U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

GEOCHEMICAL DATA OF DRILL CORE SAMPLES OF CARBONATITES AND ASSOCIATED IGNEOUS ROCKS, BENTON, ARKANSAS

by

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Open-File Report 94-450

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1994

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Introduction

Representative samples of carbonatite and associated igneous rocks were obtained from six drill cores that were drilled near Benton, Arkansas by Molycorp, Inc. and Alpha Minerals Co. as part of their mineral exploration programs. The cores, copies of the companies' well logs, and a map that shows the location of the drill holes are curated by the Arkansas Geological Commission, Little Rock, Arkansas. This report contains major-, minor-, and trace-element geochemical data of 44 of the core samples. A brief discussion of the regional geology and short descriptions of the rock types sampled are included. Drill core samples other than those for which geochemical data were obtained were also collected, but these samples are not discussed here. Core samples were obtained as part of a study of the alkaline igneous intrusions and their associated mineralization in the Southern Midcontinent of the United States, with emphasis on the intrusions located in Arkansas. Due to a change in assignment of the first author, detailed study of the cores has been deferred.

Geological Setting and Previous Work

There are numerous occurrences of alkaline igneous rocks and carbonatites in Arkansas that are part of two trends (Fig. 1). The first trend is a northeast-to-southwest direction that extends from the area of the Pascola Arch to the Prairie Creek lamproite. A second trend of intrusions extends from a large intrusion, informally referred to as the Little Rock complex herein, in central Arkansas to the Monroe Uplift and the Jackson Dome, Mississippi on the southeast. Morris (1987) provided a summary of the petrology and mineralogy of many of the alkaline igneous occurrences in Arkansas that are found in outcrop. Numerous large intrusions have been identified by gravity data (Hendricks, 1988 and references therein) and magnetic data (e.g., Hildenbrand, 1985) along the two trends, but whether these intrusions are composed of alkaline igneous rocks is not known. Fission-track geochronology (Eby, 1987) indicated that alkaline magmatism in the region is Cretaceous in age, consistent with radiometric determinations (see Eby, 1987, and Morris, 1987, for summaries of geochronological data).

The carbonatites and associated rocks that are the subject of this report are part of the Little Rock complex, a partly buried body that is at the intersection of the two trends discussed above (Fig. 1). Outcrop exposures within the area of the Little Rock complex are primarily of syenite and lamprophyre dikes (Morris, 1987). Two poorly exposed breccia pipes are also found near the town of Benton. Peterson (1972) examined the mineralogy and chemistry of breccias from one of these pipes, which is located about 1.6 km northwest of Benton. Peterson also studied lamprophyre dikes and porphyritic trachyte dikes that are associated with this breccia pipe. The second breccia pipe is located about 3.2 km west of Benton. The cores sampled as part of this study were drilled in an area located about 10 km to the southeast of the breccia pipe studied by Peterson (1972).

Location of Drill Holes

A total of seven cores drilled by Alpha Minerals Co. of Houston, Texas in 1963 were available for examination at the Arkansas Geological Commission's Well and Core Storage Library. The location of the four holes sampled for this project were reported as follows. Hole EP1-1 was located 1675′ north and 270′ east of the southwest corner of Sec. 29, T2S, R14W, at an estimated elevation of 378′. Hole EP1-2 was located 1700′

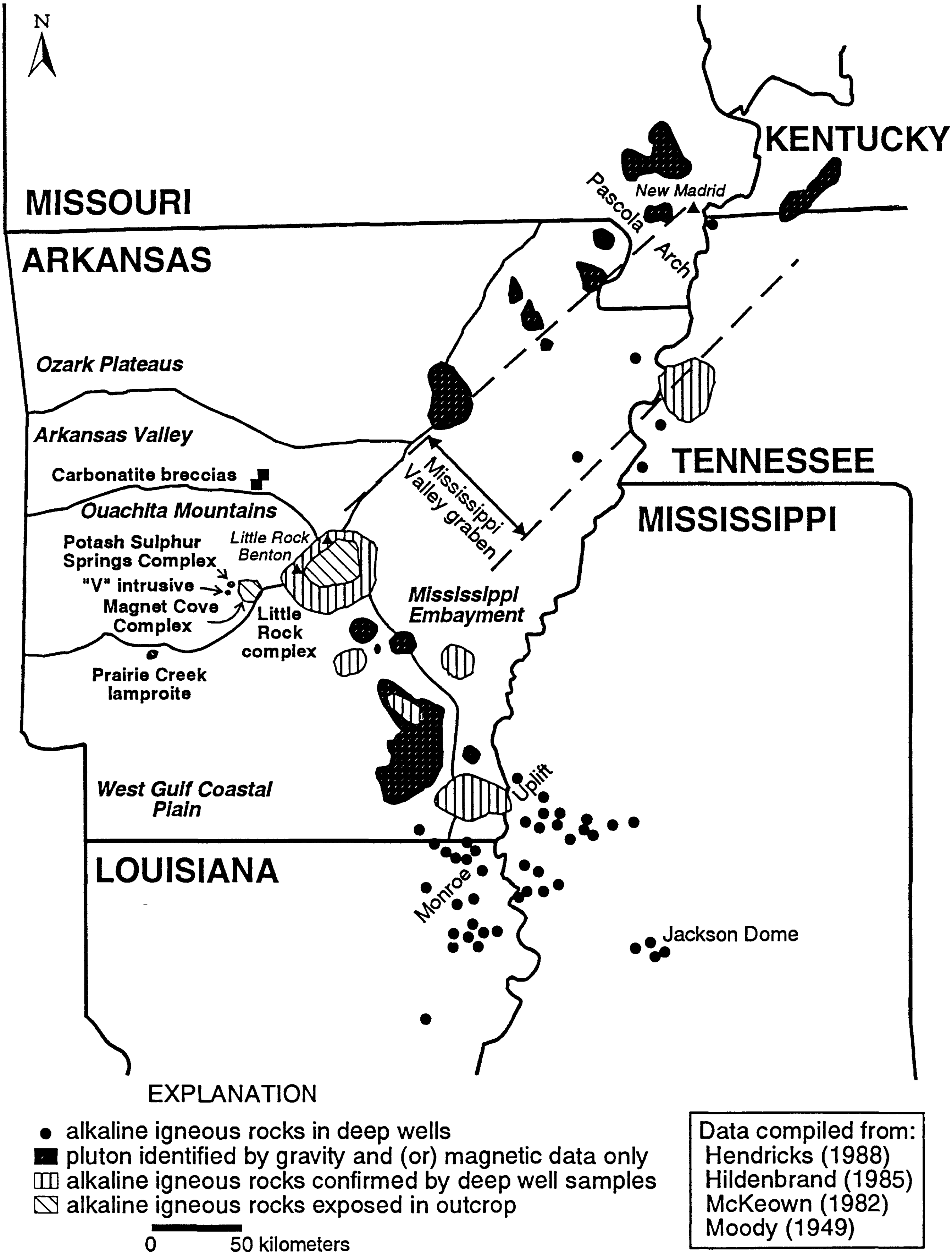

Figure 1. Simplified map of part of the Southern Midcontinent that shows the location of igneous rocks and inferred igneous rocks. See text for details.

north and 85' east of the southwest corner of Sec. 29, T2S, R14W, at an elevation of 389'. Hole EP1-3 was located 1630' north and 385' east of the southwest corner of Sec. 29, T2S, R14W, at an estimated elevation of 378'. Hole EP1-4 was located 1680' north and 125' west of the southeast corner of Sec. 30, T2S, R14W, at an elevation of 395'. The total depths of the holes, EP1-1, -2, -3, and -4, were 680', 778.3', 653.6', and 970', respectively. All drill holes were located in Saline County.

Molycorp, Inc. of Englewood, Colorado drilled holes B7 and B8 in Saline County in 1985. Hole B7 was drilled near the center of the NW¼, SE¼ of Sec. 30, T2S, R14W. Hole B8 was drilled near the NW corner of the NE¼, NE¼, SW¼, Sec. 20, T2S, R14W. Holes B7 and B8 were started at elevations of approximately 425' and 385', respectively. Elevations were not noted on the log sheets, but were estimated from a USGS 7½ minute topographic base (Benton quadrangle). The total depths for holes B7 and B8 were 1377' and 1500', respectively.

