Plans for the Eighth Lunar Science Conference are on schedule. The Program Committee co-chaired by Dr. Michael B. Duke (NASA/Johnson Space Center) and Dr. Roberto Pepin (Lunar Science Institute) met 27-29 January to consider the 360 abstracts submitted for publication and to prepare a program for the conference. Nineteen sessions, with approximately 235 oral presentations, were structured to address the seven major subject areas:

1. Constraints on structure and composition of planetary interiors
2. Characteristics and movements of materials on lunar, planetary and asteroidal surfaces
3. Characterization and evolution of maria and other volcanic landforms
4. Characterization and evolution of planetary crusts
5. Nature and effects of impact processes
6. Extraterrestrial materials as solar/interplanetary/interstellar probes
7. Earliest history of the solar system

PROGRAM HIGHLIGHTS SEE PRELIMINARY PROGRAM AND ENCLOSURE FOR DETAILS

Monday 8:30 a.m. The first plenary session will include an "Outlook for Space Science — '78" by Dr. Noel Hinners, and the presentation of samples from the Luna 24 mission to NASA from the Academy of Sciences of the USSR.

Monday 8:00 p.m. The Nassau Bay Hotel will be the scene for the all conference smoker.

Tuesday 1:30 p.m. Special session on Mars chaired by Dr. Thomas A. Mutch.

Tuesday 8:00 p.m. Report of the La Jolla Consortium open to all conference attendees, chaired by Dr. James Arnold and Dr. Isidore Adler.

Wednesday 8:00 p.m. Special session, open to conference attendees and the public on New Moons: Towing Asteroids into Earth Orbits for Exploration and Exploitation chaired by Prof. G. Arrhenius and Dr. David R. Criswell.

Friday 8:30 a.m. Summary session on each of the seven conference topics.

Registration will begin Sunday, March 13, 6-10 p.m. at the Nassau Bay Hotel and will continue through the Conference in Building 2, Auditorium at the Johnson Space Center from 8:00 a.m. to 5:00 p.m. Monday through Thursday and 8:00 to 11:00 a.m. Friday.

LUNAR SCIENCE VIII: ABSTRACTS OF PAPERS SUBMITTED TO THE EIGHTH LUNAR SCIENCE CONFERENCE will be given to Attendees at the Conference and will be available after the Conference by remitting $1.00 for U.S. mailing and $6.00 for foreign mailing to Ms. Carolyn Watkins, LSI.
JSC COMBINES SCIENCE ORGANIZATIONS

Dr. Richard S. Johnston has been named Director of Space and Life Sciences at the NASA/Johnson Space Center, in a merger of two Center organizations — the Life Sciences Directorate and the Science and Applications Directorate. The reorganization was effective in mid-January.

Mr. Peter J. Armitage is Assistant Director for Plans and Programs, Dr. Lawrence F. Dietlein is Assistant Director for Life Sciences, and Dr. Owen K. Garriott is Assistant Director for Science.

The new organization absorbs the five divisions in the former directorates: Science Payloads Division, Space Research and Operations Division, Bioengineering Systems Division, Earth Observations Division, and Lunar and Planetary Sciences Division.

ASSIGNMENT CHANGES AT NASA HEADQUARTERS

Following the retirement of Col. Arthur Strickland, Program Chief, Cartography, in the Lunar and Planetary Programs Office, Mr. Stephen E. Dwornik has been assigned the responsibility for the Lunar Cartography Program along with his other duties as Chief, Planetary Geology, which includes all planetary cartography. Mr. William Shirey, who has also been associated with the Lunar Cartography Program, has completed his tour of duty with NASA and returned to the Defense Mapping Agency Topographic Center. Ms. Mary Jo Smith will be coordinating the work on the Lunar Laser Ranging Program.

GOING SOMEWHERE!!!!!

Getting a new mailing address for any reason at all? PLEASE let us know of any change of address. For every BULLETIN returned to us by the post office with either a forwarding address, an "addressee unknown", or "moved left no forwarding" we are charged 25¢. We then use first class postage to forward the mail to you. If the mail is returned to us with no forwarding address, we have no choice but to delete the name from the mailing list. You may be missing information or having your mail from the Institute needlessly delayed. Please send your address change to: LUNAR SCIENCE INSTITUTE, ATTENTION LSIB.
NEW PUBLICATION ON THE MOON

A new publication entitled "What's New on the Moon?" has been produced at NASA Headquarters. The author is Dr. Bevan M. French, Program Chief, NASA Extraterrestrial Materials Research Program. A geologist, French has studied lunar samples and terrestrial meteorite craters for more than ten years. The booklet, replete with dramatic photographs and diagrams, reviews the events that led to Moon landings and delineates many of the findings that resulted from Apollo missions to the Moon. The booklet is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 as Stock No. 033-000-00653-5. A single copy is $1.00; multiple copies are $.70 each. The text with colored pictures is to be published in the March and April issues of SKY AND TELESCOPE.

SPACE PHOTO ALBUM OF THE WORLD PREPARED FROM SATELLITE IMAGERY

The most comprehensive and detailed "space photo album" of the world's natural and cultural features has been prepared with images from NASA's Landsat Earth Resources satellite by Nicholas M. Short, Paul D. Lowman, Jr., and Stanley C. Freden of NASA's Goddard Space Flight Center, and Dr. William A. Finch, Jr., of the San Diego State University. Titled Mission to Earth: Landsat Views the World, the atlas size publication contains some 400 Landsat images, most of them in color and near full page size. It will be available by early March 1977, through the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 at $14.00 per copy. The stock number is 033-000-00659-4.

Because of the value of the book to educators, an Educator's Guide is being prepared by the Goddard Center, and will be available at no cost upon request to the Center's Office of Public Affairs, Educational Programs, Greenbelt, MD 20771. The guide contains a "Teacher's Resource Section" which includes classroom activities, exercises and techniques for using the imagery. To facilitate the use of Mission to Earth by the teacher, the guide includes a glossary of geological and remote sensing terms which are used in the book.

The LUNAR SCIENCE INFORMATION BULLETIN is published by the Lunar Science Institute. There are usually four issues per year. It is distributed free on request to lunar and planetary scientists, educators, and students, and their institutions.

