Geophysical Research Abstracts
Vol. 13, EGU2011-13150-1, 2011
EGU General Assembly 2011

Evolution of iron oxide-copper-gold deposits from the Southern Copper Belt, Carajás Mineral Province, Brazil

Lena V. S. Monteiro (1), Carolina P. N. Moreto (1), André L. S. Pestilho (1), Caetano Juliani (2), Roberto P. Xavier (1), and Anthony E. Fallick (3)

(1) Geoscience Institute, UNICAMP, Brazil (lena@ige.unicamp.br), (2) University of São Paulo, USP, Brazil (cjuliani@usp.br), (3) Scottish Universities Environmental Research Centre, Scotland, UK

The Southern Copper Belt in the Carajás Mineral Province, located in the Amazonian Craton, is notable for the large concentration of iron oxide-copper-gold deposits (IOCG), such as the world-class Sossego, Cristalino and Alvo 118 and minor Bacaba, Castanha, Jatobá, Bacuri, and Visconde deposits. These IOCG deposits occur along an important structural corridor represented by a WNW–ESE shear zone that marks the limit of two tectonic domains, represented by the 2.76 Ga rift-related Carajás Basin, at the north, and the Transition Domain. The latter has been interpreted as a portion of the southern ($>$ 2.87 Ga) Rio Maria Granite-Greenstone terrain, which would have been extensively reworked by several Archean to Paleoproterozoic (2.85-1.88 Ga) episodes of reactivation of regional E-W trending steeply dipping fault zones.

The Carajás IOCG deposits are hosted by: (i) intrusive rocks represented by quartz-feldspar porphyry, granophyric granite, granite and gabbro bodies; (ii) mafic and felsic volcanic and volcaniclastic rocks of the 2.76 Ga volcanic-sedimentary Itacaiúnas Supergroup; (ii) ultramafic rocks, represented by imbricated lenses of talc-tremolite schist, attributed to the 2.97 Ga Sapucaia greenstone-belt; and (i) Mesoarchean basement units, including the 3.0 Ga Bacaba Tonalite and the ca. 2.86 Ga Serra Dourada Granite. These units have been intensely affected by hydrothermal alteration within the shear zone.

The Carajás IOCG deposits share a similar paragenetic evolution characterized by early high-temperature ($>$ 500 ^{o}C) sodic-(calcic) alteration with albite-scapolite-actinolite, controlled by ductile structures and mylonitic fabric, followed by magnetite-(apatite) formation and potassic (K-feldspar and biotite) metassomatism. These stages were overprinted by low-temperature ($<$ 300 ^{o}C) chloritic, carbonate-epidote or sericite-hematite alteration, coeval to the copper-gold mineralization, controlled by brittle structures. Regional spatial alteration pattern is represented by distal scapolite-rich zones (Bacaba, Jatobá, Visconde, Castanha), intermediate to deeper zones with predominance of magnetite-apatite-actinolite bodies (Sequeirinho and Castanha) e shallowest zones with prominent potassic and chloritic alteration (Sossego and Alvo 118).

Scapolite occurrence is notable in Mesoarchean basement rocks and supracrustal units. It occurs as fibrous crystals in veins ($>$ 10 m) and as zoned crystals in replacement zones associated with biotite, tourmaline and cloro-potassium hastingsite. Its formation was related to channeled hot hypersaline (28 to $>$40% equiv. NaCl) fluids with magmatic signature ($\delta^{18}O_{fluid}$ = 4.6 to 7.3‰ at 350 ^{o}C) similar to that of fluids associated with magnetite-apatite-actinolite bodies (6.0 to 7.8‰ at 550 ^{o}C). Contribution of externally-derived (300 to $<$250 ^{o}C; salinity $<$ 10% equiv. NaCl and $\delta^{18}O_{fluid}$ = –0.4 to –5.2‰ at 300 ^{o}C) might have been important in the copper-gold mineralization mainly in shallow-emplaced deposits (Alvo 118 and Sossego).

Typical presence of pirrhotite indicates relatively low fS_2 conditions in deeper or distal deposits (e.g., Castanha), in which $\delta^{34}S_{cpy}$ values (0.9 to 3.5%¸) are close to those of mantelic sources. Higher $\delta^{34}S_{cpy}$ values ($>$7.5%¸) may suggest surface-derived sulfate contribution in deposits developed in shallow zones (Sossego and Alvo 118).

Mixing of (i) hot hypersaline metalliferous fluids with an important magmatic component and (ii) modified-seawater and meteoric fluids within shear zones represent the main ore precipitation mechanism. This process might also have been favored by increase of fS_2 conditions due to expressive magnetite formation and reduction of sulfate from surface reservoirs. The relative contribution of deep-seated magmatic and externally-derived fluids may be correlated to ore reserves. In the Carajás world-class deposits, evidences of external fluid and sulfur sources in addition to magmatic ones have been identified.

Acknowledgments: VALE, CNPq 202517/2006-3, CNPq/MCT (555065/2006-5), INCT Geociências da Amazônia (CNPq/MCT/FAPESPA).