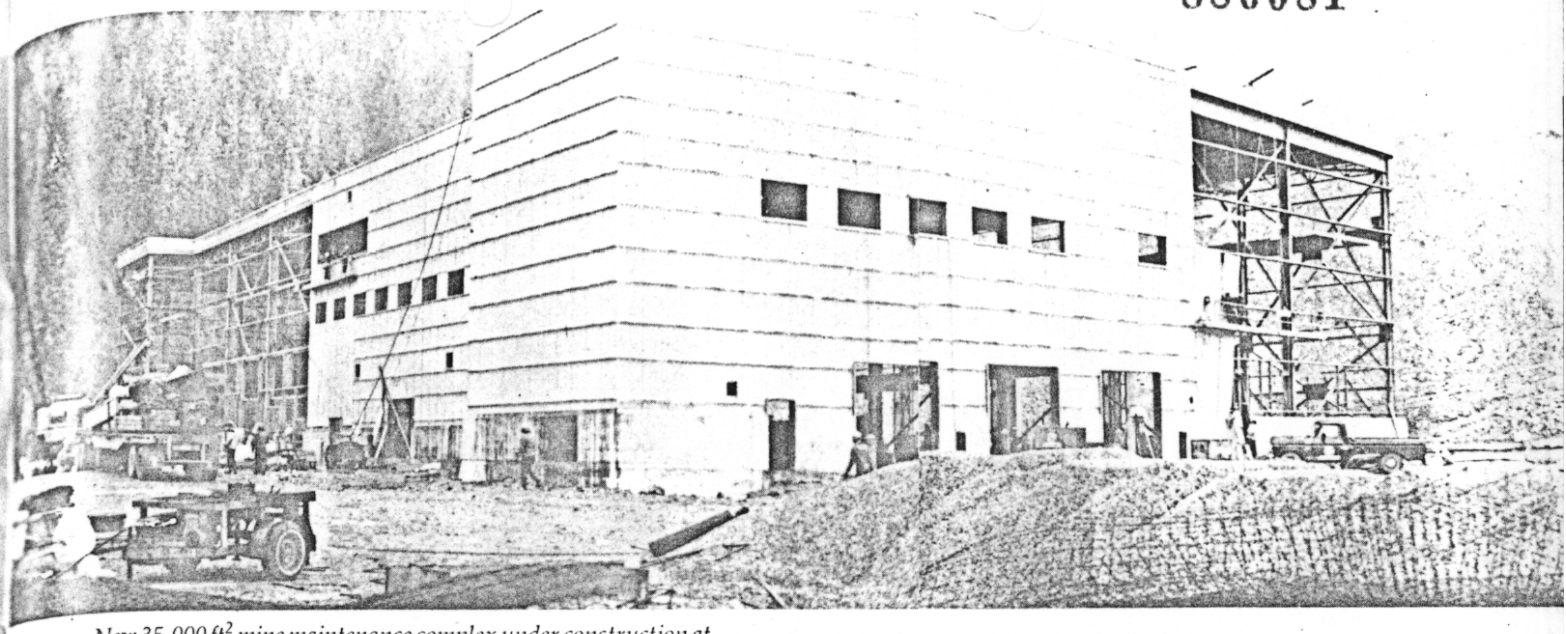


New 35,000 ft² mine maintenance complex under construction at Kitsault

Kitsault molybdenum mine gets ready for production

The Kitsault molybdenum mine northeast of Prince Rupert, British Columbia, is gearing up for production early in 1981.

Amax of Canada Limited, the new operator of the project, expects to be operating at a rate of 1200 tons/day by July 1981. The company replaced Climax Molybdenum Corporation as owner and operator following an internal corporate reorganization. Both companies are wholly-owned subsidiaries of Amax Inc of Connecticut.

Work on the $145-million project began in May 1979 and is proceeding on schedule. About 275 construction workers are currently on the site and this is expected to increase to 500 in the summer.

The mine maintenance shop has been closed in and is being finished inside. Expansion of the existing concentrator building has been completed and new equipment is being installed. A road now connects the mill to the townsite and construction of another 50 houses in the town will begin in summer 1980. Once in operation, the mill will employ some 450 people.

The following report on the project was prepared by C Allen Born, president, and Wayne D Lenton, vice-president and general manager for presentation at the Northwest Mining Association annual convention in Spokane, Washington.

HISTORY

The Kitsault mine of Amax of Canada Limited is located at the head of Alice Arm, approximately 800km north of Vancouver and 140km northeast of Prince Rupert. The orebody, which has been developed by open pit mining methods, is located about 7.25km from the existing townsite at an elevation of 610m.

