DESCRIPTION OF DATA FILES COMPILED FOR THE CENTRAL MIDWEST REGIONAL AQUIFER-SYSTEM ANALYSIS

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CONVERSION FACTORS

Factors for converting inch-pound units or other units to metric units (International System) are given below:

Multiply inch-pound unit	*By*	*To obtain metric unit*
foot	0.3048	meter
mile	1.609	kilometer
foot per day	0.3048	meter per day
foot squared per second	0.09290	meter squared per second
pound per square inch	0.07030	kilogram per square centimeter
degree Fahrenheit (°F)	°C = (°F-32)/1.8	degree Celsius (°C)

Sea level: In this report, sea level refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Mean Sea Level."

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ABSTRACT

Several types of geologic and hydrologic data were collected and compiled as part of a regional-aquifer study of the central midwest United States. The data include lithologic and geophysical logs, hydraulic heads, hydrochemical data, aquifer properties, and fluid-withdrawal rates. Data were obtained from numerous State, Federal, and private sources. Distribution of data varies considerably; most data files contain data selected to represent the regional scope of the study. In addition to site-specific (point) data, areal information in the form of model-data arrays is available for hydraulic head, transmissivity, and vertical leakance. Most of the nonproprietary parts of the data are available on magnetic tape.

INTRODUCTION

The Central Midwest Regional Aquifer-System Analysis (CMRASA) investigated the hydrology of aquifer systems in Cambrian through Cretaceous rocks in all of Kansas and Nebraska and parts of eight other Midwestern States (fig. 1). The overall plan for the analysis is outlined by Jorgensen and Signor (1981). The CMRASA compiled many types of data from many sources to define the framework, properties, and flow patterns of these aquifer systems. The compilation and handling of the data became a major part of the analysis because the CMRASA study area is extensive (fig. 1), the geohydrologic units span a large part of the geologic column (table 1), and many aspects of hydrology were investigated. Regional geohydrology is related to physiography and thus is logically described in terms of the Plains and Ozark subregions (fig. 1 and table 1). Detailed information and interpretations from the analysis are presented by Jorgensen and others (in press) and other chapters of U. S. Geological Survey Professional Paper 1414.

Purpose and Scope

The purpose of this report is to describe the data used in the CMRASA analysis. Because of the regional scope of the investigation, the data files generally contain selected representative data. This report does not include the data but describes the types of data used and their sources, distribution, and availability. In addition to site-specific (point) data, areal information such as used for computer-model input is described.

Acknowledgments

The data described in this report could not have been compiled without the cooperation and assistance of many people. U.S. Geological Survey personnel in the Arkansas, Colorado, Kansas, Missouri, Nebraska, and Oklahoma Districts are acknowledged for their efforts in compiling the data. Claud H. Baker, Jr. of the U.S. Geological Survey helped in designing and maintaining many of the data files. Appreciation is also extended to the many organizations, listed in tables 2-7 of this report, that allowed their data to be used.

SITE-SPECIFIC DATA

Several types of data were needed to fulfill the study objectives. The data files contain the information used to define the geologic framework, regional flow patterns, water quality, and fluid-transmitting properties of the geohydrologic units. All the data files contain information that was useful in the formulation and application of three-dimensional numerical flow models of the system.

Because the CMRASA data files contain only selected, representative data, they do not include all the data used for preparation of the maps shown in CMRASA interpretative reports (for example, Jorgensen and others, in press).

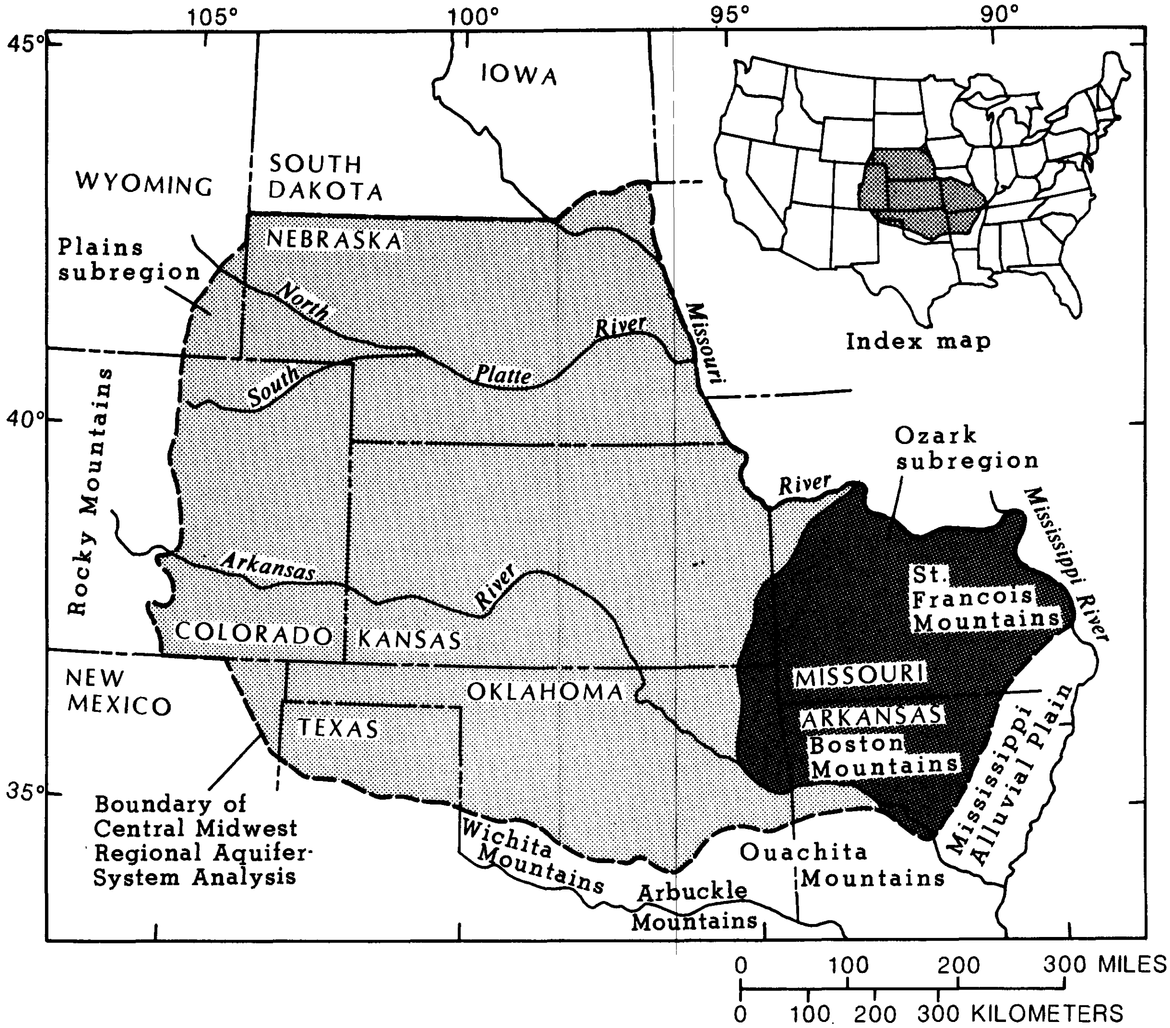

Figure 1. Location and extent of Central Midwest Regional Aquifer-System Analysis (CMRASA) study area and Plains and Ozark subregions.

Some data files include median or aggregate data values or interpretations of the data. The completeness and quality of the data in each data file varies considerably due to several factors. These factors include the availability of data, the accuracy of the data, the many different sources of data, and the range in capabilities and procedures used in compiling these data in each State in the CMRASA study area.

Parts of the hydraulic-head, hydrochemical, and aquifer-property data files are proprietary, and access to them in machine-readable form is limited.

Log Data

Log data provide the information needed to delineate the regional geologic framework in the form of maps of tops and thicknesses of geohydrologic units, maps of percentage of sandstone and shale, and cross sections. Good-quality lithologic and geophysical logs that were considered representative of fairly large areas were selected as members of the data file. Logs were selected at a density of one to three sites per county; the density of data varies from State to State due to differences in approaches used to assemble and evaluate the data. The data are

Table 1. *Generalized correlation of geohydrologic units to time-stratigraphic units in the study area*

	Geohydrologic unit: Plains subregion (fig. 1)		Geohydrologic unit: Ozark subregion (fig. 1)		CMRASA code number (table 9)	Time-stratigraphic unit
	High Plains aquifer or unnamed unit		Western Interior Plains confining system		45-49	Quaternary and Tertiary
	Great Plains confining system		Western Interior Plains confining system		50-99	Upper Cretaceous
CMRASA study interval	Great Plains aquifer system	Maha aquifer	Western Interior Plains confining system		100-149	Upper Cretaceous Lower Cretaceous
CMRASA study interval	Great Plains aquifer system	Apishapa confining unit	Western Interior Plains confining system		150-199	Lower Cretaceous
CMRASA study interval	Great Plains aquifer system	Apishapa aquifer	Western Interior Plains confining system		200-249	Lower Cretaceous
CMRASA study interval	Western Interior Plains confining system		Western Interior Plains confining system		350-549	Jurassic through Upper Mississippian (Chesterian)
CMRASA study interval	Western Interior Plains aquifer system	Upper unit	Ozark Plateaus aquifer system	Springfield Plateau aquifer	550-599	Mississippian
CMRASA study interval	Western Interior Plains aquifer system	Confining unit	Ozark Plateaus aquifer system	Ozark confining unit	650-699	Lower Mississippian and Upper Devonian
CMRASA study interval	Western Interior Plains aquifer system	Lower units	Ozark Plateaus aquifer system	Ozark aquifer	700-849	Middle Devonian through uppermost Cambrian
CMRASA study interval	Western Interior Plains aquifer system	Lower units	Ozark Plateaus aquifer system	St. Francois confining unit	850-899	Upper Cambrian
CMRASA study interval	Western Interior Plains aquifer system	Lower units	Ozark Plateaus aquifer system	St. Francois Aquifer	900-949	Upper Cambrian
	basement confining unit		basement confining unit		950-999	Cambrian and Precambrian

from many different Federal, State, and private sources. The distributions and sources of the data are shown in figures 2 and 3.

