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Breaking Up the Link Between IOCG Genesis and Granitic Magmatism at 2.6-2.5 Ga in the Carajás Province, NW Brazil

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A genetic link between magmatism and IOCG genesis is supported in some ore districts by the temporal association between granites and mineralization and the presence of magmatic fluids, identified by fluid source tracers (e.g., Olympic Dam, Salobo, and Candelaria). At the Carajás Mineral Province, NW Brazil, a set of ca. 2.6-2.5 Ga IOCG deposits (Salobo, Igarapé Bahia, Grota Funda, GT46) were previously interpreted as genetically linked with contemporary granitic intrusions, restrictedly described in the northern part of the province. Despite the timing correlation and evidence of magmatic fluid sources (i.e., stable isotopes and fluid inclusions), the association between IOCG and granite genesis is yet questionable. This is mainly because the ca. 2.6-2.5 Ga granite discordant ages are constrained by metamict, U-rich, and texturally complex zircon grains that show high Pb loss and do not display preserved igneous features. In addition, similar ages on zircons from strongly deformed and hydrothermally altered rocks have been interpreted as resetting ages due to shear activity along the Cinzento Shear Zone, the host structure of IOCG deposits, and targets at the northern part of the Carajás Province. Therefore, we studied the morphologies, textures, and trace element compositions of a set of ca. 2.6-2.6 Ga zircons from variably deformed and metasomatized granitoids, placed along the Cinzento Shear Zone. We included granites from the Salobo (Old Salobo Granite) and GT46 (Igarapé Cinzento granitoids) IOCG deposits as well as regional intrusions, previously interpreted as part of the Igarapé Gelado Intrusive suite. Zircon textures, morphologies, and trace element compositions show complex patterns of multistage fluid-mineral reactions. Relict magmatic zircon domains, with preserved or faint concentric zoning and depleted in REE+Y, HFSE, and nonformula elements (e.g., Ca, Fe), are overprinted and overgrown by textureless, spongy, or convolute zoning and fractured and inclusion-rich domains. These domains are enriched in REE+Y, U, Ca, Ta, and Nb and commonly Zr and Hf depleted. They also show negative Ce/Ce* and Eu/Eu* anomalies, reflecting partition to possible cogenetic hydrothermal minerals (e.g., monazite, allanite, and albite). Diffusion-reaction and dissolution-reprecipitation processes can account for multiple overprinted fluid-zircon reactions, facilitated in more reactive metamict porous grains, and cause, respectively, isotopic disturbances and resetting of the U-Th-Pb isotope system. IOCG hydrothermal fluids, which are alkaline (Na-K-rich) and F-Cl rich, can partially dissolve zircon and mobilize its incompatible elements, inducing zircon re-equilibration and the precipitation of REE+Y-, U-, Ca-, Ta-, and Nb-rich new domains. As these fluids circulated regionally, they have produced a broad hydrothermal footprint in zircon grains from granitic rocks along the Cinzento Shear Zone. Since the geochronological record of 2.6-2.5 Ga is intrinsically related to modified zircon domains, we interpret these registers as hydrothermal event ages in the Northern Carajás Sector, rather than granitogenesis. The magmatic ages of these intrusions must be older and possibly related to the widespread 2.74-2.74 Ga magmatism characterized in the province. Accordingly, we rule out the genetic link between ca. 2.6-2.5 Ga granitic magmatism and IOCG genesis at Carajás, since the temporal IOCG-granitogenesis association is unsupported.