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DUVAL CORPORATION

MINING AT THE ESPERANZA PROPERTY

History

The old New Years Eve underground mine, the first workings in the Esperanza area, was operated spasmodically, mining copper, from 1895 until the present Esperanza open pit property was developed.

The area was first visited by Duval personnel in the fall of 1954. In May 1955, exploration drilling was started on a 500-foot equilateral, triangular grid pattern. By May 1957, 88 churn and diamond drill holes were completed for a total footage of 30,724 feet. In addition, 2,100 feet of underground workings were excavated to gather more information concerning the ore body.

Pre-mining stripping of waste was started in November 1957, with Isbell Construction Company performing the mining under contract. By February 1959, when the mill was completed, sufficient ore was exposed to start actual production from the Esperanza Mine.

Exploratory drilling discovered ore in an adjacent area called West Esperanza in July 1960. Exploration and development drilling of this area, during 1961 and 1962, consisted of 141 rotary and diamond drill holes for a total footage of 26,139 feet. In March 1963, pre-mining stripping was started with the first ore being produced from the West Esperanza pit in August 1965.

In July 1965, Duval purchased the mining equipment at Esperanza from Isbell and took over the mining operations.

Pit Dimensions

Esperanza Pit: the highest original elevation along the west side of the pit was 4,314 feet. The lowest elevation to be mined will be 3,515 feet

for an elevation difference of 799 feet. Six benches, each 35 feet high, are presently being mined. The maximum dimensions of the pit are 4,000 feet east-west and 2,500 feet north-south.

West Esperanza Pit: the highest original elevation was 4,422 feet. The lowest elevation will be 3,800 feet for an elevation difference of 622 feet. Three benches, each 50 feet high, are presently being mined. The maximum dimensions of the pit are 2,100 feet east-west and 3,800 feet north-south.

Rock Types

The ore bodies are of the porphyry type with the main ore-bearing rocks being quartz-monzonite porphyry, quartz diorite, and andesite porphyry. Other types of rocks encountered are quartzite, welded tuff, quartz latite porphyry and dacite. The rocks are of Cretaceous and Tertiary age. The main copper minerals are chalcopyrite and chalcocite. Molybdenum mineralization occurs as molybdenite.

Blasting and Mining

In blasting the rock, 9-inch diameter holes are drilled with a rotary drill. These holes are approximately 20 feet apart and are drilled to a depth of 7 feet below the next lower bench. The holes, when dry, are loaded with ammonium nitrate mixed with diesel fuel and blasted. When the blast holes contain water, a gelatin type of blasting agent called slurry is used.

In order to determine whether the material to be mined is ore, leach, or waste, a sample is taken of the cuttings of each blast hole and assayed. The results determine whether the blasted material is to be designated as ore, leach, or waste. Material is considered ore if it contains copper and molybdenum equivalent to 0.40% copper or above. All material with a copper equivalent content between 0.15% and 0.40% is considered leach. Any material

containing less than 0.15% copper equivalent is designated as waste.

Mined Tonnage

The total tonnage mined from the Esperanza and West Esperanza pits as of July 1, 1968 was 116.5 million tons. This represents 43.0 million tons of waste, 33.5 million tons of leach and 40.0 million tons of ore containing less than 1% copper. At present, approximately 280,000 tons of material are mined per week.

Equipment

Electrically powered shovels are used for loading the blasted rock. Shovels range from five to 12 cubic yard capacity. The capacity refers to the size of the bucket on the shovel. Haulage trucks vary from 35 to 75 ton capacity. The mine operates 3 shifts per day, 7 days per week during which period 35 shovel shifts are worked. The majority of ore is hauled on the second and third shifts which enables maintenance work to be done on both the crushing and mining equipment on day shift.

Leach Dumps

Leach dumps are located between hills and over arroyos in order that the return water from the dumps can be collected. Leach solution, containing some acid, is sprayed on the surface of the dump. As the solution percolates down through the dump it dissolves the copper from the rock. The pregnant or copper-bearing solution is then collected below the dump and piped to the precipitation plant. Here the copper is removed from the pregnant solution by flowing it through beds of shredded iron scrap. The copper precipitates out in the form of a mud called cement copper or precipitate copper containing approximately 75% to 85% metallic copper.

