

Exploring Geology on the World Wide Web – Seismology and Earthquakes

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INTRODUCTION

This issue's column will focus on World Wide Web resources for learning about seismology and earthquakes. Seismology, as it applies to exploration geology and the geophysical investigation into the structure of the earth, will be dealt with in a future column on geophysics, plate tectonics, and structural geology.

All of the URL addresses in this article are available as hypertext links from a Web page I created at: <http://www.geology.uiuc.edu/~schimrich/geology/geology.html>

Connecting to the resources below from this single Web page will save you a substantial amount of typing. Also, due to the lead time between the writing of this article and its publication, along with the volatile nature of the World Wide Web, URL addresses may change periodically, and the Web page will be maintained to reflect any such changes in the resources described below.

RESEARCHCENTERS

There are quite a few seismology labs on the World Wide Web. Most of them offer general information about seismology and earthquakes along with seismograms and focal mechanism solutions for recent earthquakes. I've listed a few sites that feature interesting areas (such as California or New Madrid) and a few that offer interesting features or information about seismology and earthquakes.

Caltech

<http://www.gps.caltech.edu/seismo/seismo.page.html>

This is the seismological laboratory in the Division of Geological and Planetary Sciences at the California Institute of Technology (Caltech) in Pasadena. This Web site contains extensive information about southern California earthquakes and the laboratory's current research projects.

CERI

<http://www.ceri.memphis.edu/>

The Center for Earthquake Research and Information (CERI) is located at the University of Memphis in Tennessee. This site contains information about seismicity in the central United States and research in the New Madrid seismic zone.

Harvard

<http://tempo.harvard.edu/CMT.html>

The CMT (centroid-moment tensor) earthquake database at Harvard University in Cambridge, Massachusetts. Fill out an on-line form to search the database for earthquakes occurring at any given date between January 1, 1977 and the present.

IDC

<http://www.cdadc.org:65120/>

Web site for the Comprehensive Test Ban Treaty (CTBT) International Data Center (IDC). It is a very interesting site with information on how seismology is used to monitor compliance with the CTBT. Of particular interest is the list of world-wide earthquakes and explosions, which is automatically updated every 30 minutes.

IRIS

<http://www.iris.edu/iris.html>

The Incorporated Research Institutions for Seismology (IRIS) is a consortium of twenty-six universities involved in deploying and supporting seismic networks around the globe. Information is available on several scientific research projects including the Global Seismographic Network (GSN), the Program for the Array Seismic Studies of the Continental Lithosphere (PASSCAL), the seismic Data Management System (DMS), and the Joint Seismic Program (JSP).

Japan

<http://www.eri.u-tokyo.ac.jp/>

This is the Web page for the Earthquake Research Institute at the University of Tokyo in Japan. This server has seismograms and centroid-moment tensor (CMT) solutions for Japanese earthquakes, including the large 1995 Hyogo-Ken Nanbu (Kobe) earthquake.

MIT

<http://www-erl.mit.edu/NESN/homepage.html>

Web site for the New England Seismic Network at the Earth Resources Laboratory of the Massachusetts Institute of Technology (MIT) in Cambridge. Information about recent and historic earthquakes in the northeastern United States is archived at this site.

NCEDC

<http://quake.geo.berkeley.edu/>

The Northern California Earthquake Data Center (NCEDC) is a joint project of the University of California at Berkeley and the United States Geological

Survey at Menlo Park, California. This site contains extensive information about northern and central California earthquakes and has a feature that allows you to create your own seismogram from any of the stations in their array for a specified time period.

NCEER

<http://nceer.eng.buffalo.edu/>

The National Center for Earthquake Engineering Research (NCEER) at the State University of New York in Buffalo. Contains interesting material about the engineering problems associated with earthquakes and strong ground movements.

