British Columbia Geological Survey
Geological Fieldwork 1991

PRELIMINARY RESULTS OF DRIFT EXPLORATION STUDIES IN THE QUATSINO (92L/12) AND THE MOUNT MILLIGAN (93N/1E, 93O/4W) AREAS

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KEYWORDS: Applied geochemistry, drift exploration, surficial geology, Island Copper, Mount Milligan, till, glaciofluvial outwash, soil geochemistry, dispersal trains, porphyry copper-gold.

INTRODUCTION

This report describes the preliminary results of the Quatsino project (1991 field season) which entails a drift exploration study of the Island Copper mine area and the Quatsino map sheet (92L/12), and an investigation of regional glacial dispersal in the Mount Milligan area (Figure 3-6-1). Both projects are part of the British Columbia Geological Survey Branch's drift prospecting program designed to demonstrate the utility of a combined surficial geology–exploration geochemistry program in the search for drift-covered mineral deposits in areas of glaciated terrain. The program's main goals are:

- To define regional Quaternary stratigraphy and glacial history.
- To document glacial dispersal patterns from known mineral occurrences.
- To produce 1:50 000-scale surficial geology and RGS-style interpretive maps for use in mineral exploration.
- To develop interpretive drift-exploration models.

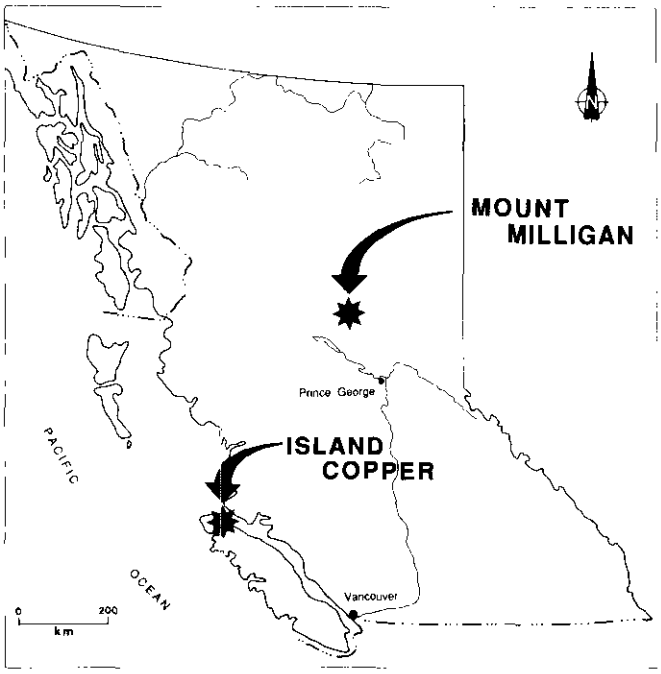

Figure 3-6-1. Location of the Island Copper and Mount Milligan deposits.

The Quatsino project is an evaluation of the use of drift sampling as a regional mineral exploration tool. The Quatsino map sheet, centred over the North Island copper belt, was chosen due to the high mineral potential of this area, the presence of known mineral deposits suitable for drift prospecting case studies, the variable drift thickness and the poor understanding of the regional Quaternary glacial history.

The drift sampling program in the Mount Milligan area will document regional patterns of geochemical dispersal trains in an area of high mineral potential and aid in the determination of regional sampling densities. This work complements the detailed surficial geological and geochemical dispersion studies carried out at the Mount Milligan deposit during the 1990 field season (Kerr, 1991; Kerr and Bobrowsky, 1991; Gravel and Sibbick, 1991).

METHODS

Quatsino Project

Preliminary airphoto interpretation of the surficial geology of the Quatsino map sheet at a scale of 1:50 000 was undertaken prior to fieldwork. Access was mainly by logging road, and by traverses on foot along streams which provided opportunities for stratigraphic studies. A helicopter was used to gain access to isolated locations. Surficial sediment types were initially plotted on 1:15 000 and 1:20 000-scale maps supplied by Western Forest Products Limited and the British Columbia Ministry of Forests. Ice-flow directions were obtained from till fabrics at 13 sites across the map area; other ice-flow indicators (striae, fluted bedrock, drumlins) were measured at numerous locations. Approximately 28 detailed stratigraphic sites were investigated, including 2 glaciomarine and marine deltas. A marine shell sample was collected, for radiocarbon analysis, at 6 metres below sea level from the pit wall of the Island Copper mine.

