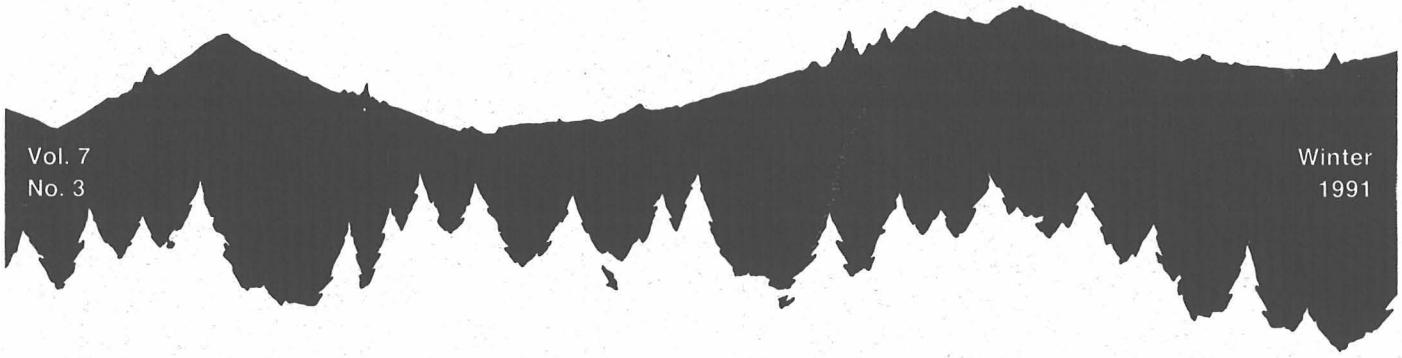
WASATCH FRONT FORUM



EARTHQUAKE HAZARDS PROGRAM

The Wasatch Front Forum is published quarterly by the Utah Geological Survey. Information, contributions, questions, and suggestions concerning future issues may be sent to the Editor at the address listed below:

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Earthquake Activity in the Utah Region

January 1 — March 31, 1991

Susan J. Nava
University of Utah Seismograph Stations
Department of Geology and Geophysics

During the three-month period January 1 through March 31, 1991, the University of Utah Seismograph Stations located 205 earthquakes within the Utah region (see accompanying epicenter map). The total includes nine earthquakes in the magnitude 3 range, specifically labeled on the epicenter map, and 88 in the magnitude 2 range. (Note: Magnitude indicated here is either local magnitude, M_L, or coda magnitude, M_C. All times indicated here are local time, which was Mountain Standard Time.)

Larger and/or Felt Earthquakes

M_L 3.3	January 26	2:49 p.m.	11 miles ESE of Escalante
M_L 3.1	January 28	5:40 a.m.	9 miles ESE of Snowville
M_L 3.1	February 6	6:46 a.m.	4 miles W of Hiawatha; felt at the U.S. Fuel Company Gentry Mtn. mine
M_L 3.4	February 21	4:23 a.m.	3 miles W of Salina; felt in Axtell, Redmond, and Salina (MMI IV), and at Aurora and Centerfield (MMI III)
M_C 3.1	February 23	2:23 a.m.	32 miles SW of Enterprise
M_L 3.3	March 2	1:41 a.m.	25 miles SSE of Vernal
M_L 3.0	March 15	1:33 p.m.	11 miles NW of Orangeville; felt at the Utah Power & Light Huntington mine
M_L 3.1	March 22	7:59 a.m.	4 miles NNE of Enoch; felt in Enoch
M_L 3.2	March 26	11:42 a.m.	10 miles NNW of Springdale; felt in Zion National Park, Virgin, Hurricane, and St. George

Significant Clusters of Earthquakes

Southwest of Price (coal-mining related): Three clusters of earthquakes make up 30% of the shocks that occurred in the Utah region during the report period.

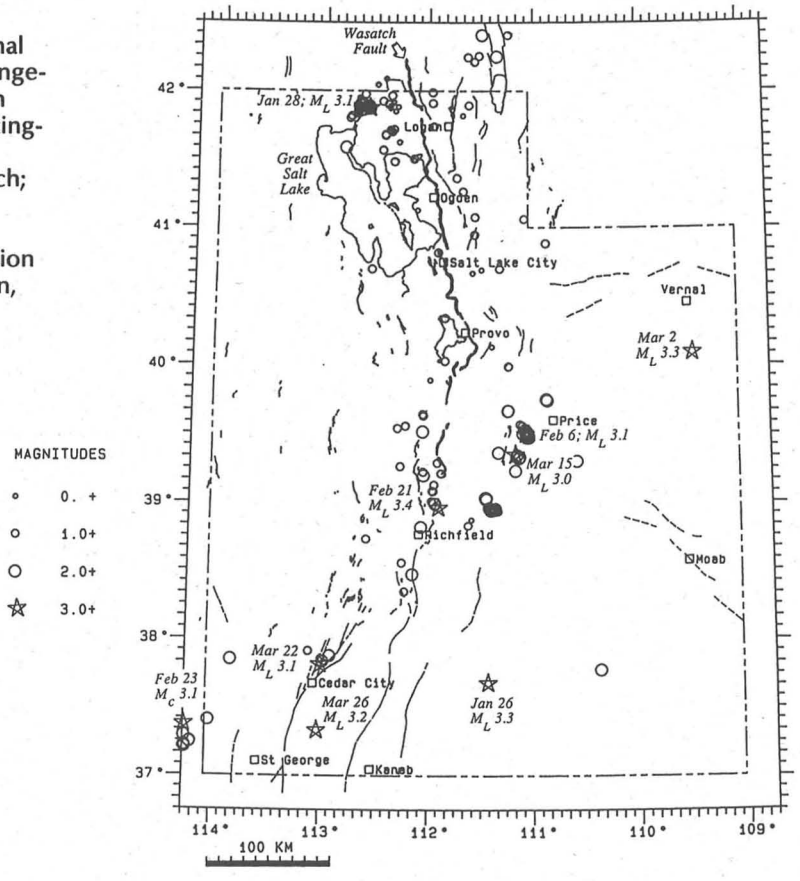
— 30 earthquakes, magnitude 1.9 to 3.1, occurred in the vicinity of the U.S. Fuel Company Gentry Mountain mine complex;

— 6 earthquakes, magnitude 2.0 to 3.0, occurred in the vicinity of the Utah Power & Light Huntington mine complex; and

— 27 earthquakes, magnitude 1.5 to 2.7, occurred in the vicinity of the Southern Utah Fuel Company Confusion Canyon mine complex.

North of the Great Salt Lake: A series of 45 earthquakes occurred NE of the northern arm of the Great Salt Lake (65 km WNW of Logan), ranging in magnitude from 1.0 to 2.6. This is one of the most seismically active regions of Utah, and the observed activity is not unusual.

Additional information on earthquakes within the Utah region is available from the University of Utah Seismograph Stations.



UTAH EARTHQUAKE ADVISORY BOARD ESTABLISHED

by Janine L. Jarva
Utah Geological Survey

and James L. Tingey
Utah Division of
Comprehensive Emergency Management

In early September 1991, D. Douglas Bodrero, Commissioner of the Utah Department of Public Safety and Chairman of the Governor's Disaster Emergency Advisory Council (DEAC), announced the creation of the **Utah Earthquake Advisory Board** (UEAB) as a subcommittee of the existing DEAC. The DEAC was created in 1981 to provide advice to the Governor on matters relating to state government emergency disaster response and recovery.

The formation of the UEAB is the culmination of significant efforts on the part of representatives from many constituencies concerned with seismic risk and safety in Utah. They devoted considerable time over the past two years attempting to broaden and strengthen the base of legislative support for earthquake hazard reduction measures. However, none of the earthquake-related bills (many prepared by the Earthquake Task Force of the Utah Advisory Council for Intergovernmental Relations (UACIR)), introduced in the 1990 and 1991 legislative sessions passed (see WFF v. 5, no. 3, p. 4; v. 5, no. 4, p. 6-7; v. 6, no. 1-2, p. 2-3; v. 6, no. 3-4, p. 2-3; v. 7, no. 1, p. 2; and v. 7, no. 2, p. 3). Although the legislative setbacks were very disappointing, Utah's earthquake advocates maintained a strong sense of their leadership role in promoting effective actions that address earthquake preparedness, mitigation, emergency response, and short- and long-term recovery planning. Their work succeeded in raising lawmakers' awareness of these issues and at the end of the 1991 legislative session they remained highly committed but believed that new avenues needed to be pursued. Formation of the UEAB represents a major step forward in this regard.

