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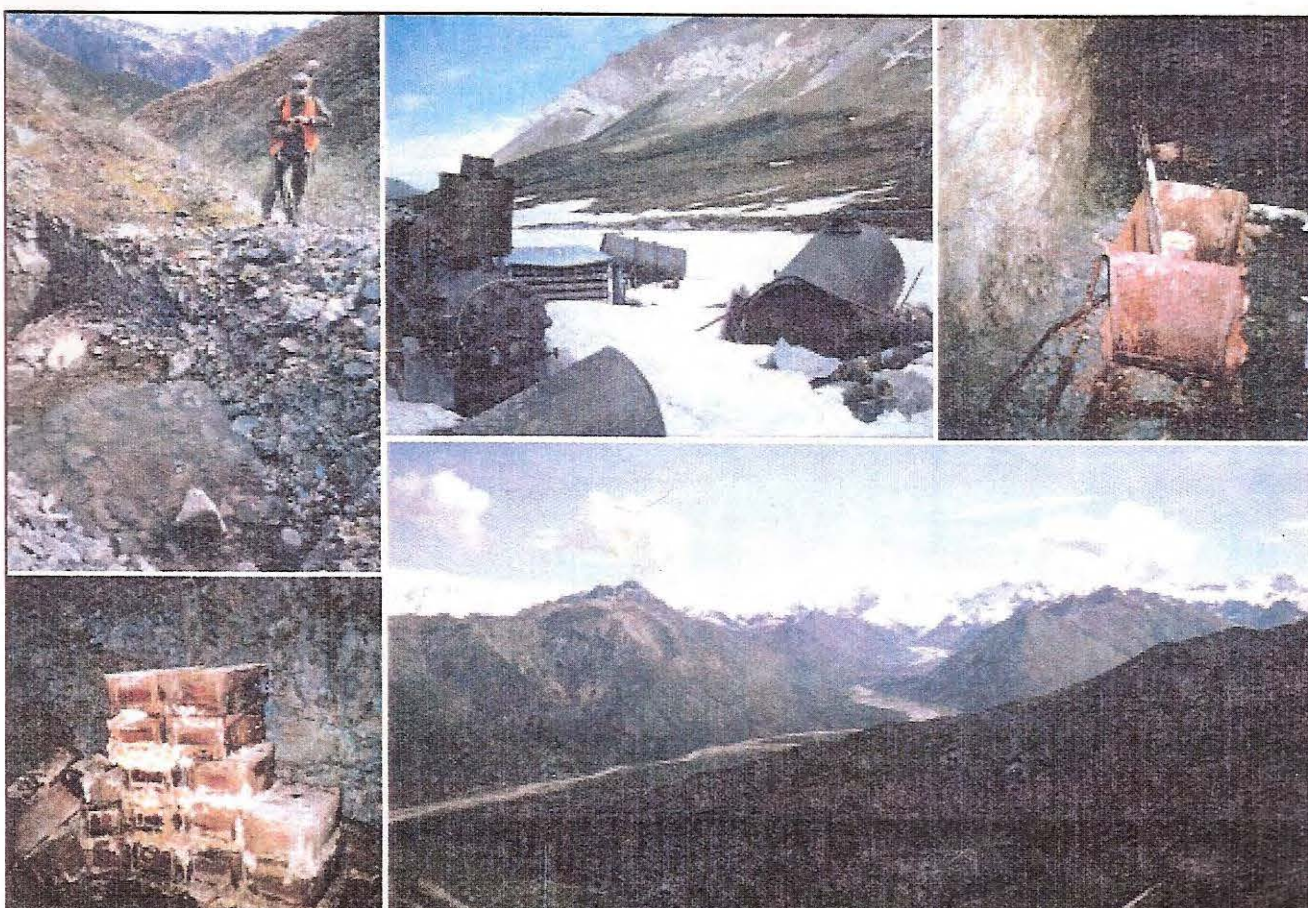
Economic Prefeasibility Studies of Mining in the Ahtna, Inc. Selections in the Wrangell-St. Elias National Park and Preserve, Alaska

James R. Coldwell



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Author

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CONTENTS

APPENDICES

ILLUSTRATIONS

TABLES

UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

cm	centimeter
dpy	days per year
g	gram
g/mt	gram per metric ton
kg	kilogram
km	kilometer
lb	pound
m	meter
Mmt	million metric tons
Mst	million short tons
mt	metric ton
mtpd	metric tons per day
mtpy	metric tons per year
ppm	parts per million
st	short ton
stpd	short tons per day
tr oz	troy ounce
yrs	years

METRIC TO ENGLISH CONVERSIONS

From	Multiply by	To
g/mt (= ppm)	0.02917	troy ounces/short ton
kg	2.2046	pounds
mt	1.1023	short tons
m	3.2808	feet
km	0.6214	miles
m^3	1.3080	cubic yards

ACRONYMS

ACRS	Accelerated Cost Recovery System
AMICEF	Alaska Mineral Industry Cost Escalation Factors
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act
CES	Cost Estimating System
DCFROR	Discounted Cash Flow Rate of Return
FEIS	Final Environmental Impact Statement
GIPV	Gross In Place Value
MAS	Minerals Availability System
RMV	Recoverable Metal Value
USBM	U.S. Bureau of Mines
USGS	U.S. Geological Survey

ECONOMIC PREFEASIBILITY STUDIES OF MINING IN THE AHTNA, INC. SELECTIONS IN THE WRANGELL-ST. ELIAS NATIONAL PARK AND PRESERVE, ALASKA

by James R. Coldwell[1]

ABSTRACT

Mining and processing cost analyses were conducted on basaltic copper, polymetallic vein, and iron skarn deposit types that are found on Ahtna, Inc. selections in the Wrangell-St. Elias National Park and Preserve. Resources and recoverable metal values (RMV) needed to make these deposits economically viable were modeled. Methods for estimating ore grades and required RMV are presented.

