

LUNAR AND PLANETARY



INFORMATION BULLETIN

FEBRUARY 1990 • NUMBER 55

Lunar and Planetary Science Conference XXI

12-16 March 1990

The TWENTY-FIRST LUNAR AND PLANETARY SCIENCE CONFERENCE will begin Sunday March 11 at 6:00 p.m. with registration and an open house at the Lunar and Planetary Institute. The pre-registration fee for the conference is \$40.00 for all attendees except students with student IDs who may register for \$20.00; there will be a late fee of \$10.00 assessed for all registrations received after March 2, including those received during the conference. A shuttle bus will run between NASA area hotels and the LPI from 5:45 p.m. to 10:00 p.m. Registration will continue throughout the conference on the second floor of the Gilruth Center at JSC. All conference activities, technical sessions, exhibits, poster sessions, etc., unless otherwise listed, will be at the Gilruth Center.

From a record total of 706 abstracts accepted for publication in *Lunar and Planetary Science XXI*, the Program Committee has constructed 33 technical sessions. The general structure of the program is as follows:

MONDAY AM, MARCH 12

- Venus Overview Prior to Magellan: I
- Origin of Components in Chondrites
- Lunar Meteorites
- Cosmic Rays

MONDAY PM, MARCH 12

- Venus Overview Prior to Magellan: II
- Chondrite Parent Body Processes
- Comets and Orbital Dust Collection
- Lunar Regolith

TUESDAY AM, MARCH 13

- Venus Overview Prior to Magellan: III
- CAIs
- Lunar Geology and Resource Utilization
- Outer Solar System



The Atlantic Ocean serves as a backup for this photo of the Long-Duration Exposure Facility, taken shortly before its recapture during the STS-32 Mission (NASA photo S32-85-063). See article on pages 7-8.

TUESDAY PM, MARCH 13

- MEVT: Martian Geophysical and Tectonic Evolution
- Solar Nebula and Planetary Origins
- Lunar Highlands
- Asteroids and Remote Sensing

WEDNESDAY AM, MARCH 14

- MEVT: Martian Volcanic Evolution
- Interplanetary Dust and LDEF
- Lunar Mare and KREEP Basalts
- Heavy Metal Meteorites

WEDNESDAY PM, MARCH 14

- MEVT: Martian Magmatic and Surface Evolution
- Isotope Anomalies and Chronology
- Collisional Processes

THURSDAY AM, MARCH 15

- Mars: Obliquity and Climate Histories
- Ureilite—HED
- Target: Earth

THURSDAY PM, MARCH 15

- Mars: Craters, Channels and Life
- Anomalous Achondrites: Angrites and Aubrites
- Isotope Anomalies

FRIDAY AM, MARCH 16

- Mars Remote Sensing
- Triton and Phobos
- Planetary Differentiation and Planetary Geological Processes

The preliminary program included in this issue (see Appendix) reflects plans for the conference as they exist early in February. Minor changes may yet occur before the conference itself.

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Conference Highlights and Peripheral Meetings

POSTERS entered in the Technical Poster Session will be highlighted Monday, Wednesday, and Thursday of the conference in the Gilruth Center. Posters will be assigned a day for display according to the technical session in which they are listed as follows: Monday morning, Monday afternoon, and Tuesday morning session posters will be displayed Monday evening; Tuesday afternoon, Wednesday morning, and Wednesday afternoon session posters will be displayed Wednesday evening; Thursday morning, Thursday afternoon, and Friday morning session posters will be displayed Thursday evening. Authors will be available for discussion from 5:00-6:30 p.m. on these days, during which time complimentary keg beer and soft drinks will be served.

The on-line and remote access capabilities of the interrelated database systems in use at the LPI will be displayed in the coffee area of the Gilruth Center during regular conference hours. These databases include the Geophysical Data Facility (GDF) and the Bibliographic Search Service (BSS) developed and maintained by the LPI, as well as the Image Retrieval and Processing System (IRPS) sponsored by Washington University, which includes the Planetary Image and Cartography System (PICS) created by USGS Flagstaff. The LPI's Computing Center for Planetary Data Analysis (C²PDA) will also be demonstrating the image processing and scientific visualization capabilities of the Stardent Titan graphics supercomputer.

The *Combined Publishers Exhibit* will be on display in the coffee area of the Gilruth Center from Monday through Friday noon. Several publishers have already indicated an intent to participate.

Sunday — March 11

A workshop entitled "Lunar and Mars Geoscience and the Human Exploration Program" will be held at 2:00 p.m. at the NSTS Conference Facility/Regents Park III, 16850 Saturn Lane, in Clear Lake City. Details of this workshop are included in the third announcement for the conference. For more information, contact Don Morrison at 713-483-5039.

Monday — March 12

NASA Night will be held Monday evening in the Building 2 auditorium. The subject will be a discussion of President Bush's Moon/Mars exploration initiative,

and tentative speakers include Aaron Cohen, Lennard Fisk, and Arnold Aldrich. The public is invited to attend.

Tuesday — March 13

Back by popular demand, there will be a barbecue and chili cook-off Tuesday evening on the LPI grounds. Paid registrants of the conference are welcome, and tickets for guests will be available for sale at the registration desk. The cook-off portion of the social will be held only if at least 20 teams enter; local and out-of-town teams are encouraged to participate by organizing a team. Forms for entering cook-off teams are included in the third announcement for the conference; if you do not receive these forms or need more information, contact the LPI Program Development Office at 713-486-2150.

Wednesday — March 14

A JSC Astronomy Seminar will be held in Room 129 of Building 31 at noon. Jim Oberg will be presenting a talk entitled "Hidden History of the Moon Race."

There will be a special Voyager evening session held in Building 2. This session is open to the public. More details will be available at the LPSC registration desk.

Thursday — March 15

The Planetary Society will host a special session entitled "A Planetary Perspective on Global Change: Lessons from Sister Worlds," to be held from 8 to 10 p.m. in the Building 2 auditorium. The public is invited to attend, and seating will be on a first-come, first-serve basis.

Abstracts

Lunar and Planetary Science XXI

An unbound copy of the abstract volumes will be sent before the conference to the correspondence authors. No copies will be sent to foreign authors this year unless the author has prepaid for the cost of postage. Due to time constraints in our printing schedule and to budgetary constraints on postage, a limited number of copies to the same institution will be mailed. It is suggested that these copies be shared among the author's colleagues.

Abstract volumes will be distributed to all conference attendees. For those who cannot attend the conference but wish to have the abstracts, a supply will be available after the conference at the cost of shipping and handling. Refer to the order form included in this Bulletin.

On-line 21st LPSC Program

To access the online program, you may use either the NASA SPAN network or dial in direct. When using NASA/SPAN, the node name for the LPI VAX is **LPI::**. Direct dial phone lines are 713-486-8214 or 713-486-9782.

When connection is made, use the following directions:

USERNAME: Program

PASSWORD: LPI

You will then get the usual "welcome" to the system and a menu of options will be displayed.

LPSC XXI BULLETIN BOARD

1. Browse the entire program.
2. Search by author/speaker name (lists an author's paper only).
3. Search by author/speaker name (lists full session in which the author appears).
4. Search by title keywords.
5. Browse by session.
6. Quit.

A series of menus and prompts will cue you to the appropriate way to access the various aspects of the program. **Note:** If you choose to browse the entire program, you must finish reviewing all of the sessions for a particular day before the system will give you the exit prompt. We hope this innovative way of presenting the program to the community almost at the same time it is formed will assist you in planning your travel arrangements and other appointments that you may wish to make.

If you have difficulty in accessing the LPI computer, please contact Kinpong Leung, LPI Computer Systems Manager, at 713-486-2165, [KLEUNG/NASA] (on NASAMAIL), or LPI::LEUNG (on SPAN).

The LUNAR AND PLANETARY INFORMATION BULLETIN is published three times a year by the Lunar and Planetary Institute, 3303 NASA Road 1, Houston, Texas, 77058-4399.

Fran Waranus, *Editor*.

Editorial and production support were provided by the LPI Publications Services Department.

Copy deadline for the May issue of the *Bulletin* is April 16, 1990. Send articles or announcements to be included to LPI Publications, 3303 NASA Road 1, Houston, TX 77058-4399.

Now Available from the Lunar and Planetary Institute:

Proceedings of the Twentieth Lunar and Planetary Science Conference

Published by the
Lunar and Planetary Institute
Virgil L. Sharpton
and Graham Ryder, editors

The *Proceedings of the Twentieth Lunar and Planetary Science Conference* is a volume of papers including original research and reviews of current interest in the planetary sciences. This book incorporates, but is not limited to, material from the Twentieth Lunar and Planetary Science Conference held in Houston, Texas in March 1989. The LPSC is one of the most important forums for research in planetary science, and thus represents a broad spectrum of disciplines and interests. Nowhere is the record of planetary exploration and the evolution of planetary sciences more completely expressed than in the 20-year history of this *Proceedings* series. Since its inception, the *Proceedings* has published nearly 3000 papers documenting the stepwise scientific exploration of the solar system and the ensuing changes in planetary science.

The *Proceedings* represents a unique service as an annual compilation of planetary studies from around the world, and for this reason the LPI is committed to its continued publication. Therefore we have elected to publish the *20th Proceedings* ourselves in an effort to substantially lower the purchase price while at the same time continuing to bring the community the quality volume it deserves and expects.

The *20th Proceedings* is edited by Drs. Virgil L. Sharpton and Graham Ryder. Topics include petrology and geochemistry of the Moon, lunar regolith processes and resources, comets and interplanetary dust, geology of Mars, geology of the Moon, petrology and geochemistry of achondrites, shock and terrestrial cratering, and geology of Venus.

The *Proceedings* should serve as an indispensable reference for scientists and college students in the fields of planetary science, astronomy, geochemistry, petrology, and geology. Librarians and other individuals are urged to ensure the continuity of the series in their collections. To order, please refer to the order form contained in this issue of the Bulletin.

Proceedings of the Twentieth Lunar and Planetary Science Conference
Edited by Virgil L. Sharpton
and Graham Ryder
ISBN 0-942862-04-X
610 pages 419 illustrations
Price: \$50.00

Available from Cambridge University Press

The following volumes are available from Cambridge University Press. Order Department, 510 North Avenue, New Rochelle, NY 10801 (Phone: 800-872-7423 or 914-235-0300). Outside North America, please order from Cambridge University Press, Customer Services Department, Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU, U.K. (Phone: 223 312393):

Proceedings of the Nineteenth Lunar and Planetary Science Conference
Edited by Graham Ryder and
Virgil L. Sharpton
ISBN 0-521-37409-X 784 pages
\$100/65£
Publication date: March 1989

Proceedings of the Eighteenth Lunar and Planetary Science Conference
Edited by Graham Ryder
ISBN 0-521-35090-5 753 pages
\$65/60£
Publication date: March 1988

Publication of 21st Proceedings

The *Proceedings of the Twenty-first Lunar and Planetary Science Conference* will be published as a hardcover book by the LPI. Virgil L. Sharpton and Graham Ryder have agreed to serve as co-editors and will be assisted by a team of distinguished associate editors.

The deadline for submission of manuscripts to the *Twenty-first Proceedings* is **May 25, 1990**. Full information will be available at the LPSC registration desk. Please contact LPI Publications at 713-486-2188 for more detailed information if you need it before then.

SSI Selects Omni Systems to Design Satellite

The Space Studies Institute of Princeton, New Jersey has announced the selection of Omni Systems Incorporated to design the Lunar Prospector Satellite. Lunar Prospector, the first private sector space probe, is being developed by a consortium consisting of SSI and Lunar Exploration Inc. Its mission will be to map the Moon from a polar orbit. Experiments to be carried out by Prospector are gamma-ray/neutron spectroscopy to do elemental mapping of the surface and to search for water ice in the polar regions; magnetometry and electron reflectometry to map the lunar magnetic fields; alpha-particle spectroscopy to monitor radon gas release events, and doppler gravity mapping to define the lunar gravity field. The discovery of water on the Moon would dramatically change the economics of space exploration and accelerate the creation of human outposts on the Moon, a goal endorsed by President Bush in his speech of July 20, 1989.

Last fall, NASA Administrator Richard Truly announced that NASA will enter into a cooperative agreement with the Space Studies Institute to provide a Gamma-Ray Spectrometer for use as part of the proposed instrument package aboard the Prospector. In return, the consortium will provide mission data to the scientific community at large.

Omni Systems Incorporated is a California-based company involved in the design and manufacture of a variety of aerospace products including communications equipment, guidance and control systems, and spacecraft. The company also provides consulting services related to space systems design, manufacture, and procurement.

The Space Studies Institute is a private, nonprofit international research and development organization located in Princeton, New Jersey. Its mission is to produce practical and innovative solutions to opening the high frontier of space. It was founded in 1977 by Dr. Gerard K. O'Neill, Professor Emeritus of Physics at Princeton University and a member of the President's National Commission on Space.

Lunar Exploration Inc. (LEI), a group of about 50 scientists and engineers from JSC and the surrounding area, provide the Lunar Prospector Project with the required scientific and engineering support. LEI is headed by co-chairmen Preston Carter and Dr. Alan Binder.

Where are Our Space Probes?

Where are our space probes and what are they doing?



Magellan

Launched on May 4, 1989 from the space shuttle Atlantis, the Magellan spacecraft continues its journey to Venus with an arrival planned for August 10, 1990.

On January 25, 1990, the Magellan spacecraft was 113,712,818 miles from Earth, traveling at a speed of 62,258 miles per hour relative to the sun. One-way light time is 10 minutes 11 seconds.

As planned, the spacecraft resumed operations in the standard cruise mode on January 18, with the beginning of cruise computer sequence 17.

The spacecraft had invoked its fault protection software on December 31 when it detected an error in the high-level privileged memory. The fault protection put the spacecraft into a safety mode, shut off the prime-A command and data subsystem, and activated its backup system.

The spacecraft also automatically switched from the high-gain antenna to the medium-gain antenna and reduced the downlink telemetry from 1200 to 40 bits per second. Successful reaction wheel desaturations and star calibrations were performed by ground commands.

The spacecraft's health and routine operations were confirmed by Magellan operations.



Galileo

Galileo was deployed from the space shuttle Atlantis on October 18, 1989.

On January 25, 1990, the Galileo spacecraft was about 21.5 million miles from Earth and 5.4 million miles from Venus.

Round-trip light time to the spacecraft is almost four minutes. Galileo has traveled almost 156 million miles since being launched into orbit around the sun, and has reached an orbital velocity of more than 78,000 miles per hour.

The spacecraft is in very good health, operating in its all-spin "safe" mode with automatic sun-pointing. All science instruments except the dust detector are turned off, and the spacecraft is spinning at a rate of 2.89 rpm, pointed within 1/2 degree of the sun. It continues to send telemetry at 1200 bits per second over the low-gain antenna.

The flight team is continuing the orderly step-by-step process of returning Galileo to a cruise configuration and preparing it for the Venus science observations scheduled for early February.

Cosmic Background Explorer (COBE)

COBE was launched November 18, 1989, aboard the last NASA-owned Delta rocket, from Vandenberg Air Force Base in California. Early results were reported by principal investigators at the American Astronomical Society meeting in January. Limited COBE data indicate a smooth, uniform Big Bang. However, small deviations from a blackbody spectrum, the characteristic signature of radiation from an opaque object of uniform temperature, would reveal energetic processes in the early universe. COBE scientists reported that the instruments onboard are performing exquisitely with precision never before achieved. Such precision puts new constraints on theories to explain the present universe. COBE will continue to collect much more data over the two-year duration of the mission. Scientists expect the final data to be ten times more sensitive than the early results.

Pioneers

Pioneers 10 and 11 are still returning data. Pioneer 10 has left the solar system and is about 4.4 billion miles from the sun. As of December 27, 1989, Pioneer 11 had almost reached the orbit of Neptune.

Using extensive light measurements made by the Pioneer spacecraft, Dr. Garry Toller of Goddard Space Flight Center and General Sciences Corp. has produced "celestial constants" that will be highly useful to astronomers and physicists. The new constants are the first "pure" measurements of the various kinds of background light in our solar system, galaxy, and universe. Toller and others used a variety of observations from Earth for the analyses, combining data on the quantities and types of stars with computer models of light scattering in the galaxy, amounts of dust and gas, and size of particles. He then compared these models to measurements made as the two spacecraft moved out of the solar system. The new data will help investigators study diffuse celestial light sources such as zodiacal light, which reaches Earth after being reflected by nearby dust. Once the Pioneer spacecraft were more than 300 million miles from Earth, the zodiacal light diminished to a negligible level. In the mid-1970s scientists were able to make the first pure measurements of background light from beyond the solar system. Since that time, over the

long flight paths of the spacecraft, it has been possible to make very exact measurements of this "outside" light.

