STATE OF ARKANSAS

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Norman F. William, State Geologist

INFORMATION CIRCULAR 30

SPECTROGRAPHIC ANALYSES OF EARLY AND MIDDLE ORDOVICIAN AGE ROCKS IN MONTGOMERY COUNTY AND VICINITY, ARKANSAS

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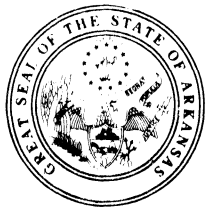
by

Marjorie S. Erickson and Barbara Chazin,
U. S. Geological Survey

and

Boyd R. Haley, Arkansas Geological Commission



Little Rock, Arkansas
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CONTENTS

ILLUSTRATIONS

TABLES

SPECTROGRAPHIC ANALYSES OF EARLY AND MIDDLE ORDOVICIAN AGE ROCKS IN MONTGOMERY COUNTY AND VICINITY, ARKANSAS

INTRODUCTION

This report is a summary of spectrographic analyses for 31 elements in rocks of Early and Middle Ordovician age in Montgomery County and vicinity, Arkansas (fig.1). Samples were collected as one of several multidisciplinary studies associated with the Conterminous United States Mineral Appraisal Program (CUSMAP) of the Harrison $1^{o} \times 2^{o}$ quadrangle. The core was obtained from two drill holes (MI-1 and MCG-1) drilled by the Arkansas Geological Commission and from four holes (MC-1, MC-4, MC-4A, and MC-5) drilled by the Exxon Minerals Corporation and released to the Arkansas Geological Commission.

The geographic location of the drill holes is shown on Figure 1. The stratigraphic location and a brief lithologic description of the rocks in the cores are shown in Figure 2. A more detailed lithologic description of the rocks in the three formations penetrated by the drill holes and of the intervening two formations may be found in Miser and Purdue (1929, p. 23-39). Geologic maps of the area shown in Figure 1 were published by Miser and Purdue (1929, pl. 3) and by Haley and others (1976, Geologic map of Arkansas).

SAMPLE COLLECTION

Representative samples of each rock type were collected from the core in each of the core boxes (generally 10-foot intervals), and particular effort was made to collect samples of the sulfide-bearing (mostly pyrite) shale, siltstone, limestone, and calcite and quartz viens.

SAMPLE ANALYSIS

Spectrographic Method

The rock samples were analysed for 31 elements using a semiquantitative, direct-current arc emission spectrographic method (Grimes and Marranzino, 1968). The elements analyzed and their lower limits of determination are listed in Table 1. Spectrographic results were obtained by visual comparison of spectra derived from the sample against spectra obtained from standards made from pure oxides and carbonates. Standard concentrations are geometrically spaced over any given order of magnitude of concentration as follows: 100, 50, 20, 10, and so forth. Samples whose concentrations are estimated to fall between those values are assigned values of 70, 30, 15, and so forth. The precision of the analytical method is approximately plus or minus two reporting intervals at the 96 percent confidence level (Motooka and Grimes, 1976). Values determined for the major elements (iron, magnesium, calcium, and titanium) are given in weight percent; all others are given in parts per million (micrograms/gram). Analytical data for the samples are listed in Tables 2-7.

ROCK ANALYSIS STORAGE SYSTEM

Upon completion of all analytical work, the analytical results were entered in a United States Geological Survey computer-based file called Rock Analysis Storage System (RASS). This data base contains both descriptive geological information and analytical data. Any or all of this information may be retrieved and converted to a binary form (STATPAC) for computerized statistical analysis or publication (VanTrump and Miesch, 1976).

DESCRIPTION OF DATA TABLES

Tables 2-7 list the analyses for the six drill core samples. For the tables, the data

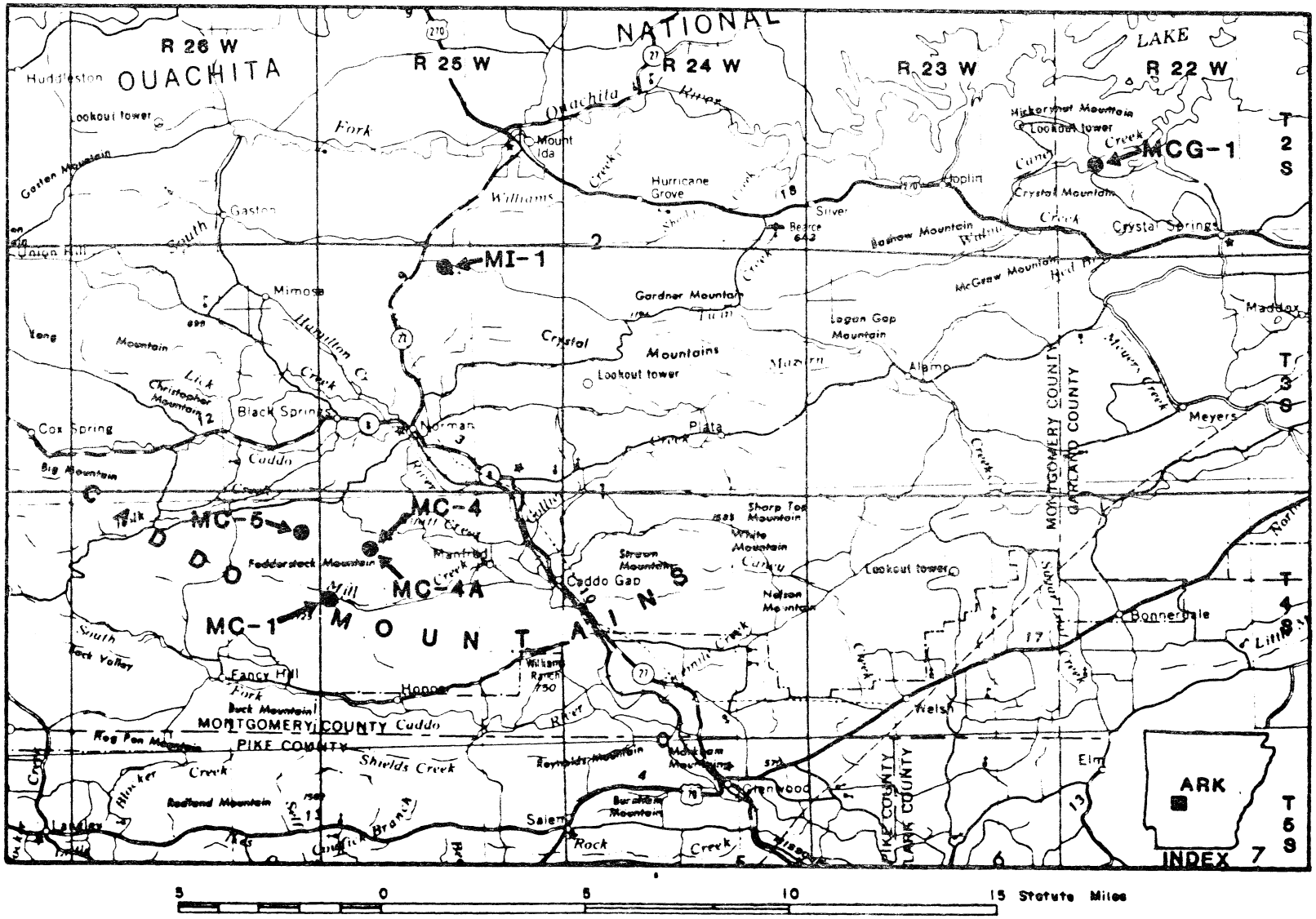

Figure 1. Location of drill holes.