Economic modeling for basaltic copper deposits indicated the RMV necessary for a 15% Discounted-Cash-Flow Rate-Of-Return (DCFROR) for an underground mine ranged from $152/st for a 10,209 stpd operation to $224/st for a 1,276 stpd operation.

Economic modeling for polymetallic vein deposits indicated the RMV necessary for a 15% DCFROR for an underground mine ranged from $155/st at 2,189 stpd to $394/st at 273 stpd.

Economic modeling for iron skarn deposits indicated the RMV necessary for a 15% DCFROR for an underground mine ranged from $163/st at 6,191 stpd to $259/st at 774 stpd.

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INTRODUCTION

This report was produced under the terms of a memorandum of understanding between the U.S. Bureau of Land Management (BLM), the National Park Service, and Ahtna, Inc. Regional Native Corporation for the mineral assessment of the 1971 Alaska Native Claims Settlement Act (ANCSA) Regional Native Corporation selections within the Wrangell - St. Elias National Park and Preserve, Alaska and should not be used for any purpose other than that for which it was originally prepared for.

This report is not an appraisal by the BLM nor an opinion of value of any mineral resources that may be found within the subject valid Ahtna Inc. ANCSA selections surrounded or substantially surrounded by the Wrangell - St. Elias National Park. This report does not conform to the general reporting standards described in BLM Manual 3070, the Uniform Appraisal Standards for Federal Land Acquisitions 1992, nor The Appraisal of Real Estate 1992.

This economic study was conducted by the BLM to meet the information requirements of the memorandum of understanding. As BLM's mineral assessment did not identify any significant resources on the subject land selections, economic models based on hypothetical mining development scenarios of mineral deposits not currently known to exist on Ahtna Inc. ANCSA selections were developed. This report is intended to be a tool to aid in the possible identification of exploration targets when used as a supplement to the BLM's mineral assessment reports.

Due to the nature of these models and the large number of assumptions they contain, additional subsequent exploration information will likely have large impacts on the estimated capital and operating costs and project economics. This additional information when available will likely reveal that substantial revision would be required as the actual operating parameters of the mine, mill, and infrastructure become known and replace the assumptions. Numerous iterations should be expected as the project moves from exploration and prefeasibility into the development and feasibility stage. Companies often use prefeasibility studies to evaluate their projects to determine if exploration should continue on a project and if it should advance into the development stage.

The work described in the above memorandum has been accomplished and is presented in four reports, with this report being the fourth or last in the series. Results of field work and analytical results from the investigations of the Ahtna, Inc. selections in the Wrangell-St. Elias National Park and Preserve were published in two open-file reports (Meyer and Shephard, 1998; Meyer and VandeWeg, 1999). A third and final open-file report planned for publication in three volumes is currently in progress, and provides a comprehensive summary of results (Meyer and others, in progress).

These reports present the results of the ground assessment of the mines, prospects, occurrences, and mineralized areas within valid ANCSA selections surrounded or substantially surrounded by the Wrangell - St. Elias National Park and Preserve to document the known and potential mineral resources. Field work consists of the collection of mineral data, and mapping and sampling to determine the location, type, amount, configuration, and physical extent of the mineral resources.

The mineral assessment also consists of analysis of the mineral potential and includes the following elements: commodity, site history, site bibliography, description of known mineralization and past production, compilation of existing analytical data and data generated under this project, deposit type(s), and a mineral resource analysis that estimates resource potential and delineates favorable areas/terranes.

This report provides supplemental economic information required in the memorandum of understanding including the future economics of metals contained within favorable areas, grade and tonnages of known producers for comparable ore deposit, estimates of mining, milling, and environmental costs for extraction, and estimates of all infrastructure costs associated with mine development.

Economic prefeasibility studies were conducted on typical mineral deposit types that may be found in the Ahtna, Inc. selections in the Wrangell-St. Elias National Park and Preserve. Two factors were addressed in this study: (1) the magnitude of resource that would have to exist, and (2) the recoverable metal value (RMV) that would be necessary to make a deposit economically feasible to mine. The RMV is the combined dollar value of all salable products from a given mineral deposit expressed in $/st, and is equal to the amount of revenues required before all expenses including royalties, mining and milling capital and operating costs, off-site transportation costs, base smelting charges, and taxes are deducted. The interrelation between these factors is shown in tabular and graphical form.

In order to make these economic assessments for the basaltic copper, polymetallic vein, and iron skarn deposit types, existing mineral deposit information was used whenever possible. Mineral deposit grades and supporting background information were furnished by the BLM's Mineral Assessment personnel. Additional information was retrieved from the Minerals Availability System, a database formerly maintained by the U.S. Bureau of Mines (USBM).

Detailed deposit characteristics such as depth, thickness, orientation, and volume have not been determined for the partially explored deposits used as examples in this study, so assumptions were made. These assumptions are discussed at the beginning of each deposit characteristics section.

Location and Access

The following descriptions of location and access, and land status were modified from the mineral assessment reports discussed previously (Meyer and Shephard, 1998, Meyer and VandeWeg, 1999). The Wrangell-St. Elias National Park and Preserve is located in southcentral Alaska. The park is the largest national park in the United States and encompasses the Wrangell and Nutzotin Mountains to the north and the Chugach and St. Elias Mountains to the south. The Alaska National Interest Lands Conservation Act (ANILCA) established 8.33 million acres for the park, and 4.85 million acres for the preserve, for a total of 13.18 million acres. ANILCA also designated 8.7 million acres within the park and preserve as wilderness.

The area studied for this mineral assessment includes approximately 123,520 acres on the north side of the Wrangell Mountains and 321,280 acres on the south side for a total of 444,800 acres. Access to the study areas is along the Glenn Highway (Tok Cut-Off) and the Nabesna Road for the northern area and the Edgerton Highway for the southern area. All the highways are connected to the Richardson Highway and the Alaska Highway system.

Helicopters were used to access the selections from either Devils Mountain Lodge for the northern area or from Kenny Lake for the southern area. To minimize impacts within the park, helicopter landing sites were carefully selected to minimize the number of landings necessary while maximizing the number of mineralized locations that could be visited from each landing site.