Lithologic Logs

There are about 850 lithologic logs in the log data file (fig. 2). The lithologic logs were compiled from sources listed in table 2 (record positions 58-59). These data are available from the original sources, the U.S. Geological Survey's Ground-Water Site Inventory (GWSI) computer file, and on magnetic tape from the U.S. Geological Survey in Lawrence, Kansas. Formation tops, lithology, location, and other pertinent information from these sites are available from GWSI. These sites are identified in GWSI by the use of components C190 and C191; the components simply indicate the storage position of this information within GWSI. Table 3 shows how these components are used. Selected parts of the data in GWSI are also available in files on magnetic tape. The format of the data available on magnetic tape is shown in table 2. Correspondence between specific geologic units and CMRASA code numbers (table 1) is shown in table 9 at the end of this report.

Geophysical Logs

There are about 750 geophysical logs in the log data file (fig. 3). The geophysical logs were compiled from sources listed in table 4 (record positions 52-53). The data are available from the original sources and from paper files stored at U.S. Geological Survey offices in the respective states. These sites are identified in GWSI by the use of components C190 and C191 (table 3), although formation tops and other pertinent data are not stored in GWSI for all sites. A list of geophysical-log sites is available on magnetic tape from the U.S. Geological Survey in Lawrence, Kansas; the format of this list is shown in table 4.

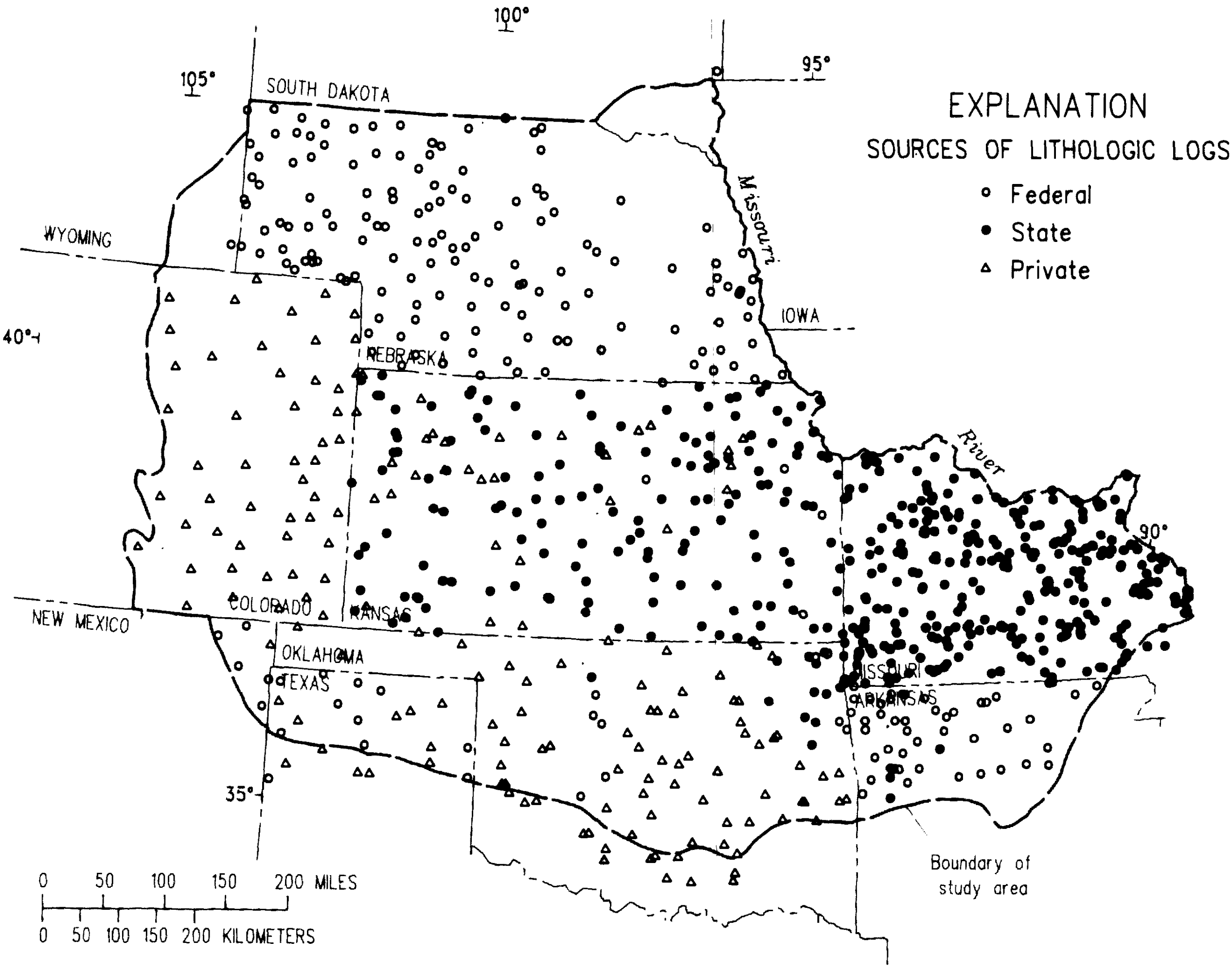

Figure 2. Distribution and sources of lithologic logs.

Table 2. *Description and format of lithologic-log data stored on magnetic tape*

Record position	Description
1-15	Site-identification number: uniquely identifies each site
16	Blank
17-22	Latitude in degrees, minutes, and seconds (ddmmss). All latitudes are north.
23	Blank
24-30	Longitude in degrees, minutes, and seconds (dddmmss). All longitudes are west.
31	Blank
32-51	Local number: identifies location of well in system used locally; system is unique to each state.
52-53	State and district code (see U.S. Department of Commerce, 1979).
54-56	County code (see U.S. Department of Commerce, 1979).
57	Blank
58-59	Source of data:
	10 = U.S. Geological Survey file or publication
	11 = Kansas Geological Survey file or publication
	14 = American Stratigraphic Company
	15 = Petroleum Information, Inc. (proprietary data)
	21 = Kansas Sample Log Service
	25 = Missouri Department of Natural Resources, Division of Geology and Land Survey
	26 = Oklahoma Geological Survey

Table 2. *Description and format of lithologic-log data stored on magnetic tape*--Continued

Record position	Description
58-59	Source of data: 27 = Oklahoma City Geological Society 28 = Texas Panhandle Sample Log Service 29 = American Association of Petroleum Geologists publication 31 = Kansas Geological Society (Type logs) 32 = Kansas Geological Society (excluding Type logs) 33 = Arkansas Geological Commission 34 = Arkansas Oil and Gas Commission
60-67	Data-file membership is indicated by a "1" in the proper record position; lack of membership is indicated by a "0."
60	Lithologic-log data-file membership.
61	Geophysical-log data-file membership.
62	Water-level data-file membership.
63-64	Blank
65	Hydraulics data-file membership.
66-67	Blank
68-75	Altitude of land surface, in feet.
76-83	Total depth of hole, in feet.
84-86	CMRASA code number (see table 1). If the code is less than 45, refer to table 9 at end of this report for the appropriate CMRASA code for the corresponding geologic unit, which is given in record positions 88-95.

Table 2. *Description and format of lithologic-log data stored on magnetic tape*--Continued

Record position	Description
87	Blank
88-95	U.S. Geological Survey geologic unit code (see Hutchison, 1975, appendix F).
96-103	Depth to top of formation or lithology, in feet (blank if log begins below top of formation or lithology).
104-111	Depth to bottom of formation or lithology, in feet (blank if log ends before bottom of formation or lithology).
112-115	U.S. Geological Survey lithologic code (see Baker and Foulk, 1975, p. B62-B66).
116	Blank
117-132	Extra information about lithology or formation.

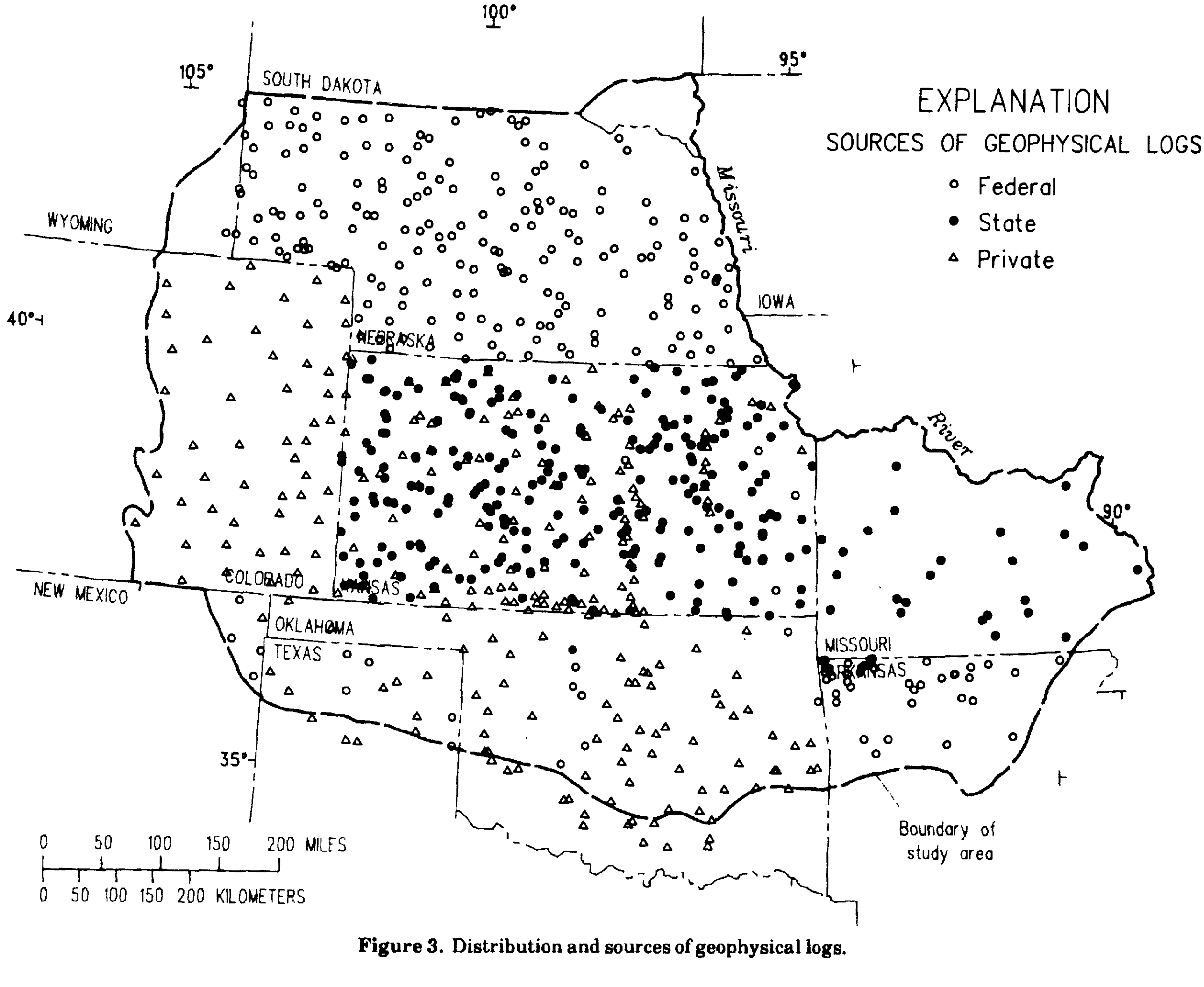

Figure 3. Distribution and sources of geophysical logs.

