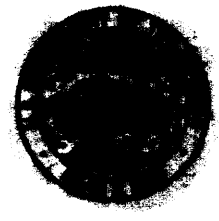
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

MACHINE-READABLE DATA FILES FROM THE MADISON LIMESTONE AND NORTHERN GREAT PLAINS REGIONAL AQUIFER SYSTEM ANALYSIS PROJECTS, MONTANA, NEBRASKA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING

By Joe S. Downey

Water-Resources Investigations 82-4107



Denver, Colorado

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UNITED STATES DEPARTMENT OF THE INTERIOR

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GEOLOGICAL SURVEY

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CONVERSION TABLE

In this report, measurements are given in inch-pound units. The following table contains factors for converting to metric units.

Multiply inch-pound units	By	To obtain metric units
foot	0.3048	meter
foot squared per second	0.0929	meter square per second
mile	1.609	kilometer
pound per square inch	0.155	pound per square centimeter

National Geodetic Vertical Datum of 1929 (NGVD 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.

MACHINE-READABLE DATA FILES FROM THE MADISON LIMESTONE AND NORTHERN GREAT PLAINS REGIONAL AQUIFER SYSTEM ANALYSIS, MONTANA, NEBRASKA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING

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ABSTRACT

This report lists the machine-readable data files developed for the Madison Limestone and Northern Great Plains Regional Aquifer System Analysis (RASA) projects that are stored on magnetic tape and available from the U.S. Geological Survey. Record format, file content, and size are given for: (1) Drill-stem-test data for Paleozoic and Mesozoic formations; (2) geologic data from the Madison Limestone project; (3) data sets used in the regional simulation model; (4) hydraulic-head data for the Lower and Upper Cretaceous aquifers; and (5) geologic data for Mesozoic formations of the Northern Great Plains.

INTRODUCTION

The machine-readable data files discussed in this report were assembled as a part of the Madison Limestone and the Northern Great Plains Regional Aquifer System Analysis (RASA) projects and include data collected in the fields of geology and hydrology. The files were prepared and used in the generation of maps and figures for various reports issued by the two projects (Brown and others, 1982; Downey, 1982a, 1982b; MacCary, 1981; MacCary and others, 1981; Miller and Strausz, 1980a, 1980b).

Because of variation in data needs by different aspects of the projects, the data sets are contained in separate machine-readable files on different magnetic tapes. Some magnetic tapes will contain two or more separate files. Data format between files is not consistent, because the data compiler used different methods in recording data; no attempt has been made to edit or reformat the original data sets for this report.

The magnetic tapes containing the data files are stored at the U.S. Geological Survey's National Computer Center, Reston, Virginia; additional information and copies of the data sets may be obtained from: Office of the Chief Hydrologist, Water Resources Division, U.S. Geological Survey, Mail Stop 409, National Center, 12201 Sunrise Valley Drive, Reston, Virginia 22092.

The wells and test holes listed in some of the data files are located according to a system of land survey in use by the U.S. Bureau of Land Management (fig. 1). The first numeral denotes the township north of a base

line; the second numeral denotes the range west of the fifth principal meridian; and the third numeral denotes the section in which the well is located. The letters A, B, C, and D designate, respectively, the northeast, northwest, southwest, and southeast quarter section, quarter-quarter section, and quarter-quarter-quarter section. For example well 150N60W15DAA is in the NE¼NE¼ sec¼ sec. 15, T. 150 N., R. 60 W.

FILE A: DRILL-STEM-TEST DATA FOR PALEOZOIC FORMATIONS

Data description:	Drill-stem-test data, such as tested interval, flow rates, shut-in time, and recovery.
Compiled by:	R. W. Miller, U.S. Geological Survey, Billings, Montana.
Tape specifications:	Tape number--118277
	Number of records--8,400
	Block size--12,960 bytes
	Record length--240 bytes
Remarks:	Each 240-byte record contains three 80-byte blocks (card images), with data formatted as shown in table 1.

FILE B: GEOLOGIC DATA, MADISON LIMESTONE PROJECT

Data description:	Geologic data, such as depth-to-top of formations, rock type, facies type, porosity, and sand thickness.
Compiled by:	Donald L. Brown, (formerly) U.S. Geological Survey, and Madison Limestone Project staff.
Tape specifications:	Tape number--223579
	Block size--12,960
	Record length--80-character card images
	File size--9,191 records
Remarks:	Data file consists of geologic data used by the Madison Limestone Project. Each well may have from 3 to 11 card images labelled A to K (fig. 2). An example of records printed from data tape is shown in figure 3.

