SSAGI

South-American Symposium
on Isotope Geology

Extended Abstracts

June 15-18, 1997
Campos do Jordão São Paulo Brazil

Geochronological interpretation in areas with complex geological evolution: The case of Piripá, central-southern Bahia, Brazil.

Cordani, U.G.[1]; Sato, K.[1]; Coutinho, J.M.V.[1] & Nutman, A.[2]

[1] Institute of Geosciences, University of São Paulo.
[2] Research School of Earth Sciences, Australian Nat. University.

Piripá and Tremedal (Bahia) are located near the northern limit of the so-called Araçuai folded belt, one of the main units of the Late Proterozoic Brasiliano orogenic cycle. Basement rocks occur, as an extension of the Archean granite-greenstone terrain of the Gavião block, covered by low to medium grade metasedimentary sequences, attributed either to the Brasiliano or to the Mid-Proterozoic Espinhaço Cycle (1,2).

A migmatitic gneiss from outcrop JM-BA-329 (samples A to J), located a few kilometers north of Piripá, was collected for geochronological work. The outcrop exhibits a banded structure, highly deformed in tight isoclinal folds. Several rock types are described, including amphibolites, plus different gneissic varieties

The amphibolites (samples G and J) are probable metabasites, made up essentially by hornblende and plagioclase, with some quartz. Epidote evidences hydrothermal alteration.

The gneisses exhibit always predominant quartz and plagioclase, plus subordinate biotite. Muscovite and epidote are present in minor amounts, and garnet was identified in a few samples. Microcline was one of the main constituints on samples B, D, E, F and I, but was unimportant or absent from samples A, C and H. The main metamorphic structure is given by the isorientation of lenses formed by biotitic aggregates. In addition, texture is granoblastic polygonal, resembling rock types formed in high grade environments, such as leptinites. However, mineralogy is typical of medium grade regional metamorphism, and microscopic evidences of retrogression were not found. From mineral composition and banded structure, a possible igneous origin of the protoliths is favoured, as a volcanic (or shallow plutonic) pile, formed by rhyolites (or syenogranites) to dacites (or tonalites).

The first geochronological results obtained for outcrop 329 were not directly interpretable. The Rb-Sr whole-rock samples analysed did not align in an isochron diagram, and they only indicated a very possible ancient original age for the protoliths. A K-Ar apparent age of 600 Ma. for amphibolite 329J (3) demonstrated the importance of metamorphic events at high temperature (at least 500 degrees) during the Brasiliano Cycle. A mineral isochron obtained for sample 329H (fig.1) confirmed the strong Late Proterozoic events, which redistributed radiogenic Sr among the minerals of the analysed sample.

A reexamination of the Rb-Sr whole-rock results (fig. 2) lead to the impression that the rock systems lost part of their Rb during an episode of chemical redistribution. For comparison, reference lines of 2000Ma. and 600Ma. were included in the diagram.

The Sm-Nd measurements on whole-rock samples, but also those on the separated minerals of sample 329H, produced a cloud in an isochron diagram (fig.3), indicating either a variety of source materials, or chemical disturbances during the evolution of the systems. The protoliths must be quite old, anyway, since the T_{DM} model ages vary between 2.9 and 3.5 Ga., and the reference line drawn in fig.3 indicates an "average" age of 3.23 Ga. Fig. 4 is a Sm-Nd evolution diagram, with a very conventional and simplified view of the $^{143}Nd/^{144}Nd$ evolution in closed systems, from material sources of different ages, but all in the range 2.9 to 3.5 Ga.

To help unraveling the complex history of outcrop 329, U-Pb SHRIMP analyses on isolated zircon grains were carried out for sample 329E, a gneiss of monzogranitic mineralogical composition. Zircon crystals from this sample are usually short prismas, about 100 microns long, light colored (yellow to orange) but with many dark metamictic portions. Some of them exhibit magmatic zoning, and some others show what appears to be an old nucleus. Most of the crystals have rounded edges, resembling zircon from high grade rocks. Eleven such grains were analysed at ANU, and their U content resulted very variable, between 350 and 1300 ppm.

