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EARTHQUAKE HAZARDS PROGRAM

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WORKSHOP ON "CONTINUING ACTIONS TO REDUCE POTENTIAL LOSSES FROM EARTHQUAKES ALONG THE WASATCH FRONT, UTAH" December 1-3, 1987

The December Workshop was well attended and enthusiastically received. Its objective was to communicate the achievements to date of the integrated research and implementation program along the Wasatch Front. Below are summaries of two Workshop sessions: William R. Lund reviews studies of the Wasatch fault zone and Genevieve Atwood summarizes the special third day session which brainstormed the future of the Earthquake Hazards Reduction Program along the Wasatch Front and set goals for 1988. No USGS Open-File "Redbook" will be produced from this workshop. Therefore, the editor strongly encourages participants in conference sessions not reviewed here to submit summaries for publication in the next issue of the Forum. This includes the sessions on ground shaking/ground failure, the communication of hazard and risk information, and the loss-reduction implementation process in Utah.

Though no Proceedings from the workshop will be published, "Assessment of Regional Earthquake Hazards and Risk Along the Wasatch Front, Utah" (Paula L. Gori and Walter W. Hays, editors, U.S. Geological Survey Open-File Report 87-585, 1987, 2 volumes) was distributed to Workshop participants. Borrowing from the foreword by the editors: "This report represents an ongoing U.S. Geological Survey effort to transfer accurate earth science information about earthquake hazards along the Wasatch Front, Utah to researchers, public officials, design professionals, land-use planners, and emergency managers in an effort to mitigate the effects of earthquake hazards. This report is a preview of the future U.S. Geological Survey Professional Paper on regional earthquake hazard and risk along the Wasatch Front.

Currently State and local governments, private institutions, and individuals are implementing earthquake hazards reduction measures in Utah. The success of their efforts will depend, in part, on the availability of accurate earth science information. The timeliness and importance of the multidisciplinary research contained in this report and the need for its utilization has made it imperative to release the information in the form of an Open-File Report while the process of publishing the Professional Paper is being completed.

The report is organized into 2 volumes. Volume I contains chapters on the tectonic framework and earthquake potential of the Wasatch Front area. Volume II contains chapters on the ground shaking hazards and aspects of loss estimation, as well as chapters on the use of hazards information for urban and regional planning and development."

A list of Workshop participants is available from the editor upon request.

1986-1987 Paleoseismic Trenching Program Summary

William R. Lund
Utah Geological and Mineral Survey

Introduction

This report summarizes the results of recent trenching studies on the Wasatch fault zone (WFZ), and updates current understanding and information related to earthquake recurrence on the WFZ. The information is a compilation of the research and thinking of several investigators, most notably: Michael N. Machette, Alan R. Nelson, Stephen F. Personius, and David P. Schwartz of the U.S. Geological Survey (USGS); William R. Lund of the Utah Geological and Mineral Survey (UGMS); and Michael E. Jackson of the University of Colorado at Boulder.

The 1986 Workshop on Earthquake Hazards Along the Wasatch Front (July 14-18, 1986, Salt Lake City, Utah), evaluated the results of the three-year Wasatch Front Earthquake Hazard Reduction Program and identified research topics where additional investigation was necessary to provide information for earthquake hazard reduction along the Wasatch Front. Recommendations regarding paleoseismic studies focused on further assessment of earthquake potential, particularly: fault segmentation, earthquake recurrence on segments, elapsed time since the most recent event on segments, and apparent changes in slip rate on the WFZ through time (Machette and others, 1986a).

Since the workshop, two trenching programs have been jointly conducted by the UGMS and the USGS to obtain additional paleoseismic data on the WFZ. In 1986, trenches were excavated at Brigham City, East Ogden, and American Fork Canyon on the Brigham City, Weber, and American Fork segments respectively (figure 1). In 1987, trenches were excavated at two sites near Mapleton on the Spanish Fork segment. The UGMS, in cooperation with the University of Colorado at Boulder, also funded trench studies during 1987 at Red Canyon on the Nephi segment and at Skinner Peaks on the Levan segment. At least one paleoseismic investigation has now been conducted on each of the WFZ segments active during the Holocene (past 10,000 years).

Earthquake Timing and Recurrence

Results of the 1986 trenching indicate that three to four earthquakes occurred on the Brigham City segment within the past 8 ka (Personius and Gill, 1987; Personius, 1988). Radiocarbon dating of all the samples is not complete, so timing of some events is not well constrained. Two earthquakes occurred within the past 6 ka, at about 3.4 ka and 4.7 ka respectively (figure 2). Timing of the third and fourth events awaits completion of the radiocarbon dates. Nelson and others (1987) identified three and possibly four earthquakes at East Ogden. All of the events occurred within the past 4.2 ka (figure 2). Elapsed time between the events is not uniform. The three youngest earthquakes are closely spaced, with intervals of 700-1000 years separating them. The interval between the two oldest events is more than twice that long (figure 2). At American Fork Canyon, three earthquakes have occurred in the past 5.4 ka. Events at about 0.5 ka, 2.7 ka, and 5.2 ka show a relatively uniform distribution through time (Machette and Lund, 1987).

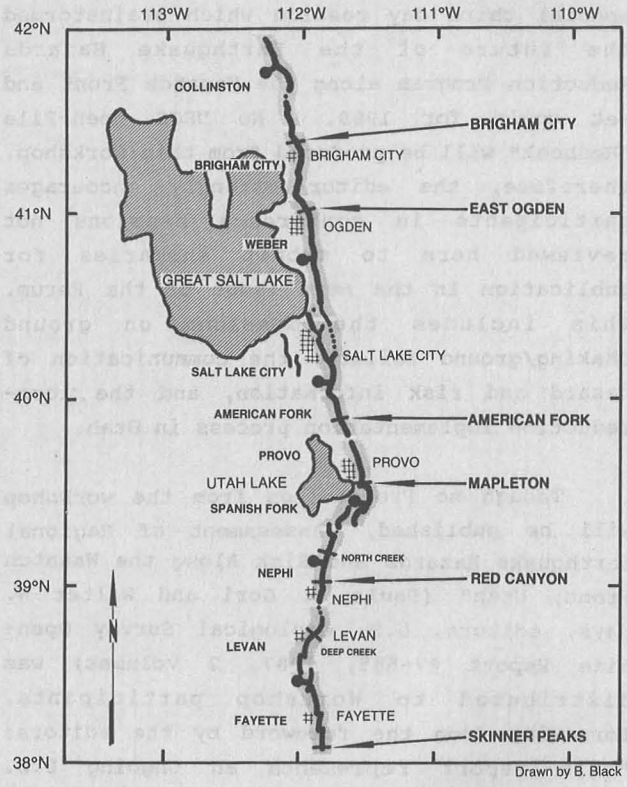


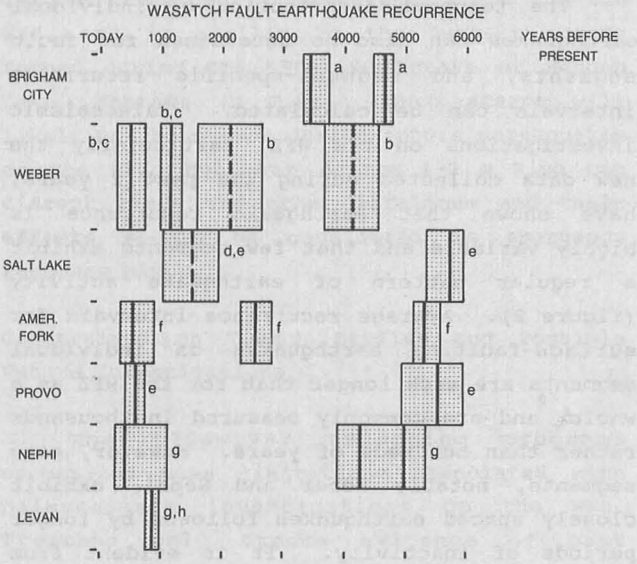
Figure 1. Location of 1986-1987 trench studies.

Investigations at Mapleton, Red Canyon, and Skinner Peaks were completed in 1987, and interpretations from those sites are still preliminary. Trenching revealed evidence for two earthquakes within the past 5.6 ka at Mapleton (Schwartz and others, 1988). Timing of the most recent event is well constrained at 0.7 ka (See Wasatch Front Forum, 1987, v. III, no. 3-4, p. 13-15: Lund, W.R. and Schwartz, D.P., "Preliminary results of a paleoseismic investigation on the Spanish Fork

segment of the Wasatch fault in Mapleton, Utah"). The previous event offsets a paleosol for which a thermoluminescence (TL) date of 5.6 ka was obtained. Additional samples submitted for radiocarbon and TL dating will help refine the timing of the older event. Three events were recognized at Red Canyon (Jackson, oral commun., 1987; and M.S. thesis in preparation). These events may correlate with the three most recent events on the Nephi segment recognized by Schwartz and Coppersmith (1984) at North Creek. There, the youngest event occurred about 0.3 to 0.5 ka, with the other two near 4.0 and 5.0 ka respectively (figure 2). Trenching results at Skinner Peaks are problematical, but a radiocarbon date show that at least one event has occurred within the past 1.8 ka, probably close to 0.9 ka (Jackson, oral commun., 1987). These results are generally compatible with a 1750 $\pm$ 350 ^{14}C yr B.P. date (Schwartz and Coppersmith, 1984) and 0.95 ka TL date (Jackson, oral commun., 1988) for the most recent event at Deep Creek also on the Levan segment. Older events may be present at Skinner Peaks, but complex structural and stratigraphic relationships in the trenches make their identification difficult.

Composite recurrence intervals (CRI) pertain to entire faults and the occurrence of earthquakes anywhere along their length. New information on earthquake timing resulting from the 1986-1987 trenching has permitted a recalculation of the CRI for surface-faulting earthquakes on the WFZ. In 1984, Schwartz and Coppersmith reported a CRI for the past 8 ka of 400-600 years with a preferred interval of 444 years. Incorporation of data acquired since 1985 results in a CRI for the last 6 ka (period of most reliable data) of 255-435 years with a preferred interval of 310-350 (Schwartrz, oral commun., 1987; Machette, oral commun., 1988).

The significance of the shorter CRI is subject to debate, and depends largely on the imperfectly known long-term behavior of the WFZ. A reduction in average time between surface-faulting earthquakes may have serious implications for the Wasatch Front. Paleoseismic studies show that elapsed time since the most recent surface-faulting event on the WFZ is everywhere longer than the average interval between such events established since mid-Holocene time. It could be concluded then that "on average" the WFZ is overdue for a large earthquake somewhere along its length. Figure 2, however, shows that during the past 6 ka large earthquakes on the WFZ have clustered into two groups, one centered at about 5 ka and the other beginning at about 0.9 ka. In each cluster, nearly all the active segments of the WFZ experienced a



Sources of data:
a. S. Personius in Machette et al., in prep.
b. A. Nelson in Machette et al., in prep.
c. Swan et al. (1980)
d. Lund and Schwartz (1986)
e. Schwartz et al. (1988)
f. Machette et al. (1987)
g. Schwartz and Coppersmith (1984)
h. M. Jackson, M.A. Thesis, U. Colorado, in prep.

