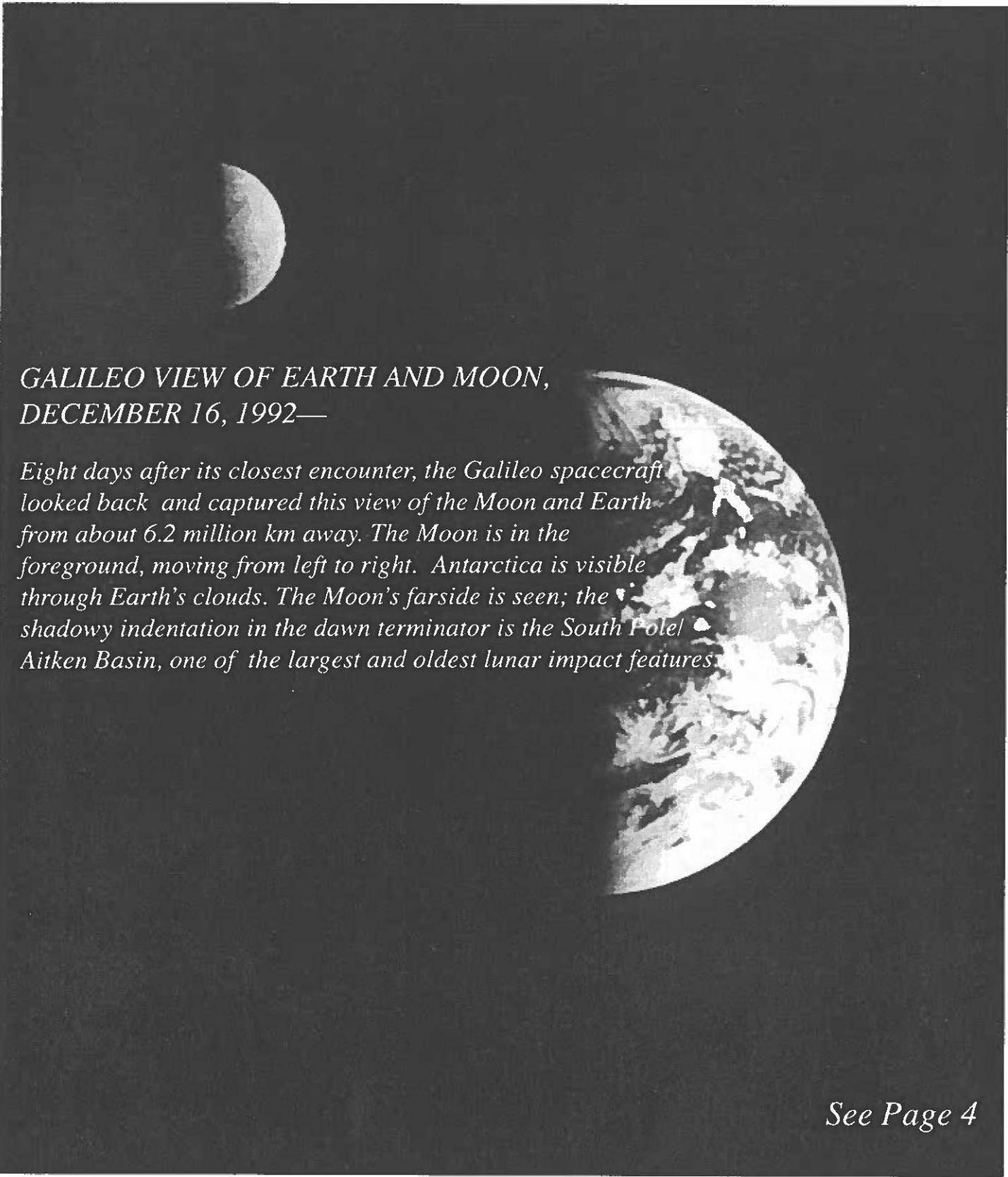


Lunar and Planetary Information

# BULLETIN

FEBRUARY 1993/NUMBER 66 • LUNAR AND PLANETARY INSTITUTE • UNIVERSITIES SPACE RESEARCH ASSOCIATION



*GALILEO VIEW OF EARTH AND MOON,  
DECEMBER 16, 1992—*

*Eight days after its closest encounter, the Galileo spacecraft looked back and captured this view of the Moon and Earth from about 6.2 million km away. The Moon is in the foreground, moving from left to right. Antarctica is visible through Earth's clouds. The Moon's farside is seen; the shadowy indentation in the dawn terminator is the South Pole/Aitken Basin, one of the largest and oldest lunar impact features.*

*See Page 4*

# 24th LPSC Conference Information

## **CONFERENCE INFORMATION**

### **REGISTRATION - LPI OPEN HOUSE**

The 24th Lunar and Planetary Science Conference will open with a Registration/Open House on Sunday, March 14 from 6:00 p.m. until 9:30 p.m. at the Lunar and Planetary Institute, 3600 Bay Area Boulevard. Registration will continue in the Gilruth Center, JSC, Monday through Thursday between 8:00 a.m. and 5:00 p.m. A shuttle bus will be available to transport participants between the LPI and local hotels Sunday evening from 5:45 p.m. to 10:00 p.m.

A message center will be open from 8:00 to 5:00, Monday through Thursday (8:00 to noon on Friday) in the registration area in the Gilruth Center. People may contact attendees by calling 713-483-0321. Messages will be posted on a bulletin board near the Registration Desk.

Assistance with arranging airline reservations is available from the Airlines Traffic Office in Room 130 of Building 1 (phone 483-3305). 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.

### **SHUTTLE BUS SERVICE**

A shuttle bus service between JSC, LPI, and the various motels will operate daily from 7:30 a.m. until 9:30 a.m., 11:00 a.m. until 2:00 p.m., and from 5:00 p.m. until 6:30 p.m. Buses will also operate 1/2 hour before and after each official evening function.

During the week of the conference, your conference badge will allow access to the Space Center at all gates, the first floor of Building 1, and the Gilruth Center. Please be reminded that this badge does not allow access to other areas or buildings not open to the general public except those specifically outlined above.

## **24th LPSC Session Guide**

### **March 15-19, 1993**

#### **Monday Morning, 8:30 a.m.**

- Basaltic Achondrites
- A Geology of Venus: A Tribute to Valery Barsukov
- Solar System Origins
- Impact Cratering and Shock Metamorphism

#### **Monday Afternoon, 1:30 p.m.**

- Solar, Cosmic Ray, and Dynamical Studies (Session honors James R. Arnold)
- Venus Volcanism
- Manson: The Hole and Shocking Story

#### **Monday Evening, 8:00 p.m.**

Harold Masursky Lectures, Public Session, Bldg. 2 Auditorium

#### **Tuesday Morning, 8:30 a.m.**

- Primitive Achondrites
- Venus Resurfacing and Tectonics
- Chicxulub, K/T Boundary, and Other Impact Ejecta
- Remote Sensing/Space Weathering

#### **Tuesday Afternoon, 1:30 p.m.**

- Meteorites and Volatiles: A Session Honoring the Service of Don Bogard as PM & G Discipline Scientist
- Venus Gravity from Magellan and Mars Geophysics
- Large Impact Events: Theory and Observations, and Galileo Earth/Moon Results
- Martian Geomorphology

#### **Tuesday Evening, 7:00-9:00 p.m.**

Poster Session I, Lunar and Planetary Institute

#### **Wednesday Morning, 8:30 a.m.**

- Interplanetary Dust: Laboratory Studies and Results from Spacecraft
- Martian Surface Mineralogy and Spectroscopy
- Rocks: From the Highlands to the Maria to Antarctica

#### **Wednesday Afternoon, 1:30 p.m.**

- Ordinary and Enstatite Chondrites
  - Mars: Tectonism and Volcanism
  - Lunar Volcanic Glasses and Regolith
- 5:00 COMPLEX Plenary: Integrated Strategy for Planetary and Lunar Exploration from 1995-2010

#### **Wednesday Evening 6:00-9:30 p.m.**

Conference Social, Landolt Pavilion

#### **Thursday Morning, 8:30 a.m.**

- Carbonaceous Chondrites and Chondrules
- Mars: Surface and Atmospheric Processes
- Lunar Geology
- Asteroid and Planetary Core Formation and Metal-rich Meteorites

#### **Thursday Afternoon, 1:30 p.m.**

- Stars, Stardust, and Isotope Anomalies
- Outer Solar System
- Future Lunar Exploration

#### **5:30 NASA Program Managers' Meeting**

#### **Thursday Evening 7:00-9:00 p.m.**

Poster Session II - Lunar and Planetary Institute

#### **Friday Morning, 8:30 a.m.**

- CAIs and Heat Sources for Chondrule/CAI Melting
- Comets and Asteroids
- Educating Young People in Earth and Planetary Sciences

## **Meetings and Special Events**

As the Conference takes shape in late January, we take this opportunity to list some of the meetings and special events planned for LPSC 24. Some of the details may change and new activities may be added between Bulletin press time and the Conference.

## **Poster Sessions**

Poster Sessions I and II will be held on Tuesday and Thursday evenings from 7:00-9:00 p.m. in the Great Room at LPI. Poster authors will be on hand to discuss

## **Conference Program and Short Abstracts On Line**

The LPSC Program with short abstracts will be accessible electronically on or about February 5 via the NASA Science Internet (NSI) or by direct dial.

- On NSI/DECNET (SPAN), type SET HOST LPI.
- On NSI/Internet, type TELNET LPI.JSC.NASA.GOV or TELNET 192.101.147.11.
- To dial direct, call 713-244-2090 or 713-244-2091. These are new modem numbers and will connect to 2400 or 1200 baud.

For all three methods of access, respond to USERNAME: LPI. No password is necessary. Choose LPSC Conference Program from the menu.

If you have difficulty in accessing the LPI computer, please contact Kinpong Leung at 713-486-2165 (LPI::LEUNG on NSI/DECNET or leung@lpi.jsc.nasa.gov on NSI/Internet) or Lorraine Willett at 713-486-2194 (LLFISHER on NASAMAIL).

their presentations with other attendees and complimentary keg beer and soft drinks will be served during these sessions.

### **Displays, Demos, and Exhibits**

The on-line and remote access capabilities of the interrelated database systems in use at LPI will be displayed throughout the week at the LPI facility at 3600 Bay Area Boulevard. Shuttle buses will be provided to transport attendees to and from the Gilruth Center; travel time is about 10 minutes.

The Washington University-based Geosciences Node of the Planetary Data System will demonstrate an electronic catalog of Magellan data products. The catalog will allow searches by geographic

## **LPSC Session on Geology of Venus is Dedicated to the Memory of Valery Barsukov**



The field of planetary science and solar system exploration lost an invaluable colleague with the untimely death of Academician Valery Leonidovich Barsukov

in July 1992. Academician Barsukov had achieved many of the highest scientific honors in the Soviet Union and Russia, and he was truly dedicated to international cooperation in scientific research and planetary exploration. During his career, Barsukov's professional interests underwent a metamorphosis from the geochemistry of ore deposits, to the study of the metallogenic aspects of Earth's mantle, to the geochemistry and geology of the planets and their satellites. As director of the V. I. Vernadsky Institute of Geochemistry and Analytical Chemistry in Moscow, he actively participated in Soviet Union missions to the Moon, Venus, and Mars.

In the latter part of his career, he developed another of his passionate interests, international cooperation in scientific research and planetary exploration. He was Vice-President of the International Union of Geological Sciences and was a well known figure at LPSC, where he often gave keynote papers on the latest Soviet planetary exploration achievements. Upon the renegotiation of a joint agreement between the U. S. and Soviet Union in the mid 1980s, he was named Soviet Chair of the Joint Working Group on Solar System Exploration.

Close friends knew that the passion and intensity of his work extended into his personal life. His significant activities in international cooperation and his legendary guitar playing and singing of Russian folk songs made all who came in contact with him a little bit more Russian and significantly better world scientific citizens. He will be greatly missed.

location, feature, orbit, and product, and will enable the user to place orders for Magellan MIDR, GxDR, ARCDR, and F-BIDR products.

The Combined Publishers Exhibit will be on display at the LPI throughout the week.

Session Chair's breakfast Meetings will be held in the Club Room, Gilruth Center, 7:45-8:15 a.m., Monday through Friday.

### **Monday—March 15**

The Hal Masursky Lectures will be open to the public at 8:00 p.m. in the Building 2 Auditorium, JSC.

### **Tuesday—March 16**

Poster Session I will be held in the Great Room, LPI, from 7:00-9:00 p.m.

### **Wednesday—March 17**

The JSC Astronomy Seminar will present "Fast Terraforming of Mars" by Jim Oberg at noon in Building 31, Room 129.

The Annual Barbeque Dinner for all registrants will be held at Landolt Pavilion. Guest tickets will be sold at the registration desk.

### **Thursday—March 18**

Poster Session II will be held in the Great Room, LPI, from 7:00-9:00 p.m.

### **RECYCLING**

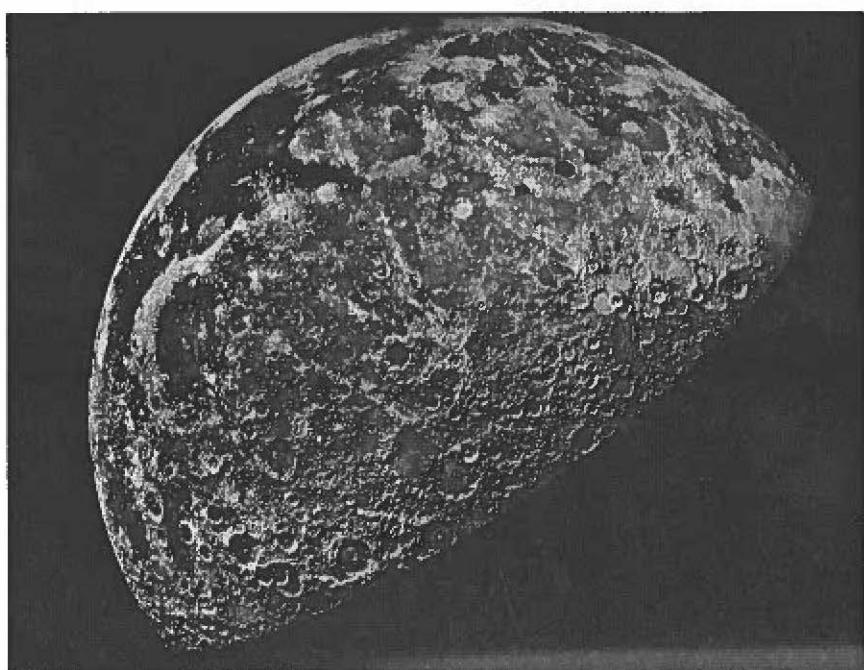
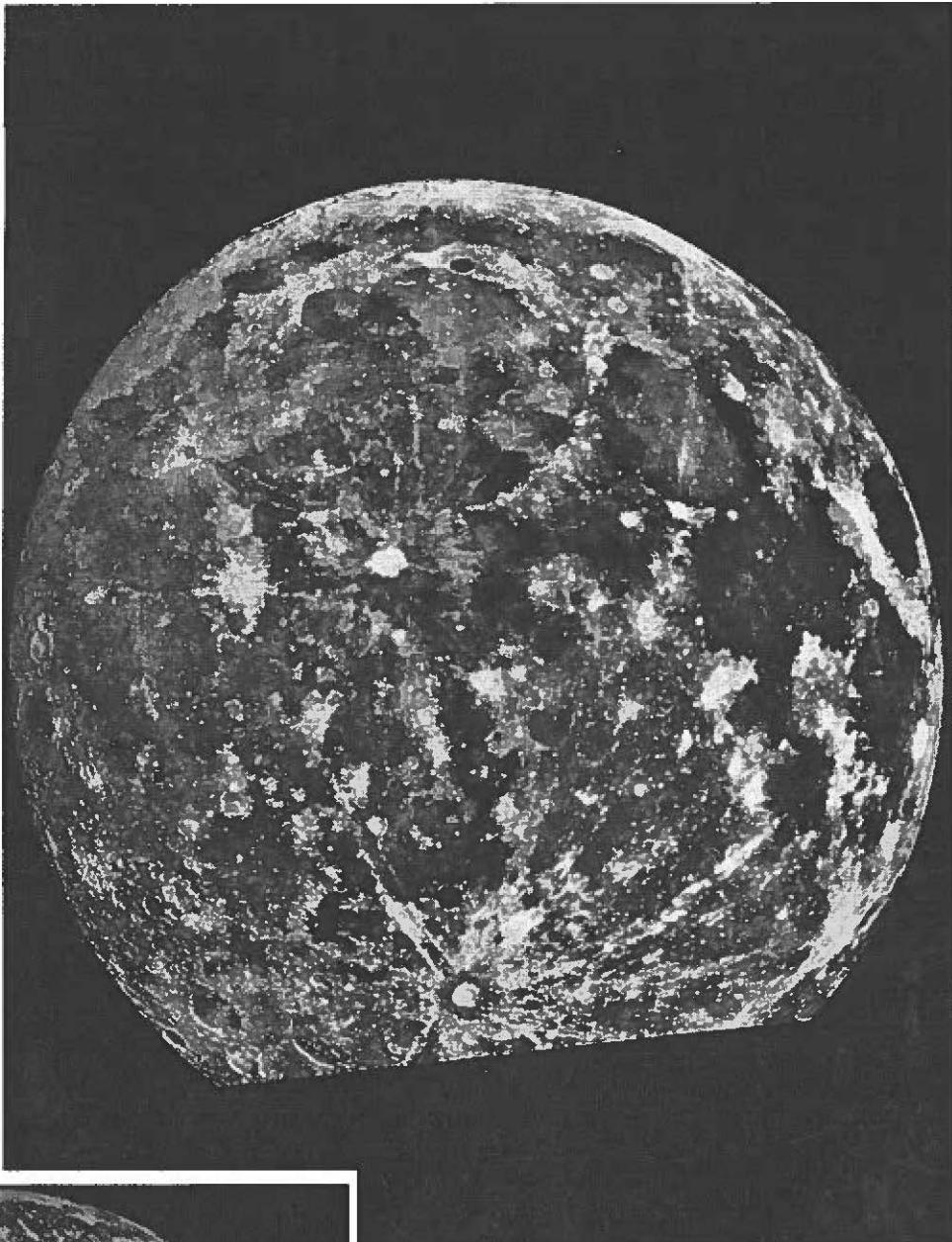
For the first time, participants who normally discard the bulky abstract volumes after the meeting will have the opportunity to recycle them. Look for notices directing you to the recycling station at the Conference. ☺

# GALILEO: EARTH. MOON ENCOUNTER



## MOON—

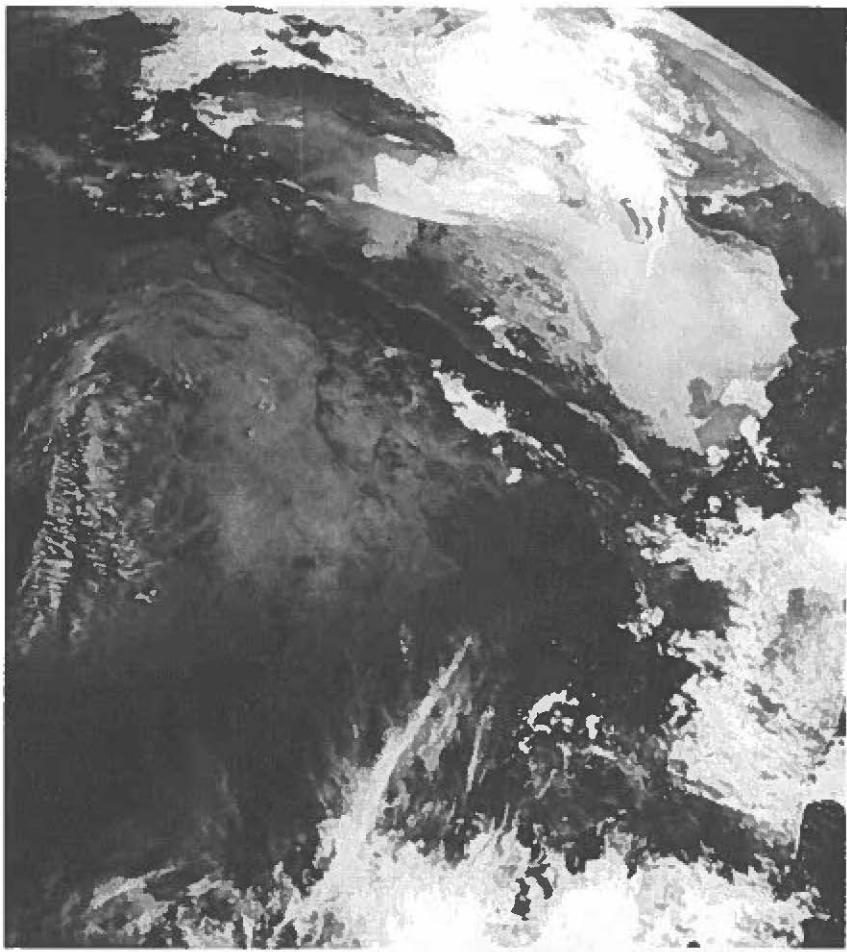
*This false-color composite (reproduced here in black and white) of 15 images of the Moon was taken through 3 color filters by the Galileo spacecraft Solid State Imaging system during its flyby through the Earth-Moon system on December 7, 1992. This view was obtained while the spacecraft was 425,000 km from the Moon and 69,000 km from Earth.*



NASA PHOTO NO. S92-52110

## MOON—

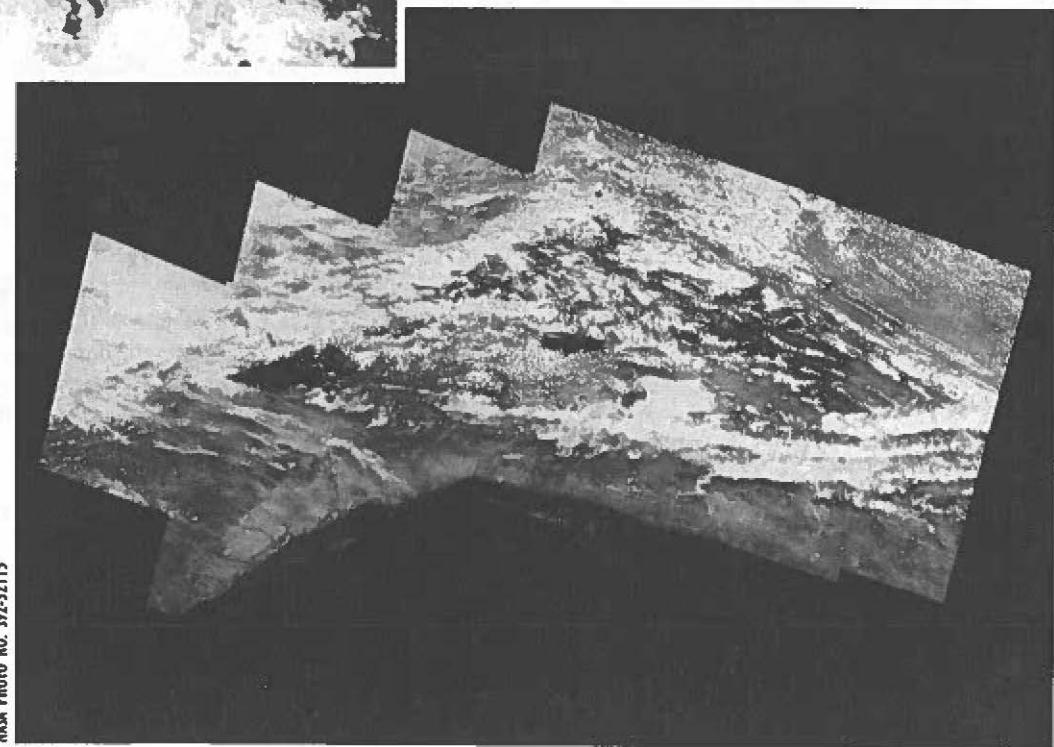
*This false-color mosaic (reproduced here in black and white) was constructed from a series of 53 images taken through 3 spectral filters by Galileo's imaging system as the spacecraft flew over the northern regions of the Moon on December 7, 1992. The lunar nearside is to the left in this view. In color, the mosaic clarifies compositional variations in the Moon's northern hemisphere.*



NASA PHOTO NO. S92-52112

#### AFRICA AND ARABIA—

This image (reproduced here in black and white from a color view) of northeast Africa and Arabia was taken from an altitude of about 500,000 km by Galileo on December 9, 1992, as it left the Earth's vicinity for Jupiter. Most of Egypt (center left) including the Nile Valley, the Red Sea (slightly above center), Israel, Jordan, and the Arabian Peninsula are cloud-free. In the center, below the cloud on the coast, is Khartoum at the confluence of the Blue and White Niles. Somalia (lower right) is mostly cloud-covered.



NASA PHOTO NO. S92-52115

#### ANDES, SOUTH AMERICA—

This false-color mosaic (reproduced here in black and white) of the central part of the Andes mountains ( $70^{\circ}\text{W}$ ,  $19^{\circ}\text{S}$ ) is made up of 42 images taken by Galileo from an altitude of 25,000 km. A combination of visible and near-infrared filters was used to distinguish regions with different vegetation and soil types. The mosaic covers the area where Chile, Peru, and Bolivia meet. (North is to the left and the Pacific coast is in the foreground.) Lakes Titicaca and Poopo are the dark patches left and right. A larger lighter area below and left of Poopo is Salar de Uyuni, a dry salt lake 120 km across. The lakes lie in the Altiplano, the region between the eastern and western Andes, which are cloud-covered.

# NEW IN PRINT

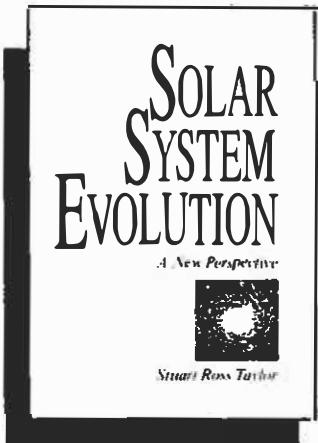
These publications are available from the publisher listed or may be ordered through local bookstores.

## A REVIEW SOLAR SYSTEM EVOLUTION A NEW PERSPECTIVE

By Stuart Ross Taylor

Cambridge University Press, New York, 1992, 307 pp.

Black and white illustrations and photographs. Hardcover, \$49.95



This recently published book by S. Ross Taylor, entitled *Solar System Evolution* and subtitled, *A New Perspective*, is a thoughtful and informative discourse on the subject. It is written from a perspective that reflects the acknowledged maturation of planetary science, and the merging of research activities in planetary science with research in astronomy and astrophysics on the one hand, and life science on the other (partial motivation for the subtitle for the book). It is also written from a perspective that proclaims the solar system to be unique in the universe, mainly because so many of the specific details of the system are a consequence of "chance events," notably impacts between objects of considerable size (several to thousands of kilometers in diameter) during the evolution of the solar system (also motivation for the subtitle). The book, as with any undertaking of this breadth, has strengths and weaknesses. Many of these are recognized and acknowledged by the author in the Preface.

The literature cited is from pre-April 1990, so students of the subject should not expect, for example, to see discussions of putative planetary systems associated with pulsars. The bibliography is extensive, with emphasis upon relatively recent reviews in many subject areas covered by the book. My only complaint about the bibliography is that it is often difficult, or impossible because the key references are not given, for a reader to discern where the seeds of key concepts first appeared. This is important, as the author himself points out, so that one can judge critically the firmness of the foundation underlying these concepts. This is probably a consequence of the heavy dependence on recent review publications, and on the breadth of the subjects treated in the volume.

The author is to be congratulated for his recognition of the growth of interest and activity directed at placing the solar system in the context of other planetary systems. His emphasis on the role of impacts in shaping the solar system is also to be lauded (this is the first book on solar system evolution that I am aware of that devotes an entire chapter to the role of impacts). The chapter on impacts is readable, and for one not familiar with the topic it provides a sense of why recognition of the significance of this process has had such a profound effect on current thinking not only on the evolution of the solar system, but the past and future evolution of life on this planet.

The story line of the book is reasonably tight. It progresses through the subject in a somewhat unusual, but useful, fashion. There are slight, occasionally awkward, digressions into topics that, while interesting in their own right, seem somewhat out of place here (e.g., discussions on the origins of galaxies and the comparison of galactic collisions with continental drift). Most of these appear in the early chapters where the subject matter is least familiar to the author, and they are minor.

My major difficulty with the tone of the book is that while, as noted above, it recognizes the significance of other planetary systems to students of this planetary system, and it emphasizes the role of impacts in the evolution of the solar system, it then places too much weight on the notion that the solar system is unique and imparts a sense that its counterpart will not be found in nature. What disturbs me about this view is that while it is probably true that an *exact* replica of the solar system does not exist, the message is that there are no defining prototypical attributes of planetary systems

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that one should seek to discern either in studies of this planetary system or of any other system. For example, the author states on page 288 that the "Division into terrestrial and giant planets is as unlikely to be repeated as is the course of the evolution of life on this planet." If this view were correct, then the study of the origin of the solar system is removed from the realm of scientific inquiry. I do not believe that such is the case, and one can in fact attempt to identify generic aspects of planetary systems through a study of our own and then test that through observations. It may turn out that the author is correct regarding this view of planetary systems, but there is no firm basis to assume so at this time, and it seems to be inconsistent with his own recognition of the likelihood of planetary systems elsewhere.

I found the book to be a readable and good introduction to most of the key issues and phenomena that are thought to have played an important role in the evolution of the solar system. It should be a useful resource for students and newcomers to the subject.

—David C. Black

(*Dr. Black is Director of the Lunar and Planetary Institute*)

## ELECTRONIC PICTUREBOOKS—A NEW WAY TO LEARN ABOUT ASTRONOMY AND PLANETARY SCIENCE



**A**s a teacher, would you want to assign your class to read an entire book on a computer screen? Sounds a bit unlikely—until you discover ExInEd's\* new electronic PictureBooks! Intended as educational aids for learning about astronomy and Earth and planetary sciences, ExInEd PictureBooks combine the benefits of traditional books with the flexibility and interactivity of electronic data. They can include full color, audio, and full-motion video. Great educational tools, the PictureBooks are built on Hypercard stacks and designed to run on a Macintosh computer with HyperCard 2.1 and QuickTime 1.5, both of which require system software version 7.0 or above. In the future, they will be available on the PC platform as well.

ExInEd's electronic PictureBooks are part of a NASA-funded experiment to discover and develop new and better ways to assemble and distribute the results of astronomy and planetary science research, particularly images. Each PictureBook contains a tutorial, text, color images, maps (as appropriate), and a glossary, as well as instructions on how to navigate through the exciting material it contains. For each PictureBook, a teacher's guide, recommended student activities, background material, and associated fact sheets are also available for classroom use. Because the PictureBooks rely heavily on visual imagery, the reading level for each book is largely determined by which of these associated materials the teacher chooses to use with it.

