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LATE CADOMIAN INTERMEDIATE MINOR INTRUSIONS OF GUERNSEY, CHANNEL ISLANDS: THE MICRODIORITE GROUP

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A distinctive group of dykes of intermediate composition trending east-north-east to west-south-west cuts many components of the Southern Metamorphic Complex of Guernsey, C.I. and postdates all units of the Cadomian Northern Igneous Complex. They are, however, cut by the albite-dolerite dykes. The microdiorite dykes are generally fine-grained porphyritic rocks, sometimes exhibiting a flow fabric. Some of the dykes show evidence of a post- emplacement deformation and all have been subjected to low temperature metamorphism to varying degrees. The primary mineralogy is essentially zoned intermediate plagioclase and magmatic amphibole with varying minor amounts of quartz and biotite. The microdiorites form a coherent petrochemical group with clear calc-alkaline character. The group is seen as representing the final phase of Cadomian magmatism on Guernsey.

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INTRODUCTION

One of the distinctive features of the geology of Guernsey is the presence of numerous dykes, with a wide range of compositions, which were emplaced at various times during the evolution of the island (Roach *et al.,* 1991). Various groups of what are here referred to as the older dykes are variably deformed, are metamorphosed (greenschist facies or higher) and predate the emplacement of the Cadomian Northern Igneous Complex (N.I.C.). These older dykes are restricted to the Southern Metamorphic Complex (S.M.C.). The most abundant examples of the older dykes are the tholeiitic to subalkaline metadolerites of the Vazon Dyke Swarm (Lees and Roach, 1987). In contrast, the younger dykes, which are either contemporaneous with or postdate the emplacement of the N.I.C., exhibit a low or very low grade of metamorphism, involving only partial alteration of the primary minerals. A table of the dyke sequence is given by Lees and Roach (1987). Three main groups of dykes can be shown to postdate all components of the N.I.C. : (1) the microdiorite group; (2) the albite dolerite group; (3) the lamprophyre group; in order of decreasing age. The albite dolerites, of alkaline basalt affinity and with a prehnite-pumpellyite metamorphic assemblage, have been described by Lees *et al.* (1989).

The present communication is concerned with the microdiorite group, examples of which occur within both the N.I.C. and S.M.C. These dykes are characterized by primary brownish amphibole, zoned plagioclase, a porphyritic texture, and a broad east-northeast to west-south-west trend. Their field relationships, petrography and variable alteration are briefly described. Major, and trace element data are presented to demonstrate their calc-alkaline character. The dykes are considered to represent a very late phase of calc-alkaline magmatism on Guernsey within the late Precambrian-early Palaeozoic Cadomian orogenic cycle rather than being related to a subsequent geotectonic regime.

PREVIOUS WORK AND FIELD RELATIONSHIPS

Drysdall (1957) was the first to distinguish dykes of an intermediate character within the N.I.C. Two groups were identified: an earlier group of microdiorites, intimately veined with leucocratic veins of intermediate to acidic composition (plagioclasite and tonalite); and a subsequent group of homogeneous microdiorites, the subject of this paper. The former, here referred to as net-veined and pillowed microdiorites, are restricted to the outcrop of the St Peter Port Gabbro, where they are seen to postdate the microbojite (microgabbro) dykes, which are also restricted to the outcrop of the gabbro. They have been briefly described by Drysdall (1957), and Bishop and French (1982), so will not be considered further in this paper. Drysdall (1957) also suggested that the later homogeneous microdiorites were emplaced at two stages, so that some dykes predated, while others postdated, the youngest components of the N.I.C. - the Cobo Granite and L'Ancresse Granodiorite.

Roach (1957) recorded microdiorite dykes cutting the main metadolerite swarm (the Vazon Dyke Swarm) in parts of the S.M.C., and tentatively suggested that they immediately predated the emplacement of the N.I.C. Subsequently Roach *et al.* (1991) equated the microdiorites in both complexes and suggested that they predated the emplacement of both the Cobo Granite and L'Ancresse Granodiorite.

In the present study the location of the microdiorite dykes sampled is depicted in Figure 1. Within the N.I.C., critical localities for establishing the age of the microdiorite group are along the west side of L'Ancresse Bay, where a single dyke cuts the L'Ancresse Granodiorite, and along the north side of Port Soif, where a single dyke cuts representatives of the Bordeaux Diorite Complex previously modified to monzodiorites and monzonites as a result of the emplacement of the Cobo Granite (D'Lemos, 1986; 1987a). Elsewhere in the N.I.C., fresh representatives of the microdiorite group cut the Bordeaux Diorite Complex in the Baie de Pecqueries area on the west coast, and between Fort Doyle and Hommet Benest along the north-east coast. Further south, well exposed microdiorite dykes intrude the St Peter Port gabbro (and its closely associated microbojite and net-veined and pillowed microdiorite dykes) at both Hougue a la Perre and near Spur Point in Belle Greve Bay.

