CPRM
Geological Survey of Brazil

TECHNICAL REPORT

N. 11
Brasília, Brazil, May 2017
ISSN: 2448-2242
DOI:

Occurrence of chromiferous horizon in the Trincheira Complex, municipality of Corumbiara, southeast of the State of Rondônia, Brazil

Guilherme F. da Silva (*guilherme.ferreira@cprm.gov.br*)
Thyago de J. Ribeiro (*thyago.ribeiro@cprm.gov.br*)
Lívio W. C. Corrêa (*livio.correa@cprm.gov.br*)
Dalton R. V. da Silva (dalton.rosemberg@*cprm.gov.br*)
Carlos E. S. de Oliveira (carlos.oliveira@*cprm.gov.br*)

CPRM – Geological Survey of Brazil, REPO – Porto Velho Office

Reference: CPRM – Geological Survey of Brazil *website:* www.cprm.gov.br / Geologia em Evidência/RECURSOS MINERAIS/Informe Técnico – CPRM/Edição Atual: Informe 11 (05/2017): Ocorrência de horizonte cromífero no Complexo Trincheira, município de Corumbiara, sudeste de Rondônia.

Abstract

The Trincheira Mafic-ultramafic Complex comprises a Mesoproterozoic layered intrusion hosted in metasedimentary rocks of the southwestern portion of the Amazonian Craton. This intrusion has an outcropping area of approximately 35 km^2, however, it has been associated to a larger ellipsoidal magnetic anomaly with N-S elongated shape. The Trincheira Complex is com-posed of partially metamorphosed pyroxenites, websterites, gabbros and anorthosites. The complex hosts Cr-rich layers associated to relevant concentrations of Ni. High concentrations of Cu, Co and V have also been detected. Preliminary analysis performed with portable X-ray diffraction indicates up to 13% Cr and occurrence of cochromite, a special variety of chromite enriched in cobalt, nickel and iron, whereas ICP-MS analyses returned concentrations of up to ~3600 ppm Cr.

Keywords: Mafic-ultramafic intrusions, Cumulate rocks, Amazonian Craton.

INTRODUCTION

New mineral occurrences were identified in ultramafic rocks of the Trincheira Complex, southeast of the State of Rondônia, Brazil, located at Fazenda Patuá (or Andreazza), sited to the margins of the state highway RO-370, "Estrada do Boi", municipality of Corumbiara, near the limit with the State of Mato Grosso and the Brazil-Bolivia border (Figure 1).

In this report, we present petrographic information, X-ray diffraction and fluorescence analyses, lithogeochemical and magnetometric data.

The analysis of the mafic-ultramafic rocks shows one sample with relevant contents of chromium (3,624 ppm), nickel (1,829 ppm) and cobalt (651 ppm), in addition to copper (470 ppm) and vanadium (318 ppm).

Considering that the occurrences are hosted in the Trincheira Complex, which has similarities with the Ni-bearing ultramafic bodies described in Morro sem Boné and Morro do Leme, it is expected that the presented data can draw the attention to new areas to investigate the potential of mineral deposits related to mafic-ultramafic bodies.

GEOLOGICAL SETTING

The Trincheira Complex was defined by Romanini (2001) as an association of mafic-ultramafic rocks intrusive in the metavolcano-sedimentary Nova Brasilândia Sequence, and consisting of gabbros, gabbronorites, tremolitites, websterites and bronzitites, partially metamorphosed under upper greenschist facies, having an outcropping surface of approximately 35 km^2.

