Arctic system model and to develop a suite of high-resolution tools to understand the Arctic as an integrated system, refine model intercomparison, reduce uncertainty in Arctic climate projections, and provide meaningful tools for stakeholders to plan for future conditions in the Arctic.

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This forum emphasizes the theme of innovative technologies and their application to a healthy and prosperous environment. Through plenary talks, thematic breakout sessions, a technology expo, and exhibits, participants will learn about the role of technology in environmental protection as well as in the United States's economic success in the global environment.

FORUM

Rationale for a Permanent Seismic Network in the U.S. Central Plains Utilizing USArray

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The eastern two thirds of the coterminous United States (from the Rocky Mountain Front to the east coast) are sparsely equipped with seismic monitoring instruments, with the number of permanent broadband seismic stations per unit area of the order of 5–10% of that in the western U.S. orogenic zone. In this Forum, we use the Central Plains area (CP)—defined here as the four-state area including Nebraska, Kansas, Iowa, and Missouri—as an example to argue that a greatly densified permanent seismic network in the stable part of the United States could significantly improve our understanding of the processes that led to the formation and four-dimensional structure of the continental lithosphere. The network would also serve as an excellent facility for long-term earthquake monitoring and for public education and outreach. This issue is timely because a state-of-the-art, uniform network could be established by simply converting a small portion of the portable stations in the ongoing USArray project into permanent ones without affecting the overall progress of the USArray.

An ideal regional seismic network should have identical instruments, utilizing a single set of data recording parameters with real-time data transfer and professional data archival, and it should be professionally sited and constructed. Stations in the transportable array (TA) component of the USArray, which will occupy a total of 156 sites in the CP region between 2009 and 2013, have all of the characteristics of an ideal network. By converting some of the TA stations after their 2-year deployment to permanent sites, an ideal regional network could be established without removing the TA stations and without the extra cost of reinstallation.

On 4 June 2007, a group of about 20 geoscientists from the four CP states and representatives from EarthScope and the Incorporated Research Institutions for Seismology (IRIS) participated in the organizational meeting of the Central Plains EarthScope Partnership (CPEP) at the University of Missouri at Kansas City. One of the goals of CPEP is to coordinate an organized effort to convert about 10% (~16) of the TA stations to be installed in the CP area into permanent stations. We estimate that these converted stations, together with existing stations and new stations to be installed by various agencies in the next several years, will increase the number of stations per state from the current one or two to seven or eight (excluding the New Madrid Seismic Zone).

Like most other areas of the stable part of the North American continent, the Central Plains area is characterized by a diverse amalgamation of tectonic features developed over the past 2 billion years. Boundaries between three major Precambrian terranes and one of the largest continental rift systems on Earth (the Midcontinent Rift) are located in this area. Preliminary geophysical studies suggest that the mantle transition between the western U.S. orogenic zone and the stable North American craton lies within the western part of this area. In addition, the New Madrid Seismic Zone is the locale for some of the most significant historical earthquakes in the United States (see Figure 1, in the online supplement to this *Eos* issue; http://www.agu.org/eos_elec). Therefore, detailed geoscientific studies of the CP will significantly improve our understanding of (1) the growth, modification, and destruction of the continental lithosphere; (2) the nature of the active-to-stable transitional area in the mantle; and (3) the formation mechanism of intracontinent earthquakes. However, the lack of damaging historic earthquakes in most of the CP has resulted in fewer geophysical research efforts relative to the western United States.