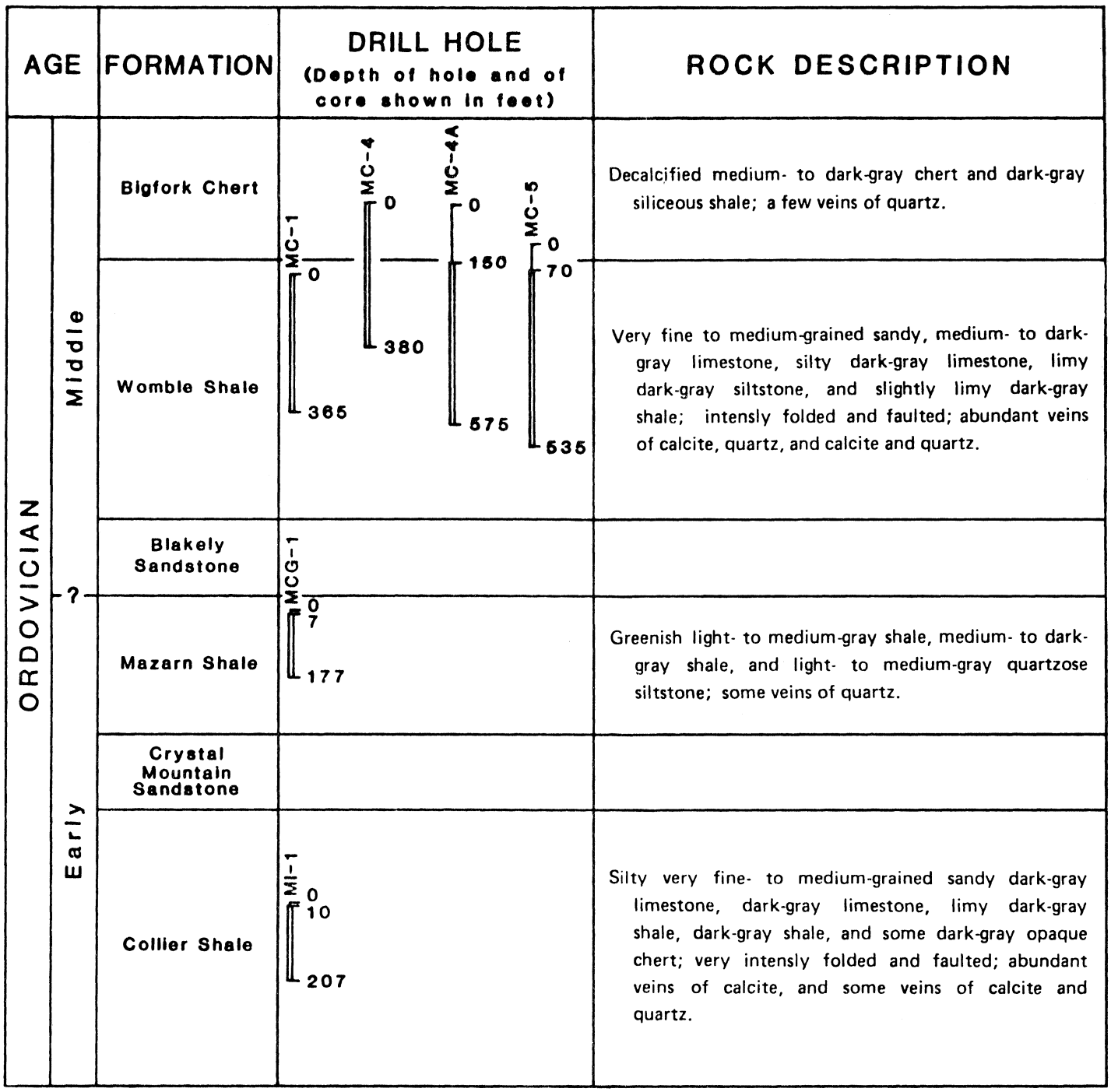

Figure 2. Stratigraphic position and lithologic description of rocks penetrated by drill holes.

are arranged so that column 1 contains the drill hole numbers. These numbers correspond to the numbers shown on the site location maps (fig. 1). The last four digits identify the depth of the sample from the drill-hole collar. Each sample is composite of drill-core chips, normally representing a 10-ft. interval from above the depth indicated. A letter "N" in the tables indicates that a given element was looked for but not detected at the lower limit of determination shown for that element in Table 1. If an element was observed but was below the lowest reporting value, a "less than" symbol (<) was entered in the tables in front of the lower limit of determination. If an element was observed but was above the highest reporting value, a "greater than" symbol (>) was entered in the tables in front of the upper limit of determination. Because of the formatting used in the computer program that produced Tables 2-7, some of the elements listed in these tables (Fe, Mg, Ca, Ti, Ag, and Be) carry one or more nonsignificant digits to the right of the significant digits. The analyst did not determine these elements to the accuracy suggested by the extra zeros.

TABLE 1.--Limits of determination for the spectrographic analysis of rocks, based on a 10-mg sample.

Elements	Lower determination limits	Upper determination limits
	Percent	
Iron (Fe)	0.05	20
Magnesium (Mg)	.02	10
Calcium (Ca)	.05	21
Titanium (Ti)	.002	1
	Parts per million	
Manganese (Mn)	10	5,000
Silver (Ag)	0.5	5,000
Arsenic (As)	200	10,000
Gold (Au)	10	500
Boron (B)	10	2,000
Barium (Ba)	20	5,000
Beryllium (Be)	1	1,000
Bismuth (Bi)	10	1,000
Cadmium (Cd)	20	500
Cobalt (Co)	5	2,000
Chromium (Cr)	10	5,000
Copper (Cu)	5	20,000
Lanthanum (La)	20	1,000
Molybdenum (Mo)	5	2,000
Niobium (Nb)	20	2,000
Nickel (Ni)	5	5,000
Lead (Pb)	10	20,000
Antimony (Sb)	100	10,000
Scandium (Sc)	5	100
Tin (Sn)	10	1,000
Strontium (Sr)	100	5,000
Vanadium (V)	10	10,000
Tungsten (W)	50	10,000
Yttrium (Y)	10	2,000
Zinc (Zn)	200	10,000
Zirconium (Zr)	10	1,000
Thorium (Th)	100	2,000

The spectrographic determinations for Au, Bi, Cd, Sb, Th, and W in the drill-hole samples were all below the lower limits of determinations shown in Table 1; consequently, the columns for these elements have been deleted from the tables.

