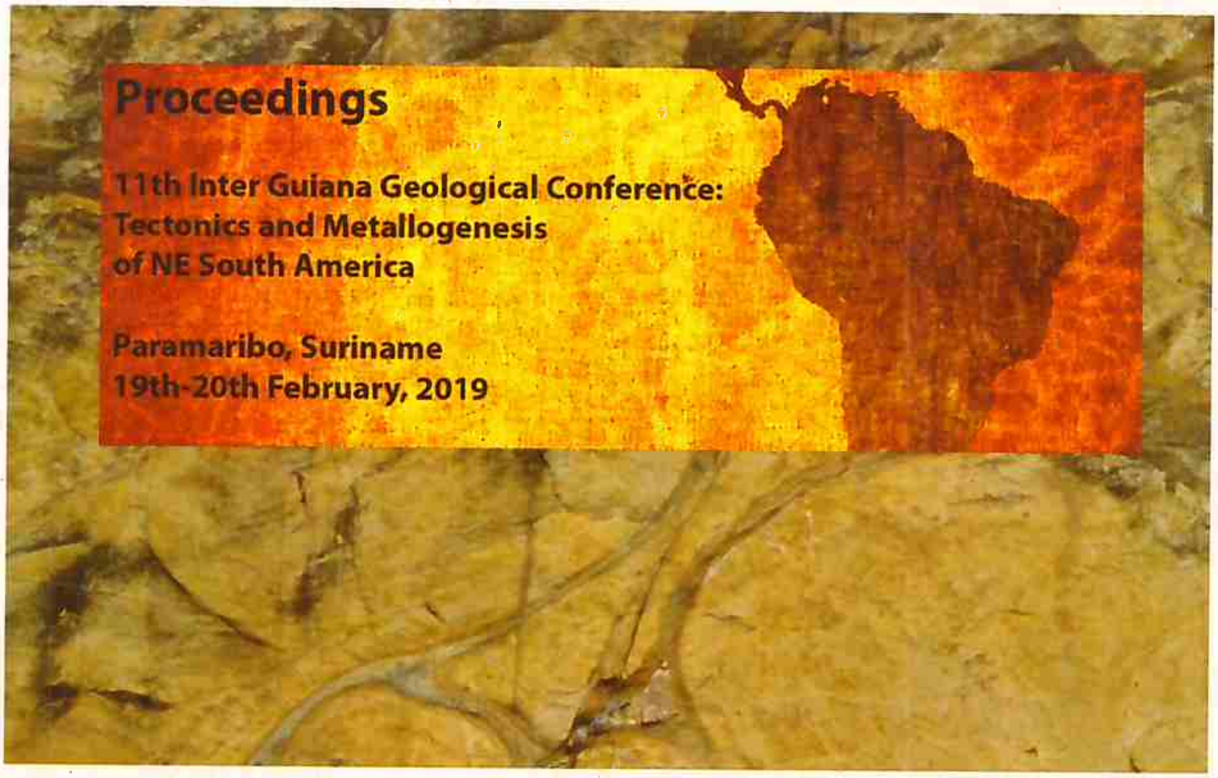
MINISTÉRIO DAS MINAS E ENERGIA

CPRM - SERVIÇO GEOLÓGICO DO BRASIL

RELATÓRIO DE VIAGEM AO EXTERIOR – SURINAME

"11TH INTER GUIANA GEOLOGICAL CONFERENCE: TECTONICS & RESOURCE POTENTIAL OF NE SOUTH AMERICA"



LÊDA MARIA BARRETO FRAGA (DIGEOB-ERJ)
15/03/2019

I – Introdução

Este relatório apresenta dados relativos à participação da Pesquisadora em Geociências Dra. Lêda Maria Barreto Fraga no evento técnico-científico "*11th Inter Guiana Geological Conference: Tectonics & Resource Potential of NE South America*".

O Dr. Evandro Klein também participou desta conferência, que reuniu pesquisadores internacionais e membros da indústria mineral que atuam ou pretendem atuar em áreas de interesse, em termos de recursos minerais, no Escudo das Guianas e na Província Borborema.

II – Objetivos da Viagem

Participar do evento técnico-científico "*11th Inter Guiana Geological Conference: Tectonics & Resource Potential of NE South America*".

III – Programa da Viagem

Seguem informações sobre a programação da viagem (ANEXO I):

16/02: Voo Rio de Janeiro-Belém-Paramaribo (data determinada pela baixa frequência de voos para Paramaribo);

19 e 20/02: Participação no evento;

21/02: Voo Paramaribo-Belém-Rio de Janeiro;

IV – Descrição das atividades

Nos dias 19 e 20 de fevereiro de 2019, pesquisadores de diversos países apresentaram palestras abordando aspectos variados da geologia e da metalogenia do Escudo das Guianas e da Província Borborema, com foco principal nas mineralizações de ouro. Casos de estudos referentes a regiões da África e do Canadá também foram apresentados.

O Dr. Evandro Luiz Klein apresentou uma *Keynote* no dia 19 e a Dra. Lêda Maria Barreto Fraga apresentou palestra sobre o Escudo das Guianas no dia 20 de fevereiro (ANEXOS II, III, IV).