Research Group on Space Sciences Formed

The GICE (Grupo de Investigación en Ciencias del Espacio: Research Group on Space Sciences) has recently been organized under the patronage of the Science Department of the Pontificia Universidad Católica del Perú in Lima. Its purposes include doing active research on subjects related to space science such as astrophysics, cosmochemistry and the origin of life, meteorites and small bodies, and space medicine and astronautics. Current plans center on experimental work related to chemical evolution, including a trip to Antarctica to collect meteorites as possible sources of extraterrestrial organic molecules.

At present, the chairman of GICE is Prof. Dr. Richard P. Korswagen, Departamento de Ciencias, Pontificia Universidad Católica del Perú, Apartado 1761, LIMA 100 — PERU.

Conference on Asteroids, Comets, Meteors, 1991

The International conference on Asteroids, Comets, Meteors, 1991, will be held June 24-28 in Flagstaff, Arizona. The conference is planned to be a U.S. counterpart to the "AGM" series of meetings held in Uppsala, Sweden in 1983, 1985, and 1989.

The meeting is planned to include all aspects of studies of asteroids, comets, meteors, and their interrelations, including discovery, astrometry, orbital dynamics, physical observations, spacecraft, and laboratory studies. The format will consist mainly of contributed papers, with invited reviews and short workshops highlighting areas of recent activity. Participation is invited from all countries and will be co-sponsored by NASA with logistics arranged by the Lunar and Planetary Institute. To be added to the list for future mailings, send your name and address to Pam Jones, ACM '91, Program Development Office, Lunar and Planetary Institute, 3303 NASA Road 1, Houston, TX 77058.

Correction to Meeting Dates

The 10th Anniversary Meeting of the European Union of Geosciences is planned for March 24-28, 1991, not 1990 as was published in a previous bulletin. We apologize for any confusion this error may have caused.

Publications

The publications listed here are not available from the Lunar and Planetary Institute. Contact the organization identified with each listing for ordering information.

New Publications from GPO

The following publications are available from the Superintendent of Documents, Government Printing Office, Washington, DC 20402. Although this agency requires prepayment on all orders, they will accept MasterCard or VISA (include the account number and expiration date on your order). Some of the publications may be available from the GPO bookstores (located in major cities around the U.S.; check your city directory for a local listing). Several of the GPO publications are offered by other distributors at widely varying prices.

Time-variable Phenomena in the Jovian System

416 pp. (includes color illustrations) 1989
Stock No. 033-000-01058-3 \$29.00

This NASA special publication SP-494, edited by M.J.S. Belton, R.A. West, and J. Rahe, is the proceedings of the Workshop on Time-Variable Phenomena in the Jovian System that was held at Lowell Observatory in August 1987. The motivation for the workshop and the book stems from a desire to prepare for and make use of the Galileo mission.

The book is organized into three sections: satellite phenomena and rings; magnetospheric phenomena; Io's torus and aurorae; and a final section on atmospheric phenomena on Jupiter itself. It is intended to be a contemporary assessment of the state of our knowledge of dynamic processes in the jovian system that should help stimulate new research initiatives to answer key questions about the intriguing and complex processes responsible for much that is observed. The book is also intended to serve as a reference point and therefore provides summaries of both the theoretical and observational foundations upon which future studies will be based.

Commercial Use of Space: A New Economic Strength for America

24 pp. (includes color illustrations) 1989
Stock No. 033-000-01035-4 \$2.25

In today's world of increasing global competition, space represents an economic frontier, a new territory of commercial opportunity. Scientific discovery and technological innovation lead to new products and services that can benefit people throughout the world, resulting in entirely new industries. Space is proving to be a fertile field for such economic growth.

The First Lunar Landing as Told by the Astronauts

24 pp. (includes color illustrations)
Stock No. 033-000-01-54-1 \$2.50

This is a reprint of NASA EP-73 to celebrate the 20th anniversary of the Apollo 11 lunar landing. The booklet contains many of the historic views obtained on this memorable mission and the transcript of the conversations between the astronauts as the landing was accomplished. If you do not have a copy of the original publication (issued in 1970), this booklet makes an excellent keepsake of this historic event.

Other Worlds from Earth: The Future of Planetary Astronomy

100 pp. (includes color illustrations) 1989
Stock No. 033-000-01052-4 \$7.00

This publication is a report of the Planetary Astronomy Committee of NASA's Solar System Exploration Division. This Committee was formed in December 1985 to assess the status and health of NASA's planetary astronomy program and to make recommendations for future pursuits in this endeavor. Specific areas of consideration are the continued characterization and detailed study of the solar system using ground-based, airborne, and Earth-orbital

capabilities, and the search for and characterization of other planetary systems. Planetary astronomy was found by the Committee to be a productive research discipline with significant potential for future progress; however, some problems were identified that must be solved to enhance future work in planetary astronomy. If the recommendations of the Planetary Astronomy Committee are implemented they will ensure a vital field of research through the turn of the century.

ASP Continues Production of Educational Materials in Astronomy

The Astronomical Society of the Pacific has announced three new slide sets, which are available from ASP, 390 Ashton Avenue, San Francisco, CA 94112.

A new set of 100 color slides showing the best images of the solar system available today has been assembled under the guidance of noted planetary astronomer David Morrison. The set includes recent Voyager views of Neptune, dramatic computer-processed views of Venus' surface from the Soviet landers, the close-up of the nucleus of Comet Halley, and new computer simulations of the Pluto-Charon system. For each planet and major satellite, Dr. Morrison has selected the most important and beautiful photos taken by such spacecraft as Viking, Mariner, Voyager, and Venera. The slides are accompanied by a book of detailed non-technical captions, extensive background information, data tables, class or home activities, and a thorough reading list. To order, request "Planetary Slides" and send \$97.95 (which includes shipping and handling) to ASP (California residents should add sales tax).

Publications

"Spectra of the Stars" is a slide set illustrating the spectra of normal and unusual stars. The 36 slides portray the spectra exhibited by stars that range from much hotter and brighter to much dimmer and colder than our sun. In addition, the slides include more unusual examples of spectra, including stars rich in the unstable element technetium, stars surrounded by vast clouds of gas, and stars that have undergone cataclysmic explosions. This set is the first modern compilation of spectra on slides and fills an important niche for those who teach astronomy. It was assembled by Dr. James Kaler of the University of Illinois, the author of *Stars and Their Spectra* (1989, Cambridge University Press), and comes with a booklet of captions, background information, and introductory readings. To order, request "Spectra Slides" and send \$39.95 to ASP (California residents add sales tax; orders from outside the U.S. should add \$5.00 for additional postage and remit in U.S. funds).

Commemorating our most recent solar system encounter, a Voyager/Neptune slide kit containing 12 images and an extensive booklet of nontechnical information from the Voyager 2 flyby has now been released. The color slides show full views of the turquoise planet, close-ups of the Great Dark Spot (a storm the size of the Earth), the complex ring system, and the bizarre and fascinating terrain on the large satellite Triton. The booklet, written by astronomer and popular author William Kaufmann, includes detailed captions, full background information on the mission and discoveries, a thorough reading list on Neptune and Voyager's other flybys, and a set of projects and activities. The set, which comes in a protective plastic binder, is available for \$17.95 (California residents should add sales tax).

In addition to the new slide sets, the ASP has recently published its new catalog of written and audiovisual materials on astronomy for teachers, hobbyists, and everyone interested in the cosmos. The 32-page catalog includes slide sets, video tapes from the NOVA television series offered for the first time at home video prices, and two outstanding new software packages that show the sky from any location at any time. It also contains a number of outstanding books for children, slides from the world's largest telescopes, posters, observing aids, and audio tapes. To obtain a copy of the illustrated catalog, please send two first-class stamps along with your name and address to "Catalog Requests," ASP, 390 Ashton Avenue, San Francisco, CA 94112.

Some New Books to be Noted

Cosmic Odyssey, by Jean Heidmann (1989, Cambridge University Press, 181 pp., \$19.95), is a nontechnical introduction to the issues of modern cosmology. It explains in detail the link between particle physics and cosmology, the very early universe, the significance of Grand Unified Theory and superstrings, the magical qualities of the inflationary universe, and the seemingly bleak scenarios for the farthest future. In the preface, the author explains "The purpose of this book is to give a description of the fabulous richness of the cosmos, and to give as clear a picture as possible of the real nature of our incredible universe. After a first look at the starry night sky, I review the enigmas posed since ancient times by the universe. Then I give a broad brush view of the universe as we understand it today. Following this, a trio of chapters take us to ultimate questions about its nature; we explore in turn the relativistic universe, the quantum universe and the inflationary universe." This fascinating story of the ultimate fate of the universe will appeal to everyone who takes an informed interest in astronomy and physics.

Formation and Evolution of Planetary Systems, edited by H. A. Weaver and L. Danly (1989, Cambridge University Press, 344 pp., \$44.50), is a collection of the review papers and discussions from a workshop held at the Space Telescope Science Institute in May 1988. The goal of the workshop was to bring together stellar and planetary scientists to review our present understanding of planetary system development in the context of star formation, to identify and address the outstanding problems in the field, and to provide a focus for future observational and theoretical work.

Lunar Base Agriculture: Soils for Plant Growth, edited by D. W. Ming and D. L. Henninger (1989, American Society of Agronomy, 255 pp., \$24.00), is a collection of papers by scientists from different disciplines who are interested in the future of agriculture at a lunar base. Over 70 specialists attended a NASA-sponsored workshop where the primary goal was to identify a course of research dealing with the interaction of lunar resources and agricultural systems. This publication addresses their goal and contains sections on (1) lunar base scenarios, (2) the lunar environment, (3) chemical and physical considerations for a lunar-derived soil, (4) biological considerations for a lunar-

derived soil, (5) current research in controlled ecological life support systems, and (6) future research needs for plant growth at a lunar base. Whether or not plants will be grown on the Moon has not been answered; however, it is a possible scenario that will continue to be discussed by the planetary community. This book will serve as an information source for those individuals seeking ways to produce food in space, particularly if the Moon serves as an outpost to launch human exploration in our inner solar system. (Available from ASA, CSSA, SSSA Headquarters Office, Attn: Book Order Department, 677 South Segoe Road, Madison, WI 53711. Visa, Mastercard, and American Express are accepted.)

On the Glassy Sea: An Astronomer's Journey, by Tom Gehrels (1988, American Institute of Physics, 340 pp., \$35.00), is an autobiography describing the life of an astronomer, beginning with Gehrel's experiences as a teenager in the Dutch Underground during World War II, his service in Indonesia after the war, his education in the Netherlands and the U.S., and his work on the properties of asteroids and comets as well as his involvement in the space program. Gehrels' work at observatories and laboratories in Arizona, India, and elsewhere led him to reflect on the research enterprise as well as more fundamental questions. He describes experiments in health and his success in healing himself of premature ventricular contractions, how his lifelong questioning and search for the truth led him to ask about the nature of God and atoms and the possible relationships between them, and how his experiences have led him to a holistic philosophy in which nature is an integrated whole whose aspects are intricately intertwined. This is a book of stories to be read for entertainment.

Space Telescope: A Study of NASA, Science, Technology, and Politics, by Robert W. Smith (1989, Cambridge University Press, 528 pp., \$39.50), presents an historical overview of the planning, building, and funding of the Space Telescope, which has been the most expensive scientific facility ever constructed as well as the most powerful optical telescope ever built. Smith and his colleagues set the fascinating history of the Space Telescope in the context of post-World War II science and technology and "Big Science"—scientific projects of a vast scale that involve thou-

sands of people, require massive amounts of federal funding, and that are as much political and managerial efforts as they are scientific and technical ones. This book reveals the astonishingly complex interactions that took place between the scientific community, government, and industry and the great range of personalities and forces—scientific, technical, political, social, institutional, and economic—that played a role in the Telescope's history. *Space Telescope* will appeal to a wide range of readers interested in astronomy, spaceflight, the history of science and technology, science studies, and science policy.

Case for Mars III, edited by Carol Stoker (1989, Univelt Inc., vols. 74 and 75 of the Science and Technology Series; vol. 74: overview papers, 750 pp., hard cover \$75, soft cover \$55; vol. 75: technical papers, 650 pp., hard cover \$70; soft cover \$50), continues the publication of the proceedings of the Case for Mars conferences that have been held in Boulder, Colorado, since 1981. These two volumes are based on material derived from the third conference, "Strategies for Exploration," held July 18–22, 1987. Volume 74 includes general interest and overview papers on (1) making the political case for Mars, (2) considerations for getting to Mars, and (3) living on Mars. Volume 75 consists of technical papers on (1) political and social issues, (2) issues for sending humans to Mars, (3) technical issues for getting to Mars, (4) living on Mars, and (5) workshop summaries.

NASA/University Joint Venture

How do we cope with several trillion bits of raw data a year, pouring in from the nation's space probes and platforms? More specifically, how can we convert this flood into a stream of useful science and engineering knowledge? And how can we ensure that there will be enough scientists and engineers to continue our exploration of space in the future? One of the answers NASA has come up with is the JOint VEnture (JOVE) program that makes available scientific and engineering data generated from space missions in exchange for analysis and interpretation by faculty and students. The partners in this venture are NASA's Marshall Space Flight Center (MSFC), the Universities Space Research Association (USRA), and U.S. colleges and universities, particularly those not previously involved with NASA research projects.

Seven universities have participated in the first phase of the pilot program at MSFC and an additional seven will be added in 1990. The seven universities currently participating have been so enthusiastic about the program that in some cases they are providing \$3 for every \$1 of NASA funding. In addition to direct analysis of space science data, participating JOVE universities assume the role of space program emissaries, using the excitement of space science research to enhance educational opportunities in their local communities.

"The research side of the JOVE program—the direct analysis of space science data—is important, but in the long run it may be the contributions of the outreach portion, which involves generating science interests in pre-college students, that will bring the most far-reaching benefits," says Rick Chappell, Associate Director of Science at MSFC and initiator of the JOVE idea. "JOVE is showing that an involvement in the space program by universities is very positive for promoting careers in science."

"Educational outreach is one of the most exciting parts of JOVE," adds Dr. Joe Perez, Department of Physics Chairman, Auburn University, who with three other Auburn physics professors spent part of last summer analyzing space physics data at MSFC. "We've received a good response across the state from elementary schools through 4-year colleges who want to participate."

"The future of the United States, particularly our economy, depends on our technology," continues Chappell. "It's the kids who are now making career choices about science and engineering who are going to generate the new technology for the nation's future. They'll be our new explorers in science and technology. By making NASA's world-class data available to institutions of higher education, JOVE could conceivably double [the number of universities participating in some area of the space program] in 5 to 10 years. Add to that the educational outreach programs, and you begin to understand the incredible impact of the JOVE program. Everybody wins—scientists, educators, students, and the nation!"

For more information on the JOVE program, contact Frank Six, Code DSOI, Marshall Space Flight Center, Huntsville, AL 35812.

Garth Stevens Inc. Introduces New Series for Children

In addition to continuing the very fine children's series "Isaac Asimov's Library of the Universe," Gareth Stevens Inc. has announced the publication of two new series: "Gareth Stevens Information Library" and "My First Reference Library." The "Gareth Stevens Information Library" is published in a format appropriate for an intermediate reading level, and "My First Reference Library" is published to more adequately suit the needs of a primary reading level. Illustration layout is the same for both series, but the text is modified to be appropriate to the particular age group. "My First Reference Library" presents primary-level (grades 2–3) readers with carefully controlled vocabulary that makes the information accessible and the reading an

achievable challenge. The "Gareth Stevens Information Library" combines more detailed and challenging text appropriate for intermediate-level readers (grades 4–6) while maintaining the same, complete visual presentation and format of the lower-reading series.

The first two volumes in these new series are concerned with animal life and space exploration. The books are beautifully illustrated and should encourage interest on the part of young readers. The books are well indexed and afford a good introduction to the subjects covered. The net school/library price for each volume is \$12.95. Note: The new address for Gareth Stevens Inc. is RiverCenter Building, Suite 201, 1555 North RiverCenter Drive, Milwaukee, WI 53212. Phone: 414-225-0333.

