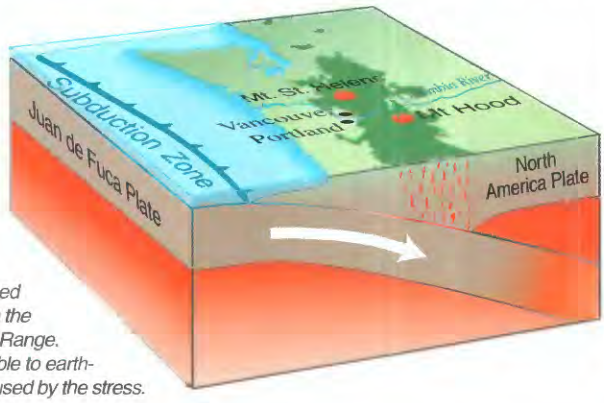
Airborne Hunt for Faults in the Portland-Vancouver Area

Geologic hazards in the Portland-Vancouver area include faults entirely hidden by river sediments, vegetation, and urban development. A recent aerial geophysical survey revealed patterns in the Earth's magnetic field that confirm the existence of a previously suspected fault running through Portland. It also indicated that this fault may pose a significant seismic threat. This discovery has enabled the residents of the populous area to better prepare for future earthquakes.

The populous Portland-Vancouver (Oregon/Washington) metropolitan area is home to 1.5 million people. This photo (view to northwest) shows downtown Portland and the Willamette River. Also shown is the long-recognized Portland Hills Fault. A 1992 aerial geophysical study conducted by the U.S. Geological Survey confirmed the existence of another fault concealed beneath sediments on the east bank of the river. The study also showed that this "East Bank Fault" might pose a significant seismic threat to the area and may be capable of producing strong earthquakes with magnitudes greater than 6. (Photo courtesy of Northern Light Studio, Portland.)

The morning of March 25, 1993, began abruptly for the 1.5 million residents of the Portland-Vancouver (Oregon/Washington) metropolitan area. At 5:34 a.m., a magnitude 5.6 earthquake had struck 30 miles to the south, rocking the entire region. The quake caused $30 million in damage and was felt over an area of more than 50,000 square miles. Only three weeks earlier, earth scientists from the U.S. Geological Survey (USGS), Oregon Department of Geology and Mineral Industries, and Portland State University had held a press conference at which they made public the results of an aerial geophysical study that indicated that the seismic hazard in the Portland-Vancouver area was greater than previously thought.

Why do earthquakes occur in the Portland-Vancouver area? The Pacific Northwest is geologically a very active region. About 75 miles off the coast, on the floor of the Pacific Ocean, is a major fault (subduction) zone where two plates of the Earth's crust meet. Along this zone, the Juan de Fuca Plate slides eastward beneath the North America Plate. Inland from the coast about 100 miles, hot materials rise from the subducted Juan de Fuca Plate to the surface of the North America Plate, where they build the volcanoes of the Cascade Range, including Mount Hood and Mount St. Helens. The Portland-Vancouver area is located on the highly stressed region of the Earth's crust between the subduction zone and the Cascade Range. Consequently, the area is susceptible to earthquakes on the numerous faults caused by the stress. These faults, however, are difficult to find and study because they are often concealed beneath sediments deposited by the Willamette and Columbia Rivers or hidden by vegetation and urban development.