Table 3. *Components of Ground-Water Site Inventory (GWSI) that identify data file of Central Midwest Regional Aquifer-System Analysis (CMRASA)*

Record position	Other site-identification numbers
	Other identifier (C190)
1-2	Source of data:
	10 = U.S. Geological Survey file or publication
	11 = Kansas Geological Survey file or publication
	12 = U.S. Bureau of Mines publication
	13 = Kansas Department of Health and Environment file
	14 = American Stratigraphic Company
	15 = Petroleum Information, Inc. (proprietary data)
	16 = Roger Hoeger, consultant (proprietary data)
	17 = Owner of well
	18 = Kansas State Board of Agriculture, Division of Water Resources
	19 = National Uranium Resource Evaluation
	20 = Petroleum Data Systems (proprietary data)
	21 = Kansas Sample Log Service
	22 = Kansas Corporation Commission
	23 = Kansas Geological Society (drill-stem-test and core-analysis data)
	24 = Drilling or testing company
	25 = Missouri Department of Natural Resources, Division of Geology and Land Survey
	26 = Oklahoma Geological Survey

Table 3. *Components of Ground-Water Site Inventory (GWSI) that identify data file of Central Midwest Regional Aquifer -System Analysis (CMRASA)*--Continued

Record position	Other site-identification numbers
1-2	Source of data:
	27 = Oklahoma City Geological Society
	28 = Texas Panhandle Sample Log Service
	29 = American Association of Petroleum Geologists publication
	30 = Riley's, Inc.
	31 = Kansas Geological Society (Type logs)
	32 = Kansas Geological Society (other than Type logs)
	33 = Arkansas Geological Commission
	34 = Arkansas Oil and Gas Commission
	35 = Arkansas Department of Health
	36 = U.S. Army Corps of Engineers
	37 = Arkansas Water Well Committee
	38 = Nebraska Oil and Gas Commission
3-10	Data-file membership is indicated by a "1" in the proper record position, lack of membership is indicated by a "0."
3	Lithologic-log data-file membership.
4	Geophysical-log data-file membership.
5	Water-level data-file membership.
6-7	Blank
8	Hydraulics data-file membership.
9-10	Blank

Table 3. *Components of Ground-Water Site Inventory (GWSI) that identify data file of Central Midwest Regional Aquifer-System Analysis (CMRASA)--Continued*

Record position	Other-site identification numbers
Other assigner (C191)	
1-6	Identifies site as including data used for this study. Always coded as: CMRASA.
7-10	Usually blank, but rarely coded as: 0254.

Hydraulic-Head Data

Hydraulic-head data provide the information needed to define regional flow patterns in the aquifers. Hydraulic-head data consist of both direct measurements of water levels in wells and equivalent freshwater heads from interpretations of drill-stem tests from oil and gas wells (figs. 4 and 5). The density of data varies from zero to many sites per county; the density also varies from state to state due to differences in availability of data and in approaches used to assemble and evaluate the data. The data are from many sources; figures 4 and 5 show the categorized sources.

Measured Water Levels

Most of the water-level measurements are from areas where the geohydrologic unit to which the water level applies is relatively shallow and contains freshwater. These measurements are direct determinations of the static water level at these sites. There are about 1,400 sites with measured water levels in the hydraulic-head data file (fig. 4). The measured water levels were compiled from sources listed in table 5 (record positions 58-59). The data are available from the original sources, GWSI, and on magnetic tape from the U.S. Geological Survey in Lawrence, Kansas. Depth to water, aquifer, location, and other pertinent information from these sites are available in GWSI. These sites are identified in GWSI by the use of components C190 and C191 (table 3). The format of the selected parts of the data in GWSI that are available on magnetic tape is shown in table 5.

Equivalent Freshwater Heads

Equivalent freshwater heads are calculated from drill-stem-test results obtained from oil- or gas-exploration holes drilled to relatively great depths in the study area. The static reservoir pressure was estimated by pressure-time data extrapolation or was assumed to be approximately equal to the reported shut-in pressure. The equivalent freshwater head was computed from this pressure, estimated fluid viscosity, and reported or estimated reservoir temperature. The quality of the equivalent freshwater-head data varies considerably because the number of sites was not restricted to a small number of sites per county. There are about 2,600 values of equivalent freshwater head; some values refer to different geohydrologic units at the same site. The distribution of sites is shown in figure 5. These reservoir-parameter data were compiled from the sources listed in table 6 (record positions 36-37). The data are available from the original sources or on magnetic tape from the U.S. Geological Survey in Lawrence, Kansas. The format of the data available on magnetic tape is shown in table 6.

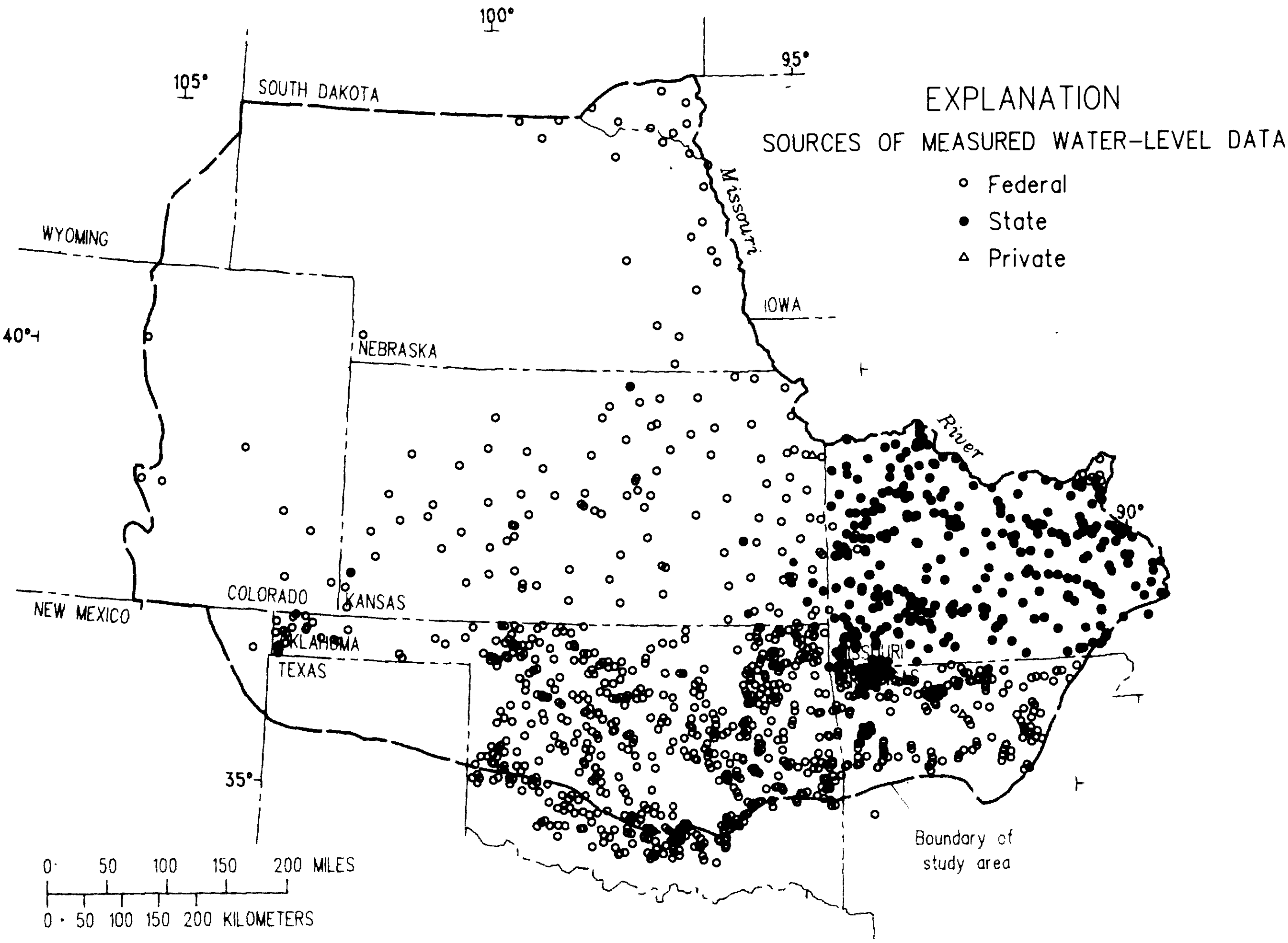

Figure 4. Distribution and sources of measured water-level data.

