Journal of the Arkansas Academy of Science

Volume 31 Article 44

1977

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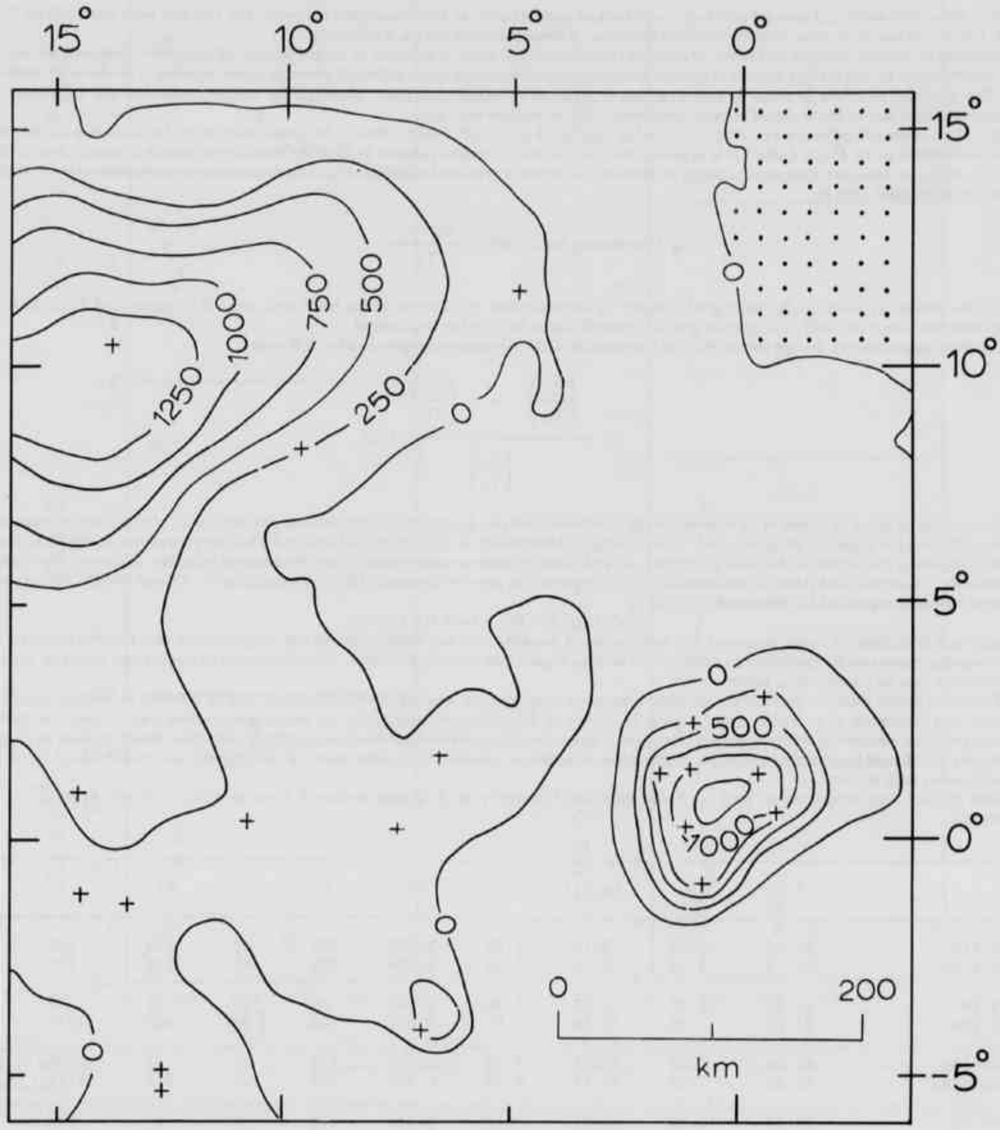
Recommended Citation

Steele, Kenneth F. and Robison, Edward C. (1977) "Chemical Weathering of Lamprophyric Rock, Central Arkansas," *Journal of the Arkansas Academy of Science*: Vol. 31, Article 44.
Available at: https://scholarworks.uark.edu/jaas/vol31/iss1/44



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CHEMICAL WEATHERING OF LAMPROPHYRIC ROCK, CENTRAL ARKANSAS

Studies of the weathering of mafic rocks are few, especially those considering trace transition metals. Wells (1959. Soil sequences from basalt and graywacke. N.Z. Inst. Agr. Sci. Proc. 1959:40-44) reports the following sequence of element removal from basalts during weathering.

