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José Henrique da Silva Nogueira de Matos, Ticiano José Saraiva dos Santos, Lena Virgínia Soares Monteiro

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# THE CARBONACEOUS PHYLLITE ROCK-HOSTED PEDRA VERDE COPPER MINE, BORBOREMA PROVINCE, BRAZIL: STABLE ISOTOPE CONSTRAINTS, STRUCTURAL CONTROLS AND METALLOGENIC EVOLUTION

José Henrique da Silva Nogueira de Matos <sup>(a)</sup>, Ticiano José Saraiva dos Santos <sup>(a)</sup>, Lena Virgínia Soares Monteiro <sup>(b)</sup>

<sup>(a)</sup> University of Campinas (UNICAMP), Geoscience Institute, 13083-870, Campinas, SP, Brazil

[zehenriquesm@gmail.com](mailto:zehenriquesm@gmail.com), [ticiano@ige.unicamp.br](mailto:ticiano@ige.unicamp.br)

<sup>(b)</sup> University of São Paulo (USP), Geoscience Institute, 05508-080, São Paulo, SP, Brazil

[lana.monteiro@usp.br](mailto:lana.monteiro@usp.br)

## ABSTRACT

The Pedra Verde Copper Mine is located in the Viçosa do Ceará municipality, State of Ceará, NE Brazil. The copper mineralization is hosted by the Pedra Verde Phyllite, which is a carbonaceous chlorite-calcite phyllite with subordinate biotite. It belongs to the Neoproterozoic Martinópolis Group of the Médio Coreaú Domain, Borborema Province.

The Pedra Verde deposit is stratabound and its ore zoning is conspicuous, according to the following sequence, from bottom to top: marcasite/pyrite, native silver, chalcopyrite, bornite, chalcocite, native copper and hematite. Barite and carbonaceous material are reported in ore zones. Zoning reflects the ore formation within a redox boundary developed due to the interaction between oxidized copper- and sulfate-bearing fluids and the reduced phyllite. Structural control on mineralization is evidenced by the association of the ore minerals with veins, hinge folds, shadow pressures, and mylonitic foliation. It was mainly exercised by a dextral transcurrent shear zone developed during the third deformational stage identified in the Médio Coreaú Domain between 590 Ma and 570 Ma. This points to the importance of epigenetic, post-metamorphic deformational events for ore formation. Oxygen isotopic composition ( $\delta^{18}\text{O}_{\text{H}_2\text{O}} = 8.94$  to  $11.28\%$ , at 250-300 °C) estimated for the hydrothermal fluids in equilibrium with calcite indicates metamorphic or evolved meteoric isotopic signatures. The  $\delta^{13}\text{C}_{\text{PDB}}$  values ( $-2.60$  to  $-9.25\%$ ) obtained for hydrothermal calcite indicate mixing of carbon sources derived from marine carbonate rocks and carbonaceous material. The  $\delta^{34}\text{S}_{\text{CDT}}$  values ( $14.88$  to  $36.91\%$ ) of sulfides suggest evaporites as sulfate sources or a closed

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