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The Trégor Dyke Swarm at Port Béni, North Brittany: a preliminary study

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The Cadomian North Trégor Batholith in N Brittany is cut by a substantial dyke swarm of approximately EW trend, which predates a regional metamorphism tentatively assigned to the Hercynian. Detailed field work in the region of Port Béni and Port la Chaîne (Côtes-du-Nord) has shown the swarm to comprise three distinct groups of dykes, clearly distinguishable using the criteria of petrography, petrochemistry, trend, and relative age. The dykes are of basaltic or basaltic-andesitic composition, one group being of calc-alkaline affinity and the other two tholeiitic. The occurrence of rare basic-acid composite dykes indicates the co-existence of both acid and basic magmas.

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Introduction

The two major Palaeozoic dyke swarms in N Brittany have almost perpendicular orientations (Barrois 1930). The more extensive swarm, with a general N-S trend, occurs within an E-W belt from Mayenne to west of Guingamp. This swarm consists of dolerites of mildly alkaline to tholeiitic basalt affinity (Velde 1970), and was possibly emplaced 350-380Ma (late Devonian-very early Carboniferous) (Leutwein *et al.* 1972).

The second, less extensive swarm, here termed the Trégor Dyke Swarm, trends broadly E-W and was emplaced into all components of the North Trégor Batholith. This major complex occupies some 40km of the Brittany (Côtes-du-Nord) coast, between Ploumanac'h in the west and the Ile de Bréhat in the east (Fig. 1), and is thought to extend further westward as the Moulin de la Rive Orthogneiss Complex (Griffiths 1985; Roach *et al.* 1988; Strachan *et al.* 1990).

The late Hercynian Ploumanac'h-Trégastel Granite Complex dated at 302±15Ma (Vidal 1980) imposes a narrow but clearly marked contact-metamorphic aureole on both the rocks of the North Trégor Batholith and representatives of the Trégor Dyke Swarm (Barriere 1975), both units having been previously affected by Hercynian metamorphism (work in progress). The limited, somewhat ambiguous, radiometric dating that has been attempted on the Trégor Dyke Swarm (see discussion below) may point to a Devonian to early Carboniferous age for emplacement of the dolerites (Auvray 1979).

This paper aims to show that the Trégor Dyke Swarm can be divided into three main groups on the basis of field relationships, petrography, mineral, and whole-rock chemistry. An early group of dykes of calc-alkaline basaltic andesite composition is shown to be cut by two groups of tholeiitic basaltic composition, of which the younger is more evolved. The approximate parallel alignment of the three groups suggests a relatively similar direction of crustal extension during the emplacement of contrasting magma types.