Long Duration Exposure Facility Shows Few Surprises

After nearly six years in space, the Long Duration Exposure Facility (LDEF) is back on Earth. The rescue of LDEF was accomplished during the STS-32 shuttle mission by Astronaut Bonnie Dunbar, who used Columbia's robot arm to grab the LDEF's grapple fixture. The LDEF was then safely stowed in the cargo bay of the shuttle for the return flight to Earth.

The objective of LDEF was to measure the effects of atomic oxygen, space radiation, micrometeoroids, man-made debris, vacuum, and other space-related phenomena on more than 10,000 test specimens. Television views, astronaut commentary, and postretrieval photos of LDEF from the STS-32 shuttle mission suggest that the facility's condition is about as NASA officials expected. Some of those effects were immediately observable on LDEF during inflight recovery operations.

Some thin film test specimens appeared to be degraded or completely eroded; some thin film balloon material test specimens were broken away at one end. These are expected results that will be fully analyzed when the principal investigators have access to their LDEF experiments.

The Kapton thermal covers on two Heavy Ions in Space experiment trays were partially peeled back, in the words of one astronaut, "like a sardine can." In addition, the thermal cover strips around the detectors of a space plasma high-voltage drainage experiment appear to have eroded. Impact on these experiments will not be known until researchers have an opportunity to examine them.

At least one of the thermal covers of an ultraheavy cosmic-ray nuclei experiment, located adjacent to LDEF's leading edge, exhibited more apparent debris or meteoroid impacts than anticipated, but there probably was no effect on the cosmic-ray data obtained. Investigators will pay particular attention to this area during postflight examination of the satellite to determine the nature of the deterioration.

LDEF program officials also noted discoloration around the high-voltage leads of an interstellar gas experiment. Just what this means will be studied in the data analyses, which are the next step in the LDEF program.

Space shuttle orbiter Columbia and LDEF arrived at Kennedy Space Center on January 26. The orbiter was separated from the Boeing 747 Shuttle Carrier Aircraft and towed to the Orbiter Processing Facility shortly thereafter. The removal of LDEF from Columbia's payload bay took place January 29.

LDEF was transferred to the Operation & Checkout Building and loaded onto a special transporter. The satellite was then moved to the Spacecraft Assembly and Encapsulation Facility II, where researchers will inspect and photograph its structure and experiment trays for about two weeks. Removal of the experiment trays was scheduled for February 22.

The LDEF, as designed, was a simple reusable structure approximately 4.3 m (14 ft) in diameter and 9.1 m (30 ft) in length. It was three-axis gravity-gradient

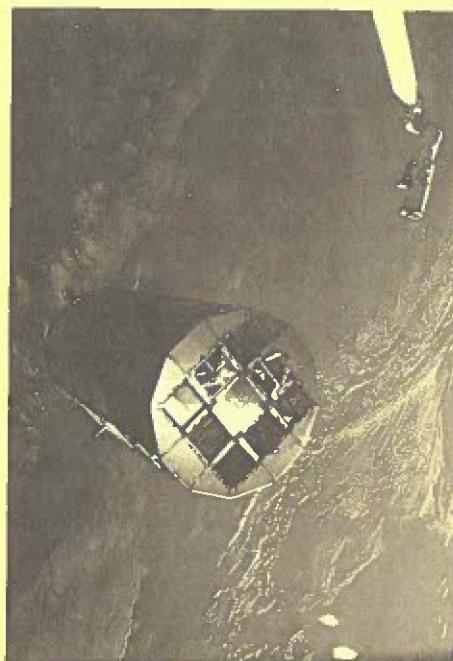
stabilized when free flying. The experiments were in totally self-contained trays mounted to the structure.

LDEF contains 57 science and technology experiments representing more than 200 investigators, 33 private companies, 21 universities, 7 NASA centers, 9 Department of Defense laboratories, and 8 foreign countries.

In addition to the valuable information that will result from the analysis of the individual experiments, the LDEF itself presents an opportunity to examine the effects of the space environment on spacecraft. A team of scientists from the Johnson Space Center will be working at Kennedy, photographing and analyzing the impact craters larger than ~1 mm. According to Dr. Michael Zolensky, JSC scientist, principal investigators on the experiments will be asked to cooperate with the JSC team by photographing the impact craters on their experiments and by capturing any of the projectiles that may be caught up in the experiment trays.

Since the LDEF was gravity stabilized, the same side always faced the Earth. By analyzing the surface, it may be possible to determine impactor flux rates and trajectories.

Analysis of the LDEF and its experiments is expected to provide invaluable data for the design of future spacecraft as well as insight into Earth's cosmic origins.



LDEF as viewed from Columbia just before its recapture. After 5½ years in orbit, the LDEF was retrieved just weeks before it was forecast to lose power and tumble from space. (NASA Photo S32-85-006)

Astronomy Day: Taking Astronomy to the People

April 28, 1990



Astronomy Day has been celebrated since 1973. Today the international event is co-sponsored by 13 astronomy and astronomy educational organizations, including the Astronomical League, Astronomical Society of the Pacific, Royal Astronomical Society of Canada, American Astronomical Society, Astronomical Association of Northern California, Planetary Society, Western Amateur Astronomers, American Association of Physics Teachers, National Deep Sky Observers Society, Association of Lunar and Planetary Observers, American Meteor Society, Association of Astronomy Educators, and American Association of Variable Star Observers.

The Astronomical League has published a handbook to help organizations host Astronomy Day events. The 120-page handbook is divided into three sections. The first section details the history of Astronomy Day along with organizational ideas for hosting special events; this section also gives the dates for Astronomy Day for the remainder of the century.

Section 2 contains ideas for special events including some display techniques, attention-getting ideas, and activities that can be performed on Astronomy Day. Two of the most important subsections are "Light Pollution" and "Astronomy for Teachers." The latter lists sources for astronomy education materials, including space camps, scholarships, training courses, and publications for teachers.

Section 3 lists the names and addresses of the ~200 organizations mentioned in the previous sections.

Astronomy clubs, science museums, etc., wishing to obtain the handbook can purchase it for \$5.00 plus postage and handling (postage is \$2.00 in U.S., \$3.00 for surface mail outside the U.S., and \$5.00 for airmail). All funds must be in U.S. dollars. Checks should be made payable to the Astronomical League. Organizations wishing free rules and entry forms for the Astronomy Day Award (for the organization that hosts the best Astronomy Day Events) without ordering the entire handbook should send a self-addressed, stamped legal-size envelope. Orders should be sent to:

Garry E. Tomlinson
Astronomy Day Coordinator
c/o Chaffee Planetarium
54 Jefferson, S.E.
Grand Rapids, MI 49503

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12-16

21st Annual Lunar and Planetary Science Conference, Houston, Texas. Contact: Pam Jones, Program Development Office, Lunar and Planetary Institute, 3303 NASA Road 1, Houston, TX 77058. Phone: 713-486-2150.

April

5-7

Third International Symposium on Experimental Mineralogy, Petrology, and Geochemistry, Edinburgh, United Kingdom. Contact: G. M. Biggar, Department of Geology and Geophysics, University of Edinburgh, West Mains Road, Edinburgh EH9 3JW, U.K.

9-12

Sixth National Space Symposium, Colorado Springs, Colorado. Contact: United States Space Foundation, P.O. Box 1838, Colorado Springs, CO 80901. Phone: 719-550-1000.

22-26

Space 90: Engineering, Construction, and Operations in Space, Albuquerque, New Mexico. Contact: Stewart Johnson, c/o BDM International Inc., 1801 Randolph Rd. S.E., Albuquerque, NM 87106. Phone: 505-848-4013.

23-27

European Geophysical Society XV General Assembly, Copenhagen, Denmark. Contact: EGS, Postfach 49, Max-Planck-Strasse 1, D-3411 Katlenburg-Lindau, F. R. Germany. Phone: 49-5556-1440.

May

2-4

V. M. Goldschmidt Conference, Baltimore, Maryland. Contact: Donna Ricketts, 409 Keller Conference Center, Pennsylvania State University, University Park, PA 16802. Phone: 813-863-1743.

29th-June 1

American Geophysical Union Spring Meeting, Baltimore, Maryland. Contact: AGU Meetings, 2000 Florida Avenue NW, Washington, DC 20009. Phone: 202-462-6903.

30-June 1

15th Symposium on Antarctic Meteorites, Tokyo, Japan. Contact: Dr. Keizo Yanai, Department of Antarctic Meteorites, National Institute of Polar Research, 9-10, Kaga 1-chome, Itabashi-ku, Tokyo 173, Japan. Phone: 03-962-4711 ext. 155; FAX: 03-962-2529.

June

4-8

Mars and Venus: Atmospheres, Ionospheres, and Solar-Wind Interactions (Chapman Conference), Lake Balaton, Hungary. Contact: AGU Meetings, 2000 Florida Avenue NW, Washington, DC 20009. Phone: 202-462-6903.

4-8

The Case for Mars IV, Boulder, Colorado. Contact: Tom Meyer, Case for Mars IV, P.O. Box 4877, Boulder, CO 80306.

July

13-15

Symposium on Automated Observatories and Global Networking, Boston, Massachusetts. Contact: Symposium Information, A.S.P., 390 Ashton Avenue, San Francisco, CA 94112. Phone: 415-337-1100.

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The Universe in the Classroom, Boston, Massachusetts. Contact: Workshop Information, A.S.P., 390 Ashton Avenue, San Francisco, CA 94112. Phone: 415-337-1100.

16-19

Symposium on the Formation and Evolution of Star Clusters, Boston, Massachusetts. Contact: Symposium Information, A.S.P., 390 Ashton Avenue, San Francisco, CA 94112. Phone: 415-337-1100.

September

17-21

53rd Annual Meeting of the Meteoritical Society, Perth, Australia. Contact: Dr. Alex Bevan, Department of Earth and Planetary Sciences, Western Australian Museum, Francis Street, Perth, Western Australia 6000. Phone: 09-427-2752.

21-22

Meteorite Impact on the Early Earth, Perth, Australia. Contact: Pam Jones, Program Development Office, Lunar and Planetary Institute, 3303 NASA Road 1, Houston, TX 77058. Phone: 713-486-2150.

October

23-26

Annual Meeting of the Division for Planetary Science of the American Astronomical Society, Charlottesville, Virginia. Contact: Bob Johnson, Department of Engineering Physics, University of Virginia, Charlottesville, VA 22903. Phone: 804-924-3244.

29-November 1

Geological Society of America Annual Meeting, Dallas, Texas. Contact: Sue Beggs, GSA Meetings Manager, P.O. Box 9140, Boulder, CO 80301. Phone: 303-447-2020.

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+ Solomon S. C.*

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Two Possible Subduction Zones on Venus

Monday, March 12, 1990

ORIGIN OF COMPONENTS IN CHONDRITES

8:30 a.m. GYM

{ Skinner W. R.*

Bipolar Outflows and a New Model of the Early Solar System. Part I: Overview and Implications of the Model

{ Skinner W. R.*

Bipolar Outflows and a New Model of the Early Solar System. Part II: The Origins of Chondrules, Isotopic Anomalies, and Chemical Fractionations

Clayton R. N. Mayeda T. K. Olsen E. J. Goswami J. N.
Oxygen Isotopic Compositions of Ordinary Chondrites and Their Chondrules

Steele I. M.*

Micro-Textural and -Chemical Features of Isolated Forsterites of C3 Meteorites with Implications for Origin

Bajt S.* Pernicka E. Traxel K.

Microdistribution and Correlation of Trace Elements in Mineral Grains of Semarkona (LL3.0) and Dhajala (H3.8) as Determined by PIXE Analysis

Brearley A. J.*

Matrix Mineralogy of the Unequilibrated CO3 Chondrite, ALH A77307: Evidence for Disequilibrium Condensation Processes and Implications for the Origin of Chondrite Matrices

Lu J.* Sears D. W. G. Keck B. D. Prinz M. Grossman J. N. Clayton R. N.
Semarkona Type I Chondrules Compared with Similar Chondrules in Other Classes

Johnson C. A.* Prinz M. Weisberg M. K.

Constraints on the Origin of Type II Chondrules from Chromite Compositions

Lofgren G.*

The Crystallization of a Melt Droplet Chondrule

Connolly H. C. Jr.* Hewins R. H. Delaney J. S.

The Reproduction of Chondrule Rims: A Preliminary Report

Bunch T. E.* Schultz P. Brownlee D. Podolak M. Reynolds R. Cassen P. Chang S.
Hypervelocity Impact Penetration Experiments--A Guide to the Origin of Rims on Chondrules

Rubin A. E.* Kallemyer G. W.

A Unique Carbonaceous Chondrite: Lewis Cliff 85332

Hartmetz C. P.* DeHart J. M. Hasan F. A.

LEW86018: A Rare L3.1 Unequilibrated Ordinary Chondrite

POSTER PRESENTATIONS

Wasilewski P. Nuth J.

Magnetic Record in Primitive Materials

DeHart J. M. Lofgren G. E.

Experimental Studies of Cathodoluminescence in Type I Chondrule Analogs

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Connolly H. C. Jr. Hewins R. H.

Calcium in Forsteritic Olivines in Type IA Chondrules: An Experimental Study

Esat T. M. Taylor S. R.

Mg Isotopic Composition of Chondrules from the Unequilibrated Ordinary Chondrite Semarkona

Kashkarov L. L. Kalinina G. V.

Pre-Accretion Irradiation of Crystals in the Tieschitz H 3.6 Chondrules

Monday, March 12, 1990
LUNAR METEORITES
8:30 a.m. Room 206

{ Delaney J. S.*

Preliminary Petrographic Data for MAC88105: Anorthositic Microbreccia

Delaney J. S.* Sutton S. R.

Petrography of Meteoritic VLT Basalt Breccia (87521) from Elephant Moraine, Antarctica

Warren P. H.* Klemme G. W. Jerde E. A.

Compositional-Petrographic Investigation of Two Newly-Acquired Moon Rocks

Yanai K.*

Anorthositic Gabbro: Cumulate Meteorite from Antarctica

Takeda H.* Saito J. Mori H. Tachikawa O. Miyamoto M.

Mineralogical Comparisons of Two Large Lunar Meteorites MAC88105 and Y86032

Neal C. R.* Taylor L. A. Patchen A. D.

New Lunar Meteorite MAC88105: A Ferroan Anorthosite Breccia with Mare Tendencies

Wentworth S. J.* McKay D. S.

Lunar Meteorite MAC88104/5: Petrography and Glass Compositions

Taylor G. J.*

Lunar Meteorite MacAlpine Hills 88105 and the Bombardment History of the Moon

Delano J. W.*

Constraints on the Highlands Source-Area of Lunar Meteorite ALHA 81005 Using Chemical Compositions of Glasses

Palme H.* Spettel B. Burghele A. Dreibus G. Weckwerth G. Wanke H. Jochum K. P. Weber H. Bischoff A.

Stöffler D.

Big MAC, Little MAC and the Composition of the Lunar Crust

Koeberl C.* Kurat G. Brandstatter F.

MAC88105--A New Meteorite from the Lunar Highlands: Preliminary Mineralogical, Petrological, and Geochemical Studies

{ Korotev R. L.* Jolliff B. L. Haskin L. A.

Preliminary Report on Geochemical Study of Lunar Meteorites MAC88104 and MAC88105

Jolliff B. L.* Haskin L. A. Korotev R. L.

Petrography and Geochemistry of Ferroan Troctolitic Anorthosite in Lunar Meteorite MAC88105

Lindstrom M. M.* Martinez R. R. Mittlefehldt D. W.

Geochemistry of Lunar Meteorites MAC88104 and MAC88105

Wang M.-S. Lipschutz M. E.*

Labile Trace Elements in Lunar Meteorite MAC 88105

Eugster O.*

Lunar Meteorite MAC88105: History Derived from Cosmic-Ray Produced and Solar Wind Trapped Noble Gases

Jull A. J. T.* Donahue D. J.

Carbon-14 Terrestrial Age of the MAC88105 Lunar Meteorite

Nishiizumi K.* Klein J. Fink D. Middleton R. Kubik P. W. Sharma P. Reedy R. C. Arnold J. R.

Exposure Histories of Lunar Meteorites MAC88104 and MAC88105

Vogt S.* Herzog G. Fink D. Klein J. Middleton R.

Cosmogenic Radionuclides in Three Lunar Meteorites from Antarctica: Yamato 86032, MacAlpine Hills 88104 and MacAlpine Hills 88105

Sears D. W. G.* Sears H. Myers B. M.

