UNIVERSIDADE DE BRASÍLIA – UnB
INSTITUTO DE GEOCIENCIAS – IG
PROGRAMA DE PÓS GRADUAÇAO EM GEOLOGIA

# Enquadramento Geológico e Geocronológico da Sequência Rio do Peixe na Sintaxe dos Pirineus, Faixa Brasília.

## DISSERTAÇÃO DE MESTRADO 452

**Caio Bussaglia Ress**

**Brasília-DF, Dezembro de 2019**

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Some folks are born made to wave the flag
Some folks are born whith silver spoon in hand
Some folks inherit star spangled eyes
It ain't me, I ain't no fortunate son

Creedence Clearwater Revival

# Abstract

The Pirineus Syntaxis is a major structure in the central portion of the Brasília Belt, splitting it into the northern and southern branches. The syntaxis was developed after Neoproterozoic continental collision between São Francisco/Congo and Amazonian/West Africa paleocontinents. Such structure has been interpreted by two different models: one proposes a bulge in the western border of the São Francisco / Congo paleocontinent, whereas the other interprets the syntaxis as a polyphasic collision. In Artulândia region, north of the Pirineus Syntaxis, there are basement windows that are interpreted as an extension of the Paleoproterozoic Campinorte Domain. In southern portion of the Syntaxis, amid the thrust faults of the Araxá Group, there are mafic metavolcanic rocks and chemical sediments of the Rio do Peixe Group. In the present study, granitic rocks occurring east of the Artulândia region were dated and show Paleoproterozoic U-Pb ages of 2195 ± 12 Ma. The whole-rock geochemistry signature of these rocks is slightly different from the ones reported in previous studies. New geochemical and isotopic data demonstrate that the granitic magmatism is older than previously thought and highlights that during Paleoproterozoic times, different magmatic enviroments coexisted in the same region, extending the Paleoproterozoic in the northern portion of syntaxis.

Furthermore, this study revealed that rocks previously grouped under the Rio do Peixe Group, the most expressive volcano-sedimentary sequence in the Pirineus Sintaxes, cover two distinct periods of the geological history. Sm-Nd isotopes and whole-rock geochemical data show two distinct magmatic events, both younger than has been proposed in earlier studies. The first magmatic event, represented by the Jaraguá mafic unit, of gabbros and amphibolites, the whole-rock geochemistry signature is MORB/E-MORB presenting a possible crustal contamination, showing U-Pb crystallisation age of 1153 ± 40 Ma; Sm-Nd model ages range between 2.20 to 2.45 Ga and εNd values range between -0.38 and -3.6. Such rocks are correlated here to the: Juscelândia, Palmeirópolis, Indaianópolis sequences and Quilombo Group, all of them interpreted as a record of the global Tonian Taphrogenesis.

The other rocks that remained in the Rio do Peixe Group, cropping out in the central part of the Pirineus Syntaxis, form a second magmatic event, and are characterized by association of amphibolites, chemical and terrigenous metasedimentary rocks. The geochemical signature of these amphibolites reveals that they are similar to current OIB/E-MORBs. Sm-Nd model ages range between 0.91 and 1.17 Ga and εNd values range between -1.24 to 3.70. These model ages are similar to those found in the Rio Verissimo and Maratá

Sequences and other occurrences of amphibolites interpreted as ophiolitic melanges inside the metasedimentary rocks of the Araxá Group.

The Araxá Group, quartzites and chlorite-schists of which were analyzed for sedimentary provenance, beans zircon crystals dated between 540 and 2600 Ma, with a higher concentration at 2.15 Ga; their Sm-Nd model ages range between 1.70 and 2.18 Ga. The patterns found in histograms of age distribution show that Paleoproterozoic terrains were a dominant source, abundantly exposed during the deposition of the Araxá Group in the studied area.

This work contributes to the geology in the region of the Pirineus Syntaxis, showing that Paleoproterozoic rocks do not occur in the southern branch of the belt. The Rio do Peixe Group, until now placed as a Paleproterozoic sequence, is proposed to be divided into two units, one derived from a magmatism of 1153 Ma, Sm-Nd model ages between 2.20 to 2.45 Ga and N-MORB signature; the other unit presents Sm-Nd model ages between range 0.91 to 1.17 Ga, signature of E-MORB/OIB type. The Araxá Group shows sedimentary provenance ages older than 540 Ma, with a higher concentration at 2.15 Ga, showing a different pattern from other locations where the unit occurs.

Keywords: Pirineus Syntaxis, Araxá Group, Rio do Peixe, Paleoproterozoic Basement.

# Resumo

A Sintaxe dos Pirineus, estrutura na porção central da Faixa Brasília, marca o limite entre as porções norte e sul da faixa. Sua evolução está ligada à colisão entre os paleocontinentes São Francisco / Congo e Amazônico / Oeste Africano, podendo ser explicado por dois modelos, uma protuberância na borda oeste do paleocontinente São Francisco / Congo ou colisão polifásica entre os paleocontinentes. Na região da sintaxe rochas do embasamento são encontradas em Artulândia, onde o membro norte da sintaxe é entendido como a extensão do Domínio Campinorte. No membro sul da sintaxe, em meio aos cavalgamentos do Grupo Araxá, ocorrem rochas metavulcânicas máficas e metassedimentares químicas e clásticas, entendidas como a sequência vulcano-sedimentar Rio do Peixe, e outros corpos tectonicamente exumados.

Neste estudo datações feitas nas rochas graníticas com ocorrência à leste de Artulandia mostraram que o embasamento paleoproterozoico é mais amplo e antigo que o previsto anteriormente, com dados isotópicos U-Pb de 2195±12 Ma. As assinaturas geoquímicas são ligeiramente diferentes dos estudos anteriores, indicando diferentes ambientes coexistindo durante a formação e diferenciação. Esses dados indicam que o embasamento paleoproterozoico antes restrito á porção norte da Faixa Brasília, com o avanço nos estudos, vem sendo encontrados de maneira esparsa e não correlacionada na porção sul da faixa.

As rochas anteriormente agrupadas no Grupo Rio do Peixe apresentam dois conjuntos de idades modelo, ambas mais jovens que o proposto em estudos anteriores. O grupo mais antigo, gerado por magmatismo Steniano - Toniano, recebeu o nome de unidade máfica de Jaraguá. São gabros e anfibolitos com assinatura tipo MORB, com idades isotópicas U-Pb de 1153±40 Ma e idades modelo Sm-Nd entre 2.2 e 2.45 Ga com εNd entre -0.38 e -3.6, indicando contaminação crustal ou a fusão do próprio embasamento. Este evento, conhecido como tafrogenêse Toniana, é o responsável também pela geração das sequências Juscelândia, Palmeirópolis e Indaianópolis e do Grupo Quilombo.

O Grupo Rio do Peixe fica restrito a porção central da Sintaxe dos Pirineus, sendo uma associação de anfibolitos intermediários junto com rochas metassedimentares químicas e terrígenas, geradas por magmatismo mais jovem, com assinatura geoquimica OIB/E-MORB e idades modelo Sm-Nd entre 0.91 e 1.17 Ga com εNd entre -3.75 e -1.24; estes dados são semelhantes aos encontrados nas sequências Maratá, Rio Verissimo e corpos máficos em meio ao Araxá, mostrando possíveis correlações temporais na porção sul da faixa.

A proveniência de zircão detrítco do Grupo Araxá na área de estudo apresentou idades modelo Sm-Nd entre 1.7 e 2.18 Ga e idades U-Pb em zircão detritico entre 540 e 2600 Ma, com um padrão na distribuição de zircão diferente dos que ocorrem em outras áreas, mostrando que o grupo é formado por fontes diferentes quanto a idade e litologia que foram erodidas ao mesmo tempo, evidencias que os terrenos paleoproterozoicos tiveram grande papel na contribuição sedimentar da unidade.

Palavras Chave: Sintaxe dos Pirineus, Grupo Araxá, Rio do Peixe, embasamento paleoproterozoico.

# SUMÁRIO

# ÍNDICE DE FIGURAS

# ÍNDICE DE TABELAS

# 1 INTRODUÇÃO

## 1.1 Apresentação, justificativas e objetivos

A presente dissertação faz parte do projeto "Arcabouço Paleoproterozoico da Faixa Brasília" que vem sendo desenvolvido desde o ano de 2007 por um grupo de professores e pesquisadores da área de geociências, com o intuito de contribuir com o entendimento da Faixa Brasília.

A porção central da Faixa Brasília, onde está localizada a Sintaxe dos Pirineus, ainda carece de estudos para uma melhor compreensão. Na região são descritas unidades paleoproterozoicas e neoproterozoicas. O Grupo Rio do Peixe é descrito como uma sequência vulcano-sedimentar com idade inferida no limite entre o Paleo e Mesoproterozoico (?) (Araújo Filho, 1999, 2000).

Esta dissertação tem o objetivo de entender e explicar a evolução deste conjunto de rochas paleoproterozoicas (?) na região da Sintaxe dos Pirineus por petrografia, geoquímica e dados isotópicos e geocronológicos U-Pb e Sm-Nd. e correlacioná-las com outras ocorrências semelhantes na Faixa Brasília.

A dissertação está dividida em 4 capítulos. Os dois primeiros são introdutórios, o primeiro, trata da introdução, objetivos a serem alcançados e descrição da metodologia empregada; o segundo trata da revisão da geologia regional, o terceiro apresenta os resultados obtidos e as interpretações; e, finalmente o quarto, apresenta os resultados obtidos e conclusões, assim como recomendações para trabalhos futuros. As referências bibliográficas bem como a apresentação completa dos dados estão disponíveis nos anexos ao final da dissertação.

## 1.2 Localização da área de estudo

A área de estudo localiza-se na região central do estado de Goiás, cerca de 150 km de Brasília e 130 km de Goiânia, abrangendo cerca de 8.300 km² e os seguintes municípios: Jaraguá, Goianésia, Pirenópolis e Corumbá de Goiás. Além destes, temos outros municípios menores e dezenas de distritos e povoados espalhados pela área de estudo (Figura 1).

O acesso até Pirenópolis a partir de Brasília pode ser feito pela BR-060 até Alexânia, de onde se segue pelas rodovias GO-139 e GO-225 até o município de Pirenópolis, também a partir de Brasília pela BR-070 até Cocalzinho de Goiás, de onde se segue pela rodovia GO-414 até Corumbá de Goiás e por fim GO-225 até Pirenópolis.

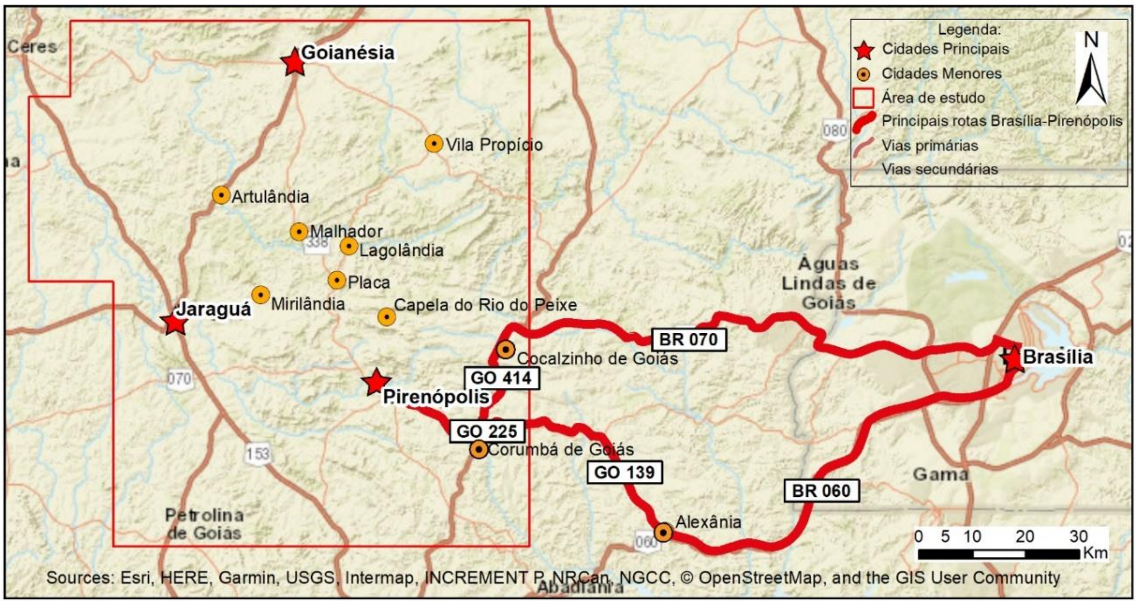

**Figura 1:** Mapa de localização da área de estudo e principais vias de acesso e deslocamento

Na área de estudo as principais vias de deslocamento são BR-153, GO-080 e GO-070 além de diversas estradas vicinais.

## 1.3 Materiais e metodologia utilizada

A presente dissertação foi confeccionada de acordo com os seguintes passos metodológicos: revisão bibliográfica; trabalho de campo e coleta de amostras; caracterização petrográfica; confecção do mapa geológico; análises isotópicas U-Pb de zircão e química de rocha total e Sm-Nd, por fim, integração e apresentação dos dados.

### 1.3.1 Sensoriamento remoto e confecção de base cartográfica

Para a elaboração da base cartográfica utilizada nesta dissertação, foram utilizadas três fontes de dados para a aquisição da informação inicial. A partir desta base, foram confeccionados mapas base, altimétricos, lineamentos e geológicos.

I Mapeamentos de trabalhos acadêmicos e agências governamentais

Coletânea e digitalização de mapas confeccionados durante os trabalhos finais de graduação da Universidade de Brasília (TF's) dos anos de 1977, 1979, 1980 e 1981 por meio da compilação destes dados feita por Araújo Filho (1999). Mapa geológico do estado de Goiás em escala 1:500.000, projeto elaborado e executado pelo Serviço Geológico do Brasil (CPRM) disponível em meio digital pelo link (http://cprm.gov.br/).

II Sensoriamento remoto

Os dados utilizados nesta fase foram obtidos gratuitamente no site do *United States Geological Survey* (USGS) pelo link (http://earthexplorer.usgs.gov). Usando imagens fornecidas pelo satélite LandSat 8, sensor OLI, cena 222/71. Foram feitos os procedimentos de composição e fusão das bandas no *software* ENVI 5.1, com o intuito de ressaltar os principais tipos de uso do solo.

A interpretação de relevo e lineamentos foi feita utilizando Modelo Digital de Elevação (MDE) adquirido pelo projeto SRTM (*Shutle Radar Topography Mission*), cenas S16W049 e S16W050, com aplicação de filtros direcionais de 45° nas direções perpendiculares as grandes estruturas da área.

A vetorização das feições geográficas e geológicas reconhecidas pelos processamentos anteriormente descritos foi feita no *software* ArcMap 10.2.2.

III Aerogeofísica

A área de estudo está contida mo projeto aerogeofísico 3009, executado no processo 23939214/03 a pedido do Governo do Estado de Goiás/SIC–MME/ CPRM Serviço Geológico do Brasil.

### 1.3.2 Trabalho de campo e amostragem

Foram feitos cinco trabalhos de campo na área de estudo, perfis geológicos em zonas de interesse pré-estabelecidas por mapas confeccionados por outros autores (Araujo Filho, 1999 e CPRM, 2008). Aproximadamente 100 pontos foram verificados e 50 amostras coletadas. A amostragem foi feita de modo a permitir a confecção de lâminas delgadas, preparação geoquímica e em alguns pontos chave foram coletadas 10 kg para separação de zircão, com a finalidade de datação isotópica.

### 1.3.3 Métodos analíticos

#### 1.3.3.I Petrografia

Para laminação foram escolhidas amostras que representassem diversidade mineral e textural, sendo confeccionadas 34 lâminas que foram analisadas junto a outras lâminas dos estudos anteriores do projeto “Arcabouço Paleoproterozóico da Faixa Brasília”. As descrições foram feitas em microscópio ótico de luz polarizada transmitida e refletida.

#### 1.3.3.II Geoquímica de rocha total, elementos maiores e menores

A partir das amostras coletadas, as que melhor se enquadravam no foco de estudo deste trabalho, e que não estivessem alterações por intemperismo foram selecionadas para análise geoquímica. Procurou-se abranger com este método a maior variedade litológica possível. A preparação consistiu em britagem do material em moinho de boca e posteriormente a pulverização de parte do material utilizando panela de carbeto de tungstênio e, por fim, quarteamento do material pulverizado enviado para análise laboratorial.

Doze amostras foram enviadas para análise no laboratório da ALS Global - Geochemistry. A rotina de análise escolhida para as amostras foi a CCP-PKG01, metodologia e a aparelhagem utilizada para as medições pode ser verificada no site da companhia www.alsglobal.com.

### 1.3.3.III Análises isotópicas de Sm-Nd

A amostragem para análise isotópica de Sm-Nd segue parâmetro mais flexível, uma vez que o fator intempérico não tem interferência no resultado da análise. A preparação consiste na pulverização do material. As análises foram realizadas no Laboratório de Estudos Geocronológicos, Geodinâmicos e Ambientais do Instituto de Geociências da Universidade de Brasília. As amostras foram pesadas e misturadas com solução *spike* de $Sm^{149}$ - $Nd^{150}$ e dissolvidas por diversos ataques ácidos, seguidos por procedimentos de cromatografia, com separação de Sm e Nd dos outros elementos terras raras em colunas de troca catiônica, e então medidas em espectrômetro de massa do tipo setor magnético, multicoletor (*Thermal Ionization Mass Spectrometer* - TIMS), seguindo a metodologia proposta por Gioia & Pimentel (2000).

### 1.3.3.IV Análises isotópicas de U-Pb

As análises isotópicas U-Pb são pouco afetadas por alterações intempéricas. Deste modo, a metodologia de amostragem foi a de escolher os litotipos que mais representassem a variedade do projeto, sendo amostrados grandes volumes de amostras. A preparação consistiu na britagem em moinho de boca e pulverização em moinho de panela por 60 segundos, peneiramento nas frações 600, 250, 150 e 90 µm, separação gravimétrica por bateamento e separação dos minerais magnetitos utilizando o separador magnético isodinâmico Frantz. Por fim, a seleção manual dos grãos de zircão com auxílio de microscópio estereoscópio, na fração não magnética. Os grãos foram dispostos em malha quadriculada e impregnados por resina epóxi em suportes circulares. Por fim foi feito o polimento, utilizando pastas diamantadas e feltros de modo a expor a superfície dos grãos.

As análises foram realizadas no Laboratório de Estudos Geocronológicos, Geodinâmicos e Ambientais do Instituto de Geociências da Universidade de Brasília, seguido a metodologia analítica descrita por Bühn *et al.* (2009) e critérios de Gioia e Pimentel (2000). É utilizado um espectrômetro de massa do tipo setor magnético, multicoletor modelo *Finnigan Neptune*, sendo o desgaste dos cristais feito por laser com *spot* de 25 µm em frequência de 10Hz e intensidade 3,08/75 J/cm² acoplado ao espectometro. O padrão utilizado foi GJ-1 fornecido pelo ARC *National Key Centre for Geochemical Evolution and Metallogeny of Continents* (GEMOC), além do padrão interno, que utiliza o zircão 91500.

O tratamento dos dados foi realizado no Software Chronus (Oliveira, 2015) e os resultados plotados em Diagrama de Concordia (Wetherhill, 1956), utilizando o suplemento de *Excel*, Isoplot (Ludwig, 2009), que faz o cálculo estatístico das idades. Somente os dados com menores discordâncias foram selecionados para plotagem.

# 2 Contexto Geológico Regional

## 2.1 Faixa Brasília

Este projeto está inserido na Sintaxe dos Pirineus, porção central da Faixa Brasília, que juntamente com as faixas Araguaia e Paraguai compõe a Província Tocantins (Fuck & Marini, 1979). A Faixa Brasília é delimitada a leste pelo Cráton São Francisco e a oeste pelas outras faixas que compõem a Província Tocantins. (Fuck *et al.,* 2005).

A Província Tocantins se desenvolveu a partir das colisões das paleoplacas São Francisco-Congo e Amazônica-Oeste Africana, envolvendo terrenos que estavam em meio a rota de colisão, bem como os blocos Rio de la-Plata e Parnaíba (Brito Neves *et al.,* 2014). Este evento é correlacionado a uma orogênese global neoproterozóica, que culminou na formação do supercontinente Gondwana (Jackson & Ramsay, 1980; Brito Neves *et al.,* 2014)

Existem diversas maneiras de dividir a Faixa Brasília. Valeriano *et al.,* (2008) dividem a Faixa Brasília em três porções estabelecidas de acordo com processos genéticos: I) Arco Magmático, II) Bloco Arqueano e III) Margen Passiva, nesta são individualizadas i) Zona Alóctone Externa, ii) Zona Alóctone Interna e iii) Zona de Antepaís. Pimentel. (2016) propõem a classificação das porções de acordo com o tipo de bacia: bacia de margem passiva, margem ativa e foreland. Estas divisões estão sintetizadas na figura 2.1 e tabela 2.1.

### 2.1.1 Arco Magmático

O Arco magmático de Goiás se coloca como o divisor oeste da Faixa Brasília, sendo dividido em dois: i) Arco de Mara Rosa (560-890Ma), faixa NE-SW localizado na porção norte da faixa (Fuck *et al.,* 2006; Junges *et al.,* 2002) e ii) Arco de Arenópolis (600-890Ma), faixa NW-SE localizado na porção sul da faixa (Pimentel *et al.,* 2003; Laux *et al.,* 2004, 2005). São terrenos de crosta juvenil neoproterozoica, compostos por rochas intrusivas variando em composição desde gabros até granitos e ortognaisses, também ocorrem sequências metavulcano-sedimentares (Pimentel & Fuck, 1992).

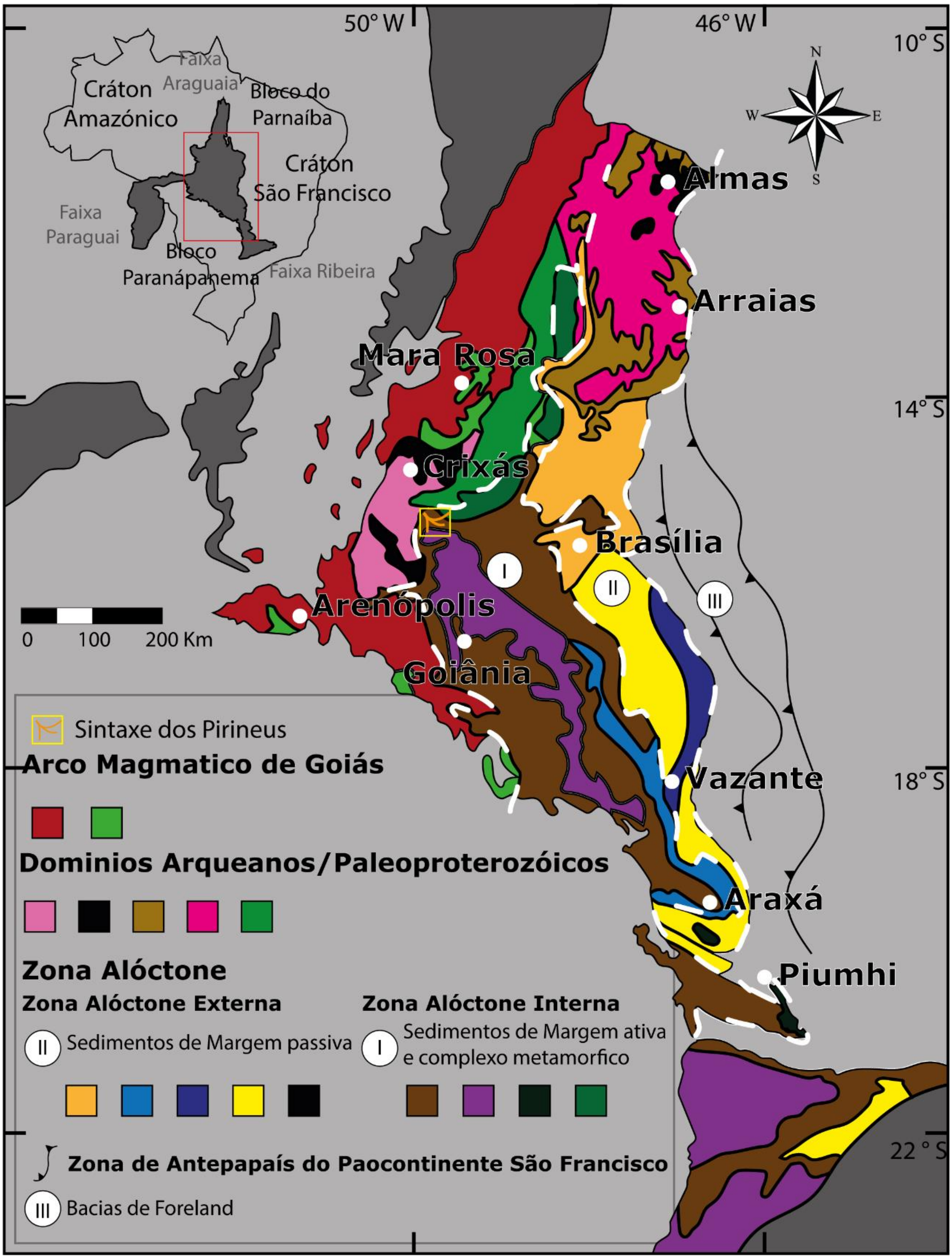

**Figura 2:** Mapa de unidades tectônicas da Faixa (Modificado de Valeriano *et al.,* 2008).

**Tabela 1:** Simplificação das unidades tectônicas da Faixa Brasília, (retirado de Valeriano *et al*., 2008).

| **Domínio** | | **Unidade Tectônica** | |
|---|---|---|---|
| **Margem Passiva** | Antepaís | Sedimentos do Grupo Bambuí depositados sobre o limite faixa-cráton | ⬜ |
| | Externa | Associação granito-*greenstone* e gnaisse-migmatitico | 🟥 |
| | | *Greenstone belts* (Almas) | ⬛ |
| | | Sucessões do tipo-Rifte (Grupos Araí e Natividade) | 🟫 |
| | Interna | Sistema de empurrão Ilicínea-Piumhi | 🟩 |
| | | Grupo Paranoá | 🟧 |
| | | Unidades quartzito-filito (Grupos Canastra e Andrelândia) e ocasionais lascas do embasamento | 🟨 |
| | | Grupo Vazante | 🟦 |
| | | Grupo Ibiá | 🟦 |
| | | Grupos Araxá e Andrelândia, e máficas toleiíticas, complexos de mélanges ofiolíticas do embasamento e leucogranitos sin-colisionais associados | 🟫 |
| | | Nappes granulíticas Complexo Anápolis-Itauçu; Nappe Socorro-Guaxupé | 🟪 |
| **Maciço de Goiás** | | Complexos granito-gnaisse-migmatiticos | 🟥 |
| | | *Greenstone belts* (Crixás-Faina) | ⬛ |
| | | Sucessões vulcanossedimentares (Juscelândia, Palmeirópolis e Serra da Mesa) | 🟩 |
| | | Complexos Máfico-ultramáficos acamadados (Barro Alto, Niquelândia e Cana Brava) | 🟩 |
| **Arco magmático de Goiás** | | Rochas supracrustais (metavulcânica/sedimentar) | 🟩 |
| | | Ortognaisses e granitóides | 🟥 |

### 2.1.2 Maciço de Goiás

O Bloco denominado Maciço de Goiás inclui complexos granito-gnáissicos arqueanos, sequências metavulcano-sedimentares e greenstone belts paleoproterozoicos, sequências meta-vulcanossedimentares mesoproterozoicas (Juscelândia, Palmeirópolis, Indaianópolis) e complexos máfico-ultramáficos acamadados meso a neoproterozoicos (Niquelândia, Barro Alto e Cana Brava). Cordeiro & Oliveira (2017) o divide em Domínio Crixás-Goiás e Domínio Campinorte.

O Domínio Crixás-Goiás, interpretado como um terreno granito-greenstone de idade arqueana-paleoproterozoica (Jost *et al.,* 2005), onde ocorrem complexos TTG bordejados por faixas de rochas metavulcâno-sedimentares greenstone (Jost *et al.,* 2012). A porção superior destas sequências tem idade paleoproterozoica, um indicio de que as bacias em que os sedimentos foram depositados ainda estavam ativas no Paleoproterozoico, afetando a idade dos depósitos, já que as mineralizações ocorrem em sua maioria em rochas metassedimentares (Tassinari *et al.,* 2006; Jost *et al.,* 2014).

O Domínio Campinorte é limitado a oeste pela Falha Rio dos Bois e a leste pelo Empurrão Rio Maranhão. É formado pela sequência vulcano-sedimentar homônima, em conjunto com os granitos e tonalitos da Suíte Pau de Mel. A sequência é composta por metatufos riolíticos, quartzitos, muscovita xistos e rochas metassedimentares químicas (grafita-xistos, gonditos e metacherts) (Kuyumijian *et al*., 2004; Oliveira *et al*., 2006, Della Giustina *et al*., 2009). A suíte plutônica é constituída por metatonalitos, metagranodioritos e metagranitos em corpos alongados N-S. As datações U-Pb fornecem idades de 2179 ± 4 Ma para uma rocha metavulcânica e idades entre 2.15 e 2.18 Ga para a Suíte Pau de Mel (Della Giustina *et al*., 2009). Análises isotópicas Sm-Nd indicam um caráter juvenil de curta residência crustal.

Na porção leste do Domínio Campinorte ocorrem os complexos máfico-ultramáficos de Barro Alto, Niquelândia e Cana Brava, formados por intrusões acamadadas junto a extensivo vulcanismo bimodal (sequências Palmeirópolis, Juscelândia e Indaianópolis) (Ferreira Filho *et al*., 2010). As idades das sequências vulcanossedimentares representam evento magmático de 1.25 Ga. Estas rochas possuem valores de εNd positivos, caracterizando magmatismo juvenil e geoquímica compatível com MORBs (Mid Ocean Ridge Basalts), sugerindo a existência de uma bacia oceânica (Morais *et al*., 2006; Ferreira Filho *et al*., 2010) O metamorfismo nos complexos máfico-ultramáfico é datado por volta de 760 Ma (Pimentel *et al*., 2006). Posteriormente, estes complexos foram exumados até níveis crustais rasos por meio do sistema de Falhas do Rio Maranhão (Pimentel *et al*., 2004).

A Falha do Rio Maranhão representa a descontinuidade sísmica definindo o limite entre o Domínio Campinorte com o Domínio Arraias-Cavalcante (Soares *et al.,* 2006). Silva *et al.,* (2008) descrevem feições similares em ambos os lados da falha, sugerindo que teria de ser mais jovem que as estruturas. Cordeiro & Oliveira (2017) se apoiam nestes dados e em conjunto com dados isotópicos, propõem que a falha do Rio Maranhão é uma feição intra-cratônica.

### 2.1.3 Zona Alóctone

#### 2.1.3. I Zona Interna

A Zona Alóctone Interna é caracterizada pelo sistema de nappes com vergência geral para leste que cavalgam o cinturão de dobras e empurrões da zona interna. São rochas metassedimentares que pertencem às unidades neoproterozoicas dos grupos Araxá e Andrelândia (Pimentel *et al*. 2011), e nappes granulíticas do Complexo Anápolis-Itauçu e de Socorro-Guaxupé (Valeriano *et al*., 2008; Fischel *et al*. 2003b) (Fig. 1.5). Ainda neste domínio são comuns janelas ou "lascas" de embasamento paleoproterozoico e neoproterozoico, compostas por metagranitos e sequências metavulcano-sedimentares subordinadas (Fischel *et al*., 2001; Klein, 2008; Moura, 2018; Piaulino *et al*., 2019).

O Grupo Araxá é dominantemente composto por quartzitos micáceos micaxistos, incluindo calcixistos, estaurolita xistos e xistos feldspáticos, e subordinadas intercalações de paragnaisses e mármores (Dardenne *et al.,* 1991), interpretados como sedimentos sin-orogenéticos de uma extensa bacia do tipo back-arc e/ou fore-arc com ambientes plataformais rasos e marinhos (Pimentel*,* 2016). Seu empilhamento estratigráfico é difícil devido à intensa deformação com o desenvolvimento de cavalgamentos. Os dados de proveniência sedimentar mostram áreas fontes com idades entre 580 e 3600 Ma (Fischel *et al.,* 2003b, Valeriano *et al.,* 2004, Falci *et al.,* 2018, Sabaraense, 2017, Navaro *et al.,* 2017, Brown, 2019, Piaulino *et al.,* 2019). São descritos corpos de anfibolitos máficos e cromititos com idades U-Pb em zircão de 760 a 834 Ma (Streider & Nilson, 1992a, b; Brod *et al.,* 1992; Valeriano & Simões, 1997; Seer *et al.,* 2001; Klein, 2008, Pimentel *et al.,* 2011, Piaulino *et al.,* 2019). Essas rochas são interpretadas como partes de sequências ofioliticas. (Drake Jr, 1980; Streider & Nilson, 1992a, b; Brown, 2019).

Na região entre Ipameri e Pires do Rio ocorrem corpos plutônicos com feições deformacionais protomiloníticas à ultramiloníticas, com paragênese de fácies anfibolito alto e retrometamorfismo para a zona da clorita. Os dados isotópicos mostram três idades de geração destes corpos: 1200 Ma, 790 Ma e 640 Ma (Klein, 2008). Na região afloram as sequências Rio Veríssimo e Maratá: quartzitos micáceos, metapelitos, xistos grafitosos e calcíferos, sedimentos químicos, metavulcânicas acidas à intermediarias (Dardenne *et al*., 1991; 1994; Pimentel *et al*., 1995), com idades U-Pb respectivas de de 790 e 770 Ma, os dados Sm-Nd indicando participação de crosta continental paleoproterozóica (Klein, 2008; Pimentel & Fuck*,* 1992, Pimentel *et al.,* 1999a; Piaulino *et al.,* 2019).

Na região da Sintaxe dos Pirineus aflora o Grupo Rio do Peixe, uma sequência metavulcâno-sedimentar máfica, com idades possivelmente paleoproterozóicas (?) (Araujo Filho, 1999, 2000). No Domínio Artulândia, porção norte da sintaxe, Filgueiras *et al*, (2019) descrevem uma sequência metavulcano-sedimentar félsica (2142±8,5 Ma) associada a uma suíte granodiorítica-tonalítica (2130 a 2156 Ma). Na região de Silvânia a sequência vulcano-sedimentar homônima (2115±23 Ma) ocorre em conjunto com a Suíte Jurubatuba. (2089±14 Ma), granitos levemente deformados apresentando xenólitos de rochas básicas e metassedimentos (Fishel *et al.,* 2001). Na região de Unaí Moura (2018) descreve granitos e tonalitos com idades de cristalização em torno de 2.14 Ga.

### 2.1.3. II Zona Externa

Em sua porção centro-sul a Zona Externa é caracterizada pela ocorrência de sedimentos meso-neoproterozóicos dos grupos Andrelândia, Paranoá, Canastra, Vazante e Ibiá depositados em ambientes plataformais e profundos, em bacias de margem passiva, metamorfizadas em baixo-médio grau (Pimentel *et al.,* 2011, Valeriano *et al.,* 2008). A porção norte envolve o que inicialmente foi denominado de terreno granito-*greenstone* do Tocantins (Costa*,* 1985; Cruz & Kuyumjian, 1999). Individualizada nos domínios Arraias-Calvacante e Almas-Conceição (Fuck *et al.,* 2014).

O Domínio Arraias-Cavalcante é formado pela Formação Ticunzal, paragnaisses grafitosos, interpretados como retrabalhamento de sedimentos pelíticos durante a colagem riaciana (2.20 a 2.46 Ga) (Cuadros *et al.,* 2017b); e pela Suíte Aurumina, sienogranitos, tonalitos e granitos intrudidos nas rochas da Formação Ticunzal (2.12 e 2.17 Ga) (Cuadros *et al.,* 2017a; Botelho *et al.,* 2006).

O Domínio Almas-Conceição, formado pela Suíte Conceição do Tocantins e Grupo Riachão do Ouro. A Suíte Conceição do Tocantins formada por tonalitos, trondhjemitos e granodioritos, dividida em: suíte 1) com assinatura química de fusão mantélica em ambiente convergente e suíte 2) fusão crustal (Cruz & Kuyumijian, 1996; Souza *et al*., 2015), apresentando idades U-Pb em zircão de 2204 ± 4 Ma (Cruz & Kuyumjian, 1999; Cruz, 2001;). O Grupo Riachão do Ouro é uma sequência metavulcano-sedimentar individualizada nas formações Córrego do Paiol e Morro do Carneiro, rochas vulcânicas ultramáficas à intermediarias (2206± 13 Ma) (Dardenne *et al.,* 2009), intercaladas com filitos sericíticos, formações ferríferas bandadas, quartzitos, cherts, conglomerados (Cruz & Kuyumijian, 1999).

### 2.1.3. III Zona de Antepaís

A Zona de Antepaís, porção extremo leste da Faixa Brasília, é formada basicamente por metassedimentos neo-mesoproterozoicos do Grupo Bambuí, depositados em ambientes plataformais em bacia pós-orogênica e que cobrem o Cráton São Francisco (Alvarenga *et al.,* 2012).