Editor: Frances B. Waranius, Lunar Science Institute
3303 NASA Road #1
Houston, TX 77058 U.S.A.
(phone: 713/488-5200 x.35)
CALENDAR

14-18 March
EIGHTH LUNAR SCIENCE CONFERENCE
Johnson Space Center
Houston, TX
see PAGE 1 and enclosures

18 April
DEADLINE for manuscripts for Eighth Lunar Science Conference
Publications Office, LSI

9-12 May
Third Princeton/AIAA Conference on Space Manufacturing Facilities
CONTACT: Conference Office
Princeton University
5 Ivy Lane
Princeton, NJ 08540
Telephone: 609/425-3371

30 May - 3 June
American Geophysical Union Spring Meeting
Washington, DC
CONTACT: AGU
1909 K Street, N.W.
Washington, DC 20036

25-29 July
Meteoritical Society Annual Meeting
University of Cambridge, England
CONTACT: Dr. E. R. D. Scott
Dept. of Mineralogy & Petrology
Downing Place
Cambridge CB2 3EW England

9-19 August
International Associations of Volcanology and Chemistry of the Earth's Interior and of Seismology and Physics of the Earth's Interior
Durham, UK
CONTACT: R. E. Long
IASPEI/IAVCEI Assembly Office
Dept. of Geological Sciences
University of Durham
South Road
Durham DH1 3LE England

International Kimberlite Conference
Santa Fe, New Mexico
CONTACT: Lois Elms
745 Gilpin Drive
Boulder, CO 80303
See EOS p. 870, December 1976 for details
# Preliminary Program

**Eighth Lunar Science Conference**

*March 14-18, 1977*

Sponsored by
Lunar Science Institute and
Lyndon B. Johnson Space Center

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### Schedule

<table>
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<th>Day</th>
<th>Time</th>
<th>Topic</th>
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- **A** - Building 2 Auditorium
- **G1** - Gilruth Center, Room 104
- **G2** - Gilruth Center, Room 206
- **B30** - Building 30 Auditorium

**Topics**

- **I** - Constraints on structure and composition of planetary interiors.
- **II** - Characteristics and movements of materials on lunar, planetary and asteroidal surfaces.
- **III** - Characterization and evolution of maria and other volcanic landforms.
- **IV** - Characterization and evolution of planetary crusts.
- **VI** - Extraterrestrial materials as solar/interplanetary/interstellar probes.
- **VII** - Earliest history of the solar system.

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**LSIB No. 12**

Enclosure
CONFERENCE INFORMATION

MESSAGE CENTER

A Message Center will be established in the registration lobby. Persons who have a need to contact you during the Conference should be instructed to call Houston, Texas, Area Code 713/488-5071. The Message Center will be operational during each day of the Conference from 8:00 a.m. to 5:00 p.m. Messages will be posted on a bulletin board at the Message Center. There will be no paging during the Conference.

TRANSPORTATION ASSISTANCE

Assistance for arranging airline reservations is available from the Airlines Traffic Office in Room 130 of Building 1. Conference badges must be worn for entrance to this building. This service will be available each day of the Conference from 8:00 a.m. to 5:00 p.m.

SMOKER

A Cash Bar Smoker for all Conference participants and their wives/husbands/dates will be held on Monday, March 14, 1977, at 8:00 p.m. in the Nassau Bay Hotel, NASA Road 1.

THE LUNAR SCIENCE INSTITUTE OPEN HOUSE

Participants at the Conference are invited to visit the LSI between 9:30 a.m. - 12:00 noon and from 2:30 p.m. - 5:00 p.m. each day except Monday morning. Tours of the building of LSI will be given at 10:00 a.m. and 3:00 p.m. beginning Monday afternoon through Friday afternoon. The Institute is located in the James Marion West Mansion just past the east gate to the Johnson Space Center (JSC) on NASA Road 1.

NASA TOUR

Arrangements may be made in the registration lobby for a conducted tour of the JSC. Tours will require approximately 1-1/2 hours and will include visits to the Mission Control Center and Space Environmental Simulation Laboratory.

BREAKFAST AND LUNCHEON

Breakfast and luncheon will be available from restaurants and cafeterias within the JSC area. Two cafeterias are open at JSC, one in Building 3 and the other in Building II. They are open from 7:00 a.m. to 2:00 p.m. Monday through Friday.

BUS SERVICE

A shuttle bus service between JSC, LSI, and the various motels/hotels will operate each day from 7:30 a.m. to 9:30 a.m., from 11:30 a.m. to 1:30 p.m., and from 5:00 p.m. to 6:30 p.m. In addition, a shuttle bus service will operate continuously between the Building 2 Auditorium and the Gilruth Recreation Center from 8:00 a.m. to 6:00 p.m.

PROGRAM COMMITTEE

The program was prepared on the basis of submitted abstracts. The Program Committee consisted of M. Duke (Johnson Space Center) and Robert O. Pepin (Lunar Science Institute), Co-Chairmen; Arden L. Albee (California Institute of Technology); Ghislaine Crozaz (Washington University); Fraser Fanale (Jet Propulsion Laboratory); Bruce Goldstein (NASA Headquarters); John C. Huneke (California Institute of Technology); William M. Kaula (University of California); John F. Kerridge (University of California); Gary E. Lofgren (Johnson Space Center); Thomas McGutchin (Los Alamos Scientific Laboratory); Russell B. Merrill (Lunar Science Institute); Carle Pieters (Massachusetts Institute of Technology); Peter H. Schultz (Lunar Science Institute); Sean C. Solomon (Massachusetts Institute of Technology).

BADGES

During the period of the Conference, your Conference badge will allow you entrance to the various buildings where sessions are being held. Your JSC and LSI hosts will be pleased to offer any assistance.