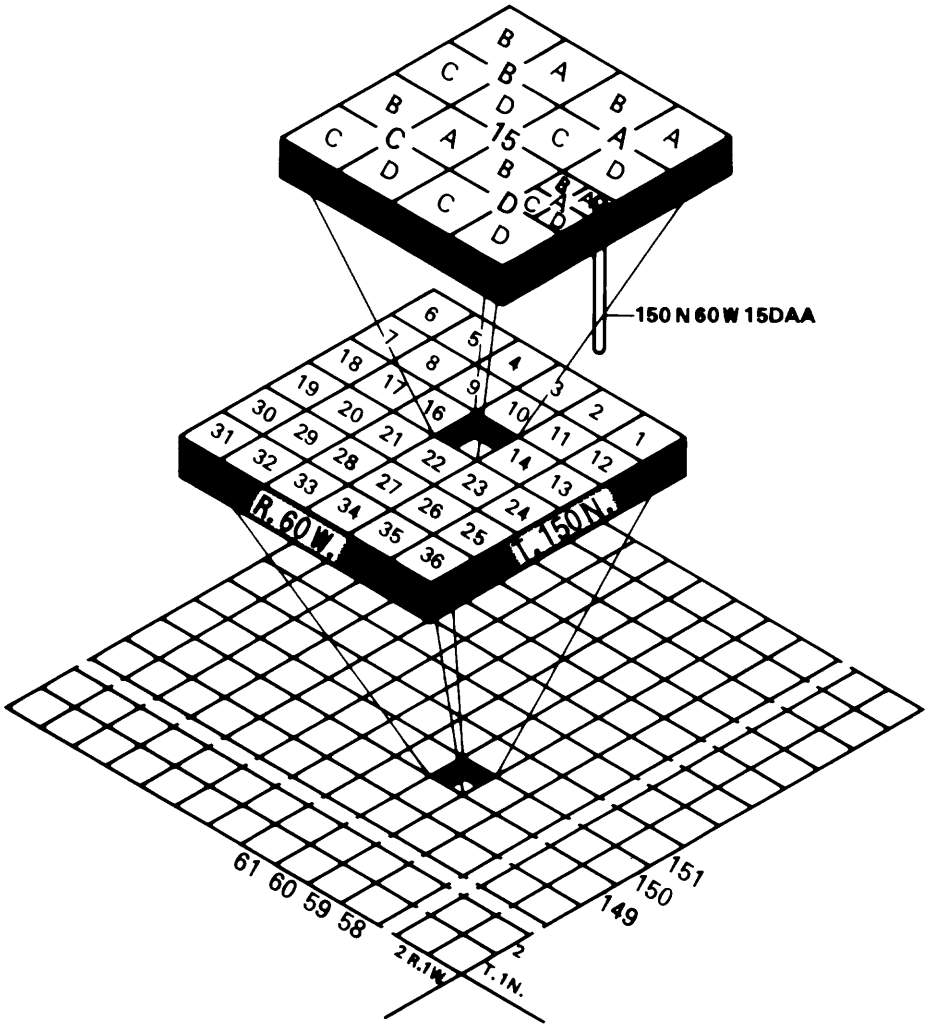


Figure 1.-- System of numbering wells and test holes.

Table 1.--*Format of Paleozoic formations drill-stem-test data: Records 1, 2, and 3*

Record 1

(1st 80 bytes)

Record columns

1-2 State codes: Montana = 30, North Dakota = 38, South Dakota = 46, Wyoming = 56.

3-17 Well location-record field subdivided as follows:

Record column	Contents
3-5	Township.
6	Township direction, north (N) or south (S).
7-9	Range.
10	Range direction, east (E) or west (W).
11-12	Section.
13-15	Quarter section location (fig. 1).
16-17	Drill-stem-test number--a code of '00' or blank indicates test number unknown.
18-42	Owner or operator, left-justified.
43-57	Well name, left-justified.
58-65	Geologic unit--codes used are those of the U.S. Geological Survey's National Water Data Storage and Retrieval System (WATSTORE).
66-69	Altitude of measuring point, in feet above National Geodetic Vertical Datum of 1929 (NGVD of 1929).
70-78	Tested interval, in feet. If tested interval is greater than 9,999 feet, the following codes are used in record columns 70 and 75.

Code	Interval	
	From	To
A	10,000	10,999
B	11,000	11,999
C	12,000	12,999
D	13,000	13,999

Table 1.--*Format of Paleozoic formations drill-stem-test data: Records 1, 2, and 3*--Continued

Record 1--Continued

Record column	Contents		
	Code	Interval	
		From	To
	E	14,000	14,999
	F	15,000	15,999

Example: If tested interval was from 11,205 to 11,750 feet, record would be coded as: B205-B750.

79-80 Card-image number--card image 1 coded as 01.

Record 2

(2nd 80 bytes)

Record columns

1-17 Same as for record 1.

18-21 Date drilled, year and month as 7302.

22-25 Depth of pressure-recording device, in feet, below measuring point. Following codes in column 22 used with depths greater than 9,999 feet.

A	Depth from 10,000 to 10,999
B	11,000 to 11,999
C	12,000 to 12,999
D	13,000 to 13,999
E	14,000 to 14,999
F	15,000 to 15,999

26-30 Altitude of water surface, in feet above or below NGVD of 1929. Descriptive information concerning measurement coded in column 30 as follows:

Code	Explanation
B	Indicates that test and final shut-in pressures were nearly equal and, by inspection of chart, had stabilized.

Table 1--*Format of Paleozoic formations drill-stem-test data: Records 1, 2, and 3*--Continued

Record 2--Continued

Record columns		
26-30	Continued	
	Code	Explanation
	C	Indicates that no chart was available, but that the test flowed or that drill-pipe recovery was large, and that the initial and shut-in pressures were nearly equal. The greatest pressure was used to calculate hydraulic head.
	E	Extrapolated from recorder chart.

Record 3

(3rd 80 bytes)

1-17	Same as for records 1 and 2.
18-78	Coded or abbreviated remarks on fluid recovery. Abbreviation used as follows:

O	oil
G	gas
M	mud
MW	muddy water
FW	freshwater
SW	saltwater
C	cut
BS	basic sediment
SL	slightly
H	heavy
WC	water cushion
WTS	water-to-surface time, in minutes
BBL	barrels

Example of coded remarks: If 100 feet of slightly gas- and oil-cut saltwater was recovered, remarks would be coded 100 SLG & OCSW.

79-80	Card number 03 for card 3.

Explanation for Figure 2 of Abbreviations and Codes Used in File B, Geologic-Data Records

AMSTRAT	American/Canadian Stratigraphic Company, Denver, Colorado.*
Rm	Resistivity of drilling mud, in ohm-meters.
RWa	Apparent water-resistivity, in ohm-meters.
Rmf	Resistivity of drilling-mud filtrate, in ohm-meters.
M-1	Geologic marker bed designations used by Madison Limestone Project (Brown and others, 1982) for various marker beds of the Madison Limestone.
M-3	
M-7	
M-8.5	
M-12	
Mc	
Biocl.	Bioclastic.
Crin.	Crinoidal.
Evap.	Evaporite.
Oolit.	Oolitic.
Lime.	Limestone.
Dolo.	Dolomite.
Sand.	Sandstone.

