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PRELIMINARY RESULTS OF GLACIAL DISPERSION STUDIES ON THE GALAXY PROPERTY, KAMLOOPS, B.C. (92I/9)

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INTRODUCTION

This report describes the 1992 field season preliminary results of a glacial dispersion study on the Galaxy porphyry copper-gold deposit in the Iron Mask batholith, 5 kilometres southwest of Kamloops (Figure 4-5-1). The project involves three drift-exploration techniques: till geochemistry, till-pebble lithology and biogeochemistry. This investigation is designed to demonstrate the applicability of a combined surficial geology - exploration geochemistry program in the search for mineral deposits in areas of glaciated terrain with thick till cover.

Successful drift-exploration strategies require an accurate interpretation and understanding of the genesis and distribution of surficial materials, and ice-flow history (DiLabio, 1989). Drift sampling in the Galaxy area documents glacial patterns of geochemical and lithological dispersion in till. The Galaxy deposit was selected due to its physiographic environment, geological setting, well understood Quaternary glacial history and overburden stratigraphy, all of which make it suitable for a glacial dispersion case study. This work complements similar surficial geology and geochemical dispersion investigations carried out on porphyry copper-gold deposits at Mount Milligan (Kerr and Bobrowsky, 1991; Gravel and Sibbick, 1991) and at the Island Copper mine (Kerr *et al.*, 1992).

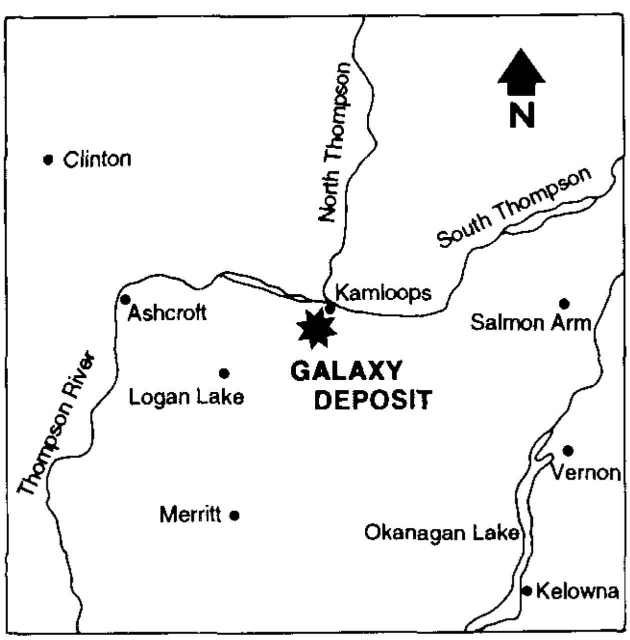

Figure 4-5-1. Location of the Galaxy property.

The objective of the Galaxy till-sampling program is to determine the style of dispersion and the rate at which anomalous elements are diluted to background concentrations within a till sheet. Studies of soil profiles will illustrate the effects of soil formation on the geochemistry of till sediments. Relationships of glacial dispersion to size-fraction element concentrations, surficial geology and glacial history will also be assessed.

REGIONAL GEOLOGY

The Galaxy deposit is one of seven porphyry copper-gold deposits located within the Afton camp. These deposits, as well as the Afton and Ajax orebodies, are hosted within the Iron Mask batholith (Preto, 1968), an elongate, northwest-trending, alkaline subvolcanic intrusive complex about 20 kilometres long by 4 kilometres wide, that intrudes comagmatic and coeval andesitic to basaltic flows, pyroclastics and sedimentary rocks of the Triassic Nicola Group. The batholith comprises four intrusive phases ranging in composition from pyroxenite and gabbro to diorite to monzonite and syenite. Emplacement of the intrusive units and the subsequent mineralizing events were controlled by a complex system of recurring northwesterly, northeasterly and northerly trending faults and related fracture zones.

Primary mineralization within the deposits consists of fracture-controlled chalcopyrite and bornite accompanied by pyrite, pyrrhotite and magnetite. The Afton deposit, prior to mining, contained a large supergene zone of native copper, chalcocite and cuprite.

