INTERNATIONAL SYMPOSIUM ON MAFIC DYKES

EXTENDED ABSTRACTS

COMPILED BY

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São Paulo, Brazil, 1991

MAFIC DYKE SWARMS IN THE NORTHERN COAST OF SÃO PAULO, BRAZIL (A preliminary report)

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GEOLOGIC SETTING

The northern coast of São Paulo is covered by gneisses, granite and anphibolite of the Costeiro Complex, striking parallel to the NE mean direction of the coast. This Complex is part of an enslalic fold belt whose geologic evolution is ascribed to late Proterozoic times. In fact, 800-500 Ma. (Brasiliano Orogenic Cycle) is an important period of rock-forming events, but Archean and Early Proterozoic are believed to be the main periods of continental accretion.

About 50 km of coast line and traverses (Fig. 1) were already trodden and more than 100 mafic dykes mapped. In Ilha Bela and on the promontores around the city of São Sebastião, over 15 Mesozoic parallel dykes can be counted along a transversal distance of 300m. The sum of successive dyke widths allows one to conclude that, at places near the coast, the crustal distension may be well over 4%. This figure however is greatly diminished on the tectonic block of Juqueriquerê (Fig. 2).

PRECAMBRIAN MAFIC ROCKS

The mafic and, in some instances, ultramafic bodies seen along the coastal slopes may be petrographically discriminated as:

1. Medium to high grade amphibolite (brown hornblende-calcic plagioclase ± biotite ± pyroxene). It is a granoblastic rock exposed as bands or boudins within the migmatitic paragneisses. It could be said that syntectonic less ductile basalts in sills or dykes have been deformed into lenses or broken into crude boudins encased in the gneiss, where they became entirely metamorphosed. One outcrop however (Juquehy) exhibits longitudinal and cross views of what might be interpreted as tightly packed pillows.

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2. Plagioclase-hornblende websterite (hypersthene-augite-brown hornblende-olivine-calcic plagioclase). This is a medium to coarse grained rock retaining much of its original magmatic (ophitic) texture and mineral composition. It also occurs as large boudins in the paragneisses and migmatites of Juquehy and nearby islands.

3. Magnesian fels (forsterite-anthophyllite-enstatite) is rarely found in large blocks fallen on the rocky littoral. Nothing is yet known about its protolith.

4. Uralitized diabase (uralite with relict augite-andesine-ore and amygdules filled with actinolite and epidote) is a fine texture metabasaltic rock exposed as a regular 1 m thick Mesozoic-looking dyke at Praia do Veloso, Ilha Bela. Low grade metamorphism in a probably shallow environment is indicated for this rock.

5. Micronorite (andesine-hypersthene with small amounts of biotite, hornblende, augite and ore). This is a fine grained rock found as a conformable and regular 2 m thick dyke at the Baleeiro peninsula (Fig. 3). It still preserves its magmatic texture but small amounts of biotite and hornblende may have been developed by metamorphism. Contacts with host gneiss are transformed into biotite-hornblende schist.

6. Low grade amphibolite (andesine-green hornblende-biotite and some cummingtonite or (relict) hypersthene). It is a fine grained rock almost certainly related to the micronorite from which it may have been derived by increased low grade metamorphic recrystalization in a shallow crustal environment. It also occurs in the Baleeiro peninsula close to the micronorite outcrop (Fig. 3) and is exposed as a low dipping sheet somewhat deformed and dismembered in elongated lenses. It shows crosscutting relationship with the host, locally folded gneiss.

The rock types described above may well integrate Precambrian dyke swarms similar to other Brazilian swarms described or compiled by Sial et al. (1987).

A variety of ages may be anticipated since field relations, mineral composition and metamorphic grades are widely distinct for each of the lithotypes.

One single chemical analysis was obtained for the less altered Precambrian rock. It belongs to the micronorite and its data fit it well in the continental and low-potassium tholeiite fields of Pearce and Cann (1973) and also, in the sodic tholeiitic series of Middlemost (1975).