Figure 2. Space-time plot of large magnitude earthquakes along the Wasatch fault zone during the past 6000 years. Heavy solid line indicates best estimate of timing; heavy dashed line is approximation. Stippled boxes reflect uncertainties in timing based on age dates and stratigraphic relationships (compiled by David Schwartz, U.S. Geological Survey, Menlo Park, California). 310-350 years (Schwartz, oral commun., 1987; Machette, oral commun., 1988).

large earthquake within a short period of time. A long interval of low activity separates the clusters. Temporal clustering on the WFZ is not well understood, and additional trenching studies are required to determine if it is a real phenomenon or the result of imperfect resolution of earthquake timing. If clustering is real, questions about long-term versus short-term patterns of earthquake activity and our relation to the current cycle become important to earthquake hazard reduction efforts along the Wasatch Front.

The temporal distribution of individual earthquakes can also be determined for fault segments, and segment-specific recurrence intervals can be calculated. Paleoseismic investigations on the WFZ, particularly the new data collected during the past 2 years, have shown that earthquake recurrence is highly variable and that few segments exhibit a regular pattern of earthquake activity (figure 2). Average recurrence intervals for surface-faulting earthquakes on individual segments are much longer than for the WFZ as a whole, and are commonly measured in thousands rather than hundreds of years. However, some segments, notably Weber and Nephi, exhibit closely spaced earthquakes followed by longer periods of inactivity. It is evident from figure 2, that the "average" recurrence interval calculated for a fault segment can vary significantly from the actual distribution of earthquakes through time on the segment.

Differentiating between the CRI for the entire WFZ and individual segment recurrence intervals is important to earthquake hazard reduction. During a large earthquake, ground shaking can affect several fault segments simultaneously, regardless of the event's location. Conversely, ground rupture is largely restricted to the segment on which the earthquake occurs. As a result, for a given site on the Wasatch Front, the exposure to ground shaking is greater than the exposure to ground rupture. Therefore, ground-shaking hazard estimates are evaluated using the shorter CRI applicable to the whole fault. The more limited spatial and temporal occurrence of ground rupture permits that hazard to be evaluated using the longer recurrence intervals applicable to individual fault segments.

Segmentation

Schwartz and Coppersmith (1984) originally proposed six segments for the WFZ, five being active during the Holocene. Based on detailed field mapping, Machette and others (1986b) proposed an increase in the number of active segments to seven and then to eight in 1987. They also proposed an additional three segments, two created by subdividing the original Collinston segment, on which no Holocene earthquakes have occurred. Because the WFZ is of finite extent (370 km), an increase in the number of segments reduces their individual length. Shorter segments mean slightly smaller earthquakes, but more important, an increase in the number of potential seismogenic sources. Differences in timing of the most recent event (MRE) are the best indicator of fault segmentation. If the age of the MRE on adjacent portions of the fault is significantly different, independent segments exist. A major goal of the 1986-1987 trenching was to determine if the new active segments proposed by Machette and others (1986b) could be verified from MRE timing. Results are preliminary, but it appears that the Ogden segment as originally proposed by Schwartz and Coppersmith (1984) can be subdivided into a northern Brigham City segment and a southern Weber segment. Results are less clear for the Provo segment (original usage), which Machette and others (1986b) subdivided from north to south into the American Fork, Provo (new usage), and Spanish Fork segments. Machette (oral commun., 1987) reports a date of about 0.5 ka for the MRE at American Fork Canyon on the American Fork segment, whereas Lund and Schwartz (See Wasatch Front Forum, 1987, v. III, no. 3-4, p. 13-15: Lund, W.R. and Schwartz, D.P., "Preliminary results of a paleoseismic investigation on the Spanish Fork segment of

the Wasatch fault in Mapleton, Utah") established a date of 0.7 ka for the MRE at Mapleton on the Spanish Fork segment. The timing for both events is similar, and it is possible, considering the uncertainty associated with each date (figure 2), that they represent the same earthquake. Trenching at Hobble Creek (Swan and others, 1980) between American Fork Canyon and Mapleton did not constrain the timing of the MRE. There are no additional trench sites on the Provo segment (original usage), however, a stream cut at Rock Creek east of the BYU campus exposes the WFZ and an associated colluvial wedge. A radiocarbon age of about 1.1 ka was obtained from organic material in the wedge (Machette and others, 1987). The origin of the organic material is uncertain. The 1.1 ka age could represent a maximum limiting age for the faulting. If so, three fault segments exist as proposed by Machette and others (1986b). However, if the organic material is reworked from an older deposit the MRE could be younger than 1.1 ka. Then, depending on the age of the faulting, one or possibly two segments could be present. Additional investigations are planned at Rock Creek to better constrain the history of faulting there.

Fault Displacement

Net tectonic displacement (NTD) and length of horizontal ground rupture (segment length) are commonly used to estimate the magnitude of past earthquakes. Schwartz and Coppersmith (1984) introduced the idea of "characteristic" earthquakes for the WFZ based on their observation that the amount of NTD for individual paleoearthquakes measured at a point along the fault repeated during successive events. Most of their measurements ranged from 1.7-2.6 m, and averaged about 2 m per event. They concluded that similarity in displacement indicates similarity in earthquake magnitude, and that most past earthquakes on the WFZ clustered around a maximum magnitude of 7-7.5. Recent trench studies show that the NTD for a single event on the WFZ can be as large as 4.5-4.75 m (Lund and Schwartz, 1987). However, that is the maximum recorded, and most new measurements have been between 1.5 and 3.0 m, close to the value suggested by Schwartz and Coppersmith (1984). Similarly, ground effects within a fault zone can be predicted from past earthquake occurrences. At Mapleton, Lund and Schwartz (See Wasatch Front Forum, 1987, v. III, no. 3-4, p. 13-15: Lund, W.R. and Schwartz, D.P., "Preliminary results of a paleoseismic investigation on the Spanish Fork segment of the Wasatch fault in Mapleton, Utah") measured a buried, single-event scarp free-face nearly 6 m high. This is the largest recorded single-event scarp on the WFZ, and is similar to the largest scarps formed during the 1959 earthquake at Hebgen Lake, Montana (M 7.5). Such scarps will likely not be common during future earthquakes on the WFZ, but even scarps 1-2 m high can disrupt roads and other lifelines and their effects should be considered in emergency response plans.

Constraints on Trench Studies and Possible Future Investigations

The 1986-1987 trenching programs emphasized some limitations associated with paleoseismic investigations on the WFZ. Trenches only expose evidence of past earthquakes that resulted in displacement at the ground surface. The threshold for ground rupture in western Utah appears to be in the 6-6.5 magnitude range (Arabasz, oral commun., 1988). The 1934 Hansel Valley earthquake (M 6.6) is the only historic earthquake known to have produced surface displacement in Utah, although other earthquakes of similar magnitude (Pocatello Valley M 6.0; Richfield M 6.5+) have occurred. Because ground shaking and related phenomena associated with a M 6-6.5 event can do considerable damage in urban areas, regardless of ground rupture, a moderate-size earthquake represents a significant, and as yet largely unevaluated, hazard to the Wasatch Front. The inability to recognize non-surface rupturing events in trenches, forces us to rely on limited historical data when trying to determine the

future likelihood of similar events. In addition, trenches on the WFZ have shown little evidence of small surface-faulting earthquakes producing less than a meter of displacement. It is unclear if such events are rare in the geologic record, or if all indication of their existence is destroyed by scarps of younger, larger earthquakes.

A second constraint on determining the earthquake history of the WFZ is the inability of standard trenching techniques to extend the geologic record beyond mid-Holocene time. A thick layer of colluvium was deposited in many places along the Wasatch Front following the retreat of Lake Bonneville from the Provo level (approximately 13,500 yr B.P.). Trenches excavated across the WFZ are generally limited to a depth of 5-6 m by backhoe capacity and site topography. Trenches of that depth can seldom completely penetrate the colluvial deposits. As a result, the stratigraphic record and dates available for establishing the timing of past earthquakes are largely limited to the post-Provo colluvium, and most often to the upper part of those deposits (past 5-6 ka). Most older dates from the colluvial sequence cluster around 6 ka (mid-Holocene) although some preliminary dates are in the 8 ka range. The number and timing of pre-Provo events were estimated using a combination of geomorphic and relative dating techniques and are considered approximate. Questions remain about the long-term pattern of fault activity and the degree to which the earthquake record since the mid-Holocene represents that pattern. Answers to those questions are important to earthquake hazard reduction because they will allow recent earthquake activity (past 6-8 ka) to be evaluated in a historical context. Understanding long-term patterns and trends of earthquake recurrence will improve our ability to forecast future events. The UGMS, USGS, and other federal agencies have discussed a possible "Megatrench" project designed to extend the earthquake record further into the Pleistocene. The project would help answer questions about long-term distribution of earthquakes on the WFZ, temporal clustering, the affect of Lake Bonneville on earthquake activity, and changes in slip rate on the WFZ through time.

Acknowledgements

I thank David Schwartz and Mike Machette of the U.S. Geological Survey and Bill Case of the Utah Geological and Mineral Survey for their timely review of this article. Their comments and suggestions were of great assistance, and improved both the accuracy and readability of the final product.

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Planning Session to Set Goals for 1988 Earthquake Hazards Reduction Program Along the Wasatch Front

Genevieve Atwood, Director,
Utah Geological and Mineral Survey

It was great to celebrate the achievements of the Earthquake Hazards Reductions Program in Utah and to spend a half-day discussing what are the most important things we should do next. It was sobering to realize that although we've come so far, there's still such a long way to go toward reducing earthquake risk in Utah.

I have tried to summarize what I heard during the planning session of the workshop's third day. The more I listened, the more apparent it was to me that the State needs a full time person to track, lead, and follow through on our priorities. I'm glad the UGMS Earthquake Scientist position is available for this mission. It also seemed that a team approach could work best on some of the major areas requiring future work. I have taken the liberty to try to summarize what might be considered "action items" from Day 3. I believe that my imagination has not invented any of these. However, I've gone a few steps further and suggested leaders, products, and time-frames for these projects. Of course, some of these goals and time-frames may be unrealistic. If I've left an action item out, if you would like to be a "leader", or if you have comments, please contact me or Doug Sprinkel at UGMS.

1. Instrumentation and Monitoring

Lead people: Walter Arabasz
Doug Sprinkel

Purpose: Upgrade equipment monitoring the seismic activity in Utah. The University of Utah Seismograph Station's needs are the greatest. In addition, strong motion devices and portable arrays are needed.

Product: a. Develop a game plan that identifies priorities and potential sources of funding (e.g. National Center for Earthquake Engineering Research at the State University of New York at Buffalo).
b. Develop a proposal for GPS for the Wasatch Front.

Time limit: Hold an informal meeting by April 1. Formulate game plan in 6 - 9 months.

2. Engineering and Construction

Lead people: Les Youd
Larry Reaveley
Loren Anderson
Comprehensive Emergency Management

Purpose: a. Synthesize what we know with respect to reducing earthquake risk along the Wasatch Front through engineering and construction practices.
b. Identify the most important things to do, short- and mid-term.

Product: a. Devise a game plan.
b. Develop a proposal for FEMA.

Time limit: Relatively regular coordinating meetings (4/yr?) Develop proposal by April.

3. Synthesis Documents - Geology/-Seismology/Geophysics

Lead people: Bob Smith/Walter Arabasz
Don Mabey

Purpose: a. Bring together the technical pieces of the puzzle in a synthesis document for scientists and engineers working on the problem.
b. Publish a "show piece" document for the educated lay person.
c. Develop a very basic product for schools and others.