ACKNOWLEDGMENTS

The authors wish to acknowledge the help and cooperation of Norman F. Williams of the Arkansas Geological Commission for making these drill cores available to the U.S. Geological Survey for this joint CUSMAP (Conterminous United States Mineral Appraisal Program) study.

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Table 2.--Analyses of rock samples from Mount Ida No. 1 drill hole, NESWSESE Sec. 19, T. 2 S., R. 22 W., Montgomery County, Arkansas.
(Hole was drilled vertical and core obtained from 10 feet to total depth of 207 feet.)
Drill hole penetrated rocks in the Collier Shale

[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown. Values are given in parts per million (micrograms/gram), except Fe, Mg, Ca, and Ti, which are given in weight percent.]

Sample	Fe	Mg	Ca	Ti	Mn	Ag	As	B	Ba	Be	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sc	Sn	Sr	V	Y	Zn	Zr
MI1020	1.0	5.0	>20.00	.100	500	N	N	N	200	N	N	15	15	N	N	N	10	<10	<5	N	1,000	50	10	N	N
MI1030	3.0	5.0	>20.00	.070	200	N	N	N	200	N	N	20	70	N	5	N	10	20	5	N	500	70	<10	N	10
MI1040	1.0	7.0	>20.00	.070	150	N	N	N	1,000	N	N	<10	10	N	N	N	7	<10	N	N	2,000	30	<10	N	10
MI1050	1.0	5.0	>20.00	.100	200	N	N	N	300	N	N	<10	10	N	N	N	10	<10	5	N	1,000	50	10	N	10
MI1060	1.5	5.0	>20.00	.150	200	N	N	N	200	N	5	20	20	N	5	N	20	N	5	N	1,000	200	15	N	20
MI1070	.5	5.0	>20.00	.050	100	N	N	N	200	N	N	<10	<5	N	N	N	<5	N	<5	N	1,500	15	N	N	N
MI1080	1.5	10.0	>20.00	.100	100	N	N	N	200	N	5	30	20	N	N	N	30	<10	<5	N	700	100	10	N	20
MI1090	1.0	10.0	>20.00	.100	150	N	N	N	300	N	5	30	50	N	N	N	30	15	<5	N	700	200	N	300	20
MI1100	1.5	7.0	>20.00	.070	300	N	N	N	700	<1.0	10	15	50	N	N	N	30	20	<5	N	700	100	10	N	20
MI1110	2.0	>10.0	>20.00	.150	200	N	N	N	200	<1.0	15	50	70	N	7	N	50	20	5	N	500	300	15	N	50
MI1120	.7	5.0	>20.00	.050	200	N	N	N	200	N	N	N	5	N	N	N	5	N	<5	N	1,500	20	<10	N	<10
MI1130	.7	7.0	>20.00	.050	200	N	N	N	150	N	N	N	7	N	N	N	7	<10	<5	N	1,000	30	10	N	<10
MI1140	1.0	5.0	>20.00	.070	200	N	N	N	300	N	5	N	10	N	N	N	7	10	<5	N	1,000	30	<10	N	N
MI1150	1.5	5.0	>20.00	.150	100	N	N	N	200	N	7	20	30	N	<5	N	20	20	<5	N	1,000	100	N	N	20
MI1160	.5	10.0	>20.00	.070	70	N	N	N	100	N	N	N	<5	N	N	N	5	N	N	N	1,500	15	N	N	N
MI1170	.7	3.0	>20.00	.070	100	N	N	N	150	N	N	N	5	N	N	N	7	N	N	N	1,000	20	<10	N	N
MI1180	.5	5.0	>20.00	.030	100	N	N	N	150	N	N	N	<5	N	N	N	5	N	N	N	1,000	10	N	N	N
MI1190	1.0	7.0	20.00	.100	300	N	N	N	100	N	5	30	50	N	N	N	30	15	5	N	1,000	150	N	N	30
MI1200	1.5	10.0	>20.00	.100	300	N	N	N	200	N	5	20	30	N	5	N	30	15	5	N	1,000	100	N	N	<10
MI1210	1.5	>10.0	15.00	.150	200	N	N	N	150	N	7	50	70	N	N	N	30	15	5	N	300	100	N	N	50

Table 3.--Analyses of rock samples from McGraw Mountain No. 1 drill hole, Cen. E/L SWNW Sec .3, T. 2 S., R. 25 W., Garland County, Arkansas.
(Hole was drilled vertical and core obtained from 7 feet to total depth of 177 feet.)
Drill hole penetrated rocks of the Mazarn Shale

[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown. Values are given in parts per million (micrograms/gram), except Fe, Mg, Ca, and Ti, which are given in weight percent.]

