Anais da Academia Brasileira de Ciências (2003) 75(1): 97-108
(Annals of the Brazilian Academy of Sciences)
ISSN 0001-3765
www.scielo.br/aabc

# Shrimp and conventional U-Pb age, Sm-Nd isotopic characteristics and tectonic significance of the K-rich Itapuranga suite in Goiás, Central Brazil

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*Manuscript received on June 4, 2002; accepted for publication on January 2, 2003;*
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**ABSTRACT**

The Itapuranga alkali granite and Uruana quartz syenite are large K-rich EW-elongated intrusions, in the central part of the Neoproterozoic Brasília Belt, central Brazil. They are associated with Pireneus lineaments, which cut the regional NNW-SSE structures of the southern part of the belt.

SHRIMP and conventional U-Pb data for the Itapuranga and Uruana intrusions indicate crystallization ages of $624 \pm 10$ Ma and $618 \pm 4$ Ma, respectively. Three zircon cores from the Itapuranga granite yielded U-Pb ages between 1.79 and 1.49 Ga. Sm-Nd $T_{DM}$ ages for both intrusions are 1.44 Ga and $\varepsilon_{Nd}(T)$ values are –5.1 and –5.7, suggesting the input of material derived from older (Paleo- to Mesoproterozoic) sialic crust in the origin of the parental magmas.

Magma mixing structures indicate co-existence of mafic and felsic end-members. The felsic end-member of the intrusions is dominantly represented by crust-derived melts, formed in response to the invasion of Paleo/Mesoproterozoic sialic crust by alkali-rich mafic magmas at ca. 620 Ma.

These intrusions are roughly contemporaneous with, or perhaps slightly younger than, the peak of regional metamorphism in the southern Brasília Belt. Their emplacement along the Pireneus lineament suggest a syn-tectonic origin for them, most probably in transtensional settings along these faults.

**Key words:** Brasília Belt, Brasiliano, Itapuranga, Uruana, U-Pb SHRIMP, Pirineus Syntaxis.

## INTRODUCTION

The Brasília Belt is part of a large Neoproterozoic (Brasiliano/Pan African) orogen developed between the Amazon and São Francisco cratons in central Brazil (Figure 1). It is formed by ca. 1.0 Ga-0.6 Ga old sedimentary units in its eastern part, and by a large juvenile, ca. 0.9-0.64 Ga magmatic arc in the west (for a review, see Pimentel et al. 2000 and Dardenne 2000). Archean and Paleoproterozoic terrains are exposed in the central part of the belt. The Goiás Archean Block (Figure 1), for example, is located to the west of an important gravimetric anomaly (Marangoni et al. 1995) suggestive of a Neoproterozoic suture zone, and is, therefore interpreted as an allochtonous block, amalgamated to the Brasília

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orogen during the Neoproterozoic (Pimentel et al. 2000). The Almas-Conceição do Tocantins Paleoproterozoic Block (Figure 1) is interpreted as an extension of the sialic terrains exposed within the northwestern part of the São Francisco Craton and represents, therefore, an autochthonous exposure of the sialic basement of the Brasília Belt sediments.

Metamorphism increases from lower greenschist facies in the east to granulite facies in the central part of the belt. Granulites underlie large areas and constitute an important portion of the Barro Alto, Niquelândia and Cana Brava layered mafic-ultramafic complexes, in the northern part of the belt, and also of the Anápolis-Itauçu Complex, in the south (Figure 1). High-grade metamorphic rocks have been dated at ca. 780-760 Ma in the northern mafic granulites (Ferreira Filho et al. 1994, Correia et al. 1997, Pimentel et al. 2001), and at ca. 620-640 Ma in the Anápolis-Itauçu Complex (Fischel et al. 1998, 2001a) (Figure 1). The peak of metamorphism at the end of the Neoproterozoic was shortly followed by, or was concomitant with uplift, erosion and extensive mafic magmatism, especially in the western and central parts of the belt (Pimentel et al. 1996, Hollanda et al. 2002).

One of the most conspicuous structural features of the Brasília Belt is the approximately EW lineaments that occur in its central and southern parts, some of which have been interpreted as lateral ramps related to the important eastward mass transport in the southern part of the belt (Strieder and Suita 1999, Araújo Filho 2000). The Pireneus lineament is the most obvious of these structures, and extends for over 200 km roughly in the EW direction, marking the so-called Pireneus Syntaxis (Araújo Filho 2000). The latter is defined as a concave to foreland curve of the Brasília Belt, interpreted as the result of interference between two structurally different belts: one to the north (northern Brasília Belt) with NNE structural trend and one to the south of the systaxis (southern Brasília Belt), with NNW-trending structures (Araújo Filho 2000). Some of the alkali rich granitoids and quartz syenitic rocks such as the Itapuranga granite and Uruana syenite (known collectively as the Itapuranga Suite, Oliveira 1997) intrude along these E-W lineaments and may be interpreted as syn- or late-tectonic. Their emplacement age and tectonic significance have been a matter of debate.

