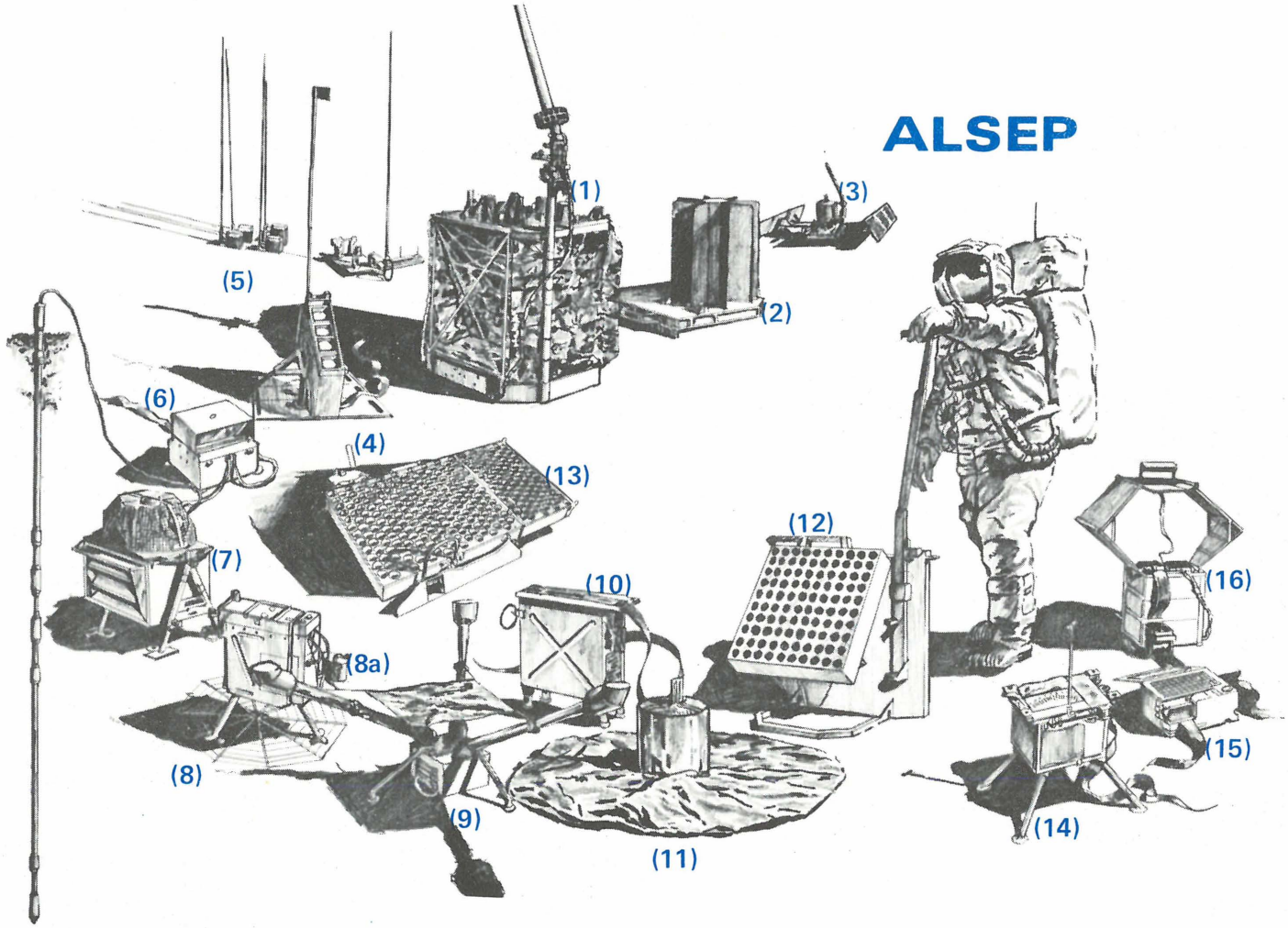
Fourteen different ALSEP lunar surface science experiments flew a total of 33 times during the Apollo Program, as shown in the table above. All of the ALSEP science stations deployed on the Moon are continuing to transmit science data except that flown on Apollo 11, which, with its solar cell power system, had a design lifetime of only 14 days. All of the Bendix-provided experiments continue to return significant science data to Earth.