Durante o evento foi possível uma importante interação com pesquisadores dos serviços geológicos da Guyana e do Suriname e com representantes de outras instituições de pesquisa participantes do consórcio SAXI - *South America Exploration Initiative*, também integrado pela CPRM.

IV – Descrição e Análise dos Assuntos Tratados

Durante o encontro, foram discutidos temas científicos sobre a geologia e a metalogenia do Escudo das Guianas.

V – Conclusões

A participação da CPRM na reunião foi uma oportunidade para a divulgação das atividades do Serviço Geológico do Brasil nas áreas objeto do consórcio e para tomar conhecimento sobre as pesquisas em andamento em instituições brasileiras e internacionais (da academia e da indústria mineral) sobre a mesma região, além de tomar conhecimento sobre as lacunas de conhecimento existentes, de modo a orientar a tomada de decisão sobre ações que o Serviço Geológico do Brasil deve implantar nas áreas-objeto.

VI – Recomendações

Recomenda-se a manutenção da parceria com o consórcio SAXI.

VII – Agradecimentos

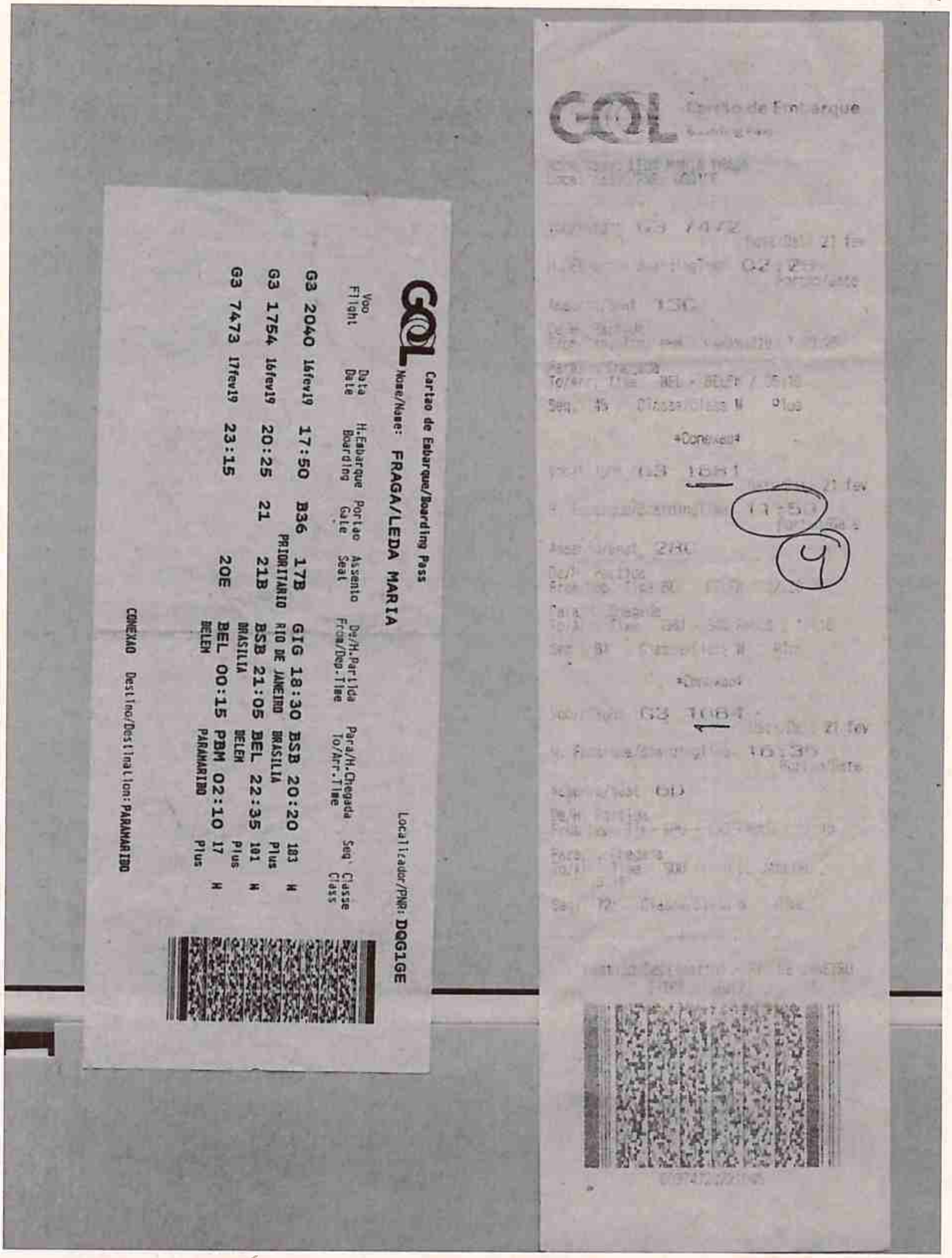
Gostaria de agradecer ao Serviço Geológico do Brasil - CPRM, na figura do seu Presidente, Sr. Esteves Pedro Colnago, e de seu Diretor de Geologia e Recursos Minerais, Sr. José Leonardo Andriotti.

