IRIS Newsletter

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KEV BHZ Δ=10° ML=3.8
Aug.16, 1997 near Novaya Zemlya

Volume XVI, Number 2

Sensing Tremors of Change in US Science and Education

Dr. Neal Lane, Director, National Science Foundation

An October workshop on future directions for seismology held at the new IRIS offices, brought together IRIS committee members, IRIS staff, past Chairmen, past Presidents, and representatives from the National Science Foundation and the US Geological Survey. After referencing his EOS article with Dr. Gordon Eaton (see box bottom of page 3), Dr. Lane discussed changes in federal support of science.

Excerpts from his speech are printed below.

I am not the only one to reminisce about the "golden age of science in America"-the period after World War II through the fifties and part of the sixties. It was a great run! Public funding for science was almost unquestioned and generous, while an agenda for science was rarely discussed. That was a unique period for America in geoeconomic terms. All science was good. More science was better. In the words of Vannevar Bush - key science advisor to President's Roosevelt and Truman, science was "an endless frontier"-and support for exploring that frontier seemed almost endless as well. The implicit consensus was that our national security required it.

It is hardly news that the earlier "golden era" is now behind us. We can no longer expect public support for science and engineering research in the form of a blank check and an undefined agenda. Today, an agency that receives even a modest increase is viewed as having great success.

You may recall that it was with great fanfare last spring that the leaders of Congress and the President announced the agreement to balance the budget by the year 2002. This was a major accomplishment. This agreement will help put the nation on solid fiscal footing as we head into the new century, but may cause disturbing tremors - if not downright quakes - throughout the research and education enterprise in future years.

This is because the focus, as most of you probably know, is on discretionary programs to achieve a big chunk of the savings necessary to balance the budget. To some extent, this further shrinks the pool of money available for federal R&D, and it certainly increases the competition for ever-scarcer resources, especially among nondefense programs.

This point is critical for a multiuse, multi-agency-funded facility like the Global Seismographic Network -a facility with many parents - since it is

Contents

Sensing Tremors of Change in US Science and Education 1

Special Section on IRIS Education and Outreach

IRIS Education and Outreach Committee 4

Seismologists Learning to Teach the Teachers 5

An Archive of Web Teaching Materials 6

Undergraduate Internship Opportunities 7

Earthquake Museum Display 8

Use of PASSCAL Instruments and Data Delivery Policy 10

Databases in the Field: Two Views 11

Further Comments on Databases 14

PASSCAL Data Access 15

1997 IRIS Workshop 16

Visiting Scientist Facility at the IRIS DMC Enhanced 19

Comments on "The Political Sensitivity of Earthquake Locations by van der Vink and Wallace" 20

Response from van der Vink and Wallace 21

New IRIS Education & Outreach Coordinator, Staff News 23

Calendar, New Members, 1998 IRIS Workshop 24

managed by the IRIS Consortium and USGS and also funded jointly by USGS and NSF. As I noted in an article which I was pleased to co-author with Gordon Eaton, Director of USGS, these facilities have had a tendency to suffer within the federal budgetary process. That is why both NSF and USGS have been working together through the leadership of the Administration to better coordinate and manage an asset like the GSN that contributes not only to fundamental earth science but to earthquake hazard assessment and to national security as well.

But no matter how creatively we manage our collective scientific assets to ensure their long-term viability, the budget deal means that resources available to the appropriations subcommittees in Congress are—and will remain—extremely tight. And this will only increase the pressure on federal programs and their constituencies to demonstrate how they contribute in meaningful ways to the health and well being of the Nation.

This last point brings me quite gracefully to my next. If there is one message that I have endeavored to relay throughout my time at NSF, it has been to emphasize how important it is for the research community, the universities, and the scientific and engineering societies to actively get the message out about science and technology and its critical connection to this country's social and economic welfare.

I know that I am preaching to the converted when I stress the significant role that science and engineering have played in building our great society and must play in shaping its bright future. But this vital contribution is not so easy to convey to an uninformed public. What

Adam Dziewonski, IRIS, Executive Committee Chair, David Simpson, IRIS President, and Neal Lane, Director, National Science Foundation, discuss the future of federally supported science at the IRIS opening.

scientists and engineers must do is convince those who support their work- the taxpayers, who are the ultimate stakeholders in this venture.

In our work to reach out to the public, we are fortunate to have a huge reservoir of public curiosity to tap that can help bridge this gap between scientists and the public. And, I think you know what it takes. There is no question that interest in the earth sciences can play an important role in bringing the excitement of science into the home and the K-12 schools. I caught the geology bug when I was a kid and it has never left me.

It is good to see that this natural connection between research and K-12 education is happening through projects like the Princeton Earth Physics Projects (PEPP), sponsored by IRIS and NSF. And there have been extraordinary new fundamental discoveries as well, such as the discovery that the inner core of the earth was spinning at a faster rate than the rest of the earth. This discovery spurred the interest of not only seismologists but sparked imagination of many in the mainstream media and the general public.

There have been numerous other recent breakthroughs, discoveries and innovations that have captured the interest of the public in science. Just this past year, we've seen one of the brightest comets of our lifetimes, Comet Hale-Bopp, featured prominently in the press and on our television screens.

The comet's appearance presented us a priceless opportunity to tap into public excitement and connect it to the research taking place. In a small but significant way, when a researcher, perhaps one we support, appears on CNN and makes that link, we've taken another step forward.

But we certainly don't have to wait for the comet of the century or - God forbid - "The Big One" - to come along - there are many other examples. A few months ago, one of my senior NSF colleagues Bob Corell, got the chance to discuss in the media some research

This issue's bannergram: The August 16, 1997 earthquake near the former Russian test site on Novaya Zemlya recorded by the IRIS GSN station Kevo (KEV). Data are bandpass-filtered at 5-10 Hz. The P/S spectral ratio for this event is relatively small (earthquake-like) compared with KEV recordings of previous nuclear explosions on Novaya Zemlya. The provisional International Data Center for the CTBT reports a magnitude of ML 3.8 and a location on the Kara Sea, about 100 km southeast of the test site. *(see article by P. Richards and W.Y. Kim, Nature, Vol. 389, 23 October 1997)* drilling off the coast of Florida and new evidence about the extinction 65 million years ago. The discovery of a "fingerprint" in the sedimentary record of a deep sea core obtained by the drill and ship Joides Resolution buttressed the theory that an asteroid impacted in the Yucatan 65 million years ago, perhaps driving the dinosaurs and many other life-forms to extinction. At least - it didn't do them any good. These examples demonstrate that much of what is done with NSF support can be made compelling and interesting to the public.

Indeed, while the "golden age" of generous funding for science is behind us - today we are experiencing a "golden age" of discovery - in essentially every field of science. And this new golden age has been enabled by the patient investments the nation has wisely made over the past several decades in science and engineering. The fact is: without the support, you don't get the discoveries. And while the American people may not fully appreciate the details of the cause and effect relationship I've just described, it is quite clear that they do believe that science is important.

Surveys funded by NSF continue to show that more than two-thirds of the public believes that science is a net good. And over 40% say they're strongly interested in science and technology. When we reach out with additional examples to convey the excitement and importance of research, we can be reassured by this reservoir of public good will. Nonetheless, only one in ten surveyed believes that he or she is well informed about science and technology, and only one in four claims some knowledge of science. And the vast majority of people have no understanding of the scientific process - 98% of them don't know what research means. To me this gap is very troubling: two-thirds laud the value of science, but 98% do not understand the enterprise.

I have said many times that these survey results may suggest more about us the research community than they do about the public. Traditional scientific training does not prepare its graduates very well to assume a role as an activist in society, to spread the word about science.

One of my favorite science communicators, whose passing we continue to mourn, was Carl Sagan, an astronomer renowned not just for ground-breaking work in planetary science, but for his one-man campaign to increase the public understanding of science. Scientists may have failed to credit him and others properly for breaking the mold of the traditional researcher and trying something new.

At NSF we are also realizing a new responsibility as an advocate for the cause of science and engineering to the public. NSF has certainly been a longtime, quiet catalyst for scientific and technical literacy - we make substantial investments in education at all levels - but we have traditionally kept a low public profile as an institution, perhaps believing that trumpeting our successes was somehow unseemly. I might suggest that this attitude may inadvertently have carried just a whiff of elitism-well, maybe more than a whiff. We are not doing a service to the research community or the public if we do not help make the case about why science and technology matter in people's lives. Given today's budgetary climate, neither the Federal R&D agencies nor the research community can afford to appear isolated from the taxpayer who pays the bills.

Probably the most important message I've tried to convey today is that we are feeling the tremors of change for science and outreach. While it is necessary to increase public understanding of science and technology, it is equally important for scientists to deepen their understanding of the public. This two-way communication has the promise to benefit us all. And, together, we can make it happen. •


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IN THIS ISSUE: RESEARCHERS EXPLORE POSSIBILITIES OF MICROGAL GRAVIMETRY, PAGE 383 ■ FALL MEETING HOUSING AND REGISTRATION, PAGE 384 ■ FORUM, PAGE 385

Seismographic Network Provides Blueprint for Scientific Cooperation

Neal Lane and Gordon Eaton

In the South Atlantic Ocean near Antarctica, ground motion created by a small, distant earthquake is recorded on South Georgia Island. Within hours of the earthquake, the data are automatically collected and made available to all government scientists and university researchers via the Internet. While near-real time access to seismic data from a remote oceanic island is a great technological accomplishment, the earthquake recorded on South Georgia Island signals a far greater achievement: operation of the 100th station of the Global Seismographic Network (Figure 1).

Neal Lane, National Science Foundation, 4201 Wilson Blvd., Arlington, VA 22230; and Gordon Eaton, U.S. Geological Survey, Mail Stop 100, National Center, 12201 Sunrise Valley Drive, Reston, VA 22092

The Global Seismographic Network is a blueprint for scientific programs that not only advance our understanding of the physical world, but also address the needs of society. Funded by both the National Science Foundation (NSF) and the U.S. Geological Survey (USGS), the Global Seismographic Network is now yielding a multi-use scientific tool that will make it possible for us to explore the Earth's interior, mitigate earthquake hazards, and monitor compliance with the recently signed Comprehensive Test Ban Treaty.

The Global Seismographic Network is managed jointly by the USGS and the Incorporated Research Institutions for Seismology (IRIS) Consortium. Under the auspices of the NSF, IRIS represents the collective scientific interests of over 90 universities. The USGS and the University of California at San Diego share responsibility for station operation and maintenance.

Each day, dozens of universities access global seismographic data for both research and to structure of the Earth's interior. Each day, the USGS uses the data for rapid earthquake reporting and for earthquake, tsunami, and volcano hazard research. And each day, the 51 Global Seismographic Network stations that are also part of the International Monitoring System confirm the end of nuclear weapons testing (Figure 2).

The multiple applications of the Global Seismographic Network help sustain the interest and support of the network's host countries, more than would be possible for any single-purpose network. In Kyrgyzstan, for example, the Ala-Archa station is supported by the host country because of concern over the earthquake threat to their nation's capitol, Bishkek. The Ala-Archa station, however, is also included in the international monitoring system, thus providing additional coverage for treaty verification that would not otherwise be possible. For the research community, the Ala-Archa station provides data for a broad area of central Asia that was previously inaccessible to western scientists.

