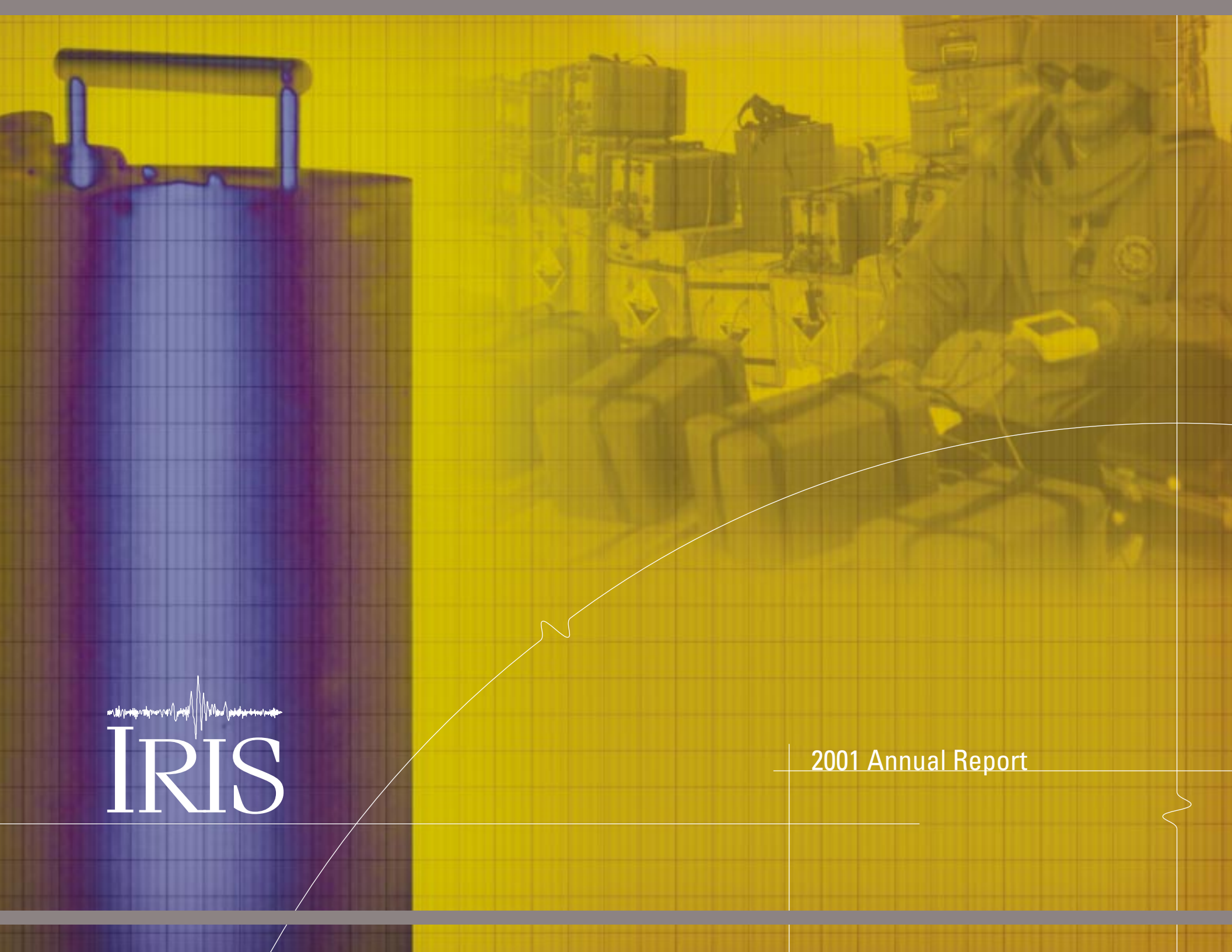


IRIS

2001 Annual Report

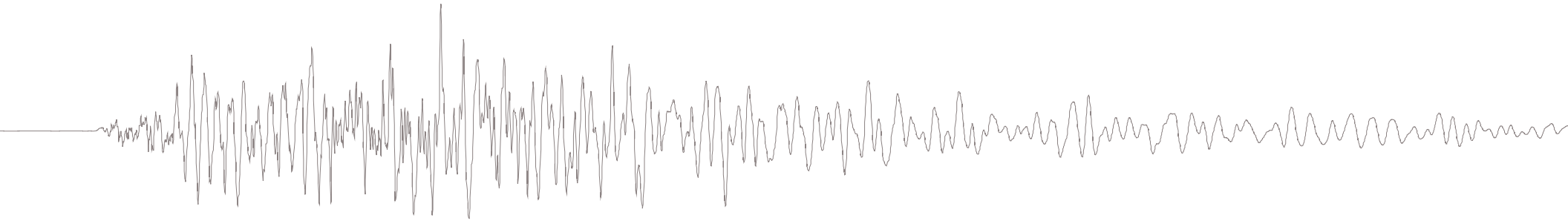
IRIS

2001 Annual Report

IRIS is a university research consortium dedicated to monitoring the Earth and exploring its interior through the collection and distribution of geophysical data.

IRIS programs contribute to scholarly research, education, earthquake hazard mitigation, and the verification of the Comprehensive Nuclear Test-Ban Treaty.

IRIS operates through a Cooperative Agreement with the National Science Foundation under the Division of Earth Science's Instrumentation and Facilities Program. Funding is provided by the National Science Foundation, other federal agencies, universities, and private foundations. All IRIS programs are carried out in close coordination with the US Geological Survey and many international partners.



Contents

Overview

With the signing of a new Cooperative Agreement in August 2001, the National Science Foundation has endorsed the IRIS Consortium's plans, on behalf of the collective scientific interests of almost 100 research institutions, for continued support of facilities for investigations of the structure and dynamics of the Earth's interior. After an extensive year-long review process that included more than thirty mail reviews, two special panels, internal NSF review and presentation to the National Science Board, the NSF approval provides the basis for continued support of our activities and facilities for the next five years. The review process indicated strong national and international support for the services provided by IRIS and our collaborating partners.

As a facilities program to support seismological research, IRIS must retain allegiance to our core programs, and the new Cooperative Agreement with NSF establishes the basis for the future health of our data collection and distribution activities. As a Consortium of national and international universities with commitments to research and education in the Earth Sciences, IRIS can also help to articulate the research community's vision for the future and work with funding agencies to develop and implement new programs that will advance our science. Over the past five years, IRIS and its members - individual and institutional - have helped to formulate the scientific goals and operational characteristics for a number of new scientific programs and operational facilities, including the National Science Foundation's EarthScope, the US Geological Survey's Advanced National Seismic System (ANSS), and the US participation in the International Monitoring System for the Comprehensive Nuclear Test-Ban Treaty. Bringing large-scale initiatives to fruition takes time, but there is real reason for optimism for eventual success in all of these initiatives. Your involvement in IRIS can contribute to these efforts by helping to coordinate and communicate community interest as these initiatives develop and work their way from inspiration to implementation.

As we enter the new millennium, these are times of significant milestones in our science: observational seismology is more than 100 years old, the National Science Foundation is entering its second half-century, and the Seismological Society of America approaches its 100th anniversary. Seismology is becoming increasingly important in areas of deep societal concern. The National

Science Foundation established “People, Ideas and Tools” as the simple statement of its strategic goals in nurturing science for the future. Through a series of cross-directorate initiatives, NSF is opening and encouraging opportunities for multi-disciplinary education and research. There are few scientific arenas as rich as the geosciences for inter-disciplinary research and applications that benefit society. We look forward to working with our member institutions in these new endeavors.

Supporting and representing and collective scientific interests of our member institutions, IRIS continues to need your advice, guidance and feedback. We seek to inform you of Consortium activities though our newsletters, websites and workshops. There are a variety of ways in which you can respond and be involved. The lists of committee members in this report indicate the breadth and depth of the governance structure that seeks your input – through your active participation or through communication with staff and committee members. Only with the continued involvement of the scientific community will IRIS be able to enhance and improve the quality of resources to support your research endeavors.

