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NEOPROTEROZOIC ALKALINE ROCKS AFFINITY FROM SOUTHEAST OF SÃO PAULO STATES – BRAZIL

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INTRODUCTION

The data in this paper presents a review of geochronological data of the terrains outcropping shore Cardoso Island, located in the southeastern littoral of São Paulo State, at the Paraná State border (**Fig**. **1**), Geologically, a mainly igneous complex (Weber 1998), represented by light-gray, leucocratic, inequigranular, medium- to coarse-grained syenitic rocks (aegirine/augite-hornblende-alkali feldspar syenite) forms Cardoso Island.

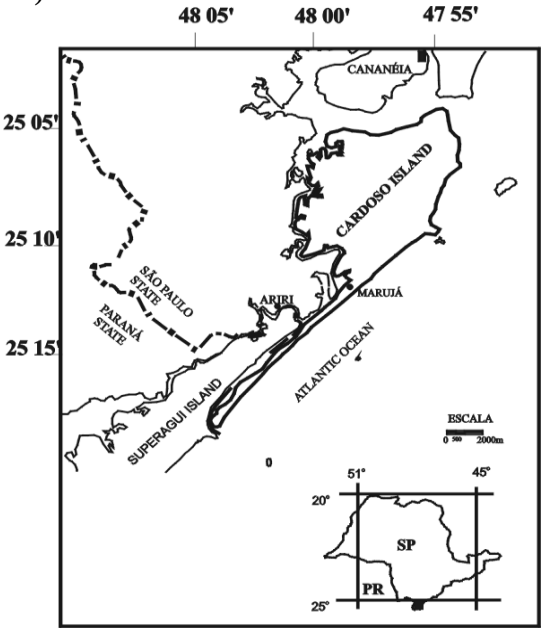

Figure 1 - Situation Map of Cardoso Island

The Três Irmãos Syenite (TIS) has a magmatic flow orientation given by the alignment of potassic feldspar and amphibole phenocrysts, and is crosscut by the gray-rosy, inequigranular, medium-grained leucocratic hornblende/biotite- alkali feldspar granites, related to the Cambriú Granite (CG). In the northern part of the island, a E-W belt of low metamorphic grade metasedimentary rocks occurs, which are Mainly composed of rhytmically interbedded metapsamitic and metapelitic schists. Quartz schists, mica-quartz schists and quartz-mica schists, usually with andaluzite and cordietite, predominate. These metasedimentary rocks continue on the continent, extending to the south in narrow belts. Equivalent metasedimentary belts were recognized within the Paranaguá Batholith granitoids (Basei et al. 1990, Siga Jr. 1995).

GEOCHEMISTRY

The chemical analyses for TIS and CG when plotted into the QAP (Streckeisen, 1976), with the distribution fields from granitoids series (Lameyre and Bowden, 1982) yield an alkaline –peralkaline affiliation with characteristics of anorogenic to late-orogenic granites (**Fig. 2**).

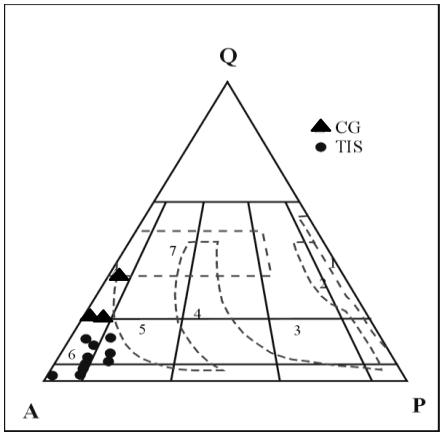

Figure 2 - Summary QAP diagram showing fields of various granitoids series: 1- tholeiitic; 2- calc-alkaline-trondhjemitic (low K); 3- calc-alckaline-granodioritic (medium K); 4- calc-alcaline-monzonitic (high K); 5- aluminous granitoids found in alkaline province; 6- alkaline and peralkaline; 7- granitoids formed by crustal melting.

The rocks have strongly fractionated REE patterns with flat HREE segments except for two samples which have HREE depletion, probably due to the participation of residual amphibole during its formation **(Fig. 3)**. The jigsaw pattern suggests that these bodies originated from crustal melting, typical of anorogenic to late-orogenic granites and that the fractionation in these elements can be related to hornblende crystallization. The hipothesis of a analytical problems is not excluded. Some samples have large negative Eu anomalies than others, suggesting that feldspar had an important rule during partial melting, followed by crystal fractionation.