Two PictureBooks are currently available to the public. *The HST's Greatest Hits* PictureBook spotlights some of the most spectacular and informative images taken with the scientific instruments of the Hubble Space Telescope (HST) during its first year of operation. Created from an existing slide set distributed by the Space Telescope Science Institute in Baltimore, Maryland, the PictureBook contains a selection of 24 images that represent new data and highlight the new theories about phenomena such as gravitational lenses and black holes now being developed as a consequence of these HST

\*ExInEd (*Exploration in Education*) is a program of the Special Studies Office of the Space Telescope Science Institute.

# NEW IN PRINT

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images. *Magellan at Venus*, the second PictureBook now being distributed, surveys some of the most exciting results of Magellan, a NASA spacecraft sent to map the surface of Venus with imaging radar. The PictureBook was created from an existing slide set distributed by the Jet Propulsion Laboratory in Pasadena, California. Both PictureBooks are available on GENIE and America On Line (using keyword "ExInEd"). Other distribution means, including CD-ROM and Internet, are also being explored.

Additional ExInEd PictureBooks available soon to the public include:

- *6.5-Meter Mirror Casting*, which describes the successful casting of a 6.5-diameter borosilicate honeycomb telescope mirror by the Steward Observatory Mirror Laboratory;
- *Terrestrial Impact Craters*, a presentation of orbital and aerial photographic views of proven or suspected impact structures on Earth from an existing Lunar and Planetary Institute slide set;
- *Science From New Worlds*, a survey of recent planetary exploration from a slide set produced by NASA's Solar System Exploration Division;
- *Earth from Orbit*, a collection of shuttle pictures of the Earth taken by NASA Astronaut Jay Apt, including his personal interpretations of these Earth views... .

...and many more in 1993!



## FROM THE ASTRONOMICAL SOCIETY OF THE PACIFIC "WORLDS IN COMPARISON" SLIDE AND ACTIVITY KIT

An updated set of 20 slides contrasting the sizes of worlds and geologic features in the solar system is available from the A.S.P. Designed by former NASA Visual Information Specialist Stephan Meszaros, the slides use the best spacecraft and radar images to give the viewer a cosmic sense of scale. They include the Earth projected on (and dwarfed by) Jupiter's Red Spot and Saturn's rings; an outline map of the U.S. superimposed on the "Grand Canyon" of Mars; a comparison of volcanos on Earth, Mars, and Jupiter's moon, Io; and the Earth's Moon compared to Neptune's icy satellite, Triton.

The slide set comes in a protective display folder with a 20-page guide that features detailed captions, introductory tables giving the main characteristics of all known planets and moons in the solar system, an up-to-date summary of all U.S. and Soviet planetary missions, several pages of classroom or home activities and projects, and a thorough, nontechnical reading list. \$29.95 from A.S.P., Worlds Slide Set Dept., 390 Ashton Avenue, San Francisco CA 94112.



# PUBLICATIONS FROM LPI

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B-ORIGINS	ORIGIN OF THE MOON	\$15.00
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## TECHNICAL REPORTS

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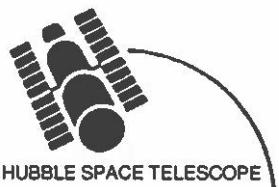
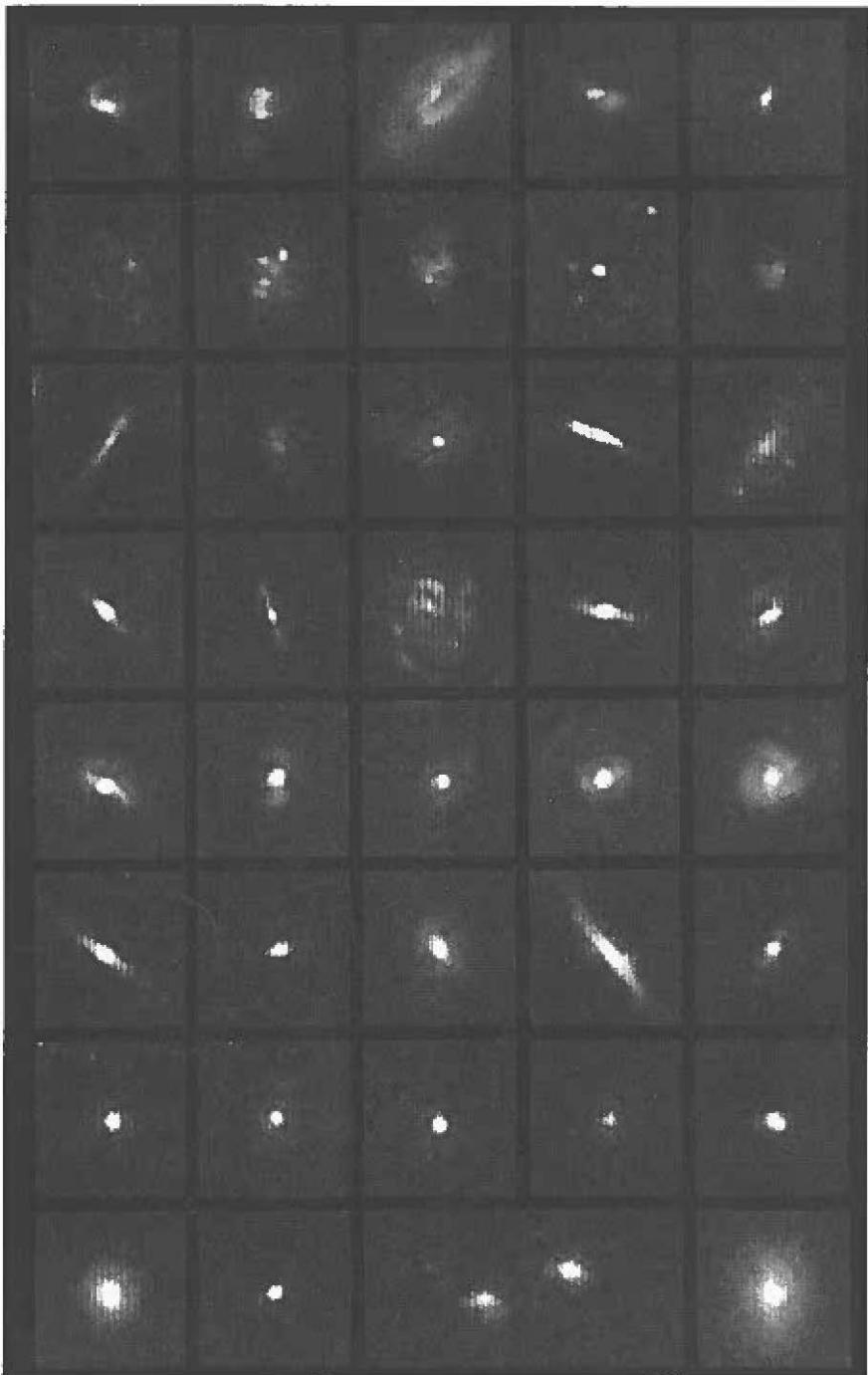
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# Researchers Use HST to Examine Ancient Galaxies

## A "HUBBLE ATLAS" OF ANCIENT GALAXIES—

Hubble Space Telescope's high resolution allows astronomers to classify galaxies in a cluster (CL 0939+4713) that existed four billion years ago, when the universe was two-thirds of its present age.

The galaxies in this mosaic are arranged according to the well-established system developed by American astronomer Edwin Hubble in the 1920s. The top three rows show familiar types of galaxies found today in nearby clusters: elliptical galaxies and lens-shaped galaxies (S0, or S-zero) that may be transition objects between spiral and elliptical galaxies. Rows 4 through 7 show spiral galaxies categorized by the openness of their pinwheel-shaped arms (Hubble classification Sa, Sb, Sc, Sd). Many of these have since disappeared. In particular the spirals in row 7 (Sd) show peculiar morphologies. The bottom row shows galaxies apparently merging into single systems.

Space Telescope reveals that star-forming galaxies were far more prevalent in the clusters of the younger universe than in modern clusters, a result having important implications for theories of galaxy evolution. The image was taken with HST's Wide Field/Planetary Camera in Wide Field Camera mode, and required a six-hour exposure.

PHOTO CREDIT: ALAN DRESSLER, CARNEGIE INSTITUTION, AND NASA CO-INVESTIGATORS: AUGUSTUS OEMLER (YALE UNIVERSITY), JAMES E. GUNN (PRINCETON UNIVERSITY), HARVEY BUTCHER (THE NETHERLANDS FOUNDATION FOR RESEARCH IN ASTRONOMY).

**L**ooking far back in time, the Hubble Space Telescope (HST) has found some suspected ancestors of today's galaxies. The pictures reveal that star-forming galaxies were far more prevalent in the clusters of the younger universe than in modern clusters of galaxies near us today. The results have important implications for theories of how galaxies have evolved since the beginning of the universe 15 billion years ago.

Serendipitously, the Hubble observations might have also discovered the most distant galaxy cluster yet seen. The cluster might be as far away as ten billion

light years, at a "look-back" time corresponding to the early epoch of galaxy formation. The research was carried out by Drs. Alan Dressler of Carnegie Institution, Augustus Oemler of Yale University, James E. Gunn of Princeton University, and Harvey Butcher of the Netherlands Foundation for Research in Astronomy.

A principal goal for the Hubble Space Telescope is to trace galaxy evolution through direct observations. This is very difficult to achieve with groundbased telescopes because the tiny images of distant galaxies smear into faint blurs

when viewed through Earth's atmosphere.

Hubble images of a pair of remote clusters of galaxies located four billion light years away allow astronomers to distinguish, for the first time, the shapes of galaxies that existed long ago.

The pictures, taken with the Wide Field/Planetary Camera (in Wide Field Camera mode), are so detailed they show a full range of galaxy types inhabiting the universe of four billion years ago: elliptical, spiral, distorted, and irregular forms. The images also reveal galaxies in collision. Some are tearing material from each other; others are merging into single systems.

Dressler said the pictures are sharp enough to distinguish between various forms of spiral galaxies, whose distinctive swirl patterns are outlined by vigorous star formation. "This shows us that clusters billions of years ago contained not only the elliptical and S0 galaxies (S-zero, lens-shaped featureless galaxies that may be the transition between spiral and elliptical) like those dominating their descendant clusters today, but also several times as many spiral galaxies."

#### THE CASE OF THE DISAPPEARING GALAXIES

"The new Hubble data are the first unambiguous sign of the influence of environment on the form of a galaxy," said Dressler. "Clearly, spirals were common in clusters in the distant past, but they have largely disappeared or changed form by now. What has been responsible for their demise?"

Based on the HST pictures and the results of earlier research with ground-based telescopes, the team thinks that the rapid decline in the spiral population can be explained by three mechanisms: merger, disruption, and fading.

HST reveals many examples of strong galaxy interactions or mergers in one of the clusters. This is evident by the presence of "tails" distorting the shapes of some galaxies. The tails are probably caused by tidal effects where the close gravitational pull between bypassing galaxies will stretch and disrupt their stellar distributions.

The result is that many ancient spirals might have merged to form giant elliptical galaxies (as proposed by MIT's Alar Toomre and Carnegie's Francois



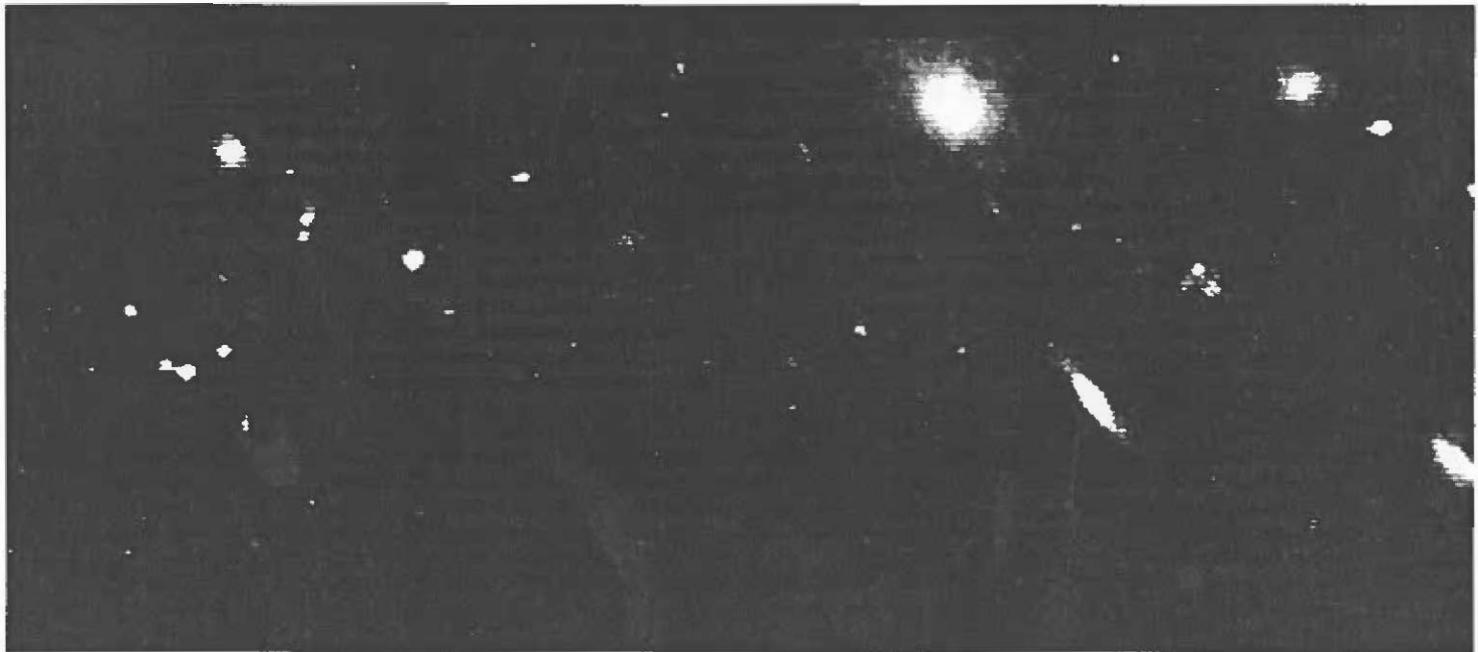
#### ***HST PHOTOGRAPHS A CLUSTER OF GALAXIES FOUR BILLION LIGHT YEARS AWAY—***

*This is a NASA Hubble Space Telescope image of a portion of a remote cluster of galaxies (CL 0939+4713) that existed when the universe was two-thirds its present age (redshift  $z = 0.4$ ). Hubble's high resolution allows astronomers to study, for the first time, the shapes of galaxies that existed long ago. The Space Telescope pictures are sharp enough to distinguish between various forms of spiral galaxies as well as galaxies in collision, some tearing material from each other, some merging into single systems.*

*The HST picture confirms that billions of years ago, clusters of galaxies contained not only the types of galaxies dominating their descendant clusters today, but also several times as many spiral galaxies. These spiral galaxies have since disappeared through possibly a variety of processes: merger, disruption, and fading. The Hubble images provide the first unambiguous evidence for the influence of environment on the form of a galaxy.*

*The image was taken with HST's Wide Field/Planetary Camera in Wide Field Camera mode, and required a six-hour exposure.*

PHOTO CREDIT: ALAN DRESSLER, CARNEGIE INSTITUTION, AND NASA CO-INVESTIGATORS AUGUSTUS OEMLER (YALE UNIVERSITY), JAMES E. GUNN (PRINCETON UNIVERSITY), AND HARVEY BUTCHER (THE NETHERLANDS FOUNDATION FOR RESEARCH IN ASTRONOMY).



#### **THE FARTHEST CLUSTER OF GALAXIES EVER SEEN?—**

*This image reveals one of the faintest and probably most distant clusters of galaxies ever seen. The cluster contains about 30 very faint objects that are unusually small and compact in appearance. (The larger objects are foreground galaxies located in a separate galaxy cluster four billion light years away.) These lumpy spots do not appear to resemble the elliptical and spiral galaxies of today. The objects might not be separate galaxies but rather sites of strong star formation embedded within primordial galaxies that are too faint to be seen in this HST exposure.*

*The colors of these objects (measured with the Mount Palomar 200-inch telescope) place the cluster at a distance of at least seven billion light years (redshift  $z > 1$ ). The cluster may be even farther if it is associated with a quasar (located near the left edge of the frame) that has a measured distance often billion light years (redshift  $z = 2.055$ ). Though the superposition of the cluster objects and the quasar could be a coincidence, both are so unusual they probably all are members of the same cluster, at the same distance. If so, then this corresponds to the early epoch of galaxy formation, about ten billion years ago.*

*The image was taken with HST's Wide Field/Planetary Camera in Wide Field Camera mode, and required a six-hour exposure.*

PHOTO CREDIT: ALAN DRESSLER, CARNEGIE INSTITUTION, AND NASA CO-INVESTIGATORS AUGUSTUS OEMLER (YALE UNIVERSITY), JAMES E. GUNN (PRINCETON UNIVERSITY), AND HARVEY BUTCHER (THE NETHERLANDS FOUNDATION FOR RESEARCH IN ASTRONOMY).

Schweizer), or simply been torn apart and dispersed by the violence of what Dressler calls the "Cuisinart environment."

Dressler, however, believes that violent collisions are not the whole story of the missing spiral galaxies. His earlier research with Gunn indicated that bursts of star formation were also much more common in the past. When the star formation subsided in many of these early spiral galaxies, they may have faded so that they are unnoticed in today's nearby clusters.

#### **THE MOST DISTANT GALAXY CLUSTER EVER SEEN?**

The HST observations may have discovered the farthest cluster of galaxies ever seen, located ten billion light years away.

The HST picture resolves a cluster of about 30 very faint objects. "The smaller, more compact appearance of the objects suggests that they are in the background, much further away than the foreground galaxies," said Dressler.

Additional evidence comes from the presence of a quasar that may be among the faint objects. Groundbased spectral observations of the quasar's redshift (an indicator of cosmological distances) place the quasar at a distance of ten billion light years.

Quasars are theorized to be the extraordinarily bright, active cores of primordial galaxies. They were prevalent in the early universe and thus most are located at a distance of about ten billion light years.

"Though the superposition of the cluster objects and the quasar could be a coincidence, both are so unusual that there is good reason to believe that all are members of the same cluster, at the same distance" said Dressler. The bright spots that appear to accompany the quasar do not resemble the elliptical and spiral galaxies of today, according to Dressler. "Conceivably, the objects might not be separate galaxies but rather 'hot spots' in galaxies whose full, extended forms are too faint to be seen in the Hubble observations."

*continued on page 20*

# TO THE MOON AND GEOGRAPHOS: The SDIO-NASA Clementine Mission

**C**lementine is a mission designed to test the space-worthiness of a variety of advanced sensors for use on military surveillance satellites. Conducted jointly by the Strategic Defense Initiative Organization and NASA, Clementine will be sent for an extended stay in the vicinity of Earth's Moon and on a flyby of the Apollo asteroid, 1620 Geographos. Thus, we are about to receive an unexpected bounty of planetary data through a serendipitous alignment of disparate technical objectives of both SDIO and NASA.

By Paul D. Spudis

The entire Clementine project, from conception through end-of-mission, will encompass approximately three years. The spacecraft and sensors are being assembled now, aiming for a late January 1994 launch. About two months will be spent mapping the Moon before the spacecraft is sent on an encounter trajectory to Geographos, an S-class near-Earth asteroid. The asteroid flyby will occur in late August 1994.

Clementine is a small (140 kg), 3-axis stabilized spacecraft that will carry a variety of advanced sensors spanning several wavelengths. A UV-VIS camera covers the spectrum from 0.25 to 1.0 micrometers ( $\mu\text{m}$ ). It is a CCD framing imager that contains a six-position filter wheel; selected filters have bands centered at 0.34, 0.415, 0.75, 0.9, 0.95 and 1.0  $\mu\text{m}$ . A near-IR CCD imager covers the spectrum from 1.0 to 5.5  $\mu\text{m}$ , with six filters at 1.1, 1.25, 1.50, 2.0, 2.6, and 2.78  $\mu\text{m}$ . Collectively, these two instruments

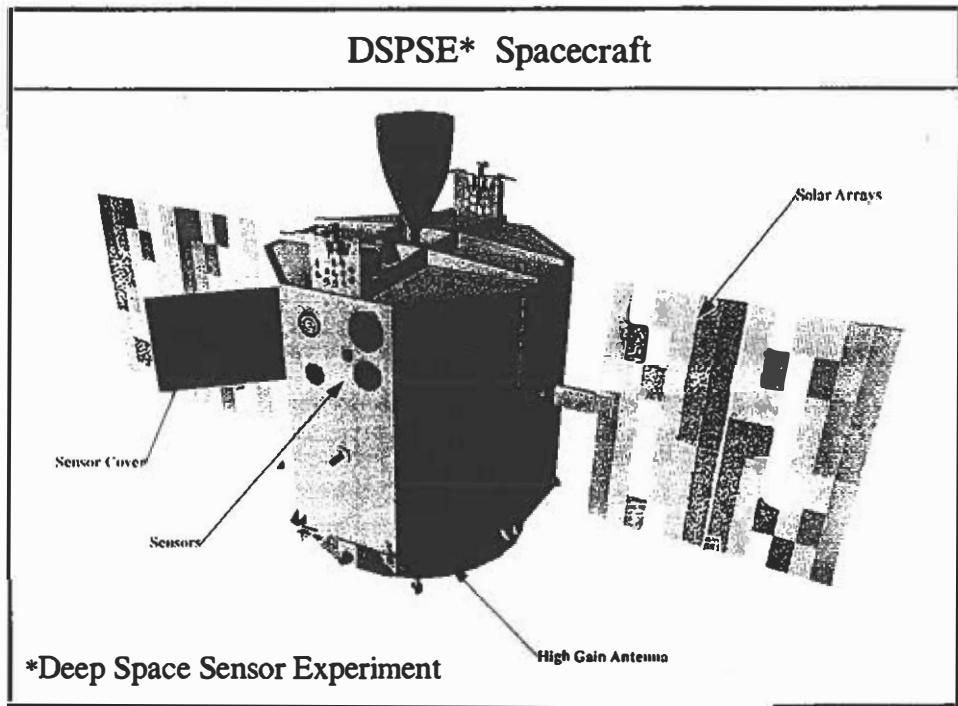


ILLUSTRATION: NAVAL RESEARCH LABORATORY

make up a 12-channel imaging spectrometer that will map the surface composition of the Moon and Geographos.

In addition to such compositional data, Clementine also carries an imaging LIDAR, which will be operated as both a high-resolution, multicolor imager (typical resolution about 6–10 m/pixel) and as a laser altimeter, if feasible (the Clementine orbit is at the extreme limits of a laser ranging capability). Finally, a broadband, mid-IR imager (5–9  $\mu\text{m}$ ) will obtain selected images of the Moon at a resolution of about 20 m/pixel.

Clementine will be launched on a Titan II booster from the Air Force Vandenberg Launch Facility in late

January 1994. After a day or so in Earth orbit, its kick motor will send Clementine to the Moon via two highly eccentric "phasing orbits," each having apogee near the lunar orbital distance; this "slow boat" route to the Moon gives Clementine a seven-day launch window, while at the same time lowers total delta-V requirements for lunar orbit insertion.

Clementine will go into polar lunar orbit (about 400 by 8300 km) one month after launch. For the first month, perilune occurs near 30°S latitude; a phasing burn moves the perilune point to 30°N latitude for the second month's mapping. In two months of mapping, Clementine will image the entire Moon in 12 spectral

bands and, with luck, obtain laser-ranging altimetric data for the middle latitudes of the Moon, from 30°N to 30°S latitude.

After mapping the Moon, Clementine will depart for a flyby of the asteroid 1620 Geographos on May 3, 1994. After another eccentric "phasing" orbit around the Earth and a lunar gravity assist, Clementine will inject into the Geographos encounter orbit on May 27, 1994. Ninety-six days later, on August 31, 1994, while Clementine is 8.5 million km from Earth, the spacecraft will fly less than 100 km from the asteroid, obtaining multichannel spectral data and high-resolution images (as good as 1 m/pixel for selected areas). End-of-mission occurs after the spacecraft has transmitted its flyby data.

The pressing need for global mapping of the Moon, by a variety of remote-sensing techniques, has been stressed repeatedly in every lunar science report for the last 20 years. The Clementine mission begins this task. The Clementine mission will allow us to construct a global digital image model (DIM) of the Moon. These data are augmented by (1) a set of topographic profiles (depending upon the efficacy of the ranging laser, topographic coverage may be nearly complete for the middle latitude band ( $\pm 60^\circ$ ) of the Moon); and (2) a geodetic control net for the whole Moon that, when tied to the Apollo data, should permit knowledge of the true positions of lunar surface features in inertial space to within a few hundred meters. Maps of the Moon made from Clementine data will enable studies of regional history and permit us to decipher the processes of volcanism, tectonism, and impact that have shaped lunar history. In a supporting mode, the global DIM will serve as a base to overlay other data; the geological context of the multispectral data must be understood to interpret such data properly.

From the combined visible and near-IR cameras, we will have a global color map that we can interpret in terms of the distribution of rock types. At a minimum, we will be able to recognize and discriminate between the absence of mafic minerals (pure feldspar) and the presence of orthopyroxene, clinopyroxene, and olivine, as has been done for the nearside of the Moon from Earth-based data.

Thus, we can distinguish, on a global basis, the distribution of anorthosite, "noritic" rocks, olivine-bearing rocks (dunites and troctolites), and gabbros. For mare deposits, visible color mapping can classify the mare in terms of Ti abundance, an element that can be used to estimate the distribution of solar wind hydrogen, an important lunar resource.

Combined with our knowledge of cratering and the use of basins as probes of the crust, these data will permit us to reconstruct the composition and petrologic structure of the crust in three dimensions. We can address the question of the existence of a magma ocean, the nature of Mg-suite magmatism, the history and extent of ancient KREEP and mare volcanism, the compositional diversity of mare units, and the effects of cratering on the composition of the lunar surface. Topographic data from the LIDAR ranger combined with spectral information will allow us to model and understand the dynamics of large impacts, e.g., the problem of depth of excavation for basin-sized impacts.

With high-resolution data from the LIDAR imager, we can study surface processes and compositions in greater detail. Many mare units display significant heterogeneity, and color imaging from the Clementine LIDAR can map different color units, some of which

are perhaps related to individual mare flows. Images of crater walls and central peaks can not only provide high-resolution compositional data, but permit us to better understand the geological setting and processes that have affected given regions, information that may prove critical to the proper interpretation of the regional compositional information. Finally, the high-resolution imaging can be used to make detailed geological studies of areas of high scientific interest.

The Clementine mission will provide us with an abundance of information about the surface morphology, topography, and composition of both the Moon and Geographos, permitting us to infer their history and the processes that have shaped that history. This information can be used to address fundamental questions in lunar science and allow us to make significant advances toward deciphering the complex story of the Moon. The Clementine mission will also permit a first-order global assessment of the resources of the Moon and provide a strategic base of knowledge upon which future robotic and human missions to the Moon can build. ☽

(Dr. Spudis is a staff scientist at Lunar and Planetary Institute, Houston )

## DSPSE Program Overview

- **Spacecraft:** Naval Research Laboratory
- **Sensors:** Lawrence Livermore National Laboratory
- **Booster:** Titan IIIG
- **Mission:**
  - Early 1994 Launch
  - Lunar Mapping (~2 Months)
  - Asteroid 'Geographos' Encounter (8/31/94)
- **Spacecraft Description:**
  - 3-Axis Stabilized
  - Deep Space Network Data Link
  - 20 MIPS On-Board Processing
  - 1.6 Gbit Data Storage
  - SDIO's Lightweight Sensors:
    - Star Tracker (2)
    - NIR
    - LWIR
    - UV/Vis
    - LIDAR

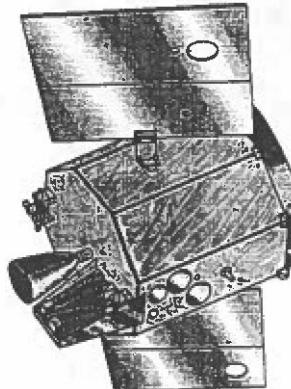


ILLUSTRATION: NAVAL RESEARCH LABORATORY

# NEWS FROM SPACE

## DANTE DEMONSTRATES THE DIFFICULTY OF ROBOTIC EXPLORATION

**A**t 5:10 p.m. EST Saturday, January 2, the Erebus project team located on the ice at the foot of the Mt. Erebus volcano in Antarctica called off any further exploration by the 8-legged rappelling robot Dante because of a physical break in the fiber optical cable that connects the robot with the computers providing its machine intelligence.

The team reported the results of a day's troubleshooting during a video conference that included their colleagues located at the remote robot control site at the Goddard Space Flight Center. The conference was called following a series of seemingly minor problems that had cropped up during two days of attempts to deploy the robot down the 750-foot, nearly vertical incline, from the rim of the continuously active volcano to the lava lake below.

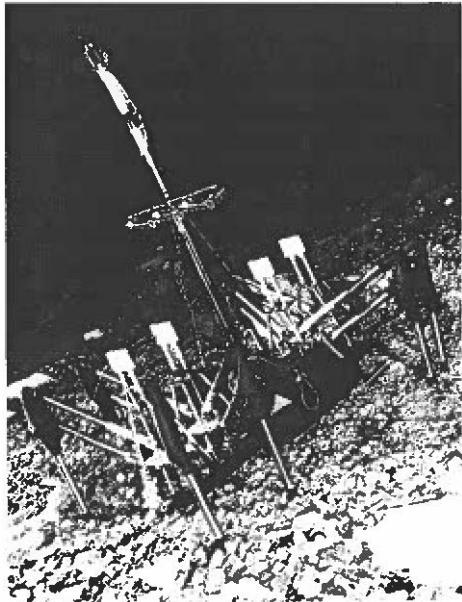
When the team called off further mission operations, the robot Dante remained suspended approximately 21 feet below the rim of the crater. Having been successfully launched on January 1, Dante had moved the 21 feet on its own during initial testing of the robot control mechanisms and had been halted by what, at the time, seemed to be computer network problems.

