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Chemical Composition of Carbonatites in Conway and Perry Counties of Arkansas

George H. Wagner
University of Arkansas

Kenneth F. Steele
University of Arkansas, Fayetteville

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Arkansas Academy of Science

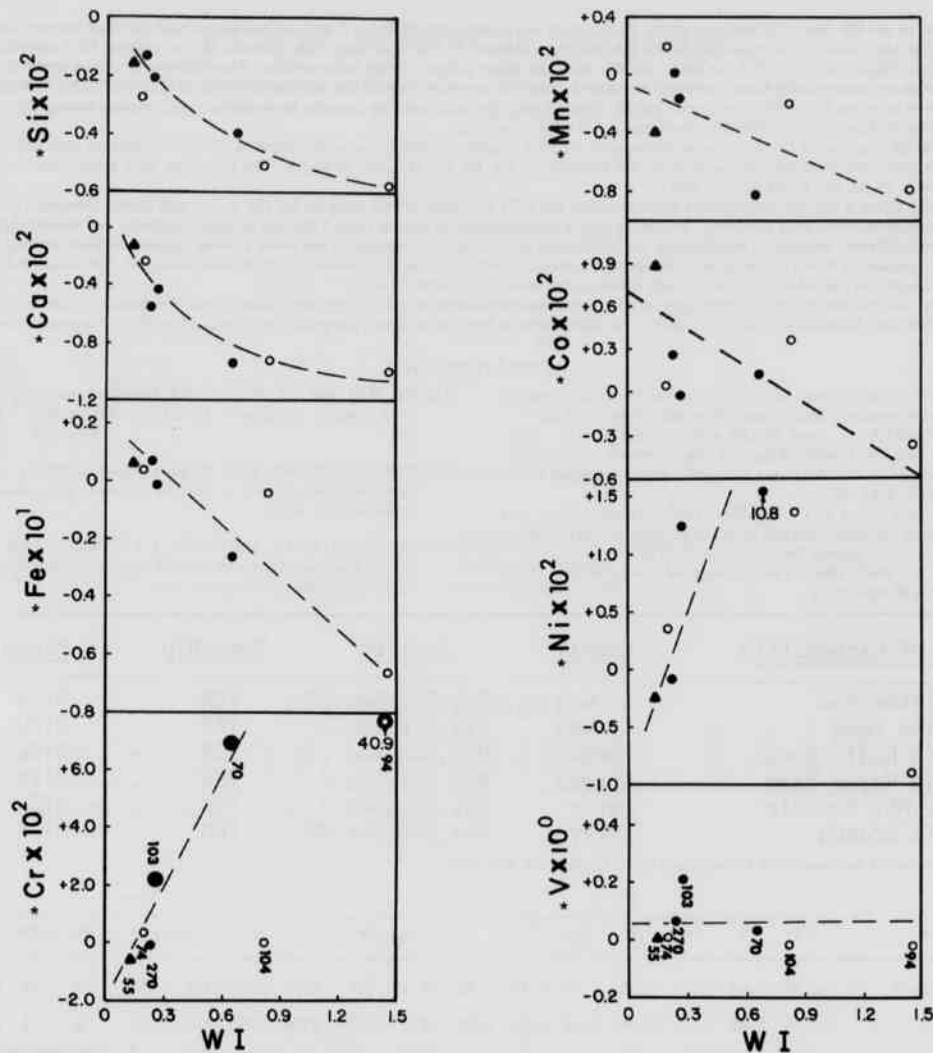


Figure 1. Change in element abundance in the weathered sample relative to the fresh sample calculated from data in Table 1. See text for definition of WI and *. In the *Cr and *V plots the numbers correspond to sample numbers in Table 1. Circled points in the *Cr plot represent minimum values.

