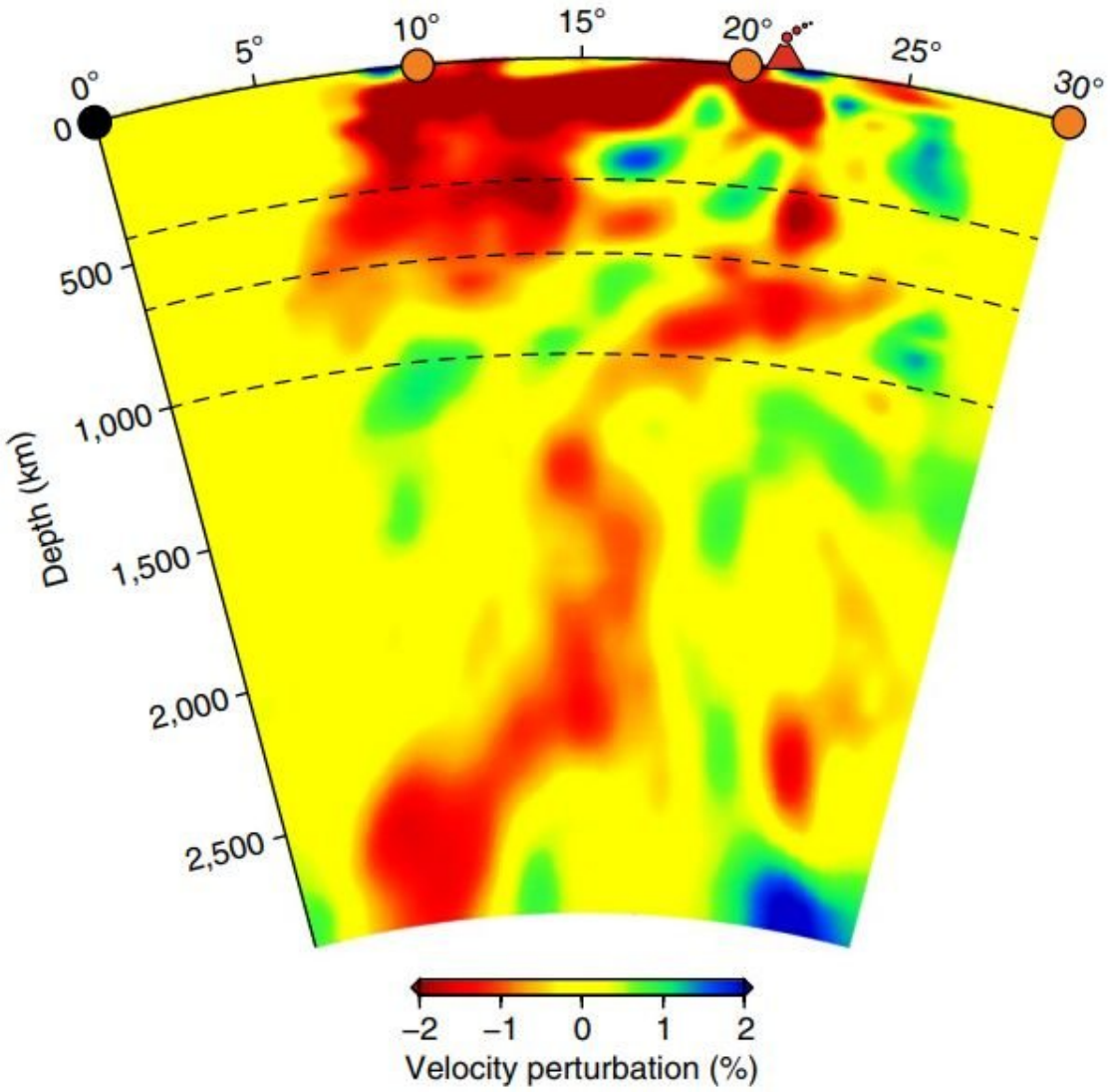
New evidence for plume beneath Yellowstone National Park

March 20 2018, by Bob Yirka



Depth cross-section through the plume structure showing its connection with the Yellowstone hotspot. Credit: *Nature Geoscience* (2018)

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A pair of researchers from the University of Texas has found what they claim is evidence of a plume beneath Yellowstone National Park. In their paper published in the journal *Nature Geoscience*, Stephen Grand and Peter Nelson further propose that the plume is part of a zone that runs to the park all the way from Mexico.

A plume is a still theoretical abnormality that lies at the boundary between the Earth's core and the mantle, and rises through the mantle into the crust—an abnormality that would exist as a vertical stream of magma. As the researchers note, the prospect of a plume beneath Yellowstone has been strongly debated—some have suggested a plume would explain the source of the heat that drives so much surface activity in the park. Others disagree pointing out that it could just as easily be explained by shallow subduction or lithospheric processes. In this new effort, the researchers have taken a new approach to studying the hot spot—they used seismic data obtained from EarthScope's USArray—a project that placed geologic listening stations across North America.

The researchers found what they describe as "a long, thin, sloping zone" (approximately 72 by 55 kilometers in size) inside of the mantle where seismic waves were traveling slower than the areas around them—this suggests a section of the mantle that is approximately 600 to 800° C degrees warmer than surrounding areas, and offers strong evidence of a plume. They conclude by suggesting that there is likely a thin plume stretching from the core-mantle boundary beneath the park and that it is responsible for the volcanism seen at Yellowstone. But they also acknowledge that more research is required because there are still questions regarding how Yellowstone exists in its current location. They theorize that it is possible because the plume is held steady by a part of

the Pacific large low-shear-velocity province. They finish by suggesting that current methods used by other researchers to study plumes may not be adequate because global tomography is not capable of capturing thin thermal plumes such as the one they suggest lies beneath Yellowstone.

More information: Lower-mantle plume beneath the Yellowstone hotspot revealed by core waves, *Nature Geoscience* (2018) DOI: 10.1038/s41561-018-0075-y , www.nature.com/articles/s41561-018-0075-y

Abstract

The Yellowstone hotspot, located in North America, is an intraplate source of magmatism the cause of which is hotly debated. Some argue that a deep mantle plume sourced at the base of the mantle supplies the heat beneath Yellowstone, whereas others claim shallower subduction or lithospheric-related processes can explain the anomalous magmatism. Here we present a shear wave tomography model for the deep mantle beneath the western United States that was made using the travel times of core waves recorded by the dense USArray seismic network. The model reveals a single narrow, cylindrically shaped slow anomaly, approximately 350 km in diameter that we interpret as a whole-mantle plume. The anomaly is tilted to the northeast and extends from the core–mantle boundary to the surficial position of the Yellowstone hotspot. The structure gradually decreases in strength from the deepest mantle towards the surface and if it is purely a thermal anomaly this implies an initial excess temperature of 650 to 850 °C. Our results strongly support a deep origin for the Yellowstone hotspot, and also provide evidence for the existence of thin thermal mantle plumes that are currently beyond the resolution of global tomography models.