The ALSEP Record

Apollo Mission	Date Deployed	Design Life (Days)	Successful Operating Time To-Date (Days)*
11	20 July 69	14	71
12	19 Nov 69	365	1,868
14	5 Feb 71	365	1,425
15	31 July 71	365	1,249
16	21 April 72	365	984
17	12 Dec 72	730	749
	Cumulative	2,204 days 6.04 years	6,346 days 17.4 years

*as of 31 December 1974

ALSEP



Apollo astronauts deployed six ALSEP scientific stations on the Moon to form an automated network of lunar science laboratories. The experiment systems, here drawn to scale, are expected to continue to return science data for many more years.

Central Station (1): The heart of ALSEP, provides the radio frequency link to Earth for telemetering data, command/control, and power distribution to the experiments.

Radioisotope Thermoelectric Generator (2): Supplies about 70 watts of electrical power for continuous day-night operation.

Early Apollo Scientific Experiment Package - EASEP (3): Flown on Apollo 11 only, this experiment package was powered by solar energy and contained an abbreviated set of experiments.

Active Seismic Experiment (4): Uses an astronaut-activated thumper device and mortar firing explosive charges to generate seismic signals. This experiment used geophone seismic listening devices to determine lunar structure to depths of about 300 meters.

Lunar Seismic Profiling Experiment (5): Flown on Apollo 17 only, this experiment is an advanced version of the Active Seismic Experiment. It uses four geophones to detect seismic signals generated by eight explosive charges weighing from about 1/16 to 3 kilograms. The charges were deployed at distances up to 3.5 kilometers from the Lunar Module and were detonated by timers after the Lunar Module departed. Lunar structure to depths of three kilometers was measured. Used in a listening mode, the experiment continues to provide data on moon/thermal quakes and meteoroid impacts.

Heat Flow Experiment (6): Probes containing temperature sensors are implanted in holes to depths of 2.5 meters to measure the near-surface temperature gradient and thermal conductivity from which heat flow from the lunar interior can be determined.

Solar Wind Spectrometer (7): Measures interaction between the Moon and the solar wind by sensing the flow-direction and energies of both electrons and positive ions. Results show that solar wind plasma measurements on the lunar surface are indistinguishable from simultaneous plasma measurements made by nearby orbiting satellites.

Suprathermal Ion Detector (8): Provides information on the energy and mass spectra of positive ions near the lunar surface. Evidence of prompt ionization and acceleration of gases generated on the Moon has been found in the returned data.

Cold Cathode Ion Gauge (8a): A separate experiment combined in an integrated package with 8. It determines the density of neutral gas particles in the tenuous lunar atmosphere.

Lunar Surface Magnetometer (9): Measures the intrinsic remanent lunar magnetic field and the magnetic response of the Moon to large-scale solar and terrestrial magnetic fields. The electrical conductivity of the lunar interior has also been determined from measurements of the Moon's response to magnetic field step-transients. Three boom-mounted sensors measure mutually-orthogonal components of the field.

Charged Particle Lunar Environment (10): Measures the fluxes of charged particles, both electrons and ions, having energies from 50 to 50,000 electron volts. The instrument measures plasma particles originating in the Sun and low-energy particle flux in the magnetic tail of the Earth.

Passive Seismic Experiment (11): Detects moon-quakes and meteoroid impacts to enable scientists to determine the Moon's internal composition.

Laser-Ranging Retroreflector (12/13): The retroreflector bounces laser pulses back to Earth ground stations to provide data for precise measurements of the Earth-Moon distance in order to determine Earth wobble about its axis, continental drift, lunar librations, etc. Arrays of 100 retroreflecting corners were flown on Apollo 11 and 14, and an array of 300 corners was flown on Apollo 15.

