

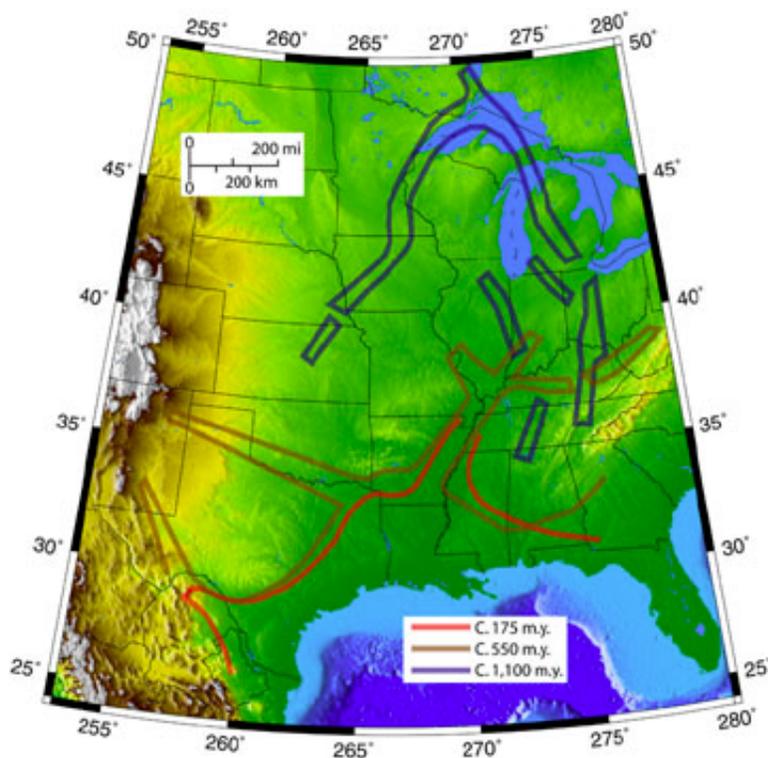
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## USArray and the Great Plains: A Pre-EARTHSCOPE Workshop

*Krista West, February 13, 2003*

*When most people think of a geoscientist, they picture a rugged individualist with rock hammer in tow on a challenging mountaintop painstakingly inspecting the rock under foot. But the modern definition of a geoscientist is far, far broader than that. Modern geosciences include a heavy dose of work in the laboratory and at the computer, and the study of seemingly geologically simple places such as the Great Plains, in the center of the United States.*

This spring, for the first time in a generation, scientists who work on the geology of the Great Plains are meeting to discuss what they know about the area, what they want to know, and how their research on the Great Plains can fit into the larger context of EarthScope, a continental scale journey of scientific exploration.



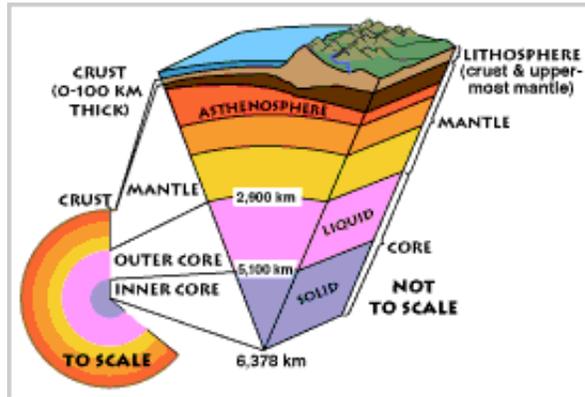
**The North American continent has developed through a series of events that slammed pieces of ancient continent together and sometimes ripped them apart. The result is a number of suture zones where the lithosphere is different. The differences set up conditions for tectonic events such as earthquakes.**

now the state of Missouri.

