METASEDIMENTS AFFECTED BY THE RIO MARANHÃO FAULT

Versus

GRANULITE EXHUMATION IN THE BRASÍLIA BELT, CENTRAL BRAZIL

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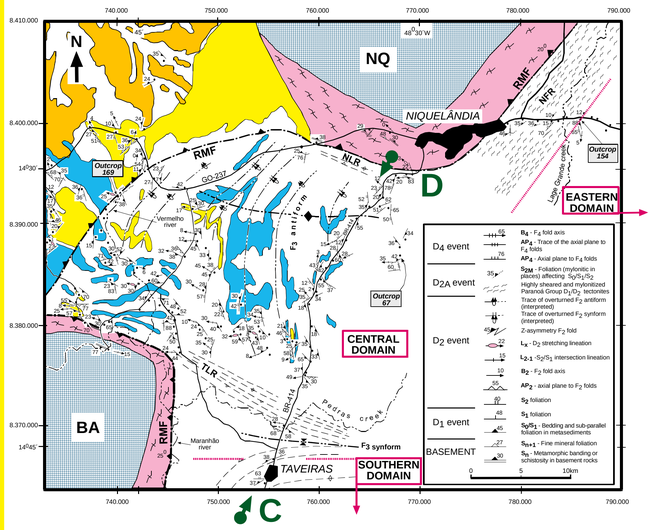

LEGEND

TERTIARY-QUATERNARY: Soil, gravel

MESO-NEOPROTEROZOIC METASEDIMENTS AND METAIGNEOUS ROCKS

- Metacarbonate
- Phyllite, slate, schist, quartzite, calci-schist metacarbonate, metarhythmite
- Quartzite
- Mafic-Ultramafic intrusions and volcanic rocks granulitized ca.780 My ago. **BA** = Barro Alto Complex, **NQ**= Niquelândia Complex

(ARCHEAN?) PALEOPROTEROZOIC BASEMENT

- Mylonitic gneiss, metadiorite, metatonalite, metaquartzdiorite (Includes Neoproterozoic syntectonic granitic intrusions)

Event D3 is solely represented by two major folds in the map. Other D3 structures, particularly the S3 foliation and B3 fold axes, have been omitted for simplicity. D3 structures are exclusively found in the Central Domain.

Figure 2: Simplified geological map of the study area, highlighting the EASTERN, CENTRAL, and SOUTHERN lithostructural domains. RMF = Rio MaranhãoFault; NFR = Niquelândia Frontal Ramp; NLR = Niquelândia Lateral Ramp; TLR = Taveiras Lateral Ramp.

TECTONIC SETTING

A W- and shallowly-dipping contraction fault defines the contact between the Internal and External zones (**IZ** and **EZ**) of the Neoproterozoic Brasília belt (Tocantins Province, Central Brazil; Fig.1) and separates a belt-parallel strip of high-T and ~10Kbar granulites (hangingwall), from a footwall consisting of passive margin-like, sub-greenschist metasediments (Paranoá Group) overlain by nappes composed of distal passive-margin (Canastra Group) and back-arc basin-related (Araxá Group) supracrustals metamorphosed under amphibolite-greenschist facies.

The high-PT belt comprises ~645-630My old, para- and orto-derived granulites (Anápolis-Itauçu Complex), and M-UM complexes that include three layered intrusions and metavolcanics partially granulitized ~750My ago and exhumed ca. 620My ago, to form a series of bodies within lower-grade tectonites, some belonging to the nappes, in the hangingwall of the Rio Maranhão Fault (**RMF**), as is named the **IZ**-**EZ** boundary fault to the north of the WNW-trending Pirineus High-Strain Zone (Fig. 1).

The **RMF** cuts across low metamorphic grade metasediments and its trace displays an arc-like shape resembling embayments to the west, in the segments between the M-UM granulitized bodies. The study area covers the trace of the **RMF** between the Niquelândia and Barro Alto bodies and to the east of both (**NQ**, **BA**; Fig. 1). Rocks of the Paranoá Group have been actually mapped in the **IZ**, around the Caldas Novas dome (D´el-Rey Silva et al., 2004), and described to the west of the **BA** complex (D´el-Rey Silva et al., 1997).