Sampling for the Quatsino project consisted of 194 drift samples collected across the map area from road cuts, hand-dug pits and stream banks, at an approximate density of one sample per 5 square kilometres (Figure 3-6-2). The unoxidized C-horizon, commonly 1 to 2 metres below the surface, was sampled whenever possible. Of the 194 samples, 134 samples consisted of till, 48 of colluvium, 11 of glaciofluvial sediment and 1 of glaciomarine material. At three-quarters of the sites, 25 pebbles were collected for lithological analyses and provenance studies. Each sample will be analysed by instrumental neutron activation analysis (INAA) and inductively coupled plasma analysis (ICP) for 40 elements.

An orientation survey was conducted around the Island Copper copper-gold-molybdenum mine, for a distance of 6

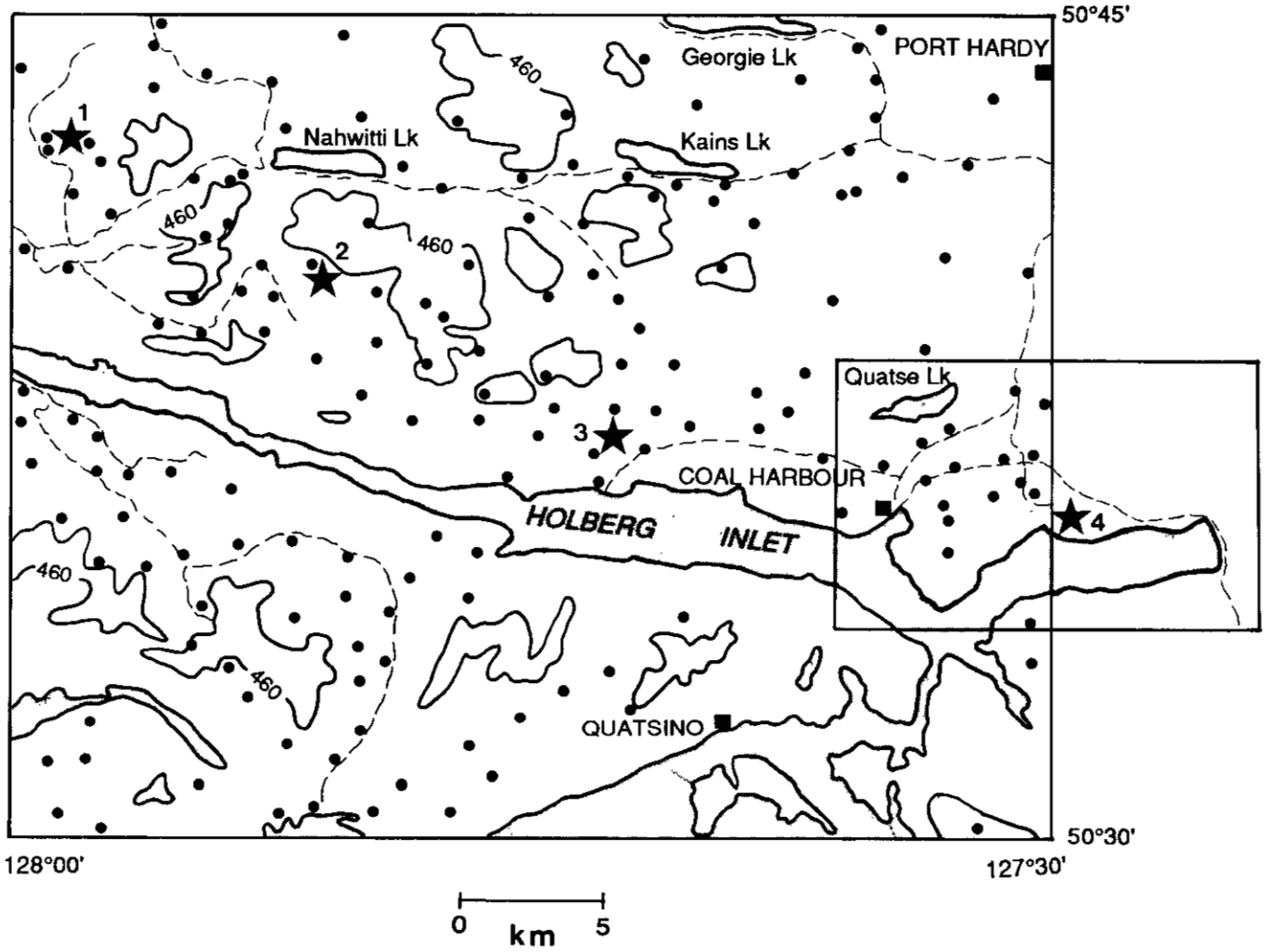

Figure 3-6-2. Geochemical sample locations and mineralized areas under investigation in the Quatsino map area (92L/12).

kilometres down-ice of the deposit (Figure 3-6-3). Near the deposit, surficial sediment cover is up to 75 metres thick, obscuring much of the bedrock near the orebody. Approximately 37 till samples were collected, providing a sampling density of one sample per square kilometre. Additional samples were collected from surficial sediments at the Red Dog and Hushamu deposits for comparative geochemical studies.

Mount Milligan

In 1991, regional-scale sampling of till was carried out down-ice from the Mount Milligan porphyry copper-gold deposit for a distance of 20 kilometres to the east-northeast (Figure 3-6-4). About 125 till samples were collected from 112 hand-dug pits within a 150 square kilometre area. The unoxidized C-horizon was preferentially sampled at depths of 0.5 to 1.5 metres. Sampling was concentrated in two distinct areas where till is the predominant surficial sediment: in the vicinity of the deposit and in the region to the east of Rainbow Creek. The intervening area, consisting of glaciofluvial outwash, was not sampled due to its different generic characteristics in comparison with till. Soil samples of the oxidized B-horizon developed in till were acquired at each site in order to contrast any differences resulting from the underlying unoxidized C-horizon. Pebble samples were also collected from each site for provenance studies. Three size fractions (−250+125, −125+62.5 and −62.5

