

STABLE ISOTOPE STUDY ON MARGARITE-CORUNDUM SCHISTS (METAMORPHOSED HIGH-SULFIDATION ALTERATION ZONES) FROM THE SERRA DO ITABERABA GROUP, BRAZIL

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1. Introduction

At northeast of São Paulo city, in the central segment of the Ribeira Fold belt, outcrops the Serra do Itaberaba Group, which constitutes a Mesoproterozoic metamorphosed volcano-sedimentary sequence (Juliani et al., 2000). The Serra do Itaberaba Group was affected by two medium-grade regional metamorphic events followed by greenschist facies retrometamorphism (Juliani et al., 1997). Paleo-hydrothermal systems that developed in the upper part of the volcano-sedimentary Pedra Preta formation (basal unit) are associated to shallow level relative small andesite to rhyodacite intrusions emplaced during the installation of a back-arc basin (Pérez-Aguilar et al., 2005). These systems were responsible for the genesis of restrict chloritic (CZ2), argillic and advanced argillic alteration zones that crosscut a first large chloritic alteration zone (CZ1) (Pérez-Aguilar et al., 2005; Fig. 1), being alteration zones similar to those associated to Kuroko-type base metal deposits (Ohmoto, 1996).

2. Margarite-corundum schists

Al-rich rocks from the Serra do Itaberaba Group are present as few to hundred meter intercalations within metabasic, metavolcanoclastic, and metapelites, being actually known four occurrences: Pedra Branca, Guaravirituba, Itaberaba, and Guarulhos. Muscovite schist and margarite schist, both typically without quartz, are commonly associated with marundites, being products of changing K^+ , Al^{3+} and Ca^{2+} activities within hydrothermal fluids. The genesis of margarite-corundum schists protoliths is interpreted by Juliani et al. (1994) and Martin & Juliani (1994) as consequence of multiple geological processes. A first magmatic-hydrothermal event was responsible for the generation of argillic and advanced argillic alteration zones within fluid channel-ways due to interaction of acid sulfate-rich fluids (high-sulfidation). Afterwards these clay-rich altered rocks reacted with saline-rich waters in exhalative pools formed around the volcani-exhalative centers. Finally the metamorphic products of Al-rich rocks resulted in rocks essentially composed of corundum + margarite + rutile, being similar to those

metamorphic rocks first described by Hall (1920) present in the Barberton greenstone belt and which were referred to as marundites. Because of similarities Al-rich rocks from the Serra do Itaberaba group are also referred to as marundites.

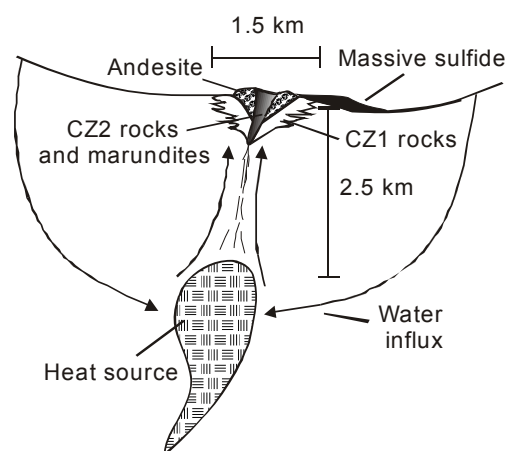


Figure 1 - Schematic reconstruction of the Serra do Itaberaba paleo-hydrothermal systems (Pérez-Aguilar et al., 2005).

3 Results

Marundites from the Pedra Branca occurrence show $\delta^{18}O$ values varying from 6.9 to 7.7‰, whereas associated margarite-chlorite schist (16.6‰) and muscovite schist (9.8‰) display higher $\delta^{18}O$ values. Muscovite from the latter has $\delta^{18}O$ and $\delta D = +9.9$ and -80 ‰, respectively. Guaravirituba marundites shows $\delta^{18}O$ values varying from 7.5 to 9.2‰, having been obtained for associated muscovite-chlorite schist a $\delta^{18}O$ of 9.1‰ and for associated muscovite schist a $\delta^{18}O$ value of 9.2‰. Margarite from margarite schist associated with this occurrence has $\delta^{18}O$ and $\delta D = 9.9$ and -100 ‰, respectively. Marundites from the Itaberaba occurrence show $\delta^{18}O$ values varying from 8.5 to 9.7‰. Hydrogen isotopic composition from these marundites is -55 ‰. The oxygen isotope value of a related metamorphosed chloritized intermediate rock from the first large chloritic zone (CZ1), spatially related with the Itaberaba marundite occurrence, is 17.2‰. One analyzed sample from the Guarulhos has $\delta^{18}O$ value of 10.1‰.

4 Discussion and concluding remarks

Oxygen stable isotope data obtained for marundites from the Serra do Itaberaba Group ranges from 6.9 to 10.1‰. These isotopic signatures, in addition to marundites' relative high enrichments in W, Co and Th (Juliani, 1997; Pérez-Aguilar et al. 2005), suggests the participation of magmatic fluids derived from intermediate to acid intrusions for the genesis of argillic and advanced argillic alteration. Thus, the Serra do Itaberaba marundites could represent the metamorphic product of low-temperature argillic and advanced argillic hydrothermal alteration generated by acid and sulfate-rich fluids circulating near the ocean floor and associated with intermediate to acid intrusions.

The Pedra Branca ($\delta^{18}\text{O} = 6.9$ to 7.7‰), Guaraviritiba ($\delta^{18}\text{O} = 7.5$ to 9.2‰), Itaberaba ($\delta^{18}\text{O} = 8.5$ to 9.7‰), and Guarulhos ($\delta^{18}\text{O} = 10.1\text{‰}$) occurrences show an increasing trend of $\delta^{18}\text{O}$ values. This is probable due to gradual increasing participation of magmatic water in fluids, due to the proximity of igneous rocks.

The margarite-chlorite schist associated to marundites from the Pedra Branca occurrence corresponds to a strongly transformed intermediate igneous rock, which was first affected by chloritic alteration event related to CZ1, being afterwards overprinted by hydrothermal processes associated to argillic alteration. The $\delta^{18}\text{O}$ value of 16.6‰ suggests that the second hydrothermal event did not substantially modify high oxygen isotope signature related to CZ1 alteration, being $\delta^{18}\text{O}$ value similar to that obtained for related chloritized metamorphosed intermediate rock from the CZ1 (17.2‰). As discussed by Pérez-Aguilar et al. (2005), these high $\delta^{18}\text{O}$ values were acquired due to interaction of rock with highly evolved hot seawater. The $\delta^{18}\text{O}$ value of 9.1‰ obtained for the muscovite-chlorite schist is interpreted as inherit from second chloritic alteration event related to CZ2 and acquired during argillic alteration event, having both events similar $\delta^{18}\text{O}$ signatures (Pérez-Aguilar et al., 2005). The $\delta^{18}\text{O}$ values obtained for associated muscovite schists from the Pedra Branca and Guaraviritiba occurrences (9.8‰ and 9.2‰, respectively) could reflect the argillic alteration event.

Hydrothermal stable isotope signatures from marundites were preserved besides the overprinting of two medium-grade metamorphic events. The characterization of high-sulfidation alteration in ocean environment where are also present chloritic alteration zones similar to those associated to Kuroko-type base metal deposits so as gold mineralizations (Juliani, 1993), shows the importance of these lithotypes for the metallogenetic modeling of paleo-hydrothermal systems of the Serra do Itaberaba Group.

3. References

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