MESOZOIC DYKE ROCKS

The dyke swarm under study is a prolongation of the southern portion of the swarm surveyed by Damasceno (1966) which was chemically characterized by Comin-Chiaramonti et al. (1983).

The dykes are, as a rule, vertical, straight and parallel to each other and to the foliation of the host gneiss. Contrary to what is observed in Precambrian dykes, chilled borders are invariably present.

Of the 130 samples collected and petrographically studied, 55% are described as lamprophyres (camptonite and monchiquite), 37% as aphiric to porphyritic diabases and 13% as microdiorite porphyry. As a counterbalance the thicker dykes consist of diabase and microdiorite porphyry with a width of 2 to 30 m. while for lamprophyre, the habitual thicknesses lie between 0,4 and 2 m.

K/Ar age determinations (Minioli et al., 1971) indicate that in the dyke suite,

microdiorite porphyry and diabase form the oldest intrusions; 124-138 Ma. In the field they are found cut by lamprophyre dykes which, in turn, are cut by trachyte sheets, dated at 80-90 Ma.

Diabases are aphyric or porphyritic (Phenocrysts; plagioclase An_{60-30} and augite in an intergranular groundmass of plagioclase, Ti-augite and Ti-magnetite). They are highly titaniferous as already pointed by Comin-Chiaramonti et al. (1983) and plot within the fields of tholeiitic basalts (Middlemost, 1975) of continental crust (Pearce & Cann, 1973).

Typical microdiorite porphyries are quite distinct from diabase in that they are invariably porphyritic (andesine-augite-hypersthene as phenocrysts in a matrix built up by granular oligoclase, orthoclase and ore, with some biotite, hornblende and quartz). They are also more potassic, more siliceous and less titaniferous than diabases.

Lamprophyres occur as zoned dykes in which the central parts are usually rich in phenocrysts and amygdales. Their main mineral component is augite, both as phenocryst and as Ti-augite grains in a panidiomorphic groundmass. Habitual companions, in camptonites are: olivine, magnetite, kaersutite, biotite and labra-dorite. In monchiquites, analcime is present as phenocrysts or in amygdales. Carbonate, talc, serpentine and zeolites are common secondary associates.

In the MgO-FeO-Al_2O_3 discriminant diagram of Pearce et al. (1977), microdiorite porphyries plot as spreading center islands, diabases are continental and lamprophyres belong to ocean island or ocean ridge and floor fields.

REFERENCES

COMIN-CHIARAMONTI, P.; GOMES, C.; PICCIRILLO, E.M.; RIVALENTE, G. (1983) Neues Jahr.Min.Abhand., 146:133-140.

DAMASCENO, E.C. (1966) An.Acad.bras.Ci., 38:293-304.

MIDDLEMOST, E.A.K. (1975) Earth Sci.Rev., 11:337-364.

MINIOLI, B.; PONÇANO, M.L.; OLIVEIRA, S.M.B. (1971) An.Acad.bras.Ci., 43:433-437.

PEARCE, J.A. & CANN, J.R. (1973) Earth Planet.Sci.Lett., 19:290-300.

PEARCE, T.H.; GORMAN, B.E.; BIRKETT, T.C. (1977) Earth Planet.Sci.Lett., 36:121-132.

SIAL, A.N.; OLIVEIRA, E.P.; CHOUDHURI, A. (1987) Mafic dyke swarms, GAC Special paper 34. Proceeding of the International Conference Univ. Toronto, Ontario, Canada, June 4-7, 1985, p.467-482.