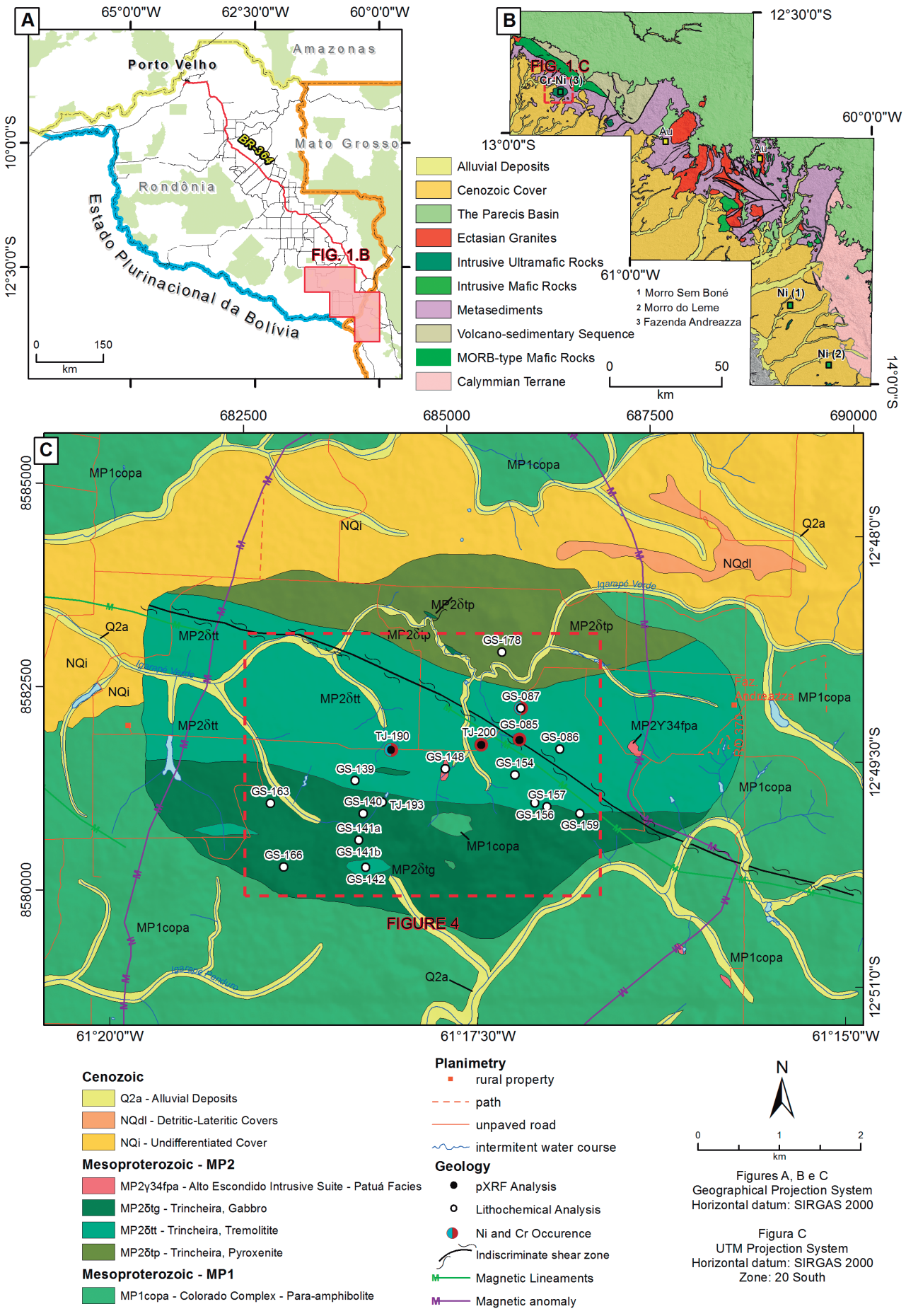

Figure 1: *A) Location of the project area between the states of Rondônia and Mato Grosso, near the border with Bolivia; B) Simplified geology of the Southeast Rondônia Project (Silva et al., 2016) and main mineral occurrences of nickel, chromium and gold; C) Detailed geological map of the outcropping portion of the Trincheira Complex, including the location of Cr-Ni (Co-V) mineral occurrences and stations with chemical and pXRF (portable X-ray fluorescence, Olympus DELTA Professional model) analyses.*

Silva et al. (2016) revisited the Trincheira Complex by adding new field, petrographic and whole-rock geochemical information. Accordingly, the Trincheira Complex is formed by layered and tabular bodies, roughly divided from north to south into ultramafic component, which grades to mafic rocks. These rocks are little deformed and locally transformed in tremolitites. The wall rocks comprise a sequence of calc-silicate rocks, para-amphibolites and metavolcanic rocks metamorphosed under upper amphibolite facies, which occasionally occur as xenoliths within the complex.