REGISTRATION

Pre-registration will be on Sunday, March 13, 6:00 p.m. - 10:00 p.m. at the Nassau Bay Hotel. Registration will also be in Building 2, Johnson Space Center, 8:00 a.m. - 5:00 p.m. Monday through Friday.
Monday, March 14, 1977
Building 2 Auditorium
8:30 a.m.
WELCOME

Christopher C. Kraft, Jr.
Welcome

Noel Hinnings
Outlook For Space Science - 78

J. Arnold
Additional Comments On The Outlook For Space Science

Presentation Of Luna 24 Samples To NASA By The Academy Of Sciences Of The USSR

V. L. Barsukov et al.
The Lunar Soil From Mare Crisium: Preliminary Data and Preliminary Description Of The Regolith Core From Mare Crisium

W. Kaula
Why Is The Moon Different From The Earth In Bulk Composition?

Florensky, Basilevsky, Burba, Nikoleeva, Pronin, Volkov, Ronca
First Panoramas Of The Venusian Surface

Results From Viking Mission

Brownlee, Tomandl, Olczewski
Interplanetary Dust; A New Source Of Extraterrestrial Material For Laboratory Studies

Monday, March 14, 1977
I-A. LUNAR EVOLUTION
Building 2 Auditorium
2:00 p.m.
Chairmen: M. G. Langseth
G. W. Wetherill

Morgan, Higuchi, Takahashi, Hertogen
A "Chondritic" Eucrite Parent Body: Inference From Trace Elements

Dreibus, Kruse, Rammensee, Spettel, Wänke
Cosmochemical Constraints On Planetary Compositions: Earth, Moon, Eucrite Parent Body

Taylor, Jakos
Geochemical Evolution Of The Moon: Taylor-Jakoš-Dence Models Revisited

Smith
Chemical Evidence On Origin Of Earth And Moon

Ringwood, Kessom
Siderophile And Volatile Elements In The Moon And The Earth's Mantle: Implications For Lunar Origin

Longhi
Magma Oceanography: 2. Chemical Evolution

Solomon, Longhi
Magma Oceanography: 1. Thermal Evolution

Herbert, Drake, Sonett, Wiskerchen
Thermal History Of Lunar Magma Ocean

Runcorn
Concerning The Early Melting Of The Moon

Keihm, Langseth
Lunar Thermal Regime To 200 km

Meissner, Lange
Comparative Calculations Of Temperatures And Viscosities In Terrestrial Planets

Toksöy, Hsui
Thermal Evolution Of Planetary Size Bodies

Goldstein, Phillips
Consequences Of Possible Lunar FeS Distributions: Core, Pods, Or Interstitial Veins
Monday, March 14, 1977

VII-A. CONDENSATION AND EARLY HISTORY OF THE SOLAR SYSTEM

Gilruth Center, Room 104
2:00 p.m.

Chairmen: F. Podosek
H. Takeda

Macdougall, Phinney
 Noble Gases And Particle Tracks In Olivine Crystals From Murchison
And Cold Bokkeveld

Heymann
 Solar Origin Of "Planetary" Neon?

Cadogan
 Palaeoatmospheric Argon In Rhynie Chert

Frick, Moniot
 Planetary Noble Gas Components In Orgueil

Flynn, Fraundorf, Shirck, Walker
 Negative Search For Fission Tracks From Superheavy Elements In
Allende

Boynton
 Fractionation Of Th, U, Pu And Cm In The Early History Of The
Solar System: Implications For Dating Techniques

Benjamin, Burnett, Ng, Seitz
 Laboratory Studies Of Pu-U-Th Fractionation

Marti, Lugmair, Scheinin
 Sm-Ae-Pu Systematics In The Early Solar System

Pellas, Storzer
 Cooling Histories Of Stony Meteorites

Fukowka, Ma, Schmitt
 Genesis Of Howardites As Mixtures Of Eucrites And Diogenites

Drake, Consolmagno
 Asteroid 4 Vesta: Possible Bulk Composition Deduced From Geo-
Chemistry Of Eucrites

Huneke, Smith, Rajan, Papamastassioiu, Wasserburg
 Comparison Of The Chronology Of The Kapeota Parent Planet And The Moon

Wilkening, Parker
 Nuclear Particle Track Studies Of The Pasmonte Eucrite

Monday, March 14, 1977

II-A. PLANETARY SURFACES

Gilruth Center, Room 206
2:00 p.m.

Chairmen: T. V. Johnson
T. B. McCord

Hapke
 The Albedo Of Lunar Soil

Mckay, Morris, Dungan, Bogard, Fruland
 Maturity Of Soil In Drive Tube 60009/10 And Implications For
Regolith Evolution

Matson, Johnson, Veeder
 Soil Maturity And Planetary Regoliths: The Moon, Mercury And
Asteroids

Gaffey, McCord
 Asteroid Surface Materials: Mineralogical Characterizations And
Cosmological Implications

Zellner, Leake, Lerbret, Dollfus
 Polarimetry Of Meteorites And The Asteroid Albedo Scale

Dollfus, Duseaux, Mandeville
 Are Some Asteroids Pieces Of Metal?

Degewij
 Small Asteroids And Collisional Fragments

Huguenin, Adams, McCord
 Mars: Surface Mineralogy From Reflectance Spectra

Peterfreund, Kieffer, Palluconi
 Thermal Inertia Of The Elysium Region Of Mars

Bell, Mao
 Crystal-Field Spectra Of Fassaite From The Angra Dos Reis Meteorites

Sung, Singer, Parkin, Loeffler, Burns
 Temperature Dependencies Of Crystal Field Transition Energies And
Their Effect On The Mineralogical Mapping Of The Lunar Surface

Criswell, De
 Photoelectric Charging And Pseudoco nductivity Of Localized Sunlit
Areas On The Moon

Alvarez
 Fines Pseudoco nductivity
Monday, March 14, 1977
8TH LSC SMOKER
NASSAU BAY HOTEL, NASA ROAD 1
8:00 p.m. - 11:00 p.m.

Tuesday, March 15, 1977
VII B. CONDENSATION AND EARLY HISTORY OF THE SOLAR SYSTEM II
Gilruth Center, Room 104
8:30 a.m.
Chairmen: J. Kerridge
D. MacDougall

Herbst, Assousa
Observational Evidence For Supernova-Induced Star Formation

Kothari, Stephens
Experimental Approach To The Condensation In A Solar Nebula

De
Thermal Physics Relevant To The Condensation Of Meteoritic Solids

Arrhenius, Simpson
Molecular And Isotopic Processes In Space Condensation

Wark, Lovering
Marker Events In The Early Evolution Of The Solar System: Evidence From Rims On Calcium-Aluminium-Rich Inclusions In Carbonaceous Chondrites

Grossman, Davis, Olsen, Santoliquido
Chemical Studies Of Condensates In The Murchison Type 2 Carbonaceous Chondrite

Haggerty
Refinement Of The Ti-Cosmothermometer In The Allende Meteorite And The Significance Of A New Mineral, TiO_2, In Association With Armalcolite