PROPERTY GEOLOGY

Copper mineralization on the Galaxy property consists of chalcopyrite and minor bornite with only minor, near-surface oxidation. The main deposit occurs within a keel-shaped zone, about 150 metres wide, 400 metres long and up to 70 metres thick, which is part of a northwest-trending, graben-like structure composed of sheared and strongly fractured Nicola Group volcanics and dioritic phases of the Iron Mask batholith (Figure 4-5-2). Irregular shaped bodies of sheared, serpentinized olivine-pyroxene-rich basic intrusive, referred to as picrite, are exposed along the southwest margin of the graben. The graben is bounded on the southwest and northeast by fine-grained syenite and microsyenite.

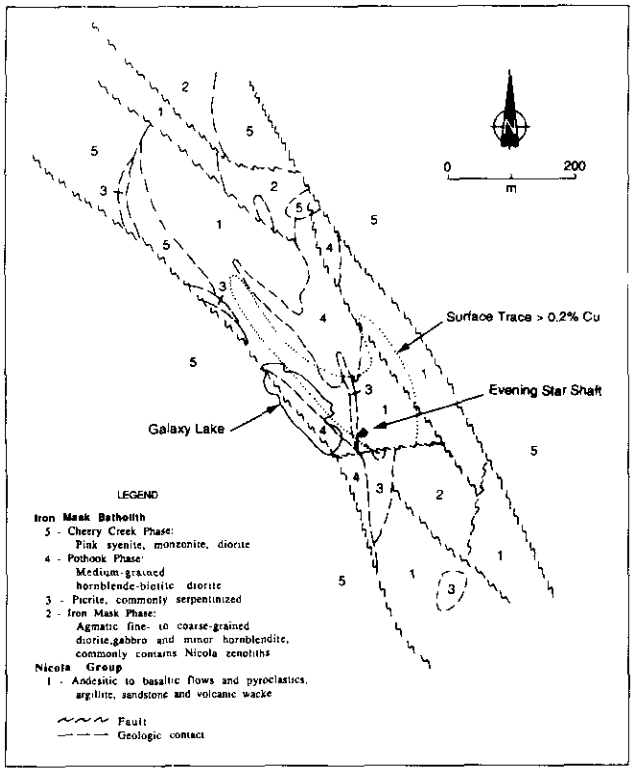

Figure 4-5-2. Simplified sketch of bedrock geology, Galaxy zone. Modified from Blanchflower (1978).

FIELD METHODS

Preliminary airphoto interpretation of the surficial geology of the Galaxy area at a scale of 1:70 000 was undertaken prior to fieldwork. Surficial sediment types and large-scale geomorphological ice-flow directional features (*i.e.*, drumlinoid ridges) were identified and plotted on a 1:5 000-scale base map. Additional ice-flow patterns were obtained from striated bedrock and till-pebble fabrics at two sites over the deposit in order to further define the direction of ice movement across the study area. Detailed stratigraphic investigations of trenches and hand-dug pits at 100 sites were undertaken to identify changes in the overburden subsurface record.

A sampling grid was established over the areas of known mineralization, extending to a distance of 1500 metres in the down-ice direction of the deposit (Figure 4-5-3). The orientation of the grid was established on the basis of inferred ice-flow direction, so that sample sites would theoretically cover the expected dispersal trains. The oxidized C-horizon, commonly occurring 0.5 to 0.75 metre below the surface, was sampled at approximately 170 sites. Along the long axis of the grid, A and B-horizon samples were also collected to contrast differences with the underlying oxidized C-horizon. Three detailed soil profiles were also sampled to identify geochemical variations with depth. The 80 mesh (-177 micron) fraction of each drift sample will be analyzed by instrumental neutron activation analysis (INAA) and inductively coupled plasma analysis (ICP) for forty elements.

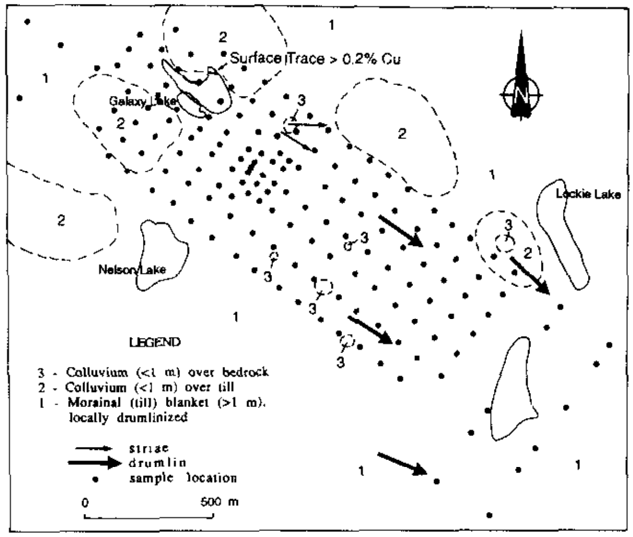

Figure 4-5-3. Surficial geology map of the Galaxy area, showing sampling grid location.

