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Hydrothermal gold occurrences hosted by middle to upper Proterozoic carbonate sequence: The example of Santa Rita prospect, Goias, Brazil

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ABSTRACT: The Santa Rita Prospec, is an example of sulfide-bearing quartz-carbonate vein type Au showing hosted by middle to upper proterozoic carbonate, psammitic and pelitic rocks of Paranoa Group. The gold grades of these veins vary between 0.1 and 10ppm, locally reaching 60ppm. Gold is hosted by As-Ni-Co bearing pyrites. The mineralization is structurally controlled by WNW-ESE high angle faults and fractures resulting from the reactivation of older NE-SW lineaments. Hydrothermal alteration is characterized by a diffuse albitization, carbonatization, silicification and pyritization associated to percolation of high to moderate saline fluids.

1. INTRODUCTION

The Middle to Upper Proterozoic Paranoa Group is in the domain of the Brasilia Belt of Tocantins Province, central-Brazil (Marini et al., 1984). This group is characterized by ten units grouped in two sequences: psamitic and pelitic (units A, B, C, D & E) and carbonate, psammitic and pelitic (units F, G, H, I & J).

The gold occurrences are distributed in areas where the carbonate, psammitic and pelitic Sequence, that have been metamorphosed to greenschist facies (up to biotite zone).

Mineralization is structurally controlled by faults and fractures resulting from reactivation of older NE-oriented lineaments, mainly associated with two tectonic zones: Rio do Carmo and Niquelandia (Olivo & Marini, 1988).

Two types of primary gold ocurrences are recognized:

1. Sulfide-bearing quartz veins enclosed in psammitic pelitic rocks (garimpos: Muquem, Foroca and Divino-Unit E and Garimpinho, Garimpo Novo and Chapadinha-Unit G).
2. Sulfide-bearing quartz-carbonate veins and veinlets in carbonate, psammitic and pelitic rocks of Unit F (garimpos: Rio do Carmo, Rio Passa Tres, Cachoeira and Santa Rita).

2. SANTA RITA PROSPECT

2.1.Geological setting

The area of Santa Rita includes upper unit E (rhythmic sequence of carbone-rich quartzite, phyllite and muscovite phyllite) and Unit F (rhythmic sequence of quartzite, quartz phyllite, muscovite phyllite lenses of metalimestone and metadolomites with calcophyllites at the top).

Four phases of folding are recognized. The first two phases are isoclinal. Planar axial schistosity is developped. The third phase comprises closed and frequently assymetric folds with N-S fold axes. The fourth phase has gentle open folds with axes oriented WNW-ESE. NNW and NE oriented fracturing and later WNW-ESE faults and fractures followed these folding events (Olivo, 1989).

2.2. Gold Ocurrence and hydrothermal alteration

Gold occurrence of Santa Rita is enclosed in pelitic, psammitic and carbonate rocks of Unit F. It is of vein-veinlet type, locally controlled by WNW-ESE high angle faults and fractures. These structures are thought to resulted from the reactivation of older NE-SW lineaments (Olivo e Marini, 1988). The thickness of these veins vary from few centimeters to 2 meters. Their extent is on the order of tens of meters. Gold grades vary between 0.1 and 10ppm, locally reaching 60ppm.

The mineralization is associated with a restricted circulation of hydrothermal fluids which percolated along faults and fractures. This hydrothermal infiltration caused alteration of the host rocks including albitization, sericitization, carbonatization, silicification, pririti zation. Enrichement in Co, Ni and As are also present.

The albitization and sericitization are restricted to the metamorphosed limestones and dolostones. The albite occurs as large crystals often associated with a sericite margin. The sericite also appears dissemi nated throughout the carbonate rocks or in fluid inclusion cavities.

Hydrothermal carbonate is present as veins or as poikloblastic grains in the psammitic and pelitic rocks. Pyrite occurs mainly associated with quartz and calcite veins and veinlets.

The gold-bearing veins consist mainly of fractured milky white quartz with carbone rich Fe-dolomite, ankerite and calcite and Au-As-Ni-Co-bearing pyrite.

2.3. Fluid inclusions

Two types of fluid inclusion are observed in the gold-bearing quartz veins of Santa Rita Occurrence:

1. Early inclusion: These include secon dary inclusions with different degree of filling, composition, shape and dimension. These inclusions also present in quartz grains that are included in gold-bearing pyrite.

These early fluids inclusions were studied by microthermometry, SEM and RAMAN Spectometry. Two kinds of were identified: (1) a highly saline CH_4-N_2-CO_2-bearing fluids with daughter minerals as halite and sylvite; (2) a CH_4-N_2-CO_2-bearing fluids with moderate to high salinities. During heating, all inclusions decrepita ted between 250°C and 300°C.

2. Late inclusions: secondary inclusions outlined healed fractures. They are usually less than 3 μm with a negative crystal forms. Such dimension do not permit microthermometric study.

3. DISCUSSION AND CONSLUSION

A genetic model using paragenetic rela tionship, fluid inclusion and published experimental data is proposed.

Two stages of hydrothermal alteration can be characterized:

1. Early stage: In this stage WNW-ESE faulting and fraturing of host rocks is observed. The fractures are filled by quartz, carbonate including carbone rich dolomite, ankerite and calcite. Albite and sericite are deposited in the metamorphosed limestone in the proximity to fractures and faults zone. CH_4-N_2-CO_2-bearing salty alkaline fluids with high PCO_2 and low FO_2 are associated to this stage (Olivo, 1989). According to Holland and Malinin (1979) and Fournier (1985) these fluids show favorable condi tions to transport carbonates and quartz. The carbonate and quartz precipitation could be a result of the hydrothermal fluid. However albite could be precipita ted as a consequence of reaction of NaOH (resulting from NaCl hydrolisis) with Al, Si taken from this hydrothermal system.

b. Main Stage: This stage can be characterized by calcite veinlets and poiquiloblastic calcite and Au-Co-Ni-As-bearing pyrite deposition. Pyrrhotite and chalcopyrite inclusions are present in pyrite.

Hydrothermal fluids of this stage have a lower NaCl concentration and a higher Ph condition than the early stage. These conditions were favorable to the precipi tation of calcite (Holland & Malinin, 1979) and Au-bearing pyrite if the gold was transported as bissulphide complex (Rytuba, 1985).

The regional thermal gradient which remained higt in the interior of the belt and slowly diminished following the com pressive phase of Brasiliana Orogenesis would have been responsable for the hydrothermal circulation in Santa Rita Prospect (Olivo, 1989).

The high Ni, Co contents in Paranoa rocks and in Au-bearing pyrites rise the question about the relationship between the source of the Paranoa sediments and gold concentration to the basic-ultrabasic massif of Niquelandia, Cana Brava and Barro Alto.

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