*Any use of trade names is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

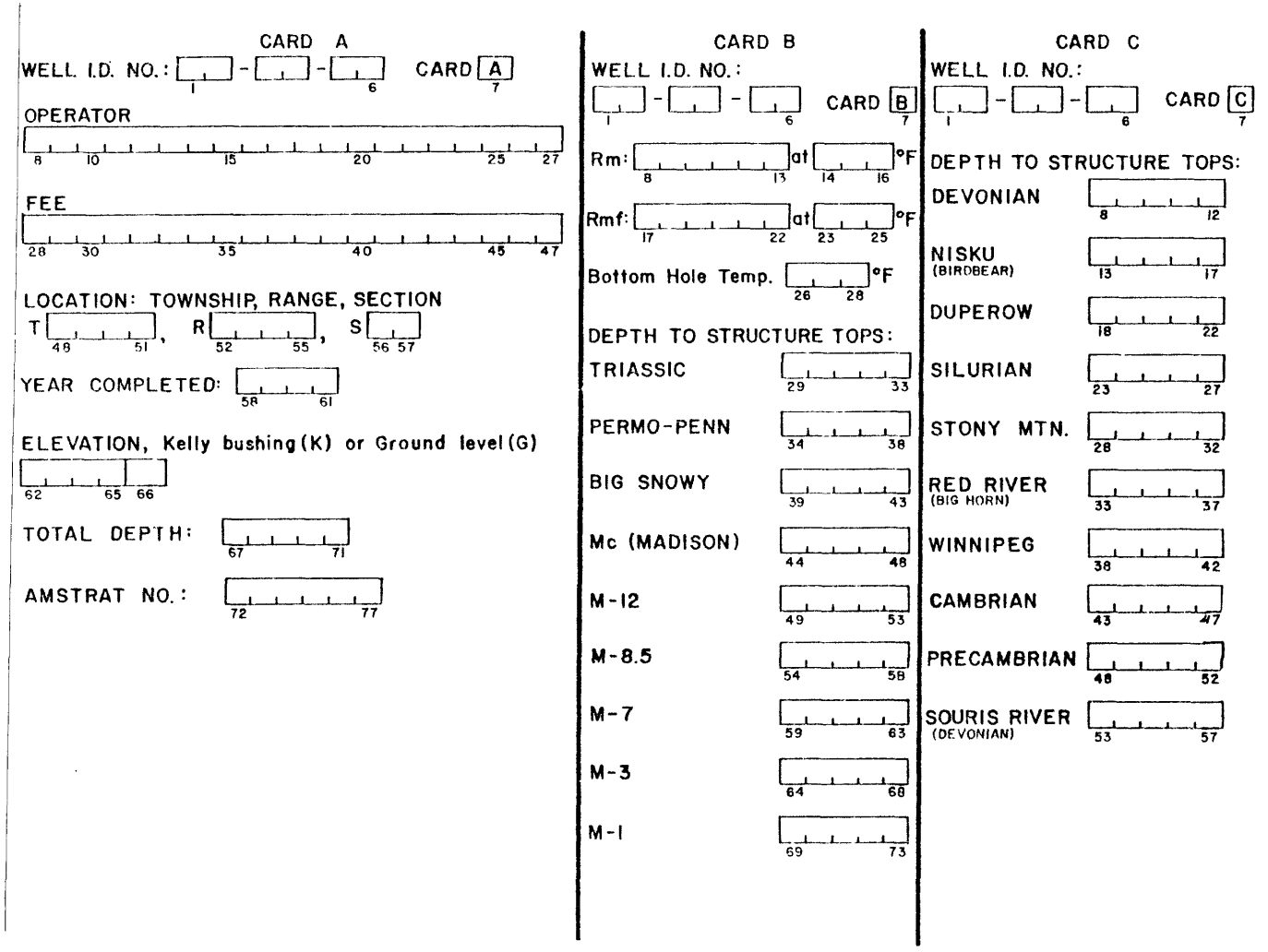


Figure 2.--Example of card image from file B, geologic-data records (cards A-K).

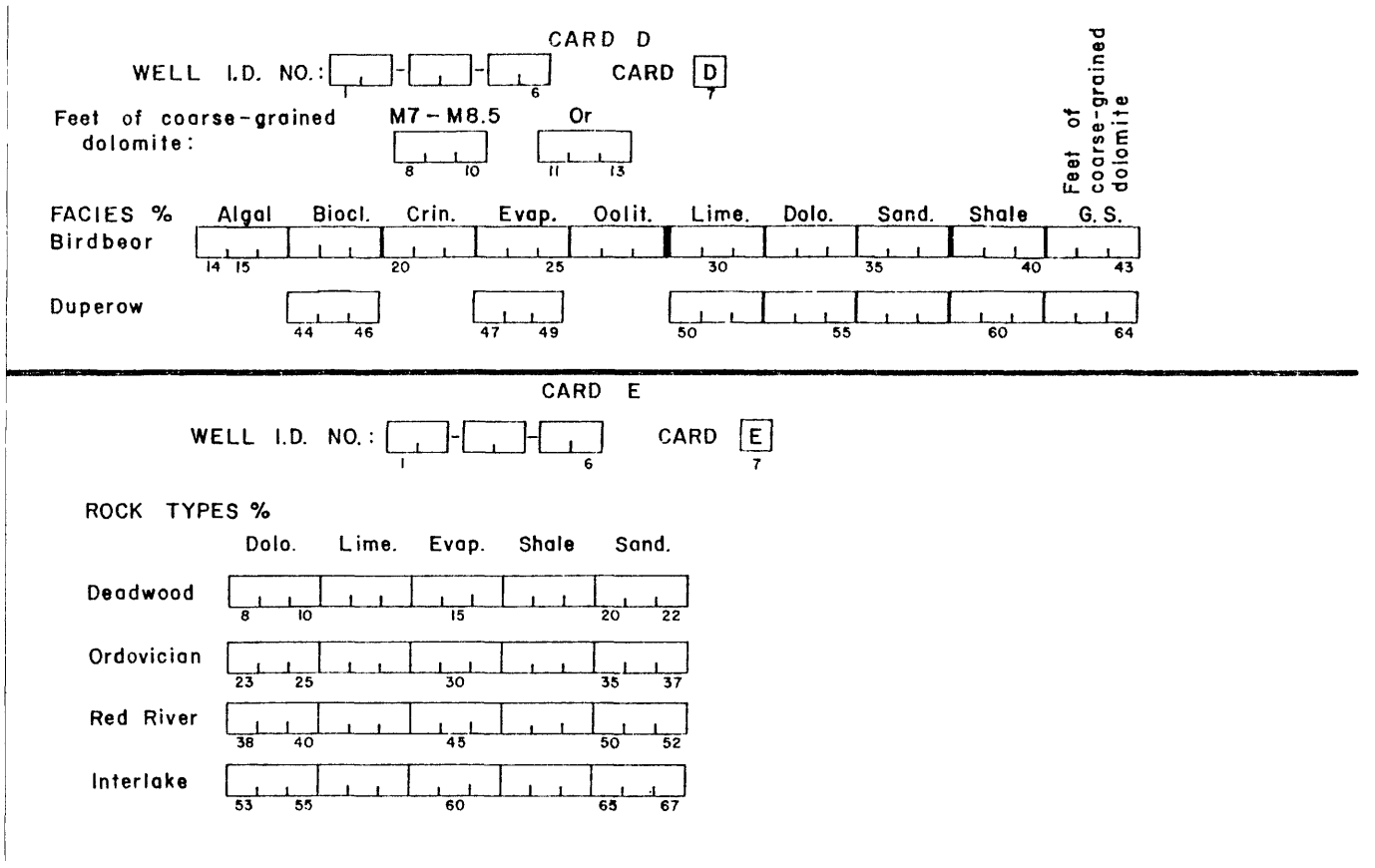


Figure 2.--Example of card image from file B, geologic-data records (cards A-K)(continued).