Hydrochemical Data

Hydrochemical data provide information needed to map spatial trends in water chemistry, help interpret regional flow systems, and define areas of suitability (or unsuitability) for use. The quality of the analyses in the hydrochemical data file varies considerably and is dependent on the source and original use of the data. In general, analyses pertaining to relatively deep oil or gas holes are less likely to be as complete or reliable as those pertaining to relatively shallow water wells. The sources of the hydrochemical data are: the National Water Data Storage and Retrieval System (WATSTORE) water-quality file (U.S. Geological Survey, 1983); the Kansas Geological Survey; the National Uranium Resources Evaluation (U.S. Department of Energy, Grand Junction, Colorado); and the Petroleum Data System (University of Oklahoma, Norman). Data from the last source are proprietary. The density of hydrochemical data also varies considerably from nonexistence in some areas to extremely dense in others, especially in areas with intense oil and gas development. Because of this variability in quality and density of the hydrochemical data, and because of spatial water-quality variations,

Table 4. *Description and format of geophysical-log data stored on magnetic tape*

Record position	Description
1-6	Latitude in degrees, minutes, and seconds (ddmmss). All latitudes are north.
7-13	Longitude in degrees, minutes, and seconds (dddmmss). All longitudes are west.
14-16	Blank
17-18	State and district code (see U.S. Department of Commerce, 1979).
19-21	County code (see U.S. Department of Commerce, 1979).
22-24	Blank
25-44	Local number: identifies location of well in system used locally; system is unique to each state.
45-47	Blank
48	Principal use of site or purpose for which the site was constructed (Baker and Foulk, 1975, p. B23.1-B25).
49	Blank
50	Principal use of water from the site (Baker and Foulk, 1975, p. B25-B28).
51	Blank
52-53	Source of data: 10 = U.S. Geological Survey file or publication 11 = Kansas Geological Survey file or publication 14 = American Stratigraphic Company

Table 4. *Description and format of geophysical-log data stored on magnetic tape*--Continued

Record position	Description
52-53	Source of data: 15 = Petroleum Information, Inc. (proprietary data) 17 = Owner of well 21 = Kansas Sample Log Service 24 = Drilling or testing company 25 = Missouri Department of Natural Resources, Division of Geology and Land Survey 26 = Oklahoma Geological Survey 27 = Oklahoma City Geological Society 28 = Texas Panhandle Sample Log Service 29 = American Association of Petroleum Geologists publication 31 = Kansas Geological Society (Type logs) 32 = Kansas Geological Society (excluding Type logs)
54-61	Data-file membership is indicated by a "1" in the proper record position; lack of membership is indicated by a "0."
54	Lithologic-log data-file membership.
55	Geophysical-log data-file membership.
56	Water-level data-file membership.
57-58	Blank
59	Hydraulics data-file membership.
60-64	Blank
65-74	Identifies sites as including data used for this study; coded as either "CMRASA" or "CMRASA0254."

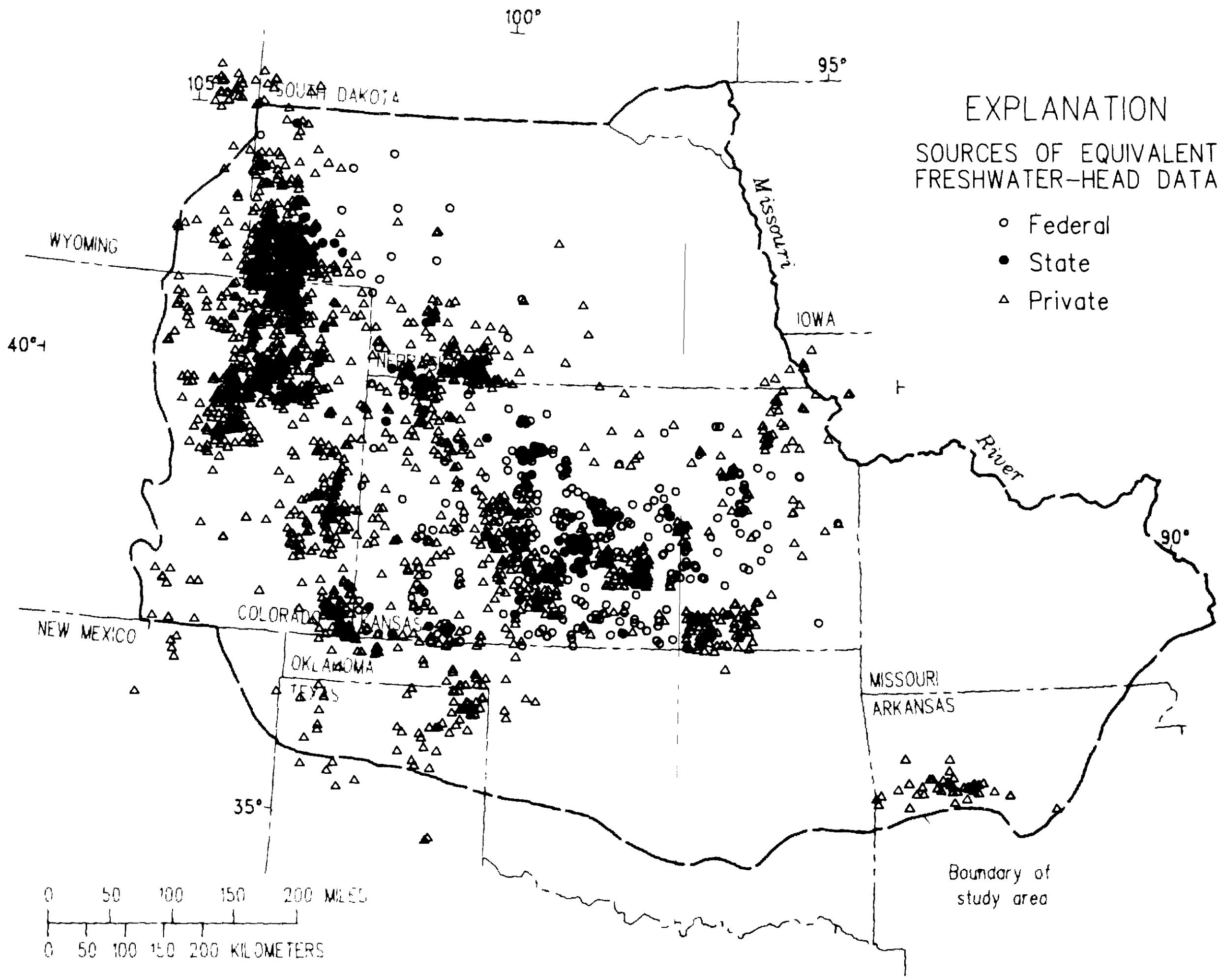

Figure 5. Distribution and sources of equivalent freshwater-head data.

data-file members were chosen as those water-quality analyses with the median concentration of dissolved solids (or chloride) within each 5-minute quadrangle of latitude and longitude in the study area for each major geohydrologic unit.

There are about 2,900 water-quality analyses in the hydrochemical data file; figure 6 shows their distribution and categorized sources of the data-file members. The hydrochemical data are available from the original sources, on magnetic tape from the U.S. Geological Survey in Lawrence, Kansas, or from U.S. Geological Survey Professional Paper 1414-D now in preparation (C.H. Baker, Jr., U.S. Geological Survey, written commun., 1988). The format of the data available on magnetic tape is shown in table 7.

Aquifer-Property Data

Aquifer-property data provide quantitative information on transmissive and storage properties of the geohydrologic units. Estimates of transmissivity can be made from pumping tests and specific-capacity tests conducted on water wells, especially large-capacity wells. Pumping tests also yield estimates of storage coefficient. Reservoir-parameter data, as used herein, are derived from drill-stem tests and core-sample analyses. Drill-stem tests can provide an estimate of the permeability factor (intrinsic permeability divided by viscosity of fluid), and core-sample analyses provide an estimate of intrinsic permeability; hydraulic conductivity then can be estimated from these results. In general, pumping and specific-

Table 5. *Description and format of measured water-level data stored on magnetic tape*

Record position	Description
1-15	Site-identification number: uniquely identifies each site.
16	Blank
17-22	Latitude in degrees, minutes, and seconds (ddmmss). All latitudes are north.
23	Blank
24-30	Longitude in degrees, minutes, and seconds (dddmmss). All longitudes are west.
31	Blank
32-51	Local number: identifies location of well in system used locally; system is unique to each state.
52-53	State and district code (see U.S. Department of Commerce, 1979).
54-56	County code (see U.S. Department of Commerce, 1979).
57	Blank
58-59	Source of data:
	10 = U.S. Geological Survey file or publication
	25 = Missouri Department of Natural Resources, Division of Geology and Land Survey
60-67	Data-file membership is indicated by a "1" in the proper record position, lack of membership is indicated by a "0."
60	Lithologic-log data-file membership.
61	Geophysical-log data-file membership.
62	Water-level data-file membership.

Table 5. *Description and format of measured water-level data stored on magnetic tape* --Continued

Record position	Description
63-64	Blank
65	Hydraulics data-file membership.
66-67	Blank
68-75	Altitude of land surface, in feet.
76-83	Total depth of hole, in feet.
84	Principal use of water from the site (Baker and Foulk, 1975, p. B25-B28).
85	Principal use of the site or the purpose for which the site was constructed (Baker and Foulk, 1975, p. B23.1-B25).
86-88	CMRASA code number (see table 1). If the code is less than 45, refer to table 9 at end of report for the appropriate CMRASA code for the corresponding geologic unit, which is given in record positions 90-97
89	Blank
90-97	U.S. Geological Survey geologic unit code (see Hutchison, 1975, appendix F).
98	Importance of geologic unit as a source of water to the well: P = Primary S = Secondary N = Noncontributing U = Unknown

Table 5. *Description and format of measured water-level data stored on magnetic tape*--Continued

Record position	Description
99-106	Depth to water, in feet. If well was not measured because it was flowing, record position 103 = "F."
107	Blank
108-117	Date of water-level measurement in order of month, day, year(mm/dd/yyyy).
118-122	Number of water-level measurements at this site.
123	Blank
124-132	Span of years during which water levels were measured (beginning year to end year).

