Cascadia

A quarterly publication of the Oregon Department of Geology & Mineral Industries

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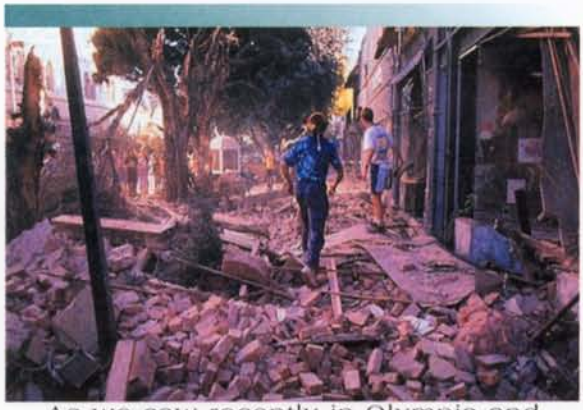
What can you do to prepare in your community?

Oregon at risk

by Lou Clark, Earth Science Information Officer

In this issue:

Imagine this:
You're on vacation on the Oregon coast the last week of a sunny August. Without warning, the ground starts to shake, bringing you to your knees. For more than three minutes the earth is moving so violently, you can't stand up. Bookshelves fall, dishes crash to the floor, windows shatter; the sound is deafening.



As we saw recently in Olympia and Seattle, brick and mortar buildings in downtown areas are at a high risk of failure during major earthquakes.

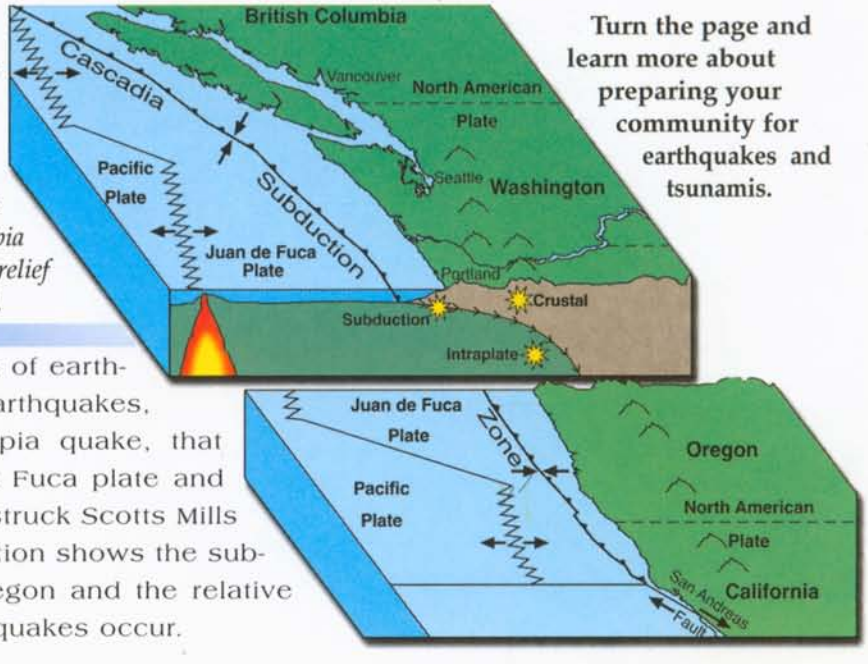
Suddenly, it's over. After gathering your family together, you remember seeing the tsunami evacuation signs on Hwy. 101. You go to your car, but realize driving is not an option, because the road has buckled, and water is pouring onto the road from a broken water-main pipe. Picking up your toddler, you hurry your family up the evacuation route, until you're at about 100 feet in elevation above the beach. A few minutes later, as you start to relax, you see a 30 foot wall of water cover the beach below, tossing cars, trees and even part of the motel like kindling. You realize all your beach stuff is gone and you wonder about your home, family and friends back in the Willamette Valley.

What you will not know for a while is this was a Cascadia subduction zone earthquake, and the devastation runs from Vancouver, British Columbia to Eureka, California. It could be days before relief arrives, and months before all services are restored.

