

Calcium: Trigger of porphyry Cu and peralkaline granite REE mineralization

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Calcium plays an important role in metallic mineralization in several hydrothermal deposits, although calcium ion is not the ligand that form metal complex such as Cl^- and HS^- in hydrothermal fluids.

In the Eocene El Salvador porphyry Cu system in Chile, anhydrite and Cu sulfides are intimately occur in veinlets in plagioclase with K-feldspar and albite. Such Cu mineralization occurs at a high temperature ranging from 600°C to 400°C in the deposit. In this temperature condition, drastic changes in temperature, pH and salinity of the hydrothermal fluids, which are the common triggers of Cu mineralization, are not expected. An increase of H_2S in the magmatic-hydrothermal system, which is an alternative trigger of Cu mineralization, may occur by reduction of SO_4^{2-} and/or disproportionation of magmatic SO_2 . Disproportionation of SO_2 inevitably occurs by condensation of SO_2 -bearing magmatic vapor by meteoric water at about 350°C or lower. Alternatively, SO_2 disproportionation may occur at a high temperature (>500°C) at the top of a porphyritic intrusion where SO_2 reacts with Ca-bearing minerals, especially plagioclase, to form anhydrite and sulfides.

In the Devonian Khaldzan Burgei peralkaline system in Mongolia, quartz syenitic pluton is intruded by Ca-free peralkaline granite and REE-Zr-Nb mineralization is observed mainly in the metasomatized quartz syenite near the contact to the granite. In the metasomatized quartz syenite, Ca-bearing minerals such as amphibole, augite and plagioclase are replaced by aegirine and albite with abundant hematite, fluorite and zircon and with REE carbonates such as bastnäsite and synchysite. These replacements indicate that during the metasomatism, Ca was extracted from the original minerals in the quartz syenite by the reaction between the quartz syenite and metasomatizing fluids derived from the granite. The elevated Ca concentration in the fluids made zirconium and REE fluoride complexes unstable, resulting in the formation of zircon, REE carbonate as well as fluorite.

Thus, these two examples shows that reaction of Ca extracted from the precursor minerals in the intrusive rocks with hydrothermal fluids triggered porphyry Cu and peralkaline granite Zr-REE-Nb mineralization.

Keywords: calcium, mineralization, trigger