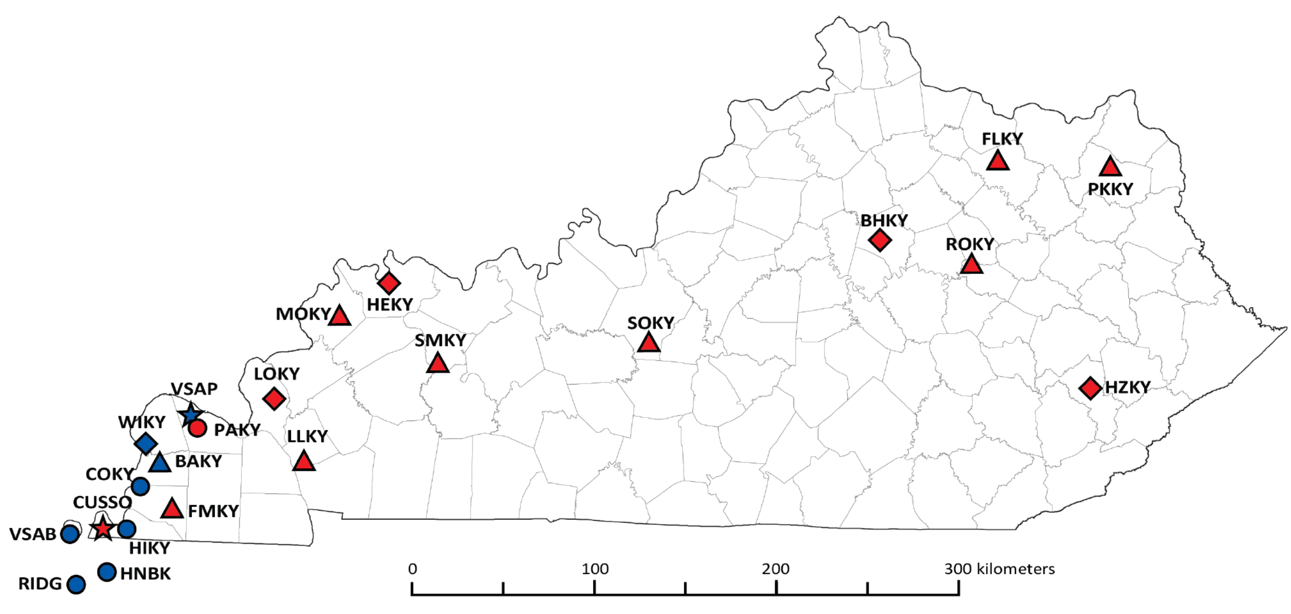
Kentucky Geological Survey
William C. Haneberg, State Geologist and Director
University of Kentucky, Lexington

The Kentucky Seismic and Strong-Motion Network: History, Service, and Research

Ronald L. Street, Zhenming Wang, N. Seth Carpenter, and Edward W. Woolery



Special Publication 1 Series XIII, 2021

On the cover: Locations of real-time and stand-alone stations in the Kentucky Seismic and Strong-Motion Network.

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Ronald L. Street
University of Kentucky, Department of Earth and Environmental Sciences, Associate Professor Emeritus

Zhenming Wang
Kentucky Geological Survey

N. Seth Carpenter
Kentucky Geological Survey

Edward W. Woolery
University of Kentucky,
Department of Earth and Environmental Sciences

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Our Mission

The Kentucky Geological Survey is a state-supported research center and public resource within the University of Kentucky. Our mission is to support sustainable prosperity of the commonwealth, the vitality of its flagship university, and the welfare of its people. We do this by conducting research and providing unbiased information about geologic resources, environmental issues, and natural hazards affecting Kentucky.

Technical Level

General — Intermediate — Technical

Statement of Benefit to Kentucky

The Kentucky Seismic and Strong-Motion Network provides the commonwealth of Kentucky with information on earthquakes and seismic hazards needed to improve our understanding of the seismotectonic background in and around Kentucky and seismic-hazard assessments used to develop mitigation measures and engineering design. The real-time information provided on earthquakes in and around Kentucky, as well as throughout the nation and the world, makes the network an essential facility.

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The Kentucky Seismic and Strong-Motion Network: History, Service, and Research

Ronald L. Street[1], Zhenming Wang[2], N. Seth Carpenter[2], and Edward W. Woolery[3]

Abstract

The development of the Kentucky Seismic and Strong-Motion Network in 1980 coincided with the commonwealth of Kentucky's need for scientific information on earthquakes and seismic hazards. The data acquired by the network not only provide the foundation for earthquake research at the University of Kentucky, but also for seismic-hazard assessments to support the development of mitigation measures and engineering design. The network has become an essential facility, operated by the Kentucky Geological Survey at the University of Kentucky, to monitor earthquakes and provide information on earthquakes and seismic hazards for the commonwealth.

Introduction

Because the foundation of scientific research is data, Ron Street, then an early-career geophysics professor in the Department of Geology (currently the Department of Earth and Environmental Sciences) at the University of Kentucky, began the Kentucky Seismic and Strong-Motion Network in 1980 to collect earthquake data.

Street established the Seismic Lab with his start-up research funding when he was hired. The first seismic station in Kentucky, L6KY, was installed at Lock 6 of the Kentucky River in mid-July 1980. Since then, the Seismic Lab's successor, the Kentucky Seismic and Strong-Motion Network, has been expanded significantly, although not without some operational difficulties.

The network was housed in Room 309 of the Slone Research Building and operated by Street until 2001, when it was relocated to Room 243B of the Mining and Mineral Resources Building. The network was operated by Zhenming Wang of KGS from 2001–2012 and has been operated by Seth Carpenter of KGS since May 2012.

Network Development Opportunities

The impetus for the network was Street's scientific curiosity, but it was also in response to the commonwealth of Kentucky's need for scientific information on earthquakes and seismic hazards following the July 27, 1980, L_g-wave magnitude 5.3 earthquake near Sharpsburg, Kentucky (Street and Foley, 1982). This earthquake, which was felt across Kentucky (Fig. 1), caused an estimated $4 million in damage (Minsch and others, 1981) and was the most significant seismic event in Kentucky since the New Madrid earthquakes in the winter of 1811-12.

A second important event in the development of the seismic network was a prediction by Iben Browning, a business consultant and author, that "for December 2 of this year [1990], plus or minus about two days, there is 50/50 probability of a large earthquake on the New Madrid zone" (www.dailymotion.com/video/x39gzo; last accessed 05/18/2021). Although the earthquake did not hap-

[1]University of Kentucky, Department of Earth and Environmental Sciences, Associate Professor Emeritus
[2]University of Kentucky, Kentucky Geological Survey
[3]University of Kentucky, Department of Earth and Environmental Sciences

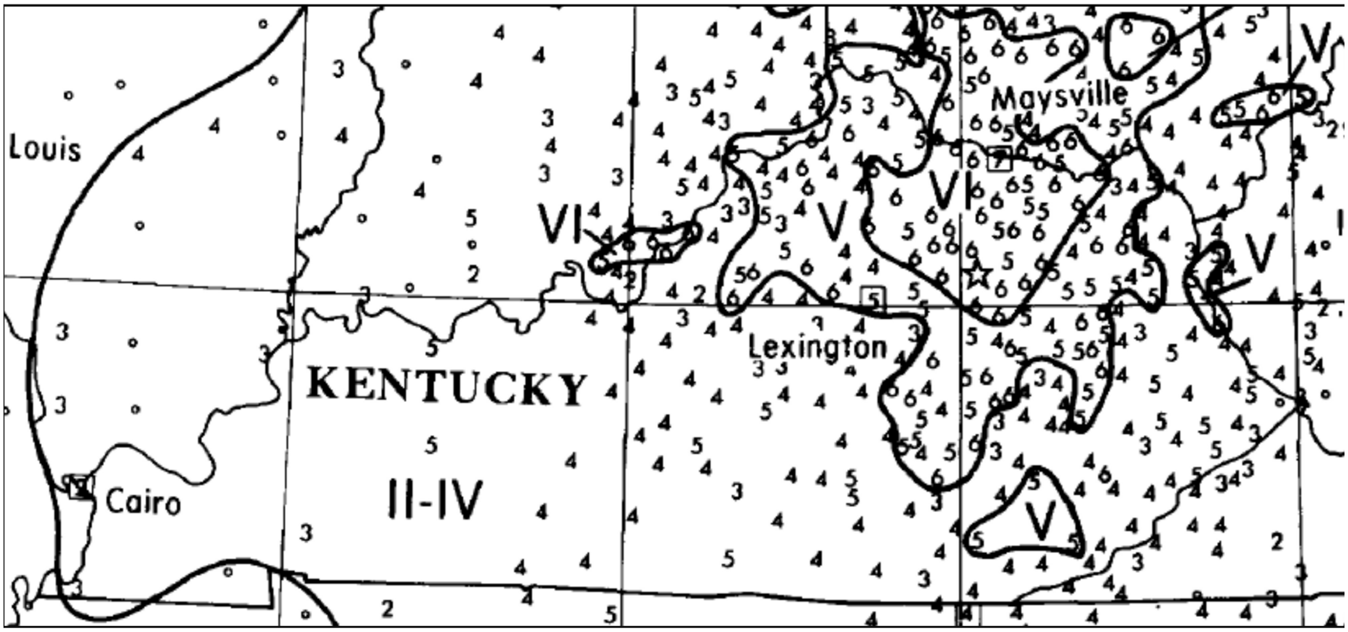


Figure 1. Isoseismal map for the Sharpsburg, Kentucky, earthquake of July 27, 1980 (Minsch and others, 1981). The epicenter is indicated with a star.

pen, the prediction captured the attention of the public and of national, state, and local government officials (Spence and others, 1993). As a result, the U.S. Geological Survey established an office in Memphis, Tennessee, in 1991 to coordinate and fund earthquake research and seismic-hazard assessment for the central and eastern United States under the National Earthquake Hazards Reduction Program (NEHRP). The Kentucky General Assembly directed the Kentucky Geological Survey and the University of Kentucky Department of Geology (now known as the Department of Earth and Environmental Sciences), through a budget modification, to expand the network to assist with earthquake hazard mitigation. Thus, after Browning's prediction, the Kentucky network was expanded significantly, particularly by adding strong-motion stations and vertical arrays in western Kentucky.

