

K-Ar, Rb-Sr and Sm-Nd geochronology of the Proterozoic mafic dyke swarms of the Southern São Francisco Craton, M.G., Brazil.

Chaves, A.O.¹; Teixeira, W.²; Gonzalez, C.¹ & Correia Neves, J.M.³

¹ Depto. Geologia Geral - Graduate student/Instituto de Geociências - USP, Brazil

² Depto. Geologia Geral - Instituto de Geociências - USP, Brazil

³ Depto. Geologia - Instituto de Geociências - UFMG

Cutting archean and paleoproterozoic terrains in the southern part of the São Francisco Craton, one finds at least two proterozoic mafic dyke swarms². They don't cut the Bambuí neoproterozoic platformal cover (fig.1).

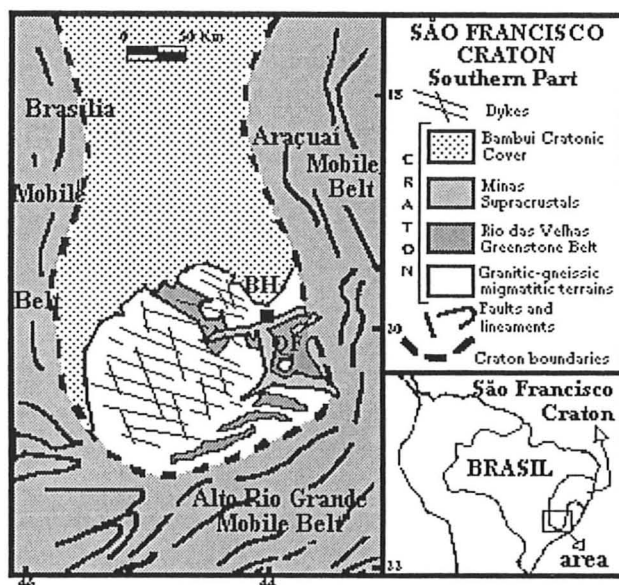


Figure 1: Mafic dyke swarms of the southern São Francisco Craton. BH - Belo Horizonte city, QF - Quadrilátero Ferrífero.

The oldest swarm intruded into transtensional sections of ductile transcurrent shear zones (TSZ). These TSZ, most of them striking N10-30W, were originated at the end of the Transamazonian Cycle as a result of a SE to NW regional compression. These syntectonic dykes trend parallel to the TSZ (have widths around 30m and maximum length of 30Km). They are metamorphosed on high amphibolite facies and display sheared margins, the last ones recording the horizontal movements along these TSZ after magmatic consolidation of dykes. They are classified as primitive continental tholeiitic basalts (Mg# 40-55, La/Yb 1.4-3.0).

K-Ar data for these dykes⁶ yield results around 2000 Ma and confirm their genetic relationship with the Transamazonian activity.

Table 1: K-Ar ages on amphiboles of some metamorphosed dykes of the southern São Francisco Craton.

SAMPLE/LAB NUMBER	% K	AGE (Ma)
1173-936/5892	0.2239	1845.8 +/- 26.3
1173-1060/5903	0.5045	2054.4 +/- 37.1
WT-MP-03/6197	0.4763	2004.6 +/- 25.6
WT-MP-05/6244	0.6628	1995.1 +/- 30.9
6322/6257	0.4356	2115.9 +/- 45.9

Geochemical data indicate tholeiitic to slightly alkaline characteristics, being more evolved (Mg# 32-43, La/Yb 5.0-6.9) than the metamorphosed dykes. Their intrusion relates to magmatic fracturing under extensional setting.

Nine from thirteen K-Ar radiometric data on plagioclase for these igneous dykes point out dates between 750 and 1000 Ma (table 2). The four others are between 550 and 670 Ma, probably indicating variable argon loss due to tectonic reactivations in the cratonic inner caused by the development of neighboring Neoproterozoic mobile belts. An age K-Ar on amphibole of 1000 Ma for one of these dykes that cuts the Bonfim Complex lacates southward from the investigated area also exists¹. The existence of basic dykes and sills dated at 906 +/- 2 Ma (U-Pb on badelleyite and zircon⁴) in the nearby Espinhaço region seems to suggest a possible correlation between them.

Table 2: K-Ar ages on plagioclase of some igneous dykes of the southern São Francisco Craton.

SAMPLE/LAB NUMBER	% K	AGE (Ma)
ESM1/7435	2,5142	551,0 +/- 6,5
CON7/7436	2,7229	665,0 +/- 8,4
PM-23/5962	2,7274	640,4 +/- 9,1
WT-MP-11/6199	2,2716	672,7 +/- 15,8
WT-MP-07/6139	2,2068	750,3 +/- 8,7
WT-MP-02/6127	2,2091	756,6 +/- 9,6
PM-03/5937	2,8549	810,4 +/- 18,3
6315/6217	2,3226	844,2 +/- 11,1
PM-11/5936	2,6179	853,8 +/- 16,6
6301/6250	2,3015	858,8 +/- 12,1
6283/6258	0,8522	865,7 +/- 11,3
PM-08/5964	2,2059	900,8 +/- 13,4
WT-MP-13/6198	3,5893	988,4 +/- 14,8

Seventeen whole rock Rb-Sr radiometric data have been obtained for these dykes (table 3). When plotted on a ⁸⁷Rb/⁸⁶Sr x ⁸⁷Sr/⁸⁶Sr diagram, they show a pronounced scattering, reflecting isotopic disturbance interpreted to be related to the Neoproterozoic tectonism. This disturbance certainly point out the opening of the Rb-Sr system and, therefore, become it in an unreliable radiometric method.

Table 3: Whole rock Rb-Sr radiometric data for selected igneous dykes of the southern São Francisco Craton.