Product: Develop a proposal for USGS to provide funding for these documents as part of the implementation section of their RFP.

Time limit: Respond to USGS solicitation for proposals by February 28.

4. Implementation and Translation

Lead people: Genevieve Atwood
Lorayne Frank
Larry Reaveley
Earthquake Scientist
County geologists
and others

Purpose: There is a need for a core steering group to review what we already know and to target the most important issues that need implementation.

Product: a. Develop a game plan.
b. Gain consensus on group(s) to target for implementation.
c. Formulate a proposal for USGS and/or FEMA.

Time limit: Relatively regular meetings, 6/yr. Proposal to USGS and/or FEMA by February 1, 1988.

5. Base Map for Digitized Information

Lead people: Bob Alexander
Mike Johnson
Genevieve Atwood

Purpose: Several government agencies appear to be creating their own digitized base maps for digitized geographic information. There is a need to design a plan and get buy-in to a cooperative effort by state, county, city, and federal agencies to develop a

single, large-scale digitized base map.

Product: Proposal to develop a single, large-scale digitized base map.

Time limit: Planning meeting in January.

6. Local Government Initiative

Lead people: Larry Reaveley
Palmer DePaulis
EERI

Purpose: Daily decisions by local government officials implement earthquake hazard reduction. In order for local officials to take actions, they need to be trained and understand the geologic, engineering and economic issues.

Product: Prepare a proposal for a 4 year pilot project in Salt Lake City and Salt Lake County, funded by EERI.

Time limit: Develop a proposal by March.

7. Legislative Initiative for CEM

Lead people: Lorayne Frank
Department of Public Safety

Purpose: Currently, Utah does not contribute financially to CEM's earthquake hazard preparedness and response mission.

Product: Request state funding for CEM through DOT.

Time limit: January through March.

8. International Decade of Hazard Reduction

Lead people: UGMS

Purpose: Organize Utah's potential participation and furtherance of the International Decade at the state level.

Product: Organizing meeting with universities, state and local agencies, to brainstorm what Utah's participation should be.

Time limit: Meeting to be held in April.

9. UGMS Earthquake Scientist

Lead people: Position will be filled in January.

Purpose: Provide leadership in geologic hazards information dissemination, and coordinate and know about the people and agencies involved in all the efforts to reduce the earthquake hazard in Utah..

Product: a. Regularly scheduled earthquake lunch bunch.
b. Computerized tracking of who's doing what.
c. Organize and plan to make earthquake information accessible from the state.

Time limit: 1988

Recently Published Proceedings of Other USGS-Sponsored Workshops

PROCEEDINGS OF A WORKSHOP ON "EARTHQUAKE HAZARDS ALONG THE WASATCH FRONT, UTAH"

Walter W. Hays and Paula L. Gori, editors, U.S. Geological Survey Open-File Report 87-154, 1987, 155 p. Held July 14-18, 1986, in Salt Lake City, Utah, the workshop was attended by 130 earth scientists, engineers, planners, and emergency management specialists. The proceedings consist mostly of the reports from teams that examined six earthquake research and mitigation themes relevant to the area: the tectonic framework and earthquake potential of the Wasatch Front area and other parts of Utah; the ground shaking hazard and various aspects of loss estimation in the Wasatch Front region of Utah; ground failure, rock falls, and tectonic deformation in the Wasatch Front area; collecting, compiling, translating, and disseminating earthquake hazards information for urban and regional planning and development in the Wasatch Front area;

development and implementation of improved loss-reduction measures in Utah; and integrating scientific and engineering information into earthquake-resistant design in Utah. An additional paper of interest is "Sugar House Quadrangle Atlas: Applying Digital Cartographic and Geographic Information Systems Technology and Products to the National Earthquake Hazards Reduction Program", by Robert Alexander et al. The paper, which includes 30 plates, describes how this specific area has served as a test site to demonstrate the ways in which digital mapping technology can contribute to the implementation of wide variety of earthquake mitigation measures.

PROCEEDINGS OF A WORKSHOP ON THE "U.S. GEOLOGICAL SURVEY'S ROLE IN HAZARDS WARNINGS"

Paula L. Gori and Walter W. Hays, editors, U.S. Geological Survey Open-File Report 87-269, 1987, 133 p. Held February 2-3, 1987, in Golden, Colorado, the workshop provided the first opportunity for USGS personnel involved with communicating risk information about geological hazards to discuss common experiences, successes, failures, and related problems. Addressed was the communication of short- and long-term hazards warnings and relevant risk information. Of the six authored presentations, three papers deserve special mention. An extensive (67 p.) paper by John Sorensen and Dennis Mileti discusses public warning needs; Risa Palm examines the lessons learned from attempts to communicate risk information about earthquakes in California; and two USGS scientists present a chronology of USGS hazards notices for the years 1976-1986, together with a discussion of how these notices would stand up when compared to geologic hazard warning criteria published in the Federal Register in January 1984. Individual recommendations offered at the conclusion of the workshop included: 1) USGS involvement in a variety of geologic hazard endeavors must be integrated and coordinated to achieve maximum social benefit; 2) the USGS has just begun to deal with the problems associated with hazards warnings, and should now consider how to systematize and routinize its procedures; and 3) scientists, like those in USGS hazards research, need to keep local communities involved in the information processes that could culminate in hazard warning.

PROCEEDINGS OF A WORKSHOP ON "DIRECTIONS IN PALEOSEISMOLOGY"

Anthony J. Crone and Eleanor M. Omdahl, editors, U.S. Geological Survey Open-File Report 87-673, 1987, 456 p. Held April 22-25, 1987, in Albuquerque, New Mexico, the workshop was the first forum dedicated solely to paleoseismology. Seventy-two geoscientists, practitioners, and scientific managers from academic institutions, the business community and government organizations convened to review past accomplishments, current status, and future objectives of paleoseismology. The proceedings contains the presentations made in technical sessions and the editor's summary of the discussions that concluded each session. Technical sessions addressed topics including the status of Quaternary dating techniques, problems associated with recognizing and characterizing individual paleoseismic events in the geologic record, difficulties in estimating Quaternary slip rates and the amounts of coseismic deformation, and application of paleoseismic data to various aspects of seismic hazard analysis. The final session examined the needs and possible future directions of paleoseismology studies from the viewpoint of both practitioners and scientific managers.

All of these publications can be obtained from Books and Open-File Reports Section, U.S. Geological Survey, Federal Center, Building 41, Box 25425, Denver, CO 80225, (303) 236-7476.

AN INTERNATIONAL DECADE FOR NATURAL HAZARD REDUCTION

Dr. Frank Press, president of the U.S. National Academy of Sciences first presented the concept of a cooperative international program to reduce natural hazards at the Eighth World Conference on Earthquake Engineering in 1984. Growing interest in his proposal for an International Decade for Natural Hazard Reduction (IDNHR) to begin in 1990, led the U.S. National Research Council to appoint an Advisory Committee composed of hazards experts from many disciplines, drawn from academia, the private sector and government agencies. They were charged with evaluating the potential of such an effort and determining how best it might be realized. Their concept of the international decade--the need for it, the benefits that might be derived, and the activities it could involve--are all outlined in the recently published booklet "Confronting Natural Disasters: An International Decade for Natural Hazard Reduction". Frank Press points out that "the time has come to view natural hazards as a world problem, but one that scientific and technological advances now provide a unique opportunity to address. The establishment of an IDNHR would be a potent first step in reducing the impacts of natural hazards through coordinated research, data gathering, and information sharing.

As outlined in the report, the Advisory Committee's recommendations are:

1. An International Decade for Natural Hazard Reduction (IDNHR) should be established for the period 1990-2000.

The IDNHR's objective is to reduce catastrophic life loss, property damage, and social and economic disruption from natural hazards. The IDNHR should initially focus on earthquakes, windstorms (cyclones, hurricanes, tornadoes), floods, tsunamis, landslides, volcanic eruptions, and wildfires. Its objective should be pursued by:

* collecting existing hazard mitigation experience and practices and identifying gaps in current knowledge.
* accelerating application of known mitigation and preparedness approaches.
* developing scientific and engineering knowledge that offers substantial potential for improving hazard mitigation practices.

This objective would be accomplished through:

* cooperative research
* demonstration projects
* information dissemination
* technical assistance
* technology transfer
* education and training

These activities should be tailored to specific hazards and locations, allowing for cultural and economic diversity.

2. The United States should establish a U.S National Decade for Natural Hazard Reduction (USDNHR) to provide a focus for U.S. activities. The National Research Council, with the concurrence of the U.S. Government, should establish a national committee for the Decade to provide leadership for U.S. national efforts; seek national support from federal and state governments, foundations, and professional, scientific, and other organizations; and coordinate U.S. activities with the IDNHR program Appointments to the National Committee for the Decade should include professional organizations, federal agencies, and others; it should be operational by October 1, 1987.

3. All nations should be encouraged to participate in the IDNHR, including those that suffer from natural disasters as well as those that can contribute to reducing the effects of natural hazards.

4. The United Nations should promote and facilitate the IDNHR, with full participation of the concerned nations and of the relevant

international engineering, scientific, and social science communities. The United Nations should convene an international planning meeting as early as possible in 1988 to define objectives for the International Decade and to formulate in institutional framework for the technical conduct of the program.

After discussing the need for the decade, the report describes the natural hazard risks that will be dealt with, and details the various approaches to coping with such risks. The report proposes activities that address what are referred to as "rapid-onset" hazards--floods, landslides, earthquakes, tsunamis, hurricanes, tornadoes, volcanic eruptions, and wildfires--and suggests that their impacts can be reduced with a common set of mitigation techniques such as immediate warnings, proper construction practices, land use planning, and emergency relief. After enumerating the causes of continually increasing hazard vulnerability in the world--population growth, concentration of people in hazardous areas, increased capital development, and economic interdependence of individuals, communities, and nations--the report sets forth methods for avoiding and minimizing disaster effects.

Scientific and technological approaches to minimizing disaster effects are of two types: 1) physical adjustments such as building standards, hazard risk mapping, hazard prediction, and preventing or altering a hazard's characteristics; and 2) social adjustments such as land use restrictions, increased public awareness, emergency preparedness programs, economic loss-spreading and hazard mitigation in reconstruction. Of these known procedures, however, many cannot be applied worldwide because experience in their application, or critical data for their effective use, may be lacking in many regions; or because the research needed to develop many procedures has not been done. The activities proposed for the decade involve cooperative projects in three main areas: application of existing knowledge, problem-focused research, and new research on general areas. A coordinated international effort offers the opportunity to perfect and apply damage mitigation strategies more quickly and cheaply than could separate national programs.

Single copies of "Confronting Natural Disasters" are available free of charge from the National Research Council, Commission on Engineering and Technical Systems, IDNHR Advisory Committee, 21201 Constitution Avenue, N.W., Washington, DC 20418.

Editor's Note: The name of the International Decade of Natural Hazard Reduction has been changed to the International Decade of Natural Disaster Reduction.

Utah's potential participation in the IDNHR was first addressed at the special third day session of the USGS/UGMS Conference in December 1987, held in Salt Lake City (see separate article, this issue). UGMS will be organizing a meeting to bring together all interested parties.