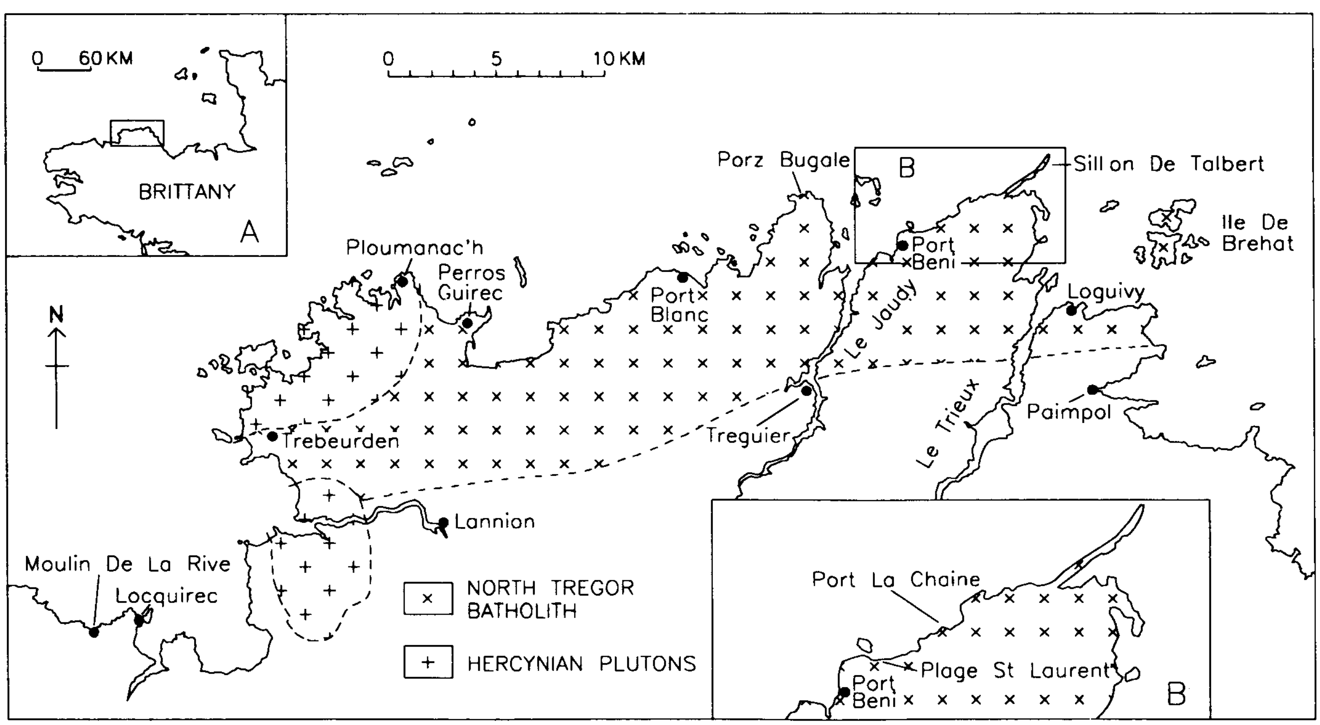

Figure 1. Simplified geological map of the Trégor region of N Brittany, France, showing the North Trégor Batholith and later Hercynian plutons. Locations indicated are those mentioned in the text. Inset A: Outline map of NW France showing location of the Trégor region. Inset B: Enlargement of the Port Béni-Sillon de Talbert area.

The North Trégor Batholith

The North Trégor Batholith is a mufti-component calc-alkaline complex comprising units ranging in composition from gabbro/diorite (e.g. Castell-Meur Diorite) through granodiorites (e.g. Talberg Granodiorite) to granites (e.g. Loguivy Microgranite). The batholith has been considered to have been emplaced during the late Proterozoic to early Palaeozoic Cadomian orogeny. Attempts to date the plutonic complex using radiogenic isotopic methods have only been partially successful. A U-Pb zircon age of 615±13Ma has been obtained from one of the late emplaced units - the Talberg granodiorite (Graviou *et al.* 1988), while a Rb-Sr isochron date of 544±19Ma has been obtained from the series of late acidic sheets labelled the Loguivy Microgranite (Auvray 1979; Vidal 1980).

The broad petrographical and petrochemical characterisation of the North Trégor Batholith, referred to above, is due to Auvray (1979). More recent detailed field observation by one of us (Roach 1988; Roach *et al.* 1988) has shown that in certain areas at least, the number and distribution of mappable units is quite complex. It has been noted by Auvray (1979) that, in the vicinity of Port Béni, situated on the east bank of the mouth of the Jaudy Estuary, remnants of old migmatitic basement material were to be found within the batholith. This material - the Port Béni Gneiss - yielded a U-Pb zircon age of 1790±10Ma (Auvray *et al.* 1980), i.e. Icartian (cf. 2018±15Ma for the Icart Gneiss, Guernsey - Calvez and Vidal 1978). The recent detailed mapping the inter-tidal tract north of Port Béni (Roach 1988; Roach *et al.* 1988) has shown these Icartian-type granite gneisses to have the form of N-S trending elongate rafts. The Cadomian plutonic components comprise coarse-grained quartz-monzonite to granodiorite and microgranodioritic porphyry, also arranged in N-S oriented strips (Fig. 2). This region perhaps represents a segment of the roof zone of the batholith subjected to E-W distension.

In the Port Béni area the components of the North Trégor Batholith and all the groups of the Trégor Dyke Swarm have been subjected to a metamorphism. This metamorphism increases in grade from sub-greenschist in the east of the Trégor to greenschist facies in the western Trégor. At the western extremity of the Trégor (between Trébeurden and Ploumanac'h) and in the Petit Trégor (in the Moulin de la Rive-Locquirec area) both the granitic rocks of the North Trégor Batholith and representatives of the dyke swarm, in addition, become variably foliated and incorporated within ductile shear zones. Both the metamorphism and the associated deformation have been tentatively assigned to the Hercynian (Verdier 1968; Griffiths 1985; Roach *et al.* 1988; and work in progress).

The Trégor Dyke Swarm

Basic dykes are a prominent feature of the intertidal tract all along the N Brittany coast between Ploumanac'h and Ile de Bréhat. Their presence and abundance has long been recognised (Barrois 1898, 1908, 1930). Previous petrographical and petrochemical studies on the dyke swarm (GJL - unpublished study 1974; Auvray 1979) were not completely successful in characterising the magmas which had produced it. Auvray (1979) divided the dykes into two groups - an unmetamorphosed group which he termed the `dolerites de Trieux', mainly collected from the banks of the Trieux Estuary, and a group of 'spilitic' dykes collected from various locations which he considered to belong to the 'albitophyres d'Er' and have a different age to the above.