KENNETH F. STEELE and EDWARD C. ROBISON, *Department of Geology, University of Arkansas, Fayetteville, Arkansas 72701.*

THE CHEMICAL COMPOSITION OF CARBONATITES IN CONWAY AND PERRY COUNTIES OF ARKANSAS

The geographical relationship of the Conway and Perry County Carbonatites to other igneous outcrops in Arkansas is outlined by Stone and Sterling (1964) in their summary of igneous rock occurrences in Arkansas. The Conway County outcrops were first described by Croneis and Billings in 1930. They have been called, proceeding historically, volcanic necks, sills, vein dikes, breccia and xenolithic dikes and classed as lamprophyres. The best and largest exposure, which is only a few square meters, is on the south side of the Arkansas River at Lock and Dam No. 9 near Morrilton, Arkansas. This material is a sill between shale and sandstone of probable Atokan age. With the help of Charles G. Stone of the Arkansas Geological Commission and R. R. Cohoon of Arkansas Technical University, Russellville, other exposures of similar looking material were located, and are summarized in Table 1.

The purpose of this study was to compare the chemical composition of the groundmass of these six outcrops of igneous rocks. Samples of the least weathered-looking material from each outcrop were obtained and a fresh, central portion of each, 1 cm thick X 4 cm X 10 cm was made with a water lubricated saw. Carefully avoiding large xenoliths which are plentiful, the dark gray groundmass was isolated and approximately 15 g were ground to 100 mesh by mortar and pestle. Samples were dissolved by HF and HCl for chemical analyses. Samples were only partially soluble in HCl. The solutions were analyzed by a Perkin Elmer Model 303 Atomic Absorption Spectrophotometer using standard techniques (Anonymous, 1973). Carbon dioxide was determined by the titration method of Shapiro (1975).

General Notes

Analyses of the HF dissolved samples of the six outcrops are summarized in Table 2 and are compared with the well known Magnet Cove carbonatite, the Alno, Sweden carbonatite and the Murfreesboro kimberlite. The Morrilton Dam material has the greatest HCl solubility, 83.6%, and the Oppello Payne Farm material the least, 24.2%, with the other samples being intermediate. The differences are believed to be due to weathering, with the most soluble being the least weathered. The CO₂ contents parallel the calcium contents as shown in Table 2. Neglecting the badly weathered samples, Perry Mountain and Oppello Payne Farm, the other outcrop samples have similar compositions among themselves and compare well to the known carbonatites for both major and minor elements.

From the HF analyses of the whole groundmass and the HCl solubility analyses, the composition of the HCl insolubles were calculated. The following elements were more concentrated in the HCl solubles: Ca, Fe, Sr, Mn, Zn, Ni and V. The following were more concentrated in the insolubles: Mg, Ti, Al, Na, K, Ba, Co, Cu and Li.

In Figures 1 and 2 the HF analyses are plotted versus the HCl solubility of the samples for the major and minor elements, respectively. Weathering should decrease HCl solubility. Assuming this, it is apparent from Figure 1 and 2 that the samples originally had similar compositions but experienced different degrees of weathering. As weathering proceeded, the content of the more soluble cations (alkaline earths) decreased and that of the refractory metal oxides (iron, aluminum, titanium, vanadium) either increased or stayed about constant. Silicification of the Perry Mountain B sample has caused even the refractory oxides to decrease in concentration.

We conclude that the igneous outcroppings are from the same or similar magma source and differ only in the degree of alteration. They are carbonatites befitting Heinrich's (1966) definition: "A carbonatite is here defined as a carbonate-rich rock of apparent magmatic derivation or descent."