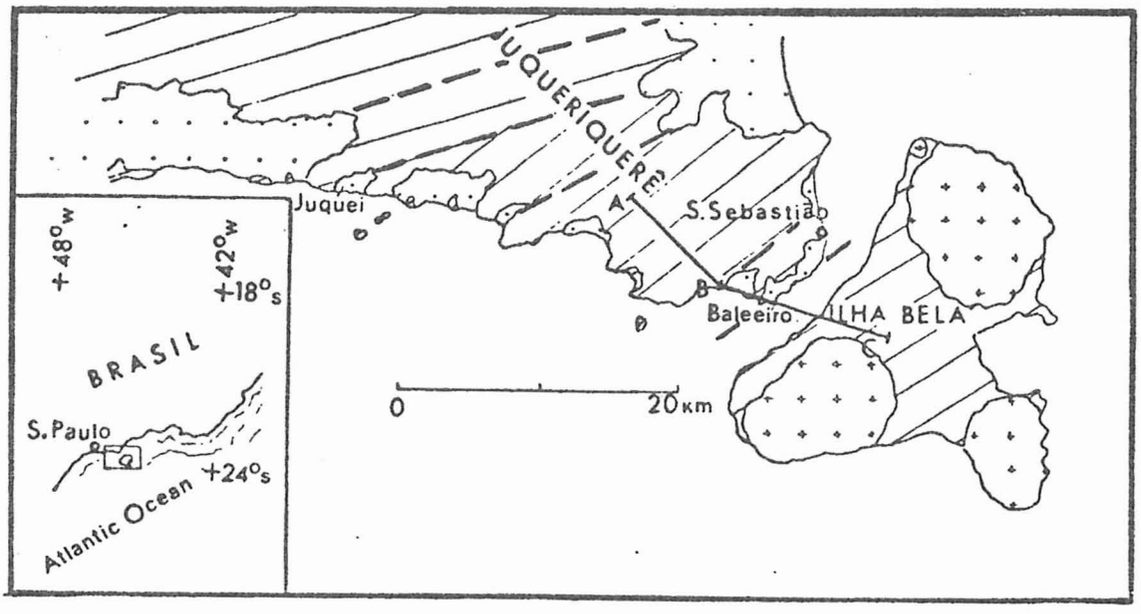

Figure 1 - General geology of the area. Dots: recent sediments, Diagonally ruled area; Precambrian gneissic basement. Crosses: alkaline intrusions. Thick dashed line; fault. A-B-C; geologic section.

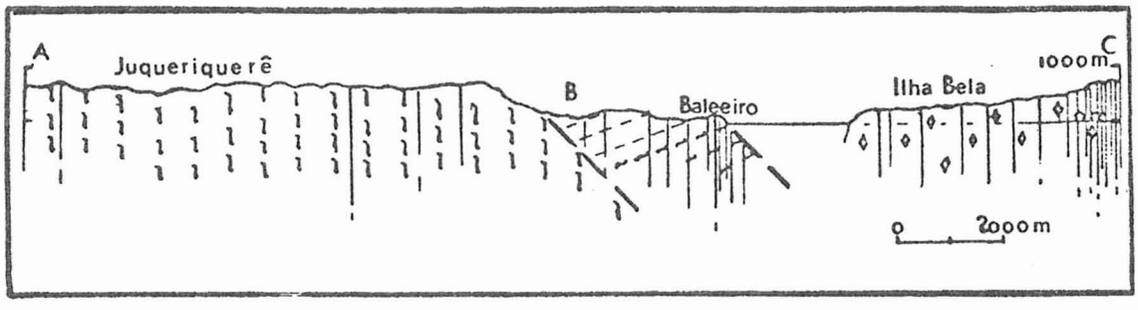

Figure 2 - Section A-B-C. Dykes in vertical straight lines. Thick dashed lines; faults. Sinuous lines; gneisses and migmatites. Diamonds; augen orthogneiss. Short dashes; leucogranite gneiss.