In this paper we present new conventional and SHRIMP U-Pb data, as well as Sm-Nd isotopic results for these rocks, and discuss their significance in relation to the timing of development of the EW faults associated with the Pireneus Syntaxis.

## GEOLOGICAL SETTING

The Pireneus Lineament and the Itapuranga and Uruana intrusions are located in the central part of the Brasília Belt, between two large Neoproterozoic granulite belts (Figure 1). The granulite belt in the north is made of three Paleo- to Mesoproterozoic mafic-ultramafic layered complexes (Barro Alto, Niquelândia and Cana Brava) extending for more than 300 km in the NE direction. They are formed by high grade mafic and ultramafic rocks in their eastern part, which have been dated at ca. 2.0 Ga (U-Pb data of Correia et al. 1997) and amphibolite facies rocks in the west (Ferreira Filho et al. 1998), which were dated at ca. 1.3 Ga (Sm-Nd data of Ferreira Filho and Pimentel 2000). These bodies have been interpreted as layered intrusions formed in a continental setting during the Meso- of Paleoproterozoic which have been metamorphosed at granulite facies during the Neoproterozoic. High grade metamorphism in these complexes has been dated by conventional and SHRIMP U-Pb methods and also by Sm-Nd garnet-whole rock isochrons, at ca. 760-780 Ma (Ferreira Filho et al. 1994, Suita et al. 1994, Correia et al. 1997, Moraes et al. 2000, Pimentel et al. 2001). A lower grade metamorphic event at ca. 620 Ma also affected these rocks, as indicated by the rutile and garnet U-Pb and Sm-Nd isotopic data of Ferreira Filho et al. (1994) and Ferreira Filho and Pimentel (2000). Granulitic rocks to the south of the study area are included in the Anápolis-Itauçu Complex, which is exposed in a large NNW-elongated area between metasediments

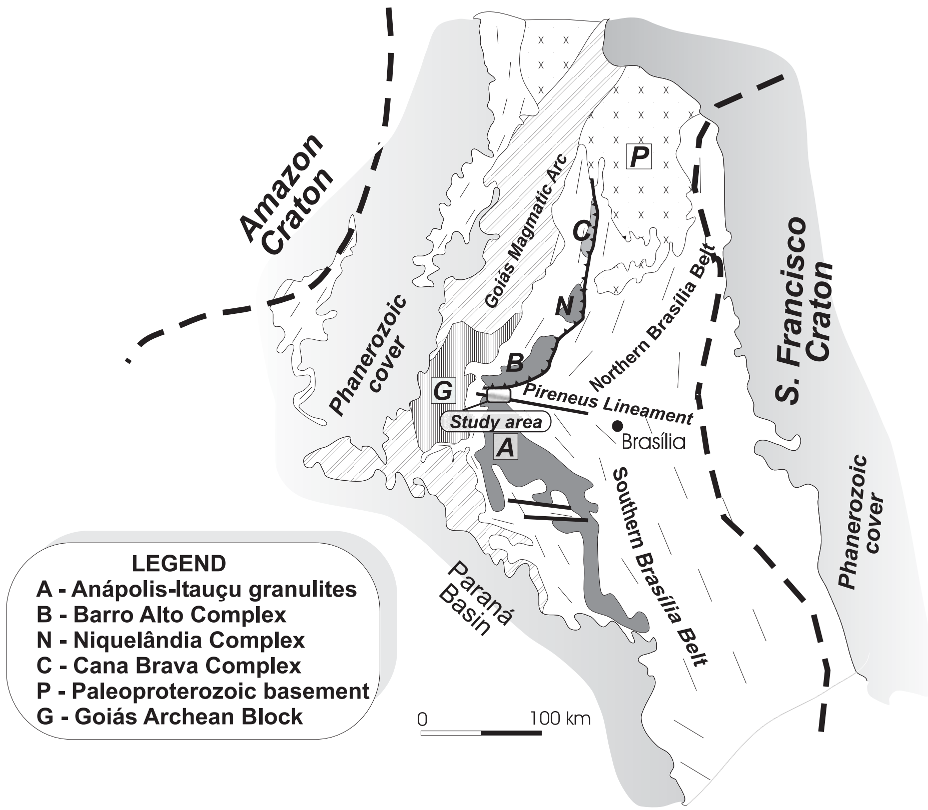


Fig. 1 – Geological sketch map of the eastern part of the Tocantins Province.

