Cancrinite-tinguaite and K-rich trachyte in the Nongcharam-Darugiri area of East Garo Hills District, Meghalaya : A Preliminary study

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Abstract

Rocks of alkaline affinity, namely cancrinite-tinguaite and K rich trachyte occur as dykes in the Precambrian gneissic and migmatitic country rocks in the Nongcharam-Darugiri area of the East Garo Hills district Meghalaya Cancrinite-tinguaite is characterized mineralogically by the presence of phenocrysts of high temperature K-feldspar cancrinite nepheline aegirine-augite aegirine, diopside, biotite and occasional barkevikite in a groundmass consisting of K-feldspar albite anorthoclase, aegirine aegirine-augite, nepheline, cancrinite, sodalite and chlorite and chemically by an agpaitic index' of about 1 2 K-rich trachyte exhibits porphyritic texture, and is chemically characterized by low Na_2O(0 45 wt %), high K_2O(13 25 wt %) resulting in high K_2O/Na_2O ratio of nearly 30

This occurrence of alkaline and related rocks together with the earlier reported occurrence of an alkaline-carbonatite complex from the nearby Wah Sung valley, Meghalaya points to an alkaline phase of magmatic activity in this part of the Indian subcontinent

Indroduction

During the course of radiometric surveys in parts of Meghalaya by the Atomic Minerals Division of the Department of Atomic Energy, occurrence of subvolcanic and volcanic rocks of alkaline affinity has been recorded in the Ailawe-Darugiri-Nongcharam tract (Fig 1) of the East Garo Hills district, Meghalaya We present here a preliminary account of petrographical and chemical features of the alkaline rocks

Geological Setting

Precambrian biotite- and biotite-hornblende-gneiss and migmatites constitute the country rocks, which show a general NE-SW trend with high angle dips toward SE or NW (Fig 1) Xenoliths of fine-grained basic rocks are present Pink and grey granites, syenites and pink pegmatites occur as intrusives, trending either parallel to foliation or intersecting at an angle of 10° to 15° Around Darugiri, trachyte occurs as a relatively smaller dyke Dark green and greyish-green tinguaite occurs either as detached outcrops (as in the hillock near Bamboo Chips factory at Nongcharam) or as a dyke-like body (as seen near Ailawe village) It may be added that exact field relationship between these dyke-like bodies and the gneissic country rocks is rather difficult to establish due to extensive soil cover and dense vegetation in the area

Petrography

Cancrinite-tinguaite Megascopically, these are dark green to greyish green in colour and are compact with a few having amygdules filled by zeolites Micro-

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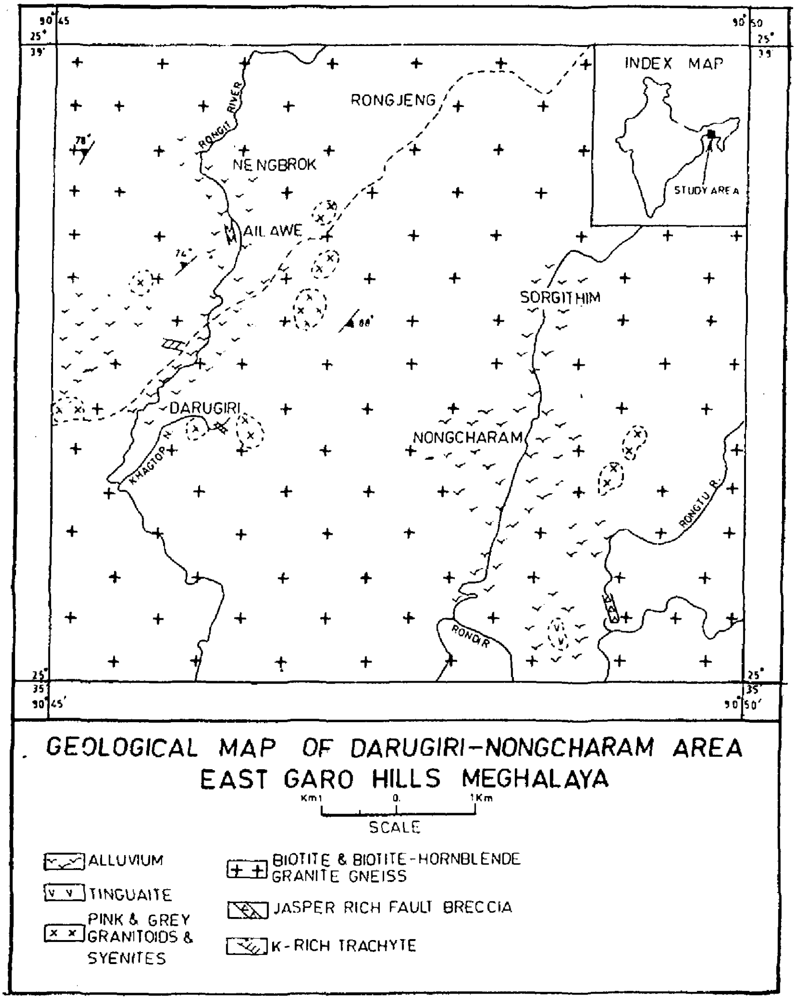

