



Universidade de Brasília

Instituto de Geociências

Programa de Pós-graduação em Geologia

**Proveniência e ambiente tectônico das
sequências metassedimentares do
Greenstone Belt Serra de Santa Rita:
implicações para evolução do Maciço de
Goiás, Brasil Central**

*Provenance and tectonic setting of the
metasedimentary sequences of the Serra de Santa
Rita Greenstone Belt: Implications for the tectonic
evolution of Goiás Massif, Central Brazil*

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Dissertação de Mestrado Nº 520

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RESUMO

O Domínio Crixás-Goiás está inserido no Maciço de Goiás, na porção centro-oeste da Faixa de Dobramentos Brasília, e é composto por uma associação de terrenos TTGs (Tonalitos, Trondjemitos e Granodioritos) e faixas de greenstone belts. O Greenstone Belt Serra de Santa Rita está localizado na porção sul do Domínio Crixás-Goiás e é composto, da base para o topo, por sequências de rochas metavulcânicas ultramáficas e máficas sotopostas a unidades metassedimentares mais jovens, que são objeto de investigação desta pesquisa. Este trabalho apresenta dados de geoquímica isotópica U-Pb, Sm-Nd e Lu-Hf das rochas metassedimentares do Greenstone Belt serra de Santa Rita com o objetivo de caracterizar possíveis fontes sedimentares, estilos de bacias, ambientes de deposição e a idade máxima de sedimentação, assim como propor uma evolução para essas bacias dentro do cenário regional. Os resultados obtidos nesta pesquisa permitiram individualizar sequências sedimentares pertencentes à duas bacias distintas: Serra de Santa Rita e Serra de Cantagalo, respectivamente. A bacia Serra de Santa Rita é constituída de meta-arcóseo, meta grauvacas, metapelito, filito carbonoso, mármore e arenitos de granulometria fina e apresenta dados de zircão detríticos com idades arqueanas e riacianas. As fontes arqueanas apresentam assinaturas isotópicas Lu-Hf e Sm-Nd condizentes com fontes crustais mais antigas, enquanto as fontes riacianas exibem uma assinatura crustal juvenil. A idade máxima de deposição, obtida com base na média ponderada das idades dos grãos de zircão mais jovens, aponta para uma idade de 2,14 Ga. A bacia Serra de Cantagalo compreende uma sequência metassedimentar composta por metaconglomerados, meta-arenitos e quartzitos e apresenta dados de zircão detrítico de idades arqueanas, riacianas, orosirianas e estaterianas. A idade máxima de deposição para a sequência sedimentar dessa bacia é de 1,98 Ga. As assinaturas isotópicas Lu-Hf e Sm-Nd obtidas para a sequência sedimentar da bacia Serra de Cantagalo são condizentes com fontes crustais mais antigas. As possíveis fontes arqueanas são os TTG presentes no Domínio Crixás-Goiás. As fontes riacianas provavelmente se originaram de rochas ígneas e metamórficas presentes nos Domínios Campinorte, Cavalcante-Araias e Almas-Conceição do Tocantins. Por sua vez, sugere-se que as fontes estaterianas e orosirianas estão relacionadas a rochas vulcânicas em um contexto geológico de rifteamento, correlacionável aos Grupos Araí e Serra da Mesa. A evolução tectono-sedimentar da bacia Serra de Santa Rita apresenta dois ciclos: o primeiro está relacionado à sua abertura, adotando um estilo de bacia do tipo pull-apart, com deposição de arcóseos e grauvacas da formação Fazenda Cruzeiro, enquanto o segundo ciclo está relacionado a um aumento do nível do mar e à deposição de uma sequência marinha, caracterizada por pelitos, filitos ricos em matéria orgânica, carbonatos e arenitos de granulometria fina da formação Fazenda Limeira. Este último ciclo é seguido pelo soerguimento da bacia após a diagênese e início da erosão. A bacia de Serra do Cantagalo pode ser relacionada a um rifteamento pós-colisional, resultante do abatimento do orógeno riaciano, ou ao mesmo evento tectônico que formou as bacias Araí e Serra da Mesa. Por fim, a Formação Serra do Cantagalo foi posicionada tectonicamente sobre o *Greenstone Belt* Serra de Santa Rita durante o evento orogenético Brasileiro-Pan Africano.

Palavras-chave: Greenstone Belt Serra de Santa Rita; Maciço de Goiás; Proveniência Sedimentar; Sistemas Isotópicos U-Pb e Lu-Hf em zircão detrítico; Sistema Isotópico Sm-Nd em rocha total

ABSTRACT

The Crixás-Goiás Domain is situated in the Goiás Massif, central-western portion of the Brasília Fold Belt, and consists of an assemblage of TTGs (Tonalites, Trondhjemites, and Granodiorites) and greenstone belts. The Serra de Santa Rita Greenstone Belt is in the southern part of the Crixás-Goiás Domain and is composed, from base to top of sequences of ultramafic and mafic metavolcanic rocks underlying younger metasedimentary units. This study presents U-Pb, Sm-Nd, and Lu-Hf isotopic geochemistry data of the metasedimentary rocks from the Serra de Santa Rita Greenstone belt with the aim of characterizing potential sedimentary sources, basin styles, deposition environments, and maximum depositional ages, as well as proposing the evolutionary history of these basins within the regional context. The results obtained in this research have allowed the identification of sedimentary sequences belonging to two distinct basins: the Serra de Santa Rita Basin and the Serra de Cantagalo Basin. The Serra de Santa Rita Basin is composed of meta-arkose, meta-graywacke, metapelites, carbonaceous phyllites, marble, and fine-grained sandstones. It presents detrital zircon data with Archean and Rhyacian ages. Archean sources exhibit Lu-Hf and Sm-Nd isotopic signatures consistent with older crustal sources, while Rhyacian sources display a juvenile crustal signature. The maximum deposition age, obtained based on the weighted mean of the youngest zircon grains, points to a 2.14Ga age. The Serra de Cantagalo Basin is a metasedimentary sequence composed of meta conglomerates, meta-arenites, and quartzites, with detrital zircon data indicating Archean, Rhyacian, Orosirian, and Statherian ages. The maximum deposition age for the sedimentary sequence in this basin is 1.98 Ga. The Lu-Hf and Sm-Nd isotopic signatures obtained for the sedimentary sequence of the Serra de Cantagalo Basin are consistent with the influence of older crustal sources. The possible Archean sources are the TTGs present in the Crixás-Goiás Domain. Rhyacian sources likely originated from igneous and metamorphic rocks of the Campinorte, Cavalcante-Arraías, and Almas-Conceição do Tocantins Domains. In turn, it is suggested that Statherian and Orosirian sources are related to volcanic rocks in a rift-related geological context, comparable to the Araí and Serra da Mesa Groups. The tectono-sedimentary evolution of the Serra de Santa Rita Basin presents two cycles: the first is related to its opening, adopting a pull-apart basin style, with the deposition of arkoses and graywackes of the Fazenda Cruzeiro Formation. The second cycle is associated with a sea-level rise and the deposition of a marine sequence characterized by pelites, organic-rich phyllites, carbonates, and fine-grained sandstones of the Fazenda Limeira Formation. This latter cycle is followed by basin uplift after diagenesis and the onset of erosion. The Serra do Cantagalo Basin may be related to post-collisional rifting, resulting from the subsidence of the Rhyacian orogen, or to the same tectonic event that formed the Araí and Serra da Mesa basins. Finally, the Serra do Cantagalo Formation was tectonically positioned over the Serra de Santa Rita Greenstone Belt during the Brasiliano-Pan African orogenic event.

Keywords: Greenstone Belt *Serra de Santa Rita*; Goiás Massif; Sedimentary Provenance; U-Pb and Lu-Hf Isotope Systems applied to detrital zircon; Whole rock Sm-Nd isotopes.

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CAPÍTULO 1

INTRODUÇÃO

1.1 Apresentação e motivação da pesquisa

Terrenos Arqueanos (4.0Ga a 2.5Ga) comumente estão relacionados aos núcleos de crátons e porções de crostas continentais antigas, por vezes ocorrendo como resquícios crustais em meio a rochas mais novas. No estudo desses terrenos se destaca a pesquisa acerca dos *greenstone belts*, que consistem em sequências vulcano-sedimentares, deformadas e metamorfizadas, geralmente envelopadas por rochas graníticas e gnáissicas com uma faixa de idade que varia do Eoarqueano (>3,6Ga) ao Neoarqueano (<2,5Ga) (Anhaeusser,2014).

A importância do estudo dessas sequências está no potencial metalogenético dessas áreas, tendo em vista que diversos depósitos polimetálicos, em especial depósitos de ouro, estão relacionados a esse contexto geológico. Além da relevância econômica, o estudo dos *greenstone belts* contribui para o entendimento da dinâmica de evolução do planeta, uma vez que possibilita acessar informações das características térmicas, químicas, atmosféricas, mantélicas, da hidrosfera e biosfera da terra primitiva (Anhaeusser,2014; Moyen & Laurent, 2017, Windlay et al. 2021).

A análise das unidades sedimentares dos *greenstone belts* e de bacias associadas, constituem ferramenta essencial na compreensão da evolução da crosta terrestre, uma vez que essas sequências possuem o potencial de preservar as assinaturas geoquímicas e isotópicas de suas áreas fonte (e.g. Taylor & McLennan 1985; Ahmad et al. 2016). Dados geocronológicos U-Pb em zircão detrítico auxiliam na individualização e na correlação dessas sequências, na determinação da idade de sedimentação máxima e na discriminação e caracterização de eventos tectônicos impressos nas rochas do embasamento (e.g. Fedo et al., 2003; Cawood et al., 2012). Por sua vez, isótopos Sm-Nd e Lu-Hf revelam as assinaturas crustais e mantélicas das áreas-fonte de sedimentação (Debruyne et al., 2015). A combinação desses dados é essencial para o estudo de proveniência sedimentar dessas bacias e na identificação de antigos segmentos crustais, que já foram totalmente erodidos (Borges et al. 2021).

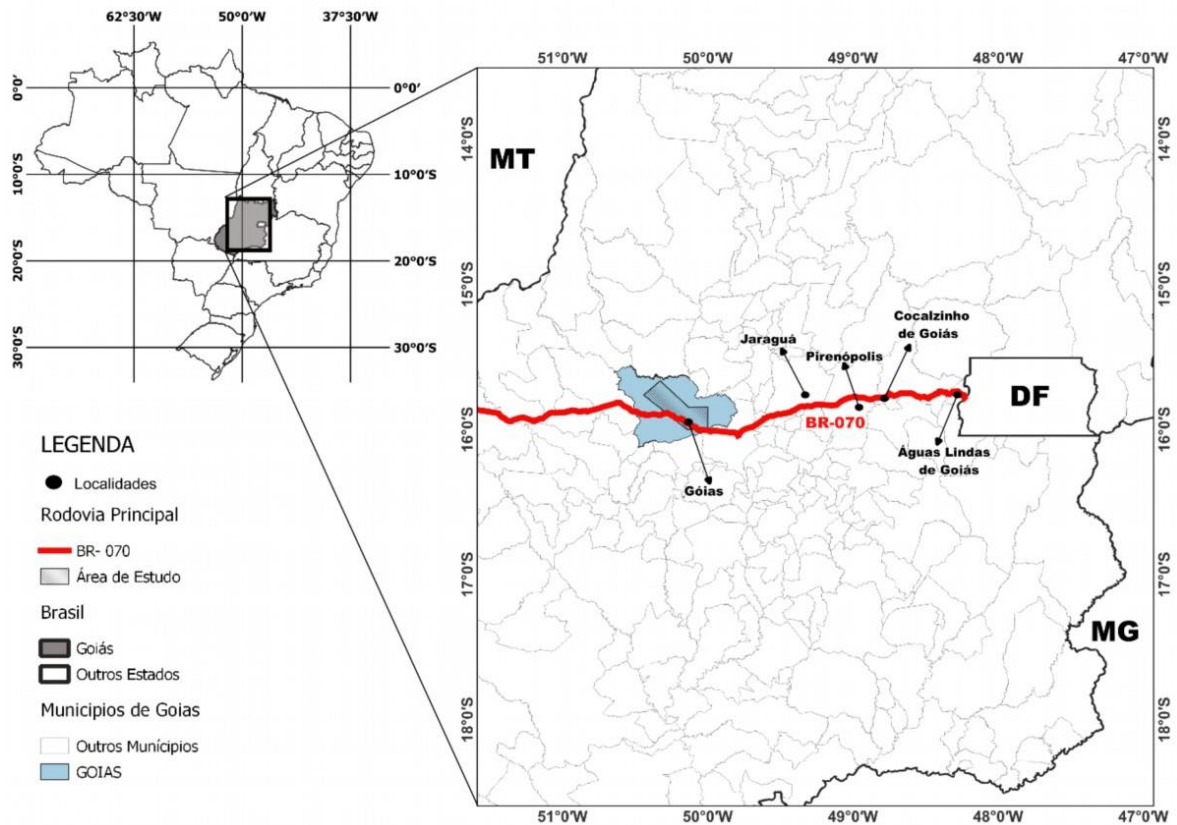


Fig. 01 – Localização da área de estudo.

O Bloco Arqueano Alóctone Crixás-Goiás (*Pimentel et al., 2000*), também denominado de Terreno Arqueano-Paleoproterozóico de Goiás (*Jost et al., 2013*) e Domínio Crixás-Goiás (*Cordeiro & Oliveira 2017*), está localizado na porção centro-oeste do estado de Goiás (Fig.01). Ele está inserido na Faixa Brasília e compreende sequências supracrustais do tipo *greenstone belt* e terrenos TTG's (Tonalitos, Trondhjemitos e Granodioritos).

Os terrenos TTGs estão distribuídos em seis complexos distintos, a norte os Complexos Anta, Caiamar, Moquém e Hidrolina e a sul os Complexos Caiçara e Uvã. Os *greenstone belts* ocorrem como cinco faixas estreitas alongadas, tectonicamente imbricadas nos complexos TTG, a norte, Crixás, Guarinos e Pilar de Goiás, e a sul, Faina e Serra de Santa Rita (Fig. 02C).

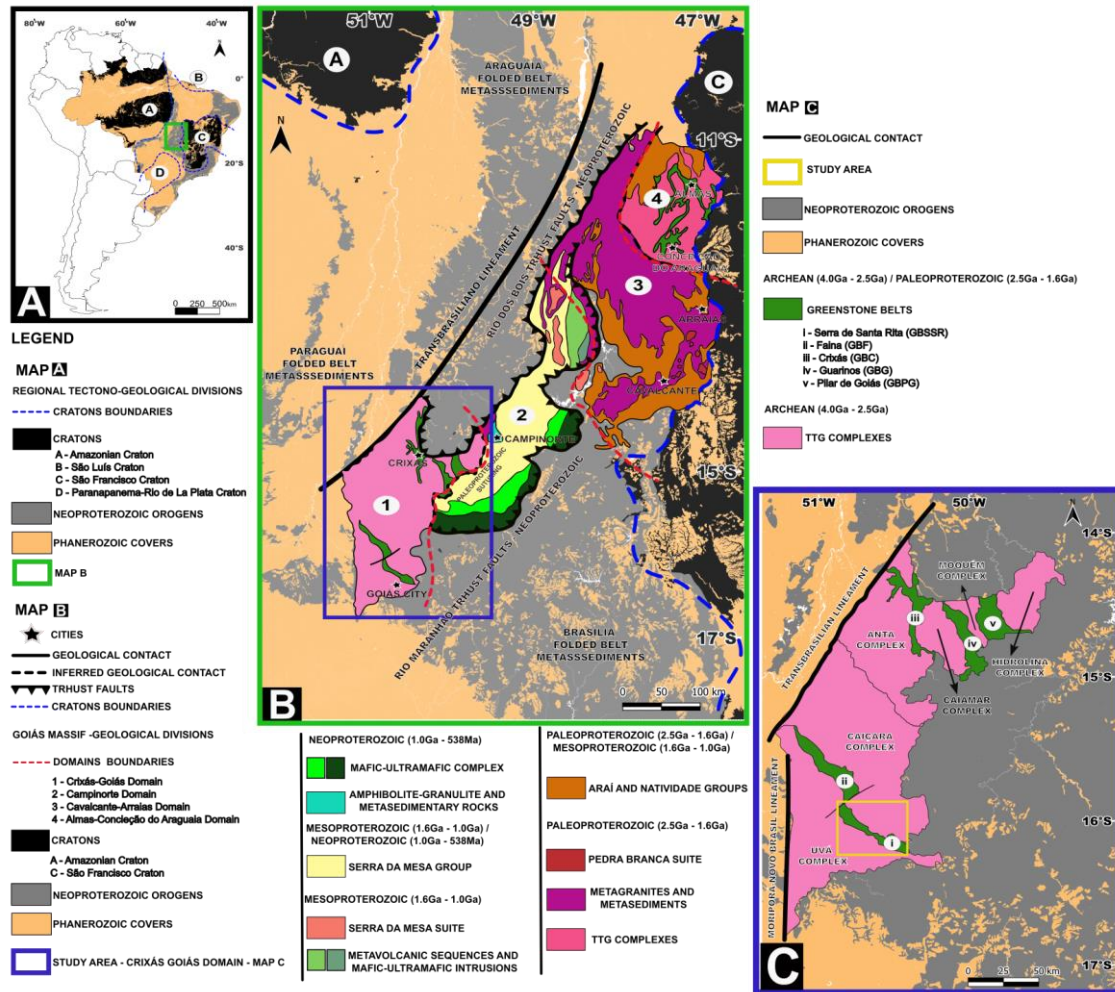


Fig. 02 – Contexto geológico da área de estudo. “A” Principais unidades tectônicas do Brasil, “B” Maciço de Goiás e seus domínios geológicos (modificado de *Cordeiro et al., 2017*) “C” Domínio Crixás-Goiás, em detalhe a área de estudo (adaptado de *Jost et al. 2014*).

A evolução tectônica desse domínio, desde o período arqueano até a sua amalgamação ao Cratón São Francisco, tem sido foco de diversas pesquisas e é uma questão importante para o entendimento da Orogenia Brasileira-Pan Africana (750Ma-500Ma), assim como para a reconstrução da evolução crustal anterior a essa orogenia.

Discussões sobre as características termiquímicas da Terra primitiva no arqueano indicam condições geológicas, geofísicas e geoquímicas diferentes da Terra atual, o que pode impedir a aplicação de vários conceitos geológicos atuais na compreensão da litosfera primitiva. No entanto, os mecanismos de acreção de terrenos e o ciclo de formação das rochas, sobretudo de rochas sedimentares, são elementos que se mantiveram durante a evolução do planeta.

Nesse sentido, estudos de proveniência sedimentar em unidades metassedimentares de *greenstone belts* e bacias associadas são ferramentas para a compreensão da evolução crustal de terrenos arqueanos e paleoproterozóicos, tendo em vista que no processo de formação de rochas sedimentares são preservadas as características geoquímicas e isotópicas das zonas fontes dos sedimentos, o que possibilita discutir as condições de erosão, deposição e diagênese característicos da bacia, reconstruindo uma parte da história evolutiva desses terrenos.

Os *greenstone belts* do Domínio Crixás-Goiás possuem unidades inferiores compostas por rochas metavulcânicas (metakomatiitos, metabasaltos, metandesitos e adakitos) sobrepostas por sucessões metassedimentares, que registram a existência de ambientes de sedimentação distintos (*Danni & Ribeiro 1978, Danni et al. 1981, Jost e Oliveira 1991, Jost et al. 2014; Borges et al. 2017, 2021*).

Estudos de proveniência sedimentar indicam que as unidades metassedimentares dos *greenstone belts* da porção norte foram alimentadas principalmente por fontes riacianas com alguma contribuição clástica arqueana (*Jost et al., 2014, Borges et al., 2021*). Nas sequências do sul, estudos preliminares no *greenstone belt* Faina apontam idades U-Pb em zircão detrítico entre 3330 e 2815 Ma (*Brant et al., 2015*).

As sequências metassedimentares do *greenstone belt* Serra de Santa Rita foram agrupadas em duas unidades supostamente arqueanas. A formação Fazenda Limeira, na base, formada por metapelitos carbonosos, metachert, formações ferríferas bandadas e metadolomitos, sotoposta em discordância erosiva pela sequência turbidítica da formação Fazenda Cruzeiro (*Danni et al., 1981; Resende et al., 1998*). Uma sequência superior constituída de rochas rudáceas da formação Serra do Cantagalo repousa em discordância sobre as unidades vulcanossedimentares e foi interpretada como uma unidade alóctone paleoproterozóica (*Resende et al., 1998*) ou neoproterozóica (*Baêta et al., 1998*), apesar da inexistência de dados isotópicos que confirmem essas hipóteses.

Assim, várias questões relativas à evolução dessas sequências supracrustais ainda permanecem em aberto, entre elas: (i) Qual seria a arquitetura original destas sequências e até que ponto a inversão tectônica promoveu a duplicação

de unidades sedimentares? (ii) Quais as fontes dos sedimentos que alimentaram essas bacias? (iii) Qual foi o ambiente tectônico de deposição dessas sequências? E, por fim, (iv) Qual a idade e o significado tectônico das diferentes sequências sedimentares na evolução do *greenstone belt* Serra de Santa Rita.

O enfoque central deste trabalho será, portanto, a caracterização tectono-estratigráfica e o estudo de proveniência sedimentar das sequências metassedimentares do *greenstone belt* Serra de Santa Rita, localizado na porção sul do Domínio Crixás-Goiás (DCG), buscando contribuir com o entendimento da evolução geodinâmica da região em âmbito regional, no contexto geológico do Domínio Crixás-Goiás e do Maciço de Goiás

1.2 Objetivos

Esta pesquisa tem como objetivo central estudar a proveniência sedimentar das sequências metassedimentares do *greenstone belt* Serra de Santa Rita, visando compreender a paleogeografia e os ambientes de deposição dessas bacias, bem como sua idade de sedimentação máxima e suas principais áreas fonte.

Os objetivos específicos incluem:

- i. Mapear estruturas regionais e locais através da interpretação de dados aerogeofísicos e trabalhos de campo;
- ii. Estabelecer as relações estratigráficas entre a Formação Serra do Cantagalo e as diferentes unidades que compõem o *greenstone belt* Serra de Santa Rita (Formação Fazenda Limeira e Formação Fazenda Cruzeiro);
- iii. Avaliar os efeitos da inversão tectônica e possíveis repetições estratigráficas na sequência sedimentar a partir da análise estrutural qualitativa da deformação impressa nessas rochas;
- iv. Caracterização petrográfica das rochas metassedimentares com o intuito de identificar os protólitos e estudar as assembleias metamórficas estabilizadas nos possíveis eventos termo tectônicos;
- v. Estudar a assinatura geoquímica e isotópica (U-Pb, Sm-Nd e Lu-Hf) das rochas metassedimentares, com o intuito de caracterizar as áreas fonte, estabelecer a idade de sedimentação máxima e detectar o ambiente tectônico de deposição dessas sequências metassedimentares.

1.3 Materiais e Métodos

Com intuito de atingir os objetivos propostos nesta pesquisa, foram realizadas as seguintes etapas de trabalho: interpretação de dados de levantamentos aerogeofísicos regionais (Magnetometria e Gamaespectrometria), trabalhos de campo e amostragem, petrografia e análises isotópicas (U-Pb, Sm-Nd e Lu-Hf).

1.3.1 Processamento e Interpretação de Dados Aerogeofísicos Regionais

O processamento e a interpretação dos dados aerogeofísicos foram feitos com base no levantamento (Gamaespectrométrico e Magnetométrico) de alta densidade de amostragem, denominado Sudeste do Mato Grosso, que recobre o Domínio Crixás Goiás (DCG) e é disponibilizado pela CPRM – Serviço Geológico do Brasil. O levantamento foi realizado com linhas de voo com 500m e linhas de controle espaçadas em 10.000m, orientadas nas direções N-S e E-W, respectivamente. Para a aquisição dos dados foram utilizadas 4 (quatro) aeronaves que realizaram o levantamento no período de 30/07/2011 a 22/05/2012. O processamento dos dados foi feito no software *Oasis Montaj Geosoft* e a interpretação foi feita em ambiente SIG (Sistema de Informação Geográfica) no software livre *QGIS*.

Para o processamento dos dados magnéticos, utilizou-se técnicas para a determinação de parâmetros geométricos, como localização de limites (geológicos e estruturais), profundidades de corpos e feições estruturais, tais como: gradiente total do campo magnético anômalo (GT), derivadas vertical (Dz) e horizontais (Dx e Dy) e do gradiente horizontal total (GHT).

Os produtos derivados do campo magnético anômalo (CMA), como o gradiente total (GT) e gradiente horizontal total do CMA foram cruciais para a interpretação das anomalias magnéticas e as derivadas vertical e horizontais para a extração de lineamentos magnéticos e onde as estruturas foram traçadas nas máximas amplitudes das anomalias identificadas.

Os dados gamaespectrométricos são obtidos medindo-se a radiação gama emitida por determinados elementos que compõe os diversos tipos de rochas.

São complementares ao estudo dos produtos derivados do campo magnético anômalo. Isto por que fontes magnéticas de várias profundidades contribuem para o campo medido enquanto que os dados radiométricos representam apenas os primeiros 30 a 40 centímetros da superfície. Foram geradas imagens a partir dos dados de contagem total corrigida ($\mu\text{R/h}$), bem como dos canais de K (%), eU (ppm), eTh (ppm). A partir destes três últimos canais foram elaboradas composições ternárias, em falsa cor, utilizando os padrões de cores RGB (K, eTh, eU) e CMY (K, eTh, eU).

1.3.2 Trabalhos de Campo e Amostragem

Os trabalhos de campo foram executados em duas campanhas, a primeira no período de 10 a 20 de outubro de 2021 e a segunda no período de 26 de maio de 2022 a 4 de junho de 2022, totalizando 20 dias de campo. As atividades de campo se basearam na realização de perfis na escala 1:25.000 com orientação SW-NE buscando interceptar as estruturas regionais principais e unidades estratigráficas ao longo do *Greenstone belt* Serra de Santa Rita. Os perfis foram espaçados de maneira a recobrir toda a área do *greenstone belt*. Foram amostrados 17 pontos para análise de zircão detrítico (U-Pb e Lu-Hf) em rochas metassedimentares, dos quais foram selecionadas 8 amostras, 21 pontos para análise petrográfica, dos quais foram confeccionadas 30 lâminas delgadas, 25 pontos para análise isotópicas Sm-Nd, dos quais foram selecionados 11 amostras.

1.3.3 Estudos Petrográficos

A petrografia consistiu na descrição de 30 lâminas delgadas, onde se buscou características texturais sedimentares e metamórficas, definição das assembleias metamórficas e suas relações com a deformação regional, assim como as características principais dos protólitos de cada unidade metassedimentar estudada.

1.3.4 Análises Isotópica

Os sistemas isotópicos utilizados neste trabalho foram U-Pb, Sm-Nd e Lu-Hf, com objetivo a obtenção das idades das principais fontes das rochas metassedimentares, assim como as relações do tempo de residência crustal de tais fontes.

1.3.4.1 Sistema U-Pb

As amostras foram preparadas no laboratório de Geocronologia da Universidade de Brasília e os dados isotópicos foram coletados na Universidade Federal de Ouro Preto (UFOP) utilizando uma metodologia sistemática. Inicialmente, as amostras geológicas foram submetidas a um processo de britagem, seguido pela passagem por um moinho de discos para obtenção de material finamente triturado. Posteriormente, o material resultante foi submetido a técnicas de concentração utilizando uma bateia, seguido de secagem em uma faixa de temperatura de 50 a 70 graus Celsius. A separação magnética foi então empregada para isolar a fração magnética da fração não magnética, realizada utilizando um ímã de neodímio.

A fração não magnética foi dividida em dois segmentos com base em sua densidade, sendo uma parte com densidade superior a 3,31 g/cm³ e a outra com densidade inferior a 3,31 g/cm³. Essa segregação foi realizada utilizando um funil de decantação e diiodometano. A fração mais densa foi posteriormente submetida à separação em componentes diamagnéticos e paramagnéticos utilizando um separador magnético Frantz. Com o auxílio de um microscópio e lupas, os grãos de zircão contidos nas amostras foram separados da fração diamagnética.

Os grãos de zircão foram incorporados em resina acrílica e passaram por um processo de polimento utilizando pó de alumina. Imagens de catodoluminescência (CL) foram adquiridas utilizando um Microscópio Eletrônico de Varredura (SEM), especificamente o modelo JEOL 6510.

A análise U-Pb foi realizada utilizando um instrumento Neptune Plus Thermo Finnigan acoplado a um sistema laser Photon-Machines de 193nm. A aquisição

de dados foi conduzida no modo de pulso de pico, incluindo uma medição de fundo de 20 segundos, uma ablação de zircão de 20 segundos e um tamanho de ponto de 30 micrômetros. A redução e o processamento de dados foram realizados utilizando o software Saturn.

Cálculos de idade e histogramas de frequência foram gerados utilizando o software Isoplot 4.15 desenvolvido por *Ludwig 2012*. É importante destacar que todos os dados de zircão incluídos nos histogramas apresentaram pelo menos 90% de concordância. Vale ressaltar que, para algumas amostras, esse nível de concordância resultou em uma redução estatística no número de grãos de zircão analisados. No entanto, o conjunto de dados compreende mais de 200 grãos no total, cada amostra sendo submetida a mais de 250 análises individuais, incluindo amostras de zircão e padrões. É digno de nota que, de acordo com os padrões estabelecidos neste estudo, algumas amostras apresentaram populações estatisticamente válidas abaixo de 50 grãos.

1.3.4.2 Sistema Lu-Hf

As análises isotópicas Lu-Hf foram realizadas no Laboratório de Geoquímica Isotópica da Universidade Federal de Ouro Preto (UFOP). As análises foram obtidas utilizando um instrumento Neptune Plus Thermo Finnigan acoplado a um sistema laser Photon-Machines de 193nm, analisando as mesmas amostras de grãos utilizadas na análise U-Pb, conforme a metodologia descrita por *Gerdes & Zeh (2006, 2009)*. Cerca de dez grãos por amostra foram selecionados, sendo escolhidos aqueles que apresentaram dados com concordância $\geq 95\%$, representando os picos de idade mais proeminentes. A interpretação dos dados e a confecção dos gráficos foi feita com o *software* Microsoft Excel.

1.3.4.3 Sistema Sm-Nd

A preparação das amostras e a análise isotópica foram realizadas no Laboratório de Estudos Geodinâmicos, Geocronológicos e Ambientais da Universidade de Brasília. As amostras foram submetidas à trituração e pulverização em grãos extremamente finos. Os detalhes dos procedimentos analíticos isotópicos podem ser encontrados em *Gioia e Pimentel (2000)*.

Aproximadamente 50 a 100 mg de cada amostra foram combinados com uma solução contendo ^{149}Sm - ^{150}Nd spike, sendo então dissolvidos em copos de Teflon Savillex por meio de tratamentos ácidos sucessivos (HNO_3 , HF e HCl). Nd, Sm e Sr foram separados usando colunas cromatográficas. O estrôncio e os Elementos Terras Raras (ETR) foram separados em uma coluna primária empacotada com resina de troca catiônica AG 50W-X8, enquanto Sm e Nd foram isolados usando técnicas de cromatografia de troca catiônica convencionais empregando colunas de Teflon preenchidas com resina LN-Spec (HDEHP - ácido fosfórico di-2-etil-hexil suportado com pó de Teflon). Frações de estrôncio, Sm e Nd foram depositadas em filamentos de dupla evaporação de Réssio, e as medidas isotópicas foram conduzidas usando um espectrômetro de massa de ionização térmica multicoletores TRITON Plus (TIMS). A análise do material de referência NBS-987 produziu uma razão média de $^{87}\text{Sr}/^{86}\text{Sr}$ de $0,71028 \pm 0,000035$ (2SE), consistente com o valor recomendado (*Hodell et al., 2007*). A análise repetida do material de referência BHVO-2 produziu uma razão de $^{143}\text{Nd}/^{144}\text{Nd}$ de $0,512970 \pm 0,000002$ (2SE), em concordância com o valor recomendado (*Weis et al., 2005*).

As razões de amostras de $^{143}\text{Nd}/^{144}\text{Nd}$ medidas são expressas na notação Epsilon Neodímio (ϵNd) como a variação fracionária em partes por 10^4 (unidades) em relação ao valor de $^{143}\text{Nd}/^{144}\text{Nd}$ do Reservatório Uniforme Condritico (CHUR).

1.4 Estrutura da dissertação.

Esta dissertação de mestrado está estruturada em três partes principais: a primeira parte (Capítulo I) engloba a apresentação, objetivos da pesquisa, e materiais e métodos. A segunda parte (Capítulo II) está organizada em formato de artigo, onde são apresentados o contexto geológico regional, os resultados da pesquisa e as principais discussões. A terceira parte (Capítulo III) consiste na discussão dos resultados obtidos na pesquisa e correlações regionais com implicações para o entendimento da evolução do Maciço de Goiás.

