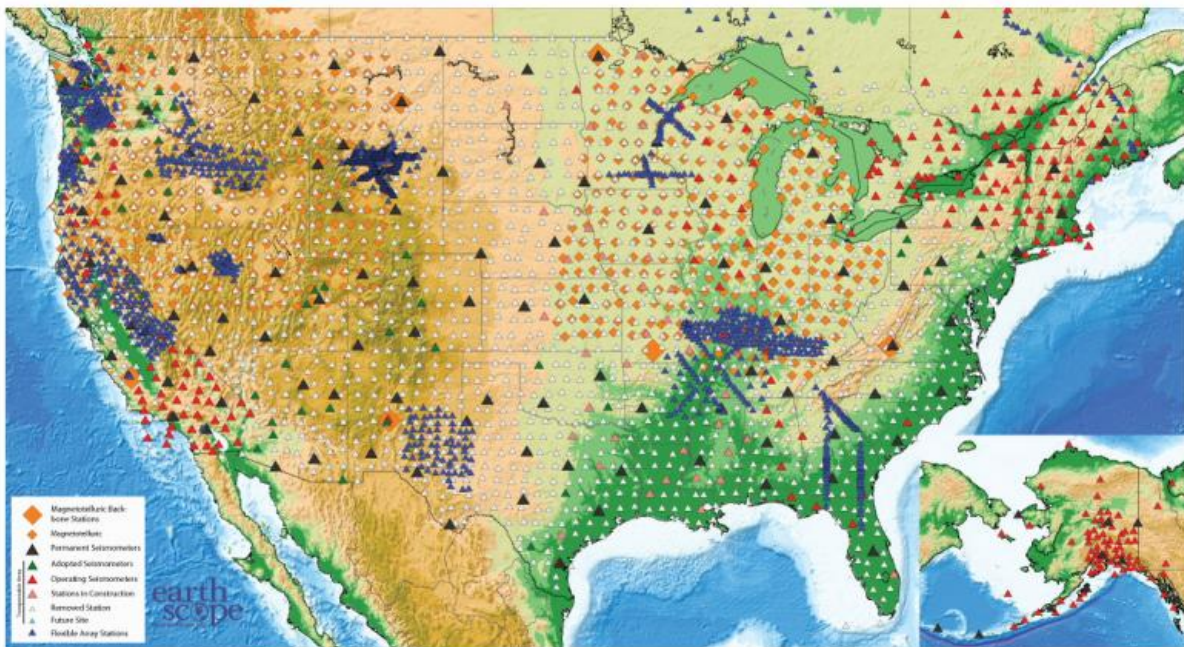


Rolling in the deep: Mantle flow stress best indicator of US intermountain seismicity

August 26 2015, by Mary-Ann Muffoletto

USArray Status as of June 2015



A June 2015 map of the USArray component of the National Science Foundation-funded Earthscope project. Earthscope is a continental-scale seismic observatory designed to support integrated studies of continental lithosphere and deep Earth structure. Scientists from Utah State University, the University of Southern California, Roma Tre University, the University of New Mexico, Scripps and MIT used data collected from the project to study seismicity of the Intermountain Seismic Belt. They published findings in *Nature*. Credit: Earthscope.

Much of what we understand about earthquakes is based on plate tectonics. But for residents of Utah's seismically restless Wasatch Front, a 120-mile-long metropolitan region anchored by Salt Lake City and bounded by the steep Wasatch Mountains and Great Salt Lake, such theory has fundamental limitations.

Because the state's population center sits deep within the interior of the North American Plate, reasons why the Wasatch Fault is earthquake-prone, while other parts of the state are quieter, are poorly understood.

Plate motions across California's San Andreas Fault, the Utah capitol's nearest plate boundary some 760 miles away, don't give a clear picture of what's happening across the Beehive state and other areas of the Intermountain Seismic Belt, says Utah State University geophysicist Tony Lowry.

"In continental interiors, we know little about the forces that drive the earthquake cycle," he says. "We rely mostly on the history of past earthquakes to assess hazards. But, because seismic observations cover only a tiny fraction of the time between the largest earthquakes, we can easily miss important parts of the story."

Lowry suggests [mantle flow](#) stress, occurring deep within the earth, gives new insight into potential hazards that could shake the intraplate belt, which stretches from southwestern Utah up through Idaho and Wyoming to Yellowstone National Park and north through western Montana to Canada. He and colleagues Thorsten Becker of the University of Southern California, Claudio Faccenna of Italy's Roma Tre University, Brandon Schmandt of The University of New Mexico, Adrian Borsa of the University of San Diego's Scripps Institution of Oceanography and Chunquan Yu of the Massachusetts Institute of Technology publish the

foundation of an emerging model in the August 27, 2015 issue of *Nature*. Their research is supported by the National Science Foundation.

