

AN ISOTOPIC INSIGHT OF THE SERGIPANO BELT STRATIGRAPHY: RADIOGENIC AND CARBON ISOTOPES

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INTRODUCTION

The aim of this work is to constrain the depositional time interval of some stratigraphic units that belong to the Sergipano fold belt (SFB), northeastern Brazil. Based on a review of the existing radiogenic and stable isotope data, as well as on field stratigraphic considerations, a new stratigraphic position for the Macururé (MA) and Araticum (AT) groups is proposed as well as their relationship with other stratigraphic units.

The SFB belongs to the Borborema Geotectonic Province and is located in the northern margin of the São Francisco Craton (SFC) (Fig. 1). A generalized stratigraphic division of this belt was proposed by Humphrey & Allard (1962, 1969), in which they identified that the Miaba (MI) and Vaza Barris (VB) groups are located in the SFB itself and that the Estância (ES) Group is located overlying the (SFC). North of this area, the same authors also identified biotite-garnet schists surrounding some granitic stocks, and considered them as hornfelses. On the other hand, Barbosa (1970) characterized the Canudos (CA) Group, west of the Tucano basin, which is equivalent to the MI and VB. Additionally, this author characterized the MA, which is

composed by siliciclastic metasediments and is correlative with the hornfelses of Humphrey and Allard (1969). According to Silva Filho & Torres (2002) the Araticum complex comprises the Araticum, Timbaúba e Batalha units from Silva Filho et al. (1981) and is correlative with the hornfelses from Humphrey and Allard (1969), which then were characterized as pelitic (Traipú) and quartz-feldspar (Jaramataia) hornfelses. Additionally, Silva Filho & Torres (2002) separated the AT from the MA and proposed different age and depositional environments for them, based on the presence of amphibolites (MORB metabasalts) and some BIF in the AT that are not present in the MA.

D'el-Rey Silva (1995), modified the stratigraphic division from Humphrey & Allard (1969) and a new stratigraphy was proposed for the SFB. Nevertheless, Davison & Santos (1989) came up with another subdivision in which the Estância Domain and its respective foreland basin (ES); the Vaza Barris Domain including the MI and VB; the Macururé Domain including the MA; the Poço Redondo Domain; Marancó Domain and the Canindé Domain were proposed based on tectono-stratigraphic considerations.

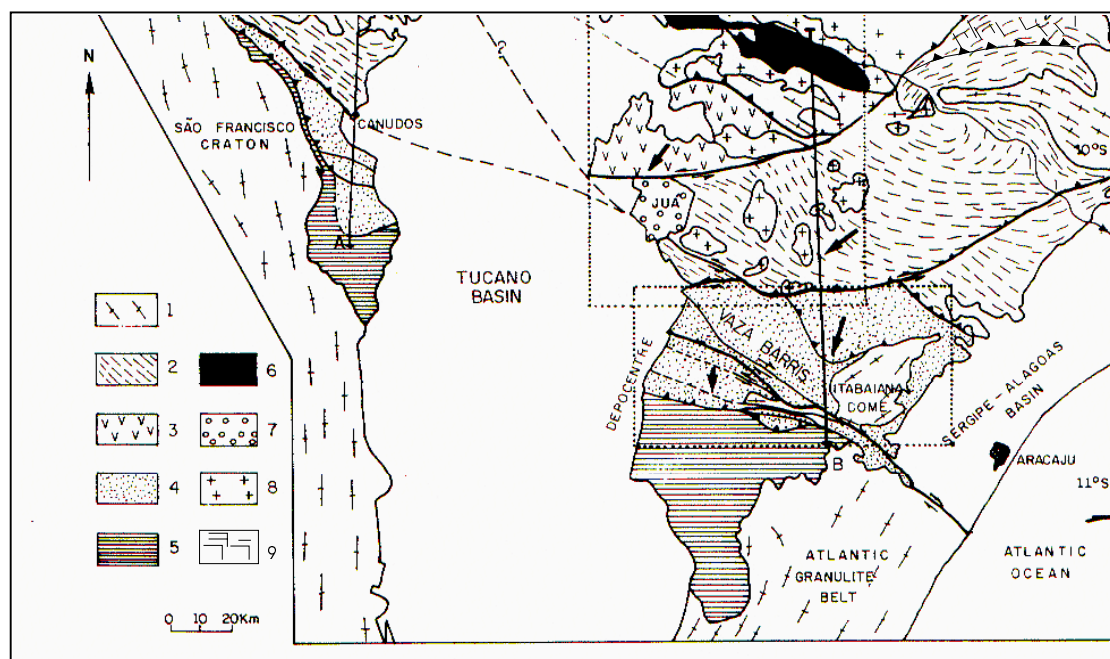


Figure 1. Simplified geologic map of the Sergipano fold belt and its basement. 1- High-grade gneiss; 2- Macururé; 3- Marancó; 4- Vaza Barris; 5- Estância; 6- Canindé; 7- Juá graben; 8- Granites; 9- Rio Coruripe Domains.