NEIC

<http://www.neic.cr.usgs.gov/>

This is the Web site for the National Earthquake Information Center (NEIC) of the United States Geological Survey (USGS) in Golden, Colorado. It has extensive information on seismology and earthquakes around the world along with many seismograms and moment tensor solutions. Of particular interest is their collection of educational material including a small glossary of seismology terms.

SASO

<http://www.geo.arizona.edu/saso/>

The Southern Arizona Seismic Observatory (SASO) at the University of Arizona in Tucson. This Web site, like that at the NCEER, also allows you to make your own custom seismogram and contains information about the AZPEPP program, which is placing seismometers into Arizona's high schools as an aid for teaching earth science.

St. Louis

http://www.eas.slu.edu/Earthquake_Center/earthquakecenter.html

The Earthquake Center at St. Louis University in Missouri. The Web site has a lot of information about seismicity in the central United States, the famous 1811-1812 New Madrid earthquake, and the present-day New Madrid seismic zone.

USGS

<http://quake.wr.usgs.gov/>

Earthquake information from the United States Geological Survey (USGS) in Menlo Park, California. This site provides information about the USGS, its role in earthquake-hazard reduction, and about the various research projects the organization is engaged in throughout the country.

GENERAL INFORMATION

The following are some links to resources that have general information about seismology and earthquakes that may be of interest to the earth-science teacher.

Disasters

<http://www.disaster.net/disaster/earth.htm>

The Internet Disaster Information Network site for earthquakes. This site is maintained as a public service by a commercial Internet provider and multimedia

development company and provides links to resources about recent disasters (including, but not limited to, earthquakes). I'm not sure how often this site is updated, but it may be worth a visit after the next large, damaging earthquake.

Earthquake Locations

<http://geovax.ed.ac.uk/quakes/quakes.html>

The World-Wide Earthquake Locator from the Department of Geography at the University of Edinburgh in Scotland. This is a server that takes recent earthquake information from the USGS National Earthquake Information Center and map information from the Xerox PARC map server and displays custom maps showing earthquakes occurring throughout the world during the past week.

Geophysics

<http://cancer.mss.co.jp/Geophysics/>

This is a list of geophysics resources available on the Internet maintained by geophysicist Nobuhiro Furuse in Japan. Many of the resources listed are for seismology and earthquakes. World Wide Web resources for geophysics in general will be covered in a future article.

Seismicity Maps

<http://quake.wr.usgs.gov/QUAKES/WEEKREPS/weekly.html>

Weekly seismicity maps and reports from the United States Geological Survey in Menlo Park, California are available at this Web site. Maps and reports are produced for central and northern California, the San Francisco Bay area, the Long Valley caldera in eastern California, the continental United States, and the world.

San Francisco Quakes

<http://www.slip.net/~dfowler/1906/museum.html>

This is the Web page for the Museum of the City of San Francisco with on-line information about the famous 1906 San Francisco earthquake and the recent 1989 Lorna Prieta earthquake. Many official reports from city and state agencies are reproduced along with newspaper stories and images of the damage. This is an interesting site for learning about the impact of earthquakes on society.

Seismo-Surfing

<http://www.geophys.washington.edu/seismosurfing.html>

This is an index of seismic information available on the Internet from the Geophysics Department at the University of Washington in Seattle. Many seismology research centers with Web pages throughout the world are listed here.

Tutorial

<http://www.seismo.unr.edu/ftp/pub/louie/class/100/plate-tectonics.html>

This site features several Web pages of tutorial material on earthquakes and plate tectonics from the University of Nevada at Reno's Seismological Laboratory. Some topics covered are the earth's interior, plate

tectonics as the cause of earthquakes, seismic waves, the Mercalli scale of earthquake intensity, the Richter scale, and the 1995 Hyogo-Ken Nanbu (Kobe) earthquake in Japan. These are a number of very educational pages with many high-quality images (making the site a bit slow but well worth the wait).

PROFESSIONAL ORGANIZATIONS

Finally, here are a couple of World Wide Web pages of professional organizations for geophysicists and seismologists.