CAPÍTULO 2

**PROVENANCE AND TECTONIC
SETTING OF THE
METASSEDIMENTARY SEQUENCES
OF THE SERRA DE SANTA RITA
GREENSTONE BELT: A RECORD OF
ARCHEAN-TO-OROSIRIAN CRUSTAL
EVOLUTION ALONG THE WESTERN
MARGIN OF THE SÃO
FRANCISCO CRATON, BRAZIL**

1 INTRODUCTION

Sedimentary provenance analysis has become prominent for understanding the evolution of Earth's crust and tectonic settings in Precambrian basins (*Borges et al., 2021, Drabon et al., 2019, Nutman et al., 2009, Morris et al., 2007, Kirkland et al. 2021*). Analyzing source rock characteristics, weathering styles, transport, sorting, and diagenesis, provides valuable data to understanding the basin's tectonic history. Furthermore, provenance investigation of clastic sedimentary rocks gives critical insights into the continental crust evolution. U–Pb analysis of detrital zircons yields the ages of source areas and Lu–Hf isotopic analysis reveals information about the nature of the sources for each zircon grain, which makes it possible to examine the major events of crustal growth through the studies of detrital zircons.

The analysis of sedimentary units within greenstone belts has crucial importance to unraveling the Earth's crustal evolution, given that these sequences have the potential to preserve the geochemical and isotopic signatures of their source areas (*Taylor & McLennan 1985, Ahamad et al. 2016*). U–Pb geochronological data derived from detrital zircon can be used as an auxiliary method for the individualization of these sequences, in determining the age of maximum sedimentation and in the discrimination and characterization of tectonic events imprinted in the basement rocks (*Fedo et al., 2003, Cawood et al., 2012*), *Vermeesch and Garzanti 2015*, recently conducted a multi-method investigation, highlighting that detrital zircon age distributions provide more direct information about sediment sources compared to petrography and whole rock geochemistry. This aligns with previous findings emphasizing greenstone belts as the primary repositories of the Archean sedimentary record (*Eriksson et al., 1994; Condie, 2016*). Additionally, the Sm–Nd and Lu–Hf isotopes reveal the crustal and mantle signatures of the source areas (*e.g., Caxito et al., 2014; Debruyne et al., 2015*). The combination of these datasets is essential for investigating the sedimentary provenance of these basins and identifying ancient crustal segments that have already been completely eroded (*Borges et al. 2021*).

The Crixas-Goiás Domain, located in central Brazil, is part of the Goiás Massif and is included in the Tocantins Province, a Neoproterozoic orogen related to the

Brasiliano-Pan-African orogeny (*Almeida 1977*). This domain is characterized by the presence of tonalite-trondhjemite-granodiorite (TTGs) complexes and greenstone belt sequences. The greenstone belts occur as five narrow, elongated fragments, tectonically imbricated in the TTG complexes. The stratigraphic records within these greenstone belts consist of lower metavolcanic units (metakomatiites, metabasalts, metandesites and adakites) overlain by diverse metasedimentary sequences (*Danni et al., 1981, Jost et al., 2014, Borges et al., 2017*).

The Serra de Santa Rita greenstone belt, the primary focus of this research, is located in the southern part of the Crixas-Goiás Domain. The lower unit of this supracrustal sequence is composed of Mesoarchean metavolcanic rocks, including metakomatiite and metabasalt, known respectively as the Manoel Leocadio Formation and Digo-Digo Formation. The upper metasedimentary unit includes a lower member, the Fazenda Limeira Formation, which consists of metapelitic rocks, and an upper member known as the Fazenda Cruzeiro Formation, composed of meta-arkose and metagraywacke.

Additionally, an upper sequence consisting of rudaceous rocks from the Serra do Cantagalo Formation lies unconformably over the units of the Fazenda Cruzeiro Formation and has been interpreted as a Paleoproterozoic (*Resende et al., 1998*) or Neoproterozoic (*Baeta et al., 1998*) allochthonous unit, despite the absence of isotopic data confirming these hypotheses. The stratigraphy of the GBSSR has been the subject of research by *Dani et al. (1981)*, *Teixeira (1981)*, and *Rezende et al. (1998)*, each of whom proposed varying stratigraphic divisions and distinct geochronological interpretations for the metasedimentary units.

This paper provides an integrated investigation that encompasses geological data, Sm-Nd and Lu-Hf isotopes, as well as LA-ICP-MS U-Pb detrital zircon geochronology of the metasedimentary units within the greenstone belt Serra de Santa Rita. This study aims to assess the maximum deposition age of each sequence, their potential source areas, and the tectonic setting in which these sequences were deposited.

2 GEOLOGICAL SETTING

The Tocantins Province is a complex geological entity located in central Brazil, limited at Northwest by the Amazonian Craton, at Southeast by the São Francisco-Congo Craton, at north by the Parnaíba Basin, at south by the Parana Basin, and at Northeast by the Borborema Province (*Almeida et al., 1981*). The Tocantins Province is subdivided into three main folded belts, including the Araguaia Folded Belt in the north, the Paraguai Folded Belt in the west, and the Brasília Folded Belt in the central-southern portion. These folded belts were formed during the Neoproterozoic era, as a consequence of the Brasiliano-Pan African Orogeny, which occurred due to the collision of the Amazonian, São Francisco-Congo, and Paranapanema Cratons and resulted in the amalgamation of the Western Gondwana supercontinent in the Neoproterozoic.

The GSBSSR is located in the Goiás Massif, central portion of the Brasília folded belt. The Goiás Massif is divided into 4 domains from southeast to the northeast, denominated the Crixás-Goiás, Campinorte, Cavalcante-Araias, and Almas-Conceição do Tocantins domains (*Cordeiro et al., 2017*) (Fig.02B), the Massif is bounded to the west by the Rio dos Bois Thrust fault, to the north by the Parnaíba Basin, to the south by the Brasília folded belt supracrustal units, and to the east by the sedimentary rocks of the Bambuí and Urucuia groups. The Crixás-Goiás Domain is composed of Archean TTG and Archean to Paleoproterozoic greenstone belt sequences (*Borges et al., 2017, 2021; Jost et al., 2013; Queiroz et al., 2008*); the Campinorte Domain, almost entirely covered by the Serra da Mesa group (Meso-Neo-Proterozoic), is composed of a Paleoproterozoic metavolcano-sedimentary Sequence, the Pau de Mel Suite and granulites (*Cordeiro et al., 2014, Giustina et al., 2009*); the Cavalcante Arraías Domain is composed of Paleoproterozoic granites of the Aurumina Suite intruded in the Ticunzal Formation, a metasedimentary sequence, of Rhyacian age (*Cuadros et al., 2017*), these units are covered by the Araí group, a rift-related basin with volcanism age of 1771Ma (*Pimentel et al., 1991*), the Almas-Conceição do Tocantins Domain is composed of Paleoproterozoic TTG terranes and greenstone belt sequences with ages ranging from 2.4Ga to 2.1Ga (*Fuck et al., 2014; Martins- Ferreira et al., 2020*).

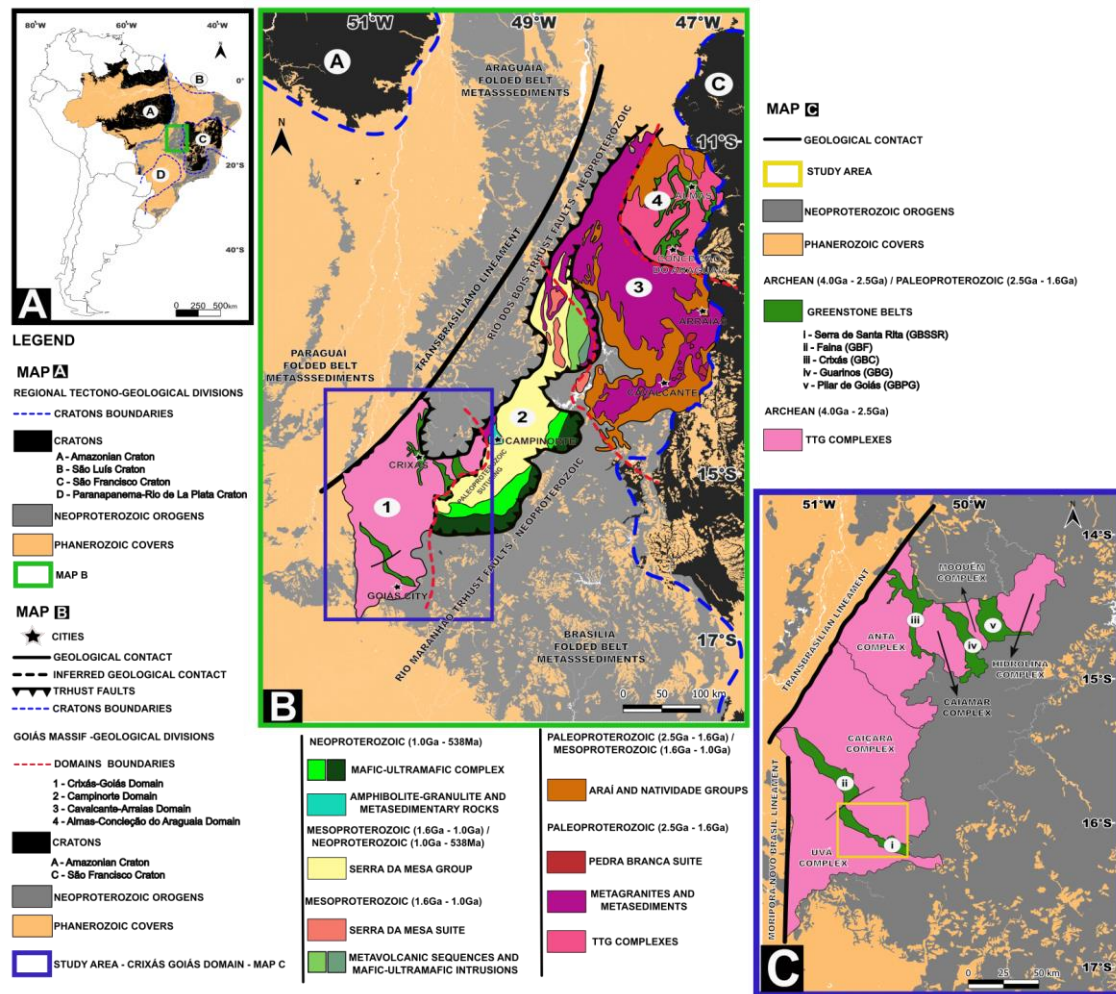


Fig. 02 – Geological Context of the Study Area. “A” Tectonic Units of Brazil, “B” Goiás Massif and its Geological Domains (modified from *Cordeiro et al., 2017*) “C” Crixás-Goiás Domain, with a detailed focus on the study area (adapted from *Jost et al., 2014*)

2.1 Crixás-Goiás Domain

The Crixás-Goiás Domain (*Cordeiro et al., 2017*) also known as Archean Allochthonous Crixas-Goiás Block (*Pimentel et al., 2000*), or Archean-Paleoproterozoic Terrain of Goiás (*Jost et al., 2013*), comprises greenstone belt supracrustal sequences and TTG terrains (Tonalites, Trondhjemites and Granodiorites) (Fig. 02C). The TTG terrains are further divided into six distinct complexes. In the northern region, these complexes include the Anta, Caiamar, Moquém, and Hidrolina complexes, whereas in the southern region, they consist of the Caiçara and Uvá complexes (Fig. 02C). The greenstone belts occur as five elongated narrow bands tectonically imbricated in the TTG complexes. In the northern region, the greenstone belts are named Crixás, Guarinos, and Pilar de

Goiás, while in the southern region, they are referred to as Faina and Serra de Santa Rita greenstone belts.

The greenstone belts of the Crixás-Goiás Domain, in summary, have lower units composed of metavolcanic rocks overlain by younger metasedimentary units. *Danni & Ribeiro (1978)* initially described these units in the northern portion, followed by the studies of *Sabóia et al. (1979)*, *Sabóia & Teixeira (1983)*, modified by *Danni et al. (1982)*, *Danni et al. (1986)*, *Castro & Magalhães (1984)*, and *Jost & Oliveira (1991)*. In the southern portion these units were described by *Danni et al. (1981)*, modified by *Tommazoli (1985)* and *Resende et al. (1998)*.

The tectonic evolution of the Crixás-Goiás Domain until the accretion onto the Brasília fold belt is still uncertain. A classical interpretation of the Crixás-Goiás Domain understands this block as an allochthonous microcontinent amalgamated at the western margin of the Brasília fold belt in Neoproterozoic Brasiliano-Pan African Orogeny. However, an alternative hypothesis suggests that the different domains within the Goiás Massif, including the Crixás-Goiás Domain, were amalgamated during successive orogenic events in the Paleoproterozoic, forming the western margin of the São Francisco-Congo paleocontinent (*Cordeiro et al., 2017; Borges et al., 2021*).

2.2 Serra de Santa Rita Greenstone Belt

The Serra de Santa Rita Greenstone Belt is in the southern portion of the Crixás-Goiás Domain and consists of a northwest-southeast trend synform located between the Uvã and Caiçara TTGs complexes (Fig.03). The contacts between the greenstone belt and TTGs complexes are tectonic and marked by medium-angle northeast-verging thrust faults.

The Serra de Santa Rita Greenstone Belt is bounded to the northwest by the dextral strike-slip Faina fault, which separates it from the Faina Greenstone Belt. To the southeast, its boundary is formed by the Araxá Group, a Neoproterozoic to Mesoproterozoic metasedimentary sequence.

The Caiçara Complex has a huge variety of plutonic rocks; however, it is composed mainly of tonalitic orthogneissic rocks with small intrusions of granodiorites, granites and charnockites with ages ranging from 2.8Ga to 3.1Ga, and minor granitic intrusions with ages of 2.7Ga (*Beghelli Junior et al., 2012*). The

Uv complex comprises two groups of orthogneisses (Jost *et al.*, 2013). The oldest group includes granodioritic to tonalitic orthogneisses and dioritic stocks with ages ranging from 3040Ma to 2930Ma (Jost *et al.*, 2013, Pimentel *et al.*, 2003). The youngest group consists of minor tonalite and monzogranite sheet-like intrusions with U-Pb ages ranging from 2846 Ma and 2764 Ma. The complexes were intruded by mafic and ultramafic dikes with ages ranging between 2.3Ga and 2.45Ga (Tomazzoli *et al.*, 1994, 2001, Corra da Costa *et al.*, 2003, 2004).

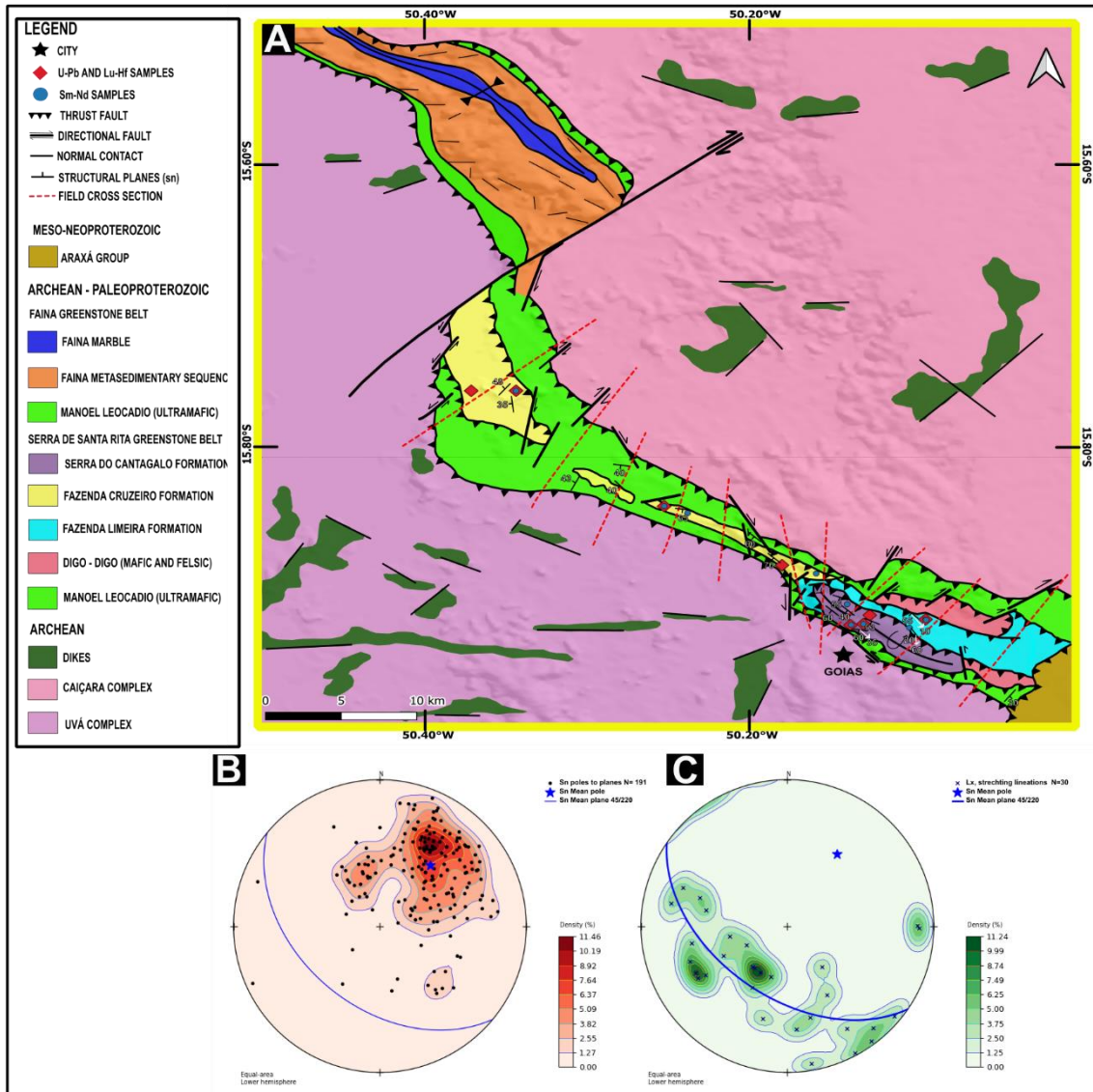


Fig. 03 – “A” Geological Map of the study area showing the locations of the studied geological cross sections and the samples analyzed for U-Pb, Lu-Hf, and Sm-Nd isotopes.”B” Structural planes Stereograms and “C” Mineral Stretching Lineaments Stereograms

The most recent stratigraphic column proposed for the Serra de Santa Rita greenstone belt was formulated by Rezende *et al.* (1998) (Fig.05) and consists of the following stratigraphy, from bottom to top. Metakomatiites with

intercalations of banded iron formation, metachert, and carbonaceous schist from the Manuel Leocadio Formation are overlapped by the sequence of mafic volcanics from the Digo-Digo Formation, which is composed of metabasalts, dacitic to rhyolitic volcanoclastic rocks, andesites, and adakites. These rocks underwent amphibolite facies metamorphism, with greenschist facies overprint (*Borges et al., 2017*).

The upper unit of the Serra de Santa Rita Greenstone Belt is the Fazenda Paraíso group, a metasedimentary unit comprising two Formations. The first is the Fazenda Limeira Formation, composed of metapelites, marble, carbonaceous schist, and metachert. The contact with the Manoel Leocádio Formation and Digo-Digo Formation is tectonic, marked by thrust faults. The second member is the Fazenda Cruzeiro Formation, defined as metarhythmites composed of decametric layers of feldspathic or mica-bearing quartzite grading into layers of metapelites and quartz-mica schist with layers of feldspathic and micaceous, fine- to medium-grained, gray quartzite with relicts of primary sedimentary features. The contact between the Fazenda Cruzeiro Formation and Fazenda Limeira Formation is tectonic, marked by thrust faults and locally intercalated.

Overlapped to the Fazenda Paraíso Group, is the Serra do Cantagalo Formation, composed of orthoquartzites, sericite-quartz schists, and conglomeratic quartzites with lenses of polymictic metaconglomerates (*Danni et al., 1981*). The contact of this unit with the Serra de Santa Rita Greenstone Belt is an unconformity suggesting the later emplacement of these rocks at the top of the Serra de Santa Rita Greenstone Belt.

The structural framework of the studied region consists of an isoclinal fold with layers dipping between 40° and 60° and verging to the southwest (220° to 240°). Due to the region's high stage of erosion, the only portion where synclinal layers are observed is in the area where the Serra do Cantagalo Formation outcrops. Stereograms of structural measurements (Fig. 03 B and C) show a significant concentration of points with NE-SW dip direction and the presence of secondary planes indicating a N-S fold. The blue line represents the most recurrent plane, 45/220 (Dip/Dip Direction), while mineral lineations represent the frontal ramp, which becomes oblique.

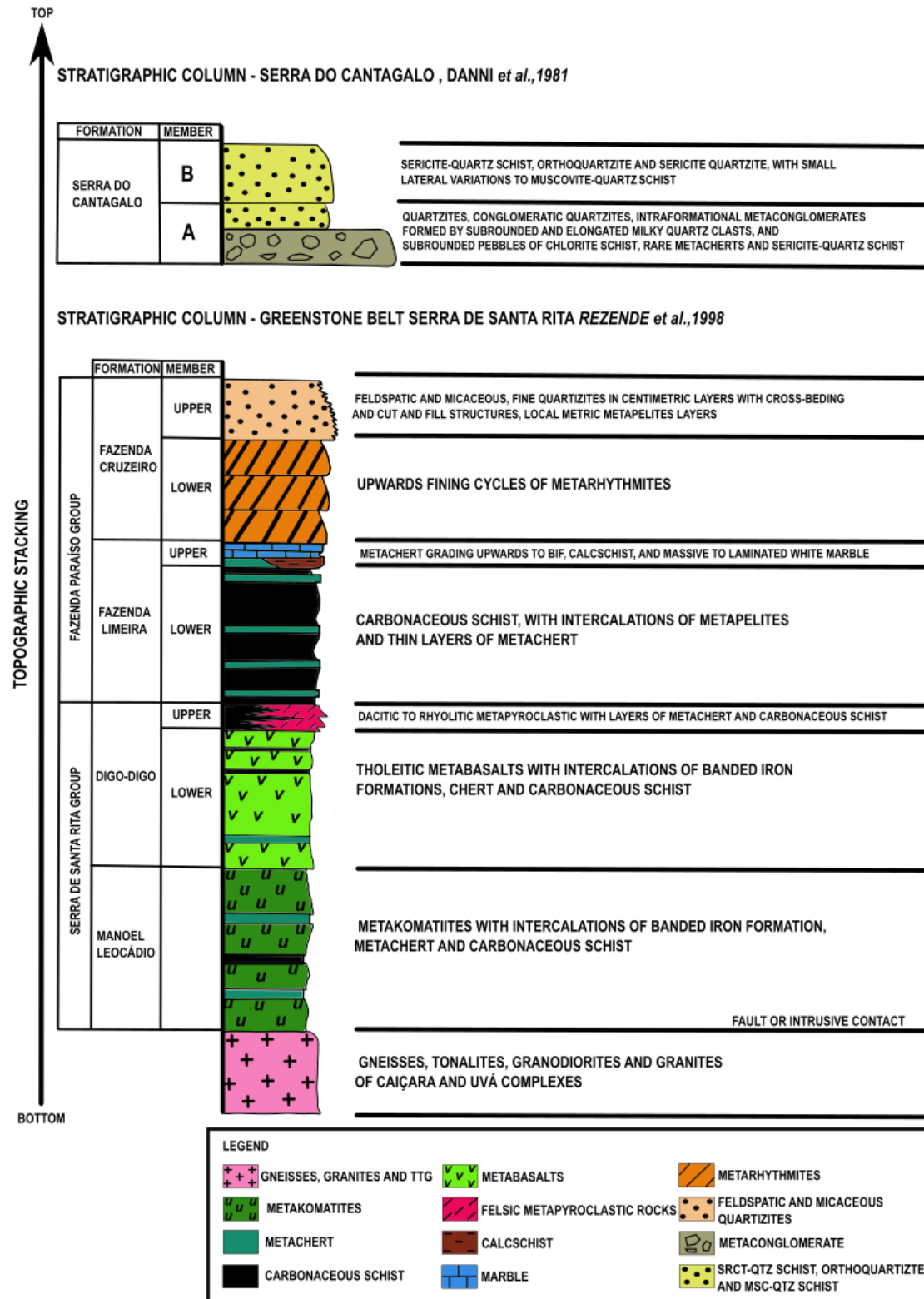


Fig. 04 –Stratigraphic Column of the study area. Serra de Santa Rita greenstone belt stratigraphic column, modified from *Rezende et al. (1998)*, and Serra do Cantagalo stratigraphic column, adapted from *Danni et al. (1981)*.

The regional metamorphic grade ranges from amphibolite to greenschist facies, and the predominant geological contact is tectonic, marked by thrust faults. This geological setting suggests the possibility of stratigraphic inversions, which makes it difficult to understand the original stacking of the metasedimentary layers. The age of deposition for the metasediments, their provenance, the tectonic regime associated with their deposition, and the specific basin type accommodating these sediments remain unknown. Addressing these questions is the central objective of this research.

3 ANALYTICAL METHODS

3.1 Sampling

Rock sampling was conducted during two field campaigns, utilizing geological cross section with a scale of 1:20,000 and a southwest-northeast (SW-NE) orientation, which is perpendicular to the general structural trend of the greenstone belt (Fig.03). The objective of these cross sections was to intersect the major regional structures and stratigraphic units along the Serra de Santa Rita Greenstone Belt. The cross sections were strategically spaced to ensure comprehensive coverage of the entire greenstone belt area. Covering all lithological units, 30 samples were selected for petrography, 11 samples for Sm-Nd analysis, and 8 samples were selected for U-Pb and Lu-Hf analyses.

3.2 Petrographic analysis

The petrography consisted of the description of 30 thin sections, focused on sedimentary and metamorphic textural characteristics, definition of metamorphic assemblages and their relationships with regional deformation, as well as the main petrographic characteristics of each metasedimentary unit studied.

3.3 U-Pb geochronology

The preparation of selected samples for U-Pb zircon dating was conducted at the Geochronology Laboratory of the University of Brasília (UnB). Initially, geological samples underwent a process of comminution, followed by passage through a disk mill to obtain finely crushed material. Subsequently, the resulting

material was subjected to concentration techniques employing a pan, followed by drying within a temperature range of 50 to 70 degrees Celsius. Magnetic separation was then employed to isolate the magnetic fraction from the non-magnetic fraction, accomplished using a neodymium magnet.

The non-magnetic fraction was further divided into two segments based on their density, with one portion exhibiting a density greater than 3.31 g/cm³ and the other having a density less than 3.31 g/cm³. This segregation was achieved using a decantation funnel and diiodomethane. The denser fraction was subsequently subjected to separation into diamagnetic and paramagnetic components utilizing a Frantz magnetic separator machine. With the aid of a microscope and magnifying glasses, the zircon grains contained in the samples were separated from the diamagnetic fraction.

The zircon grains were embedded in acrylic resin and underwent a polishing process utilizing alumina powder. Cathodoluminescence (CL) images were acquired using a Scanning Electron Microscope (SEM), specifically the JEOL 6510 model.

U-Pb isotopic data were collected at the Laboratory of Isotopic Geochemistry at the Federal University of Ouro Preto (UFOP) utilizing a systematic methodology. U-Pb analysis was performed utilizing a Neptune Plus Thermo Finnigan instrument coupled with a Photon-Machines 193nm laser system. Data acquisition was conducted in peak jumping mode, which included a 20-second background measurement, a 20-second zircon ablation, and a 30-micrometer spot size. Data reduction and processing were carried out using the Saturn Software.

Age calculations and frequency histograms were generated employing the Isoplot 4.15 software developed by *Ludwig (2012)*. Notably, all zircon data included in the histograms exhibited at least 90% concordance. It should be noted that for some samples, this level of concordance led to a statistical reduction in the number of zircon grains analyzed. Nevertheless, the dataset comprised more than 150 grains in total, including zircon samples and standards, each sample underwent more than 250 individual analyses. It is worth mentioning that, in accordance with the standards established in this study, a few samples exhibited statistically valid populations below 50 grains.

3.4 Lu-Hf Isotopes

The Lu-Hf isotopic analyses were carried out at the Laboratory of Isotopic Geochemistry at Federal University of Ouro Preto (UFOP). The analysis was obtained using a Neptune Pluss Thermo Finnigan coupled with a Photon-Machines 193nm laser system on the same grain samples of U-Pb analysis, according to the methodology at *Gerdes & Zeh (2006, 2009)*. Around ten grains per sample were selected. Grains with at least 95% concordance, which represented the most prominent age peaks, were used.

3.5 Whole Rock Sm-Nd Isotopes.

Sample preparation and isotopic analysis took place at the Geodynamic, Geochronological, and Environmental Studies Laboratory of the University of Brasilia. The samples underwent to crushing and pulverization into extremely fine grains. Details of the isotope analytical procedures can be found in *Gioia and Pimentel (2000)*. Approximately 50 to 100 mg of each sample were combined with a solution containing $^{149}\text{Sm} - ^{150}\text{Nd}$ spike, then dissolved in Teflon Savillex beakers through successive acid treatments (HNO_3 , HF, and HCl). Nd, Sm, and Sr were separated using chromatographic columns. Strontium and Rare-Earth Elements (REEs) underwent separation in a primary column packed with AG 50W-X8 cation exchange resin, while Sm and Nd were isolated using conventional cation exchange chromatography techniques employing Teflon columns filled with LN-Spec resin (HDEHP-di-2-ethylhexyl phosphoric acid supported with Teflon powder). Fractions of Strontium, Sm, and Nd were deposited onto double Re evaporation filaments, and isotopic measurements were conducted using a multicollector TRITON Plus Thermal Ionization Mass Spectrometer (TIMS). Analysis of the NBS-987 reference material produced an average $^{87}\text{Sr}/^{86}\text{Sr}$ ratio of 0.71028 ± 0.000035 (2SE), consistent with the recommended value (Hodell et al., 2007). Repeated analysis of the BHVO-2 reference material yielded a $^{143}\text{Nd}/^{144}\text{Nd}$ ratio of 0.512970 ± 0.000002 (2SE), in agreement with the recommended value (Weis et al., 2005).

The measured $^{143}\text{Nd}/^{144}\text{Nd}$ sample ratios are expressed in Epsilon Neodymium notation (ϵNd) as the fractional deviation in parts per 10^4 (units) from the $^{143}\text{Nd}/^{144}\text{Nd}$ value of the Chondritic Uniform Reservoir (CHUR).

4 RESULTS

4.1 Field aspects and petrography of metasedimentary units

The rocks of the GBSSR in general has undergone high grade of weathering, preserved surface outcrops are scarce, and a remarkable feature of the studied area is the notable erosion observed in the central and northwest sections of the greenstone belt, leading to a significant reduction in the volume of preserved metasedimentary rocks, compared to that of metavolcanic rocks (Fig.03). This distribution pattern is reversed towards the southeastern part of the greenstone belt, where the largest volume of metasedimentary rocks is observed (Fig.03). The general lithological contact between the units is tectonic, marked by thrust faults. The units of the Fazenda Paraíso Group at some sections in the northwest portion of the Greenstone Belt exhibit transitional contacts, however, due to the weathering in this region, these features are difficult to distinguish.

Petrographic analyses focused on three metasedimentary units: the Serra do Cantagalo formation, which overlaps the southeast portion of GBSSR, and the members of the Fazenda Paraíso Group (Fazenda Cruzeiro Formation and Fazenda Limeira Formation) (Rezende *et al.*, 1998) (Fig.05).

4.1.1 Fazenda Limeira Formation

The Fazenda Limeira formation encompasses a variety of lithotypes, including carbonaceous phyllites (Fig.05A), metapelites (Fig.05B), metachert, fine-grained quartzites (Fig.05C), and marble (Fig.05D). It has the most extensive distribution within the GBSSR, with outcrops present in the northwest, central, and southeast parts of the region. However, the southeastern portion is characterized by the largest and most significant exposures of this formation. Carbonaceous phyllite is characterized by non-crystalline form of organic matter, and micaceous minerals, such as muscovite (Fig.05A) and chlorite. The marbles (Fig.05D) are

fine grained rocks with mineral composition comprising (45%-60%) carbonates, (35%-45%) quartz and (5%-10%) micaceous minerals. Additionally, iron oxides/hydroxides and zircon are present as accessory minerals. The metapelites are represented by fine-grained quartz-chlorite-muscovite schists (Fig.08B) and are composed of (40%-55%) muscovite, (25%-30%), chlorite (15%-25%), quartz and (10%-5%) iron oxides/hydroxides, along with zircon.

The absence of graphite in the carbonaceous phyllite mineral assemblage suggests a greenschist facies condition, which is further supported by the metamorphic assemblage characterized in the chlorite-muscovite schists.

