U. S. BUREAU OF MINES MINERAL INVESTIGATIONS IN THE UNAKWIK AREA CHUGACH NATIONAL FOREST, ALASKA

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with

MINING FEASIBILITY STUDY FOR THE UNAKWIK AREA

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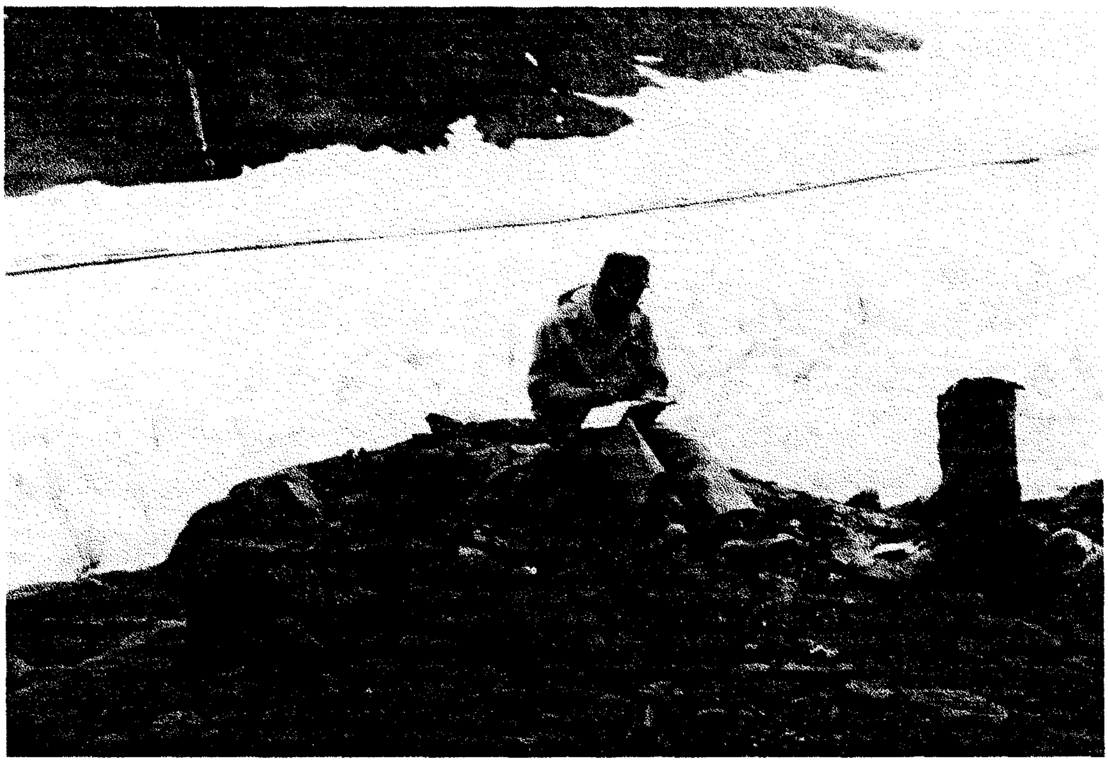

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

cm	centimeter
°	degree of arc
ft	foot
g	gram
g/mt	gram per metric ton
g/m^3	gram per cubic meter
ha	hectare
in	inch
kg	kilogram
km	kilometer
lb	pound
m	meter
m^3	cubic meter
mi	mile
mm	millimeter
′	minute of arc
mt	metric ton
oz	ounce
oz/st	ounce per short ton
oz/yd^3	ounce per cubic yard

UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT--Continued

pct	percent
ppb	part per billion
ppm	part per million
″	second of arc
st	short ton
yd^3	cubic yard

U. S. BUREAU OF MINES MINERAL INVESTIGATIONS IN THE UNAKWIK AREA, CHUGACH NATIONAL FOREST, ALASKA

By Christopher H. Roe[1]

MINING FEASIBILITY STUDY FOR THE UNAKWIK AREA

By Michael D. Balen[2]

ABSTRACT

The U. S. Bureau of Mines and the U. S. Geological Survey did a resource assessment of 40,500 ha (100,000 acre) between Unakwik Inlet and Columbia Glacier in the Chugach National Forest in South Central Alaska during 1992. The Bureau collected and evaluated data on 33 prospects, occurrences, and sample sites. The USGS collected and evaluated data on the geology and geochemistry of the area. Bureau personnel visited 26 sites and collected 127 samples. Four of the sites were new discoveries. A mining feasibility study for 10 deposits having the best deposit grades and resources in the study area concluded that none of these deposits could be economically mined.

The Bureau concluded that 30 sites have a low mineral development potential, two sites could not be evaluated because they were not found, and one site has an unknown mineral development potential because of limited data.

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INTRODUCTION

In 1995, the U.S.D.A. Forest Service (FS), Chugach National Forest (CNF), will revise its Forest Plan, which will include the management of mineral resources[3]. (See figure 1). The CNF is particularly interested in that portion of the Forest located between Unakwik Inlet and Columbia Glacier. (See figure 2). The U. S. Bureau of Mines (Bureau) had previously investigated mineral occurrences in this area during the Roadless Area Review and Evaluation II (RARE II) and reported the results in Open File Report (OFR) 44-85(32)[4]. During the RARE II study, however, the Bureau discovered more mineral occurrences[5] than it could properly evaluate in the allotted time. The CNF requested additional information with regard to future mineral development potential in areas of poor mineral information coverage.

The Bureau and the U.S. Geological Survey (USGS) agreed to conduct a joint mineral resource and geological investigation of this area because each agency has expertise that would compliment each other in this study. The USGS has expertise in studying egional geology while the Bureau is adept at evaluating mineral deposits[6]. According to the agreement, the Bureau would collect information from previously published sources and from

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[3]Resource- A concentration of naturally occurring solid, liquid, or gaseous material in or on the Earth's crust in such form or amount that economic extraction of a commodity from the concentration is currently or potentially feasible(49).

[4]Underlined numbers in parentheses refer to items in the list of references at the end of this report.

[5]Occurrence- A mineral deposit where no evidence of development work is apparent(28).

[6]Mineral deposit- A body of mineral matter in or near the earth's surface which may be utilized for its industrial mineral or metal content(43, p. 710).

a field investigation of known prospects[7] and recently discovered mineral occurrences. Meanwhile, the USGS would investigate the regional geology and geochemistry. This report discusses the results of the Bureau's literature and field investigation of the Unakwik study area. It will be provided to the USGS and to the CNF. The USGS will use the data it collected during the study and the information contained in this report to determine the probability of an undiscovered economically minable deposit existing in the Unakwik area. The CNF will then use the USGS estimates plus this Bureau report for developing the minerals portion of the CNF management plan.

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[7]Prospect- A mineral deposit where development work was done, but no ore was shipped(28).

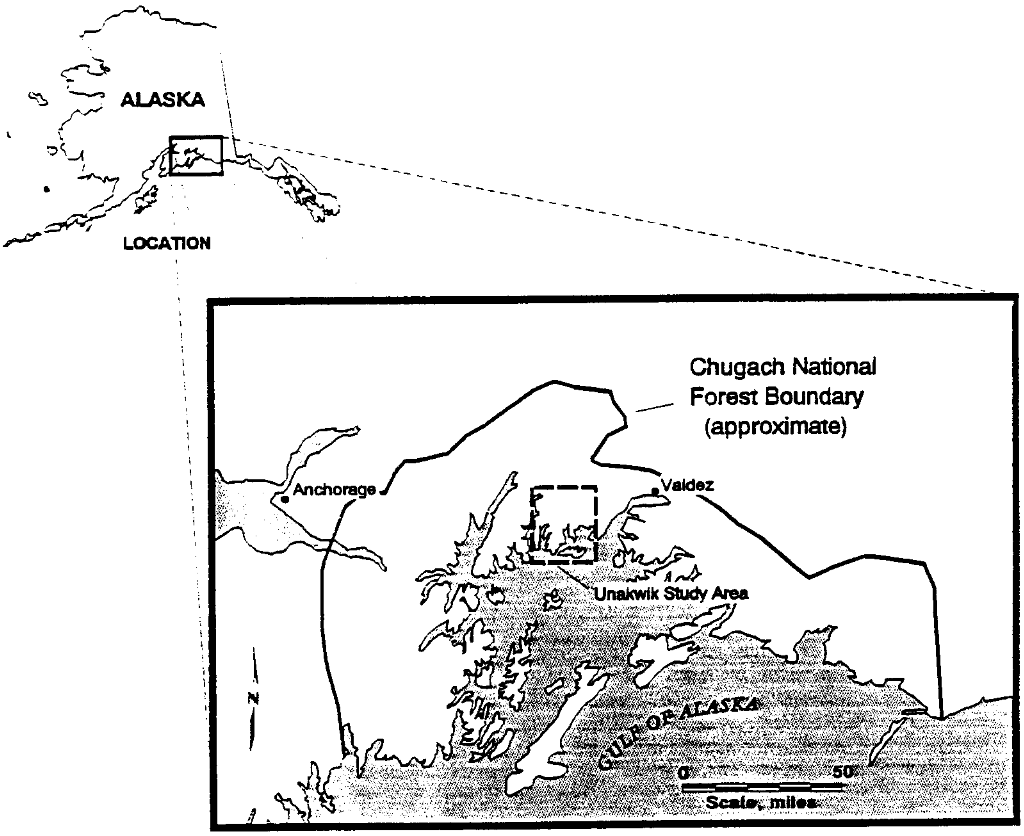

Figure 1.- Map showing the location of the Chugach National Forest, Alaska.

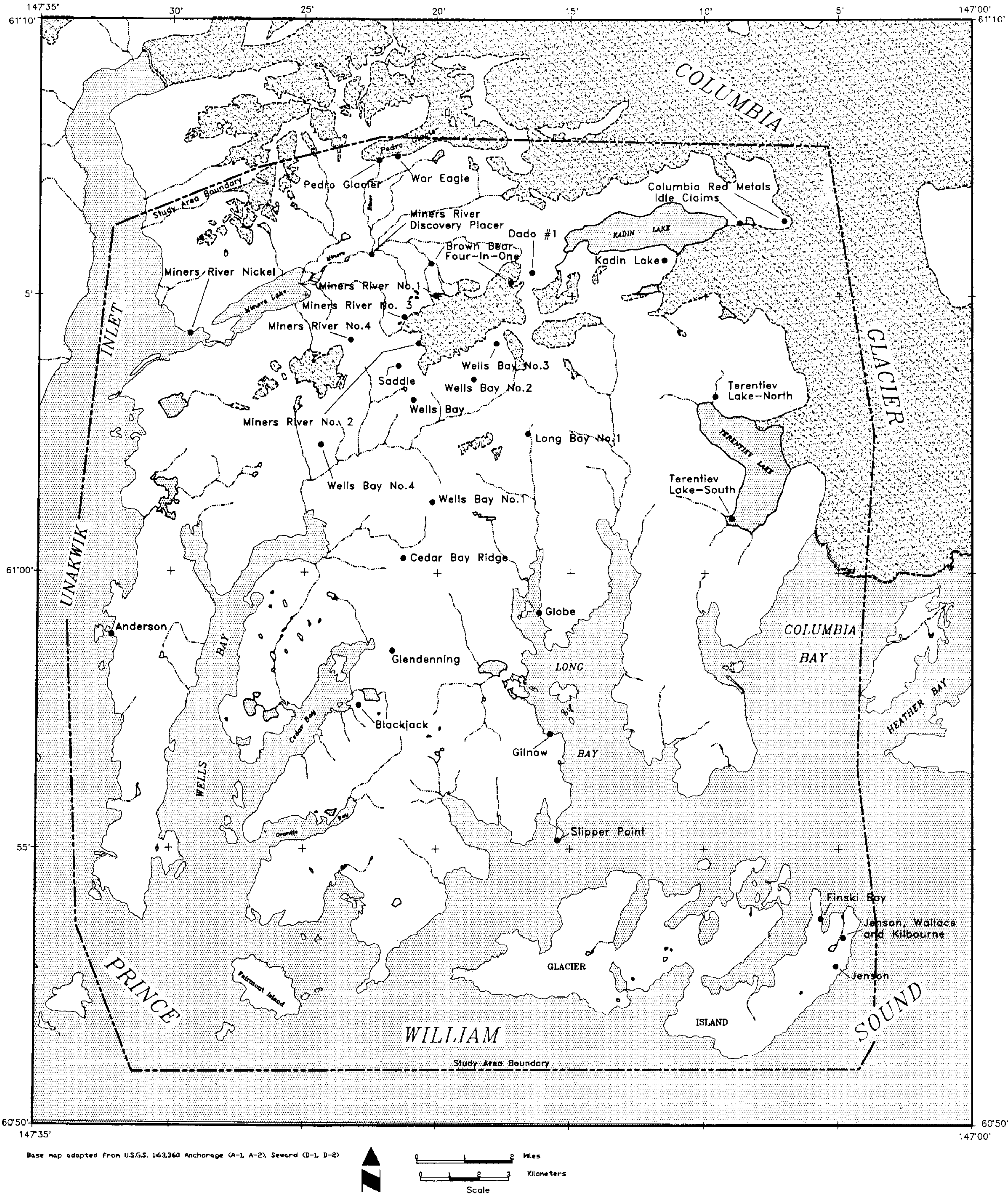

Figure 2.– Map of the Unakwik study area with loctions of the sites discussed in this report.

ACKNOWLEDGEMENTS

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LOCATION AND ACCESS

The study area contains approximately 40,500 ha (100,000 acre) and is bounded by Unakwik Inlet on the west, Columbia Glacier on the east, the mouth of Wells Bay on the south, and Pedro Glacier on the north(32). (See figure 2). Access to this area is limited to boats, helicopters, and float planes due to the remoteness of the region, rugged terrain, and lack of roads. It is approximately 144 km (90 mi) from Anchorage and 51 km (32 mi) from Valdez.

PHYSIOGRAPHIC SETTING

The study area is within the Kenai-Chugach Mountains physiographic provenance(52). The area is rugged with mountains up to 1,280 m (4,200 ft) high. Valley glaciers are common and glacial erosion has profoundly shaped the landscape. Columbia Glacier, on the eastern border of the study area, is the largest tidewater glacier in the United Sates(34). Several north-south oriented fiords are located along the southern coast. Vegetation consists of spruce forests and muskeg(32).

LAND STATUS

The entire study area is Federal land located in the CNF and is managed by the USFS. The only private land is the group of patented mining claims at the Glendenning Prospect(32,50,51).

GEOLOGICAL SETTING

The geology of Prince William Sound is dominated by the Tertiary Orca Group and the Cretaceous Valdez Group. Both groups are separated by the Contact Fault that extends from Mount St. Elias in the east to Kodiak Island in the west. The Valdez Group lies north of the fault and the Orca Group is south of it. In the Unakwik study area, the Contact Fault extends through Kadin Lake, along Miners River, and west to Miners Bay. The geological units in the study area are: Quaternary surficial deposits, Tertiary Orca Group, Cretaceous Valdez Group, mid-Cretaceous sediments and volcanics, and Tertiary intrusives(34,35). (See figure 3).

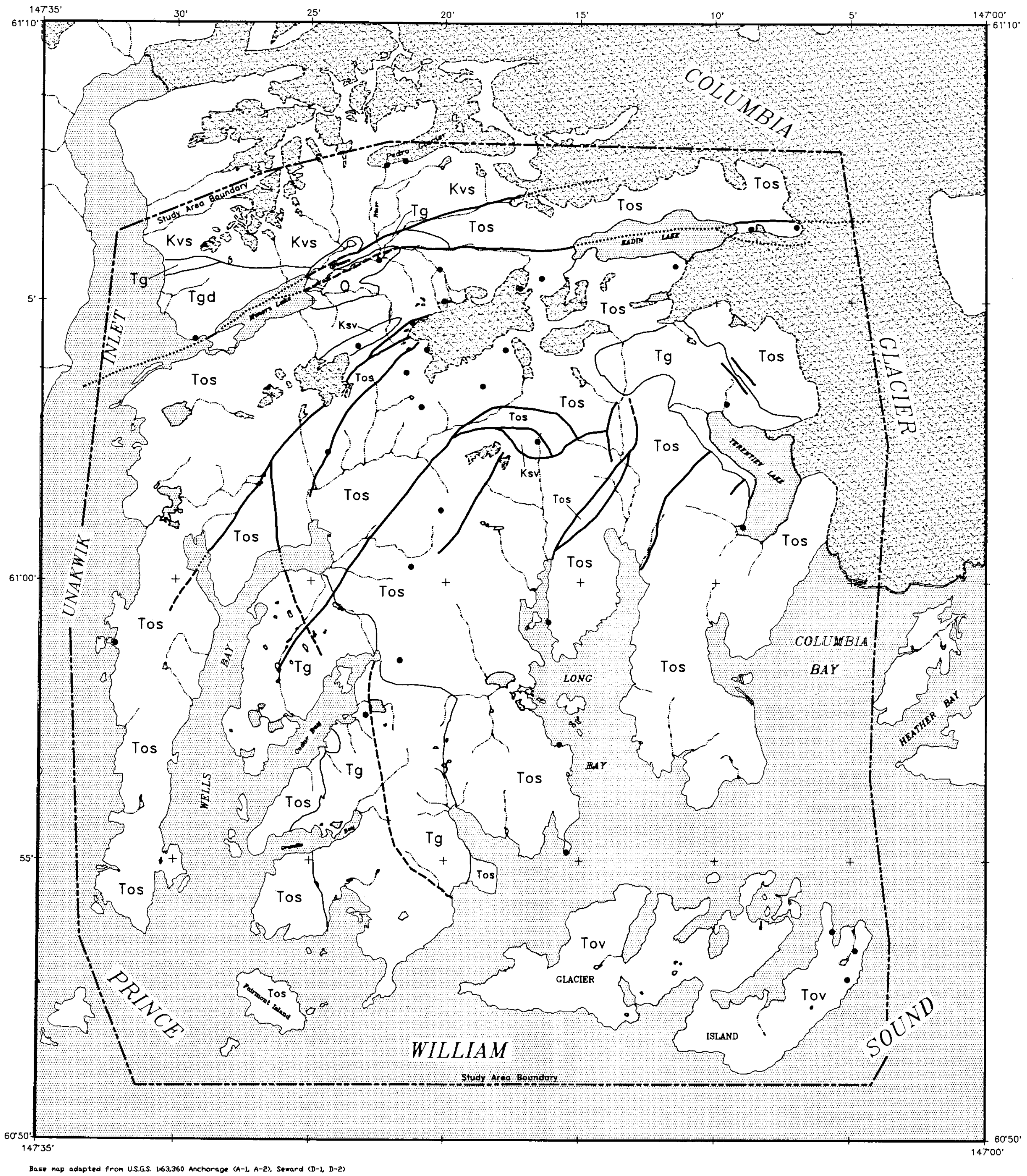
The Quaternary surficial deposits are undivided sand and gravel sized alluvium from nonglacial streams and glacial outwash. Moraines left from retreating glaciers consist of unsorted deposits of sand, gravel, cobbles, and boulders. Talus and landslide deposits are accumulations of angular bedrock material(34,35).

The Tertiary Orca Group is a widespread accretionary sequence of metasedimentary and mafic volcanic rocks. The sedimentary rocks occur as turbidites that were deposited in deep-sea fans. In the Unakwik study area, Nelson and others recognize the following Orca Group lithofacies: conglomerate; massive sandstone; rhythmic layers of sandstone, siltstone, and shale; rhythmic layers of siltstone and shale; massive sandstone and rhythmites; chaotic deposits due to mass movement; and shale or argillites(34,35).

The mafic igneous complexes in the Orca Group are pillow basalts and sheeted dikes which occur predominantly on Knight Island and Glacier Island. The pillow basalts are often interbedded with siltstone, shale, or argillite and grade into the sheeted dikes. They generally trend north-south and are often vertical. Pillow basalts, sheeted dikes, and other rocks are characteristic of ophialites found in mid-oceanic rift basins(34,35).

Winkler and Plafker estimated the thickness of the Orca Group to be as much as 9,800 m (32,000 ft)(56). Most of these rocks underwent regional metamorphism ranging from advanced diagenesis to low greenschist facies. The degree of metamorphism advanced to the albite-epidote-hornfels facies near the Tertiary plutons. Rocks adjacent to the Contact Fault are locally metamorphosed to the greenschist facies(32,35).

The regional strike of the Orca Group is to the northeast. Locally, however, the sedimentary rocks are faulted, folded, and commonly overturned as a result of tectonic activity. This is most evident in an area informally called the "knot" in the central portion of the study area. Here, intense folding, faulting, and erosion have exposed older mid-Cretaceous sediments and volcanics, which are described below(34,35).



EXPANATION

Quaternary

Q	Surficial Deposits. Undifferentiated glacial—moraine, outwash, beach, and terrace deposits.

Orca Group (Eocene and Paleocene)

Tos	Turbidites. Undifferentiated conglomerate, massive sandstone, and rhythmic layers of sandstone, siltstone, and shale. Locally may contain surficial deposits, felsic dikes (Tertiary), and granitic intrusives (Tertiary).
Tov	Volcanics. Undifferentiated volcanoclastic rocks, pillows basalts, and sheeted dikes.

Valdez Group (Late Cretaceous)

Kvs	Turbidites. Undifferentiated massive sandstone and rhythmic layers of sandstone, siltstone, and shale.

Undivided Volcanic and Sedimentary Rocks (Mid Cretaceous)

Ksv	Volcanoclastic rocks and limestone. Volcanic mudstone with broken pillow basalt fragments, shale, and limestone.

Intrusive Rocks (Tertiary)

Tg	Granite (Oligocene)
Tgd	Gabbro and diorite (Oligocene).

Fault, dashed where approximate; dotted where concealed.

Contact

• Property site

Miles

Kilometers

Scale

Geology after Steve W. Nelson, Marti L. Miller, Peter J. Haeussler and Lawrence W. Snee (U.S. Geological Survey); and Carol Huber (U.S. Forest Service) 1994.

Figure 3. — Map showing the simplified geology of the Unakwik study area (34).

Most of the major faults in the study area strike to the northeast with near vertical dips. No marker beds are evident in the study area to determine significant relative movement, however, studies in other areas of Prince William Sound suggest high-angle reverse or thrust fault displacement from northwest-southeast oriented compressive forces(34,35). These faults, along with associated shear zones, are often the sites of mineral occurrences.

The Valdez Group is in the northern portion of the study area, north of the Contact Fault. Nelson and others describe the rock units as: massive sandstone; turbidites or rhythmic layers of sandstone, siltstone, and shale; and massive sandstone interlayered with rhythmites. Sedimentary features such as graded bedding, cross laminations, and convolute bedding are present, locally. The thickness of the layers varies from 2 cm (less than 1 in) to about 2 m (6 ft). No information is available as to the total thickness of the group, however, it is an accretionary unit and is probably several thousand meters thick. The metamorphic grade ranges from zeolite to amphibolite, but the low greenschist faces is prevalent. Upper greenschist-facies metamorphism occurs in pockets near major faults(34).

The Valdez Group has a regional strike to the northeast in the western portion of Prince William Sound, but a northwestern strike in the Unakwik study area. This oroclinal bending probably occurred along a northwestern axis in Prince William Sound(35).

The USGS discovered previously unrecognized mid-Cretaceous rocks during its 1992 field investigation. Nelson and others describe these rocks as: volcanoclastics; limestone; volcanic mudstone with broken pillow basalt fragments; purple or green calcareous shale; and thin beds of gray, green, and purple limestone. Fossils in the limestone indicate a mid-Cretaceous age. Although these rocks have a similar lithology to the Orca Group, the USGS has mapped them as a separate unit because they have a significantly different age. They occur in two locations in the north-central portion of the study area. One of these locations is the "knot" mentioned previously(34).

Intrusive rocks in the study area consist of two suites: 1) the Miners Bay pluton and 2) granitic plutons and dikes at Cedar Bay, Granite Cove, and Terentiev Lake. The Miners Bay pluton consists of medium to coarse-grained gabbro and diorite which have been dated at about 35 million years old. The granitic plutons are generally medium-grained, biotite granite and hornblende-biotite granite with minor amounts of granodiorite and tonalite. These intrusives were emplaced 35 and 55 million years ago in Prince William Sound, however, the plutons in the study area are only 35 million years old(34,35).

Many small dikes, sills, and stocks occur in the study area. They are usually 0.3 to 3 m (1 to 10 ft) wide and are traceable up to 91.4 m (300 ft) along strike. They are fine to coarse-grained porphyries of granitic composition and often contain aplite. They have not been dated but are likely to be of an age similar to the granitic plutons(34,35).

MINERAL DEPOSITS

In this report, mineral deposit does not imply that the minerals are economically extractable. Considering all of the mineral exploration in the Unakwik study area, no long-term, economically-sustainable mining[8] ever occurred.

Throughout the Prince William Sound area, certain commodities are associated with

[8]Mine- A mineral deposit from which ore shipments were made over a period of several years(28).

particular formations. For example, gold generally occurs in the Valdez Group and copper is commonly in the Orca Group. In fact, in areas where the rocks of the Valdez and Orca Groups are otherwise indistinguishable, previous investigators have used the type of mineral deposits present to identify the particular geological formation(35,45).

Copper

In the study area, copper deposits occur in the metasedimentary rocks and igneous dikes. The sedimentary deposits are in quartz-filled, shear zones[9] which are typically 0.3 to 3 m (1 to 10 ft) wide and traceable up to 1,000 m (3,000 ft). The strike of these shear zones is usually northwest with a near-vertical dip. These shear zones are typically silicified and contain chalcopyrite, pyrite, galena, and sphalerite(32,35).

The copper-bearing dikes have a granitic or felsic composition, generally strike due north, and dip steeply northwest. The typical sulfide minerals present are chalcopyrite, sphalerite, pyrrhotite, and pyrite(32).

Lead and Zinc

Lead and zinc are present in some of the felsic dikes and shear zones. The lead-zinc bearing dikes have no preferred orientation, but they usually contain sphalerite, chalcopyrite, galena, arsenopyrite, and pyrite. The shear zones have strikes from northeast to northwest with near vertical dips. Galena, sphalerite, arsenopyrite, and pyrite are associated with these shear zones(32).

Nickel

[9]Shear zone- A zone of rock fracturing which consists of many closely spaced, parallel cracks. These openings allow ore-bearing solutions to percolate through them to form an ore body(43, p. 997).

Nickel and copper occur in the diorite at Miners Bay. A weakly-mineralized, shear zone strikes N 20 to 40° E and dips 70° SE within the diorite. The diorite contains chalcopyrite and pyrite while pyrrhotite, chalcopyrite, and pendlandite occur in the shear zone(32).

Gold and Silver

Gold-silver veins are also associated with shear zones in sedimentary rocks. A typical shear zone strikes northeast, dips steeply northwest, is approximately 10 m (30 ft) wide, and extends up to 30 m (100 ft) along strike. The principle minerals present are pyrite, arsenopyrite, and quartz(32).

Placer gold was reportedly found in only one location in the study area: Miners River Discovery. Meyer and Fechner described placer gold in the Recent alluvial gravels along Miners River. In addition to gold, their samples contained copper, lead, and zinc(32). In view of this solitary occurrence and its close proximity to the Contact Fault, it is probable that the gold originated in the Valdez Group to the north and migrated along Miners River into the Recent gravels in the valley below.

Fluorite

The Wells Bay No. 1 Occurrence is the only reported fluorite resource in the study area. Meyer and Fechner described one particular fluorite-quartz-calcite vein which strikes N 10 to 25° W and dips 80° SW. The vein is 1 to 4 m (3 to 12 ft) wide and 33 m (100 ft) long(32).

MINING HISTORY

While other areas of Prince William Sound such as Knight, Latouche, and Ellamar Islands, have a history of mining activity, the Unakwik study area has none. The available reports emphasize the active mining areas in other parts of the Sound, but only mention the Unakwik area occasionally. Therefore, the only information available describes exploration activity in the area.

Prospecting in the Prince William Sound area was sporadic until the beginning of the 20th century, then became very active for several minerals including copper from 1903 to 1907(16,17). In 1905, Grant did a general reconnaissance of the geology and mineral resources of Prince William Sound including the area of the current investigation. He noted a 2.4-m (8-ft) adit at the nickel prospect at Miners Bay (Miners River Nickel Prospect). He also visited a copper prospect near the eastern end of Glacier Island which had a short adit (Jenson Prospect)(15). By 1908 several other prospects were active in the area. Plate IV of USGS Bulletin 379, published in 1909, shows the following properties[10]: Finski Bay; Gilnow; Glendenning; Jenson; and Jenson, Wallace, and Kilbourne(17). In 1910, Grant noted that nearly 200 copper prospects were located along the shores of Prince William Sound area, some of which were in the current study area(18). In 1913, 1914, and 1915 Johnson reported that assessment work had been done on copper properties on Unakwik Inlet, Wells Bay, and Glacier Island and that new copper prospects had been discovered in the vicinity of Wells and Long Bays(23,24,25). Johnson reported that in 1916, seven men drove an adit 122 m (400 ft) at the Glendenning property. He also noted that a cross-cut was started at the Wells Bay Gold and Copper Mining Company (Blackjack Prospect) and work was in progress at the Anderson property on Unakwik Inlet(26). During 1917, a new copper

[10]Property- A mineral deposit where mining claims have been staked, either in the past or currently.

discovery was made on Long Bay (Globe Prospect) and the Lenora Group of five claims (Glendenning Prospect) were surveyed for patent. That same year Jens Jenson did considerable development work on his property (Jenson Prospect)(27).

After 1917 little, if any, work was done on the claims in the study area. Moffit and Fellows wrote in 1950(33) that the Glendenning property was patented, several claims were restaked, and other claims were left open for relocation. In particular, they noted that one property near Cedar Bay (Blackjack Prospect) had changed hands several times and been relocated in June, 1943(33). During the present investigation, Bureau personnel found a claim notice at the Dado No.1 Prospect that was dated 1955. As late as 1962, claims at the Miners River Discovery Prospect were staked, but eventually were allowed to lapse(48).

According to the Bureau of Land Management (BLM) records, no active claims existed in the study area in 1992, at the time of the investigation(50).

PREVIOUS STUDIES

F. C. Schrader of the USGS was the first person to describe the geology of Prince William Sound(42). Since then, the USGS has studied and described the geology and mineral deposits in the area several times. In 1964, Plafker and MacNeil used fossils to date the Orca Group as Tertiary in age(41). Plafker also studied the tectonic effects of the 1964 Alaska earthquake in the area(39,40). The USGS has published maps which show the geology and mineral deposits of the Anchorage and Seward Quadrangles(6,8,9,30,31,45,56). In particular, Nelson and others published a comprehensive geologic map with detailed rock type descriptions in 1985(35). The USGS completed studies, as part of the Alaska Mineral

Resource Assessment Program (AMRAP), in the Seward and Anchorage Quadrangles which include this study area(6,44,45).

The Territorial Department of Mines did several site specific examinations such as the mapping and sampling of the Cedar Bay Zinc Property (Blackjack Prospect)(14), the Brown Bear Prospect(13), the Four-In-One Prospect(55), and the War Eagle Prospect(38).

The Bureau did site specific and regional investigations during 1944 which included examinations of the Blackjack Prospect(53) and the Miners Bay Nickel Prospect(54). The USGS and Bureau have published summaries of the work done from 1979 to 1982 for the RARE II program(32,36).

PRESENT INVESTIGATION

The Bureau and the USGS conducted investigations of the study area in 1992. The Bureau's project encompassed both a literature search and a field study. The literature search included the following: USGS publications; published and unpublished Bureau reports, such as the Minerals Availability System (MAS) files(47); BLM records(50); Territory and State of Alaska reports, such as the MinFile (Kardex) systems(1,46); and published journal papers.

The Bureau spent 29 days in July and August, 1992, conducting the field investigation which consisted of: mapping and sampling of known underground and surface prospect workings; mapping and sampling of previously unreported deposits; and placer sampling. The Bureau visited a total of 26 sites[11] in the study area. Table 1 lists the sites in the study

[11]Site- A generic term which refers to any mine, prospect, occurrence, or sample point without regard to any significant minerals or mineral development at that location.

area and shows the type of site. It also indicates whether each site was: visited and sampled; not found, but the area sampled; or not found or visited.

Table 1.- Recapitulation of Bureau activity at each of the prospects, occurrences, and sample sites in the Unakwik study area.

Name	Type	Found or Visited and Sampled	Not Found, But Area Sampled	Not Found or Visited
Anderson	Prospect			X
Blackjack	Prospect	X		
Brown Bear	Prospect		X	
Cedar Bay Ridge	Occurrence	X		
Columbia Red Metals	Prospect	X		
Dado No. 1	Prospect	X		
Finski Bay	Prospect	X		
Four-In-One	Prospect	X		
Gilnow	Prospect			X
Glendenning	Prospect	X		
Globe	Prospect	X		
Idle Claim	Prospect	X		
Jenson	Prospect			X
Jenson, Wallace, and Kilbourne	Prospect		X	

Kadin Lake	Sample Site	X		
Long Bay No. 1	Occurrence	X		
Miners River Discovery	Prospect	X		
Miners River Nickel	Prospect	X		
Miners River No. 1	Occurrence		X	
Miners River No. 2	Occurrence	X		
Miners River No. 3	Occurrence	X		
Miners River No. 4	Occurrence	X		
Pedro Glacier	Sample Site	X		
Saddle	Occurrence	X		
Slipper Point	Occurrence	X		
Terentiev Lake-North	Sample Site	X		
Terentiev Lake-South	Sample Site	X		
War Eagle	Prospect		X	
Wells Bay	Prospect	X		
Wells Bay No. 1	Occurrence			X
Wells Bay No. 2	Occurrence			X
Wells Bay No. 3	Occurrence			X
Wells Bay No. 4	Occurrence			X
Total		22	4	7

The Bureau visited and sampled 11 prospects, seven occurrences, and four sample sites. Bureau personnel searched for another three prospects (Brown Bear; Jenson, Wallace, and Kilbourne; and War Eagle) and one occurrence (Miners River No. 1), but could not locate them with certainty. They, however, collected representative rock samples from each of these areas. Two of the prospects visited (Globe and Wells Bay) had been described in the literature, but not found during previous investigations. Four of the occurrences visited were new discoveries (Cedar Bay Ridge, Miners River No. 3, Miners River No. 4, and Saddle).

An additional seven prospects were known to be in the study area, but were not visited. The Bureau searched for two of them (Anderson and Jenson), but could find them. Five sites (Gilnow, Wells Bay No. 1, Wells Bay No. 2, Wells Bay No. 3, and Wells Bay No. 4) were known to be in the study area, but were not visited due to time constraints.

This report discusses information for 33 sites in the Unakwik study area: the 26 sites visited plus the seven sites not visited. (See figure 2).

Appendix A is a summary of information regarding the 33 sites and includes: name, location, cross-reference identification, type of property, current status, commodity, geology, Bureau work, type of deposit, sample data, resource information, and references. The reader should note that the Bureau also collected samples at two properties on the eastern end of Glacier Island. These sites are included to present all the data available which might be of use to CNF planners in the future.

Sample Collection

Hardrock Sampling

The Bureau collected 124 rock samples and three placer samples at the 26 sites. Seven types of rock samples were collected(28):

Continuous chip- Small rock fragments chipped off an outcrop in a continuous line for a measured distance.

Channel sample- Rock fragments and dust collected from a channel of uniform width and depth cut across an outcrop of mineralized rock.

Random-chip sample- Rock fragments collected from random points of a homogeneous mineralized outcrop.

Spaced-chip sample- Rock fragments collected in a continuous line at designated intervals across an outcrop.

Representative-chip sample- A sample volume of rock fragments in proportion to the different rock types present in a particular outcrop.

Select sample- Rock fragments obtained from the part of a mineralized zone having the highest observed mineralization.

Grab sample- Rock fragments collected at random from float material, an outcrop, or a mine dump.

Placer Sampling

Placer samples consisted of approximately 0.08 m^3 (0.1 yd^3) of stream or bank material run through a 25 cm by 122 cm (10 in by 48 in) sluice box and then panned down to produce approximately 78 g (2.5 oz) of concentrate. If visible gold was observed, it was recovered from the sample and weighed. If the sample contained at least 1.5 g (0.048 oz) of gold, the gold-fineness was determined. In the three placer samples collected during this investigation, however, little or no gold was visible so the concentrates were sent to a laboratory for gold analysis by Induction Coupled Plasma methods as discussed below.

Sample Analysis

The samples were analyzed using Inductively Coupled Plasma Emission Spectroscopy(ICP) equipment, Fire Assay methods plus Directly Coupled Plasma Emission

Spectroscopy(FA+DCP) equipment, Atomic Adsorption Spectroscopy(AA) equipment and fire assay(FA) methods. It might appear that some duplication of the analyses has occurred for some elements such as lead, zinc, copper, and silver; however, several different types of analyses were done to gain as much information as possible from the samples collected during this investigation. Bondar-Clegg and Company, Ltd.[12] of Vancouver, British Columbia, Canada, prepared and analyzed all of the rock and placer samples.

Inductively Coupled Plasma Emission Spectroscopy(ICP)

All of the samples were analyzed using ICP equipment to gain data on the presence of a wide variety of elements. This information could be used to discover characteristic associations of elements which would indicate the presence of a mineral deposit. Table 2 shows the 33 elements for which each sample was analyzed with the detection limits for each element.

Table 2.- Detection limits for 33 elements analyzed using ICP equipment.

Element (Symbol)	Detection Limits	Units
Aluminum (Al)	0.01-10.00	pct
Antimony (Sb)	5-2,000	ppm
Arsenic (AS)	5-2,000	ppm
Barium (Ba)	5-2,000	ppm
Bismuth (Bi)	5-2,000	ppm
Cadmium (Cd)	0.5-2,000	ppm
Calcium (Ca)	0.01-10.00	pct

[12]Disclosing the name of a private company in this report does not constitute Bureau of Mines endorsement of this company's products or services.

Chromium (Cr)	2-20,000	ppm
Cobalt (Co)	1-20,000	ppm
Copper (Cu)	1-20,000	ppm
Gallium (Ga)	10-2,000	ppm
Iron (Fe)	0.01-10.00	pct
Lanthanum (La)	5-20,000	ppm
Lead (Pb)	2-10,000	ppm
Lithium (Li)	2-20,000	ppm
Magnesium (Mg)	0.01-10.00	pct
Manganese (Mn)	5-20,000	ppm
Molybdenum (Mo)	1-20,000	ppm
Nickel (Ni)	1-20,000	ppm
Niobium (Nb)	5-2,000	ppm
Potassium (K)	0.01-10.00	pct
Silver (Ag)	0.5-50	ppm
Sodium (Na)	0.01-10.00	pct
Strontium (Sr)	1-2,000	ppm
Tantalum (Ta)	5-2,000	ppm
Tellurium (Te)	25-2,000	ppm
Tin (Sn)	20-2,000	ppm
Titanium (Ti)	0.01-10.00	pct
Tungsten (W)	20-2,000	ppm
Vanadium (V)	2-2,000	ppm
Yttrium (Y)	5-2,000	ppm
Zinc (Zn)	2-20,000	ppm
Zirconium (Z)	5-2,000	ppm

The ICP analytical results for the samples are listed in Appendix B.

Fire Assay Plus Directly Coupled Plasma Emission Spectroscopy(FA+DCP)

All samples were analyzed for gold, palladium, and platinum using FA+DCP equipment. The samples collected during the RARE II study had not been analyzed for palladium or platinum so these two elements were included in the present investigation to increase the available information on the geochemistry of the study area. Table 3 shows the detection limits for these three elements using FA+DCP equipment.

Table 3.- Detection limits for gold, palladium, and platinum using FA+DCP equipment.

Element (Symbol)	Detection Limit	Units
Gold (Au)	1-10,000	ppb
Palladium (Pd)	1-5,000	ppb
Platinum (Pt)	5-5,000	ppb

The FA+DCP analytical results for the samples are also shown in Appendix B.

Atomic Adsorption Spectroscopy(AA)

All samples were analyzed for copper, lead and zinc using AA equipment. This type of analysis is useful when the samples might contain substantial quantities of an element. That is to say, greater than parts per million. Table 4 shows the AA detection limits for copper, lead, and zinc.

Table 4.- Detection limits for copper, lead, and zinc using AA equipment.

Element (Symbol)	Detection Limit	Units
Copper (Cu)	0.01-15.00	pct
Lead (Pb)	0.01-15.00	pct
Zinc (Zn)	0.01-15.00	pct

The results of the AA analyses are shown in Appendix C.

Fire Assay(FA)

All rock samples were analyzed using FA methods for gold and silver. Fire assays are used when the sample might contain larger quantities of these elements, that is, larger than parts per million. Table 5 shows the lower detection limits for gold and silver using FA methods. The laboratory provided the raw data as ounces per short ton which is shown in this table and in Appendix C. Elsewhere in the text, the data was converted to grams per metric ton.

Table 5.- Lower Detection limits for gold and silver using FA methods.

Element (Symbol)	Lower Detection Limit	Units
Gold	0.001	oz/st
Silver	0.02	oz/st

The FA analytical results are also shown in Appendix C. Of all the samples analyzed by this method, none of them contained enough gold to provide meaningful data. Sample number 3333 was the only exception and it contained less than 0.034 g/mt (0.001 oz/st).

Mineral Resource Classification

Resource information for a number of the prospects and occurrences in the study area are shown in Appendix A. This information was gathered from a variety of sources including Bureau permanent individual property records(47), Bureau OFR 44-85(32), and USGS Bulletins. Resource classifications were based on the following criteria developed by the Bureau and the USGS(49):

Measured resources- The quantity is computed using deposit dimensions from outcrops, trenches, workings, or drill holes; grade and quality are computed from the results of detailed sampling. The sites for inspection, sampling, and measurement are spaced so closely and the geologic character is so well defined that size, shape, depth, and mineral content of the resource are well established.

Indicated resources- Quantity and grade are computed from information similar to that used for measured resources, but the sites for inspection, sampling, and measurement are farther apart or are otherwise less adequately spaced. The degree of assurance, although lower than that for measured resources, is high enough to assume continuity between points of observation.

Inferred resources- Estimates are based on an assumed continuity beyond measured and indicated resources, for which there is geologic evidence. Inferred resources may or may not be supported by samples or measurements.

Deposit Grade and Tonnage Calculations

The deposit grade and tonnage data for several properties is available from published reports, such as Bureau OFRs 5-84(22) and 44-85(32). For several previously known and newly discovered sites, the Bureau collected samples to calculate revised or new deposit grade and tonnage estimates. This was done by first calculating the weighted-average, deposit grade then calculating the tonnage.

The weighted-average, deposit grade was determined by the following formula:

Weighted-average assay = {sum [(width of each sample) x (assay value of each sample)]} ÷ sum of the sample widths(37)

The weighted-average assay values were calculated as parts per million, percent, or ounces per short ton (converted to grams per metric ton).

All of the deposits are veins or shears and were considered to be tabular in shape. Accordingly, the deposit volume was calculated by the following formula:

Deposit volume = (average width of samples across vein or shear) x (length of the shear or vein along the strike) x (1/2 the strike length)

The volume was calculated as cubic feet and used in the following equation:

Deposit tonnage = Deposit volume ÷ Tonnage factor (37)

The tonnage factor is a number based on the estimated average rock density. For these calculations, 13 ft^3/st was used. The resulting deposit tonnage was calculated as short tons and then converted to metric tons.

Mining Feasibility Study

M. D. Balen did a mining feasibility study for selected deposits in the study area. His report is in Appendix D. The deposits used were those which had deposit grade and reserve estimates obtained from published reports or calculated during the current investigation. These deposits were considered to have the highest potential for development. Table 6 shows a recapitulation of the deposits used, the resource estimate, the commodity types and grades, and the gross contained metal value (GCMV) for each of the ten deposits.

Mr. Balen's analysis shows that the GCMV for each of these deposits will not provide enough income for a mining company to break even on the venture (receive a 0 pct rate of return on the investment). Normally, when a company mines a deposit, it expects to receive at least a 15 pct rate of return on its investment. In other words, a mining company would spent more money extracting the minerals from these deposits, than it would receive from selling the metals derived from these minerals. In fact, even if the GCMV could be increased ten times by new ore discoveries at these sites, a mining company would still not break even, let alone receive a 15 pct rate of return. The reader should consult Mr. Balen's report for a discussion of the assumptions, methodology, and other details of the mining feasibility analysis.

Table 6.- Recapitulation of deposit information used in the mining feasibility study for the Unakwik study area.

Deposit Name	Resource Estimate (mt)	Commodity 1		Commodity 2		Commodity 3		Gross Contained Metal Value ($/mt)
		Name	Grade	Name	Grade	Name	Grade	
Four-In-One	55	Copper	0.67 pct	Silver	13.40 ppm			13.46
Brown Bear	364	Zinc	2.5 pct	Lead	0.8 pct			33.36
Idle Claim	665	Zinc	1.85 pct	Copper	0.38 pct	Silver	10.61 ppm	28.12
Miners River No. 2	1,365	Zinc	4.23 pct	Lead	2.24 pct	Silver	5.88 ppm	64.34
Globe	3,000	Silver	2.46 ppm	Copper	0.4 pct	Zinc	0.01 pct	9.96
Columbia Red Metals	9,977	Copper	2.45 pct	Silver	73.79 g/mt	Zinc	0.48 pct	58.09
Miners River Nickel	10,010	Nickel	0.2 pct					10.36
Cedar Bay	12,000	Copper	0.24 pct	Silver	8.90 g/mt			5.42
Miners River No. 3	82,192	Zinc	0.25 pct					2.70
Dado No. 1	111,773	Copper	0.51 pct	Silver	23.14 g/mt			12.15

Mineral Development Potential Classification

All the sites identified in the study area were classified according to the following Bureau criteria(28):

High mineral development potential- High grades and probable continuity of mineralization exist. The property is likely to have economically minable resources under current economic conditions. A high potential exists for developing tonnage or volume with reasonable geologic support for continuity of grade. None of the sites investigated in this study could be classified in this category.

Moderate mineral development potential- Either high grade or continuity of mineralization exists, but not both. Mineralization has limited extent and/or grades are low. The property cannot be mined at a profit (i.e., due to low tonnages or grades) under existing conditions (economical, political, technological). None of the sites investigated in this study could be classified in this category.

Low mineral development potential- The property exhibits uneconomic grades and/or little evidence of continuity of mineralization. There is little or no potential for developing mineral resources or it is an insignificant source of the material of interest. Most of the sites investigated in this study were classified in this category.

Unevaluated- This category includes all properties not located or visited in the field. Data are only available from previous reports.

Unknown- Insufficient work was done at the prospect for an evaluation.

Placer samples were rated according to the following classification based on Bureau sampling criteria(20):

Highly significant- Recovered values were greater than 0.185 g/m^3 (0.005 oz/yd^3 gold)

Significant- Recovered values ranged from 0.0185 to 0.185 g/m^3 (0.0005 to 0.005 oz/yd^3) gold.

Background- Recovered values were less than 0.0185 g/m^3 (0.0005 oz/yd^3) gold.

Based on these mineral development criteria, the Bureau's field investigation, and the mining feasibility study, the Bureau concludes that the mineral development potential for each of the occurrences and sample sites is as shown in Table 7.

Table 7.- Mineral development potential for each of the sites in this investigation.

Name	Mineral Development Potential				
	High	Medium	Low	Unevaluated	Unknown
Anderson				X	
Blackjack			X		
Brown Bear			X		
Cedar Ridge			X		
Columbia Red Metals			X		
Dado No. 1			X		
Finski Bay			X		
Four-In-One			X		
Gilnow			X		
Glendenning			X		
Globe			X		

Idle Claim			X		
Jenson			X		
Jenson, Wallace, and Kilbourne			X		
Kadin Lake			X		
Long Bay No. 1					X
Miners River Discovery			X		
Miners River Nickel			X		
Miners River No. 1			X		
Miners River No. 2			X		
Miners River No. 3			X		
Miners River No. 4			X		
Pedro Glacier			X		
Saddle			X		
Slipper Point			X		
Terentiev Lake-North			X		
Terentiev Lake-South			X		
War Eagle				X	
Wells Bay			X		
Wells Bay No. 1			X		
Wells Bay No. 2			X		
Wells Bay No. 3			X		
Wells Bay No. 4			X		
Totals	0	0	30	2	1

Thirty sites have a low mineral development potential based on the conclusions of the mining feasibility study or the analytical results. The Bureau obtained only a few samples at several of these sites. This occurred because: samples were needed from a previously unsampled area (such as Kadin Lake), the mineralized area was small (such as Slipper Point), or the minerals were very sparse in hand specimen (such as Wells Bay).

Two sites, Anderson and War Eagle, are unevaluated because the Bureau has not been able to locate or sample them with certainty and no published information is available for analysis.

One site, Long Bay No. 1, has an unknown mineral development potential. During the RARE II study, the Bureau determined that this occurrence had a moderate mineral development potential because of its "unexplored nature"(48). The Bureau was able to collect only two samples during 1992 field season due to time constraints. As a result, insufficient information was available to estimate grade and tonnage. Although the samples from this occurrence had high lead and zinc values, the author considers this occurrence to be no bigger or richer that the deposits analyzed in the mining feasibility study which were determined to have a low mineral development potential. Future work at Long Bay No. 1 might show that it can be economically mined. Until that time the author will classify this deposit as unevaluated.

CONCLUSIONS

During 1992, the Bureau collected information on 33 sites in the Unakwik study area and visited 26 of them. The Bureau collected 127 samples: 124 rock samples and three placer samples. Grade and reserve estimates were determined for the ten best deposits in the study area, based on information from this investigation and published reports. A mining feasibility study of these ten deposits concluded that none of them had sufficient reserves or grade to make any potential mining venture profitable.

The two placer sites had only background gold values.

Based on available information and the mining feasibility study, the Bureau concludes that for the 33 sites considered in this investigation: 30 sites have a low mineral development potential, 2 are unevaluated because they were not visited and sampled, and 1 site has an unknown mineral development potential because of limited information.

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APPENDIX A

MINERAL PROPERTY SUMMARIES

This appendix shows information for all of the sites in the Unakwik study area that are discussed in this report. The information for each site is given under the following headings;

Name: The name of the site used in this report.