Land Status

Land in the study area is situated within the Wrangell - St. Elias National Park and Preserve. In 1980, ANILCA, Title II, Section 201(9) established and included the park in the National Park System. Under terms of ANCSA, Section 12 (c), Ahtna, Inc. has selected approximately 650,000 acres within the park. Other native selections include selections made by local village corporations under ANSCA, as well as individual native allotments granted under the Native Allotment Act of 1906. There are also numerous private and State of Alaska inholdings and rights-of-way occurring within the park boundary.

Currently, there are no active unpatented mining claims located within or adjacent to the Ahtna selections. Patented mining claims are present in the following locations: 1) Clear Creek Mine, 2) Copper King Mine, 3) Franklin prospect, 4) Hubbard-Elliott Mine, 5) Minneapolis prospect, 6) Mullen Mine, 7) Nabesna and Royal Development Co. mines, 8) Nugget Creek Mine, 9) War Eagle prospect, and 10) Warner prospect

Environmental and Socioeconomic Issues

This preliminary study does not address environmental and socioeconomic concerns in a direct manner. For each model the acquisition cost represents the cost of mine permitting activities, environmental studies such as baseline data collection, water quality sampling and monitoring, wildlife studies, preparation of permit applications to the required local, State, and Federal agencies, and other related activities.

Environmental issues that may arise during the course of mineral development of ANCSA selections surrounded or substantially surrounded by the Wrangell - St. Elias National Park and Preserve may include, but are not limited to, abandoned mine lands, access, acquisition costs of mining properties, aquatic ecosystem integrity, claim validity, criteria for cumulative impact analysis, economic impacts, fish habitat, fisheries, heavy metals contamination, hydrologic changes, impact thresholds, impact to scenic values, impacts from past mining operations, impacts on subsistence, impacts on visitor use, impacts from access, long-term and short-term impacts, monitoring and enforcement, non-mining uses of patented claims, reclamation, significance of impacts, threatened and endangered species, water quality, wetlands impacts, wilderness, and wildlife habitat. These issues were identified during the public scoping phase of a National Park Service Final Environmental Impact Statement concerning the cumulative impacts of mining in Wrangell - St. Elias National Park and Preserve, Alaska (National Park Service, 1990).

Socioeconomic concerns may include, but are not limited to, potential impacts on the population (e.g. population increase, movement, or relocation in response to the project), public services and facilities, housing supply, employment, education (e.g. student population increase), local, State and Federal tax revenues and expenditures, transportation, and quality of life (Berger, 1991).

The population would likely increase in the communities that are in close proximity to the proposed mineral development and cause potential socioeconomic impacts such as increased demands for housing, local school district student capacity, health care, social services, impacts on public utilities such as electric power, water and sewer, public safety, traffic, and recreation impacts, and so forth.

Potential mitigation requirements developed during the permitting process would likely attempt to measure these impacts relative to future scenarios of economic growth and development of other industries or projects in the area, and seek compensation in some form from Athna to offset and mitigate these impacts. These mitigation measures and the costs involved could have a significant impact on mineral development on Athna Inc.'s valid ANCSA selections.

Mitigation measures and associated costs developed during the permitting process are unique for each mineral development project. It is difficult to estimate these costs without benefit of public scoping and at least a preliminary environmental and socioeconomic assessment for the proposed mineral development project.

Measuring these socioeconomic impacts is beyond the scope of this study, and although it is assumed they would exist, the extent and magnitude of these impacts was not determined relative to current population, current unemployment rates, current school enrollments, etc. These issues and the associated costs of mitigation are not addressed in the economic models.

Environmental considerations of mine development in an area adjacent to a National Park could far outweigh economic considerations. Recent events surrounding Crown Butte Mining, Inc.'s (Crown Butte) proposed New World Mine development proposal from November, 1990 - August 1996 illustrates this potential. Crown Butte's proposed mine location was 2 ½ miles northeast of Yellowstone National Park, near the town of Cooke City, Montana. Over the course of almost six years, Crown Butte's efforts to permit the mine were unsuccessful. Work on the environmental impact statement (EIS) was delayed due to opposition to the mine and challenges to the document. Presenting an accurate long term risk assessment to the public for mine operations, mine abandonment, and reclamation proved to be another difficulty. Intense local, national, and world wide media attention as well as the emotional issue of locating a large scale mining operation at a gateway to Yellowstone National Park prompted political involvement. In August, 1996, President Clinton announced that Crown Butte and the Federal government had reached agreement where in exchange for $65 million of Federal lands elsewhere, Crown Butte would relinquish their lands, and interests in lands in the New World Mining district to the Federal government (National Park Service, 1999).

These environmental and socioeconomic issues are normally addressed, and companies usually initiate related studies when a project reaches the feasibility stage and a decision to proceed with development has been reached. If an exploration project doesn't advance to this stage, then there is no reason to incur the additional costs involved. For the purposes of this economic study, it is assumed that the mineral development project would be successfully permitted, and these environmental and socioeconomic issues would be satisfactorily mitigated during the environmental review and permitting process.

ECONOMIC MINE PREFEASIBILITY STUDIES

Economic prefeasibility studies for three mineral deposits types were conducted to establish the recoverable metal value (RMV) per short ton necessary to meet a 15% Discounted-Cash-Flow Rate-Of-Return (DCFROR).

The RMV is the combined dollar value of all salable products from a given mineral deposit expressed in dollars per short ton ($/st) (Baggs and Sherman, 1987: Sherman, 1990). The RMV was used to reduce the individual effects of commodity grades, recoveries, and metal prices to a common base so that a single curve relating ore value of the deposit to DCFROR could be created. See Appendix B for further information and a sample calculation of RMV.

This pre-feasibility report considers a number of factors controlling the feasibility of mineral development including physical attributes and geographic location of the deposit, metallurgical attributes of the minerals, metal markets, and infrastructure availability. Results presented here should be considered preliminary. Additional factors such as perceived risk, political and economic climate, environmental constraints, and corporate policy may be present but aren't considered.

