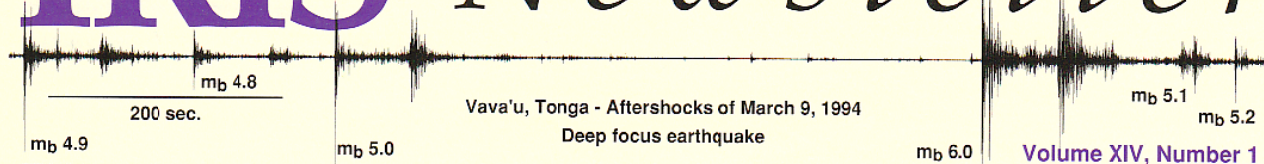


IRIS Newsletter



The Southwest Pacific Seismic Experiment

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Introduction

The Southwest Pacific Seismic Experiment (SPASE) is one of the first extensive deployments of broadband, PASSCAL type instruments in a subduction zone setting. Eleven broadband sensors were deployed in Fiji, Tonga, and Niue Island (Figure 1) during November, 1993 and August, 1994, and will remain deployed until December, 1995. The goals of the experiment are to study the complex upper mantle velocity and attenuation structure of the subducting Tonga Slab and Lau backarc spreading center, as well as the source parameters of deep earthquakes in Tonga slab. Since about two-thirds of the world's deep earthquakes are located in the Tonga subduction zone, the Tonga-Fiji region is an ideal site for this type of experiment. A related deployment of 29 ocean bottom seismographs in the Lau backarc and Tonga forearc (Dorman, Hildebrand, Webb, and Wiens, co-PIs) was carried out during September through December, 1994, and should provide better imaging of small scale structures than would be possible with the land stations alone.

Deployment

Instruments were deployed at 12 sites on 11 different islands. The sites were chosen to maximize coverage of the northern part of the Tonga slab as well as for logistical reasons. All of the sites can

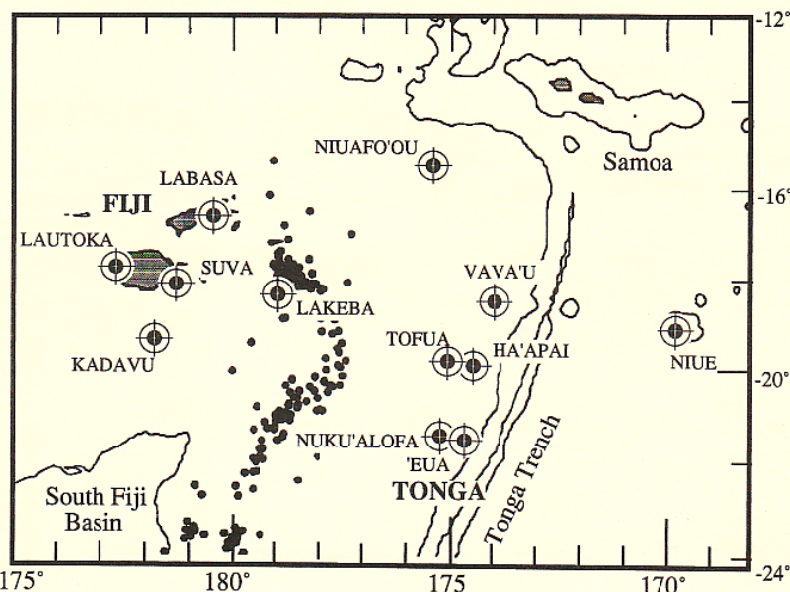


Figure 1. Map showing the locations of the broadband stations of the Southwest Pacific Seismic Experiment. A two year sampling of deep earthquakes (black dots) outlines the Tonga deep seismic zone.

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be reached by scheduled air service, except Niuafu'ou Island, which was deployed and picked up from ships servicing the OBS deployment, and Tofua Island, which is reached by a charter seaplane which lands in a caldera lake.

Eight Streckeisen STS-2 and three Guralp CMG3-ESP sensors were deployed, with each sensor connected to a Reftek 24 bit DAS equipped with GPS timing and 1.0 or 1.2 Gb disks. At most sites, the sensors were housed in one meter diameter fiberglass cylinders, which were cemented to bedrock or coral and equipped with a fiberglass lid and filled with styrofoam insulation. The sensors were placed on a small slab of concrete inside the cylinders and about one meter below the ground surface. The electronic equipment and two automobile batteries were placed in wooden field boxes near the vaults, and powered by two 30 watt solar panels (Figures 2 and 3).

Because of the high frequency-

dependent seismic noise levels on the islands, the Reftek triggering algorithm would miss many smaller events. Therefore, we record only a single, continuous data stream at 20 or 25 samples/sec. The stations are serviced at three month intervals, when disks are swapped and the data are downloaded on a field computer in Suva, Fiji. A service trip to all the stations from North America takes more than one month and entails



Figure 2. A typical field installation, this one located in Ha'apai, Tonga. The sensor is deployed in the fiberglass cylinder at the rear, and the batteries and recording gear in the plywood box, with solar panels mounted on top. Washington University graduate student Erich Roth inspects the site, which is complete with a "Tapu" sign and a fence to keep out marauding pigs and chickens.



Figure 3. Paul Friberg of the Lamont PASSCAL Instrument Center sets up the station at the Ratu Finau School, in Lakeba, Fiji. The seismograph installation provided rare lunchtime entertainment for several hundred children at the school.

about 30 separate plane flights. Kiti Draunidalo of the Fiji Mineral Resources Department services the stations on approximately one-half of the service runs. A copy of all the data is retained in Suva for use by the local scientists in seismic hazard studies. Data recovery over the first year of operation has been about 85-90 percent.

The bankruptcy of Polynesian Airlines midway through the experiment left Niue Island with only one weekly scheduled flight from anywhere in the world, such that servicing this one station takes about nine days. We are therefore cooperating with the PASSCAL Instrument Center at Lamont in testing an ARGOS satellite state-of-health communications system.

This issue's bannergram:

This 18 minute seismogram beginning about 8 minutes after the March 9, 1994 Tonga-Fiji deep earthquake (Mw 7.6, 564 km depth) shows at least 12 identifiable aftershocks, more than were known for any previous deep earthquake. This record was recorded by a PASSCAL STS-2 broadband seismograph at Vava'u, Tonga (epicentral distance 490 km) and high pass filtered at 2 Hz. •

Data will be returned by using local people to swap out disks and return them to the US by air cargo, and the station state-of-health will be monitored via the ARGOS satellite. This system should render it necessary to visit the island only in the case of equipment failure.

Initial Results

We have now processed data from December, 1993 through June, 1994, which is enough to make some initial studies. Over 1000 earthquakes were located in the Tonga-Fiji region during the first seven months of the experiment, most of which were not detected by the PDE or other global earthquake compilations.

Deep Earthquakes: The March 9, 1994 large deep earthquake (M_w 7.6, depth 570 km) was the largest deep earthquake in 20 years, and even though now exceeded by the deep Bolivian event (June 9, 1994, M_w 8.3), it promises to provide a wealth of detail on the source processes of deep earthquakes. Prior to this event, a true aftershock sequence had not been observed for any deep earthquake, and rupture zones of deep earthquakes were poorly constrained due to the lack of aftershocks to delineate the fault planes. The March 9 event was unusually prolific in producing aftershocks compared to other large deep events; we found a sequence of 83 aftershocks ranging from m_b 3.8 to 6.0 and extending for at least 40 days. The aftershocks show a power law decay with time similar to shallow aftershock sequences, and the number and magnitude distribution of the aftershocks is similar to that observed for typical shallow earthquakes. The contrast between this strong aftershock sequence and the weak aftershock sequence of the Bolivian event is particularly striking.

Most of the well-located aftershocks locate along a steeply dipping plane (Figure 4), consistent with one of the main shock nodal planes and appear to delineate a 50 km by 65 km main shock rupture zone. Inversion of broadband body waveforms, recorded on-scale by

six regional stations, also suggests this plane denotes the fault plane. Both the region of moment release and the aftershock zone cuts entirely through the active seismic zone and extends about 20 kilometers into the surrounding aseismic region. Thus there must be a mechanism for producing both rupture and aftershocks within the normally aseismic region surrounding the active slab. The width of the rupture zone is hard to reconcile with predictions of the transformational faulting hypothesis for the origin of deep earthquakes, which suggests that deep earthquakes should be confined to a thin zone of metastable olivine (see report in December 8, 1994 issue of *Nature*).