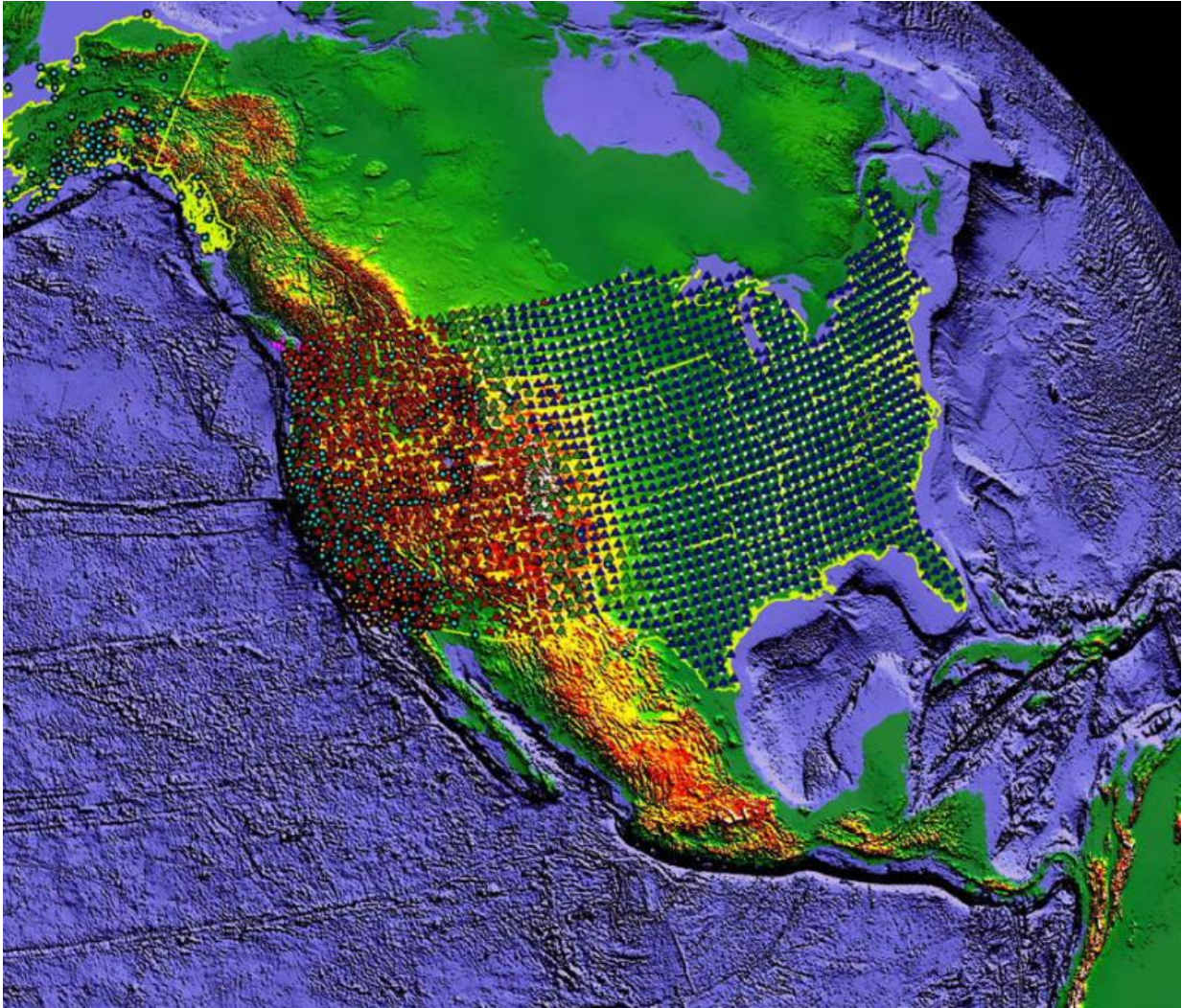


Illustration of the massive EarthScope GPS receiver array across the United States. The National Science Foundation-funded project is a continental scale observatory designed to support integrated studies of continental lithosphere and deep Earth structure. Scientists from Utah State University, the University of Southern California, Roma Tre University, the University of New Mexico, Scripps and MIT used data collected from the project to study seismicity of the Intermountain Seismic Belt. They published findings in *Nature*. Credit: Earthscope.

"We've explored various aspects of how and why rocks break and flow, but this is the first time we've recognized the importance of deep mantle flow," says Lowry, associate professor in USU's Department of Geology. "This developing model gives us a new tool for understanding what makes earthquakes tick."

In the past decade or so, researchers have focused on three possible mechanisms driving earthquakes. One is variations in gravitational potential energy, another is changes in thickness of the earth's crust along the Intermountain Belt and the third is changes in strength of the lithosphere; that is, the crust and upper mantle.

Using new seismic and GPS data available from the massive NSF-funded Earthscope array across the western United States, the researchers looked at these observations simultaneously and found some surprises.



Utah State University geophysicist Tony Lowry kneels beside an Earthscope GPS receiver in northern Utah's Wellsville Canyon. Using new seismic data and GPS data available from the massive NSF-funded Earthscope array across the western United States, Lowry and colleagues are developing a new model to better understand seismicity within the interior of the North American Plate. The researchers published findings in *Nature*. Credit: Donna Barry, Utah State University

"In our earlier work, we tried to understand how deep mantle flow contributed to high elevations in the western United States," Lowry says. "Thorsten (Becker) pushed us to explore whether or not elevation changes predicted by the same mantle flow models could explain the uplift we were observing with the Earthscope GPS measurements."

It turns out the model did a poor job of explaining the GPS uplift, but gave a remarkable approximation of where to find earthquake belts because the upward push by mantle flow instead stretches the strong upper layer where earthquakes occur.

"Our findings represent the birth of a new idea and lay the groundwork for a better understanding of earthquakes," Lowry says. "We now know we need to be looking for the impetus – that nudge that sets an [earthquake](#) system in motion – from flow at depths of 60 to 100 miles, much deeper than where we'd been looking."

Becker, lead author on the paper, says the team's work won't be the last word on the origin of intraplate earthquakes.

"Our work shows how imaging advances in seismology can be combined

with mantle flow modeling to probe the links between seismicity and mantle convection," he says.

More information: *Nature*, [DOI: 10.1038/nature14867](https://doi.org/10.1038/nature14867)

Provided by Utah State University

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