Although multi-use scientific resources have both scientific and financial advan- within the federal budgetary process. Despite statements of strong support for science in the Congress and the White House, the requirements for a balanced budget by the year 2002 continue to exert financial strain on the federal agencies that support science. As these agencies adapt to the new financial climate by reaffirming the core activities that define their individual missions, it is all too tempting for both sides of the partnership to lessen their costs by shifting the financial burden to those outside the agency. Programs that cross budgetary boundaries are especially difficult to champion within the context of funding ceilings and Congressional budget authorities, much as interdisciplinary studies sometimes struggle when they fall across the narrow disciplinary boundaries defined by university departments.

To address multipurpose seismological networks, John H. Gibbons, Assistant to the President for Science and Technology, formed the Ad Hoc Working Group on Coordination of Federal Support for International Multipurpose Seismological Networks. The Working Group recognized that the NSF and USGS

Fig. 1. The 100th station of the Global Seismographic Network, South

★ Existing ☆ Installation in 97/98 ☆ Proposed

HOPE

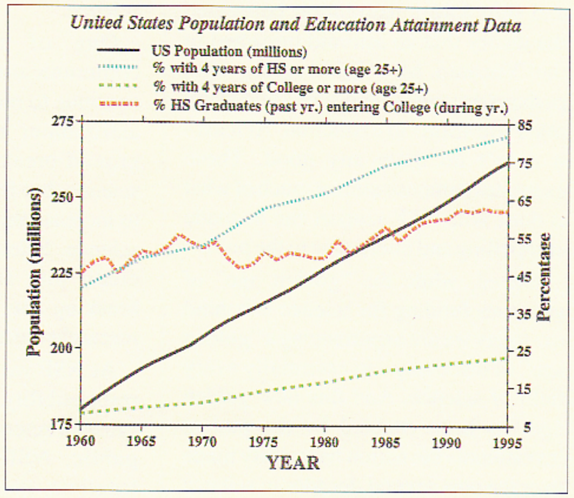
Fig. 2. Map of the Global Seismographic Network

IRIS Develops a New Program in Education and Outreach

Larry Braile, Purdue University
Chair, IRIS Education and Outreach Committee

One year ago, IRIS formally created the Education and Outreach program. In the past year, several new education and outreach activities have been initiated and some existing programs enhanced. The E&O program is aimed at improving seismology and related Earth science education in K-12 schools, colleges and universities and in adult education. IRIS and the E&O committee have obtained some NSF funding for initial program development and support for the Program Planning workshop to be held in April of 1998. Several of the E&O activities are described in the following articles.

Recently, there has been considerable discussion by educators, scientists, and government officials concerning the performance of the US educational system in science and mathematics teaching and of the apparently low level of science literacy within the public. (As I continue to investigate the subject of science education in America, I find that the issues are complicated, there is an extensive and sometimes conflicting literature, and there are plenty of opinions.) Recent studies and surveys have documented a low level of understanding by the general public of the nature of science. Furthermore, the benefits of scientific research and development are not sufficiently recognized or appreciated. However, as the accompanying figure shows, during the last few decades, as the US population has increased to nearly 270 million people, education in America has been increasingly valued and record percentages of Americans have attained basic and higher levels of education. Increasing technology and employment demands have encouraged these trends.



Below are some data that I compiled from various sources (NSF reports, US census data, the Educational Digest) that are related to science education in America.

UNITED STATES CURRENT TOTALS	
270,000,000	Americans
50,000,000	K-12 Students
14,000,000	College Students
3,000,000	K-12 Teachers
2,000,000	New K-12 Teachers needed in next decade
1,650,000	Physical and Mathematical Scientists
670,000	College Faculty (FTE)
120,000	Earth Scientists
4,000	Seismologists (estimate)

UNITED STATES CURRENT YEARLY TOTALS	
2,600,000	High School Graduates
1,200,000	Bachelor's Degrees awarded
370,000	Science and Engineering Bachelor's Degrees
58,000	Physical, Math., Earth, Ocean, and Atmos.Sci. Bachelor's Degrees
3,266	Geoscience Bachelor's Degrees
1,073	Geoscience Master's Degrees
509	Geoscience Doctoral Degrees

It is clear that if we wish to contribute to enhancing science education, our efforts need to be targeted toward all students, at all levels (science literacy goal), not just (the few) future scientists (or seismologists). It is also clear that making a significant impact will be a formidable task because of the large numbers of students and the relatively small numbers of scientists who are willing and able to participate in these efforts. I also infer from these numbers that science education programs with the potential for high impact will involve teachers and college faculty as part of the effort to reach students of all ages.

Improving science education in the US is a goal that is clearly worthy of our substantial efforts. These efforts can also be interesting and rewarding, and seismology is an excellent subject for engaging students in the the world around them and in the excitement of science! We invite your ideas, suggestions and involvement in the IRIS education and outreach program. The IRIS E&O Committee consists of Karen Fischer, Glenn Kroeger, Guust Nolet, Michelle Hall-Wallace, Jeff Barker, Bob Hutt, and Larry Braile, Chair. Greg van der Vink has been working with the committee to help develop the program. Catherine Johnson has recently been selected as the new IRIS Education and Outreach Program Manager. •

Seismologists Learning to Teach the Teachers

Michelle Hall-Wallace, University of Arizona, and
Larry Braile, Purdue University, Chair, IRIS Education and Outreach Committee

A one day workshop on teaching seismology at the K-12 grade level was held June 8, 1997 at the annual IRIS workshop in Breckenridge Colorado. The workshop, Seismologists Learning To Teach The Teachers, was hosted by the new Education and Outreach committee to encourage and assist IRIS members in developing outreach programs in their own community. The goals of the workshop were to introduce participants to current practices in K-12 science classrooms and to engage them in some new activities that allow students to learn science by doing science. The workshop was designed to provide ideas and materials so that the participants can conduct similar one day workshops in their own community.

We began the day with an ice breaker activity in which participants were given a list of questions about K-12 education and were asked to find the answers by asking others in the workshop. Leonard Johnson was the most successful at this activity and won a Nutrageous candy bar for his efforts. Larry Braile followed with an overview of the new National Science Standards which provide a framework for developing effective programs for outreach and teacher education in the sciences. Two K-12 teachers, Sheryl Braile, from Burtsfield Elementary School, West Layfayette, Indiana and Graciela Rendon-Coke, from Cibola High School, Yuma, Arizona shared vignettes of their experiences in the classroom that helped elucidate the new directions in science education and the role scientists can fill in making science a success in K-12.

Learning science is best done by doing science, thus most of the day was spent doing everything from developing models of the interior of the earth to designing buildings for earthquake safety. Larry and Sheryl Braile introduced an activity in which students created clay models of the earth. The challenge was to divide the clay into three balls that represented the volume of the crust, mantle outer core and inner core. Although all the participants could probably easily rattle off the depth to the important boundaries in the earth, dividing the layers by volume provided many an new view of the Earth and insight into struggles a student might have in visualizing the Earth. IRIS Chairman, Adam Dziewonski confided that his clay model gave him new insight into Earth structure and provided ideas for a new NSF proposal.

Michelle Hall-Wallace and Graciela Rendon-Coke introduced an activity from Seismic Sleuths (AGU and FEMA, 1996) in which participants investigated the natural frequency of buildings to determine the relationship between frequency of shaking and height of a building. Participants also learned how the horizontal forces associated with earthquakes pass through a building and how to reinforce a structure to withstand the forces. Participants knowledge was put to the test with a challenge to build a structure of Styrofoam and tooth picks that would withstand the greatest horizontal force. John Tabor and Jeff Barker were the clear winners and took home the prize of a National Enquirer report on earthquakes and two Nutrageous candy bars.

Technology is an essential tool of a seismologist young or old, and several pieces of software suitable for the young were demonstrated. Seismic and Seismic Waves, written by Alan Jones, were introduced as well as software from the Princeton Earth Physics Project, TASAs Plate Tectonics and others. Unfortunately, our plans for locating earthquakes with a human model of ray paths and travel time calculations were canceled due to rain and the possibility that dispersion would adversely affect our results.

IRIS will provide each participant with the materials needed to offer a similar workshop for 20 teachers in their community this coming year. The outcome of the workshop is that more than 400 teachers nationwide will be introduced to new methods and materials for teaching earthquakes in the K-12 classroom. Due to the popularity of the workshop, co-convenors, Larry Braile and Michelle Hall-Wallace are planning to offer a similar workshop again next year. •

An Archive of Web Teaching Materials

Jeff Barker, SUNY, Binghamton

More and more IRIS members are using the web to distribute materials for courses they teach. In addition to course syllabi, many provide reviews, supplementary readings, or copies of slides used in lectures; some even lecture from the web. This enables them to use color figures, sound, animations, interactive Java applets, etc. to enhance the communication of concepts (i.e. teaching). However, all face the problem that putting materials on the web is a form of publishing and is restricted by copyright. This is not a problem if only original figures and diagrams are used, but generating these entails a lot of work (and some artistic talent as well). The IRIS Education and Outreach Committee would like to provide a service to IRIS members by maintaining an archive of contributed, copyright-free teaching materials. These would be served from a webpage with thumbnails for browsing and with a keyword search capability.

Several universities and agencies currently provide similar archives, particularly of geologic photos. We do not wish to duplicate these efforts. On the other hand, we would like to provide a central, stable location where professors can be assured of finding web materials at the same address, without having to search every time a course is taught. Cooperative arrangements are being worked out. Perhaps we can mirror other valuable sites; at least we can provide links to them.

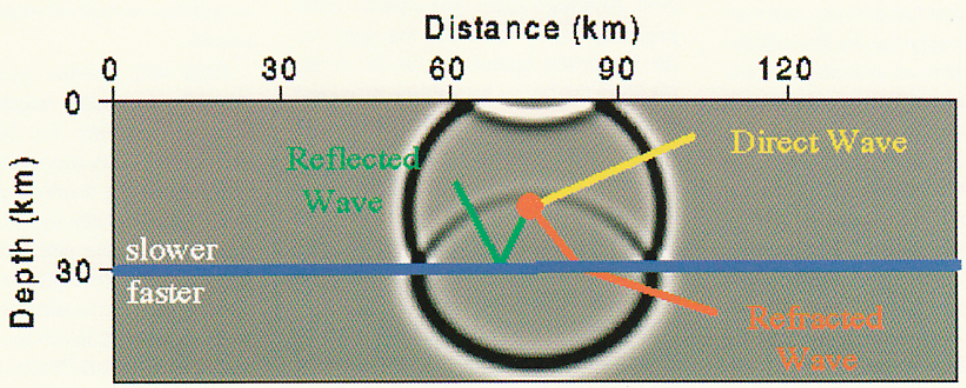
In the meantime, we would like to build up our own archive of materials by soliciting contributions. If you have materials such as images (GIF, JPEG, PICT, Postscript), sound files, animations, text descriptions of demonstrations or lab exercises, etc., which you know are free of copyright restrictions (either your own original creations or substantially modified with acknowledgment of the original source), please contribute these to the archive. Although we are seismologists, we also teach courses covering a broader range of topics (physical geology, oceanography, environmental science, general geophysics, etc.), so contributions from a range of sub-disciplines are welcome.

A web submission form may be found at http://www.iris.washington.edu/EandO/resource.form.html.

You will be prompted for your name, address and email address, a brief description of the figure or material, a caption, and a set of keywords. If the material is already on the web, simply enter the URL where it can be found. If not, you can ftp it to the IRIS anonymous ftp directory. Upon clicking the "submit" button, you are agreeing to a statement which attests that the material is free of copyright restriction, allows IRIS to disseminate the material, and allows it to be used for any legitimate purpose.

Some image archives are accessible only to those who have contributed, but since our purpose is to facilitate improved teaching through the use of web materials, we wish to maintain open access. Therefore we are relying on the generosity of IRIS members to contribute. The scope and usefulness of the archive will evolve as more contributions are received. You can access the archive from the IRIS homepage or the Education and Outreach page:
(http://www.iris.washington.edu/EandO/).

