STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS

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SEISMIC, VOLCANIC, AND TSUNAMI MITIGATION IN ALASKA - AN UNMET NEED

By
J.N. Davies

STATE OF ALASKA
Department of Natural Resources
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

According to Alaska Statute 41, the Alaska Division of Geological and Geophysical Surveys is charged with conducting 'geological and geophysical surveys to determine the potential of Alaska lands for production of metals, minerals, fuels, and geothermal resources; the locations and supplies of ground waters and construction materials; the potential geologic hazards to buildings, roads, bridges, and other installations and structures; and shall conduct other surveys and investigations as will advance knowledge of the geology of Alaska.'

In addition, the Division shall collect, evaluate, and publish data on the underground, surface, and coastal waters of the state. It shall also file data from water-well-drilling logs.

DGGS performs numerous functions, all under the direction of the State Geologist---resource investigations (including mineral, petroleum, and water resources), geologic-hazard and geochemical investigations, and information services.

Administrative functions are performed under the direction of the State Geologist, who maintains his office in Anchorage (3001 Porcupine Dr., 99501, ph 274-9681).

This report is for sale by DGGS for $1. It may be inspected at any of the four DGGS information offices: Alaska National Bank of the North Bldg., Geist Rd. and University Ave., Fairbanks; 3601 C St. (10th Floor), Anchorage; 230 So. Franklin St. (4th Floor), Juneau; and the State Office Bldg., Ketchikan. Mail orders should be addressed to DGGS, P.O. Box 80007, College, AK 99708.

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Pictured (left to right): front row - George Carte, Selena Billington, Klaus Jacob, Ray Steinmetz, J.P. Singh; second row - Lynn Sykes, Bob Engdahl, Cliff Frolich, Tom Sokolowski; third row - Carl Benson, Woody Savage, John Lahr; back row - Bob Page, Mike Blackford, Juergen Kienle.

Not pictured: Ross Schaff, Bill Barnwell, Randy Updike, John Reeder, Dick Reger, John Davies, Rod Combellick (photographer), Jack Townshend, Tom Miller, Jim Riehle, John Sindorf, Niren Biswas, Hans Pulpan, Larry Gedney, Lloyd Turner, Don Drury, Dennis Thomason, Bob Horner.

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Alaska Tsunami Warning Center, National Weather Service
Division of Geological and Geophysical Surveys, Department of Natural Resources, State of Alaska
Division of Emergency Services, Department of Military Affairs, State of Alaska
Geophysical Institute, University of Alaska, Fairbanks
Pacific Geoscience Centre, Victoria B.C.
Lamont-Doherty Geological Observatory, Columbia University
Cooperative Institute for Research in Environmental Sciences (University of Colorado/National Oceanic and Atmospheric Administration)
Geophysics Institute, University of Texas, Austin
Alaska Oil and Gas Association
Woodward-Clyde Consultants
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Failure of the Bootlegger Clay Formation beneath the Turnagain subdivision, Anchorage, March 1964. Some homes were destroyed, others nearby emerged relatively unscathed. (Anchorage Historical and Fine Arts Museum, negative B69.11.20.)

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SEISMIC, VOLCANIC, AND TSUNAMI HAZARDS MITIGATION IN ALASKA - AN UNMET NEED

Report from the Seismology Workshop
held in Wasilla, Alaska - February 15-16, 1982

By
J.N. Davies

EXECUTIVE SUMMARY

In mid-February 1982, seismologists from federal and state agencies, universities, and the private sector met in a workshop sponsored by the Alaska Division of Geological and Geophysical Surveys (DGGS) to discuss specific initiatives to improve the availability of critical seismological information in Alaska. The motivation for holding this workshop was a widespread concern for the lack of a statewide program to collect and disseminate seismic data essential to mitigate the hazards from earthquakes, volcanoes, and tsunamis. The workshop also focused on Alaskan seismological programs jeopardized by rapidly declining federal support.