Although this story may read like pulp fiction, scientists agree that a similar occurrence can happen at any time. Scientists also know the last Cascadia earthquake like the one just described was probably a magnitude 9 on January 26, 1700 and that these types of earthquakes have occurred many times in the Pacific Northwest in the last few thousand years.

Whatever size of earthquake your community can reasonably expect in the future, the same preparation steps can be taken to prevent damage and protect lives.

Turn the page and learn more about preparing your community for earthquakes and tsunamis.



Oregon is at risk from 3 different types of earthquakes: Cascadia subduction zone earthquakes, intraplate earthquakes, like the Olympia quake, that occur deep in the subducting Juan de Fuca plate and crustal earthquakes like the ones that struck Scotts Mills and Klamath Falls in 1993. This illustration shows the subduction process going on beneath Oregon and the relative depths at which these 3 types of earthquakes occur.

Through the eyes of the State Geologist

by John D. Beaulieu,
Oregon State Geologist

The Oregon Department of Geology and Mineral Industries has been releasing valuable geologic information to the public through a periodical since November, 1939. First titled *The Ore Bin* the publication was first produced by hand using "state-of-the-art" mimeograph equipment in the historic Woodlark Building in downtown Portland.

Over the years the manner of production and format has changed, the title has changed (to *Oregon Geology* beginning in 1979), but the purpose remained the same – the timely release of interesting information on the geology of Oregon.

Concurrently, this agency has seen a broader need for new types of geologic information that address emerging problems in our state, including watersheds, public safety, and environmental protection. One way to address these needs is to enhance and expand our public education efforts in the printed medium beyond *Oregon Geology*.

By maintaining our current periodical as a quarterly publication with its focus on timely release of topical geologic data *and* by expanding our ability to meet new audiences with a new publication, we have fashioned a creative solution.

Cascadia will release more general information to *Oregon Geology* subscribers and to a broader audience.

Looking to the future, we believe Oregonians will benefit from the addition. Timely articles will continue to find an avenue for release through this Department, and in addition, more general information will be provided to new audiences that increasingly need our services. We welcome your comments. Please contact James Roddey, Community Education Coordinator by phone at (503) 731-4100, ext. 242 or e-mail at james.roddey@state.or.us.

Oregon at risk

Is your community prepared?

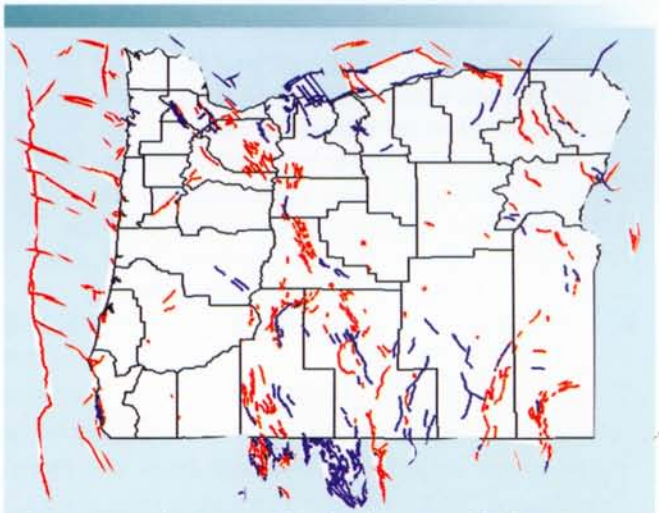
Most earthquakes in Oregon are small in size, but many can produce significant damage at a local level. It's not just people in western Oregon who are at risk: the last earthquake-related deaths were in Klamath Falls, and there have been several swarms of small earthquakes in eastern Oregon in the last few years.

Is your community prepared? A large earthquake will inevitably produce damage, but your preparations can keep it from being a catastrophe. A 1988 magnitude 6.8 earthquake in Armenia caused 25,000 deaths, but the 1989 magnitude 7.1 Loma Prieta quake that struck the San Francisco Bay area caused only 62 deaths. The deep earthquake that struck the Seattle area on February 28th had only one death associated with it. Whatever size of earthquake your community can reasonably expect, the same preparation steps can be taken. The following questions are posed to community leaders, but many are equally applicable to companies or individuals.

