Geol. Soc. Malaysia, Bulletin, 11, Dec. 1979; pp. 315–321.

Aspects of exploration for tin mineralization in the Amazon Region, Brazil

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Abstract: Tin and gold mineralisations are considered in the context of their geological setting in an area in the Rondonia Tin Province of the Amazon Region. Mineral investigation methods are outlined and maps illustrating the distribution of some anomalous target areas are provided. Preliminary controls are indicated. A possible anomalous xenothermal type of deposit, mineralogically correlatable to areas of similar mineralisation, is suggested.

INTRODUCTION

CPRM, Companhia de Pesquisa de Recursos Minerais, a semi-governmental mineral research and exploration organization, linked with the Mines and Energy Ministry, has the objectives of stimulating new discoveries and of intensifying the exploitation of Brazilian mineral resources. Besides this it provides financial support, assistance and technical cooperation with a view to promoting mineral exploration by private enterprise. Based on this principle, regional geological mapping, specific projects and detailed geological research is being made while several projects of the private sector are financed.

EMAL, Empresa de Mineracao Aripuana Ltda., is a private company conducting mineral exploration, principally for cassiterite and gold, in an area northwest of Mato Grosso State in the Rondonia Tin Province of the Amazon Region with CPRM aid. University of Brasilia, is giving special collaboration in the geological aspects and their correlation with possible mineralised units.

This report outlines the applied research methods used and the preliminary results obtained. At this stage it is found to be of interest only to present the geological and genetic aspects, without any other specific information.

MINERAL INVESTIGATION METHODS

Usually mineral investigation starts with a field geological reconnaissance and is followed by geochemical exploration. In a great number of areas in the Amazon Region, this normal sequence is not practical because the rocks are intensely decomposed in various localities and the dense vegetation, thick soil capping and weathering further hinder the compilation of a geological map. Most of the cratonic crustal area is also covered by younger geological formations and the characteristics of many ore deposits could not be observed. On account of the above factors, geological reconnaissance and geochemical sampling are normally carried out simultaneously.

A typical mineral exploration programme is conducted in two stages as detailed below:

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First stage:

1. Photogeological interpretation of the area with delimitation of lithological units to a scale 1:100,000;
2. Field reconnaissance both along channels and streams, and trails through forest zones;
3. Collection of samples, mainly from recent stream sediments and panned con-concentrates and outcrops;
4. Petrographic determinations;
5. Semiquantitative spectrographic analysis (30 elements) and atomic absorption determinations (for gold in stream sediments and panned concentrates) and other qualitative determinations;
6. Plotting of analysis data and delineation of geochemical anomalies;
7. Definition of target areas.

Second stage:

8. Geochemical, geophysical and detailed geological studies in target areas;
9. Excavation of pits and trenches where necessary;
10. Definition of possible mineralised areas;
11. Drilling in mineralised areas;
12. Ore reserve estimation;
13. Compilation of final report.

EMAL has concluded that the first stage results were encouraging for tin and gold exploration. Besides tin and gold, the geochemical data also indicated anomalies for lead, zinc, silver, molybdenum, bismuth and tungsten. The results permitted the selection of two target areas for the second stage exploration.

OUTLINE OF CRATONIC PRE-CAMBRIAN GEOLOGY

Geologically in the Pre-Cambrian cratonic domain, this 1,100 sq. km is represented by a sequence of rocks shown in the following provisional geological column:

CENOZOIC			ALLUVIUM
	P	UNIT "B"	— Fine to medium grained meta-arkosic sandstones (?)
	R		
	E	(?)	
		UNIT "A"	— Intrusive granites; sub-volcanic to plutonic rocks;
M		(1,000 my)	Granodiorites; diorites and quartz diorites and
I	C		quartz veins.
D	A		Fine to medium grained quartzitic sandstones
D	M		(?) with sub-ordinate banded ferruginous
L	B	(1,400 to	jaspilitic cherts, and meta-conglomerates.
E	R	1,900 my)	Predominantly volcanic and pyroclastic rocks
	I		such as rhyolites, dacites, andesites and por-
	A		phyrites. Mafic and ultramafic metavolcanic
	N		to plutonic rocks as metabasites, melagabbros, etc.
LOWER PRE-CAMBRIAN		(around 2,200 my)	Migmatites and granitic gneisses; granites.