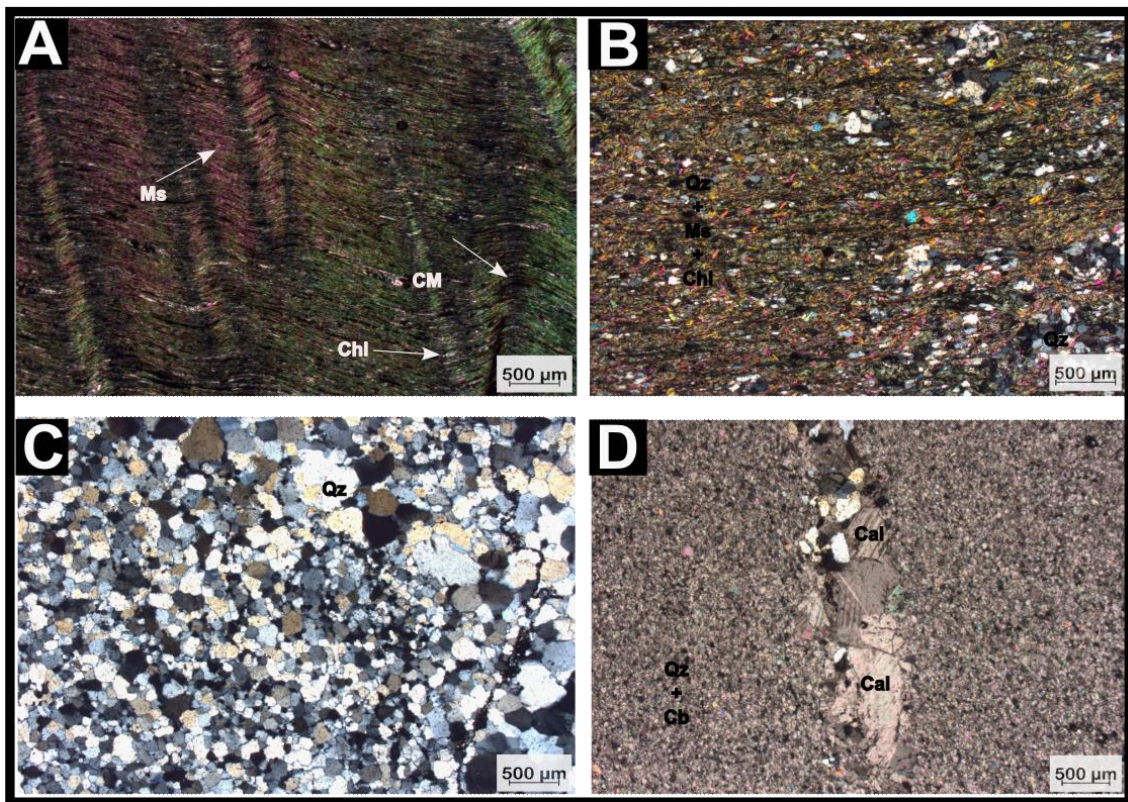


Fig.05 –Photomicrographs of most common lithotypes in the Fazenda Limeira Formation. (A) Carbonaceous phyllite composed of muscovite and non-crystalline carbonaceous matter. (B) metapelite composed of fine-grained quartz and micaceous minerals. (C) fine-grained quartzite with recrystallized portions. (D) marble composed of fine to coarse grains of quartz, carbonate, and muscovite. Ms=Muscovite, Qz=Quartz, CM=Carbonaceous Matter, Chl=Chlorite, and Cal= Calcite.

4.1.2 Fazenda Cruzeiro Formation

The Fazenda Cruzeiro Formation has a restricted occurrence, primarily in the central and northwest regions of the GBSSR. This region represents the least preserved area within the greenstone belt and exhibits the lowest concentration

of metasedimentary rocks when compared to the southeast region. The lithotypes within this formation consist of meta-arkoses, metagraywackes, and Meta rhythmites.

Meta-arkoses and metagraywackes have a mineral composition of (20%-35%) plagioclase, (35%-45%) quartz, (15%-25%) muscovite, (5%-20%) chlorite, iron oxides/hydroxides, Apatite, and zircon as accessory minerals. The distinction between meta-arkoses and metagraywackes lies in the proportion of fine-grained matrix; if it exceeds 15%, it was classified as metagraywacke. The metarhythmites consist of centimetric intercalations of quartzite and metapelites. The metapelites are represented by fine-grained quartz-chlorite-muscovite schists and are composed of (40%-55%) muscovite, (25%-30%) chlorite, (15%-25%) quartz, and (10%-5%) iron oxides/hydroxides.

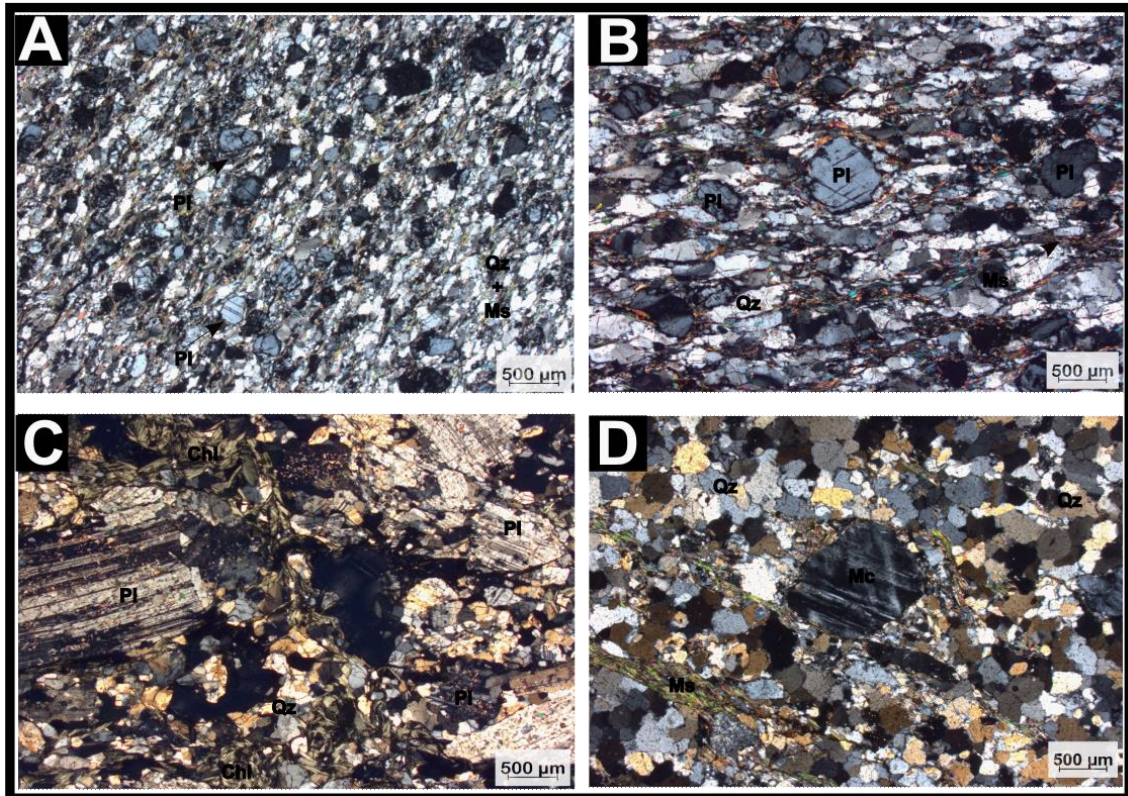


Fig. 06– Photomicrographs of most common lithotypes in Fazenda Cruzeiro Formation. (A) metagraywacke composed of fine-grained quartz, thin muscovite layers and angular to subangular rotated plagioclase. (B) meta-arkose composed of medium to coarse recrystallized and elongated quartz, angular plagioclase grains and thin layers of muscovite. (C) meta-arkose composed of fine to medium recrystallized quartz, coarse-grained angular plagioclase, and chlorite layers. (D) metagraywacke composed of fine to medium recrystallized quartz, coarse-grained angular microcline, and muscovite. PI=Plagioclase, Mc=Microcline, Qz=Quartz, Ms=Muscovite and Chl=Chlorite.

4.1.3 Serra do Cantagalo Formation

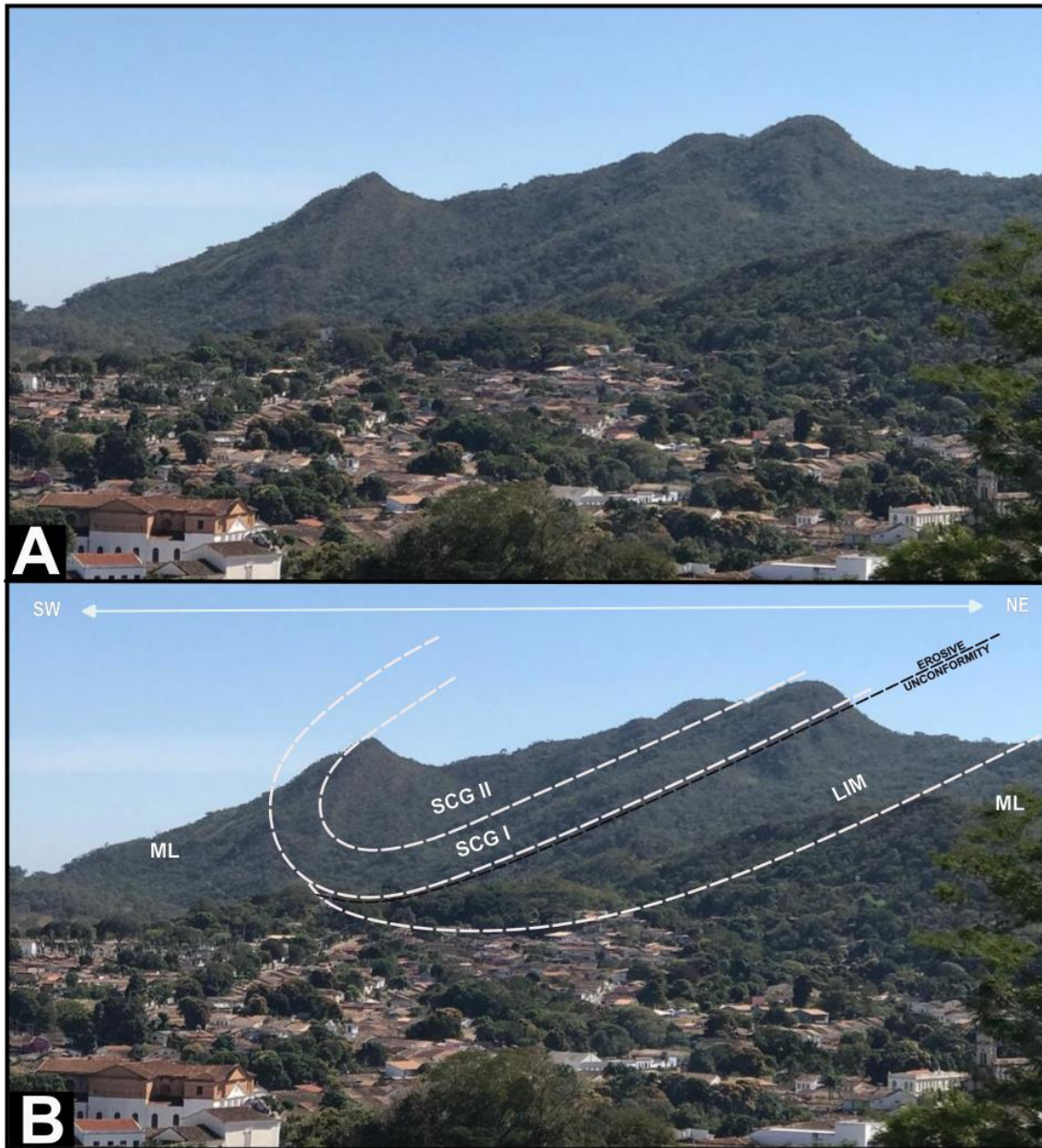


Fig. 07 – (A) view (SE-NW) of the Serra do Cantagalo height, (B) Synclinatorium observed in a SW-NE profile which transects the Cantagalo elevation. ML = Manoel Leocádio Formation, LIM= Fazenda Limeira Formation, SCGI = Serra do Cantagalo Formation Lower member and SCGII= Serra do Cantagalo Formation upper member.

The main outcrops of this geological unit are predominantly found within a height situated in the southeastern region of the GBSSR. This elevation is commonly referred to by several names; including Serra da Via Sacra, Serra de Santa Rita, Serra de São Francisco, and Serra do Cantagalo. In this portion of the greenstone belt, the Serra de Cantagalo Formation underwent tectonic

superposition upon the Fazenda Limeira Formation and within the same tectonic event the units were folded into a synclinorium.

The lithologies present in the lower member of the Serra de Cantagalo Formation (SCGI) consist of conglomeratic quartzites with lenses of polymictic metaconglomerate and muscovite-quartz schist. The metaconglomerate contains pebbles of quartzite, muscovite-quartz schist, and metavolcanic rocks. The matrix comprises (5%-10%) sulfides, (50%-65%) quartz with granulometry ranging from fine to medium, (5%-10%) non-crystalline carbonaceous matter, (20%-30%) muscovite and sericite (5%-15%). The matrix of conglomeratic quartzite consists of (80%-90%) quartz and (10%-20%) muscovite (Fig.07). The most common rock in this member is muscovite-quartz schist, characterized by a grain size ranging from fine to medium, composed of (55%-65%) quartz, (45%-35%) muscovite, and iron oxides/hydroxides and zircon, which are present as accessory minerals in all lithologies. The upper member of the Serra de Cantagalo Formation (SCGII) has a broader distribution of outcrops and consists of muscovite-quartz schist and orthoquartzites. These rocks are primarily composed of (55%-95%) quartz and (5%-45%) muscovite.

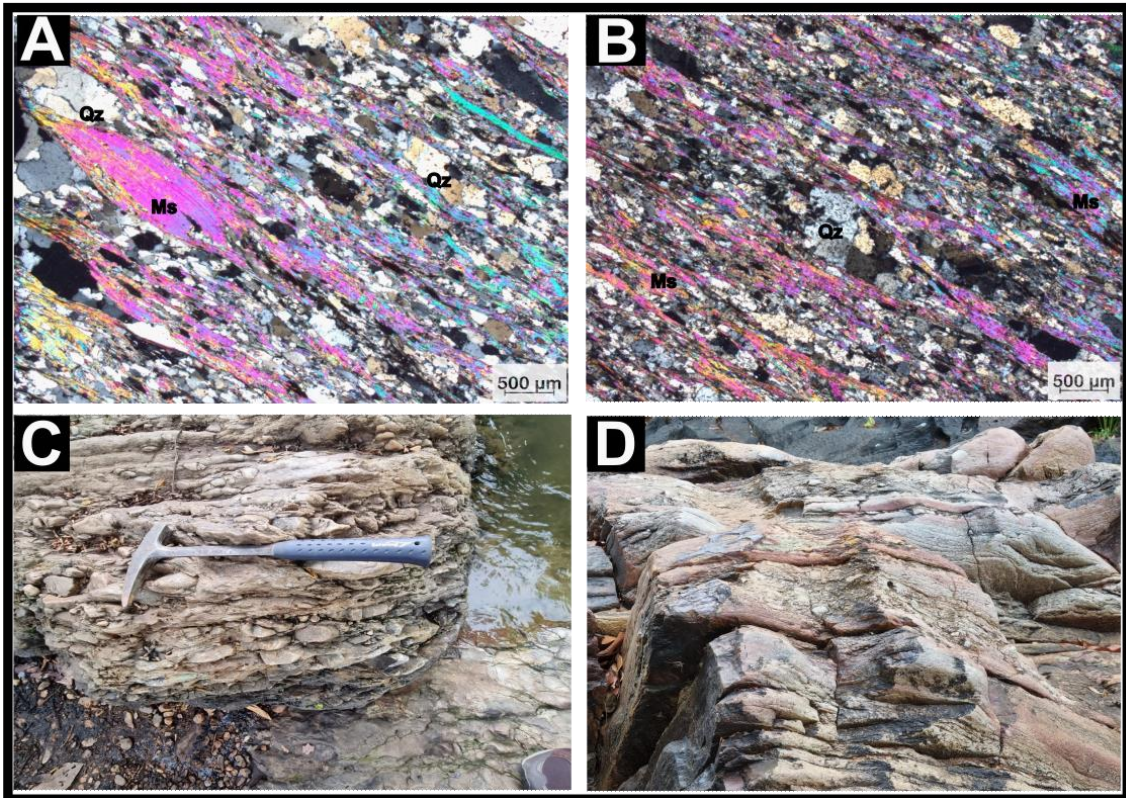


Fig. 08 – (A) and (B) Photomicrographs of most common rocks in the SCG, muscovite-quartz schist, composed of fine to medium stretched and recrystallized quartz intercalated with micaceous minerals in a lepidoblastic texture., (C) metaconglomerate outcrop, (D) muscovite-quartz schist outcrop, Ms=Muscovite, Qz=Quartz.

4.2 Detrital zircon U-Pb geochronology

Eight samples were selected for detrital zircon U-Pb analysis, distributed across the three regions of the greenstone belt: northwest, central and southeast, as well as in the three analyzed metasedimentary units. The Samples 21TG15, 21TG6A and 21TG25 represent the Serra do Cantagalo Formation, while 21TG16A and 22TG65 represent the Fazenda Limeira Formation. Additionally, samples 22TG46, 22TG30, and 22TG13B represent the Fazenda Cruzeiro Formation.

The populations of detrital zircon analyzed in all samples are heterogeneous with euhedral prismatic grains, rounded and sub-rounded shapes with internal growth zoning, and different colors and sizes. The grains populations can be divided into two main groups: an older with ages ranging in the Archean (3.6Ga to 2.5Ga), and a younger concentrated in the Rhyacian (2.3Ga to 2.05Ga). One sample from the lower member of the Serra do Cantagalo (SCGI), 21TG6A, exhibits the youngest ages, ranging in the Orosirian (2.05Ga to 1.8Ga). This is the only, and important, sample of this population (Fig.09).

All zircon data presented in the histograms are at least 90% concordant. Some samples showed statistically valid populations (according to the standard established in this work) below 50 grains, however more than 200 grains were analyzed for each sample.

The sample 21TG15, collected from a pelitic lense outcrop at the top of the Serra do Cantagalo Formation (SCGII), provided 72 concordant grains. It exhibits an age peak at 2.8Ga and an age distribution ranging from 3.08Ga to 2.5Ga. A total of 72 detrital zircon grains were recovered in the sample 21TG6A, which represents the matrix of the metaconglomerate from the lower member of the Serra de Cantagalo Formation. This sample shows three distinct populations: one peak in the Rhyacian, the second peak in the Archean, and a few grains in the Orosirian (Fig.09). Sample 21TG25 represents a quartzite sample located in the northeast limit of the Serra de Cantagalo elevation, belonging to the upper member of the Serra de Cantagalo Formation (SCGII). This particular sample exhibits the lowest number of concordant zircon grains, and an age peak at 2.9Ga, its age distribution of populations is similar to that of sample 21TG15, ranging from 3.0Ga to 2.8Ga.

Sample 21TG16A, from a carbonaceous phyllite of the Fazenda Limeira Formation, in the southeast portion of the GBSSR, provided 42 concordant grains and a population peak at 2.15Ga, with a distribution age restricted to the Rhyacian (Fig. 09). At the northwest portion of the GBSSR, the sample 22TG65 represents the metapelites of the Fazenda Limeira formation, with 95 concordant zircon grains. This sample shows two populations: the highest peak at the Rhyacian interval and a lower contribution of Archean ages.

The Fazenda Cruzeiro Formation still has two samples, one at the central portion of the GBSSR, the sample 22TG30, which represents meta-arkose, with 47 concordant grains. The main age peak is at 2.9Ga and the population ranges in Archean ages. Sample 22TG46 represents the meta-arkose and metagraywacke from the northwest portion of the GBSSR, with 71 concordant grains. The zircon populations revealed Archean ages, with a dominant peak at 2.9 Ga. In the central portion of the GBSSR, the sample 22TG13B represents the metarhythmites, with 37 concordant grains showing an age peak at 2.8Ga and ages concentrated in the Archean.

Sample 22TG13 represents the metarhythmites from the Fazenda Cruzeiro Formation. During fieldwork, this sample was subdivided into two distinct portions, denoted as sample A and sample B. Specifically, sample A corresponds to the pelitic component, whereas sample B is the quartzite component. Regrettably, the pelitic sample exhibited a limited abundance of zircon grains, so it was decided by analysis of sample B only.

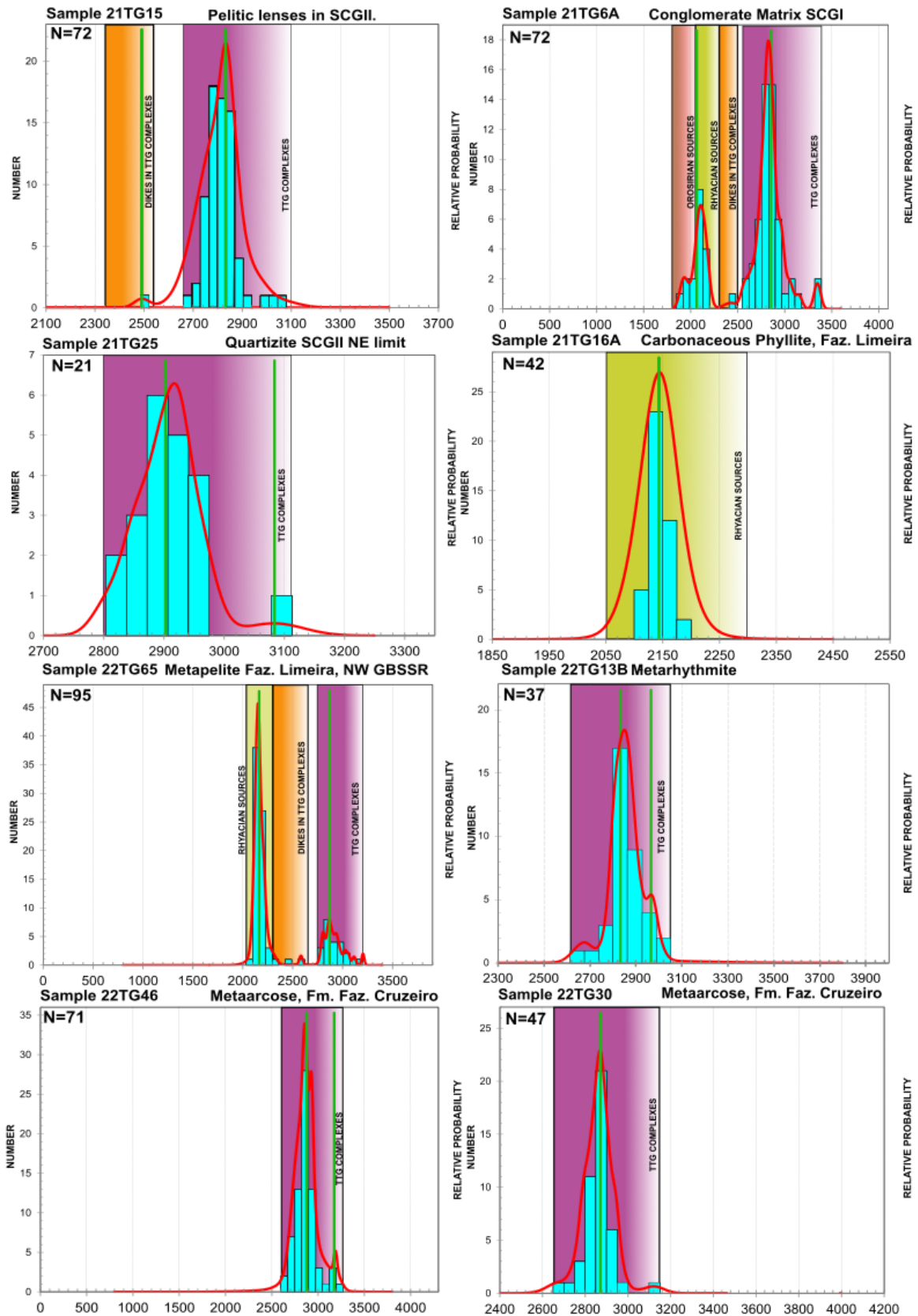


Fig.09 –Frequency histograms for detrital zircon grains of metasedimentary rocks of the Serra de Santa Rita Greenstone Belt. All zircon data presented in the histograms are at least 90% concordant. 207Pb/Pb206 ages were used for histogram plots.

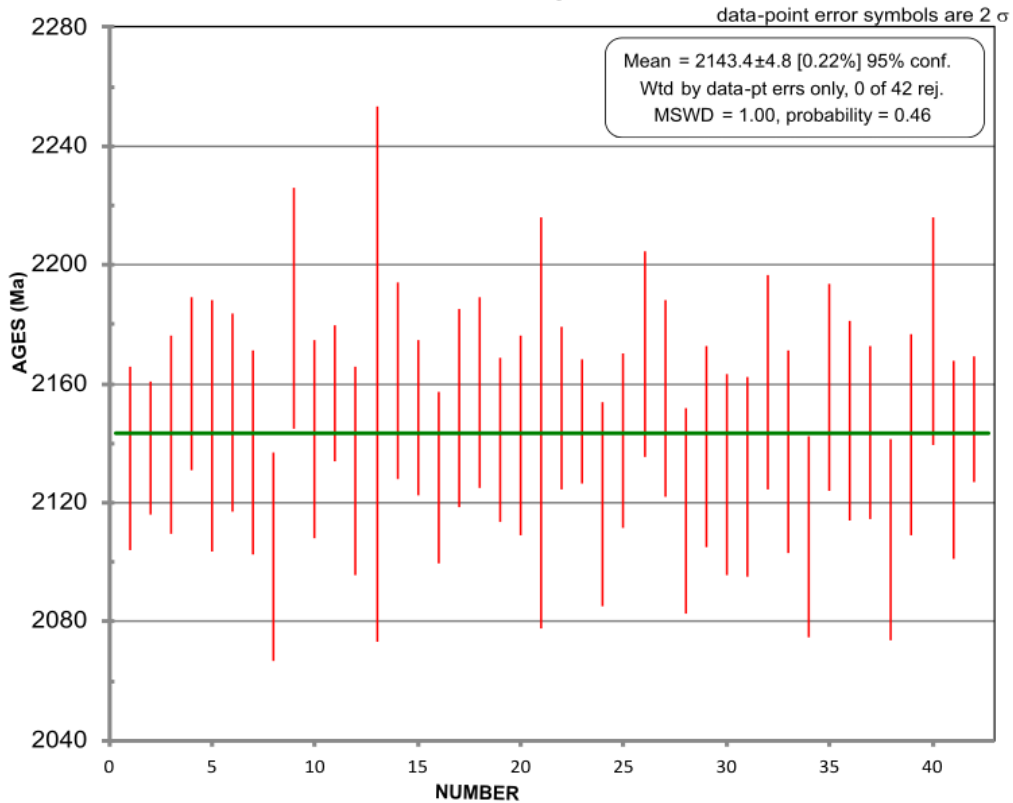
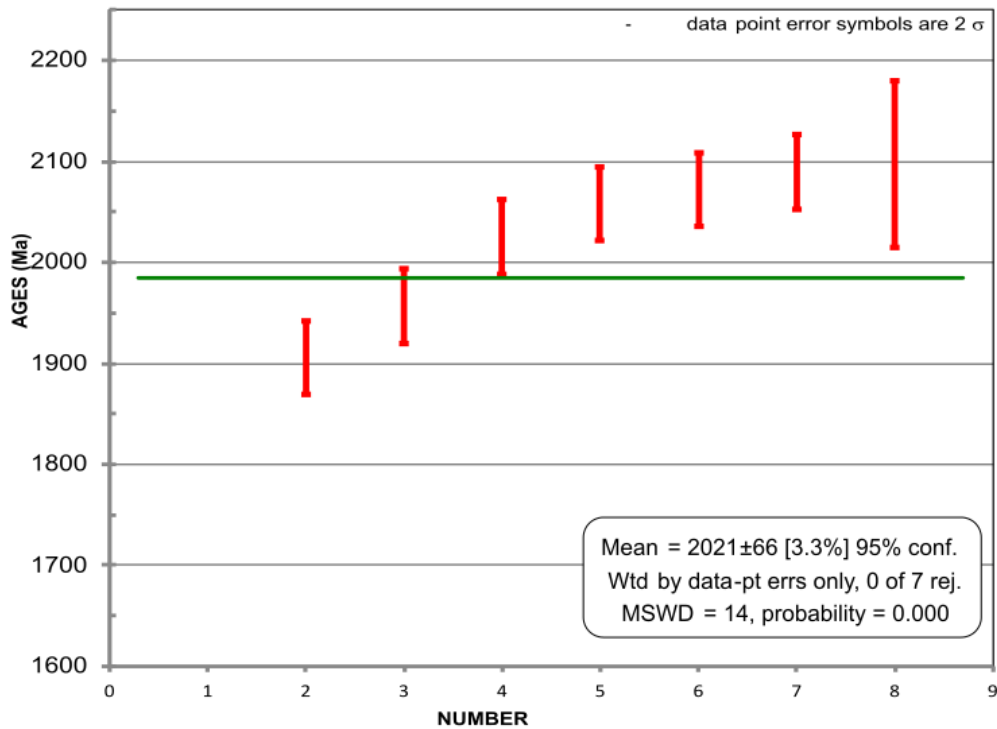
A**21TG16A - Carbonaceous Phyllite, Faz. Limeira Fm****B****Sample 21TG6A - Conglomerate Matrix SCGI, Youngest Zircon**

Fig. 10 – Maximum deposition age calculated by the weighted mean of the youngest zircon population from the youngest rock sample for the metasedimentary rocks of the Fazenda Limeira Formation (A) and Serra do Cantagalo Formation (B).

The maximum age of deposition was calculated by the weighted mean of the youngest zircon population from the youngest rock sample of each metasedimentary unit. The first sequence was delimited by the sample 21TG16A, with maximum deposition age at 2.14Ga and youngest zircon at 2.1Ga. The second sequence was delimited by the sample 21TG6A, with grains younger than 2.1Ga, the maximum deposition age was calculated at 2.02Ga, and the youngest zircon has a 1.9 Ga age.

4.3 Lu – Hf Isotopes

Lu-Hf analyzes were carried out in the same group of zircon analyzed for U-Pb geochronology, according to the methodology explained in this study. The data were separated by formation. The ϵ_{Hf} was calculated based on U-Pb age for each zircon grain.

Tab.01 – Lu-Hf isotopic data of metasedimentary rocks from the Fazenda Limeira Formation.

SAMPLES	Grain Lu-Hf	Grain U-Pb	Age $\text{Pb}^{207}/\text{Pb}^{206}$ (Ma)	ROCK TYPE	Formation	$^{176}\text{Lu}/^{177}\text{Hf}$	$\pm 2\sigma$	$^{176}\text{Hf}/^{177}\text{Hf}$	$\pm 2\sigma$	ϵ_{Hf} $t=0$	ϵ_{Hf} $t=\text{Age}$ $\text{Pb}^{207}/\text{Pb}^{206}$	$\pm 2\sigma$	T_{DM} (Ga)
21TG16A	40	190	2149	Carbonaceous Phyllite	Faz. Limeira	0.001345	12.715	0.281377	23.704	-49.793	-3.12	1.185	2.59
	41	186	2102			0.000608	3.999	0.281301	21.884	-52.466	-5.80	1.094	2.71
	42	190	2149			0.001023	8.493	0.281518	24.072	-44.799	2.37	1.204	2.29
	43	180	2157			0.000804	6.803	0.281283	22.716	-53.104	-5.47	1.135	2.73
	44	176	2141			0.000715	5.852	0.281460	23.240	-46.841	0.58	1.162	2.38
	45	196	2186			0.000754	5.998	0.281406	22.474	-48.769	-0.39	1.124	2.47
	46	197	2128			0.000704	4.860	0.281304	21.313	-52.381	-5.25	1.065	2.70
	47	153	2119			0.000625	4.357	0.281433	20.235	-47.825	-0.76	1.012	2.44
	48	77	2141			0.000889	5.506	0.281340	23.536	-51.105	-3.95	1.176	2.63
22TG65B	49	30	2161			0.000730	7.590	0.281462	23.266	-46.781	1.08	1.163	2.37
	65	155	2106	Metapelite NW GBSSR	Faz. Limeira	0.001074	7.281	0.281555	20.192	-43.491	2.65	1.010	2.24
	66	164	2902			0.005402	56.875	0.281646	28.354	-40.270	15.35	1.418	2.15
	67	165	2309			0.001412	8.689	0.281542	22.805	-43.959	6.22	1.141	2.20
	68	166	2786			0.001197	8.600	0.281041	15.053	-61.675	-0.49	0.752	2.95
	69	248	2893			0.000760	4.903	0.280999	20.935	-63.149	1.30	1.045	2.93
	70	194	2884			0.000913	7.055	0.281010	26.195	-62.758	1.20	1.308	2.93
	71	134	2065			0.001808	18.900	0.281069	25.977	-60.686	-16.58	1.297	3.27
	72	116	3058			0.000661	5.661	0.280893	25.649	-66.921	1.52	1.280	3.05
	73	118	2163			0.000807	4.952	0.281303	22.623	-52.420	-4.65	1.131	2.69
	74	193	2211			0.001137	13.023	0.281433	17.609	-47.803	0.58	0.880	2.44

Samples 21TG16A and 21TG65 from the Fazenda Limeira Formation have ten grains analyzed each (Tab.01). Sample 21TG16A has three grains indicating superchondritic ϵ_{Hf} values, varying between 0.58 to 2.37, and TDM ages ranging from 2.29Ga to 2.38Ga

The others seven grains showed sub-chondritic ϵ_{Hf} values, varying between -0.39 to -5.80, and TDM ages ranging from 2.44Ga to 2.71Ga. Thus, the two groups can be separated according to the TDM ages: ages smaller than 2.38Ga present superchondritic ϵ_{Hf} values, and ages greater than 2.38Ga present sub-

chondritic ϵ_{Hf} values. Sample 21TG65 has five grains indicating superchondritic ϵ_{Hf} values, varying between 0.58 to 2.65, and two grains with high values (6.22 and 15.35). The TDM ages range from 2.24Ga to 3.05Ga. The high ϵ_{Hf} value grains are correlated with TDM ages of respectively 2.2Ga and 2.15Ga. The other three grains of this sample have sub-chondritic ϵ_{Hf} values, varying between -0.49 to -16.58, and TDM ages ranging from 2.69Ga to 3.27Ga.

