MINERAL POTENTIAL ASSESSMENT OF THE SKEENA-NASS AREA

(93E, L,M, 94D, 103G, H, I, J, P, 104A, B)

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KEYWORDS: mineral potential, Skeena, Nass, mining history, compilation, mineral assessment tracts, digital data, exploration expenditures, past production, mineral inventory, mineral occurrences.

INTRODUCTION

The Skeena-Nass project is one of seven projects comprising the Mineral Potential Initiative (Figure 1). Other areas include Vancouver Island, Cariboo-Chilcotin, Thompson-Okanagan, Kootenay, Mid-Coast and Northeast B.C. The final project, Northwest B.C., will be started in 1995. The main purpose of these projects is to produce a new series of high quality, digital mineral potential maps that can be used for land-use planning.

This report describes the general geology and mineral resources of the Skeena-Nass area and the results of the phase 1 mineral potential evaluation. An overview of the Mineral Potential Initiative, including methodology used for the phase 1 and phase 2 mineral potential assessments, is described elsewhere in this volume (Kilby, 1995).

LOCATION

The Skeena-Nass area is situated in west-central British Columbia between latitudes 53° and 57° North and longitudes 126° and 132° West (Figure 2). The project name is derived from the Skeena and Nass rivers which drain the area. The study area includes the 1:250 000-scale NTS map sheets 93E, 93L, 93M, 94D, 103G, 103H, 103J, 103P, 104A and 104B (Figure 1). The total land area is approximately 1 244 000 hectares. Major towns in the area include Prince Rupert, Kitimat, Terrace, Stewart, Hazelton, Smithers and Houston. The principle transportation routes through the area are Highway 16, Highway 37 and the Canadian National Railway.

MINING AND EXPLORATION HISTORY

The mining and exploration history of the Skeena-Nass area can be divided into three phases. The initial phase coincided with the first major influx of European fortune seekers to northwestern North America in 1889 as a result of the Klondike gold rush. A second phase was driven by mineral requirements for the Second World War. The third phase spans the period from 1965 to the early 1980s when large-tonnage porphyry deposits were the main exploration target. In recent years deposits containing gold have been the main exploration targets with several new discoveries made in the Stewart mining camp.

Figure 1. Location of the Skeena-Nass project (6) and the Mid-Coast (1), Vancouver Island (2), Cariboo-Chilcotin (3), Thompson-Okanagan (4), Kootenay (5) and Northeast (7) mineral potential projects.

The Skeena-Nass area is one of the most richly endowed parts of the province for mineral resources with 1954 mineral occurrences recorded in the MINFILE database for this area. This represents approximately 20% of the total number of occurrences in the province. Most of the occurrences contain base and/or precious metals. Of these, there are 165 past-producing mines and three current producers. The total value of past production is $7.13 billion. In-ground reserves are valued at $27.14 billion. Total exploration expenditures are estimated at $133.67 million. These values are in 1986 Canadian
dollars and were derived from data in the MINFILE and ARIS databases and from historical mining records.

Mineral occurrences within the study area cluster into specific camps as shown in Figure 2. These camps reflect the presence of important controls to mineral accumulation, for example the presence of high-level intrusions or major fracture systems. The highest incidence of deposits is clearly within the continental and island arc volcanic rocks and include a variety of deposit types genetically associated with arc development. These

Figure 2. The Skeena-Nass project area showing NTS map sheets, major towns and transportation routes, location of mining camps and terrane boundaries. Terranes shown are Wrangellia (WR), Alexander (AX), Nisling (NS), Taku (Tu), metamorphic and plutonic rocks of the Coast Plutonic complex (m), Stikinia (ST), Cache Creek (CC), Quesnellia (QN), Kokanee (KO) and Cassiar (CA). Diamonds represent major prospects, crossed pick and shovels represent past and current producers.

