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INTRODUCTION

This is the second semi-annual report of a series describing current research and operations at the National Earthquake Information Center (NEIC) of the U.S. Geological Survey in Golden, Colorado. Selected investigations that characterize research activities are summarized in the first section of this report. General information on data services available from the NEIC are included in a separate Operations section.

This issue begins with an article by S. Nishenko that summarizes a probabilistic study of long-term earthquake potential in the circum-Pacific region. Another article, submitted by W. Spence, describes the results of a recent study of stresses within the Cascadia subduction zone in the northwest United States. The Research section concludes with a note by J. Boatwright and G. Choy concerning an ongoing investigation of source spectra for shallow, subduction-zone earthquakes.

The Operations section includes a detailed discussion of several interesting features of reconstructed broadband signals from two earthquakes that occurred in 1988. Also included is a progress report outlining the current status of the U.S. National Seismograph Network. As presented in the first number of this Volume, digital-data and station-status information pertaining to the Network Day Tape program of the U. S. Geological Survey is included under the heading "Global Digital Seismic Data". An appendix to the report lists studies currently in progress or completed during 1988 by NEIC researchers.

Carlos Mendoza

RESEARCH AND DEVELOPMENT

Circum-Pacific Seismic Potential: 1989-1999

S. Nishenko

In the past 30 years, great strides have been made in the fields of seismology and geophysics towards understanding the nature of large and great earthquake occurrence along simple plate boundaries. More recently, these advances have led to the development of long-term earthquake forecasts for specific fault zones. Proof that these techniques and ideas are applicable to at least some areas of the circum-Pacific region was demonstrated by the successful forecast of the M_S 7.8 1985 Valparaiso, Chile, earthquake (Nishenko, 1985). Current national earthquake prediction programs in the United States (e.g., Parkfield, California) and Japan (e.g., Tokai district) have identified specific areas for intensive study based on regularities in the pattern of historic earthquake occurrence and the expectation of future earthquakes. On a broader scale, the recent report prepared by the Working Group on California Earthquake Probabilities (WGCEP, 1988) represents one of the first national probabilistic forecasts for earthquake activity.

The known seismic history for more than 110 seismic gaps around the circum-Pacific region has been investigated to assess the potential for future large and great earthquake activity in terms of a conditional probability for occurrence in the next 10 years (1989-1999). An example of the results of the study are presented in Figures 1, 2, and 3, which summarize earthquake probabilities for three different sections of the eastern and northern Pacific. The level of reliability associated with these forecasts varies from region to region and is influenced by the completeness of the historic record and by our present understanding of the mode of earthquake rupture in these regions. Presenting these data in a probabilistic framework accounts for individual variations in recurrence time along a specific fault segment, as well as for errors in the determination of repeat time, and provides a basis for uniform comparison of seismic hazard between segments with different recurrence times.

The assessment of long-term seismic hazard for the simple plate boundaries of the circum-Pacific region is an active and rapidly-developing field. The time-dependent nature of these forecasts necessitate that this and similar studies be regularly updated. In addition, new data and improvements to the model on which these assessments are based are likely to lead to a revision and refinement of the seismic hazard forecasts currently derived for the circum-Pacific region. Development of reliable intermediate-term forecast methods should also be included in the revised assessments as these become available.

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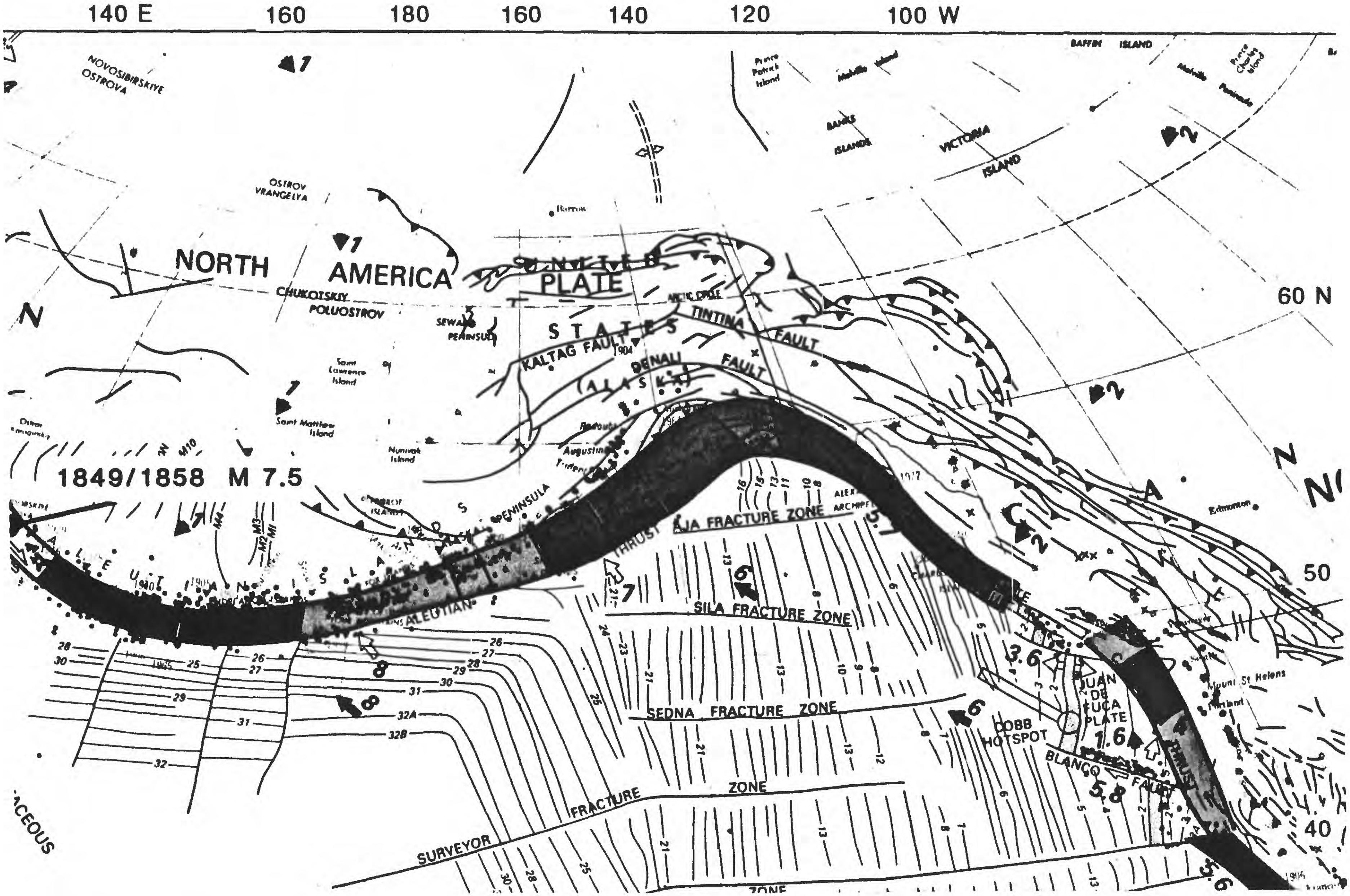

Figure 1. Seismic potential of the Queen Charlotte-Alaska-Aleutian seismic zone: 1989-1999. Colors portray the level of conditional probability for occurrence of large and great (M_S 7.0 or larger) earthquakes during the next 10 years, 1989-1999, and range from dark blue, 0-20%; green, 20-40%; yellow, 40-60%; and red, 60-100%. Light blue regions are those areas with no historic record of large or great earthquakes. Specific dates and magnitudes refer to areas with incomplete historic records (from Nishenko, 1989).

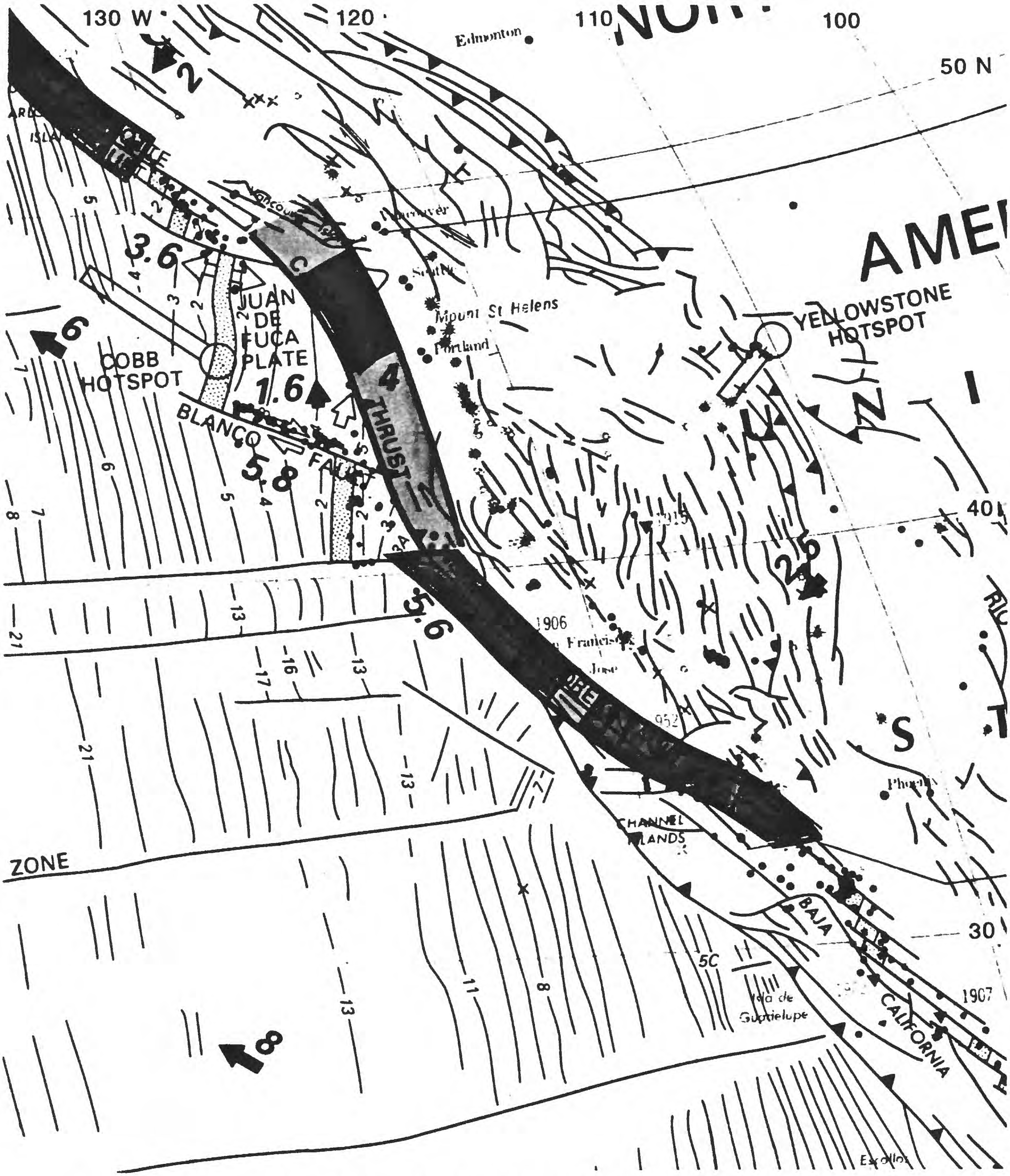

Figure 2. Seismic potential of the San Andreas fault and Washington-Oregon seismic zone: 1989-1999. Colors portray the level of conditional probability for occurrence of large and great (M_S 7.0 or larger) earthquakes during the next 10 years, 1989-1999, and range from dark blue, 0-20%; green, 20-40%; yellow, 40-60%; and red, 60-100%. Light blue regions are those areas with no historic record of large or great earthquakes. Specific dates and magnitudes refer to areas with incomplete historic records (from Nishenko, 1989).

