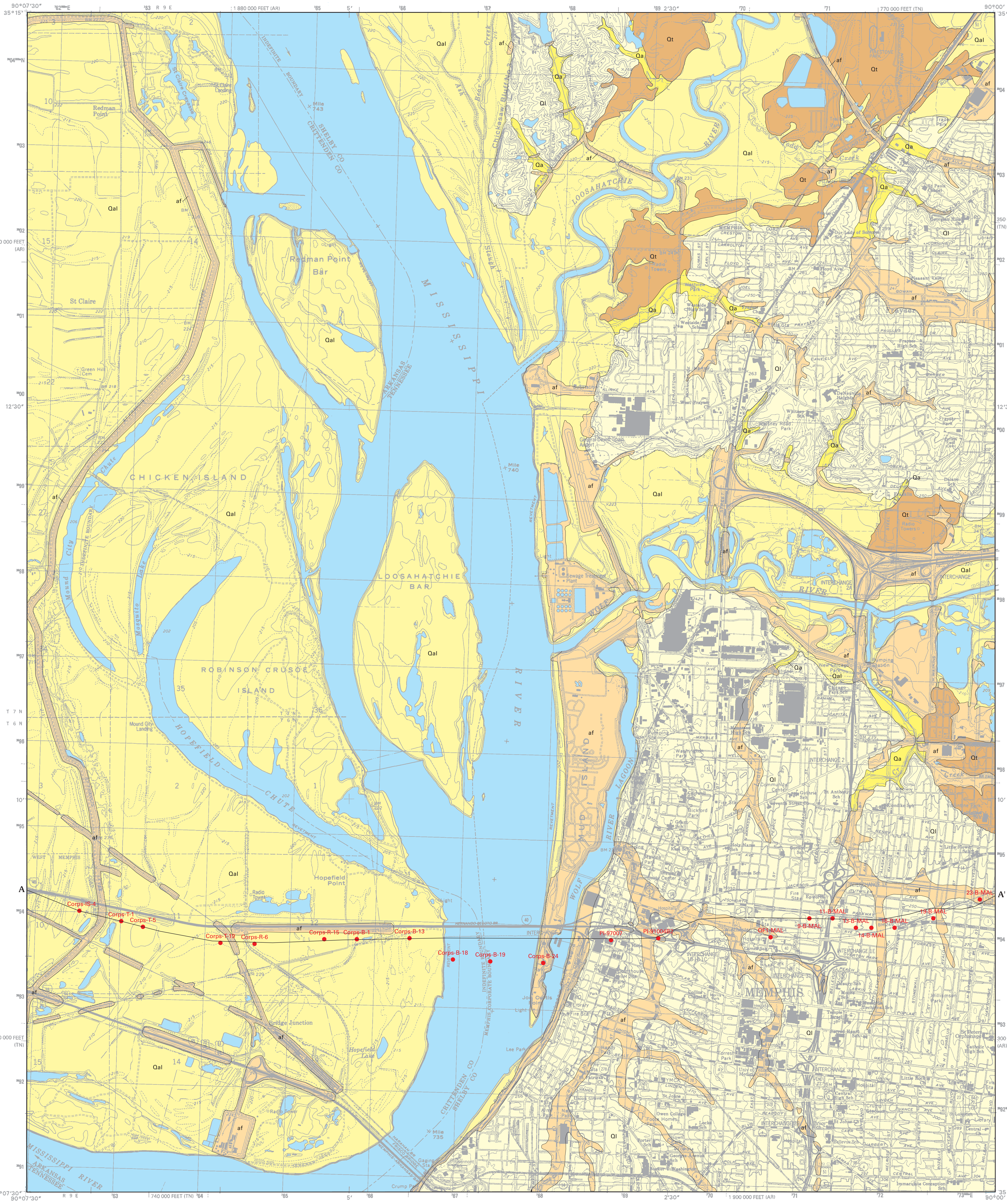


Base from U.S. Geological Survey 1997
1927 North American Datum (NAD 27)
Projection and 1,000-meter grid: Transverse Mercator, zone 15
10,000-foot ticks: Tennessee Coordinate System and Arkansas Coordinate System (north zone)

