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Item #14

Nevada.
Lander Co.
Cortez Gold Deposit

AIME – NYC
FEB 68

p. 1 of 3

Geology and Mineralogy of the Cortez Gold Deposit, Nevada

J. D. Wells, *Ralph Erickson*, U. S. Geological Survey, Denver, Colorado and *Lee R. Stoiser*, American Exploration & Mining Co., San Francisco, Calif.

A gold deposit recently discovered at Cortez, Nev., about 45 miles southwest of Carlin, occurs in a window of carbonate rocks of the lower plate of the Roberts Mountains thrust fault. The host rock consists of thin bedded silty dolomitic limestone and calcareous dolimitic siltstone that contains syngenetic pyrite cubes and aggregates. These rocks have been assigned to the upper part of the Silurian Roberts Mountains Limestone and/or lower part of the Devonian Wenban Limestone. The rocks have been repeatedly faulted and folded. The gold occurs along fractures and bedding planes in a zone where the rocks have been bleached and the pyrite oxidized. During oxidation the iron was redistributed, giving the rock a color ranging from light gray to dark red. The alteration zone envelops an intrusive body of biotite-quartz-sanidine porphyry, which is also altered. The genetic relationship between the mineralization and the intrusive body is unknown. The gold metallization generally accompanied silicification, iron-oxide staining, decalification and, in extreme cases, dedolomitization, although any one of these phases of hydrothermal alteration may have been well developed without introduction of significant amounts of gold. The gold is in particles of native metal ranging less than 0.2 to 10 microns in diameter. It occurs mostly within chalcedony introduced between the original silt grains and to a lesser extent in quartz filled microfractures and hematite-geothite pseudomorphs after pyrite. The gold was discovered during examination of an arsenic-antimony-tungsten-mercury geochemical anomaly in the area. Other gold deposits in north-central Nevada are known to be associated with such anomalies.

Notes by J. G. Roylance, Jr.

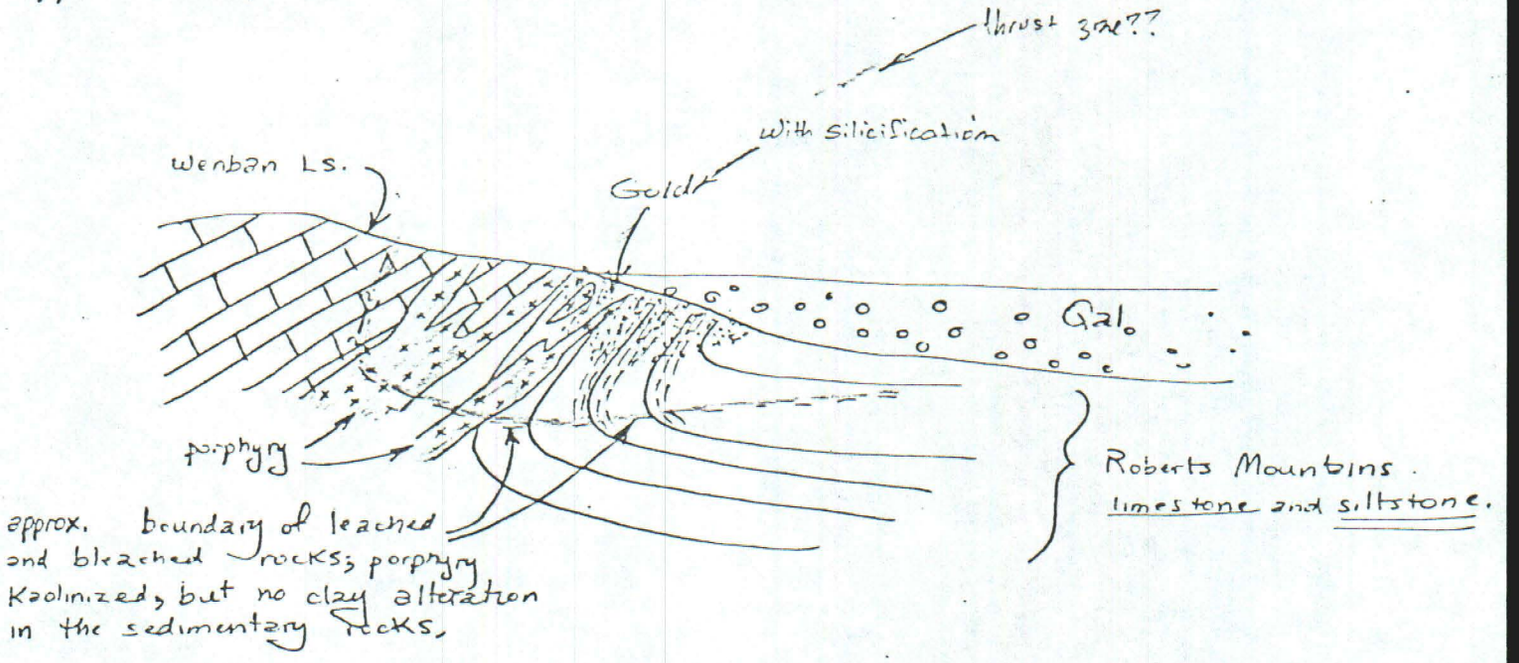
Gold discovered at Cortez by the USGS in 1966 and currently being drilled by Amex. Deposits are in lower plate of Roberts Mountains thrust fault (upper plate eroded off this area), in Silurian Roberts Mountains Limestone and the overlying ~~Silurian~~ Devonian Wenban Limestone.