Sample	Fe	Mg	Ca	Ti	Mn	Ag	As	B	Ba	Be	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sc	Sn	Sr	V	Y	Zn	Zr
MCG1017	2.0	2.0	1.00	.200	200	N	N	150	500	1.0	10	100	70	N	N	N	20	20	10	N	N	100	10	N	200
MCG1027	5.0	5.0	1.50	.200	500	N	N	200	500	1.5	15	100	50	N	N	N	30	20	15	N	200	100	15	N	200
MCG1037	5.0	5.0	2.00	.200	700	N	N	200	500	<1.0	20	100	100	N	N	N	30	50	15	N	<100	100	10	N	150
MCG1047	3.0	3.0	2.00	.200	1,000	N	N	150	500	<1.0	20	50	100	N	N	N	20	30	10	N	<100	100	10	N	200
MCG1057	5.0	3.0	.07	.200	150	N	N	200	500	1.0	20	100	100	N	N	N	30	10	10	N	N	100	10	N	200
MCG1067	5.0	3.0	.10	.200	100	N	N	200	500	<1.0	30	70	50	N	N	N	30	20	15	N	N	100	<10	N	150
MCG1077	7.0	5.0	.10	.300	100	N	N	300	700	1.0	30	100	70	N	N	N	50	15	20	N	N	150	10	N	200
MCG1087	5.0	5.0	2.00	.200	700	N	N	150	500	<1.0	20	70	70	N	N	N	20	10	10	N	N	100	10	N	200
MCG1097	5.0	10.0	2.00	.200	700	N	N	100	500	1.0	20	70	50	N	N	N	20	50	15	N	<100	150	10	N	200
MCG1107	3.0	10.0	10.00	.150	1,000	N	N	100	500	<1.0	15	20	10	N	N	N	20	30	7	N	<100	50	<10	N	100
MCG1117	2.0	7.0	10.00	.100	1,000	N	N	50	200	<1.0	10	20	15	N	N	N	15	100	5	N	100	70	<10	N	100
MCG1127	2.0	>10.0	10.00	.150	1,000	N	N	100	200	<1.0	10	30	15	N	N	N	20	20	5	N	100	100	10	N	150
MCG1137	1.5	7.0	10.00	.070	500	N	N	100	200	N	5	15	10	N	N	N	15	15	<5	N	<100	30	N	300	15
MCG1147	2.0	10.0	15.00	.100	700	N	N	70	150	N	5	10	15	N	N	N	20	20	5	N	100	50	N	N	70
MCG1157	2.0	3.0	7.00	.200	200	N	N	100	200	1.0	20	50	100	N	N	N	20	100	10	N	<100	150	30	N	150
MCG1167	5.0	5.0	2.00	.200	300	N	N	100	300	<1.0	20	70	70	N	N	N	30	30	10	N	<100	100	10	N	150
MCG1177	3.0	5.0	2.00	.200	300	N	N	100	300	1.0	15	70	100	N	N	N	30	20	10	N	<100	150	10	N	150

Table 4.--Analyses of rock samples from Mill Creek No. 1 drill hole, NENESW Sec. 18, T. 4 S., R. 25 W., Montgomery County, Arkansas.
(Hole was drilled 30 degrees from vertical on an azimuth of 194 degrees and core obtained from surface to total depth of 365 feet.)
Drill hole penetrated rocks of the Womble Shale

[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown. Values are given in parts per million (micrograms/gram), except Fe, Mg, Ca, and Ti, which are given in weight percent.]

Sample	Fe	Mg	Ca	Ti	Mn	Ag	As	B	Ba	Be	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sc	Sn	Sr	V	Y	Zn	Zr
MC10010	5.0	1.0	5.00	.200	200	1.5	N	500	100	2.0	20	100	100	50	15	N	50	30	10	N	300	200	20	1,000	70
MC10020	3.0	1.5	7.00	.150	200	2.0	N	500	100	2.0	10	100	50	50	7	N	50	20	7	N	700	200	20	>10,000	70
MC10030	2.0	1.0	7.00	.150	150	N	N	500	150	2.0	<5	50	20	30	5	<20	20	15	5	N	500	150	20	N	70
MC10042	2.0	1.0	10.00	.150	200	N	N	500	200	1.5	5	50	30	50	10	<20	30	20	7	N	700	200	20	N	70
MC10051	2.0	1.5	7.00	.070	300	1.5	N	300	150	1.5	5	50	50	30	7	N	20	30	7	N	700	100	20	500	30
MC10059	3.0	1.0	2.00	.150	200	1.5	N	700	200	3.0	15	100	50	50	10	N	50	30	10	N	200	150	15	300	70
MC10069	5.0	1.5	7.00	.200	200	.7	N	700	200	1.5	15	100	30	50	5	N	30	20	10	N	700	200	20	N	70
