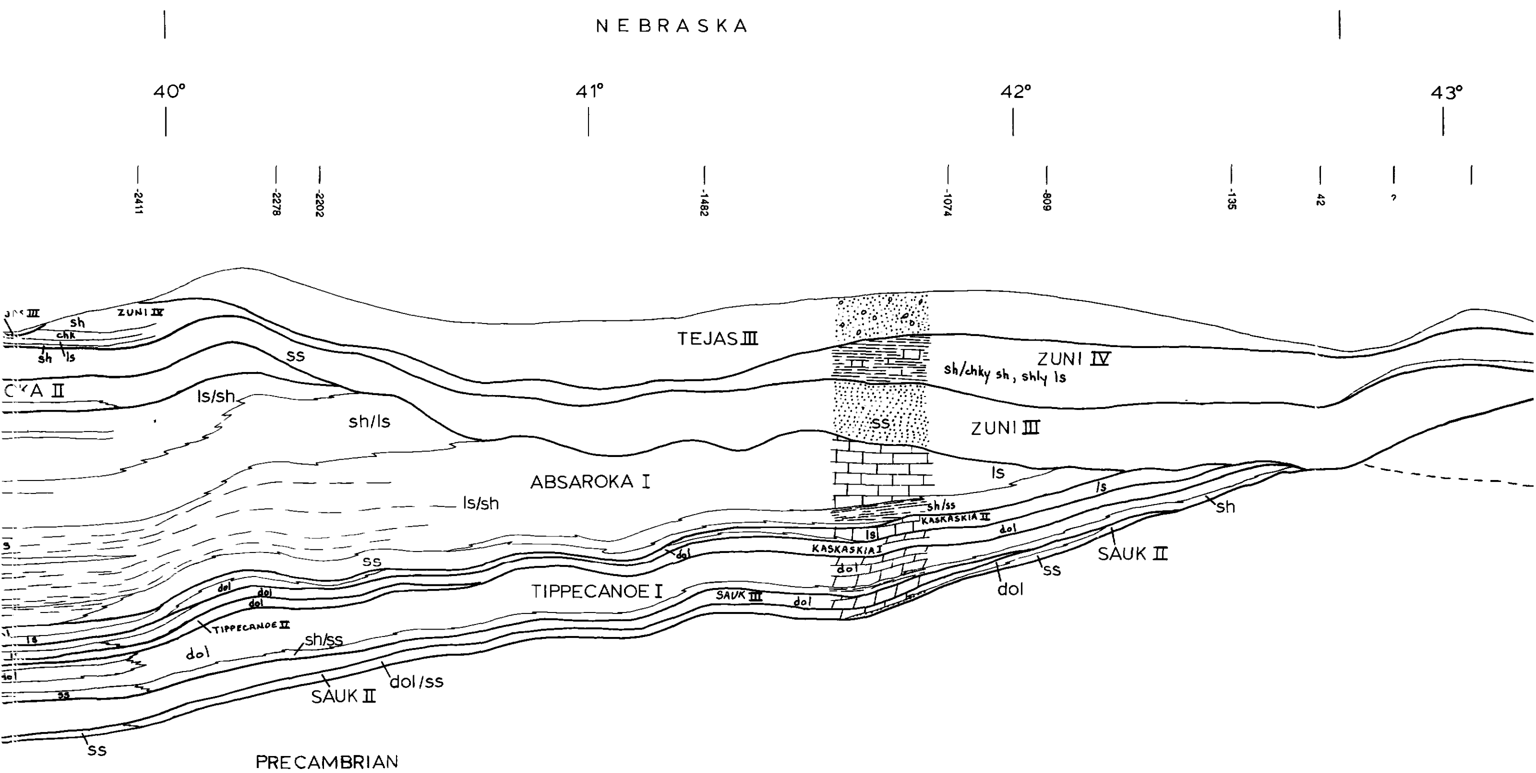

The Midcontinent Strategic and Critical Minerals Project— Summary and Background Information to Accompany Folio of Maps of the Northern Midcontinent Area, Latitude 36°–46° N. and Longitude 88°–100° W.

U.S. GEOLOGICAL SURVEY CIRCULAR 1124

Prepared in cooperation with the geological surveys of Arkansas, Illinois, Iowa, Kansas, Kentucky, Minnesota, Missouri, Nebraska, Oklahoma, South Dakota, Tennessee, and Wisconsin

Cover. A portion of map MF–1835–G, Lithologic cross sections, showing part of section along long 98° W. (reduced approximately 50 percent). *From* Mugel, D.N., and Pratt, W.P., 1991, compilers., Lithologic cross sections of Phanerozoic rocks in the northern Midcontinent, U.S.A.: U.S. Geological Survey Miscellaneous Field Studies Map MF–1835–G, scale 1:1,000,000.

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By Walden P. Pratt

INTRODUCTION

The Midcontinent Strategic and Critical Minerals Project was a cooperative effort between the U.S. Geological Survey and the geological surveys of Arkansas, Illinois, Iowa, Kansas, Kentucky, Minnesota, Missouri, Nebraska, Oklahoma, South Dakota, Tennessee, and Wisconsin. The project was begun in 1984 as a broad investigation into the mineral resource potential of the northern Midcontinent region of the United States. The purpose of this report is to summarize briefly the history of the project and the general content of the 11 map publications that make up the northern Midcontinent folio, and to give a visual sense of the scope and content of the folio through page-size samples of each of the map products.

The premise of the Midcontinent Strategic and Critical Minerals (SCM) Project was that the subsurface of the Midcontinent region is one of the last great frontiers for mineral exploration in the United States. Four world-class base-metal mining districts occur within this region: the Upper Mississippi Valley lead-zinc district, the Illinois-Kentucky fluorspar (-lead-barite) district, the Southeast Missouri lead-zinc (-silver-copper-nickel-cobalt) district, and the Tri-State (Missouri-Kansas-Oklahoma) lead-zinc district (fig. 1). Significantly, all four districts lie outside the areas of glacial cover (the Upper Mississippi Valley district is dominantly inside the perimeter of the "driftless area" of southern Wisconsin), and the original discoveries of all four districts were made at the surface. All four districts are hosted by Paleozoic platform carbonate rocks, and the same sedimentary succession continues north and northwest in the subsurface all the way through Canada, where the succession hosts the Pine Point lead-zinc district, and on through Alaska to the Arctic Ocean.

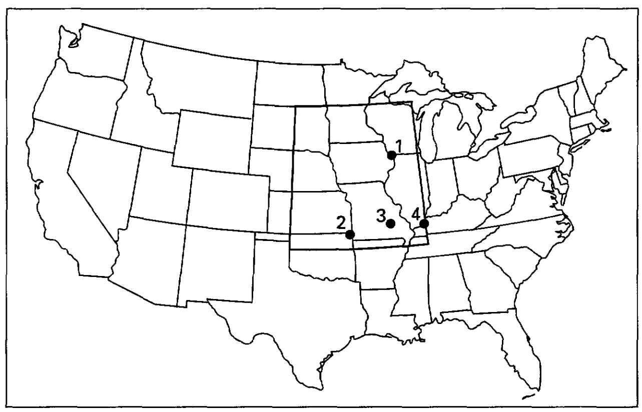

Figure 1. Midcontinent Strategic and Critical Minerals Project—area of initial inventory, showing major mining districts. 1, Upper Mississippi Valley district; 2, Tri-State district; 3, Southeast Missouri district; 4, Illinois-Kentucky fluorspar district.

Similarly, Precambrian basement rocks occur throughout the region, but with the orientation of exposed terranes reversed. The famous iron ores of the Lake Superior district, potentially valuable copper-nickel deposits in the Duluth Complex, and zinc-copper massive sulfide deposits in metamorphosed volcanic rocks in northern Wisconsin are all in Precambrian terranes that are known at least partly from outcrops in the shield area and that appear to extend southward beneath the Phanerozoic sedimentary cover. Drilling throughout the Midcontinent has shown that the basement also contains many other Precambrian terranes, some of which have potential as host rocks for other kinds of mineral deposits.

In summary, the subsurface terranes of the Midcontinent region are believed to have some potential for undiscovered mineral deposits of the following types:

Precambrian Rocks
• Sedimentary iron ores of Lake Superior type
• Layered gabbros and ultramafic rocks with chromium, copper-nickel sulfides, platinum-group metals, and gold
• Massive sulfide deposits of base and precious metals
• Olympic Dam-type deposits—iron oxide with associated copper, cobalt, molybdenum, gold, silver, and uranium
• Algoma-type volcanogenic iron-ore deposits
• Conglomeratic quartzites with potential for gold and uranium
Phanerozoic Rocks
• Mississippi Valley-type (stratabound, carbonate-hosted) lead-zinc ores with silver, copper, nickel, and cobalt
• Zambian-type (stratabound, sandstone-hosted) copper-silver ores
• Black shales containing a variety of metals (silver, vanadium, zinc, chromium, nickel, and molybdenum)
• Sedimentary manganese ores
• Diatremes of alkalic-ultramafic intrusive rocks with rare-earths, fluorspar, base metals, and possibly diamonds

The Midcontinent SCM Project was a major integrated effort to more clearly define this varied mineral potential, with the following objectives.