The intrusive porphyry rock is 34 million years old, the same age as the nearby welded tuffs.

Same (age? or strathgraphic?) interval as at Carlin gold mine.

Syn(?)genetic pyrite cubes found in sedimentary rocks.

Red-brown areas generally, but not always, are mineralized with gold, whereas gray areas are barren. Gold is fine, too fine to be panned for the most part. Sampling showed up to 3 ozs Au/ton.



Alteration caused an increase in porosity of the sedimentary rocks which aided in the introduction of hydrothermal silica; generally, the silicified rocks contain gold.

Carbon removed during hydrothermal phase -- as at Carlin. Organic carbon apparently had little to do with mineralization CaO also removed; this resulted in increased porosity.

Antimony and mercury show some dispersion out from the high grade gold, but copper, tungsten, and arsenic seem to coincide with the gold distribution. Ore zone contains very weak silver -- < 1ppm.

Gold is very fine: some is less than 0.1 micron, but most is about 1 micron. Gold occurs 1) in quartz veinlets, 2) in siliceous groundmass, 3) in goethite pseudomorphs after pyrite.

Cortez gold p. 3 of 3 Feb. 8

AIME - NYC

Total iron content of fresh rock is about equal to total iron content of comparable altered rock. Surface waters removed iron from altered pyrite (apparently oxidized by hydrothermal solutions, if I understood the speaker) and distributed it widely in rocks mins silicate. The gold deposit probably contained 0.1% FeS_2 prior to oxidation.

Possibly 1 ppm gold was present in syngenetic pyrite; therefore, ~~all gold may have~~ hydrothermal flushing of syngenetic gold and ~~reconsidered~~ deposition in porous areas is considered a possible explanation of the origin of the Cortez gold ore deposit.

RENO GAZETTE

Cortez Gold 9 MAR 68 Production Scheduled

Cortez Gold Mines will place its gold property in the Cortez mining district of Nevada into production "as soon as possible," the company announced today.

"The construction program will start as soon as possible, and is expected to be completed by the end of 1968," a company spokesman said, in a news release from San Francisco.

"Total cost of the program is estimated at $9 million, and when in production the property will employ more than 100 men and produce in excess of 400 ounces of gold a day."

RENO GAZETTE - 9 MAR 68

Cortez Gold Mines is a joint venture, composed of American Exploration & Mining Co., a wholly owned subsidiary of Placer Development Limited, The Bunker Hill Co., Vernon F. Taylor, Jr., and Webb Resources, Inc. The project will be managed by American Exploration & Mining Co. of San Francisco.