The Mill

The mined ore is passed through three crushing stages during which it is reduced to less than one inch in size. It is then conveyed to the mill

which, on an operating basis of 24 hours per day, 7 days per week, has a daily milling capacity of 15,000 tons. Here it is passed through rod and ball mills in which it is ground to a very fine, almost powder, size. It then goes through the flotation sections where the copper and molybdenum are separated from the ore pulp. Further processing through flotation separates the copper from the molybdenum. The copper concentrate, containing approximately 25% copper, is shipped to smelters. The molybdenum concentrate, containing approximately 58% molybdenum, is further refined and shipped direct to the consumer.

VISITOR'S
INFORMATION
PAMPHLET

DUVAL SIERRITA CORPORATION
GEOLOGY DEPARTMENT

ROBERT A. METZ, CHIEF MINE GEOLOGIST

A. HARVEY JAMES, MINE GEOLOGIST

BOB GALYON, DRAFTSMAN

DUVAL SIERRITA CORPORATION

SIERRITA PROPERTY

ORGANIZATION

Resident Manager	S. H. Martin
Mine Superintendent	A. P. Holzworth
Chief Mine Engineer	F. H. Buchella, Jr.
Chief Mine Geologist	R. A. Metz
Safety Supervisor	D. L. Gidak
Chief Accountant	S. C. Polasek
Purchasing Agent	J. K. Peters
Personnel Relations Supervisor	S. L. Vaughn

Geology - Esperanza and Sierrita

ESPERANZA

Rock types within the ore zone consist of cretaceous welded tuffs, quartz diorite, latite, quartz monzonite porphyry. Hypogene metallization is syngenetic with rock type formation and consists of chalcopryrite, pyrite, molybdenite with minor sphalerite, galena and magnetite. Favored hypogene ore host is quartz monzonite porphyry. Supergene (chalcocite) metallization zone averaged 125 feet thick. Dominant structural trend is NE to ENE.

SIERRITA

Rock types within the ore zone consist of quartz diorite, quartz monzonite, and quartz monzonite porphyry. Metallization, again partly syngenetic, consists of chalcopryrite and molybdenite with minor amounts of sphalerite, galena and magnetite. There is no enriched blanket in the Sierrita ore body. Dominant structural trend is identical to that of Esperanza, which is NE to ENE.

THIS PAMPHLET EXCERPTED FROM "AIME" FIELD TRIP 3 PAPER.

The Sierrita property consists of over 13,000 acres, which includes property rights for water field, tailing disposal and rights of way for pipe lines and a railroad spur. Included in this total acreage are 143 unpatented mining claims which were purchased by Duval Corporation. Approximately 58 percent of the Sierrita ore body was acquired in the purchase of these claims. The remaining 42 percent of the ore body was controlled by patented mining claims which were part of Duval's Esperanza Property. Duval has transferred these unpatented and patented mining claims to the Sierrita property.

EXPLORATION AND PRELIMINARY DEVELOPMENT

A total of 137 test holes have been drilled in order to delineate the Sierrita ore body and to test proposed waste dump areas. Some of the tests were drilled to check certain holes drilled by another mining company which had previously drilled 60 core tests in the area.

ORE RESERVES

The exploration and preliminary development program delineated an ore body of 414 million tons with an average copper content of 0.35% (Seven pounds) and an average molybdenum content of 0.036% (0.72 pounds). Engineering pit design indicates that a total of 634 million tons of waste must be handled prior to and during the mining of the 414 million tons ore reserve. This total of over a billion tons of ore and waste, which will be mined, represents more than twice the tonnage excavated in the construction of the Panama Canal.