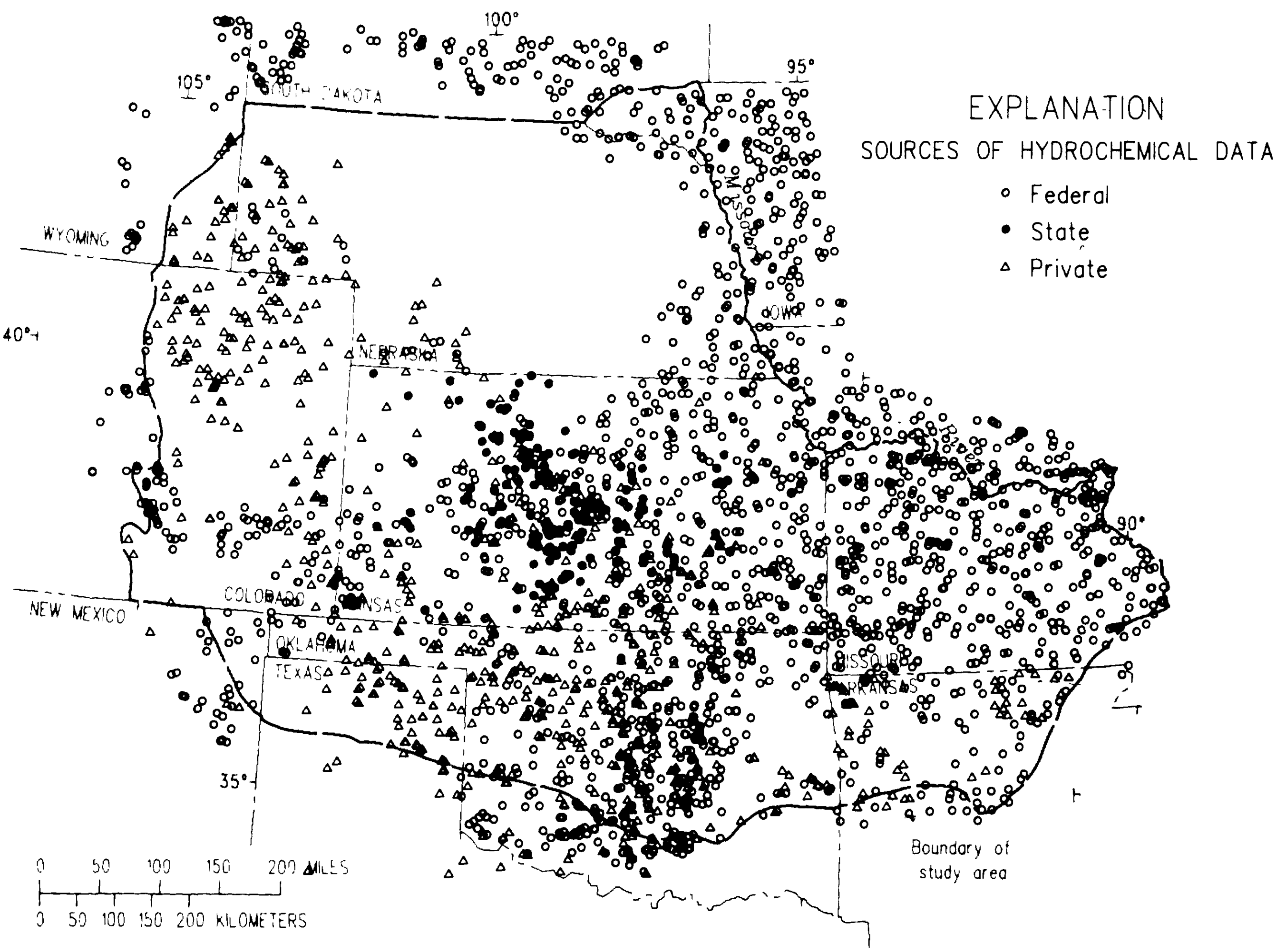

Figure 6. Distribution and sources of hydrochemical data.

Table 6. *Description and format of reservoir-parameter data stored on magnetic tape*

Record position	Description
1-6	Latitude in degrees, minutes, and seconds (ddmmss). All latitudes are north.
7-13	Longitude in degrees, minutes, and seconds (dddmmss). All longitudes are west.
14-15	Sequence number (important where there is more than one well at the same location).
16	Blank
17-18	State and district code (see U.S. Department of Commerce, 1979).
19	Blank
20-22	County code (see U.S. Department of Commerce, 1979).
23	Blank
24-34	Local number: identifies location of well in system used locally; system is unique to each state.
35	Blank
36-37	Source of data: 10 = U.S. Geological Survey file or publication 11 = Kansas Geological Survey file or publication 15 = Petroleum Information, Inc. (proprietary data) 16 = Roger Hoeger, consultant (proprietary data) 22 = Kansas Corporation Commission 23 = Kansas Geological Society

Table 6. *Description and format of reservoir-parameter data stored on magnetic tape*--Continued

Record position	Description
36-37	Source of data:
	24 = Drilling or testing company
	26 = Oklahoma Geological Survey
	27 = Oklahoma City Geological Society
	28 = Texas Panhandle Sample Log Service
	38 = Nebraska Oil and Gas Commission
38	Blank
39-43	Date of drill-stem test in order of month and year (mm/yy).
44	Blank
45	Quality of data:
	1 = good-quality pressure data only;
	2 = good-quality permeability data only;
	3 = good-quality pressure and permeability data;
	blank or 9 = medium- to poor-quality pressure and permeability data.
46	Blank
47-49	CMRASA code number (see table 1).
50	Blank
51-58	U.S. Geological Survey geologic unit code (see Hutchison, 1975, appendix F).
59-63	Altitude of land surface, in feet.

Table 6. *Description and format of reservoir-parameter data stored on magnetic tape*--Continued

Record position	Description
64-69	Depth to top of tested interval, in feet.
70-75	Depth to bottom of tested interval, in feet.
76-80	Pressure, in pounds per square inch (graphically extrapolated according to conventional drill-stem-test analysis methods, or the reported shut-in pressure).
81-86	Altitude of pressure-recording gage, in feet, or the top of tested interval if gage location unknown.
87-96	Permeability factor (ratio of intrinsic permeability to viscosity), in millidarcies per centipoise.
97-102	Viscosity of fluid, in centipoise.
103-106	Reservoir temperature, in degrees Celsius.
107-115	Intrinsic permeability, in millidarcies.
116-122	Altitude of equivalent freshwater head, in feet, corrected for temperature and density of formation water.
123-131	Hydraulic conductivity (horizontal), in feet per day.

capacity tests are from relatively shallow water wells, whereas reservoir-parameter data are from relatively deep oil-and-gas wells.

Water-well data are limited; most were transferred directly from the literature to work maps and were not stored in computerized form. Transmissivity, storage coefficient, formation tested, location, and other pertinent information from some of the pumping and specific-capacity tests are available in GWSI; these sites are identified in GWSI by the use of components C190 and C191 (table 3).

Reservoir-parameter data were compiled from sources listed in table 6 (record positions 36-37). The number of data sites per county was not restricted. There are about 1,050 aquifer-property values from oil- and gas-well data (fig. 7). These data are available from the original sources or on magnetic tape from the U.S. Geological Survey in Lawrence, Kansas. The format of the data available on magnetic tape is shown in table 6.

AREAL INFORMATION

Areal information described herein consists of nonpoint data that are considered representative of an area. Most of this information was developed for use as input to a computer flow model. Fluid-withdrawal data are discussed separately because these data were compiled only for use within the CMRASA study.

Table 7. *Description and format of hydrochemical data stored on magnetic tape*

Record position	Description
	<u>H, N, and type-2 cards.</u>
1	Card type H = header card (uniquely identifies site), N = name card (name of well and formation tested), 2 = sample-analysis information.
2-16	Site-identification number; unique number for each site, which usually corresponds to latitude and longitude. Appears on each H, N, and type-2 card.
	<u>H cards only.</u>
17-22	Latitude in degrees, minutes, and seconds (ddmmss). All latitudes are north.
23-29	Longitude in degrees, minutes, and seconds (dddmmss). All longitudes are west.
30-31	Sequence number (01 for the first well at any location; subsequent wells at the same location are assigned larger numbers).
32-35	State and district code (see U.S. Department of Commerce, 1979).
36-38	County code (see U.S. Department of Commerce, 1979).
39-40	Site type; GW = ground water.
41-80	Blank

Table 7. *Description and format of hydrochemical data stored on magnetic tape*--Continued

Record position	Description
	N cards only.
17-36	Local number: identifies location of well in system used locally; system is unique to each state.
37-38	Blank
39-40	Source of data: 10 = WATSTORE water-quality file (U.S. Geological Survey, 1983); 11 = Kansas Geological Survey; 19 = Natural Uranium Resource Evaluation (U.S. Department of Energy, Grand Junction, Colorado); 20 = Petroleum Data System (University of Oklahoma, Norman). These data are proprietary.
41-64	Blank
65-72	U.S. Geological Survey geologic unit code (see Hutchison, 1975, appendix F).
73-80	Blank
	Type-2 cards only.
17-22	Date of sample in order of year, month, and day (yymmdd).
23-26	Time of sample in 24-hour-time notation.
27-32	Blank
33-37	Parameter code of analyzed constituent (see Hutchison, 1975, appendix D).

Table 7. *Description and format of hydrochemical data stored on magnetic tape*--Continued

Record position	Description
38-43	Value of analyzed constituent; reported as a decimal fraction (record positions 38-41) multiplied by a power of 10 (exponent in record positions 42-43).
44	Remarks code (see U.S. Geological Survey, 1983, p. A14-A15).
45-49	Parameter code of analyzed constituent (see Hutchison, 1975, appendix D).
50-55	Value of analyzed constituent; reported as a decimal fraction (record positions 50-53) multiplied by a power of 10 (exponent in record positions 54-55).
56	Remarks code (see U.S. Geological Survey, 1983, p. A14-A15).
57-61	Parameter code of analyzed constituent (see Hutchison, 1975, appendix D).
62-67	Value of analyzed constituent; reported as a decimal fraction (record positions 62-65) multiplied by a power of 10 (exponent in record positions 66-67).
68	Remarks code (see U.S. Geological Survey, 1983, p. A14-A15).
69-73	Parameter code of analyzed constituent (see Hutchison, 1975, appendix D).
74-79	Value of analyzed constituent; reported as a decimal fraction (record positions 74-77) multiplied by a power of 10 (exponent in record positions 78-79).
80	Remarks code (see U.S. Geological Survey, 1983, p. A14-A15).

