

United States Geological Survey Award Number 01HQPA0002

**SOURCE CHARACTERIZATION STUDY OF A PORTION OF THE
SOUTHERN PORTLAND HILLS FAULT, PORTLAND METROPOLITAN
AREA, OREGON**

Mark A. Hemphill-Haley
Department of Geology
Humboldt State University
Arcata, CA 95521
Phone: 707-826-3933
Fax: 707-826-5241
E-mail: mah54@humboldt.edu

Lee M. Liberty
Center for Geophysical Investigation of the Shallow Subsurface
1910 University Dr.
Boise State University
Boise, ID 83725
Phone: 208 426-1166
E-mail: lml@cgiss.boisestate.edu

Ian P. Madin
Oregon Department of Geology and Mineral Industries
800 NE Oregon Street #28, Suite 965
Portland, OR 97232
Phone: 503-731-4100
Fax: 503-731-4066
E-mail: Ian.p.madin@state.or.us

TECHNICAL ABSTRACT

The Portland metropolitan area historically is the most seismically active region in Oregon. The Portland Hills Fault extends directly beneath downtown Portland. The temporal and behavioral characteristics of these faults are poorly understood, and the surface geologic record does not provide the information required to assess the seismic hazards associated with these faults. The limited geologic information stems from a surface topography that has not maintained a cumulative geologic record of faulting, in part, due to large deposits from young, catastrophic flood events and the dominant strike-

slip component of the faults. We integrated multiple high-resolution geophysical techniques, including seismic reflection, ground penetrating radar, and magnetic methods, with regional geological and geophysical surveys to determine that the Portland Hills Fault is presently active with a zone of deformation that extends at least 400 m. The style of deformation is consistent with at least 2 major earthquakes in the last 12-15 ka, as confirmed by a temporary excavation trench. High-resolution geophysical methods provide detailed images of the upper 100 m across the active fault zone.

NON-TECHNICAL ABSTRACT

The Portland, Oregon metropolitan area is located in an area prone to earthquake activity. We do not understand the sources of the earthquakes. The Portland Hills fault extends through downtown Portland. The seismic history of the fault is poorly understood because extensive erosion and deposition occurred along the fault between 12,000 and 15,000 years ago due to large scale regional catastrophic flooding. This flooding removed much of the geologic evidence that could be used to determine the activity of the fault. We have employed geophysical methods that provide a better image of the fault buried at depth. Through these methods we have imaged the southern portion of the fault at North Clackamas Park. This image suggests that the fault has disrupted sediments that may be as young as 12,000 to 15,000 years old. Attempts to locate the fault at a terrace of the Clackamas River farther to the south proved unsuccessful. We were able to image faulted and folded sediments as young as 12,000 to 15,000 years old on the property of a middle school north of North Clackamas Park. A temporary excavation provided direct evidence for deformation of these sediments. Based on the evidence collected in this investigation the Portland Hills fault is likely active.