1. To prepare an inventory of geologic data on the "core" area of the Midcontinent—a rectangle bounded by lat 36°–46° N. and long 88°–100° W. (fig. 1). This area was selected as representative of the Midcontinent geologic terrane. To the north, it "anchors" onto the exposed Precambrian Shield, and to the south it includes several contiguous 1°×2° quadrangles for which substantial databases were accumulated through the Conterminous United States Mineral Assessment Program (CUSMAP). The product of this first-stage inventory is a folio of 1:1,000,000-scale maps and cross sections, published in the U.S. Geological Survey Miscellaneous Field Studies (MF) and Miscellaneous Investigations (I) map series, giving a grossly accurate three-dimensional picture of the major geologic and hydrologic terranes and known mineral systems in the region.
2. To develop and refine mineral-occurrence models for the types of mineral deposits likely to be associated with these terranes.
3. To define and pursue both regional and topical problems pertinent to the mineral-occurrence models.
4. On the basis of this research, to prepare 1:1,000,000 maps indicating mineral favorability of basement and sedimentary terranes in the region.

The Midcontinent SCM Project was formally begun as a multi-State cooperative effort in January 1984. One of the first tasks undertaken in the project was to compile an inventory of selected aspects of subsurface geology of the core area of the project—the area delimited by lat 36°–46° N. and long 88°–100° W. The U.S. Geological Survey (USGS) contracted with the various State geological surveys for input, which consisted of 1:500,000- or 1:1,000,000-scale maps compiled by geologists in each State from drill-hole logs available in the respective State files. The USGS then combined the State maps for each product onto a common 1:1,000,000-scale base for publication and use in studies of resource potential. Eleven such maps have been published, and these products together constitute the folio of the northern Midcontinent. The remainder of this report contains descriptions of each of these 11 map publications, accompanied by representative portions of each map, reduced to page size (approximately 1:2,000,000).

Progress reports on many aspects of the Midcontinent project were presented at a public symposium held in St. Louis, Mo., in April 1989 (Pratt and Goldhaber, 1990). In addition, reports on the following topical studies resulting from the project have been published: Geology and metallogeny of Archean and Proterozoic basement terranes (Sims and others, 1987); Stratigraphy and geochemistry of the Cretaceous rocks of southwestern Minnesota (Setterholm and others, 1987); Does the Midcontinent contain permissive terranes for an Olympic Dam-type deposit? (Pratt and Sims, 1990); Geology and mineral paragenesis of the Pea Ridge iron ore mine, Missouri (Nuelle and others, 1992); Mineralogical and geochemical aspects of Middle and Upper Pennsylvanian marine black shales (Desborough and others, 1992); Mineralogical and geochemical analysis of the metal- and organic-rich Grassy Creek Shale in Hardin County, Illinois (Desborough, 1992); Paleohydrology of the Central United States (Jorgensen, 1992); Precambrian clastic sedimentary rocks associated with the Midcontinent rift system (Berendsen and Barczuk, 1993); Feldspar diagenesis in Cambrian clastic rocks of the southern Ozark Mountains and Reelfoot rift—Implications for Mississippi Valley-type ore genesis (Diehl and Goldhaber, in press); and Regional potential of selected Paleozoic carbonate units for undiscovered Mississippi Valley-type lead-zinc deposits (Pratt, in press). Two other reports are in review: Petrology of an extensive pre-Cretaceous weathering profile in east-central and southwestern Minnesota, by G.B. Morey and D.R. Setterholm, and geologic maps and cross sections of mine levels of the Pea Ridge iron mine, Washington County, Missouri, by C.M. Seeger and others.

MISCELLANEOUS FIELD STUDIES MAPS (MF SERIES)

MF–1835–A: DRILL-HOLE MAP

Map compiled by Douglas N. Mugel

The Midcontinent drill-hole map (fig. 2) shows the location and other data for more than 3,000 drill holes in the "initial inventory" area. Most of the drill holes shown are oil or mineral tests or water wells. The information shown for each hole consists of hole location, State drill-hole log number, bottom-hole elevation, age of rock at total depth, and types of samples, if any, that are available. The map is intended to show the availability of data and samples for representative deep drill holes in the northern Midcontinent region. It was compiled from maps prepared by each of the State geological surveys to meet the following specifications: (1) basement penetration, or (2) other holes that in the judgment of the State contributor are deep enough to provide data and (or) samples for a significant part of the sedimentary section. Data obtained from these holes constitute an important database for the project; many of the holes have been utilized in the cross sections and some of the maps of this folio. The map is also intended as a database for other investigators involved in research into mineral potential in the Midcontinent area.

Of the more than 3,000 drill holes shown on this map, most penetrate at least as deep as the Ordovician rocks, and about one-half penetrate the Precambrian basement. Drill-hole samples exist for approximately 2,000 of the drill holes, of which approximately 200 are core samples.

MF–1835–B: EQUIVALENT FRESHWATER HEAD AND DISSOLVED-SOLIDS CONCENTRATION OF WATER IN ROCKS OF CAMBRIAN, ORDOVICIAN, AND MISSISSIPPIAN AGE

Map compiled by D.G. Jorgensen, J.O. Helgesen, R.B. Leonard, *and* D.C. Signor

These two 1:1,000,000-scale maps (part of one of which is shown in fig. 3) show preliminary interpretations of pre-development hydrogeologic conditions of water in the two aquifer systems named, and can be used in a manner described by Signor and others (1980) to develop conceptual and predictive models of hydrologic and geochemical aspects of regional flow systems.

The maps indicate that each of the two aquifers contains three major regional ground-water flow systems and that the regional extent and dissolved-solids concentration (salinity) of the three systems are similar in both aquifers. The flow systems in each aquifer in the Ozark area in southwestern Missouri and northwestern Arkansas make a pair, each containing fresh water with less than 1,000 milligrams per liter (mg/L) dissolved solids. A similar pair of flow systems is in northeastern Oklahoma and southeastern Kansas and contains water with a salinity ranging from about 20,000 to more than 200,000 mg/L. In each aquifer, these two flow systems merge in a narrow zone of mixed waters about 40 km wide, which trends southward through southeast Kansas and northeast Oklahoma.

The third pair of major flow systems is generally similar in areal extent but less so in the patterns of salinity. Water in the aquifer in Cambrian and Ordovician rocks flows southeastward (or locally to the Mississippi River) from recharge areas in northeastern Nebraska, northwestern Iowa, southeastern Minnesota, and southern Wisconsin, and the salinity ranges from less than 500 mg/L in eastern Iowa to more than 1,000 mg/L in western Iowa. This concentration gradient implies that water has flowed from east to west under different geologic and hydrologic conditions than at present. In particular the concentration gradient is believed to reflect the paleoflow direction from east to west during the Pleistocene. Water in the aquifer in Mississippian rocks in this third system flows southeast from east-central Nebraska and west-central Iowa, and salinity decreases from 5,000 mg/L in western Iowa to less than 500 mg/L in central Iowa. This distribution of dissolved solids may result from mixing of meteoric water with formation water.

MF–1835–C: RADIOMETRIC AGES OF BASEMENT ROCKS

Map compiled by R.F. Marvin

This product consists of two maps (part of one of which is shown in fig. 4) showing age ranges of available radiometric dates for basement rocks throughout the Midcontinent, and accompanying tables listing pertinent data for the plotted samples. Map A shows sample localities for 111 samples giving 410 U-Pb zircon ages. These ages indicate that basement rocks in the northern reaches of the region are Archean, whereas those in the remainder of the region are Proterozoic, probably dominantly Middle Proterozoic; in general, the ages of basement rocks become younger from north to south. Map B, which shows sample localities for 560 samples giving 139 K-Ar and more than 400 Rb-Sr dates, indicates the