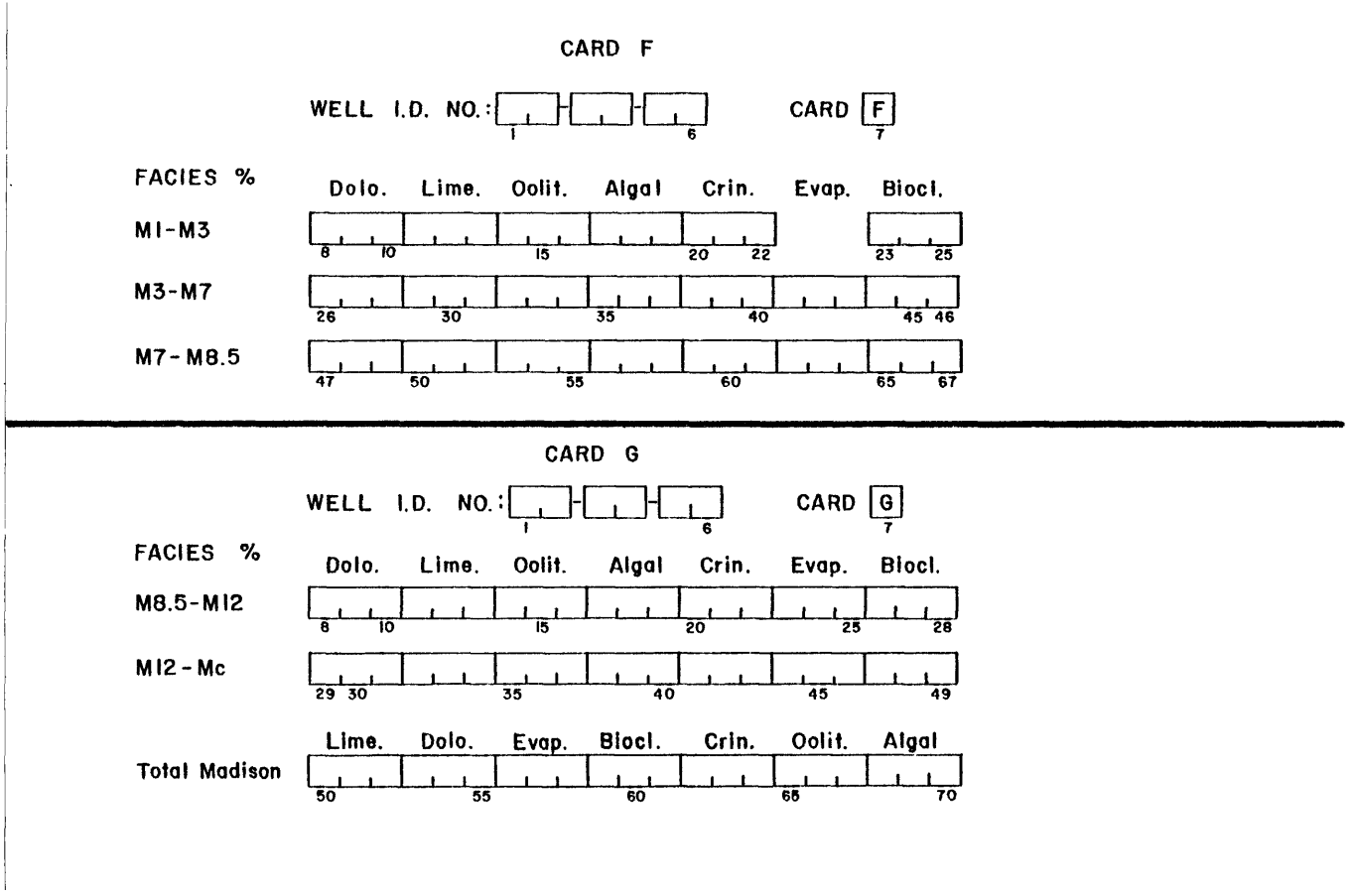
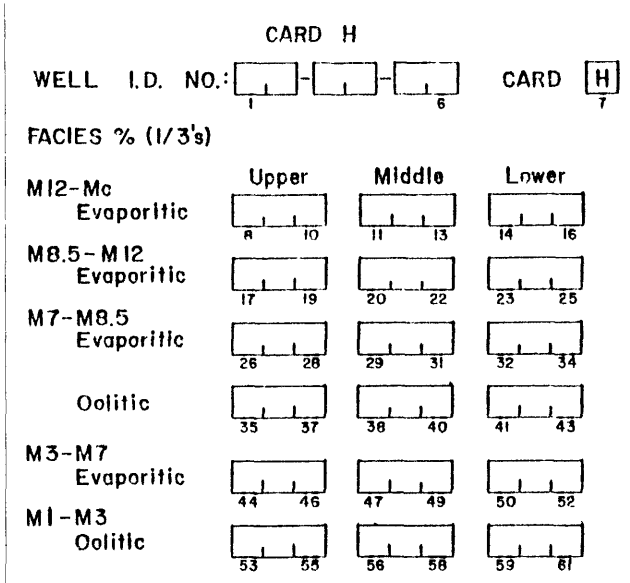


Figure 2.--Example of card image from file B, geologic-data records (cards A-K)(continued).