The igneous rocks encountered in the drill holes do not crop out at the surface but are covered by Tertiary sedimentary rocks, as identified in the Molycorp well logs. Details of the sedimentary stratigraphy in the area of the Benton breccia pipes were presented by Gordon and others (1958) and Peterson (1972).

Analytical Methods

Samples were prepared for analysis using standard procedures (Arbogast, 1990) by USGS personnel. Outer surfaces of drill core samples were removed before the samples were submitted for preparation to ensure that no contamination by the drill core was present.

All analytical work was performed by USGS personnel. The following methods were used for the analyses reported in Table 1. Where a given element was determined by more than one method, all values are reported without attempting to evaluate the superiority of one method over another method. Si, Ti, Al, total Fe, Mn, Mg, Ca, Na, K, and P were analyzed by wavelength-dispersive X-ray fluorescence spectrometry (WDXRF; Taggart and others, 1987) by J. S. Mee and D. F. Siems and are reported as weight percent of the oxides. Ferrous iron, reported as FeO, was determined by H. Smith who used the colorimetric titration method of Peck (1964). Ferric iron, reported as Fe_2O_3, was calculated from the total iron as obtained by WDXRF and the measured ferrous iron. F^- and Cl^- were determined by selective ion electrode by C.J. Skeen and J.R. Gillison-Colbert using the methods of Kirschenbaum (1988) and Aruscavage and Campbell (1983), respectively. Total S was analyzed by first combusting the sample in a sulfur analyzer and then measuring the evolved sulfur dioxide by an infrared (IR) detector (Kirschenbaum, 1983; analyst: C.J. Skeen). CO_2 was measured by first digesting the sample with $HClO_4$, a process during which CO_2 is evolved and carried into a coulometric cell. The CO_2 was then converted into a strong acid by ethanolamine and is titrated coulometrically (Engleman and others, 1985; analyst: H. Smith). H_2O^-, or nonessential water, is determined by weighing the sample before and after drying it for one hour at 100°C (Shapiro, 1975; analyst: H. Smith). Total water was determined by H. Smith who used the method of Jackson and others (1987): the sample was mixed with a flux, heated to 950°C, and the evolved water was determined coulometrically by Karl-Fischer titration. H_2O^+, or bound water, is the difference between the total water and H_2O^-. Loss on ignition (LOI) is determined as part of the WDXRF analytical work-up and is determined by weighing the sample before and after heating at 925°C for 45 minutes. A large number of elements were determined by instrumental neutron activation analysis (Baedecker and

McKown, 1987) by G. Wandless and J.N. Grossman. Additional important trace elements were analyzed using inductively coupled plasma-atomic emission spectrometry (ICP-AES; Lichte and others, 1987) by M. W. Doughten or by energy-dispersive X-ray fluorescence spectrometry (EDXRF; Johnson, 1984; Johnson and King, 1987) by J. Kent.

Partial chemical analyses of three additional samples were obtained (Table 2). Many of the elements reported in Table 2 were obtained using the same methods as reported in Table 1. In addition to the analysts cited above, D.L. Fey obtained the ICP-AES data reported in Table 2.

Sums reported in Table 1 are low for several samples. High concentrations of one or more elements that usually occur in trace amounts in most igneous rocks (i.e., Ba, Mo, Sr, rare earth elements [REE]) occur in these samples and account for a large part of the deficiencies in the reported sums. High concentrations of the aforementioned elements are not unusual in carbonatites and alkaline igneous rocks (Woolley and Kempe, 1989; Rock, 1991) and may reflect high concentrations of these elements in the source region(s) of the parent magmas.

Compositions of minerals in several of the samples included in this report were obtained by the first author using a JEOL 8900 electron microprobe in the USGS, Reston electron microprobe laboratory. Compositional data are summarized in the discussion, below, as appropriate. Mineral end member compositions were calculated from cation values as follows. For olivine, the forsterite component (Fo) is defined as Mg/(Mg+Fe). For pyroxene, the method of Morimoto (1988) was used, with the wollastonite component (Wo) defined as $Ca/(Ca+Mg+\Sigma Fe)$, the enstatite component (En) defined as $Mg/(Ca+Mg+\Sigma Fe)$, and the ferrosilite component (Fs) defined as $\Sigma Fe/(Ca+Mg+\Sigma Fe)$, where $\Sigma Fe = Fe^{2+} + Fe^{3+} + Mn$. Minerals were also identified with the petrographic microscope and by X-ray powder diffraction.

Rock Types

The rock types analyzed include carbonatite, carbonatite-pyroxenite breccias, pyroxenite, lamprophyre, serpentinized olivine-bearing pyroxenite/peridotite, relatively felsic rocks that are partly altered, and highly altered, clay-rich rocks that were probably altered from one or more of the mafic lithologies. Pale green to apple green veins of serpentine cut serpentinized pyroxenite/peridotite in core MCB7. Partial chemical analyses of two such veins are reported in Table 2. Brief descriptions of the rock types and mineral compositional data, where available, are given below.

Carbonatites and carbonatite-pyroxenite breccias. Carbonatites have a range of compositions that reflect the presence of a variety of accessory minerals. Carbonatites are ordered (Table 1) from low to high SiO_2 contents, which is indicative of the increasing abundance of accessory silicate minerals. Accessory silicate minerals include Mn-bearing olivine (Fo_{96}-Fo_{98}) and phlogopite. Sparse electron microprobe data indicate that phlogopite in calcite carbonatite is low in Ti (<1 wt% TiO_2) and contains ~9-12 wt% Al_2O_3. Calcite carbonatite appears to be the most common carbonatite present in the Benton drill cores examined and may contain accessory ankerite or magnesian calcite. Accessory minerals in carbonatites include magnetite, Mn-bearing ilmenite, fluorapatite, pyrite, pyrrhotite, and chalcopyrite. Molybdenite, barite, and quartz occur in magnesian carbonatites EP1-2-675.5 and EP1-2-685. Fluorite is a major constituent of carbonatite EP1-2-794.3 (Table 2).

Extensive brecciation was noted in the Molycorp well logs. The breccia zones consist of partly altered clasts of pyroxenite in carbonatite. Sodic amphibole is commonly developed at the contacts between carbonatite and pyroxenite clasts. The amphibole, Ti- and Al-bearing phlogopite, and diopside replace pyroxene in the clasts. Other reaction zones (e.g., EP1-3-632.5B) contain abundant red (in hand sample) mica and no amphibole. Preliminary evaluation of the data suggests that sodic amphibole + phlogopite reaction zones developed at the contacts between Ca-rich carbonatites and pyroxenite, whereas mica-rich reaction zones developed at the contacts between more Mg-rich carbonatites (e.g., EP1-3-632.5A) and pyroxenite. This observation further suggests that sodic + potassic alteration is associated with the more Ca-rich carbonatites and that potassic alteration alone may be restricted to more Mg-rich (more evolved?) carbonatites. Additional study is required to determine whether these observations may be generalized for all carbonatites in the Benton region.

Pyroxenite. Pyroxenite consists of coarse to medium grained clinopyroxene with accessory titaniferous magnetite. Pyroxene is diopsidic and contains significant concentrations of Ti (~2-4 wt% TiO_2) and Al (~5-9 wt% Al_2O_3). Ti concentrations are positively correlated with Al concentrations and with the En component; Cr was not detected in pyroxene by electron microprobe analysis. Interstitial mineral assemblages consist of calcite + amphibole ± titanite ± apatite ± phlogopite and are observed in some samples. Amphibole compositions cluster in the magnesio-hastingsite to pargasite fields with edenite and richterite being less common. Amphibole in pyroxenite is distinct in composition from the sodic amphibole found in carbonatite-pyroxenite breccias. Phlogopite is intergrown with pyroxene and (or) marginally replaces pyroxene in some pyroxenite samples and appears to be more common in the coarser-grained variety of pyroxenite. Phlogopite in the interstitial assemblages is less Al- and Ti-rich than phlogopite that is intergrown with or that replaces pyroxene and which contains ~16-17 wt% Al_2O_3 and ~3-5 wt% TiO_2. Several mica pyroxenite samples contain unusual phlogopite in which individual grains, which are optically continuous, contain laminations of microcrystalline quartz. Brecciated pyroxenite MCB7-1319 contains clasts of quartz that appear pale blue in hand sample. Petrographic examination showed that the quartz contains abundant inclusions of blue sodic amphibole. Veinlets that cut pyroxenite contain calcite or calcite + albite + a TiO_2 polymorph.