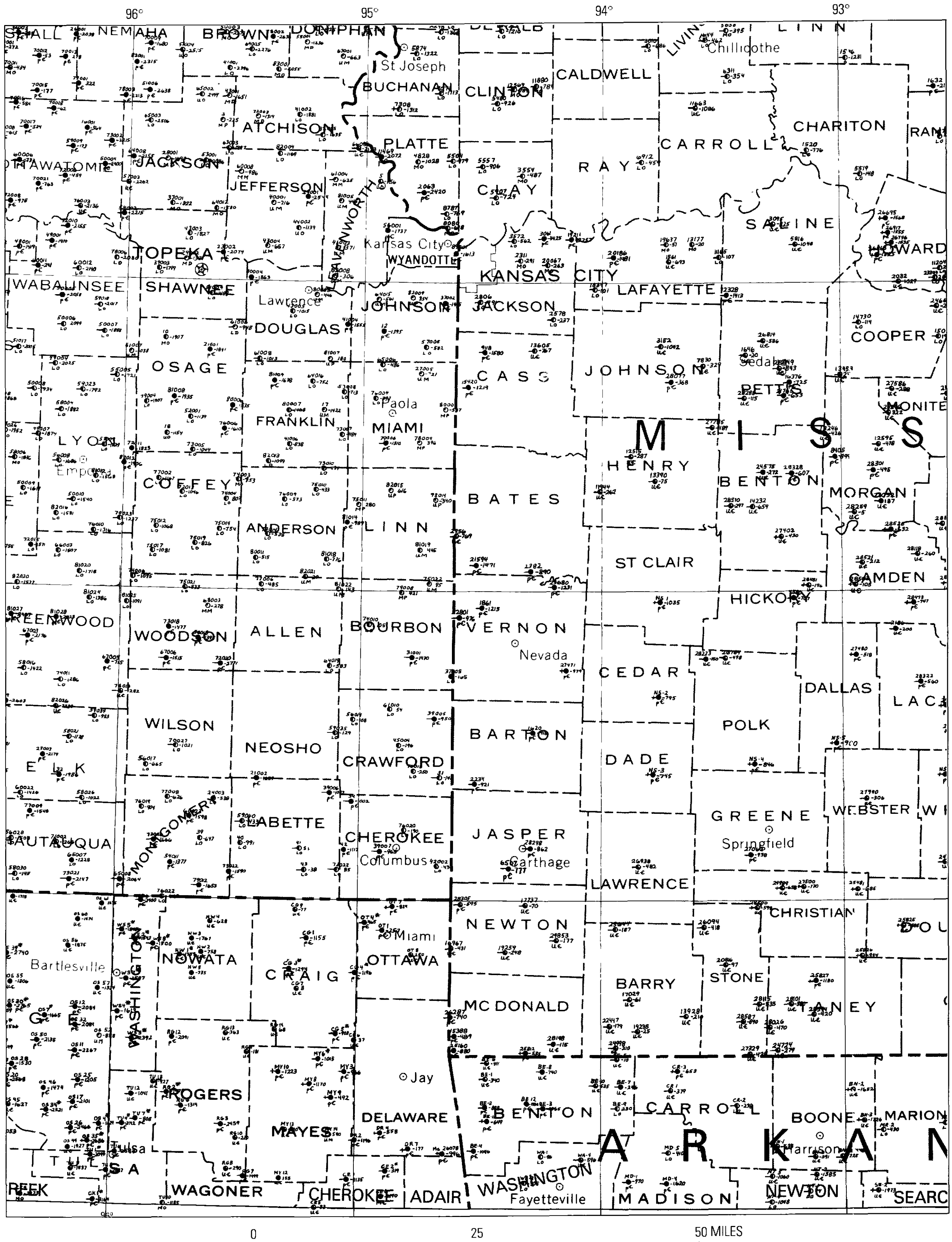

Figure 2. Portion of map MF–1835–A, selected deep drill holes.

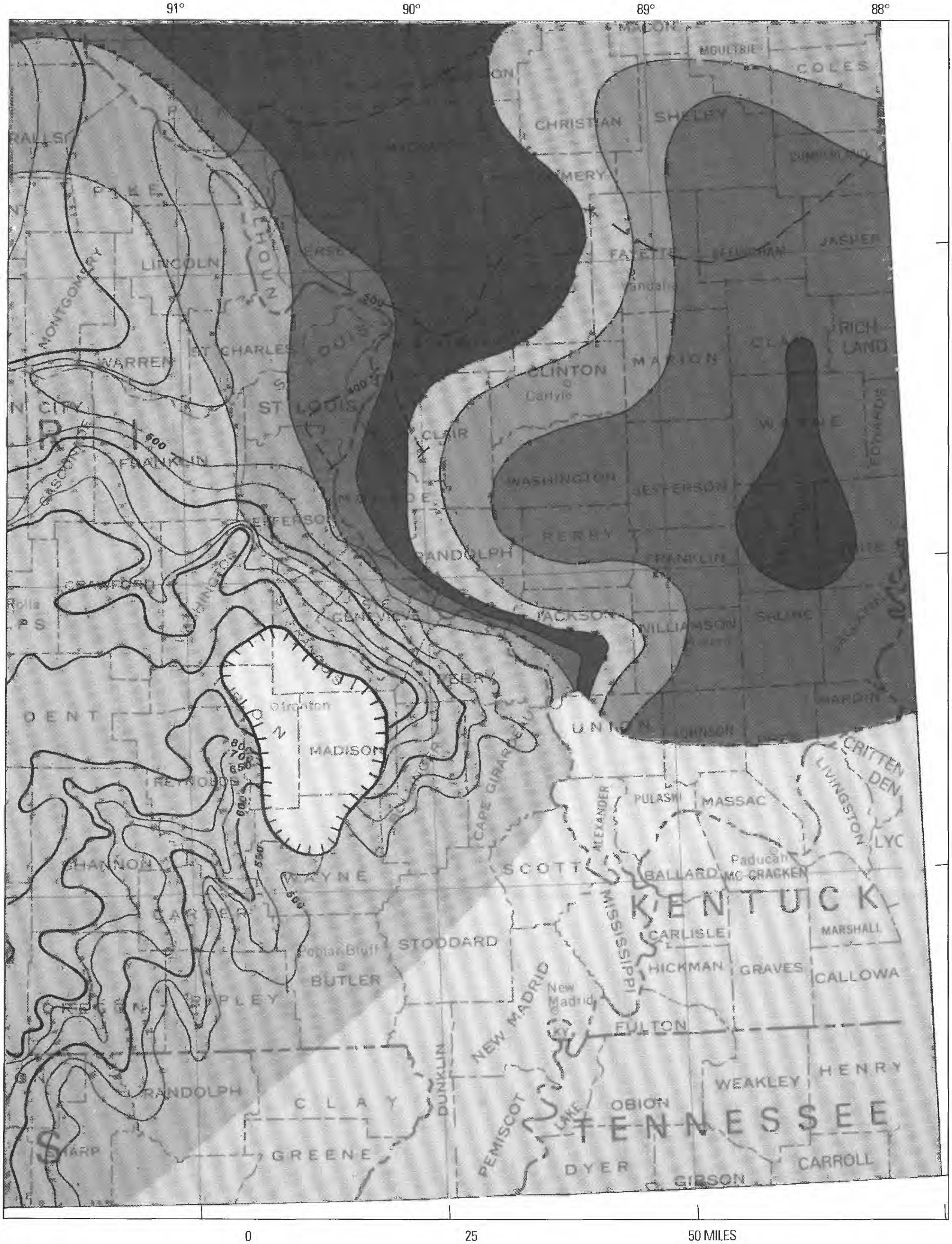

Figure 3. Portion of map MF–1835–B, equivalent freshwater head and dissolved-solids concentration. Original map has shades of gray and pink.

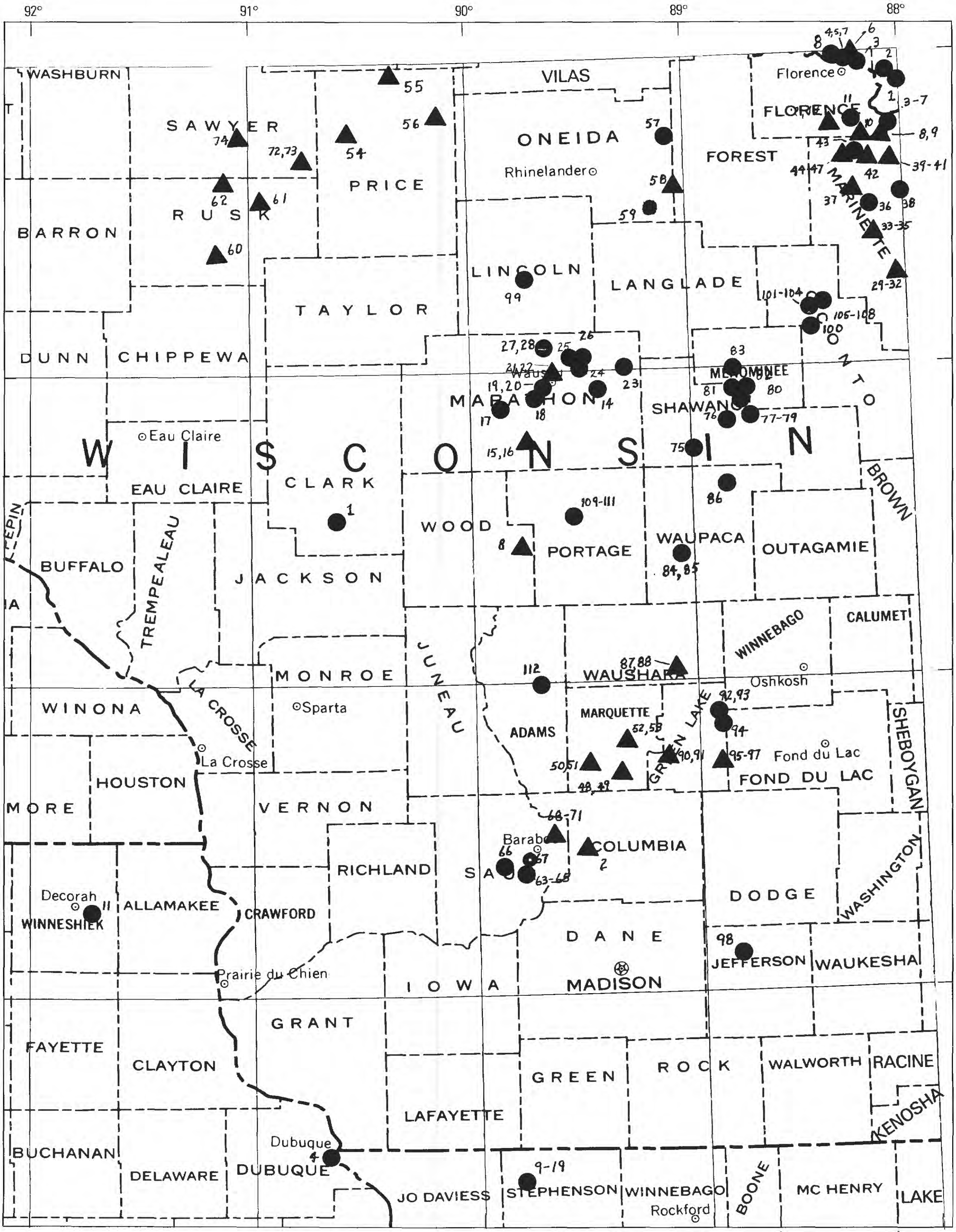

Figure 4. Portion of map MF–1835–C, radiometric ages of basement rocks (map B).

same general trend but with a much wider age span from oldest to youngest dates. Moreover, Proterozoic thermotectonic events in Wisconsin, Michigan, and probably the eastern Dakotas have affected the K-Ar and Rb-Sr isotopic systems to such an extent that Archean rocks generally have secondary (reset) Proterozoic ages. Much of the buried basement has not yet been dated radiometrically owing to the absence of samples.