Resolutions from this workshop called for:

a) Establishing an Alaska Division of Geological and Geophysical Surveys program to ensure and coordinate the statewide collection and dissemination of seismic data for Alaska

b) Exploring methods to support seismic-hazard-mitigation programs in Alaska through direct and indirect funding from various sources---state and local agencies, subsidized transmission of seismic data, building-permit fees, a levy on property insurance, and the establishment of an endowment fund

c) The appointment (by the State Geologist) of a working group on Alaskan earthquakes, volcanoes, and tsunamis to annually assess the future needs of seismic research, hazards mitigation, and hazards education in Alaska, and to be available to evaluate earthquake and eruption predictions and monitor ongoing seismic and volcanic crises

d) Improving the preparedness of coastal communities vulnerable to tsunamis through upgraded communications and better mapping of potential postearthquake water heights

e) Creating both a national program focused on Alaska for comprehensive studies of explosive volcanism and a Cook Inlet volcanological research consortium

f) Making a strong statement to the Committee on Seismology of the National Academy of Sciences asserting that Alaska should receive increased priority in the setting of national objectives for earthquake research and monitoring.

BACKGROUND

Alaska is the most tectonically active state in the United States. Most activity---great earthquakes, explosive volcanism, and giant tsunamis---is concentrated in the Aleutian Islands, the Alaska Peninsula, and Prince William Sound. Until recently, the risk posed by these geologic hazards has been minimal because of a sparse population and a limited industrial base. But this situation is changing. The increasing pace of development of Alaska's abundant natural resources (minerals, fish, timber) has brought about a corresponding growth in population and a more sophisticated industrial infrastructure. With this, there is an increasing need to evaluate the vulnerability of Alaska's people and economy to the potentially devastating effects of major earthquakes and volcanic eruptions.

The state of Alaska does not have an adequate program to mitigate the hazards from earthquakes, volcanoes, and tsunamis. Elements of such a program would include:

a) Geologic studies to understand the tectonic framework of Alaska, to identify active faults, and to determine the recurrence rates of major earthquakes

b) Seismological studies to document the seismic history of Alaska and to use that history to forecast future seismic activity and its expected effects

c) Geotechnical studies to characterize the seismic stability of geologic deposits

d) Using the above studies in land-use planning, zoning, developing building codes, and siting major public buildings and facilities

e) Seismic engineering investigations to develop earthquake design criteria for specific construction projects.

Critical data are lacking to apply any one of these elements to a specific seismic-risk study almost anywhere in Alaska. However, the most fundamental need is for comprehensive earthquake data, especially strong-motion accelerograph data from southern Alaska.

Seismologists are aware of these problems and until recently were content to rely on various federally funded research and hazard-mitigation programs to address Alaska's needs. Indeed, under the potpourri of programs that have existed in Alaska, including the Outer Continental Shelf Environmental Assessment Program (OCSEAP), about 180 sensitive seismographic stations were established in Alaska. But with the demise of OCSEAP support for seismology and with the stringencies that exist for most nondefense federal programs, about half of the existing stations are expected to close in 1983.

Concern for the deteriorating situation in seismic monitoring and for a state program in seismic-hazards mitigation and its underlying data base prompted this meeting on Alaskan seismology. Participants hope that the state

will, by adopting a coordinating role and providing a modest level of support, make much more effective use of the data that are collected. The consequences of not establishing the required comprehensive earthquake data base will not necessarily mean that unsafe construction and planning will take place (although in some cases it is likely). Rather, the more probable result with respect to critical facilities will be overly conservative designs and delays in licensing caused by uncertainties about actual risks.

The remainder of this report is devoted to resolutions made at the workshop. The first seven resolutions address specific aspects of the overall need to improve seismic- and volcanic-hazards-mitigation efforts in Alaska. The last two resolutions are directed at somewhat different audiences. Resolution 8 is primarily from some Alaskan scientists requesting that the state consider a general funding arrangement for the study of Alaska's natural resources, including natural hazards. Resolution 9 is directed at the national level of scientific funding and calls for an increased emphasis on Alaskan seismology and volcanology.

RESOLUTIONS

Resolution 1. Alaska Division of Geological and Geophysical Surveys program in seismology

WHEREAS, Alaska, the most seismically active state, will continue to be an area of rapid development of natural resources, major construction projects, and population growth during the next few decades; and

WHEREAS, cost-effective planning and safe design for this development require an adequate definition of the seismic hazards; and

WHEREAS, a uniform and continuous base of seismic information (including strong-motion data) collected over a long period of time is lacking but is necessary to mitigate these hazards; and

WHEREAS, the need for these data at a specific site is commonly recognized just prior to individual construction projects, but no one project can be expected to accept responsibility for such long-term data collection; and

WHEREAS, this responsibility is appropriately undertaken by a state or federal agency; and

WHEREAS, DGGS has statutory responsibility to determine potential geologic hazards in the State of Alaska;

THEREFORE BE IT RESOLVED that DGGS establish a seismic program to:

a) Ensure the operation of a statewide seismographic network, including instrumentation to record strong ground motion in areas of significant earthquake potential

b) Establish a statewide seismic-data center

c) Coordinate the collection and dissemination of seismic data for Alaska.