The team reported that further troubleshooting of the computer network problem disclosed kinks in the fiber optical cable connecting sensors and motor mechanisms of the robot with the computer systems that provide Dante with depth perception and a self-navigating capability. While examining the fiber optical cable kinks, the team caused a break that severed all communications between the robot and the controlling computers. Dave Lavery, project supervisor and NASA telerobotic program manager, reported, "By late in the afternoon, the problem had been isolated to the fiber optic cable, which stretches between the robot and the control station two kilometers away. It was found that the passive deployment system which releases the fiber from the robot as it walks had formed multiple kinks in the fiber which had reduced data communications to the robot. At 1955 hours, while the team was removing the fiber optic cable from the deployment mechanism, the fiber was severed entirely, cutting off all communications with the robot. Without integrity in this cable, the robot cannot operate."

One of the considerations in the decision to call off the demonstration project was the time period remaining until they must leave the side of the volcano. By January 15 the team must be back at McMurdo Station because of impending ice-up of the Ross Sea and a worsening of general weather conditions. This time constraint had existed all along but became of higher importance when the break in the fiber optical cable occurred.

The team indicated they had contacted McMurdo Station and determined that a replacement fiber cable was not available, nor were connectors for this type of cable that might have allowed for a repair operation of this cable. The supporting team at the Goddard payload operations control center was able to find a supplier for identical cable but could not guarantee delivery of that cable to the Antarctic in time to make the repair, perform the rest of the descent down into the volcano, and still get the robot back up to the top and pack everything up in time to depart on January 15.

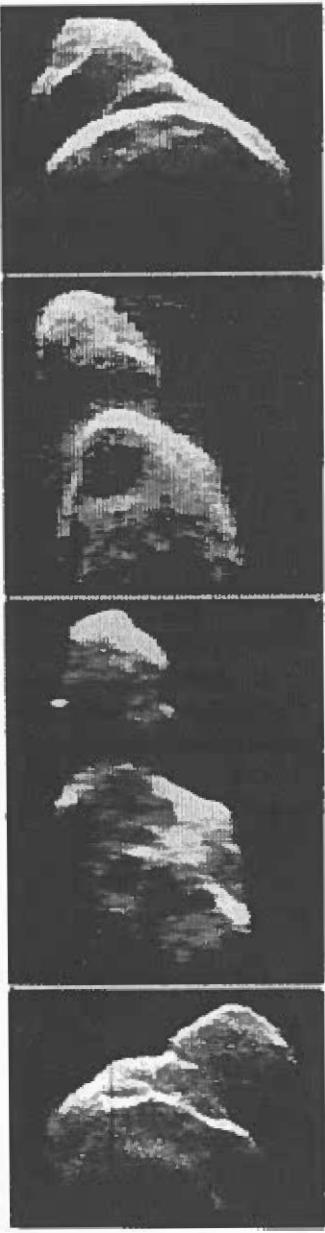
Lavery said that the team considered the project an "unqualified success" in one of the three primary objectives, that of testing the remote control of a robot. The Carnegie-Mellon University team located at Goddard had successfully commanded the Dante robot the previous day while the robot was poised at the rim awaiting its deployment into the volcano crater.



NASA PHOTO NO: 92-HC-720

*NASA's Dante robot makes a test climb up a slag pile at Carnegie Mellon University, Pittsburgh, Pennsylvania, in preparation for its Antarctic expedition.*

**4179  
TOUTATIS**



JPL PHOTO NO. P-41525

**ABOVE—**

Radar images of asteroid 4179 Toutatis as it passed about 4 million km from Earth in December revealed a "contact binary": an asteroid made of two irregular objects, now joined, that rotates at a period of 10–11 days. The two pieces (4 and 2.5 km), themselves heavily cratered, are the result of past collisions in the asteroid belt.

The robot demonstration project had three objectives: to test telerobotic capabilities, to test the use of such sophisticated hardware in a very harsh and demanding environment, and to test the use of advanced computer programs that would enable machines such as the Dante robot to act under a form of machine intelligence. According to Lavery, the first two objectives of this experiment were met. The robot never got to a point where it was under operation of its own autonomous control systems.

NASA and the National Science Foundation undertook this demonstration project to develop technology and telecommunications capabilities that NASA could use in future explorations of the Moon or Mars and that NSF might apply to its ongoing research activities in the Antarctic. Part of the project involved transferring control of the robot from the Mt. Erebus team to team members located at the Goddard payload control center. This portion tested the "telepresence" capabilities of such robots and was called an unqualified success.

Carnegie-Mellon University and the New Mexico Institute of Mining and Technology are partners with NASA and the NSF as robotics and volcano experimenters for this project. Team members from Carnegie-Mellon were located both in the Antarctic and at Goddard. New Mexico Tech members were at Mt. Erebus. The robot included six different sensors that were to have provided significant and new data about the physical and chemical composition of gases and aerosols being released into the atmosphere by the Mt. Erebus volcano.

**JAN HENDRIK OORT, APRIL 28, 1900–NOVEMBER 5, 1992**

**T**he Leiden Observatory announced the death of longtime staff member and former director Jan Oort in November. "Jan Oort played a crucial role in twentieth century astronomy. His name is forever linked to the Oort cloud of comets and to the Oort constants of galactic rotation. Not only did he make fundamental contributions to science, but he was one of the fathers of radio astronomy, which, as he foresaw, has indeed turned out to be essential for probing the universe. He was the founder and first director (1949–1970) of the Netherlands Foundation for Radio Astronomy (now Astron) and instigated construction of the Dwingeloo 25-meter telescope and the Westerbork Synthesis Radio Telescope.

His strong inner conviction of the need for international collaboration is reflected in his career: he was General Secretary of the International Astronomical Union (IAU) from 1935–1948, during the difficult period when the Netherlands were occupied territory during the Second World War. From 1958–1961 he was president of the IAU. In 1953–1954, he was one of the founders of the European Southern Observatory. In addition he strongly advocated the merging of national astronomical journals into the European journal, *Astronomy and Astrophysics*.

Jan Oort was the recipient of many honors and prestigious prizes. Yet, with all his achievements, he remained an essentially modest man, driven by an intense curiosity about how the universe functions and why."

# CALENDAR 1993

## FEBRUARY

### 28-Mar 5

Digital Image Processing, Kona, Hawaii. Contact: C. V. Freiman, Engineering Foundation, 345 E. 47th Street, New York NY 10017. Phone: 212-705-7835.

## MARCH

### 9-10

31st AAS Goddard Memorial Symposium, Arlington, Virginia. Contact: AAS Business Office. Phone: 703-866-0020.

### 15-19

24th Lunar and Planetary Science Conference, Houston, Texas. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

## APRIL

### 1-3

Fractals and Dynamic Systems in Geosciences international meeting, Frankfurt/Main, Germany. Contact: Jorn H. Kruhl, Geology-Paleontology Institute, JW Goethe-University, Senckenberganlage 32, D-6000 Frankfurt/Main, Germany. Phone: 0049-69-7982695; FAX: 0049-69-7988383.

### 1-4

National Science Teachers Association Annual Meeting, Kansas City, Missouri. Contact: NSTA, 1742 Connecticut Avenue NW, Washington DC 20009-1171. Phone: 202-328-5800; FAX: 202-328-0974.

### 4-8

25th International Symposium on Remote Sensing and Global Environmental Change, Graz, Austria. Contact: Nancy Wallman, ERIM Symposium, P.O. Box 134001, Ann Arbor MI 48113-4001. Phone: 313-994-1200, ext. 3234; FAX: 313-994-5123.

### 5-8

Global Warming International Meeting, Chicago, Illinois. Contact: Sinyan Shen, Natural Resource Management Division, SUPCON International. One Heritage Plaza, Woodridge IL 60517-0275. Phone: 708-910-1551; FAX: 708-910-1561.

### 15-16

Science and Technology Policy Meeting, Washington, DC. Contact: American Association for the Advancement of Science, 1333 H Street NW, Washington DC 20005. Phone: 202-326-6400.

## APRIL (CONTINUED)

### 21-25

Geoscience Education and Training, Southampton, UK. Contact: Esther Johnson, GEOED Conference Secretariat, University of Southampton, Southampton SO9 5NH, UK. Phone: (0703) 593049; FAX: (0703) 593052; telex: 47662 SOTONU G.

### 23-26

Robotic Observatories: The First Decade, Tucson, Arizona. Contact: B. Rafert, Florida Institute of Technology, Physics and Space Sciences, 150 West University Boulevard, Melbourne FL 32901. Phone 407-768-8000, ext. 7324; FAX: 407-984-8461.

### 28-30

Advanced Technologies for Planetary Instruments, Fairfax, Virginia. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone 713-486-2150; FAX: 713-486-2160

## MAY

### 15-17

Workshop on the Analysis of Interplanetary Dust Particles, Houston, Texas. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

### 17-19

Annual Meeting of the Geological Association of Canada and Mineralogical Association of Canada, Edmonton, Alberta, Canada. Contact: J. W. Kramers, Alberta Geological Survey, P.O. Box 8330, Station F, Edmondtion, Alberta T6H 5X2, Canada. Phone: 403-438-7644; FAX: 403-438-3644.

## JUNE

### 6-9

5th International Space Conference of Pacific-Basin Societies, ISCOPS, Shanghai, China. Contact: AAS Business Office. Phone: 703-866-0020.

### 8-10

1st GEOTAIL Workshop, Sagamihara, Japan. Contact: A. Nishida, ISAS, 3-11-1 Yoshinodai, Sagamihara, Kanagawa 229, Japan. Phone: +81-427-51-3911; FAX: +81-427-59-4236.

### 14-18

Asteroids, Comets, Meteors 1993, Belgirate (Novara), Italy. Contact: Vincenzo Zappala, Astronomical Observatory, Strada Observatorio 20, 10025 Pino Torinese (70), Italy, or Program Services Department, LPI,

## JUNE (CONTINUED)

3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

### 21-23

**Catastrophic Disruptions of Small Solar System Bodies**, Gubbio (Umbria), Italy. Contact: Paolo Paolicchi, Dipartimento di Fisica, Universita di Pisa, Piazza Torricelli 2, I-56126, Pisa, Italy.

### 22-25

**Io: An International Conference**, San Juan Capistrano, California. Contact: Doug Nash, San Juan Institute, 31872 Camino Capistrano, San Juan Capistrano CA 92675. Phone: 714-240-2010; FAX: 714-240-0482.

### 28-30

**MSATT Workshop on Atmospheric Transport on Mars**, Corvallis, Oregon. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

## JULY

### 5-9

**Gordon Research Conference on Origins of Solar Systems**, New London, New Hampshire. Contact: John A. Wood, Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge MA 02138. Phone: 617-495-7278; FAX: 617-495-7001.

SPAN: CFA::WOOD

Bitnet: WOOD@CFA

Internet: WOOD@CFA.HARVARD.EDU

### 6-9

**Pluto & Charon**, Flagstaff, Arizona. Contact: Mary Guerrieri, Lunar and Planetary Laboratory, University of Arizona, Tucson AZ 85721. Phone: 602-621-2902.

SPAN: LOONEY::GUERRIERI

Internet: mary@lpl.arizona.edu

### 10-16

**105th Annual Meeting of the Astronomical Society of the Pacific**, San Diego, California. Contact: ASP, 390 Ashton Avenue, San Francisco CA 94112. Phone: 415-337-1100.

### 10-11

**Universe 93—A Weekend Astronomy Exposition and Fair**, San Diego, California. Contact: Meeting Information, Astronomical Society of the Pacific, 390 Ashton Avenue, San Francisco CA 94112. Phone: 415-337-1100.

### 13-14

**The Universe in the Classroom: A Workshop on Teaching Astronomy in Grades 3-12**, San Diego, California. Contact: Meeting Information,

## JULY (CONTINUED)

Astronomical Society of the Pacific, 390 Ashton Avenue, San Francisco CA 94112. Phone: 415-337-1100.

### 13-17

**Solar Terrestrial Physics Gordon Conference on Active Phenomena in Solar System Plasmas**, Plymouth, New Hampshire. Contact: Marty Lee, EOS-SERB, University of New Hampshire, Durham NH 03824. Phone: 603-862-3509.

### 15

**Teaching About the Universe**, a one-day program on astronomy education in the U.S., San Diego, California. Contact: Meeting Information, Astronomical Society of the Pacific, 390 Ashton Avenue, San Francisco CA 94112. Phone: 415-337-1100.

**Environmental Context of Human Evolution (International Scientific Congress and Exhibition)**, The Netherlands and Indonesia. Contact: Hans Beijer, Geological Survey of the Netherlands, P.O. Box 157, NL-2000 AD Haarlem, The Netherlands. FAX: 31 23 351614.

### 19-23

**56th Meteoritical Society Meeting**, Vail, Colorado. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

### 26-28

**MSATT Workshop on Early Mars: How Warm and How Wet**, Colorado. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

## AUGUST

### 8-14

**MSATT Workshop/Field Trips on the Martian Northern Plains: Sedimentologic, Periglacial, and Paleoclimatic Evolution**, Fairbanks, Alaska. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

### 16-19

**AAS/AIAA Astrodynamics Conference**, Victoria, British Columbia, Canada. Contact: AAS Business Office. Phone: 703-866-0020.

## SEPTEMBER

### 25-Oct 1

**International Association of Volcanology and Chemistry of the Earth's Interior General Assembly**, Canberra, Australia. Contact: IAVCEI ACTS, GPO Box 2200, Canberra ACT 2601, Australia. Phone: 61-6-257-3299; FAX: 61-6-257-3256.

# CALENDAR

## OCTOBER

**18-22**

**25th Annual Meeting of the Division for Planetary Sciences of the American Astronomical Society**, Boulder, Colorado. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

**25-28**

**Geological Society of America Annual Meeting**, Boston, Massachusetts. Contact: Vanessa George, GSA, Box 9140, Boulder CO 80301. Phone: 303-447-2020.

## NOVEMBER

**15-17**

**MSATT Conference—Mars: Past, Present, and Future Results from the MSATT Program**, Houston, Texas. Contact: Program Services Department, LPI, 3600 Bay Area Boulevard, Houston TX 77058-1113. Phone: 713-486-2150; FAX: 713-486-2160.

*Continued from page 13*

Dressler suggested that the small spots seen in the more distant cluster could be sites of vigorous star formation. This would explain their blue colors, because young, massive stars are brightest in blue and ultraviolet light. "If the cluster is as far as the quasar, then it will offer an unprecedented opportunity to learn how galaxies formed. With so many objects, it seems likely that among them are the ancestors of common galaxies like our own Milky Way."

The team believes that the further study of this cluster and similar ones could be a major breakthrough in seeing galaxies in the very act of formation. When HST's full optical capabilities are restored during a Space Shuttle servicing mission in late 1993, HST will be able to resolve the morphology of these very young galaxies. Hubble will be capable of showing the evolution of galaxy form over a wide range of environments and in even earlier epochs. This will greatly aid astronomers in their efforts to understand this key piece of the cosmological puzzle.

### THE MYSTERY OF GALAXY EVOLUTION

Astronomers have long sought to understand the origins of the different forms of galaxies, from the disk-shaped spiral galaxies with their lacy pattern of

newborn stars, to the bulbous elliptical galaxies, which seem to have completed star formation long ago.

In the 1770s French astronomer Charles Messier first included galaxies in his sky catalog of "fuzzy-looking" objects. Their true nature wasn't known, however, until the 1920s. Edwin Hubble, using a telescope of comparable size to HST, was able to measure the vast distances to nearby "spiral nebulae." This proved they were "island universes" far separated in time and space. Edwin Hubble first attempted to classify galaxies according to their spiral and elliptical shapes and look for an evolutionary track.

In the 1960s a number of remarkable discoveries—quasars, active galaxies, and confirmation of the Big Bang by the detection of the cosmic microwave background—all converged to reinforce the notion that galaxies simply weren't made the way we see them today, but must have evolved into their present shapes.

In 1978 H. Butcher and A. Oemler surprised the astronomical community when they discovered that distant clusters contained a high percentage of blue galaxies, the color associated with the birth of new stars in spiral galaxies. In contrast, nearby "modern" clusters of

galaxies are dominated by elliptical and S0 galaxies, objects whose red colors indicate a long absence of star formation.

Were there more spiral galaxies in clusters billions of years ago? Dressler and Gunn pursued this question in a ten-year program with the 200-inch telescope at Caltech's Palomar Observatory, California. They took spectra of the faint blue galaxies and showed that most did show signs of vigorous star formation. The Hubble Space Telescope now provides an unprecedented opportunity to directly observe the birth of galaxies. ☒

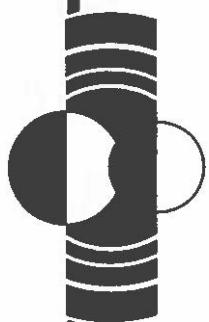
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Pam Thompson, Editor

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**Twenty-Fourth  
Lunar and Planetary  
Science Conference**

**Preliminary Program  
March 15-19**

Preliminary Conference Program  
 24th Lunar and Planetary Science Conference  
 March 15-19, 1993

\* Designates Speaker

Monday, March 15, 1993  
**BASALTIC ACHONDRITES**  
 8:30 a.m. Room A

Chairs: T. L. Grove and J. J. Papike

Ganguly J.\* Tazzoli V.

*Fe<sup>2+</sup>-Mg Interdiffusion in Orthopyroxene: Constraints from Cation Ordering and Structural Data and Implications for Cooling Rates of Meteorites*

Mittlefehldt D. W.\*

*Igneous Fractionation and Subsolidus Equilibration of Diogenite Meteorites*

Papike J.J.\* Spilde M.N. Fowler G. W. Shearer C.K.

*Orthopyroxenes as Recorders of Diogenite Petrogenesis: Major and Minor Element Systematics*

Shearer C. K.\* Papike J. J. Layne G. D.

*Orthopyroxenes as Recorders of Diogenite Petrogenesis: Trace Element Systematics*

Phinney W. C.\* Lindstrom D. J. Mittlefehldt D. W. Martinez R. R.

*Post-Igneous Redistribution of Components in Eucrites*

Stewart B. W. Papanastassiou D. A.\* Capo R. C. Wasserburg G. J.

*Fine Resolution Chronology Based on Initial <sup>87</sup>Sr/<sup>86</sup>Sr*

Shukolyukov A.\* Lugmair G. W.

*<sup>60</sup>Fe and the Evolution of Eucrites*

Collinson D. W.\* Morden S. J.

*Remanent Magnetism of HED Meteorites—Implications for Their Evolution and Ancient Magnetic Fields*

Jurewicz A. J. G. Jones J. H.\* Weber E. T. Mittlefehldt D. W.

*Partial Melting of Ordinary Chondrites: Lost City (H) and St. Severin (LL)*

Delaney J. S.\* Boesenberg J. S.

*Fel/Mn Constraint on Precursors of Basaltic Achondrites*

Grove T.L.\*

*Petrologic Constraints on the Surface Processes on Asteroid 4 Vesta and on Excavation Depths of Diogenite Fragments*

Binzel R. P.\*

*The Asteroid-Meteorite Connection: Forging a New Link to Vesta as the Parent Body of Basaltic Achondrite (HED) Meteorites*

Jurewicz A. J. G.\* McKay G. A.

*Angrite LEW87051: Are the Olivines Pheno's or Xeno's? A Continuing Story*

Monday, March 15, 1993

THE GEOLOGY OF VENUS: A TRIBUTE TO ACADEMICIAN  
 VALERY LEONIDOVICH BARSUKOV  
 8:30 a.m. Room B

Co-sponsored by:

International Union of Geological Sciences  
 Commission on Comparative Planetology

The field of planetary science and solar system exploration lost a dear friend and invaluable colleague with the untimely death of Academician Valery Leonidovich Barsukov in July 1992. Academician Barsukov had achieved many of the highest scientific honors in the Soviet Union and Russia, and he was truly dedicated to international cooperation in scientific research and planetary exploration. During his career, Academician Barsukov's professional interests underwent a metamorphosis from the geochemistry of ore deposits, to the study of the metallogenic aspects of the Earth's mantle, and then to the geochemistry and geology of the planets and their satellites. As director of the V.I. Vernadsky Institute of Geochemistry and Analytical Chemistry in Moscow he actively participated in Soviet Union missions to the Moon, Venus, and Mars. In the latter part of his career, he developed another of his passionate interests, international cooperation in scientific research and planetary exploration. He was Vice-President of the International Union of Geological Sciences and was a well-known figure at the annual Lunar and Planetary Science Conference in Houston, where he often gave keynote papers on the latest Soviet planetary exploration achievements. Upon the renegotiation of a joint agreement between the United States and the Soviet Union in the mid 1980s he was named the Soviet Chair of the Joint Working Group on Solar System Exploration. Close friends of Academician Barsukov knew that the passion and intensity of his work extended into his personal life. His significant activities in international cooperation and his legendary guitar playing and singing of Russian folk songs made each of us who came in contact with him a little bit more Russian and a significantly better citizen of the scientific world. We will miss him greatly.

Chairs: J. W. Head III and R. S. Saunders

Saunders R. S.\* Stofan E. R. Plaut J. J. Senske D. A.  
*Magellan at Venus: Summary of Science Findings*

Senske D. A.\* Stofan E. R. Bindschadler D. L. Smrekar S. E.

*Volcanic Rises on Venus: Geology, Formation, and Sequence of Evolution*

Turcotte D. L.\*

*Is There Uniformitarian or Catastrophic Tectonics on Venus?*

Phillips R.J.\* Hansen V.L.

*Venus Magmatic and Tectonic Evolution*

Hansen V. L.\* Phillips R. J.

*Ishitar Deformed Belts: Evidence for Deformation from Below?*

Marchenkov K. I.\* Saunders R. S. Banerdt W. B.

*Geophysical Models of Western Aphrodite-Niobe Region: Venus*

Grosfils E. B.\* Head J. W. III  
*Spatially Extensive Uniform Stress Fields on Venus Inferred from Radial Dike Swarm Geometries: The Aphrodite Terra Example*

Stofan E. R.\* Hamilton V. E. Cotugno K.  
*Parga and Hecate Chasmata, Venus: Structure, Volcanism and Models of Formation*

Basilevsky A. T.\*  
*Estimation of Age of Dali-Ganis Rifting and Associated Volcanic Activity, Venus*

Robinson C. A.\*  
*Subduction on the Margins of Coronae on Venus: Evidence from Radiothermal Emissivity Measurements*

Brown C. D.\* Grimm R. E.  
*Flexure and the Role of Inplane Force Around Coronae on Venus*

Burt J. D.\* Head J. W. III  
*Buoyant Subduction on Venus: Implications for Subduction Around Coronae*

Monday, March 15, 1993  
**SOLAR SYSTEM ORIGINS**  
 8:30 a.m. Room C

**Chairs:** E. H. Levy and T. Stepinski

Moore M. Ferrante R. Hudson R. Tanabe T. Nuth J.\*  
*Catalytic Crystallization of Ices by Small Silicate Smokes at Temperatures Less Than 20K*

Cameron A. G. W.\*  
*The Giant Impact Produced a Precipitated Moon*

Humayun M.\* Clayton R. N.  
*Potassium Isotope Cosmochemistry, Volatile Depletion and the Origin of the Earth*

Stevenson D. J.\*  
*Volatile Loss from Accreting Icy Protoplanets*

Wasilewski P. J.\* Faris J. L. O'Bryan M. V.  
*Magnetic Record in Chondrite Meteorites*

Stepinski T. F. Reyes-Ruiz M.\*  
*Magnetically Controlled Solar Nebula*

Dolginov A. Z. Stepinski T. F.\*  
*Are Cosmic Rays Effective for Ionization of the Solar Nebula?*

Levy E. H.\* Ruzmaikina T. V.  
*Possible Dust Contamination of the Early Solar System*

Cassen P.\*  
*Why Convective Heat Transport in the Solar Nebula was Inefficient*

Boss A. P.\*  
*Midplane Temperatures in the Solar Nebula*

Weidenschilling S. J. Ruzmaikina T. V.\*  
*Coagulation of Grains in Static and Collapsing Protostellar Clouds*

Malhotra R.\*  
*On the Delivery of Planetesimals to a Protoplanet in the Solar Nebula*

Wetherill G. W.\*  
*Variety in Planetary Systems*

**Monday, March 15, 1993**

**IMPACT CRATERING AND SHOCK METAMORPHISM**  
8:30 a.m. Room D

**Chairs:** M. B. Boslough and R. Bottomley

Holsapple K. A.\*

*The Size of Complex Craters*

Takata T.\* Ahrens T. J.

*SPH Modelling of Energy Partitioning During Impacts on Venus*

Schmidt R. M.\*

*Pressure Versus Drag Effects on Crater Size*

Bamouin O. S.\* Schultz P. H.

*Behavior of Vortices Generated by an Advancing Ejecta Curtain in Theory, in the Laboratory, and on Mars*

Crawford D. A.\* Schultz P. H.

*Macroscopic Electric Charge Separation During Hypervelocity Impacts: Potential Implications for Planetary Paleomagnetism*

Fiske P. S.\* Gratz A. J. Nellis W. J.

*NMR Spectroscopy of Experimentally Shocked Single Crystal Quartz: A Reexamination of the NMR Shock Barometer*

Boslough M. B.\* Cygan R. T. Kirkpatrick R. J.

*<sup>29</sup>Si NMR Spectroscopy of Naturally Shocked Quartz from Meteor Crater, Arizona: Correlation to Keiffer's Classification Scheme*

Spray J. G.\*

*Delimitation of Terrestrial Impact Craters via Pseudotachylitic Rock Distribution*

Schultz P. H.\* Bunch T. E. Koeberl C. Collins W.

*Further Analyses of Rio Cuarto Impact Glass*

Bottomley R. J.\* York D. Grieve R. A. F.

*Age of Popigai Impact Event Using the <sup>40</sup>Ar-<sup>39</sup>Ar Method*

Brandt D.\* Reimold W. U.

*A Structural and Petrographic Investigation of the Pretoria Saltpan Impact Structure*

Koeberl C.\* Shirey S. B.

*Osmium Isotopes in Ivory Coast Tektites: Confirmation of a Meteoritic Component and Rhodium Depletion*

**Monday, March 15, 1993**

**SOLAR, COSMIC RAY, AND DYNAMICAL STUDIES**  
Session is dedicated to Professor James R. Arnold  
in honor of his seventieth birthday.

1:30 p.m. Room A

**Chairs:** D. Black and R. C. Reedy

Garrison D. H.\* Rao M. N. Bogard D. D. Reedy R. C.

*SCR <sup>21</sup>Ne and <sup>36</sup>Ar in Lunar Rock 68815: The Solar Proton Energy Spectrum over the Past 2 Myr*

Rao M. N.\* Garrison D. H. Bogard D. D.

*SCR Neon and Argon in Kapoeta Feldspar: Evidence for an Active Ancient Sun*

Wieler R.\* Baur H. Signer P.

*A Long-Term Change of the Ar/Kr/Xe Fractionation in the Solar Corpuscular Radiation*

Reedy R. C.\* Masarik J. Nishiizumi K. Arnold J. R. Finkel R. C. Caffee M. W. Southon J. Juli A. J. T. Donahue D. J.

*Cosmogenic-Radionuclide Profiles in Knyahinya: New Measurements and Models*

Arnold J. R.\* Kohl C. P. Nishiizumi K. Caffee M. W. Finkel R. C. Southon J. R.

*Measurements of Cosmogenic Nuclides in Lunar Rock 64455*

Graf Th.\* Niedermann S. Marti K.

*A Calibration of the Production Rate Ratio  $P_{21}/P_{36}$  by Low Energy Secondary Neutrons: Identification of Ne Spallation Components at the  $10^5$  Atoms/g Level in Terrestrial Samples*

Loeken Th.\* Scherer P. Schultz L.

*Noble Gases in Twenty Yamato H-Chondrites: Comparison with Allan Hills Chondrites and Modern Falls*

Nishiizumi K.\* Arnold J. R. Caffee M. W. Finkel R. C. Southon J. R. Nagai H. Honda M. Imamura M. Kobayashi K. Sharina P.

*Exposure Ages of Carbonaceous Chondrites-I*

Dodd R. T.\* Lipschutz M. E.

*A CM Chondrite Cluster and CM Streams*

Herzog G. F.\* Souzis A. E. Xue S. Klein J. Juenemann D. Middleton R.

*<sup>26</sup>Al-<sup>26</sup>Mg Ages of Iron Meteorites*

Asphaug E.\* Melosh H. J. Ryan E.

*Ejecting Basaltic Achondrites from Vesta: Hydrodynamical Impact Models*

Williams D. R.\* Wetherill G.

*Equilibrium Models of Mass Distribution and Collisional Lifetimes of Asteroids*

Zook H. A.\* Grün E. Baguhl M. Balogh A. Bame S. J. Fechtig H. Forsyth R.

Hanner M. S. Horanyi M. Kissel J. Lindblad B.-A. Linkert D. Linkert G. Mann I.

McDonnell J. A. M. Morfill G. E. Phillips J. L. Polanskey C. Schwehm G. Siddique N.

Staubach P. Svestka J. Taylor A.

*On Dust Emissions from the Jovian System*

Monday, March 15, 1993  
**VENUS VOLCANISM**  
 1:30 p.m. Room B

**Chairs:** B. Campbell and J. B. Garvin

Kauhanen K.\*

*Tectonics of Neyterkob Corona on Venus*

Garvin J. B.\* Williams R. S. Jr.

*Morphometric Comparison of Icelandic Lava Shield Volcanoes Versus Selected Venusian Edifices*

Wilson L.\* Pinkerton H. Head J. W. Magee Roberts K.

*A Classification Scheme for the Morphology of Lava Flow Fields*

Campbell B. A.\* Zimbelman J. R.

*Lava Flows on Venus: Analysis of Motion and Cooling*

Zimbelman J. R.\* Campbell B. A. Kousoum J. Lampkin D. J.

*Numerical Simulation of Lava Flows: Applications to the Terrestrial Planets*

Sakimoto S. E. H.\* Zuber M. T.

*Venus Pancake Dome Formation: Morphologic Effects of a Cooling-induced Variable Viscosity During Emplacement*

Bulmer M. H.\* Guest J. E. Michaels G. Saunders S.

*Scalloped Margin Domes: What are the Processes Responsible and How do they Operate?*

Bussey D. B. J.\* Sørensen S. A. Guest J. E.

*The Origin of Venusian Channels: Modelling of Thermal Erosion by Lava*

Komatsu G.\* Baker V. R.

*Meander Properties of Venusian Channels*

Weitz C. M.\* Basilevsky A. T.

*Geology and Radiophysical Properties of the Venera and Vega Landing Sites*

Fegley B. Jr.\* Lodders K.

*The Rate of Chemical Weathering of Pyrite on the Surface of Venus*

Straub D. W.\*

*The Role of CO<sub>2</sub> in Weathering Reactions and the Presence of S<sub>2</sub> on Venus: Implications for the Pyrite Stability Field*

Monday, March 15, 1993

**MANSON: THE HOLE AND SHOCKING STORY**  
 1:30 p.m. Room C

**Chairs:** R. Anderson and E. M. Shoemaker

Shoemaker E. M. Roddy D. J.\* Anderson R. R.