Accompanying tables list locations (county, latitude, and longitude), rock types, stratigraphic or plutonic names (if known), minerals or material dated, radiometric ages, and references.

MF–1835–D: SAUK SEQUENCE ISOPACH AND LITHOFACIES MAP

Map compiled by Walden P. Pratt

This map (fig. 5) was compiled from 1:1,000,000-scale isopach and lithofacies maps contributed by the States in the hope of defining a regional limestone-dolostone interface to be used as a prospecting guide for Mississippi Valley-type lead-zinc sulfide deposits (see below under map MF–1835–I). It shows that Cambrian and Lower Ordovician sedimentary rocks of the Midcontinent pinch out across Kansas, Nebraska, and Minnesota, and thicken south and east from the pinchout. Excluding the basal clastics, the rocks are overwhelmingly dolomite. Thicknesses of limestone that are locally significant within certain formations, such as the Bonneterre Formation in southeast Missouri, are for the most part obscured by the preponderance of dolomite when the Sauk sequence is considered in its entirety.

MF–1835–E: PHANEROZOIC STRUCTURAL FEATURES

Map compiled by R.R. Anderson

Because Precambrian structural features may provide controls for undiscovered mineral deposits hosted by Phanerozoic sedimentary rocks, this map (fig. 6) was prepared to evaluate the possibility of locating Precambrian structural features by their expression in the structures of overlying Phanerozoic rocks. The map includes most known Phanerozoic structural features in the region—areas of Phanerozoic uplift or depression and Phanerozoic paleotopographic highs, as well as known and inferred Phanerozoic faults, synclines, and anticlines. Because many areas have been subjected to multiple tectonic episodes, many of these structures overlap. Different shades of pink and gray are used on the map to differentiate between these overlapping structures. The goal of this map compilation is to show the combined trends of multiple Phanerozoic structures that may define major buried Precambrian structures.

A preliminary examination of the map suggests that many of the major Precambrian structural features, as interpreted by Sims (1990), Sims and Peterman (1986), Anderson and Ludvigson (1986), and others, are reflected in the trends of some of the mapped Phanerozoic structures. Other Phanerozoic structural trends do not appear to relate to any known Precambrian features.

MF–1835–F: ALKALINE IGNEOUS ROCKS, CARBONATITES, AND PERIDOTITES

Map compiled by F.A. Hills, R.W. Scott, Jr., T.J. Armbrustmacher, *and* Pieter Berendsen

This map (fig. 7), prepared by the U.S. Geological Survey from all available data, shows the locations of alkaline and ultramafic igneous rocks, including carbonatites and kimberlites, and of structural domes and diatremes known or thought to be associated with similar igneous rocks. Also shown are other structures and geophysical anomalies of uncertain origin that may be related to buried igneous intrusions. These include cryptoexplosion structures, some of which have been interpreted as astroblemes, and gravity and magnetic anomalies that have been interpreted as indicating buried mafic plutons. A pamphlet accompanying the map includes (1) tables summarizing what is known of the petrography, age, and structural setting of each occurrence; (2) a list of the principal references for each occurrence; and (3) larger scale maps of areas in which occurrences of igneous rocks and related features such as diatremes are too dense to show clearly at 1:1,000,000 scale.

MF–1835–G: LITHOLOGIC CROSS SECTIONS OF PHANEROZOIC ROCKS

Compiled by Douglas N. Mugel *and* Walden P. Pratt

Thirteen cross sections of the study area along even-numbered lines of latitude and longitude were compiled from cross sections at 1:500,000 horizontal scale prepared by the State geological surveys. With a vertical scale of 1 inch = 1,000 ft (vertical exaggeration 83×), the sections show major lithologies and the stratigraphic-tectonic sequences and subsequences of Sloss (1982) for the entire Phanerozoic (fig. 8). Major lithologies are limestone, dolomite, evaporite, sandstone and related clastics, shale, and organic shale. The sections also include important structural features, such as major faults, and the topography of the buried Precambrian surface.

The objective of these cross sections is to show, at a usable scale, the general stratigraphy and major structural

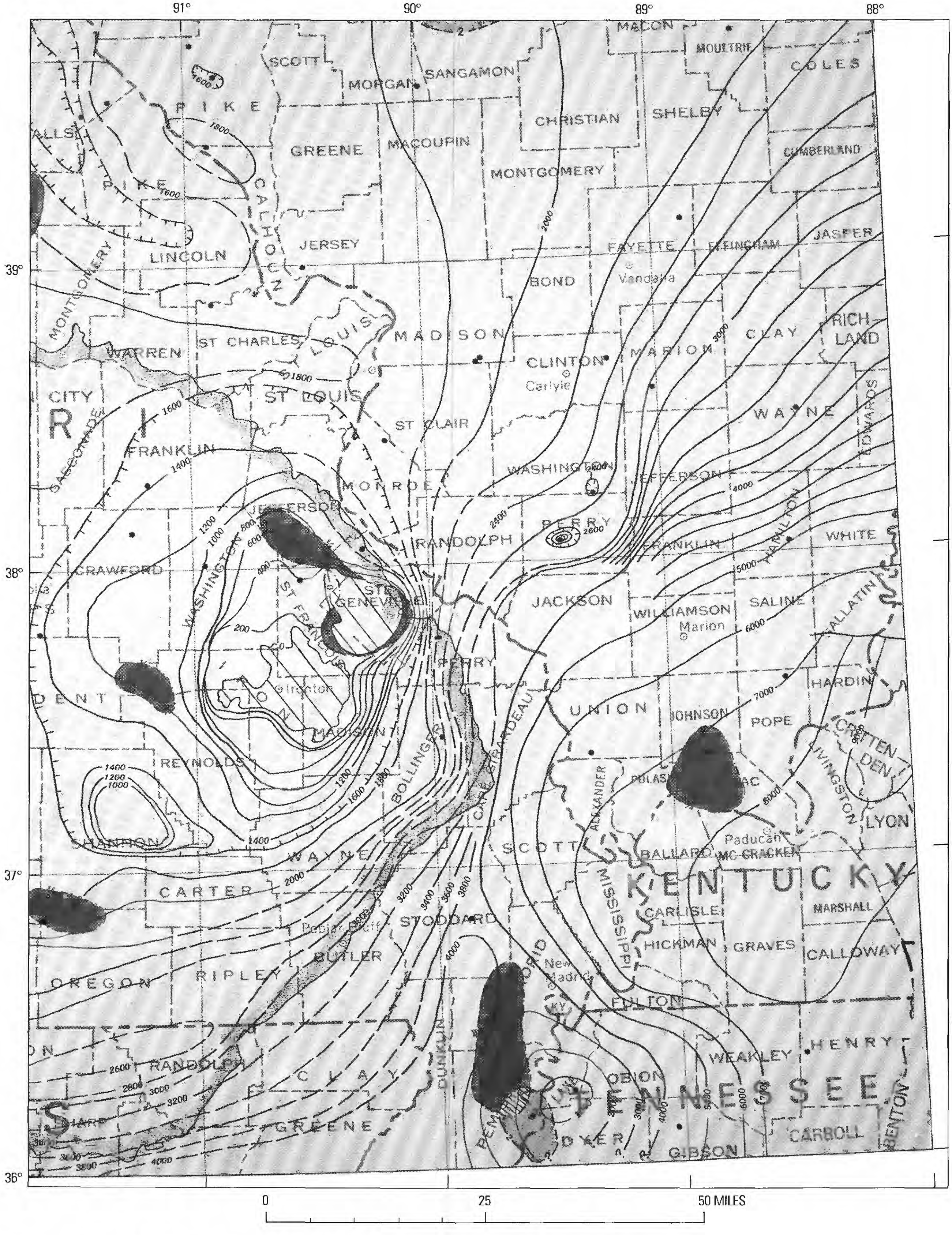

Figure 5. Portion of map MF–1835–D, isopach and lithofacies map of the Sauk sequence.