## 2.4 A Sintaxe dos Pirineus

A Sintaxe dos Pirineus marca o limite entre as porções meridional e setentrional da Faixa Brasília. Araújo Filho (1999) coloca a sua formação relacionada à fase final da colagem Brasiliana. Suas feições estendem-se por uma área compreendida entre as cidades de Goianésia, Jaraguá e Corumbá de Goiás com a cidade de Pirenópolis na porção central da inflexão, individualizada em dois braços, norte e sul, nos quais as rochas ocorrem como lascas alongadas, colocando tectonicamente em contato unidades do embasamento com unidades da cobertura (Figura 3).

O Grupo Rio do Peixe, considerado o embasamento na Sintaxe dos Pirineus é descrito como uma sequência vulcano-sedimentar em conjunto com granitos (Araújo Filho, 1981; 2000). A sequência é individualizada em porção inferior: rochas vulcânicas máficas e intermediarias; e porção superior: intercalações de rochas vulcânicas félsicas com sedimentos terrígenos e químicos (grafita xistos, magnetititos, gonditos). O protólito da porção inferior é interpretado como subvulcânicas máficas e para a porção superior são interpretados metapelitos, grauvacas, litoarenitos e arcóseos. As paragêneses indicam um pico metamórfico na fácies anfibolito médio, com retrometamorfismo para zona da clorita (Araújo Filho, 1999).

Filgueiras *et al* (2019) fez estudos na região próximo a Artulândia, porção norte da sintaxe, onde a sequência é constituída por metavulcânicas félsicas, em meio a rochas metassedimentares clásticas e químicas. Associados a estas rochas ocorrem corpos de composição tonalítica a granodiorítica. Idade U-Pb em zircão para sequência é de 2.142 Ma, enquanto para as rochas intrusivas houve variação de idades entre 2.130 e 2.156 Ma.

Esta unidade ainda carece de dados geoquímicos e geocronológicos, o que dificulta a definição do seu contexto tectônico e período de formação. Porém, devido às relações de campo e estratigrafia já descritas para a Sequência Rio do Peixe, pode se assumir que esta unidade é basal ao Grupo Araxá e intrudida por diversos corpos graníticos peraluminosos (Granito Artulândia).

Na área ocorrem coberturas neoproterozóicas descritas como mica xistos, calcixistos, quartzitos, granada xistos e grafita xistos pertencentes ao Grupo Araxá. Estas rochas, deformadas pela orogênese Brasíliana, ocorrem como *nappes* descontinuas intercaladas com *nappes* do embasamento. Estas rochas são tratadas como uma porção mais distal em relação à unidade em sua área tipo, descritas por Seer *et al.,* (2001).

Araújo Filho (1999) propõe que as unidades se desenvolveram em um ambiente oceânico extensional que posteriormente foi comprimido, gerando uma sequência ofiolítica incompleta. Os amfibolitos do embasamento representam as porções de crosta oceânica exumadas enquanto que as porções superiores indicariam sedimentos depositados em ambientes distais. Durante a orogênese as rochas basais foram exumadas e colocadas em meio às rochas metassedimentares.

Tectonicamente, a Sintaxe dos Pirineus mostra um arranjo definido na orogenese Brasíliana. O modelo proposto por Fonseca (1996) interpreta que a sintaxe se formou pela colisão da faixa com uma protuberância rigida na borda oeste do Cráton São Francisco, gerando arqueamento da faixa. Outro modelo é proposto por Araujo Filho (2000), em que três fases deformacionais ocorreram em dois sentidos oblíquos, a primeira fase resulta de um esforço no sentido WSW para ENE, gerando a exumação dos corpos do embasamento e foliações de baixo ângulo, visíveis principalmente no braço sul em um sistema de falhas NNW-SSE, que expõem *nappes* de anfibolitos do Grupo Rio do Peixe. As deformações da segunda fase são geradas por esforço no sentido NNW para SSE, gerando a exumação de unidades basais no Domínio Artulândia em um sistema de falhas ~E-W. As feições impressas na última fase deformacional de direção WSW-ENE são foliações espaçadas abertas, paralelas ao eixo das dobras apertadas a localmente invertidas, e a criação de zonas de cisalhamentos de direção N15W nos corpos graníticos do Domínio Artulândia (Araújo Filho, 2000).

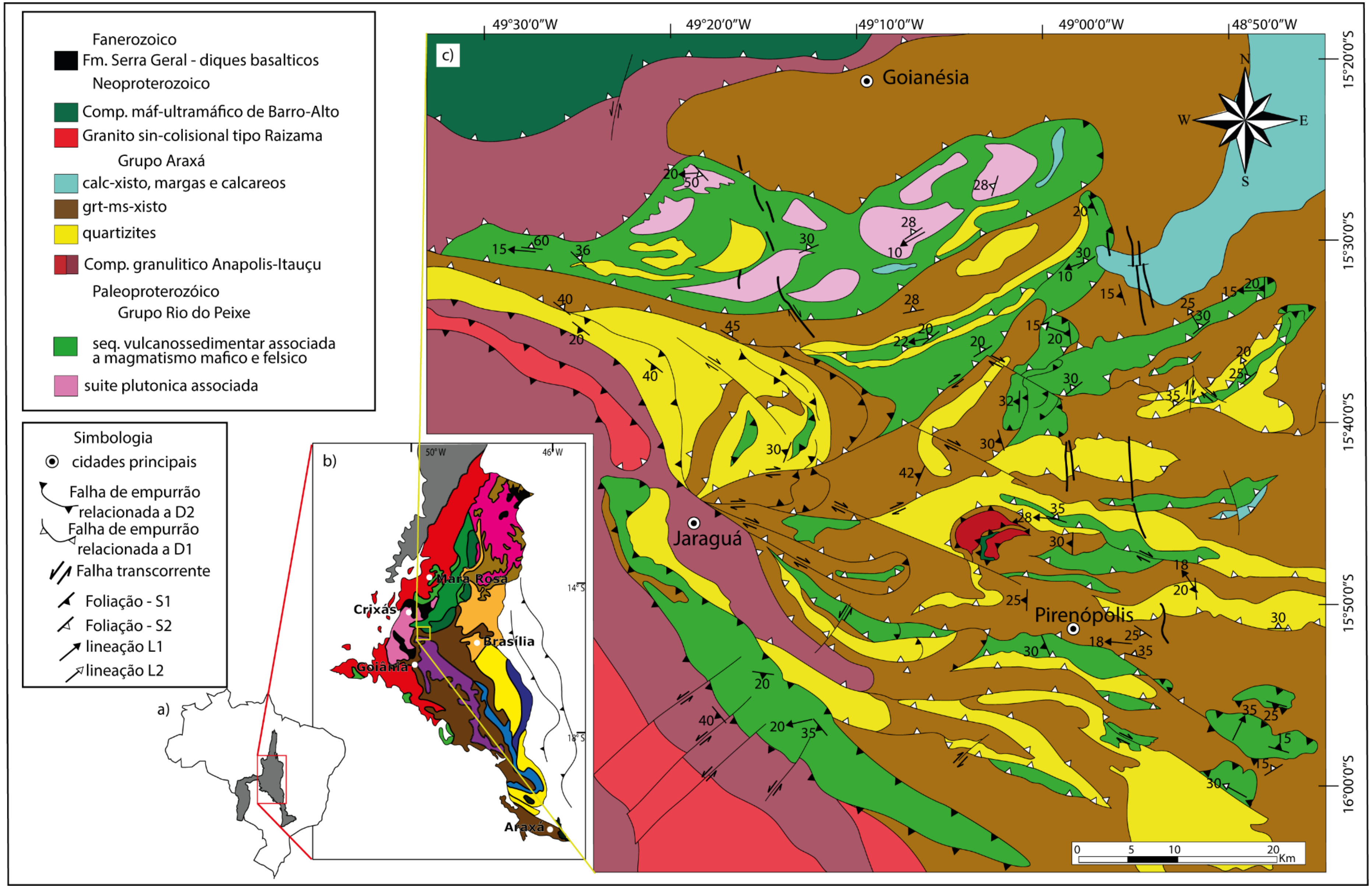

**Figura 3:** Mapa geológico da Sintaxe dos Pirineus (modificado de Araujo Filho, 1999).

# Geological and Geochronological Settings of the Rio do Peixe Sequence in Pirineus Syntaxis, Brasilia Belt.

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## Abstract

The Pirineus Syntaxis is a major structure in the central portion of the Brasília Belt, splitting it into the northern and southern branches. The syntaxis was developed after Neoproterozoic continental collision between São Francisco/Congo and Amazonian/West Africa paleocontinents. Such structure has been interpreted by two different models: one proposes a bulge in the western border of the São Francisco / Congo paleocontinent, whereas the other interprets the syntaxis as a polyphasic collision. In the Artulândia region, north of the Pirineus Syntaxis, there are basement windows that are interpreted as an extension of the Paleoproterozoic Campinorte Domain. In the southern portion of the Syntaxis, amid the thrust faults of the Araxá Group, there are mafic metavolcanic rocks and chemical sediments of the Rio do Peixe Group. In the present study, granitic rocks occurring east of the Artulândia region were dated and show Paleoproterozoic U-Pb ages of 2195 ± 12 Ma. The whole-rock geochemistry signature of these rocks is slightly different from the ones reported in previous studies. New geochemical and isotopic data demonstrate that the granitic magmatism is older than previously thought and highlights that during Paleoproterozoic times, different magmatic enviroments coexisted in the same region, extending the Paleoproterozoic in the northern portion of syntaxis.

Furthermore, this study revealed that rocks previously grouped under the Rio do Peixe Group, the most expressive volcano-sedimentary sequence in the Pirineus Sintaxes, cover two distinct periods of the geological history. Sm-Nd isotopes and whole-rock geochemical data show two distinct magmatic events, both younger than has been proposed in earlier studies. The first magmatic event, represented by the Jaraguá mafic unit, of gabbros and amphibolites, the whole-rock geochemistry signature is MORB/E-MORB presenting a possible crustal contamination, showing U-Pb crystallisation age of 1153 ± 40 Ma, Sm-Nd model ages range between 2.20 to 2.45 Ga and εNd values range between -0.38 and -3.60. Such rocks are correlated here to the: Juscelândia, Palmeirópolis, Indaianópolis sequences and Quilombo Group, all of them interpreted as a record of the global Tonian Taphrogenesis.

The other rocks that remained in the Rio do Peixe Group, cropping out in the central part of the Pirineus Syntaxis, form a second magmatic event, and are characterized by association of amphibolites, chemical and terrigenous metasedimentary rocks. The geochemical signature of these amphibolites reveals that they are similar to current OIB/E-MORBs. Sm-Nd model ages range between 0.91 and 1.17 Ga and εNd values range between -1.24 to 3.70. These model ages are similar to those found in the Rio Verissimo and Maratá Sequences and other occurrences of amphibolites interpreted as ophiolitic melanges inside the metasedimentary rocks of the Araxá Group.

The Araxá Group, where quartzites and chlorite-schists of which were analyzed for sedimentary provenance, beans zircon crystals dated between 540 and 2600 Ma, with a higher concentration at 2.15 Ga; their Sm-Nd model ages range between 1.70 and 2.18 Ga. The patterns found in histograms of age distribution show that Paleoproterozoic terrains were a dominant source, abundantly exposed during the deposition of the Araxá Group in the studied area.

This work contributes to the geology in the region of the Pirineus Syntaxis, showing that Paleoproterozoic rocks do not occur in the southern branch of the belt. The Rio do Peixe Group, until now placed as a Paleproterozoic sequence, is proposed to be divided into two units, one derived from a magmatism of 1153 Ma, Sm-Nd model ages between 2.20 to 2.45 Ga and N-MORB signature; the other unit the presents Sm-Nd model ages between range 0.91 to 1.17 Ga, signature of E-MORB/OIB type. The Araxá Group shows sedimentary provenance ages older than 540 Ma, with a higher concentration at 2.15 Ga, showing a different pattern from other locations where the unit occurs.

Keywords: Pirineus Syntaxis, Araxá Group, Rio do Peixe, Paleoproterozoic Basement.

## 1. Introduction

The Brasília Belt developed on the western margin of the São Francisco Craton during its convergence towards the Amazonian and Paranapanema cratons, in the Neoproterozoic Brasiliano orogeny (Almeida *et al.*, 1981, 2000). Araújo Filho (2000) suggests that the belt developed in two different stages and formed a concave to foreland setting, towards São Francisco craton. The geometry of the belt reflects the intersection of two non-parallel fold-thrust belts of different ages. The southern branch is believed to be older, and formed as a response to a NE-SW convergence of the São Francisco and the concealed Paranapanema cratons. The younger northern branch developed as a consequence of the NW-SE convergence between the Amazonian and São Francisco cratons. The Pirineus Syntaxis is the area where the two belts intersect, where the deformation and the metamorphism affected basement and sedimentary layers as a whole. In the Pirineus Syntaxis, thrusting, folding and amphibolite facies metamorphism made volcano-sedimentary sequences hard to individualize and for a long time, sediments deposited in different tectonic settings have been interpreted as one long-lived basin. However, new data presented in this paper show that at least four different units crop out in the same area.

New geochronological data, Nd isotope results and bulk geochemistry show that there is a Paleoproterozoic terrane within younger sedimentary rocks. This terrane is composed of arc-related granites and associated volcano-sedimentary sequence. It was named Artulândia region and is the extension of the Campinorte Arc to the eastern side of the Rio Maranhão Fault (Filgueiras *et al*., 2019). This Paleoproterozoic terrane is surrounded by Neoproterozoic metasedimentary rocks of Araxá Group and by the Rio do Peixe Group, which was once considered the oldest basement in the syntaxis (Araújo Filho, 1981, 1992, 1999 and 2000). In this paper we show that whole-rock Nd data from Rio do Peixe Group rocks indicate that this geological unit is much younger, and possibly correlated to Araxá Group, instead of correlater to the Paleoproterozoic basement.

These data contribute to the discussion of how the São Francisco western passive margin evolved prior to the begnining of the Brasiliano Orogeny, during the break up of Rodinia, and whether an incipient oceanic crust was developed. Furthermore, we also corroborate to the studies of Sousa *et al*. (2016), Cordeiro & Oliveira (2017) and Filgueiras *et al*. (2019), who propose that São Francisco paleoplate is much larger than the craton current outline (Teixeira *et al*., 2017), and that the Paleoproterozoic arc-related rocks in the Pirineus Syntaxis essentially are parts of São Francisco craton drifted after taphrogenetic events.

## 2. Regional geologic setting

The Brasiliano Collage was responsible for the development of the Brasília, Paraguai and Araguaia belts (Almeida, 1967a, 1969), which are coeval to the Pan-African orogenic event (Kennedy, 1964; Jackson & Ramsay, 1980). The Brasília Belt is composed of Meso to Neoproterozoic sedimentary sequences deposited above Paleoproterozoic granitic basement. The Brasília belt has two branches developed with different orientations, according to the direction of compression between landmasses. The study area is located where the two branches intersect (Fig. 1), in the area named Pirineus Syntaxis (Fuck & Marini, 1979). There are two different models that explain this structural feature: (1) The effect of an bulge on the east border of the San Francisco-Congo plate, acting as a rigid bulkhead (Fonseca, 1996) or (2) a polyphasic collision, with the initial strain towards WSW to ENE followed by an NNW to SSE strain that initiated another WSW to ENE strain (Araujo Filho, 2000). Araujo Filho (2000) describes the syntaxis as an area where structures present northwest or east-west directions (Fig. 2). Both structures are affected by foliations, parallel to the axis, creating N15W direction shear zones visible mainly in the granitic bodies, and Paleoproterozoic slices of basement crop out within sedimentary rocks (Araujo Filho, 2000).

The Paleoproterozoic terranes in the belt have been previously grouped under the term Goiás Massif (Pimentel *et al*., 2000), but recent studies divided them into four tectonic domains (Cordeiro & Oliveira, 2017), that expand beyond the original area of the Goiás Massif. The four domains are named Crixás, Campinorte, Arraias-Cavalcante and Almas-Conceição, after towns in their vicinities. All of them exhibit arc-related rocks and volcano-sedimentary sequences. Cordeiro & Oliveira (2017) proposed that these domains are part of São Francisco Paleoplate.

Among these Paleoproterozoic domains, the Campinorte Arc is of special relevance for this work because of its geographic proximity to the studied area. The Campinorte Domain is composed of tonalites of ca. 2.17 Ga and its coeval volcano-sedimentary sequence, in which clastic, chemical and volcanic rocks are present (Della Giustina *et al.*, 2009; Oliveira *et al.*, 2006) (Fig. 1). A sliver of the Campinorte Domain, named Artulândia region (Filgueiras *et al.*, 2019), crops out in the studied area. In the Campinorte Domain and Artulândia area, tonalites/granodiorites have slightly positive εNd values and are interpreted as arc-related rocks (Della Giustina *et al*, 2009; Cordeiro *et al.*, 2014, Filgueiras *et al.*, 2019).

Valeriano *et al.* (2008) showed that the metasedimentary sequences of the Brasília Belt belong to the outochtonous external zone (rift and passive margin metasedimentary sequences deposited above Almas-Conceição and Arraias Cavalcante domains) or to the allochthonous internal zone (syn-orogenic basin, ophiolitic mélange, granulitic complex) (Fig. 1). In the study area, the two metasedimentary sequences that crop out are Araxá Group and Rio do Peixe sequence, both part of the allochtonous internal zone.

The Araxá Group is composed of quartzites and chlorite schists that may contain grafite and garnet (Brod & Jost 1991; Dardenne *et al.*, 1991). U-Pb provenance data on zircon grains show ages between 0.5 and 3.6 Ga for the Araxá Group (Fischel *et al.*, 2003b; Valeriano *et al.*, 2004; Falci, 2018; Sabaraense, 2016; Navarro *et al.*, 2017; Brown, 2019; Piaulino *et al.*, 2019). Interbedded with quartzites and schists, there are ophiolitic mélanges of 760 to 800 Ma and $T_{DM}$ ages of 0.80 to 4.22 Ga (Drake Jr, 1980; Strieder & Nilson, 1992a; Brown, 2019), mafic amphibolites with E-MORB/OIB signatures (Brod *et al.*, 1992; Seer *et al.*, 2001, Piauilino *et al.*, 2019) and granites and high-grade metamorphic rocks from Anapolis-Itauçu (orthogranulites and paragranulites) with ages ranging Paleoproterozoic to Neoproterozoic (Dardenne *et al.*, 1994; Pimentel 1999a, Fischel *et al.*, 2003a; Seer *et al*, 2005; Klein, 2008; Moura, 2018).

The Maratá Sequence (790 Ma, positive εNd(t) values and $T_{DM}$ ages between 1.6 to 2.0 Ga) (Dardenne *et al.*, 1994; Klein, 2008; Piauilino *et al.*, 2019); Rio Veríssimo Sequence (979 Ma, positive εNd(t) values and TDM ages around 1,40 Ga) (Dardenne *et al.*, 1994; Piauilino *et al.*, 2019) and Rio do Peixe sequence (Araújo Filho, 1981, 1999), occur similarly in the middle of the Araxá Group and will be discussed in this work (Fig. 1).

The Rio do Peixe Group (Araujo Filho, 1981, 1999) occurs throughout the Pirineus Syntaxis. It is composed at the base by mafic to ultramafic volcanic and sub-volcanic rocks, followed by mafic and felsic volcanic rocks, interbedded with clastic and chemical sediments. In this portion occur: quartzites, arkoses, cherts, gondites, magnetitites, graphite shales, marls, calcschists and tuffs. Sometimes rocks present high concentrations of sulfides and oxides (Filgueiras *et al.*, 2019). These rocks have been previously described as Paleoproterozoic meta volcano-sedimentary sequences formed in an incipient extensional tectonic environment (Araujo Filho, 1999).

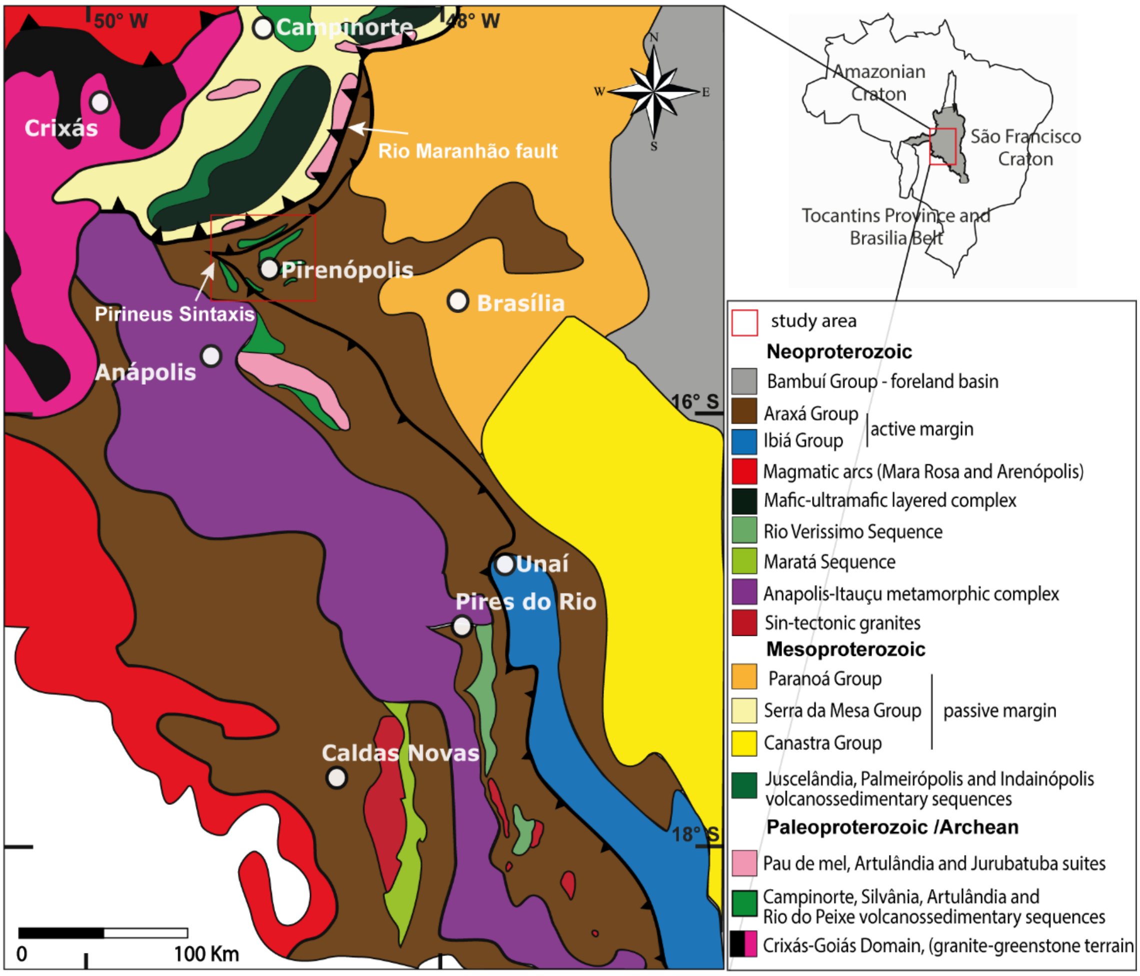

**Fig. 1.** Schematic tectonostratigraphic map of the Brasília Belt (modified after Valeriano *et al.*, 2009).

## 3. Local Geology

In the study area, we were able to map and analyze rocks from four different units: (i) Paleoproterozoic Campinorte Arc (in Artulândia area), (ii) Rio do Peixe Sequence, (iii) Jaraguá mafic intrusive unit and (iv) Araxá Group (Fig. 2).

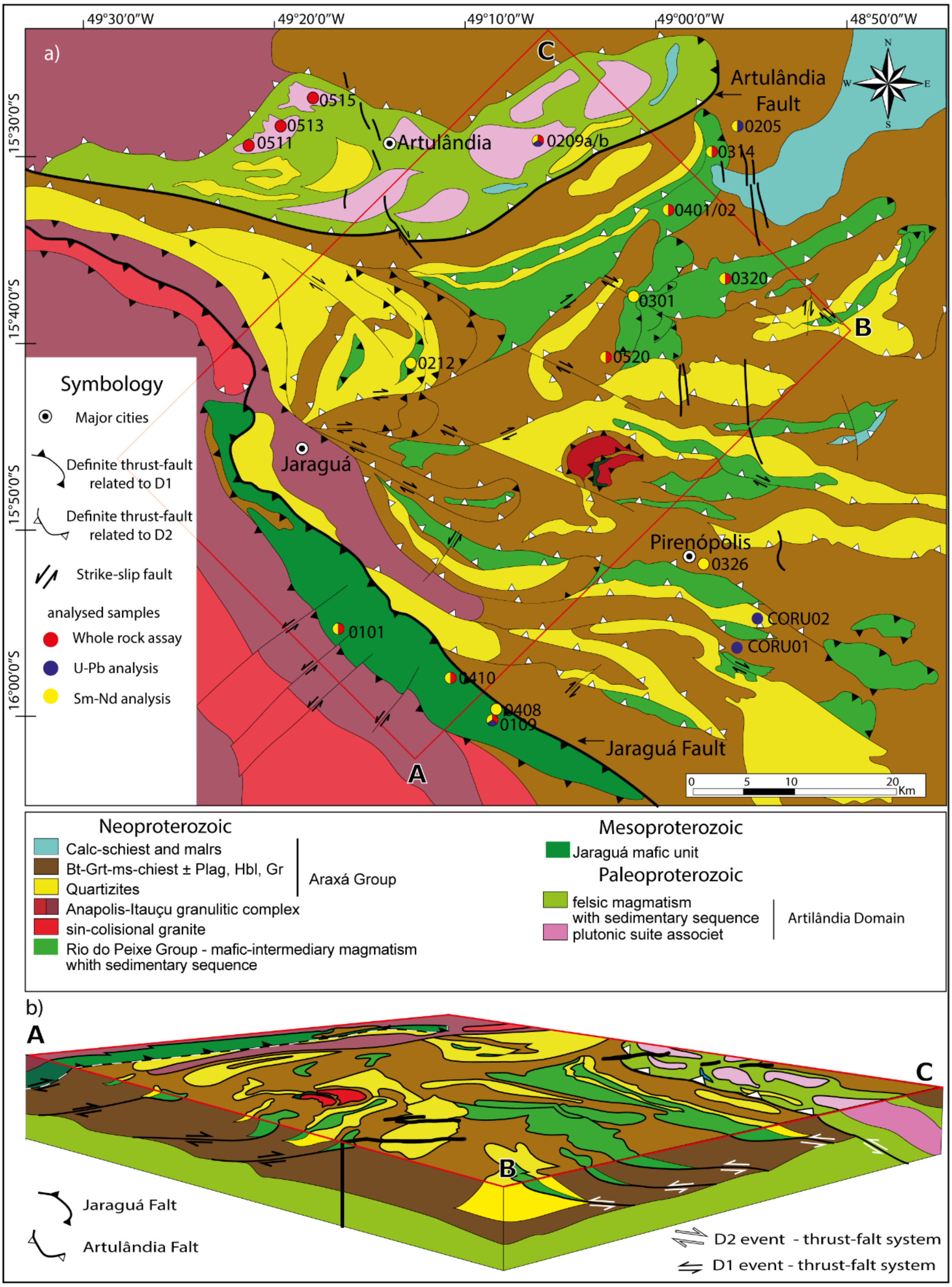

**Fig. 2.** (a) Geologic map of the Pirineus Sintaxys, with the distribuition of the analysed samples (modified after Araujo Filho, 1999), (b) schematic block-diagram, for best view of the oblique direction faults.

### 3.1 Campinorte Arc in Artulândia area

The Campinorte Arc is represented by granitic rocks that are restricted to the Artulândia area, at the northern portion of the Pirineus Syntaxis, and so are felsic volcanic rocks (Filgueiras *et al*., 2019) (Fig. 2 A). The area is formed of tonalites, granodiorites and ortho-mylonites. Plutons are deformed at their borders. Tonalites are usually equigranular with minerals that exhibit poligonal contacts (Fig 3D). Amphibole, biotite and garnet are secondary minerals (Fig 3C). Pegmatitic veins are common in the plutons (Fig. 3A, B) Associated with the tonalites and granodiorites, there is a volcano-sedimentary sequence in which felsic volcanic rocks predominate (Filgueiras *et al*., 2019).

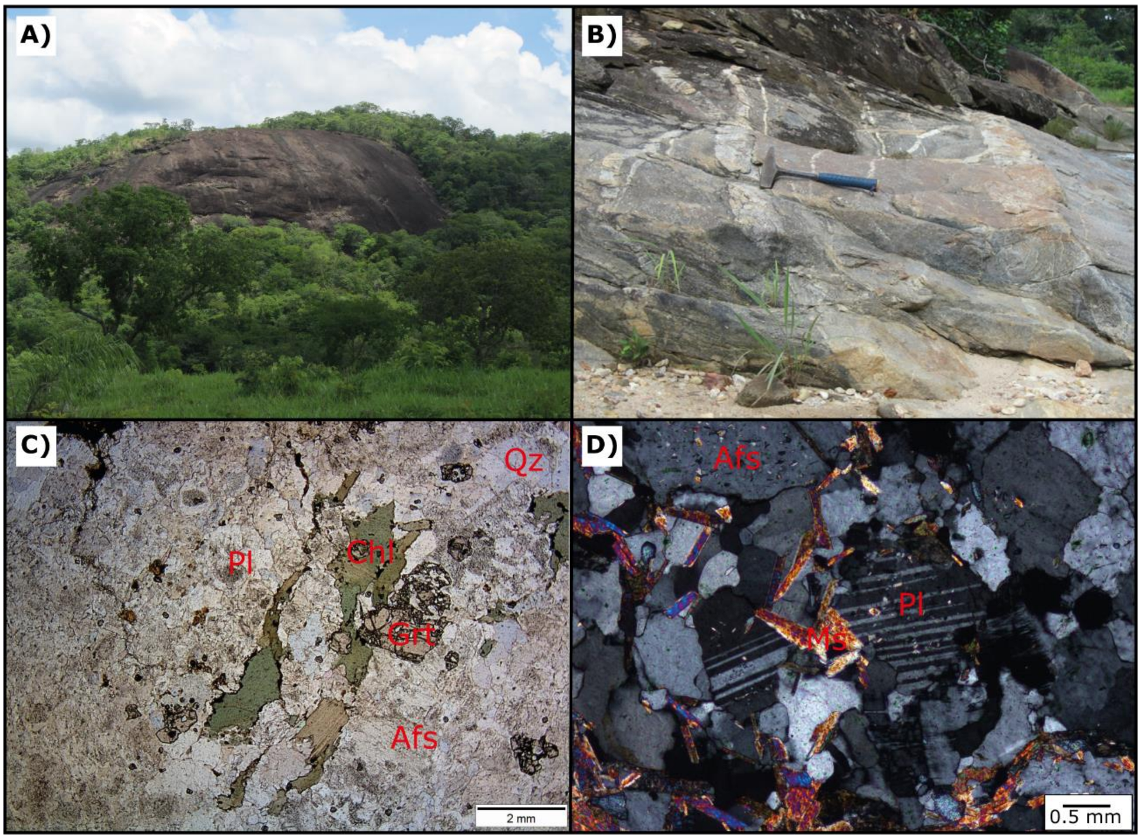

**Fig. 3.** Artulândia Domain: (A) domic occurrence of plutonic rocks (B) tonalite outcroop with multiple pegmatite dikes, (C) granodiorite, white metamorphic crystals of chlorite and garnet, (N//) and (D) equigranular tonalite (NX).

## 3.2 Rio do Peixe Sequence

The Rio do Peixe Sequence crops out in a sparse and discontinuous way, restricted to the south-central portion of the syntaxis (Fig. 2 A). There amphibolites and amphibole schists composed of hornblende, plagioclase, garnet, biotite, titanite and pyrite. The mineral assemblage indicates amphibolite facies metamorphism (Fig. 4A, B) that was retrograded to greenschist facies, indicated by the presence of chlorite, muscovite and epidote (Fig. 4C, D, E, F). The protoliths of the sequence are probably volcanic and sub-volcanic mafic rocks. These amphibolites are common at the basal part of the sequence, and at the top, intermediate effusive rocks are described.

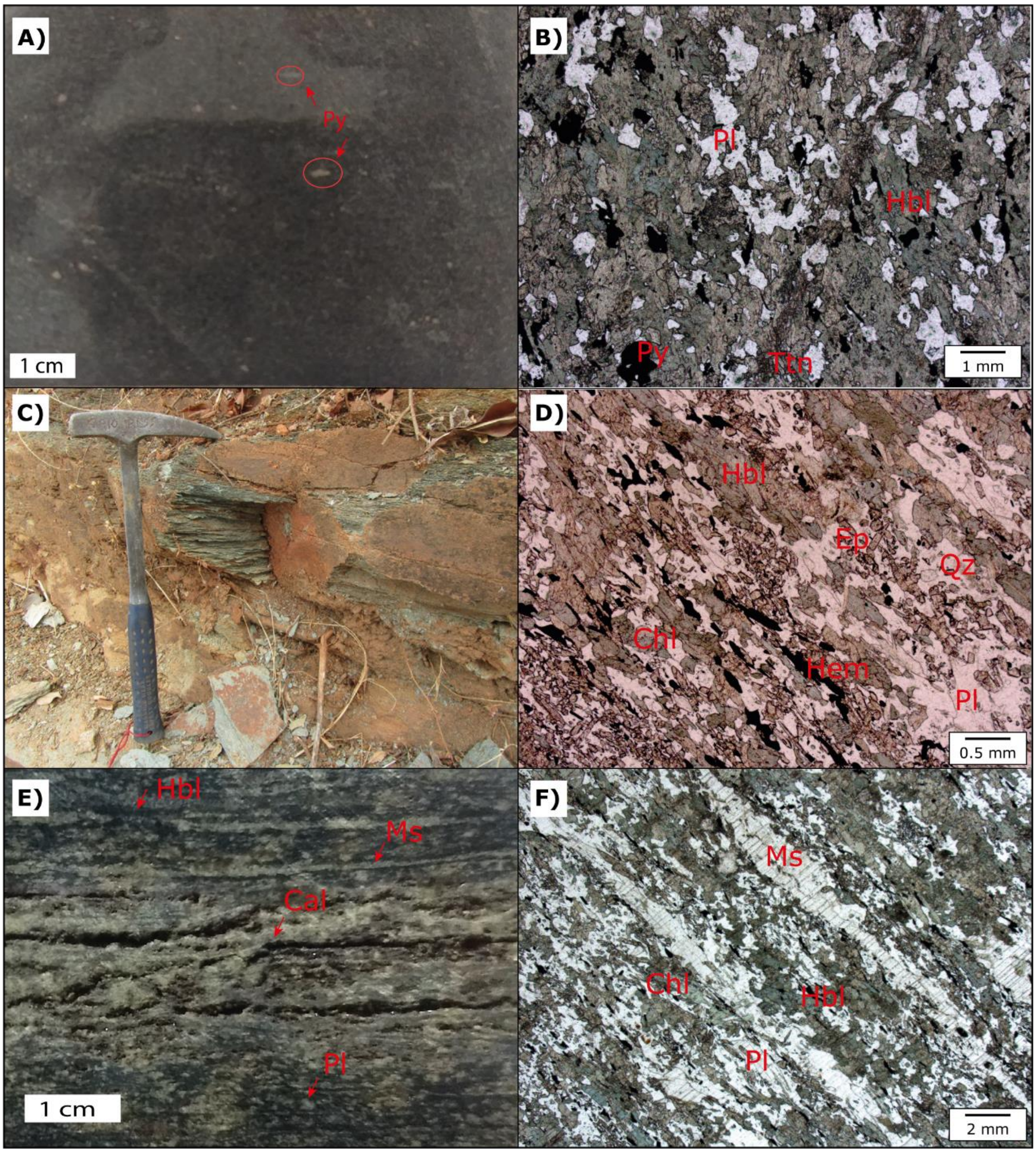

**Fig. 4.** Lower portion of Rio do Peixe Sequence: (A, B) basal mafic amphibolite with pyrite dissemination, thin section with granoblastic texture and high amphibolite weil metamorphic grade mineralogy (N//); (C, D) outcrop of amphibole schist, rock presents a centimetrical foliation, thin section with nematoblastic texture, with retrometamorphic textures, sulphide transformed in hematite and hornblende in chlorite and epidote (N//); (E, F) altered amphibolite, in thin section the higher metamorphic grade mineralogy has been substituted the retro metamorphic mineralogy, chlorite, hornblend and muscovite (N//).

The upper portion of the Rio do Peixe Sequence displays volcanoclastic tuffs, clastic and chemical sediments, such as chlorite-muscovite schists, quartzites, garnet schists, gondites, magnetitites, metacherts, marls and carbonaceous schists (Fig. 5). The basic mineralogy of the volcanoclastic rocks is quartz, muscovite, chlorite, epidote and plagioclase, which is always saussuritized (Fig. 5 C, D). Biotite, garnet, hornblende, choritoid, riebeckite and pyrite may also be present (Fig. 5 F, G). Rocks from this unit are intensely wheathered, due to their fine strata and prone to alteration mineralogy. The mineral paragenesis from the metamorphic peak is almost completely replaced by the greenschist retrometamorphism.

The occurrence of intermediate volcanic rocks associated with clastic and chemical sediments, calcischists is indicative of a marine environment. The carbonaceous schists present distinctive characteristics: they may present a massive carbonaceous material, or an association of graphite, quartz, feldspar, tremolite and pyrite (Fig. 5 G, H, I). These rocks associations suggest an active volcanic environment, with the presence of fumaroles in the extentional oceanic environment.