Alternate Names: Other names for the site.

Kardex: A unique number assigned to a property by the Alaska Division of Mines. These numbers are not used in this report, however, they might be helpful in cross-referencing information. Not all sites in the appendix have a Kardex number(1).

MAS/MILS Sequence Number: The unique number assigned to the site in the Bureau's Minerals Availability System (MAS) and the Minerals Industry Location System (MILS)(2,47).

RARE II Map Number: The unique number assigned to each site during the Bureau's Roadless Area Review and Evaluation program (RARE II) from 1979 to 1982. Although these numbers are not used in this report, they might be helpful when cross-referencing information about these sites in the Bureau's RARE II reports such as: OFR 44-85 (32) or OFR 5-84 (22). Not all sites have a RARE II map number.

Latitude: Latitude of the site.

Longitude: Longitude of the site.

Meridian: The local meridian used for township and range designation.

Township: The township designation: either North (N) or South (S).

Range: The range designation: either East (E) or West (W).

Section: The section number: one through 36.

Quarter: The quarter part of the section where the site is located: Northeast (NE), Southeast (SE), Southwest (SW), or Northwest (NW).

Elevation: The elevation of the site above sea level in meters (m) and feet (ft). For sites with underground workings the elevation for the site is the elevation of the portal. For sites with several portals, the elevation given is for the lowest portal. For sites with no underground workings, the elevation of the site is the approximate median elevation for the site.

Map Name: The name of the U.S. Geological Survey, 1:63,360 scale, topographic map for the site location.

Type: Either mine, prospect, occurrence, or sample site, as discussed in the body of the report.

Current Status: The status of the property as to mining or exploration activity.

Commodities: The mineral commodities, such as copper or lead, which are most prevalent or of major interest at the site.

Geology: A description of the geology at the site based on published information and the 1992 field investigation.

Mineral Deposit Type: A description of how the minerals occur: vein, shear zone, and so forth.

Past Bureau Work: Information about the site obtained during previous investigations. The most significant work was done during the RARE II program and was published in Bureau OFR 44-85(32).

1992 Bureau Work: Information about the site obtained during the 1992 field investigation.

Sample Data: The table shows selected data from the Inductively Coupled Plasma Emission Spectroscopy (ICP) and Fire Assay plus Directly Coupled Plasma Emission Spectroscopy (FA+DCP) analyses (Appendix B). For each sample collected, the table indicates the sample number, type of sample, sample size, and analytical values for the most significant commodities. The table is not intended to be all inclusive, but merely to show the most significant values. If the reader needs more analytical data for a sample, he or she should consult Appendix B. Selected analytical data follows the table. This information is from the Fire Assay (FA) and Atomic Absorption Spectroscopy (AA) analyses(Appendic C).

Resources: The estimated resource and grade of significant commodities at the site. The resource and grade estimates are based on published reports (Published) or data collected during the present investigation (Estimated). The resource is given as metric tons (mt) and short tons (st). Grade is given as percent (pct), parts per million (ppm), grams per metric ton (g/mt), or ounces per short ton (oz/st).

Mineral development potential: The potential for mineral development is classified as high, moderate, low, unevaluated, or unknown, as discussed in the body of the report. The classification is based on published Bureau information and the mining feasibility study discussed in Appendix D.

References: Underlined numbers in parentheses refer to items in the list of references at the end of the report.

Name: ANDERSON PROSPECT

Alternate Names: Beachcomber **Kardex Number:** 095-254

MAS/MILS Sequence Number: 0020950134 **RARE II Map Number:** S-118

Latitude: N 60° 58' 54" **Longitude:** W 147° 32' 24"

Meridian: Seward **Township:** 10 N **Range:** 11 E **Section:** 5 **Quarter:** SW

Elevation: At or near sea level

Map Name: Seward D-2

Type: Prospect **Current Status:** Inactive

Commodities: Copper

Geology: The country rock consists of the Orca Group turbidites composed of sandstone, siltstone, and shale(34). Gold, silver, copper, and zinc reportedly occur in a quartz vein in limestone(48).

Mineral Deposit Type: Vein

Past Bureau Work: Bureau personnel looked for this prospect during the RARE II study in 1980, but did not find it. Samples collected in the area during the RARE II study contained 10 to 50 ppm copper(48).

1992 Bureau Work: The Bureau looked for this property again in 1992, but did not find it.

Sample Data: None

Resources: Not determined.

Mineral development potential: Unevaluated. Bureau personnel have not found this property.

References:(1,10,21,22,26,34,45,47,48)

Name: BLACKJACK PROSPECT

Alternate Names: Cedar Bay Zinc, Wells Bay Gold and Copper Company

Kardex Number: 095-097

MAS/MILS Sequence Number: 0020950051 **RARE II Map Number:** S-115

Latitude: N 60° 57' 38" **Longitude:** W 147° 22' 49"

Meridian: Seward **Township:** 10 N **Range:** 12 E **Section:** 18 **Quarter:** NE

Elevation: 59 m (195 ft)

Map Name: Seward D-2

Type: Prospect **Current Status:** Inactive

Commodities: Zinc, copper, lead, silver

Geology: The country rock is Cedar Bay Granite, which is believed to be Oligocene in age(34). The granite contains less than 1 pct biotite. The color is light-gray to pink and the texture is medium to coarse grained(48). Two adits are present. The upper adit is located at 90 m (295 ft) elevation. The adit consists of approximately 12 m (40 ft) of workings driven along the shear. The lower adit is located at 59 m (195 ft) elevation. It consists of approximately 85 m (280 ft) of workings, which include a 76-m (250-ft) crosscut and a 9-m (30-ft) drift.

The mineral deposit is in a silicified granite along a shear zone which strikes from N 5° E to N 5° W and dips 75° W. The shear zone is approximately 1.6 km (1.0 mi) along strike and averages 3.6 m (12 ft) wide. Sulfide minerals along the shear zone include pyrite, pyrrhotite, sphalerite, and chalcopyrite. In the workings, the sulfide mineralization decreases with depth(48).

Mineral Deposit Type: Shear

Past Bureau Work: The Bureau examined the property in 1944, 1979, 1980, and 1981. In 1944, the Bureau collected samples from both adits. The highest mineral values for the upper adit were 1.51 pct zinc, 0.16 pct copper, and 17 g/mt (0.5 oz/st) silver. The average value for a 3.8 m (12.6 ft) width was 0.7 pct zinc and 0.1 pct copper. The samples from the lower adit contained 0.2 to 2.1 pct lead, 0.02 to 0.17 pct zinc, 0.02 to 0.05 pct copper, and 4.46 to 10.3 g/mt (0.13 to 0.3 oz/st) silver(53).

In 1979 and 1980, the Bureau examined the prospect again and collected three more samples from the lower adit. The samples contained 0.01 to 0.29 pct lead, 2.9 to 9.0 pct zinc, 0.2 to 0.57 pct copper, and 10 to 20 ppm silver. The Bureau obtained one sample from the upper adit which contained 40 ppm zinc, and 285 ppm copper. Five grab samples were taken from the shear zone north of the mine. The samples contained 10 to 125 ppm lead, 22 to 230 ppm zinc, 6 to 250 ppm copper, and 0.3 to 4.2 ppm silver(32).

1992 Bureau Work: The Bureau visited the property again in 1992 and collected 8 samples. The following 1.5 m (5 ft) channel chip samples were collected in the lower adit. Sample 3316 came from the east side of the adit near the face and northeast of the mineralized zone. Sample 3317 came from the short drift on the east side of the adit. Sample 3318 came from the east of the adit adjacent to and south of the drift. Sample 3319 came from the east side of the adit adjacent to sample 3318. Sample 3320 also came from the east side of the adit next to sample 3319.

The Bureau collected two random chip samples from the upper adit. Sample 3321 came from the shear zone at the face of the adit and sample 3322 came from an area opposite and southwest from the face. (See figure A-1).

Sample 3323 was a grab sample from an outcrop of the same shear zone which is in the Blackjack Prospect, but located approximately 0.4 km (0.25 mi) north-northeast of the property. Sample 3330 was a random chip sample from the west side of the shear zone at the same location as 3323.

Sample Data: Table A-1 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at or near the Blackjack Prospect. (See Appendix B).

TABLE A-1. - Selected sample data for the Blackjack Prospect.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3316	Chip channel	1.5	0.9	18	57	328
3317	Chip channel	1.5	1.0	85	109	797
3318	Chip channel	1.5	0.7	39	61	117
3319	Chip channel	1.5	0.5	36	63	89
3320	Chip channel	1.5	0.5	31	58	80
3321	Random chip		3.9	594	540	4,273
3322	Random chip		15.6	2,788	540	3,710
3323	Grab		7.1	99	58	177
3330	Random chip		1.1	96	54	54

The FA/AA results indicate that sample 3321 had 0.45 pct zinc while sample 3322 had 15.1 g/mt (0.44 oz/st) silver and 0.28 pct copper. (See Appendix C).

Resources: Not determined, due to low analytical values.

Mineral development potential: Low, based on published Bureau information(22).

References:(1,3,10,12,14,21,22,32,33,34,44,45,48)

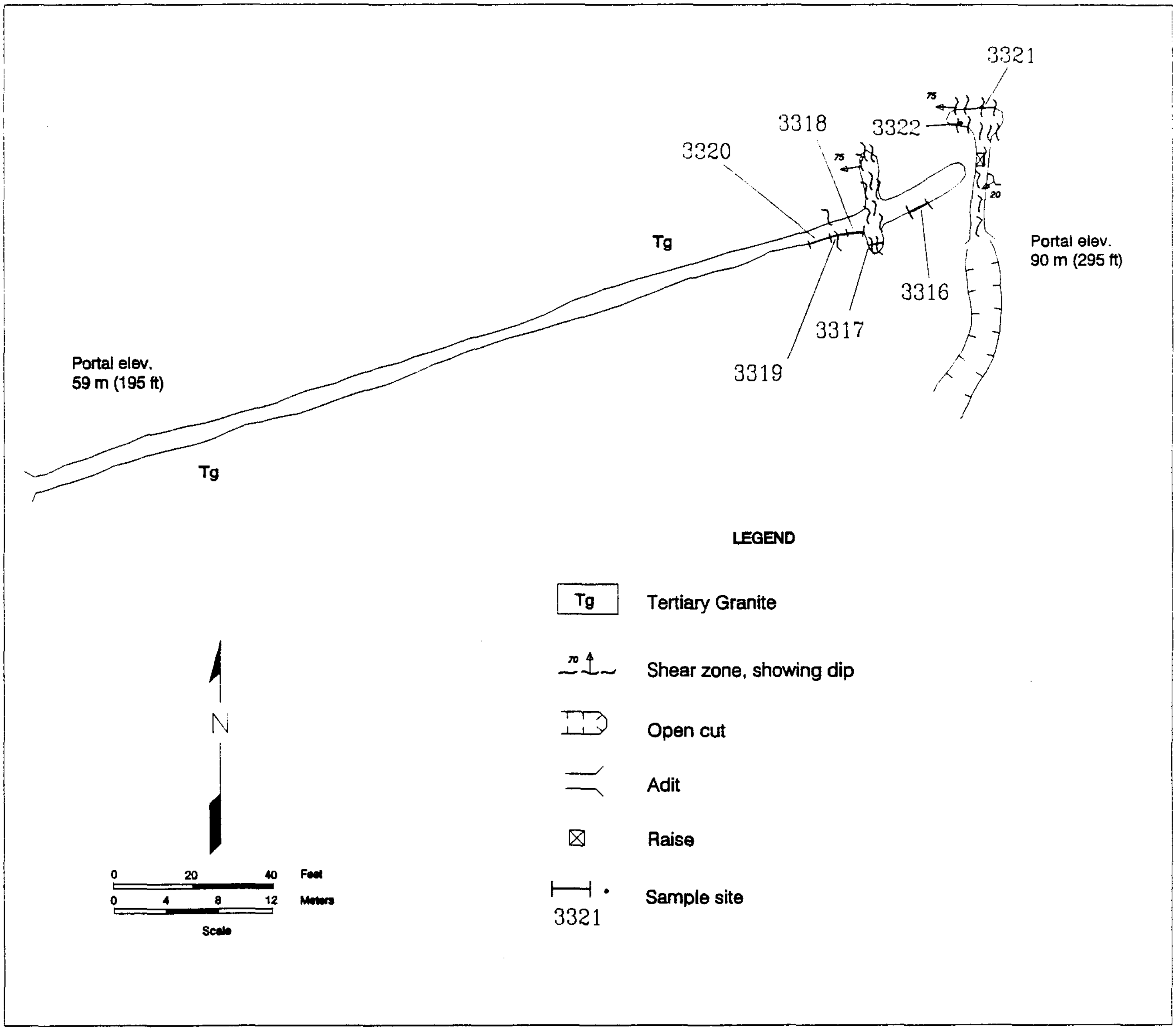


Figure A-1.- Map of the Blackjack Prospect showing the geology and sample locations. Base map is from Bureau OFR 44-85(32).

Name: **BROWN BEAR PROSPECT**

Alternate Names: A. D. Thompson, Eureka **Kardex Number:** 085-097

MAS/MILS Sequence Number: 0020850114 **RARE II Map Number:** A-12

Latitude: N 61° 05' 00" **Longitude:** W 147° 22' 30"

Meridian: Seward **Township:** 12 N **Range:** 12 E **Section:** 32 **Quarter:** SW

Elevation: 213 m (699 ft)

Map Name: Anchorage A-1

Type: Prospect **Current Status:** Inactive

Commodities: Lead, zinc, silver

Geology: The country rock consists of Orca Group metasediments. Two mineralized quartz veins are reportedly present. One vein cuts brecciated graywacke, strikes N 50° E, and dips 60° SE. Sphalerite, galena, pyrite, and quartz are present in the vein. A second vein is located 122 m (400 ft) southeast of the first vein. The vein strikes N 40° E and dips 70° SE and ranges from 2.5 to 46 cm (1 to 18 in) wide. The minerals reportedly present include galena, sphalerite, pyrite, calcite, and quartz(13,32,38,48).

In 1930, Pilgrim collected two samples of the veins which contained 4.45 to 17.7 pct lead, 12.29 to 28.8 pct zinc, 123 to 987 g/mt (3.6 to 28.8 oz/st) silver, and 2.74 to 6.5 g/mt (0.08 to 0.19 oz/st) gold(38).

Mineral Deposit Type: Vein

Past Bureau Work: Bureau personnel attempted to locate the Brown Bear Prospect during the RARE II study, but were unsuccessful.

1992 Bureau Work: The Bureau attempted to locate this property, but was unsuccessful. Four samples were collected in the proximity of the prospect. Sample 3367 was a grab sample of an iron-stained graywacke outcrop. Sample 3381 was a select sample of breccia float containing pyrite. Samples 3382 and 3383 were representative chip samples from the hanging wall of a shear/ breccia zone in slate. The shear zone strikes N 10° W, dips vertically, and is approximately 4.6 m (15 ft). The width of the limonite-stained zone within the shear zone is about 1.5 m (5 ft).

Sample Data: Table A-2 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained in the vicinity of the Brown Bear Prospect. (See Appendix B).

TABLE A-2. - Selected sample data for the vicinity of the Brown Bear Prospect.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3367	Grab		0.5	30	29	134
3381	Grab		0.5	53	26	38
3382	Representative chip		0.5	62	31	85
3383	Representative chip		0.5	51	44	106

The FA/AA results indicate that sample 3383 contained 1.71 g/mt (0.05 oz/st) silver. (See Appendix C).

Resources: Published(22,32)-

Inferred; 364 mt (400 st) of 2.5 pct zinc, 0.8 pct lead, and 8.5 ppm silver

Mineral development potential: Low, based on published information and the mining feasibility study(22).

References: (1,13,22,32,38,48)

Name: CEDAR BAY RIDGE OCCURRENCE

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: None **RARE II Map Number:** None

Latitude: N 61° 00' 15" **Longitude:** W 147° 21' 10"

Meridian: Seward **Township:** 11 N **Range:** 12 E **Section:** 32 **Quarter:** NE

Elevation: 564 m (1,850 ft)

Map Name: Anchorage A-1

Type: Occurrence **Current Status:** Unclaimed

Commodities: Copper, silver

Geology: The country rock is Orca Group sandstone with rhythmites of siltstone and shale(34). A shear zone strikes due north, dips 90°, has an average width of 1.8 m (6 ft), and extends for approximately 73 m (240 ft) along strike. The shear zone is highly silicified and contains 10 to 50 pct pyrite.

Mineral Deposit Type: Shear

Past Bureau Work: None

1992 Bureau Work: The USGS discovered the site and informed Bureau personnel who collected four samples. Three samples (3368-3370) were from the shear zone within 0.9 m (3.0 ft) of each other. Sample 3371 was a representative chip sample of the shear zone 45.6 m (150 ft) north of the point where the previous samples were collected.

Sample Data: Table A-3 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at the Cedar Bay Ridge Occurrence. (See Appendix B).

TABLE A-3. - Selected sample data for the Cedar Bay Ridge Occurrence.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3368	Representative chip	0.05	20.3	16,521	12	213
3369	Continuous chip	1.8	1.7	1,755	14	199
3370	Representative chip		27.8	> 20,000	50	296
3371	Representative chip		12.6	3,030	42	95

The FA/AA results indicate that sample 3370 had 27 g/mt (0.8 oz/st) silver and 5.41 pct copper. (See Appendix C).

Resources: Estimated-

Inferred: 12,000 mt (13,300 st) of 0.24 pct copper and 8.9 g/mt (0.26 oz/st) silver.

Mineral development potential: Low, based on the mining feasibility study.

References: (34)

Name: COLUMBIA RED METALS PROSPECT

Alternate Names: Group, Harrison **Kardex Number:** 085-090

MAS/MILS Sequence Number: 0020850165 **RARE II Map Number:** A-1

Latitude: N 61° 06' 19" **Longitude:** W 147° 07' 30"

Meridian: Copper River **Township:** 9 S **Range:** 11 W **Section:** 11 **Quarter:** NW

Elevation: 503 m (1,650 ft)

Map Name: Anchorage A-1

Type: Prospect **Current Status:** Inactive

Commodities: Copper, silver, zinc, lead

Geology: The country rock is Orca Group turbidites consisting of sandstone, siltstone, and shale which strike N 80° W and dip 80° SW. At least four shear zones are present. Three of the zones strike from N 35° W to N 35° E and dip from 45° to 80° N. The fourth zone strikes N 70° E and dips 80° SE. The shear zones are from 7.6 cm to 5.5 m (3 in to 18 ft) wide and are up to 244 m (800 ft) along strike. Sulfide minerals are present for 61 m (200 ft) along strike. The mineral occurrence ranges from 2.5 cm (1 in) wide chalcopyrite and pyrite veinlets to 1.2 m (4 ft) wide zones of massive chalcopyrite. Disseminated galena, sphalerite, pyrite, and chalcopyrite are present in a 1.2 m (4 ft) wide zone(32,34,48).

Mineral Deposit Type: Shear

Past Bureau Work: The Bureau examined the area in 1982 during the RARE II study and collected seven samples from the shear zones. The samples contained 0.42 to 0.72 pct lead, 0.16 to 0.87 pct zinc, 0.07 to 7.0 pct copper, and 0.011 to 305 g/mt (0.00032 to 8.9 oz/st) silver(32).

1992 Bureau Work: Bureau personnel established a 213-m (700-ft) baseline oriented N 15° W along the trend of the shear with the origin at the northern end. They collected four samples along the baseline to further define the character of the mineralization. (See figure A-2). In addition, the Bureau collected samples 3328 and 3329 from a shear zone located 0.4 km (0.25 mi) west of the baseline. This shear strikes N 23° E and dips 52° SE.

Sample Data: Table A-4 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at or near the Columbia Red Metals Prospect. (See Appendix B).

TABLE A-4. - Selected sample data for the Columbia Red Metals Prospect area.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3324	Channel	1.0	>50.0	2,384	2,362	1,452
3325	Channel	1.0	>50.0	11,304	852	454
3326	Channel	1.0	38.1	2,253	175	178
3327	Continuous chip	1.47	>50.0	>20,000	229	1,713
3328	Continuous chip	1.12	>35.9	1,409	2,487	579
3329	Continuous chip	1.12	>50.0	1,801	>10,000	575

The FA/AA results indicate that sample 3324 had 209 g/mt (6.09 oz/st) silver and sample 3325 had 211 g/mt (6.16 oz/st) silver. Sample 3327 had 163 g/mt (4.76 oz/st) silver and 3.94 pct copper. (See Appendix C).

Resources: Published-

Inferred(22): 9,800 mt (11,000 st) of 1.57 pct copper and 50 g/mt (1.46 oz/st) silver

Inferred(32): 5,986 mt (6,600 st) of 0.095 pct copper, 12.5 ppm silver, 0.37 pct zinc, and 0.01 pct lead;
2,449 mt (2,700 st) of 6.08 pct copper, 166 g/mt (4.85 oz/st) silver, 0.5 pct zinc;
1,542 mt (1,700 st) of 0.12 pct copper, 19.7 ppm silver, 0.87 pct zinc, and 0.42 pct lead.

Estimated- (Averaged from published values)

Inferred: 9,977 mt (11,000 st) of 2.45 pct copper, 73.79 g/mt (2.15 oz/st) silver, and 0.48 pct zinc.

Mineral development potential: Low, based on the mining feasibility study.

References: (1,19,22,32,34,48)

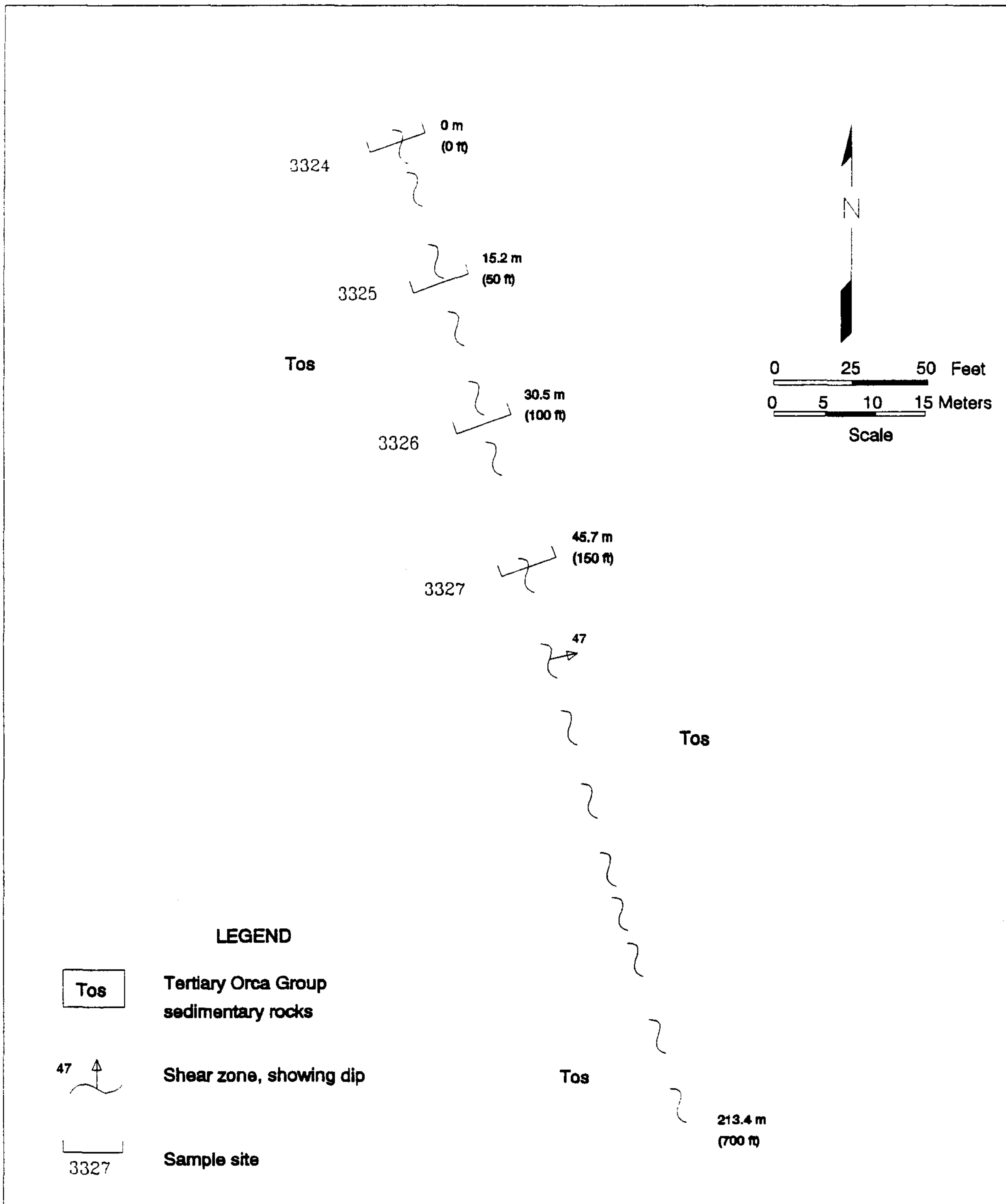


Figure A-2.- Map of the Columbia Red Metals Prospect showing the geology and sample locations. Base map is from Bureau OFR 44-85(32).

Name: DADO NO. 1 PROSPECT

Alternate Names: Four-In-One, East Vein **Kardex Number:** 085-056, 085-056

MAS/MILS Sequence Number: 0020850115 **RARE II Map Number:** A-8

Latitude: N 61° 05' 24" **Longitude:** W 147° 16' 34"

Meridian: Seward **Township:** 12 N **Range:** 12 E **Section:** 35 **Quarter:** NW

Elevation: 617 m (2,025 ft)

Map Name: Anchorage A-1

Type: Prospect **Current Status:** Inactive

Commodities: Copper, zinc, silver

Note: In previous reports this property was included under the Four-In-One Prospect. The area contains two mineralized zones: the Red Vein (Four-In-One Prospect) and the East Vein (Dado No. 1 Prospect). The Dado No. 1 Prospect (East Vein) is located approximately 0.5 km (0.3 mi) northeast of the Four-In-One Prospect (Red Vein)(32). This property is listed separately from the Four-In-One Prospect in this report because the mineralized areas are separate and distinct from each other. Also, separating these properties simplified the mining feasibility analysis because any mining that might occur would also be in two separate locations. The name, Dado No. 1, is used because while investigating this property in 1992, Bureau personnel found claim papers dated 1953 which used that name.

Geology: The country rock consists of Orca Group metasediments which strike N 55° E and dip 35° SE. A silicified, sulfide-bearing, sandstone breccia is confined to a N 5° E trending shear zone that dips steeply to the East. The breccia zone varies from 1.5 to 4.6 m (5 to 15 ft) in width and is intermittently exposed for 0.8 km (0.5 mi) along strike, beyond which it is either tundra or snow covered. Sulfides are concentrated within the breccia and consist of pyrite, pyrrhotite, and chalcopyrite. They occur as stringers and disseminations.

Small shears and faults cut across the breccia zone, but no offsets are evident. Some of the cross-cutting shears contain concentrations of sulfides that extend for several meters beyond the breccia into the surrounding sandstone. The oxidation of the sulfides has caused limonite staining within the breccia.

In 1954, Williams obtained several samples which contained 0.22 to 2.33 pct copper, 0 to 2.06 g/mt (0 to 0.06 oz/st) gold, and a trace of silver(55).

Mineral Deposit Type: Shear

Past Bureau Work: Bureau personnel visited the site in 1980 and 1981 during the RARE II study. They collected three samples which contained 0.002 to 0.29 pct copper and 2.6 to 28.6 ppm silver(32).

1992 Bureau Work: Bureau personnel visited, mapped, and sampled this property. They established a 276.7-m (907.8-ft) baseline along the shear zone. Sample 3376 was a 2.4-m (8.0-ft) wide, continuous-chip sample. Sample 3377 was a select sample of graywacke from around a blast hole. Sample 3378 was a 1.5-m (5.0-ft) wide, continuous-chip sample. Sample 3379 was a 0.6-m (2.0-ft) wide, select sample. Sample 3380 was a 1.5-m (5.0-ft) wide, continuous-chip sample. Sample 3384 was a select sample of a shear zone. Sample 3385 was a 1.5-m (5.0-ft) wide, continuous-chip sample of two shear zones which were from 40.6 to 45.7 cm (16.0 to 18.0 in) wide. Sample 3386 was a 2.1-m (7.0-ft) wide, continuous-chip sample. At this point the shear zone had a strike of N 17° E and a dip of 55° E. Sample 3387 was a select sample taken near sample 3386. Sample 3388 was a 2.4-m (8.0-ft) wide, continuous-chip sample which was composed of graywacke and conglomerate containing pyrite and chalcopyrite.

Sample 3401 was a select sample of trench dump material which had 5 pct or less chalcopyrite and minor malachite. Sample 3402 was a 2.4-m (8.0-ft) wide, continuous-chip sample across a quartz-cemented, breccia zone which contains chalcopyrite and minor malachite. This zone has a strike of N 14° W and a dip of 65° NE. Sample 3403 was a 1.8-m (6.0-ft) wide, continuous-chip sample across another quartz-cemented, breccia zone which had chalcopyrite and pyrrhotite. This breccia zone has a strike of N 5° W and a dip of 67° NE. Sample 3404 was a select sample from the 5-cm (2.0-in) wide, central portion of a 0.9-m (3.0-ft) wide, vein and shear zone. This zone strikes N 70° E and dips 58° NE. The material has silicic alteration and 15 pct chalcopyrite which occurs in stringers. Sample 3405 was a 0.9-m (3.0-ft) wide, continuous-chip sample across the entire width of a silicified breccia zone which cut a shear. The sample material contained chalcopyrite with minor malachite.

Sample 3406 was a 1.4-m (4.5-ft) wide, continuous-chip sample across a silicified breccia shear which is bounded by a fault on the east side. This zone has chalcopyrite with minor malachite, strikes N 4° E, and dips 60° SE. This shear zone is similar to that sampled by 3405, but no high-grade zone is present. Sample 3407 was a 1.5-m (5.0-ft) wide, continuous-chip sample of a silicified, brecciated, shear zone. This zone has chalcopyrite, strikes N 60° W, and dips 90°. (See figure A-3).

Sample Data: Table A-5 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at the Dado No. 1 Prospect. (See Appendix B).

TABLE A-5. - Selected sample data for the Dado No. 1 Prospect.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3376	Continuous chip	2.4	46.2	5,111	42	106
3377	Select		>50.0	11,971	27	120
3378	Continuous chip	1.5	>50.0	13,247	30	237
3379	Select	0.6	>50.0	19,563	70	271
3380	Continuous chip	1.5	15.5	2,078	30	57
3384	Select		12.4	1,384	45	46
3385	Continuous chip	1.5	9.4	2,065	34	74
3386	Continuous chip	2.1	20.2	1,299	125	218
3387	Select		9	848	45	90
3388	Continuous chip	2.4	1.8	39	49	29
3401	Select		>50.0	>20,000	35	512
3402	Continuous chip	2.4	26.1	6,597	36	179
3403	Continuous chip	1.8	25.1	2,855	50	57
3404	Select		>50.0	>20,000	113	626
3405	Continuous chip	0.9	5.2	1,899	18	88
3406	Continuous chip	1.4	15.2	6,997	27	198
3407	Continuous chip	1.5	1.4	90	24	34

The FA/AA results indicate that sample 3404 contained 176 g/mt (5.15 oz/st) silver and 7.02 pct copper. (See Appendix C).

Resources: Published(32)-

Inferred: 30,385 mt (33,500 st) of 0.22 pct copper and 21.3 ppm silver.

Estimated-

Indicated: 111,773 mt (123,234 st) of 23.14 g/mt (0.67 oz/st) silver and 0.51 pct copper.

Mineral development potential: Low, based on the mining feasibility study.

References: (1,3,8,11,22,32,33,48,55)

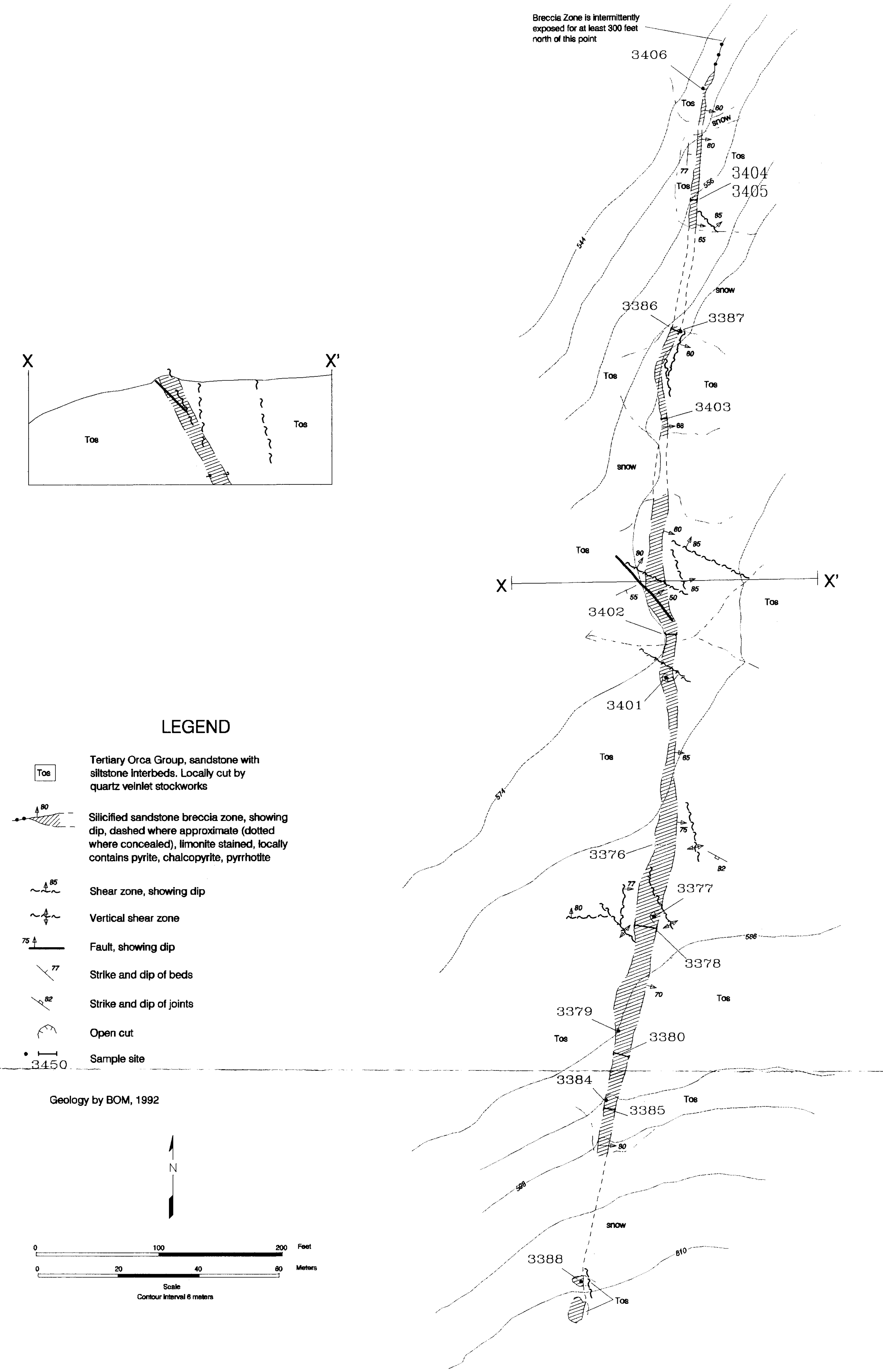


Figure A-3. - Map of the Dado No.1 Prospect showing the geology and sample locations

Name: FINSKI BAY PROSPECT

Alternate Names: None **Kardex Number:** 095-258

MAS/MILS Sequence Number: 0020950228 **RARE II Map Number:** S-105

Latitude: N 60° 53' 32" **Longitude:** W 147° 05' 38"

Meridian: Copper River **Township:** 11 S **Range:** 10 W **Section:** 24 **Quarter:** SE

Elevation: 1 m (3 ft)

Map Name: Seward D-1

Type: Prospect **Current Status:** Inactive

Commodities: Copper

Geology: The country rock is Orca Group pillow basalt. Pyrite and chalcopyrite are present in several quartz veins. The main vein strikes N 54° W, dips 73° SW, and is 15 cm (6.0 in) wide. A second vein strikes N 40° E, dips 65° SE, and is 0.3 m (1.0 ft) wide(48). Underground workings consist of a 21.3-m (70-ft) adit.

Mineral Deposit Type: Vein

Past Bureau Work: The Bureau mapped and sampled the workings in 1979 and 1980 during the RARE II study. Samples taken from one quartz vein contained 11 to 70 ppm copper(48).

1992 Bureau Work: Bureau personnel collected two samples. Samples 3363 and 3364 were representative-chip samples of the basalt outcrop which contains minor quartz veining and pyrite.

Sample Data: Table A-6 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at the Finski Bay Prospect. (See Appendix B).

TABLE A-6. - Selected sample data for the Finski Bay Prospect.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3363	Representative chip		0.5	59	63	611
3364	Representative chip		1.0	244	49	427

The FA/AA results indicate that sample 3364 contained 2.06 g/mt (0.06 oz/st) silver. (See Appendix C).

Resources: Not determined due to the low analytical values.

Mineral development potential: Low, based on published Bureau report(22). Data obtained during the current study does not indicate any higher potential.

References: (1,12,17,21,22,45,48)

Name: FOUR-IN-ONE PROSPECT

Alternate Names: Red Vein, Miners River **Kardex Number:** 085-056, 085-114

MAS/MILS Sequence Number: 0020850115 **RARE II Map Number:** A-8

Latitude: N 61° 05' 32" **Longitude:** W 147° 16' 30"

Meridian: Seward **Township:** 12 N **Range:** 12 E **Section:** 34 **Quarter:** NE

Elevation: 701 m (2,300 ft)

Map Name: Anchorage A-1

Type: Prospect **Current Status:** Inactive

Commodities: Copper, gold, silver

Note: The area contains two mineralized zones: the Red Vein (Four-In-One Prospect) and the East Vein (Dado No. 1 Prospect). The Dado No. 1 Prospect (East Vein) is located approximately 0.5 km (0.3 mi) northeast of the Four-In-One Prospect (Red Vein)(32). These properties are listed separately in this report because the mineralized areas are separate and distinct from each other. Also, separating these properties simplified the mining feasibility analysis because any mining that might occur would be in two separate locations.

Geology: The country rock consists of Orca Group slates and graywackes, which strike N 55° E and dip 35° SE. An iron-stained shear zone is located at the head of a cirque. The shear zone is approximately 30 m (100 ft) wide, strikes N 25° W, and dips 65° NE. The shear zone contains pyrite and chalcopyrite veinlets from 2.5 to 30 cm (1.0 to 12 in) wide. An 18-m (60-ft) long adit intersects the shear zone at the face. In 1954, Williams collected samples at this prospect which contained 0.79 pct copper with trace amounts of gold and silver(48,55).

Mineral Deposit Type: Shear

Past Bureau Work: Bureau personnel examined the property in 1980 and 1981 during the RARE II study. They collected two samples which contained 0.94 to 3 pct copper and 2.7 to 46 ppm silver(32).

1992 Bureau Work: Bureau personnel collected four samples. Sample 3355 was a 0.6-m (2.0-ft) wide, representative-chip sample of a calcite breccia zone located in the adit 9.1 m (30.0 ft) from the portal. Sample 3356 was a 1.5-m (5.0-ft) wide, representative-chip sample of graywacke with calcite veinlets taken near the face of the adit. Sample 3357 was a high grade select sample of the calcite veinlets at the face of the adit. These veinlets contained pyrite and chalcopyrite. Sample 3362 was a select sample of calcite veinlets located 6.1 m (20.0 ft) from the portal. (See figure A-4).

Sample Data: Table A-7 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at the Four-In-One Prospect. (See Appendix B).

TABLE A-7. - Selected sample data for the Four-In-One Prospect.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3355	Representative chip	0.6	6.5	4,338	74	1,452
3356	Representative chip	1.5	10.1	5,624	20	95
3357	Select		50.0	>20,000	59	781
3362	Select		27.2	14,642	64	106

The FA/AA results indicate that sample 3357 contained 68.2 g/mt (1.99 oz/st) silver and 3.67 pct copper. (See Appendix C).

Resources: Published(32)-

Inferred: 55 mt (60 st) of 0.67 pct copper and 13.4 ppm silver.

Mineral development potential: Low, based on the mining feasibility study.

References: (1,3,8,11,22,32,33,48,55)

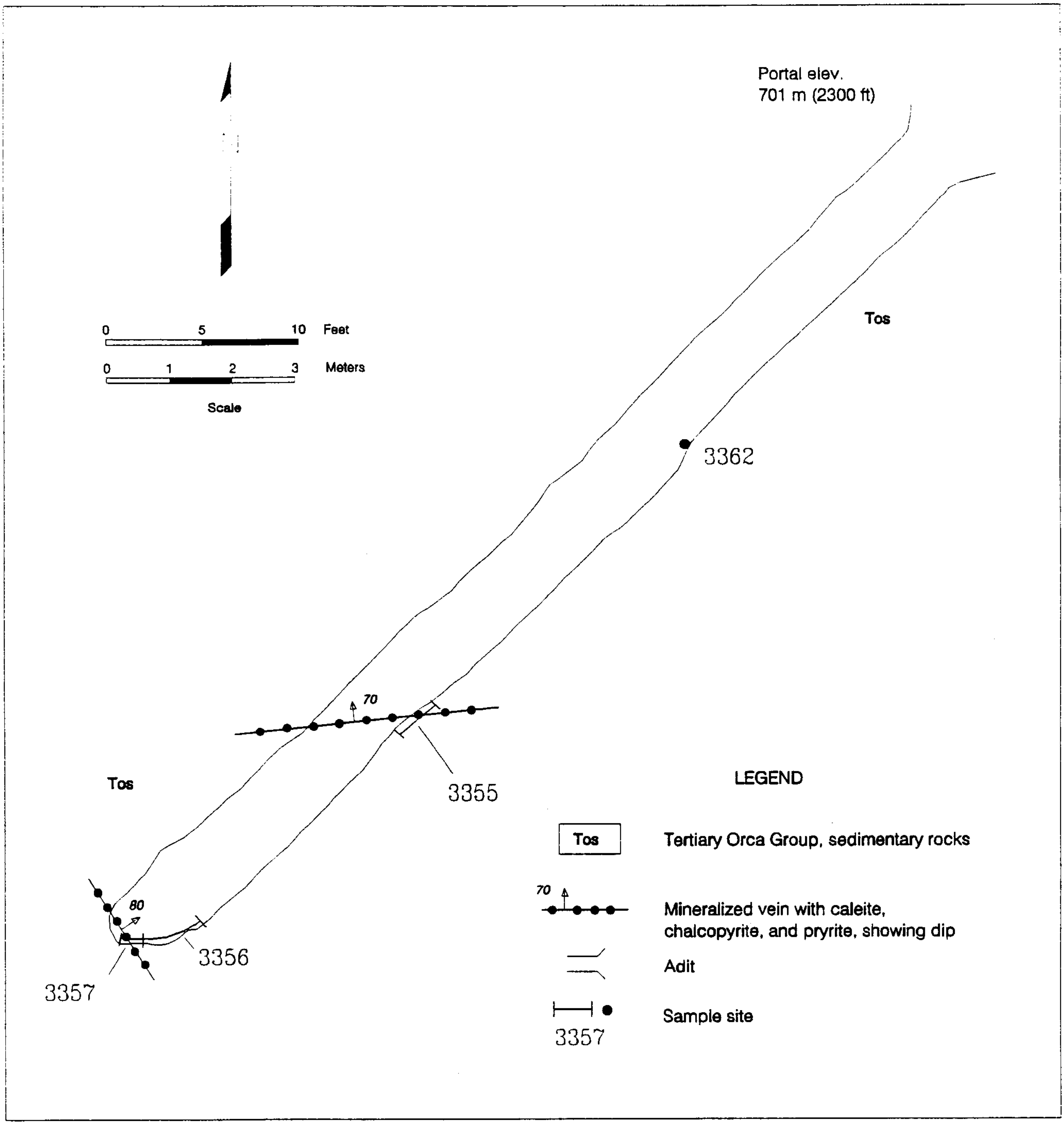


Figure A-4.- Map of the Four-In-One adit showing the geology and sample locations. Base map is from Bureau OFR 44- 85(32).

Name: **GILNOW PROSPECT**

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: 0020950370 **RARE II Map Number:** S-114

Latitude: N 60° 56' 58" **Longitude:** W 147° 15' 43"

Meridian: Seward **Township:** 10 N **Range:** 12 E **Section:** 23 **Quarter:** NE

Elevation: 76 m (250 ft)

Map Name: Seward D-1

Type: Prospect **Current Status:** Inactive

Commodities: Copper

Geology: The country rock consists of Orca Group slates. A 30-m (100-ft) wide, iron-stained shear zone is present. It strikes N 70° E, dips 90°, and contains disseminated pyrrhotite(32,48).

Mineral Deposit Type: Shear

Past Bureau Work: The Bureau examined the prospect in 1979 and 1981 during the RARE II study. Two grab samples from the shear zone contained 33 to 45 ppm copper (22,32).

1992 Bureau Work: The Bureau did not visit this property.

Sample Data: None

Resources: Not determined.

Mineral development potential: Low, based on published Bureau information(22).

References: (3,10,19,21,22,32,33,45,48)

Name: GLENDENNING PROSPECT

Alternate Names: Silver Falls, Vera **Kardex Number:** 095-257

MAS/MILS Sequence Number: 0020950371 **RARE II Map Number:** S-116

Latitude: N 60° 58' 28" **Longitude:** W 147° 21' 43"

Meridian: Seward **Township:** 10 N **Range:** 12 E **Section:** 8 **Quarter:** NW

Elevation: 122 m (400 ft)

Map Name: Seward D-1

Type: Prospect **Current Status:** Patented, inactive

Commodities: Copper

Geology: The country rock is Orca Group metasediments. A 2 to 21-m (6 to 70-ft) wide shear zone occurs in a silicified graywacke. The shear zone strikes N 5° E and dips 70° NW. Veinlets of quartz, pyrite, and chalcopyrite from 1.0 to 8.0 cm (0.5 to 3.0 in) wide are present in the shear zone. A 213-m (700-ft) long adit intersects the shear zone about 76 m (250 ft) in from the portal and then follows the shear zone(32,48).

Mineral Deposit Type: Shear

Past Bureau Work: Bureau personnel examined the property in 1982 during the RARE II study. Three chip samples taken across the shear zone in the adit contained from 30 to 825 ppm copper(32).

1992 Bureau Work: Bureau personnel collected three samples. Sample 3372 was a 1.2-m (4.0-ft) wide, continuous-chip sample across the shear zone within 3.0 m (10 ft) of the face of the drift. Sample 3373 was a grab sample of fault gouge taken 22.8 m (75.0 ft) from the face. Sample 3374 was a 1.2-m (4.0-ft) wide, spaced-chip sample of the shear material located 107 m (350 ft) from the face. (See figure A-5).

Sample Data: Table A-8 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at the Glendenning Prospect. (See Appendix B).

TABLE A-8. - Selected sample data for the Glendenning Prospect.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3372	Continuous chip	1.2	<0.5	537	17	189
3373	Grab		<0.5	126	30	59
3374	Spaced chip	1.2	1.2	991	36	99

The FA/AA results indicate that sample 3374 contained 2.06 g/mt (0.06 oz/st) silver. (See Appendix C).

Resources: Not determined due to low analytical values.

Mineral development potential: Low, based on published Bureau information(22). Data obtained during the current investigation does not indicate that the potential is any higher.

References: (1,3,10,19,22,24,32,33,45,48)

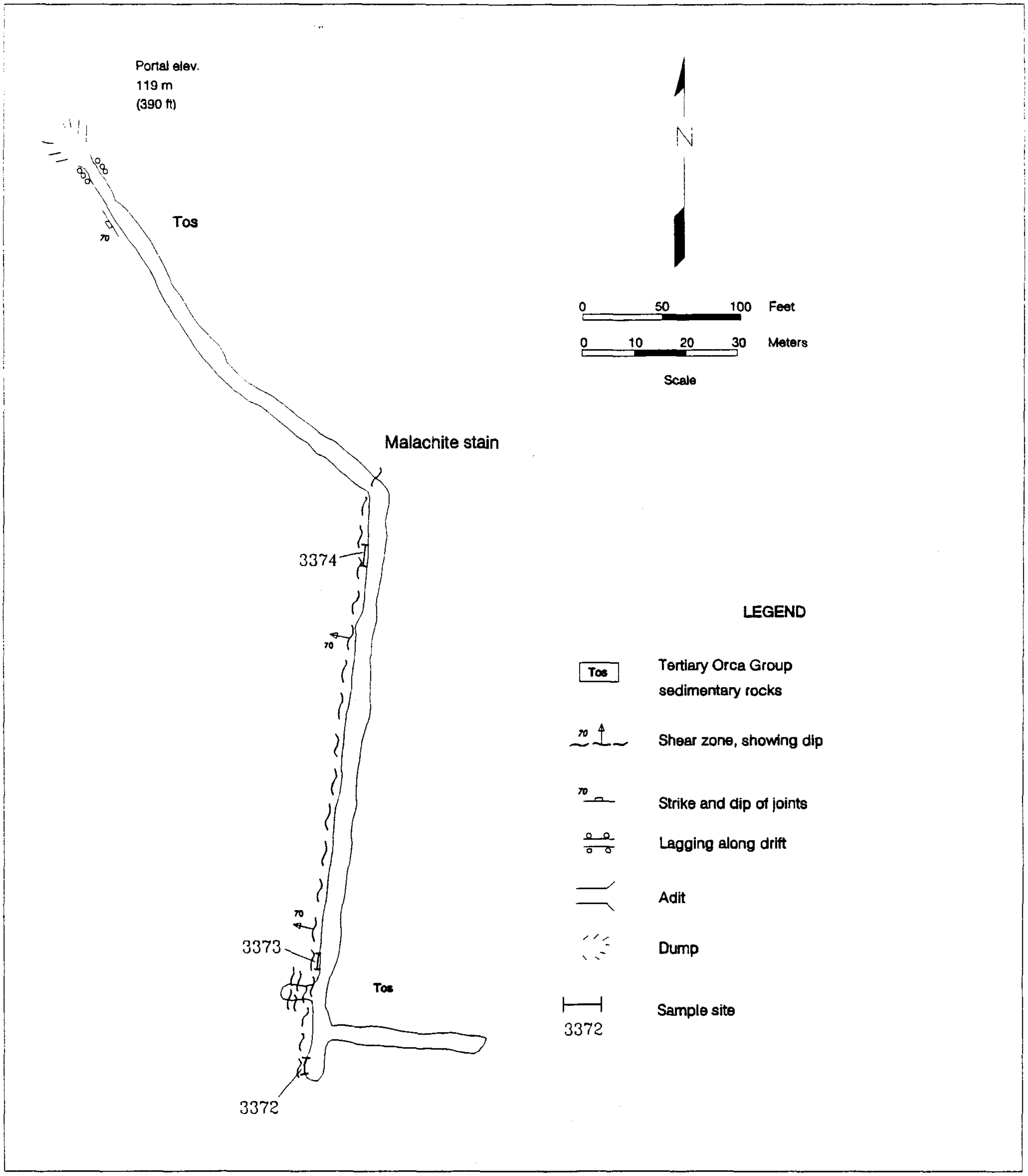


Figure A-5.- Map of the Glendenning Prospect showing the geology and sample locations. Base map is from Bureau OFR 44- 85(32).