Figure 1.

scopically, they are holocrystalline-porphyritic, defined by phenocrysts of high-temperature turbid K-feldspar (sanidine and anorthoclase, identified by XRD), cancrinite, rhomb-shaped squares of altered nepheline, aegirine-augite, aegirine, diopside, resorbed biotite and occasional barkevikite, set in a groundmass comprising of aegirine-augite and aegirine needles, K-feldspar, albite laths, nepheline, cancrinite, sodalite and chlorite. Accessories include apatite, calcite, sphene and magnetite. Reaction rims of aegirine, aegirine-augite and chlorite were observed around phenocrysts of biotite and barkevikite. Nepheline is partly altered to zeolite, cancrinite and calcite.

K-rich trachyte: Megascopically, the specimens (sp. gr. ca. 2.44) are fine-grained, pink coloured and relatively compact. In thin-section, they are seen to be composed of phenocrysts of mostly euhedral K-feldspar, 1 to 2 mm long, with a tendency to trachytoid alignment and a little irregular shaped quartz set in a groundmass of

K-feldspar. K-feldspar is both orthoclase and microcline, with the former in minor amounts and at places transforming into the latter. Limonitic material occurs in the groundmass as well as around and along microfractures of the phenocrysts.

Petrochemistry

Chemical analyses and C.I.P.W. norms of cancrinite-tinguaite and K-rich trachyte are compared with related standard analyses in Table I.

The cancrinite-tinguaite of the present area as compared to the average tinguaite is characterized by relative depletion of SiO_2 and enrichment in CaO and Na_2O. This is because of the presence of cancrinite (chemically contains lower SiO_2 and higher CaO and Na_2O compared to nepheline) as an essential mineral in addition to nepheline. The agpaitic index of the analyzed sample is 1.23.

K-rich trachyte of the area under study as compared to that of Keiserstuhl carbonatite complex of West Germany (Sutherland, 1967) is marked by higher K and lower Na resulting in high K_2O/Na_2O ratio of about 30. In contrast to both these, the K-rich trachyte occurring as a small dyke-like outcrop intrusive into the Precambrians of Molvern Hills, England (Thorpe, 1971, 1982) is silica-undersaturated and contains still higher K_2O and lower Na_2O, resulting in abnormally high K_2O/Na_2O ratio of 138.

Discussion

It is generally supposed that magma of trachytic composition is the immediate parent of both phonolites (mineralogically very similar to tinguaites) and alkaline rhyolites, as the undersaturated and oversaturated end-members, respectively, are each associated with trachyte in many provinces like the Gronnedal-Ika alkaline complex in southwest Greenland (Gill, 1972). This hypothesis on the derivation of phonolite and alkaline rhyolite from a trachytic parental magma is also consistent with the results of experimental petrology in the system of Na_2O-Al_2O_3-Fe_2O_3-SiO_2 (Bailey and Schairer, 1966) and Qz-Ne-Kp (Morse, 1969). It is pertinent to add here that in the area under study, in addition to cancrinite-tinguaite and K-rich trachyte described above, an altered radioactive Fe-rich rhyolite (with 0.27% U_3O_8 and 0.039% ThO_2, mainly from brannerite and goethite) having high K_2O/Na_2O (comparable to that of K-rich trachyte) has been identified (Dhana Raju, unpublished report AMD/DAE 1981). In the light of above, it appears that in the present area also, trachyte may be the immediate parent magma for both tinguaite and rhyolite. Further, the presence of appreciable amounts of phenocrysts of K-feldspar, cancrinite and nepheline in tinguaite and K-rich trachyte indicates that fractional crystallization was the main mechanism of magmatic fractionation.