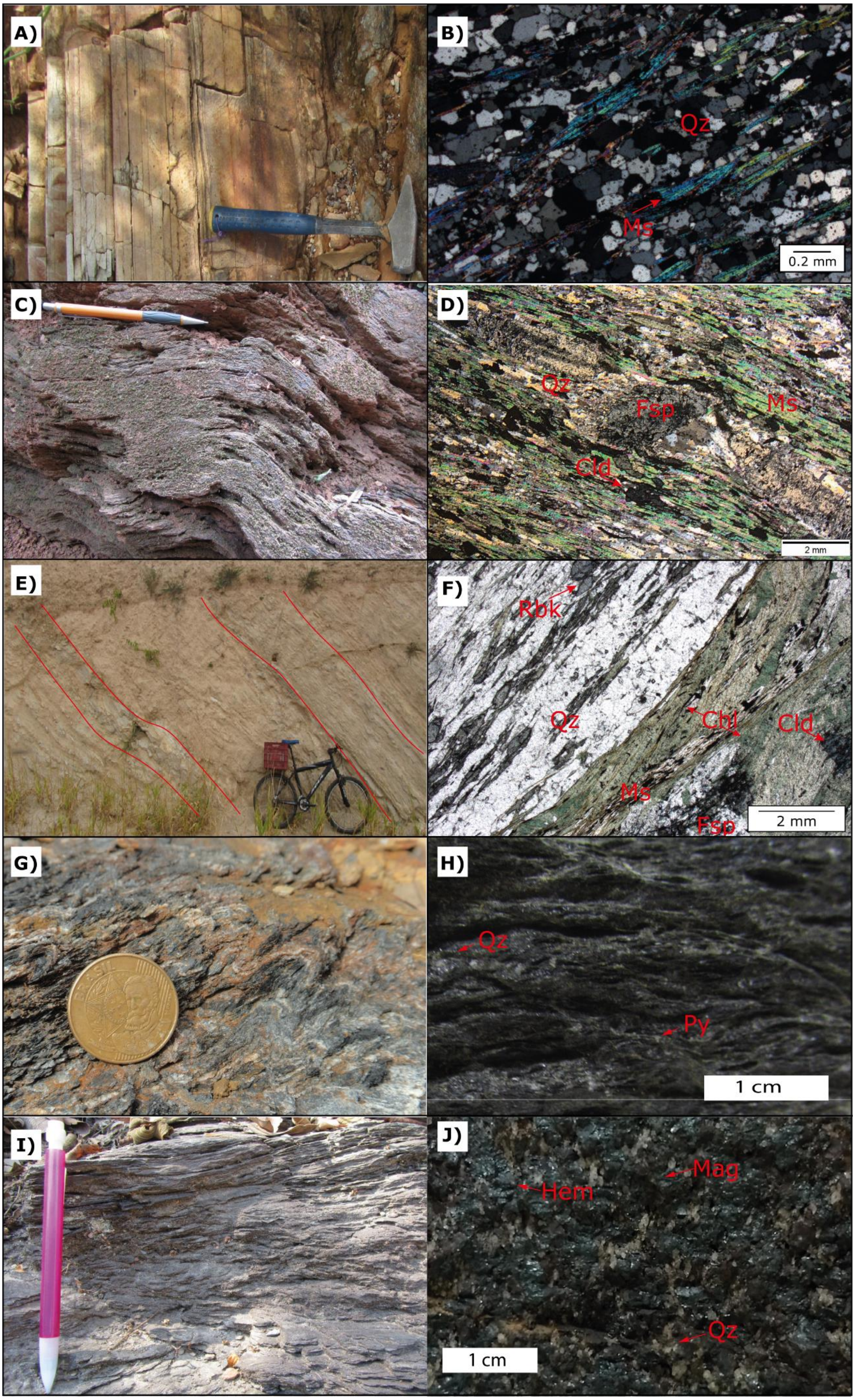
A)
B)
Qz
Ms
0.2 mm
C)
D)
Qz
Fsp
Ms
Cld
2 mm
E)
F)
Rbk
Qz
Chl
Cld
Ms
Fsp
2 mm
G)
H)
Qz
Py
1 cm
I)
J)
Hem
Mag
Qz
1 cm

**Fig. 5.** Upper portion of the Rio do Peixe Sequence: (A, B) muscovite-quartzite, thin section mineralogy composed exclusively of fine quartz and muscovite (N//); (C, D) outcrop of folded chlorite schist; the rock presents a sub-centimetrical foliation, thin section demonstrating feldspar crystals intensly saussuritized, the is a possible volcanoclastic tuff, (N//); (E, F) metric interpered outcrop of quartzites, chlorite schists; in thin section: contact between quartz with riebeckite crystals and chlorite schist presenting riebeckite and chloritoid (N//); (G, H, I) a variety of carbonaceous schists and graphite schists found study area; (J) magnetitite, presents a small amounts garnet.

## 3.3 Jaraguá mafic unit

The Jaraguá mafic unit, recently mapped, is a NW-SE elongated body exposed by the Jaraguá Fault (Fig. 2). It is represented by gabros and amphibolites, composed of hornblende, plagioclase, titanite and quartz (Fig. 6 C, D). In more preserved parts of the body, it is possible to observe the primary mineralogy: pyroxene, plagioclase, titanite and chalcopyrite. In these parts, it is common to find corona reequilibration textures around the pyroxene crystals (Fig. 6 A, B).

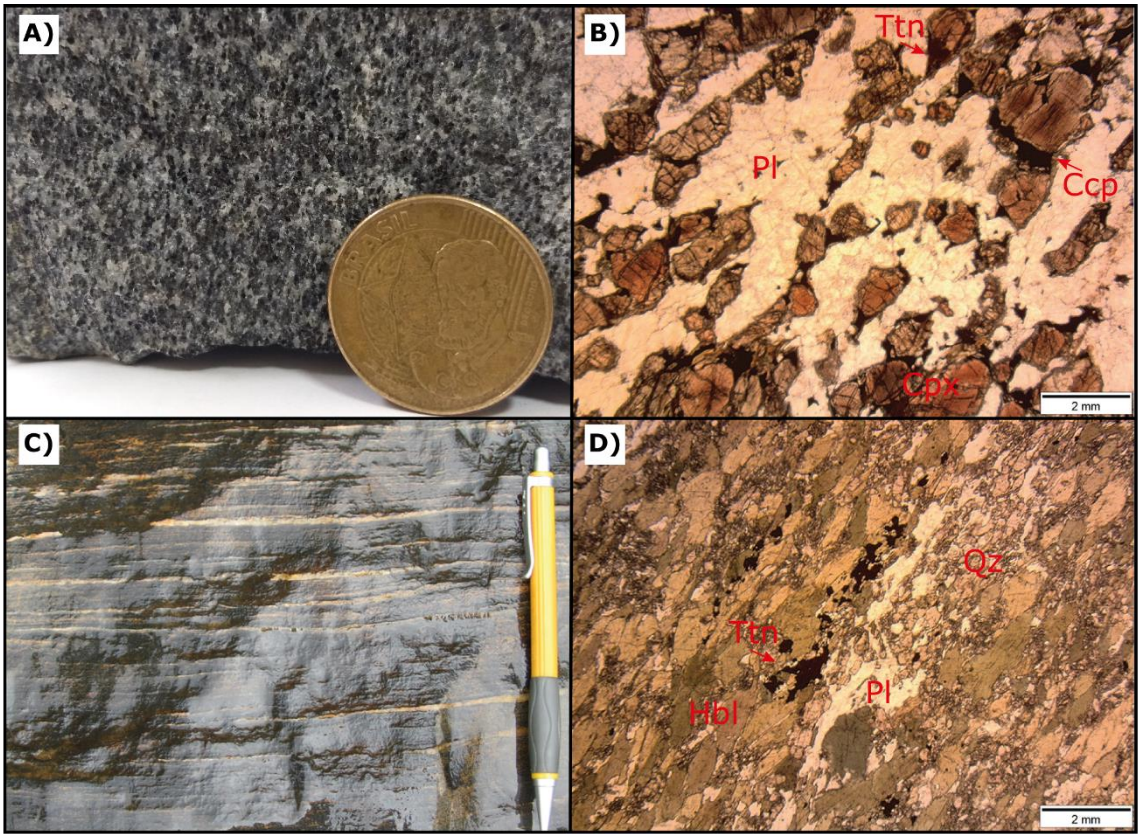

**Fig. 6.** Jaraguá mafic unite: (A, B) gabbroic rock with preserved primary mineralogy and texture, in shows thin section the primary texture are preserved (N//); (C, D) banded amphibolite outcrop, thin section metamorphic mineralogy: hornblende and plagioclase, titanite and quartz (N//).

## 3.4 Araxá Group

The other unit that crops out in the area is the Araxá Group, that has been thoroughly studied for being one of the sedimentary units that formed with sediments from the Neoproterozoic magmatic arc (Pimentel *et al*., 2001a; Fischel *et al*., 2003a; Falci *et al*, 2018). However, Araxá Group is very heterogeneous and its composition is controlled by the proximity of source terranes. In this study, we included Araxá in the discussion to compare it with Rio do Peixe Sequence, since the upper part of the sequence is very similar to the Araxá Goup. In the Araxá Group the main rocks are garnet-muscovite schist and garnet-chlorite schist (Fig. 7 A, B), that differ from the upper part of the Rio do Peixe Sequence for presenting better preserved garnet crystals, little or no sulfides and less accessory minerals (Fig. 7 C, D).

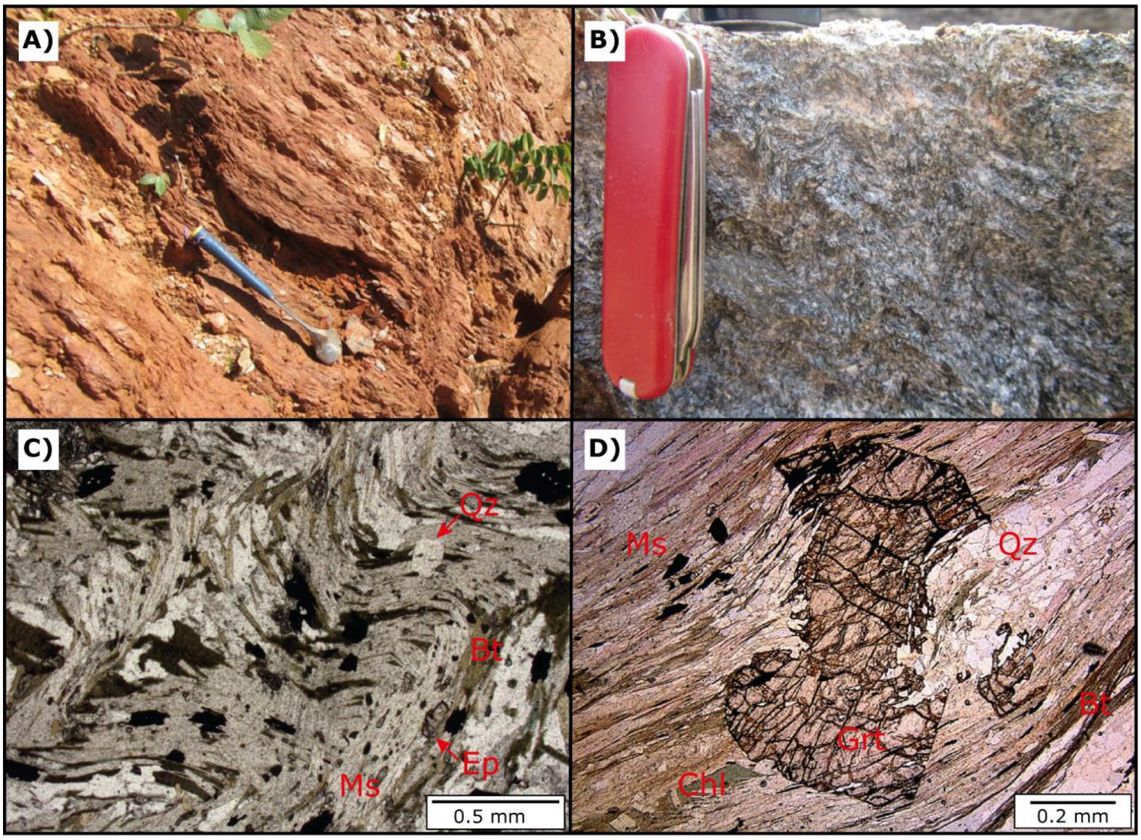

**Fig. 7.** Araxá Goup: (A) altered outcroop of chlorite schist; (B) unaltered sample of garnet-chlorite schist, (C) micro folded biotite-muscovite schist (N//), (D) garnet-chlorite schist, metamorphic porfiroblast.

## 3. Methods

The present work was developed after field work and recognition of the geologic units in the Pirineus Syntaxis. The analytic methods employed are listed bellow.

### 3.1 U-Pb dating

In order to perform U-Pb dating in different rocks of the studied units, four samples were selected: a chlorite schist from the Araxá Goup, two intrusive samples from Artulândia area and one sample from the intrusive unit of the Rio do Peixe Group.

Samples were in a pan mil for 60 seconds, then sieved in 600, 250, 150 and 90 µm sieves. After sieving, samples had their dense fraction mechanically separated and then had the magnetic fraction removed by Frantz magnetic separator. The non-magnetic dense fraction was observed in stereoscope and zircon grains hand-picked for mounting in epoxy. Grains were then polished and cleaned for analyses, that were performed at the Geochronology Laboratory of the University of Brasília.

Zircon grains were dated using a 213 nm wavelength laser ablation equipment coupled to a Finnigan Neptune ICP-MS, following the procedures described by Gioia & Pimentel (2000) and Bühn *et al*. (2009). The laser spot was set to 25 µm diameter, at a frequency of 10 Hz and 3.08-2.75 J/cm2. Ar and He were used as carrying gases. GJ-1 (ARC National Key Centre for Geochemical Evolution and Metallogeny of Continents - GEMOC) was used as primary standard, and 91500 (Wiedenbeck *et al*., 1995) was used as internal standard. Results were processed in Chronus software (Oliveira, 2015), and diagrams were made using Isoplot (Ludwig, 2009) in Excel.

## 3.2 Whole-rock chemistry

Among samples collected during the field work, twelve samples with little weathering were selected for bulk geochemistry analysis. Samples were powdered in a widia pan, using a pan mill and sent to ALS labs, for analysis following the complete characterization package (CCP-PKG01) routine, involving standard lithium meta/tetraborate fusion followed by diluted nitric acid digestion methods with assay by ICPOES/AES and ICP-MS. Detailed analytic methods are available at www.alsglobal.com.

## 3.3 Sm-Nd analysis

Samples selected for Sm-Nd isotope determination were powdered in a widia pan mill. Analyses were performed in the Geochronology Laboratory of the University of Brasília, following the methods described by Gioia & Pimentel (2000). Analyses were performed in a TIMS (Thermal Ionization Mass Spectrometry) equipment.

# 4. Results

## 4.1 U-Pb dating

Sample MCR-02-09A is a granodiorite from Artulândia area with colorless elongated prismatic zircon grains, that may exhibit zonation. 28 analyzed grains yielded an upper intercept at 2195±8.5 Ma. This age is interpreted as crystallization of the granodiorite, while the lower intercept at 786±43 Ma reveals the metamorphic reseting of U-Pb during the Brasiliano Orogeny (Fig. 8A).

A pegmatitic dike (MCR-02-09B) composed of alkaline feldspar, with perthitic exsolution, quartz, garnet, chlorite and muscovite, is intrusive in granite (MCR-02-09A). Its zircon grains belong to a single population of colorless, tabular and zoned crystals. The upper intercept at 2164±14 Ma reflects the inherited zircon grains from the host rock while the lower intercept at 549±37 Ma is interpreted as aged of Brasiliano Orogeny (Fig. 8B).

The Jaraguá intusive mafic unit (MCR-01-09) has 125-250 µm zircon grains, that are colorless and rounded. Results show 1153± 53 Ma of crystallization age, followed by a loss of Pb during the metamorphic event in the Neoproterozoic at 593± 23 Ma (Figure 8C).

Three Araxá Group samples were prepared, two schists (MCR-02-07 and CORU01) and one quartzite (CORU02). The sample MCR-02-07, a chlorite-schist, presents three populations of zircons grains: Archean, Paleoproterozoic and Neoproterozoic; the 56 analyzed grains yielded ages between 640 and 2680 Ma. Paleoproterozoic zircons grains are the most abundant, with ages between 1.8 and 2.25 Ga, being 2.15 Ga the most common age of the crystals (Fig. 8D). In sample CORU01, a biotite-garnet schist with significant concentrations of plagioclase and hornblende, 38 zircons grains were analyzed; the ages range between 592 and 2404 Ma, also occur the same three populations. The distribution shows that zircon grains are dominantly Neoproterozoic (640 to 800 Ma), with 21 grains of common age in 774 Ma (Fig 8E). The quartzite (CORU02), had 42 grains analyzed; the ages are between 718 and 2302 Ma and three populations: Mesoproterozoic, Paeleoproterozoic. The most abundant ages are 1880 to 2120 Ma, with 16 grains in 1980 Ma (Fig. 8F).

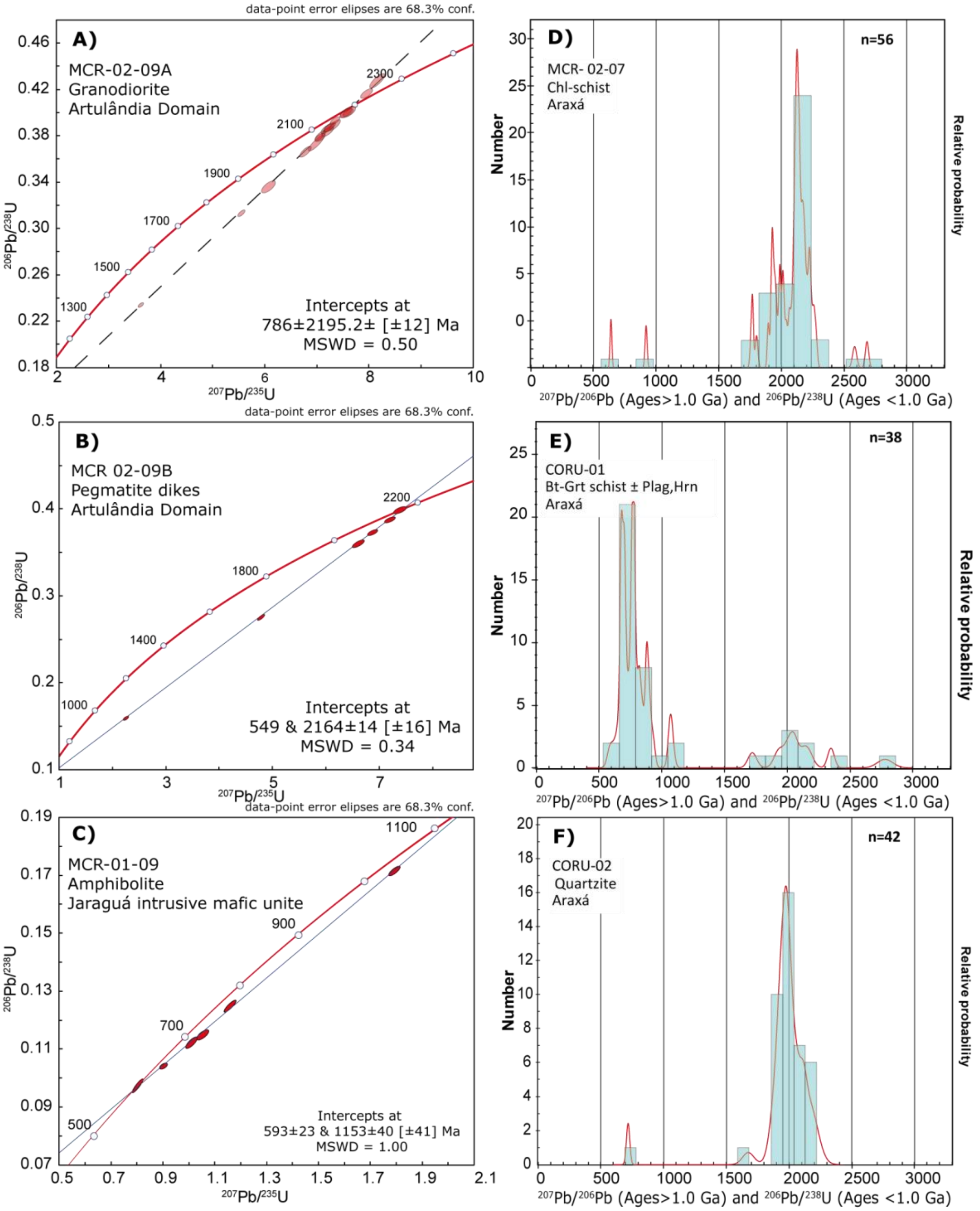

**Fig. 8.** (A, B, C) Concordia diagrams from: granodiorite of Artulândia Domain, pegmatite dike and anfibolite mafic unite, Jaraguá Unit, respectively. (D, E, F) Probability density plot of ages obtained from detrital zircon grains for Araxá samples, chlorite schist, garnet-chlorite schist and quartzite, respectively.

## 4.2 Bulk geochemistry

Geochemistry results are shown in table 1 and were first plotted in Otha & Aray (2007) to verify their reliability. The parameters proposed by Otha & Aray (2007) are useful to check whether the primary chemistry of the samples was changed, due to enrichments in Si, Al and other mobile elements caused by metamorphic and weathering processes is easily recognized. Samples that evidence some degree of weathering were considered with caveat.

Data shown in table 1 were grouped according to mapped units: intrusive rocks from Artulândia domain, volcanicderived amphibolites from Rio do Peixe Sequence and Jaraguá unit; and graphite schists from Araxá Group and Rio do Peixe Sequence.

### 4.2.1 Campinorte Arc in Artulândia area

Figures 9, 10 and 11 show results of the intrusive rocks of Artulândia área. These samples are classified as tonalites and granodiorites according to Debon & Le Fort (1982) diagram (Fig. 14a), and have a peraluminous trend, according to the aluminium saturation index (Shand, 1943). In Ross & Bedard (2009) diagram (Fig. 14b), these rocks have a calc-alkaline to transitional signature.

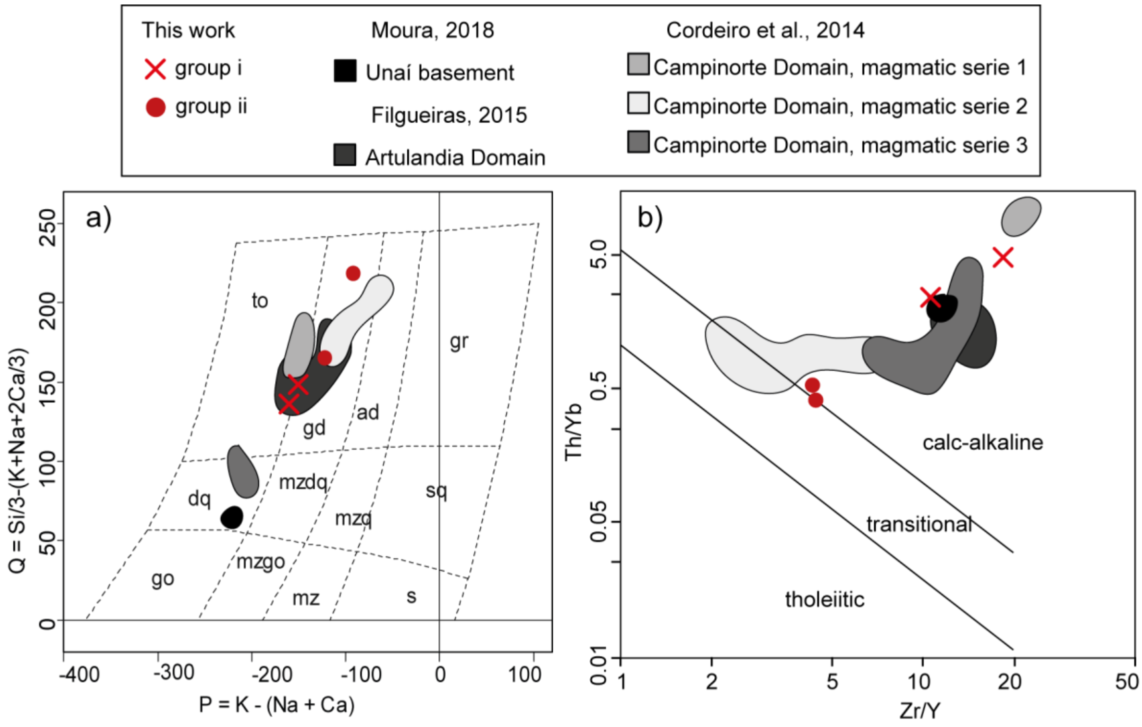

**Fig. 9.** Classification diagrams: (a) K-(Na+Ca) x Si/3-(K+Na+2Ca/3) Debon & Le Fort (1982), (b) Zr/Y x Th/Yb (Ross & Bedard, 2009).

Among samples from this unit, we have separated two groups with distinctive features. The first group presents higher contents of Cs, Sr and V, while the second group presents greater values of Zr, Hf and In. These variations may be due to continental contamination, slower crystallization or interaction with fluids. In REE diagrams, these two groups are also distinguishable (Fig. 10). In group 1, La/Yb ratios vary between 10 and 100, showing a moderate LREE relative to HREE. These results together with Sr/Y ratio indicate a greater depth of crystallization when compared to group 2 samples.

**Table 1:** Whole-rock geocheistrie data.

| Rock | Suite Artulândia | | | | Volcanic and Sub-volcanic | | | | | Graphite-schist | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample | **0209** | **0515** | **0513** | **0511** | **0101** | **0410** | **0109** | **0314** | **0320** | **0401** | **0402** | **0520** |
| Group | **I** | | **II** | | **Jaraguá mafic unit** | | | **Rio do Peixe** | | **Rio do Peixe** | | **Araxá** |
| Major elements (wt %) | | | | | | | | | | | | |
| SiO2 | 69.6 | 68.1 | 75.5 | 75.6 | 50.7 | 47.9 | 48.9 | 44 | 52.7 | 61.2 | 44.1 | 61.2 |
| TiO2 | 0.3 | 0.4 | 0.23 | 0.23 | 1.21 | 1.74 | 1.05 | 3.25 | 1.25 | 1.08 | 1.18 | 0.89 |
| Al2O3 | 14.2 | 15.1 | 11.95 | 11.65 | 12.75 | 13.5 | 15.6 | 14.55 | 12.2 | 16.3 | 28.4 | 19.9 |
| Fe2O3 | 3.11 | 3.74 | 3.6 | 3.72 | 10.9 | 15.85 | 12 | 14.8 | 8.82 | 8.97 | 1.46 | 4.42 |
| MnO | 0.04 | 0.05 | 0.05 | 0.06 | 0.4 | 0.26 | 0.15 | 0.14 | 0.14 | 0.09 | <0.01 | 0.01 |
| MgO | 0.74 | 1.06 | 0.48 | 0.4 | 10.05 | 7.46 | 6.71 | 5.35 | 6.72 | 1.58 | 2.3 | 1.31 |
| CaO | 1.86 | 2.8 | 0.46 | 0.72 | 9.03 | 10.35 | 11.1 | 10.95 | 15.5 | 0.86 | 0.1 | 0.03 |
| Na2O | 4.51 | 4.61 | 4.32 | 4.2 | 2.56 | 1.76 | 2.53 | 2.65 | 0.3 | 1.4 | 0.28 | 0.54 |
| K2O | 2.54 | 2.23 | 2.66 | 2.73 | 0.22 | 0.43 | 0.44 | 0.19 | 0.1 | 2.97 | 9.39 | 5.53 |
| P2O5 | 0.14 | 0.17 | 0.03 | 0.04 | 0.44 | 0.15 | 0.08 | 1.12 | 0.4 | 0.51 | 0.02 | 0.04 |
| LOI | 1.19 | 1.12 | 1.12 | 0.84 | 0.8 | 1.65 | 1.64 | 1.61 | 1.9 | 4.83 | 13.5 | 4.83 |
| Total | 98.35 | 99.52 | 100.47 | 100.27 | 99.15 | 101.07 | 100.27 | 98.69 | 100.12 | 99.88 | 100.86 | 98.79 |
| C | 0.06 | 0.06 | 0.14 | 0.06 | 0.04 | 0.16 | 0.01 | 0.02 | 0.01 | 1.14 | 8.94 | 0.93 |
| S | 0.05 | 0.01 | 0.01 | 0.01 | 0.14 | 0.41 | <0.01 | 0.58 | <0.01 | 0.36 | 0.01 | 0.01 |
| Trace (ppm) | | | | | | | | | | | | |
| Rb | 92.8 | 86.5 | 54.3 | 70.7 | 2.3 | 3.8 | 12.2 | 1.3 | 2.7 | 143.5 | 229 | 226 |
| Cs | 4.23 | 5.93 | 0.44 | 0.26 | 0.2 | 0.15 | 0.52 | 0.19 | 0.07 | 9.26 | 5.08 | 6.42 |
| Sr | 356 | 519 | 79 | 78.2 | 275 | 172.5 | 92.8 | 659 | 439 | 137 | 117 | 85 |
| Ba | 770 | 770 | 595 | 654 | 386 | 31.7 | 72.1 | 37.7 | 27.8 | 582 | 684 | 648 |
| Ga | 19.5 | 19.6 | 22.1 | 22 | 16.5 | 20.4 | 16.5 | 23.8 | 23 | 23.9 | 36.8 | 29.2 |
| Zr | 192 | 188 | 367 | 374 | 128 | 68 | 57 | 159 | 292 | 260 | 223 | 189 |
| Nb | 7.2 | 8.5 | 11.9 | 11.4 | 9.2 | 8.6 | 1.7 | 67.4 | 44.7 | 19.7 | 30.3 | 20.2 |
| Hf | 4.8 | 4.7 | 10.1 | 10.3 | 3.3 | 2 | 1.7 | 3.7 | 7.7 | 7.1 | 5.8 | 4.9 |
| Ta | 0.9 | 1.1 | 1 | 1 | 1.1 | 0.8 | 0.5 | 3.9 | 3.1 | 1.6 | 2 | 1.6 |
| Th | 7.94 | 7.08 | 8.06 | 7.35 | 5.14 | 0.53 | 0.18 | 5.32 | 4.06 | 15.8 | 23.5 | 10.55 |
| U | 1.65 | 0.89 | 1.75 | 1.68 | 2.77 | 0.15 | <0.05 | 1.43 | 1.19 | 3.12 | 3.69 | 0.92 |
| V | 23 | 34 | 9 | 9 | 243 | 418 | 289 | 293 | 145 | 134 | 219 | 123 |
| Ni | 2 | 4 | 2 | <1 | 58 | 52 | 102 | 28 | 113 | 36 | <1 | <1 |
| Cu | 213 | 4 | 19 | 19 | 7340 | 233 | 79 | 49 | 45 | 46 | 4 | 11 |
| Zn | 147 | 60 | 103 | 86 | 98 | 120 | 89 | 121 | 57 | 105 | 42 | 45 |
| Pb | 22 | 12 | 12 | 18 | 3 | 9 | <2 | 40 | <2 | 18 | 25 | 19 |
| In | 0.007 | 0.006 | 0.023 | 0.024 | 0.025 | 0.029 | 0.012 | 0.016 | 0.01 | 0.01 | 0.005 | 0.009 |
| Rare earth elements (ppm) | | | | | | | | | | | | |
| La | 32.7 | 59.9 | 44 | 59.1 | 28.9 | 9.4 | 2.7 | 58.9 | 39.6 | 53.8 | 53.8 | 33.9 |
| Ce | 60.6 | 83.4 | 84.9 | 95.4 | 65.1 | 25.2 | 6.8 | 111 | 85.3 | 110 | 65.7 | 59 |
| Pr | 6.52 | 9.3 | 10.05 | 12.65 | 7.55 | 3.64 | 1.17 | 12.6 | 10.75 | 12.1 | 12.25 | 7.18 |
| Nd | 25 | 33.5 | 45.2 | 53.6 | 35.6 | 17.4 | 7.1 | 54.6 | 44.5 | 50.1 | 45.5 | 29.1 |
| Sm | 4.19 | 4.56 | 10.2 | 11.55 | 9.77 | 4.98 | 2.66 | 10 | 9.3 | 10.15 | 8.43 | 4.85 |
| Eu | 0.89 | 1.05 | 1.49 | 1.57 | 1.83 | 1.48 | 0.88 | 4.12 | 2.88 | 2.11 | 1.51 | 0.87 |
| Gd | 3.04 | 3.56 | 11.65 | 12.5 | 12.05 | 5.34 | 3.73 | 9.72 | 8.75 | 9.86 | 5.06 | 3.83 |
| Tb | 0.4 | 0.57 | 2.04 | 2.06 | 2.25 | 0.85 | 0.69 | 1.38 | 1.31 | 1.61 | 0.78 | 0.72 |
| Dy | 1.91 | 3.28 | 13.7 | 13.55 | 15.3 | 5.62 | 4.41 | 7.82 | 8.14 | 8.58 | 4.7 | 4.5 |
| Ho | 0.36 | 0.61 | 2.98 | 2.98 | 3.05 | 1.1 | 0.96 | 1.59 | 1.46 | 1.75 | 1.02 | 0.97 |
| Er | 1.01 | 1.74 | 8.34 | 8.63 | 8.28 | 3.17 | 2.82 | 4.33 | 4.14 | 4.98 | 2.76 | 2.67 |
| Tm | 0.15 | 0.21 | 1.32 | 1.37 | 1.34 | 0.45 | 0.38 | 0.62 | 0.48 | 0.76 | 0.41 | 0.42 |
| Yb | 0.85 | 1.47 | 7.99 | 8.46 | 9.06 | 3 | 2.71 | 3.64 | 3.23 | 4.51 | 2.63 | 2.37 |
| Lu | 0.13 | 0.19 | 1.1 | 1.17 | 1.32 | 0.42 | 0.41 | 0.59 | 0.41 | 0.63 | 0.37 | 0.36 |
| Y | 10.4 | 17.7 | 84.7 | 86.4 | 81.8 | 28.5 | 25 | 40.7 | 36.2 | 48.5 | 24.6 | 26.3 |
| ΣREE | 148.15 | 221.04 | 329.66 | 370.99 | 283.2 | 110.55 | 62.42 | 321.61 | 256.45 | 319.44 | 229.52 | 177.04 |

Chondrite-normalized REE diagram (Boynton, 1984) of samples from Artulândia intrusive unit also presents two different patterns. Group 1 rock are enriched in LILE (large-ion lithophile element) relative to HFS (high field strength elements), when compared to group 2 (Fig. 10a). These differences probably occur due to magma differentiation. In multielementar diagrams (Sun & McDonough, 1989), it is also possible to observe two different behaviours among samples from Artulândia intrusive unit. Both types have U, Nb, Ta, P, Eu and Ti depletion and enrichment in Pb, but group 1, is more enriched in Cs and Li (Fig. 10b).

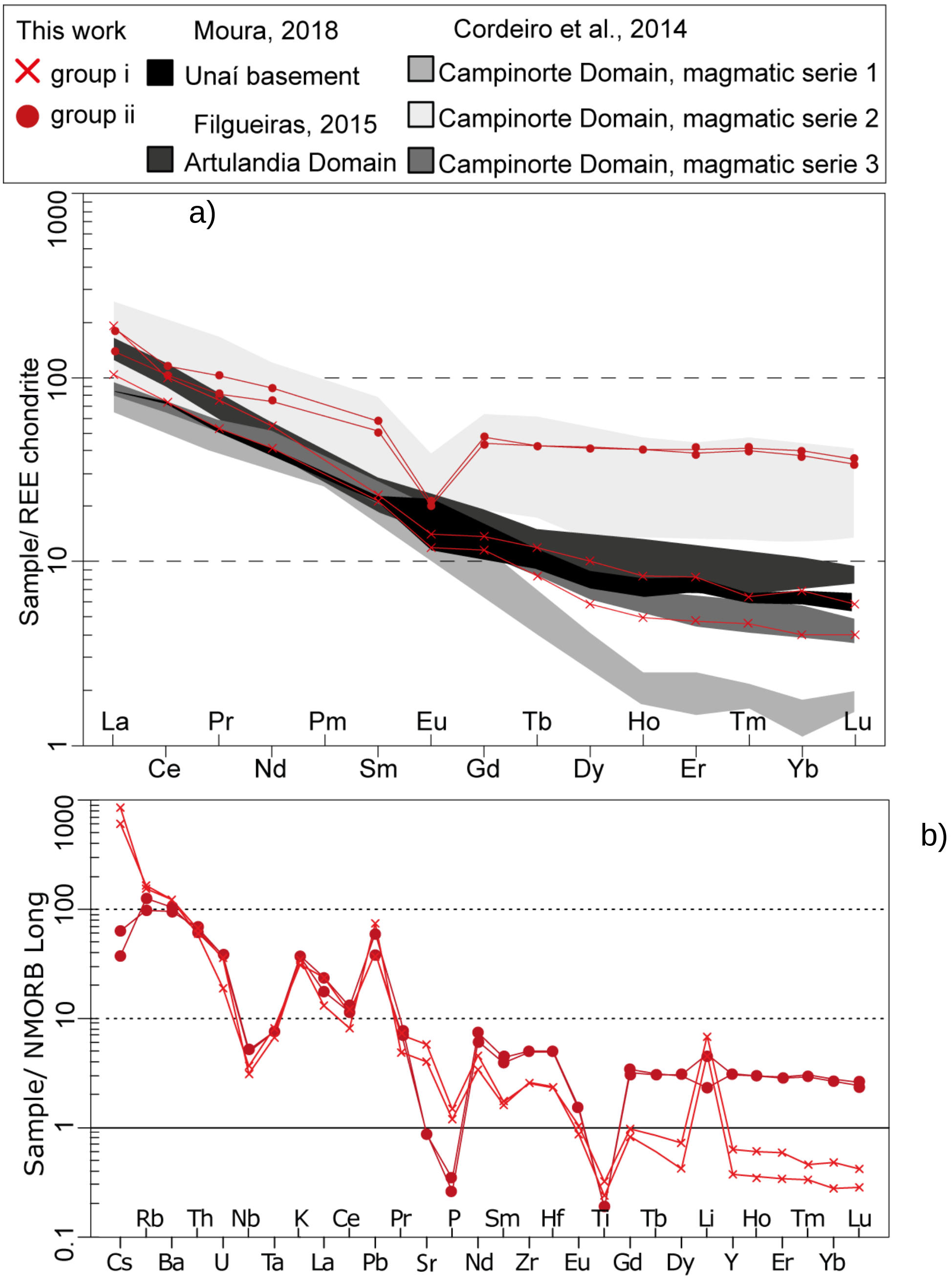

**Fig. 10.** Multielementary diagrams: (a) ERR elements normalized to the chondrite (Boynton, 1984), and (b) immobile elements normalized to the chondrite (Sun & McDogonough, 1989).

