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The Abundance of Several Relatively Rare Elements in Igneous Rocks of North America[1]

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Methods of precision spectrochemical analysis, which have recently been developed in the Department of Geology, MIT, are being applied to the quantitative analysis of 17 relatively rare elements in approximately 150 igneous rock specimens from North America. The whole project will involve 2,000–2,500 determinations, each in duplicate. Thus far, about 1,500 determinations have been made. There will, however, be considerable delay before the project is complete, and all the data assembled and discussed; this note is a preliminary report.

These elements are being determined: Li, Rb, Cu, Ag, Ga, Pb, La, Y, Nd, Sc, V, Co, Cr, Sr, Ba, Zr, and F. The present investigation is concentrated mainly on some common rock types, namely, diabase, granite, and basalt; later investigations may include other rock types, including sediments. One object of the investigation is the determination of the abundance of the above elements in igneous rocks of North America, first, for the sake of intercontinental comparisons and, second, to check existing abundance values for these elements in the earth's crust and to provide new and more precise values. Another object is a statistical survey of the abundance distribution of each element within a given rock type. Because precision methods are being used and because many specimens of each rock type have been analyzed, the analytical data may be handled statistically on a quantitative basis. For example, it is a well-known *qualitative* fact that gallium is relatively uniformly distributed in igneous rocks because of its close association with aluminum. Fig. 1 is a histogram based on 75 specimens, which shows this quantitatively for diabase. For comparison, a histogram showing the distribution of zirconium in the same suite of specimens is also given in Fig. 1.

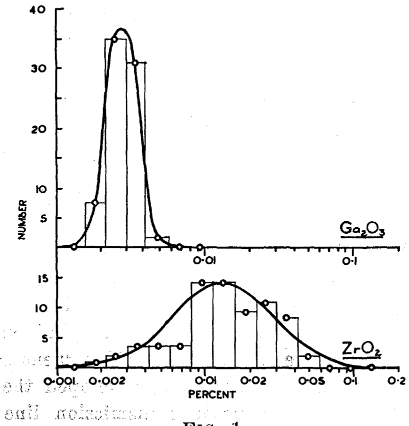

FIG. 1.

For many of the abundance measurements given during the past two decades, spectrochemical methods were employed. Although these served the desired purpose successfully, for the most part they were semiquantitative, and in many cases the analysis of each element involved a separate operation (re-arcing). In this investigation we have attempted to develop a limited number of general methods, each of which can handle several elements, and each of which may be regarded as a precision method. For example, in one method, Ga, Pb, Cu, and Ag are determined in a single operation; in another, V, Cr, Sc, Y, La, Nd, Zr, Co, Ni, Sr, and Ba are determined. An indication of the reproducibility (precision) is given in Table 1, which shows some replicate analyses of gallium and of zirconium in a specimen of diabase.

TABLE 1

	% Ga_2O_3		% ZrO_2
	0.0027		0.014
	.0027		.014
	.0028		.013
	.0031		.014
	.0028		.012
	.0025		.014
	.0028		.014
	.0027		.013
	.0023		.013
	0.0025		0.012
Mean	0.0027	Mean	0.013

Although a given spectrochemical method may be precise, it may nevertheless introduce a systematic error (bias). The presence of such an error may cause considerable difficulty in correlating sets of analytical data from different laboratories. To reduce possible systematic error to a minimum, all determinations will be calibrated in terms of two naturally occurring standard specimens, one of granite and one of diabase. These specimens have been analyzed spectrochemically and colorimetrically for some elements in several laboratories.

[1] This investigation is part of a general program of spectrographic research carried on in the Department of Geology, MIT, under contract with the Office of Naval Research, Washington, D. C., and under the supervision of H. W. Fairbairn.