Serpentinized pyroxenite/peridotite. Olivine (Fo_{86}-Fo_{90}), Ti- and Al-bearing clinopyroxene, Ti-bearing magnetite, and perovskite are relict phases in MCB7-1194. The Ti- and Al-bearing pyroxene is compositionally similar to the pyroxene, described above, that occurs in pyroxenite. Diopside (~$Wo_{49}En_{48}Fs_3$) is intergrown with Ti- and Ba-bearing phlogopite and these two minerals are late crystallizing phases. The extensive serpentinization present in both MCB7-1194 and MCB7-893 makes it difficult to determine the original pyroxene/olivine ratio and to assign the correct rock name.

Lamprophyre dikes. Four lamprophyre dike samples (MCB8-786, MCB8-775, MCB7-1362, EP1-4-650.5) were analyzed. Trace-element concentrations indicate that the dikes belong to the alkaline lamprophyre group of Rock (1991). Only limited petrographic and electron microprobe work have been completed on two of the dikes, MCB8-775 and EP1-4-650.5. Dike EP1-4-650.5 contains phenocrysts of kaersutite and aluminous diopsidic clinopyroxene found within a groundmass of albite and calcite; titaniferous magnetite, pyrite, and chalcopyrite are accessory phases. Dike MCB8-775 contains phenocrysts of Ti-rich phlogopite, magnesio-hastingsite, and aluminous diopsidic clinopyroxene. Albite and titaniferous magnetite are accessory minerals.

Felsic rocks. Rocks identified as microsyenite dikes (MCB8-873.5, MCB8-880, MCB8-1324) in the Molycorp well logs and as white or gray altered aphanitic or phonolitic dikes (EP1-4-966, EP1-4-962.5, EP1-4-766) in the Alpha Minerals well logs are simply classified herein as felsic rocks. No additional data have been collected. All six samples are at least partly altered, with phenocrysts (presumably originally feldspar) now altered to clay. The felsic rocks sampled in core MCB8 are more mafic than those sampled by Alpha Minerals and relative trace element abundances, including the REE, are similar to those observed in the lamprophyre dikes, which suggests a possible genetic relationship.

Altered rocks. Five samples of altered rock were analyzed. Sample EP1-4-903.5 is a brecciated rock that has been extensively replaced and veined by a finely disseminated red-purple Fe-oxide (hematite?), ankerite, calcite, and quartz. Compositions of relict clinopyroxene and phlogopite suggest that the rock was originally pyroxenite. The mineralogy of the replacement assemblage suggests that it is a ferrocarbonatite. The four other analyzed altered rocks (Table 1) are clay rich (smectite group clays) and contain relict phlogopite, calcite, ankerite, pyrite, and quartz.

Acknowledgements

The assistance of Mr. Jack D. Stephenson and Mr. Benjamin F. Clardy, recently retired, (Arkansas Geological Commission) in locating specific cores and supplying supporting documents during the first author's visit to Little Rock is gratefully acknowledged.

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Table 1. Geochemical data of drill core samples, Benton, Arkansas

[Sample - MCB7, MCB8 Molycorp drill core numbers, EP1-1, EP1-2, EP1-3, EP1-4 Alpha Minerals drill core numbers, number following core number is depth in feet; Lab No. - USGS laboratory sample number; pct - percent; WDXRF - wavelength-dispersive X-ray fluorescence spectrometry; col. titra. colorimetric titration; SIE - selective ion electrode; comb./IR - combustion/IR spectroscopy; coul. titra. - coulometric titration; diff. - by difference (methods for obtaining H_2O^+ and H_2O^- are given in the text); calc. - calculated; INAA - instrumental neutron activation analysis; LOI - loss on ignition; 925°C - LOI determined after heating sample to 925°C; EDXRF - energy-dispersive X-ray fluorescence; ICP-AES - inductively coupled plasma-atomic emission spectrometry; nd - not determined due to interference; ppm - parts per million; ppb - parts per billion; -- - not analyzed; cbt - carbonatite; pxnt - pyroxenite; bx - breccia; rx - reaction; serp - serpentinized; prd - peridotite; qtz - quartz]

		Sample	MCB7-1032.5	MCB8-1217	MCB8-793	EP1-4-945.5	MCB8-1173.5	EP1-3-632.5A	EP1-2-675.5
		Lab No.	W256913	W256888	W256886	W256914	W256887	W256881	W256885
		Rock type	Carbonatite	Carbonatite	Carbonatite	Carbonatite	Carbonatite	Carbonatite	Carbonatite
SiO_2	pct	WDXRF	0.86	1.00	1.96	2.29	2.98	5.73	7.80
TiO_2	pct	WDXRF	<0.02	0.07	0.02	<0.02	0.24	0.09	0.14
Al_2O_3	pct	WDXRF	<0.10	<0.10	0.12	0.27	0.86	0.28	0.16
Fe_2O_3	pct	calc.	0.76	0.76	0.94	0.30	1.3	2.4	0.10
FeO	pct	col. titra.	1.4	0.96	0.96	3.7	0.84	1.8	3.7
MnO	pct	WDXRF	0.55	0.43	0.75	0.80	0.54	1.02	0.85
MgO	pct	WDXRF	3.82	2.65	4.40	17.5	3.52	14.5	10.5
CaO	pct	WDXRF	47.9	48.4	46.1	29.2	44.8	31.9	16.8
Na_2O	pct	WDXRF	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
K_2O	pct	WDXRF	<0.02	0.08	0.02	0.04	0.56	0.08	0.04
P_2O_5	pct	WDXRF	<0.05	0.13	0.19	0.65	3.23	0.13	2.52
F^-	pct	SIE	0.022	0.20	0.16	0.11	0.26	8.0	0.26
Cl^-	pct	SIE	0.084	0.032	0.018	0.021	0.013	0.008	0.012
Total S	pct	comb./IR	0.29	0.59	0.65	0.013	0.78	1.9	3.2
CO_2	pct	coul. titra.	42.1	41.2	42.1	43.7	36.4	35.4	29.3
H_2O^+	pct	diff.	0.32	<0.01	0.13	<0.01	0.24	<0.01	0.05
H_2O^-	pct	diff.	0.54	0.32	0.10	0.64	0.11	0.25	0.17
-F≡oxy	pct	calc.	0.009	0.084	0.067	0.046	0.109	3.37	0.11
-Cl≡oxy	pct	calc.	0.019	0.007	0.004	0.005	0.003	0.002	0.003
-S≡oxy	pct	calc.	0.15	0.30	0.33	0.01	0.39	0.95	1.6
Sum	pct	calc.	98.5	96.4	98.2	99.2	96.2	99.2	73.9
LOI	pct	925°C	41.5	40.1	40.3	43.6	34.3	32.6	26.4
Na	pct	INAA	0.083	0.167	0.084	0.081	0.103	0.071	<8
K	pct	INAA	<2	<2	<4	<0.2	<5	<0.3	--
Ca	pct	INAA	33.6	35.8	32.8	21.6	35.1	21.6	<11
Fe	pct	INAA	1.94	1.38	1.41	3.33	1.60	3.16	4.04
V	ppm	ICP-AES	<10	21	<10	28	23	32	77
Li	ppm	ICP-AES	<5	7.7	<5	<5	<5	<5	8.6
Ba	ppm	EDXRF	880	720	1500	116	2200	410	>5000

