OATS

The Oregon Array for Teleseismic Study

Newsletter

The University of Wisconsin - Madison

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In This Issue

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Dear OATS Participant,

We want to thank you for letting us install a seismic station on your land and helping us with this project all the way.

After two years' operating, OATS stations have collected abundant data of excellent quality, allowing us to investigate the geodynamics along the array from a perspective of geophysics the first time. Our stations also recorded the great Sumatra-Andaman earthquake occured on December 26, 2004, which caused the disastrous tsunami in Indonesia, and earthquake swarms from the surface bulge near Sisters.

There will not be a fall service and we will be removing the equipments in the spring 2006 approximately between the April and May. Once again, we thank you for your help and cooperation with this project. We look forward to seeing you in the spring.

- The OATS team

OATS target - the Newberry hotspot track

Here, the word Hotspot track is used to denote a linear progression of surface volcanism/magmatism. It is generally attributed to the absolute motion of a plate over a deep mantle plume composed of hot mantle materials (Fig. 1a). The Newberry volcano is actually the west end of a hotspot track, the Newberry hotspot track. Located in the northwestern United States, the track consists of a sequence of age-progressive silicic volcanic domes and lava flows, showing a monotonic age progression from the ~17 million years old McDermitt Caldera to west, ending at the Newberry Caldera, less than 1 million years old. Age contours of the track are shown in red lines with 1 Ma increments (Fig. 1b).

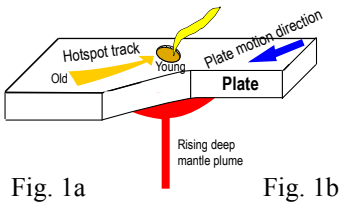


Fig. 1a

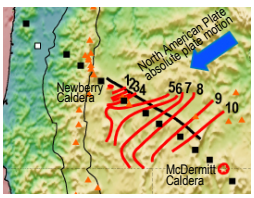


Fig. 1b

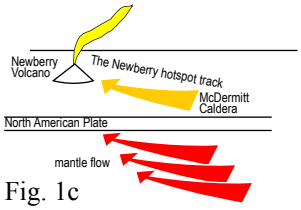
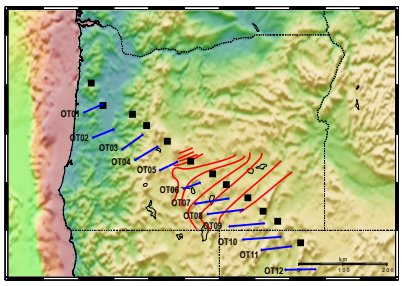


Fig. 1c

As the orientation of the track is not parallel to the plate motion direction, it cannot be a result of a mantle plume as shown in Fig. 1a. Instead, two categories of mechanism have been proposed. One consider the track a result of westward asthenosphric flow (Fig. 1c) either and the other think the lithospheric processes are responsible, such as faulting or basin and range extension. Next page we will see what OATS tells us.