The Natural TL Survey of the 1987/1988 Antarctic Meteorite Collections: Pairing, an Unusual Carbonaceous Chondrite Group and the Lunar Meteorites

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Grady M. M. Pilling C. T.

Stable Isotope Geochemistry of MAC 88105: Comparison with Apollo Soils and Other Lunar Meteorites

Jolliff B. L.

General Petrography and Bulk Composition of Lunar Meteorite MAC88105

Monday, March 12, 1990

COSMIC RAYS

8:30 a.m. Room 204

Rao M. N.* Garrison D. H. Bogard D. D. Murali A. V. Black D. C.

Composition of Solar Flare Argon Deduced from Kapoeta Etched Mineral Separates

Rao M. N.* Garrison D. H. Bogard D. D. Murali A. V. Black D. C.

Activity of the Ancient Sun Based on Noble Gas Studies of Etched Kapoeta Mineral Separates

Murty S. V. S.*

Cosmogenic Nitrogen in Kapoeta: An Attempt to Isolate Solar Cosmic Ray Produced Component

Wieler R.* Signer P. Jull A. J. T. Pellas P. Tuniz C. Maras A. Fink D.

Klein J. Middleton R. Herzog G. F. Vogt S.

Noble Gas, ^{26}Al , ^{10}Be , and ^{14}C Concentrations and Track Densities of Bur Gheluai: Evidence for a Two-Stage Exposure History

Nishiizumi K. Arnold J. R.* Fink D. Klein J. Middleton R.

Depth Profile of ^{41}Ca in the Apollo 15 Long Core

Klein J.* Fink D. Middleton R. Vogt S. Herzog G. F. Reedy R. C. Sisterson J. M. Kochler A. M. Magliss A.

Average SCR Flux During Past 10^5 Years: Inference from ^{41}Ca in Lunar Rock 74275

Reedy R. C.*

Solar-Alpha-Particle Production of Nickel-59 in the Moon

Englert P. A. J.* Drake D. M. Shunk E. R. M. Drosog Reedy R. Bruckner J.
Simulation of Galactic Cosmic Ray Interactions with 'Martian Soil': Implications for Cosmogenic Nuclide Studies and
Planetary Gamma Ray Spectroscopy

Benit J.* Bibring J.-P.
Irradiation Effects on the Surface of Icy Bodies

Monday, March 12, 1990
VENUS OVERVIEW PRIOR TO MAGELLAN: II
1:30 p.m. Room 104

Crumpler L. S.* Head J. W.
Formation and Evolution of Plume Plateaus on Venus

Grimm R. E.* Phillips R. J.
Gravity Anomalies and the Geodynamics of Lakshmi Planum, Venus

Roberts K. M.* Head J. W.
Models for the Origin of Lakshmi Planum, Venus

Kiefer W. S.* Hager B. H.
Crustal Convergence and Mantle Downwelling in the Ishtar Terra Region of Venus

Vorder Bruegge R. W.* Head J. W.
Formation of Eastern Ishtar Terra, Venus, Through Accretion of Crustal of Crustal Terranes

Namiki N.* Solomon S. C.
Thermal Evolution of Venus Mountain Belts

Herrick D. L.* Parmentier E. M.
The Initiation of Subduction: Thermal and Compositional Considerations with Application to Venus

Frank S. L.* Head J. W.
Styles of Compressional Deformation on Venus: Examples from Ridge Belts

Arkani-Hamed J.*
Thermal State of Venus Inferred from Its Gravity and Surface Topography

Smrekar S. E.* Phillips R. J.
Geoid to Topography Ratios for 14 Venusian Features: Implications for Compensation Mechanisms

Janes D. M.* Melosh H. J.
Finite Element Modeling of Venusian Coronae

Williams D. R.* Greeley R.
A Tectonic Model for Tellus Regio, Venus, Based on Stress Analysis and Comparison with Venera 15/16 Radar Images

Bindschadler D. L.*
Origin and Evolution of the Tessera Terrain of Venus: Implications for Global Tectonics and Magellan

Monday, March 12, 1990
CHONDRITE PARENT BODY PROCESSES
1:30 p.m. GYM

McSween H. Y. Jr.*

Kinetic Pathways to Chondrite Petrologic Types

Jones R. H.* Rubie D. C.

Thermal Metamorphism in CO3 Chondrites: Application of Olivine Diffusion Modelling to Post-Accretionary Metamorphism

Geiger T.* Bischoff A.

Exsolution of Spinel and Ilmenite in Magnetites from Type 4-5 Carbonaceous Chondrites - Indications for Metamorphic Processes

McCoy T. J.* Taylor G. J. Scott E. R. D. Keil K.

Metallographic Cooling Rates Correlated with Petrologic Type in LL3.0-4 Chondrites: Implications for Parent Body Structures

Duffield C. E. Williams D. B. Goldstein J. I.*

The Structure and Composition of Taenite Particles in Two Type VI Ordinary Chondrites

Zolensky M. E.* Barrett R. A. Klock W. Gooding J. L.

The Mineralogy of Matrix and Chondrule Rims in CM Chondrites

Brearley A. J.*

Constraints on the Shock and Thermal Histories of some Components from the Unique Chondrite, Allan Hills 85085, and Their Implications

Bogard D. D.* Garrison D. H. Scott E. R. D. Keil K. Taylor G. J. Vogt S.

Herzog G. F. Klein J.

The Chico, NM, L-6 Chondrite: A Large, 500 My-Old Impact Melt with a Long Cosmic Ray Exposure

Graf T.* Marti K.

Exposure Ages and Collisional History of L-Chondrite Parent Bodies

Lipschutz M. E.* Samuels S. M.

Multivariate Statistical Analysis of Compositional Data from Ordinary Chondrites

Haas J. R.* Haskin L. A.

A Compositional Study of Whole-Rock Fragments of the L6 Chondrite Bruderheim

Nichols R. H. Jr.* Hohenberg C. M. Olinger C. T. Rubin A. E.

Allende Chondrules and Rims: I-Xe Systematics

POSTER PRESENTATIONS

Heymann D.

Raman Study of Olivines in Thirty Seven Heavily and Moderately Shocked Ordinary Chondrites

Jull A. J. T. Wlotzka F. Palme H. Donahue D. J.

Terrestrial Age and Petrologic Type of Meteorites from the Libyan Desert

Miura Y. Hanaura Y.

Plagioclase (-like) Compositions of Yamato-691 Chondrite

Keller L. P. Buseck P. R.

Aqueous Alteration Products in CV3 and CO3 Carbonaceous Chondrite Meteorites: Phyllosilicates

Shock E. L. Schulte M. D.

Implications of the Reported Amino Acid Concentrations in the Murchison Meteorite

Petaev M. I.

Chromite-Troilite Distribution of Fe and Cr in Highly Shocked Chondrite Novosibirsk
(H 4-5)

PRESENTED BY TITLE ONLY

Eugster O. Michel Th. Wang D.

Chinese and Other Chondrites: Exposure Ages, Radiogenic and Trapped Noble Gases and Mineralogy

Fuji N. Horii Y. Takeda H.

Hardness and Shape Irregularity of Metallic Particles in Antarctic Ordinary Chondrites

Hewins R. H.

Chondrule Evolution Revisited: Semarkona and Chainpur

Kashkarov L. L. Korotkova N. N. Kashkarova V. G. Skripnik A. Ya.

The Glass Inclusions from Kaidun CV2 Carbonaceous Chondrite as Indicator of Its Thermal History on Data of Track and TL Studies

Kashkarov L. L. Korotkova N. N. Kashkarova V. G. Skripnik A. Ya.

Study of Nikol'skoe L4-5 Chondrite Olivine Chondrule by Track and Thermoluminescence Methods

Kashkarov L. L. Kashkarova V. G.

Chondrule Thermoluminescence: Implication for the Thermal History of Type 3-5 Ordinary Chondrites

Kashkarov L. L. Kalinina G. V. Kashkarova V. G. Baryshnikova G. V.

Thermoluminescence and Track Parameters for the Chondrules from the Tieschitz H3.6 Ordinary Chondrite

Mendybaev R. A. Kuyunko N. S. Mironenko M. V. Lavrukhina A. K.

On the Origin of the Carbon-Rich Aggregates in the Ordinary Chondrites

Miyamoto M.

Heating Experiments (300-700 °C) of the Murchison (CM2) Meteorite: Infrared Spectroscopy

Miyamoto M.

Infrared Diffuse Reflectance Spectra of Some Antarctic Carbonaceous Chondrites

Miyamoto M. Kato A.

Infrared Diffuse Reflectance Spectra of Some Hydrous Carbonates

Rode O. D.

Saratov Meteorite: Grain Size Study

Semenova A. S. Kononkova N. N. Guseva E. V.
Olivine-Hypersthene Chondrite in the Luna 16 Soil

Tomeoka K.

Matrix Compositions and Mineralogy of the Alais and Ivuna CI Carbonaceous Chondrites

Monday, March 12, 1990
COMETS AND ORBITAL DUST COLLECTION
1:30 p.m. Room 206

Simpson J. A. Tuzzolino A. J.*

Two-Dimensional Position-Sensing PVDF Dust Detector for Measurement of Dust Particle Trajectory

Tsou P.* Bradley J. P. Brownlee D. E. Fechtig H. Hrubesh F. L. Keaton P. W.

Laurance M. Simon C. G. Stradling G. L. Teetsov A. Albee A. L.

Intact Capture of Cosmic Dust Analogs in Aerogel

Zolensky M. E. Barrett R. A.* Hrubesh L. Horz F. Lindstrom D.

Cosmic Dust Capture Simulation Experiments Using Silica Aerogels

Hartmetz C. P. Gibson E. K. Jr.* Lauer H. V.

A Study of Aerogel's Suitability as an IDP Collection Substrate: Potential Solutions to Volatile Contamination Problems

Helin E. F.* Roman B. P. Alu J. T.

Comets Discovered by PCAS in 1989

Jackson A. A.* Zook H. A.

Long Time Orbital Dynamics of Dust Grains from Comets: Encke and Halley

Thiel K.* Kolzer G. Kochan H. Grun E. Kohl H.

Recent Results of the Comet Simulation Project (KOSI): Implications for the Dust Components of Comets

Mauersberger K.* Michel H.-J. Krankowsky D. Lammerzahl P. Hesselbarth P.

Measurement of the Volatile Component in Particles Emitted from an Artificial Comet

Hsiung P.* Roessler K.

Diffusion of Volatiles in Cometary Analogs

Roessler K.* Eich G. Patnaik A. Zador E.

Polycyclic Aromatic Hydrocarbons via Multicenter Reactions Induced by Solar Radiation

Blake D. F.* Allamandola L. J. Palmer G.

Direct Determination of the Morphology, Structure and Composition of Planetary, Cometary and Interstellar Ice Analogs

Marov M. Y.* Kolesnichenko A. V. Skorov Y. V.

On the Formation of Cometary Atmosphere

POSTER PRESENTATIONS

Cole K. J. Feingold H. McAdams J. Stancati M. L. French J. R.

A Planetary Small Missions Program Using Small Spacecraft

Khare B. N. Thompson W. R. Sagan C. Arakawa E. T. Meissel C. Gilmour I.
Optical Constants of Kerogen from 0.15 to 40 μ m: Comparison with Meteoritic Organics

Kochan H. Seidensticker K. Koever W.
Angular Distribution and Velocities of Dust Emissions Observed at Artificial Comets

Konno I. Huebner W. F. Boice D. C.
A Hydrodynamic Model of Dusty Gas Flows in Comet Comae with Dust Fragmentation

PRESENTED BY TITLE ONLY

Lang B. Grochowski T.
Organic Compounds in Cometary Dust: Their Chemical Systematics Using Similarity of Molecular Graphs

Monday, March 12, 1990
LUNAR REGOLITH
1:30 p.m. Room 204

Graf J.*
Fractal Grainshape Analysis of Lunar Soils 67941 and 68501

Cintala M. J.* Horz F.
Mineral-Dependent Comminution During Impact Cratering

McKay D. S.* Wentworth S. J.
Natural Reduction of Lunar Iron Oxide

Basu A.* Wentworth S. J. McKay D. S.
Soils in 15009 and the Geology of the Apollo 15 Site

Rao M. N. McKay D. S.* Garrison D. H. Wentworth S. J. Bogard D. D.
Characterization of Soil Components from the 79001/2 Core

Nishiizumi K. Arnold J. R.* Kubik P. W. Sharma P.
New Results on History of Gardening in Lunar Cores 15008 and 76001 Using Cosmogenic Radionuclides

Becker R. H.*
Model Calculations of Solar Wind and SEP Neon Isotopic Distributions in Lunar Regolith Grains

Kerridge J. F.* Eugster O. Kim J. S. Marti K.
Lunar and Solar Nitrogen from 3.7GYR Ago

Esat T. M.* Taylor S. R.
Mg Isotope Fractionation in Lunar Soils

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Niedermann S. Eugster O.
Anomalous Kr and Xe Adsorption on Lunar Anorthositic Breccia 65315

Simon S. B. Papike J. J.
Comparative Petrology of Lunar Regolith Breccias and Soils, and Implications for the Howardite Parent Body Regolith

Tuesday, March 13, 1990
VENUS OVERVIEW PRIOR TO MAGELLAN: III
8:30 a.m. Room 104

Aubele J. C.*

Two Global Concentrations of Small Dome-Like Hills on Venus

Klose K. B.*

Radar-Bright Haloes of Loukha Planitia: Implications for Venus Volcanic Style

Wood C. A.* Coombs C. R.

Meridional Symmetry of the Venus Polar Complex

Schaber G. G.* Kozak R. C.

New USGS Open-File Geomorphic/Geologic and Tectonic Maps of the Northern Quarter of Venus

McCollom T. M.* Jakosky B. M.

Slope Properties of Some Terrestrial Surfaces and Implications for Planetary Radar Interpretation

Stofan E. R.* Head J. W. Campbell D. B.

Beta-Eisila Deformation Zone: Analysis from Recent Arecibo Images

Plaut J. J.* Jurgens R. F.

Radar Backscattering Behavior in the Equatorial Region of Venus - Goldstone Observations

Jurgens R. F.* Franck C. Greiner W. Howard D. Robinett L. Slade M. A. Wyss K. Arvidson R. E. Plaut J.

Radar Observations of Tinatin Planitia: Goldstone 1988 Observations of Venus

Senske D. A.* Head J. W. Stofan E. R. Campbell D. B.

Geology and Structure of Beta Regio: Results from New Arecibo Data

Campbell D. B.* Head J. W. Senske D. A. Hine A. A. Stacy N. J. Fisher P. C.

Venus Southern Hemisphere: Age and Geologic Characteristics of Major Terrains in the Themis Regio-Alpha Regio-Lada Terra Region

Campbell B. A.* Campbell D. B.

Volcanic Deposits in Western Eisila Regio: Preliminary Results of Radar Polarization Studies

Alexandrov Yu. N. Krivtsov A. P. Rzhiga O. N.*

Venera 15 and 16 Spacecraft: Some Results of Venus Surface Reflectivity Measurements

Wall S. D.* Johnson W. T. K.

Radiometric Calibration of the Magellan Radar

Tuesday, March 13, 1990

CAIs

8:30 a.m. GYM

Sylvester P. J.* Grossman L. MacPherson G. J.

Chemical Compositions of Leoville and Vigarano Inclusions

Weisberg M. K.* Prinz M.

Refractory-rich Inclusions in CR2 (Renazzo-type) Chondrites

Holmberg B. B.* Hashimoto A.
Long-Sought Primordial Fine-Grained Inclusion Discovered

Ireland T. R. Palme H.* Spettel B.
Trace-Element Inventory of the Allende (CV3) Meteorite

Paque J. M.*
Relict Grains in a Ca-Al-rich Inclusion from Allende

Simon S. B.* Davis A. M. Grossman L.
"Relict" Fassaite in Type B1 CAI's: Products of Late-Stage Liquids?