*Research Program on the Manson Impact Crater, Iowa*

Anderson R. R.\* Witzke B. J. Hartung J. B. Shoemaker E. M. Roddy D. J.

*Descriptions and Preliminary Interpretations of Cores Recovered from the Manson Impact Structure (Iowa)*

Roddy D. J.\* Shoemaker E. M. Anderson R. R.

*The Manson Impact Crater: Estimation of the Energy of Formation, Possible Size of the Impacting Asteroid or Comet, and Ejecta Volume and Mass*

Keiswetter D. A.\* Black R. Steeples D. W. Anderson R. R.

*High-Resolution Seismic Reflection Survey at the Manson Crater, Iowa*

Plescia J. B.\*

*Gravity Investigation of the Manson Impact Structure, Iowa*

Steiner M. B.\* Shoemaker E. M.

*Two-Polarity Magnetization in the Manson Impact Breccia*

Zeitler P. K.\* Kunk M. J.

*Age and Thermochronology of K-Feldspars from the Manson Impact Structure*

Kunk M. J.\* Snee L. W. French B. M. Harlan S. S. McGee J. J.

*Preliminary <sup>40</sup>Ar/<sup>39</sup>Ar Age Spectrum and Laser Probe Dating of the M1 Core of the Manson Impact Structure, Iowa: A K-T Boundary Crater Candidate*

Izett G. A.\* Reynolds R. L. Rosenbaum J. G. Nishi J. M.

*A Discontinuous Melt Sheet in the Manson Impact Structure*

Bell M. S.\* Reagan M. K. Anderson R. R. Foster C. T. Jr.

*Petrography and Preliminary Interpretations of the Crystalline Breccias from the Manson M-1 Core*

Short N. M.\* Gold D. P.

*Petrography of Shock Features in the 1953 Manson 2-A Drill Core*

Crossey L. J.\* McCarville P.

*Post-Impact Alteration of the Manson Impact Structure*

Koeberl C.\* Anderson R. R. Hartung J. B. Reimold W. U.

*Manson Impact Structure, Iowa: First Geochemical Results for Drill Core M-1*

Blum J. D.\* Chamberlain C. P. Hingston M. J. Koeberl C.

*Strontium and Oxygen Isotope Study of M-1, M-3 and M-4 Drill Core Samples from the Manson Impact Structure, Iowa: Comparison with Haitian K-T Impact Glasses*

**Monday, March 15, 1993**  
**PUBLIC SESSION**  
**HAROLD MASURSKY LECTURES**  
**8:00 p.m. Building 2, Auditorium**

**Chairs:** To be announced

**Speakers to be announced**

**Tuesday, March 16, 1993**  
**PRIMITIVE ACHONDRITES**  
**8:30 a.m. Room A**

**Chairs:** D. Bogard and O. Eugster

McCoy T. J.\* Keil K. Clayton R. N. Mayeda T. K.  
*Classificational Parameters for Acapulcoites and Lodranites: The Cases of FRO 90011, EET 84302 and ALH A81187/84190*

Davis A. M.\* Prinz M. Weisberg M. K.  
*Trace Element Distributions in Primitive Achondrites*

Bogard D. D.\* Garrison D. H. McCoy T. J. Keil K.  
*<sup>39</sup>Ar-<sup>40</sup>Ar Ages of Acapulcoites and Lodranites: Evidence for Early Parent Body Heating*

Kim Y.\* Mani K.  
*Isotopic Signatures and Distribution of Nitrogen and Trapped and Radiogenic Xenon in the Acapulco and FRO90011 Meteorites*

Eugster O.\* Weigel A.  
*Xe-Q in Lodranites and a Hint for Xe-L. FRO90011 Another Lodranite?*

Boynton W. V.\* Hill D. H.  
*Trace-Element Abundances in Several New Ureilites*

Goodrich C. A.\* Lugmair G. W.  
*Stalking the LREE-enriched Component in Ureilites*

Russell S. S.\* Arden J. W. Franchi I. A. Pillinger C. T.  
*A Carbon and Nitrogen Isotope Study of Carbonaceous Vein Material in Ureilite Meteorites*

Casanova I.\* McCoy T. J. Keil K.  
*Metal-rich Meteorites from the Aubrite Parent Body*

Takeda H.\* Saiki K. Otsuki M. Hiroi T.  
*A New Antarctic Meteorite With Chromite, Orthopyroxene and Metal With Reference to a Formation Model of S Asteroids*

Petaev M. I.\*  
*Opaque-rich Lithology in the Divnoe Achondrite: Petrology and Origin*

**Tuesday, March 16, 1993**  
**VENUS RESURFACING AND TECTONICS**  
**8:30 a.m. Room B**

**Chairs:** R. R. Herrick and E. M. Parmentier

Thompson T. W.\* Magellan Flight Team  
*Magellan Mission Progress Report*

Simpson R. A.\* Tyler G. L. Maurer M. J. Holmann E. Wong P. B.  
*Scattering by Venus' Surface*

Izenberg N. R.\* Arvidson R. E. Phillips R. J.  
*A First-Order Model for Impact Crater Degradation on Venus*

Strom R. G.\*  
*Parabolic Features and the Erosion Rate on Venus*

Kaula W. M.\*  
*Implications of Crater Distributions on Venus*

Malin M. C. Grimm R. E.\* Herrick R. R.  
*Tectonic Resurfacing of Venus*

Solomon S. C.\*  
*A Tectonic Resurfacing Model for Venus*

Solomatov V. S.\* Stevenson D. J.  
*Differentiation of Magma Oceans and the Thickness of the Depleted Layer on Venus*

Parmentier E. M.\* Hess P. C. Sotin C.  
*Mixing of a Chemically Buoyant Layer at the Top of a Thermally Convecting Fluid: Implications for Mantle Dynamics with Application to Venus*

Gilmore M. S.\* Head J. W. III  
*The Formation and Evolution of Alpha and Tellus Tesserae on Venus*

Raitala J.\*  
*Chocolate Tablet Aspects of Cytherean Meshkenet Tessera*

Tuesday, March 16, 1993

**CHICXULUB, KT BOUNDARY, AND OTHER IMPACT EJECTA**  
8:30 a.m. Room C

Chairs: B. Schuraytz and B. Bohor

Hildebrand A. R.\* Grégoire D. C. Attrup M. Jr. Claeys P. Thompson C. M. Boynton W. V.  
*Trace-Element Composition of Chicxulub Crater Melt Rock, K/T Tektites and Yucatán Basement*

Urrutia-Fucugauchi J.\* Marin L. E. Sharpton V. L. Quezada-Muñeton J. M.  
*Reverse Polarity Magnetized Melt Rocks from the Chicxulub Impact Structure, Yucatán Peninsula, Mexico*

Sharpton V. L.\* Burke K. Hall S. Lee S. Marin L. E. Suarez G. Quezada J. M.  
Urrutia-Fucugauchi J.  
*Chicxulub Impact Basin: Gravity Characteristics and Implications for Basin Morphology and Deep Structure*

Carey S.\* Sigurdsson H. D'Hondt S. Espindola J. M.  
*Stratigraphy and Sedimentology of the K/T Boundary Deposit in Haiti*

Bohor B. F.\* Glass B. P. Betterton W. J.  
*K/T Spherules from Haiti and Wyoming: Origin, Diagenesis, and Similarity to Some Microtektites*

Glass B. P.\* Bohor B. F. Betterton W. J.  
*Cretaceous-Tertiary Boundary Spherules and Cenozoic Microtektites: Similarities and Differences*

Premo W. R.\* Izett G. A.  
*U-Pb Provenance Ages of Shocked Zircons from the K-T Boundary, Raton Basin, Colorado*

Espindola J. M.\* Carey S. Sigurdsson H.  
*Modelling of Dispersal and Deposition of Impact Glass Spherules from the Cretaceous-Tertiary Boundary Deposit*

Bostwick J. A.\* Kyle F. T.  
*Impact Mineralogy and Chemistry of the Cretaceous-Tertiary Boundary at DSDP Site 576*

Chamberlain C. P.\* Blum J. D. Koeberl C.  
*Oxygen Isotopes as Tracers of Tektite Source Rocks: An Example From the Ivory Coast Tektites and Lake Bosumtwi Crater*

Claeys P.\* Casier J.-G.  
*Microtektite-like Glass Spherules in Late Devonian (367 Ma) Shales*

Mittlefehldt D. W.\* See T. H. Scott E. R. D.  
*Siderophile Element Fractionation in Meteor Crater Impact Glasses and Metallic Spherules*

Tuesday, March 16, 1993

**REMOTE SENSING/SPACE WEATHERING**  
8:30 a.m. Room D

Chairs: B. Clark and B. W. Hapke

Goguen J. D.\*  
*A Test of the Applicability of Independent Scattering to High Albedo Planetary Regoliths*

Nelson R. M.\* Hapke B. W. Smythe W. D. Gharakhanian V. Herrera P.  
*The Coherent Backscattering Opposition Effect*

Shepard M. K.\* Guinness E. A. Arvidson R. E.  
*The Roughness of the Martian Surface: A Scale Dependent Model*

Brackett R. A.\* Arvidson R. E.  
*Compositional and Textural Information from the Dual Inversion of Visible, Near and Thermal Infrared Remotely Sensed Data*

Salisbury J. W. Wald A.\* D'Aria D. M.  
*Thermal Infrared Remote Sensing and Kirchhoff's Law: I Laboratory Measurements*

Henderson B. G.\* Jakosky B. M.  
*Near-Surface Temperature Gradients and Their Effects on Thermal-Infrared Emission Spectra of Particulate Planetary Surfaces*

Lucey P. G. Domergue-Schmidt N.\* Henderson B. G. Jakosky B.  
*First Results from a Laboratory Facility for the Measurement of Emission Spectra Under Simulated Planetary Conditions*

Hapke B.\*  
*Why is the Moon Dark?*

Allen C. C.\* Morris R. V. Lauer H. V. Jr. McKay D. S.  
*Effects of Microscopic Iron Metal on the Reflectance Spectra of Glass and Minerals*

Pieters C. M.\* Fischer E. M. Rode O. D. Basu A.  
*Optical Effects of Space Weathering on Lunar Soils and the Role of the Finest Fraction*

Fanale F. P.\* Clark B. E.  
*Chondrites, S Asteroids, and "Space Weathering": Thumping Noises from the Coffin?*

Gaffey M. J.\* Bell J. F. Brown R. H. Burbine T. H. Piatek J. L. Reed K. L. Chaky D. A.  
*Spectral Evidence of Size Dependent Space Weathering Processes on Asteroid Surfaces*

Tuesday, March 16, 1993

MARTIAN METEORITES AND VOLATILES: A SESSION HONORING  
THE SERVICE OF DON BOGARD AS PM&G DISCIPLINE SCIENTIST  
1:30 p.m. Room A

Dedication: L. Nyquist

Chairs: D. S. Burnett and J. Longhi

Jagoutz E.\* Luck J. M. Ben Othman D. Wänke H.

*Os Isotopes in SNC Meteorites and Their Implications to the Early Evolution of Mars and Earth*

Wasylewski L. E.\* Jones J. H. Le L. Jurewicz A. J. G.

*Equilibrium and Fractional Crystallization of a Primitive Shergottite Composition*

Ford D. J.\* Rutherford M. J.

*Primitive SNC Parent Magmas and Crystallization: Low P<sub>H2O</sub> Experiments*

Treiman A. H.\*

*The Parent Magma of the Nakhla (SNC) Meteorite: Reconciliation of Composition Estimates from Magmatic Inclusions and Element Partitioning*

McKay G.\* Le L. Wagstaff J.

*The Nakhla Parent Melt: REE Partition Coefficients and Clues to Major Element Composition*

Wadhwa M.\* Crozaz G.

*Rare Earth Elements in Individual Minerals in Shergottites*

McCoy T. J.\* Keil K. Taylor G. J.

*The Dregs of Crystallization in Zagami*

Chen J. H.\* Wasserburg G. J.

*LEW88516 and SNC Meteorites*

Becker R. H.\* Pepin R. O.

*Nitrogen and Noble Gases in a Glass Sample from LEW88516*

Grady M. M.\* Wright I. P. Franchi I. A. Pillinger C. T.

*Nitrates in SNCs: Implications for the Nitrogen Cycle on Mars*

Wright I. P.\* Douglas C. Pillinger C. T.

*The Carbon Components in SNC Meteorites of Feldspathic Harzburgite Composition*

Karlsson H. R.\* Clayton R. N. Mayeda T. K. Jull A. J. T. Gibson E. K. Jr.

*Martian Carbon Dioxide: Clues from Isotopes in SNC Meteorites*

Watson L. L.\* Hutchison I. D. Epstein S. Stolper E. M.

*High D/H Ratios of Water in Magmatic Amphiboles in Chassigny: Possible Constraints on the Isotopic Composition of Magmatic Water on Mars*

Wasserburg G. T.

*Remarks and Observations*

Tuesday, March 16, 1993

VENUS GRAVITY FROM MAGELLAN AND MARS GEOPHYSICS  
1:30 p.m. Room B

Chairs: W. Sjogren and B. Bills

Sjogren W. L.\* Konopliv A. S. Borderies N. Batchelder M. Heirath J. Wimberly R. N.  
*Venus Gravity: New Magellan Low Altitude Data*

Smrekar S. E.\* Parmentier E. M.

*Response of the Topography and Gravity Field on Venus to Mantle Upwelling Beneath a Chemical Boundary Layer*

Buck W. R.\*

*Can Weak Crust Explain the Correlation of Geoid and Topography on Venus?*

Moresi L.\*

*Effective Elastic Thickness of the Venusian Lithosphere with Lateral Viscosity Variations in the Mantle*

Simons M.\* Hager B. H. Solomon S. C.

*Geoid, Topography, and Convection-driven Crustal Deformation on Venus*

Smith D. E.\* Lerch F. J. Nerem R. S. Zuber M. T. Patel G. B. Fricke S. K. Lemoine F. G.  
*GMM-1: A 50<sup>th</sup> Degree and Order Gravitational Field Model for Mars*

Bills B. G.\* Frey H. V. Kiefer W. S. Nerem R. S. Zuber M. T.

*Spectral Analysis of the Gravity and Topography of Mars*

Kiefer W.\* Bills B. Frey H. Nerem S. Roark J. Zuber M.

*An Inversion of Geoid and Topography for Mantle and Crustal Structure on Mars*

Frey H.\* Bills B. G. Kiefer W. S. Nerem R. S. Roark J. H. Zuber M. T.

*New Mars Free-Air and Bouguer Gravity: Correlation with Topography, Geology, and Large Impact Basins*

Lemoine F. G.\* Smith D. E. Fricke S. K. McCarthy J. J.

*A Simultaneous Estimation of the Mass of Mars and Its Natural Satellites, Phobos and Deimos, from the Orbital Perturbations on the Mariner 9, Viking 1, and Viking 2 Orbiters*

Stevenson D. J.\*

*Expectations for the Martian Core Magnetic Field*

Dolginov A. Z.\*

*Magnetic Fields and Nonuniform Structures of the Moon*

Tuesday, March 16, 1993

LARGE IMPACT EVENTS: THEORY AND OBSERVATIONS  
1:30 p.m. Room C

Chair: P. H. Warren

O'Keefe J. D.\* Ahrens T. J.  
*Dynamics of Large-scale Impacts on Venus and Earth*

Ivanov B. A.\* Ford P. G.  
*The Depths of the Largest Impact Craters on Venus*

Chadwick D. J.\* Schaber G. G.  
*A Two-Stage (Turbulent-Drainage) Mechanism for the Emplacement of Impact Crater Outflows on Venus*

Ahrens T. J.\*  
*Giant Impact-induced Atmospheric Blow-off*

Vickery A. M.\*  
*Numerical Modeling of Impact Erosion of Atmospheres: Preliminary Results*

Warren P. H.\*  
*Limits on Differentiation of Melt "Sheets" from Basin-scale Lunar Impacts*

Theriault A. M.\* Reid A. M. Reimold W. U.  
*Origin of the Vredefort Structure, South Africa: Impact Model*

Tuesday, March 16, 1993  
GALILEO EARTH/MOON RESULTS  
3:15 p.m. Room C

Chair: A.S. McEwen

Greeley R.\* Belton M. J. S. Head J. W. McEwen A. S. Pieters C. M. Neukum G. Becker T. L. Fischer E. M. Kadel S. D. Robinson M. S. Sullivan R. J. Sunshine J. M. Williams D. A.

*Galileo Imaging Results from the Second Earth-Moon Flyby: Lunar Maria and Related Units*

Head J. W.\* Belton M. Greeley R. Pieters C. Fischer E. Sunshine J. Klaasen K. McEwen A. Becker T. Neukum G. Oberst J. Pilcher C. Plutckak J. Robinson M. Johnson T. Williams D. Kadel S. Sullivan R. Antonenko I. Bridges N.  
Galileo Imaging Team  
*Lunar Impact Basins: New Data for the Nearside Northern High Latitudes and Eastern Limb from the Second Galileo Flyby*

Carlson R. W. Kieffer H. H.\* Baines K. H. Becker K. J. Danielson G. E. Edwards K. Fanale F. P. Forsythe J. Gaddis L. R. Granahan J. C. Hui J. Johnson T. V. Lopes-Gautier R. Kamp L. W. Matson D. L. McCord T. B. Mehlman R. Ocampo A. C. Soderblom L. A. Smythe W. D. Torson J. Weissman P. R.  
*Preliminary Report of Lunar Observations by the Near-Infrared Mapping Spectrometer (NIMS) During the Second Galileo Earth-Moon Encounter*

Pieters C. M.\* Belton M. Head J. W. Greeley R. McEwen A. Fischer E. M. Sunshine J. M. Klaasen K. Plutckak J. Neukum G. Johnson T. V. SSI Team  
*Compositional Diversity of the Lunar North Pole: Preliminary Analyses of Galileo SSI Data*

McEwen A. S.\* Greeley R. Head J. W. Pieters C. M. Fischer E. M. Johnson T. V. Neukum G. Galileo SSI team  
*Galileo SSI Lunar Observations: Copernican Craters and Soils*

Greenberg R. Belton M. DeJong E. Ingersoll A. Klaasen K. Geissler P.\* Moersch J. Thompson W. R. Galileo Imaging Team  
*Earth Imaging Results from Galileo's Second Encounter*

**Tuesday, March 16, 1993**  
**MARTIAN GEOMORPHOLOGY**  
**1:30 p.m. Room D**

**Chairs:** R. A Craddock and J. Grant

Leonard G. J.\* Tanaka K. L.

*Hellas Basin, Mars: Formation by Oblique Impact*

Ching D.\* Taylor G. J. Mouginis-Mark P. Bruno B. C.

*Fractal Dimensions of Rampart Impact Craters on Mars*

Barlow N. G.\*

*Increased Depth-Diameter Ratios in the Medusae Fossae Formation Deposits of Mars*

Grant J. A.\* Schultz P. H.

*Martian Crater Degradation by Eolian Processes: Analogy with the Rio Cuarto Crater Field, Argentina*

Greeley R.\* Anderson F. S. Blumberg D. Lo E. Xu P.

*Sand Transport on Mars: Preliminary Results from Models*

Christensen P. R. Malin M. C.\*

*A Simple Model of Clastic Sediments on Mars*

Craddock R. A.\* Crumpler L. S. Aubele J. C.

*Geologic History of Central Chryse Planitia and the Viking 1 Landing Site, Mars*

**Wednesday, March 17, 1993**  
**INTERPLANETARY DUST: LABORATORY STUDIES AND RESULTS FROM SPACECRAFT**  
**8:30 a.m. Room A**

**Chairs:** J. A. M. McDonnell and G. Blanford

Stephan T.\* Klöck W. Jessberger E. K. Rulle H. Zehnpfenning J.

*Multielement Analysis of Interplanetary Dust Particles Using TOF-SIMS*

Clemett S. J.\* Maechling C. R. Zare R. N. Swan P. D. Walker R. M.

*Measurement of Polycyclic Aromatic Hydrocarbon (PAHs) in Interplanetary Dust Particles*

Keller L. P.\* Thomas K. L. McKay D. S.

*Carbon Abundances, Major Element Chemistry, and Mineralogy of Hydrated Interplanetary Dust Particles*

Thomas K. L.\* Keller L. P. Blanford G. E. McKay D. S.

*Cometary Interplanetary Dust Particles? An Update on Carbon in Anhydrous IDPs*

Bradley J. P.\*

*Unequilibrated, Equilibrated, and Reduced Aggregates in Anhydrous Interplanetary Dust Particles*

Flynn G. J.\* Sutton S. R. Bajt S.

*Trace Element Content of Chondritic Cosmic Dust: Volatile Enrichments, Thermal Alterations, and the Possibility of Contamination*

Rietmeijer F. J. M.\*

*Micrometeorite Dynamic Pyrometamorphism: Observation of a Thermal Gradient in Iron-Nickel Sulfide*

Nier A. O.\* Schlutter D. J.

*Helium in Interplanetary Dust Particles*

Brownlee D. E.\* Joswiak D. J. Love S. G. Nier A. O. Schlutter D. J. Bradley J. P.

*Identification of Cometary and Asteroidal Particles in Stratospheric IDP Collections*

Presper T.\* Kurat G. Koeberl C. Palme H. Maurette M.

*Elemental Depletions in Antarctic Micrometeorites and Arctic Cosmic Spherules: Comparison and Relationships*

Barrett R. A.\* Zolensky M. E. Bernhard R.

*Mineralogy of Chondritic Interplanetary Dust Particle Impact Residues from LDEF*

Bernhard R. P.\* See T. H. Hötz F.

*Composition and Modal Frequencies of Hypervelocity Particles <1 mm in Diameter in Low-Earth Orbit*

McDonnell J. A. M.\*

*Resolving LDEF's Flux Distribution: Orbital (Debris?) and Natural Meteoroid Populations*

Wednesday, March 17, 1993

MARTIAN SURFACE MINERALOGY AND SPECTROSCOPY  
8:30 a.m. Room B

Chairs: J. Bishop and R. V. Morris

Bell J. F. III\* Mustard J. F.

*A Comparison of Telescopic and Phobos-2 ISM Spectra of Mars in the Short-Wave Near-Infrared (0.76–1.02 μm)*

Mustard J. F.\* Murchie S. L. Erard S.

*Composition of Weakly Altered Martian Crust*

Miller J. S.\* Singer R. B.

*Analysis of Pyroxene Absorptions Observed in Martian Dark Regions*

Sabol D. E. Jr.\* Bell J. F. III Adams J. B.

*Detectability of Crystalline Ferric and Ferrous Minerals on Mars*

Murchie S.\* Mustard J. Erard S. Geissler P. Singer R.

*Variations in the Fe Mineralogy of Bright Martian Soil*

Farrand W. H.\* Singer R. B.

*A Comparison of the Visible and Near Infrared Reflectance of Hydrovolcanic Palagonite Tuffs and Martian Weathered Soils*

Bishop J. L.\* Pieters C. M. Burns R. G.

*Reflectance Spectra of Sulfate- and Carbonate-bearing Fe<sup>2+</sup>-doped Montmorillonites as Mars Soil Analogs*

Morris R. V.\* Lauer H. V. Jr. Golden D. C.

*Terrestrial Impact Melts as Analogs for the Hematization of Martian Surface Materials*

Merényi E.\* Edgett K. S. Singer R. B.

*Deucalionis Regio, Mars: Evidence for a Unique Mineralogic Endmember and a Crusted Surface*

Burns R. G.\*

*Chemical Weathering on Mars: Rate of Oxidation of Iron Dissolved in Brines*

Moore J. M.\* Bullock M. A. Stoker C. R.

*Mars Brine Formation Experiment*

Wenrich M. L.\* Christensen P. R.

*A Study of Carbonates, Sulfates, and Phosphates Using Thermal Emission Spectroscopy*

Christensen P. R.\* Harrison S. T. Barbera P. Ruff S.

*Thermal-Infrared Emission Spectroscopy of Natural Surfaces: Application to Coated Surfaces*

Presley M. A.\* Christensen P. R.

*Thermal Conductivity Measurements of Particulate Materials Under Martian Conditions*

Wednesday, March 17, 1993

MOON ROCKS: FROM THE HIGHLANDS TO THE MARIA TO ANTARCTICA  
8:30 a.m. Room C

Chairs: O. B. James and H. Takeda

Taylor S. R.\* Norman M. D. Esat T. M.

*The Mg-Suite and the Highland Crust: An Unsolved Enigma*

Jolliff B. L.\* Bishop K. M.

*Apollo 17 Materials Viewed from 2–4 mm Soil Particles: Pre-Serennitatis Highlands Components*

Cushing J. A.\* Taylor G. J. Norman M. D. Keil K.

*The Granulite Suite: Impact Melts and Metamorphic Breccias of the Early Lunar Crust*

Norman M. D.\* Alibert C. McCulloch M. T.

*Fragments of Ancient Lunar Crust: Ferroan Noritic Anorthosites from the Descartes Region of the Moon*

Premo W. R.\* Tatsumoto M.

*U-Pb Isotopic Systematics of Ferroan Anorthosite 600:25*

Snyder G. A.\* Taylor L. A. Halliday A. N.

*Geochronology and Petrogenesis of the Western Highlands Alkali Suite: Radiogenic Isotopic Evidence from Apollo 14*

Shih C.-Y.\* Wiesmann H. Garrison D. H. Nyquist L. E. Bogard D. D.

*Chronology of Lunar Granite I2033,576: Resetting of Rb-Sr and K-Ca Isochrons*

Yanai K. Takeda H. Lindstrom M. M.\* Tatsumoto M. Torigoe N. Misawa K.

Warren P. H. Kallemeyn G. W. Koebel C. Kojima H. Takahashi K. Masuda A.

Nishiizumi K.

*Consortium Reports on Lunar Meteorites Yamato 793169 and Asuka 881757, a New Type of Mare Basalt*

Takeda H.\* Arai T. Saiki K.

*Ti-bearing Oxide Minerals in Lunar Meteorite Y793169 with the VLT Affinity*

Warren P. H.\* Lindstrom M. M.

*Consortium Study of Lunar Meteorites Yamato-793169 and Asuka-881757: Geochemical Evidence of Mutual Similarity, and Dissimilarity vs. Other Mare Basalts*

Torigoe N.\* Misawa K. Dalrymple G. B. Tatsumoto M.

*U-Ti-Pb, Sm-Nd, and Ar-Ar Isotopic Systematics of Lunar Meteorite Yamato 793169*

Nyquist L. E.\* Shih C.-Y. Wiesmann H. Bansal B. M.

*<sup>146,147</sup>Sm-<sup>142,143</sup>Nd Formation Interval for the Lunar Mantle and Implications for Lunar Evolution*

Neal C. R.\* Taylor L. A.

*Petrogenesis of Apollo 12 Mare Basalts, Part I: Multiple Melts and Fractional Crystallization to Explain Olivine and Ilmenite Basalt Compositions*

Jerde E. A.\* Snyder G. A. Taylor L. A.

*On the Composition of neuKREEP: QMD Contamination at Apollo 11?*

**Wednesday, March 17, 1993**  
**ORDINARY AND ENSTATITE CHONDRITES**  
**1:30 p.m. Room A**

**Chairs:** K. Kell and M. Prinz

**Rubin A. E.\***

*Euhedral Metallic-Fe-Ni Grains in Extraterrestrial Samples*

**Yang C. W.\* Williams D. B. Goldstein J. I.**

*Preliminary AEM Study of the Microstructure and Composition of Metal Particles in Ordinary Chondrites*

**Podosek F. A.\* Brannon J. C. Perron C. Pellas P.**

*Elevated Initial  $^{87}\text{Sr}/^{86}\text{Sr}$  in Ordinary Chondrite Metal*

**Burkland M. K.\* Swindle T. D. Baldwin S. L.**

*Studies of the Release of Radiogenic  $^{138}\text{Xe}$  from Bjurböle: Evidence Against Simple Diffusion Models*

**Kehm K.\* Nichols R. H. Jr. Hohenberg C. M. McCoy T. J. Keil K.**

*I-Xe Structure of Ilasegh 009 and Shallowater: Evidence for Early Formation and Rapid Cooling of Impact-derived Enstatite Meteorites*

**Scott E. R. D.\* McCoy T. J. Keil K.**

*Post-Metamorphic Brecciation in Type 3 Ordinary Chondrites*

**Crozaz G.\* Hsu W.**

*Anomalous REE Patterns in Unequilibrated Enstatite Chondrites: Evidence and Implications*

**Weisberg M. K.\* Prinz M. Fogel R. A. Shimizu N.**

*The Formation of FeO-rich Pyroxene and Enstatite in Unequilibrated Enstatite Chondrites: A Petrologic-Trace-Element (SIMS) Study*

**Zhang Y.\* Benoit P. H. Sears D. W. G.**

*Lewis Cliff 87057: A New Metal-rich E3 Chondrite with Similarities to Mt. Egerton, Shallowater and Happy Canyon*

**Brearley A. J.\* Jones R. H.**

*Chondrite Thermal Histories from Low-Ca Pyroxene Microstructures: Autometamorphism vs Prograde Metamorphism Revisited*

**Benoit P. H.\* Sears D. W. G.**

*The Great 8 Ma Event and the Structure of the H-Chondrite Parent Body*

**Wolf S. F. Lipschutz M. E.\***

*Multivariate Statistical Analysis: Principles and Applications to Coorbital Streams of Meteorite Falls*

**Yanai K.\* Kojima H.**

*Regolith Breccia Consisting of H and LL Chondrite Mixture*

**Wednesday, March 17, 1993**  
**MARS: TECTONISM AND VOLCANISM**  
**1:30 p.m. Room B**

**Chairs:** W. B. Banerdt and J. Plescia

**Zuber M. T.\***

*Wrinkle Ridges, Reverse Faulting, and the Depth Penetration of Lithospheric Stress in Lunae Planum, Mars*

**Banerdt W. B.\***

*Horizontal Stresses Induced by Vertical Processes in Planetary Lithospheres*

**Tanaka K. L.\* Chadwick D. J.**

*Extensional History of Mars' Tharsis Region*

**Chadwick D. J.\* Lucchitta B. K.**

*Fault Geometries and Extension in the Valles Marineris, Mars*

**Watters T. R.\* Zimbelman J. R. Scott D. H.**

*Arcuate and Circular Structures in the Tharsis Region: Evidence of Coronae on Mars*

**Balogh S. M.\* Spudis P. D.**

*Reconstruction of the Dynamics of the 1800-1801 Hualalai Eruption: Implications for Planetary Lava Flows*

**Biuno B. C.\* Taylor G. J. Lopes-Gautier R. M. C.**

*Quantifying the Effect of Rheology on Plan-View Shapes of Lava Flows*

**Lopes-Gautier R.\* Bruno B. G. Taylor G. J. Rowland S. Kilburn C. R. J.**

*Martian Lavas: Three Complementary Remote Sensing Techniques to Derive Flow Properties*

**Mouginis-Mark P.\***

*The Influence of Oceans on Martian Volcanism*

**Gregg T. K. P.\* Williams S. N.**

*Explosive Mafic Volcanism on Earth and Mars*

**Plescia J. B.\***

*Geology of Biblis Patera, Ulysses Patera, and Jovis Tholus, Mars*

**Robinson M. S.\* Mouginis-Mark P. J. Zimbelman J. R. Wu S. S. C.**

*Chronology, Eruption Duration, and Atmospheric Contribution of Apollinaris Patera, Mars*

Wednesday, March 17, 1993

LUNAR VOLCANIC GLASSES AND REGOLITH  
1:30 p.m. Room C

Chairs: J. Delano and D. S. McKay

Delano J. W.\*

*Compositional Heterogeneity Within a Dumbbell-shaped Apollo 15 Green Glass:  
Evidence for Simultaneous Eruption of Different Magmas*

Shearer C. K.\* Papike J. J.