Executive Committee and Officers

Anne Meltzer (Chair)	Lehigh University
Göran Ekström (Vice Chair)	Harvard University
Thomas Jordan	University of Southern California
Stephen Malone	University of Washington
Gary Pavlis	Indiana University
Candy Shin	IRIS Treasurer
David W. Simpson	IRIS President
Clifford Thurber	University of Wisconsin, Madison
Rob van der Hilst	MIT
Michael Wysession (Secretary)	Washington University, St. Louis

Planning Committee

Adam Dziewonski (Chair)	Harvard University
Arthur Lerner-Lam	Columbia University
Anne Meltzer	Lehigh University
John Orcutt	University of California, San Diego
Robert Smith	University of Utah
Gregory van der Vink	IRIS Director of Planning
Terry Wallace	University of Arizona

Program Coordination Committee

Göran Ekström (Chair)	Harvard University
Timothy Ahern	IRIS DMS
Lawrence Braile	Purdue University
Rhett Butler	IRIS GSN
James Fowler	IRIS PASSCAL
Shane Ingate	IRIS Director of Operations
Roy Johnson	University of Arizona
Alan Levander	Rice University
Gary Pavlis	Indiana University
Barbara Romanowicz	University of California, Berkeley
John Taber	IRIS E&O

Consortium

The IRIS management structure is an interface between the scientific community, funding agencies, and the programs of IRIS. The structure is designed to focus scientific talent on common objectives, to encourage broad participation, and to efficiently manage IRIS programs.

IRIS is governed by a Board of Directors consisting of representatives from each member institution. Operational policies are set by an Executive Committee elected by the Board of Directors. The Executive Committee, in turn, appoints members to the Planning Committee, the Program Coordination Committee, and the four Standing Committees that provide oversight of the Global Seismographic Network (GSN), the Program of Array Seismic Studies of the Continental Lithosphere (PASSCAL), the Data Management System (DMS), and the Education and Outreach Program (E&O). In addition, special advisory committees and *ad hoc* working groups are convened for special tasks. It is the role of the Standing Committees and the advisory subcommittees to develop recommendations for the Executive Committee which evaluates and approves such recommendations on behalf of the Board of Directors.

IRIS Member Institutions

INSTITUTION—*BOARD MEMBER • ALTERNATE*

University of Alabama
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University of Alaska
Douglas H. Christensen • Nirendra N. Biswas
University of Arizona
Terry C. Wallace, Jr. • Susan Beck
Arizona State University
Ed Garnero • Matthew J. Fouch
University of Arkansas at Little Rock
Haydar J. Al-Shukri • Jeffery B. Connelly
Auburn University
Lorraine W. Wolf
Boise State University
John R. Pelton • James Zollweg
Boston College
John Ebel • Alan Kafka
Boston University
Geoffrey Abers • Carol Simpson
Brown University
Karen Fischer • Donald Forsyth
California Institute of Technology
Donald Helmberger • Thomas Heaton
University of California, Berkeley
Thomas V. McEvilly • Lane Johnson
University of California, Los Angeles
John Vidale • Paul Davis
University of California, Riverside
Stephen K. Park • David D. Oglesby
University of California, San Diego
Peter Shearer • Jon Berger
University of California, Santa Barbara
Craig Nicholson • Ralph Archuleta
University of California, Santa Cruz
Thorne Lay • Susan Schwartz
Carnegie Institution of Washington
Paul Silver • Selwyn Sacks
Central Washington University
Timothy Melbourne • Charles Rubin
University of Colorado, Boulder
Mike Ritzwoller • Anne Sheehan
Colorado School of Mines
Roel Snieder • Thomas Boyd
Columbia University
Paul G. Richards • Arthur Lerner-Lam
University of Connecticut
Vernon F. Cormier • Lanbo Liu
Cornell University
Muawia Barazangi • Dogan Seber
University of Delaware
Susan McGeary
Duke University
Peter Malin • Eylon Shalev
Florida International University
Dean Whitman
University of Georgia
Robert Hawman • James Whitney
Georgia Institute of Technology
Leland T. Long • James Gaherty
Harvard University
Göran Ekström • Jeroen Tromp
University of Hawaii at Manoa
Gerard Fryer • Charles Helsley
IGPP/Lawrence Livermore National Laboratory
William Walter • Peter Goldstein
IGPP/Los Alamos National Laboratory
Hans Hartse • Leigh House
Idaho State University
Joseph M. Kruger
University of Illinois at Urbana Champaign
Wang-Ping Chen • Xiaodong Song
Indiana University
Gary L. Pavlis • Michael Hamburger
Indiana University/Purdue University at Fort Wayne
Dipak Chowdhury
Kansas State University
Stephen Gao • Charles Oviatt
University of Kansas
Ross A. Black
Lawrence Berkeley National Laboratory
D.W. Vasco • E.L. Majer
Lehigh University
Anne Meltzer
Louisiana State University
Juan Lorenzo • Roy Dokka
Macalester College
John P. Craddock • Karl R. Wirth
Massachusetts Institute of Technology
Robert van der Hilst • Bradford H. Hager
University of Miami
The University of Memphis
Jer-Ming Chiu • Arch Johnston
University of Michigan
Larry Ruff
Michigan State University
Kazuya Fujita • David W. Hyndman
Michigan Technological University
Wayne D. Pennington • Jimmy F. Diehl
University of Minnesota
University of Missouri
Joseph Engeln
University of Montana
Michael Stickney • Marvin Speece
University of Nevada, Reno
Glenn Biasi • Steve Jaume
University of New Orleans
Abu K.M. Sarwar
New Mexico Institute of Mining & Technology
Richard C. Aster • Harold Tobin
New Mexico State University
James Ni • Thomas Hearn
State University of New York at Binghamton
Francis T. Wu • Jeff Barker
State University of New York at Stony Brook
William Holt • Daniel Davis
University of North Carolina, Chapel Hill
Jonathan Lees • Jose Rial
Northern Illinois University
Paul Stoddard • Philip Carpenter
Northwestern University
Ray Russo • Seth Stein
The University of Oklahoma
Roger Young • Judson Ahern
University of Oregon
Eugene Humphreys • Doug Toomey
Oregon State University
John Nabelek • Anne Trehu
Pennsylvania State University
Shelton S. Alexander
Princeton University
Guust Nolet • Robert Phinney
Purdue University
Lawrence W. Braile • Scott King
Rensselaer Polytechnic Institute
Steven Roecker • Robert McCaffrey
Rice University
Alan R. Levander • Dale Sawyer
Saint Louis University
Brian J. Mitchell
San Diego State University
Steven M. Day • Eric Frost
San Jose State University
Donald L. Reed • Richard Sedlock
Southeast Missouri State University
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University of South Carolina
Tom Owens • Pradeep Talwani
University of Southern California
Thomas H. Jordon • Ta-Liang Teng
Southern Methodist University
Eugene T. Herrin
Stanford University
Gregory C. Beroza • Simon Klemperer
Syracuse University
Douglas K. Nelson
University of Tennessee
Richard T. Williams
Texas A&M University
Richard Gibson • Philip D. Rabinowitz
Texas Tech University
Harold Gurrola • Calvin Barnes
University of Texas at Austin
Clifford A. Frohlich • Stephen P. Grand
University of Texas at Dallas
George McMechan • John Ferguson
University of Texas at El Paso
G. Randy Keller, Jr. • Diane Doser
University of Tulsa
Christopher Liner • Bryan Tapp
University of Utah
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Virginia Polytechnic Institute
J. Arthur Snoke • John Hole
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University of Wisconsin, Madison
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University of Wisconsin, Milwaukee
Keith A. Sverdrup • Vincent Cronin
University of Wisconsin, Oshkosh
Thomas Laudon
Woods Hole Oceanographic Institution
Ralph Stephen • Alan Chave
Wright State University
Ernest C. Hauser • Paul J. Wolfe
University of Wyoming
Scott B. Smithson
Yale University
Jeffrey J. Park

U.S. Affiliate Member Institutions

INSTITUTION—*REPRESENTATIVE*

Naval Air Weapons Station, Geothermal Program Office
Francis Monastero
Maryland Geological Survey
Gerald R. Baum