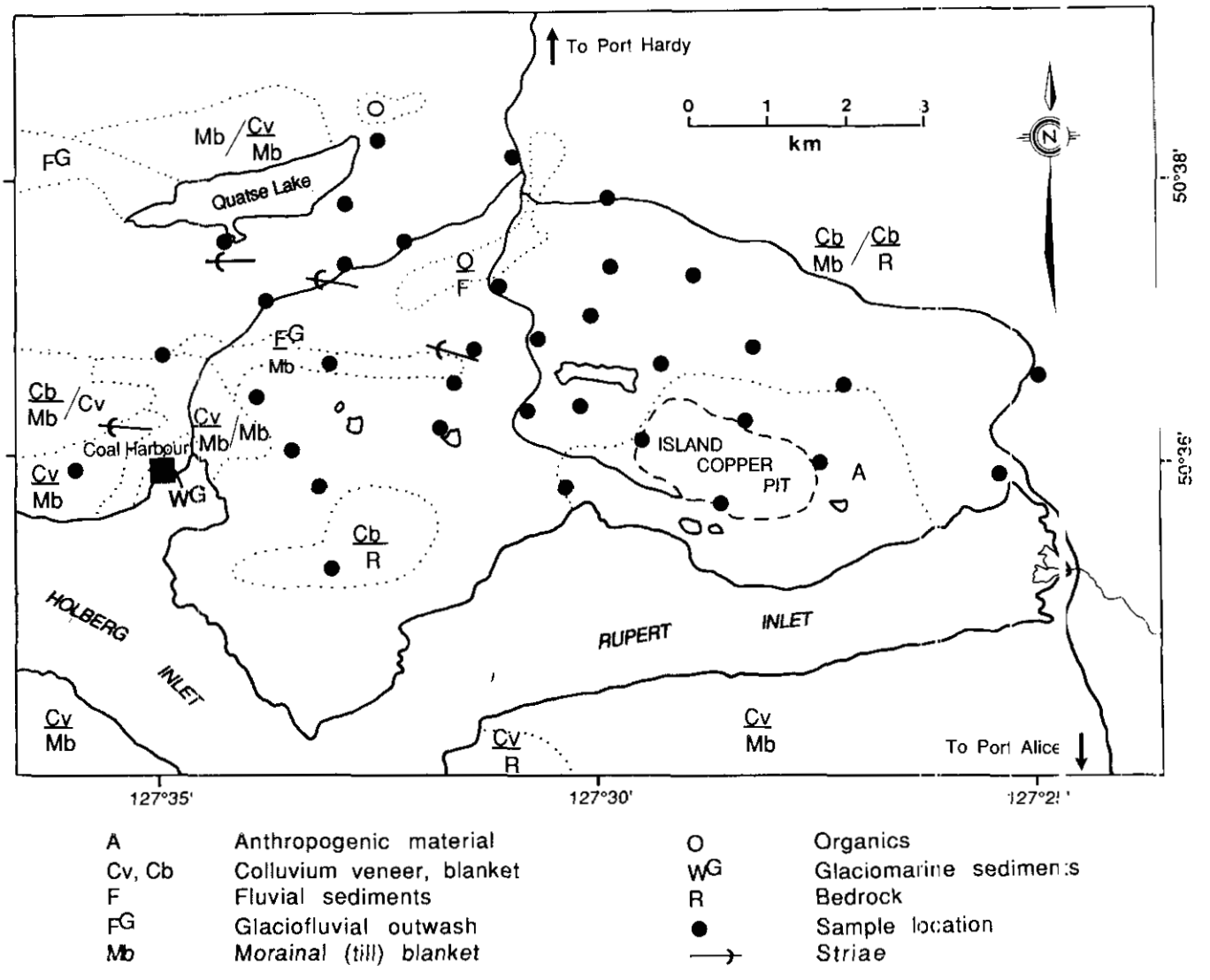

Figure 3-6-3. Detailed surficial geology and geochemical sample location map of the Island Copper area.

microns) of each sample will be analysed by instrumental neutron activation analysis (INAA) and inductively coupled plasma analysis (ICP) for 40 elements.

RESULTS

Quatsino Project

The Quatsino map area (Plate 3-6-1) was last glaciated during the Late Wisconsinan (Fraser glaciation) about 20 000 to 10 000 years ago. Howes (1983) has reported evidence for two glaciations based on the presence of two distinct tills in the north-central regions of Vancouver Island. However, the present authors have found evidence for only one glaciation within the study area. Regional ice-flow direction during the last glaciation was generally toward the northwest, originating from the Coast Mountains and crossing Queen Charlotte Strait. There is, however, considerable variation in glacier flow direction on a local scale; during the initial stages of the glacial advance, individual tongues of ice followed pre-existing valleys, some ice lobes flowing to the west, southwest and south. As opposed to the Nimpkish Valley to the south where small alpine glaciers developed, there is no evidence for any local ice sources in the Quatsino area.

Field mapping shows that surficial materials consist of minor glaciomarine and marine sediments along coastal lowlands below 25 to 30 metres elevation. Widespread deposits of till (Plate 3-6-2), attaining tens of metres in thickness in valleys, are common in both highlands and lowlands. Glaciofluvial outwash, consisting of sand and gravel 1 to 15 metres thick, is generally restricted to valley bottoms. Isolated pockets of silty clay glaciolacustrine sediments occur in valleys where glacial meltwaters were once ponded by stagnant lobes of ice. Colluvium derived from till and weathered bedrock is found not only on steeper slopes, but as a ubiquitous veneer (<1 m) or blanket (>1 m) which covers most other types of surficial sediment types (Plate 3-6-3).