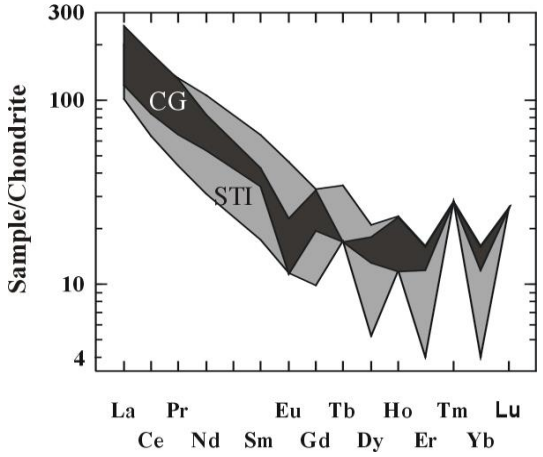

Figure 3- REE Diagram to TIS and CG samples

For the metasedimentary rocks, only the data relative to REE (**Fig. 4**) were considered, which show a strong fractionation between LREE and HREE. The strong Ce depletion occurs in rocks that may have lost Ce during weathering. The other two samples are from more psammitic terms, which do not show such anomalies. The slight Eu depletion and LREE enrichment indicate that andesitic rocks developed in continental island arcs or arcs formed close to continental margins as sediment sources (Bathia & Crook, 1986). The LREE enrichment also implies that 80% of the original material has as source felsic igneous rocks (Ericksson & Soegaard, 1985).

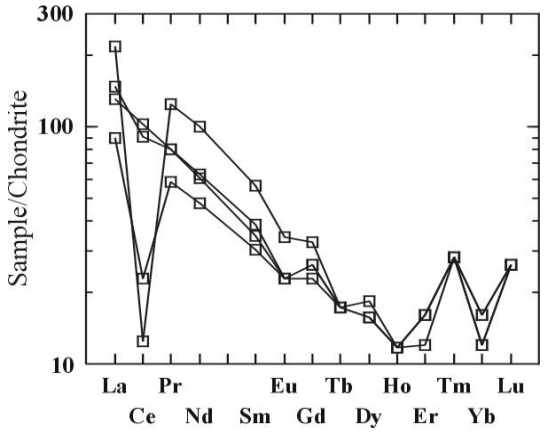

Figure 4- REE to metasedimentary rocks

GEOCHRONOLOGY

U-Pb analyses in zircons from the Cardoso Island gray syenitic terms (TIS) were performed for two outcrops, one located in the Fole Beach (sample WW-46), and the other in the Sambaqui Mirim River (sample WW-75). For the former, two zircon fractions M(-4) and NM(-5) were concentrated, which intercept the Concordia curve at 617 ± 6.7 My, **(Fig 5)**.

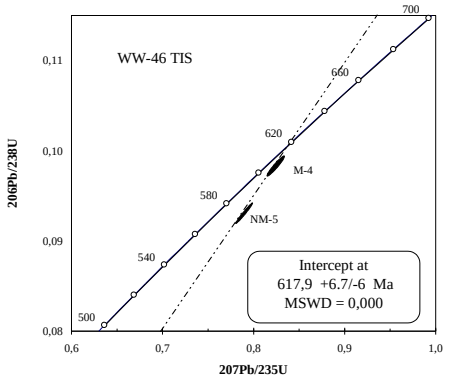

Figure 5- Sample WW-46 U-Pb concord diagram (in zircons)

Prismatic, idiomorphic, translucent zircons with rare fluid inclusions predominate in all fractions observed and were therefore chosen for dating. Three zircon fractions from sample WW-75 (alkali feldspar syenite) were analyzed, from which M(-5), M(-4A) and M(-4B) plotted relatively close to the Concordia curve in the U-Pb diagram, presenting the age of 616±19 My for the upper intercept (**Fig.6**).

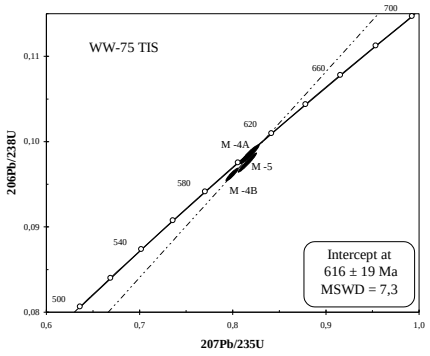

Figure 6- Sample WW-75 U-Pb concord diagram (in zircons)

The dated zircons show a typology very similar to that observed in the zircons of the syenitic rock outcropping in WW-46. The ages obtained for both samples are interpreted as related to the time of zircon crystallization, thus indicating the time of emplacement of the syenitic rocks.