SLIP RATE AND EARTHQUAKE POTENTIAL OF THE EAST GREAT SALT LAKE FAULT, UTAH

(Abstract for talk at Association of Engineering Geologists, Utah Section meeting, February 1988)
Based on collaborative research with W.P. Nash, J.J. Viveiros, and R.B. Smith

James C. Pechmann
Department of Geology and Geophysics,
University of Utah

Gravity and seismic reflection data indicate a major NNW-striking fault concealed beneath the Great Salt Lake that I and my coworkers conclude is of first-order importance for regional seismic hazard

(Figures 1, 2). This west-dipping fault, named the East Great Salt Lake fault by Cook et al. (1980), follows the west boundary of a linear topographic high formed by the Promontory Mountains and Fremont and Antelope Islands. This fault and related faults cut late Quaternary sediments, and must therefore be considered active. The East Great Salt Lake fault appears to be separated by a basement ridge into two segments, each at least 40-50 km long. These segment lengths are comparable to those proposed for the Wasatch fault, suggesting that the East Great Salt Lake fault could generate earthquakes of up to the maximum M_S of 7.5±0.2 estimated for the Wasatch fault. Most of the East Great Salt Lake fault has been remarkably aseismic since at least 1962, but there is a 10-km wide band of epicenters (M_L<3) along the northernmost 4-km of the fault that could represent associated seismic activity.

We have determined the slip rate of the East Great Salt Lake fault from a combined interpretation of seismic reflection data (released by Amoco) and published depths of Pliocene and Quaternary time markers found in wells. The time markers include volcanic

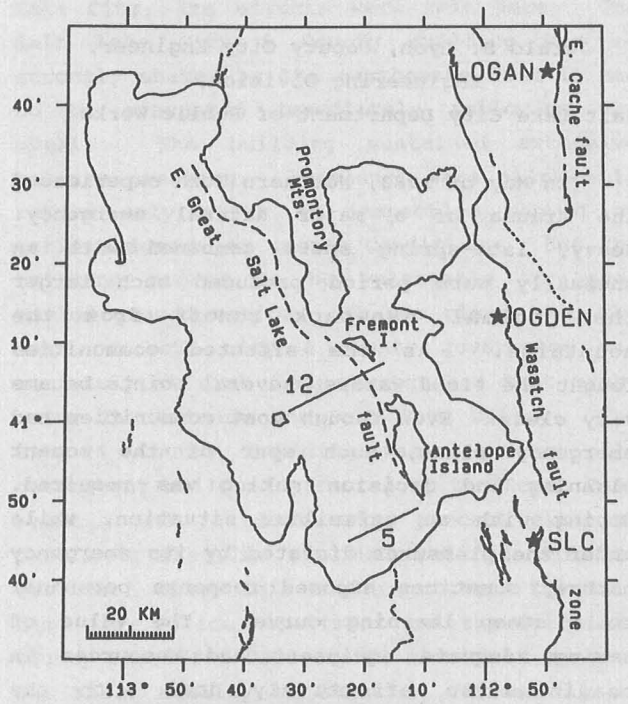

Figure 1. Map showing traces of late Quaternary faulting in the vicinity of the Great Salt Lake, from Arabasz et al. (1987). The location of the East Great Salt Lake fault was taken from Cook et al. (1980) and Viveiros (1986), and is only approximate. Also shown are the locations of seismic reflection profiles UQ 12 and UQ 5, the July 1984 shoreline of the Great Salt Lake, and major cities (stars).

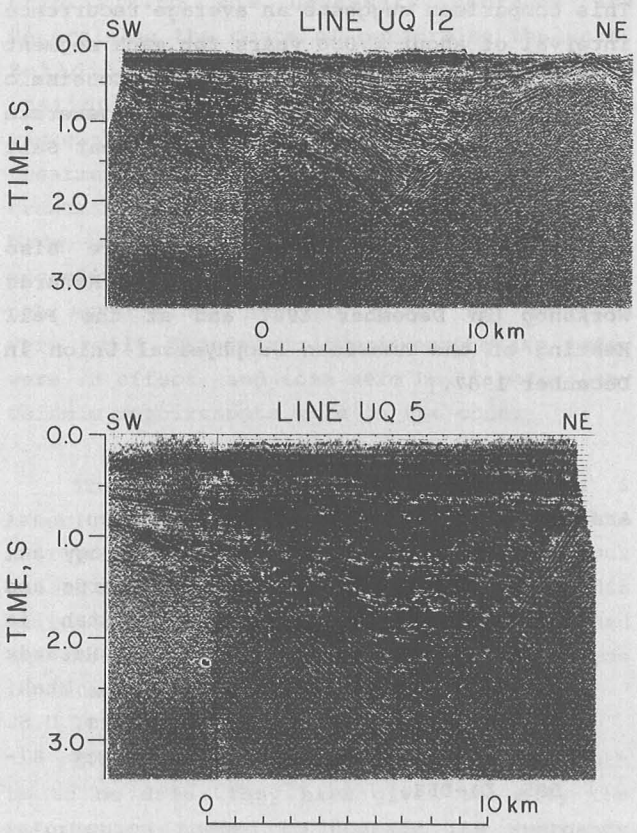

Figure 2. Seismic reflection profiles UQ 12 and UQ 5 in the Great Salt Lake. See Figure 1 for locations. Profiles are 24-fold stacked marine data from an airgun source. The East Great Salt Lake fault is clearly visible bounding the eastern edge of the asymmetric sedimentary basin underlying the lake. Reflection profiles courtesy of AMOCO Production Company. Figure modified from Smith and Bruhn (1984).

ashes, a basalt, and stratigraphic horizons identified from palynology. Results indicate vertical subsidence rates of 0.3 to 0.4 mm/yr near the fault over the last 0.61 to 5.3 m.y. Taking subsurface fault dip into account, these rates translate into fault slip rates of 0.4 to 0.7 mm/yr, assuming that the sedimentation rates are controlled by subsidence along the fault. These slip rates are about half of those measured for the last 4,500 to 19,000 years on the central segments of the Wasatch fault, when the average recurrence intervals for maximum earthquakes have been about 2,000 years on each segment. This comparison suggests an average recurrence interval of about 4,000 years for each segment of the East Great Salt Lake fault. Coseismic displacement of the lake floor could generate large, damaging water waves in the Great Salt Lake.

[Shorter versions of this talk were also presented at the USGS/UGMS Earthquake Hazards Workshop in December 1987 and at the Fall Meeting of the American Geophysical Union in December 1987.]

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REVIEW OF SALT LAKE CITY SEISMIC UPGRADE PROGRAM

Jerald S. Lyon, Deputy City Engineer,
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In May of 1983, Northern Utah experienced the trauma of a major natural emergency. Heavy, late-spring snows combined with an unusually warm period produced much larger than normal snowpack runoff from the mountains. As the affected communities fought the flood waters, several points became very clear. Even though most communities had emergency plans, much spur of the moment planning and decision making was required. Coping with an unfamiliar situation, while under the pressures dictated by its emergency nature, sometimes exposed response personnel to a steep learning curve. The value of having adequate equipment and resources in readiness to effectively deal with the situation was clearly demonstrated. Most importantly, it became apparent that the sheer size of a natural emergency makes human efforts to cope with it seem quite inadequate.

In the months that followed the 1983 floods, Salt lake City evaluated its emergency plan in light of the lessons that had been learned. The evaluation was not limited to a flood response, but looked at all types of emergencies and the needed responses to them.

Following the evaluations, the plan was modified.

The value of this preparation became clear in the spring of 1984 when snowmelt runoff matched the 1983 flows. Because Salt Lake City was ready with better equipment and techniques, very little flooding occurred and very little inconvenience to the public resulted. Adequate planning and preparation was the key to successful emergency management.

Close on the heels of the 1983 floods, and in the midst of the review of the City's emergency plan, the Borah Peak earthquake occurred in October of 1983. While this earthquake was hundreds of miles from Salt Lake City, its effects were felt here. The Salt Lake City & County Building was so strongly shaken by the earthquake that it had to be evacuated immediately following the event. The building sustained extensive masonry cracking. Personnel were allowed to return only after an inspection showed no serious damage or unsafe conditions. But the building proved to be vulnerable to long-period ground motion. It was clear that the seat of both city & county government was seriously at risk from earthquakes that might occur far outside the Salt Lake Valley. The City & County Building was not the only government building affected by the Borah Peak event. Only a block away, precast exterior panels cracked in the Metropolitan Hall of Justice. Since this building houses the Salt Lake City Police Department and the Salt Lake County Sheriff's Department, there was concern for their ability to function efficiently in the aftermath of a major earthquake. In addition to the demonstrated effects of an earthquake on two essential city buildings, an increased public awareness of earthquake potential in the region was generated by the U.S. Geological Survey focus on the Wasatch Front in the following years.

In light of the increased knowledge of the vulnerability of some of Salt Lake City's emergency facilities, and in keeping with Mayor Palmer DePaulis' desire to make all city facilities not only safe for occupants but also to have them survive an earthquake and be able to function during the recovery period, two studies were commissioned to determine the need for seismic strengthening of city buildings.

In 1986, an in-house survey of all city owned buildings was undertaken. Those buildings which were deemed in need of strengthening were then studied under a contract with Reaveley Engineers & Associates. The study was to analyze each building, prioritizing the necessary upgrades and determining the costs of performing the work. Buildings studied included nine fire stations, the Fleet/Street complex, the wastewater treatment plant, all city water treatment plants, and the Metropolitan water treatment plant. Each facility was found to have strength deficiencies when analyzed according to current building codes. This was not surprising, however, since all of them were built before stringent earthquake codes were in effect, and some were built before any seismic requirements were in the code.

Then, in 1987, Reaveley Engineers & Associates completed a similar analysis of the Metropolitan Hall of Justice tower. Serious seismic deficiencies were found in this building as well, even though it was designed and constructed in conformance with the code in effect at the time it was built.

Even though these studies show that much is to be done, they have given the city the information needed to upgrade its emergency response plan. Priorities are being set for construction upgrading of each building, based on projected life, importance, and cost. The city has the opportunity to perform very cost effective measures while maintenance work is done to a given building. For example, several fire stations need new roofs and have been scheduled for this work. While the roofing material is being replaced, diaphragms will be strengthened and attached to walls. This has already been done on one station,

and will be done on several others soon. Battery and radio racks and other office equipment are being anchored to walls at very low cost. Tanks of chemicals will be anchored down to reduce or eliminate spillage. Later, projects will be created to complete all needed seismic work in these buildings. The city is also budgeting to do the complete seismic upgrade all at once on several fire stations. Over time, each deficient station will be strengthened as required.

Substantial progress has been made in the past three years to make city-owned buildings capable of withstanding the forces of an earthquake. A priority list has been created to upgrade fire stations in an orderly manner. Seismic issues are covered when remodeling work is done on any city building. The first fire station to have a complete seismic renovation has been chosen, money budgeted, and the design completed. Construction should begin later this year. The City & County Building has been sewn together and set on seismic isolators. When completed, the work should allow it to ride through a substantial earthquake with minimal damage. Thus, the City & County Building will remain functional which is very important as any recovery effort begins in the aftermath of a natural emergency. An existing multi-story building will be purchased by the city to house the police department and the fire department headquarters. Included in the building is the fire/police dispatch function. The police will move from the Metropolitan Hall of Justice and the fire headquarters will move from a station which has been determined to be seismically deficient. The building is being remodeled to meet seismic zone III requirements, including a 1.5 importance factor. Other funds are being sought for a seismic upgrade of the Metropolitan Hall of Justice after the police personnel have moved out.