British Columbia Geological Survey Branch
TABLE 1. MAJOR DEPOSIT TYPES

<table>
<thead>
<tr>
<th>Deposit Type</th>
<th>Examples</th>
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<tbody>
<tr>
<td>Porphyry Cu-Mo</td>
<td>Kitsault</td>
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<tr>
<td></td>
<td>Ajax</td>
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<tr>
<td></td>
<td>Hudson Bay Mtn.</td>
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<td></td>
<td>Bell</td>
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<td></td>
<td>Granisle</td>
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<td></td>
<td>Huckleberry</td>
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<td></td>
<td>Berg</td>
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<tr>
<td></td>
<td>Poplar Lake</td>
</tr>
<tr>
<td></td>
<td>Kerr</td>
</tr>
<tr>
<td>VMS - Besshi</td>
<td>Ecstall</td>
</tr>
<tr>
<td></td>
<td>Anyox</td>
</tr>
<tr>
<td></td>
<td>Granduc</td>
</tr>
<tr>
<td></td>
<td>Eskay</td>
</tr>
<tr>
<td>Basalt hosted Cu</td>
<td>Sustut Copper</td>
</tr>
<tr>
<td>Epithermal Veins</td>
<td>Equity</td>
</tr>
<tr>
<td></td>
<td>Premier</td>
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<tr>
<td>Mesothermal Veins</td>
<td>Dome Mtn.</td>
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<tr>
<td></td>
<td>Snip</td>
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<tr>
<td></td>
<td>Red Mountain</td>
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<tr>
<td></td>
<td>Surf Inlet</td>
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<tr>
<td></td>
<td>Surf Point</td>
</tr>
<tr>
<td>Skarns</td>
<td>Yreka</td>
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<tr>
<td></td>
<td>Silverado</td>
</tr>
<tr>
<td>Coal</td>
<td>Klappan</td>
</tr>
<tr>
<td></td>
<td>Telkwa</td>
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</tbody>
</table>

are epithermal and mesothermal veins, porphyry copper and molybdenum deposits, massive sulphide deposits, skarns and basalt-hosted copper deposits. In addition, the area has important coal resources at Klappan and Telkwa. Table 1 lists major deposit types found in the area.

GEOLOGICAL FRAMEWORK

The Skeena-Nass area is part of the North American Cordillera, a broad belt of deformed igneous, metamorphic and sedimentary rocks that extends from Mexico to Alaska. The Cordillera is divisible into a number of distinct geologic terranes, many of which were accreted to the edge of the North American continent in Mesozoic time. The study area includes rocks of Wrangellia (WR), Alexander terrane (AX), Nisling terrane (NS), undivided metamorphic rocks of the Coast Belt (m), Stikinia (ST), Cache Creek terrane (CC) and Quesnellia (QN). Pericratonic and displaced continental margin rocks of ancestral North America (Kootenay and Cassiar terranes) are only found in the extreme northeast corner of the area.

A detailed discussion of the geology of the area is beyond the scope of this report. The reader is referred to published maps and reports of the Geological Survey of Canada and the British Columbia Geological Survey Branch for more geologic information. A list of selected references is included with this report.

MINERAL POTENTIAL EVALUATION

The Skeena-Nass mineral potential project was started in April 1993. Don Maclntyre, Chris Ash and Jim Britton were assigned responsibility for the geologic compilation and digital data capture; Ward Kilby and Eric Grunsiky did the phase 1 and phase 2 assessments.

The key stages in the evaluation process are summarized in Figure 3. The evaluation involved compilation of geologic maps at 1:100 000 scale, selection of tracts based on geology, and evaluation of the potential of each of these tracts. The evaluation of mineral potential involves two phases, one based on historical data (phase 1) and one using probabilistic determinations based on expert assessments (phase 2). The methodologies used for assessing the mineral potential of the Skeena-Nass area are similar to those used in the Mid-Coast (Bellevontaine and Alldrick, 1995, this volume), Vancouver Island (Massey, 1995, this volume) and Thompson-Okanagan (Church, 1995, this volume) projects.