Name: GLOBE PROSPECT

Alternate Names: Long Bay **Kardex Number:** 085-213

MAS/MILS Sequence Number: 0020850118 **RARE II Map Number:** A-3

Latitude: N 60° 59' 16" **Longitude:** W 147° 15' 37"

Meridian: Seward **Township:** 10 N **Range:** 12 E **Section:** 2 **Quarter:** NE

Elevation: 2 m (6 ft)

Map Name: Seward D-1

Type: Prospect **Current Status:** Inactive

Commodities: Copper

Geology: The country rock consists of Orca Group metasediments. The 37.5-m (123-ft) long adit exposes a shear zone for 36.6 m (120 ft). This shear averages 0.3 m (1 ft) in width, strikes E-W to N 85° W, and dips 80° NE. Minerals present in the shear zone are chalcopyrite and pyrite(48).

Mineral Deposit Type: Shear

Past Bureau Work: The Bureau looked for this occurrence during the RARE II study in 1981, but did not find it.

1992 Bureau Work: The USGS found this property and Bureau personnel mapped the adit and collected 12 samples. Each sample was a 3.0-m (10-ft) wide, continuous-chip sample taken every 3.0 m (10 ft) along the length of the adit. The mineralized zone was 0.3 m (1.0 ft) wide at its widest point and contained chalcopyrite and pyrite. Sample 3353 was a select sample from the dump material in front of the portal. (See figure A-6).

Sample Data: Table A-9 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at the Globe Prospect. (See Appendix B).

TABLE A-9. - Selected sample data for the Globe Prospect.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3341	Continuous chip	3	0.9	256	83	64
3342	Continuous chip	3	0.8	241	44	59
3343	Continuous chip	3	2.3	670	19	50
3344	Continuous chip	3	3.6	1,189	24	42
3345	Continuous chip	3	1.4	5,312	14	52
3346	Continuous chip	3	1.3	1,754	15	50
3347	Continuous chip	3	5.4	11,524	32	55
3348	Continuous chip	3	1.8	5,868	8	36
3349	Continuous chip	3	9.2	>20,000	25	86
3350	Continuous chip	3	1.7	2,797	25	38
3351	Continuous chip	3	0.5	1,856	21	43
3452	Continuous chip	3	0.6	361	17	37
3453	Grab		4.8	14,806	21	23

The FA/AA results indicate that sample 3349 contained 9.60 g/mt (0.28 oz/st) silver and 4.64 pct copper. (See Appendix C).

Resources: Estimated-

Inferred: 3,000 mt (3,308 st) of 2.46 ppm silver, 0.4 pct copper, and 0.01 pct zinc.

Mineral development potential: Low, based on the mining feasibility study.

References: (1,3,8,10,11,19,22,27,30,33,48)

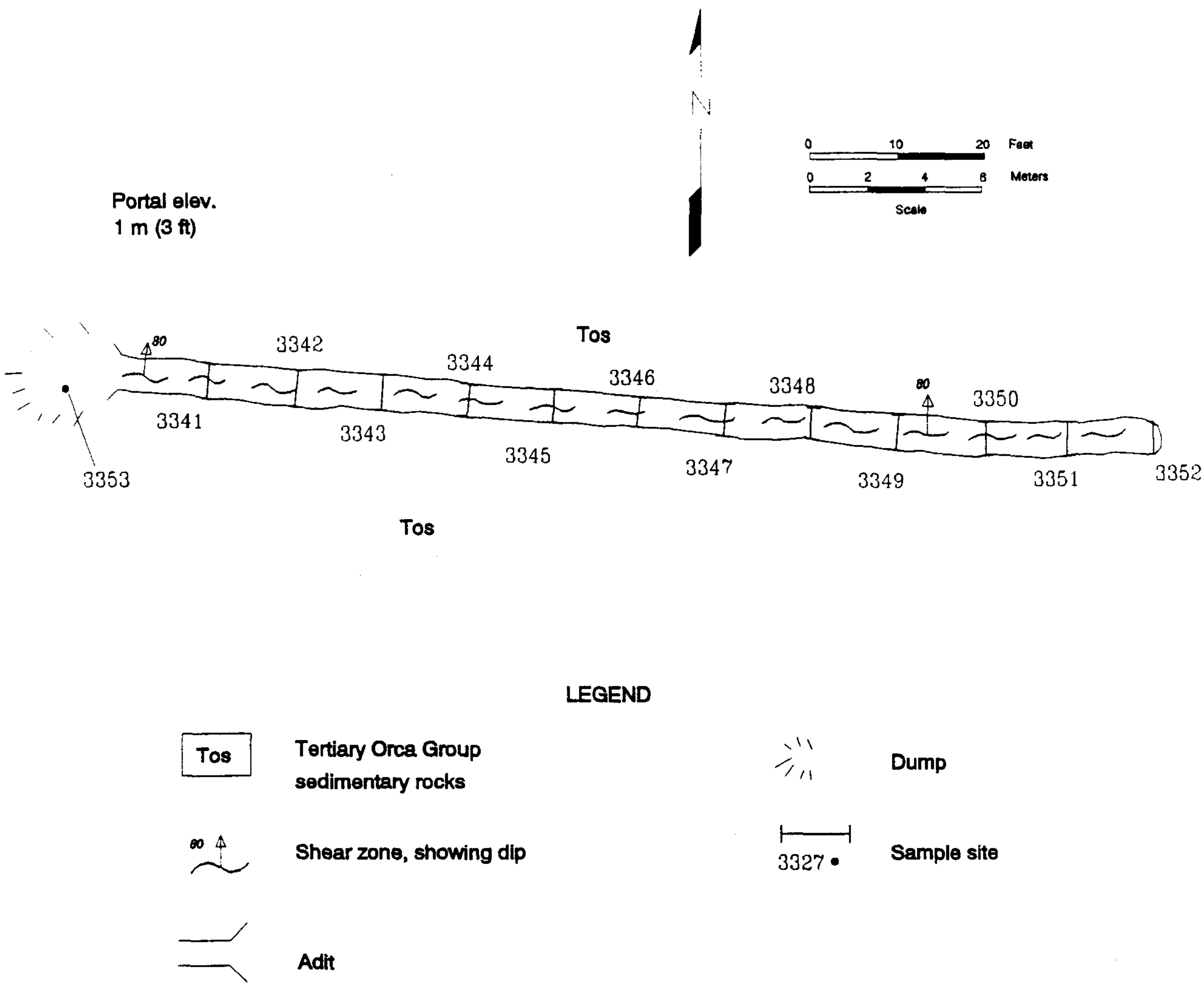


Figure A-6.- Map of the Globe Prospect showing the geology and sample locations.

Name: IDLE CLAIM PROSPECT

Alternate Names: Columbia Red Metals, Kadin Lake **Kardex Number:** None

MAS/MILS Sequence Number: 0020850298 **RARE II Map Number:** A-2

Latitude: N 61° 06' 18" **Longitude:** W 147° 08' 51"

Meridian: Copper River **Township:** 9 S **Range:** 11 W **Section:** 10 **Quarter:** NE

Elevation: 320 m (1,050 ft)

Map Name: Anchorage A-1

Type: Prospect **Current Status:** Inactive

Commodities: Zinc, copper, silver, lead

Geology: The country rock consists of Orca Group metasediments and Tertiary felsic dikes. An adit follows a shear zone which strikes from N 25° to 60° E and dips 47° to 55° SE. The shear zone intersects a 0.9-m (3.0-ft) wide, felsic dike that strikes N 60° E and dips 55° SE. A prospect pit above the adit exposes a 1.2-m (4.0-ft) wide, sheared, felsic dike which strikes N 50° E and dips 55° SE. Chalcopyrite and sphalerite occur within a 0.1-m (0.3-ft) wide zone(32,48).

Approximately 300 m (1,000 ft) north of the adit, open cuts expose a 4.6-m (15.0-ft) wide, felsic dike which strikes N 50° E and dips 75° NW. The dike contains 0.3-cm (0.1-in) wide veinlets of arsenopyrite(48).

Mineral Deposit Type: Shear, dike

Past Bureau Work: Bureau personnel examined the property in 1982 during the RARE II Study. They obtained five samples which contained 0.02 to 0.22 pct lead, 0.04 to 2.85 pct zinc, 0.16 to 0.7 pct copper, 6.7 to 11.1 ppm silver, and 0.01 to 1.65 pct arsenic(32,48).

1992 Bureau Work: Bureau personnel mapped the underground workings and collected samples from the workings and the vicinity. Samples 3358 and 3359 where each 0.9-m (3.0-ft) wide, representative-chip samples obtained at the face of the adit. (See figure A-7). Samples 3331 and 3332, which contained massive chalcopyrite, were collected from an outcrop approximately 0.4 km (0.25 mi) west of the adit. Sample 3360 was from a shear zone 0.4 km (0.25 mi) northeast of the property.

Sample Data: Table A-10 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at or near the Idle Claim Prospect. (See Appendix B).

TABLE A-10. - Selected sample data for the Idle Claim Prospect area.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3331	Continuous chip	0.9	15.6	2,618	1,263	2,643
3332	Continuous chip	0.9	<0.5	53	26	68
3358	Representative chip	0.1	15.6	4,775	585	>20,000
3359	Representative chip	0.1	9.1	5,146	325	>20,000
3360	Representative chip		>50.0	5,757	>10,000	483

The FA/AA results indicate that sample 3360 contained 1,194 g/mt (34.82 oz/st) silver, 0.54 pct copper, and 1.05 pct lead. This sample contained the highest silver value of all the samples collected during this study. Other samples in this area had 36 ppm to 211 g/mt (6.16 oz/st) silver. (See Appendix C).

Resources: Published-

Inferred(32):

Underground; 258 mt (285 st) of 2.38 pct zinc, 0.25 pct copper, and 9.92 ppm silver

Surface; 45 mt (50 st) of 1.65 pct zinc, 0.7 pct copper, and 12.0 ppm silver

Felsic dike; 362 mt (400 st) of 0.11 pct zinc, 0.4 pct copper, 0.22 pct lead, and 11.1 ppm silver

Inferred(22): 318 mt (350 st) of 2.27 pct zinc

Estimated- (Averaged from published values)

Inferred: 665 mt (733 st) of 1.85 pct zinc, 0.38 pct copper, and 10.61 ppm silver.

Mineral development potential: Low, based on the mining feasibility study.

References: (22,32,48)

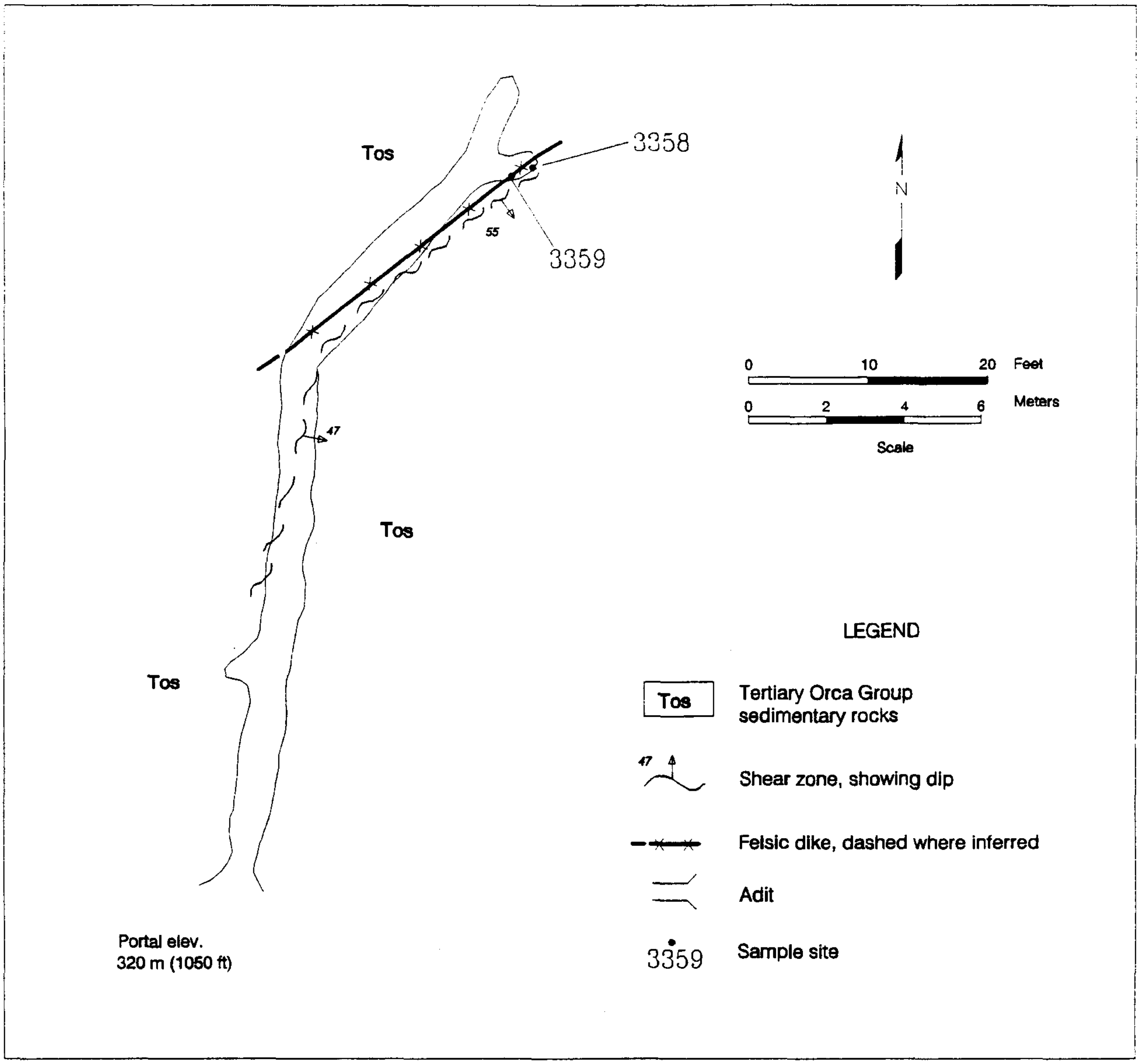


Figure A-7.- Map of the Idle Claim Prospect showing the geology and sample locations. Base map is from Bureau OFR 44-85(32).

Name: **JENSON PROSPECT**

Alternate Names: Portsmouth, Scotia Bell **Kardex Number:** 095-258

MAS/MILS Sequence Number: 0020950049 **RARE II Map Number:** S-108

Latitude: N 60° 52' 53" **Longitude:** W 147° 05' 16"

Meridian: Copper River **Township:** 11 S **Range:** 11 W **Section:** 25 **Quarter:** SE

Elevation: 84 m (275 ft)

Map Name: Seward D-1

Type: Prospect **Current Status:** Inactive

Commodities: Copper, silver

Geology: The country rock consists of Orca Group pillow basalts. A shear zone strikes N 10 to 20° E and dips 60 to 75° NW. The shear zone is from 12.7 cm to 3.0 m (5.0 in to 10 ft) wide and extends for more than 183 m (600 ft). Minerals in the shear include chalcopyrite and pyrite in quartz veins(48).

Mineral Deposit Type: Shear

Past Bureau Work: Bureau personnel examined the prospect in 1980 during the RARE II study. They collected samples which contained 0.06 to 3 pct copper and 8 to 40 ppm silver(22,48).

1992 Bureau Work: Bureau personnel did not visit this property.

Sample Data: None

Resources: Not determined.

Mineral development potential: Low, based on published Bureau information(22).

References: (1,3,10,12,19,22,25,26,27,33,45,48)

Name: JENSON, WALLACE, AND KILBOURNE PROSPECT

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: 0020950366 **RARE II Map Number:** S-107

Latitude: N 60° 53' 21" **Longitude:** W 147° 04' 53"

Meridian: Copper River **Township:** 11 S **Range:** 10 W **Section:** 30 **Quarter:** NW

Elevation: 2 m (7 ft)

Map Name: Seward D-1

Type: Prospect **Current Status:** Inactive

Commodities: Copper

Geology: The country rock is Orca Group pillow basalt. Ore minerals are present in a major north, northeast-trending shear and include quartz veinlets less than 1.00 mm (0.04 in) wide with disseminated pyrite, chalcopyrite, and pyrrhotite(48).

Mineral Deposit Type: Shear

Past Bureau Work: Bureau personnel examined the prospect in 1979 and 1980 during the RARE II study. They collected samples which contained 2 to 420 ppm copper(22,48).

1992 Bureau Work: Bureau personnel looked for this property, but could not locate it with certainty. Sample 3365 was a representative sample from an outcrop in the area.

Sample Data: Table A-11 shows selected descriptive and ICP/FA+DCP analytical information for the sample obtained in the vicinity of the Jenson, Wallace, and Kilbourne Prospect. (See Appendix B).

TABLE A-11. - Selected sample data for the Jenson, Wallace, and Kilbourne Prospect area.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3365	Representative chip		<0.5	36	20	60

The FA/AA results indicate that sample 3365 contained 0.68 g/mt (0.02 oz/st) silver. (See Appendix C).

Resources: Not determined due to the low analytical values.

Mineral development potential: Low, based on published Bureau information(22). The data obtained during the current investigation does not indicate that the potential is any higher.

References: (3,10,12,21,22,45,48)

Name: **KADIN LAKE SAMPLE SITE**

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: None **RARE II Map Number:** None

Latitude: N 61° 05' 44" **Longitude:** W 147° 11' 18"

Meridian: Copper River **Township:** 12 N **Range:** 11 W **Section:** 16 **Quarter:** NW

Elevation: 442 m (1,450 ft)

Map Name: Anchorage A-1

Type: Sample Site **Current Status:** Unclaimed

Commodities: Zinc

Geology: The country rock is Orca Group metasediments. A Tertiary felsic dike strikes N 50° E with an undetermined dip.

Mineral Deposit Type: Dike

Past Bureau Work: None.

1992 Bureau Work: Bureau personnel obtained sample 3361 which was a 0.3-m (1.0-ft) wide, representative-chip sample from the dike.

Sample Data: Table A-12 shows selected descriptive and ICP/FA+DCP analytical information for the sample obtained at the Kadin Lake Sample Site. (See Appendix B).

TABLE A-12. - Selected sample data for the Kadin Lake Sample Site.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3361	Representative chip	0.3	0.6	57	26	167

The FA/AA results indicate that sample 3361 contained 1.37 g/mt (0.04 oz/st) silver. (See Appendix C).

Resources: Not determined due to the low analytical values.

Mineral development potential: Low, based on the limited extent of the outcrop and the low analytical values.

References: None

Name: LONG BAY NO. 1 OCCURRENCE

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: 0020850299 **RARE II Map Number:** A-4

Latitude: N 61° 02' 28" **Longitude:** W 147° 16' 41"

Meridian: Seward **Township:** 11 N **Range:** 12 E **Section:** 14 **Quarter:** SW

Elevation: 487 m (1,640 ft)

Map Name: Anchorage A-1

Type: Occurrence **Current Status:** Inactive

Commodities: Zinc, lead, copper, silver

Geology: The country rock consists of undivided mid-Cretaceous volcanoclastic rocks and limestone. The limestone bedding strikes N 40° W and dips 80° NE. Numerous mineralized 10-cm to 6.1-m (4.0-in to 20-ft) shear zones occur in the area. Most of the zones strike from N 25° W to N 20° E and dip 80° S to vertical. A second suite of shear zones strike N 55 to 78° E and dip steeply. Ore minerals occur as pods and veinlets of sphalerite, galena, pyrite, and arsenopyrite along the shear zones. Gossan is also present over some of the zones(32,48).

Mineral Deposit Type: Shears, dikes

Past Bureau Work: During the RARE II study in 1979, Bureau personnel collected geochemical samples along the drainages of Long Bay. Two stream sediment samples from the West Fiord of Long Bay contained unusually high values of copper, lead, and zinc. Follow-up investigations in 1981 and 1982 revealed numerous shear zones. Bureau personnel collected samples which had metal values up to 3.2 pct lead, 2.6 pct zinc, 1.6 pct arsenic, and 274 g/mt (8 oz/st) silver(22,32,48).

1992 Bureau Work: Bureau personnel obtained two samples. Sample 3339 was a 1.2-m (4.0-ft) wide, continuous-chip sample across a shear zone which contains quartz, galena, chalcopyrite, and pyrite. Sample 3340 was from the same shear zone, but 15 m (50 ft) west of sample 3339. It was a 1.2-m (4.0-ft) wide, channel sample.

Sample Data: Table A-13 shows selected descriptive and analytical ICP/FA+DCP information for the samples obtained at the Long Bay No. 1 Occurrence. (See Appendix B).

TABLE A-13. - Selected sample data for the Long Bay No. 1 Occurrence.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3339	Continuous chip	1.2	44.3	426	>10,000	8,694
3340	Channel	1.2	21.6	903	>10,000	4,274

The FA/AA results indicate that sample 3339 contained 49.0 g/mt (1.43 oz/st) silver, 0.05 pct copper, 2.55 pct lead, and 0.85 pct zinc. (See Appendix C).

Resources: Not determined due to the limited data available.

Mineral development potential: Unknown. Published Bureau information classified this occurrence as having a moderate mineral development potential based on its "unexplored nature"(48). This occurrence appears to have no higher reserves or grade than those deposits analyzed in the mining feasibility study which were determined to have a low mineral development potential. Until further work is done to define the grade and reserves, this occurrence is classified as having an unknown mineral development potential.

References: (21,22,32,48)

Name: MINERS RIVER DISCOVERY PROSPECT

Alternate Names: Miners Bay Discovery **Kardex Number:** 085-298

MAS/MILS Sequence Number: 0020850220 **RARE II Map Number:** P-31

Latitude: N 61° 05' 44" **Longitude:** W 147° 22' 30"

Meridian: Seward **Township:** 12 N **Range:** 12 E **Section:** 29 **Quarter:** SW

Elevation: 49 m (160 ft)

Map Name: Anchorage A-1 and A-2

Type: Placer **Current Status:** Inactive

Commodities: Gold

Geology: The material along Miners River is Recent alluvium which is underlain by Orca Group metasediments. The thickness of the alluvium is undetermined. The sample site is less than 0.8 km (0.5 mi) south of the Contact Fault which separates the Valdez Group in the north from the Orca Group to the south. Miners River flows from Pedro Glacier southward into the adjacent valley, then westward parallel to the Contact Fault to Miners Lake. Thus, the alluvium might have originated from the Valdez Group and been transported downstream. This could account for the reported presence of gold in the area because gold is usually associated with the Valdez Group metasediments. The alluvium ranges in size from sand (0.1 mm or 0.004 in) to cobble (20 cm or 8 in) and consists of graywacke with quartz veins 3 to 12 mm (0.1 to 0.47 in) wide(32,34).

Mineral Deposit Type: Placer

Past Bureau Work: In 1981, Bureau personnel obtained two placer samples from this area. One sample contained 3.86 g/m^3 (0.104 oz/yd^3) gold. The other sample less than 0.03 ppm gold, 345 ppm copper, 215 ppm lead, and 300 ppm zinc(32,48).

1992 Bureau Work: The Bureau obtained two placer samples from the area. Sample 3334 was taken from Miners River 1.4 km (0.9 mi) below Pedro Glacier and sample 3335 was taken from a tributary of Miners River, 75 m (250 ft) from sample 3334.

Sample Data: Table A-14 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained from the Miners River Discovery Prospect. (See Appendix B).

TABLE A-14. - Selected sample data for the Miners River Discovery Prospect.

Sample Number	Type	Size m^3	Gold ppm	Silver ppm	Platinum ppm	Palladium ppm
3334	Placer	0.08	2.1	0.5	0.010	0.010
3335	Placer	0.08	0.8	0.8	<0.005	0.010

No FA/AA analyses were done on these samples due to the low ICP values.

Resources: Not determined due to the low analytical values.

Mineral development potential: Low. The ICP analytical results of the most recent samples indicate that they contained no more than background values of gold.

References: (1,22,32,34,48)

Name: **MINERS RIVER NICKEL PROSPECT**

Alternate Names: None **Kardex Number:** 085-220

MAS/MILS Sequence Number: 0020850113 **RARE II Map Number:** A-14

Latitude: N 61° 04' 22" **Longitude:** W 147° 29' 51"

Meridian: Seward **Township:** 11 N **Range:** 11 E **Section:** 3 **Quarter:** SW

Elevation: 0.6 m (2 ft)

Map Name: Anchorage A-2

Type: Prospect **Current Status:** Inactive

Commodities: Nickel, cobalt, copper

Geology: The country rock consists of Tertiary gabbro and diorite of the Miners Bay Pluton which intrudes Valdez Group sediments. Nelson and others determined the age of the diorite to be 38 million years old(35). A shear zone in the diorite strikes N 20° to 40° E, dips 70° SE, and is from 3.0 to 7.6 m (10 to 25 ft) wide. Chalcopyrite and pyrite occur in the diorite while disseminated pyrrhotite, chalcopyrite, and pentlandite occur in fractured areas along the shear zone. Two adits follow the shear zone. The lower adit is 2.4 m (8 ft) long and is at sea level. The upper adit has 61 m (200 ft) of workings and is located 6.1 m (20 ft) above sea level(32,48).

Mineral Deposit Type: Shear

Past Bureau Work: In 1944, Bureau personnel sampled the workings. The samples contained 0.2 to 0.29 pct nickel with a minor amount of copper(54).

In 1980 and 1982 during the RARE II study, Bureau personnel collected 27 samples in and near the workings. The samples contained 30 ppm to 0.2 pct cobalt, less than 10 ppm to 0.25 pct nickel, and less than 10 ppm to 0.31 pct copper(32).

1992 Bureau Work: In 1992, Bureau personnel collected only one sample because this property had been extensively sampled in prior years. Sample 3375 was a grab sample from the dump in front of the lower adit. (See figure A-8).

Sample Data: Table A-15 shows selected descriptive and ICP/FA+DCP analytical information for the sample obtained at the Miners River Nickel Prospect. (See Appendix B).

TABLE A-15. - Selected sample data for the Miners River Nickel Prospect.

Sample Number	Type	Size m	Nickel ppm	Copper ppm	Cobalt ppm	Chromium ppm
3375	Grab		2,240	2,053	138	383

The FA/AA results indicate that sample 3375 contained 1.37 g/mt (0.04 oz/st) silver and 0.21 pct copper. (See Appendix C).

Resources: Published(32)-

Measured: 4,095 mt (4,500 st) of 0.2 pct Ni

Indicated: 5,915 mt (6,500 st) of 0.2 pct Ni

Mineral development potential: Low, based on the mining feasibility study.

References: (1,8,10,11,15,16,19,22,30,31,32,35,48,54)

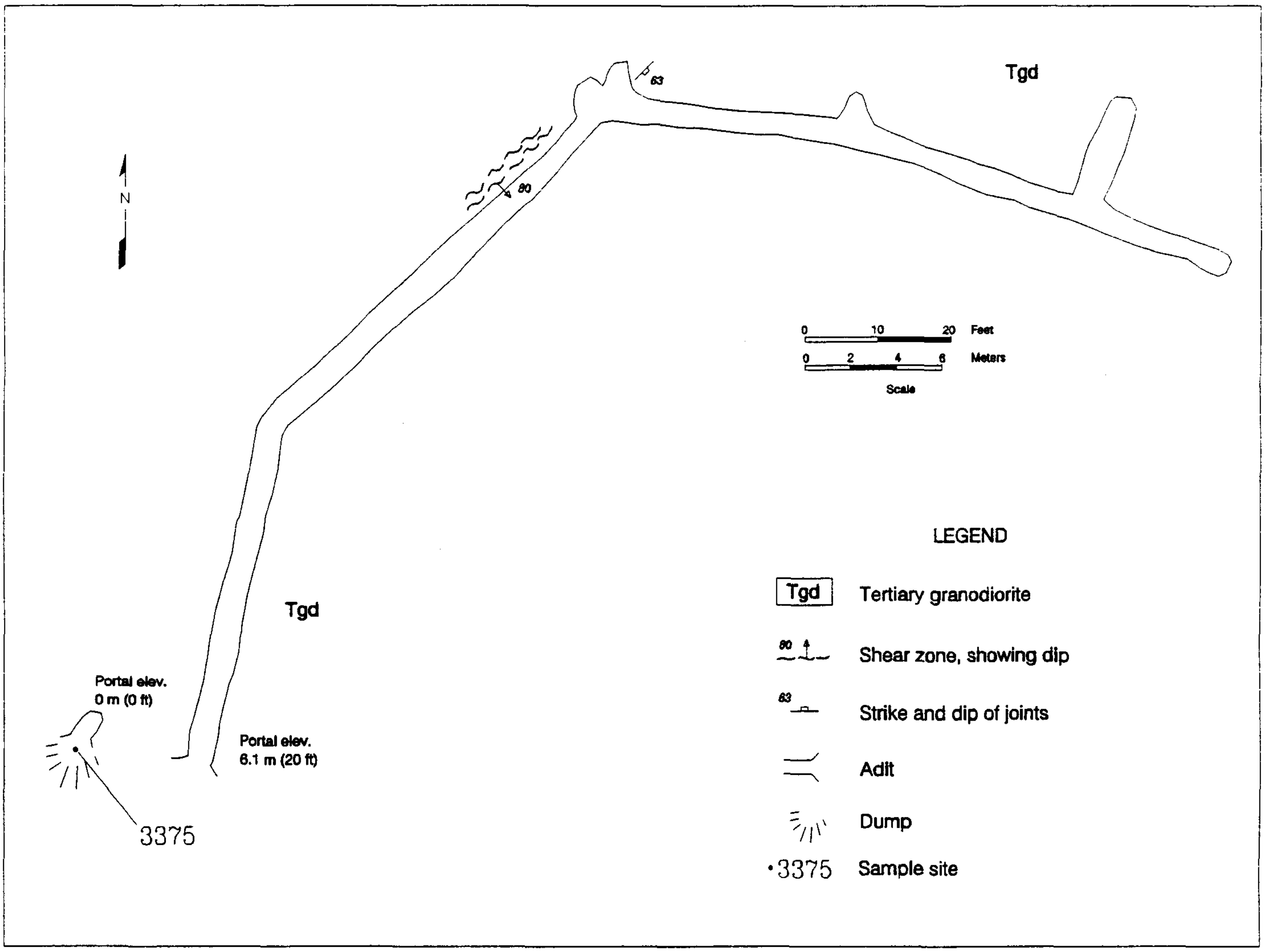


Figure A-8.- Map of the Miners River Nickel Prospect showing the geology and sample location. Base map is from Bureau OFR 44-85(32).

Name: MINERS RIVER NO. 1 OCCURRENCE

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: 0020850303 **RARE II Map Number:** A-9

Latitude: N 61° 04' 59" **Longitude:** W 147° 19' 35"

Meridian: Seward **Township:** 12 N **Range:** 12 E **Section:** 33 **Quarter:** SE

Elevation: 732 m (2,400 ft)

Map Name: Anchorage A-1

Type: Occurrence **Current Status:** Unclaimed

Commodities: Zinc, lead, copper

Geology: The country rock consists of Orca Group metasediments. Within these sediments is a 137-m (450-ft) wide, shear zone. It strikes in a north-south direction and extends for approximately 0.8 km (0.5 mi). The shear zone consists of parallel brecciated zones containing quartz, calcite, galena, sphalerite, and arsenopyrite. The brecciated zones are from 2.5 cm to 1.5 m (1.0 in to 5.0 ft) wide. Float material at the site contains arsenopyrite, galena, and sphalerite(32,48).

Mineral Deposit Type: Shear zone

Past Bureau Work: Bureau personnel discovered this occurrence in 1981 during the RARE II study. They collected four samples which had values of less than 0.001 to 16 pct arsenic, less than 10 ppm to 1.7 pct lead, 10 ppm to 4.8 pct zinc, less than 10 ppm to 0.6 pct copper, less than 0.34 to 75 g/mt (0.01 to 2.2 oz/st) silver, and less than 0.10 to 2.1 g/mt (0.003 to 0.06 oz/st) gold(32,48).

1992 Bureau Work: Bureau personnel looked for this site, but did not find the exact location with certainty. They collected two samples from the area. Sample 3423 was a select sample from a silicified, breccia zone. The zone is 15.2 cm (6.0 in) wide, strikes N 66° W, and dips 65° NE. The zone has a strike length of 45.7 m (150 ft) and cuts across carbonaceous shales which strike N 32° E and dip 75° SE. The minerals present are pyrite, chalcopyrite, and galena. Ankerite is also present and gives the rock a distinctive orange color.

Sample 3426 was a 0.6-m (2.0-ft) wide, continuous-chip sample from a silicified, breccia zone. It has a strike of N 77° E, a dip of 80° NW, and an exposed length of 15.2 m (50.0 ft). Pyrite occurs disseminated, in stringers, and in fine-grained lenses. Calcite and Ankerite are in the hanging wall of the zone.

Sample Data: Table A-16 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at the Miners River No. 1 Occurrence. (See Appendix B).

TABLE A-16. - Selected sample data for the Miners River No. 1 Occurrence.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3423	Select		2.1	938	4,206	7,069
3426	Continuous chip	0.6	0.7	13	28	57

The FA/AA results indicate that sample 3423 had 2.74 g/mt (0.08 oz/st) silver, 0.41 pct lead, and 0.7 pct zinc. (See Appendix C).

Resources: Not determined due to the limited data available.

Mineral development potential: Low, based on published Bureau information(22). One select sample had high lead and zinc values, however, Bureau personnel could be sure that this sample represented the Miners River No. 1 Occurrence.

References: (22,32,48)

Name: MINERS RIVER NO. 2 OCCURRENCE

Alternate Names: None **Kardex Number;** None

MAS/MILS Sequence Number: 0020850304 **RARE II Map Number:** A-10

Latitude: N 61° 03' 58" **Longitude:** W 147° 20' 38"

Meridian: Seward **Township:** 11 N **Range:** 12 E **Section:** 4 **Quarter:** SW

Elevation: 838 m (2,300 ft)

Map Name: Anchorage A-1

Type: Occurrence **Current Status:** Unclaimed

Commodities: Zinc, lead, silver, copper

Geology: The country rock consists of Orca Group slates, graywackes, and conglomerates which strike from N 55 to 80° E and dip steeply. Felsic dikes which strike from N 45° E to N 85° W and dip from 60 to 80° N are also present. Numerous shears striking N 15 to 70° W and up to 152 m (500 ft) long are confined to a zone up to 61 m (200 ft) wide which cuts interbedded Orca Group sandstone, shale, and conglomerate. This shear zone is characterized by limonitic staining on weathered surfaces and is exposed for 427 m (1,400 ft) along strike. Galena, sphalerite, pyrite, and arsenopyrite are mainly concentrated within the shears which are 2.5 to 15 cm (1.0 to 6.0 in) wide. Pyrite occurs as disseminations and pods throughout the entire shear zone(32,48).

Mineral Deposit Type: Shear

Past Bureau Work: Bureau personnel discovered and examined this occurrence in 1982 during the RARE II study. They obtained 31 samples including several from diamond drill holes. The highest metal values for these samples were 3.7 pct lead, 19 pct zinc, 470 g/mt (13.7 oz/st) silver, and 2.88 g/mt (0.084 oz/ton) gold(32,48).

1992 Bureau Work: Bureau personnel mapped the site and collected 22 samples from the area. Samples 3391, 3392, 3393, 3395 and 3399 were select samples collected from small silicified shear zones containing pyrite and chalcopyrite. Sample 3394 was a select sample of a silicified shear zone having a strike of due North and a dip of 70° E. The zone is 0.9 to 1.2 m (3.0 to 4.0 ft) wide with quartz veins and contains pyrite and chalcopyrite. Samples 3396, 3397, and 3398 were select samples from silicified shear zones which have strikes from N 50 to 70° W and dips of 75 to 81° SW. The minerals present include pyrite, chalcopyrite, and galena.

Sample 3408 was a 7.6-m (25-ft) wide, representative-chip sample of a shear zone which is approximately 9.1 m (30 ft) wide. This shear zone is composed of individual shears 2.5 to 7.6 cm (1 to 3 in) wide. Minerals in these smaller shears include pyrite and sphalerite with minor amounts of pyrite in small lenses. Sample 3409 was a select sample of a fault zone which has pyrite mixed with fault breccia. Sample 3410 was a select sample from a quartz vein which has a strike of N 67° W and a dip of 85° NE. It cuts across a major shear zone and shows a local concentration of sulfides. The quartz vein is 2.5 to 7.5 cm (1.0 to 3.0 in) wide and contains sphalerite, galena, pyrite, and minor amounts of covellite.

Sample 3411 was a select sample of a 10-cm (4.0-in) wide shear which has an E-W strike and a vertical dip. It cuts across the trend of the main shear zone and has numerous quartz veinlets which contain pyrite. Sample 3412 was a select sample of a 3-m (10-ft) wide shear zone that contains numerous 5 to 7.5-cm (2.0 to 3.0-in) wide shears. The major shear strikes N 63° W and has an undetermined dip. Minerals in this zone include pyrite, galena, and minor amounts of sphalerite. The pyrite occurs in stringers and pods within the shear zone. Sample 3413 was a select sample of a 2.5-cm (1.0-in) wide, fault zone which strikes N 24° W and dips 62° E. This fault forms the eastern boundary of a major shear zone. The minerals within the fault plane include sphalerite and galena.

Sample 3414 was a 1.2-m (4.0-ft) wide, continuous-chip sample of a shear zone which has a N-S strike, a vertical dip, and contains pyrite. Sample 3415 was a select sample from the western margin of a silicified, breccia zone. This zone strikes N 12° E, dips 75° E, and is 15 cm (6.0 in) wide. The minerals in this zone include galena, sphalerite, and pyrite. Sample 3416 was a 1.7-m (5.5-ft) wide, continuous-chip sample across a sheared sandstone which strikes N 48° W and dips 90°. Sphalerite is concentrated east of the margin of this shear and disseminated pyrite occurs throughout the shear. Sample 3417 was a 0.7-m (2.3-ft) wide, continuous-chip sample from a shear which strikes N 45° W and dips 90°. This shear contains galena and sphalerite. Sample 3418 was a select sample from a 15.2-cm (6-in) wide, high-grade, galena zone within a shear. The shear strikes N 37° W, dips 90°, and contains galena, sphalerite, and pyrite. Sample 3419 was a select sample of a 0.3-m (1.0-ft) wide, shear zone which strikes N 20° W and dips 72° E. The minerals present in this zone include galena, pyrite, and minor amounts of chalcopyrite. (See figure A-9).

Sample Data: Table A-17 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at the Miners River No. 2 Occurrence. (See Appendix B).

TABLE A-17. - Selected sample data for the Miners River No. 2 Occurrence.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3391	Select		9.1	249	3,029	3,971
3392	Select		5.4	320	2,539	1,465
3393	Select		<0.5	55	128	162
3394	Select		9.4	122	>10,000	>20,000
3395	Select		1.1	38	741	362
3396	Select		32.5	296	3,897	917
3397	Select		7.2	104	3,420	584
3398	Select		12.4	34	361	261
3399	Select		3	38	1,888	1,295
3408	Representative chip	7.6	1.1	65	178	653
3409	Select		1.4	37	91	175
3410	Select		39	5,212	>10,000	16,053
3411	Select		0.7	28	82	138
3412	Select		20.9	1,930	>10,000	2,655
3413	Select		21	289	9,396	>20,000
3414	Continuous chip	1.2	1.6	242	1,411	828
3415	Select		33.6	451	>10,000	>20,000
3416	Continuous chip	1.7	5.7	92	4,847	10,926
3417	Continuous chip	0.7	4.8	59	3,120	17,100
3418	Select		>50.0	439	>10,000	13,981
3419	Select		4.5	95	5,745	3,075

The FA/AA results indicate that: sample 3410 had 0.54 pct copper, sample 3415 had 13.22 pct zinc, and sample 3418 had 103 g/mt (3.01 oz/st) silver and 10.6 pct lead. (See Appendix C).

Resources:

Published(32)-

Inferred: 1,365 mt (1,500 st) of 4.23 pct zinc, 2.24 pct lead, and 5.88 ppm silver

Estimated- A viable resource estimate could not be determined from the 1992 investigation due to the widely scattered nature of the sulfides.

Mineral development potential: Low, based on the mining feasibility study.

References: (22,32,48)

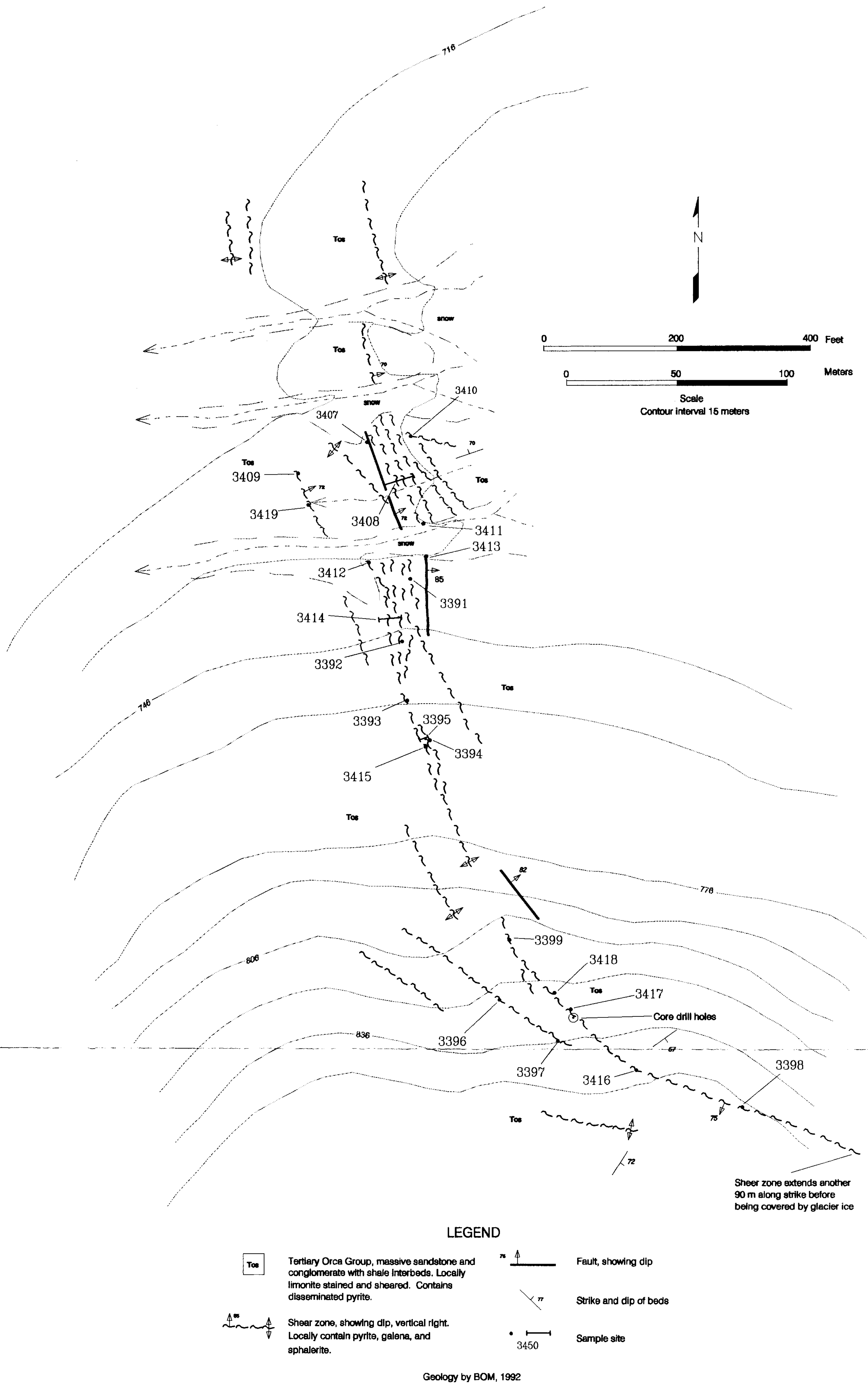


Figure A-9. - Map of the Miners River No.2 Occurrence showing the geology and sample locations.

Name: MINERS RIVER NO. 3 OCCURRENCE

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: None **RARE II Map Number:** None

Latitude: N 61° 04' 10" **Longitude:** W 147° 23' 45"

Meridian: Seward **Township:** 11 N **Range:** 12 E **Section:** 6 **Quarter:** SE

Elevation: 777 m (2,550 ft)

Map Name: Anchorage A-2

Type: Occurrence **Current Status:** Unclaimed

Commodities: Copper, lead, zinc

Geology: The country rock is Orca Group graywacke which hosts a shear zone that strikes N 50 to 60° W and dips 81° SW. The shear is 2.5 to 76 cm (1.0 to 30.0 in) wide and is exposed for 97.5 m (320 ft) along strike. The shear contains sphalerite and pyrite which occur as pods and lenses with trace amounts of chalcopyrite and galena.

Mineral Deposit Type: Shear

Past Bureau Work: None

1992 Bureau Work: USGS personnel discovered this occurrence and Bureau personnel examined, mapped, and sampled the site. Sample 3420 was a 0.7-m (2.5-ft) wide, continuous-chip sample from a silicified shear zone which strikes N 45° W and dips 85° SW. This zone contains sphalerite, pyrite, and lenses of calcite. Sample 3421 was a 0.3-m (1.0-ft) wide, continuous-chip sample of a silicified shear zone which strikes N 35° W and dips 70° NE. Sample 3422 was a 5.2-m (17-ft) wide, continuous-chip sample across several silicified shears which strike N 33 to 55° W and dip 87° SW to 90°. They contain brecciated material with pyrite and Gossan.

Sample 3450 was a select sample from a silicified shear zone which strikes N 60° W and dips 80° SW. The shear zone contains a pyrite vein which is 1.9 cm (0.75 in) wide and 25 cm (10 in) long. The vein contains more than 50 pct pyrite. Sample 3451 was a select sample of a calcite vein that has a strike of N 65° W and a dip of 63° SW. The vein is 2.5 cm (1.0 in) wide, 0.3 m (1.0 ft) long, and contains galena. Sample 3452 was a 5.2-m (17.0-ft) wide, spaced-chip sample of a shear zone which strikes N 60° W and dips 80° SW. The shear zone has calcite veins 0.3 to 5.1 cm (0.1 to 2.0 in) wide and 15 to 61 cm (6.0 to 24.0 in) long. It contains pyrite and galena. Sample 3453 was a select sample from a silicified shear zone with a strike of N 60° W and a dip of 80° SW. The shear contains minor amounts of pyrite. Sample 3454 was a select sample from a felsic dike which strikes N 65° W and has an undetermined dip. The dike material contains arsenopyrite. (See figure A-10).

Sample Data: Table A-18 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at the Miners River No. 3 Occurrence. (See Appendix B).

TABLE A-18. - Selected sample data for the Miners River No. 3 Occurrence.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3400	Select		<0.5	144	41	1,377
3420	Continuous chip	0.7	8.8	624	344	>10,000
3421	Continuous chip	0.2	11.7	314	348	2,721
3422	Continuous chip	5.2	<0.5	111	71	2,943
3450	Select		5.9	292	339	4,185
3451	Select		1.3	104	57	7,049
3452	Spaced chip	5.2	0.6	96	41	1,340
3453	Select		1.2	186	213	2,652

The FA/AA results indicate that sample 3420 had 1 pct zinc and sample 3421 had 10.4 g/mt (0.37 oz/st) silver. (See Appendix C).

Resources: Estimated-

Inferred: 82,192 mt (90,620 st) of 0.25 pct zinc.

Mineral development potential: Low, based on the mining feasibility study.

