INTRODUCTION

The eastern portion of the Guiana Shield, in South America, consists of an exceptionally large Paleoproterozoic belt, named Maroni-Itacaiúnas Province (Tassinari and Macambira, 2004), in which the evolution took place during the Transamazonian orogenic cycle (2.26-1.95 Ga), and that matches with the Eburnean orogen in West African Craton (Feybesse and Milési, 1994; Ledru et al., 1994). Despite the coherent Paleoproterozoic geochronological pattern of this belt, two major Archean domains have been documented in its northwestern and southeastern portions, the Imataca Block, in Venezuela, and the Amapá Block, in the north of Brazil (Figs. 1, 2A).

The basement assemblage from the southwestern portion of the Amapá Block is constituted by several granulitic-gneissic metamorphic complexes, which present Paleoproterozoic reworking of the Neoarchean zircons ages (>3.0 to 2.60 Ga) for their igneous precursors (Rosa-Costa et al., 2003, in press; Klein et al., 2003), and also includes Neoarchean charnockitic plutons dated between 2.65 and 2.60 Ga (Ricci et al., 2002; Rosa-Costa et al., in press). This Paleoproterozoic domain consists principally of calc-alkaline gneisses and granitoids (charnockites, charnockendebrites and mesoperite-granites) dated between 2.65-2.60 Ga (Ricci et al., 2002; Rosa-Costa et al., in press), which supposedly mark the time of an Archean granulitic event. Migmatization is widespread in the basement rocks, and the occurrence of charnockitic leucosomes indicates that it also occurred under granulite-facies conditions. These basement complexes host several orogenic granitic plutons, dated at about 2.22 Ga, 2.18 Ga, 2.15 Ga, 2.05 Ga and 2.03 Ga (Rosa-Costa et al., 2003, in press). Post-orogenic plutonic magmatism is marked by the emplacement of 1.75 m.y. old A-type granitic plutons (Vasquez and Lafon, 2001).

Along the southwestern border of the Amapá Block an expressive supracrustal belt marks the boundary of this Archean block with the Carecuru Domain, a granitoid-greenstone terrane, developed in a magmatic arc setting, which was accreted to the southwestern border of the Archean block during the Transamazonian orogenesis (Rosa-Costa et al., in press). This Paleoproterozoic domain consists principally of calc-alkaline gneisses and granitoids, dated at 2.19-2.18 Ga and at 2.15-2.14 Ga, and of supracrustal sequences, constituted mainly by mafic metavolcanics. Several granitic plutons mark episodes of crustal reworking in the Carecuru Domain, being one of them dated at about 2.10 Ga. In addition, granulitic rocks with Archean precursors are registered within that domain, in an oval-shaped nucleus basically composed of granulitic gneisses dated at about 2.60 Ga (Rosa-Costa et al., 2003), which host 2.07 m.y. old charnockitic plutons (Rosa-Costa et al., in press).

REGIONAL GEOLOGICAL BACKGROUND

The Archean basement assemblage of the southwestern portion of the Amapá Block includes: 1) granulitic orthogneisses (mainly enderbitic and charnockitic banded gneisses) that have their igneous protoliths dated at about 2.8 Ga (Rosa-Costa et al., 2003, in press); 2) undated mesoperite and/or clinopyroxene-bearing granitic orthogneisses, metamorphosed under amphibolite-granulite transition facies; 3) undated paraderived granulites; 4) amphibolite-facies grey gneisses (mainly tonalitic and granodioritic), which have igneous protoliths dated at about 2.65-2.60 Ga (Rosa-Costa et al., 2003, in press); and 5) several plutons of catazonal granitoids (charnockites, charnockendebrites and mesoperite-granites) dated between 2.65-2.60 Ga (Ricci et al., 2002; Rosa-Costa et al., in press), which supposedly mark the time of an Archean granulitic event. Migmatization is widespread in the basement rocks, and the occurrence of charnockitic leucosomes indicates that it also occurred under granulite-facies conditions. These basement complexes host several orogenic granitic plutons, dated at about 2.22 Ga, 2.18 Ga, 2.15 Ga, 2.05 Ga and 2.03 Ga (Rosa-Costa et al., 2003, in press). Post-orogenic plutonic magmatism is marked by the emplacement of 1.75 m.y. old A-type granitic plutons (Vasquez and Lafon, 2001).

