EXTENDED ABSTRACTS

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Crustal evolution of the São Francisco craton, Brazil, from Sm-Nd model ages

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INTRODUCTION

Nd isotopic data are used to calculate model ages that record the time at with crustal rocks separates from their source in the depleted upper mantle. On this basis it could be argued that TDM model age is a good procedure to asses the origin and early evolution of the Earth's continental crust.

For the S. Francisco craton, the first Sm-Nd model age is reported by (8). Other Sm-Nd results are included in several studies, such as, (11), (2), (7) and (10).

GROWTH OF THE S. FRANCISCO CRATON

The São Francisco Craton (SFC), defined by (1), is completely surrounded by Neoproterozoic mobile belts of the Braziliano orogenic cycle.The SFC area considered in fig. (1) has about 700,000 Km^2. Most of the SFC is covered by the Neoproterozoic chemical clastic sedimentary rocks. Archaean and Lower Proterozoic basement are well exposed mainly in the northern part of the SFC (Bahia State), and in a small window in the southern part (Quadrilátero Ferrifero -Minas Gerais).

The geological and geochronological setting of the SFC has seen revised by (3), (5) and (9). Sato (1986) reported the interpretation of the crustal evolution of the ancient terrain of the northern part of this craton, based mainly in Sr evolution diagrams. These Sr evolution diagrams indicated that the Archaean terrains are mainly formed by accretion of mantle derived material, but some crustal reworking is indicated by high initial $^{87}Sr/^{86}Sr$ values of the Jequié Complex. The Salvador-Juazeiro Transamazonian mobile belt includes both types of materials, but the initial $^{87}Sr/^{86}Sr$ values, generally lower than that the Jequié Complex, seems to plecude a direct derivation. During Middle and Late Proterozoic , the continental crust was already well consolidated, and reworking of crustal material predominated in the Espinhaço folded system, as well as in the Brasiliano mobile belts surrounding the SFC.

Figure (2) is based on Sm_Nd model ages dates from several references, indicated in Table(1). The main periods of crustal growth in the SFC are immediately evident between 3600-2800Ma. with about 84% in volume. In the interval among 2800 until 2200 Ma intense crustal reworking occur, but also followed by new additions around 14% in volume.

After 2200 Ma. until today, that rate of crustal accretion in the SFC decreases and no more juvenile additions to the crust directly from mantle sources were detect.

This pattern is quite different in comparison with others areas of the Brazilian Shield that just about 45% of the present continental crustal were formed at the end Archaean, and 80% at the end of the Early Proterozoic Transamazonian orogeny (4).

The ε(Nd) is used as tracers in planetary evolution. This parameter indicates the deviation of the $^{143}Nd/^{144}Nd$ value of sample from that of Chondritic Uniform Reservoir (CHUR). The MORB have ε (Nd) of about +10 with a standard deviation of about 1.5, (6). These mantle reservoirs, by virtue of their positive ε(Nd) values, this implies that the light REEs are depleted relative to the heavy REEs in the mantle.

The ε(Nd) versus crystallization ages are used to define evolutionary paths for the crust in the area. In the area studied the majority of the ε(Nd) for time emplacement indicated negative values. This indicates a certain time of crustal residence for the source material or re-melting from pre-existent rocks (7).

TABLE (1)