AIMS OF THIS STUDY

A detailed lithostructural mapping of the metasediments on both sides of the **RMF** was carried out with the aid of data about the Sm-Nd isotopic system (2003-2005), aiming to understand the **RMF** and its role in the exhumation of the granulites in the **IZ**. The combination of detailed structural and isotopic studies is a pioneer approach across a domain boundary in the Brasília Belt.

GEOLOGY OF THE AREA

1 – Lithostratigraphy and lithostructural domains

The metasediments across the trace of the **RMF**, and to the east of the **BA** and **NQ** bodies, do not differ as lithotypes, and display the same isotopic signature (Sm-Nd), deformation, and metamorphism that is basically of low greenschist facies. The geology data allow defining the CENTRAL, EASTERN, and SOUTHERN lithostructural domains. About 170 outcrops were described in detail. The deformation events, their tectonic effects, their structures and symbols, and their domainal distribution, are all summarized in Table 1. The geological map of the CENTRAL DOMAIN (Fig. 2) includes solely small parts of the EASTERN and SOUTHERN domains.

Metasediments found across the **RMF** comprise metapelite, phyllite, and metarhythmite, together with metacarbonate and quartzite, the same lithotypes typical of the Paranoá Group defined by Marini and Fuck (1981) for a large area enclosing Niquelândia and Taveiras, and spreading eastwards of both, into the **EZ** (Figs. 1 and 2). Even dm-thick layers of chlorite schist intercalated with quartzite, and dm-thick layers of mica schist's in metarhythmite, that could all suggest an apparently higher metamorphic grade in the hangingwall of the **RMF**, are also found in the footwall. Schist-like layers are rare outside the CENTRAL DOMAIN, but have been described in local zones of higher and layer-parallel strain, in outcrops outside of road BR-414, between Taveiras and Quebra Linha, the latter in the southern end of the SOUTHERN DOMAIN (outside of Fig.2; D´el-Rey Silva et al., 1997).

DEFORMATION EVENTS	D_1	D_2	D_{2A}	D_3	D_4
	Progressive D_1-D_2 deformation		Progressive Post-D_2 deformation		
TECTONIC EFFECTS	Layer-parallel shearing (folding), transport to ESE	Folding thrusting, transport to ESE	Tectonic escape, extra tightening, verticalization, and sheathing of F_2 folds	Folding, N-S shortening	Folding, E-W shortening
STRUCTURES & SIMBOLS	Foliation (S_1), folds (F_1), axis, plus intersection and stretching lineations (B_1; L_{1-0}; L_X)	Folds (F_2), Foliation (S_2), axis, plus intersection and stretching lineations (B_2; L_{2-0}; L_X)	Foliations orthogonal to F_2 folds tectonic axes **a** and **b**, and local folds (S_{2H}; F_{2H}; S_{2V}; F_{2V})	Folds (F_3), Foliation (S_3), axis, and intersection lineation (B_3; L_{3-0})	Folds (F_4), Foliation (S_4), axis, and intersection lineation (B_4; L_{4-0})
CENTRAL DOMAIN	YES	YES F_2 sheath folds very common	Solely along the **RMF** and the **NFR** (Fig. 2)	YES	YES
SOUTHERN DOMAIN	YES	YES F_2 sheath folds very rare	YES	NO	NO
EASTERN DOMAIN	YES	YES F_2 sheath folds very rare	YES	NO	NO

Table 1: Summary of deformation events, tectonic effects, and structures observed in the study area.