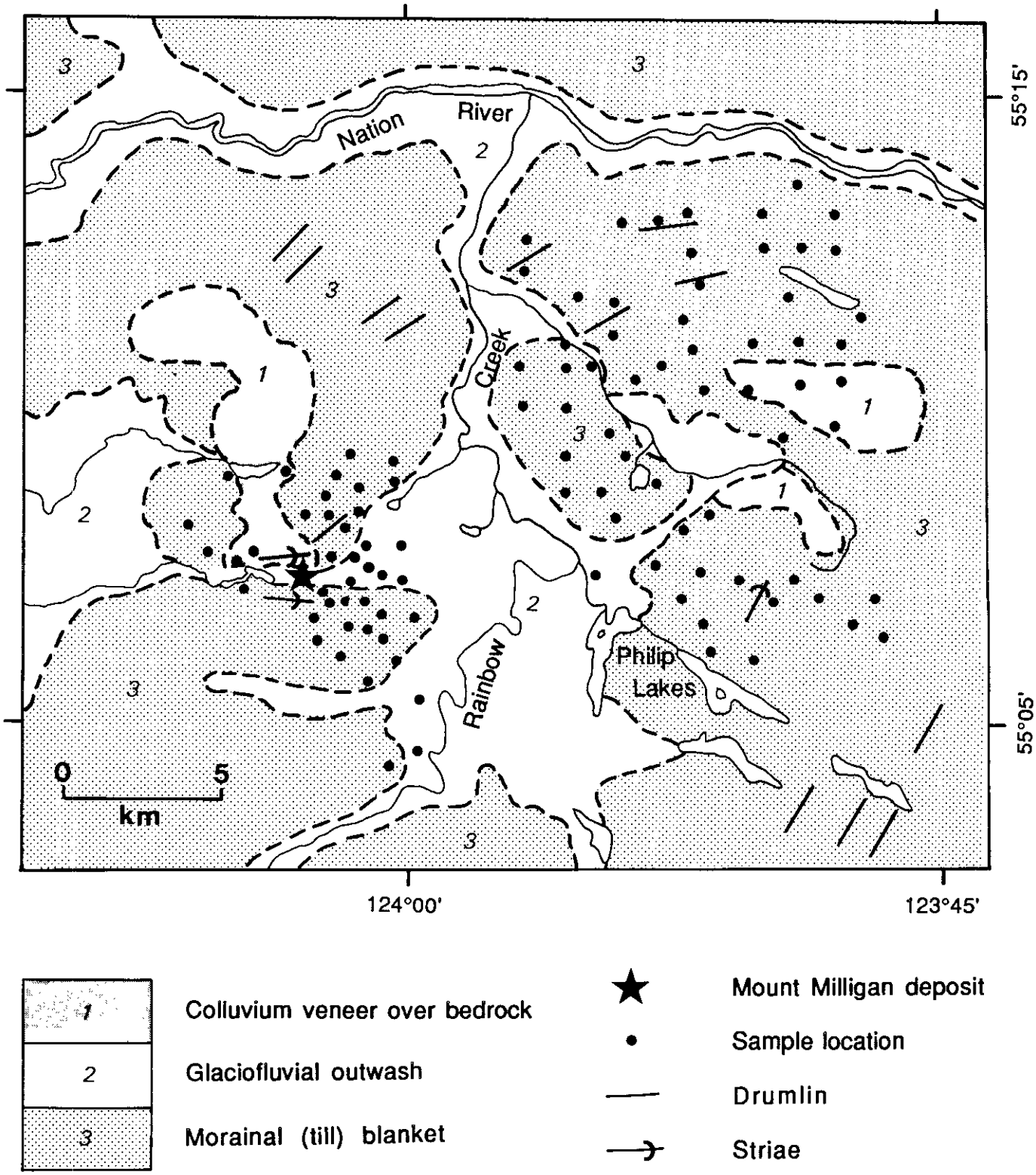

Figure 3-6-4. Generalized surficial geology and geochemical sample location map of the Mount Milligan deposit area.

Plate 3-6-1. Aerial view of Quatsino area relief north of Holberg Inlet, looking north: note fluted landforms developed in till, trending northwest in the foreground, Pemberton Hills in background.