GECHRONOLOGICAL STUDY

Three samples were selected for study and their location is shown in the figure 1. Monazite concentrates were extracted from two enderbitic gneisses (MV-27A and LT-214) and from a charnockitic leucosome (MV-27E). Zircon grains from this leucosome were also selected for dating.

The analyses on monazite grains were carried out on a Cameca SX 50 electron probe micro-analyzer (EPMA), at laboratory of BRGM, France. Age calculations were...
analyses were performed on a Finnigan MAT262 mass
evaporation method (Kober, 1986, 1987). The isotopic
level.

The zircon geochronology was based on the Pb-
evaporation method (Kober, 1986, 1987). The isotopic
analyses were performed on a Finnigan MAT262 mass
spectrometer, at the Laboratory Pará-Iso of the UFPA,
Brazil. The zircon ages and the 2σ errors on the ages were
calculated following Gaudette et al. (1998).

In the enderbitic gneiss LT-214, 138 U-Th-Pb EPMA
measurements were obtained on 8 monazite grains and
yielded individual ages ranging between 2156 and 2010
Ma. These ages are considered as representing an
unimodal population, and an average weighted age of 2086
± 3 Ma (MSWD = 1.6) was calculated (Fig. 2B).

Nine monazite grains from the enderbitic gneiss MV-
27A furnished individual ages between 2026 and 2182 Ma,
collected on 137 analytical points, providing an average
weighted age of 2096 ± 6 Ma (MSWD = 1.6).

In the charnockitic leucosome MV-27E, six monazite
gains gave individual ages varying between 1988 and
2179 Ma, yielding a weighted average age of 2087 ± 8 Ma
(MSWD = 1.5). In addition, 7 zircon grains were analyzed
and provided ages spreading between 2045 Ma and 2091
Ma, at the higher steps of temperature of 1500 and 1550
°C. A mean age of 2091 ± 5 Ma (USD = 2.6) was
 calculated from three oldest grains and is interpreted as the
crystallization age of the charnockitic leucosome, which is
in agreement with the monazite age of the same sample
(Fig. 2B).

DISCUSSION

The monazite and zircon ages, which are similar
within the errors, make unambiguous the existence of a
tectono-thermal event at about 2.09 Ga affecting the
Archean basement of the southwestern portion of the
Amapá Block.

The closure temperature (Tc) of Th-U-Pb system in
monazite has been largely accepted to be at least about
700-750 °C (Suzuki et al., 1994), and even higher than 750
°C (Copeland et al., 1988; Spear and Parrish, 1996; Bingen
and Bremen, 1998; Braun et al., 1998). It has also been
demonstrated that, the U-Pb system of monazite may be
resetted by secondary replacement of newly grown
monazite rather than by volume diffusion of Pb (De Wolf
et al., 1993; Zhu et al., 1997). Consequently, if diffusive
Pb loss is not a common process in monazites, a record of
the prograde path of metamorphism and even of peak
metamorphic conditions should be preserved.

Based on these considerations, we conclude that
monazite ages from the studied granulites may be
interpreted as growth ages and, consequently, provides a
reliable estimate of the age of the granulite-facies
metamorphism, occurred at about 2.09 Ga, which possibly
reached temperatures of at least 750°C. The zircon and
monazite ages of the charnockitic leucosome reinforce this
interpretation, since elucidative field data indicate that this
leucosome is product of in situ melting of the enderbitic
gneiss MV-27A. Furthermore, the metamorphic mineral
assemblage (orthopyroxene-bearing) of the leucosome
strongly suggests that the migmatization event marks the
time when peak metamorphic conditions were reached.