In the early 2000s, in order to address high seismic-design requirements for homes, buildings, highway structures and bridges, and critical facilities in western Kentucky, the network was expanded further (Structural Engineers Association of Kentucky, 2002; Wang, 2003). The short-period design response accelerations for western Kentucky and the San Francisco Bay Area developed by NEHRP (Building Seismic Safety Council, 1997) (Fig. 2) indicated higher seismic-design requirements for Paducah, Kentucky, than for San Francisco: the short-period design response acceleration for Paducah was about 1.75 g whereas for San Francisco was 1.50 g. These 1997 NEHRP provisions were adopted by federal agencies such as the Environmental Protection Agency, state agencies such as the Kentucky Cabinet for Energy and Environment, local governments, and nongovernmental organizations concerned with seismic design and other policies. Unfortunately, the very restrictive building construction requirements in these provisions resulted in permitting problems in western Kentucky. For example, the U.S. Department of Energy was not able to obtain a permit from federal and state regulators to construct a landfill at the Paducah Gaseous Diffusion Plant, a federal facility to produce enriched uranium, because of the high seismic-design requirement.

To address these requirements, the Kentucky Geological Survey held a workshop on Nov. 18, 2002, attended by 110 persons from federal and state agencies, local governments, universities, private organizations, and the public (Wang, 2003). As a result of the workshop, KGS received funding from federal agencies including DOE and USGS; state agencies including the Cabinets for Economic

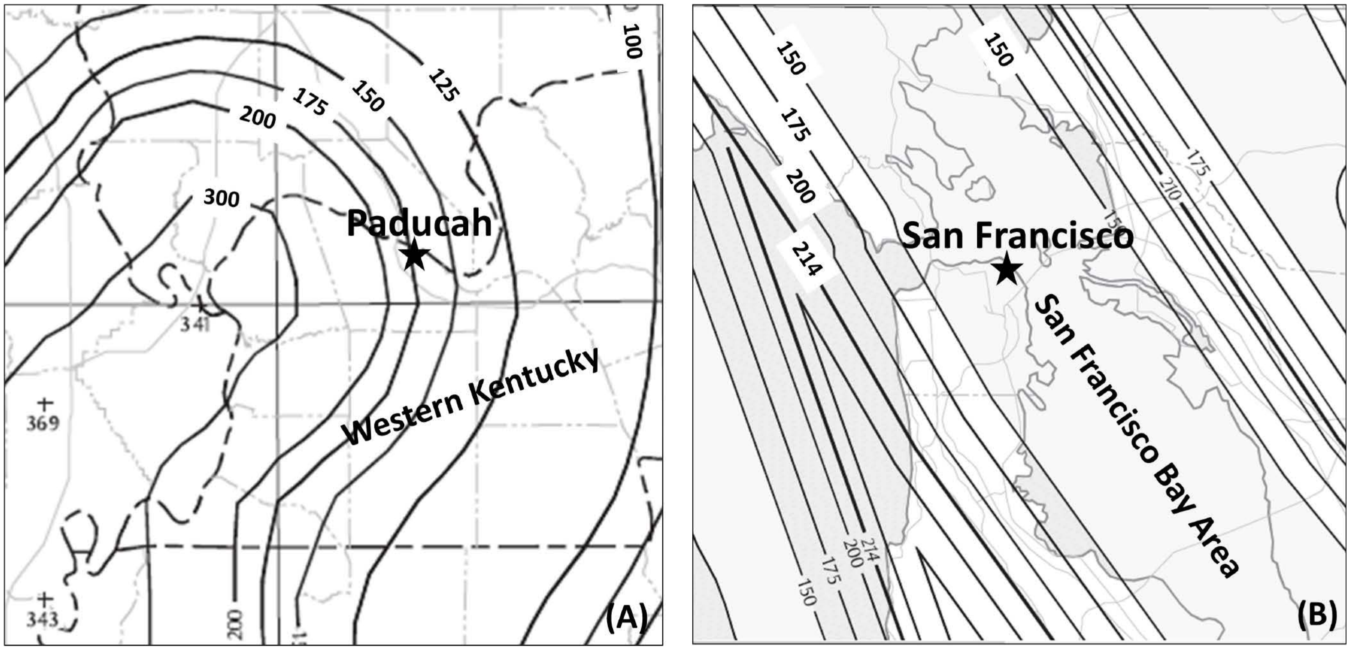


Figure 2. The 1997 NEHRP short-period design response accelerations for western Kentucky (A) and the San Francisco Bay Area (B) (Building Seismic Safety Council, 1997). Acceleration is measured as a percentage of gravity (g).

Development, Transportation, and Energy and Environment; and other organizations including the Kentucky Research Consortium for Energy and Environment and Kentucky Transportation Center to conduct research related to the high seismic-design requirements (Wang and others, 2003, 2008; Wang and Woolery, 2008, 2013; Orton and others, 2016). As a component of this research, more seismic and strong-motion stations, including the Central U.S. Seismic Observatory (CUSSO), were installed in western Kentucky (Woolery and Wang, 2002, 2010; Wang and Woolery, 2010).

Seismic Network

The first seismic station in Kentucky, L6KY, was installed at Kentucky River Lock 6 in July 1980. The seismographs installed at L6KY had three-component short-period seismometers (Fig. 3a). A dedicated telephone line transmitted the data from L6KY to the Seismic Lab on the UK campus, and the first paper seismic record was obtained on Nov. 15, 1980 (Fig. 4). The second seismic station in the network, BHKY, was installed on the UK campus in mid-June 1982; it consisted of a single vertical-component seismometer in a borehole in front of Bowman Hall. Following the Sharpsburg earthquake in 1980, a grant from the U.S. Nuclear Regulatory Commission was secured to establish three temporary seismic stations, each with a single vertical-component seismometer, in Sharpsburg (SBKY), Judy (JUDY), and Owingsville (OWGS), Kentucky. The data from these three stations were transmitted through dedicated telephone lines to the Seismic Lab. SBKY was in operation from June 1981 to May 1983, JUDY operated from January to July 1982, and OWGS operated from August 1981 to January 1982. These three stations were closed after completion of the Nuclear Regulatory Commission project. All equipment and seismometers were subsequently reused to establish new permanent seismic stations elsewhere in Kentucky.

In July 1984, the first seismic station that made use of the robust, all-weather Kentucky Emergency Warning System communications network was installed at a KEWS substation near Sacramento, Kentucky. KEWS was built as a statewide public-safety communication system in 1979, and is operated and maintained by the Kentucky Commonwealth Office of Technology (technology.ky.gov/KEWS; accessed January 2021). The data from SMKY were transmitted through the KEWS network to the Seismic Lab on the UK campus. The KEWS facilities and communications network provided significant cost savings and increased efficiency of

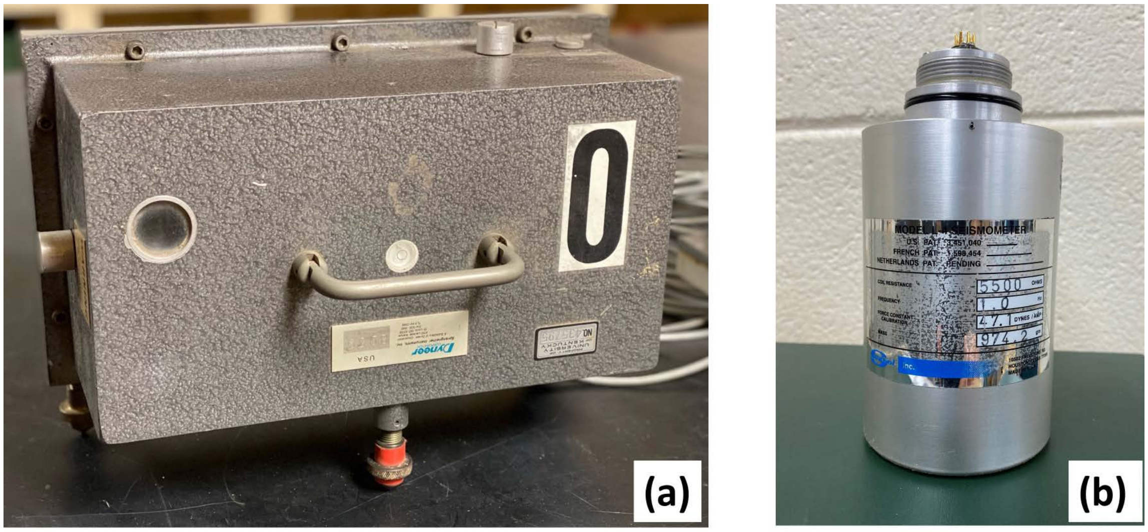


Figure 3. (a) Horizontal-component seismometer installed at the first seismic station, L6KY, at Kentucky River Lock 6 in July 1980. (b) Single vertical-component seismometer, one of which was installed at each of the temporary stations SBKY, JUDY, and OWGS in Sharpsburg, Judy, and Owingsville, Kentucky, respectively.