Hutcheon
Micro-Mineralogy Of Calcium-Aluminium-Rich Inclusions From Allende

Wasserburg, Lee, Papanastassiou
Mg And Ca Isotopic Study Of Individual Microscopic Crystals From The Allende Meteorite By The Direct Loading Technique

Epstein, Yeh
The 18O, 17O, 28Si And 29Si Of Oxygen And Silicon In Stony Meteorites And Allende Inclusions

Woolum, Bies-Horn, Burnett, August
Bi Microdistributions In Chondrites

Wasson, Boynton, Kallemeyn
Classification And Elemental Fractionation Among Carbonaceous Chondrite Classes

Matza, Lipschutz
Retention Of Eleven Trace Elements In Murchison C2 Chondrite Heated From 400-1000°C
O'Keefe, Ahrens
Partitioning Of Energy And The Degree Of Melting And Vaporization In Planetary Impact Processes

Kieffer
The Role Of Volatiles In The Impact Process

Simonds, Phinney, Warner
Effect Of Water On Cratering: A Review Of Craters And Impactites On The Earth, Moon and Mars

Stöffler
Structure Of The Ries Crater And Distribution Of Target Rocks Within Different Types Of Impact Breccias

Hörz, Gall, Hüttnern, Oberbeck
Shallow Drilling In The "Bunte Braccia" Impact Deposites, Ries Crater, Germany

Phinney, Warner, Simonds
Petrologic Evidence For Formation And Solidification Of Impact Melts

Uhmann, Klein, Pettyjohn
Crystallization Kinetics, Viscous Flow And Thermal History Of Lunar Breccia 67975

Frieland, Morris, McKay
Apollo 17 Ropy Glasses

Simmons, Siegfried, Richter, Hörz
Microcracks In Shocked Rock

Schäfle, Hörz
Shock Effects In Some Lunar Basalts

Sclar, Bauer
Electron Microscopy Of Shock-Induced Crystalllographically Controlled Planar Features In Quartz

Jeanloz
Electron Damage: A New Analytic Technique Applied To Plagioclase In Shocked Chondrites And Basalts

Friel, Goldstein, Ronig Jr.
The Effect Of Carbon On Phosphate Reduction
The afternoon has been left free to accommodate special informal sessions which consider subjects that do not fit readily within the topical framework of the Conference. Descriptions of these sessions are included in your registration packet.

**Wednesday, March 16, 1977**

**IV-A. EVOLUTION OF THE PLANETARY CRUST:**

**STUDY OF EARLY IMPACTITES AND THE NATURE OF THE EARLY CRUST**

Building 2 Auditorium

8:30 a.m.

Chairmen: A. J. Irving  
R. B. Merrill

---

Jovanovic, Jensen, Reed Jr.

*Further Insights Into The Evolution Of The Early Moon:*

I. Convection Cells, II. Ru-Os Partitioning And Mixing

---

Ryder, Wood

*Seronitites And Imbrium Impact Melts: Implications For Lunar Crustal Composition And Stratigraphy*

---

Warren, Mittlefehldt, Boynton, Wasson

*In Quest Of Primary Highlands Rocks*

---

Hartgen, Janssens, Takahashi, Palme, Anders

*A Moon-Like Planetesimal And Other Antiquities At North Ray Crater, Apollo 16*

---

Reid, Richardson, Duncan

*Non-Mare "Igneous" Clasts In Apollo 15 Breccias*

---

Warner, Bickel, Phinney, Simonds

*Feldspathic, Granulitic Impactites That Pre-Date The Final Lunar Bombardment*

---

Neve, Winzer, Lindstrom, Meyerhoff, Lum, Schuhmann, Lindstrom, Philpotts

*Rind Glass And Breccia: A Study Of Lunar Sample 15255*

---

Winzer, Meyerhoff

*Petrography And Petrology Of Clasts From Consortium Breccia 61175*

---

Chao, Minkin, Thompson

*Petrology Of Consortium Sample 67455, From A White-Matrix Breccia Boulder Near The Rim Of North Ray Crater, Descartes*

---

Consortium Studies Of Breccias 73215 And 73255

---

James, Martí

*Consortium Breccia 73255*

---

James

*Petrology Of Clasts*

---

Blanchard, Brannon, Jacobs, Maskin

*Major And Trace Element Abundances In Anorthositic Gabbro Clasts And A Clast Of K-Rich Felsite From Consortium Breccia 73215*
Wednesday, March 16, 1977

JOINT SESSION - LI & VI-A.
PHYSICS AND CHEMISTRY OF THE LUNAR SURFACE

Gilruth Center, Room 104
8:30 a.m.

Chairmen: W. V. Boynton
J. A. M. McDonnell

Staudacher, Jessberger, Kirsten
40Ar-39Ar Age Systematics Of Consortium Breccia 73215. II.

Müller, Plieninger, James, Schaeffer
Laser Probe 40Ar-39Ar Dating Of Materials From Consortium Breccia 73215

Compston, Foster, Grey
Rb-Sr Systematics In Clasts And Aphanites From Consortium Breccia 73215

Meyer Jr., Schonfeld
Ion Microprobe Study Of Glass Particles From Lunar Sample 15101

Basu
Exposure Age And Agglutinate Content Of Lunar Soils

Hu, Taylor
Agglutinate Formation: Lack Of Chemical Fractionation

Blanchard, Brannon
Effects On Composition Of Maturation In A Well Documented, Isochronal Suite Of Soils From Drive Tube 60009/10

Cirlin, Housley
An Atomic Absorption Study Of Volatile Trace Metals In Lunar Samples

Allen Jr., Jovanovic, Reed Jr.
Volatile Metals—Mode Of Transport

Krähenbühl, Grütter, von Guten, Meyer, Wegmüller, Wytenbech
Distribution Of Volatile And Non-Volatile Elements In Grain-Size Fractions Of Apollo 17 Lunar Soils

Alexander Jr., Seito, Dragon, Coscio Jr., Pepin
40Ar-39Ar And Rare Gas Studies Of Lunar Soils

Schultz, Weber, Spettel, Hinterberger, Wänke
Agglutinates: Noble Gas And Element Distribution In Grain Size Fractions Of The Apollo 15 Soil 15601

Signer, Baur, Derksen, Etique, Funk, Horn, Wieler
Light Noble Gas Records Of Lunar Soil Evolution

Bogard
Soil Maturation And Grain Size-Dependence Of Trapped Solar Gases
Wednesday, March 16, 1977