Comparatively, the body in the Andreazza Farm resembles the Ni-mineralized ultramafic bodies of Morro sem Boné and Morro do Leme (Nunes, 2000), which are located in the municipality of Comodoro (State of Mato Grosso, Brazil), 100 km southeast of the occurrences discussed here, in the boundary region between the Rio Negro-Juruena Province and the Alto Guaporé Belt, both occurring in the same geological setting (Rizzotto et al., 2000).

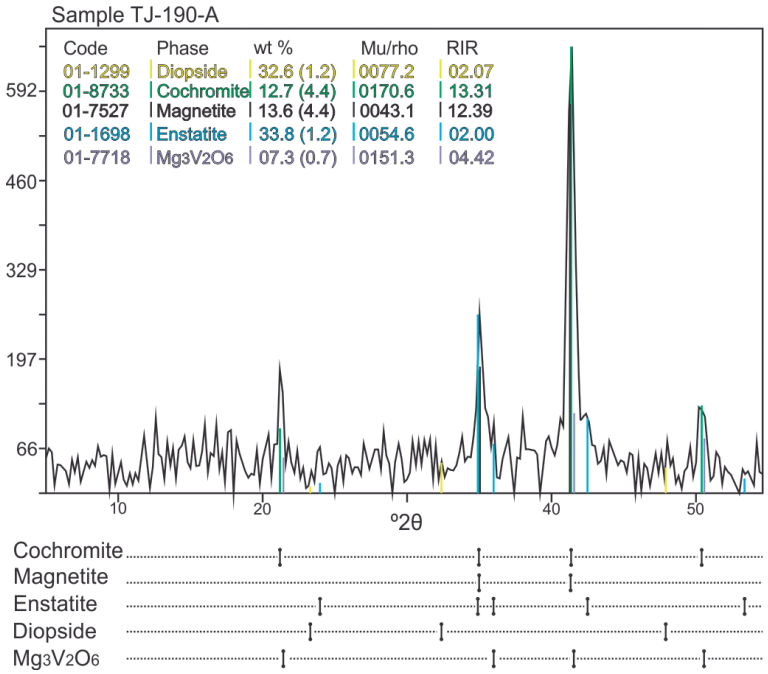

Figure 2*: X-ray diffractogram with the main mineral phases detected: cochromite, magnetite, enstatite, diopside and Mg3V2O6 (magnesiocoulsonite?). The analyses were done with pXRD (portable X-ray diffractometer, Olympus TERRA Mobile model).*

OCCURRENCE DESCRIPTION

Four samples were identified with relevant concentrations of Cr and Ni, cropping out as subangular to tabular blocks within tremolitites and pyroxenites layers (Table 1). Three of the occurrences are aligned parallel to the igneous bedding, indicating that they are part of the same horizon.

In outcrop, mineralized rocks have an alteration cover of iron oxides and hydroxides, which give a reddish color to the rock and that can be easily confused with laterite. When fresh, the rocks are black, with sub-centimetric crystals of minerals with metallic brightness, some of which strongly magnetic, immersed in a matrix of silicates visible to the naked eye.

The X-ray diffraction analysis of sample TJ-190 (Figure 2) indicates the presence pyroxenes in addition to magnetite, magnesiocoulsonite (?) and cochromite (chromite variety enriched in Ni, Co and Fe).

Table 1*: Location of occurrences*

Outcrop	*UTM-E	*UTM-N
GS-085	687411	8581659
GS-087	656913	8582233
TJ-190	684319	8581724
TJ-200	685428	8581181

*Datum: SIRGAS 2000, zone 20 South.

The cumulate nature of both wall and mineralized rocks was confirmed by petrography, where mineralized samples show cumulate crystals of chromite and magnetite dispersed in a partially serpentinized matrix (Figure 3).

