Hot Fluids and Deep Earthquakes

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Fluids in the Earth's lower crust are an underlying force in shaking things up where continental plates slip under each other, according to a study recently published in Nature. Donna Eberhart-Phillips, a UC Davis researcher in geology, collaborated on the study with Martin Reyners from GNS Science, New Zealand, and Graham Stuart from the University of Leeds, England.

Eberhart-Phillips said that these findings contradict the existing model for explaining earthquakes in the lower crust, which assumed that the lower crust had to be cold and brittle for earthquakes to occur. The new study shows that the presence of hot fluids can also weaken the crust from below.

"Rifting is caused not just by properties of the crustal material, but of the mantle below it where fluids are being released," Eberhart-Phillips said.

The study focused on the Taupo Volcanic Zone (TVZ), an active continental rift that cuts across the face of New Zealand's North Island. Located where the Pacific continental plate slips under the Australian plate, the TVZ is the most active and productive volcanic system on Earth. Eberhart-Phillips said that earthquakes in this area are deeper than average and occur in swarms, which is characteristic of fluids present at depth. Swarms consist of several small quakes occurring simultaneously, as opposed to a large quake followed by aftershocks.

The researchers used three-dimensional imaging to map the decrease of energy released from more than 1,600 seismic events in the TVZ. Their seismic velocity readings penetrated 200 miles through the Earth's crust and into the mantle, the layer below the crust.

"The thing that is unique about our study is the combination of the 3-D attenuation image of the whole region, and looking within that at the swarm earthquakes in detail," Eberhart-Phillips said.

Of particular interest to the researchers was the end of the subduction zone, where expected volcanic action does not occur. Three-dimensional imaging data suggests that thick crust chokes off the fluids at this end. Fluids appear to flow laterally along the TVZ, which may contribute to its high magma production.

The work was published in the April 26 issue of the journal *Nature*.

Source: UC Davis

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