The City's remodel effort is not limited to buildings. The 400 South viaduct is being repaired this year and will have seismic strengthening work included as part of the project.

Salt Lake City, like other cities in Utah, is providing services on a limited budget. The city is making every effort to strengthen its buildings as quickly as possible. Budget limitations make the progress slow, but the direction has been set, and, in the not too distant future, Salt Lake City should have all of its disaster response facilities strengthened and functional in the event of an earthquake.

Editor's Note: For an interesting comparison of the mitigation effort in Los Angeles, California, see the invited comment "Earthquake Hazard Mitigation Experience in California: Picture Windows of Opportunity" (Natural Hazards Observer, January 1988, Volume XII, Number 3, pages 1-2) by Shirley Mattingly, Director of Emergency Management, City of Los Angeles. She notes "We hate to say that we need a moderate earthquake every once in a while, but experience shows that it surely helps to sell all kinds of seismic safety programs:

* It took the 1933 Long Beach earthquake to get the Field Act passed in California requiring the strengthening of our public schools.
* It took the 1971 San Fernando earthquake for Los Angeles to enact a retrofit ordinance requiring reinforcement or demolition of our 8,000 unreinforced masonry buildings, and the 1985 Mexico City earthquake to shorten its compliance period.
* It took the 1983 Coalinga earthquake to get the state of California to require the identification of unreinforced masonry buildings in risk areas throughout the state.

Perhaps one of the reasons we have accomplished so much in earthquake hazard mitigation in California is that whenever concern over the seismic threat ebbs for too long, the earth rumbles and shakes and warns us that we had better take this threat seriously."

WASATCH FRONT COUNTY GEOLOGISTS RETAINED

Gary Christenson,
Utah Geological and Mineral Survey

In 1985, the UGMS received a grant from the U.S. Geological Survey (USGS) to fund the Wasatch Front County Geologist Program. Funding was provided for five Wasatch Front counties (Weber, Davis, Salt Lake, Utah, Juab) to hire geologists on their planning staffs for a period of three years, with the UGMS providing assistance in hiring and technical supervision and support throughout the program. Three geologists were hired to cover the five counties, with Weber and Davis Counties and Utah and Juab Counties each sharing a geologist. The geologists were hired in June 1985, and funding expires in June 1988, at which time the counties must provide funding if they wish to retain the geologist. Much valuable work has been accomplished to date under this program, including compilation of maps showing geologic hazards areas, aid in writing and implementing ordinances addressing geologic hazards, and performance of engineering geologic studies as required for siting critical facilities, solving problems affecting public health, and monitoring and evaluating geologic hazard events.

The County geologists are a major component of the USGS and UGMS effort to reduce losses from geologic hazards in the Wasatch Front area, and it is very important that their work continue. The Wasatch Front counties involved in the program share in this commitment and have elected to fund the program beyond June 1988. Both Salt Lake and Utah-Juab Counties have hired the geologists as permanent merit employees on their planning staffs. Negotiations are still underway in Weber and Davis Counties to maintain their geologist for at least the remainder of 1988 with the possibility of permanent employment in the 1989 budget cycle. The UGMS is very pleased with the success of the program and the commitment of Wasatch Front counties to responsible land-use planning with respect to geologic hazards, and looks forward to continued involvement with the county geologists.

UTAH GEOLOGIC HAZARDS OUTREACH PROGRAM OFFERED BY UTAH MUSEUM OF NATURAL HISTORY

DeeDee O'Brien, UMNH Docent

The Utah Museum of Natural History (UNMH) contributes to the geologic education of the general public through exhibits, classes, lecture series, film series, fieldtrips, outreach programs, teaching kits and teacher workshops. Collections are also used for research.

Docents (Museum volunteers) go into the classroom upon request to teach a variety of natural history subjects. They carry with them rock mineral, and fossil specimens for individual inspection.

Since the fall of 1985, Utah Geologic Hazards has been a popular outreach program. In a slide presentation format, the docent educates Utahns from age 10 to adult, about the natural geologic processes that affect our state and can affect our lives and property. Geologic Hazards Part I deals with some of the major mountain leveling processes such as rockfalls, landslides, mudflows and floods as well as lake-level rises. All of these are illustrated with Utah occurrences since 1983. Part II of the Geologic Hazards program deals with earthquake hazards. A two foot square, 3-dimensional model of a section of the Wasatch Front is used to demonstrate all of the hazards associated with earthquakes. An earthquake safety discussion concludes the program. The Utah Geologic Hazards models and slides are now packaged as a kit available for classroom use by teachers who complete the Hazards teacher workshop training.

Since the fall of 1986, UMNH has been working with the Staff Development Specialists at the Utah State Office of Education and individual school district offices to offer classes to teachers for in-service or University of Utah credit. These help teachers fill requirements for recertification, endorsement, or salary lane change. In this school year more than 400 teachers of grades K-12 have taken such geology courses as Great Basin Geology, Dinosaur Update, Utah Geologic Hazards, and Earthquakes. Such courses help teachers enrich their classrooms as well as better teach science core curriculum requirements.

For further information call the Education Department of the Utah Museum of Natural History at 581-4887 or the general Museum number 581-6927.

UTAHNS HONORED FOR EFFORTS TO REDUCE EARTHQUAKE HAZARDS

Several Utahns have received recognition for their accomplishments in fostering activities designed to reduce earthquake hazards in Utah. Awards were presented during a recent workshop on "Continuing Actions to Reduce Potential Losses from Earthquakes Along the Wasatch Front, Utah." Recipients were:

* Don Mabey, Geophysicist, retired from U.S. Geological Survey and past Deputy Director of Utah Geological and Mineral Survey (UGMS);
* Bob Smith, Professor and current Chairman of the Department of Geology and Geophysics, University of Utah;
* Walter Arabasz, Director of the University of Utah Seismograph Stations;
* Loren Anderson, Professor and current Chairman of the Department of Civil Engineering, Utah State University;
* Jeff Keaton, Engineering Geologist, Dames & Moore; Adjunct Professor at University of Utah; Utah State University; PhD candidate at Texas A&M; and Past President of the Utah Section of Association of Engineering Geologists;
* Jerry Barnes, Planner, Salt Lake County;
* James Tingey, Earthquake Preparedness Planner, Utah State Division of Comprehensive Emergency Management (CEM);
* Ed Yeates, Medical and Science Specialist, KSL Television;
* Wes Dewsnup, Hazardous Materials Planning Coordinator with the Utah State Division of Comprehensive Emergency Management (CEM);
* Gary Clayton, Lt. Director of Emergency Services, Utah County;
* Ralph Findlay, Chief of Plans and Preparedness, Utah State Division of Comprehensive Emergency Management (CEM).

The awards were presented by John R. Filson, Chief, Office of Earthquakes, Volcanoes and Engineering, U.S. Geological Survey (USGS) and Richard Krimm, Assistant Associate Director, Office of Natural and Technological Hazards Program, Federal Emergency Management Agency (FEMA).

This is the second year awards were given for implementation activities under the auspices of the National Earthquake Hazards Reduction Program. The workshop was sponsored by USGS, FEMA, UGMS and CEM. The cooperative research and implementation effort began in October, 1983 and is continuing.

UGMS POSITIONS AVAILABLE

The Utah Geological and Mineral Survey has openings for two engineering geologists and an engineering seismologist in the Applied Geology Program. Successful candidates will conduct engineering geologic studies, including site investigations and geologic hazards mapping, and/or earthquake ground-shaking studies throughout the State. Applicants with specialties and experience in the following areas are sought:

1) Debris-flow and flood hazards, surface-water hydrology, landslides
2) Engineering geologic site investigation, hazards mapping, and project review
3) Earthquake ground shaking, engineering seismology, probabilistic hazards assessment

Positions require at least a Bachelor's degree in geology, geophysics, seismology, engineering geology, or related field and two years experience or an equivalent combination of education and experience. Salary will be commensurate with qualifications, ranging from $23,300 to $30,200. Please contact Gary E. Christenson, Senior Geologist for Applied Geology at UGMS (801-581-6831), if you have questions regarding these positions. Submit resume including transcripts by May 20, 1988 (engineering geologists, positions 1 and 2 above) and June 3, 1988 (engineering seismologist, position 3 above) to:

Utah Department of Natural Resources
Attention: Human Resources Management
1636 W. North Temple
Salt Lake City, Utah 84116

THE NEXT FIVE YEARS OF NEHRP

When Congress established the National Earthquake Hazards Reduction Program in 1977, it required that the agencies legally responsible for implementing the NEHRP jointly develop a five-year plan detailing the earthquake hazard reduction activities to be undertaken by each. Congress further provided that the five-year plan be revised every three years. The Federal Emergency Management Agency, as designated lead agency, established an Expert Review Committee in 1987 to examine current NEHRP activities, identify critical issues, and give recommendations about problem solutions. The committee's report has just been released and will be considered by the agencies as they formulate the revised Five-Year Plan for 1989-1993.

The 85-page committee report is divided into five sections: research, implementation, earthquake insurance, the leadership role, and funding. Each section analyzes progress to date, shortcomings in the program, and issues that remain to be addressed, and it concludes with recommendations on each area of concern. The research section is further broken down into discussions of earthquake engineering, earthquake prediction and hazard assessment, fundamental studies of earthquake processes, earthquake data collection, societal response, and international cooperation. The implementation section comprises treatments of state and local participation in earthquake hazard reduction, mitigation of seismic hazards to the built environment, and public education and information transfer. The report directs recommendations to the responsible agency (FEMA, U.S. Geological Survey, National Science Foundation, or National Bureau of Standards) where possible, and it also identifies other federal agencies that have expertise applicable to certain issues or problems.

Single copies of "Commentary and Recommendations of the Expert Review Committee, 1987" can be requested for no cost from Jane Bullock, FEMA, Earthquakes and Other Natural Hazards Division, Room 625, 500 C Street, S.W., Washington, DC 20472.

- Reprinted From Natural Hazards Observer

UTAH GOVERNOR'S CONFERENCE ON COMPREHENSIVE HAZARDS REDUCTION: "Safe and Scenic in the 90's"

The Utah Division of Comprehensive Emergency Management is sponsoring this 2-day conference May 5-6, 1988, at the Olympic Hotel in Park City, Utah, to reinforce the need to promote hazards reduction as a part of Utah public safety issues. A comprehensive array of hazards will be addressed with respect to the issues of threat, risk and mitigation. Special mitigation projects conducted by CEM, such as multi-hazard planning, earthquake mitigation planning, and statewide hazard mitigation planning, are recognized nationally as being exceptional in quality.