Silva Filho & Torres (2002), recognized the above mentioned domains, as well as the Rio Coruripe (RC) Domain, including the AT and the Pernambuco-Alagoas (PE-AL) Domain, which comprise Meso-Neoproterozoic metaplutonic and metasedimentary rocks and Neoproterozoic granitoids. These authors also stated that the VB, MA and RC belong to an ensialic fold belt (SFB) and that the others to an oceanic fold belt, known as the Sul-Alagoano fold belt respectively, which amalgamated along the Jeremoabo-Belo Monte shear zone.

PROBLEM CHARACTERIZATION

Based on geochronologic data in some granites which show ages around 0.6 Ga, the SFB has been considered as part of a group of fold belt affected by the Brasiliano orogeny (Brito Neves et al., 1978; Santos et al., 1998). However, some 1.04 and 1.0 Ga (U/Pb) ages were obtained in felsic metavolcanic rocks from the MA and other of 0,98 Ga from some orthogneiss that intrude the Cabrobó Complex (CC) in the PE-AL (Van Schmus, et al., 1995; Silva Filho et al., 1997) .

The time span of deposition of the MA and AT sequences is a topic of continuous debate. The existing discrepancies are based on the lack of fossils and radiogenic data. For instance, the MA was considered older than the CA by Barbosa (1970), while Silva Filho et al. (1978) and Santos et al., (1998) considered it as the coeval deep water equivalent of the VB and MI and proposed a Neoproterozoic age. Silva Filho & Torres (2002) considered the MA as correlative of the MI, both of Mesoproterozoic age. Davison & Santos (1989) proposed a Neoproterozoic age for the previously mentioned domains, but without following any stratigraphic consideration. The AT was separated from the MA, but was considered as correlative of the CC, assigning a Meso-Neoproterozoic age (Silva Filho and Torres, 2002).

STABLE vs. RADIOGENIC ISOTOPES

Sial et al., (2000), analyzed several carbonate sequences located in the SFB using C and O stable isotopes and compared the resulting C-isotope data with preexisting C-isotope secular variation curves (Hoffman et al., 1998 ; Kha et al. , 1999). These authors collected 25 samples in a 80m thick marble sequence in the Batalha city (Al) region and obtained fluctuating positive $\delta^{13}\text{C}$ values between +3 a +4 ‰ PDB and two slight shifts to values as low as 0 ‰ (Fig. 2). According to Silva Filho and Torres (2002) these marbles belong to the AT and therefore the secular variation curve proposed by Sial et al (2000) might represents Meso-Neoproterozoic ages instead of solely representing Neoproterozoic ages. On the other hand, Silva and Sial (2003) found similar $\delta^{13}\text{C}$ pathways in marbles from the São Caetano Complex whose age range between 1.1 and 0.98 Ga.

Sial et al. (2000) also sampled the Acauã Formation of the ES, the Jacoca Formation of the MI, and the Olhos D'Água Formation of the VB. In the Acauã Formation 21 samples were collected by these authors and $\delta^{13}\text{C}$ values around -4 ‰ , as well as some small shift in the

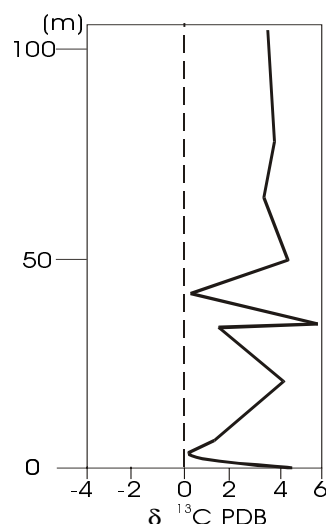


Figure 2. C-Isotope chemostratigraphic profile of the Meso-Neoproterozoic Araticum complex. (Isotopic data after Sial et al., 2000).

top, were found (Fig. 3a). In the Jacoca Formation a 300m thick carbonate sequence was studied and 31 samples collected. The $\delta^{13}\text{C}$ values vary between -6,4 and -2,8 ‰ PDB with a mean of -4 ‰ PDB (Fig. 3b). The $\delta^{13}\text{C}$ record of the Acauã and Jacoca formations confirm the contemporaneous age proposed by Silva Filho et al. (1978). The Frei Paulo Formation, is currently considered as the result of facies lateral variation of the Jacoca Formation and present carbonates stratigraphically overlaying the latter formation. The $\delta^{13}\text{C}$ values obtained by Sial et al. (2000) vary from +3 to +8 ‰ PDB and from -9 to -6 ‰ PDB, suggesting that they are postglacial cap carbonates.