Tab.02 – Lu-Hf isotopic data of metasedimentary rocks from the Fazenda Cruzeiro Formation.

SAMPLES	Grain Lu-Hf	Grain U-Pb	Age Pb ²⁰⁷ /Pb ²⁰⁶ (Ma)	ROCK TYPE	Formation	¹⁷⁶ Lu/ ¹⁷⁷ Hf	$\pm 2\sigma$	¹⁷⁶ Hf/ ¹⁷⁷ Hf	$\pm 2\sigma$	ϵ_{Hf} t=0	ϵ_{Hf} t= Age Pb207/Pb2	$\pm 2\sigma$	T _{DM} (Ga)
22TG46	85	20	3135	MetaArcose	faz. Cruzeiro	0.001379	9.454	0.280876	27.14121	-67.4973	1.19	1.354208	3.57
	86	24	2745			0.000971	13.485	0.280929	21.4045	-65.6156	-4.98	1.068245	3.44
	87	98	2683			0.000623	4.171	0.280991	19.97082	-63.4229	-3.54	0.996966	3.29
	88	168	2748			0.000368	3.017	0.280984	20.03922	-63.6959	-1.84	1.00039	3.28
	89	175	2851			0.000369	2.493	0.280981	16.89191	-63.7918	0.46	0.843267	3.29
	90	385	2904			0.000664	5.582	0.28098	21.62694	-63.8215	1.07	1.079589	3.31
	91	414	2859			0.000609	4.457	0.280995	25.7527	-63.2935	0.68	1.285617	3.28
	92	399	2886			0.000529	3.545	0.280983	21.47431	-63.7256	1.02	1.072002	3.30
	93	395	2921			0.000729	5.341	0.280906	20.32773	-66.4488	-1.30	1.014458	3.46
	94	437	3188			0.002241	13.626	0.28087	18.48633	-67.7357	0.28	0.922243	3.65
22TG30	75	485	2879	MetaArcose	faz. Cruzeiro	0.000837	5.477	0.280969	26.40614	-64.2088	-0.23	1.318072	3.35
	76	544	2664			0.000632	4.290	0.280964	19.77993	-64.4108	-4.99	0.987337	3.34
	77	497	2780			0.00196	17.676	0.280961	25.21159	-64.5176	-4.94	1.258202	3.45
	78	433	3777			0.000505	5.329	0.280984	22.84147	-63.6725	22.01	1.140259	3.29
	79	573	2903			0.000854	5.665	0.280982	19.88939	-63.7525	0.76	0.992834	3.33
	80	516	2803			0.001115	7.383	0.281021	21.15756	-62.3666	-0.64	1.056245	3.27
	81	518	3122			0.00153	9.708	0.280901	23.56703	-66.6309	1.46	1.175953	3.54
	82	350	2880			0.000776	5.448	0.280978	19.47608	-63.8864	0.23	0.972201	3.33
	83	363	2936			0.00149	9.325	0.28097	29.82677	-64.1712	-0.19	1.488676	3.40
	84	335	2872			0.000331	2.045	0.28097	18.41358	-64.1688	0.65	0.919198	3.31
22TG13B	95	245	2837	Metarhythmite GBSSR center	Faz. Cruzeiro	0.001277	10.683	0.281018	19.618	-62.481	-0.31	0.979	2.98
	96	243	2951			0.000593	3.705	0.280988	22.729	-63.546	2.59	1.135	2.90
	97	273	2803			0.000684	4.171	0.280955	20.662	-64.727	-2.21	1.031	3.05
	98	327	2684			0.001213	8.990	0.281018	21.558	-62.478	-3.65	1.076	3.04
	99	328	2806			0.002569	21.489	0.281149	23.099	-57.864	1.15	1.153	2.87
	100	314	2793			0.001684	21.870	0.281013	30.400	-62.662	-2.26	1.517	3.05

Samples 21TG46, 22TG30 and 22TG13B from the Fazenda Cruzeiro Formation have twenty-six grains analyzed (Tab.02). Sample 21TG46 has six grains indicating near chondritic to superchondritic nature, which ϵ_{Hf} values vary between 0.28 to 1.19, and TDM ages range from 3,28 Ga to 3.65Ga. The other 4 grains showed sub-chondritic ϵ_{Hf} values, varying between -1.30 to -4.98, and TDM ages ranging from 3.28Ga to 3.46Ga. Sample 22TG30 has four grains indicating near chondritic to superchondritic nature, with ϵ_{Hf} values varying between 0.23 to 1.46, and one grain with high values (22.01). The TDM ages range from 3.31Ga to 3.54Ga. The grain with high ϵ_{Hf} value has TDM age of 3.29Ga. Sample 22TG13B has two grains indicating superchondritic nature, with ϵ_{Hf} values varying between 1.15 to 2.59 and TDM ages ranging from 2,87 Ga to 2.9Ga. The others 4 grains showed sub-chondritic ϵ_{Hf} values varying between -

0.31 to -3.65 and TDM ages ranging from 2.98Ga to 3.05Ga. Two groups can be separated according to the TDM ages for this sample: ages smaller than 2.9Ga present superchondritic ϵ_{Hf} values, while ages greater than 2.9Ga present sub-chondritic ϵ_{Hf} values.

Tab.03 –Lu-Hf isotopic data of metasedimentary rocks from the Serra do Cantagalo Formation.

SAMPLES	Grain Lu-Hf	Grain U-Pb	Age Pb ²⁰⁷ /Pb ²⁰⁶ (Ma)	ROCK TYPE	Formation	¹⁷⁶ Lu/ ¹⁷⁷ Hf	$\pm 2\sigma$	¹⁷⁶ Hf/ ¹⁷⁷ Hf	$\pm 2\sigma$	ϵ_{Hf} t=0	ϵ_{Hf} t=Age Pb ²⁰⁷ /Pb ²	$\pm 2\sigma$	T _{DM} (Ga)
21TG6A	21	37	2978	Matrix Meta Conglomerate	SCGI	0.001387	9.214	0.281001	25.944	-63.083	2.07	1.295	2.95
	22	400	3358			0.001176	8.243	0.281031	23.906	-62.039	12.25	1.193	2.68
	23	368	2881			0.000312	1.941	0.280884	23.353	-67.212	-2.17	1.165	3.11
	24	369	2754			0.000895	5.643	0.281008	19.452	-62.853	-1.85	0.971	3.00
	25	344	2426			0.002233	14.833	0.280904	18.410	-66.500	-15.19	0.918	3.47
	26	329	2956			0.000265	1.703	0.280931	20.619	-65.565	1.33	1.029	2.98
	27	326	2072			0.001712	16.688	0.281570	21.949	-42.949	1.53	1.097	2.28
	28	293	2107			0.000412	2.493	0.281535	20.801	-44.220	2.88	1.040	2.23
	29	243	1905			0.000792	4.879	0.281629	21.724	-40.890	1.12	1.087	2.17
21TG15	30	487	3073	Metapelite	SCGII	0.00074	13.444	0.280799	23.612	-70.232	-1.62	1.177	3.23
	31	478	2673			0.00071	4.600	0.280991	25.169	-63.441	-3.95	1.256	3.05
	32	493	2781			0.00091	6.765	0.281010	18.910	-62.786	-1.20	0.944	2.98
	33	579	3011			0.00137	8.684	0.280984	19.694	-63.695	2.22	0.983	2.97
	34	580	2925			0.00063	3.950	0.280939	24.508	-65.263	0.19	1.223	3.02
	35	587	2831			0.00080	5.026	0.280987	20.593	-63.593	-0.64	1.028	2.99
	36	95	2845			0.00044	2.637	0.280952	27.082	-64.834	-0.87	1.351	3.01
	37	115	2980			0.00079	5.689	0.280988	20.538	-63.547	2.83	1.025	2.91
	38	97	2845			0.00084	5.229	0.281059	20.459	-61.040	2.17	1.021	2.84
21TG25	39	73	2490	Quartzite	SCGII	0.00057	5.081	0.281019	25.774	-62.447	-6.90	1.286	3.07
	55	36	2931			0.00058	3.630	0.280925	21	-65.766	-0.08	1.028	3.04
	56	113	2945			0.00074	4.793	0.280971	24	-64.152	1.53	1.207	2.96
	57	76	2972			0.00319	22.506	0.281155	27	-57.636	3.75	1.324	2.85
	58	245	2837			0.00112	7.295	0.281048	20	-61.428	1.05	0.984	2.90
	59	226	2953			0.00197	12.403	0.281049	19	-61.391	2.02	0.952	2.94
	60	255	3084			0.00089	6.091	0.280789	27	-70.574	-2.04	1.356	3.26
	61	267	2805			0.00072	4.804	0.280988	22	-63.558	-1.05	1.094	2.99
	62	259	2925			0.00079	5.318	0.280914	20	-66.148	-1.03	0.985	3.08
	63	145	2921			0.00146	25.391	0.280981	24	-63.780	-0.07	1.207	3.03
	64	118	2891			0.00162	16.977	0.281036	22	-61.866	0.86	1.113	2.95

Samples 22TG6A, 21TG15 and 21TG25 from the Serra do Cantagalo Formation have twenty-nine grains analyzed. Only the sample 22TG6A has nine grains, whereas the other samples have ten (Tab.03). Sample 22TG6A has five grains indicating superchondritic ϵ_{Hf} values varying between 1.12 to 2.88, and one grain with high value (12.25). The TDM ages range from 2.17Ga to 2.95Ga. The grain with high ϵ_{Hf} value has TDM age of 2.68Ga, while the other three grains showed sub-chondritic ϵ_{Hf} values varying between -2.17 to -15.19, and TDM ages ranging from 3.0Ga to 3.47Ga. Two groups can be separated for this sample, according to the TDM ages: ages smaller than 3.0Ga present superchondritic ϵ_{Hf} values, and ages greater than 3.0Ga present sub-chondritic ϵ_{Hf} values. Sample 21TG15 has four grains indicating near chondritic to superchondritic ϵ_{Hf} values, varying between 0.19 to 2.83, with TDM ages ranging from 2.84Ga to 3.02Ga. The others six grains showed sub-chondritic ϵ_{Hf} values

varying between -0.64 to -6.90, and TDM ages ranging from 2.98Ga to 3.23Ga. Sample 21TG25 has five grains indicating superchondritic ϵ_{Hf} values, varying between 0.86 to 3.75. The TDM ages range from 2.85Ga to 2.96Ga. The others four grains showed near chondritic to sub-chondritic ϵ_{Hf} values varying between -0.07 to -2.04, and TDM ages ranging from 2.99Ga to 3.26Ga.

The isotopic evolution of ϵ_{Hf} correlated with Pb-Pb ages (Fig.11), in general, presents values slightly higher or lower than the CHUR. Two groups can be defined from the graph, one of Archean age and the other of Rhyacian age for the samples of all formations. Archean sources show a diagonal dispersion trend and Rhyacian sources show a vertical dispersion trend.

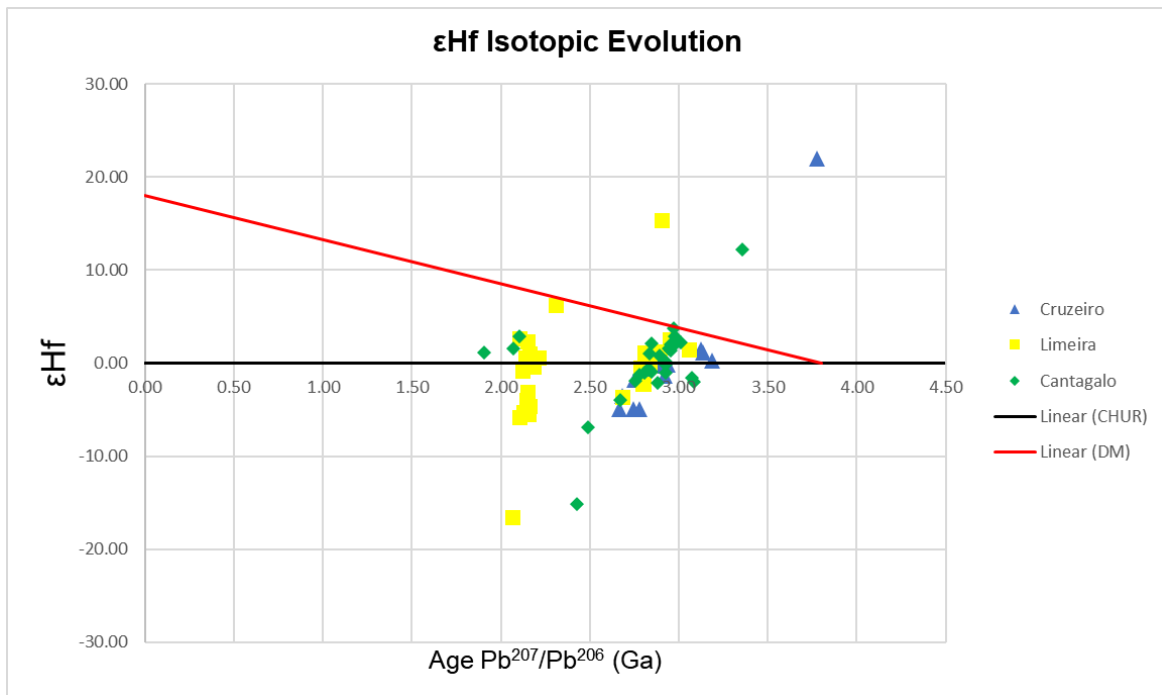


Fig. 11 – Isotopic Evolution of ϵ_{Hf} values correlated to Age $^{207}\text{Pb}/^{206}\text{Pb}$ Ga for all samples.

4.4 Sm-Nd Isotopes

The Sm-Nd analyses were conducted on whole rock scale and encompassed 11 samples distributed in the three studied metasedimentary units. These samples included Samples 21TG3B, 21TG5B, 21TG15B, and 22TG8B from the Serra do Cantagalo Formation (SCG1 and SCG2), samples 21TG16HB, 21TG16EB, and 21TG23AB from the Fazenda Limeira Formation, as well as

samples 22TG25B, 22TG30B, 22TG46B, and 22TG62B from the Fazenda Cruzeiro Formation. The results are shown in the table below.

Tab.04 – Sm-Nd isotopic data from the Serra de Santa Rita greenstone belt metasedimentary sequences.

SAMPLES	ROCK TYPE	Formation	Sm (ppm)	Nd (ppm)	$\frac{^{147}\text{Sm}}{^{144}\text{Nd}}$	$\frac{^{143}\text{Nd}}{^{144}\text{Nd}} \pm 2\text{SE}$	ϵ_{Nd} t= 2143 Ma	ϵ_{Nd} t= 2021 Ma	T _{DM} (Ga)
21TG3B	Meta-arenite (sandstone)	SCG1	1.821	7.674	0.143	0.511374+/-21	-	-12.17	3.70
21TG5B	Metaconglomerate (Matrix)	SCG1	1.727	9.311	0.112	0.510940+/-19	-	-12.50	3.17
21TG15B	Metapelite	SCG2	0.768	4.005	0.116	0.511017+/-26	-	-11.96	3.17
22TG8B	Meta-arenite (sandstone)	SCG2	1.519	8.393	0.109	0.511017+/-14	-	-10.28	2.97
21TG16HB	Metapelite (Mudstone)	Faz. Limeira	4.922	25.663	0.116	0.511263+/-6	-5.02	-	2.78
21TG16EB	Metapelite (Siltstone)	Faz. Limeira	2.911	15.234	0.116	0.511197+/-15	-6.19	-	2.87
21TG23AB	Carbonaceous Phyllite	Faz. Limeira	6.217	34.236	0.110	0.511649+/-4	4.26	-	2.03
22TG25B	Meta-arcose	Faz. Cruzeiro	1.174	5.737	0.124	0.510992+/-18	-12.48	-	3.52
22TG30B	Meta-arcose	Faz. Cruzeiro	1.281	8.053	0.096	0.510820+/-14	-8.23	-	2.88
22TG46B	Meta-arcose	Faz. Cruzeiro	1.166	7.003	0.101	0.510833+/-9	-9.23	-	2.99
22TG62B	Meta-arcose	Faz. Cruzeiro	0.785	3.927	0.121	0.511150+/-17	-8.58	-	3.12

The ϵ_{Nd} values were calculated at the maximum deposition age determined for these metasedimentary units (Tab.04). The metasedimentary rocks from the Fazenda Cruzeiro exhibit TDM ages ranging from 2.88Ga to 3.52Ga and $\epsilon_{\text{Nd}}(t)$ values ranging from -8.23 to -12.48. The metasedimentary rocks from the Fazenda Limeira Formation yield TDM ages ranging from 2.87Ga to 2.03 Ga and $\epsilon_{\text{Nd}}(t)$ values ranging from +4.26 to -6.19. The Serra do Cantagalo Formation shows TDM ages spanning from 2.97Ga to 3.70Ga and $\epsilon_{\text{Nd}}(t)$ values from -9.77 to -11.98.

The time-integrated isotopic evolution of ϵ_{Nd} (Fig.12) shows negative values for almost all samples. The values were calculated based on the basin ages proposed by the detrital zircon grains analysis (Fig.10): basin one (2143Ma) and basin two (2021Ma). The behavior of the curves of the Fazenda Cruzeiro and Serra do Cantagalo formations are practically the same, whereas for the Fazenda Limeira Formation, a higher angular coefficient is observed, with this formation being the only one that presents positive values.

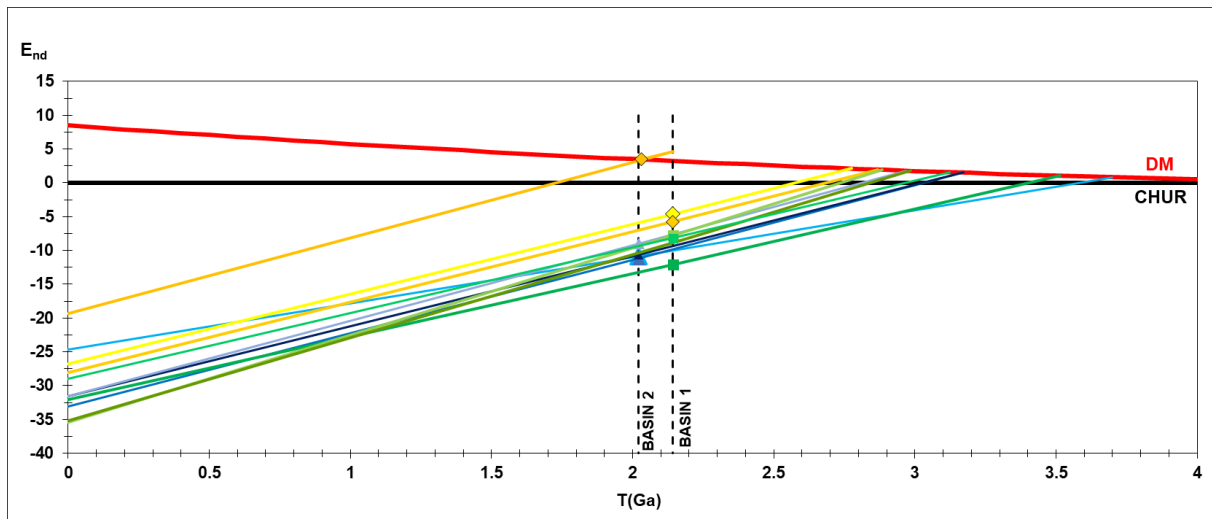


Fig.12 – Nd isotopic evolution diagram of metasedimentary units from the Serra de Santa Rita greenstone belt. The blue and green lines correspond to samples from the Serra do Cantagalo and Fazenda Cruzeiro formations, respectively, while the yellow lines represent samples from the Fazenda Limeira Formation. Depleted mantle (DM), bulk earth (CHUR), Basin 1= Serra de Santa Rita Basin, Basin 2= Serra do Cantagalo Basin, reference lines.

5 DISCUSSION

5.1 Stratigraphic Constraints

The studied region has a complex framework marked by geological structures like thrust faults, transcurrent faults and folds, which makes it difficult to apply the classical sequence stratigraphy concepts. The stratigraphic column defined by *Rezende et al. (1998)* has a direct correlation with topography which is a valid analysis when considering the structural complexity and strong erosion of the central and northwestern portions of the Serra de Santa Rita greenstone belt.

The differences between the source areas of the metasedimentary units within the Serra de Santa Rita greenstone belt are quite notable, as shown by our data. Nonetheless, our fieldwork observations and the transitional geological contact between Fazenda Limeira and Fazenda Cruzeiro Formations reinforce the hypothesis that these units belong to the same basin but exhibit varying sources and sedimentation environments.

However, a point to be reevaluated is the position of the Fazenda Cruzeiro Formation in the Serra de Santa Rita greenstone belt stratigraphy. The outcrops of this unit are restricted to the central and northwest portion of the greenstone

belt, a region highly eroded, and was not found in the portion where metasedimentary rocks are best preserved (southeastern portion) (Fig. 03). This setting makes it harder to explain how the top of a sequence can be preserved in a highly eroded region (topographic high) and have been eroded in the more preserved region (topographic low). Another important aspect is observed in the central portion of the greenstone belt, where outcrops of the Fazenda Cruzeiro Formation overlie the Manoel Leocádio Formation. The Fazenda Cruzeiro Formation is composed of metagraywackes and meta-arkoses, which consist of immature poorly reworked sediments with Archean detrital zircons, exhibiting ages corresponding to the Caiçara and Uvã TTGs, this suggests that the deposition of the Cruzeiro Formation took place proximal to the TTG source area.

According to the new stratigraphic positioning proposed in this work for the Fazenda Cruzeiro Formation, the metagraywackes and meta-arkoses would represent immature proximal sediments deposited near Archean sources, probably the TTG complexes (Fig.09). In this context, the metarhytmities at the top of the Fazenda Cruzeiro Formation mark the transition to a new depositional environment represented by metapelites and carbonaceous phyllites in the marine sedimentary sequence of the Fazenda Limeira Formation. The inverse stacking observed in certain field locations is a result of thrust faults promoting tectonic inversion of the stratigraphy.

Based on these observations, this study proposes a new stratigraphy for the sedimentary sequences of the Serra de Santa Rita greenstone belt, as seen in the figure below.

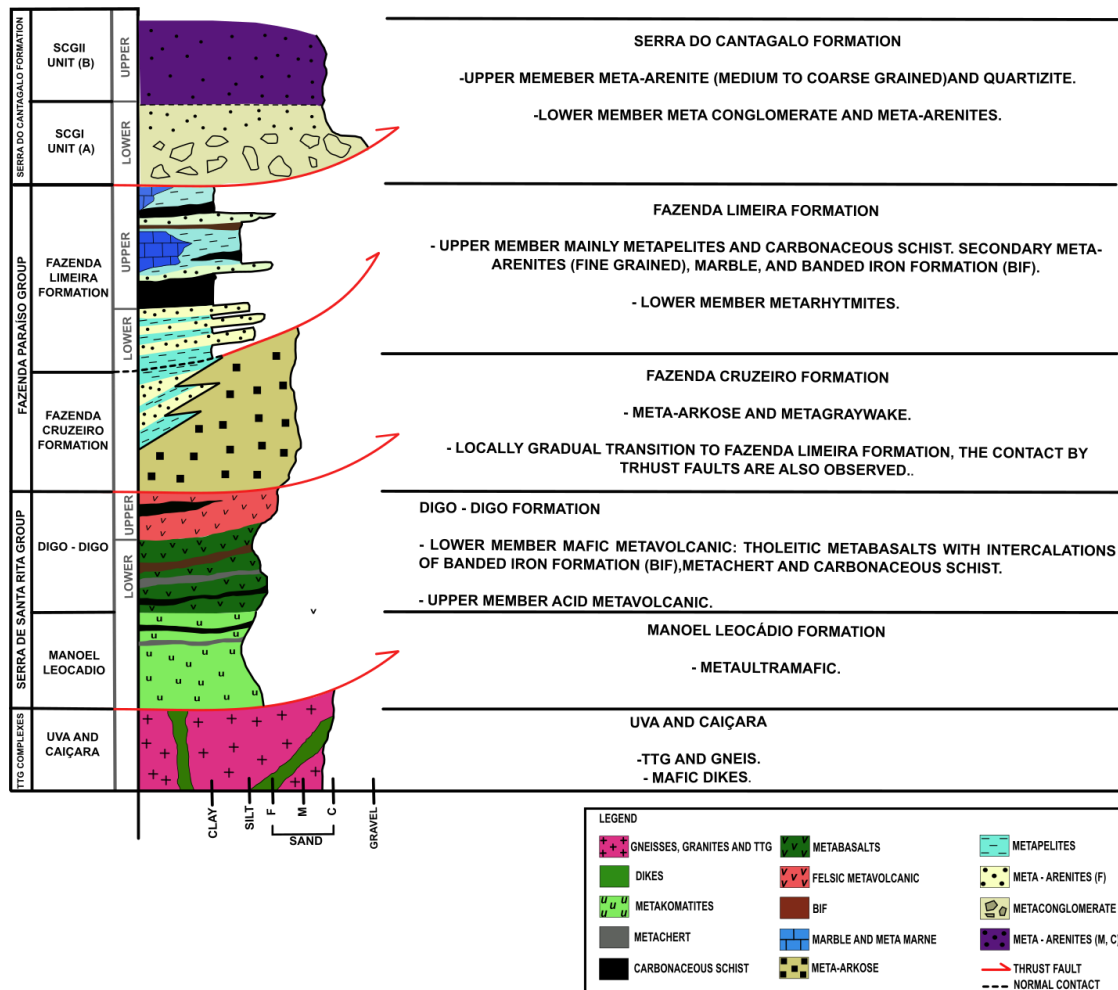


Fig.13 – New Stratigraphic Column proposed for the sedimentary sequences of the Serra de Santa Rita greenstone belt.

5.2 Provenance of the metasedimentary units

The results of the detrital zircon populations associated with the characteristics of the three metasedimentary units from the Serra de Santa Rita greenstone belt, allow the interpretation and the construction of some hypotheses about the source areas, the sedimentary basins, and some tectonic aspects.

The metasedimentary rocks from the three examined formations exhibit clear distinctions, both in terms of petrographic analyses and U-Pb zircon age spectra. The Serra do Cantagalo Formation is the youngest unit, which supports the idea of later emplacement of these rocks over the Santa Rita greenstone belt. The

Fazenda Limeira formation has characteristics of a marine sequence with a main source composed of Rhyacian rocks. The Fazenda Cruzeiro formation exhibits mineralogical and textural features that suggest transportation of sediments from a nearby source area, based on the preservation degree of the plagioclase and microcline grains and their angular shapes.

The Fazenda Cruzeiro Formation samples 22TG46 and 22TG30 have zircon populations restricted to Archean sources (Fig.09). Considering the geological context of the basin and its surroundings, as well as the petrological evidence of weak sediment transportation, and direct correspondence with the ages of the TTG complexes Uv (Jost *et al.*, 2013), and Caiara (Beghelli Junior *et al.*, 2012), makes it possible to affirm that the sources of this formation are these two TTG complexes (Fig.09).

The Fazenda Limeira Formation samples 21TG16A, 22TG65 and 22TG13B present three populations of zircon in their distributions (Fig.09). The first population is the Archean sources due to local geological characteristics that can be also correlated with the TTG terrains. The second population is the small Siderian peak which can be derived from the mafic dikes swarm described by Tomazzoli *et al.* (1994, 2001) and Correa da Costa *et al.* (2003, 2004). The presence of this population and the position of these intrusions along the TTG complexes suggest that the sediment transport coverage larger areas than the Faz. Cruzeiro Formation. Another potential source is the Siderian granite-gneisses located in the Paleoproterozoic Almas-Conceio do Tocantins Domain (Martins-Ferreira *et al.*, 2020). The last population is the Rhyacian sources. Based on the lack of extensive Rhyacian crust inside the Crixas-Goias Domain, it can be suggested that potential sources may be linked to the other domains of the Goias Massif, such as the Almas-Conceio do Tocantins (Fuck *et al.*, 2014), Cavalcante-Arraas (Botelho *et al.*, 2006, Cuadros *et al.*, 2017a, 2017b). and Campinorte domains (Giustina *et al.*, 2009, Cordeiro *et al.*, 2014), which comprise granite-gneissic rocks with ages ranging from 2.2Ga to 2.1Ga.

The Serra do Cantagalo Formation is represented by the samples 21TG15 and 21TG25 (SCGII) and 21TG6A (SCGI). The Sample of SCGII (21TG15) has main peaks and zircon grains populations with Archean ages and a small peak with Siderian ages (Fig.09). Considering the geological context and the

surroundings of the basin, the main source of the sediments is possibly the TTGs, in particular the Caiçara and Uvã complexes. Sample 21TG6A, from the conglomerate matrix, has the greatest range of ages in the zircon population histogram. The respective unit is composed of meta conglomerates, meta-arenites and quartzites, which suggests a deposition environment with weak sediment transportation, poor sorting and sediments sources close to the basin. The origin of the Archean and Siderian grains is likely the same as those from sample 21TG15, previously discussed. The Rhyacian grains may be associated with the erosion of the Fazenda Limeira Formation in the Serra de Santa Rita Greenstone Belt or with the Rhyacian domains of the Goiás Massif (Fig.02). The Orosirian grains exhibit small peaks on the histogram, which suggests some possible scenarios. The first scenario is this sources are far from the basin, and the second one is this respective source rocks have a low concentration of zircon, and the last possibility corresponds to both scenarios.

In the region, nearby sources with Orosirian ages are present in the metavolcanic rocks of the Mossamedes Sequence, with a Rb/Sr isochoric age of 1933Ma (*Pimentel et al., 1996*). Other basins in this geological context have a similar zircon population distribution (Fig.14), more precisely, the younger sedimentary rocks of the Araí and Serra da Mesa Groups, covering the Campinorte and Cavalcante-Araí domains, respectively. These younger zircon populations have been attributed to volcanic rocks in a rifting context.

Previous studies on the Serra de Santa Rita greenstone belt metasedimentary units interpret the Serra do Cantagalo Formation as a nappe of the Meso-Neoproterozoic Araxá Group (*Danni et al., 1981 and Baêta et al., 1998*). Although the rocks of the Araxá group outcrop near the Serra de Santa Rita greenstone belt (see Fig.03), and there are some lithological similarities between these sequences, the detrital zircon studies in the Araxá Group (*Piuzana et al., 2003*) highlights the signature of Meso-Neoproterozoic sources of the Brasiliano-Pan African Orogeny. Another research carried out in the southeast limit of the Araxá Group (*Falci et al., 2018*) discuss the shift of sediments source on this portion of the basin with greater input of cratonic sediments, although still has the important presence of Meso-Neoproterozoic sources. Such sources were not found in the analyses of detrital zircon from the Serra do Cantagalo formation

in this study. Therefore, based on our data, it is not feasible to establish a correlation between the Serra do Cantagalo rocks and the Neoproterozoic Araxá Group (Fig.14).

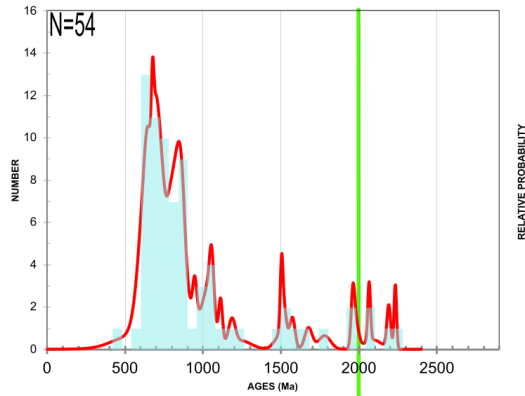
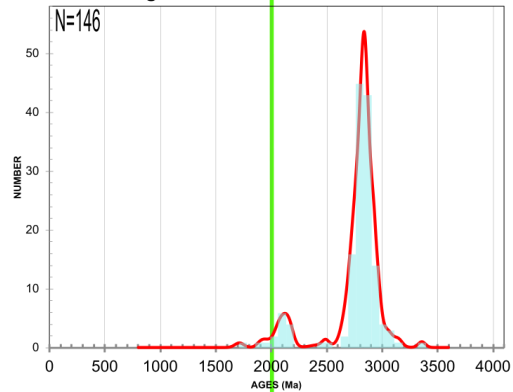
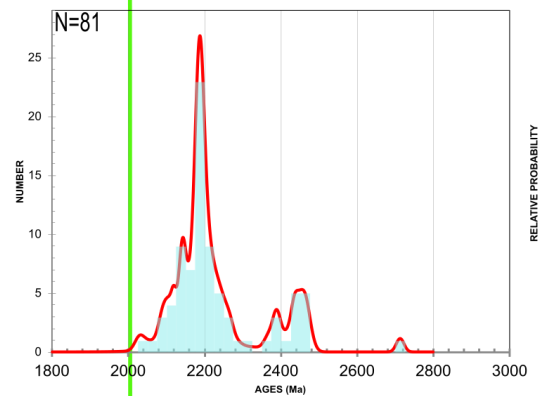
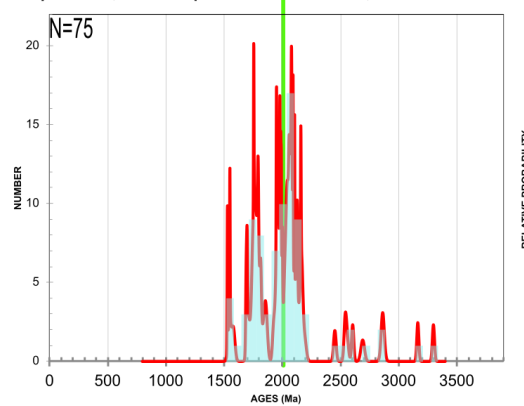
Piuzana et al., 2003 samples ANA18 and ANA34, Araxá Group*Cantagalo Detrital Zircon SCG1 and SCG2**Marques et al., 2010 samples PM255 and PM267, Traíras Fm.(Quartzites) Araí Group**Marques et al., 2010 samples PM297 and PM314, Quartzites Serra da Mesa Group*

Fig.14 - Comparison between detrital zircon data of the Araxá group (*Piuzana et al., 2003*), Serra do Cantagalo Formation, Traíras Formation - Araí Group and Serra da Mesa Group (*Marques et al., 2010*), in green guideline at the 2.0Ga.