Scientific Rationale

The permanent network would significantly expand the USArray's capability for understanding the formation, dynamics, and structure of the North American continent, as well as expand its capability for seismic hazard mitigation and public education and outreach. Because of the limited duration of recording and the unfavorable location of the CP in terms of the availability of the *SKS* phase (*P*-to-*S* converted phase at the core-mantle boundary) from the world's major earthquake zones, a low number of high-quality *SKS* arrivals are expected for the 2-year deployment period of the transportable array. Although such data would be sufficient to obtain a pair of averaged splitting parameters, they would be inadequate for studying complex anisotropy such as multiple anisotropy layers [*Marone and Romanowicz*, 2007]. In addition, most seismic tomographic techniques using either body waves or surface waves require as many as possible high-quality raypaths from different azimuths and with different angles of incidence to obtain high-resolution images of the Earth's interior. Thus, a densified permanent seismic network would lead to greater resolving power of virtually all the seismic tomographic techniques.

Although earthquakes have not been a serious public concern for the CP (except for the New Madrid Seismic Zone), damaging historical earthquakes have occurred in this area, which is the home of numerous earth-embankment dams and essential structures such as various types of power stations. In addition, the mechanism that forms intracontinental earthquakes is still unknown. The 2-year recording period of the TA was chosen to balance the need for the TA to progress across the country in a timely manner and the need to record a sufficient amount of data for mapping large-scale structures, and thus the TA was not designed for monitoring earthquakes. A permanent seismic network in the CP would significantly improve the detection threshold of small earthquakes, and consequently would make it possible to identify and characterize potentially active basement faults. This improvement, in turn, would increase our understanding of intracontinental earthquakes, assist in the reduction of earthquake hazards, and vastly improve long-term public planning.

A potential network of permanent seismic stations in the CP area is an excellent facility for educating the next generation of geoscientists and for public outreach. The network would continue the legacy and excitement about geoscience already being created by the transportable array among the general public and in schools [*Levy and Taber*, 2005]. An improved understanding of the true nature of science and scientific research by the general public is essential for the well-being of the entire scientific community because the public provides the underlying support for ongoing research. Thus, the education and outreach efforts that utilize the permanent seismic network would benefit not only the geophysical community, but also the physical sciences in general, and at many levels of understanding.

In summary, creating a permanent seismic network in the Central Plains by converting some of the transportable array stations is a unique opportunity. The proposed conversion is cost-effective and would serve the public interest for many decades to come. By taking advantage of USArray, CPEP could set a model of coordinated effort to improve seismic station coverage in tectonically stable areas.

Acknowledgments

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—Stephen S. Gao, Missouri University of Science and Technology, Rolla; E-mail: sgao@mst.edu; Tina M. Niemi, University of Missouri at Kansas City; Ross A. Black, University of Kansas, Lawrence; Kelly H. Liu, Missouri University of Science and Technology, Rolla; Raymond R. Anderson, Iowa Geological Survey, Iowa City; Robert M. Joeckel, Nebraska Geological Survey, Lincoln; and Robert W. Busby and John Taber, Incorporated Research Institutions for Seismology, Washington, D. C.

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There are several types of committees: committees of Council, policy and operating committees, and medal and award selection committees. The Council designates the committees of the Council. The Union president appoints the chairs and members of the other Union committees and most ad hoc working groups.

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Hess Medal: For the constitution and evolution of the Earth and other planets.

Horton Medal: For hydrology.

Lehmann Medal: For the structure, composition, and dynamics of the Earth's mantle and core.

Revelle Medal: For atmospheric sciences, atmosphere-ocean coupling, atmosphere-land coupling, biogeochemical cycles, or related aspects of the Earth system.