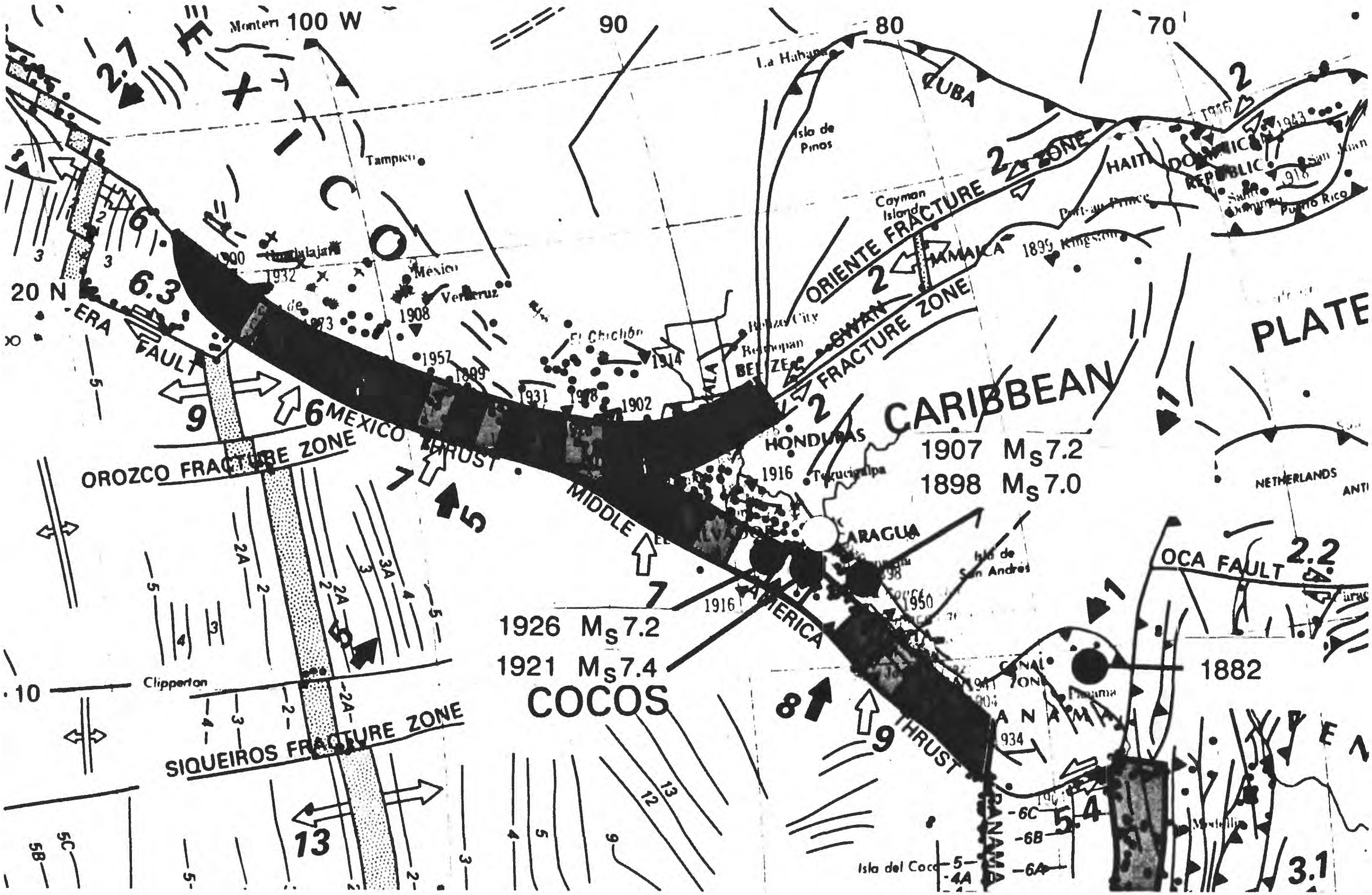

Figure 3. Seismic potential of the Central American seismic zone: 1989-1999. Colors portray the level of conditional probability for occurrence of large and great (M_S 7.0 or larger) earthquakes during the next 10 years, 1989-1999, and range from dark blue, 0-20%; green, 20-40%; yellow, 40-60%; and red, 60-100%. Light blue regions are those areas with no historic record of large or great earthquakes. Specific dates and magnitudes refer to areas with incomplete historic records (from Nishenko, 1989).

STRESS ORIGINS AND EARTHQUAKE POTENTIALS AT CASCADIA

W. Spence

Cascadia refers to a broad region that is centered in the Cascade Mountains of the northwestern United States. This region includes the elements of subducting oceanic lithosphere (i.e., the Juan de Fuca plate, the Explorer subplate, and the Gorda block) and the adjoining section of the continental North American plate. The search for a comprehensive tectonic model for Cascadia has been frustrated for decades by the puzzling and contradictory tectonic and seismic data from that region. Focal mechanism solutions for shallow earthquakes throughout Cascadia indicate that the primary regional stress is northerly compression, even though the Juan de Fuca plate generally is thought to be subducting at N 50°E. This compression is pervasive throughout the Gorda-Juan de Fuca-Explorer plate system and much of the adjoining section of the North American plate. Modeling, using a discrete element code, shows that this stress is primarily due to the Pacific plate being driven into the Gorda block and the Juan de Fuca plate (at the Medocino and Blanco fracture zones). This plate collision causes northerly compression of the offshore plate system northwards through Vancouver Island and leads to transfer of this stress into the overriding plate. Much of the data used in this study and the computed trajectories of maximum compressive stress are shown in Figure 4. The northerly compression in the Cascadia plate system has caused large earthquakes in the regions of Vancouver Is. and northern California, and may be capable also of causing large earthquakes offshore of and in Washington and Oregon. Several independent lines of evidence confirm that the interface between the subducting and overriding plates at Cascadia is coupled strongly and that subduction must be accompanied by significant earthquakes, rather than occurring aseismically. For numerous earthquakes within the subducted plate, focal mechanisms indicate extensional stresses that trend downdip. These earthquakes reflect plate extension that is due to the sinking of a more deeply subducted plate and to plate motion being resisted at the shallow subduction interface. The sinking plate can lead to subduction earthquakes, and the potential exists for magnitude 7.5 to 8.0 earthquakes at segments of the subduction boundary at Washington, Vancouver Is., and possibly Oregon. Thus, a comprehensive tectonic model for stresses and earthquakes at the Cascadia province explains these data as primarily resulting from the action of the Pacific plate on the Gorda-Juan de Fuca-Explorer plate system, from a transfer of this action into the overriding plate, and from the independent sinking of subducted oceanic plate. A paper that develops this model more fully is currently in press in the Journal of Geophysical Research.