The K-Ar analysis of horblende grains, concentrated from a sample of the same outcrop (WW-46), yielded the age of 597±14 My, indicating quick cooling.

Whole rock Sm-Nd analyses yield T_{DM} ages, show ages around 2030±56 My, related to a differentiation period of mantle – upper crust from TIS protoliths.

The geochronological pattern observed in the Cambriú-type granitoids (CG), that crosscut the TIS syenitic terms is distinct from that presented by those syenites. The name "Cambriú type" is applied due to the excellent expositions of these rocks in the homonymous locality, where enclaves of the syenitic terms with varied shapes and sized are observed within the rosy granitoids.

U-Pb analyses were performed in zircon fractions M(-1), M(-3), M(-4) and M(-4A), extracted from the alkali-granite rock numbered WW-79. The data obtained are well distributed and relatively aligned in the U-Pb diagram, indicating for the upper intercept an age of 574±19 My (**Fig. 7**). Such zircons were not abraded, which might explain the strong clustering of points (mainly the M-4 fraction) on the Concordia curve, resulting in a higher precision of the age obtained. The grains are long prisms, biterminated, with well-developed edges and faces, and in general contain fluid inclusions. They are different from TIS grains , some are fractured and light gray. These characteristics could partly explain the higher discordance of these zircons. K-Ar analysis done in amphiboles concentrated from a sample of the same outcrop (WW-79) indicated the age of 531±5 My, relative to the cooling of these rocks.

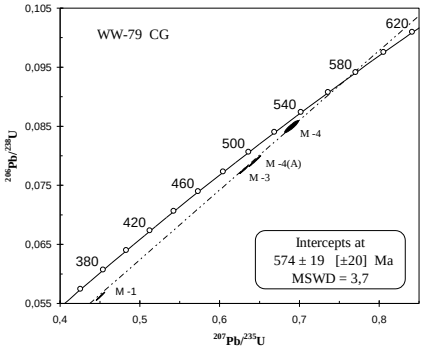

Figure 7- Sample WW-79 U-Pb concord diagram (in zircons)

Whole rock Sm-Nd analyses yield T_{DM} ages, show to the alkali granites (CG), ages around 1536±49 My, relative to a mantel-upper crust differentiation for those rocks.

FINAL CONSIDERATIONS

The geochronological pattern for the Cardoso Island igneous rocks defers two distinct magmatic episodes, the older being TIS, with ages around 619 My, which defines as a probable age of formation of these rocks, with cooling to around 597 My. The second episode regards CG to age of formation around 580 My and cooling around 531 My.

The TIS and CG samples form two different groups in the εNd vs. T diagram, showing that their sources are different **(Fig. 8)**

The geological relation between the terrains of the island and the continent suggests a possible continuity of the metasediments of the island with similar rocks that, from the Pariquera-Açu region, extending southwards throughout the coastal portion to Guaraqueçaba and Paranaguá, and are thought to be correlated to the Rio das Cobras Formation. These metasediments crop out as narrow and elongated belts, suggesting a distribution conditioned to long NE-SW-trending lineaments.

The igneous and metamorphic rocks from Cardoso Island, despite their particularities, possibly form part of the Paranaguá Domain Terrains (Basei et al 1990; Basei et al, 1992 e Siga Jr., 1995) being significantly different from those observed in the other tectonic blocks known in the region.

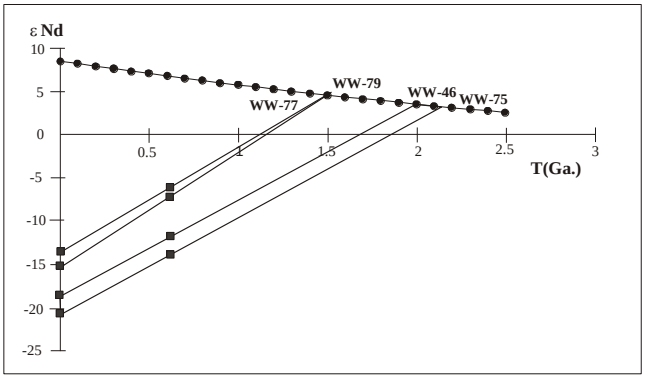

Figure 8- ƐNd vs T (Gy) showing different sources

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