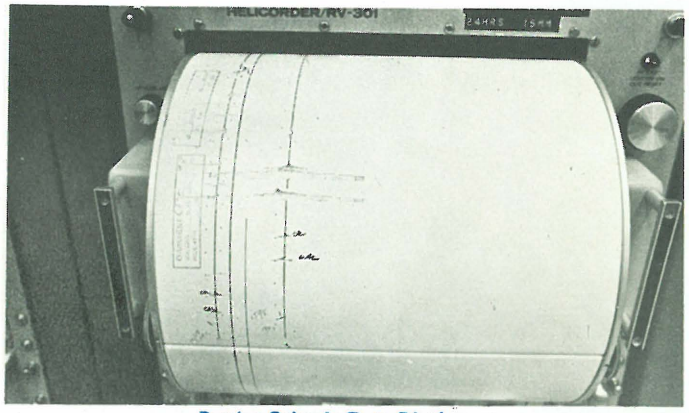
Lunar Ejecta and Meteorites Experiment (14): Three separate detectors which measure energy, speed, and direction of dust particles, are oriented to face east, west, and up. The dust particles measured are meteorites, secondary ejecta from meteorites, and, possibly, lunar surface particles levitated and accelerated by little-understood lunar surface phenomena.

Lunar Mass Spectrometer (15): Uses a magnetic deflection mass spectrometer to identify lunar atmospheric components and their relative abundances.

Lunar Surface Gravimeter (16): Measures and senses changes in the vertical component of lunar gravity, using a spring mass suspension. It also provides data on the lunar tides.

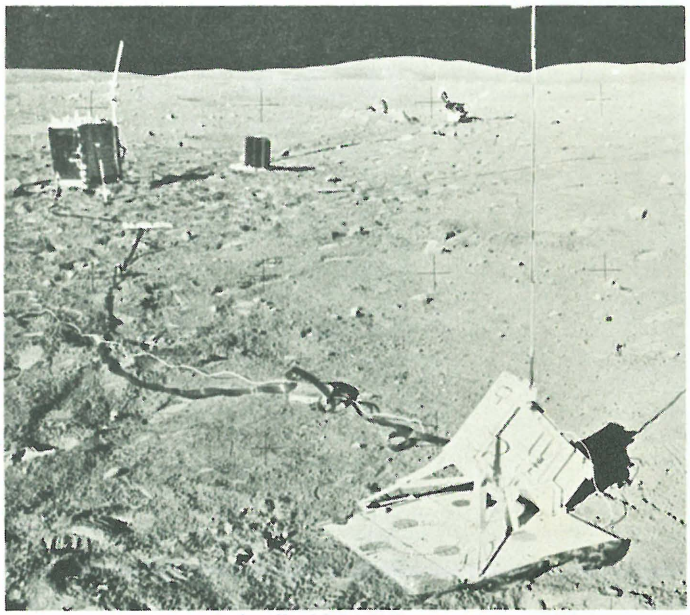
ALSEP Today

Data from all five ALSEP stations, totaling about 460 million bits per day, are recorded at ground stations, processed, and provided to scientific investigators. The data are also archived for possible use by future investigators.

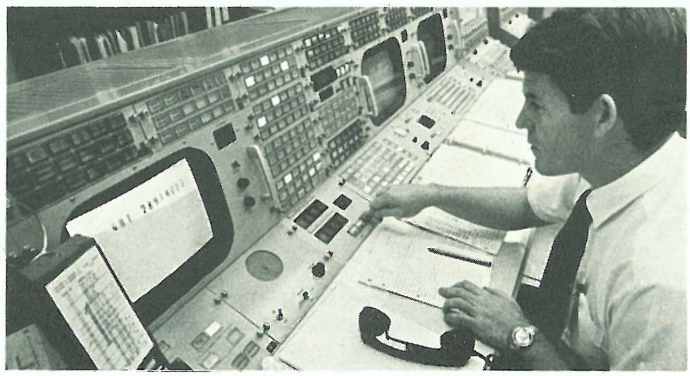


Passive Seismic Data Display

Apollo 17 ALSEP



Apollo 16 ALSEP



ALSEP Control Console Johnson Spacecraft Center

ALSEP And The Future

The continuing output of ALSEP data is steadily improving our understanding of the Earth-Moon relationship and the entire Solar System. Although nearly all experiments have far exceeded their initial scientific objectives, systematic science data collection is planned to be extended far into the future.

The Apollo Lunar Surface Experiments Packages were developed by the Bendix Corporation, Aerospace Systems Division, under the direction of the National Aeronautics and Space Administration's Johnson Spacecraft Center.

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