References: None

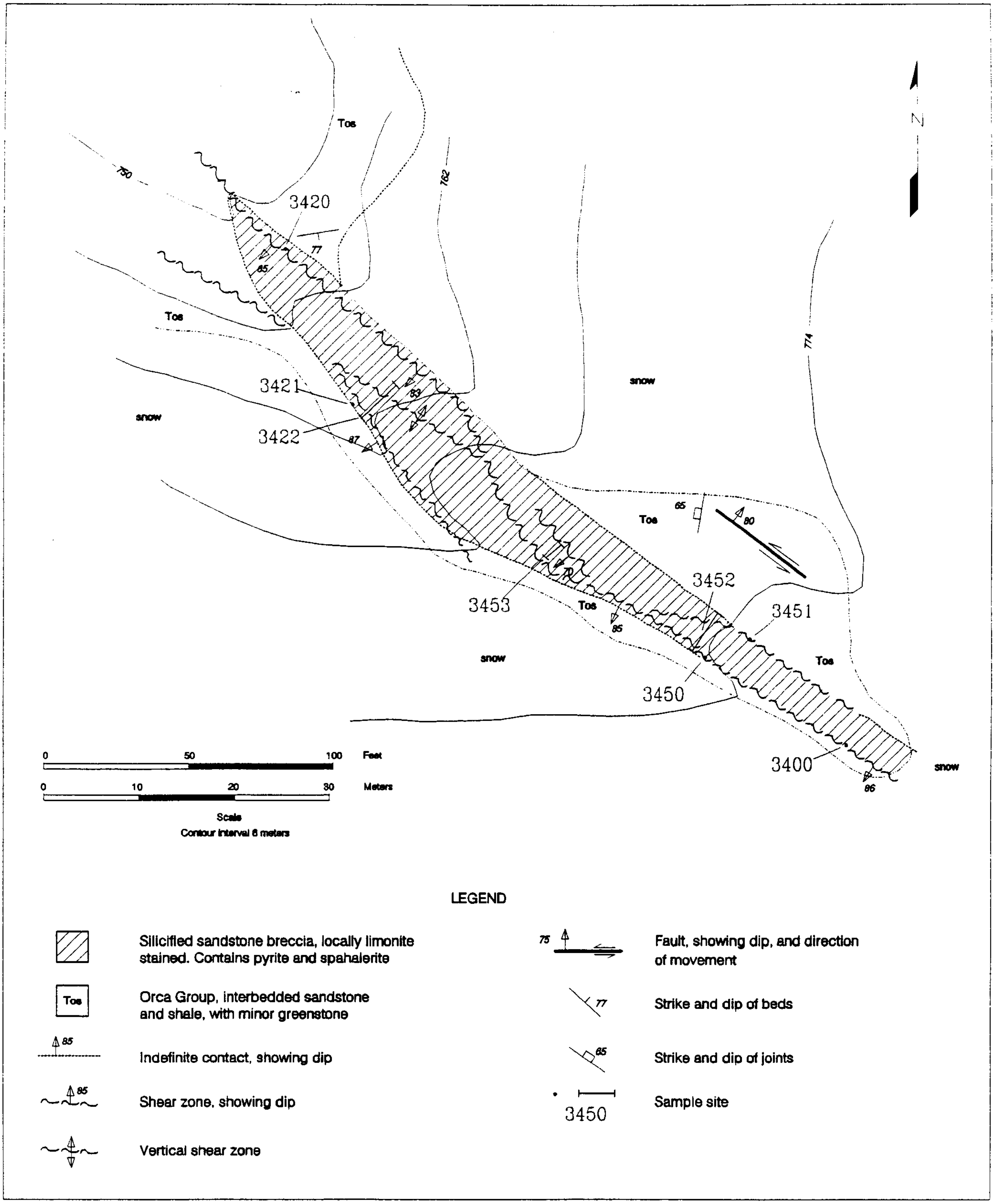


Figure A-10.- Map of the Miners River No. 3 Occurrence showing the geology and sample locations.

Name: MINERS RIVER NO. 4 OCCURRENCE

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: None **RARE II Map Number:** None

Latitude: N 61° 04' 35" **Longitude:** W 147° 21' 10"

Meridian: Seward **Township:** 11 N **Range:** 12 E **Section:** 5 **Quarter:** NE

Elevation: 594 m (1,950 ft)

Map Name: Anchorage A-1

Type: Occurrence **Current Status:** Unclaimed

Commodities: Zinc

Geology: The country rock is mid-Cretaceous carbonaceous shale. The occurrence consists of a felsic dike and several minor shear zones. One portion of the dike is 7.6 m (25.0 ft) wide, 85.3 m (280 ft) long, strikes N 55° W, and dips 75° SW to 90°. The other portion of the dike is 3 to 11 m (10 to 35 ft) wide, 97.5 m (320 ft) long, strikes N 48° E, and has an undetermined dip. The dike contains pyrite and ankerite which gives the dike surface a distinctive orange color. The dike is intensely jointed parallel to the wallrock contacts.

One shear zone is oriented N 10° W and dips vertically. The northern end of this shear terminates at the dike. Another shear trends N 56° E and dips 80° SE. The shears contain arsenopyrite, chalcopyrite, and galena.

Mineral Deposit Type: Dike, shear

Past Bureau Work: None

1992 Bureau Work: USGS personnel discovered this occurrence and Bureau personnel examined, mapped, and sampled the site.

Sample 3424 was a select sample of silicified, breccia and fault gouge on the east side of the dike. Sample 3425 was a 7.6-m (25.0-ft) wide, representative-chip sample across the width of the dike. Sample 3455 was a 25-cm (10.0-in) wide, representative-chip sample across the dike. Sample 3456 was a 30-cm (12.0-in) wide, representative-chip sample taken near sample 3455. (See figure A-11).

Sample Data: Table A-19 shows selected descriptive and ICP/FA+DCP analytical information for the samples from Miners River No. 4 Occurrence. (See Appendix B).

TABLE A-19. - Selected sample data for the Miners River No. 4 Occurrence.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3424	Select		0.5	28	29	66
3425	Representative chip	7.6	0.5	22	51	93
3454	Select		0.5	6	25	29
3455	Representative chip	0.25	0.5	3	21	26
3456	Representative chip	0.30	0.5	<1	25	19

The FA/AA results indicate that sample 3456 had 2.01 g/mt (0.06 oz/st) silver. (See Appendix C).

Resources: Not determined because the occurrence is small and the analytical values are low.

Mineral development potential: Low, based on the low analytical results.

References: None

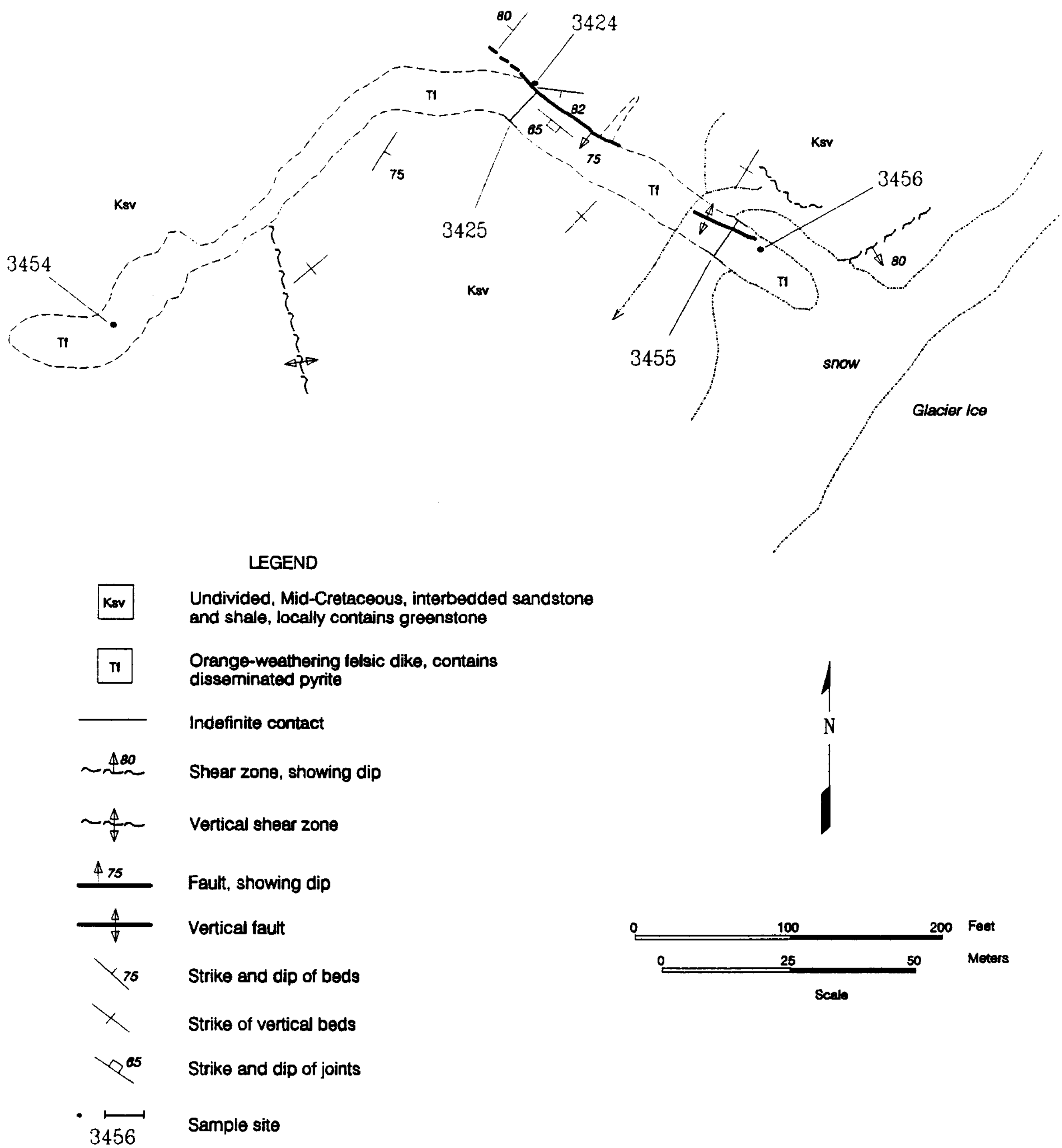


Figure A-11.- Map of the Miners River No. 4 Occurrence showing the geology and sample locations.

Name: PEDRO GLACIER SAMPLE SITE

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: None **RARE II Map Number:** None

Latitude: N 61° 07' 29" **Longitude:** W 147° 21' 34"

Meridian: Seward **Township:** 12 N **Range:** 12 E **Section:** 17 **Quarter:** SW

Elevation: 421 m (1,380 ft)

Map Name: Anchorage A-1

Type: Sample site **Current Status:** Unclaimed

Commodities: Zinc

Geology: The country rock consists of Valdez Group metasediments. The site is in the glacial outwash plane of Pedro Glacier. The material is graywacke and ranges in size from course sand (2 mm or 0.008 in) to cobbles (20 cm or 7.8 in) in diameter.

Mineral Deposit Type: Placer

Past Bureau Work: None

1992 Bureau Work: Bureau personnel obtained one 0.08 m^3 (0.1 yd^3) placer sample (3333) approximately 45.7 m (150 ft) from the toe of the glacier. The concentrate had only a trace of very-fine gold so the Bureau did not collect any additional samples.

Sample Data: Table A-20 shows selected descriptive and ICP/FA+DCP analytical information for the sample obtained at the Pedro Glacier Sample Site. (See Appendix B).

TABLE A-20. - Selected sample data for the Pedro Glacier Sample Site.

Sample Number	Type	Size m^3	Gold ppm	Silver ppm	Lead ppm	Zinc ppm
3333	Placer	0.08	0.04	0.5	61	90

The FA/AA results indicate that sample 3333 contained less than 0.034 g/mt (0.001 oz/st) gold and 2.40 g/mt (0.07 oz/st) silver. (See Appendix C).

Resources: Not determined due to the low analytical values.

Mineral development potential: Low, based on the low analytical values.

References: None

Name: **SADDLE OCCURRENCE**

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: None **RARE II Map Number:** None

Latitude: N 61° 03' 44" **Longitude:** W 147° 21' 39"

Meridian: Seward **Township:** 11 N **Range:** 12 E **Section:** 8 **Quarter:** NW

Elevation: 765 m (2,510 ft)

Map Name: Anchorage A-1

Type: Occurrence **Current Status:** Unclaimed

Commodities: Lead, zinc

Geology: The country rock consists of silicified, Orca-Group sandstone and shale. Felsic dikes trend N 60 to 85° W and dip 82 to 90° NE. The dikes contain minor amounts of pyrite, but in one location a breccia zone on the dike margin contains galena and sphalerite. In another 2.4 by 2.4-m (8 by 8-ft) area, a dike intersects sheared, silicified, carbonaceous shales which contain galena, pyrite, and sphalerite. On the south side of the saddle is a pyrite bearing zone 7.6 to 9.1 m (25 to 30 ft) wide and 76 m (250 ft) long. The margins of this zone contain fault breccia and galena in localized areas. The center of the zone is a sandstone which shows iron staining and contains numerous quartz veinlets.

Mineral Deposit Type: Dikes, shears

Past Bureau Work: None

1992 Bureau Work: Bureau personnel discovered and sampled this occurrence. Sample 3427 was a select sample from the 2.4-m by 2.4-m (8-ft by 8-ft) mineralized area where a felsic dike and a brecciated dike intersect in silicified sandstone and shale. The dike-shale contact strikes N 62° W and dips 90°.

Sample 3428 was a select sample of the quartz-cemented, breccia on the western margin of the felsic dike. A 0.6-m (2.0-ft) wide zone extends for 4.6 m (15.0 ft) along the contact. Sphalerite, galena, and a trace of chalcopyrite occur in this zone. Limonitic staining and gossan are also present. Sample 3429 was a select sample from a 12.5-cm (5-in) wide, fault-breccia, zone which strikes N 65° W and dips 77° NE. The fault is exposed for 15.2 m (50.0 ft) along the strike and cuts interbedded conglomerate and sandstone. The minerals in this zone include pyrite and sphalerite.

Sample 3430 was a grab sample of coarse sandstone near a fault zone. It has a green staining which may be due to copper or arsenic oxides. Sample 3431 was 0.9-m (3.0-ft) wide, continuous-chip sample across a shear zone in a coarse-grained, silicified, sandstone which contains numerous quartz veinlets. The shear zone strikes N 78° W, dips vertically, and extends for 45.7 m (150 ft) along strike. A 7.6-m (25-ft) wide zone is enclosed between two shear contacts. Sample 3432 was a grab sample from a 0.9-m (3.0-ft) wide, felsic dike which strikes N 85° W and dips 82° NE. The dike contains disseminated pyrite and very fine-grained arsenopyrite.

Sample 3459 was a 35.6-cm (14.0-in) wide, representative-chip sample of a quartz vein which contains chalcopyrite. (See figure A-12).

Sample Data: Table A-21 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at the Saddle Occurrence. (See Appendix B).

TABLE A-21. - Selected sample data for the Saddle Occurrence.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3427	Select		>50.0	288	>10,000	11,400
3428	Select		14	337	9,147	>20,000
3429	Select		5.2	480	616	>20,000
3430	Grab		22.1	39	5,830	611
3431	Continuous chip	0.9	6.4	68	1,868	125
3432	Grab		0.5	11	243	300
3459	Representative chip	0.35	1	7	21	14

The FA/AA results indicate that sample 3427 contained 141 g/mt (4.12 oz/st) silver and 6.38 pct lead. Sample 3429 contained 3.44 pct zinc. (See Appendix C).

Resources: Not determined. The samples had significant lead, zinc, and silver values, but the mineralized zone is so discontinuous that a resource estimate could not be made.

Mineral development potential: Low, based on the discontinuous nature of the occurrence.

References: None.

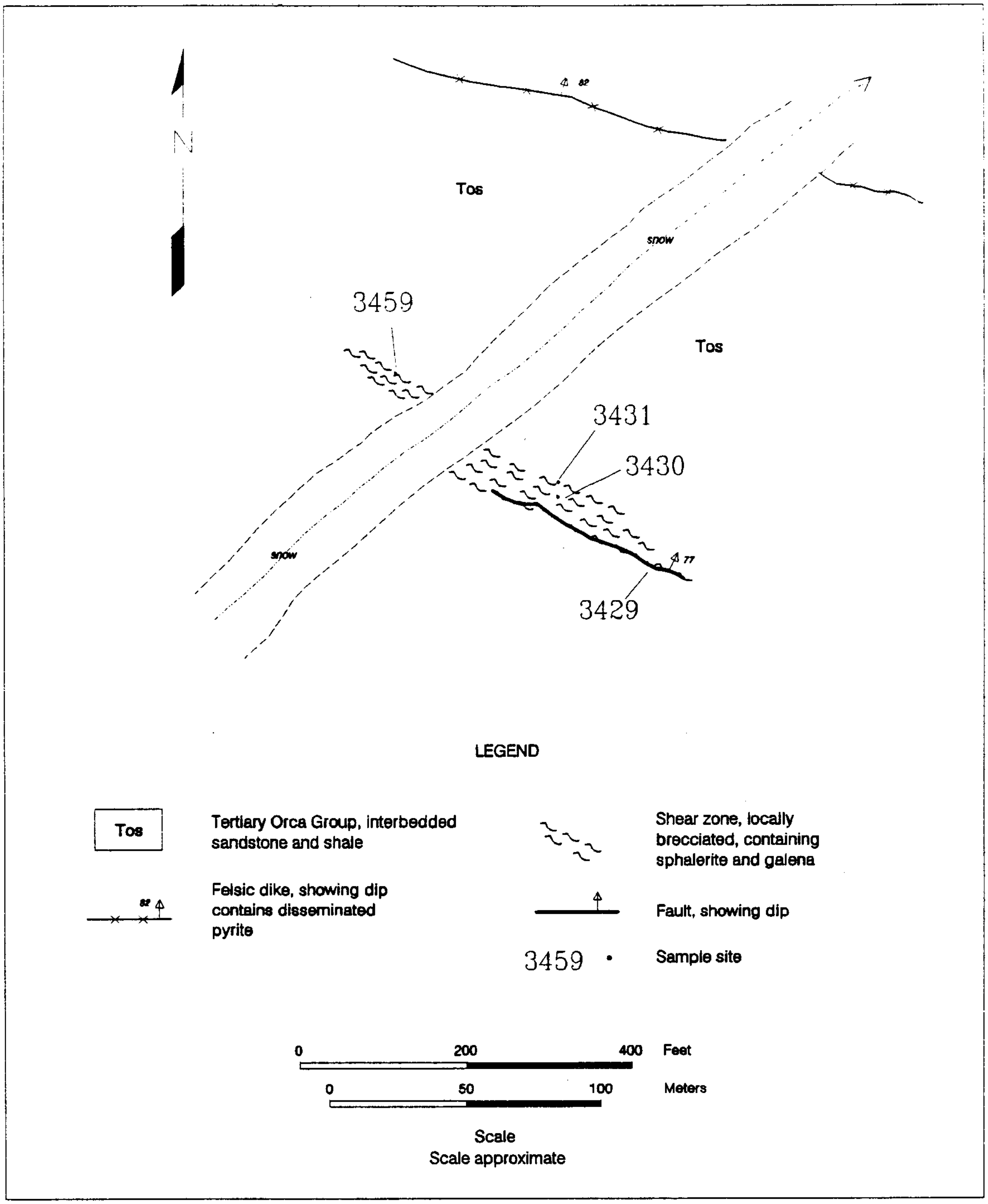


Figure A-12.- Map of the Saddle Occurrence showing the geology and sample locations.

Name: **SLIPPER POINT OCCURRENCE**

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: None **RARE II Map Number:** None

Latitude: N 60° 55' 05" **Longitude:** W 147° 15' 30"

Meridian: Seward **Township:** 10 N **Range:** 12 E **Section:** 35 **Quarter:** NE

Elevation: 0.9 m (3.0 ft)

Map Name: Seward D-1

Type: Occurrence **Current Status:** Unclaimed

Commodities: Copper, silver, zinc

Geology: The country rock is Orca Group sandstone which is overlain by a sheeted dike and a broken, pillow-basalt flow. A vein composed of quartz-sandstone, breccia trends N 20° E and dips 75° NW and contains chalcopyrite, malachite, and covellite. The vein is 2.5 to 13 cm (1.0 to 5.0 in) wide and approximately 15 m (50 ft) long.

Mineral Deposit Type: Vein

Past Bureau Work: None

1992 Bureau Work: USGS and USFS personnel found this site while conducting a shoreline reconnaissance. Bureau personnel subsequently examined the site and collected samples 3389 and 3390 of the breccia vein.

Sample Data: Table A-22 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at the Slipper Point Occurrence. (See Appendix B).

TABLE A-22. - Selected sample data for the Slipper Point Occurrence.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3389	Select		36.2	19,173	31	106
3390	Select		>50.0	>20,000	126	5,130

The FA/AA results indicate that sample 3390 contained 54 g/mt (1.6 oz/st) silver, 4.18 pct copper, and 0.49 pct zinc. (See Appendix C).

Resources: Not determined due to the small size of the occurrence.

Mineral development potential: Low. Although the samples had significant silver, copper, and zinc values, the mineralized zone is very small.

References: None

Name: **TERENTIEV LAKE-NORTH SAMPLE SITE**

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: None **RARE II Map Number:** None

Latitude: N 61° 03' 09" **Longitude:** W 147° 09' 43"

Meridian: Copper River **Township:** 9 S **Range:** 11 W **Section:** 27 **Quarter:** SW

Elevation: 171 m (561 ft)

Map Name: Anchorage A-1

Type: Sample Site **Current Status:** Unclaimed

Commodities: Copper

Geology: The country rock is Tertiary granite. Small zones along shears contain pyrite and chalcopyrite.

Mineral Deposit Type: Shear

Past Bureau Work: None

1992 Bureau Work: Bureau personnel collected two samples in a stream cut from an area which had previously been covered by Terentiev Lake. Sample 3336 was a grab sample of granite having minor amounts of pyrite. Sample 3337 was a sample of a 15-cm (6.0-in) wide vein that contains chalcopyrite, pyrite, quartz, and chlorite.

Sample Data: Table A-23 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at the Terentiev Lake-North Sample Site. (See Appendix B).

TABLE A-23. - Selected sample data for the Terentiev Lake-North Sample Site.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3336	Grab		2	213	26	49
3337	Grab		1	676	14	38

The FA/AA results indicate that sample 3336 had 2.0 g/mt (0.06 oz/st) silver and sample 3337 had 0.07 pct copper. (See Appendix C).

Resources: Not determined due to the low analytical values.

Mineral development potential: Low, based on the low analytical results.

References: None

Name: **TERENTIEV LAKE-SOUTH SAMPLE SITE**

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: None **RARE II Map Number:** None

Latitude: N 61° 01' 00" **Longitude:** W 147° 09' 00"

Meridian: Copper River **Township:** 10 S **Range:** 11 W **Section:** 10 **Quarter:** SE

Elevation: 174 m (570 ft)

Map Name: Anchorage A-1

Type: Sample site **Current Status:** Unclaimed

Commodities: Zinc

Geology: The country rock is Orca Group slates, graywackes, and arkosic sandstones. Several felsic dikes strike N 25° W, and are approximately 15 m (50 ft) apart. No sulfide minerals were seen, but hornfels occurs approximately 0.3 m (1.0 ft) wide along the contact with the dike.

Mineral Deposit Type: None

Past Bureau Work: None

1992 Bureau Work: Bureau personnel collected two samples near the southern end of Terentiev Lake. Sample 3338 was a grab sample of a fined-grained, mafic rock from an area that had been formerly covered by the lake. Sample 3354 was a grab sample of typical rocks in the area and was collected in a stream cut above the former lake level.

Sample Data: Table A-24 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at the Terentiev Lake-South Sample Site. (See Appendix B).

TABLE A-24. - Selected sample data for the Terentiev Lake-South Sample Site.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3338	Grab		0.5	41	42	148
3354	Grab		0.5	51	<2	27

The FA/AA results indicate that sample 3338 contained 0.02 pct zinc. (See Appendix C).

Resources: Not determined due to the low analytical values.

Mineral development potential: Low, based on the low analytical results.

References: None

Name: WAR EAGLE PROSPECT

Alternate Names: War Eagle No. 1 **Kardex Number:** 085-084

MAS/MILS Sequence Number: 0020850306 **RARE II Map Number:** A-13

Latitude: N 61° 07' 28" **Longitude:** W 147° 21' 37"

Meridian: Seward **Township:** 12 N **Range:** 12 E **Section:** 17 **Quarter:** SE

Elevation: 643 m (2,000 ft)

Map Name: Anchorage A-1

Type: Prospect **Current Status:** Inactive

Commodities: Copper

Geology: The country rock is Valdez Group graywackes and sandstones. An iron-stained, shear zone in the graywacke which may be associated with the War Eagle prospect is located in a cliff on the south side of Pedro Glacier. The shear zone strikes N 60° W, dips 40° W and is 0.9 m (3.0 ft) wide. Tensional cracks along the shear are filled with calcite and minor amounts of pyrite.

Mineral Deposit Type: Shear

Past Bureau Work: The Bureau searched for, but did not find this property during the RARE II Study(32).

1992 Bureau Work: Bureau personnel again searched for this property, but still did not locate it. They found a shear zone, but could not be certain that it was associated with the War Eagle Prospect. Sample 3366 was a representative chip sample of the shear.

Sample Data: Table A-25 shows selected descriptive and ICP/FA+DCP analytical information for the sample obtained in the vicinity of the War Eagle Prospect. (See Appendix B).

TABLE A-25. - Selected sample data for the War Eagle Prospect area.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3366	Chip		<0.5	30	20	150

The FA/AA results indicate that sample 3366 contained 0.01 pct zinc. (See Appendix C).

Resources: Not determined due to lack of information.

Mineral development potential: Unevaluated. The Bureau did not locate this property.

References: (1,22,32,36).

Name: WELLS BAY PROSPECT

Alternate Names: None **Kardex Number:** 085-210

MAS/MILS Sequence Number: 0020850117 **RARE II Map Number:** A-15

Latitude: N 60° 03' 15" **Longitude:** W 147° 20' 42"

Meridian: Seward **Township:** 11 N **Range:** 12 E **Section:** 9 **Quarter:** SW

Elevation: 835 m (2,740 ft)

Map Name: Anchorage A-1

Type: Prospect **Current Status:** Inactive

Commodities: Zinc, copper

Geology: The country rock consists of Orca Group graywacke. An iron-stained, shear zone trends N 10° E and dips 80° NW. The minerals present include trace amounts of pyrite and chalcopyrite. A 3.0-m (10-ft) adit follows the shear zone at an elevation of 835 m (2,750 ft)(48).

Mineral Deposit Type: Shear

Past Bureau Work: The Bureau searched for this property during the RARE II Study, but did not locate it.

1992 Bureau Work: USGS and Bureau personnel located the property. Sample 3457 was a grab sample collected from the face of the adit. Sample 3458 was a grab sample of the waste rock below the portal. (See figure A-13).

Sample Data: Table A-26 shows selected descriptive and ICP/FA+DCP analytical information for the samples obtained at the Wells Bay Prospect. (See Appendix B).

TABLE A-26. - Selected sample data for the Wells Bay Prospect.

Sample Number	Type	Size m	Silver ppm	Copper ppm	Lead ppm	Zinc ppm
3457	Grab		<0.5	87	7	372
3458	Grab		<0.5	280	18	496

The FA/AA results indicate that sample 3457 had 0.08 pct zinc and sample 3458 contained 0.03 pct copper and 0.05 pct zinc. (See Appendix C).

Resources: Not determined due to the low analytical values.

Mineral development potential: Low, based on the low analytical results.

References: (1,3,8,10,11,19,22,30,33,48)

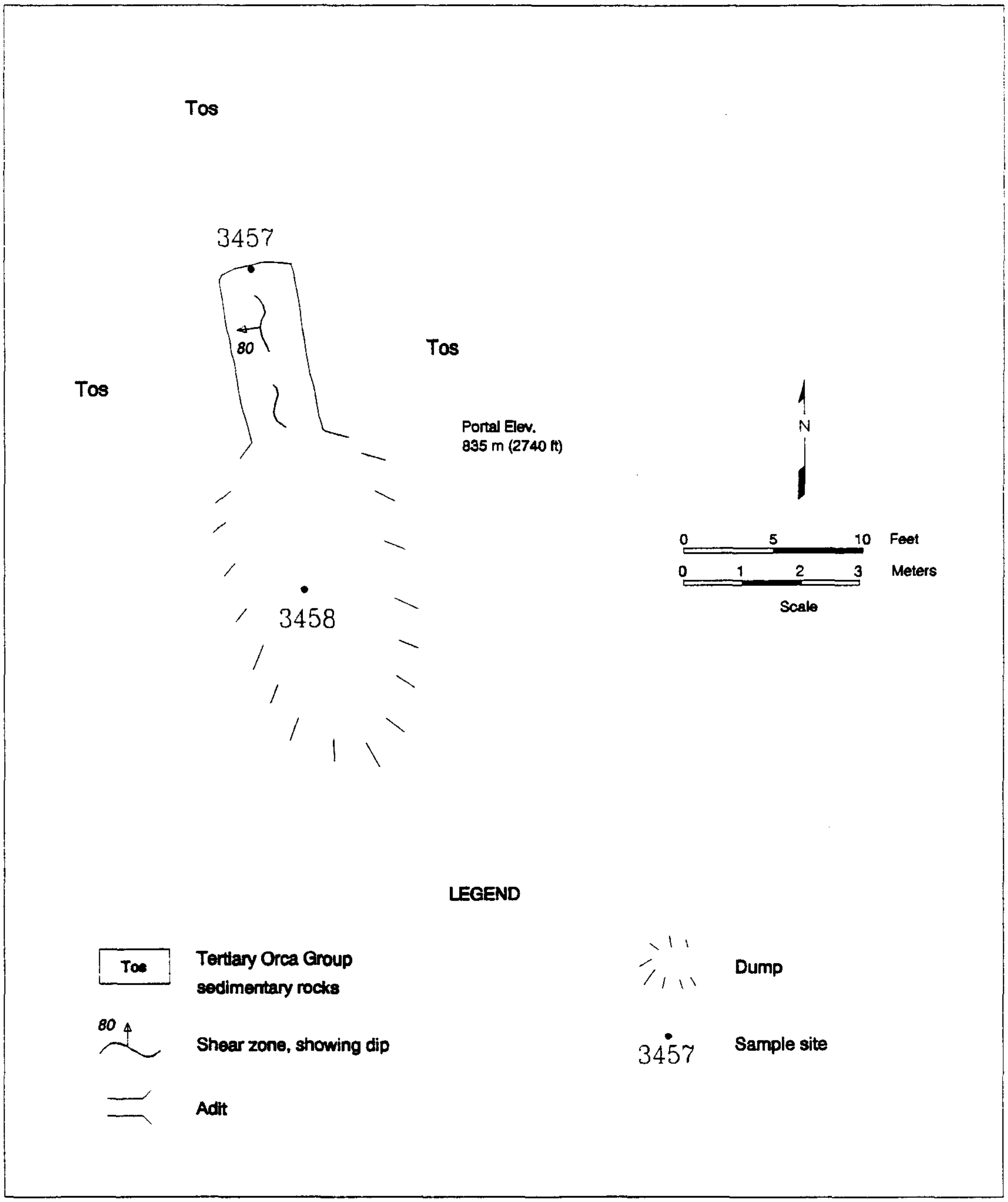


Figure A-13.- Map of the Wells Bay Prospect showing the geology and sample locations.

Name: WELLS BAY NO. 1 OCCURRENCE

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: 0020850300 **RARE II Map Number:** A-5

Latitude: N 61° 01' 13" **Longitude:** W 147° 20' 13"

Meridian: Seward **Township:** 11 N **Range:** 12 E **Section:** 28 **Quarter:** NW

Elevation: 768 m (2,519 ft)

Map Name: Anchorage A-1

Type: Occurrence **Current Status:** Unclaimed

Commodities: Fluorine

Geology: The country rock consists of Orca Group slates. A fluorite-quartz-calcite vein strikes N 10 to 25° W and dips 80° SW. The vein is from 0.9 to 3.7 m (3.0 to 12.0 ft) wide and extends at least 30.5 m (100 ft) along strike(32,48).

Mineral Deposit Type: Vein

Past Bureau Work: The Bureau discovered and examined this occurrence in 1981 during the RARE II study. A 0.9-m (3.0-ft) chip sample taken across the vein contained 17.5 pct fluorine(32).

1992 Bureau Work: Bureau personnel did not visit this site.

Sample Data: None

Resources: Published(22,32) -

Inferred: 1,365 mt (1,500 st) of 17.5 pct fluorine

Mineral development potential: Low, based on published Bureau information(22).

References: (22,32,48)

Name: WELLS BAY NO. 2 OCCURRENCE

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: 0020850301 **RARE II Map Number:** A-6

Latitude: N 61° 03' 28" **Longitude:** W 147° 18' 30"

Meridian: Seward **Township:** 11 N **Range:** 12 E **Section:** 10 **Quarter:** SW

Elevation: 731 m (2,400 ft)

Map Name: Anchorage A-1

Type: Occurrence **Current Status:** Unclaimed

Commodities: Lead, copper, gold, silver

Geology: The country rock consists of Orca Group metasediments and felsic dikes. A 3.1-m (10.0-ft) wide, felsic dike strikes N 10° W and dips 90°. The dike extends approximately 0.8 km (0.5 mi) along strike. Nine shear zones occur between 562 and 701 m (1,840 and 2,300 ft) elevation. The shear zones range from 0.3 to 6.1 m (1.0 to 20 ft) wide and extend more than 76 m (250 ft) along strike. The zones strike N-S to N 45° E and dip steeply. Sulfide minerals in the shears include pyrite, arsenopyrite, galena, and chalcopyrite. The dike contains minor amounts of pyrite and arsenopyrite(32,48).

Mineral Deposit Type: Shear, dike

Past Bureau Work: Bureau personnel discovered and examined the occurrence in 1981 and 1982 during the RARE II study. They obtained nine samples which contained less than 0.001 to 0.54 pct arsenic, 0.001 to 1.1 pct lead, 0.001 to 0.5 pct copper, and 0.9 to 10.6 ppm silver, and less than 0.03 to 1.42 ppm gold(32,48).

1992 Bureau Work: Bureau personnel did not visit this site.

Sample Data: None

Resources: Not determined.

Mineral development potential: Low, based on published Bureau information(22).

References: (22,32,48)

Name: WELLS BAY NO. 3 OCCURRENCE

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: 0020850302 **RARE II Map Number:** A-7

Latitude: N 61° 03' 58" **Longitude:** W 147° 17' 51"

Meridian: Seward **Township:** 11 N **Range:** 12 E **Section:** 3 **Quarter:** SE

Elevation: 1,051 m (3,448 ft)

Map Name: Anchorage A-1

Type: Occurrence **Current Status:** Unclaimed

Commodities: Zinc, lead, silver

Geology: The country rock consists of Orca Group metasediments. Two shear zones, 0.3 to 1.2 m (1.0 to 4.0 ft) wide cut slates and conglomerates. One shear zone strikes N 26° W and dips 64° NE and the other zone strikes N 28° E with an undetermined dip. One shear extends for 45.7 m (150 ft) along strike. Minerals present include sphalerite, galena, pyrite, and arsenopyrite. Gossan alteration occurs over some of the more highly mineralized zones(32,48).

Mineral Deposit Type: Shear

Past Bureau Work: The Bureau discovered and examined this occurrence in 1982 during the RARE II study. They obtained eight samples which contained less than 0.001 to 2 pct lead, less than 0.001 to 4.6 pct zinc, less than 0.001 to 1.1 pct arsenic, and up to 69 g/mt (2.0 oz/st) silver(32,48).

1992 Bureau Work: The Bureau did not visit this property.

Sample Data: None

Resources: Not determined, due to low analytical values.

Mineral development potential: Low, based on published Bureau information(22).

References: (22,32,48)

Name: WELLS BAY NO. 4 OCCURRENCE

Alternate Names: None **Kardex Number:** None

MAS/MILS Sequence Number: 0020850305 **RARE II Map Number:** A-11

Latitude: N 61° 02' 53" **Longitude:** W 147° 24' 10"

Meridian: Seward **Township:** 11 N **Range:** 12 E **Section:** 18 **Quarter:** NW

Elevation: 670 m (2,200 ft)

Map Name: Anchorage A-2

Type: Occurrence **Current Status:** Unclaimed

Commodities: Gold, silver, arsenic

Geology: The country rock is Orca Group metasediments. A shear is exposed which is 9.1 m (30.0 ft) wide and 30.4 m (100 ft) long. The zone contains fractured graywacke cemented by pyrite, arsenopyrite, and quartz(32,48).

Mineral Deposit Type: Shear

Past Bureau Work: The Bureau discovered and investigated this occurrence in 1980 during the RARE II study. Eight grab samples contained from less than 0.171 to 0.411 g/mt (0.005 to 0.012 oz/st) gold, less than 6.9 to 21 g/mt (0.2 to 0.6 oz/st) silver, and up to 0.2 pct arsenic(32,48).

1992 Bureau Work: Bureau personnel did not visit this site.

Sample Data: None

Resources: Not determined due to low analytical values.

Mineral development potential: Low, based on published Bureau information(22).

References: (22,32,48)

APPENDIX B

DATA FOR SAMPLES ANALYZED USING INDUCTIVELY COUPLED PLASMA EMISSION SPECTROSCOPY (ICP) EQUIPMENT AND FIRE ASSAY PLUS DIRECTLY COUPLED PLASMA EMISSION SPECTROSCOPY (FA+DCP) EQUIPMENT

Appendix B shows the data for the samples analyzed using Inductively Coupled Plasma Emission Spectroscopy (ICP) equipment and Fire Assay methods plus Directly Coupled Plasma Emission Spectroscopy (FA+DCP) equipment. See the report for the discussion of these methods.

Results for ICP and FA+DCP analysis

Sample	Ag	Al	As	Au	Ba	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	K	La	Li	Mg	Mn	Mo
#	PPM	PCT	PPM	PPB	PPM	PPM	PCT	PPM	PPM	PPM	PPM	PCT	PPM	PCT	PPM	PPM	PCT	PPM	PPM
3316	0.9	3.04	54	9	345	< 5	0.07	< 2.0	7	228	18	3.1	14	0.9	11	18	0.4	716	4
3317	1	3.35	84	14	233	< 5	0.04	< 2.0	5	180	85	4.55	21	1.11	12	17	0.41	405	3
3318	0.7	3.35	13	11	1295	17	0.22	< 2.0	5	160	39	0.67	16	1.63	18	10	0.32	290	6
3319	< 0.5	3.51	19	7	1004	6	0.21	2.2	4	182	36	0.77	16	1.44	14	9	0.39	274	5
3320	< 0.5	3.5	< 5	1	878	7	0.21	< 2.0	1	169	31	0.75	17	1.82	17	9	0.36	242	6
3321	3.9	1.44	91	24	88	18	< 0.01	15.3	4	321	594	5.11	< 10	0.54	< 5	25	0.19	137	26
3322	15.6	1.26	46	16	125	43	< 0.01	16	3	389	2788	5.83	< 10	0.56	< 5	29	0.06	61	13
3323	7.1	1.83	20	8	157	8	< 0.01	< 2.0	2	420	99	4.24	< 10	0.86	8	30	0.08	57	4
3324	> 50.0	1.29	317	146	421	21	< 0.01	5.4	7	447	2384	4.95	< 10	0.56	< 5	43	0.13	133	< 1
3325	> 50.0	3.64	192	19	447	15	0.03	< 2.0	18	301	11304	> 10.00	28	0.69	12	39	0.98	1111	10
3326	38.1	3.22	64	13	1436	12	0.04	< 2.0	6	282	2253	5.56	15	0.91	8	27	0.67	732	2
3327	> 50.0	4.89	177	20	628	50	0.09	< 2.0	69	140	> 20000	> 10.00	24	0.95	9	45	1.66	2104	3
3328	35.9	3.1	15	18	1276	11	0.03	< 2.0	4	209	1409	4.75	18	1.04	7	25	0.5	891	3
3329	> 50.0	1.28	437	198	592	< 5	< 0.01	< 2.0	2	313	1601	7.29	12	0.75	< 5	30	0.08	94	2
3330	1.1	2.86	24	5	208	12	0.01	< 2.0	15	260	96	7.3	18	0.44	< 5	28	0.64	538	6
3331	15.6	3.17	1173	61	1119	17	0.04	6.3	7	218	2618	3.72	18	2.01	10	22	0.52	433	3
3332	0.5	2.91	513	41	869	16	0.04	< 2.0	19	103	53	5.71	17	2.29	< 5	32	1.18	285	< 1
3333	< 0.5	6.97	44	40	808	16	1.1	< 2.0	9	278	42	4.09	21	1.08	37	37	1.33	916	3
3334	< 0.5	7.25	119	2097	701	28	1.21	< 2.0	14	556	51	4.64	19	1.19	47	35	1.34	1118	13
3335	0.8	7.16	85	798	788	25	1.27	< 2.0	11	306	27	3.61	19	0.48	43	27	1.25	684	5
3336	2	2.6	69	16	109	< 5	0.04	< 2.0	3	248	213	2.9	16	0.39	13	14	0.07	36	3
3337	1	1.1	11	4	42	9	0.04	< 2.0	5	215	676	5.16	14	0.02	< 5	11	0.52	325	3
3338	< 0.5	5.74	32	6	1194	20	1.61	< 2.0	11	166	41	4.14	26	1.2	16	25	1.27	805	< 1
3339	44.3	0.54	92	11	56	11	0.02	22.5	6	355	426	2.94	< 10	0.16	6	20	0.06	108	4
3340	21.6	4.06	104	17	250	28	0.75	< 2.0	25	145	903	> 10.00	26	0.76	6	18	0.97	1660	6
3341	0.9	5.13	26	6	764	24	0.49	< 2.0	35	156	256	5.14	19	0.93	18	37	1.54	784	< 1
3342	0.8	4.27	32	31	1167	17	0.39	< 2.0	13	160	241	3.57	22	1.77	16	26	1.32	577	< 1
3343	2.3	3.7	26	7	927	17	0.37	< 2.0	18	149	670	4.87	17	1.36	12	38	1.52	650	< 1
3344	3.6	3.75	98	46	686	19	0.41	< 2.0	55	104	1189	8.34	20	1.62	13	55	1.72	731	< 1
3345	1.4	5.69	95	20	310	35	0.5	< 2.0	86	105	5312	> 10.00	26	0.69	29	84	2.65	1158	1
3346	1.3	4.34	36	19	996	28	0.48	< 2.0	20	125	1754	6.08	24	2.01	12	40	1.69	697	< 1
3347	5.4	4.64	99	62	575	37	0.46	< 2.0	145	105	11524	> 10.00	23	1.05	17	54	1.81	773	< 1
3348	1.8	3.79	24	13	682	27	0.28	< 2.0	28	131	5868	5.85	19	1.29	10	37	1.31	535	< 1
3349	9.2	3.77	125	47	238	65	0.19	< 2.0	258	101	> 20000	> 10.00	21	0.48	10	46	1.69	736	< 1
3350	1.7	5.25	184	45	236	31	0.38	< 2.0	142	104	2797	> 10.00	21	0.59	16	46	1.74	784	< 1
3351	< 0.5	4.56	63	18	780	31	0.51	< 2.0	51	122	1856	7.82	23	1.22	11	44	1.6	713	< 1
3352	0.6	4.25	31	11	972	21	0.47	< 2.0	17	125	361	4.61	19	1.34	9	38	1.34	545	< 1
3353	4.8	0.89	26	11	52	27	0.03	< 2.0	18	378	14806	2.94	< 10	0.17	< 5	26	0.41	206	< 1
3354	0.5	5.69	23	5	954	18	2	< 2.0	8	138	51	3.88	23	1.14	12	38	1.4	205	< 1
3355	6.5	2.91	47	< 1	355	< 5	5.93	< 2.0	33	88	4338	3.99	37	0.89	6	40	2.69	1911	6
3356	10.1	2.08	33	2	345	< 5	7.59	< 2.0	43	75	5624	4.03	29	0.57	< 5	34	3.05	2646	3
3357	> 50.0	1.88	130	12	73	19	2.35	< 2.0	173	134	> 20000	6.36	32	0.21	< 5	35	1.37	1083	< 1
3358	15.6	2.42	26	3	137	< 5	2.87	99.6	31	140	4775	2.89	23	1.56	< 5	21	0.56	1360	15
3359	9.1	2.68	101	10	158	< 5	3.62	163.6	26	136	5146	3.71	32	1.17	34	28	0.86	1626	26
3360	> 50.0	0.6	1293	13	129	299	0.03	< 2.0	< 1	234	5757	> 10.00	30	0.52	< 5	33	0.05	42	1
3361	0.6	0.88	10	< 1	1346	< 5	0.02	7.1	< 1	85	57	0.76	33	1.38	< 5	18	0.11	55	3
3362	27.2	1.38	108	6	87	< 5	> 10.00	< 2.0	126	47	14642	3.82	32	0.7	< 5	22	3.92	3017	< 1
3363	< 0.5	2.88	10	6	138	< 5	1.44	< 2.0	28	192	59	5.03	29	0.19	< 5	24	3.8	1788	1
3364	1	1.8	18	24	128	< 5	0.73	6.9	7	293	244	3.03	26	0.73	< 5	38	0.95	387	15
3365	< 0.5	1.16	< 5	48	29	< 5	0.09	< 2.0	22	162	36	9.32	33	0.15	< 5	16	1.2	379	5
3366	< 0.5	1.54	102	16	583	< 5	3.32	< 2.0	4	185	30	3	34	0.79	< 5	19	0.92	817	< 1
3367	< 0.5	2.74	< 5	5	805	< 5	4.37	< 2.0	2	121	30	3.17	33	1.45	< 5	41	1.56	1027	7
3368	20.3	0.98	523	24	54	74	0.02	< 2.0	99	78	16521	> 10.00	49	0.16	< 5	32	0.49	1141	2
3369	1.7	3.67	30	4	352	20	0.09	< 2.0	30	111	1755	> 10.00	39	0.66	6	35	0.86	1091	2
3370	27.8	1.26	92	8	20	65	0.03	< 2.0	72	78	> 20000	> 10.00	54	0.26	< 5	31	0.52	1047	4
3371	12.6	2.91	644	47	418	34	0.04	< 2.0	18	126	3030	8.95	46	0.7	< 5	23	0.64	848	< 1
3372	< 0.5	3.37	11	< 1	768	< 5	0.25	3.5	9	144	537	2.63	33	1.91	7	30	1.41	1548	2
3373	0.5	1.07	88	31	32	< 5	0.07	3.4	5	173	126	5.15	28	0.93	6	49	0.45	299	9
3374	1.2	0.7	7	2	629	6	0.36	< 2.0	31	182	991	4.47	< 10	0.94	< 5	20	0.62	736	8
3375	1.5	2.72	34	74	90	< 5	7.28	< 2.0	138	383	2053	5.75	12	0.21	< 5	26	4.53	941	< 1
3376	46.2	1.63	155	79	198	< 5	0.05	< 2.0	7	215	5111	5.14	< 10	0.6	< 5	49	0.38	490	< 1
3377	> 50.0	1.18	170	42	63	< 5	0.06	< 2.0	12	269	11971	4.34	< 10	0.57	< 5	55	0.26	275	4
3378	> 50.0	1.92	137	45	150	< 5	0.05	< 2.0	19	233	13247	5.31	< 10	0.79	< 5	46	0.51	629	< 1
3379	> 50.0	2.58	35	5	127	13	0.07	< 2.0	29	185	19563	8.39	< 10	0.52	< 5	23	0.95	1415	3
3380	15.5	2.4	43	20	298	6	0.12	< 2.0	12	231	2078	4.86	< 10	0.6	5	34	0.78	943	< 1