Tectonic discriminant diagrams from Whalen *et al.,* (1987), Pearce *et al*. (1984) and Eby (1992) (Fig. 11) show that intrusive rocks from Artulândia area are volcanic arc granites and late-orogenic granites (Fig. 11 d, e).

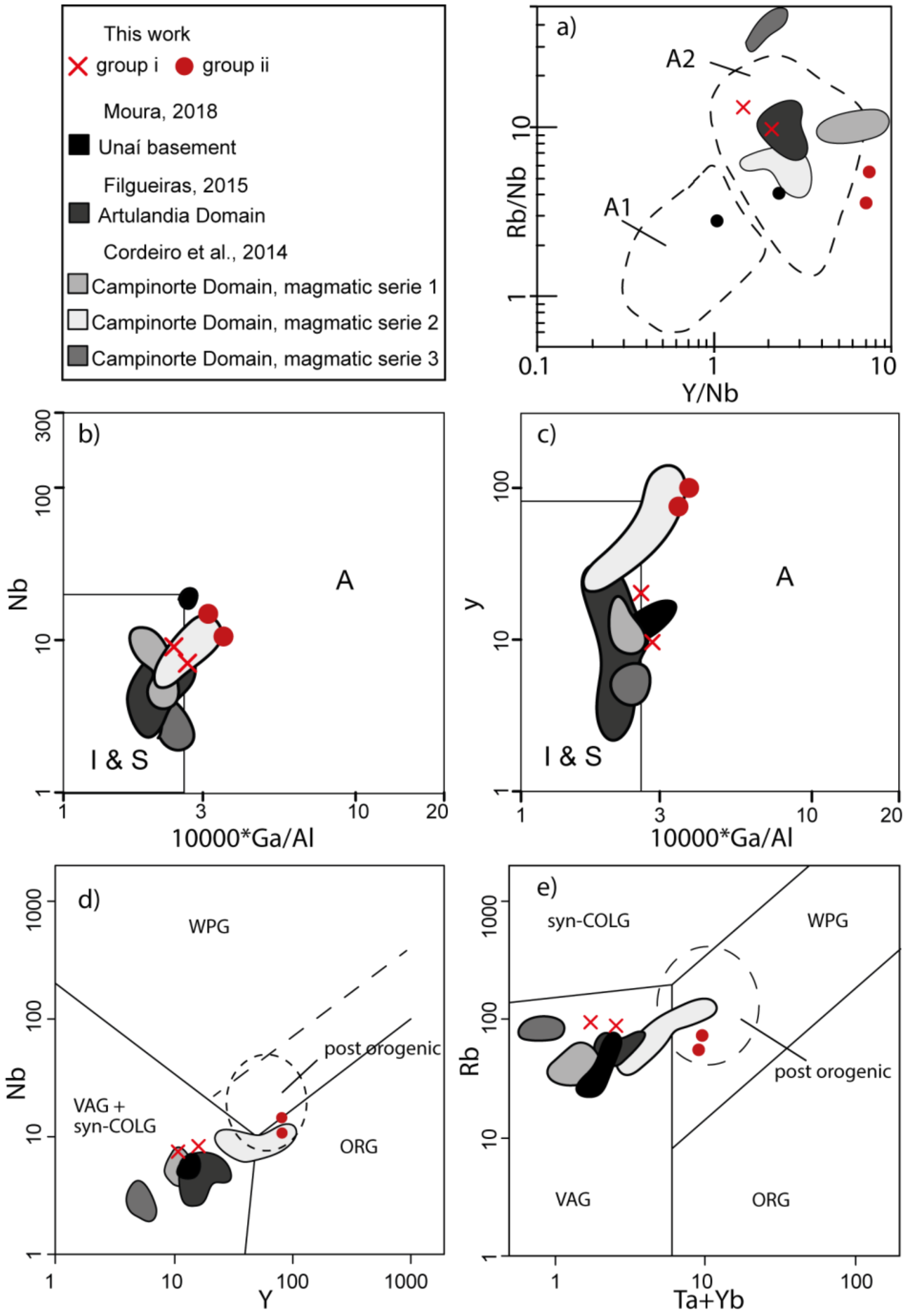

**Fig. 11.** Discriminant diagrams: (a) Nb vs Ga/Al e Y VS Ga/Al (Whalen *et al,* 1987), (d,e) Nb/Y e Rb vs Ta+Yb (Pearce *et al*., 1984) and (b,c) Rb/Nb vs Y/Nb(Eby,1992).

### 4.2.2 Amphibolites Rio do Peixe and Jaraguá unit

Regarding the volcanic rocks from the lowermost part of the Rio do Peixe Sequence and Jaraguá unit, they can be classified as basalts, andesitic basalts or trachyandesites (Pearce, 1996) (Fig. 12a). In the Ross & Bedard (2009) diagram, samples can be divided in a be enriched in Sr, Nb and Ta, when compared to the calc-alkaline series. Such anomalies may be caused in the subdution environment (Fig. 12b). Individually analyzing elements, see that tholeitic series rocks have significantly lower values of Sr, Nb and Ta. Such anomalies may be associated with magmas generated in subduction environment.

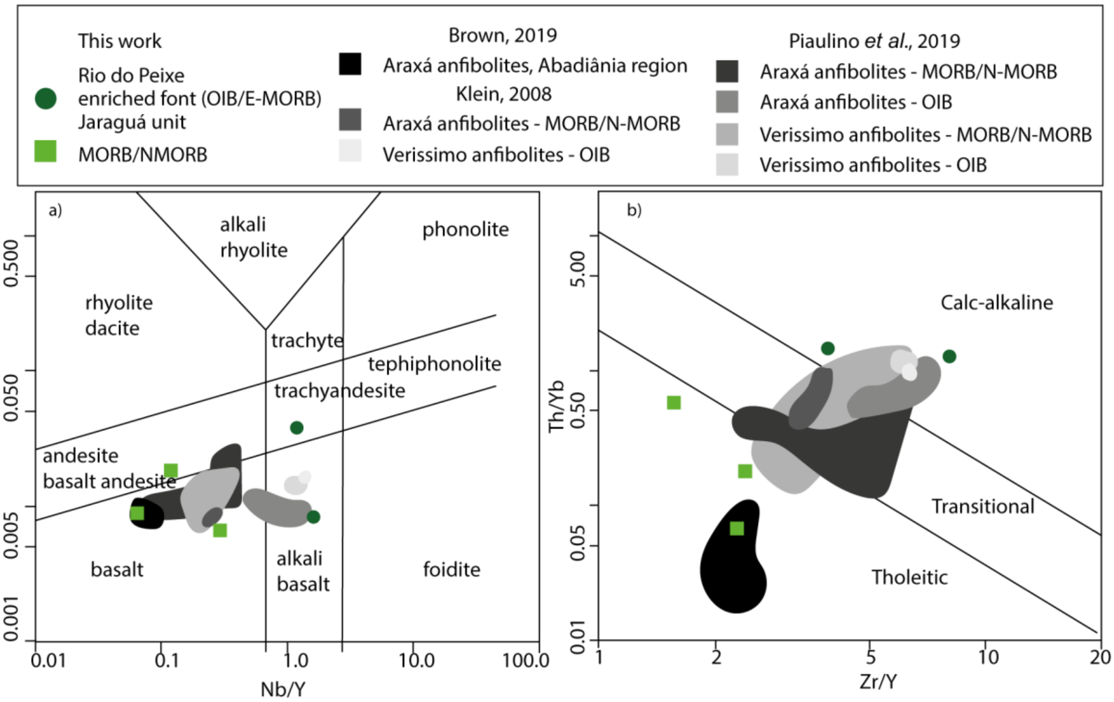

**Fig. 12.** Classification diagrams: (a) Zr/Ti vs Nb/Y (Pearce, 1996) and (b) Th/Yb vs Zr/Y (Ross & Bedard 2009).

REE diagram normalized to chondrite (Boynton, 1994) (Fig. 13) also suggests that there are different sources for the basalts, one enriched and other as depleted, E-MORB and MORB for Rio do Peixe Sequence and Jaraguá Unit respectively. Sample MCR0101 presents negative Eu anomaly, that might indicate that part of the magma had more time do crystallize, and resulting in greater contamination by the host rock (Fig. 12b). In multielement diagram, different behaviours suggest different sources for these magmas (Fig. 13).

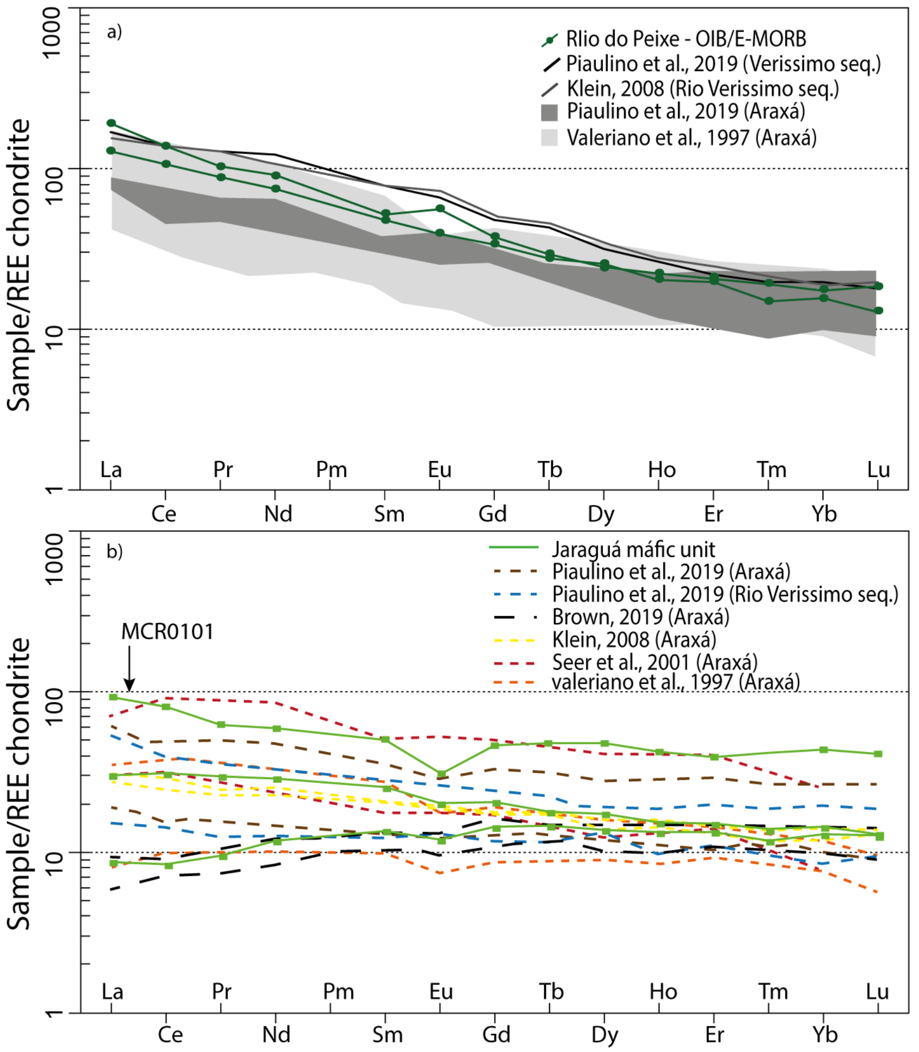

**Fig. 13.** (a, b) REE elements plots normalized to chontrite (Boynton, 1984), Rio do Peixe Sequence as enriched and Jaraguá unit as depleted sources respectively.

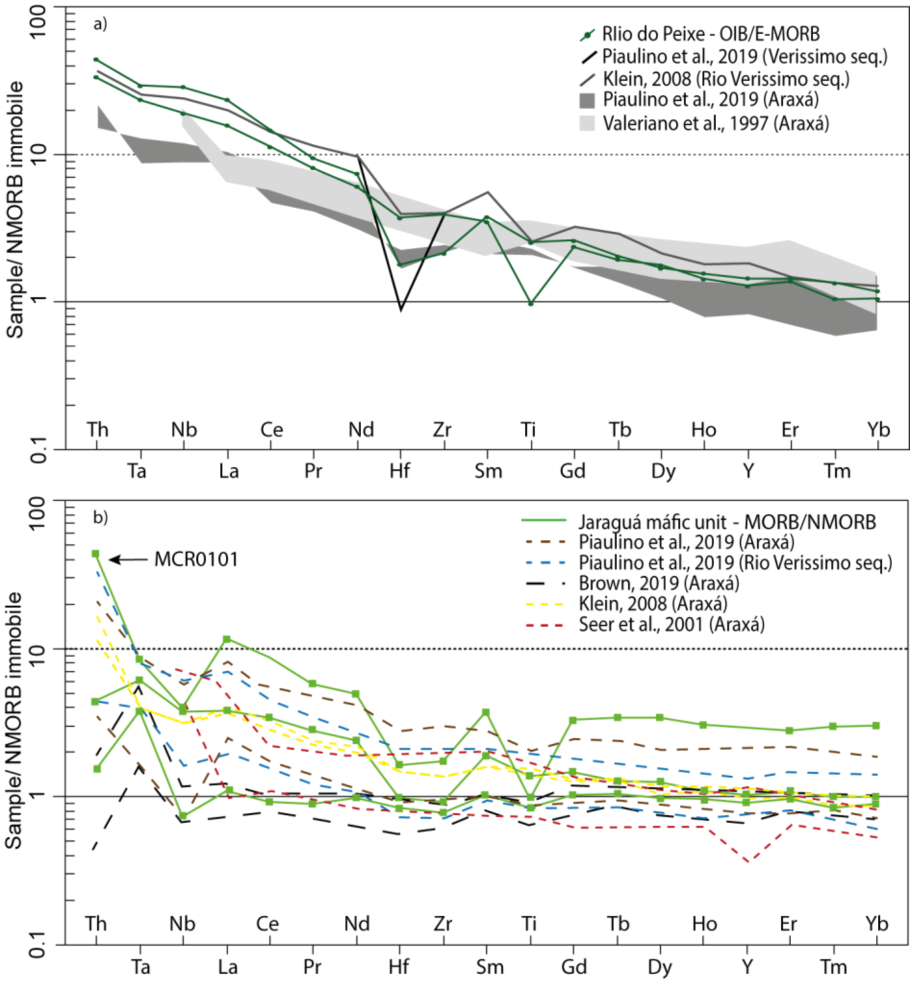

**Fig. 14.** (a, b) Multielement diagram normalized to chondrite (Sun & McDonough, 1989), Rio do Peixe Sequence as enriched and Jaraguá unit as depleted source respectively.

In tectonic discriminant diagrams (Argrawal *et al,* 2008; Pearce, 1982; Wood, 1980), samples from Rio do Peixe Sequence plot in a within plate environment (Fig. 15) and are enriched in LREE (Fig. 13a and 14a). Thus, we do not discard the hypothesis of an OIB environment for their formation. Jaraguá unit plots in the field of MORB (Fig, 15).

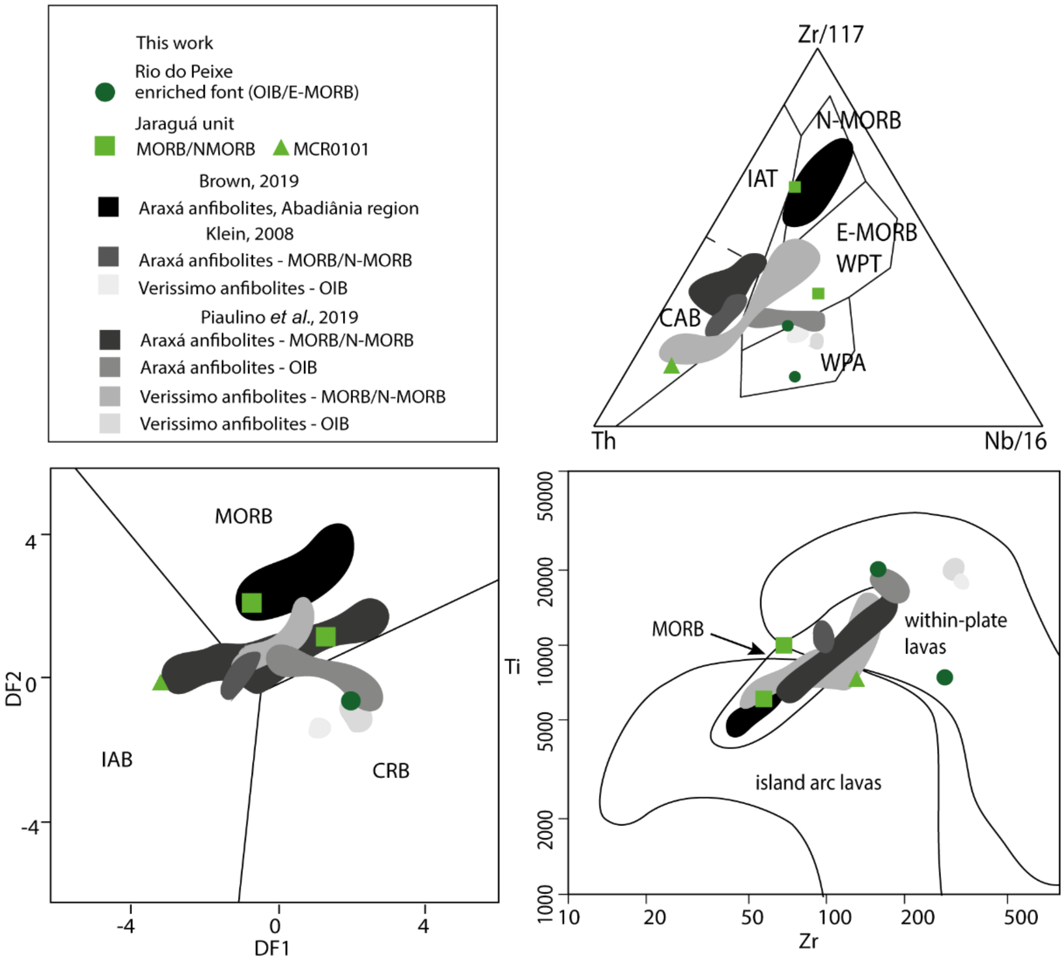

**Fig. 15.** Discriminant diagram: (a) DF1 vs DF2 (Argrawal *et al*, 2008), (b) Ti vs Zr (Peace,1982), (c) Zr/117 vs Th vs Nb/16 (Wood, 1980)

### 4.2.3 Graphite schists Araxá Group and Rio do Peixe Sequence

Graphite schists that are really weathered samples and will be interpreted in an attempt to identify its probable protolith. REE show two distinctive signatures: samples from Rio do Peixe Sequence exhibit greater enrichment in LILE relative to HFSE when compared to samples from Araxá Group (Fig. 16).

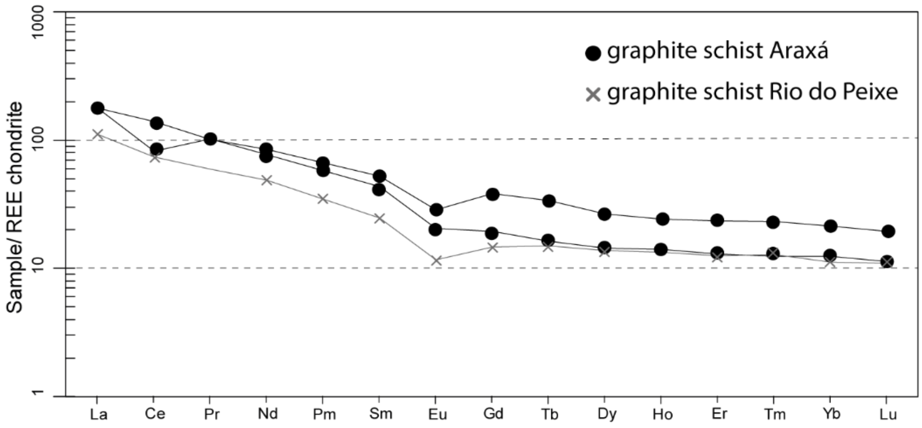

**Fig. 16.** multielement REE diagram normalized to the chondryte (Boynton 1984).

Based on mobile elements, according to parameters proposed by Hayashi *et al.* (1997) (fig. 17 a, b), Floyd *et al.* (1989, 1991) (Fig. 17 c) and Herron (1988) (Fig. 17 d), grafite schists from Rio do Peixe Sequence have a mafic protolith and sediments from Araxá Group have intermediate volcanic rocks as protolith.

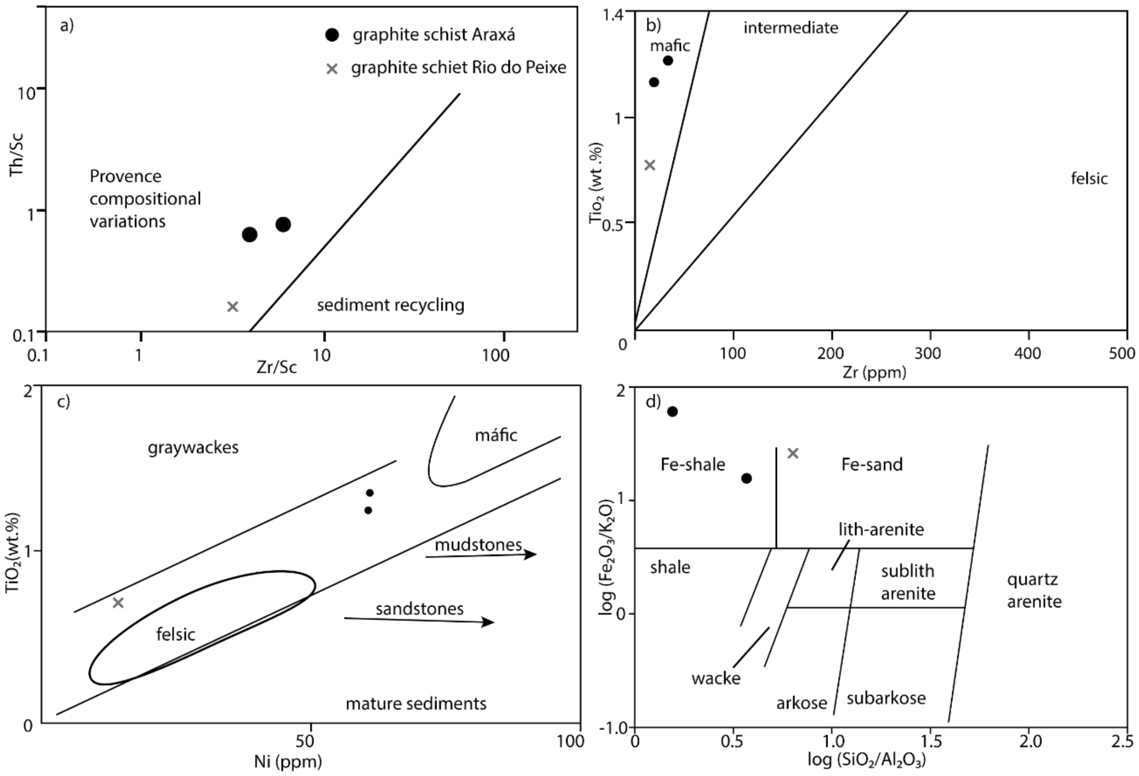

**Fig. 17.** Discriminat diagrams for sedimentary sources, (a, b) Th/Sc vs Zr/Sc and $TiO_2$ vs Ni (Hayashi *et al.*, 1997), (c) $TiO_2$ vs. Zr (Floyd *et al*, 1989, 1991) and (d) $Fe_2O_3/SiO_2$ vs $K_2O/Al_2O_3$ (Herron, 1988).

## 4.4 TDM ages and εNd values

Sm-Nd results are shown in table 2. Samples are divided into four groups: granitic rocks from Artulândia area, amphibolites the Rio do Peixe Sequence, and the Jaraguá instrusive mafic unit and sedimentary rocks from the Araxá Group.

Isochron dating of the Jaraguá intrusive mafic unit (Fig. 18b) showed an age of 1153 Ma that is in agreement with U-Pb results, despite the error (ca. 110 Ma). $T_{DM}$ values vary between 2.2 and 2.4 Ga, and εNd values are slightly positive to slightly negative. The evolution of the rocks is intermediary between Neoproterozoic rocks (amphibolites form Araxá Group and Goiás Magmatic Arc) and Paleoproterozoic units (Fig. 19b).

The amphibolites from the Rio do Peixe Sequence yielded an isochron age of 1042±74 Ma (Fig 18a), and $T_{DM}$ ages between 1.17 and 0.91 Ga, and εNd values are moderately negative to moderately positive. The εNd evolution lines are concordant with other amphibolites of Araxá Group (Fig. 19c).

**Table 2:** isotópic Sm-Nd data.

| Sample | Litology | Sm(ppm) | Nd(ppm) | $Nd^{143}/Nd^{144}$ | ±2σ | εNd(T) | $T_{DM}$(Ga) |
|---|---|---|---|---|---|---|---|
| | **Tonalite Artulândia (T = 2.19 Ga)** | | | | | | |
| 0209a | granodioritic | 4.31 | 25.63 | 0.511246 | 3.0x10$^{-6}$ | -0.38 | 2.43 |
| | **Jaraguá mafic unit (T = 1.15 Ga)** | | | | | | |
| 0109 | amphibolite | 2.53 | 6.59 | 0.512836 | 1.4x10$^{-5}$ | -1.32 | 2.30 |
| 0408 | amphiboite | 6.80 | 27.92 | 0.512078 | 1.2x10$^{-5}$ | -3.65 | 2.20 |
| 0410 | amphibolite | 5.33 | 18.52 | 0.512402 | 1.6x10$^{-5}$ | -1.24 | 2.45 |
| | **Rio do Peixe Sequence (T = 1.0 Ga)** | | | | | | |
| 0212 | amphibolite | 85.04 | 603.02 | 0.512049 | 1.0x10$^{-5}$ | 2.76 | 1.17 |
| 0301 | amphibolite | 7.78 | 39.84 | 0.512469 | 1.1x10$^{-5}$ | 6.77 | 0.91 |
| 0314 | amphibolite | 10.70 | 56.85 | 0.512397 | 1.0x10$^{-5}$ | 5.92 | 0.98 |
| 0320 | amphibolite | 18.46 | 82.97 | 0.512496 | 4.0x10$^{-6}$ | 5.18 | 1.05 |
| 0401 | graphite schist | 11.17 | 55.01 | 0.511866 | 1.1x10$^{-5}$ | -5.60 | 1.95 |
| 0402 | graphite schist | 7.93 | 46.22 | 0.511751 | 1.2x10$^{-5}$ | -5.42 | 1.78 |
| | **Araxá Group** | | | | | | |
| 0205 | Chl-schist | 9.09 | 53.60 | 0.511598 | 5.0x10$^{-6}$ | - | 1.96 |
| 0326 | Chl-schist | 12.76 | 65.17 | 0.511888 | 8.0x10$^{-6}$ | - | 1.83 |
| 0520 | graphite schist | 5.31 | 30.50 | 0.511478 | 1.2x10$^{-5}$ | - | 2.18 |

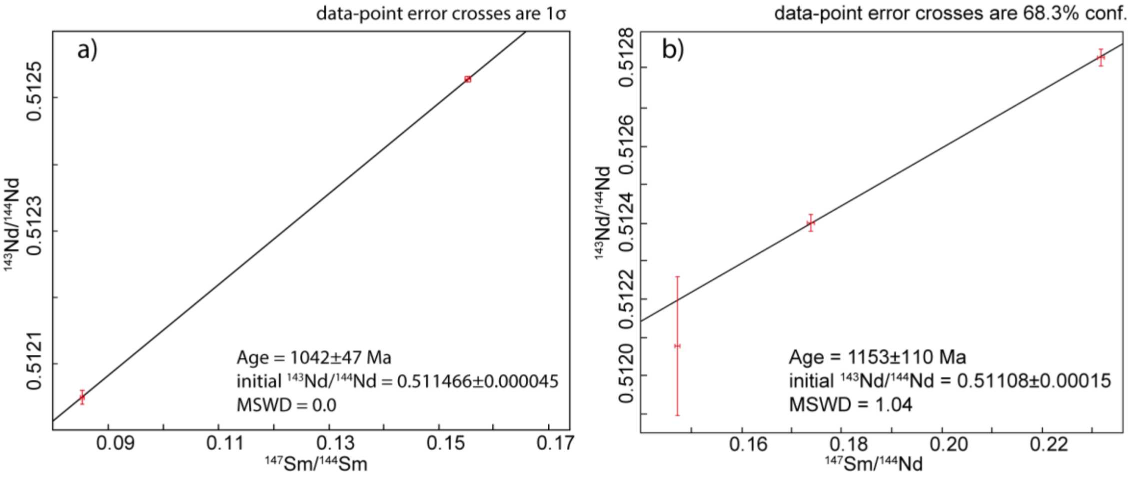

**Fig. 18.** Sm-Nd isochrons from (a) Rio do Peixe Sequence and (b) Jaraguá mafic unit amphibolites and gabbros. .

A single granodiorite sample from east Artulândia area (sample MCR0209A) shows $T_{DM}$ age of 2.43 Ga, and positive εNd values, concordant with rocks of the Artulândia and Campinorte domains (Fig. 19a). The sedimentary rocks from the Araxá Goup, as well as graphite schist and carbonaceous schists from the Rio do Peixe Sequence, have Paleoproterozoic $T_{DM}$ ages (Fig. 19d).

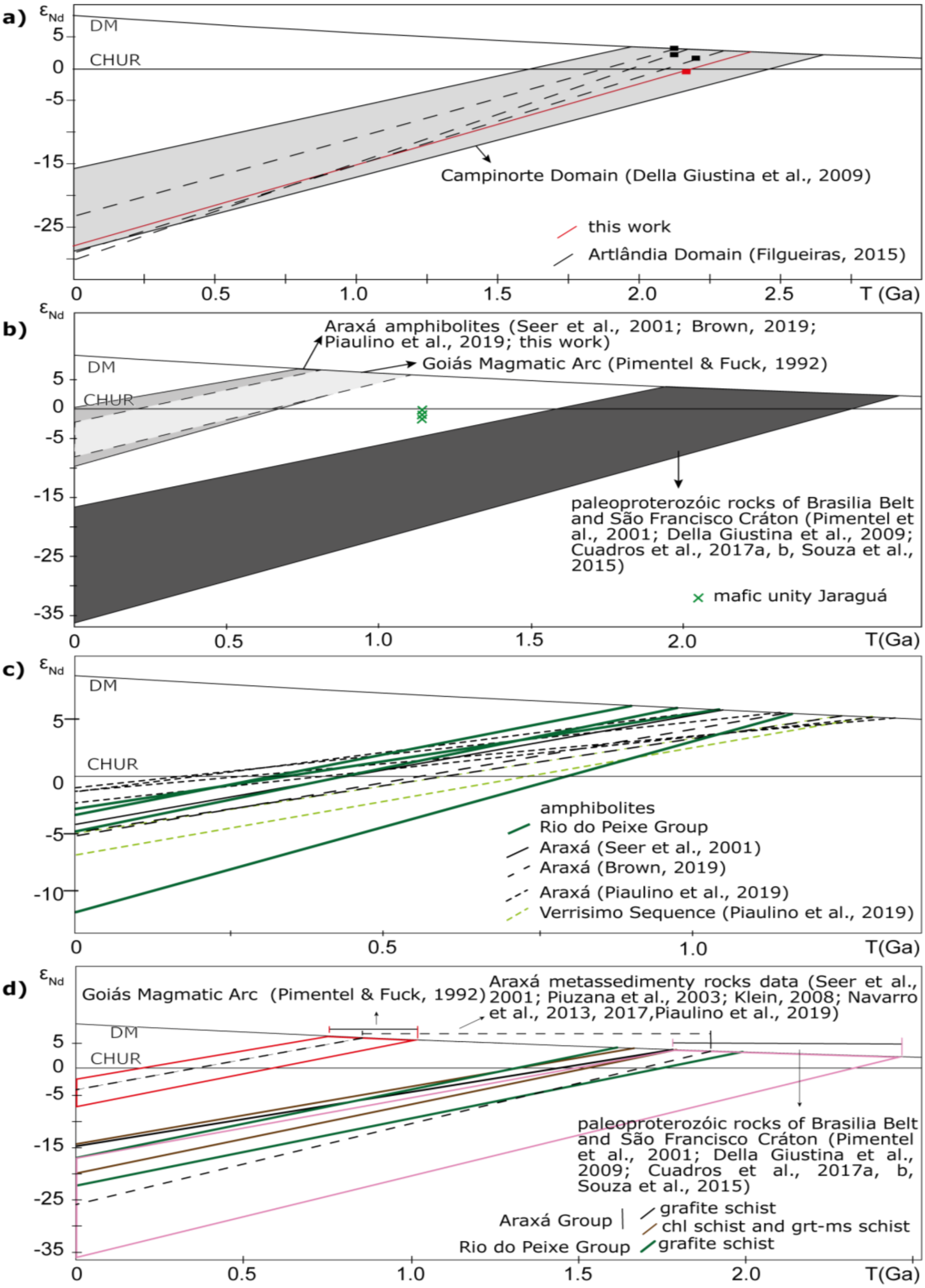

**Fig. 19.** Nd evolution diagram vs. ages: (a) plutonic rocks of the Artulândia Domain, (b) Jaraguá unit, (c) amphibolites of the Rio do Peixe Sequence, (d) metasedimentary rocks of the Rio do Peixe Sequence and Araxá Group.

# 5. Discussion

## 5.1 Evolution of the Paleoproterozoic basement

The data presented in this paper suggest that Paleoproterozoic rocks in the Pirineus Syntaxis are restricted to the Artulândia area, which was studied in detail by Filgueiras *et al.* (2019). Filgueiras *et al.* (2019) and data presented here show that the Paleoproterozoic terranes reflect the evolution of a long-lived orogenic system, that crops out in the Pirineus Syntaxis as tonalites, granodiorites and volcanic rocks within younger meta sedimentary rocks.

Geochemical data corroborate the ideas proposed by Kuyumijian *et al.* (2004), Cordeiro *et al.* (2014) and Filgueiras *et al.* (2019), indicating different processes of crystalization and even generation (Fig. 16 d, e), for the rocks. The U-Pb isotopic data presented in this work now place the beginning of magmatism at 2194 Ma, showing that the collage is older than the ages proposed by Filgueiras *et al.* (2019), of 2130 to 2156 Ma. The two ages acquired by lower intercept, are an evidence of the polyphasic event to proposed by Araujo Filho, (1999) the first phase in 786±43 Ma (sample MCR-02-09A) and the second phase in 549±37 Ma (MCR-02-09B). The obtained Sm-Nd TDM ages between 2.43 and 2.14 Ga are similar to the ages presented in the Campinorte Domain by Filgueiras *et al.* (2019) (Fig. 10 a), corroborating the idea that the Artulândia Domain is a sliver of the Campinorte Domain (Filgueiras *et al.*, 2019).

## 5.2 Tectonic meaning of the Jaraguá mafic unit

The Jaraguá intrusive unit has a MORB signature, indicating its intrusion is probably related to a thinning of the crust. It presents signs of crustal contamination, which distinguishes it from the Rio do Peixe Sequence. While the Rio do Peixe Sequence is enriched in LREE relative to HREE, the Jaraguá unit is contaminated by crustal material (Fig 18, 19).

