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## NOTAS BREVES

# A SILICO-BEFORSITIC FLOW FROM THE SAPUCAI COMPLEX (CENTRAL-EASTERN PARAGUAY)

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## ABSTRACT

On the basis of geochemical data, the occurrence of material of carbonatitic affinity in the Central Alkaline Province of Eastern Paraguay has been noticed for the first time. The rock, a dolomite-rich flow 2 m thick, is found in association with volcanic sequences of the Mesozoic alkaline complex of Sapucai.

## INTRODUCTION

The Sapucai volcanic complex represents the largest outcrop of K-alkaline rock-types in the Asunción-Sapucai graben (Central-Eastern Paraguay: Gomes et al., 1989; Comin-Chiaramonti et al., 1990, 1992). Lava flows, subeffusive stocks and associated dykes are widespread over an area of about 98 km² and range in composition from tephrites to phonolites. The age is around 120 Ma (Velázquez et al., 1992), both for effusive and sub-effusive rock-types, to the rapid ascent of magma batches. Rare carbonate-rich flows are occasionally present among the volcanic sequences.

This paper intends to show the carbonatitic affinity of a dolomite-rich flow (sample PS-72), about 2 m thick, sandwiched between peralkaline phonolites and tephrites near the town of Sapucai at 25°41'S and 56°59'W (Fig. 1).

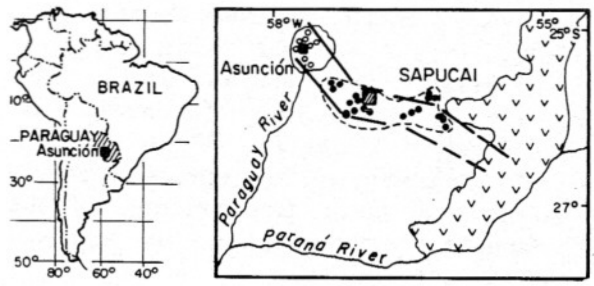


Figure 1 – Location map of the Sapucai complex.

## PETROGRAPHY AND GEOCHEMISTRY

The rock-type is aphyric with alkali feldspar, opaques, biotite and scarce apatite microlites set in a microcrystalline carbonatic matrix. X-ray diffraction analyses show a mineral association of alkali feldspar, dolomite, magnetite, biotite and calcite. The compositions of whole rock and of mineral phases are listed in Table 1. Assuming stoichiometric calcite, the following composition was calculated from the mass balance: dolomite 21.5%, calcite 2.8%, alkali feldspar 61.3%, magnetite 8.6%, biotite 5.2%, apatite 0.6%. From the above results, and considering the carbonates to be of

Table 1 – Whole-rock mineral compositions (X-ray fluorescence and microprobe techniques, respectively) of the silico-beforsitic flow from the Sapucai complex.

| | Whole-rock | Dolomite | Alkali feldspar | Magnetite | Biotite | Apatite |
|---|---|---|---|---|---|---|
| $SiO_2$ | 42.89 | 0.00 | 67.38 | 0.21 | 36.36 | 0.34 |
| $TiO_2$ | 1.70 | 0.00 | 0.00 | 11.30 | 7.21 | 0.00 |
| $Al_2O_3$ | 13.39 | 0.00 | 19.44 | 0.85 | 14.31 | 0.06 |
| $FeO_t$ | 8.38 | 2.51 | 0.00 | 71.14 | 14.52 | 0.18 |
| MnO | 0.15 | 0.26 | 0.00 | 0.83 | 0.11 | 0.02 |
| MgO | 4.62 | 20.17 | 0.00 | 5.20 | 13.58 | 0.07 |
| CaO | 7.70 | 30.04 | 0.58 | 0.14 | 0.01 | 51.95 |
| $Na_2O$ | 3.06 | 0.25 | 6.31 | 0.00 | 0.50 | 0.10 |
| $K_2O$ | 5.24 | 0.00 | 6.39 | 0.00 | 9.29 | 0.05 |
| $P_2O_5$ | 0.30 | 0.00 | 0.00 | 0.00 | 0.00 | 44.29 |
| LOI | 12.00 | nd | nd | nd | nd | nd |
| F | 0.05 | nd | nd | nd | nd | nd |
| Total | 99.41 | 53.23 | 100.10 | 89.67 | 95.43 | 98.86 |

carbonatitic affinity, the rock can be classified as a silico-beforsite following Woolley & Kempe's (1989) nomenclature.

The REE analysis of the carbonate fraction is given in Table 2. Strong enrichment in LREE can be seen from the chondrite-normalized chart of Figure 2. This distribution is similar to those present in carbonatites from other regions (e.g. Samoylov & Smirnova, 1980; Nelson et al., 1988), except for the more moderate LREE/HREE fractionation trend with respect to the Chiriguelo carbonatite (Northeastern Paraguay, Censi et al., 1989). Moreover, an Eu anomaly, probably due to the early fractionation of the feldspar-rich silicate phase, is apparent (Eu/Eu* = 0.90) as can be inferred from the REE behaviour of the associated K-alkaline rock-types (Fig. 2; Comin-Chiaramonti, unpublished data).