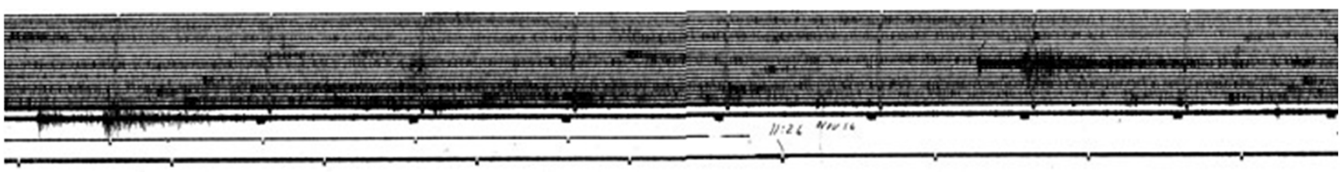


Figure 4. Scanned copy of the first paper seismic recording from station L6KY obtained at the University of Kentucky on Nov. 15, 1980.

seismic-station operation and maintenance. Station L6KY was decommissioned in April 1988 because of the significant cost of the dedicated telephone line for transmitting its data. Subsequently, more permanent seismic stations were installed at other KEWS substations throughout Kentucky: SOKY near Sonora in October 1984, PKKY near Grayson in May 1985, LLKY in the Land Between the Lakes in September 1985, FMKY in Fulgham in October 1986, FLKY in Flemingsburg in October 1989, MOKY near Morganfield in October 1989, ROKY near Stanton in November 1989, PAKY at the Paducah airport in November 1990, and LOKY near Salem in June 1993. These stations, each operating a single vertical-component seismometer (Fig. 3b), formed the backbone of a real-time network for monitoring seismicity in Kentucky.

Three additional seismic stations—CUSSO, HEKY, and HZKY—were added to the permanent seismic network later. HEKY was installed with three-component (two orthogonal horizontal components and a vertical component) short-period seismometers at the Kentucky Geological Survey's western Kentucky office in Henderson in August 2005. A three-component medium-period seismometer was installed at CUSSO near Sassafras Ridge in Fulton County in western Kentucky in October 2009. A vertical-component seismometer was installed at the Perry County Library in Hazard, in eastern Kentucky, in December 2012. The data from these three stations are transmitted through the internet in real time to the UK campus. Figure 5 shows the locations of the current real-time seismic stations in Kentucky; the recordings from these stations can be accessed at www.uky.edu/KGS/earthquake (last accessed March 2021).

Similar to the temporary seismic stations installed for the Nuclear Regulatory Commission project, a temporary seismic network of six short-period seismic stations—ARKY, BAKY, BLKY, DEKY, LAKY, and LVKY—was installed in the Jackson Purchase Region in 2002-03 for a project funded by the Kentucky Cabinet for Economic Development (Fig. 6) (Wang and others, 2003). The

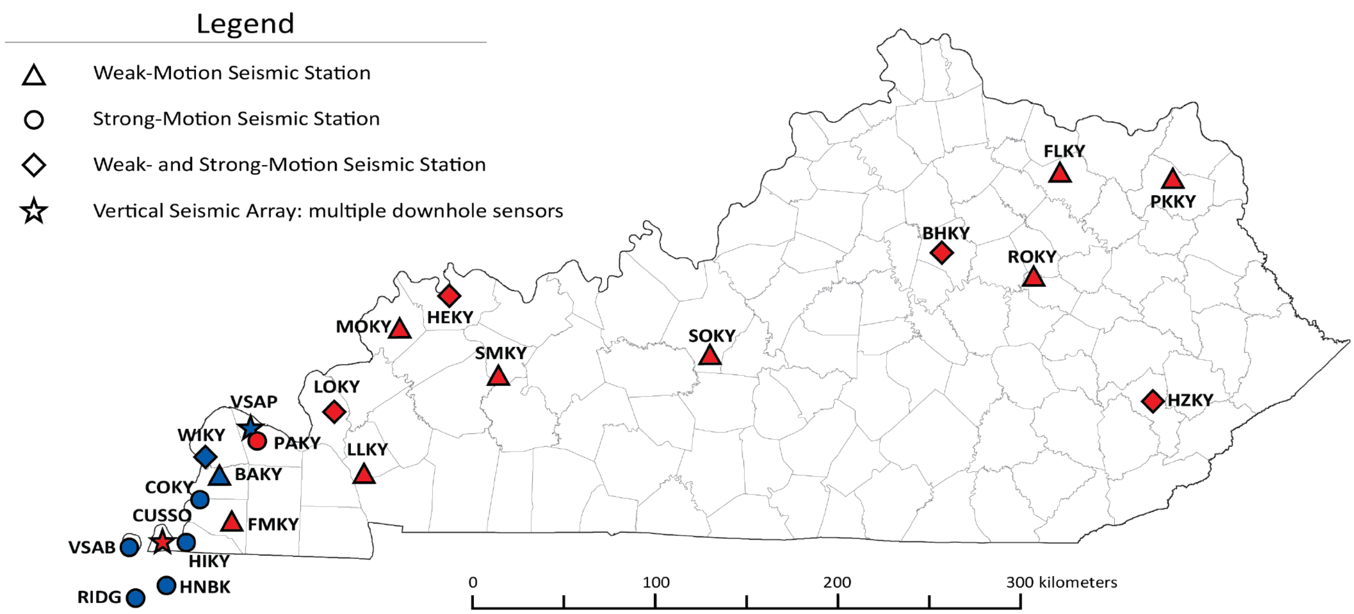


Figure 5. Real-time and standalone stations in the Kentucky Seismic and Strong-Motion Network. Red indicates real-time stations and blue indicates standalone stations.

temporary network operated from 2003 to 2007 and was removed after the project ended. The equipment and seismometers were reused to upgrade permanent seismic-network stations later.

A temporary network of 14 broadband sensors and 24-bit dataloggers was deployed in eastern Kentucky in mid-2015 and November 2015 through a partnership between KGS, the UK Department of Earth and Environmental Sciences, Cimarex Energy Co., and Nanometrics (Carpenter and others, 2019) (Fig. 7). This temporary network was used to characterize natural seismicity rates and the conditions that might lead to induced or triggered events if hydraulic fracturing and fluid injections take place in the future. Eight stations remained in operation during preparation of this report as part of a project funded by the U.S. Department of Energy to continue characterizing microseismicity in the Rome Trough. These stations are scheduled to be decommissioned in 2021, and the instruments from them will be reused for upgrades at permanent Kentucky network stations.

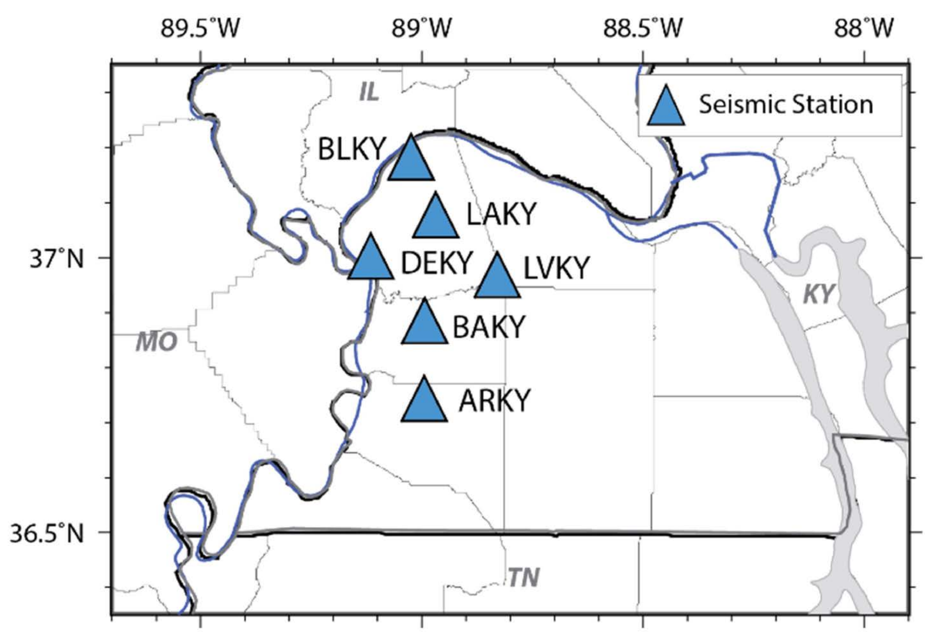


Figure 6. Locations of the temporary seismic network stations in the Jackson Purchase Region.