Ca > Si > Mn, Co, Ni > Ti, V, Cr, Fe

This sequence is similar to that given by Tiller (1958. The geochemistry of basaltic materials and associated soils of southeastern South Australia. J. Soil Sci. 9:225-241) for basalts.

Ca > Co > Mn > Ni > V > Fe > Ti

Weathered and fresh samples of seven lamprophyric dikes (Table 1) were collected in Saline County, Arkansas. The weathered samples were ground with a mortar and pestle and then dried at 105°C for six hours to remove excess moisture. The weathered and fresh material was then ground to minus 200 mesh and pressed into boric acid-backed pellets for x-ray spectrographic analyses. The samples were analyzed for Si, Ca, Fe, Ti, Mn, Co, Cr, Ni and V in order to determine the behavior of these elements during weathering.

Because of volume changes and removal of some elements (which leads to increase in weight percent of immobile elements) during weathering, it is convenient in weathering studies to normalize elements data for fresh and weathered material to the number of atoms of an immobile element. The absolute numbers of these immobile atoms is assumed to remain constant, although the weight percent in the weathered material generally increases due to the removal of mobile elements and/or volume changes.

Based on chemical behavior and other weathering studies (Wells, 1959; Tiller, 1958) Ti has been assumed to be immobile for this study and all data normalized to Ti. From Table 1 it is apparent that the increased weight percent of Ti in the weathered sample is largely due to the loss of Ca. By plotting the absolute elemental change in abundance versus a weathering index, Fig. 1) it is possible to compare rates of change. The weathering index used here is:

$$\text{Weathering Index (WI)} = \frac{Ti_w - Ti_f}{Ti_f}$$

Ti_w is the number of Ti atoms in the weathered sample; Ti_f is the number of Ti atoms in the fresh rock and WI is increase of Ti in the weathered sample relative to the fresh rock. The greater the WI value the more intense the weathering.

Before plotting elemental change versus WI, the abundance of the element was normalized as follows:

$$E^* = \frac{\left(\frac{E_w}{Ti_w}\right) - \left(\frac{E_f}{Ti_f}\right)}{\left(\frac{E_f}{Ti_f}\right)} \mathrm{X}\ 10_n.$$

E_w represents the number of atoms of an element in the weathered sample; E_f represents the number of atoms of an element in the fresh rock, n is a power of 10 used for graphing purposes, and $^*E$ the change in abundance of the element in the weathered sample relative to the fresh rock.

By comparing the slopes of the lines in Figure 1, it is possible to make a comparison of relative element mobility. Although there are limited data available (7 samples) and there is considerable scatter of points for several elements (Mn, and especially Co, Cr and Ni), the relative sequence of element mobility suggested for lamprophyric rock is

$$Ca > Co > Si > Mn > Fe > V > Cr > Ni.$$

This sequence is similar to those proposed for weathering of basalts, and any differences in the lamprophyre and basalt element - mobility weathering sequences can be explained as a result of scatter in Figure 1 and the lack of data. The differences in mineralogy between lamprophyre and basalt may also be a controlling factor.

There are major changes in absolute element content of lamprophyre with weathering that may not be obvious in normal weight percent tabulation (e.g. compare Si in Table 1 and Figure 1). Effect of lamprophyre weathering on water composition can at least be qualitatively estimated from the element mobility sequence. Because of the intensive weathering of most lamprophyre outcrops, based on data in Figure 1 and by analyzing weathered lamprophyre samples, it should be possible to calculate the composition of the original rock which could be of value for regional igenous rock studies.

This project was supported in part by funds from the University of Arkansas Research Reserve Fund and the Arkansas Geological Commission.

	SiO_2	CaO	$Fe_2O_3^*$	TiO_2	MnO	Cr	Co	Ni	V
LS-270	42.00	15.00	9.70	3.85	0.160	698	39	264	670
LS-270W	45.75	8.20	12.75	4.74	0.204	726	66	304	870
LS-70	42.50	14.70	12.55	4.74	0.263	<5	47	31	770
LS-70W	42.75	1.00	15.50	7.81	0.078	650	90	600	1310
AGS-104	46.50	6.80	13.85	3.73	0.177	136	52	52	622
AGS-104W	42.25	1.00	24.25	6.78	0.395	228	155	228	1112
AGS-55	44.25	10.40	11.75	4.08	0.230	100	32	87	688
AGS-55W	42.50	8.20	14.25	4.65	0.189	48	69	76	796
AGS-103	43.83‡	10.60‡	12.00	3.72	0.190	<5	49	27	562
AGS-103W	44.00	7.50	14.95	4.65	0.199	136	61	76	850
AGS-94	42.54‡	12.40‡	13.75	3.72	0.170	<5	68	17	640
AGS-94W	44.50	1.00	12.50	9.12	0.097	512	109	455	1520
AGS-74	45.25	14.00	10.75	3.23	0.200	70	43	39	562
AGS-74W	40.00	12.80	13.50	3.89	0.255	102	54	75	688