5.3 Sm-Nd and Lu-Hf Isotopic data

The three analyzed units presented two distinctive groups of ϵNd (t) values. The Fazenda Cruzeiro Formation and Serra do Cantagalo Formation are defined by $\epsilon\text{Nd}(t) < 0$ (Fig.12), and the main source of sediments for these two formations is older crustal rocks. The source for the Fazenda Cruzeiro Formation is the Archean TTG complexes, while the sources for the Serra do Cantagalo Formation are probably the TTG complexes, the rocks of the Greenstone Belt Serra de Santa Rita, and the Paleoproterozoic sources of the Goiás Massif. The second group represents the Fazenda Limeira Formation and shows a trend marked by an angular coefficient slightly bigger than the first group and has the only value of $\epsilon\text{Nd}(t) > 0$ (Fig.12). The presence of $\epsilon\text{Nd}(t) > 0$ values together with $\epsilon\text{Nd}(t) < 0$ values provide evidence of a mixture of older and younger crustal sources in the Fazenda Limeira Formation.

The three analyzed units in general present initial ϵHf values slightly higher or lower than the CHUR (Fig.11), However, two trends can be separated in this data set, the Archean sources has a diagonal tendency, and the Rhyacian sources has a vertical tendency. The diagonal trend of Archean data suggests an evolution wherein the initial $\epsilon\text{Hf} > 0$, and over geological time, the ϵHf values gradually become < 0 . It can be considered that around 2.7 Ga or 2.8 Ga, the age of TTG cratonization in the region (*Borges et al., 2017*), a shift from $\epsilon\text{Hf} > 0$ to $\epsilon\text{Hf} < 0$ occurred, implying increased crustal reworking from that point onward and consequently the predominance of $\epsilon\text{Hf} < 0$ values, marking a shift from juvenile mantle signatures to crustal signatures. The vertical tendency of Rhyacian sources (Fig.11) suggests that grains of this age have distinct source compositions, one with $\epsilon\text{Hf} > 0$ that can be correlated with juvenile mantle sources, and another with $\epsilon\text{Hf} < 0$ that can be interpreted as having a crustal signature. This confirms the hypothesis of mixing between juvenile and old sources within the Rhyacian age group. The Orosirian age grains exhibit initial ϵHf values > 0 . Based on this, it can be interpreted that the sources of this age possess a juvenile mantle signature.

5.4 Implications to the crustal evolution, basin styles and sedimentation

The understanding of crustal evolution in polydeformed Precambrian sedimentary basins must consider two relevant aspects: i) the identification and reconstruction of the structural framework related to the formation and geometry of the basins; and ii) understanding the sedimentary evolution with the basin-filling types and their source areas.

The crustal evolution of these basins fits within the tectono-crustal evolution of the Goiás Massif (Fig.02) and its domains (*Cordeiro et al. 2017*), considering the significance of the Crixás-Goiás Domain in the formation of the massif. Due to geometry, proximity and similarities between the greenstone belts Serra De Santa Rita and Faina, the crustal evolution will embrace in some aspects both greenstone belts.

The crustal evolution starts after the tectonic stabilization at ~2.8Ga (*Borges et al., 2017*) and the intrusion of last mafic dikes swarms in the TTG complexes at ~2.4Ga/~2.5Ga (*Tomazzoli et al., 1994, 2001, Corrêa da Costa et al., 2003, 2004*) (Fig.15A). At ~ 2.2Ga to ~ 2.1Ga, a collisional event between Crixás-Goiás Domain and Campinorte Domain started (*Borges et al., 2021a, 2021b*). The tensions developed in this collision generated the original basin geometry characterized by a pull-a-part basin (Fig.15B). The basin was opened (Fig.15B), initially filled by fluvial sediments characterized by low transport and poor sorting, and subsequently by marine sediments (Fig.15B and C). The diagenesis developed and ended, and then the Serra de Santa Rita greenstone Belt was uplifted (erosion started) (Fig.15D), in a syn-tectonic event, probably in a Transpression structural context. The event of uplifting of the Serra de Santa Rita Greenstone Belt is very important as it marks the separation of the Serra de Santa Rita and Faina Greenstone Belt. In addition, it explains the strong erosion that the Serra de Santa Rita Greenstone Belt underwent in comparison to Faina Greenstone Belt, which is much more preserved.

The sedimentary evolution is based on the stratigraphic column proposed (Fig.13) and provenance of our study (Fig.09). The Santa Rita Basin (Fig.15) started as a pull-a-part basin; however, it has two styles/cycles of sedimentation.

The first cycle is defined by the opening of the basin and very close sediments sources (pull-a-part sedimentation), weak transportation and deposition of the conglomerates in the Faina Basin (*Rezende et al., 1998*) and arkoses from Fazenda Cruzeiro Formation in the Serra de Santa Rita Basin (Fig.15B). The second cycle is characterized by a sea level raise and deposition of the Fazenda Limeira Formation marine sequence (Fig.15C). The deposition and diagenesis are followed by the uplifting of the Serra de Santa Rita Greenstone Belt (Fig.15D).

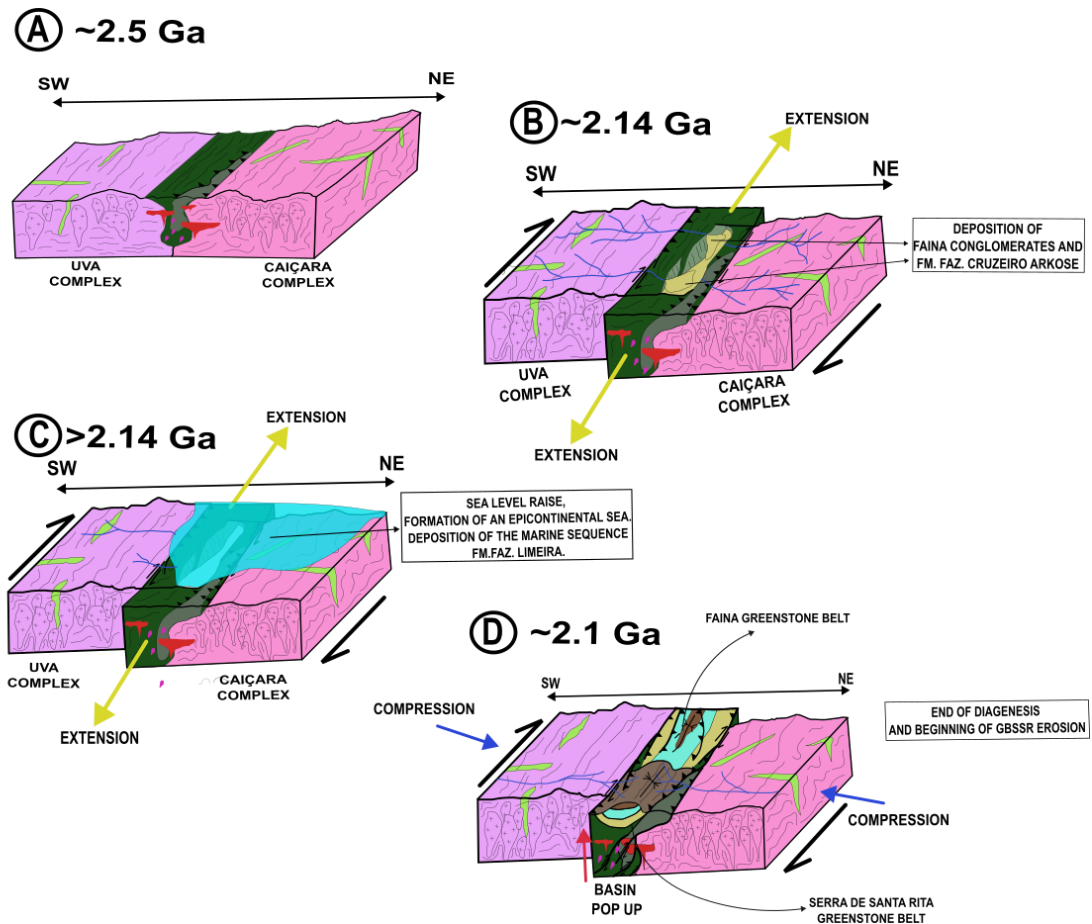


Fig.15 - Tectonic evolution of the Serra de Santa Rita Basin Greenstone Belt. Hypothetical tectonic strains.

A process between ~80Ma and ~200Ma marks the limit between closing and uplifting of the first basin (Serra de Santa Rita Basin) and opening the second basin (Serra do Cantagalo Basin). Close to the TTG's Complexes (Uvã and Caiçara) at ~2.02Ga, possibly a post-collisional extension, or the same tectonic event that opened the Serra da Mesa and Araí basins, the basin geometry of the Serra do Cantagalo was created in a rifting structural context (Fig.16A). The sedimentation and diagenesis of the Serra do Cantagalo Formation developed and was completed, forming conglomerates, sandstones, and pelitic rocks. In the Neoproterozoic, the Brasiliano - Pan African orogeny was responsible for the tectonic emplacement of the Serra do Cantagalo Formation over the GBSSR (Fig. 16 B, C and D) and the nucleation of the transcurrent Faina Fault.

The Serra do Cantagalo Basin deposition style is related to a rift-type basin (Fig.16). Probably starting with the deposition of the SCGI and SCGII units (Fig.16 A and B). After the basin sedimentation and diagenesis due to the

compressive strain of the Brasiliano-Pan African Orogeny, detachment faults are formed (Fig.16B) and the nappe started the transport towards the Serra de Santa Rita Greenstone Belt. The unit is put in place over an eroded greenstone belt (Fig.16 C) and in the course of the Brasiliano-Pan African tectonic efforts, the units were folded and underwent greenschist overprint (Fig.16D).

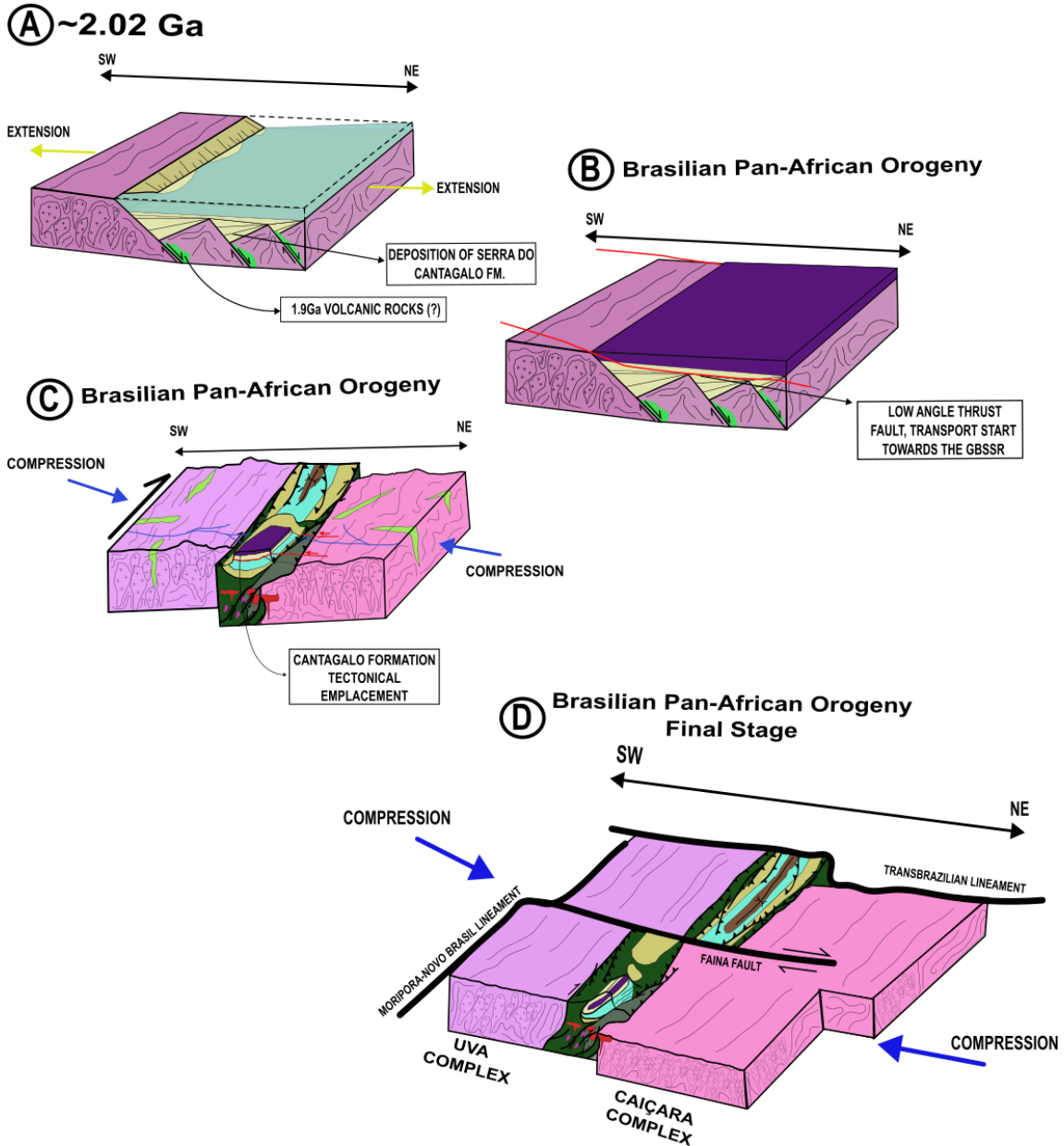


Fig.16 - Tectonic evolution of the Serra do Cantagalo Basin. Hypothetical tectonic strains.

6 CONCLUSIONS

The data and interpretations carried out in this study, integrated with the information available in the literature for the Serra de Santa Rita greenstone belt, have allowed this study to draw the following conclusions and hypotheses:

- i. A thermo-tectonic event with an age between 2.2Ga and 2.1Ga, along with felsic intrusions of the same age, occurred at the boundary of the Crixás-Goiás, Campinorte, and Cavalcante-Arraias domains. Probably, this event is related to the collisional event that resulted in the amalgamation of the Crixás-Goiás Domain on the western margin of the São Francisco Craton during the Paleoproterozoic.
- ii. The U-Pb isotopic data has enabled the identification of sediment sources for the diverse metasedimentary units within the Serra de Santa Rita greenstone belt. The sediments of the Fazenda Cruzeiro Formation likely originate from the TTG blocks Caiçara and Uvã, while the sediments of the Fazenda Limeira Formation are derived from TTG complexes and Rhyacian within the Goiás Massif domains (Almas-Conceição do Tocantins, Cavalcante-Arraias, and Campinorte domains). In the Serra do Cantagalo Formation, the sediments predominantly derived from the TTG Complexes Caiçara and Uvã and the Goiás Massif domains. Orosirian sources can be correlated with the volcanic rocks of Mossamedes metasedimentary sequence and Statherian sources can be correlated with rocks generated during the Statherian rifting event, such as those found in the Serra da Mesa group (Campinorte Domains) and Araújo group (Cavalcante-Arraias Domain).
- iii. The data collected in this study enables the identification of at least two distinct sedimentary basins associated with the Serra de Santa Rita greenstone belt: the Serra de Santa Rita Basin and the Serra do Cantagalo Basin. The maximum depositional age of the Serra de Santa Rita Basin is 2.143Ma and the youngest zircon has an 2.100 Ma age. For the Serra do Cantagalo Basin, the maximum depositional age is 2.021Ma and the youngest zircon has a 1.900Ma age.

- iv. Isotopic data Sm-Nd and Lu-Hf led to the definition of the crust senility of the sediment's sources. Fazenda Cruzeiro Formation main source derived from older crust, Fazenda Limeira Formation mixed sources of older Archean crust and Rhyacian youngest crust. Serra do Cantagalo Formation mainly derived from older crust.
- v. The high erosion observed in the GBSSR analyzed together with the structural data collected on the field activities allowed to suggest a reorganization of the stratigraphic column, changing the position of the Fazenda Cruzeiro Formation to the bottom of the metasedimentary sequence.

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CAPÍTULO 3 CONSIDERAÇÕES FINAIS E CORRELAÇÕES REGIONAIS.

Os dados apresentados neste trabalho, juntamente com as correlações estabelecidas em relação a estudos anteriores, como *Borges et al. (2021)*, *Botelho et al. (2006)*, *Giustina et al. (2009)*, *Cordeiro et al. (2014, 2017)*, *Cuadros et al. (2017a, 2017b)* e *Martins-Ferreira (2020)*, apontam para a construção de uma hipótese evolutiva que difere da interpretação mais amplamente aceita sobre a evolução da margem oeste do Cráton São Francisco, na região que abrange desde o Domínio Crixás-Goiás até o Domínio Almas-Conceição do Tocantins, no Maciço de Goiás (conforme ilustrado na Figura 02). Atualmente, o entendimento da amalgamação desses blocos alóctones é atribuído a orogenia Brasileira-Pan Africana, porém, as idades Riaccianas e a dinâmica tectono-geológica ocorrida sobretudo no Paleo-Mesoproterozóico, que envolve intrusões (suite Aurumina e Pau-de-Mel), arco vulcânico e metamorfismo (Campinorte), bacias sedimentares de margem passiva (Fm. Ticunzal), sequências metassedimentares em *greenstone belts* (Crixás e Serra de Santa Rita) e sucessões mesoproterozóicas de rift (grupos Araíá e Serra da Mesa), evidenciam uma complexidade tectono-evolutiva que requer uma nova abordagem, interpretações e maior atenção.

Este estudo se encaixa nesse contexto, oferecendo uma contribuição significativa para a compreensão da evolução crustal dos greenstone belts do Domínio Crixás-Goiás, com ênfase na região de Serra de Santa Rita. Além disso, investiga os padrões de sedimentação e as bacias associadas, ao mesmo tempo em que estabelece correlações relevantes com a Formação Serra do Cantagalo. Secundariamente, abordando a evolução tectônica do Domínio Crixás-Goiás.

1 Considerações sobre a análise de zircão detrítico

A técnica utilizada baseia-se principalmente nos conceitos de bacias sedimentares e fontes de sedimentos, com maior ênfase neste último. Ou seja, ela analisa os grãos de zircão erodidos das fontes e transportados para a bacia sedimentar. Fontes localizadas mais próximas da bacia e com uma grande abundância de grãos de zircão têm uma maior probabilidade de serem erodidas e transportadas até a bacia. Isso significa que as fontes sílicas presentes terão uma população mais expressiva, tornando essa análise um indicador da orogenia cronologicamente mais próxima da formação da bacia e/ou do início/fim

da sedimentação. Por outro lado, fontes muito distantes ou com baixa abundância de zircão, como as rochas vulcânicas, apresentarão populações reduzidas ou podem não aparecer nas distribuições populacionais de zircão detrítico.

1.1 Fontes arqueanas e riacianas

Ao analisar a bacia Serra de Santa Rita, é possível observar na distribuição das populações de zircão correlações com dois ciclos sedimentares distintos que foram descritos e propostos por *Rezende et al. (1998)*. Isso foi uma das variáveis que norteou a evolução tectono-sedimentar proposta. Na formação Fazenda Cruzeiro, as fontes são puramente arqueanas, com assinatura geocronológica dos TTG Uvã e Caiçara. Isso, juntamente com o caráter imaturo e pouco retrabalhado das rochas dessa formação, corroborou para a definição desse ciclo sedimentar inicial de transporte próximo com fontes próximas (vindas dos TTG circundantes). O segundo ciclo está relacionado com a elevação do nível do mar na região e a deposição da formação Fazenda Limeira, que é uma sequência marinha caracterizada pelos carbonatos, arenitos finos, pelitos e filitos carbonosos. As fontes arqueanas nesses sedimentos incluem fontes próximas e distantes, devido às características dos sedimentos e ao ambiente de deposição. Isso significa que abrangem todos os TTG's, caracterizando essa bacia como uma área de drenagem e abrangência muito maior do que a do primeiro ciclo.

Fontes riacianas estão exclusivamente relacionadas à bacia do segundo ciclo de sedimentação (formação Fazenda Limeira). Devido à ausência de fontes próximas com essa idade e às características desse ciclo sedimentar, se define que são fontes distantes, compostas por rochas ricas em zircão possivelmente rochas da suite Aurumina, suite Pau-de-Mel e rochas metamórficas, localizadas nos outros domínios do Maciço de Goiás, onde predominam rochas de ~2.2-2.1 Ga.

Considerando a petrografia e o contexto geológico das rochas na bacia Cantagalo, é possível inferir que as fontes riacianas reveladas pelos grãos detríticos dessa unidade têm origem nos TTG's ou no próprio *greenstone belt* sotoposto (retrabalhamento dos grãos paleoproterozóicos das rochas

metassedimentares da formação Fazenda Limeira), indicando a possibilidade de ser uma bacia que reciclou uma outra bacia mais antiga.

1.2 Fontes Orosirianas

Essa fonte é exclusiva da bacia Cantagalo, como já se esperava, por ser mais jovem que a bacia Serra de Santa Rita, devido à posição atual da formação em relação ao *Greenstone Belt*. As fontes orosirianas podem estar relacionadas as rochas vulcânicas da sequência metassedimentar de Mossâmedes. Por outro lado, a possível correlação entre essa bacia e o Grupo Araí e Serra da Mesa sugerem que podem se tratar de fontes muito distantes da bacia ou de origem vulcânica, provavelmente correlacionáveis a um evento tafrogênético. Além das Fontes Orosirianas, um grão de idade Estateriana (1700Ma) foi observado na mesma amostra que possui os grãos Orosirianos, porém se optou por manter as populações com maior robustez estatística na análise das bacias, mas essa idade pode ter relevância para a bacia Cantagalo.

2 Formação Cantagalo e Grupo Araxá

Trabalhos anteriores na região, como *Danni et al. (1981)* e *Baêta et al. (1998)* correlacionaram a Formação Cantagalo com uma nappe do Grupo Araxá que se sobrepõe tectonicamente ao *Greenstone Belt* Serra de Santa Rita. No entanto, estudos de proveniência de zircão detrítico no Grupo Araxá, realizados por *Piuzzana et al. (2003)* e *Falci et al. (2018)*, apontam para a presença marcante de fontes de sedimentos Meso-Neoproterozoicos (idade da Orogenia Brasileira). A ausência dessas fontes na formação Cantagalo levanta questões importantes sobre os sedimentos brasileiros nessa região, uma vez que a proximidade geográfica com os sedimentos do Grupo Araxá possibilita uma correlação direta entre eles. Nesse contexto, duas hipóteses podem ser levantadas para explicar a diferença nas fontes e a proximidade geográfica desses sedimentos (Fig.03). A primeira hipótese parte da ideia de que se tratam de bacias diferentes, com fontes distintas, e que, devido à orogenia brasileira, elas estão tectonicamente imbricadas, com a bacia Araxá (neoproterozóica) sobreposta a uma bacia mais antiga, a bacia Cantagalo e esta última teve uma lasca transportada e sobreposta ao *Greenstone Belt* Serra de Santa Rita. A segunda hipótese sugere que as

fontes são as mesmas, porém, o que é conhecido como o Grupo Araxá nessa região pode ser outra bacia mais antiga, contemporânea ao Grupo Serra da Mesa e ao Grupo Araí, e a formação Serra do Cantagalo seria uma lasca desses sedimentos.

3 Orogenia Transamazônica na borda oeste do Cráton São Francisco

Terrenos formados entre 2,2 Ga a 2,0 Ga, com metamorfismo ocorrendo por volta de 2,1 Ga, são encontrados na borda do Cráton São Francisco, conforme discutido por *Cordeiro et al.*, (2017), como no caso da Faixa Itabuna-Salvador-Curaçá, Faixa Rio Capim, os *Greenstone belts* do Rio Itapicuru e o Complexos Mantiqueira e Juiz de Fora. Essa orogenia no CSF está relacionada à amalgamação de microcontinentes nas bordas do Cráton, resultando na formação de arcos acrecionários. O entendimento dessa orogenia, sua extensão e importância para a formação do Cráton São Francisco ainda está em seus estágios iniciais de entendimento e interpretação. Nesse contexto, os dados coletados neste estudo associam a porção sul do Bloco Arqueano-Paleoproterozoico de Goiás, mais os *Greenstone Belts* de Faina e Serra de Santa Rita, a idades Riácianas que, por sua vez, estão relacionadas à Orogenia Transamazônica. Outro ponto importante são as idades das fontes encontradas na formação Serra do Cantagalo e a correlação com os Grupos Araí e Serra da Mesa, que estão associados a uma tafrogênese que atuou no Cráton São Francisco na região do Rift Araí e da Bacia do Espinhaço. Essas correlações levantam a hipótese de que o Bloco Arqueano-Paleoproterozoico de Goiás já estaria amalgamado ao Cráton São Francisco antes da Orogenia Brasileira-Pan Africana.

4 Sugestão de Estudos Futuros

Os dados e interpretações estabelecidos neste trabalho levantam questões e hipóteses relacionadas à evolução crustal da região do Domínio Crixás-Goiás e do Maciço de Goiás. Com o objetivo de aprimorar as interpretações ou refutar as hipóteses apresentadas neste estudo, futuras pesquisas podem abordar os pontos propostos a seguir.

- Estudos de proveniência sedimentar realizados na porção NW do Grupo Araxá, na região de Mossamêdes, Serra Dourada e nas proximidades do *Greenstone belt* Serra de Santa Rita.
- Estudos de proveniência nas sequências metassedimentares dos *greenstone belts* Faina, Pilar de Goiás e Guarinos.
- Levantamentos estruturais nos *Greesntone Belts* que visem o entendimento e possível separação dos dois eventos tectônicos que atuam na região do Domínio Crixás-Goiás.
- Levantamento Bibliográfico que vise correlacionar as porções do Cráton São Francisco que possuem evidências da Orogenia Transamazônica (bordas sul, leste e oeste), explorando suas similaridades e possíveis correlações entre os cinturões e faixas paleoproterozoicas que margeiam o Cráton.

A integração dos dados deste trabalho com informações anteriores e dados de estudos futuros pode esclarecer as relações tectônicas dos domínios envolvidos, além de abrir caminho para novas interpretações e questões que contribuirão para a compreensão da borda oeste do Cráton São Francisco.

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ANEXOS

Dados de U-Pb.