If you have questions or suggestions, please contact Jeff Barker (barker@sunquakes.geol.binghamton.edu) or Debbie Barnes (debbie@iris.washington.edu). •



P-wave Propagation

Undergraduate Internship Opportunities

Karen Fischer, Brown University

One facet of the IRIS Education and Outreach Program is the development and coordination of Summer research internships for undergraduate students. The goal of these internships is to provide students with hands-on work experience in seismological research and to build students' interest in seismology, whether they choose graduate school and research or move into another career path. Benefits to IRIS members who sponsor interns include access to talented undergraduates from other institutions not only for Summer research, but also as potential graduate students.

The Education and Outreach Committee is developing two modes of linking up undergraduates to research opportunities at IRIS member institutions: a web-based research job bank, and an internship program that will place undergraduates with PASSCAL experiments or other seismological research projects in the Summer of 1998.

Undergraduate Job Bank. Are you looking for undergraduates to participate in your research? Consider listing your project in the Undergraduate Job Bank on the Education and Outreach Program webpage. Researchers interested in posting research opportunities (either paid or volunteer positions) will soon be able to submit project descriptions online. Students will be able to browse Job Bank listings and submit inquiries directly to the project contact person. The Education and Outreach Program webpage is now under development, but soon will be accessible through the IRIS webpage (www.iris.edu).

Education and Outreach / PASSCAL Undergraduate Summer Internship Program. Are you interested in having an undergraduate work with you on research for 5 - 8 weeks this Summer? If so, consider sponsoring an undergraduate through the Summer Internship Program. The goal of this program is to help principal investigators at IRIS member institutions involve undergraduate students in their research. Research projects may involve any aspect of seismology and may be based in the field or at the PI's home institution, although preference will be given to projects that involve students in PASSCAL experiments. Undergraduate interns will be employed by the PI's home institution, and the PI will be responsible for their activities. However, the Education and Outreach Program will provide the PI's institution with funds for student stipend ($280/week for 5 - 8 weeks) and for travel expenses while in the field (up to $600). The Education and Outreach Program will solicit and screen applications from interested undergraduates, but participating PI's will make the final selection among applicants. Three undergraduates will be funded in the Summer of 1998. If more than three PI's are interested in sponsoring undergraduate interns, three projects will be chosen based on their educational merit. Student applications and letters of interest from PASSCAL PI's should be submitted to IRIS Headquarters by March 1. Please see the Education and Outreach webpage for a more detailed description of the program and application procedures. •

National Science Foundation
Funding for Geoscience Education

"The National Science Foundation's (NSF) Directorate for Geosciences (GEO) and its Advisory Committee for Geosciences (AC/GEO) have identified geoscience education as a high priority. Geoscience education contributes to a higher degree of scientific understanding among the general population, and it helps knowledgeable and skilled individuals assume positions as productive geoscientists in the future. Geoscience education therefore is an investment in the future of the Nation as well as in the future of the geosciences themselves. GEO supports the work of outstanding geoscience researchers, who push the frontiers of knowledge of how the Earth works. GEO seeks to further facilitate the involvement of leading researchers in efforts to improve the quality of geoscience education at all levels, thereby facilitating the effective integration of research and education."

Information on several programs are available from the following NSF sites:

Awards to Facilitate Geoscience Education	www.geo.nsf.gov/adgeo/eduprog/97_174.htm
Geoscience Education: A Recommended Strategy	www.geo.nsf.gov/adgeo/euprog/97_171.htm
Directorate for Geosciences Long Range Plan	www.geo.nsf.gov/lrplan/execsum.htm

Earthquake Museum Display to be Seen by 5 Million People

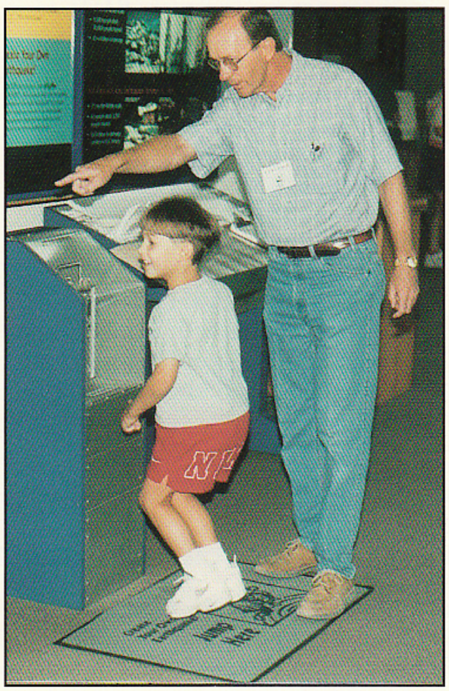
Bob Hutt, Albuquerque Seismological Laboratory
David Baccadutre, New Mexico Museum of Natural History & Science
Gregory van der Vink, IRIS, Director of Planning

Over the next four years, the museum exhibit "Earth in Motion" will travel to six of the largest science museums across the country and be viewed by more than 5 million people. The display, featured at the IRIS workshop in Breckenridge, was developed cooperatively by the USGS Albuquerque Seismological Laboratory (USGS/ASL), the New Mexico Museum of Natural History and Science, and IRIS. The display has been requested by the Franklin Institute Science Museum in Philadelphia for inclusion in their touring exhibit known as "Powers of Nature". Special funding has been provided by the National Science Foundation to support the display.

The display got its start in 1990 when Bob Hutt of ASL approached the NM Museum about the possibility of loaning them some used seismic equipment in order to help create a museum display that would inform the public about seismology and current earthquakes. The display would complement an existing "Pulsing Earth" exhibit, a 20'x 30' fiber optic relief map of the earth which displays ocean plates, continents, continental shelves, and illuminates an 8-day historical record of seismic activity around the world.

The first step in setting up the equipment was the installation of an antenna at the Museum to provide a radio link from a seismometer located deep down a quiet borehole at the Albuquerque Seismic Lab. This would allow recording of seismic activity of magnitude 4.5 or greater nearly anywhere in the world. Shortly thereafter the Museum put together a planning team of staff and volunteers to develop the content of the exhibit, write text and determine graphic needs. Next, the drum recorders and seismometer were installed, text panel mock-ups produced, and a lengthy evaluation period began which relied heavily on visitor input. In 1992 the exhibit was produced, opened to rave reviews, and continues to be one of the Museum's most popular exhibits.

The exhibit attempts to teach visitors about why earthquakes happen, where they're most likely to occur, how earthquakes are measured, what kind of damage they can do, and that New Mexico does indeed experience earthquakes. The inclusion of a working seismograph in the display gives visitors a hands-on approach to seismology: Visitors walking into the atrium of the Museum are frequently greeted by dozens of kids excitedly jumping up and down on the floor. First impression suggests a school field trip gone awry, but closer examination reveals that these enthusiastic youngsters are actually creating their own earthquake on the small seismograph installed directly on the Museum floor.



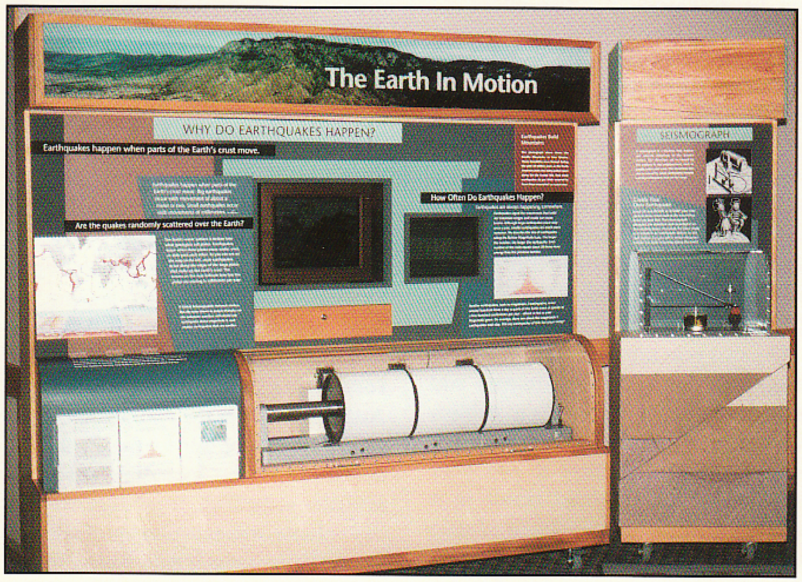
Over the past year, IRIS has joined the New Mexico Museum of Natural History & Science and the USGS Albuquerque Seismological Lab in developing a prototype travelling museum display, based on the one still operating at the NM Museum. The exhibit's objective is to present earthquakes not as destructive events, but rather as signals of the geological forces that build our mountains and create our ocean basins. In other words, the exhibit seeks to develop an appreciation for earthquakes as a reminder that we are living on the thin, outer crust of a planet whose interior is still cooling.

The display begins with a working mass-and-spring seismometer. By jumping on the ground in front of the display, a visitor sees ground motion recorded as the velocity between the moving frame of the seismometer and a suspended mass that remains stationary through inertia. The earthquake produced by each visitor is recorded on a rotating drum recorder.

After creating their own earthquake, the visitor sees on two other two drum recorders similar signals from actual earthquakes being recorded in real time from two Global Seismograph Network (GSN) stations in other parts of the world (China and South America, for example). Realizing that the seismic signals have been recorded at these stations, the visitor can look up at a large video monitor that shows the location of the earthquake plotted on a world map. A second video display lists the time, magnitude, and geographic location of earthquakes that have occurred within the last few days, all of which are also displayed on the global map. In many cases, the viewer will be able to see on the rotating drum recorded signals from distant seismic stations, and realize that those ground motions were produced by a magnitude 6 earthquake that occurred, say, on the mid-Atlantic ridge earlier that day.

Along with the recent earthquakes, the world map also includes historical seismicity for the previous five-years. Text explains where earthquakes occur and the relationship between global seismicity patterns and plate tectonics. Additional text explains why earthquakes occur, the frequency of earthquakes, and the Richter magnitude scale along with familiar events of equivalent energy (tornadoes and explosions, for example). The visitor learns that earthquakes are always happening somewhere, and learns of the relationship between seismicity and plate tectonics.

This prototype museum display was developed as a launching point for further interest in seismology. Two handouts "How often do Earthquakes Occur?" and "Why do Earthquakes Occur?" allow the viewer to take home the main points of the exhibit for further reference and distribution. An additional handout "Watch Earthquakes as they Occur" allows viewers to continue monitoring seismicity and learning more about earthquakes through sites on the world-wide web. •



Powers of Nature Exhibit Schedule and Anticipated Attendance (April 1998 - October 2001)

Date	Museum	Attendance
April 1998	Franklin Institute Science Museum Philadelphia, PA.	450,000
October 1998	California Museum of Science and Industry Los Angeles, CA.	1,000,000
April 1999	Center of Science and Industry Columbus, OH	350,000
October 1999	Boston Museum of Science Boston, MA	550,000
April 2000	St. Paul Science Museum of Minn St. Paul, MN.	375,000
October 2000	Ft. Worth Museum of Science and History Ft. Worth, TX.	600,000
April 2001	Museum of Science and Industry Chicago, IL.	1,250,000
October 2001	Franklin Institute Science Museum Philadelphia, PA.	450,000
	Total Audience	**5,025,000**

Have your museum display idea built and seen by millions

We plan to expand the display for the tour with additional interactive kiosks that will illustrate related concepts such as:

1) continuous plate tectonic motion creates strain that is released catastrophically by earthquakes.
2) earthquakes produce compressional, extensional, and shear forces that are translated into different types of seismic waves.
3) the radioactive decay of the Earth's interior powers plate motions which manifest themselves through earthquakes.