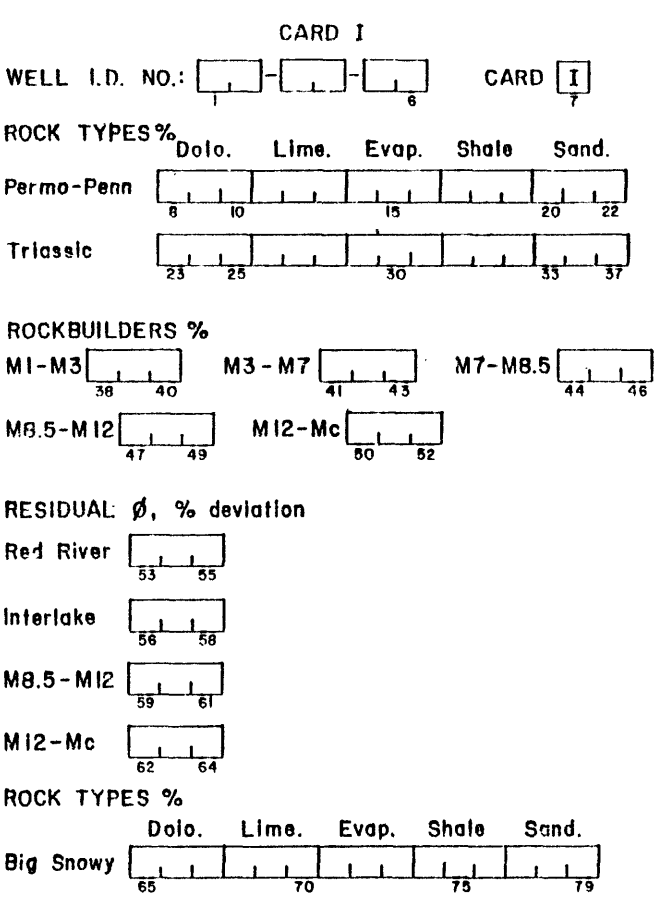


Figure 2.--Example of card image from file B, geologic-data records (cards A-K)(continued).

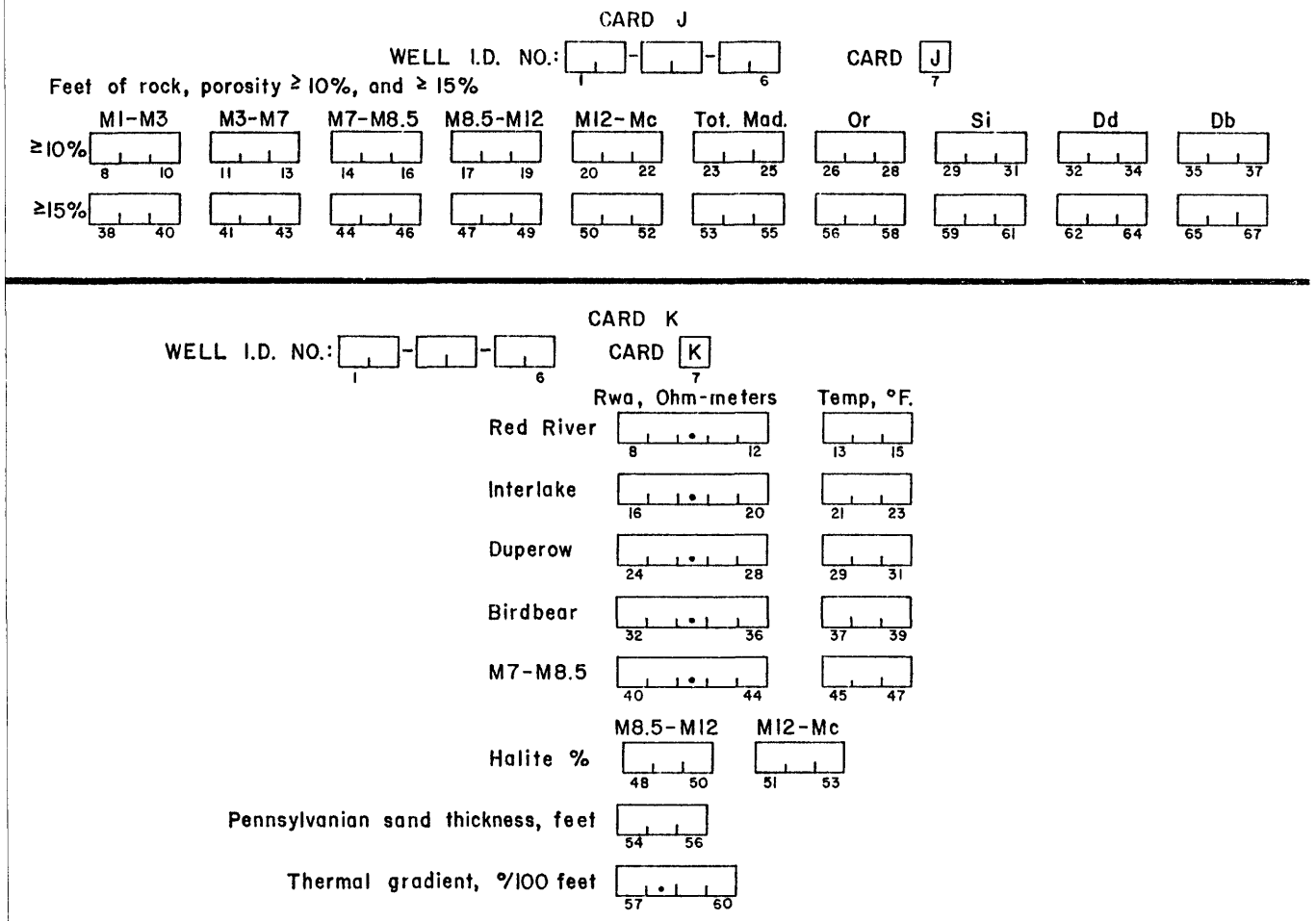


Figure 2.--Example of card image from file B, geologic-data records (cards A-K)(continued).

