Comunicaciones, N° 35 (1985): 225 - 226
Departamento de Geología Universidad de Chile Santiago

EPOCAS DE MINERALIZACION CUPRIFERA RELACIONADAS A INTRUSIVOS EN LOS ANDES

EPOCHS OF INTRUSION–RELATED COPPER MINERALIZATION IN THE ANDES

RICHARD H. SILLITOE
8 West Hill Park, Highgate Village, London N6 6ND, England.

More than 90 percent of Andean copper production and resources depend on deposits directly related to intrusive activity. Preeminent throughout the Andes are porphyry copper deposits, although in Peru skarn-type and enargite-bearing replacement copper deposits also possess economic importance. Veins and breccia pipes are widespread but contain relatively small tonnages of copper.

Copper mineralization at 69 localities, including most of the major deposits, has been dated radiometrically by several investigators. Most of the mineralization was dated by the K-Ar method but confirmatory Rb-Sr isochron ages were obtained for two deposits.

Pre-ore volcanic sequences and plutons, as well as ore related stocks and hydrothermal alteration, were dated from the vicinities of a number of deposits. The results confirm that both volcanic and/or plutonic precursors characterize several deposits, although some pre-ore plutons were emplaced at least 15 Ma. prior to stock intrusion and copper mineralization. At most localities, the time interval required for multiple pulses of stock emplacement and alteration-mineralization is irresolvable with the dating techniques employed, as it is at most copper deposits elsewhere.

Precambrian and Paleozoic intrusive rocks in the Andes are largely barren of copper mineralization, although porphyry copper occurrences of Early Carboniferous and Late Carboniferous-Early Permian ages are known from western Argentina and contiguous northern Chile. All important copper deposits of intrusive affiliation are Mesozoic or Cenozoic in age, with the exploited deposits pertaining to the latter era. Copper deposits through-out the Andes were emplaced in a series of longitudinal sub-belts which are roughly parallel to the continental margin.

The largest and highest-grade porphyry copper deposits are confined to three sub-belts of different ages: Middle-Late Miocene in central Chile, Late Eocene-Early Oligocene in northern Chile, and Paleocene-Early Eocene in northernmost Chile and southernmost Peru. The Middle-Late Miocene sub-belt is exceptionally wide and also encompasses a number of porphyry copper prospects and occurrences in western Argentina. These Cenozoic sub-belts are flanked westward by a composite Cretaceous sub-belt of limited commercial significance as far as intrusion-related copper deposits are concerned. The south-ward extension of the Paleocene-Early Eocene sub-belt in northern Chile contains many groups of copper-bearing breccia pipes.

The Middle-Late Miocene sub-belt is poorly represented (with respect to copper) on the Altiplano of western Bolivia and southern Peru, but is well developed in central and northern Peru, where it includes a number of important porphyry, skarn and replacement copper deposits. The Middle-Late Miocene sub-belt probably continues into southern

Ecuador. The Late Eocene-Early Oligocene sub-belt also reappears in southern Peru, where it is host to a series of skarn copper deposits.

In Colombia, porphyry copper prospects and occurrences are present in sub-belts of Middle-Late Miocene, Early-Middle Eocene, and Middle Jurassic-earliest Cretaceous ages, the last probably composite in nature.

The distribution and epochs of copper mineralization in the Andes are strongly influenced by the segmentation of the orogen, and particularly by the Abancay deflection (lat. 14°S). The Paleocene-Early Eocene and Late Eocene-Early Oligocene sub-belts have been defined only to the south of the Abancay deflection, to the north of which the Middle-Late Miocene sub-belt gains in importance and becomes strongly polymetallic in character. The overall chronology of copper mineralization, as well as the size and grade of deposits, also appears to change where the Carnegie Ridge abuts the Peru-Chile trench, although the Middle-Late Miocene epoch persists from the central Andes into the northern Andes of Colombia.

Sub-belts of copper deposits and associated magmatic rocks migrated systematically eastward during the Meso-Cenozoic in Chile, Argentina and Peru, as they did in the Colombian Andes from the Eocene onward. However, marked westward migrations of the loci of magmatism and copper mineralization characterized the Late Paleozoic to Triassic interval in Chile-Argentina, and the Jurassic to Eocene interval in Colombia (and possibly also Ecuador). The Plio-Pleistocene andesitic arc also jumped westward in parts of Chile and southern Peru; copper mineralization is known from this arc in southern Peru. Eastward migration may be attributed to flattening of the subducted slab and/or to tectonic erosion of the leading edge of the South American plate. The reverse trend may be due to a steepening of the angle of subduction and/or to accretion of subduction complexes or exotic suspect terranes at the continental margin. All these processes are inferred to have affected the Andean margin since the Late Paleozoic.