PRESENTATION TO

THE SCIENCE ADVISOR

TO THE PRESIDENT

SEPTEMBER 3, 1971
APOLLO 15
PASSIVE SEISMIC EXPERIMENT

- ESTABLISHED THIRD STATION IN NETWORK
- MONITORED LRV - WILL PROVIDE DATA ON UPPER 1-2 KM
- PERIGEE EVENTS TENTATIVELY LOCATED
- LM IMPACT CONFIRMED LONG DISTANCE RECEPTION OF SMALL SEISMIC SOURCES
- S-IVB IMPACT PROVIDED DATA TO DEPTHS OF 50-100 KM VS 30 KM
APOLLO 15
HEAT FLOW EXPERIMENT
TEMPERATURE HISTORY OF PROBE 1

ECLIPSE
4 HRS 6 AUG 71

TIME OF PROBE INSERTION

TOP (43 CM)
MIDDLE (96 CM)
BOTTOM (146 CM)

CALENDAR DATES
APOLLO 15
LUNAR SURFACE MAGNETOMETER

• VERY SMALL LOCAL FIELD: $5 \pm 5$ GAMMAS
  • APOLLO 12: $38 \pm 3$ GAMMAS
  • APOLLO 14: $43 \pm 6$ GAMMAS, $103 \pm 5$ GAMMAS

• SHOULD DETERMINE THEORETICAL MODEL OF MOON TO CENTER

• TWO STATIONS IN OPERATION
  • APOLLO 12 OPERATES 7 DAYS PER LUNATION (INTERMITTENT OPEN CIRCUIT WHEN COLD)
APOLLO 15
SUPRATHERMAL ION DETECTOR

- MONITORED LM DEPRESSURIZATIONS AND LM LIFT-OFF

- THREE INSTRUMENTS NOW IN OPERATION WITH DIFFERENT POINTING DIRECTIONS.
  WILL STUDY:
  - MOTION OF ION CLOUDS OVER MOON'S SURFACE
  - INTERACTION OF SOLAR WIND IONS WITH EARTH'S MAGNETIC FIELD
  - CHEMICAL COMPOSITION OF ION CLOUDS

- INSTRUMENT NOW ON THRU LUNAR NIGHT, WILL BE TURNED OFF WHEN INSTRUMENT
  TEMPERATURE REACHES APPROXIMATELY 50°F.

COLD CATHODE GAUGE

- MONITORED LM DEPRESSURIZATIONS AND LM LIFT-OFF

- TWO INSTRUMENTS NOW IN OPERATION POINTED AT POLES, WILL STUDY:
  - ATMOSPHERIC PRESSURE
  - SOURCES OF TRANSIENT GAS CLOUDS
  - PHYSICAL CHARACTERISTICS OF CLOUDS

- INSTRUMENT HAS SAME OPERATING CYCLE AS SIDE, PRESENTLY READING AN
  ATMOSPHERIC PRESSURE IN LOW $10^{-12}$ TORR RANGE
APOLLO 15

SOLAR WIND SPECTROMETER

- MONITORED LM IMPACT

- TWO INSTRUMENTS NOW IN OPERATION. WILL STUDY:
  - SOLAR WIND PROTONS AND ELECTRONS AND DIRECTION OF IMPINGEMENT ON LUNAR SURFACE
  - DEFLECTION OF SOLAR WIND AROUND LUNAR LIMB
  - INTERACTION OF SOLAR WIND AND EARTH'S MAGNETIC FIELD
APOLLO 15
SOLAR WIND COMPOSITION

○ DATA FROM PREVIOUS MISSIONS:
  • ABSOLUTE FLUX OF $^4\text{He}$, $^3\text{He}$, $^{20}\text{Ne}$, $^{22}\text{Ne}$
  • APPROXIMATE ABUNDANCES $^{21}\text{Ne}$
  • CONCENTRATIONS OF $^{36}\text{Ar}$, $^{38}\text{Ar}$

○ EXPECTED DATA FROM APOLLO 15:
  • PRECISE ABUNDANCES OF $^{21}\text{Ne}$, $^{38}\text{Ar}$
  • ACCELERATION AND FRACTIONATION PROCESSES IN SOLAR ATMOSPHERE

EXPOSURE DURATION

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<th>HR:MIN</th>
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<tr>
<td>APOLLO 11</td>
<td>1:17</td>
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<td>APOLLO 12</td>
<td>18:42</td>
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<td>APOLLO 14</td>
<td>21:00</td>
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<tr>
<td>APOLLO 15</td>
<td>41:08</td>
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LASER RANGING RETRO-REFLECTOR LOCATIONS

30° W.  20° W.  10° W.  0  10° E.  20° E.  30° E.