V-B. IMPACT CRATER FORMATION AND EVOLUTION
Gilruth Center, Room 206
8:30 a.m.
Chairmen: R. Pike, Jr.
N. J. Trask

Reddy, Ulrich
Cratering Subsurface Motion Sequences And Structural Deformation:
Experimental Techniques

Melosh
The Role Of Slumping In Crater Modification

Dvorak, Phillips
The Subsurface Structure Of Large Young Lunar Craters

Hawke, Head
Impact Melt In Lunar Crater Interiors

Rehfuss, Michael, Anselmo, Kincheloe
Wind-Transport Of Ejecta And The Fragmentation Parameter

Oberbeck, Aggarwal
Topography Of Lunar Secondary Craters And Implications

Woronow
A Simulation Of The Lunar Highlands Crater Population

Cintala, Wood, Head, Mutch
Interplanetary Comparisons Of Fresh Crater Morphology:
Preliminary Results

Croft
Volumetric Studies Of Lunar Craters: Evidence For A Megagregolith

Eppler, Nummedal, Ehrlich
Large Scale Geologic Trends In Lunar Bedrock -- Fourier Analysis
Of Planimetric Crater Shape

Wood, Head, Cintala
Degradation Trends Of Mercurian Craters And Correlation With The Moon

Carusi, Fulchignoni, Poscolieri, Caputo, Casacchia, Parotto
Mercury Cratering: Physiographic Units Statiistical Recognition
And Their Evolutive History

Wednesday, March 16, 1977

III-A. KINETICS AND BASALT PETROGENESIS
Building 2 Auditorium
1:30 p.m.
Chairmen: J. Longhi
J. Papke

Gibson Jr., Andrawes
The Role Of Sulfur In The Apollo 12 Basalts

Knecht, Simons, Woermann, El Goresy
The Chromium Concentration Of Ilmenite And Its Possible Application
As A Lunar Thermometer

Gatehouse, Grey, Lovering, Wark
Structural Studies On Tranquillityite And Related Synthetic Phases

Cadenhead, Brown
Porosity, Or Its Absence, In Lunar And Terrestrial Samples

Heiken, McKay
Sample 74001 And Its Significance For Models For Eruption Behavior
Of A Volcanic Vent In Eastern Mare Serenitatis

Huggins, Huffman
Effect Of Temperature And Composition On Superparamagnetic Clusters
Of Fe<sup>2+</sup> Spins In Olivines - A Potential Thermal History Indicator

Taylor, Walker, Onorato, Uhlmann
Fe-Ni Diffusion In Olivines: A Cooling Rate Indicator

Grove, Bence
Pyroxenes As Recorders Of Lunar Basalt Petrogenesis Revisited: An
Experimental Study Of Pyroxene-Liquid Interaction

Walker, Longhi, Stolper, Grove, Hays
Slowly Cooled Microgabbros 15505 And 15555

El Goresy, Ramdohr
Apollo 17 TiO<sub>2</sub>-Rich Basalts: Spinel Chemical Bimodality In The
Two Major Basalt Types And Genetic Significance Of Inverted Toning
Of Chromian Ultraspinel

Schreiber
Ti(IV)-Ti(II), Eu(III)-Eu(II), And Cr(III)-Cr(II) Redox Equilibria In Synthetic Silicate Melt Analogs Of Lunar Basaltic Magmas

Roedder, Weiblen
Differentiation Trends In Mare Lavas, As Indicated By Silicate Melt Inclusions
Wednesday, March 16, 1977

JOINT SESSION - II & VI-B.
PHYSICS AND CHEMISTRY OF THE LUNAR SURFACE
Gilruth Center, Room 104
1:30 p.m.
Chairmen: R. Fruland
E. Zinner

Büchner, Kiko, Kirsten, Plieninger, Warhaut
He And Ne Depths Profiles In Lunar Soil Particles

Hartung, Plieninger, Müller, Schaeffer
Helium, Neon, And Argon On Sunlit And Shaded Surfaces Of Lunar Rock
12034 By Laser Probe Mass Spectrometry

Hodges Jr.
Synodic Effects On The Escape Of Helium And Hydrogen From The Moon

Ivanov
On The Intensity Of Sodium Vaporization From the Mare Regolith

Filleux, Tombrello, Burnett
Direct Measurement Of Surface Carbon Concentrations

Pillinger, Gardner, Jull, Woodcock, Stephenson

Morris
Fine-Grained Metal Distribution In Grain-Size Separates Of Lunar Soils: Production And Evolution Of The Fine-Grained Metal

Baron, Bilson, Gold, Colton, Hapke, Steggert
A Comparison Of ESCA-XPS And Auger Electron Spectroscopy For The Study Of The Surface Chemical Composition Of Lunar Soil Samples

Housley, Grant
An ESCA Study Of Reduced Fe And Other Surface Chemical Alteration Profiles In Lunar Fines

Russell, Papanastassiou, Tombrello, Epstein
Search For Ca Isotopic Fractionation And Correlation Of Ca And O Effects

Bibring, Chaumont, Oran, Lalou, Langevin, Maurette, Vassent
Solar Wind Erosion Of Lunar Dust Grains: A Progress Report

McDonnell
Accretionary Particles: Production And Equilibrium On 12034

Wednesday, March 16, 1977

V-C. DATING AND STATISTICS OF LUNAR CRATERS
Gilruth Center, Room 206
1:30 p.m.
Chairmen: R. E. Arvidson
C. Chapman

Fruchter, Laul, Rancitelli, Perkins
Exposure Age And Other Information On Lunar Surface Material And Meteorites From 53Mn Measurements

Mörgeli, Eberhardt, Eugster, Geiss, Grögler, Jungck
The Age Of Shorty Crater

Drozd, Hohenberg, Morgan, Podocek, Hroge
Cosmic Ray Exposure History At Taurus-Littrow

Mandeville
Impact Microcraters On 12034 Rock

Fechtig, Nagel, Stähle, Schneider, Neukum, Grögler
Primary And Secondary Impact Crater Phenomena On An Apollo 12 Sample

Arvidson, Guinness, Hohenberg
On The Constancy Of The Lunar Cratering Flux Over The Past 3.3 Billion Years

Young
The Lunar Impact Flux, Radiometric Age Correlation, And Dating Of Specific Lunar Features