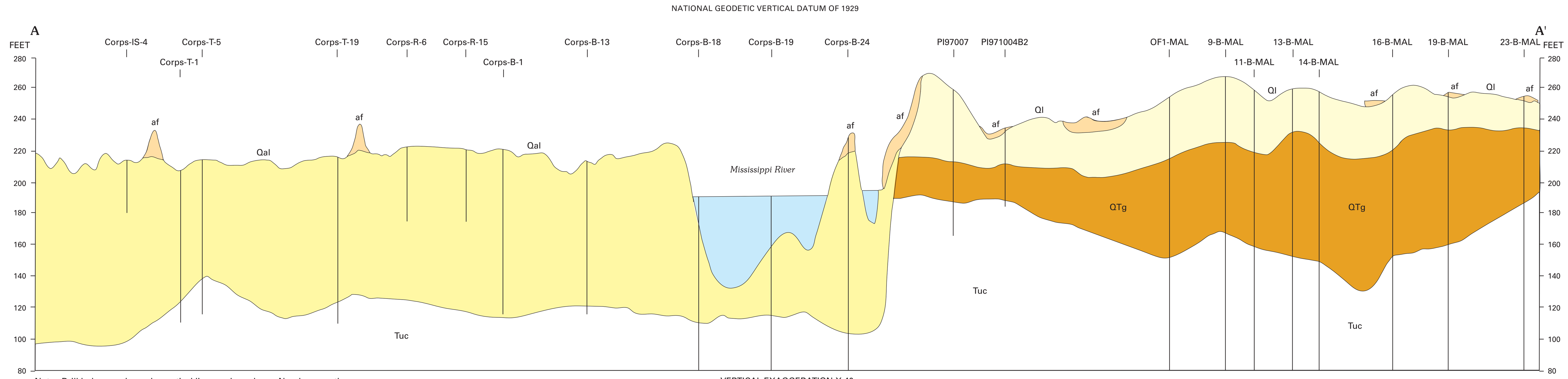
APPROXIMATE MEAN DECLINATION, 1999

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
SUPPLEMENTAL CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

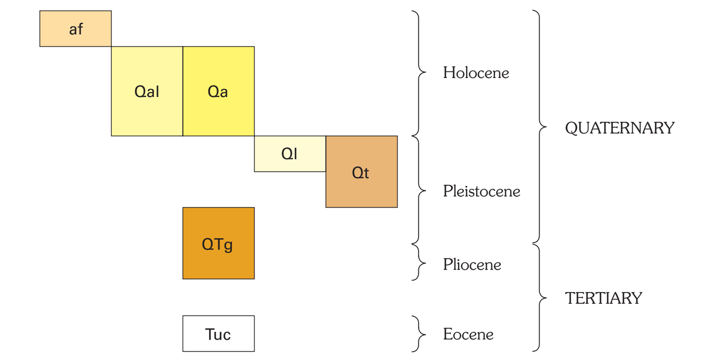
QUADRANGLE LOCATION

Geology mapped by Broughton and Van Arsdale in 2002
Manuscript approved for publication June 8, 2004
Editing and digital cartography by Alessandro J. Donatich, Central Publications Group



Note: Drill holes are shown by vertical lines and numbers. Numbers are the Shelby_id numbers of the Shelby County database of the Groundwater Institute, University of Memphis. Total depth of some holes exceeds the vertical dimension of the cross section and is not plotted. Some holes projected into cross section

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

af — **Artificial fill (Holocene)**—Brown (10YR 6/2) mostly silt, sand, and chert gravel; locally derived from loess, alluvium, and map unit QTg. Fill occurs along roadways and reclaimed sand and gravel quarries, and as building pads. Thickness generally 1–2 m, but 20±10 m in reclaimed quarries and some bridge approaches