Foreign Affiliate Member Institutions

INSTITUTION—*REPRESENTATIVE*

Academia Sinica, Institute of Earth Sciences, Taiwan
Honn Kao
Academy of Sciences, Seismological Center, Albania
Betim Muco
Australian National University
Brian Kennett
Centro de Investigacion Cientifica y de Educacion Superior de Ensenada, Mexico
Cecilio J. Rebollar
Ecole Polytechnique, Canada
Geological Survey of Canada, Continental Geoscience Division
Isa Asudeh
Geophysical Institute, Czech Republic
Axel Plesinger
Hanyang University
So Gu Kim
Institute of Geophysics, Polish Academy of Sciences
Pawel Wiejacz
Institute of Geophysics, Switzerland
Domenico Giardini
Institute of Geology, SSB, Beijing, PRC
Qiyuan Liu
Institute of Geophysics, Beijing, PRC
Gongwei Zhou
Instituto Geofisico Del Peru
Edmundo Norabuena
Instituto Superior Técnico, Portugal
Joao F.B.D. Fonseca
International Institute of Earthquake Engineering and Seismology, Iran
Manouchehr Bahavar
Istanbul Technical University
Tuncay Taymaz
Kuban State University, Russia
Vladimir Babeshko
Masaryk University, Czech Republic
Petr Firbas
National Central University, Taiwan
Kuo-Gong Ma
National Institute for Earth Physics, Romania
Andrei Bala
National Research Institute of Astronomy and Geophysics, Egypt
Amin Ibrahim Hussein
Observatório Nacional, Brazil
Jorge Luis de Souza
Peking University, China
Shao Xian Zang
Russian Academy of Sciences, Russia
Vitaly V. Adushkin
The University of Leeds, England
Roger Clark
The University of Queensland, Australia
Peter Mora
Tubitak-Marmara Research Centre, Turkey
M. Namik Yalcin
Universidad Nacional, Costa Rica
Federico Güendel
Universidade de Brasilia, Brazil
Joao Willy Rosa
Universidade do Porto, Faculdade de Engenharia
Rui Carneiro-Barros
Universidade de São Paulo, Brazil
Marcelo Assumpção
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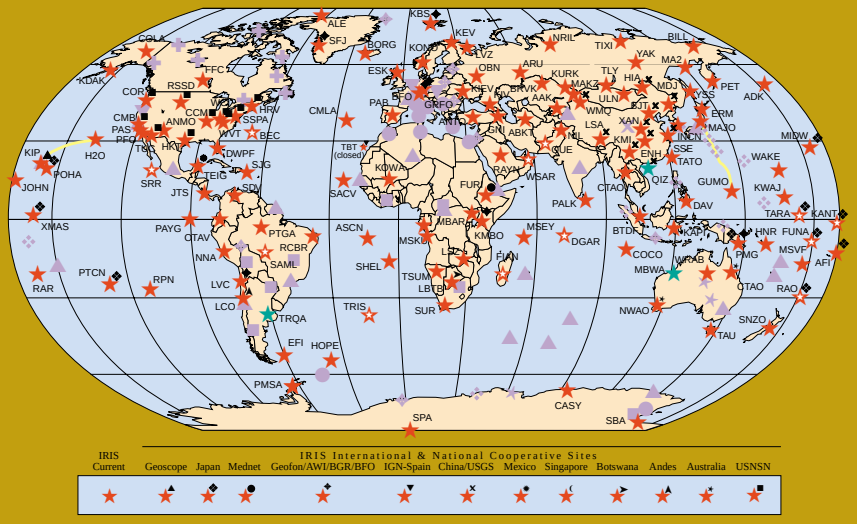
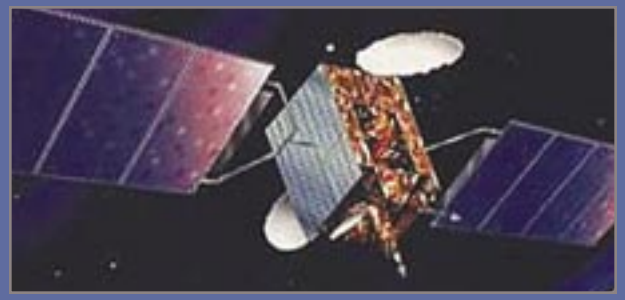
University of Bristol, England
George Hellfrich
University of British Columbia
Michael G. Bostock
University of Cambridge, England
Keith Priestley
University of Hong Kong
Lung Sang Chan
University of Leicester, United Kingdom
Peter Maguire
University of Otago, New Zealand
Helen Anderson
Utrecht University, The Netherlands
Roel Snieder
Victoria University, Institute of Geophysics, New Zealand
John Taber

GSN global seismographic network

GLOBAL SEISMOGRAPHIC NETWORK



The Global Seismographic Network is a permanent worldwide network of seismological observatories designed to provide uniform coverage of the globe.



The Global Seismographic Network is a permanent network of state-of-the-art seismological and geophysical sensors connected by telecommunications to serve the research and monitoring requirements of the scientific community. All GSN data are freely and openly available to anyone via the Internet. Installed to provide broad, uniform global coverage of the Earth, 126 GSN stations are now sited from the South Pole to Siberia and from the Amazon basin to the seafloor of the Northeast Pacific Ocean, in cooperation with over 100 host organizations and seismic networks in 57 countries worldwide.

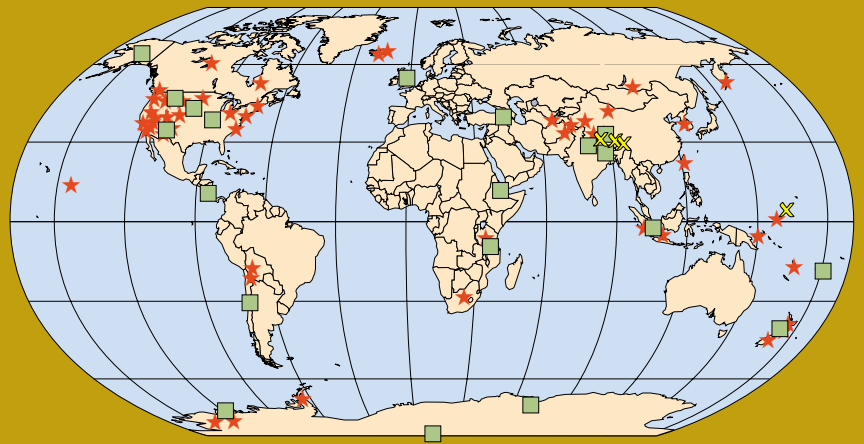
The GSN continues to create opportunities to extend new telecommunications capabilities to our stations. We are in transition from air-mailed media, dial-up telephone, and slow-speed Internet access to broadband VSAT satellite links and high-speed Internet. In 2001 all 10 of our Chinese stations were upgraded from dial-up access to satellite connections linked to the Internet, in cooperation with our Chinese hosts and the US Geological Survey Albuquerque Seismological Laboratory (ASL). ASL has also installed GSN funded VSAT equipment at our sites in Ecuador and Argentina, and worked with the Australian Geological Survey to link GSN sites at Narrogin and Charters Towers to their national satellite network and the Internet. With our colleagues at Columbia University and our hosts in Kazahkstan, satellite linked Internet access was established to our GSN stations in Borovoye and Kurchatov. The University of California at San Diego IRIS/IDA group has arranged for Internet access to our stations in Sri Lanka, Cape Verde Islands, East Falkland Island, and Cocos-Keeling Island. Working with our Russian colleagues, GSN has arranged an Internet connection to Norilsk in northernmost Siberia. In addition to these new connections, substantial improvements in the bandwidth of international Internet links during the past year now offer high-speed connections to GSN sites from which only limited data could be received before.

Real-time GSN data are valuable to agencies with responsibility for operational monitoring, and the GSN works to establish direct data links for mutual benefit. About 50 GSN stations have been designated for participation in the International Monitoring System (IMS) for the Comprehensive Test-Ban Treaty Organization (CTBTO). The US National Weather Service (NWS) uses GSN data for its Tsunami Warning System. Both organizations require direct access, avoiding less reliable Internet circuits. GSN has been working with the IMS to link stations to the CTBTO International Data Centre via their global communication infrastructure being established for secure communication. To avoid duplication of satellite equipment in remote locations and to provide for operations and maintenance, the GSN has been testing with the CTBTO the concept of sharing their satellite system to carry GSN data streams to the IRIS DMC. In the Pacific, with cooperation with our Japanese colleagues who provided equipment, IRIS has established a satellite hub on Oahu to bring GSN data directly to the Pacific Tsunami Warning Center, which will then forward it to the Internet. NWS is funding the satellite space segment costs for this access.