Extensive fracturing, faulting, and circular structures characterise the structural features.

Based on these geological aspects it is possible that the great variety of volcanic rocks, granitic rocks, and the sedimentary unit consitutes a granite greenstone terrain that forms part of the Pre-Cambrian cratonic area.

The exposed Lower Pre-Cambrian consists of an assemblage of granitic components that has been subjected to more than one stage of granite remobilisation. Superposed on this sequence are the volcano-sedimentary greenstone accumulation (Middle Pre-Cambrian) characterised by a variety of mafic and ultramafic meta-volcanic and plutonic rocks followed by intermediate to acid volcanic rocks and an arenaceous assemblage consisting of quartzitic sandstones with subordinate banded ferruginous jaspilitic cherts, and meta-conglomerates.

In many places the Middle Pre-Cambrian has been extensively invaded and fragmented by the intrusion of a wide variety of granitic rocks.

Overlying the greenstone sequence are fine to medium grained arkosic sandstones derived from the disintegration of the acid igneous rocks with a granitoid texture.

All these geological aspects represent a preliminary interpretation, warranting further investigation.

PRELIMINARY RESULTS AND INTERPRETATIONS

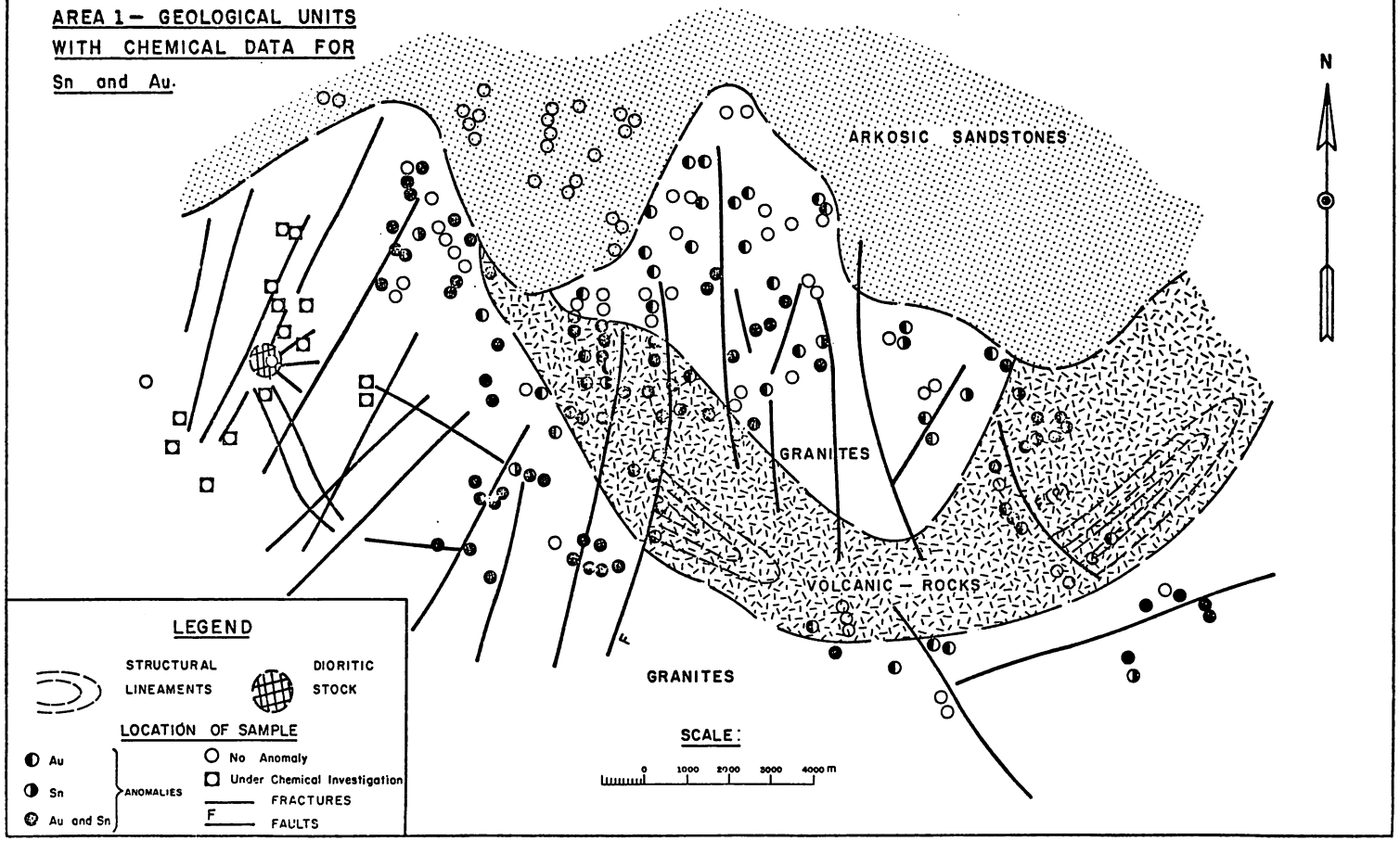
The results of the first stage exploration indicate two main anomalous areas with possible mineralisation.