Qal — **Alluvium (Holocene)**—White (10YR 8/2) sand, brown (10YR 6/2) clayey silt, and minor tan (10YR 7/4) gravel. Sand is very fine grained to coarse-grained quartz with chert. Thick-bedded, basal point bar sands are overlain by overbank clayey silt to silty clay, as much as 5 m thick in Mississippi River. Bottom of basal sand not visible but floodplain borings indicate thickness as much as 60 m

Qa — **Alluvium (Holocene)**—Brown (10YR 6/2) silt (reworked loess) and minor mixed sand and clay in smaller streams. Silt beds are thin to massive; total thickness of silt floodplains <6 m. Dispersed sand is very fine to very coarse grained quartz and minor chert. Channel beds are covered with thin sand and gravel bars (W.S. Parks, unpub. mapping, 1978; Broughton and others, 2001)

Ql — **Loess (late Pleistocene)**—Brown (10YR 6/6) and light-brown (10YR 7/4) silt with <10 percent sand and <10 percent clay (Spann, 1998). Regionally, loess is predominantly quartz with minor amounts of plagioclase, orthoclase, and dolomite (Gelderloos, 1996). Borings reveal loess is 2–20 m thick

Qt — **Terrace deposit (Pleistocene)**—White (oxidized orange), dense, crossbedded, medium-grained sand capped by loess silt (Saucier, 1987)

QTg — **Gravel ("Lafayette Gravel" of Hilgard, 1892, early Pleistocene and Pliocene?)**—Shown in cross section only. Highly oxidized, fine- to coarse-grained sand, chert gravel, and minor silt and clay; thickness 0–30 m. Thickness varies because upper and lower contacts are erosional. Color varies from strong brown (7.5YR 4/6) to red (2.5YR 4/6). Gravel is primarily medium pebbles that are subrounded to subangular (Autin and others, 1991). Vertical cylindrical structures locally present that appear to be root casts or burrows. Upper part of unit exposed in some stream banks and in construction excavations

Tuc — **Claiborne Group, upper part (Eocene)**—Shown in cross section only. Clay, silt, and sand. Generally consists of clay and silt, but locally may consist predominantly of fine sand (Kingsbury and Parks, 1993)

Contact—Relatively certain

Corps-T-1 — **Drill-hole locality and identification number**

INTRODUCTION

The map locates surficial deposits and materials. Mapping them is the first step to assessing the likelihood that they could behave as a viscous liquid (liquefy) and (or) slump during strong earthquakes. This likelihood depends partly on the physical characteristics of the surficial deposits (Youd, 1991; Hwang and others, 2000), which are described here. Other possible uses of the map include land-use planning, zoning, education, and locating aggregate resources. The Northwest Memphis quadrangle is one of several quadrangles that were mapped recently for these purposes (fig. 1).

The City of Memphis lies within the upper Mississippi embayment, which is seismically active (Schweig and Van Arsdale, 1996) and near the New Madrid Seismic Zone (NMSZ) (fig. 2). Proximity to the NMSZ raises concerns that if earthquakes as strong as those that occurred near New Madrid, Mo., in 1811–1812 were to occur again, life and infrastructure in Memphis would be at risk (Hamilton and Johnston, 1990). The evidences suggestive of a seismic risk for the Northwest Memphis quadrangle are: (1) probable earthquake-induced liquefaction features (sand dikes) exist in Wolf River alluvium inside Memphis city limits (Broughton and others, 2001), (2) severe damage in the area of present-day Memphis was caused by an 1843 earthquake in the NMSZ, near Marked Tree, Ark. (Stover and Coffman, 1993), and (3) in the mid-continent, earthquake energy waves travel long distances outward from their source, compared to distances of wave transmission from earthquakes of comparable magnitude in California (Johnston and Kanter, 1990; Tuttle and Schweig, 1996).