Several other deep earthquakes with $M_w > 5.5$ have occurred during the experiment. Most of these events have shown several aftershocks, including one M_w 6.4 event which showed nine. These results, combined with the March 9 aftershock sequence, suggests that Tonga

deep earthquakes have more active aftershock sequences than deep earthquakes in other subduction zones.

Attenuation Structure: The broadband body waveforms show first order differences in attenuation between paths following the slab and various paths within the backarc region. We are developing a three-dimensional Q model for the upper mantle beneath the Lau backarc using a differential attenuation method which determines the dt^* along the raypaths of regionally propagating P and S waves. The dt^* measurements and the raypaths can then be inverted to determine the lateral and depth dependent Q variations. Initial results suggest that Q increases rapidly with depth. A low Q region is found in the upper several hundred kilometers beneath the Lau backarc spreading center, possibly suggesting the presence of partial melt, and much higher Q is found beneath the South Fiji Basin, an older, inactive region.

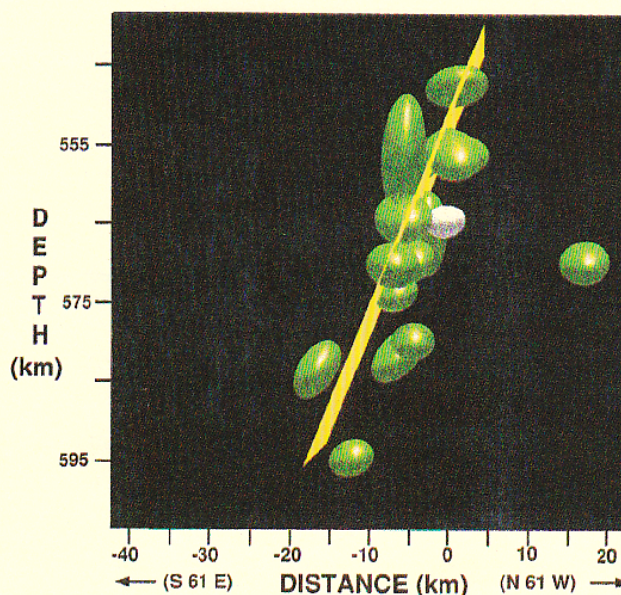


Figure 4. 3-D visualization of locations of the main shock hypocenter (white ellipsoid) and the best located aftershocks (green ellipsoids) from the March 9, 1994 (M_w 7.6) deep earthquake. The ellipsoids denote the 95% confidence regions for the relative position of each earthquake determined using a hypocentroidal decomposition inversion of arrival time data. The yellow plane (viewed nearly edge-on in this figure) represents the plane which best fits the aftershock locations, and is nearly coincident with one of the nodal planes of the main shock focal mechanism.

Anisotropy: Shear wave splitting is readily observed on records of intermediate and deep earthquakes recorded in Fiji, and we are currently investigating anisotropy beneath the Lau backarc and Fiji platform in collaboration with Karen Fischer (Brown University). All Fiji stations generally show about 1 s. of splitting, with an average fast direction of about N60W (Figure 5). There appears to be little variation in the amount of splitting with event depth or path length for sources between depths of 400 to 650 km, and several teleseismic SKS phases show similar splitting results. This suggests that the splitting occurs largely within the upper 400 km of the mantle beneath the station. These results are consistent with a 1% azimuthal anisotropy uniformly distributed in the upper 400 km of the mantle, or greater anisotropy if the splitting occurs at shallower depths. The fast direction of the anisotropy is approximately parallel with the convergence direction of the Pacific plate and the spreading direction in the Lau backarc, suggesting the anisotropy may be produced by counterflow induced within the backarc by the subducting slab or the back arc extension.

Other studies of the velocity structure of the subducting slab and backarc basin

using arrival time data and waveforms are also underway, as well as source parameter studies of regional earthquakes. The Southwest Pacific Seismic experiment will produce a better understanding of the seismic structure and geodynamics of island arc - backarc systems, as well as a better understanding of the rupture processes of deep earthquakes. The data will be made available to the entire community through the IRIS Data Management Center one year after the end of the experiment.

Acknowledgments: We thank George Hade (Cornell), Paul Friberg (PIC - Lamont), George Sionhalo (Niue Dept. of Survey), Saimone Helu and Tavita Fatai (Tonga Ministry of Lands and Survey) for assistance with the deployment of the seismographs. We also thank Bob Busby (PIC - Lamont) for assistance with the equipment and planning of the experiment, and Hersh Gilbert, Brian Park-Li and Rachel Sakata for carrying out various aspects of the analysis.

This research was funded by the U.S. National Science Foundation.

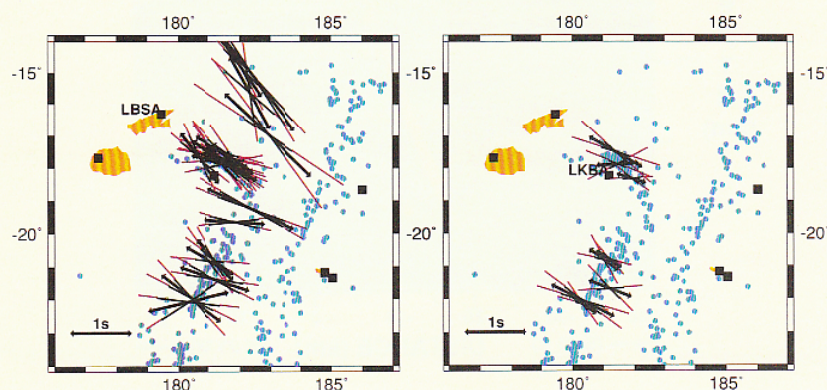


Figure 5. Figures showing shear wave splitting results for deep earthquakes recorded at stations in Labasa (LBSA, left) and Lakeba (LKBA, right), Fiji. Arrows plotted at the earthquake source location represent the fast direction, with increasing length reflecting increased splitting times. Lines denote the 95% confidence bounds on the fast direction. The splitting results indicate about 1 second splitting with a N60W fast direction, nearly parallel to the convergence direction at the Tonga trench.

New PASSCAL Datasets Available

Little Skull Mountain Aftershock Deployment

PASSCAL Data Set 95-001; A. Sheehan, S. Gillett, K. Smith, M. Savage, University of Nevada-Reno

1993 Oregon Snake River Plains Experiment

PASSCAL Data Set 94-014; K. Dueker & E. Humphreys, University of Oregon

PACE 1989 Seismic Refraction Survey - Northern Arizona

PASSCAL Data Set 94-013; J. McCarthy, W. Kohler, E. Criley, USGS, Menlo Park

San Francisco Bay Area Broadband Transect

PASSCAL Data Set 94-012; J. Evans (1), J. Coakley (1), H. Iyer (1), S. Ruppert (2), S. Schwartz (3), J. Vidale (1,3), G. Zandt (2)

1. USGS, Menlo Park; 2. LLNL; 3. UC, Santa Cruz

BASIX 1991 Wide-angle Fan Shots

PASSCAL Data Set 94-011; J.A. Hole & S.L. Klemperer, Stanford University

Baikal 1991 & 1992 Seismic Array Project - University of Wisconsin

PASSCAL Data Set 94-010; R.P. Meyer, P. Burkholder, L. Delitsin, University of Wisconsin

Wide-angle Seismic Imaging in the Peninsular Ranges

PASSCAL Data Set 94-009; T. Henyey, D. Okaya, Y. Li., USC; P. Davis, UCLA; S. Day, SDSU; B. Bohannon, USGS

Boulder Batholith 1992 Experiment

PASSCAL Data Set 94-008; L. Vejmelk & S. Smithson, University of Wyoming

Baikal 1992 Seismic Array Project

PASSCAL Data Set 94-007; P.M. Davis, S. Gaol, P.D. Slack, M. Benthien, D. Daniels, UC, Los Angeles

Minnesota River Valley 1990 Wide-angle Experiment

PASSCAL Data Set 94-006; W. Clement & S. Smithson, University of Wyoming

1989 Greenland Seismic Survey

PASSCAL Data Set 94-005; S. Smithson & N. Boyd, University of Wyoming

For more information please refer to IRIS DMC electronic bulletin board (telnet iris.washington.edu) userid = bulletin password = board or MOSAIC server (<http://www.iris.washington.edu/>)

The Tanzania Broadband Experiment

Thomas J. Owens, University of South Carolina,

Andrew A. Nyblade, Charles A. Langston, Pennsylvania State University

The Tanzania Broadband Experiment is a collaborative project (Tanzania Geological Survey, the University of South Carolina, and the Pennsylvania State University) designed to record seismic data from teleseismic, regional and local earthquakes that sample rifted Proterozoic and unrifted Archean lithosphere in East Africa. The experiment, which began in May, 1994, consists of 20 PASSCAL instruments deployed for one year in two ~1000 km-long arrays spanning Tanzania from east to west and northeast to southwest (Figure 1).