Area 1: In this area (see map 1) the outcrops are relatively abundant and provide a more detailed account of the structural and lithological aspects. Photogeology, field reconnaissance and chemical data indicate the following:-

1. The effusive rocks are predominantly rhyolites, andesites, dacites, tuffs and quartz-porphyries;
2. The area has largely been granitized by potash-rich granites in which some phases are porphyritic in character;
3. Small stock of homogeneous massive diorite, intruding into granitic rocks, is identified. Radial fractures from this dioritic stock are visible;
4. Probable intrusion of granitic rocks resulting in a series of broad folds in the volcanic unit, encircle the granitic body, and produce tensional fissures;
5. Pyrite mineralisation is observed in quartz-filled dilatation fractures and faults (characterised by cataclastic zones);
6. Anomalous values of Au, Sn, Pb, Zn, W, Ag, Mo and Cu are registered in stream sediments and panned concentrates;
7. A great number of tin and gold anomalies occur in the volcanic sequence and granites. The majority of these anomalies are concentrated near fratures and faults;

MAP 1:

AREA 1 – GEOLOGICAL UNITS WITH CHEMICAL DATA FOR Sn and Au.



8. It seems that tin and gold-bearing quartz veins are controlled by structures produced by granite intrusions. The latter deformed the country rocks, into which they are intruded and themselves are often fractured and filled by quartz veins.

Thus mineralisation may extend from the greenstone remmants into the granitic rocks.

Area 2: In the second area (see map 2) the rocks are intensely decomposed and are covered by younger alluvial and elluvial formations that obscure greatly the geological aspects. However the following main geological features are indicated:-

1. The probable greenstone sequence is intruded by granodioritic and dioritic stocks in which some phases are porphyritic.
2. The ellipsoidal structures observed in aerial photographs probably represent the broad fold produced by underlying stocks in the volcanic unit. Fine to medium grained quartzitic sandstones, banded ferruginous jaspilitic cherts, and metalomerates overly the volcanic unit and Lower Pre-Cambrian rocks.
3. Anomalous values for Cr suggest that the above mentioned volcano-sedimentary sequence is characterised by a variety of mafic and ultramafic metavolcanic to plutonic rocks. Some outcrops of gabbros and mela-gabbros were observed.
4. The Lower Pre-Cambrian migmatites and granitic gneisses can be observed along the Madeirinha River. A small pyrite-bearing dioritic stock intrude this unit.
5. Two main faults are confirmed in the field by the presence of mylonites and tensional fissures.
6. Anomalous values of Au, Pb, Zn, Mo, W and Sn are registered in stream sediments and panned concentrates.
7. There are more gold anomalies than tin anomalies. The tin anomalies occur mainly in the northern circular structure comprising probably of granodioritic rocks.
8. The majority of these anomalies are concentrated near fractures or faults; the mineralisation, having similar characteristics as that of the first area, extends from the greenstone to intrusive rocks. It appears that tin mineralisation is associated with Na-rich granitic rocks.

CONCLUSIONS

The results thus far obtained proved to be very encouraging and further search for primary and alluvial tin and gold is warranted.