The conference will be opened by Governor Norman H. Bangerter, Lorayne Frank, Director of CEM, and John T. Nielsen, Commissioner of Public Safety. Dr. Riley Chung of the National Academy of Sciences and Jerome M. Oakley of FEMA will address the conference on the National Decade for Natural Hazard Reduction: national and state involvement. Subsequent speakers and their topics include Fred May, State Hazard Mitigation Officer, CEM, "Utah: Successes in Hazards Reduction"; Jim Tingey, State Earthquake Preparedness Planner, CEM, "Wasatch Front Earthquake Risk, Progress and Risk Reduction"; Terry Holzworth, Director, Salt Lake County Public Works Department, "Salt Lake County Flood and Ground Failure Risk Reduction"; Lorin Larsen, Chief, Hazard Mitigation Section, CEM, "Hazardous Materials Risk Reduction"; Wes Dewsnup, Multi-Hazard Planner, CEM, "Multi-Hazard Approach to Risk Reduction Including Hazardous Materials and Title III"; Morgan and Sarah Haroldsen, residents of the epicentral area north of Mackay, Idaho, "Life at the Epicenter"; Ken Lavas, Meteorologist, National Weather Service, "Satellite Monitoring of Global Weather as a Hazard Mitigation Measure"; Steve Sorenson, Utah Attorney General's Office, "Liability Issues in Hazard Mitigation"; and Edward G. Leary, Chief Examiner, Utah Department of Financial Institutions, "Utah's Current and Planned Involvement in International Hazards Reduction Programs". Intensive, concurrent work sessions on May 5 will deal with 1) hazardous materials risk reduction; 2) earthquake risk reduction, 3) hydrologic hazards risk reduction; and 4) ground failure hazards reduction and dam safety. The results and recommendations coming out of each work session will be presented to all participants on May 6. A conference proceedings will also be produced and distributed.

If you would like to attend or need more information, contact CEM at 533-5271.

UTAH PRESERVATION CONSORTIUM'S DISASTER PLANNING WORKSHOP

The Utah Preservation Consortium, a new group whose members represent collecting institutions such as museums, archives, and libraries throughout the state, is organizing and sponsoring the first state-wide disaster planning workshop for anyone concerned with preservation of cultural property. The meeting will be held at the Brigham Young University Conference Center, Provo, Utah, September 15-16, 1988. Speakers and topics will include:

Thursday, September 15 - Disaster Planning and Preparedness

John P. Barton, Head Conservator, Archives of Ontario, "Creating a Disaster Plan."

Randall Butler, Archivist & Conservation Officer, Loma Linda University, California, "The L.A. County Library Fire and the Santa Barbara Earthquake: Reasons for Disaster Planning."

Durell Barney, Fire Marshall, Brigham Young University, Provo, Utah, "Pre-Fire Planning and the Use of Fire Suppression Systems."

Harry Gerlach, The H.B. Gerlach Company, Bountiful, Utah, "Freeze Drying Technology & Its Applications to Disaster Recovery."

Jim Tingy, Utah Division of Comprehensive Emergency Management, Salt Lake City, Utah, "The Nature of the Earthquake Predicted Along the Wasatch Fault."

Friday, September 16 - Disaster Response and Recovery

Barbara Roberts, Head Conservator, Decorative Arts and Sculpture Conservation, J. Paul Getty Museum, Santa Monica, California, "First Response Procedures for the Recovery of Water Damaged Museum Objects."

John P. Barton, Head Conservator, Archives of Ontario, "Recovery of Water Damaged Books, Documents and Microfilm."

Eric Lundquist, Document Reprocessors, San Francisco, California, "On-Sight Freeze Drying of Water Damaged Books and Documents."

Don Hartsell, Air Dex Corporation, Houston, Texas, "Humidity Stabilization Following Water Damage to Library, Archives and Museum Collections."

John Telford, Photographic Services, University of Utah, Salt Lake City, Utah, "Recovery of Water Damaged Historical Photographs."

Richard Trela, Art Conservator, Brigham Young University,Provo, Utah, "First Response Procedures for the Recovery of Water Damaged Paintings."

In a news article reprinted from the Abbey Newsletter: Bookbinding and Conservation (December 1987, v. 11, no. 8, p. 122) Randall Butler, one of the above speakers, reports on damage to Los Angeles Libraries from the recent 1987 Whittier earthquake:

> At 7:42 am on October 1, an earthquake of 6.1 magnitude on the Richter scale hit the Los angeles area, especially the town of Whittier, damaging 450 buildings and leaving thousands homeless (a full week after the quake, almost 2,000 were still homeless). After shocks continued into October, bringing the number of dead to seven. Library stacks collapsed and books were strewn on the floor, except in libraries where the stacks were properly braced; 50 of 300 public libraries closed on the day of the quake, and 20 were still closed October 5.
>
> Randall Butler, Archivist and Conservation Officer at Loma Linda University, has written a detailed report which will appear in CAN. It describes the factors that seemed to make a difference between stacks that collapsed and those that did not. Sturdy bracing at close intervals at the Wardman Library at Whittier College minimized damage despite the fact that it was at the epicenter, and that its stacks were oriented so as to take the full force of the north-south motion of the quake.
>
> The main concerns about the effects of earthquakes in libraries are deaths that could be caused by collapsing stacks, replacement of damaged stacks, and reshelving or repair of books damaged by the fall.

Barbara Roberts, another workshop speaker, was the featured presenter at a recent National Center for Earthquake Engineering, Seminar on Earthquakes (NCEER Bulletin, January 1988, v. 2, no. 1, 10 p.), "Art Collections: A Discussion on Earthquake Mitigation":

> On November 16, 1987, Ms. Barbara Roberts discussed the problems faced by museum curators in trying to protect art collections from the effects of earthquakes.
>
> Most of the world's art collections are located in seismic areas. As such, they are also subject to hazards resulting from earthquakes such as fires and floods. The J. Paul Getty Museum has taken many steps to insure that their

collection is protected from these hazard. Built in 1976, the museum and its exhibits were designed to withstand seismic events. In 1984, the museum sponsored a seismic evaluation of the museum and its contents. The Imperial Valley earthquake of 5/18/40 was chosen as a typical example of an earthquake which might occur in the area. Known acceleration and displacement factors were used to estimate basic failure modes - both rigid body and dynamic. The resulting information provided important data about the types of problems that would be incurred by the museum should an earthquake of this magnitude occur.

The area of protecting art from natural hazards is one in which the engineering community has an opportunity to make a very positive contribution to the art world.

Details of finalized cost and registration procedures will be published in the next issue of the Forum. For more information contact Randy Silverman, 6216 HBLL, Brigham Young University, Provo, UT 84062, (801) 378-2512.

A new publication of related interest is "Between Two Earthquakes: Cultural Property in Seismic Zones", Bernard M. Feilden, The Getty Conservation Institute, 1987, 105 p. Copies cost $8.00 and can be purchased from the J. Paul Getty Trust Publications, Book Warehouse, the J. Paul Getty Museum, P.O. Box 2112, Santa Monica, CA 90406. Add $2.00 for shipping and handling; California residents add 6.5% sales tax.

ATC-14 SEMINAR ON EVALUATING THE SEISMIC RESISTANCE OF EXISTING BUILDINGS, IN UTAH MAY 19, 1988

The Applied Technology Council is planning a series of seminars in seismically active parts of the country to introduce practicing structural engineers to the recently published ATC-14 Report (see Upcoming Conferences for Utah Seminar, May 19, 1988). This 370-page report describes a new method for performing preliminary and detailed building seismic evaluations. It incorporates both past earthquake building performance and appropriate analysis techniques to provide procedures that bring consistency to the seismic evaluation of buildings.

The NSF-sponsored ATC-14 Report includes a state-of-practice review; seismic loading criteria; data collection procedures; a detailed description of the building classification system, which contains 15 model building types; preliminary and detailed analysis procedures for the 15 model building types; and example case studies, including nonstructural considerations. The preliminary evaluation procedures, which require approximately one to three days of engineering effort to apply to a specific building, involve limited calculations and those building characteristics that have proven to be vulnerable in past earthquakes. The detailed evaluation procedures involve approaches consistent with today's codes.

Copies of the ATC-14 Report can be obtained at the Seminar or from Applied Technology Council, 3 Twin Dolphin Drive, Ste. 275, Redwood City, Ca 94065. Price $50.00 per copy.

- Excerpted From EERI Newsletter

WHY NOT IN UTAH NEXT?

AIA/ACSA Sponsor Workshops On Seismic Design

To help architects and related building professionals respond to the potential threat of earthquakes from coast to coast, The American Institute of Architects (AIA) and the Association of Collegiate Schools of Architecture (ACSA) will present three

regional seismology workshops, Oct. 30-31, 1988, St. Louis; Jan. 29-30, 1988, San Francisco; and April 1988, Boston.

The key role that architects and other design professionals must play in reducing loss of life and damage to the built environment will be addressed by internationally recognized experts in seismic-resistant design at the workshops sponsored by the AIA/ACSA Council on Architectural Research and cosponsored by the local AIA components.

Funded by the Federal Emergency Management Agency (FEMA), the workshops will examine the potential threat of seismic damage facing communities in each region.

Results of the ongoing funded research project, "Architectural and Urban Design Lessons from the 1985 Mexico City Earthquake", will be presented at all workshops.

Speakers at each workshop will cover the use of conceptual design, innovative structural systems, land use, cost/benefit considerations, as well as other mitigation techniques to assist design professionals in understanding earthquakes and how to protect human life by designing seismically safe buildings and communities. The program will also cover geological and risk analysis, ground motion and its effect on buildings, nonstructural design, and mechanical systems. Other topics will include seismic building codes, roles and opportunities of design professionals, the "whole" building approach to seismic design, and the National Earthquake Hazards Reduction Program concerning Recommended Provisions.

The core faculty will feature an internationally recognized group of seismic experts, as well as local authorities and public officials.

For more information, contact the AIA/ACSA Research Council, (202) 785-2324.

- Excerpted From EERI Newsletter

SEMINAR IS DESIGNED AND AVAILABLE ON LEARNING FROM EARTHQUAKES

The Continuing Education Committee of EERI has initiated a continuous long-term program to meet the needs of the membership, the professions, and the various publics for timely, state-of-the-art information that can be used to achieve the goals of earthquake hazards mitigation throughout the nation. The seminar on "Learning from Earthquakes" is an example of a new initiative for accomplishing this goal. It is based on the recent EERI report "Reducing Earthquake Hazards: Lessons Learned From Earthquakes". The study leading to this comprehensive multidisciplinary report was sponsored by NSF. It synthesized the essential lessons learned since 1971 in post-earthquake investigations of more than 200 earthquake and recommended specific actions that, if implemented, will achieve damage and loss control. The seminar can be designed for 1 or 2 days (or more) and, depending on the selected duration, will focus in some detail on: 1) the geosciences and geotechnical engineering, 2) engineering buildings, lifeline systems, and industrial facilities, 3) architecture and urban planning, and 4) social sciences. The speakers will be drawn from across the nation.

The state-of-the-art report, identified above, is the text and will be provided to each participant attending the seminar. A set of slides keyed directly to the report is available for purchase by the participants.

For further information, contact Earthquake Engineering Research Institute, 6431 Fairmount Avenue, El Cerrito, CA 94530, (415) 525-3668.

BSSC INTRODUCES NEW INFORMATION SERVICES

The Building Seismic Safety Council (BSSC) has begun providing information on seismic-resistant design and construction of new buildings through a toll-free telephone information service and a national speakers bureau.

An independent body established in 1979 under the auspices of the National Institute of Building Sciences to further seismic safety of buildings, the BSSC has been integrally involved in the National Earthquake Hazards Reduction Program (NEHRP). Specifically, the BSSC developed the "NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings", a comprehensive set of building design provision covering building types and construction practices (see BSSC publications below). The new BSSC "800" telephone service is intended primarily to answer inquiries related to the use and application of that document, but it will also function to answer other earthquake hazard mitigation questions and to refer persons to other agencies that can better meet their needs or solve their problems.

