Chalcophile element geochemistry of arc-related submarine lavas associated with seafloor sulfide deposits

Jung-Woo PARK

Assistant Professor, School of Earth and Environmental Sciences

Seoul National University

There are two principal hypotheses for the origin of metals in seafloor massive sulfide (SMS) deposits, the wall-rock leaching and magmatic-hydrothermal hypothesis. In the former the metals are leached from the wall rocks above a sub-volcanic magma chamber whereas the latter requires them to be deposited from magmatic fluids derived from an underlying magma chamber. The SMS deposits forming at arc volcanos or immature back-arc spreading centers are considered to have more magmatic fluid component than those at mid ocean ridge spreading centers. The abundance of ore metals in the magma at the time of volatile exsolution is a critical factor for the formation of a Cu-Au-rich SMS deposit if the latter is true. The behavior of these chalcophile elements is largely controlled by sulfide phases during magma evolution because of their strong affinity with sulfide phases. The platinum group elements (PGE) can be used as a sensitive indicator of sulfide saturation because their partition coefficients into immiscible sulfide melts are several orders of magnitude higher than those of Cu and Au, and they are less mobile than these elements during low temperature alteration.

Recent studies on the PGE and chalcophile element geochemistry of two submarine volcanic suites, the Pual Ridge lavas and Niuatahi-Motutahi (N-M) lavas, which are associated with Cu and Au mineralization, suggest that both magmas have experienced late sulfide saturation during their evolution. This results in them being enriched in chalcophile ore metals such as Cu and Au until the point of volatile saturation and so that they could form Cu-and Au-rich magmatic hydrothermal deposits. The SMS deposits with the highest Au ore grade are often found in arc or back arc settings. This can be attributed to the oxidized nature of arc-related magmas, which increases sulfur solubility in the magma and delays the timing of sulfide saturation.