U-Pb dating indicates a crystallization age of 1153±40 Ma and reseting of U-Pb system at 593±23 Ma, when the unit was probably exhumed (Fig 8D). This age is coeval with the granulite facies metamorphic event recorded in rocks from Anápolis-Itauçu Complex (Fischel *et al.*, 1998). This event followed the exhumation of mafic-ultramafic complexes (Barro Alto, Niquelândia and Canabrava) (Ferreira Filho *et al.*, 1994, 2010). TDM ages of 2.20 to 2.45 Ga, and εNd values between 4 and -11 suggest that the Neoproterozoic magmatism has origen in fusion of Paleoproterozoic basement or that it was contamined by the Paleoproterozoic basement (Fig. 10).

Although rare in the Brasília Belt, magmatisms of this age are known at the borders of the São Francisco-Congo paleoplate (Fonte-Boa *et al.*, 2017, Chemale *et al.*, 2012a, Guadagnin *et al.*, 2015), as well as in other parts of Rodinia (Brito Neves *et al.*, 1991; 2001; 2011). Magmatism of this age is interpreted as responses to a Stenian/Tonian taphrogenetic event (Brito Neves *et al*., 1999).

In the northern branch of the Brasília Belt, the volcano-sedimentary sequences of Juscelândia, Palmeirópolis and Indaianápolis are coeval to the intrusion of the Jaraguá unit. In the southern branch, in Unaí and Vazante groups, it is also possible to find evidence of 1.4 and 1.25 Ga old volcanism (Moraes *et al*., 2006; Moura, 2018; Carvalho *et al*., 2019).

This magmatism was generated in a rift environment (Fig. 19). The age and characteristics of the basin are comparable to the Paranoá Group, which is composed of 1200 Ma metasedimentary rocks (Freitas-Silva & Dardenne, 1997; Dardenne, 2000). If is this magmatism and the Paranoá Group are correlated, these local occurences may be related to the Espinhaço Super Group (1918-1190 Ma) (Chemale *et al*., 2012a) reinforcing it association with the Stenian/Tonian taphrogenesis.

## 5.3 The similarities between the Rio do Peixe Sequence and the Araxá Group

The Rio do Peixe Group has been previosuly described as part of the Paleoproterozoic basement (Araujo Filho, 2000). However, we showed that it developed at an extensional environment around 1042 Ma and exhibits E-MORB signature. Clastic sedimentary rocks from both Araxá Group and and Rio do Peixe Sequence are utterly similar.

The Araxá Group has a wide occurrence, yet not fully understood, in the Brasília Belt. Its rocks show great mineral variability, interpreted as heterogeneous source areas. The most likely depositional environment for the Araxá Group is an oceanic basin, in which mica schists and quartzites are intercalated with amphibolites, cromitites, limestones and cherts (Pimentel, 2016; Strieder & Nilson, 1992a; Seer *et al*., 2001; Brown, 2019). The volcanic rocks are expressions of ophilitic mélanges from the subduction (Drake Jr, 1980; Strieder & Nilson, 1992b).

U-Pb zircon provenance data show that Araxá sediments are sourced in 580 Ma to 2600 Ma terranes. The dominance of Rhyacian zircon grains is probably explained by the proximity of the basin to Paleoproterozoic terrains. TDM ages of 1.83 to 2.18 Ga also reveal a strong Paleoproterozoic contribution (Fig 8 C, D, F).

When compared to other ocorrences of the Araxá Group, at different locations, (Fischel *et al*., 2003b; Valeriano *et al*.,2004; Sabaraense, 2016; Falci, 2018; Navarro *et al*., 2017; Piaulino *et al*., 2019; Brown, 2019), we see how heterogeneous the group is, due to different source areas of the Araxá basin (Fig. 20). Araxá Group outcrops in Brasília Belt reveal coeval enviroments with different source terranes and evolution (Falci, 2018) (Fig. 19).

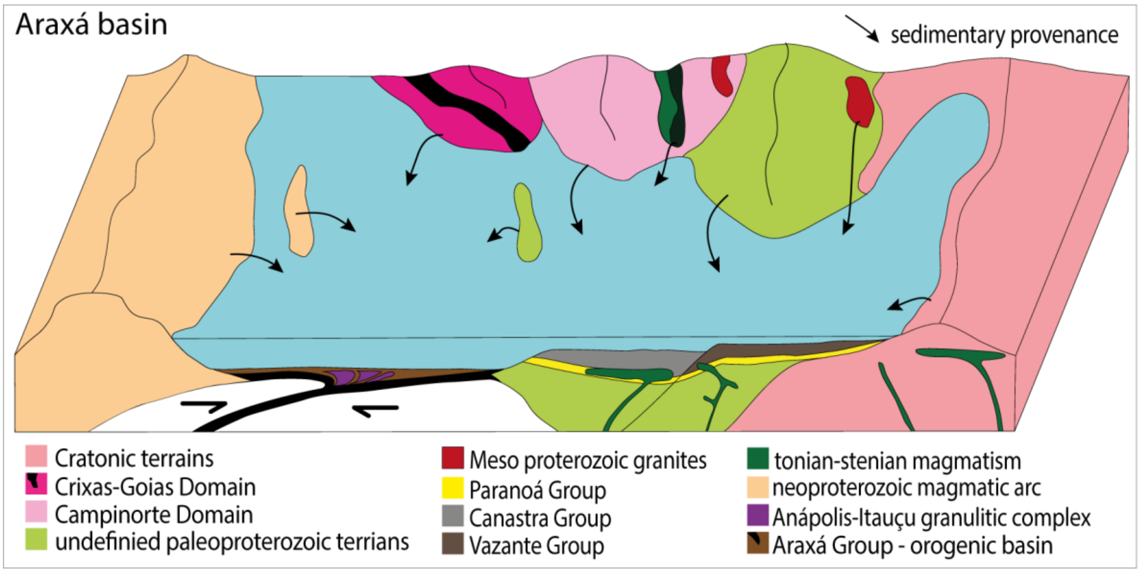

**Fig. 20.** Schematic diagram, showing, the Araxá Basin and the source areas.

From zircon populations, we can predict possible sediment sources for the Araxá Group: >2700 Ma zircon grains may come the from São Francisco Cráton; 2700-1800 Ma zircon grains may come from Crixás-Goiás, Campinorte, Arraias-Cavalcante and Almas-Dianópolis domains (Cordeiro & Oliveira, 2017); 1900 to 1500 Ma zircon grains are probably from Araí volcanic rocks and coeval granites from Serra da Mesa, Serra Dourada and Paranã suites (Pimentel & Nilson, 2001); grains between 1400 e 1100 Ga are probably from the volcano-sedimentary sequences of Palmeirópolis, Indianapolis, Juscelândia and Quilombo (Moraes *et al*., 2006; Moura, 2018; Carvalho *et al*., 2019); 1200 to 600 Ma are sourced in younger volcano-sedimentary sequences such as Verissimo and Maratá, or in orthogneisses (Fischel *et al*., 2003a, b; Klein, 2008; Piaulino *et al*., 2019). Part of the 900 to 600 Ma zircon grains may be from the Goiás Magmatic Arc (Pimentel & Fuck, 1992) (Fig. 21)

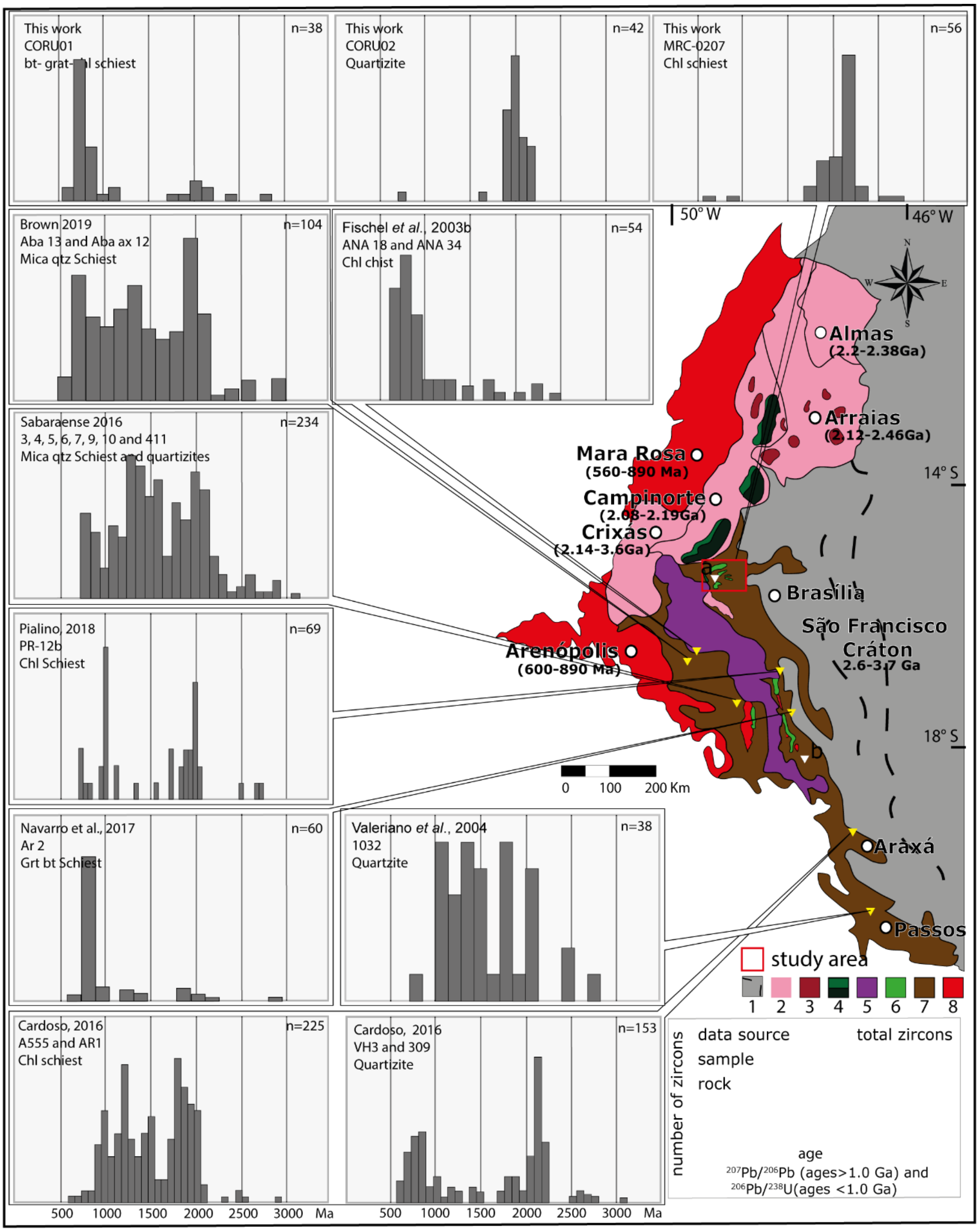

**Fig. 21.** Provenance ages U-Pb in zircons for Araxá Group. (Fischel *et al*,. 2003b; Valeriano *et al*., 2004; Falci, 2018; Sabaraense, 2016; Navarro *et al*., 2017; Piaulino *et al*., 2019; Brown. 2019), Brasilia Belt with the main source areas for the Araxá Group. Legend: 1- São Francisco Cráton, falts São Domingos and Serra Maravilha, marks the limit of craton to mobile belt, 2- Paleoproterozoics domains (Crixas-Goiás, Arraias-Cavalcante, Almas-Dianópolis and Campinorte), 3- Mesoproterozoic granites and Araí volcanics, 4- mesoproterozoics type rift sequences (Juscelândia, Indaiapólis, and Palmeiropólis, Quilombo, Jaraguá) and layed mafic-ultramafic complex, 5- Anápolis-Itauçu high grade complex, 6- Neoproterozoic volcano-sedimentary sequences (Rio do Peixe, Marata and Rio Verissimo), 7- Araxá Group, 8- magmatic arcs (Mara Rosa and Arenópolis) and granites in midle to Araxá Goup.

The stratigraphic columns of the Araxá Group are not very conclusive, because the unit is strongly affected by thrusts. In Fig. 21, there are two proposed stacks: one for the Pirenópolis region and another one for the vicinities of Pires do Rio town. Within the sedimentary layers there are levels of volcanic rocks, interpreted as intraplate magmatism.

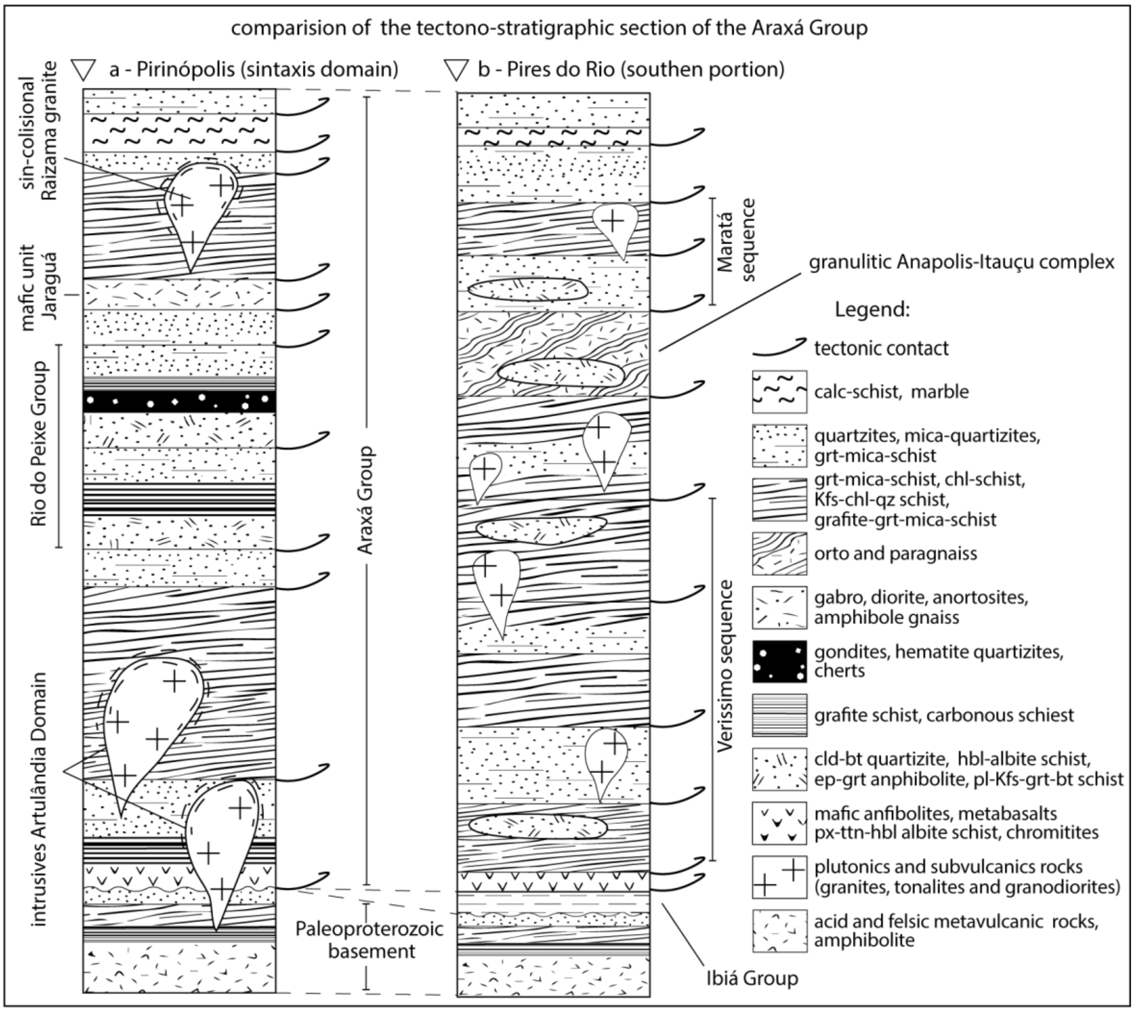

**Fig. 22.** Tectono-stratigraphic sections of Araxá Group, for regions, a-Pirenópolis and b-Pires do Rio. (modified after Piaulino *et al.,* 2019)

The Rio do Peixe Sequence, initially described by Araujo Filho (1981), is a geologic unit linked to a deep ocean environment, with slivers of mafic to intermediate subvolcanic and volcanic rocks, clastic and chemical metasedimentary rocks. The unit was interpreted as Paleoproterozoic, and was later placed in the middle of the Araxá Group. Our geochemical and isotopic data demonstrate that the unit is a sequence that shares the same petrography, and possibly the same environment as the Araxá Group.

Occurrences in the northern portion of the syntaxis demonstrated unique characteristics of the Paleoproterozoic sequences, such as mineralizations of zinc, lead, copper, silver and bismuth (Filgueiras *et al*., 2019). These authors propose the area is an extension of the Campinorte Domain. The Rio do Peixe Group rocks in the study area have characteristics that differ from the other volcano-sedimentary sequences in the central portion of the syntaxis, as shown by petrography (Fig. 3, 5), geochemical (fig. 14, 15, 16) and isotopic Sm-Nd data (table 2). The Jaraguá unit should be ungrouped from the Rio do Peixe Group, due to its extensional magmatism characteristics.

We propose that the occurrences of the Rio do Peixe Group are only the occurrences restricted to the central syntaxis, formed by an association of volcanic and subvolcanic rocks. These are the only samples that can be designated as Rio do Peixe Sequence. The geochemical data from the amphibolites of Rio do Peixe Sequence indicate an enriched source, such as EMORB or OIB (Fig. 14a, 15a). The enrichment in LILE, relative to HFSE also suggests an enriched source, probably mantle with little continental contamination, being a correlate unit to Marata and Rio Verissimo sequences. Thus, the sediments were possibly deposited in a back-arc or intraplate environment (Fig 22). Graphitic schists from the Araxá Group and Rio do Peixe Sequence present a very similar REE pattern (Fig. 17), and indicate a mafic to intermediate igneous protolith (Fig. 18).

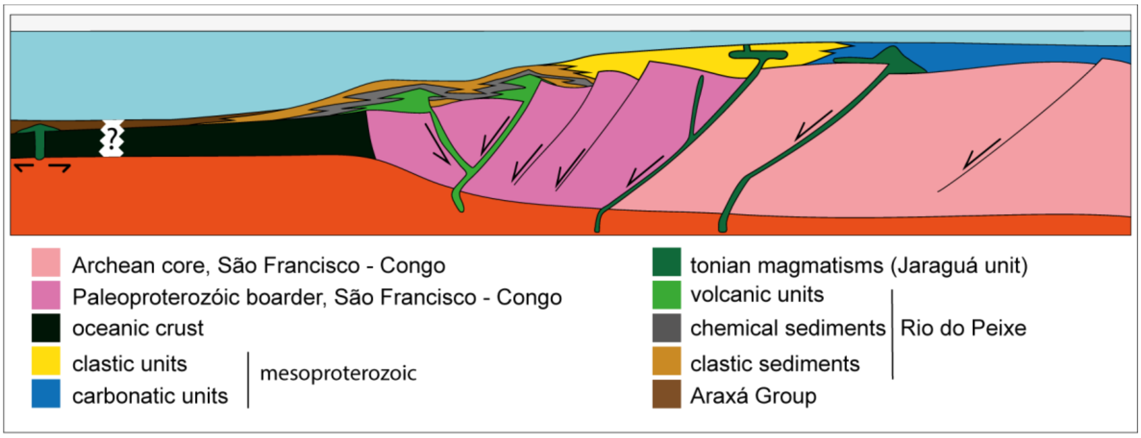

**Fig. 23.** Schematic section showing the architectonic and rock environments of the Jaraguá Unit (tonian magmatism) and Rio do Peixe Sequene.

## 6. Conclusions

This study shows that among (volcano) sedimentary rocks that crop out in the Pirineus Syntaxis, it is possible to differentiate sequences of different age and tectonic evolution.

Paleoproterozoic volcano-sedimentary rocks are restricted to the Artulândia domain. The Rio do Peixe Sequence that has been previously interpreted as Paleoproterozoic, possibly formed during a Stenian/Tonian Taphrogenetic event. Thus, the EMORB or OIB signature of amphibolites from this unit may reflect thinning of the continental crust during its formation.

The MORB signature of the Jaraguá Intrusive unit is a strong evidence of the formation of an oceanic crust at the border of the São Francico paleoplate after the breakup of Rodinia. The different TDM model ages found in the Jaraguá intrusive unit and in amphibolites form Rio do Peixe Sequence an explained by different sources. However, their existence corroborates the interpretation of an extensional environment at the Stenian/Tonian (Brito Neves *et al*., 2001; 2011).

The Araxá Group was deposited in a wide basin, and therefore it is a unit formed by clastic and chemical sediments with variable sources, according to the depositional environment and the source area. The deposition is linked to the Brasiliano orogeny, with the beginning of deposition in a passive margin evolving to an active margin.

The occurrences in the middle of the unit show a temporal and environmental correlation to the Rio do Peixe Sequence: metavolcanic rocks and metasedimentary rocks, a which are chemically similar to other Neoproterozoic sequences in the middle of the Araxá Group stacking, Maratá and Rio Veríssimo sequences make, us believe that the basaltic volcanism and the development of an oceanic crust in the Neoproterozoic basin have been historically underestimated. This is an important find that helps understanding how rift and drift were the sons of Rodinia

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# 4 Conclusões e recomendações

- A bacia na qual os sedimentos do Grupo Araxá se depositaram possui uma variedade de ambientes cronocorrelatos, mostrando que a bacia possuía uma dinamicidade na evolução dos ambientes com o passar do tempo. Os dados de proveniência sedimentar em zircão detrítico mostram que as áreas fontes paleoproterozóicas eram abundantes, de modo que hoje essas areas estão em sua maioria cobertas pelas coberturas mesoproterozóicas e neoproterozóicas.
- O Grupo Rio do Peixe fica com ocorrência restrita à porção central da Faixa Brasília, passando a ser entendido como uma sequência vulcano-sedimentar neoproterozóica, gerada em ambiente intraplaca, com um conjunto de sedimentos químicos e clásticos em sua porção superior, podendo ser correlacionada às sequências vulcano-sedimentares Maratá e Rio Veríssimo, além de outras ocorrências menores na região de Abadia dos Dourados e Araxá.
- As rochas subvulcânicas máficas que formam o corpo de Jaraguá, antes colocadas como pertencentes ao Grupo Rio do Peixe, agora por meio de dados geoquímicos e geocronológicos ficam enquadradas a magmatismo anterior (1153 Ma), com valores de εNd negativos, indicando mistura com material paleoproterozóico, provavelmente a encaixante; as assinaturas geoquímicas tipo MORB indicam ambiente extensional.
- As ocorrências paleoproterozoicas graníticas a leste do Domínio Artulândia indicam uma ampliação dos limites do Arco Campinorte, e mostram que estes terrenos paleoproterozóicos são formados pela colagem de múltiplos arcos à borda oeste da paleoplaca São Francisco-Congo durante o Paleoproterozóico.

O autor propõe como recomendações para os futuros trabalhos na área e no tema, o levantamento de mais amostras a fim de aumentar a confiabilidade das correlações e afirmações feitas.

# 5 Referências Bibliográficas

Almeida F F M de. (1967). Nota sobre o Pré-Cambriano na região central de Goiás. Bol. Paranaense de Geociências, 26:19-22.

Almeida F.F.M. 1969. Evolução tectônica do Centro-Oeste brasileiro. Anais da Academia Brasileira de Geociências, 40:280-296.

Almeida F.F.M., Brito Neves B.B., Carneiro C.D.R. 2000. The origin and evolution of the South American Platform. Earth-Sciences Reviews, 50:77-111.

Almeida, F. F. M., Hasui, Y., Brito Neves, B. B, Fuck, R. A. (1981). Brazilian structural provinces: an introduction. Earth-Science Reviews, 17, 1–29.

Alvarenga, C. J. S., Dardenne, M. A., Vieira, L. C., Martinho, C. T., Guimarães, E. M., Santos, R. V., Santana, R. O. (2012). Estratigrafia da borda ocidental da Bacia do São Francisco.

Araújo Filho, J.O. (1981). Contribuição à estratigrafia e tectônica da região da mega-inflexão dos Pirineus-Goiás Centro Meridional. *SIMP. GEOL. CENTRO-OESTE*, *1*, 24-27.

Araújo Filho J O de. (1992a). A estrutura do granitóide de Fazenda Raizama: um exemplo de uma mega dobra-em bainha na Mega-Inflexão dos Pirineus. IG/UnB, Simp. de Geociências do IG, 1, 1:17.

Araújo Filho, J. O. (1999). *Structural characteristics and tectonic evolution of the Pirineus Syntaxis, central Brazil;* Tese Doutorado: Universidade de Illinois, Urbana-Champaign.

Araújo Filho, J. O. (2000). The pirineus syntaxis: an example of the intersection of two Brasíliano Fold-Thrust belts in central Brazil and its implications for the tectonic evolution of western Gondwana. *Revista Brasileira de Geociências*, *30*(1), 144-148.

Araújo Filho, J. O, Wald, D.H.G. Projeto Pirinopolis-Corumbá de Goiás relatório final de graduação (seis volumes) 1977 - Universidade de Brasília – Não publicado

Araújo Filho, J. O., Walde, D.H.G., Leonardos, O. H., Danni, J.C.M. Projeto Jaraguá-Pirenópolis (treze volumes) 1979 - Universidade de Brasília – Não publicado

Araújo Filho, J. O., Barreira, C.F., Andrade, G.F., Wing, M. Kuyumijian, R.M. Projeto Pirineus-Pirenópolis (seis volumes) 1981 – Universidade de Brasília – Não publicado.

Botelho, N. F., Fuck, R. A., Dantas, E. L., Laux, J. H., Junges, S. L. (2006). The Paleoproterozoic peraluminous Aurumina granite suite, Goiás and Tocantins, Brazil: geological, whole rock geochemistry and U-Pb and Sm-Nd isotopic constraints. *The Paleoproterozoic Record of the São Francisco Craton, Brazil*, IGCP 509, 9-21.

Boynton, W. V. (1984). Cosmochemistry of the rare earth elements: meteorite studies. In *Developments in geochemistry* (Vol. 2, pp. 63-114). Elsevier.

Brito Neves, B.B., (2011). The Paleoproterozoic in the South American continent: Diversity in the geologic time. Journal of South American Earth Sciences 32, 270-286.

Brito Neves, B. B., & Cordani, U. G. (1991). Tectonic evolution of South America during the late Proterozoic. Precambrian Research, 53(1-2), 23-40.

Brito Neves, B.B.; Campos Neto, M. C.; Fuck, R. A (1999) From Rodinia to Western Gondwana: an approach to the Brasiliano-Pan-African Cycle and orogenic collage. Episodes, v. 22, n. 3, p. 155-166.

Brito Neves, B. B., Van Schmus, W. R., & Fetter, A. H. (2001). Noroeste da África-Nordeste do Brasil (Província Borborema) ensaio comparativo e problemas de correlação. Geologia USP. Série Científica, 1, 59-78.

Brito Neves, B.B., Fuck, R. A.; Pimentel, M. M. (2014). The Brasiliano collage in South America: a review. Brazilian Journal of Geology, 44(3), 493-518

Brod J.A., Jost H. (1991) – Características estruturais, litológicas e magmáticas da zona de cisalhamento dúctil do Rio Traíras, bloco do Complexo Níquelândia, Goiás. *Revista Brasileira de Geociências*, 21:205–217.

Brod, J.A., Leonardos, O.H., Meneses, P.R., Albuquerque, M.A.C., Almeida, R., Blanco, S.B., Cardoso, F.B.F., Romão, P.A., Tallarico, F.H.B., Thomsen, F.P.R. (1992). Geoquimica da Sequência Vulcano-Sedimentar de Abadia dos Dourados e Complexo Chapada das Perdizes, Triangulo Mineiro – MG. Rev. Esc. Minas de Ouro Preto 45 (2), 164–166.

Brown, M.T.; 2019 Mélanges e corpos ofiolíticos do Grupo Araxá e sua associação com terrenos acrescionários. Tese de Doutorado: Universidade de Brasília, Distrito Federal.

Bühn, B., Pimentel, M. M., Matteini, M., Dantas, E. L. (2009). High spatial resolution analysis of Pb and U isotopes for geochronology by laser ablation multi-collector inductively coupled plasma mass spectrometry (LA-MC-ICP-MS). *Anais da Academia Brasileira de Ciências*, *81*(1), 99-114.

Carvalho, M. D. O., Valeriano, C. D. M., Aguiar Neto, C. C., Oliveira, G. D., Heilbron, M. (2019). The Vazante and Canastra groups revisited: Sm-Nd and Sr isotopes-evidence for contribution from Tonian intraplate magmatism during passive margin development along the SW São Francisco margin, Brazil. Brazilian Journal of Geology, 49(1).

Chemale Jr, F., Dussin, I. A., Alkmim, F. F., Martins, M. S., Queiroga, G., Armstrong, R., Santos, M. N. (2012a). Unravelling a Proterozoic basin history through detrital zircon geochronology: the case of the Espinhaço Supergroup, Minas Gerais, Brazil. *Gondwana Research*, *22*(1), 200-206.

Cordeiro, P. F., de Oliveira, C. G., Della Giustina, M. E. S., Dantas, E. L., dos Santos, R. V. (2014). The Paleoproterozoic Campinorte arc: tectonic evolution of a Central Brazil pre-Columbia orogeny. *Precambrian Research*, *251*, 49-61.

Cordeiro, P. F.O., Oliveira, C. G. (2017). The Goiás Massif: Implications for a pre-Columbia 2.2–2.0 Ga continent-wide amalgamation cycle in central Brazil. *Precambrian Research*, *298*, 403-420.

Costa, J.B.S. (1985). Aspectos litoestruturais e evolução crustal da região centro-norte de Goiás. Tese de Doutorado: Centro de Geociências, Universidade Federal do Pará.

Cruz, E. L. C. C. (2001). *A gênese e o contexto tectônico da mina Córrego Paiol: um depósito de ouro hospedado em anfibolito do embasamento da Faixa de Dobramentos Brasília*. Tese Doutorado, Instituto de Geociências, Universidade Brasília, Brasília.

Cruz, E. L. C. C., Kuyumjian, R. M. (1996). Chemical characterization of metabasalts and granitoids from the Almas-Dianópolis granite-greenstone terrane, central Brazil. In *SBG/Núcleo Brasília. Symposium on Archaean Terranes of South American Platform, Extended abstracts* (pp. 53-54).

Cruz, E. L. C. C., Kuyumjian, R. M. (1999). Mineralizações auríferas filoneanas do terreno granito-greenstone do Tocantins. *Revista Brasileira de Geociências*, *29*(3), 291-298.

Cuadros, F. A., Botelho, N. F., Fuck, R. A., Dantas, E. L. (2017a). The peraluminous Aurumina granite suite in central Brazil: An example of mantle-continental crust interaction in a Paleoproterozoic cordilleran hinterland setting?. *Precambrian Research*, *299*, 75-100.

Cuadros, F. A., Botelho, N. F., Fuck, R. A., Dantas, E. L. (2017b). The Ticunzal Formation in central Brazil: Record of Rhyacian sedimentation and metamorphism in the western border of the São Francisco Craton. *Journal of South American Earth Sciences*, *79*, 307-325.

Dardenne, M. A. (2000). The Brasília fold belt. In *Tectonic Evolution of South America. In 31st International Geological Congress, Rio de Janeiro* (Vol. 231, p. 263).

Dardenne, M.A., Fuck, R.A., Meneses, P.R., Pimentel, M.M. Projeto Sucuri. 1991 – Universidade de Brasília – Não publicado.

Dardenne, M.A., Fuck, R.A., D'el Rey Silva, L.H., Pimentel, M.M. Projeto Rio Verissimo.1994 - Universidade de Brasília – Não publicado.

Dardenne, M. A., Giustina, M. E. S. D., Sabóia, A. M., & Bogossian, J. (2009). Datação geocronológica U-Pb da sequência vulcânica de Almas, Tocantins. *sbg, simp. Geol. Centro-oeste*, *11*. Anais, 1 CD-Rom

De Sousa, I. M. C., Della Giustina, M. E. S., de Oliveira, C. G. (2016). Crustal evolution of the northern Brasília Belt basement, central Brazil: A Rhyacian orogeny coeval with a pre-Rodinia supercontinent assembly. Precambrian Research, 273, 129-150.

Debon, F., & Le Fort, P. (1982). A chemical–mineralogical classification of common plutonic rocks and associations. *Earth and Environmental Science Transactions of the Royal Society of Edinburgh*, *73*(3), 135-149.

Della Giustina, M. E. S., Oliveira, C. G., Pimentel, M. M., de Melo, L. V., Fuck, R. A., Dantas, E. L., Buhn, B. (2009). U-Pb and Sm-Nd constraints on the nature of the Campinorte sequence and related Palaeoproterozoic juvenile orthogneisses, Tocantins Province, central Brazil. *Geological Society, London, Special Publications*, *323*(1), 255-269.

Drake Jr. A.A. (1980) – The Serra de Caldas window, Goiás. In:Tectonic Studies in the Brazilian Shield. U.S. *Geological Survey Professional Paper*, 119A–B:1–11.

Eby, G. N. (1992). Chemical subdivision of the A-type granitoids: petrogenetic and tectonic implications. *Geology*, *20*(7), 641-644.

Falci, A., de Andrade Caxito, F., Seer, H. J., de Morisson Valeriano, C., Dias, P. H. A., Pedrosa-Soares, A. C. (2018). Provenance shift from a continental margin to a syn-orogenic basin in the Neoproterozoic Araxá nappe system, southern Brasília belt, Brazil. Precambrian Research, 306, 209-219.

Ferreira Filho, C. F., Kamo, S. L., Fuck, R. A., Krogh, T. E., Naldrett, A. J. (1994). Zircon and rutile U/Pb geochronology of the Niquelândia layered mafic and ultramafic intrusion, Brazil: constraints for the timing of magmatism and high grade metamorphism. *Precambrian Research*, *68*(3-4), 241-255.

Ferreira Filho, C. F., Pimentel, M. M., Araújo, S. M., Laux, J. H. (2010). Layered intrusions and volcanic sequences in Central Brazil: geological and geochronological constraints for Mesoproterozoic (1.25 Ga) and Neoproterozoic (0.79 Ga) igneous associations. *Precambrian Research*, *183*(3), 617-634.

Filgueiras, B.C., Oliveira, C.G., Sousa, I.M.C., Cordeiro, P.F.O. (2019). Further evidence of Rhyacian arc-back arc magmatism in Brasilia Belt basement. Journal of South American Earth Sciences.

Fischel, D.P. ; Pimentel, M. M. ; Fuck, R.A . (1998). Idade do metamorfismo de alto grau no Complexo Anápolis-Itauçu, Goiás, determinada pelo método Sm-Nd. Revista Brasileira de Geociências, 28(4), 607-609.

Fischel, D.P., Pimentel, M.M., Fuck, R.A., Armstrong, R., (2001). U-Pb SHRIMP and Sm-Nd geochronology of the Silvânia Volcanics and Jurubatuba Granite: juvenile Paleoproterozoic crust in the basement of the Neoproterozoic Brasília Belt, Goiás, central Brazil. Anais Academia Brasileira de Ciências 73, 445-460.

Fischel, D.P.; Pimentel, M. M. ; Fuck, R. A.; Armstrong, R. (2003A). SHRIMP U-Pb and Sm-Nd data for the Araxá Group and associated magmatic rocks: constraints for the age of sedimentation and tectonic evolution of the southern Brasília Belt, central Brazil. Precambrian Research, 125, 139-160.

Fischel, D.P.; Pimentel, M. M. ; Fuck R. A.; Armstrong, R. (2003B). Neoproterozoic magmatism and high-grade metamorphism in the Brasília Belt, central Brazil: regional implications of SHRIMP U-Pb and Sm-Nd geochronological studies. Precambrian Research, 125, 245-273.

Floyd, P. A., Winchester, J. A., Park, R. G. (1989). Geochemistry and tectonic setting of Lewisian clastic metasediments from the Early Proterozoic Loch Maree Group of Gairloch, NW Scotland. *Precambrian Research*, *45*(1-3), 203-214.

Floyd, P. A., Shail, R., Leveridge, B. E., Franke, W. (1991). Geochemistry and provenance of Rhenohercynian synorogenic sandstones: implications for tectonic environment discrimination. *Geological Society, London, Special Publications*, *57*(1), 173-188.

Fonseca, M. A. (1996). Estilos estruturais e o arcabouço tectônico do segmento setentrional da Faixa Brasília. *Tese de Doutorado. Instituto de Gecociências, Univesidade de Brasília*.

Fonte-Boa, T. M. R., Novo, T. A., Pedrosa-Soares, A. C., Dussin, I. (2017). Records of Mesoproterozoic taphrogenic events in the eastern basement of the Araçuaí Orogen, southeast Brazil. *Brazilian Journal of Geology*, *47*(3), 447-466.

Freitas-Silva, F. H., Dardenne, M. A. (1997). Pb/Pb isotopic patterns of galenas from Morro do Ouro (Paracatu Formation), Morro Agudo/Vazante (Vazante Formation) and Bambuí Group deposits [ext. abs.]. In *South American Symposium on Isotope Geology, Extended Abstracts* (pp. 118-120).

Fuck, R. A., Marini, O. J. (1979). O Grupo Araxá e unidades homotaxiais. In: *1º Simpósio sobre o Craton do São Francisco, Salvador,* 118-130.

