

Rare Earth Element Analysis of Anhydrite Veins and Source Magmas from the Ertsberg Mining District, Papua, Indonesia

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The Ertsberg Mining District in Papua, Indonesia, contains one of the largest Cu-Au deposits on the planet. Igneous intrusions rose through the crust along weak points of a strike-slip faulting regime. Cooling and crystallization of anhydrous phases caused fluid accumulation at the top of a cupola in a stock above a batholithic magma chamber. Hydrothermal fluid episodically escaped through fractures, forming veins which are combinations of quartz, pyrite, chalcopyrite, and anhydrite.

Anhydrite is a common vein mineral phase in these hydrothermal systems. It precipitates from magmatic fluids when sulfur dioxide reacts with water to form hydrogen sulfide and sulfuric acid. This reaction occurs between 400-600°C and results in the precipitation of sulfide and sulfate minerals. The purpose of this study is to determine if trace element analysis of anhydrite can be used to chemically fingerprint veins to specific source magmas.

Ninety-seven anhydrite samples were chosen from several locations in the Ertsberg Mining District based on mineral assemblage and volume. This study uses Quadrupole Inductively Couple Plasma – Mass Spectrometry (ICP-MS) solution analysis of anhydrite to determine trace element abundances, including Rare Earth Elements (REE). This data has been compared to major and minor trace element geochemistry of igneous rocks from the district. Almost 30 trace elements are easily detectable in the sample. While Sr, Ba, Mg, K, Na are the most abundant, there are no obvious correlations of trace elements from the concentration plots. It was discovered that chondrite normalized REE ratios have two distinct patterns in the veins, but the parental igneous rocks have only one pattern. Both anhydrite and igneous rocks have REE patterns with a La/Yb ratio of twenty or lower (n=10; 36). The anhydrite shows similar patterns, but also exhibits high light REE (LREE) concentrations with La/Yb ratios as high as 241 (n= 14).

REE profiles appear to be a basis for correlating anhydrite with potential parental intrusions. This study has discovered that REE in anhydrites can be measured, and have patterns similar to the intrusive rocks in the district. The hypothesis is that the increase of LREE comes from the fractionation effect of REE from the fluid into precipitating anhydrite. Two studies are ongoing: 1) Sedimentary anhydrite analysis to compare with values of magmatic anhydrite and 2) Sr isotopic analysis on anhydrite to make another type of correlation with the intrusions in the district.

Keywords: Anhydrite, REE, porphyry ore deposit, hydrothermal systems