Our newest station in the GSN was installed by ASL this year in Marble Bar, Western Australia. This site, which includes two borehole seismometers (installed at 100 in depth to minimize the influence of near surface noise) and a strong-motion sensor, holds to the basic GSN design goal to record with full fidelity all signals across the entire seismic frequency band.

PASSCAL program for array seismic studies of the continental lithosphere

PASSCAL Broadband Experiments



Broadband Experiment History	Pre 2001	2001	2002
	★	□	X

The Program for the Array Seismic Studies of the Continental Lithosphere (PASSCAL) is a program of portable instruments for use by individual scientists for high-resolution experiments in areas of special interest.

During 2001, PASSCAL supported between 50 and 60 experiments, maintaining a level that has evolved over the past couple of years. Broadband instrumentation continues to be in high demand, a situation that has contributed to problematical wait times between project funding and actual fieldwork. However, during this year, the number of broadband stations increased to a total of 250, and it is hoped that this will have a beneficial effect in the near future to decrease experiment wait times.

PASSCAL 3-channel instruments continue to be heavily used in both active-source experiments and in passive-source local and regional earthquake studies. Nearly constant use of all of the recorders is taking its toll on the hardware, and the PASSCAL Instrument Center has spent the year servicing each instrument as it comes in from the field to make sure that all of the circuit boards are up to date. This task is complicated by the number of different generations of each board that we own, and the fact that some of the components are no longer commercially available.

The active-source instrument pool grew through the acquisition of 200 single-channel "Texan" instruments. These instruments, along with those we support at the University of Texas-El Paso, bring the total number of single-channel instruments available to the community to over 800. The instruments are very popular because of their small size and easy operation. They have been used extensively in the last few years in experiments ranging from ultra-dense 3-D near-surface experiments to large-scale lithospheric transects.

Both broadband-array systems are installed at Parkfield, CA in support of the SAFOD experiment, providing in excess of 50 stations operating in the array at the present time. Each broadband array is configured to record teleseismic events as well as local and regional events. The broadband array system is proving to be a valuable test bed for the development of both hardware and software for the next generation of seismic instruments, and has provided practical insights into eventual management and operation of a very large real-time array such as proposed for USArray.

Field software development has continued with the goal of making it easier for investigators to quality control field information, convert it to a useful processing format and archive it at the Data Management Center (DMC). Over the last year, the backlog in delivery of data to the DMC has been reduced significantly. This improvement in data archival efficiency has resulted from experiential learning and very close collaboration between PASSCAL Instrument Center and DMC staff.

Helping to address the growing problems of increasing instrument demands and aging equipment, Congress appropriated $1,000,000 for the PASSCAL program in the FY01 budget. The funding, provided through DOE's Nonproliferation and National Security research and development account, allows for the purchase of 25 broadband seismic stations. In recognition of the importance of this support and the interagency cooperation that helped to make it possible, the IRIS Executive Committee passed a resolution that gives peer-reviewed research programs funded by DOE priority in the use of the equipment.

Advancing our anticipated migration to new PASSCAL DAS systems, prototypes of "Next Generation" instruments are now being tested to evaluate their utility for both PASSCAL and the USArray.

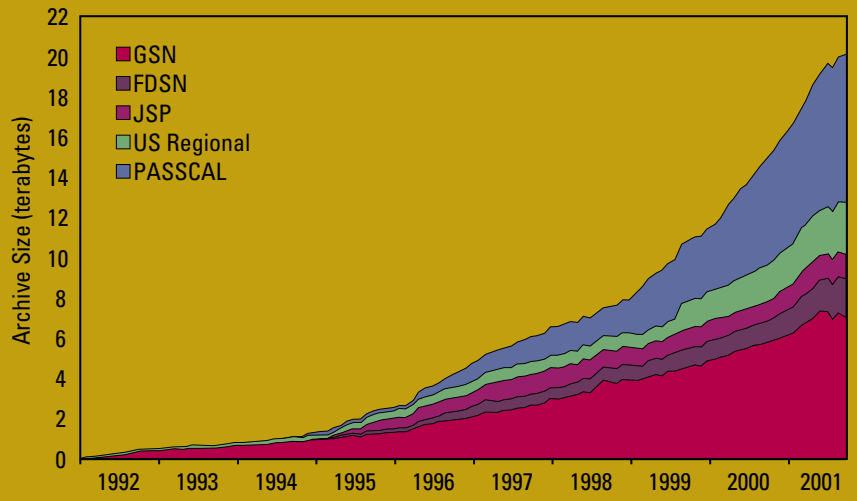
Standing Committee

Roy Johnson (Chair)	University of Arizona
Geoffrey Abers	Boston University
Joan Gomberg	University of Memphis
Art Lerner-Lam	Columbia University
John Louie	University of Nevada, Reno
Kurt Marfurt	University of Houston
David Okaya	University of Southern California
Thomas Owens	University of South Carolina
Steve Roecker	Rensselaer Polytechnic Institute
James C. Fowler	PASSCAL Program Manager

DMS data management system

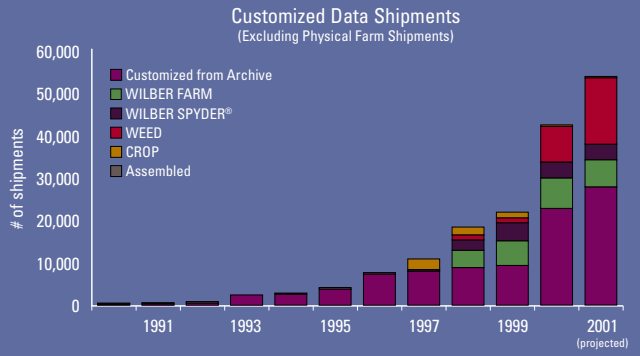
Photo courtesy of NCAR

The Data Management System (DMS) is a data system for collecting, archiving, and distributing data from IRIS facilities, as well as a number of other national and international networks and agencies.



The IRIS DMC Seismological Archive. This figure shows the growth in GSN, FDSN, JSP, US Regional Networks and PASSCAL data from 1992 until October, 2001. We presently manage roughly 20 terabytes of waveform data in the dual sorted archive.

StorageTek Mass Storage System. The new DMC Mass Storage System can hold 6000 tapes, each with a capacity of 60 gigabytes. The system presently has 9 T-9940 high performance tape drives with an aggregate input/output rate of nearly 100 megabytes/second. (Photo courtesy of NCAR)



We project that roughly 60,000 data requests will be serviced this year by the IRIS DMC. Roughly half of them will come from the quality controlled data archive and the other half will come from the on-line FARM and SPYDER® event archives.

The DMS is currently archiving about 6 terabytes of new waveform data per year, while still meeting the needs of the scientific community for data with shorter delivery times. Many requests are serviced immediately by Internet access to selected data sets available from on-line systems. The median time to service a complex request for data from the full archive is measured in hours. The archive size figure shows that the total volume of our dual sorted (time and station) archive has reached 20 terabytes. While the figure accounts for the two sort orders, the IRIS DMC actually manages roughly 50 terabytes of data, in 12.5 million files, when we account for the on-line and off-site copies of the archived data. While data flow from the GSN and PASSCAL programs has stabilized, the number of other data sources has increased dramatically.

During the first 6 months of this year the IRIS DMC transcribed roughly 20 terabytes of data to a new high performance STK Powderhorn robot equipped with T9940 tape drives. This system currently can store more than 350 terabytes of information. With anticipated improvements in tape technology, the capacity of this system could exceed 1 petabyte (1,000,000,000,000,000 bytes) within 3 years.

Data Shipments from the DMC

We anticipate servicing approximately 60,000 data requests this year, comprising nearly 1 terabyte of seismic waveforms. Shipments this year have gone to more than 33 countries around the world, 145 different institutions and 563 different seismologists.

The shipment figure shows the number of projected data shipments for 2001. While the bulk shipment of FARM products, via ftp and tape, is less than last year, the total number of customized requests continues to rise.