Plate 3-6-2. Striated bedrock (309) overlain by massive till; trowel for scale.

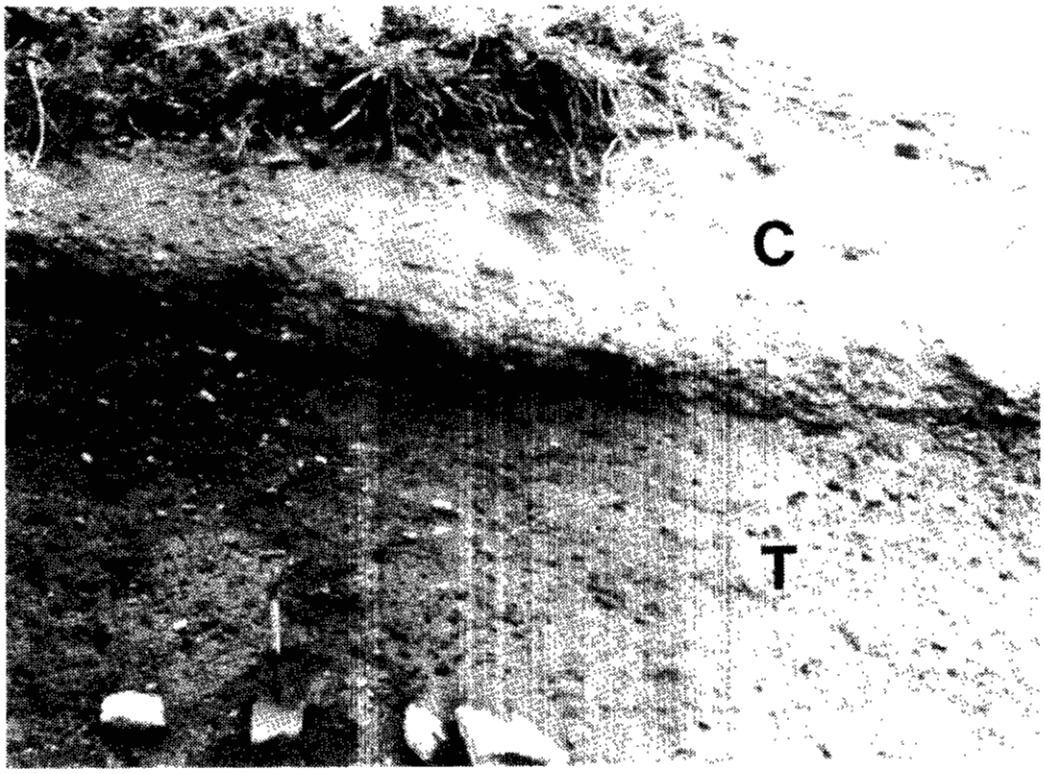

Plate 3-6-3. Massive till (T) sharply overlain by colluvium blanket (C); shovel for scale.

