
The production of copper metal from oxide ores accounts for nearly 30% of total annual copper produced worldwide. Copper oxide ore deposits represent an attractive exploration target because even low-grade (less than 0.2 wt-% Cu, or less than 2000 ppm) prospects have the potential to produce low-cost copper in an environmentally friendly fashion. Derived from hypogene and/or supergene sulfides, copper oxides comprise a series of distinct assemblages that characterize a variable-pH, oxidizing geochemical environment, termed the oxide zone. Development of oxide copper minerals is a direct result of the low-temperature mobility of metals, including Fe, and the mobility of sulfur as an oxidized species. Transport and accumulation of copper is a function of source rock and host rock mineralogy, pyrite and other copper sulfide abundance and distribution, fracture density and distribution, phreatic/vadose zone occurrence and stability, and maturity of the weathering profile.

The paragenesis of copper oxide mineral formation reflects local, dynamic changes in supergene solution composition attributable to reaction between host rock mineral components and dissolved species. Especially important are the concentrations of Fe$$^{+++}$$ (vs. Fe$$^{++}$$), SO$$\text{4}$$$$^{-}$$, H$$^{+}$$, and Cu$$^{++}$$ (vs. Cu$$^{+}$$). Because mineral assemblages, even those that are metastable, represent the geochemical environment in which they formed, identification and mapping of copper oxides is useful in interpreting the geochemical history of an oxide zone. Furthermore, practical application of oxide zone geochemistry is significant in the recognition and solution of problems associated with weathering-engendered metals oxidation and removal from mine wastes.