REFERENCES CITED

Autin, W.J., Burns, S.F., Miller, B.J., Saucier, R.T., and Snead, J.L., 1991, Quaternary geology of the Lower Mississippi Valley, *in* Morrison, R.B. ed., Quaternary nonglacial geology; conterminous U.S.: Boulder, Colo., Geological Society of America, The Geology of North America, v. K-2, p 547–782.

Broughton, A.T., Van Arsdale, R.B., and Broughton, J.H., 2001, Liquefaction susceptibility mapping in the city of Memphis and Shelby County, Tennessee: Engineering Geology, v. 62, p. 207–222.

Gelderloos, D.M., 1996, ESR as a dating technique for the Peoria loess—A preliminary evaluation: Memphis, Tenn., University of Memphis MS thesis, 58 p.

Gomberg, Joan, and Schweig, Eugene, 2002, Earthquake hazard in the heart of the homeland: U.S. Geological Survey Fact Sheet FS–131–02, 4 p.

Hamilton, R.M., and Johnston, A.C., 1990, Tecumseh's prophecy—Preparing for the next New Madrid earthquake: U.S. Geological Survey Circular 1066, 30 p.

Hilgard, E.W., 1892, The age and origin of the Lafayette formation: American Journal of Science, v. 43, p. 389–402.

Hwang, H., Wang, L., and Yuan, Z., 2000, Comparison of liquefaction potential of loess in Lanzhou, China, and Memphis, USA: Soil Dynamics and Earthquake Engineering, v. 20, p. 389–395.

Johnston, A.C., and Kanter, L.R., 1990, Earthquakes in stable continental crust: Scientific American, v. 262, p. 68–75.

Kingsbury, J.A., and Parks, W.S., 1993, Hydrogeology of the principal aquifers and relation of faults to interaquifer leakage in the Memphis area, Tennessee: U.S. Geological Survey Water-Resources Investigations Report 93–4075, 5 pl., 18 p.

Saucier, R.T., 1987, Geomorphological interpretation of late Quaternary terraces in western Tennessee and their regional tectonic implications: U.S. Geological Survey Professional Paper 1336–A, 19 p.

Schweig, E.S., and Van Arsdale, R.B., 1996, Neotectonics of the upper Mississippi embayment: Engineering Geology, v. 45, p. 185–203.

Spann, E.W., 1998, Selected sediment and geochemical properties of Quaternary and Tertiary sediments from five boreholes in Shelby County, Tennessee—Implications for contaminant retardation potential: Memphis, Tenn., University of Memphis MS thesis, 105 p.

Stover, C.W., and Coffman, J.L., 1993, Seismicity of the United States, 1568–1989 (revised): U.S. Geological Survey Professional Paper 1527, 418 p.

Tuttle, M.P., and Schweig, E.S., 1996, Recognizing and dating prehistoric liquefaction features—Lessons learned in the New Madrid seismic zone, central United States: Journal of Geophysical Research, v. 101, p. 6171–6178.

Youd, T.L., 1991, Mapping of earthquake-induced liquefaction for seismic zonation, *in* Borcherdt, R.D., and Shah, H.C., co-chairs, Proceedings of the Fourth International Conference on Seismic Zonation I: Stanford, Calif., International Conference on Seismic Zonation, v. 4, p. 111–147.