Implementation. An initial step to implement this program is to designate an Alaskan seismic-data center. Criteria for data storage, use, and dissemination would have to be established. Existing earthquake-data sets would be assembled and cataloged as a continuing function of the data center. To provide for uniform and continuous monitoring of Alaskan earthquakes, a statewide standardized seismograph network would be designed.

This network would be initially based on a selected configuration of seismograph stations now operated by a number of organizations and supplemented by additional stations as required. The network would be upgraded in phases to provide high-dynamic-range, broad-band recording of ground motions statewide. Also, an effective and efficient system for data collection and processing would be implemented to incorporate existing facilities in the state. These data would thus update the earthquake-data base now used for ongoing seismic analyses.

Special-purpose networks will probably be operated in the state from time to time; these networks will be coordinated and their data integrated with the statewide network as appropriate.

The seismic-data center will also provide information on earthquake hazards to the public.

Resolution 2. A multielement program to provide funds for collection and dissemination of earthquake-hazard data

WHEREAS, the evaluation of potential geologic hazards is mandated for DGGS by the State of Alaska; and

WHEREAS, the maintenance of long-term earthquake-data collection is a necessary aspect of the earthquake-hazard-investigation program; and

WHEREAS, the federal government has provided major financial support for seismic data collection and research in Alaska, but this support is diminishing; and

WHEREAS, stability of funding is necessary to maintain the continuity of data collection and the maintenance of related technical expertise; and

WHEREAS, the primary financial support for the collection and dissemination of earthquake-hazard data should be provided by those who have the strongest requirements for these data;

THEREFORE BE IT RESOLVED, that a multielement program of funding should be established to provide long-term fiscal support, recognizing both the startup and long-term-operations costs of the program. In the funding program:

a) The State Geologist should actively coordinate and pursue financial support for both a statewide seismic-monitoring network and long-term collection of seismic data, and make these data available for scientific and public use

b) The Alaska Power Authority and the Alaska Department of Transportation and Public Facilities---two state agencies with primary responsibility for large-scale construction that are major beneficiaries of seismic data used in designing earthquake-resistant structures---should contribute financial support for the long-term collection of seismic data

c) The feasibility of a permit fee should be investigated to provide support for the collection and dissemination of strong-ground-motion and structural-response data that are of direct benefit to the safe design of engineered facilities. This fee could be equal to a percentage of the costs of construction of new facilities built in seismically active areas

d) DGGS should establish a matching program with municipalities and boroughs to fund the purchase, maintenance, and operation of strong-ground-motion recorders

e) The potential for obtaining funding for long-term seismic-data collection from a levy on property insurance should be researched through the appropriate state agency.

Resolution 3. State of Alaska support for seismic-data transmission

WHEREAS, the State of Alaska, through its statewide computer network and teleconferencing systems, has a statewide communications network; and

WHEREAS, seismic networks operated by the state government and university, by the federal government, and by private universities provide data essential for the mitigation of earthquake hazards and safe construction and development of resources; and

WHEREAS, seismic networks in Alaska are faced with large annual operating costs for transmission of earthquake data to centralized recording facilities;

THEREFORE BE IT RESOLVED, that the state should consider subsidizing the costs of transmission of seismic data.