30° N.  SEA OF RAINS

20° N.

10° N.

10° S.

30° S.

ARCHIMEDES

HADLEY RILLE

APOLLONIUS MOUNTAINS

SEA OF VAPORS

SEETHING BAY

CENTRAL BAY

FRA MAURO

LALANDE

PTOLEMAEUS

HIPPARCHUS

DESCARTES

APOLLO 15

APOLLO 12

REINHOLD

APOLLO 14

1055 KM

1310 KM

975 KM

SEA OF SERENITY

SEA OF TRANQUILITY
APOLLO 15
LUNAR LASER RANGING EXPERIMENT

- Present precision of ±30 cm
  Expected precision of ±3.0 cm

- Ranging to three arrays is leading to:
  - Better mass distribution information
  - Point location of retroreflectors with respect to center of mass of the Moon
  - Lunar elasticity information

- Ranging to 300 cube array is easier and more frequent than the other two arrays
  - All attempts since acquisition have been successful

- Japan and France are preparing for laser ranging. Other countries are expected to follow
APOLLO 15
DRILL CORE

• TOTAL LENGTH - 2.4M (93.6"

• TOTAL WEIGHT - APPROXIMATELY 1332g

• RECOVERY - DRILL STEM FULL EXCEPT FOR BOTTOM 3"

• CORE DESCRIPTION:

  • 44 LAYERS OBSERVED BY X-RADIOGRAPH

  • LAYERS APPEAR UNDISTURBED

  • CORE CONSISTS OF RANDOMLY ALTERNATING LAYERS OF VERY FINE GRAINED TO COARSE GRAINED SOIL WITH INTERSPERSED ROCK FRAGMENTS UP TO 14MM LONG. SOME LAYERS ALMOST ENTIRELY OF VERY FINE SOIL, OTHERS HAVE LARGE PERCENTAGE ROCK FRAGMENTS COARSER THAN 1MM
APOLLO 15
SURFACE GEOLOGY AND SAMPLES

• THREE TRAVERSES WITH LRV
  • FIRST TRAVERSE TO FRONT - 10.3 KM
  • SECOND TRAVERSE TO FRONT - 12.5 KM
  • THIRD TRAVERSE TO HADLEY RILLE - 5.1 KM
  TOTAL 27.9 KM

• SAMPLES COLLECTED 166# - 171# TOTAL
  • 60 DOCUMENTED SAMPLES
  • DRILL CORE - 2.4M
  • ONE SINGLE CORE - TWO DOUBLE CORES
  • TWO TRENCH SAMPLES
  • TWO SESC SAMPLES
  • THREE COMPREHENSIVE SAMPLES

• 1143 HASSELBLAD PHOTOGRAPHS

SOIL MECHANICS

• SIX PENETROMETER READINGS

• PHOTOGRAPHIC DOCUMENTATION

• CREW DESCRIPTION
• GAMMA RAY SPECTROMETER
  • ACQUIRED 62 HOURS OF PRIME DATA
  • BACKSIDE RADIOACTIVITY SLIGHTLY LOWER THAN FRONTSIDE
  • SOME PRELIMINARY EVIDENCE FOR LOCAL HIGH ACTIVITY AREAS
  • AVERAGE LUNAR RADIOACTIVITY LESS THAN APOLLO 14 FRA MAURO SAMPLES

• X-RAY SPECTROMETER
  • 100 HOURS OF LUNAR AND 50 HOURS OF GALACTIC DATA
  • HIGHLANDS ARE RICHER IN ALUMINUM THAN MARE
  • MARE ARE RICHER IN MAGNESIUM THAN HIGHLANDS
  • BACKSIDE HIGHLANDS ARE MORE ENRICHED IN ALUMINUM THAN APENNINE HIGHLANDS
  • SEVEN DISCRETE GALACTIC X-RAY SOURCES OBSERVED

• ALPHA PARTICLE SPECTROMETER
  • 100 HOURS OF LUNAR AND 50 HOURS OF DEEP SPACE DATA
  • DIFFUSION OF RADON $10^3$ LESS THAN TERRESTRIAL RATES
APOLLO 15
X-RAY SPECTROMETER

THREE ORBITAL TRACKS
RELATIVE ABUNDANCES
NORMALIZED TO SILICON

- HIGH MAGNESIUM, LOW ALUMINUM
- LOW MAGNESIUM, HIGH ALUMINUM
APOLLO 15
ORBITAL SCIENCE

- MASS SPECTROMETER
  - 40 HOURS OF LUNAR AND 50 HOURS OF DEEP SPACE DATA
  - UNEXPECTED POPULATION OF MOLECULES IN LUNAR ORBIT
  - AN ORDER OF MAGNITUDE MORE GAS IN LUNAR ORBIT THAN DEEP SPACE
  - TWO UNEXPLAINED TRANSIENT PHENOMENA OBSERVED