MC10077	1.0	1.5	20.00	.050	200	1.0	N	100	70	<1.0	<5	20	70	N	5	N	20	<10	<5	N	1,500	150	15	500	30
MC10087	1.5	1.5	>20.00	.050	300	.7	N	150	50	<1.0	N	15	30	N	7	N	15	10	<5	N	2,000	150	20	300	50
MC10097	1.0	1.5	20.00	.070	300	.5	N	100	50	N	N	20	20	N	10	N	20	<10	5	N	1,500	150	20	300	50
MC10106	3.0	1.5	>20.00	.070	500	.5	N	150	30	N	N	20	20	N	7	N	20	20	5	N	2,000	150	20	200	50
MC10117	2.0	2.0	20.00	.100	300	.5	N	500	150	1.0	5	50	50	N	15	N	20	20	7	N	1,000	200	20	N	50
MC10127	5.0	1.5	10.00	.150	200	1.0	N	700	150	2.0	15	100	50	30	20	N	70	30	10	N	500	300	20	500	50
MC10136	7.0	1.5	5.00	.100	200	2.0	N	1,000	150	2.0	15	100	70	N	10	N	70	50	10	N	500	200	15	<200	50
MC10147	3.0	1.5	1.50	.100	70	2.0	N	1,000	300	3.0	10	50	30	70	15	N	50	50	7	10	500	200	15	N	30
MC10159	15.0	2.0	15.00	.070	500	3.0	300	500	100	<1.0	20	50	150	N	7	N	100	100	7	N	700	150	30	<200	30
MC10168	3.0	1.5	10.00	.100	200	1.0	N	300	100	1.0	7	70	100	N	10	N	30	15	7	N	700	150	15	<200	30
MC10178	2.0	1.5	15.00	.100	150	1.0	N	500	100	1.0	5	70	50	N	7	N	30	15	7	N	1,000	200	15	<200	30
MC10187	3.0	2.0	>20.00	.100	200	.7	N	300	100	N	<5	50	50	N	5	N	30	10	7	N	1,000	150	20	<200	30
MC10196	3.0	2.0	10.00	.150	200	1.0	N	500	150	2.0	5	100	50	30	5	N	30	15	7	N	500	150	15	200	30
MC10205	3.0	2.0	10.00	.150	150	.7	N	500	150	2.0	<5	100	50	50	5	N	30	<10	7	N	700	200	15	<200	50
MC10214	5.0	2.0	>20.00	.100	300	1.5	N	300	150	<1.0	5	70	50	20	10	N	50	20	5	N	1,500	150	20	500	70
MC10224	5.0	2.0	15.00	.150	200	1.5	N	700	200	2.0	5	100	100	30	10	N	70	15	7	N	1,000	200	15	300	70
MC10233	3.0	1.5	7.00	.150	100	3.0	N	500	200	1.0	5	100	150	N	20	N	100	15	5	N	500	500	10	1,000	50
MC10243	1.0	1.5	20.00	.050	100	.7	N	100	50	<1.0	N	50	30	N	<5	N	15	10	<5	N	1,000	200	15	N	20
MC10253	.7	1.5	>20.00	.050	100	.5	N	100	50	N	N	50	20	N	<5	N	10	<10	<5	N	1,500	200	20	N	<10
MC10262	1.0	1.0	5.00	.070	50	1.0	N	150	100	1.0	N	70	100	N	10	N	30	10	<5	N	500	200	10	N	10
MC10271	3.0	2.0	20.00	.100	100	5.0	N	200	150	N	5	100	150	N	20	N	70	20	5	N	1,000	500	20	3,000	50
MC10280	1.5	1.5	15.00	.070	70	2.0	N	200	100	N	N	100	70	N	20	N	50	10	<5	N	1,000	300	20	2,000	50
MC10290	1.5	1.5	>20.00	.100	100	1.5	N	700	100	N	5	100	150	N	20	N	50	10	5	N	1,000	300	20	200	20
MC10299	1.5	1.0	5.00	.100	30	1.0	N	200	100	<1.0	N	100	100	N	15	N	50	<10	5	N	500	200	10	N	20
MC10308	1.5	1.5	20.00	.100	70	1.5	N	150	100	N	N	100	70	N	10	N	30	15	5	N	1,000	200	15	N	20
MC10317	5.0	1.0	10.00	.150	100	1.5	N	500	200	1.5	7	100	100	30	10	N	50	20	7	N	500	200	20	700	100
MC10327	1.5	2.0	>20.00	.100	200	.7	N	300	150	<1.0	N	50	20	N	<5	N	10	10	5	N	1,500	100	20	N	20
MC10336	1.0	1.0	10.00	.100	100	.5	N	200	100	1.5	N	50	20	20	5	N	7	10	5	N	1,000	100	15	N	50
MC10345	2.0	2.0	5.00	.150	100	1.5	N	200	100	1.5	<5	100	100	N	20	N	50	10	5	N	200	500	10	N	50
MC10355	1.5	1.5	15.00	.100	70	1.0	N	200	150	N	5	70	50	20	5	N	20	15	5	N	500	200	15	300	30
MC10365	1.5	1.5	15.00	.150	100	1.0	N	200	200	1.0	<5	70	30	20	10	N	20	10	5	N	700	300	15	500	50