Moving Toward Real Time Data Reception

As we position ourselves to handle data from USArray, the International Monitoring System for the Comprehensive Nuclear Test-Ban Treaty, and other large programs, the IRIS DMS is turning towards real time reception of data.

Major Projects for 2001

Roughly half of the shipments made by the DMC now come out of the pre-assembled event-oriented collections at the DMC. The SPYDER® event products are assembled within hours of significant events and in general contain un-reviewed data. The FARM event-oriented products come from the quality-controlled data in the main DMC archiving systems, and are now produced roughly 5-6 weeks behind real time. There are currently about 2600 events in the FARM for events from 1990 until present. A total of about 3.3 million seismograms from every network that has contributed to the IRIS DMC are available.

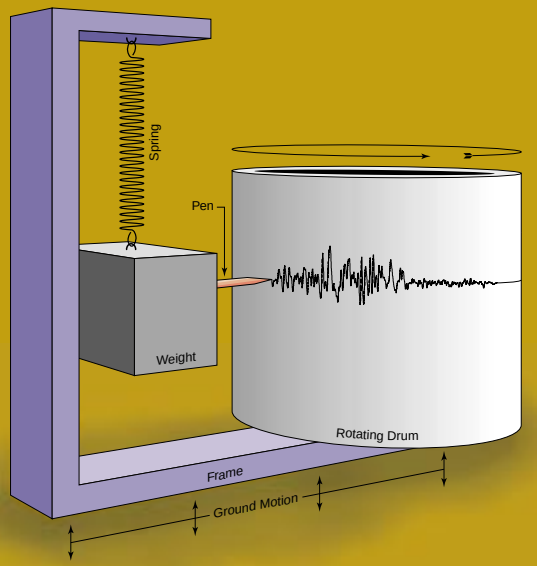
The new FARM and SPYDER® systems now include data from all networks that contribute data to the IRIS DMC and are automatically updated when new data arrive so that they always contain the most recent version of the metadata.

New Data Handling Techniques

The IRIS DMS is continuing to improve our Data Handling Interface. This object-oriented approach to data request and delivery systems is now focusing on the development of a variety of client-side applications that will make access to the IRIS DMC resources more transparent.

E&O education and outreach

The Education and Outreach program (E&O) integrates research and education by making our data and science widely accessible through a variety of programs and partnerships.



Schematic illustration demonstrating the principle by which a seismometer works.

The E&O program is committed to making significant and lasting contributions to science education, science literacy and the general public's understanding of the Earth, using seismology and the unique resources of the IRIS consortium. The E&O program has activities that span all educational levels from public outreach to K-12 and college education. As part of our commitment to college education, IRIS has established a new Educational Affiliate membership category to provide two- and four-year colleges with better access to IRIS educational activities.

Our museum program, a partnership between IRIS, the US Geological Survey, and several major museums across the nation, reaches a large audience (8 million people per year) and receives rave reviews from our hosts. Real-time earthquake exhibits are now operating at the New Mexico Museum of Natural History and Science in Albuquerque, New Mexico, the Carnegie Museum of Natural History in Pittsburgh, Pennsylvania, and the American Museum of Natural History (AMNH) in New York. The AMNH opened a second earthquake exhibit in June as part of the AMNH Discovery Room, a hands-on learning center within the museum. The new exhibit compliments our existing exhibit in the AMNH's Hall of Planet Earth. Our travelling display (on tour with the Franklin Institute's "Powers of Nature" exhibit) opened at the Space and Rocket Center in Huntsville, Alabama, in April and will remain there through 2001. The E&O program continuous to work with all museum partners to evaluate the existing exhibits and develop modules for future displays.

The E&O program promotes Earth science awareness and learning in the pre-college curriculum through educational seismographs for K-12 science teachers. In the past year, inexpensive AS-1 vertical seismographs have been distributed to 25 schools, along with computer software and explanatory materials for use in the classroom. The seismograph is easy to set up and use and only requires a Windows-based computer to operate. Technical support (through Indiana University) has also been provided for Princeton Earth Physics Project (PEPP) seismographs. Over 25 school PEPP stations are now connected via the internet and plans are underway for the data to be archived at the IRIS Data Management Center. Using seismograms recorded at the school, students can study seismic waves in the Earth, where earthquakes occur, plate tectonics, the concepts of earthquake magnitude and intensity, earthquake location, earthquake hazards, and many other topics that are interesting and relevant to students.

Continuing E&O core activities include workshops for geoscience educators, the IRIS summer undergraduate internship program, and the development of educational materials. To reach a wider audience we collaborate with other geoscience education programs, such as the Digital Library for Earth System Education (DLESE), the American Geophysical Union's Committee on Education and Human Resources and the Coalition for Earth Science Education.

New software tools are under development though a subaward to University of South Carolina. These tools will provide much better accessibility to IRIS data sets for educational purposes. The new Virtual Seismic Network Explorer software and associated instructional materials will be the key to leveraging the valuable seismic data sets that are at the heart of IRIS. The success of the E&O program is directly attributable to those who have volunteered their time and energy. In particular we acknowledge the enormous contributions of the E&O committee members, and we encourage continued participation by individuals within and beyond IRIS.

Standing Committee

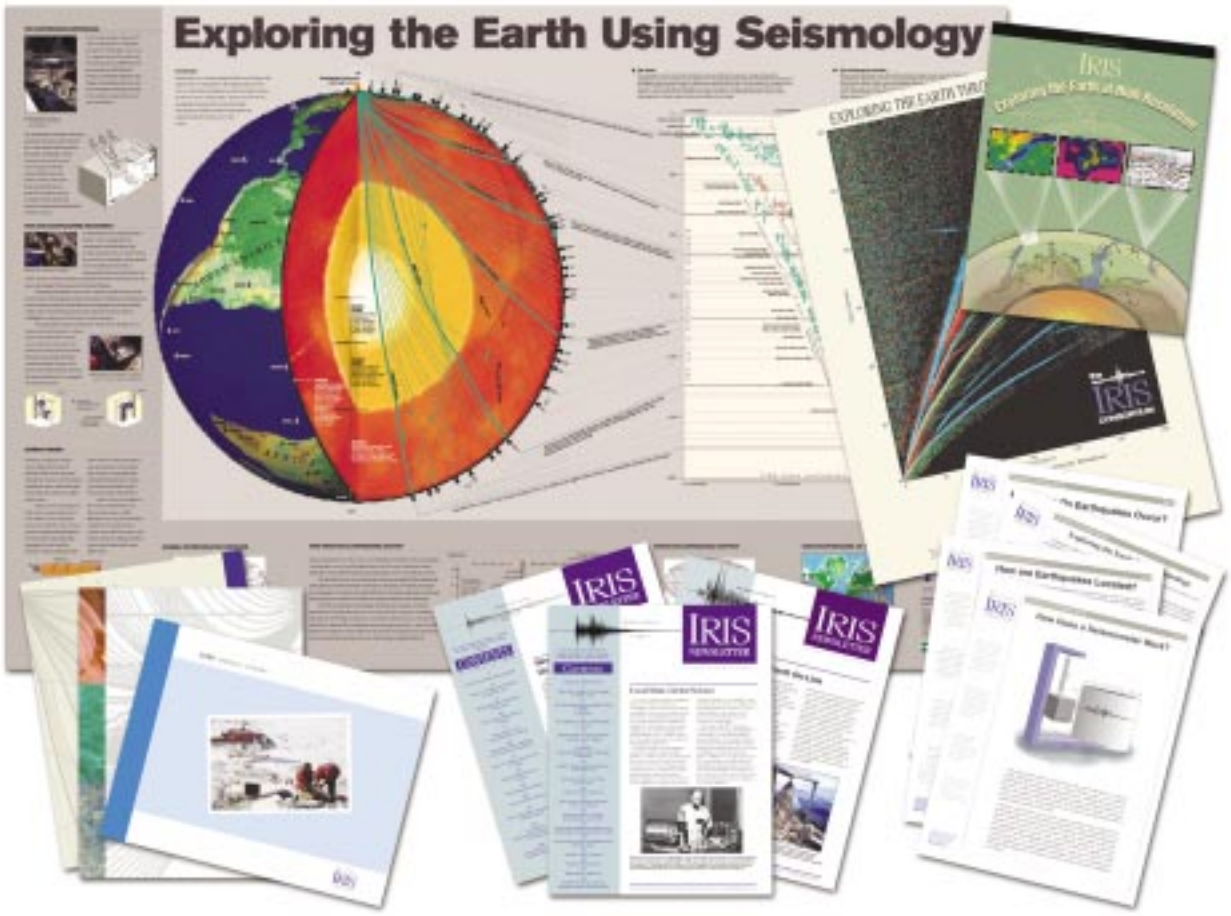
Larry Braile (Chair)	Perdue University
Rick Aster	New Mexico Tech
Michael Hamburger	Indiana University
Glenn Kroeger	Trinity University
John Lahr	US Geological Survey, Denver
Robert Mellors	San Diego State University
Susan Schwartz	University of California, Santa Cruz
John Taber	E&O Program Manager

Activities & Publications

The 2001 IRIS Workshop was held this year at Jackson Lake Lodge, located at the foot of the Grand Tetons in Moran, Wyoming.