Send IRIS your proposal for a display to illustrate any of the above concepts (or any other concepts you think should be included). Include a sketch and text. The designs will be judged by the museum development experts at the Franklin Institute. The winning designs will be constructed by staff from the New Mexico Museum of Natural History & Science and included in the "Powers of Nature" exhibit with your name and institution.

Deadline for submission March 2, 1998

Use of PASSCAL Instruments and Data Delivery Policy

Anne Meltzer, Lehigh University, Chair, PASSCAL Standing Committee, and Jim Fowler, PASSCAL Program Manager

The IRIS/PASSCAL facility provides equipment (sensors, portable field recording equipment, and field computers) to any research or educational institution to use for research or educational purposes. PASSCAL publishes an inventory of all of its equipment through the IRIS World Wide Web site (http://www.iris.edu). A description of the capabilities of the various pieces of equipment and a copy of the current instrument schedule are available with the inventory. The PASSCAL instrumentation and technical support to maximize the success of each field deployment are provided, without charge, as part of the facility support developed by IRIS through funding from the Instrumentation and Facilities Program, Earth Sciences Division, National Science Foundation. The efficient use of these instruments requires cooperation and communication between PASSCAL and the experiment PI. The Principal Investigator is encouraged to contact the PASSCAL Program Manager about any planned experiment during the proposal development stage to address any questions about instrument capabilities. Initial instrument requests can be submitted via the Worldwide Web at http://www.iris.edu and should be sent to IRIS at the time the proposal is sent to the funding agency.

As a community resource, IRIS and NSF rely on the individual PIs to conform to a limited number of rules and conditions related to the use of PASSCAL instruments, to treat the instruments with care, and to acknowledge the support which is provided. The equipment in the PASSCAL facility represents a significant community resource. In order to encourage the use of the data by others making the facility more valuable to the community, IRIS policy states that all data collected by instruments from the PASSCAL facility should be submitted to the Data Management Center so that it can be accessed by other interested investigators after a two year proprietary period. IRIS's policy is that delivery of data to the DMC is an obligation of the PI. The official data delivery policy is that IRIS expects data delivery while the experiment is in the field (for long term deployments), or immediately at the conclusion of the experiment. The data and Data Report will remain confidential for a period of two years after the end of the field work.

The two year time period is generally reasonable for most experiments and provides enough time for PIs to publish significant results. Some concerns have been expressed because a two year proprietary period could result in a significant delay in the release of data from a long term broadband deployment. The concern is greatest when data are recorded from a significant global event (eg. large magnitude or deep focus). We encourage PIs who might fortuitously record such an event during a PASSCAL deployment to consider releasing waveforms from at least one station before the two year restricted period ends, so that these events can be studied by the broader IRIS community.

The ultimate responsibility for delivery of the data rests with the Principal Investigator. Every field computer has the software necessary to accomplish the data delivery task and each of the PASSCAL Instrument Centers has personnel who can provide assistance to the PI during and after the experiment. Each of the Instrument Centers also has software, computers, and large disk systems available for use by the PI. The Data Management System has additional facilities and support available to the PI. The PI is encouraged to utilize these resources at all stages of the work.

PIs conducting a passive source experiment can use the PASSCAL database or equivalent software to provide all of the data collected to the DMC for archive in SEED format. It is expected that the PI will ship the data to the DMC on a continuing basis during the experiment, as soon as timing and other corrections are made and that the final data will arrive shortly after the experiment is over. The advantage of completing these tasks in the field is that the analysis phase of the project begins almost immediately after leaving the field, rather than having to deal with merging field notes, correcting, and formatting data post-experiment. Archiving data at the completion of the field experiment allows the PI to take advantage of the incredible resources available at the DMC to produce network day volume or event volumes of selected events for continuous data. Active source experiments can submit data in SEGY format. The DMC will make the data available only to the PI or designated representative for a period of two years after the completion of the experiment. After that, the data will be made available to the public.

The Data Report is not intended as a formal technical paper but at a minimum should contain:

- A short description of the experiment;
- A list of stations occupied along with coordinates and a short description of the sites;
- A description of the type of calibration information acquired; and
- For non-SEED data, a description of the data archive volume.

The full text of the PASSCAL policy for instrument use and data delivery is available at www.iris.edu. The PASSCAL Standing Committee will continue to review the data delivery policy on an as needed basis and we welcome input from the IRIS community. •

Databases in the Field: Two Views

A Dissenting View

B. R. Julian, U. S. Geological Survey, Menlo Park
G. R. Foulger, University of Durham, UK

Introduction

PASSCAL is currently devoting a major effort to developing PDB (PASSCAL Data Base), a collection of software to manage data from seismic field projects and to convert them to SEED format for archiving at the IRIS DMC. Given the requirement to supply data to the DMC in this format, it seems that it will become effectively mandatory to use PDB in all PASSCAL- supported experiments in future.

On the basis of extensive field experience, we think this effort is misguided. PDB is far too complicated for use under field conditions, a situation that will persist even if, at some future date, it is free of bugs and fully documented. The complex organization of the DMC is best suited for data from permanent and stable seismograph networks, and not for a forever-changing rag-bag of short-term field experiments conducted for different purposes by different people with different levels of expertise. Imposing the use of such a complicated system upon field projects jeopardizes their primary goal, which is collecting scientifically useful data. Archiving data for possible future use is important, but it can and should be done without threatening the primary objectives of field experiments in the name of facilitating later access to data by armchair seismologists unconnected with the original experiments.

The Iceland Hotspot Experiment

Our opinions are based on personal exposure to PDB. We are currently operating a 35-station network of PASSCAL broadband instruments in Iceland for a period of about two years. The network was installed in the summer of 1996 by a group that included three PIs, a post-doctoral research assistant, two postgraduate research assistants and two Ph.D. students. The instruments record three channels continuously at 20 sps and require disk changes about every two months.

Data dumping and archiving are done at the Geophysics Division of the Meteorological Office of Iceland, in Reykjavik. The Geophysics Division is excellently equipped with a network of Sun workstations and Internet facilities and staffed with a large group of experts in both seismology and computing. The computer support is better than at most American university departments. The network and data dumping/archiving work is conducted year-round by the two postgraduate research assistants.

continued on page 12

A Broader Perspective

Anne Meltzer, Lehigh University,
Chair, Passcal Standing Committee

IRIS/PASSCAL has been very successful in developing a facility to promote portable array seismology. Its success is measured by the continued demand on the instrument pool, the quality and quantity of data archived, and the advance of our science through publication of experiment results in scientific journals. The equipment in the PASSCAL facility represents a significant community resource. The quality of the data collected by PASSCAL experiments using this resource is such that it is and will continue to be of interest to investigators for many years, reaching far beyond the intent of the original PIs. PASSCAL has two priorities, the support of experiments and PIs in the field and the timely delivery of PASSCAL data to the DMC for archiving and use by the broader IRIS community. The archiving of data, whether from the GSN or PASSCAL is a primary commitment of IRIS and is an integral component of our Cooperative Agreement with the National Science Foundation. No one experiment justifies the tremendous resources NSF has invested in our community. Collectively we strive to justify this investment. Equipment in the PASSCAL facility is available to any research or educational institution, free of charge. Use of the equipment includes the technical support required to maximize the success of each experiment in the field. The only stipulation placed on those borrowing instruments from the PASSCAL facility is that they agree to submit their data to the DMC for use by the community at large after a two year proprietary period.

One reason PASSCAL has been so successful is that it has enfranchised a large number of seismologists at a wide range of institutions to conduct field experiments. No longer are field programs restricted to seismologists at only the largest research institutions. Part of PASSCAL's mission is to continue to develop and provide hardware solutions and software tools that make the job of collecting data in the field easier and more fool proof. A recent development in the software domain is a suite of tools encompassed by the PASSCAL database (PDB) software. These tools provide a uniform integrated interface to help QC experiments in the field: view log files and waveforms, monitor network uptime, track instruments, make timing corrections, associate events, produce event gathers and produce archive volumes for submission to the DMS.

During PDB development, PASSCAL requested that three different 1996 experiments (Abitibi, Iceland, and Nanga Parbat) beta test the system. The Abitibi experiment consisted of 30

continued on page 13

continued from page 11: A Dissenting View

PDB was installed in two Sun workstations supplied by PASSCAL, prior to their shipment to Iceland, and during the network installation the PASSCAL staff logged on to them frequently via the Internet to debug and maintain the software. Despite these favorable circumstances, we were unable to implement PDB in the sense that SEED volumes could be routinely generated during the three-month network installation period. Part of the reason was the immature state of the system and documentation, but the main reasons were simply the complexity of the task. As is usual in field projects, we were swamped by the overwhelming amount of work involved in installing stations, checking and servicing them, getting the 20-Gigabyte/two-workstation computer system running in Reykjavik, training the research assistants in UNIX and simple data-dumping/archiving work, dealing with customs, project administration, accounting, liaising with colleagues, etc. We had only three months in which to set up this $1 million experiment, and to have spent more time on PDB would have jeopardized the data collection. In order to satisfy the requirements of PASSCAL for SEED archives, we arranged a second trip to Reykjavik for a week in January 1997, along with a PASSCAL software engineer familiar with PDB. However, despite the even-better conditions it took a whole week to get PDB working. Our research assistant was trained to operate PDB during the second week and has since then been able to archive data successfully if consultations and Internet contact with PASSCAL staff are available on a daily basis. Some of the PDB programs are, however, very time-consuming to run. For example, it takes 11 hours to archive to tape four field-days of data. Backlogs of archiving thus build up when the research assistants go to the field to swap disks and when key PASSCAL personnel (whose efforts and dedication to duty we cannot praise too highly) are unavailable for a few days.

Scientific field experiments seldom enjoy the logistical and infrastructure advantages that the Iceland HOTSPOT project does and are usually much shorter-term. Often they must operate in remote areas without adequate transportation and telephone (to say nothing of Internet) services. Personnel often rotate during field experiments, and vary greatly in their geophysical and computer expertise. Simply getting to stations for periodic servicing nearly always is a taxing undertaking. Networks must be kept operating in the face of hardware failures, software failures, bad weather, political and personnel problems, shortages of money, vandalism and safety problems.

Field hardware and software need to be as simple and trouble-free as possible.

A single failure (for example of a field computer) may cause the entire experiment to grind to a halt.

Field hardware and software need to be as simple and trouble-free as possible. Any unnecessary burden placed on field workers will inevitably reduce the amount and quality of data that can be collected.

Computer database management systems are enormously complicated collections of software. Keeping a database operating normally requires a highly trained, full-time "Database Administrator". A DBMS can provide useful services such as simultaneous multi-user data entry and access, guaranteed data consistency, audit trails, and user-specified variations in the data organization. Most of these services are irrelevant to field seismic experiments.

The data-management requirements of a field seismic experiment are:

- To keep track of hardware;
- To transfer digital seismograms to tape;
- To scan representative seismograms.

PDB addresses the first requirement only, and in a way not optimized for field experiments. In addition to keeping track of useful data, PDB also includes a huge body of superfluous information such as the start and end times of every data block, information already stored on the data tapes and in the log files. Well-designed field service sheets and data scanning charts are more suited to keeping track of hardware and data. Careful use of such charts is much more likely to lead to benefits such as recognition of faulty units than is burying the information in a computerized database. Transferring data to tape takes vastly more computer and tape drive time under PDB than do simpler approaches.