CHEMICAL ANALYSIS

Sixteen rock samples were collected along the Trincheira Complex (Table 2). The chemical analyses were done in the SGS Geosol laboratories. The concentrations of MgO, TiO_2, CaO and FeO_t were obtained by X-ray fluorescence in samples opened with lithium metaborate. The contents of S, Cr, Ni, Co, V and Cu were obtained using ICP-MS after multiacid digestion. Pt values were obtained by ICP-AES after fusion by fire assay.

In addition, in situ analyses were carried out in three samples, using a portable X-ray fluorescence (pXRF). The results returned high concentrations of chromium and nickel, and one sample also shows relevant concentrations of cobalt and vanadium (Table 3).

The analyses were compiled in order to simulate a possible intrusion stratigraphy (Figure 4). Considering that the layered body is not inverted, the ultramafic (basal) portion lies to the north, and the upper mafic units to the south. Thus, it is possible to observe the anomalous values of the chromitites of the sample GS-87 in FeO_t, Cr, Ni, Co and Cu compared to the average contents of their host rocks. There is a negative correlation between sulphur and nickel concentrations, suggesting that the latter may also be present in a mineral phase other than pentlandite, as previously described by Romanini (2001).

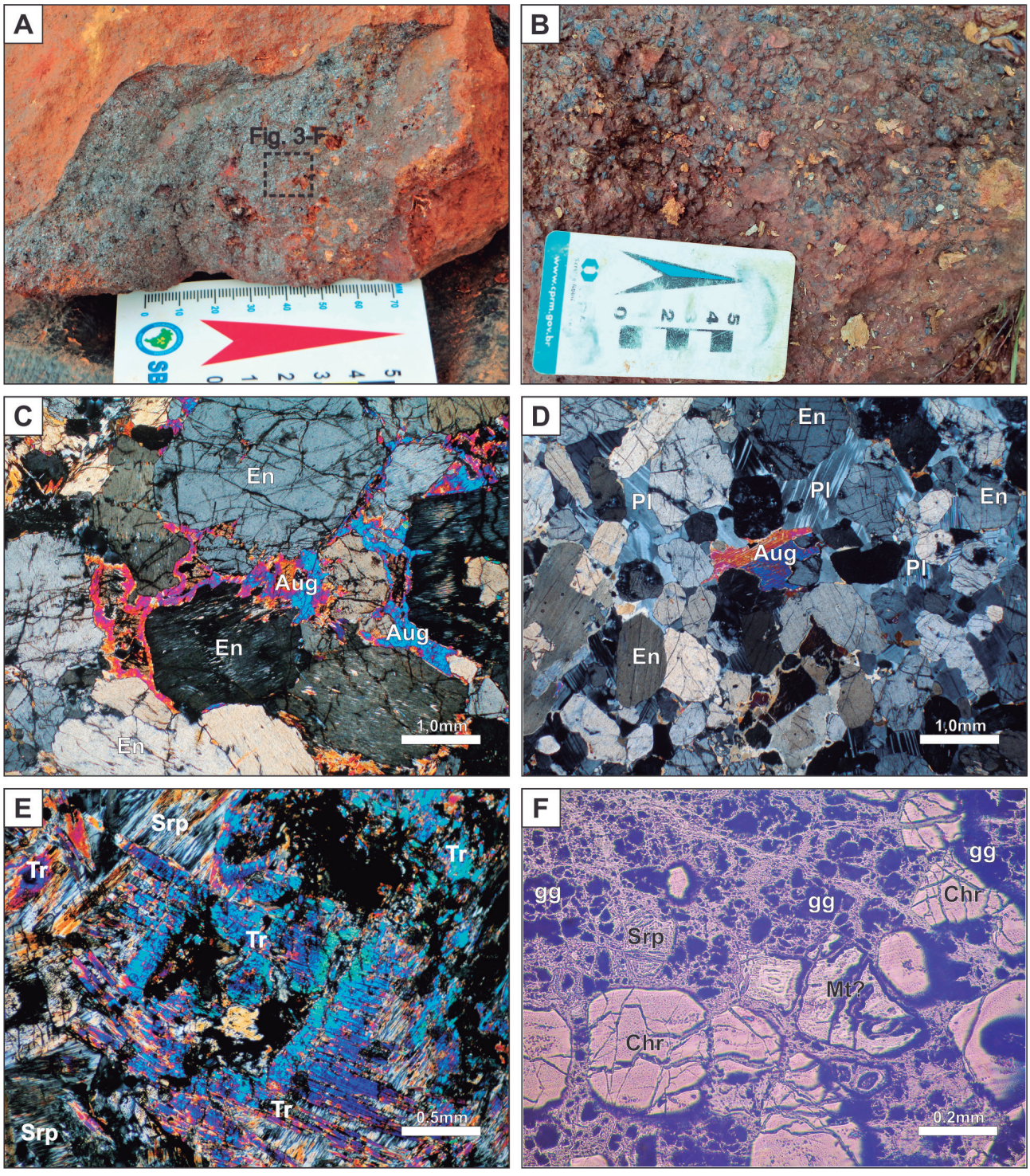

Figure 3: A) Blocks of massif chromitite occurring within partially tremolitized pyroxenites; sample TJ-190; B) Cumulate chromitite with coarse texture, partially lateritized; sample GS-087; C) Photomicrography (crossed polarizer) of websterite, composed of enstatite accumulations with augite intercumulus; sample TJ-030; D) Photomicrography (crossed polarizer) of gabbronorite composed of accumulations of enstatite and augite, dispersed in plagioclase matrix; sample GS-092; E) Photomicrography in crossed