Table 1. Geochemical data of drill core samples, Benton, Arkansas - Continued

Element	Unit	Sample	MCB7-1032.5	MCB8-1217	MCB8-793	EP1-4-945.5	MCB8-1173.5	EP1-3-632.5A	EP1-2-675.5
Cu	ppm	EDXRF	18	19	10	<10	20	81	16
Ni	ppm	EDXRF	47	<10	<10	25	12	14	18
Zn	ppm	EDXRF	<10	12	68	43	14	22	73
Sc	ppm	INAA	10.60	16.3	10.33	20.0	15.46	14.09	43.5
Cr	ppm	INAA	<3	<4	5.9	2.4	11.4	3.9	22.6
Co	ppm	INAA	33.6	6.58	5.27	16.0	12.96	30.3	9.71
Ni	ppm	INAA	73	15	<23	19	<31	26	<50
Zn	ppm	INAA	10.2	6.0	97	37.0	15	26	75
As	ppm	INAA	<2	4.7	<2	1.13	4.8	50.4	<80
Se	ppm	INAA	<0.4	<0.8	<0.4	<0.4	<0.9	1.2	1.4
Rb	ppm	INAA	<5	<4	<4	<4	16.4	<4	<12
Sr	ppm	INAA	8118	10121	4784	4782	12806	4848	6378
Zr	ppm	INAA	<50	67	61	<100	254	<80	<220
Mo	ppm	INAA	<6	<12	<7	5.6	17	<6	251
Sb	ppm	INAA	0.15	0.74	0.19	0.16	1.21	30.5	2.15
Cs	ppm	INAA	<0.09	<0.4	<0.08	0.10	0.35	<0.08	<0.3
Ba	ppm	INAA	906	783	1576	149	2414	440	87386
La	ppm	INAA	512	461	692	81.2	974	153	19435
Ce	ppm	INAA	739	751	979	149.1	1605	253	16650
Nd	ppm	INAA	233	249	285	56.7	478	86	2185
Sm	ppm	INAA	33.8	47.9	45.7	10.82	66.0	13.9	133
Eu	ppm	INAA	7.63	12.44	11.03	3.82	16.3	3.45	22.1
Tb	ppm	INAA	2.61	3.58	3.19	2.67	4.92	1.17	3.39
Yb	ppm	INAA	6.42	8.01	8.06	3.15	10.0	2.68	4.5
Lu	ppm	INAA	0.876	1.09	1.09	0.368	1.28	0.348	0.40
Hf	ppm	INAA	<0.09	0.59	0.11	0.127	2.21	<0.08	1.57
Ta	ppm	INAA	<0.2	6.57	0.084	0.078	28.5	0.122	0.54
Th	ppm	INAA	0.26	55.9	71.1	55.9	45.3	20.0	25.3
U	ppm	INAA	<1	3.53	<1	0.85	18.1	0.55	14
Au	ppb	INAA	<14	16	<14	<7	<30	15	<140

Element	Unit	Lab No.	W258884	W258859	W258857	W258885	W258858	W258852	W258856
Y	ppm	ICP-AES	50	70	52	41	86	22	38
Sr	ppm	ICP-AES	8200	10000	4600	4700	10000	3700	5800
Zr	ppm	ICP-AES	<1.0	18	12	5.3	40	<1.0	61
Ba	ppm	ICP-AES	1300	960	1900	120	2300	440	92000
Mo	ppm	ICP-AES	3.0	2.7	1.5	4.8	1.5	1.4	358
Nb	ppm	ICP-AES	<1.0	2400	9.2	8.7	2220	40	238

Table 1. Geochemical data of drill core samples, Benton, Arkansas - Continued

		Sample	MCB8-1489	EP1-2-685	MC-B7-796	EP1-3-632.5B	EP1-2-768.5	MCB7-1276B	MCB7-1329
		Lab No.	W256892	W256890	W256884	W256882	W256889	W256903	W256897
		Rock type	Carbonatite	Carbonatite	Cbt-pxnt bx	Rx zone	Cbt-pxnt bx	Cbt-pxnt bx	Mica pyroxenite
SiO_2	pct	WDXRF	8.77	9.93	22.4	24.2	25.9	25.6	30.6
TiO_2	pct	WDXRF	0.16	0.03	0.07	3.06	3.93	0.54	3.44
Al_2O_3	pct	WDXRF	0.26	0.37	0.61	5.59	6.06	6.95	7.47
Fe_2O_3	pct	calc.	14	1.5	1.4	4.6	10	1.9	5.1
FeO	pct	col. titra	3.9	2.9	0.8	4.4	2.7	1.6	3.9
MnO	pct	WDXRF	0.65	1.17	0.37	0.65	0.27	0.27	0.18
MgO	pct	WDXRF	5.68	13.7	8.54	16.3	8.62	20.5	12.9
CaO	pct	WDXRF	16.0	23.2	29.4	12.7	15.2	17.7	17.0
Na_2O	pct	WDXRF	<0.15	<0.15	<0.15	0.46	1.74	<0.15	0.56
K_2O	pct	WDXRF	0.15	0.02	0.18	4.24	1.82	3.93	2.9
P_2O_5	pct	WDXRF	0.20	1.33	0.19	0.73	<0.05	0.74	<0.05
F^-	pct	SIE	0.18	0.014	0.27	2.5	0.44	0.084	0.14
Cl^-	pct	SIE	nd	0.019	0.013	0.004	nd	0.035	0.007
Total S	pct	comb./IR	14	1.6	0.088	2.5	7.7	0.17	0.039
CO_2	pct	coul. titra.	22.8	36.3	33.7	18.0	17.2	12.2	11.8
H2O$^+$	pct	diff.	0.13	<0.01	0.15	1.0	0.45	4.5	1.8
H2O$^-$	pct	diff.	0.23	0.54	0.28	0.34	0.20	0.36	1.4
-F≡oxy	pct	calc.	0.076	0.006	0.114	1.053	0.185	0.035	0.059
-Cl≡oxy	pct	calc.	--	0.004	0.003	0.001	--	0.008	0.002
-S≡oxy	pct	calc.	7.00	0.80	0.04	1.25	3.85	0.09	0.02
Sum	pct	calc.	79.7	91.8	98.3	99.0	98.5	96.9	99.1
LOI	pct	925°C	17.4	32.6	32.0	15.2	12.2	17.2	14.0
Na	pct	INAA	<4	<4	0.123	0.423	1.42	0.163	0.495
K	pct	INAA	nd	nd	<2	3.15	2.28	3.22	2.55
Ca	pct	INAA	5.9	16.4	23.8	8.4	10.2	11.5	11.5
Fe	pct	INAA	16.43	3.95	1.64	7.00	10.29	2.69	7.05
V	ppm	ICP-AES	114	nd	40	180	447	130	218
Li	ppm	ICP-AES	10	5.5	9.6	284	73	24	16
Ba	ppm	EDXRF	>5000	>5000	1500	950	980	>5000	2200
Cu	ppm	EDXRF	35	14	23	114	39	<10	<10
Ni	ppm	EDXRF	124	22	25	55	91	37	136
Zn	ppm	EDXRF	510	47	780	160	35	89	31
Sc	ppm	INAA	16.1	33.4	25.3	15.59	95.0	25.9	74.5
Cr	ppm	INAA	72	34	18.6	42.5	282	94.2	243
Co	ppm	INAA	173	15.7	12.20	43.8	61.7	13.19	57.73
Ni	ppm	INAA	282	<40	<50	63	132	34	173