Finalmente, agradecemos a equipe da ASSUNI pelo apoio e a diligência nas providências para a viagem.

VIII – Anexos

ANEXO I – Bilhetes Aéreos;
ANEXO II – Programa do evento;
ANEXO III - Palestra da Dra. Lêda Maria Barreto Fraga;
ANEXO IV – Trabalho Apresentado;

ANEXO I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Cartao de Embarque/Boarding Pass
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G3 2040 | 16fev19 | 17:50 | B36 | 17B PRIORITARIO | GIG 18:30 RIO DE JANEIRO | BSB 20:20 BRASILIA | 183 Plus | N
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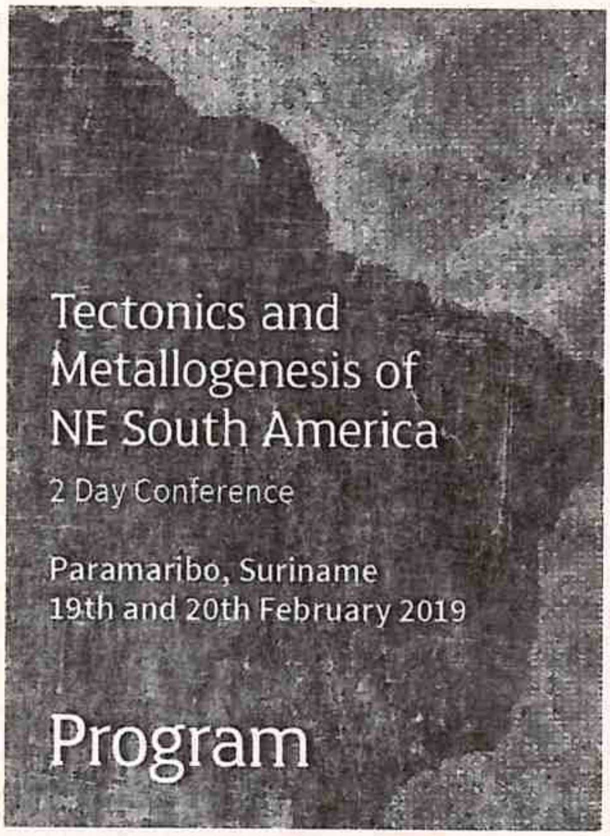
CONEXAO Destino/Destination: PARAMARIBO
GOL Cartão de Embarque

ANEXO II



Program 20th February

Time	Title	Authors
08:00 – 08:30	Coffee	
08:30 – 08:50	Magnetite geochemistry as a tool for exploration in Guyana	La Cruz, N. L., Simon, A.C., Harden, M.
08:50 – 09:10	Complex 3D Integration for Mineral Exploration	de Kemp, E.A.
09:10 – 09:30	Regional lithostratigraphic record as a proxy for mineral systems of the South West African Craton	Thebaud, N., Davis, J., Miller, J.
09:30 – 09:50	Innovations for gold exploration in Precambrian greenstone belts: highlights from the Footprints and Metal Earth programs and potential applications to the Guiana Shield	Perrouty, S, and the NSERC-CMIC Footprint Team and the CFREF Metal Earth Team
09:50 – 10:10	Polyphased gold mineralization at the Yaou deposit, French Guiana	Combes, V. Eglinger, A., André Mayer, A.-S., Scheffer, C., Gibert, P., Heuret, A.
10:10 – 10:30	Coffee Break	
10:30 – 11:10	Gold Systems in Brazil: brief review (Keynote)	Lobato, L., da Costa, M.A., Hagemann, S.G., Silva, R.F., Berni, G.V.

Title	Authors
The West African Exploration Initiative as a model for cooperative research and training in NE South America	Jessell, M., and the WAXI team
2.12 – 2.08 Ga Late- to postcollisional peraluminous granitoid magmatism in the Marowijne Greenstone Belt of Suriname	Kromopawiro, S.C., Kroonenberg, S.B., Kriegsman, L., Mason, P.R.D.
Ultramafic rocks of the Paleoproterozoic greenstone belt in the Guiana Shield of Suriname, and their mineral potential	Naipal, R., Kroonenberg, S.B., Mason, P.R.D.
The K3 Copper Deposit in the Bakhuis Granulite Belt, W Suriname	Patadien, R., LaPoint, D., de Roever, E.W.F.
Multiphase TTG intrusions in the Paleoproterozoic greenstone belt of Suriname and their role in gold mineralization in the Rosebel gold district	Ramlal, S., Kroonenberg, S.B., Mason, P.R.D., Kriegsman, L.M., O'Sullivan, P.
Late Quaternary geochronology of detrital gold	Spencer, J.
Arc volcanism and sedimentation in a synkinematic Paleoproterozoic basin: Rosebel Gold Mine, northeastern Suriname	Watson, T., LaPoint, D., Stewart, K.
Petrography, geochemistry and age of the Armina Formation metaturbidites of the Coppename River, Suriname	Wijngaarde, G.W., Kroonenberg, S.B., Mason, P.R.D., Kriegsman, L.M.