The decision to place the property into production follows an exploration program conducted during the last eight years in the Cortez area by the joint partners. The gold anomaly was identified in 1966 by the United States Geological Survey while carrying out a heavy metals research program in the Cortez area.

The basic engineering study was made by Bechtel Corp. in San Francisco, which firm also developed the flow sheet and concepts for the gold cyanide treating plant.

The detailed plant design and construction will be done by Wright Engineers and Commonwealth Construction Co. of Vancouver, B.C., respectively.

The property has a presently measured ore reserve of approximately 3.4 million tons containing 0.29 ounces of gold per ton which will be mined by open pit methods and processed through a mill of 1,500 tons per day capacity.

6.3 years life @ 360 days/yr, 1500 tpd

Prod. @ 540,000 tons/yr.

CORTEZ GOLD MINES

From field trip,
October 18, 1969
SAT

HISTORICAL REVIEW

The Cortez district was discovered in 1862 by prospectors from the silver camp of Austin, about fifty miles to the south. From 1864 to 1867 Simeon Wenban and George Hearst, in partnership, mined rich ores in the district. In 1867 Wenban bought out Hearst, acquired all the important mines in the district and operated them until his death in 1895. The period from 1864 to 1895 was the most productive in the district's history, with the bulk of the production in silver, although minor amounts of gold, lead and copper were recovered. Much of the ore was very rich, running into hundreds of ounces of silver per ton. During the period 1923 to 1930 Consolidated Cortez Silver Mines operated a 100 ton per day concentration plant mining deeper ore and also recovering some of the lower grade back-fill residue from earlier operations. In other periods from 1895 to 1959 various lessees conducted small operations in the district.

In 1959 American Exploration & Mining Co. (Amex) examined the Cortez Mine and entered into a lease and option agreement on the properties of the Cortez Metals Company. A program of geologic mapping and property consolidation on the part of Amex ensued. Concurrently, Webb Resources, Inc., was interested in the district and had personnel investigating open ground lying northwest of the Amex holdings.

In 1963, Amex entered into an exploration agreement with Idaho Mining Corporation which had acquired large areas of mineralized ground adjoining Amex holdings.

In 1964, geologic investigations led to the conclusion that effective exploration in the area would require a substantially larger amount of high-risk capital. In order to spread this risk Amex joined in forming the Cortez Joint Venture with The Bunker Hill Company, Vernon Taylor, Jr., and Webb Resources, Inc. A program of exploration involving extensive drilling and underground development plus geological, geophysical and geochemical coverage was initiated and carried through until 1966. Much of this work has so far proved to be economically unfruitful, although moderate encouragement was encountered in underground exploration work in the old Cortez Silver Mine. During this period several holes were drilled in the altered frontal area, some of which narrowly missed parts of the presently known gold deposit.

During the period between 1960 and 1966 the U.S. Geological Survey had been making extensive geological and geochemical studies in northeastern Nevada, including the area embracing the Cortez district. In August of 1966, following previously developed geochemical trends, the Survey discovered a gold anomaly in the largely gravel-covered frontal area. Since the discovery had possible economic significance and occurred on properties controlled by the Cortez Joint Venture, exploration of the anomalous gold area was commenced by drilling in September of 1966. As drilling results became progressively encouraging and configuration of the orebody became clearer, the rate of drilling was increased to a practical maximum.

Early in 1967 sufficient drilling results had been accumulated to indicate the existence of a significant tonnage of low-grade open-pit ore. By the end of 1967 the known gold reserves totalled 3.4 million tons of open-pit ore, averaging 0.29 ounces of gold per ton.

On March 11, 1968, following engineering feasibility studies, the Cortez Joint Venture Management Committee decided to put the gold property into production. An operating joint venture, Cortez Gold Mines, was formed to equip and operate the property, complete the necessary mine development and contract for engineering design and construction of the concentrator. The 1,500 t.p.d. mill went on stream on January 10, 1969, ten months after the decision to go ahead. The first shipment of bullion was made on February 19, 1969.