The tectonic framework of East Africa comprises several Precambrian terrains which have experienced Cenozoic extensional tectonism related to the

rifting of Arabia from Africa. The Precambrian terrains include the Archean Tanzania Craton and a number of early to late Proterozoic mobile belts which surround the craton (Figure 1). Regional seismicity indicates that the entire area is under tensional stress, and extension in the Proterozoic mobile belts has led to rift faulting and modification of the lithospheric mantle. The eastern margin of the Tanzania Craton has also been fractured by rift faults, but it is not clear if the deep cratonic structure has been disrupted as well.

The nature of lithospheric structure beneath the craton has important implications for understanding the dynamic evolution of continental lithosphere. A principal assertion of the current Tectosphere model is that cratons are true islands of tectonic stability within a generally mobile and less stable lithosphere. If the deep structure of the Tanzania Craton has not been modified significantly by Cenozoic extension, then the assertion of cratonic stability, and consequently the Tectosphere hypothesis, would be corroborated. However, if cratonic structure in East Africa has been disrupted by Cenozoic extension, the issue of cratonic stability as well as the Tectosphere hypothesis would then need to be reexamined.

The principal objective of the experiment, therefore, is to record broadband data that will enable us to image upper mantle structure beneath both the craton and rifted mobile belts, letting us examine deep continental

structure as it evolves within a modern extensional regime. Most importantly, we want to determine whether or not the Cenozoic extensional event which has clearly disrupted lithospheric structure beneath the Proterozoic mobile belts has similarly modified deep structure under the Tanzania Craton.

Location of seismic stations with respect to the Tanzania Craton and the major Cenozoic rift faults can be seen in Figure 1. Sites cross the craton and the rifted mobile belts, with station spacing varying from 50 to 200 km. Criteria used for site selection included access to bedrock, security, and year-round road conditions. Sites were constructed in about six weeks using 55 gallon metal drums as vaults. One drum was used as a sensor vault and the other for the PASSCAL DAS and batteries. Sensor pads were made of concrete poured in a 40 cm diameter PVC pipe form decoupled from the drum wall. Sensors were insulated with two layers of foam, and the sites were buried with 20-60 cm of soil for insulation and security. Two 30 W solar panels provide power at each site. To minimize vandalism, sites were located within 100 m of an occupied hut, solar panels were installed on top of the huts, and villagers were employed as guards. Over the past 8 months of network operation, only one site has been removed due to security problems.

Site installation was completed in 20 days, and the array was 100% operational on June 10, 1994. Each site is equipped with a PASSCAL 24-bit DAS and a 1 Gb hard disk. Originally, all sites used OMEGA timing, however OMEGA reception problems have required the subsequent installation of GPS clocks at several sites. We are currently recording three data streams, a 1 sample/sec continuous stream, a 20 sample/sec

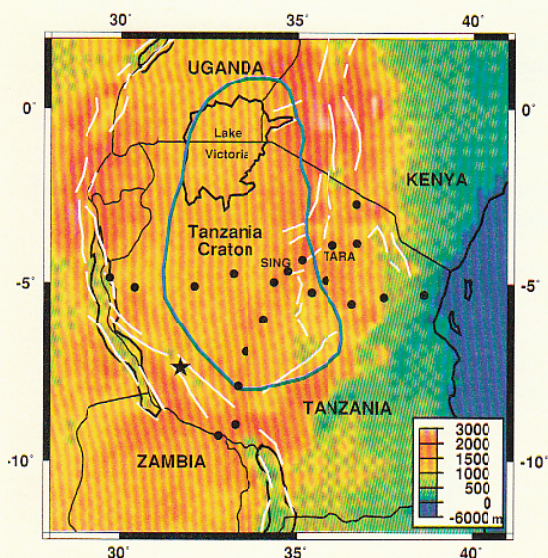


Figure 1. Map of East Africa showing station locations (solid circles) for the Tanzania Broadband Experiment with respect to elevation, the Tanzania Craton (blue line), and major Cenozoic rift faults (white lines). The location of the Rukwa earthquake shown in Figure 3 is indicated with a solid star.

continuous stream, and a 40 sample/sec "phantom" trigger stream that logs event triggers but does not record any data to disk. This configuration results in about 7 Mb of compressed data recorded to disk per station per day, and yields an uncompressed data volume of 447 Mb per station per day. Stations are serviced every 60 to 100 days, which requires processing up to 50 Gb of data per service trip.

Our recording scheme offers several operational advantages. First, due to limited disk space on the field computer, we cannot easily preview the 20 sample/sec data. Recording a 1 sample/sec stream allows us to check the quality of all data at our field base (near site SING, Figure 1). The "phantom" trigger allows us to do trigger correlations across the network to determine the most appropriate time windows to extract from the 20 sample/sec continuous data stream upon returning from the field. Local seismicity is high (> 100 events/day at some sites) and few events appear in the PDE listings, so the event correlations are quite useful.

Currently, about 160 days of data have been returned to the US. Data recovery for the first five to six months of network operation was nearly 100%, although a small portion of the data do not have accurate time due to the OMEGA clock problems cited above. We presently have a field crew doing the rainy-season

service trip, and their reports indicate that several unusual problems (wire-eating insects, among others) have reduced our uptime at a number of sites, lowering data recovery for the last two to three months to about 80%. However, the rainy season is almost over and all sites are currently operational.

Because the large volume of data that we are collecting is difficult to manipulate on our local computer systems, we have elected to use the "YODA" facility at the IRIS DMC in Seattle to process the data. The IRIS DMC Metrum-based virtual file system allows us to dump individual station DAT tapes written on the field computer in Tanzania to disk. After timing corrections are made, station-day files are then migrated to the Yoda's Metrum mass store, where they are sorted into network-day volumes and written to archive tapes for use in our research. It takes about one week at the IRIS DMC to produce network-day volumes for each service trip. Copies of these tapes are left at the DMC for eventual release to the community, and in this fashion we simultaneously minimize the time spent processing the data and preparing it for timely release to the community. Data release is scheduled for July 1, 1996.

Figures 2 and 3 illustrate data from the Tanzania network. One of the first large teleseismic events recorded when the

bulk of the network was operational was the June 9, 1994 deep Bolivian earthquake. Record sections from this event (Figure 2) show spectacular shear wave arrivals. Overall, seismicity levels have been high for teleseismic events but somewhat less than average for regional events above the threshold needed for PDE locations. However, we have recorded numerous smaller regional events which we are in the process of locating and that we will use in our research. On August 18, 1994 at 00:45:45 GMT, a $M_b=5.9$ event occurred near Lake Rukwa within our network (see Figure 1). This event was widely felt throughout Tanzania and was well-recorded on scale by our 24-bit instruments (Figure 3). Preliminary study of this event indicates a focal depth of about 25 km, and analysis of the P-wave travel times suggests a P_n velocity of 8.4 km/s across the network.

The broadband waveform data will be used in a variety of ways to deduce lithospheric structure across Tanzania. Teleseismic data are currently being analyzed using the receiver function technique to place constraints on crustal and upper mantle structure under each recording site. These models will be further constrained using surface wave dispersion from shallow teleseisms, and body wave traveltimes from regional and local events. Waveform inversion

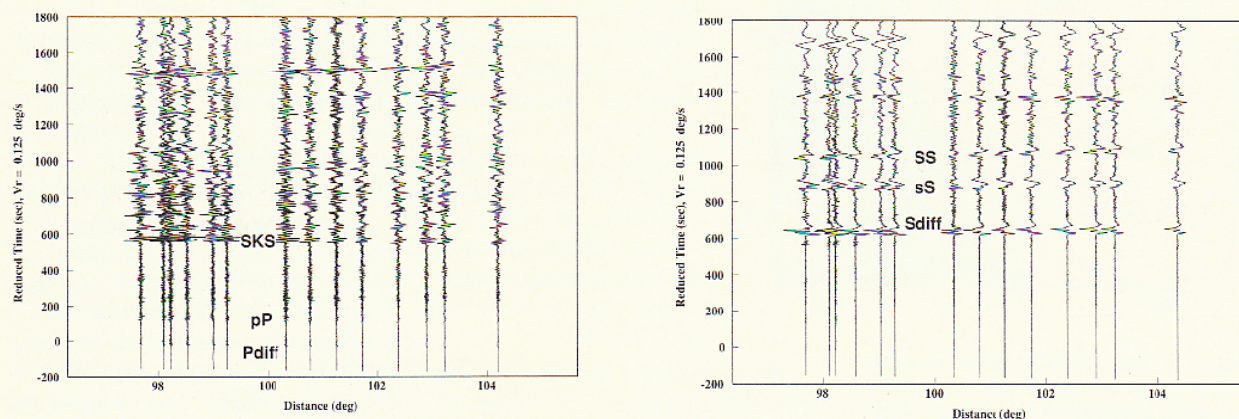


Figure 2. Record sections showing the east-west (left) and north-south (right) seismometer components of the June 9, 1994 deep Bolivian earthquake. Since the event location is almost due west of our network, the east-west and north-south sections are nearly radial and tangential component sections, respectively. Relative amplitudes between the traces are accurate.

and tomographic studies for structure will also be preformed. The spectacular regional signals from the Rukwa earthquake will play an important role in deducing variations in velocity structure throughout Tanzania.