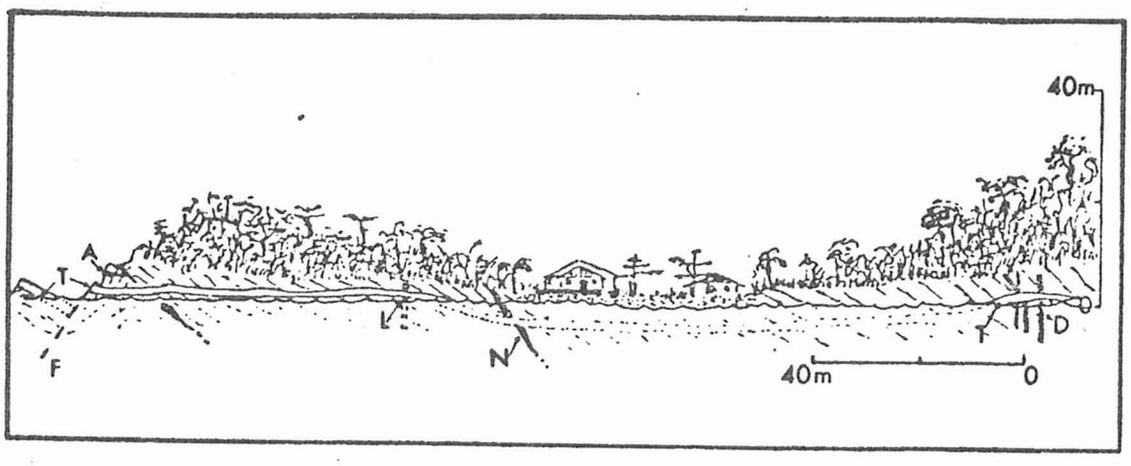

Figure 3 - View from NE of the Baleeiro Peninsula showing Mesozoic; trachyte sheet (T) lamprophyre dyke (L) diabase dyke (D) and Precambrian; amphibolite sheet (A) and norite dyke (N) - F; normal fault. Dykes and sheets are intrusive in low dipping paragneiss.

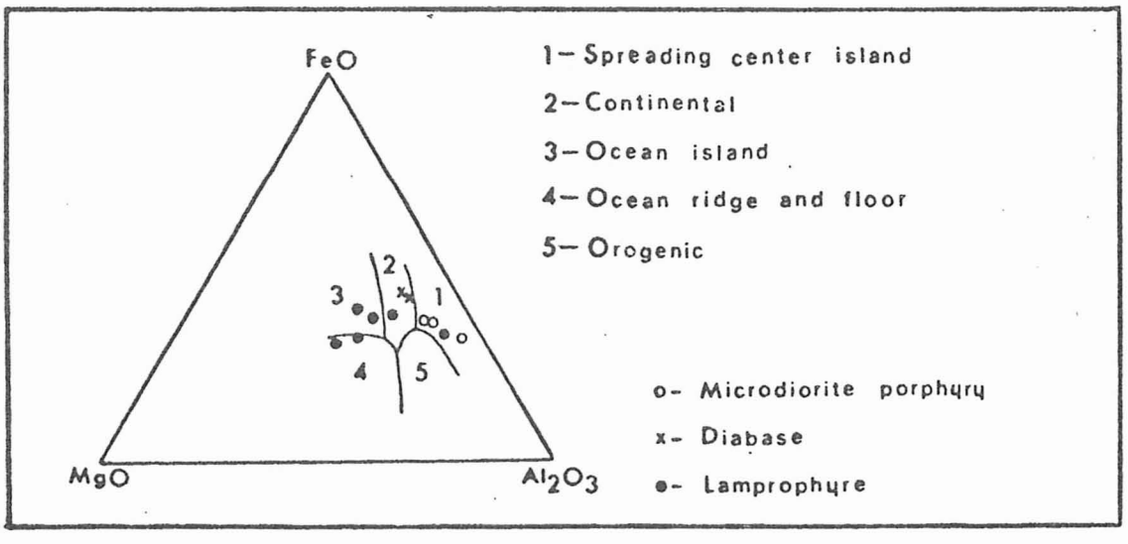

Figure 4 - Plotting of mafic dykes analyses in the discriminant diagram MgO-FeO-Al_2O_3 (Pearce et al., 1977).