Exploration Vectoring Tools in Complex Magmatic-Hydrothermal Systems: Application to the Potrerillos District in Northern Chile

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The Potrerillos Mining District is located in the southern part of the world-class Eocene-Oligocene metallogenic belt of Northern Chile, central Andes. The district hosts several ore systems, including porphyry, epithermal and skarn occurrences, which contain important resources of Cu, Au, Mo, Ag and Mn. The geology of this region consists of Jurassic to Palaeocene sedimentary (marine and continental) and volcanic sequences that were intruded by porphyries and hydrothermal breccias between 40 and 31 Ma. The diverse host rocks produced a complex arrangement of hydrothermal alteration and mineralization, which makes this district an ideal case to test simultaneously different vectoring tools.

Previous studies have demonstrated that the composition of hydrothermal minerals, such as epidote and chlorite (green rocks), and quartz and calcite (white rocks) provide powerful tools to track the pathways of hydrothermal fluids and vector towards the centre of magmatic-hydrothermal systems. This study aims to test and improve these tools by the application of a combination of them in the complex Potrerillos District, and to enhance orebody knowledge in the district.

We have collected eighty-five outcrop samples, covering several sedimentary, igneous and volcanoclastic lithologies and alteration assemblages. Field observations, along with short-wave infrared data, show that the carbonate rocks and propylitic alteration have a wide distribution within the district. The carbonates exhibit a range of colours and intensities of short-wave ultra-violet fluorescence (SW-UVF), which indicate different trace element compositions and fluid sources. Preliminary results of mineral chemistry using LA-ICP-MS show significant variations in Ti and Mg in chlorite, As and Sb in epidote, Ti/Sb in quartz and Mn/Mg in carbonates, as well as a SW-UVF response, towards the ore deposit centres, especially closer to porphyries. These results are promising for the use of the combination of these tools in complex magmatic-hydrothermal districts.