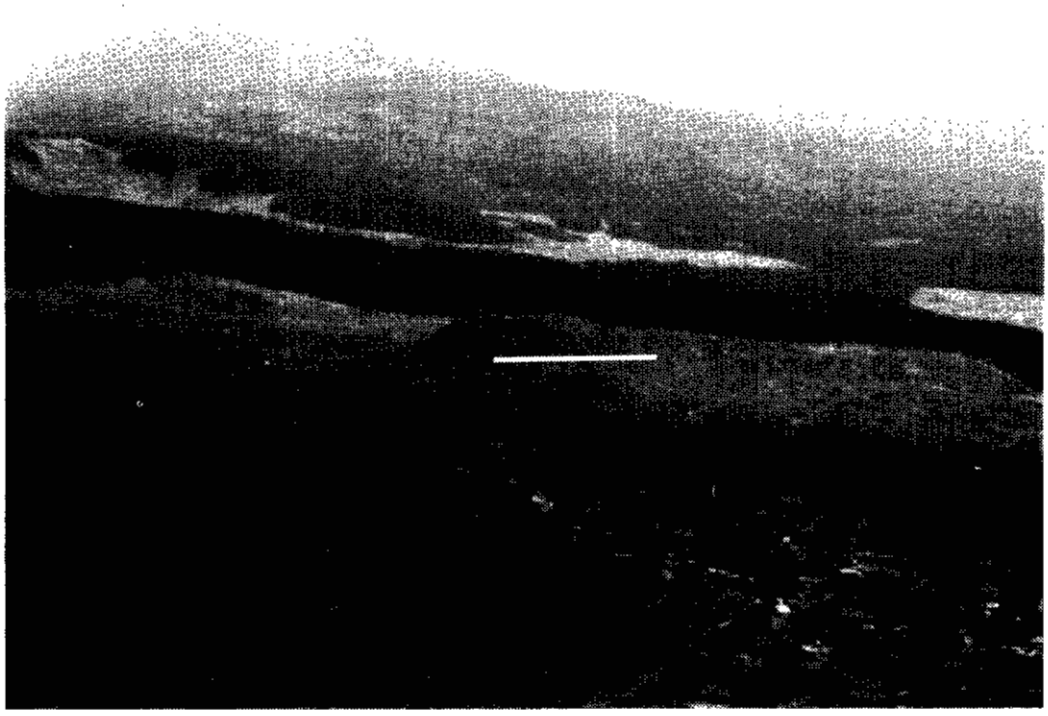

Plate 3-6-4. Aerial view of the subdued relief east of the Mount Milligan property, looking north. Glaciofluvial veneer over till in extensively drilled mineralized areas in foreground and till in centre/background. Note northeast-trending drumlin in centre and Mount Milligan in distance.

MOUNT MILLIGAN

The last glacial episode in the Mount Milligan region occurred 20 000 to 10 000 years ago during the Late Wisconsinan. Regional ice movement during this event was primarily to the northeast, as interpreted from ice-flow indicators such as well-developed striae scoured into bedrock and drumlinoid features developed in and on unconsolidated sediments.

The sample area (Figure 3-6-4; Plate 3-6-4) can be divided into two general surficial units: a broad, predominantly morainal (till) blanket which is dissected by a central corridor of glaciofluvial outwash. The till was deposited during the last ice advance and is commonly hummocky and drumlinized. Glacial striae, drumlins and other fluted landforms in the southern and western map areas indicate that, on a local scale, ice was initially funnelled through the narrow east-west-oriented valleys between the highlands north and south of the Mount Milligan deposit, and then flowed toward the northeast during full glacial conditions. South of the Nation River, ice flow was reoriented towards the east, as suggested by the drumlinized features which reflect a gradual change in flow direction. In general, the till consists of a dense diamicton composed of very poorly sorted angular to well-rounded pebbles to cobbles in a sand-silt-clay matrix.

A large concentration of glaciofluvial sand and gravel dominates the central part of the map area along Rainbow Creek. This outwash-sediment complex consists of sinuous esker ridges up to 10 kilometres long, kame deposits and a series of broad overlapping outwash fans. Together with outwash sediments along the Nation River and smaller east-west glaciofluvial corridors in the western map area, this complex forms part of a larger regional glaciofluvial system. The stratified sands and gravels in the Rainbow Creek area and elsewhere were deposited by glacial meltwaters during phases of ice retreat. These sediments represent the end product of a long period of glacial and fluvial erosion, transportation and reworking of many types of surficial sediments from an area hundreds of square kilometres in size.

Drift thickness is highly variable, ranging from less than 1 metre on rocky highlands, to over 80 metres in the Rainbow Creek area. Detailed drilling around the Mount Milligan deposit has helped to define topographic bedrock lows toward the northeast. Further drilling, however, would be required to determine the extent and trend of these buried valleys.

ACKNOWLEDGMENTS

The authors wish to thank Lorne Warner and Dale Sketchley of Placer Dome Inc., John Fleming of BHP-Utah Mines Ltd. and Peter Dasler of Moraga Resources for logistical support during the field season, as well as Western Forest Products Limited, Tribune Timber Limited and W.D. Moore Logging Limited for their hospitality and assistance in the field.

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NOTES