polarizer showing ultramafic protolith metamorphic rock composed of tremolite, serpentine and opaque minerals, without well-developed planar fabric; sample GS-086; F) Photomicrography under reflected light showing predominantly cumulate chromite and magnetite, with lamellae of ilmenite exsolution, dispersed in serpentine matrix; polished section of sample TJ-190. Abbreviations: En = Enstatite; Aug = Augite; Pl = Plagioclase; Srp = Serpentine; Tr = Tremolite; Chr = Chromite; Mt = Magnetite; gg = Gangue.

Table 2*: Results of chemical analysis in rock samples of the Trincheira Complex*

Sample	UTM_E	UTM_N	MgO	TiO_2	CaO	FeO_t	S	Cr	Ni	Co	V	Cu	Pt
			%	%	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppb
GS-086	686390	8581731	27.1	0.31	1.4	12.1	< 0.01	770	488	46.3	126	147.8	< 5
GS-087	685913	8582233	3.53	0.91	0.06	42.4	0.02	3624	1829	651.2	318	470.8	< 5
GS-139	683871	8581343	26.3	0.35	0.93	10.6	< 0.01	803	395	51.6	113	98.7	< 5
GS-140	683968	8580941	7.67	0.96	10.6	12.0	0.03	76	56.3	44.2	215	36.9	< 5
GS-141A	683917	8580614	13.6	0.61	11	10.7	0.11	309	230	52.8	176	100.6	5
GS-141B	683917	8580614	13.6	0.67	14	9.7	0.09	313	185	49.7	199	137.7	10
GS-142	684000	8580279	23.9	0.56	2.85	11.6	0.01	549	614	54.8	124	195.8	< 5
GS-148	684979	8581489	17.9	0.27	3.84	18.5	0.11	370	530	66	150	34.2	< 5
GS-154	685837	8581416	30.1	0.19	1.24	11.3	0.01	580	1286	75.3	68	26.8	< 5
GS-156	686081	8581070	28.0	0.28	0.68	10.7	< 0.01	763	500	66.1	103	14.6	< 5
GS-157	686232	8581023	28.3	0.19	2.32	9.9	0.03	525	641	73.4	77	71.7	N.A.
GS-159	686638	8580941	24.4	0.23	1.21	15.7	0.02	432	690	79.8	108	12	7
GS-163	682828	8581068	6.89	1.43	10.9	15.0	0.04	39	46.8	40.4	210	42.1	< 5
GS-166	682991	8580284	9.39	0.34	10.9	8.2	0.12	86	131	43.5	113	43.4	< 5
GS-178	685679	8582924	13.9	0.22	10.9	8.2	0.15	143	216	48.7	116	43.1	< 5
TJ-193	684203	8581081	6.08	1.65	11	13.4	0.14	14	9.9	37.8	258	36.3	N.A.