Capital and operating costs for the deposit models were determined using the USBM's Cost Estimation System (CES) version 2.3 . Cost estimates were escalated using the USBM's Alaska Mineral Industry Cost Escalation Factors (AMICEF) of 1.78 for operating labor, 1.71 for capital labor, 1.30 for capital costs, and 1.73 for electricity to reflect higher costs in the Wrangell-St. Elias National Park and Preserve Area. These factors are a set of calculated values that are used to escalate itemized capital and operating costs for mining and milling operations from the central front range of the Rocky Mountains (Denver vicinity) to any point in Alaska. The Denver vicinity is used as the base for the CES (Balen and Allen, 1993).

Published cost information from permitting documents, environmental impact statements, and private reports were also used (Red Dog FEIS, 1983; Greens Creek FEIS, 1984). All cost estimates are expressed in 1999 dollars.

Using the estimated capital and operating costs, economic models were compiled using cash flow analysis techniques. The RMV and DCFROR were computed. See Appendix A for the economic models and Appendix B for the inflation adjusted, ten-year, twenty-year, and thirty-year commodity price averages.

Basaltic Copper Models

The basaltic copper mine models are based on the geology and mineralized rock present at the Clear Creek, Copper King, Hubbard-Elliott, Mullen, and Nugget Creek mines and the Ammann, Barrett Young and Nafsted, Bluebird, Cave, Divide Creek, Fall Creek Upper, Falls Creek, Forget-Me-Not, Hidden Treasure, Homestake, Larson West, Lime Creek, Newhome, Mountain Sheep, Peacock Claim, Roaring Creek, Sunrise, Sunset, Surprise/Sunshine, and Warner prospects and mineral occurrences.

The basaltic copper deposit model is described as a diverse group including disseminated native copper and copper sulfides in the upper parts of a thick sequence of subaerial basalt and copper sulfides in overlying sedimentary beds. The mineralogy is described as native copper, native silver in flows and coarse clastic beds, chalcocite and other Cu_2S minerals, and locally bornite and

Cox and Singer (1987) present lists of known producers for comparable ore deposits types from which they derived their mineral deposit models. This information will not be repeated in this report, but is incorporated by reference.

The basaltic copper mine models assume that the structural characteristics of the orebody favor the use of underground mining methods. Exploration expenditures range from $10-44 million, increasing as the size of the resource increases from 3.6 to 58.2 million short tons (Mst). Five underground mine models are developed with capacities of 1,276 to 10,209 short tons per day.

It is assumed that conventional highway trucks would transport concentrates from the proposed mine via the Glenn Highway (Alaska Route 1) and the Richardson Highway (Alaska Route 4) to Valdez. It is assumed a new road, approximately 25 miles in length, would be built and maintained from the proposed mine to it's intersection with the Glenn Highway and Richardson Highway along the western perimeter of the park. In total, the assumed haulage distance from the proposed mine to Valdez is estimated at 225 miles one way.

It is assumed a deep water, export, bulk mineral concentrate marine terminal would be built in Valdez to serve the needs of the mine. It is assumed that the mine operator would retain the services of a commercial stevedoring firm to handle receiving, mineral concentrate storage, reclaiming, and shiploading. A trucking firm would handle both incoming supplies and fuel delivery to the mine and outgoing mineral concentrate shipments for the majority of the mine's shipping needs. Concentrates would be shipped year-round to a smelter, assumed to be located in Japan.
It is assumed that the Gulkana airstrip near Glennallen, a public airport maintained by the Alaska Department of Transportation and Public Facilities, would serve the mine's needs for expedited cargo shipping, and no provision for an additional airstrip at the mine site is included in the cost estimate.

The population in the immediate area of the mine is relatively small. According to December 1999 population estimates by the Alaska Department of Community and Economic Development, the local population is about 1,400 people, distributed as follows: Chistochina - 52, Chitina - 94, Copper Center - 553, Gakona - 22, Glenallen - 494, Gulkana - 90, McCarthy - 37, Slana - 55.

It is assumed that the local population in the immediate area would be sufficient to recruit a work force. Mining industry wages are among the highest for industrial occupations and it is assumed this would provide an incentive for job seekers to relocate to the area.

The work force would commute to the mine at their own expense. Based on this assumption, no additional costs would be incurred by the mine operator, other than the construction and maintenance of an employee parking lot.
Based on information from the Rural Electric Cooperative Association, Inc. (ARECA), a trade association for electric utilities in Alaska, it appears unlikely that the mine would be located in an electrical utility service area. It is assumed that the project would produce its own electric power using diesel powered generators.

It was assumed that a suitable tailings pond location could be found within a ½ mile of the mill. Land area requirements were estimated as follows: for a 5-year mine life - 17 acres per 1,000 stpd mill capacity, for a 10-year mine life - 32 acres per 1,000 stpd mill capacity, and for a 20-year mine life - 62 acres per 1,000 stpd capacity (Ritcey 1989).

An initial starter dam would be constructed that would be an upstream dam design, followed in subsequent years by three raises, added as necessary to meet the mill's requirements. It is assumed that the starter dam and each of the three raises would each hold approximately 25% of the total tailings volume over the life of the mine.