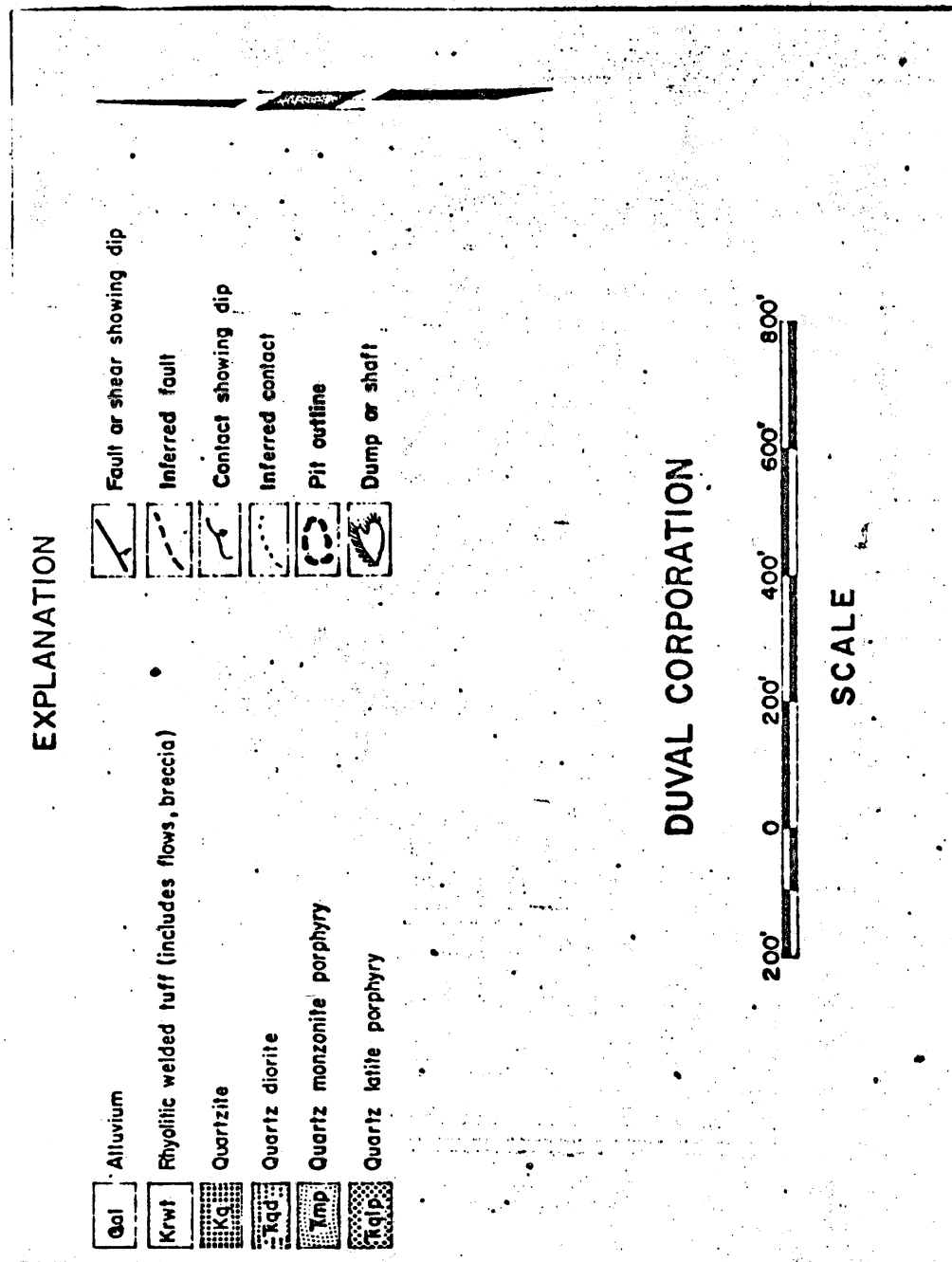
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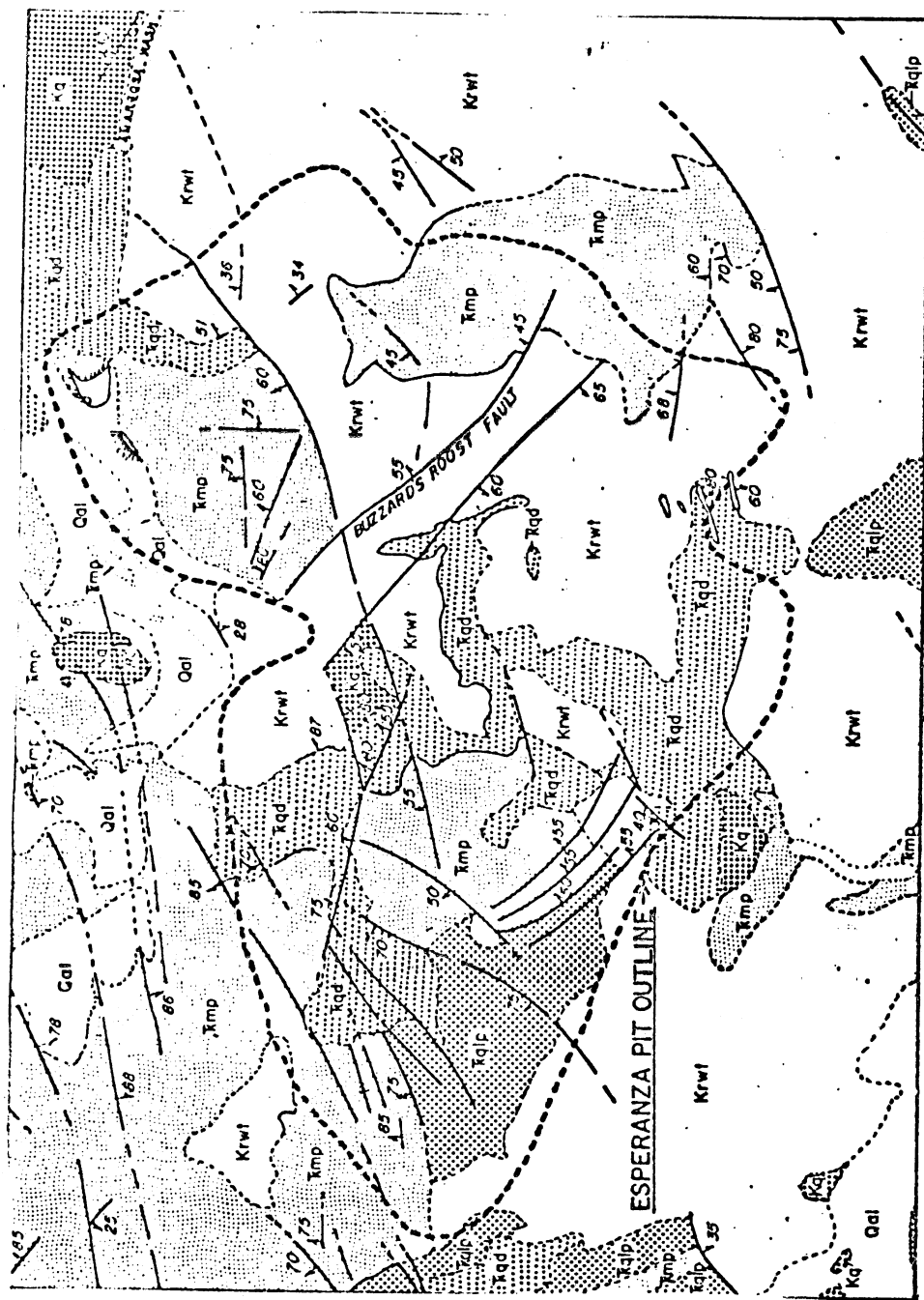
It is anticipated that the eventual perimeter of the Sierrita open pit will encompass an area of approximately 460 acres. As presently designed, the pit will ultimately reach a depth of 1850 feet below the highest elevation of the pit area prior to commencement of mining. By comparison, the Empire State Building is only two-thirds as tall as the pit will be deep.