Table 5.--Analyses of rock samples from Mill Creek No. 4 drill hole, NWSENW Sec. 8, T. 4 S., R. 25 W., Montgomery County, Arkansas. (Hole was drilled 30 degrees from vertical on an azimuth of 040 degrees and core was obtained from surface to total depth of 380 feet.) Contact between Bigfork Chert and Womble Shale at depth of 149 feet.

[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown. Values are given in parts per million (micrograms/gram), except Fe, Mg, Ca, and Ti, which are given in weight percent.]

Sample	Fe	Mg	Ca	Ti	Mn	Ag	As	B	Ba	Be	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sc	Sn	Sr	V	Y	Zn	Zr
MC4035	.5	.1	.20	.050	<10	N	N	100	200	10.0	N	20	100	N	N	N	20	N	<5	N	5,000	200	30	<200	100
MC4045	.5	.2	.10	.050	<10	N	N	100	70	<1.0	N	20	100	N	N	N	50	N	<5	N	200	150	15	N	100
MC4050	1.0	.3	.20	.100	<10	N	N	150	150	<1.0	N	50	100	N	7	N	70	N	<5	N	100	200	20	N	150
MC4060	1.0	.2	.07	.100	10	<.5	N	150	150	<1.0	N	50	100	N	5	N	70	N	N	N	N	200	N	N	50
MC4065	1.0	.2	.10	.100	10	.5	N	200	100	<1.0	N	70	150	N	10	N	70	N	N	N	N	200	<10	N	50
MC4073	1.5	.2	.05	.100	15	.7	N	200	150	<1.0	N	50	100	N	N	N	30	N	N	N	N	150	N	N	100
MC4076	1.0	.2	.07	.100	10	.5	N	200	150	<1.0	N	50	100	N	7	N	50	N	<5	N	<100	200	N	N	20
MC4080	.5	.2	5.00	.030	50	N	N	70	100	N	N	20	15	N	5	N	30	N	N	N	700	50	N	N	20
MC4086	.5	.1	.20	.050	<10	N	N	100	100	N	N	20	20	N	<5	N	20	N	N	N	100	100	N	N	20
MC4091	.5	.1	.20	.050	10	N	N	100	150	1.0	N	30	50	N	N	N	30	N	<5	N	200	100	N	<200	20
MC4093	.7	.3	15.00	.050	100	N	N	100	100	N	N	30	50	N	N	N	30	N	<5	N	1,500	150	15	N	10
MC4117	2.0	.3	.70	.150	20	.7	N	200	200	1.0	N	70	50	N	5	N	70	N	5	N	200	150	20	500	100
MC4135	1.0	.2	5.00	.070	50	1.0	N	100	150	1.0	N	20	70	N	10	N	70	N	<5	N	1,000	200	20	500	20
MC4149	1.5	.5	>20.00	.050	200	.5	N	50	50	1.5	N	20	50	N	5	N	100	N	N	N	1,500	150	20	200	10
MC4150	1.0	.5	>20.00	.100	200	.5	N	100	50	N	N	20	50	N	10	N	30	N	<5	N	1,500	100	15	N	20
MC4152	.7	1.0	20.00	.070	200	.5	N	70	50	N	N	30	50	N	N	N	30	N	N	N	2,000	100	15	N	10
MC4162	.7	1.0	>20.00	.070	200	.7	N	30	50	N	N	20	50	N	<5	N	20	N	N	N	3,000	100	20	N	10
MC4173	.7	1.0	>20.00	.070	200	1.0	N	50	30	N	N	30	50	N	N	N	30	N	N	N	3,000	300	20	200	10
MC4181	3.0	1.0	>20.00	.070	700	1.0	N	70	50	N	N	50	100	N	N	N	70	N	N	N	5,000	200	20	200	10
MC4191	1.5	.7	20.00	.050	500	2.0	N	100	70	N	N	70	150	N	<5	N	70	N	<5	N	1,500	100	30	200	15
MC4201	1.0	1.5	>20.00	.100	70	.7	N	100	100	<1.0	N	50	50	N	5	N	70	N	<5	N	>5,000	100	15	N	20
MC4210	1.5	1.0	>20.00	.070	500	.7	N	50	100	N	N	50	150	N	5	N	70	N	<5	N	5,000	100	20	<200	10
MC4231	1.0	.7	15.00	.150	100	.5	N	200	100	1.0	N	50	100	N	5	N	100	N	5	N	3,000	150	30	N	30
MC4240	1.0	1.0	20.00	.100	200	1.0	N	200	150	<1.0	N	50	70	50	5	N	70	N	<5	N	3,000	200	20	N	20
MC4249	1.0	.7	20.00	.100	100	2.0	N	70	70	N	N	50	70	N	5	N	70	N	<5	N	2,000	200	20	300	10
MC4260	1.0	.5	7.00	.150	100	1.5	N	150	150	<1.0	N	70	100	N	5	N	100	N	<5	N	1,500	200	15	200	20
MC4270	1.5	1.5	>20.00	.150	100	1.5	N	100	100	N	N	50	100	N	7	N	100	<10	<5	N	5,000	150	20	N	20
MC4279	1.5	1.0	15.00	.150	100	1.5	N	200	300	1.0	N	70	150	N	5	N	100	<10	<5	N	5,000	200	15	300	20
MC4288	.2	.7	10.00	.030	70	N	N	20	50	N	N	N	30	N	N	N	20	N	N	N	1,500	50	10	N	<10
MC4298	.7	1.0	>20.00	.070	200	<.5	N	50	500	N	N	N	15	N	<5	N	30	N	N	N	5,000	70	20	N	10
MC4307	.7	1.0	>20.00	.070	200	.5	N	150	1,000	N	N	20	100	N	<5	N	50	N	<5	N	>5,000	150	20	N	10
MC4316	1.0	1.0	20.00	.100	100	.7	N	150	500	N	N	30	100	N	5	N	70	N	<5	N	2,000	200	20	N	10
MC4325	1.0	.7	20.00	.070	150	2.0	N	30	50	N	N	20	150	N	5	N	50	10	N	N	3,000	200	20	200	<10
MC4335	1.0	1.5	20.00	.070	100	1.5	N	50	100	N	N	50	100	N	<5	N	70	15	<5	N	3,000	100	20	N	10
MC4344	1.0	1.5	>20.00	.100	200	2.0	N	200	150	N	N	100	100	<20	5	N	100	15	7	N	>5,000	200	50	500	50
MC4353	1.0	1.0	15.00	.100	200	1.0	N	200	100	1.0	N	100	100	N	10	N	100	N	5	N	5,000	200	30	200	30
MC4362	1.5	5.0	>20.00	.100	700	2.0	N	150	100	<1.0	N	100	100	N	5	N	50	<10	5	N	3,000	200	30	<200	20
MC4372	1.0	.5	20.00	.070	150	1.5	N	50	30	N	N	50	100	N	10	N	70	N	N	N	2,000	300	20	500	<10
MC4379	.5	1.5	>20.00	.050	1,000	.7	N	50	50	N	N	20	20	N	<5	N	30	N	<5	N	3,000	200	30	200	15