It is conventional to regard alkaline olivine basalt as the progenitor for trachyte, but so far, no alkaline olivine basalt has been recorded in the present area. Talukdar (1967) has reported the occurrence of rhyolite and alkali basalt from the Sylhet trap of Dwara and Umier gorges of the nearby Khasi Hills district of Meghalaya, and some 'alkaline lamprophyres' are also reported from the northeastern Garo Hills (Geol. Surv. India, 1975). These occurrences indicate the possibility of alkaline basalt as the progenitor for trachyte in this province also.

Of the two rock types described in the present note, the cancrinite-tinguaite is truly alkaline due to the presence of cancrinite, nepheline, aegirine-augite and barkevikite, and this is corroborated by its normative nepheline and acmite as well as its agpaitic index of 1.23. K-rich trachyte, though not strictly alkaline by definition,

TABLE I Chemical analyses and C I P W norms

	3856	3	ME-997	K 21	BU 1641	7
SiO_2	48 32	54 08	62 66	60 09	55 1	61 21
TiO_2	0 67	0 54	0 10	0 33	0 86	0 70
Al_2O_3	18 90	18 65	18 90	18 58	14 8	16 96
Fe_2O_3	3 91	3 92	0 51	3 64	2 9	2 99
FeO	1 51	2 28	0 18	0 10	2 6	2 29
MnO	0 23	0 22	0 03	0 09	0 12	0 15
MgO	0 03	1 07	0 78	0 18	2 5	0 93
CaO	5 43	2 77	0 15	0 57	3 7	2 34
BaO	—	—	0 97	—	0 21	—
Na_2O	11 50	8 10	0 45	1 21	0 1	5 47
K_2O	4 06	5 52	13 25	12 63	13 80	4 98
P_2O_5	0 76	0 20	0 05	0 08	0 31	0 21
L O I	4 41	2 39	1 71	2 72	4 2	1 71
Total	99 73	99 74	99 74	100 22	101 20	99 94
C I P W norms						
Q	—	—	7 22	3 49	—	5 00
or	23 99	32 63	78 33	74 73	80 6	29 41
ab	6 40	26 03	3 83	10 22	—	46 26
an	—	—	2 14	1 95	—	7 05
C	—	—	3 03	2 17	—	—
ne	36 96	21 22	—	—	—	—
ac	11 32	2 90	—	—	—	—
ns	2 28	—	—	—	—	—
di	4 01	7 24	—	—	—	2 14
wo	7 26	1 26	—	—	—	—
hy	—	—	1 95	0 45	1 2	2 06
ol	—	—	—	—	4 1	4 33
mt	—	4 22	0 37	—	3 7	—
hm	—	—	0 26	3 65	—	—
il	1 27	1 03	0 20	0 41	1 7	1 34
ap	1 82	0 48	0 13	0 20	0 6	0 49

3856 Cancrinite-tinguaite, Nongchaiam East Garo Hills district, Meghalaya, India (Analyst G S Chowdary A M D

3 and 7 Average tinguaite and trachyte respectively (Le Maitre 1976)

ME-997 K-rich trachyte, Darugiri East Garo Hills district, Meghalaya, India (Analyst G S Chowdary, A M D)

K 21 K rich trachyte Keiserstuhl carbonatite complex, West Germany (Sutherland, 1967)

BU 1641 K rich trachyte from the Malvern complex, Earnslaw quarry, England (L O I includes 3 0 % CO_2) Thorpe, 1982) has the distinction of being highly K-rich with low Na and Si. The low Na_2O content (0.45 wt.%) and high K_2O (13.25 wt.%) and high K_2O/Na_2O ratio of about 30 in K-rich trachyte, point to the depletion of Na and enrichment in K. This might have taken place either due to K-metasomatism after the emplacement of original rock, as suggested by Sutherland (1967) or by interaction of meteoric water with the original glassy siliceous rocks resulting in preferential leaching of Na^+ and consequent enrichment of K^+, as advocated by Stewart (1979) for the siliceous potassic glassy rocks. It is further possible that the parental magma for this trachyte was itself rich in K, a point which needs to be verified by future geochemical study.

The occurrence of cancrinite-tinguaite and K-rich trachyte in conjunction with the reported occurrence of an alkaline-carbonatite complex from the nearby Wah Sung valley of Jaintia Hills (Yusuf and Saraswat, 1977) points to a distinct alkaline phase of igneous activity in this part of India.

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