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By J. E. Harrison and J. D. Wells

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*This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

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GEOLOGY AND ORE DEPOSITS OF THE CHICAGO CREEK AREA, CLEAR CREEK COUNTY, COLORADO

By J. E. Harrison and J. D. Wells

ABSTRACT

The Chicago Creek area, Clear Creek County, Colo., forms part of the Front Range mineral belt, which is a northeast-trending belt of coextensive porphyry intrusive rocks and hydrothermal veins of Tertiary age. More than $4.5 million worth of gold, silver, copper, lead, zinc, and uranium was produced from the mines in the area between 1859 and 1954. This investigation was made by the Geological Survey on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

The bedrock in the area is Precambrian and consists of igneous rocks, some of which have been metamorphosed, and metasedimentary rocks. The metasedimentary rocks include biotite-quartz-plagioclase gneiss that is locally garnetiferous, sillimanitic biotite-quartz gneiss, amphibolite, and lime-silicate gneiss. Rocks that may be metasedimentary or meta-igneous are quartz monzonite gneiss and granite gneiss and pegmatite. The granite gneiss and pegmatite locally form a migmatite with the biotitic metasedimentary rocks. These older rocks have been intruded by granodiorite, quartz diorite, and associated hornblendite, biotite-muscovite granite, and granite pegmatite. During Tertiary time the Precambrian rocks were invaded by dikes and plugs of quartz monzonite porphyry, alaskite porphyry, granite porphyry, monzonite porphyry, bostonite and garnetiferous bostonite porphyry, quartz bostonite porphyry,

trachytic granite porphyry, and biotite-quartz latite porphyry. Solifluction debris of Wisconsin age forms sheets filling some of the high basins, covering some of the steep slopes, and filling parts of some of the valleys; talus and talus slides of Wisconsin age rest on or are mixed with solifluction debris in some of the high basins. Recent and/or Pleistocene alluvium is present along valley flats of the larger streams and gulches.

Two periods of Precambrian folding can be recognized in the area. The older folding crumpled the metasedimentary rocks into a series of upright and overturned north-northeast plunging anticlines and synclines. Quartz monzonite gneiss, granite gneiss and pegmatite, granodiorite, and quartz diorite and associated hornblendite are metamorphosed during this period. The second period of folding appears to have been the reflection at depth of faulting nearer the surface; it resulted in crushing as well as some folding of the already folded rocks into terrace and monoclinal folds that plunge gently east-northeast. The biotite-muscovite granite, which is the youngest major Precambrian rock unit, is both concordant (phacolithic) and crosscutting along the older fold system and has been fractured by the younger fold system.

Arching of the Front Range highland during Laramide time is believed responsible for the development of a regional joint pattern consisting of a north-northwest trending longitudinal joint, a related cross joint, and two related diagonal joints. Joints of this regional pattern can be distinguished from Precambrian and Tertiary joints. Northwest-trending faults known as the "breccia reef" system, formed possibly during or following the arching. During Tertiary time the

bedrock was intruded by porphyritic dike rocks that probably were emplaced under tensional stresses. Later regional shear stresses caused east- to north-northeast-trending fractures in the bedrock and at places reopened the "breccia reef" faults. These openings were the loci of deposition of hydrothermal veins.

The fractures formed under the regional shear stress are as much as 2½ miles long and are relatively straight fault-fissures that follow the "grain" of the bedrock. Many faults are subparallel to foliation, axial planes of folds, contacts between rock units, or pre-existing joints.

The veins in the district are typical mesothermal fillings of fault-fissures. Some of the veins are lodes that have smooth bounding walls and abundant slickensides; the faults containing these veins are fairly regular in strike and dip, and irregularities, where present, commonly provided favorable structures for the deposition of the ore minerals.

A series of five vein types and one sub-type can be recognized in the area. Most of these veins contain quartz, carbonate minerals, pyrite, chalcopyrite, tetrahedrite-tennantite, galena, and sphalerite, and many contain minor amounts of gold, silver, or polybasite. The proportion of the metallic minerals in any vein is used as the basis for classifying the veins into types. The five vein types are: (1) pyritic; (2) pyritic with copper sulfides; (3) pyritic galena-sphalerite with copper sulfides and copper and silver sulfo-salts; (4) galena-sphalerite with pyrite and/or marcasite and copper and silver sulfo-salts; and (5) galena-sphalerite. The sub-type is similar to the

pyritic type but is telluride-bearing. Many veins are composite and contain two or more types of ore. Wherever composite veins have been observed, the older type of ore is always more pyritic than a younger type. The writers believe that the veins resulted from repeated fracturing, each fracture being filled at the time of opening by solutions that changed with time from predominantly iron-depositing through copper-depositing, to lead-zinc depositing.

Some of the veins, pegmatites, and Tertiary porphyries are abnormally radioactive. All the known occurrences in the porphyries are of too low grade to be important commercially. Most of the abnormally radioactive material in veins and pegmatites is either too low-grade or in too small quantities to be of commercial importance. Some of the occurrences in veins have been explored inadequately and could not be evaluated in 1955; one mine (the Martha E winze) within the district shipped 2,920 pounds of 0.14 percent ore that was hand-picked from high-grade spots.

Structural control of some of the ore shoots in the area is well-defined. Openings favorable for the deposition of ore were formed at vein intersections, along deflections in strike or dip of veins, and along deflections where a vein enters a rock of different competency.

About 60 mines, ranging in size from those containing a few hundred feet of workings to those containing several miles of workings, are scattered throughout the area. Most of the mines have not been worked for years, many since before 1900. During 1953, 1954, and the first half of 1955 only one mine was in continual operation, and only three others had a small amount of exploration work done in them.