Strong-Motion Network

With funding from the University of Kentucky, strong-motion (strong enough to cause damage to homes and other structures) instrumentation was incorporated into

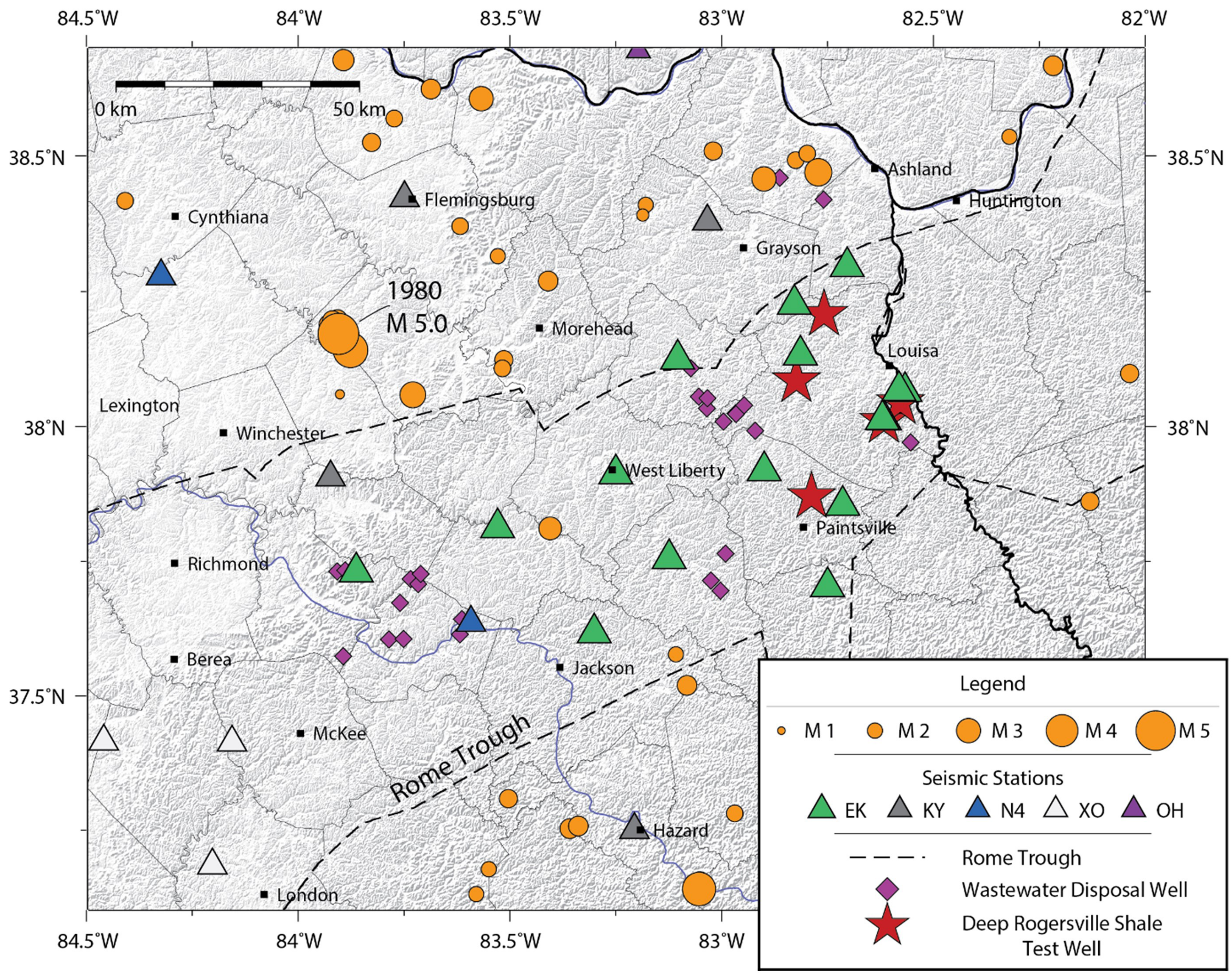


Figure 7. Eastern Kentucky Microseismic Monitoring Network stations (green) and other seismic stations that operated during at least part of the microseismic network operation in eastern Kentucky. The deep Rogersville Shale wells are horizontal wells drilled by industry to test for oil and gas potential.

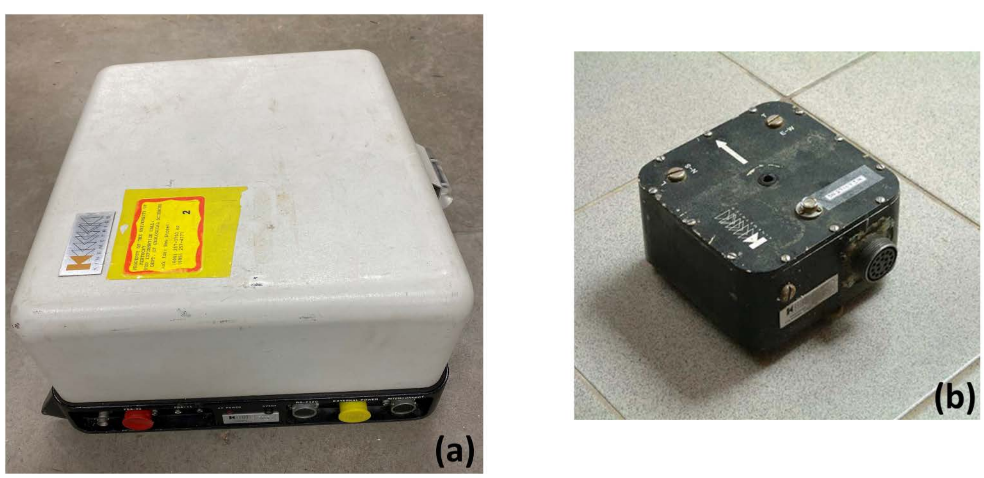


Figure 8. Accelerograph (a) and accelerometer (b) used in Kentucky Seismic and Strong-Motion Network strong-motion stations.

the network in 1989 with the installation in western Kentucky of free-field stations using accelerographs and accelerometers (Fig. 8). The strong-motion network is aimed at recording ground motions that are strong enough to cause damage to homes and other facilities. The first stations established were COKY at Belmont-Columbia State Park, HIKY at the National

Guard armory in Hickman, and WIKY at Wickliffe Mounds State Historical Site in Wickliffe (Fig. 6). Most strong-motion stations are configured to operate in trigger mode (i.e., the station will be triggered to record ground motion if the motion exceeds a set threshold), and data are stored locally. The first strong-motion record was obtained at station HIKY on Sept. 26, 1990, from an $m_{b,Lg}$ 4.5 earthquake in the New Madrid Seismic Zone (Fig. 9).

Additional strong-motion stations have been installed since 1990, including stations RIDG and HNBK, which were turned over to UK by the Lamont-Doherty Earth Observatory of Columbia University. Accelerographs and accelerometers were installed in these stations. The first vertical strong-motion array, VSAP, was at the Paducah Gaseous Diffusion Plant (Fig. 6). Figure 10 shows the instrument configurations on the surface and in boreholes at VSAP (Street and others, 1995, 1997a). The first strong-motion recording at VSAP was from the Feb. 5, 1994, southern Illinois earthquake of $m_{b,Lg}$ 4.2 (Fig. 11) (Street and others, 1997a). Another vertical strong-motion array was installed to a depth of 120 m at VSAB in the Kentucky Bend area (Fig. 5) (Street and others, 1995), but was struck by lightning and destroyed shortly after both the downhole and surface accelerometers recorded the magnitude-3 earthquake on March 2, 1993.

In 2002, another borehole array, VSAS, was installed near Sassafras Ridge in Fulton County, Kentucky, with partial support from the U.S. Geological Survey (Woolery and Wang, 2002). The vertical accelerometer array at VSAS consisted of three three-component accelerometers, recorded on a 24-bit, 12-channel digital recorder. The deepest accelerometer was at the bottom of the 260-m-deep hole. The second accelerometer was at the bottom of a 30-m-deep hole. The third accelerometer was at the surface. Figure 12 shows the first record obtained at VSAS from the Oct. 21, 2004, Tiptonville, Tennessee, earthquake (M_d 2.5) (Wang and Woolery, 2006).