1. What is your area's earthquake risk?

Although many earthquakes occur on previously unknown faults, you can find out if there are any faults mapped near you, and whether they are considered active (there are many known faults that geologists no longer expect to move). Different rock and soil types behave differently in earthquakes. Are you on bedrock? If so, earthquake waves may be dampened in your area. Are you on alluvium in a river valley? If so, waves may be amplified; unfortunately, this is the case for much of the Willamette Valley.

The Oregon Department of Geology and Mineral Industries (DOGAMI) has produced maps for many communities that specifically address earthquakes and a wealth of information can be found on our website: www.OregonGeology.com, or by calling our Portland office at (503) 731-4100.



This map shows only the known faults in Oregon. Faults that have moved most recently are shown in red.

In June, 2000, almost 100 scientists from around the world met in Seaside for the tricentennial of the last great Cascadia subduction zone earthquake.They exchanged the latest research about what happened in the past and what is likely to happen in the future along this dangerous fault line. The conference was sponsored by the Oregon Department of Geology and Mineral Industries (DOGAMI), U.S. Geological Survey, Geological Society of America, Geological Survey of Canada, and URS Corporation. Scientists were able to produce a Consensus Statement, a summary of the latest scientific understanding of the Cascadia subduction zone. Exerpts from this statement are reprinted below. The complete conference summary, **Penrose Conference, 2000, Great Cascadia Earthquake Tricentennial program summary and abstracts, Special Paper-33,** *is available for $15. See page 7 for order information.*

Excerpts from the GSA Penrose Conference Consensus Statement

Damage, injuries, and loss of life from the next great earthquake at the Cascadia subduction zone will be great and widespread, and will impact the national economies of Canada and the United States for years or decades.

The Cascadia subduction zone produces great earthquakes, the most recent of which occurred in 1700 and was of magnitude 9.

Great Cascadia earthquakes generate tsunamis, the most recent of which was at least 10 m (32 feet) high on the Pacific coast of Washington, Oregon and British Columbia.

The mean recurrence interval for great plate-boundary earthquakes in the Pacific Northwest is 500-600 years, but some of the past earthquakes had intervals less than the time that has elapsed since the 1700 earthquake.

2. Are there special geologic hazards in the area?

Steep slopes can be particularly hazardous during and after earthquakes. In the long rainy season of winter and spring, soils can become saturated and quakes can produce rapidly moving landslides. In dry areas, rock fall can be deadly; one death in the 1993 Klamath Falls earthquake was from rock fall.

Earthquakes can turn soil to quicksand, a process called liquefaction. This typically happens along river channels, or former river channels. Another special hazard of river soil is amplification. In the Willamette Valley, the area of amplification is several miles wide in general. Small, deep earthquakes near Woodburn in the past several years have been felt in an anomalously large area; this is probably attributable to the amplification properties of the valley alluvium. DOGAMI earthquake hazard maps include outlines of specific areas that are susceptible to landslides, liquefaction, and amplification.

"Along coastal areas, tsunamis can be the most devastating part of an earthquake."

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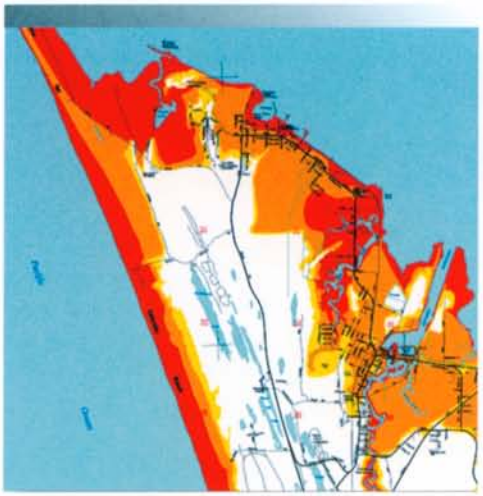


Detailed tsunami innundation zone maps, like this one for the Warrenton area, can help coastal communities plan for future earthquakes.