N.A. = not analysed

Table 3*: Chemical results for mineral occurrences analyzed by pXRF*

Amostra	UTM_E	UTM_N	MgO	TiO_2	FeO	Co	Ni	Cr	V
			%	%	%	ppm	ppm	ppm	ppm
GS-086	686390	8581731	27.1	0.31	12.1	770	488	46.3	126
GS-087	685913	8582233	3.53	0.91	42.4	3624	1829	651.2	318
GS-139	683871	8581343	26.3	0.35	10.6	803	395	51.6	113

FINAL REMARKS

The Trincheira Mafic-Ultramafic Complex shows to be a new prospective target with Cr, Fe, Ni, Co, V and PGE chemical association from the recognition and characterization of a probable cumulate chromite horizon within the layered body (more horizons might be present).

Our data are insufficient to make any inference about the accumulation of sulfide layers. So far, it appears that the Ni-Co concentrations may be in the oxides, possibly in a cobaltiferous chromite, the cochromite, as the main mineral. Previous descriptions reported the presence of pentlandite as the sulfide phase in the complex (Romanini, 2001). It was observed that calcium enriched rocks had the highest concentrations of sulfur (gabbros, gabbronorites and anorthosites).

Figure 5 suggests that the magnetic anomaly attributed to the Trincheira Complex occurs in a much larger area than that of the outcrop. If this magnetic anomaly actually represents buried portions of the complex below the calc-silicate wall rocks, the Trincheira Mafic-Ultramafic Complex will have its prospective potential significantly extended.

Detailed studies are recommended to recognize other mineralized horizons, seeking to verify the lateral and depth extension of these mafic-ultramafic bodies. We also suggest detailed ground-based gravity and magnetometry because of the density and magnetic contrasts between the mineralized and other rocks, as observed in hand sample. Induced polarization (IP) survey can be done to identify possible layers enriched in PGE and of massive sulfide. Microprobe studies could provide more reliable information on the mineral phases that contain the Fe-Ni-Co and Cr-Ti associations.