El Goresy A.* Caillet C. Zinner E.
Vigarano CAI 477B: Petrography and Mg Isotopic Composition of the Core and Individual Rim Layers

Sheng Y. J.* Hutcheon I. D. Wasserburg G. J.
Mg Isotope Heterogeneity in Plagioclase Olivine Inclusions

Kennedy A. K.* Beckett J. R. Hutcheon I. D.
Trace Element and Isotopic Constraints on the Formation and Crystallization of a Type B1 CAI from Allende

Chamberlin L.* Beckett J. R. Stolper E.
Experimental Determination of Oxide Activities in Silicate Melt: An Application to the Condensation of CAI Liquids

Davis A. M.* Simon S. B. Grossman L.
Effective Fassaite/Liquid Trace Element Distribution Coefficients for Type B CAI's

McKeegan K. D.* Ryerson F. J.
Diffusion of Oxygen in Diopside and Spinel: Implications for Oxygen Isotopic Anomalies in CAIs

POSTER PRESENTATION

Meeker G. P.
Evidence for Low Temperature Equilibration in Allende CAI

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Simon S. B. Grossman L.
Compositionally Zoned Fassaite in an Allende Coarse-grained Inclusion

Nagahara H.
Vaporization Experiments in the System Plagioclase- Hydrogen: 2. Composition of the Gas

Tuesday, March 13, 1990
LUNAR GEOLOGY AND RESOURCE UTILIZATION
8:30 a.m. Room 206

Pieters C. M.* Pratt S. F. Sunshine J. M.
Petrology of the Olivine Mountains at Copernicus

Sunshine J. M.* Pieters C. M.
Extraction of Compositional Information from Olivine Reflectance Spectra: A New Capability for Lunar Exploration

Hawke B. R.* Spudis P. D. Lucey P. G. Bell Jeffrey F.
The Composition of the Crust in the Orientale Region of the Moon: A Pre-Galileo View

Coombs C. R.* Hawke B. R. Peterson C. A. Zisk S. H.
Regional Pyroclastic Deposits in the North-Central Portion of the Lunar Nearside

Bruno B. C.* Lucey P. G. Hawke B. R.
Preliminary Results of High Resolution UV-Visible Spectroscopy of Lunar Red Spots

Chevrel S.* Pinet P.
Multispectral Imaging of Crater Gassendi in Ten Bands (UV to Near-IR)

Lucey P. G.*
Comparison of Thermal Emission Spectroscopic Measurements of the Lunar Surface

Dollfus A.*
Video-Polarimetry of the Lunar Regolithic Surface

Gillett S. L.*
Chloride Lavas: A Possible Magmatic Differentiation Product Under Anhydrous Conditions?

Johnson J. R.* Larson S. M. Singer R. B.
Estimates of Lunar Mare Titanium and Ilmenite Abundances from CCD Imaging and Spectroscopy

Muhich T. Vaniman D.* Heiken G.
Ilmenite in High-Ti Apollo 17 Basalts: Variations in Composition with Degree of Exsolution

Taylor L. A. Oder R. R.*
Magnetic Beneficiation of Highlands Soils: Concentrations of Anorthite and Agglutinates

Taylor L. A. Oder R. R.*
Magnetic Beneficiation of Hi-Ti Mare Soils: Concentrations of Ilmenite and Other Components

Fegley B. Jr.* Kong D.
Lunar Volcanic Gases: Further Thermodynamic Modeling Results for the Transport of Trace Metals and Volatile Elements

POSTER PRESENTATIONS

Shevchenko V. V.
A Possible Lunar Science Objective for Galileo

Lucey P. G. Hawke B. R. Bruno B. C.
Preliminary Results of Imaging Spectroscopy of the Humorum Basin Region of the Moon

Campbell B. A. Zisk S. H. Bell James. F. Hawke B. R.
High-Resolution Remote-Sensing Studies of Crater Ray Materials in Mare Serenitatis

Coombs C. R. Hawke B. R. Peterson C. A. Lucey P. G.
Pyroclastic Deposits in the Nectaris Region of the Moon

Clark P. E. Basu A.
The Distribution of Glass on the Moon

Agosto W. N.

Aqueous Processing of Lunar Regolith for In-Situ Production of Structural Materials and Fuels

Talent D. L. Smith H.J. Vilas F.

Lunar-Outpost Astronomy: A Scenario for Paced, High-Return Growth

PRESENTED BY TITLE ONLY

Korotev R. L. Jolliff B. L. Haskin L. A.

Compositional Survey of Particles from the Luna 16 Regolith, Part 2

Korotov R. L.

Provenance of Ropy Glasses from Shorty Crater at Apollo 17

Rodionova Zh. F. Shevchenko V. V.

The Boundary of an Ancient Depression as Indicated by Crater Statistics

Rodionova Zh. F. Shevchenko V. V. Zazulyak P. M. Zinger V. E.

Dependence on the Density of Lunar Crater Distribution on Relief

Colson R. O.

Characterization of Metal Products of Silicate Melt Electrolysis

Tuesday, March 13, 1990

OUTER SOLAR SYSTEM

8:30 a.m. Room 204

Spencer J. R.* Shure M. A. Ressler M. E. Toomey D. DeNault A. Sinton W. M. Goguen J. D.

Disk-resolved Ground Based Infrared Imaging of Io

Johnson M. L.* Burnett D. S.

Igneous Origin for Na in the Cloud of Io

Binzel R. P.*

Long Term Variations of a Volatile Methane Reservoir on Pluto

Hillier J. K. Squyres S. W.*

Differential Thermal Stresses: A Source for Early Extensional Tectonism on the Saturnian and Uranian Satellites

Dissly R. W.* Brown R. H. Matson D. L.

Laboratory Measurements of the Solid-state Greenhouse Effect in Glass Beads

Bell James. F.*

Color Units on the Uranian Satellites: An Outer Solar System Solar System Analog to Lunar Vitrification Darkening?

Helfenstein P.* Hillier J. Weitz C. Veverka J.

Oberon: Color Photometry and its Geological Implications

Hogenboom D. L.* Kargel J. S.

Ammonia-Water Densities and Phase Relations to Four Kilobars

Boone S.* Nicol M. F.

Ammonia-Water Mixtures at High Pressures Revisited

Halfen C. W.* Schultz P. H. Gault D. E.

Origin of Anomalous Crater Chains and Their Implications for the Cratering Record

Durham W. B.* Kirby S. H.

Planetary Ices: A Comparison of Rheologies at T < 200 K

Schenk P. M.*

Central Pit Formation in Craters on Icy Satellites

POSTER PRESENTATIONS

Im E. Werner C. Roth L.

Titan Radar Mapper for the Cassini Mission

Ohtsuki K.

Collisional Dynamics of Ring Particles in the Gravitational Field of Saturn

Rothery D. A.

Collapsed "Lava" Tubes on Ariel?

Forni O. Coradini A. Federico C.

Strength in the Lithosphere of a Small Icy Satellite

Eluszkiewicz J. Stevenson D. J.

Physico-Chemical State of Titan's Subsurface Layers

Pozio S. Kargel J. S.

The Cratering Record and Geological History of Enceladus

Schenk P. M.

Crater Morphology and Modification on Ganymede, Callisto, and Tethys

PRESENTED BY TITLE ONLY

Kuramoto K. Matsui T.

Early Thermal History and Atmospheric Evolution of Titan

Moses J. I. Nash D. B.

Can Metastable Sulfur Allotropes Exist on Io?

Fegley B. Jr.

The Chemistry of Deuterium Bearing Gases in the Atmosphere of Uranus

Fegley B. Jr.

Water Cloud Condensation in the Atmosphere of Uranus

Fegley B. Jr.

New Chemical Models of the Atmosphere of Uranus. I. Carbon and Nitrogen Bearing Gases

Fegley B. Jr.

New Chemical Models of the Atmosphere of Uranus. II. Chemical Probes of Atmospheric Dynamics

Fegley B. Jr.

Ammonia Depletion Mechanisms on Uranus

Schultz R. A.

Origin of the Echelon Geometries of Joints and Faults on Planetary Surfaces

Azuma H. Fujii N.

Multi Kubelka Analysis of Vis-Nir Reflectance Spectra

Tuesday, March 13, 1990

MEVIV: MARTIAN GEOPHYSICAL AND TECTONIC EVOLUTION

1:30 p.m. Room 104

† Phillips R. J.*

Geophysics at Mars: Issues and Answers

Turcotte D. L.* Huang J.

Implications of Crustal Formation on Mars from Parameterized Convection Calculations

Stevenson D. J.* Bittker S. S.

Why Existing Terrestrial Planet Thermal History Calculations Should Not Be Believed (and What To Do About It)

Banerdt W. B.* Golombek M. P.

The Evolution of Tharsis: Implications of Gravity, Topography, and Tectonics

McGill G. E.* Hills L. S.

Polygonal Terrane of Mars: Stresses from Drape Folding

Schultz R. A.*

Complex Early Rifting in Valles Marineris: Results from Preliminary Geologic Mapping of the Ophir Planum Region of Mars, 1:500,000 Scale

Watters T. R.*

The Nature and Origin of Periodically Spaced Wrinkle Ridges on Mars

Golombek M.* Suppe J. Narr W. Plescia J. Banerdt B.

Does Wrinkle Ridge Formation on Mars Involve Most of the Lithosphere?

Peulvast J. P.*

Erosional Landforms and Morphotectonic Development in Valles Marineris (Mars): Melas Chasma

Lucchitta B. K. * Blaser R. A. Bertolini L. M.

Valles Marineris, Mars: Are Pit Chains Formed by Erosion and Troughs by Tectonism?

McEwen A. S.*

Valles Marineris Landslides: Evidence for Mechanics of Large Rock Avalanches

POSTER PRESENTATIONS

Chadwick D. J. Watters T. R. Tuttle M. J.

Crosscutting, Periodically Spaced Wrinkle Ridges of Hesperia Planum

Wichman R. W. Schultz P. H.

A Model for Crustal Subduction by Large Impacts

- Forsythe R. D.**
Polyphase Noachian Tectonism of the Memnonia/Aeolis Region; Evidence for Greater Pre-Tharsis Lithospheric Mobility of Mars
- Bertolini L. M. McEwen A. S.**
Digital Mosaic and Elevation Model of Central Valles Marineris, Mars
- Wu S. S. C. Howington-Kraus A.**
Volumetric Distributions of Mars Topography
- Zimbelman J. R.**
Geologic Mapping of the Central Mangala Valles Region, Mars
- Ruff S. W. Greeley R.**
Sinuous Ridges of the South Polar Region, Mars: Possible Origins
- McDonnell J. H.**
Development of the Southwest Elysium Canyon Complex, Mars
- Watters T. R. Tuttle M. J.**
Domains of Regional Pure Shear on the Terrestrial Planets
- Plescia J. B.**
Photoclinometric Analysis of Wrinkle Ridges on Lunae Planum, Mars
- Chicarro A. F.**
Options for the Scientific Exploration of Mars in ESA
- PRESENTED BY TITLE ONLY**
- Wu S. S. C. Garcia P. A. Howington-Kraus A.**
Volumetric Determinations of Valles Marineris of Mars
- Schultz R. A.**
Strike-Slip Faulting, Wrinkle Ridges, and Time Variable Stress States in the Coprates Region of Mars
- Wichman R. W. Schultz P. H.**
Large Scale Compression Structures in the Eridania-Phaethontis Region: More Evidence for Polar Wandering
- Watters T. R. Tuttle M. J. Kiger F. J.**
Symmetry of Inferred Stress Fields in the Tharsis Region of Mars
- Watters T. R. Chadwick D. J. Liu M. C.**
Distribution of Strain in the Floor of the Olympus Mons Caldera
- Watters T. R. Tuttle M. J.**
Origin of Curvilinear Graben in Southwest Lunae Planum, Mars
- Jons H.-P.**
Further Evidences for Horizontal Block-/Plate Movements or Nappe Tectonics Within the Tanova - Updoming, Mars

Tuesday, March 13, 1990
SOLAR NEBULA AND PLANETARY ORIGINS
1:30 p.m. GYM

Black D. C.* Eck A. Jackson A. A.

Orbital Stability: Constraints on the Nature of Other Planetary Systems

Nakamoto T.* Nakagawa Y.

Disk Self-Gravity Effects on the Time Evolution of the Solar Nebula

Watanabe S.* Miyama S. M.

Collision and Tidal Interaction Between Planetesimals

Wetherill G. W.*

Runaway Planetesimal Growth: Agreement Between Analytical Solution of the Coagulation Equation and the Results of Numerical Physical Modelling

Malcuit R. J.* Mehringer D. M. Winters R. R.

Intact Planetoid Capture: Identification of Some Favorable Capture Orientations for a Lunar-Like Planetoid

Boss A. P.* Cameron A. G. W. Benz W.

Tidal Disruption of Inviscid Protoplanets

Cameron A. G. W.* Benz W. Wasson J. T.

Heating During Asteroidal Collisions

Tonks W. B.* Melosh H. J. McKinnon W. B.

The Fate of Ejected Mercury Mantle Material from a Giant Impact

Pepin R. O.*

Adsorption of Nebular Gases on Protoplanetary Cores

Matsui T.* Tajika E.

Evolution of Proto-CO₂-Atmosphere on the Earth

Ruzmaikina T. V.*

Chondrule Formation in the Accretional Shock

Newsom H. E.* Beserra T. B.

Geochemical Constraints on the Origin of the Moon

POSTER PRESENTATIONS

Marquez C. Hartmctz C. P. Gibson E. K. Jr. Oro J.

Volatile Molecules Produced from Carbides of Iron, Calcium, and Manganese by Laser Pulse

Sasaki S.

Heating of an Accreting Protoplanet by Blanketing Effect of a Primary Solar-Composition Atmosphere

Donn B. Peck D. Lee S.-Y. Fullar E. Dankelman L.

An Experimental Program to Study Impacts on Compressible Aggregates

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Nakagawa Y. Sekiya M.

Non-Axisymmetric Gravitational Instabilities in a Dust Layer in a Solar Nebula

Bottke W. F. Greenberg R. Valsecchi G. B. Carusi A.

Mapping Effects of Distant Perturbations on Particle-Planet Encounters

Greenberg R. Bottke W. F.

Planetary Accretion Rates: Analytic Formulae Confirmed by a Variety of Numerical Simulations

Biral C. Fabris M. Marzari F. Vanzani V.

Proto-Jupiter Perturbations in the Primordial Asteroid Belt

Tuesday, March 13, 1990

LUNAR HIGHLANDS

1:30 p.m. Room 206

Phinney W. C.*

Anorthosites, Melts and the Bulk Moon

McGee J. J.*

Mineralogy and Compositional Variations in Lunar Ferroan Anorthosites

Premo W. R.* Tatsumoto M.

Pb Isotopes in Norite 78235

Shervais J. W.*

The Western Highland Province at the Apollo 14 Site

Jolliff B. L.*

Fragments of Quartz Monzodiorite and Felsite in Apollo 14 Soil Particles

Marvin U. B.* Holmberg B. B. Lindstrom M. M.

New Pieces of the Lunar Granite-Quartz Monzodiorite Puzzle

Lindstrom M. M.* Marvin U. B.

A Geochemical-Petrologic Study of the Populations of Coarse-fines Particles in Apennine Front Soils

Hess P. C.* Horzempa P. Rutherford M. J. Devine J.

Phosphate Equilibria in Lunar Basalts

Neal C. R.* Taylor L. A.

"REEP" Metasomatism of the Apollo 14 Highlands: Evidence from the Mg-Suite

Neal C. R.* Taylor L. A. Patchen A. D.

The Dichotomy Between Primitive Highland Cumulates and Evolved Interstitial Whitlockites: The Process of "REEP-Fraction" Metasomatism

Spudis P. D.* Taylor G. J. McCormick K. A. Ryder G. Keil K. Grieve R. A. F.

Clasts in Lunar Impact Melts and the Origin of Low-K Fra Mauro Basalt

Swindle T.* Spudis P. D. Taylor G. J. Korotev R. Nichols R. H. Olinger C. T.
Searching for Crisium Basin Ejecta: Chemistry and Ages of Luna 20 Impact Melts

Norman M. D.* Taylor S. R.
Trace Element Geochemistry of Lunar Breccia 67016

Wanke H.* Dreibus G. Palme H.
Lunar Siderophiles

Esat T. M.* Ringwood A. E.
Constraints Placed on Bulk Moon Composition from Mg Isotope Fractionation in Vaporised Pyrolite

POSTER PRESENTATION

James O. B. McGee J. J. Lindstrom M. M.
Mineralogy, Petrology and Chemistry of Splits from Lunar Ferroan Anorthosite 60025

PRESENTED BY TITLE ONLY

Korotev R. L.
Arc Apollo 16 Soils Foreign to the Apollo 16 Site?