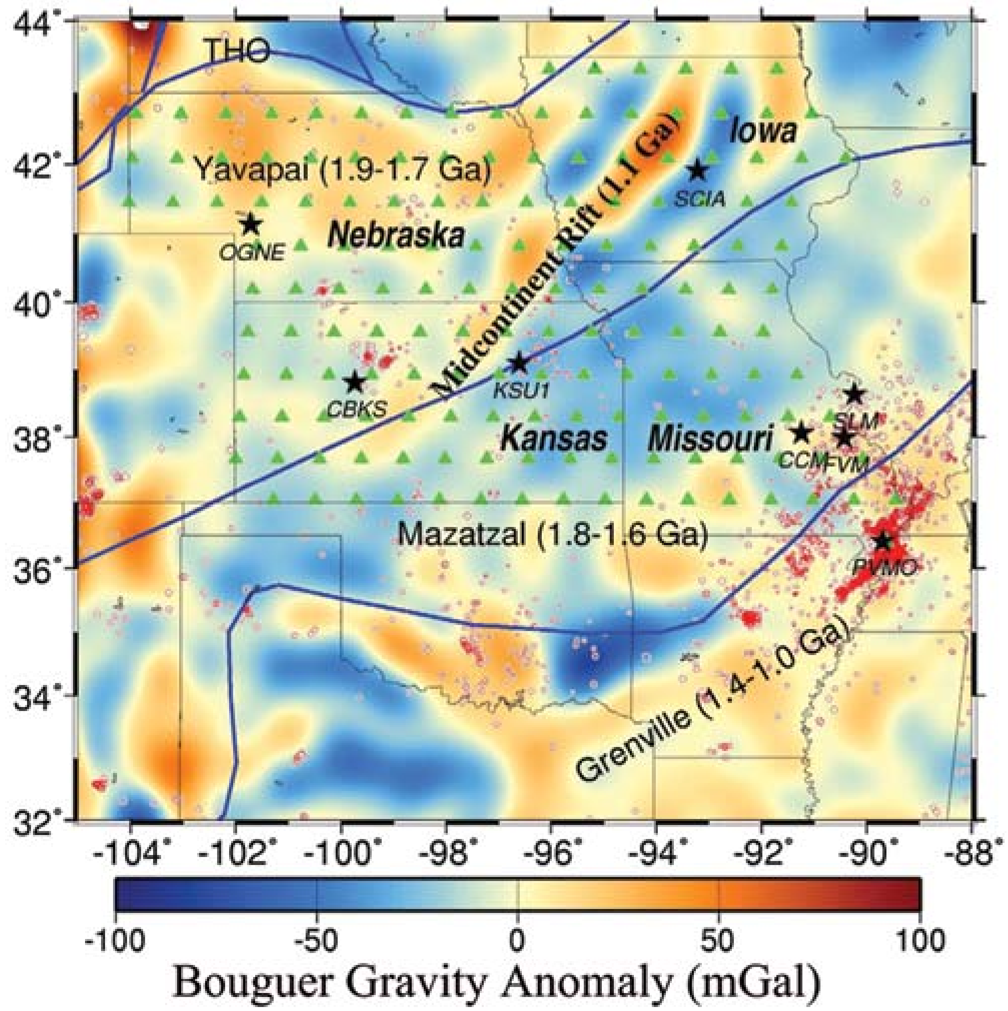

Fig. 1. Bouguer gravity map and major tectonic features of the Central Plains and adjacent areas. Triangles represent planned transportable array (TA) stations in the four-state area of Nebraska, Kansas, Iowa, and Missouri; stars are existing broadband seismic stations; and dots are earthquakes. Some of the TA stations will be converted into permanent stations, as described in the article. THO stands for Trans-Hudson Orogen. Blue lines separate crustal blocks with different ages, which become progressively younger toward the south. Bouguer gravity anomalies are measures of spatial variations of the density of underground rocks. High gravity values (warm colors; see the scale bar at the bottom of the figure) correspond to geologic features with dense rocks (such as the Midcontinent Rift, which is filled with heavy igneous rocks buried by younger sedimentary rocks), and low values (cool colors) in the study area correspond mostly to sedimentary basins. Although most of the pre-Cambrian crystalline basement rocks beneath the Central Plains are covered by younger sedimentary rocks and thus cannot be studied directly, major tectonic features can be observed from the gravity anomalies. The permanent seismic network advocated in the article would enable a significantly improved understanding about the formation, evolution, and structure of these tectonic features and their roles in the formation and distribution of earthquakes in the Central Plains.