It has long been recognized in Utah that comprehensive actions to reduce earthquake risk will require cooperation from many professionals in both the public and private sectors. A responsibility for family and personal preparedness extends to the private individual. The issues and actions needed will affect so many people and groups that a consensus board is required to provide effective and coordinated leadership and promote and support the needed actions. The Utah Earthquake Advisory Board, as a standing subcommittee of the DEAC, was created to:

- Identify information needs and review data pertaining to all aspects of earthquake hazard and risk in Utah.
- Prepare recommendations to identify and mitigate the hazard and/or risk as it is known to exist.
- Task UEAB staff, appropriate agencies, or individuals to conduct cost/benefit analyses for the recommendations prepared by UEAB.
- Prioritize the recommendations and present them to state or local government or other appropriate entities as potential policy or loss-reduction strategies.
- Act as both a sounding board for individuals and groups concerned with earthquake safety and as a promoter of earthquake loss-reduction measures.

The UEAB includes individuals representing state government, local governments, private businesses, and numerous professions and organizations, and is similar to the composition of the former UACIR Earthquake Task Force. Its sixteen members are appointed by the Governor from the following agencies and groups. Individuals currently holding these appointments are also listed. These members are further divided into the Technical and Socioeconomic Subcommittees, indicated by a T or an S in the listing below.

1-Division of Comprehensive Emergency Management and Chairperson of UEAB: Lorayne Frank, Director, S, non-voting

1-Utah Geological Survey: M. Lee Allison, Director, T

1-University of Utah Seismograph Stations: Walter J. Arabasz, Director, T

1-Utah Department of Environmental Quality: Brent C. Bradford, Deputy Director, S

1-Utah Department of Transportation: James Golden, Assistant Chief Structural Engineer, Structures Division, T

1-Utah Department of Natural Resources: Alton V. Frazier, Associate Director, S

2-Utah Department of Administrative Services: Steve Grimshaw, Director, Division of Information Technology, S, and Frank Fuller, Project Coordinator, Division of Facilities, Construction and Management, T

1-Utah Office of Education: Bill Boren, Education Specialist, S

1-Governor's Office of Planning and Budget: Steven M. Klass, Deputy State Planning Co-ordinator and Executive Director, UACIR, S

2-Local government members at large: Commissioner Pete A. Coleman, Wasatch County Commission, Utah ACIR, S, and Ken Bullock, Executive Director, Utah League of Cities and Towns, T

1-Private sector structural engineer: David Curtis, President, Structural Engineers Association of Utah, T

1-Private sector geotechnical engineer: T. Leslie Youd, Professor, Department of Civil Engineering, Brigham Young University, T

1-Private sector architect: Mike Stransky, American Institute of Architects Chair, Western Mountain Region Task Force on Disaster Preparedness, S

1-American Red Cross: Virginia Lopez, Director, Emergency Services, S

The **Technical Subcommittee** will be broadly concerned with: geotechnical issues, geology and geologic hazards, site investigations, seismology and instrumentation, earthquake probability, hazard zones, land use, structural engineering and architecture, buildings and other structures, infrastructure engineering and vulnerability, retrofit, building codes, and damage and loss estimation. Although no specific actions are being endorsed or promoted by UEAB at this time, some of the issues which will be considered first on their agenda include:

- Establish a strong-motion instrumentation program to obtain needed information about earthquake-induced ground motions in Utah.
- Obtain appropriate modern instrumentation to meet State needs for earthquake engineering, hazard assessment, and emergency response communications.
- Update loss estimation studies (updating the 1976 study). *
- Accelerate the State seismic risk mapping program to achieve completed mapping of the major risk areas within five years.
- Seismic vulnerability assessments for Wasatch Front infrastructure: communications systems, transportation systems, highways and bridges, public utilities, water supply and wastewater systems, hospitals, public and private schools, fire stations, law enforcement facilities, and state, county, and city-owned structures. *
- Recommend a program to bring existing essential services, facilities, and structures into substantial compliance with existing building codes at all jurisdictional levels.
- Ensure proper planning (land-use ordinances) for new construction, particularly essential facilities, in areas of earthquake and other geologic hazards.
- Develop guidelines for developers to meet to define the earthquake hazard and the engineering options for reducing the earthquake hazard.
- Adopt legislation requiring that site evaluations for geologic hazards be made for all public-use facilities.

- Require plan checks for all buildings (public and private) to more effectively implement the Uniform Building Code structural/seismic provisions. *

- Amend existing Uniform Building Code (UBC) provisions to require a life-safety analysis of all existing and new structures prior to the issuance of a building permit.

- Adopt legislation requiring compliance with earthquake safety provisions of the building code.

- Enforce earthquake safety code provisions in facilities under State jurisdiction. *

- Undertake a program of selective retrofit or replacement of high-hazard facilities that are essential in our communities or that have large occupancies. *

- Develop and implement abatement programs leading to eventual elimination of existing high-hazard, publicly occupied facilities. *

- Utilize regulatory authorities now available to ensure that new schools and health-care facilities meet appropriate earthquake safety standards. *

- Recommend that the State require separate seismic building standards for schools. *

- Promulgate guidelines and procedures within the Department of Health to reduce the earthquake risk to water supply and waste disposal systems. *

- Identify and correct conditions in water supply systems that are vulnerable to earthquake damage.

- Establish seismic standards and review procedures for dams and reservoirs. *

- Strengthen licensing laws for architects and engineers to improve professional accountability.

- Address cross-state licensing and reciprocity for professionals in disaster and emergency conditions.

* The Socioeconomic Subcommittee is also participating in this evaluation.

The **Socioeconomic Subcommittee** will deal with issues of: planning, public awareness, education and training, disaster management, communications, health and medical, environmental impact, emergency sheltering, public relations, local government interaction, legal issues, disaster recovery, and ordinances and legislation. In addition to the joint concerns mentioned above, some specific issues they will be addressing initially include:

- Establish an earthquake-survivable communications system.

- Establish rules of succession to ensure continuity of government (state and local) following an earthquake.

- Initiate a plan for multijurisdictional response.

- Plan for effective earthquake response and recovery, including agency preparedness, training, and assessment of available resources.

- Require state agencies to develop and test operations resumption plans for critical applications.

- Amend planning statutes to provide explicit authority for local governments to plan for earthquake safety.

- Allow fire districts over municipal boundaries.

- Request public and private employers with over 50 employees to provide specified earthquake safety information to employees and encourage smaller employers to do so as well.

- Train school personnel in disaster preparedness and response.

- Require that all public and private schools prepare and practice their earthquake safety plans/programs.

- Promote education and public information aimed at earthquake safety and greater awareness of natural hazards.

- Increase public awareness to improve personal and family preparedness.
- Prepare and disseminate information about the available insurance coverage for earthquake damage and loss.
- Support federal earthquake insurance.
- Require disclosure of geological hazards in real estate transactions.
- Establish legislation for the identification of potentially hazardous buildings (URM, soft story, pre-cast, tilt-up, etc.).
- Encourage local governments to safeguard fire equipment and buildings from operational disfunction due to earthquakes through assistance from the State Fire Marshall's office.
- Identify and evaluate hazardous materials storage and disposal sites.
- Assist local governments to strengthen building code enforcement of public utility systems.
- Develop search and rescue capability.

Recommendations prepared by the UEAB will be presented to the DEAC for review and submittal to the Governor. They will also be published and sent to local governments, private businesses, and professional groups for review and possible adoption. With approval from DEAC, they may also be presented to appropriate groups for legislative action.

The UEAB will initially be funded by the Division of Comprehensive Emergency Management through a one-year grant from the Federal Emergency Management Agency. The Division of Comprehensive Emergency Management provides staff to the UEAB through the Earthquake Preparedness Information Center (EPICenter), Jim Tingey, Manager.

The old UACIR Earthquake Task Force provided significant input in developing bills for consideration by the Utah Legislature. The more formalized standing of the UEAB as a subcommittee of the Cabinet-level DEAC will allow Utah's earthquake advocates to actively pursue and achieve needed actions on a broader front.