König, Neukum, Fechtig
Recent Lunar Cratering: Absolute Ages Of Kepler, Aristarchus, Tycho

Schultz, Greeley, Gault
Interpreting Statistics Of Small Lunar Craters

Neukum
Different Ages Of Lunar Light Plaines

Ahrens, Jackson, Jeanloz
Dynamic Properties Of Ilmenite-Rich Mare Basalt And The Relative Ages Of Lunar Cratered Surfaces
Wednesday, March 16, 1977

IV- B. MAGNETIC INVESTIGATIONS; RE-INVESTIGATIONS OF ORBITAL DATA

Building 30 Auditorium
1:30 p.m.
Chairmen: A. Brecher
G. W. Pearce

Lin, Anderson, Bush
Age Distribution Of Lunar Surface Magnetic Fields

Cisowski, Fuller, Hale
On The Intensity Of Ancient Lunar Magnetic Fields

Weiss, Hood, Coleman Jr.
The Cratered-Shell Model Of The Lunar Permanent Magnetic Field:
Multipolar Analysis

Šrka
Spontaneous Magnetic Field Generation In Hypervelocity Impacts

Brecher
New Evidence For Textural Magnetization (TXM) In Lunar Rocks
Synthetic Analogies And Meteorites

Lanoix, Strangway, Pearce, Wu, Taylor
Anomalous Acquisition Of Thermoremanence At 150°C In Iron And
Paleointensity Of Meteorites

Stephenson, Runcorn, Collinson
A Preliminary Paleointensity Result For Sample 10017

Anderson, Bush, Lin
Magnetized Regions On The Lunar Farside Detected By Electron
Reflection Techniques

McCoy, Lin, Anderson
Magnetic Modeling Of The Rima Sirealis Lunar Magnetic Anomaly

Bieläfeld
Lunar Surface Chemistry Of Regions Common To The Orbital X-Ray
And Gamma-Ray Experiments

Hubbard
A Re-Examination Of The Orbital X-Ray Data From Apollo 15 And 16

Parker, Haines, Metzger
Thorium Concentrations In The Lunar Surface

Pratt, Moore, Parsons, Anderson
Pattern Recognition Studies On Apollos 11, 15, 16 And 17 Data

Schonfeld
Comparative Study Of Orbital And Lunar Sample Geochemistry

Thursday, March 17, 1977

IV- C. EVOLUTION OF THE PLANETARY CRUST:
AGE OF EARLY IMPACTITES, COOLING HISTORY, KREEP,
AND EVOLUTION OF EARLY MELTS

Building 2 Auditorium
8:30 a.m.
Chairmen: H. S. Huebner
G. A. McKay

Hinthorne, Conrad, Church
Lead-Lead Age And Rare Earth Element Determinations In Lunar
Norite 76535

Jessberger, Dominik, Kirsten, Staudacher
New 40°-39°Ar Ages Of Apollo 16 Breccias And 4.42 AE Old
Anorthosite

Delano, Bence
4.2-4.3 AE Soil Fragments: Equilibrated Or Unequilibrated,
Polycomponent Systems?

Takeda, Miyamoto
Inverted Pigeonites From Lunar Breccia 76255 And Pyroxene-
Crystallization Trends In Lunar And Achondritic Crystals

Nord Jr., Huebner, Ross
Structure, Composition, And Significance Of "C-P" Zones In
76535 Orthopyroxene

Charette, Taylor, Adams, McCord
The Detection Of Fra Mauro Basalts In The Lunar Highlands By
Remote Spectral Reflectance Techniques And Implications For
Crustal Stratigraphy

McKay, Weill
KREEP

Nyquist, Wiesmann, Shih, Bansal
REE And Rb-Sr Analysis Of 15405 Quaria-Monzodiorite (Super-KREEP)

Hollister, Crawford
Evidence For A Direct Genetic Connection Between Apollo 15 KREEP
And Apollo 12 And 15 Basalts

Irving
Chemical And Experimental Constraints On The Genesis Of Apollo 15
And Apollo 17 KREEP Basalts

Hess, Rutherford, Campbell, Dick
Fractionation Of Lunar Feldspathic Magmas

Dymek, Quick, Albee
The Role Of Silicate Liquid Immiscibility: Constraints From A
Terrestrial Example
Dynamic Crystallization Experiments Bearing On The Origin Of Textures In Impact Generated Liquids

Thursday, March 17, 1977

III-D. REGIONAL GEOLOGY AND LOCAL FEATURES
Gilruth Center, Room 104
8:30 a.m.

Chairmen: W. R. Muehlberger
R. S. Saunders

Johnson, Mosher, Matson
Lunar Spectral Units: A Northern Hemispheric Mosaic

Saunders, Thompson, Mosher
Characteristics Of Lunar Maria: Earth-Based Data

Scott, Drez, Watkins
Lunar Farside Tectonics And Volcanism

Pieters, Adams, Bryan, Head, McCord, Zisk
Geology And Geochemistry Of The Flamsteed Region Of Oceanus Procellarum: A Preliminary Report Based On Remote Sensing And Lunar Sample Information

Whitford-Stark, Head
Oceanus Procellarum: Volcanic And Tectonic Evolution

Lucchitta
Mare Ridges, Topography, And Structure In Southern Imbrium And Northern Procellarum

Muehlberger
Comparison Of Structural Style Between Northern Mare Tranquilitatis And Southern Mare Serenitatis

Boyce, Schaber
Ring-Moats On The Lunar Maria: Buried Impact Craters And Their Implication To Crater Erosion Model

Hodges
Basaltic Ring Structures Of The Columbia Plateau And Possible Extraterrestrial Analogue

Andre, Adler, Wolfe, Weidner, Philpotts
Chemical Character Of The Partially Flooded Smythii Basin From AL/SE Orbital X-Ray Data

Maxwell, Strain, El-Baz
Analysis Of Low Altitude X-Ray Fluorescence Data From Mare Cramium And Mare Smythii

Greeley, Schultz, Wilbur
Volcanic Features Of The Smythii Basin

DeHon
Mare Humorum And Mare Nubium: Basalt Thickness And Basin Formation History
Thursday, March 17, 1977

VI-C. LUNAR ENVIRONMENT AND ITS PAST VARIATIONS

Gilruth Center, Room 206
8:30 a.m.
Chairmen: R. H. Becker
D. E. Brownlee

Davie, Bell, Durrani
Charged-Particle Track And Micrometeorite-Crater Studies On Apollo
15 Green-Glass Spherules