Results for ICP and FA+DCP analysis

Sample	Ag	Al	As	Au	Ba	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	K	La	Li	Mg	Mn	Mo
#	PPM	PCT	PPM	PPB	PPM	PPM	PCT	PPM	PPM	PPM	PPM	PCT	PPM	PCT	PPM	PPM	PCT	PPM	PPM
3381	< 0.5	1.73	25	< 1	739	< 5	> 10.00	< 2.0	7	58	53	4.34	< 10	0.96	6	11	6.04	1369	< 1
3382	< 0.5	6.75	27	< 1	873	< 5	0.14	< 2.0	15	108	62	3.81	< 10	1.6	19	19	0.7	172	< 1
3383	< 0.5	1.8	30	26	453	< 5	0.05	< 2.0	13	115	51	2.59	< 10	1.46	5	12	0.23	151	< 1
3384	12.4	1.33	123	3	398	< 5	0.04	< 2.0	12	212	1384	4.65	< 10	0.74	10	31	0.62	864	22
3385	9.4	1.73	31	7	248	7	0.09	< 2.0	9	201	2065	3.73	< 10	0.58	< 5	32	0.63	938	< 1
3386	20.2	1.07	> 2000	1500	86	< 5	0.05	< 2.0	7	236	1299	4.68	< 10	0.58	< 5	63	0.24	654	2
3387	9	1.99	> 2000	884	318	< 5	0.07	< 2.0	7	194	848	3.01	< 10	0.75	< 5	45	0.43	862	4
3388	1.8	1.62	992	425	156	< 5	0.07	< 2.0	5	221	39	7.48	< 10	0.84	< 5	66	0.35	363	2
3389	36.2	1.48	751	71	33	< 5	0.07	< 2.0	139	314	19173	4.07	< 10	0.77	7	58	0.34	177	6
3390	> 50.0	1.11	1163	110	10	8	0.04	4.5	604	244	> 20000	> 10.00	< 10	0.43	10	54	0.31	161	3
3391	9.1	2.18	152	112	176	< 5	0.05	7.2	2	184	249	2.34	< 10	1.69	8	31	0.36	153	< 1
3392	5.4	2.18	113	30	199	< 5	0.03	3.7	4	240	320	2.99	< 10	1.61	8	41	0.1	133	4
3393	0.5	2.73	47	13	549	< 5	0.06	< 2.0	1	183	55	2.37	< 10	1.97	< 5	32	0.66	258	4
3394	9.4	1.85	270	90	92	< 5	0.02	82.2	6	231	122	3.04	< 10	1.74	< 5	54	0.16	349	12
3395	1.1	3.35	125	19	537	< 5	0.06	< 2.0	5	172	38	2.91	< 10	1.82	< 5	28	0.52	322	2
3396	32.5	2.01	> 2000	389	206	< 5	0.04	< 2.0	4	336	296	2.5	< 10	1.47	6	43	0.25	324	3
3397	7.2	2.98	1799	191	495	< 5	0.03	< 2.0	5	167	104	2.07	< 10	1.7	< 5	39	0.44	215	1
3398	12.4	2.88	695	78	397	< 5	0.04	< 2.0	2	310	34	1.77	< 10	1.46	10	71	0.31	104	< 1
3399	3	1.94	> 2000	221	153	< 5	0.05	< 2.0	< 1	230	38	3.04	< 10	1.2	8	46	0.49	282	7
3400	< 0.5	2.33	34	17	1018	< 5	0.09	< 2.0	9	168	144	2.99	< 10	1.54	< 5	49	0.63	371	3
3401	> 50.0	1.54	180	5	50	< 5	2.4	< 2.0	112	193	> 20000	6.42	< 10	0.26	< 5	22	0.73	1304	2
3402	26.1	3.61	79	2	374	< 5	0.06	< 2.0	22	217	6597	> 10.00	< 10	0.82	9	33	1.23	1404	< 1
3403	25.1	2.15	> 2000	640	251	< 5	0.11	< 2.0	7	188	2855	3.89	< 10	0.87	< 5	63	0.4	466	3
3404	> 50.0	2.26	120	24	29	20	0.12	< 2.0	30	146	> 20000	> 10.00	< 10	0.81	< 5	20	0.79	934	1
3405	5.2	3.42	13	11	794	< 5	1.8	< 2.0	11	208	1899	4.24	< 10	0.95	10	36	1.58	2518	1
3406	15.2	3.06	45	13	265	5	0.43	< 2.0	19	187	6997	5.38	< 10	0.92	7	32	1.12	1443	4
3407	1.4	1.86	1103	204	253	< 5	0.06	< 2.0	7	271	90	2.07	< 10	0.71	5	51	0.29	360	2
3408	1.1	3.47	54	12	515	< 5	0.19	< 2.0	4	207	65	2.8	< 10	1.87	10	39	0.54	867	6
3409	1.4	3.53	66	37	676	< 5	0.09	< 2.0	9	191	37	2.33	< 10	1.95	11	38	0.35	836	< 1
3410	39	2.97	412	279	38	< 5	0.08	32.9	19	170	5212	> 10.00	< 10	1.79	< 5	27	0.5	947	9
3411	0.7	1.98	41	28	356	< 5	0.04	< 2.0	< 1	207	28	1.84	< 10	1.56	9	34	0.24	277	7
3412	20.9	1.76	113	140	55	< 5	0.03	5.4	7	220	1930	3.99	< 10	1.44	11	40	0.17	190	5
3413	21	2.24	53	16	117	< 5	0.04	86.4	8	185	289	1.75	< 10	1.69	8	47	0.22	294	10
3414	1.6	2.21	179	33	223	< 5	0.03	2.3	6	198	242	2.84	< 10	1.81	8	32	0.32	198	6
3415	33.6	2.02	339	96	32	< 5	0.02	422.3	17	148	451	5.4	< 10	2.04	5	33	0.07	1285	47
3416	5.7	2.93	1423	109	239	< 5	0.11	23	10	180	92	2.96	< 10	1.62	< 5	35	0.49	713	5
3417	4.8	3.11	517	103	188	< 5	0.49	43.9	7	169	59	2.8	< 10	1.47	6	47	0.49	770	8
3418	> 50.0	0.53	> 2000	532	17	< 5	0.01	19.1	5	237	439	7.1	< 10	0.26	< 5	71	0.09	211	9
3419	4.5	1.65	91	17	119	< 5	0.04	3.3	6	303	95	2.61	< 10	1.43	10	54	0.26	811	3
3420	6.8	2.44	228	148	88	< 5	0.49	9.9	47	149	624	> 10.00	< 10	1.03	< 5	66	1.07	718	5
3421	11.7	2.27	608	1002	623	< 5	0.4	< 2.0	9	175	314	8.09	< 10	1.47	7	48	0.22	286	12
3422	< 0.5	4.02	73	43	443	< 5	0.49	< 2.0	19	158	111	4.87	< 10	1.95	6	68	0.88	707	7
3423	2.1	2.15	65	22	109	< 5	> 10.00	19	15	93	938	4.67	< 10	0.91	11	57	4.2	1950	4
3424	< 0.5	2.71	84	35	315	< 5	4.48	< 2.0	7	160	28	2.92	< 10	1.21	13	62	2.73	1360	2
3425	< 0.5	3.87	39	9	852	< 5	2.06	< 2.0	2	144	22	1.22	< 10	1.84	14	31	1.24	727	3
3426	0.7	2.81	47	54	89	< 5	9.79	< 2.0	8	87	13	3.93	< 10	1.19	15	34	1.64	1399	3
3427	> 50.0	2.66	137	55	105	< 5	0.2	26.6	11	172	288	4.33	< 10	1.1	8	85	0.72	557	8
3428	14	1.04	51	22	204	< 5	0.3	78.6	8	144	337	2.15	< 10	1.28	< 5	94	0.32	541	18
3429	5.2	1.39	> 2000	1105	87	< 5	0.03	41.9	19	227	480	4.05	< 10	1.04	< 5	71	0.21	109	17
3430	22.1	2.48	1691	258	332	< 5	0.01	< 2.0	1	256	39	1.27	< 10	1.06	11	58	0.3	66	< 1
3431	6.4	2.05	> 2000	209	249	< 5	0.01	< 2.0	4	241	68	3.44	< 10	1.46	< 5	54	0.22	175	< 1
3432	0.5	1.68	155	59	1766	< 5	0.03	< 2.0	1	115	11	1.4	< 10	2.18	11	43	0.15	39	3
3450	5.9	0.72	708	625	37	< 5	0.51	< 2.0	66	361	292	> 10.00	< 10	0.86	< 5	59	0.07	174	4
3451	1.3	0.68	68	42	272	< 5	> 10.00	16.2	26	31	104	1.61	< 10	0.45	9	16	0.06	2029	6
3452	0.6	1.81	29	28	991	< 5	1.11	< 2.0	11	241	96	2.08	< 10	1.3	6	50	0.3	400	< 1
3453	1.2	2.02	98	67	647	< 5	0.2	< 2.0	14	167	186	3.7	< 10	1.78	< 5	40	0.37	417	3
3454	< 0.5	1.18	9	6	546	< 5	0.02	< 2.0	1	138	6	0.52	< 10	1.08	8	39	0.17	22	12
3455	< 0.5	0.92	9	9	650	< 5	0.02	< 2.0	3	144	3	0.58	< 10	1.75	< 5	32	0.09	24	< 1
3456	< 0.5	0.71	33	10	603	< 5	0.01	< 2.0	< 1	119	< 1	0.4	< 10	1.24	5	31	0.08	16	4
3457	< 0.5	0.87	5	8	462	< 5	0.15	< 2.0	2	73	87	1.39	< 10	0.79	< 5	7	0.52	566	2
3458	< 0.5	2.12	27	23	1001	< 5	2.14	< 2.0	10	121	280	2.65	< 10	1.44	6	18	1.18	1390	1
3459	1	0.73	307	60	87	< 5	0.02	< 2.0	2	272	7	1.41	< 10	0.56	< 5	127	0.1	57	1

Sample	Na	Nb	NI	Pb	Pd	Pt	Sb	Sn	Sr	Ta	Te	Ti	V	W	Y	Zn	Zr
#	PCT	PPM	PPM	PPM	PPB	PPB	PPM	PPM	PPM	PPM	PPM	PCT	PPM	PPM	PPM	PPM	PPM
3316	0.16	5	8	57	< 1	< 5	< 5	< 20	8	< 100	< 25	0.08	13	< 20	9	328	7
3317	0.2	6	9	109	2	< 5	7	< 20	7	< 100	< 25	0.12	22	< 20	14	797	9
3318	2.87	8	12	61	9	14	< 5	< 20	87	< 100	< 25	0.19	29	< 20	21	117	8
3319	2.92	8	10	63	2	< 5	< 5	< 20	96	< 100	< 25	0.18	28	< 20	21	89	17
3320	2.88	10	9	58	1	< 5	< 5	< 20	86	< 100	< 25	0.25	47	< 20	23	80	< 5
3321	0.05	< 5	8	540	4	5	12	< 20	3	< 100	< 25	0.02	11	< 20	< 5	4273	< 5
3322	0.05	< 5	11	540	3	< 5	< 5	< 20	3	< 100	< 25	0.03	10	< 20	< 5	3710	< 5
3323	0.06	< 5	7	58	3	< 5	< 5	< 20	5	< 100	< 25	0.03	11	< 20	6	177	< 5
3324	0.08	< 5	13	2362	4	< 5	19	< 20	13	< 100	< 25	0.03	29	< 20	< 5	1452	< 5
3325	0.46	11	16	852	4	< 5	30	< 20	29	< 100	< 25	0.13	84	< 20	< 5	454	14
3326	0.87	5	16	175	13	5	< 5	< 20	63	< 100	< 25	0.16	63	< 20	< 5	178	10
3327	0.9	28	32	229	20	7	< 5	22	33	< 100	< 25	0.2	100	< 20	5	1713	25
3328	0.43	< 5	14	2487	5	< 5	< 5	204	52	< 100	< 25	0.13	67	< 20	< 5	579	10
3329	0.05	< 5	10	> 10000	4	< 5	38	21	18	< 100	< 25	0.03	26	< 20	< 5	575	< 5
3330	0.09	< 5	10	54	7	7	< 5	< 20	4	< 100	< 25	0.07	16	< 20	< 5	54	5
3331	1	8	15	1263	5	5	< 5	< 20	105	< 100	< 25	0.28	69	< 20	< 5	2643	17
3332	0.65	6	24	26	7	< 5	< 5	< 20	59	< 100	< 25	0.71	263	< 20	< 5	68	18
3333	2.07	12	41	61	5	5	< 5	< 20	273	< 100	< 25	0.6	139	< 20	17	90	37
3334	1.77	14	47	38	10	10	< 5	22	289	< 100	< 25	0.73	101	< 20	21	42	46
3335	1.97	10	35	28	10	< 5	18	< 20	349	< 100	< 25	0.56	89	< 20	16	44	29
3336	1.85	6	6	26	6	7	< 5	< 20	46	< 100	< 25	0.05	7	< 20	19	49	7
3337	0.03	8	7	14	4	5	< 5	< 20	4	< 100	< 25	0.01	4	< 20	15	38	8
3338	2.6	20	26	42	5	7	< 5	< 20	310	< 100	< 25	0.45	139	< 20	13	146	26
3339	0.09	< 5	8	> 10000	5	< 5	9	< 20	9	< 100	< 25	0.02	12	< 20	11	8694	< 5
3340	0.56	12	20	> 10000	5	< 5	38	31	51	< 100	< 25	0.25	90	< 20	7	4274	18
3341	2.25	8	23	83	6	< 5	< 5	< 20	177	< 100	< 25	0.27	87	< 20	8	64	15
3342	2.49	8	24	44	5	< 5	< 5	< 20	175	< 100	< 25	0.31	99	< 20	8	59	13
3343	2.03	9	25	19	7	24	< 5	< 20	130	< 100	< 25	0.29	96	< 20	7	50	15
3344	1.75	9	24	24	7	< 5	8	< 20	71	< 100	< 25	0.31	108	< 20	7	42	16
3345	0.86	12	22	14	7	12	< 5	< 20	50	< 100	< 25	0.29	105	< 20	12	52	28
3346	1.65	11	27	15	6	8	< 5	< 20	131	< 100	< 25	0.36	119	< 20	8	50	20
3347	1.43	16	27	32	5	8	7	< 20	105	< 100	< 25	0.3	97	< 20	9	55	22
3348	1.96	9	20	8	7	5	< 5	< 20	122	< 100	< 25	0.25	77	< 20	6	36	14
3349	0.52	31	16	25	12	9	< 5	< 20	29	< 100	< 25	0.13	47	< 20	< 5	86	22
3350	1.52	9	21	25	6	6	< 5	< 20	76	< 100	< 25	0.24	74	< 20	9	38	19
3351	1.83	10	23	21	10	11	7	< 20	133	< 100	< 25	0.31	100	< 20	9	43	18
3352	2.75	8	22	17	8	11	< 5	< 20	260	< 100	< 25	0.28	83	< 20	7	37	12
3353	0.06	10	12	21	8	13	< 5	< 20	6	< 100	< 25	0.02	14	< 20	< 5	23	6
3354	2.48	11	29	< 2	10	11	< 5	< 20	310	< 100	< 25	0.34	107	< 20	13	27	46
3355	0.59	7	23	20	8	6	9	< 20	103	< 100	< 25	0.17	47	< 20	14	74	11
3356	0.63	7	17	20	6	5	< 5	< 20	112	< 100	< 25	0.1	33	< 20	12	95	6
3357	0.17	19	17	59	7	< 5	< 5	< 20	28	< 100	< 25	0.06	14	< 20	10	781	11
3358	1.28	5	23	585	7	8	11	< 20	121	< 100	< 25	0.14	34	< 20	15	> 20000	13
3359	0.69	< 5	24	325	4	6	18	26	110	< 100	< 25	0.1	29	< 20	32	> 20000	9
3360	0.1	< 5	12	> 10000	8	7	< 5	< 20	3	< 100	< 25	0.02	10	< 20	8	483	< 5
3361	2.44	6	6	26	6	11	< 5	< 20	77	< 100	< 25	0.07	< 2	< 20	18	167	54
3362	0.24	12	17	64	8	14	< 5	< 20	144	< 100	< 25	0.06	25	< 20	12	106	6
3363	2.67	< 5	65	63	10	13	< 5	< 20	46	< 100	< 25	0.39	167	< 20	20	611	15
3364	0.95	< 5	34	49	28	17	< 5	< 20	20	< 100	< 25	0.22	73	< 20	12	427	< 5
3365	0.2	< 5	19	20	3	< 5	< 5	< 20	2	< 100	< 25	0.27	73	< 20	11	60	6
3366	2.63	< 5	35	20	8	9	< 5	< 20	343	< 100	< 25	0.26	73	20	12	150	< 5
3367	0.71	< 5	23	29	11	7	< 5	< 20	97	< 100	< 25	0.22	67	< 20	14	134	17
3368	0.21	9	19	12	7	17	< 5	23	4	< 100	< 25	0.24	53	< 20	8	213	14
3369	0.43	5	23	14	7	6	< 5	< 20	21	< 100	< 25	0.3	70	< 20	14	199	24
3370	0.14	27	19	50	8	7	9	30	4	< 100	< 25	0.2	41	< 20	9	296	18
3371	0.14	7	20	42	9	8	< 5	< 20	5	< 100	< 25	0.28	50	< 20	11	95	29
3372	1.65	6	26	17	6	< 5	< 5	< 20	104	< 100	< 25	0.25	56	< 20	17	189	16
3373	0.06	< 5	17	30	11	10	< 5	< 20	6	< 100	< 25	0.11	31	< 20	17	59	12
3374	1.15	8	26	36	8	8	< 5	< 20	46	< 100	< 25	0.3	82	< 20	< 5	99	17
3375	1.78	< 5	2240	38	17	10	17	< 20	163	< 100	< 25	0.11	198	< 20	< 5	68	< 5
3376	0.05	< 5	18	42	11	7	28	< 20	9	< 100	< 25	0.1	33	< 20	< 5	106	13
3377	0.05	6	26	27	7	9	25	< 20	9	< 100	< 25	0.08	28	< 20	< 5	120	12
3378	0.06	9	19	30	9	14	21	< 20	9	< 100	< 25	0.13	49	< 20	< 5	237	18
3379	0.07	12	32	70	9	5	10	< 20	7	< 100	< 25	0.12	48	< 20	< 5	271	20
3380	0.07	< 5	21	30	9	10	< 5	< 20	12	< 100	< 25	0.15	47	< 20	< 5	57	18

Results for ICP and FA+DCP analysis

Sample	Na	Nb	Ni	Pb	Pd	Pt	Sb	Sn	Sr	Ta	Te	Ti	V	W	Y	Zn	Zr
#	PCT	PPM	PPM	PPM	PPB	PPB	PPM	PPM	PPM	PPM	PPM	PCT	PPM	PPM	PPM	PPM	PPM
3381	0.79	5	10	26	10	5	6	< 20	191	< 100	< 25	0.11	52	< 20	< 5	38	14
3382	0.87	6	36	31	11	14	5	< 20	34	< 100	< 25	0.4	171	< 20	11	85	63
3383	0.14	5	32	44	10	5	< 5	< 20	16	< 100	< 25	0.31	133	< 20	< 5	106	53
3384	0.09	< 5	27	45	6	6	8	< 20	14	< 100	< 25	0.15	54	< 20	< 5	46	13
3385	0.05	< 5	19	34	10	< 5	5	< 20	8	< 100	< 25	0.12	45	< 20	< 5	74	11
3386	0.06	< 5	14	125	7	11	200	< 20	9	< 100	< 25	0.06	18	< 20	< 5	218	7
3387	0.05	< 5	17	45	10	12	116	< 20	9	< 100	< 25	0.12	35	< 20	< 5	90	13
3388	0.08	< 5	16	49	11	18	50	< 20	10	< 100	< 25	0.12	35	< 20	< 5	29	13
3389	0.45	10	69	31	4	< 5	< 5	< 20	27	< 100	< 25	0.06	22	< 20	5	106	6
3390	0.31	41	170	126	4	20	< 5	49	18	< 100	< 25	0.04	15	< 20	6	5130	18
3391	0.9	< 5	19	3029	3	5	< 5	< 20	41	< 100	< 25	0.28	76	< 20	< 5	3971	18
3392	0.12	< 5	14	2539	1	5	< 5	< 20	41	< 100	< 25	0.18	45	< 20	< 5	1465	15
3393	1.07	5	17	128	2	7	21	< 20	32	< 100	< 25	0.31	97	< 20	< 5	162	29
3394	0.09	< 5	16	> 10000	3	9	73	< 20	14	< 100	< 25	0.16	57	< 20	< 5	> 20000	13
3395	0.78	6	14	741	4	12	< 5	< 20	46	< 100	< 25	0.36	100	< 20	< 5	362	32
3396	0.09	< 5	14	3897	3	< 5	224	< 20	20	< 100	< 25	0.17	43	< 20	< 5	917	13
3397	0.15	< 5	12	3420	5	12	44	< 20	22	< 100	< 25	0.28	71	< 20	< 5	584	24
3398	0.33	< 5	14	361	3	< 5	69	< 20	24	< 100	< 25	0.21	60	< 20	< 5	261	21
3399	0.33	< 5	16	1888	4	9	40	< 20	22	< 100	< 25	0.23	65	< 20	< 5	1295	19
3400	0.8	5	28	41	4	< 5	< 5	< 20	50	< 100	< 25	0.31	106	< 20	< 5	1377	33
3401	0.07	19	32	35	10	13	14	< 20	35	< 100	< 25	0.05	26	< 20	< 5	512	16
3402	0.13	7	22	36	10	7	< 5	< 20	9	< 100	< 25	0.19	69	< 20	< 5	179	20
3403	0.08	< 5	14	50	12	18	127	< 20	13	< 100	< 25	0.12	37	< 20	5	57	17
3404	0.15	40	28	113	7	< 5	< 5	27	11	< 100	< 25	0.17	65	< 20	< 5	626	29
3405	0.16	< 5	19	18	4	21	< 5	< 20	33	< 100	< 25	0.15	47	< 20	8	88	13
3406	0.22	7	25	27	2	5	< 5	27	19	< 100	< 25	0.19	63	< 20	< 5	198	16
3407	0.05	< 5	14	24	6	< 5	35	< 20	11	< 100	< 25	0.08	36	< 20	< 5	34	6
3408	0.72	5	17	178	4	5	11	< 20	66	< 100	< 25	0.25	73	< 20	8	653	19
3409	0.24	6	26	91	4	< 5	9	< 20	59	< 100	< 25	0.3	90	< 20	11	175	23
3410	0.68	7	22	> 10000	5	< 5	43	35	33	< 100	< 25	0.19	48	< 20	5	16053	15
3411	0.56	< 5	15	82	3	9	< 5	< 20	51	< 100	< 25	0.21	71	< 20	9	138	17
3412	0.42	< 5	18	> 10000	3	< 5	62	< 20	38	< 100	< 25	0.16	66	< 20	19	2655	16
3413	0.22	< 5	15	9396	4	14	28	< 20	29	< 100	< 25	0.16	52	< 20	< 5	> 20000	13
3414	0.36	< 5	14	1411	5	8	48	< 20	27	< 100	< 25	0.28	82	< 20	6	828	25
3415	0.12	< 5	29	> 10000	4	10	204	45	19	< 100	< 25	0.12	42	< 20	< 5	> 20000	9
3416	0.2	6	22	4847	7	13	56	< 20	37	< 100	< 25	0.31	95	< 20	< 5	10926	29
3417	0.36	< 5	19	3120	6	15	29	< 20	39	< 100	< 25	0.24	63	< 20	< 5	17100	17
3418	0.03	< 5	19	> 10000	7	19	120	< 20	10	< 100	< 25	0.03	8	< 20	< 5	13981	< 5
3419	0.08	< 5	18	5745	8	15	< 5	< 20	33	< 100	< 25	0.12	45	< 20	8	3075	10
3420	0.48	< 5	27	344	5	12	< 5	< 20	35	< 100	< 25	0.2	73	< 20	< 5	10000	18
3421	0.21	< 5	19	348	6	10	29	< 20	47	< 100	< 25	0.21	53	< 20	< 5	2721	19
3422	0.41	5	35	71	8	12	5	< 20	71	< 100	< 25	0.32	100	< 20	8	2943	32
3423	0.14	< 5	25	4206	6	18	39	< 20	153	< 100	< 25	0.08	41	< 20	7	7069	9
3424	0.18	< 5	24	29	5	5	8	< 20	81	< 100	< 25	0.15	68	< 20	9	66	21
3425	0.45	6	12	51	6	7	23	< 20	47	< 100	< 25	0.12	23	< 20	18	93	69
3426	0.18	7	19	28	8	16	< 5	< 20	167	< 100	< 25	0.14	43	< 20	< 5	57	22
3427	0.15	< 5	23	> 10000	7	17	91	< 20	12	< 100	< 25	0.18	62	< 20	22	11400	18
3428	0.09	< 5	14	9147	6	14	25	< 20	7	< 100	< 25	0.2	47	< 20	< 5	> 20000	25
3429	0.22	< 5	22	616	6	11	213	< 20	7	< 100	< 25	0.12	28	< 20	< 5	> 20000	12
3430	0.11	< 5	8	5830	6	13	44	< 20	9	< 100	< 25	0.16	61	< 20	5	611	25
3431	0.07	< 5	9	1868	6	15	31	< 20	7	< 100	< 25	0.21	61	< 20	< 5	125	23
3432	0.13	< 5	8	243	10	13	< 5	< 20	12	< 100	< 25	0.25	29	< 20	12	300	114
3450	0.06	< 5	19	339	15	65	11	< 20	10	< 100	< 25	0.05	15	< 20	< 5	4185	< 5
3451	0.19	< 5	9	57	8	17	< 5	< 20	130	< 100	< 25	0.03	30	< 20	12	7049	< 5
3452	1.15	< 5	19	41	7	19	< 5	< 20	69	< 100	< 25	0.21	49	< 20	5	1340	12
3453	0.7	5	23	213	9	14	7	< 20	49	< 100	< 25	0.32	83	< 20	< 5	2652	31
3454	0.41	< 5	9	25	7	13	< 5	< 20	12	< 100	< 25	0.04	3	< 20	14	29	34
3455	0.16	< 5	6	21	6	14	< 5	< 20	9	< 100	< 25	0.09	10	< 20	7	26	48
3456	0.12	< 5	6	25	7	17	6	< 20	9	< 100	< 25	0.06	2	< 20	8	19	41
3457	0.95	< 5	12	7	7	11	6	< 20	69	< 100	< 25	0.12	39	< 20	< 5	372	9
3458	2.14	7	26	18	7	15	< 5	< 20	116	< 100	< 25	0.26	78	< 20	5	496	16
3459	0.07	< 5	12	21	7	16	< 5	< 20	7	< 100	< 25	0.05	16	< 20	< 5	14	< 5

APPENDIX C

DATA FOR SAMPLES ANALYZED USING FIRE ASSAY (FA) METHODS AND ATOMIC ADSORPTION SPECTROSCOPY (AA) EQUIPMENT

Appendix C shows the data for samples analyzed using Fire Assay (FA) methods and Atomic Adsorption Spectroscopy (AA) equipment. See the report for the discussion of these methods.

Results for Fire Assay-Atomic Adsorption Analysis

Sample #	Au oz/st	Ag oz/st	Cu %	Pb %	Zn %
3316	NA	0.04	< 0.01	< 0.01	0.03
3317	NA	0.06	< 0.01	< 0.01	0.08
3318	NA	< 0.02	< 0.01	< 0.01	0.01
3319	NA	< 0.02	< 0.01	< 0.01	0.01
3320	NA	< 0.02	< 0.01	< 0.01	0.01
3321	NA	0.14	0.06	0.05	0.45
3322	NA	0.44	0.28	0.05	0.38
3323	NA	0.2	0.01	< 0.01	0.02
3324	NA	6.09	0.24	0.24	0.14
3325	NA	6.16	1.15	0.09	0.05
3326	NA	1.12	0.23	0.02	0.02
3327	NA	4.76	3.94	0.02	0.17
3328	NA	1.03	0.15	0.26	0.05
3329	NA	1.48	0.16	1.31	0.05
3330	NA	0.04	0.01	< 0.01	< 0.01
3331	NA	0.46	0.26	0.13	0.25
3332	NA	0.04	< 0.01	< 0.01	< 0.01
3333	< 0.001	0.07	< 0.01	< 0.01	< 0.01
3336	NA	0.06	0.02	< 0.01	< 0.01
3337	NA	0.04	0.07	< 0.01	< 0.01
3338	NA	< 0.02	< 0.01	< 0.01	0.02
3339	NA	1.43	0.05	2.55	0.85
3340	NA	0.28	0.09	1.33	0.41
3341	NA	< 0.02	0.03	< 0.01	< 0.01
3342	NA	< 0.02	0.03	< 0.01	< 0.01
3343	NA	0.08	0.07	< 0.01	< 0.01
3344	NA	0.1	0.14	< 0.01	< 0.01
3345	NA	0.06	0.56	< 0.01	< 0.01
3346	NA	0.05	0.18	< 0.01	< 0.01
3347	NA	0.16	1.2	< 0.01	< 0.01
3348	NA	0.06	0.61	< 0.01	< 0.01
3349	NA	0.28	4.64	< 0.01	< 0.01
3350	NA	0.06	0.28	< 0.01	< 0.01
3351	NA	0.04	0.19	< 0.01	< 0.01
3352	NA	< 0.02	0.04	< 0.01	< 0.01
3353	NA	0.12	1.52	< 0.01	< 0.01
3354	NA	< 0.02	< 0.01	< 0.01	< 0.01
3355	NA	0.2	0.43	< 0.01	< 0.01
3356	NA	0.28	0.55	< 0.01	< 0.01
3357	NA	1.99	3.67	< 0.01	0.08
3358	NA	0.45	0.44	0.06	2.56
3359	NA	0.32	0.5	0.03	4.68
3360	NA	34.82	0.54	1.05	0.05
3361	NA	0.04	< 0.01	< 0.01	0.02
3362	NA	0.78	1.47	< 0.01	< 0.01
3363	NA	< 0.02	< 0.01	< 0.01	0.06
3364	NA	0.06	0.02	< 0.01	0.04

Results for Fire Assay-Atomic Adsorption Analysis

Sample #	Au oz/st	Ag oz/st	Cu %	Pb %	Zn %
3365	NA	0.02	< 0.01	< 0.01	< 0.01
3366	NA	< 0.02	< 0.01	< 0.01	0.01
3367	NA	< 0.02	< 0.01	< 0.01	0.01
3368	NA	0.64	1.62	< 0.01	0.02
3369	NA	0.1	0.17	< 0.01	0.02
3370	NA	0.8	5.41	< 0.01	0.03
3371	NA	0.42	0.31	< 0.01	< 0.01
3372	NA	0.04	0.05	< 0.01	0.02
3373	NA	0.04	0.01	< 0.01	< 0.01
3374	NA	0.06	0.11	< 0.01	< 0.01
3375	NA	0.04	0.21	< 0.01	< 0.01
3376	NA	1.2	0.52	< 0.01	0.01
3377	NA	1.62	1.22	< 0.01	0.01
3378	NA	2.08	1.33	< 0.01	0.03
3379	NA	2.02	1.99	< 0.01	0.03
3380	NA	0.43	0.2	< 0.01	< 0.01
3381	NA	0.04	< 0.01	< 0.01	< 0.01
3382	NA	0.02	0.01	< 0.01	< 0.01
3383	NA	0.05	< 0.01	< 0.01	0.01
3384	NA	0.74	0.14	< 0.01	< 0.01
3385	NA	0.28	0.21	< 0.01	< 0.01
3386	NA	0.59	0.13	< 0.01	0.02
3387	NA	0.28	0.09	< 0.01	< 0.01
3388	NA	0.08	< 0.01	< 0.01	< 0.01
3389	NA	1.02	1.92	< 0.01	< 0.01
3390	NA	1.6	4.18	0.01	0.49
3391	NA	0.28	0.02	0.29	0.39
3392	NA	0.2	0.04	0.25	0.15
3393	NA	0.04	< 0.01	0.02	0.02
3394	NA	0.33	0.01	1.53	2.47
3395	NA	0.04	< 0.01	0.08	0.04
3396	NA	0.93	0.05	0.38	0.09
3397	NA	0.2	0.02	0.33	0.06
3398	NA	0.37	< 0.01	0.04	0.03
3399	NA	0.12	< 0.01	0.18	0.13
3400	NA	0.04	0.01	< 0.01	0.14
3401	NA	1.92	3.54	< 0.01	0.04
3402	NA	0.72	0.66	< 0.01	< 0.01
3403	NA	0.72	0.28	< 0.01	< 0.01
3404	NA	5.15	7.02	0.01	0.06
3405	NA	0.18	0.2	< 0.01	0.01
3406	NA	0.48	0.72	< 0.01	0.02
3407	NA	0.06	0.01	< 0.01	< 0.01
3408	NA	0.06	< 0.01	0.02	0.07
3409	NA	0.06	< 0.01	< 0.01	0.02
3410	NA	1.26	0.54	1.72	1.68
3411	NA	0.05	< 0.01	< 0.01	0.02

Results for Fire Assay-Atomic Adsorption Analysis

Sample #	Au oz/st	Ag oz/st	Cu %	Pb %	Zn %
3412	NA	0.63	0.2	1.2	0.26
3413	NA	0.63	0.03	0.91	2.85
3414	NA	0.1	0.03	0.13	0.08
3415	NA	0.98	0.05	5.36	13.22
3416	NA	0.22	< 0.01	0.48	1.1
3417	NA	0.18	< 0.01	0.31	1.82
3418	NA	3.01	0.04	10.6	1.34
3419	NA	0.18	< 0.01	0.54	0.29
3420	NA	0.26	0.06	0.04	1
3421	NA	0.37	0.03	0.04	0.28
3422	NA	0.06	0.01	0.01	0.3
3423	NA	0.08	0.1	0.41	0.7
3424	NA	0.04	< 0.01	< 0.01	< 0.01
3425	NA	0.04	< 0.01	< 0.01	0.02
3426	NA	< 0.02	< 0.01	< 0.01	< 0.01
3427	NA	4.12	0.03	6.38	1.16
3428	NA	0.44	0.03	0.92	2.74
3429	NA	0.18	0.05	0.07	3.44
3430	NA	0.66	< 0.01	0.56	0.07
3431	NA	0.25	< 0.01	0.21	0.01
3432	NA	0.08	< 0.01	0.03	0.03
3450	NA	0.26	0.03	0.04	0.44
3451	NA	0.04	0.01	0.01	0.75
3452	NA	0.06	< 0.01	< 0.01	0.13
3453	NA	0.08	0.02	0.02	0.28
3454	NA	0.02	< 0.01	< 0.01	< 0.01
3455	NA	0.04	< 0.01	< 0.01	< 0.01
3456	NA	0.06	< 0.01	< 0.01	< 0.01
3457	NA	0.04	0.02	< 0.01	0.08
3458	NA	0.04	0.03	< 0.01	0.05
3459	NA	0.05	< 0.01	< 0.01	< 0.01

APPENDIX D

MINING FEASIBILITY STUDY

Appendix D is the mining feasibility study done by M. D. Balen for selected sites in the study area.

MINING FEASIBILITY STUDY FOR THE CHUGACH NATIONAL FOREST - UNAKWIK STUDY AREA

By M. D. Balen, Mining Engineer
U. S. Department of the Interior, Bureau of Mines
Alaska Field Operations Center, Anchorage, AK

INTRODUCTION

This summary report presents results of a generalized mining feasibility investigation conducted for the mineral properties of relative significance found in the Unakwik Study Area, Chugach National Forest (CNF). This mining feasibility investigation was conducted for an appropriate set of hypothetical mineral deposit models that are based on the real deposits which occur in the study area. The hypothetical set was created to minimize the quantity of total unknowns in the mineral economic equation, thereby making it possible to portray, with a reasonable probability, the nature of the solution to the economic equation for mining in the study area. To define the economic equation, a set of underground mine models were developed for application to the mineral deposit models such that the mining method employed in each mine model is dependent mainly upon the mining rate. For each mine model, an appropriate milling model was applied, dependent mainly upon mineralogy. The goal of the feasibility study was to determine the monetary value per metric ton of minable ore that would cause the simulated cash flow of each of the mine models to achieve certain pre-defined rates of return for the invested capital.

MINING FEASIBILITY STUDIES

This generic mining feasibility study evaluated the capital and operating costs, and the discounted cash flow rate of return on investment (DCFROR) for 36 mining/milling models. These mining/milling models are applied to mineral/geologic deposit models which in turn are based on the relatively significant mineral occurrences that exist within the Unakwik Study Area. Several methods of mining technology (mine models) were applied to the deposit models to illustrate the effect that economy of scale would have on various types of mine and deposit model configurations. In general, the deposit models are all considered to be tabular ore bodies of variable thickness, dipping at angles greater than 50 degrees. The variation in the mine models used in this study is based primarily upon mining rate of the proposed deposit model. Mining feasibility investigations were conducted for low grade copper vein, shear, or fissure-type, and for complex base-metal sulfide vein, shear, or fissure-type deposits.

It is important to emphasize that the mining and milling scenarios as presented in this report are applied to generalized deposit models, and that they are preliminary in nature. The data presented here serve only as a guide toward understanding the potential for mineral development in the study area, and cannot be construed to represent all the factors that must be considered in a full scale mining feasibility analysis. A full scale mining feasibility investigation requires detailed evaluation of the vast number of variables embodied by the 1) metallurgical, geometrical, and structural characteristics of the ore body, 2) metal markets, 3) availability of infrastructure, 4) sociopolitical climate, 5) environmental constraints, 6) corporate policy, and 7) profitability analysis. The nature of the mining feasibility studies in this report precludes all but the profitability analysis portion of a full scale mining feasibility study.

Mining Feasibility Parameters

The evaluation of the feasibility of mining each deposit model involved the resolution of numerous variables such as deposit tonnage, mining and milling methods, mining rate, mine life, and deposit access requirements. Deposit model tonnages were estimated by assuming a probable range of deposit tonnages within which all deposits that could exist in the study area would fall. In all cases, the estimated deposit model tonnages represent minable, diluted reserves.

Mine models were created by designing a mining and milling plan for each deposit model. Mine models were then evaluated by varying the mining plan to accommodate various deposit model tonnages. By evaluating the feasibility of mining each deposit model over a range of tonnages, a distribution of results was generated that showed the effect of the economy of scale. The deposit tonnage estimates were used to calculate the mining rate and the mine life for each deposit according to Taylor's Rule (12) where mine life (years) = $0.2(T)^{0.25}$, and mining rate (mtpd ore) = $(T^{0.75})/70$ (T = deposit size in metric tons).

The mine model types used in this study were selected in a way that provided a qualitative method to estimate the costs for the mining and milling techniques that might be applied to deposits in the study area. Table 1 itemizes these mining and milling techniques as applied to each deposit model.

TABLE 1. - Mineral deposit and mine model descriptions.

MINE MODELS					
Deposit type	Deposit size (mt)	Mine model (extraction method)	Mining rate (mtpd)	Mine life (years)	Mill type
Polymetallic base metal (low grade Cu)	175,000	Overhand	125	4.1	1 prod. flotation
Polymetallic base metal (low grade Cu)	350,000	Overhand	210	4.9	1 prod. flotation
Polymetallic base metal (low grade Cu)	500,000	Overhand	275	5.4	1 prod. flotation
Polymetallic base metal (low grade Cu)	750,000	Cut-and-fill	365	5.9	1 prod. flotation
Polymetallic base metal (low grade Cu)	1,000,000	Cut-and-fill	500	6.5	1 prod. flotation
Polymetallic base metal (low grade Cu)	1,500,000	Cut-and-fill	615	7.0	1 prod. flotation
Polymetallic base metal (low grade Cu)	2,000,000	Cut-and-fill	760	7.5	1 prod. flotation
Polymetallic base metal (low grade Cu)	5,000,000	Cut-and-fill	1,515	9.5	1 prod. flotation
Polymetallic base metal (low grade Cu)	10,000,000	Cut-and-fill	2,550	11.3	1 prod. flotation
Polymetallic base metal (complex sulfide ores)	175,000	Overhand	125	4.1	2 prod. flotation
Polymetallic base metal (complex sulfide ores)	350,000	Overhand	210	4.9	2 prod. flotation
Polymetallic base metal (complex sulfide ores)	500,000	Overhand	275	5.4	2 prod. flotation
Polymetallic base metal (complex sulfide ores)	750,000	Cut-and-fill	365	5.9	2 prod. flotation
Polymetallic base metal (complex sulfide ores)	1,000,000	Cut-and-fill	500	6.5	2 prod. flotation
Polymetallic base metal (complex sulfide ores)	1,500,000	Cut-and-fill	615	7.0	2 prod. flotation
Polymetallic base metal (complex sulfide ores)	2,000,000	Cut-and-fill	760	7.5	2 prod. flotation
Polymetallic base metal (complex sulfide ores)	5,000,000	Cut-and-fill	1,515	9.5	2 prod. flotation
Polymetallic base metal (complex sulfide ores)	10,000,000	Cut-and-fill	2,550	11.3	2 prod. flotation

The overhand mining method as applied in this feasibility study is a variation of cut-and-fill mining practices. The mining method incorporates ore chutes, man-ways and haulage-ways in a system of mining that develops a block of ore by driving two-compartment raises every 31-62 m (100-200 ft) along the strike of an ore body. After the raises are completed, a slot is cut along the bottom of the ore block between two raises to initiate the cut-and-fill process. Ore is removed from the stope in horizontal slices that are blasted from the back. Sand back-fill is added to keep the floor of the workings at a convenient working distance below the back. Drilling is accomplished with jackleg drills and slushers are used to remove broken material from stopes to the ore chutes. This mining method is differentiated from cut-and-fill, by lower production rates.

Cut-and-fill mining practices as applied to the deposit models in this feasibility study incorporate a series of bald-headed sublevel haulage-ways equipped with ore chutes and draw points that are used for extracting broken ore from stopes. Two-compartment raises provide access to the stopes, and storage for broken ore. Stopes are mined by blasting a horizontal cut from the back of the ore body. Ore is blasted down onto the floor of the stope, and is moved to ore chutes with slushers or load-haul-dump (LHD) vehicles (depending on production rate). Once the broken ore is removed, sand backfill is added to the stope to bring the floor up to a convenient elevation below the back in preparation for the next cut.

All the mine models developed for this study have several features in common. Escalation factors were applied to the calculated costs to inflate dollars from the 1984 base to March 1994 values, unless otherwise noted. Additionally, Alaska escalation factors were applied to inflate costs to reflect the added expense of operating in remote locations in south-central Alaska. The Alaska escalation factors were derived in a previous Bureau publication ("Alaska Mineral Industry Cost Escalation Factors" BuMines OFR 76-93). Electric power for all model mining operations is supplied by diesel generators. Each mining feasibility model operates 2 shifts per day and 355 days per year unless otherwise noted, for the life of the mine. All mining models include a camp facility of sufficient size to house and feed the entire mine and mill crew.

Recoverable Metal Value

The estimated costs for each mine/mill model and a capital investment schedule (CIS) outlining the timing for capital investment for each mine model are presented in Attachment D to this report. The CIS's were the basis for the cash flow analysis procedure used to evaluate the economics of each mine model. The cash flow analysis procedure uses the CIS for each mine model to solve for two unknowns, namely the discounted cash flow rate of return on investment (DCFROR) and an independent variable, the recoverable metal value (RMV). The RMV is the gross monetary value of the metal recovered from the mineral deposit, less smelter royalty, less shipping costs for concentrate. The cash flow analysis procedure evaluates the cash flow equation for a mine model through an iterative process that varies the RMV between assigned limits, solving in increments for the DCFROR. This procedure generates the distribution of RMV versus DCFROR as a function of the time value of money. The RMV was used in this study to eliminate the affect of changeable metal prices, ore grades, and mill recoveries in the cash flow analysis of a mining scenario. This can be done because of the independent nature of the RMV variable due to the iterative method by which the RMV is calculated. An RMV that produces a solution to a cash flow equation that equals a DCFROR of 0.0% was considered a break-even RMV. This value of RMV caused the mine model to recover all costs, and achieve zero profit upon exhaustion of the deposit. A mine model was considered to be economic if the cash flow analysis yielded a 15% DCFROR.

ANALYSIS OF MODELS

Mine Models

The polymetallic base metal low grade copper and complex sulfide deposit models in this study are based on geologic information available for mineralization that occurs in the study area. The mine models designed for application to these deposit models assume a moderately to steeply dipping, fairly competent ore body of relatively consistent width. Each deposit model is evaluated for mining at 9 different mining rates, and for each mining rate, the mining model is further subdivided for cost analysis as an adit entry and shaft entry mine. Adit entry mine models assume that the ore body is exposed at the surface, and that there is sufficient back to warrant an adit entry. Shaft entry mine models assume that the top of the ore body is 35 meters below the shaft collar. Overall geometry of the ore body is assumed to be tabular with depth equal to length.

A total of 6 overhand mine models and 12 cut-and-fill mine models were developed for application to this deposit model. Table 1 lists the basic mine model description. Each applicable mine model in Table 1 was evaluated as either an adit entry mine or a shaft entry mine.

Adit and shaft entry overhand mine models incorporate stopers and jackleg drills for production. Jackleg drills are also used for drift development. Slushers are used to move ore from the stopes to ore chutes, and LHD's are used to move ore from the chutes to ore storage locations. Shaft entry overhand mine models access the deposit through one production shaft. Shaft entry models also incorporate one combination ventilation-escapeway raise. Hydraulic sand is used to back-fill the stopes in each overhand mine model.

Adit and shaft entry cut-and-fill mine models incorporate jackleg drills and stopers for production development. Small jumbo drills are used for drift development. Slushers are used to move ore from the stopes to ore chutes, and LHD's are used to move ore from the chutes to ore storage locations. Shaft entry cut-and-fill mine models access the deposit through one production shaft. Shaft entry models also incorporate one combination ventilation-escapeway raise. Hydraulic sand is used to back-fill the stopes in each cut-and-fill mine model.

Mill Models

For each mine model listed in table 1, an associated mill model was applied (dependent upon the deposit model mineralogy) using either a one-product or two-product flotation circuit for concentration of the ore. For all mill models, ore preparation involves crushing and grinding circuits that will reduce the ore to 80% -325 mesh. After grinding, ore will proceed to either a one- or two-product flotation circuit. One-product mills are designed to recover copper from low-grade ores; two product flotation mills are designed to recover copper and either lead or zinc from complex sulfide ores. Concentrates from either type of circuit will proceed to storage to await shipment to smelters. The application of the mill models to the original 18 mine models resulted in the creation of 36 mine/mill model combinations for economic evaluation. Attachment C summarizes all of the calculated RMV's for each mining/milling scenario across a range of profitability from 0% to 15%.

Grade Tonnage Estimations

Data for known deposits existing in the study area was used to develop point estimates of grade and tonnage for the purpose of comparing the analytical cash flow data to actual gross contained metal value per tonne of ore (GCMV) data for the area. Attachment A shows the grade-tonnage estimates that can be documented for deposits in the Unakwik Study Area. Given current metal prices, GCMV's for each of the profiled deposits can be estimated. Attachment A shows that the highest GCMV ($64.34/mt) occurs for one of the smallest deposits in the area (1,365 mt). Also shown is largest tonnage deposit (111,773 mt), with one of the lowest GCMV's ($12.15/mt).

CONCLUSIONS

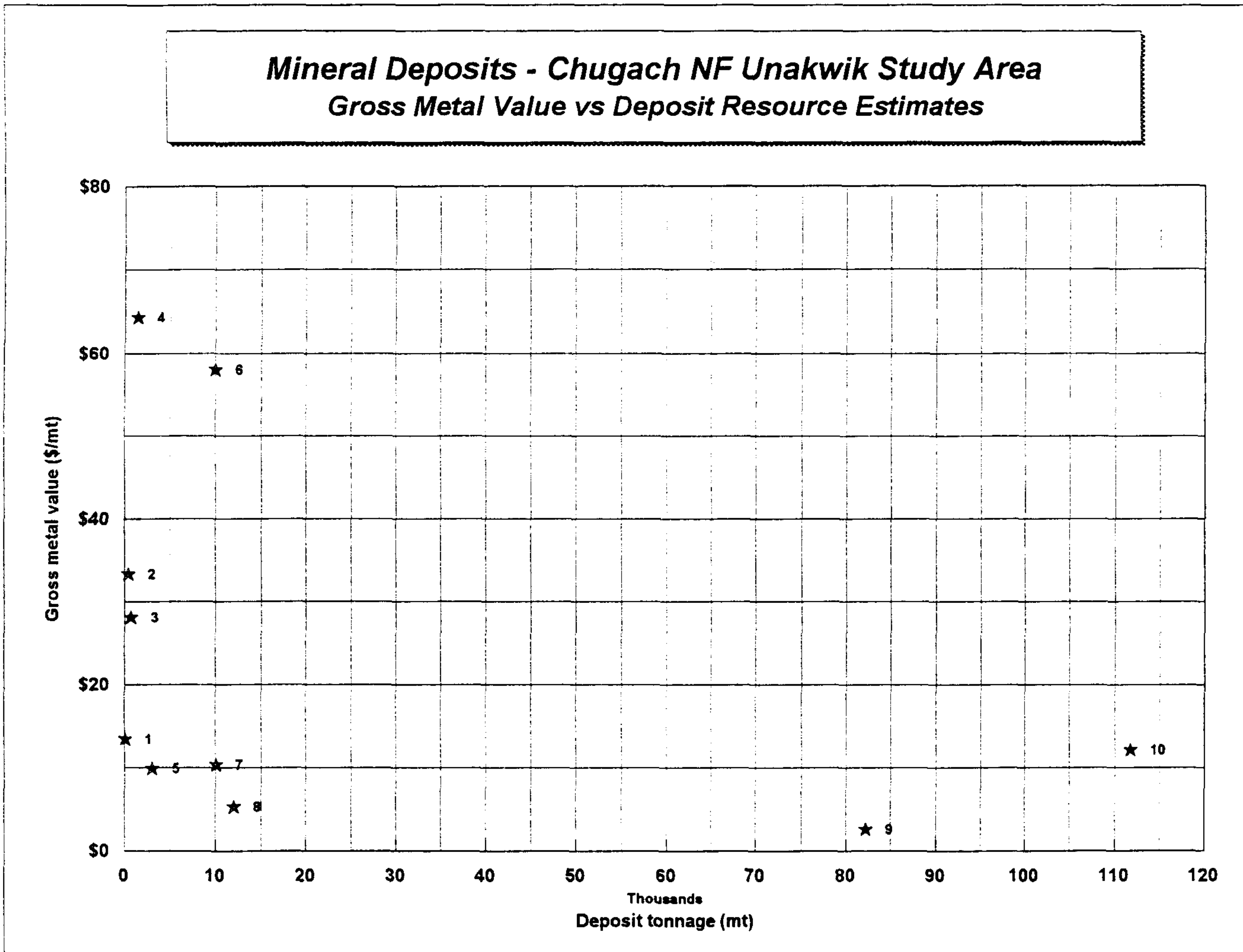
For all known deposits evaluated, the maximum estimated GCMV does not even approach to within an order of magnitude the best case break-even (zero percent return) scenario modeled in the mining feasibility study. None of the deposits for which sufficient data exists contain high enough grade, nor sufficient tonnage to be considered even marginally economic. Most are an order of magnitude below marginally economic.

Alternatively, the economic range (minimum 15% DCFROR) of recoverable grade and tonnage in which deposits existing in the study area would have to fall is between approximately $200.00/mt for a 10 million tonne deposit and $675.00/mt for a 180,000 tonne deposit. Attachment B shows these relationships compared to the values shown in Attachment A. The points for the known deposits shown in this figure represent GCMV's at March, 1994 prices, and do not represent the value of metals that could be recovered if these deposits were to be mined. In fact, the value of the recoverable metal in these deposits probably falls somewhere between 60% and 85% of the values shown. This fact effectively lowers the ordinate value for those data points by the probable percentage for metal recovery that would be achieved in an actual mining operation. Additionally, the points and the associated regression curve representing the RMV - tonnage relationship for hypothetical mines operating at a 15% DCFROR have already accounted for the probable loss due to the inherent inefficiencies of mining and milling.