British Columbia Molybdenum Limited, a subsidiary of the Kennecott Copper Corporation, developed the open pit mine, constructed a 5440 tonne/day concentrator and built a townsite composed of 56 single family homes and 250 single mens' quarters to house employees. Operations started in late 1967 and continued into mid-1972. During the period that British Columbia Molybdenum Limited operated the property, approximately 10.5-million kg of molybdenum were produced from 9-million tonnes of ore at an average mill recovery of 90%. The average ore grade was 0.20% MoS_2. A stripping ratio of approximately 1.50:1.0 resulted in 13.6-million tonnes of waste being mined.

In late 1972 Amax purchased the Kitsault property from the Kennecott Copper Corporation.

GEOLOGY AND MINERALIZATION

The Kitsault orebody occurs in metamorphosed and altered Hazelton and Bowser Lake formations east of the coast range crystalline complex. Molybdenite mineralization is related to complex stocks of early tertiary age. The coast range crystalline complex in the Alice Arm area consists of numerous diorite, granodiorite and quartz diorite intrusives which are believed to be 45- to 55-million years old.

Intrusion of the Alaskite phase produced the first molybdenite mineralization as minor disseminated rosettes. A second period of mineralization followed the Alaskite. Initially quartz-feldspar veins cut by quartz-molybdenite veins, and, lastly, quartz-pyrite veins.

After the second period of mineralization, intramineral porphyries were emplaced. This event was followed by the third period of mineralization, which is identical to the second period, except that veins of this age are not cut by intramineral dikes. The fourth period of mineralization, similar to periods two and three, is characterized by wide, banded quartz-molybdenite veins.

Most of the molybdenite occurs in quartz-veins, with minor amounts disseminated in Alaskite and as molybdenite paint on fracture surfaces. Generally, the highest grade material is in the central portions of the ore lodes. Mineralization occurs along the contact between the Lime Creek stock and Hornfels in the west, north and east, but

cuts across the center of the stock in the southern part of the orebody.

Galena, sphalerite, chalcopyrite and copper-lead-bismuth sulfosalts occur primarily in late polymetallic veins. Galena is probably present as either attachments on, or encapsulated within the molybdenite grains.

Alteration of the orebody has decided effects on the rock competency and milling characteristics of the ore. Generally, silicified and feldspathized rock is more competent and slightly harder than the unaltered rock. Argillization and sericitization reduces competency and softens the rock.

MINE RESERVES

A mineable ore reserve of 105-million tonnes having an average grade of 0.192% MoS_2 has been indicated. Insufficient drilling below the 365m depth prevents estimation of grades with any degree of confidence at lower levels.

The mineral inventory was developed from diamond drill holes with assays from each 3.05m sample interval. These assays, when composited into 12.2m intervals to correspond to the bench height, gave an average grade of 0.192% MoS_2 with a stripping ratio of 1.82:1.0. A three dimensional mineral model, comprised of 15.2 × 15.1 × 12.2 metre blocks, was developed from the assay data using a spherical interpolation distance of 122 × 122 × 30.5 metre in the X Y and Z directions respectively. Variogram studies supported the selection of these interpolation distances. With a mill throughput of 10,887 tonnes/day, a mine life of 26 years is predicted.

PROJECT DEVELOPMENT

The 1979 program included placement of orders for equipment and delivery of equipment needed for development, initial work on the dock, townsite expansion, concrete, structural steelwork on the concentrator, access roads, tailing disposal, mine office and shop, primary crushing, coarse ore storage and secondary and tertiary crushing and screening.

In 1980, all areas worked on in 1979 plus the water supply, fine ore storage, tailings line and outfall will be completed. Approximately 2.5-million tonnes of preproduction stripping will start at mid-year 1980 and continue through the first quarter of 1981. Additional open pit mining equipment needed to meet a 10,887-tonne/day mill production rate will be delivered late in 1980 and early 1981.

The second quarter of 1981 will be devoted to commissioning the mill and crusher, continued stripping and completion of the townsite development. Start-up of production is scheduled for mid 1981.

T SHOP AND OFFICE

e pit shop will provide a maintenance area for all open pit equipment as well as office space, dry rooms and warehouse for both pit operations and maintenance.

The maintenance area includes eight bays capable of handling haulage trucks. Two bays will be allocated to dozer repair and one bay to welding area. A small vehicle service area is also provided. The eight bays are serviced by a 22.7-tonne overhead crane. The structure will be two stories with the first floor for shops and warehouse and the second floor for office space and locker rooms. Support facilities include electrical and machine shops, warehouse, tool-room, offices and both men's and women's locker rooms. An ambulance and fire truck garage and a first-aid room are included in the shop layout.

PIT OPERATION

The production capacity of the open pit is restricted by the nearly vertical cylindrical shape of the orebody and it is unlikely that tonnages exceeding 10,887 tonnes/day could be sustained over long periods of time.