Similarly, the BSSC speakers bureau will help organizations identify experts who can speak on earthquake risk, various aspects of seismic-resistant design and construction, and application of the NEHRP Recommended Provisions.

The new BSSC services are available by calling toll free 1-800-66-NEHRP (1-800-666-3477) between 9:00 am and 5:00 pm eastern time.

- Excerpted From Natural Hazards Observer

NEW AND NOT-SO-NEW BSSC PUBLICATIONS

In an ongoing program conducted by the BSSC and FEMA to achieve national seismic safety goals, the BSSC has produced a series of reports for voluntary use by interested participants at all levels in the non-Federal sector of the building community:

"Guide to Application of the NEHRP Recommended Provisions in Earthquake-Resistant Building Design." FEMA Publication #140 (Earthquake Hazards Reduction Series #25), 1987, 359 p.

"Guidelines for Preparing Code Changes Based on the NEHRP Recommended Provisions (1985 edition)." FEMA Publication #98 (Earthquake Hazards Reduction Series #21), 1986, 120 p.

"Improving Seismic Safety of New Buildings: A Non-Technical Explanation of the NEHRP Recommended Provisions." FEMA Publication #99 (Earthquake Hazards Reduction Series #20), 1986, 64 p.

The BSSC has also prepared (and FEMA has published) a series of publications that examine the effects of earthquakes on lifelines and the potential for mitigating the damages. The cover volume is entitled "Abatement of Seismic Hazards to Lifelines: Action Plan". Released in 1987 the Action Plan is 240 pages long and is identified as FEMA Publication #142 (Earthquake Hazards Reduction Series #32). FEMA also sponsored a BSSC workshop to further identify and explore mitigation activities related to lifelines. Held in November of 1986, the workshop generated a set of proceedings that FEMA has published in six volumes:

Volume 1--"Papers on Water and Sewer Lifelines." FEMA Publication #135 (Earthquake Hazard Reduction Series #26). July 1987, 184 p.

Volume 2--"Papers on Transportation Lifelines." FEMA Publication #136 (Earthquake Hazard Reduction Series #27). July 1987, 162 p.

Volume 3--"Papers on Communications Lifelines." FEMA Publication #137 (Earthquake Hazard Reduction Series #28). July 1987, 120 p.

Volume 4--"Papers on Power Lifelines." FEMA Publication#138 (Earthquake Hazard Reduction Series #29). July 1987, 78 p.

Volume 5--"Papers on Gas and Liquid Fuel Lifelines." FEMA Publication #139 (Earthquake Hazard Reduction Series #30). July 1987, 134 p.

Volume 6--"Papers on Political, Economic, Social, Legal, and Regulatory Issues and General Workshop Presentations." FEMA

Publication #143 (Earthquake Hazard Reduction Series #31). July 1987, 236 p.

Single copies of the aforementioned publications can be obtained free of charge from FEMA, P.O. Box 70274, Washington, DC 20024. When requesting publications from FEMA, please remember to include the correct identification number(s).

- Excerpted from Natural Hazards Observer

Editor's Note: The EERI Newsletter recently reported that BSSC'S effort to update the 1985 Edition of the "NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings" is progressing. Since early in 1987, Technical Committees have been addressing nine subjects--seismic risk maps, structural design, foundations, concrete, masonry, steel, wood, architectural/ mechanical/electrical systems, and regulatory use. A draft version of the updated Provisions will soon be prepared.

QUICK EPICENTER DETERMINATION PROGRAM

The exact epicenter of the most recent tremor anywhere in the world is as near as your fingertips and computer terminal because of a new program of the National Earthquake Information Center. The Quick Epicenter Determinations (QED) program is available seven days a week, 24 hours a day through the Center's On-Line Information Program. Individuals and groups with access to a 3-baud terminal with dial-up capabilities can contact a commercial telephone number in Golden, Colorado, for the information. QED is also available on a toll-free WATS number to all users in the United States outside Colorado. The WATS line will accept either 300-baud or 1200-baud terminals, but it prefers the 300-baud variety. There is no cost for the service beyond what you have to pay to the phone company to use its lines.

The period of time for which data are available is approximately three weeks. Events less than seven days old are revised and re-evaluated for the QED as new data are received from contributing observatories. Events older than seven days are no longer revised, but are retained in the data base until they are published in the monthly "Preliminary Determination of Epicenters". The event list is revised once a day early in the morning; in addition to the daily update, any earthquake for which the NEIC has issued a press release is added to the QED list within about an hour of the release. The data base may be searched for any or all of the following parameters: events within a given date, events within a given radius of geographic location, and events equal to or greater than a given magnitude.

Questions, problems, or suggestions for improvements regarding this new program should be directed to Bruce W. Presgrave, U.S. Geological Survey, Stop 967, National Earthquake Information Center, Box 25046, Denver Federal Center, Denver, CO 80225, (303) 236-1500.

- Reprinted From Natural Hazards Observer

EARTHQUAKE HAZARD MITIGATION GRANTS

Social science research on earthquake hazards is supported by the National Science Foundation under the Earthquake Systems Integration element of the Earthquake Hazard Mitigation Program. Current grantees include sociologists, geographers, political scientists, economists, planners, and psychologists. The goals of the program are to: 1) provide a knowledge base for further mitigation and preparedness planning in the U.S., 2) improve societal responses to earthquakes, and 3) contribute to the development of an effective delivery system for seismic safety information. Proposals are

being accepted from U.S. research institutions for investigating such areas as the social, economic, and institutional aspects of mitigation and preparedness; earthquake impacts, including emergency, recovery, and reconstruction activities; and risk communication. Interdisciplinary proposals are considered.

"Earthquake Hazard Mitigation Program," Division of Critical Engineering Systems, National Science Foundation. Research proposals may be submitted at any time. Inquiries about the program are welcomed by William A. Anderson, Program Director, Earthquake Hazard Mitigation Program, CES Division, Room 1130, National Science Foundation, Washington, DC 20550, (202) 357-9780.

- Reprinted From Natural Hazards Observer

EARTHQUAKE HAZARDS REDUCTION ASSISTANCE FROM FEMA

The Federal Emergency Management Agency has announced its policy for providing financial and technical assistance to states and local governments under the Earthquake Hazards Reduction Act of 1977. Under that law, FEMA is designated as the lead agency for implementing the federal government's interdepartmental National Earthquake Hazards Reduction Program (NEHRP). In addition, FEMA's duties include responsibility for supporting--both financially and with technical assistance--state and local earthquake hazards reduction projects. The activities for which states may apply for funding fall into six major categories or program elements: state seismic advisory boards, hazard identification, vulnerability assessments, preparedness and response planning, mitigation planning, and public awareness/education.

It is the federal government's policy that state and local governments have the initial, direct responsibility for the protection of lives and property from earthquakes. FEMA's role is to support and encourage development at the state level of an institutionalized capability in earthquake hazards reduction. FEMA believes that having states share the cost of their projects is an effective way of developing and sustaining commitment to earthquake hazards reduction. Hence, in keeping with the trend of federal cost-sharing, FEMA is initiating a cost-sharing program with state and local governments for their earthquake hazards reduction projects. These projects have in the past been (in most cases) 100% federally funded, but FEMA'S new policy is to share the costs of such projects on a 50/50 basis--with the nonfederal contribution required to be in cash.

Realizing that such a demand on state finances could be extremely burdensome and difficult to achieve for fiscal year 1988, FEMA will continue to fund state projects for that year without requiring state matching funds. However, in FY 89, minimum cost-share requirements will oblige states to contribute 25% of the total cost of their projects either in cash or inkind services or materials. Beginning in FY 90, the full cost-sharing provisions will require that states contribute in cash 50% of the cost of earthquake hazard reduction projects.

Additional information on this policy is available from Terry Feldman, Earthquakes and Natural Hazards Programs Division, Office of Natural and Technological Hazards Programs, State and Local Programs and Support, Federal Emergency Management Agency, 500 C street, S.W., Washington, DC 20472, (202) 646-4145.

- Reprinted From Natural Hazards Observer

UTAH EARTHQUAKE ACTIVITY

Ethan D. Brown
University of Utah Seismograph Stations
Department of Geology and Geophysics

July through September 1987

The University of Utah Seismograph Stations records an 85-station seismic network designed for local earthquake monitoring within Utah, southeast Idaho, and western Wyoming. During July 1 to September 30, 1987, 130 earthquakes were located within the Utah region, including 49 greater than magnitude 2.0. The epicenters in Figure 1 show earthquake activity extending from south-central Utah northward through Utah's main seismic region to the Utah-Idaho border. Clusters of events occurred west of the Great Salt Lake and 40 km southwest of Richfield, Utah. The largest earthquake, M_L 4.7 (UUSS; 4.9 USGS), during this time period occurred on September 25 (GMT) and was located 100 km west of Ogden, and west of the Lake. This earthquake was reported felt from Wendover (on the Utah-Nevada border) to the Salt Lake Valley, and was the largest Utah earthquake since the 1975 M_L 6.0 Pocatello Valley event. The only other felt earthquake in the report period was a small earthquake, M_L 1.7, on November 10 in the north-east Salt Lake Valley, which was felt in a localized area near the University of Utah.

Over half of the earthquakes during the report period were associated with two spatial clusters. The larger cluster, located west of the Great Salt Lake, contains 40 events including the M_L 4.7 earthquake on September 25. This sequence began on September 17 with an M_L 3.9 earthquake, and was continuing as of November 9, 1987. Four telemetered stations were deployed in the epicentral area to provide continuous data for detailed study. The cluster 40 km southwest of Richfield contains 30 events of $M_L \leq 3.4$. This cluster actually comprises two sequences about 20 km apart. The northern subset occurred during the last week of August. Activity then shifted to the southwest in early September and continued for about one week.

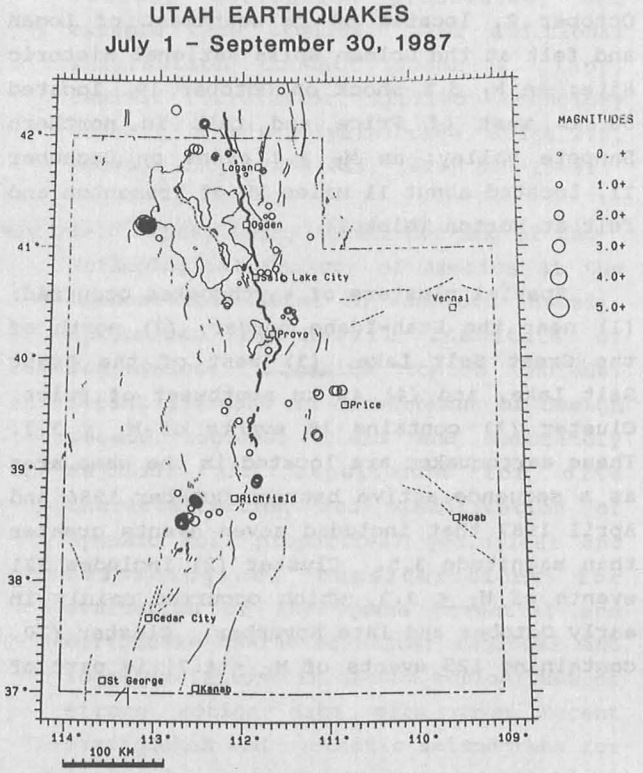

Figure 1. Utah Earthquakes, July 1 - September 30, 1987

October through December 1987

During October 1 to December 31, 1987, 248 earthquakes were located within the Utah region, including 69 greater than or equal to magnitude 2.0. The epicenters in Figure 2 show earthquake activity extending from south-central Utah northward through Utah's main seismic region to the Utah-Idaho border. Clusters of events are shown north and west of the Great Salt Lake and 40 km southwest of Price, Utah. The largest earthquake during this time period, M_L 4.7, occurred on October 26 and was located 100 km west of Ogden, just west of the Great Salt Lake. This earthquake was reported felt from Wendover (on the Utah-Nevada border) to the Salt Lake Valley, and is part of an earthquake sequence that included the M_L 4.8 event on September 25, 1987. An M_L 4.3 event in the same area on October 23 was

felt strongly by workers close to the epicenter. Other felt earthquakes during the report period include: an M_L 3.5 event on October 2, located 50 km southwest of Logan and felt at the Golden Spike National Historic Site; an M_L 3.8 shock on October 19, located 50 km west of Price and felt in northern Sanpete Valley; an M_L 3.2 event on December 11, located about 11 miles NW of Tremonton and felt at Morton Thiokol.