ATTACHMENT A

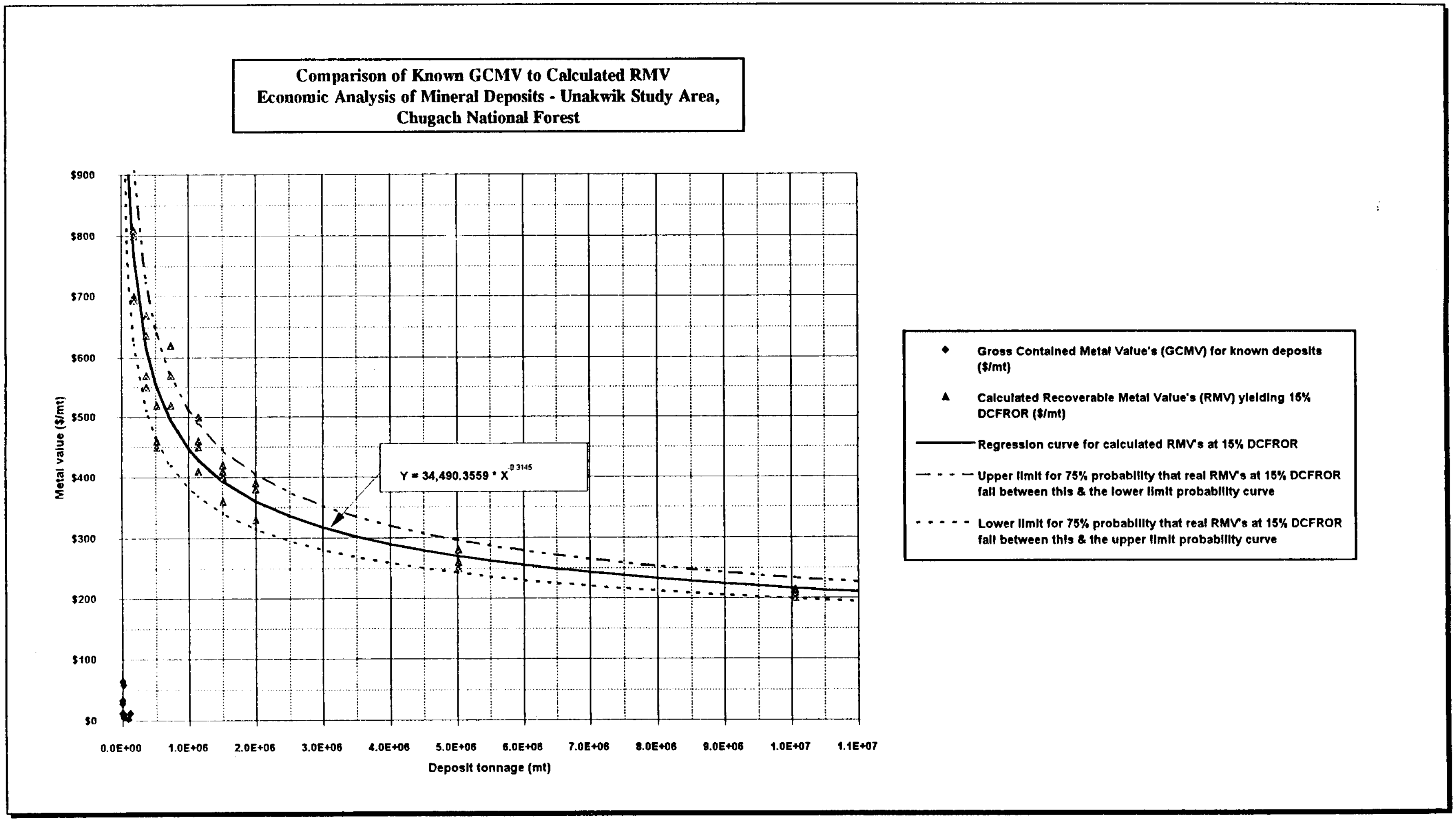
Chugach National Forest Mineral Deposits

Deposit Name	Deposit #	Resource estimate (mt)	Commodity 1 data Name	Commodity 1 data Grade	Commodity 1 data Units	Commodity 2 data Name	Commodity 2 data Grade	Commodity 2 data Units	Commodity 3 data Name	Commodity 3 data Grade	Commodity 3 data Units	Gross metal value ($/mt)
Four in one	1	55	Cu	0.67%	%	Ag	13.40	ppm				$13.46
Brown Bear	2	364	Zn	2.5%	%	Pb	0.8%	%				$33.36
Idle Claim	3	665	Zn	1.85%	%	Cu	0.38%	%	Ag	10.61	ppm	$28.12
Mines river #2	4	1,365	Zn	4.23%	%	Pb	2.24%	%	Ag	5.88	ppm	$64.34
Globe	5	3,000	Ag	2.46	ppm	Cu	0.4%	%	Zn	0.01%	%	$9.96
Columbia Red Metals	6	9,977	Cu	2.45%	%	Ag	73.79	g/mt	Zn	0.48%	%	$58.09
Miners River Nickel	7	10,010	Ni	0.2%	%							$10.36
Cedar bay Occurance	8	12,000	Cu	0.24%	%	Ag	8.90	g/mt				$5.42
Miners River #3	9	82,192	Zn	0.25%	%							$2.70
Dado #1	10	111,773	Cu	0.51%	%	Ag	23.14	g/mt				$12.15



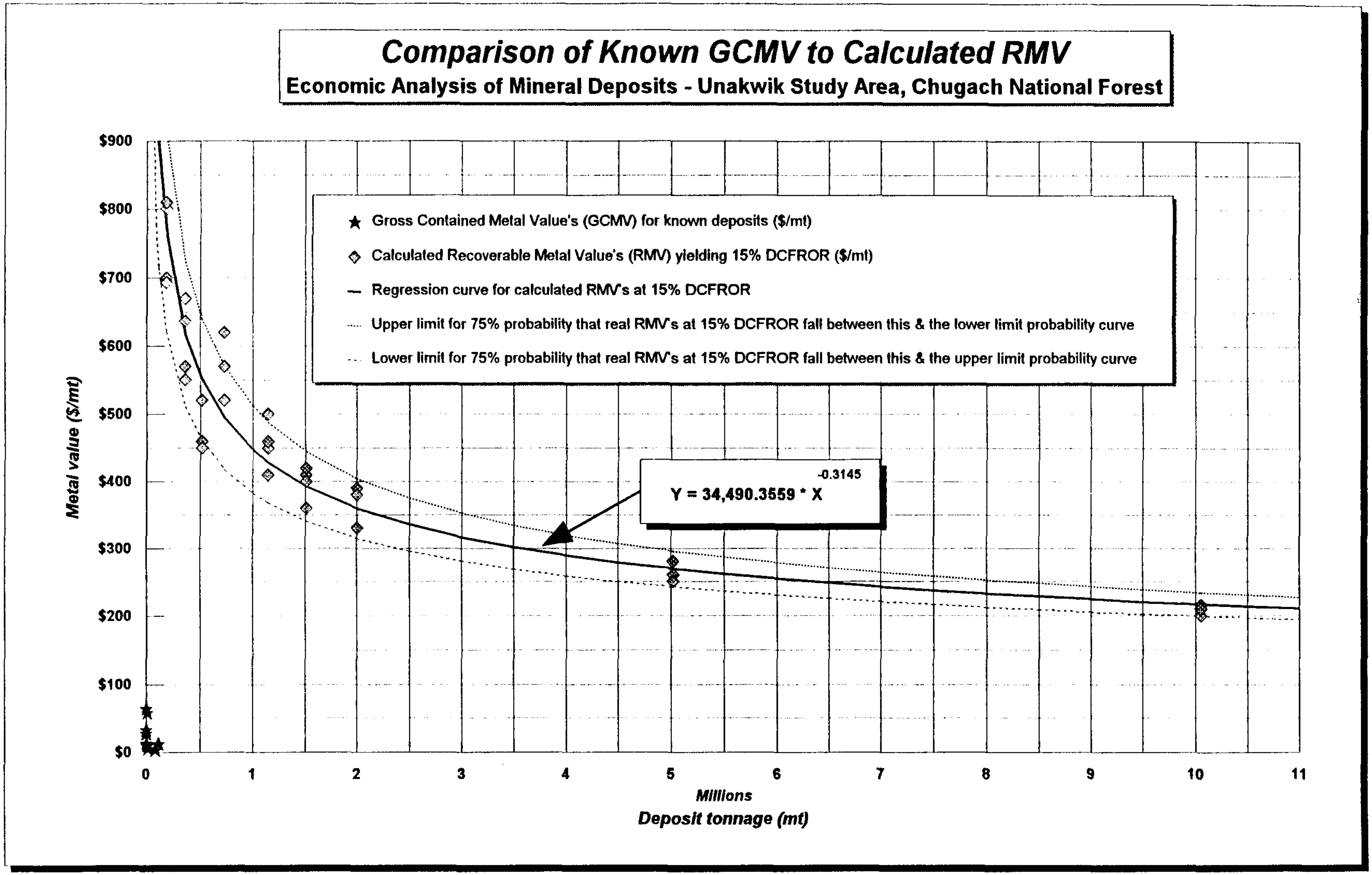
Current metal prices	Code	Price
Copper ($/lb)	Cu	$0.78
Zinc ($/lb)	Zn	$0.49
Lead ($/lb)	Pb	$0.36
Silver ($/oz)	Ag	$4.58
Nickel ($/lb)	Ni	$2.35

ATTACHMENT B

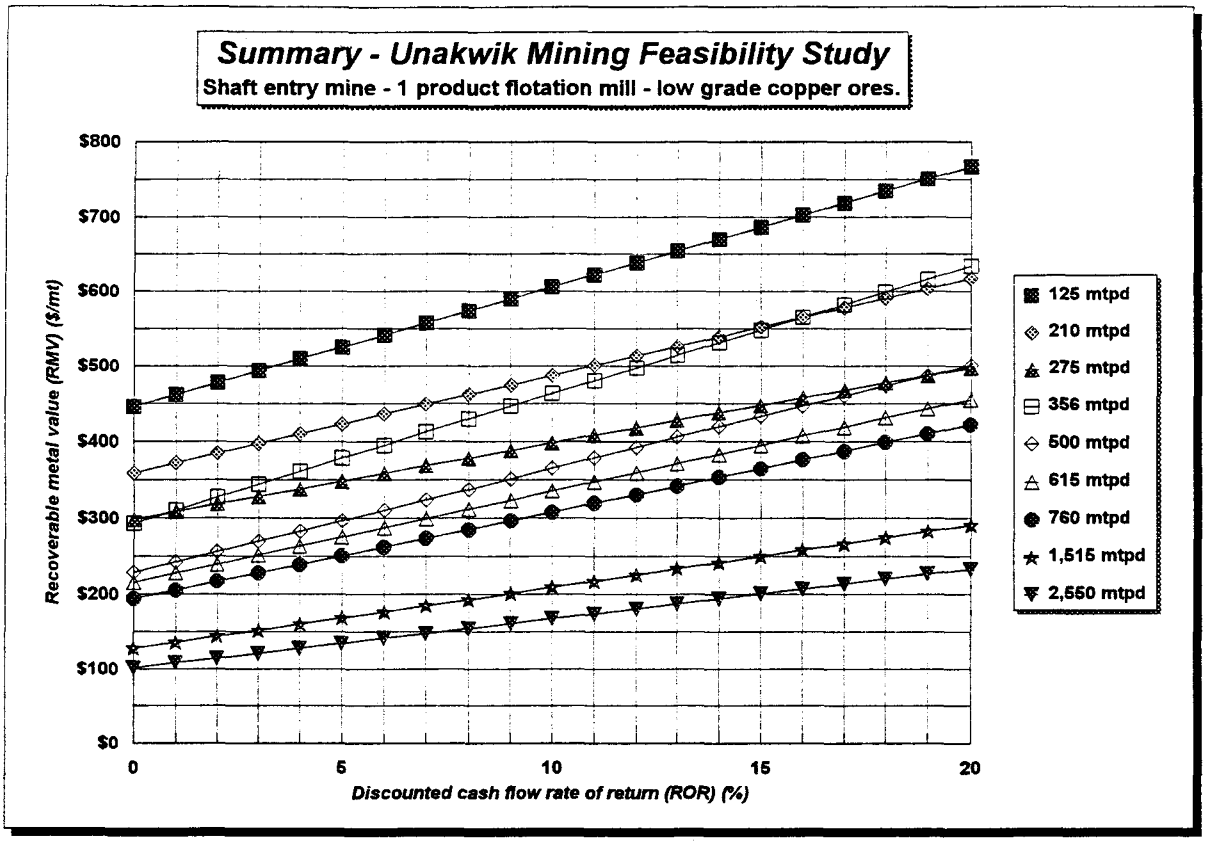


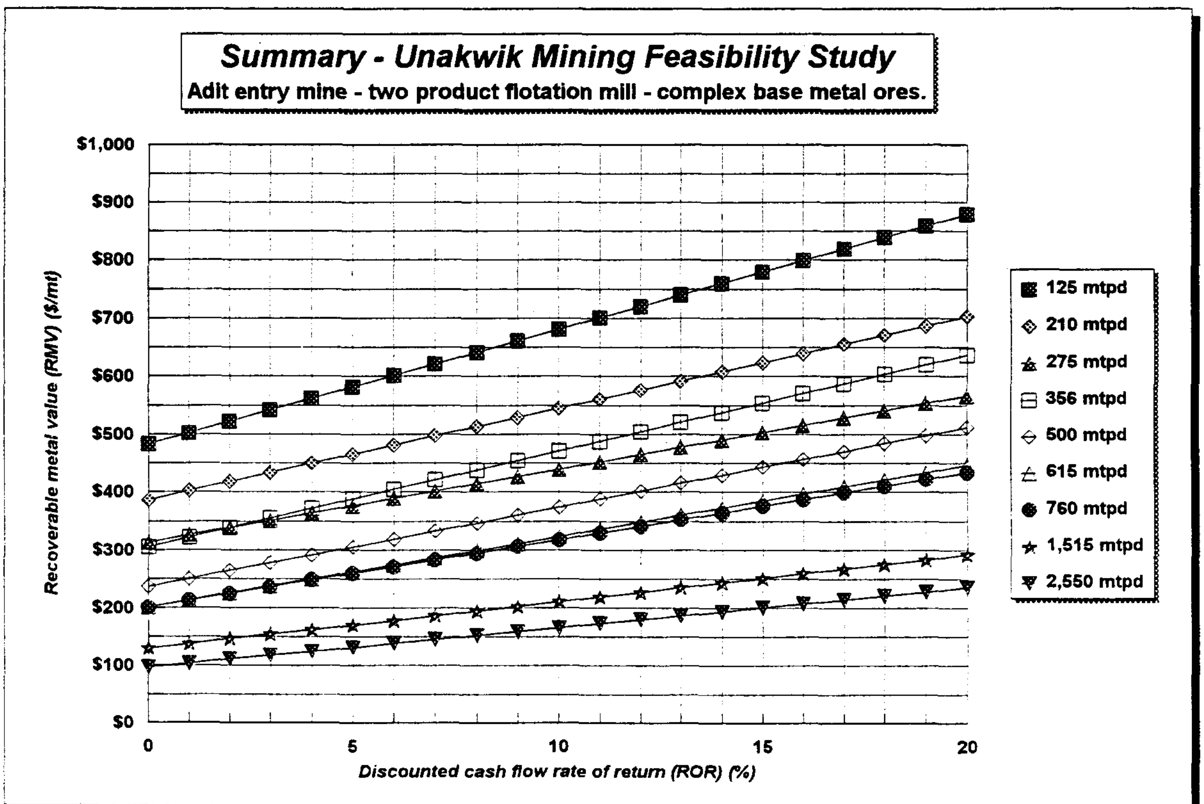
Comparison of Known GCMV to Calculated RMV
Economic Analysis of Mineral Deposits - Unakwik Study Area,
Chugach National Forest
$900
$800
$700
$600
$500
$400
$300
$200
$100
$0
Metal value ($/mt)
Y = 34,490.3559 * X^-0.3145
0.0E+00
1.0E+06
2.0E+06
3.0E+06
4.0E+06
5.0E+06
6.0E+06
7.0E+06
8.0E+06
9.0E+06
1.0E+07
1.1E+07
Deposit tonnage (mt)
Gross Contained Metal Value's (GCMV) for known deposits ($/mt)
Calculated Recoverable Metal Value's (RMV) yielding 15% DCFROR ($/mt)
Regression curve for calculated RMV's at 15% DCFROR
Upper limit for 75% probability that real RMV's at 15% DCFROR fall between this & the lower limit probability curve
Lower limit for 75% probability that real RMV's at 15% DCFROR fall between this & the upper limit probability curve

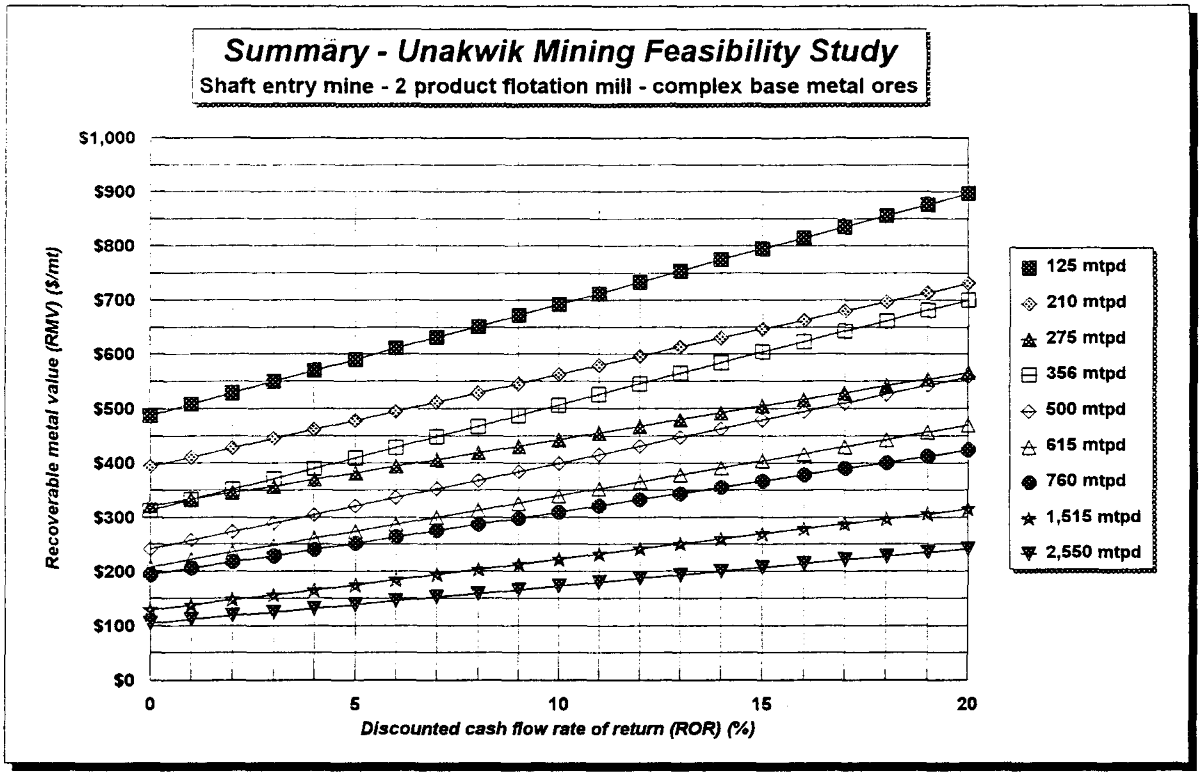
ATTACHMENT C

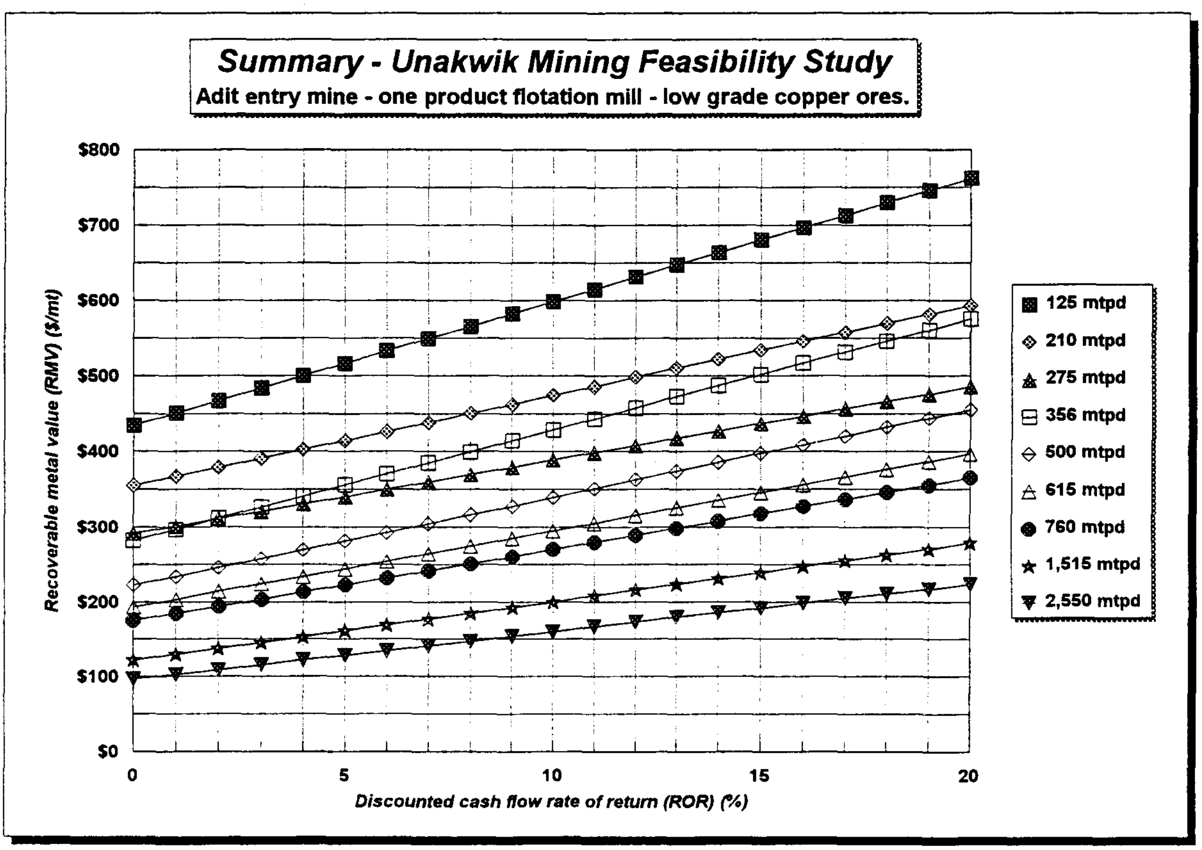


Comparison of Known GCMV to Calculated RMV
Economic Analysis of Mineral Deposits - Unakwik Study Area, Chugach National Forest
Gross Contained Metal Value's (GCMV) for known deposits ($/mt)
Calculated Recoverable Metal Value's (RMV) yielding 15% DCFROR ($/mt)
Regression curve for calculated RMV's at 15% DCFROR
Upper limit for 75% probability that real RMV's at 15% DCFROR fall between this & the lower limit probability curve
Lower limit for 75% probability that real RMV's at 15% DCFROR fall between this & the upper limit probability curve
Y = 34,490.3559 * X -0.3145
Metal value ($/mt)
$900
$800
$700
$600
$500
$400
$300
$200
$100
$0
0
1
2
3
4
5
6
7
8
9
10
11
Millions
Deposit tonnage (mt)


Summary - Unakwik Mining Feasibility Study
Shaft entry mine - 1 product flotation mill - low grade copper ores.
$800
$700
$600
$500
$400
$300
$200
$100
$0
Recoverable metal value (RMV) ($/mt)
0
5
10
15
20
Discounted cash flow rate of return (ROR) (%)
125 mtpd
210 mtpd
275 mtpd
356 mtpd
500 mtpd
615 mtpd
760 mtpd
1,515 mtpd
2,550 mtpd


Summary - Unakwik Mining Feasibility Study
Adit entry mine - two product flotation mill - complex base metal ores.
$1,000
$900
$800
$700
$600
$500
$400
$300
$200
$100
$0
Recoverable metal value (RMV) ($/mt)
0
5
10
15
20
Discounted cash flow rate of return (ROR) (%)
125 mtpd
210 mtpd
275 mtpd
356 mtpd
500 mtpd
615 mtpd
760 mtpd
1,515 mtpd
2,550 mtpd


Summary - Unakwik Mining Feasibility Study
Shaft entry mine - 2 product flotation mill - complex base metal ores
$1,000
$900
$800
$700
$600
$500
$400
$300
$200
$100
$0
Recoverable metal value (RMV) ($/mt)
0
5
10
15
20
Discounted cash flow rate of return (ROR) (%)
125 mtpd
210 mtpd
275 mtpd
356 mtpd
500 mtpd
615 mtpd
760 mtpd
1,515 mtpd
2,550 mtpd

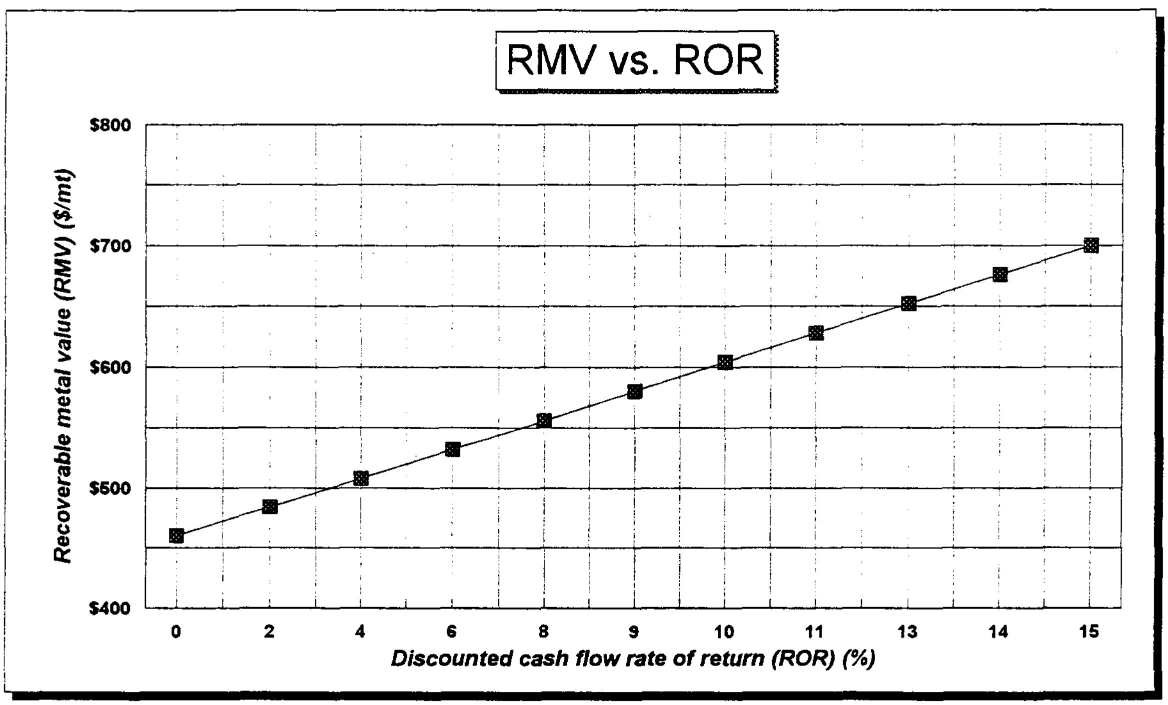

Summary - Unakwik Mining Feasibility Study
Adit entry mine - one product flotation mill - low grade copper ores.
$800
$700
$600
$500
$400
$300
$200
$100
$0
Recoverable metal value (RMV) ($/mt)
0
5
10
15
20
Discounted cash flow rate of return (ROR) (%)
125 mtpd
210 mtpd
275 mtpd
356 mtpd
500 mtpd
615 mtpd
760 mtpd
1,515 mtpd
2,550 mtpd

ATTACHMENT D

Deposit Model - "Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - overhand stope.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 125
Deposit size (mt) - 180,306
Mine life (years) - 4.12
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$755,700	$755,700	-4	-4
Exploration	$1,235,300	$247,060	-5	-1
Infrastructure	$13,386,450	$4,462,150	-3	-1
Mine	$9,454,500	$3,151,500	-3	-1
Mill	$11,325,677	$3,775,226	-3	-1
Working capital	$1,740,998	$1,740,998	0	0
TOTAL PREPRODUCTION	***$37,898,624***			
Mine op cost ($/mt)	$173.66	$7,706,029	0	4.12
Mill op cost ($/mt)	$58.48	$2,594,873	0	4.12
TOTAL PRODUCTION	***$232.13***	***$10,300,902***		

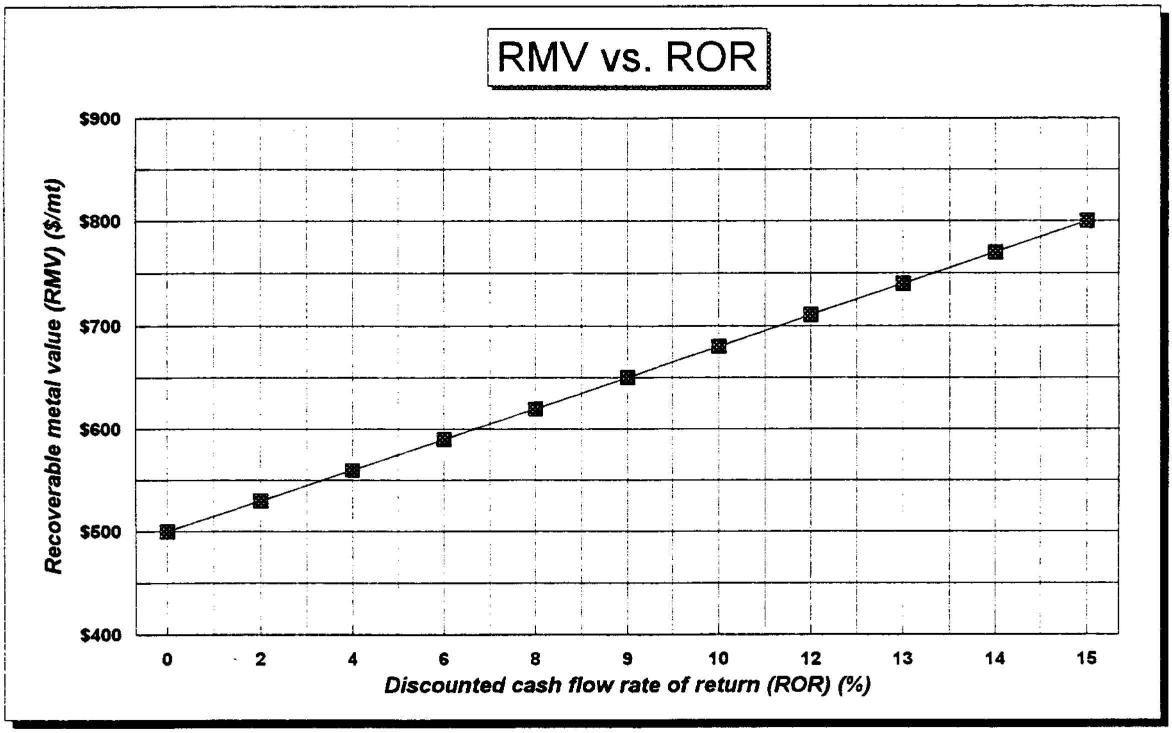
Recoverable metal value	ROR
460	0
484	2
508	4
532	6
556	8
580	9
604	10
628	11
652	13
676	14
700	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - overhand stope.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 125
Deposit size (mt) - 180,306
Mine life (years) - 4.12
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$755,700	$755,700	-4	-4
Exploration	$1,235,300	$247,060	-5	-1
Infrastructure	$13,386,450	$4,462,150	-3	-1
Mine	$7,975,000	$2,658,333	-3	-1
Mill	$19,983,344	$6,661,115	-3	-1
Working capital	$1,766,663	$1,766,663	0	0
TOTAL PREPRODUCTION	***$45,102,457***			
Mine op cost ($/mt)	$162.65	$7,217,416	0	4.12
Mill op cost ($/mt)	$72.91	$3,235,338	0	4.12
TOTAL PRODUCTION	***$235.56***	***$10,452,754***		

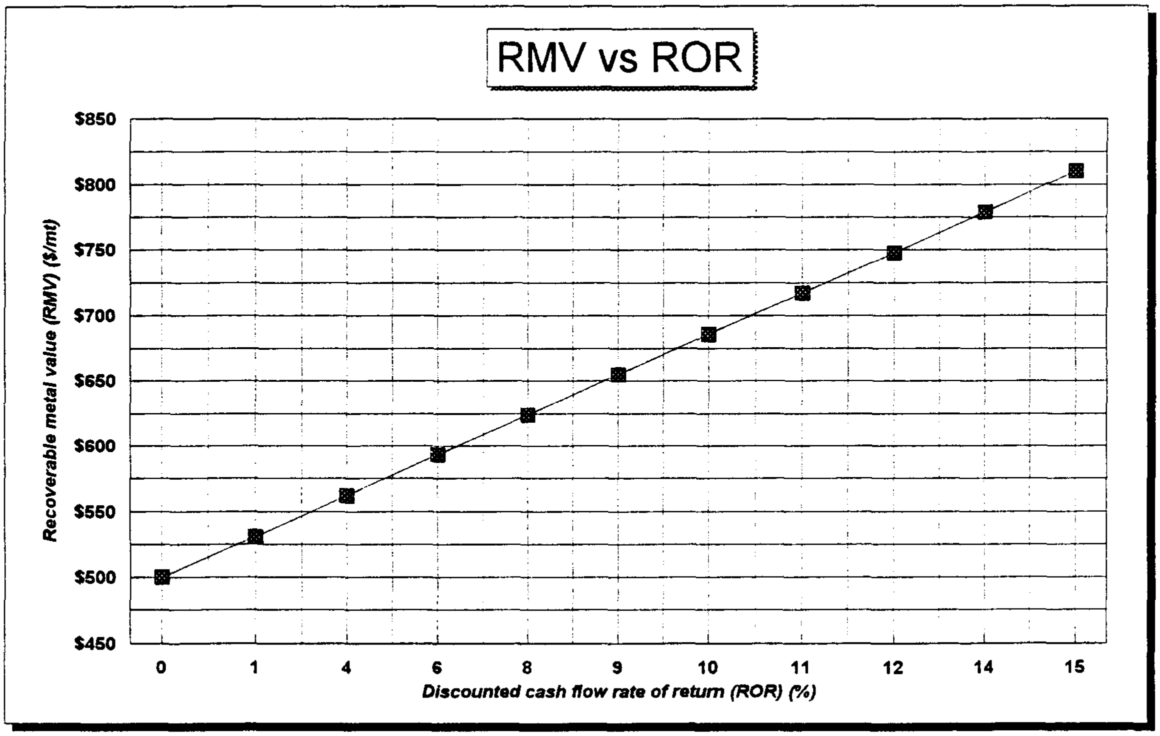
Recoverable metal value	ROR
500	0
530	2
560	4
590	6
620	8
650	9
680	10
710	12
740	13
770	14
800	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - overhand stope.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 125
Deposit size (mt) - 180,306
Mine life (years) - 4.12
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$755,700	$755,700	-4	-4
Exploration	$1,235,300	$247,060	-5	-1
Infrastructure	$13,386,450	$4,462,150	-3	-1
Mine	$9,454,500	$3,151,500	-3	-1
Mill	$19,983,344	$6,661,115	-3	-1
Working capital	$1,740,998	$1,740,998	0	0
TOTAL PREPRODUCTION	***$46,556,292***			
Mine op cost ($/mt)	$173.66	$7,706,029	0	4.12
Mill op cost ($/mt)	$58.48	$2,594,873	0	4.12
TOTAL PRODUCTION	***$232.13***	***$10,300,902***		

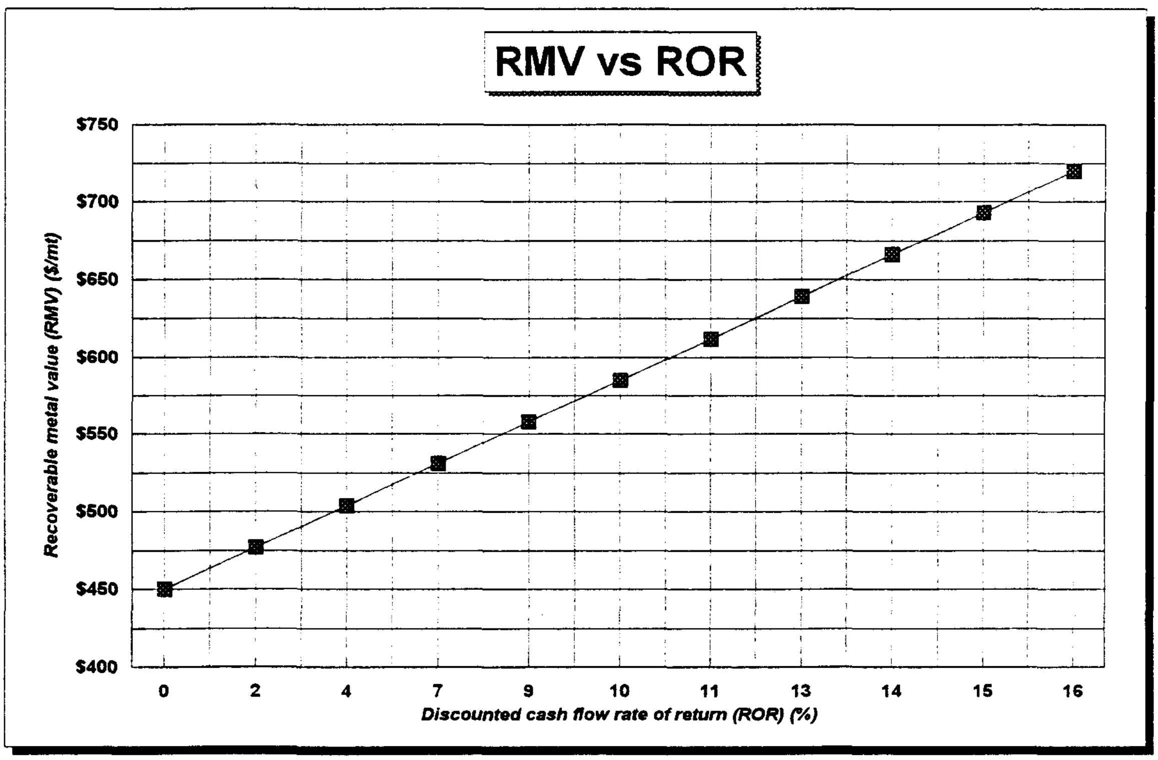
Recoverable metal value	ROR
500	0
531	1
562	4
593	6
624	8
655	9
686	10
717	11
748	12
779	14
810	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - overhand stope.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 125
Deposit size (mt) - 180,306
Mine life (years) - 4.12
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$755,700	$755,700	-4	-4
Exploration	$1,235,300	$247,060	-5	-1
Infrastructure	$13,386,450	$4,462,150	-3	-1
Mine	$7,975,000	$2,658,333	-3	-1
Mill	$11,325,677	$3,775,226	-3	-1
Working capital	$1,766,663	$1,766,663	0	0
TOTAL PREPRODUCTION	***$36,444,789***			
Mine op cost ($/mt)	$162.65	$7,217,416	0	4.12
Mill op cost ($/mt)	$72.91	$3,235,338	0	4.12
TOTAL PRODUCTION	***$235.56***	***$10,452,754***		

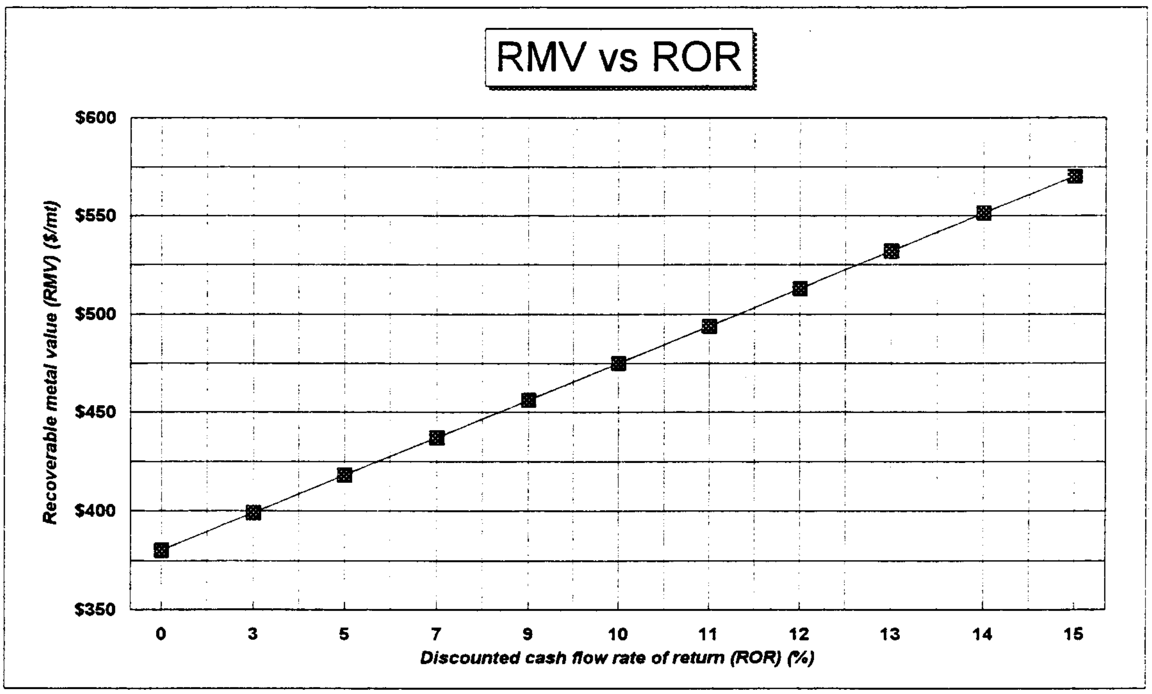
Recoverable metal value	ROR
450	0
477	2
504	4
531	7
558	9
585	10
612	11
639	13
666	14
693	15
720	16



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - overhand stope.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 210
Deposit size (mt) - 360,100
Mine life (years) - 4.90
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$860,200	$860,200	-4	-4
Exploration	$1,525,700	$305,140	-5	-1
Infrastructure	$17,837,820	$5,945,940	-3	-1
Mine	$11,766,700	$3,922,233	-3	-1
Mill	$14,591,185	$4,863,728	-3	-1
Working capital	$2,488,840	$2,488,840	0	0
TOTAL PREPRODUCTION	***$49,070,445***			
Mine op cost ($/mt)	$155.80	$11,615,188	0	4.90
Mill op cost ($/mt)	$41.72	$3,110,450	0	4.90
TOTAL PRODUCTION	***$197.53***	***$14,725,638***		

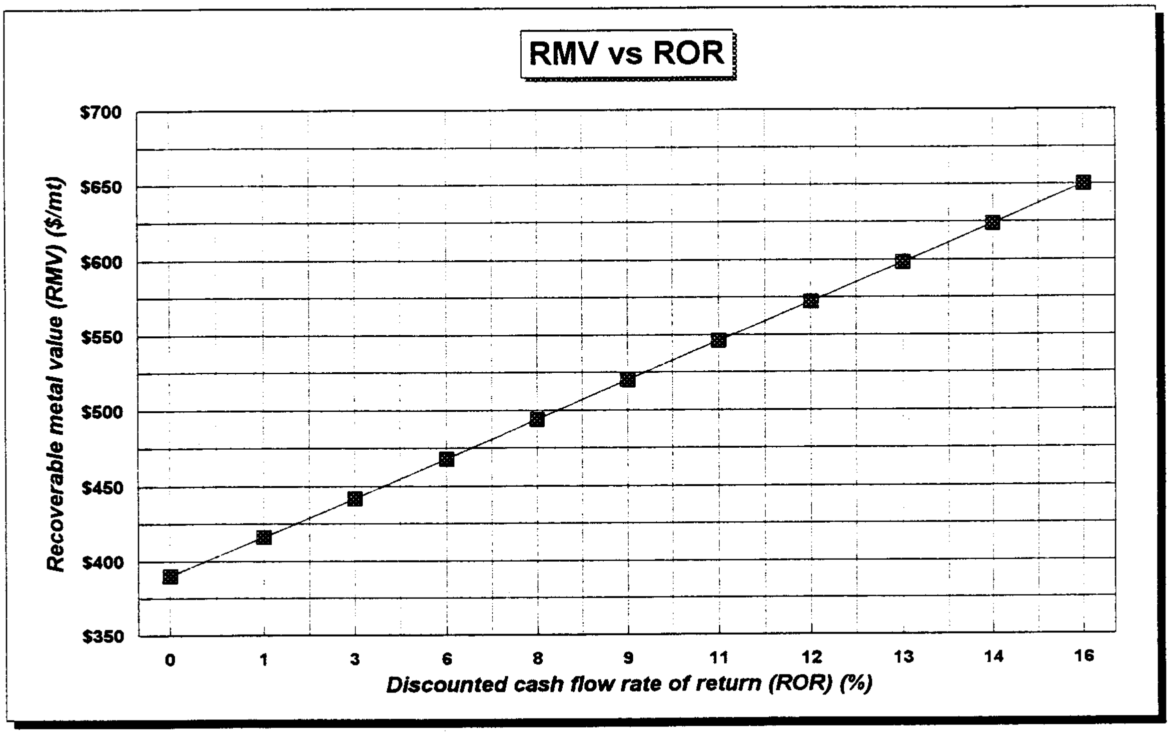
Recoverable metal value	ROR
380	0
399	3
418	5
437	7
456	9
475	10
494	11
513	12
532	13
551	14
570	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - overhand stope.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 210
Deposit size (mt) - 360,100
Mine life (years) - 4.90
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$860,200	$860,200	-4	-4
Exploration	$1,525,700	$305,140	-5	-1
Infrastructure	$17,837,820	$5,945,940	-3	-1
Mine	$9,982,500	$3,327,500	-3	-1
Mill	$25,970,632	$8,656,877	-3	-1
Working capital	$2,475,291	$2,475,291	0	0
TOTAL PREPRODUCTION	***$58,652,143***			
Mine op cost ($/mt)	$144.87	$10,800,059	0	4.90
Mill op cost ($/mt)	$51.58	$3,845,414	0	4.90
TOTAL PRODUCTION	***$196.45***	***$14,645,472***		

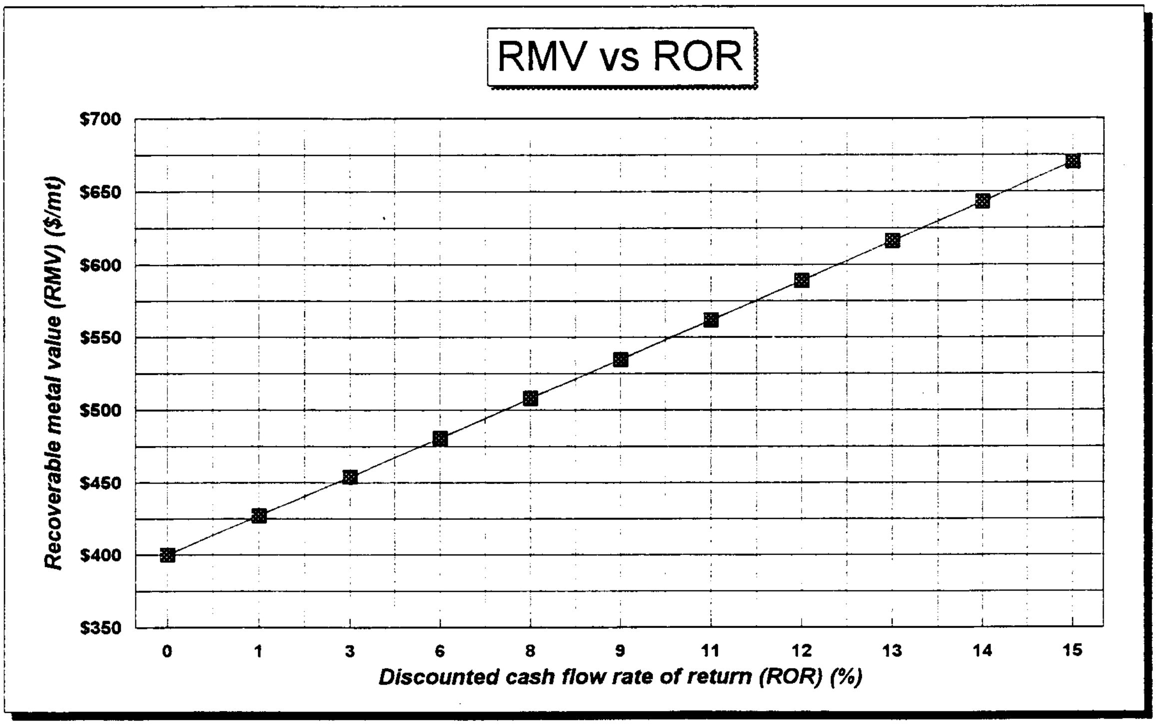
Recoverable metal value	ROR
390	0
416	1
442	3
468	6
494	8
520	9
546	11
572	12
598	13
624	14
650	16



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - overhand stope.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 210
Deposit size (mt) - 360,100
Mine life (years) - 4.90
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$860,200	$860,200	-4	-4
Exploration	$1,525,700	$305,140	-5	-1
Infrastructure	$17,837,820	$5,945,940	-3	-1
Mine	$11,766,700	$3,922,233	-3	-1
Mill	$25,970,632	$8,656,877	-3	-1
Working capital	$2,488,840	$2,488,840	0	0
TOTAL PREPRODUCTION	***$60,449,892***			
Mine op cost ($/mt)	$155.80	$11,615,188	0	4.90
Mill op cost ($/mt)	$41.72	$3,110,450	0	4.90
TOTAL PRODUCTION	***$197.53***	***$14,725,638***		