SAMPLE 21TG15

SPOT	238U(ppm	232Th(ppm	238U / 232Th	207Pb/(cpb	206Pb/(cpb	208Pb/(cps	202Hg/(cps	204Pb/(cps	207Pb/206	2sigma(‰	207Pb/238	2sigma(‰	206Pb/238	2sigma(‰	Rho	AgePb206	2sigma(at	AgePb207	2sigma(at	AgePb207	2sigma(at	Concord�	Concord�
1.sMPABC443.TXT	198.8311	76.29639	0.383725	155156.6	553211.9	314767	3493.214	4143.633	0.270085	4.614741	35.32232	9.910308	0.948523	8.770312	0.884969	4300.22	281.2649	3647.695	106.1359	3306.517	74.30027	117.8887	130.0529
1.sSMPABC420.TXT	44.02871	16.58482	0.376682	15537.8	77068.27	12674.47	3973.5	118.7799	0.918126	4.211738	15.58976	5.654533	0.589429	3.77293	0.66724	2987.107	90.833	2851.994	57.994	2757.877	70.8984	104.7375	108.3118
1.sSMPABC440.TXT	42.91743	20.00418	0.466109	15271.37	74507.73	15107.7	3839.855	248.8175	0.197356	4.142514	16.08368	5.255814	0.591063	3.23468	0.615448	2993.731	77.9325	2881.783	54.11247	2804.455	69.40456	103.8847	106.7491
1.sSMPABC548.TXT	58.87633	23.38085	0.397118	19051.4	97251.32	15108.64	3509.044	-2.79367	0.188679	4.123066	14.86693	5.241732	0.571475	3.236678	0.617483	2913.875	76.32663	2806.759	53.65152	2730.677	69.54572	103.8163	106.7089
1.sSMPABC595.TXT	83.7767	30.7801	0.367406	29259.88	144992.5	22311.71	3317.291	72.15516	0.198738	4.125101	16.24678	5.265617	0.592905	3.272653	0.621514	3001.187	79.00817	2891.43	54.25087	2815.861	69.03345	103.7959	106.5815
1.sSMPABC466.TXT	57.25816	27.4408	0.479247	19228.29	97831.3	19634.11	3992.671	406.1192	0.191897	4.112611	15.27977	5.259815	0.577494	3.279038	0.623413	2938.516	77.85097	2832.841	53.94584	2758.489	69.18475	103.7304	106.5263
1.sSMPABC544.TXT	79.24473	20.89426	0.263668	26539.14	133225.1	15565.18	3540.213	-10.5809	0.192729	4.097346	15.37403	5.212778	0.578547	3.222546	0.618201	2942.821	76.59072	2838.703	53.49984	2765.593	68.87613	103.6678	106.4083
1.sSMPABC430.TXT	82.76735	35.50022	0.428916	26508.82	137561.9	24146.23	4024.625	312.8759	0.185769	4.153934	14.35744	5.264151	0.560535	3.233591	0.614266	2868.838	75.31246	2773.621	53.72788	2705.061	70.249	103.433	106.0545
1.sSMPABC565.TXT	74.84871	28.9028	0.38615	25622.46	126173.7	20335.76	3725.724	113.4366	0.196113	4.161103	15.73384	5.296482	0.581872	3.27688	0.61889	2956.384	78.1746	2860.774	54.43286	2794.116	69.79008	103.3421	105.8075
1.sSMPABC574.TXT	45.3796	15.7067	0.346118	16130.51	78353.1	11100.3	3579.396	276.9092	0.201867	4.090879	16.37388	5.183409	0.588282	3.183149	0.614103	2982.454	76.45505	2898.896	53.45483	2841.347	68.28805	102.8828	104.9662
1.sSMPABC476.TXT	63.60855	15.3532	0.24137	23071.71	110968.4	10265.37	3458.352	-46.6987	0.20316	4.087869	16.52703	5.170646	0.590005	3.166213	0.612344	2989.443	76.18677	2907.797	53.36241	2851.75	68.17233	102.8078	104.8284
1.sSMPABC480.TXT	58.76691	20.85341	0.35485	20749.87	101134.4	13182.85	3779.729	442.1871	0.200222	4.329735	16.09418	5.591371	0.582983	3.537912	0.632745	2960.909	84.54536	2882.406	57.49246	2828.006	72.46609	102.7235	104.6995
1.sSMPABC475.TXT	67.50428	27.81101	0.411989	23764.14	115939.4	18969.12	3751.328	215.0017	0.200326	4.182719	16.03882	5.401805	0.580675	3.418239	0.632796	2951.505	81.46151	2879.113	55.56911	2828.856	69.93871	102.5144	104.3356
1.sSMPABC497.TXT	48.63914	27.26138	0.560482	17056.13	82538.8	17677.8	3927.416	92.83317	0.200575	4.104739	15.98161	5.213283	0.577887	3.213944	0.616491	2940.125	76.32949	2875.698	53.66011	2830.878	68.59031	102.2404	103.8591
1.sSMPABC543.TXT	91.66871	26.34444	0.287388	31864.88	153432	20139.77	3222.973	-125.806	0.201175	4.216857	15.95339	5.674023	0.575145	3.7964	0.669804	2928.909	89.98591	2874.009	58.2889	2835.756	70.4796	101.9102	103.285
1.sSMPABC586.TXT	111.806	27.61871	0.247024	40403.76	190760.9	18690.38	3311.045	18.33465	0.208251	4.244656	16.8221	5.731382	0.585858	3.851186	0.671947	2972.607	92.37379	2924.749	59.09048	2891.981	70.59737	101.6363	102.7879
1.sSMPABC417.TXT	87.89413	23.01327	0.26183	28048.29	140963.6	13739.06	3544.773	328.2501	0.187438	4.128037	14.02767	5.321659	0.542784	3.358477	0.631096	2795.09	76.62328	2751.579	54.00333	2719.811	69.70292	101.5813	102.7678
1.sSMPABC588.TXT	75.60176	22.21921	0.293988	26410.54	126548	15949.74	3644.175	146.8603	0.204688	4.248713	16.28964	5.502186	0.577189	3.496067	0.635396	2937.272	83.00909	2893.951	56.64315	2863.946	70.84451	101.497	102.5603
1.sSMPABC590.TXT	63.08108	19.48595	0.308903	21854.04	104904	13771.67	3426.174	47.86593	0.203886	4.399957	16.17218	5.550503	0.575282	3.383558	0.609595	2929.471	80.15144	2887.029	57.10052	2857.557	73.4749	101.4701	102.5166
1.sSMPABC568.TXT	92.07028	29.88599	0.3246	30345.32	149841	17603.47	3571.395	157.9296	0.196524	4.097558	15.15215	5.206915	0.559188	3.212784	0.617023	2863.272	74.70904	2824.85	53.38189	2797.544	68.67657	101.3601	102.3495
1.sSMPABC530.TXT	49.72156	14.90059	0.299681	16792.43	82748.74	9503.063	3393.854	237.2973	0.199104	4.1025	15.43896	5.193087	0.562388	3.183968	0.613116	2876.49	74.30786	2842.721	53.31968	2818.868	68.62711	101.1879	102.0441
1.sSMPABC496.TXT	48.85275	16.17463	0.33109	15598.49	78528.46	9682.041	3672.082	55.39592	0.192801	4.104994	14.55282	5.184324	0.547441	3.166423	0.610769	2814.52	72.61965	2786.457	52.98889	2766.202	69.00393	101.0071	101.7468
1.sSMPABC115.TXT	40.20392	13.4017	0.333343	30364.5	137092.5	23323.29	1974.017	370.4272	0.21985	2.250161	18.18486	4.762532	0.599005	4.197438	0.881346	3029.456	102.266	2999.564	49.59975	2979.591	36.70554	100.9965	101.6736
1.sSMPABC096.TXT	54.53223	27.53334	0.5049	36277.42	176677.8	27066.57	1963.85	253.5633	0.20382	2.029526	15.9765	5.887021	0.568503	3.31511	0.852866	2901.672	77.92665	2875.392	40.43039	2857.035	33.4221	100.914	101.5624
1.sSMPABC536.TXT	84.26948	42.08967	0.499465	29380.23	140777.5	26841.12	3389.492	78.88996	0.203822	4.108215	15.96807	5.224745	0.568197	3.228084	0.617845	2900.413	75.84269	2874.888	53.77183	2857.052	68.48711	100.8879	101.5177
1.sSMPABC090.TXT	69.64633	38.65988	0.555089	44216.83	221280.5	38438.67	2054.02	252.9021	0.198355	1.267631	15.2348	1.990693	0.557047	1.534917	0.771047	2854.415	35.49675	2830.032	21.71396	2812.71	20.86612	100.8616	101.4827
1.sSMPABC580.TXT	138.5846	15.9978	0.115437	51149.16	237240.6	13815.23	3732.124	-112.621	0.212572	4.508381	17.0781	6.047274	0.582683	4.030387	0.66648	2959.687	96.37081	2939.231	62.35825	2925.257	74.87962	100.696	101.177
1.sSMPABC493.TXT	78.18602	30.69721	0.392168	25079.82	125173.5	22283.94	3642.481	158.812	0.194544	4.096219	14.62253	5.212522	0.545135	3.223567	0.618427	2804.906	73.735	2790.988	53.29035	2780.96	68.75867	100.4903	100.861
1.sSMPABC095.TXT	32.19562	35.45781	1.101324	20917.54	102652	31910.25	2079.505	247.9321	0.202273	1.352751	16.01004	2.072657	0.559391	1.570341	0.757647	2864.111	36.41655	2852.684	22.55919	2844.622	22.21421	100.406	100.8851
1.sSMPABC463.TXT	101.691	32.76787	0.32223	34397.96	166814.6	18821.49	3761.531	-11.5563	0.20102	4.106969	15.38306	5.249907	0.555012	3.270219	0.62291	2845.986	75.68518	2839.263	53.87416	2834.494	68.6059	100.2388	100.4054
1.sSMPABC083.TXT	56.13945	29.4163	0.523986	36225.15	178281.5	23841.06	1759.289	246.8439	0.201702	1.98954	15.46965	2.190899	0.562438	1.833725	0.836974	2851.108	42.3906	2844.615	23.69124	2840.018	19.67922	100.2283	100.3905
1.sSMPABC116.TXT	41.90644	33.65473	0.803092	26989.64	132605.1	19955.61	2582.305	266.8671	0.202027	1.736728	15.50912	2.712794	0.556771	2.083993	0.768209	2853.27	48.22694	2847.046	28.78772	2842.643	28.58848	100.2186	100.3739
1.sSMPABC097.TXT	57.5925	37.29295	0.647531	37265.94	182854.1	35710.29	2022.522	241.9778	0.202302	1.166606	15.54187	1.944244	0.557189	1.55535	0.799977	2855.002	33.9765	2849.058	21.30379	2844.856	19.13638	100.2086	100.3566
1.sSMPABC585.TXT	180.3188	37.28757	0.307141	57194.9	285991.1	21909.59	3538.867	83.54795	0.196854	4.096955	14.75079	5.216668	0.543693	3.239333	0.619447	2977.928	73.72665	2799.3	63.36839	2805.289	68.64887	99.95098	99.91569
1.sSMPABC573.TXT	31.02949	5.962336	0.92151	9749.611	48998.73	4600.973	3401.701	47.37022	0.194974	1.617396	14.46635	3.306709	0.538619	3.292585	0.620457	2777.663	74.73441	2780.796	54.18892	2783.609	69.87215	99.88736	99.80576
1.sSMPABC118.TXT	138.9209	134.7549	0.970012	85003.51	428383.3	103211.5	2234.742	164.8074	0.196958	1.995828	14.73865	2.859323	0.542728	2.047534	0.716091	2794.856	46.60269	2798.517	30.08997	2801.156	33.02715	99.86919	99.77509
1.sSMPABC099.TXT	42.68315	23.88597	0.559611	26787.69	133122.4	21960.15	2120.197	-22.0741	0.199744	1.176002	15.07832	1.877229	0.547492	1.463218	0.779456	2814.733	33.45823	2820.198	20.59325	2824.106	19.32762	99.80624	99.6681
1.sSMPABC579.TXT	90.83266	25.95476	0.285743	35969.67	158215.8	19885.36	3572.081	155.135	0.22416	4.099274	18.30692	5.228835	0.592318	3.246023	0.620793	2998.814	78.31237	3006.005	54.33117	3010.817	67.41538	99.76078	99.60133
1.sSMPABC094.TXT	81																						

SAMPLE 21TG6A

SPOT	238U(ppm)	232Th(ppm)	238U / 232Th	207Pb(cps)	206Pb(cps)	208Pb(cps)	202Hg(cps)	204Pb(cps)	207Pb/206Pb	2sigma(%)	207Pb/238U	2sigma(%)	206Pb/238U	2sigma(%)	Rho	AgePb206	2sigma(a)	AgePb207	2sigma(a)	AgePb207	2sigma(a)	Concordia	Concordia
1.sSMPABC278.TXT	50.01568	11.71665	0.23426	14642.64	120892.3	7620.732	4314.745	198.8264	0.118117	2.181462	14.14543	4.935673	0.868562	4.427425	0.897026	4030.101	134.0511	2759.505	50.39586	1927.937	39.60549	146.0443	209.0369
1.sSMPABC328.TXT	49.83637	-1.86394	-0.0374	28418.36	126985.1	902.5495	3786.154	217.7288	0.218362	2.025732	28.40239	3.093613	0.943356	2.338131	0.755793	4283.103	73.58454	3433.087	33.91259	2968.655	33.03272	124.7595	144.2776
1.sSMPABC300.TXT	36.60216	0.729952	0.019943	16389.42	84878.94	702.5634	4198.213	25.80474	0.18803	1.999569	21.76621	3.107939	0.839567	2.379287	0.765552	3929.283	70.3839	3173.354	33.49801	2725.004	33.32328	123.8211	144.1936
1.sSMPABC390.TXT	46.68246	-1.79271	-0.0384	21699.91	108824.7	1544.083	3443.313	157.068	0.193495	2.460364	22.74237	4.096128	0.852443	3.274885	0.799508	3974.249	97.88766	3215.983	43.54129	2772.095	40.9344	123.578	143.3663
1.sSMPABC279.TXT	213.4846	62.62055	0.293326	181522.1	643554.4	334677.6	4401.459	5142.679	0.274922	2.090598	41.03297	5.278583	1.082486	4.846941	0.918228	4728.847	164.496	3795.963	57.13573	3334.323	33.10156	124.5757	141.8233
1.sSMPABC335.TXT	38.13968	0.453531	0.011891	14506.53	77796.66	-1892.25	3956.42	197.7994	0.180981	2.168372	18.69389	3.208861	0.749144	2.365365	0.737135	3604.362	65.63953	3026.155	34.14275	2861.88	36.38863	119.107	135.4066
1.sSMPABC249.TXT	45.17678	6.534395	0.144641	19120.85	94819.69	8656.624	4005.597	263.5529	0.197497	2.210178	20.51667	4.11807	0.753435	3.47471	0.843772	3620.158	96.97405	3116.036	43.48269	2805.62	36.60525	116.1783	129.0324
1.sSMPABC318.TXT	106.2448	50.56808	0.475958	19710.71	148246.9	11949.59	4187.353	126.0527	0.130225	1.986467	9.288925	3.438244	0.517332	2.806327	0.816209	2687.854	61.97709	2366.927	34.1496	2101.002	35.30392	113.5588	127.932
1.sSMPABC375.TXT	57.70582	18.15257	0.314571	17690.69	98682.68	12870.09	3852.679	196.3834	0.17365	2.369678	15.26424	4.215084	0.637528	3.485909	0.827008	3179.293	88.08636	2831.872	43.53204	2593.136	40.07927	112.2683	122.6042
1.sSMPABC386.TXT	40.55452	15.75406	0.388466	18861.07	82525.52	12009.77	3962.312	221.2627	0.217701	2.170857	22.18869	3.416874	0.739214	2.638637	0.772237	3567.66	72.70458	3192.024	36.63651	2963.764	35.44404	111.768	120.376
1.sSMPABC396.TXT	62.25571	45.16119	0.725414	24012.86	116136.8	36126.72	3282.039	149.5037	0.230438	2.708741	24.37676	3.78801	0.76722	2.647969	0.69904	3670.64	74.53648	3283.58	40.59971	3055.904	44.01971	111.7877	120.1482
1.sSMPABC265.TXT	11.60941	8.966631	0.772617	4701.54	22541.3	3706.625	4111.185	83.27792	0.204765	2.405732	19.88792	3.334382	0.70442	2.3088	0.692422	3437.388	61.80729	3085.923	35.54627	2864.562	39.67783	111.3893	119.997
1.sSMPABC234.TXT	471.94626	72.5128	0.153647	154413.1	838217.1	109040.7	4548.418	1423.318	0.178751	3.328519	5.34852	9.186215	0.622755	8.562179	0.932068	1320.873	215.3781	2837.12	94.08498	2641.315	56.34611	110.0014	118.156
1.sSMPABC333.TXT	17.76715	6.984013	0.393086	6378.169	31709.63	4341.777	3778.694	389.752	0.195534	2.09763	17.71832	3.052002	0.657201	2.216904	0.726377	3256.278	56.92515	2974.568	32.45473	2789.28	34.7702	109.4706	116.7426
1.sSMPABC370.TXT	107.6947	50.3353	0.467389	28980.04	165373.7	25246.08	3783.777	323.8761	0.170709	2.0979	13.47799	3.470411	0.572623	2.76452	0.796597	2918.58	65.21943	2713.742	35.79281	2564.602	35.52456	107.5482	113.8025
1.sSMPABC366.TXT	15.55924	4.248672	0.273064	5931.34	2191.366	3660.341	176.2102	0.208455	2.234238	19.00243	3.214044	0.661142	0.2310467	0.718866	0.3271.589	59.55391	3041.939	34.23493	2893.507	36.71746	107.5495	113.0639	
1.sSMPABC267.TXT	31.3634	15.26323	0.486657	12530.42	57151.77	10186.56	4398.665	161.9529	0.215081	2.268132	19.58626	3.291489	0.660462	2.385262	0.724676	3268.949	61.45277	3071.152	35.08074	2944.226	37.1162	106.4405	111.0291
1.sSMPABC374.TXT	87.45737	31.43886	0.359476	13370.51	100426.4	16039.89	3612.639	237.4135	0.129173	2.089743	7.630782	3.089127	0.428446	2.275013	0.736458	2298.708	44.13877	2188.491	30.09037	2086.745	37.22306	105.0362	110.1576

1.sSMPABC294.TXT	118.2578	30.81218	0.260551	40923.25	201695.4	20458.87	4404.772	-33.5523	0.197203	2.003062	16.66941	3.014464	0.613063	2.252717	0.747303	3082.255	55.42993	2916.012	31.93014	2803.188	33.14213	105.701	109.9553
1.sSMPABC343.TXT	41.95487	17.32631	0.412911	14929.09	71665.3	10159.04	3916.6	215.3246	0.201148	2.088912	17.22696	3.140287	0.621143	2.344749	0.746667	3114.465	58.17588	2947.558	33.25605	2835.535	34.4786	105.6626	109.8369
1.sSMPABC324.TXT	100.5243	23.57615	0.274532	13141.29	107047.6	9968.478	4017.274	268.6537	0.120053	2.064948	6.541005	3.146663	0.395159	2.374338	0.754557	2146.71	43.4984	2051.435	29.94621	1956.999	37.33396	104.6443	109.694
1.sSMPABC218.TXT	54.98823	15.07682	0.241833	19499.85	94331.31	13072.44	4507.246	389.914	0.200506	2.32771	17.06228	3.435907	0.617176	2.527295	0.735554	3098.671	62.47827	36.15488	2830.318	38.49194	105.4565	109.4814	
1.sSMPABC220.TXT	135.4718	45.81039	0.338154	22331.43	163880	23952.92	4394.681	334.2074	0.132155	1.976342	7.874485	3.088112	0.432152	2.372869	0.768388	2315.41	46.32321	2216.764	30.20927	2126.801	35.01965	104.45	108.8682
1.sSMPABC283.TXT	29.62246	12.0346	0.406266	14471.43	57552.93	8541.162	4370.597	-0.63486	0.244642	2.134532	23.48464	3.093863	0.696228	2.239589	0.723881	3406.328	59.53296	3247.241	33.52443	3150.421	34.30117	104.8991	108.123
1.sSMPABC337.TXT	223.6745	90.85037	0.406172	82411.22	381160.1	57922.18	4054.525	179.8789	0.209528	1.944642	18.03167	3.986026	0.624156	2.265992	0.758865	3126.436	56.3819	2991.424	31.84524	2901.895	31.8809	104.5133	107.7377
1.sSMPABC319.TXT	53.5135	24.8336	0.464062	16911.91	84970.06	11057.63	4283.219	245.7958	0.194924	2.097672	15.83004	3.307398	0.589	2.557079	0.773319	2985.366	61.39319	2866.594	34.67706	2784.16	34.78723	104.1433	107.2268
1.sSMPABC389.TXT	128.1585	54.23181	0.423162	18946.18	143512.2	23494.27	3786.98	178.4661	0.127109	2.020464	7.144208	3.049917	0.40764	2.284671	0.749093	2204.122	42.7925	2129.57	29.65514	2058.368	36.09069	103.5008	107.081
1.sSMPABC345.TXT	24.45618	10.65921	0.435849	8051.367	39600.69	7029.168	4210.793	92.99163	0.196189	2.126274	15.90173	3.143242	0.587853	2.280967	0.725673	2980.712	54.66836	2870.91	33.07392	2794.75	35.84408	103.8247	106.654
1.sSMPABC394.TXT	122.989	37.46549	0.304625	10469.33	103741.5	10138.82	3509.387	240.5558	0.104848	2.180999	4.706554	3.538275	0.325569	2.78615	0.787432	1816.869	44.26432	1768.407	31.65935	1711.644	40.66657	102.7405	106.1476
1.sSMPABC240.TXT	92.43367	22.16021	0.239742	15324.46	111271.7	10830.03	4100.525	159.1696	0.134067	2.048624	7.860037	3.127753	0.425209	2.363467	0.755644	2284.083	45.61706	2215.11	30.5687	2151.909	36.21438	103.1138	106.1422
1.sSMPABC225.TXT	83.6556	59.34209	0.709362	28979.89	140348.8	36507.45	4336.732	187.3782	0.200127	2.024593	16.31694	3.077481	0.591333	2.317738	0.753128	2994.825	55.76104	2895.553	32.49539	2827.23	33.4295	103.4284	105.9279
1.sSMPABC269.TXT	86.50047	56.54977	0.653751	28531.34	144047.4	37302.98	3972.736	226.9309	0.199158	2.056283	16.34166	3.193526	0.587553	2.443421	0.765117	2979.491	58.56071	2884.778	33.60802	2819.311	33.98342	103.2832	105.6815
1.sSMPABC346.TXT	44.3567	24.61948	0.555034	15917.13	73630.06	15912.06	4407.122	250.9485	0.208561	2.082658	17.31901	3.10802	0.602268	2.307016	0.742278	3038.968	56.14528	2952.672	32.95091	2894.393	34.1937	102.9226	104.995
1.sSMPABC295.TXT	47.94217	17.49305	0.364878	16298.13	78367.96	11848.55	4103.889	267.0387	0.202177	2.046271	16.39511	3.102583	0.588139	2.332122	0.751671	2981.874	55.91695	2900.126	32.75511	2843.855	33.74106	102.8188	104.8532
1.sSMPABC268.TXT	66.18094	24.13278	0.364648	18064.57	98294.47	13492.52	3756.588	384.3595	0.180207	2.097556	13.36731	3.136506	0.537985	2.331937	0.773482	2705.007	52.79965	2705.95	32.51486	2654.781	35.20938	102.552	104.5287
1.sSMPABC214.TXT	104.1192	7.197918	0.069132	43141.58	181633.8	4389.6	4108.134	114.3709	0.23024	1.995104	20.22739	3.023687	0.637172	2.272058	0.75142	3177.893	57.25683	3102.292	32.4908	3053.719	32.29241	102.4369	104.0663
1.sSMPABC033.TXT	29.12889	12.02776	0.412915	8989.144	68938.61	7705	2933.912	315.969	0.129919	4.561546	7.170274	5.466663	0.400278	3.012758	0.551115	2170.318	55.75792	2132.815	51.82284	2096.869	82.40824	101.7584	103.5028
1.sSMPABC334.TXT	117.5053	50.36298	0.428602	66884.07	180420.9	29517.01	4246.64	34.18693	0.198575	2.026323	15.4603	3.092642	0.564665	2.336333	0.755449	2885.878	54.58332	2844.039	32.50064	2814.524	33.49697	101.4711	103.532
1.sSMPABC323.TXT	111.2567	32.2971	0.290295	15511.83	117284.3	14545.95	4001.335	24.72873	0.129394	2.083552	6.980634	3.13091	0.391271	2.369544	0.741628	2121.71	42.5075	2108.969	30.09489	2809.758	37.09865	100.9186	101.8645
1.sSMPABC034.TXT	64.01485	20.3521	0.317366	42770.44	211847	19297.63	2850.531	-50.1645	0.198805	1.180203	15.34456	2.57429	0.559792	1.924346	0.85426	2865.77	46.67509	2836.874	24.32077	2816.407	19.14064	100.1366	101.7527
1.sSMPABC326.TXT	89.09221	22.87739	0.256783	12177.43	92894.83	8166.298	4338.032	81.44826	0.128065	2.03832	6.826034	3.07229	0.386577	2.298743	0.748218	2106.933	41.47726	2089.106	29.46284	2071.585	36.35854	100.8533	101.7063
1.sSMPABC368.TXT	96.13342	38.3106	0.398728	31469.15	148263.5	23289.18	3917.005	222.7559	0.206885	2.049654	16.36845	3.182948	0.573822	2.345175	0.765069	2923.496	57.94902	2898.568	33.54261	2881.299	33.68447	100.86	101.4618
1.sSMPABC037.TXT	96.00268	51.00609	0.531299	74662.9	338643.5	46651.85	2746.831	158.3657	0.219663	2.73489	18.0797	4.285213	0.596942	2.390388	0.769865	3017.505	79.99082	2993.984	44.78835	2979.226	44.74329	100.7856	101.3189
1.sSMPABC054.TXT	24.23865	18.58266	0.560372	16385.27	80530.47	12999.26	2549.405	156.3739	0.202674	1.881717	15.75023	2.949533	0.563622	2.271319	0.77006	2881.58	52.9952	2861.768	33.14575	2847.85	30.96862	100.6923	101.1844
1.sSMPABC050.TXT	24.31591	19.85414	0.615608	16825.85	81580.12	18454.68	2533.808	158.3421	0.205444	1.727746	16.11289	2.749939	0.568826	2.139405	0.777983	2902.909	50.2060	2883.517	29.24544	2869.939	28.36971	100.6756	101.1519
1.sSMPABC038.TXT	32.8891	12.47452	0.37929	21286.24	107314.5	12068.45	2664.516	198.4518	0.17962	1.674244	15.04782	2.888116	0.552527	2.353322	0.814829	2534.555	54.20033	2818.27	30.42501	2806.641	27.63976	100.5778	100.9668
1.sSMPABC293.TXT	47.38471	29.85921	0.630145	6927.517	51522.64	13956.39	4229.922	331.7379	0.130661	2.01185	7.035134	3.01801	0.390503	2.249631	0.745402	2125.163	40.85619	2115.879	29.09851	2106.869	35.73683	100.4387	100.9643
1.sSMPABC035.TXT	26.23205	31.41861	1.197718	18294.89	88226.98	28778.43	2588.884	361.3899	0.206602	1.89058	16.20888	3.127672	0.569006	2.491594	0.796529	2903.738	58.51367	2889.197	32.97197	2879.078	31.04759	100.5033	100.8656
1.sSMPABC045.TXT	26.91526	11.91561	0.442708	18558.19	89994.9	11239.06	2357.387	194.247	0.205433	1.782236	16.0459	3.220485	0.564649	2.353867	0.800677	2893.392	55.10665	2879.534	30.90582	2869.856	38.37804	100.4813	100.8201
1.sSMPABC369.TXT	86.40088	26.58918	0.370602	24369.14	124132.4	16179.16	3702.867	222.2933	0.191317	2.145498	14.11202	3.920186	0.539496	2.359496	0.763876	2762.386	57.10968	2757.263	34.91032	2753.515	35.69105	100.1858	100.8222
1.sSMPABC385.TXT	64.31531	22.84359	0.355181	18901.12	94236.92	13326.86	3598.589	159.2496	0.190928	1.984405	14.03585	3.117811	0.533172	2.04762	0.771298	2754.802	54.13636	2752.132	32.47611	2750.174	32.99025	100.097	100.1683
1.sSMPABC316.TXT	91.84491	8.261893	0.089955	26522.53	133600.3	2162.379	4333.227	155.4886	0.194437	2.565648	14.4379	13.3512	0.538466	1.104073	0.974029	2777.359	254.0701	2778.927	116.2164	7800.065	42.69636	99.94361	99.9027
1.sSMPABC069.TXT	31.11588	33.89845	1.089426	20703.68	101552.8	29269.36	2143.416	86.00471	0.203039	1.335154	15.53342	3.253167	0.554864	2.966557	0.911898	2845.372	68.60791	2848.538	34.09039	2850.78	21.91899	99.88881	99.81027
1.sSMPABC329.TXT	81.92221	4.695188	0.057313	28436.29	127978.8	2970.892	4404.394	230.8599	0.216655	1.9744	17.26197	0.026696	0.575786	2.294043	0.757936	2939.995	54.38279	2949.506	32.19396	2955.999	32.22139	99.67757	99.45861
1.sSMPABC059.TXT	47.91341	10.18567	0.215254	31062.84	152827.5	11299.31	2205.076	243.8819	0.20245	2.911056	15.30488	3.032684	0.548292	2.790606	0.692014	2818.064	64.02217	2834.406	41.73336	2846.047	48.22493	99.42345	99.01676
1.sSMPABC285.TXT	78.21082	11.82623	0.151171	22440.45	114460.3	3863.417	3902.115	97.70466	0.190626	2.094255	13.77745	3.226392	0.524187	2.544322	0.760702	2716.914	54.64334	2734.531	33.08409	2747.567	34.84735	99.35576	98.88435
1.sSMPABC040.TXT	215.4113	67.92329	0.172119	148680.09	261857.7	18696.02	3760.346	245.9106	0.279161	2.067097	25.77633	3.297276	0.666187	2.568879	0.779091	3304.627	67.76392	33.47031	33.87011	3358.243	32.66526	99.95754	98.40346
1.sSMPABC395.TXT	76.17233	51.14769	0.671473	22052.26	108853.9	29606.79	3820.564	-40.982	0.217091	2.													

SAMPLE 21TG25

SPOT	238U(ppm)	232Th(ppm)	238U / 232Th	207Pb(cp)	206Pb(cp)	208Pb(cp)	202Hg(cp)	204Pb(cp)	207Pb/206	2sigma(%)	207Pb/235	2sigma(%)	206Pb/238	2sigma(%)	Rho	AgePb206	2sigma(a)	AgePb207	2sigma(a)	AgePb207	2sigma(a)	Concord�	Concord�ncia
1.sSMPABC150.TXT	23.21837	10.47636	0.45121	11823.91	56503.28	7396.004	1171.351	31.23346	0.208041	1.352082	18.75272	2.146696	0.653755	1.667387	0.776722	3242.857	42.63177	3029.183	23.65394	2890.343	22.11286	107.0538	112.1962636
1.sSMPABC256.TXT	62.23914	51.66321	0.830076	42589.56	201609.3	54234.93	2208.462	161.0172	0.209614	3.268749	16.79614	5.392157	0.581148	4.288431	0.795309	2953.433	102.418	2923.269	55.65624	2902.567	54.00216	101.0319	101.7524548
1.sSMPABC147.TXT	49.70808	20.72683	0.416971	21581.1	105391	16858.9	1321.123	107.7551	0.203492	1.189011	15.95113	1.937282	0.568517	1.529481	0.789499	2901.73	35.83633	2873.874	21.28801	2854.408	19.48975	100.9693	101.6578774
1.sSMPABC259.TXT	84.36722	92.41789	1.095424	57950.45	270541.1	82358.68	1839.111	-26.1236	0.212544	0.99364	16.8668	1.878456	0.575549	1.594138	0.848643	2930.563	37.64975	2927.293	20.82353	2925.045	16.16768	100.1117	100.1886472
1.sSMPABC243.TXT	21.0852	27.95739	1.325925	14951	68687.14	24910.15	2186.525	9.154431	0.215992	1.674345	17.3734	2.580234	0.583373	1.963206	0.760863	2962.499	46.79751	2955.683	27.75625	2951.047	27.28889	100.2306	100.3806055
1.sSMPABC076.TXT	9.078314	12.27712	1.352357	4362.136	19937.06	6942.985	1763.967	186.7712	0.218781	1.469047	17.64406	2.416421	0.584907	1.918592	0.793981	2968.741	45.80639	2970.531	26.1803	2971.744	23.87173	99.93972	99.89893672
1.sSMPABC245.TXT	75.98206	40.08933	0.527616	47504.79	234131	40269.8	2307.578	27.29689	0.201335	1.944129	15.3228	2.983905	0.551974	2.263636	0.758615	2833.376	52.10903	2835.521	31.41042	2837.046	32.0574	99.92436	99.87065748
1.sSMPABC226.TXT	104.6979	138.9995	1.327624	73760.22	338459.3	124782.6	2336.076	48.32431	0.21626	1.300854	17.22114	2.145193	0.577544	1.705765	0.795157	2938.722	40.3832	2947.233	23.46992	2953.048	21.15229	99.71123	99.51488171
1.sSMPABC267.TXT	137.1898	107.3691	0.782631	81850.42	411386.1	89767.73	1622.384	-110.627	0.197419	1.526531	14.66655	2.383809	0.538813	1.830915	0.768063	2778.477	41.46049	2793.855	25.4464	2804.976	25.18333	99.44958	99.0552691
1.sSMPABC145.TXT	51.93209	18.38869	0.354091	23154.72	108496.2	15694.61	1319.547	-105.607	0.21205	1.28607	16.35768	2.231711	0.559477	1.823885	0.817259	2864.468	42.31983	2897.939	24.20875	2921.277	20.96807	98.84503	98.05535682
1.sSMPABC255.TXT	82.59298	58.01245	0.70239	64014.45	270775.3	51343.83	2094.165	81.58352	0.234584	2.995374	19.0215	3.902609	0.588091	2.501618	0.641012	2981.679	59.9968	3042.907	41.10595	3083.591	48.64255	97.98784	96.6500879
1.sSMPABC118.TXT	119.1463	43.80878	0.367689	50192.83	241387.5	26879.21	1480.019	-47.9775	0.208172	1.709618	15.42293	2.26525	0.537333	1.23945	0.778993	2772.273	48.03456	2841.731	28.90814	2891.368	28.0157	97.55578	95.88101382
1.sSMPABC113.TXT	44.2825	38.5551	0.870662	19548.45	91157.9	22058.32	1388.806	263.9233	0.215159	1.885479	16.20474	3.272359	0.546237	2.674567	0.817321	2809.505	61.19793	2888.953	34.39673	2944.81	30.7843	97.24995	95.40531552
1.sSMPABC036.TXT	133.2751	78.57586	0.589576	57680.16	270333.6	48605.66	2076.109	268.9876	0.213304	1.353329	15.90189	2.194754	0.540691	1.727844	0.787261	2786.34	39.20816	2870.92	23.788	2930.814	22.05483	97.05382	95.07052173
1.sSMPABC084.TXT	33.35064	14.36199	0.430636	13148.18	65255.38	5378.405	1414.34	259.2298	0.202297	1.316299	14.52519	2.321476	0.520752	1.912226	0.823711	2702.367	42.35021	2784.652	24.81867	2844.821	21.61066	97.04506	94.99250692
1.sSMPABC227.TXT	58.52625	31.30655	0.534915	37394.6	175380.3	25643.85	2227.629	49.79875	0.211586	2.853982	15.62052	3.953803	0.535436	2.7363	0.692068	2764.315	61.80706	2853.874	41.02023	2917.731	46.97218	96.86182	94.74191296
1.sSMPABC034.TXT	72.90814	100.7066	1.600852	38303.93	182365.8	83373.98	2522.925	126.6797	0.208419	1.159959	14.92884	2.587574	0.519432	2.503041	0.907309	2696.771	55.39855	2810.586	29.14037	2893.294	18.94475	95.95047	93.2076434
1.sSMPABC136.TXT	37.95252	28.01774	0.738231	15517.24	72854.74	19248	1314.222	8.987081	0.211786	1.216451	14.9288	2.091247	0.511241	1.701048	0.813413	2661.924	37.2031	2810.711	22.64664	2919.265	19.82852	94.70644	91.18475124
1.sSMPABC196.TXT	42.69956	11.35915	0.266025	16410.85	78556.01	8382.397	1076.349	17.48658	0.209926	1.405934	14.55997	2.160733	0.503028	1.640767	0.759357	2626.795	35.49647	2786.923	23.26566	2904.977	22.97107	94.25431	90.42396278
1.sSMPABC126.TXT	216.2508	10.73846	0.049657	85522.37	408289.2	4863.588	1442.557	81.37557	0.208958	1.582474	14.43438	2.754673	0.501	2.254773	0.818526	2618.092	48.6987	2778.695	29.01389	2897.481	25.89904	94.22021	90.3575106