In the S.M.C. the best and most easily accessible representatives of the microdiorite group are encountered along the west coast. In the centre of Vazon Bay a well exposed microdiorite dyke cuts Icart gneiss and representatives of the Vazon metadolerite dyke swarm, while along the west of Vazon Bay two parallel microdiorite dykes cut the Perelle Gneiss and Vazon metadolerite dykes (see the map in Lees and Roach, 1987, Fig. 2a). Other examples can be readily examined south of Compass Rock at the south-west tip of Rocquaine Bay. Here, along the east side of the north-south trending outcrop of the Pleinmont metasediments (Brioverian?), two east-west trending microdiorite dykes cut both the metasediments and the L'Eree Granite to the east. The dykes also cut a north-south acidic dyke (see Roach *et al.,* 1991, Fig. 12, -where they were erroneously labelled metadolerite). Further examples can be found along the less accessible south coast, for instance, at Belle Elizabeth, in Le Jaonnet Bay, and in Telegraph Bay (Figure 1). Microdiorite dykes also cut the Castle Cornet Gneiss, Perelle gneiss, Vazon metadolerite dykes, and the Havelet type diorite - tonalite net-vein sheets (Roach, 1966) around Havelet Bay and Castle Cornet on the east coast.

The 25 microdiorites sampled occur as generally parallel-sided dykes which trend dominantly between 070 - 090. This direction is not markedly different from that of the younger albite dolerite dykes (Lees *et al.,* 1989), which can be shown to postdate the microdiorites. The dyke walls are generally vertical or dip steeply northwards. Some intrusions, particularly those in the S.M.C., depart markedly from this attitude. Most of the dykes have a width in the range 0.5 - 1 m, with minimum values ranging from 0.2 m up to a maximum of circa 3 m.