(mostly metapelites) of the Neoproterozoic Araxá Group. Rock types of different nature constitute the complex, including: (i) orthogranulites represented by mafic-ultramafic layered bodies, as well as granulites of tonalitic and granodioritic compositions, (ii) aluminous granulites, leptinites and garnet gneisses associated with supracrustal rocks such as marble, calcsilicate rocks, quartzite and fine grained amphibolites, (iii) narrow strips of Neo- and Paleoproterozoic volcano-sedimentary sequences made of amphibolite, micaschist, felsic metavolcanic, metachert and iron formation (e.g. Silvânia, Bonfinópolis and Rio do Peixe sequences; Araújo Filho 1981, Lacerda Filho and Oliveira 1995), and (iv) a large number of granitoid intrusions forming NW-SE elongated bodies. SHRIMP U-Pb results (Fischel et al. 2001a) show that most of the granitoid rocks are Neoproterozoic, ranging in age between ca. 650 and 620 Ma.

Fischel et al. (1998, 2001a) have demonstrated that the high grade metamorphic event happened at the end of the Neoproterozoic, during the Brasiliano orogeny, and is at least 140 Ma younger than the high grade metamorphism in the northern part of the belt.

## THE ITAPURANGA AND URUANA INTRUSIONS

The Itapuranga and Uruana bodies are exposed just to the north of the Anápolis-Itauçu high-grade complex and are intrusive into orthogneisses of unknown age, supracrustal rocks of the possibly Paleoproterozoic Rio do Peixe volcano-sedimentary sequence and also into metasediments of the Araxá Group and Serra Dourada Sequence (Figure 2). In gen-

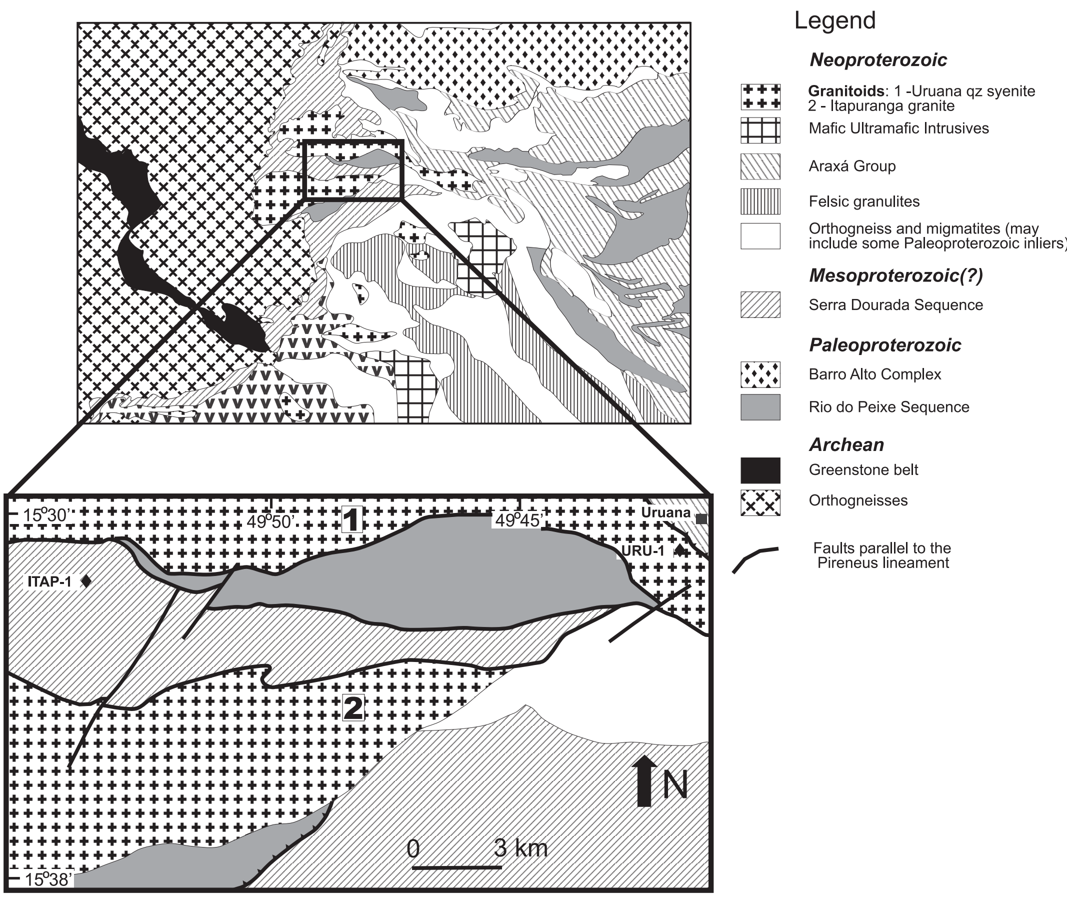


Fig. 2 – Simplified geological map of the Itapuranga-Uruana area (sheet SD.22-Z-C-VI), adapted from Oliveira (1997).

eral, the contacts between the intrusions and the country-rocks are marked by mylonitic zones and cross-cutting relationships are rarely observed.