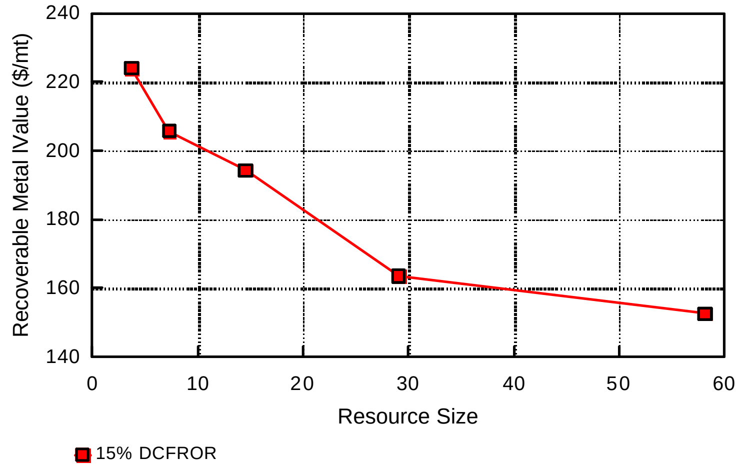

Figure 1. - RMV vs. resource size basaltic copper mine models

Table 1 summarizes the cash flow analysis of the various models. The RMV per short ton of minable ore required to achieve a 15% DCFROR ranges from $224/st for a 1,276 stpd (3.64 Mst) mine to a low of $152/st for a 10,209 stpd (58.20 Mst) mine. Figure 1 graphically presents the results for the basaltic copper deposit mine models. The downward sloping curve illustrates the cost advantages larger deposits achieve through economies of scale.

Table 1. - Summary of cash flow analysis for basaltic copper models

Deposit type	Deposit size (Mst)	Mining rate (stpd)	RMV ($/st) 15% DCFROR
Basaltic copper	3.64	1,276	$224
Basaltic copper	7.28	2,146	206
Basaltic copper	14.55	3,609	194
Basaltic copper	29.10	6,070	164
Basaltic copper	58.20	10,209	$152

Polymetallic Vein Models

The polymetallic vein mine models are based on the geology and mineralized rock present at Silver Star Mine and O'Hara prospect. The polymetallic vein deposit model is described as quartz-carbonate veins with gold and silver associated with base-metal sulfides, related to hypabyssal intrusions in sedimentary and metamorphic terranes. The mineralogy is described as native gold and electrum with pyrite, sphalerite, chalcopyrite, galena, arsenopyrite, tetrahedrite-tennanite, silver sulfosalts, argentite, and hematite in veins of quartz, chlorite, calcite, dolomite, ankerite, siderite, rhodochrsosite, barite, fluorite, chalcedony, and adularia (Cox and Singer, 1987).

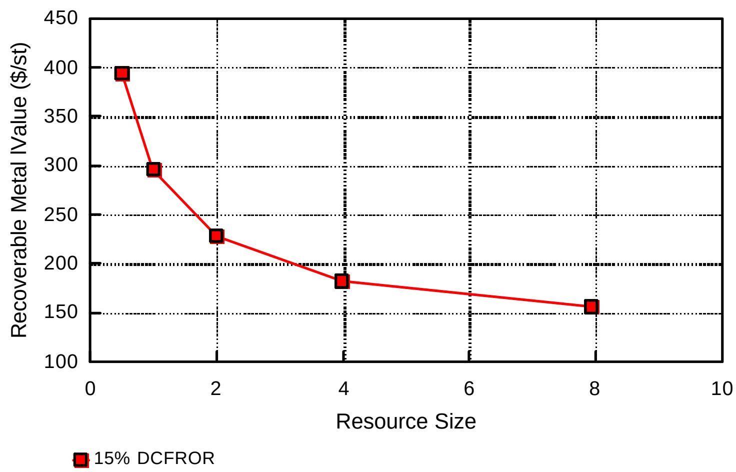

Figure 2. - RMV vs. resource size polymetallic mine models

The mine models assume ore is mined by shrinkage stoping methods using stopers for drilling and jacklegs for rock bolting. Stopes, stope raises, laterals, and crosscuts necessary for production are developed using drilling and blasting methods. The ore is flotation milled. Electric power will be produced by on-site diesel generators. The same transportation, marine terminal, airport, work force, and tailings pond assumptions as the basaltic copper mine model in the previous section are used for the polymetallic vein models.

Figure 2 graphically presents the relation between RMV per short ton and deposit size for the polymetallic vein mine models.

Table 2 summarizes the results of the analysis for the various models. The RMV per short ton of minable ore required to achieve a 15% DCFROR range from $155/st for an 2,189 stpd (7.94 Mst) mine to $394/st for a 273 stpd (0.50 Mst) mine.

Table 2. - Summary of cash flow analysis for polymetallic vein mine models

Deposit type	Deposit size (Mst)	Mining rate (stpd)	RMV ($/st) 15% DCFROR
polymetallic vein	0.50	273	$394
polymetallic vein	0.99	460	296
polymetallic vein	1.98	774	228
polymetallic vein	3.97	1,302	182
polymetallic vein	7.94	2,189	$155

Iron Skarn Mine Models

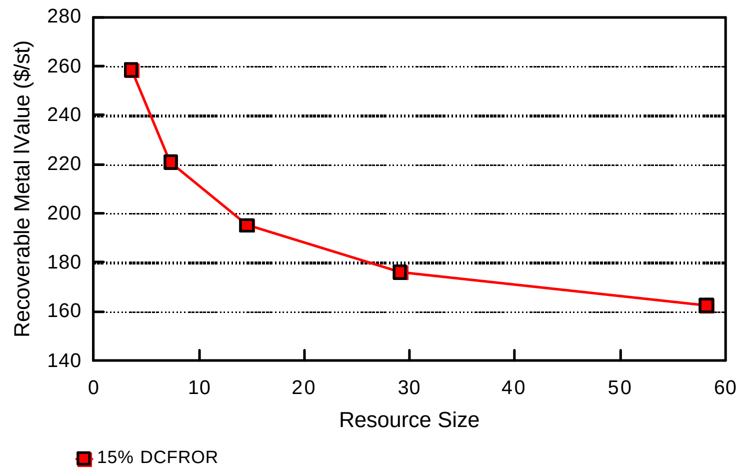

Figure 3. - RMV vs. resource size iron skarn models

The iron skarn mine models are based on the geology and mineralized rock present at the Nebsena and Rambler Mines. The iron skarn deposit model is described as magnetite in calc-silicate contact metasomatic rocks. The mineralogy includes magnetite, chalcopyrite, pyrite, and pyrrhotite. and rarely cassiterite in iron skarns in tin granite terranes (Cox and Singer, 1987).