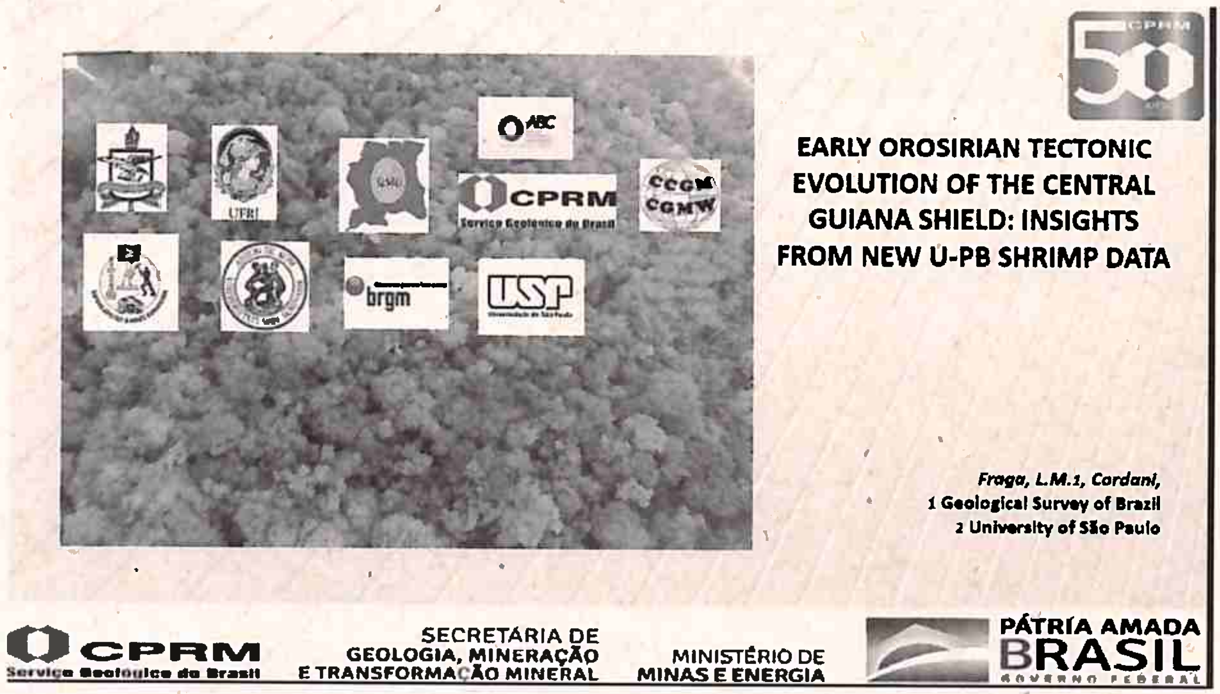
Program 19th February

Time	Title	Authors
08:00 – 08:30	Registration and Coffee	
08:30 – 08:45	Opening Alla Kondre Show	
08:45 – 09:00	Opening speech	Wong, Th.
09:00 – 09:15	Overview of the SAXI program	Jessell, M.
09:15 – 09:30	Speech Minister NH	
09:30 – 10:00	Geology and mineral deposits of the Guiana Shield (Keynote)	Kroonenberg, S.B., Mason, P.R.D., Kriegsman, L. M., de Roever, E.W.F., Wong, T.E.
10:00 – 10:30	Coffee Break	
10:30 – 11:10	Metallogenic evolution of the Guiana Shield in Brazil (Keynote)	Klein, E.
11:10 – 11:30	The Nivré gold deposit. Dorlin Project, French Guiana	Bertoni, C. and the Dorlin Project Team
11:30 – 11:50	Geochemical and isotopic characterization of hydrothermal alteration and gold mineralization at the Karouni orogenic gold deposits: Guyana, South America	Tedeschi, M., Hagemann, S.G., Davis, J.
11:50 – 12:10	From small scale miners to Discovery, the Nassau Project and the Discovery of the Merian Mine	La Point, D.

Time	Title	Authors
11:10 – 11:30	Gold mineralisation in the Paleoproterozoic greenstone belt of Suriname: geochemical constraints on precursor rocks of the strongly silicified Overman deposit	Kioe-A-Sen, N., van Bergen, M.
11:30 – 11:50	To be announced	To be announced
11:50 – 12:10	Metallogeny of Copper, Gold and Iron in the Borborema Province	Berni, G.V., Parente, C.V., Lobato, L.M., de Sampaio, C.C.F.T., Hagemann, S.G.
12:10 – 13:10	Lunch	
13:10 – 13:30	Bauxite formation on Proterozoic basement and Tertiary sediments in Suriname	Monsels, D.
13:30 – 13:50	A multi-scale roughness map of the Guiana shield	Baratoux, D.
13:50 – 14:10	Mapping and correlation of West African and South American mafic dykes	Baratoux, L., Jessell, M.W., Ernst R.E.
14:10 – 14:30	Paleoproterozoic crustal growth and differentiation of the Transamazonian orogenic belt of French Guiana: A guide for the understanding of Au mineral system	Vanderhaeghe, O., Ledru, P.