Fuck., H.A.; Danni, J.C.M.; Winge, M.; Andrade, G.F.; Barreira, C.F.; Kuyumijian, R.M. Projeto Barro Alto-Goianésia (8 volumes) 1980 – Universidade de Brasília – Não publicado

Fuck, R. A., Pimentel, M. M., Soares, J. E. P., Dantas, E. L. (2005). Compartimentação da Faixa Brasília. *in: IX Simpósio de Geologia do Centro-Oeste*, 26-27.

Fuck, R. A., Dantas, E. L., Pimentel, M. M., LAUX, J. H., Junges, S. L., Oliveira, C. G., Sordi D. A., Chiarini, M. F. N. (2006). The Santa Terezinha Sequence, Goiás Magmatic Arc, Central Brazil: constraints from U-Pb and Sm-Nd data.

Fuck, R. A., Dantas, E. L., Pimentel, M. M., Botelho, N. F., Armstrong, R., Laux, J. H., Praxedes, I. F. (2014). Paleoproterozoic crust-formation and reworking events in the Tocantins Province, central Brazil: A contribution for Atlantica supercontinent reconstruction. *Precambrian Research*, *244*, 53-74.

Gioia, S. M. C. L., Pimentel, M. M. (2000). The Sm-Nd isotopic method in the geochronology laboratory of the University of Brasília. *Anais da Academia Brasileira de Ciências*, *72*(2), 219-245.

Guadagnin, F., Chemale Jr, F., Magalhães, A. J., Santana, A., Dussin, I., Takehara, L. (2015). Age constraints on crystal-tuff from the Espinhaço Supergroup—Insight into the Paleoproterozoic to Mesoproterozoic intracratonic basin cycles of the Congo–São Francisco Craton. *Gondwana Research*, *27*(1), 363-376.

Hayashi, K. I., Fujisawa, H., Holland, H. D., Ohmoto, H. (1997). Geochemistry of∼ 1.9 Ga sedimentary rocks from northeastern Labrador, Canada. *Geochimica et Cosmochimica Acta*, *61*(19), 4115-4137.

Herron, M.M., 1988. Geochemical classification of terrigenous sands and shales from core or log data. J. Sediment. Petrology 58 (5), 820e829.

Jackson, N. J., Ramsay, C. R. (1980). What is the “Pan-African”? A consensus is needed. *Geology*, *8*(5), 210-211.

Jost, H., Fuck, R.A., Dantas, E.L., Rancan, C.C., Rezende, D.B., Santos, E., Portela, J.F., Mattos, L., Chiarini, M.F.N., Oliveira, R.C., Silva, S.E. (2005). Geologia e geocronologia do Complexo Uvá, bloco arqueano de Goiás. Revista Brasileira de Geociências, 35(4), 559-572

Jost, H., Rodrigues, V. G., de Carvalho, M. J., Junior, F. C., Marques, J. C. (2012). Estratigrafia e geocronologia do greenstone belt de Guarinos, Goiás. *Geologia USP. Série Científica*, *12*(2), 31-48.

Jost, H., Carvalho, M. J., Rodrigues, V. G., Martins, R. (2014). Metalogênese dos greenstone belts de Goiás. In: Metalogênese das Províncias Tectônicas Brasileiras, CPRM, Belo Horizonte, 141-168.

Junges, S. L., Pimentel, M. M., Moraes, R. (2002). Nd isotopic study of the Neoproterozoic Mara Rosa Arc, central Brazil: implications for the evolution of the Brasília Belt. *Precambrian Research*, *117*(1-2), 101-118.

Kennedy, W. Q. (1964). The structural differentiation of Africa in the Pan-Africa (±500 my) tectonic episode. *University Leeds.*, 48-49.

Klein, P.B.W., 2008. Geoquimica de Rocha Total, Geocronologia de U-Pb e Geologia Isotopica de Sm-Nd das Rochas Ortognaissicas e Unidades Litologicas Associadas da Regiao Ipameri – Catalao (Goias). Tese de Doutorado: Universidade de Brasília, Instituto de Geociências.

Kuymjian, R. M., de Oliveira, C. G., Campos, J. E. G., de Queiroz, C. L. (2016). Geologia do limite entre os terrenos arqueanos e o Arco Magmático de Goiás na região de Chapada-Campinorte, Goiás. Revista Brasileira de Geociências, 34(3), 329-334.

Laux, J. H., Pimentel, M. M., Dantas, E. L., Armstrong, R., Armele, A., Nilson, A. A. (2004). Mafic magmatism associated with the Goiás magmatic arc in the Anicuns region, Goiás, central Brazil: Sm–Nd isotopes and new ID-TIMS and SHIMP U–Pb data. *Journal of South American Earth Sciences*, *16*(7), 599-614.

Laux, J. H., Pimentel, M. M., Dantas, E. L., Armstrong, R., Junges, S. L. (2005). Two Neoproterozoic crustal accretion events in the Brasília belt, central Brazil. *Journal of South American Earth Sciences*, *18*(2), 183-198.

Ludwig, K.R., 2009, User’s Manual for Isoplot/Ex v. 4. A Geochronological Toolkit for Microsoft Excel. BGC Special Publication 4, Berkeley, 71 pp.

Moraes, R., Fuck, R. A., Pimentel, M. M., Gioia, S. M., de Hollanda, M. H., Armstrong, R. (2006). The bimodal rift-related Juscelândia volcanosedimentary sequence in central Brazil: Mesoproterozoic extension and Neoproterozoic metamorphism. *Journal of South American Earth Sciences*, *20*(4), 287-301.

Moura, F.G.; 2018. GEOLOGIA DO GRUPO QUILOMBO E SEU EMBASAMENTO CRISTALINO NA REGIÃO DE UNAÍ-MG. Dissertação de Mestrado: Universidade de Brasília, Instituto de Geociências.

Navarro, G. R. B., Zanardo, A., Montibeller, C. C., da Conceição, F. T., de Morisson Valeriano, C., Leme, T. G., Simões, L. S. A. (2017). PROVENIÊNCIA DOS METASSEDIMENTOS DO GRUPO ARAXÁ NA REGIÃO DE RIO QUENTE-CALDAS NOVAS. Geociências (São Paulo), 36(2), 395-413.

Ohta, T., Arai, H. (2007). Statistical empirical index of chemical weathering in igneous rocks: A new tool for evaluating the degree of weathering. *Chemical Geology*, *240*(3-4), 280-297.

Oliveira, C. G., Oliveira, F. B., Dantas, E. L., Fuck, R. A., Almeida, T. (2006). Nota Explicativa e Mapa Geológico da Folha Campinorte (Folha SD. 22-XD-IV, 1: 100.000). *Brasília, CPRM*.

Oliveira, F. V. D. (2015). Chronus: um novo suplemento para a redução de dados U-Pb obtidos por LA-MC-ICPMS. Universidade de Brasília, Instituto de Geociências, Dissertação de Mestrado.

Pearce, J. (1996). Sources and settings of granitic rocks. *Episodes*, *19*, 120-125.

Pearce, J. A. (1982). Trace element characteristics of lavas from destructive plate boundaries. Andesites, 8, 525-548.

Pearce, J. A., Harris, N. B., Tindle, A. G. (1984). Trace element discrimination diagrams for the tectonic interpretation of granitic rocks. *Journal of Petrology*, *25*(4), 956-983.

Piaulino, P. F., Hauser, N., Dantas, E. L. (2019). From passive margin to continental collision: geochemical and isotopic constraints for e-morb and oib-like magmatism during the neoproterozoic evolution of the southeast brasília belt. Precambrian Research.

Pimentel, M.M., (2016) The tectonic evolution of the Neoproterozoic Brasilia Belt, central Brazil: a geochronological and isotopic approach. Braz. J. Geol. 46 (June), 67–82.

Pimentel, M. M., Fuck, R. A. (1992a). Neoproterozoic crustal accretion in central Brazil. *Geology*, *20*(4), 375-379.

Pimentel, M. M., Fuck, R. A., Botelho, N. F. (1999a). Granites and the geodynamic history of the Neoproterozoic Brasília belt, central Brazil: a review. *Lithos*, *46*(3), 463-483.

Pimentel M.M., Fuck R.A., D´el-Rey Silva L.J.H., Menezes P.R. (1995a) – O magmatismo ácido peraluminoso associado ao Grupo Araxá na região entre Pires do Rio e Ipameri, Goiás: características geoquímicas e implicações geotectônicas. V Simpósio de Geologia do Centro-Oeste, 5, Goiânia, Ata. Goiânia:68–71.

Pimentel, M. M., Fuck, R. A., Jost, H., Ferreira Filho, C. F., Araújo, S. D. (2000). The basement of the Brasília fold belt and the Goiás magmatic arc. In *Tectonic Evolution of South America. 31st International Geological Congress, Rio de Janeiro* (Vol. 195-229).

Pimentel. M.M., Dardenne M.A., Fuck R.A., Viana M.G., Junges S.L., Fischel D.P., Seer H.J., Dantas E.L. (2001a). Nd isotopes and the provenance of detrital sediments of the Neoproterozoic Brasília Belt, Central Brazil. Journal of South American Earth Sciences, 14(6):571-585.

Pimentel, M. M., Botelho, N. F. (2001b). Sr and Nd isotopic characteristics of 1.77-1.58 Ga rift-related granites and volcanics of the Goiás tin province, central Brazil. *Anais da Academia Brasileira de Ciências*, *73*(2), 263-276.

Pimentel, M. M., Hollanda, M. H., Armstrong, R. (2003). Shrimp U-Pb age and Sr-Nd isotopes of the Morro do Baú mafic intrusion: implications for the evolution of the Arenópolis volcano-sedimentary sequence, Goiás Magmatic Arc. *Anais da Academia Brasileira de Ciências*, *75*(3), 331-339.

Pimentel, M. M., Ferreira Filho, C. F., Armstrong, R. A. (2004). SHRIMP U–Pb and Sm–Nd ages of the Niquelândia layered complex: Meso-(1.25 Ga) and Neoproterozoic (0.79 Ga) extensional events in central Brazil. *Precambrian Research*, *132*(1-2), 133-153.

Pimentel, M.M., Ferreira Filho, C.F., Armele, A., 2006. Neoproterozoic age of the Niquelandia complex, Central Brasil: further ID-TIMS and Sm–Nd isotopic evi- dence. Journal of South American Earth Sciences 21, 228–238.

Pimentel, M. M., Rodrigues, J. B., Della Giustina, M. E. S., Junges, S., Matteini, M., Armstrong, R. (2011). The tectonic evolution of the Neoproterozoic Brasília Belt, central Brazil, based on SHRIMP and LA-ICPMS U–Pb sedimentary provenance data: a review. *Journal of South American Earth Sciences*, *31*(4), 345-357.

Queiroz, C. L., Jost, H., & McNaughton, N. J. (1999). U/Pb-SHRIMP ages of Crixás granite-greenstone belt terranes: from Archaean to Neoproterozoic. *In: VII Simpósio Nacional de Estudos Tectônicos*, 35-37.

Ross, P. S., Bédard, J. H. (2009). Magmatic affinity of modern and ancient subalkaline volcanic rocks determined from trace-element discriminant diagrams. *Canadian Journal of Earth Sciences*, *46*(11), 823-839.

Sabaraense, L. D.; 2017. Proveniência dos grupos Araxá e Ibiá na porção sul da Faixa Brasília. Dissertação de Mestrado: Universidade de Brasília, Instituto de Geociências.

Seer, H. J., Brod, J. A., Fuck, R. A., Pimentel, M. M., Boaventura, G. R., Dardenne, M. A. (2001). Grupo Araxá em sua área tipo: um fragmento de crosta oceânica neoproterozóica na Faixa de Dobramentos Brasília. *Revista Brasileira de Geociências*, *31*(3), 385-396.

Seer, H.J., Brod J.A., Valeriano C.M., Fuck R.A. (2005) – Leucogranitos intrusivos no Grupo Araxá: Registro de um evento magmático durante colisão neoproterozóica na porção meridional da Faixa Brasília. Revista Brasileira de Geociências.35(1):33-42.

Shand, S. J. (1943). *Eruptive rocks: their genesis, composition, and classification, with a chapter on meteorites*. J. Wiley & Sons, Incorporated.

Silva, L. J. D. E. R., De Vasconcelos, M. A., Silva, D. V. (2008). Timing and role of the Maranhão River Thrust in the evolution of the Neoproterozoic Brasília Belt and Tocantins Province, central Brazil. *Gondwana Research*, *13*(3), 352-374.

Soares, J. E., Berrocal, J., Fuck, R. A., Mooney, W. D., Ventura, D. B. (2006). Seismic characteristics of central Brazil crust and upper mantle: a deep seismic refraction study. *Journal of Geophysical Research: Solid Earth*, *111*(B12), 302-333.

Sousa, I.M; Della Giustina, M.E.S; de Oliveira, C.G. (2016). Crustal Evolution of the northen Brasilia belt basement, central Brazil: A Rhyacian orogeny coeval with a pre-Rodinia supercontinente assembly. Precambrian Reserach 129-150.

Strieder, A. J., NILSON, A. A. (1992A). ESTUDO PETROLÓGICO DE ALGUNS FRAGMENTOS TECTÔNICOS DA MELANGE OFIOLÍTICA EM ABADIÂNIA (GO): I - O PROTOLITO DOS CORPOS DE SERPENTINITO. *Revista Brasileira de Geociências*, *22*(3), 338-352.

Strieder, A. J., Nilson, A. A. (1992B). Melange ofiolítica nos metassedimentos Araxá de Abadiânia (GO) e implicações tectônicas regionais. *Revista Brasileira de Geociências*, *22*(2), 204-215.

Sun, S. S., McDonough, W. F. (1989). Chemical and isotopic systematics of oceanic basalts: implications for mantle composition and processes. *Geological Society, London, Special Publications*, *42*(1), 313-345.

Tassinari, C. C. G., Jost, H., Santos, J. C., Nutman, A. P., Bennell, M. R. (2006). Pb and Nd isotope signatures and SHRIMP U–Pb geochronological evidence of Paleoproterozoic age for Mina III gold mineralization, Crixás District, Central Brazil. In *5th South American Symposium on Isotope Geology*, 527-529.

Teixeira, W., Oliveira, E. P., Marques, L. S. (2017). Nature and evolution of the Archean crust of the São Francisco Craton. In São Francisco Craton, Eastern Brazil (pp. 29-56). Springer.

USGS (United States Geological Survey). Shuttle Radar Topography Mission. http://edc.usgs.gov/srtm/mission.html.

USGS (United States Geological Survey). Using the USGS Landsat 8 Product. Disponível em: http://landsat.usgs.gov/using_Landsat_7_data.php.

Valeriano, C. D. M., Dardenne, M. A., Fonseca, M. A., Simões, L. S. A., Seer, H. J. (2004). A evolução tectônica da Faixa Brasília. *Geologia do Continente Sul-Americano: Evolução da obra de Fernando Flávio Marques de Almeida. BECA*, 575-592.

Valeriano, C. D. M., Simões, L. S. A. (1997). Geochemistry of Proterozoic mafic rocks from the Passos nappe (Minas Gerais, Brazil): tectonic implications to the evolution of the southern Brasília Belt. Brazilian Journal of Geology, 27(1), 99-110.

Valeriano, C. D. M., Pimentel, M. M., Heilbron, M., Almeida, J. C. H., Trouw, R. A. J. (2008). Tectonic evolution of the Brasília Belt, Central Brazil, and early assembly of Gondwana. *Geological Society, London, Special Publications*, *294*(1), 197-210.

Wetherill, G. W. (1956). Discordant uranium-lead ages, I. *Eos, Transactions American Geophysical Union*, *37*(3), 320-326.

Whalen, J. B., Currie, K. L., & Chappell, B. W. (1987). A-type granites: geochemical characteristics, discrimination and petrogenesis. *Contributions to mineralogy and petrology*, *95*(4), 407-419.

Wiedenbeck, M. A. P. C., Alle, P., Corfu, F., Griffin, W. L., Meier, M., Oberli, F. V., Spiegel, W. (1995). Three natural zircon standards for U-Th-Pb, Lu-Hf, trace element and REE analyses. Geostandards Newsletter, 19(1), 1-23.

Wood, D. A. (1980). The application of a Th-Hf-Ta diagram to problems of tectonomagmatic classification and to establishing the nature of crustal contamination of basaltic lavas of the British Tertiary Volcanic Province. Earth and Planetary Science letters, 50(1), 11-30.

# 6 Anexos

## Coordenadas de pontos citados

| Ponto/amostra | Coordenadas (graus decimais) | | Rocha | Lâmina | Geoquímica | Sm-Nd | U-Pb |
|---|---|---|---|---|---|---|---|
| | Lat (S) | Long (W) | | | | | |
| MCR0101 | -15.923899 | -49.285900 | Meta-gabro | X | X | X | |
| MCR0109 | -15.998200 | -49.13719 | Anfibolito | X | X | X | X |
| MCR 0120 | -15.853823 | -49.890255 | Dike máfico | X | | X | |
| MCR0207 | -15.497699 | -48.932998 | Chl-xisto | | | X | X |
| MCR0209A | -15.506199 | -49.130699 | Meta-tonalito | X | X | X | X |
| MCR0209B | -15.506199 | -49.130699 | Dique-pegmatitico | X | | | X |
| MCR0212 | -15.704299 | -49.116699 | Anfibolito | X | | X | |
| MCR0301 | -15.621800 | -49.023601 | Anfibolito | X | | X | |
| MCR0314 | -15.535699 | -48.989299 | Anfibolito | X | X | X | |
| MCR0320 | -15.620200 | -48.953201 | Anfibolito | X | X | X | |
| MCR0326 | -15.863400 | -48.960098 | Ms-grt-xisto | X | | X | |
| MCR0401 | -15.550100 | -48.997501 | Xisto-carbonoso | X | X | X | |
| MCR0402 | -15.551899 | -48.992698 | Xisto-carbonoso | X | X | X | |
| MCR0408 | -15.998200 | -49.137190 | Orto-gnaisse | X | | X | |
| MCR0410 | -16.010599 | -49.116298 | Anfibolito | X | X | X | |
| MCR0511 | -15.472200 | -49.343299 | Meta-tonalito | | X | | |
| MCR0513 | -15.470009 | -49.318599 | Meta-granodiorito | | X | | |
| MCR0515 | -15.459799 | -49.306800 | Meta-granodiorito | | X | | |
| MCR0520 | -15.728300 | -49.060398 | Xisto-carbonoso | | X | X | |
| CORU01 | -15.918443 | -48.809568 | Bt-grt-xisto | X | | | X |
| CCORU02 | -15.843896 | -48.770428 | Quartzito | | | | X |

## Análises de geoquímica de Rocha total

| SAMPLE | MCR0209 | MCR0511 | MCR0513 | MCR0515 | MCR0401 | MCR0402 | MCR0520 | MCR0101 | MCR0410 | MCR0109 | MCR0314 | MCR0320 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rock | granodiorito | tonalito | tonalito | granodiorito | Xisto-carbonoso | Xisto-carbonoso | Xisto-carbonoso | Meta-gabro | anfibolito | anfibolito | Anfibolito | Anfibolito |
| Major elements (wt %) | | | | | | | | | | | | |
| SiO2 | 69.6 | 75.6 | 75.5 | 68.1 | 61.2 | 44.1 | 61.2 | 50.7 | 47.9 | 48.9 | 44 | 52.7 |
| TiO2 | 0.3 | 0.23 | 0.23 | 0.4 | 1.08 | 1.18 | 0.89 | 1.21 | 1.74 | 1.05 | 3.25 | 1.25 |
| Al2O3 | 14.2 | 11.65 | 11.95 | 15.1 | 16.3 | 28.4 | 19.9 | 12.75 | 13.5 | 15.6 | 14.55 | 12.2 |
| Fe2O3 | 3.11 | 3.72 | 3.6 | 3.74 | 8.97 | 1.46 | 4.42 | 10.9 | 15.85 | 12 | 14.8 | 8.82 |
| Cr2O3 | <0.002 | <0.002 | <0.002 | <0.002 | 0.013 | 0.04 | 0.017 | 0.019 | 0.013 | 0.058 | 0.007 | 0.039 |
| MnO | 0.04 | 0.06 | 0.05 | 0.05 | 0.09 | <0.01 | 0.01 | 0.4 | 0.26 | 0.15 | 0.14 | 0.14 |
| MgO | 0.74 | 0.4 | 0.48 | 1.06 | 1.58 | 2.3 | 1.31 | 10.05 | 7.46 | 6.71 | 5.35 | 6.72 |
| CaO | 1.86 | 0.72 | 0.46 | 2.8 | 0.86 | 0.1 | 0.03 | 9.03 | 10.35 | 11.1 | 10.95 | 15.5 |
| SrO | 0.03 | <0.01 | <0.01 | 0.05 | 0.01 | 0.01 | <0.01 | 0.02 | 0.01 | <0.01 | 0.07 | 0.05 |
| BaO | 0.09 | 0.08 | 0.07 | 0.09 | 0.07 | 0.08 | 0.07 | 0.05 | <0.01 | 0.01 | <0.01 | <0.01 |
| Na2O | 4.51 | 4.2 | 4.32 | 4.61 | 1.4 | 0.28 | 0.54 | 2.56 | 1.76 | 2.53 | 2.65 | 0.3 |
| K2O | 2.54 | 2.73 | 2.66 | 2.23 | 2.97 | 9.39 | 5.53 | 0.22 | 0.43 | 0.44 | 0.19 | 0.1 |
| P2O5 | 0.14 | 0.04 | 0.03 | 0.17 | 0.51 | 0.02 | 0.04 | 0.44 | 0.15 | 0.08 | 1.12 | 0.4 |
| LOI | 1.19 | 0.84 | 1.12 | 1.12 | 4.83 | 13.5 | 4.83 | 0.8 | 1.65 | 1.64 | 1.61 | 1.9 |
| Total | 98.35 | 100.27 | 100.47 | 99.52 | 99.88 | 100.86 | 98.79 | 99.15 | 101.07 | 100.27 | 98.69 | 100.12 |
| C | 0.06 | 0.06 | 0.14 | 0.06 | 1.14 | 8.94 | 0.93 | 0.04 | 0.16 | 0.01 | 0.02 | 0.01 |
| S | 0.05 | 0.01 | 0.01 | 0.01 | 0.36 | 0.01 | 0.01 | 0.14 | 0.41 | <0.01 | 0.58 | <0.01 |
| Rare earth elements (ppm) | | | | | | | | | | | | |
| Li | 20 | 10 | 20 | 30 | 30 | 70 | 50 | 20 | 10 | 20 | 20 | <10 |
| Rb | 92.8 | 70.7 | 54.3 | 86.5 | 143.5 | 229 | 226 | 2.3 | 3.8 | 12.2 | 1.3 | 2.7 |
| Cs | 4.23 | 0.26 | 0.44 | 5.93 | 9.26 | 5.08 | 6.42 | 0.2 | 0.15 | 0.52 | 0.19 | 0.07 |
| Sr | 356 | 78.2 | 79 | 519 | 137 | 117 | 85 | 275 | 172.5 | 92.8 | 659 | 439 |
| Ba | 770 | 654 | 595 | 770 | 582 | 684 | 648 | 386 | 31.7 | 72.1 | 37.7 | 27.8 |
| Ga | 19.5 | 22 | 22.1 | 19.6 | 23.9 | 36.8 | 29.2 | 16.5 | 20.4 | 16.5 | 23.8 | 23 |
| Zr | 192 | 374 | 367 | 188 | 260 | 223 | 189 | 128 | 68 | 57 | 159 | 292 |
| Nb | 7.2 | 11.4 | 11.9 | 8.5 | 19.7 | 30.3 | 20.2 | 9.2 | 8.6 | 1.7 | 67.4 | 44.7 |
| Hf | 4.8 | 10.3 | 10.1 | 4.7 | 7.1 | 5.8 | 4.9 | 3.3 | 2 | 1.7 | 3.7 | 7.7 |
| Ta | 0.9 | 1 | 1 | 1.1 | 1.6 | 2 | 1.6 | 1.1 | 0.8 | 0.5 | 3.9 | 3.1 |
| Sn | 5 | 4 | 4 | 4 | 4 | 6 | 4 | 2 | 3 | 1 | 2 | 4 |
| Th | 7.94 | 7.35 | 8.06 | 7.08 | 15.8 | 23.5 | 10.55 | 5.14 | 0.53 | 0.18 | 5.32 | 4.06 |
| U | 1.65 | 1.68 | 1.75 | 0.89 | 3.12 | 3.69 | 0.92 | 2.77 | 0.15 | <0.05 | 1.43 | 1.19 |
| V | 23 | 9 | 9 | 34 | 134 | 219 | 123 | 243 | 418 | 289 | 293 | 145 |
| Cr | 30 | 30 | 30 | 30 | 110 | 320 | 140 | 160 | 90 | 390 | 70 | 250 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ni | 2 | <1 | 2 | 4 | 36 | <1 | <1 | 58 | 52 | 102 | 28 | 113 |
| Cu | 213 | 19 | 19 | 4 | 46 | 4 | 11 | 7340 | 233 | 79 | 49 | 45 |
| Zn | 147 | 86 | 103 | 60 | 105 | 42 | 45 | 98 | 120 | 89 | 121 | 57 |
| Pb | 22 | 18 | 12 | 12 | 18 | 25 | 19 | 3 | 9 | <2 | 40 | <2 |
| Tl | 0.24 | 0.2 | 0.18 | 0.35 | 0.43 | 0.03 | 0.08 | 0.03 | 0.02 | 0.05 | 0.15 | 0.02 |
| Sc | 6 | 4 | 3 | 5 | 20 | 19 | 18 | 69 | 54 | 44 | 24 | 34 |
| Ge | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | 6 | <5 |
| W | 224 | 210 | 197 | 302 | 220 | 9 | 51 | 211 | 104 | 141 | 130 | 194 |
| As | 1.7 | 0.9 | 0.5 | 0.6 | 1.8 | 0.1 | 1.5 | 1.3 | 2.3 | 1.1 | 2.4 | 0.5 |
| Bi | 0.11 | 0.02 | 0.69 | 0.28 | 0.31 | 0.43 | 0.24 | 4.71 | 0.04 | 0.05 | 0.98 | 0.02 |
| Hg | <0.005 | 0.172 | 0.14 | 0.274 | 0.174 | 0.009 | 0.047 | 0.015 | 0.093 | <0.005 | 0.142 | 0.154 |
| In | 0.007 | 0.024 | 0.023 | 0.006 | 0.01 | 0.005 | 0.009 | 0.025 | 0.029 | 0.012 | 0.016 | 0.01 |
| Re | 0.001 | 0.001 | 0.002 | 0.002 | 0.001 | <0.001 | <0.001 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 |
| Sb | <0.05 | <0.05 | <0.05 | 0.06 | 0.11 | 0.07 | 0.07 | 0.07 | 0.26 | 0.18 | 0.66 | 0.08 |
| Se | <0.2 | 0.9 | 0.6 | 0.4 | 0.6 | 0.5 | 0.9 | 0.2 | 0.8 | <0.2 | 1 | 0.4 |
| Te | 0.1 | 0.01 | 0.03 | 0.01 | 0.01 | 0.02 | 0.03 | 2 | 0.02 | 0.04 | 0.12 | <0.01 |
| Ag | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 1.3 | <0.5 | <0.5 | <0.5 | <0.5 |
| Cd | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | 0.6 | <0.5 | <0.5 | <0.5 | <0.5 |
| Co | 30 | 30 | 28 | 46 | 50 | 7 | 9 | 60 | 67 | 49 | 64 | 50 |
| Mo | <1 | <1 | 1 | 1 | <1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| SAMPLE | MCR0209 | MCR0511 | MCR0513 | MCR0515 | MCR0401 | MCR0402 | MCR0520 | MCR0101 | MCR0410 | MCR0109 | MCR0314 | MCR0320 |
| Trace (ppm) | | | | | | | | | | | | |
| La | 32.7 | 59.1 | 44 | 59.9 | 53.8 | 53.8 | 33.9 | 28.9 | 9.4 | 2.7 | 58.9 | 39.6 |
| Ce | 60.6 | 95.4 | 84.9 | 83.4 | 110 | 65.7 | 59 | 65.1 | 25.2 | 6.8 | 111 | 85.3 |
| Pr | 6.52 | 12.65 | 10.05 | 9.3 | 12.1 | 12.25 | 7.18 | 7.55 | 3.64 | 1.17 | 12.6 | 10.75 |
| Nd | 25 | 53.6 | 45.2 | 33.5 | 50.1 | 45.5 | 29.1 | 35.6 | 17.4 | 7.1 | 54.6 | 44.5 |
| Sm | 4.19 | 11.55 | 10.2 | 4.56 | 10.15 | 8.43 | 4.85 | 9.77 | 4.98 | 2.66 | 10 | 9.3 |
| Eu | 0.89 | 1.57 | 1.49 | 1.05 | 2.11 | 1.51 | 0.87 | 1.83 | 1.48 | 0.88 | 4.12 | 2.88 |
| Gd | 3.04 | 12.5 | 11.65 | 3.56 | 9.86 | 5.06 | 3.83 | 12.05 | 5.34 | 3.73 | 9.72 | 8.75 |
| Tb | 0.4 | 2.06 | 2.04 | 0.57 | 1.61 | 0.78 | 0.72 | 2.25 | 0.85 | 0.69 | 1.38 | 1.31 |
| Dy | 1.91 | 13.55 | 13.7 | 3.28 | 8.58 | 4.7 | 4.5 | 15.3 | 5.62 | 4.41 | 7.82 | 8.14 |
| Ho | 0.36 | 2.98 | 2.98 | 0.61 | 1.75 | 1.02 | 0.97 | 3.05 | 1.1 | 0.96 | 1.59 | 1.46 |
| Er | 1.01 | 8.63 | 8.34 | 1.74 | 4.98 | 2.76 | 2.67 | 8.28 | 3.17 | 2.82 | 4.33 | 4.14 |
| Tm | 0.15 | 1.37 | 1.32 | 0.21 | 0.76 | 0.41 | 0.42 | 1.34 | 0.45 | 0.38 | 0.62 | 0.48 |
| Yb | 0.85 | 8.46 | 7.99 | 1.47 | 4.51 | 2.63 | 2.37 | 9.06 | 3 | 2.71 | 3.64 | 3.23 |
| Lu | 0.13 | 1.17 | 1.1 | 0.19 | 0.63 | 0.37 | 0.36 | 1.32 | 0.42 | 0.41 | 0.59 | 0.41 |
| Y | 10.4 | 86.4 | 84.7 | 17.7 | 48.5 | 24.6 | 26.3 | 81.8 | 28.5 | 25 | 40.7 | 36.2 |
| ΣREE | 148.15 | 370.99 | 329.66 | 221.04 | 319.44 | 229.52 | 177.04 | 283.2 | 110.55 | 62.42 | 321.61 | 256.45 |

# Dados Isotópicos U-Pb

## MCR 02 07

**Clorita xisto**

| Identifier | 206* (%) | Th/U | $^{207}$Pb/$^{206}$Pb | $1\sigma$ % | $^{207}$Pb/$^{235}$U | $1\sigma$ % | $^{206}$Pb/$^{238}$U | $1\sigma$ % | Rho | $^{207}$Pb/$^{206}$Pb | $2\sigma$ abs | $^{206}$Pb/$^{238}$U | $2\sigma$ abs | $^{207}$Pb/$^{235}$U | $2\sigma$ abs | % U-Pb disc[5] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 003-ZR1 | 0.0785 | 0.723 | 0.12006 | 0.95 | 5.769 | 1.59 | 0.3485 | 1.22 | 0.77 | 1957 | 34 | 1927 | 40 | 1942 | 27 | 1.52 |
| 006-ZR4 | 0.0015 | 0.415 | 0.12225 | 0.42 | 5.860 | 0.89 | 0.3476 | 0.70 | 0.78 | 1989 | 15 | 1923 | 23 | 1955 | 15 | 3.32 |
| 009-ZR7 | 0.0119 | 0.591 | 0.13192 | 0.52 | 6.933 | 0.95 | 0.3811 | 0.70 | 0.74 | 2124 | 18 | 2082 | 25 | 2103 | 17 | 1.99 |
| 010-ZR8 | 0.0123 | 0.588 | 0.11924 | 0.63 | 5.750 | 1.03 | 0.3497 | 0.73 | 0.71 | 1945 | 22 | 1933 | 24 | 1939 | 18 | 0.61 |
| 012-ZR10 | 0.0067 | 0.306 | 0.13547 | 0.55 | 7.636 | 1.18 | 0.4088 | 0.98 | 0.83 | 2170 | 19 | 2209 | 37 | 2189 | 21 | -1.81 |
| 015-ZR11 | 0.0112 | 0.707 | 0.13227 | 0.70 | 6.772 | 1.59 | 0.3713 | 1.37 | 0.87 | 2128 | 24 | 2035 | 48 | 2082 | 28 | 4.37 |
| 016-ZR12 | 0.0079 | 0.430 | 0.11953 | 0.86 | 5.825 | 1.34 | 0.3534 | 0.96 | 0.72 | 1949 | 31 | 1951 | 32 | 1950 | 23 | -0.09 |
| 017-ZR13 | 0.0051 | 0.283 | 0.11805 | 0.43 | 5.516 | 0.78 | 0.3389 | 0.53 | 0.69 | 1927 | 15 | 1881 | 17 | 1903 | 13 | 2.37 |
| 018-ZR14 | 0.0071 | 0.912 | 0.11014 | 0.61 | 4.795 | 0.95 | 0.3158 | 0.62 | 0.66 | 1802 | 22 | 1769 | 19 | 1784 | 16 | 1.81 |
| 020-ZR16 | 0.0044 | 0.634 | 0.10826 | 0.40 | 4.962 | 0.85 | 0.3324 | 0.65 | 0.77 | 1770 | 15 | 1850 | 21 | 1813 | 14 | -4.49 |
| 021-ZR17 | 0.0078 | 0.625 | 0.13218 | 0.52 | 7.114 | 0.98 | 0.3903 | 0.74 | 0.76 | 2127 | 18 | 2124 | 27 | 2126 | 17 | 0.13 |
| 022-ZR18 | 0.0132 | 0.652 | 0.13363 | 0.53 | 6.971 | 1.21 | 0.3783 | 1.02 | 0.85 | 2146 | 18 | 2068 | 36 | 2108 | 21 | 3.62 |
| 028-ZR22 | 0.0081 | 0.566 | 0.14058 | 0.64 | 7.564 | 1.09 | 0.3902 | 0.80 | 0.74 | 2234 | 22 | 2124 | 29 | 2181 | 20 | 4.95 |
| 029-ZR23 | 0.0166 | 0.690 | 0.13194 | 0.64 | 6.678 | 1.07 | 0.3671 | 0.78 | 0.72 | 2124 | 22 | 2016 | 27 | 2070 | 19 | 5.10 |
| 031-ZR25 | 0.0069 | 1.543 | 0.13964 | 0.46 | 7.373 | 1.17 | 0.3829 | 1.01 | 0.86 | 2223 | 16 | 2090 | 36 | 2158 | 21 | 5.98 |
| 032-ZR26 | 0.0053 | 0.418 | 0.11598 | 0.45 | 5.292 | 0.84 | 0.3309 | 0.61 | 0.72 | 1895 | 16 | 1843 | 19 | 1868 | 14 | 2.76 |
| 034-ZR28 | 0.0019 | 0.463 | 0.14255 | 0.56 | 7.877 | 1.19 | 0.4008 | 0.98 | 0.82 | 2258 | 19 | 2173 | 36 | 2217 | 21 | 3.80 |
| 035-ZR29 | 0.0167 | 0.485 | 0.07209 | 1.23 | 1.525 | 1.61 | 0.1534 | 0.98 | 0.61 | 988 | 49 | 920 | 17 | 940 | 20 | 6.92 |
| 040-ZR32 | 0.0092 | 0.511 | 0.13506 | 0.45 | 7.178 | 0.97 | 0.3854 | 0.77 | 0.80 | 2165 | 16 | 2102 | 28 | 2134 | 17 | 2.92 |
| 041-ZR33 | 0.0106 | 0.438 | 0.13335 | 0.50 | 6.890 | 0.98 | 0.3747 | 0.75 | 0.77 | 2143 | 18 | 2051 | 26 | 2097 | 17 | 4.25 |
| 042-ZR34 | 0.0212 | 0.448 | 0.13656 | 0.64 | 6.856 | 1.11 | 0.3641 | 0.84 | 0.75 | 2184 | 22 | 2002 | 29 | 2093 | 20 | 8.35 |
| 045-ZR37 | 0.0063 | 0.466 | 0.13822 | 0.54 | 7.568 | 1.19 | 0.3971 | 1.00 | 0.84 | 2205 | 19 | 2156 | 37 | 2181 | 21 | 2.24 |
| 046-ZR38 | 0.0155 | 0.411 | 0.14398 | 0.64 | 7.944 | 1.09 | 0.4001 | 0.80 | 0.74 | 2276 | 22 | 2170 | 29 | 2225 | 20 | 4.66 |
| 047-ZR39 | 0.0099 | 0.434 | 0.13034 | 0.69 | 6.586 | 1.06 | 0.3665 | 0.72 | 0.68 | 2102 | 24 | 2013 | 25 | 2057 | 19 | 4.27 |
| 048-ZR40 | 0.0078 | 0.609 | 0.13230 | 0.69 | 6.914 | 1.04 | 0.3790 | 0.69 | 0.66 | 2129 | 24 | 2072 | 24 | 2100 | 18 | 2.69 |
| 053-ZR41 | 0.0072 | 0.692 | 0.13231 | 0.55 | 6.580 | 0.98 | 0.3607 | 0.72 | 0.74 | 2129 | 19 | 1985 | 25 | 2057 | 17 | 6.74 |
| 056-ZR44 | 0.0118 | 0.159 | 0.13372 | 0.58 | 6.436 | 0.99 | 0.3491 | 0.72 | 0.72 | 2147 | 20 | 1930 | 24 | 2037 | 17 | 10.12 |
| 057-ZR45 | 0.0043 | 0.308 | 0.17280 | 1.00 | 11.505 | 1.23 | 0.4829 | 0.62 | 0.50 | 2585 | 33 | 2540 | 26 | 2565 | 23 | 1.75 |
| 058-ZR46 | 0.0020 | 0.382 | 0.18340 | 0.82 | 13.280 | 1.15 | 0.5251 | 0.72 | 0.63 | 2684 | 27 | 2721 | 32 | 2700 | 22 | -1.38 |
| 060-ZR48 | 0.0207 | 0.237 | 0.13836 | 0.97 | 7.386 | 1.73 | 0.3872 | 1.39 | 0.80 | 2207 | 33 | 2110 | 50 | 2159 | 31 | 4.40 |
| 061-ZR49 | 0.0369 | 0.499 | 0.13280 | 1.05 | 6.902 | 1.46 | 0.3769 | 0.94 | 0.64 | 2135 | 37 | 2062 | 33 | 2099 | 26 | 3.44 |
| 062-ZR50 | 0.0089 | 0.384 | 0.14118 | 1.05 | 7.441 | 1.75 | 0.3823 | 1.35 | 0.77 | 2242 | 36 | 2087 | 48 | 2166 | 31 | 6.91 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 066-ZR52 | 0.0016 | 0.500 | 0.13440 | 0.58 | 7.305 | 1.02 | 0.3941 | 0.75 | 0.74 | 2156 | 20 | 2142 | 27 | 2149 | 18 | 0.66 |
| 067-ZR53 | 0.0091 | 0.663 | 0.12013 | 1.14 | 5.427 | 1.73 | 0.3276 | 1.24 | 0.72 | 1958 | 40 | 1827 | 39 | 1889 | 29 | 6.71 |
| 069-ZR55 | 0.0031 | 0.399 | 0.12440 | 0.59 | 6.572 | 1.17 | 0.3831 | 0.95 | 0.81 | 2020 | 21 | 2091 | 34 | 2056 | 21 | -3.50 |