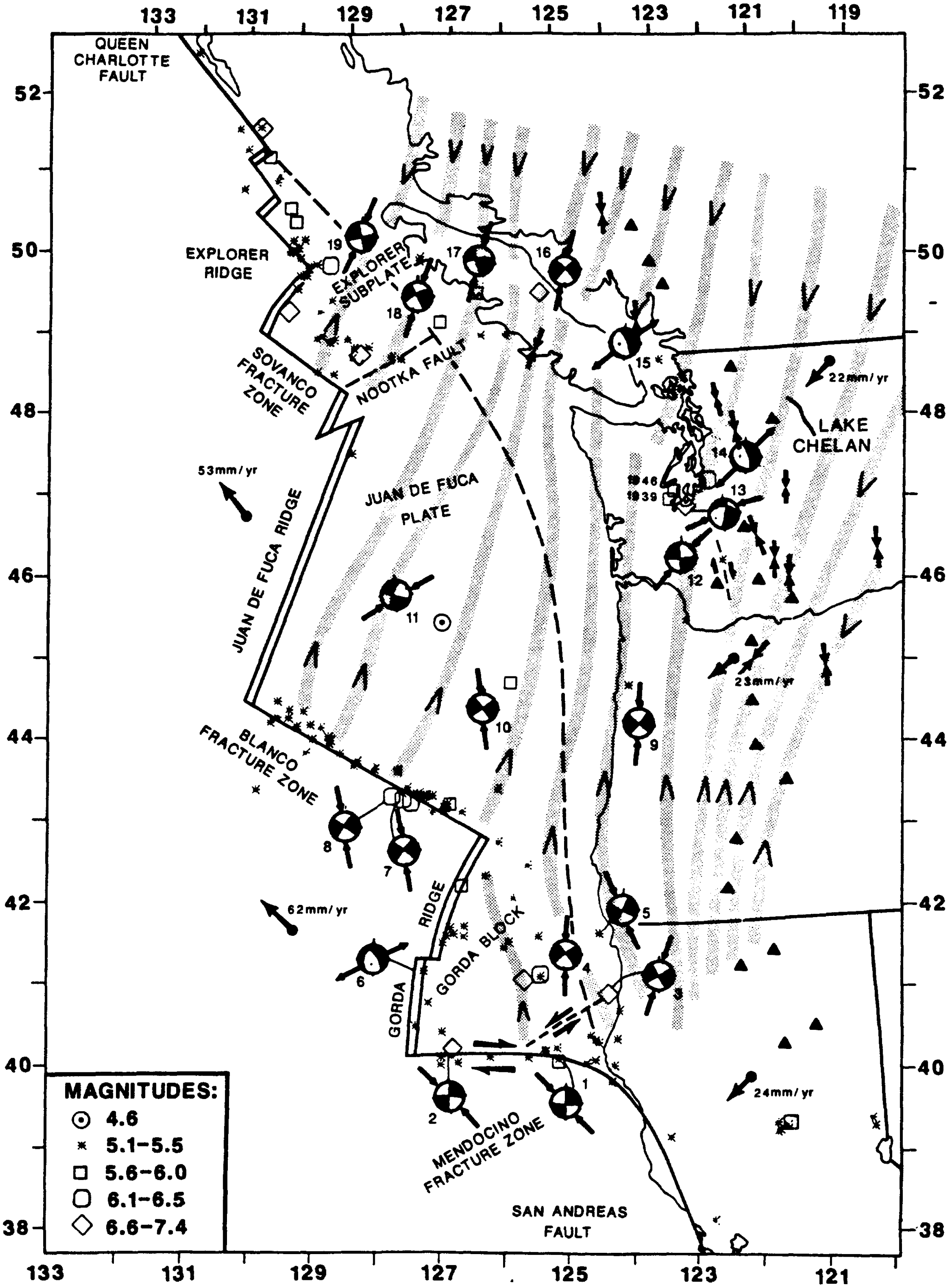

Figure 4. Cascadia seismicity, 1964 - June 1986, for earthquakes of magnitude $\geq$ 5.1. Additional key earthquakes are designated by dates or focal mechanisms. For earthquake focal mechanisms, directions of greatest compressional stress are indicated by convergent arrows for strike-slip events; directions of least compressional stress are indicated by divergent arrows for normal faulting events (all deeper than 50 km); and filled quadrants correspond to compressional P-wave first motions. Additional stress data, indicated by arrows that meet, show predominantly N-S compression in Washington and east of Vancouver Island. The half-tone lines with converging arrows are trajectories of maximum compressive stress that result from the discrete-element modeling. Active and potentially active volcanoes are indicated by triangles.

ACCELERATION SPECTRA FOR SUBDUCTION ZONE EARTHQUAKES

J. Boatwright and G. Choy

A method for estimating the source spectra of shallow earthquakes from recordings of the teleseismic P-wave groups (P+pP+sP) has been derived using frequency dependent corrections for the attenuation and for the interference of the free surface. The method also incorporates a finite depth range for the earthquake source. We determine the average P-wave spectra for 11 large ($6.2 \leq M_S \leq 8.1$) subduction-zone earthquakes on the frequency band from 0.01 to 2.0 Hz and complement these spectra with lower frequency (0.001 to 0.01 Hz) spectral estimates derived from surface-wave and normal-mode analyses. The observational results indicate that moderate ($M_0 < 10^{27}$ dyne-cm) subduction-zone earthquakes exhibit ω^2 or Brune-type acceleration spectra, while large ($M_0 > 10^{27}$ dyne-cm) subduction-zone earthquakes exhibit acceleration spectra with distinct intermediate slopes that increase as $\omega^{5/4}$ for frequencies from 0.005 to 0.05 Hz. The change in spectral shape appears to be a discontinuous function of seismic moment.

OPERATIONS

Introduction

The NEIS routinely interprets broadband data from the GDSN, CDSN and other digitally recording networks that contribute to the Event Tape. Since the October 1985 Monthly Listing, the Preliminary Determination of Epicenters (PDE) has published estimates of depth from broadband seismograms. Starting with the September 1988 Monthly Listing, the PDE has incorporated polarities of pP and sP from broadband displacement and velocity seismograms in the determination of fault plane solution. Occasionally, the Comments in the Monthly Listings have also included remarks on the complexity of earthquake rupture. It is the purpose of this section to describe in greater detail than is possible within the Monthly Listings the features on the broadband seismograms from which depth, fault plane solution, and rupture complexity have been inferred. In each issue of the NEIC Semi-Annual Technical Report, this section will be devoted to the discussion of selected earthquakes.

The advantages of using broadband records for teleseismic analysis have been discussed by Choy and Boatwright (1981). As a result of the broad bandwidth in the data, there is often sufficient resolution in the waveforms to distinguish source functions and depth phases by direct inspection. Methods of interpretation have been described by Choy et al. (1983) and by Choy and Engdahl (1987).

A. The Deep Earthquake South of Honshu, Japan, of 7 September 1988

The inversion of high quality differential travel times of pP-P and sP-P normally yields a well-controlled estimate of depth. There are, however, some seismologically active regions for which the inversion of even high-quality travel times is unable to converge at a satisfactory depth. Such data cannot be modeled until the development of acceptable three-dimensional Earth models. For such earthquakes the NEIS will compute a best-fitting depth and provide a comment to identify the anomaly. The identification of such regions on a systematic basis may eventually aid in development of laterally heterogeneous Earth models and a better understanding of tectonic processes in the Earth. An example is the deep earthquake from the South of Honshu, Japan that occurred on 7 September 1988. The description in the Monthly Listings for this earthquake states "Depth determined from broadband displacement seismograms. There appears to be a strong azimuthal variation of depth determined from depth phases." Figure 5 illustrates the type of high-quality broadband data that are available for this earthquake. Three representations of the P wave recorded at station COL are shown. The top trace shows the raw short-period record. The next two traces show broadband displacement and velocity. In the broadband records the identification of the depth phases is unequivocal and the measurement of differential travel times with respect to the direct P wave is accurate at all azimuths. However, the inversion of 6 pairs of high-quality differential travel times from stations in predominantly northwest azimuths yields a depth of 496 km. The inversion of 5 pairs of high-quality differential travel times from stations in predominantly northeastern azimuths yields a best-fitting depth of 477 km. Evidently, upgoing pP and sP body waves are encountering significantly different Earth structure depending on whether their ray paths are normal or parallel to the axis of the downgoing slab. The published depth of 485 km for this earthquake is based on the inversion using the entire set of differential travel times.

B. The Nepal-India Border Region Earthquake of 20 August 1988

The advantages of using broadband data to constrain a fault plane solution are shown in Figure 6. The example is from the large (M_S 6.6) earthquake that occurred in the Nepal-India border region on 20 August 1988. Three representations of the broadband P wave recorded at station HIA are presented in Figure 6. The direct P and the depth phases, pP and sP, are easily identified in displacement (top trace). The polarities and arrival times of these body waves are also easily measured in velocity (middle trace). Finally, from the velocity-squared data (bottom trace), the USGS radiated energy (from the method of Boatwright and Choy [1986]) is computed to be 2.3×10^{14} Nm. The depth obtained by inverting the differential travel times of pP-P and sP-P from 8 stations is 57 km. Figure 7 shows the USGS fault plane solution. Polarity data from the broadband data obviously provide strong constraints on the mechanism. The NEIS also routinely publishes the mechanisms derived from two different moment-tensor inversions. The best-fitting double-couple solutions from these methods are also plotted in Figure 7. The moment tensor solutions have nodal planes that do not fit the polarities of some stations. This type of variation, however, is not uncommon. Choy and Dewey (1988) have pointed out that source mechanisms from low-frequency analyses, such as the moment tensor inversions, may be dominated by quasistatic or aseismic processes that are significantly different from source properties derived from broadband data which carry most of the radiated energy.

George L. Choy
Bruce W. Presgrave

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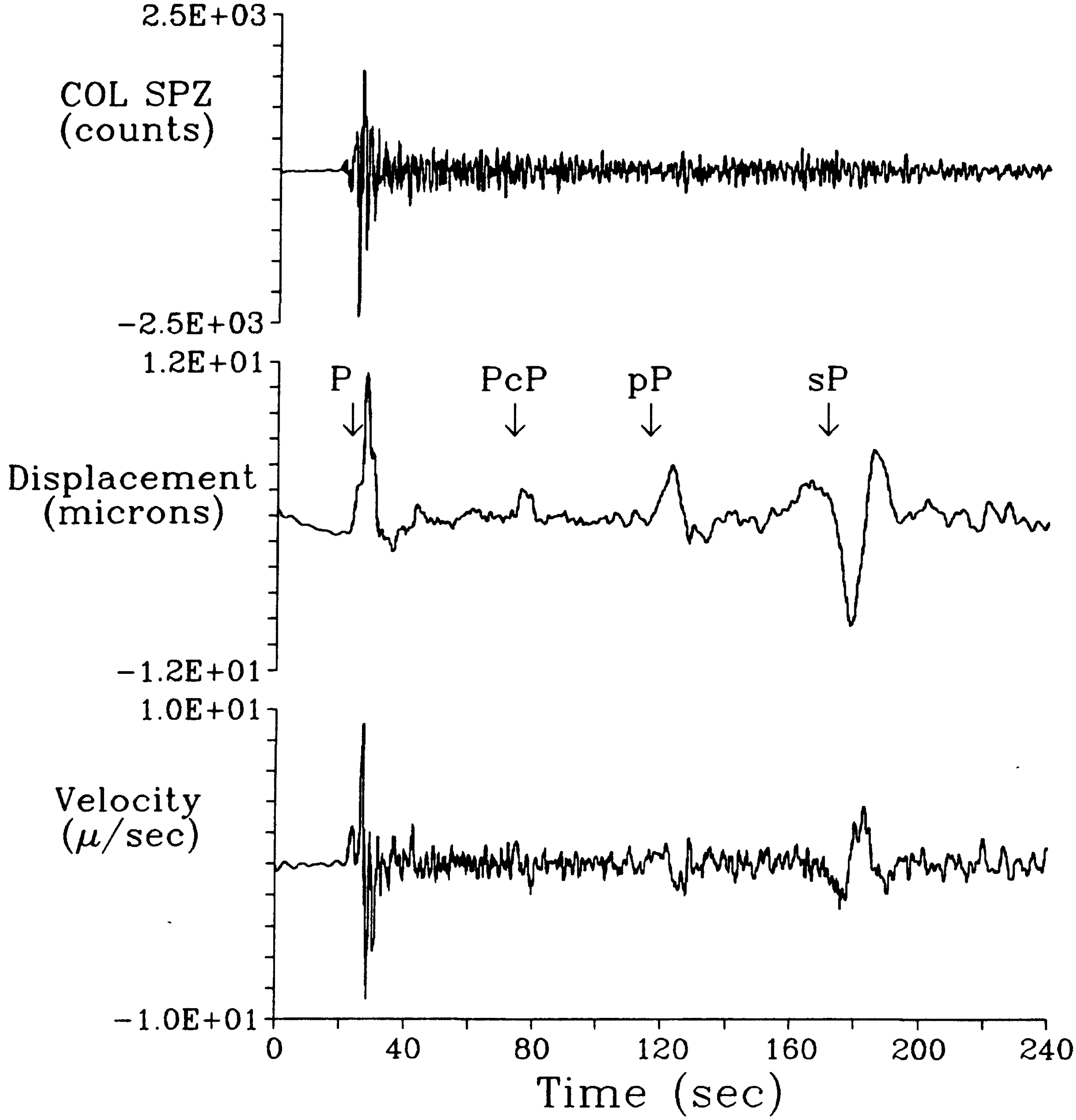

Figure 5. P-wave data recorded at COL from the deep South of Honshu, Japan, earthquake of 7 September 1988 (NEIC origin time 11h 53m 25.5s; 30.3°N, 137.4°E; m_b 6.0; broadband depth 485 km). (Top) The raw short-period record. (Middle) The corresponding broadband displacement record. (Bottom) The corresponding broadband velocity record.

