Tectonic Stress and Metallogenesis—Southwest Pacific Island Arc Region

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In 1980, I expressed a hypothesis that the extensional tectonic stress environment is favorable for volcanogenic massive sulfide mineralization, while the compressional stress environment is conducive to porphyry-type copper concentration. The genetic control of tectonic stress on major porphyry copper mines and prospects, with more than 3×10^5 tons of metallic copper in the Southwest Pacific, has been investigated.

(1) The distribution of these deposits is generally confined to the island arcs formed by collision/accretion tectonics.

(2) Highly compressional tectonic stress environments of collision tectonics, if active at the time of porphyry intrusions and the ore emplacement, seem to be one of the most favorable controlling factors for copper concentration of this type.

(3) Highly compressive tectonic stresses produce higher confining pressures in the porphyry intrusive body than those produced under extensional deviatoric stress conditions. When intrusive stocks solidify by cooling, high confining pressures retard second boiling of the stage of lower temperature and higher crystal ratio. The fluid phase, separated by the second boiling, will be more saline and may have a higher partitioning ration of chalcophile metals. When inner pressure overcomes the outer strength, brittle failure causes myriads of minute cracks, in the surrounding solid rock, which the metal-laden fluid will permeate. Copper sulfides will be disseminated as a stockwork deposit.

(4) Physico-chemical processes, governed by tectonic dynamics, seem to be very favorable for rich concentration of porphyry-type metal deposits.

Metal concentration of the extensional stress environment, such as they produced by exhalation of hot metallic solutions at ocean rifts, can be compared to that of the compressive type.