UBC COMMISSION VOTES ON PROPOSING SEISMIC ZONE CHANGE FOR THE WASATCH FRONT

by Susan S. Olig
Utah Geological Survey

Over the past year, the Uniform Building Code (UBC) Commission has considered changing the seismic zone from 3 to 4 along the central Wasatch Front (figure 1). The Commission administers the UBC throughout Utah. After reviews by advisory committees and much deliberation, the Commission held a public forum on June 26, 1991 to discuss and debate whether to propose an amendment to the International Conference of Building Officials (ICBO) that would change the zone. The forum was fairly well-attended and presentations were given on many aspects of the issue by a variety of professionals. Carl Eriksson, with Salt Lake County Development Services and Chair of the Structural Advisory Committee to the Commission moderated the forum. Engineers, building officials, seismologists, and contractors in the audience voiced a variety of opinions on the proposed amendment. The forum was co-sponsored by the Utah Divisions of Comprehensive Emergency Management, Facilities Construction and Management, and Occupational and Professional Licensing, and the Federal Emergency Management Agency.

After the forum, the Commission voted 5 to 1 to submit the proposed zone change to ICBO. The reason for the proposed change, as stated in the code change submittal, follows.

> "Under the auspices of the National Earthquake Hazard Reduction Program (NEHRP), extensive research on earthquake sources and hazards along the Wasatch Front was conducted in the past ten years. Much of the knowledge gained was incorporated into a 1987 probabilistic ground-shaking analysis that indicates larger peak ground accelerations than were mapped in previous studies that were the

basis for the 1988 Seismic Zone Map. These new estimates of accelerations, with a 10 percent probability of being exceeded in 50 years, range from 0.3 g to 0.4 g along the central Wasatch Front. By definition, (Structural Engineers Association of California Blue Book) this meets the criteria for seismic zone 4."

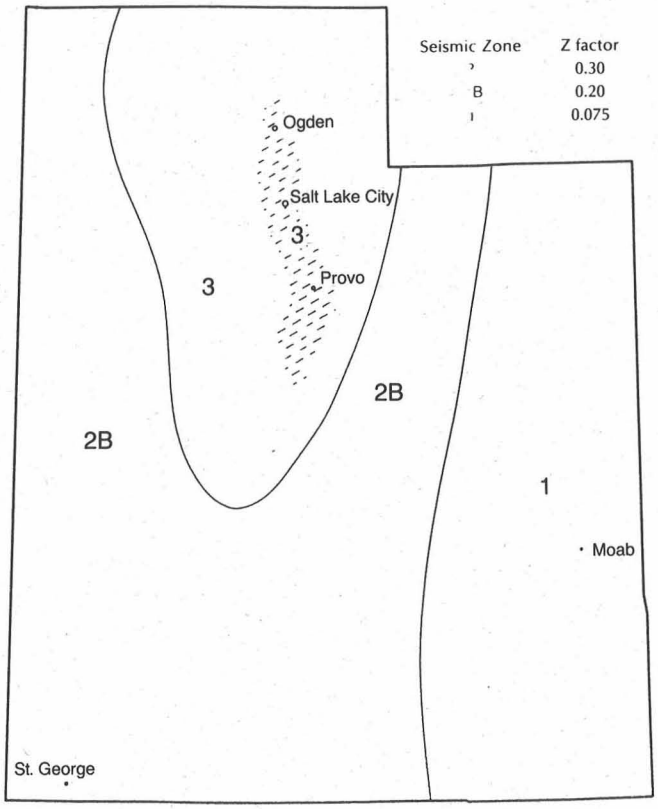


Figure 1. The 1988 UBC seismic zone map for Utah. Shading shows areas with accelerations greater than 0.3 g. This area would fall into seismic zone 4. The UBC Commission has voted to submit an amendment to ICBO to change this area from zone 3 to zone 4, which will be considered for the 1994 edition of the code.

The submittal is presently being reviewed by the ICBO staff. It will then be reviewed by the seismology committee of ICBO. Findings will be reported in Building Standards magazine and discussed at a conference in February 1992. Although only members of ICBO ultimately vote on the submittal, any professional in a related field may present information, comments, or opinions at the conference and either challenge or support the submittal. Copies of the submittal, which includes an appendix containing technical background information, may be obtained from Judd Weiler, Division of Occupational and Professional Licensing, 530-6731.

NATIONAL EARTHQUAKE PREDICITION EVALUATION COUNCIL HOLDS MEETING IN UTAH

by Gary E. Christenson
Utah Geological Survey

The National Earthquake Prediction Evaluation Council (NEPEC) held a two-day meeting in Alta, Utah on June 11-12, 1991. NEPEC was established in January 1980 to advise the U.S. Geological Survey regarding issues related to earthquake prediction(s). Members on the Council are all nationally recognized experts from the USGS, academia, or state government. The Working Group on California Earthquake Probabilities, which successfully identified a high probability for an earthquake on the Southern Santa Cruz Mountains segment of the San Andreas fault in 1988, prior to the 1989 Loma Prieta earthquake, was convened under the auspices of NEPEC. The Ad Hoc Working Group on the December 2-3, 1990 Earthquake Prediction, which discounted the prediction by Iben Browning for the New Madrid seismic zone, was also convened by NEPEC.

This meeting was the first time NEPEC has met in Utah. On June 11, speakers working in Utah were invited to discuss research results bearing on earthquake predictions and probabilistic earthquake hazard evaluations for the Utah region. The Utah Geological Survey and University of Utah participated in this discussion, which continued well into the night. The Council showed great concern for Utah's earthquake problems, and offered valuable advice regarding predictions, hazards research, and public policy. June 12 was spent handling other NEPEC business, but the Council left with a better appreciation of the

earthquake problem in Utah. By hosting the meeting, Utah has hopefully gained a valuable ally in our search for support for additional studies in the state, and in pursuing research and policy matters related to both short-term predictions and longer-term earthquake probability assessments.

ASSOCIATION OF CONTINGENCY PLANNERS CONFERENCE

by Bob Carey
Utah Division of
Comprehensive Emergency Management

The Salt Lake City Chapter of the Association of Contingency Planners held a conference on Contingency Planning for Business Recovery, October 2, 1991, at the Salt Lake Airport Hilton Hotel. This year's theme was "The Future is Now," emphasizing that preparations for business and other corporate disaster recovery and mitigation must be made now, for once disaster strikes, it is too late to prepare.

The conference featured a one-day format, assuring that time away from the job was kept to a minimum. The information-packed agendas and specially invited vendors provided both the theory and know-how for building the foundations of a solidly-based contingency program. Presenters at the conference included Gerald Ventelo of AT&T, Jed Erickson of the University of Utah Medical Center, Cole Emerson of Stanford Research Institute, and Cynthia Crose of IBM. Topics ranged from the setup of emergency operations centers to the human factors in a disaster.

STATE EARTHQUAKE EXERCISE HELD

by Bob Carey
Utah Division of
Comprehensive Emergency Management

An exercise to review and test the response capability of state agencies was held April 26, 1991 (see WFF, v. 7, no. 1, p. 4). The scenario used was a major earthquake located within Salt Lake County, impacting nearly all Wasatch Front communities. Representatives from the Utah Departments of Health, Natural Resources, Public Safety, Administrative Services, Human Services, Transportation, and the University of Utah Seismograph Stations participated in the mock earthquake.

Participants were asked what actions would be taken in certain situations and whether or not their agencies would be involved in providing resources or other decision-making tasks. Because the state of Utah is now closely allied with the Federal Response Plan, many disaster situations would require both state and federal response. A response task which would require significant state and federal cooperation and coordination is the rapid assessment of dams by Utah's Dam Safety Office, the Bureau of Reclamation, and the Army Corps of Engineers. This highly time-dependant function and any associated evacuations, may be one of the most complex response operations.

Other important response functions discussed during the exercise were mass-care issues which involve the emergency sheltering of thousands of people, communication capabilities, rapid assesment of damaged buildings for safety evaluations, and multiple roles for the Department of Transportation.

After the exercise, state agencies were encouraged to critique existing plans and procedures at the division, department, and state levels, for possible revision of the Utah Natural Disaster Response Plan.

CONSORTIUM FOR U.S. REGIONAL SEISMIC NETWORKS

by Robert Crosson
University of Washington

and Walter J. Arabasz
University of Utah Seismograph Stations

Regional and local networks have traditionally been established for specific tectonic, seismicity, and hazard studies. With recent instrumentation advances, combined with advances in our ability to

transmit and analyze large quantities of seismic data, regional networks will play an increasingly important role in global studies as well. For example, many regional networks are planning the addition of broadband, high dynamic range stations to increase observational capabilities, and combining data from regional networks promises to provide new avenues of research.

