

NORTHERN VANCOUVER ISLAND INTEGRATED PROJECT

By A. Panteleyev, P.T. Bobrowsky, G.T. Nixon and S.J. Sibbick

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INTRODUCTION

The Northern Vancouver Island project is one of five new integrated studies resulting from the Ministry's 1993 *Mineral Strategy*, an initiative intended to revitalize base metal exploration in the province. Northern Vancouver Island (Figure 1) was chosen as an ideal starting point for a two-year study because the region has been assessed to have high mineral potential. Also, although the area has an established mining base and infrastructure, ore reserves at Island Copper mine are rapidly being depleted and closure is imminent.

The project typifies the integrated approach taken in these "targeted" geoscience programs. The project includes bedrock and surficial geological mapping; water, till and bedrock geochemistry; and alteration and mineral deposits studies. This work is supported by specialized stratigraphic, geochronological and remote sensing investigations by investigators from the Geological Survey of Canada, universities and the Canadian Centre for Remote Sensing.

Recent geological work that provides a foundation for the project includes regional geological mapping in the Mahatta Creek map area (92L/5) by Nixon *et al.* (1993a, 1993b) and Hammack and Nixon (1993), till geochemistry investigations in Quatsino map area, (92L/12) by Kerr *et al.* (1992) and mineral deposits and related natural acid drainage studies to the west of Island Copper mine by Panteleyev and Koyanagi (1993) and Koyanagi and Panteleyev (1993).

The economic geology of northern Vancouver Island is dominated by mineral deposits in Jurassic volcanic rocks of the Bonanza Group and the coeval rocks of the Island Plutonic Suite. These units define an Early Jurassic island arc, much akin to some present day western and southwestern Pacific volcanic arcs. Important mineral deposits in this setting are typically porphyry copper with related peripheral base and precious metal vein and replacement deposits, as well as skarn deposits. A fine Northern Vancouver Island example is Island Copper mine, a major porphyry copper deposit of superior quality by British Columbia standards. Major prospects are the Hushamu porphyry copper deposit (EXPO claims), 26 kilometres to the west

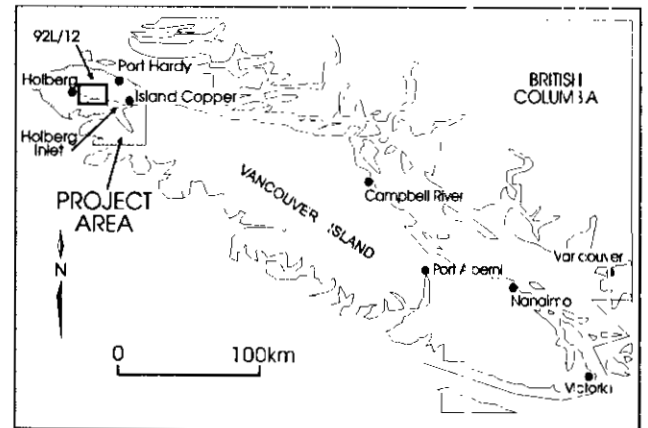


Figure 1. Location map.

of Island Copper mine and the smaller Red Dog deposit, 37 kilometres west-northwest of the mine. Hushamu is a large, but lowgrade copper-gold-molybdenum deposit; geological reserves within a larger resource are 172.5 million tonnes with an average grade of 0.28 % copper, 0.34 gram per tonne gold and 0.009 % molybdenum (Jordex Resources Inc. report, 1993). Red Dog mineral reserves are 31.2 million tonnes with an average grade of 0.313 % copper, 0.45 gram per tonne gold and 0.007 % molybdenum (Crew Natural Resources Ltd. prospectus, 1992). Skarn deposits include the past-producing mines at Yreka, a copper-gold-silver deposit 9 kilometres northwest of Port Alice, and the Merry W dow, Kingfisher and Old Sport copper-iron-gold deposits near Benson Lake, 16 kilometres southeast of Port Alice. The potential for precious and base metal replacement and epithermal-type occurrences is the new and current exploration focus in the region.

COMPONENT STUDIES WITHIN THE INTEGRATED PROJECT

The four component fields of study in this integrated project: regional mapping, surficial geology, economic geology and exploration geochemistry, are summarized elsewhere in this volume by Nixon *et al.*, Bobrowsky and Meldrum, Panteleyev and Koyanagi, and Sibbick, respectively. Fieldwork in Northern Vancouver Island is expected to continue in 1994.



Plate 1. Northern Vancouver Island targeted geological study 1993; integrated project team. Left to right: Garry Payie, Graham Nixon, Jack Hamilton and Jan Hammack, regional mapping; Victor Koyanagi, regional mapping and economic geology; Jessie (in front), regional mapping and bear patrol; Peter Bobrowsky, surficial geology; Andre Panteleyev, economic geology; Bill McMillan, manager. Missing: Dan Meldrum and Wayne Jackaman. Photograph taken overlooking Nahwitti Lake.

REGIONAL MAPPING

The regional bedrock geological mapping team, (Plate 1) investigated the central and eastern half of Quatsino map area (92L/12) and the western quarter of the adjoining 92L/11 map area. The area mapped at 1:20 000 scale for publication at 1:50 000 scale, covers approximately 800 square kilometres between Holberg and Port Hardy on the north to within 12 kilometres of Port Alice on the south. It contains the Island Copper mine and most of the significant known mineral deposits in the region. Samples were collected for petrochemistry, petrography, assay, isotopic dating, macrofossil and microfossil (conodont and radiolaria) identification.