RMF = Rio Maranhão Fault; **NFR** = Niquelândia Frontal Ramp

Figure 2

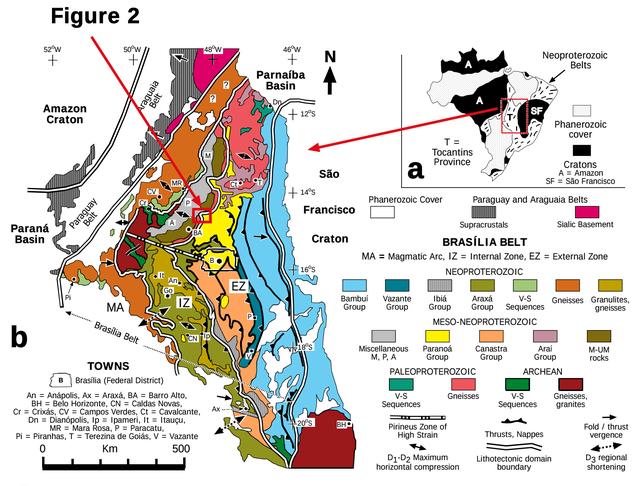

Figure 1: Simplified geological map of the central part of the Tocantins province, highlighting the main lithotectonic units of the Brasília Belt: **MA** = Magmatic arc; **IZ** = Internal Zone; **EZ** = External Zone.

The Sm-Nd isotopic data obtained (Geochronology Laboratory, IG - UNB) from 15 samples of metasediments collected in the hangingwall and footwall indicate the same signature. All samples display highly negative values of ε_{ND} pointing to erosion of continental crust in the source areas. T_{DM} model ages for 13 of the samples vary in the 1.94-2.22 Gy interval and suggest a strong contribution of Paleoproterozoic sources during sedimentation, but contribution of Archean continental crust is also required, particularly to explain T_{DM} model ages of 2.69 and 2.68 Gy respectively found in mylonitic quartzites of the hangingwall, and quartz-rich mylonites along the **RMF** (outcrop 169; Fig.2). In addition, T_{DM} model ages of 1.97 and 1.56 Gy, respectively for samples of quartzite and siltic metapelite layers of the same outcrop of metarhythmite, situated in the very core the EASTERN DOMAIN, indicate also contribution of Mesoproterozoic sources, likely to be igneous rocks part of the Araí and Serra da Mesa groups, and/or their basement (Fig. 2). The Sm-Nd signature is fully compatible with the signature of typical Paranoá rocks in other areas of the Brasília Belt (Pimentel et al., 2001).

Metasediments of the study area underwent the same progressive D_1-D_2 deformation, but metasediments in the footwall of the **RMF** also record post-D_2 deformation related to exhumation of granulites (D_{2A}, D_3 and D_4, the events) and not observed in the hangingwall of the **RMF**. The CENTRAL DOMAIN comprises the footwall metasediments situated between the two **M-UM** bodies, and displays abundant F_2 sheath folds (these are in fact D_{2A} features; explanation ahead) affected by D_3 and D_4 structures that occur solely in that part of the area. F_2 sheaths are almost absent in the EASTERN and SOUTHERN domains.

The similar style and orientation of D_1-D_2 structures and the sheath folds, in the CENTRAL DOMAIN and in the hangingwall of the **RMF,** justified including their D_1-D_2 data in the same stereograms (Fig. 3). The EASTERN and SOUTHERN domains comprise the metasediments situated eastwards of the **NQ** and **BA** complexes, respectively. They characteristically display evidence of D_{2A} event, but differ in the orientation of D_2 structures (Figs. 4 and 5). The structural data also allowed definition of the Taveiras and Niquelândia lateral ramps (**TLR**, **NLR**), and the Niquelândia Frontal Ramp (**NFR**), three tectonic features (Fig. 2) related to the evolution of the **RMF**. These are all due to post-D_2 deformation and to exhumation of the granulites, and are responsible for the three domains to exist.

All the above, coupled with the fact that field work did not indicate a basic difference in the horizontal and vertical distribution of metasediments across the **RMF**, neither this difference is seen in regional maps (Lacerda Filho et al., 1999), largely indicate that the study area is underlain by the Paranoá Group (Fig. 2).

2 – Structural database

D_1 structures deform the bedding (S_0) of the metasediments and imprint foliation S_1 and folds F_1 in the area. S_1 is mostly a mineral foliation of white mica and chlorite, and is commonly an S-C mylonitic foliation sub- parallel to bedding. F_1 are far less common than the F2 folds, but have been observed in outcrops of the hangingwall and footwall. They are generally dm- to m-scale, mostly isoclinals, asymmetric, E-verging, and the fold axis B_1 is sub-parallel to the axis of F_2 folds.