Although the network was designed to take advantage of teleseismic and regional wave propagation for deducing lithospheric structure, we are finding that it is providing a fascinating reconnaissance into the levels of local seismicity in an area of active continental rifting. For example, a study of microseismicity over the first month of the deployment has yielded 20 to 30 microearthquakes per day that are recorded by four or more stations of the network. Indeed, an initial test deployment at TARA (Figure 1) yielded 100 events in a 13 hour period. Studies are currently underway to locate these earthquakes and to determine focal mechanisms for understanding the geometry of faults and the current state of stress within and between the

branches of the East African Rift System.

The logistics of installing and servicing a 20 station network within Tanzania are challenging but add a certain exotic spice to collecting important scientific data for an unexplored area. The scientific adventure is accentuated by the simple physical demands and surprises that are encountered in the field, whether it is negotiating a heavily rutted dirt road through the bush, coming upon grazing giraffes, or watching the ubiquitous but sinister-looking dust devils cavort on the plains. It is a tribute to the IRIS/PASSCAL program and the National Science Foundation that make such experiments possible. There is no substitute for high-quality, broadband digital data, taken locally, to solve major geophysical and tectonic problems. The Tanzanian Broadband Experiment is well on its way to providing a unique data set to the community that will be used for study of regional problems in Africa as well as global problems of structure and earth-quake sources.

Acknowledgments: We gratefully acknowledged the work of all participants in the field deployment; R. Busby, P. Crotwell, D. Guo, J. Hammer, R. Last, C. Moshy, P. Ngereja, S. Owens, and A. Tesha. Funding for this project has been provided by the National Science Foundation. •

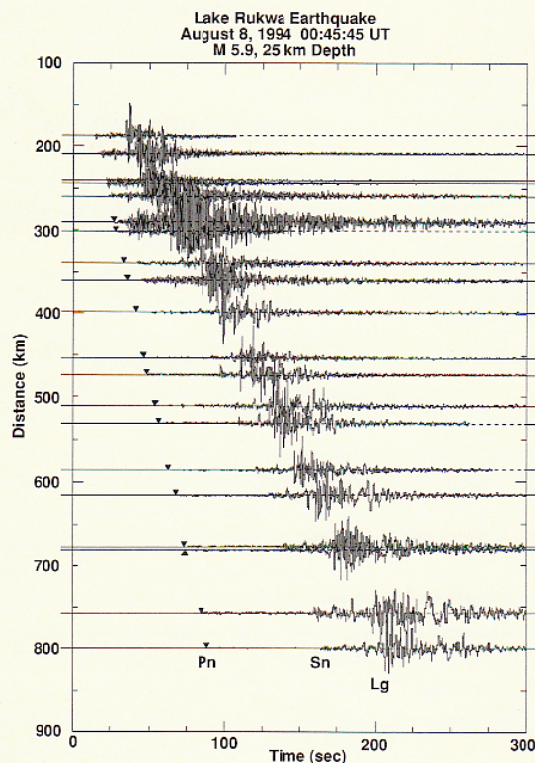


Figure 3. Record section for the Rukwa earthquake. Event location is shown by a solid star in Figure 1.

Execom News

IRIS PROPOSAL TO NSF

IRIS is funded by NSF through a Cooperative Agreement which lasts five years. This Cooperative Agreement is based on a proposal prepared by IRIS which outlines our scientific goals and directions. The review process for the proposal is quite rigorous; it includes a review by a special panel assembled by NSF and approval by the National Science Board. We are about to enter the last year of our second Cooperative Agreement (1991-1996), and are working on submission of a new five year proposal by the end of June, 1995. In preparation for this proposal the EXECOM appointed a Science Task Force, chaired by Bob Phinney and John Orcutt to help identify future directions of seismology to which IRIS must respond. The STF met in mid January and has issued a preliminary report to the EXECOM, which has now developed a plan for the proposal. It will be composed of three separate parts:

- (1) the actual proposal, a focused summary of the future of IRIS,
- (2) a review of the accomplishments of IRIS in the last decade, and essays on the direction of earth sciences in the next five years, and
- (3) the budget and implementation plan.

The proposal will be developed and written by mid-May. After that time it will be available via a special IRIS MOSAIC page for your comments and suggestions. We will revise the proposal in time for the Annual Workshop (June 21-24), where the EXECOM will ask the IRIS membership for final approval. We need broad community input to make this proposal excellent — I hope each and every one of you will get involved.

Terry Wallace, chair

POSEIDON

Seiji Tsuboi

Earthquake Research Institute, University of Tokyo

The POSEIDON (Pacific Orient SEismic Digital Observation Network) project was planned in the mid 1980s by a group of Japanese seismologists. In its first plan, the main target of the project was to install permanent ocean bottom broadband seismographs in the north western Pacific Ocean. Although we had continuously negotiated with the Ministry of Education, the project has unfortunately not been funded. However, even though the full size project did not start, a land-based broadband seismograph networks in and around Japan have been realized by various kinds of funds. More than 30 broadband seismograph stations are now operating in and around Japanese islands, and the south west Pacific, including one in Antarctica. These broadband seismograph stations are installed and maintained by various universities and government institutions. We collectively refer to this broadband seismograph observation network as POSEIDON (Figure 1). Stations outside of Japan in this figure are: Parapat in Indonesia, Pohang in Korea, Tagaytay in Philippines, Kamenskoye in Russia and Ponape in Micronesia. This figure also includes stations installed under collaboration with other seismic networks, such as, Port Moresby in Papua New Guinea, which is between IRIS, GEOFON and POSEIDON and Yuzhno-Sakhalinsk in Russia which is between IRIS and POSEIDON. It also includes two planned stations: one in Indonesia and the other in Palau. Among these 30 stations, 21 stations are equipped with the Streckeisen STS-1 broadband seismograph and 24 bit digitizer. The rest of stations are equipped with the Streckeisen STS-2 broadband seismograph and 24 bit digitizer. Most of the

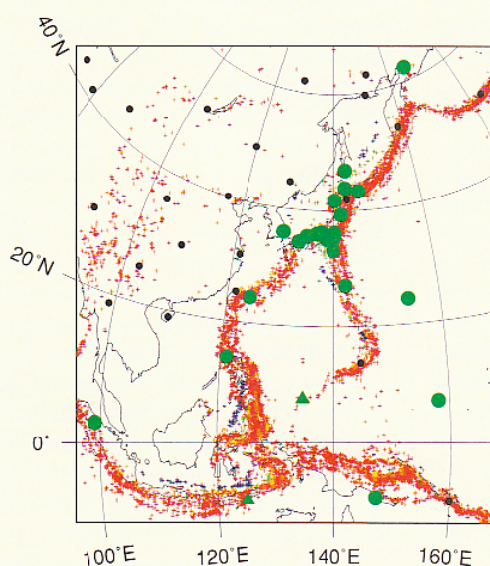


Figure 1. This figure shows locations of POSEIDON stations. The green circles are existing POSEIDON stations as of February 1995. The green triangles are planned POSEIDON stations. The black circles are existing stations of other networks. Also shown are locations of hypocenters from ISC bulletin by plus symbols. The colors of symbols illustrates the depth of hypocenters. The depth becomes deeper as the color changes from red to blue.

STS-1 seismographs were installed in tunnels of existing seismological observatories to obtain high signal to noise ratio. Some of the STS-2 sites of this network, however, are not necessarily quiet since a good location was not available. All of the stations within the Japanese Islands and in Korea and Micronesia are remotely accessible by the telephone line or the Internet and event/continuous data are available in quasi-realtime if necessary.