Geological units recognized in the map area include the Upper Triassic Karmutsen volcanics, Parson Bay sediments and Quatsino limestone; the Lower Jurassic Bonanza volcanics with surprisingly little interbedded sedimentary material; the Jurassic Island Plutonic Suite and associated porphyries; Cretaceous sediments believed to be equivalent to the Longarm Formation (Kyuquot Group); and rare Tertiary dikes. The Bonanza volcanics were subdivided into major stratigraphic units that are mappable at 1:50 000 scale. The map units include a

succession of rhyolitic lavas and ash-flow tuffs intercalated with plagioclase-augite-phyric and rarely hornblende-phyric intermediate to mafic lavas, tuffs and tuff-breccias. The structure of the area is dominated by northwesterly striking, southwesterly dipping stratigraphic packages and right-lateral faulting. The rocks have undergone at least one episode of post-Lower Jurassic flexural-slip folding. The distinctive acid sulphate alteration found over large areas to the west of Island Copper mine and north of Holberg Inlet is hosted, to a large degree, by the Bonanza rhyolitic units.

SURFICIAL GEOLOGY

Quaternary geological investigations were conducted in NTS map areas 92L/6 (Alice Lake) and 92L/11 (Port McNeill) in order to provide surficial geology data and interpretations to assist mineral exploration. This work attempts to integrate overburden studies into traditional base and precious metal exploration strategies. Surficial geology was mapped at 1:50 000 scale on a regional reconnaissance level throughout the two map sheets. A till geochemistry program was conducted in the western half of the same map sheets (92L/6 and 92L/11). In total, 178 sites were sampled for drift and pebble

samples; eight fabric locations were evaluated and another 16 paleoflow directional locations were documented. This study proposes to generate surficial geology maps and derivative exploration products currently termed "sample media confidence maps". This work will lead to the development of regional drift-exploration models.

Mapping has determined that all major sediment types are present in the study area and patterns in sediment type distribution and thickness are clearly discernible. For example, marine and glaciomarine deposits are restricted to coastal areas below the 35-metre contour. In the eastern part of the map area, the subdued topography is predominately underlain by ground moraine containing both supraglacial and subglacial till deposits. Thickness is variable but generally ranges between 5 and 20+ metres. A greater amount of bedrock is exposed to the west. There, sediment tends to be primarily a thin colluvium that rarely exceeds a few metres in thickness. Ice flow was regionally to the northwest with ice originating on the mainland in the Coast Mountains. The last glaciation occurred between 20 000 and 14 000 years ago.

ECONOMIC GEOLOGY

The mineral deposit studies focus on genetic models for intrusion-related mineralization in the northern belt of Bonanza volcanics and Island intrusions of the Jurassic Bonanza volcanic island arc. The distinction in arc terranes between epithermal and porphyry copper environments of mineralization is largely one of convenience for exploration rather than one of reality; there can be overlap. Zones of advanced argillic, acid sulphate alteration, with or without enargite and other high sulphidation assemblages, may mark the high-level near-surface expression of intrusive-related mineralized hydrothermal systems. The hydrothermally altered rocks can be hosts for precious metal and/or copper deposits or be barren hypogene leakage from concealed, deeper porphyry copper deposits. The large amount of acid leaching that occurs in the most strongly altered rocks needs to be carefully studied and interpreted in order to understand its origins. Generally only zones of alteration resulting from magmatic-hydrothermal processes are favourable for exploration. Similar looking acid-leached siliceous and clay-altered rocks produced by steam-heated (boiling) groundwaters and supergene processes are rarely mineralized.

The weathering of sulphide-rich deposits by surface leaching leads to the generation of acidic groundwaters and extensive (supergene) clay alteration. The leached rocks, together with the hydrothermally altered rocks, are commonly marked by visually striking limonite staining, clay alteration, acidic waters and surface deposits of bog iron (ferricrete blankets). The challenge in exploration is to identify commonly overlapping zones of supergene and hydrothermal alteration and identify ore controls.

EXPLORATION GEOCHEMISTRY

A follow-up of Regional Geochemical Survey (RGS) data released in 1989 (Matysek *et al.*, 1989) focused on geochemical anomalies in Bonanza Group rocks and their potential for hosting porphyry copper, transitional acid sulphate and epithermal mineralization. Emphasis was placed on the less prominent anomalies which originated in Bonanza rocks, especially those close to intrusive bodies. Of the six anomalous areas selected and inspected, only two had mineral properties located within their drainages. Further interpretations for collected samples are awaiting analytical results.

An analysis of the areal coverage of the RGS was undertaken through the use of catchment basin analysis. Catchment basins, also known as drainage basins, represent the land area drained by a particular creek or stream. Two hundred and ninety-four catchment basins sampled in the Regional Geochemical Survey in map area 92L/SW were digitized as polygons. Calculations reveal that these drainage basins range from 0.6 to 20 square kilometres in area. Only 54 % of the land area of 92L/SW is covered by these catchment basins. More importantly, approximately 46 % of the map area is *not* covered by the RGS sampling. There is, therefore, a large amount of unsurveyed, undetermined ground remaining. Mineralization in unsurveyed areas might be indicated by geochemical patterns expressed in drainages that border the untested areas.

COMMENTS

Preliminary results of field surveys were presented at a widely advertised public meeting in Port Hardy on August 27. An ensuing field-trip illustrated stratigraphic, lithologic, hydrothermal alteration and other features of interest. Other information including discussions, poster displays and Open File maps will be made available at the 1994 Cordilleran Roundup.

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