Along coastal areas, tsunamis can be the most devastating part of an earthquake. Computer models suggest a tsunami would follow a subduction zone earthquake in just a few minutes, and could produce waves 30-50 feet high. Research has shown that in events where the population did not know how to respond to a tsunami, up to 60 percent of the population died. In areas such as Japan where the populace knows what to do, fatalities were less than 20 percent.

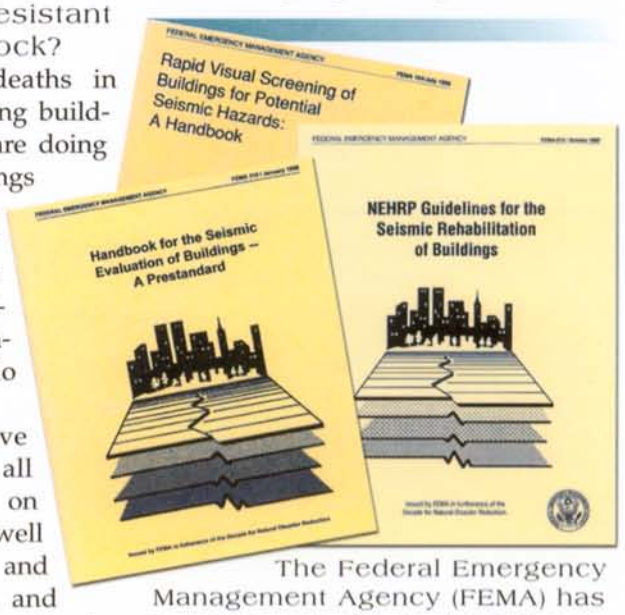
DOGAMI has produced general tsunami hazard maps for the entire coastline; some areas have more detailed maps. These maps can be used in conjunction with other resources to produce safe evacuation routes and staging areas.

3. How earthquake-resistant is your building stock?

Most injuries and deaths in earthquakes are from falling buildings. Some communities are doing inventories of their buildings to see how much damage they might expect. In general, wood-frame houses withstand earthquakes reasonably well, while unreinforced brick buildings do poorly.

If you don't have resources to inventory all buildings, you can focus on priority structures: how well do you expect your fire and police stations, city hall and hospitals to fare? These and other buildings, perhaps schools, major employers, or home improvement stores, will be particularly important to have in working order after an earthquake. For example, air travel into Seattle was severly disrupted when both Seatac and Boeing field were damaged and Washington lawmakers have had to relocate their curent session while the extent of damage to the capitol building is determined.

As we learn more about the risk, building codes require more stringent earthquake-resistant measures. As older buildings are substantially remodelled, or completely rebuilt, the risk of collapsing buildings will decline.



The Federal Emergency Management Agency (FEMA) has a number of excellent publications to help communities assess their seismic risk.

4. How vulnerable are your utilities and transportation system?

The vulnerability of these lifelines can be a major factor in how much damage your community suffers, and how quickly rebuilding takes place after a damaging earthquake. For example, fire and the inability to put it out because of damaged water lines is a major cause of destruction after large earthquakes.

To assess your risk, you need to know the location of the natural gas and water pipelines in use. You need to evaluate whether fire-fighting equipment can get out of stations after an earthquake, and whether debris from falling buildings, liquefaction, or other processes will make streets impassable. How important is a functioning airport after a big jolt?

DOGAMI's earthquake hazard maps are available in digital formats on CD-ROM that can easily be used in a Geographic Information System (GIS) to overlay utility lines, streets, or other data. This can be an

Fires after an earthquake can be a major source of destruction. Above, neighbors pitch in to help overwhelmed firefighters battle a major blaze in the Marina District of San Francisco following the 1989 magnitude 7.1 Loma Prieta Earthquake.

invaluable tool for emergency planning, or for prioritizing areas for special mitigation efforts.

Go to OregonGeology.com for an online copy of this story.