The mining plans provide for the removal of 105 million tons of waste overburden before the commencement of ore mining operations. A daily average of 200,000 tons per day will be mined during the pre-mine stripping period. Thereafter, the mining of ore and waste will be conducted on a scale of approximately 235,000 tons per day for the initial six-year production period, after which the scale of mining operations will be somewhat reduced as less waste will be handled.

MINING EQUIPMENT AND FACILITIES

The mining equipment features six power shovels of P & H manufacture equipped with 15 cubic yard buckets and an initial order of 28 electric wheel haul trucks of 120-ton capacity which will be expanded to 40 by the completion of pre-mine stripping. These shovels and trucks are of the largest presently used in the copper mining industry. In addition, six rotary blast hole drills, 11 dozers and numerous other units such as motor patrols, fork lifts, cranes, water trucks, personnel buses and miscellaneous small trucks supplement the operation. Service facilities consist of two modern shops, steam cleaning pad, change room and offices.





Because the power shovels and haul trucks represent the largest of these machines used in the industry, some pertinent facts concerning these units are of interest:

Power Shovels:

1. The weight of each shovel is approximately 450 tons.
2. Shovels are rated at 750 HP and are electrically powered by 4160 volt AC current.
3. When loaded, the 15 cubic yard bucket contains approximately 25 tons.

Haul Trucks:

1. The initial purchase of 28 electric wheel trucks was evenly divided between KW Dart Company and Westinghouse Air Brake Company.
2. The truck engines are 12 cylinder diesels rated at 1000 HP.
3. Engines drive DC electric generators, which supply power to electric motor assemblies in the rear wheels.
4. Trucks have a rated capacity of 120 tons and weigh approximately 75 tons empty.
5. Fuel tanks hold 450 gallons of diesel oil and the engines use one gallon per mile under full load conditions and level haul.
6. Truck tires are constructed of 48 ply, stand nine feet in height and weigh 3000 pounds.

PLANT FACILITIES

Stearns-Roger Corporation of Denver, Colorado has been awarded an engineering construction contract to build the Sierrita concentrator and associated facilities. The concentrator, which will have a designed capacity in excess of 60,000 tons of ore per day, and the associated

facilities are estimated to cost \$84 million. This capacity will be greater than any single copper-molybdenum concentrator in North America. The construction of plant facilities is expected to be completed in the third quarter of 1969.