The key to interpretation of the dyke rocks cutting the North Trégor Batholith has proved to be the detailed mapping of the Port Béni reefs (by RAR), in the course of which the cross-cutting dykes were mapped and examined. In this area the dykes could be divided into three groups on the basis of their macroscopic character and relative age relationships (Fig. 2). Subsequent study of petrography, texture, mineral chemistry, and bulk rock petrochemistry has confirmed and reinforced this division. Extension of the mapping eastward to Plage St Laurent and towards Port la Chaîne has established that the rare basic-acid composite intrusions, known previously from the Perros-Guirec region and subsequently from

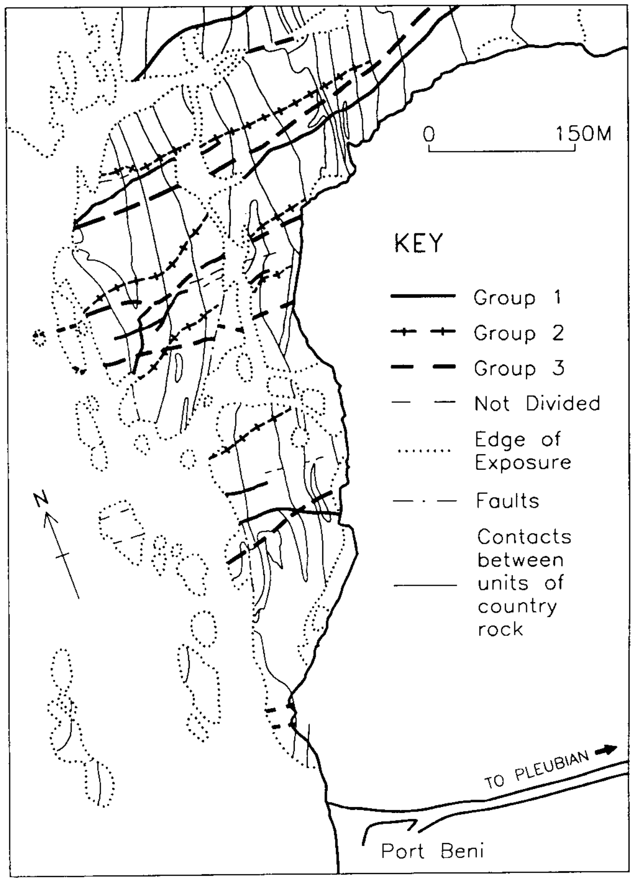

Figure 2. Map of the reefs N of Port Béni harbour with the largely N-S trending contacts between the Port Béni Gneiss and components of the North Trégor Batholith lightly outlined. The map shows the distribution of the three groups of dykes forming the Trégor Dyke Swarm.

Sillon de Talbert, form an integral part of the swarm and may constitute a fourth group.

The work on the Port Béni `type area' has enabled the previous studies to be re-interpreted. A preliminary analysis indicates that the grouping of the dykes proposed here appears to stand up very well in other areas of the Trégor. However, the purpose of this paper is to present the results obtained on the dykes from the Port Béni-Port la Chaîne type area. Work on the dykes in the rest of the batholith is in progress.

Field characteristics

As indicated above, the Trégor Dyke Swarm at Port Béni is divisible into 3 groups of dykes, Groups 1, 2, 3, which have a consistent relationship to each other. These groups are related by Group 3 postdating Group 2 which postdates Group 1.

The Group 1 dykes are fine grained, usually porphyritic and of dark olive-green to grey colour. Their macroscopic appearance is much more reminiscent of rocks of intermediate composition than those of the Groups 2 and 3 rocks which are thoroughly basic. Phenocryst phases are plagioclase feldspar and a mafic mineral, usually clinopyroxene. These are the thinnest dykes, rarely exceeding 3.5m. Group 2 dykes can be up to 12m thick, are generally dark blue to dark purple in colour, generally aphyric, and are typically spheroidally weathered. Group 3 dykes are the most common; they are usually massive in appearance and may be up to 13m thick. Usually aphyric, they are of variable grain-size between basaltic and microgabbroic; they are typically dark grey or black in colour.

A histogram of dyke thicknesses is given in Fig. 3. It can be seen that overall, the Group 3 dykes have the highest modal value (6m) while the Group 1 dykes are much thinner (1.5m for mode). The trends of the three groups is also given in Fig. 3. It may be seen from the rose diagrams that while the overall dyke trend is broadly E-W, that for the individual groups varies slightly. Group 1 trend seems to be rather more NE-SW, while Group 3 is strongly E-W. Group 2 is intermediate in direction, perhaps even bimodal.