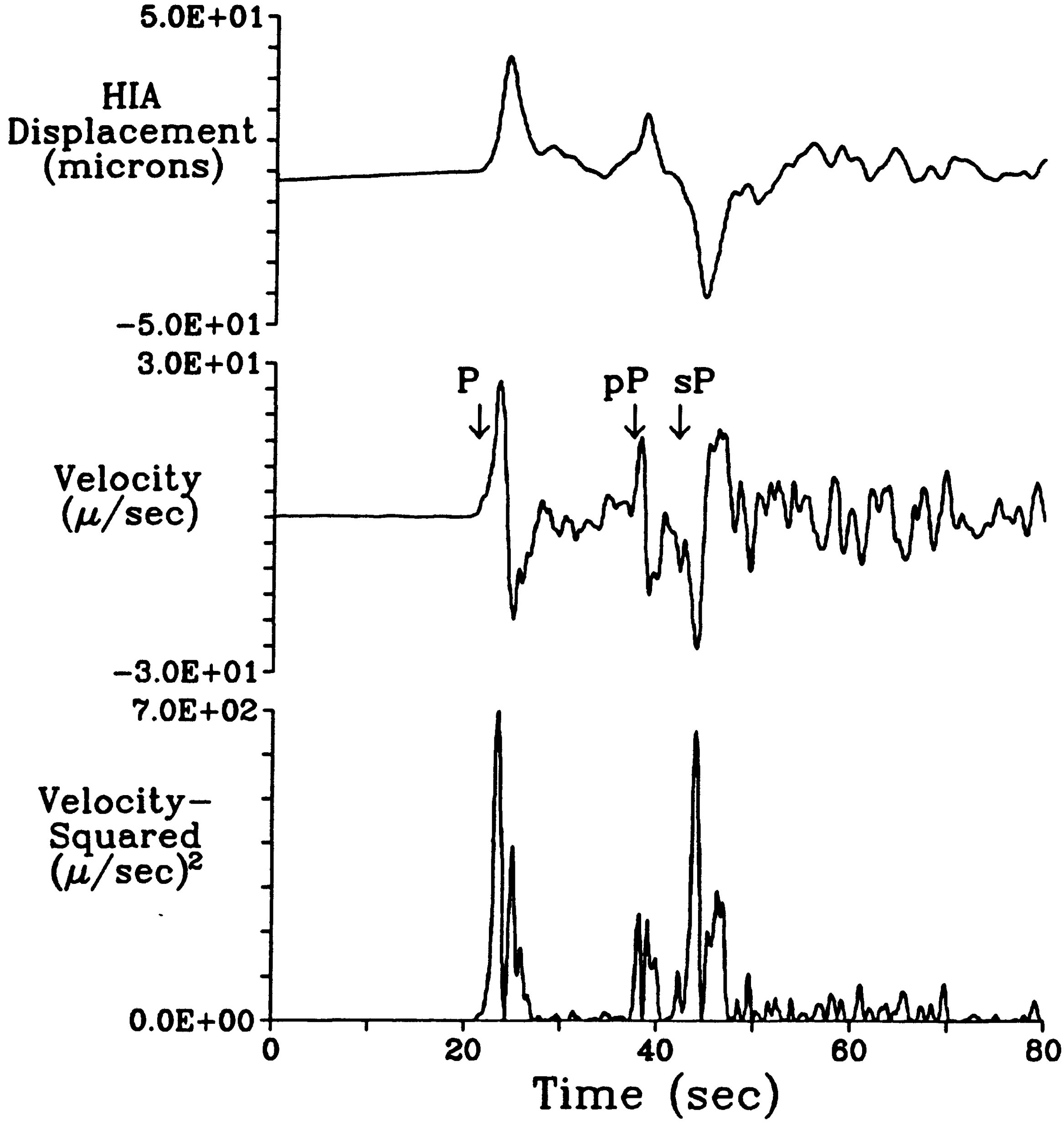

Figure 6. The P-wave data recorded at HIA for the large Nepal-India border-region earthquake of 20 August 1988 (NEIC origin time 23h 09m 09.5s; 26.8°N, 86.6°E; m_b 6.4, M_S 6.6; broadband depth 57 km). (Top) The broadband displacement record. (Middle) The broadband velocity record. (Bottom) The velocity-squared record.

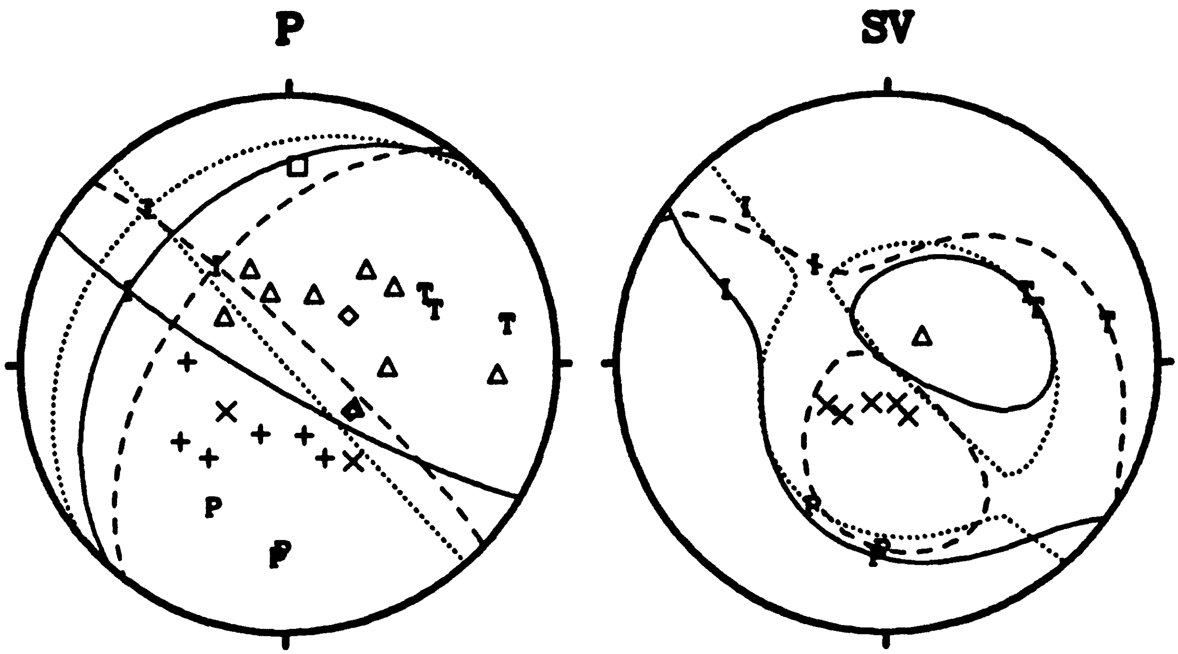

Figure 7. The P and SV radiation patterns for (1) the USGS fault plane solution, derived from P-wave first motions and polarities of direct and surface-reflected body waves read from broadband records (solid line), (2) the body-wave moment tensor inversion (dashed line), and (3) the centroid moment-tensor inversion (dotted line). P and pP takeoff angles used in the broadband analysis are plotted in the lower hemisphere projection of the P radiation pattern. Polarity of the data are indicated by triangles (compression) or ×'s (dilatation) for direct P. The polarities of pP are indicated by diamonds (compression) and +'s (dilatation). The polarities of sP in the SV radiation pattern are indicated by triangles (compression) and ×'s (dilatation).

SEISMICITY MAPS

The National Earthquake Information Center (NEIC) has published three full-color state seismicity maps as Open-File Reports of the U .S. Geological Survey (USGS). One of the maps (OFR 88-285) shows the seismicity of Hawaii from 1962 to 1985. The second map (OFR 88-286) shows earthquakes of magnitude 3.0 or greater that occurred in California from 1808 to 1987. The third map (OFR 89-98) shows earthquakes of magnitude 5.0 or greater that occurred in Alaska from 1786 to 1987. All three maps display earthquake epicenter data on highly detailed, elevation-tinted, shaded-relief state base maps. The three-dimensional illusion of these maps enable the viewer to obtain a clearer understanding of where earthquakes have occurred in relation to geographical features such as mountains, valleys, lakes and cities.

Photographic 35-mm slides of the maps are also available. For more information on how to obtain maps or slides, please write to the following address.

National Earthquake Information Center
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Attn: Susan Goter

Susan K. Goter

NATIONAL SEISMOGRAPH NETWORK

The National Seismograph Network (NSN) is under development by the U.S. Geological Survey (USGS). Funding for completion of the network east of the Rocky Mountains is being provided by the Nuclear Regulatory Commission. Elsewhere, some of the funding will come from various agencies of the Departments of Energy and Defense, and from the National Science Foundation through the Incorporated Research Institutions for Seismology (IRIS). When completed, the network will consist of approximately 150 broadband digital seismograph stations distributed across the conterminous states, Alaska, Hawaii, Puerto Rico, and the Virgin Islands. A few of these stations will be located in Canada and Mexico to provide better azimuthal coverage of nearby earthquakes in the United States. The approximate configuration of the network in the conterminous states is shown in Figure 8.

The operational goal of the network is to provide the capability to locate and determine the energy release of earthquakes of magnitude 2.5 or larger in all states except for some parts of Alaska. In addition, the extremely wide dynamic range of the dual-level, 24-bit samples should provide waveform data of unprecedented quality for the investigation of earthquake source and path characteristics in the frequency range from DC to 15 Hz. Sources of these data can be provided in real time to research institutions nearly anywhere in the world.

The following summarizes accomplishments through the end of 1988: (1) six prototype NSN stations were transmitting waveform data via satellite to the network master station in Golden, Colorado; (2) discussions and briefings had been held with 22 universities, 21 state geological surveys, and representatives of nine federal agencies, including two from Canada and one from Mexico; (3) a Request for Proposals (RFP) to supply seismometers for the network had been issued; and (4) four RFP's for satellite telemetry, master station hardware, station processors, and mass storage hardware were nearly ready to be issued.