SAMPLE 21TG16A

SPOT	238U(ppm)	232Th(ppm)	238U / 232Th	207Pb(cp)	206Pb(cp)	208Pb(cp)	202Hg(cp)	204Pb(cp)	207Pb/206	2sigma(%)	207Pb/235	2sigma(%)	206Pb/238	2sigma(%)	Rho	AgePb206	2sigma(a)	AgePb207	2sigma(a)	AgePb207	2sigma(a)	Concord�	Concord�ncia
1.sSMPABC183.TXT	67.9408	33.85618	0.498319	20383.36	152366.3	21115.67	1756.61	198.6909	0.132767	1.741453	7.290663	2.881875	0.398268	2.296202	0.796774	2161.059	42.29971	2147.667	28.00134	2134.884	30.78553	100.6236	101.2261
1.sSMPABC188.TXT	86.72001	43.26139	0.498863	63085.86	194609.6	30113.8	1791.254	111.9634	0.133027	1.262406	7.314831	2.078693	0.398808	1.651453	0.794467	2163.547	30.42386	2150.623	20.68663	2138.303	22.2437	100.601	101.1806
1.sSMPABC039.TXT	131.4646	40.30148	0.306558	63736.42	474361.5	56691.75	8516.524	230.4298	0.133377	1.879407	7.336379	2.544763	0.398934	1.715707	0.674211	2164.128	31.61765	2153.251	24.94303	2142.893	33.22234	100.5051	100.9909
1.sSMPABC173.TXT	56.69249	34.16292	0.6026	17425.99	128396.6	21302.27	1946.791	75.55486	0.134697	1.642175	7.459363	2.448802	0.401645	1.816561	0.741816	2176.61	33.64382	2168.121	24.12489	2160.094	28.93146	100.3915	100.7646
1.sSMPABC218.TXT	95.63173	56.44896	0.590274	28746.44	213516.3	36950.65	2196.007	203.4052	0.133604	2.398992	7.339781	3.351894	0.398438	2.340947	0.698395	2161.844	43.13997	2153.665	32.34289	2154.875	42.52735	100.3798	100.7442
1.sSMPABC035.TXT	126.3002	54.80854	0.433954	61554.75	455411.2	76646.75	8529.315	125.1717	0.133954	1.892599	7.360032	2.573021	0.398493	1.743131	0.677465	2162.098	32.09888	2156.128	25.2128	2150.446	33.42998	100.2769	100.5419
1.sSMPABC139.TXT	69.17421	24.24571	0.350502	32716.77	243012.7	32642.53	7024.258	88.15466	0.132917	1.947833	7.248643	2.70996	0.395527	1.883667	0.695168	2148.409	34.50818	2142.508	26.4043	2136.854	34.46955	100.2754	100.5408
1.sSMPABC186.TXT	31.97143	14.37665	0.449672	14723.73	111492.1	16432.11	6606.512	25.54866	0.130285	1.90093	6.947522	2.65444	0.386754	1.766909	0.665643	2107.755	31.84489	2104.747	25.73904	2101.809	35.20111	100.1429	100.2829
1.sSMPABC198.TXT	49.47324	21.26698	0.473301	97010.499	70537.06	12396.31	6009.31	160.2263	0.134764	1.880837	7.34216	2.510473	0.395138	1.662807	0.662348	2146.614	30.43102	2153.955	24.63274	2160.96	33.18095	99.6592	100.1621
1.sSMPABC077.TXT	169.2359	56.57155	0.334276	81181.13	602032.5	79642.24	6939.481	281.8579	0.133246	1.885019	7.246178	2.542499	0.394415	1.706166	0.671059	2143.272	31.18538	2142.204	24.87767	2141.181	33.32907	100.0498	100.0977
1.sSMPABC217.TXT	84.71764	74.52818	0.879725	25573.66	188767.6	50092.55	2464.46	75.30195	0.134442	1.305988	7.369883	2.056701	0.39758	1.58884	0.772519	2157.889	29.20316	2157.323	20.50963	2156.785	22.9703	100.0262	100.0511
1.sSMPABC197.TXT	54.31828	29.69199	0.54663	25400.93	190408.2	35850.18	6102.164	12.64673	0.132456	1.975405	7.150279	2.714026	0.391517	1.861105	0.685736	2129.859	33.84469	2130.327	26.3918	2130.778	34.98721	99.97805	99.95689
1.sSMPABC193.TXT	56.71167	45.04637	0.794305	17239.47	226778.2	32978.84	1868.095	456.3143	0.13495	5.017174	7.397186	9.552186	0.39755	0.53805	0.53805	2157.75	58.99673	2160.63	56.6095	2163.368	90.21463	99.86671	99.74035
1.sSMPABC030.TXT	60.56836	30.14304	0.49767	29528.2	216713.3	41775.48	8499.391	118.9795	0.134764	1.880837	7.34216	2.510473	0.395138	1.662807	0.662348	2146.614	30.43102	2153.955	24.63274	2160.96	33.18095	99.6592	100.1621
1.sSMPABC190.TXT	36.63915	19.28543	0.526361	19092.44	80851.95	14537.55	2101.07	211.9767	0.133823	1.480408	7.237945	2.316916	0.392269	1.782272	0.769243	2133.344	32.45234	2141.19	22.81904	2148.726	26.08995	99.63358	99.28413
1.sSMPABC197.TXT	149.9584	91.3481	0.609156	43505.64	268742.1	53878.19	1947.573	117.9716	0.132628	1.628598	7.063617	2.554448	0.387322	2.221407	0.80648	2110.396	40.10433	2119.472	26.71272	2128.429	28.79205	99.57175	99.15923
1.sSMPABC125.TXT	118.3822	40.48674	0.342	55931.36	415115.7	54709.53	7477.363	288.3341	0.134051	1.890294	7.250713	2.59529	0.392292	1.778291	0.685199	2133.45	32.38102	2142.763	25.36144	2151.703	33.38412	99.56537	99.15166

SAMPLE 22TG65B

SPOT	238U(ppm)	232Th(ppm)	238U / 232Th	207Pb(cp)	206Pb(cp)	208Pb(cp)	202Hg(cp)	204Pb(cp)	207Pb/206	Zsiga(ma)	207Pb/235	Zsiga(ma)	206Pb/238	Zsiga(ma)	Rho	AgePb206	Zsiga(al)	AgePb207	Zsiga(al)	AgePb207	Zsiga(al)	Concorda	Concorda
1.SMPABC197.TXT	41.50408	10.21583	0.24614	54054.94	390881.4	27254.31	5657.924	34.59378	0.136832	0.775352	12.39563	2.838895	0.657022	2.730692	0.619681	3255.582	70.18553	2634.846	29.41145	2187.484	13.54769	123.587	148.8277
1.SMPABC097.TXT	19.45133	13.43466	0.690691	24252.57	174417.2	26110.88	9947.995	466.2466	0.1372	1.006313	11.3394	2.194148	0.599427	1.949775	0.888625	3027.527	47.27875	2551.452	22.99323	2192.152	17.59661	118.659	138.1076
1.SMPABC063.TXT	23.28165	0.070129	0.003012	52523.7	265941.6	2629.503	9756.323	560.1366	0.194597	1.150075	20.31509	2.080512	0.751748	1.73374	0.833324	3633.791	48.33947	3106.478	23.15413	2781.411	18.97218	116.9746	130.6456
1.SMPABC015.TXT	60.27895	26.28372	0.436035	39543.24	380088.9	38755.52	14023.56	712.1907	0.102601	4.570809	5.608401	5.258811	0.396449	6.600538	0.494511	2152.667	47.76962	1917.39	48.06747	1671.696	68.98067	112.2707	128.7715
1.SMPABC238.TXT	33.69482	16.892	0.501323	33612.88	240146.4	38433.91	5571.347	268.8708	0.138188	1.212938	9.599143	2.66387	0.501704	2.371705	0.890323	2621.117	51.28244	2393.25	26.94934	2204.619	21.20945	109.5212	118.8921
1.SMPABC237.TXT	0.20754	0.352078	1.696437	2052.083	3638.83	4633.225	5564.443	403.3332	0.556752	3.855667	94.7686	4.17534	1.23453	1.602279	0.383748	5183.117	57.31935	4632.111	47.03449	4398.992	57.54719	111.8954	117.8251
1.SMPABC226.TXT	40.87056	23.6092	0.581033	43069.41	286209.9	50026.02	5137.82	89.71796	0.148584	1.334459	10.16835	2.423711	0.496336	2.022934	0.834643	2598.032	43.40811	2450.205	24.87371	2329.699	23.04812	106.0333	111.5179
1.SMPABC219.TXT	44.98202	27.0795	0.601924	119172	468316.8	84535.59	5242.929	138.8097	0.2514	1.101115	25.43725	2.295464	0.733845	2.014125	0.877437	3547.73	55.1895	3325.15	25.69277	1933.601	17.52894	106.6398	111.0887
1.SMPABC043.TXT	19.85767	5.362011	0.272789	34594.77	173174.5	15567.36	10487.14	587.996	0.197223	1.032322	15.70064	1.941904	0.773716	1.644823	0.847	2938.034	38.92884	2858.757	21.30179	2803.352	16.98401	102.7731	104.8943
1.SMPABC163.TXT	71.20927	32.16109	0.451642	22530.87	166577.4	22630.97	2138.106	361.0346	0.134241	2.881755	7.667963	3.963039	0.414279	2.720509	0.68647	2234.455	51.57774	2192.856	38.20559	2154.18	51.18895	101.897	103.7265
1.SMPABC070.TXT	49.08722	31.88311	0.64952	65969.7	376826	87567.87	9740.092	621.9592	0.17249	0.982999	12.11221	2.022908	0.509281	1.768013	0.873996	2653.559	38.57355	2613.133	21.5217	2581.955	16.50835	101.547	102.7732
1.SMPABC086.TXT	105.0968	37.42324	0.356084	22402.59	976356.4	117382.2	9055.068	411.054	0.226274	0.912448	19.28026	1.947774	0.617983	1.720832	0.883486	3101.888	42.50994	3055.945	21.75111	3025.881	14.71588	101.5034	102.5119
1.SMPABC133.TXT	22.21399	10.98857	0.494669	7198.003	52257.11	7769.444	2382.443	202.6461	0.136717	1.492738	7.820873	7.249883	0.414889	4.732379	0.652752	2237.237	50.08207	2210.612	69.41448	2186.021	98.80112	101.2044	102.3429
1.SMPABC150.TXT	7.410593	3.269749	0.441226	3315.794	20204.6	3780.502	2504.893	-156.944	0.162883	1.649788	10.82445	14.94552	0.481981	2.709398	0.181285	2535.887	57.05563	2508.168	151.544	2485.806	271.7389	101.1051	102.0147
1.SMPABC154.TXT	70.88382	57.42286	0.810098	21681.44	161501.4	38077.13	2312.587	82.13155	0.133243	2.810422	7.40369	3.928315	0.409947	2.734665	0.696868	2182.823	51.02347	2161.416	37.7043	2141.145	49.973	100.9904	101.9465
1.SMPABC151.TXT	82.06064	51.78903	0.631107	24707.69	185240.8	32101.9	2509.37	1.10253	0.132381	1.535413	7.290906	3.216056	0.399249	1.734662	0.74867	2166.473	31.90409	2147.697	22.83574	2129.788	27.12472	100.8742	101.7224
1.SMPABC145.TXT	32.98158	15.68563	0.475588	9066.074	74409.19	1097.586	2166.019	159.3581	0.132135	1.967689	7.26117	0.302357	0.398554	2.307247	0.708876	2162.38	42.52758	2144.049	29.36272	2126.531	34.86554	100.855	101.6858
1.SMPABC146.TXT	48.39455	25.36035	0.524033	15565.65	113196.6	15892.72	2100.339	243.0555	0.137359	1.950667	7.826855	3.242882	0.413266	2.591046	0.768095	2229.834	49.02588	2211.3	31.6171	2194.168	34.2904	100.8382	101.6255
1.SMPABC147.TXT	38.50042	28.63952	0.74385	12157.38	88936.67	17146.59	2025.216	186.7367	0.135675	2.846769	7.636054	4.13066	0.408195	2.956427	0.715728	2206.665	55.48275	2189.111	39.74375	2172.706	51.13756	100.8019	101.5613
1.SMPABC083.TXT	122.9709	49.20485	0.400172	131019.5	1208920	171594.4	9186.986	304.8721	0.252965	0.815634	22.79041	0.260337	0.653416	1.892126	0.918313	3241.539	48.38434	3218.036	23.76191	3203.42	12.95309	100.7303	101.1899
1.SMPABC240.TXT	49.83004	3.002416	0.060689	82685.51	400329.2	7963.828	5629.293	165.7103	0.203928	1.664799	15.89359	3.225416	0.565254	2.765262	0.856498	2888.304	64.63452	2870.421	33.88103	2857.896	27.35553	100.623	101.064
1.SMPABC155.TXT	96.41822	30.40491	0.315291	28017.26	212930.8	19519.83	2197.651	256.3383	0.130593	1.518991	7.034229	2.646062	0.390657	1.765307	0.811842	2125.875	39.35672	2115.765	25.71037	2105.953	26.90226	100.678	100.946
1.SMPABC165.TXT	24.31256	16.38234	0.673859	8830.125	59693.59	11964.07	2213.055	190.0597	0.146812	1.702662	8.804264	2.459355	0.434941	1.774645	0.721259	2327.954	34.76937	2137.934	24.77183	2309.12	29.52653	100.4323	102.8156
1.SMPABC148.TXT	21.93	6.272452	0.286022	6921.69	50388.39	3989.167	2167.545	186.1371	0.136339	2.064641	7.633554	2.979665	0.406703	1.844909	0.721024	2196.943	40.12197	2188.817	29.08297	2181.211	36.38236	100.3713	102.7212
1.SMPABC248.TXT	16.84939	9.89366	0.5872	28906.57	136970.6	22878.86	5704.547	324.6245	0.208338	0.340889	16.39858	5.633448	0.570688	4.722229	0.841799	2911.385	112.0641	2900.328	57.99485	2892.662	50.21466	100.3812	100.6473
1.SMPABC217.TXT	35.69004	28.635	0.802325	58126.18	294006.6	82874.66	4944.671	-81.4697	0.202664	2.572734	15.63296	3.724193	0.595451	2.962128	0.795388	2864.361	68.87126	2854.634	38.7516	2847.775	37.2524	100.3408	100.5824
1.SMPABC100.TXT	87.84404	23.30618	0.343526	54125.64	400812.2	57646.08	8564.918	224.9533	0.133251	1.230658	7.269239	2.602288	0.396655	2.292899	0.881109	2149.001	42.03945	2145.04	25.4347	2141.248	21.673	100.1847	100.3621
1.SMPABC204.TXT	14.5057	3.967899	0.27354	10968.99	81658.6	9996.394	5341.116	271.5702	0.132885	1.485555	7.225387	2.632281	0.394351	2.173024	0.825529	2142.975	39.74032	2139.641	25.68593	2136.441	26.21644	100.1558	100.3058
1.SMPABC137.TXT	28.9541	18.18297	0.282595	22492.93	166528.1	20390.11	6942.84	564.8916	0.133015	2.360966	7.231864	3.881116	0.394555	2.826868	0.767521	2143.917	51.7652	2140.973	35.32476	2138.149	41.87981	100.1375	100.2698
1.SMPABC134.TXT	18.6899	9.519793	0.509925	5444.167	40026.8	5971.225	2252.536	146.0494	0.127561	1.655149	6.615469	5.236658	0.378814	3.428213	0.665083	2607.796	61.90333	2066.211	49.15132	2064.632	70.62253	100.0767	100.1533
1.SMPABC175.TXT	74.6644	12.27533	0.164407	5784.777	427793.5	26211.93	5748.765	22.80306	0.133601	1.090568	7.288571	2.169424	0.396699	1.875307	0.684426	2149.065	34.36034	2147.411	21.5003	2145.828	19.18215	100.0771	100.1509
1.SMPABC067.TXT	207.4456	83.53514	0.402684	159357.5	1205481	87323.13	9631.077	451.0678	0.130244	0.937419	6.920959	2.450961	0.385397	2.26461	0.923968	2101.448	40.73968	2101.348	23.87955	2101.25	16.55377	100.0048	100.0904
1.SMPABC153.TXT	29.53899	13.88109	0.469925	9253.588	67283.6	9760.15	107.345	200.2985	0.136501	1.802697	7.816354	2.564553	0.404284	1.824066	0.711261	2182.075	33.85465	2182.682	25.24182	2183.272	31.70881	99.9715	100.9451
1.SMPABC125.TXT	117.0139	53.72798	0.459159	90737.38	663795.5	76144.5	5187.168	240.735	0.134965	0.770421	7.416572	1.978787	0.39885	1.805267	0.920934	2162.357	33.53192	2162.972	19.80231	2163.555	13.49672	99.97159	99.94465
1.SMPABC146.TXT	121.9378	25.69336	0.210065	93073.52	69902.04	43751.64	3371.298	509.8728	0.132333	0.932321	7.12918	1.956739	0.399152	1.72035	0.671992	2126.317	31.23479	2127.695	19.50221	2129.026	16.4119	99.93524	99.87276
1.SMPABC244.TXT	33.19167	12.53609	0.377688	26057.77	128952.7	21918.4	5546.729	25.43026	0.135952	1.594712	7.512559	2.727269	0.400775	2.21244	0.811229	2127.608	40.93552	2174.486	26.70078	2176.259	28.03686	99.9162	99.83222
1.SMPABC136.TXT	100.3133	56.53144	0.563549	30919.27	126715.4	33516.34	2327.817	212.6784	0.135363	1.89231	7.442472	2.8457	0.398164	2.125364	0.746869	2163.345	39.17797	2166.091	27.75129	2168.695	33.35698	99.87321	99.75332
1.SMPABC183.TXT	69.68884	44.35374	0.636454	55185.43	402123.2	88699.44	5968.102	274.1598	0.135657	1.132081	7.474571	2.351186	0.399577	2.046064	0.87645	2167.093	38.03792	2169.945	23.23963	2172.643	19.85572	99.86856	99.74452
1.SMPABC205.TXT	105.1417	51.24381	0.487739	79447.76	589409	59664.71	5384.422	427.7757	0.133337	1.20577													

SAMPLE 22TG13B

SPOT	238U(ppm)	232Th(ppm)	238U / 232Th	207Pb(cp)	206Pb(cp)	208Pb(cp)	202Hg(cp)	204Pb(cp)	207Pb/206Pb	2sigma(%)	207Pb/235U	2sigma(%)	206Pb/238U	2sigma(%)	Rho	AgePb206/2sigma(a)	AgePb207/2sigma(a)	2sigma(abs)	Concordia	Concordia			
1.SSMPABC244.TXT	103.666	60.07492	0.579504	30195.43	169931.1	32650.27	1035.891	-153.754	0.178858	2.24971	13.46127	3.613991	0.545855	2.828381	0.78262	2807.909	64.70565	2712.569	37.1909	2642.307	37.8426	103.5147	106.2673
1.SSMPABC339.TXT	114.5033	91.59381	0.799923	44662.02	210936.3	57459.67	889.1344	303.5268	0.206264	1.868709	17.38749	2.651476	0.605511	1.881024	0.709425	3052.003	45.89509	2956.461	28.45883	2892.082	30.64911	103.2316	105.5296
1.SSMPABC224.TXT	110.2012	34.15825	0.309963	42510.8	197895.5	21292.97	1043.609	84.46106	0.213016	1.860003	17.50812	2.678005	0.596109	1.926682	0.719447	3014.144	46.55419	2963.101	28.73587	2928.632	30.40677	101.7226	102.9199
1.SSMPABC24.TXT	118.1268183	94.32103912	0.798473	91295.16	401820.3	115282.2	1578.135	482.483	0.225410859	13.2974931	19.14961717	20.8345331	0.616146502	16.03915351	0.769835	3094.566	406.7545	3049.383	226.6272	3019.747631	231.2840326	101.4817	102.4776
1.SSMPABC289.TXT	100.4151087	52.7061909	0.524883	65238.48	315608.4	48956.74	1865.978	346.4899	0.205092671	2.623898175	16.01972175	4.1999727	0.566504746	3.279470845	0.780831	2893.453	76.90985	2877.974	43.54531	2867.159391	43.32130522	100.5378	100.9171
1.SSMPABC317.TXT	81.59384	41.16843	0.504553	27220.75	137409.8	21921.41	899.0936	128.2551	0.19898	1.900063	15.19988	2.81944	0.554025	2.083027	0.738809	2841.891	48.05097	2827.846	29.77969	2817.849	31.37715	100.4967	100.8532
1.SSMPABC296.TXT	77.92783957	41.27552685	0.529663	50776.21	244631.9	38291.04	2019.173	-52.7021	0.2059371195	1.380400632	16.08196483	2.24225296	0.56637365	1.766972681	0.788034	2892.913	41.31872	2881.681	24.2753	2873.839691	22.61277738	100.3898	100.6637
1.SSMPABC327.TXT	20.83463599	4.57186376	0.219436	11035.9	59704.62	5278.328	1864.994	-1.087	0.183381511	1.907259679	13.12997603	2.69677542	0.519286594	1.906556634	0.706976	2696.154	42.14579	2689.037	28.20048	2683.692136	31.89137889	100.2647	100.4644
1.SSMPABC329.TXT	42.16758485	38.12361088	0.904098	27981.9	132753.4	35350.31	1843.701	316.4417	0.209115118	2.142789919	16.45362727	3.06230081	0.570656737	2.187724308	0.714405	2910.516	51.44418	2903.536	32.36771	2898.699653	35.17986313	100.2404	100.4077
1.SSMPABC283.TXT	125.8248	51.86032	0.412163	42140.57	209198.2	31263.05	1087.849	-64.1814	0.201128	2.229787	15.39534	3.079704	0.555158	2.124294	0.689772	2846.588	49.07121	2840.023	32.36228	2835.368	36.8347	100.2311	100.3957
1.SSMPABC328.TXT	115.4760401	114.8048575	0.994188	69419.82	348723.2	102669.3	1976.243	249.848	0.197495678	1.107267493	14.9037089	2.01350998	0.547312654	1.681719693	0.835218	2813.986	38.46132	2809.11	21.88952	2805.611882	18.22121066	100.1736	100.2985
1.SSMPABC314.TXT	138.9991787	63.04949485	0.453596	82608.73	418187.9	55985.67	1566.981	283.7591	0.195985414	2.074588869	14.70518399	3.69005606	0.544183585	3.051654434	0.826994	2800.937	69.7021	2796.356	38.22343	2793.052782	34.37175654	100.1638	100.2823
1.SSMPABC294.TXT	34.67864611	13.00056188	0.374887	21708.17	106743	12961.86	1720.627	14.09718	0.201777867	1.673419567	15.44586405	2.39647108	0.555184593	1.715441803	0.71582	2846.699	39.58888	2843.148	25.68966	2840.631121	27.54119003	100.1249	100.2136
1.SSMPABC228.TXT	44.23882	14.78637	0.33424	15178.75	74522.44	9729.397	973.1069	70.72128	0.203678	1.939924	15.68208	2.788281	0.558416	2.002799	0.718292	2860.079	46.42939	2857.628	29.55408	2855.901	31.93309	100.0857	100.1463
1.SSMPABC390.TXT	45.63704	22.85288	0.500753	15649.04	76685.62	14335.99	857.3069	0.626513	0.204618	1.901163	15.79393	2.714687	0.559817	1.937809	0.713824	2865.873	44.99003	2864.414	28.85108	2863.387	31.26702	100.0509	100.0868
1.SSMPABC273.TXT	135.4575205	105.005958	0.775195	81531.48	410283.3	91928.06	1938.436	186.5195	0.197175419	1.195341176	14.80850044	2.24623336	0.544699575	1.90176859	0.846648	2803.091	43.37597	2803.014	24.13261	2802.957896	19.68535302	100.0028	100.0047
1.SSMPABC326.TXT	59.1207307	48.10309697	0.813642	43136.71	192654.3	50659.60	1845.722	403.5701	0.222139207	1.648322221	18.0837715	2.43671658	0.590421983	1.794609018	0.736487	2991.132	43.09124	2994.2	26.43244	2996.261408	26.7561997	99.89753	99.82881
1.SSMPABC343.TXT	52.96643	10.6283	0.200661	18781.45	89843.28	9130.882	861.6809	41.84766	0.206321	1.998878	15.92847	2.912074	0.559926	2.117702	0.727214	2866.322	49.18872	2872.515	30.80718	2876.861	32.85325	99.78438	99.63364
1.SSMPABC286.TXT	45.13579794	15.57684474	0.345111	31821.81	144721	14604.85	2212.036	51.08522	0.218168142	1.340542312	17.37695195	2.47045577	0.577671566	0.839972	2939.243	49.16769	2955.879	26.6779	2967.220279	21.77591851	99.43719	99.05712	
1.SSMPABC277.TXT	29.13640795	19.73702241	0.677401	19426.15	90970.71	17585.64	1740.42	-42.0792	0.2118812	4.501963153	16.41269028	5.84669227	0.561805616	3.730434064	0.638042	2874.086	87.08974	2901.152	60.15407	2919.989084	74.80502757	99.06707	98.42797
1.SSMPABC315.TXT	129.6190906	67.41002841	0.520063	80085.57	390943	52139.94	2035.671	177.618	0.203239945	1.535789431	15.28982077	4.0126333	0.545622224	3.707098165	0.923857	2806.94	84.91772	2833.468	41.53267	2852.393138	25.22919368	99.06378	98.40640
1.SSMPABC386.TXT	70.46484	43.51768	0.61758	22517.42	114279.9	26413.08	716.0089	84.37286	0.198632	1.884779	14.68514	2.711049	0.536202	1.948691	0.718796	2767.53	43.99695	2795.059	28.63337	2814.986	31.13006	99.0151	98.31419
1.SSMPABC313.TXT	163.9084153	26.82962219	0.163686	100940.5	492310	24913.45	1763.69	236.3657	0.203421504	2.223522355	15.23562958	3.99245523	0.543203136	3.315967831	0.830559	2796.843	75.68585	2830.084	41.32133	2853.846966	36.66880832	98.82543	98.00254
1.SSMPABC248.TXT	71.94743	45.84521	0.637204	23763.43	117168.1	25793.87	1063.91	100.5327	0.203976	1.849068	15.25774	2.670594	0.542512	1.92692	0.721532	2793.955	43.83676	2831.466	28.33488	2858.28	30.41493	98.67522	97.74654
1.SSMPABC346.TXT	146.1846	58.72175	0.401696	47422.86	235182.5	38485.12	883.2032	215.1999	0.198931	1.886255	14.61774	2.776833	0.532398	2.037852	0.733876	2753.821	45.83384	2790.687	29.26268	2817.444	31.14776	98.67897	97.7418
1.SSMPABC340.TXT	80.55595	16.31026	0.202471	26951.21	131768.9	742.6181	1083.49	55.79674	0.202092	1.896693	14.99632	2.70408	0.538189	1.92733	0.712749	2775.862	43.6182	2815.006	28.6186	2843.165	31.24933	98.60946	97.63282
1.SSMPABC284.TXT	206.6899375	116.2370442	0.562374	119177	603468.4	112053.5	2022.988	385.0957	0.195946655	4.500466177	14.20766012	6.48169017	0.525876096	4.664559104	0.719652	2724.053	104.4738	2763.669	65.892	2792.729008	75.6449252	98.56655	97.5409
1.SSMPABC268.TXT	82.55612	42.99483	0.520795	26868.31	132931.6	19616.22	931.7399	-14.0074	0.201631	1.869693	14.88049	2.708101	0.535253	1.959096	0.723421	2763.545	44.18149	2807.627	28.63825	2839.444	30.80996	98.42993	97.32689
1.SSMPABC333.TXT	87.91719	40.70145	0.462952	28665.18	142625.1	16188.04	863.1585	85.81252	0.199496	1.92722	14.6043	2.788135	0.53094	2.014825	0.722643	2745.412	45.20274	2789.812	29.37047	2822.076	31.81846	98.40849	97.28341
1.SSMPABC240.TXT	44.36499	18.86647	0.425256	13535.07	69256.15	9797.314	1040.458	143.5605	0.1967	2.763201	14.08247	3.691005	0.519247	2.447088	0.662987	2695.984	54.14216	2755.275	38.0932	2799.007	45.94115	97.84909	96.31931
1.SSMPABC293.TXT	44.50245	33.54452	0.753768	14934.22	72458.25	12684.28	859.152	97.70748	0.20721	1.972431	15.33227	2.8098	0.536653	2.001123	0.712194	2769.424	45.20972	2836.11	29.70764	2883.851	32.39344	97.64969	96.03215
1.SSMPABC293.TXT	75.58405	58.30466	0.771391	26528.95	132182.3	20129.49	895.8058	127.5607	0.214895	1.86898	16.15388	2.69231	0.545268	1.937897	0.71979	2805.461	44.23278	2885.946	28.68663	2942.602	30.51788	97.21114	95.39848
1.SSMPABC380.TXT	72.98682	25.71638	0.352343	23575.09	115721	16131.95	898.4826	33.19487	0.206344	1.912634	14.84835	2.851626	0.521897	2.115089	0.741713	2707.222	46.92738	2805.57	30.03337	2877.047	31.41946	96.49454	94.09725
1.SSMPABC365.TXT	31.23363	25.43454	0.814332	9688.491	47489.25	14462.37	935.4891	44.76443	0.204306	1.955908	14.29342	2.743485	0.507405	1.923833	0.701237	2645.54	41.88131	2769.379	28.87936	2860.906	32.18477	95.52827	92.47208
1.SSMPABC300.TXT	75.91227077	61.39340961	0.808742	48829.48	221584.1	61726.24	1901.025	184.3506	0.219086525	1.166273646	15.91735995	1.8377565	0.526931421	1.420265727	0.772826	2728.51	31.67297	2871.849	20.31667	2973.999751	18.91504023	95.00883	91.74578
1.SSMPABC378.TXT	79.56998	44.12653	0.554563	23801.91	119000.7	27207.18	1014.865	141.0471	0.202626	1.927622	13.76187	2.79625	0.492585	2.025565	0.724419	2581.85	43.23961	2733.459	29.29149	2847.465	31.75235	94.45359	90.67189
1.SSMPABC350.TXT	89.5157	65.9012	0.736197	26572.18	131236.5	25523.43	752.4076	103.3574	0.199891	1.846515	13.44524	2.704154	0.487837	1.975559	0.730564	2561.311	41.89265	2711.443	28.33571	2825.303	30.4627		

SAMPLE 22TG46

SPOT	238U(ppm)	232Th(ppm)	238U / 232Th	207Pb(cps)	206Pb(cps)	208Pb(cps)	202Hg(cps)	204Pb(cps)	207Pb/206Pb	2sigma(%)	207Pb/235U	2sigma(%)	206Pb/238U	2sigma(%)	Rho	AgePb206	2sigma(al)	AgePb207	2sigma(al)	AgePb207	2sigma(al)	Concordia	Concordia
1.sSMPABC089.TXT	0.972963	0.693978	0.713263	731.2891	3202.203	993.3494	4303.819	-134.902	0.223705	6.223179	33.54887	6.725801	1.087679	2.551165	0.37931	4744.902	86.25734	3596.867	71.80213	3007.551	103.6777	131.9176	157.7663
1.sSMPABC137.TXT	1.901158	3.545174	1.864745	1236.559	5842.654	1630.335	4188.434	52.82862	0.206442	8.901884	28.96591	9.284026	1.017625	2.63621	0.283951	4524.875	86.2877	3452.364	98.53862	2877.818	152.5064	131.066	157.2328
1.sSMPABC094.TXT	1.885331	0.85699	0.454557	1265.715	5536.942	5.983716	4312.646	-7.79588	0.222849	15.43871	29.88843	15.66877	0.972729	2.675169	0.170733	4379.808	85.60006	3483.152	169.9778	3001.388	272.7612	125.7427	145.9261
1.sSMPABC148.TXT	2.273884	1.823606	0.801978	1352.752	6011.538	349.0117	4422.305	150.9118	0.219104	4.983428	26.48972	5.626277	0.876885	2.611599	0.464179	4058.629	79.1377	3364.789	59.61908	2974.12	82.64882	120.6206	136.4649
1.sSMPABC140.TXT	2.385273	-0.17596	-0.07377	1342.652	6028.246	1012.565	4101.38	83.82682	0.217366	5.516905	25.09176	6.116804	0.837216	2.64179	0.431891	3921.04	78.07664	3311.793	64.52497	2961.284	91.89178	118.3963	132.4102
1.sSMPABC133.TXT	16.20233	3.945248	0.243499	8350.78	39224.41	2629.403	4037.83	-26.2482	0.207347	3.415304	22.90895	4.447371	0.801319	2.84865	0.640525	3793.838	82.21262	3223.083	47.12035	2884.925	56.56082	117.7084	131.5056
1.sSMPABC043.TXT	16.82691	3.805922	0.226181	10922.37	44920.89	307.0739	4742.569	50.29761	0.237645	4.096207	28.41946	5.763225	0.867332	4.054115	0.703446	4025.855	122.5461	3433.677	61.24608	306.458	66.83327	117.2462	129.6877
1.sSMPABC039.TXT	12.80295	1.189562	0.092913	6528.833	29984.79	2369.685	5049.222	-42.9826	0.212369	3.72174	22.27433	4.803145	0.760698	3.036256	0.632139	3646.803	85.12325	3195.767	50.65577	2923.71	61.53516	114.1136	124.732