The rare acid-basic composite dykes, encountered throughout the Trégor, also have a general ENE-WSW trend and comprise some of the thickest dykes encountered. Two of these dykes, one at Plage St Laurent and the other at the Sillon de Talbert, are both of simple B-A-B type with doleritic basic margins and a microporphyritic granophyric centre.

Petrography

Group 1

This group of dolerites possesses a distinctly microporphyritic texture. They are finer grained than Groups 2 and 3. The matrix of these dykes usually contains plagioclase feldspar and chlorite, often with minor amounts of interstitial quartz.

Microphenocrysts of both plagioclase and clinopyroxene are prominent, often in glomeroporphyritic clusters. Orange-brown amphibole is characteristic of Group 1 dykes; it occurs frequently either

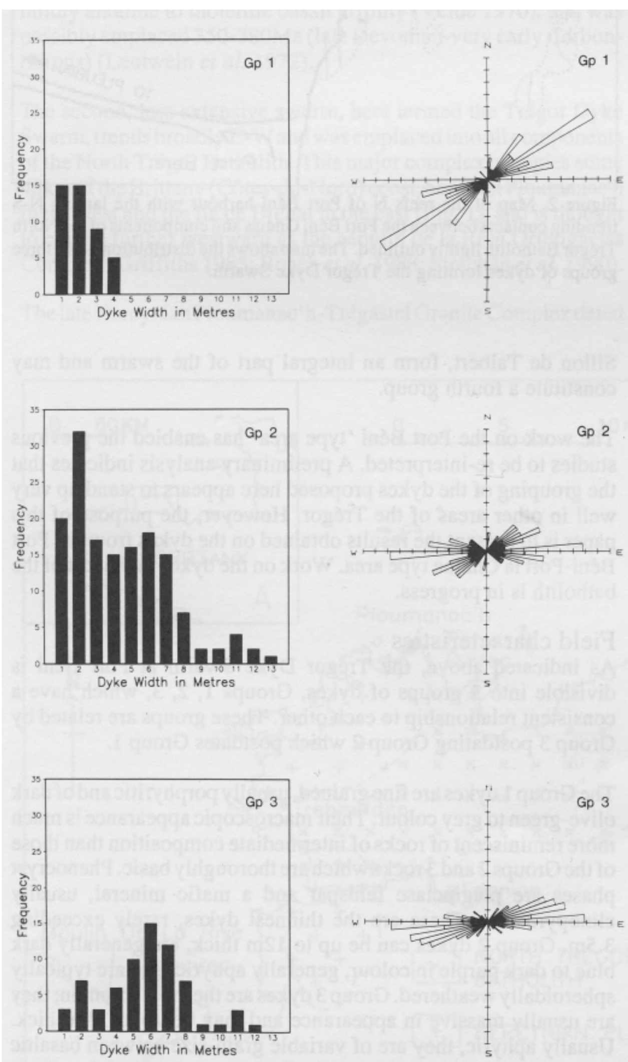

Figure 3. Dyke thickness and orientation data for the Trégor Dyke Swarm. a) Histograms of dyke thickness for Group 1 - top, Group 2 - centre, and Group 3 dykes - bottom. b) Rose diagrams of dyke orientation for Group 1 - top, Group 2 - centre and Group 3 dykes - bottom.