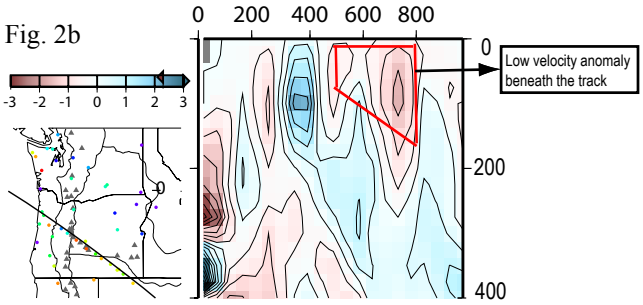
OATS preliminary results

Fig. 2a



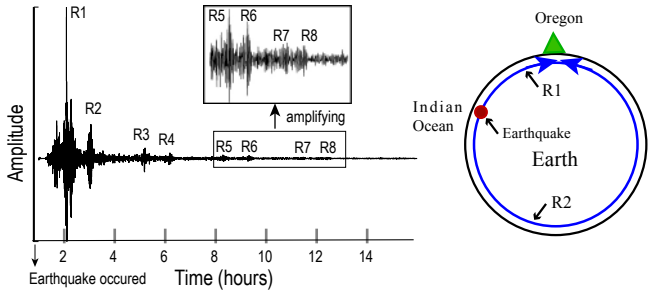
Mantle is mainly composed of Olivine. The fast axis of Olivine tends to align with mantle flow direction. So the asthenospheric flow model (Fig. 1c) requires the fast axis to be parallel to the Newberry track as the black arrow shown in Fig. 2a. We applied a technique called shear-wave splitting on our OATS data to resolve orientations of the fast axis beneath the track. As the observed fast axes (blue lines in Fig. 2a) are not aligned with the track as the asthenospheric flow model suggests, therefore the Newberry track is more likely a product of lithosphere-controlled processes.

Fig. 2b



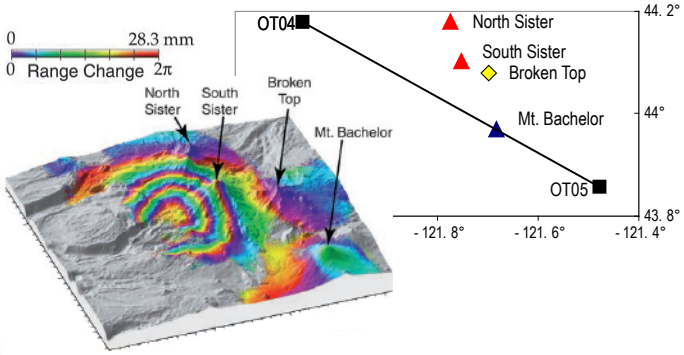
The asthenospheric flow model would also exect hot ashenospheric material beneath the Newberry track to a depth at least ~150 miles. By using tomography (similar to X-ray imaging), we can view the velocity structure beneath Oregon (Fig. 2b). Red indicates low velocity (hot) and blue indicates high velocity (cold). We observed low velocity anomalys all along the track to a depth ~100 miles and no further continuation to deep mantle, suggesting there is no migrating melt body in the asthenosphere beneath the region, consistent with the conclusion from our shear-wave splitting.

The great Sumatra-Andaman earthquake occured on December 26, 2004



Multiple surface waves circle the earth. Odd-numbered arrivals (R1, R3, etc.) take the shortest path from the earthquake to the station, whereas even-numbered arrivals (R2, R4, etc) travel in the opposite direction. For either direction, an increase of 2 in subscript indicates the arrival circled the Earth one more time.

The 2004 Indian Ocean earthquake, known by the scientific community as the Sumatra-Andaman earthquake, was an undersea earthquake that occurred at 7:58 PM (local time) on December 26, 2004. The tsunami generated by the earthquake killed almost 175,000 people, making it one of the deadliest disasters in modern history. Our stations recorded surface waves generated by this earthquake. Fig. 3 gives an example of the data recorded at OT06. We can see that surface waves were still detectable even after they had traveled around the Earth 4 times. - From Wikipedia



Three Sisters volcanic center is located between OT04 and OT05. Images from satellite interferometric synthetic aperture radar (InSAR) reveal a bulge covering about 100 square miles with uplift as much as 10 inches in this region.

Surface bulge near Sisters

A recent survey of the bulge indicates it is still growing at ~1.4 inches per year. Scientists infer that the likely cause of the bulge could be a pool of magma or anything from the birth of a new volcano -- a fourth Sister in the making. A swarm of 350 small earthquakes in March 2004 indicated magma was on the move, but the bulge has been quiet ever since. Whether the magma will move again or ever reach the surface is a mystery. But if it did, geological history suggests it would result only in small cinder cones that spew ash and lava.

- From Live Science