At a meeting June 17-19, 1991, in Alta, Utah, convened by Al Lindh of the U.S. Geological Survey and Bob Smith of the University of Utah, scientists involved in regional seismograph network operation from the U.S. and Canada gathered to exchange ideas on problems, challenges, and opportunities facing regional networks in the current decade. As an outgrowth of the meeting, effort was initiated to form a new consortium for regional networks in the U.S. A provisional name for the consortium is CUSRN (Consortium for U.S. Regional Networks), and a steering committee has been selected to guide its formation. The mission of the new consortium is to ensure stable, long-term support and coordination for regional to national level seismic networks within the United States in order to meet research, educational, engineering, and public safety objectives. Its specific goals are:

- Ensure continuous recording of U.S. seismicity in all areas of the country at a level adequate to characterize seismic and volcanic hazards.
- Encourage, coordinate, and support standardization of instrumentation, data acquisition, software, and data-exchange formats.
- Ensure the permanent archiving (for ease of access) of regional seismic network data already in hand and to be collected in the future.
- Form a partnership among network seismologists in government, academic, and private sectors.
- Provide forums, as needed, for exchange of information about issues and technical problems confronting regional seismic networks.

Working groups were formed to study and make recommendations on: sensors and telemetry; recording systems; data center and exchange format; and coordination with the U.S. National Seismic Network.

On December 10, 1991, as part of the American Geophysical Union's Fall Meeting in San Francisco, a public forum will be held on CUSRN, in the Civic Auditorium, Room 313, from 4:40 p.m. to 6:00 p.m. It is intended both to share information on developments to date and to invite input from interested individuals and groups. All are invited. Information updates from CUSRN's steering committee and the working groups mentioned above, as well as from representatives of the U.S. National Seismic Network, will be presented. The forum will then proceed to an open discussion about future directions. For further information, contact Walter J. Arabasz, Chairman, CUSRN Steering Committee, (801) 581-6274.

REDUCING EARTHQUAKE HAZARDS IN UTAH: THE CRUCIAL CONNECTION BETWEEN RESEARCHERS AND PRACTITIONERS

By William J. Kockelman
U.S. Geological Survey

[This is the fifth excerpt from the publication entitled "Reducing Earthquake Hazards in Utah: The Crucial Connection Between Researchers and Practitioners" to be reprinted in the Forum (see WFF, v.6, no.1-2, p. 16-25, 1990, v.6, no. 3-4, p. 9-17, 1990, v. 7, no. 1, p. 6-13, 1990, and v. 7, no. 2, p. 7-19, 1990). Although the full paper will be included in the USGS Professional Paper "Assessment of Regional Earthquake Hazards and Risk Along the Wasatch Front, Utah" currently in press, the editors feel the information to be timely and relevant enough to reprint herein. This information is available now as USGS Open-File Report 90-217. Questions can be directed to Bill Kockelman at (415) 329-5158. Ed.]

TRANSFER TO NONTECHNICAL USERS

The objective of transferring hazard information is to ensure its use in reducing losses from future earthquakes. Translated hazard information is a prerequisite for transfer to

nontechnical users. Its objective has been previously described as: making the users aware that a hazard exists; providing them with information that they can easily present to their superiors, clients, or constituents; and providing them with materials that can be directly used in a reduction technique (list 2). the Utah work plan is quite specific as to what is expected of transfer activities:

- foster the creation and implementation of hazard-reduction measures ....
- ... users will have easy access to data ....
- ... information is released promptly.
- ... most effective educational, advisory, and review services appropriate to the targeted users.
- ... both its transfer and its effective use for hazard reduction.

Definition

Various terms are used to convey "transfer" of information to users, namely, disseminate, communicate, circulate, promulgate, and distribute. Often these terms are interpreted conservatively, for example, merely issuing a press release on hazards or distributing research information to potential users. This level of activity cannot be expected to result in effective hazard-reduction techniques or even to make users aware of the hazard.

According to Slovic (1986), communicators must appreciate the limitations of public understanding, namely: 1) people's perceptions are often inaccurate; 2) risk information may frighten and frustrate the public; 3) strong beliefs are hard to modify; and 4) naive views are easily manipulated by the format used to present other perspectives. He then suggests that research is needed in the areas of informed consent, information relevance, perceived risk, and the use of the media. Sorensen and Mileti (1987) provide an excellent discussion on the dilemmas of perception, the warning response process, the determinants of senders and receivers, the personalizing of warnings, and the nonbehavioral aspects of response.

No clear concise definition of, or criteria for, "transfer" has been offered, or can be found in the literature except by inference or by analysis of what actually works for those who have developed and adopted reduction techniques. Therefore, I suggest that we use "transfer" to mean the delivery of a translated product in a usable format at a scale appropriate to its use by a specific person or group "interested" in, or responsible for, reducing hazards. To delivery of a product, we must add assistance and encouragement in its use; in other words, an active ongoing learning experience!

This definition of "transfer" is somewhat analogous to the passing of a football or baton. Assume that the football or baton is understandable and in a usable format. Once the hand-off or passing has taken place, the receiver (for various reasons) may not run, wiN the race, or otherwise act appropriately.

It is the same with a receiver of earthquake-hazard information. The information alone without action will not reduce casualties, damages, and interruptions. Obviously, something else is needed. My experience indicates that effective transfer must include not only delivery but assistance and encouragement in the selection and adoption of an appropriate reduction technique. Only then have the researchers, translators, and transfer agents fulfilled their professional obligation.

Transfer Techniques

Such delivery, assistance, and encouragement can be accomplished through specific transfer techniques which may be categorized into educational, advisory, and review services (list 4). These services were identified and tested by me during the 1960s, successfully used by the Southeastern Wisconsin Regional Planning Commission (1968, 1987), incorporated into the overall program design for the New Mexico State Planning Office (Kockelman, 1970, p. 34-41), brought to the attention of the USGS (Kockelman, 1976a), and incorporated into its national landslide-hazard-reduction program (U.S. Geological Survey, 1982, p. 34-47). In addition, these services are provided by some of the USGS's scientists, engineers, planners, and others as a personal commitment or under various earth-sciences application and public information programs. The remarkable effort in Utah to provide these services can be seen in the following section.

List 4

Examples of Techniques for Transferring Hazard Information

Educational services

Providing serial and other types of publications reporting on hazard research underway, reduction techniques in process, and the adoption and enforcement of reduction techniques.

Assisting and cooperating with universities, their extension divisions, and other schools in the preparation of course outlines, detailed lectures, casebooks, and audio or visual materials.

Contacting speakers and participating as lecturers in state and community educational programs related to the use of hazard information.

Sponsoring, conducting, and participating in topical and areal seminars, conferences, workshops, short courses, technology utilization sessions, cluster meetings, innovative transfer meetings, training symposia, and other discussions with user groups.

Releasing information needed to address critical hazards early through oral briefings, newsletters, seminars, map-type "interpretive inventories," open-file reports, reports of cooperative agencies, and "official use only" materials.

Sponsoring or cosponsoring conferences or workshops for planners, engineers, and decisionmakers at which the results of hazard studies are displayed and reported on to users.

Providing speakers to government, civic, corporate, church, and citizen groups, and participating in radio and television programs to explain or report on hazard-reduction programs and techniques.

Assisting and cooperating with state and community groups whose intention it is to incorporate hazard information into school curricula.

Preparing and exhibiting displays that present hazard information and illustrate their use for hazard reduction.

Guiding field trips to disaster areas, damaged structures, and potentially hazardous sites.

Preparing and distributing brochures, TV spots, films, kits, and other visual materials to the news media and other users.

Operating public inquiries offices, sales offices, and clearinghouses.

Advisory services

Preparing annotated and indexed bibliographies of hazard information and providing lists of pertinent reference material to users.

Assisting local, state, and federal agencies in designing policies, procedures, ordinances, statutes, and regulations that are based on, cite, or make other use of hazard information.

Providing explanations of hazard information and reduction techniques during public hearings.

Assisting local, state, and federal agencies in the design of their hazard information collection and interpretation programs and in their work specifications.

Providing expert testimony and depositions concerning hazard research information and its use in reduction techniques.