Spatial clusters of earthquakes occurred: (1) near the Utah-Idaho border, (2) north of the Great Salt Lake, (3) west of the Great Salt Lake, and (4) 40 km southwest of Price. Cluster (1) contains 18 events of $M_L \leq 3.2$. These earthquakes are located in the same area as a sequence active between October 1986 and April 1987 that included seven events greater than magnitude 3.5. Cluster (2) includes 221 events of $M_L \leq 3.3$, which occurred mainly in early October and late November. Cluster (30, containing 125 events of $M_L \leq 4.7$, is part of an ongoing sequence of earthquakes that began in September 1987. Cluster (4) was active through November and early December and contains 27 earthquake of $M_L \leq 3.3$.

Additional information on earthquakes within Utah is available from the University of Utah Seismograph Stations, Salt Lake City, Utah 84112, (801) 581-6274.

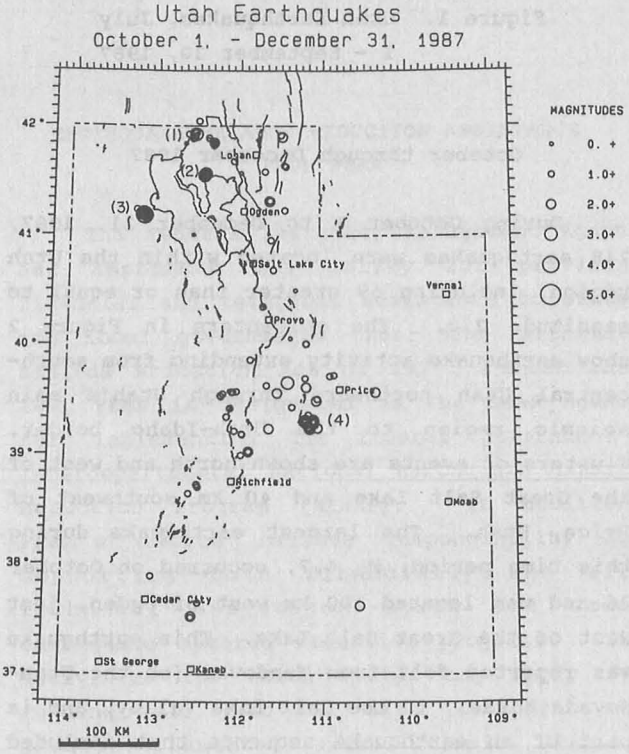

Figure 2. Utah Earthquakes, October 1 - December 31, 1987

CONFERENCES

May 5-6, 1988, Governor's Conference on Comprehensive Hazards Reduction "Safe and Scenic in the 90's", sponsored by Utah Division of Comprehensive Emergency Management, held at the Olympic Hotel in Park City, Utah. The conference objective is to reinforce the need to promote hazards reduction as a part of Utah public safety issues relative to a comprehensive array of hazards. For specific agenda information, see related article, this issue. For more information, contact Utah Division of Comprehensive Emergency Management, 1543 Sunnyside Avenue, Salt Lake City, UT 84108-8100, (801) 533-5271.

May 10-13, 1988, Earthquake Countermeasures meeting held in Beijing, China. For information contact Sino-American Technology Conference Center, 312 5th Avenue, 4th Floor, New York, NY 10001, (212) 971-3438.

May 11-14, 1988, International Seismic Isolation/Historic Preservation Symposium: "Earthquake Risks and the Architectural Landmark" sponsored by Salt Lake City Corporation, Office of the Mayor at Little America Hotel, Salt Lake City, Utah. Held in the shadow of the Salt Lake City and County Building--the world's first retrofit of an innovative earthquake mitigation design within a historic landmark--this convocation is

intended for architects, engineers, preservationists, financiers, contractors, earthquake-risk specialists, and public officials. Technical sessions will cover the following topics: seismic isolation--history and theory; current research and development; base isolation for the Salt Lake City and County Building--structural design; engineering feasibility review; life-safety issues--fire protection, conservation codes, municipal inspections; enacting public policy; economic viability and public funding; preventative and scheduled maintenance; analysis and treatment of exterior stonework; interior restoration of historic fabric; and the general contractor's viewpoint. For additional information, contact W. Dee Halverson, Symposium Director, Salt Lake City Corporation, Office of the Mayor, 324 South State Street, Fifth Floor, Suite 500, Salt Lake City, UT 84111, (801) 535-6042.

May 16-18, 1988, Rocky Mountain Section, Geological Society of America Meeting in Sun Valley, Idaho. For information contact Edna Collis, GSA, 3300 Penrose Place, Box 9140, Boulder, CO 80301, (303) 447-2020.

May 19, 1988, ATC-14 Seminar on "Evaluating the Seismic Resistance of Existing Buildings" sponsored by the Applied Technology Council and the Structural Engineers Association of Utah, at Westminster College, Salt Lake City, Utah. The purpose of this seminar is to introduce practicing structural engineers, building regulatory officials, and other design professionals to a recently completed methodology for evaluating the seismic resistance of existing buildings. The seminar will provide participants with practical information and methodology for determining if buildings are a life-safety hazard in the event damaging levels of earthquake ground shaking occur. Topics to be addressed include data collection and building classification; evaluation procedures; and example case studies. For additional information contact Susan K. Lapp, Seminar Coordinator, Applied Technology Council, 3 Twin Dolphin Drive, Suite 275, Redwood City, CA 94065, (415) 595-1542.

May 24-27, 1988, 1988, Annual Meeting of the Seismological Society of America at the Prince Kuhio Hotel in Honolulu, Hawaii, sponsored by Hawaii Institute of Geophysics. Session topics include: recent advances in development of design ground motions; field and laboratory methods and experience for site characterization and specification of dynamic soil properties; geological and seismological considerations for evaluation of earthquake potential and earthquake characteristics; regional and local variations in ground motion; use of strong motion data sets from recent earthquakes and synthetic seismograms for estimating ground motions and analytical and empirical techniques for evaluating ground motions and ground deformations during large earthquakes. For information, contact the Seismological Society of America, 6431 Fairmount Avenue, Suite 7, El Cerrito, CA 94530, (415) 525-5474.

June 27-30, 1988, Earthquake Engineering and Soil Dynamics II "Recent Advances in Ground Motion Evaluation", an ASCE Specialty Conference sponsored by ASCE Geotechnical Engineering Division, Earthquake Engineering Research Institute, Seismological Society of America, Structural Engineers Association of Utah, and Utah Section of American Society of Civil Engineers at Prospector Square Hotel, Park City, Utah. This conference will focus on recent advances in earthquake engineering and soil dynamics relative to the development of design ground motions. Sessions will include geotechnical engineering;

geologic considerations and earthquake potential; measurement and characterization of strong ground motion on a regional scale; local variations and their importance to site specific evaluations; analysis of strong ground motion and associated large deformations; evaluation of ground motion for engineering design; and a full-day field trip to survey the Wasatch fault in the Salt Lake City area. For further information contact Dr. T. Leslie Youd, Specialty Conference Chairman, Department of Civil Engineering, Brigham Young university, Provo, UT 84602, (801) 378-6327.

July 27-29, 1988, Second U.S.-Japan Workshop on Urban Earthquake Hazards Reduction sponsored by Earthquake Engineering Research Institute's Committee on Planning for Earthquake Hazards will be held at Shizuoka, Japan, near Tokyo, just prior to the Ninth World Conference (below). The workshop will examine earthquake problems at the urban scale, impacting the highly urbanized/industrialized and populated areas of Japan and the United States. Topics include policy problems of earthquake prediction; public and private preparedness; earthquake vulnerability/estimation of damage; fire and hazardous materials following earthquakes; search and rescue/emergency response; recover/repair/reconstruction/rehabilitation; governmental response to the earthquake problem; and insurance. For more information contact Earthquake Engineering Research Institute, 6431 Fairmount Avenue, Suite 7, El Cerrito, CA 94530-3624, (415) 525-3668.

August 2-9, 1988, Ninth World Conference on earthquake Engineering held in Tokyo/Kyoto, Japan. For information, contact Dr. Hajime Umemura, President of IAEE, c/o Japan Convention Services, Inc., Nippon Press Center Building; 2-1, 2-chome, Uchisaiwai-cho, Chiyoda-Ku, Tokyo 100; Japan.

August 17-19, 1988, Annual Highway Geology Symposium "Construction to Minimize Environmental Impact" sponsored by Brigham Young University, Utah Department of Transportation and Utah Geological and Mineral Survey held at Genesis Resort, Park City, Utah. Session topics include rock slopes; slope stability; retaining walls; expansive soils; and a field trip to view Thistle landslide, Jordanelle Dam site, Great Salt Lake dikes, and Provo River Canyon. For more information contact Dr. T. Leslie Youd, Department of Civil Engineering, 368 Clyde Building, Brigham Young University, Provo, UT 84602, (801) 378-6327.

September 15-16, 1988, Utah Disaster Planning Workshop, at the Brigham Young University Conference Center in Provo, Utah, sponsored by the Utah Preservation Consortium. See related article, this issue. For more information contact Randy Silverman, 6216 HBLL, Brigham Young University, Provo, UT 84062, (801) 378-2512.

September 19-23, 1988 International Symposium on Engineering Geology "Study, preservation and protection of ancient works", held in Athens, Greece. For more information contact the Symposium Secretary, Greek Committee on Engineering Geology, P.O. Box 19140, GR-11710, Athens, Greece, Telex: 454312 POLX.

October 16-21, 1988, Association of Engineering Geologists Annual Meeting, held in Kansas City, Missouri. For information contact Thomas J. McClain, Technical Program Chairman, Kansas Geological Survey, 1930 Constant Avenue, Lawrence, KS 66046, (913) 864-3965.

October 31-November 3, 1988, Geological Society of America Annual Meeting,

Centennial Celebration held in Denver, Colorado. For information contact Jean Kinney, GSA, Box 9140, Boulder, CO 80301, (303) 447-2020.

December 7-11, 1988, American Geophysical Union fall meeting held in San Francisco, California. For information contact AGU, 2000 Florida Avenue, N.W., Washington, DC 20009, (202) 462-6903.

July 9-19, 1989, 28th International Geological Congress, in Washington, DC. For information contact Bruce B. Hanshaw, Box 1001, Herndon, VA 22070-1001, (703) 648-6053.

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