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C.I.M. Field Trip, April 17-20, 1968 (Bethlehem, Endako)
— hand-out prepared by J.M. CARR re Highland Valley.

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FIELD TRIP STOPS

1 Bethlehem Copper Mine

~~2 Endako Molybdenum Mine~~

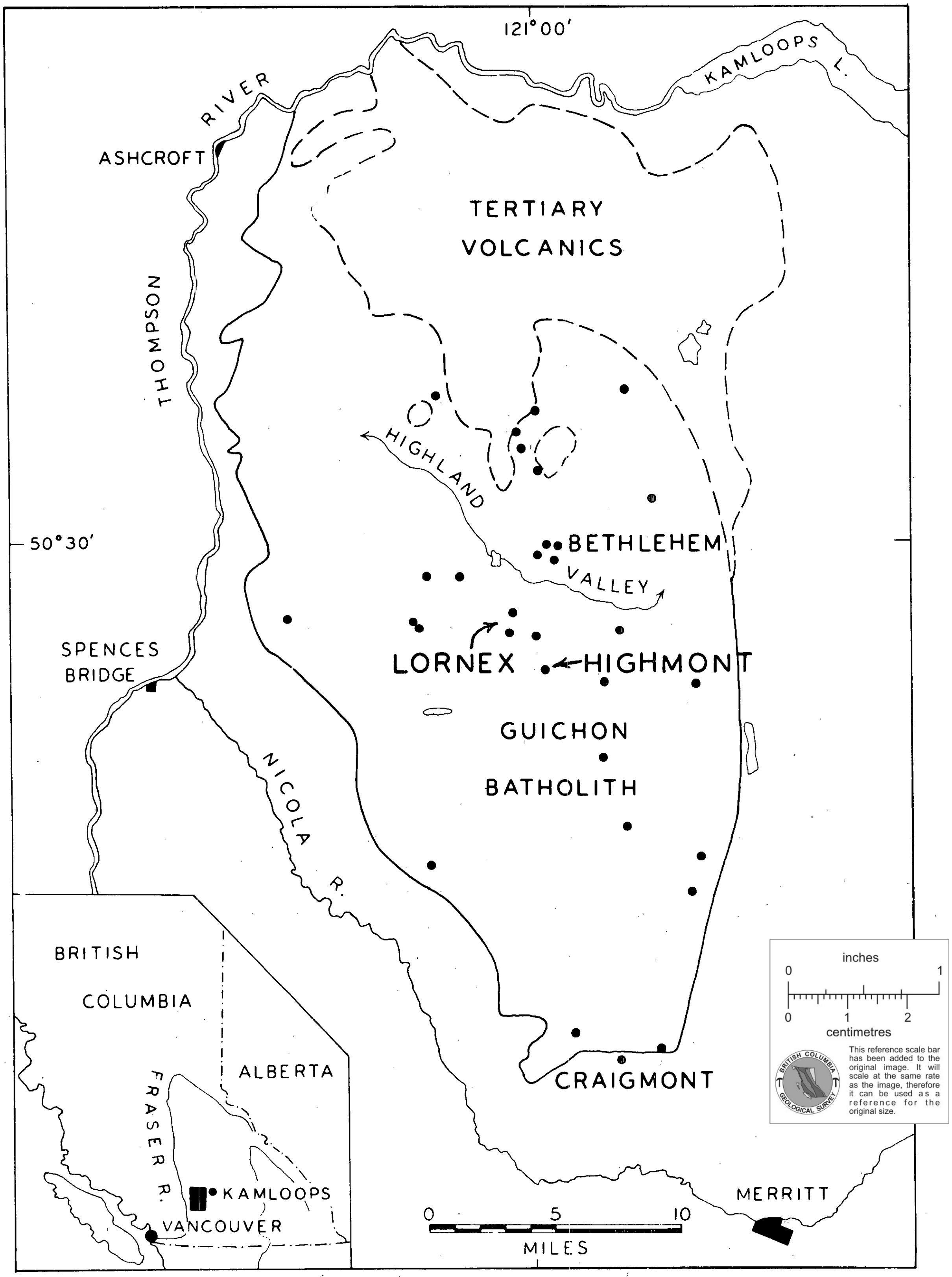

Figure 1

Copper deposits in the Bethlehem area.