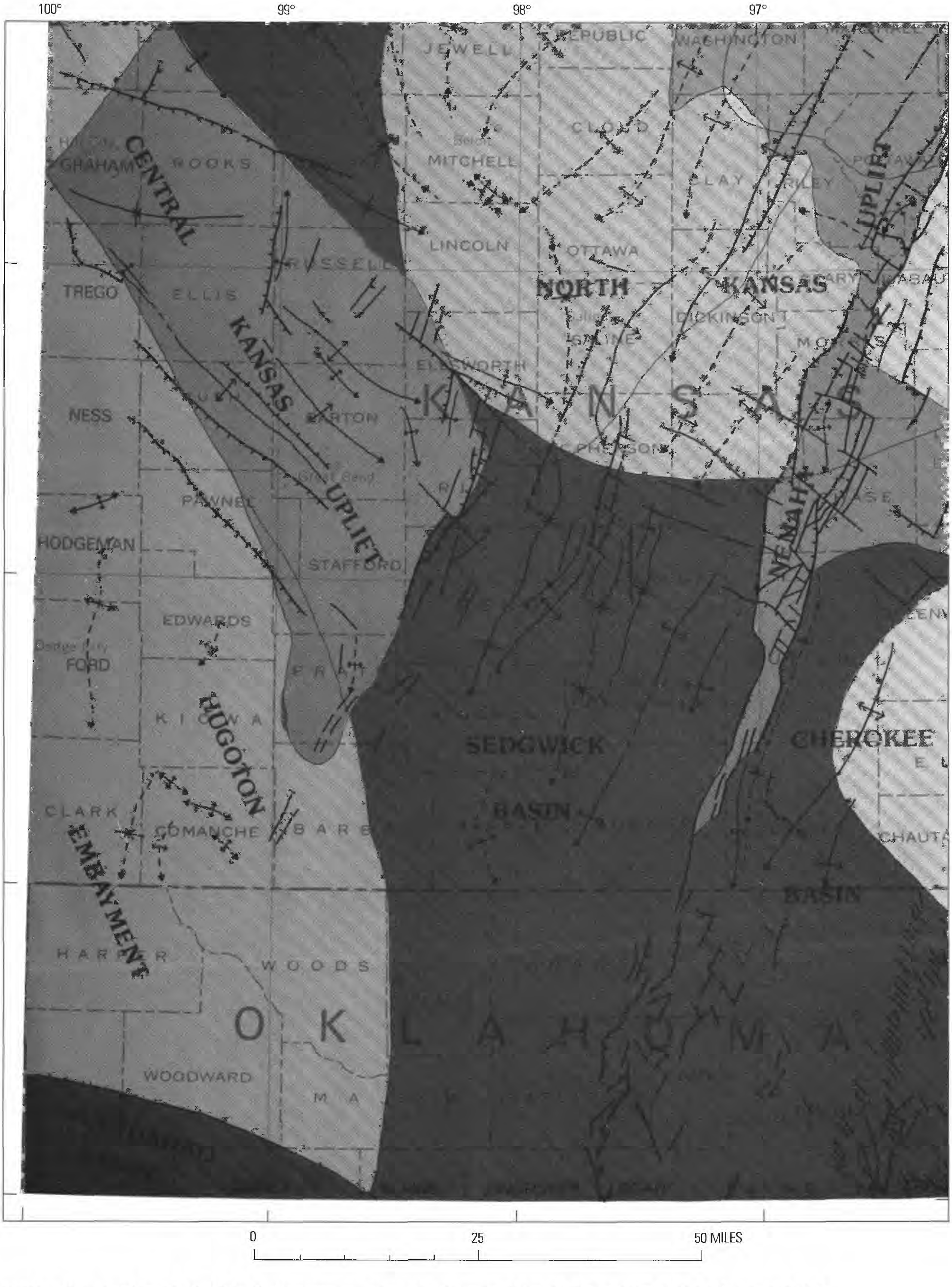

Figure 6. Portion of map MF–1835–E, Phanerozoic structural features. Original map shows shades of gray and pink.

Figure 7. Portion of map MF–1835–F, alkaline igneous rocks.

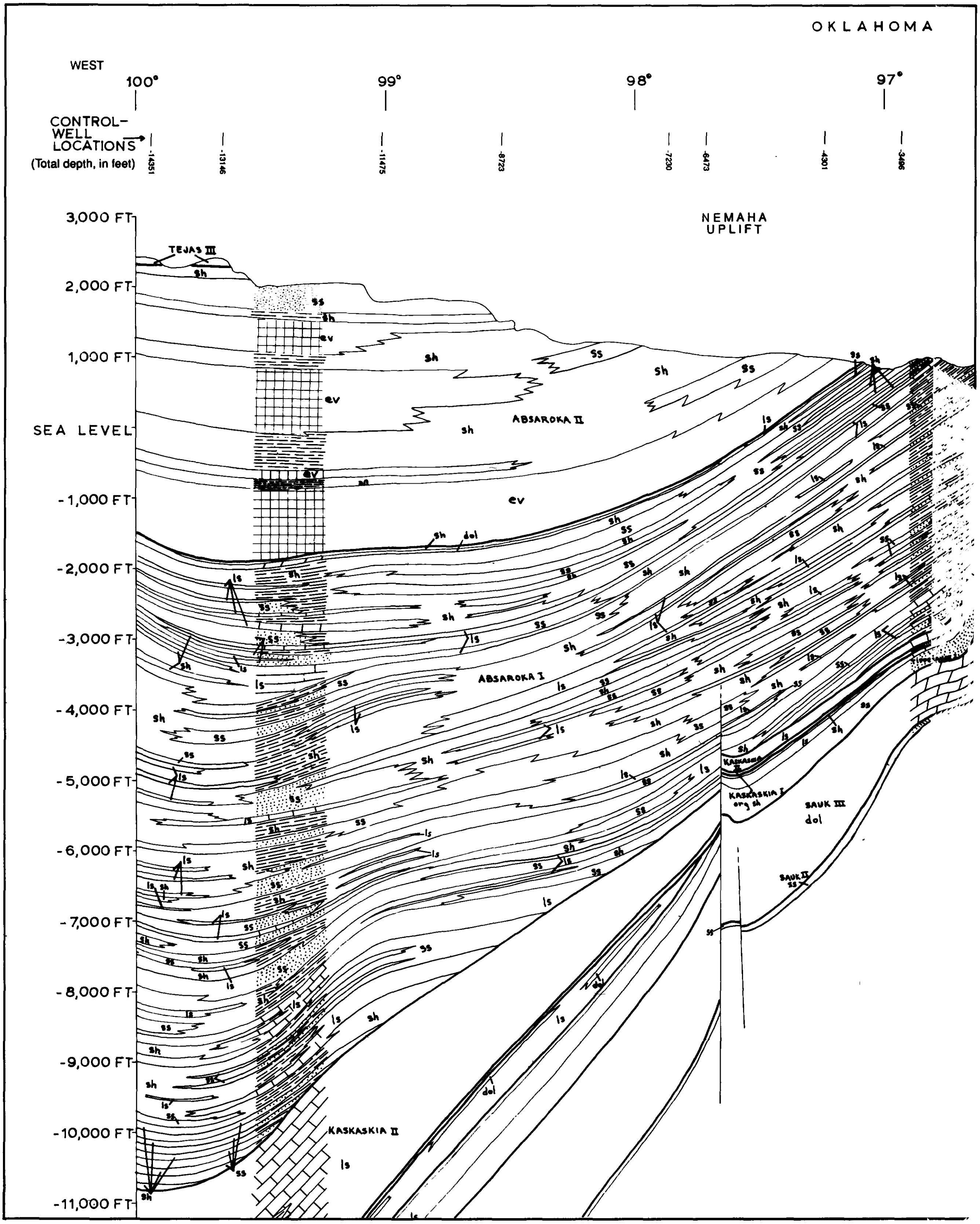

Figure 8. Portion of map MF–1835–G, lithologic cross sections (section along lat 36° N.).

features of the Midcontinent region. When used in conjunction with some of the maps compiled for this project, they will help to evaluate the potential of the region for sediment-hosted ore deposits.

MF–1835–H: AREAL EXTENT OF SELECTED PALEOZOIC SHALES

Map compiled by Walden P. Pratt

These maps (part of one of which is shown in fig. 9) and the carbonate maps in the following set (MF–1835–I) were prepared as an aid to regional appraisal and prospecting for Mississippi Valley-type (MVT) lead-zinc sulfide deposits. MVT deposits in the Midcontinent are predominantly galena-sphalerite stratabound deposits in shallow-water platform carbonate host rocks. The currently favored model for their genesis invokes upward movement of metal-bearing brines from an underlying aquifer to a site in the carbonate section where the metals are precipitated as sulfides (Leach and Rowan, 1986; Palmer and Hayes, 1989). Implicit in this model, as factors that control the site of mineralization, are (1) windows through any regional shale underlying the host unit, and for many workers, (2) a shale caprock overlying the host unit. The seven maps in this report (MF–1835–H) show the areal extent of eight principal groups of Paleozoic shales whose thicknesses are 5 ft or more; 5 ft was selected by consensus as the minimum thickness of shale necessary to form an effective aquitard. The stratigraphic positions of these eight groups of shales are shown in figure 10. The formations containing shale units, and the respective maps, are as follows, from the base up. Map A shows the Upper Cambrian Davis Formation and equivalents, including the Lone Rock Formation in Iowa and the Franconia Formation in Minnesota. Map B, the Middle Ordovician (Champlainian) Glenwood Shale and equivalents, shows a shaly facies of the St. Peter Sandstone in Nebraska. Map C, the Middle Ordovician (Champlainian) Decorah Formation and equivalents, shows in part the composite Simpson Group in Oklahoma and Kansas; in Iowa and Illinois the unit mapped is the Spechts Ferry Shale Member of the Decorah Formation. Map D shows the Upper Ordovician (Cincinnatian) Maquoketa Shale and partly equivalent Sylvan Shale in Oklahoma. Map E, the Upper Devonian and Lower Mississippian Chattanooga Shale and partial equivalents, shows the Maple Mill Shale (Upper Devonian) in Iowa and Nebraska, the Boice Shale (Lower Mississippian) in Nebraska, and the New Albany Shale (Middle Devonian to Lower Mississippian) in Illinois. Map F shows the Mississippian (Kinderhookian) Northview Shale in Kansas and southwestern Missouri, and the Mississippian (Meramecian) Warsaw Shale in northern Missouri and Iowa, together with the Mississippian (Meramecian and Osagean) Borden Siltstone and (Osagean) Springville Shale in Illinois. Map G shows the Middle Pennsylvanian (Atokan to Desmoinesian) Cherokee Group, and in Arkansas, the Cane Hill Member of the Hale Formation (Morrowan). Age assignments of all these formations reflect the usage of Adler (1986) and the participating State geological surveys.