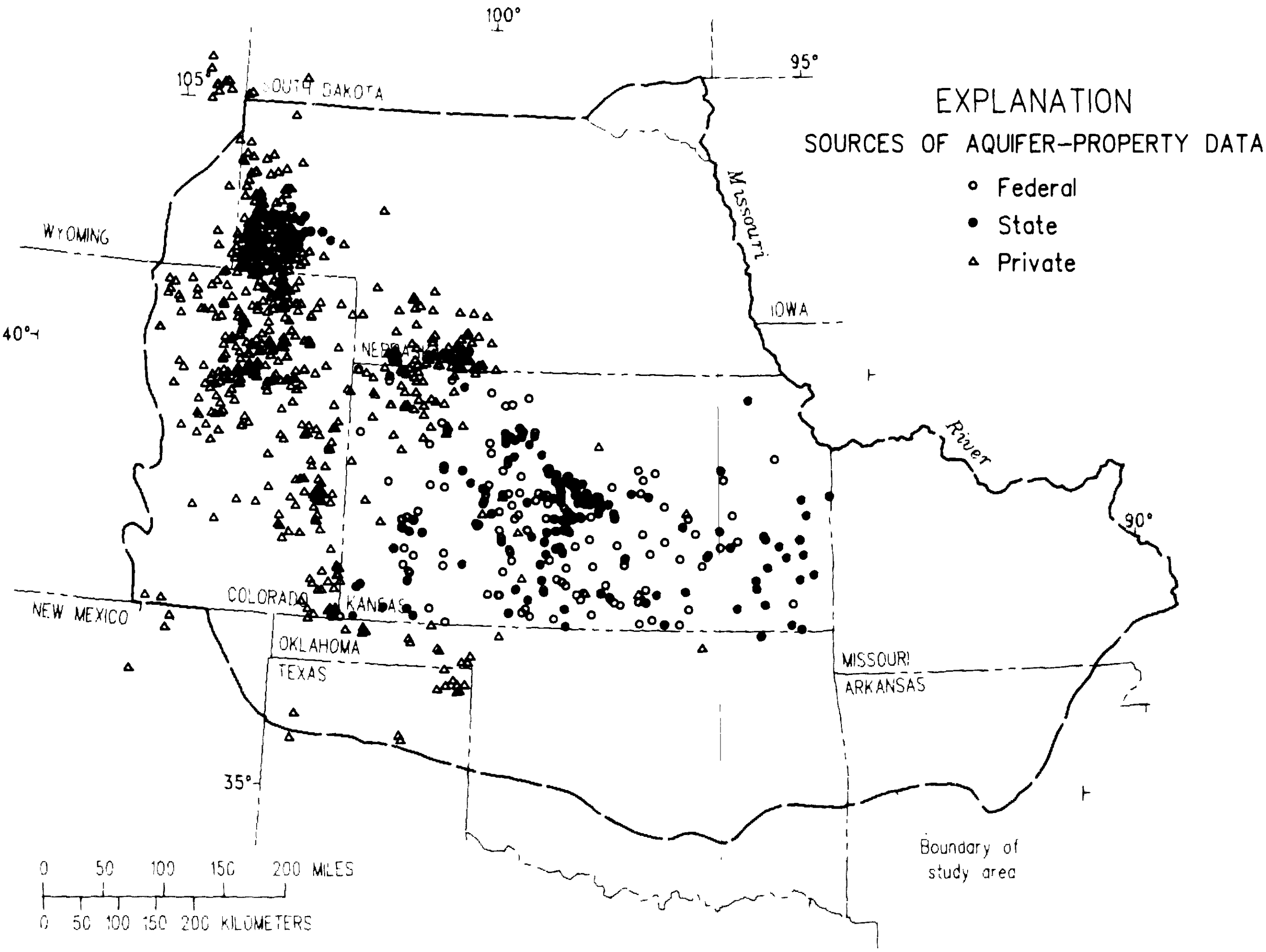

Figure 7. Distribution and sources of aquifer-property data.

Model Data

Application of a three-dimensional numerical model aided in the definition of steady-state ground-water flow patterns and rates. The finite-difference model of McDonald and Harbaugh (1984) was used. Required input to the model is typically in the form of regular arrays of data, and each value is assumed to characterize the area represented by a particular model cell. The grid of model cells (fig. 8) consists of 28 rows and 33 columns. The third dimension of the model consists of 5 layers, each having the grid shown in figure 8. The five layers, numbered from top to bottom, represent major geohydrologic units within the study area (refer to table 1). Layer 1 represents whichever geohydrologic unit directly overlies the CMRASA study interval. Layer 2 represents the Great Plains aquifer system. Layer 3 represents the Western Interior Plains confining system. Layer 4 represents the upper unit of the Western Interior Plains aquifer system (Plains subregion) or the Springfield Plateau aquifer (Ozark subregion). Layer 5 represents the lower units of the Western Interior Plains aquifer system (Plains subregion) or the Ozark aquifer-to-St. Francois aquifer interval (Ozark subregion).

The geographic position of the overall grid is defined based on the location of a cell near the center of the grid in central Kansas, on the angle of orientation of the grid, and on the cell dimensions. The south corner of cell 14,17 (row 14, column 17) has coordinates of 38°36'25" north latitude and 97°45'40" west longitude. The orientation of rows of the grid is N. 35° W., and the orientation of columns is N. 55° E. Each cell

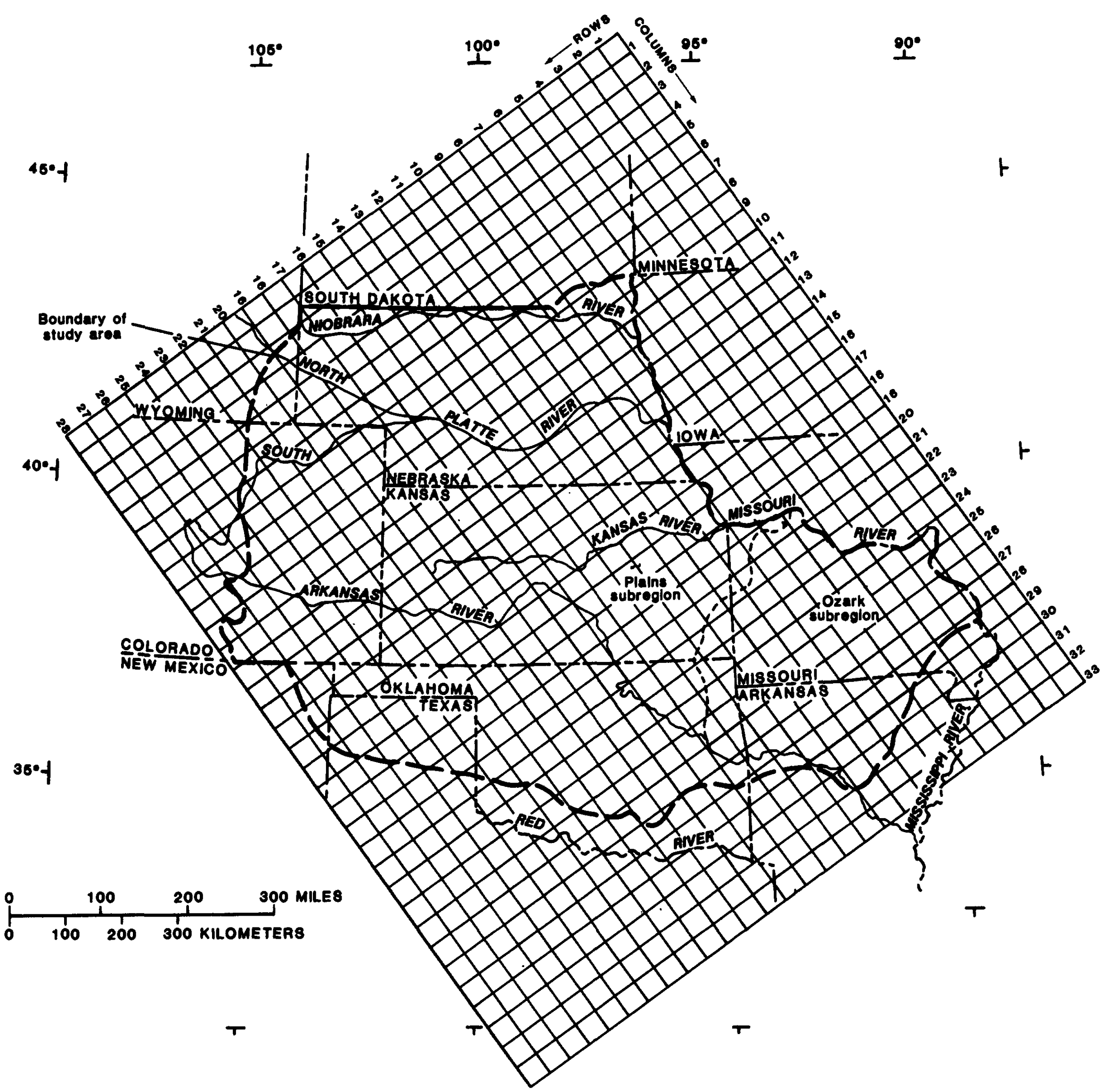

Figure 8. Horizontal finite-difference grid for computer model.

represents a square area of 45 kilometers (147,670 feet) on a side.

Input to the model includes several geohydrologic characteristics. Three types of areally distributed data are described herein--hydraulic head, transmissivity, and vertical leakance. Most other types of data used by the model describe boundary conditions (such as water-table or stream altitudes) rather than attributes of the geohydrologic units themselves. Proper descriptions of these data require detailed explanation of the hydrology and modeling procedures, which are included in U.S. Geological Survey Professional Paper 1414-C now in preparation (D.C. Signor, U.S. Geological Survey, written commun., 1988).