In the study area, the Rio do Peixe volcano-sedimentary sequence is formed by amphibolite, calc-silicate rock, and micaschist with garnet and staurolite. Less abundant felsic metavolcanics have also been described (Oliveira 1997). This sequence has been traditionally correlated with the Silvânia metavolcanics, exposed to the southeast of the area, and dated recently at ca. 2.1 Ga (Fischel et al. 2001b). The Araxá Group is formed dominantly by pelitic schists with garnet and thin quartzite layers, and the Serra Dourada Sequence, of unknown age, comprises quartz schist and quartzite.

The Uruana and Itapuranga intrusions are part of an extended suite (Itapuranga Suite) comprising mainly quartz syenite, alkali granite, with less abundant quartz monzonite, quartz diorite, granodiorite and tonalite (Souza et al. 1993, Lacerda Filho and Oliveira 1995, Oliveira 1997). They form large intrusions elongated in the E-W direction, emplaced mainly into metasediments of the Brasília Belt.

The Uruana and Itapuranga bodies are petrographically and structurally very similar to each other. They present a pervasive EW to WNW foliation which becomes progressively better developed towards the margins of the intrusions. Mylonitic, protomylonitic and augen textures are common and ultramylonites have been described in some places

(Oliveira 1997). The intrusions comprise medium- to coarse-grained quartz syenites, alkali granites, which are largely dominant over quartz monzonites, granodiorites, tonalities and quartz diorites. Primary mineralogy includes K-feldspar, plagioclase, quartz, biotite, hornblende, riebeckite and clinopyroxene (Lacerda Filho and Oliveira 1995). Round to elongated mafic enclaves are not rare and suggest that mixing between mafic and felsic magmas took place during the origin of the plutons. The presence of blue amphibole and aerigine in these mafic enclaves suggests an original alkaline nature for the basic end-member (Oliveira 1997).

The general geochemical features reveal the alkaline nature of the magmatism. According to Souza et al. (1993) and Oliveira (1997), major and trace element composition of the Itapuranga and Uruana granite and quartz syenite bear similarities with rocks of the shoshonite clan. The high contents of Nb, Y, Rb and Zr are similar to those found in within plate granites (Oliveira 1997).

## MATERIALS AND METHODS

### Analytical Procedures

Zircon concentrates were extracted from ca. 10 kg rock samples, using conventional gravimetric (DENSITEST®) and magnetic (Frantz isodynamic separator) techniques at the Geochronology Laboratory of the University of Brasília. Final purification was achieved by hand picking using a binocular microscope.

For the conventional U-Pb analyses, fractions were dissolved in concentrated HF and $HNO_3$ ($HF:HNO_3 = 4:1$) using microcapsules in Parr-type bombs. A mixed $^{205}Pb$-$^{235}U$ spike was used. Chemical extraction followed standard anion exchange technique, using Teflon microcolumns, following procedures modified from Krogh (1973). Pb and U were loaded together on single Re filaments with $H_3PO_4$ and Si gel, and isotopic analyses were carried out on a Finnigan MAT-262 multi-collector mass spectrometer equipped with secondary electron multiplier - ion counting, at the Geochronology Laboratory of the University of Brasília. Procedure blanks for Pb, at the time of analyses, were better than 50 pg. PBDAT (Ludwig 1993) and ISOPLOT-Ex (Ludwig 2001a) were used for data reduction and age calculation. Errors for isotopic ratios shown in Table II are $2\sigma$. Ion microprobe analyses were carried out using SHRIMP I at the Research School of Earth Sciences, Australian National University, Canberra, Australia. Zircon grains were mounted in epoxy resin and polished. Transmitted and reflected light microscopy, as well as scanning electron microscope cathodoluminescence imagery was used to investigate the internal structures of the zircon crystals prior to analysis. Data were collected and reduced as described by Williams and Claesson (1987) and Compston et al. (1992). Uncertainties reported in Table I are given at 1 $\sigma$ level, and final age quoted at 95% confidence level. Reduction of raw data was carried out using Squid 1.02 (Ludwig 2001b). U/Pb ratios were referenced to the RSES standard zircon AS3 (1099 Ma, $^{*206}Pb/^{238}U = 0.1859$, Paces and Miller 1993). U and Th concentrations were determined relative to those measured in the RSES standard SL13. All errors quoted in Table I are $1\sigma$, but error for concordia age of sample ITAPU-1 is quoted within 95% confidence limits.

Sm-Nd isotopic analyses followed the method described by Gioia and Pimentel (2000) and were carried out at the Geochronology Laboratory of the University of Brasília. Whole rock powders (ca. 50 mg) were mixed with $^{149}Sm$-$^{150}Nd$ spike solution and dissolved in Savillex capsules. Sm and Nd extraction of whole-rock samples followed conventional cation exchange techniques, using Teflon columns containing LN-Spec resin (HDEHP – diethylhexil phosphoric acid supported on PTFE powder). Sm and Nd samples were loaded on Re evaporation filaments of double filament assemblies and the isotopic measurements were carried out on a multi-collector Finnigan MAT 262 mass spectrometer in static mode. Uncertainties for Sm/Nd and $^{143}Nd/^{144}Nd$ ratios are better than $\pm 0.4\%$ $(1\sigma)$ and $\pm 0.005\%$ $(1\sigma)$ respectively, based on repeated analyses of international rock standards BHVO-1 and BCR-1. $^{143}$Nd/$^{144}$Nd ratios were normalized to $^{146}$Nd/$^{144}$Nd of 0.7219 and the decay constant used was $6.54 \times 10^{-12}$ $a^{-1}$. $T_{DM}$ values were calculated using DePaolo's (1981) model.