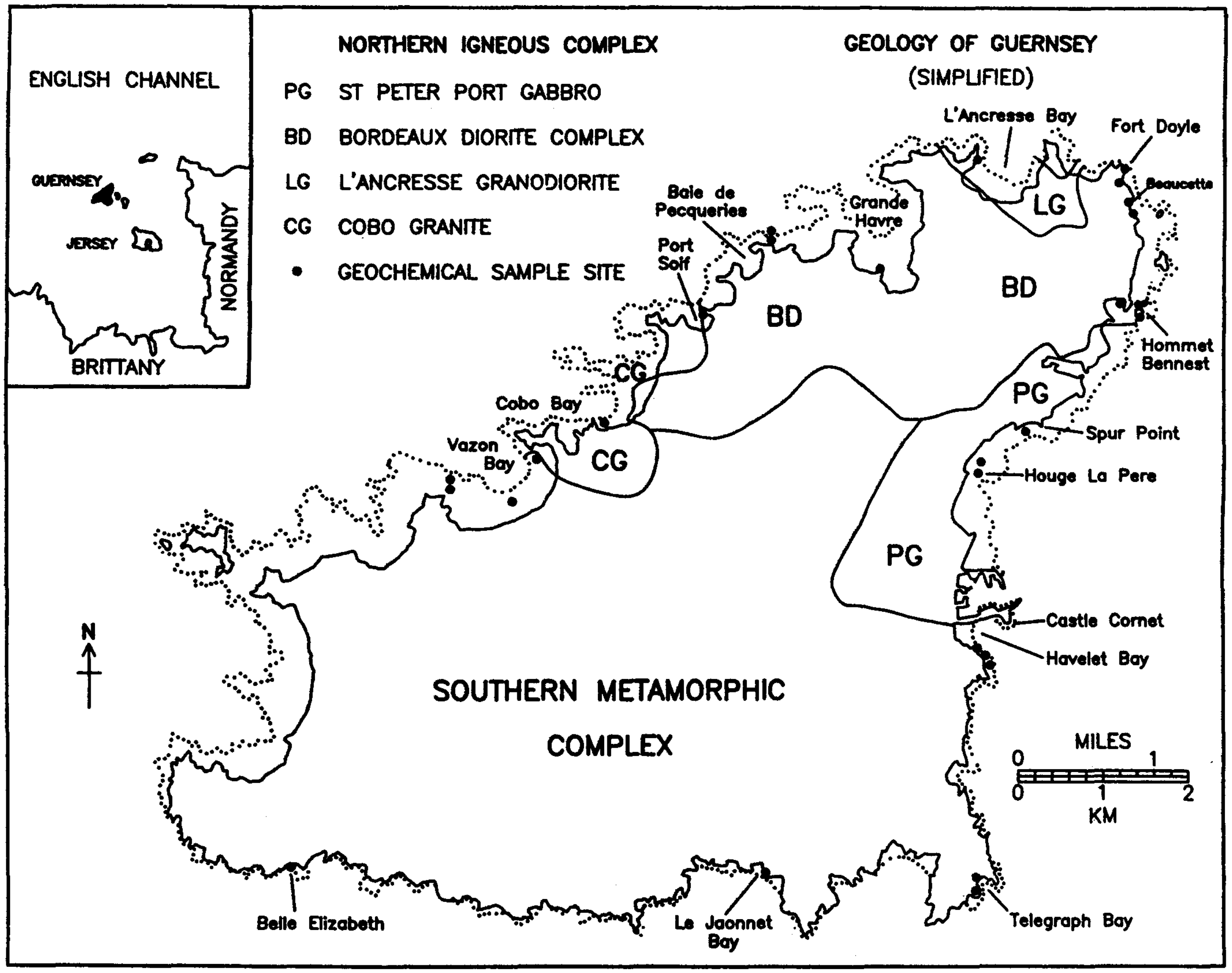

Figure 1. Map of Guernsey, Channel Islands, showing the distribution of microdiorite dykes. The outline distribution of the country rock-types is also given.

The dykes weather with a grey to brownish green carapace but are dark grey when fresh. They are generally porphyritic with phenocrysts of tabular plagioclase and less frequently of thin prismatic amphibole. Chilled margins are recognizable and these, together with the sharp straight margins and regular orientation of those examples encountered in the N.I.C., indicate that there had been a sufficient time interval for this complex to have cooled and crystallized so as to behave as a rigid mass by the time the microdiorite dykes were emplaced. While the dykes may be offset to a minor degree across late faults, a more noticeable feature is the occasional presence of a platy structure parallel or slightly oblique to the dyke walls. This appears to be related to late movement zones sited along the dyke outcrop. Examples are seen in the dyke on the west side of Spur Point and two dykes at the south end of the Beaucette layered diorite section (labelled basic by Bishop and French, 1982, Fig. 2).

Not all of the dykes sampled in the N.I.C. proved mineralogically and geochemically to be microdiorites. At Hommet immediately to the west of Hommet Benest (Figure 1); two parallel, closely set dykes with an east-north-east to west-south-west trend are more basic in composition. Thin sections revealed secondary green amphibole which appears to have replaced a primary pyroxene. Relative to the typical microdiorite dykes, their higher mafic mineral contents and lower plagioclase content suggest these dykes to be modified dolerites. Another more basic example is the well exposed east-north-east to west-south-west dyke at H.W.T.M. west from Spur Point. A fourth example is the highly altered dark green dyke cutting the Cobo Granite along the south-side of Cobo Bay. Although these altered, more mafic dykes resemble those of the Vazon Dyke Swarm (Lees and Roach, 1987), field relationships clearly indicate that they are not part of this swarm. On the east coast south of St Peter Port harbour (Figure 1) the Havelet-type net-veined sheets intrude Vazon metadolerite dykes. These Havelet-type sheets merge, on the north side of Havelet Bay and on Castle Cornet, into the border facies of the St Peter Port Gabbro. In addition, on the west coast, in the north-east part of Vazon Bay and along the Cobo to St Peter Port road, the Cobo granite veins Vazon metadolerite dykes. The Vazon metadolerites thus unequivocally pre-date the emplacement of the N.I.C.

PETROGRAPHY

Texturally, the microdiorite dyke rocks vary from porphyritic to more rarely aphyric. While plagioclase and amphibole are the principal