Table 1. Geochemical data of drill core samples, Benton, Arkansas - Continued

		Sample	MCB8-1489	EP1-2-685	MC-B7-796	EP1-3-632.5B	EP1-2-768.5	MCB7-1276B	MCB7-1329
Zn	ppm	INAA	676	41	1138	165	58	80	39
As	ppm	INAA	299	75	12.0	29.6	113	1.2	2.8
Se	ppm	INAA	13.1	6.2	<0.6	<0.5	<3	<2	<2
Rb	ppm	INAA	<40	<20	<5	121	36.6	110	132
Sr	ppm	INAA	5485	6782	2908	2763	1606	1363	368
Zr	ppm	INAA	1017	321	101	<60	<270	<80	<190
Mo	ppm	INAA	<40	1900	181	<5	<9	17.9	<6
Sb	ppm	INAA	2.95	14.2	16.3	4.99	12.58	0.35	0.65
Cs	ppm	INAA	1.19	0.29	<0.1	2.77	1.35	4.68	2.12
Ba	ppm	INAA	53535	16660	1678	971	1048	5898	2186
La	ppm	INAA	3967	6589	532	126	140	210	29.1
Ce	ppm	INAA	8760	6015	844	224	169	301	45.3
Nd	ppm	INAA	5234	908	250	83	44	97	21.2
Sm	ppm	INAA	1623	90	36.0	13.6	8.89	14.47	4.29
Eu	ppm	INAA	354	23.4	9.56	3.39	2.87	3.21	1.22
Tb	ppm	INAA	41.4	10.23	4.68	1.11	1.19	1.028	0.35
Yb	ppm	INAA	9.0	17.8	30.9	2.35	2.59	2.41	0.57
Lu	ppm	INAA	0.65	1.94	4.00	0.310	0.426	0.321	0.093
Hf	ppm	INAA	1.4	1.24	0.95	2.23	4.13	0.63	3.56
Ta	ppm	INAA	0.79	<0.1	<0.1	1.77	1.29	1.046	1.03
Th	ppm	INAA	2755	394	360	5.19	32.7	1.57	0.84
U	ppm	INAA	<16	21.6	2.73	0.80	0.48	1.4	<0.5
Au	ppb	INAA	430	<60	15	<12	39	<7	<6

		Lab No.	W258863	W258861	W258855	W258853	W258860	W258874	W258868
Y	ppm	ICP-AES	130	110	60	22	16	18	6.0
Sr	ppm	ICP-AES	4400	6000	2200	2900	1300	1300	310
Zr	ppm	ICP-AES	180	54	69	12	68	24	68
Ba	ppm	ICP-AES	55000	18000	1600	1100	1300	6300	2300
Mo	ppm	ICP-AES	31	2290	200	1.4	4.4	19	4.6
Nb	ppm	ICP-AES	59	3.3	75	444	794	216	11

Table 1. Geochemical data of drill core samples, Benton, Arkansas - Continued

		Sample	EP1-4-779	EP1-3-632.5C	EP1-4-699	EP1-4-663	EP1-4-661	MCB8-1253	MCB8-928
		Lab No.	W256899	W256883	W256898	W256902	W256900	W256901	W256906
		Rock type	Mica pxnt	Pyroxenite	Mica pxnt	Pyroxenite	Pyroxenite	Pyroxenite	Pyroxenite
SiO_2	pct	WDXRF	33.7	37.6	37.6	38.6	40.0	40.7	43.6
TiO_2	pct	WDXRF	3.79	4.32	3.24	4.66	3.66	3.82	2.62
Al_2O_3	pct	WDXRF	6.53	7.71	7.37	7.00	6.95	6.25	5.38
Fe_2O_3	pct	calc.	9.4	8.3	6.4	9.7	8.2	9.1	6.3
FeO	pct	col. titra.	5.6	4.6	4.6	5.4	5.3	4.4	3.3
MnO	pct	WDXRF	0.15	0.15	0.13	0.14	0.14	0.12	0.12
MgO	pct	WDXRF	11.2	10.7	11.8	11.8	12.2	13.2	16.6
CaO	pct	WDXRF	17.9	21.9	17.9	20.5	19.1	21.0	19.6
Na_2O	pct	WDXRF	0.40	0.39	0.70	0.23	0.56	0.19	0.32
K_2O	pct	WDXRF	1.26	0.43	1.73	0.18	1.01	0.06	0.22
P_2O_5	pct	WDXRF	<0.05	1.36	0.07	<0.05	0.07	<0.05	<0.05
F^-	pct	SIE.	0.14	0.32	0.56	0.042	0.035	0.034	0.032
Cl^-	pct	SIE.	0.008	0.012	0.016	0.006	0.012	0.010	0.018
Total S	pct	comb./IR	0.040	0.010	0.035	0.022	0.022	0.020	0.013
CO_2	pct	coul. titra.	7.9	1.7	5.9	0.99	1.9	0.31	0.37
H_2O^+	pct	diff.	0.88	0.26	0.88	0.16	0.47	0.23	0.81
H_2O^-	pct	diff.	0.74	0.24	0.8	0.22	0.29	0.21	0.66
-F≡oxy	pct	calc.	0.059	0.135	0.236	0.018	0.015	0.014	0.013
-Cl≡oxy	pct	calc.	0.002	0.003	0.004	0.001	0.003	0.002	0.004
-S≡oxy	pct	calc.	0.02	0.01	0.02	0.01	0.01	0.01	0.01
Sum	pct	calc.	99.5	99.8	99.5	99.6	99.9	99.7	99.9
LOI	pct	925°C	8.73	1.2	6.81	0.86	1.69	0.32	1.51
Na	pct	INAA	0.379	0.361	0.596	0.341	0.543	0.25	0.311
K	pct	INAA	0.98	<0.4	1.37	<0.6	1.16	<0.9	<1
Ca	pct	INAA	12.8	14.9	12.6	13.1	13.3	14.4	14.1
Fe	pct	INAA	11.66	9.84	8.61	11.59	10.41	10.61	7.60
V	ppm	ICP-AES	287	345	193	273	294	172	150
Li	ppm	ICP-AES	8.1	11	15	<5	10	<5	<5
Ba	ppm	EDXRF	890	275	1300	230	610	<30	110
Cu	ppm	EDXRF	<10	305	17	14	14	11	10
Ni	ppm	EDXRF	132	60	114	77	90	100	142
Zn	ppm	EDXRF	32	31	35	30	36	25	22
Sc	ppm	INAA	106.8	54.8	95.2	88.0	92.6	138.7	145.5
Cr	ppm	INAA	89.1	34.4	236	42.2	121	393	988
Co	ppm	INAA	57.5	51.5	53.0	58.0	59.1	53.7	54.0
Ni	ppm	INAA	128	69	126	94	117	140	152

Table 1. Geochemical data of drill core samples, Benton, Arkansas - Continued

		Sample	EP1-4-779	EP1-3-632.5C	EP1-4-699	EP1-4-663	EP1-4-661	MCB8-1253	MCB8-928
Zn	ppm	INAA	75.2	42	48	51	50	41	37
As	ppm	INAA	1.3	4.3	<0.9	2.1	<2	<2	<2
Se	ppm	INAA	<2	<1	<1	<2	1.5	<1	<1
Rb	ppm	INAA	65	22.4	74	12.2	39.4	14	22
Sr	ppm	INAA	224	439	333	267	317	245	317
Zr	ppm	INAA	362	250	221	289	<400	247	431
Mo	ppm	INAA	<7	<7	<6	<4	<9	<9	<9
Sb	ppm	INAA	0.30	1.04	0.28	<0.3	<0.3	0.28	0.32
Cs	ppm	INAA	1.74	1.21	2.15	0.42	0.99	<0.3	<0.6
Ba	ppm	INAA	990	303	1325	241	715	<70	135
La	ppm	INAA	10.6	52	15.8	44.4	22.6	17.2	11.6
Ce	ppm	INAA	27.3	121	37.7	106	48.2	38.3	31.4
Nd	ppm	INAA	18.2	66	23.3	57	25.9	23.4	23.5
Sm	ppm	INAA	4.21	12.24	4.95	9.36	5.84	4.91	4.29
Eu	ppm	INAA	1.12	2.99	1.27	2.18	1.49	1.27	1.14
Tb	ppm	INAA	0.367	0.94	0.433	0.62	0.49	0.401	0.35
Yb	ppm	INAA	0.60	1.03	0.57	0.81	0.83	0.70	0.58
Lu	ppm	INAA	0.132	0.175	0.147	0.137	0.128	0.104	0.096
Hf	ppm	INAA	6.13	9.55	5.99	9.19	7.09	7.36	5.96
Ta	ppm	INAA	0.95	2.12	1.41	5.16	1.93	0.74	0.75
Th	ppm	INAA	0.45	3.33	0.87	8.45	1.67	<0.2	<0.3
U	ppm	INAA	<0.7	<1	<0.8	<0.8	0.54	<0.6	<0.6
Au	ppb	INAA	<8	36.2	<9	<6	<6	<7	<9