The Earth has three great layers that differ in composition and mechanical behavior. The rigid crust,

When funded by Congress for fiscal year 2003, EarthScope will include a project called the **USArray**. The goal of the **USArray** is to use seismic waves to image the details of the rocks deep beneath the Earth's surface. Traditionally, places like the Great Plains have not received much attention from geoscientists because at first glance, they just do not seem that interesting. From east of the Rocky Mountains to the western edge of the aging Appalachians, the land is largely flat and void of large geologic features. Although the geology of the Great Plains may seem simple, deep beneath the corn and wheat fields are the remains of ancient mountain ranges, volcanoes, and ocean beaches. And though the mid-continent is thousands of kilometers from the plate boundaries where most of the geologic action takes place today, there are many signs that the Great Plains area is not geologically "dead". In fact, the largest historical earthquakes in the conterminous US occurred in the winter of 1811-1812 along the boot heel of what is

which bends and breaks through earthquakes, makes up the outermost 30 to 50 km of rock. The mantle, which comprises almost 76% of the Earth and stretches from the crust to the core, is stiff at its shallow depths but flows like plastic deeper in the Earth. And the core, a mysterious zone of molten and solid iron, nickel and sulfur, which lies at 2200 km depth, is responsible for our magnetic field. The rigid crust and stiff part of the upper mantle combine to form the lithosphere or the "plates", which shift around on the surface of the Earth.



**A diagram showing the major layers in Earth. Note how the lithosphere is made of both crust and mantle material**

Understanding the relationship between the plastic-like mantle and the geologic features we see on the surface of lithospheric plates has fueled a longtime debate in the scientific community that is far from resolved. It boils down to two questions: is slow convection of mantle rock driving the movements and deformation of the Earth's lithospheric plates? Or, are movements of the Earth's lithospheric plates driving flow in the mantle? If we can understand why and how Earth's plates move, scientists agree, then we may be able to better understand earthquakes, volcanoes, and other significant geologic features.

Recent research shows that the lithosphere varies considerably in thickness, age and composition across the continent. Understanding these variations is key to understanding how the mantle and plates interact. For example, beneath the Great Plains the lithosphere is generally thick, stiff and over a billion years old. But, it appears in some places the younger and weaker lithosphere beneath the Rockies extends across the Great Plains and into Kansas. There are also anomalies in the thickness and density of the lithosphere beneath Iowa and Minnesota that do not correspond to geologic features at the surface and these remain to be explained. The USArray will be particularly good at gathering information about the behavior and characteristics of the mantle, and scientists hope it will help us understand what's happening in the Great Plains. EarthScope is motivating geoscientists who work in that region to increase collaborations and resolve these questions.

One such scientist is Mary Hubbard of Kansas State University. Dr. Hubbard is a structural geologist who has spent much of her career studying mountain ranges including the Rockies. Dr. Hubbard is organizing the "USArray and the Great Plains Pre-EarthScope Workshop" at Kansas State this April to make plans for carrying out EarthScope-related experiments. Dr. Hubbard and her fellow Kansas State co-organizers Steve Gao, Kelly Liu, Jack Oviatt, and Kirsten Nicolaysen, are currently soliciting participants for the workshop from different disciplines and different workplaces, including academia and government.



**View a QuickTime presentation on the USArray.**

The main question to be discussed at the workshop is how to best use USArray to unravel the geologic history in the Great Plains region. The USArray itself will be a group of instruments that are systematically moved across the United States, gathering slices of information about the inner Earth.

USArray will deploy about 400 seismometers, placed about 70 km apart on land, which will record very small to large shaking of Earth due to earthquakes or man-made explosions such as those at a local mine. Interpreting these recorded vibrations allows scientists to create a rough image of the shape and composition of the rock layers underground. The quality of the image and the depth at which scientists can gather good information actually depends on the distance between the seismometers. The spacing acts much like a focus on a camera, gathering seismic signals from a specific depth below the surface. At 70 km apart, the USArray will be particularly good at imaging the mantle.

In addition, the roving grid of USArray seismometers will be accompanied by another 2,500 seismometers that scientists can use for more detailed studies of the crust and mantle in particular places of interest. Determining which areas of the Great Plains would benefit most from these detailed investigations is a main goal of the workshop, Hubbard says.

Because the placement of the extra instruments is flexible, it means scientists will also need to decide on a depth inside the Earth that they want to study. If they put the seismometers close together, they can image features closer to the surface of the Earth than the main portion of the USArray.

Hubbard hopes the workshop will identify sites of geologic interest and give the Great Plains more of the attention she believes it deserves. Meeting organizers also plan to showcase the middle of the continent. Workshop participants will journey to the Konza Prairie, a tall grass prairie preserve in the Flint Hills of eastern Kansas to get a better feel for the geology and ecology of the region, and perhaps catch a glimpse of a reintroduced buffalo.

## More information

[Register for the USArray and the Great Plains Workshop](#)

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