James Taggart

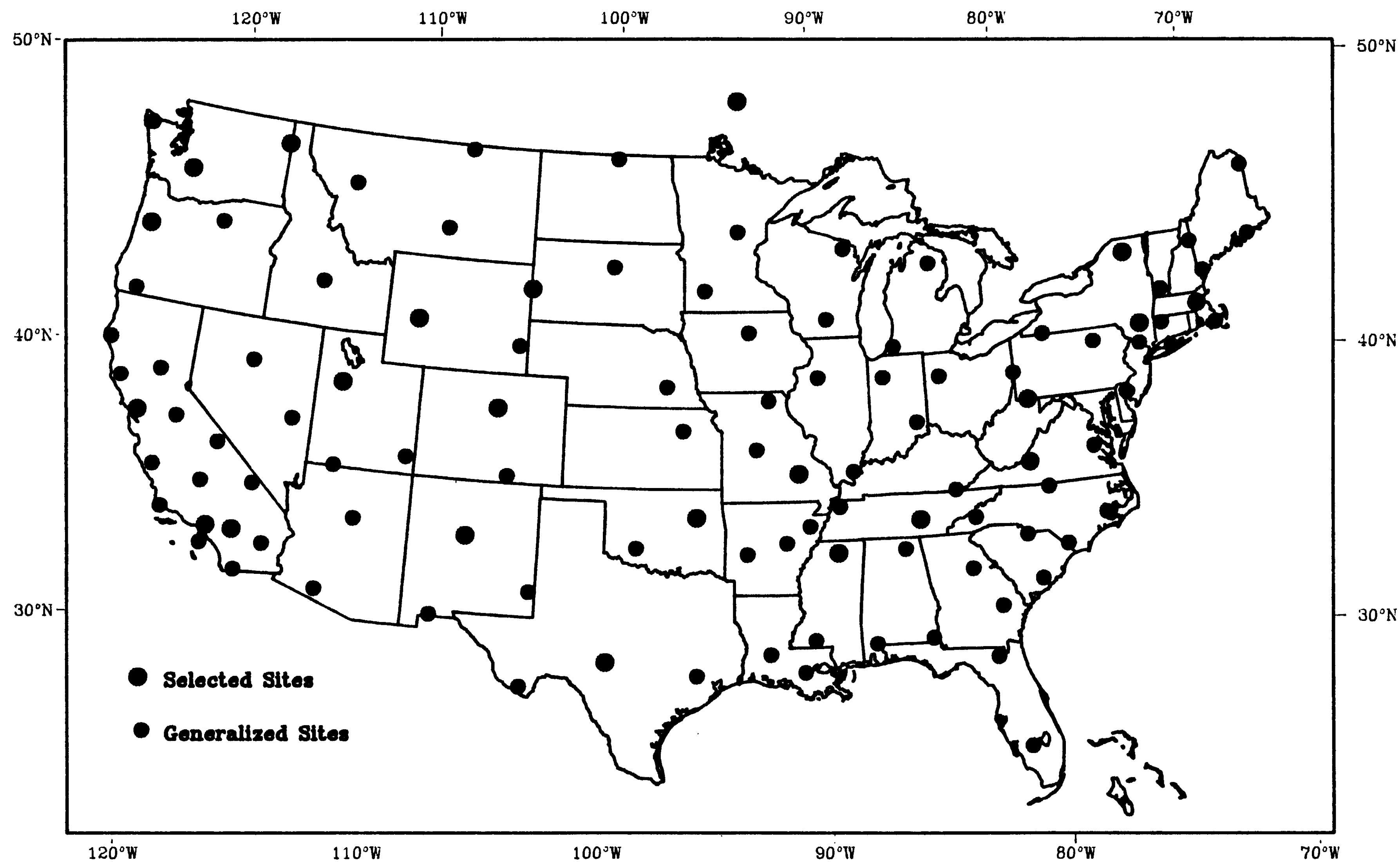


Figure 8. Approximate station configuration of the National Seismograph Network within the conterminous United States.

GLOBAL DIGITAL SEISMIC DATA

Earthquake data recorded by stations of the Global Digital Seismograph Network (GDSN) are routinely collected by the Albuquerque Seismic Laboratory and distributed by the National Earthquake Information Center (NEIC) to the seismologic community through several Regional Data Centers located at research institutions in the United States and other countries. Currently, the GDSN network is comprised of eleven Seismic Research Observatory (SRO) stations, four Abbreviated Seismic Research Observatory (ASRO) stations, and fourteen Digital Worldwide Standardized Seismograph Network (DWWSSN) stations. A complete listing of the current GDSN stations is presented in Table 1. Stations of the Regional Seismic Test Network (RSTN) also form part of the digital network. However, due to budgetary constraints, the RSTN stations are temporarily closed. The NEIC also collects digital data contributed by other worldwide networks such as the China Digital Seismograph Network (CDSN) and the Network of Autonomous Recording Stations (NARS) and Gräfenburg Arrays in western Europe. The additional stations that currently contribute to the NEIC digital-data program are listed in Table 2.

Within the past six months, two GDSN stations, MAJO and GUMO, have been upgraded. The seismometers at MAJO have been replaced with Streckeisen instruments, and the Streckeisen instruments at GUMO have been replaced with a KS36000 borehole seismometer. Also, one new station, KIP, has been added to the digital-data collection program. The new KIP station is a GEOSCOPE/IRIS system similar to an IRIS-1. Two additional IRIS-1 stations are to be installed at College Station, Alaska, and at Onondaga Park, Missouri, in the near future.

A comprehensive list of all GDSN and contributing digital stations that have had problems and/or modifications to date is presented in Tables 3 and 4. This list is periodically updated and will be included in each semi-annual report. Problems and/or modifications that have been identified since the last issue are listed below.

MAJO: Streckeisen seismometers were installed effective August 23, 1988.

GUMO: A KS36000 borehole seismometer was installed effective November 22, 1988.

ZOBO: LPN and LPE polarities were reversed from January 20, 1987 to June 20, 1988.

CTAO: Transfer functions were incorrect from January 1 to June 2, 1988. The KEV or COL intermediate-period transfer functions can be used for the short-period data. For the long-period component, the standard transfer function from KEV or COL can be used.

COL, KEV, AFI, TOL: Since these four stations were converted to Streckeisen seismometers (Feb. 5, Mar. 12, Apr. 27, and Oct. 5, 1987, respectively), the transfer functions for the SPZ component at all four stations have had one pole missing. The missing pole, -.838e+01, was included in the header data for the Network Volumes on February 15, 1989. In addition, all transfer functions for the AFI and TOL stations were incorrect from January 1 to June 2, 1988. The correct transfer functions can be obtained from the COL or KEV header data for this time period.

HIA: The SPZ and SPE components had reverse polarity from installation (Mar. 1987) until August 10, 1988. The azimuth and dip were adjusted in the header data of the Network Volumes on June 19, 1988 to compensate for the error. Unfortunately, all three short-period components were adjusted, resulting in a reversed SPN component from June 19, 1988 to January 4, 1989, when the changes to the header were removed. This also resulted in reversed polarities for the SPZ and SPE components from August 10, 1988 to January 4, 1989.

MDJ: All short-period components had reverse polarity from installation (Oct. 1986) until August 9, 1988.

KIP: An IRIS-1 station was installed at Kipapa, Hawaii, effective August 16, 1988. The arithmetic sign of the transfer function was positive since installation. This may result in reversed polarity during analysis. The transfer-function sign was changed to negative on February 15, 1989.

PAS: The arithmetic sign of the transfer function was positive from the date of installation (Apr. 3, 1988) until February 15, 1989, when it was changed to negative.

HRV: The arithmetic sign of the transfer function was positive from the date of installation (Jan. 1, 1988) until February 15, 1989, when it was changed to negative. Also, the vertical seismometer was replaced on October 27, 1988, resulting in (1) a polarity reversal on the vertical component, (2) a zero being inadvertently excluded from the vertical transfer function, and (3) the accidental removal of the Cascade 2 coefficients from all HRV transfer functions. On January 1, 1989, the zero and the Cascade coefficients were replaced, and the dip was changed in the header record to compensate for the polarity reversal, thereby correcting all three problems. The horizontal seismometers at HRV were originally aligned towards magnetic north instead of true north, and the azimuths in the header had been set to 345 degrees for the N-S component and 75 degrees for the E-W component. HRV has advised that the components were realigned correctly in December 1987. Header azimuths have been corrected on February 9, 1989. Thus all Network Volumes from January 1, 1988 through February 9, 1989 contain a 15-degree error in the horizontal azimuths.

John Hoffman

TABLE 1. CURRENT GDSN STATIONS

SRO STATIONS	*CODE*	*ID*	*INSTALLED*
Albuquerque, New Mexico	ANMO	30	01 Sep 1974
Ankara, Turkey	ANTO	31	01 Aug 1978
Bogota, Colombia	BOCO	32	13 Mar 1978
Chiang Mai, Thailand	CHTO	33	01 Jul 1977
Bar-Giyyora, Israel	BGIO	34	15 Apr 1986
Guam, Mariana Islands	GUMO	35	01 Dec 1975
Bangui, Central African Republic	BCAO	37	12 Jun 1979
Mundaring (Narrogin), Australia	NWAO	38	01 Apr 1976
Gräfenberg, Germany	GRFO	39	01 Oct 1978
Taipei, Taiwan	TATO	41	13 May 1976
Wellington (South Karori), New Zealand	SNZO	42	15 Mar 1976
ASRO STATIONS			
Charters Towers, Australia	CTAO	50	09 Oct 1976
La Paz (Zongo), Bolivia	ZOBO	51	10 Sep 1976
Matsushiro, Japan	MAJO	53	15 Jun 1977
Kongsberg, Norway	KONO	54	01 Sep 1978
DWWSSN STATIONS			
State College, Pennsylvania	SCP	61	29 Jan 1981
College, Alaska	COL	62	06 Jan 1982
Longmire, Washington	LON	63	01 Oct 1980
Columbia College, California	CMB	64	11 Nov 1986
Honolulu, Hawaii	HON	66	21 Mar 1983
Kevo, Finland	KEV	67	14 Oct 1981
Afiamalu, Western Samoa	AFI	69	15 May 1981
Godhavn, Greenland	GDH	70	26 Aug 1982
Silverton, South Africa	SLR	71	24 Oct 1981
Brasilia, Brazil	BDF	72	08 Jun 1982
Toledo, Spain	TOL	73	03 Nov 1981
Hobart, Tasmania	TAU	74	10 Jun 1981
Lembang, Indonesia	LEM	76	02 Jun 1982
Kingsbay (Svalbard), Norway	KBS	79	02 Oct 1985