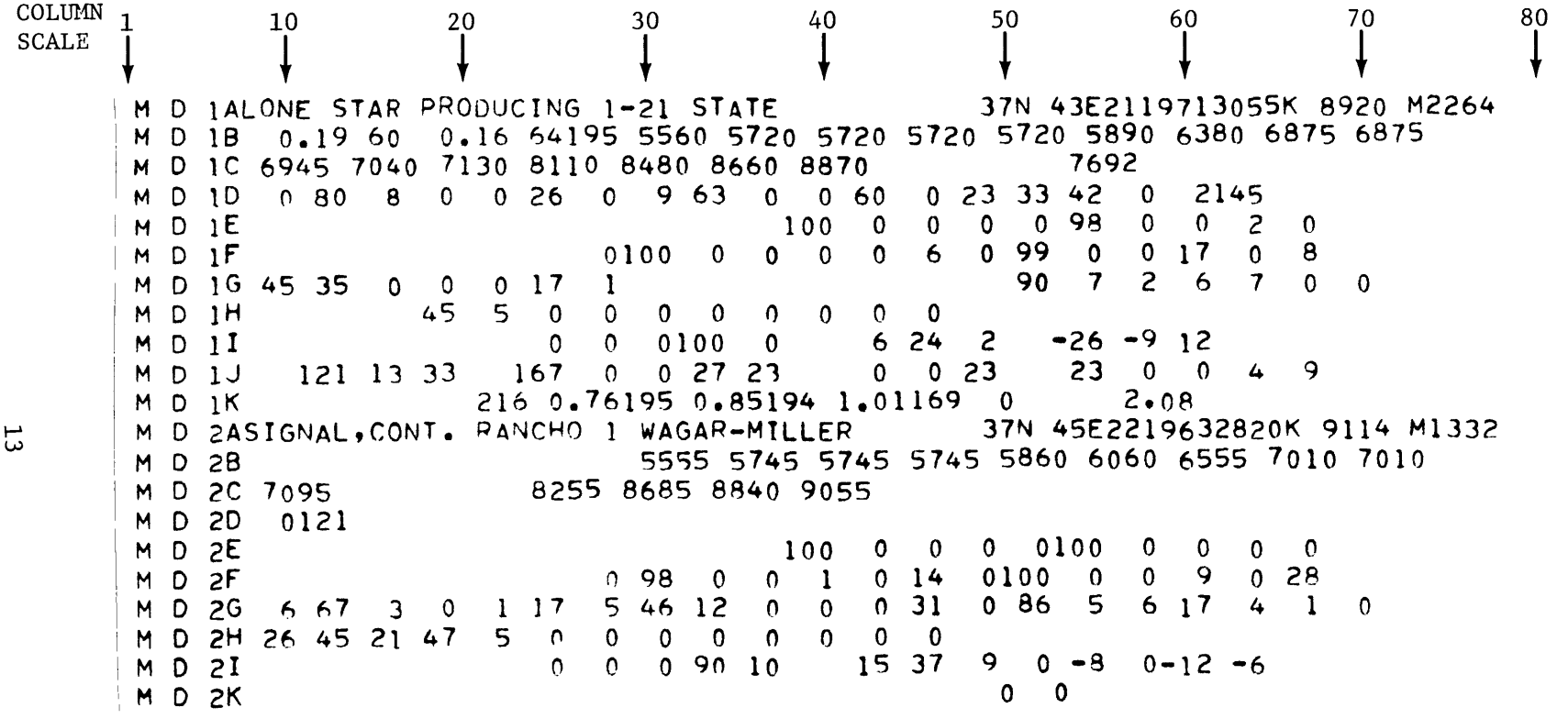


Figure 3.-- Example of record from file B, geologic-data file.

FILES C1 AND C2: DATA SETS FOR REGIONAL SIMULATION MODEL (C1) AND FORTRAN SOURCE CODE (C2)

Data description: File C1 contains the final calibration data sets developed for the three-dimensional simulation model of the Paleozoic and Mesozoic aquifers in the Northern Great Plains. File C2 contains FORTRAN subroutines that have been modified for use with the U.S. Geological Survey's three-dimensional ground-water flow model (Trescott, 1975).

Compiled by: Joe S. Downey, U.S. Geological Survey, Lakewood, Colorado

Tape specifications: Tape number--220529

Block size--12,960

Record length--80-character card images
Tape contains two separate files, C1 and C2, with standard IBM system-360 header labels for each file.

File size--File C1: 2,100 records
File C2: 450 records

Remarks: File C1 contains input data from the final calibration of the three-dimensional simulation model of the Paleozoic and Mesozoic aquifers in the Northern Great Plains. The file is formatted in 80-character card images, with a FORTRAN format of 8F10.4. Four 80-character records list data for each model grid row (fig. 4). The data are recorded on the tape in the following order:

A. Initial hydraulic head, by aquifer, in feet above NVGD of 1929, follows:
   1. Cambrian-Ordovician,
   2. Madison,
   3. Pennsylvanian,
   4. Lower Cretaceous, and
   5. Upper Cretaceous.