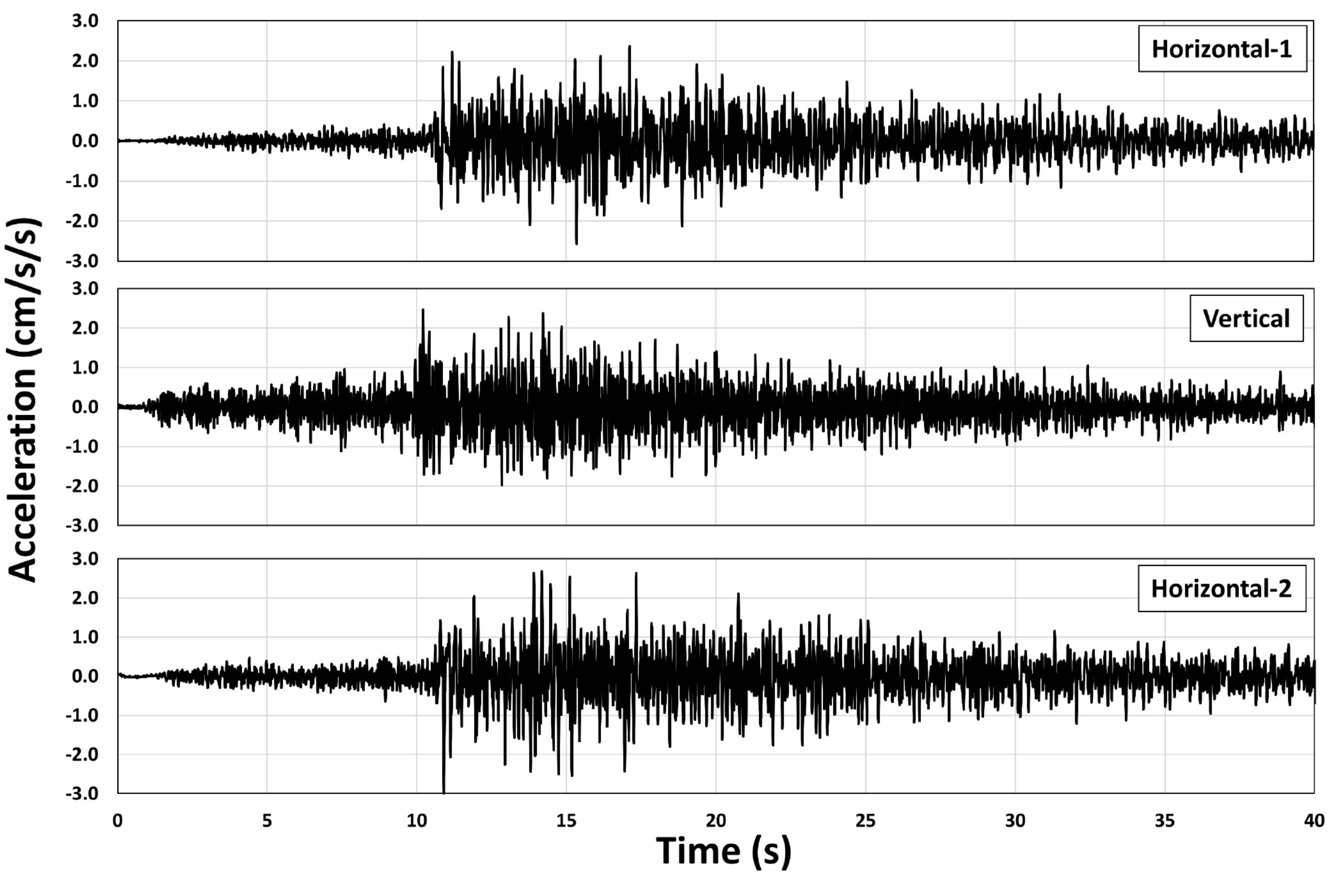
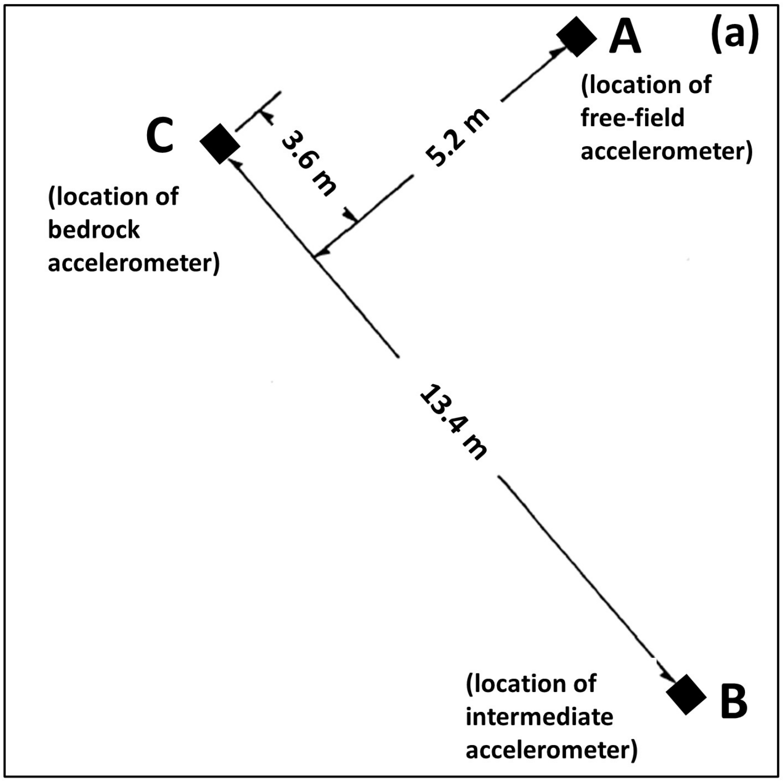


Figure 9. The first strong-motion record at station HIKY from the Sept. 26, 1990, $m_{b,Lg}$ 4.5 earthquake in the New Madrid Seismic Zone.



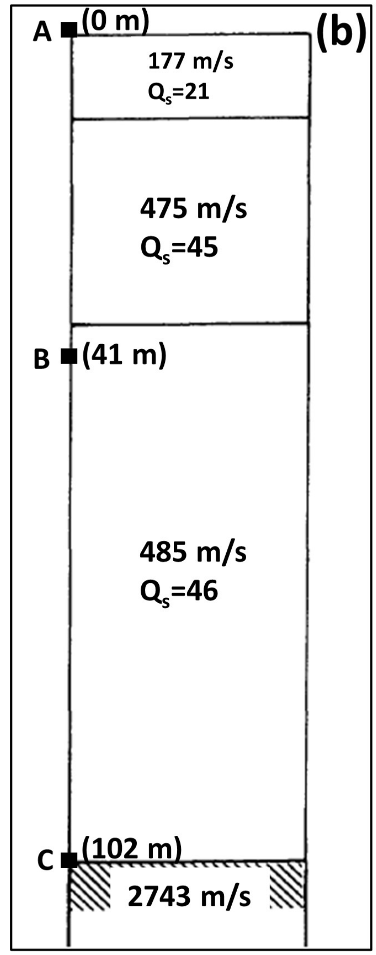


Figure 10. The instrument configurations on the surface (a) and in boreholes (b) at station VSAP (Street and others, 1997a).

In 2009, with support from the U.S. Department of Energy through the Kentucky Research Consortium for Energy and Environment and from the U.S. Geological Survey, a deep borehole with total depth of 595 m was drilled at VSAS and instrumented (Woolery and others, 2016). The station was then renamed the Central U.S. Seismic Observatory in 2009. Figure 13 is a schematic representation of the three-borehole arrays at CUSSO. A 24-bit, 36-channel datalogger was used to record and transmit data in real time to UK through wireless internet. Figure 14 shows waveforms recorded on the full CUSSO array from the Feb. 28, 2011, M4.7 Arkansas earthquake, 308 km to the west-southwest. In 2011, the sensors in the deepest borehole were damaged by high water pressure in the borehole, and an attempt to reinstall the repaired sensors in 2014 was not successful.

Thirteen network stations currently operate at least one strong-motion accelerometer, six of which telemeter data in near-real time to the Kentucky Geological Survey in Lexington.