MF–1835–I: THICKNESS AND LIMESTONE-DOLOSTONE RATIOS OF SELECTED PALEOZOIC CARBONATE UNITS

Map compiled by Walden P. Pratt *and* Craig J. Wandrey

The preceding map in this folio (MF–1835–H) shows the extent of eight principal Paleozoic shale units in the project area. These three maps (MF–1835–I) show the other main part of the MVT depositional model mentioned previously—specifically, the areal extent, thickness, and carbonate lithofacies of the region's three principal carbonate units that have proven potential as host rocks. As shown in figure 10, from the base up these are (1) the Upper Cambrian carbonate units (Bonneterre and Eau Claire Formations and equivalents), which are the principal host rocks of MVT deposits in the Southeast Missouri district (Snyder and Gerdemann, 1968); (2) the Middle and Upper Ordovician carbonate units, (Galena Dolomite–Viola Limestone–Kimmswick Limestone and equivalents), host rocks in the Upper Mississippi Valley district (Heyl, 1968); and (3) the Lower Mississippian (Kinderhookian-Osagean-Meramecian) carbonate units (Chouteau-Burlington-Keokuk and Ste. Genevieve Limestones and equivalents), host rocks in the Tri-State (Kansas-Missouri-Oklahoma) district (Brockie and others, 1968) and in the Illinois-Kentucky fluorspar district (Grogan and Bradbury, 1968). At this writing, map MF–1835–I is still in press and therefore cannot be reproduced here. The three printed maps that make up this publication will show carbonate isopachs in black and limestone-dolostone isopleths in red, in values of 1/4, 1/2, 1, 2, and 4.

Map MF–1835–D in this series, described above, attempted to define permissive lithologies for MVT deposits by showing the carbonate-to-clastic and limestone-to-dolostone ratios of the Sauk sequence—rocks of Cambrian and Early Ordovician age. That attempt failed as a regional prospecting guide because of the great preponderance of dolostone over limestone when the Sauk sequence is considered in its entirety. However, it was that failure that led us to the approach of mapping the limestone-dolostone ratio for thinner stratigraphic units—the three units shown on the present set of maps.

The limestone-to-dolostone ratio is shown on these maps because of the apparent importance of the limestone-dolostone interface (defined as the 1:1 ratio) as one of the most important controls of ore deposition in many Midcontinent MVT districts (Snyder, 1968, p. 278); therefore, it is important as a first-cut prospecting tool, especially if

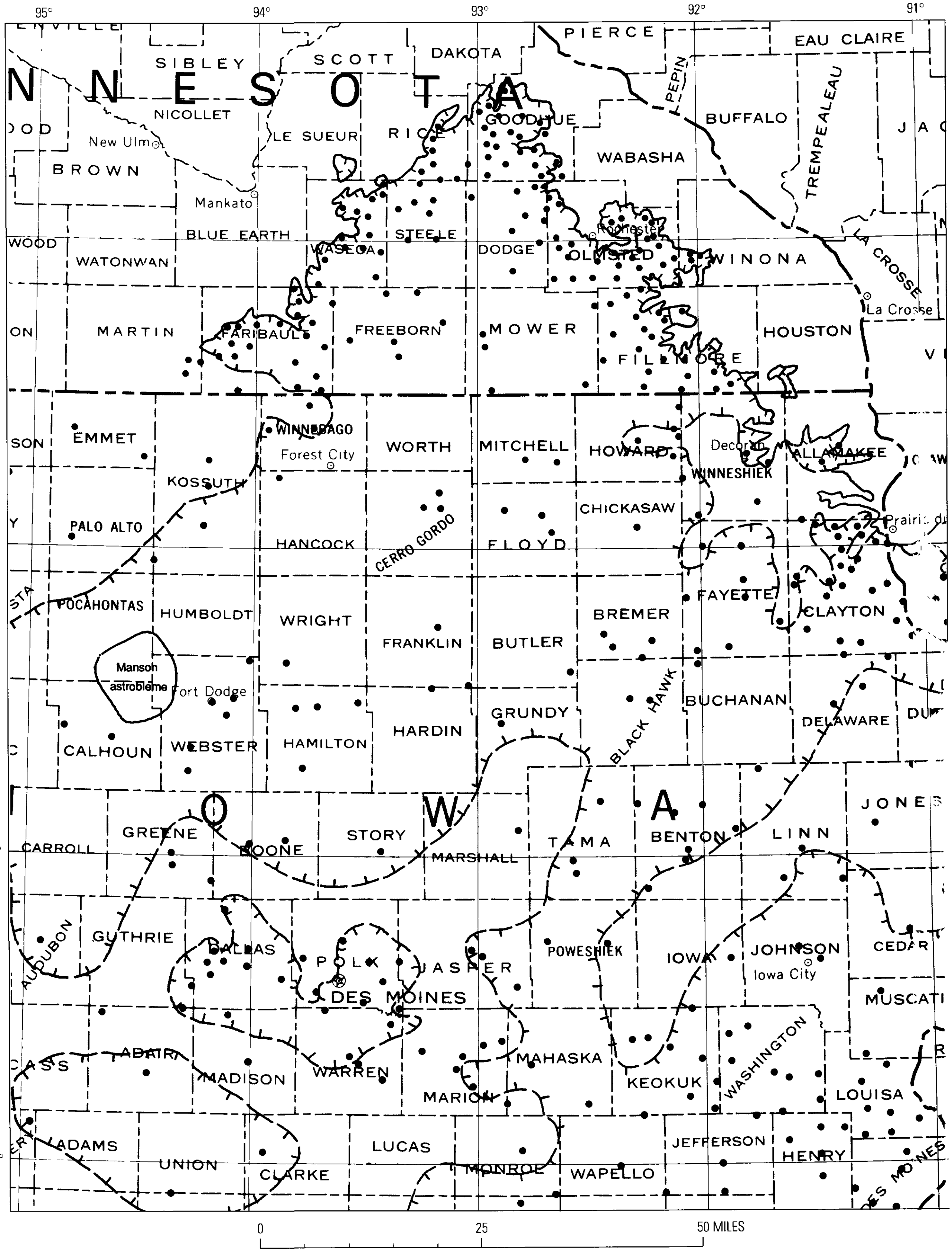

Figure 9. Portion of map MF–1835–H, selected Paleozoic shales (map B).

