Fluid evolution and gold deposition at the Cuiabá mine, SE Brazil: fluid inclusions and stable isotope geochemistry of carbonates

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The Cuiabá mine, northern sector of the Iron Quadrangle is hosted by a carbonaceous sedimentary unit located within tholeiitic basalt flows of the Archean Rio das Velhas greenstone belt. Episodes of hydraulic fracturing enhanced the focussing percolation of fluids along the primary layering, which promoted pervasive carbonation and sulfidation associated with crosscutting fractures and quartz-carbonate veins/breccias. The gold mineralization is closely related to the sulfide-rich zones. Fluid inclusion investigations in quartz of gold-bearing veins/breccias showed that the ore fluids were dominantly aqueous, of low salinity, with variable concentrations of CO_2 (0 – 11.4 mol%), CH_4 (1.5 – 10.2 mol%) and subordinate N_2 (0 – 0.7 mol%). The greenschist facies nonmineralized sedimentary unit and the gold-related carbonate/sulfide alteration zones and veins/breccias show contrasting carbon isotope compositions of calcite/ankerite and siderite, respectively, $\delta^{13}C_{cc\text{-}ank}$= -0.2‰/-2.1‰, $\delta^{13}C_{sid}$= -1.8‰/-4.3‰; and $\delta^{13}C_{cc\text{-}ank}$= -5.5‰/-8.1‰, $\delta^{13}C_{sid}$= -6‰/-8‰. The range of carbonate $\delta^{18}O$ values is broadly similar, with a slightly larger variation in the mineralized zones ($\delta^{18}O_{sid}$= 10.6‰/15.2‰). On the basis of these data the following points may be raised: (1) the ore fluid was externally derived and originally H_2O-CO_2-rich; (2) significant concentrations of CH_4 were added in situ via the hydrolysis of the carbonaceous matter; (3) the addition of CH_4 may have caused the higher $\delta^{13}C$ values of the gold-related alteration carbonate; (4) gold deposition may have been triggered by a sharp decrease in fO_2 caused by the CH_4 enrichment.