TABLE 2. CURRENT CONTRIBUTING STATIONS

CDSN STATIONS	*CODE*	*ID*	*START*
Beijing, China	BJI	101	Oct 1986
Lanzhou, China	LZH	102	Oct 1986
Kunming, China	KMI	104	Oct 1986
Urumqi, China	WMQ	107	Oct 1986
Hailar, China	HIA	108	Mar 1987
Mudanjiang, China	MDJ	109	Oct 1986
NARS Array			
Goteborg, Sweden	NE01	201	Sep 1985
Monsted, Denmark	NE02	202	Sep 1985
Logumkloster, Denmark	NE03	203	Sep 1985
Witteveen, Netherlands	NE04	204	Sep 1985
Dourbes, Belgium	NE06	206	Sep 1985
Villiers-Adam, France	NE07	207	Sep 1985
Les-Eyzies, France	NE09	209	Sep 1985
Arette, France	NE10	210	Sep 1985
Ainzon, France	NE11	211	Sep 1985
Puertollano, Spain	NE13	213	Sep 1985
Granada, Spain	NE14	214	Sep 1985
Valkenburg, Netherlands	NE15	215	Sep 1985
Clermont-Ferrand, France	NE16	216	Sep 1985
Toledo, Spain	NE17	217	Sep 1985
IRIS-1 STATIONS			
Harvard, Massachusetts	HRV	510	01 Jan 1988
Pasadena, California	IPAS	511	03 Apr 1988
Kipapa, Hawaii	KIP	512	16 Aug 1988
OTHER STATIONS			
Glen Almond, Quebec, Canada	GAC	43	26 Apr 1982
NORESS array site A0	NRA0	301	Sep 1985
Haidhof, Germany	GRA1	302	Sep 1985
Bruennthal, Germany	GRB1	303	May 1986
Eglofsdorf, Germany	GRC1	304	May 1986

TABLE 3. GDSN PROBLEMS AND MODIFICATIONS

Station	Date	Description
AFI	15 May 1981	Station installed.
	27 April 1987	Streckeisen seismometers installed.
	01 May 1987 thru 13 May 1987	Date was 24 hours ahead. To obtain the correct date, one day should be subtracted in the tape header.
	01 Jan 1988 thru 02 Jun 1988	Transfer functions were incorrect. The appropriate transfer functions can be obtained from the KEV or COL data.
	27 Apr 1987 thru 14 Feb 1989	One pole, -.838e+01, is missing from the SPZ transfer function.
ANMO	01 Sep 1974	Station installed.
	09 Dec 1975	4-pole Bessel filters replaced 4-pole Butterworth anti-aliasing filters (long-period signals).
	24 Jul 1978 thru 31 Jul 1978	Multiplexing errors occurred from 24 Jul 16:45:57.0 through 31 Jul 15:57:56.0. Channel sequence is N, E, Z.
	23 Oct 1978	Single-pole low-pass sections cornered at 16 Hz in short-period channels removed.
	30 Jul 1980	Long-period sensitivities changed: Z = 4500 counts, N-S = 5000 counts, and E-W = 5500 counts per micrometer of ground motion at a period of 25 seconds.
	13 May 1981	Clip detectors installed.
	05 Apr 1983	Horizontal short-period components installed.
	24 May 1983	The six second notch filter was removed, as were two single pole high-pass corners on the ANMO long-period filters. Pole 1 was moved from 250 seconds to 1200 seconds, and pole 2 was moved from 670 seconds to 1200 seconds.
	19 Mar 1984	22 Feb 1984 software installed. Calibration procedure revised.
	01 Oct 1984	During the first three weeks of October 1984, a new borehole was drilled close to the existing ANMO borehole. The long-period channels at ANMO became saturated during drilling operations. Drilling hours varied between 1500 and 2300 hours UTC.
	20 Feb 1985	Both short-period horizontal components were removed from the ANMO recording system to facilitate testing of a modified borehole seismometer. The SPZ component will be included with the ANMO data for the next few months.
	09 Dec 1985 thru 08 Jan 1986	Polarity reversed on the LPE channel.

ANTO	01 Aug 1978	Station installed.
	26 Feb 1979	The 4-pole Bessel anti-aliasing filter on the N-S component failed and was temporarily replaced with a 4-pole Butterworth filter on February 26, 1979. The Butterworth filter was replaced with a new Bessel filter on October 10, 1979. This was the N-S component only.
	03 Oct 1980	Long-period sensitivities changed: Z = 4500 counts, N-S = 5000 counts, and E-W = 5500 counts per micrometer of ground motion at a period of 25 seconds.
	27 Jul 1984 thru 07 Sep 1984	The time was exactly one hour fast. To obtain the correct time, one hour should be subtracted from the time listed in the tape header.
	19 Oct 1984 thru 16 Nov 1986	The time was exactly one hour fast from 16 Oct 07:40 through 19 Nov 1984 00:00 UTC. To obtain the correct time, one hour should be subtracted from the time listed in the record header.
BCAO	12 Jun 1979	Station installed.
	12 Jun 1979 thru 26 Apr 1980	Polarity reversals on both horizontal components.
	25 Sep 1980	Long-period sensitivities changed: Z = 4500 counts, N-S = 5000 counts, and E-W = 5500 counts per micrometer of ground motion at a period of 25 seconds.
	Nov 1981	The BCAO system was damaged by lightning during November 1981. When repairs to the system were completed, including a new borehole seismometer, it was found that the seismometer cable was damaged at the point where it connects to the seismometeer. Only the long-period vertical component was affected, and the station has been in operation since 01 Mar 1982 withhout that component. On 07 Sep 1982 the cabling connections were replaced and all components are now recording data.
	29 Feb 1984	The 6 sec. notch was removed, and two single-pole high-pass corners were moved from 250 and 670 seconds to 1200 seconds.
	03 Mar 1984	Long-period transfer functions changed by removing the six second notch filters and by moving the two single-pole high-pass corners. Pole 1 was moved from 250 seconds to 1200 seconds, and pole 2 was moved from 670 seconds to 1200 seconds.
	14 Aug 1984	22 Feb 1984 software installed. Calibration procedure revised.
	14 Aug 1984	Horizontal short-period components installed.
	14 Aug 1984	Clip detectors installed.
BER	10 Aug 1981	Station installed.
	01 Sep 1984	Station closed. The digital recording system moved to Kingsbay, Svalbard (KBS).
BGIO	10 Jul 1986	Station installed.
	10 Jul 1986 thru 25 Jul 1986	Longitude incorrectly listed as 35.08 West instead of East.

BOCO	13 Mar 1978	Station installed.
	24 Oct 1978 thru 28 Oct 1978	Multiplexing errors occurred from 24 Oct 13:48:16.0 through 28 Oct 00:45:56.0. Channel sequence is N, E, Z.
	21 Nov 1978 thru 07 Dec 1978	Multiplexing errors occurred from 21 Nov 18:33:03.0 through 07 Dec 15:34:06.0. Channel sequence is E, Z, N.
	08 Mar 1979	Long-period sensitivities changed: Z = 4500 counts, N-S = 5000 counts, and E-W = 5500 counts per micrometer of ground motion at a period of 25 seconds.
CHTO	01 Jul 1977	Station installed.
	04 Feb 1979	Single-pole low-pass sections cornered at 16 Hz in short-period channels removed.
	06 Jul 1979	4-pole Bessel filters replaced 4-pole Butterworth anti-aliasing filters (long-period signals).
	10 Dec 1980	Long-period sensitivities changed: Z = 4500 counts, N-S = 5000 counts, and E-W = 5500 counts per micrometer of ground motion at a period of 25 seconds.
	May 1983	After being inoperative for more than 1 year, CHTO came on line in early May 1983 after the installation of a new power system.
	22 May 1983 thru 7 Jan 1984	Polarity reversed on all long- and short-period channels.
	21 May 1984	2-22-84 software installed. Calibration procedure revised.
	24 May 1984	Long-period transfer functions changed by removing the six second notch filters and by moving the two single-pole high-pass corners. Pole 1 was moved from 250 seconds to 1200 seconds, and pole 2 was moved from 670 seconds to 1200 seconds.
	24 May 1984	Horizontal short-period components installed.
	21 Sep 1984	Clip detectors installed.
COL	06 Jan 1982	Station installed.
	05 Feb 1987	Streckeisen seismometers installed.
	05 Feb 1987 thru 14 Feb 1989	One pole, -.838e+01, is missing from the SPZ transfer function.
CTAO	09 Oct 1976	Station installed.
	01 Jan 1980 thru 01 May 1981	A pole was not included in the original long-period transfer function listings on the network-day tapes. The pole which should be added is (-0.159E+00, -0.594E+00).

	29 Dec 1980	Long-period sensitivities changed: Z = 9000 counts, N-S = 10000 counts, and E-W = 11000 counts per micrometer of ground motion at a period of 25 seconds.
	03 Jun 1983	Short-period sensitivity was reduced from 10^5 to 10^6 counts per micrometer at one second.
	27 Sep 1987	Streckeisen seismometers installed.
	01 Jan 1988 thru 02 Jun 1988	Transfer functions were incorrect. CTAO short-period data use the intermediate-period transfer function from KEV or COL. The long-period data use the standard transfer function from KEV or COL.
GRFO	01 Oct 1978	Station installed.
	03 Nov 1978 thru 11 Dec 1978	Vertical component recorded simultaneously on channels 1 and 2 from 3 Nov 1978 at 05:41 through 11 Dec 1978 at 14:53. Channel sequence is Z, Z, E.
	19 Jun 1979	Single-pole low-pass sections cornered at 16 Hz in short-period channels removed.
	08 Mar 1980 thru 03 Apr 1980	Long-period channels multiplexed incorrectly. Channel sequence is E, Z, N.
	18 Oct 1980	Long-period sensitivities changed: Z = 4500 counts, N-S = 5000 counts, and E-W = 5500 counts per micrometer of ground motion at a period of 25 seconds.
GUMO	01 Dec 1975	Station installed.
	27 Apr 1976	Short-period sensitivity reduced from 2,000,000 to 2,000 digital counts per micrometer of ground motion at a period of 1 second. The *RESPONSE TO EARTH DISPLACEMENT* table located in the short-period data log was modified beginning on Day 326, 1981. Changes in the values for the relative amplitudes average 2%-3%. Changes in the phase angle values are more significant, averaging between 5%-10%.
	19 Dec 1979	4-pole Bessel filters replaced 4-pole Butterworth anti-aliasing filters (long-period signals).
	29 Jul 1980	Long-period sensitivities changed: Z = 4500 counts, N-S = 5000 counts, and E-W = 5500 counts per micrometer of ground motion at a period of 25 seconds.
	08 Jan 1985 thru 11 Apr 1985	Station closed on 8 Jan 1985 for replacement of the Model KS36000 borehole seismometer with the Streckeisen Model STS-I surface seismometer. New transfer functions and sensitivites are included in station and data logs. GUMO became fully operational on 11 Apr 1985.
	15 Jan 1985	22 Feb 1984 software installed. Calibration procedure revised.
	15 Jan 1985	Clip detectors installed.
	22 Nov 1988	KS36000 borehole seismometer installed.
JAS	01 Oct 1980	Station installed.
	26 Jun 1984	Station closed. Seismograph system moved to a new location. The new station code is JAS1.

