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The efficiency of copper extraction from magma bodies: Implications for mineralization potential and fluid-silicate melt partitioning of copper

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Abstract

Multiple factors may downgrade the mineralization potential of an intermediate-felsic intrusion, such as the commonly invoked inefficient fluid exsolution and lack of ore-forming species (metals and their ligands) in magmas. However, other factors may affect the mineralization potential of a magma body but have poorly understood roles in the formation of magmatic-hydrothermal ore deposits. Here, we present a comparison between two Cu mineralizing plutons and a Cu-poor, Fe mineralizing pluton in the Edong district. Efficient fluid exsolution and extraction occurred during the solidification of all three plutons, as evidenced by extensive skarn alteration around them. The results show that the oxidation state of the three plutons is similar (within a range of ~ΔNNO+0.9 to ΔNNO+2.5). A systematic comparison of the Cu contents of a certain suite of minerals of the three plutons shows that the Cu concentrations of all minerals in the Cu mineralizing plutons are lower than those of the Cu-poor Fe mineralizing pluton. This indicates that the Cu mineralizing plutons underwent more efficient copper extraction. Thus, igneous crystals with anomalously low Cu contents may potentially be used as a tool to identify Cu mineralizing magmatic units in a deposit with multiphase intrusions. We suggest that the inefficient copper extraction from plutons may be ascribed to the lack of reduced S species during fluid exsolution or different evolution paths of Cu and Cl during magma crystallization.

Keywords: Geothermobarometry, fluid exsolution, copper deposit, magma, ore-forming potential