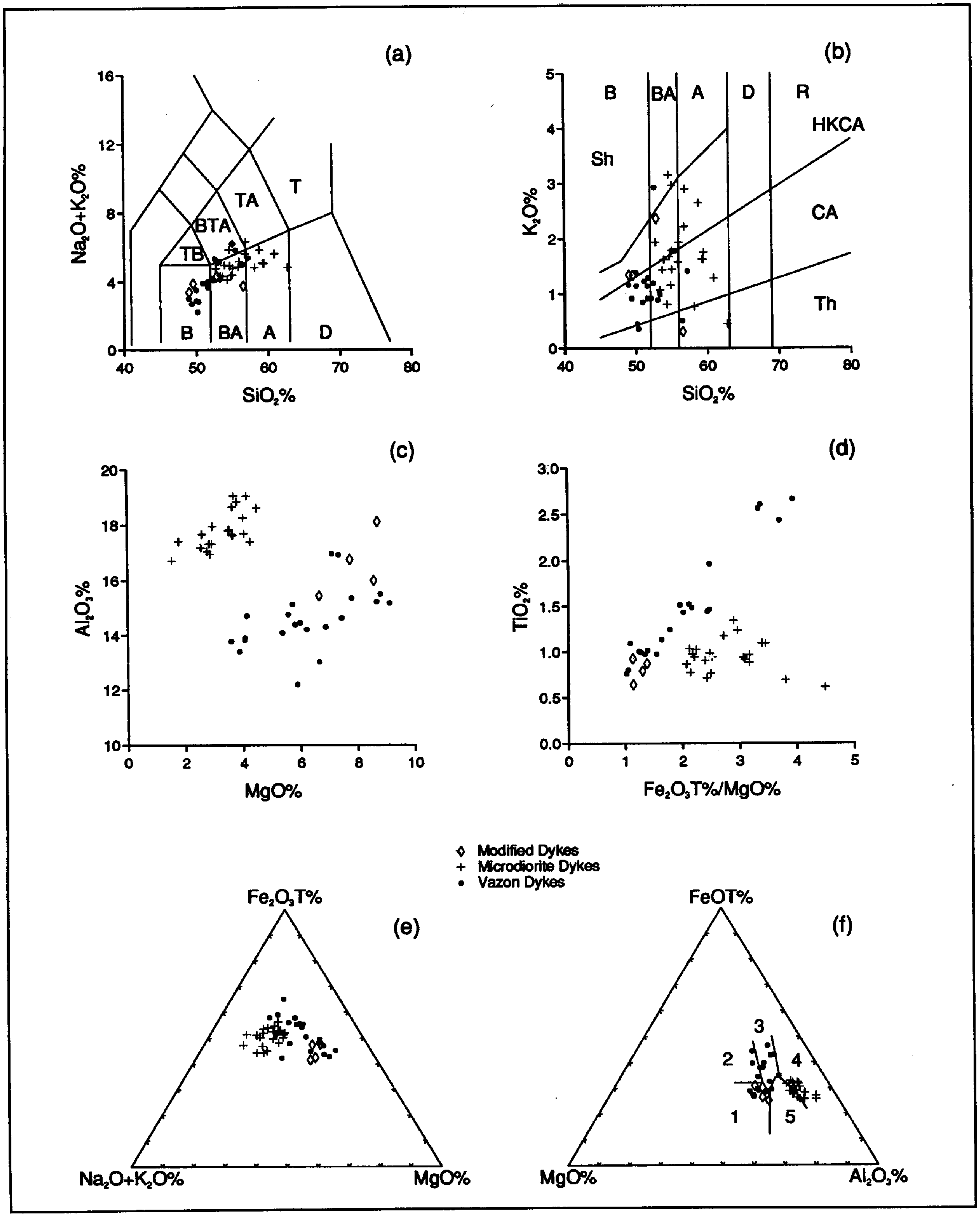

Figure 2. Bivariate and ternary major oxide plots showing the compositional variation of the microdiorite dykes and the Vazon Metadolerites: (a) Total Alkalies-Silica diagram with fields from Le Maitre et al. (1989), ie. B- basalt, BA- basaltic-andesite, A - andesite, D- dacite, TB -trachy-basalt, BTA - basaltic-trachyandesite, TA - trachyandesite, T - trachyte; (b) K_2O-SiO_2 diagram with fields from Ewan (1982), ie. rock-type fields (columns) as (a), Th - tholeiitic rock series, CA - calc-alkaline, HKCA - high-K calc-alkaline, Sh - shoshonitic; (c) Al_2O_3- -MgO diagram showing the clear separation of microdiorite and Vazon dyke compositions; (d)TiO_2-FeOT/MgO diagram (Miyashiro 1974) showing the marked difference in trends between the two groups; (e) A-F-M ternary diagram of microdiorites and Vazon dykes; (f)MgO-FeOT-Al2o3 ternary discrimination diagram for geotectonic environment (Pearce et al. 1977) showing the fields: 1 - MORB, 2 - Ocean Island, 3 - Continental, 4 - Spreading centre island, 5 - Orogenic. For further explanation, see text.

phenocryst phases, very occasionally corroded quartz phenocrysts occur.