Earthquake Education

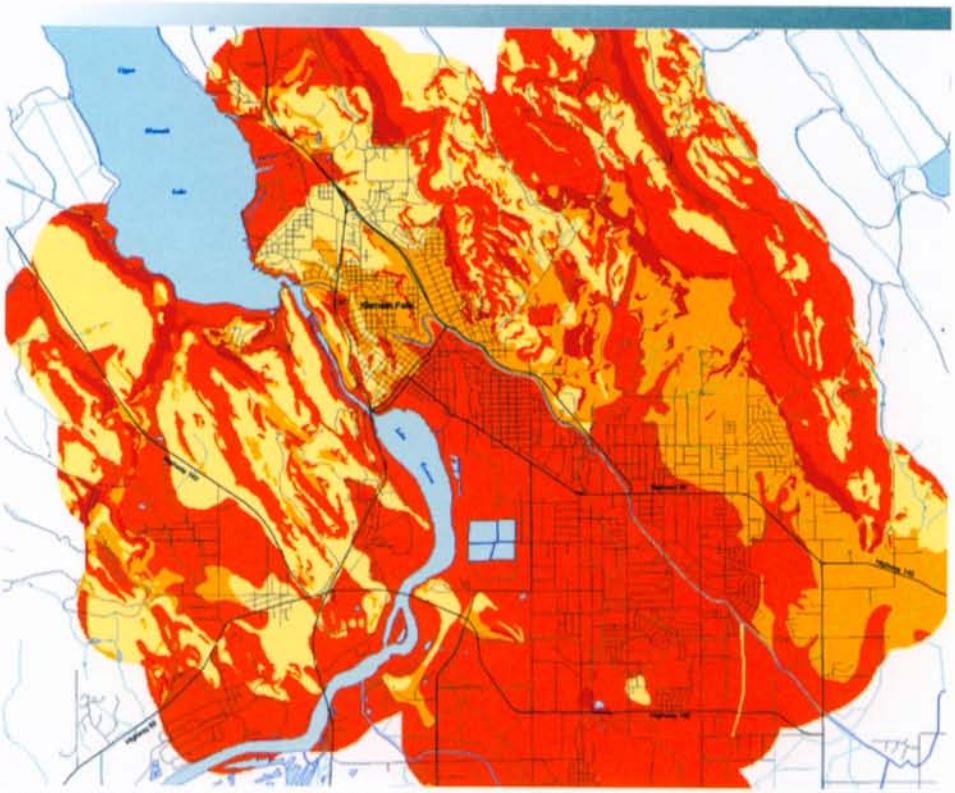
Oregon state law requires schools to have regular earthquake drills. Consequently, many children are learning to instinctively "drop, cover and hold" when they feel an earthquake. Unfortunately, most adults have not learned this technique.

Some communities are starting Community Response Teams, where members of the general public are given basic training on how to help in many types of emergencies. Studies have shown that 80 percent of response and rescue is done by neighbors in a major earthquake.

Not all education comes from government agencies. In many communities, the news media have stories about earthquake preparation and safety. Not-for-profit groups like the Red Cross, Salvation Army, or churches can also provide information.

There are many resources to help, including DOGAMI, Oregon Emergency Management (OEM), Oregon Department of Transportation (ODOT), US Geological Survey (USGS), Federal Emergency Management Agency (FEMA), and others.

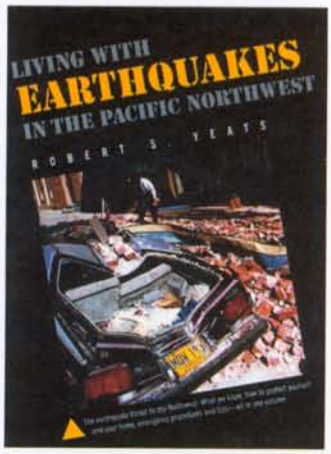
Crustal and Intraplate earthquakes will continue to strike the Pacific Northwest. Scientists also agree that there will be a Cascadia subduction zone earthquake in Oregon's future. Whether it will be a series of magnitude 8 quakes, or a single magnitude 9, no one can tell. Nor can anyone predict when it will happen. The fault has an irregular history of earthquakes, some more than 1,000 years apart, (continued on pg 6)



The recently completed Klamath Falls relative earthquake hazard map will help city fathers pinpoint areas of concern. Darker colors indicate increasingly higher risk areas during an earthquake.