The U-Pb results were included in Fig. 5, a Concordia diagram which suggests that all points were aligned along a discordia connecting roughly 2000 Ma. and 3200 Ma. The position of the points suggest some additional lead loss towards younger ages. Three of the analytical points (2, 6 and 9) were almost perfectly concordant to an age of 2008 +-12 Ma., that should be considered as one of the major events which affected sample 329E. Tentatively, we suggest that this Early Proterozoic age represents the high grade metamorphic event responsible for the rounded shape of the zircon crystals, and the polygonal texture os the gneissic samples.

In conclusion, the geochronological interpretation for the basement rocks of the Piripá area can be envisaged as follows:

1 - About 3200 Ma. - Formation of the igneous protoliths, as parts of the granite-greenstone terrain of the Gavião Block.

2 - About 2000 Ma. - High grade metamorphism, within an Early Proterozoic (Transamazonian) orogenic belt. Shaping of the rounded zircon crystals.

3 - About 600 Ma. - Medium grade metamorphism, within the Late Proterozoic Araçuai folded belt. Complete transformation of the main mineralogy, within amphibolite facies metamorphic conditions.

It is apparent that the Mid-Proterozoic Espinhaço orogeny, although important to the north (4) was not detected in the geochronological pattern of outcrop JM-BA329, possibly because metamorphic grade was low in the Piripá region. It is also quite evident that, if we want to establish a reasonably complete geologic history for a complex region, several geochronological methods shall be used, each one with its proper and very specific interpretative value, which depends on the relative mobility of the radioactive-radiogenic pair of isotopes during the evolutionary processes.

References:

1. Inda, H.A. V. and Barbosa, J.F. Mapa Geológico do Est. da Bahia SME, CPM (1978).
2. Cordani U.G., Sato,K. and Marinho,M.M. - *Precambrian Res.* **27**: 187-213, (1985).
3. Mascarenhas,J.F and Garcia, T. - Mapa Geocronológico Est. Bahia, Texto Explicativo, SME (1988).
4. Cordani, U.G.; Iyer,S.S; Taylor, P.N; Kawashita, K.; Sato, K. and McReath, I. - *J. S. Am. Earth Sci.* **5**, Nº1,33-46 (1992).

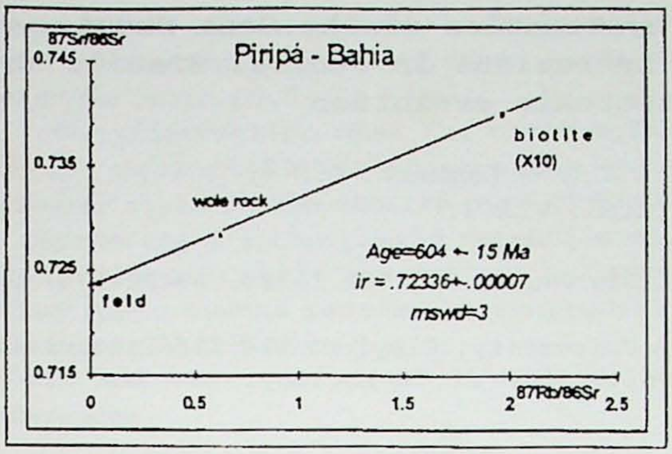

Fig. 1 - Rb-Sr mineral isochron for sample JM/BA 329H.

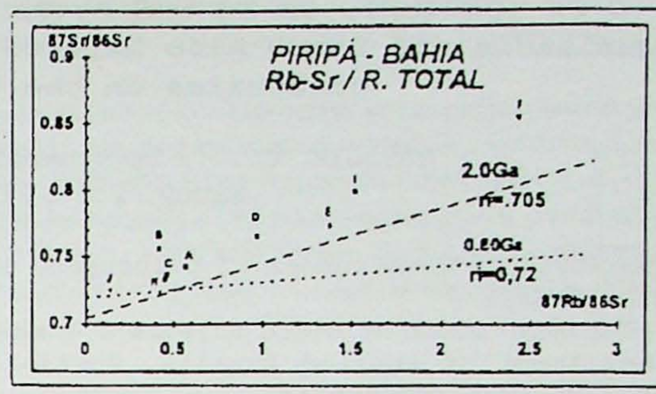

Fig. 2 - Rb-Sr wole rock diagram for the Piripá gneisses. Reference isochrons of 2.0Ga (IR=0.705) and 0.60Ga (IR=0.72) are shown for comparison.