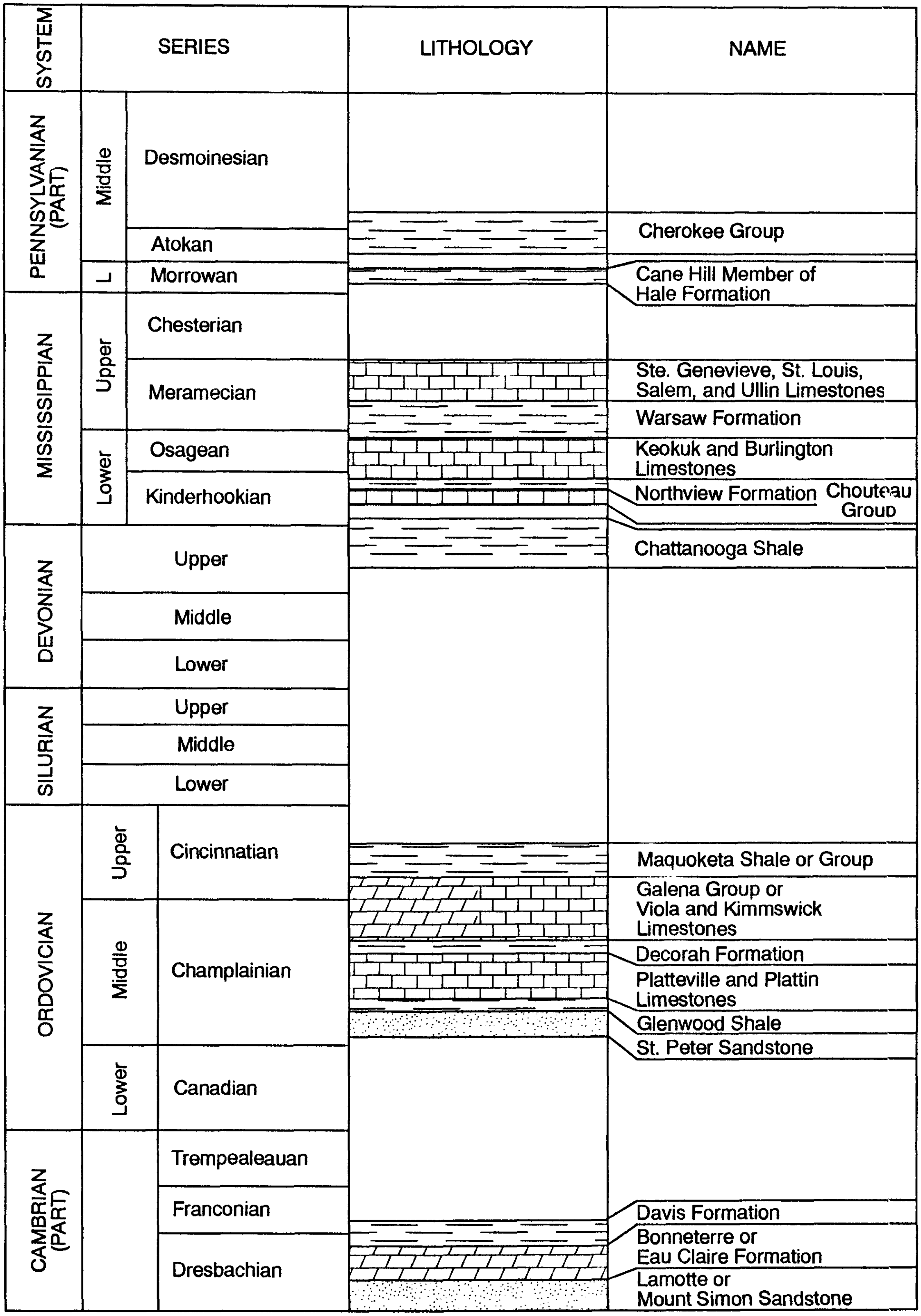

Figure 10. Stratigraphic relationship of selected shale units and principal carbonate units in the northern Midcontinent region and their relation to sandstone aquifers. Blank sections are formations not pertinent to this report. Names and series assignments are in current usage by participating State geological surveys. Modified from Adler (1986).

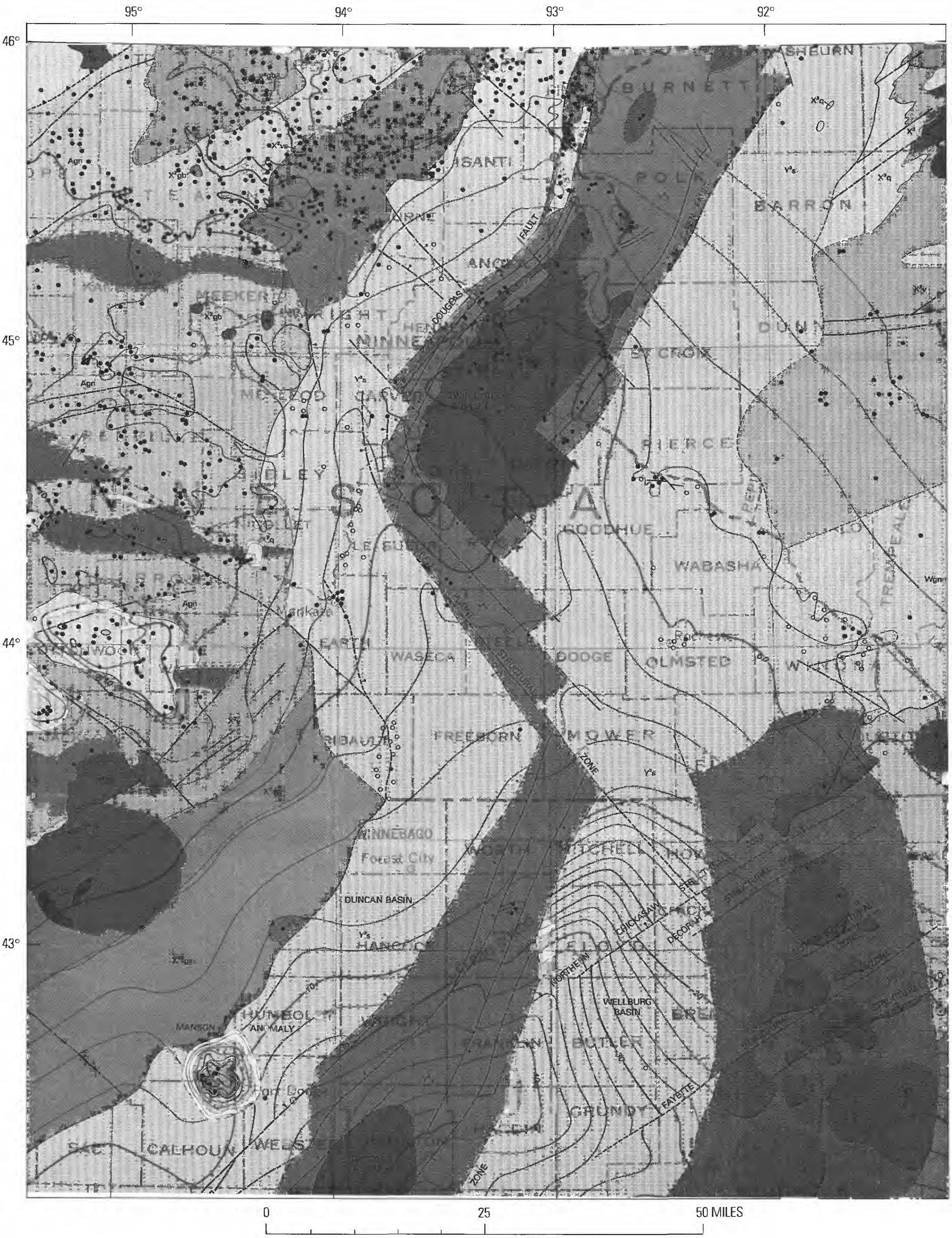

Figure 11. Portion of map I–1853–A, Precambrian basement map. Original map is multicolor.

combined with other potential ore controls such as faults, folds, or regional distribution of shales as underlying windows or overlying caprocks. The reason for control by the limestone-dolostone interface is not known, but such control does seem to be empirically valid (Pratt and others, 1984).

It is widely agreed that the Midcontinent MVT deposits are of hydrothermal origin, and a more direct indicator of hydrothermal activity in some places is coarsely crystalline, sparry dolomite—not the same as the regional, diagenetic dolostone discussed in the previous paragraphs. Occurrences of sparry dolomite reported on drill logs are indicated on the Cambrian and Ordovician maps.

MISCELLANEOUS INVESTIGATIONS SERIES MAPS (I SERIES)

I–1853–A: PRECAMBRIAN BASEMENT MAP OF THE NORTHERN MIDCONTINENT

Map compiled by Paul K. Sims

This map (fig. 11) was compiled from 1:500,000-scale maps contributed by the respective State geological surveys showing basement drill holes, lithotypes or geologic map units, and basement topography, contoured at 200-ft intervals (500- and 1,000-ft intervals in the Illinois Basin). In compiling the map, available aeromagnetic and gravity anomaly maps were used to help define the trend, extent, and boundaries of individual rock bodies. The completed map shows basement topography, structure, and principal lithologic terranes comprising more than 50 individual units. The principal geologic contribution resulting from this compilation is the recognition and delineation of a major, buried, northwest-trending Early Proterozoic orogen, named the Central Plains orogen (Sims and Peterman, 1986). It extends from Nebraska through Kansas into Missouri, where it is overlapped by Middle Proterozoic rhyolite-granite terranes, and it sharply truncates Archean rocks and an older Proterozoic orogenic (Penokean) belt in the inner part of the craton.

The I–1853 series consists of map I–1853–A only.

I–2214: PRECAMBRIAN BASEMENT MAP OF THE TRANS-HUDSON OROGEN AND ADJACENT TERRANES

Map compiled by P.K. Sims, Zell E. Peterman, T.G. Hildenbrand, *and* Shannon Mahan

The Trans-Hudson orogen (Hoffman, 1981) is a deformed, generally north-trending orogenic belt of Early Proterozoic age that extends from outcrop areas in the Canadian Shield southward beneath Phanerozoic strata into the subsurface of the Northern Great Plains of the United States. It consists of Early Proterozoic, mainly arc-related rocks (Lewry and others, 1985; Green and others, 1985) and Archean rocks. The orogen separates two major Archean cratons, the Superior on the east and the Wyoming on the west, and represents a major constructional phase in the assembly of Laurentia (Hoffman, 1988), the North American craton. It terminates against the younger Early Proterozoic Central Plains orogen in southern South Dakota (Sims and Peterman, 1986; Bickford and others, 1986).

This Precambrian basement map of the area enclosed by lat 42°–49° N. and long 96°–106° W. (fig. 12) was prepared as a companion to the basement map of the northern Midcontinent region, described above (Sims, 1990), in order to provide a better geologic framework of the Precambrian basement in the North-Central United States. It was compiled from drill-hole data and magnetic and gravity data. The States submitted 1:1,000,000-scale maps or other records showing basement drill holes and lithotypes; in addition, the Nebraska and North Dakota Geological Surveys submitted 1:1,000,000-scale maps showing basement topography, contoured at 200-ft intervals. J.S. Klasner submitted a map and report on the basement rocks of North Dakota and South Dakota, prepared under an earlier Federal-State contract. In addition, the geologic map of that part of eastern South Dakota and Nebraska between lat 42° N. and lat 46° N. and east of long 100° W. was revised because of the availability of some new drill-hole data and new gravity and aeromagnetic data. This area, together with a narrow strip of Minnesota and Iowa, was included in the earlier basement map of the northern Midcontinent (Sims, 1990). A report by Faircloth (1988) provided petrologic and geochemical data on several basement drill-core samples in North Dakota, South Dakota, and Minnesota.