1.sSMPABC125.TXT	29.95926	30.21276	1.008461	11359.9	55211.19	17430.09	4080.02	85.08085	0.199509	3.261379	16.78184	4.287223	0.610066	2.782748	0.649079	3070.266	68.33212	2922.453	44.56776	2822.181	54.26863	105.0579	108.7906
1.sSMPABC190.TXT	22.21677	9.337053	0.42027	8113.998	39955.11	5882.595	4094.497	166.9148	0.193407	3.789798	15.89131	5.337847	0.595919	3.758995	0.704215	3013.375	91.1239	2870.284	54.8886	2771.348	63.5555	104.9853	108.7332
1.sSMPABC138.TXT	10.99338	7.852461	0.71429	3920.157	19668.67	4975.723	4049.303	27.50025	0.194459	3.979769	15.88645	5.107213	0.592514	3.200792	0.62672	2999.604	77.23066	2869.992	52.5725	2780.244	66.76196	104.5161	107.89
1.sSMPABC180.TXT	21.87279	6.670088	0.304949	8852.872	40792.35	6261.914	3936.229	59.90423	0.204104	4.021396	17.26015	5.639563	0.613327	3.953865	0.701094	3083.309	97.63244	2949.405	58.26536	2859.299	66.99158	104.54	107.8344
1.sSMPABC025.TXT	5.913011	-0.91601	-0.15492	2419.729	11304.46	2195.565	4814.218	-233.718	0.209133	7.425006	17.92762	8.780307	0.550011	0.617408	0.429336	3.945828	3099.595	105.1735	2995.155	88.35842	2898.835	125.8093	104.0428
1.sSMPABC065.TXT	126.1011	23.99863	0.190313	42826.13	222717.1	13898.94	4593.423	7.150885	0.190655	3.134186	15.12815	4.320286	0.575487	2.973508	0.688266	2930.31	70.40075	2823.34	44.54395	2747.824	52.47095	103.7888	106.6411
1.sSMPABC183.TXT	60.90750	20.63251	0.387571	21839.23	107107.7	12432.63	4020.95	301.855	0.192515	3.194219	15.33379	4.236443	0.578774	2.782879	0.65689	2943.745	66.10378	2836.204	43.75947	2760.648	53.43128	103.7917	106.6324
1.sSMPABC083.TXT	2.454252	1.339655	0.545443	943.955	4525.391	290.3886	4267.397	-46.2591	0.205476	1.295558	17.20399	12.87136	0.60725	2.65015	0.205895	3058.981	64.8718	2946.277	134.267	2870.194	221.0604	103.8253	106.5775
1.sSMPABC115.TXT	25.89421	12.41999	0.479644	9650.75	46472.24	7848.648	3947.645	311.5906	0.20056	3.28303	16.4553	4.493452	0.594966	3.068033	0.682779	3009.605	74.20364	2903.517	46.55988	2830.761	54.5933	103.6538	106.3179
1.sSMPABC045.TXT	39.81881	25.15737	0.631796	14713.75	72266.01	15668.99	4835.211	91.16103	0.199265	3.221835	16.2007	4.281316	0.589659	2.819476	0.658554	2988.038	67.77423	2888.714	44.39207	2820.188	53.60783	103.4384	105.9517
1.sSMPABC075.TXT	22.09362	4.371785	0.197875	8915.864	41577.81	2435.885	4026.441	191.3768	0.212382	3.304362	18.05408	4.282637	0.616533	2.724367	0.636142	3096.109	67.33203	2992.62	44.75613	2923.81	54.49953	103.4581	105.893
1.sSMPABC127.TXT	21.22731	12.94582	0.609896	8093.083	38311.19	7431.841	4375.166	32.3966	0.205118	3.571402	16.8948	4.710369	0.597375	3.071265	0.652022	3019.255	74.47011	2928.882	48.82226	2867.362	59.29368	103.0856	105.2973
1.sSMPABC188.TXT	84.41046	2.942708	0.029531	31903.51	150467	1208.892	4138.635	434.0297	0.201209	3.529646	16.3434	5.311251	0.589106	3.968752	0.747235	2985.998	95.54932	2897.103	54.73331	2836.028	58.75187	103.0615	105.281
1.sSMPABC096.TXT	6.971814	0.661344	0.09486	2585.234	12414.92	80.02165	4156.091	42.63207	0.202635	4.282403	16.48955	5.18495	0.590193	2.923138	0.563774	2990.203	70.31991	2905.624	53.49752	2847.536	71.52657	102.9109	105.0102
1.sSMPABC164.TXT	5.687419	-0.28742	-0.05054	2212.464	10219.31	1240.318	4077.133	185.2848	0.206497	3.903175	16.92762	11.90596	0.59454	4.529385	0.551307	3007.803	159.731	2930.743	123.4566	2878.249	171.26268	102.6294	104.5011
1.sSMPABC149.TXT	5.433059	-2.11842	-0.39991	1809.07	9202.098	171.737	3936.297	183.803	0.191283	6.819501	14.81734	7.689	0.561815	3.551779	0.46193	2874.125	82.89285	2803.581	78.39507	2753.221	116.6767	102.5162	104.3913
1.sSMPABC120.TXT	15.03355	4.511989	0.300128	5904.077	27202.24	4311.424	4089.888	3.738874	0.209932	3.217163	17.34919	4.269289	0.599376	2.806543	0.65738	3027.325	68.16051	2954.344	44.49653	2905.019	53.12225	102.4703	104.2102
1.sSMPABC064.TXT	44.57368	17.02387	0.381927	16711.19	80390.95	10668.93	4470.134	96.47535	0.206052	3.128971	16.98913	4.137406	0.587431	2.706966	0.654627	2978.996	64.90038	2917.145	43.05629	2874.742	51.77857	102.1202	103.6265
1.sSMPABC177.TXT	26.98096	13.46653	0.499112	9354.281	45774.9	6817.394	4251.293	162.8022	0.192147	3.357306	14.7851	4.46524	0.558071	2.943953	0.659305	2858.651	68.33622	2801.569	45.89888	2760.627	56.21378	102.0397	103.5508
1.sSMPABC130.TXT	21.86492	8.074123	0.396273	8125.293	38482.9	4635.733	4158.268	-68.4448	0.205316	3.903772	16.92762	5.120002	0.582509	3.312851	0.647041	2958.977	79.09299	2905.663	52.84475	2868.929	64.9304	101.8349	103.1388
1.sSMPABC123.TXT	50.7053	4.08687	0.0806	19157.61	89676.96	221.6832	4144.945	-160.446	0.206921	3.2944	16.70738	4.675161	0.585601	3.317237	0.709545	2971.56	79.46511	2918.192	48.43029	2881.586	54.53589	101.8288	103.1224
1.sSMPABC068.TXT	57.4318	20.36529	0.3546	20579.67	101144.4	12829.86	4386.504	48.60687	0.201821	3.156556	15.99029	4.218259	0.574629	2.798189	0.663352	2926.801	66.16551	2876.217	43.72099	2840.983	52.40243	101.7587	103.0207
1.sSMPABC044.TXT	33.57409	9.979815	0.297248	11484.67	57761.12	3712.606	4783.077	183.3464	0.194458	3.383825	14.98681	4.468759	0.558962	2.918824	0.653162	2862.337	67.81962	2814.402	45.98339	2780.237	56.56396	101.7032	102.953
1.sSMPABC187.TXT	50.91268	2.782089	0.056444	18371.25	87519.1	1153.806	4047.598	-69.9234	0.198864	3.17669	15.59595	4.278952	0.567466	2.866718	0.669958	2897.408	67.25251	2850.143	44.23161	2816.894	52.85842	101.6584	102.8583
1.sSMPABC080.TXT	4.510366	-0.26448	-0.05864	1642.256	7921.407	625.7339	4261.571	34.80656	0.201744	5.000156	16.29386	5.763194	0.572765	2.865806	0.49726	2937.582	67.97094	2894.199	59.68776	2864.154	83.74796	101.499	102.5637
1.sSMPABC066.TXT	64.74805	19.07849	0.294657	23432.7	114086.1	11176.1	4333.504	130.247	0.203691	3.145675	16.13121	4.206937	0.574372	2.793393	0.663997	2925.747	66.03265	2884.604	43.63758	2856.004	52.14773	101.4263	102.442
1.sSMPABC128.TXT	24.48637	10.6691	0.435716	8783.934	42239.19	6270.35	3751.293	137.4178	0.201991	3.264884	15.90089	4.345155	0.570937	2.867212	0.659864	2911.665	67.52739	2870.86	44.96422	2842.353	54.22875	101.4213	102.4385
1.sSMPABC147.TXT	4.665723	7.914126	1.696227	2030.624	8707.324	292.8379	4278.1	80.85046	0.227212	3.530322	19.389	6.15527	0.618903	3.060769	0.49726	3105.551	75.87588	3061.375	63.98374	3032.514	88.30971	101.443	102.4085
1.sSMPABC135.TXT	15.74111	8.88818	0.564647	5477.88	26786.19	4392.743	4475.321	-138.248	0.199345	3.282752	15.48583	4.886957	0.563342	3.036941	0.621438	2880.245	70.9349	2845.49	50.26925	2820.842	63.93203	101.2277	102.1123
1.sSMPABC049.TXT	52.91516	5.004819	0.064552	23947.36	101355.4	1956.05	4705.669	-60.425	0.231194	3.046858	19.4022	5.335236	0.622335	2.919808	0.673492	2911.203	72.61054	2806.61	54.52888	2865.483	52.18365	101.0557	101.7524
1.sSMPABC090.TXT	3.282823	2.214586	0.665276	399.2593	9157.962	719.0845	417.0863	335.2958	0.177855	5.693177	12.58851	6.419504	0.514123	0.606256	0.477845	2674.207	67.49692	2649.362	64.61791	2630.444	96.92141	100.9777	101.6637
1.sSMPABC020.TXT	7.660972	2.367293	0.309007	3081.246	13557.36	171.6847	3991.968	149.3268	0.217636	5.939276	17.83646	6.636774	0.594397	3.238012	0.48789	3007.225	78.29095	2980.956	68.56593	2962.282	96.63843	100.8812	101.4829
1.sSMPABC016.TXT	113.8468	1.250222	0.010997	60266.74	233034.1	319.1046	5005.946	285.9706	0.254037	3.234496	22.99871	4.382994	0.656605	2.972613	0.676671	3253.96	76.40348	3226.887	48.57916	3210.104	52.0565	100.839	101.3662
1.sSMPABC079.TXT	4.003066	3.566699	0.890992	1582.184	7210.369	1387.538	4270.34	90.78856	0.216829	4.517369	17.68812	5.614288	0.591647	3.333708	0.59379	2996.096	80.38347	2972.928	58.10639	2959.292	74.82176	100.7793	101.3122
1.sSMPABC014.TXT	65.95952	0.22604	0.030446	33973.76	133443.3	570.1927	5262.878	9.979326	0.25067	3.488228	22.48413	4.702621	0.690536	3.159287	0.619239	3230.3	80.77352	3204.879	49.69761	3189.006	56.31852	100.7932	101.2949
1.sSMPABC336.TXT	174.005	19.84695	0.14046	117211.6	551453.3	21885.73	1635.773	284.154	0.210837	1.521497	18.85953	5.803313	0.579959	3.354487	0.839895	2948.581	55.95366	2926.879	29.87985	2911.991	94.86049	100.7415	101.2565
1.sSMPABC126.TXT	33.52766	25.37104	0.756988	9735.588	51471.21	10470.67	4107.153	88.14193	0.176723	19.24296	12.38229	19.63981	0.508168	3.92816	0.20001	2668.746	85.99287	2633.835	205.8753	2622.357	361.9297	100.5681	101.0082
1.sSMPABC413.TXT	66.29271	33.58647	0.506639	44245.69	204652.1	31125.03	1576.75	97.87074	0.204756	2.669405	15.98795	3.850841	0.566312	2.775474	0.720745	2892.659	65.01612	2876.077	49.07416	2864.485	41.04946	100.5766	100.9836
1.sSMPABC385.TXT	32.7311	15.14383	0.462674	21722.12	102728.1	15256.61	1662.603	-42.1634	0.209548	2.525591	16.58466	4.805094	0.573451	4.087764	0.887075	2921.973	96.76143	2917.131	49.70569	3002.642	41.54086	100.3724	100.6313
1.sSMPABC414.TXT	67.43829	34.9044	0.515755	42541.49	206737.3	29324.37	1339.607	21.03869	0.204108	1.225954</													

SAMPLE 22TG30

SPOT	238U(ppm)	232Th(pp)	238U / 232Th	207Pb(cp)	206Pb(cp)	208Pb(cp)	202Hg(cp)	204Pb(cp)	207Pb/206	2sigma(%)	207Pb/235	2sigma(%)	206Pb/238	2sigma(%)	Rho	AgePb206	2sigma(a)	AgePb207	2sigma(a)	AgePb207	2sigma(a)	Concordá	Concordá
1.sSMPABCS59.TXT	30.98002	18.24167	0.588821	10840.95	52262.91	10640.48	721.2878	60.29804	0.209266	3.045575	16.63251	4.665112	0.576445	3.5338	0.757495	2934.231	83.84181	2913.89	48.31388	2899.868	50.26119	100.6981	101.185
1.sSMPABCS18.TXT	17.10882	4.225488	0.246977	7809.862	32148.77	2671.779	751.3376	-88.1114	0.240364	2.87339	20.93431	4.49936	0.631666	3.46235	0.769521	3156.176	86.99064	3135.556	47.38899	3122.382	46.47864	100.6576	101.0823
1.sSMPABCS30.TXT	133.1037	36.05991	0.270916	86831.8	416824.9	34816.82	1796.106	99.42264	0.20666	1.674065	16.22275	2.592735	0.569332	1.979844	0.736312	2905.077	46.46912	2890.015	27.72109	2879.536	27.45622	100.5212	100.887
1.sSMPABCS33.TXT	68.89965	76.00954	1.103192	45268.17	216488.9	67404.06	1765.258	174.7509	0.207447	1.851575	16.29976	2.767725	0.569866	2.057176	0.743273	2907.271	48.31996	2894.545	29.4481	2885.704	30.38225	100.4397	100.7474
1.sSMPABCS44.TXT	69.48496	28.86892	0.41547	19512.96	106380.9	14727.52	737.9105	46.69911	0.181236	2.74896	12.8705	4.34981	0.51505	3.371063	0.774991	2678.153	74.3033	2670.218	44.23276	2664.214	46.28027	100.2972	100.5232
1.sSMPABCS35.TXT	88.80186	49.99744	0.563022	57321.83	276400.2	46653.82	1625.144	23.81373	0.205745	1.513757	16.01859	2.526116	0.564669	2.022326	0.800567	2885.893	47.22048	2877.907	27.03948	2872.323	24.81986	100.2775	100.4724
1.sSMPABCS363.TXT	82.87458	4.023568	0.04855	56917.09	263808.9	1781.855	1777.937	125.4057	0.214029	2.020378	17.10987	2.717679	0.579793	1.81765	0.668824	2947.907	43.14734	2941.013	29.07267	2936.301	33.03714	100.2344	100.3963
1.sSMPABCS379.TXT	51.42619	31.33263	0.609274	34337.64	161487.3	30851.5	1849.013	212.8723	0.210928	1.758502	16.6719	2.582928	0.573257	1.891874	0.732453	2921.179	44.59244	2916.156	27.6885	2912.691	28.77076	100.1722	100.2914
1.sSMPABCS364.TXT	198.6178	70.25079	0.353698	116637.1	591671.1	64204	1739.275	236.8044	0.195557	0.969612	14.63203	2.164587	0.542661	1.935274	0.894062	2794.579	44.03537	2791.615	23.31393	2789.474	15.96666	100.1062	100.183
1.sSMPABCS339.TXT	165.2227	200.2501	1.212001	115263.8	529337.1	197567.7	1810.529	116.2794	0.216025	1.626418	17.32175	2.777103	0.581549	2.251015	0.810562	2955.067	53.58015	2952.824	29.68672	2951.297	26.49984	100.076	100.1278
1.sSMPABCS24.TXT	72.61686	48.71768	0.670887	25467.19	122585.3	31039.59	668.9142	150.3425	0.20571	2.787429	15.92269	4.721726	0.561385	3.81116	0.807154	2872.349	88.94443	2872.169	48.72348	2872.042	46.04529	100.0063	100.0107
1.sSMPABCS446.TXT	31.76943	17.52541	0.551644	11439.17	54269.18	9727.096	818.7106	26.72172	0.212027	4.508814	16.75864	6.3483	0.573254	4.46895	0.70396	2921.167	105.8357	2921.127	65.33777	2921.1	74.91454	100.0014	100.0023
1.sSMPABCS493.TXT	52.04187	33.28735	0.639626	17017.04	83930.3	19534.14	737.2379	-4.91883	0.198651	2.76926	14.98583	4.37195	0.547129	3.383068	0.773812	2813.221	77.58952	2814.34	45.02271	2815.143	45.97575	99.96022	99.93173
1.sSMPABCS533.TXT	57.42942	25.24837	0.439642	19334.43	95539.62	15445.93	659.6438	51.35845	0.200262	2.761939	15.19477	4.372162	0.550294	3.38932	0.775205	2826.395	78.0256	2827.526	45.07418	2828.332	45.7973	99.96	99.93151
1.sSMPABCS443.TXT	40.55983	15.38587	0.379338	13522.99	66645.82	9048.955	694.7614	136.4382	0.203828	2.815567	15.65601	4.408707	0.557077	3.392533	0.769508	2854.537	78.72203	2856.04	45.54274	2857.101	46.58013	99.94737	99.91028
1.sSMPABCS438.TXT	33.75136	19.8921	0.589372	11445.52	55328.51	8547.152	869.8415	-15.0725	0.20693	2.796726	16.0526	4.412945	0.562627	3.413563	0.773534	2877.475	79.72121	2879.934	45.67187	2881.654	46.16176	99.91461	99.85497
1.sSMPABCS354.TXT	69.28821	25.16365	0.363174	44070.31	212987	21682.32	1728.69	180.4858	0.205268	2.085121	15.82578	3.255948	0.559169	2.500694	0.768039	2863.192	58.07419	2866.338	34.16975	2868.549	34.31339	99.89026	99.81325
1.sSMPABCS345.TXT	122.2215	108.3823	0.886769	78089.12	376433.8	100676.1	1804.282	133.2234	0.205797	1.893017	15.87725	2.808401	0.559544	2.074513	0.738681	2864.746	48.16067	2869.438	29.78218	2872.734	31.10561	99.83647	99.72194
1.sSMPABCS20.TXT	40.0834	19.65615	0.490381	13593.3	66312.77	11154.93	786.7616	-10.7825	0.202898	2.854687	15.49683	4.429332	0.553941	3.386701	0.764608	2841.543	78.29949	2846.289	45.71189	2849.651	47.26987	99.83324	99.71546
1.sSMPABCS436.TXT	49.47457	59.88268	1.210373	16332.55	79915.56	34771.47	769.6292	34.27313	0.203993	2.80692	15.6334	4.423836	0.555823	3.419287	0.772924	2849.345	79.23122	2854.661	45.68818	2858.415	46.42924	99.81379	99.6827
1.sSMPABCS355.TXT	164.8371	185.2312	1.123723	110604.4	517382.4	157654	1815.502	123.5095	0.212074	3.976338	16.69769	4.587737	0.571041	2.288246	0.498774	2912.093	53.841	2917.636	47.55325	2921.463	65.85679	99.81002	99.6793
1.sSMPABCS369.TXT	198.7947	7.070041	0.035565	155630.1	662582.7	8061.032	1623.052	152.3631	0.233006	0.948876	19.51996	1.599685	0.607591	1.287878	0.805082	3060.35	31.45485	3067.876	18.35687	3072.808	15.24198	99.75467	99.59456
1.sSMPABCS514.TXT	51.13085	19.65958	0.384496	16835.81	82718	11747.53	888.726	63.92151	0.201163	2.8639	15.20567	4.483141	0.54822	3.449149	0.76936	2817.767	79.21699	2828.209	46.17888	2835.659	47.48495	99.63081	99.36903
1.sSMPABCS344.TXT	90.58841	61.76213	0.681788	57283.54	277064.7	61154.9	1599.208	58.76431	0.20511	0.920229	15.71191	1.877367	0.555572	1.636364	0.871627	2848.306	37.78511	2859.442	20.6761	2867.298	15.04326	99.61056	99.33765
1.sSMPABCS365.TXT	137.2973	71.12092	0.518007	87452.78	420367.4	68177.54	1712.263	-51.2962	0.206377	1.410588	15.87298	2.652233	0.557822	2.246014	0.846839	2857.624	52.05481	2869.182	28.25185	2877.307	23.10421	99.59716	99.31591
1.sSMPABCS575.TXT	68.70088	28.17823	0.410158	22656.75	111458.1	17448.56	662.5035	100.1867	0.203338	2.804271	15.44461	4.415805	0.550881	3.41107	0.772468	2828.835	78.58371	2843.07	45.56547	2853.177	46.40655	99.4993	99.14686
1.sSMPABCS569.TXT	45.31647	15.6271	0.344844	14867.31	72625.61	10017.87	649.7171	-6.60755	0.203797	2.832347	15.49154	4.425296	0.551309	3.400156	0.768345	2830.613	78.37018	2845.964	45.67056	2856.852	46.8634	99.46059	99.08152
1.sSMPABCS465.TXT	13.60811	9.912847	0.728451	4800.933	23496.37	4564.947	838.8573	39.85782	0.203289	3.174393	15.40549	5.668978	0.549618	4.696865	0.828521	2823.582	108.2942	2840.652	58.08798	2852.785	52.64796	99.39911	98.97636
1.sSMPABCS485.TXT	92.02432	51.00267	0.55423	32133.78	152344.8	33284.18	832.2511	-72.6619	0.206599	2.757592	15.62679	4.360865	0.54858	3.378288	0.774683	2819.266	77.61276	2854.257	45.06045	2879.053	45.51593	98.77406	97.92337
1.sSMPABCS497.TXT	187.1263	15.47393	0.082692	56992.06	287502.1	3920.584	755.8884	57.23235	0.194471	2.748817	14.08379	4.338964	0.525246	3.357173	0.773727	2721.392	74.96139	2755.364	44.47005	2780.349	45.77648	98.76703	97.87951
1.sSMPABCS529.TXT	35.80428	17.74588	0.495636	11961.19	58369.11	10730.51	765.122	42.1432	0.202882	2.773483	15.08868	4.371171	0.539395	3.378599	0.772928	2780.917	76.77067	2820.852	45.03942	2849.52	45.90386	98.58429	97.59248
1.sSMPABCS479.TXT	58.50661	42.3194	0.723327	19716.5	96263.17	24836.52	853.3812	93.49282	0.201083	2.768018	14.82796	4.365509	0.534816	3.381649	0.774629	2761.711	76.41282	2804.263	44.92081	2835.009	45.75074	98.48261	97.41455
1.sSMPABCS336.TXT	55.53494	23.7645	0.42792	18497.53	90107.78	15940.76	683.9388	-58.9341	0.203051	2.771845	15.05951	4.382696	0.537905	3.394834	0.7746	2774.672	77.00236	2819.01	45.14685	2850.875	45.8707	98.42719	97.32701
1.sSMPABCS94.TXT	83.90244	19.05568	0.227117	27217.79	131840.4	12776.99	593.6874	68.92323	0.207386	2.737199	15.49721	4.335034	0.541968	3.361586	0.775446	2791.682	76.61948	2846.313	44.77478	2885.224	45.1491	98.08063	96.7579
1.sSMPABCS516.TXT	162.1442	142.5862	0.879379	49198.27	246690.4	72732.17	699.436	13.75027	0.197231	2.748603	13.96479	4.34822	0.51352	3.369302	0.774869	2671.641	74.11767	2747.322	44.52983	2803.42	45.67607	97.24528	95.29935
1.sSMPABCS73.TXT	33.32692	20.19596	0.605996	10852.54	51673.47	11876.79	734.8481	119.3518	0.209735	2.832438	15.29015	4.42122	0.528738	3.394772	0.767836	2736.131	76.13745	2833.488	45.58357	2903.496	46.67035	96.56406	94.23575
1.sSMPABCS449.TXT	28.29664	18.48465	0.653245	9096.455	44283.25	8640.824	910.2487	-35.3178	0.206692	2.806156	14.80014	4.413372	0.519326	3.406368	0.771829	2696.322	75.49874	2802.476	45.38836	2879.786	46.32767	96.21212	93.62924
1.sSMPABCS564.TXT	98.66865	74.33542	0.753384	25793.31	136950.6	7720.871	646.5506	200.8723	0.186891	4.946243	12.39621	6.347254	0.481061	3.977727	0.626685	2531.885	83.83032	2634.891	63.81076	2714.991	83.96908	96.09071	93.25576
1.sSMPABCS427.TXT	72.1563	22.5806	0.31294	21785.79																			

Dados de Lu-Hf

AMOSTRAS																	
21TG6A																	
ine\user\Neptune\Dados\PTL3RD_20230518-153538\021PTL.dat	0.0356	31	0.00139	9	1.46715	1.88683	7	0.281001	26	0.280921813	2.06532	1.29749	3.1	3.2	3.0	2978	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\022PTL.dat	0.0298	26	0.00118	8	1.46719	1.88688	9	0.281031	24	0.280954552	12.24693	1.19678	2.8	3.0	2.7	3358	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\023PTL.dat	0.0065	5	0.00031	2	1.46721	1.88701	8	0.2808884	23	0.280867124	-2.16797	1.16742	3.2	3.4	3.1	2881	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\024PTL.dat	0.0216	18	0.00089	6	1.46720	1.88673	9	0.281008	19	0.280960427	-1.85366	0.97242	3.1	3.3	3.0	2754	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\025PTL.dat	0.0618	53	0.00223	15	1.46726	1.88694	8	0.280904	18	0.280801011	-15.18566	0.91914	3.6	3.7	3.5	2426	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\026PTL.dat	0.0067	6	0.00026	2	1.46722	1.88690	10	0.280931	21	0.280915915	1.33055	1.03110	3.1	3.2	3.0	2956	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\027PTL.dat	0.0469	54	0.00171	17	1.46723	1.88685	7	0.281570	22	0.281502955	1.52571	1.09762	2.4	2.5	2.3	2072	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\028PTL.dat	0.0106	9	0.00041	2	1.46718	1.88686	7	0.281535	21	0.281518005	2.87834	1.04036	2.3	2.5	2.2	2107	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\029PTL.dat	0.0199	16	0.00079	5	1.46721	1.88677	8	0.281629	22	0.281599995	1.12337	1.08632	2.2	2.4	2.2	1905	1
21TG15																	
ine\user\Neptune\Dados\PTL3RD_20230518-153538\030PTL.dat	0.0182	35	0.00074	13	1.46715	1.88683	8	0.280799	24	0.280755375	-1.61805	1.18041	3.4	3.5	3.2	3073	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\031PTL.dat	0.0165	14	0.00071	5	1.46718	1.88687	8	0.280991	25	0.28095479	-3.94936	1.25797	3.2	3.3	3.0	2673	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\032PTL.dat	0.0219	20	0.00091	7	1.46718	1.88687	9	0.281010	19	0.28090608	-1.19532	0.94542	3.1	3.2	3.0	2781	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\033PTL.dat	0.0371	31	0.00137	9	1.46718	1.88680	10	0.2809894	20	0.280904585	2.22189	0.98043	3.1	3.2	3.0	3011	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\034PTL.dat	0.0150	12	0.00063	4	1.46724	1.88686	9	0.280939	25	0.280904236	0.18536	1.22543	3.1	3.3	3.0	2925	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\035PTL.dat	0.0181	15	0.00080	5	1.46722	1.88690	10	0.280987	21	0.280943089	-0.63722	1.02959	3.1	3.3	3.0	2831	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\036PTL.dat	0.0109	9	0.00044	3	1.46720	1.88672	8	0.280952	27	0.280927765	-0.87323	1.35401	3.1	3.3	3.0	2845	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\037PTL.dat	0.0190	17	0.00079	6	1.46715	1.88685	8	0.280988	21	0.280942523	2.83491	1.02722	3.0	3.2	2.9	2980	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\038PTL.dat	0.0190	16	0.00084	5	1.46713	1.88663	8	0.281059	20	0.2810131	2.16963	1.02318	3.0	3.1	2.8	2845	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\039PTL.dat	0.0155	17	0.00057	5	1.46718	1.88688	8	0.281019	26	0.280991779	-6.90175	1.28784	3.2	3.3	3.1	2490	1
21TG16A																	
ine\user\Neptune\Dados\PTL3RD_20230518-153538\040PTL.dat	0.0311	37	0.00135	13	1.46712	1.88692	8	0.281377	24	0.281321871	-3.12018	1.18486	2.7	2.9	2.6	2149	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\041PTL.dat	0.0126	11	0.00061	4	1.46718	1.88674	9	0.281301	22	0.281276981	-5.80294	1.09359	2.8	3.0	2.7	2102	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\042PTL.dat	0.0272	29	0.00102	8	1.46719	1.88681	8	0.281518	24	0.281476261	2.36683	1.20387	2.4	2.6	2.3	2149	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\043PTL.dat	0.0179	19	0.00080	7	1.46714	1.88664	9	0.281283	23	0.281250207	-5.47069	1.13520	2.8	3.0	2.7	2157	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\044PTL.dat	0.0170	20	0.00072	6	1.46718	1.88679	7	0.281460	23	0.28143124	0.57947	1.16209	2.5	2.7	2.4	2141	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\045PTL.dat	0.0188	20	0.00075	6	1.46720	1.88690	7	0.281406	22	0.281374512	-0.39338	1.12365	2.6	2.7	2.5	2186	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\046PTL.dat	0.0153	13	0.00070	5	1.46719	1.88681	9	0.281304	21	0.281275196	-5.25267	1.06508	2.8	3.0	2.7	2128	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\047PTL.dat	0.0142	13	0.00062	4	1.46721	1.88704	8	0.281433	20	0.281407366	-0.76146	1.01167	2.5	2.7	2.4	2119	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\048PTL.dat	0.0197	16	0.00089	6	1.46717	1.88671	8	0.281340	24	0.281303584	-3.94501	1.17633	2.7	2.9	2.6	2141	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\049PTL.dat	0.0169	20	0.00073	8	1.46723	1.88688	8	0.281462	23	0.281432036	1.07852	1.16343	2.5	2.6	2.4	2161	1
21TG25																	
ine\user\Neptune\Dados\PTL3RD_20230518-153538\050PTL.dat	0.0138	11	0.00058	4	1.46715	1.88695	9	0.280925	21	0.280892865	-0.08434	1.02990	3.2	3.3	3.0	2831	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\051PTL.dat	0.0195	17	0.00074	5	1.46720	1.88686	9	0.280971	24	0.280928995	1.53214	1.20937	3.1	3.2	3.0	2945	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\052PTL.dat	0.1068	97	0.00319	23	1.46714	1.88681	7	0.281155	27	0.280973426	3.74987	1.32680	3.0	3.1	2.9	2972	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\053PTL.dat	0.0285	23	0.00112	7	1.46713	1.88682	7	0.281048	20	0.280988653	1.05151	0.98561	3.0	3.2	2.9	2837	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\054PTL.dat	0.0532	45	0.00197	12	1.46712	1.88694	8	0.281049	19	0.280937342	2.02375	0.95410	3.1	3.2	2.9	2953	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\055PTL.dat	0.0229	22	0.00089	6	1.46720	1.88688	8	0.280789	27	0.28073648	-2.04353	1.35897	3.4	3.5	3.3	3084	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\056PTL.dat	0.0167	14	0.00072	5	1.46712	1.88665	8	0.280988	22	0.280949019	-1.04978	1.09652	3.1	3.3	3.0	2805	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\057PTL.dat	0.0215	19	0.00079	5	1.46714	1.88689	8	0.280914	20	0.280869998	-1.03453	0.98747	3.2	3.4	3.1	2925	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\058PTL.dat	0.0356	66	0.00146	25	1.46718	1.88686	8	0.280981	24	0.280899675	-0.06684	1.20995	3.1	3.3	3.0	2821	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\059PTL.dat	0.0537	70	0.00162	17	1.46714	1.88690	8	0.281036	22	0.280945418	0.85634	1.11525	3.1	3.2	3.0	2891	1
22TG65B																	
ine\user\Neptune\Dados\PTL3RD_20230518-153538\060PTL.dat	0.0265	24	0.00107	7	1.46704	1.88681	9	0.281555	20	0.281512049	2.64548	1.00987	2.3	2.5	2.2	2106	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\061PTL.dat	0.1771	216	0.00540	57	1.46718	1.88684	7	0.281646	28	0.281345462	15.34778	1.41989	2.3	2.4	2.2	2902	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\062PTL.dat	0.0368	31	0.00141	9	1.46716	1.88690	8	0.281542	23	0.281479711	6.21843	1.14098	2.3	2.5	2.2	2309	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\063PTL.dat	0.0297	27	0.00120	9	1.46717	1.88695	11	0.281041	15	0.280977010	-0.49321	0.75262	3.1	3.2	2.9	2786	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\064PTL.dat	0.0168	14	0.00076	5	1.46718	1.88676	8	0.280999	21	0.280957047	1.30082	1.04689	3.0	3.2	2.9	2893	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\070PTL.dat	0.0221	21	0.00091	7	1.46716	1.88675	9	0.281010	26	0.280959773	-2.01378	1.30988	3.0	3.2	2.9	2884	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\071PTL.dat	0.0472	58	0.00181	19	1.46718	1.88681	9	0.281069	26	0.280997853	-15.53639	1.29670	3.3	3.5	3.3	2965	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\072PTL.dat	0.0150	15	0.00066	6	1.46715	1.88679	9	0.280893	26	0.280853736	1.52248	1.28265	3.2	3.3	3.0	3058	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\069PTL.dat	0.0176	14	0.00081	5	1.46720	1.88696	9	0.281303	23	0.281269386	-6.64593	1.13063	2.8	3.0	2.7	2163	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\074PTL.dat	0.0357	46	0.00114	13	1.46720	1.88685	8	0.281433	18	0.281385276	0.57875	0.88052	2.5	2.7	2.4	2211	1
22TG30																	
ine\user\Neptune\Dados\PTL3RD_20230518-153538\075PTL.dat	0.0218	18	0.00084	5	1.46724	1.88678	7	0.280969	26	0.280923063	-0.22964	1.32029	3.1	3.3	3.0	2879	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\076PTL.dat	0.0166	14	0.00063	4	1.46724	1.88693	9	0.280964	20	0.280931318	-4.98538	0.98852	3.2	3.4	3.1	2664	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\077PTL.dat	0.0518	55	0.00196	18	1.46717	1.88684	11	0.280961	25	0.280856096	-4.93589	1.25997	3.3	3.5	3.2	2780	1
ine\user\Neptune\Dados\PTL3RD_20230518-153538\078PTL.dat	0.0117	14	0.00051	5	1.46715	1.88693	7	0.280984	23	0.280947514	22.01407						