

# Isotopic data on the Paleoproterozoic Mineiro belt, southern São Francisco Craton: a review

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## Geologic setting

The Mineiro belt (MB) lays in the southern sector of the São Francisco craton surrounding an Archean platform stabilized between 2.7 and 2.6 Ga (1,2). The MB evolved during the Transamazonian cycle. Early stages of the MB evolution are related to platformal sedimentation starting prior to 2.42 Ga (3). Syn to postectonic sedimentation, plutonism and metamorphism took place in the 2.2-1.9 Ga time span. Tectonism within the MB deeply affected the Archean crust inducing isotopic resetting and giving rise to gneissic domes (1,4,5,6).

The MB comprise a large area of reworked Archean basement including TTG gneisses and migmatites, greenstone belts and high-grade gneisses, intruded by many paleoproterozoic granitoid bodies. Paleoproterozoic supracrustal sequences are restricted to the Quadrilátero Ferrífero region and to a narrow belt linking the southwestern tip of the Quadrilátero Ferrífero to the Bonsucesso ridge.

## Sedimentary record

The sedimentary evolution of the MB was established based on dating of hundreds of detrital zircons (6). The Minas Supergroup sedimentary sequence records the change from platformal to synorogenic sedimentation. Deposition ages of the lower platformal sequence are constrained by the following data: the basal Moeda Formation contains zircons with minimum ages of ca. 2600 Ma (6), and marbles of the Gandarela Formation yielded a deposition age of ca. 2420 Ma (3). The scarcity of 2.6-2.4 Ga zircons is symptomatic of the absence of magmatic-metamorphic activity in that period of time (6). The upper unit of the Minas Supergroup (Sabará Formation) contains 2125 Ma zircon and the overlying Itacolomi Group contains zircon of ca. 2.06 Ga, identical to the ages of regional metamorphism (5,6). These units should represent a flysh-molasse deposit of the MB.

## Isotopic data on granitoid intrusions and petrogenesis

Granitoid intrusions form a string of bodies extending nearly 300 km westwards from the southern border of the Quadrilátero Ferrífero (fig. 1) and have isotopic ages between 2.2-1.9 Ga. The plutons are syn- to postectonic and constitute tonalitic and granitic calc-alkaline suites. A number of alkaline plutons occurs to the east and south of this magmatic arc (7). The plutons and the available isotopic data are:

1. *Alto Maranhão*: U-Pb analyses in zircon and sphene yielded an intrusion age of  $2124 \pm 2$  Ma (5). The pluton has a predominantly tonalitic composition and is well foliated. A mantelic derivation is indicated by a Sm-Nd model age (TDM) in the same range of the intrusion age and a positive  $\epsilon_{Nd} = 2.45$ .

2. *Ressaquinha*: This intrusion is mainly composed by poorly foliated rocks of granodioritic to tonalitic composition (8). A former Rb-Sr whole rock isochron (8) was recalculated by adding new data and yielded  $2010 \pm 52$  Ma (MSWD=9.43) with initial  $^{87}\text{Sr}/^{86}\text{Sr} = 0.7086 \pm 0.0006$ . Sm-Nd analyses defined a TDM=2.25 Ga and  $\epsilon_{Nd} = -1.66$ .

3. *Campolide*: A weakly foliated and locally porphyritic pluton with a Rb-Sr whole rock isochron of  $1998 \pm 97$  Ma (MSWD=1.91) and high initial  $^{87}\text{Sr}/^{86}\text{Sr}=0.7157 \pm 0.0018$ .

4. *Ritápolis*: This body is chiefly composed by a highly fractionated peraluminous granite with well preserved igneous texture (9). A preliminary Rb-Sr isochron yielded  $1863 \pm 44$  Ma with a very high initial  $^{87}\text{Sr}/^{86}\text{Sr}$  ratio. Sm-Nd model ages (TDM) between 3.3-3.1 Ga and very negative  $\epsilon\text{Nd}$  (-5.95/-6.95) indicate reworking of much older sialic crust.

5. *Itutinga*: A small intrusion similar to the Ritápolis granite. Sm-Nd analyses yielded a highly negative  $\epsilon\text{Nd}$  (-7.35) and a very old TDM=3.48 Ga.

6. *Alto Jacarandá*: A postectonic granitic intrusion cutting Archean high-grade gneisses (10). A Rb-Sr whole rock isochron for these rock yielded  $1900 \pm 108$  Ma (MSWD=3,95) with initial  $^{87}\text{Sr}/^{86}\text{Sr}=0.7096 \pm 0.0018$  (1).

7. *Tabuões*: The pluton has a trondhjemitic composition and is non-foliated (9). Two Rb-Sr whole rock isochrons are available:  $1932 \pm 20$  Ma (11) and  $2248 \pm 75$  Ma. The low initial  $^{87}\text{Sr}/^{86}\text{Sr}=0.7017$  coupled with a slightly positive  $\epsilon\text{Nd}=0.13$  (TDM=2.36 Ga) points to a mantelic origin.