Assisting in the presentation and adoption of plans and plan implementation devices that are based upon hazard information.

Assisting in the incorporation of hazard information into local, state, and federal studies and plans.

Preparing brief fact sheets or transmittal letters about hazard products explaining their impact on, value to, and most appropriate use by local, state, and federal planning and development agencies.

Assisting users in the creation, organization, staffing and formation of local, state, and federal planning and plan implementation programs so as to ensure the proper and timely use of hazard information.

Preparing and distributing appropriate guidelines and guidebooks relating to natural-hazards processes, mapping, and reduction techniques.

Preparing models for state safety legislation, regulations, and development policies.

Preparing models for local safety policies, safety plan criteria, and hazard-reduction techniques.

Advising on and providing examples of the methods or criteria for hazard identification, vulnerability assessments, hazard reduction, and emergency management.

Review services

Reviewing proposed programs designed for

collecting and interpreting hazard information.
Reviewing local, state, and federal policies, administrative procedures, and legislative analyses that relate to assessing and reducing hazards.
Reviewing studies and plans that are based on, cite, or otherwise use hazard information.
Reviewing proposed regulations, policies, and procedures that incorporate or cite hazard information.

Educational services range from merely announcing the availability of earthquake-hazard information, through the publishing and distributing of newsletters and brochures, to sponsoring, conducting, or participating in seminars and workshops for potential users.

Advisory services range from explaining or interpreting earthquake-hazard reports and maps, through publishing guidebooks and assisting in the design of regulations based upon the information, to giving expert testimony and depositions concerning the information.

Review services include review and comment on policies, procedures, studies, plans, statutes, ordinances, or other regulations, that are based upon, cite, interpret, or apply earthquake-hazard information.

The educational and advisory services should not supplant existing programs or activities of educational institutions, or replace services of private consulting firms or state and local organizations; instead they should supplement them!

The importance of educational and advisory services to accomplish delivery, assistance, and encouragement is obvious. The importance of review services is less obvious. When hazard information is used in a regulatory technique that affects land use and property values, it is eventually challenged in a courtroom or other public forum. At that time the researcher is requested or subpoenaed to explain (or confirm the proper use of) his or her research information.

If the researcher hasn't been given the opportunity to review its use and the opportunity to correct its potential misuse, the regulation will lose validity, the researcher embarrassed, and the user chagrined. It is foolish not to review when the effort to review is compared with the time and scarce resources needed to perform the required scientific and engineering studies (list 1), to translate and transfer them, and to prepare, adopt, and enforce a reduction technique (list 2).

Multiple ways of imparting information should be encouraged. A single exposure to new information, especially if the information is complex or differs from a user's previous knowledge, is often insufficient. Repeated exposure in different formats and through different conduits is needed. This strategy is particularly successful when new information is provided by persons who are customarily looked to for guidance, such as members of the same professional group. The most effective transfer techniques (list 4) should be selected jointly (if possible) by the translator, transfer agent, and user.

Most public hearings or presentations to decisionmakers allow little time, and the transfer agent is competing with numerous other issues. The most concise, simplest translation and transfer techniques are the most successful. One of USGS's senior scientists (A.H. Lachenbruch, written commun., 1981) with experience in successfully transferring research information to Congress, as well as local decisionmakers, observed: "Simple maps with a few bright colors are needed ...." Obviously such maps must be derived from larger scale and more detailed information which, if needed to meet a challenge, is readily available.

Transfer Agents

For the purposes of this report, the term "transfer agents" is defined as those who deliver translated research information to potential users and assist and encourage them in selecting and adopting appropriate hazard-reduction techniques. In his final report on the County Hazards Geologist Program, Christenson (1988, p. 3) identifies several options for transferring geologic expertise to local governments, namely:

- Permanent, full-time city or county geologist.
- Circuit-rider geologist serving several governments simultaneously.
- Geologist employed by an umbrella agency (regional association of governments, state survey) but dedicated to serving local governments.
- Private consulting geologist on retainer or under contract with local government.

It should be noted that consultants under contract with a local government may have the appearance of a "conflict-of-interest" if they represent parties other than the local government within its jurisdiction.

Potential transfer agents of earthquake-hazard information in Utah are given in list 5. Many of the users in list 3 will also be transferring such information. Bates (1979, p. 11) notes that: "although both the use of transfer agents and the education of planners in the earth science, ... are increasingly important components of the information-transfer system, nothing replaces intensive producer-user interaction ...."

List 5

Potential transfer agents for earthquake-hazard information in Utah

American Planning Association, Utah Chapter
American Society of Civil Engineers, Utah Section
American Society of Public Administrators, Utah Chapter
Association of Engineering Geologists, Utah Section
Bear River Association of Governments

Children's Museum
Church groups, church organizations, and church leaders
Civic and voluntary groups
Consultants (engineers, planners, geologists, and others)
County geologists and extension agents

Educators (university, college, secondary, and elementary)

Of course, geologists, seismologists, and other earthquake researchers may be available to provide some of the educational, advisory, and review services, but to rely solely or heavily on these skilled and scarce resources is unreasonable and would divert them from their work of understanding the process, assessing the hazard, and translating their research.

The role of professional associations -- planners, engineers, geographers, and geologists -- should be emphasized. For example, Petak (1984, p 457) points out that "hazard and risk assessment must be ... fully supported by the efforts of the geotechnical profession." The professions can not only contribute to identifying user needs, translating and transferring complex information, and fostering an environment for use, but are principal users themselves. The Yin and Andranovich (1987) study on getting research used in the natural-hazard field concluded that the role of professional associations "is a diffuse model, in which multiple sources of ideas are mixed with multiple types of users ...." Transfer agents should solicit and use the expertise of those members of the sociological community who are trained and experienced in reducing natural hazards.

Examples of successful transfer agents and their transfer programs:

- Circuit-rider geologist in the State of Washington (Thorsen, 1981).
- Planning, reviewing, and enforcing by city and county geologists (McCalpin, 1985; Christenson, 1988).
- Advisory services unit of the California Division of Mines and Geology (Amimoto, 1980).
- Educational, advisory and review services by the Southeastern Wisconsin Regional Planning Commission (1968, 1987).
- Earth-science information dissemination activities of the U.S. Geological Survey (Information Systems Council's Task Force on Long-range Goals for USGS's Information Dissemination, 1987).
- Earthquake-hazard reduction activities of the staff, members, and committees of the California Seismic Safety Commission (1986).

Successful Transfer

One of the best ways to determine which transfer techniques are effective is to closely look at techniques that have been used and which have resulted in the reduction of natural hazards. For over 25 years a midwestern multicounty planning commission has transferred geologic, hydrologic, and pedologic hazard information to public and private users. The annual project completion report by the Southeastern Wisconsin Regional Planning Commission (1968) shows that almost every educational, advisory, and review service in list 4 was repeatedly used.

Many other examples of the transfer techniques shown in list 4, including their transfer agents, can

be cited. Selected examples follow:

- Earthquake-hazard reduction series by the Federal Emergency Management Agency (1985-1988).
- Home guide section on how a house withstands an earthquake in the Chicago Tribune by Kerch (1988).
- Guidebook on reducing earthquake risks for planners by Jaffe and others (1981).
- Isoseismal map users guide by the Central United State Earthquake Consortium (1987).
- Canoe trip to view evidence of probable magnitude 8 or 9 earthquake in the Pacific Northwest by Atwater (1988).
- Introduction to geologic and hydrologic hazards in the United States by Hays (1981).
- Using earth-science information for earthquake-hazard reduction in the Los Angeles region by Kockelman (1985).
- Guidelines for preparing a safety element of the city and county general plan by a governor's office of planning and research (Mintier, 1987, p. 1436-153).
- Case studies on strengthening hazardous buildings by the San Francisco Bay Area Regional Earthquake Preparedness Project (1988).
- Guidebook for disaster mitigation for planners, policymakers, and communities by Lohman and others (1988).
- Guidebook on identifying and mitigating seismic hazards in buildings, including a model ordinance for rehabilitating masonry buildings by the California Seismic Safety Commission (1987).
- Guidebook on seismic safety and land use planning by Blair and Spangle (1979).
- Handbook on land-use planning for earthquake-hazard mitigation for planners by Bolton and others (1986).
- Analyzing and portraying geologic and cartographic information for land-use planning, emergency response, and decisionmaking in San Mateo County, California, by Brabb (1987).
- Getting ready for a big quake in Sunset Magazine by Lane Publishing Company (1982).
- Landslide-hazard mitigation plan for Colorado by Jochim and others (1988).
- Trail signs describing the 1959 Hebgen Lake earthquake-triggered landslides and vertical displacement along the fault in the Gallatin National Forest, Montana, by the U.S. Forest Service.
- Workshop on the evaluation of regional and urban earthquake hazard and risk in Alaska convened by Hays and Gori (1986).
- Periodical on earthquakes and volcanoes (formerly Earthquake Information Bulletin) by U.S. Geological Survey (Spall, 1975 to present).
- Bibliography and index to seismic hazards of western Washington from 1855 to 1988 compiled by Manson (1988).
- Review of state landslide-hazard maps by USGS physical scientist W.M. Brown (written commun., 1985).
- Peace of mind in earthquake country -- How to save your home and life by Yanev (1974).
- Selected annotated bibliography of recent publications concerning natural hazards by Morton (1986).
- Washington state earthquake hazards by Noson and others (1988).
- Pilot earthquake education projects in Arkansas, Tennessee, Mississippi, Washington, and South Carolina (Bolton and Olson, 1987b, app. B).
- Steps to earthquake safety for local governments by Mader and Blair-Tyler (1988).

