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Hydrothermal alteration of volcanic rocks in the Portuguese sector of the Iberian Pyrite Belt – Application in mineral prospecting

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The Iberian Pyrite Belt (IPB) is located in the South Portuguese Zone, in the SW region of the Iberian Peninsula, extending over 230 km long and 20-70 km wide. The IPB is one of the most outstanding volcanogenic provinces of the world being composed of over 80 known deposits containing over 1 850 Mt of sulphides (mined and resources). The province hosts the largest concentration of volcanogenic massive sulphide deposits worldwide, including several giant deposits (> 200 Mt), e.g. Aljustrel, Neves-Corvo (Portugal) and Rio Tinto (Spain) and medium size deposits such as Tharsis, Aguas Tenidas and Sotiel (Spain) and São Domingos, Lagoa Salgada, Lousal and Caveira (Portugal).

The massive sulphide lens-shaped mineralizations are associated with felsic volcanic rocks and black shales of the Volcano Sedimentary Complex (VSC). This Famennian-Lower Visean age Complex comprises several bimodal volcanic rocks, black shales, siltstones, minor quartzwackes, siliceous shales, jaspers and cherts and purple shales and massive sulphide lenses. The VSC includes several volcanic episodes of both intrusive and extrusive volcanic rocks dominated by felsic (rhyolites, rhyodacites and dacites) coherent facies and monomictic breccias and mafic rocks (basalts, spilites and minor andesites).

The geochemical products of reactions associated with the IPB dominant sea and sub-sea floor ore-zone hydrothermal alteration can be observed in the hydrothermal halos associated with the massive and stockwork mineralization. These halos are characterized by proximal and distal assemblages, produced by circulation of hydrothermal fluids and thus provide evidence for pathways of fluid travel and geochemical evidence for the physical and chemical conditions of alteration; systematic arrangement of hydrothermal alteration zones, and recognition of this arrangement, may provide useful information for mineral exploration and may, in some cases, provide vectors to undiscovered deposits.

Over the last decades, several lithogeochemical techniques have been proposed to characterize the hydrothermal alteration, namely alteration indexes such as the i) Ishikawa Alteration Index (AI), proposed to measure the intensity of sericitic and chloritic alteration in the footwall of VMS deposits - it is defined as: [100(K2O+MgO)/(K2O+MgO+Na2O+ CaO)] and ii) the box plot proposed by Large, which combined the AI with a chlorite-carbonate-pyrite index (CCPI) defined as: [100(MgO+FeOtotal)/(MgO + FeOtotal +Na2O+K2O)].

For the present work, drill core samples of volcanic rock from several mineralized and sterile areas of the IPB were selected from the following study areas: Cercal, Aljustrel, Neves-Corvo, Montinho-Aldeia dos Elvas, Lousal-Caveira, Roxo-Albernôa, Serra Branca and Lagoa Salgada. The lithogeochemistry data compilation includes 2500 samples. A lithogeochemical classification of each of the samples was applied and the proposed hydrothermal alteration indexes were calculated in order to ascertain the mining potential of each region, having in mind the stratigraphic position of each sample in relation to the VSC sequence and favourable sulphide horizons. The results revealed previously unknown zones with strong hydrothermal alteration, allowing the outline of new target areas with high mining potential.

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