The models assume ore is mined by shrinkage stoping methods using stopers for drilling and jacklegs for rock bolting. Stopes, stope raises, laterals, and crosscuts necessary for production are developed using drilling and blasting methods. The ore is flotation milled. Electric power will be produced by on-site diesel generators. The same transportation, marine terminal, airport, work force, tailings pond assumptions as the basaltic copper and polymetallic vein mine models would be used for the iron skarn models.

Figure 3 graphically presents the relation between RMV per short ton and deposit size for the polymetallic vein mine models.

Table 3 summarizes the results of the analysis for the various models. The RMV per short ton of minable ore required to achieve a 15% DCFROR range from $162/st for an 6,191 stpd (58.2 Mst) mine to $259/st for a 774 stpd (3.64 Mst) mine.

Table 3. - Summary of cash flow analysis for iron skarn mine models

Deposit type	Deposit size (Mst)	Mining rate (stpd)	RMV ($/st) 15% DCFROR
iron skarn	3.64	774	$259
iron skarn	7.28	1,302	221
iron skarn	14.55	2,189	195
iron skarn	29.10	3,681	176
iron skarn	58.20	6,191	$162

SUMMARY AND CONCLUSIONS

Mining prefeasibility investigations were conducted for basaltic copper, polymetallic vein, and iron skarn deposit models under the terms of a memorandum of understanding between the BLM, the National Park Service, and Ahtna, Inc. Regional Native Corporation for the mineral assessment of ANCSA Regional Native Corporation selections within the Wrangell - St. Elias National Park and Preserve, Alaska.

This report is not an appraisal by the BLM nor an opinion of value of any mineral resources that may be found within the subject valid Ahtna Inc. ANCSA selections surrounded or substantially surrounded by the Wrangell - St. Elias National Park and Preserve. This report does not conform to the general reporting standards described in BLM Manual 3070, the Uniform Appraisal Standards for Federal Land Acquisitions 1992, nor The Appraisal of Real Estate 1992.

Mine models were developed for application to the mineral deposit models. Capital and operating costs for the models were determined using the USBM's Cost Estimation System (CES) version 2.3. As BLM's mineral assessment did not identify any significant resources on the subject land selections, these economic models are based on hypothetical mining development scenarios of mineral deposits not currently known to exist on Ahtna Inc. ANCSA selections. These models were developed as a tool to aid in the possible identification of exploration targets on the subject land selections when used as a supplement to the BLM's mineral assessment reports.

Published cost information was drawn from industry publications, permitting documents, and environmental impact statements. All costs were escalated by factors that reflect the higher cost of labor, transportation, and electricity in Alaska.

The cost data for each mine model were used to perform a cash flow analysis. The goal of the prefeasibility study was to determine the RMV per short ton of minable ore that would provide a 15% DCFROR for each of the mine models.

Economic modeling for basaltic copper deposit types indicates the RMV necessary for a 15% Discounted Cash-Flow Rate-Of-Return (DCFROR) for an underground mine ranges from $152/st for a 10,209 stpd operation to $224/st for a 1,276 stpd operation.

Economic modeling for polymetallic vein deposit types indicates the RMV necessary for a 15% DCFROR for an underground mine ranges from $155/st at 2,189 stpd to $394/st at 273 stpd.

Economic modeling for iron skarn deposit types indicates the RMV necessary for a 15% DCFROR for an underground mine ranges from $163/st at 6,191 stpd to $259/st at 774 stpd.

This preliminary study does not provide an in-depth analysis of environmental and socioeconomic concerns. Environmental considerations of mineral development in an area adjacent to a National Park may far outweigh economic considerations.

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APPENDIX A. - CAPITAL AND OPERATING COSTS FOR MINE MODELS

The tables in this appendix give the mineral deposit type and mine model descriptions; and capital and operating costs for the basaltic copper, polymetallic vein, and iron skarn mine models. Capital costs are categorized into six groups which include acquisition, exploration, infrastructure, mine, mill, working capital, and reclamation costs for each model. Operating costs are categorized into five groups, which include infrastructure, mine, mill, smelting, and transportation.

An eight-year pre-production period is assumed for each model. The models assume exploration and acquisition would run concurrently and would take six years from 2002-2007. Two years from 2008-2009 would be needed for construction. Production would begin in 2010.

Table A-1. - Mineral deposit and mine model descriptions

Deposit type	Deposit size (Mst)	Mine model	Mining rate (stpd)	Mine life (yrs)[2]	Mill type
Basaltic copper	3.64	Shrinkage stoping	1,276	8	Flotation
Basaltic copper	7.28	Shrinkage stoping	2,146	10	Flotation
Basaltic copper	14.55	Shrinkage stoping	3,609	12	Flotation
Basaltic copper	29.10	Shrinkage stoping	6,070	14	Flotation
Basaltic copper	58.20	Shrinkage stoping	10,209	16	Flotation
Polymetallic vein	0.50	Shrinkage stoping	273	5	Flotation
Polymetallic vein	0.99	Shrinkage stoping	460	6	Flotation
Polymetallic vein	1.98	Shrinkage stoping	774	7	Flotation
Polymetallic vein	3.97	Shrinkage stoping	1,302	9	Flotation
Polymetallic vein	7.94	Shrinkage stoping	2,189	10	Flotation
Iron skarn	1.98	Shrinkage stoping	774	15	Flotation
Iron skarn	3.97	Shrinkage stoping	1,302	16	Flotation
Iron skarn	7.94	Shrinkage stoping	2,189	18	Flotation
Iron skarn	15.87	Shrinkage stoping	3,681	20	Flotation
Iron skarn	31.75	Shrinkage stoping	6,191	22	Flotation

[2] Mine life estimate is based on 350 days of operation per year.