‡ Average value

Table 1. Chemical analyses of weathered and unweathered lamprophyre samples. Cr, Co, Ni and V in ppm and all other values in weight percent. $Fe_2O_3^*$ is total iron calculated as ferric oxide. Samples AGS-74, AGS-94 and AGS-104 are ouachitite; sample LS-270 is a melamonchiquiate samples AGS-103 and LS-70 are monchiquite and sample AGS-55 is a theralite.

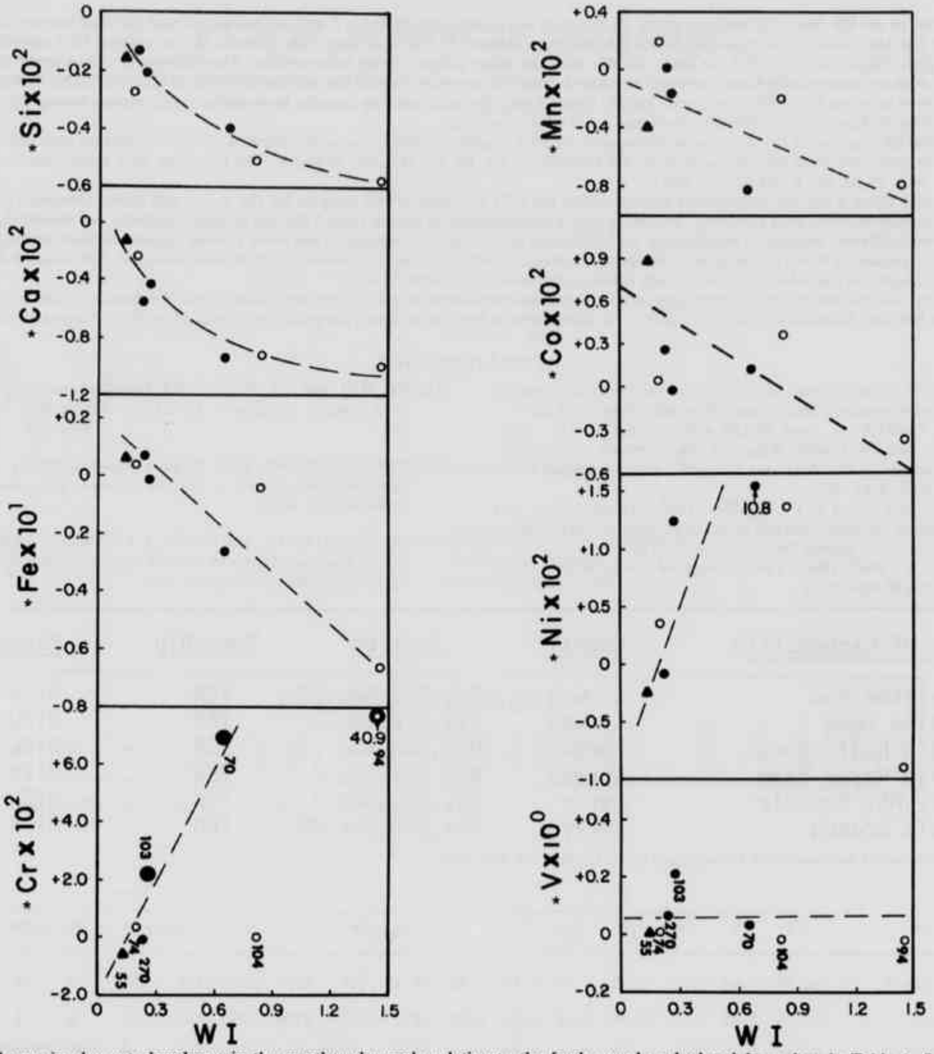

Figure 1. Change in element abundance in the weathered sample relative to the fresh sample calculated from data in Table 1. See text for definition of WI and *. In the *Cr and *V plots the numbers correspond to sample numbers in Table 1. Circled points in the *Cr plot represent minimum values.

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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, in 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 igenous 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 HC1 for chemical analyses. Samples were only partially soluble in HC1. 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).