Since various data logging systems were used in this network because of funding by different institutions, it was not possible to use the same data format and the same sampling rate. We are now trying to install PC-based data logging systems, developed at the Earthquake Research Institute (ERI) of the University of Tokyo, at each station to retrieve continuous data with 20 Hz sampling rate and the same format. The event/continuous broadband seismograms of POSEIDON stations retrieved by this system, which is called the

Earthquake Research Institute Observation System (ERIOS), are now available at the POSEIDON Data Center at ERI. This is a center for collecting, distributing and archiving the digital seismograms recorded at those broadband stations. At present, continuous data from Aobayama (AOB), Inuyama (INU: collaboration with GEOPSCOPE), Ishigaki-jima (ISG), Kitagami (KGJ), Kaminokuni (KKJ), Chichi-jima (OGS), Shiraki (SHK), and Tsukuba (TSK) are collected in quasi-realtime by telephone line or the Internet and archived on a magneto-optical disk library system at ERI, which has a maximum capacity of 1 Terabyte. Archived data can be retrieved through the Internet by using the Data Request Manager system running on our workstation. We are planning to add continuous data from several more stations to this system by the end of

1995. Continuous data from broadband stations outside of Japan, such as PSI (Prapat, Indonesia), PHN (Pohang, Korea), TGY (Tagaytay, Philippines), KMS (Kamenskoye, Russia), PATS (Ponape, Micronesia), and SYO (Syowa, Antarctica) will be available also through this system in the future. The Data Request Manager system is still in a developing stage and has some limitations in its usage. Please contact us or send email to poseidon@eri.u-tokyo.ac.jp as for the current status of the system.

In 1991, GOPHER (now called SPYDER) was installed at ERI in collaboration with the IRIS DMC. ERI's GOPHER now calls IRIS/GSN stations MAJO in Matsushiro and TATO in Taiwan automatically when triggered by the BADGER system at the IRIS DMC. Then event data from these stations are transferred to the IRIS DMC by the Internet from ERI. We also trigger ERI's GOPHER to retrieve POSEIDON stations when local earthquakes occur in and around the Japanese islands. Event data from broadband stations in Japan and several IRIS stations for local and global earthquakes are available through the ERI "gopher view" via the bulletin board of the IRIS DMC.

Among the research done using the broadband data of the POSEIDON network, here we show an example of an automated processing to determine source mechanisms of earthquakes done by Hitoshi Kawakatsu at ERI. The process consists of the following four parts: (1) The process is initiated by email (at present QED event e-mail is used). (2) Retrieve waveform data through GOPHER or ERIOS. (3) Determine the source mechanism using the centroid moment tensor (CMT) inversion method for long-period bodywave data. (4) Distribute CMT solutions by e-mail.

The whole process can be put in several

shell scripts on a UNIX machine, and nobody at ERI needs to touch the process of determining source mechanisms. The method has been successfully applied since October 1993 for all the major earthquakes in the world for which we received QED event mail. At the moment, the most time consuming part is the first step (QED e-mail arrives several hours after the occurrence of earthquakes). The last two steps usually take less than ten minutes, and the second

step depends on how many stations we need to use. Figure 2 shows the elapsed time needed to obtain final CMT solutions for the events that occurred in 1994. It is now possible to obtain solutions within six hours in most cases. For the Northridge, CA earthquake in January 1994, the solution was obtained within three hours, because we received the QED e-mail earlier than usual. For local events (e.g., events in Japan or in western Pacific), we believe that it is possible to determine CMT solutions within 30 minutes from the occurrence of earthquakes, using an efficient dialup data retrieval system, such as ERIOS.

There are now three projects in Japan related to broadband seismograph networks that are scheduled to start in 1996. One is to install dozens of broadband seismographs during the next ten years in the Japanese islands and retrieve continuous data in realtime. This project is funded by the Science and Technology Agency and will be conducted by the National Institute of Earth Science and Disaster Prevention. The second project is to install ocean bottom seismographs in the north western pacific region. This project is funded by the Ministry of Education, Science and Culture. The third one is also funded by the Science and Technology Agency and will provide assistance in installing broadband seismograph stations in the Pacific Ocean. Since

all three projects are scheduled to start in 1996, we are now discussing ways to integrate all projects into one project with a new name instead of "POSEIDON". Then all the data from these projects will be sent to one data center to create an integrated database. After almost ten years since its planning, POSEIDON has never started officially and will finish its role in 1996, evolving into a new stage. •

ERI AUTOCMT PERFORMANCE

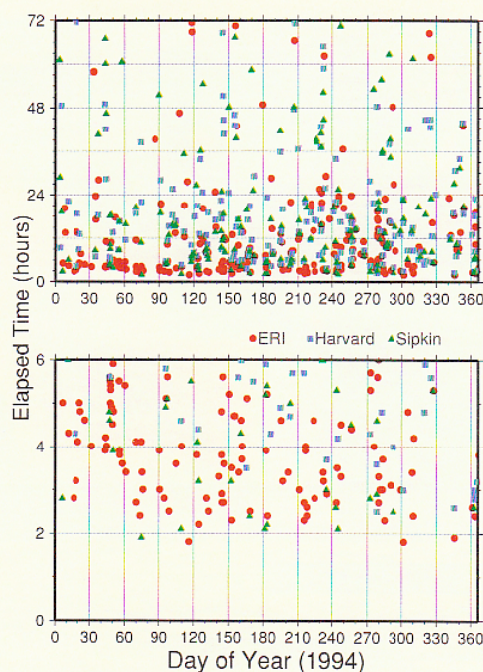


Figure 2. This colorful figure shows the time performance of AUTOCMT and quick moment tensor solutions of Harvard and Stuart Sipkin of USGS. The horizontal axis gives Julian day corresponding the occurrence of earthquakes, and the vertical axis is the time elapsed to obtain moment tensor solutions, estimated from e-mail headers. (It corresponds to the time that e-mail is sent and may not represent the actual time when solutions are determined). Red circles are for AUTOCMT, blue squares are for Harvard quick CMT, and green triangles are for Sipkin's solutions.

ASET - Array based Seismic Emission Tomography

Vladimir Gurevich, Vasily Kiselevich, and Boris Shoubik
IRIS Moscow Data Analysis Center (MDC)

The Moscow Data Analysis Center (MDC) in Moscow, Russia is the only non-US node in the IRIS Data Management System (DMS). A variety of software related projects are undertaken using support from the IRIS DMS. ASET is an example of the type of work being performed at MDC and the host SYNAPSE science center.

The ASET project is oriented toward the application of mobile seismic arrays in seismic research. The aim of the project is the development of the seismic noise array method and related software for seismic array data processing. The technique falls into the class of emission tomography methods but, in contrast to classic tomography, 3-D images of the microseismic activity of the media are obtained by a passive seismic antenna scanning the half-space, rather than by solution of the inverse Radon problem.

It is reasonable to expect that areas of geothermal activity, active faults, areas of volcanic tremors and hydrocarbon deposits act as sources of intense internal microseismic activity or as effective sources for scattered (secondary) waves. The traditional approaches to seismic investigation of a geological medium involve analysis of narrow-time window signals from artificial or natural sources. However, continuous seismic oscillations (e.g. endogenous microseisms,

coda and scattering waves), can give very important information about the structure of the Earth. The presence of microseismic sources or inhomogeneities within the Earth, can result in the appearance of coherent seismic components in a stochastic wave field

recorded on the surface by a seismic array. By carefully processing seismic array data, these coherent components can be used to develop a 3-D model of the microseismic activity of the media or images of the noisy objects. First steps in this direction were made by Drs.

Alexey Nikolayev and Peter Troitsky from IPE in early 1980 during processing of NORSAR data. The processing is mainly based on calculations of the relative energy of coherent radiation of spherical waves originating from different points or small volumes below the seismic array. Thus in contrast to classic seismology where narrow windows are used to get the best time resolution of seismic signals, this model requires a long record length for the best spatial resolution.

The processing algorithm is based on a linear additive model of signals and noise. The "Semblance" (S) or "Signal/Noise Estimation" (RO) procedures are used to calculate the relative energy of coherent radiation. These estimates are very sensitive to the presence of coherent components in the multichannel seismic recording. The set of S (or RO) values calculated for number point (Xi, Yj, Zk) of the scanned volume

reflect the spatial distribution of seismic activity (radiated or scattered) of the medium beneath the array.