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Name of Carbonatite	County	Section	Township	Range
Morrilton Dam	Conway	SW $\frac{1}{4}$, SW $\frac{1}{4}$, Sec. 34	T6N	R17W
Oppello Dump	Conway	SW $\frac{1}{4}$, NE $\frac{1}{4}$, Sec. 1	T5N	R17W
Oppello Boat Launch	Conway	NE $\frac{1}{4}$, NW $\frac{1}{4}$, Sec. 17	T5N	R16W
Oppello Payne Farm	Conway	NW $\frac{1}{4}$, SE $\frac{1}{4}$, Sec. 2	T5N	R17W
Perry Mt. Breccia	Perry	SW $\frac{1}{4}$, NE $\frac{1}{4}$, Sec. 3	T4N	R17W
Brazil Branch	Perry	SW $\frac{1}{4}$, SE $\frac{1}{4}$, Sec. 28	T4N	R17W

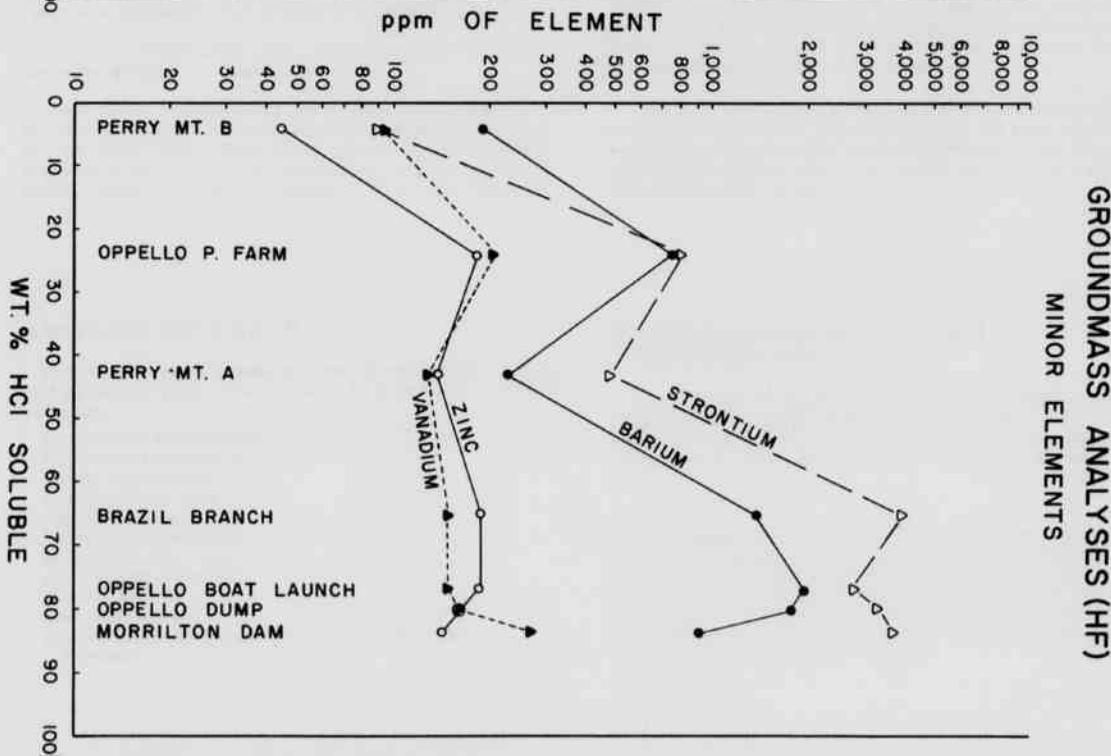
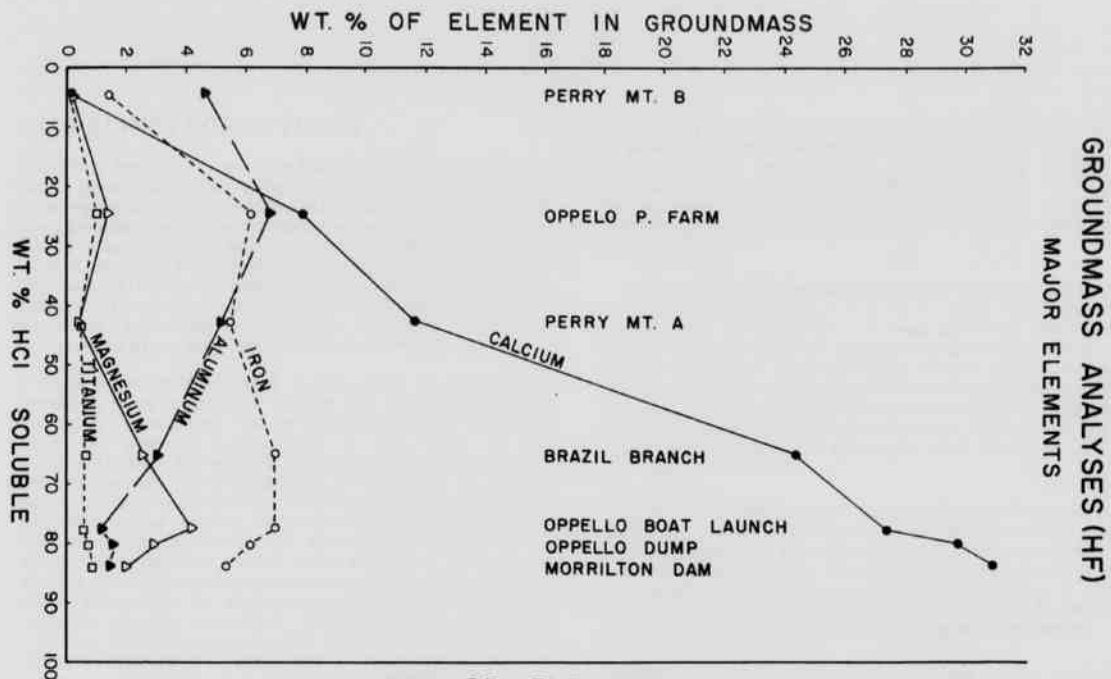
Table 1. Location of Carbonatites in Conway and Perry Counties in Arkansas