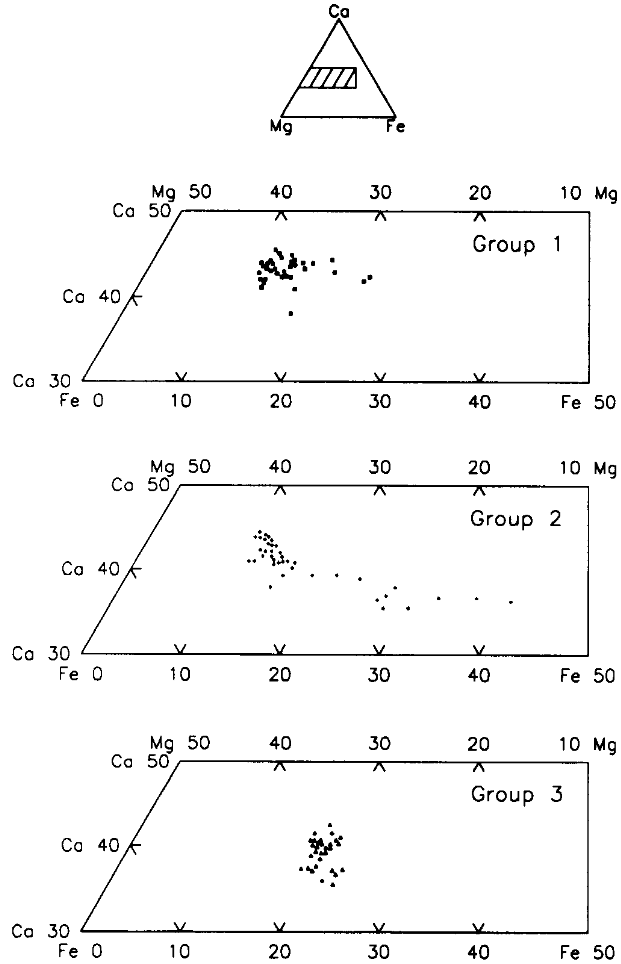

Figure 4. Variation in clinopyroxene composition from three samples of the Trégor Dyke Swarm (one for each group) as represented by the quadrilateral components ie. Ca^{2+}, Mg^{+2}, Fe^{+2}.

in epitaxial relationship to the microphenocrysts of clinopyroxene or as separate microphenocrysts. Amphibole also occurs as a groundmass phase. Secondary minerals are common in these rocks; pumpellyite, prehnite, and epidote are found within altered plagioclase feldspars, while chlorite aggregates pseudomorph possible olivine crystals. A distinctive feature is the presence of vesicles aligned in clusters parallel to dyke margins and infilled with chlorite, prehnite and calcite.

Group 2

These dykes contain essentially clinopyroxene and plagioclase in approximately equal amounts. The distinctive textural feature of this group is the way the fresh plagioclase feldspar laths, often as stellate radiating clusters, are subophitically enclosed by clinopyroxene. Fe-Ti oxide grains are common. Chlorite, actinolite and a colourless mica are the main secondary phases.

Group 3

Plagioclase (now highly sodic in composition due to alteration) is more abundant in Group 3 dolerites than in those of Group 2. Clinopyroxene is usually subhedral to anhedral. The overall texture is intersertal and quartz or quartz and feldspar intergrowths are common interstitial phases. The distinctive features of this group are the abundance of euhedral-anhedral grains of Fe-Ti oxide and the presence of small acicular apatite crystals. Pyrite is common in these dykes. Chlorite, actinolite and epidote are ubiquitous secondary phases.

Table 1. Summary chemical compositions of the dyke groups of the Trégor Dyke Swarm form the Port Béni `type' area.

	Group 1		Group 2		Group 3	
	X	s	X	s	X	s
SiO_2	52.71	0.44	48.87	0.76	51.2	2.05
TiO_2	0.79	0.04	1.24	0.22	2.26	0.47
Al_2O_3	16.82	0.59	15.34	0.84	13.41	0.37
Fe_2O_3T	9.59	0.22	10.67	1.34	14.43	1.09
MnO	0.14	0.01	0.16	0.02	0.21	0.02
MgO	5.41	0.8	7.9	0.78	4.36	0.38
CaO	7.19	0.94	10.73	0.71	7.45	0.61
Na_2O	2.71	0.65	2.07	0.31	3.43	0.36
K_2O	1.77	0.45	0.75	0.3	1.38	0.22
P_2O_5	0.22	0.04	0.18	0.04	0.44	0.16
LOI	2.77	0.23	2.19	0.79	1.54	0.24

Mineral chemistry

Three samples of dykes, chosen as the least altered and most representative from each group, were analysed using a Cameca (Camebox) electron microprobe in the Geology Department, University of Manchester. Clinopyroxene and plagioclase feldspar are the main fresh primary igneous phases in these dolerites, but even plagioclase is altered completely to albite in both Group 1 and 3 dykes samples. The ore phase is now largely titanite, a secondary phase, which is accompanied in the Group 1 dolerite sample by iron-rich pumpellyite, prehnite, and chlorite. In addition, in the Group 1 dolerite sample, primary amphibole (titanian ferroan pargasite) is present.

a) Clinopyroxene

The clinopyroxenes in all the three groups of dyke are of augite composition according to the nomenclature of Morimoto (1988). These compositions are quite distinct from the diopsidic clinopyroxenes developed in the albite dolerites of Guernsey (Lees *et al.* 1989) or the Wolf Cave gabbro, Jersey (Rowbotham and Lees 1990) which have crystallised from alkali basaltic magma.

Quadrilateral components. Texturally the clinopyroxenes are distinct in the three groups of dykes and this is also reflected in their chemistry. Composition of clinopyroxenes from the Group 3 dyke sample cluster around Ca_{40} Mg_{40} Fe_{20} (Fig. 4). There is a limited intracrystalline variation in composition and the most evolved rim composition is $Ca_{35.5}$ Mg_{42} $Fe_{22.5}$. In contradistinction to this limited range, clinopyroxenes from the Group 2 dyke sample have a more extended compositional range with core compositions of Ca_{44} Mg_{45} Fe_{11} and rims up to Ca_{36} M_{g24} Fe_{40}.