Comment

Many researchers provide educational, advisory, and review services on a limited and informal basis. Federal, state, and university scientists are frequently called upon to assist users. Such services should be formally recognized and included as a work element in any earthquake-hazard reduction program as was done in the Utah work plan.

Many of these services are provided in Utah through cooperative agreements, serial publications, report and map-sales offices, geologic-inquiries staff, public-inquiries offices, professional groups, local and State geologists, municipal planners and engineers, and ordinary day-to-day contacts with the public by the researchers and translators of earthquake-hazard information. Specific examples from Utah are given in the following section.

The reader familiar with the successful transfer agents, programs, and techniques cited here will note that they accomplished the following:

- Delivered the information to those who are interested or required to use it.
- Conveyed the hazard in such a way as to result in the users' awareness.
- Provided the user with a wide selection of reduction techniques.
- Suggested a strategy for using the hazard information in reduction technique through examples.

It is my experience that educational, advisory, and review services must accompany any successful earthquake research, hazard assessment, translation, and transfer program designed for planners, engineers, and decisionmakers.

Several benefits accrue to the transfer agents and those researchers and translators involved in transfer activities. These benefits include:

- Satisfaction that they have discharged their professional obligations and the "ball is now in another court."
- Sense of accomplishment when community safety is improved.
- Perception of how local, state, and corporate decisions are made.
- Awareness of where and how they can now make a civic contribution to encourage appropriate decisions.

REFERENCES CITED

Amimoto, Perry Y., 1980, Advisory services: Sacramento, California Division of Mines and Geology, California Geology, May 1980, p. 99-100.

Atwater, B.F., 1988, Probable local precedent for earthquakes of magnitude 8 or 9 in the Pacific Northwest, in Hays, W.W., ed., Workshop on "Evaluation of earthquake hazards and risk in Puget Sound and Portland areas" -- Proceedings of Conference XLII, 1988: U.S. Geological Survey Open-File Report 88-541, p. 62-68.

Bates, T.F., 1979, Transferring earth science information to decisionmakers -- Problems and opportunities as experienced by the U.S. Geological Survey: U.S. Geological Survey Circular 813, 30 p.

Blair, M.L., and Spangle, W.E., 1979, Seismic safety and land-use planning -- Selected examples from the San Francisco Bay region, California: U.S. Geological Survey Professional Paper 941B, 82 p.

Bolton, P.A., Heikkala, S.G., Greene, M.M., and May, P.J., 1986, Land-use planning for earthquake hazard mitigation -- A handbook for planners: Boulder, University of Colorado, Institute of Behavioral Science, Natural Hazards Research and Applications Information Center, Special Publ. 14, 123 p.

Bolton, P.A., Olson, Jon, 1987b, Final report on the evaluation of three earthquake education projects: Seattle, Battelle Human Affairs Research Centers, BHARC 800-88-027, 153 p.

Brabb, E.E., 1987, Analyzing and portraying geologic and cartographic information for land-use planning, emergency response, and decisionmaking in San Mateo County, California, in GIS '87 -- San Francisco "... into the hands of the decisionmaker," Second Annual International Conference, Exhibits and Workshops on Geographic Information Systems, October 26-30, 1987: Falls Church, Virginia, American Society for Photogrammetry and Remote Sensing and the American Congress on Surveying and Mapping, p. 362-374.

California Seismic Safety Commission, 1986, California at risk -- Reducing earthquake hazards, 1987 to 1992: Sacramento, California Seismic Safety Commission, 92 p.

----1987, Appendix to the guidebook to identify and mitigate seismic hazards in buildings: Sacramento, California Seismic Safety Commission, Report SSC 87-03, 96 p.

Central United States Earthquake Consortium, 1987, Map user's guide: Memphis, Tenn., Central United States Earthquake Consortium, 4 p.

Christenson, G.E., 1988, Final technical report -- Wasatch Front county hazards geologist program: Salt Lake City, Utah Geological and Mineral Survey, USGS Grant 14-08-0001-G991, 14 p.

Federal Emergency Management Agency, 1985-1988, (various titles relating to seismic safety): Washington, D.C., Federal Emergency Management Agency, Hazards-reduction series nos. 1-39.

Hays, W.W., 1981, ed., Facing geologic and hydrologic hazards -- Earth-science considerations: U.S. Geological Survey Professional Paper 1240B, 109 p.

Hays, W.W., and Gori, P.L., eds., 1986, A workshop on "Evaluation of regional and urban earthquake hazards and risk in Alaska," Proceedings on Conference XXXI, Anchorage, Alaska, Sept. 5-7, 1985: U.S. Geological Survey Open-File Report 86-79, 450 p.

Information Systems Council's Task Force on Long-Range Goals for USGS's Information Dissemination, 1987, Review of current and developing U.S. Geological Survey earth-science information dissemination activities (summary version): Reston, Va., U.S. Geological Survey, update of May 1985 report, 6 p.

Jaffe, Martin, Butler, JoAnne, and Thurow, Charles, 1981, Reducing earthquake risks -- A planner's guide: Chicago, American Planning Association Advisory Services Report 364, 82 p.

Jochim, C.L., Rogers, W.P., Truby, J.O., Wold, R.L., Jr., Weber, George, and Brown, S.P., 1988, Colorado landslide hazard mitigation plan: Denver, Colorado Geological Survey Bulletin 48, 149 p.

Kerch, Steve, 1988, In quakes, many homes shake, rattle -- not roll: Chicago, Ill., Chicago Tribune, Home Guide section, February 27, 1988, 2 p.

Kockelman, W.J., 1970, Overall program design for the State Planning Office: Santa Fe, New Mexico State Planning Office, 124 p., 16 app.

----1976a, Educational, advisory, and review services: Menlo Park, Calif., U.S. Geological Survey administrative report, 25 p.

----1985, Using earth-science information for earthquake-hazard reduction, in Ziony, J.I., editor, Evaluating earthquake hazards in the Los Angeles region -- An earth-science perspective: U.S. Geological Survey Professional Paper 1360, p. 443-469.

Lane Publishing Co., 1982, Getting ready for a big quake: Menlo Park, Calif., Lane Publishing Company, Sunset Magazine, p. 104-111.

Lohman, Ernst, Vrolijks, Luc, and Roos, Jaap, 1988, Disaster Mitigation -- A manual for planners, policymakers, and communities, final draft: Geneva, United Nations Office of the Disaster Relief Coordinator, 489 p.

Mader, G.G., and Blair-Tyler. M.L., 1988, California at risk -- Steps to earthquake safety for local government: Sacramento, California Seismic Safety Commission Report SSC-88-01, 55 p.

Manson, C.J., 1988, Seismic hazards of western Washington and selected adjacent areas -- Bibliography and index, 1855-June 1988: Olympia, Washington Division of Geology and Earth Resources, Open-File Report 88-4, 1,039 p.

McCalpin, James, 1985, Engineering geology at the local government level -- Planning, review, and enforcement: Association of Engineering Geologists Bulletin, v. 22, no. 3, p. 315-327.

Mintier, J.L., 1987 (rev.), State of California general plan guidelines: Sacramento, California, Governor's Office of Planning Research, 368 p.