In addition to program oversight and administration, the Consortium also serves the role of an on-going forum for exchanging ideas, setting community priorities, and fostering cooperation. To enhance this role, IRIS engages the broader community through the IRIS Newsletter and through workshops. The Newsletter, which is widely distributed without charge, is organized around topical issues that highlight emerging opportunities for seismology. The annual workshop is used to assess the state of the science, introduce programs, and provide training. Through a student grant program, young scientists attend the workshop at little or no cost, and become introduced to the programs and services of the Consortium.

As a Consortium, IRIS also serves as a representative for the Geoscience community. IRIS staff and Committee members serve on White House Committees, State Department Advisory Boards, US Geological Survey panels, and testify before Congress. Such broad interactions raise the profile of Geosciences and provide a direct societal return from the federal investment in IRIS.



Through the Education and Outreach Program, IRIS develops and distributes posters about seismology. The posters are featured at various scientific and educational meetings, and can be found on classroom walls around the world.

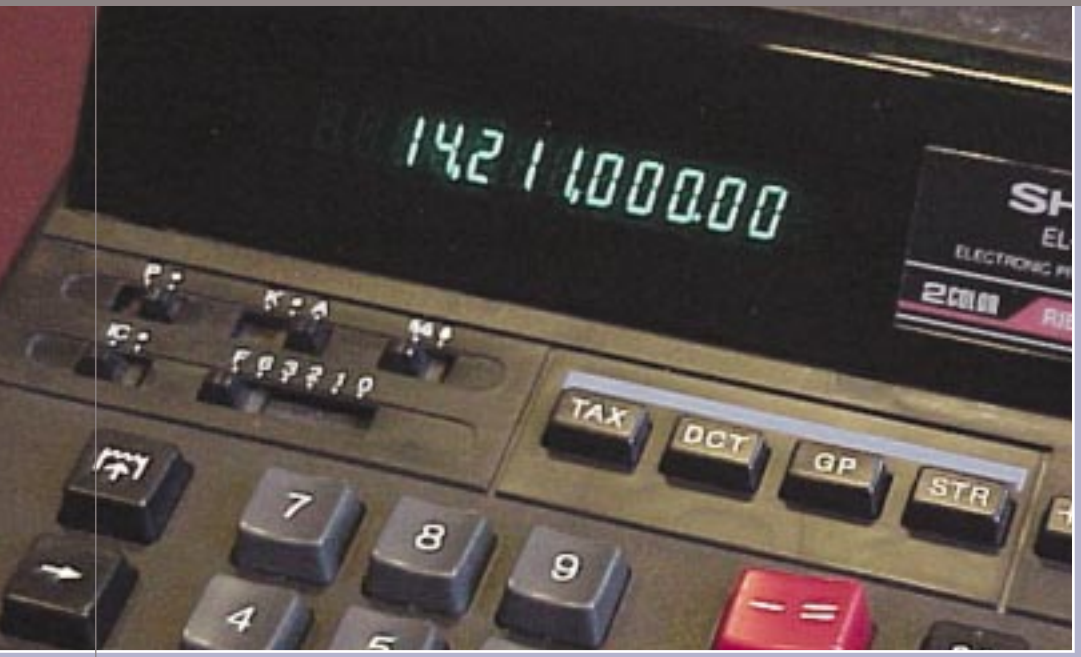
The IRIS Newsletter, with a distribution of 2500, is a well-illustrated collection of technical articles, field reports, news items, and policy discussions of interest to the IRIS community.

IRIS has developed a series of ”one-pagers” to attract the attention of students, educators, decision-makers, and the general public. The one-pagers provide succinct explanations of basic seismological concepts, and are available in hard-copy and on the web in both English and Spanish.

Meetings and Publications Subcommittee

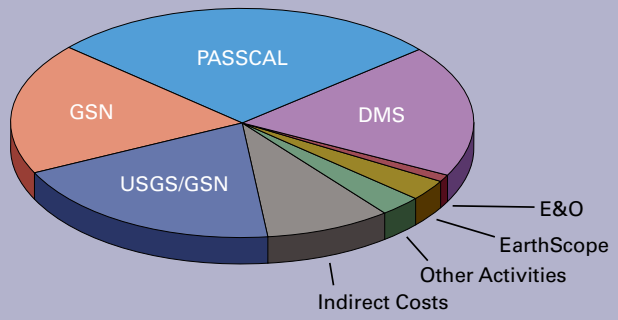
Gary Pavlis (Chair)	Indiana University
Lawrence Braile	Purdue University
Roy Johnson	University of Arizona
Alan Levander	Rice University
Barbara Romanowicz	University of California, Berkeley
Gregory van der Vink	IRIS Director of Planning

Financial Overview

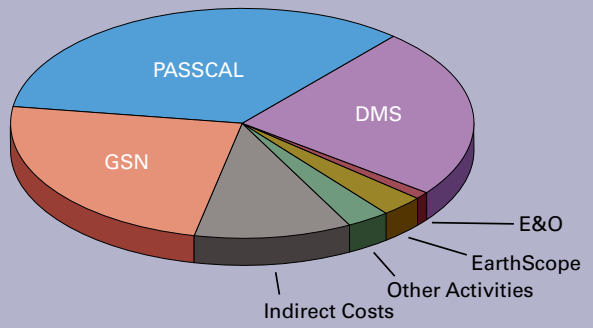


The Incorporated Research Institutions for Seismology (the IRIS Consortium) is a 501(c)(3) non-profit consortium of research institutions founded in 1984 to develop scientific facilities, distribute data, and promote research. IRIS is incorporated in the State of Delaware.

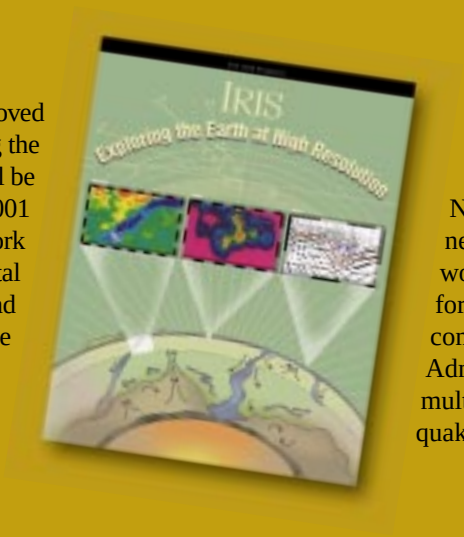
Total Program Budget



Direct IRIS Support



In August 2001, the National Science Foundation (NSF) approved five more years of support for the activities described in "Exploring the Earth at High Resolution: the IRIS Proposal". The NSF funding will be administered through a five-year Cooperative Agreement (July 1, 2001 to June 30, 2006) that supports the Global Seismographic Network (GSN), the Program for Array Seismic Studies of the Continental Lithosphere (PASSCAL), the Data Management System (DMS) and the Education and Outreach Program. Funds are also provided for the continued management of the Consortium activities.



IRIS programs have been built through a combination of strong NSF support for core program activities, financial and "in-kind" partnerships with universities, government agencies and international network operators, and augmented funding based on unique opportunities for multi-use applications. In particular, significant program funding has come from special appropriations by members of Congress and the Administration who recognized the value of expanding IRIS facilities into multi-use systems that serve not only academic research, but also earthquake hazard mitigation and nuclear test monitoring.