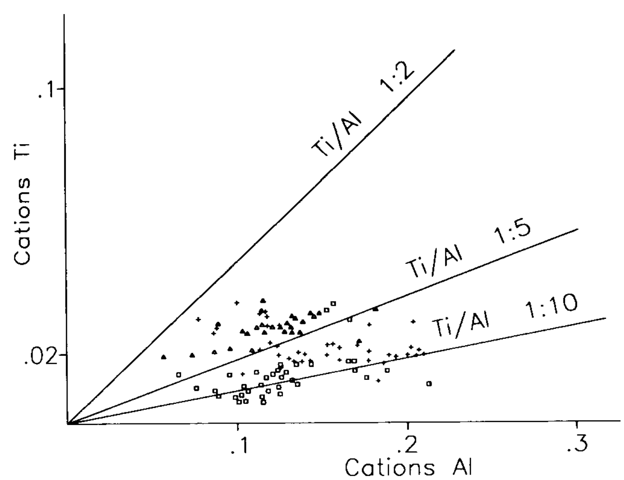

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Figure 5. Variation in clinopyroxene composition from three samples of the Trégor Dyke Swarm (one for each group) as represented by the non-quadrilateral components Ti+4 and Al+3. Group 1 dykes are represented by squares, Group 2 dykes by crosses and Group 3 dykes by triangles.

iron-rich rims are relatively narrow and probably indicate that the final interstitial liquid had been depleted in magnesium and calcium components as a result of the earlier crystallisation of plagioclase and clinopyroxene cores in the magma. The Group 1 sample clinopyroxenes occur dominantly as glomerocrysts and they are chemically similar to Group 2 core compositions (Ca_{44} Mg_{46} Fe_{10}) but with a much more restricted range of rim composition (Ca_{42} Mg_{36} Fe_{22}).

Non-quadrilateral components. In addition to the quadrilateral components of the clinopyroxenes, there are differences in the ratios of Ti:Al in all three dolerite groups (Fig. 5). There are similar maximum abundances (0.2 atoms) of total Al but the variation is revealed in the differing amounts of Ti. The clinopyroxenes from the alkali basaltic dyke on Jersey have much greater amounts of AI (up to 0.35 atoms) and Ti (up to 0.11 atoms) than the clinopyroxenes from the Trégor.

In Group 3 dyke clinopyroxenes the Ti:Al ratio clusters around 1:4 with no composition having a ratio greater than 1:5; with the exception of one analysis the maximum Al content is 0.15 atoms. Group 2 clinopyroxenes, however, show differences in Ti:Al ratios from core to rim compositions. In the cores this ratio lies between 1:5 and 1:9 but the rims show values between 1:4 and 1:2, which indicates that the Ti content is greater when there is a higher amount of Fe in the structure. This observation agrees with data obtained in Guernsey (Lees *et al.* 1989) and Jersey (Rowbotham and Lees 1990). Group 1 clinopyroxenes have similarities to Group 2 i.e. lower overall Ti contents than in Group 3, but, with the exception of rim compositions, the Ti:Al ratio clusters around 1:10.

The initial core compositions of the clinopyroxenes, the compositional trends within the crystals, together with the overall low concentrations of non-quadrilateral components, all indicate a subalkaline nature to the magma from which they crystallised.

b) Plagioclase feldspars

Fresh plagioclase feldspars are only present in the Group 2 dolerite sample. The core compositions of plagioclase feldspars are close to An_{78} Ab_{22}. The amount of zoning in these plagioclase feldspars is quite large in some grains (An_{71} to An_{44}). The zoning is always from calcic cores to sodic rims, and even on the extreme rims the Or content is below 1 mol %.

Petrochemistry

49 bulk rock samples have been analysed for major and trace elements by XRFS using an ARL 8420 spectrometer. The samples are nearly all located in the region between Port Béni and Port la Chaîne (Fig. 1) with a few from up to 3km eastwards at Sillon de Talbert. These include representatives of all three dyke groups plus 3 samples (1 basic margin and 2 acid interiors) of composite dykes.

The mean composition of the three groups is given in Table 1. The SiO_2 contents of both Group 2 and Group 3 dykes characterise them as of basaltic composition, while Group 1 is basaltic andesite. The Group 3 dykes may easily be distinguished from those of Group 2 by their higher SiO_2, TiO_2, lower Al_2O_3, MgO, and CaO contents in the major elements, by their higher incompatible element (Y, Zr, etc.) concentrations and extremely low Cr and Ni contents among the trace elements. The Group 1 dykes may be distinguished from both Groups 2 and 3 by higher SiO_2, Al_2O_3, low CaO, total iron, TiO_2 and Y. Most other components show concentrations intermediate between the two.