Recommended reading from Nature of the Northwest

A detailed account of the region's violent past and the likelihood of future catastrophes, Living with Earthquakes in the Pacific Northwest by earthquake expert Robert Yeats, is also a call to action. This is an excellent overview for the non-scientist and includes information on the 1993 Oregon earthquakes, and the great tsunami that swept down the Northwest coast in 1964. Yeats stresses the need for better earthquake planning and awareness in the region. Published by Oregon State University Press.



Available from Nature of the Northwest Information Center for $21.95. Call (503) 872-2750 or log on at www.NatureNW.org to order.

Field notes

MLRP

The Mined Land Reclamation Program (MLRP) has the lead responsibility for mine regulation in Oregon. Over the course of the last biennium, the program opened 84 mine sites and closed 60. Currently 5807 acres (about 9 square miles) are under reclamation bond and 2560 acres have been reclaimed to a variety of uses since the program was initiated in 1972.

The number one issue for the program is floodplain mining and its relationship to off-site resources including the potential for habitat restoration.

GRANTS PASS

Mapping efforts are underway in Klamath and Josephine Counties. In Klamath County, emphasis includes earthquake and volcanic hazards, watershed health, and geologic controls on ground-water. Geologic mapping in Josephine County is addressing issues including watershed health, geologic hazards, groundwater, and mineral resources.

BAKER CITY

Geologists are currently working on the Grande Ronde Basin mapping project and additional areas in Eastern Oregon. A key to these important mapping projects is understanding how and where the geology controls vegetative patterns and the distribution of surface and subsurface water resources.

COASTAL

Last year, DOGAMI opened a new Coastal Field Office at Newport, Oregon. This program was created to better serve coastal communities with unbiased, scientifically sound information on coastal geologic resources and hazards. Current projects include work in Tillamook County, Port Orford and Newport.

(continued from page 5)

some less than 200 years apart. The last quake was 300 years ago, so the next event could be tomorrow, or several hundred years from now.

There is no reason to panic. But it is time to take prudent steps to protect ourselves from the many earthquakes, great or small, that will be part of our future.

The Oregon Department of Geology and Mineral Industries will continue its unique role researching and describing our actual risk. We will use that information to work in partnerships with the great variety of organizations, businesses and individuals who are interested in helping to reduce the risk. There's also a wealth of free information that can get you started on earthquake preparadness at your home or workplace.

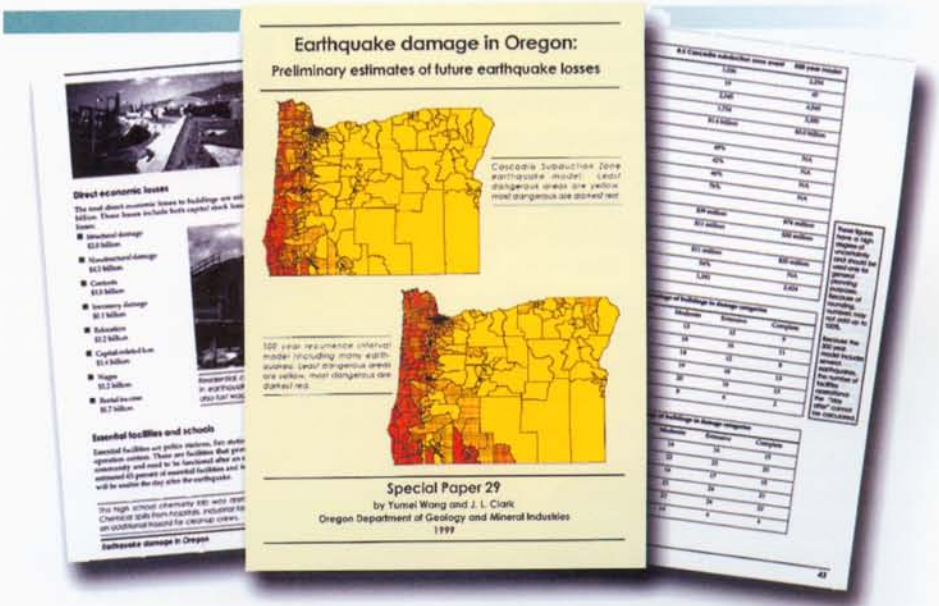
Twenty years ago, Oregon was thought to be fairly earthquake-free. Now we know very differently. In a short time we have made significant progress in preparing ourselves; but twenty years from now, we must be much more prepared.