Plagioclase phenocrysts form tablets which may reach lengths of 5 mm. Generally, however, they contribute to a porphyritic to microporphyritic texture in which both plagioclase tablets and amphibole prisms range between 0.25 mm and 1 mm in length. A distinctive feature of the plagioclase, which generally forms 60-70% of the rock, is the development of marked oscillatory zoning. In the phenocrysts the compositional range is approximately Ab_{50-70} In the matrix plagioclase laths (0.01-0.1 mm in length) appear slightly more sodic in the range Ab_{65-80}. They may show flow alignment to give a trachytic fabric.

The amphibole, when least altered, is a pale to medium brown hornblende, which occurs as euhedral to subhedral prismatic phenocrysts up to 6 mm long. It also occurs as a matrix phase and in total forms approximately 25-35% of the mode. A common distinctive feature is the presence of inclusions, occurring as dark, very fine microcrystalline aggregates of what appears to be rutile and an opaque ore. These may be aligned parallel to prominent cleavage or crystallographic directions. Euhedral to subhedral basal sections show the inclusions in a zone parallel to crystal faces. Some of the alignments appear similar to those described by Mongkoltip and Ashworth (1983).

Other primary matrix phases are small plates of green-brown biotite and intersertal quartz in areas up to 0.5 mm across. The latter, which can constitute a maximum of about 8% of the mode, occasionally forms an exceedingly fine intergrowth with an unidentified feldspar. Accessory minerals are mainly small acicular apatite and single grains or aggregates of opaque ores, including pyrite.

The primary magmatic assemblage of plagioclase and hornblende with minor biotite and quartz has been modified to various degrees by secondary alteration, and in some cases by the imposition of a secondary foliation. The zoned plagioclase is variably cloudy mainly due to development of white mica and minor epidote. Alteration may affect the whole grain (except for a clear sodic selvage) or be restricted to the core area. The brown hornblende is both frequently mantled and more patchily replaced by blue-green actinolitic amphibole which lacks the dark inclusions. Quartz may exhibit either slight undulose extinction or has been sufficiently strained to exhibit sub-grain development. The biotite is frequently altered to chlorite, which may also partly replace the hornblende. Additionally, epidote, sphene, and calcite occur as discrete secondary grains. These alterations are mirrored by the post- magmatic modifications seen in the components of the N.I.C., particularly those of intermediate and basic composition, a fact not emphasised by previous workers.

As indicated earlier, some of the microdiorite dykes carry a steeply-dipping cleavage which is slightly oblique (in a clockwise relationship) to their general east-west to east-north-east to west-south-west trend. The clearest examples are along the east side of the N.I.C. Here, the curvature of this cleavage at the margins of those dykes is consistent with a sinistral shear sense. Thin sections reveal that the cleavage is marked by aligned concentrations of small chlorite flakes and opaque ore grains. Hornblende and plagioclase grains are sometimes slightly disrupted and extended, while the quartz is strained and granular. This fabric cuts obliquely across the trachytic fabric previously mentioned. Clearly, some of the microdiorite dykes have acted as the loci for late movement. Other narrow, steeply dipping shear zones, not associated with the dykes, are present elsewhere in the N.I.C., particularly the St Peter Port gabbro. Many have a similar trend to those of the dykes and also a sinistral displacement. Evidence for post-microdiorite dyke tectonism in the S.M.C. is illustrated by the thin, southerly dipping microdiorite dyke cutting Perelle Gneiss and Vazon metadolerite dykes west of Belle Elizabeth. At one locality, a microdiorite with north-south cleavage invades one of the representatives of the Vazon Dyke Swarm which had previously been converted to a greenschist within a Cadomian zone of high strain (see Lees and Roach, 1987, Fig 3e).

PETROCHEMISTRY

Analyses have been made of 22 samples of microdiorite dykes for major and trace elements by X.R.F.S. at the University of Keele. These show the microdiorites to occupy a relatively small compositional space (cf. Table 1 and Figure 2). The microdiorites have a thoroughly intermediate chemistry, with SiO_2 between 52.8 and 62.8%, all falling into the basaltic- andesite and andesite fields of Ewart (1982). Al_2O_3 values between 16.8 and 19.0% reflect the high feldspar content of the rocks. Their Fe_2O_3T/MgO ratios are also relatively high, i.e. between 2.1 and 4.7.