Resolution 4. Working Group on Alaskan Earthquakes, Volcanoes, and Tsunamis

WHEREAS, there exists a significant potential for seismic, volcanic, and tsunami hazards in Alaska that may adversely affect the public safety, future development, and economy of Alaska; and

WHEREAS, there is a large variety of federal, state, academic, and private organizations performing research related to seismic, volcanic, and tsunami hazards in Alaska with a variety of techniques; and

WHEREAS, the State Geologist has statutory responsibility for identification and evaluation of these hazards; and

WHEREAS, there exists a body of expertise in Alaskan seismic, volcanic, and tsunami research that could be drawn on for advice by the State Geologist and various state and federal agencies; and

WHEREAS, there exists a general lack of public awareness of potential seismic, volcanic, and tsunami hazards in Alaska;

THEREFORE BE IT RESOLVED, that a working group on Alaskan earthquakes, volcanoes, and tsunamis meet at least annually to:

a) Evaluate and document both the state of research and data collection and any additional research necessary on seismic, volcanic, and tsunami hazards in Alaska

b) Recommend standards for seismic monitoring and data reporting by the organizations operating seismic stations in Alaska

c) Assist in public education on mitigation of seismic, volcanic, and tsunami hazards in Alaska.

In addition, participants of the Working Group could be called on by the State Geologist to:

a) Recommend mitigation measures related to seismic, volcanic, and tsunami hazards in Alaska

b) Evaluate short- and long-term predictions of earthquakes, volcanic eruptions, and tsunamis

c) Monitor ongoing seismic, volcanic, and tsunami crises and apprise government officials of the duration, severity, areal extent, and effects.

The Working Group should be composed of seismologists, volcanologists, and others directly involved in research, data acquisition, engineering, or planning applicable to evaluation and mitigation of seismic, volcanic, and tsunami hazards in Alaska. A recommended means of establishing the membership of the Working Group is selection, by the State Geologist, of 10 to 15 voluntary participants.

Resolution 5. Continuous capability for tsunami warning to Alaskan coastal communities

WHEREAS, numerous coastal communities in Alaska are exposed to significant tsunami hazards; and

WHEREAS, some of these communities presently cannot always receive tsunami warnings because of a lack of a continuously functional communications system; and

WHEREAS, through satellite telemetry or other means, most of these communities could receive warnings 24 hours a day,

THEREFORE BE IT RESOLVED, that the Alaska Division of Emergency Services investigate communications options and seek funds to establish round-the-clock warning capability for all vulnerable coastal communities.

Resolution 6. Tsunami-runup determinations for Alaskan coastal communities

WHEREAS, tsunami runups (the maximum height of water expected along a coast following a major earthquake or volcanic eruption) have in general only been subjectively determined in Alaska; and

WHEREAS, the imprecise nature of runup determinations has resulted in delineation of larger hazard zones than may be required if current computation techniques were used; and

WHEREAS, these techniques require both expertise and extensive computer capability unavailable in the National Weather Service Tsunami Warning System or any cognizant state agency;

THEREFORE BE IT RESOLVED, that DGGS seek funding to obtain improved tsunami-runup determinations for those communities with a high tsunami risk, as identified by the Alaska Tsunami Warning Center.

Resolution 7. A national program focused on Alaska for the study of explosive volcanism and a Cook Inlet volcanological-research consortium

WHEREAS, the United States research effort on explosive volcanism has devoted less than 1 percent of its total commitment to Alaska, which contains 90 percent of the explosive volcanoes in the country and hence the greatest research opportunities; and

WHEREAS, of the 40 historically active volcanoes in the Aleutian arc, 28 have advanced to caldera stage, which attests to the great explosivity of the arc volcanoes; and

WHEREAS, other north-Pacific-rim nations such as Japan and the U.S.S.R. have established major programs to study and understand explosive volcanism; and

WHEREAS, the funding for volcanological research in the United States has remained at a very low level compared with that of many other sciences;

THEREFORE BE IT RESOLVED, that a major innovative program on a national scale be created to study explosive volcanism in Alaska. This program should be multidisciplinary and should include universities and the federal and state governments; and further,

WHEREAS, the size and geographical extent of the problem are so overwhelming, efforts must be focused primarily on that region of greatest social and economic importance to Alaska, the Cook Inlet area,

BE IT ALSO THEREFORE RESOLVED, that funds should be sought to establish a Cook Inlet volcanological research consortium to conduct multidisciplinary research on the geologic history, seismotectonic setting, eruptive style, and hazards of the five active volcanoes in the Cook Inlet area. Such an umbrella organization would use the resources and facilities of established federal, state, and university researchers with expertise on explosive volcanism.