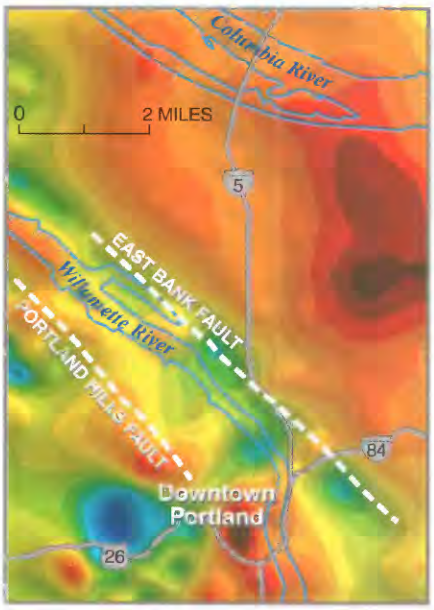


The Pacific Northwest region is geologically very active. Off the coast is a major fault (subduction) zone where two plates of the Earth's crust meet and one slides under the other. Inland, hot materials rise from the subducted plate to the surface, where they build the volcanoes of the Cascade Range, including Mount Hood and Mount St. Helens. The Portland-Vancouver area is located on the highly stressed region of the Earth's crust between the subduction zone and the Cascade Range. Consequently, the area is susceptible to earthquakes on the numerous faults caused by the stress.

To help locate and understand these concealed hazards, the USGS in 1992 conducted the aerial geophysical survey

of the Portland–Vancouver area that led to the March 1993 press conference. Using a specially designed airplane and instruments, scientists measured the magnetic field of the Earth at an altitude of about 800 feet above the ground. Faults often produce distinctive patterns in the Earth's magnetic field. Careful analysis of these "magnetic anomalies" can help scientists locate and analyze unknown or poorly understood faults. The USGS uses aircraft with magnetometers to study geologic hazards, mineral resources, and environmental problems throughout the United States. The Portland–Vancouver magnetic survey was planned in cooperation with scientists from the Oregon Department of Geology and Mineral Industries and from Portland State University. The data from the survey were interpreted by cooperating scientists and the USGS and are now being used by state and local planners to assess the seismic-hazard potential in the area.

The best known fault in the Portland–Vancouver area is the Portland Hills Fault, which runs northwest-southeast through the heart of downtown Portland. The aerial survey found two parallel and distinct magnetic patterns with the same northwest-southeast trend. Surprisingly, the stronger of these two linear patterns was not along the Portland Hills Fault. On the basis of data from water wells, geologists had suspected the existence of another northwest-southeast trending fault in the same position as the stronger anomaly. This fault, called the East Bank Fault, is completely concealed beneath river sediments and was not thought to be particularly significant.



This map shows variations in the strength of the Earth's magnetic field (colors) in metropolitan Portland, Oregon. It was derived from part of the 1992 aerial geophysical study conducted in the Portland-Vancouver (Oregon/Washington) area by the U.S. Geological Survey. The study found two parallel and distinct magnetic patterns with the same northwest-southeast trend. Surprisingly, the stronger of these two linear patterns was not along the well-known Portland Hills Fault, but was along the east bank of the Willamette River. There another fault, the "East Bank Fault," had been previously suspected but was completely concealed beneath river sediments. The magnetic data for the entire study area showed that this fault extends at least 30 miles to the southeast and may be capable of producing strong earthquakes.

In 1992, U.S. Geological Survey (USGS) scientists used this airplane, specially equipped with a magnetometer (white boom at rear of aircraft), to measure variations in the Earth's magnetic field in the Portland–Vancouver (Oregon/Washington) area. The USGS uses such aircraft to study geologic hazards, mineral resources, and environmental problems throughout the United States.

The strong magnetic pattern not only confirmed the existence of the East Bank Fault but also suggested that it might have the potential to produce large earthquakes. The magnetic pattern associated with this fault extends at least 30 miles to the southeast of Portland, much farther than previously thought. Scientists now believe that the East Bank Fault, the Portland Hills Fault, and other faults with similar trends in the Portland-Vancouver metropolitan area form a broad zone of faulting called the Portland Hills Fault Zone. The East Bank Fault appears to be the longest fault in the zone and may pose a significant seismic hazard to the Portland–Vancouver community. Although no evidence has yet been found of past strong earthquakes on this fault, its length suggests that it could produce shocks with magnitudes greater than 6.

Because of the success of the 1992 aerial magnetic survey, a similar survey was conducted south of Portland in 1995. This new study investigates the area of the March 1993 earthquake and includes the cities of Salem, Woodburn, and Mt. Angel, Oregon. The continuing work of earth scientists in the Pacific Northwest is helping to protect the lives and property of citizens of the region from the earthquakes that are inevitable in the future.

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