GEOLOGICAL COMPILATION

The bulk of the evaluation process involved researching, compiling and digitizing the geology of the study area to produce an up-to-date digital geological database. Mineral tracts were defined using this database. Geological compilation data for the project was released as GIS-compatible digital files in February, 1994 (Maclntyre et al., 1994).

The data used for the geological compilation were obtained from existing published and unpublished sources as summarized in the list of references at the end of this report. Geological data are primarily from memoirs, papers and open file maps published by the Geological Survey of Canada, bulletins, papers, open file and preliminary maps published by the British Columbia Geological Survey, university theses and journal publications. In addition, discussions with many individuals currently or previously involved in research or exploration in the region proved invaluable.

The primary source of geological data for the mineral potential project is the 1:250 000-scale geologic maps produced by the Geological Survey of Canada. They have published maps at this scale for each of the NT50 map sheets covering the study area. Unfortunately there is considerable variation in the vintage and detail of mapping and this poses problems in correlating geological units across map boundaries. However, for some areas, in particular the Coast Belt and in large part the Bowser Basin, these maps are the only source of geological information.

The British Columbia Geological Survey Branch has mapped selected areas within the study area at 1:50 000 and 1:100 000 scale. Most of this mapping is recent and covers areas of known mineral potential such as the Stewart, Smithers and Whitesail regions. In most cases, the amount of detailed geologic information contained on
Milestones

- Sept. 9th - Smithers map review
- Nov. 2nd - GSC map review, Vancouver
- Jan. 28th - poster display at Roundup
- Jan. 28th - digital data released as Open File 1994-14
- Feb. 8th - expert workshop, Smithers
- Feb. 10th - expert workshop, Vancouver

Figure 3. Time line for the Skeena-Nass project showing project milestones.

After the maps were digitized and edited, the digital data was exported in DXF format and imported into Terrasoft using a DXF translation routine. Terrasoft was used to clean up linework, build a topology and link geology polygons to an associated attribute table. The GIS created a total of 5350 polygons, each of which was given a unique identification number by the system. Geology tags were entered manually for each of the polygons using the GIS tagging routines.

TRACT SELECTION

Mineral tracts were defined on the basis of geology and known mineral occurrence distribution. Typically, tract boundaries are defined by geological contacts - either stratigraphic or tectonic. However, in a number of cases it was necessary to place tract boundaries arbitrarily through areas of similar geology in order to reduce the size of a tract. This was particularly true for parts of the Coast Plutonic Complex and Bowser Basin.

The geological compilation maps were used as a basis for dividing the Skeena-Nass area into 97 mineral tracts (Figure 4). Individual tracts were assigned a sequential identification code based on the dominant lithostratigraphic unit within the tract (JH - Hazelton Group, CC - Cache Creek, ST - Stikine Assemblage; CP - Coast Plutonic Complex; KK - Kasalka Group; KS - Skeena Group; JB - Bowser Lake Group; PL - Lay Range Assemblage; PI - Ingenika Group; TA - Takla Group; TV - Tertiary volcanics). A list of mineral assessment tracts in order of phase I ranking and showing tract identification code, tract name, area in hectares, number of mineral occurrences, value of mineral inventory, total exploration expenditures, value of past production and weighted phase I score for each tract, is presented in Table 2.
<table>
<thead>
<tr>
<th>Potential Class</th>
<th>Fieldwork Year</th>
<th>Paper Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>1995</td>
<td></td>
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</table>

**TABLE 2. SKEENA-NASS MINERAL ASSESSMENT TRACTS - PHASE 1 DATA**

<table>
<thead>
<tr>
<th>Potential Class</th>
<th>Fieldwork Year</th>
<th>Paper Year</th>
</tr>
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<tbody>
<tr>
<td>1994</td>
<td>1995</td>
<td></td>
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</tbody>
</table>

**LOW-POTENTIAL (20% or less of Total Area)**

<table>
<thead>
<tr>
<th>Potential Class</th>
<th>Fieldwork Year</th>
<th>Paper Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>1995</td>
<td></td>
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</table>
Figure 4. Skeena-Nass mineral assessment tracts showing tracts ranked high, medium and low in the phase 1 assessment.
Figure 5. Bar graphs of phase 1 mineral assessment data normalized to tract area and ordered by rank.
PHASE 1