## ISOTOPIC RESULTS AND DISCUSSION

U-Pb isotopic results for samples ITAPU-1 and URU-1 are in Tables I and II, respectively. Morphology of the zircon grains in both samples is very homogeneous, and all grains analyzed are prismatic, pink, and free of inclusions and cracks. Sm-Nd isotopic analyses were carried out for the same samples of the Itapuranga and Uruana intrusions and the results are shown in Table III.

Zircon grains in sample ITAPU-1 are pink, prismatic and stubby. Some of them present inherited cores, which are obvious in the cathodoluminescence images, surrounded by overgrowths displaying oscillatory zoning. As the main objective of the study was to assess the age of igneous crystallization, most of the analyses were carried out on igneous rims and not on the inherited nucleii. Nevertheless, three SHRIMP U-Pb analyses of cores yielded concordant to sub-concordant results with $^{207}$Pb/$^{206}$Pb age of ca. 1790, 1759 and 1491 Ma (Figure 3a), indicating Paleoproterozoic and Mesoproterozoic inheritance. Magmatic overgrowths and individual igneous crystals present typical oscillatory zoning and resulted in concordant analyses allowing the calculation of the concordia age (Ludwig 1998) of $624 \pm 10$ Ma (probability of concordance of 0.87) for 11 concordant analytical points (Figure 3b). This represents the best estimate for the age of crystallization of the Itapuranga alkali granite.

Zircon crystals in the Uruana syenite are very similar to those from the Itapuranga granite. Only clear, prismatic grains, without visible cores under a binocular microscope were selected for analysis. Conventional U-Pb results for five fractions are in Figure 3c. Fractions URU-1.1, URU-1.2 and URU-1.3 define a discordia indicating the upper intercept age of $648 \pm 7$ Ma. However, it is likely that fractions 2 and 3 contain a small inherited component, or alternatively have been under-corrected for the presence of common lead. Fractions 4 and 5 indicate much younger $^{207}$Pb/$^{206}$Pb ages (626 and 612 Ma). A regression line through fractions 1, 4 and 5 results in an upper intercept age of $618 \pm 4$ Ma $(2\sigma)$, which agrees, within uncertainty, with the SHRIMP U-Pb zircon age of the Itapuranga granite. This is taken here, therefore, as the best estimate for the age of crystallization of the Uruana syenite. U-Pb data, therefore, indicate that the Uruana and Itapuranga intrusions crystallized roughly at the same time, at ca. 620 Ma, at the final stages of the Brasiliano event, in central Brazil.

Sm-Nd isotopic analysis for samples ITAPU-1 and URU-1 show that both rock samples are rich in LREE, have low Sm/Nd ratios and negative $\varepsilon_{Nd}(T)$ values (–5.1 and –5.7). Therefore, the Sm-Nd isotopic data also indicate contribution of older sialic crust to the Uruana and Itapurangparental magmas. TDM model ages of 1.44 Ga for both rock units most probably represent mixed ages between a mantle-derived Neoproterozoic component and a Paleoproterozoic (and Mesoproterozoic?) crustal contaminant. Together with field evidence, which indicate mixing of mafic and felsic magmas, the Nd isotopic data suggest that partial melting of Paleo- or Mesoproterozoic sialic lower crust occurred due to the emplacement of hot mantle-derived mafic magmas. Intermediate facies of these intrusions, including quartz diorite, tonalite and granodiorite are not voluminous, and might represent, therefore, local products of mixing between mafic and felsic end-members.

## CONCLUSIONS

Conventional and SHRIMP U-Pb ages of the Uruana and Itapuranga quartz syenite and alkali granite intrusions indicate that they are roughly coeval and have crystallized at $624 \pm 10$ Ma and $618 \pm 4$ Ma, respectively. They are contemporaneous with, or perhaps, slightly younger than the peak of regional metamorphism of the Brasiliano orogenic event in