JAS1	03 Jul 1984	Station installed.
	27 Jul 1984	Digital data included on network-day tapes.
	06 Nov 1986	Station closed. Seismograph system was moved to a new location. The new station code is CMB.
KAAO	10 May 1977	Station installed.
	12 Sep 1978 thru 13 Sep 1978	Multiplexing errors occurred from 12 Sep 18:32:15.0 through 13 Sep 07:33:28.0. Channel sequence is N, E, Z.
	08 Dec 1978 thru 10 Dec 1978	Multiplexing errors occurred from 08 Dec 06:02:59.0 through 10 Dec 06:10:28.0. Channel sequence is N, E, Z.
	11 Dec 1978 thru 24 Dec 1978	Time is 330 seconds fast from 11 Dec 1978 through 24 Dec 1978 at 0:700.
	01 Jan 1980 thru 01 May 1981	A pole was not included in the original long-period transfer function listings on the network-day tapes. The pole which should be added is (-0.159E+00, -0.594E+00).
	20 Jan 1981 thru 17 Feb 1982	The EW and Z components were switched.
	30 Jul 1982	Last data received. Station closed.
KEV	14 Oct 1981	Station installed.
	15 Mar 1982 thru 26 Mar 1982	The network-day tape data starting 15 Mar 1982 through 26 Mar 1982 at 06:00 UTC is approximately 15 to 20 minutes fast.
	12 Mar 1987	Streckeisen seismometers installed.
	12 Mar 1987 thru 14 Feb 1989	One pole, -.838e+01, is missing from the SPZ transfer function.
KONO	01 Sep 1978	Station installed.
	01 Jan 1980 thru 01 May 1981	A pole was not included in the original long-period transfer function listings on the network-day tapes. The pole which should be added is (-0.159E+00, -0.594E+00).
	12 Oct 1980	Long-period sensitivities changed: Z = 9000 counts, N-S = 10000 counts, and E-W = 11000 counts per micrometer of ground motion at a period of 25 seconds.
	30 May 1983	Short-period sensitivity was reduced from 10^5 to 10^6 counts per micrometer at one second. Calibration procedure for SRO/ASRO was revised.
LON	01 Oct 1980	Station installed.

	06 Apr 1981 thru 18 Jan 1982	All digital short-period vertical component data during this time frame has reversed polarity.
MAIO	14 Oct 1975	First data distributed on Station Tape.
	24 Nov 1977 thru 27 Nov 1977	Multiplexing errors occurred from 24 Nov 7:35:30.0 through 27 Nov 5:20:59.0. Channel sequence is N, E, Z.
	11 Oct 1978	Last data received. Station closed.
MAJO	15 Jun 1977	Station installed.
	20 Nov 1977 thru 21 Nov 1977	Multiplexing errors occurred from 20 Nov 05:39:24.0 through 21 Nov 00:54:23.0. Channel sequence is N, E, Z.
	01 Jan 1980 thru 01 May 1981	A pole was not included in the original long-period transfer function listings on the network-day tapes. The pole which should be added is (-0.159E+00, -0.594E+00).
	03 Aug 1980	Long-period sensitivities changed: Z = 9000 counts, N-S = 10000 counts, and E-W = 11000 counts per micrometer of ground motion at a period of 25 seconds.
	03 Mar 1983	Short-period sensitivity was reduced from 10^5 to 10^6 counts per micrometer at one second.
	23 Aug 1988	Streckeisen seismometers installed.
NWAO	01 Apr 1976	Station installed.
	20 Mar 1977 thru 21 Mar 1977	Multiplexing errors occurred from 20 Mar 17:25:27.0 through 21 Mar 03:00:57.0. Channel sequence is N, E, Z.
	01 Aug 1977 thru 3 Aug 1977	Multiplexing errors occurred from 1 Aug 03:23:46.0 through 3 Aug 23:49:31.0. Channel sequence is E, Z, N.
	01 Dec 1977	Single-pole low-pass sections cornered at 16 Hz in short-period channels were removed.
	05 May 1978 thru 6 May 1978	Multiplexing errors occurred from 5 May 06:30:00.0 through 6 May 07:38:59.0. Channel sequence is E, Z, N.
	13 Jun 1978 thru 14 Jun 1978	Multiplexing errors occurred from 13 Jun 07:04:14.0 through 14 Jun 04:29:30.0. Channel sequence is E, Z, N.
	30 Dec 1978	4-pole Bessel filters replaced 4-pole Butterworth anti-aliasing filters (long-period signals).
	01 Aug 1979 thru 21 Aug 1979	Long-period channels multiplexed incorrectly. Channel sequence is N, E, Z.
	24 Dec 1980	Long-period sensitivities changed: Z = 4500 counts, N-S = 5000 counts, and E-W = 5500 counts per micrometer of ground motion at a period of 25 seconds.

	21 Jan 1982 thru 01 Feb 1982	The network-day tape data starting 21 Jan 16:23 UTC through 01 Feb 00:31 UTC is 7 hours 52 minutes slow.
RSCP	12 Dec 1982	Data included on Network-Day Tapes. (V1N2)
	13 May 1985	Station has been modified to make the transfer functions and sensitivities identical to other RSTN stations.
	01 Apr 1985	The short-period horizontal components have been switched from the KS36000 to the S-750 borehole seismometer.
	22 Oct 1986	RSTN network temporarily closed.
RSNT	12 Dec 1982	Data included on Network-Day Tapes.
	15 Feb 1983 thru 01 Mar 1984	The short-period vertical transfer function included four incorrect poles plus the wrong sign for A0. The incorect poles were P03, P04, P05 and P06.
	01 Apr 1985	The short-period horizontal components have been switched from the KS36000 to the S-750 borehole seismometer.
	22 Oct 1986	RSTN network temporarily closed.
RSSD	12 Dec 1982	Data included on Network-Day Tapes.
	15 Feb 1983 thru 08 Jul 1984	The short-period vertical transfer function included four incorrect poles plus the wrong sign for A0. The incorect poles were P03, P04, P05 and P06.
	01 Apr 1985	The short-period horizontal components have been switched from the KS36000 to the S-750 borehole seismometer.
	22 Oct 1986	RSTN network temporarily closed.
RSNY	12 Dec 1982	Data included on Network-Day Tapes.
	12 Dec 1982 thru 02 Mar 1984	The short-period horizontal transfer functions have listed an incorrect A0 constant plus a missing zero (Z01).
	15 Feb 1983 thru 01 Mar 1984	The short-period vertical transfer function included four incorrect poles plus the wrong sign for A0. The incorect poles were P03, P04, P05 and P06.
	01 Apr 1985	The short-period horizontal components have been switched from the KS36000 to the S-750 borehole seismometer.
	12 Dec 1982 thru 22 Oct 1986	Seismometer orientation was in error 17°clockwise.
	22 Oct 1986	RSTN network temporarily closed.
RSON	01 Jul 1978	Station installed.
	12 Dec 1982 thru 02 Mar 1984	The short-period horizontal transfer functions have listed an incorrect A0 constant plus a missing zero (Z01).

	15 Feb 1983 thru 01 Mar 1984	The short-period vertical transfer function included four incorrect poles plus the wrong sign for A0. The incorect poles were P03, P04, P05 and P06.
	01 Apr 1985	The short-period horizontal components have been switched from the KS36000 to the S-750 borehole seismometer.
	22 Oct 1986	RSTN network temporarily closed.
SHIO	01 Jul 1978	Station installed.
	01 Aug 1978 thru 26 Sep 1978	Polarity reversals on both horizontal components.
	14 Sep 1978 thru 21 Sep 1978	Multiplexing errors occurred from 14 Sep 06:31:06.0 through 21 Sep 09:39:35.0. Channel sequence is E, Z, N.
	14 Sep 1978 thru 21 Sep 1978	Long-period channels multiplexed incorrectly. Channel sequence is E, Z, N.
	25 Mar 1980 thru 28 Mar 1980	Long-period channels multiplexed incorrectly. Channel sequence is E, Z, N.
	30 Nov 1980	Long-period sensitivities changed: Z = 4500 counts, N-S = 5000 counts, and E-W = 5500 counts per micrometer of ground motion at a period of 25 seconds.
	19 Feb 1984	Long-period transfer functions changed by removing the six second notch filters and by moving the two single-pole high-pass corners. Pole 1 was moved from 250 seconds to 1200 seconds, and pole 2 was moved from 670 seconds to 1200 seconds.
	31 Mar 1985	22 Feb 1984 software installed. Calibration procedure revised.
	31 Mar 1985	Horizontal short-period components installed.
	31 Mar 1985	Clip detectors installed.
	27 May 1985 thru 18 Aug 1985	Station tapes arrived at the Albuquerque Seismological Laboratory after the network-day tapes had been written. Station day tapes have been produced containing data from SHIO only in day tape format for this period.
	03 Mar 1986	Last data received. Station closed.
SLR	24 Oct 1981	Station installed.
	14 Feb 1986 thru 01 May 1986	All data is in error by exactly 24 hours starting at 14 Feb at 04:00 until 1 May at 00:00 UTC. The data is one day late. After a power outage on 14 Feb 1986 the clock was incorrectly reset to 15 Feb 1986.
SNZO	15 Mar 1976	Station installed.