GEOLOGY OF THE BETHLEHEM MINE, HIGHLAND VALLEY

By J. M. Carr (adapted from C.I.M. Special Volume No. 8, 1966)

The Bethlehem mine is in the southern interior of British Columbia and is at the centre of the Lower Jurassic Guichon batholith. Figure 1 shows its position relative to other copper mines and prospects in and around the batholith, which lies at the north end of the so-called Nicola copper belt. The Bethlehem deposits in Highland Valley are of unenriched porphyry copper type and are more or less similar to others being explored a short distance to the south on the Lornex and Highmont properties. The Craigmont mine lies 20 miles south of Bethlehem and is a copper-iron skarn in Upper Triassic strata at the south edge of the batholith. Except for a small tonnage of copper ore mined many years ago at a few of the prospects, none of them has yet achieved production.

At Bethlehem four known commercial deposits contain more than 70 million tons of material averaging about 0.70 per cent copper and a little molybdenum. The orebodies are distributed along a semi-circular arc which is about 1 mile in length and is concave toward the south (Fig. 3). In clockwise order the orebodies are the Huestis, Jersey, East Jersey, and Iona. Open-pit mining started in 1962 at the small and relatively high-grade East Jersey orebody and progressed to the Jersey early in 1965. The initial mining rate of 3,400 tons per day was increased by stages to a current rate of 12,000 tons per day. Total production to the end of 1967 was 138,516,105 pounds of copper. Production of molybdenite concentrate was maintained for a short period in 1964 and is expected to re-commence shortly.

All the orebodies except apparently the Huestis are situated along an embayed, highly irregular intrusive contact between older quartz diorite to the north and younger quartz diorite to the south. Emplacement of the younger quartz diorite, which is a porphyritic rock approaching granodiorite in composition, was followed by intrusion of a porphyritic granodiorite stock on the south side of Highland Valley and by a porphyry dyke swarm that extends northward from the stock across the Bethlehem property (Fig. 2). The dykes are of several ages and are mostly dacite porphyrites but include quartz latite and rhyolite porphyries. At Bethlehem the earliest dykes are few in number and are quartz porphyries of dacitic composition. So far as known they occur only in the vicinity of the ore deposits. One of these north-trending dykes (D-D on Fig. 3) intersects the weakened contact zone between the quartz diorites and there expands to form a multiple-branched intrusion. Breccia which occurs alongside the branching sheets of this porphyry body is composed of quartz diorite and porphyry fragments set in an abundant matrix mainly of quartz and feldspar. The breccia forms frayed, tabular bodies as much as 50 feet wide and 800 feet deep. It is believed to have formed as the result of intrusion of porphyry into cold, well-fractured rocks. Under these conditions the surfaces of the porphyry sheets would be quickly chilled to form an impervious seal, thus trapping the volatiles being released by crystallization of the remaining porphyry liquid. Explosion of the porphyry sheets resulted when the mounting internal pressure exceeded the confining pressure exerted by the host rocks.

Subsequent intrusion of numerous other porphyry dykes mainly on north and northeast trends was followed by faulting, which initiated mineralization. Most of the rock alteration occurred at about this time and introduced a variety of minerals many of which are present also at Craigmont. They include quartz, sericite, chlorite, kaolin, calcite, orthoclase, biotite, tourmaline, actinolite, and epidote. Zeolites were deposited after the sulphides, as at Craigmont. The principal ore minerals are bornite and chalcopyrite with molybdenite accompanying them in small amounts. Pyrite is present in parts of the Iona orebody and as a halo around the Jersey orebody. Malachite occurs at shallow depths but there is no appreciable change in copper content by supergene processes.

The orebodies are a combination of sulphide veins and disseminations that are partly due to replacement and partly to fracture filling. The Bethlehem staff has shown that the assay plans of the three best-known orebodies reflect closely a horsetail fault pattern, which is mapped in each orebody and consists mainly of west dipping northerly faults and attendant well-mineralized northeasterly faults (Coveney, 1962), Factors which served to localize ore at Bethlehem were mainly those contributing to the fracturing and alteration of the rocks, namely: (1) the younger quartz diorite contact; (2) porphyry intrusion and accompanying brecciation; (3) faults. The importance of these factors is demonstrated by a geological cross-section of the Jersey and East Jersey orebodies (Fig. 4).