*Basaltic Magmatism on the Moon. A Perspective from Volcanic Picritic Glasses*

Finnila A. B.\* Hess P. C. Rutherford M. J.

*Assimilation in Lunar Basalts and Volcanic Glasses: Implications for a Heterogeneous  
Mantle Source Region*

McKay D. S.\* Wentworth S. J.

*Grain Surface Features of Apollo 17 Orange and Black Glass*

Rutherford M. J. Fogel R. A.\*

*C-O Volatiles in Apollo 15 and Apollo 17 Picritic Glasses*

Colson R. O.\*

*Graphite "Solubility" and CO Vesiculation in Basalt-like Melts at One-Atm*

Hess P. C.\*

*The Ilmenite Liquidus and Depths of Segregation for High-Ti Picrite Glasses*

Longhi J.\*

*Liquidus Equilibria of Lunar Analogs at High Pressure*

Wagner T. P.\* Grove T. L.

*Origin of High-Ti Lunar Ultramafic Glasses*

Norris J. A.\* Keller L. P. McKay D. S.

*Impact Glasses from the Ultrafine Fraction of Lunar Soils*

Korotev R. L.\* Morris R. V. Lauer H. V. Jr.

*Composition and Maturity of the 60013/14 Core*

Kerridge J. F.\* Kim Y. Kim J. S. Marti K.

*Nitrogen Isotopic Signatures in Agglutinates from Breccia 79035*

Brilliant D. R.\* Franchi I. A. Pillinger C. T.

*Multiple Nitrogen Components in Lunar Soil Sample 12023*

Wednesday, March 17, 1993

COMPLEX PLENARY

"Integrated Strategy for Planetary and Lunar Exploration from 1995 to 2010"  
5:30 p.m. Room C

Discussion Leader: J. A. Burns

Open Discussion

Members of COMPLEX (The Committee on Planetary and Lunar Exploration; Space Studies Board of the National Academy of Sciences/National Research Council) will discuss the above report which is being prepared for NASA. This document (a) summarizes our current understanding of the solar system, (b) identifies the most significant scientific questions that remain; and (c) establishes priorities for study and scientific exploration of the solar system over the next 15 years. A formal presentation will describe the study so far and will then seek community input on key scientific questions and on future scientific priorities.

**Thursday, March 18, 1993**  
**CARBONACEOUS CHONDrites AND CHONDRULES**  
**8:30 a.m. Room A**

**Chairs:** J. Gooding and L. Grossman

Prinz M.\* Weisberg M. K. Clayton R. N. Mayeda T. K.

*Oxygen Isotopic Relationships Between the LEW85332 Carbonaceous Chondrite and CR Chondrites*

Kallemeyn G. W.\*

*The Al Rais Meteorite: A CR Chondrite or Close Relative?*

Brandstätter F.\* Kurat G. Ivanov A. V. Palme H. Spettel B.

*Mineralogy Versus Bulk Composition of the Carbonaceous Chondrite Clast Kaidun II*

Steele I. M.\*

*Fe/Mn in Olivine of Carbonaceous Meteorites*

Hua X.\* Buseck P. R.

*Olivines in the Kaba Carbonaceous Chondrite and Constraints on Their Formation*

Browning L. B.\* McSween H. Y. Jr. Zolensky M. E.

*Determining the Relative Extent of Alteration in CM Chondrites*

Woolom D. S.\* Poelstra K. Alexander C. Ireland T.

*LREE Variability in CM Matrices: Another Look at Meteorite "Compaction Ages"*

Gilmour I.\* Pillinger C. T.

*Extraction and Isotopic Analysis of Medium Molecular Weight Hydrocarbons from Murchison Using Supercritical Carbon Dioxide*

Misawa K.\* Fujita T. Kitamura M. Nakamura N.

*Refractory Precursor Components in an Allende Ferromagnesian Chondrule*

Jones R. H.\*

*Complex Zoning Behavior in Pyroxene in FeO-rich Chondrules in the Semarkona Ordinary Chondrite*

Krot A. N.\* Rubin A. E.

*Chromite-rich Mafic Silicate Chondrules in Ordinary Chondrites: Formation by Impact Melting*

Huang S.\* Benoit P. H. Sears D. W. G.

*The Group A3 Chondrules of Krymka: Further Evidence for Major Evaporative Loss During the Formation of Chondrules*

Lofgren G. E.\* DeHart J. M. Dickinson T. L.

*Experimentally Reproduced Relict Enstatite in Porphyritic Chondrules of Enstatite Chondrite Composition*

**Thursday, March 18, 1993**

**MARS: SURFACE AND ATMOSPHERIC PROCESSES**

8:30 a.m. Room B

**Chairs:** V. Gulick and K. Herkenhoff

Gulick V. C.\* Baker V. R.

*Fluvial Erosion on Mars: Implications for Paleoclimatic Change*

Leyva I. A.\* Clifford S. M.

*The Seismic Response of an Aquifer to the Propagation of an Impact Generated Shock Wave: A Possible Trigger of the Martian Outflow Channels?*

Parker T. J.\* Gorsline D. S.

*Constraints on the Rate of Discharge and Duration of the Mangala Valles Flood*

Betts B. H.\* Murray B. C.

*Thermal Studies of Martian Channels and Valleys Using Termoskan Data*

Lucchitta B. K.\* Isbell N. K. Howington-Kraus A.

*Sedimentation, Volcanism, and Ancestral Lakes in the Valles Marineris: Clues from Topography*

De Hon R. A.\*

*Classification of Martian Deltas*

Herkenhoff K. E.\*

*Thermal Inertia and Radar Reflectivity of the Martian North Polar Erg: Low-Density Aggregates*

Zent A. P.\* Roush T. L.

*Spectral Analysis of Chemisorbed CO<sub>2</sub> on Mars Analog Materials*

Crisp D.\* Bell J. F. III

*Near-Infrared Spectra of the Martian Surface: Reading Between the Lines*

Moroz V. I.\* Titov D. V. Gektin Yu. M. Naraeva M. K. Selivanov A. S.

*Altitude Profile of Aerosols on Mars from Measurements of Its Thermal Radiation on Limb*

Murphy J. R.\* Pollack J. B.

*Dust-Dynamic Feedbacks in the Martian Atmosphere: Surface Dust Lifting*

Dollfus A.\* Ebisawa S.

*Dust in the Martian Atmosphere: Polarimetric Sensing*

Mellon M. T.\* Jakosky B. M.

*The Effects of Orbital and Climatic Variations on Martian Surface Heat Flow*

Bell J. F. III\* Calvin W. M. Pollack J. B. Crisp D.

*An Observational Search for CO<sub>2</sub> Ice Clouds on Mars*

**Thursday, March 18, 1993**  
**LUNAR GEOLOGY**  
**8:30 a.m. Room C**

**Chairs:** **J. Granahan and P. Spudis**

**Stacy N. J. S. Campbell D. B.\***

*Earth-based Measurement of Lunar Topography Using Delayed Radar Interferometry*

**Bahar E.\* Haugland M.**

*Interpretation of Lunar and Planetary Electromagnetic Scattering Using the Full Wave Solutions*

**Cooper B. L.\* Carter J. L.**

*Using Lunar Sounder Imagery to Distinguish Surface from Subsurface Reflectors in Lunar Highlands Areas*

**Mendell W. W.\* Wieczorek M. A.**

*Thermogeologic Mapping of the Moon from Lunar Orbit*

**Tompkins S.\* Pieters C. M. Mustard J. F.**

*Distribution and Geologic History of Materials Excavated by the Lunar Crater Bullialdus*

**Kadel S. D.\* Greeley R. Neukum G. Wagner R.**

*The History of Mare Volcanism in the Orientale Basin: Mare Deposit Ages, Compositions and Morphologies*

**Hiesinger H.\* Jaumann R. Neukum G. GLL Imaging Team**

*Earth-based and Galileo SSI Multispectral Observations of Eastern Mare Serenitatis and the Apollo 17 Landing Site*

**Spudis P. D.\* Hawke B. R. Lucey P. G.**

*Geology and Deposits of the Serenitatis Basin*

**Hawke B. R.\* Blewett D. T. Lucey P. G. Taylor G. J. Peterson C. A. Bell J. F.**

**Robinson M. S. Bell J. III Coombs C. R. Jaumann R. Hiesinger H. Neukum G. Spudis P. D.**

*Remote Sensing Studies of the Northeastern Portion of the Lunar Nearside*

**Blewett D. T.\* Hawke B. R. Lucey P. G. Bell J. F. III Jaumann R. Hiesinger H. Neukum G. Spudis P. D.**

*Spectral and Multispectral Imaging Studies of Lunar Mantled Mare Deposits*

**Head J. W.\* Wilson L.**

*Mode of Emplacement of Lunar Mare Volcanic Deposits: Graben Formation Due to Near Surface Deformation Accompanying Dike Emplacement at Rima Parry V*

**Koehler U.\* Jaumann R. Neukum G.**

*Age Determinations and Earth-based Multispectral Observations of Lunar Light Plains*

**Helfenstein P.\* Veverka J. Head J. W. Pieters C. Pratt S. Mustard J. Klaasen K.**

**Neukum G. Hoffmann H. Jaumann R. Rebhan H. McEwen A. S. Belton M.**

*Galileo Photometry of Apollo Landing Sites*

**Thursday, March 18, 1993**  
**ASTEROID AND PLANETARY CORE FORMATION**  
**AND METAL-RICH METEORITES**  
**8:30 a.m. Room D**

**Chairs:** **G. W. Lugmair and H. Newsom**

**Keil K. Wilson L.\***

*Explosive Volcanism and the Compositions of the Cores of Differentiated Asteroids*

**Jurewicz S. R.\* Jones J. H.**

*Experimental Segregation of Iron-Nickel Metal, Iron-Sulfide, and Olivine in a Thermal Gradient: Preliminary Results*

**Zhou Y.\* Steele I. M.**

*Chemical Zoning and Diffusion of Ca, Al, Mn, and Cr in Olivine of Springwater Pallasite*

**Holzheid A.\* Borisov A. Palme H.**

*Siderophile Elements in the Upper Mantle of the Earth: New Clues from Metal-Silicate Partition Coefficients*

**Newsom H. E.\* Maehr S.**

*Core Formation in the Moon: The Mystery of the Excess Depletion of Mo, W and P*

**Haack H.\* Scott E. R. D. Rubio G. S. Gutierrez D. F. Lewis C. F. Wasson J. T.**

**Brooks R. R. Guo X. Ryan D. E. Holzbecher J.**

*Systematic Chemical Variations in Large IIIAB Iron Meteorites: Clues to Core Crystallization*

**Walker R. J.\* Morgan J. W. Horan M. F. Grossman J. N.**

*Rhenium-Osmium Isotope Systematics of Ordinary Chondrites and Iron Meteorites*

**Esat T.\* Bennett V.**

*Re-Os Dating of IIIAB Iron Meteorites*

**Creaser R. A.\* Papanastassiou D. A. Wasserburg G. J.**

*Rhenium-Osmium Isotope Systematics of Group IIa and Group IVA Iron Meteorites*

**Eisenhour D. D. Buseck P. R. Palme H.\* Zipfel J.**

*Micro-Zoning in Minerals of a Landes Silicate Inclusion*

**Stewart B. W.\* Papanastassiou D. A. Wasserburg G. J.**

*Sm-Nd Systematics of Silicate Inclusions in Iron Meteorites: Results from Caddo (IAB)*

**Jacobsen S. B.\* Harper C. L. Jr.**

*Constraints on the Differentiation of the Earth from the Coupled  $^{140,142,144}\text{Nd}/^{144}\text{Nd}$  Systematics*

**Harper C. L. Jr.\* Jacobsen S. B.**

*$^{142}\text{Nd}/^{144}\text{Nd}$  in Bulk Planetary Reservoirs, the Problem of Incomplete Mixing of Interstellar Components and Significance of Very High Precision  $^{145}\text{Nd}/^{144}\text{Nd}$  Measurements*

**Thursday, March 18, 1993**  
**STARS, STARDUST, AND ISOTYPE ANOMALIES**  
**1:30 p.m. Room A**

**Chairs:** D. Papanestassiou and A. M. Davis

Dong Q. W. Thiemens M. H.\*

*Development of a Molecular Beam Technique to Study Early Solar System Silicon Reactions*

Yurimoto H.\* Nagasawa H. Mori Y.

*Inter- and Intra-Crystalline Oxygen Isotope Distribution of Fassaites in Allende CAI*

Nittler L. R.\* Walker R. M. Zinner E. Hoppe P. Lewis R. S.

*Identification of an Interstellar Oxide Grain from the Murchison Meteorite by Ion Imaging*

Lewis R. S.\* Srinivasan B.

*A Search for Noble-Gas Evidence for Presolar Oxide Grains*

Amari S.\* Zinner E. Lewis R. S.

*Interstellar Graphite in Murchison: Continued Search for Isotopically Distinct Components*

Huss G. R.\* Hutcheon I. D. Wasserburg G. J.

*Do SiC Grains in Orgueil Differ from Those in Murchison?*

Yates P. D.\*

*Micrometeorite Pre-solar Diamonds from Greenland Cryoconite?*

Verchovsky A. B.\* Russell S. S. Pillinger C. T. Fisenko A. V. Shukolyukov Yu. A.  
*Are the C<sub>a</sub> Light Nitrogen and Noble Gases Located in the Same Carrier?*

Clayton D. D.\* El Eid M. Brown L. E.

*Carbon and Nitrogen in Type II Supernova Diamonds*

Sharp C. M.\* Wasserburg G. J.

*Molecular Equilibria and Condensation Sequences in Carbon Rich Gases*

Wasserburg G. J. Gallino R.\* Busso M. Raiteri C. M.

*AGB Stars as a Source of Short-lived Radioactive Nuclei in the Solar Nebula*

**Thursday, March 18, 1993**  
**OUTER SOLAR SYSTEM**  
**1:30 p.m. Room B**

**Chairs:** L. J. Horn and R. Malhotra

Matson D. L.\* Veverka G. J. Johnson T. V. Blaney D. L. Goguen J. D.

*A Decade's Overview of Io's Volcanic Activity*

Kargel J. S.\*

*Crustal Structure and Igneous Processes in a Chondritic Io*

Hogenboom D. L.\* Kargel J. S. Ganashan J. P. Lee L.

*Phase Equilibria of the Magnesium Sulfate-Water System to 4 Kbars*

Goldsby D. L.\* Kohlstedt D. L. Durham W. B.

*Rheology of Water and Ammonia-Water Ices*

Croft S. K.\*

*Porosity and the Ecology of Icy Satellites*

Pappalardo R.\* Greeley R.

*Structural Evidence for Reorientation of Miranda About a Paleo-Pole*

Denk T.\* Jaumann R. Neukum G.

*Disk-resolved Spectral Characteristics of Saturn's Medium-sized Satellites*

Horn L.J.\* Russell C. T.

*Mass of Saturn's A Ring*

Strom R. G.\* Croft S. K.

*Triton's Cratering Record and Its Time of Capture*

Boyce J. M.\*

*A Structural Origin for the Cantaloupe Terrain of Triton*

Schenk P.\* Jackson M. P. A.

*Diapirs and Cantaloupes: Layering and Overturn of Triton's Crust*

Hansen C. J.\* Paige D. A.

*A Pluto Thermal Model*

Levison H. F.\* Stern S. A.

*Mapping the Stability Region of the 3:2 Neptune-Pluto Resonance*

**Thursday, March 18, 1993**  
**FUTURE LUNAR EXPLORATION**  
**1:30 p.m. Room C**

**Chairs:** **M. B. Duke and D. A. Morrison**

**Head J. W.\*** Belton M. Greeley R. Pieters C. McEwen A. Neukum G. McCord T.  
*Lunar Scout Missions: Galileo Encounter Results and Application to Scientific  
 Problems and Exploration Requirements*

**Pieters C. M.\* Head J. W. McCord T. B. MinMap Team**  
*MinMap: An Imaging Spectrometer for High Resolution Compositional Mapping  
 of the Moon*

**Neukum G.\***  
*The High Resolution Stereo Camera (HRSC) for the Lunar Scout-I Mission*

**Moss C. E.\* Burt W. W. Edwards B. C. Martin R. A. Nakano G. H. Reedy R. C.**  
*Gamma-Ray Spectrometer for Lunar Scout II*

**Auchampaugh G.\* Barraclough B. Byrd R. Drake D. Feldman W. Moss C. Reedy R.**  
*The Los Alamos Neutron Spectrometer for the Lunar Scout-I Mission*

**Clark P. E. Evans L. G. Trombka J. I.\***  
*Remote Sensing X-Ray Fluorescence Spectrometry for Future Lunar  
 Exploration Missions*

**Cheng A. F.\***  
*Lunar Scout Two Spacecraft Gravity Experiment*

**Shoemaker E. M.\* Nozette S.**  
*Clementine: An Inexpensive Mission to the Moon and Geographos*

**Lucey P. G.\***  
*The Clementine Instrument Complement*

**McEwen A. S.\***  
*Clementine: Anticipated Scientific Datasets from the Moon and Geographos*

**Spudis P. D.\* Lucey P. G.**  
*Contributions of the Clementine Mission to Our Understanding of the Processes and  
 History of the Moon*

**Meyer C.\***  
*Opportunity for Early Science Return by the Artemis Program*

**Lofgren G. E.\***  
*The First Lunar Outpost: The Design Reference Mission and a New Era in  
 Lunar Science*

**Chicarro A. F.\***  
*Mission to the Moon: An ESA Study on Future Exploration*

**Thursday, March 18, 1993**  
**NASA PROGRAM MANAGERS' MEETING**  
**5:30 p.m. Room A**

**Tammy Dickinson, NASA Headquarters**  
*Planetary Materials and Geochemistry*

**Stephan Baloga, NASA Headquarters**  
*Planetary Geology and Geophysics*

**Henry Brinton, NASA Headquarters**

**Joseph Boyce, NASA Headquarters**

**Friday, March 19, 1993**

CAIs

8:30 a.m. Room A

**Chair:** G. MacPherson

Meeker G. P.\* Quick J. E. Paque J. M.

*Limited Subsolidus Diffusion in Type B1 CAI; Evidence from Ti Distribution in Spinel*

Deloule E.\* Kennedy A. K. Hutcheon I. D. El Goresy A.

*Isotopic and Trace Element Characteristics of an Unusual Refractory Inclusion from Essebi*

Greenwood R. C.\* Morse A. Long J. V. P.

*Petrography, Mineralogy, and Mg Isotope Composition of Victa: A Yigarano CoAl<sub>2</sub>O<sub>3</sub>-bearing Type A Inclusion*

Casanova I.\* Grossman L.

*Distribution of Vanadium and Melting of Opaque Assemblages in Efremovka CAIs*

Lindstrom D. J.\* Keller L. P. Martinez R. R.

*INAA of CAIs from the Maralinga CK4 Chondrite: Effects of Parent Body Thermal Metamorphism*

Simon S. B.\* Grossman L. Hsu A.

*Petrography and Origin of Refractory Inclusions from the Murray and Murchison C2 Chondrites*

Beckett J. R.\* Stolper E.

*The Stability of Hibonite and Other Aluminous Phases in Silicate Melts: Implications for the Origin of Hibonite-bearing Inclusions*

Wang J.\* Davis A. M. Hashimoto A. Clayton R. N.

*Diffusion-controlled Magnesium Isotopic Fractionation of a Single Crystal Forsterite Evaporated from the Solid State*

Nagahara H.\*

*Evaporation in Equilibrium, in Vacuum, and in Hydrogen Gas*

Paillat O.\* Wasserbarg G. J.

*Self-Diffusion of Alkaline-Earth in Ca-Mg-Aluminosilicate Melts, Experimental Improvements on the Determination of the Self-Diffusion Coefficients*

**Friday, March 19, 1993**

**HEAT SOURCES FOR CHONDRULE/CAI MELTING**

11:00 a.m. Room A

**Chair:** A. E. Rubin

Connolly H. C. Jr.\* Hewins R. H. Lofgren G. E.

*Flash Melting of Chondrule Precursors in Excess of 1600°C. Series I: Type II (B1) Chondrule Composition Experiments*

Hood L. L.\* Horanyi M.

*Gas-Grain Energy Transfer in Solar Nebula Shock Waves: Implications for the Origin of Chondrules*

Wasson J. T.\*

*Multiplicity of Chondrule Heating Events and the Coarsening of Chondrule Textures*

Eisenhour D.\* Buseck P. R.

*Primordial Lightning: Evidence Preserved in Chondrites*

**Friday, March 19, 1993**  
**COMETS AND ASTEROIDS**  
**8:30 a.m. Room B**

**Chairs:** D. T. Britt and S. Murchie

Schulz R.\* A'Hearn M. F. Birch P. V. Bowers C. Kempin M. Martin R.  
*C<sub>2</sub>, CN and Dust in Comet Wilson (1987VII)*

Fomenkova M.\* Chang S.  
*Mass and Spatial Distribution of Carbonaceous Component in Comet Halley*

Hartmann W. K.\*  
*The Physical Mechanism of Comet Outbursts: An Experiment*

Grimm R. E.\* McSween H. Y. Jr.  
*Heliocentric Zoning of the Asteroid Belt by Aluminum-26 Heating*

Britt D. T.\* Howell E. S. Bell J. F. Lebofsky L. A.  
*1.2- to 3.5- $\mu$ m Observations of Asteroid 4179 Toutatis*

Kelley M. S.\* Gaffey M. J.  
*An Initial Perspective of S-Asteroid Subtypes Within Asteroid Families*

Clark B. E.\* Lucey P. G. Bell J. F. Fanale F. P.  
*Spectral Mixing Models of S-type Asteroids*

Sunshine J. M.\* Pieters C. M.  
*Determining the Composition of Olivine on Asteroidal Surfaces*

Hiroi T.\* Pieters C. M. Zolensky M. E.  
*Comparison of Reflectance Spectra of C Asteroids and Unique C Chondrites Y86720, Y82162, and B7904*

Vilas F.\* Hiroi T. Zolensky M. E.  
*Comparison of Visible and Near-Infrared Reflectance Spectra of CM2 Carbonaceous Chondrites and Primitive Asteroids*

Murchie S.\* Erard S.  
*The Spectrum of Phobos from Phobos 2 Observations at 0.3–2.6  $\mu$ m: Comparison to Previous Data and Meteorite Analogs*

Chapman C. R.\* Neukum G. Veverka J. Belton M.  
*Cratering on Gaspra*

Bottke W. F. Jr.\* Nolan M. C. Greenberg R.  
*Collision Lifetimes and Impact Statistics of Near-Earth Asteroids*

**Friday, March 19, 1993**  
**EDUCATING YOUNG PEOPLE IN EARTH AND PLANETARY SCIENCES**  
**8:30 a.m. Room C**

**Chairs:** J. O. Annexstad and J. M. Boyce

Taylor G. J.\* Lindstrom M. M.  
*Sparking Young Minds with Moon Rocks and Meteorites*

Lindstrom M. M.\* NASA Partners-in-Space Team  
*SpaceShip Earth: A Partnership in Curriculum Writing*

Lebofsky L. A.\* Lebofsky N. R.  
*Teaching Planetary Sciences to Elementary School Teachers: Programs that Work*

Allton J. H.\* Allton C. S.  
*Encouraging Interest in Space Exploration and Planetary Science Among Navajo Primary Students*

Barlow N. G.\*  
*Encouraging Female Interest in Science and Mathematics*

Postawko S. E.\* Morrissey M. L. Taylor G. J. Mouginis-Mark P.  
*Schools of the Pacific Rainfall Climate Experiment*

Metzger S. M.\*  
*Do It Yourself Remote Sensing: Generating an Inexpensive High-Tech, Real Science Lake Mapping Project for the Classroom*

Tatsumura M. J.\* Taylor G. J. Mouginis-Mark P. J.  
*Tumuli and Tubes: Teaching Scientific Techniques*

Annexstad J. O.\* Melchior R. C.  
*A Space Studies Curriculum for Small Colleges and Universities*

Guinness E. A.\* Arvidson R. E. Martin M. Dueck S.  
*The Planetary Data System Educational CD-ROM*

French L. M.  
*Planetary Science and Astronomy in the Middle School Classroom*

**Tuesday, March 16, 1993**  
**POSTER SESSION I**  
**7:00–9:00 p.m. LPI**

### CHICXULUB, KT BOUNDARY, AND OTHER IMPACT EJECTA

Ortiz Aleman C. Pilkington M. Hildebrand A. R. Roest W. R. Grieve R. A. F. Keating P.  
*Modelling the Gravity and Magnetic Field Anomalies of the Chicxulub Crater*

Borho B. F. Betterton W. J.  
*Arroyo El Mimbral, Mexico, K/T Unit: Origin as Debris Flow/Turbidite, Not a Tsunami Deposit*

Claeys P. Alvarez W. Smit J. Hildebrand A. R. Montanari A.  
*KT Boundary Impact Glasses from the Gulf of Mexico Region*

Pope K. O. Ocampo A. C. Baines K. H. Ivanov B. A.  
*Global Blackout Following the K/T Chicxulub Impact: Results of Impact and Atmospheric Modeling*

Tyburczy J. A. Ahrens T. J.  
*Impact-induced Devolatilization of CaSO<sub>4</sub> Anhydrite and Implications for K-T Extinctions: Preliminary Results*

Chen G. Ahrens T. J.  
*Shock Induced Reaction in Chicxulub Target Materials (CaSO<sub>4</sub> and SiO<sub>2</sub>) and Their Relation to Extinctions*

Boundy-Sanders S. Q. Hervig R. L.  
*Minor and Trace Element Composition and Age of Yukon Probable-Micrometeorites*

### IMPACT CRATERING AND SHOCK METAMORPHISM

Colwell J. E.  
*Power-Law Confusion: You Say Incremental, I Say Differential*

Benz W. Ashbaugh E.  
*Explicit 3D Continuum Fracture Modeling with Smooth Particle Hydrodynamics*

Coombs C. R. Atkinson D. R. Watts A. J. Wagner J. W. Allbrooks M. K. Hennessy C. J.  
*Modelling Hypervelocity Impacts into Aluminum Structures Based on LDEF Data*

Housen K.  
*Simulation of Collisional Fragmentation with Explosives*

Schultz P. H. Gault D. E.  
*Impactor Control of Central Peak and Peak-Ring Formation*

Evans N. J. Ahrens T. J. Shahinpoor M. Anderson W. W.  
*Projectile-Target Mixing in Melted Ejecta Formed During a Hypervelocity Impact Cratering Event*

Cintala M. J. Grieve R. A. F.  
*Differential Scaling: Implications for Central Structures in Large Lunar Craters*

Watts A. J. Atkinson D. R. Ricco S. R. Brandvold J. B. Lapin S. L. Coombs C. R.  
*A Fresh Look at Crater Scaling Laws for Normal and Oblique Hypervelocity Impacts*

Yanagisawa M. Itoi T.  
*Antipodal Fragment Velocities for Porous and Weak Targets at Catastrophic Impacts*

Reimold W. U. Le Roux F. G. Koeberl C. Shirey S. B.  
*Kakkop Crater, Eastern Cape—A New Impact Crater in South Africa*

Storzer D. Koeberl C. Reimold W. U.  
*The Age of the Pretoria Saltpan Impact Crater, South Africa*

Wong A. M. Reid A. M. Hall S. A. Sharpton V. L.  
*Characterization of the Marquez Dome Buried Impact Crater Using Gravity and Magnetic Data*

Xue S. Herzog G. F. Hall G. S. Klein J. Middleton R. Juenemann D.  
*Stable Ni Isotopes and <sup>10</sup>Be and <sup>26</sup>Al in Metallic Spheroids from Meteor Crater, Arizona*

Tonks W. B. Melosh H. J.  
*Core Formation by Giant Impacts: Conditions for Intact Melt Region Formation*

Hartmann W. K. Gaskell R. W.  
*Confirmation of Saturation Equilibrium Conditions in Crater Populations*

Chyba C. F.  
*Collisions of Small Spacewatch Asteroids with the Earth*

Melosh H. J. Artemjeva N. A. Golub A. P. Nemchinov I. V. Shuvalov V. V.  
 Trubitskaya I. A.  
*Remote Visual Detection of Impacts on the Lunar Surface*

Wieczorek M. A. Mendell W. W.  
*Degradation Sequence of Young Lunar Craters from Orbital Infrared Survey*

### DIFFERENTIATED METEORITES

Drake M. J. Owen T. Swindle T. Musselwhite D.  
*Noble Gas Evidence of an Aqueous Reservoir Near the Surface of Mars More Recently than 1.3 Ga*

Wentworth S. J. Gooding J. L.  
*Weathering Features and Secondary Minerals in Antarctic Shergottites ALHA77005 and LEW88516*

Agerkvist D. P. Vistisen L.  
*Mössbauer Spectroscopy of the SNC Meteorite Zagami*

Fisher D. S. Burns R. G.  
*Cronstedtite and Iron Sulfide Mineralogy of CM-type Carbonaceous Chondrites from Cryogenic Mössbauer Spectra*

Brearley A. J.

*Carbonaceous Chondrite Clasts in the Kapoeta Howardite*

Nazarov M. Brandstätter F. Kurat G.

*Carbonaceous Xenoliths from the Erevon Howardite*Buchanan P. C. Zolensky M. E. Reid A. M. Barrett R. A.  
*EET87513 Clast N: A CM2 Fragment in an IIE Polymict Breccia*

Petaev M. I.

*Lamellar Olivine in the Divnoe Achondrite: Evidence for High-Pressure Exsolution?*

Grady M. M. Pillinger C. T.