TABLE A-2. - Capital and operating costs - basaltic copper mine models

Model Description					
Resource size (Mst)	3.64	7.28	14.55	29.10	58.20
Mining rate (stpd)	1,276	2,146	3,609	6,070	10,209
Capital Costs ($ millions)					
Acquisition	$9.07	$12.18	$16.85	$23.66	$33.88
Exploration	10.55	14.56	20.67	29.88	44.02
Infrastructure	18.64	22.57	28.67	38.17	52.96
Mine	28.44	39.20	54.22	75.10	104.25
Mill	29.92	41.66	60.14	87.65	130.42
Working Capital	3.65	4.90	6.78	9.53	13.64
Reclamation	15.82	25.05	40.08	64.68	105.05
TOTAL	$116.10	$160.12	$227.41	$328.65	$484.20
Operating Costs ($/st)					
Infrastructure	$1.25	$0.74	$0.44	$0.26	$0.16
Mine	39.88	36.60	33.61	30.89	28.39
Mill	23.65	18.50	14.85	12.23	10.36
Smelting	42.35	42.38	42.36	42.37	42.36
Transportation	44.72	44.75	44.73	44.74	44.74
TOTAL	$151.85	$142.97	$135.99	$130.49	$126.01

TABLE A-3. - Capital and operating costs - polymetallic vein mine models

Model Description					
Resource size (Mst)	0.50	0.99	1.98	3.97	7.94
Mining rate (stpd)	273	460	774	1,302	2,189
Capital Costs ($ millions)					
Acquisition	$3.13	$3.46	$4.16	$5.06	$6.50
Exploration	4.16	4.73	5.75	7.09	9.17
Infrastructure	20.19	21.72	24.42	28.29	34.33
Mine	3.82	4.70	8.13	11.88	18.33
Mill	15.09	16.53	18.89	22.07	26.59
Working Capital	3.45	5.21	6.94	9.62	13.85
Reclamation	2.67	3.01	3.65	4.49	5.82
TOTAL	$52.51	$59.36	$71.94	$88.49	$114.60
Operating Costs ($/st)					
Infrastructure	$14.33	$27.19	$17.67	$11.63	$7.78
Mine	50.25	43.67	39.39	36.52	34.52
Mill	75.58	53.57	38.43	28.02	20.83
Smelting	42.55	42.55	42.55	42.55	42.55
Transportation	14.35	14.35	14.35	14.35	14.35
TOTAL	$197.06	$181.34	$153.39	$133.07	$120.04

TABLE A-4. - Capital and operating costs - iron skarn mine models

Model description					
Resource size (Mst)	1.98	3.97	7.94	15.88	31.75
Mining rate (stpd)	774	1,302	2,189	3,681	6,191
Capital Costs ($ millions)					
Acquisition	$7.00	$9.18	$12.41	$17.10	$24.07
Exploration	7.96	10.70	14.83	21.01	30.42
Infrastructure	16.21	18.80	22.80	29.02	38.70
Mine	20.94	28.79	39.72	54.89	76.05
Mill	22.29	30.36	42.85	61.29	89.58
Working Capital	2.82	3.70	5.00	6.89	9.69
Reclamation	10.33	16.14	25.56	40.92	66.07
TOTAL	$87.55	$117.67	$163.17	$231.12	$334.56
Operating costs ($/mt)					
Infrastructure	$2.06	$1.22	$0.73	$0.43	$0.26
Mine	43.33	39.73	36.47	33.53	30.78
Mill	30.60	23.41	18.34	14.73	12.15
Smelting	42.53	42.55	42.55	42.56	42.56
Transportation	44.92	44.94	44.93	44.95	44.95
TOTAL	$163.44	$151.85	$143.02	$136.20	$130.70

APPENDIX B. - ECONOMIC ASSUMPTIONS

This appendix includes information regarding the development of the economic prefeasibility mine models. It notes all major assumptions for income tax rates, depletion, depreciation, commodity prices, exploration and permitting costs, working capital, salvage value, and reclamation expense.

Economic Factors

It is important to emphasize that the mine models described in this report are based on hypothetical mining and milling scenarios. The models are not meant to represent a feasibility analysis of specific deposits. This would be inappropriate since such an analysis requires more precise data than that available for this report.

The models do not include proprietary company data which, if available, would probably change the outcome of the evaluation. When applicable, cost information from developing or producing mines in Alaska was used in constructing the models. Alaska Mineral Industry Cost Escalation Factors (AMICEF) of 1.78 for operating labor, 1.71 for capital labor, 1.30 for capital costs, and 1.73 for electricity were used to reflect higher costs in the Wrangell - St. Elias area. These factors are a set of calculated values that are used to escalate itemized capital and operating costs for mining and milling operations from the central front range of the Rocky Mountains (Denver vicinity) to any point in Alaska (Balen and Allen, 1993).

A number of factors control the feasibility of mineral development, including physical attributes of the deposit, metallurgical attributes of the minerals, metal markets, infrastructure availability, political climate, environmental constraints, and corporate policy. Any forecast of the development potential should weigh all of these factors. Results presented here are preliminary.

Cash Flow Assumptions

All RMV ($/st) are equal to the amount of revenues required before deducting all expenses, including royalties, mining and milling capital and operating costs, off-site transportation costs, smelting charges, and taxes.

Federal income tax, Alaska corporate income tax, and Alaska mining license tax rates are simulated with a 41% tax rate during the first 3 years of production, 43% in the 4th year, and 45% thereafter. All projects were assumed to be equity financed by a single corporate producer that expensed tax due against other income. Modified Accelerated Cost Recovery System (ACRS) depreciation and percentage depletion were utilized.

Exploration costs were considered for all models. Acquisition capital cost represents the direct cost of permitting, and was estimated at 12% of the total project cost. Reclamation costs were included in all mine models. Mine and mill reinvestment were not considered for the models. It was assumed that the project would have no salvage value recovered at final reclamation. Working capital for all models is the cash required to sustain a mining operation between mining the ore and receiving revenues from its sale. Working capital was estimated at 90 days of operating costs and was invested in the first year of production and recovered in the last year of production for cash flow purposes.