The Olhos d'Água Formation is overlaying diamictite sediments of the Palestina Formation. 130 samples were collected by Sial et al. (2000) in discontinuous marble outcrops, covering the whole sequence from the contact with the diamictite to the Pinhão anticline. The $\delta^{13}\text{C}$ values oscillate between -7 ‰ and -1 ‰ PDB, at the base, and shift to values around 0 and -1 ‰ PDB , and then shift to values as high as 10 ‰ PDB at the top (Fig. 3c). These $\delta^{13}\text{C}$ characteristics as well as the underlying diamictite led Sial et al. (2000) to propose a post glacial origin (cap carbonates).

The composition of the $\delta^{13}\text{C}$ values obtained in the AT (Fig. 2) with the general C-isotope secular variation curve proposed by Kah et al. (1999) (Fig. 4a), suggests that the AT deposition time interval spans from the late Mesoproterozoic to early Neoproterozoic. According to Silva Filho and Torres (2002) this sequence deposited in a rift-like basin and its chronostratigraphic correlation with the CC is plausible given that the latter is intruded by Cariris Velhos orthogneiss (0.98 Ga).

Given that the MA is not intruded by the Cariris Velhos orthogneiss (0.98 Ga) but by some leucogranites of 0.76 Ga age (Rb-Sr) (Amorim, 1995) the age for the deposition of this complex can be restricted between 0.98 and 0,76 Ga. The presence of the 0.76 Ga leucogranites characterizes the first NW trending deformation event

that affected this group. (Dextro et al., 1993; Silva Filho, et al., 2002).

Figures 3b and 3c show the $\delta^{13}\text{C}$ curve for the Jacoca and Olhos d'Água formations. Comparing these curves with the curve in figure 4, Sial et al. (2002) proposed the ages 0.74 and 0.72 Ga respectively for these groups, and that they registered the Sturtian glaciation in the Brazilian shield. The age of the Canindé Complex (0.748 Ga – K-

Ar) (Bezerra et al., 1992), as well as the anorogenic environment assigned by Oliveira & Tarney (1990) allow to the statement that there probably were some extensional movements coeval with the deposition of the Ribeirópolis Formation. Figure 4b shows the strong correlation between the stratigraphy of the Otavi Group in Namibia (Hoffman et al., 1998a,b) and the stratigraphic units in the SFB.