Data

Seismic signals from the first permanent seismic stations were analog, transmitted through KEWS to UK and recorded on paper and a desktop computer at a rate of 100 samples per second. All paper seismic recordings were later scanned and archived at KGS through a data preservation project funded by the U.S. Geological Survey. In August 2003, an 18-bit, 36-channel digitizer was installed at UK to convert the telemetered analog signals to digital data files. Since 2011, digital recorders have been installed at all telemetered stations except for LLKY, using dataloggers procured

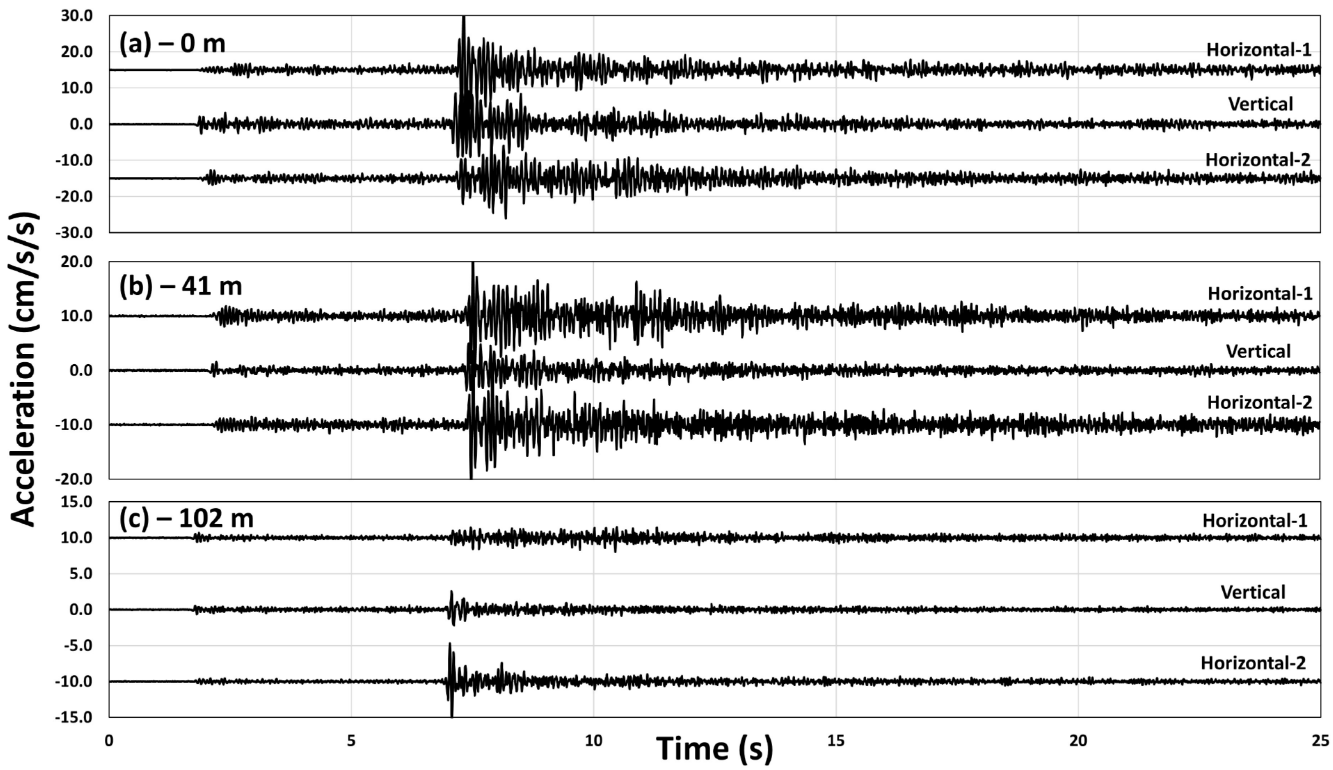


Figure 11. Accelerograms recorded at VSAP for the southern Illinois earthquake of Feb. 5, 1994, at the surface (a), 41 m beneath the surface (b), and at bedrock, 102 m beneath the surface (c).

during temporary projects. All digital seismic network data are archived at KGS on redundant disk arrays. Images of daily recordings from real-time seismic network stations are also posted online at www.uky.edu/KGS/earthquake.

KGS also shares its real-time data with the seismic network operated by the University of Memphis and with the Data Management Center at Incorporated Research Institutions for Seismology (ds.iris.edu/mda/KY; last accessed March 2021) for archiving and global usage. Recordings from seismic stations in and around Kentucky operated by other organizations are also acquired simultaneously by KGS to be used with our own data to analyze seismic events. As Figure 15 shows, the rate of usage of the Kentucky network data by global institutions has been increasing since IRIS began keeping track of data usage for the Kentucky network.

Sharing Kentucky Seismic and Strong-Motion Network data with other networks in the region has increased the sensitivity of earthquake monitoring in and around Kentucky. As shown in Figure 16, more smaller earthquakes have been identified and located in and around Kentucky since the establishment of the Kentucky network. Since the installation of station L6KY, more than three small-magnitude (less than 3) earthquakes have been located within the commonwealth each year on average, compared to an average of one approximately every five years for the prior period. The additional stations have also improved the accuracy of locating epicenters for local and regional earthquakes. For example, the average epicenter error for earthquakes that were located in the commonwealth during the instrumental era (since 1900) and prior to the network's inception was ±19 km. For earthquakes that occurred since the installation of station L6KY, the average error decreased to less than ±3 km.

Research and Results

Kentucky Seismic and Strong-Motion Network data have been used by numerous students for a variety of studies, including research projects

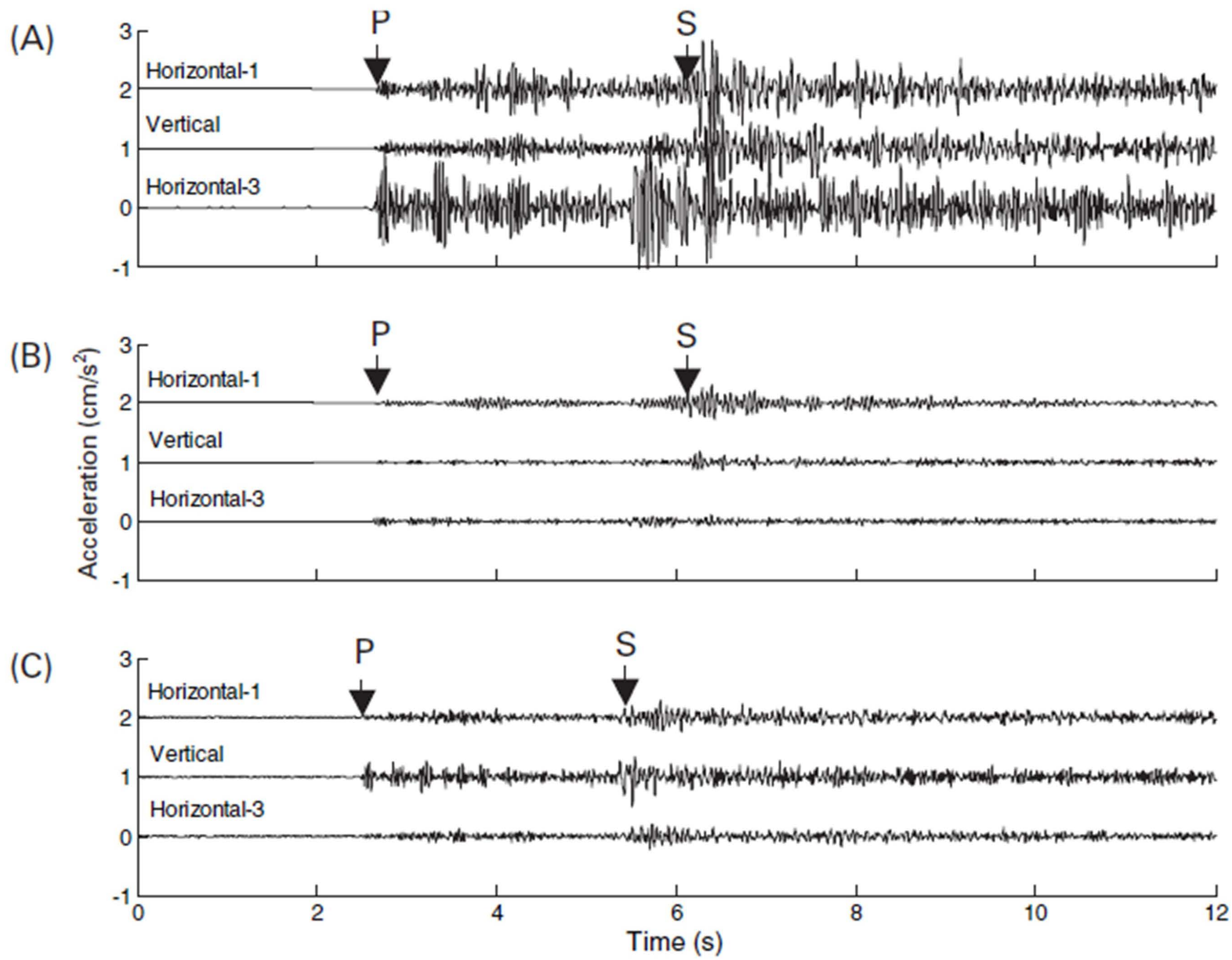


Figure 12. Acceleration recordings from the Oct. 21, 2004, Tiptonville, Tennessee, earthquake at vertical strong-motion array VSAS at the surface (A), 30 m deep (B), and 260 m deep (C).

by high school students, undergraduate students, and graduate students. They include:

1. Alex Zekulin (1985). Thesis: "Seismic Velocity Discontinuities in the Precambrian Basement of Southeastern Kentucky."
2. Mei Zhang (1991). Thesis: "Site Investigations and Corrections for the June 10, 1987, Southeastern Illinois Earthquake: Far-Field Particle Velocity Recordings."
3. James Harris (1992). Dissertation: "Site Amplification of Seismic Ground Motions in the Paducah, Kentucky, Area."
4. Alex Zekulin (1992). Dissertation: "Velocity Structure Variations of the Upper Mantle and Crust in Kentucky, Tennessee, Ohio, and Indiana."
5. Zhenming Wang (1993). Thesis: "Q_s Estimation for Unconsolidated Sediments and Site Amplification of Strong Ground Motion in Western Kentucky."
6. Brian Higgins (1997). Thesis: "Site Amplification of Earthquake Ground Motions in Unconsolidated Sediments in Henderson, Kentucky."
7. Zhenming Wang (1998). Dissertation: "Two-Dimensional Ground-Motion Simulation in the Upper Mississippi Embayment."
8. Ting-li Lin (2003). Thesis: "Local Soil-Induced Amplification of Strong Ground Motion in Maysville, Kentucky."
9. Cora Anderson and others (2005). Senior project (undergraduate): "Observed Seismicity in