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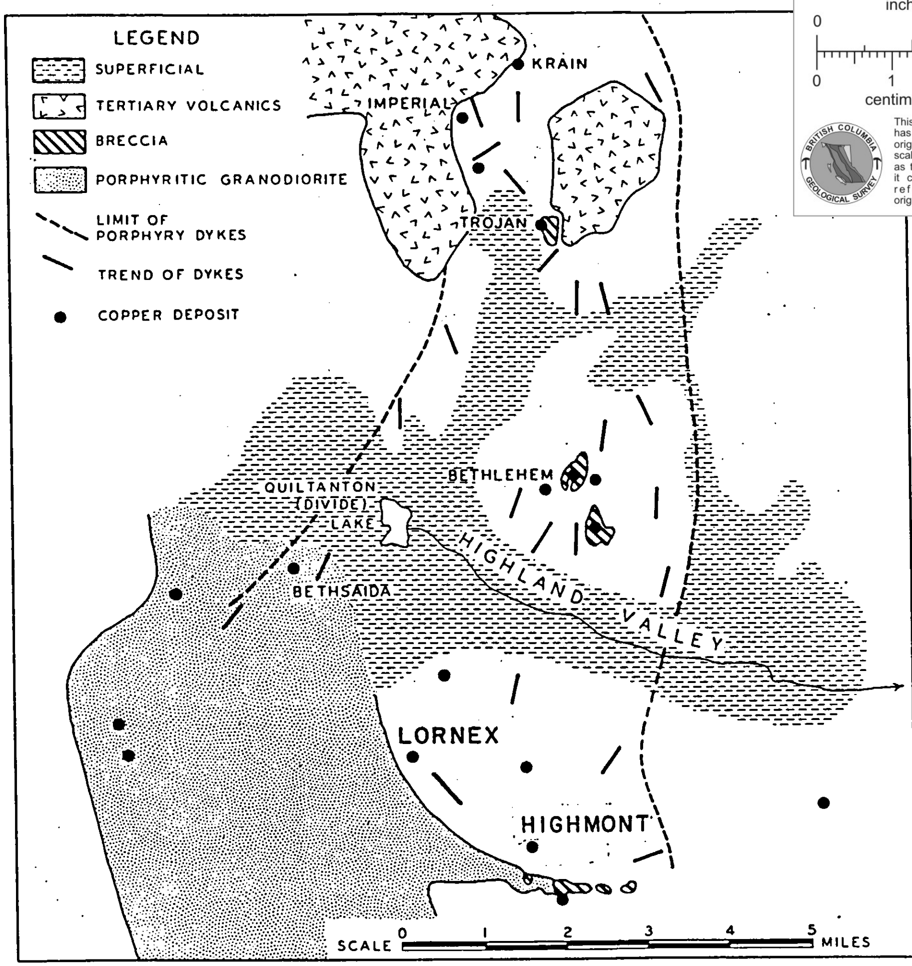
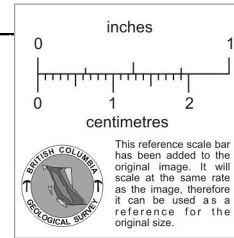


Figure 2

Distribution of porphyries and breccia in Highland Valley.



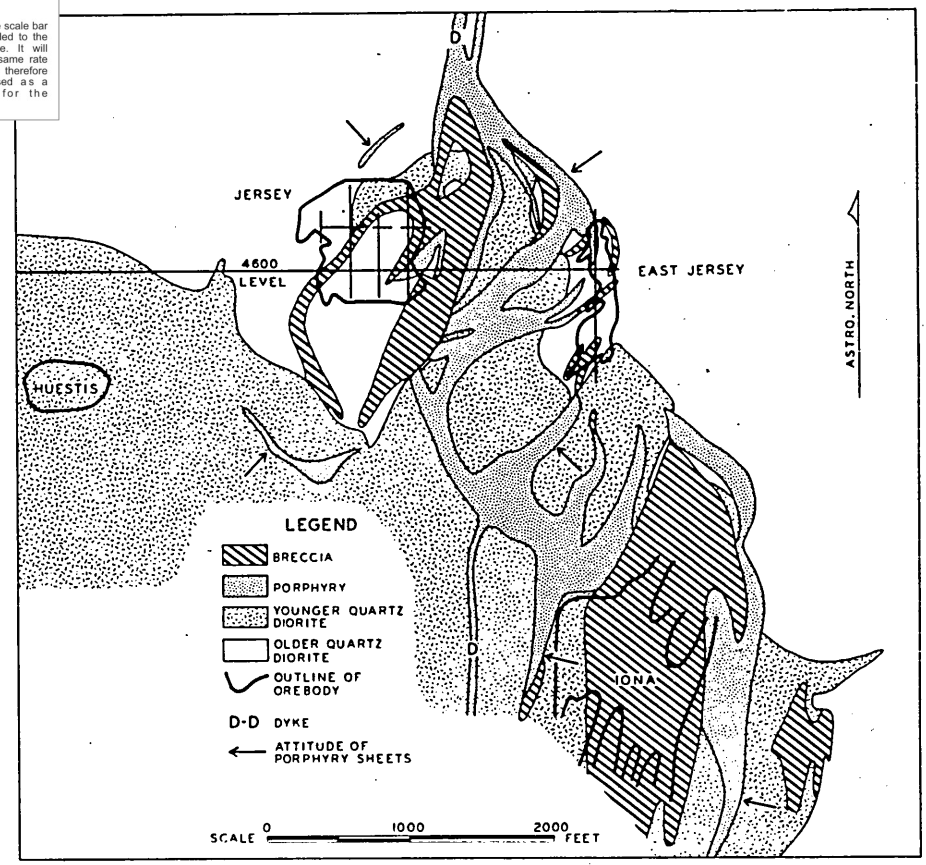


Figure 3

Simplified geological map of the Bethlehem property.