*EUROMET Ureilite Consortium: A Preliminary Report on Carbon and Nitrogen Geochemistry*Petaev M. I. Clarke R. S. Jr. Olsen E. J. Jarosewich E. Davis A. M. Steele I. M. Lipschutz M. E. Wang M.-S. Clayton R. N. Mayeda T. K. Wood J. A.  
*Chaunskij: The Most Highly Metamorphosed, Shock-modified and Metal-rich Mesosiderite***TECHNIQUES AND EXPERIMENTAL STUDIES**

Kubicki J. D. Stolper E. M.

*Evaporation Kinetics of  $Mg_2SiO_4$  Crystals and Melts from Molecular Dynamics Simulations*

Borisov A. Palme H. Spettel B.

*The Solubility of Gold in Silicate Melts: First Results*

Boesenberg J. S. Delaney J. S.

*Preliminary Results of Mn Partitioning Experiments on Murchison Analogues*

Jurewicz S. R. Jones J. H.

*Experimental Partitioning of Zr, Ti, and Nb Between Silicate Liquid and a Complex Noble Metal Alloy and the Partitioning of Ti Between Perovskite and Platinum Metal*

Sutton S. R. Delaney J. Bajt S. Rivers M. L. Smith J. V.

*Microanalysis of Iron Oxidation State in Iron Oxides Using X-ray Absorption Near Edge Structure (XANES)***TERRESTRIAL STUDIES**

Liu Y.-G. Schmitt R. A.

*Earth's Partial Pressure of  $CO_2$  Over the Past 120 Ma: Evidence from Ce Anomalies in the Deep (>600 m) Pacific Ocean, I*Niedermann S. Eugster O. Hofmann B. Thalmann Ch. Reimold W. U.  
*Dating Native Gold by Noble Gas Analyses*

Kurosawa M. Yurimoto H. Sueo S.

*Water in Earth's Mantle: Hydrogen Analysis of Mantle Olivine, Pyroxenes and Garnet Using the SIMS*

Snyder G. A. Jerde E. A. Taylor L. A. Halliday A. N. Sobolev V. N. Sobolev N. V.

Clayton R. N. Mayeda T. K. Deines P.

*Primary Differentiation in the Early Earth: Nd and Sr Isotopic Evidence from Diamondiferous Eclogites for Both Old Depleted and Old Enriched Mantle, Yakutia, Siberia***COSMIC RAY EFFECTS, ION IMPLANTATION, AND ORBITS**

Masarik J. Reedy R. C.

*Effects of Bulk Composition on Production Rates of Cosmogenic Nuclides in Meteorites*

Wacker J. F.

*Aluminum-26 Activities in Meteorites*

Michlovich E. Elmore D. Vogt S. Lipschutz M. Masarik J. Reedy R. C.

 *$^{26}Al$  Production Profile and Model Comparisons in Canyon Diablo*

Shima M. Okada A. Nagao K.

*The Chondrite Mihone seki—New Observed Fall*

Pedroni A.

*Abundance and Composition of Solar Kr in the H3-H6 Chondrite Acfer 111*

Sugiura N. Futagami T. Nagai S.

*Implantation of Nitrogen: Effects of Hydrogen and Implantation Energy*

Ponganis K. V. Graf Th. Marti K.

*Low Energy Ion Implantation: Large Mass Fractionation of Argon*

Benoit P. H. Sears D. W. G.

*Meteorites from Recent Amor-type Orbits*

Jackson A. A. Zook H. A.

*Orbital Evolution of Dust from Comet Schwassmann-Wachmann 1: A Case of One-to-One Resonance Trapping***REMOTE SENSING/SPACE WEATHERING**

Clark B. E. Fanale F. P. Robinson M. S.

*Simulation of Possible Regolith Optical Alteration Effects on Carbonaceous Chondrite Meteorites*

Mustard J. F. Sunshine J. M. Pieters C. M. Hoppin A. Pratt S. F.

*From Minerals to Rocks: Toward Modeling Lithologies with Remote Sensing*

Pieters C. M. Mustard J. F. Pratt S. F. Sunshine J. M. Hoppin A.

*Visible-Infrared Properties of Controlled Laboratory Soils*

Wilson L. Parfitt E. A.

*Formation of Perched Lava Ponds on Basaltic Volcanoes: Interaction Between Cooling Rate and Flow Geometry Allows Estimation of Lava Effusion Rates*

## SOLAR SYSTEM ORIGINS

Ruzmaikina T. V. Khatuncev I. V. Konkina T. V.  
*Formation of the Low-Mass Solar Nebula*

Sears W. D.  
*Diffusive Redistribution of Water Vapor in the Solar Nebula Revisited*

Boss A. P. Myhill E. A.  
*Initiating Solar System Formation Through Stellar Shock Waves*

Malcuit R. J. Winters R. R.  
*Tidal Regime of Inact Planetoid Capture Model for the Earth-Moon System: Does It Relate to the Archean Sedimentary Rock Record?*

## VENUS CRATERS

Ivanov M. A. Basilevsky A. T.  
*Density of Impact Craters on Tessera, Venus*

Wood C. A. Tam W.  
*Morphologic Classes of Impact Basins on Venus*

Wichman R. W.  
*Elevation and Igneous Crater Modification on Venus: Implications for Magmatic Volatile Content*

Wichman R. W. Schultz P. H.  
*Large Floor-fractured Craters and Isostatic Crater Modification: Implications for Lithospheric Thickness on Venus*

Spudis P. D. Sharpton V. L.  
*Impact Basins on Venus and Some Interplanetary Comparisons*

Speidel D. H.  
*The "Missing" Impact Craters on Venus*

Schultz P. H.  
*Searching for Ancient Venus*

Johnson J. R. Baker V. R.  
*Radar Properties of Several Fluidized Ejecta Blankets on Venus*

Herrick R. R.  
*The Three Ages of Venus: A Hypothesis Based on the Cratering Record*

Alexopoulos J. S. McKinnon W. B.  
*Morphology of Large Impact Craters and Basins on Venus: Implications for Ring Formation*

## VENUS GEOLOGY AND GEOPHYSICS: GLOBAL SYNTHESIS

Törnänen T.  
*Complex Ridged Terrain-Related Ridge Belts on Venus: Global Distribution and Classification*

Manley C. R.  
*Venusian "Pancake" Domes: Insights from Terrestrial Voluminous Silicic Lavas and Thermal Modeling*

Magee Roberts K. Head J. W.  
*Large-scale Volcanism Associated with Coronae on Venus*

Raitala J. Törnänen T. Kauhanen K. Tokkonen T.  
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- Evlanov E. N. Frolov V. A. Prilutskii O. F. Veselova G. V. Rodin A. M. Klingelhöfer G.  
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- Ulamiec S. Svedhem H. Kochan H.  
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 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Martian Geomorphology, Tue. p.m., Room D  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Future Lunar Exploration, Thu. p.m., Room C  
 Lunar Samples Posters, Thu. p.m., LPI  
 Comets and Asteroids Posters, Thu. p.m., LPI

Baguhl M.  
 BaharE.\*  
 Baines K. H.  
 Baines K. H.  
 BainesK. H.  
 Bajt S.  
 Bajt S.  
 Bajt S.  
 Bajt S.  
 Bajt S.  
 Baker V. R.  
 Baker V. R.  
 Baker V. R.  
 Baldwin S. L.  
 Baloga S. M.\*  
 Balogh A.  
 Bame S. J.  
 Banerdt W. B.  
 Banerdt W. B.\*  
 Bansal B. M.  
 Barbera P.  
 Barlow N. G.\*  
 Barlow N. G.\*  
 Barnet C.D.  
 Barnouin O. S.\*  
 Barracough B.  
 Barrett R. A.  
 Barrett R. A.\*  
 Barrett R. A.  
 Basilevsky A. T.  
 Basilevsky A. T.  
 Basilevsky A. T.\*  
 Basilevsky A. T.  
 Basu A.  
 Batchelder M.  
 Baur H.  
 Becker K. J.  
 Becker R. H.\*  
 Becker T. L.  
 Becker T. L.  
 Beckett J. R.\*  
 Beebe R. F.  
 Bell J. F.  
 Bell J. F.  
 BellJ. F.  
 Bell J. F.  
 Bell J. F. III  
 Bell J. F. III  
 Bell J. F. III \*  
 Bell M. S.\*  
 Belton M. J. S.  
 Belton M. J. S.  
 Belton M. J. S.

Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Lunar Geology, Thu. a.m., Room C  
 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Lunar Samples Posters, Thu. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Undifferentiated Meteorites Posters, Thu. p.m., LPI  
 Techniques & Experimental ... Posters, Tue. p.m., LPI  
 Meteorites: Therm. ... Posters, Thu. p.m., LPI  
 Venus Volcanism, Mon. p.m., Room B  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Venus Craters Posters, Tue. p.m., LPI  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Mars: Tectonism and Volcanism, Wed. p.m., Room B  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Mars: Tectonism and Volcanism, Wed. p.m., Room B  
 Moon Rocks, Wed. a.m., Room C  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Martian Geomorphology, Tue. p.m., Room D  
 Educating Young People ... Sciences, Fri. a.m., Room C  
 Outer Solar System Posters, Thu. p.m., LPI  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Future Lunar Exploration, Thu. p.m., Room C  
 Undifferentiated Meteorites Posters, Thu. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Venus Craters Posters, Tue. p.m., LPI  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Venus Volcanism, Mon. p.m., Room B  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 CAIs, Fri. a.m., Room A  
 Outer Solar System Posters, Thu. p.m., LPI  
 Lunar Geology, Thu. a.m., Room C  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Comets and Asteroids, Fri. a.m., Room B  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Lunar Geology, Thu. a.m., Room C  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Future Lunar Exploration, Thu. p.m., Room C  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Comets and Asteroids, Fri. a.m., Room B

- Belton M. J. S.  
 Belton M. J. S.  
 Ben Othman D.  
 Benner L. A. M.  
 Bennett M. E.  
 Bennett M. L.  
 Bennett V.  
 Benoit P. H.  
 Benoit P. H.  
 Benoit P. H.\*  
 Benoit P. H.  
 Benoit P. H.  
 Benz W.  
 Bernhard R. P.\*  
 Betterton W. J.  
 Betterton W. J.  
 Betts B. H.\*  
 Bibring J.-P.  
 Bills B. G.\*  
 Bilotti F.  
 Bindschadler D. L.  
 Bindschadler D. L.  
 Binzel R. P.\*  
 Birch P. V.  
 Bishop J. L.\*  
 Bishop J. L.  
 Bishop K.M.  
 Black R.  
 Blaney D. L.  
 Blaney D. L.  
 Blanford G. E.  
 Blanford G. E.  
 Blewett D. T.\*  
 Blewett D. T.  
 Blum J. D.  
 Blum J. D.\*  
 Blumberg D.  
 Boesenberg J. S.  
 Boesenbergen J. S.  
 Bogard D. D.\*  
 Bogard D. D.  
 Bohor B. F.\*  
 Bohor B. F.  
 Borderies N. J.  
 Borderies N. J.  
 Borg J.  
 Borisov A.  
 Borisov A.  
 Boslough M. B.\*  
 Boss A. P.\*  
 Boss A. P.  
 Bostwick J. A.\*  
 Bottke W. F. Jr.\*  
 Bottomley R. J.\*
- Lunar Geology, Thu. a.m., Room C  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Outer Solar System Posters, Thu. p.m., LPI  
 Meteorites: Therm. ... Posters, Thu. p.m., LPI  
 Meteorites: Therm. ... Posters, Thu. p.m., LPI  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Meteorites: Therm. ... Posters, Thu. p.m., LPI  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Cosmic Ray ... Orbit Posters, Tue. p.m., LPI  
 Lunar Samples Posters, Thu. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Venus Gravity ... Mars Geophysic, Tue. p.m., Room B  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Basaltic Achondrites, Mon. a.m., Room A  
 Comets and Asteroids, Fri. a.m., Room B  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Moon Rocks, Wed. a.m., Room C  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Outer Solar System, Thu. p.m., Room B  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Lunar Geology, Thu. a.m., Room C  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Martian Geomorphology, Tue. p.m., Room D  
 Techniques & Experimental ... Posters, Tue. p.m., LPI  
 Basaltic Achondrites, Mon. a.m., Room A  
 Primitive Achondrites, Tue. a.m., Room A  
 Moon Rocks, Wed. a.m., Room C  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Venus Gravity ... Mars Geophysic, Tue. p.m., Room B  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Interplanetary Dust... Posters, Thu. p.m., LPI  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Techniques & Experimental ... Posters, Tue. p.m., LPI  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Solar System Origins, Mon. a.m., Room C  
 Solar Systems Origin Posters, Tue. p.m., LPI  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Comets and Asteroids, Fri. a.m., Room B  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D
- Boundy-Sanders S. Q.  
 Bowers C.  
 Boyce J. M.\*  
 Boyd W. T.  
 Boynton W. V.  
 Boynton W. V.\*  
 Brackett R. A.\*  
 Bradley J. P.\*  
 Bradley J. P.  
 Brandstätter F.  
 Brandstätter F.\*  
 Brandstätter F.  
 Brandt D.\*  
 Brandvold J. B.  
 Brannon J. C.  
 Brearley A. J.  
 Brearley A. J.  
 Brearley A. J.\*  
 Brekke D. W.  
 Bridges N. T.  
 Bridges N. T.  
 Brilliant D. R.\*  
 Brinton K. L. F.  
 Britt D. T.\*  
 Brizi E.  
 Brooks R. R.  
 Brown C. D.\*  
 Brown L. E.  
 Brown R. H.  
 Browning L. B.\*  
 Brownlee D. E.  
 Brownlee D. E.\*  
 Brueneman D. J.  
 Bruno B. C.\*  
 Bruno B. C.  
 Buchanan P. C.  
 Buck W. R.\*  
 Bullock M. A.  
 Bullock M. A.  
 Bulmer M. H.\*  
 Bunch T. E.  
 Burbine T. H.  
 Burbine T. H.  
 Burke K.  
 Burkland M. K.\*  
 Burl M. C.  
 Burnett D. S.  
 BumsR.G.\*  
 BumsR.G.  
 BumsR.G.  
 Bums R.G.  
 Burt J. D.\*  
 Burt W. W.  
 Buseck P. R.
- Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Comets and Asteroids, Fri. a.m., Room B  
 Outer Solar System, Thu. p.m., Room B  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Primitive Achondrites, Tue. a.m., Room A  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Undifferentiated Meteorites Posters, Thu. p.m., LPI  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Exploration Posters, Thu. p.m., LPI  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Mars: Geol./Geophy. Processes Posters, Thu. p.m., LPI  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Lunar Samples Posters, Thu. p.m., LPI  
 Comets and Asteroids, Fri. a.m., Room B  
 Meteorites: Therm. ... Posters, Thu. p.m., LPI  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Exploration Posters, Thu. p.m., LPI  
 Mars: Tectonism and Volcanism, Wed. p.m., Room B  
 Martian Geomorphology, Tue. p.m., Room D  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Venus Volcanism, Mon. p.m., Room B  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Outer Solar System Posters, Thu. p.m., LPI  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Future Lunar Exploration, Thu. p.m., Room C  
 Asteroid and Planetary Core..., Thu. a.m., Room D

Buseck P. R.  
 Buseck P. R.  
 Bussey D. B. J.\*  
 Busso M.  
 Byrd R.  
 Cabrol N. A.  
 Caffee M. W.  
 Calvin W.M.  
 Calvin W.M.  
 Cameron A. G. W.\*  
 Campbell B. A.\*  
 Campbell B. A.  
 Campbell D. B.\*  
 Capo R.C.  
 Carey S.\*  
 Carlson R. W.  
 Carlson R. W.  
 Carter J. L.  
 Casanova I.\*  
 Casanova I.\*  
 Casier J.-G.  
 Cassen P.\*  
 Cellino A.  
 Cerroni P.  
 Cerroni P.  
 Chadwick D. J.\*  
 Chadwick D. J.\*  
 Chaky D.A.  
 Chamberlain C. P.\*  
 Chamberlain C. P.  
 Chambers J. G.  
 Chang S.  
 Chapman C. R.\*  
 Chapman M. G.  
 Chen G.  
 Chen J. H.\*  
 Cheng A. F.\*  
 Chicarro A. F.\*  
 Ching D.\*  
 Christensen P. R.\*  
 Christensen P. R.  
 Chyba C. F.  
 Cintala M. J.  
 Claeys P.  
 Claeys P.\*  
 Clark B. E.  
 Clark B. E.  
 Clark B. E.  
 Clark B. E.\*  
 Clark B. E.  
 Clark B. C.  
 Clark P. E.  
 Clarke R. S. Jr.  
 Clayton D. D.\*

Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Heat Sources for Chondrule/CAI Melting, Fri. a.m., Room A  
 Venus Volcanism, Mon. p.m., Room B  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 Future Lunar Exploration, Thu. p.m., Room C  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Solar System Origins., Mon. a.m., Room C  
 Venus Volcanism, Mon. p.m., Room B  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Lunar Geology, Thu. a.m., Room C  
 Basaltic Achondrites, Mon. a.m., Room A  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Lunar Geology, Thu. a.m., Room C  
 Primitive Achondrites, Tue. a.m., Room A  
 CAIs, Fri. a.m., Room A  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Solar System Origins., Mon. a.m., Room C  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Large Impact Events: Theory & Observ., Tue. p.m., Room C  
 Mars: Tectonism and Volcanism, Wed. p.m., Room B  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Exploration Posters, Thu. p.m., LPI  
 Comets and Asteroids, Fri. a.m., Room B  
 Comets and Asteroids, Fri. a.m., Room B  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Future Lunar Exploration, Thu. p.m., Room C  
 Future Lunar Exploration, Thu. p.m., Room C  
 Martian Geomorphology, Tue. p.m., Room D  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Martian Geomorphology, Tue. p.m., Room D  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Remote Sensing/Space Weathering Posters, Tue. p.m., LPI  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Comets and Asteroids, Fri. a.m., Room B  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Future Lunar Exploration, Thu. p.m., Room C  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A

Clayton R. N.  
 Clemett S. J.\*  
 Clifford S. M.  
 Cocheo P. A.  
 Collins J.  
 Collins W.  
 Collinson D. W.\*  
 Colson R. O.\*  
 Colvin T. R.  
 Colwell J. E.  
 Connolly H. C. Jr.\*  
 Connors C.  
 Cook A.C.  
 Coombs C.R.  
 Coombs C.R.  
 Cooper B. L.\*  
 Coradini A.  
 Coradini A.  
 Coradini A.  
 Costard F. M.  
 Cotugno K.  
 Craddock R. A.\*  
 Crawford D. A.\*  
 Creaser R. A.\*  
 Crisp D.\*  
 Crisp D.  
 Croft S. K.\*  
 Crofts S. K.  
 Crossey L. J.\*  
 Crowell L. B.  
 Crown D. A.  
 Crozaz G.  
 Crozaz G.\*  
 Crumpler L. S.  
 Crumpler L. S.  
 Crumpler L. S.  
 Cushing J. A.\*  
 Cygan R. T.  
 D'Aria D.M.  
 D'Hondt S.  
 Dakryple G. B.  
 Danielson G. E.  
 Dasch E. J.  
 Davies M. E.  
 Davies M. E.  
 Davis A. M.  
 Davis A. M.\*  
 Davis A. M.

Primitive Achondrites, Tue. a.m., Room A  
 Solar System Origins., Mon. a.m., Room C  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 CAIs, Fri. a.m., Room A  
 Terrestrial Studies Posters, Tue. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Basaltic Achondrites, Mon. a.m., Room A  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Heat Sources for Chondrule/CAI Melting, Fri. a.m., Room A  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Lunar Geology, Thu. a.m., Room C  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Lunar Geology, Thu. a.m., Room C  
 Outer Solar System Posters, Thu. p.m., LPI  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Martian Geomorphology, Tue. p.m., Room D  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Outer Solar System, Thu. p.m., Room B  
 Outer Solar System Posters, Thu. p.m., LPI  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Martian Geomorphology, Tue. p.m., Room D  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Moon Rocks, Wed. a.m., Room C  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Moon Rocks, Wed. a.m., Room C  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Lunar Samples Posters, Thu. p.m., LPI  
 Exploration Posters, Thu. p.m., LPI  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Primitive Achondrites, Tue. a.m., Room A  
 CAIs, Fri. a.m., Room A

Davis D. R.  
 Dawidowicz G.  
 Day T.  
 De Angelis G.  
 De HonR. A.\*  
 DeHart J. M.  
 DeHartJ. M.  
 Deines P.  
 DeJong E.  
 Delaney J. S.  
 Delaney J. S.\*  
 Delano J. W.\*  
 Deloule E.\*  
 DenkT.\*  
 Des Marais D.  
 Dickinson T. L.  
 Dodd R. T.\*  
 DohmJ. M.  
 Dolginov A. Z.\*  
 Dolginov A. Z.  
 Dollfus A.\*  
 Dollfus A.  
 Domanik K. J.  
 Domergue-Schmidt N.\*  
 Donahue D. J.  
 Dong Q. W.  
 Douglas C.  
 Drake D.  
 Drake M. J.  
 Drossart P.  
 Dueck S.  
 Durham W. B.  
 Ebisawa S.  
 Edgett K. S.  
 Edwards B. C.  
 EdwardsK.  
 EdwardsK.  
 Eisenhour D. D.\*  
 Eisenhour D. D.  
 El Eid M.  
 El Goresy A.  
 Ellis S. B.  
 Ellison M.  
 Elmore D.  
 Elphic R. C.  
 EncrenazT.  
 England A. W.  
 EngrandC.  
 Epstein S.  
 Epstein S.  
 Erard S.  
 Erard S.  
 Erard S.  
 Erard S.

Comets and Asteroids Posters, Thu. p.m., LPI  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Undifferentiated Meteorites Posters, Thu. p.m., LPI  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Terrestrial Studies Posters, Tue. p.m., LPI  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Techniques & Experimental ... Posters, Tue. p.m., LPI  
 Basaltic Achondrites, Mon. a.m., Room A  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 CAIs, Fri. a.m., Room A  
 Outer Solar System, Thu. p.m., Room B  
 Exploration Posters, Thu. p.m., LPI  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Solar System Origins., Mon. a.m., Room C  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Future Lunar Exploration, Thu. p.m., Room C  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Educating Young People...Sciences, Fri. a.m., Room C  
 Outer Solar System, Thu. p.m., Room B  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Future Lunar Exploration, Thu. p.m., Room C  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Heat Sources for Chondrule/CAI Melting, Fri. a.m., Room A  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 CAIs, Fri. a.m., Room A  
 Outer Solar System Posters, Thu. p.m., LPI  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Cosmic Ray ... Orbits Posters, Tue. p.m., LPI  
 Exploration Posters, Thu. p.m., LPI  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Outer Solar System Posters, Thu. p.m., LPI  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Comets and Asteroids, Fri. a.m., Room B  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI

Emst R. E.  
 EsatT. M.\*  
 Esat T. M.  
 Espindola J. M.\*  
 EugsterO.\*  
 Eugster O.  
 Evans L. G.  
 Evans N. J.  
 Evergreen H.S. Research Class  
 Evlanov E. N.  
 Fagents S. A.  
 Fanale F. P.\*  
 Fanale F.P.  
 Fanale F.P.  
 Fanale F. P.  
 Farinella P.  
 Faris J. L.  
 Farmer J. D.  
 Farrand W. H.\*  
 Fayyad U. M.  
 Fechtig H.  
 Federico C.  
 Fegley B. Jr.\*  
 Feldman W.  
 Ferrante R.  
 Finkel R. C.  
 Finnla A. B.\*  
 Fischer E. M.  
 Fischer E. M.  
 Fischer E. M.  
 Fisenko A. V.  
 Fisher D. S.  
 Fiske P. S.\*  
 Flynn G.J.  
 Flynn G. J.\*  
 Flynn G.J.  
 Fogel R. A.\*  
 Fogel R. A.  
 Foh J.  
 Fomenkova M.\*  
 Ford D. J.\*  
 Ford P. G.  
 Formi O.  
 Forsyth R.  
 Forsythe J.  
 Foster C. T. Jr.  
 Fowler G. W.  
 Franchi I. A.  
 Franchi I. A.  
 Franchi I. A.  
 Franklin H. A.  
 French B. M.

Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Moon Rocks, Wed. a.m., Room C  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Primitive Achondrites, Tue. a.m., Room A  
 Terrestrial Studies Posters, Tue. p.m., LPI  
 Future Lunar Exploration, Thu. p.m., Room C  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Remote Sensing/Space Weathering Posters, Tue. p.m., LPI  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Comets and Asteroids, Fri. a.m., Room B  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Solar System Origins., Mon. a.m., Room C  
 Exploration Posters, Thu. p.m., LPI  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Outer Solar System Posters, Thu. p.m., LPI  
 Venus Volcanism, Mon. p.m., Room B  
 Future Lunar Exploration, Thu. p.m., Room C  
 Solar System Origins., Mon. a.m., Room C  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Comets and Asteroids, Fri. a.m., Room B  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Large Impact Events: Theory & Observ., Tue. p.m., Room C  
 Outer Solar System Posters, Thu. p.m., LPI  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Basaltic Achondrites, Mon. a.m., Room A  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Primitive Achondrites, Tue. a.m., Room A  
 Exploration Posters, Thu. p.m., LPI  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C

French L. M.  
 Frey H. V.  
 Frey H. V.\*  
 Fricke S. K.  
 Friedman L.  
 Frolov V. A.  
 Fujita T.  
 Funsten H. O. III  
 Futagami T.  
 Gaddis L. R.  
 Gaffey M.J.  
 Gaffey M.J.\*  
 Gaffey M.J.  
 Galileo Imaging Team  
 Galileo SSI Team  
 Galileo SSI Team  
 Galindo C.  
 Gallino R.  
 Ganasan J. P.  
 Ganguly J.  
 Ganguly J.\*  
 Garrison D. H.  
 Garrison D. H.\*  
 Garrison D. H.  
 Garrison D. H.  
 Garvin J. B.\*  
 Gaskell R. W.  
 Gault D. E.  
 Gebhard J.  
 Geissler P. E.  
 Geissler P. E.\*  
 Geissler P. E.  
 Gektin Yu. M.  
 Ghail R. C.  
 Charakanian V.  
 Ghose S.  
 Gibson E. K.  
 Gibson M. A.  
 Gilmore M. S.\*  
 Gilmour I.  
 Gilmour I.\*  
 Girard M.  
 Gladstone G. R.  
 Glass B.P.\*  
 GILL Imaging Team  
 Goguen J. D.  
 Goguen J. D.\*  
 Gold D.P.  
 Golden D.C.  
 Goldsby D. L.\*  
 Goldstein J. I.  
 Golub A. P.  
 Gooding J. L.  
 Gooding J. L.  
 Goodrich C. A.\*

Educating Young People ... Sciences, Fri. a.m., Room C  
 Mars: Geol./Geophy. Processes Posters, Thu. p.m., LPI  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Exploration Posters, Thu. p.m., LPI  
 Cosmic Ray ... Orbits Posters, Tue. p.m., LPI  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Comets and Asteroids, Fri. a.m., Room B  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 Outer Solar System, Thu. p.m., Room B  
 Meteorites: Therm. ... Posters, Thu. p.m., LPI  
 Basaltic Achondrites, Mon. a.m., Room A  
 Primitive Achondrites, Tue. a.m., Room A  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Moon Rocks, Wed. a.m., Room C  
 Venus Volcanism, Mon. p.m., Room B  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Meteorites: Therm. ... Posters, Thu. p.m., LPI  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Exploration Posters, Thu. p.m., LPI  
 Venus Resurfacing and Tectonics, Tue. a.m., Room B  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Lunar Geology, Thu. a.m., Room C  
 Outer Solar System, Thu. p.m., Room B  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Outer Solar System, Thu. p.m., Room B  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Meteorites: Therm. ... Posters, Thu. p.m., LPI  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Primitive Achondrites, Tue. a.m., Room A

Gorsline D. S.  
 Goswami J. N.  
 Grady M. M.  
 Grady M. M.\*  
 Graf J.  
 Graf Th.\*  
 Graf Th.  
 Granahan J. C.  
 Granahan J. C.  
 Grant J. A.\*  
 Grant J. A.  
 Gratz A. J.  
 Greeley R.  
 Greeley R.\*  
 Greeley R.  
 Greeley R.\*  
 Greeley R.  
 Greeley R.  
 Greeley R.  
 Greeley R.  
 Greeley R.  
 Greeley R.  
 Greenberg R.  
 Greenberg R.  
 Greenwood R. C.\*  
 Gregg T. K. P.\*  
 Grégoire D. C.  
 Grieve R. A. F.  
 Grieve R. A. F.  
 Grieve R. A. F.  
 Grimm R. E.  
 Grimm R. E.\*  
 Grimm R. E.\*  
 Grin E. A.  
 Grinspoon D. H.  
 Grosfils E. B.  
 Grosfils E. B.\*  
 Grossman J. N.  
 Grossman L.  
 Grove T. L.  
 Grove T. L.\*  
 GrünE.  
 GrünE.  
 Guest J. E.  
 Guest J. E.  
 Guinness E. A.  
 Guinness E. A.\*  
 Gulick V. C.\*  
 Guo X.  
 Gutierrez D. F.  
 Haack H.\*  
 Hager B. H.  
 Hall G. S.  
 Hall S.  
 Hall S. A.  
 Halliday A. N.

Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Undifferentiated Meteorites Posters, Thu. p.m., LPI  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Exploration Posters, Thu. p.m., LPI  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Cosmic Ray ... Orbits Posters, Tue. p.m., LPI  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Martian Geomorphology, Tue. p.m., Room D  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Future Lunar Exploration, Thu. p.m., Room C  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Martian Geomorphology, Tue. p.m., Room D  
 Outer Solar System, Thu. p.m., Room B  
 Exploration Posters, Thu. p.m., LPI  
 Lunar Geology, Thu. a.m., Room C  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Comets and Asteroids, Fri. a.m., Room B  
 CAIs, Fri. a.m., Room A  
 Mars: Tectonism and Volcanism, Wed. p.m., Room B  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Venus Resurfacing and Tectonics, Tue. a.m., Room B  
 Comets and Asteroids, Fri. a.m., Room B  
 Mars: Geol./Geophy. Processes Posters, Thu. p.m., LPI  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 CAIs, Fri. a.m., Room A  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Basaltic Achondrites, Mon. a.m., Room A  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Venus Volcanism, Mon. p.m., Room B  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Educating Young People ... Sciences, Fri. a.m., Room C  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Terrestrial Studies Posters, Tue. p.m., LPI

Halliday A. N.  
 Hamilton V. E.  
 Hamilton V. E.  
 Hanner M. S.  
 Hansen C. J.\*  
 Hansen G. B.  
 Hansen G. B.  
 Hansen V. L.\*  
 Hansen V. L.  
 Hapke B. W.\*  
 Hargraves R. B.  
 Harlan S. S.  
 Harper C. L. Jr.\*  
 Harrison S. T.  
 Hartmann W. K.  
 Hartmann W. K.\*  
 Hartung J. B.  
 Harvey R. P.  
 Hashimoto A.  
 Haugland M.  
 Hawke B. R.\*  
 Hawke B.R.  
 Head J. W. III  
 Head J. W. III  
 Head J. W. III\*  
 Head J. W. III  
 Head J. W. III \*  
 Head J. W. III  
 Heffernan C.  
 Heirath J.  
 Held P.  
 Helfenstein P.\*  
 Helgerud M. B.  
 Henderson B. G.\*  
 Hennessy C. J.  
 Herkenhoff K. E.\*  
 Herrera P.  
 Herrick R. R.  
 Herrick R. R.  
 Hervig R. L.  
 Hervig R. L.  
 Herzog G. F.  
 Herzog G. F.\*  
 Hess P. C.  
 Hess P. C.\*  
 Hewins R. H.  
 Hiesinger H.\*  
 Hildebrand A. R.  
 Hildebrand A. R.\*  
 Hill D. H.