| **Identifier** | **206* (%)** | **Th/U** | **$^{207}Pb/^{206}Pb$** | **1σ %** | **$^{207}Pb/^{235}U$** | **1σ %** | **$^{206}Pb/^{238}U$** | **1σ %** | **Rho** | **$^{207}Pb/^{206}Pb$** | **2σ abs** | **$^{206}Pb/^{238}U$** | **2σ abs** | **$^{207}Pb/^{235}U$** | **2σ abs** | **% U-Pb disc$^{5}$** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 070-ZR56 | 0.0465 | 0.527 | 0.13142 | 1.34 | 6.278 | 1.80 | 0.3464 | 1.15 | 0.64 | 2117 | 46 | 1917 | 38 | 2015 | 31 | 9.43 |
| 071-ZR57 | 0.0149 | 0.447 | 0.13006 | 0.91 | 7.009 | 1.37 | 0.3908 | 0.96 | 0.70 | 2099 | 32 | 2127 | 35 | 2113 | 24 | -1.34 |
| 072-ZR58 | 0.0139 | 0.207 | 0.13661 | 0.78 | 7.738 | 1.33 | 0.4108 | 1.02 | 0.76 | 2185 | 27 | 2219 | 38 | 2201 | 24 | -1.55 |
| 073-ZR59 | 0.0007 | 0.237 | 0.13604 | 0.66 | 7.711 | 1.35 | 0.4111 | 1.12 | 0.83 | 2177 | 23 | 2220 | 42 | 2198 | 24 | -1.95 |
| 074-ZR60 | 0.0126 | 0.418 | 0.13989 | 0.76 | 8.510 | 1.62 | 0.4412 | 1.38 | 0.85 | 2226 | 26 | 2356 | 54 | 2287 | 29 | -5.84 |
| 077-ZR61 | 0.0033 | 0.131 | 0.12583 | 0.50 | 6.640 | 0.85 | 0.3827 | 0.58 | 0.68 | 2041 | 18 | 2089 | 21 | 2065 | 15 | -2.37 |
| 078-ZR62 | 0.0051 | 0.410 | 0.12732 | 0.48 | 6.677 | 0.83 | 0.3803 | 0.56 | 0.68 | 2061 | 17 | 2078 | 20 | 2070 | 15 | -0.80 |
| 079-ZR63 | 0.0112 | 0.422 | 0.11809 | 0.59 | 5.615 | 1.06 | 0.3449 | 0.80 | 0.76 | 1927 | 21 | 1910 | 27 | 1918 | 18 | 0.91 |
| 080-ZR64 | 0.0033 | 0.329 | 0.13329 | 0.60 | 7.096 | 0.99 | 0.3861 | 0.70 | 0.70 | 2142 | 21 | 2104 | 25 | 2123 | 18 | 1.74 |
| 081-ZR65 | 0.0098 | 0.418 | 0.12194 | 0.47 | 6.123 | 1.09 | 0.3642 | 0.92 | 0.84 | 1985 | 17 | 2002 | 32 | 1994 | 19 | -0.86 |
| 082-ZR66 | 0.0097 | 0.717 | 0.12388 | 0.53 | 6.295 | 0.91 | 0.3685 | 0.65 | 0.71 | 2013 | 19 | 2022 | 22 | 2018 | 16 | -0.47 |
| 083-ZR67 | 0.0044 | 0.397 | 0.11776 | 0.54 | 5.526 | 1.18 | 0.3403 | 0.98 | 0.83 | 1923 | 19 | 1888 | 32 | 1905 | 20 | 1.79 |
| 084-ZR68 | 0.0156 | 0.658 | 0.13022 | 0.65 | 6.957 | 1.14 | 0.3874 | 0.87 | 0.76 | 2101 | 23 | 2111 | 31 | 2106 | 20 | -0.47 |
| 085-ZR69 | 0.0145 | 0.329 | 0.13116 | 0.67 | 6.345 | 1.09 | 0.3508 | 0.77 | 0.71 | 2114 | 23 | 1939 | 26 | 2025 | 19 | 8.27 |
| 090-ZR72 | 0.0122 | 0.390 | 0.13070 | 0.55 | 7.169 | 0.95 | 0.3978 | 0.68 | 0.72 | 2107 | 19 | 2159 | 25 | 2133 | 17 | -2.44 |
| 091-ZR73 | 0.0113 | 0.525 | 0.10771 | 0.54 | 4.757 | 1.06 | 0.3203 | 0.83 | 0.78 | 1761 | 20 | 1791 | 26 | 1777 | 18 | -1.71 |
| 092-ZR74 | 0.0186 | 0.275 | 0.13652 | 0.60 | 7.563 | 1.10 | 0.4017 | 0.85 | 0.77 | 2184 | 21 | 2177 | 31 | 2180 | 20 | 0.30 |
| 094-ZR76 | 0.0554 | 0.793 | 0.06146 | 1.23 | 0.884 | 1.75 | 0.1043 | 1.20 | 0.68 | 655 | 52 | 639 | 15 | 643 | 17 | 2.46 |
| 096-ZR78 | 0.0175 | 0.537 | 0.13153 | 0.54 | 6.503 | 1.18 | 0.3585 | 0.99 | 0.83 | 2118 | 19 | 1975 | 34 | 2046 | 21 | 6.76 |
| 097-ZR79 | 0.0046 | 0.171 | 0.12346 | 0.51 | 6.013 | 1.15 | 0.3532 | 0.96 | 0.84 | 2007 | 18 | 1950 | 32 | 1978 | 20 | 2.83 |
| 098-ZR80 | 0.0212 | 0.728 | 0.12846 | 0.61 | 6.261 | 1.13 | 0.3535 | 0.87 | 0.77 | 2077 | 21 | 1951 | 29 | 2013 | 20 | 6.06 |

Dados não utilizados no histograma de frequencia pelo elevado grau de discordância

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 008-ZR6 | 0.0048 | 0.811 | 0.13240 | 0.35 | 5.859 | 0.86 | 0.3209 | 0.69 | 0.81 | 2130 | 12 | 1794 | 22 | 1955 | 15 | 15.76 |
| 011-ZR9 | 0.0004 | 0.440 | 0.21368 | 1.79 | 14.339 | 2.12 | 0.4867 | 1.08 | 0.51 | 2934 | 57 | 2556 | 45 | 2772 | 40 | 12.86 |
| 023-ZR19 | 0.0124 | 0.397 | 0.13312 | 0.82 | 6.169 | 1.27 | 0.3361 | 0.89 | 0.70 | 2139 | 29 | 1868 | 29 | 2000 | 22 | 12.69 |
| 024-ZR20 | 0.0102 | 0.372 | 0.11793 | 0.75 | 4.910 | 1.12 | 0.3019 | 0.75 | 0.67 | 1925 | 27 | 1701 | 22 | 1804 | 19 | 11.64 |
| 027-ZR21 | 0.1922 | 0.156 | 0.13390 | 0.64 | 6.071 | 1.21 | 0.3288 | 0.96 | 0.79 | 2150 | 22 | 1833 | 31 | 1986 | 21 | 14.76 |
| 030-ZR24 | 0.0107 | 0.407 | 0.13416 | 0.72 | 6.000 | 1.19 | 0.3243 | 0.87 | 0.73 | 2153 | 25 | 1811 | 27 | 1976 | 21 | 15.89 |
| 033-ZR27 | 0.7314 | 0.514 | 0.14778 | 0.67 | 5.762 | 1.74 | 0.2828 | 1.56 | 0.90 | 2320 | 23 | 1605 | 44 | 1941 | 30 | 30.81 |
| 036-ZR30 | 0.0027 | 0.410 | 0.18764 | 0.68 | 11.581 | 1.18 | 0.4476 | 0.90 | 0.76 | 2722 | 22 | 2385 | 36 | 2571 | 22 | 12.38 |
| 043-ZR35 | 0.0247 | 0.299 | 0.13301 | 0.97 | 5.703 | 1.44 | 0.3110 | 1.00 | 0.69 | 2138 | 34 | 1745 | 30 | 1932 | 25 | 18.37 |
| 044-ZR36 | 0.0420 | 0.647 | 0.06169 | 1.42 | 0.673 | 1.83 | 0.0791 | 1.08 | 0.59 | 663 | 60 | 491 | 10 | 522 | 15 | 26.03 |
| 054-ZR42 | 0.0015 | 0.884 | 0.17245 | 1.29 | 9.715 | 1.83 | 0.4086 | 1.25 | 0.68 | 2582 | 43 | 2208 | 47 | 2408 | 33 | 14.45 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 059-ZR47 | 0.1931 | 0.395 | 0.10110 | 1.47 | 2.215 | 2.13 | 0.1589 | 1.50 | 0.70 | 1644 | 54 | 951 | 26 | 1186 | 30 | 42.18 |
| 065-ZR51 | 0.2339 | 0.551 | 0.12792 | 0.73 | 4.717 | 1.44 | 0.2674 | 1.18 | 0.82 | 2070 | 26 | 1528 | 32 | 1770 | 24 | 26.18 |
| 068-ZR54 | 0.0310 | 0.407 | 0.10914 | 0.63 | 3.874 | 1.00 | 0.2574 | 0.69 | 0.69 | 1785 | 23 | 1477 | 18 | 1608 | 16 | 17.28 |
| 095-ZR77 | 0.0101 | 0.608 | 0.12528 | 0.41 | 5.465 | 1.01 | 0.3163 | 0.85 | 0.84 | 2033 | 14 | 1772 | 26 | 1895 | 17 | 12.84 |
| **Identifier** | **206* (%)** | **Th/U** | **$^{207}$Pb/$^{206}$Pb** | **1σ %** | **$^{207}$Pb/$^{235}$U** | **1σ %** | **$^{206}$Pb/$^{238}$U** | **1σ %** | **Rho** | **$^{207}$Pb/$^{206}$Pb** | **2σ abs** | **$^{206}$Pb/$^{238}$U** | **2σ abs** | **$^{207}$Pb/$^{235}$U** | **2σ abs** | **% U-Pb disc$^{5}$** |
| Dados descartados pelo elevado erro analítico | | | | | | | | | | | | | | | | |
| 004-ZR2 | 0.0330 | 0.343 | 0.11820 | 2.23 | 3.858 | 6.27 | 0.2367 | 5.84 | 0.93 | 1929 | 79 | 1370 | 143 | 1605 | 99 | 29.01 |
| 005-ZR3 | 0.1136 | 0.648 | 0.14160 | 3.98 | 6.527 | 4.06 | 0.3343 | 0.70 | 0.17 | 2247 | 135 | 1859 | 23 | 2050 | 70 | 17.26 |
| 007-ZR5 | 0.0034 | 0.234 | 0.12621 | 1.76 | 5.989 | 1.88 | 0.3441 | 0.57 | 0.30 | 2046 | 61 | 1907 | 19 | 1974 | 33 | 6.81 |
| 019-ZR15 | 0.2895 | 0.586 | 0.12288 | 0.99 | 3.909 | 4.92 | 0.2307 | 4.80 | 0.98 | 1998 | 35 | 1338 | 116 | 1616 | 78 | 33.04 |
| 039-ZR31 | 0.0186 | 0.326 | 0.12777 | 0.74 | 4.613 | 2.21 | 0.2618 | 2.05 | 0.93 | 2067 | 26 | 1499 | 55 | 1752 | 37 | 27.49 |
| 055-ZR43 | 0.0077 | 0.800 | 0.11765 | 0.77 | 3.263 | 2.22 | 0.2011 | 2.05 | 0.92 | 1921 | 28 | 1181 | 44 | 1472 | 34 | 38.49 |
| 086-ZR70 | 0.0661 | 0.463 | 0.12839 | 1.08 | 5.389 | 6.70 | 0.3044 | 6.60 | 0.99 | 2076 | 38 | 1713 | 197 | 1883 | 112 | 17.48 |
| 089-ZR71 | 0.1251 | 0.400 | 0.07094 | 12.09 | 0.695 | 16.07 | 0.0710 | 10.58 | 0.66 | 956 | 459 | 442 | 90 | 536 | 130 | 53.73 |
| 093-ZR75 | 0.0253 | 0.834 | 0.13103 | 1.61 | 8.355 | 3.06 | 0.4624 | 2.57 | 0.84 | 2112 | 56 | 2450 | 105 | 2270 | 55 | -16.03 |

## MCR 02 09A

**Granodiorito**

| Identifier | 206* (%) | Th/U | $^{207}$Pb/$^{206}$Pb | $1\sigma$ % | $^{207}$Pb/$^{235}$U | $1\sigma$ % | $^{206}$Pb/$^{238}$U | $1\sigma$ % | Rho | $^{207}$Pb/$^{206}$Pb | $2\sigma$ abs | $^{206}$Pb/$^{238}$U | $2\sigma$ abs | $^{207}$Pb/$^{235}$U | $2\sigma$ abs | % U-Pb disc[5] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 004-ZR2N | 0.0043 | 0.207 | 0.13480 | 0.51 | 7.179 | 0.93 | 0.3862 | 0.69 | 0.74 | 2161 | 18 | 2105 | 25 | 2134 | 17 | 2.60 |
| 006-ZR3 | 0.5648 | 0.167 | 0.13094 | 0.97 | 6.074 | 1.44 | 0.3364 | 0.99 | 0.69 | 2111 | 34 | 1870 | 32 | 1987 | 25 | 11.42 |
| 007-ZR4N | 0.0127 | 0.440 | 0.13830 | 0.60 | 8.158 | 1.18 | 0.4278 | 0.94 | 0.80 | 2206 | 21 | 2296 | 36 | 2249 | 21 | -4.07 |
| 010-ZR6 | 0.0051 | 0.321 | 0.13549 | 0.47 | 7.351 | 0.83 | 0.3935 | 0.57 | 0.69 | 2170 | 16 | 2139 | 21 | 2155 | 15 | 1.45 |
| 013-ZR8B | 0.8981 | 0.137 | 0.11213 | 0.60 | 3.626 | 0.93 | 0.2345 | 0.60 | 0.65 | 1834 | 22 | 1358 | 15 | 1555 | 15 | 25.97 |
| 017-ZR10 | 0.0089 | 0.263 | 0.13607 | 0.67 | 7.210 | 1.10 | 0.3843 | 0.79 | 0.72 | 2178 | 23 | 2096 | 28 | 2138 | 20 | 3.74 |
| 018-ZR11 | 0.0184 | 0.041 | 0.13762 | 0.53 | 7.598 | 0.86 | 0.4004 | 0.56 | 0.66 | 2197 | 18 | 2171 | 21 | 2185 | 15 | 1.21 |
| 021-ZR14N | 0.0100 | 0.410 | 0.13660 | 0.51 | 7.342 | 1.01 | 0.3898 | 0.78 | 0.78 | 2185 | 18 | 2122 | 28 | 2154 | 18 | 2.87 |
| 022-ZR14B | 0.4350 | 0.110 | 0.12839 | 0.43 | 5.549 | 0.83 | 0.3134 | 0.61 | 0.73 | 2076 | 15 | 1757 | 19 | 1908 | 14 | 15.35 |
| 023-ZR15 | 0.0053 | 0.345 | 0.13478 | 0.50 | 7.072 | 0.97 | 0.3805 | 0.75 | 0.77 | 2161 | 17 | 2079 | 27 | 2120 | 17 | 3.81 |
| 025-ZR17 | 0.3575 | 0.032 | 0.13532 | 0.65 | 7.071 | 0.93 | 0.3790 | 0.56 | 0.60 | 2168 | 22 | 2071 | 20 | 2120 | 16 | 4.46 |
| 029-ZR19 | 0.0103 | 0.552 | 0.13551 | 0.61 | 7.253 | 1.02 | 0.3882 | 0.73 | 0.72 | 2171 | 21 | 2114 | 26 | 2143 | 18 | 2.59 |
| 038-ZR28 | 0.0246 | 0.208 | 0.13761 | 0.87 | 7.607 | 1.27 | 0.4009 | 0.84 | 0.66 | 2197 | 30 | 2173 | 31 | 2186 | 23 | 1.10 |
| 042-ZR30 | 0.1433 | 0.302 | 0.13686 | 0.64 | 7.559 | 1.02 | 0.4006 | 0.71 | 0.69 | 2188 | 22 | 2172 | 26 | 2180 | 18 | 0.74 |
| 043-ZR31 | 0.0186 | 0.301 | 0.13559 | 0.59 | 6.992 | 1.42 | 0.3740 | 1.23 | 0.87 | 2172 | 21 | 2048 | 43 | 2110 | 25 | 5.69 |
| 044-ZR32 | 0.0116 | 0.375 | 0.13536 | 0.54 | 7.228 | 0.95 | 0.3872 | 0.68 | 0.72 | 2169 | 19 | 2110 | 25 | 2140 | 17 | 2.71 |
| 048-ZR35 | 0.0067 | 0.483 | 0.13841 | 0.57 | 7.958 | 0.96 | 0.4169 | 0.67 | 0.70 | 2207 | 20 | 2247 | 25 | 2226 | 17 | -1.77 |
| 049-ZR36 | 0.0044 | 0.571 | 0.13413 | 0.61 | 6.784 | 1.11 | 0.3668 | 0.85 | 0.76 | 2153 | 21 | 2014 | 29 | 2084 | 20 | 6.43 |
| Dados não utilizados no cálculo da idade | | | | | | | | | | | | | | | | |
| 003-ZR1 | 0.3088 | 0.297 | 0.14092 | 0.54 | 7.438 | 0.92 | 0.3828 | 0.64 | 0.70 | 2239 | 19 | 2089 | 23 | 2166 | 16 | 6.66 |
| 005-ZR2B | 0.0527 | 0.123 | 0.12695 | 0.99 | 4.596 | 1.72 | 0.2626 | 1.36 | 0.79 | 2056 | 35 | 1503 | 36 | 1749 | 29 | 26.90 |
| 008-ZR4B | 0.0020 | 0.023 | 0.13536 | 1.16 | 7.033 | 1.37 | 0.3768 | 0.63 | 0.46 | 2169 | 40 | 2061 | 22 | 2116 | 24 | 4.94 |
| 019-ZR12 | 0.7079 | 0.180 | 0.14093 | 0.61 | 7.721 | 1.09 | 0.3973 | 0.82 | 0.75 | 2239 | 21 | 2157 | 30 | 2199 | 19 | 3.66 |
| 020-ZR13 | 0.0191 | 0.337 | 0.13780 | 0.86 | 7.255 | 1.33 | 0.3818 | 0.93 | 0.70 | 2200 | 30 | 2085 | 33 | 2143 | 24 | 5.23 |
| 026-ZR18 | 0.0281 | 0.429 | 0.13893 | 0.78 | 7.082 | 1.34 | 0.3697 | 1.03 | 0.77 | 2214 | 27 | 2028 | 36 | 2122 | 24 | 8.40 |
| 035-ZR25 | 0.0041 | 0.042 | 0.13503 | 0.46 | 7.682 | 0.83 | 0.4126 | 0.58 | 0.70 | 2164 | 16 | 2227 | 22 | 2195 | 15 | -2.88 |
| 045-ZR33 | 1.5415 | 0.126 | 0.12506 | 2.35 | 4.765 | 2.59 | 0.2763 | 1.02 | 0.39 | 2030 | 82 | 1573 | 29 | 1779 | 43 | 22.51 |
| 047-ZR34B | 0.0050 | 0.096 | 0.13234 | 0.49 | 6.916 | 0.94 | 0.3790 | 0.71 | 0.76 | 2129 | 17 | 2072 | 25 | 2101 | 17 | 2.71 |
| 050-ZR37 | 0.7959 | 0.293 | 0.12659 | 1.13 | 4.352 | 1.63 | 0.2493 | 1.12 | 0.69 | 2051 | 40 | 1435 | 29 | 1703 | 27 | 30.04 |
| Dados mais antigos ou discordantes | | | | | | | | | | | | | | | | |
| 012-ZR8N | 0.0075 | 0.386 | 0.15215 | 0.68 | 9.587 | 1.11 | 0.4569 | 0.80 | 0.72 | 2370 | 23 | 2426 | 32 | 2396 | 20 | -2.35 |
| 016-ZR9 | 0.9683 | 0.400 | 0.14479 | 0.58 | 8.050 | 0.97 | 0.4032 | 0.68 | 0.70 | 2285 | 20 | 2184 | 25 | 2237 | 17 | 4.44 |
| 024-ZR16 | 0.0472 | 0.375 | 0.14586 | 0.92 | 6.956 | 1.38 | 0.3458 | 0.97 | 0.70 | 2298 | 31 | 1915 | 32 | 2106 | 24 | 16.68 |
| 031-ZR21 | 0.0039 | 0.413 | 0.14458 | 0.53 | 8.971 | 1.06 | 0.4500 | 0.85 | 0.80 | 2283 | 18 | 2395 | 34 | 2335 | 19 | -4.92 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 032-ZR22 | 0.0713 | 0.609 | 0.14846 | 0.68 | 6.914 | 1.28 | 0.3377 | 1.02 | 0.79 | 2328 | 23 | 1876 | 33 | 2100 | 23 | 19.43 |
| 033-ZR23 | 0.0160 | 0.284 | 0.14908 | 0.45 | 8.668 | 0.96 | 0.4217 | 0.77 | 0.80 | 2335 | 15 | 2268 | 29 | 2304 | 17 | 2.88 |
| 034-ZR24 | 0.0050 | 0.466 | 0.14660 | 0.41 | 8.857 | 0.85 | 0.4381 | 0.65 | 0.76 | 2307 | 14 | 2342 | 26 | 2323 | 15 | -1.55 |
| 036-ZR26 | 0.0062 | 0.389 | 0.18613 | 0.61 | 13.142 | 0.96 | 0.5120 | 0.65 | 0.67 | 2708 | 20 | 2665 | 28 | 2690 | 18 | 1.59 |
| **Identifier** | **206* (%)** | **Th/U** | **$^{207}Pb/^{206}Pb$** | **1σ %** | **$^{207}Pb/^{235}U$** | **1σ %** | **$^{206}Pb/^{238}U$** | **1σ %** | **Rho** | **$^{207}Pb/^{206}Pb$** | **2σ abs** | **$^{206}Pb/^{238}U$** | **2σ abs** | **$^{207}Pb/^{235}U$** | **2σ abs** | **% U-Pb disc[5]** |
| 037-ZR27 | 0.0118 | 0.569 | 0.14344 | 0.68 | 8.274 | 1.05 | 0.4183 | 0.70 | 0.67 | 2269 | 23 | 2253 | 27 | 2261 | 19 | 0.71 |
| 046-ZR34N | 0.0592 | 0.364 | 0.14877 | 0.52 | 8.597 | 0.90 | 0.4190 | 0.63 | 0.70 | 2332 | 18 | 2256 | 24 | 2296 | 16 | 3.25 |
| Dados descartados pelo elevado erro analítico | | | | | | | | | | | | | | | | |
| 009-ZR5 | 0.0719 | 0.304 | 0.12092 | 5.57 | 6.016 | 5.67 | 0.3608 | 1.00 | 0.18 | 1970 | 192 | 1986 | 34 | 1978 | 96 | -0.83 |
| 030-ZR20 | 0.1248 | 0.256 | 0.13647 | 4.12 | 6.827 | 4.78 | 0.3628 | 2.40 | 0.50 | 2183 | 140 | 1995 | 82 | 2089 | 83 | 8.59 |
| 041-ZR29 | 0.0271 | 0.093 | 0.13417 | 0.74 | 6.322 | 3.59 | 0.3417 | 3.49 | 0.97 | 2153 | 26 | 1895 | 114 | 2022 | 62 | 12.00 |
| Dados descartados pelo elevado 204Pb | | | | | | | | | | | | | | | | |
| 011-ZR7 | 9.4526 | 0.165 | 0.22322 | 4.97 | 9.955 | 5.13 | 0.3234 | 1.23 | 0.24 | 3004 | 155 | 1806 | 39 | 2431 | 93 | 39.87 |

## MCR 02 09B

**Dique-pegmatitico**

| Identifier | 206* (%) | Th/U | $^{207}$Pb/$^{206}$Pb | $1\sigma$ % | $^{207}$Pb/$^{235}$U | $1\sigma$ % | $^{206}$Pb/$^{238}$U | $1\sigma$ % | Rho | $^{207}$Pb/$^{206}$Pb | $2\sigma$ abs | $^{206}$Pb/$^{238}$U | $2\sigma$ abs | $^{207}$Pb/$^{235}$U | $2\sigma$ abs | % U-Pb disc[5] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 009-ZR7N | 0.0115 | 0.327 | 0.13415 | 0.69 | 7.379 | 1.03 | 0.3989 | 0.67 | 0.65 | 2153 | 24 | 2164 | 25 | 2158 | 18 | -0.52 |
| 010-ZR7B | 0.0109 | 0.268 | 0.13448 | 0.55 | 7.195 | 0.91 | 0.3880 | 0.62 | 0.68 | 2157 | 19 | 2114 | 22 | 2136 | 16 | 2.03 |
| 011-ZR8 | 0.0064 | 0.189 | 0.13328 | 0.56 | 6.866 | 0.91 | 0.3736 | 0.62 | 0.68 | 2142 | 19 | 2046 | 22 | 2094 | 16 | 4.45 |
| 012-ZR9N | 0.0459 | 0.550 | 0.13278 | 0.64 | 6.600 | 1.12 | 0.3605 | 0.84 | 0.75 | 2135 | 22 | 1985 | 29 | 2059 | 20 | 7.05 |
| 026-ZR20 | 1.7174 | 0.259 | 0.10166 | 1.09 | 2.240 | 1.54 | 0.1598 | 1.03 | 0.67 | 1655 | 40 | 956 | 18 | 1194 | 22 | 42.25 |
| 033-ZR25 | 0.4351 | 0.237 | 0.12572 | 0.43 | 4.778 | 0.97 | 0.2757 | 0.78 | 0.81 | 2039 | 15 | 1569 | 22 | 1781 | 16 | 23.03 |
| Dados não utilizados no cálculo da idade | | | | | | | | | | | | | | | | |
| 004-ZR2 | 1.7748 | 0.291 | 0.10470 | 1.77 | 2.974 | 1.99 | 0.2060 | 0.83 | 0.42 | 1709 | 64 | 1208 | 18 | 1401 | 30 | 29.34 |
| 013-ZR9B | 0.2713 | 0.102 | 0.12728 | 0.76 | 2.744 | 1.57 | 0.1564 | 1.31 | 0.84 | 2061 | 27 | 936 | 23 | 1340 | 23 | 54.56 |
| 016-ZR10 | 0.0062 | 0.343 | 0.13198 | 0.69 | 7.135 | 1.01 | 0.3921 | 0.64 | 0.63 | 2124 | 24 | 2132 | 23 | 2128 | 18 | -0.37 |
| 017-ZR11 | 2.8783 | 0.110 | 0.13182 | 1.81 | 2.377 | 2.22 | 0.1308 | 1.22 | 0.55 | 2122 | 63 | 792 | 18 | 1236 | 31 | 62.67 |
| 023-ZR17 | 1.0816 | 0.027 | 0.11244 | 1.21 | 3.723 | 2.70 | 0.2401 | 2.38 | 0.88 | 1839 | 43 | 1387 | 59 | 1576 | 43 | 24.58 |
| 024-ZR18 | 2.1340 | 0.776 | 0.12596 | 0.67 | 3.810 | 0.98 | 0.2194 | 0.61 | 0.62 | 2042 | 23 | 1279 | 14 | 1595 | 16 | 37.39 |
| 031-ZR23 | 1.9013 | 0.022 | 0.10901 | 0.92 | 2.494 | 1.90 | 0.1659 | 1.61 | 0.85 | 1783 | 34 | 990 | 30 | 1270 | 27 | 44.50 |
| 039-ZR31 | 0.3301 | 0.259 | 0.11581 | 0.84 | 3.762 | 2.17 | 0.2356 | 1.97 | 0.91 | 1893 | 30 | 1364 | 48 | 1585 | 35 | 27.95 |
| Dados descartados pelo elevado 204Pb | | | | | | | | | | | | | | | | |
| 003-ZR1 | 7.0338 | 0.112 | 0.08432 | 6.74 | 1.265 | 6.90 | 0.1088 | 1.46 | 0.21 | 1300 | 251 | 666 | 19 | 830 | 77 | 48.78 |
| 005-ZR3 | 3.3179 | 0.349 | 0.09946 | 1.52 | 1.186 | 2.11 | 0.0864 | 1.41 | 0.67 | 1614 | 56 | 534 | 14 | 794 | 23 | 66.89 |
| 006-ZR4 | 22.9141 | 3.093 | 0.29426 | 1.87 | 5.396 | 2.07 | 0.1330 | 0.80 | 0.38 | 3440 | 58 | 805 | 12 | 1884 | 35 | 76.61 |
| 007-ZR5 | 7.3161 | 1.517 | 0.13659 | 8.71 | 3.354 | 9.00 | 0.1781 | 2.20 | 0.24 | 2184 | 288 | 1056 | 43 | 1494 | 136 | 51.64 |
| 008-ZR6 | 7.7938 | 0.795 | 0.13962 | 2.36 | 3.437 | 3.82 | 0.1785 | 2.98 | 0.78 | 2223 | 81 | 1059 | 58 | 1513 | 59 | 52.36 |
| 018-ZR12 | 18.3055 | 0.356 | 0.27253 | 11.23 | 5.280 | 12.72 | 0.1405 | 5.96 | 0.47 | 3321 | 331 | 847 | 94 | 1866 | 206 | 74.48 |
| 019-ZR13 | 3.1552 | 0.717 | 0.12166 | 2.45 | 2.770 | 4.05 | 0.1651 | 3.20 | 0.79 | 1981 | 86 | 985 | 58 | 1348 | 60 | 50.26 |
| 020-ZR14 | 3.7925 | 0.314 | 0.10913 | 7.98 | 4.168 | 8.56 | 0.2770 | 3.05 | 0.36 | 1785 | 278 | 1576 | 85 | 1668 | 136 | 11.70 |
| 021-ZR15 | 13.5022 | 2.706 | 0.21586 | 5.21 | 5.279 | 5.28 | 0.1773 | 0.83 | 0.16 | 2950 | 163 | 1052 | 16 | 1865 | 88 | 64.33 |
| 022-ZR16 | 9.8010 | 3.231 | 0.15034 | 2.22 | 2.283 | 3.63 | 0.1101 | 2.85 | 0.78 | 2350 | 75 | 674 | 36 | 1207 | 51 | 71.33 |
| 025-ZR19 | 7.2811 | 1.378 | 0.16437 | 2.43 | 5.994 | 2.62 | 0.2644 | 0.92 | 0.35 | 2501 | 81 | 1513 | 25 | 1975 | 45 | 39.53 |
| 029-ZR21 | 3.4746 | 0.012 | 0.05154 | 22.55 | 1.288 | 22.68 | 0.1812 | 2.39 | 0.11 | 265 | 897 | 1074 | 47 | 840 | 244 | -305.07 |
| 030-ZR22 | 31.1746 | 0.662 | 0.44864 | 4.72 | 8.698 | 5.12 | 0.1406 | 1.96 | 0.38 | 4081 | 137 | 848 | 31 | 2307 | 91 | 79.22 |
| 032-ZR24 | 24.8803 | 0.724 | 0.35517 | 1.74 | 2.588 | 2.66 | 0.0528 | 1.98 | 0.74 | 3729 | 53 | 332 | 13 | 1297 | 39 | 91.10 |
| 034-ZR26 | 13.6459 | 0.304 | 0.18351 | 2.75 | 4.783 | 3.05 | 0.1890 | 1.27 | 0.42 | 2685 | 90 | 1116 | 26 | 1782 | 51 | 58.43 |
| 035-ZR27 | 22.2603 | 2.184 | 0.28493 | 1.55 | 4.631 | 2.14 | 0.1179 | 1.43 | 0.67 | 3390 | 48 | 718 | 19 | 1755 | 35 | 78.81 |
| 036-ZR28 | 9.3919 | 0.888 | 0.17642 | 2.36 | 4.449 | 2.49 | 0.1829 | 0.69 | 0.28 | 2619 | 78 | 1083 | 14 | 1722 | 41 | 58.66 |
| 037-ZR29 | 4.7965 | 0.922 | 0.09918 | 1.26 | 0.832 | 1.64 | 0.0609 | 0.98 | 0.60 | 1609 | 46 | 381 | 7 | 615 | 15 | 76.33 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 038-ZR30 | 3.3649 | 0.163 | 0.12893 | 3.77 | 2.529 | 5.19 | 0.1423 | 3.55 | 0.68 | 2083 | 130 | 858 | 57 | 1281 | 74 | 58.84 |