		Lab No.	W258870	W258854	W258869	W258873	W258871	W258872	W258877
Y	ppm	ICP-AES	5.8	14	5.9	7.7	6.9	5.5	5.0
Sr	ppm	ICP-AES	200	380	310	170	220	130	190
Zr	ppm	ICP-AES	110	310	160	160	170	160	130
Ba	ppm	ICP-AES	1000	320	1500	240	610	38	160
Mo	ppm	ICP-AES	<1.0	<1.0	2.4	2.3	<1.0	1.6	1.5
Nb	ppm	ICP-AES	7.7	26	16	24	25	5.2	4.5

Table 1. Geochemical data of drill core samples, Benton, Arkansas - Continued

		Sample	MCB7-675	MCB8-786	MCB8-775	MCB7-1362	EP1-4-650.5	MCB7-1319	MCB8-880
		Lab No.	W256911	W256912	W256905	W256909	W256916	W256891	W256907
		Rock type	Pyroxenite	Lamprophyre	Lamprophyre	Lamprophyre	Lamprophyre	Pxnt-qtz bx	Felsic
SiO_2	pct	WDXRF	47.0	38.0	38.7	39.5	44.5	45.7	43.9
TiO_2	pct	WDXRF	2.46	3.28	3.60	3.74	2.70	1.12	2.74
Al_2O_3	pct	WDXRF	5.71	13.2	12.2	14.2	11.9	2.59	16.1
Fe_2O_3	pct	calc.	4.5	5.8	6.4	3.9	5.0	3.4	3.8
FeO	pct	col. titra.	2.0	6.4	6.3	7.0	4.7	2.0	4.6
MnO	pct	WDXRF	0.07	0.25	0.21	0.25	0.17	0.17	0.23
MgO	pct	WDXRF	13.8	5.53	8.35	7.58	7.30	11.5	3.05
CaO	pct	WDXRF	23.3	10.9	11.8	8.71	11.7	16.7	7.59
Na_2O	pct	WDXRF	0.21	3.31	2.77	2.30	3.62	1.60	5.08
K_2O	pct	WDXRF	0.03	3.7	2.73	3.35	1.86	1.04	4.03
P_2O_5	pct	WDXRF	<0.05	1.1	0.75	1.18	0.57	0.08	0.70
F^-	pct	SIE.	0.27	0.21	0.19	0.23	0.19	0.70	0.29
Cl^-	pct	SIE.	<0.004	0.018	0.027	0.016	0.027	<0.004	0.026
Total S	pct	comb./IR	<0.010	0.75	0.26	0.43	0.14	0.13	0.23
CO_2	pct	coul. titra.	0.37	4.4	3.4	2.2	3.8	12.6	4.0
H_2O^+	pct	diff.	0.13	1.7	1.7	4.0	0.84	0.46	1.9
H_2O^-	pct	diff.	0.46	0.76	0.29	0.86	0.66	0.82	0.55
-F≡oxy	pct	calc.	0.114	0.088	0.080	0.097	0.080	0.295	0.122
-Cl≡oxy	pct	calc.	--	0.004	0.006	0.004	0.006	--	0.006
-S≡oxy	pct	calc.	--	0.38	0.13	0.22	0.07	0.07	0.12
Sum	pct	calc.	100.2	98.8	99.5	99.2	99.5	100.3	98.6
LOI	pct	925°C	0.82	5.52	4.13	6.18	4.25	11.8	5.64
Na	pct	INAA	0.234	2.63	2.13	1.83	2.79	1.36	3.88
K	pct	INAA	<1	3.3	1.82	3.4	1.2	1.61	3.3
Ca	pct	INAA	15.1	7.7	8.5	5.9	8.4	11.6	5.11
Fe	pct	INAA	4.85	9.53	9.90	8.68	7.32	4.24	6.40
V	ppm	ICP-AES	80	373	386	405	328	140	246
Li	ppm	ICP-AES	<5	33	22	36	25	145	29
Ba	ppm	EDXRF	<30	1000	800	1000	435	240	1400
Cu	ppm	EDXRF	<10	91	85	24	53	<10	15
Ni	ppm	EDXRF	83	28	72	13	88	140	<10
Zn	ppm	EDXRF	<10	78	73	116	82	30	81
Sc	ppm	INAA	154.6	13.90	28.2	8.78	28.3	89.3	4.62
Cr	ppm	INAA	460	3.4	73.5	<2	391	348	1.8
Co	ppm	INAA	27.7	43.1	50.6	31.9	35.9	53.6	14.38
Ni	ppm	INAA	86	<31	64	<23	86	139	<25

Table 1. Geochemical data of drill core samples, Benton, Arkansas - Continued

		Sample	MCB7-675	MCB8-786	MCB8-775	MCB7-1362	EP1-4-650.5	MCB7-1319	MCB8-880
Zn	ppm	INAA	<23	125	99	131	89	44	114.5
As	ppm	INAA	<2	9.1	7.1	5.0	1.8	19.7	5.5
Se	ppm	INAA	4.4	<2	<0.9	<2	<0.7	<1	<0.8
Rb	ppm	INAA	<9	93	86	92	52.2	<30	92
Sr	ppm	INAA	134	1509	1063	912	1014	531	1570
Zr	ppm	INAA	<200	400	281	459	322	<300	474
Mo	ppm	INAA	<4	7.9	5.2	8.1	6.9	<4	6.6
Sb	ppm	INAA	0.32	2.19	0.79	0.37	0.50	0.92	0.968
Cs	ppm	INAA	<0.3	4.19	3.61	10.9	6.15	0.82	3.00
Ba	ppm	INAA	<80	1035	834	1012	460	240	1356
La	ppm	INAA	8.9	123	85.3	107	87.9	34.6	111.2
Ce	ppm	INAA	27.3	229	163	216	169	49.8	214
Nd	ppm	INAA	18.3	91	70	93	74	21.3	89.8
Sm	ppm	INAA	4.16	16.2	12.57	17.00	13.92	5.85	16.0
Eu	ppm	INAA	1.07	4.08	3.28	4.29	3.46	1.83	4.04
Tb	ppm	INAA	0.40	1.41	1.14	1.59	1.29	0.78	1.47
Yb	ppm	INAA	<0.9	2.70	2.30	3.05	2.66	1.31	3.39
Lu	ppm	INAA	0.137	0.386	0.300	0.427	0.353	0.207	0.446
Hf	ppm	INAA	5.76	7.72	7.19	9.08	7.13	3.72	8.72
Ta	ppm	INAA	0.52	11.09	7.72	11.54	8.29	0.29	10.55
Th	ppm	INAA	<0.3	15.22	9.85	14.40	10.10	6.99	14.66
U	ppm	INAA	<0.8	3.84	2.43	3.75	2.88	<1	3.54
Au	ppb	INAA	<8	18	<14	<11	<11	<18	<10

		Lab No.	W258882	W258883	W258876	W258880	W258887	W258862	8878
Y	ppm	ICP-AES	4.9	23	19	26	22	11	25
Sr	ppm	ICP-AES	140	1400	1000	820	1000	510	1600
Zr	ppm	ICP-AES	130	380	350	410	320	100	500
Ba	ppm	ICP-AES	12	990	990	1200	530	230	1700
Mo	ppm	ICP-AES	1.0	1.8	2.9	3.9	3.9	2.9	3.7
Nb	ppm	ICP-AES	2.2	160	121	150	122	111	165