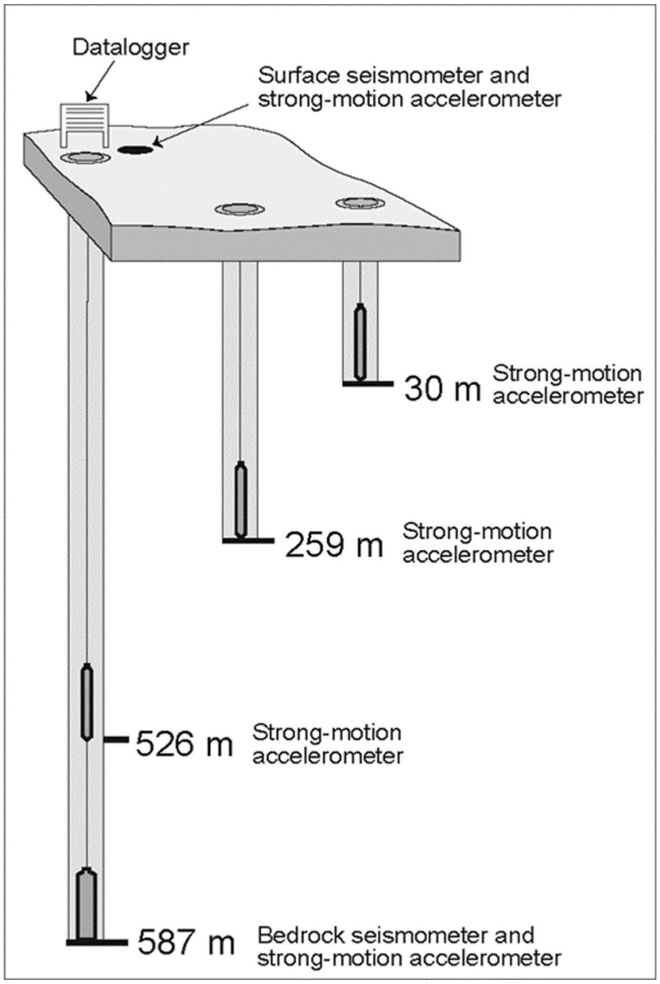


Figure 13. Schematic representation of the three-borehole CUSSO array, including the instrumentation and depth below ground surface. The 595-m-deep well is laterally separated from the 259-m-deep and 30-m-deep wells by 23.5 m and 25.5 m, respectively. The 259-m-deep and 30-m-deep wells are separated by 7.1 m. The free-surface instrumentation is offset from the 595-m-deep wellhead by 3.5 m.

the Jackson Purchase Region of Western Kentucky Between January 2003 and June 2005."

10. David Vance (2006). Thesis: "Shear-Wave Velocities and Derivative Mapping for the Upper Mississippi Embayment."
11. Jonathan McIntyre (2008). Thesis: "An Evaluation of Earthquake Ground-Motion Site Effects at Two Sites Underlain by Deep Soils in Western Kentucky."
12. Kenneth Macpherson (2009). Dissertation: "Long-Period Ground Motions in the Upper Mississippi Embayment From Finite-Fault, Finite-Difference Simulations."
13. Shoba Gowda (2011). Thesis: "One-Dimensional Ground-Motion Modeling at the Central United States Seismic Observatory."
14. Clayton Brengman (2014). Thesis: "Instrument Correction and Dynamic Site Profile Validation at the Central United States Seismic Observatory, New Madrid Seismic Zone."
15. Alice Orton (2014). Thesis: "Science and Public Policy of Earthquake Hazard Mitigation in the New Madrid Seismic Zone."
16. Paul Rodriguez Asihama (2016). Thesis: "Development of a Semi-automated Methodology for Discriminating Between Natural and Manmade Seismic Events Using the OIINK Seismic Array."
17. Kyle Combs and others (2017). Capstone project (high school senior): "Microseismicity in and Around Kentucky Using Permanent and Temporary Seismic Arrays."
18. Andrew Holcomb (2017). Thesis: "Initial Microseismic Recordings at the Onset of Unconventional Hydrocarbon Development in the Rome Trough, Eastern Kentucky."
19. Seth Carpenter (2019). Dissertation: "Characterizations of Linear Ground Motion Site Response in the New Madrid and Wabash Valley Seismic Zones and Seismicity in the Northern Eastern Tennessee Seismic Zone and Rome Trough, Eastern Kentucky."

Using data from the Kentucky network has enabled researchers at UK to systematically review national and regional earthquake catalogs and to differentiate between natural earthquakes in Kentucky and seismic events from mining or other human activities. Street and others (2002) found that 46 percent of the identifiable events listed as earthquakes for the years 1984 through 1999 in national and regional catalogs in Kentucky were in fact blasts or other mining-related phenomena. Including blasts and other mining-related disturbances in the earthquake catalog could result in an incorrect estimate of the rate of seismicity and, consequently, the seismic hazard for Kentucky (Street and others, 2002). Discriminating between natural earthquakes and mine blasts is a time-consuming, manual task that requires analyst judgment. To increase analyst efficiency and reduce the risk of incorrectly categorizing recorded seismic events, researchers at KGS developed an automated procedure using machine

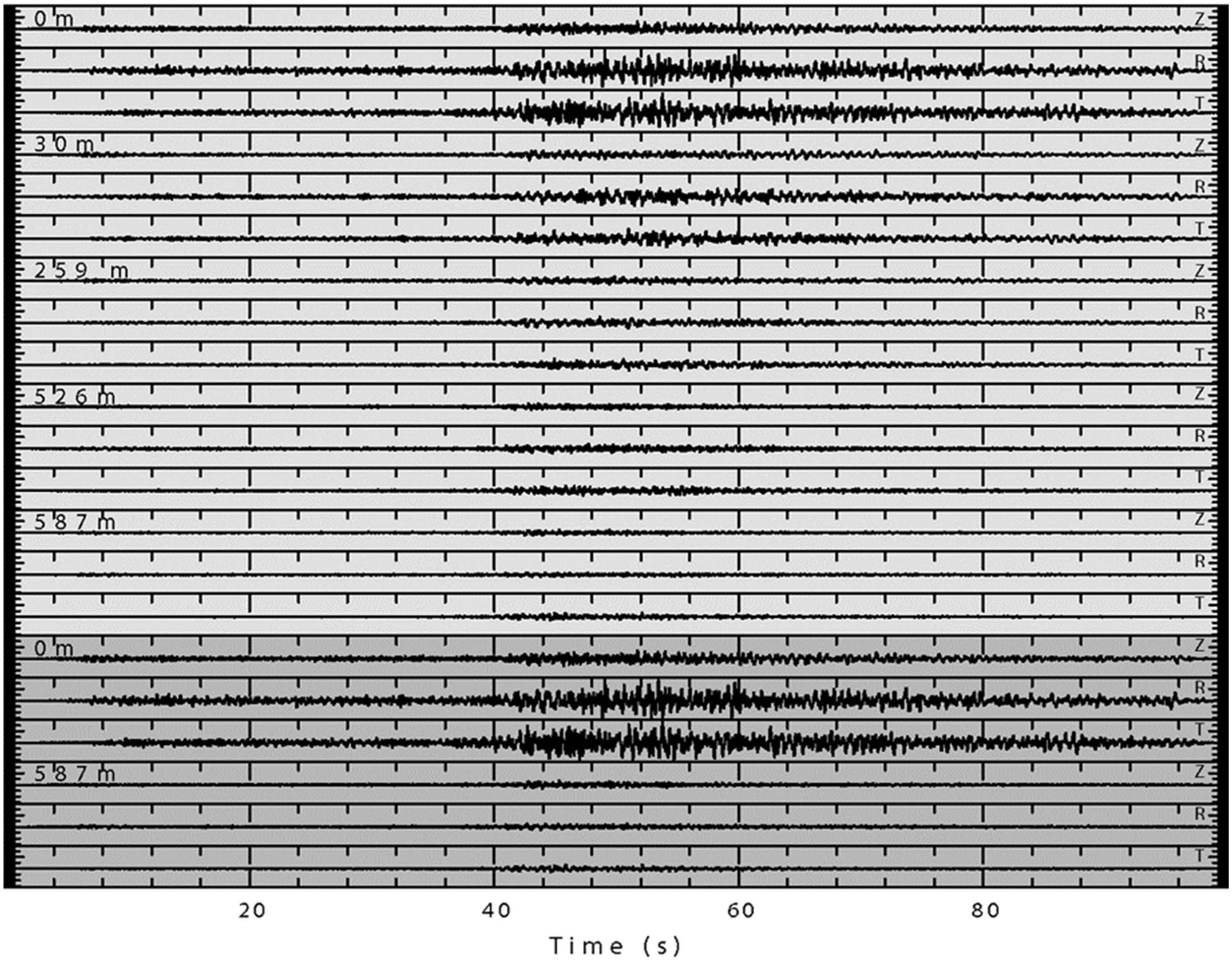


Figure 14. Waveforms from the Feb. 28, 2011, M_w 4.7 Arkansas earthquake, 308 km to the west-southwest, recorded by the full CUSSO array. The numbers indicate the depths of the trios of recordings from each three-component sensor; each recording is labeled by the corresponding component's orientation—Z, up-down; R, toward-away from the earthquake; T, orthogonal to R. Accelerometer records have a light-gray background and seismometer records have a dark gray background.

learning to classify natural earthquakes and mine blasts from recordings from the recent, temporary broadband network in the Rome Trough (Miao and others, 2020).