The main justification for PDB apparently is to facilitate conversion of seismograms to SEED format for storage at the IRIS DMC, and the complexity of SEED is the main reason for the cost and complexity of PDB. The tail is wagging the dog. The success of PASSCAL-supported experiments is being jeopardized for the sake of storing the data in the particular form desired by some researchers.

Suggestions

1. Less complexity. The initial versions of PASSCAL field software (circa 1991) consisted of a small number of relatively simple programs to transfer data from field disks to tapes and to scan data for quality control. The current software release (1.9), on the other hand, contains 108 listings, of which 30 relate primarily to PDB. Many programs have graphical user interfaces, which make it easy to do things the programmer envisaged and impossible to do anything else. Field projects are better served by simple, flexible tools, produced by

continued on page 14

continued from page 11: A Broader Perpective

broadband stations for a six month period. One person did most of the work to service stations, quality control data, and produce archive tapes. I was the PI on the Nanga Parbat experiment and we also successfully used the PDB in the field. We operated a 60 station array for four months in the Himalayas of NE Pakistan. We certainly had no access to Internet or reliable phones. We serviced our stations on a three week interval and over half our stations could only be accessed by a 3-5 day trek. We had a PASSCAL field computer system installed in a rented house in Gilgit. It was clear, even from these first beta tests, that the PDB can be used effectively in the field to help with experiments. In my experience, not only did the PDB software not jeopardize the field component of the experiment, it was an asset. We found the PDB helpful for monitoring the uptime of our array, viewing log files, and identifying problems with instruments and timing. By continuing to update our network configuration, inconsistencies in field notes were identified and resolved immediately rather than at some later date when memory begins to fade. Perhaps most importantly, we were able to generate archive volumes for the DMC and time corrected associated events tapes for our own analysis in a timely fashion. We were able to begin the analysis phase of our project almost immediately after leaving the field rather than having to deal with merging field notes, correcting, and formatting data post-experiment.

To use the database software successfully, it is important for PIs to coordinate with the PIC during the planning stage. A database specific to each experiment can be built and installed on the field computer before the experiment begins. The database software is a sophisticated software package, but a day of pre-experiment training goes a long way toward understanding how to use it. It has a GUI interface and feedback from PIs continues to improve the ease of use of the software. Actually running the database software and updating network configuration files as necessary does not add significant time to data download procedures if it is integrated into the data processing flow in the field lab. If PIs let a significant amount of data build up, it is easy to fall behind. Generating SEED volumes does take time, but it takes time whether you do it after the experiment is completed or during the experiment. In addition to helping QC the experiment, one of the biggest benefits is in the amount of time saved post-experiment. If run correctly, PIs leave the field with a set of tapes ready for archiving at the DMC and a second set of tapes ready for data analysis. Archiving data at the completion of the field experiment allows the PI to take advantage of the incredible resources available at the DMC to produce network day volume or event volumes. This is a significant improvement over past operations where PASSCAL PIs spent months or sometimes years reducing and formatting their data for analysis. A quick scan of PASSCAL data sets recently contributed to the DMC shows experiments post-PDB have been submitted within a few months of when the experiment left the field compared to PASSCAL data acquired pre-PDB, which often took up to 6 years to be submitted.

tools like the PDB software go a long way toward increasing the success ratio of each experiment

It is not mandatory to use the PDB. It is mandatory for all passive source PASSCAL experiments to submit data to the DMS in SEED format. PIs are free to use any software they choose to produce SEED volumes. The PDB software does provide an effective means for producing archive volumes for PIs who might not otherwise have this capability. Since the three beta test experiments, nine experiments have successfully used the PDB in support of field experiments.

IRIS PASSCAL is a university consortium, not a commercial operation. We try to run the PASSCAL Instrument Centers in an efficient manner while still servicing the community needs. We tend to keep personnel costs to a minimum, maximizing our ability to continue to purchase additional instruments. This can lead to a certain amount of frustration for both instrument center personnel and PIs. However, it is quite clear that much of PASSCAL's success is due to a working partnership between a talented and dedicated technical support staff and creative PIs. As we progress, experiments become more ambitious and complex. We stretch the envelope with each new experiment to maximize the amount of data recorded. We feel that tools like PDB go a long way toward increasing the success ratio of each experiment. The need for fairly sophisticated software in support of field experiments is a reality and will become increasingly important as we move toward the next generation instrument and real time systems. The notion that we will continue to track our experiments by hand is unrealistic. The experiments that are successful today benefit from the accumulated experience of previous experiments, just as the experiments that will run next year benefit from the advances provided by today's experiments.

PASSCAL is a community run facility. Our ability to advance and improve is dependent on input from the community. We appreciate the opportunity to engage in open debate and look forward to feedback from the community. •

continued from page 12: A Dissenting View

packaging a few basic programs into executable command files, customized for particular experiments.

2. More reliability. Despite the huge programming effort undertaken by PASSCAL, reliability has not kept up with volume output. PASSCAL's efforts should be concentrated on maintaining, debugging, and documenting a small number of simple programs for saving data to tape and verifying data quality in the field.

It is clear from our Iceland experiment that, operating PDB is a major undertaking. Setting PDB up is a time-consuming task best done by an expert, learning how to use it requires a substantial training course, entering the data requires a great deal of extra work, and all these tasks require close liaison with PASSCAL staff via a reliable Internet connection. Archiving data for future scientific re-scrutiny is important, but it must be done in a way that does not jeopardize the acquisition of the data in the first place. •

These comments reflect the views of the authors, and not necessarily those of other members of the Iceland HotSpot consortium.

Further Comments on Databases

Susan Y. Schwartz, University of California, Santa Cruz, Chair, IRIS Data Management System

Julian and Foulger's article "Databases in the Field: A Dissenting View" is more than a criticism of a software package designed to assist PASSCAL investigators with data management in the field; it is also a condemnation of IRIS's policy of open access to seismological data. IRIS's enlightened attitude concerning the importance of open data exchange is responsible for its success in acquiring the impressive resources used to collect seismological data on both a global (GSN) and regional (PASSCAL) scale. Several other, less-generous, scientific communities still struggle with the concept of open data exchange and their attitudes have negatively impacted their ability to garner the support and funding required for significant advances in their science. Vigilance in maintaining open access to seismological data has resulted in the PASSCAL program's priority of ensuring timely delivery of data to the Data Management Center (DMC) for incorporation into the data archive as well as supporting experiments and investigators in the field. Data as a community resource was a design criteria of the PASSCAL program, is the hallmark of IRIS, and is non-negotiable.

Although PASSCAL data are in general of more variable quality than GSN data, it is not uncommon for PASSCAL broadband stations to have uptimes and noise levels that equal or exceed the GSN standards. Thus the importance of archiving PASSCAL broadband data should not be underestimated. Contrary to Julian and Foulger's characterization of PASSCAL temporary stations as "a rag-bag of short term field experiments", data from PASSCAL broadband stations archived in SEED format are a rich resource that over the last year has accounted for 10% of all SEED formatted data requests to the IRIS DMC. These approximate 1000 requests for SEED formatted PASSCAL data contrast with 43 requests for variably formatted assembled PASSCAL data sets in the same year. In addition, PASSCAL data have and will continue to provide unique, spectacular recordings of important earthquakes (1994 Fiji and Bolivian events) that would not exist if not for a fortuitously located PASSCAL experiment. PASSCAL experiments are funded based on the importance of the seismological data they are designed to collect. This importance, initially recognized by an individual PI is validated by the larger community in the proposal review process. Thus there should be little mystery about the significance of PASSCAL data to the seismological community and the increasing proportion of PASSCAL data requested from the DMC attests to its utility.

There is little question that PASSCAL data are important and of use to the seismological community. There is also little question that the DMC has a mandate and is well-suited to archive this important data. PASSCAL broadband data is archived in a similar manner as GSN data and all request mechanisms and data manipulation tools available for GSN data are applicable to PASSCAL data as well. This allows easy and seamless access to the data by the seismological community and also provides convenient data processing tools and large disk space to the PIs during the proprietary period. This year, ten PASSCAL experiments presently within the proprietary data period have used DMC tools and large data buffers to perform event, station and waveform extractions on their large data sets archived in SEED format at the DMC. The minority opinion expressed by Julian and Foulger regarding the importance of PASSCAL data standardization harkens back to the days of permanently proprietary data collection efforts that repeatedly under utilized the full potential of the seismic signals. The community will not return to those dark ages. •

PASSCAL Data Access

Deborah Barnes, IRIS Data Management Center

One of the functions of the IRIS Data Management System is to archive data from PASSCAL field experiments. Until recently, most if not all of the PASSCAL data sets have arrived at the IRIS Data Management Center in Seattle as assembled data sets in various formats (SEGY, SAC, etc.). However, a great number of the new data sets are now arriving at the DMC in SEED format while the experiments are still in the field. These data sets are available to the P.I.s of a project as soon as the data can be archived at the DMC.

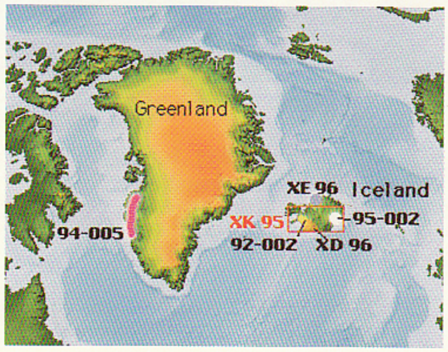
There is a two year moratorium for all PASSCAL data sets but there is also a mechanism by which a user not associated with the experiment can get permission to request and use these data sets. If a P.I. chooses he/she may remove the two year restriction for all users or give permission to selected users to request these data sets. Permission comes from the PI in the form of a password. Users that have obtained the password may register for access to this restricted data over the internet:

http://www.iris.washington.edu/FORMS/restricted.sets.form.htm

Information on the availability of PASSCAL data (and other temporary network data at the DMC) and the format in which the data is archived, as well as the name(s) of the PI(s), can also be viewed on the DMC web site:

http://www.iris.washington.edu/PASSCAL/dataindx.htm

The "Temporary Network Data" pages include mapped locations of past and present experiments, details of the experiments, station locations, data format and availability, and in some cases preliminary findings and publications. If the data set is an archived SEED volume a user can take advantage of an added "Map Stations" option - a web utility that allows the user to create a GMT map of all stations included in the experiment.



Example of regional map on the Temporary Networks page for Greenland and Iceland

Pre-assembled data sets usually arrive at the DMC after the two year restriction period and are therefor available as soon as they are received. To request an assembled set the user need only send email and include the name of the data set, the medium on which they would like to receive the data and their mailing address. Assembled sets can only be sent on tapes since the data is not stored on the DMC mass storage system. Data in SEED format is requested in the same manner as GSN data (using BREQ_FAST, WEED, etc.). Please view the DMC's on-line Data Access Tutorial for more information about request mechanisms:

http://www.iris.washington.edu/manuals/tutorial.html •

PASSCAL Assembled data set 92-002
Status: Available

ICELAND PASSCAL Data Set 92-002

South Iceland Seismic Refraction Experiment of 1990
William Menke
Lamont-Doherty Earth Observatory of Columbia University

Description:
The experiment design was a linear profile of 210 receiver points and 11 shot points crossing the Western Volcanic Zone and South Iceland Seismic Zone of southern Iceland. The profile is oriented northwest-southeast and is about 170 km long.

The main goals were to image the upper 10-15 km of the crust with a resolution of 1 km vertically and 5-10 km horizontally in the South Iceland Transform zone, and to measure crustal thickness through the measurement of moho reflection travel times.

