Tracing the hydrothermal evolution of the Pantera and Pedra Branca IOCG deposits, Carajás Province, Amazon Craton

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The Pantera and Pedra Branca iron oxide-copper-gold (IOCG) deposits are located in the Southern Copper Belt of the Carajás Province, Amazon Craton, along the WNW–ESE-trending Canaã dos Carajás shear zone. The Mesoarchean Ourilândia Plutonic Suit host the Pantera deposit. The Pedra Branca deposit is hosted by i) metasyenogranites and pegmatites, and ii) banded orthogneisses and amphibolites. The hydrothermal alteration is related to shearing in both deposits, with distal incipient alteration within weakly deformed rocks grading to proximal pervasive alteration in strongly sheared rocks. At the Pantera deposit, the hydrothermal alteration is marked by (i) a distal Na alteration (albite I and quartz I), (ii) an intermediate to proximal Ca alteration (actinolite I + epidote II + carbonate I) and a proximal Ca-Fe alteration (Fe-actinolite II + magnetite I + pyrite I ± chalcopyrite). The Pedra Branca deposit hydrothermal alteration halos are marked by (i) a distal Na alteration halo (Albite I), (ii) an intermediary to proximal Na-Ca alteration (albite II, hastingsite I, actinolite I, titanite I, and apatite I), (iii) a proximal Ca alteration (actinolite II, apatite II, titanite II and epidote II), followed by a proximal Ca-Fe alteration (actinolite III + apatite III + epidote III + magnetite I). The styles of copper mineralization are similar in both deposits with (i) ore breccias; (ii) massive sulfide bodies; (iii) veins and veinlets; (iv) chalcopyrite along mylonitic foliation; (v) disseminated chalcopyrite. The ore zone of both deposits is enveloped by the Ca-Fe halo and dominated by chalcopyrite and magnetite with accessory pyrite, pyrrhotite, pentlandite (millerite, siegenite at Pantera), F-apatite, monazite and uraninite. Mineral chemistry via Electron probe micro-analyzer (EPMA) revealed that the amphibole from the distal zones plots between the hornblende and actinolite I compositional fields at Pantera. Actinolite I (higher Si, Mg, Fe^{2+}, and Cl) replaces magmatic hornblende and biotite. In the ore zone, actinolite I is replaced by a Fe-rich actinolite II, with higher contents of Si and Fe^{2+}, Ca and Cl and lower contents of Al^{VI}, Mg, Na and K. At the Pedra Branca deposit, distal amphibole plots within the hornblende and hastingsite fields. Hastingsite I replaces magmatic hornblende, which shows higher Al^{VI}, Fe^{3+}, Na, and K contents. In the ore zone, Fe-actinolite III (higher contents of Si, Mg, Fe2+; lower Cl contents) replaces actinolite II. The magnetite composition in the Pantera mineralization zone presents relatively higher contents of FeO, Cr_2O_3 and NiO when compared to Pedra Branca. The latter shows magnetite with higher contents of MgO, Al_2O_3 and TiO_2. Ti+V/Al+Mn (Wt%) diagram shows higher temperatures for magnetite precipitation at Pedra Branca than Pantera. Both deposits show Ti/(Ni/Cr) (ppm) and (Mg+Mn)/(Si+Al)/(Mg+Mn) (wt%) values compatible with hydrothermal sources. Thus, the early high-temperature sodic and sodic-calcic alteration overprinted by late, ore-bearing, calcic-ferric alteration, in addition to similarities in ore styles and paragenesis, point to a similar evolution in both deposits, likely formed in the same Neoarchean metallogenetic event.

Palavras chave: Carajás Province, Southern Copper Belt, IOCG, Pantera, Pedra Branca, footprints.