Ahtna, Inc. is subject to ANCSA 7(i) revenue sharing which means Ahtna, Inc. would share 70 percent of its income from developing its natural resources with each of the 12 Regional Native Corporations in Alaska. These revenues are pooled together and then apportioned back to the regional corporations on a per capita basis. This profit sharing arrangement does not present an impediment to mineral development, as all would stand to benefit, so it was not considered in the economic models. The economic models were evaluated from the standpoint of a single corporate entity.

The Exploration Incentive Credit bill signed into law by Governor Knowles in 1995 may also provide Ahtna, Inc. with credits toward future tax and royalty obligations due the State of Alaska. The Exploration Incentive Credits are for exploration work on new mining operations. The law provides 100 percent credit for all eligible exploration costs against future mining license tax, corporate taxes, and royalties on production. Credits are limited to no more than 50 percent of the taxes or royalities due the state in any given year and must be taken within 15 years of beginning production. A cap of $20 million is placed on the total exploration credits for any new mining operation.

These Exploration Incentive Credits were not considered in the economic models as it is not possible to account for them without knowledge of Ahtna Inc. proprietary financial information. Ahtna, Inc. stock is not publicly traded and is subject to restrictions under ANSCA, as to who the authorized shareholders may be and their rights to sell the stock. This is similar for all Native Regional Corporations and Ahtna, Inc.'s financial information is not a matter of public record.

Although, the effect of the incentive would be positive, it would likely represent only a small reduction in the RMV required to attain a 15% DCFROR. Evaluated on a stand-alone basis, with the $20 million cap for total exploration credits used against future mining license tax and corporate taxes, it is estimated that on average, the incentive would likely reduce RMV no more than 2.8%. At a pre-feasibility level evaluation, the effect of the Exploration Incentive Credits is almost insignificant.

Calculation of RMV

Assume mill feed with grades of 11% zinc, 11.6 tr oz/st silver, 3% lead, and 0.10 tr oz/st gold is mined from a deposit. Mill recoveries were estimated at 90% for zinc, 85% for silver, 81% for lead, and 71% for gold. Smelter recoveries were estimated at 75% for zinc, 87% for silver, 80% for lead, and 55% for gold. Assume ten-year (1989-98) average prices from Table B-1 (1998 dollars) are used. The RMV ($/st) equals $180.

The equation used in calculating RMV for a deposit is:

$$\sum_{I=1}^{n} GiRiSiVi,$$

where

Gi = mill feed grade of commodity I,
Ri = mill recovery of commodity I,
Si = smelter recovery of commodity I,
Vi = $/unit of commodity I,
and n = total number of commodities.

The calculations are shown in the worksheet below.

CALCULATION OF RECOVERABLE METAL VALUE						
Commodity	**Grade (decimal)**	**Mill recovery (decimal)**	**Smelter recovery (decimal)**	**Unit**	**Price**	**RMV**
	Gi	**Ri**	**Si**		**Vi**	**(GiRiSiVi)**
Zinc	0.11	0.90	0.75	st	$1,340	$99
Silver	11.6	0.85	0.87	tr oz	$5.62	48
Lead	0.03	0.81	0.80	st	$900	17
Gold	0.10	0.71	0.55	tr oz	$417.79	16
TOTAL						$180

How To Use Worksheet

1. Estimate minable resource size, and resource commodity grades to be evaluated.

2. Refer to Figure 1, 2, or 3, select appropriate x-axis value representing nearest estimated minable resource size. Read RMV ($/st) from y-axis. This is the minimum value per short ton of minable resource adjusted for mining recovery, dilution, mill, and smelter recovery required to yield a 15% DCFROR using the hypothetical mining and milling scenarios described in this report.

3. To translate this value into a gross in place value (GIPV), back calculate value using assumed mill recoveries or pilot testing results if available, and appropriate smelter recoveries. Suggested commodity prices shown in Table B-1 may be used or other prices as desired.

Commodity Prices

Commodity prices provided for individual metals were determined by using an inflation adjusted thirty-year average for the years 1969-98. Prices for 1967-96 from various USBM publications were escalated to 1996 dollars using U.S. Department of Commerce Gross National Product implicit price deflators and then averaged. Prices after 1996 came from the U.S. Geological Survey (USGS) Commodity Statistics and Information web site.

Ten-(1989-98), twenty-(1979-98), and thirty year-(1969-98) average prices are shown for the commodities of interest. All prices shown in Table B-1 are given in 1998 dollars. Price fluctuations over the short term may have substantial impacts on project economics, with the obvious impacts of low prices resulting in low profitability or even financial losses. Higher profits will be realized during periods of higher prices.

Obviously, higher prices do not represent a problem for the mine operator. Low prices may force the mine operator into re-evaluating project economics and determining if the mine and mill should be idled, or if production should be reduced for some temporary period of time, or if the mine should be closed permanently. As there are significant expenses involved in idling and/or closing a mine, mine operators often elect to continue operating the mine at a loss, as it may often be less costly than idling or closing the mine.

When considered with ongoing maintenance expenses for meeting permit requirements, keeping a small work force to maintain the mine and mill in standby condition, cash flow requirements, the loss of production, incurring reclamation expenses and so forth, the decision will always rest on a case by case assessment of metal prices, the mine's unique situation, financial circumstances, closure expenses, and the operator's view of what the future may hold.

For the purposes of this report, it is assumed that over the long term life of the mine that the average price trends listed in Table B-1 would continue in the future. The mine would be continuously operated regardless of temporary short-term price fluctuations. As price is only one of four components that comprise recoverable metal value (RMV) in the models, it should be considered with the other components in arriving at different price assumptions.

Table B-1. - Ten, twenty, and thirty year average commodity prices (1969-1998)

Commodity	30 year average (1969 - 1998)	20 year average (1979 - 1998)	10 year average (1989 - 1998)	
Copper	$1.47	$1.28	$1.26	lb
Gold	441.36	523.07	417.79	tr oz
Lead	.52	.50	.45	lb
Silver	10.06	10.58	5.62	tr oz
Zinc	$0.69	$0.50	$0.67	lb