Time	Title	Authors
14:30 – 14:50	A paleomagnetic approach to establishing pre-Atlantic correlations between Africa and South America	Tohver, E.
14:50 – 15:10	Break	
15:10 – 15:30	Stratigraphy of Guyana Greenstone Belts	Heesterman, L.
15:30 – 15:50	Early Orosirian tectonic evolution of the Central Guiana Shield: insights from new U-Pb SHRIMP and LA-ICP-MS data	Fraga, M.L., Cordani, U.
15:50 – 16:10	The Bakhuis Granulite Belt in W Surinam, its development and exhumation	de Roever, E.W.F., Beunk, F.F., Yi, K., de Groot, K., Klaver, M., Nanne, J.A.M., van de Steeg, W., Thijssen, A.C.D., Uunk, B., Vos, H., Davies, G.R., Brouwer, F.
16:10 – 16:30	Zircon U-Pb geochronology by LA-ICP-MS in the Marowijne Greenstone Belt, Suriname: methodology & preliminary results	Kriegsman, L., Mason, P.R.D., Kroonenberg, S.B.
16:30 – 17:00	The Marjowijne Greenstone Belt	Mason, P.
17:00 – 18:00	Farewell drinks + Brass Band	

ANEXO III



EARLY OROSIRIAN TECTONIC EVOLUTION OF THE CENTRAL GUIANA SHIELD: INSIGHTS FROM NEW U-PB SHRIMP DATA
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MINISTÉRIO DE MINAS E ENERGIA
PÁTRIA AMADA BRASIL
GOVERNO FEDERAL

ANEXO IV

Early Orosirian tectonic evolution of the Central Guiana Shield: insights from new U-Pb SHRIMP data

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SUMMARY

U-Pb SHRIMP analyses of detrital zircon from paragneisses of the Cauarane-Coeroeni Belt (CCB) indicate major provenance from Rhyacian (2210-2050 Ma) and Early Orosirian (2050-2010 Ma) sources, and subordinate contribution from Archaean and Siderian sources. The deposition of the CCB basin post-dates the evolution of the Bakhuis Belt. The closing of the basins and syn-kinematic high-grade metamorphism are tentatively admitted at 2020 Ma, associated to the amalgamation of Early Orosirian 2.04-2.03 Ga magmatic arcs. Ages within the 1990-1960 Ma and 1940-1920 Ma intervals, obtained in zircon crystals rims, exhibiting low Th/U ratios (<0.1), are interpreted as reflecting thermal perturbation, fluid input and migmatization caused by the emplacement of nearby huge igneous belts. The Early Orosirian Orogeny is named here Akawai Orogeny.

INTRODUCTION

The Guiana Shied, in the northern part of the Amazonian Craton, remains barely studied mainly due to the great difficulties of access and the wide coverage of rainforest.

In Brazil, *airborne geophysical magnetic and gamma-ray spectrometry* data are available and geological mapping programs have been carried out in many parts of the shield during the last decades, including studies along the Brazil-Suriname and Brazil-Guyana borders. The interpretation and integration of the available information and the revaluation of the geological maps and reports of the sixties and seventies allowed the characterization of the Cauarane-Coeroeni Belt (CCB) (Fraga *et al.*, 2009a, b) and led to the proposition of a new tectonic configuration for the central part of the shield.

This short paper presents U-Pb SHRIMP zircon ages for rocks of the CCB and discusses the contribution of the new data for the understanding of the geodynamic evolution of the Guiana Shield. Four key samples were analyzed at the Geochronology Research Center of the Universidade de São Paulo (USP) as part of a broad geochronological program carried out by the second author.

GEOLOGICAL SETTING

A vast Early to Meso-Rhyacian granite-greenstone terrain expands along the northeast border of the Guiana Shield, between two Achaean domains: the NE-SW-trending Imataca Complex (IC), at the northwest, and the NW-SE-trending Amapa Block (AB) at the southeast (Fig.1). The Archaean protoliths along the AB and IC were intensely reworked during two Paleoproterozoic tectono-thermal episodes of continental *collision that occurred in the Late Rhyacian for the AB and in the Early Orosirian for the IC.*

The assembly of the granite-greenstone terrain with the AB, associated with crustal thickening and *clockwise P-T-t path* high-grade metamorphism, took place around 2.10-2.08 Ga, and was followed by post-collisional magmatism and migmatization at about 2.06-2.04 Ga (Rosa-Costa *et al.*, 2008, and references therein). Far north of the AB, the amalgamation of island arcs occurred without significant crustal thickening. Along that part of the Guiana shield, prolonged oblique convergence associated with sinistral shear zones led to the opening and closing of pull-apart-basins (Delor *et al.*, 2003 and references therein) and to the development of anticlockwise ultra-high temperature metamorphism in the NE-SW-trending Bakhuis Belt at 2.07-2.05 Ga (Klaver *et al.*, 2015 and references therein). In a different scenario, within the IC, the peak conditions of the *clockwise P-T-t path* high-grade metamorphism occurred around 2.02 Ga (Tassinari *et al.*, 2004). After that, the Imataca complex was submitted to exhumation and cooling until 1.96 Ga, when the rocks passed below 600-550 °C (Tassinari *et al.*, 2004). The main elements of the Early Orosirian tectonic evolution of the shield are preserved along its central part, and will be discussed below.