The clear discrimination of the compositions into the three groups is shown in Fig. 6, by four binary plots: two compatible major oxides (Fe_2O_3T*v*.MgO); two compatible trace elements (Cr v. Ni); two incompatible minor oxides (TiO_2 *v*. P_2O_5); and two incompatible trace elements (Y v. Zr). In Fig. 6a, the Group 3 dolerites may be clearly distinguished from both Group 2 and Group 1 dykes by their high total iron and low MgO contents. Discrimination between Group 2 and Group 1 dykes is not so clear, but those of Group 1

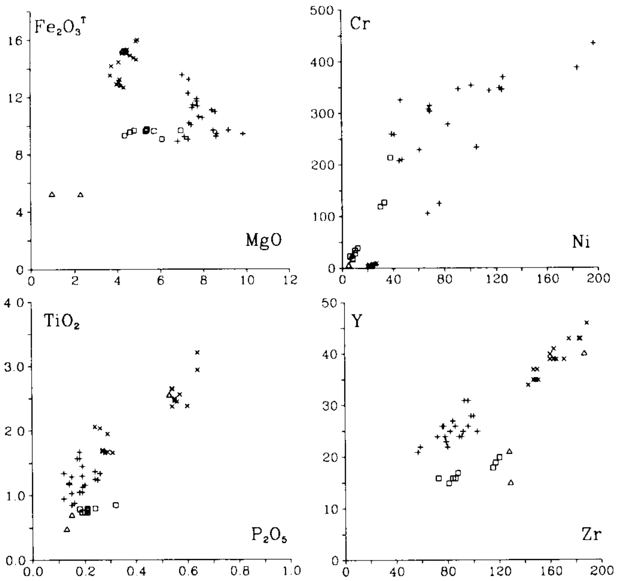

Figure 6. Binary scattergrams showing the chemical features of the groups of dykes in the Trégor Dyke Swarm: (a) Fe_2O_3T *v.* MgO; (b) Cr *v.* Ni; (c) TiO_2 *v.* P_2O_5; (d) Y *v.* Zr. Group annotation is as shown in Fig. 5, except that Group 3 dykes are represented by X and the Composite dykes by triangles.

show a linear trend with virtually constant total iron content and variable MgO. The basic margin of the composite dyke plots unambiguously in the Group 3 field. In Fig. 6c, Group 3 dykes are more enriched in both TiO_2 and P_2O_5 than Group 1 and Group 2 dykes. The Group 1 dykes are characterised by their virtually constant TiO_2 content relative to a varying P_2O_5. Fig. 6b shows a very clear distinction between the Group 3 dykes, with almost no Cr content, and the others. The Group 1 dykes show an almost linear trend of positive slope with Cr increasing much faster than Ni, while Group 2 dykes show a wide spread of points, but all with relatively high Cr and Ni values. Fig. 6d demonstrates that all three groups have different Zr:Y ratios. Group 1 dykes have a sub-linear trend with a very narrow range of Y contents not passing anywhere near to the origin - a feature characteristic of calc-alkaline basalt suites (cf. Lees 1986, 1990). The Zr:Y ratios are relatively high in Group 1 dykes, while Group 2 and Group 3 dykes have much closer but lower Zr:Y ratios with elongate groupings of points whose trends would pass through the origin. The Group 3 dykes however have much higher overall contents for both Y and Zr than do Group 2.

Discussion

The prime purpose of this paper has been to put forward the evidence for the clear division into three groups of the dykes forming the Trégor Dyke Swarm in the Port Béni region. Field observations, petrography, petrochemistry, and mineral chemistry of major modal components are all consistent in indicating such a tripartite division, the individual components of which are clearly distinguishable from one another. Using the discrimination criteria established here for the Port Béni dykes, the pre-existing data of Auvray (1979) and Lees (unpublished) for dykes of the swarm emplaced elsewhere in the North Trégor Batholith have been re-examined. The divisions seem to be applicable with success right across the batholith, despite variations in metamorphic grade from east to west, and even, very tentatively at present, into the Moulin de la Rive Orthogneiss Complex further west again (Fig. 1). On reinvestigating Auvray's (1979) results on his `dolerites de Trieux', it is obvious that his sampling was very biased towards that of Group 3 dykes. Of 8 analyses, 5 were of Group 3, 1 of Group 2, 1 of Group 1 and one did not fit in any of the predetermined groups. (The dykes sampled under the heading 'filons spilitiques des Albitophyres d'Er' are all Group 1 dykes). Because of this it has been felt inappropriate to continue to use the term Trieux Dolerites; the term Trégor Dyke Swarm has been used here to describe the whole swarm of post-Cadomian basic and intermediate dykes.