The PC version of the software (ASET 1.0) was developed by Vasily Kiselevich and Boris Shoubik during the Academy of Sciences of the USSR expedition (lead by Professor. Rykunov) to NE-Iceland Axarfjordur region in 1988 and

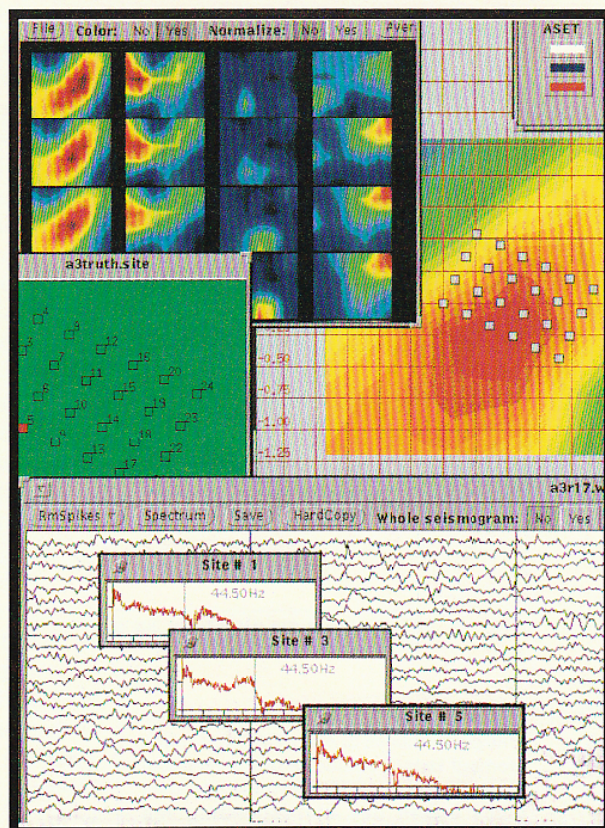


Figure 1. Example of ASET tools using data from a 24 element mobile array in Iceland. Lower window - data preprocessing tool with facility for data visualization, editing, stacking and spectral analysis. Left-middle window - interactive, graphical editor for site and volume files. Upper-left window - cross sections of medium under seismic array. Background window - contoured S-map with array location.

1989, when mobile arrays were located over a high temperature geothermal field. The software developed included numerical modeling, field data acquisition, and seismic array data processing. In 1992-1993 in cooperation with Prof. C. Archambeau (University at Colorado, Boulder), the software was redesigned at the MDC/SYNAPSE by Kiselevich, Shoubik and Vladimir Gurevich. During 1992/93 the Sun version of ASET (ASET 2.0) was developed. The most important goal of this project was to provide users with a convenient tool combining sophisticated data processing algorithms, ability to access data represented in common formats, easy data manipulation (stacking, time series analysis, color mapping of scanned medium, etc.), and advanced graphics facilities. The ASET user interface and color 2D and 3D graphics were implemented using Xlib and XView toolkit. ASET is able to process data represented in CSS 2.8/3.0 formats, with several new ASET-specific relations added to the standard database schema. Figure 1 presents some results of ASET 2.0 processing of mobile seismic array data from the Arafjordur region.

The applications of this technique are directed toward: a) the formation of 3-D spatial images of the intensity distribution of noisy objects (and/or secondary wave sources) by using microseisms or the coda-waves from both artificial and natural sources; b) the study and monitoring of the seismic source zones and in areas of potential environmental impact; c) the monitoring of well drilling or of mineral deposit exploitation. •

Seventh Annual IRIS Workshop

Registration and travel information forms are now available for the Seventh Annual IRIS Workshop. If you have not received them, please contact Anne or Liz at the IRIS office. The registration deadline is **April 14**.

Activities will begin with an icebreaker and registration on Wednesday evening, followed by scientific sessions Thursday and a half day Friday. Friday afternoon we will offer an optional field trip to Teton Fault which will end in an evening barbeque. Saturday will feature more sessions, concluding in the evening. Information about a self-guided tour of Yellowstone will also be presented.

Talks at the scientific sessions will be *by invitation only*. All participants are encouraged to bring posters on any IRIS-related subject. One page abstracts for posters must be submitted to the IRIS office by **May 1**.

Participation in the workshop is not limited to IRIS members and all interested parties are welcome to attend, subject to availability of accommodations.

General questions may be directed to Liz McDowell (liz@iris.edu) or Anne DeLaBarre (anne@iris.edu) at IRIS headquarters (703/524-6222). See you in Wyoming! •

IRIS Bids Farewell To a Loyal Employee

February 3rd was a bittersweet day for IRIS headquarters employees as they bid farewell to Newsletter Production Editor, Denise Dillman Crump. Denise served many roles during her four years of service, and was instrumental in reshaping the IRIS Newsletter and Annual Report into professional publications distributed and read throughout the scientific community and around the world. She also played a major part in assisting with coordination of IRIS Workshops in South Carolina, New Mexico, Hawaii and California. Denise relocated to Utah to be near her family and although we miss her, we wish her much happiness and the best of luck and success!

Anne DeLaBarre is replacing Denise as Newsletter Production Editor. •

van der Vink Appointed to Advisory Committee

Gregory van der Vink, IRIS Director of Planning, has been appointed by President Bill Clinton to serve on the Scientific and Policy Advisory Committee of the Arms Control and Disarmament Agency. The Committee will advise the President, the Secretary of State, and the Director of the United States Arms Control and Disarmament Agency on scientific, technical, and policy matters related to arms control, nonproliferation, and disarmament. •

PEPP Participants Selected

Eleven proposals were received in response to the request for IRIS member institutions to take part in teacher training programs and installation of high school seismographs through the Princeton Earth Physics Project (PEPP). The two groups selected for participation in 1995 were from the University of Arizona (Michelle Hall-Wallace, George Zandt and Terry Wallace) and Oregon State University (Anne Trehu and John Nabalek). Teacher training sessions will be held this summer and installation of seismographs will take place later in the year. An announcement for participation in the next and expanded stage of the PEPP network will be announced in the IRIS Newsletter later in 1995. •

New Information Products Available

The JSP Center has submitted one new Information Product since the last Newsletter.

Chinese Nuclear Test of October 7, 1994

An underground nuclear test was conducted at the Chinese Nuclear Test site at Lop Nor on October 7, 1994. This preliminary information product contains data from the SPYDER system as well as network data from the JSP Kyrgyz network.

For more information please refer to IRIS DMC electronic bulletin board (telnet iris.washington.edu) userid = bulletin, password = board, or MOSAIC server (<http://www.iris.washington.edu/>).

IRIS Home Page

The IRIS Home Page is now available on Mosaic. Viewers can access the home page through URL: <http://www.iris.edu/> to obtain information on membership, the committee members, and IRIS publications, including an on-line version of the latest newsletter. The PASSCAL section has copies of the latest instrument schedules, instrument request forms as well as information and manuals for all of the equipment. The DMC connection allows direct connection to the DMC for information on data available and access to the on-line data.

Correction: We apologize for an error in the Fall, 1994 Newsletter when UNAVCO was omitted as an organizer of the Global Geophysical Observatories Workshop held at IGPP in April, 1994.

Rescue Of Unique Czech/Polish Very-Broad-Band Data Archive

*Axel Plesinger, Geophysical Institute of the Czech Academy of Sciences
Tim Ahern, IRIS Data Management Center*

The Feedback-controlled Broad-band Velocity-sensing Seismograph System (FBVSS), was installed at the Czech seismic station Kasperske Hory (KHC) in 1971-72 and put into continuous operation on January 1, 1973 (Plesinger and Horalek, 1976). This station was most likely the first routinely operated three-component VBB system in the world. Although the principle of the FBVSS differs from that of broad-band force-balance seismometers (the outputs of moving-coil long-period seismometers are amplified by feedback-controlled photoamplifiers, and the pass-bands of the seismometer-photoamplifier systems are extended to about 300 seconds by negative feedback to the seismometer proportional to the 1st and 2nd derivatives of the pendulum deflection), their frequency response is consistent with that accepted in the 1980's as standard VBB response (Wielandt and Steim, 1986). The VLP and, especially, ULP resolution of FBV systems is, however, much lower than that of Streckeisen STS-2 or Guralp CMG-3 force-balance seismometers. The FBVSS records each seismic component (Z,N,E) bi-level with an overall dynamic range of 80 dB (2-times 60 db with 40 db overlapping) in frequency-modulated (FM) form on 12-track analog magnetic tape. Timing information is recorded redundantly in the forms of IRIG standard time code and radio-controlled minute marks.