SAMPLE/LAB NUMBER	Rb ppm	Sr ppm	⁸⁷ Rb/ ⁸⁶ Sr	⁸⁷ Sr/ ⁸⁶ Sr
15AL/13133	177,0	400,5	1,2840 +/- 0,0360	0,747210 +/- 0,000110
16AL/13134	144,6	379,6	1,1060 +/- 0,0310	0,743880 +/- 0,000150
60AL/13135	127,6	353,0	1,0480 +/- 0,0300	0,725830 +/- 0,000080
75AL/13136	82,8	389,1	0,6170 +/- 0,0170	0,723490 +/- 0,000180
MG109TEX/12972	104,3	287,6	1,0511 +/- 0,0300	0,725930 +/- 0,000070
MG82TEX/12973	57,5	629,2	0,2648 +/- 0,0039	0,712690 +/- 0,000070
CON-12/12976	66,5	299,6	0,6430 +/- 0,0180	0,716560 +/- 0,000090
CON-17/12974	40,5	414,3	0,2835 +/- 0,0040	0,715620 +/- 0,000080
CON-26/12977	69,0	422,0	0,4740 +/- 0,0130	0,722020 +/- 0,000070
CON-35/12975	27,0	521,6	0,1502 +/- 0,0021	0,721400 +/- 0,000060
ESM-3/12978	132,2	300,3	1,2760 +/- 0,0360	0,722250 +/- 0,000090
ESM-6/13016	83,1	300,2	0,8030 +/- 0,0230	0,727800 +/- 0,000070
ESM-8/12979	71,4	334,7	0,6180 +/- 0,0170	0,720780 +/- 0,000080
WTMP02/10687	50,5	492,0	0,2970 +/- 0,0080	0,720180 +/- 0,000070
WTMP13/10689	86,0	537,5	0,4640 +/- 0,0130	0,721010 +/- 0,000070
6301/11237	34,2	421,8	0,2347 +/- 0,0011	0,719990 +/- 0,000110
6315/11204	47,0	324,0	0,4077 +/- 0,0110	0,714300 +/- 0,000070

The dykes of the youngest swarm trend N50-70W preferentially and have widths between 5-100m and some of them more than 100Km length. They are unmetamorphosed, i.e., preserve igneous mineralogy and textures (ophitic to subophitic), but display alteration processes (saussuritization).

Six whole rock Sm-Nd radiometric data were also obtained for the dykes already investigated by the Rb-Sr geochronology (table 4). When plotted on a $^{147}\text{Sm}/^{144}\text{Nd}$ x $^{143}\text{Nd}/^{144}\text{Nd}$ diagram, the linear arrangement fails and an isochronic age can't be obtained. Except for the latter sample (MG81TEX), ϵNd values calculated to 0,91 Ga (age U-Pb for the dykes in the Espinhaço area⁴) are very negative. This probably means that dyke's magma originated from lithospheric mantle or assimilated the archaean wall rocks.

For these five samples, model ages seems to point out a Transamazonian minimum age for the dyke source.

Sample MG81TEX yields isotopic signature different from the five others, as indicated by the positive ϵNd value (for $t = 0,91$ Ga). This last feature is similar to the dykes that cut the Espinhaço system³.

Table 4: Whole rock Sm-Nd radiometric data, ϵ and T DM values for some igneous dykes of the southern São Francisco Craton.

SAMPLE/LAB NUMBER	Sm ppm	Nd ppm	$^{147}\text{Sm}/^{144}\text{Nd}$	$^{143}\text{Nd}/^{144}\text{Nd}$	ϵNd (0 Ga)	ϵNd (1.71 Ga)	ϵNd (0.91 Ga)	T DM (Ga)
ESM-6/529	8.105	37.906	0.130096	0.51164	-19.5	-5.2	-11.9	2,438
CON-26/530	6.521	29.526	0.134381	0.51147	-22.7	-9.3	-15.6	2,835
WTMP02/545	8.430	39.247	0.126496	0.51161	-20.1	-4.9	-12.0	2,392
WTMP13/546	12.800	72.150	0.124709	0.51186	-15.1	+0.5	-6.8	1,952
6301/547	10.114	48.650	0.130703	0.51163	-19.6	-5.4	-12.0	2,464
MG81TEX/531	19.003	92.719	0.107946	0.51225	-7.6	-	+2.7	1,154

It's important to mention, however, a recently published U-Pb age of 1714 Ma for the Ibitiré Gabbro⁵, located at the Quadrilátero Ferrífero region, which seems to be demonstrating the existence of a Mesoproterozoic basic magmatism in the southern São Francisco Craton related to opening of the Espinhaço Basin. It's necessary to investigate whether this magmatism is expressed as a third dyke swarm within of the investigated region or whether the igneous dyke swarm mentioned in text has mesoproterozoic age (when calculated for $t = 1.71$ Ga, ϵNd values display variation between +0.5 to -9.3). This last possibility seems unlikely due to presented K-Ar ages around 1000 Ma.

References

1. Carneiro, M.A. *Tese Doutor.*, Inst.Geoc./Univ. São Paulo, 235p(1992)
2. Chaves, A.O. *Dissert.Mestr.*, Inst.Geoc./Univ. F. Min. Gerais, 102p(1996)
3. Dussin, T.M. *These Docteur.* Université D'Orleans. 177p. (1994)
4. Machado, N. et al. *Anais V Simp. Geol. M.G.* **10**: 171-174 (1989)
5. Silva, A.M. et al. Submitted to J. South American E. Sci. (1996)
6. Teixeira, W. et al. *XXXV Cong. Bras. Geol.*, **6**, 2870-2886 (1988)
7. Teixeira, W. et al. *XXXIX Cong. Bras. Geol.* **6**, 614-616 (1996)