B. Transmissivity, by aquifer, in feet squared per second, in same order as initial hydraulic-head data.

C. Leakance, in seconds^{-1}, for model confining layers TR1, TR2, TR3, and TR4.

D. Water density, in grams per cubic centimeter, for:
   1. Cambrian-Ordovician aquifer, and
   2. Madison aquifer.

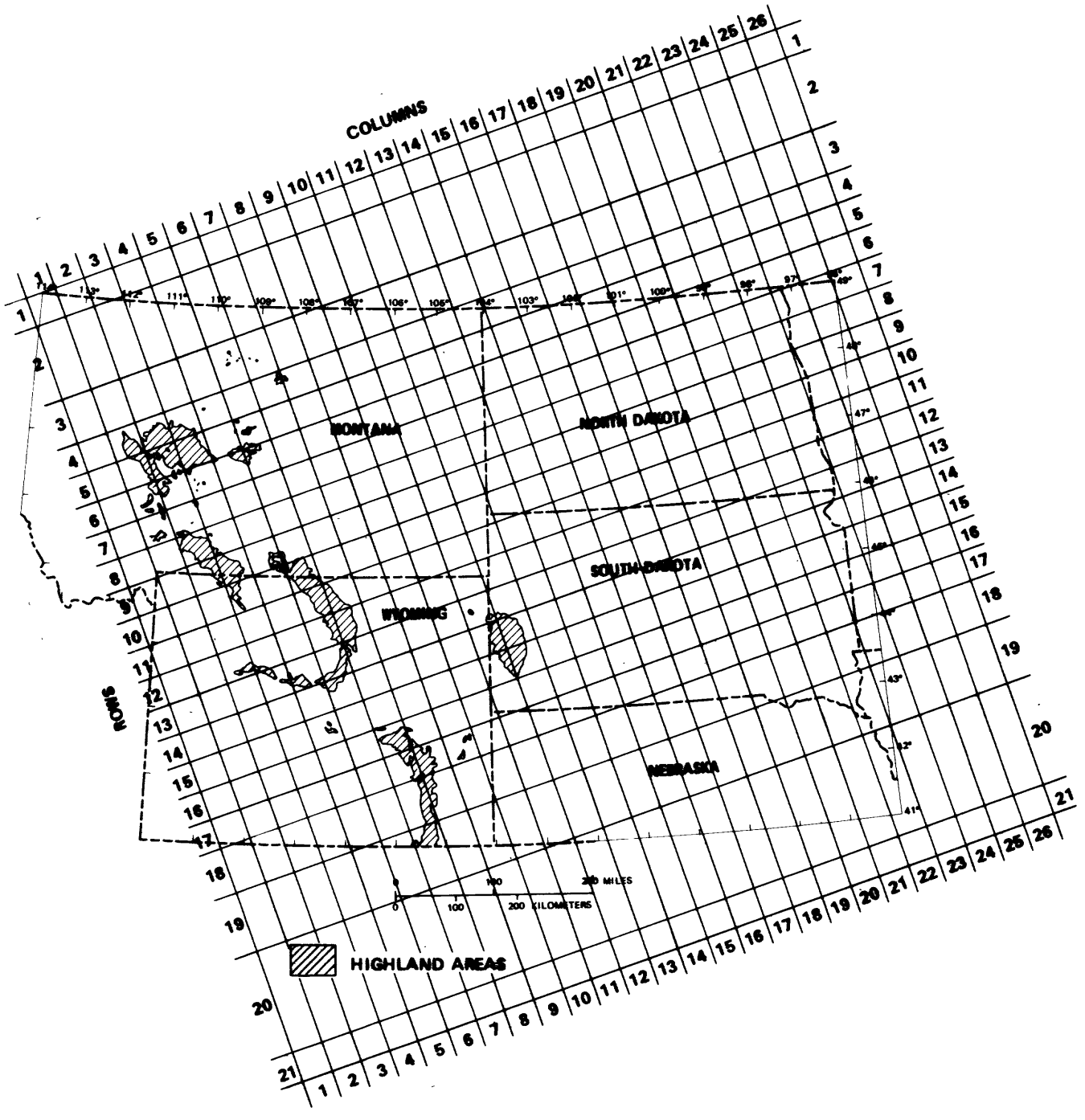


Figure 4.-- Location grid for simulation-model data.

E. Thickness of confining layers, in feet, for model confining layers TR1, TR2, TR3, and TR4.

F. Aquifer altitude, by aquifer, in feet above NGVD of 1929, in similar order to hydraulic-head data. Altitude given is top of aquifer unit.

G. Aquifer thickness, by aquifer, in feet, in similar order to initial hydraulic-head data.

H. Node spacing, in feet, for model columns 1 to 26.

I. Node spacing, in feet, for model rows 1 to 21.

An example of data records from file C1 is shown in figure 5. File C2 of this tape contains FORTRAN subroutines that have been modified from those in the U.S. Geological Survey's three-dimensional ground-water simulation model (Trescott, 1975). These modified subroutines replace the original subroutines of the three-dimensional model of the same name; they are necessary in order to use the data contained in file C1.

FILES D1, D2, AND D3: DATA SETS FOR DRILL-STEM TEST DATA FOR MESOZOIC FORMATIONS (D1), HYDRAULIC-HEAD DATA FOR LOWER CRETACEOUS FORMATIONS (D2), AND HYDRAULIC-HEAD DATA FOR UPPER CRETACEOUS FORMATIONS (D3)

Data description: File D1 contains drill-stem test data for Mesozoic formations, such as well location, formation code, altitude, depth of recording device, and shut-in pressure.

File D2 contains measured hydraulic-head data from selected wells for Lower Cretaceous formations.

File D3 contains measured hydraulic-head data from selected wells for Upper Cretaceous formations.

Compiled by: David H. Lobmeyer, U.S. Geological Survey, Lakewood, Colorado.

Tape specification: Tape number--220530
Tape contains three separate files with standard IBM system-360 header labels.

Block size--12,960 bytes (all files)

Record length--80 bytes (all files)

Row	Columns 1 to 26							
1	.0	.0	.0	.0	.0	.0	.0	.0
	.0	.0	.0	.0	.0	.0	.0	.0
	.0	.0	.0	.0	.0	.0	.0	.0
	.0	.0						
2	.0	.0	.0	.0	.0	3706.	3594.	3509.
	3414.	3296.	3151.	2921.	2741.	2591.	2410.	2276.
	2130.	1970.	1816.	1522.	1215.	1100.	1015.	884.3
	712.0	.0						
3	.0	.0	.0	.0	3600.	3872.	3794.	3702.
	3597.	3455.	3271.	3105.	2945.	2789.	2678.	2579.
	2434.	2242.	1985.	1595.	1240.	1113.	1014.	880.1
	712.0	.0						
4	.0	.0	.0	.0	.0	3956.	3850.	3789.
	3707.	3570.	3371.	3182.	3110.	3033.	2947.	2805.
	2648.	2371.	2104.	1522.	1454.	1214.	1026.	915.0
	725.0	.0						
5	.0	.0	.0	.0	.0	.0	3695.	3811.
	3729.	3620.	3451.	3285.	3247.	3279.	3165.	3010.
	2770.	2408.	2145.	1850.	1624.	1308.	1088.	959.0
	740.0	.0						

Figure 5.-- Example of records from simulation-model data file C1, printed from tape.

File size--File D1: 5,291 records

File D2: 4,000 records

File D3: 3,000 records

Remarks: Example of data record from file D1 is shown in figure 6. Data format for file D1 is given in table 2. Data format for files D2 and D3 is given in table 3. Example of data record from files D2 and D3 is shown in figure 7.

FILE E: GEOLOGIC DATA FOR MESOZOIC FORMATIONS OF THE NORTHERN GREAT PLAINS

Data description: Geologic data such as depth-to-top of formation and formation thickness for selected Mesozoic formations.

Compiled by: Lawrence O. Anna, (formerly) U.S. Geological Survey, Lakewood, Colorado.

Tape specification: Tape number--112620

Block size--12,960 bytes

Record length--80 bytes

File size--6,000 records

Remarks: Example of records printed from the tape is shown in figure 8. Format of well-location record is shown in figure 9, and format of data record is shown in figure 10. Formation codes used in the data records are given in table 4.