Table 2 – REE content (ppm) in the carbonate fraction of the silico-beforsitic flow from the Sapucai complex.

| | | | |
|---|---|---|---|
| La | 239.06 | Dy | 10.57 |
| Ce | 420.34 | Ho | 2.05 |
| Pr | 46.82 | Er | 5.40 |
| Nd | 159.89 | Tm | 0.74 |
| Sm | 19.06 | Yb | 3.16 |
| Eu | 3.90 | Lu | 0.32 |
| Gd | 14.90 | ΣREE | 928.33 |
| Tb | 2.12 | Y | 23.75 |

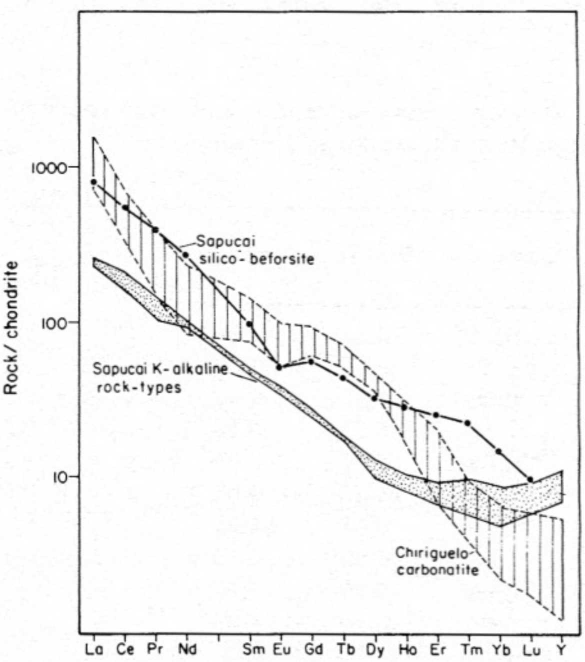


Figure 2 – REE diagram (carbonate fraction) for the Sapucai silico-beforsitic flow.

The La/Yb vs La diagram (Fig. 3) shows that the carbonate fraction from the Sapucai silico-beforsite lies well within the carbonatite field. For comparison, fields of other Gondwanic carbonatites were plotted (Brazil: Juquiá and Jacupiranga; Northeastern Paraguay: Sarambí and Chiriguelo; Angola: Bonga. Sources of data: Morbidelli et al., 1986; Beccaluva et al., 1992; Censi, unpublished analyses) and of metasediments from Eastern Paraguay (Censi, unpublished analyses).

Finally, the $\delta^{13}C$ and $\delta^{18}O$ isotopic values (dolomite: $\delta^{13}C_{PDB-1}$ = -5.63, $\delta^{18}O_{SMOW}$ = +14.00; calcite $\delta^{13}C_{PDB-1}$ = -6.54, $\delta^{18}O_{SMOW}$ = +14.47) also evidence the carbonatitic affinity of the Sapucai rock (Fig. 4). It should be noted that the $\delta^{18}$ is almost constant whereas there is an enrichment of heavy carbon in the dolomite with respect to the calcite, probably due to calcite reequilibration at low temperatures (e.g. < 100°C; cf. Cole et al., 1983; Censi et al., 1989).

## Final remarks

The carbonate matrix of the carbonate-rich flow from the Sapucai complex appears to have a strong carbonatitic affinity as indicated by the high REE content, the LREE/HREE fractionation (La/Yb = 9.2) and the $\delta^{18}C$-$\delta^{18}O$ values.

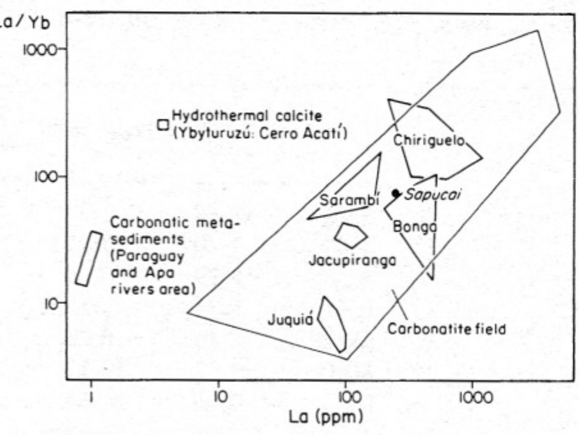


Figure 3 – La/Yb vs La diagram for the Sapucai silico-beforsitic flow (carbonate fraction). Sources of data: carbonatite field, Wass & Roger, 1980; Chiriguelo, Censi et al., 1989; other occurrences, unpublished results.

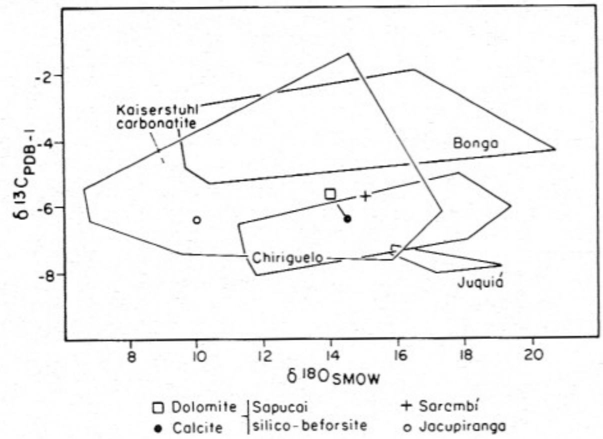


Figure 4 – $\delta^{13}C$ vs $\delta^{18}O$ diagram for the dolomite and calcite pair of the Sapucai silico-beforsitic flow. Sources of data: Kaiserstuhl et al., 1988; Chiriguelo, Censi et al., 1989; other occurrences, unpublished results.

From the overall mineral composition (carbonate < 25% wt.) the rock-type is a silico-beforsite. This fact suggests the possibility of carbonatitic occurrences in Central-Eastern Paraguay (i.e. Asunción-Sapucai graben) associated with K-alkaline magmatism, whereas up to now Paraguayan carbonatites were confined to the northeastern areas of the country (i.e. Cerro Chiriguelo, Cerro Sarambí an Cerro Guazú, according to Wiens, 1982).

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