No REE or low level incompatible trace element (e.g. Hf, Ta, U, Th) data are yet available for the Port Béni dyke rocks. However, some 5 analyses are available from the earlier work of Lees, encompassing all three groups of dykes. These data indicate that, on chondrite-normalised REE profiles (Nakamura 1974) and MORB-normalised profiles (Pearce 1983), the Group 1 dykes have a calc-alkaline affinity, while Group 2 and Group 3 dykes are tholeiitic. This is consistent with the major and trace element abundances and with the mineral chemistry of the pyroxenes in the three groups of dykes constituting the swarm. Detailed consideration of the geodynamic implications of the geochemical affinities of the three dyke groups will be deferred for a future publication when a much greater number of dykes across the whole pluton will have been sampled and analysed.

From the preliminary data now available it is suggested that the parallel orientation of the three groups indicates a broadly similar direction of crustal extension during their emplacement. It could be argued that the calc-alkaline nature of the Group 1 dykes is indicative of eruption into an active continental margin environment. However, recent work in the northern continuation into Canada of the Basin and Range Province of the western USA, and elsewhere, has shown that extensive calc-alkaline magmatism is often indicative of the initial rapid extension phase of continental rifting prior to flood basalt eruption (P.R. Hooper, 1990 - pers. comm.). The tholeiitic nature of the Group 2 and Group 3 dykes is more consistent with accepted ideas of eruption during crustal extension, though the nature of the two is very different. The Group 2 dykes are more `primitive' with lower SiO_2, higher MgO, Cr, Ni contents and more Mg-rich clinopyroxenes. The Group 3 dykes appear much more evolved with higher SiO_2 and total iron, low MgO, and very low Cr and Ni contents. The higher incompatible element contents (e.g. Y and Zr - Fig. 6d) in the latter group also point to their evolved nature. It is interesting to note here the presence of late chlorapatite in the Group 3 dykes.

The division into an earlier calc-alkaline phase and a later tholeiitic phase has a parallel in the Jersey Main Dyke Swarm (Lees 1986, 1990), where a model has been put forward for emplacement above a decaying or decayed active continental margin followed, after cratonization, by emplacement of tholeiitic dykes in a continental intraplate environment during N-S crustal extension during Palaeozoic times.

While the age of emplacement of the Trégor Dyke Swarm is well defined in general terms - it postdates the youngest members of the Cadomian North Trégor Batholith, i.e. younger than c.544Ma, and predates both the emplacement of the late Hercynian Ploumanac'h-Trégastel Granite Complex (c.302Ma) and the earlier Hercynian shearing and metamorphic episodes - the stratigraphic position is uncertain. The attempt at radiometric age dating of the dyke swarm by Auvray (1979) using the K/Ar isotope method must remain ambiguous in the light of the results of this study. Auvray obtained four dates - 435Ma, 445Ma, 350Ma and 356Ma - on rocks of his 'dolerites de Trieux' group, collected from two locations: at Pors Bugale, near Plougrescant, some 5km to NW of Port Béni, which yielded the older ages; and near the Sillon de Talbert, some 5km to the E of Port Béni, which yielded the younger ages. These samples do not seem to correspond to those selected for geochemical work so their affinities cannot be checked. It is therefore not certain whether this clear geographical division of ages into 2 groups is due to a difference in dyke group type, since dykes for more than one group occur at both locations, or to the effects of metamorphism. With regard to the latter, however, there seems an apparent contradiction in that the metamorphic grade, through very low in both places, rises from east to west but that the older ages are found in the west.

Conclusions

(1) The Trégor Dyke Swarm is a broadly E-W trending basic to intermediate swarm of dykes largely emplaced within the North Trégor Batholith.

(2)On the basis of a detailed preliminary study in the region around Port Béni, the dykes of the Trégor Dyke Swarm can be divided into three distinct groups, together with rare composite acid-basic dykes.

(3) Distinction into groups is on the basis of trend, thickness, relative age, petrography, and petrochemistry. (4) The calc-alkaline Group 1 dykes are consistently post-dated by the tholeiitic Group 2 dykes, while the Fe-rich tholeiitic dykes of Group 3 post-date both the other two.

(5) The age of emplacement of the Trégor Dyke Swarm is constrained by the emplacement of late units of the North Trégor pluton at c.545Ma and by emplacement of the late Variscan Ploumanac'h-Trégastel Granite complex at c.300Ma. They could be Devono-Carboniferous in age, but have been affected by Hercynian metamorphism and deformation.

(6) The occurrence of composite dykes indicates the co-existence of both basic and acid magmas during emplacement. The basic component of such dykes has a composition resembling that of the Group 3 rocks.

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