In general, the distribution of each geohydrologic characteristic was first mapped on the basis of site-specific data or some assumed regional relationship. Computer processes then were used to digitize contours and grid the data to transform the information to an array format usable by the model. These model-input data are available on magnetic tape from the U.S. Geological Survey in Lawrence, Kansas. The files are listed in the order discussed herein (hydraulic head, transmissivity, vertical leakance) and the data are in FORTRAN format

(6X, 10G12.5). Within each file, the order of the arrays is always from top (layer 1) to bottom. Hydraulic-head and transmissivity data refer to each of the five layers, listed from top to bottom. Vertical-leakance data consist of four arrays, the first referring to connection between layers 1 and 2, the next between layers 2 and 3, and so forth. Within each array, data corresponding to columns of the model grid are aligned horizontally in the file; data corresponding to rows of the model grid are aligned vertically in the file.

Data are stored in consistent units of length, in feet, and time, in seconds. Zero values in data arrays generally denote inactive model cells that represent areas either beyond the modeled area or where the particular geohydrologic unit is absent (an exception to this is described under "Vertical Leakance"). In light of this and other qualifications pertaining to the model data, these data are used properly only in conjunction with interpretive CMRASA reports that describe the natural system and model analyses in detail. Brief descriptions of the available data arrays follow.

Hydraulic Head

Initial (predevelopment) hydraulic head, expressed in feet above sea level, provides starting conditions for the model simulation. However, it is included here primarily because it was also the hydraulic-head distribution generally mapped from field data. Because much of the system contains saltwater of variable density, hydraulic heads have been adjusted to represent equivalent freshwater heads. In many areas, conditions in the aquifers have been altered locally by oil- and gas-development activities, and initial hydraulic-head distributions have been inferred.

Transmissivity

Transmissivity, in feet squared per second, was determined by multiplying appropriate unit thickness by hydraulic conductivity. Thickness was mapped based on lithologic- and geophysical-log interpretation. Hydraulic conductivity was estimated based on an empirically derived relationship between intrinsic permeability, porosity, and cementation factor (Jorgensen, in press). The calculation of hydraulic conductivity included adjustments for the effects of salinity and temperature variations throughout the study area.

Vertical Leakance

Vertical leakance, in seconds^{-1}, is a term that controls the rate of simulated vertical flow between model layers. It generally was computed as either: (1) estimated vertical hydraulic conductivity of a discrete confining unit between two aquifer units divided by its thickness, or (2) a term that involves weighted values of vertical hydraulic conductivity and thickness of two vertically adjacent units. Where units are absent in the subsurface within the study area, nonzero values were assigned to maintain vertical continuity. Also, where extensive and thick evaporites prevail near the top of layer 3, vertical connection between layers 2 and 3 was assumed to be negligible, and leakance was set equal to zero in the appropriate model cells.

Thickness data were based on log interpretation. Vertical hydraulic- conductivity values were assumed to be certain fractions of estimated horizontal hydraulic conductivity; the fraction assigned was dependent on the lithologic character of the unit.

Fluid-Withdrawal Data

Fluid-withdrawal data provide estimates of withdrawal rates of freshwater, oil and gas, and saltwater produced with the oil and gas. These withdrawal rates are used in the flow-model analysis and quantification of the regional system. Fluid-withdrawal data were compiled from many State, Federal, and private sources and generally are of poor-to-fair quality because the compilation necessitated various assumptions and approximations. These data were compiled areally by county, vertically by geohydrologic unit, and temporally by decade. Fluid-withdrawal data were necessary for study purposes, but they are not necessarily considered suitable for other uses; therefore, they are not available in computerized form.

MAGNETIC TAPE

Data files described herein that are stored on magnetic tape are available on request from the U.S. Geological Survey in Lawrence, Kansas. The characteristics of each nonproprietary file stored on magnetic tape are described in table 8. These files can be copied onto magnetic tape in various densities and formats depending on the needs of the requestor. At this time (1989), the densities available are 1,600 and 6,250 bytes per inch on nine-track tape. The formats available are MAGSAV, ASCII, EBCDIC, BCD, or eight-bit BINARY. The maximum physical block size must be less than or equal to 10,000 characters. To obtain a copy of the files on magnetic tape, contact the U.S. Geological Survey office at 4821 Quail Crest Place, Lawrence, KS 66049 [telephone (913) 842-9909] and request the particular files to be copied onto a magnetic tape. The requestor will be charged for the cost of the tape and the labor involved in making the tape (about $25.00 in 1989).

SUMMARY

Several types of geologic and hydrologic data were collected and compiled as a part of the Central Midwest Regional Aquifer-System Analysis. The study described the hydrology of Cambrian through Cretaceous rocks in all of Kansas and Nebraska and parts of eight other states. Information from both water wells and petroleum wells was obtained from numerous State, Federal, and private sources. The completeness, quality, and distribution of the data varies considerably. Most data files contain data selected to represent the regional scope of the study.

The log data file contains about 850 lithologic logs and about 750 geophysical logs. The hydraulic-head data file contains about

Table 8. *Characteristics of nonproprietary files stored on magnetic tape*

File name	Type of file	Record length	Lines of data	Lines of introduction	Lines in file	Bytes in file
LITH.DB	Lithologic-log data	132	12,749	109	12,858	1,697,256
GEOPHYS.DB	Geophysical-log data	74	752	90	842	62,308
MEASWL.DB	Measured water-level data	132	11,750	102	11,852	1,564,464
RESPAR.DB	Reservoir-parameter data from oil and gas records	131	687	112	799	104,669
HYDROCHEM.DB	Hydrochemical data	80	17,720	113	17,833	1,426,640
MODEL.HEAD	Model-input values of hydraulic head	126	580	5	585	73,710
MODEL.TRANS	Model-input values of transmissivity	126	580	5	585	73,710
MODEL.VERT	Model-input values of vertical leakance	126	580	5	585	73,710

1,400 measured water levels and about 2,600 values of equivalent freshwater head derived from drill-stem-test analyses. The hydrochemical data file contains about 2,900 water-quality analyses. The aquifer-property data file contains about 1,050 values. In addition to site-specific data, areal information in the form of model-data arrays is available for initial hydraulic head, transmissivity, and vertical leakance. These data describe the major geohydrologic units studied in terms of a three-dimensional grid, 28 rows x 33 columns x 5 layers.

Parts of the hydraulic-head, hydrochemical, and aquifer-property data files are proprietary. The fluid-withdrawal data file was developed for study use only. Most other data described herein are available on magnetic tape from the U.S. Geological Survey in Lawrence, Kansas.

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U.S. Department of Commerce, National Bureau of Standards, 1979, Counties and county equivalents of the States of the United States and the District of Columbia: Federal Information Processing Standards (FIPS) Publication 6-3, 35 p.

U.S. Geological Survey, 1983, National Water Data Storage and Retrieval System user's guide, volume 3--Water-quality file: Reston, Virginia, unpublished U.S. Geological Survey report, unnumbered pages.

Table 9. *Correspondence between geologic unit code and CMRASA code number*

U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]
100CNZC	45	123BRUL	45	211CRLL	50
		123CDRN	45	211D	100
110ALVM	45	123WRVR	45	211DKOT	100
110QRNR	45			211DKOT	150
110TRRC	45	124WLCX	45	211DKOT	200
110WDBS	45				
		125CLTN	45	211FRHS	50
111LOSS	45	125PRCK	45	211FRLD	50
		125RTON	50	211FXHL	50
112DRFT	50			211GRNR	50
112DUNE	45	200MSZC	50	211GRRS	50
112EOLN	45				
112GCDF	45	210CRCS	50	211HDSP	50
112LOSS	45	210CRCS	100	211HYGN	50
		210CRSC	200	211LNCE	50
112PLSC	45			211LRMI	50
112SDGV	45	211ARPH	50	211LWIS	50
112TERC	45	211BGCK	50		
112TRRCH	45	211BLSM	50	211MCNR	50
112TULE	45	211BNTN	50	211MENF	50
		211CDLL	50	211MNCS	50
120OTRCC	50			211MNTN	50
120TRTR	45	211CLFH	50	211MVRD	50
		211CLRD	50		
121OGLL	45	211CODY	50	211NBRR	50
		211CRCS	50	211NCTC	100
122ARKR	45	211CRCSU	50	211OLCK	500
122HMGF	45			211PCCF	50
122MOCN	45			211PIRR	50

Table 9. *Correspondence between geologic unit code and CMRASA code number*--Continued

U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]
211PNLK	50	217FUSN	200	218COX	200
211PRKM	50	217INKR	100	218EDRD	200
211SMKH	50	217INKR	200	218GDLD	200
211SNNN	50	217J	100	218GLYD	100
211SSSX	50	217J&D	100	218HLCK	200
211TRDD	50	217KIOW	150	218KMCH	150
211TRNS	50	217LKOT	200	218MSRC	200
211TSCL	50	217MDDY	100	218PLXY	200
211VRMJ	50	217MDDY	200	218TRNT	200
		211NCSL	100	218TVPK	200
212BRNS	50				
212OZAN	50	217OMDI	100	218WSHT	150
212TOKO	50	217PRGR	200		
212WDBN	100	217RDSS	100	220JCTC	300
		217RDSS	200	220JRSC	300
217BRCN	200	217SKCK	150	220NVJO	300
217CCKM	100				
217CLVL	200	217STPL	150	221BRSB	300
217CRCS	150			221CNVL	300
217CRCSL	100	218ALRS	50	221ENRD	300
		218ALRS	200	221JCCK	300
217CYNN	200	218BKOT	100	221JRSCU	300
217D	100	218BNNG	100		
217D&J	100	218CDDO	150	221MRSN	300
217DKOT	100			221SKRK	300
217FLRV	200			221SLWS	300
				221SMKV	300
				221SNDC	300

Table 9. *Correspondence between geologic unit code and CMRASA code number*--Continued

