

Isotopic Signature of Polymetallic Epithermal Deposits Associated With Ediacaran Post-orogenic Rift Magmatism in the Camaquã Basin, Mantiqueira Province, Southern Brazil

Felipe Brito Mapa^{1,2}, Saulo Batista de Oliveira¹, Caetano Juliani, Lena Virgínia Soares Monteiro¹, João Luis Carneiro Naleto²

¹University of São Paulo, São Paulo, Brazil, ²Geological Survey of Brazil, São Paulo, Brazil

The Camaquã Basin is a main geological elements of the Mantiqueira Province (Southern Brazil), developed in a post-orogenic extensional rift system during the Ediacaran to Cambrian. The region, characterized by continental siliciclastic sedimentation, bimodal volcanism, and alkaline granitic magmatism, hosts significant base- and precious-metal potential (Cu, Pb, Zn, Au, Ag), including mines, deposits and numerous occurrences. The metallogenesis of these deposits remains debated, with interpretations ranging from epithermal-porphyry systems to syngenetic sedimentary origins and IOCG type mineralization.

Based on new petrography, hyperspectral scanning, 3D geological modelling, and C–O–S isotopic data from base-metal sulfides and hydrothermal carbonates across four deposits, together with C–O–H–S isotopic and fluid inclusion datasets compiled from other well studied deposits, we conducted a comparative metallogenetic study of the region's main deposits to evaluate whether they share a common metallogenic model.

Results indicate that the orebodies are structurally controlled and associated with the major fault systems of the province. Mineralization occurs in base-metal sulfide-bearing veins displaying massive, venular, stockwork and brecciated structures, with colloform, crustiform, comb, and blade textures. These ore bodies are surrounded by extensive hydrothermal alteration halos, including silicification, carbonatization, and argillization in proximal zones, and chloritization in distal zones.

Isotopic data show $\delta^{13}\text{C}$ (VPDB) values ranging from 0.28 to -8.43‰ and $\delta^{18}\text{O}$ (SMOW) values from -4.45 to 24.05‰ in hydrothermal carbonates. The $\delta^{34}\text{S}$ (VCDT) values range from -22.74 to 10.80 in Cu-sulfides, -9.34 to 1.10 in sphalerite, -6.16 to -2.10 in galena, -4.71 to 4.9 in pyrite, and 4.36 to 10.65 in barite. These data, combined with fluid inclusion temperatures from 20 to 289 °C and salinities from 0 to $22\text{wt.}\%$ NaCl-equivalent, and calculated δD and $\delta^{18}\text{O}$ fluid compositions, indicate that the Cu-Au-(Zn-Pb-Ag) deposits in the region share a similar epithermal-porphyry mineral system related to post-orogenic Ediacaran rift magmatism.