Resolution 8. An endowment fund for research on natural resources and hazards

WHEREAS, the primary source of Alaska's wealth comes from renewable and nonrenewable natural resources, but natural phenomena such as frost heaving, avalanches, earthquakes, flood, and volcanic eruptions can destroy Alaskan lives and property. To care for and develop these resources and to mitigate fear and damage from these hazards, it is essential to understand them. This understanding is best gained by basic research on the fundamental physical and biological processes that yield the resources and contribute to the hazards.

THEREFORE BE IT RESOLVED, that an endowment fund be established, the interest from which is to be used for research on natural resources and hazards.

Two options may be considered for implementation:

a) Establish a fund for research, care, and development of Alaska's natural resources and mitigation of damage from natural hazards. The fund would be invested and administered in a manner similar to that of the Alaska Permanent Fund. It could be disbursed by the Alaska Council on Science and Technology (ACST) as special-project funding, beyond the range of the council's present scope. The present function of ACST would not be altered by assuming this added responsibility

b) Set aside 5 percent of the earnings from the Permanent Fund for this purpose.

Resolution 9. An increased national emphasis on Alaskan seismology and volcanology

Several critical decisions are coming up regarding a United States national seismic network, the funding of regional networks, and directions for future research in earthquake prediction and hazards.

Alaska is the most seismically active state, has the highest proven reserves of petroleum and several other natural resources, represents a unique tectonic setting, and is likely to play an even more important role in future research in areas of high national priority. Nevertheless, Alaska has consistently received low priority in the setting of national objectives for earthquake research and monitoring. Unique opportunities exist to study subduction processes, active volcanism, seismic gaps in which great earthquakes can occur, transitions in tectonic style from oceans to continents and from interplate motion to intraplate processes, geothermal energy, and the generation of tsunamis.

Members of the workshop recommended establishing a network of digitally recording broad-band seismographs to uniformly monitor earthquakes statewide, a center to process and disseminate the data, an intensified program of broad-based geological and geophysical measurements in seismic gaps, an array of portable instruments and ocean-bottom seismometers for both special Alaska-Aleutian studies and response to major earthquakes, an adequate deployment of strong-motion instrumentation, and advanced data-communication techniques that will help reduce the increasing costs of transmitting data. The group also emphasized the necessity for geodetic, in-situ stress and sea-level measurements in zones of active deformation. To focus attention on Alaskan seismology, the workshop members recommended special Alaskan themes at national meetings, holding future national meetings in Alaska, and conducting seismic-reflection profiles across Alaska of the Consortium for Continental Reflection Profiling (COCORP)-type (such as a north-south transect across the state that would also include the adjacent continental margins). Members also recommended a periodic review of projects in Alaska, particularly a review of the status of major seismic gaps and other areas of special seismic study.

ACKNOWLEDMENTS

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APPENDIX A

GENERALIZED AGENDA

Workshop on Alaskan Seismology

February 15-16, 1982
Wasilla, Alaska

MONDAY MORNING

Open Plenary Session, John Davies, Chair
Welcome by Ross Schaff
Introduction and general discussion of Workshop I, Combellick
Introduction and general discussion of Workshop II, Davies
Introduction and general discussion of Workshop III, Carte
Introduction and general discussion of Workshop IV, Miller
Introduction and general discussion of Workshop V, Page
Introduction and general discussion of Workshop VI, Sykes

MONDAY AFTERNOON

Workshops I, II, and III meet separately

MONDAY EVENING

Workshops IV, V, and VI meet separately

TUESDAY MORNING

Open Plenary Session, Davies, Chair
Discussion of resolutions from Workshop I, Combellick
Discussion of resolutions from Workshop II, Davies
Discussion of resolutions from Workshop III, Carte
Discussion of resolutions from Workshop IV, Miller
Discussion of resolutions from Workshop V, Page
Discussion of resolutions from Workshop VI, Sykes

TUESDAY AFTERNOON

Final rewrite of resolutions
Trip to Palmer Observatory

WORKSHOP TITLES

I. Alaska Council on Tsunamis, Earthquakes, and Volcanoes
II. State of Alaska Seismic Observatory
III. Cook Inlet Volcano Observatory
IV. New Basis for Funding
V. New Basis for Funding
VI. Input to National Dialogue on Seismology

APPENDIX B

LIST OF PARTICIPANTS AND ADDRESSES

Workshop on Alaskan Seismology

February 15-16, 1982
Wasilla, Alaska

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