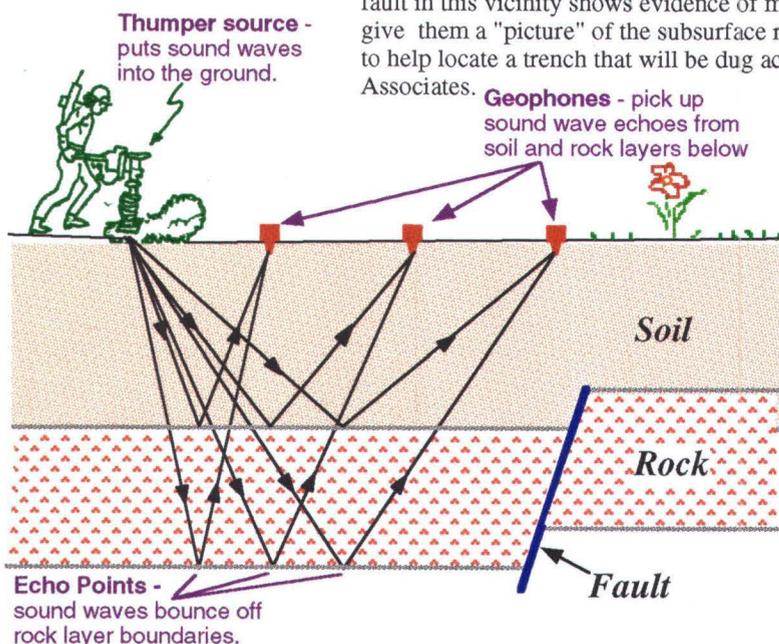# Echo-Sounding Method Aids Earthquake Hazard Studies

Dramatic examples of catastrophic damage from an earthquake occurred in 1989, when the M 7.1 Loma Prieta rocked the San Francisco Bay area, and in 1994, when the M 6.6 Northridge earthquake jolted southern California. The surprising amount and distribution of damage to private property and infrastructure emphasizes the importance of seismic-hazard research in urbanized areas, where the potential for damage and loss of life is greatest.

During April 1995, a group of scientists from the U.S. Geological Survey and the University of Tennessee, using an echo-sounding method described below, is collecting data in San Antonio Park, California, to examine the Monte Vista fault which runs through this park. The Monte Vista fault in this vicinity shows evidence of movement within the last 10,000 years or so. The data will give them a "picture" of the subsurface rock deformation near this fault. The data will also be used to help locate a trench that will be dug across the fault by scientists from William Lettis & Associates.

**Thumper source** - puts sound waves into the ground.

**Geophones** - pick up sound wave echoes from soil and rock layers below

*Soil*

*Rock*

**Echo Points** - sound waves bounce off rock layer boundaries.

*Fault*

The scientists use an echo-sounding technique as diagrammed on the left. This technique involves hitting the ground with small hammers, charges, and thumpers, and listening to the sound-wave echoes with a line of sensors (geophones) placed on the ground.

**What can we learn from this work?**

By measuring the speed of sound through the rock and analyzing the echoes, we get a picture of the subsurface and the presence of buried folds and faults (see diagram below). From this picture we will be able to assess the style and timing of deformation caused by the fault, which will lead to an improved assessment of earthquake risk from this fault.

The green figure on the right shows a final record section that is used for interpretation of subsurface rock formations.

The vertical green lines represent how much the ground surface moved in response to impacts from our thumpers. A more wiggly line indicates more ground motion.

## Typical Subsurface Picture Using Sound Echoes

Distance in meters

possible fault

reflecting echoes

Depth in Meters

Time in Milliseconds