Early Orosirian 2.04-2.03 Ga granitoids and gneisses of the Anauá Complex and the Trairão Suite were identified in the Roraima State of Brazil (Fig. 1) and interpreted as recording magmatism along island or continental arc settings (Faria *et al.*, 2002; Santos, 2003; Almeida *et al.*, 2007; Fraga *et al.*, 2009a, b). U-Pb zircon ages reported for these granitoids and gneisses correspond to 2028±9 Ma for the Anauá Complex (SHRIMP, Faria *et al.* 2002) and to 2026±5 Ma and 2044±17 Ma for the Trairão Suite (LA-ICPMA, Fraga *et al.*, 2009 a, b). The Anauá and Trairão units exhibit medium to /high-K calc-alkaline affinities and record juvenile contribution for their magma genesis, as indicated by Sm-Nd data (Fraga *et al.*, 2009 a).

The Early Orosirian 2.04-2.03 Ga crustal fragments occur in the vicinities of the CCB (Fraga *et al.*, 2009 a), which corresponds to a sinuous structure joining the high-grade supracrustal rocks of the Cauarane Group (Brazil), Kanuku Complex (Guyana) and Coeroeni Group (Suriname) (Fig. 1). The NW-SE-ENE-WSW-NE-SW disposition of the CCB largely fits to the structural and aeromagnetic lineaments on the central part of the Guiana Shield. The supracrustal rocks, within the entire belt correspond to migmatitic aluminous paragneisses with subordinate calc-silicate rocks, amphibolites, meta-cherts, quartzites, gondites and mafic schists recording syn-kinematic metamorphism at amphibolite to granulite facies, with a superimposed static amphibolite facies metamorphism (Kroonenberg, 1976; Berrangé, 1977; Dreher *et al.*, 2009).

Concerning the provenance of the CCB supracrustals, detrital zircon crystals of 2074 Ma and 2038 Ma have been reported by Santos (2003). Values of 1969±4 Ma (U-Pb-SHRIMP zircon, Santos, 2003) and 1995±4 Ma (U-Pb SHRIMP on monazite for an S-type granite, Fraga *et al.*, 2009a) have been interpreted as reflecting the main high-grade syn-kinematic metamorphism on the supracrustal rocks. Concerning the static metamorphism, Berrangé, (1976), Kroonenberg (1977) and Fraga *et al.* (2009) interpreted it as the effect of extensive granitic plutonism bordering the CCB. Fraga *et al.* (2009a), proposed for the CCB an evolution from a series of coeval sedimentary basins, associated with the Trairão and Anauá arcs, which were closed during the amalgamation of these Early Orosirian magmatic arcs with older Rhyacian crustal blocks.

With a different point of view, Kroonenberg *et al.* (2016) proposed a common evolution for the CCB and the Bakhuis Belt (Fig. 1) with an initial prograde metamorphic path between 2.07 and 2.05 Ga, and a retrograde path around 1.98 Ga. In our view, this interpretation cannot be supported taking into account the geochronological data presented in this abstract and commented below. Moreover, the evidence reported by Klaver *et al.* (2015) for the Bakhuis Belt does not support the assumption that a metamorphism around 1.98 Ga could corresponds to the retrograde phase of a metamorphic event that had its first phase around 2.07-2.05 Ga.

Bordering the CCB to the north, the extensive volcanic-plutonic felsic magmatism linked to the Orocaima Igneous Belt (OIB), named after Reis et al. (2003) extends for almost 1000 km from Suriname to Venezuela (Fig 1) (Fraga *et al.*, 2017). The belt consists of 1.99-1.96 Ga A-type, shoshonitic and high-K calc-alkaline high crustal level granitoids and volcanic rocks. U-Pb SHRIMP LA-ICP-MS and Pb-Pb evaporation zircon ages for this belt (Santos, 2003, De Roever *et al.*, 2015; Nadeau, 2014; Fraga *et al.*, 2017, and references therein) vary from 1989±20 Ma to 1956±5 Ma. Santos (2003) and Kroonenberg *et al.* (2016) proposed a magmatic arc setting for this magmatism. However, the presence of coeval shoshonitic, high-K calc-alkaline and A-type granitoids, including riebeckite granite bodies (Fraga *et al.* 2017), without any zoning across the OIB, makes it very difficult to conciliate with syn-subduction setting magmatism. Otherwise, this is a common scenario for post-collisional magmatism, as proposed by Fraga *et al.* (2009a), after the suturing of the CCB. Granitoids of 1.99-1.96 Ga have also been identified in the southern part of the shield (Almeida *et al.*, 2007; Castro *et al.*, 2014). Immediately to the south of the CCB, 1.95-1.93 Ga granitoids and gneisses predominate along the Rio Urubu Igneous Belt (RUIB) (Fraga *et al.*, 2017). These granitoids and gneisses exhibit A-type and high-K calc-alkaline affinities and in addition charnockites and granulite lens crop out, recording emplacement and crystallization/ recrystallization / metamorphism occurring during post-collisional transpression at deeper crustal levels (Fraga *et al.*, 2009b). Xenoliths of high-grade supracrustal rocks very similar to those making part of the CCB occur inside the granitoid rocks of the OIB and RUIB. In this context, we infer that the age of these granitoids constrains the maximum age for the syn-kinematic high-grade metamorphism that affected the CCB.