Morton, D.R., ed., 1986, A selected annotated bibliography of recent (1985-1986) hazards publications: Boulder, University of Colorado Natural Hazards Research and Applications Information Center, 146 p.

Noson, L.L., Qamar, Anthony, and Thorsen, G.W., 1988, Washington State earthquake hazards: Olympia, Washington Division of Geology and Earth Resources Information Circular 85, 77 p.

Petak, W.J., 1984, Geologic hazard reduction -- The professional's responsibility: College Station, Tex., Association of Engineering Geologists Bulletin, v. 12, no. 4, p. 449-458.

San Francisco Bay Area Regional Earthquake Preparedness Project, 1988, Hazardous buildings -- Case studies: Oakland, Calif., Bay Area Regional Earthquake Preparedness Project, 4 studies, glossary.

Slovic, Paul, 1986, Informing and educating the public about risk: Journal of the Society for Risk Analysis, New York, Plenum Publishing Corp., v. 6, no. 4, p. 403-415.

Sorenson, J.H., and Mileti, Dennis, 1987, Public warning needs, in Gori, P.L., and Hays, W.W., eds., A workshop on "The U.S. Geological Survey's Role in Hazards Warnings," Feb. 2-3, 1987, Proceedings of Conference XL, Denver, Colorado: U.S. Geological Survey Open-File Report 87-269, p. 9-75.

Southeastern Wisconsin Regional Planning Commission, 1968, Project completion report, urban planning grant project no. Wis. P-53 -- Educational, advisory, and review service programs: Waukesha, Wisc., Southeastern Wisconsin Regional Planning Commission, 32 p.

----1987, Twenty-five years of regional planning in southeastern Wisconsin -- 1960-1985:

Waukesha, Wisc., Southeastern Wisconsin Planning Commission, 49 p.

Spall, Henry, ed., 1975 to present, Earthquakes and Volcanoes (bimonthly) (formerly Earthquake Information Bulletin); Reston, VA., U.S. Geological Survey.

Thorsen, G.W., 1981, The circuit rider geologist: Final report, U.S. Geological Survey Agreement 7020-086-79, Project 9-7020-26001, 29 p.

U.S. Geological Survey, 1982, Goals and tasks of the landslide part of a ground-failure hazards reduction program: U.S. Geological Survey Circular 880, 48 p.

Yanev, Peter, 1974, Peace of mind in earthquake country: San Francisco, Chronicle Books, 304 p.

Yin, R.K., and Andranovich, G.D., 1987, Getting research used in the natural hazards field -- The role of professional associations: Washington, D.C., Cosmos Corporation, 205 p.

MEETINGS AND CONFERENCES

January 9-10, 1992, Frontiers of Broad Band Seismology Workshop, held at the Seismograph Station, U.C. Berkeley and sponsored by the Seismograph Station and Caltech's Seimological Laboratory. Data from all operational broad band stations across California and neighboring states represent a powerful tool for the study of structure and earthquakes in the western U.S. The goals of this workshop are to stimulate the exchange of ideas on the most exciting science than can be done with the new broad band network and to establish ways of efficiently exchanging data between institutions. For more information, contact Professor Barbara Romanowicz, Seismograph Station, U.C. Berkeley, Earth Science Building 475, Berkeley, CA 94720, (415) 643-5690, fax 415-643-5811.

February 6-8, 1992, Earthquake Engineering Research Institute Annual Meeting, held at the Golden Gateway Holiday Inn in San Francisco, California. Meeting sessions will focus on development of codes, existing buildings, public policy, lifeline engineering, testing of retrofits, and recent earthquakes. Abstracts are due December 2, 1992. For more information or to submit abstracts, contact EERI, 499 14th Street, Suite 320, Oakland, CA 94612-1902, (415) 451-0905.

February 6-11, 1992, Annual Meeting of the American Association for the Advancement of Science, held in Chicago, Illinois. For information, contact AAAS, 133 H Street N.W., Washington, D.C. 20005, (202) 326-6400.

March 25-28, 1992, Earthquake Hazards in the Eastern San Francisco Bay Area, held in Hayward, California. For more information, contact S.E. Hirschfeld, Department of Geological Sciences, California State University, Hayward, CA 94542, (415) 881-3486.

April 14-16, 1992, Seismological Society of America Annual Meeting, held in Santa Fe, New Mexico. Abstracts are due by January 15, 1993 to Dr. Marianne Walck, Geophysics Division 6231, Sandia National Laboratory, Albuquerque, NM 87185-5800. For more conference information, contact SSA Headquarters, 201 Plaza Professional Building, El Cerrito, CA 94530.

May 14-16, 1992, Geological Society of America, Rocky Mountain Section Meeting, held at the Ogden Park Hotel in Ogden, Utah. The abstract deadline for papers is January 29, 1992. For further information contact Sidney R. Ash, Department of Geology, Weber State University, Ogden, UT 84408-2507, (801) 626-6908.

July 19-25, 1992, Tenth World Conference on Earthquake Engineering, held in Madrid, Spain, one week prior to the 1992 Olympics in Barcelona, Spain. The official language of the conference will be English. Abstract deadline is April, 1991 and the deadline to receive papers is May, 1992. Individuals wishing to receive the first, and subsequent, announcement circulars should request them from 10WCEE, Steering Committee, c/o Tilesa, Londres 39 - 1 B, 28028 Madrid, Spain.

August 24 - September 3, 1992, International Geological Congress, held in Kyoto, Japan. The 1992 congress will include sessions on the IDNDR, remote sensing of natural hazards, evaluation of seismic hazards, prediction and reduction of

geologic hazards, and hazard mapping. Abstracts are due December 1, 1991. For a conference circular with information on abstract submission and registration, contact the Secretary General, 29th IGC, P.O. Box 65, Tsukuba, Ibaraki 305, Japan, 81/298/54-3627, FAX 81/298/54-3629.

October 3-9, 1992, Association of Engineering Geologists Annual Meeting, held in Long Beach, California. For information contact John Byer, Kovacs-Byer, Inc., 11430 Ventura Boulevard, Studio City, CA 91604, (818) 980-0825.

June 1-6, 1993, Third International Conference on Case Histories in Geotechnical Engineering, held in St. Louis, Missouri. One of the themes of this conference will be geotechnical earthquake engineering. Abstracts are due by February 28, 1992. For further information on the conference or the call for papers, contact Shamsher Prakash, Conference Chairman, III CHGE, 308 Civil Engineering, University of Missouri-Rolla, Rolla, MO 65401, (314) 341-4489, fax 314-341-4729.

RECENT PUBLICATIONS

Agnew, D.C., 1991, Prediction probabilities from foreshocks: Journal of Geophysical Research, v. 96, no. B7, p. 11959-11971.

Ali, Mubarik, 1991, Shallow faults mapped with seismic reflections: Lost River fault, Idaho: Geophysical Research Letters, v. 18, no. 9, p. 1767-1770.

Bay Area Regional Earthquake Preparedness Project, 1990, Loma Prieta in print, a selected, annotated bibliography: Networks, special issue, v. 5, no. 3, p. 1-16.

Bay Area Regional Earthquake Preparedness Project, 1990, Strengthening wood frame houses for earthquake safety: available as publication #P90004BAR for $4.00 from ABAG, P.O. Box 2050, Oakland, CA 94604.

Best, M.G., and Christiansen, E.H., 1991, Limited extension during peak Tertiary volcanism, Great Basin of Nevada and Utah: Journal of Geophysical Research, v. 96, no. B8, p. 13509-13528.

Bolt, B.A., 1991, Balance of risks and benefits in preparation for earthquakes: Science, v. 251, p. 169-251.

Bonamassa, Ornella, Vidale, J.E., Houston, Heidi, and Schwartz, S.Y., 1991, Directional site resonances and the influence of near-surface geology on ground motion: Geophysical Research Letters, v. 18, no. 5, p. 901-904.

Bonilla, M.G., and Lienkaemper, J.J., 1991, Factors affecting the recognition of faults exposed in exploratory trenches: U.S. Geological Survey Bulletin 1947, 54 p. $3.25.

Carlson, J.M., 1991, Time intervals between characteristic earthquakes and correlations with smaller events: an analysis based on a mechanical model of a fault: Journal of Geophysical Research, v. 96, no. B3, p. 4255-4267.