Status — ready for Shipment
Format — **AH**
Preferred Media — Exabyte

Make request

Example of entry on the Temporary Networks page for Greenland and Iceland

Ninth Annual IRIS Workshop

Participants at the Ninth Annual IRIS Workshop (photo courtesy of Michael Hasting)

The Ninth Annual IRIS Workshop was held June 8-12th at the Beaver Run Resort in Breckenridge Colorado. More than 250 people attended the Workshop and participated in various activities, including four fieldtrips of hiking - Geology of the Northern Rio Grande Rift lead by Colorado School of Mines; a hike to the snow line lead by T. Wallace; white-water rafting lead by the Breckenridge Outdoor Education Center, who also lead a canoeing trip on the ecology of Lake Dillon. Even rain did not dampen the spirts of the participants.

IRIS introduced our new Education and Outreach Program by providing a one day short course on "Seismologists Learning to Teach the Teachers" (described on page 5). There was also an evening of "the Great Debate" where four members of the community debated the relative importance of science education from K-12 to the graduate level, and public education.

Scientific Sessions

The "Continental Roots and Orogens" session at the 1997 IRIS Workshop explored a wide range of issues including the seismic, thermal, rheological and geochemical properties of continental mantle roots, the role of continental roots in mantle flow, strong variations in crust and mantle properties between stable continental interiors and orogenic belts, and evidence for dramatic reworking of continental crust during orogenesis.

Tom Jordan led off the session with a talk entitled "New Constraints on the Structure and Evolution of the Continental Tectosphere" (co-authored by Jim Gaherty). Key points included xenolith evidence for chemical depletion in the tectosphere/mantle root (resulting in positive chemical buoyancy that competes with negative thermal buoyancy) and for roughly similar ages between archean cratonic crust and the underlying mantle. Jordan integrated these results into a model in which the tectosphere formed by multiple episodes of advective thickening prior to its stabilization. In a refinement of the original tectosphere hypothesis, Jordan used waveform inversion results from Australia to argue that the Lehman discontinuity occurs at 190 to >250 km depth, marking a transition from more rigid anisotropic tectosphere at shallower depth to more mobile, isotropic tectosphere at greater depth. In "The Thermal and Dynamical Evolution of Sub-continental Lithosphere," Chris Kincaid (with Paul Silver as co-author) explored a wide variety of geodynamical calculations that emphasized the large impact of continental root buoyancy and viscosity

The Great Debate, lead by Gregory van der Vink. The participants - Adam Dziewonski (K-12), Steven Bohlen (undergraduate), Ian MacGregor (graduate), and Kaye Shedlock (public education) - debated the relative importance of science education at various grade levels.

on mantle flow patterns. The stability of mantle roots over long times scales (> 1 Ga) appears to be controlled by root density and thermal and chemical contributions to root viscosity, and in models where downwelling does occur, it may be localized at root margins as well as beneath root interiors. In numerical modeling of the effects of orogenesis, Kincaid showed that for high values of lithospheric stress (> 200 MPa), viscous heating during orogenesis can substantially increase temperatures in the sub-continental lithosphere, resulting in slower seismic velocities.

Turning the session's focus to the question of large-scale continental root morphology, Rob van der Hilst presented "Constraints on Deep Continental Structure from Broadband Seismic Imaging." Using data recorded by the SKIPPY project that spanned the Australian continent with a series of broadband arrays, van der Hilst showed velocity images obtained by inverting fundamental and higher mode Rayleigh and body waves. Key features included fast velocities to depths of 300 km or more beneath the Precambrian craton in western and central Australia and thinner lithosphere with a strong low velocity zone in the 140-200 km depth range beneath Phanerozoic eastern Australia, as well as similar strong velocity gradients across root margins in North America (Van der Lee and Nolet) and Europe (Zielhuis and Nolet). Van der Hilst also raised the idea that phase picks from portable arrays be routinely reported to data centers such as the ISC and NEIC, thus offering better coverage in the global travel-time dataset for earthquake location and travel-time inversions.

The next two talks focused on crust and mantle structure across the boundary between craton and orogenic belt in the western U.S. In "Exploring the Depth of Continental Tectonics in the Western United States," Anne Sheehan (with Ken Dueker as co-author) reviewed the numerous and dense PASSCAL experiments that have been conducted across the Wyoming Craton, Rocky Mountains, Colorado Plateau, Basin and Range and adjacent regions over the last several years. One fundamental result from crustal models in the Southern Rocky Mountains, Sierra Nevada and Snake River Plain is that simple crustal roots are insufficient to isostatically support the observed surface topography, arguing for additional support from mantle structure and processes. Sheehan also explored the "410" km and "660" km mantle discontinuities using stacks of Ps conversions recorded by PASSCAL arrays in the Snake River Plain and Rocky Mountains. The "410" and "660" discontinuities have significant topography (15 - 40 km) over short length scales and the "410" and "660" topographies are not simply correlated, arguing that the topography is due to small-scale thermal and/or chemical heterogeneity, rather than thermal anomalies that are vertically coherent through the transition zone. Tim Henstock (with Alan Levander as co-author) then delivered "Contrasting Phanerozoic and Archean Mantle in Western North America: The Deep Probe Experiment." Deep Probe was a 1995 active source deployment that reached 3000 km from southern New Mexico to Great Slave Lake, Canada, crossing from Phanerozoic orogen in the south to Archean craton north of Wyoming. Henstock showed data collected from various shotpoints that reveal fundamental differences in crust and mantle structure between the Colorado Plateau and Wyoming craton. For instance, the mantle beneath the Wyoming craton is high velocity and contains a positive velocity gradient to depths of 150 km or more. However, the mantle beneath the more recently tectonized Colorado Plateau is lower velocity and contains a low velocity zone with a velocity minimum at roughly 80 km depth, a structure reminiscent of young oceanic lithosphere.

In the final talk of the session, "Crustal Reworking During Orogeny: The Nanga Parbat Seismic Experiment," Anne Meltzer focused attention on the effects of orogenesis at shallower depths and more detailed scales. The Nanga Parbat PASSCAL experiment was part of a broad multi-disciplinary effort and involved the deployment of 10 broadband and 50 short period stations in the dramatic topography on and around the Nanga Parbat massif in northeast Pakistan. The age of metamorphism on the massif is very young, and, along with rapid rates of exhumation and young intrusive rocks, suggests very anomalous thermal structure, an elevated geothermal gradient in particular. High rates of local seismicity were recorded during the deployment, and initial event locations show that seismicity is restricted to shallow depths (roughly 8 km or less), providing constraints on the brittle-ductile transition within the crust. Future analyses will include tomographic imaging of the velocity and attenuation structure beneath the massif.

The Tuesday morning session featured a variety of talks concerning the dynamics and upper mantle structure of mid-ocean ridges and continental rifts, lead by Doug Wiens. Don Forsyth presented results from the recent MELT experiment along the East Pacific Rise. This experiment consisted of 51 ocean bottom seismographs (OBS) deployed in two arrays spanning an 800 km region near the spreading center. The results show no evidence of a narrow zone of low velocities near the ridge crest that are predicted by models of active dynamic flow. Melt appears to be broadly distributed near the ridge crest, particularly towards the west, which shows lower seismic velocities and higher topography than the eastern flank. Shear wave splitting and Rayleigh wave phase velocities show pronounced anisotropy, with fast axes parallel to the spreading direction.

Doug Wiens described results from a combined land-sea experiment in the Tonga-Fiji region that used 12 IRIS-PASSCAL land broadband seismic stations and 30 OBSs to image the Lau backarc spreading center and the subducting Tonga slab. Waveform inversion shows exceptionally low seismic velocities at depths of 30-90 km beneath the Lau spreading center, consistent with a zone of magma production. Seismic tomography shows the slow velocities associated with the spreading center are separated from those associated with the Tonga magmatic arc at shallow depths, but merge at depths greater than 100 km, suggesting that slab signatures in backarc magmas may originate through interchanges at greater depths. Some slow velocity signature of the backarc extends to depths of 400 km, possibly due to slab dewatering.

In recent years there have been several different large-scale experiments in Iceland. Guust Nolet described possible ways to study the interaction of a hotspot with a mid-ocean ridge. Seismic tomography images the slow velocity anomaly of the Iceland hotspot extending down into the mantle. The depth extent of the hotspot anomaly is difficult to resolve. One possible way to obtain better resolution of the hotspot anomaly is to model body wave amplitude anomalies caused by focusing. Andy Nyblade continued the discussion by addressing seismic velocity anomalies in the upper mantle beneath the East African Rift. A plume model has been proposed to explain low upper mantle velocities and the volume of volcanics in the rift. However, results from a PASSCAL experiment in Tanzania show the craton is intact to depths of at least 200 km, showing that the mantle has not been disturbed in this region.

Jason Phipps Morgan described his model for the role of the asthenosphere in global mantle flow. He proposed that the asthenosphere is fed by upwelling hot mantle from plumes. The asthenospheric material may be incorporated into lithospheric plates at spreading centers far from the original hotspot source. This model is consistent with the observed dynamic topography and geochemical evidence. Marc Spiegelman completed the discussion by asking whether geochemistry can tell us anything useful about ridge dynamics. Not surprisingly, he concluded that it can, and described how the observed geochemistry is sensitive to the dynamic processes at mid-ocean ridges.

The 'Earthquakes, Up Close and Personal' session focused on important issues currently at the forefront of earthquake research. These ranged from the very practical, including a discussion by Tom Heaton on recent earthquake ground motion results and their relevance to building response, and a talk by Art Frankel on the new national hazard maps currently recently released by the US Geological Survey. Frankel also illustrated how a large-scale PASSCAL deployment could make important contributions to a better understanding of regional seismic hazard. Frankel and Heaton both discussed issues, such as 'deaggregation' of seismic hazard and building ductility, that may be relatively alien to the seismological community, but that are critical to a successful interface between earthquake scientists and the public. As Kaye Shedlock pointed out in the lively earlier section on education, the public are the policy makers.

The four other talks in the session discussed open research issues in earthquake science. Raul Madariaga presented recent three-dimensional simulations of dynamic rupture in which spontaneous Heaton pulses are generated even in a model with no intrinsic discreteness. An understanding of the rupture characteristics of the rare, largest earthquakes is necessary to quantify potential future ground motions. Dave Jackson illustrated the importance of understanding the long term magnitude distribution in a given region. In particular, the frequency and size of the rare, largest earthquake can have important consequences in the quantification of hazard. Nano Seeber presented results concerning a hypothesis that has been discussed at some length in the earthquake research community: that the static stress changes caused by an earthquake play an important role in triggering aftershocks (and sometimes other large earthquakes). Seeber's result showing that it is possible to recover much of the 1992 Landers slip distribution, by assuming the aftershocks to have been triggered by Coulomb stress changes and then finding the optimal slip distribution for the mainshock, provides one potentially important confirmation of the hypothesis. In the final talk, Charlie Sammis presented intriguing results from the application of a critical point model to regional seismicity. He showed that increases in regional seismicity prior to large earthquakes seem to be ubiquitous, and that, according to the critical point model, this increase is due not to interaction between earthquakes, but to the earthquake occurrence reflecting the correlation dimension of the regional stress field. If borne out, these results suggest that it might be possible to identify regions in which the stress field is well enough correlated to produce a large earthquake, although still not to predict individual earthquakes in a classical sense.