25	035	06830	04892287	11221090	602	CBNK	3974	DF	2805	195	1
25	035	06830	04892287	11221090	602	CBNK	3974	DF	2868	820	1
25	035	06833	04892296	11233813	602	CBNK	4082	DF	3099	900	1
25	035	06862	04894093	11234790	602	CBNK	4112	DF	3153	810	1
25	035	06865	04894182	11224558	602	CBNK	3784	DF	2627	840	1
25	035	06871	04894393	11234463	602	CBNK	4058	DF	3120	1160	1
25	035	06884	04894886	11234864	602	CBNK	4046	DF	3095	855	1
25	035	06888	04898110	11223963	602	CBNK	3781	KB	2589	510	1

Figure 6.-- Example of data records from file D1.

Table 2.--*Format of Northern Great Plains drill-stem-test data*

Record columns	
1-2	State code.
4-6	County code.
8-12	Well number.
14-21	Decimal latitude, implied decimal point after column 16. FORTRAN format F8.5.
23-30	Decimal longitude, implied decimal point after column 25. FORTRAN format F8.5.
32-39	Petroleum Information Corporation formation code.
41-44	Land-surface altitude, in feet above National Geodetic Vertical Datum of 1929.
47-48	Measuring point, KB = Kelly bushing, DF = drill floor.
50-54	Depth to recording device, in feet.
56-60	Final shut-in pressure, in pounds per square inch.
62	Test number.

Table 3.--*Format of hydraulic-head data for Lower and Upper Cretaceous formations*

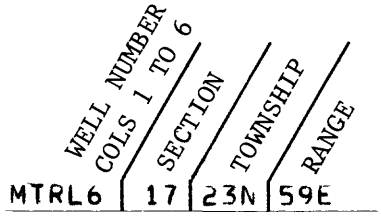
Record columns	
6-11	Decimal latitude.
18-24	Decimal longitude.
33-40	Water level, in feet above National Geodetic Vertical Datum of 1929.
45-52	Petroleum Information Corporation formation code.
67-76	Date of measurement--month, day, and year.

48.359	110.655	3080.	217BCKF	08/01/1963
48.359	110.655	3080.	217BCKF	08/02/1963
48.359	110.655	3290.	217BCKF	08/02/1963
48.359	110.655	3260.	217BCKF	08/04/1963
48.468	110.855	2860.	217BCKF	07/22/1963
48.773	110.810	2680.	217BCKF	08/08/1963
48.890	110.850	2790.	217BCKF	12/12/1973
48.916	110.966	3020.	217BCKF	01/22/1976
48.753	109.836	2000.	217BCLF	07/22/1978
48.171	109.455	3370.	217BILD	12/10/1976
48.301	109.500	2940.	217BILD	09/21/1973

Figure 7.-- Example of data records from files D2 and D3.

WELL LOCATION RECORD	MTRV24 7 29N 49E										
DATA RECORDS	MTRV242533PI	665	1075ME	-	-JR	-	-CG	-	-EA	1740	840
	MTRV242533MW	3225	260NC	3485	40SC	3525	130BS	3655	100DK	3755	55
	MTRV242533NI	2580	115CA	2695	210GH	2905	140FR	-	-BF	3045	180
	MTRV242533FU	3810	180LA	3990	55MR	-	-SW	4045	585RI	4630	175
	MTRV242533PP	4805	255NE	5060	120TR	5180					
	MTRV25 27 28N 51E										
	MTRV252162PI	-	-ME	-	-JR	-	-CG	-	-EA	1185	855
	MTRV252162MW	2770	225NC	2995	65SC	3060	230BS	-	-DK	3290	80
	MTRV252162NI	2040	140CA	2180	240GH	2420	135FR	-	-BF	2555	215
	MTRV252162FU	3370	240LA	3610	70MR	-	-SW	3680	500RI	4180	180
	MTRV252162PP	4360	220NE	4580	115TR	4695					
	MTRV28 16 30N 50E										
	MTRV282247PI	-	-ME	-	-JR	1310	190CG	1500	270EA	1770	860
	MTRV282247MW	3310	240NC	3550	35SC	3585	150BS	3735	115DK	3850	90
	MTRV282247NI	2630	90CA	2720	260GH	2980	135FR	-	-BF	3115	195
	MTRV282247PP	4855	280NE	5135	125TR	5260					
	MTRV282247FU	3940	175LA	4115	60MR	-	-SW	4175	545RI	4720	135

Figure 8.-- Example of well location and data records from file E.



State Code (cols. 1 and 2)
MT = Montana
WY = Wyoming
SD = South Dakota
ND = North Dakota

Figure 9.-- Example of format of well-location record from file E.

WELL LOCATION	DEPTH TO TOP	FORMATION CODE*	DEPTH TO TOP	FORMATION THICKNESS	FORMATION CODE*	DEPTH TO TOP	FORMATION THICKNESS	FORMATION CODE*	DEPTH TO TOP	FORMATION THICKNESS	FORMATION CODE*	DEPTH TO TOP	FORMATION THICKNESS	FORMATION CODE*	DEPTH TO TOP	FORMATION THICKNESS
MTRL6	2164	PP	6370	200	NE	6570	130	TR	6795							
MTRL6	2164	FU	5410	250	LA	5660	20	MR	-	-	SW	5680	540	RI	6220	150
MTRL6	2164	MW	4780	200	NC	4980	110	SC	5090	225	BS	-	-	DK	5315	95
MTRL6	2164	NI	3930	170	CA	4100	310	GH	4410	140	FR	-	-	BF	4550	230
MTRL6	2164	PI	1580	1160	ME	-	-	JR	2740	30	CG	2770	330	EA	3100	830

* Formation codes shown in Table 4.

Figure 10.-- Example of format of data records from file E.

Table 4.--*Codes for formations and geologic units used in file E*

Formation code	Formations or geologic units
PI	Pierre Shale
ME	Mesa Verde Formation
JR	Judith River Formation
CG	Claggett Formation
EA	Eagle Sandstone
NI	Niobrara Formation
CA	Carlile Shale
GH	Greenhorn Formation
FR	Frontier Formation
BF	Belle Fourche Shale
MW	Mowry Shale
NC	Newcastle Sandstone (or Muddy Sandstone)
SC	Skull Creek Shale
BS	Basal silt of Skull Creek Shale
DK	Dakota Sandstone
FU	Fuson Shale
LA	Lakota Sandstone or Formation
MR	Morrison Formation
SW	Swift Formation
RT	Rierdon Formation
PP	Piper Formation
NE	Nesson Formation
TR	Triassic rocks

SELECTED REFERENCES

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