**TABLE I**

**Summary of SHRIMP U-Th-Pb isotopic data for the Itapuranga granite.**

| Grain spot | (1) $\%^{206}Pb_c$ | ppm U | ppm Th | $^{232}Th$ $/^{238}U$ | ppm Rad 206Pb | (1) $^{206}Pb/^{238}U$ Age | $1\sigma$ err | (1) $^{207}Pb/^{206}Pb$ Age |
|---|---|---|---|---|---|---|---|---|
| ITAPU1-1.1r | 1.76 | 1830 | 123 | 0.07 | 159.2 | 611.3 | 15.2 | 603 |
| ITAPU1-1.2c | 0.45 | 234 | 174 | 0.77 | 63.9 | 1772.4 | 41.3 | 1759 |
| ITAPU1-2r | 0.55 | 308 | 229 | 0.77 | 26.2 | 605.2 | 16.1 | 457 |
| ITAPU1-3.1c | 0.29 | 50 | 38 | 0.80 | 12.7 | 1677.1 | 43.9 | 1790 |
| ITAPU1-3.2r | 0.23 | 658 | 274 | 0.43 | 58.0 | 628.4 | 15.8 | 554 |
| ITAUP1-4.1r | 0.07 | 376 | 131 | 0.36 | 32.4 | 615.4 | 15.8 | 602 |
| ITAPU1-5.1r | 1.30 | 198 | 48 | 0.25 | 15.5 | 556.7 | 15.1 | 488 |
| ITAPU1-5.2r | 0.09 | 761 | 325 | 0.44 | 67.4 | 631.8 | 15.8 | 645 |
| ITAPU1-6.1r | 0.03 | 317 | 232 | 0.76 | 28.4 | 639.2 | 16.6 | 641 |
| ITAPU1-7r | 2.86 | 387 | 303 | 0.81 | 37.2 | 664.6 | 20.6 | -217 |
| ITAPU1-8r | –0.14 | 258 | 123 | 0.49 | 23.5 | 650.9 | 16.9 | 639 |
| ITAPU1-9.1r | 0.19 | 122 | 60 | 0.51 | 10.1 | 595.1 | 17.3 | 600 |
| ITAPU1-9.2r | –0.10 | 822 | 386 | 0.49 | 68.9 | 600.3 | 16.7 | 677 |
| ITAPU1-10.1r | 0.17 | 223 | 147 | 0.68 | 19.4 | 620.0 | 20.0 | 607 |
| ITAPU1-11.1c | –0.10 | 212 | 65 | 0.32 | 44.2 | 1401.8 | 34.4 | 1491 |
| ITAPU1-11.2r | 0.04 | 1585 | 339 | 0.22 | 143.9 | 647.3 | 16.1 | 613 |

| Grain spot | $1\sigma$ err | % Discor-dant | (1) $^{207}Pb^*$ $/^{206}Pb^*$ | % err | (1) $^{207}Pb^*$ $/^{235}U$ | % err | $^{206}Pb^*$ $/^{238}U$ | % err |
|---|---|---|---|---|---|---|---|---|
| ITAPU1-1.1r | 112 | –1 | .0600 | 5.2 | 0.82 | 5.8 | .0995 | 2.6 |
| ITAPU1-1.2c | 28 | –1 | .1076 | 1.5 | 4.69 | 3.1 | .3164 | 2.7 |
| ITAPU1-2r | 75 | –24 | .0561 | 3.4 | 0.76 | 4.4 | .0984 | 2.8 |
| ITAPU1-3.1c | 52 | 7 | .10194 | 2.8 | 4.48 | 4.1 | .2971 | 3.0 |
| ITAPU1-3.2r | 50 | –12 | .0586 | 2.3 | 0.83 | 3.5 | .1024 | 2.6 |
| ITAUP1-4.1r | 48 | –2 | .0599 | 2.2 | 0.83 | 3.5 | .1002 | 2.7 |
| ITAPU1-5.1r | 189 | –12 | .0569 | 8.6 | 0.71 | 9.0 | .0902 | 2.8 |
| ITAPU1-5.2r | 26 | 2 | .0612 | 1.2 | 0.87 | 2.9 | .1030 | 2.6 |
| ITAPU1-6.1r | 51 | 0 | .0610 | 2.4 | 0.88 | 3.6 | .1042 | 2.7 |
| ITAPU1-7r | 474 | –133 | .0422 | 18.9 | 0.63 | 19.1 | .1086 | 3.3 |
| ITAPU1-8r | 63 | –2 | .0610 | 2.9 | 0.89 | 4.0 | .1062 | 2.7 |
| ITAPU1-9.1r | 103 | 1 | .0599 | 4.7 | 0.80 | 5.6 | .0967 | 3.0 |
| ITAPU1-9.2r | 31 | 13 | .0621 | 1.4 | 0.84 | 3.3 | .0976 | 2.9 |
| ITAPU1-10.1r | 70 | –2 | .0601 | 3.2 | 0.84 | 4.7 | .1009 | 3.4 |
| ITAPU1-11.1c | 24 | 6 | .0932 | 1.3 | 3.12 | 3.0 | .2429 | 2.7 |
| ITAPU1-11.2r | 21 | –5 | .0603 | 1.0 | 0.88 | 2.8 | .1056 | 2.6 |

Errors are $1\sigma$; Pbc and Pb* indicate the common and radiogenic portions, respectively. (1) Common Pb corrected using measured $^{204}Pb$. Error in Standard calibration is 0.83% ($2\sigma$) (not included in above errors, but required when comparing data from different mounts). c = core, r = rim.