U-Pb SHRIMP AGES - RESULTS AND DISCUSSION

We present new U-Pb SHRIMP analytical results for four samples of poli-folded (biotite)-cordierite-(garnet)-sillimanite migmatitic gneisses of the CCB: UC-30, LM-13, SK-811 and SK-826 (Fig.1). The information on the three former samples have been preliminary reported by Fraga *et al.* (2017). Figure 2 shows the $^{207}Pb/^{206}Pb$ ages (<10% discordance) in a probability diagram with green and red colors indicating respectively analyzed spots with Th/U<0.1 and with Th/U>1. CL images of a few selected zircons are also shown and illustrate the typical structures observed in the analyzed crystals, with detrital nuclei and metamorphic/metasomatic overgrowths. Some of the nuclei exhibit original igneous oscillatory zoning and othersshow a complex internal structure.

An integration of all ages obtained from the detrital zircon crystals of the 4 samples shown in figure 2 record the contribution of Archaean (20 crystals) and Siderian (10 crystals) sources, but the major contribution was due to Rhyacian (47 crystals with ages between 2210 and 2050 Ma) and Early Orosirian (17 crystals with ages between 2050 and 2010 Ma) sources. One probable source area for the Archaean zircon population could correspond to the AB ancient landmass which records important additions to the crust by 3.26-2.83 Ga and a widespread reworking at 2.65-2.60 Ga (Rosa-Costa *et al.*, 2008). However, concerning the Siderian zircon nuclei, rocks with ages in this time interval are not yet known within the Guiana Shield. Moreover, the possible source areas for the inherited Early to Meso-Rhyacian zircon populations could be found in the granite-greenstone-belt terrains, as well as in the collisional terrains at the northern and western parts of the shield. Finally, the detrital zircon crystals, which form the highest peaks in all four probability diagrams, within the 2070-2050 Ma interval, may correspond to the post-collisional magmatism that followed the Late Rhyacian collisional event. It is worth noting that this is the time interval of the ultra-high temperature metamorphism in the Bakhuis Belt (De Roever *et al.*, 2003; Klaver *et al.*, 2015). Otherwise, the internal structures of the nuclei of the zircon crystals within the 2070-2050 Ma interval suggest that most of them are of igneous origin, but some shows complex structure, and are possibly derived from the Bhakhuis Belt.

As reported by Fraga *et al.* (2017), some rims of the zircon crystals, or patches crossing through them were also analyzed in order to investigate the age of the metamorphic events described for the CCB. The analytical results (forming the younger peaks with green color in Fig. 2) are related to rims with very low Th/U ratios < 0.1, falling into two main intervals, 1990-1960 Ma (13 crystals) and 1945-1915 Ma (5 crystals). Although not diagnostic, these low Th/U ratios <0.1 are common in metamorphic and hydrothermal environments and reflect element availability and partitioning between zircon and co-existing minerals, fluids and melts (Harley et al., 2007). This evidence is in concordance with earlier propositions (Berrangé, 1977; Kroonenberg, 1976; Fraga *et al.*, 2009a) arguing in favor of a static thermal metamorphism affecting the CCB, probably related to the emplacement of granitic plutons. On this subject, Fraga *et al.* (2017) suggested that the zircon populations with ages of 1990-1960 Ma and 1940-1920 Ma are related to the emplacement of the Orocaima and Rio Urubu igneous belts, respectively. Allied to the thermal perturbation, the emplacement of these two continental scale igneous belts providedan important fluid/melt input inside the previously metamorphosed supracrustal rocks of the CCB, resulting in local migmatization and static metamorphism. Concerning the syn-kinematic metamorphic phase, the data is yet very limited. Only two zircon rims with very low Th/U ratios were dated at *ca.* 2020 Ma and could be related to this metamorphic phase.

Considering the geological data available for the central part of the shield and the U-Pb data for the supracrustal rocks of the CCB, we propose that after the final episodes of the Rhyacian orogeny, the continuity of the oblique approximation of the paleoplates and possibly the docking of some unknown terrane led to a shift in the stress field in *inner* regions of the "Amazonia" *plate. This may have produced extensional stresses with the consequent* development of narrow oceans and the formation of 2.04-2.02 Ga magmatic arcs, installed at the margins of the recently built continental masses. The assembly of Archaean and Rhyacian crustal fragments with the 2.04-2.02 Ga magmatic arcs occurred during the Early Orosirian collisional event at 2.02-2.00 Ga and is recorded on the IC and on the CCB. The

final tectonic event, over the stabilized continental mass, was the post collisional magmatism that took place earlier in the northern part of the CCB, forming the OIB, and later in the southern part, forming the RUIB.
Considering the importance of the Early Orosirian orogeny to the evolution of the Guyana Shield, we propose to name it as Akawai Orogeny, in a reference to the word for the Amerindian populations in the language of the Wapixana people, that occupy large areas on the central part of the shield, where the main tectonic elements of the orogeny are exposed.