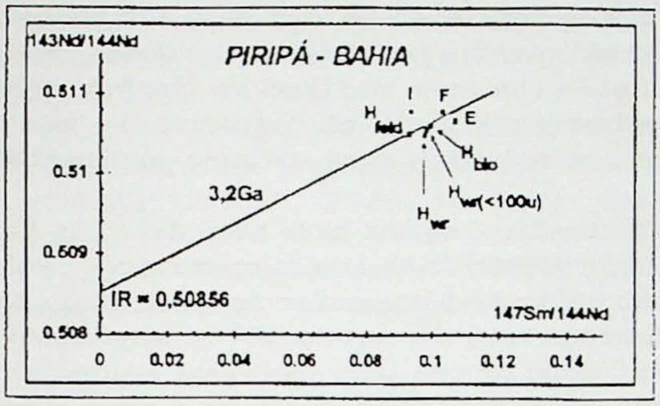

Fig. 3 - Sm-Nd isochron diagram. A reference isochron with 3.2Ga and IR=0.50856 (ε_{Nd}= +2.4) is shown.

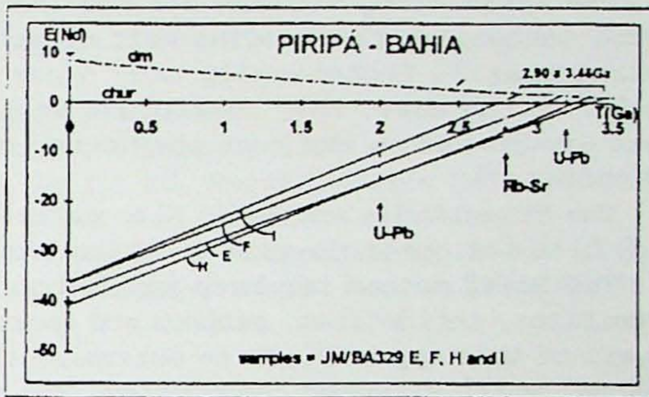

Fig. 4 - Sm-Nd evolution for Piripá gneisses, during geologic time.

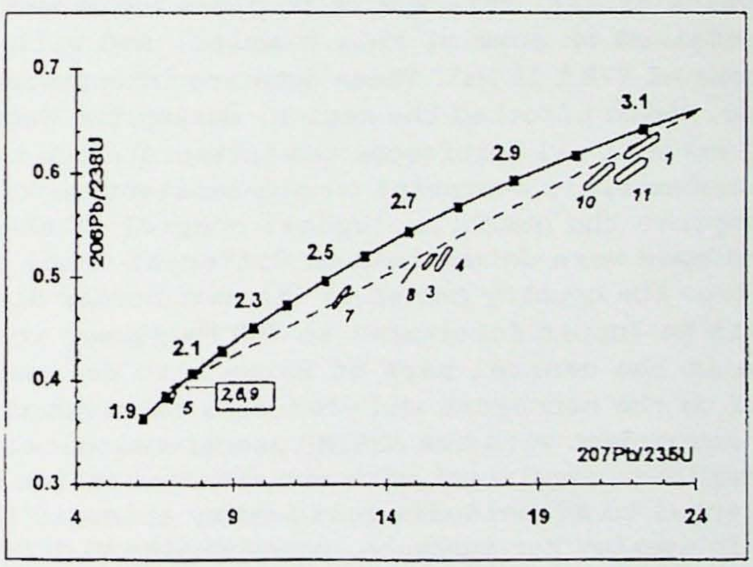

Fig. 5 - SHRIMP U-Pb concordia diagram for sample JM/BA 329E.
Numbers refer to individual zircon grains (1σ uncertainty boxes).