Table 1. Geochemical data of drill core samples, Benton, Arkansas - Continued

		Sample	MCB8-873.5	MCB8-1324.5	EP1-4-766	EP1-4-966	EP1-4-962	MCB7-893	MCB7-1194
		Lab No.	W256908	W256893	W256894	W256895	W256896	W256910	W256904
		Rock type	Felsic	Felsic	Felsic	Felsic	Felsic	Serp pxnt/prd	Serp pxnt/prd
SiO_2	pct	WDXRF	44.0	46.2	52.1	53.8	54.6	34.6	35.2
TiO_2	pct	WDXRF	2.66	1.56	0.81	0.83	0.80	0.52	0.43
Al_2O_3	pct	WDXRF	16.2	17.3	17.5	17.3	17.9	1.08	0.63
Fe_2O_3	pct	calc.	3.3	2.6	2.1	1.6	1.2	9.8	8.4
FeO	pct	col. titra.	4.7	2.9	2.2	3.0	2.8	3.3	5.4
MnO	pct	WDXRF	0.23	0.21	0.19	0.20	0.18	0.25	0.40
MgO	pct	WDXRF	3.05	1.98	1.60	1.22	1.17	34.8	37.4
CaO	pct	WDXRF	7.99	5.74	3.81	3.28	2.81	1.98	1.54
Na_2O	pct	WDXRF	4.99	3.21	3.68	4.82	3.93	<0.15	<0.15
K_2O	pct	WDXRF	4.11	6.74	6.02	5.42	6.62	0.35	0.19
P_2O_5	pct	WDXRF	0.68	0.30	0.26	0.25	0.24	<0.05	<0.05
F^-	pct	SIE.	0.16	0.50	0.28	0.16	0.40	0.06	0.09
Cl^-	pct	SIE.	0.021	0.018	0.008	0.015	0.022	0.21	0.67
Total S	pct	comb./IR	0.32	1.7	1.2	0.83	0.081	0.032	0.074
CO_2	pct	coul. titra.	4.1	8.0	5.3	5.2	4.6	1.7	0.67
H_2O^+	pct	diff.	2.1	0.85	0.99	0.66	0.97	11.5	9.2
H_2O^-	pct	diff.	0.37	0.28	1.5	0.65	0.74	0.70	0.81
-F≡oxy	pct	calc.	0.067	0.211	0.118	0.067	0.168	0.025	0.038
-Cl≡oxy	pct	calc.	0.005	0.004	0.002	0.003	0.005	0.047	0.151
-S≡oxy	pct	calc.	0.16	0.85	0.60	0.42	0.04	0.02	0.04
Sum	pct	calc.	98.7	99.0	98.8	98.7	98.8	100.8	100.9
LOI	pct	925C	5.68	6.83	6.23	5.28	5.89	13.3	10.3
Na	pct	INAA	4.02	2.48	2.70	3.66	2.76	0.059	0.062
K	pct	INAA	4.8	5.8	4.51	4.4	4.98	0.32	<0.4
Ca	pct	INAA	5.8	3.8	3.02	2.55	2.41	1.45	0.86
Fe	pct	INAA	6.55	4.27	3.32	3.49	3.10	9.68	10.65
V	ppm	ICP-AES	232	183	103	79	87	55	185
Li	ppm	ICP-AES	18	64	14	16	23	<5	<5
Ba	ppm	EDXRF	1400	4000	1600	740	1400	225	93
Cu	ppm	EDXRF	11	12	<10	<10	10	<10	<10
Ni	ppm	EDXRF	<10	<10	<10	<10	<10	470	500
Zn	ppm	EDXRF	70	435	20	55	79	55	120
Sc	ppm	INAA	4.75	3.44	3.60	2.21	2.75	12.25	12.68
Cr	ppm	INAA	2.7	3.3	1.35	1.66	<2	56.0	69.1
Co	ppm	INAA	14.34	10.7	7.58	7.24	5.87	130.6	140.7
Ni	ppm	INAA	<18	<30	<11	<13	<9	477	458

Table 1. Geochemical data of drill core samples, Benton, Arkansas - Continued

		Sample	MCB8-873.5	MCB8-1324.5	EP1-4-766	EP1-4-966	EP1-4-962	MCB7-893	MCB7-1194
Zn	ppm	INAA	121	452	26.0	56.2	86.9	68	117
As	ppm	INAA	6.3	28.0	32.7	10.5	3.0	<0.5	<0.6
Se	ppm	INAA	<0.9	<0.9	<0.4	<0.5	<1	<0.7	<0.7
Rb	ppm	INAA	96	139	109	114	160	18.6	11.0
Sr	ppm	INAA	1602	1514	681	561	616	<150	<160
Zr	ppm	INAA	461	412	501	510	564	<120	<100
Mo	ppm	INAA	<5	8.9	5.3	6.9	10.7	<4	<7
Sb	ppm	INAA	0.81	2.66	2.18	1.24	0.764	0.112	<0.09
Cs	ppm	INAA	2.48	0.52	0.406	0.327	1.12	0.45	0.30
Ba	ppm	INAA	1463	3861	1495	699	1337	246	105
La	ppm	INAA	115	151	141.7	118	120	8.26	29.7
Ce	ppm	INAA	224	245	223	172	182	13.3	49.8
Nd	ppm	INAA	92	79	82.5	50.2	53.3	4.1	16.0
Sm	ppm	INAA	16.1	12.74	17.0	8.55	9.06	0.844	1.77
Eu	ppm	INAA	4.17	3.11	3.83	1.93	2.20	0.28	0.40
Tb	ppm	INAA	1.52	1.08	1.010	0.785	0.908	0.08	0.103
Yb	ppm	INAA	3.45	3.10	3.41	2.98	2.99	0.24	<0.3
Lu	ppm	INAA	0.459	0.422	0.487	0.428	0.438	0.029	0.038
Hf	ppm	INAA	9.3	6.88	8.95	8.97	9.6	0.54	0.49
Ta	ppm	INAA	11.35	9.92	6.46	6.14	6.37	0.21	0.116
Th	ppm	INAA	13.50	29.0	38.8	22.8	28.4	<0.3	0.60
U	ppm	INAA	3.09	5.2	2.24	4.43	5.66	<0.5	<0.1
Au	ppb	INAA	<10	12.2	18.5	11	<6	<4	<4

		Lab No.	W258879	W258864	W258865	W258866	W258867	W258881	W258875
Y	ppm	ICP-AES	25	20	15	15	14	1.3	1.4
Sr	ppm	ICP-AES	1300	1500	500	620	520	29	44
Zr	ppm	ICP-AES	360	310	150	420	480	12	11
Ba	ppm	ICP-AES	1100	3800	2200	910	1400	230	100
Mo	ppm	ICP-AES	1.8	6.1	6.2	1.5	3.9	<1.0	<1.0
Nb	ppm	ICP-AES	146	257	179	148	155	4.8	43

Table 1. Geochemical data of drill core samples, Benton, Arkansas - Continued

		Sample	EP1-4-903.5	EP1-2-745	EP1-4-649.5	EP1-4-761	EP1-4-768	EP1-4-768.2
		Lab No.	W256915	W257484	W257485	W257486	W257487	W257488
		Rock type	Altered	Altered	Altered	Altered	Altered	Altered
SiO_2	pct	WDXRF	37.8	51.4	46.9	36.9	40.8	25.6
TiO_2	pct	WDXRF	1.88	4.47	3.00	5.11	6.19	4.38
Al_2O_3	pct	WDXRF	3.63	7.37	12.9	7.89	8.59	8.28
Fe_2O_3	pct	calc.	7.1	11.4	6.1	11.4	8.6	9.2
FeO	pct	col. titra.	5.0	3.9	1.3	12.9	5.0	5.2
MnO	pct	WDXRF	0.24	0.44	0.07	0.81	0.40	0.25
MgO	pct	WDXRF	10.6	2.10	2.04	2.93	3.77	6.68
CaO	pct	WDXRF	18.9	0.97	9.22	1.92	4.27	13.7
Na_2O	pct	WDXRF	0.22	0.38	3.71	0.61	0.53	1.28
K_2O	pct	WDXRF	0.24	0.17	0.59	0.06	0.41	1.57
P_2O_5	pct	WDXRF	<0.05	<0.05	0.62	<0.05	0.09	0.3
F^-	pct	SIE.	0.06	0.08	1.3	0.81	0.41	0.51
Cl^-	pct	SIE.	0.008	nd	0.010	0.017	nd	0.006
Total S	pct	comb./IR	0.012	5.6	0.13	0.072	4.4	1.4
CO_2	pct	coul. titra.	12.8	3.4	6.3	11.0	8.6	17.4
H_2O^+	pct	diff.	0.43	3.7	2.9	3.1	3.4	2.2
H_2O^-	pct	diff.	0.75	2.5	1.9	2.9	3.2	1.4
-F≡oxy	pct	calc.	0.025	0.034	0.547	0.341	0.173	0.215
-Cl≡oxy	pct	calc.	0.002	--	0.002	0.004	--	0.001
-S≡oxy	pct	calc.	0.01	2.80	0.07	0.04	2.20	0.70
Sum	pct	calc.	99.7	95.0	98.3	98.0	96.3	98.5
LOI	pct	925°C	13.2	16.6	12.1	17.9	18.7	18.6
Na	pct	INAA	0.229	0.289	3.00	0.470	0.409	1.052
K	pct	INAA	<0.3	<2	<1	<0.5	0.41	1.65
Ca	pct	INAA	12.8	<2	7.1	<2	3.0	9.9
Fe	pct	INAA	9.41	11.81	5.68	19.7	10.52	11.31
V	ppm	ICP-AES	105	413	336	448	536	502
Li	ppm	ICP-AES	9.6	50	76	57	55	50
Ba	ppm	EDXRF	370	154	350	162	240	640
Cu	ppm	EDXRF	16	16	25	<10	20	50
Ni	ppm	EDXRF	182	158	53	128	134	88
Zn	ppm	EDXRF	29	72	36	96	108	75
Cr	ppm	EDXRF	---	315	550	116	180	98
Sc	ppm	INAA	92.2	107	32.9	115.4	121.3	76.2
Cr	ppm	INAA	1076	291	471	129	169	60.8