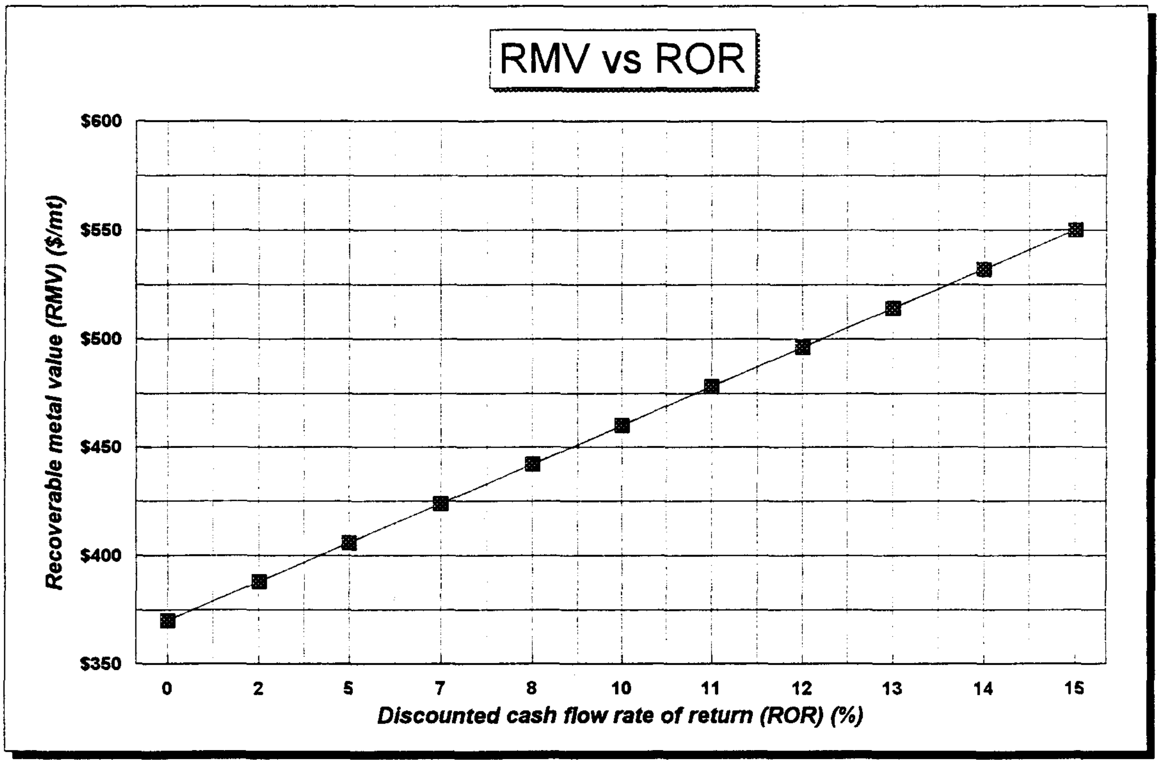
Recoverable metal value	ROR
400	0
427	1
454	3
481	6
508	8
535	9
562	11
589	12
616	13
643	14
670	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - overhand stope.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 210
Deposit size (mt) - 360,100
Mine life (years) - 4.90
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$860,200	$860,200	-4	-4
Exploration	$1,525,700	$305,140	-5	-1
Infrastructure	$17,837,820	$5,945,940	-3	-1
Mine	$9,982,500	$3,327,500	-3	-1
Mill	$14,591,185	$4,863,728	-3	-1
Working capital	$2,475,291	$2,475,291	0	0
TOTAL PREPRODUCTION	***$47,272,696***			
Mine op cost ($/mt)	$144.87	$10,800,059	0	4.90
Mill op cost ($/mt)	$51.58	$3,845,414	0	4.90
TOTAL PRODUCTION	***$196.45***	***$14,645,472***		

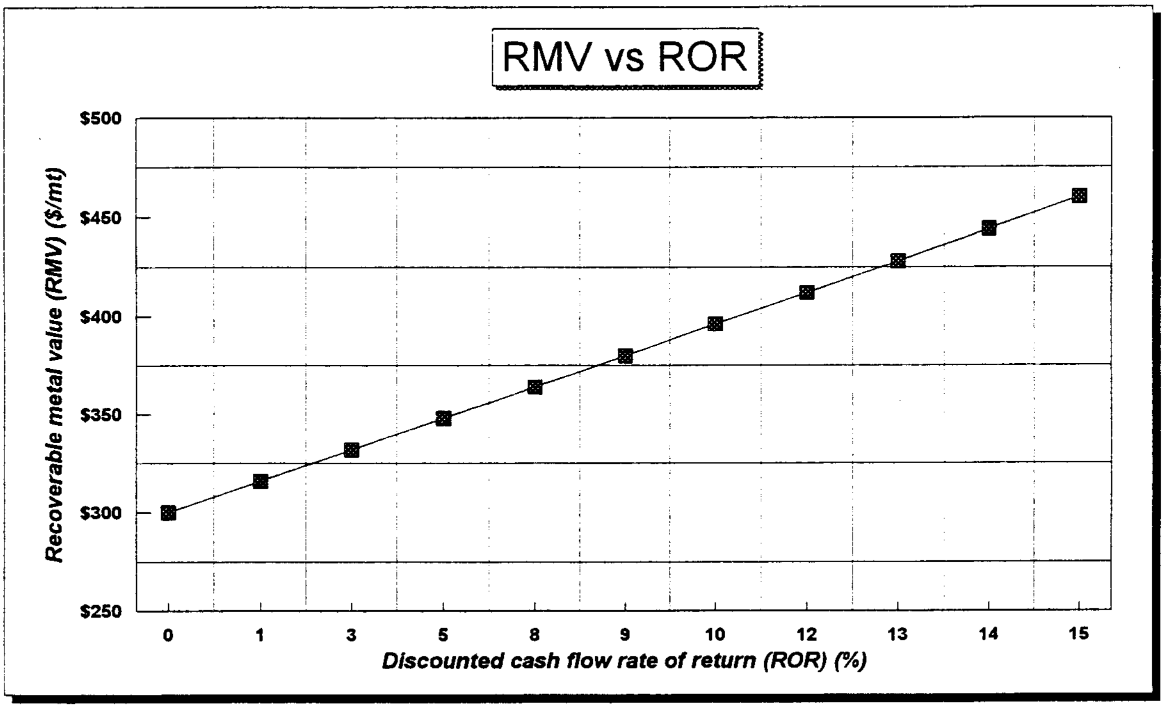
Recoverable metal value	ROR
370	0
388	2
406	5
424	7
442	8
460	10
478	11
496	12
514	13
532	14
550	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - overhand stope.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 275
Deposit size (mt) - 515,910
Mine life (years) - 5.36
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$940,500	$940,500	-4	-4
Exploration	$1,747,900	$349,580	-5	-1
Infrastructure	$20,714,925	$6,904,975	-3	-1
Mine	$13,206,600	$4,402,200	-3	-1
Mill	$16,962,235	$5,654,078	-3	-1
Working capital	$3,023,427	$3,023,427	0	0
TOTAL PREPRODUCTION	***$56,595,587***			
Mine op cost ($/mt)	$147.75	$14,424,289	0	5.36
Mill op cost ($/mt)	$35.49	$3,464,321	0	5.36
TOTAL PRODUCTION	***$183.24***	***$17,888,610***		

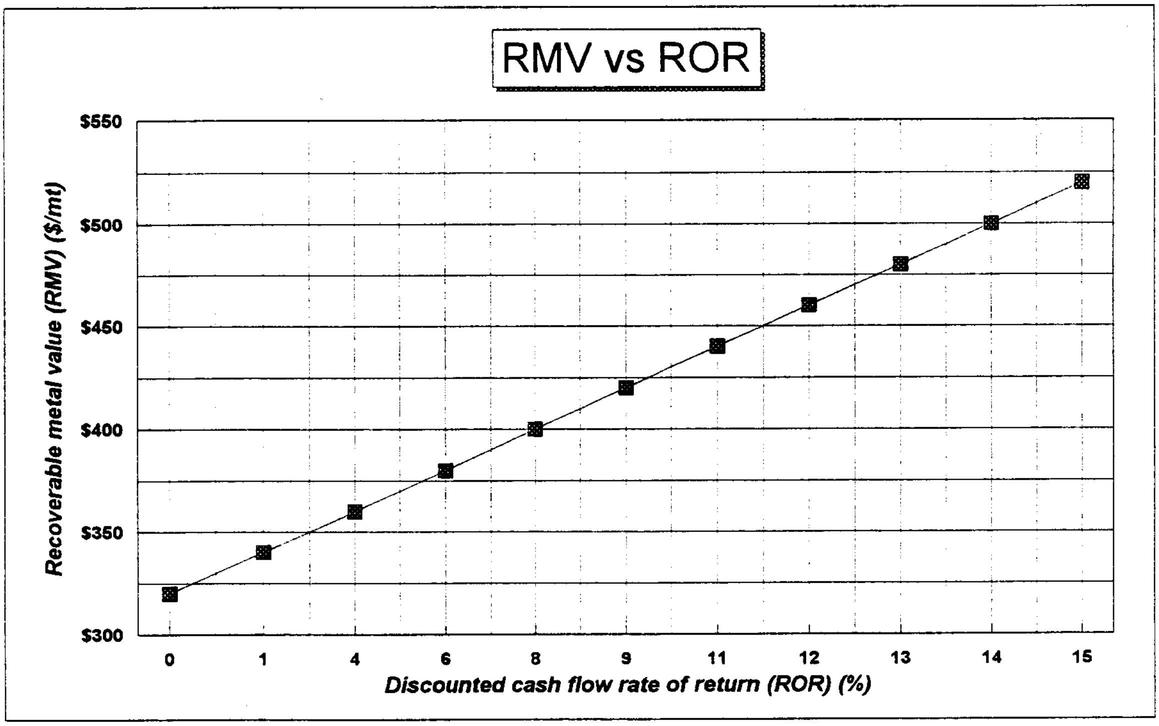
Recoverable metal value	ROR
300	0
316	1
332	3
348	5
364	8
380	9
396	10
412	12
428	13
444	14
460	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - overhand stope.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 275
Deposit size (mt) - 515,910
Mine life (years) - 5.36
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$940,500	$940,500	-4	-4
Exploration	$1,747,900	$349,580	-5	-1
Infrastructure	$20,714,925	$6,904,975	-3	-1
Mine	$11,231,000	$3,743,667	-3	-1
Mill	$30,019,336	$10,006,445	-3	-1
Working capital	$2,976,028	$2,976,028	0	0
TOTAL PREPRODUCTION	***$67,629,689***			
Mine op cost ($/mt)	$136.83	$13,357,931	0	5.36
Mill op cost ($/mt)	$43.54	$4,250,232	0	5.36
TOTAL PRODUCTION	***$180.37***	***$17,608,163***		

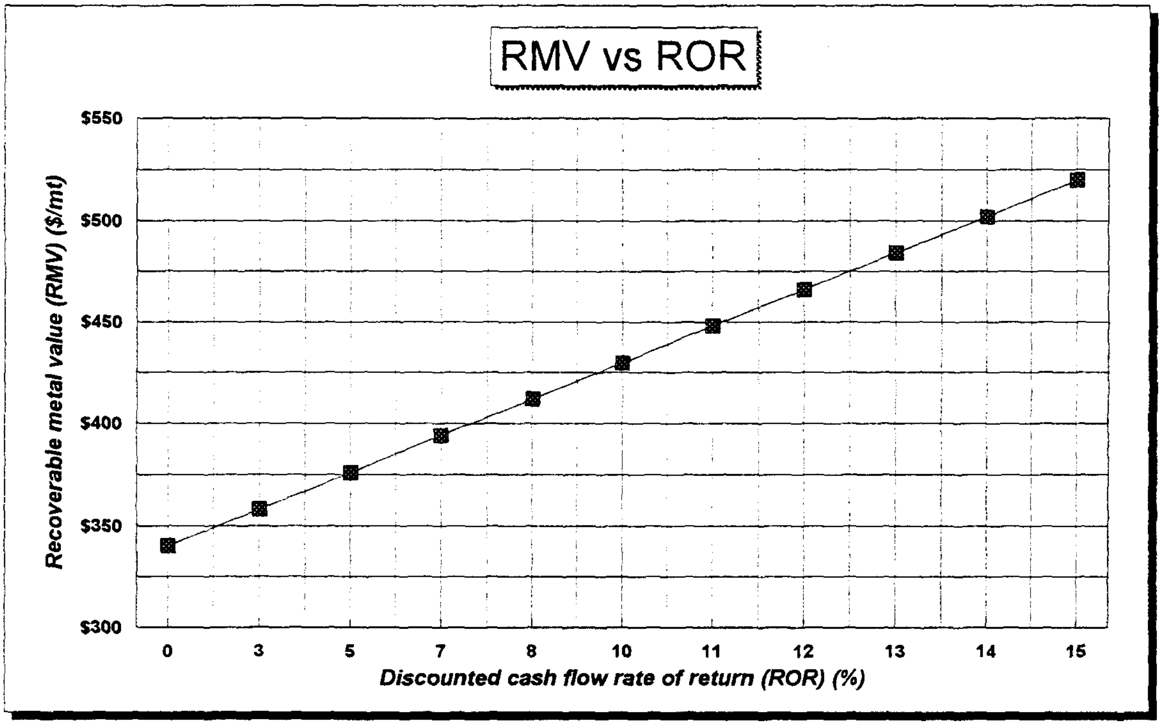
Recoverable metal value	ROR
320	0
340	1
360	4
380	6
400	8
420	9
440	11
460	12
480	13
500	14
520	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - overhand stope.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 275
Deposit size (mt) - 515,910
Mine life (years) - 5.36
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$940,500	$940,500	-4	-4
Exploration	$1,747,900	$349,580	-5	-1
Infrastructure	$20,714,925	$6,904,975	-3	-1
Mine	$13,206,600	$4,402,200	-3	-1
Mill	$30,019,336	$10,006,445	-3	-1
Working capital	$3,023,427	$3,023,427	0	0
TOTAL PREPRODUCTION	***$69,652,688***			
Mine op cost ($/mt)	$147.75	$14,424,289	0	5.36
Mill op cost ($/mt)	$35.49	$3,464,321	0	5.36
TOTAL PRODUCTION	***$183.24***	***$17,888,610***		

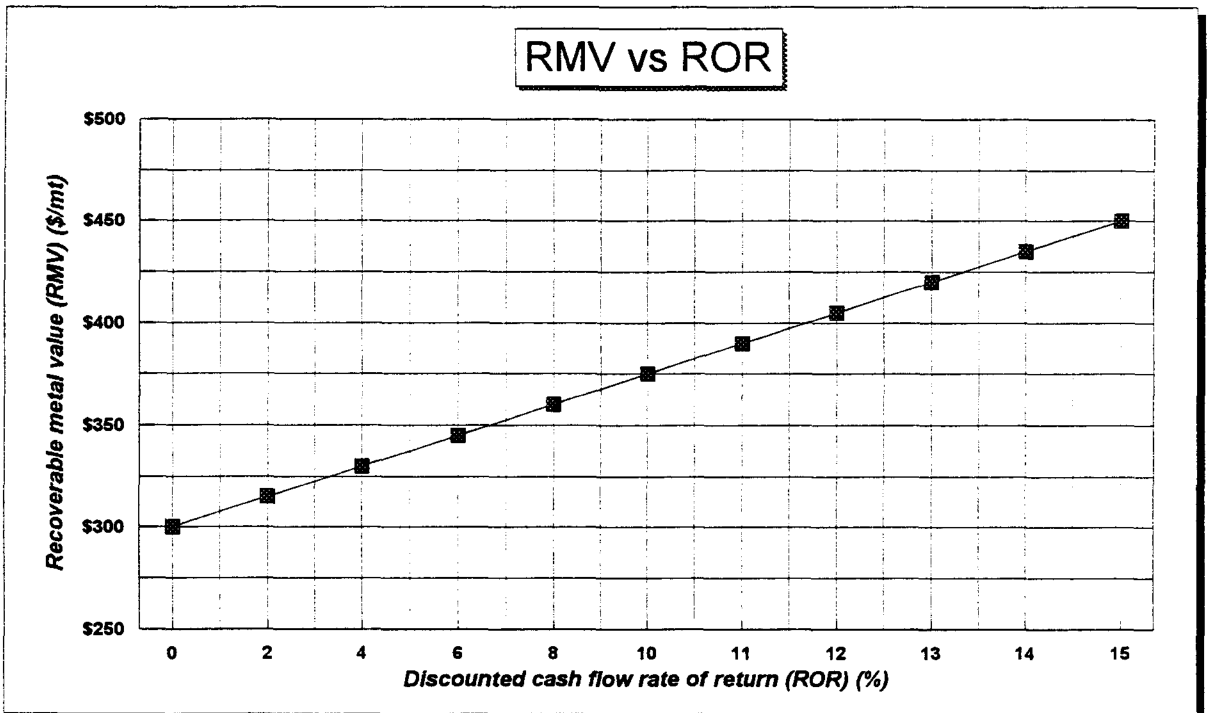
Recoverable metal value	ROR
340	0
358	3
376	5
394	7
412	8
430	10
448	11
466	12
484	13
502	14
520	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - overhand stope.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 275
Deposit size (mt) - 515,910
Mine life (years) - 5.36
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$940,500	$940,500	-4	-4
Exploration	$1,747,900	$349,580	-5	-1
Infrastructure	$20,714,925	$6,904,975	-3	-1
Mine	$11,231,000	$3,743,667	-3	-1
Mill	$16,962,235	$5,654,078	-3	-1
Working capital	$2,976,028	$2,976,028	0	0
TOTAL PREPRODUCTION	***$54,572,587***			
Mine op cost ($/mt)	$136.83	$13,357,931	0	5.36
Mill op cost ($/mt)	$43.54	$4,250,232	0	5.36
TOTAL PRODUCTION	***$180.37***	***$17,608,163***		

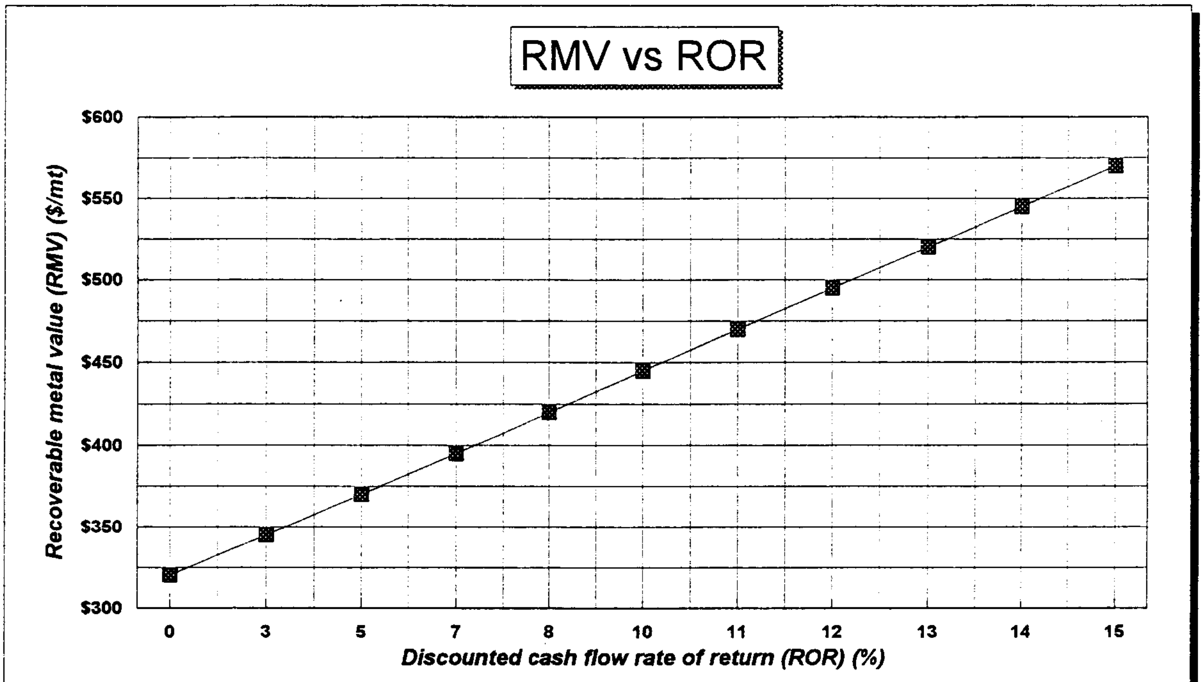
Recoverable metal value	ROR
300	0
315	2
330	4
345	6
360	8
375	10
390	11
405	12
420	13
435	14
450	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - cut-and-fill.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 356
Deposit size (mt) - 727,887
Mine life (years) - 5.84
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,050,500	$1,050,500	-5	-5
Exploration	$2,054,800	$342,467	-6	-1
Infrastructure	$24,242,295	$6,060,574	-4	-1
Mine	$49,339,400	$12,334,850	-4	-1
Mill	$19,983,350	$4,995,838	-4	-1
Working capital	$3,153,868	$3,153,868	0	0
TOTAL PREPRODUCTION	***$99,824,214***			
Mine op cost ($/mt)	$117.40	$14,837,391	0	5.84
Mill op cost ($/mt)	$30.25	$3,822,995	0	5.84
TOTAL PRODUCTION	***$147.65***	***$18,660,386***		

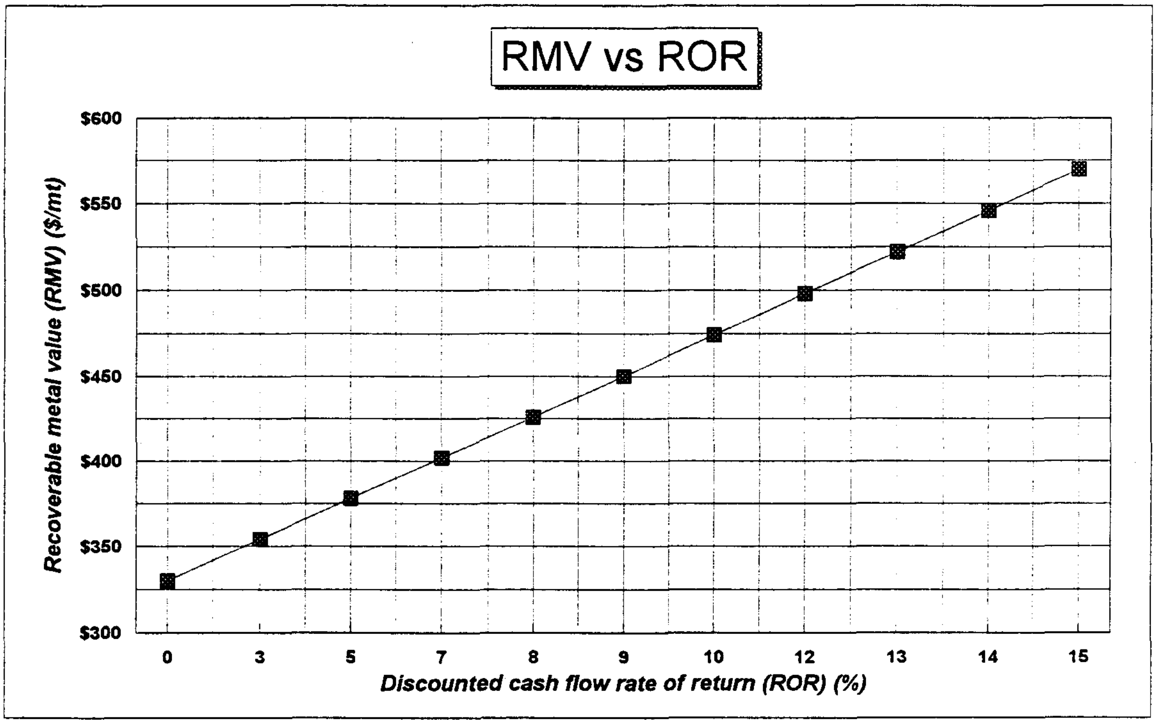
Recoverable metal value	ROR
320	0
345	3
370	5
395	7
420	8
445	10
470	11
495	12
520	13
545	14
570	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - cut-and-fill.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 356
Deposit size (mt) - 727,887
Mine life (years) - 5.84
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,050,500	$1,050,500	-5	-5
Exploration	$2,054,800	$342,467	-6	-1
Infrastructure	$24,242,295	$6,060,574	-4	-1
Mine	$37,107,400	$9,276,850	-4	-1
Mill	$34,671,537	$8,667,884	-4	-1
Working capital	$3,244,625	$3,244,625	0	0
TOTAL PREPRODUCTION	***$102,371,157***			
Mine op cost ($/mt)	$114.69	$14,494,017	0	5.84
Mill op cost ($/mt)	$37.22	$4,703,348	0	5.84
TOTAL PRODUCTION	***$151.90***	***$19,197,365***		

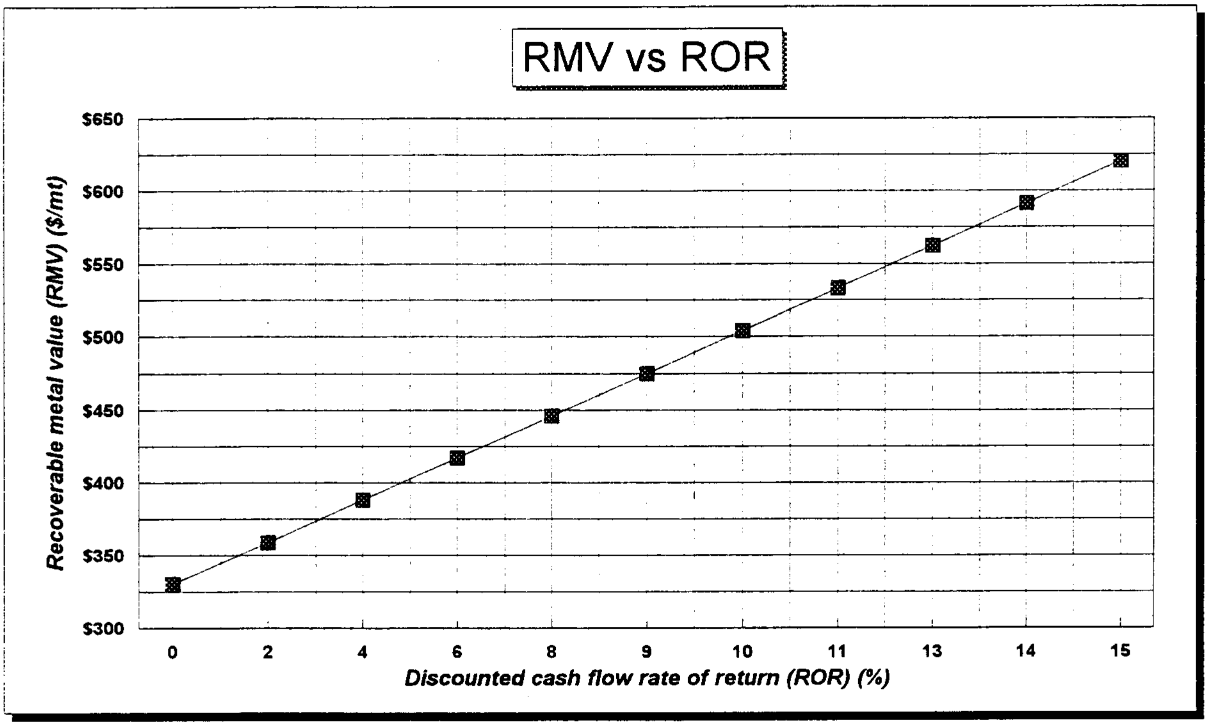
Recoverable metal value	ROR
330	0
354	3
378	5
402	7
426	8
450	9
474	10
498	12
522	13
546	14
570	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - cut-and-fill.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 356
Deposit size (mt) - 727,887
Mine life (years) - 5.84
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,050,500	$1,050,500	-5	-5
Exploration	$2,054,800	$342,467	-6	-1
Infrastructure	$24,242,295	$6,060,574	-4	-1
Mine	$49,339,400	$12,334,850	-4	-1
Mill	$34,671,537	$8,667,884	-4	-1
Working capital	$3,153,868	$3,153,868	0	0
TOTAL PREPRODUCTION	***$114,512,400***			
Mine op cost ($/mt)	$117.40	$14,837,391	0	5.84
Mill op cost ($/mt)	$30.25	$3,822,995	0	5.84
TOTAL PRODUCTION	***$147.65***	***$18,660,386***		

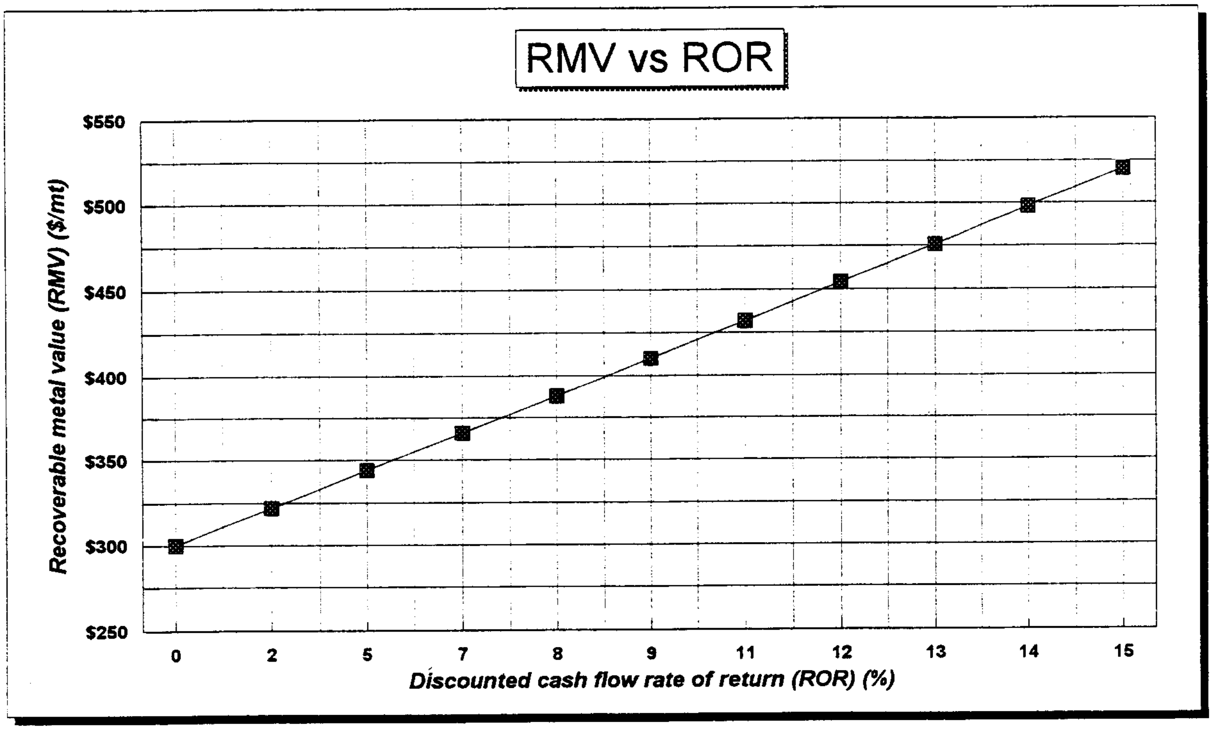
Recoverable metal value	ROR
330	0
359	2
388	4
417	6
446	8
475	9
504	10
533	11
562	13
591	14
620	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - cut-and-fill.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 356
Deposit size (mt) - 727,887
Mine life (years) - 5.84
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,050,500	$1,050,500	-5	-5
Exploration	$2,054,800	$342,467	-6	-1
Infrastructure	$24,242,295	$6,060,574	-4	-1
Mine	$37,107,400	$9,276,850	-4	-1
Mill	$19,983,350	$4,995,838	-4	-1
Working capital	$3,244,625	$3,244,625	0	0
TOTAL PREPRODUCTION	***$87,682,971***			
Mine op cost ($/mt)	$114.69	$14,494,017	0	5.84
Mill op cost ($/mt)	$37.22	$4,703,348	0	5.84
TOTAL PRODUCTION	***$151.90***	***$19,197,365***		

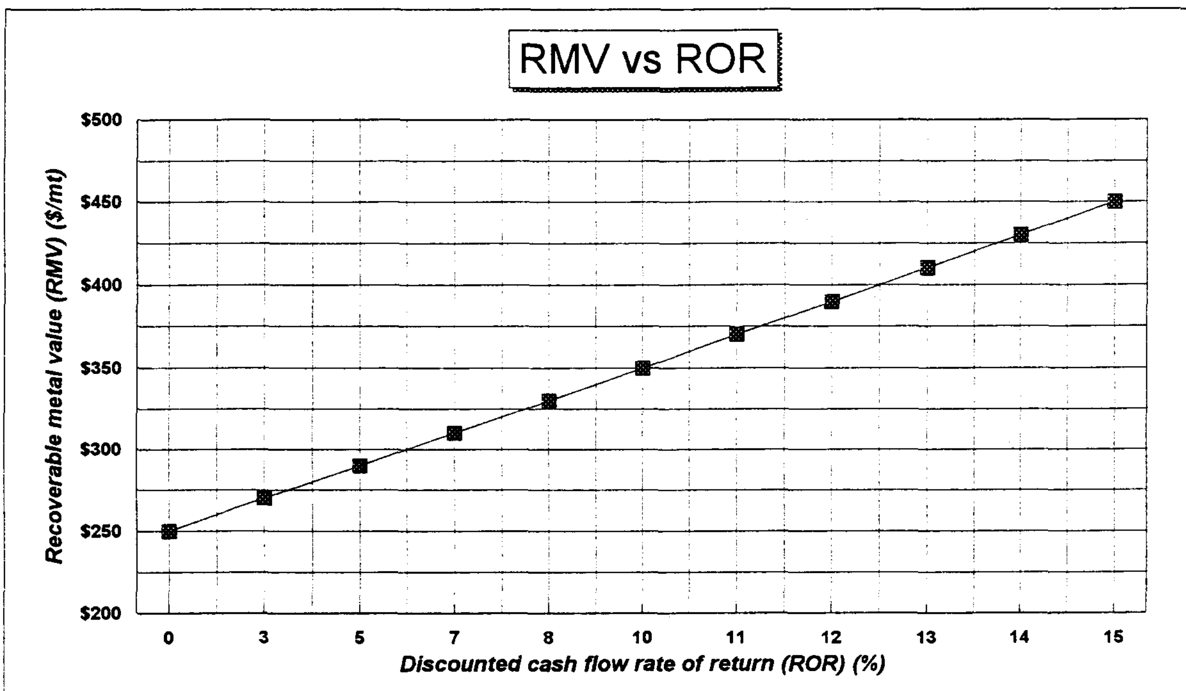
Recoverable metal value	ROR
300	0
322	2
344	5
366	7
388	8
410	9
432	11
454	12
476	13
498	14
520	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - cut-and-fill.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 500
Deposit size (mt) - 1,144,873
Mine life (years) - 6.54
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,217,700	$1,217,700	-5	-5
Exploration	$2,515,700	$419,283	-6	-1
Infrastructure	$28,879,620	$7,219,905	-4	-1
Mine	$55,116,600	$13,779,150	-4	-1
Mill	$24,832,885	$6,208,221	-4	-1
Working capital	$3,957,690	$3,957,690	0	0
TOTAL PREPRODUCTION	***$116,520,195***			
Mine op cost ($/mt)	$106.35	$18,876,770	0	6.54
Mill op cost ($/mt)	$25.58	$4,539,563	0	6.54
TOTAL PRODUCTION	***$131.92***	***$23,416,333***		

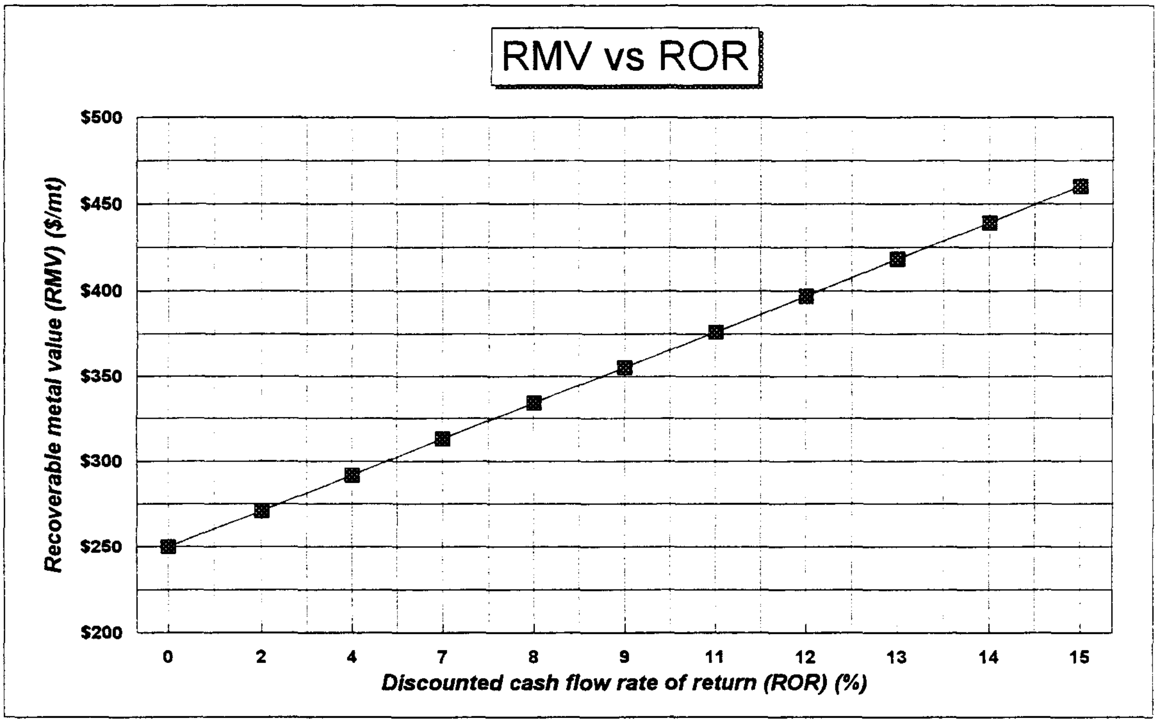
Recoverable metal value	ROR
250	0
270	3
290	5
310	7
330	8
350	10
370	11
390	12
410	13
430	14
450	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - cut-and-fill.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 500
Deposit size (mt) - 1,144,873
Mine life (years) - 6.54
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,217,700	$1,217,700	-5	-5
Exploration	$2,515,700	$419,283	-6	-1
Infrastructure	$28,879,620	$7,219,905	-4	-1
Mine	$42,693,200	$10,673,300	-4	-1
Mill	$42,237,429	$10,559,357	-4	-1
Working capital	$4,022,829	$4,022,829	0	0
TOTAL PREPRODUCTION	***$121,566,479***			
Mine op cost ($/mt)	$103.61	$18,390,598	0	6.54
Mill op cost ($/mt)	$30.49	$5,411,143	0	6.54
TOTAL PRODUCTION	***$134.09***	***$23,801,741***		

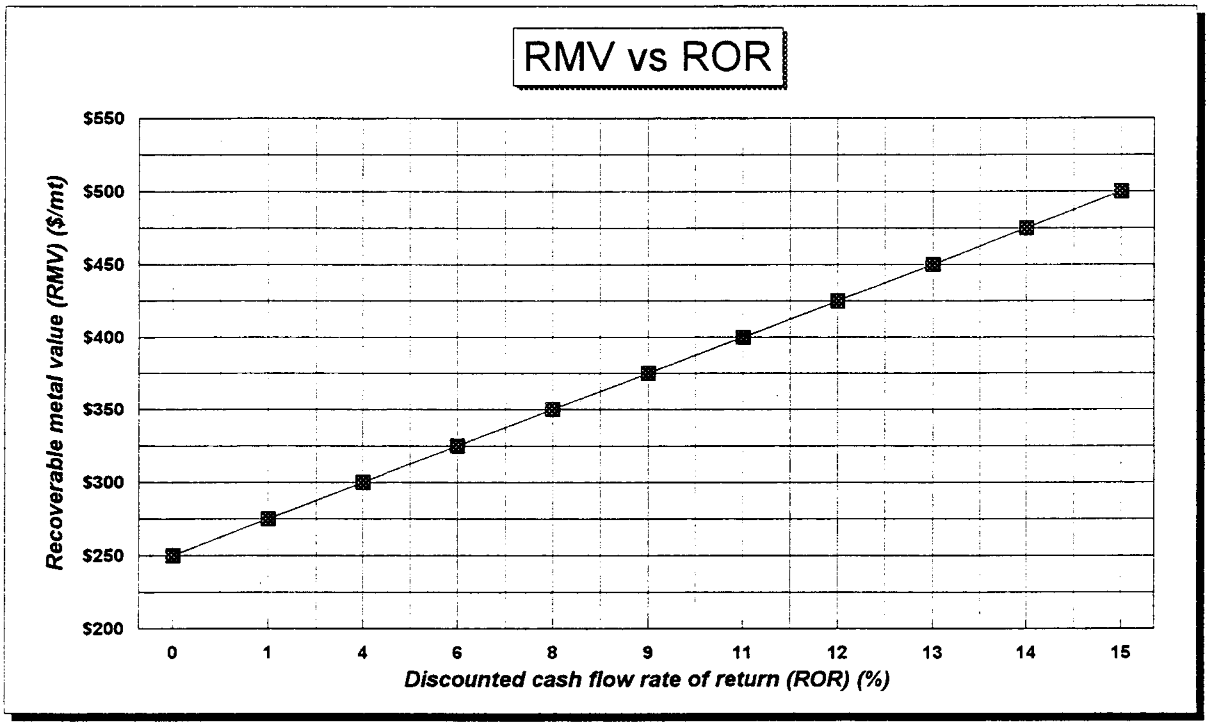
Recoverable metal value	ROR
250	0
271	2
292	4
313	7
334	8
355	9
376	11
397	12
418	13
439	14
460	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - cut-and-fill.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 500
Deposit size (mt) - 1,144,873
Mine life (years) - 6.54
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,217,700	$1,217,700	-5	-5
Exploration	$2,515,700	$419,283	-6	-1
Infrastructure	$28,879,620	$7,219,905	-4	-1
Mine	$55,116,600	$13,779,150	-4	-1
Mill	$42,237,429	$10,559,357	-4	-1
Working capital	$3,957,690	$3,957,690	0	0
TOTAL PREPRODUCTION	***$133,924,739***			
Mine op cost ($/mt)	$106.35	$18,876,770	0	6.54
Mill op cost ($/mt)	$25.58	$4,539,563	0	6.54
TOTAL PRODUCTION	***$131.92***	***$23,416,333***		

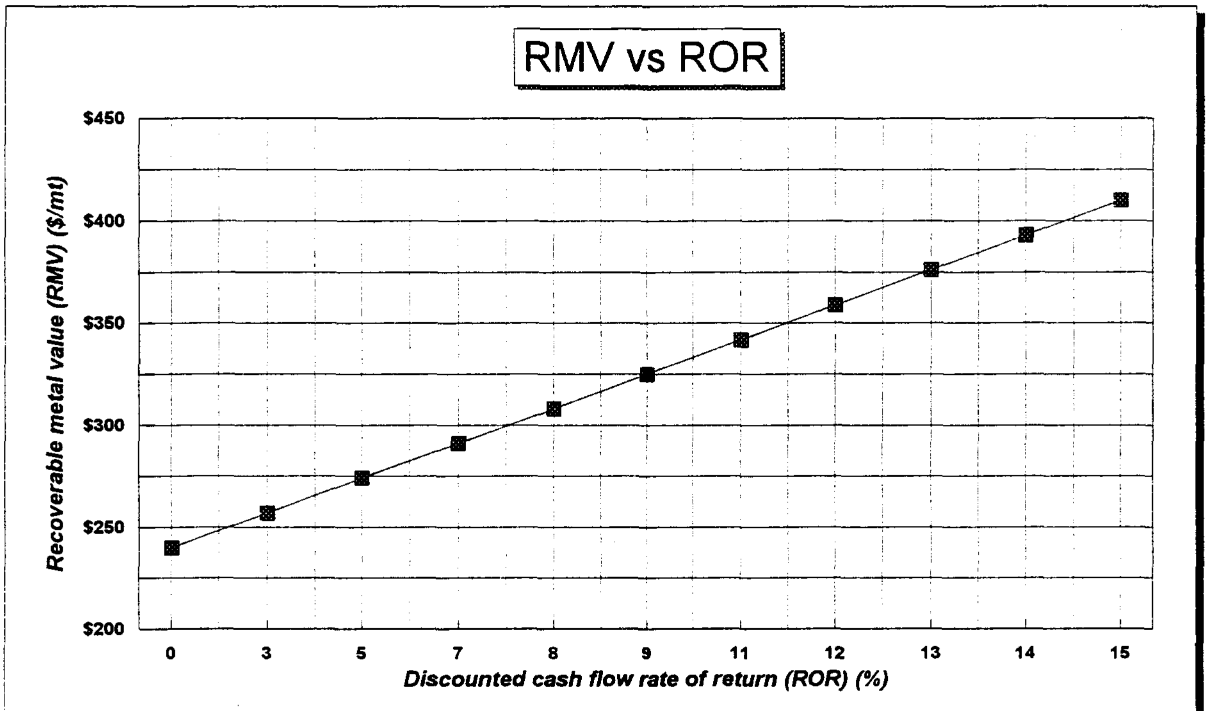
Recoverable metal value	ROR
250	0
275	1
300	4
325	6
350	8
375	9
400	11
425	12
450	13
475	14
500	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - cut-and-fill.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 500
Deposit size (mt) - 1,144,873
Mine life (years) - 6.54
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,217,700	$1,217,700	-5	-5
Exploration	$2,515,700	$419,283	-6	-1
Infrastructure	$28,879,620	$7,219,905	-4	-1
Mine	$42,693,200	$10,673,300	-4	-1
Mill	$24,832,885	$6,208,221	-4	-1
Working capital	$4,022,829	$4,022,829	0	0
TOTAL PREPRODUCTION	***$104,161,934***			
Mine op cost ($/mt)	$103.61	$18,390,598	0	6.54
Mill op cost ($/mt)	$30.49	$5,411,143	0	6.54
TOTAL PRODUCTION	***$134.09***	***$23,801,741***		

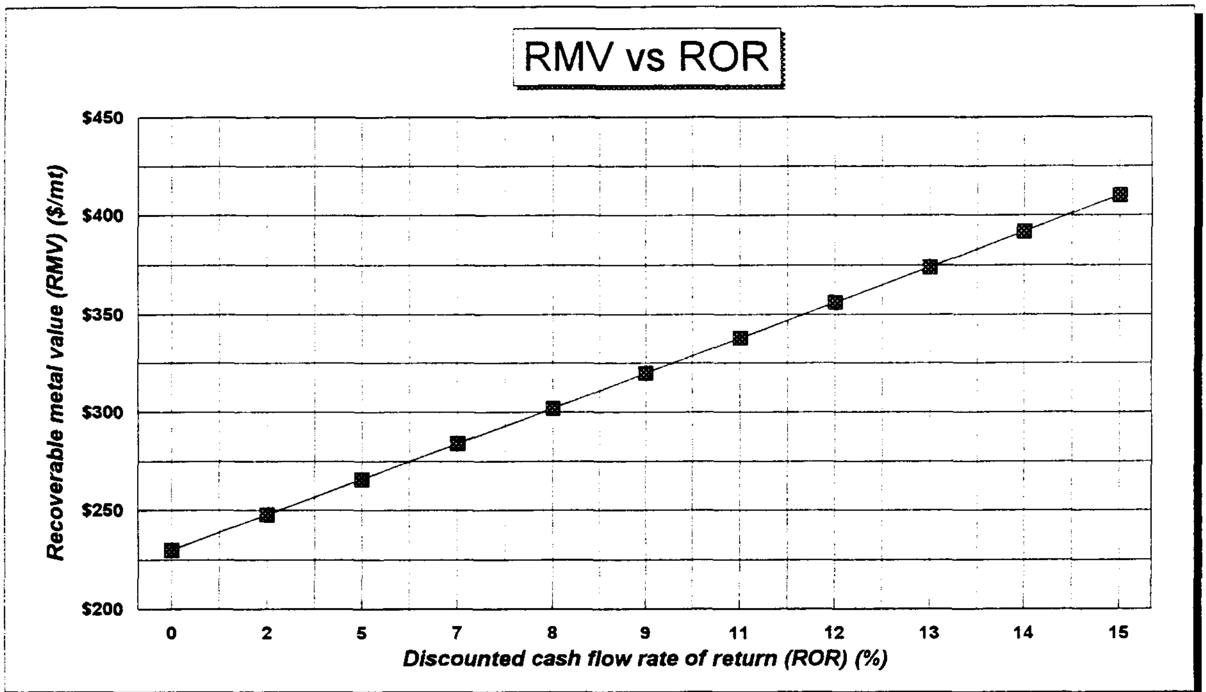
Recoverable metal value	ROR
240	0
257	3
274	5
291	7
308	8
325	9
342	11
359	12
376	13
393	14
410	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - cut-and-fill.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 615
Deposit size (mt) - 1,508,797
Mine life (years) - 7.01
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,358,500	$1,358,500	-5	-5
Exploration	$2,908,400	$484,733	-6	-1
Infrastructure	$32,408,145	$8,102,036	-4	-1
Mine	$59,398,900	$14,849,725	-4	-1
Mill	$28,773,017	$7,193,254	-4	-1
Working capital	$4,531,062	$4,531,062	0	0
TOTAL PREPRODUCTION	***$129,378,024***			
Mine op cost ($/mt)	$99.77	$21,782,285	0	7.01
Mill op cost ($/mt)	$23.02	$5,026,496	0	7.01
TOTAL PRODUCTION	***$122.79***	***$26,808,782***		