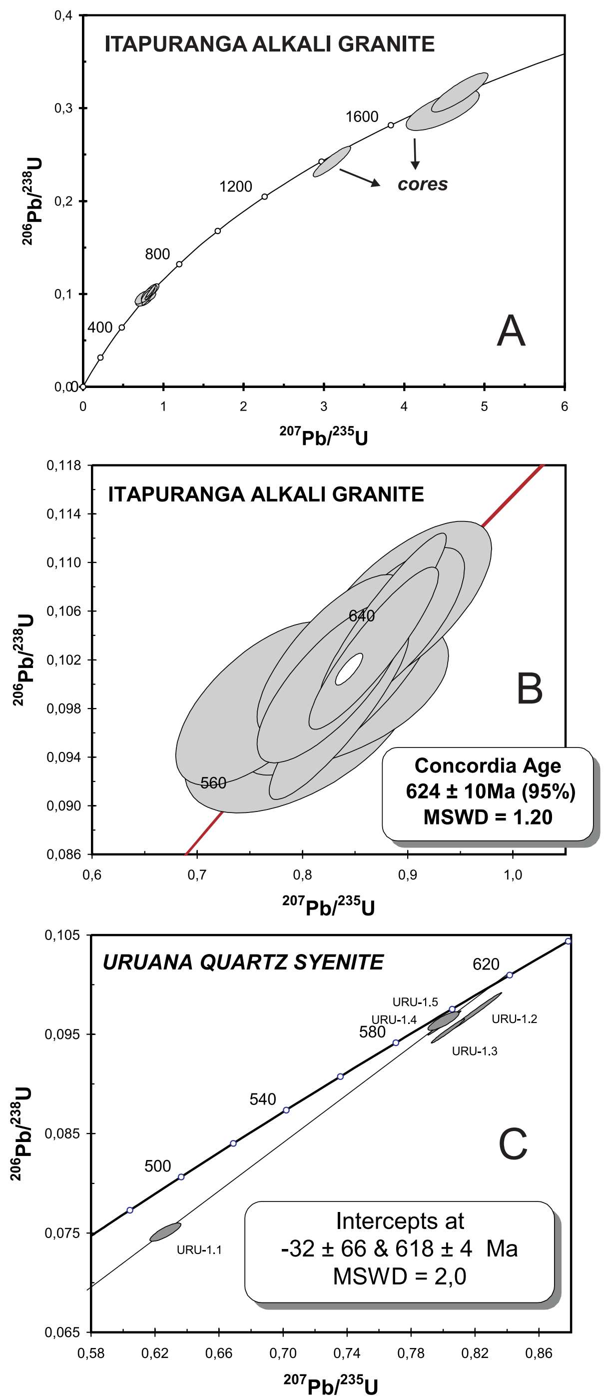


Fig. 3 – U-Pb concordia diagrams for the Itapuranga granite (a and b) and Uruana syenite (c).

**TABLE II**

**U-Pb isotopic data for the Uruana syenite.**

| Sample Fraction | Size (mg) | U (ppm) | Pb (ppm) | $^{206}Pb/^{204}Pb$ | $^{207}*Pb/^{235}U$ | ($2\sigma$ %) | Pb206* U238 |
|---|---|---|---|---|---|---|---|
| Uru 1.1 | 0.100 | 233 | 25.6 | 221 | 0.6315 | 1.22 | 0.0755 |
| Uru 1.2 | 0.134 | 243 | 32.9 | 268 | 0.8200 | 1.58 | 0.0973 |
| Uru 1.3 | 0.087 | 241 | 29.8 | 411 | 0.8032 | 1.05 | 0.0953 |
| Uru 1.4 | 0.047 | 387 | 46.6 | 472 | 0.8014 | 1.02 | 0.0962 |
| Uru 1.5 | 0.014 | 1630 | 185 | 1096 | 0.8005 | 0.90 | 0.0964 |

| Sample Fraction | ($2\sigma$%) | Correl. Coeff. (rho) | Pb207* Pb206* | (pct) | Pb206* U238 Age | Pb207* U235 Age | Pb207* Pb206* Age |
|---|---|---|---|---|---|---|---|
| Uru 1.1 | 0.99 | 0.83 | 0.0663 | 0.69 | 469 | 497 | 626 |
| Uru 1.2 | 1.56 | 0.992 | 0.0611 | 0.18 | 598 | 608 | 643 |
| Uru 1.3 | 1.03 | 0.983 | 0.0611 | 0.18 | 587 | 598 | 643 |
| Uru 1.4 | 1.01 | 0.992 | 0.0605 | 0.12 | 592 | 598 | 620 |
| Uru 1.5 | 0.70 | 0.840 | 0.0602 | 0.40 | 593 | 597 | 612 |