American Geophysical Union

<http://www.agu.org>

The American Geophysical Union (AGU) is an international professional organization for geophysicists. This Web site features information about the organization and its various publications and twice-yearly meetings. Abstracts for the meetings, with special sessions devoted entirely to seismology and large recent earthquakes, are available on-line. The information may be too advanced for many students but the site is definitely worth a look.

Society of Exploration Geophysicists

<http://sepwww.stanford.edu/seg/>

The Society of Exploration Geophysics (SEG) is an international professional organization for geophysicists primarily in the petroleum exploration field. Seismology is not only used for detecting earthquakes, it's also used to determine the structure of the earth's crust. While resources for the scientific applications of seismology will be discussed in a future column on geophysics, this site was included since it contains some useful information on publications and various types of educational material. Like the AGU site, much of the information here may be too advanced for many students.

DISCUSSION

Many of the World-Wide Web sites listed above contain useful educational information about the science of seismology, seismographs and seismograms, earthquake mechanisms and plate tectonics, seismic waves, and the different scales for measuring the strength of earthquakes. The National Earthquake Information Center, in particular, has many files that may be of general interest to students and instructors such as the lists and maps of the largest and most damaging historic earthquakes.

Students may wish to learn about topics such as the Richter magnitude scale from the National Earthquake Information Center Web site (somewhat superficial) or from the tutorial at the University of Nevada at Reno's Seismological Laboratory (which is more substantial and quantitative).

Information about large historic earthquakes is also available at most of the above Web sites. Students may

read about the 1811-1812 New Madrid, Missouri earthquakes at the Center for Earthquake Research and Information in Memphis and at the St. Louis University Earthquake Center Web pages. Fascinating information about the infamous 1906 San Francisco earthquake is available at the Museum of the City of San Francisco Web site. The recent devastating 1995 Hyogo-Ken Nanbu (Kobe) earthquake in Japan is described in detail, with images, at the Earthquake Research Institute at the University of Tokyo. It may be useful to divide the students into groups and have each group research a recent large earthquake. Some earthquakes for which it's easy to obtain information are the 1995 Hyogo-Ken Nanbu (Kobe) earthquake in Japan, the 1994 Northridge and 1992 Landers earthquakes in southern California, and the 1989 Loma Prieta earthquake near San Francisco. Be sure to check out the "Earthquakes in Southern California" link from Caltech's Seismological Laboratory for multimedia information on the Landers and Northridge earthquakes.

Using information from the New England Seismic Network at MIT, it might be interesting for students to compile, for example, a list of all the earthquakes that have occurred in Boston, Massachusetts (a locality not usually thought of as having large earthquakes). How large were the earthquakes? When did they occur? Can it happen again? This site, along with those in the central United States (CERI and St. Louis University) demonstrate that earthquakes don't occur only in California.

Students may utilize the user-friendly Harvard University CMT database to determine how many earthquakes occurred, for example, on their birthday the previous year. This database describes the locations of the earthquakes, their latitudes and longitudes, the GMT times of occurrence, the depths of the foci, and their magnitudes. Another activity might be to have students keep an eye on the newspapers for news of a large earthquake occurring somewhere in the world. When one occurs, have them use the Web to find out more about it – where exactly it occurred, what its magnitude was, how deep the focus was, and any other available information.

For more advanced students, seismograms and focal mechanism solutions may be downloaded for teaching and detailed examination.

Finally, students and instructors may wish to visit the Comprehensive Test Ban Treaty International Data Center to learn how seismology is used – monitor atomic-bomb testing or visit various seismology research centers such as Caltech and the Incorporated Research Institutions for Seismology (IRIS) to learn how seismology is being used for scientific research in geology and geophysics.

My next column will continue this discussion with a list of resources available on the World Wide Web for learning about geophysics, plate tectonics, and structural geology.