The FBVSS at KHC had been in continuous operation until 1986. Another station of the same type was established through Czech-Polish collaboration at the Ksiaz (KSP) observatory, Poland, in 1977. This system is still recording at KSP but will be upgraded in May of 1995 to a 16 bit digital system that will be flat to velocity from 0.1 to 120 seconds. At present the KHC/KSP FBVSS data archive consists of over 180 tapes containing more than 10000 complete (P, S, L and coda) VBB seismograms of regional mb > 3.5 and teleseismic mb > 5.2 events, of strong local events, and of selected time intervals corresponding to reported nuclear explosions (Nevada, Kazakh, Novaya Zemlya, Semipalatinsk, Mururoa). The lengths of the archived FM records range from several tens of minutes for local/regional events to several hours for teleseismic events. In no case is the recorded pre-event portion shorter than 20 minutes. Additionally, in cases of free modes excited by very strong earthquakes, the record lengths exceed one day.

In order to rescue the KHC/KSP FBVSS FM-tape archive, which is approaching the limit of its life expectancy (the first KHC tapes are now 21 years old), and to provide the unique data in conventional digital formats to the seismological community, an agreement between the IRIS DMC, Seattle, and the Geophysical Institute of the Czech Academy of Sciences, Prague, was signed last year. Within this agreement, the FM data from the archived tapes are being successively converted into binary digital form; the raw binary data are converted, together with station and calibration information, to standard GSE and SEED formats; the GSE data are stored on CD-ROMS in Prague; and the data in SEED format on Exabyte tapes are forwarded to IRIS DMC for incorporation into the global digital database.

The necessary special hardware (PC-controlled multichannel FM- demodulation, analog pre-processing and A/D conversion system) and software (program GEOSCAN for interactive quasi-on-line multichannel A/D conversion) was

developed in the GI CAS in collaboration with an external expert in computer-aided ADC. The basic parameters of the A/D conversion are: a sampling rate of 15 samples per second, additionally a 1 sample per second channel for long period representation of strong events and free modes; a corner-frequency of anti-aliasing filters 3 Hz and 0.2 Hz, respectively; number of converted channels 3 + 1 (components Z,N,E + minute marks); resolution 16 bits (96 db); effective dynamic range of original analog data 56 - 62 db.

The systematic transcription of the entire data set was started in Prague in April 1994. The first data were successfully archived at the IRIS DMC in January, 1995. These first data contained the seismograms from KHC for the years 1973 through 1976 and are stored in the IRIS DMC Data Management Center under network code CZ. The data are distributed in SEED format and therefore include full response information.

The routine work at the Geophysical Institute of the Czech Academy of Sciences is being done by Josef Horalek and co-workers, and by Jan Zednik and Miloslav Musil. The transcription of the complete KHC/KSP archive will take the team about two years. Bernard Dost and Reinoud Sleeman of the ORFEUS Data Center in De Bilt, The Netherlands, contributed to the data rescue project by solving tricky problems of GSE to SEED format conversion of FBVSS seismograms. The incorporation of the data into the global database at IRIS DMC is taken care of by DMC operations staff including Rick Benson, Raoul Titus, Rob Casey and Anh Ngo. Data requests are serviced in the same manner as data requests for IRIS GSN or Federation of Digital Seismographic Networks (FDSN) data.

GSN Update

Seven new GSN stations have been installed since the last newsletter.

The IRIS/ASL team has completed five vault sites: DAV, Davao, Philippines; KBS, Ny-Alesund, Spitzbergen, Norway; AAE, Addis Ababa Ethiopia; SEO, South Korea; and ULN, Ulaan Baatar, Mongolia. The KBS site is a cooperative joint station with the German GEOForschungsNetz (GEOFON) and the Alfred Wegner Institute for Polar Research (AWI). AAE is a cooperative site with Addis Ababa University. SEO and AAE currently only record Guralp sensors at 40 sps in WWSSN vaults—Strecker STS-1s will be installed when new vaults are completed.

The IRIS/IDA group has completed the installation of two borehole sites: ASCN, Ascension Island, South Atlantic, and NIL, Nilore, Pakistan.

Current Seismological Observations in the Czech Republic

To continue the long-term tradition in broad-band observations in the Czech Republic, a dial-up STS-2/Quanterra station was deployed at Dobruska/Polom (DPC) in Northeast-Bohemia in 1992. DPC soon became a part of the SPYDER (formerly GOPHER system). The VBB data, sampled at 20 Hz, are recorded and regularly shipped to the Albuquerque Seismological Laboratory and finally merged into SEED volumes at the IRIS DMC. Like KHC and KSP, the DPC site is characterized by an excellent S/N ratio. All three sites were carefully chosen with respect to detecting nuclear explosions and to undisturbed recording of long-period and ultra-long-period seismic signals. The seismometers have been installed in temperature-stable conditions on compact underlays in underground vaults at depths of 10 meters (DPC) and 40 meters (KHC and KSP).

In the past four years the well-known high detection capability of KHC has deteriorated because of a revival of local gold-mining activities. This is why no continuation of VBB observations at this otherwise ideal observation site is foreseen at present. In the near future, the FBV system at KSP will be replaced by a digital broad-band system with Geotech-Teledyne BB13 sensors.

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Wielandt, E. and J.M. Steim, 1986: A digital very broad-band seismograph. *Annal. Geophys.*, 4B, 227-232.



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IRIS Newsletter

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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.

Executive Editor: David Simpson (simpson@iris.edu)

Production Editor: Anne P. DeLaBarre (anne@iris.edu)

New FARM Products, Yours for the Picking

*Tim Ahern and Rick Benson, IRIS Data Management Center
Ken Creager, University of Washington*

In 1993 the demand on the IRIS DMC was increasing exponentially. A strategy of developing a Fast Archive Recovery Method (FARM) was pursued in an effort to both improve the response time for users and decrease the load on the DMC. The FARM was recognition that many seismologists are satisfied with waveform data from seismic events. By systematically assembling all of the data for an earthquake into a single SEED volume, the DMC staff could produce one FARM product that would meet the needs of many researchers. By placing these products in the anonymous ftp area, researchers could gain immediate access to the data of interest without interacting with DMC staff. The important ability for a researcher to gain access to any recorded data, even when events did not exist, could still be met by the variety of methods users have for making Customized Requests.

The first FARM products were produced in 1993, using the algorithm that the NEIC had used so successfully for the NEIC Event CDROMs. In 1993 and 1994 a total of 2,884 FARM products were sent to researchers worldwide. In fact the number of FARM shipments during 93-94 was almost identical to the number of Customized Requests the DMC serviced. By the end of 1994 we were seeing a significant shift toward the use of FARM products.

Near the beginning of 1994 it became clear that the windows used for the FARM products were too short to include many of the later arriving phases. For this reason the FARM algorithm was changed early in 1994 and a systematic rebuilding of the entire FARM products was undertaken.

FARM products are assembled for all events with $M_w \geq 5.8$. In the case of events deeper than 100 kilometers the magnitude threshold is lowered to $M_w \geq 5.5$. In general the DMC must wait for about six months behind real time to insure that all data that are going to be contributed from the IRIS GSN have been collected and passed through quality control. The FARM forms a very complimentary data set to the SPYDER (previously GOPHER) data set of data that is recovered in near real time using a variety of telemetry techniques. It is noteworthy that at the present time, SPYDER datasets of non-quality controlled data are removed from on-line access when the corresponding FARM product is made available.

The time windows in the new FARM products are greatly enlarged. For broad, mid, intermediate, and short period channels the window begins 2 minutes before the predicted P or Pdiff time and continues for one hour. For events $M_w > 7.7$, the windows are increased to roughly 3 hours. The long period data streams use the NEIC algorithm starting 10 minutes

before the P or Pdiff arrival time and continuing for 1 hour for small events up to 12 hours for $M_w = 8.0$.

FARM products are mounted in the anonymous FTP area of dmc.iris.washington.edu. You can access by either:

- Using MOSAIC (URL=<http://www.iris.washington.edu/>).
- Using ftp ([ftp dmc.iris.washington.edu; cd pub/farm](ftp://dmc.iris.washington.edu/cd/pub/farm)).
- An access through the IRIS DMC Electronic Bulletin Board is under development.

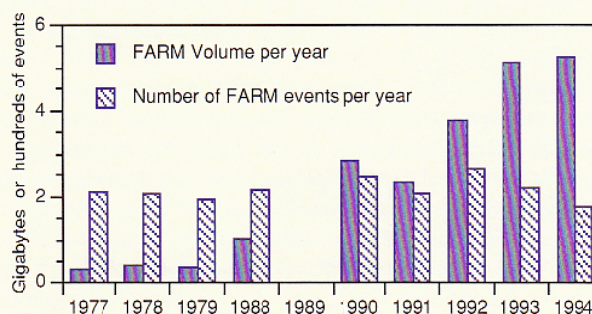


Figure 1. Yearly volume and number of event contained in the FARM archive. Note 1994 includes events only up to September.