PRODUCTION

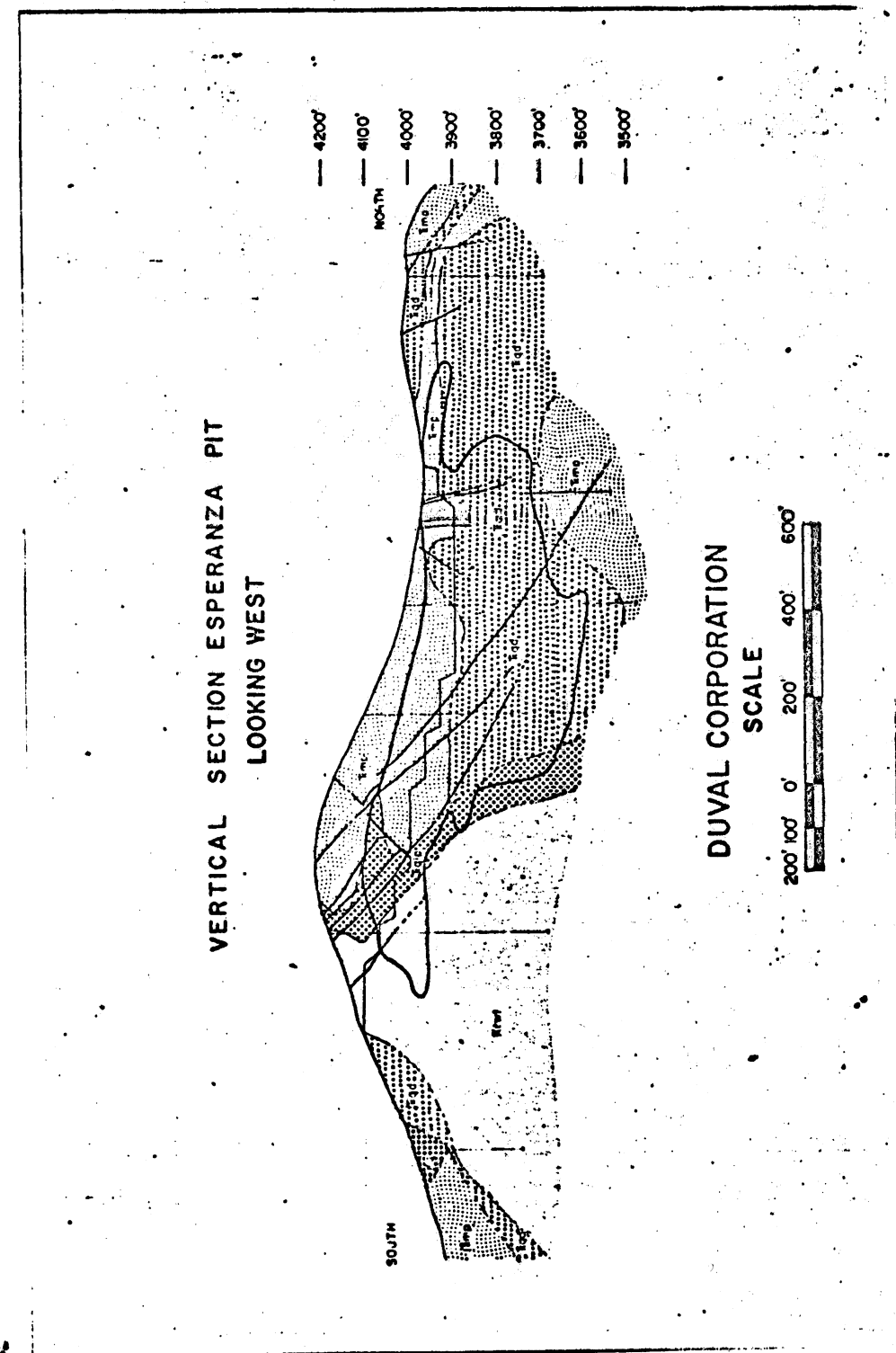
The Sierrita property will produce an annual minimum average of 114 million pounds of copper during the first five years of operations and 136 million pounds thereafter. In addition, the property will produce approximately 12 million pounds of molybdenum and 455,000 ounces of silver annually. When Sierrita reaches full production, Duval Corporation will rank fourth in U. S. copper mine production and supply approximately 14 percent of the free world's molybdenum.

