Geochronology of the Bahia Prospect copper deposit - Carajás Province - Brazil

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Introduction

The Bahia Prospect copper deposit is located 45 Km east of the "Serra dos Carajás" N4 iron deposit(Fig.1).The mineralization was discovered in 1974 by DOCEGEO SA mining company by stream sediment geochemical exploration,followed by soil geochemistry and further drilling(Fonseca et al.,1984).

Since the discovery,the deposit host rocks have been Known as metasediments and correlated to the Rio Fresco Formation of Early Proterozoic age(Hirata et al.,1982).Nevertheless,Ferreira Filho (1985) and Ferreira Filho & Danni(1985) have shown that the mineralization is hosted by a volcanic-sedimentary sequence, formed by silicic pyroclastic rocks,basic flows and sills,finely laminated sediments and banded iron formations.They also demonstrated a volcanic-exalative origin to the mineralization that is related to extensive zones of intense primary hydrothermal alteration and to the banded iron formation beds.

These new data have shown clearly that this volcanic-sedimentary sequence is not correlated to the Rio Fresco Formation. The geochronological research then initiated,had the principal aim to give a more realistic position of this sequence within the Carajás Mineral Province stratigraphy.

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Samples Selection

A careful petrographic study have been made to avoid samples that show the effect of the hydrothermal alteration related to the copper deposit.Samples with eye see venulation or high content of sulphides have been excluded.

Within the silicic pyroclastic rocks were chosen the most homogeneous one.These rocks are formed by quartz and feldspars crystals within a fine grained matrix of quartz,sericite and chlorite,with minor zircon.The SiO_2 content of these rocks are variable and rest between 60-73 wt%(Ferreira Filho & Danni,1985).

Small bodies of basic to intermediate granophyres are intrusive in the volcanic-sedimentary pile.These granophyric rocks are formed by saussuritized plagioclase,amphibole and a granophyric intergrowth of quartz and alkali feldspar,with minor chlorite and magnetite. The SiO_2 content of these rocks rest between 53-56 wt%.

Three faneritic metabasic rocks with well preserved ophitic to subophitic texture have been chosen for amphibole separation. These rocks are formed essencially by saussuritized plagioclase and a pale green pleocroic amphibole,with minor quartz,chlorite and magnetite. These rocks,with a SiO_2 content between 46-50 wt%,are spilitic basalts and dolerites.

Experimental Methods

All the determinations were made at the Centro de Pesquisas Geocronológicas of the University of São Paulo,Brazil. Suitable unweathered drill hole samples were selected after careful petrographic study.

The Rb-Sr analysis were carried out on whole rock material. Total Rb and Sr contents were measured by X-ray fluorescence. In addition,a mass spectrometric isotope-dilution technique was employed for rocks having low Rb and Sr contents.The analytical procedures were similar to those described by Kawashita et al. (1974).

The K-Ar analysis were carried out on amphiboles separeted from the metabasic rocks.These analysis used the techniques described by Amaral et al.(1966).

Results and Discussion

Seven silicic pyroclastic rocks from the drill holes of the Bahia Prospect area were selected for Rb-Sr isotopic analysis.The Rb-Sr isotopic data(Table I) when plotted on an isochron diagram (Fig.2),yielded an age of 2330 ± 60 Ma with an initial $^{87}Sr/^{86}Sr$ ratio of 0.715 ± 0.003.The not perfect colinearity of the isochron, probably due to the hydrothermal alteration and to the pyroclastic nature of these rocks,reduce the meaning of the age obtained,that must be regarded as a reference age for these pyroclastic rocks. The high initial $^{87}Sr/^{86}Sr$ ratio indicates a continental crust-derived melt to this magmatism.

Four basic granophyric rocks from a single intrusive body were selected for Rb-Sr isotopic analysis.The Rb-Sr isotopic data(Table I) plot on an isochron with an age of 2700 Ma and an irrealistic initial $^{87}Sr/^{86}Sr$ ratio of 0.695.An isochron diagram without the number 11 sample(Fig.3),yielded an age of 2577 ± 72 Ma with a more realistic initial $^{87}Sr/^{86}Sr$ ratio of 0.702.These data may be regarded as an approximate age of this intrusive body,and as a minimum age for the volcanic-sedimentary pile.The very low initial $^{87}Sr/^{86}Sr$ ratio indicate a mantle-derived melt to this magmatism.

K-Ar ages of amphiboles from two metabasalts and one basic granophyre were obtained(Table II).Two of the results are similar, with K-Ar ages of 2274 ± 67 Ma and 2268 ± 41 Ma,and may be regarded as a possible cratonization age for the "Serra dos Carajás" region. The other one gives a K-Ar age of 1587 ± 30 Ma and don´t have yet a definitive geological meaning.

Conclusions

Although not yet definitive, the geochronological data obtained point out to a late Archean age to the Bahia Prospect volcanic-sedimentary sequence. Regionally, these data show a chronological correlation of the Bahia Prospect Sequence with the Grão Pará Group of late Archean age(2758 ± 39 Ma U-Pb zircon age - Wirth et al.1986).