The phase 1 mineral potential assessment is based on the mineral occurrence density, value of past production, previous exploration expenditures and value of known in-ground "reserves" for each tract as described elsewhere in this volume (Kilby, 1995). The score shown in Table 2 is calculated by ranking each tract according to these factors relative to tract area, and then applying a weighting factor to the resultant ranks and adding the results. The weighting factors are 25 for known resources, 10 for past exploration work and 5 for number of mineral occurrences and past production. The tracts are then given a rank from 1 to 97, with 1 being highest potential and 97 lowest. The per hectare values calculated for each tract and arranged by rank out of 97 are shown graphically in Figure 5. This ranking is specific to the project area only and does not relate to ranks assigned in adjacent areas (e.g. Mid-Coast). Tracts ranked low in the Skeena-Nass area may still have significantly higher mineral potential than those in adjacent areas that are not as well endowed with mineral deposits. A low rank does not imply no mineral potential, only relatively low potential by comparison with other tracts in the project area.

After a phase 1 ranking has been determined, the tracts are then divided into groups representing high, medium and low potential based on cumulative area. In this way tracts representing the top 33.08 % of the area (4,115 143 ha) are assigned to the high potential category, the next 33.11 % (4,119 066 ha) are considered medium potential and the bottom 33.80 % (4,204 551 ha) are considered to have low potential (Table 2).

Figure 4 shows the distribution of tracts in the area with a shading pattern reflecting high, medium and low potential. The highest ranked tract (JH30) is in the Stewart area and contains the Eskay Creek deposit; the lowest ranked tract (PII) is in the extreme northeast corner and is underlain by unmineralized Proterozoic rocks. In general, tracts containing volcanic rocks of Triassic, Jurassic and Cretaceous age are ranked medium and high while those containing successor basin sedimentary rocks (Bowser Lake Group) or large unmineralized plutons such as those of the Coast Plutonic Complex are ranked low.

PHASE 2

The phase 2 estimation process is designed to identify tracts with potential for undiscovered mineral deposits. The estimates are done by experts with personal knowledge of the area, and, when combined with the phase 1 results give an overall ranking for the mineral potential of a given tract. The phase 2 estimates take into account previous levels of exploration and current deposit models that may not have been the focus of previous exploration efforts. In this way, tracts with favourable geology but no known production or reserves can often be ranked higher than tracts which are considered to be well explored and to have less potential for new discoveries.

Expert estimation for the phase 2 mineral potential assessment were completed for the Skeena-Nass project in February, 1994. Unfortunately, the number of estimators participating in the process was relatively low. Consequently, not all tracts and deposit types were considered by the estimators and it may be necessary to conduct a new set of estimates using a revised methodology.

DISCUSSION

The phase 1 rankings clearly reflect the weighting criteria used to score the tracts. Well explored areas with known reserves and historical production are the top ranked tracts; tracts with no known occurrences and no previous exploration or production history score very low. Tract size can also be important because scores are based on per hectare values not total values. A small tract with numerous occurrences and historical reserves will score higher than larger tracts with similar values.

A complete assessment of the mineral potential of the Skeena-Nass area must await completion of the phase 2 assessment. Although useful as a guide to areas of favourable mineral endowment, the phase 1 assessment does not by itself, address the potential for undiscovered deposits. This information is required before a final mineral potential map and report can be produced for the project.

ACKNOWLEDGMENTS

The senior author would like to acknowledge the hard work and dedication of the compilation team. Without their efforts it would not have been possible to meet the deadline for completion of the compilation and data capture phase of the project. We would also like to thank Tom Richards, Glen Woodsworth, Carol Evenchik, Susan Gareau and Peter van der Heyden of the Geological Survey of Canada for their review of the compilation maps. Much of the data used in the compilation was obtained from the Geological Survey and their contribution to the project is gratefully acknowledged.

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