Global Seismographic Network

The Global Seismographic Network is operated in partnership with the US Geological Survey. Funding from NSF for the GSN supports the installation and upgrade of new stations, and the operation and maintenance of stations of the IDA Network and other stations not funded directly within the budget of the USGS. Operation and maintenance of USGS/GSN stations is funded directly through the USGS budget. Subawards include the University of California, San Diego, the University of California, Berkeley, the California Institute of Technology, Columbia University, University of Hawaii, Albuquerque Seismological Laboratory, and Synapse Science Center, Moscow.

PASSCAL

Funding for PASSCAL is used to purchase new instruments, support the Instrument Center at the New Mexico Institute of Mining and Technology, train scientists to use the instruments, and provide technical support for instruments in the field. Subawards include the New Mexico Institute of Mining and Technology, Stanford University, the University of California, San Diego, and University of Texas at El Paso.

Data Management System

Funding for the Data Management System supports data collection, data archiving, data distribution, communication links, software development, data evaluation, and web interface systems. Subawards include the University of Washington, Harvard University, the University of California, San Diego, Columbia University, Synapse Science Center, Moscow, and University of South Carolina.

Education and Outreach

Funding for the Education and Outreach program is used to support teacher and faculty workshops, undergraduate internships, the production of hard-copy and web-based educational materials, the development of museum displays.

Indirect Expenses

Costs include corporate administration salaries, business office salaries, accounting and legal consultant services, insurance, administrative staff, computer and office charges, and corporate travel costs.

Other Activities

Other activities include IRIS workshops, publications and special projects such as KNET, development of special workshops, the annual IRIS Workshop, the IRIS Newsletter, other publications, and membership services.

The consolidated financial statements of IRIS and IRIS Ocean Cable, Incorporated, and the Auditor's Report are available from the IRIS business office upon request.

Budget and Finance Subcommittee

Clifford Thurber (Chair)	University of Wisconsin, Madison
Thomas Jordan	University of Southern California
Candy Shin	IRIS Business Manager
Rob van der Hilst	MIT

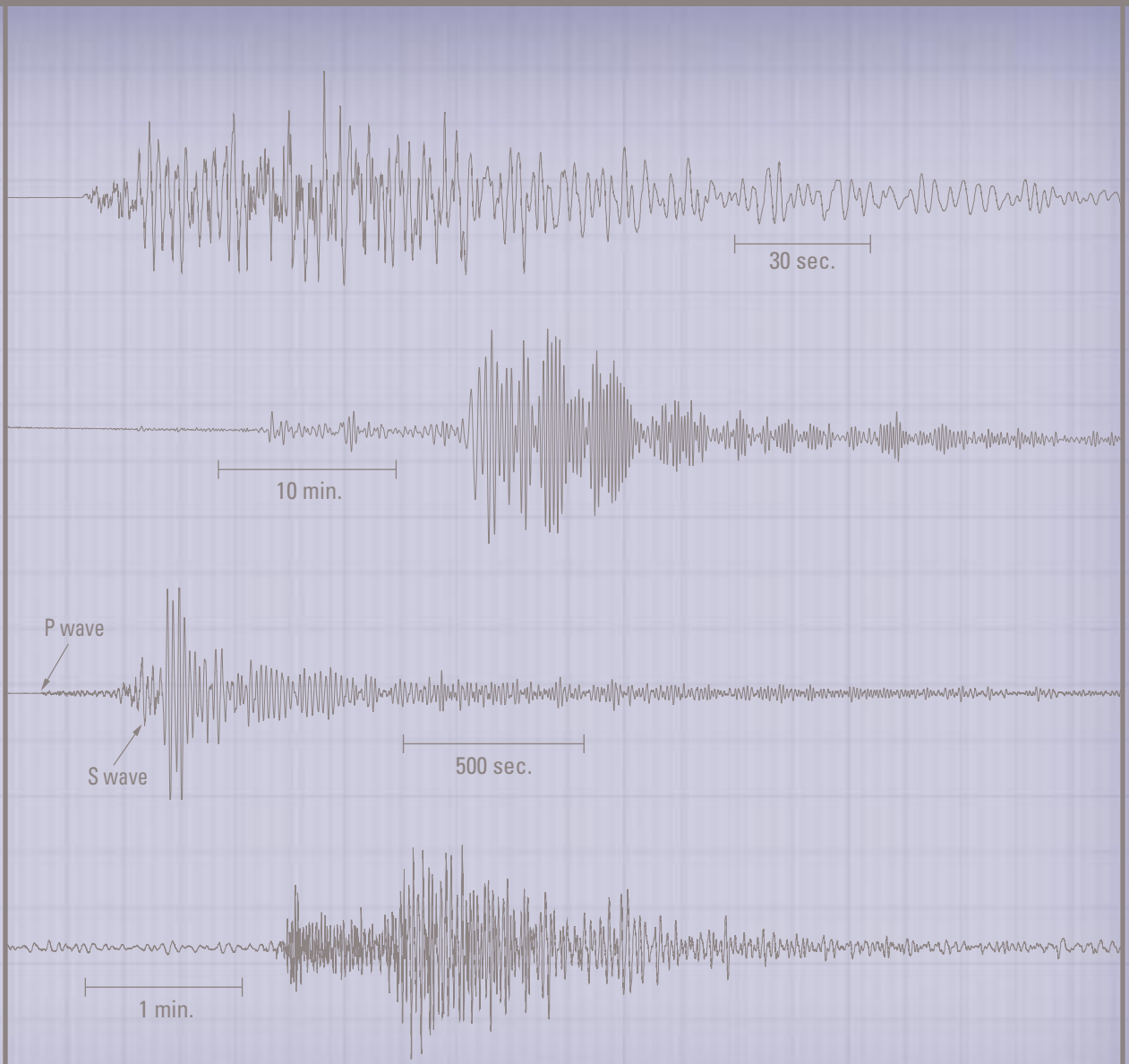
Featured Seismograms

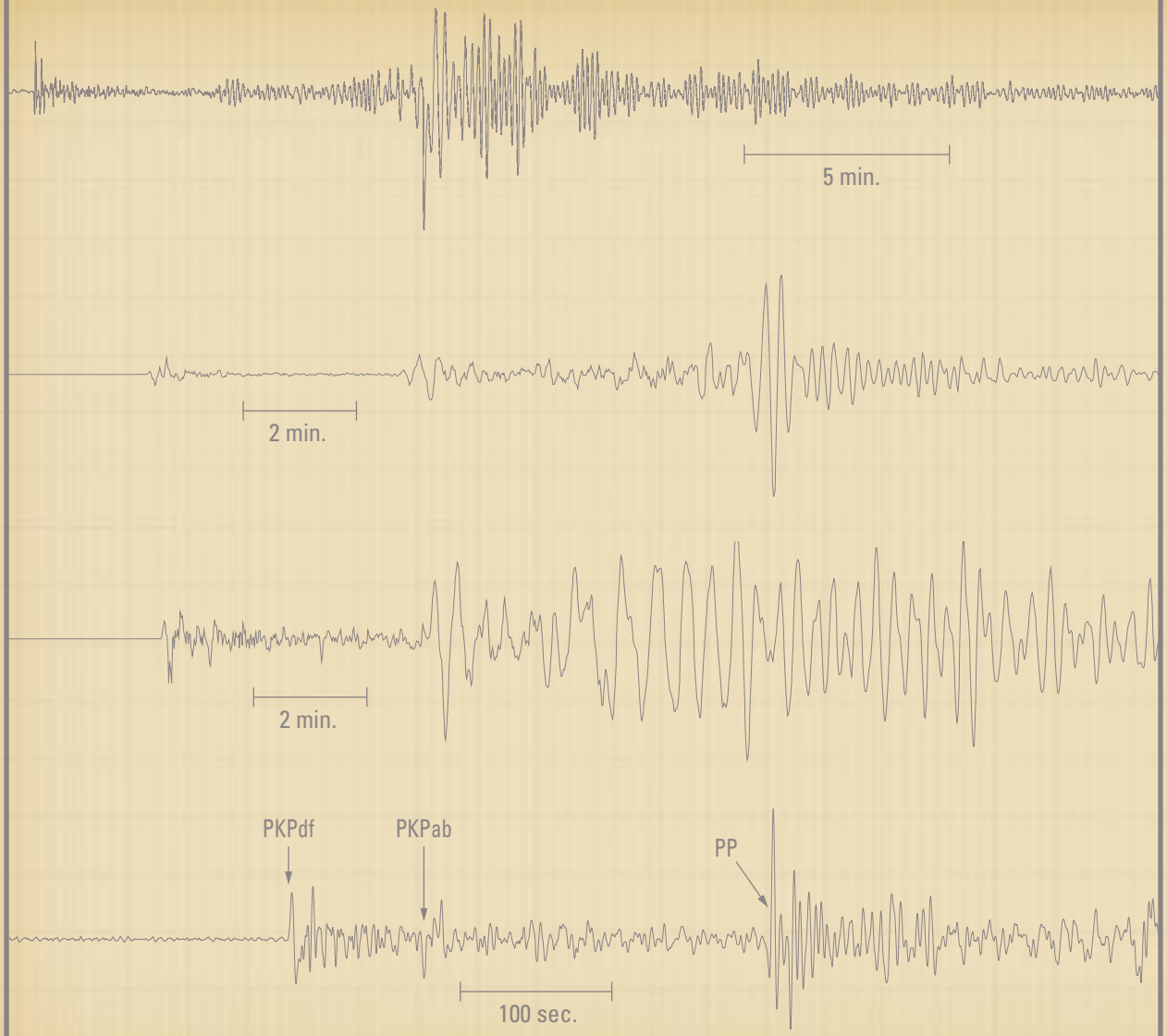
inside front. Magnitude 6.8 earthquake that struck Puget Sound on February 28, 2001 recorded by IRIS GSN station COR near Corvallis, Oregon. The earthquake was caused by normal faulting at 52 km depth as the Juan de Fuca plate is bending and subducting eastward under the North American plate.

