DiscoveryNews

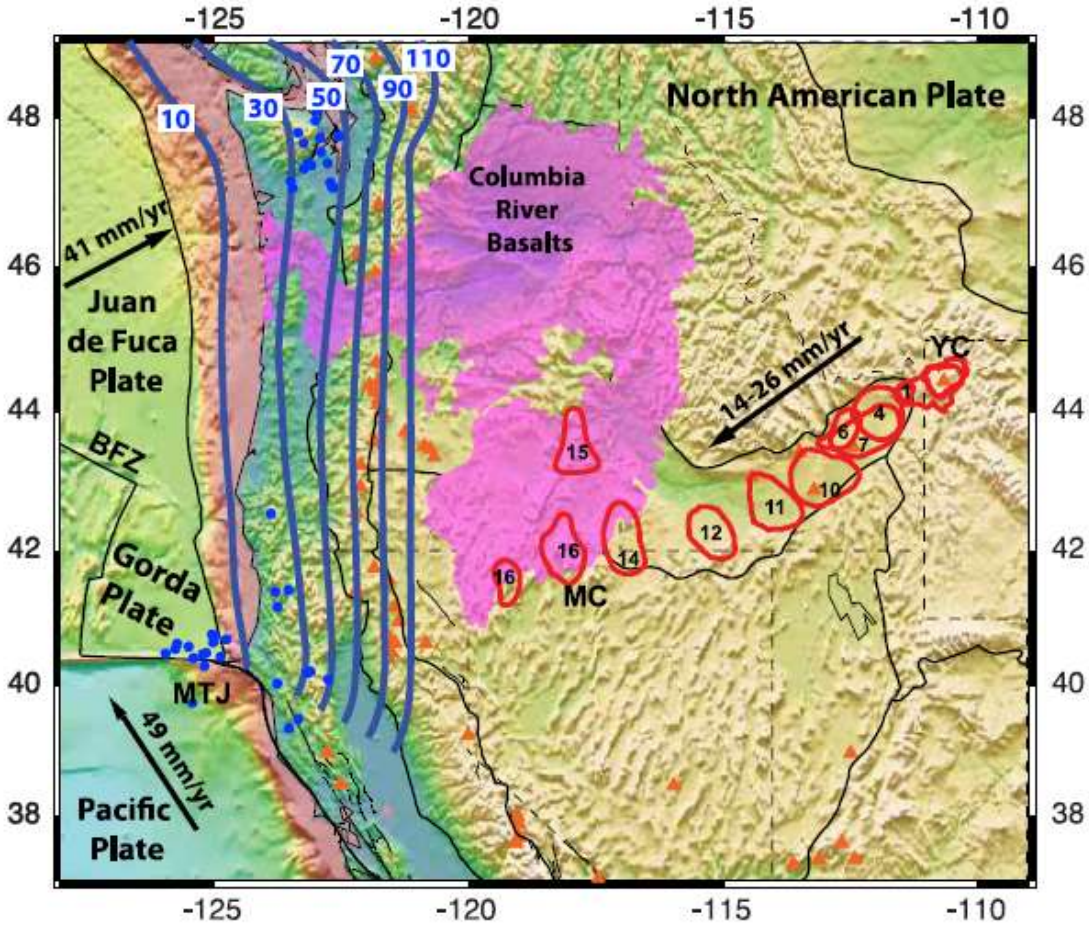
Yellowstone Hot Spot Shreds Ancient Pacific Ocean

By Michael Reilly | Thu Sep 2, 2010 05:15 PM ET

If you thought the geysers and overblown threat of a supervolcanic eruption in Yellowstone National Park were dramatic, you ain't seen nothing: deep beneath Earth's surface, the hot spot that feeds the park has *torn an entire tectonic plate in half*.

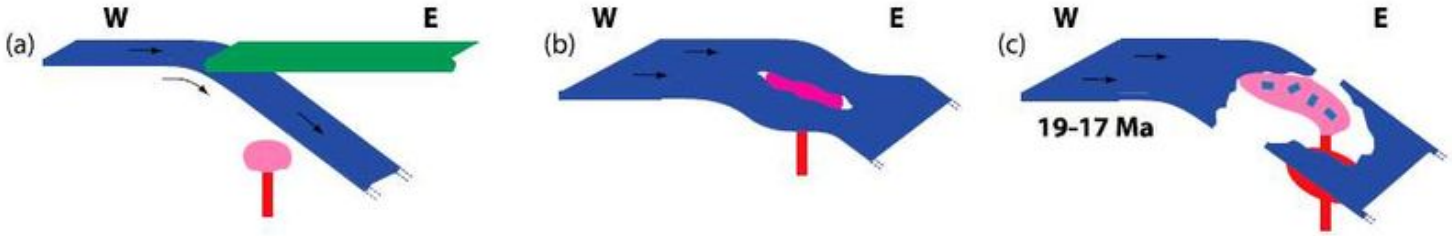
The revelation comes from a new study in the journal *Geophysical Research Letters* that peered into the mantle beneath the Pacific Northwest to see what happens when ancient ocean crust from the Pacific Ocean runs headlong into a churning plume of ultra-hot mantle material.

Geologically speaking, the Pacific Northwest is a peculiar place. Hot spots usually sit way out on their own in the middle of a tectonic plate (think Hawaii or the Galapagos). Not Yellowstone -- it pokes its way to the surface just a few hundred miles from the edge of the North America plate, where a giant trench sends the Juan de Fuca tectonic plate sliding underneath Washington, Oregon, and northern California.



Peering into the middle of this tectonic traffic jam is a tricky business. So scientists, led by Mathias Obrebski of the University of California, Berkeley, had to build an image from seismic waves bouncing around inside the mantle. What they found was a subterranean world filled with violence.

The original data figures are a little hard to look at, but the team built a cartoon representation of what they think is going on down there. Around 19 million years ago, the Yellowstone hot spot first ascended from deep within the mantle. As it neared the surface, it ran into the subducting Juan de Fuca plate.



But the Juan de Fuca plate was itself young at the time (there's a mid-ocean ridge just off the coast of Oregon that forms brand new crust to this day), so it hadn't had the chance fully harden yet. When the crust and hot spot met, the hot mantle plume to found a weakness in the plate -- perhaps a pre-existing fracture -- and punched a giant hole through it.

So, who cares? The encounter has had several amazing consequences. First, and most obvious, it resurfaced much of northern Nevada, Idaho, and Wyoming over the last several million years in basalt through a series of massive volcanic eruptions. Then there were the tremendous supervolcanic explosions, which coated much of the western U.S. in thick blankets of ash and made the Yellowstone park region what it is today.

Second, the team points out that the rise of the Yellowstone plume also coincided with a large change in the rate at which the crust of the Pacific Ocean dives beneath North America. It's possible that the shattered underlying plate simply didn't pull as much weight anymore, and the subduction zone slowed down.

It's a new chapter in what we know about Yellowstone's legendary power to change the landscape. Not only did its massive eruptions coat North America in ash from Idaho to the Mississippi River, and south almost to the Gulf of Mexico, but its deep plume sent a ripple effect through the very roots of the continent and the Pacific Ocean that fundamentally altered the coastline of the Pacific Northwest.

Images: AGU