Goswami, Lal
Particle Track Correlation Studies In Lunar Soils: Long Term
Fluctuations In Ancient Meteoritic Flux In Lunar Space

Hartung, Breig, Comstock
Microcrater Studies On 60015 Do Not Support Time Variation Of
Meteoroid Flux

Morrison, Zinner
Microcraters And Solar Cosmic Ray Tracks

Bhandari
Solar Flare Induced Al-26 In Short Exposure Age Rocks

Gopalan, Goswami, Rao, Suthar, Venkatesan
Solar Cosmic Ray Produced Noble Gas Isotopes And Fossil Tracks In
Lunar Soil, 14163

Dartyge, Oran, Duraud, Langevin, Maurette
Thermal Annealing Of Nuclear Particle Tracks In Minerals And The
Chemical Composition Of Very Heavy Cosmic Rays

Reedy
Solar Proton Fluxes Since 1956

Zinner, Walker, Chaumont, Dran
Surface Enhanced Elements And Microcraters In Lunar Rock 76115

Fireman, Defelice, D'Amico
Carbon-14 In Lunar Soil (Temperature-Release And Size-Fraction
Study)

Becker, Clayton
Solar Wind Nitrogen As An Indicator Of Regolith History

Kerridge, Kaplan, Lingenfelter, Boynton
Solar Wind Nitrogen: Mechanisms For Isotopic Evolution
Thursday, March 17, 1977

III-C. PETROLOGY, GEOCHEMISTRY, AND ISOTOPIC SYSTEMATICS OF NARE BASALTS

Building 2 Auditorium

1:30 p.m.

Chairmen: T. Grove
K. Marti

Palm, Wlotzka
Trace Element Fractionation During Crystallization Of Lunar Rock

Haskin, Jacobs, Brannon
Dispersions In REE Among Lunar And Terrestrial Basalts

Murali, Ma, Schmitt, Warner, Keil, Taylor
Chemistry Of 30 Apollo 17 Rake Basalts; 71597 A Product Of Partial
Olivine Accumulation

Vaniman, Papke
The Apollo 17 Drill Core: Chemistry And Stratigraphy Of Monomineralic
Fragments And The Discovery Of A New Very Low Ti (VLF) Mare Basalt

Rhodes, Blanchard, Brannon, Rodgers, Dungan
Chemistry, Classification And Petrogenesis Of Apollo 15 Mare Basalts

Dungan, Brown, Meyer
Petrography And Petrology Of Apollo 15 Ilmenite Basalts 12005 And
12006

Nyquist, Bansal, Hooden, Wiesmann
Sr-Isotopic Constraints On The Petrogenesis Of Apollo 15 Ilmenite
Basalts

Papanastassiou, DePaolo, Tera, Wasserburg
An Isotopic Triptych On Mare Basalts: Rb-Sr, Sm-Nd, U-Pb

Guggisberg, Eberhardt, Geiss, Grötler, Stettler, Brown, Peckett
Youngest And Oldest Mare Basalts: The Temporal Extent Of Mare
Filling

Hayakuma, Unruh, Gensho, Tatsumoto
Evolution History Of Lunar Mare Basalts: Apollo 15 Samples
Revisited

Lugnai, Marti
Evolution Of The Lunar Interior: Sm-Nd Systematics Of 416 Green
Glass And The Question Of The Lunar Initial 143Nd/144Nd

Murthy, Coscio Jr.
Rb-Sr Isotopic Systematics And Initial Sr Considerations For
Some Lunar Samples

Schaeffer, Müller, Grove
Laser Ar-Ar Study Of Apollo 17 Basalts

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Thursday, March 17, 1977

VII-C. INTERACTIONS OF SOLID BODIES; ORIGIN OF THE MOON

Gilruth Center, Room 104

1:30 p.m.

Chairmen: D. Gault
E. M. Shoemaker

Freeman
A Model Of The Magnetic Field In The Solar Nebula

Ip
Monte Carlo Simulation Of The Jet Stream

Greenberg, Hartmann, Chapman
Orbital Resonances In The Planet-Building Process

Hartmann
Experiments On Early Growth Of Moon And Planets

Turcotte, Nordmann
Numerical Calculations Of The Cross Section For The Acorential
Capture Of The Moon By The Earth

Blinder
Fission Origin For The Moon: Accumulating Evidence

Friedlander, Smith
Limits To Tidal Control On Lunar Asymmetry

Harris
The Effect Of Tidal Friction On The Origin And Thermal Evolution
Of The Moon

Ramsford
The Moon's Post-Acorential Temperature Distribution

Wetherill
Evolution Of The Earth's Planetesimal Swarm Subsequent To The
Formation Of The Earth And Moon

Malin
Early Evolution Of Planetary Surfaces

Davis, Chapman
The Collisional Evolution Of Asteroid Compositional Classes
Thursday, March 17, 1977

II-B. LUNAR CORES: CHARACTERIZATION AND DEPOSITIONAL HISTORY
Gilruth Center, Room 206
1:30 p.m.
Chairmen: G. H. Heiken
D. Heymann

Langevin, Maurette
Galactic Cosmic Ray Induced Isotopes, Meteoritic Gardening, and The Deposition History of Lunar Core Tubes

Goswami, Borg, Langevin, Maurette, Price
Microstratification in Apollo 15 and 16 Core Tubes: Implications to Regolith Dynamics

Blanford, McKay, Wood
Particle Track Densities in Double Drive Tube 60009

Crozaz, Dust
Irradiation History of Lunar Cores and the Accumulation of the Regolith

Nagle
Possible Sources of Immature Soil at the Apollo 16 ALSEP Site

Morris, Gose
Ferromagnetic Resonance and Magnetic Studies of the Apollo 16 Deep Drill Core: Surface Exposure and Compositional Stratigraphy

Meyer, McCallister
The Apollo 16 Deep Drill Core

Heymann, Ray, Walker, Dziczkaniec, Palme
Inert Gas Stratigraphy of the Lower Half of the Apollo 16 Drill Core

Kohl, Russ III, Arnold, Nishiizumi, Imamura, Honda
38Ar in Lunar Cores: Evidence for the Time Scale of Surface Gardening