	AREAS/DOMAINS	TDM(Ma.)	εNd(t)	t(Ma)	N^{O}.	ref.
a	Laje-Mutuipe (Jequié Complex=JC)	2920-3500	-0.5/-3.7	2700	8	11
a	Mutuípe-M.Vitorino (JC)	2900-3110			3	8
a	Maracás (JC)	3180-3390	-2.7/-4.9	2700	4	7
a	Moenda (JC)	2810			1	8
b	Ubaitaba-Gandu (Salv.Juaz. M. belt)	2400-2900	+1.4/-10	2150	7	2
c	Boa Vista (Contend.-Mirante Comp.)	3452-3500	-0.9/-2.1	3350	7	7
c	Boa Vista (Cont.-Mir. Complex=CM)	3600			1	8
d	Lagoa do Morro (CM)	3354-3560	-1.9/-3.8	3200	2	7
d	Pé de Serra (CM)	3110-3180	-3.3/-4.4	2250	4	7
d	Rio Jacaré (CM)	3060-3400	-3.3/-6.0	2500	3	7
e	Rio Capim (northern part of SFC	3500	-4.5	3000	1	*
e	Piripá (Gavião Block)	2800-3370			3	*
e	Minas Gerais-(southern part of SFC)	2800-3000	+0.0/-3.0	2750	6	10
f	Jequié Complex	2600-3300			7	11
f	Contendas - Mirante Complex	2400-3460			34	7
f	Rio Capim	2200			1	*

a=granulite facies terrain; b=granulites, charnockites, migmatites and gneiss;c=tonalite (basement); d= plutons -(intrusive rocks); e = granitic, gneiss, and migmatitic terrain; f = supracrustal; * = this work; N^{O}.=. number.of determinations; t= Rb-Sr crystallization ages

REFERENCES

(1) Almeida, F.F.M - 1967 - Origem e Evolução da Plataforma Brasileira, Bull. Dep. Nac. Prod. Min. Div. Geol./ Min., R.J.; 241:36pp

(2) Barbosa, J.S.F. - 1990 - The granulites of the Jequié Complex and Atlantic mobile belt, Southern Bahia, Brazil - An expression of Archaean Proterozoic Plate convergence. Granulites and Crustal Evolution. Edited by D. Vielzeuf , Ph. Vidal Proc. of ARW, Clermont Ferrand (France), 1988-1990, 585 p. Springer - Verlarg.

(3) Cordani, U.G. and Brito Neves,B.B. de - 1982 - The geologic evolution of South America during the Archaean and Early Proterozoic. Rev. Bras. Geosc. 12(1-3):78-88.

(4) Cordani U.G.; Teixeira,W.; Tassinari, C.C.G.; Kawashita , K.; Sato, K. - 1988 - The Growth of the Brazilian Shield. Episodes . V11(3) p 163-167.

(5) Cordani, U.G.; Sato, K.; and Marinho,M.M., 1985. The geologic evolution of the ancient granite-greenstone terrain of central-southern Bahia, Brazil. Precambrian Res. ,27:187-213

(6) DePaolo, D. J. - 1988 -Neodymiun Isotope Geochemistry. Springer - Verlag, 187pg

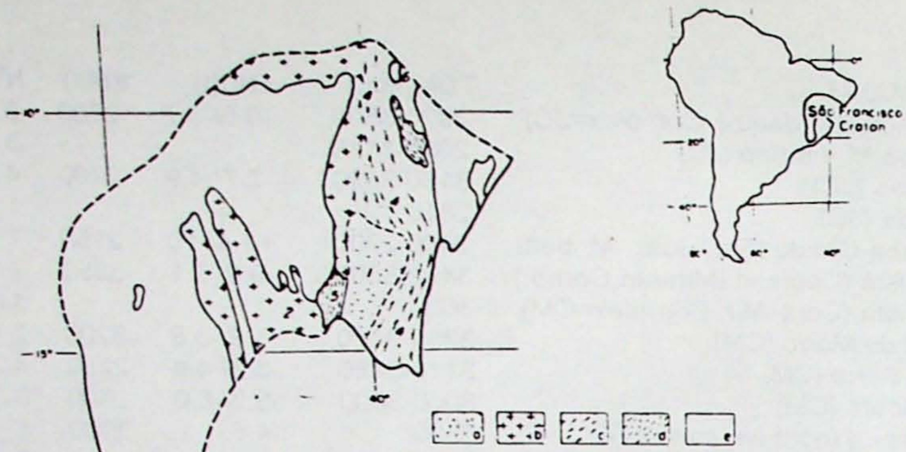
(7) Marinho, M.M -1991 - La sequence Volcano-Sedimentaire du Contedas-Mirante et la Bordure Ocidentale du Bloc Jequié (Craton du S. Francisco, Brésil) : Un exemple de transition archeen-proterozoique.- Doct. Thesis (unpublished).