Recent works on the Grão Pará Group(Meireles et al.,1984;Gibbs et al.,1986;Meirelles,1986) have shown that, besides the thick unit of basalts and iron formations, this Group comprises a significant contribution of clastic sediments and acid volcanic rocks, which means that at least locally the Grão Pará Group and the Bahia Prospect Sequence have a similar volcanic-sedimentary pile.

The geochronological data obtained is also in agreement with the correlation of this area with the old cratonic nucleous of the Central Amazonian Province, as suggested by Cordani et al.(1984).

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Sample Number	Rock type	Rb (ppm)	Sr (ppm)	Rb/Sr	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
1	silicic pyroclastic	40.6	12.0	3.38	10.878±0.061	1.0916±0.0003
2	"" ""	89.7	9.4	9.54	29.673±0.102	1.6881±0.0004
3	"" ""	34.1	14.0	2.44	8.105±0.036	0.9964±0.0002
4	"" ""	41.5	10.2	4.07	13.098±0.039	1.1511±0.0004
5	"" ""	19.2	21.7	0.88	2.332±0.007	0.7904±0.0001
7	"" ""	53.9	20.5	2.63	14.895±0.115	1.2393±0.0012
8	"" ""	7.4	15.7	0.47	2.010±0.009	0.7893±0.0003
9	granophyre	66.4	98.2	0.68	1.970±0.055	0.7734±0.0002
10	"" ""	58.7	104.7	0.56	1.631±0.046	0.7617±0.0003
11	"" ""	128.0	46.8	2.73	8.170±0.224	1.0335±0.0003
12	"" ""	83.5	59.7	1.40	4.106±0.114	0.8529±0.0001

Table I - Rb-Sr whole rock data for the Bahia Prospect rocks.

Sample Number	Rock type	K(%)	Ar^{40} rad. ccSTP/gx10^{-6}	Ar^{40}atm (%)	age(Ma)
13	granophyre	1.274	125.97	3.63	1,587±30
14	metabasalt	0.682	120.73	32.73	2,274±67
15	metabasalt	0.634	111.75	8.58	2,268±41

Table II - K-Ar age data for amphiboles from the Bahia Prospect.

