and mineral zoning is expected to reflect this style of flow.

PROPERTIES OF PYRITES FROM ORE AND NON-ORE ENVIRONMENTS

Steven L. Kurz, Arthur H. Brownlow, and Won C. Park

Department of Geology, Boston University, Boston, Massachusetts 02215

Pyrites from fresh and hydrothermally altered rocks from the Boulder batholith were analyzed for iron, cobalt, nickel, copper, and sulfur with an electron-microprobe. Pyrites from various igneous, sedimentary, and metamorphic ore deposits throughout the world were also studied for comparison. Sulfur values are lowest (54.59 wt. %) in the fresh rock pyrites of the batholith while Butte ore pyrites contain significantly more sulfur (55.39 wt. %), reflecting higher sulfur fugacity associated with ore-producing environments. Iron content of pyrites decreases from 45.43 wt. % north of Butte to 44.30 wt. % in the ore zone. Sulfur: Metal ratios of fresh igneous, hydrothermally altered, and Butte ore pyrites are 1.998, 2.164, and 2.144 respectively. Pyrites of hydrothermally affected and ore rocks in the batholith contain higher amounts of Co (0.21 wt. %), and Ni (0.06 wt. %) than pyrites from fresh rocks. Butte ore pyrites contain the highest Cu (0.24 wt. %) among all pyrites. Pyrites from twenty igneous, sedimentary and metamorphic ore deposits contain less Co (0.08%), Ni (0.03%), and Cu (0.07%). Micron-sized chalcopyrite, mackinawite, pyrrhotite and complex sulfide inclusions are abundant in pyrites of hydrothermally altered rocks, while fresh rock pyrites contain less sulfide but more oxide inclusions. Pyrite grains with inclusions measure on the average 110 microns, while those without measure 72 microns.

Abundant sulfide inclusions in pyrites and high Co, Ni, and Cu contents in pyrites may be utilized as a possible guide to ore mineralization in conjunction with other geochemical and mineralogical indicators.

A MODEL FOR THE FORMATION OF SEDIMENTARY COPPER DEPOSITS IN NEW MEXICO

Dennis J. LaPoint

Department of Geological Sciences, University of Colorado, Boulder, Colorado 80302

Field, petrographic, and geochemical studies of sedimentary copper deposits in New Mexico indicate that at the start of both Permian and Triassic deposition, the sedimentary environment was a moderate to low gradient alluvial plain. Precambrian highlands composed of metavolcanic rocks with high copper contents were the original source. Some copper was incorporated into clays or transported short distances in surface waters before precipitating as oxide copper minerals in stream sediments as is shown by a comparison of mineralization in recent alluvial gravels and the Permian Abo Formation at the Zuni District.

During diagenesis, copper and other ions were released by dissolution of silicates, sulfides, and oxides to form a copper-rich groundwater (<1 ppm). Deposition of copper occurred in paleo stream channels by sulfur associated with woody debris (Triassic Agua Zarca Sandstone at the Nacimiento Mine).

Permian channels are smaller, commonly lack large concentrations of coarse woody debris, and are closely associated with backswamp and fine grain channel-fill deposits. Field relations indicate that discharging groundwater can precipitate copper in organic-rich, often calcareous, reduced muds and silts adjacent to channel deposits (Scholle and High Rolls Districts), or down gradient in organic supratidal sands (Pintada Mine) or in beach and nearshore marine sands with H_2O (Rayo District). Discharge of groundwater into marine sediments may form copper-rich shale, or the copper may be dispersed. However, copper deposits such as those at the Lisbon Valley District, Utah, may represent later remobilization of copper during the dissolution of evaporites or compaction of sediments.

CURRENT STATUS OF THE LOS ALAMOS DRY HOT ROCK GEOTHERMAL ENERGY EXPERIMENT

A. William Laughlin, Roland A. Pettitt, and Francis G. West

University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545

The Los Alamos Scientific Laboratory (LASL) has for the past four years been actively investigating the potential for and the problems associated with the extraction of geothermal energy from regions containing hot, but essentially dry, rock at moderate depths. In brief, the LASL concept is to drill a deep hole into hot, impermeable rock and create a large hydraulic fracture. A second hole is drilled to intersect the fracture, creating a circulation loop for the injected water. To locate a drilling site LASL drilled four shallow heat-flow holes. Subsequently, two deeper holes were drilled into the Precambrian basement. The first of these, GT-1, reached a total depth of 785 m and penetrated about 47 m of Precambrian rocks. The second hole, GT-2, has a total depth of 2929 m. This hole penetrated 2199 m of Precambrian rocks and had a bottomhole temperature of 197°C. Hydraulic fracturing experiments were successful in GT-1 and at two levels in GT-2. A small hydraulic fracture with a radius of about 60 m has been generated at the bottom of GT-2. This fracture is currently being extended. A third deep hole, EE-1, was started in May, 1975. This hole has a projected depth of about 3800 m and a projected bottomhole temperature of about 250°C. It is expected that this hole will be completed in August 1975. An exploration program has been initiated to locate new drilling sites in both the western and eastern United States.

62 P 231