Major pieces of equipment include 7.6m shovels, 11.5m loaders, 77-tonne trucks, 32-tonne trucks, dozers, drills, graders and a crushing plant for road aggregate.

The required ore and waste tonnage can be produced by operating two shovels and eight trucks for three shifts per day, seven days a week, 350 days per year.

The pit mining operations will utilize three shovels and 12 trucks, and the 24-hour operation will require four crews of 12 men each. Drilling will require two drills around the clock utilizing four crews of two men each. The four smaller 32-tonne trucks and a loader will operate only on day shift along with some of the grader and dozer operations. Drilling and blasting operation and maintenance will be performed primarily on day and afternoon shifts. Two hundred men will be required for the pit operation at full production.

MILL EXPANSION

Site work consists of general clean-up and grading of the site. With the addition of coarse ore storage, considerable rock excavation adjacent to the secondary crusher building is required. Relocation of a road section around the northeast corner of the stockpile is also required. The existing millwater supply system will be upgraded with the addition of three vertical pumps to accommodate the mill and crusher expansion. At a maximum predicted milling rate of 14,282 tonnes/day, for a 10,887 tonne/day average milling rate, millwater requirements are estimated to be 25,000 litres/minute. Additionally 680

litres/minute are required for potable water.

Electrical work will include the upgrading of the incoming high voltage system from 69Kv to 138Kv. A standby 138000/4160V transformer will be installed. Secondary existing transformers and switchgear will require refurbishment and upgrading. The addition of 3700HP in grinding and crushing capacity, 600HP in the flotation circuit and considerable additional power requirements for heating will be areas for increased power requirements. Total power requirement is estimated at 18 megawatts.

The initial cost estimate anticipated replacing all instrumentation in the plant, however, recent inspections indicate this is not required. New control panels are needed for primary crushing, secondary crushing plants. A small central control room for the grinding and flotation area will be added. The filtering, drying, leaching and packaging areas will have their dedicated control panels.

Work on the primary crusher includes major concrete work to accommodate the 77-tonne trucks. A rock breaker will be installed over the dump pocket to handle oversize material. The secondary/tertiary crusher building will be insulated and heated. A 8925-tonne live storage stockpile will be provided to allow operational separation of primary and secondary/tertiary crushing.

Two secondary screens will be installed in the secondary crushing and screening plant. Modifications to the fine ore bin consist of the installation of slot feeders and construction of access walkways and ladders. Fluorescent lighting will replace existing incandescent lighting in all areas.

A second tertiary crusher will be installed matching the existing tertiary crusher which will be refurbished.

Alterations to the concentrator will be extensive so that capacity can be raised from 5443 tonnes/day to 10,887 tonnes/day. The mill building has been expanded to the south to accommodate two additional grinding units and a small addition was made on the west side for reagent mixing and storage.

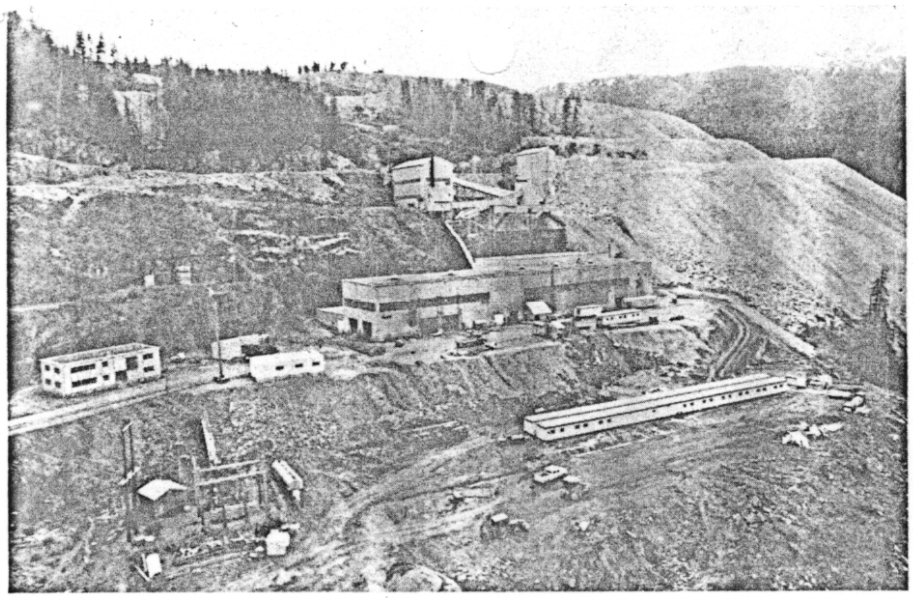
The grinding circuit will be expanded to three ball mills and two rod mills with the addition of one 4.42m × 5.49m ball mill and one 3.81m × 4.88m rod mill. Two new banks of 8.5m^3 rougher cells will increase the flotation capacity by 133%. The first regrind circuit will remain the same except for the addition of one bank of cleaner cells.

