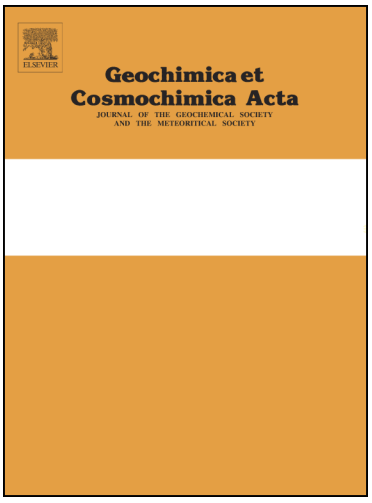

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Metal endowment reflected in chemical composition of silicates and sulfides of mineralized porphyry copper systems, Urumieh-Dokhtar magmatic arc, Iran

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Abstract

The present work attempts to discriminate between the geochemical features of magmatic-hydrothermal systems involved in the early stages of mineralization in high grade versus low grade porphyry copper systems, using chemical compositions of silicate and sulfide minerals (i.e., plagioclase, biotite, pyrite and chalcopyrite). The data indicate that magmatic plagioclase in all of the porphyry copper systems studied here has high An% and Al content with a significant trend of evolution toward $AlAl_3SiO_8$ and $\square Si_4O_8$ endmembers, providing insight into the high melt water contents of the parental magmas. Comparably, excess Al and An% in the high grade deposits appears to be higher than that of selected low grade deposits, representing a direct link between the amounts of exsolving hydrothermal fluids and the potential of metal endowment in porphyry copper deposits (PCDs). Also, higher Al contents accompanied by elevated An% are linked to the increasing intensity of disruptive alteration (phyllic) in feldspars from the high grade deposits. As calculated from biotite compositions, chloride contents are higher in the exsolving hydrothermal fluids that contributed to the early mineralization stages of highly mineralized porphyry systems. However, as evidenced by scattered and elevated log $(fH_2O)/(fHF)$ and log $(fH_2O)/(fHCl)$ values, chloride contents recorded in biotite could be influenced by post potassic fluids. Geothermometry of biotite associated with the onset of sulfide mineralization indicates that there is a trend of increasing temperature from high grade to low grade porphyry systems. Significantly, this is coupled with a sharp change in copper content of pyrite assemblages precipitated at the early stages of mineralization such that Cu decreased with increasing temperature. Based on EMPA and detailed WDS elemental mapping, trace elements do not exhibit complex compositional zoning or solid solution in the sulfide structure. Nevertheless, significant amounts of Cu and Au are contained in pyrite assemblages as micro- to nano-sized inclusions, especially in the high grade fertile porphyry deposits. However, unexpectedly high concentrations of Te, Se, and Re may be associated with early stage of sulfide

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