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SOME TRACE-ELEMENT DATA ON PLIOCENE BASALTIC ROCKS FROM TWO DISTRICTS IN HOKKAIDO

by

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(with 1 table and 1 text-figure)

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Abstract

Trace elements Rb, Sr, Zr, Y, Cu, Ni, Zn, Co, and Pb are recorded from basaltic rocks of the Kitami-Monbetsu district of east Hokkaido and the Takikawa-Fukagawa Basin and Kabato Mountains of central-west Hokkaido. Those of the former district, although petrologically similar to some from the latter district, show a different distribution of trace elements. In particular Zr and Zn are higher, and Rb and Sr are lower in the eastern basalts. Other slight differences are suggested. The reason may be an initial abundance variation.

Introduction

Pliocene basaltic rocks from two areas in Hokkaido (Kabato Mountains and Takikawa-Fukagawa basin to the north and northeast of Sapporo, and the Kitami-Monbetsu district fronting the Okhotsk Sea in northeast Hokkaido) have been studied by Ōba (1968, 1971, 1972, 1975), who presented 30 major-element analyses. Eleven of these rocks have been analysed for trace-elements Rb, Sr, Zr, Y, Cu, Ni, Zn, Co and Pb in theX-ray laboratory of the Department of Geology and Mineralogy, University of Queensland, Brisbane, by A.S. Bagley using a Philips PW1410 X-ray spectrometer. Checks were made against standards BCR-1, G-2, AGV-1 and GSP-1.

Eight of the analysed rocks come from the more westerly occurrence; they comprise four "Basin type basalts" (Ōba, 1972) from the Takikawa-Fukagawa basin (W1, W2, W4, W6) and two each from the Hamamasu (W7, W12) and Etai-dake (W14, W18) basalt complexes of the Kabato Mountains. These range from porphyritic olivine basalt (W1, W7) through basalts with phenocrysts of olivine and augite (W.2, W4, W6, W14) to olivine-bearing basaltic andesites (W12, W18). The Basin type basalts are high in Al_2O_3, but are classified as

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primitive alkali olivine basalts; those of Hamamasu and Etai-dake are in the high-alumina basalt field or close to its boundary with the alkali basalt field. The remaining three basalts from northeast Hokkaido are olivine basalts, and have been plotted in much the same field as those from Hamamasu and Etai-dake, except that some of the more basic rocks have less alkalies.

Discussion of Results

From the limited number of analyses carried out (Table 1), the following suggestions are made:

1. Zr is higher and Sr lower in the Kitami-Monbetsu (eastern) basalts.
2. Rb is lower and Zn slightly higher in the eastern basalts and W1, compared with the remainder.
3. Cu is slightly lower in the eastern basalts.
4. Y is slightly higher in the eastern basalts and W18.
5. Pb is lower in the Kabato Mountains basalts (especially in the two Hamamasu samples) except for an anomalously low Basin type basalt (W2).
6. Ni is variable, and at least in the western basalts is correlated with the percentage of olivine phenocrysts.
7. Co is fairly uniform, but appears to be slightly lower in the basaltic andesites (increasing SiO_2).

Table 1 Tracè-element data in ppm.

Sample	Rb	Sr	Zr	Y	Cu	Ni	Zn	Co	Pb	K/Rb
E1	15	369	156	36	36	113	81	30	2	321
E4	11	366	145	32	27	71	102	29	3.1	498
E7	18	374	160	30	33	114	82	25	2.2	332
W1	16	415	88	23	58	187	82	34	2.3	400
W2	44	665	110	27	54	42	73	24	>0.1	232
W4	22	460	82	26	40	87	67	26	2.7	260
W6	23	488	87	26	39	71	67	25	2.3	303
W7	44	510	81	23	61	79	74	26	0.6	240
W12	51	579	105	22	42	69	60	22	0.3	231
W14	36	509	92	27	46	125	67	28	1.0	224
W18	62	432	113	33	55	110	54	23	1.8	200
mE	15	370	154	33	32	99	88	28	2.4	384
mW	37	507	95	26	49	96	68	26	1.4	261

Pb results as calculated (precision less than results infer).
E = Kitami-Monbetsu district (Ōba, 1975, Table 2): W = Western Hokkaido (Ōba, 1972, Table 2): mE, mW = mean of E and W rocks respectively.
See text for districts and names of rocks.

The main trace-element differences are between the eastern (Kitami-Monbetsu) and western (Basin type and Kabato Mountains) basalts as indicated by the mean values in Table 1. The eastern basalts however are not distinctive,