Steele I. M.
Crystal Structure of Yoshiokaite Based on Synthetic Sample - Relation to Nepheline

Neal C. R. Taylor L. A. Patchen A. D.
An Apollo 17 Safari: Exciting New Clasts from Breccia "Pull-Apart" Efforts

Shih C.-Y. Bansal B. M. Wiesmann H. Dasch E. J. Nyquist L. E. Bogard D. D.
Sm-Nd Age of a Pristine Norite Clast from Breccia 15445

Jolliff B. L.
The Search for Igneous Precursors of Apollo 14 Impact Melt Breccias: Clues in Soil Particles

Haskin L. A. Jolliff B. L. Korotev R. L.
Fragment of Terrestrial Origin in Regolith Breccia Sample 14313,108

Tuesday, March 13, 1990
ASTEROIDS AND REMOTE SENSING
1:30 p.m. Room 204

Hiroi T.* Takeda H.
The S-Type Reflectance Spectrum Simulated by a Chondrite and an Iron Meteorite

Gaffey M. J.* Bell Jeffrey F. Brown R. H. Burbine T.
Mineralogical Variations Within the S-Asteroid Population

Britt D. T. Tholen D. J. Bell Jeffrey F.* Pieters C. M.
Comparison of Asteroid and Meteorite Spectra by Principal Components Analysis

Britt D. T.* Pieters C. M.
The Spectral Effects of Dispersed Opaques in Optically Altered Ordinary Chondrites

McGuire A.* Hapke B.
Light Scattering by Large, Irregular Particles

Nelson M. L.*
Sensitivity of Hapke Modeling of Mixtures to Grain Size

Nash D. B.* Salisbury J. W.
Infrared Reflectance Spectra of Plagioclase Feldspars

Hoffman H.* Jaumann R. Neukum G.
Chemical Versus Mineralogical Influence on Reflectance Spectra of Andesitic Whole Rock Powders

Farinella P. Davis D.* Paolicchi P. Cellino A. Zappala V.
On the Collisional Evolution of Asteroid Rotation Rates

Shoemaker E. M.* Shoemaker C. S. Wolfe R. F. Holt H. E.
Earth-Crossing Asteroids, 1989

Shoemaker C. S.* Shoemaker E. M.
Survey for Bright Trojan Asteroids

Wolfe R. F.*
Proposed New Asteroid Families

Harris A. W.*
On the Tidal Evolution of Binary Asteroids

POSTER PRESENTATION

Vilas F. McFadden L. A.
CCD Reflectance Spectra of Selected Asteroids

Wednesday, March 14, 1990
MEVTIV: MARTIAN VOLCANIC EVOLUTION
8:30 a.m. Room 104

*** Tanaka K. L.***
Martian Geologic "Revolutions": A Tale of Two Processes

Forsythe R. D.* Zimbelman J. R.
A Discussion of Mars' Western Equatorial Dichotomy Boundary Zone; Enigmas, Anomalies and Controversies

Frey H. V.* Schultz R. A.
MEVTIV Study: Early Tectonic Evolution of Mars--Crustal Dichotomy to Valles Marineris

Schneid B. D.* Greeley R.
Global Relationships Between Volcanic Vents and Fractures Radial to Large Impact Basins on Mars

Crown D. A.* Greeley R.
Styles of Volcanism, Tectonic Associations and Evidence for Magma-Water Interactions in Eastern Hellas, Mars

McGovern P. J.* Solomon S. C.

State of Stress and Eruption Characteristics of Martian Volcanoes

Mouginis-Mark P. J.* Robinson M. S. Zuber M. T.

Evolution of the Olympus Mons Caldera, Mars

Zuber M. T.* Mouginis-Mark P. J.

Constraints on the Depth and Geometry of the Magma Chamber of the Olympus Mons Volcano, Mars

Robinson M. S.*

Precise Topographic Measurements of Apollinaris and Tyrrhena Patera, Mars

Wilson L.* Parfitt E. A.

Widths of Dikes on Earth and Mars

Plescia J. B.*

Young Flood Lavas in the Elysium Region, Mars

Porter T. K.* Schultz P. H.

Formation of Rhyolitic Ridges on Martian Basalts

POSTER PRESENTATIONS

Frey H. V. Doudnikoff C. E. Mongeon A. M.

Are Noachian-age Ridged Plains (Nplrs) Actually Early Hesperian in Age?

Williams S. H. Zimbelman J. R.

Preliminary Geologic Mapping Near the Nilosyrtis Mensae, Mars

Dimitriou A. M.

Stratigraphy of the Ismenius Lacus SE Subquadrange: Clues to an Upland/Lowland Boundary Forming Event?

McBride K. Barlow N. G.

Martian Crater Counts on Elysium Mons

Geissler P. E. Singer R. B. Lucchitta B. K.

Dark Materials in Valles Marineris: Indications of the Style of Volcanism and Magnetism on Mars

De Hon R. A. Mouginis-Mark P. J.

Geologic Map of the Galaxias Region (MTM 35217) Northwest Elysium Region, Mars

Jons H.-P.

The Planet Mars: Presentation of a Global Map

McBride K. Zimbelman J. R.

Small Volcanic Features in Western Elysium Planitia

Crown D. A. Price K. H. Greeley R.

Evolution of the East Rim of the Hellas Basin, Mars

Moore H. J. Davis P. A.

Analyses and Morphology of a Lava Flow, Ascracus Mons, Mars

Robinson C.

The Highland-Lowland Boundary Formed on Mars Between the Late Noachian and the Early Hesperian

PRESENTED BY TITLE ONLY

Cave J. A.

Crater Morphology Variations in the Elysium Region: Implications for Ice Distribution on Mars

Hayashi-Smith J. Mousginis-Mark P.

Morphometry of Fresh Impact Craters in Hesperia Planum, Mars

Schultz R. A.

Possible Deficiency of Large Martian Craters and Relative Cratering of the Terrestrial Planets

Schultz R. A. Frey H. V.

Geology, Structure, and Statistics of Multi-Ring Basins on Mars

Shalimov I. V.

The Relation of the Lava Complexes of the Olympus Mons on Mars

Edgett K. S.

Possible Cinder Cones Near the Summit of Pavonis Mons, Mars

**Wednesday, March 14, 1990
INTERPLANETARY DUST AND LDEF
8:30 a.m. GYM**

LDEF Meteoroid and Debris Special Investigation Group

Zolensky M. E.*

Inspection of the Long Duration Exposure Facility and Plans to Characterize the Dust Environment in Low-Earth Orbit

McDonnell J. A. M.* Stevenson T. J.

First Results from LDEF's Multiple Foil Microabrasion Package

Zook H. A.*

Flux vs Direction of Impacts on LDEF by Meteoroids and Orbital Debris

Klock W.* Thomas K. L. McKay D. S. Zolensky M. E.

Olivine Compositions in Anhydrous and Hydrated IDPs Compared to Olivines in Matrices of Primitive Meteorites

Germani M. S. Bradley J. P.* Brownlee D. E.

A Comparative Study of "Layer Silicate" Interplanetary Dust Particles (IDPs) and CI/CM Carbonaceous Chondrites

Thomas K. L.* Zolensky M. E. Klock W. McKay D. S.

Mineralogical Descriptions of Eight Hydrated Interplanetary Dust Particles and Their Relationship to Chondrite Matrix

Schramm L. S.* Brownlee D. E.

Iron-Nickel Sulfides in Interplanetary Dust

Brownlee D. E.* Schramm L. S.
The Composition of Picogram to Milligram Meteoritic Spherules

Sutton S. R.* Bradley J. P. Flynn G. J.
Trace Element Compositions and Mineralogy of Low-Nickel Stratospheric Particles

Flynn G. J. Sutton S. R.*
Element Abundances in Seven Particles from the Large Area Collectors

Lindstrom D. J.* Zolensky M. E. Martinez R. R.
INAA of Cosmic Dust Particles from the Large Area Collector

Nier A. O.* Schlutter D. J.
Helium and Neon Isotopes in Individual Stratospheric Particles--A Further Study

Olinger C. T.*
Implanted Solar Neon in Greenland Micrometeorites

Flynn G. J.* Sutton S. R.
Evidence for a Bimodal Distribution of Cosmic Dust Densities

POSTER PRESENTATIONS

Harvey R. P. Maurette M.
The Best Cosmic Dust Source in the World? The Origin and Significance of the Walcott Neve, Antarctica Micrometeorites

Fleming R. H. Meeker G. P. Radicati di Brozolo F. Blake D. F. White L. D.
Isotope Ratio Imaging of Interplanetary Dust Particles

Flynn G. J. Sutton S. R.
Chemical Purity of Proposed Capture Materials: Implications for Trace Element Analyses on Captured Particles

Hartmetz C. P. Gibson E. K. Jr.
Volatiles Present in Interplanetary Dust Particles and Contaminants Collected on the Large Area Collectors

Rietmeijer F. J. M.
Turbostratic Carbon with Remnant Precursor Material in Individual Chondritic Porous Interplanetary Dust Particles

Tanner W. G. McDonald R. A. Alexander W. M. Horz F.
Hypervelocity Impact Studies Conducted to Analyze the Dynamics of Fragmentation and Dispersion of Micron-sized
Fragments of an Interplanetary Dust Particle Analog

Stadermann F. J. Walker R. M. Zinner E.
Stratospheric Dust Collection: An Isotopic Survey of Terrestrial and Cosmic Particles

PRESENTED BY TITLE ONLY

Starukhina L. V. Shkuratov Yu. G. Kodina L. A. Ogloblina A. I. Stankevich N. P. Peregon T. I. Tishchenko L. P.
Radiation-induced Formation of Polycyclic Aromatic Hydrocarbons (PAH's) on Graphite Surface: Implication for Cosmic
Dust and Bodies

- Rietmeijer F. J. M. Nuth J. A.
Analytical Electron Microscope Analyses of Refractory Circumstellar, Interstellar and Interplanetary Dust Analogs
- Reedy R. C.
Cosmogenic-Radionuclide Production Rates in Mini-Spherules
- Robin E. Jehanno C. Koerner R. M. Pilon J. Rocchia R.
Discovery of Non-Contaminated Unmelted Cosmic Particles in Antarctica and Northern Canada Territories
- Lindstrom D. L. Zolensky M. E. Martinez R. R.
Compositional Variations in Cosmic Dust-sized Pieces of Murchison Matrix
- Bonny Ph. Balageas D.
Entry Corridor of Micrometeorites Containing Organic Material
- Horz F. Cintala M. J. Bernhard R. Cardenas F. Haynes J. Davidson W. E. See T. H.
Thin-film Penetration Experiments at Oblique Impact Angles
- Wednesday, March 14, 1990
LUNAR MARE AND KREEP BASALTS
8:30 a.m. Room 206
- Delano J. W.*
Experimental Constraints on the Oxidation State of the Lunar Mantle
- McKay G.* Wagstaff J. Le L.
REE Distribution Coefficients for Pigeonite: Constraints on the Origin of the Mare Basalt Europium Anomaly
- Shaffer E.* Brophy J. G. Basu A.
La/Sm Ratios in Mare Basalts as a Consequence of Mafic Cumulate Fractionation from an Initial Lunar Magma
- Shervais J. W.* Vetter S. K.
Lunar Mare Volcanism: Mixing of Distinct, Mantle Source Regions with KREEP-like Component
- Hughes S. S.* Neal C. R. Taylor L. A.
Petrogenesis of Apollo 14 High Alumina (HA) Parental Basaltic Magma
- Paces J. B.* Nakai S. Neal C. R. Taylor L. A. Halliday A. N. Lee D.-C. McKinney M. L.
Resolution of Ages and Sr-Nd Isotopic Characteristics in Apollo 17 High-Ti Basalts
- Paces J. B.* Neal C. R. Nakai S. Taylor L. A. Halliday A. N.
Open- and Closed-System Magma Evolution of Apollo 17 High-Ti Basalts and Origin of Source Heterogeneities at 4.1 Ga:
Sr-Nd Isotopic Evidence
- Neal C. R.* Paces J. B. Taylor L. A. Hughes S. S. Schmitt R. A.
Two New Type C Basalts: Petrogenetic Implications for Source Evolution and Magma Genesis at the Apollo 17 Site
- Neal C. R.* Taylor L. A. Hughes S. S. Schmitt R. A.
The Importance of Fractional Crystallization in the Petrogenesis of Apollo 17 Type A and B High-Ti Basalts

Hall R. P.* Hughes D. J.
Lunar-type Pyroxenes in Terrestrial Tholeiites?

Warren P. H.* Jerde E. A.
Olivine-Porphyritic Vitrophyre 12024,15: A Sample of the Margin of a Lunar Lava Flow

Ryder G.*
Origin of a 6 mm Glass Sphere from the Apennine Front: Debris in the Rind

Delano J. W.* Liu Y.-G. Schmitt R. A.
Geochemistry of Apollo 11 Impact Glasses: Regolith Compositions

Bogard D. D. Ryder G.* Garrison D. H.
A Major ~2.1 Ga Impact Event Recorded in Some Apollo 15 KREEP Basalts: Autolycus?

Shih C.-Y.* Bansal B. M. Wiesmann H. Nyquist L. E.
Rb-Sr and Sm-Nd Isotopic Studies of an Apollo 17 KREEPy Basalt

POSTER PRESENTATIONS

Schuraytz B. Ryder G.
An Evaluation of the Reliability and Usefulness of Microprobe Fused Bead Analyses for Petrogenetic Interpretations

Neal C. R. Taylor L. A.
Strontium Isotope and Major Element Evidence for AFC in the Petrogenesis of Apollo 14 High-Alumina Basalts

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Korotov R. L. Jolliff B. L. Haskin L. A.
Compositional Survey of Particles from the Luna 24 Regolith

Korotev R. L.
Correction for Loss of Metallic Iron in "Fused-Bead" Analysis of Metal-Bearing Silicate Samples

Stievenard M. Jouzel J. Robert F.
The Isotopic Signature of Hydrogen in Lunar Basalts: Spallogenic or Primordial?

Capobianco C. J. Drake M. J. Rogers P. S. Z.
Experimental Solubilities and Partitioning Behavior of Noble Metals Among Lithophile Magmatic Phases

Capobianco C. J.
A Method for the Extraction of Thermodynamic Properties of Alloys Which are Sparingly Soluble in Silicate Melts at High Temperature

Colson R. O. Keedy C. R.
Redox Relationships in Silicate Melts and Silicate Melt Structure

Keedy C. R. Colson R. O. Haskin L. A.
A Study of Redox Behavior of Ni in Silicate Melts of Diopsidic to Anorthitic Composition

Wednesday, March 14, 1990
HEAVY METAL METEORITES
8:30 a.m. Room 204

Davis A. M. Olsen E. J.*

Phosphates in the El Sampa IIA Iron Meteorite Have Excess ^{53}Cr and Primordial Lead

Scott E. R. D.* Taylor G. J.

Origins of Pallasites at the Core-Mantle Boundaries of Asteroids

Armstrong J. T.* Kennedy A. K. Carpenter P. K. Albee A. L.

Petrography and Trace Element Chemistry of Colomera (IIE) Silicate Inclusions: Rhyolitic Plums in the Pudding

Jones J. H.* Walker D.

Thermal Diffusion in Fe-Ni-S-P Metallic Liquids

Janney P. E.* Jones J. H.

Partitioning of Ni, P, Ir, Au and Ge Between Taenite and P-rich Kamacite

Wasson J. T.*

Bimodal IR Distribution in the Canyon Diablo Meteoroid

Wednesday, March 14, 1990

MEVTIV: MARTIAN MAGMATIC AND SURFACE EVOLUTION

1:30 p.m. Room 104

* Holloway J. R.*

Martian Magmas and Mantle Source Regions: Current Experimental and Petrochemical Constraints

Blaney D. L.* McCord T. B.

Earth-based Telescopic Observations of Mars in the $4.4\mu\text{m}$ to $5.1\mu\text{m}$ Region

Adams J. B.* Smith M. O.

Limits on the Compositional Variability of the Martian Surface

Longhi J.*

Magnetic Processes on Mars: Insights from SNC Meteorites

Bertka C. M.* Holloway J. R.

Martian Mantle Primary Melts

Gooding J. L.* Aggrey K. E. Muenow D. W.

Volatile Compounds in Shergottite and Nakhelite Meteorites

Burns R. G.* Fisher D. S.

Chemical Evolution and Oxidative Weathering of Magmatic Iron Sulfides on Mars.

Allen C. C.* Conca J. L.