8. *Lavras*: Is a granodioritic intrusion, weakly foliated (12). A Rb-Sr whole rock isochron for this pluton yielded  $1982 \pm 134$  Ma (MSWD=0.61) with initial  $^{87}\text{Sr}/^{86}\text{Sr}=0.7041 \pm 0.0017$  (1,12), and a Sm-Nd model age (TDM) of 2.41 Ga with  $\epsilon\text{Nd}=-2.12$  (13).

7. *Porto Mendes*: A large and mostly undeformed granitic batholith with well preserved igneous structures. Isotopic analyses of this intrusion yielded a Rb-Sr whole rock isochron of  $2200 \pm 175$  Ma (1), and a Sm-Nd model age (TDM) of 2.54 Ga with  $\epsilon\text{Nd}=-3.73$  (13).

8. *Alkaline plutons*: These bodies are possibly related to the Transamazonian event (7) as indicated by two Rb-Sr "errorochrons" of  $2030 \pm 352$  Ma (Matola complex) and  $2159 \pm 137$  Ma (Mercês-Ubaí complex). Further studies pretend to ascribe the alkaline magmatism to specific stages of the MB evolution.

### Metamorphism and cooling ages

U-Pb ages in sphenes from Quadrilátero Ferrífero gneisses define the peak of the Transamazonian metamorphism at  $2065\text{--}2035$  Ma (2,5). Metamorphic grade increases eastwards from the Bonfim complex, where sphene ages are Archean (14) to the Bação Complex where sphene U-Pb analyses are concordant at 2059 Ma (2). In the Belo Horizonte complex sphene analyses plot in a discordia line between 2860 Ma and 2041 Ma (5). East of the Quadrilátero Ferrífero the Transamazonian metamorphism reached granulitic grade (15). K-Ar amphibole ages in the MB as a whole range from 2.1 to 1.9 Ga and should have resulted from progressive uplift accompanying the belt stabilization. The great majority of K-Ar biotite ages shows partial to total resetting due to Meso and Neoproterozoic thermal events.

### Final remarks

A tectonic scenario for the MB evolution suggests a Late Archean passive margin evolving into an Andean-type margin and a continent-collisional belt. Mantle-derived tonalitic (trondhjemitic) plutons (Alto Maranhão and Tabuões) are 2.2-2.1 Ga and should be related to the consumption of the oceanic crust, marking the initial stage of the Transamazonian event (5). Collision should be completed around 2.0 Ga and syn- to postcollisional granites make up most of the magmatic arc. Sr and Nd data indicate that some of these plutons are derived by mixing of Transamazonian juvenile material and reworked Archean crust (Ressaquinha, Lavras, Porto Mendes). Others intrusions like Ritápolis and Itutinga plutons are essentially crust-derived.

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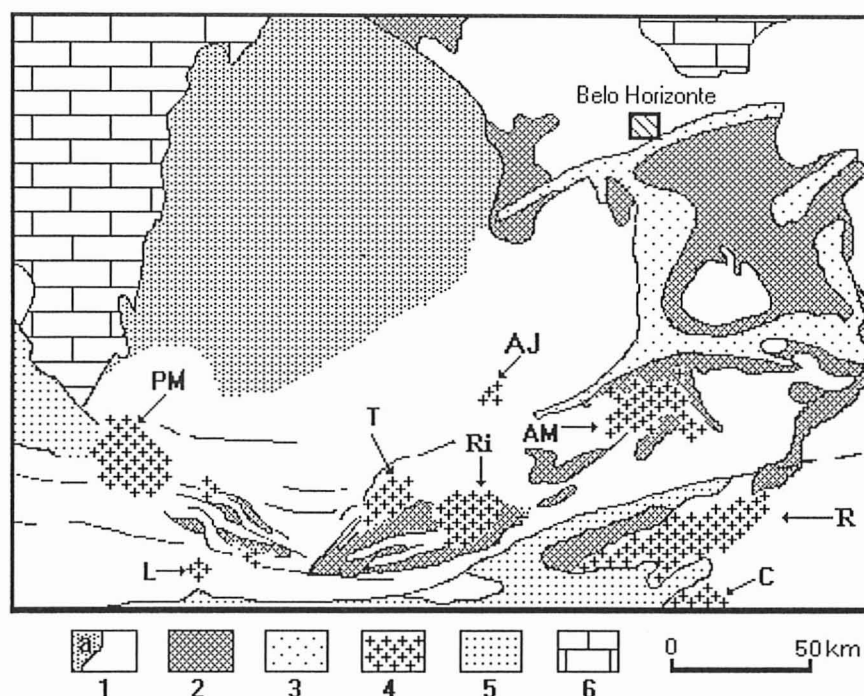


Figure 1. The Mineiro Belt and its granitic plutons (AM-Alto Maranhão, R-Ressaquinha, C-Campolide, Ri-Ritápolis, AJ-Alto Jacarandá, T-Tabuões, L-Lavras, PM-Porto Mendes). Legend: 1. Archean gneissic complexes (a-Archean cratonic area), 2. Archean greenstone belts, 3. Minas Supergroup, 4. Paleoproterozoic granitic plutons, 5. Araxá and São João del Rei groups, 6. Bambuí Group.