**TABLE III**

**Sm-Nd isotopic results for the Uruana and Itapuranga intrusions.**

| Sample | Sm (ppm) | Nd (ppm) | $^{147}Sm/^{144}Nd$ | $^{143}Nd/^{144}Nd$ ($\pm 1\sigma$) | $T_{DM}$ (Ga) | $\varepsilon_{Nd}(0)$ | $\varepsilon_{Nd}(620)$ |
|---|---|---|---|---|---|---|---|
| URU-1 | 17.94 | 109.43 | 0.0991 | 0.511949 (10) | 1,44 | –13.44 | –5.72 |
| ITAPU-1 | 7.960 | 44.46 | 0.1082 | 0.512018 (13) | 1,44 | –12.10 | –5.09 |

the southern part of the Brasília Belt, as evidenced by SHRIMP U-Pb and Sm-Nd garnet analyses in granulites of the Anápolis-Itauçu Complex (Fischel et al. 1998, 2001a, Pimentel et al. 2001). SHRIMP U-Pb data for zircon cores of the Itapuranga granite indicate inheritance varying in age from ca. 1.79 and 1.49 Ga.

Sm-Nd isotopic data revealed $T_{DM}$ model ages of ca. 1.44 Ga, also indicating, therefore, participation of older (Paleo- to Mesoproterozoic) continental crust in the origin of the parental magma.

Magma mixing features indicating co-existence of mafic and felsic end-members in both the Uruana and Itapuranga intrusions, suggest a mantle derived mafic component in the original magma. Mafic magmatism between ca. 630 and 580 Ma is abundant in the Goiás Magmatic Arc, to the northwest and southwest of the studied area, and have promoted extensive crustal anatexis during the latest stages of the Brasiliano orogeny in central Brazil (Pimentel et al. 1996, Hollanda et al. 2002). The same scenario can be put forward for the origin of the Uruana and Itapuranga intrusions, in which felsic magmas are mostly derived from, or are heavily contaminated with, older sialic crust, which has been invaded by mafic magmas at the end of the Brasiliano event. This has been interpreted as the product of mantle melting due to adiabatic decompression shortly following the main metamorphic event (Pimentel et al. 1996).

The EW elongation of the Itapuranga and Uruana intrusions and their association with the EW Pireneus lineament suggest that the original magmas ascended through this weakness zone, most probably at transtensional sites. Their age mark, therefore, the age of development of the EW faults, and, in consequence, of the formation of the Pireneus Syntaxis, as roughly contemporaneous or slightly younger than the peak of Brasiliano metamorphism in the central part of the Brasília Belt.

Regionally, the new geochronological data indicate that granite intrusions emplaced along the common EW faults in the NNW part of the southern Brasília Belt, represent late-orogenic granite magmatism linked with the development of these lateral ramps which in turn are associated to the important thrust sheets in the Araxá Group.

**ACKNOWLEDGMENTS**

The authors are grateful to CNPq (grants 42.0081-99-2, 46.0408/00-2 to RAF) and FAP-DF (grant 193.000.068/96 to RAF) for financial support for field and laboratory work. The authors also thank two anonymous referees for their helpful comments and suggestions.

**RESUMO**

O alcali-granito de Itapuranga e o quartzo-sienito de Uruana são corpos alongados na direção E-W na porção central da Faixa Brasília. Eles são associados com o lineamento dos Pireneus, que cortam as estruturas regionais NNW da faixa.

Dados U-Pb (SHRIMP e convencional) para as intrusões de Itapuranga e Uruana indicaram idades de 624 $\pm$ 10 Ma e 618 $\pm$ 4 Ma, respectivamente. Núcleos de três cristais de zircão do granito Itapuranga têm idades entre 1.79 e 1.49 Ga. Idades modelo Sm-Nd são de 1.44 Ga e valores de $\varepsilon_{Nd}$(T) são –5.1 e –5.7, indicando participação de crosta siálica mais antiga (Paleo- a Mesoproterozóica). Feições diagnósticas de mistura de magmas indicam a co-existência de líquidos máficos e félsicos, de forma que os membros-finais félsicos das intrusões possivelmente representam líquidos derivados predominantemente da fusão de crosta continental, formados em resposta à intrusão de magmas máficos de natureza alcalina há ca. 620 Ma.

Essas intrusões são contemporâneas, ou umpouco mais jovens, que o pico metamórfico Brasiliano na porção sul da Faixa Brasília. Seu alojamento ao longo do lineamento dos Pireneus sugere tratar-se de corpos sin-tectônicos em relação a essas estruturas, tendo os magmas originais cristalizado em zonas de transtensão ao longo das falhas.

**Palavras-chave:** Faixa Brasília, Brasiliano, Itapuranga, Uruana, U-Pb SHRIMP, Sintaxe dos Pireneus.

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