Chemical Weathering of Basaltic Rocks Under Cold Arid Conditions

Morris R. V.* Gooding J. L. Lauer H. V. Jr. Singer R. B.
Iron Mineralogy of a Hawaiian Palagonitic Soil with Mars-like Spectral and Magnetic Properties

Wright I. P.* Grady M. M. Pillinger C. T.
A Search for Carbonate Minerals in Chassigny

Odezhynskyj M. Holloway J. R.*
Stability, Composition and Phase Relations of Martian Mantle Carbonates

Stephens S. K.* Stevenson D. J.
Dry Carbonate Formation on Mars: A Plausible Sink for an Early Dense CO₂ Atmosphere?

POSTER PRESENTATIONS

Ben-Shlomo T. Banin A.
Iron-enriched Smectite Clays as Mars Soil Analogs: Chemical Reactivity in the Labeled Release Experiment

Blaney D. L.
Implications of the Low Carbonate Abundance in the Optical Surface of Mars

Chapman M. G. Tanaka K. L.
Geologic Mapping of Lower Mangala Valles, Mars: Evidence of Flooding, Sapping, Debris Flow, and Volcanism

PRESENTED BY TITLE ONLY

Wentworth S. J. Gooding J. L.
Pre-Terrestrial Origin of "Rust" in the Nakhla Meteorite

Burns R. G. Martinez S. L.
Mossbauer Spectra of Olivine-rich Weathered Achondrites: II. Brachina, Chassigny, ALHA 77005, and Nakhla

Wednesday, March 14, 1990
ISOTOPE ANOMALIES AND CHRONOLOGY
1:30 p.m. GYM

{ **Gao X. Thiemens M.***
Sulfur Isotopic Studies in Meteorites

Thiemens M.* Gao X.
Excess ³³S and ³⁶S in Iron Meteorites

Clayton D. D.*
Nucleosynthesis Updates for Isotopic Anomalies

Volkening J.* Papanastassiou D. A.
Zinc Isotope Anomalies and Neutron-rich Statistical Equilibrium Synthesis

Loss R. D.* Lugmair G. W. MacPherson G. J. Davis A. M.
Isotope Anomalies in Vigarano CAI's - Hic et Ubique

Prombo C. A.* Nyquist L. E. Weismann H.
Titanium Isotopes in Allende Fine Grained Inclusions

- Rotaru M.* Birck J. L. Allegre C. J.**
Chromium Isotopes in C Chondrites: Isotopic Heterogeneity and Further Evidence for Extinct ^{53}Mn
- Chen J. H. Wasserburg G. J.***
The Presence of ^{107}Pd in the Early Solar System
- Sturgeon G.* Marti K.**
Nitrogen Components and Isotopic Signatures in the Acapulco Meteorite
- Prinzhofe A.* Papanastassiou D. A. Wasserburg G. J.**
Relationship Between Extinct and Live Chronometers: Sm-Nd in Meteorites
- Podosek F. A.* Brannon J. C.**
Chondrite Chronology by Initial $^{87}\text{Sr}/^{86}\text{Sr}$ in Phosphates?
- Perron C.* Bourot-Denise M. Kim J. S. Marti K. Pellas P. Sagon G.**
Noble Gas Components and Mineral Inclusions in Chondritic Metal: The Early History of FeNi
- Morgan J. W. Walker R. J.* Grossman J. N.**
Rhenium - Osmium Isotope Systematics in Enstatite Chondrites
- Jagoutz E.* Yin Q. Z. Wanke H.**
On the Excess Lead in Carbonaceous Chondrites
- POSTER PRESENTATION**
- Harper C. L. Nyquist L. E. Shih C.-Y. Weismann H.**
Zirconium Isotopes as an Astrophysical Probe of the Nucleosynthetic Source Conditions of Primitive Solar System "Components"
- PRESENTED BY TITLE ONLY**
- Prombo C. A. Yang S. V. Buchanan P. C.**
Petrography and Bulk Compositions of Allende Fine Grained Aggregates
- Wednesday, March 14, 1990
COLLISIONAL PROCESSES
1:30 Room 206
- O'Keefe J. D.* Ahrens T. J.**
Large Scale Oblique Impacts on the Earth
- Schultz P. H. Gault D. E.**
Decapitated Impactors in the Laboratory and on the Planets
- Vickery A. M.***
Interaction Between Ejecta Vapor Plumes and Atmospheres, with Application to the KT Extinctions
- Gazis C. A.* Ahrens T. J.**
Shock-Induced Devolatilization of Noble Gases: Solid Recovery Experiments with Vitreous Carbon

Hiyagon H.* Ozima M.
Formation of Earth Atmosphere: Impact Degassing

Melnik W. L.* O'Keefe J. A.
On the Ablation of Flanged Australian Tektites

Holsapple K. A.*
Scaling Issues for Impact Cratering

Schmidt R. M.*
Crater Simulations in Subscale Jointed Rock: Preliminary Results

Asphaug E.* Ryan E. Melosh H. J.
Two-Dimensional Fragmentation Hydrocode

Yanagisawa M.* Eluszwickicz J. Ahrens T. J.
Efficiency of Angular Momentum Transfer in Low Velocity Oblique Impacts

Crawford D. A.* Schultz P. H.
Langmuir Probe Measurements of Impact-Generated Plasma

Hood L. L.*
Magnetic Effects of Large-Scale Impacts on Airless Planetary Bodies

POSTER PRESENTATIONS

Schultz P. H.
Atmospheric Effects on Cratering Efficiency

Ryan E. V. Davis D. R. Hartmann W. K.
Impact Experiments: Catastrophic Fragmentation of Aggregate Targets

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Ishibashi T. Kitabayashi S. Azuma H. Fujii N. Sangen K.
A Temperature Rise Associated with Low Velocity Impact Experiments

Boslough M. B.
Natural Detonations in the Earth and Theoretical Limits on Associated Shock Pressures

Yajima H. Matsuda J. Syono Y. Kusaba K.
Diamond Synthesis by Shock Transformation and Noble Gas Studies

Rietmeijer F. J. M. Albrecht A.
Scanning Electron Microscope Analyses of Forsterite Powders Shocked at 14.8, 51.4 and 78.8 GPa

Badjukov D. D.
Shock Metamorphic Effects Caused by Hypervelocity Impact of Meteorite Projectile into Quartz Target

Nemchinov I. V. Svetsov V. V.
Radiative Processes in the Earth's Atmosphere Resulting from Comet Impact

Thursday, March 15, 1990
MARS: OBLIQUITY AND CLIMATE HISTORIES
8:30 a.m. Room 104

Ward W. R.* Rudy D. J.
Did Mars Pass Through a Secular Spin-Orbit Resonance?

Bills B. G.*
Obliquity Histories of Earth and Mars: Influence of Inertial and Dissipative Core-Mantle Coupling

Henderson B. G.* Jakosky B. M.
The Martian South Polar Cap: Stability and Water Transport at Low Obliquities

Fanale F. P.* Postawko S. E.
Heat Flow vs. Atmospheric Greenhouse on Early Mars

Carr M. H.*
The Effects of Floods, Volcanism and Polar Processes on the D/H Ratio in the Martian Atmosphere

Baker V. R.* Strom R. G. Croft S. K. Gulick V. C. Kargel J. S. Komatsu G.
Ancient Ocean-Land-Atmosphere Interactions on Mars: Global Model and Geological Evidence

Gulick V. C.* Baker V. R.
Valley Development on Mars: A Global Perspective

Komatsu G.* Strom R. G.
Layered Deposits with Volcanic Intrusions in Gangis Chasma, Mars

Kargel J. S.* Strom R. G.
Ancient Glaciation on Mars

Herkenhoff K. E.*
Weathering and Erosion of the Polar Layered Deposits on Mars

Clow G. D.* Haberle R. M.
Free Convection in the Martian Atmosphere

Lindner B. L.* Ackerman T. P. Pollack J. B. Toon O. B. Thomas G. E.
Solar and IR Radiation Near the Martian Surface: A Parameterization for CO₂ Transmittance

Jakosky B. M.* Haberle R. M.
The Thermal Inertia of Mars: Re-Interpretation Using a Better Atmospheric Model

POSTER PRESENTATIONS

Clow G. D. Haberle R. M.
Characteristics of the Martian Atmospheric Surface Layer

Musselwhite D. S. Lunine J. I.
Clathrate Storage of Volatiles on Mars

Justus C. G. James B.
Scientific and Engineering Applications of the Mars-Global Reference Atmospheric Model (Mars-GRAM)

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Forsythe R. D.

A Case for Martian Salars and Saline Lakes During the Noachian

Zimbelman J. R.

Henry Crater, Mars: Thick, Layered Deposit Preserved on a Crater Floor in the Martian Highlands

Schaefer M. W.

Chemical Evolution of the Early Martian Hydrosphere

Thursday, March 15, 1990

UREILITE - HED

8:30 a.m. GYM

Buchanan P. C.* Reid A. M. Schwarz C.

Clast Populations in Three Antarctic Achondrites

Saiki K. Takeda H.* Toyoda K. Tagai T.

Occurrence of Zircon in Magnesian Non-Cumulate Eucrite Yamato 791438

Berkley J. L.*

Strange Clasts in Antarctic Howardites: Evidence for Advanced Differentiation and Complex Processes

Batchelor J. D.* Sears D. W. G.

The Metamorphic, Shock and Brecciation History of Eucrite Association Meteorites

Hewins R. H.*

Geologic History of LEW 85300, 85302 and 85303 Polymict Eucrites

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

Ar-Ar, Rb-Sr, and Sm-Nd Studies of Eucritic Clast LEW85300,55

Heavilon C. F.* Crozaz G.

Ce Anomalies in the Antarctic Eucrite LEW 85300

Bartels K. S.* Grove T. L.

High Pressure Experiments on Magnesian Eucrite Magmas: Constraints on Magmatic Processes in the Eucrite Parent Body

Paslick C. R.* Jones J. H. McKay G.

Constraints on the Partial Melt Model of Eucrite Genesis Through Investigation of SC Partition Coefficients for Olivine and Pyroxene

Jones J. H. Paslick C. R.* McKay G. A.

Experimental Constraints on the Composition of the Eucrite Parent Body

Brouxel M.* Tatsumoto M.

The Estherville Mesosiderite: A Polymict Breccia Formed 4.42 to 4.55 Ga Ago: U-Pb, Rb-Sr, and Sm-Nd Isotopic Evidence

Goodrich C. A.* Patchett P. J. Lugmair G. W. Drake M. J.
Sm-Nd Isotopic Systematics of Ureilites: A 3.74 Ga Isochron for Kenna, Novo Urci, and ALHA77257

Berkley J. L.*
Petrology of Newly Recovered Orthopyroxene-Bearing Antarctic Ureilites: A New Ureilite Type?

POSTER PRESENTATIONS

Saito J. Takeda H.
Information of Elemental Distributions in Heavily Shocked Ureilites as a Guide to Deduce the Ureilite Formation Process

Martinez S. L. Burns R. G.
Mossbauer Spectra of Olivine-rich Weathered Achondrites: I. Ureilites

Petaev M. I. Zaslavskaya N. I.
The Divnoe Meteorite. V. Classification, Proposed Genesis, Relation with Other Meteorite Types

Petaev M. I. Ustinov V. I. Perelygin V. P. Shukolyukov Yu. A.
The Divnoe Meteorite. IV. Oxygen Isotopes and Track Studies

Zaslavskaya N. I. Petaev M. I.
The Divnoe Meteorite. I. Petrology and Mineralogy

Zaslavskaya N. I. Petaev M. I. Kononkova N. N. Kolesov G. M.
The Divnoe Meteorite. II. Mineral Chemistry

Petaev M. I. Barsukova L. D. Kolesov G. M. Zaslavskaya N. I.
The Divnoe Meteorite. III. Bulk Chemistry

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Cisowski S. M. Dunn J. R. Fuller M.
Further Evidence for the Absence of Strong Magnetic Fields on the Achondrite Parent Body, and Implications for Heat Sources in the Early Solar System

Clare A. K. Hewins R. H.
Volatile Loss and Fractionation Trends in Eucrites

Migdisova L. F. Yaroshevsky A. A.
Chromite and Ilmenite in the Eucrite Pomozdino

Thursday, March 15, 1990
TARGET: EARTH
8:30 a.m. Room 206

Lakomy R.*
Distribution of Impact Induced Phenomena in Complex Terrestrial Impact Structures: Implications for Transient Cavity Dimensions

Sharpton V. L.* Gibson J. W. Jr.
The Marquez Dome Impact Structure, Leon County, Texas

Koeberl C.* Reimold W. U. Bishop J. Miller R. McG.
Roter Kamm Impact Crater, SWA/Namibia: New Geochemical and Isotopic Studies and Further Evidence for Post-Impact Hydrothermal Activity

Grant J. A.* Schultz P. H.
Amounts and Styles of Ejecta Erosion at Meteor Crater, Arizona

Garvin J. B.*
Topographic Cross-Sections and Interior Volumes of Craterform Structures

Nazarov M. A.* Barsukova L. D. Badjukov D. D. Kolesov G. M. Nizhegorodova I. V.
The Kara Impact Structure: Iridium Abundances in the Crater Rocks
Nazarov M. A.* Badjukov D. D. Suponeva I. V. Alekseev A. S.
The Kara Impact Structure: Distribution of Shocked Quartz Grains Through the Suevite Complex

Hartung J. B.* Anderson R. R.
Manson Impact Structure Rocks: Evidence for Impact Melting

Miura Y.*
Mineralogical Data of Shocked Quartz Grains from K-T Boundary

Bohor B. F.* Betterton W. J.
K-T Spherules--Clarifying the Concept

Gilmour I.*
Ejecta Fallout as a Killing Mechanism at the K-T Boundary: Evidence from a Volcanic Ash Layer

Hildebrand A. R.* Boynton W. V.
On the Location of the K/T Boundary Impact Site

Chatterjee S.*
A Possible K/T Impact Site at the India-Seychelles Boundary

Murali A. V.* Blanchard D. P. Bhandari N. Macdougall J. D.
Relationship of Deccan Volcanism to Global K-T Biotic Extinctions: A Case of Unfounded Assumptions?