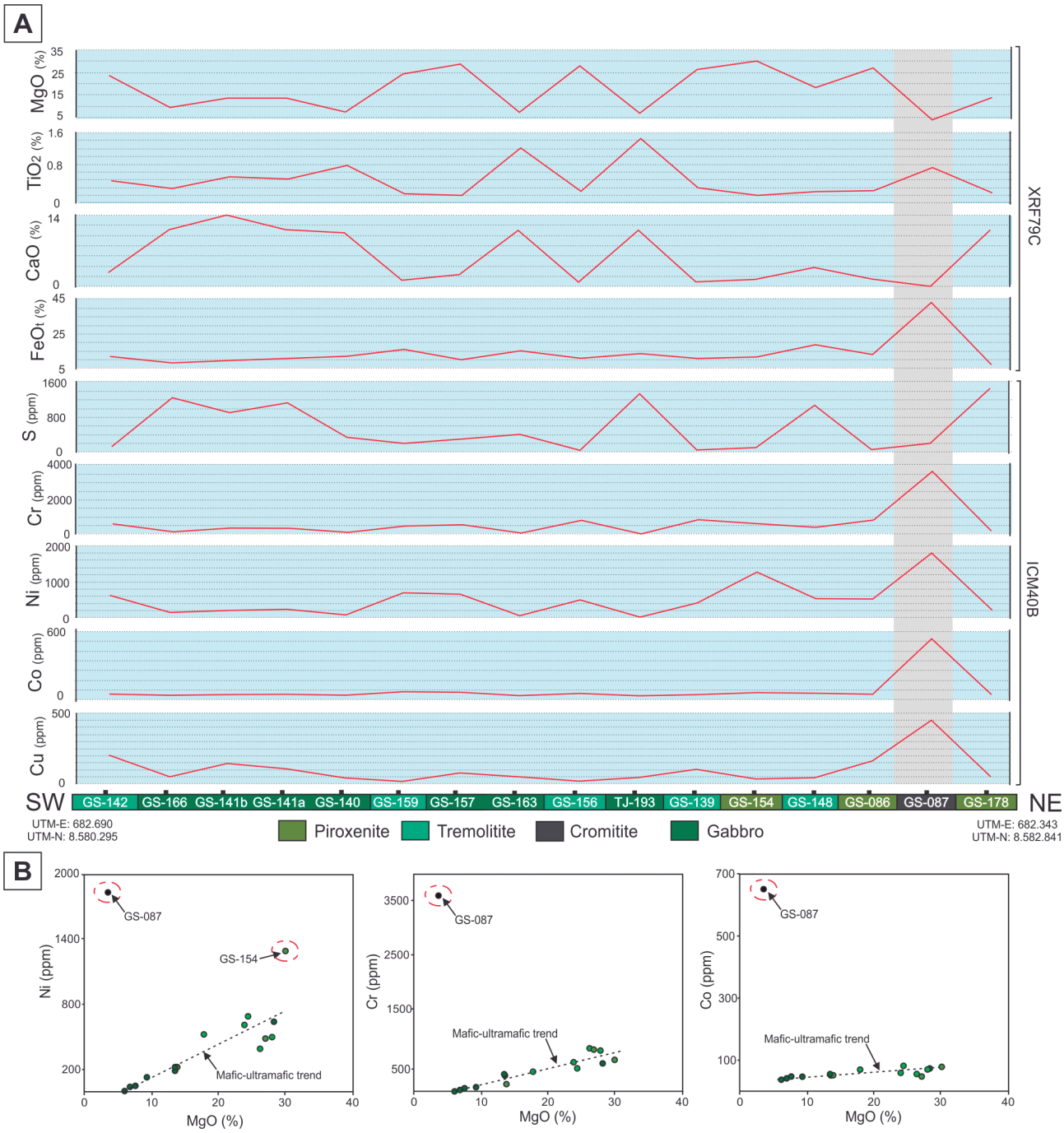

Figure 4: A) Chemostratigraphy of the Trincheira Complex from the projection of chemical analyses along an NE-SW-trending intermediate axis, which crosses the lithofacies (see Fig. 1). The color associated with the samples in the horizontal bar shows the lithotype as indicated in the legend. B) Ni, Cr and Co (ppm) versus MgO (%) diagrams. There is a strong positive linear correlation with the gabbros, pyroxenites and tremolitites samples in the three diagrams. Samples GS-154 and GS-087 show concentrations above this trend in Ni and Ni, Cr and Co respectively. The GS-087 sample shows the highest concentrations of the three elements, but has a low concentration of magnesium. This can be explained by the fact that this rock is composed of oxidized cumulate minerals and smaller amounts of magnesium rich silicate phases (serpentine, pyroxenes and tremolite).