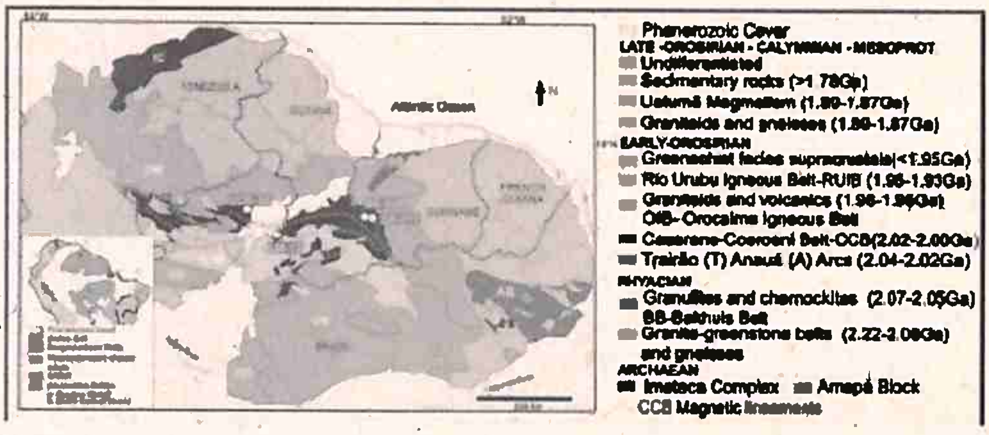

Figure 1- Simplified Geological Map of the Guiana Shield.

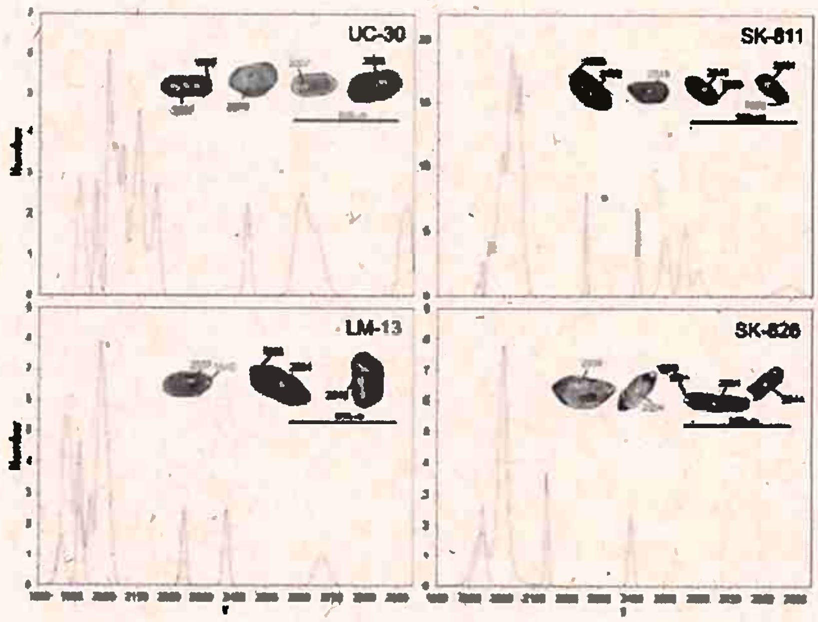

Figure 2 – Probability diagram for $^{207}Pb/^{206}Pb$ ages (<10% discordance) and CL images of selected zircon crystals of samples UCR-30, LM-13, SK-811 and SK-826.

CONCLUSIONS

The interpretation of the U-Pb SHRIMP data for four samples of paragneisses of the Cauarane-Coeroeni Belt within the context of the geology of the Guiana Shield indicates that:

- Archaean (2930-2540 Ma) and Siderian sources (2500-2300 Ma) contributed to the CCB basins. However, the data suggests major contributions of Rhyacian sources (2210-2050 Ma) and Early Orosirian sources with younger ages to 2010 Ma.
- The deposition of The CCB basins post-date the evolution of the Bakhuis belt.
- The syn-kinematic high grade metamorphism and the closing of the CCB basins is tentatively admitted circa 2020 Ma, coeval to the high grade metamorphism on the IC.

- The emplacement of the Orocaima and Rio Urubu igneous belts caused important thermal perturbations, associated to fluid input and migmatization, as recorded by zircon borders with Th/U ratios (<0.1) which yielded ages falling into the 1990-1960 and 1940-1920 Ma intervals;
- The main elements of the Early Orosirian Orogeny, to which the name Akawai Orogeny is proposed in this work, are represented along the central part of the Guyana Shield.

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