Table 6.--Analyses of rock samples from Mill Creek No. 4A drill hole, NWSENW Sec. 8, T. 4 S., R. 25 W., Montgomery County, Arkansas.
(Hole was drilled as a twin of Mill Creek No. 4 drill hole and core was obtained from 150 feet to total depth of 575 feet.)
Contact between Bigfork Chert and Womble Shale at a depth less than 150 feet.

[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown. Values are given in parts per million (micrograms/gram), except Fe, Mg, Ca, and Ti, which are given in weight percent.]

Sample	Fe	Mg	Ca	Ti	Mn	Ag	As	B	Ba	Be	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sc	Sn	Sr	V	Y	Zn	Zr
MC4A0161	1.0	2.0	>20.00	.050	200	.7	N	70	100	<1.0	N	70	70	N	5	N	30	50	<5	N	2,000	100	15	<200	20
MC4A0171	.7	.7	15.00	.070	100	1.0	N	100	70	<1.0	N	50	30	N	7	N	30	20	<5	N	2,000	150	10	<200	10
MC4A0181	1.0	1.0	>20.00	.050	700	1.0	N	70	50	N	N	50	100	N	7	N	50	20	N	N	1,500	100	20	<200	30
MC4A0191	5.0	.7	>20.00	.050	150	2.0	N	100	50	N	N	70	150	N	<5	N	50	30	<5	N	2,000	150	20	200	10
MC4A0200	.7	.7	20.00	.030	500	.5	N	100	30	<1.0	N	70	100	N	5	N	50	10	<5	N	2,000	150	20	300	10
MC4A0211	.5	1.5	>20.00	.020	200	<.5	N	70	100	<1.0	N	50	20	N	<5	N	15	10	<5	N	5,000	50	20	200	10
MC4A0229	10.0	.3	7.00	.050	200	<.5	300	150	30	<1.0	10	50	30	N	5	N	30	10	<5	N	700	50	15	200	<10
MC4A0238	1.0	1.5	>20.00	.070	200	2.0	N	100	30	N	N	70	100	N	7	N	50	15	5	N	1,500	150	20	300	20
MC4A0247	.7	.5	7.00	.070	70	1.0	N	100	70	1.0	N	70	20	N	7	N	50	<10	<5	N	700	100	15	200	20
MC4A0259	3.0	.5	>20.00	.020	1,500	1.0	N	100	20	<1.0	N	50	30	N	5	N	30	<10	5	N	1,000	100	20	200	10
MC4A0269	1.0	.5	>20.00	.030	1,500	<.5	N	70	30	<1.0	N	50	30	N	7	N	20	<10	<5	N	1,500	70	15	N	10
MC4A0278	1.0	1.5	>20.00	.020	200	.5	N	70	50	N	N	50	70	N	5	N	15	10	<5	N	2,000	150	20	200	10
MC4A0288	.7	.7	10.00	.050	100	.5	N	70	50	N	N	50	20	N	7	N	30	<10	<5	N	1,500	100	15	N	10
MC4A0297	.7	1.0	10.00	.050	100	.5	N	150	700	<1.0	N	50	30	N	7	N	30	<10	N	N	1,500	100	15	N	10
MC4A0307	1.0	1.5	>20.00	.030	200	.7	N	70	150	N	N	50	30	N	7	N	20	20	<5	N	2,000	100	20	N	20
MC4A0317	.7	.3	5.00	.050	200	.7	N	50	100	<1.0	N	70	20	N	7	N	50	<10	N	N	1,000	150	15	<200	10
MC4A0327	.7	.3	5.00	.050	70	.7	N	50	100	1.0	N	70	20	N	7	N	50	10	N	N	1,000	100	10	500	15
MC4A0337	.7	.5	20.00	.050	150	.7	N	70	150	1.0	N	50	30	N	7	N	50	10	<5	N	2,000	100	15	<200	20
MC4A0347	.7	1.0	>20.00	.050	200	.5	N	50	100	<1.0	N	70	20	N	5	N	20	<10	5	N	2,000	100	20	500	20
MC4A0356	.7	1.5	15.00	.050	300	.5	N	70	20	1.0	N	50	20	N	<5	N	15	<10	<5	N	1,500	70	15	200	<10
MC4A0366	1.0	2.0	20.00	.070	500	1.5	N	70	<20	<1.0	N	70	20	N	5	N	50	10	<5	N	2,000	150	20	500	15
MC4A0380	.3	1.0	>20.00	.030	500	.5	N	50	100	N	N	15	15	N	5	N	15	10	<5	N	3,000	100	20	<200	20
MC4A0390	1.0	1.0	20.00	.070	500	1.0	N	150	150	1.0	N	20	100	N	30	N	70	20	5	N	1,000	300	20	<200	100
MC4A0401	.5	.5	20.00	.050	200	.7	N	100	100	N	N	20	30	N	20	N	50	<10	<5	N	1,000	200	15	<200	20
MC4A0411	1.0	1.0	10.00	.100	200	.5	N	500	300	1.0	N	15	20	N	7	N	20	20	7	N	1,000	150	20	<200	100
MC4A0421	1.0	1.0	15.00	.100	150	.5	N	500	200	1.0	5	20	50	N	15	N	50	15	5	N	1,000	100	20	300	100
MC4A0430	2.0	1.0	20.00	.100	200	.7	N	500	150	1.0	10	20	30	N	10	N	70	20	5	N	1,000	150	20	200	50
MC4A0441	1.0	1.5	>20.00	.070	300	.5	N	200	100	N	N	20	15	N	10	N	20	10	<5	N	2,000	100	20	200	30
MC4A0450	10.0	1.0	7.00	.150	150	2.0	N	500	200	1.0	15	30	150	N	20	N	150	50	7	N	1,000	150	15	700	30
MC4A0461	1.5	1.0	15.00	.070	200	.5	N	500	150	1.0	5	20	30	N	10	N	30	20	5	N	1,000	100	20	<200	30
MC4A0471	3.0	2.0	10.00	.150	300	<.5	N	700	200	1.0	15	70	30	N	7	N	50	15	10	N	1,000	200	20	200	30
MC4A0482	3.0	2.0	7.00	.150	200	1.0	N	700	200	1.0	20	70	50	N	10	N	70	50	10	N	500	150	20	1,000	50
MC4A0492	2.0	2.0	15.00	.100	200	1.0	N	1,000	200	1.0	10	100	20	N	5	N	30	20	10	N	1,000	150	15	500	50
MC4A0501	3.0	2.0	20.00	.100	200	1.0	N	500	200	1.0	7	50	30	N	10	N	50	20	7	N	1,000	100	15	300	20
MC4A0511	1.5	1.5	7.00	.100	50	1.5	N	500	200	<1.0	N	100	100	N	10	N	50	15	7	N	700	300	20	300	20
MC4A0520	1.5	1.0	20.00	.050	50	1.5	N	200	70	N	<5	50	50	N	20	N	50	20	<5	N	1,500	150	15	700	20
MC4A0530	1.0	1.5	5.00	.100	50	1.0	N	200	100	<1.0	N	70	150	N	10	N	50	10	<5	N	500	200	10	<200	30
MC4A0539	1.0	2.0	20.00	.100	50	1.0	N	200	70	N	N	100	50	N	15	N	50	10	5	N	1,000	200	20	N	30
MC4A0549	2.0	1.5	>20.00	.030	100	1.0	N	100	50	N	N	50	20	N	5	N	20	20	<5	N	1,500	100	15	N	20
MC4A0559	1.5	1.5	5.00	.070	50	1.5	N	200	100	<1.0	N	100	150	N	10	N	50	10	5	N	500	300	10	200	30
MC4A0568	1.5	1.5	>20.00	.070	70	1.5	N	100	70	N	N	70	50	N	10	N	30	100	5	N	1,000	200	20	700	30
MC4A0576	1.0	1.0	10.00	.050	100	1.0	N	150	50	<1.0	N	50	50	N	10	N	50	10	<5	N	700	150	15	1,000	<10