Chemical classification of intermediate rocks depends largely on their alkali contents. Unfortunately, the microdiorites have undergone a low grade metamorphism, albeit to varying degrees and rarely to the extent that the primary mineralogy has been completely destroyed. Under such conditions the alkali elements, particularly Na and K, tend to be mobile. However, the total alkali content tends to behave much more coherently. In the TAS (total alkali versus silica) diagram (Le Maitre *et al.,* 1989) (Figure 2a), the microdiorites mostly plot in the subalkaline field. Further classification of subalkaline volcanic rocks depends on the K_2O content - which can be highly mobile under low grade metamorphic conditions. In the K_2O versus SiO_2 diagram of Ewart (1982) (Figure 2b), however, the behaviour of the microdiorites is again reasonably coherent - nearly all plot in the calc-alkaline and some in the high-K calc-alkaline fields. Little in the way of clear trends can be seen in the various bivariate scatterplots (Figures 2 and 3), the microdiorites usually forming an elliptical cloud of points. This is again characteristic of many calc-alkaline associations (e.g. Brown *et al.,* 1990).

In the chemical diagrams of Figures 2 and 3, the compositions of the microdiorites are compared with those of the Vazon metadolerites from the dataset of Lees and Roach (1987) augmented by further analyses. A clear separation between the two groups is clearly evident on many bivariate plots, eg. Al_2O_3 - SiO_2, Al_2O_3 - MgO (Figure 2c), Ba - Sr (Figure 3a), etc. The microdiorites have significantly higher contents of Al_2O_3 Sr, Ba than the Vazon dyke rocks, but significantly lower contents of MgO, Fe_2O_3T, and TiO_2.

Miyashiro (1974) used the FeOT/MgO ratio with SiO_2, FeOT, and TiO_2 to discriminate between tholeiitic and calc-alkaline volcanic suites. Neither the SiO_2 vs FeOT/MgO nor the FeOT vs FeOT/MgO plots (not shown) classify the microdiorites as calcalkaline on the basis of his discriminant boundaries, the FeOT/ MgO ratio being too high. However, the trend in the former plot is clearly that of SiO_2 enrichment, while the latter shows a trend of constant to slightly declining FeOT content, with increasing FeOT/MgO ratio. These trends contrast marked with those of the Vazon metadolerites, where SiO_2 remains constant and FeOT increases markedly with increasing FeOT/MgO. More unequivocal is the almost perpendicular difference in the trends of the two groups in the TiO_2 vs FeOT/MgO plot (Figure 2d); the microdiorites show a trend of constant to slight decrease in TiO_2 content with increasing FeOT/MgO while the Vazon dykes show a clearly marked increase. The former is characteristic of calc-alkaline suites, the latter of tholeiitic ones.

In the A-F-M ternary diagram (Figure 2e), the microdiorites occupy a tight rounded field towards the alkali apex, differing from that of the Vazon dykes which has a distinct iron enrichment trend. Comparison with the distribution of the plutonic rocks of the N.I.C. (Brown *et al.,* 1990) emphasises the limited compositional range of the microdiorite dykes compared to the full calc-alkaline spread seen in the components of the N.I.C. Both datasets show a moderate degree of iron enrichment when compared with the classic calc-alkaline trend of Daly (1933). Differences in trace element behaviour between the microdiorites and the Vazon dykes are considered further in discussion.

Geotectonic discrimination diagrams for intermediate rocks are very few. However, the MgO-FeOT-Al_2O ternary plot of Pearce *et al.* (1977) is claimed by its authors to be most sensitive for rocks with SiO_2 contents between 51 and 56%. The microdiorites on the boundary of the fields for rocks of orogenic origin and

Roach and Lees 1994 Table 1

	Microdiorites		Vazon Metadolerites	
Number of Samples	22		21	
	Mean	Std-Devn	Mean	Std-Devn
SiO_2	56.45	2.674	52.24	2.289
TiO_2	0.95	0.177	1.49	0.611
Al_2O_3	17.82	0.683	14.6	1.129
Fe_2O_3T	8.71	1.159	11.48	2.032
MnO	0.13	0.037	0.17	0.035
MgO	3.26	0.784	6.19	1.664
CaO	5.93	0.986	8.29	2.295
Na_2O	3.39	0.429	3.04	0.914
K_2O	1.73	0.714	1.17	0.549
P_2O_5	0.21	0.082	0.18	0.075
LOI	1.42	0.682	1.22	0.497
TOTAL	100	0.353	100.07	0.79
FeOT/MgO	2.8	0.624	2.07	0.891
Fe_2O_3	8.71	1.159	2.6	3.669
FeO	0	0	8.09	4.201
Na_2O+K_2O	5.12	0.617	4.21	1.092
Cr	16	9.9	174	167
Cu	21	8.7	46	22
Ga	21	1.9	18	2
Nb	8	2	10	3
Ni	8	3.2	84	143
Pb	9	4.5	16	5
Rb	71	36.6	53	24
Sr	424	80.3	240	55
Th	2	1.6	3	2
V	168	57	293	85
Y	25	4	34	10
Zn	82	21.8	92	39
Zr	141	23.4	128	44
Ba	529	183.7	262	122
La_{XRF}	15	5.3	11	8
Ce_{XRF}	38	13.9	17	17
Nd_{XRF}	27	7.6	28	14
Cl	357	445.9	290	216
S	157	93	212	160