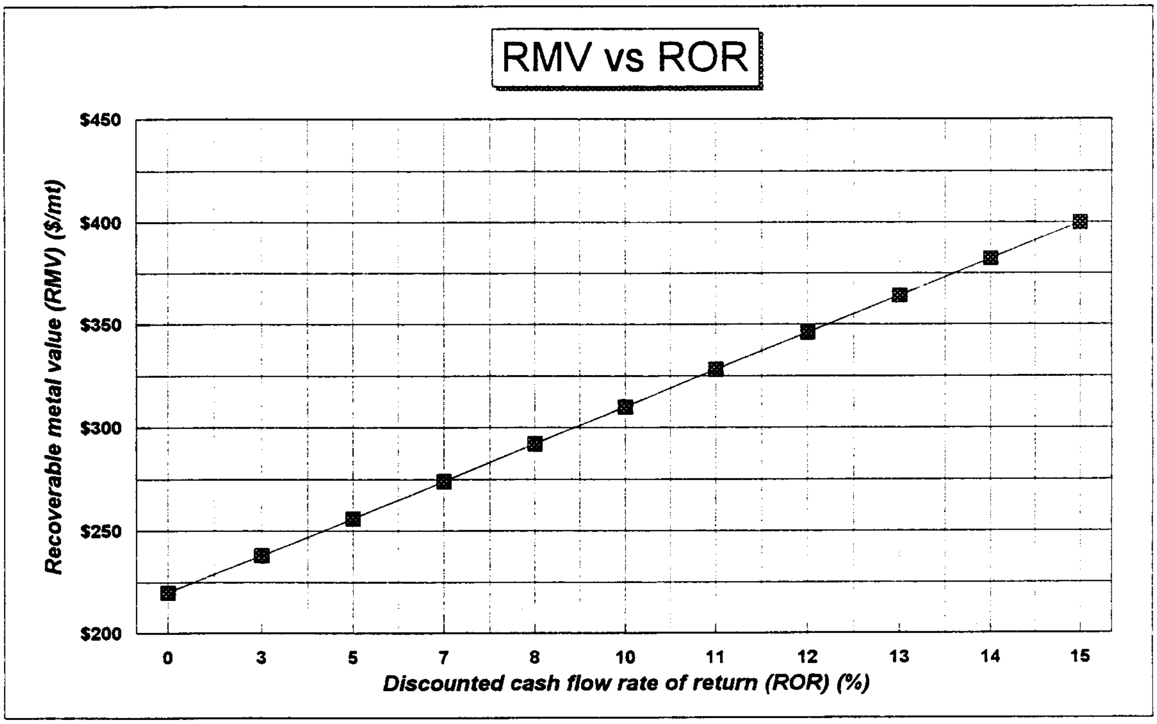
Recoverable metal value	ROR
230	0
248	2
266	5
284	7
302	8
320	9
338	11
356	12
374	13
392	14
410	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - cut-and-fill.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 615
Deposit size (mt) - 1,508,797
Mine life (years) - 7.01
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,358,500	$1,358,500	-5	-5
Exploration	$2,908,400	$484,733	-6	-1
Infrastructure	$32,408,145	$8,102,036	-4	-1
Mine	$46,831,400	$11,707,850	-4	-1
Mill	$47,839,613	$11,959,903	-4	-1
Working capital	$4,578,600	$4,578,600	0	0
TOTAL PREPRODUCTION	***$135,924,659***			
Mine op cost ($/mt)	$97.00	$21,177,088	0	7.01
Mill op cost ($/mt)	$27.08	$5,912,963	0	7.01
TOTAL PRODUCTION	***$124.08***	***$27,090,051***		

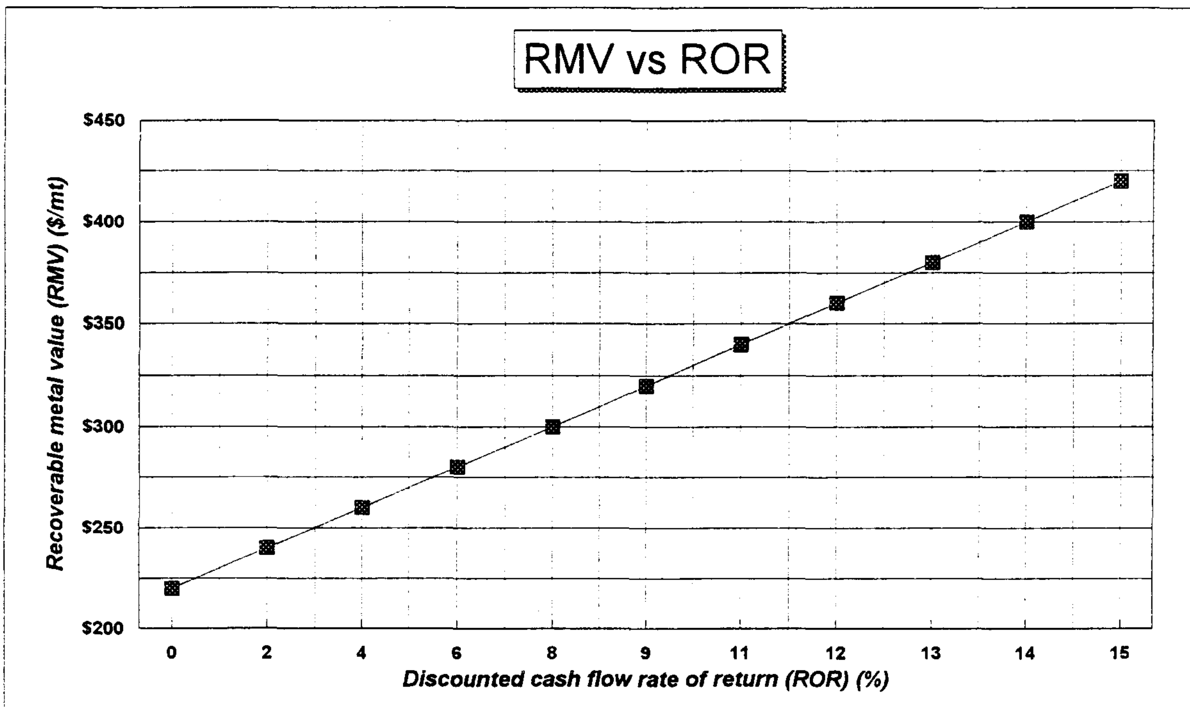
Recoverable metal value	ROR
220	0
238	3
256	5
274	7
292	8
310	10
328	11
346	12
364	13
382	14
400	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - cut-and-fill.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 615
Deposit size (mt) - 1,508,797
Mine life (years) - 7.01
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,358,500	$1,358,500	-5	-5
Exploration	$2,908,400	$484,733	-6	-1
Infrastructure	$32,408,145	$8,102,036	-4	-1
Mine	$59,398,900	$14,849,725	-4	-1
Mill	$47,839,613	$11,959,903	-4	-1
Working capital	$4,531,062	$4,531,062	0	0
TOTAL PREPRODUCTION	***$148,444,620***			
Mine op cost ($/mt)	$99.77	$21,782,285	0	7.01
Mill op cost ($/mt)	$23.02	$5,026,496	0	7.01
TOTAL PRODUCTION	***$122.79***	***$26,808,782***		

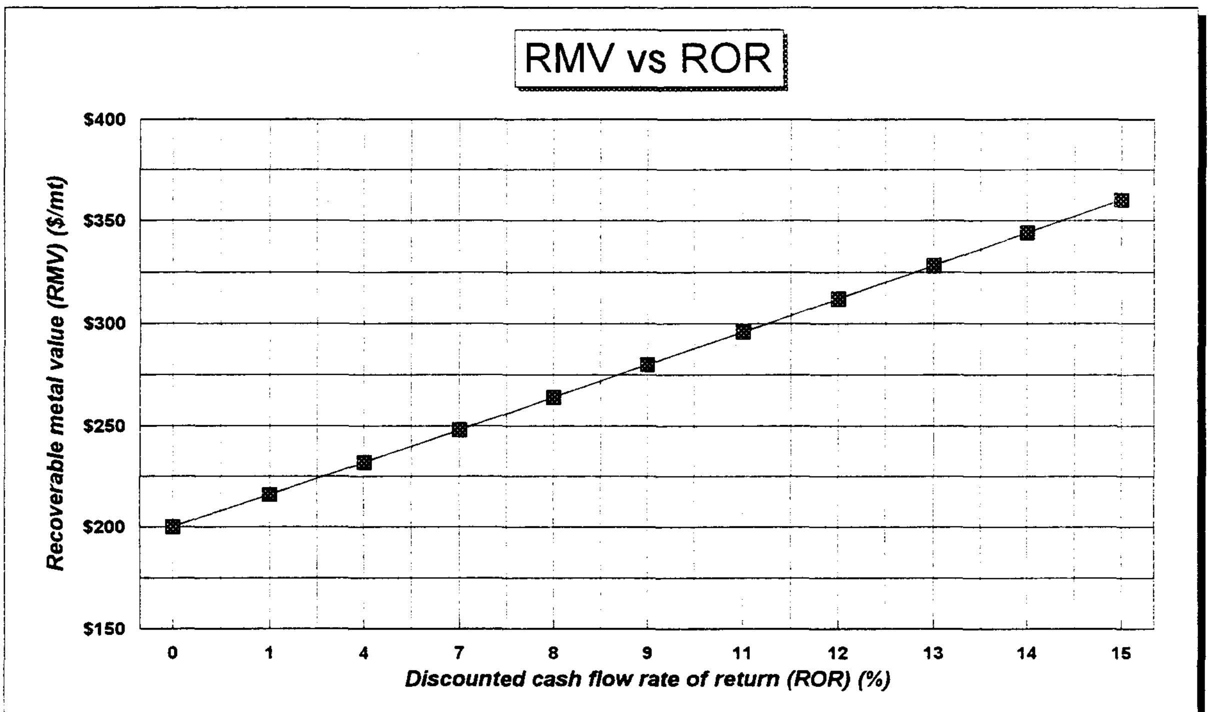
Recoverable metal value	ROR
220	0
240	2
260	4
280	6
300	8
320	9
340	11
360	12
380	13
400	14
420	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - cut-and-fill.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 615
Deposit size (mt) - 1,508,797
Mine life (years) - 7.01
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,358,500	$1,358,500	-5	-5
Exploration	$2,908,400	$484,733	-6	-1
Infrastructure	$32,408,145	$8,102,036	-4	-1
Mine	$46,831,400	$11,707,850	-4	-1
Mill	$28,773,017	$7,193,254	-4	-1
Working capital	$4,578,600	$4,578,600	0	0
TOTAL PREPRODUCTION	***$116,858,063***			
Mine op cost ($/mt)	$97.00	$21,177,088	0	7.01
Mill op cost ($/mt)	$27.08	$5,912,963	0	7.01
TOTAL PRODUCTION	***$124.08***	***$27,090,051***		

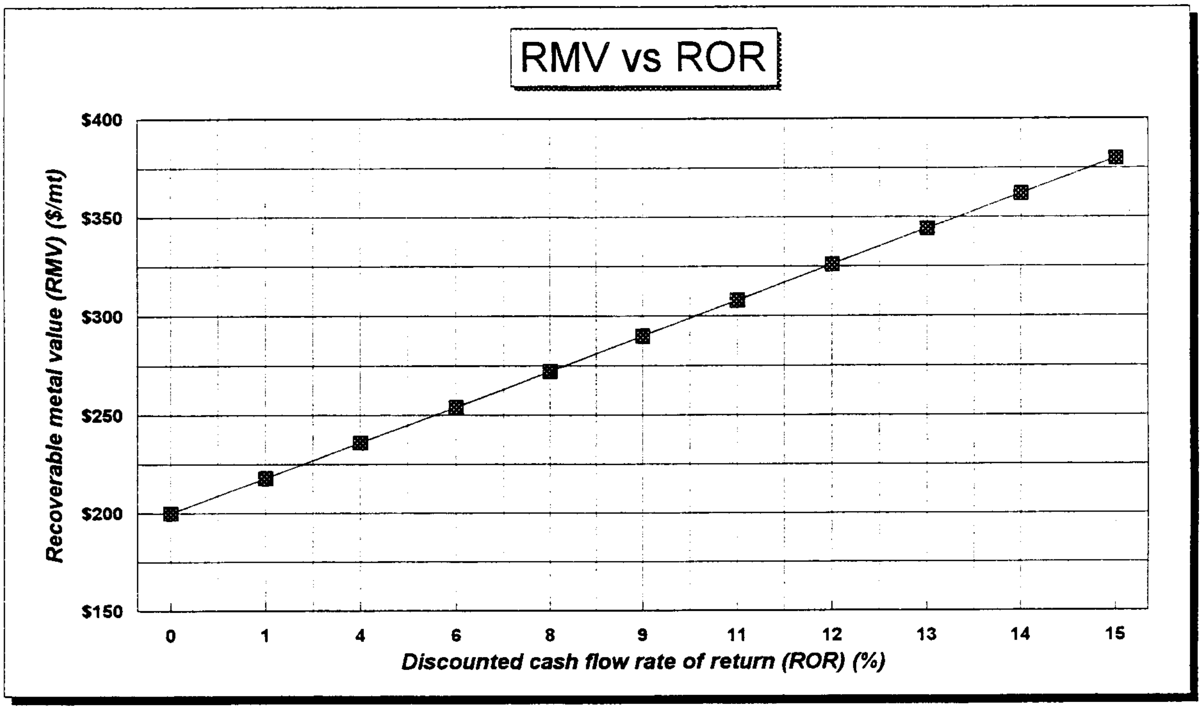
Recoverable metal value	ROR
200	0
216	1
232	4
248	7
264	8
280	9
296	11
312	12
328	13
344	14
360	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - cut-and-fill.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 760
Deposit size (mt) - 2,000,855
Mine life (years) - 7.52
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,537,800	$1,537,800	-5	-5
Exploration	$3,403,400	$567,233	-6	-1
Infrastructure	$36,465,660	$9,116,415	-4	-1
Mine	$64,220,200	$16,055,050	-4	-1
Mill	$33,732,763	$8,433,191	-4	-1
Working capital	$5,214,132	$5,214,132	0	0
TOTAL PREPRODUCTION	***$144,573,955***			
Mine op cost ($/mt)	$93.56	$25,241,139	0	7.52
Mill op cost ($/mt)	$20.79	$5,609,142	0	7.52
TOTAL PRODUCTION	***$114.35***	***$30,850,281***		

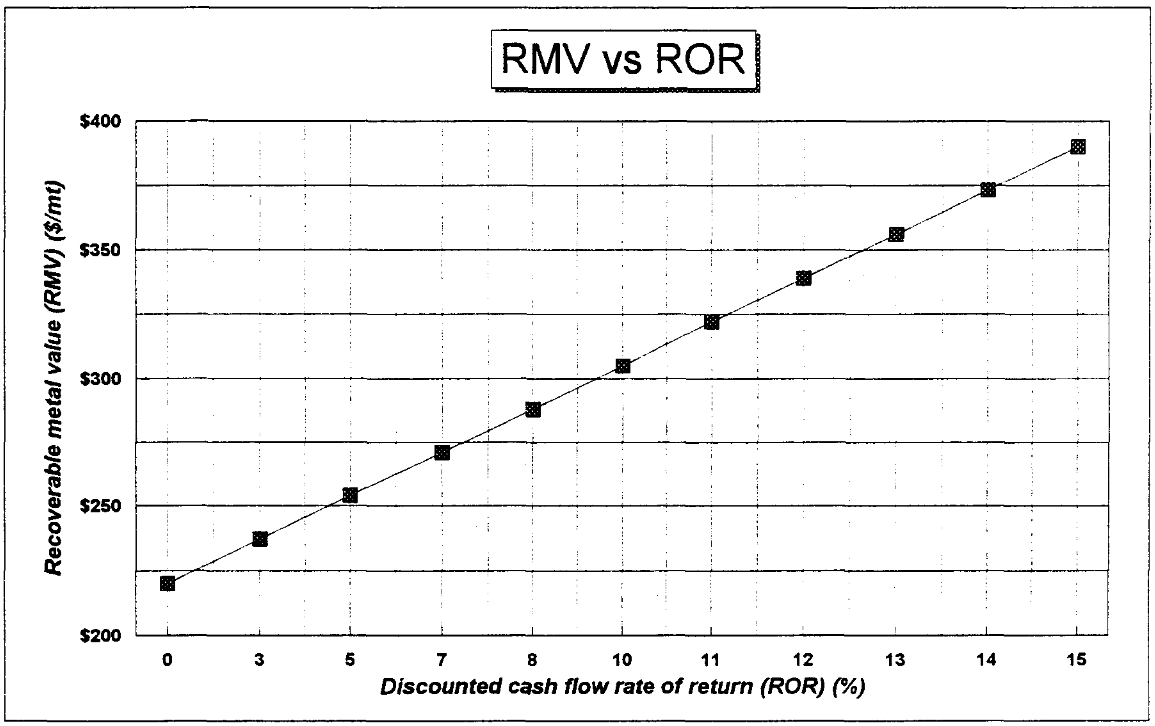
Recoverable metal value	ROR
200	0
218	1
236	4
254	6
272	8
290	9
308	11
326	12
344	13
362	14
380	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - cut-and-fill.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 760
Deposit size (mt) - 2,000,855
Mine life (years) - 7.52
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,537,800	$1,537,800	-5	-5
Exploration	$3,403,400	$567,233	-6	-1
Infrastructure	$36,465,660	$9,116,415	-4	-1
Mine	$51,489,900	$12,872,475	-4	-1
Mill	$54,514,744	$13,628,686	-4	-1
Working capital	$5.234,308	$5,234,308	0	0
TOTAL PREPRODUCTION	***$152,645,812***			
Mine op cost ($/mt)	$90.74	$24,481,382	0	7.52
Mill op cost ($/mt)	$24.05	$6,488,273	0	7.52
TOTAL PRODUCTION	***$114.79***	***$30,969,655***		

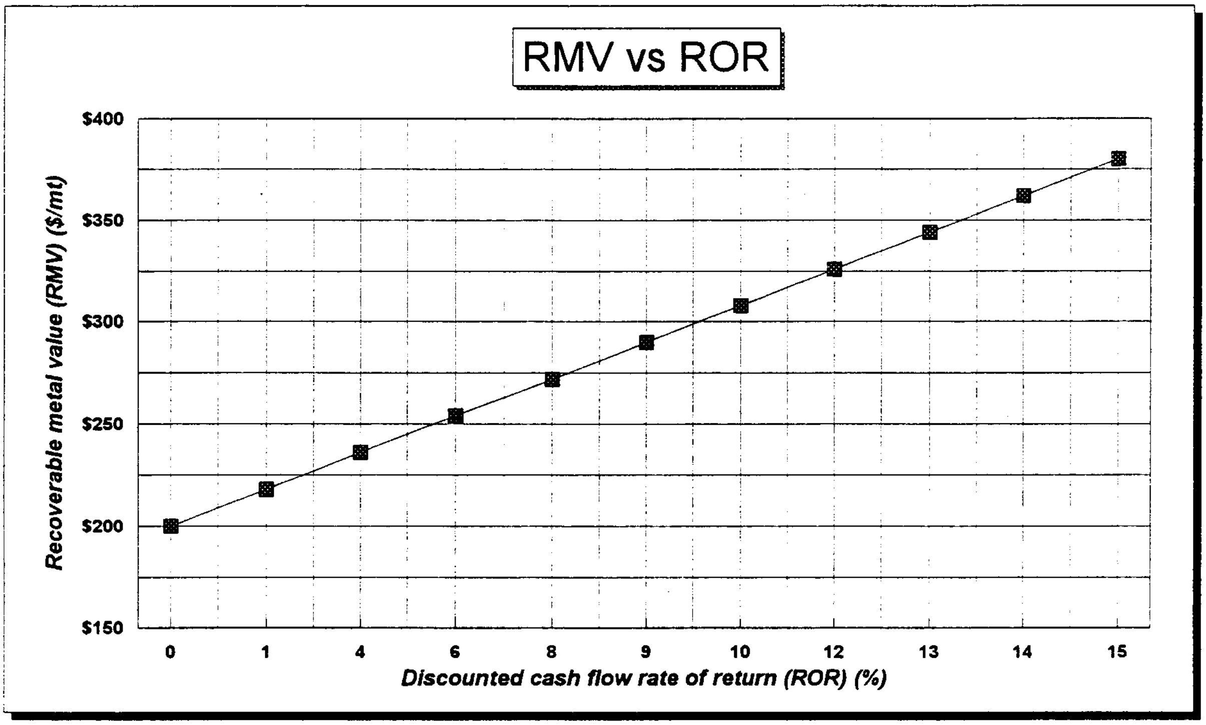
Recoverable metal value	ROR
220	0
237	3
254	5
271	7
288	8
305	10
322	11
339	12
356	13
373	14
390	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - cut-and-fill.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 760
Deposit size (mt) - 2,000,855
Mine life (years) - 7.52
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,537,800	$1,537,800	-5	-5
Exploration	$3,403,400	$567,233	-6	-1
Infrastructure	$36,465,660	$9,116,415	-4	-1
Mine	$64,220,200	$16,055,050	-4	-1
Mill	$54,514,744	$13,628,686	-4	-1
Working capital	$5,214,132	$5,214,132	0	0
TOTAL PREPRODUCTION	***$165,355,936***			
Mine op cost ($/mt)	$93.56	$25,241,139	0	7.52
Mill op cost ($/mt)	$20.79	$5,609,142	0	7.52
TOTAL PRODUCTION	***$114.35***	***$30,850,281***		

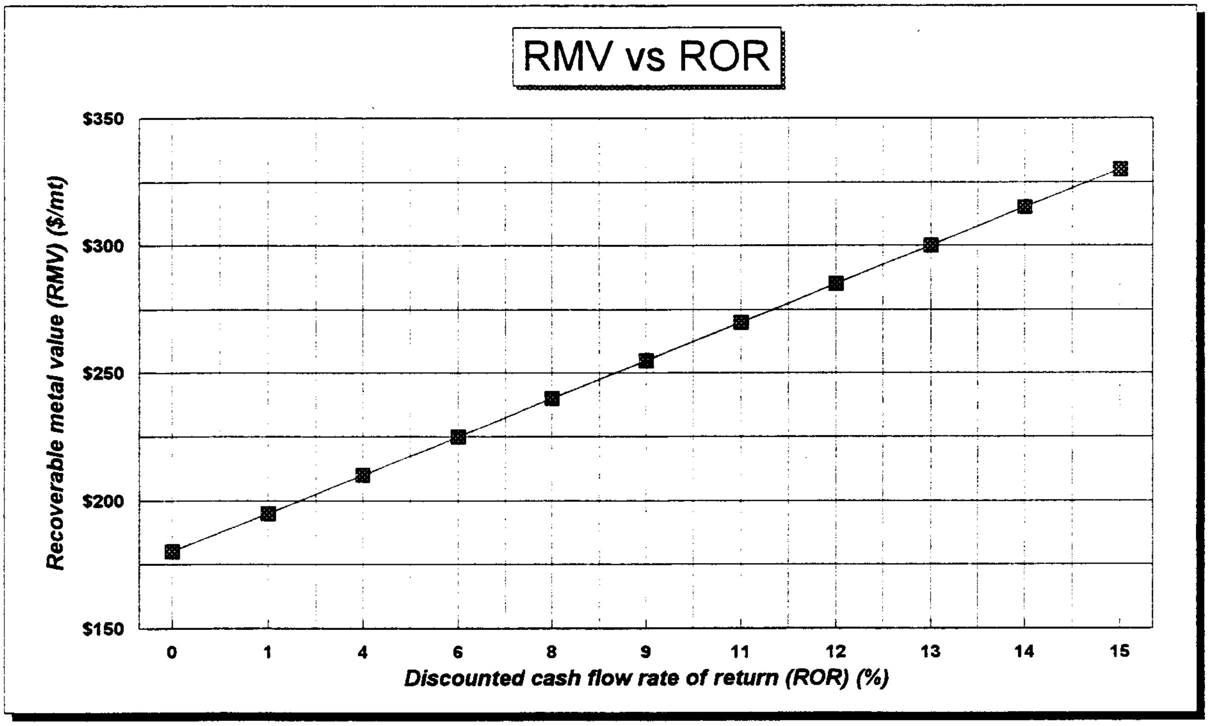
Recoverable metal value	ROR
200	0
218	1
236	4
254	6
272	8
290	9
308	10
326	12
344	13
362	14
380	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - cut-and-fill.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 760
Deposit size (mt) - 2,000,855
Mine life (years) - 7.52
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$1,537,800	$1,537,800	-5	-5
Exploration	$3,403,400	$567,233	-6	-1
Infrastructure	$36,465,660	$9,116,415	-4	-1
Mine	$51,489,900	$12,872,475	-4	-1
Mill	$33,732,763	$8,433,191	-4	-1
Working capital	$5,234,308	$5,234,308	0	0
TOTAL PREPRODUCTION	***$131,863,831***			
Mine op cost ($/mt)	$90.74	$24,481,382	0	7.52
Mill op cost ($/mt)	$24.05	$6,488,273	0	7.52
TOTAL PRODUCTION	***$114.79***	***$30,969,655***		

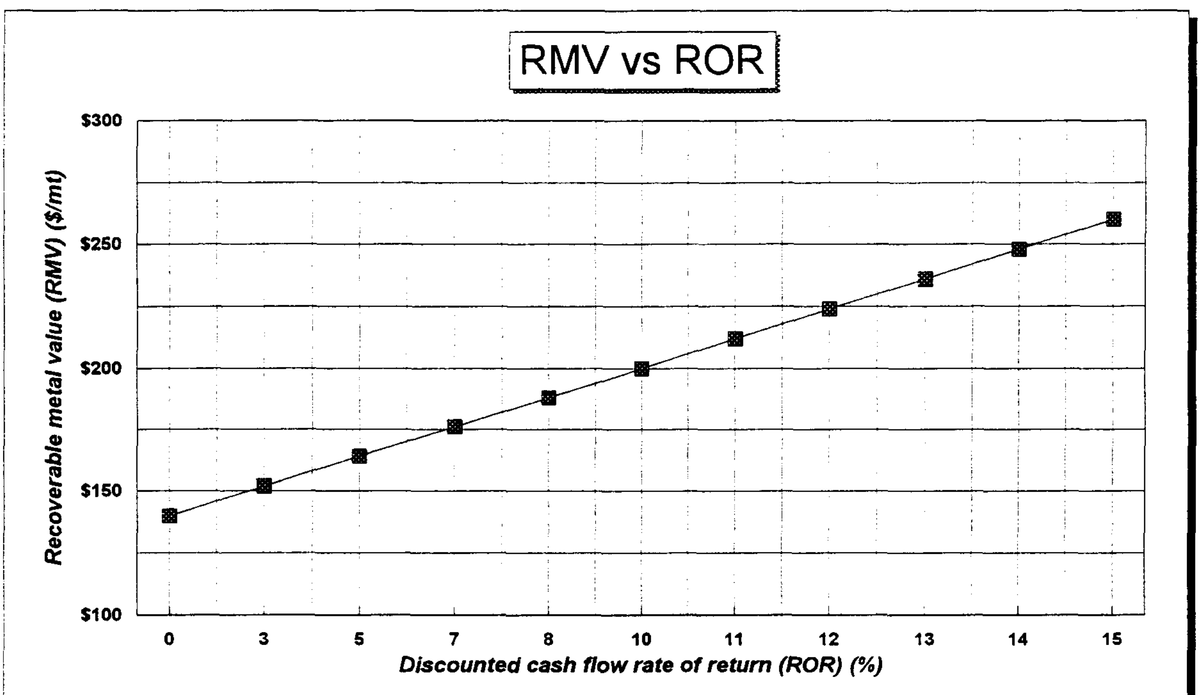
Recoverable metal value	ROR
180	0
195	1
210	4
225	6
240	8
255	9
270	11
285	12
300	13
315	14
330	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - cut-and-fill.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 1,515
Deposit size (mt) - 5,019,736
Mine life (years) - 9.47
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$2,467,300	$2,467,300	-6	-6
Exploration	$5,981,800	$854,543	-7	-1
Infrastructure	$53,595,465	$10,719,093	-5	-1
Mine	$83,655,000	$16,731,000	-5	-1
Mill	$60,143,870	$12,028,774	-5	-1
Working capital	$8,350,165	$8,350,165	0	0
TOTAL PREPRODUCTION	***$214,193,600***			
Mine op cost ($/mt)	$76.43	$41,104,889	0	9.47
Mill op cost ($/mt)	$15.43	$8,300,253	0	9.47
TOTAL PRODUCTION	***$91.86***	***$49,405,142***		

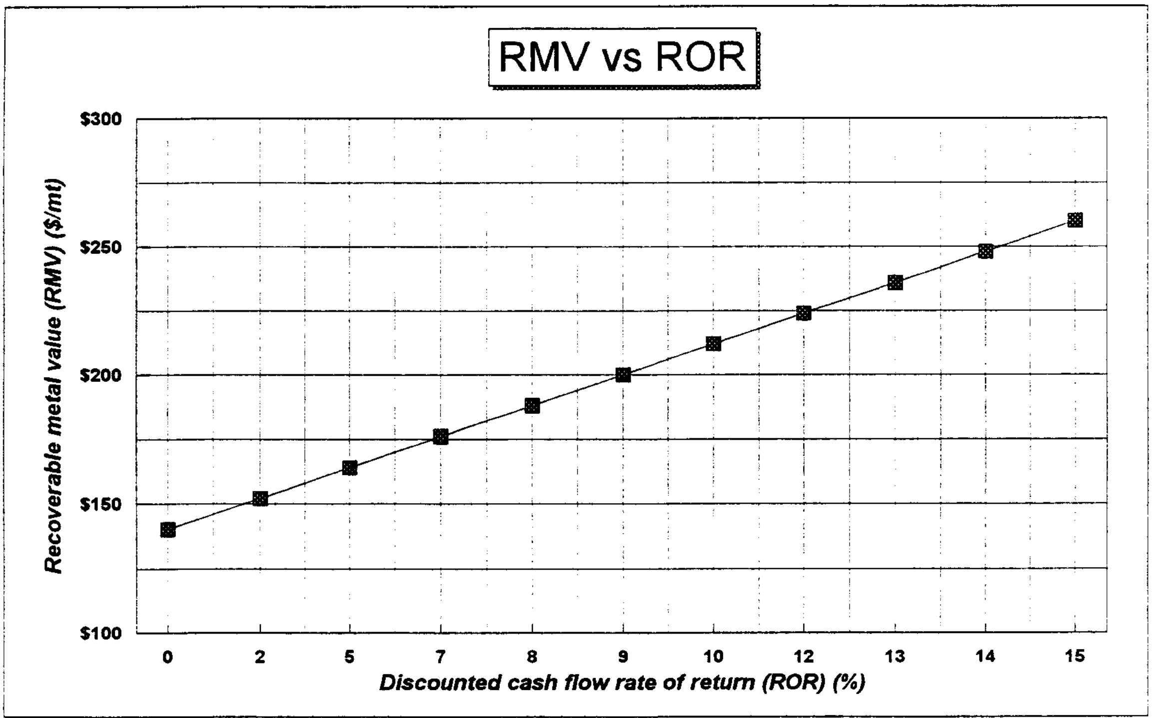
Recoverable metal value	ROR
140	0
152	3
164	5
176	7
188	8
200	10
212	11
224	12
236	13
248	14
260	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - cut-and-fill.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 1,515
Deposit size (mt) - 5,019,736
Mine life (years) - 9.47
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$2,467,300	$2,467,300	-6	-6
Exploration	$5,981,800	$854,543	-7	-1
Infrastructure	$53,595,465	$10,719,093	-5	-1
Mine	$70,254,800	$14,050,960	-5	-1
Mill	$85,300,462	$17,060,092	-5	-1
Working capital	$8,182,062	$8,182,062	0	0
TOTAL PREPRODUCTION	***$225,781,890***			
Mine op cost ($/mt)	$73.49	$39,525,297	0	9.47
Mill op cost ($/mt)	$16.52	$8,885,237	0	9.47
TOTAL PRODUCTION	***$90.01***	***$48,410,535***		

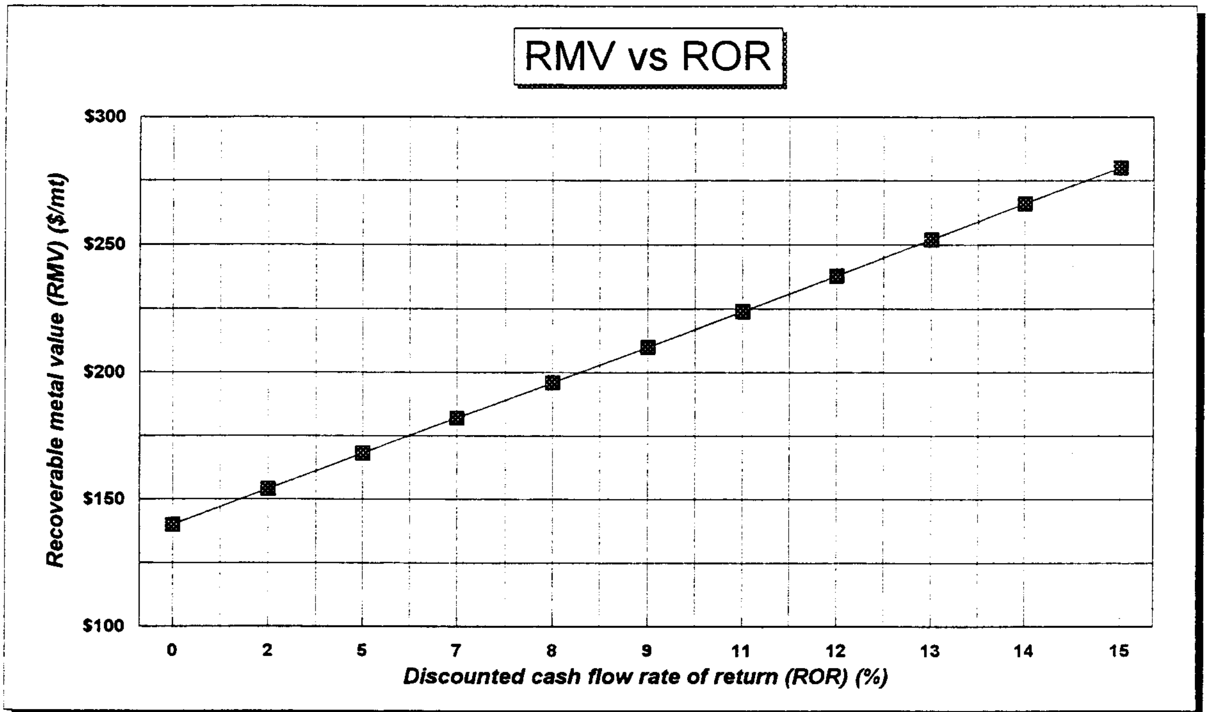
Recoverable metal value	ROR
140	0
152	2
164	5
176	7
188	8
200	9
212	10
224	12
236	13
248	14
260	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - cut-and-fill.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 1,515
Deposit size (mt) - 5,019,736
Mine life (years) - 9.47
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$2,467,300	$2,467,300	-6	-6
Exploration	$5,981,800	$854,543	-7	-1
Infrastructure	$53,595,465	$10,719,093	-5	-1
Mine	$83,655,000	$16,731,000	-5	-1
Mill	$85,300,462	$17,060,092	-5	-1
Working capital	$8,350,165	$8,350,165	0	0
TOTAL PREPRODUCTION	***$239,350,192***			
Mine op cost ($/mt)	$76.43	$41,104,889	0	9.47
Mill op cost ($/mt)	$15.43	$8,300,253	0	9.47
TOTAL PRODUCTION	***$91.86***	***$49,405,142***		

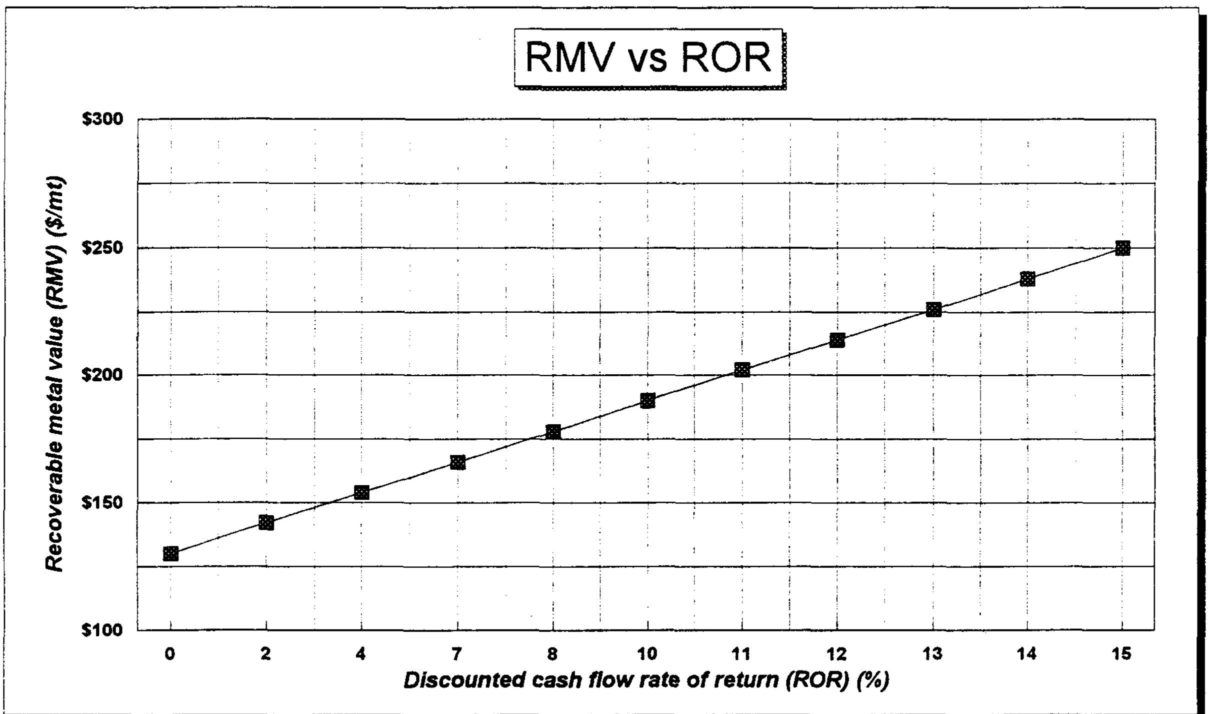
Recoverable metal value	ROR
140	0
154	2
168	5
182	7
196	8
210	9
224	11
238	12
252	13
266	14
280	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - cut-and-fill.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 1,515
Deposit size (mt) - 5,019,736
Mine life (years) - 9.47
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$2,467,300	$2,467,300	-6	-6
Exploration	$5,981,800	$854,543	-7	-1
Infrastructure	$53,595,465	$10,719,093	-5	-1
Mine	$70,254,800	$14,050,960	-5	-1
Mill	$60,143,870	$12,028,774	-5	-1
Working capital	$8,182,062	$8,182,062	0	0
TOTAL PREPRODUCTION	***$200,625,297***			
Mine op cost ($/mt)	$73.49	$39,525,297	0	9.47
Mill op cost ($/mt)	$16.52	$8,885,237	0	9.47
TOTAL PRODUCTION	***$90.01***	***$48,410,535***		

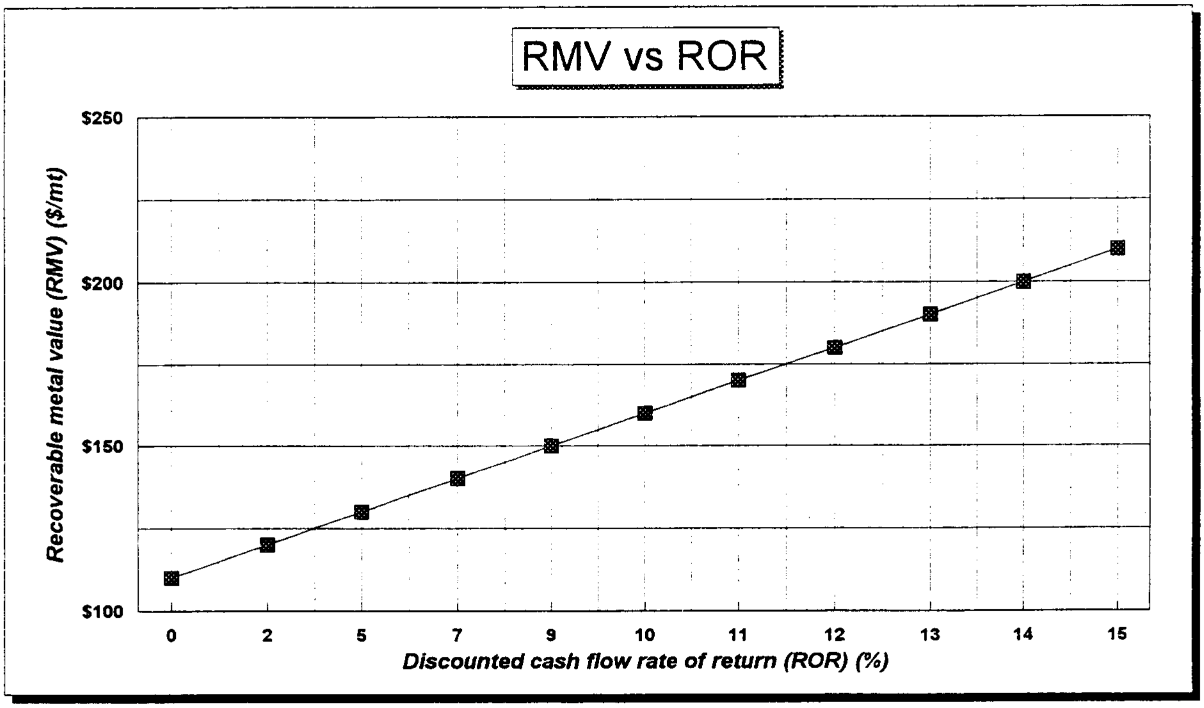
Recoverable metal value	ROR
130	0
142	2
154	4
166	7
178	8
190	10
202	11
214	12
226	13
238	14
250	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - cut-and-fill.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 2,550
Deposit size (mt) - 10,050,422
Mine life (years) - 11.26
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$3,743,300	$3,743,300	-6	-6
Exploration	$9,515,000	$1,359,286	-7	-1
Infrastructure	$71,713,950	$14,342,790	-5	-1
Mine	$103,072,200	$20,614,440	-5	-1
Mill	$100,079,101	$20,015,820	-5	-1
Working capital	$12,053,646	$12,053,646	0	0
TOTAL PREPRODUCTION	***$300,177,197***			
Mine op cost ($/mt)	$66.02	$59,766,416	0	11.26
Mill op cost ($/mt)	$12.76	$11,550,990	0	11.26
TOTAL PRODUCTION	***$78.78***	***$71,317,406***		

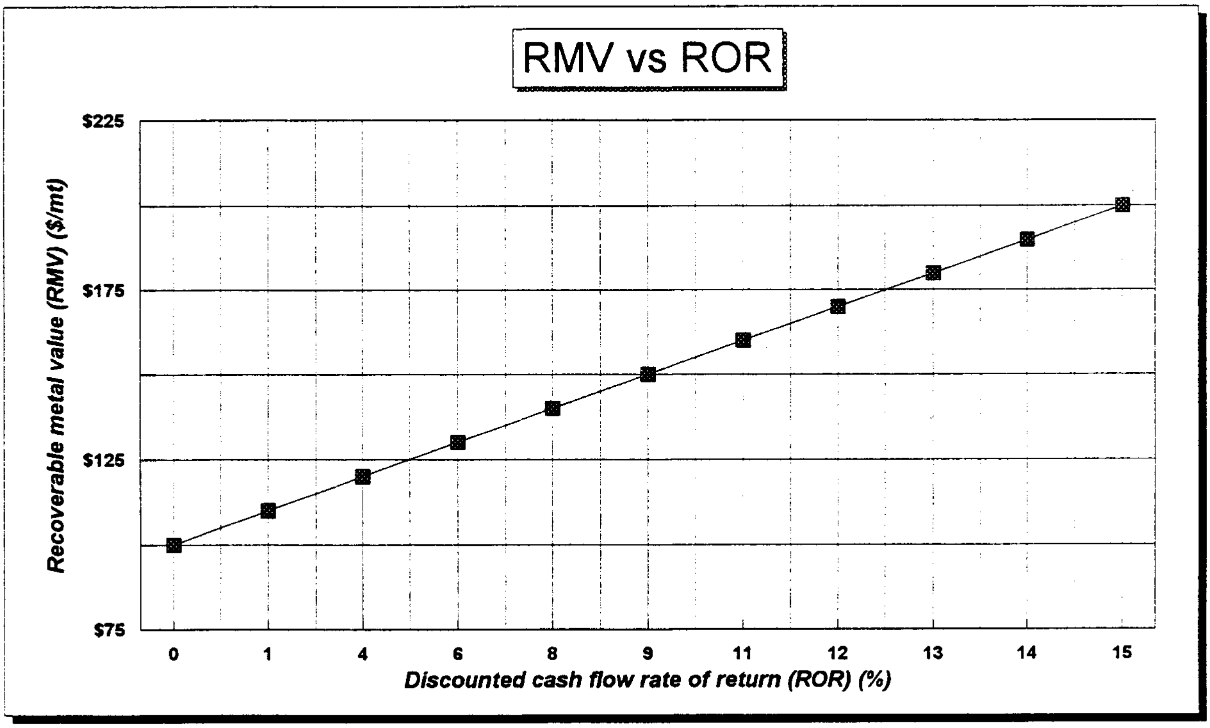
Recoverable metal value	ROR
110	0
120	2
130	5
140	7
150	9
160	10
170	11
180	12
190	13
200	14
210	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - cut-and-fill.
Mill Model - One product flotation mill for low grade copper ores.
Production Rate (mptd) - 2,550
Deposit size (mt) - 10,050,422
Mine life (years) - 11.26
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$3,743,300	$3,743,300	-6	-6
Exploration	$9,515,000	$1,359,286	-7	-1
Infrastructure	$71,713,950	$14,342,790	-5	-1
Mine	$88,991,100	$17,798,220	-5	-1
Mill	$100,079,101	$20,015,820	-5	-1
Working capital	$11,567,317	$11,567,317	0	0
TOTAL PREPRODUCTION	***$285,609,767***			
Mine op cost ($/mt)	$63.05	$57,077,823	0	11.26
Mill op cost ($/mt)	$12.55	$11,362,133	0	11.26
TOTAL PRODUCTION	***$75.60***	***$68,439,956***		

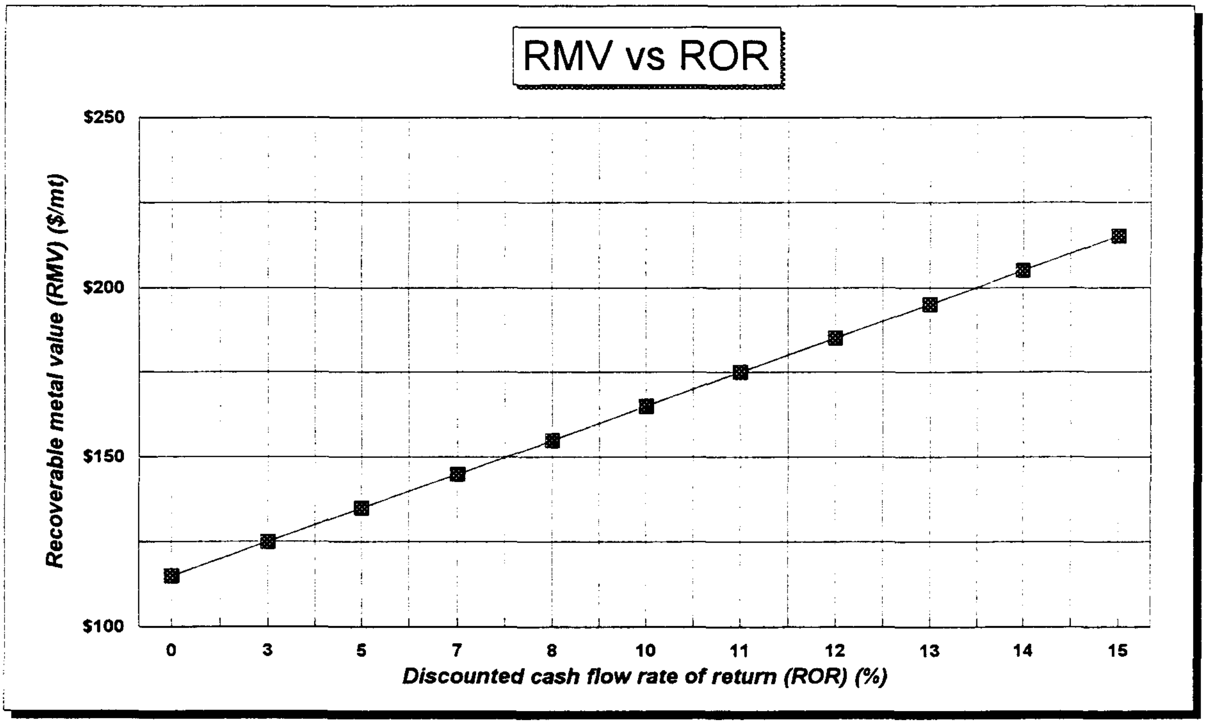
Recoverable metal value	ROR
100	0
110	1
120	4
130	6
140	8
150	9
160	11
170	12
180	13
190	14
200	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Shaft entry - cut-and-fill.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 2,550
Deposit size (mt) - 10,050,422
Mine life (years) - 11.26
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$3,743,300	$3,743,300	-6	-6
Exploration	$9,515,000	$1,359,286	-7	-1
Infrastructure	$71,713,950	$14,342,790	-5	-1
Mine	$103,072,200	$20,614,440	-5	-1
Mill	$122,180,056	$24,436,011	-5	-1
Working capital	$12,053,646	$12,053,646	0	0
TOTAL PREPRODUCTION	*$322,278,152*			
Mine op cost ($/mt)	$66.02	$59,766,416	0	11.26
Mill op cost ($/mt)	$12.76	$11,550,990	0	11.26
TOTAL PRODUCTION	*$78.78*	*$71,317,406*		

Recoverable metal value	ROR
115	0
125	3
135	5
145	7
155	8
165	10
175	11
185	12
195	13
205	14
215	15



Deposit Model - Polymetallic base metal ± precious metal(s) vein- or shear zone- type.
Mine Model - Adit entry - cut-and-fill.
Mill Model - Two product flotation mill for complex base metal ores.
Production Rate (mptd) - 2,550
Deposit size (mt) - 10,050,422
Mine life (years) - 11.26
Operating days/yr - 355

Cost catagory	Total cost	Cost/yr	Beginning year	Ending year
Acquisition	$3,743,300	$3,743,300	-6	-6
Exploration	$9,515,000	$1,359,286	-7	-1
Infrastructure	$71,713,950	$14,342,790	-5	-1
Mine	$88,991,100	$17,798,220	-5	-1
Mill	$122,180,056	$24,436,011	-5	-1
Working capital	$11,567,317	$11,567,317	0	0
TOTAL PREPRODUCTION	***$307,710,723***			
Mine op cost ($/mt)	$63.05	$57,077,823	0	11.26
Mill op cost ($/mt)	$12.55	$11,362,133	0	11.26
TOTAL PRODUCTION	***$75.60***	***$68,439,956***		

Recoverable metal value	ROR
110	0
120	3
130	6
140	7
150	9
160	10
170	11
180	12
190	13
200	14
210	15