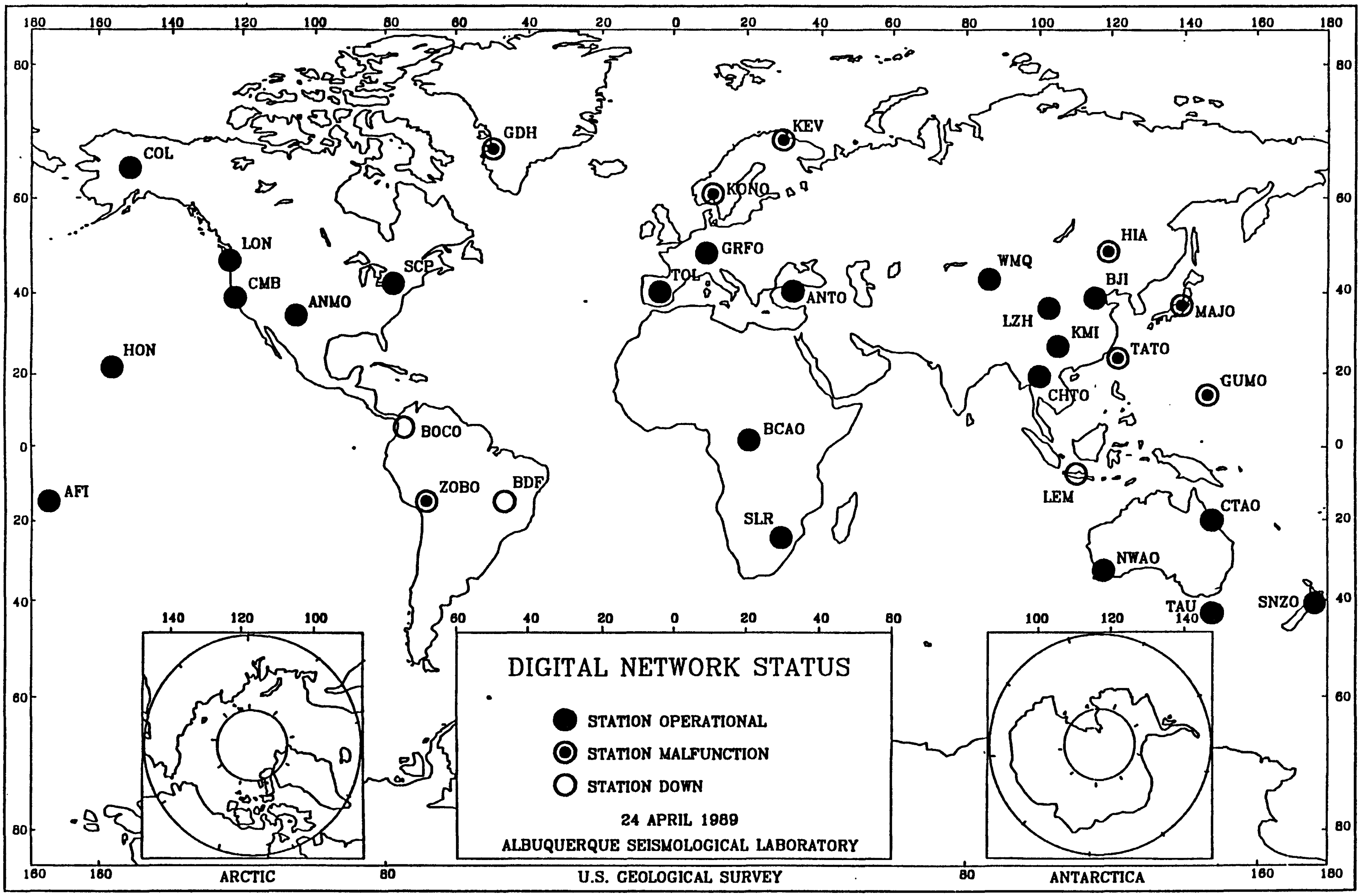
	15 Mar 1976	Short-period sensitivity reduced from 2,000,000 to 2,000 digital counts per micrometer of ground motion at a period of 1 second. The *RESPONSE TO EARTH DISPLACEMENT* table located in the short-period data log was modified beginning on Day 326, 1981. Changes in the values for the relative amplitudes average 2%-3%. Changes in the phase angle values are more significant, averaging between 5%-10%.
	10 Nov 1978	4-pole Bessel filters replaced 4-pole Butterworth anti-aliasing filters (long-period signals).
	10 Nov 1978	Single-pole low-pass sections cornered at 16 Hz in short-period channels removed.
	07 Jan 1981	Long-period sensitivities changed: Z = 4500 counts, N-S = 5000 counts, and E-W = 5500 counts per micrometer of ground motion at a period of 25 seconds.
TATO	13 May 1976	Station installed.
	13 May 1976	Short-period sensitivity reduced from 2,000,000 to 2,000 digital counts per micrometer of ground motion at a period of 1 second. The *RESPONSE TO EARTH DISPLACEMENT* table located in the short-period data log was modified beginning on Day 326, 1981. Changes in the values for the relative amplitudes average 2%-3%. Changes in the phase angle values are more significant, averaging between 5%-10%.
	16 Sep 1977 thru 17 Sep 1977	Multiplexing errors occurred from 16 Sep 03:12:04.0 through 17 Sep 04:02:34.0. Channel sequence is N, E, Z.
	06 Sep 1978 thru 07 Sep 1978	Multiplexing errors occurred from 06 Sep 03:24:17.0 through 07 Sep 05:37:16.0. Channel sequence is N, E, Z.
	30 Nov 1978	Single-pole low-pass sections cornered at 16 Hz in short-period channels removed.
	25 Jan 1979	4-pole Bessel filters replaced 4-pole Butterworth anti-aliasing filters (long-period signals).
	14 Sep 1979 thru 26 Aug 1980	Polarity reversals on both horizontal components.
	22 Aug 1980	Long-period sensitivities changed: Z = 4500 counts, N-S = 5000 counts, and E-W = 5500 counts per micrometer of ground motion at a period of 25 seconds.
TOL	03 Nov 1981	Station installed.
	05 Oct 1987	Streckeisen seismometers installed.
	01 Jan 1988 thru 02 Jun 1988	Transfer functions were incorrect. The appropriate transfer functions can be obtained from the KEV or COL data.
	5 Oct 1987 thru 14 Feb 1989	One pole, -.838e+01, is missing from the SPZ transfer function.
ZOBO	10 Sep 1976	Station installed.

27 Dec 1977 thru 28 Feb 1978	The E-W channel was down. The N-S and E-W channels were temporarily switched from 10 Feb 1978 through 14 Feb 1978.
10 Feb 1978 thru 11 Feb 1978	Multiplexing errors occurred from 10 Feb 16:41:06.0 through 11 Feb 12:51:05.0. Channel sequence is N, E, Z.
06 Jun 1978 thru 14 Jun 1978	Multiplexing errors occurred from 06 Jun 18:48:02.0 through 14 Jun 14:48:33.0. Channel sequence is N, E, Z.
18 Sep 1978	During recalibration of the LPN and LPE components, incorrect motor constants were used, resulting in a sensitivity setting of 10000 digital counts per 1.4 microns of ground motion at a period of 25 seconds. LPN and LPE calibrations since that date are for an equivalent ground motion of 1.4 microns. The actual calibration for 1 micron of ground motion is approximately 7150 digital counts. The station log in the network-day tapes contained the following statement in the comment section: 'Long-period horizontal calibration values should be increased by 27%'. This statement should read: 'Long-period horizontal calibration values should be divided by 1.4'. The log comments were corrected on 10 Jun 1981. The average calibration values on the network-day tapes for the long-period horizontal components were changed on 30 Jun 1981 to their correct values (approximately 7150 counts).
01 Jan 1980 thru 01 May 1981	A pole was not included in the original long-period transfer function listings on the network-day tapes. The pole which should be added is (-0.159E+00, -0.594E+00).
11 May 1982	The station was recalibrated, and motor constants corrected. Also, the sensitivities were adjusted to coincide with those at other ASRO stations, which are Z = 9000, N-S = 10000, and E-W = 11000 digital counts per micrometer of ground motion at a period of 25 seconds.
11 Aug 1983	During a maintenance visit, the long-period sensitivities for all channels were incorrectly adjusted. The long- period sensitivities are LPZ = 10,900, LPN = 9,900, LPE = 10,100 digital counts per micron of ground motion at a period of 25 seconds.
11 May 1984	22 Feb 1984 Software installed. Calibration procedure revised.
20 Jan 1987 thru 20 Jun 1988	Polarity reversed on LPN and LPE components.

TABLE 4. PROBLEMS ASSOCIATED WITH CONTRIBUTING STATIONS

Station	Date	Description
BJI	Oct 1986	Data included on Network-Day Tape.
	29 Apr 1987 thru 03 Aug 1987	Due to a problem with the Tape Copy System in Beijing, events triggered on the short-period and broadband records may start 2 minutes late.
HIA	Mar 1987	Data included on Network-Day Tape.
	27 Apr 1987 thru 20 Jul 1987	Due to a problem with the Tape Copy System in Beijing, events triggered on the short-period and broadband records may start 2 minutes late.
	Mar 1987 thru 19 Jun 1988	Polarity reversed on SPZ and SPE components
	19 Jun 1988 thru 04 Jan 1989	Polarity reversed on SPN component.
	10 Aug 1988 thru 04 Jan 1989	Polarity reversed on SPZ and SPE components
KMI	Oct 1986	Data included on Network-Day Tape.
	27 Apr 1987 thru 20 Jul 1987	Due to a problem with the Tape Copy System in Beijing, events triggered on the short-period and broadband records may start 2 minutes late.
LZH	Oct 1986	Data included on Network-Day Tape.
	Oct 1986 thru 24 Oct 1987	Polarity reversed on long- and short-period horizontal components.
	24 May 1987 thru 20 Jul 1987	Due to a problem with the Tape Copy System in Beijing, events triggered on the short-period and broadband records may start 2 minutes late.
MDJ	Oct 1986	Data included on Network-Day Tape.
	Oct 1986 thru 09 Aug 1988	Polarity reversed on all short-period components.
WMQ	Oct 1986	Data included on Network-Day Tape.
	13 Apr 1987 thru 18 Jul 1987	Due to a problem with the Tape Copy System in Beijing, events triggered on the short-period and broadband records may start 2 minutes late.
KIP	16 Aug 1988	Data included on Network-Day Tape.
	16 Aug 1988 thru 14 Feb 1989	Arithmetic sign of transfer functions was positive. This may result in reversed polarity during analysis.

PAS	03 Apr 1988	Data included on Network-Day Tape.
	03 Apr 1988 thru 14 Feb 1989	Arithmetic sign of transfer functions was positive. This may result in reversed polarity during analysis.
HRV	01 Jan 1988	Data included on Network-Day Tape.
	01 Jan 1988 thru 14 Feb 1989	Arithmetic sign of transfer functions was positive. This may result in reversed polarity during analysis.
	27 Oct 1988 thru 01 Jan 1989	Polarity reversed on vertical component, one zero missing from the vertical transfer function, and Cascade coefficients missing from all transfer functions.
	01 Jan 1988 thru 09 Feb 1989	Header records have incorrect azimuths for the horizontal components. The N-S azimuth should be 360°instead of 345°, and the E-W azimuth should be 90°rather than 75°.


DIGITAL NETWORK STATUS
STATION OPERATIONAL
STATION MALFUNCTION
STATION DOWN
24 APRIL 1989
ALBUQUERQUE SEISMOLOGICAL LABORATORY
U.S. GEOLOGICAL SURVEY
ARCTIC
ANTARCTICA
COL
LON
CMB
ANMO
SCP
HON
AFI
GDH
BOCO
ZOBO
BDF
KEV
KONO
GRFO
TOL
ANTO
BCAO
SLR
WMQ
HIA
BJI
LZH
KMI
MAJO
TATO
CHTO
GUMO
LEM
CTAO
NWAO
TAU
SNZO

APPENDIX
PUBLISHED REPORTS AND STUDIES IN PROGRESS

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