Dames and Moore, 1990, Loss-reduction provisions of a federal earthquake insurance program: Federal Emergency Management Agency Publication 200 (full technical report) and 201 (summary report). Available free upon written request from F.E.M.A., P.O. Box 70274, Washington, D.C. 20024.

Dorris, V.K., 1990, Earthquake-chaser saves lives: Engineering News Record, v. 225, no. 12, p. 32C14.

ENR News, 1990, Mormon Church renovates: Engineering News Record, v. 225, no. 12, p. 21.

Englekirk, R.E., and Sabol, T.A., 1991, Strengthening buildings to a life safety criterion: Earthquake Spectra, v. 7, no. 1, p. 81-87.

Forman, S.L., Nelson, A.R., and McCalpin, J.P., 1991, Thermoluminescence dating of fault-scarp-derived colluvium: deciphering the timing of paleoearthquakes on the Weber segment of the Wasatch fault zone, north central Utah: Journal of Geophysical Research, v. 96, no. B2, p. 595-605.

Gates, G.O., 1990, Safety and survival in an earthquake: Earthquakes and Volcanoes, v. 22, no. 1, p. 26-32.

Gori, P.L., 1991, Communication between scientists and practitioners: the important link in knowledge utilization: Earthquake Spectra, v. 7, no. 1, p. 89-95.

Hays, W.W., 1990, International decade for natural disaster reduction: Earthquakes and Volcanoes, v. 22, no. 1, p. 33-39.

Hearn, Thomas, Beghoul, Noureddine, and Barazangi, Muawia, 1991, Tomography of the western United States from regional arrival times: Journal of Geophysical Research, v. 96, no. B10, p. 16369-16381.

Holdahl, S.R., and Dzurisin, Daniel, 1991, Time-dependent models of vertical deformation for the Yellowstone-Hebgen Lake region, 1923-1987: Journal of Geophysical Research, v. 96, no. B2, p. 2465-2483.

Jackson, M.E., 1991, Paleoseismology of Utah, volume 3: the number and timing of paleoseismic events on the Nephi and Levan segments, Wasatch fault zone, Utah: Utah Geological Survey Special Studies 78, 23 p. [See WFF, v.7, no. 2, p. 5-6, for volumes 1 and 2.] Ed.

Jackson, S.M., 1991, 1984 Devil Canyon sequence near Challis, Idaho: structural complexity near the north end of the Borah Peak aftershock zone [abs.]: Seismological Research Letters, v. 62, no. 1, p. 51.

Janecke, S.U., Geissman, J.W., and Bruhn, R.L., 1991, Localized rotation during Paleogene extension in east central Idaho: paleomagnetic and geologic evidence: Tectonics, v. 10, no. 2, p. 403-432.

Kanamori, Hiroo, and Mikumo, Takeshi, 1990, Proceedings of conference XLVI: the seventh U.S.-Japan seminar on earthquake prediction: U.S. Geological Survey Open-File Report 90-0098, 275 p., $44.00, microfiche $4.00.

Kosowatz, J.J., and Dorris, V.K., 1990, Scars heal slowly after Loma Prieta: Engineering News Record, v. 225, no. 16, p. 36-39.

Kossobokov, V.G., and Keilis-Borok, V.I., 1990, Localization of intermediate-term earthquake prediction: Journal of Geophysical Research, v. 95, no. B12, p. 19763-19772.

Lund, W.R., editor, 1990, Engineering geology of the Salt Lake City metropolitan area, Utah: Utah Geological and Mineral Survey Bulletin 126, 66 p.

Lund, W.R., Christenson, G.E., Harty, K.M., Hecker, Suzanne, Atwood, Genevieve, Case, W.F., Gill, H.E., Gwynn, J.W., Klauk, R.H., Mabey, D.R., Mulvey, W.E., Sprinkel, D.A., Tripp, B.T., Black, B.D., and Nelson, C.V., 1990, Geology of Salt Lake City, Utah, United States of America: Bulletin of the Association of Engineering Geologists, v. 27, no. 4, p. 391-478.

Marone, C.J., Scholtz, C.H., and Bilham, Roger, 1991, On the mechanics of earthquake afterslip: Journal of Geophysical Research, v. 96, no. B5, p. 8441-8452.

McCalpin, J.E., and Forman, S.L., 1991, Late Quaternary faulting and thermoluminescence dating of the east Cache fault zone, north-central Utah: Bulletin of the Seismological Society of America, v. 81, no. 1, p. 139-161.

Meertens, C.M., and Smith, R.B., 1991, Crustal deformation of the Yellowstone caldera from first GPS measurements: 1987-1989: Geophysical Research Letters, v. 18, no. 9, p. 1763-1766.

Mittler, Elliott, 1991, The California earthquake insurance program: developments in 1990: Earthquake Spectra, v. 7, no. 3, p. 391-411.

Oviatt, C.G., 1991, Quaternary geology of the Black Rock Desert, Millard County, Utah: Utah Geological and Mineral Survey Special Studies 73, 23 p. scale 1:100,000, $6.00

Pechmann, J.C., 1991, Plans for replacement of recording and analysis computers for the University of Utah regional seismic network [abs.]: Seismological Research Letters, v. 62, no. 1, p. 23.

Peck, D.L., 1991, Natural hazards and public perception: earth scientists can make the difference: Geotimes, v. 36, no. 5, p. 5.

Plafker, George, and Galloway, J.P., eds., 1989, The Loma Prieta, California earthquake of

October 17, 1989: Earthquakes and Volcanoes, v. 21, no. 5, entire issue, p. 176-211.

Planke, Sverre, and Smith, R.B., 1991, Cenozoic extension and evolution of the Sevier Desert Basin, Utah, from seismic reflection, gravity, and well log data: Tectonics, v. 10, no. 2, p. 345-365.

Rodriguez, M., and Park, R., 1991, Repair and strengthening of reinforced concrete buildings for seismic resistance: Earthquake Spectra, v. 7, no. 3, p. 439-459.

Smith, R.B., 1991, Earthquake and geodetic surveillance of Yellowstone [abs.]: Seismological Research Letters, v. 62, no. 1, p. 27.

Soong, T.T., Masri, S.F., and Housner, G.W., 1991, An overview of active structural control under seismic loads: Earthquake Spectra, v. 7, no. 3, p. 483-505.

Spall, Henry, 1991, Entire issue of Earthquakes and Volcanoes, commemorating its 20th anniversary. Leading seismologists and volcanologists from around the world have contributed their personal comments on a past, present, or future view of thier science in the form of thought-provoking short essays: Earthquakes and Volcanoes, v. 22, no. 3, p. 91-153.

Stanton, John, and Roeder, Charles, 1991, Advantages and limitations of seismic isolation: Earthquake Spectra, v. 7, no. 6, p. 301-324.

Steidtmann, J.R., and Middleton, L.T., 1991, Fault chronology and uplift history of the southern Wind River Range, Wyoming: implications for Laramide and post-Laramide deformation in the Rocky Mountain foreland: Geological Society of America Bulletin, v. 103, no. 4, p. 472-485.

Thenhaus, P.C., 1990, Perspectives on earthquake hazards in the New Madrid seismic zone, Missouri: Earthquakes and Volcanoes, v. 22, no. 1, p. 4-21.

Wallace, R.E., 1990, The San Andreas fault system, California: U.S. Geological Survey Professional Paper 1515, 283 p.

Ward, P.L., 1991, On plate tectonics and the geologic evolution of southwestern North America: Journal of Geophysical Research, v. 96, no. B7, p. 12479-12496.

Ward, P.L., and Page, R.A., 1989, The Loma Prieta earthquake of October 17, 1989: What happened? What is expected? What can be done?: Earthquakes and Volcanoes, v. 21, no. 6, entire issue, p. 216-246.

Weldon, R.J., II, 1991, Active tectonic studies in the United States, 1987-1990, in U.S. National Report to International Union of Geodesy and Geophysics 1987-1990: Reviews of Geophysics, Supplement to v. 29, Part 2, p. 890-906.

Xiao, H.-B., Dahlen, F.A., and Suppe, John, 1991, Mechanics of extensional wedges: Journal of Geophysical Research, v. 96, no. B6, p. 10301-10318.

Yeats, R.S., and Schwartz, D.P., 1990, Paleoseismicity: extending the record of earthquakes into prehistoric time: Episodes, v. 13, no. 1, p. 9-12.

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