- PANORAMIC CAMERA
  - V/H SENSOR MALFUNCTIONED
  - 80% OF PHOTOGRAPHY IS NOMINAL; MAXIMUM RESOLUTION - ALL FILM IS EXCELLENT
  - PRIMARY OBJECTIVES PHOTOGRAPHED IN HIGH RESOLUTION STEREO
    - APOLLO 15 LANDING SITE
    - APOLLO 15 LUNAR MODULE IMPACT POINT
    - POTENTIAL NEW LANDING SITES SOUTHWEST OF MARE CRISIUM

- MAPPING CAMERA
  - ALL PLANNED COVERAGE OBTAINED
  - FILM HAS BEEN DEVELOPED AND IS OF EXCELLENT QUALITY

- LASER ALTIMETER
  - NOMINAL PERFORMANCE ON REV 15
  - SHOWS SHAPE AND SLOPE OF MARE BASINS
  - REV 15 DATA SHOWS MOON'S CENTER OF MASS OFFSET FROM CENTER OF FIGURE
APOLLO PANORAMIC CAMERA FIELD-OF-VIEW
(MONOSCOPIC MODE) ON LUNAR SURFACE

(DIRECTION OF MOTION)

DISTANCE ON LUNAR SURFACE (IN. MI.)

0 10 20 30 40
50 60 70 80
90 100

20.5 N. MI.

(NOTE: SHADED AREA CORRESPONDS TO RECTIFIED AREA)
APOLLO 15
PAN CAMERA COVERAGE
NEAR SIDE
APOLLO 15
PAN CAMERA COVERAGE
FAR SIDE
APOLLO DATA SENSORS

Star Sensor

Laser Altimeter Distance

Tracking Data
APOLLO 15
MAPPING CAMERA COVERAGE
FAR SIDE
APOLLO 15
ORBITAL SCIENCE

• SUBSATELLITE
  • DEPLOYED IN 76 X 54 NAUTICAL MILE ORBIT
  • ORBIT INCLINATION 28°
  • S-BAND TRACKING FOR GRAVITY DOPPLER EVERY TWELFTH ORBIT
  • BATTERY CHARGING PASS FOLLOWING S-BAND TRACKING PASS

• PARTICLE DETECTOR EXPERIMENT
  • PARTICLE TELESCOPES DETECTED LARGE PROTON FLUX IN MAGNETOPAUSE
  • GOOD PARTICLE COUNTS IN PLASMA SHEATH
  • EXCELLENT DIRECTIONAL INDICATION OF PARTICLE FLUXES

• MAGNETOMETER
  • MAGNETIC FLUX VARIATIONS DETECTED IN AGREEMENT WITH LSM
  • DETECTS LUNAR SURFACE ANOMALIES WHILE IN EARTH’S MAGNETOTAIL
    • VAN DE GRAAF
    • GAGARIN
    • KOROLEV

• S-BAND DOPPLER GRAVITY EXPERIMENT
  • EXCELLENT DOPPLER DATA
  • NEW MASCON LOCATED NEAR EASTERN LIMB
  • GRAVITY DATA WITH LASER ALTIMETRY ALLOWS COMPARISON OF SHAPE
    OF BASINS WITH SHAPE OF MASCONS
  • ALL MASCONS DO NOT HAVE SAME SHAPE
APOLLO 15
ORBITAL SCIENCE

- DIM LIGHT PHOTOGRAPHY
  GEGENSCHEN
  ZODIACAL LIGHT
  SOLAR CORONA
  LUNAR LIBRATION REGIONS
  LUNAR SURFACE TERMINATOR

- UV PHOTOGRAPHY - EARTH AND MOON
  FIRST UV PHOTOGRAPHY OF EARTH FROM SPACE

- DOWNLINK BISTATIC RADAR
  S-BAND AND VHF BISTATIC WILL DETERMINE ROUGHNESS AND DIELECTRIC CONSTANT

- APOLLO WINDOW MICROMETEOROID

- COMMAND MODULE PHOTOGRAPHY AND VISUAL OBSERVATIONS
LUNAR LANDING SITES

LANDING SITES
APOLLO
11 SEA OF TRANQUILITY
12 OCEAN OF STORMS
14 FRA MAURO
15 HADLEY-APENNINE
16 DESCARTES
17 ALPHONSONUS
    (TENTATIVE)