U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]
221TDLT	300	310SGRC	400	313RSPG	350
		310WEBR	350	313SADR	350
230LKNS	350	310WLNG	350		
230SPRF	300	310WTRS	350	317ADMR	400
230TCPM	300	310OYESO	350	317BDER	400
230TRSC	300			317BRNS	400
		311BGBS	350	317BTTI	400
231CGTR	300	311DCRK	350	317CMRN	350
231CHNL	300	311PRMN	350		
231DCKM	300	311PRMNU	350	317CSPR	350
231SNRS	300			317CTTN	400
231WNGT	300	312CDCF	350	317FLRC	400
		312DOXY	350	317FNTN	400
234TRSC	300	312ELKC	350	317FRRL	400
		312WRFD	350		
300PLZC	350			317HCNS	350
		313ALBS	350	317HRNG	350
310GLRT	350	313BLIN	350	317HRNG	400
310LYNS	350	313BRBN	350	317HRPR	350
310MNKT	350	313BRWN	350	317IDCV	350
310MNLS	500	313DGCK	350		
310NLNS	400			317IGLD	400
		313ELRN	350	317KRDR	350
310NNSC	350	313FLRP	350	317LGCK	400
310PMPV	350	313GDLP	350	317MNLS	350
310PRMN	350	313HGLR	350	317MNLS	400
310PRMN	400	313MRLW	350		
310QRRM	350				

Table 9. *Correspondence between geologic unit code and CMRASA code number--* Continued

U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]
317MRRL	350	318OSCR	350	320PSLF	500
317NEVA	400	318OSCR	400	320PSLF	700
317NPPL	350	315PRCL	350	320PSLV	400
317OPCH	350	318PSOK	350	320PSLV	500
317PMPV	400	318RDCV	350	320SNDI	500
317PRMN	400	318SCRL	350	321BERN	400
317PRMNL	400	318SLPL	350	321BFLS	400
317SCRL	350	318WCHT	350	321CDVL	400
317SMNR	350			321CFVL	400
317STNK	350	319ADMR	400	321CHNT	400
		319CCGV	400		
317TSLP	350	319CHSE	400	321CNYN	400
317WBRC	400	319EKDG	400	321CRVL	400
317WFLD	400	319FRCK	400	321CSCO	400
317WRFD	400			321DNPN	400
		319GRNL	400	321DRY	400
318BSON	350	319PNTC	400		
318CDHL	350	319RDEG	400	321ELMN	400
318CLFK	350	319WFCP	400	321EVCK	400
318FRMN	350	319WFMP	350	321FCCK	400
318GRBR	350			321FRDC	400
		319WFMP	400	321FRLY	400
318HNNS	350				
318HNSS	350	320GRWS	500	321HBNR	400
318KNGM	350	320GRWS	900	321HPLR	400
318LNRD	350	320MNLS	400	321HVVL	400
318MNKT	350	320PSLC	400	321IRLD	400
		320PSLC	500	321LBSP	400

Table 9. *Correspondence between geologic unit code and CMRASA code number*--Continued

U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]
321MDER	400	322HXBR	400	323DEWY	400
321MSRN	400	322KNWK	400	323DNNS	400
321PRSP	400	322LRNC	400	323DRUM	400
321PSLV	400	322ORED	400	323ERCS	400
321PSLVU	400	322SCRN	400	323GLBG	400
321SLDN	400	322SHWN	400	323HGSR	400
321STNR	400	322SRGR	400	323HRTH	400
321TCKT	400	322SVRY	400	323HXBR	400
321TFGM	400	322TCMS	400	323IOLA	400
321TNGX	400	322TOPK	400	323KSCC	400
321TRKO	400	322VMOS	400	323KSSC	400
321TRNT	400	322VNSS	400	323LDOR	400
321WCLD	400	322VRGL	400	323LINN	400
		322VRLG	400	323LNSG	400
322ABRN	400	322WBNS	400	323LSNG	400
322ADA	400				
322BERN	400	322WLRD	400	323MSRN	400
322BRGL	400	322ZNDL	400	322MSSC	400
322CLHN	400			323MSSG	400
		323BRDL	400	323MSSR	400
322DGLS	400	323BSPG	400	323NLBL	400
322DRCK	400	323CCKB	400		
322ELGN	400	323CFVL	400	323PLBG	400
322EMPR	400	323CHNT	400	323PLSN	400
322HWRD	400			323ROWE	400
				323SMNL	400
				323STNN	400

Table 9. *Correspondence between geologic unit code and CMRASA code number--* Continued

U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]
323SWOP	400	325ALMN	500	325STRT	500
323TLNT	400	325BGGY	500	325SVNN	500
323VILS	400	325BJCK	500	325TRMN	500
323WANN	400	325BNDR	500	325WRNR	500
323WNDT	400	325CBNS	500	325WTMK	500
323YULE	400	325CHRK	500	325WWOK	500
		325CLVN	500		
324AKBD	500	325DEES	500	326ACTK	500
324ALMN	500	325DSMN	500	326ATCK	500
324BLCT	400	325DSMS	500	326ATKN	500
324BRKA	500			326ATOK	500
324CBNS	500	325FRSC	500		
		325HGVL	500	327MRRN	500
324CHAT	400	325HLDV	500	327PSLV	500
324CHAT	500	325HRSR	500	327PSLVL	500
324CHAT	550	325KRBS	500	327UNVL	500
324DSMS	500				
324EGLV	500	325LBTT	500	328BLVD	500
		325LGND	500	328BLYD	500
324FRKS	500	325LLOG	500	328BRND	500
324GRNR	500	325LNPH	500	328CNHL	500
324HLTP	400	325MCAL	500	328DCKH	500
324PRFM	500				
324PSLV	400	325MRMN	500	328FRBK	500
		325NOWT	500	328HALE	500
324PSLVM	500	325OLGH	500	328JKFK	500
324STRN	500	325PWNE	500	328JSVL	500
324WRLD	500	325SNOR	500	328KSLR	500

Table 9. *Correspondence between geologic unit code and CMRASA code number*--Continued

U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]
328MRRN	500	332CSTR	550	338BRLG	550
328MRRW	500	332FTVL	500	338ELSY	550
328PRGV	500	332FTVL	550	338FRGL	550
328SPRG	500	332GDRD	500	338GDFL	550
328SPRG	550	332GDRD	550	338KKKB	550
328WLSY	500	333DLCK	500	338KKUK	550
328WPCK	500	333DLCK	550	338OGKK	550
		333MRMC	550	338OSGE	550
330BOON	550	333SGSL	550	338OSGEO	550
330OCTNG	650	333SGVV	550	338PRSN	550
330MSSP	550				
330STNL	500	333SLEM	550	338RSPG	550
330STNL	550	333SLSM	550	338SCMR	550
		333SPRG	550	338SCMR	750
331BOON	550	333STLS	550	338SRCK	550
331BSVL	500	333WRSW	550		
331HDVL	500			339BOIC	650
331LDVL	550	337BOIC	650	339GLMC	550
331MDSN	550	337CHUT	550	339HMPN	550
		337CHUT	650	339KDRK	550
331MFLD	500	337CMPN	650	338KDRK	650
331MSSP	550	337CRSN	500		
331PTKN	500			339NRTV	650
331RDDL	500	337MPDV	650	339SDLI	650
		337PHSP	550	339MSSP	550
332AXVS	500	337STJO	550		
332CKCK	550			340DVNN	700
332CRSN	550			340ODVSL	700
332CRVL	550			340HNTN	700
332CSTR	500			340MSNR	650

Table 9. *Correspondence between geologic unit code and CMRASA code number*--Continued

U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]
341ARKS	650	350BLCK	700	361SLVN	800
341BBRG	650	350SCLR	700	361VIOL	800
341CHFF	650	350SLRN	700	361VKMK	800
341CTNG	650			361WMBL	800
341DVNN	700	355BBDG	700		
				362ABCK	800
341GRCK	650	357BFLD	700	362CAPE	800
341LMCK	700	357CMNL	700		
341LOSN	650	357LFRT	700	363SMPS	800
341LUSN	650				
341SLMR	650	358EDGD	650	364BGFK	800
		358GRRD	650	364BMRD	800
341SSPG	650	358SXCK	650	364BRGN	800
341WDFD	650			364BRMD	800
				364DCRH	800
		360ODVC	800		
344CDVL	700	360OVCB	800		
344CLCK	650			364EVRN	800
344CLFT	700	361CSON	700	364GLEN	800
344CLLY	700	361EVRN	800	364HNTR	800
344DVNNM	650	361FRVL	800	364JCHM	800
		361MQKT	650	364JONS	800
344GRDT	650	361MQKT	700		
344HNTN	700			364KMCK	800
344SLRN	650	361ODVC	700	364MCLS	800
344WPPC	700	361ODVCU	800	364ODVC	700
		361PKCK	700	364ODVCM	800
347BILY	650	361RCMD	700	364OLCK	800
347LLSL	650	361SLVN	700		
347PNRS	700				

Table 9. *Correspondence between geologic unit code and CMRASA code number*--Continued

U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]	U.S. Geological Survey geologic unit code[1]	CMRASA code number[2]
364PLTN	800	367GSCDU	800	371CMBRU	900
364SMPS	800	367KDBD	800	371DDWD	800
364SPEV	800	367MNTU	800	371DRBD	850
364STPR	800	367ODVCL	800	371DVIS	850
364TPCK	800	367OVCB	900	371ELVS	850
364TYNR	800	367RBDX	800	371EMCE	800
		367SMVP	800	371EMCP	800
365CLLR	800	367VNBR	800	371EMNC	800
365DTCN	800			371FRSL	800
365JCHM	800	368CNDN	800	371GRNT	900
365PLTN	800	368GSCD	800		
365RKLV	800	368GSCDU	800	371JRDN	800
		368JFRC	800	371LMRG	900
365SMPS	800	368PLCR	800	371LMTT	900
365TRNN	800			371POTS	800
		368PWLL	800	371REGN	900
367ABCK	550	368SCRK	800	371SWCH	900
367ABCK	800				
367ABCKU	800	370CMBR	850	371TMBH	900
367CLCK	800	370CMBR	900	371TRAK	900
367CRJF	800				
		371ABCK	800	400GRNT	950
367CTTR	800	371ABCKL	800	400IGNS	950
367ELBG	800	371BNTR	900	400PCMB	950
367GNTR	800	371BTRL	800	400PCMBC	950
367GSCD	800	371CMBR	800	400SXWS	900
367GSCDL	800				

[1]Hutchison, 1975, appendix F.
[2]Number in this column is lower limit of code-number range given in table 1.