spreading centre islands (e.g. Iceland or Galapagos) but completely away from the other feasible contender - continental origin. An origin for these rocks in a supra-subduction zone environment at an active continental margin is in accord with the current views of most workers as to the geotectonic situation of Guernsey during late Cadomian times (cf. Brown *et al*., 1990).

Four samples from dykes originally sampled as belonging to the microdiorite group have been removed from the dataset. It is not certain that the four dykes form a coherent grouping in themselves since two are foliated. The samples from these dykes differ considerably from the rest in their chemical composition. In Figures 2 and 3 they are annotated as modified dykes. They tend to plot much more with the Vazon metadolerites than with the microdiorites, being significantly enriched in MgO, and depleted in Al_2O_3, Sr, Ba, and Fe_2O_3T/MgO ratio.

DISCUSSION AND CONCLUSIONS

Field, petrographical, and petrochemical data for the microdiorite dykes, which clearly postdate all major components of both the N.I.C. and S.M.C. of Guernsey, show that they constitute a distinct, coherent group of minor intrusions. It is also clear from their preferred orientation and sharp, frequently chilled, contacts with the component of the N.I.C. that the latter had cooled sufficiently for it to act as a rigid mass during dyke emplacement.

The pervasive secondary alteration indicates the subsequent imprint of a low temperature (low greenschist facies) metamorphism, rather than a late stage magmatic/deuteric alteration. This conclusion is supported by the fact that a similar secondary alteration assemblage is present in the gabbros and diorites of the N.I.C. The alteration is thought to have occurred prior to the emplacement of the albite dolerite dykes (Lees *et al.,* 1989) which exhibit an even lower temperature post-emplacement modification involving the formation of prehnite and pumpellyite, phases not encountered in the microdiorites except as vein fillings in late fractures.

Dallmeyer *et al.* (1992) have suggested that the microdiorite dykes form part of the Vazon dyke swarm, which latter was emplaced over a protracted period straddling the emplacement of the members of the N.I.C. The field evidence is clear that the Vazon metadolerites always predate all the members of the N.I.C. In contrast, the microdiorite dykes clearly postdate both. The dykes of the two groups are easily distinguishable in the field. There are clear differences visible in thin section: the Vazon metadolerites are much richer in mafic minerals than the microdiorites and often exhibit subophitic texture (Lees and Roach 1987); the microdiorite dykes are much richer in plagioclase feldspar and almost always contain abundant magmatic quartz.

The chemical compositions of the two groups of dykes are quite distinct (Table 1). Bivariate diagrams involving Al_2O_3, Sr, and Ba show clear separation of the fields occupied by the two groups (Figures 2 and 3)

In the Y vs Zr diagram (Figure 3b) the trends of the two dyke groups are different. The Vazon metadolerite trend has a distinctly greater slope than that of the microdiorites. Lees and Roach (1987) have shown the Vazon metadolerite swarm to have affinities with continental flood tholeiitic basalts. In contrast, the petrochemistry of the microdiorites is clearly calc-alkaline in character (Figure 2b and c). The slope of the microdiorite envelope in the Y vs Zr diagram is in turn greater than that of the jersey Main Dyke Swarm (J.M.D.S.), categorized by Lees (1986; 1990) as being of high-K, calc-alkaline affinity.

The position of the four dykes categorized in this paper as the modified dykes is uncertain. In their petrographic and petrochemical character they show more affinity with the Vazon dykes than with the microdiorites, being distinctly richer in mafic minerals, in MgO, and compatible elements than the microdiorites. While they clearly postdate the Vazon dyke swarm, their relationship with typical microdiorite dykes is unknown since the two are not seen to intersect. Whether the anomalous dykes even form a coherent group remains open to doubt. Assuming that they do, comparison could be made with the J.M.D.S. where it can be shown clearly that dykes injected very late in the history of the swarm had begun to acquire a more tholeiitic character, indicating perhaps the final decay of the subduction zone as a source of magma and a change to a more intraplate character (Lees, 1990).