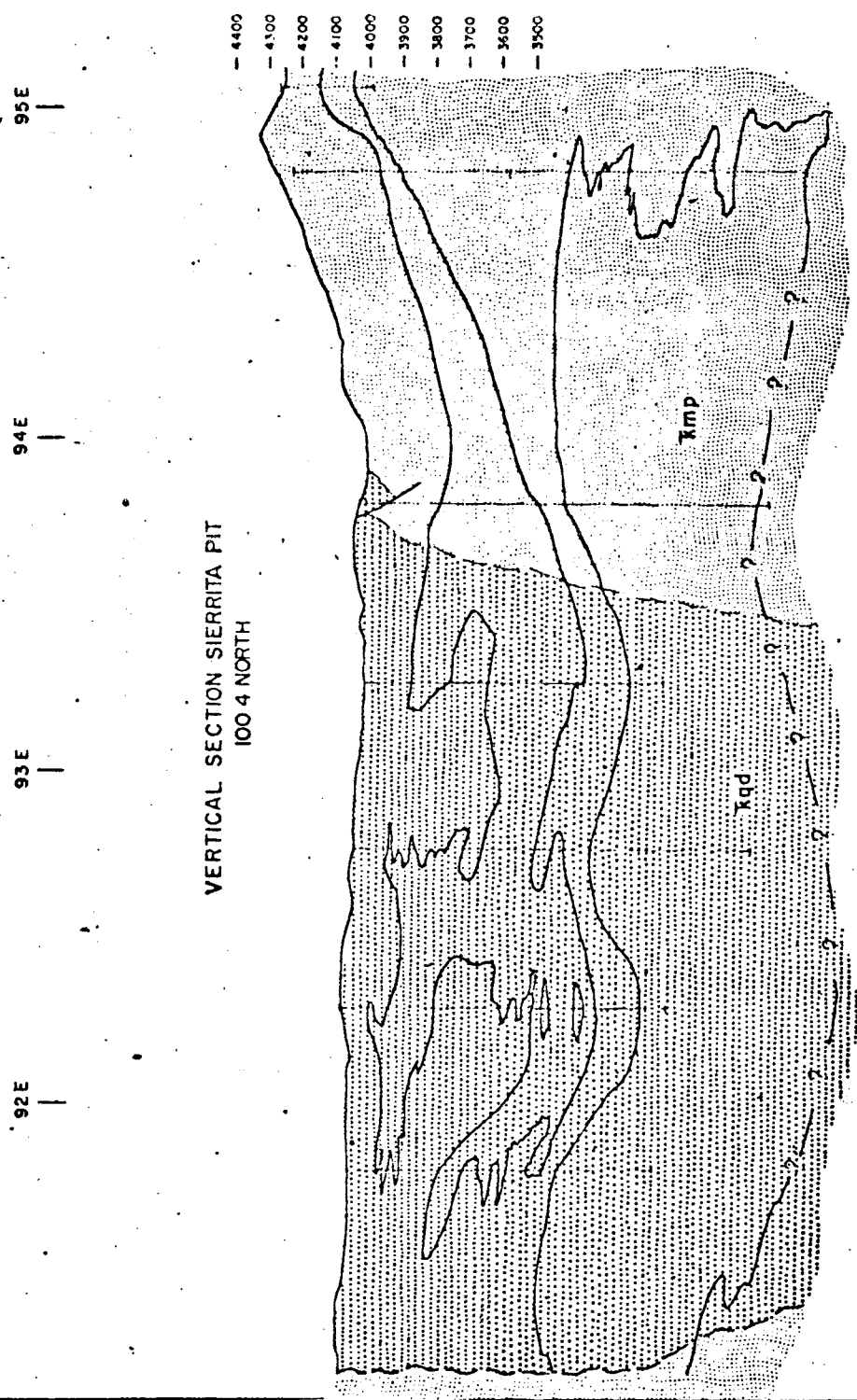
EMPLOYMENT

Peak employment during construction at the Sierrita property is expected to reach some 2,800. It is estimated, average permanent employment during production will be 1,100.

UTILITIES

Power and natural gas will be supplied by Tucson Gas and Electric Company. Power requirements are expected to be approximately 60,000 kilowatts or 40 million kilowatt hours per month. This amount of power would supply an average city of more than 100,000 population.