POSTER PRESENTATIONS

Dietz R. S. McHone J. F.
Chesterfield Structure (Hudson Bay): Possible Astrobleme

Craddock R. A. Torries T. F.
Suspect Impact Structures in the United Republic of Tanzania

Murali A. V. Williams S. Lulla K.
Ramgarh Crater, Rajasthan, India: Study of Multispectral Data Obtained by Indian Remote Sensing Satellite (IRS-1A)

Bohor B. F. Mcier A. L.
REE Abundances of Tonsteins and K-T Boundary Claystones by ICP-MS

Deino A. L.* Becker T. A. Garvin J. B.
Laser-Fusion $^{40}\text{Ar}/^{39}\text{Ar}$ Ages of Acid Zhamanshinite

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Kashkarov L. L. Kashkarova V. G. Izokh E. P.
Thermoluminescence Dating of Glasses from Zhamanshine Crater

Korotayeva N. N. Sazonova L. V.
Relationship of Porosity and Impact Melt Rocks Composition (Zhamanshin Astrobleme, USSR)

Sazonova L. V.
Peculiarities of Cation Diffusion in Shock Plagioclase Melts (Popigai Astrobleme, USSR)

Kolesnikov E. M. Nazarov M. A. Badjukov D. D. Lebedeva L.M. Myasnikova V. L.
Current Results of Potassium-Argon Dating of the Kara Impact Structure

Lakomy R.
Implications for Cratering Mechanics from Breccias in the Basement of the Sudbury Impact Crater, Canada

Deutsch A. Brockmeyer P. Buhl D.
Sudbury Again: New and Old Isotope Data

Reimond W. U. Hart R. J. Andreoli M. A. G.
Fracture Density Statistics Along Radial Traverses Through the Crystalline Basement of the Vredefort Dome, South Africa--New Data from a NNW-Traverse

See T. H. Mittlefehldt D. W. Horz F. Wasson J.
Projectile Dissemination and Fractionation at Wabar Crater, Saudi Arabia

Schmitt R. A.
A General Theory of Mass Extinctions in the Phanerozoic, I. Observations and Constraints

Schmitt R. A.
A General Theory of Mass Extinctions in the Phanerozoic, II. A Brief Outline

Schmitt R. A.
Reducing Conditions in the Pacific Ocean Before, At, and After the K/T (Cretaceous/Tertiary) Boundary, III

Thursday, March 15, 1990
MARS: CRATERS, CHANNELS AND LIFE
1:30 p.m. Room 104

MacKinnon D. J.* Tanaka K. L.
A Physical Model of the Impacted Martian Crust: Hydrologic and Mechanical Properties and Geologic Implications

Cabrol N. A.*
Physiographic Characteristics of Martian Drainage Basins

Craddock R. A.* Maxwell T. A.
Evidence for Widespread Resurfacing in the Martian Highlands

Zimbelman J. R.* Craddock R. A.
An Evaluation of the Possible Extent of Bedrock Exposure in the Sinus Meridiani Region of the Martian Highlands

- Scott D. H.* Dohm J. M.**
Evidence for Multiple Flooding Episodes in Kasei Valles, Mars
- De Hon R. A.***
Hydraulic Routing of the Maja Outflow Across Xanthe Terra
- Costard F. M.***
Thermokarstic Depressions at the Mouth of Elysium Channels (Mars): New Evidence for the Presence of Massive Icy Beds
- Barlow N. G.***
Martian Impact Craters: Continuing Analysis of Lobate Ejecta Sinuosity
- Schultz P. H.***
Evidence for Atmospheric Effects on Martian Crater Shape
- Newsom H. E.* Brittelle G. E.**
Impact Cratering on Mars and the Formation of Crater Lakes: A Possible Environment for the Origin of Life
- Oberbeck V. R.* Marshall J. R. Schwartz D. E.**
A Model for Chemical Evolution of Life on Mars
- Oberbeck V. R.* Marshall J. R. Schwartz D. E. Mancinelli R. L.**
Search for Life: A Science Rationale for a Permanent Base on Mars

POSTER PRESENTATIONS

- Craddock R. A. Zimbelman J. R. Greeley R.**
Geologic History of the Southern Reaches of Mangala Valles, Mars
- Kochel R. C. Miller J. R.**
Post-Flooding Modifications to Chryse Basin Channels, Mars: Implications for Source Volumes and Evolution of the Channels
- Petrov S. B. Arvidson R. E.**
Spectral Emissivity of the Silver and Lunar Lake Playas - Relevance to Analyses of Mars TIR Data
- Chapman M. G. Scott D. H. Tanaka K. L.**
Elysium Basin, Mars: Implications of a Deep, Intermittent Lake System
- Cloutis E. A.**
Cold Polar Deserts: Weathering Rates, Mechanisms, and Implications for Remote Sensing of Mars
- Aguirre-Puente J. Costard F. M. Posado-Cano R.**
Contribution to the Study of Thermal Erosion on Mars
- Scott D. H. Underwood J. R.**
Mottled Terrain: A Continuing Martian Enigma
- Williams S. H.**
Possible Aeolian Megaripples on Mars

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Dimitriou A. M.

Minimum Estimates for Volume Removal from the Martian Fretted Terrain Between 270°W and 360°W

Thursday, March 15, 1990

ANOMALOUS ACHONDRITES: ANGRITES AND AUBRITES

1:30 p.m. GYM

McKay G.* Crozaz G. Wagstaff J. Yang S.-R. Lundberg L.

A Petrographic, Electron Microprobe, and Ion Microprobe Study of Mini-Angrite Lewis Cliff 87051

Prinz M.* Weisberg M. K. Nehru C. E.

LEW 87051, a New Angrite: Origin in a Ca-Al-enriched Eucriotic Planetesimal?

Mittlefehldt D. W.* Lindstrom M. M.

Geochemistry of LEW87051 and Comparison of the Angrites

Warren P. H.* Kallemeyn G. W.

Geochemistry of the LEW87051 Angrite, and Other Basaltic Achondrites

Treiman A. H.*

Crystallization of Angrites, CAIs and Ca-Al Chondrules: Fassaite-Spinel Liquidi in CMAST

Lofgren G.* Lanier A. B.

Dynamic Crystallization Characteristics of ADOR

Hohenberg C. M. Bernatowicz T. J.*

Comparative Xenology of Two Angrites

Eugster O.*

Angrites LEW87051 and LEW86010: Transport Time to Earth and Comparison with Angra dos Reis

Wang M.-S. Lipschutz M. E.*

Labile Trace Elements in Angrites

Casanova I.* Newsom H. E. Scott E. R. D. Keil K.

Origin of Metal in Aubrites: Siderophile Element Abundances in Cm-Sized Nodules of Norton County

Wheelock M. M.* Heavilon C. F. Keil K.

An Ion Microprobe Study of REE Distributions in Sulfide and Silicate Minerals in the Norton County Aubrite

Lodders K.* Palme H.

Fractionation of REE During Aubrite Formation: The Influence of FeS and CaS

Dickinson T. L.* Lofgren G. E. McKay G. A.

REE Partitioning Between Silicate Liquid and Immiscible Sulfide Liquid: The Origin of the Negative Eu Anomaly in Aubrite Sulfides

Thursday, March 15, 1990
ISOTOPE ANOMALIES
1:30 p.m. Room 206

Alexander C. M. O'D. Swan P. D. Walker R. M.*
The Detection of SiC In Situ in CM Meteorites: A Progress Report

Alexander C. M. O'D.* Arden J. W. Pier J. Walker R. M. Pillinger C. T.
Ion Probe Studies of Interstellar SiC in Ordinary Chondrites

Stone J.* Hutcheon I. D. Epstein S. Wasserburg G. J.
Si Isotopes in SiC from Carbonaceous and Enstatite Chondrites

Huss G. R.* Lewis R. S.
Interstellar Diamonds and Silicon Carbide in Enstatite Chondrites

Hohenberg C. M.* Nichols R. H. Jr. Alexander C. M. O'D. Olinger C. T. Arden J. W.
Interstellar Noble Gas Components in Inman and Tieschitz

Amari S.* Lewis R. S. Anders E.
Interstellar Graphite in Meteorites: Growing Complexity, Implied by its Noble-Gas Components

Zinner E.* Wopenka B. Amari S. Anders E.
Interstellar Graphite and Other Carbonaceous Grains from the Murchison Meteorite: Structure, Composition and Isotopes of C, N, and Ne

Palma R. L.* Heymann D.
Neon in Material Separates of the Allende and Orgueil Meteorites

Russell S. S.* Pillinger C. T. Arden J. W.
Nitrogen Concentration of Interstellar Diamond

Yuen G. U. Pecore J. A. Kerridge J. F. Pinnavaia T. J. Rightor E. G. Flores J. Wedeking K. Mariner R. Des Marais D. J. Chang S.*
Carbon Isotope Fractionation in Fischer-Tropsch Type Reactions

Wen J. Thiemens M. H.*
A New Isotope Effect and its Possible Importance in Meteoritics

POSTER PRESENTATIONS

Nelson R. N. Qing W. D. Thiemens M. H. Nuth J. A. III
Non-Mass Dependent Oxygen Isotopic Fractionation During the Condensation of Simple Oxide Smokes

Sugiura N.* Hashizume K.
Heavy Nitrogen in Y74191 (L3) Chondrite

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Ott U. Begemann F.
S-Process Material in Murchison: Sr and More on Ba

Russell S. S. Ash R. D. Pillinger C. T. Arden J. W.
On the Existence of Occluded Isotopically Light Carbon in Allende?

Suzuki K. Matsuda J.
Noble Gases in the Amorphous Carbon Synthesized by Glow-Discharge CVD

Friday, March 16, 1990
MARS REMOTE SENSING
8:30 a.m. Room 104

Thompson T. W. Moore H. J.*
A Radar-Echo Model for Mars

Bibring J.-P.* Langevin Y. Erard S. Forni O. Masson P. Sotin C. Combes M. Moroz V. Coradini A. Formisano V. Head J. Soderblom L. Fanale F. McCord T. Cruikshank D.

The Observation of the Surface of Mars by the ISM Instrument on Board the Phobos 2 Spacecraft

Erard S.* Bibring J.-P. Langevin Y. Combes M. Hurtrez S. Sotin C. Head J. W. Mustard J. F.
Determination of Spectral Units in the Syrtis Major-Isidis Planitia Region from Phobos/ISM Observations

Mustard J. F.* Bibring J.-P. Erard S. Fischer E. M. Head J. W. Hurtrez S. Langevin Y. Pieters C. M. Sotin C. J.
Interpretation of Spectral Units of Isidis-Syrtis Major from ISM-Phobos-2 Observations

Kuzmin R. O.* Moroz V. I. Grigoryev A. V. Nikolsky Y. V. San'ko N. F.
Khatuntsev I. V. Kiselev A. V. Bibring J.-P. Langevin Y. Soufflot A. Combes M.
Variation of the Bound Water Contents on the Martian Surface from ISM-Experiment Data on Phobos-2: Preliminary Results

Betts B. H.* Svitek T. Santee M. L. Murray B. C. Crisp D. Paige D. A. Naraeva M. Selivanov A.
Preliminary Quantitative Assessment and Analysis of Phobos 88 Termoskan Observations of Mars

Combes M.* Drossart P. Encrenaz Th. Lellouch E. Rosenqvist J. Bibring J.-P. Langevin Y. Moroz V. I.
Grigoriev A. V. Sanko N. F. Titov D. V.
Scattering Properties and Minor Constituents in the Atmosphere of Mars from the ISM/Phobos Experiment

Clancy R. T.* Lee S. W.
Derivation of Mars Atmospheric Dust Opacities from Radiative Transfer Analysis of Viking IRTM Emission Phase Function Sequences

Lee S. W.* Clancy R. T.
The Effects of Atmospheric Dust on Observations of the Surface Albedo of Mars

Singer R. B.* Miller J. S. Wells K. W. Bus E. S.
Visible and Near-IR Spectral Imaging of Mars During the 1988 Opposition

Roush T.* Singer R. B.
Estimates of Absolute Flux and Radiance Factor of Localized Regions on Mars in the 2-4 m Wavelength Region

Reyes D. P.* Christensen P. R.
Mid-Infrared Spectra of Komatiite vs. Basalt

Edgett K. S.* Christensen P. R.
Intercrater Sand on Mars: Physical Properties Related to Regional Winds, Sediment Supply

POSTER PRESENTATIONS

Guinness E. A. Arvidson R. E. Irons J. R. Harding D. J.
Use of Aircraft Multispectral and Multiple Emission Angle Data to Determine Surface Roughness and Composition at the Lunar Lake Playa in Nevada

Rzhiga O. N. Selivanov A. S.
On Application of SAR-Method for the Geological Nature of Mars Exploration

Straub D. W. Burns R. G.
Ferrolysis of Iron-bearing Martian Brines: Origin of Dust-Storm Particulates on Mars

Straub D. W. Burns R. G.
Oxidized Pyroxenes and Degradation of Their Visible-Near Infrared Spectra: Implications to Remote-sensing of Mars

Efford N. D.
Photometric Techniques for Lander Site Certification

Gaskell R. W.
Martian Surface Simulations

Calvin W. M. King T. V. V.
Analysis of Mariner 6 and 7 Spectra for Weak Absorption Features from 2 to 6 μ m

Roush T. Pollack J. Orenberg J.
Derivation of Mid-Infrared (5-25 μ m) Optical Constants of Some Silicates and Palagonite

Weiblen P. W.
Simulants for Martian Surface Minerals

Edgett K. S. Zimbelman J. R.
The Arsia Mons-Oti Fossae Thermal Anomaly: A Region with a Higher Thermal Inertia than the Rest of Tharsis

Bell James F. * McCord T. B.
Can Iron Oxide/Oxyhydroxide Minerals be Identified on the Martian Surface from Groundbased VIS-NIR Spectra?

Jankowski D. G. Squyres S. W.
What's Wrong with Photoclinometry?

Feldman W. C. Jakosky B. M.
Thermal Neutron Leakage from Martian Carbonates

Drake D. M. Wender S. Nelson R. Shunk E. R. Amian W. Englert P. Bruckner J. Drosg M.
Experimental Simulation of Martian Neutron Leakage Spectrum

Agresti D. G. Wills E. L. Shaffer T. D. Iwanczyk J. S. Dorri N. Morris R. V.
Development of a Solid-state Mossbauer Spectrometer for Planetary Missions

Economou T. Iwanczyk J. Turkevich A.
The X-ray Mode of the Alpha Particle Analytical Instrument

Economou T. Turkevich A.
A Gamma Ray Mode of the Alpha Particle Analytical Instrument

PRESENTED BY TITLE ONLY

Bockstein I. M. Chochia P. A. Kronrod M. A. Gektin Yu. M.
Processing of Mars Surface Images Received from Phobos-2 Space Station

Selivanov A. Naraeva M.
Thermoscanning of the Mars Surface

Farrand W. H. Singer R. B.
Analysis of Poorly Crystalline Clay Mineralogy: Near Infrared Spectrometry Versus X-ray Diffraction

Bruckner J. Korfer M. Wanke H. Schroeder A. N. F. Filges D. Dragovitsch P. Englert P. A. J. Starr R. Trombka J. I.
Taylor I. Drake D. Shunk E.
Radiation Damage in Germanium Detectors: Implications for the Gamma-ray Spectrometer of the Mars Observer
Spacecraft

Moore H. J. Keller J. M.
Surface-Material Maps of Viking Landing Sites on Mars

Ivanov M. A. Moroz V. I. Grigoryev A. V. Nicolsky Yu. V. San'ko N. F. Khatuntsev I. V. Kiselev A. V. Bibring J.-P.
Combes M. Langevin Y. Soufflot A.
Water Distribution on Martian Soils in Region Southward Olympus Mons, Mars (Preliminary Results)

Bell James F. Robinson M. S. McCord T. B. Fanale F. P.
Comparison of New Groundbased and Phobos-2 VSK Color Ratio Data for Mars

Bell James F. Lucey P. G. McCord T. B. Ozoroski T.
Groundbased Imaging Spectroscopy of Mars During 1988 and 1990: Instrumentation and Methodologies for the Future of
Planetary Spectroscopy

Dagge G. Dragovitsch P. Filges D. Bruckner J.
Calculation of Martian Gamma Ray Spectra

Craddock R. A.
Rationale for a Mars Rover/Sample Return Mission to Chryse Planitia and the Viking 1 Lander

Friday, March 16, 1990
TRITON AND PHOBOS
8:30 a.m. GYM

Stevenson D. J.* Gandhi A. S.
Puzzles of Triton

Leith A. C.* McKinnon W. B.
Orbital Evolution of a Triton Captured by Gas Drag

McKinnon W. B.* Benner L.A. M.
Triton's Post-Capture Thermal History

Strom R. G.* Croft S. K. Boyce J. M.
The Cratering Record on Triton

Croft S. K.*
Fire and Ice on Triton: Models for Cryovolcanism and Glaciology

Kargel J. S.* Strom R. G.
Cryovolcanism on Triton

Kirk R. L.*
Thermal Models of Insolation-Driven Nitrogen Geysers on Triton

Langevin Y.* Bibring J.-P. Gondet B. Combes M. Grigoriev A. V. Joukov B. Nikolsky Y. V.
Observations of Phobos from .8 to $3.15\mu\text{m}$ with the ISM Experiment On-Board the Soviet "Phobos II" Spacecraft

Hauber E.* Schwarz G. Regner P. Schmidt K. Neukum G.
Color Decorrelation for the Phobos Mission Camera Experiment

Murchie S.* Britt D. Head J. Pratt S. Fisher P. Zhukov B. Kuzmin A. Ksanfomality L. Nikitin G. Zharkov A.
Fanale F. Blaney D. Robinson M.
Color Variations on the Surface of Phobos and Their Relationship to Geologic Features

Sasaki S.*
Origin of Phobos--Aerodynamic Drag Capture by the Primary Atmosphere of Mars

Schultz P. H.* Crawford D. A. Gault D. E.
Impact Generation of Orbiting Debris Around Mars

Hartmann W. K.*
Phobos and the Scattering of C Asteroids at the End of Planet Formation

POSTER PRESENTATIONS

McEwen A. S.
Global Color and Albedo Variations on Triton

Croft S. K.
Triton: Geology and Geologic History

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**Carroll M. R. Sutton S. R.* Woolum D. Lewotsky K. Rogers P. S. Z.
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The Early Siliceous Component of Planetary Crusts: Experimental Petrology of the Tonalite-Trondhjemite Rock Series

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Geochemistry of the Base of the Main Anorthosite-Bearing Series, Stillwater Complex

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 DeHart J. M.
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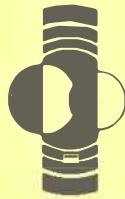
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