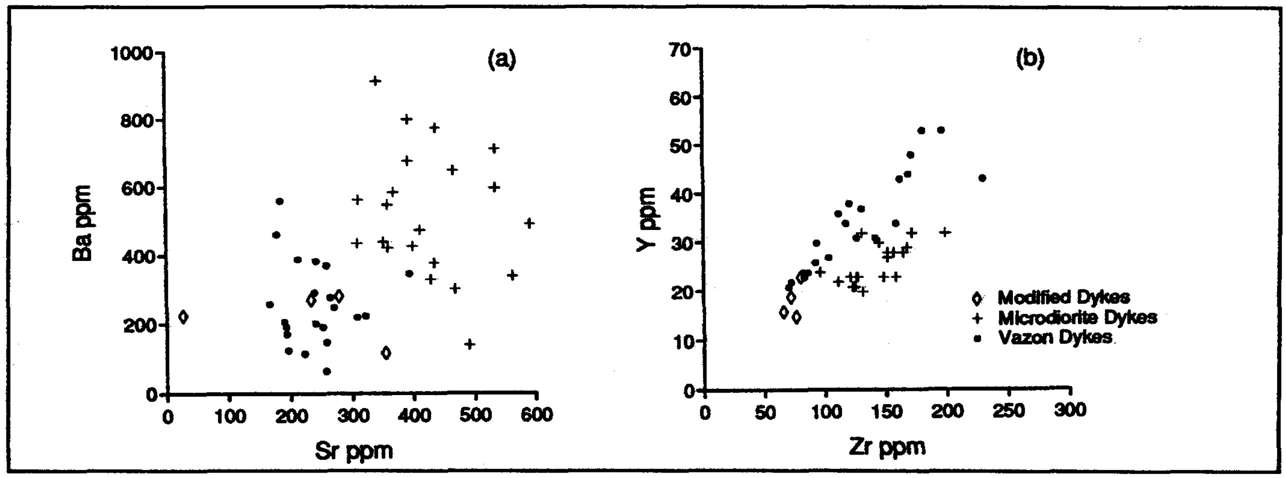

Figure 3. Bivariate trace element plots of the microdiorites and the Vazon metadolerites. (a) Ba-Sr plot showing the separation between the two groups, reflecting the modal difference in feldspar; (b) Y-Zr plot showing both groups lying on different trend lines. For further explanation, see text.

A lower limit for the age of the microdiorite group is uncertain at present in view of the range of isotopic dates that have been obtained from components of the N.I.C. Adams (1976) concluded, on the basis of mineral age data, that the regional cooling of the basic components of the younger Cadomian igneous complexes (e.g. the St Peter Port gabbro) commenced at least 590 Ma., but was locally interrupted by: (1) the emplacement of the younger granites (e.g. a combined whole-rock and mineral Rb/Sr isochron of 570±15 Ma (λ^{87}Rb = $1.39\text{x}10^{-11}$ a^{-1}) was obtained for the Cobo Granite); and (2) the effect of a late Cadomian retrograde metamorphism, which on Guernsey postdated the Cobo granite emplacement. Adams (op.cit.) considered that the final cooling of these Cadomian igneous complexes could have continued until 520 Ma. Evidence for this late metamorphism is the occurrence of secondary minerals of the microdiorite dykes. D'Lemos (1987b), however, obtained a whole-rock Rb/Sr isochron date of 496±13 Ma. (MSWD = 2.2) (λ^{87}Rb = $1.42\text{x}10^{-11}a^{-1}$), interpreted as giving the emplacement age not only of the Cobo Granite but also for the adjacent Bordeaux Diorite Complex, which D'Lemos (1986) had concluded was contemporaneous with the Cobo Granite. The most recent dates are those of Dallmeyer *et al.* (1992) who, on the basis of ^{40}Ar/^{39}Ar mineral cooling ages, argued that all the components of the N.I.C. were emplaced contemporaneously at circa 570 Ma.

The isotopic dating can therefore be taken to indicate that the microdiorite group was emplaced either post - 570 Ma. or post -496 Ma. (Cambrian - Tremadocian). The group is seen as representing the final phase of calc-alkaline Cadomian magmatism on Guernsey and, as such, is analogous in its setting to that of the calc-alkaline Jersey Main Dyke Swarm, which has a similar trend (Lees, 1986; 1990). The subsequent low temperature alteration and local deformation of the group is also seen as an end-Cadomian (early Palaeozoic) event which predated the emplacement of the mildly alkaline albite dolerites of probable Upper Palaeozoic age.

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