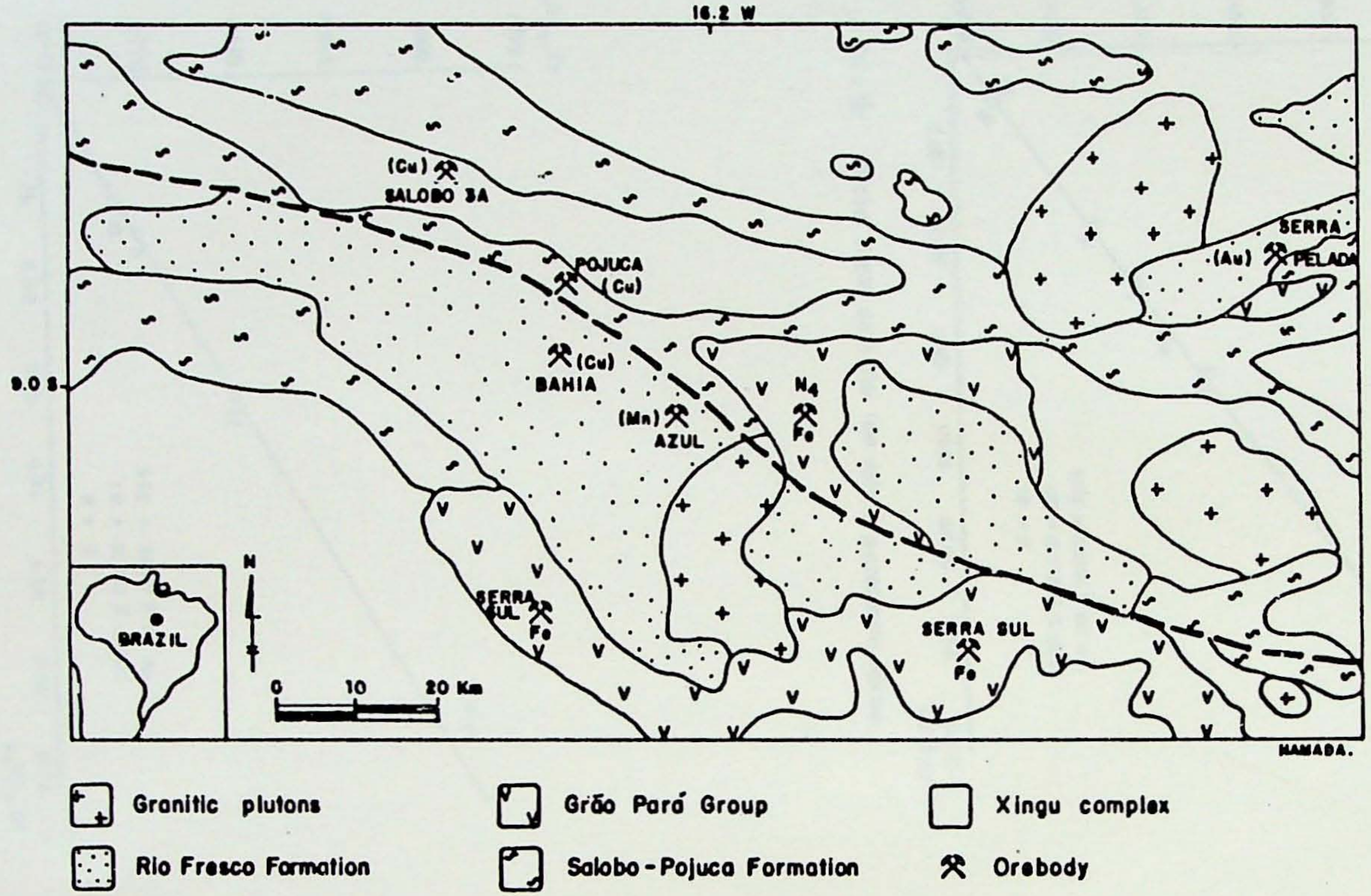

Fig. 1 _ Geology of Carajás Mineral Province (modified after Hirata et al., 1982).

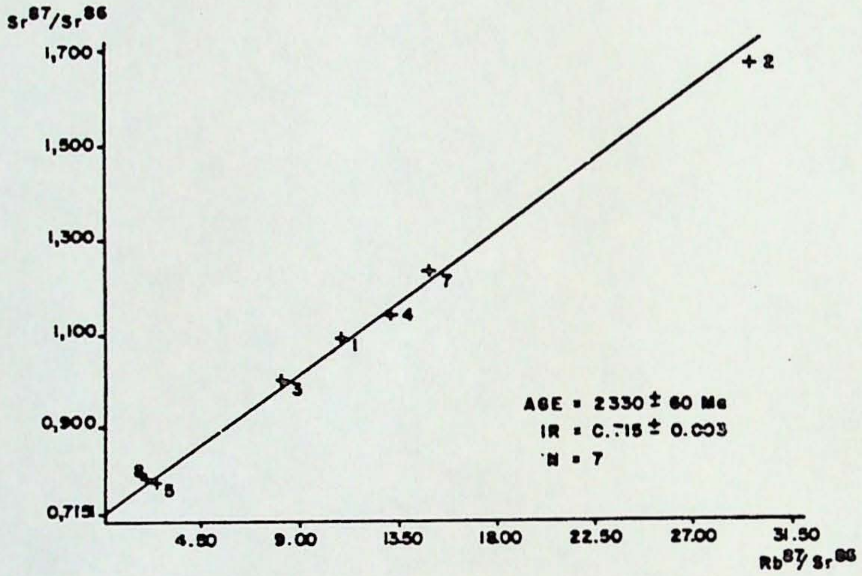

Fig. 2 _ Rb - Sr whole rock data for the silicic pyroclastic rocks.

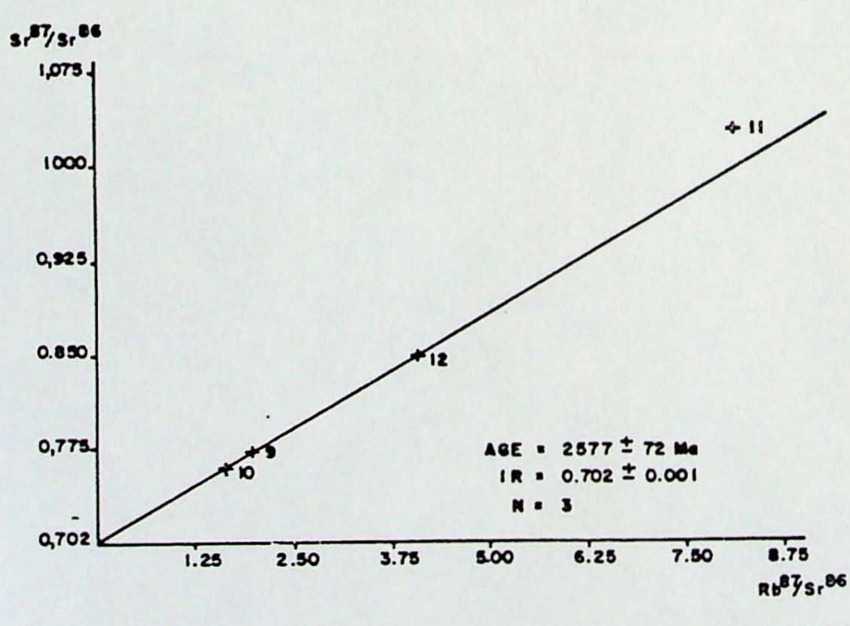

Fig. 3 _ Rb - Sr whole rock data for the granophyric rocks . Isochron was computed without sample 11.