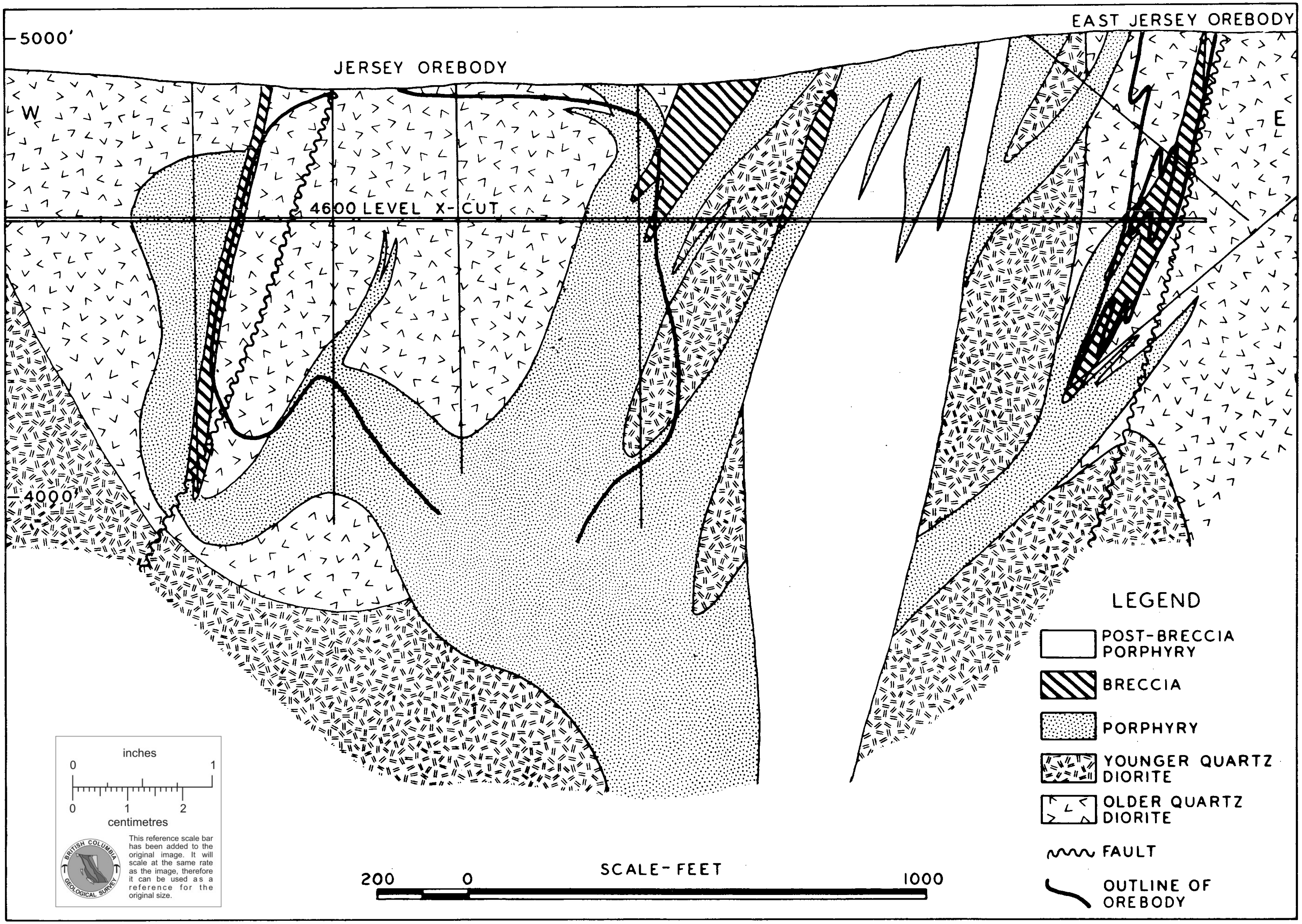


Figure 4

Simplified geological section of the Bethlehem property. Not all the drill holes are shown.