Carbonatites	WT. %										ppm						
	Ca	Mg	Fe	Ti	Al	Na	K	CO ₂	Ba	Sr	Mn	Zn	Co	Ni	Cu	V	Li
Morrilton Dam A	30.88	1.99	5.30	0.91	1.72	0.19	0.48	34.3	901	5714	3540	142	32	<7	30	277	27
Oppello Dump	29.78	2.98	6.15	0.74	1.68	0.44	0.43	32.7	1762	3305	2350	163	<5	5	6	164	24
Oppello Boat Launch	26.70	4.24	7.07	0.60	1.30	0.15	0.10	30.7	1939	2823	4780	190	19	21	5	147	5
Brazil Branch	24.36	2.58	6.92	0.64	3.06	1.07	2.23	28.8	1363	3884	4780	190	37	10	12	147	11
Perry Mt. A	11.60	0.37	5.49	0.44	5.22	3.09	1.96	13.5	227	479	3230	136	30	36	17	130	4
Oppello Payne Farm	6.96	1.35	6.15	1.06	6.95	3.24	2.32	7.3	748	790	1920	182	38	58	24	202	9
Magnet Cove ¹	38.14	0.63	0.54	0.06	0.17	0.00	0.13	39.4	1000	-	5000	-	0	0	10	200	-
Alnö, Sweden ²	25.80	3.49	5.22	0.44	1.74	0.31	1.31	28.5	3600	3900	5300	-	17	8	2	-	-
Kimberlite ³	2.77	15.88	4.20	0.53	3.62	0.58	2.12	-	-	-	-	-	-	-	-	-	-

¹ analysis of sample L-304, Erickson and Blade (1963)² from p 222 and 225, Heinrich (1966)³ from Miser and Ross, (1923)

Table 2. Groundmass Analyses of Carbonatites of Conway and Perry Counties, Arkansas (HF dissolved)

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GEORGE H. WAGNER and KENNETH F. STEELE, Department of Geology, University of Arkansas, Fayetteville, 72701.