

tents. Relics of calcic plagioclase, pseudomorphed olivine phenocrysts, and other textural features indicate derivation from abyssal basalts, which typically have soda around 2.7% and potash around 0.2%. The alkali contents of the greenstones are evidently a result of metasomatism during metamorphism, and do not indicate a primary spilitic magma or reaction between magma and sea water.

The greenstones occur with augite-rich dolerites and fresh oceanic tholeiites which are similar to those from which the greenstones were derived. It is thus possible that the greenstones were produced in a localized hydrothermal aureole, perhaps around a volcanic vent. However, the widespread occurrence of the greenstones in the area and a poorly developed schistosity in some fragments indicate derivation by regional metamorphism.

These greenschist facies rocks add complexities to the present simple models of the Mid-Atlantic Ridge. Typical estimates of greenschist pressures and temperatures require some burial under subsequent extrusions or sediments even in the deep sea. Thus, a temporary halt in, or even reversal of, the commonly postulated upward movement of material beneath the ridge is required. Furthermore, heat flow, seismic magnetic, and gravity data perhaps may be more satisfactorily treated by models which assume the presence of metabasalts as well as fresh basaltic rocks, serpentinites, and fresh ultramafics.

Roedder, Edwin, and Creel, John P., Geological Survey: "Fluid Inclusions from Bingham, Utah" (875th meeting, November 10, 1965).

"Fluid inclusions from transparent ore and gangue minerals from the porphyry copper deposit at Bingham, and its peripheral Pb-Zn deposits at Lark, Utah, give evidence on the nature of the ore fluids. The preliminary data consist of 300 freezing-stage measurements of the depression of the freezing point (a measure of salinity, see Econ. Geology, 57, p. 1045, 1962),

plus optical identification and volume estimates of the phases present.

The composition of the fluids at various stages of mineralization and later fracturing and rehealing ranged from nearly fresh water to water containing more than 40 weight percent dissolved salts at the temperature of trapping. Inclusion-filling temperatures have not been determined, but the size of some daughter crystals indicates temperatures well above 350°C. Many samples show at least two inclusion types, differing in gas-liquid ratios, which are roughly proportional to temperature of formation, and (or) salinity. These differences, representing changes in the fluids with time, can be seen in primary inclusions in various zones of color-zoned sphalerite crystals, and in primary vs secondary inclusions. Evidence also exists for two grossly different fluids: a dense fluid containing more than 30 percent NaCl, and a low-density, CO<sub>2</sub>-rich "steam" containing only a few percent NaCl. The latter may represent a vapor phase, which boiled off from the first at high temperatures.

Daughter minerals, found in the inclusions, include major amounts of halite and sylvite, minor anhydrite (?), hematite (0.5%), and several opaque phases. Reasonably good evidence was found for the identification of liquid H<sub>2</sub>S in inclusions in a coarse, blue, fetid marble that partially envelops one Pb-Zn ore shoot at Lark.

The details are too complex for meaningful generalizations at present, but several conclusions concerning the Cu-Mo core of the deposit at Bingham seem to be valid. First, the temperatures of formation, estimated from phase ratios, were much higher here than in the peripheral ore. Second, although the fluids at any one place obviously varied in composition with time, highly concentrated fluids were present only in the core. Third, the only evidence of possible boiling is found in the core. However, much more work will be required before such data permit a real understanding of the complex sequence of events and plumbing system in this large deposit.

1966 v. 56 #7 p 172