Exploring Earth

It can be difficult to explore areas you cannot visit, such as outer space and deep underground. Scientists mostly explore the layers of the Earth by studying earthquake vibrations. These vibrations are called seismic waves.

Equipment that measures the strength of seismic waves (seismometers) are set up all around the world, but scientists most interested in exploring the depths set up seismometers in areas where strong earthquakes are most likely to occur. They are arranged in an arc 105° and 142° away from the earthquake's most likely epicentre. Sometimes seismometers are set up in areas where nuclear testing takes place as well!

Seismic waves can only really be measured on Earth's surface. As the waves travel underground, they slow down or speed up. From this, scientists can work out whether the waves passed through dense rock, soft molten rock or even rock containing gas or oil. This is because these rock types have different densities.

There are different types of seismic waves. The fastest waves can travel up to 14 kilometres/second. At this speed, it would take only 20 minutes or so for these waves to travel through the centre of the Earth and reach the other side (about 12 000 kilometres). P waves are pressure or compression waves. S waves are shear waves, which do not travel through Earth's core but may be converted to P waves when they hit the core.

Some waves travel down and hit an area called the diffractive phase (near the outer core and mantle boundary). These waves get bogged down then are reflected and race back to the surface. This bottom 100 kilometres of the mantle slows down seismic waves by a few per cent.

Scientists also explore the layers of the Earth by analysing data on how the Earth rotates, its inertia, magnetic fields, and by performing laboratory experiments on melting and alloying iron.

More Information

Scientific American Ask the Experts 6 October 1997
Why is the earth's core so hot? And how do scientists measure its temperature?
http://www.sciam.com/print_version.cfm?articleID=000B2C71-BCF0-1C71-9EB7809EC588F2D7

How do scientists know what is in the core of the Earth?
http://www.soest.hawaii.edu/GG/ASK/earths_core.html

United States Geological Survey
Inside the Earth http://pubs.usgs.gov/publications/text/inside.html
The Interior of the Earth http://pubs.usgs.gov/gip/interior/

Earth's Interior http://www.seismo.unr.edu/ftp/pub/louie/class/100/interior.html

How do we know what the inside of the Earth is like?
http://www.madsci.org/posts/archives/oct98/909513628.Es.r.html

New Scientist Vol 160 issue 2156 17 October 1998, page 38 Deep Secrets