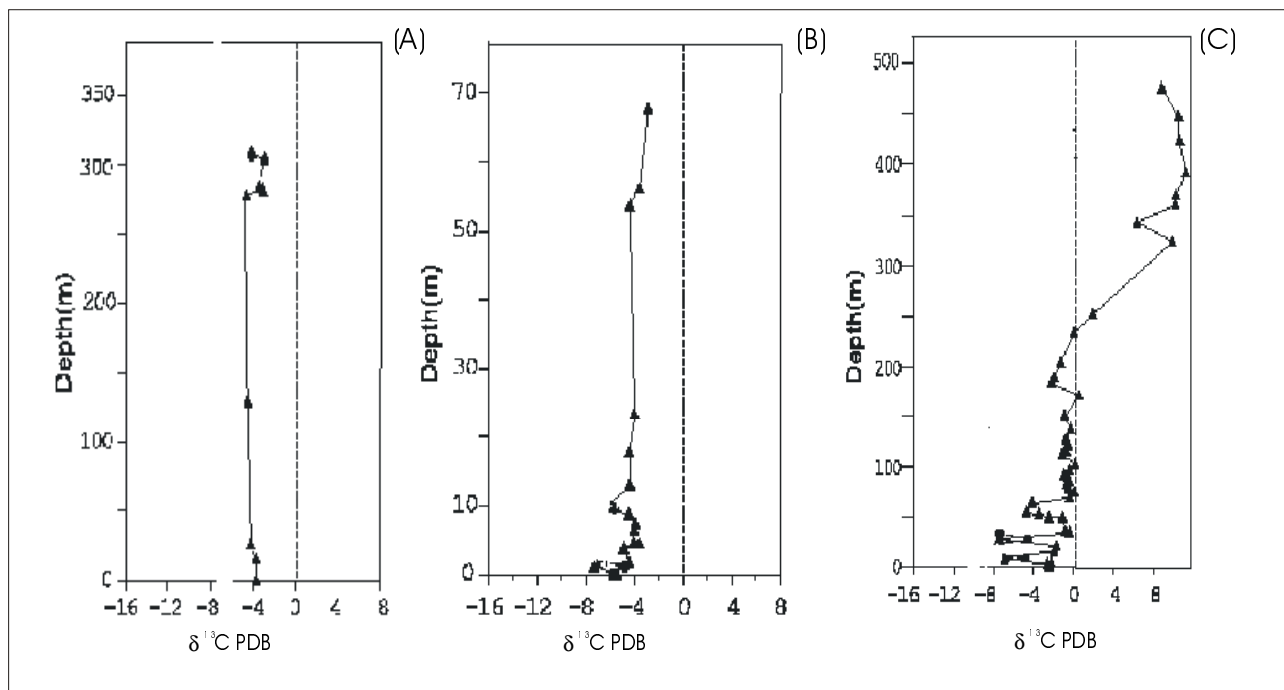


Figure 3. C-Isotope chemostratigraphic profiles of some Neoproterozoic sequences in the Sergipano Belt. (a) Acauã (b) Jacoca (c) Olhos D'Água. (Sial et al., 2000).

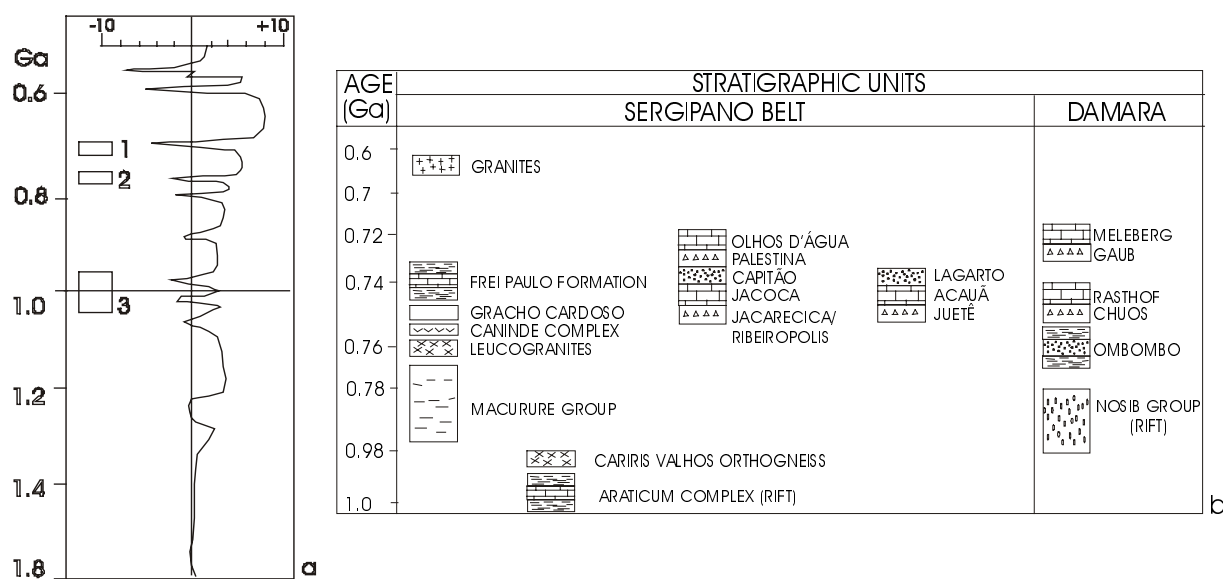


Figure 4. (a) Meso-Neoproterozoic C-isotope secular curve (After Kah et al., 1999) 1. Olhos D'Água 2. Jacoca 3. Araticum. (b) Stratigraphic framework for the studied sequences (Sergipano belt) and other coeval sequences (Damara belt).

CONCLUSIONS

The C-isotope data of carbonate (limestone/marble) sequences are useful for the delimitation of depositional intervals. Based on the data published by Sial et al (2000) and other published radiogenic data, it was possible to propose a stratigraphic framework for some units located in the Sergipano fold belt as follow:

- a- The Araticum Complex not only represents Neoproterozoic ages but late Mesoproterozoic to early Neoproterozoic ages.
- b- The Jacoca and Olhos d'Água formations were deposited at 0.74 and 0.72 Ga, respectively.
- c- It is suggested that the Jacarecica diamictites were diacronic with some spreading movements (an-orogenic) registered in the Canindé Domain, which are represented by the stratified gabbroic Canindé Complex.
- d- It is proposed that in the Macururé Domain not only exist present metasedimentary rocks from the Macururé Group (0.98 and 0.76 Ga), but also metasedimentary rocks from the Ribeirópolis Formation.

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