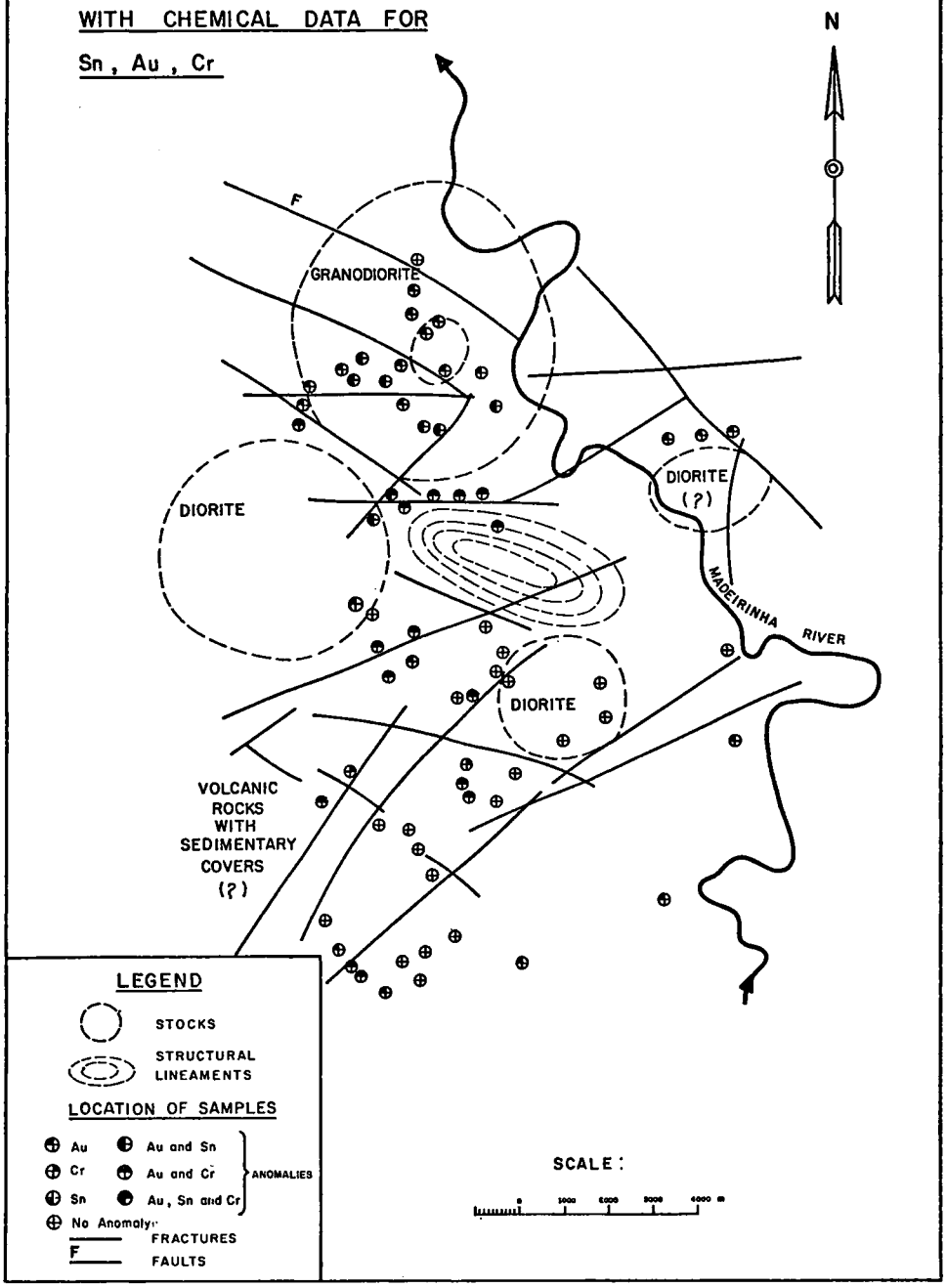
It is considered likely that mineralisation occurred in at least two periods with variable amounts of Pb, Zn, Cu, and Ag. The first is a volcanogenic metallogeny. In the second phase, granitic intrusion provided hydrothermal solutions rich in silica Sn, W and Mo remobilised from the volcanic environments into the fractures and faults. These probably indicate that the mineralisation is anomalous xenothermal type.

ACKNOWLEDGEMENTS

The authors wish to thank the Companhia de Pesquisa de Recursos Mineras and Empresa de Mineracao Aripuana Ltda. for authorising the publication of this paper.

MAP-2

AREA 2 GEOLOGICAL UNITS WITH CHEMICAL DATA FOR Sn , Au , Cr



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