The Paleoproterozoic ages obtained in the investigated
samples indicate that, if basement rocks from the Amapá
Block were submitted to a high-grade event during
Archean times, they were completely resetted during the
Paleoproterozoic overprinting. Then, based on the current
data, we can not establish any genetic or chronological
relationship between the Neoarchean charnockitic
magmatism and the granulitic rocks of the region, as
previously suspected (Rosa-Costa et al., 2003)

The basement rocks from the southwestern part of the
Amapá Block commonly exhibit pervasive NW-SE ductile
foliation, dipping systematically 20-50° SW, and mineral
lineation with low plunge predominantly to SW. This
pattern is strongly disturbed along NW-SE transcurrent
zones defined by steeply dipping mylonitic foliation and
sub-horizontal lineation, marking the strike-slip
movement. The structural features are coherent with a
regime of oblique thrusting, with tectonic vergency from
SW to NE. Apparently, the strike-slip zones development
coincides with the final stages of the thrusting movement.

Structural field features strongly indicate that the
granulitic metamorphism was contemporaneous to the
development of the thrusting system. For instance, the
leucosome MV-27E, presenting monazite and zircon ages
about 2.09 Ga, occur in layers concordant to the foliation
of the parental gneisses, MV-27A.

![Figura 1](image)

**Figura 1.** Location of the Amapá Block in southeastern Guiana
Shield.
Milési, 1994; Ledru et al., 1994) que can be represented by the Amapá and Itaituba blocks.

REFERENCES
Rosa-Costa, L.T.; Lafon, J.M.; Delor; C. In press . Zircon geochronology and Sm-Nd isotopic study: further constraints for the Archean and Paleoproterozoic geodynamic evolution of the southeastern Guiana Shield, north of Brazil. (Gondwana Research)

RESUMO
O Bloco Amapá, sudeste do Escudo das Guianas, constitui um bloco arqueano envolvido em uma extensa faixa paleoproterozoica, cuja evolução principal ocorreu durante a Orogênese Transamazônica (2,26-1,95 Ga). Gnaisses granulíticos e um leucossoma charnoquítico da porção sudoeste do Bloco Amapá foram datados pelos métodos U-Th-Pb por microsonda eletroímã em monazita e Pb-Pb em zircão. As monazitas de um gnaisses echarnoquítico forneceram uma idade U-Th-Pb de 2086 ± 3 Ma (MSWD = 1,6). Para um outro gnaisses echarnoquítico, as monazitas apresentaram uma idade de 2097 ± 4 Ma (MSWD = 1,7). As monazitas de um leucossoma charnoquítico forneceram uma idade U-Th-Pb de 2087 ± 8 Ma (MSWD = 1,5), enquanto que os zircões de mesmo leucossoma apresentaram uma idade Pb-Pb de 2091 ± 5 Ma (USD = 2,6). As idades obtidas nas monazitas podem ser interpretadas como idades de formação e, consequentemente, fornecem a idade do metamorfismo granulítico em torno de 2,09 Ga, o qual alcançou temperaturas de pelo menos 750°C. As idades em zircão e monazita do leucossoma charnoquítico, produto da fusão in situ do gnaisses echarnoquítico, reforçam essa interpretação e sugerem fortemente que o evento de fusão marca o momento em que o pico do metamorfismo foi alcançado. Os padrões estrutural e geocronológico da porção sudeste do Bloco Amapá caracterizam um estágio colisional da orogênese Transamazônica, em torno de 2,10-2,09 Ga.
Figure 2. – (A) Geological map of the investigated area, based on Ricci et al. (2001); (B) Th/Pb vs. U/Pb diagrams for the dated monazites and Pb-evaporation diagram for the dated zircons.