Table 1. Geochemical data of drill core samples, Benton, Arkansas - Continued

		Sample	EP1-4-903.5	EP1-2-745	EP1-4-649.5	EP1-4-761	EP1-4-768	EP1-4-768.2
Co	ppm	INAA	71.2	104.6	24.0	63.6	102.7	58.7
Ni	ppm	INAA	202	228	48	145	174	98
Zn	ppm	INAA	44	63	48.3	99	102	70
As	ppm	INAA	1.7	75.6	1.50	<0.9	70	32
Se	ppm	INAA	<1	<0.7	<1	2.4	<2	<1
Rb	ppm	INAA	16	<10	20.1	<11	16.3	62.4
Sr	ppm	INAA	636	202	1006	649	711	1084
Zr	ppm	INAA	213	334	375	318	400	252
Mo	ppm	INAA	<3	<4	4.4	3.6	2.9	<3
Sb	ppm	INAA	0.56	15.8	0.64	1.74	8.09	3.57
Cs	ppm	INAA	3.04	1.49	2.62	1.34	1.49	4.60
Ba	ppm	INAA	406	166	338	173	272	648
La	ppm	INAA	9.2	151	42.9	18.9	27.5	83.4
Ce	ppm	INAA	23.3	198.9	88.982	42.449	43.953	129.29
Nd	ppm	INAA	12.6	60.45	38.088	22.749	17.235	47.676
Sm	ppm	INAA	3.07	9.64	7.54	5.71	4.24	8.95
Eu	ppm	INAA	0.84	2.49	1.87	1.58	1.43	2.36
Tb	ppm	INAA	0.23	1.00	0.69	0.68	0.85	0.94
Yb	ppm	INAA	0.47	3.32	1.46	2.89	2.86	2.03
Lu	ppm	INAA	0.109	0.473	0.196	0.411	0.398	0.259
Hf	ppm	INAA	3.99	8.40	8.67	8.79	10.5	7.96
Ta	ppm	INAA	0.58	1.26	9.69	1.13	2.02	3.31
Th	ppm	INAA	0.54	13.3	11.0	<0.6	7.8	8.8
U	ppm	INAA	<0.4	1.15	1.15	<0.6	1.42	2.17
Au	ppb	INAA	<6	35	<8	<6	33.9	26.7

		Lab No.	W258886	W258963	W258964	W258965	W258966	W258967
Y	ppm	ICP-AES	4.0	23	11	13	21	16
Sr	ppm	ICP-AES	500	280	810	390	770	900
Zr	ppm	ICP-AES	98	190	320	200	300	220
Ba	ppm	ICP-AES	540	200	340	170	350	720
Mo	ppm	ICP-AES	1.6	2.7	5.4	2.9	3.4	2.2
Nb	ppm	ICP-AES	4.0	151	118	7.0	196	127

Table 2. Partial geochemical analyses of drill core samples, Benton, Arkansas

[abbreviations as given in Table 1; Fe_2O_3(t) - total Fe reported as ferric]

			EP1-2-749.3	MCB7-881	MCB7-908
		Lab No.	W257489	W257490	W257491
		Rock type	Carbonatite	Serp vein	Serp vein
TiO_2	pct	ICP-AES	<0.008	0.03	0.02
Al_2O_3	pct	ICP-AES	0.34	1.64	0.64
Fe_2O_3(t)	pct	ICP-AES	4.15	4.00	2.14
MnO	pct	ICP-AES	0.09	0.05	0.05
MgO	pct	ICP-AES	5.80	34.82	34.82
CaO	pct	ICP-AES	30.78	1.82	2.80
Na_2O	pct	ICP-AES	0.05	0.01	0.01
K_2O	pct	ICP-AES	0.04	<0.01	<0.01
P_2O_5	pct	ICP-AES	0.14	<0.01	<0.01
F^-	pct	SIE	16.2	--	--
Cl^-	pct	SIE	0.007	--	--
Total S	pct	comb/IR	0.82	--	--
CO_2	pct	coul. titra.	17.1	--	--
Na	pct	INAA	<0.7	0.023	0.022
K	pct	INAA	--	<0.06	<0.07
Ca	pct	INAA	24.2	1.38	1.9
Fe	pct	INAA	2.94	2.82	1.54
V	ppm	ICP-AES	19	6	4
Li	ppm	ICP-AES	17	6	<2
Nb	ppm	EDXRF	<10	<10	<10
Rb	ppm	EDXRF	<10	<10	<10
Sr	ppm	EDXRF	1100	38	144
Zr	ppm	EDXRF	<10	<10	10
Y	ppm	EDXRF	162	<10	<10
Ba	ppm	ICP-AES	1500	8	47
Ce	ppm	ICP-AES	4000	7	5
La	ppm	ICP-AES	4100	<2	<2
Cu	ppm	ICP-AES	14	<1	<1
Ni	ppm	ICP-AES	5	4	2
Zn	ppm	ICP-AES	1400	3	<2
Sc	ppm	INAA	6.75	2.13	2.32
Cr	ppm	INAA	<2	8.6	<0.8
Co	ppm	INAA	2.22	2.26	0.63
Ni	ppm	INAA	<20	<11	<14

Table 2. Partial geochemical analyses of drill core samples, Benton, Arkansas - Continued

		Sample	EP1-2-749.3	MCB7-881	MCB7-908
Zn	ppm	INAA	1270	5.4	<4
As	ppm	INAA	17	<0.2	0.43
Se	ppm	INAA	0.59	<0.3	<0.4
Rb	ppm	INAA	<4	<3	<3
Sr	ppm	INAA	1300	33	146
Zr	ppm	INAA	<30	<40	<40
Mo	ppm	INAA	37	<2	<2
Sb	ppm	INAA	6.35	<0.04	<0.04
Cs	ppm	INAA	0.17	<0.09	<0.08
Ba	ppm	INAA	1650	<13	47
La	ppm	INAA	3430	2.99	1.67
Ce	ppm	INAA	3490	6.36	3.93
Nd	ppm	INAA	631	3.5	2.8
Sm	ppm	INAA	62	0.941	0.621
Eu	ppm	INAA	16.7	0.146	0.279
Tb	ppm	INAA	6.52	0.08	0.058
Yb	ppm	INAA	14.5	0.073	0.097
Lu	ppm	INAA	1.85	0.012	0.017
Hf	ppm	INAA	0.26	0.19	0.432
Ta	ppm	INAA	<0.08	<0.04	<0.05
Th	ppm	INAA	108.5	0.1	<0.06
U	ppm	INAA	3.07	<0.1	<0.2
Mo	ppm	ICP-AES	13	<2	<2
Pb	ppm	ICP-AES	320	<4	4
Au	ppb	INAA	<29	2	2.8