One of the authors (TGH) compiled digital aeromagnetic and gravity maps of the Northern Great Plains at the compilation scale; Lindrith Cordell compiled a magnetic potential terrace map (Cordell and McCafferty, 1989) at a scale of 1:2,000,000 for use in the geologic interpretation. These geophysical maps were used to define, insofar as possible, the trend, extent, and boundaries of gross geologic rock units.

Six major tectono-stratigraphic terranes were delineated for the first time in the map area, from oldest to youngest:

1. Archean gneiss terrane of Superior craton (3,600–2,600 Ma);
2. Archean gneiss terrane of Wyoming craton (3,400–2,500 Ma);
3. Archean greenstone-granite terrane of Superior craton (2,750–2,600 Ma);
4. Wisconsin magmatic terranes of Penokean orogen (1,890–1,840 Ma);
5. Trans-Hudson orogen (1,910–1,800 Ma) (exclusive of older continental-margin rocks; and
6. Central Plains orogen (1,800–1,630 Ma).

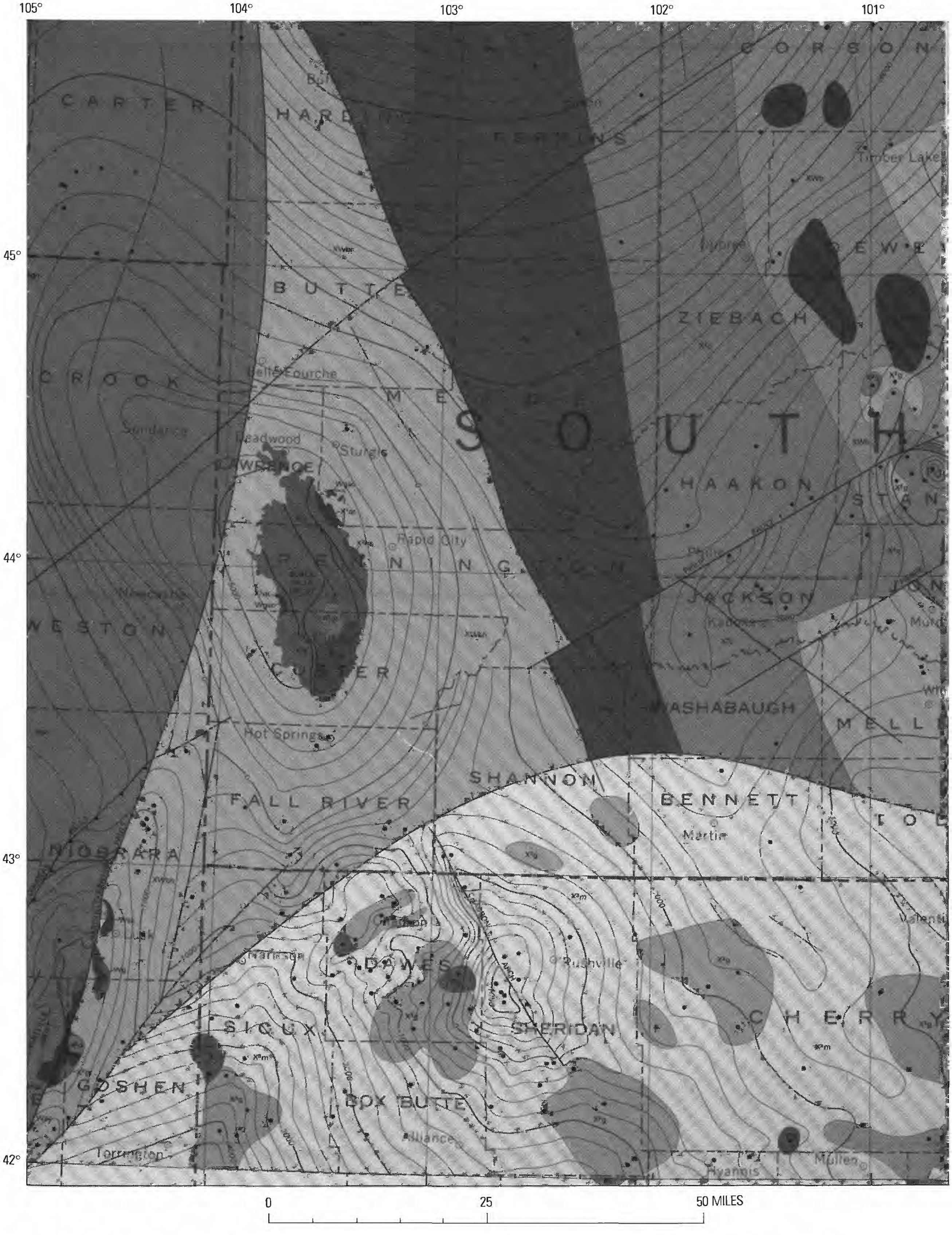

Figure 12. Portion of map I–2214, Precambrian basement map of the Trans-Hudson orogen. Original map is multicolor.

In addition, the Sioux Quartzite forms a coherent, platform sedimentary body unconformably overlying Early Proterozoic and Archean rocks in eastern South Dakota and a small adjacent part of Nebraska and Iowa.

A 53-page pamphlet accompanying this map includes selected published and unpublished age data, well records used in constructing the maps (except for Minnesota and Iowa), and a brief discussion of mineral resource potential in the Trans-Hudson orogen.

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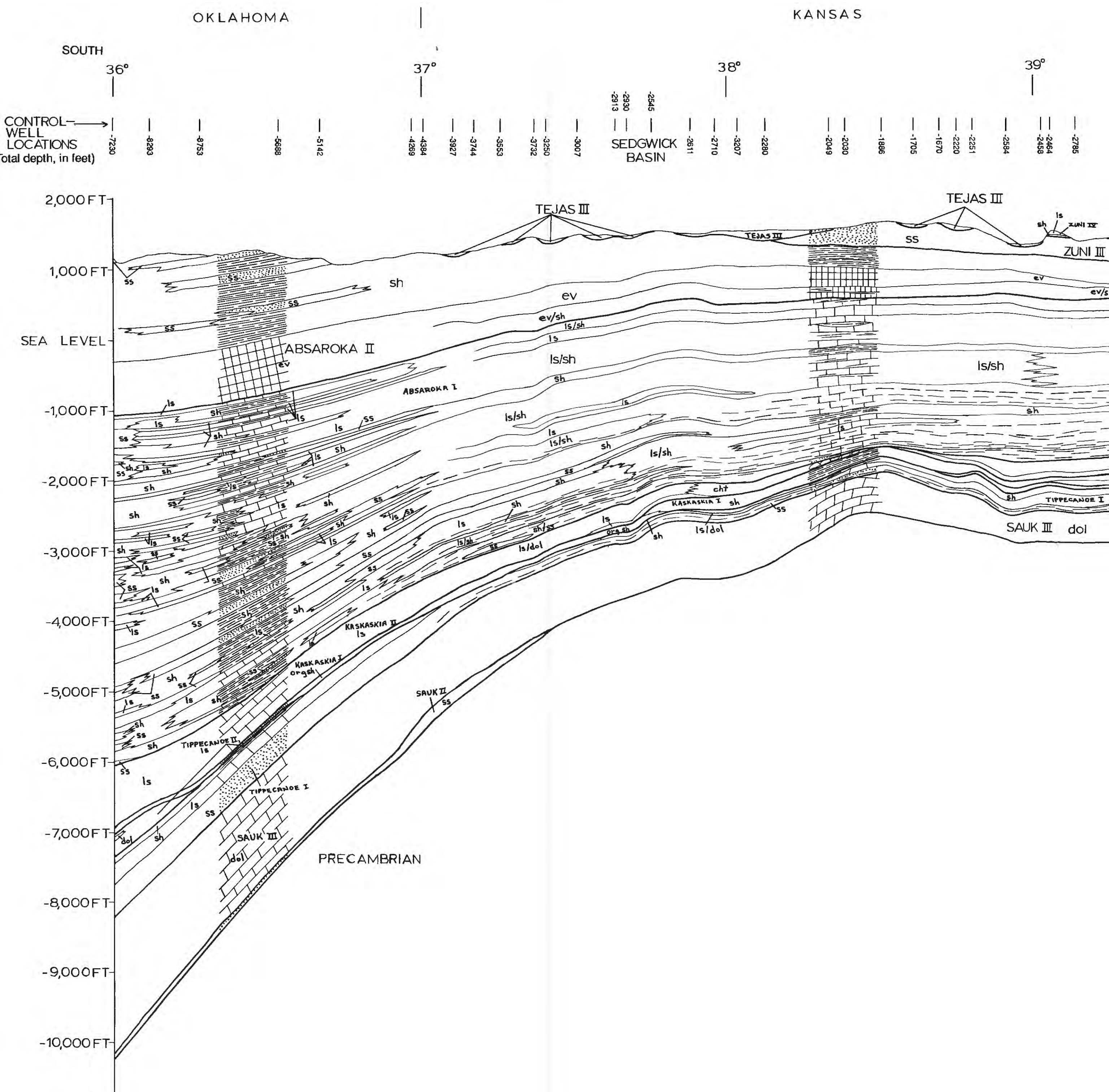

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