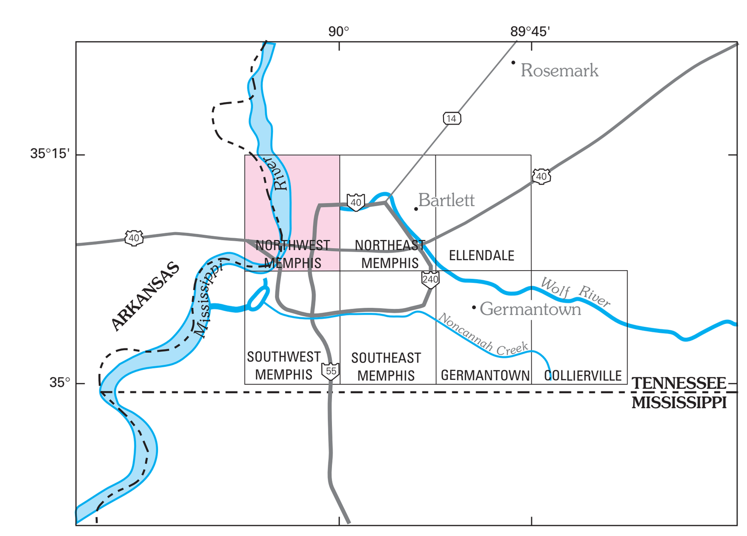


Figure 1. Locations of quadrangles for which the geology has been mapped recently as part of the National Earthquake Hazards Reduction Program of the USGS.

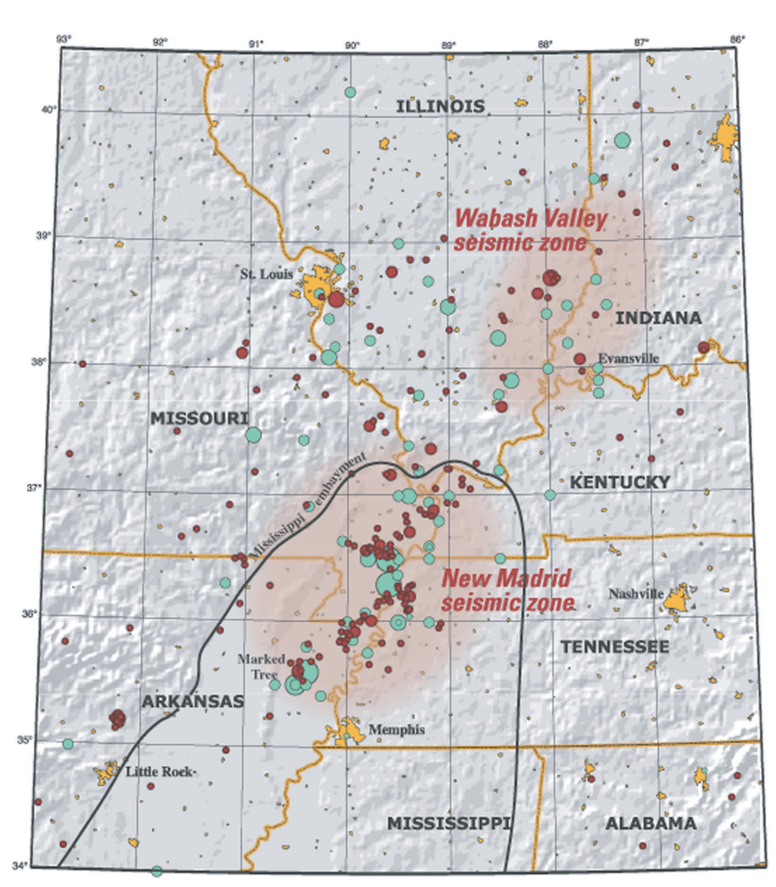


Figure 2. New Madrid and Wabash Valley seismic zones, showing earthquakes as circles. Red, earthquakes that occurred from 1976 to 2002 with magnitudes >2.5, located using modern instruments (University of Memphis). Green, earthquakes that occurred prior to 1974. Larger circle represents larger earthquake. Modified from Gomberg and Schweig (2002).

SURFICIAL GEOLOGIC MAP OF THE NORTHWEST MEMPHIS QUADRANGLE, SHELBY COUNTY, TENNESSEE, AND CRITTENDEN COUNTY, ARKANSAS

By
Jason Broughton and Roy Van Arsdale

2004

This map was produced on request, directly from digital files, on an electronic plotter

For sale by U.S. Geological Survey Information Services
Box 25286, Federal Center, Denver, CO 80225
1-888-ASK-USGS

ArcInfo coverages and a PDF for this map are available at
http://pubs.usgs.gov