Data from the Kentucky network also enabled researchers at UK to study earthquake source mechanisms and seismotectonic environments in and around Kentucky. For example, Street and others (1993) used permanent and temporary seismic network stations to investigate the source characteristics of the Sept. 7, 1988, L_g-wave magnitude-4.6 earthquake in northeastern Kentucky. Carpenter and others (2014) investigated the Nov. 10, 2012, moment magnitude-4.2 Perry County, Kentucky, earthquake, as well as the Eastern Tennessee Seismic Zone, using seismic data from the Kentucky network and regional networks. Carpenter and others (2020a) also investigated natural seismicity as well as seismotectonic characteristics in and around the Rome Trough of eastern Kentucky using seismic data primarily from the Kentucky network's permanent and temporary stations.

Strong-motion data from the network, particularly from the vertical arrays, have enabled researchers at UK to systematically study earthquake ground-motion site response. Zhang and others (1993) published a note on the influence of site conditions on ground motions in the central United

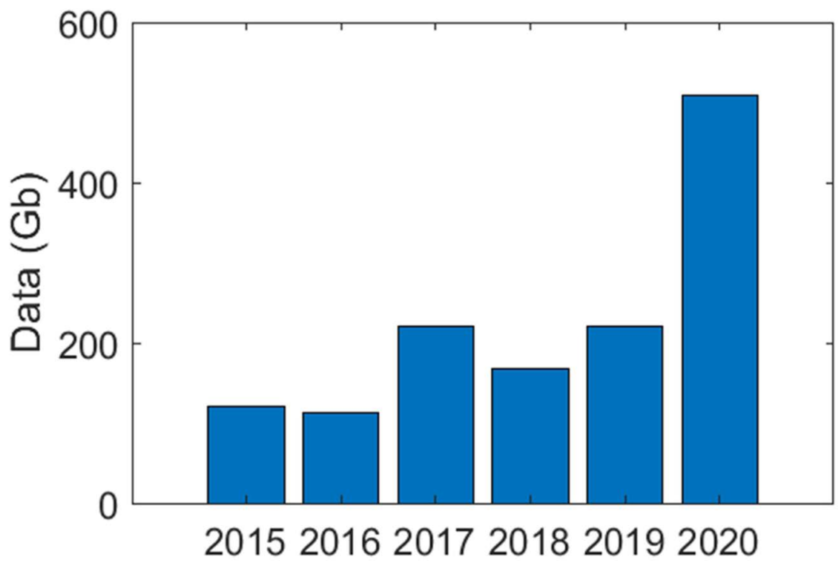


Figure 15. Annual global usage of Kentucky Seismic and Strong-Motion Network data from records produced by Incorporated Research Institutions for Seismology.

States. Harris and others (1994) conducted a study on site response for the Paducah area. Street and others (1997a) were the first to study site response in the central and eastern United States using the recordings from the vertical strong-motion array at the Paducah Gaseous Diffusion Plant. Other studies on earthquake ground motions and site responses include Street and others (1997b, 2001, 2005), Woolery and others (2008, 2009, 2012), Macpherson and others (2010), and Carpenter and others (2018, 2020).

These results have provided better scientific information on earthquakes and seismic hazards and support for the development of seismic design and other mitigation measures in Kentucky. For example, the information on seismic hazards was used to develop the Kentucky Residential Code (Structural Engineers Association of Kentucky, 2002), engineering design and analysis of bridges and highway facilities (Wang and others, 2008), and engineering design of the C-746-U contained landfill at the Paducah

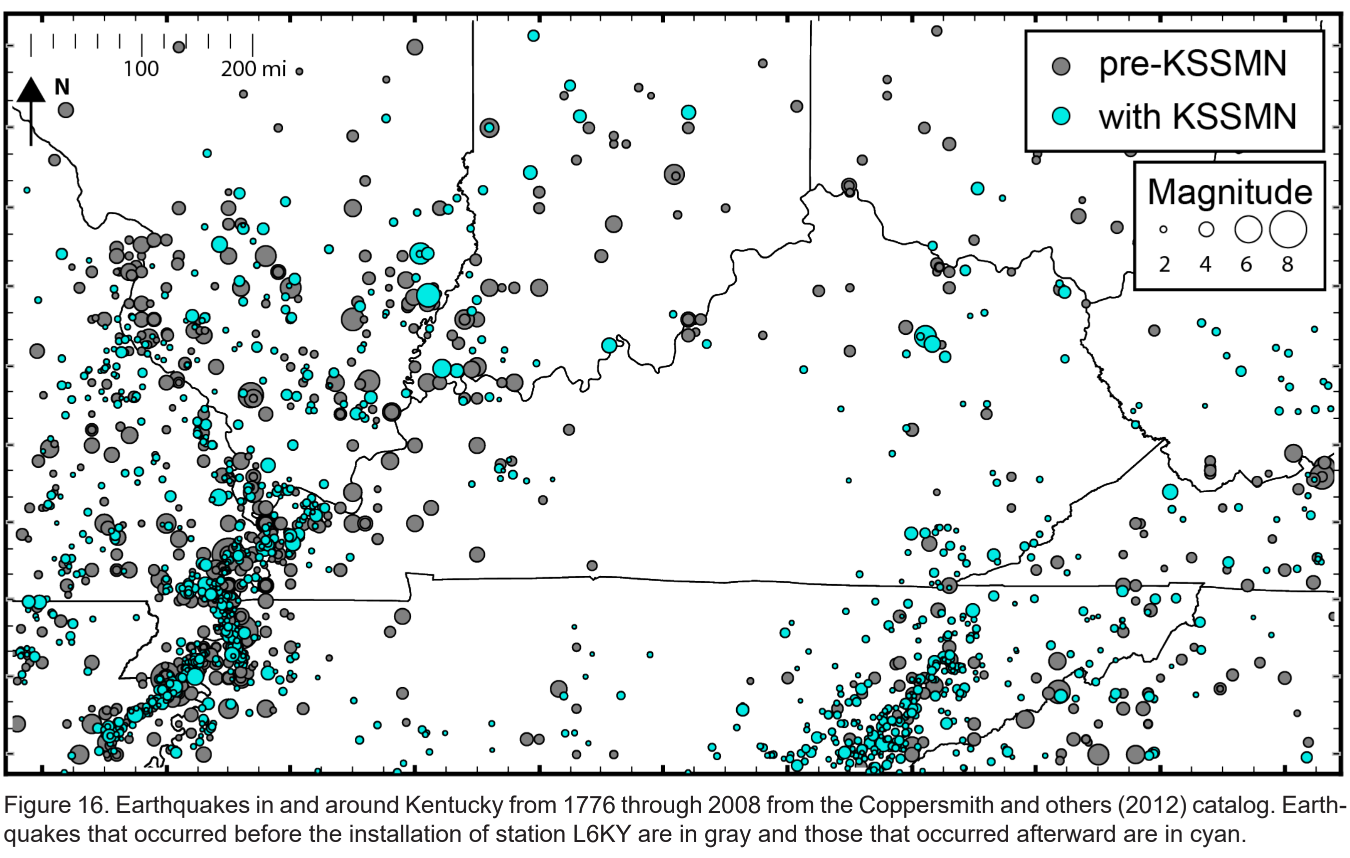


Figure 16. Earthquakes in and around Kentucky from 1776 through 2008 from the Coppersmith and others (2012) catalog. Earthquakes that occurred before the installation of station L6KY are in gray and those that occurred afterward are in cyan.

Gaseous Diffusion Plant (James E. Beavers Consultants, 2010).

Summary

Although the Kentucky Seismic and Strong-Motion Network was started to satisfy scientific curiosity, its development coincided with the commonwealth of Kentucky needing information on earthquakes and seismic hazards. Data acquired by the network have enabled researchers at the University of Kentucky to gain a better understanding of the seismotectonic background in and around Kentucky, and to improve seismic-hazard assessments used to develop mitigation measures and engineering design. The network also provides real-time information on earthquakes in and around Kentucky, as well as in the nation and world, for the general public. The network has become an essential facility, operated by the Kentucky Geological Survey at the University of Kentucky, monitoring earthquakes and providing information on earthquakes and seismic hazards to the commonwealth.

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