Refining the understanding of the hydrothermal systems footprint using automated quantitative mineralogy in the Carajás Mineral Province.

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To better utilise petrophysical data for defining the hydrothermal footprint, mineralogy should be used as a common language to explain the distinct physicochemical properties involved in targeting mineralised systems. Methods that employ new technologies for large-scale geological material characterisation are essential for defining the mineral footprint. The Carajás Mineral Province, located in the southeastern sector of the Amazonian Craton, represents the largest and best-preserved Archean sector of the craton and known for hosting several IOCG type deposits. Despite the geographical proximity, each deposit has distinctive petrophysical, geochemical and geophysical characteristics.

We propose a new workflow that integrates automated quantitative mineralogy on 100 samples, analysed using the Elemission ECORE high speed LIBS scanner and the TESCAN TIMA SEM-EDS system, together with petrophysical and geochemical data from the Salobo, Paulo Afonso and Santa Inês Gabbro targets. Samples representing different lithotypes and distinct petrophysical characteristics were primarily selected for laser-induced breakdown spectroscopy (LIBS) scanning using the ECORE equipment. For validating the LIBS classification, key samples were selected for a high-resolution analysis using TIMA. Mineral abundance data, mineral and elemental maps, mineral association and grain size were generated for each sample.

For each target, representative samples of the host rock, distal and proximal parts of the hydrothermal alteration envelope, and the mineralised alteration zone were analysed to investigate variations in rock physical properties based on contrasts observed in the petrophysical data. The mineral footprint emerged as a critical factor in characterising hydrothermal system alterations. This highlights the value of combining ECORE and TIMA, an efficient workflow for mineral characterisation that can be scaled to enhance understanding of the hydrothermal footprint and improve confidence in exploration surveys.