The second regrind circuit will have new pumps, sampler, thickener and cleaner cells. A new 1.52m × 3.05m middling regrind mill and cyclones, a bank of middling cleaner flotation cells and samplers will be added. A third 1.52m × 2.13m regrind mill with cyclones and cleaner flotation cells will be added. An agglomerator tank and a bank of fourth cleaner flotation cells will complete the addition and modifications to the grinding and flotation circuits. A lead leach circuit will be incorporated. The mill control center will also be relocated and upgraded.

The existing filtering, drying and packing equipment will be re-located. In addition new packaging equipment to accommodate one-tonne poly bags will be added. Alternates of utilizing bulk 'seatainers' for concentrate shipment are presently being investigated.

MILL OPERATION

The crusher and concentrator were operated for approximately five years by the former operator, at a nominal rate of 5433 tones/day. Considerably higher rates were achieved when the 'softer' diorite-granodiorite ore was milled. The mill expansion has been designed to handle an average 10,887 tonnes/day of combined hard and soft ore. Based on the analyses of the former operator's operating data and the research done by the Amax Metallurgical Laboratory, grind and recovery relationships were developed. These studies and tests indicated that depending on head grade,



Concentrator building before being expanded and refurbished

average recoveries of 85-95% MoS_2 could be achieved at an average grind of 40-45% plus 100 mesh in the rougher circuit. The final concentrate would contain over 90% MoS_2. Since the concentrate would otherwise be high in lead, nokes reagent will be added to grinding and flotation stages and the final concentrate will be subjected to a hot hydrocloric acid leach. The nokes addition and subsequent hot hydrochloric acid leaching will produce a molybdenite concentrate containing less than 0.02% lead.

TAILINGS DISPOSAL

A gravity tailings pipeline will be constructed along the existing townsite/mine access road to the edge of the townsite. From the townsite the pipeline will swing 1500m south and terminate at an ocean outfall structure situated at high tide level. Tailings will be deposited via underwater pipeline installed to a depth of 50m below sea level. Tailings deposition will be in full compliance with the applicable federal and provincial regulations.

Since the mill site is located at an elevation of 550m and 7.2km inland an energy dissipation method is required. The 'drop box' method and the 'orifice choke station' methods were investigated. Based on lower initial capital cost as well as lower operating downtime, the 'drop box' method was selected. A total of 150 drop boxes with a drop of 3.5m will be installed. Total length of the tailings line is 7.75km.

TOWNSITE

Expansion of the townsite to accommodate a population of approximately 1000 people with an initial married/single ratio of 30%/70% is needed to provide for the projected work force of 450 people. A new town centre, including recreation and commercial centres will be added to the existing facilities which consist of 56 single family houses and a single men's quarters and guest house. The school will be relocated to the central area. Special attention will be given to the town planning and development to attract and maintain a stable work force. Amenities such as a shopping centre, garage, ice arena, gymnasium and marina will be incorporated.

A new sewage treatment plant, along with the miscellaneous associated municipal works will be constructed. The dock facilities require rebuilding so that 2000-ton barges which will provide the primary materials transportation to the site, can be accommodated on all tides. Molybdenite concentrate will be shipped by barge.

In an effort to reduce the isolation of Kits[illegible] an access road is planned to conn[illegible] the townsite with the existing Stewart-Terrace road in the Nass River Valley. Terrace has a population of approximately 17,000 people. The road addition will improve transportation service and supplies delivery as well as giving residents their freedom of access. The road will be a typical BC Forest Service standard gravel surface road with a 8.5m top. Maximum grades of 8% will be maintained. Improvements to the existing 8km townsite/mill/mine road will be required as this stretch of road will form part of the proposed access road. New construction of approximately 40km from Clary Lake (mill water supply) eastward over very rugged terrain will tie into the Canadian Cellulose logging road and the existing Nass River bridge which connects with the Stewart-Terrace road. Six bridges and many smaller culvert stream crossings will be required.

SURFACE MAINTENANCE

A small townsite maintenance shop and garage will be refurbished on the waterfront in the townsite. These facilities will include carpenter, electrical and plumbing shops as well as interim materials storage and staging area for barge delivery of equipment and supplies.

ADMINISTRATION

The administrative offices including accounting, purchasing, safety, labour relations, personnel, security and miscellaneous management functions will be accommodated in existing general offices which will be refurbished. It is planned that this office staff along with all mine and mill personnel will be bused to their respective work areas from the townsite.

WM

Cookhouse and construction camp at Kitsault in November '79