At 11 sites along the long axis of the grid, 25 pebbles were collected for lithological analyses and provenance studies. In addition, the stems, leaves and flowers of rabbitbush (*Chrysothamnus nauseosus*) plants were sampled for comparison with soil data. Rabbitbush is a compact (50 cm high), olive-green shrub topped by a mass of small yellow flowers which is common in the dry interior of British Columbia (Lyons, 1991). Field observations show that the taproot of this shrub may extend 1 metre or more below the surface. Rabbitbush samples were analysed by ICP for 30 elements and results are expressed on an ashed basis.

RESULTS

SURFICIAL GEOLOGY

The last glacial episode in the Kamloops region occurred during the Late Wisconsinan (Fraser Glaciation) between 20 230±270 years B.P. (GSC-194) and10 500±170 years B.P. (GSC-1524). Ice movement during this final event was primarily to the southeast, as interpreted from ice-flow indicators such as well-developed drumlin fields developed in till. This observation of regional flow is in accordance with earlier studies by Fulton (1963) in the Kamloops Lake area. Fulton (1975) also mapped the extent of glacial and nonglacial sediments and noted the presence of ice-flow indicators to the east, southeast and south of the study area. Previous glacial episodes also affected the area, but the conditions surrounding these older events can only be interpreted from more deeply buried deposits preserved in bedrock depressions and larger valleys. During deglaciation phases, ice appears to have retreated towards the north and northwest.

Drumlinized till sediments are widespread throughout the Kamloops area occurring primarily as a blanket (1 m) in the northern and southern plateaus along the South Thompson Valley, as well as in range country which continues discontinuously south to Princeton. The shape and size of the flutings are variable, but the dominant trend of these land-

Plate 4-5-1. Gently rolling topography developed on till south of the Galaxy property; view southeast.

Plate 4-5-2. Massive till and soil development exposed in a trench; large boulder measures 40 centimetres.

forms is to the southeast. Surficial sediments identified in the Galaxy area include fluted diamicton (till) of variable thickness, thin veneers (m) of colluviated till over till on steeper slopes, and less than 5 per cent bedrock (Plate 4-5-1). Drift cover ranges from less than 1 metre to tens of metres in thickness. Near the deposit, surficial sediment cover averages 3 to 5 metres, obscuring much of the bedrock near the deposit. Drill-hole data from assessment reports show that significant thicknesses of unconsolidated sediments, in excess of 20 to 30 metres, are common southeast and south of the deposit (Blanchflower, 1978; Belik, 1990a, b). For most areas, the till is compact very poorly sorted and consists of angular to well-rounded pebbles to boulders in a sand-silt-clay matrix (Plate 4-5-2).

GEOCHEMISTRY

Soils developed in the area of the Galaxy deposit consist of orthic dark brown chernozems in the grasslands and eutric brunisols under areas of forest cover. Results for copper in soil samples collected along the sample baseline indicate that soil copper contents are generally highest in the C-horizon (till) and lowest in the A-horizon (Figure 4-5-4). This feature may be due to the addition of loess to the upper soil horizons (H. Luttmerding, personal communication, 1992) which would dilute the original metal (*i.e.*, copper) content of the upper soil horizons. As deposition of loess in the postglacial period was controlled by factors such as wind patterns and topography, dilution of the upper soil horizons (and their metal concentrations) would be highly variable and bear no relation to the original A and B-horizon metal contents.

Rabbitbush samples reported higher copper contents than corresponding soils at eight of eleven sites, but show no consistent trend with distance from the deposit (Figure 4-5-4). Rabbitbush was also found to contain higher mean concentrations of boron, calcium, lead, magnesium, molybdenum, strontium and zinc. Additional biogeochemical studies are suggested in order to more accurately define the reliability and accuracy of this technique.

Preliminary results (Figure 4-5-5) indicate the existence of a strongly anomalous (200 ppm), ribbon-shaped dispersion train of copper extending for up to 1 kilometre down-ice from the deposit. Copper concentrations along the farthest down-ice sample line (approximately 1500 m from the deposit) average 136 ppm copper, suggesting that a significant (100 ppm) anomaly may extend for a greater distance.