Posters, SIGS, Talks and Trips

In addition to the scientific sessions, the workshop included opportunities for informal discussions that allowed participants to share posters on current projects, computer demonstrations of PASSCAL, and Data Management System software, and SIGSs (Special Interest Groups). SIGs this year included Instrumentation — the Next Generation lead by T. McEvilly; Current Status of CTBT R&D Funding lead by Rongsong Jih; a panel discussion on IRIS Contributions to the NAS Science of Earthquakes Study lead by C. Meade, T. Jordan & G. Beroza; and FISSURES: Framework for Integration of Scientific

Visiting Scientist Facility at the IRIS DMC Enhanced

Tim Ahern, IRIS Data Management Center

Many of the data sets that need processing and analysis today tax the capacity of the systems at many universities and research institutions. For this reason the IRIS Data Management System has developed a shared resource that is available to the seismological community. Anyone can request to use this facility by sending an email to the IRIS DMS Program Manager (tim@iris.washington.edu). Approval is given with input from the DMS Standing Committee and availability of the resources needed.

Over several years the IRIS DMS has allocated a small percentage of its funds to acquire hardware and software systems that can be used by scientists wishing to visit the IRIS DMC (located at the University of Washington) or for scientists that wish to use systems remotely over the Internet. Roughly 20 visiting scientists have made use of the Visiting Scientist facility since its inception. The majority of users to date have been PASSCAL investigators wishing to analyze their data sets or prepare them for distribution through the IRIS DMC.

Currently the Visiting Scientist facility consists of two reasonably powerful SUN servers that provide processing and storage capability that may not be available at other institutions. The first (original) machine is a Sparc 10 workstation (YODA) that is directly attached to a METRUM RSS-48 1 terabyte tape based mass storage system. In addition to the large mass storage system, YODA also has 44 gigabytes of RAID disk, Exabyte stackers and DAT stackers. The stackers are managed by a software system that allows control of the robotic tape handlers by scripts. DLT drives can also be made available. The second machine was added last year - a large SUN Enterprise Server 3000 (MEG). This system has 83 gigabytes of RAID disk; soon to be in a single partition. This system has a DLT drive as well as a single Exabyte drive.

Perhaps of more interest is the software presently loaded on MEG and/or YODA. This includes:

- OMEGA® - a 3 dimensional reflection seismic processing package
- MATLAB 5
- S.U. - a Seismic Processing package from the Colorado School of Mines
- Arc/Info
- GMT - a Mapping Utility
- PDB Tools - PASSCAL DBMS software
- Datascope Seismic Application Package (DSAP) - developed by the IRIS JSPC
- Postgress 95 Database Management System
- PDCC Toolkit - portable Data Collection Center software developed by the IRIS DMS for data quality assurance and conversion to SEED format
- SAC from LLNL

Rob Casey, an IRIS DMC staff member, acts as host to the visiting scientist. Rob is familiar with most of these applications and is available to assist visitors in making full use of the facilities at the DMC.

Those interested in using this facility can contact Tim Ahern for more information or to schedule use of the facility. (tim@iris.washington.edu) •

contiued from page 18

Software for University Research in Earth Sciences lead by K. Creager. Our lunch speaker this year was Dennis Mileti,Director, Natural Hazards Center, University of Colorado. He spoke on "What the hazard specialist really needs from the earthquake seismologist" .

We wish to thank the 1997 Workshop Committee: Karen Fischer, Brown University; Doug Wiens, Washington University; and Tom Boyd, Colorado School of Mines.

Group photograph courtesy of Michael Hasting Navel Air Weapons Station, China Lake, CA. For copies of this photom you may contact Michael Hasting at the following:
mike @geowiz.chinalake.navy.mil

GSN Update

Five new GSN sites have been installed since the last Newsletter. The IRIS/IDA (University of California, San Diego) team has installed GSN site KDAK, Kodiak Island, Alaska. IRIS/USGS teams (Albuquerque Seismological Laboratory) have completed installations in Ethiopia, China, and the Pacific. WAKE is a new GSN station on Wake Island in the Western Pacific Ocean. XMAS, Kiritmati (Christmas) Island, Kiribati, in the Central Pacific is a new cooperative joint station with the Japan's National Research Institute for Earth Science and Disaster Prevention (NIED). ENH, Enshi, China is a cooperative joint station with the New Chinese Digital Seismographic Network (NCDSN). FURI, Mt. Furi, Ethiopia is a new GSN station which replaces AAE, Ethiopia.

Comments on "The Political Sensitivity of Earthquake Locations by van der Vink and Wallace"

M. Henger and K. Koch, Federal Institute for Geosciences and Natural Resources, Germany
B. O. Ruud and E. S. Husebye, University of Bergen, Norway

In the Fall 1996 IRIS Newsletter, van der Vink and Wallace (1996) use as one of their examples a small seismic event (magnitude 2.4) on 13 January 1996 near the former USSR test site on Novaya Zemlya. Other seismologists who were requested to evaluate this event obtained a different epicenter location from that of van der Vink and Wallace although they used the same data, namely that from the ARCESS (ARA0) and Spitsbergen (SPA0) arrays. Data from the three-component Norilsk (NRI) station in Siberia indicates that the location determined by van der Vink and Wallace is incorrect and supports the other determinations (Figure 1).

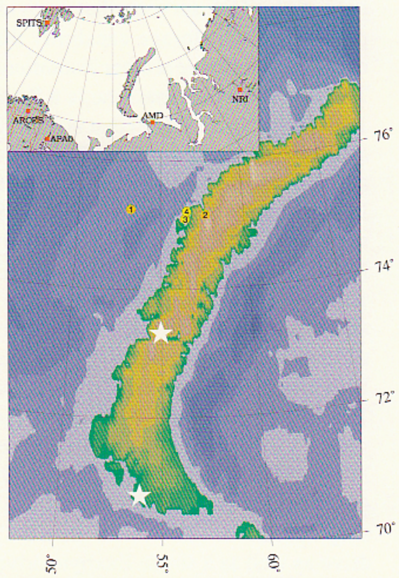


Figure 1. Various epicenter determinations for the 13 January 1996 event at/near Novaya Zemlya: (1) two-array location (SPA0 & ARA0) using IASPEI tables, (2) as for (1) but using Bergen University tables, (3) two arrays and the NRI station using IASPEI tables, and (4) same as (3) but using Bergen University tables. Note, Ringdal's (1996) two-array location at 75.38°N, 56.7°E is close to our epicenter (4). That of van der Vink and Wallace (1996) would coincide with (1) if we add 5 sec to their Sn-reading. The Novaya Zemlya test sites are marked by stars. The map insert shows the seismic arrays and 3C stations in the vicinity of Novalya Zemlya. Records from APA0 (Apatity) and the new AMD (Amderma) array were not available to us. To our understanding the APA0 array did not detect this event.

Data Analysis

We extracted relevant time segments of recordings from the Norilsk three-component station. At ARA0 and SPA0 the noise conditions are dominated by strong, low-frequency microseisms up to 2 Hz, so the optimum signal-to-noise ratios (SNRs) are in the 2 - 10 Hz band. At NRI the local noise conditions are very different with much less noise at the low frequencies. The S-wave is visible even at very low frequencies and there is a clear wavelet near the expected P arrival time with a dominant frequency of 1.5 Hz (Figure 2a & b).

The methods for analyzing array-recorded signals are well established and in cases with good SNRs even simple bandpass filtering and subsequent stacking suffice to accurately pick Pn and Sn arrival times. For the 13 January event, this was not the case, due to interference in the SPA0 records with signals from an earthquake on the mid-oceanic ridge west of Spitsbergen (Ringdal, 1996). Van der Vink and Wallace, being unaware of this, picked a too early Sn arrival at SPA0, which resulted in a shorter epicenter distance and hence 'moved' the epicenter well into the Barents Sea.

Apart from the misinterpretation of the Sn arrival due to the interfering event, another aspect contributed to the move of the epicenter westward. The differential epicenter angle between SPA0 and ARA0 is only about 45 deg, so the epicenter location resolution is relatively poor in the east/west direction as it depends strongly on the traveltime model used. However, the accuracy improves considerably if relevant Pn and Sn arrival times can be extracted from the NRI records. An additional advantage here is that with three station observations the choice of traveltime table used for location is less critical (Kennett, 1996) if the azimuth coverage is reasonable.

Envelope processing (Husebye et al., 1998) proved successful, as demonstrated in Figure 2c. The top trace is the envelope for the 1.0 - 2.5 Hz passband and a prominent, presumably P-wave arrives at 113 sec. It was also seen in the original records. However, extensive 3C analysis gave an azimuth of about 260 degrees which is far off the 310 degrees expected for Novaya Zemlya and polarization characteristics were non-P. The corresponding waveform has some semblance to a local Rg-wave - no sharp onset and monochromatic pulses. In Figure 2c we also display the 3C envelope for the 2 - 5 Hz passband; a presumed weak P-arrival at 122 sec (SNR ~ 1.3) and a clear, presumed Sn-arrival at 243 sec (SNR ~ 1.5). A SNR of 1.5 is taken to indicate a significant signal in the 3C envelope since this process is similar to incoherent beamforming with a rather long STA window (a threshold of 1.6 is used for NORSAR incoherent beams). As an additional check, we used the Pisarenko et al. (1987) phase-picking algorithm, whose picks coincide with

continued on page 22

Response from van der Vink and Wallace

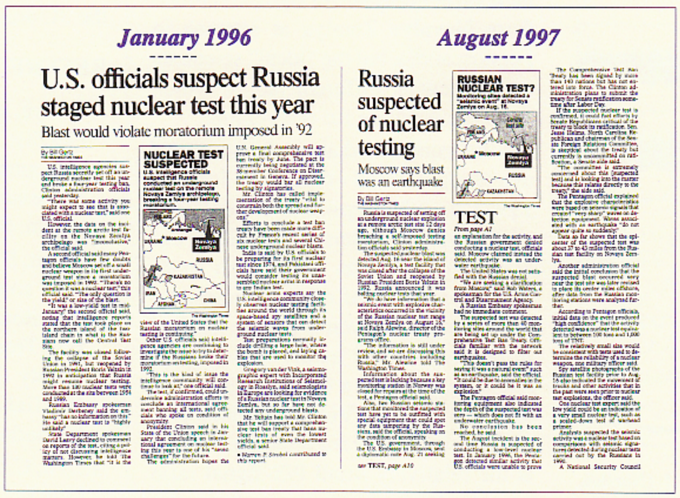
Gregory van der Vink, IRIS, and Terry Wallace, University of Arizona

We agree. Henger et al. provide a more accurate location for the epicenter of the 13 January event in Novaya Zemlya — one of the examples presented in our article. We based our location on the data from the ARCESS (ARA0) and Spitsbergen (SPA0) arrays, and were unaware that signals from Norilsk (NRI) indicated a contemporaneous earthquake on the mid-ocean ridge west of Spitsbergen.

The conclusions of our article, however, are in no way altered by the refinement of the epicenter location. As we have repeatedly seen, earthquakes that occur in sensitive areas during politically sensitive times are vulnerable to misinterpretation. Independent of which location is used (all of the epicenter determinations for the 13 January 1996 event are more than 200 kilometers from the Russian test site), the earthquake raised concern over Russian compliance with the ban on nuclear testing. Given the lowering of detection thresholds and the continuation of subcritical experiments, it is not surprising that such coincidences occur. And in fact, since the writing of our article, such a coincidence has occurred again. (see news articles inset and the bannergram of this Newsletter).

To help prevent such false alarms in the future, data from all available stations needs to be examined. Henger et al.'s extraction of critical travel-time information for a magnitude 2.4 event from a single 3-component station at a distance of 1200 km is an enlightening example for those who may still debate the importance of auxiliary stations for the monitoring of the CTBT. For the more recent 16 August 1997 false alarm, critical data came from the IRIS GSN station KEV, which is not even part of the official CTBT monitoring system.