(8) Sato, K. - 1986 - Síntese geocronológico do Est. da Bahia e evolução crustal, com base no diagrama de evolução do Sr e razões iniciais 87Sr/86Sr. Master Thesis.(unpublished). Inst. de Geoc. - USP, 214 pg.

(9) Nutman, A.P. and Cordani U.G., SHIRIMP U-Pb zircon Geochronology of early Archaean gneiss, S. Francisco Craton, Brazil. Precambriam Research (in press).

(10) Teixeira, W.; Carneiro, M.A.; Noce, C.M.; Machado, N. and Sato, K. - 1994 Pb, Sr and Nd isotope constraints on the Archean evolution of gneiss- granitoid complex in the Southern S.Francisco Craton, Brazil. Precambrian Research (submitted).

(11) Wilson, N. - 1987 - Combined Sm-Nd, Pb-Pb and Rb-Sr geochronology and isotope geochemistry in polymetmorphic Precambriam terrains examples from Bahia, Brazil and Channel Island, U.K-.Master Thesis (unpublished), Oxford Univ., U.K.



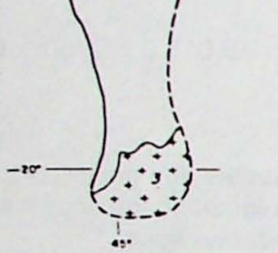


Fig. (1): S. Francisco Craton map showing areas with dating in Sm-Nd model ages. a=granulite facie terrain, b = granitic-gneiss-migmatitic terrain, c = granulites, charnockites migmatites and gneiss, d=supracrustal belts, e= Phanerozoic, Brazilian and pre-Brazilian cover. 1 = Jequié Complex, 2 = Gavião Block, 3 = Minas , 4=Salvador -Juazeiro mobile belt, 5 = Contendas-Mirante Complex, 6 = Rio Capim. (simplified map adapted from Cordani and Brito Neves (1982).

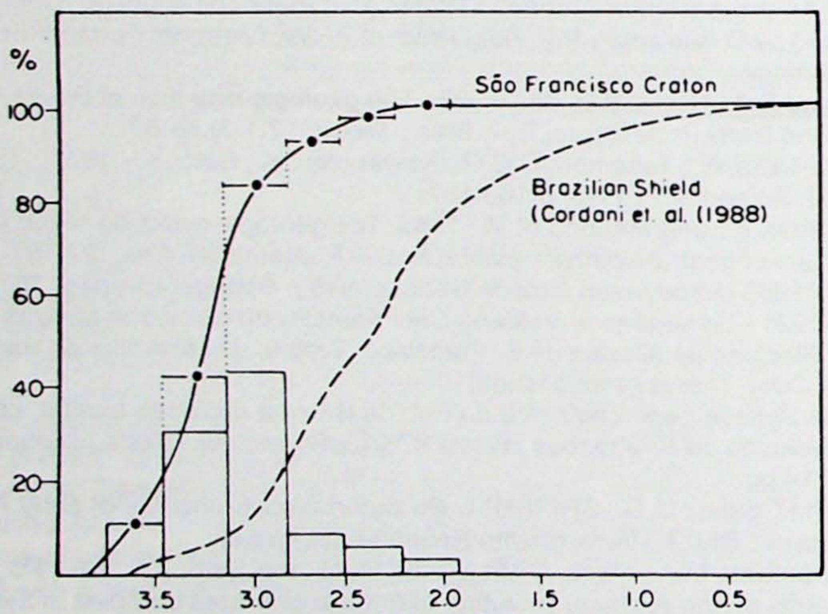


Fig. (2): Histogram and cumulative curve showing the growth of the continental crust of the São Francisco Craton