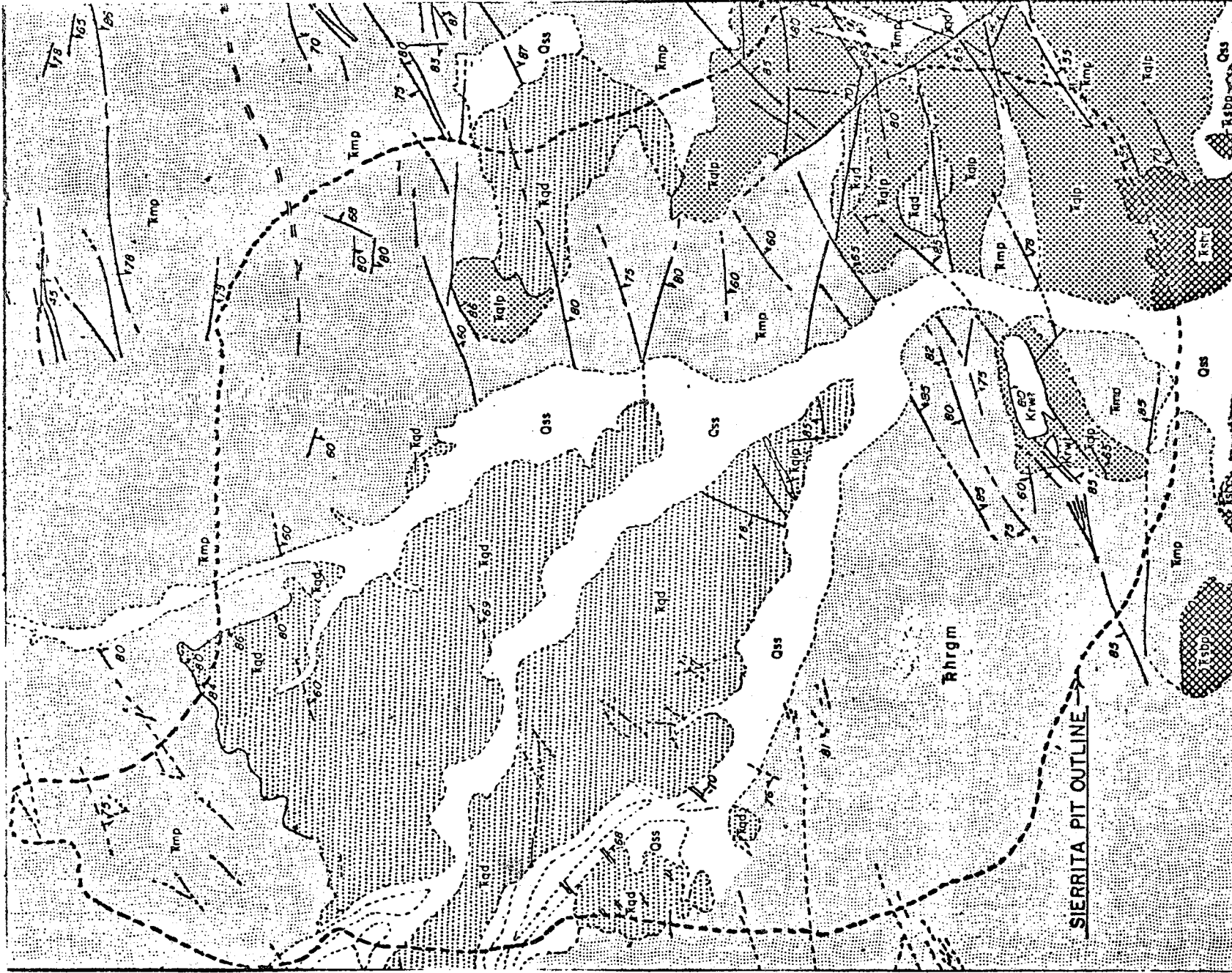














DUVAL - SIERRITA CORPORATION

Gas requirements are expected to be some 50 million cubic feet per month with all but a fraction of the gas being utilized in roasting molybdenum sulphide concentrates into the oxide form.

Water requirements for the operation will be on the order of 15,000 gallons per minute with most of this amount being used in the milling operation. This water will be pumped from wells along the Santa Cruz River Basin belonging to the Sierrita property. To secure this advantageous site with its water rights, a 5900-acre ranch, which was part of an original Spanish Land Grant, was purchased.



EXPLANATION

- | | | | |
|--|---|--|----------------------------|
|  Qss | Quaternary stream sediments |  Kgd | Quartz diorite |
|  Krip | Rhyolitic welded tuffs (includes flows, breccias) |  Klp | Quartz latite porphyry |
|  Klp | Silverbell andesite porphyry |  45 | Fault or shear showing dip |
|  45 | Inferred fault |  45 | Contact showing dip |
|  45 | Inferred contact |  45 | Inferred contact |

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