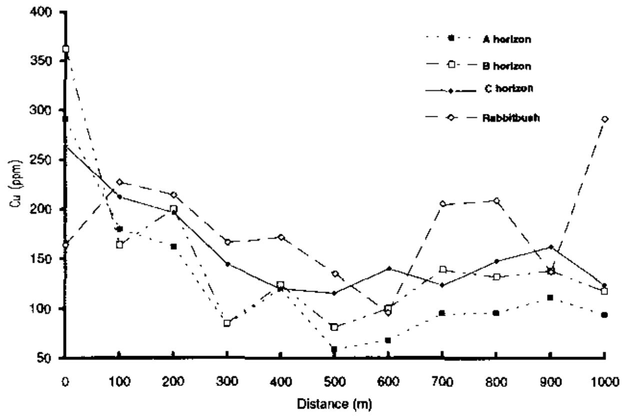

Figure 4-5-4. Down-ice dispersion of copper in A, B and C-horizon soils and rabbitbush.

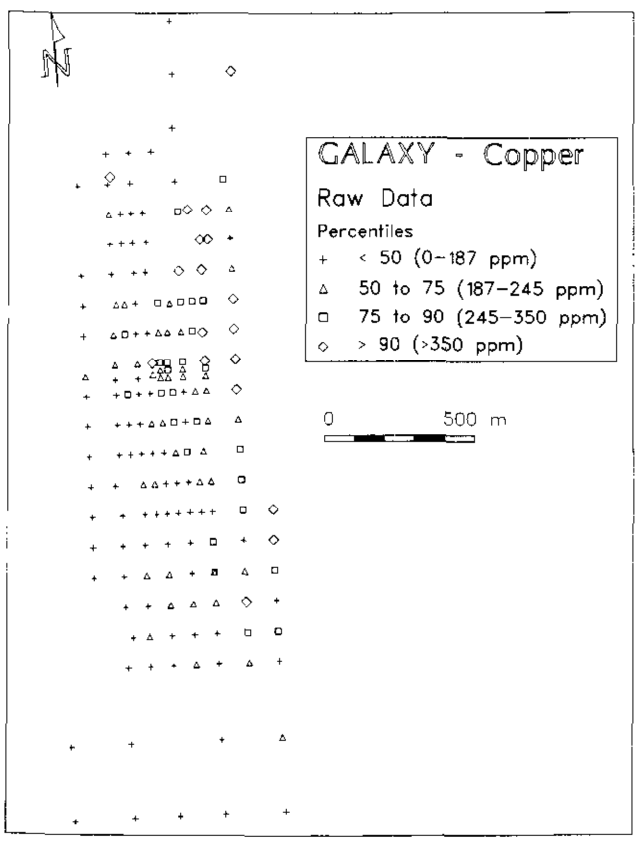

Figure 4-5-5. Copper concentrations overlying and down-ice from the Galaxy deposit.

These early results suggest similarities with the work described by Young and Rugg (1971) at the Island Copper mine; a linear geochemical anomaly, developed in till less than 9 metres thick over the orebody, extends for more than 600 metres in the down-ice direction parallel to ice flow. Fox *et al.*, (1987) describe a well-defined dispersion train developed in till over the Quesnel River gold deposit; this linear down-ice soil anomaly has been defined for approximately 1 kilometre.

CONCLUSIONS AND IMPLICATIONS

Studies at the Galaxy property focus on the controls of glacial dispersion and soil formation on geochemical anomaly formation. Data collected from this project will be used to develop a conceptual model of glacial dispersion and soil processes applicable to the search for porphyry copper-gold deposits. These studies will aid in the design and interpretation of drift-prospecting and geochemical soil surveys conducted in the province. Geochemical, lithological and biogeochemical orientation surveys will highlight the effects of mechanical and chemical dispersion and will define the grain-size fractions which provide the highest anomaly contrast. These surveys characterize the sediments over and down-ice from the deposit and may serve as a guide to similar mineral deposits with comparable surficial geology cover elsewhere in the southern Interior, notably in the Kamloops - Aspen Grove - Princeton region. Ongoing studies investigate the hypothesis that significantly higher metal values are associated with the oxidized C-horizon in till as opposed to oxidized B-horizon soils developed from the same parent material. Mapping of ice-flow patterns and an understanding of the nature and origin of surficial sediments are essential in the interpretation stages of soil geochemical surveys.

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NOTES