Banerjee, Gingrich, Marvin
Remanent Magnetization Stratigraphy of Lunar Cores

Papike, Lellis, Becker, Vaniman
The Apollo 17 Drill Core: Modal Data (Sections 70007, 70008, 70009)

Taylor, Keil, Warner
Petrolgy of Apollo 17 Deep Drill Core-I. Depositional History Based on Modal Analyses of 70009, 70008, and 70007

Ali, Ehmann
Chemical Characterization of Apollo 17 Deep Drill Cores 70007-70009

Friday, March 18, 1977

SUMMARY SESSION
Building 2 Auditorium
8:30 a.m.
Chairmen: M. Duke
T. McGetchin

SUMMARY ON EACH MAJOR CONFERENCE TOPIC

I. Constraints on Structure and Composition of Planetary Interiors.
Summarizer: S. Solomon

Summarizer: John B. Adams

III. Characterization and Evolution of Maria and Other Volcanic Landforms.
Summarizer: A. E. Bence

IV. Characterization and Evolution of Planetary Crusts.
Summarizer: Lincoln Hollister

V. Nature and Effects of Impact Processes.
Summarizer: Thomas Ahrens

VI. Extraterrestrial Materials as Solar/Interplanetary/Interstellar Probes.
Summarizer: R. Housley

VII. Earliest History of the Solar System.
Summarizer: D. S. Burnett
NEW MOONS

TOWING ASTEROIDS INTO EARTH ORBITS
FOR EXPLORATION AND EXPLOITATION

SPECIAL SESSION OF THE EIGHTH LUNAR SCIENCE CONFERENCE

16 (Wednesday) March 1977
GILRUTH CENTER - Room 104
8:00 p.m. - 10:30 p.m.
JOHNSON SPACE CENTER

THIS IS AN OPEN SESSION. ALL CONFERENCE ATTENDEES, MEMBERS OF THE JOHNSON SPACE CENTER, AND HOUSTON TECHNICAL COMMUNITY, AND THE PUBLIC ARE CORDIALLY INVITED TO ATTEND.

Two recent developments encourage immediate consideration of the possibility of bringing asteroids into orbits about the earth for exploration and exploitation:

(1) The distribution of crater sizes on the moon, Mars, Mercury, and the earth, and recent astronomical surveys indicate the possible existence of many thousands of asteroids larger than 100 meters in diameter in orbits approximately 1 AU from the sun and with velocity differences with respect to earth of \( \geq 3 \) km/second. Retrieval of such asteroids requires 10 to 100 times less energy than for similar main belt asteroids located between Mars and Jupiter.

(2) The mass-driver, first proposed for ejecting soil pellets from the moon, can be used in space as an electric rocket engine. A mass-driver coupled to a 100 megawatt power plant (possibly a solar array) could be assembled in low earth orbit. Reaction mass necessary to propel the mass driver tug for the 3 to 9 month cruise to rendezvous with an asteroid could be obtained by pelletizing the oxygen/hydrogen tanks from the 30-50 shuttle flights necessary to lift the tug assemblies into low earth orbit. After rendezvous the tug would cruise back to earth in 3 to 5 years using approximately 80% of the asteroid as reaction mass. Conceivably, the initial venture could return 10,000,000 metric tons of material to earth orbit for less than 20c/kilogram (vs. $1000/kilogram - shuttle & tug launch to geosynchronous orbit) by the mid-1980's at a cost of 1 to 2 billion dollars.

Scientific results of immense importance should result from studies of virtually unlimited quantities of the materials returned. Asteroids should provide far less altered samples of early solar condensates than obtained from the moon or certainly from Mars. At long last cosmochemists can do "whole" rock analyses. Of far wider interest is the possible economic potential.

Speculative Scenario

Between mid-1977 and 1979 intense ground based and space (possibly using surveillance satellites) searches discover several \( > 100 \) meter earth-crossing asteroids with small velocity differences with respect to earth. A nuclear or solar powered tug is deployed by 1981 in the first major shuttle program and asteroid rendezvous and docking occur in mid-1982. Automatic analysis of asteroid material supplied to the mass driver allows between 1982 and 1985 design, fabrication and deployment of chemical processing equipment and manufacturing machinery. Men, machines and the asteroid rendezvous in high earth orbit in 1985. Now hollowed-out the astrogid provides raw materials for construction of space solar power stations (SSPS) of \( 3 \cdot 10^{12} \) watts output and simultaneously a shelter against radiation for workers. Presently, the U.S. consumes \( 5 \cdot 10^{11} \) watts/year and needs \( 6 \cdot 10^{10} \) watts/year of new electrical generating capacity. The first remotely located ground/sea stations are designed to receive very high microwave beam densities from the space platforms.
in order to speed construction, lower costs and allow industrially significant production of synthetic fuels for immediate input to the U.S. tanker and pipeline networks starting in 1987 and meet all demands for new energy supplies for the U.S. by 1990. The following program and speakers do not intend to promote or justify this scenario but to explore the concept of asteroid detection, retrieval, and general scientific and economic utilization.

PROGRAM

CHAIRMEN: Prof. G. Arrhenius - University of California, San Diego
Dr. David R. Criswell - Lunar Science Institute

WELCOME Prof. G. Arrhenius

(1) Dr. Brian J. O'Leary - Princeton University
   General overview of the development, deployment, and cost of a mass driver tug and retrieval of an earth approaching asteroid.

   Probable population of earth approaching asteroids and present and future telescopic searches.

(3) Prof. T. B. McCord and Dr. M. Gaffey - University of Hawaii
   Remote determinations of the composition of earth approaching asteroids (ground and space based systems); need for direct assay and return samples.

(4) Dr. John C. Niehoff - Science Applications, Inc.
   Return trajectories - (1) Specific example, and (2) Ease of retrieval as a function of flight time, Δv, and population distributions of the asteroids.

(5) Prof. Henry Kolm - Massachusetts Institute of Technology
   Mass drivers.

(6) Mr. H. P. Davis - Johnson Space Center
   Technological challenges of deploying the mass driver systems in low earth orbit.

(7) Prof. J. R. Arnold - University of California, San Diego
   Lunar versus asteroid resources.

(8) Dr. David R. Criswell - Lunar Science Institute
   "New Moons" - Scientific and economic values of a 1980's space program built on retrieval of earth approaching asteroids.

(Presentations 10 to 15 minutes with a Q/A session at end.)

FOR ADDITIONAL INFORMATION CONTACT:

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