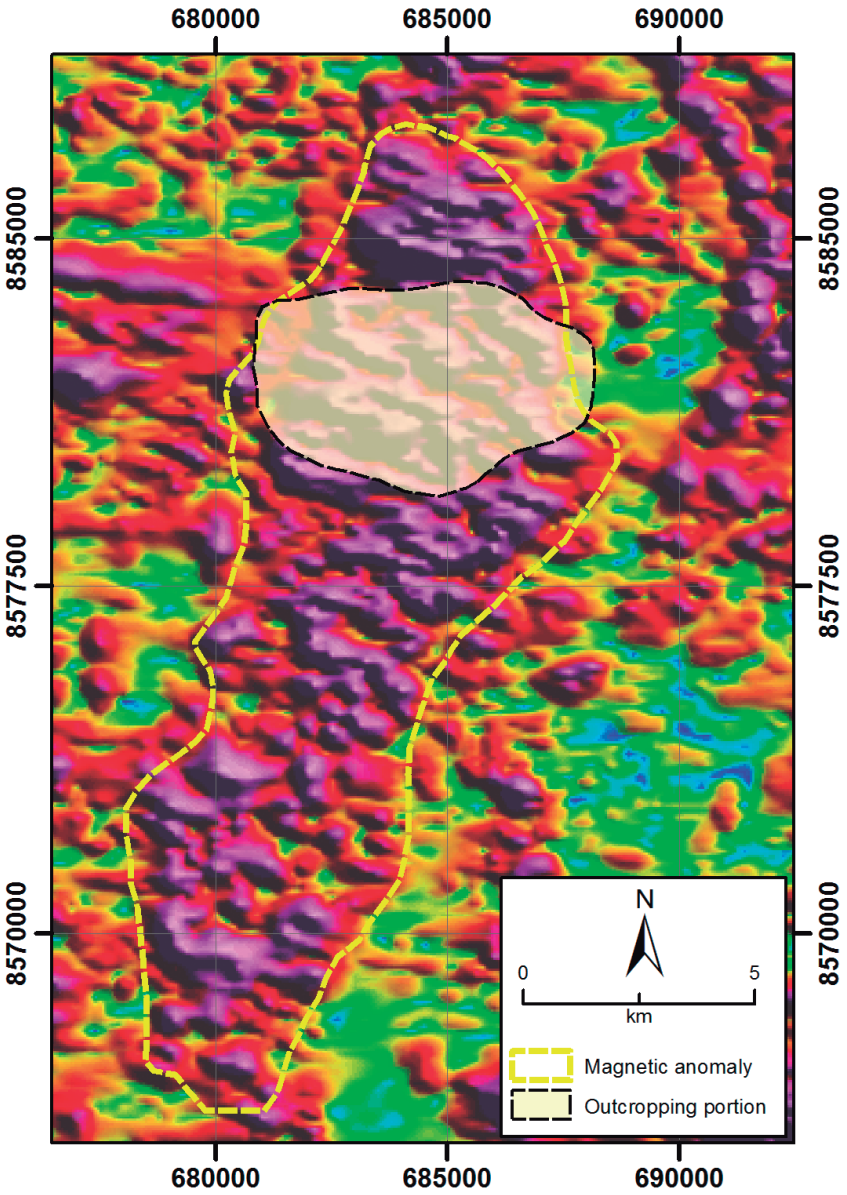

Figure 5: Total Gradient Magnetic Map with indication of the outcropping portion of the Trincheira Complex and its probable sub-surface extension, based on the magnetic anomaly.

REFERENCES

NUNES, N. S. V.; 2000. **Geologia e resultados prospectivos das áreas Morro do Leme e Morro Sem Boné – Mato Grosso**. Goiânia, GO: CPRM - Companhia de Pesquisa de Recursos Minerais, 2000.

RIZZOTTO, G. J. et al. 2013. **The Mesoproterozoic Guaporé suture in the SW Amazonian Craton: Geotectonic implications based on field geology, zircon geochronology and Nd-Sr isotope geochemistry**. Journal of South American Earth Sciences, v. 48, p. 271–295, 2013.

ROMANINI, S.; 2001 **Aspectos geológicos, geoquímicos e metalogenéticos do magmatismo básico/ultrabásico do estado de Rondônia e área adjacente**. CPRM - Companhia de Pesquisa de Recursos Minerais, 2001.

SILVA, G. F.; RIBEIRO, T. J.; OLIVEIRA, C. E. S.; CORRÊA, L. W. C.; ADÔRNO, R. R.; SILVA, D. R. V.; 2016. **Mapa Geológico Preliminar Integrado Novas Fronteiras Sudeste de Rondônia. Escala 1:100.000, apresentado em escala 1:200.000. Projeto Avaliação do Potencial Mineral do Sudeste de Rondônia**. Porto Velho, RO. CPRM - Companhia de Pesquisa de Recursos Minerais, 2016.

TECHNICAL REPORT N. 11
Brasília,Brazil, May 2017

Serial online publication by CPRM – Geological Survey of Brazil

Available at www.cprm.gov.br

CPRM - Geological Survey of Brazil
SBN – Quadra 02 – Bloco H, Ed. Central Brasília, 1st floor
Brasília - DF - Brazil
CEP: 70040-904
Phone: +55 (61) 2108-8400
Contacts: bibliotecarj@cprm.gov.br
evandro.klein@cprm.gov.br