Earthquake waves: How do they spread?

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Propagation of earthquake waves within the Earth is not uniform. Experiments indicate that the velocity of shear waves (s-waves) in Earth's lower mantle between 660 and 2900 km depth is strongly dependent on the orientation of ferropericlase. In the latest issue of *Science* (*Vol. 325, 10.04.2009*), researchers from the German Research Center for Geosciences GFZ, the Karlsruhe Institute of Technology, the University of Bayreuth, and Arizona State University report unexpected properties of ferropericlase, which is presumably the second most abundant mineral of the lower mantle.

"The dependence of wave velocity on direction increases significantly at a pressure of about 50 Giga-Pascal, corresponding to approximately 1300 km depth. This is caused by a change in electronic arrangement of the iron ions in ferropericlase," explains Hauke Marquardt from GFZ. In addition, flow in the lower mantle results in a preferred mineral orientation; this causes the detectable non-uniform propagation of earthquake waves. This flow is the driving force of tectonic plate movements, formation of mountains, earthquakes, and volcanic activities and therefore, strongly affects our life on Earth's surface.

Because the deep interior of our planet is not accessible to direct observations, the researchers simulate the conditions of Earth's interior by generating the extreme pressures in their laboratory. Diamond anvil cells are used at GFZ to perform the high-pressure experiments, which are complemented by X-ray diffraction experiments at "Diamond Light Source" in Didcot, UK.

These new findings are of practical importance: Only if we know the properties of the materials that constitute the deep Earth, we can derive information about its internal flow from the non-uniform propagation of earthquake waves. This can help to better understand plate tectonic processes.

Source: GFZ German Research Centre for Geosciences