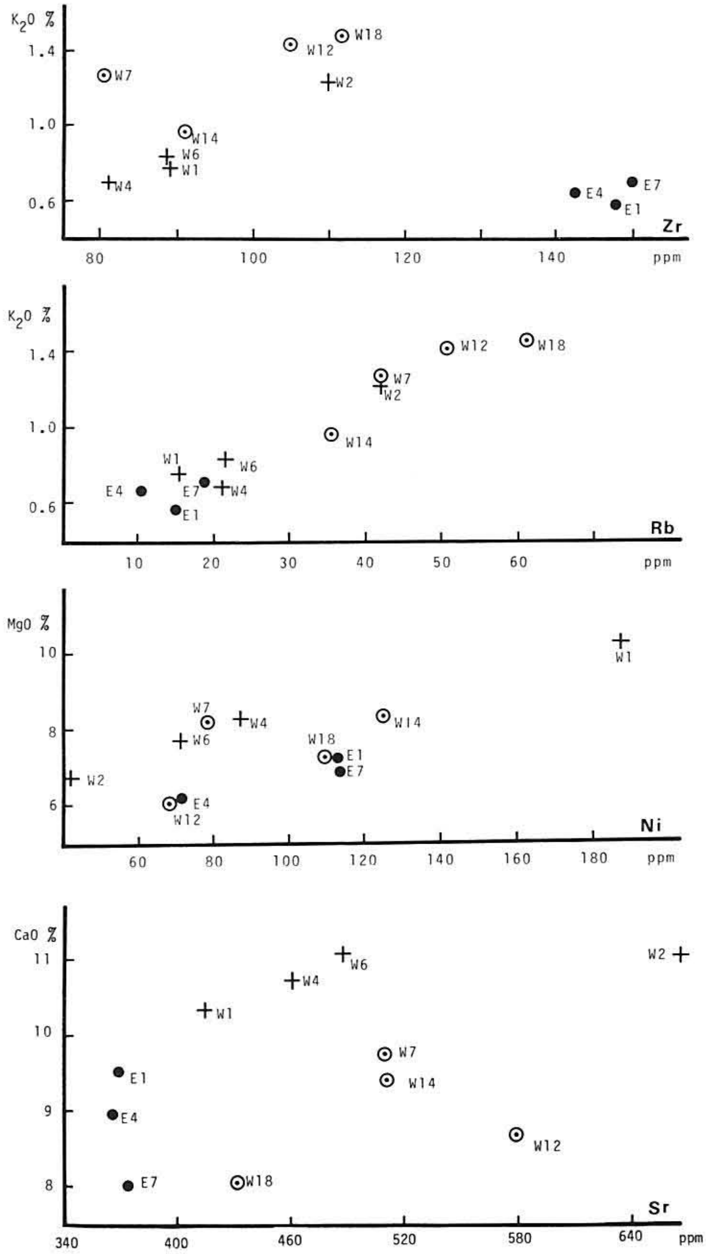

Fig. 1 Zr and Rb v. K_2O, Ni v. MgO, and Sr v. CaO.

petrologically or mineralogically, from the western basalts; they have similar petrographic features to those of the Kabato Mountains and both these groups are plotted mainly in the field of high-alumina basalts (Ōba, 1975). The three eastern basalts chosen for trace-element analysis lie on either side of the join line between the fields of alkali basalts and high alumina basalts (Kuno, 1968) and have total alkalies comparable with the Basin type basalts. The eastern basalts are also slightly lower in alumina than the western basalts, and the analysed samples E1, E4 and E7 are slightly higher in soda and lower in potash.

The more alkaline olivine basalts in these districts are the Basin type basalts, which should have more Rb, Sr and Zr than tholeiites, but less Cu and Y (Prinz, 1967, p.318). These relations should also hold between alkali basalts and high-alumina basalts, but although the Basin type basalts have more Rb and Sr and less Y than the eastern basalts, they have less Zr and more Cu. Differences between trace-elements of Basin type and Kabato Mountains basalts are less obvious and some have already been noted in the summary above.

Correlations of trace with major elements Na, K. etc. have been noticed, e.g. K – Rb, MgO – Ni and (in the western basalts) Zr – K and Zr – Total alkalies (Fig. 1), but not Ca – Sr. In the K/Zr ratio, the eastern basalts are distinctive (mean 35), compared with Basin type basalts (79) and Kabato Mountains basalts (110). There is also a positive correlation between Rb and K content, with K/Rb ratios higher in the eastern basalts and W1, and lowest in the most differentiated western basalts.

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References

Kuno, H., 1968. Differentiation of basalt magmas. In: H.H. Hess and A. Poldervaart (Editors), *Basalt, The Poldervaart Treatise on Rocks of Basaltic Composition,* Interscience, New York, vol.2, pp.623-688.

Ōba, Y., 1968. Petrological study of the Neogene basalts from the western part of Hokkaido, (1) The basin type basalts of Takikawa-Fukagawa district. *J. Japan. Ass. Min. Petr. Econ. Geol.,* 60: 222-227. (in Japanese with English abstract)

Ōba, Y., 1971. Petrological study of the Neogene basalts from the western part of Hokkaido, (2) Petrology of the Etai-dake basalts. *J. Japan. Ass. Min. Petr. Econ. Geol.*, 66: 190-196. (in Japanese with English abstract)

Ōba, Y., 1972. Petrology of the late Pliocene basalts of the western part of Hokkaido. *J. Fac. Sci., Hokkaido Univ., Ser.4,* 15: 11-26.

Ōba, Y., 1975. Late Neogene basaltic rocks from the Kitami-Monbetsu district, northeast Hokkaido. *J. Fac. Sci., Hokkaido Univ., Ser.4,* 16: 501-510.

Prinz, M., 1967. Geochemistry of basaltic rocks: Trace elements. In: H.H. Hess and A. Poldervaart (Editors), *Basalt, The Poldervaart Treatise on Rocks of Basaltic Composition,* Interscience, New York, vol.1, pp.271-323.

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