We disagree with Henger at al in their assertion that a magnitude 2.4 event, which is equivalent to a yield not exceeding 100 tons of TNT, "could hardly be termed a nuclear device in a CTBT context". From the United States' perspective, it most certainly would. On August 11, 1996 President Clinton rejected proposals for continued sub-kiloton tests, and announced his decision to pursue a "true zero-yield comprehensive test ban." He based such a decision in recognition that the act of nuclear testing, not the threshold of such tests, is objectionable within the non-proliferation regime.



Both the United States and Russia are conducting hydrodynamic experiments at their test sites. Whether these experiments must remain sub-critical, or whether they can produce modest yields is unclear from the negotiations. Because nuclear materials such as plutonium are used in the experiments, they are conducted in a manner similar to nuclear tests. Although there is currently no precise agreed upon technical definition of the maximum explosive energy from hydrodynamic experiments, a seismic signal corresponding to 100 tons of tamped explosive would be assumed as a violation of the ban on nuclear testing by the United States.

Areas such as Novaya Zemlya, that are generally considered aseismic at teleseismic magnitude levels, will appear seismic at the lower magnitude levels detectable from regional coverage. Regional networks now provide a detection capability for the Novaya Zemlya area that is near mb 2.5 (NORSAR, 1996). Accordingly, we can expect to find events of concern every few years, such as 16 August 1997, 13 January 1996, 13 January 1995, and 31 December 1992. Open networks in the western United States, where the seismicity is greater and the coverage more extensive, provide a detection threshold below magnitude 2.2 for the US nuclear test site (Hennet et al. 1996). In fact, six days before the US' second 1997 subcritical experiment, a seismic event was recorded on the Nevada Test Site.

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NORSAR semi-annual technical report, November 1996.

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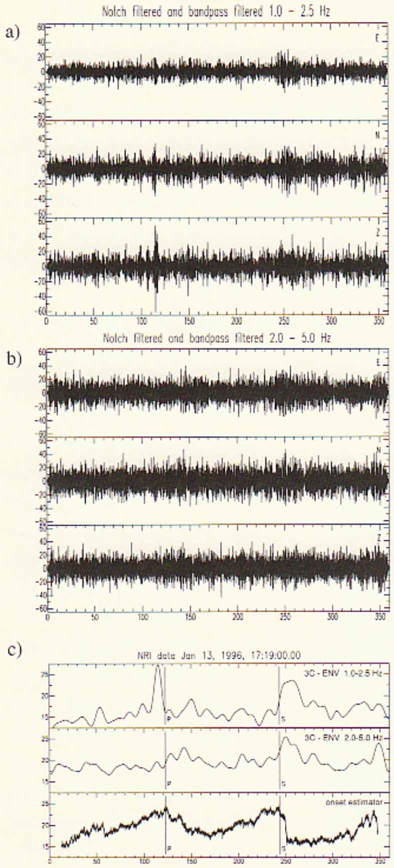

Figure 2. The 3-component NRI (Norilsk, Siberia) records for the 13 Jan 1996 event. The upper and middle parts) show filtered records in the 1.0 - 2.5 Hz and 2.0 - 5.0 Hz passbands respectively. Notch filters were used in addition to bandpass for removing spectral spikes. In c) the two upper traces are 3 C envelopes (Husebye et al. 1998) Pn-and Sn-arrival times as picked for this event are marked.

the envelope records (Figure 2c). Using the derived NRI Pn and Sn arrival times, we obtained an epicenter location of 75.38° N, 56.55° E, using the Bergen University traveltime curves (Figure 1). The residuals using the Bergen University traveltime curves are not unreasonably large (less than 1.6 sec), while for the IASPEI model the residuals varied +/- 5.6 sec, although the corresponding epicenter difference was less than 15 km. Note, the weak Pn-arrival in the records are not critical for the epicenter determination; we have also located the event using a Pn arrival at 113 sec (see Figure 2c) and also without the P-arrival of NRI. In the first case the epicenter moved 10 km and in the second case only 2 km (in both cases the local traveltime tables were used).

Discussion and Conclusion

Reexamining the van der Vink and Wallace (1996) location, we found that their small misreading of the Sn-arrival time was not as critical as their use of the IASPEI tables. Non-Scandinavian scientists appear to consider the IASPEI tables to be adequate for signals recorded from Novalya Zemlya at stations in Fennoscandia, but the "local" scientists use somewhat different tables, which are more accurate for this region.

What can be said about the source of this much debated event of 13 January 1996? Its mb magnitude of only 2.4, which is equivalent to a yield not exceeding 100 tons TNT. Such small charges are typical of many chemical explosions and, even if it were nuclear in origin, it could hardly be termed a nuclear device in a CTBT context, as argued by van der Vink and Wallace. A criterion in favor of an earthquake source is the relatively small P/S-signal ratio (van der Vink and Wallace, 1996). We are not convinced that such a criterion can be used here without extensive modification, because the Barents Sea sedimentary basin blocks Lg-propagation, in other words, Lg-waves leak as S-waves into the upper mantle and reappear in the Sn coda (Mendi et al. 1997). Observationally, this is manifested in an extended Sn-wave train, as seen in Novaya Zemlya recordings.

Using the novel envelope analysis technique we could extract useful traveltime information from the Norilsk 3C station, despite the poor quality of the NRI records for an event of magnitude 2.4 at an epicenter distance of about 1200 km. However, we confess that such low magnitude events can neither be accurately located nor clearly identified with seismological means only. In particular, the IASPEI travel time tables are not well suited for accurate event locations in the Novaya Zemlya area for regional epicenter distances. Clearly, certain event location areas remain politically sensitive, as this event has demonstrated.

ACKNOWLEDGMENT

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New IRIS Education & Outreach Coordinator

IRIS is pleased to announce that Dr. Catherine Johnson has been appointed to the position of Coordinator for the IRIS program in Education and Outreach. She will take up the position full time in January, 1998. As Coordinator, she will be responsible for working with IRIS members to develop and implement programs and activities which build on the facilities and resources of IRIS to bring the excitement and stimulation of seismology to the classroom and to the public.

Catherine received a B.Sc. in geophysics from the University of Edinburgh in 1989, having spent her junior year abroad at the University of Pennsylvania. From Edinburgh, Catherine went to IGPP, Scripps Institution of Oceanography, obtaining her PhD in 1994, and continuing at IGPP for a further year as a postdoc. Her thesis work comprised studies in two distinct fields: planetary geophysics, in particular studies of Venus using Magellan satellite data (working with Professor David Sandwell) and geomagnetism, specifically behavior of the Earth's magnetic field over the past 5 Myr (working with Professor Catherine Constable). Since October 1995 Catherine has been a postdoctoral fellow at the Carnegie Institution of Washington's Department of Terrestrial Magnetism, working with Dr. Sean Solomon. Catherine has continued her work in planetary geophysics as a PI in NASA's Planetary Geology and Geophysics Program. Her studies of Earth's geomagnetic field have broadened to include paleomagnetic field and laboratory work.

Catherine has a broad background in seismology: she was responsible for seismic and well log interpretation of North Sea prospects while working for Esso Exploration and Production, U.K. Ltd., during the summers of 1989-1991; she has worked in the field in Jalisco on a portable broadband experiment in 1996; in addition she has been surrounded by colleagues interested in global and regional problems in seismology at IGPP and DTM! Catherine has supervised four undergraduate thesis projects, two via NASA's Planetary Geology and Geophysics summer internship program. Through these experiences she developed a broader interest in Earth science education (both for future scientists and future non-scientists) as a means of heightening public interest and excitement in science, as a way of promoting educated opinion about environmental issues, and as a way of providing a solid training in the physical sciences. Catherine comes to the IRIS Education and Outreach Program with a strong commitment to Earth science education at all levels.

Staff News

At the end of December IRIS will bid a fond farewell to Shawn Boo, Director of Finance and Administration. Shawn has been with IRIS for close to six years. He was instrumental in developing an efficient Business Department. With Candy Shin now taking the helm, along with the very capable assistance of Chau Tran and Christina Jenkins, the business functions of IRIS will run better than ever. We wish him the best of luck and success in managing his own hedge fund.

Well, it has finally happened. Kris Skjellerup, long time employee of the IRIS DMC, has finally been discovered! Her talents as a great event coordinator, office manager, and all around personality are to be put to use as the Manager of Corporate Services for the Paramount Theater in Seattle. We wish her the best of luck in her new position. We will miss her.

We welcome to the staff Leanne Beach, DMC's new Office Manager. Leanne comes to us from Western Washington University were she was the Office Support Supervisor for the Seattle branch.

the IRIS CONSORTIUM

The IRIS Newsletter is published quarterly by The IRIS Consortium. Please address your letters or inquires to:

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The Incorporated Research Institutions for Seismology (IRIS) is a consortium of over 85 research institutions with major commitments to research in seismology and related fields. IRIS operates a facilities program in observational seismology and data management sponsored by the National Science Foundation through its Division of Earth Sciences.

The IRIS Newsletter welcomes contributed articles. Articles should be less than 1000 words and four figures. Please send articles or requests for submission of articles to the address listed above.

Editor-in-Chief: David Simpson (simpson@iris.edu)
Executive Editor: Gregory van der Vink (gvdv@iris.edu)
Production Editor: Anne DeLaBarre Miller (anne@iris.edu)

Calendar

1998

March 16-18	SSA Boulder, CO
April 27-30	IASPEI meetings Santiago, Chile
May 26-29	AGU Boston, MA
July 8-12	IRIS Workshop Santa Cruz, CA
Aug. 23-28	XXVI General Assembly of the European Seismological Commission Tel Aviv, Israel

New Members

IRIS welcomes as new members: University of Tulsa, Duryodhan Epili, Representative; Leicester University, Peter Maguire, Representative

Tenth Annual IRIS Workshop

July 8-12, 1998

University of California, Santa Cruz, CA

The 1998 IRIS Workshop will be held on the campus of the University of California, Santa Cruz, Santa Cruz, California. The University provides great meeting facilities, a scenic location, and the area provides many outdoor and family activities.

The Workshop will begin with an icebreaker and registration on Wednesday evening, followed by scientific sessions Thursday through Saturday. We will take one afternoon to offer optional group field trips to areas of local interest. Please contact the IRIS office if you have suggestions for scientific themes, SIGS or demonstrations.

Participation in the workshop is not limited to IRIS members and all interested parties are welcome to attend, subject to availability of accommodations. Mark your calendars, and keep an eye out for more information to be mailed early in February 1998. For further information, please contact Susan Strain: susan@iris.edu •

Staff Changes at IDA

Holly Given recently left her position as Executive Director of the IDA project at the University of California, San Diego, part of the Global Seismographic Network. She will join the Comprehensive Nuclear Test Ban Treaty Organization (CTBTO) in Vienna, Austria. This new international organization has been created to monitor compliance with the Comprehensive Nuclear Test Ban Treaty, signed by the United States and 14 other nations one year ago. Among her new responsibilities, Holly will be working to make the International Monitoring System (IMS) fully operational, and to certify that contributing seismic stations meet the treaty's technical specifications. Her more than ten years of experience building the modern IDA component of the IRIS GSN made her superbly qualified for the position. This is quite an honor for Holly, and we may all be proud of her achievement.

Pete Davis will take over as Executive Director of IDA. Pete came to IDA four years ago to run the Data Collection Center. He is well acquainted with the workings of the network, and hopes to build on the momentum Holly developed during her tenure. •

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