Go to OregonGeology.com for an online copy of this story.

Learn more

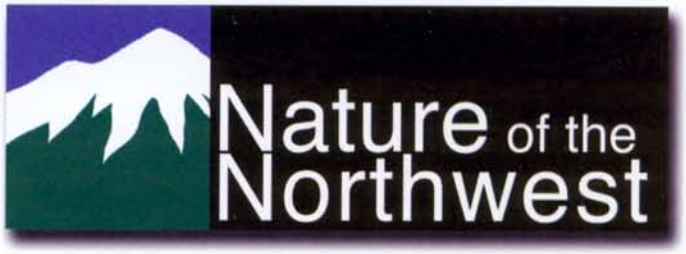
Technical information can be used to better understand many types of hazards and to better focus community efforts. Properly used, it can help us choose cost effective strategies to reduce risk. Some information is of a geologic nature, and some relates to construction practices. Judicious use of existing publications can help to focus efforts to reduce risk in existing buildings and structures and in communities in general.

Available publications for Oregon include: ground shaking hazard maps (GMS 100 and USGS 1996 NEHRP maps), earthquake ground response maps (DOGAMI has maps for more than 60 communities), tsunami inundation maps for the coast, FEMA 154 (rapid visual screening of buildings), FEMA 178 and 310 (more detailed analysis of the structure of selected buildings), FEMA 273 (building-specific strategies for seismic rehabilitation), and risk assessments at the state and county level (DOGAMI Special Paper 29).



Special Paper 29 and many more earthquake related publications are available from the Nature of the Northwest Information Center by calling (503) 872-2750 or logging on at: www.naturenw.org.

Earthquake publications available from



These and many other earthquake related publications can be accessed through the web at www.naturenw.org.

Earthquakes-Converging on Cascadia, Symposium Proceedings, Special Paper 28, **$12.**

Earthquake damage in Oregon: Preliminary estimates of future earthquake losses, Special Paper 29, **$10.**

Mitigating geologic hazards in Oregon: A technical reference manual, Special Paper 31, **$20.**

Earthquake Database for Oregon, 1833 through October 25, 1993, Open-File Report O-94-04, **$10.**

Using Earthquake Hazard Maps. A Guide for Local Governments in the Portland Metropolitan Region, Open-File Report O-98-04, **$10.**

Relative Earthquake Hazard Maps of:

Portland Metro Region, IMS-1, **$12.**

St.Helens-Columbia City-Scappose, Sandy, Hood River, McMinnville-Dayton-Layfette, Newberg-Dundee, Sheridan-Willamina, Dallas & Monmouth, IMS-7, **$20.**

Canby-Barlow-Aurora, Lebanon, Sweet Home, Woodburn-Hubbard, Silverton-Mt. Angel, & Stayton-Sublimity-Aumsville, IMS-8 **$20.**

Ashland, Cottage Grove, Grants Pass, Sutherlin-Oakland and Roseburg, IMS-9, **$20.**

Astoria-Warrenton, Brookings, Coquille, Florence-Dunes City, Lincoln City, Newport, Reedsport-Winchester Bay, Seaside-Gearhart-Cannon Beach and Tillamook, IMS-10, **$20.**