page 6. Pursuing the goal to provide continuous global data coverage, the 126th IRIS Global Seismographic Network (GSN) station was installed in September 2001 in Marble Bar, western Australia. The station's inaugural data included this magnitude 6.3 earthquake on the Pacific Antarctic Ridge recorded on September 2 (Harold Bolton, Albuquerque Seismological Laboratory).

page 8. On June 23, 2001 a magnitude 8.4 earthquake shook the coast of Peru. It was the largest earthquake recorded worldwide in more than 25 years. The offshore earthquake triggered a tsunami with inundation distances extending more than 1 kilometer inland and with runup heights of more than 7 meters. This seismogram was recorded at PASSCAL station HEDI near Hedionda in western Argentina as part of the CHARGE experiment (University of Arizona CHARGE team).

page 10. Mining induced earthquake near the border of France and Germany on June 21, 2001 recorded by the IRIS GSN station GRFO near Graefenberg in Germany. Eyewitnesses described this event as explosion-like. The magnitude 4.2 earthquake killed one person in the French mine Merlebach, and damaged houses on both sides of the border.





page 12. Teacher Tom Diener and his students at the Marshall School in Duluth, Minnesota recorded this magnitude 5.8 earthquake off Vancouver Island on September 14, 2001. The event was recorded on an AS-1 seismometer as part of the IRIS E&O Seismographs in Schools program (Larry Braile, Purdue University).

page 14 & 16. One of the deadliest earthquakes of the year devastated northwest India on January 26, 2001. The magnitude 7.7 earthquake killed at least 20,000 people and destroyed more than 1,000,000 houses. Ground shaking was felt throughout northern India, and in parts of Pakistan, Bangladesh, and western Nepal. The earthquake occurred along an east-west trending thrust fault at 70 km depth. Two seismograms for this event demonstrate the effect of crustal structure on seismic signals. IRIS GSN station WMQ near Urumqi in China recorded the earthquake at about 2,800 km distance northeast of the epicenter (**top**). IRIS GSN station GNI near Garni in Armenia recorded the event at about 3,000 km distance northwest of the epicenter (**bottom**).

page 21. Magnitude 7.0 earthquake south of the Mariana Islands on October 12, 2001 recorded at IRIS GSN station RCBR near Riachuelo in Brazil at a distance of almost 20,000 km (173 degrees). Near the antipodal distance, several branches of P-waves traversing the outer core (PKPdf, PKPab) and P-waves reflected once at the Earth's surface (PP) dominate this seismogram (Tyler Storm, Albuquerque Seismological Laboratory).

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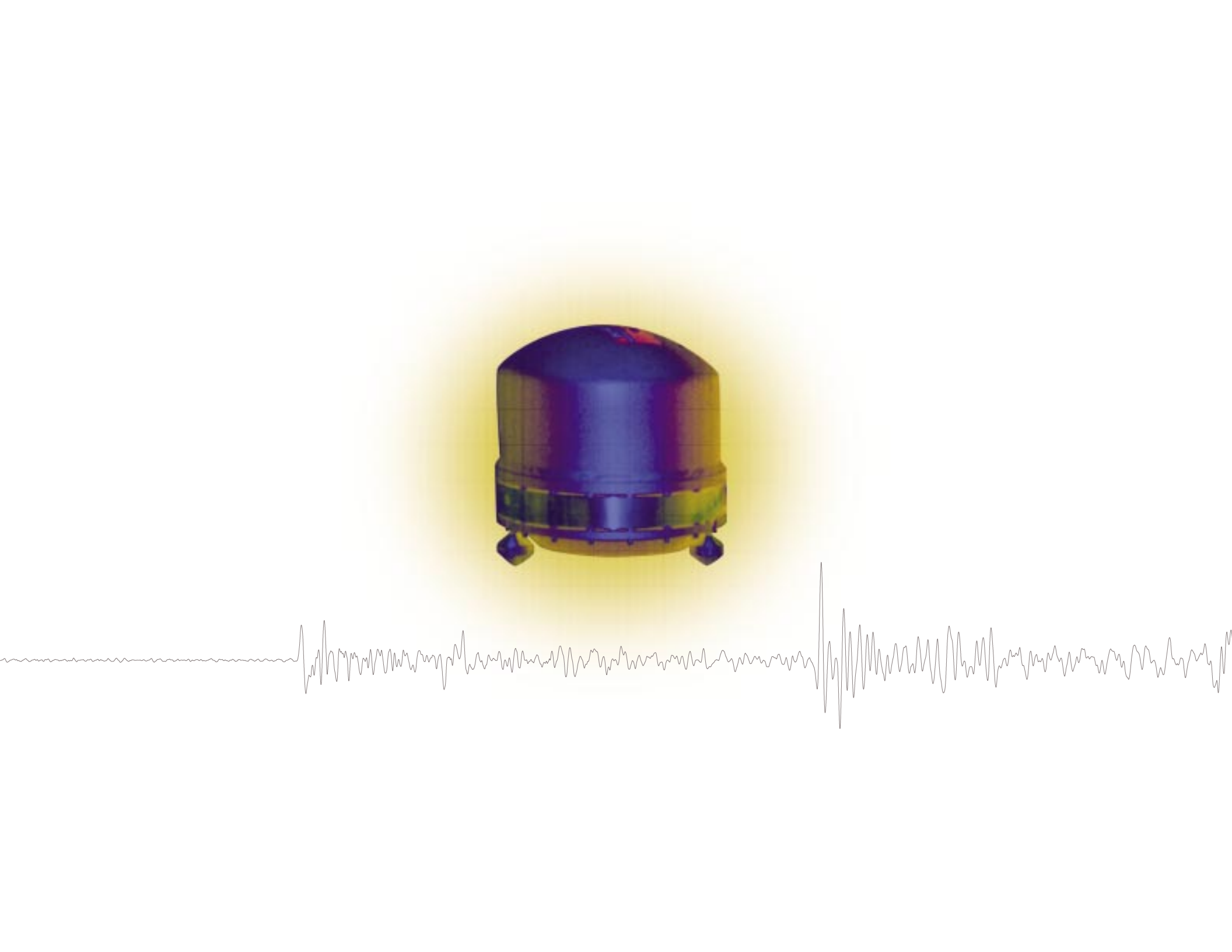

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