Moon Rocks, Wed. a.m., Room C  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
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 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Comets and Asteroids, Fri. a.m., Room B  
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 Meteorites: Therm. ... Posters, Thu. p.m., LPI  
 CAIs, Fri. a.m., Room A  
 Lunar Geology, Thu. a.m., Room C  
 Lunar Geology, Thu. a.m., Room C  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Venus Volcanism, Mon. p.m., Room B  
 Lunar Geology, Thu. a.m., Room C  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Future Lunar Exploration, Thu. p.m., Room C  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Venus Resurfacing and Tectonics, Tue. a.m., Room B  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Lunar Geology, Thu. a.m., Room C  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Venus Craters Posters, Tue. p.m., LPI  
 Venus Resurfacing and Tectonics, Tue. a.m., Room B  
 Exploration Posters, Thu. p.m., LPI  
 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Venus Resurfacing and Tectonics, Tue. a.m., Room B  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Heat Sources for Chondrule/CAI Melting, Fri. a.m., Room A  
 Lunar Geology, Thu. a.m., Room C  
 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Primitive Achondrites, Tue. a.m., Room A

Hingston M. J.  
 Hiroi T.  
 Hiroi T.\*  
 Hoffmann H.  
 Hofmann B.  
 Hogenboom D. L.\*  
 Hohenberg C. M.  
 Holloway J. R.  
 Holmann E.  
 Holsapple K. A.\*  
 Holzbecher J.  
 Holzheid A.\*  
 Honda M.  
 Hood L. L.\*  
 Hoppe P.  
 Hoppin A.  
 Horan D. M.  
 Horan M. F.  
 Horanyi M.  
 Horanyi M.  
 Hom L. J.\*  
 Hörz F.  
 Housen K.  
 Howell E.S.  
 Howington-Kraus A.  
 Hsu A.  
 Hsu W.  
 HuaX.\*  
 Huang H.-P.  
 Huang S.\*  
 Hudson R.  
 Hughes S. S.  
 HuiJ.  
 Humayun M.\*  
 Huss G. R.\*  
 Hutcheon I. D.  
 Hutcheon I. D.  
 Hutcheon I. D.  
 Iliffe J. C.  
 Imamura M.  
 Ingwersen A.  
 Ireland T.  
 Isbell N. K.  
 Itoi T.  
 Ivanov A. V.  
 Ivanov B. A.\*  
 Ivanov B. A.  
 Ivanov M. A.  
 Ivanov M. A.  
 Izenberg N. R.\*  
 Izett G. A.\*  
 Izett G. A.  
 Jackson A. A.  
 Jackson M. P. A.

Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Primitive Achondrites, Tue. a.m., Room A  
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 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
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 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Heat Sources for Chondrule/CAI Melting, Fri. a.m., Room A  
 Outer Solar System, Thu. p.m., Room B  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Comets and Asteroids, Fri. a.m., Room B  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 CAIs, Fri. a.m., Room A  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Solar System Origins., Mon. a.m., Room C  
 Lunar Samples Posters, Thu. p.m., LPI  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Solar System Origins., Mon. a.m., Room C  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 Mars: Meteorites and Volatiles, Tue. p.m., Room A  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 CAIs, Fri. a.m., Room A  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Large Impact Events: Theory & Observ., Tue. p.m., Room C  
 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Venus Craters Posters, Tue. p.m., LPI  
 Venus Resurfacing and Tectonics, Tue. a.m., Room B  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Cosmic Ray ... Orbit Posters, Tue. p.m., LPI  
 Outer Solar System, Thu. p.m., Room B

- Jacobsen S. B.\*  
 Jäger H.  
 Jagoutz E.\*  
 Jakosky B. M.  
 Jakosky B. M.  
 Jakosky B. M.  
 Jarosewich E.  
 Jarvis K. S.  
 Jaumann R.  
 Jaumann R.  
 Jerde E. A.\*  
 Jerde E. A.  
 Jerde E. A.  
 Jessberger E. K.  
 Johnson C. L.  
 Johnson J.  
 Johnson J. R.  
 Johnson J. R.  
 Johnson T. V.  
 Johnson T. V.  
 Jolliff B. L.\*  
 Jolliff B. L.  
 Jones C. H.  
 Jones J. H.  
 Jones J. H.  
 Jones J. H.  
 Jones J. H.\*  
 Jones K. W.  
 Jones R. H.  
 Jones R. H.  
 Joswiak D. J.  
 Joswiak D. J.  
 Juenemann D.  
 Juenemann D.  
 Jull A. J. T.  
 Jull A. J. T.  
 Jurewicz A. J. G.  
 Jurewicz A. J. G.\*  
 Jurewicz S. R.  
 Jurewicz S. R.\*  
 Kadel S. D.  
 Kadeis. D.\*  
 Kalleymen G. W.  
 Kalleymen G. W.\*  
 Kamatsu G.  
 Kamp L. W.  
 Kamp L. W.  
 Kanamori H.  
 Kankeleit E.  
 Kargel J. S.\*  
 Kargel J. S.  
 Karlsson H. R.\*  
 Kauhanen K.  
 Kauhanen K.\*
- Asteroid and Planetary Core..., Thu. a.m., Room D  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Mars: Geol./Geophy. Processes Posters, Thu. p.m., LPI  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Lunar Geology, Thu. a.m., Room C  
 Outer Solar System, Thu. p.m., Room B  
 Moon Rocks, Wed. a.m., Room C  
 Terrestrial Studies Posters, Tue. p.m., LPI  
 Exploration Posters, Thu. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Venus Craters Posters, Tue. p.m., LPI  
 Outer Solar System, Thu. p.m., Room B  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Moon Rocks, Wed. a.m., Room C  
 Lunar Samples Posters, Thu. p.m., LPI  
 Exploration Posters, Thu. p.m., LPI  
 Techniques & Experimental ... Posters, Tue. p.m., LPI  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Basaltic Achondrites, Mon. a.m., Room A  
 Meteorites: Therrn ... Posters, Thu. p.m., LPI  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Basaltic Achondrites, Mon. a.m., Room A  
 Techniques & Experimental ... Posters, Tue. p.m., LPI  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Lunar Geology, Thu. a.m., Room C  
 Moon Rocks, Wed. a.m., Room C  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Exploration Posters, Thu. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Outer Solar System, Thu. p.m., Room B  
 Mars: Geol./Geophy. Processes Posters, Thu. p.m., LPI  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Primitive Achondrites, Tue. a.m., Room A  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Moon Rocks, Wed. a.m., Room C  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Exploration Posters, Thu. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Undifferentiated Meteorites Posters, Thu. p.m., LPI  
 CAIs, Fri. a.m., Room A  
 Comets and Asteroids, Fri. a.m., Room B  
 Outer Solar System Posters, Thu. p.m., LPI  
 Comets and Asteroids, Fri. a.m., Room B  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 CAIs, Fri. a.m., Room A  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Solar Systems Origin Posters, Tue. p.m., LPI  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Mars: Tectonism and Volcanism, Wed. p.m., Room B  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Primitive Achondrites, Tue. a.m., Room A  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Lunar Geology, Thu. a.m., Room C  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Exploration Posters, Thu. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Exploration Posters, Thu. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Moon Rocks, Wed. a.m., Room C  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A
- Kauhanen K.  
 Kaula W. M.  
 Kaula W. M.\*  
 Keating P.  
 Keddie S. T.  
 Keep M.  
 KehmK.\*  
 Keil K.  
 KeiIK.  
 KeiIK.  
 KeiIK.  
 KeiIK.  
 Keiswetter D. A.\*  
 Keller L. P.  
 KellerL. P.  
 Keller L. P.\*  
 Keller L. P.  
 Keller L. P.  
 Keller L. P.  
 Kelley M.S.\*  
 Kelly W. D.  
 Kempin M.  
 Kemurjian A.  
 Kennedy A. K.  
 Kerridge J. F.\*  
 Khatuncev I. V.  
 Kiefer W.S.\*  
 Kieffer H. H.\*  
 Kilburn C. R. J.  
 Kim J. S.  
 KimY.  
 KimY.\*  
 Kirk R. L.  
 Kirkpatrick R. J.  
 KisselJ.  
 Kitamura M.  
 Klaasen K.  
 Klaasen K.  
 Klaasen K. P.  
 Klein H.  
 KleinJ.  
 Klein J.  
 Klingelhöfer G.  
 Klöck W.  
 Klöck W.  
 Knudsen C. W.  
 Knudsen J. M.  
 Kobayashi K.  
 Kochan H.  
 Koeberl C.  
 Koeberl C.\*  
 Koeberl C.  
 Koeberl C.  
 Koeberl C.

Koeberl C.  
 Koehler U.\*  
 Kohl C. P.  
 Kohlstedt D. L.  
 Kojima H.  
 Kojima H.  
 Kölzer G.  
 Komatsu G.\*  
 Komatsu G.  
 Konkina T. V.  
 Konopliv A. S.  
 Korotev R. L.\*  
 Koshiishi H.  
 Kousoum J.  
 Kring D. A.  
 Krot A. N.\*  
 Krot T. V.  
 Kubicki J. D.  
 Kucinskas A. B.  
 Kuehn D.M.  
 Kunk M.J.\*  
 Kuramoto K.  
 Kurat G.  
 Kurat G.  
 Kurat G.  
 Kurat G.  
 Kurokawa M.  
 Kyte F. T.  
 LaFave N.  
 Lampkin D. J.  
 Lancaster M. G.  
 Landheim R.  
 Landry J. C.  
 Lapin S. L.  
 Larson S. M.  
 Lauer H. V. Jr.  
 Lauer H. V. Jr.  
 Lauer H. V. Jr.  
 Lauer H. V. Jr.  
 Layne G. D.  
 Le L.  
 Le L.  
 Le Roux F. G.  
 Lebofsky L. A.  
 Lebofsky L. A.\*  
 Lebofsky N. R.  
 Lee L.  
 Lee S.  
 Leenhouw J. M.  
 Lemoine F. G.\*  
 Leonard G. J.\*  
 Lerch F. J.  
 Levison H. F.\*  
 Levy E. H.\*

Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Lunar Geology, Thu. a.m., Room C  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Outer Solar System, Thu. p.m., Room B  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Moon Rocks, Wed. a.m., Room C  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Venus Volcanism, Mon. p.m., Room B  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Solar Systems Origin Posters, Tue. p.m., LPI  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Exploration Posters, Thu. p.m., LPI  
 Venus Volcanism, Mon. p.m., Room B  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Techniques & Experimental ... Posters, Tue. p.m., LPI  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Outer Solar System Posters, Thu. p.m., LPI  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Terrestrial Studies Posters, Tue. p.m., LPI  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Exploration Posters, Thu. p.m., LPI  
 Venus Volcanism, Mon. p.m., Room B  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Exploration Posters, Thu. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Basaltic Achondrites, Mon. a.m., Room A  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Comets and Asteroids, Fri. a.m., Room B  
 Educating Young People ... Sciences, Fri. a.m., Room C  
 Educating Young People ... Sciences, Fri. a.m., Room C  
 Outer Solar System, Thu. p.m., Room B  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Undifferentiated Meteorites Posters, Thu. p.m., LPI  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Martian Geomorphology, Tue. p.m., Room D  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Outer Solar System, Thu. p.m., Room B  
 Solar System Origins., Mon. a.m., Room C

Lewis C. F.  
 Lewis R.S.\*  
 Leyva I. A.\*  
 Lindblad B.-A.  
 Lindstrom D. J.  
 Lindstrom D. J.\*  
 Lindstrom D. J.  
 Lindstrom M. M.\*  
 Lindstrom M. M.\*  
 Linkert D.  
 Linkin V.  
 Lipschutz M. E.  
 Lipschutz M. E.\*  
 Lipschutz M. E.  
 Lipschutz M. E.  
 Liu Y.-G.  
 LoE.  
 Lockwood J. F.  
 Lodders K.  
 Locken Th.\*  
 Lofgren G. E.  
 Lofgren G. E.  
 Lofgren G. E.\*  
 Lofgren G. E.\*  
 Long J. V. P.  
 Longhi J.  
 Longhi J.\*  
 Lopes-Gautier R. M. C.  
 Lopes-Gautier R. M. C.\*  
 Lorenz E.  
 Love S. G.  
 Love S. G.  
 LuJ.  
 Lucchitta B. K.\*  
 Lucchitta B. K.  
 Lucey P. G.  
 Lucey P. G.  
 Lucey P. G.\*  
 Lucey P. G.  
 Lucey P. G.  
 Lucey P. G.  
 Lucey P. G.  
 Luck J. M.  
 Lugmair G. W.  
 Lugmair G. W.  
 Lunine J. I.  
 Maag A.J.  
 Maag C. R.  
 Madsen M. B.  
 Maechling C. R.  
 Maehr S.  
 Magee Roberts K.  
 Magee Roberts K.  
 Magellan Flight Team

Asteroid and Planetary Core..., Thu. a.m., Room D  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Basaltic Achondrites, Mon. a.m., Room A  
 CAIs, Fri. a.m., Room A  
 Lunar Samples Posters, Thu. p.m., LPI  
 Moon Rocks, Wed. a.m., Room C  
 Educating Young People ... Sciences, Fri. a.m., Room C  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Cosmic Ray ... Orbita Posters, Tue. p.m., LPI  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Terrestrial Studies Posters, Tue. p.m., LPI  
 Martian Geomorphology, Tue. p.m., Room D  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Venus Volcanism, Mon. p.m., Room B  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Undifferentiated Meteorites Posters, Thu. p.m., LPI  
 Heat Sources for Chondrule/CAI Melting, Fri. a.m., Room A  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Future Lunar Exploration, Thu. p.m., Room C  
 CAIs, Fri. a.m., Room A  
 Lunar Samples Posters, Thu. p.m., LPI  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Mars: Tectonism and Volcanism, Wed. p.m., Room B  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Meteorites: Therm. ... Posters, Thu. p.m., LPI  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Mars: Tectonism and Volcanism, Wed. p.m., Room B  
 Lunar Geology, Thu. a.m., Room C  
 Exploration Posters, Thu. p.m., LPI  
 Future Lunar Exploration, Thu. p.m., Room C  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Comets and Asteroids, Fri. a.m., Room B  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Basaltic Achondrites, Mon. a.m., Room A  
 Primitive Achondrites, Tue. a.m., Room A  
 Outer Solar System Posters, Thu. p.m., LPI  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Venus Volcanism, Mon. p.m., Room B  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Venus Resurfacing and Tectonics, Tue. a.m., Room B

Malcuit R. J.  
 Malhotra R.\*  
 Malin M.C.  
 Malin M. C.\*  
 Manley C. R.  
 Mann I.  
 Marchenkova K. I.\*  
 Marin L. E.  
 Marti K.  
 Marti K.  
 Marti K.  
 Marti K.  
 Martin M.  
 Martin R. A.  
 Martin R. A.  
 Martin T.Z.  
 Martin T.Z.  
 Martinez R. R.  
 Martinez R. R.  
 Martinez R. R.  
 Martinez R. R.  
 Masarik J.  
 Masarik J.  
 Masuda A.  
 Matson D. L.\*  
 Matson D. L.  
 Matsui T.  
 Matsui T.  
 Matsushima K.  
 Maureer M.J.  
 Maurette M.  
 Maurette M.  
 Mayeda T. K.  
 McCarthy J. J.  
 McCarville P.  
 McCord T. B.  
 McCord T. B.  
 McCoy T. J.\*  
 McCoy T. J.\*  
 McCoy T. J.  
 McCulloch M. T.  
 McDonald J. S.  
 McDonnell J. A. M.\*  
 McDonnell J. A. M.  
 McEwen A. S.\*  
 McEwen A. S.\*  
 McEwen A. S.  
 McEwen A. S.  
 McEwen A. S.  
 McGee J. J.

**Solar Systems Origin Posters, Tue. p.m., LPI**  
**Solar System Origins., Mon. a.m., Room C**  
**Venus Resurfacing and Tectonics, Tue. a.m., Room B**  
**Martian Geomorphology, Tue. p.m., Room D**  
**Venus ... Global Synthesis Posters, Tue. p.m., LPI**  
**Solar, Cosmic Ray ... Studies, Mon. p.m., Room A**  
**Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B**  
**Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C**  
**Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C**  
**Primitive Achondrites, Tue. a.m., Room A**  
**Solar, Cosmic Ray ... Studies, Mon. p.m., Room A**  
**Cosmic Ray ... Orbits Posters, Tue. p.m., LPI**  
**Educating Young People...Sciences, Fri. a.m., Room C**  
**Comets and Asteroids, Fri. a.m., Room B**  
**Future Lunar Exploration, Thu. p.m., Room C**  
**Mars Surface Mineralogy ... Posters, Thu. p.m., LPI**  
**Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI**  
**Basaltic Achondrites, Mon. a.m., Room A**  
**Lunar Samples Posters, Thu. p.m., LPI**  
**CAIs, Fri. a.m., Room A**  
**Cosmic Ray ... Orbits Posters, Tue. p.m., LPI**  
**Solar, Cosmic Ray ... Studies, Mon. p.m., Room A**  
**Moon Rocks, Wed. a.m., Room C**  
**Outer Solar System, Thu. p.m., Room B**  
**Galileo Earth/Moon Results, Tue. p.m., Room C**  
**Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI**  
**Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI**  
**Exploration Posters, Thu. p.m., LPI**  
**Venus Resurfacing and Tectonics, Tue. a.m., Room B**  
**Interplanetary Dust ... Posters, Thu. p.m., LPI**  
**Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A**  
**Primitive Achondrites, Tue. a.m., Room A**  
**Martian Meteorites and Volatiles, Tue. p.m., Room A**  
**Differentiated Meteorites Posters, Tue. p.m., LPI**  
**Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A**  
**Terrestrial Studies Posters, Tue. p.m., LPI**  
**Venus Gravity ... Mars Geophysics, Tue. p.m., Room B**  
**Manson: The Hole and Shocking Story, Mon. p.m., Room C**  
**Future Lunar Exploration, Thu. p.m., Room C**  
**Galileo Earth/Moon Results, Tue. p.m., Room C**  
**Primitive Achondrites, Tue. a.m., Room A**  
**Martian Meteorites and Volatiles, Tue. p.m., Room A**  
**Ordinary and Enstatite Chondrites, Wed. p.m., Room A**  
**Moon Rocks, Wed. a.m., Room C**  
**Lunar Remote Sensing Posters, Thu. p.m., LPI**  
**Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A**  
**Solar, Cosmic Ray ... Studies, Mon. p.m., Room A**  
**Future Lunar Exploration, Thu. p.m., Room C**  
**Galileo Earth/Moon Results, Tue. p.m., Room C**  
**Exploration Posters, Thu. p.m., LPI**  
**Mars Surface Mineralogy ... Posters, Thu. p.m., LPI**  
**Lunar Remote Sensing Posters, Thu. p.m., LPI**  
**Lunar Geology, Thu. a.m., Room C**  
**Manson: The Hole and Shocking Story, Mon. p.m., Room C**

McGovern P. J.  
 McKay D. S.  
 McKay D. S.  
 McKay D. S.  
 McKay D. S.\*  
 McKay D. S.  
 McKay G. A.\*  
 McKay G. A.  
 McKinnon W. B.  
 McKinnon W. B.  
 McSween H. Y. Jr.  
 McSween H. Y. Jr.  
 McSween H. Y. Jr.  
 Meeker G.P.\*  
 MehlmanR.  
 Melchior R. C.  
 Melendrez D. E.  
 Mellon M. T.  
 Mellon M. T.\*  
 Melosh H. J.  
 Melosh H. J.  
 Mendell W. W.\*  
 Mendell W. W.  
 MerenyiE.\*  
 Metzger S. M.\*  
 MeyerC.\*  
 Michaels G.  
 Michlovich E.  
 Middleton R.  
 Middleton R.  
 Miller J. S.\*  
 MinMapTeam  
 Misawa K.  
 Misawa K.\*  
 Mittlefehldt D. W.\*  
 Mittlefehldt D. W.\*  
 Miura Y.  
 Miyamoto M.  
 Moersch J.  
 Molin G. M.  
 Montanari A.  
 Moore H. J.  
 Moore J. M.\*  
 Moore J. M.  
 Moore M.  
 Morden S. J.  
 MoreSiL.\*  
 Morfill G. E.  
 Morgan J. W.  
 Mori Y.  
 Moroz L. V.  
 Moroz V. I.\*  
 Morris R. V.  
 Morris R. V.

**Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI**  
**Exploration Posters, Thu. p.m., LPI**  
**Remote Sensing/Space Weathering, Tue. p.m., Room D**  
**Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A**  
**Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C**  
**Lunar Samples Posters, Thu. p.m., LPI**  
**Martian Meteorites and Volatiles, Tue. p.m., Room A**  
**Basaltic Achondrites, Mon. a.m., Room A**  
**Outer Solar System Posters, Thu. p.m., LPI**  
**Venus Craters Posters, Tue. p.m., LPI**  
**Meteorites: Therm. ... Posters, Thu. p.m., LPI**  
**Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A**  
**Comets and Asteroids, Fri. a.m., Room B**  
**CAIs, Fri. a.m., Room A**  
**Galileo Earth/Moon Results, Tue. p.m., Room C**  
**Educating Young People ... Sciences, Fri. a.m., Room C**  
**Lunar Remote Sensing Posters, Thu. p.m., LPI**  
**Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI**  
**Mars: Surface and Atmos. Processes, Thu. a.m., Room B**  
**Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI**  
**Solar, Cosmic Ray ... Studies, Mon. p.m., Room A**  
**Lunar Geology, Thu. a.m., Room C**  
**Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI**  
**Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B**  
**Educating Young People ... Sciences, Fri. a.m., Room C**  
**Future Lunar Exploration, Thu. p.m., Room C**  
**Venus Volcanism, Mon. p.m., Room B**  
**Cosmic Ray ... Orbits Posters, Tue. p.m., LPI**  
**Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI**  
**Solar, Cosmic Ray ... Studies, Mon. p.m., Room A**  
**Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B**  
**Future Lunar Exploration, Thu. p.m., Room C**  
**Moon Rocks, Wed. a.m., Room C**  
**Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A**  
**Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C**  
**Basaltic Achondrites, Mon. a.m., Room A**  
**Undifferentiated Meteorites Posters, Thu. p.m., LPI**  
**Lunar Samples Posters, Thu. p.m., LPI**  
**Galileo Earth/Moon Results, Tue. p.m., Room C**  
**Meteorites: Therm. ... Posters, Thu. p.m., LPI**  
**Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI**  
**Venus Volcanism and Geology Posters, Tue. p.m., LPI**  
**Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B**  
**Outer Solar System Posters, Thu. p.m., LPI**  
**Solar System Origins., Mon. a.m., Room C**  
**Basaltic Achondrites, Mon. a.m., Room A**  
**Venus Gravity ... Mars Geophysics, Tue. p.m., Room B**  
**Solar, Cosmic Ray ... Studies, Mon. p.m., Room A**  
**Asteroid and Planetary Core..., Thu. a.m., Room D**  
**Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A**  
**Mars Surface Mineralogy ... Posters, Thu. p.m., LPI**  
**Mars: Surface and Atmos. Processes, Thu. a.m., Room B**  
**Comets and Asteroids Posters, Thu. p.m., LPI**  
**Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C**

Morris R. V.  
 Morris R. V.  
 Morris R. V.\*  
 Morrissey M. L.  
 Morse A. D.  
 Morse A. D.  
 Moss C. E.\*  
 Mouginis-Mark P. J.\*  
 Mouginis-Mark P. J.  
 Mouginis-Mark P. J.  
 Muller J.-P.  
 Murchie S. L.\*  
 Murchie S. L.\*  
 Murphy D. L.  
 Murphy J. R.\*  
 Murray B. C.  
 Murray J. B.  
 Musselwhite D.  
 Mustard J. F.  
 Mustard J. F.  
 Mustard J. F.\*  
 Mustard J. F.  
 Myhill E. A.  
 Nagahara H.\*  
 Nagai H.  
 Nagai S.  
 Nagao K.  
 Nagasawa H.  
 Nakamura N.  
 Nakano G. H.  
 Naraeva M. K.  
 NASA Partners-in-Space Team  
 Nazarov M.  
 Neal C. R.\*  
 Nellis W. J.  
 Nelson R. M.\*  
 Nemchinov I. V.  
 Nemchinov I. V.  
 Neiem R. S.  
 Nerem S.  
 Ness R. O.  
 Neukum G.\*  
 Neukum G.  
 Neukum G.  
 Neukum G.  
 Neukum G.  
 Newsom H. E.\*  
 Newton J.  
 Nguyen T.  
 Nichols R. H. Jr.  
 Niedermann S.  
 Niedermann S.  
 Nier A. O.\*

**Exploration Posters, Thu. p.m., LPI**  
**Remote Sensing/Space Weathering, Tue. p.m., Room D**  
**Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B**  
**Educating Young People ... Sciences, Fri. a.m., Room C**  
**CAIs, Fri. a.m., Room A**  
**Undifferentiated Meteorites Posters, Thu. p.m., LPI**  
**Future Lunar Exploration, Thu. p.m., Room C**  
**Mars: Tectonism and Volcanism, Wed. p.m., Room B**  
**Martian Geomorphology, Tue. p.m., Room D**  
**Educating Young People ... Sciences, Fri. a.m., Room C**  
**Mars: Geol./Geophy. Processes Posters, Thu. p.m., LPI**  
**Comets and Asteroids, Fri. a.m., Room B**  
**Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B**  
**Exploration Posters, Thu. p.m., LPI**  
**Mars: Surface and Atmos. Processes, Thu. a.m., Room B**  
**Mars: Surface and Atmos. Processes, Thu. a.m., Room B**  
**Mars: Geol./Geophy. Processes Posters, Thu. p.m., LPI**  
**Differentiated Meteorites Posters, Tue. p.m., LPI**  
**Lunar Remote Sensing Posters, Thu. p.m., LPI**  
**Lunar Geology, Thu. a.m., Room C**  
**Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B**  
**Remote Sensing/Space Weathering Posters, Tue. p.m., LPI**  
**Solar Systems Origin Posters, Tue. p.m., LPI**  
**CAIs, Fri. a.m., Room A**  
**Solar, Cosmic Ray ... Studies, Mon. p.m., Room A**  
**Cosmic Ray ... Orbits Posters, Tue. p.m., LPI**  
**Cosmic Ray ... Orbits Posters, Tue. p.m., LPI**  
**Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A**  
**Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A**  
**Future Lunar Exploration, Thu. p.m., Room C**  
**Mars: Surface and Atmos. Processes, Thu. a.m., Room B**  
**Educating Young People ... Sciences, Fri. a.m., Room C**  
**Differentiated Meteorites Posters, Tue. p.m., LPI**  
**Moon Rocks, Wed. a.m., Room C**  
**Impact Cratering and Shock Metamorphism, Mon. a.m., Room D**  
**Remote Sensing/Space Weathering, Tue. p.m., Room D**  
**Mars: Geol./Geophy. Processes Posters, Thu. p.m., LPI**  
**Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI**  
**Venus Gravity ... Mars Geophysics, Tue. p.m., Room B**  
**Venus Gravity ... Mars Geophysics, Tue. p.m., Room B**  
**Exploration Posters, Thu. p.m., LPI**  
**Future Lunar Exploration, Thu. p.m., Room C**  
**Galileo Earth/Moon Results, Tue. p.m., Room C**  
**Lunar Geology, Thu. a.m., Room C**  
**Outer Solar System, Thu. p.m., Room B**  
**Lunar Remote Sensing Posters, Thu. p.m., LPI**  
**Comets and Asteroids, Fri. a.m., Room B**  
**Asteroid and Planetary Core..., Thu. a.m., Room D**  
**Undifferentiated Meteorites Posters, Thu. p.m., LPI**  
**Exploration Posters, Thu. p.m., LPI**  
**Ordinary and Enstatite Chondrites, Wed. p.m., Room A**  
**Terrestrial Studies Posters, Tue. p.m., LPI**  
**Solar, Cosmic Ray ... Studies, Mon. p.m., Room A**  
**Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A**

Nishi J. M.  
 Nishiizumi K.\*  
 Nishiizumi K.  
 Nittler L. R.\*  
 Nolan M.C.  
 Noma Y.  
 Norman M. D.\*  
 Nonis J. A.\*  
 Nozette S.  
 Nozette S.  
 Ruth J.\*  
 Nyquist L. E.\*  
 Nyquist L. E.  
 O'Bryan M. V.  
 O'Keefe J. D.\*  
 Oberst J.  
 Ocampo A. C.  
 Ocampo A. C.  
 Oder R. R.  
 Okada A.  
 Olsen E. J.  
 Orenberg J. B.  
 Ortiz Aleman C. O.  
 Otsuki M.  
 Owen T.  
 Paige D. A.  
 Paillat O.\*  
 Palme H.  
 Palme H.\*  
 Palme H.  
 Palme H.  
 Paolicchi P.  
 Papanastassiou D. A.  
 Papanastassiou D. A.\*  
 Papike J. J.  
 Papike J. J.\*  
 Pappalardo R.\*  
 Paque J. M.  
 Parfitt E. A.  
 Parfitt E. A.  
 Parfitt E. A.  
 Parker T. J.  
 Parker T. J.\*  
 Parmentier E. M.\*  
 Parmentier E. M.  
 Patchen A.  
 Patel G. B.  
 Patterson W.  
 Pedroni A.  
 Pellas P.  
 Peng H.  
 Pepin R. O.  
 Perelomova A. A.  
 Perreau M.

Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Moon Rocks, Wed. a.m., Room C  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 Comets and Asteroids, Fri. a.m., Room B  
 Undifferentiated Meteorites Posters, Thu. p.m., LPI  
 Moon Rocks, Wed. a.m., Room C  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Exploration Posters, Thu. p.m., LPI  
 Future Lunar Exploration, Thu. p.m., Room C  
 Solar System Origins., Mon. a.m., Room C  
 Moon Rocks, Wed. a.m., Room C  
 Lunar Samples Posters, Thu. p.m., LPI  
 Solar System Origins., Mon. a.m., Room C  
 Large Impact Events: Theory & Observ., Tue. p.m., Room C  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Exploration Posters, Thu. p.m., LPI  
 Cosmic Ray ... Orbits Posters, Tue. p.m., LPI  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Primitive Achondrites, Tue. a.m., Room A  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Outer Solar System, Thu. p.m., Room B  
 CAIs, Fri. a.m., Room A  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Techniques & Experimental ... Posters, Tue. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Basaltic Achondrites, Mon. a.m., Room A  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Basaltic Achondrites, Mon. a.m., Room A  
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 CAIs, Fri. a.m., Room A  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Mars: Geol./Geophy. Processes Posters, Thu. p.m., LPI  
 Remote Sensing/Space Weathering Posters, Tue. p.m., LPI  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Venus Resurfacing and Tectonics, Tue. a.m., Room B  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Exploration Posters, Thu. p.m., LPI  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Cosmic Ray ... Orbits Posters, Tue. p.m., LPI  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Mars: Geol./Geophy. Processes Posters, Thu. p.m., LPI  
 Interplanetary Dust ... Posters, Thu. p.m., LPI

Perron C.  
 Petaev M. I.\*  
 Petaev M. I.  
 Peterson C. A.  
 Peterson C. A.  
 Phillips J. L.  
 Phillips R.J.\*  
 Phillips R. J.  
 Phinney W. C.\*  
 Piatek J. L.  
 Pierazzo E.  
 Pieters C. M.\*  
 Pieters C. M.\*  
 Pieters C. M.  
 Pilcher C.  
 Pilkington M.  
 Pillinger C. T.  
 Pimperl M. M.  
 Pinkerton H.  
 Pinkerton H.  
 Plaut J. J.  
 Plaut J. J.  
 Plescia J. B.\*  
 Plescia J. B.\*  
 Plutchak J.  
 Podosek F. A.\*  
 Poelstra K.  
 Polanskey C.  
 Pollack J. B.  
 Pollack J. B.  
 Ponganis K. V.  
 Pope K.O.  
 Posado-Cano R.  
 Postawko S. E.  
 Postawko S. E.\*  
 Pratt S. F.  
 Pratt S. F.  
 Premo W. R.  
 Premo W. R.\*

Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Primitive Achondrites, Tue. a.m., Room A  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Lunar Geology, Thu. a.m., Room C  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Venus Resurfacing and Tectonics, Tue. a.m., Room B  
 Basaltic Achondrites, Mon. a.m., Room A  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Future Lunar Exploration, Thu. p.m., Room C  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Lunar Geology, Thu. a.m., Room C  
 Comets and Asteroids, Fri. a.m., Room B  
 Exploration Posters, Thu. p.m., LPI  
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 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
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 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Undifferentiated Meteorites Posters, Thu. p.m., LPI  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Primitive Achondrites, Tue. a.m., Room A  
 Exploration Posters, Thu. p.m., LPI  
 Venus Volcanism, Mon. p.m., Room B  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Mars: Tectonism and Volcanism, Wed. p.m., Room B  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Cosmic Ray ... Orbits Posters, Tue. p.m., LPI  
 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Mars: Oeol/Geophy. Processes Posters, Thu. p.m., LPI  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Educating Young People ... Sciences, Fri. a.m., Room C  
 Lunar Geology, Thu. a.m., Room C  
 Remote Sensing/Space Weathering Posters, Tue. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Lunar Samples Posters, Thu. p.m., LPI  
 Moon Rocks, Wed. a.m., Room C

Premo W. R.\*  
 Presley M. A.\*  
 Prosper Th.\*  
 Prosper Th.  
 Price K. H.  
 Price M.  
 Prilutskii O. F.  
 Prinz M.  
 Prinz M.\*  
 Prinz M.  
 Prinz M.  
 Quezada-Muñeton J. M.  
 Quick J. E.  
 Raitala J.  
 Raitala J.\*  
 Raiteri C. M.  
 Rao M. N.\*  
 Reagan M. K.  
 Rebhan H.  
 Reed K. L.  
 Reedy R. C.\*  
 Reedy R. C.  
 Reid A.M.  
 Reid A. M.  
 Reid A. M.  
 Reidy A.-M.  
 Reimold W. U.  
 Reimold W. U.  
 Reimold W. U.  
 Reimold W. U.  
 Reyes-Ruiz M.\*  
 Reynolds R. L.  
 Rice A.  
 Riecco S. R.  
 Rietmeijer F. J. M.\*  
 Rivers M. L.  
 Rivers M. L.  
 Rivers M. L.  
 Roark J.  
 Roark J. H.  
 Roberts K. M.  
 Robinson C. A.\*  
 Robinson M. S.  
 Robinson M. S.  
 Robinson M. S.  
 Robinson M. S.\*  
 Robinson M. S.\*  
 Robinson M. S.  
 Roddy D. J.\*  
 Rode O. D.  
 Rodin A. M.  
 Roest W. R.  
 Rogers P.G.

Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Undifferentiated Meteorites Posters, Thu. p.m., LPI  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Primitive Achondrites, Tue. a.m., Room A  
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 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
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 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
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 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
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 Cosmic Ray ... Orbits Posters, Tue. p.m., LPI  
 Large Impact Events: Theory & Observ., Tue. p.m., Room C  
 Differentiated Meteorites Posters, Tue. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Terrestrial Studies Posters, Tue. p.m., LPI  
 Large Impact Events: Theory & Observ., Tue. p.m., Room C  
 Solar System Origins., Mon. a.m., Room C  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
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 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Techniques & Experimental ... Posters, Tue. p.m., LPI  
 Meteorites: Thern. ... Posters, Thu. p.m., LPI  
 Lunar Samples Posters, Thu. p.m., LPI  
 VenusGravity ... Mars Geophysics, Tue. p.m., Room B  
 VenusGravity ... Mars Geophysics, Tue. p.m., Room B  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Remote Sensing/Space Weathering Posters, Tue. p.m., LPI  
 LunarGeology, Thu. a.m., Room C  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Mars: Tectonism and Volcanism, Wed. p.m., Room B  
 Galileo Earth/Moon Results, Tue. p.m., Room C  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI

Rosenbaum J. G.  
 Rothery D. A.  
 Roush T. L.  
 Roush T. L.  
 Rowland S.  
 Rubin A. E.  
 Rubin A. E.\*  
 Rubio G.S.  
 Rulf S.  
 Rulle H.  
 Russell C. T.  
 Russell S. S.\*  
 Russell S. S.  
 Rutherford M. J.  
 Rutherford M. J.  
 Ruzmaikina T. V.\*  
 Ruzmaikina T. V.  
 Ryan D.E.  
 Ryan E. V.  
 Ryan E. V.  
 Sabol D. E. Jr.\*  
 Sahuaro Astro. Research Class  
 Saiki K.  
 Saiki K.  
 Saito J.  
 Sakimoto S. E. H.\*  
 Salisbury J. W.  
 Sandwell D. T.  
 Sappenfield P.  
 Saunders R. S.\*  
 Saunders R. S.  
 Schaber G. G.  
 Schaefer M. W.  
 Schenk P.  
 Schenk P.\*  
 Scherer P.  
 Schlutter D. J.  
 Schmidt R. M.\*  
 Schmitt R. A.  
 Schubert G.  
 Schultz L.  
 Schultz P. H.  
 Schultz P. H.  
 Schultz P. H.\*  
 Schultz P. H.  
 Schultz P. H.  
 Schulz R.\*  
 Schwehm G.  
 Scott D. H.  
 Scott D. H.  
 Scott E. R. D.\*  
 Scott E. R. D.  
 Scott E. R. D.  
 Sears A. S. R.

Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Mars: Geol./Geophy. Processes Posters, Thu. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Mars: Tectonism and Volcanism, Wed. p.m., Room B  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Outer Solar System, Thu. p.m., Room B  
 Primitive Achondrites, Tue. a.m., Room A  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Martian Meteorites and Volatiles, Tue. p.m., Room A  
 Solar System Origins., Mon. a.m., Room C  
 Solar Systems Origin Posters, Tue. p.m., LPI  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Venus ... Global Synthesis Posters, Tue. p.m., LPI  
 Moon Rocks, Wed. a.m., Room C  
 Primitive Achondrites, Tue. a.m., Room A  
 Exploration Posters, Thu. p.m., LPI  
 Venus Volcanism, Mon. p.m., Room B  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Interplanetary Dust ... Posters, Thu. p.m., LPI  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Venus Volcanism, Mon. p.m., Room B  
 Large Impact Events: Theory & Observ., Tue. p.m., Room C  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Outer Solar System Posters, Thu. p.m., LPI  
 Outer Solar System, Thu. p.m., Room B  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Terrestrial Studies Posters, Tue. p.m., LPI  
 Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Martian Geomorphology, Tue. p.m., Room D  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Venus Craters Posters, Tue. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Comets and Asteroids, Fri. a.m., Room B  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Mars: Geol./Geophy. Processes Posters, Thu. p.m., LPI  
 Mars: Tectonism and Volcanism, Wed. p.m., Room B  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Asteroid and Planetary Core..., Thu. a.m., Room D  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Meteorites: Therm. ... Posters, Thu. p.m., LPI

Sears D. W. G.  
 Sears W. D.  
 See T. H.  
 See T. H.  
 Selivanov A. S.  
 Senske D. A.  
 Senske D. A.\*  
 Shahinpoor M.  
 SharinaP.  
 Sharp C. M.\*  
 Sharp L. L.  
 Sharpton V. L.  
 Sharpton V. L.  
 Sharpton V. L.\*  
 Shearer C. K.\*  
 Shearer C. K.\*  
 Shelfer T. D.  
 Shen M. H.  
 Shepard M. K.\*  
 Shih C.-Y.\*  
 Shima M.  
 Shimizu N.  
 Shirey S. B.  
 Shirey S. B.  
 Shoemaker E. M.  
 Shoemaker E. M.\*  
 Shoemaker E. M.  
 Short N. M.\*  
 Shukolyukov A.\*  
 Shukolyukov Yu. A.  
 Shuvalov V. V.  
 Shuvalov V. V.  
 Siddique N.  
 Signer P.  
 Sigurdsson H.  
 Simon S. B.\*  
 Simons M.\*  
 Simpson R. A.\*  
 Singer R. B.  
 Singer R. B.  
 Singer R. B.  
 Sjogren W. L.\*  
 Skinner W. R.  
 Smit J.  
 Smith D. E.\*  
 Smith G.  
 Smith J. V.  
 Smith J. V.  
 Smrekar S. E.

Meteorites: Therm. ... Posters, Thu. p.m., LPI  
 Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Cosmic Ray ... Orbita Posters, Tue. p.m., LPI  
 Lunar Samples Posters, Thu. p.m., LPI  
 Solar Systems Origin Posters, Tue. p.m., LPI  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A  
 Mars: Surface and Atmos. Processes, Thu. a.m., Room B  
 Venus Volcanism and Geology Posters, Tue. p.m., LPI  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 Exploration Posters, Thu. p.m., LPI  
 Venus Craters Posters, Tue. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 Lunar Volcanic Glasses and Regolith, Wed. p.m., Room C  
 Basaltic Achondrites, Mon. a.m., Room A  
 Exploration Posters, Thu. p.m., LPI  
 Exploration Posters, Thu. p.m., LPI  
 Remote Sensing/Space Weathering, Tue. p.m., Room D  
 Moon Rocks, Wed. a.m., Room C  
 Cosmic Ray ... Orbita Posters, Tue. p.m., LPI  
 Ordinary and Enstatite Chondrites, Wed. p.m., Room A  
 Impact Cratering and Shock Metamorphism, Mon. a.m., Room D  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Exploration Posters, Thu. p.m., LPI  
 Future Lunar Exploration, Thu. p.m., Room C  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Manson: The Hole and Shocking Story, Mon. p.m., Room C  
 Basaltic Achondrites, Mon. a.m., Room A  
 Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A  
 Mars: Geol./Geophy. Processes Posters, Thu. p.m., LPI  
 Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Solar, Cosmic Ray ... Studies, Mon. p.m., Room A  
 Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C  
 CAIs, Fri. a.m., Room A  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Venus Resurfacing and Tectonics, Tue. a.m., Room B  
 Lunar Remote Sensing Posters, Thu. p.m., LPI  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B  
 Mars Surface Mineralogy ... Posters, Thu. p.m., LPI  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Undifferentiated Meteorites Posters, Thu. p.m., LPI  
 Chicxulub, KT Boundary ... Posters, Tue. p.m., LPI  
 Venus Gravity ... Mars Geophysics, Tue. p.m., Room B  
 Comets and Asteroids Posters, Thu. p.m., LPI  
 Techniques & Experimental ... Posters, Tue. p.m., LPI  
 Lunar Samples Posters, Thu. p.m., LPI  
 Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B

- Smrekar S. E.\***  
**Smyth P.**  
**Smythe W. D.**  
**Smythe W.D.**  
**Snee L. W.**  
**Snyder G. A.\***  
**Snyder G.A.**  
**Sobolev N. V.**  
**Sobolev V. N.**  
**Soderblom L. A.**  
**Soderblom L. A.**  
**Solomatov V. S.\***  
**Solomon S. C.\***  
**Solomon S. C.**  
**Solomon S. C.**  
**Sorensen S-A.**  
**Sotin C.**  
**Southon J. R.**  
**Souzis A. E.**  
**Speidel D. H.**  
**Spettel B.**  
**Spettel B.**  
**Spilde M.N.**  
**Spray J. G.\***  
**Spudis P. D.\***  
**Spudis P. D.\***  
**Spudis P. D.**  
**Squires S. W.**  
**Srinivasan B.**  
**Srinivasan G.**  
**Stacy N. J. S.**  
**Staubach P.**  
**Steele I. M.**  
**Steele I. M.\***  
**Steele I. M.**  
**Steeple D. W.**  
**Steiner M. B.\***  
**Stephan T.\***  
**Stepinski T. F.\***  
**Stem S.A.**  
**Stevenson D. J.**  
**Stevenson D. J.\***  
**Stevenson D. J.\***  
**Stevenson T. J.**  
**Stewart B. W.**  
**Stewart B. W.\***  
**Stofan E.R.**  
**Stofan E. R.\***  
**Stoker C. R.**  
**Stolper E. M.**  
**Stolper E. M.**
- Venus Gravity ... Mars Geophysics, Tue. p.m., Room B**  
**Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI**  
**Remote Sensing/Space Weathering, Tue. p.m., Room D**  
**Galileo Earth/Moon Results, Tue. p.m., Room C**  
**Manson: The Hole and Shocking Story, Mon. p.m., Room C**  
**Moon Rocks, Wed. a.m., Room C**  
**Terrestrial Studies Posters, Tue. p.m., LPI**  
**Terrestrial Studies Posters, Tue. p.m., LPI**  
**Terrestrial Studies Posters, Tue. p.m., LPI**  
**Mars Surface Mineralogy ... Posters, Thu. p.m., LPI**  
**Galileo Earth/Moon Results, Tue. p.m., Room C**  
**Venus Resurfacing and Tectonics, Tue. a.m., Room B**  
**Venus Resurfacing and Tectonics, Tue. a.m., Room B**  
**Venus Gravity ... Mars Geophysics, Tue. p.m., Room B**  
**Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI**  
**Venus Volcanism, Mon. p.m., Room B**  
**Venus Resurfacing and Tectonics, Tue. a.m., Room B**  
**Solar, Cosmic Ray ... Studies, Mon. p.m., Room A**  
**Solar, Cosmic Ray ... Studies, Mon. p.m., Room A**  
**Venus Craters Posters, Tue. p.m., LPI**  
**Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A**  
**Techniques & Experimental ... Posters, Tue. p.m., LPI**  
**Basaltic Achondrites, Mon. a.m., Room A**  
**Impact Cratering and Shock Metamorphism, Mon. a.m., Room D**  
**Lunar Geology, Thu. a.m., Room C**  
**Future Lunar Exploration, Thu. p.m., Room C**  
**Lunar Remote Sensing Posters, Thu. p.m., LPI**  
**Lunar Geology, Thu. a.m., Room C**  
**Venus Craters Posters, Tue. p.m., LPI**  
**Mars: Tectonism and Volcanism, Wed. p.m., Room B**  
**Exploration Posters, Thu. p.m., LPI**  
**Stars, Stardust and Isotope Anomalies, Thu. p.m., Room A**  
**Undifferentiated Meteorites Posters, Thu. p.m., LPI**  
**Lunar Geology, Thu. a.m., Room C**  
**Solar, Cosmic Ray ... Studies, Mon. p.m., Room A**  
**Asteroid and Planetary Core..., Thu. a.m., Room D**  
**Carbonaceous Chondrites and Chondrules, Thu. a.m., Room A**  
**Differentiated Meteorites Posters, Tue. p.m., LPI**  
**Manson: The Hole and Shocking Story, Mon. p.m., Room C**  
**Manson: The Hole and Shocking Story, Mon. p.m., Room C**  
**Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A**  
**Solar System Origins., Mon. a.m., Room C**  
**Outer Solar System, Thu. p.m., Room B**  
**Venus Resurfacing and Tectonics, Tue. a.m., Room B**  
**Solar System Origins., Mon. a.m., Room C**  
**Venus Gravity ... Mars Geophysics, Tue. p.m., Room B**  
**Interplanetary Dust ... Posters, Thu. p.m., LPI**  
**Basaltic Achondrites, Mon. a.m., Room A**  
**Asteroid and Planetary Core..., Thu. a.m., Room D**  
**Venus Volcanism and Geology Posters, Tue. p.m., LPI**  
**Geology of Venus: Tribute to V. Barsukov, Mon. a.m., Room B**  
**Martian Surface Mineral. & Spectroscopy, Wed. a.m., Room B**  
**CAIs, Fri. a.m., Room A**  
**Martian Meteorites and Volatiles, Tue. p.m., Room A**
- Stolper E. M.**  
**StorzerD.**  
**Straub D. W.**  
**Straub D. W.\***  
**Strom R. G.\***  
**Strom R.G.\***  
**SuarezG.**  
**SuenoS.**  
**Sugita S.**  
**Sugiura N.**  
**Sullivan R. J.**  
**Sunshine J. M.**  
**Sunshine J. M.\***  
**Sunshine J. M.**  
**Sunshine J. M.**  
**SuppeJ.**  
**Sutton S. R.**  
**SvedhemH.**  
**SvestkaJ.**  
**SvobodaR.**  
**Swan P. D.**  
**Swindle T. D.**  
**Swindle T. D.**  
**Takahashi K.**  
**Takata T.\***  
**Takeda H.\***  
**Takeda H.\***  
**TakedaH.**  
**Tam W.**  
**Tanabe T.**  
**Tanaka K. L.**  
**Tanaka K. L.\***  
**Tanaka K. L.**  
**Tanner W.G.**  
**Tatsumoto M.**  
**Tatsumura M. J.\***  
**Taylor A.**  
**Taylor F. W.**  
**Taylor G. J.**  
**Taylor G.J.**  
**Taylor G.J.**  
**Taylor G.J.\***  
**Taylor G.J.**  
**Taylor G.J.**  
**Taylor G.J.**  
**Taylor G.J.**  
**Taylor L. A.**  
**Taylor L. A.**  
**Taylor L. A.**  
**Taylor S. R.\***
- Techniques & Experimental ... Posters, Tue. p.m., LPI**  
**Impact Cratering ... Metamorphism Posters, Tue. p.m., LPI**  
**Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI**  
**Venus Volcanism, Mon. p.m., Room B**  
**Outer Solar System, Thu. p.m., Room B**  
**Venus Resurfacing and Tectonics, Tue. a.m., Room B**  
**Chicxulub, KT Boundary ... Impact Ejecta, Tue. a.m., Room C**  
**Terrestrial Studies Posters, Tue. p.m., LPI**  
**Venus: Volcanoes & Weathering Posters, Tue. p.m., LPI**  
**Cosmic Ray ... Orbits Posters, Tue. p.m., LPI**  
**Galileo Earth/Moon Results, Tue. p.m., Room C**  
**Galileo Earth/Moon Results, Tue. p.m., Room C**  
**Comets and Asteroids, Fri. a.m., Room B**  
**Remote Sensing/Space Weathering Posters, Tue. p.m., LPI**  
**Lunar Remote Sensing Posters, Thu. p.m., LPI**  
**Venus ... Global Synthesis Posters, Tue. p.m., LPI**  
**Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A**  
**Interplanetary Dust ... Posters, Thu. p.m., LPI**  
**Undifferentiated Meteorites Posters, Thu. p.m., LPI**  
**Techniques & Experimental ... Posters, Tue. p.m., LPI**  
**Meteorites: Therrn ... Posters, Thu. p.m., LPI**  
**Lunar Samples Posters, Thu. p.m., LPI**  
**Comets and Asteroids Posters, Thu. p.m., LPI**  
**Solar, Cosmic Ray ... Studies, Mon. p.m., Room A**  
**Exploration Posters, Thu. p.m., LPI**  
**Interplanetary Dust: Lab. Studies ..., Wed. a.m., Room A**  
**Differentiated Meteorites Posters, Tue. p.m., LPI**  
**Ordinary and Enstatite Chondrites, Wed. p.m., Room A**  
**Moon Rocks, Wed. a.m., Room C**  
**Impact Cratering and Shock Metamorphism, Mon. a.m., Room D**  
**Moon Rocks, Wed. a.m., Room C**  
**Primitive Achondrites, Tue. a.m., Room A**  
**Lunar Samples Posters, Thu. p.m., LPI**  
**Venus Craters Posters, Tue. p.m., LPI**  
**Solar System Origins., Mon. a.m., Room C**  
**Mars: Geol/Geophy. Processes Posters, Thu. p.m., LPI**  
**Mars: Tectonism and Volcanism, Wed. p.m., Room B**  
**Martian Geomorphology, Tue. p.m., Room D**  
**Interplanetary Dust ... Posters, Thu. p.m., LPI**  
**Moon Rocks, Wed. a.m., Room C**  
**Educating Young People ... Sciences, Fri. a.m., Room C**  
**Solar, Cosmic Ray ... Studies, Mon. p.m., Room A**  
**Venus Volcanism and Geology Posters, Tue. p.m., LPI**  
**Martian Meteorites and Volatiles, Tue. p.m., Room A**  
**Mars: Tectonism and Volcanism, Wed. p.m., Room B**  
**Martian Geomorphology, Tue. p.m., Room D**  
**Educating Young People ... Sciences, Fri. a.m., Room C**  
**Moon Rocks, Wed. a.m., Room C**  
**Lunar Remote Sensing Posters, Thu. p.m., LPI**  
**Lunar Geology, Thu. a.m., Room C**  
**Moon Rocks, Wed. a.m., Room C**  
**Terrestrial Studies Posters, Tue. p.m., LPI**  
**Exploration Posters, Thu. p.m., LPI**  
**Moon Rocks, Wed. a.m., Room C**

Tazzoli V.  
 Teucher R.  
 Thalmann Ch.  
 Therriault A. M.\*  
 Thiel K.  
 Thiemens M. H.\*  
 Thomas K. L.\*  
 Thomas K. L.  
 Thomas P. C.  
 Thompson C. M.  
 Thompson T. W.\*  
 Thompson W. R.  
 Thom K. S.  
 Thorlill G. D.  
 Titov D. V.  
 Tokkonen T.  
 Tompkins S.\*  
 Tonks W. B.  
 Torigoe N.  
 Torigoye N.\*  
 Törmänen T.  
 Torson J.  
 Treiman A. H.\*  
 Tribaudino M.  
 Trombka J. I.\*  
 Trubetskaya I. A.  
 Tsou P.  
 Tufts B. R.  
 Turcotte D. L.\*  
 Turcotte D. L.  
 Tyburczy J. A.  
 Tyler G. L.  
 Ulamec S.  
 Ulyanov A. A.  
 Urutia-Fucuguchi J.\*  
 Utashima M.  
 Vander Auwera J.  
 Vander Wood T. B.  
 Veeder G. J.  
 Verchovsky A. B.\*  
 Veselova G. V.  
 Veverka J.  
 Veverka J.  
 Vickery A. M.\*  
 Vilas F.  
 Vilas F.\*  
 Vistisen L.  
 Vistisen L.  
 Vogt S.  
 Vondrak R. R.  
 Vorder Bruegge R. W.  
 Wacker J. F.  
 Wadhwa M.\*  
 Wagner J. R.

**Basaltic Achondrites**, Mon. a.m., Room A  
**Mars Surface Mineralogy ... Posters**, Thu. p.m., LPI  
**Terrestrial Studies Posters**, Tue. p.m., LPI  
**Large Impact Events: Theory & Observ.**, Tue. p.m., Room C  
**Comets and Asteroids Posters**, Thu. p.m., LPI  
**Stars, Stardust and Isotope Anomalies**, Thu. p.m., Room A  
**Interplanetary Dust ... Posters**, Thu. p.m., LPI  
**Interplanetary Dust: Lab. Studies ...**, Wed. a.m., Room A  
**Exploration Posters**, Thu. p.m., LPI  
**Chicxulub, KT Boundary ... Impact Ejecta**, Tue. a.m., Room C  
**Venus Resurfacing and Tectonics**, Tue. a.m., Room B  
**Galileo Earth/Moon Results**, Tue. p.m., Room C  
**Meteorites: Therm. ... Posters**, Thu. p.m., LPI  
**Mars: Geol/Geophy. Processes Posters**, Thu. p.m., LPI  
**Mars: Surface and Atmos. Processes**, Thu. a.m., Room B  
**Venus ... Global Synthesis Posters**, Tue. p.m., LPI  
**Lunar Geology**, Thu. a.m., Room C  
**Impact Cratering ... Metamorphism Posters**, Tue. p.m., LPI  
**Moon Rocks**, Wed. a.m., Room C  
**Moon Rocks**, Wed. a.m., Room C  
**Venus ... Global Synthesis Posters**, Tue. p.m., LPI  
**Galileo Earth/Moon Results**, Tue. p.m., Room C  
**Martian Meteorites and Volatiles**, Tue. p.m., Room A  
**Meteorites: Therm. ... Posters**, Thu. p.m., LPI  
**Future Lunar Exploration**, Thu. p.m., Room C  
**Impact Cratering ... Metamorphism Posters**, Tue. p.m., LPI  
**Interplanetary Dust ... Posters**, Thu. p.m., LPI  
**Outer Solar System Posters**, Thu. p.m., LPI  
**Geology of Venus: Tribute to V. Barsukov**, Mon. a.m., Room B  
**Venus: Volcanoes & Weathering Posters**, Tue. p.m., LPI  
**Chicxulub, KT Boundary ... Posters**, Tue. p.m., LPI  
**Venus Resurfacing and Tectonics**, Tue. a.m., Room B  
**Comets and Asteroids Posters**, Thu. p.m., LPI  
**Undifferentiated Meteorites Posters**, Thu. p.m., LPI  
**Chicxulub, KT Boundary ... Impact Ejecta**, Tue. a.m., Room C  
**Exploration Posters**, Thu. p.m., LPI  
**Lunar Samples Posters**, Thu. p.m., LPI  
**Interplanetary Dust ... Posters**, Thu. p.m., LPI  
**Outer Solar System**, Thu. p.m., Room B  
**Stars, Stardust and Isotope Anomalies**, Thu. p.m., Room A  
**Mars Surface Mineralogy ... Posters**, Thu. p.m., LPI  
**Comets and Asteroids**, Fri. a.m., Room B  
**Lunar Geology**, Thu. a.m., Room C  
**Large Impact Events: Theory & Observ.**, Tue. p.m., Room C  
**Comets and Asteroids Posters**, Thu. p.m., LPI  
**Comets and Asteroids**, Fri. a.m., Room B  
**Mars Surface Mineralogy ... Posters**, Thu. p.m., LPI  
**Differentiated Meteorites Posters**, Tue. p.m., LPI  
**Cosmic Ray ... Orbits Posters**, Tue. p.m., LPI  
**Exploration Posters**, Thu. p.m., LPI  
**Exploration Posters**, Thu. p.m., LPI  
**Cosmic Ray ... Orbits Posters**, Tue. p.m., LPI  
**Martian Meteorites and Volatiles**, Tue. p.m., Room A  
**Impact Cratering ... Metamorphism Posters**, Tue. p.m., LPI

Wagner R.  
 Wagner R.  
 Wagner T. P.\*  
 Wagstaff J.  
 Wald A.\*  
 Walker R. J.\*  
 Walker R. M.  
 Walker R. M.  
 Wang J.\*  
 Wang M.-S.  
 Wänke H.  
 Warren P. H.\*  
 Warren P. H.\*  
 Wasilewski P. J.\*  
 Wasserburg G. J.\*  
 Wasserburg G. J.  
 Wasson J. T.  
 Wasson J. T.\*  
 Wasylewski L. E.\*  
 Watson L. L.\*  
 Walters T. R.\*  
 Watts A. J.  
 Weber E. T.  
 Weidenschilling S. J.  
 Weigel A.  
 Weisberg M. K.  
 Weisberg M. K.  
 Weisberg M. K.\*  
 Weisberg M. K.  
 Weissman P. R.  
 Weitz C. M.  
 Weitz C. M.\*  
 Wenrich M. L.\*  
 Wentworth S. J.  
 Wentworth S. J.  
 Wentworth S. J.  
 Wetherill G. W.  
 Wetherill G. W.\*  
 Wichman R. W.  
 Więczorek M. A.  
 Więczorek M. A.  
 Wieler R.\*  
 Wiesmann H.  
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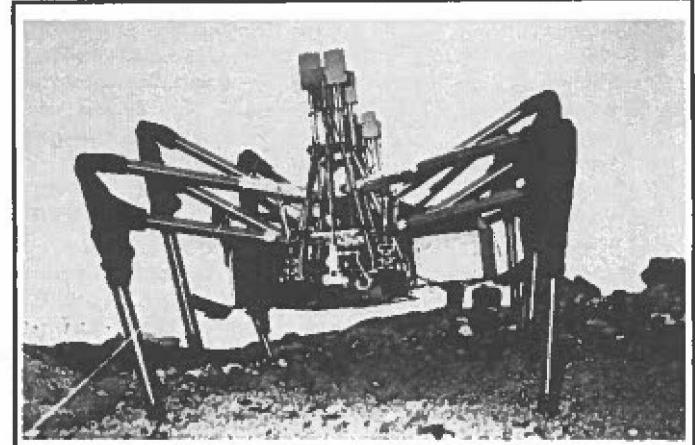
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