## MCR 03 25

**Anfibolito**

| Identifier | 206* (%) | Th/U | $^{207}$Pb/$^{206}$Pb | 1σ % | $^{207}$Pb/$^{235}$U | 1σ % | $^{206}$Pb/$^{238}$U | 1σ % | Rho | $^{207}$Pb/$^{206}$Pb | 2σ abs | $^{206}$Pb/$^{238}$U | 2σ abs | $^{207}$Pb/$^{235}$U | 2σ abs | % U-Pb disc$^{5}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 006-ZR4 | 0.1278 | 0.942 | 0.06637 | 0.93 | 1.054 | 1.44 | 0.1152 | 1.03 | 0.72 | 818 | 39 | 703 | 14 | 731 | 15 | 14.11 |
| 009-ZR7 | 0.0158 | 0.189 | 0.07578 | 0.32 | 1.794 | 0.82 | 0.1717 | 0.65 | 0.80 | 1089 | 13 | 1021 | 12 | 1043 | 11 | 6.23 |
| 012-ZR10 | 0.0112 | 0.225 | 0.06529 | 0.84 | 1.011 | 1.48 | 0.1123 | 1.15 | 0.78 | 784 | 35 | 686 | 15 | 709 | 15 | 12.45 |
| 019-ZR15 | 0.0455 | 0.242 | 0.05976 | 0.64 | 0.804 | 1.77 | 0.0975 | 1.61 | 0.91 | 595 | 28 | 600 | 18 | 599 | 16 | -0.84 |
| 026-ZR22 | 0.0403 | 0.221 | 0.06279 | 0.87 | 0.903 | 1.15 | 0.1043 | 0.64 | 0.56 | 701 | 37 | 640 | 8 | 654 | 11 | 8.74 |
| 027-ZR23 | 0.0135 | 0.243 | 0.06728 | 0.51 | 1.160 | 1.30 | 0.1251 | 1.14 | 0.87 | 846 | 21 | 760 | 16 | 782 | 14 | 10.25 |
| Dados não utilizados no cálculo da idade | | | | | | | | | | | | | | | | |
| 005-ZR3 | 0.0221 | 0.805 | 0.06215 | 1.48 | 0.982 | 1.79 | 0.1146 | 0.93 | 0.52 | 679 | 63 | 699 | 12 | 695 | 18 | -2.97 |
| 011-ZR9 | 0.0058 | 0.139 | 0.06555 | 0.36 | 1.112 | 0.82 | 0.1230 | 0.63 | 0.77 | 792 | 15 | 748 | 9 | 759 | 9 | 5.55 |
| 016-ZR12 | 0.0104 | 0.597 | 0.07010 | 0.65 | 1.419 | 1.10 | 0.1469 | 0.81 | 0.74 | 931 | 26 | 883 | 13 | 897 | 13 | 5.13 |
| 018-ZR14 | 0.5123 | 0.071 | 0.06733 | 1.38 | 1.002 | 2.09 | 0.1079 | 1.52 | 0.73 | 848 | 57 | 661 | 19 | 705 | 21 | 22.12 |
| 025-ZR21 | 0.0089 | 0.724 | 0.06109 | 1.05 | 0.734 | 2.04 | 0.0872 | 1.72 | 0.84 | 643 | 45 | 539 | 18 | 559 | 18 | 16.16 |
| Dados mais antigos ou discordantes | | | | | | | | | | | | | | | | |
| 015-ZR11 | 0.0237 | 0.097 | 0.27048 | 1.92 | 20.450 | 2.48 | 0.5483 | 1.52 | 0.61 | 3309 | 60 | 2818 | 69 | 3113 | 47 | 14.83 |
| 022-ZR18 | 0.0088 | 1.008 | 0.08217 | 0.54 | 2.013 | 1.99 | 0.1776 | 1.88 | 0.94 | 1250 | 21 | 1054 | 36 | 1120 | 27 | 15.66 |
| Dados descartados pelo elevado erro analítico | | | | | | | | | | | | | | | | |
| 007-ZR5 | 0.4616 | 0.164 | 0.07827 | 5.27 | 1.141 | 5.40 | 0.1057 | 1.09 | 0.20 | 1154 | 203 | 648 | 13 | 773 | 58 | 43.87 |
| 008-ZR6 | 0.2129 | 0.115 | 0.07625 | 2.42 | 0.724 | 5.43 | 0.0688 | 4.85 | 0.89 | 1102 | 95 | 429 | 40 | 553 | 46 | 61.05 |
| 010-ZR8 | 0.0156 | 0.275 | 0.11953 | 1.03 | 3.218 | 2.43 | 0.1953 | 2.17 | 0.89 | 1949 | 37 | 1150 | 46 | 1462 | 37 | 41.01 |
| 020-ZR16 | 0.0383 | 0.527 | 0.07281 | 1.57 | 1.262 | 3.93 | 0.1257 | 3.58 | 0.91 | 1009 | 63 | 763 | 51 | 829 | 44 | 24.30 |
| 023-ZR19 | 0.4186 | 0.434 | 0.08432 | 3.71 | 2.068 | 4.15 | 0.1778 | 1.82 | 0.44 | 1300 | 141 | 1055 | 35 | 1138 | 56 | 18.84 |
| 024-ZR20 | 0.6204 | 0.563 | 0.07124 | 3.76 | 1.492 | 3.92 | 0.1519 | 1.03 | 0.26 | 964 | 150 | 911 | 17 | 927 | 47 | 5.49 |
| Dados descartados pelo elevado 204Pb | | | | | | | | | | | | | | | | |
| 003-ZR1 | 5.2594 | 1.275 | 0.31024 | 4.52 | 13.524 | 5.10 | 0.3161 | 2.33 | 0.46 | 3522 | 136 | 1771 | 72 | 2717 | 94 | 49.72 |
| 004-ZR2 | 2.6470 | 0.532 | 0.09027 | 3.23 | 0.996 | 5.34 | 0.0800 | 4.24 | 0.79 | 1431 | 121 | 496 | 40 | 702 | 53 | 65.32 |
| 017-ZR13 | 1.9922 | 0.389 | 0.08427 | 2.23 | 1.325 | 2.35 | 0.1140 | 0.66 | 0.28 | 1299 | 85 | 696 | 9 | 857 | 27 | 46.40 |
| 021-ZR17 | 6.2538 | 0.165 | 0.10368 | 5.28 | 1.461 | 5.35 | 0.1022 | 0.77 | 0.14 | 1691 | 189 | 627 | 9 | 914 | 64 | 62.91 |

## CORU01

**Biotita-granada xisto**

| Identifier | 206* (%) | Th/U | $^{207}$Pb/$^{206}$Pb | 1s % | $^{207}$Pb/$^{235}$U | 1s % | $^{206}$Pb/$^{238}$U | 1s % | Rho | $^{207}$Pb/$^{206}$Pb | 2s abs | $^{206}$Pb/$^{238}$U | 2s abs | $^{207}$Pb/$^{235}$U | 2s abs | % U-Pb disc[5] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 004-Z1 | 0.01 | 0.80 | 0.11742 | 0.7 | 5.9309 | 2.1 | 0.36632 | 2.0 | 0.94 | 1917.4 | 12.6 | 2012.1 | 33.8 | 1965.8 | 18.0 | -4.94 |
| 005-Z2 | 0.01 | 0.30 | 0.06201 | 0.5 | 0.9879 | 1.5 | 0.11554 | 1.4 | 0.93 | 674.6 | 11.3 | 704.8 | 9.3 | 697.7 | 7.5 | -4.49 |
| 006-Z3 | 0.26 | 0.26 | 0.07048 | 2.5 | 1.4541 | 3.0 | 0.14964 | 1.7 | 0.79 | 942.3 | 51.1 | 898.9 | 14.4 | 911.6 | 18.2 | 4.60 |
| 007-Z4 | 0.02 | 0.20 | 0.07225 | 0.6 | 1.7988 | 1.8 | 0.18058 | 1.7 | 0.94 | 992.9 | 12.9 | 1070.1 | 17.1 | 1045.0 | 12.0 | -7.78 |
| 008-Z5 | 0.09 | 0.20 | 0.06511 | 1.4 | 1.0173 | 2.5 | 0.11331 | 2.1 | 0.84 | 778.0 | 28.9 | 691.9 | 14.0 | 712.5 | 13.0 | 11.07 |
| 009-Z6 | 0.02 | 0.35 | 0.16269 | 0.6 | 9.8798 | 1.5 | 0.44043 | 1.4 | 0.92 | 2483.8 | 9.4 | 2352.6 | 26.8 | 2423.6 | 13.6 | 5.28 |
| 012-Z7 | 0.02 | 0.28 | 0.12617 | 0.9 | 6.0876 | 2.4 | 0.34994 | 2.2 | 0.92 | 2045.2 | 15.8 | 1934.3 | 36.7 | 1988.5 | 20.7 | 5.42 |
| 013-Z8 | 0.02 | 0.67 | 0.12984 | 0.7 | 6.9844 | 3.0 | 0.39015 | 2.9 | 0.97 | 2095.8 | 12.0 | 2123.5 | 52.3 | 2109.5 | 26.4 | -1.32 |
| 014-Z9 | 0.05 | 0.55 | 0.06118 | 1.6 | 0.9642 | 3.0 | 0.11430 | 2.6 | 0.84 | 645.6 | 35.1 | 697.6 | 16.9 | 685.4 | 15.1 | -8.06 |
| 015-Z10 | 0.07 | 0.32 | 0.06685 | 4.0 | 1.0327 | 5.0 | 0.11203 | 2.9 | 0.82 | 833.3 | 83.5 | 684.5 | 19.0 | 720.3 | 25.6 | 17.85 |
| 016-Z11 | 0.01 | 0.31 | 0.06635 | 0.8 | 1.2823 | 2.2 | 0.14016 | 2.0 | 0.93 | 817.5 | 16.3 | 845.6 | 16.2 | 837.9 | 12.5 | -3.43 |
| 017-Z12 | 0.01 | 0.22 | 0.06332 | 0.6 | 1.1041 | 3.4 | 0.12646 | 3.3 | 0.99 | 719.0 | 12.2 | 767.6 | 24.2 | 755.3 | 18.1 | -6.77 |
| 020-Z13 | 0.05 | 0.66 | 0.06046 | 1.4 | 0.9103 | 2.9 | 0.10921 | 2.6 | 0.87 | 620.0 | 30.6 | 668.1 | 16.2 | 657.2 | 14.1 | -7.77 |
| 021-Z14 | 0.06 | 0.19 | 0.06680 | 1.6 | 1.1466 | 2.8 | 0.12450 | 2.3 | 0.82 | 831.5 | 33.0 | 756.4 | 16.5 | 775.7 | 15.2 | 9.03 |
| 023-Z16 | 0.02 | 0.25 | 0.06097 | 1.4 | 0.9271 | 1.9 | 0.11029 | 1.3 | 0.83 | 638.1 | 31.1 | 674.4 | 8.2 | 666.1 | 9.4 | -5.69 |
| 024-Z17 | 0.01 | 0.10 | 0.06573 | 0.7 | 1.1504 | 1.8 | 0.12694 | 1.6 | 0.90 | 797.8 | 15.5 | 770.4 | 11.6 | 777.4 | 9.6 | 3.44 |
| 025-Z18 | 0.03 | 0.26 | 0.06498 | 0.8 | 1.1676 | 2.2 | 0.13032 | 2.1 | 0.93 | 773.6 | 17.6 | 789.7 | 15.4 | 785.5 | 12.2 | -2.08 |
| 029-Z20 | 0.00 | 0.35 | 0.16147 | 0.8 | 12.0273 | 2.8 | 0.54024 | 2.7 | 0.96 | 2471.1 | 13.5 | 2784.5 | 61.8 | 2606.5 | 26.7 | -12.68 |
| 030-Z21 | 0.12 | 0.31 | 0.13050 | 0.6 | 7.1883 | 2.3 | 0.39950 | 2.3 | 0.97 | 2104.7 | 10.7 | 2166.8 | 41.7 | 2135.1 | 20.9 | -2.95 |
| 031-Z22 | 0.04 | 0.33 | 0.06806 | 2.8 | 1.2963 | 4.2 | 0.13814 | 3.1 | 0.90 | 870.4 | 58.7 | 834.1 | 24.5 | 844.1 | 24.2 | 4.16 |
| 033-Z24 | 0.01 | 0.09 | 0.12130 | 1.0 | 6.1557 | 4.3 | 0.36805 | 4.2 | 0.97 | 1975.5 | 18.7 | 2020.2 | 72.7 | 1998.2 | 37.8 | -2.26 |
| 036-Z25 | 0.04 | 0.40 | 0.06198 | 0.9 | 0.8894 | 3.6 | 0.10407 | 3.5 | 0.97 | 673.3 | 18.8 | 638.2 | 21.0 | 646.0 | 17.1 | 5.21 |
| 037-Z26 | 0.07 | 0.62 | 0.06845 | 0.6 | 1.2545 | 2.5 | 0.13291 | 2.4 | 0.97 | 882.3 | 12.3 | 804.5 | 18.4 | 825.4 | 14.1 | 8.82 |
| 040-Z29 | 0.03 | 0.05 | 0.06692 | 0.8 | 1.1716 | 2.8 | 0.12697 | 2.7 | 0.96 | 835.3 | 15.8 | 770.6 | 19.7 | 787.4 | 15.4 | 7.75 |
| 041-Z30 | 0.03 | 0.33 | 0.12097 | 0.7 | 5.1167 | 2.4 | 0.30676 | 2.3 | 0.95 | 1970.6 | 13.3 | 1724.8 | 34.7 | 1838.9 | 20.5 | 12.48 |
| 044-Z31 | 0.00 | 0.55 | 0.12053 | 0.5 | 6.2460 | 1.8 | 0.37585 | 1.7 | 0.95 | 1964.0 | 9.7 | 2056.9 | 30.0 | 2010.9 | 15.6 | -4.73 |
| 045-Z32 | 0.01 | 0.37 | 0.07298 | 0.6 | 1.8330 | 2.3 | 0.18215 | 2.2 | 0.97 | 1013.5 | 11.7 | 1078.7 | 21.7 | 1057.4 | 14.8 | -6.43 |
| 047-Z34 | 0.06 | 0.44 | 0.06529 | 1.2 | 1.1549 | 2.0 | 0.12830 | 1.5 | 0.89 | 783.6 | 25.6 | 778.1 | 11.3 | 779.6 | 10.7 | 0.70 |
| 049-Z36 | 0.05 | 0.48 | 0.06452 | 1.5 | 1.0689 | 2.7 | 0.12015 | 2.2 | 0.82 | 758.9 | 32.3 | 731.4 | 15.1 | 738.2 | 14.0 | 3.62 |
| 052-Z37 | 0.04 | 0.23 | 0.06261 | 1.1 | 0.9621 | 1.8 | 0.11146 | 1.4 | 0.80 | 694.9 | 22.5 | 681.2 | 9.3 | 684.4 | 8.9 | 1.96 |
| 054-Z39 | 0.01 | 0.17 | 0.06413 | 0.6 | 1.1111 | 1.6 | 0.12566 | 1.5 | 0.94 | 746.0 | 11.7 | 763.0 | 10.9 | 758.7 | 8.6 | -2.29 |
| 055-Z41 | 0.02 | 0.23 | 0.06378 | 0.9 | 1.1277 | 2.4 | 0.12824 | 2.3 | 0.93 | 734.3 | 19.3 | 777.8 | 16.5 | 766.7 | 13.1 | -5.92 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 057-Z42 | 0.02 | 0.29 | 0.06260 | 1.2 | 0.9969 | 2.6 | 0.11550 | 2.3 | 0.88 | 694.5 | 25.1 | 704.6 | 15.1 | 702.2 | 12.9 | -1.45 |
| 060-Z43 | 0.09 | 0.05 | 0.06117 | 1.6 | 0.8109 | 4.5 | 0.09615 | 4.2 | 0.93 | 645.2 | 34.3 | 591.8 | 23.6 | 603.0 | 20.3 | 8.27 |
| 061-Z44 | 0.12 | 0.19 | 0.06404 | 2.6 | 1.0037 | 4.3 | 0.11368 | 3.4 | 0.79 | 742.9 | 55.5 | 694.1 | 22.4 | 705.7 | 21.9 | 6.57 |
| 068-Z49 | 0.54 | 0.11 | 0.06524 | 1.9 | 1.0264 | 3.0 | 0.11410 | 2.3 | 0.77 | 782.1 | 38.9 | 696.5 | 15.4 | 717.1 | 15.3 | 10.94 |
| 072-Z53 | 0.02 | 0.66 | 0.06440 | 0.8 | 1.2083 | 1.7 | 0.13608 | 1.5 | 0.88 | 754.8 | 16.9 | 822.5 | 11.7 | 804.4 | 9.5 | -8.97 |
| 073-Z54 | 0.00 | 0.23 | 0.06793 | 0.6 | 1.3688 | 1.4 | 0.14614 | 1.2 | 0.88 | 866.6 | 13.1 | 879.3 | 9.9 | 875.7 | 8.0 | -1.47 |
| **Dados não utilizados no histograma de frequencia pelo elevado grau de discordância** | | | | | | | | | | | | | | | | |
| 065-Z48 | 0.01 | 0.13 | 0.12520 | 0.6 | 8.3219 | 3.3 | 0.48208 | 3.3 | 0.98 | 2031.6 | 11.4 | 2536.3 | 68.8 | 2266.7 | 30.3 | -24.84 |
| 055-Z40 | 0.02 | 0.20 | 0.07117 | 2.0 | 2.0615 | 5.1 | 0.21007 | 4.7 | 0.97 | 962.3 | 40.0 | 1229.2 | 52.1 | 1136.1 | 34.6 | -27.74 |
| 074-Z55 | 0.06 | 0.49 | 0.06880 | 1.5 | 1.8398 | 5.8 | 0.19394 | 5.6 | 0.96 | 892.9 | 31.6 | 1142.7 | 58.8 | 1059.8 | 38.3 | -27.98 |
| 070-Z51 | 0.04 | 0.17 | 0.06498 | 1.5 | 1.5656 | 4.3 | 0.17474 | 4.1 | 0.94 | 773.8 | 31.8 | 1038.2 | 39.0 | 956.7 | 26.9 | -34.17 |
| 053-Z38 | 4.88 | 0.07 | 0.20386 | 3.6 | 4.7427 | 4.4 | 0.16873 | 2.6 | 0.58 | 2857.4 | 57.9 | 1005.1 | 24.0 | 1774.8 | 36.9 | 64.82 |
| 064-Z47 | 0.02 | 0.13 | 0.05766 | 7.1 | 1.2925 | 7.9 | 0.16257 | 3.6 | 0.45 | 517.0 | 155.1 | 971.1 | 32.1 | 842.4 | 45.3 | -87.82 |
| 032-Z23 | 0.11 | 0.50 | 0.16880 | 10.9 | 3.7620 | 11.7 | 0.16163 | 4.3 | 0.36 | 2545.8 | 183.3 | 965.9 | 38.2 | 1584.7 | 94.2 | 62.06 |
| 028-Z19 | 1.72 | 0.18 | 0.16119 | 18.6 | 3.2691 | 23.9 | 0.14709 | 15.1 | 0.63 | 2468.2 | 313.4 | 884.6 | 124.9 | 1473.7 | 186.1 | 64.16 |
| 046-Z33 | 0.28 | 0.42 | 0.08707 | 4.9 | 1.6562 | 5.3 | 0.13795 | 2.2 | 0.41 | 1362.1 | 93.9 | 833.1 | 17.1 | 991.9 | 33.8 | 38.84 |
| 038-Z27 | 0.28 | 0.22 | 0.07004 | 1.6 | 0.8780 | 5.9 | 0.09091 | 5.6 | 0.96 | 929.6 | 33.7 | 560.9 | 30.3 | 639.9 | 27.9 | 39.66 |
| 039-Z28 | 0.80 | 0.11 | 0.08291 | 5.3 | 0.7328 | 13.0 | 0.06410 | 11.8 | 0.97 | 1267.2 | 104.2 | 400.5 | 45.9 | 558.2 | 55.6 | 68.39 |
| 062-Z45 | 0.85 | 0.32 | 0.06486 | 1.6 | 1.3878 | 2.6 | 0.15519 | 2.0 | 0.78 | 769.6 | 33.1 | 930.0 | 17.4 | 883.8 | 15.0 | -20.84 |
| 063-Z46 | 0.01 | 0.18 | 0.06103 | 1.4 | 1.2284 | 3.4 | 0.14598 | 3.1 | 0.96 | 640.3 | 30.3 | 878.4 | 25.1 | 813.6 | 18.9 | -37.19 |
| 022-Z15 | 0.07 | 0.27 | 0.06642 | 0.8 | 0.8215 | 5.8 | 0.08970 | 5.8 | 0.99 | 819.7 | 17.0 | 553.8 | 30.7 | 608.9 | 26.7 | 32.45 |
| 048-Z35 | 0.03 | 0.46 | 0.06247 | 1.4 | 1.2763 | 2.3 | 0.14817 | 1.8 | 0.79 | 690.4 | 29.5 | 890.7 | 14.8 | 835.2 | 12.8 | -29.02 |
| **Dados descartados pelo elevado erro analítico** | | | | | | | | | | | | | | | | |
| 069-Z50 | 0.05 | 0.50 | 0.06510 | 0.8 | 1.0956 | 4.1 | 0.12205 | 4.0 | 0.98 | 777.7 | 15.8 | 742.4 | 28.2 | 751.2 | 21.7 | 4.55 |
| 071-Z52 | 0.01 | 1.25 | 0.06589 | 1.0 | 1.1608 | 1.8 | 0.12778 | 1.5 | 0.90 | 802.7 | 21.2 | 775.2 | 10.8 | 782.3 | 9.8 | 3.43 |

CORU02

**Quartizite**

| Identifier | 206* (%) | Th/U | $^{207}$Pb/$^{206}$Pb | 1s % | $^{207}$Pb/$^{235}$U | 1s % | $^{206}$Pb/$^{238}$U | 1s % | Rho | $^{207}$Pb/$^{206}$Pb | 2s abs | $^{206}$Pb/$^{238}$U | 2s abs | $^{207}$Pb/$^{235}$U | 2s abs | % U-Pb disc[5] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 004-Z1 | 0.14 | 0.44 | 0.14620 | 1.1 | 7.9227 | 3.0 | 0.39304 | 2.8 | 0.92 | 2301.9 | 19.5 | 2136.9 | 50.5 | 2222.3 | 27.0 | 7.17 |
| 007-Z4 | 0.04 | 0.54 | 0.12943 | 1.5 | 6.2716 | 3.0 | 0.35143 | 2.6 | 0.86 | 2090.3 | 27.1 | 1941.4 | 42.9 | 2014.5 | 26.2 | 7.12 |
| 008-Z5 | 0.04 | 0.23 | 0.13085 | 1.3 | 6.3763 | 2.6 | 0.35343 | 2.3 | 0.86 | 2109.3 | 23.2 | 1951.0 | 38.2 | 2029.0 | 23.1 | 7.51 |
| 009-Z6 | 0.04 | 0.37 | 0.12903 | 1.6 | 6.0083 | 3.2 | 0.33771 | 2.7 | 0.86 | 2084.8 | 28.7 | 1875.7 | 44.4 | 1977.0 | 27.7 | 10.03 |
| 011-Z7 | 0.01 | 0.36 | 0.13385 | 1.1 | 6.5161 | 2.5 | 0.35307 | 2.3 | 0.90 | 2149.1 | 18.7 | 1949.3 | 38.2 | 2048.1 | 22.1 | 9.30 |
| 012-Z8 | 0.01 | 0.24 | 0.12859 | 1.7 | 6.4678 | 3.3 | 0.36480 | 2.8 | 0.86 | 2078.8 | 29.1 | 2004.9 | 48.3 | 2041.5 | 28.6 | 3.55 |
| 014-Z10 | 0.05 | 0.52 | 0.12781 | 3.5 | 6.2553 | 4.7 | 0.35497 | 3.1 | 0.87 | 2068.0 | 61.1 | 1958.3 | 52.9 | 2012.2 | 40.9 | 5.31 |
| 015-Z11 | 0.05 | 0.62 | 0.13057 | 1.6 | 6.5188 | 3.2 | 0.36211 | 2.8 | 0.86 | 2105.6 | 28.8 | 1992.2 | 47.4 | 2048.4 | 28.3 | 5.39 |
| 019-Z13 | 0.04 | 0.25 | 0.12974 | 1.4 | 6.7881 | 2.8 | 0.37946 | 2.4 | 0.86 | 2094.5 | 25.2 | 2073.8 | 43.3 | 2084.2 | 25.1 | 0.99 |
| 020-Z14 | 0.02 | 0.27 | 0.12953 | 1.2 | 7.1111 | 2.9 | 0.39817 | 2.7 | 0.92 | 2091.6 | 20.3 | 2160.6 | 49.2 | 2125.4 | 26.0 | -3.30 |
| 021-Z15 | 0.08 | 0.47 | 0.12827 | 3.1 | 6.2604 | 5.8 | 0.35397 | 4.9 | 0.85 | 2074.4 | 54.8 | 1953.5 | 83.1 | 2012.9 | 51.1 | 5.83 |
| 022-Z16 | 0.09 | 0.15 | 0.13771 | 2.8 | 7.3833 | 3.2 | 0.38886 | 1.4 | 0.68 | 2198.6 | 49.0 | 2117.5 | 25.4 | 2159.0 | 28.2 | 3.69 |
| 023-Z17 | 0.01 | 0.04 | 0.12781 | 1.2 | 6.4503 | 2.2 | 0.36602 | 1.8 | 0.83 | 2068.1 | 20.8 | 2010.6 | 31.4 | 2039.2 | 19.0 | 2.78 |
| 024-Z18 | 0.03 | 0.15 | 0.13444 | 1.3 | 7.5344 | 3.7 | 0.40645 | 3.5 | 0.94 | 2156.8 | 22.2 | 2198.7 | 64.3 | 2177.1 | 33.0 | -1.94 |
| 027-Z19 | 0.02 | 0.30 | 0.12811 | 1.1 | 6.1548 | 3.0 | 0.34843 | 2.8 | 0.93 | 2072.2 | 18.6 | 1927.1 | 45.9 | 1998.0 | 25.8 | 7.00 |
| 028-Z20 | 0.04 | 0.37 | 0.13419 | 1.4 | 6.6380 | 3.2 | 0.35876 | 2.9 | 0.90 | 2153.5 | 24.3 | 1976.3 | 48.6 | 2064.4 | 28.1 | 8.23 |
| 029-Z21 | 0.02 | 0.38 | 0.12985 | 1.2 | 6.6662 | 2.5 | 0.37234 | 2.2 | 0.88 | 2095.9 | 20.8 | 2040.4 | 39.0 | 2068.2 | 22.3 | 2.65 |
| 029-Z22 | 0.06 | 0.35 | 0.12736 | 6.3 | 6.4453 | 7.5 | 0.36703 | 4.0 | 0.79 | 2061.9 | 111.0 | 2015.4 | 69.8 | 2038.5 | 65.7 | 2.25 |
| 030-Z23 | 0.01 | 0.08 | 0.13641 | 1.1 | 7.1391 | 2.9 | 0.37957 | 2.7 | 0.93 | 2182.1 | 18.9 | 2074.3 | 47.4 | 2128.9 | 25.7 | 4.94 |
| 034-Z25 | 0.02 | 0.30 | 0.12889 | 1.3 | 6.3591 | 2.4 | 0.35782 | 2.1 | 0.85 | 2082.9 | 22.5 | 1971.8 | 35.2 | 2026.6 | 21.4 | 5.33 |
| 035-Z26 | 0.03 | 0.26 | 0.12665 | 0.9 | 5.9525 | 2.7 | 0.34088 | 2.6 | 0.94 | 2052.0 | 15.8 | 1890.9 | 42.0 | 1968.9 | 23.6 | 7.85 |
| 036-Z27 | 0.01 | 0.46 | 0.13526 | 0.7 | 7.5773 | 3.0 | 0.40629 | 2.9 | 0.98 | 2167.4 | 11.4 | 2197.9 | 54.2 | 2182.2 | 26.7 | -1.41 |
| 038-Z29 | 1.05 | 0.32 | 0.13341 | 1.0 | 6.3696 | 2.5 | 0.34628 | 2.3 | 0.92 | 2143.3 | 17.1 | 1916.8 | 38.1 | 2028.1 | 21.7 | 10.57 |
| 036-Z27 | 0.01 | 0.46 | 0.13526 | 0.7 | 7.5773 | 3.0 | 0.40629 | 2.9 | 0.98 | 2167.4 | 11.4 | 2197.9 | 54.2 | 2182.2 | 26.7 | -1.41 |
| 042-Z31 | 0.02 | 0.36 | 0.12807 | 1.1 | 6.3779 | 2.3 | 0.36120 | 2.0 | 0.87 | 2071.6 | 19.8 | 1987.9 | 34.3 | 2029.2 | 20.2 | 4.04 |
| 043-Z32 | 0.01 | 0.85 | 0.13751 | 0.5 | 6.8159 | 1.4 | 0.35949 | 1.3 | 0.92 | 2196.1 | 9.5 | 1979.8 | 21.8 | 2087.8 | 12.3 | 9.85 |
| 047-Z36 | 0.01 | 0.46 | 0.12891 | 0.8 | 6.6784 | 2.0 | 0.37572 | 1.8 | 0.91 | 2083.2 | 13.9 | 2056.3 | 31.7 | 2069.8 | 17.4 | 1.29 |
| 050-Z37 | 0.02 | 0.42 | 0.12729 | 0.8 | 6.1994 | 2.0 | 0.35322 | 1.8 | 0.91 | 2060.9 | 14.1 | 1949.9 | 30.1 | 2004.4 | 17.1 | 5.39 |
| 051-Z38 | 0.02 | 0.12 | 0.06582 | 1.1 | 1.0698 | 2.2 | 0.11788 | 2.0 | 0.87 | 800.5 | 22.8 | 718.4 | 13.4 | 738.6 | 11.8 | 10.26 |
| 052-Z39 | 0.01 | 0.28 | 0.12943 | 0.7 | 6.2461 | 1.7 | 0.35001 | 1.6 | 0.92 | 2090.2 | 11.7 | 1934.6 | 26.8 | 2010.9 | 15.2 | 7.44 |
| 053-Z40 | 0.01 | 0.35 | 0.13312 | 3.3 | 6.4161 | 4.2 | 0.34955 | 2.5 | 0.82 | 2139.6 | 58.4 | 1932.5 | 41.6 | 2034.5 | 36.6 | 9.68 |
| 054-Z41 | 0.03 | 0.32 | 0.12712 | 1.0 | 5.9417 | 2.5 | 0.33900 | 2.2 | 0.90 | 2058.5 | 18.5 | 1881.9 | 36.5 | 1967.4 | 21.5 | 8.58 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 055-Z42 | 0.02 | 0.45 | 0.12935 | 0.9 | 6.5428 | 1.8 | 0.36687 | 1.6 | 0.87 | 2089.1 | 15.3 | 2014.6 | 26.8 | 2051.7 | 15.7 | 3.56 |
| 058-Z43 | 0.01 | 0.30 | 0.13328 | 0.9 | 6.4748 | 2.6 | 0.35235 | 2.4 | 0.93 | 2141.6 | 16.4 | 1945.8 | 39.9 | 2042.5 | 22.5 | 9.14 |
| 059-Z44 | 0.04 | 0.22 | 0.13035 | 1.4 | 7.1423 | 3.3 | 0.39741 | 3.0 | 0.90 | 2102.7 | 24.8 | 2157.1 | 55.3 | 2129.3 | 29.7 | -2.59 |
| 061-Z46 | 0.01 | 0.30 | 0.13292 | 0.9 | 6.6194 | 1.7 | 0.36118 | 1.5 | 0.90 | 2136.9 | 16.3 | 1987.7 | 24.9 | 2061.9 | 15.2 | 6.98 |
| 062-Z47 | 0.04 | 0.37 | 0.12899 | 1.3 | 6.3838 | 3.0 | 0.35894 | 2.7 | 0.90 | 2084.2 | 23.2 | 1977.2 | 46.7 | 2030.0 | 26.7 | 5.14 |
| 063-Z48 | 6.19 | 0.26 | 0.11283 | 2.4 | 4.6184 | 4.0 | 0.29687 | 2.9 | 0.77 | 1845.5 | 43.4 | 1675.8 | 45.8 | 1752.6 | 32.5 | 9.20 |
| 066-Z49 | 0.01 | 0.40 | 0.13112 | 0.8 | 6.4114 | 2.3 | 0.35464 | 2.2 | 0.93 | 2113.0 | 14.5 | 1956.7 | 36.4 | 2033.8 | 20.3 | 7.40 |
| 067-Z50 | 0.02 | 0.45 | 0.13371 | 0.8 | 7.1139 | 2.4 | 0.38587 | 2.2 | 0.94 | 2147.3 | 14.6 | 2103.7 | 40.1 | 2125.8 | 21.2 | 2.03 |
| 069-Z52 | 0.03 | 0.30 | 0.12894 | 2.1 | 6.4038 | 2.7 | 0.36020 | 1.7 | 0.82 | 2083.6 | 37.0 | 1983.1 | 28.9 | 2032.8 | 23.7 | 4.82 |
| 071-Z54 | 0.01 | 0.31 | 0.11661 | 3.5 | 6.0707 | 4.5 | 0.37758 | 2.8 | 0.63 | 1904.9 | 62.3 | 2065.0 | 49.6 | 1986.1 | 38.9 | -8.40 |
| **Dados não utilizados no histograma de frequencia pelo elevado grau de discordância** | | | | | | | | | | | | | | | | |
| 005-Z2 | 0.06 | 0.66 | 0.12891 | 1.0 | 5.7614 | 3.5 | 0.32414 | 3.3 | 0.96 | 2083.2 | 17.9 | 1809.9 | 52.4 | 1940.6 | 30.1 | 13.12 |
| 013-Z9 | 0.04 | 0.28 | 0.12767 | 1.4 | 5.5023 | 2.9 | 0.31257 | 2.5 | 0.87 | 2066.2 | 24.9 | 1753.3 | 38.8 | 1901.0 | 24.9 | 15.14 |
| 031-Z24 | 0.05 | 0.37 | 0.13118 | 2.2 | 5.6574 | 3.9 | 0.31278 | 3.2 | 0.83 | 2113.9 | 38.3 | 1754.4 | 49.4 | 1924.9 | 33.6 | 17.01 |
| 039-Z30 | 1.04 | 0.52 | 0.13263 | 0.7 | 5.4898 | 1.7 | 0.30021 | 1.6 | 0.92 | 2133.1 | 11.4 | 1692.3 | 23.4 | 1899.0 | 14.5 | 20.66 |
| 044-Z33 | 3.62 | 46.12 | 0.08554 | 5.0 | 0.9344 | 5.3 | 0.07922 | 1.9 | 0.35 | 1327.8 | 93.3 | 491.5 | 9.2 | 670.0 | 25.8 | 62.99 |
| 046-Z35 | 0.52 | 0.43 | 0.13238 | 0.8 | 5.2845 | 2.9 | 0.28952 | 2.7 | 0.96 | 2129.8 | 14.6 | 1639.1 | 39.6 | 1866.4 | 24.2 | 23.04 |
| 068-Z51 | 3.33 | 0.57 | 0.19374 | 3.5 | 9.6864 | 4.3 | 0.36261 | 2.4 | 0.56 | 2774.2 | 56.0 | 1994.5 | 41.7 | 2405.4 | 38.4 | 28.10 |
| 070-Z53 | 0.61 | 0.38 | 0.13956 | 1.2 | 5.1633 | 3.1 | 0.26833 | 2.9 | 0.92 | 2221.8 | 21.6 | 1532.3 | 39.0 | 1846.6 | 26.5 | 31.03 |
| **Dados descartados pelo elevado erro analítico** | | | | | | | | | | | | | | | | |
| 006-Z3 | 0.15 | 0.25 | 0.13472 | 9.1 | 6.4549 | 10.4 | 0.34750 | 5.0 | 0.74 | 2160.4 | 158.5 | 1922.6 | 83.4 | 2039.8 | 91.2 | 11.01 |
| 016-Z12 | 0.01 | 0.50 | 0.13080 | 0.7 | 6.0640 | 2.1 | 0.33623 | 2.0 | 0.95 | 2108.8 | 11.9 | 1868.5 | 32.4 | 1985.1 | 18.4 | 11.40 |
| 037-Z28 | 1.12 | 0.61 | 0.13407 | 6.1 | 6.2434 | 6.4 | 0.33774 | 1.9 | 0.53 | 2152.0 | 102.5 | 1875.8 | 32.0 | 2010.5 | 54.4 | 12.83 |
| 037-Z28 | 1.12 | 0.61 | 0.13407 | 6.1 | 6.2434 | 6.4 | 0.33774 | 1.9 | 0.53 | 2152.0 | 102.5 | 1875.8 | 32.0 | 2010.5 | 54.4 | 12.83 |
| 045-Z34 | 2.05 | 0.42 | 0.12893 | 1.0 | 5.7383 | 2.9 | 0.32278 | 2.7 | 0.97 | 2083.5 | 18.2 | 1803.3 | 43.2 | 1937.1 | 25.1 | 13.45 |
| 060-Z45 | 0.01 | 0.39 | 0.13158 | 0.8 | 6.1059 | 2.4 | 0.33657 | 2.3 | 0.94 | 2119.1 | 13.9 | 1870.1 | 37.1 | 1991.1 | 21.1 | 11.75 |

## Dados Isotópicos Sm-Nd em rocha total

| Sample | Sm(ppm) | Nd(ppm) | $Nd^{143}/Nd^{144}$ | $^{147}Sm/^{144}Nd$ | ±2σ | εNd (T) | $T_{DM}$(Ga) |
|---|---|---|---|---|---|---|---|
| **Granito Domínio Artulândia (T = 2.19 Ga)** | | | | | | | |
| 0209A | 4.31 | 25.63 | 0.511246 | 0.1017 | 0.000003 | -0.38 | 2.43 |
| **Unidade máfica de Jaraguá (T = 1.15 Ga)** | | | | | | | |
| 0109 | 2.53 | 6.59 | 0.512836 | 0.2317 | 0.000014 | -1.32 | 2.30 |
| 0408 | 6.80 | 27.92 | 0.512078 | 0.1473 | 0.000012 | -3.65 | 2.20 |
| 0410 | 5.33 | 18.52 | 0.512402 | 0.1738 | 0.000016 | -1.24 | 2.45 |
| **Rio do Peixe (T = 1.0 Ga)** | | | | | | | |
| 0212 | 85.04 | 603.02 | 0.512049 | 0.0853 | 0.000010 | -11.49 | 1.17 |
| 0301 | 7.78 | 39.84 | 0.512469 | 0.1180 | 0.000011 | -3.30 | 0.91 |
| 0314 | 10.70 | 56.85 | 0.512397 | 0.1137 | 0.000010 | -4.70 | 0.98 |
| 0320 | 18.46 | 82.97 | 0.512496 | 0.1346 | 0.000004 | -2.77 | 1.05 |
| 0401 | 11.17 | 55.01 | 0.511866 | 0.1227 | 0.000011 | -15.06 | 1.95 |
| 0402 | 7.93 | 46.22 | 0.511751 | 0.1037 | 0.000012 | -17.30 | 1.78 |
| **Sedimentos Araxá** | | | | | | | |
| 0205 | 9.09 | 53.60 | 0.511598 | 0.1025 | 0.000005 | -20.29 | 1.96 |
| 0326 | 12.76 | 65.17 | 0.511888 | 0.1183 | 0.000008 | -14.63 | 1.83 |
| 0520 | 5.31 | 30.50 | 0.511478 | 0.1052 | 0.000012 | -22.63 | 2.18 |