FARM products exist in a date-oriented directory structure in [ftp/pub/farm](ftp://pub/farm). The directory for each year contains 12 monthly directories and a file called `eg. 1994_EVENTS`. This is a simple text file that will give you a summary of the events for which FARM products have been built for the selected year. In each of the monthly directories are series of subdirectories with names in the form "yrmoda_hrmn" (eg. 940103_1324). This directory will contain all of the FARM related information for the event (i.e. January 3, 1994 at UTC time 13:24) including at least four files whose name begins with the date and time of the event and has one of four suffixes:

`.contents`- result of running the RDSEED contents (c option) on the SEED volume. It includes the stations, channels and time windows in the SEED volume along with the SEED volume creation date and hypocenter information pertinent to this event.

`.gif`- a pseudo record section display of all the broadband vertical channels in the SEED volume, produced by the CORAL program developed by Ken Creager and Tom McSweeney of the University of Washington.

`.problems`- the result of the RDSEED error logging, plus any problems discovered either by DMC staff or by users.

.seed- the SEED volume containing the waveform data for the event. This file is normally quite large, so it is wise to see how large it will be before you try to transfer it.

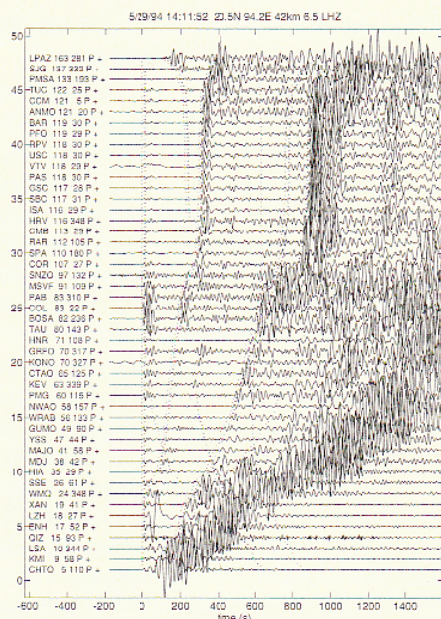


Figure 2. An example of the pseudo record section plot included as a .gif file with each FARM event. Stations are sorted (but not scaled) by distance. Information on the left includes station name, distance (degrees) and azimuth.

There may also be other files and directories in an event's directory. For instance FDSN SEED event files will be included for some of the events for which FARM products exist. Also included could be some near real time data collected by the SPYDER system that did not get processed in the normal quality controlled data in the FARM products. The best place to look for "additional data" for a specific event will always be in the appropriate FARM directory.

Disk space limitations prevent us from storing all FARM products on-line. We are developing a mass storage migration utility that will allow a virtually unlimited number of FARM products to exist and for users to automatically gain access to them without operator intervention. The mass storage systems are robotic systems available 24 hours a day, 7 days a week. If you see a file name such as 940529_1411.seed_offline it means that the SEED volume containing the data is not on magnetic disk but rather is in the mass storage system. By accessing the .seed_offline file (by clicking on it in Mosaic or getting it in anonymous ftp) a routine will recover the desired SEED volume for you and place it in the appropriate FARM directory with the .seed suffix.

The IRIS DMC presently has 1939 FARM products for the years 1977 through 1979 and from 1988 through September of 1994. The average size of the FARM products in this period is

just over 10 megabytes and they increase in size as one gets closer to the current time due to the large increase in the number of IRIS GSN stations. The largest volume (102 megabytes) is for the 1994 Bolivian earthquake. We anticipate adding 1989 FARM products in the very near future.

The DMC presently has 21.4 gigabytes of FARM products on-line and available to anyone wishing to access them. We think that more than 90% of user's needs will be met by these products and we encourage the research community to turn to the FARM before making customized requests. We have implemented a system that compares a user's request with what is available in a FARM product and users whose requests intersect an existing FARM product significantly will be notified and encouraged to use the FARM product. We intend to always give the users what is requested but requests that have significant overlap with FARM products may be processed with a lower priority at the DMC in the future.

One disadvantage with the FARM products is that they may contain far more data than the user may want. A user who is only interested in long period data may be unhappy to transfer 25 megabytes of data when most of it is broadband data. We are currently developing a capability to selectively recover portions of the FARM products. The Customized Reduction Of Products (CROP) capability will do just as the name implies. A FARM product can be cropped to contain only the information of interest. A user could extract all the data for a few stations from a product, or only the long period vertical channels. Eventually they will even be able to extract smaller time windows based on phase arrivals. The CROP procedure will use RDSEED which Chris Laughon at the DMC has modified so that it can take any SEED volume as input and output a smaller SEED volume as output. The end user will still receive a complete SEED volume.

The FARM products contain no Very Long Period or Ultra Long Period data. A separate FARM product called the UV-FARM is being systematically constructed at the DMC. The UV-FARM will consist of data from all IRIS stations that generate either Very Long Period (VLP) or Ultra Long Period (ULP) data streams. The UV-FARM products will contain two weeks of continuous from the ULP and VLP channels. 1995 should see the completion of the UV-FARM products as well. At the present time UV-FARM exists for 1992.

The FARM Products are produced routinely at the DMC. Many people's efforts have gone toward the production of this valuable resource. Tom McSweeney at the University of Washington has made valuable contributions both toward the design and construction of the FARM products. DMC staff including Rick Benson, Raoul Titus, and Rob Casey have worked diligently for long hours to bring this resource to you. Anh Ngo, a new DMC employee is developing the off-line migration system that will provide access to the FARM products in the mass storage system. We expect this facility to be complete by the second quarter of 1995. •

Calendar

JUNE

21-24 **Seventh Annual IRIS Workshop, Jackson Lake Lodge, Grand Teton National Park, Wyoming**

JULY

1-15 **IUGG Meeting, Boulder, Colorado**

New Members

IRIS welcomes as a new member: Southeast Missouri State University, Haydar Al-Shukri, Representative. IRIS also welcomes as new foreign affiliates: Istanbul Technical University, Turkey, Tunçay Taymaz, Representative; Peking University, China, Shao Xian Zang, Representative; Tubitak-Marmara Research Centre, Turkey, M. Namik Yalçın, Representative; National Central University, Taiwan, KuoFong Ma, Representative; Geophysical Institute, Czech Republic, Axel Plesinger, Representative; University of Hong Kong, Hong Kong, Lung Sang Chan, Representative.

IRIS - 2000

IRIS Needs Your Participation and Help

Plans are now developing of the next IRIS five-year proposal to the National Science Foundation (see EXCOM News from Terry Wallace on page 7).

To create a compelling proposal, we need to provide strong evidence of the utility and application of IRIS data and facilities, and the impact they have had on Earth science research. We encourage your active support in the following ways:

Bibliographies - IRIS is intended to support research in the Earth sciences and the publication of research results is the most concrete evidence of a successful program. Please mail, fax (703-527-7256) or e-mail (proposal@iris.edu) a list of any publications that have utilized IRIS data or facilities. The most convenient way may be to provide us with a copy of the publications section of your curriculum vitae, with IRIS-related articles identified. Reprints of articles would also be appreciated.

"One-pagers" - A key section of the proposal will be short descriptions of recent advances in seismology and geophysics that have resulted from the use of IRIS data and facilities. It will be printed as a stand-alone document that will serve as a useful teaching and reference volume. Copies will be provided to all contributors. IRIS members and users of IRIS data are encouraged to submit one page descriptions of the main results of their recent investigations. The focus should be on how IRIS and our facilities have had an impact on your research. Especially appropriate are short descriptions of studies using GSN data or PASSCAL experiments, with a map, sample of data and summary of results. One or two figures can be included and you should append a list of resulting publications. Submission in electronic form (RTF or unformatted ASCII text and PostScript figures) to proposal@iris.edu is preferred. Please submit material as soon as possible, but no later than May 10. Feel free to submit more than one article. All material will be "published" in a Mosaic version of the proposal and selected articles will be included in the printed version. Guust Nolet and Jeffrey Park (park@dana.yale.edu) are acting as compilers of this section of the proposal.

Ideas - You are also encouraged to provide any general comments on the future directions for IRIS or ideas for the proposal to the Chair of the IRIS Executive Committee, Terry Wallace (wallace@eqsun.geo.arizona.edu) or David Simpson, IRIS President (simpson@iris.edu).

A productive future for IRIS depends on your support and participation - please contribute!



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