Klamath Falls Metro Area, IMS-19, **$10.**

Siletz Bay Area, Coastal Lincoln County, GMS-93, **$20.**

Eugene-Springfield Metro Area, GMS-105, **$12.**

Map showing faults, bedrock geology, and sediment thickness of the weastern half of the Oregon City 1:100,000 quadrangle, Washington, Multnomah, Clackamas, and Marion Counties, IMS-4, **$10.**

Earthquake scenario and probabilistic ground shaking map for Portland, Portland Hills fault M 6.8 earthquake, Multnomah, Washington and Clackamas Counties, IMS-15, $10. This and 11 other technical maps and CD, IMS-16, **$80.**

NATURE OF THE NORTHWEST PUBLICATION ORDERS

Mark desired titles on list above and fill out this form. A complete list of publications is on the Nature of the Northwest homepage: http://www.naturenw.org. You can order directly from the website or send this order form to The Nature of the Northwest Information Center, Suite 177, 800 NE Oregon Street, Portland, OR 97232-2162, or FAX (503) 731-4066. If you wish to order by phone, have your credit card ready and call (503) 872-2750. Payment must accompany orders of less than $50. Payment in U.S. dollars only. Publications are sent postpaid, except where noted. All sales are final.

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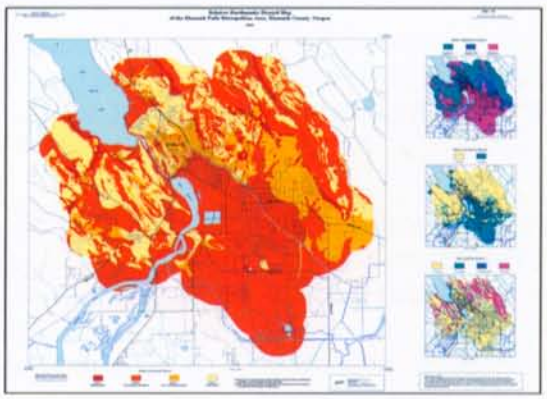
Recent publications

Available from the Nature of the Northwest Information Center.
To order, call (503) 872-2750 or log on at www.naturenw.org.

Released November 2, 2000:

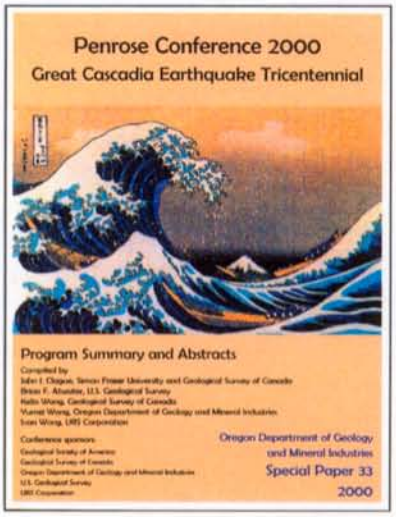
Relative Earthquake Hazard Map of the Klamath Falls Metropolitan Area, by G. Black, Z. Wang, T. Wiley, and G. R. Priest, Interpretive Map Series IMS-19, 2000, map scale 1:24,000, 1 map, 17 p. text, 1 CD, $10.



This map combines the effects of ground shaking amplification, liquefaction and earthquake-induced landsliding to show the earthquake hazard relative to the local geologic conditions. It incorporates the latest scientific information showing the risks residents in the area face from earthquakes.

Released August 24, 2000:

Penrose Conference 2000, Great Cascadia Earthquake Tricentennial. Program summary and abstracts, compiled by J.J. Clague, B.F. Atwater, K. Wang, Y. Wang, and I. Wong. Special Paper 33, 156 p., $15.



To commemorate the Cascadia earthquake tricentennial, almost 100 geologists, geophysicists, engineers and public officials from around the world gathered in Seaside, Oregon, in the first week of June, 2000, to critically review current knowledge about great Cascadia earthquakes. The program summary and consensus statement summarize the latest scientific knowledge about the 800 mile long earthquake fault line that lies off the Pacific Northwest coast.

Cascadia
from the Oregon Department
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