Table 7.--Analyses of rock samples from Mill Creek No. 5 drill hole, NESENE Sec. 12, T. 4 S., R. 26 W., Montgomery County, Arkansas.
(Hole was drilled 30 degrees from vertical on an azimuth of 020 degrees and core was obtained from 70 feet to total depth of 535 feet.)
Contact between Bigfork Chert and Womble Shale at a depth of less than 70 feet.

[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown. Values are given in parts per million (micrograms/gram), except Fe, Mg, Ca, and Ti, which are given in weight percent.]

Sample	Fe	Mg	Ca	Ti	Mn	Ag	As	B	Ba	Be	Co	Cr	Cu	La	Mo	Nb	Ni	Pb	Sc	Sn	Sr	V	Y	Zn	Zr
MC50082	1.0	.7	15.00	.070	70	1.5	N	70	100	<1.0	N	100	70	N	10	N	50	10	5	N	3,000	200	20	500	20
MC50090	1.0	.7	15.00	.050	50	.5	N	50	100	N	N	100	30	N	10	N	50	10	<5	N	2,000	200	15	N	20
MC50098	.7	1.5	>20.00	.020	100	.5	N	50	100	N	N	20	20	N	5	N	10	10	N	N	5,000	50	15	N	20
MC50104	1.0	2.0	20.00	.070	100	.7	N	100	100	N	N	50	50	N	5	N	30	10	5	N	3,000	150	20	N	20
MC50113	.5	1.5	20.00	.015	100	.5	N	30	50	N	N	15	15	N	<5	N	10	<10	N	N	2,000	100	10	N	N
MC50123	1.0	1.0	10.00	.050	50	1.0	N	50	100	<1.0	N	50	50	N	10	N	50	10	<5	N	1,500	100	15	200	20
MC50132	.7	1.0	10.00	.050	70	.5	N	50	100	<1.0	N	70	50	N	15	N	20	<10	<5	N	1,500	100	15	N	10
MC50141	1.5	1.5	>20.00	.050	150	2.0	N	50	200	N	N	50	50	N	20	N	50	15	<5	N	>5,000	150	15	500	30
MC50151	1.0	1.0	>20.00	.070	150	1.5	N	100	500	N	N	70	50	N	20	N	30	10	<5	N	2,000	200	20	200	30
MC50160	.7	1.0	10.00	.050	100	1.0	N	100	300	1.0	N	100	30	N	15	N	50	<10	<5	N	2,000	100	20	<200	30
MC50170	1.0	1.0	>20.00	.050	200	1.5	N	70	200	N	N	70	50	N	10	N	30	<10	<5	N	2,000	100	15	N	30
MC50179	1.0	1.5	20.00	.050	300	1.5	N	100	100	1.0	N	100	100	N	10	N	50	10	<5	N	1,500	150	15	500	20
MC50188	1.0	1.5	20.00	.070	300	1.5	N	100	100	1.0	N	100	100	N	10	N	50	10	5	N	3,000	100	20	<200	30
MC50197	1.0	1.0	>20.00	.050	500	1.5	N	70	30	N	N	100	100	N	10	N	30	10	<5	20	2,000	200	20	200	20
MC50207	1.0	.7	1.50	.070	70	2.0	N	100	100	1.0	10	70	200	N	50	N	100	<10	N	N	500	700	10	1,500	50
MC50217	5.0	1.0	.70	.150	50	5.0	N	1,000	200	2.0	5	50	150	N	15	<20	70	50	5	10	500	100	15	500	200
MC50226	.7	3.0	>20.00	.030	500	1.5	N	50	50	N	N	30	50	N	7	N	15	10	<5	N	2,000	100	15	N	10
MC50235	1.0	1.0	20.00	.050	500	1.5	N	100	150	<1.0	N	50	150	N	20	N	50	<10	<5	N	2,000	200	20	300	20
MC50245	1.5	1.5	>20.00	.100	700	2.0	N	100	300	1.5	N	50	30	N	15	N	30	20	5	N	2,000	200	20	300	50
MC50254	.7	1.5	>20.00	.030	700	1.0	N	100	100	N	N	30	30	N	10	N	20	20	<5	N	3,000	150	20	<200	10
MC50263	.7	1.0	>20.00	.020	700	1.0	N	100	100	N	N	15	20	N	5	N	15	10	<5	N	3,000	150	10	<200	<10
MC50272	1.0	1.5	>20.00	.050	500	1.0	N	100	100	<1.0	N	20	30	N	10	N	20	10	N	N	1,500	200	15	<200	30
MC50284	1.0	1.0	20.00	.050	500	1.0	N	100	70	<1.0	N	20	15	N	5	N	15	15	N	N	1,500	100	20	200	30
MC50293	1.0	1.5	15.00	.070	500	1.5	N	100	100	N	<5	50	100	70	20	N	30	10	5	N	1,500	300	15	300	20
MC50303	1.0	1.0	20.00	.150	300	2.0	N	500	500	1.5	N	15	50	N	15	<20	30	30	7	N	1,000	150	20	700	150
MC50312	1.0	1.0	15.00	.050	500	2.0	N	100	70	N	N	30	30	N	7	N	30	10	<5	N	2,000	300	20	1,500	50
MC50323	1.0	.7	>20.00	.030	1,000	.7	N	100	30	N	N	20	30	N	5	N	15	<10	N	N	2,000	100	10	500	20
MC50332	1.0	1.0	>20.00	.050	700	1.5	N	100	100	N	N	50	30	N	10	N	30	10	N	N	2,000	200	20	500	20
MC50341	.7	.5	15.00	.030	500	.7	N	100	70	1.0	N	15	15	20	5	N	15	10	N	N	1,500	150	10	200	20
MC50346	1.0	.5	7.00	.070	200	1.5	N	200	200	1.0	N	70	50	30	15	N	50	10	N	N	1,000	300	20	300	50
MC50360	1.5	.7	>20.00	.070	500	2.0	N	100	100	N	N	30	30	N	15	N	50	15	5	N	2,000	500	20	700	50
MC50361	.7	.5	20.00	.050	300	1.5	N	100	100	N	N	20	30	N	15	N	30	10	<5	N	1,500	200	10	500	10
MC50370	1.5	2.0	7.00	.070	300	1.5	N	150	100	N	<5	30	50	20	10	N	30	10	<5	N	1,000	300	15	1,000	20
MC50380	1.5	1.5	>20.00	.070	500	1.0	N	200	150	<1.0	N	10	20	N	<5	N	10	15	<5	N	2,000	50	15	500	50
MC50389	.7	1.5	>20.00	.050	300	.5	N	150	100	1.0	N	15	15	N	7	N	20	10	N	N	2,000	100	15	N	50
MC50398	1.0	1.5	>20.00	.070	500	1.0	N	200	100	1.0	N	20	50	N	10	N	30	10	N	N	2,000	200	15	500	50
MC50407	1.0	2.0	20.00	.100	300	1.0	N	300	150	1.0	7	30	20	N	10	N	30	15	5	N	2,000	300	20	N	70
MC50417	3.0	2.0	20.00	.200	300	2.0	N	1,000	500	1.0	15	20	150	30	20	N	100	50	5	N	1,500	200	20	1,000	150
MC50426	5.0	2.0	15.00	.070	300	.5	N	150	100	N	N	20	100	N	5	N	30	15	<5	N	1,500	300	20	200	50
MC50436	3.0	1.0	20.00	.050	200	1.5	N	500	200	1.0	N	<10	100	20	<5	N	10	70	5	N	1,500	50	20	<200	50
MC50445	1.0	1.5	>20.00	.100	300	1.0	N	300	150	1.0	N	15	30	N	7	N	20	15	<5	N	2,000	150	20	300	100
MC50455	1.0	2.0	>20.00	.070	500	1.0	N	200	150	<1.0	N	15	20	N	5	N	20	20	<5	N	3,000	100	20	500	50
MC50464	1.0	2.0	>20.00	.070	500	1.0	N	150	100	N	N	20	20	N	5	N	20	10	<5	N	2,000	300	20	700	50
MC50474	1.0	1.5	5.00	.200	100	1.5	N	1,000	300	2.0	10	50	50	70	20	<20	50	15	7	N	500	300	20	200	200
MC50483	1.5	1.5	3.00	.300	70	1.5	N	1,000	700	2.0	15	20	50	100	20	20	100	30	7	N	500	300	20	1,000	300
MC50492	3.0	1.5	10.00	.100	200	.7	N	500	200	<1.0	7	30	100	N	20	<20	50	15	<5	N	700	300	15	700	50
MC50501	2.0	2.0	20.00	.150	300	.7	N	500	200	1.0	5	50	200	N	20	N	50	10	5	N	1,500	500	15	700	70
MC50511	10.0	1.5	>20.00	.200	300	2.0	N	700	2,000	1.0	10	15	150	150	15	N	70	70	<5	N	2,000	100	20	N	100
MC50521	7.0	2.0	>20.00	.150	500	1.5	N	1,000	150	1.0	7	20	100	N	15	N	70	50	5	N	2,000	100	20	<200	100
MC50530	2.0	1.5	>20.00	.070	500	<.5	N	700	100	1.0	<5	20	20	N	15	N	50	15	<5	N	3,000	150	15	N	30
MC50535	2.0	2.0	>20.00	.100	300	<.5	N	500	200	1.0	5	70	15	30	10	N	50	15	5	N	2,000	150	15	<200	30
MC50477	15.0	1.0	10.00	.070	200	3.0	<200	500	150	1.0	7	15	300	N	7	N	100	150	N	N	1,500	100	15	700	30