The discovery and development of the Cortez gold property within the Cortez district is an outstanding example of the results that can be achieved by co-operation between private industry and government agencies (in this case, the U.S. Geological Survey), utilizing advanced exploration techniques. The courteous and constructive cooperation of personnel of the Nevada Bureau of Mines and the U.S. Bureau of Mines must also be given special acknowledgement. On the industry side, Newmont Mining Corporation's Carlin Gold Mining Co. not only pioneered the treatment of this type of ore but also extended the Cortez venture help and hospitality above and beyond the call of duty.

GENERAL REMARKS

Cortez Gold Mines is a joint venture consisting of American Exploration & Mining Co. of San Francisco; The Bunker Hill Company of Kellogg, Idaho; Vernon F. Taylor, Jr., and Webb Resources, Inc., both of Denver. American Exploration & Mining Co., a wholly-owned subsidiary of Placer Development

Limited, is the managing co-venturer. The Bunker Hill Company is a subsidiary of Gulf Resources and Chemical Corporation. Idaho Mining Corporation holds a carried interest in the venture.

Cortez Gold Mines is situated in Lander County near the old Cortez townsite in northeastern Nevada, and lies approximately 65 miles southwest of Elko. The property is reached by following the paved Route 21 approximately 28 miles south from the Beowawe junction on U.S. 40 and then travelling east over seven miles of new oiled gravel road, constructed jointly by Lander County, the State of Nevada and Cortez, to the minesite. A 4500 ft. private airstrip is under construction.

Electric power is supplied by Sierra Pacific Power Co. over a newly-constructed 26-mile 60 k.v.a. pole line. Bell Telephone of Nevada has extended telephone service from Crescent Valley to the mine. Water is supplied from two wells, each 400 ft. deep and capable of pumping approximately 350 g.p.m., located within the plant area.

The basic engineering study, conceptual design and mill flowsheet were made by the Bechtel Corporation and the Placer engineering department. The detailed plant design and construction were done by Wright Engineers and Commonwealth Construction Co. of Vancouver, B.C., respectively. Final optimization of pit design, equipment selection and preproduction pit development were carried out by the Cortez Gold Mines staff.

At start-up in early January personnel totalled 75, including 26 staff members. A total of 16 single-dwelling and duplex units were constructed in a new Carlin subdivision and a 34-unit trailer park was built in Crescent Valley. Employees live in these developments as well as in Elko, Battle Mountain and Beowawe. A labor agreement is in effect with Local No. 3 of the International Union of Operating Engineers, AFL - CIO, which represents all hourly-paid employees.

A 10,500 sq. ft. steel building houses the warehouse, a four-bay maintenance shop plus ancillary service areas. The modern assay facility, change house and administrative office are all prefabricated frame structures. An additional metal building will be constructed close to the mill for reagent storage.

GEOLOGY AND MINING

Regionally, the rocks in the district consist principally of Tertiary volcanics and Paleozoic limestones, shales, cherts and quartzites intruded by a large quartz monzonite stock and quartz porphyry dikes of Jurassic and Tertiary age. The most important structural feature is the Roberts Thrust fault, which has placed upper plate predominantly silicious rocks into juxtaposition with lower plate carbonate rocks. Most of the mineral deposits of the district, including the Cortez Gold Mines deposit, occur in the lower plate rocks which are exposed in a window produced by erosion.

The Cortez Gold Mines deposit occurs in folded and faulted silicified siltstone members of the upper portion of the Roberts Mountain limestone formation. Sparsely disseminated pyrite is usually found in the unaltered limestone bordering the deposit, but the deposit itself is generally oxidized, giving the host rock a predominantly reddish-brown limonitic appearance. To date, no significant amounts of carbonaceous material have been recognized in the deposit. The gold mineralization is erratically disseminated as micron-sized particles of metallic gold within certain favorable siltstone horizons that are closely associated with altered quartz porphyry dike and sill-like masses.

Ore reserves, totalling 3.5 million tons averaging 0.28 ounces of gold per ton, were delineated by drilling several hundred rotary drill holes with samples taken at 10 ft. intervals. The general pit area trends about 3,400 ft. northwesterly and is approximately 1,000 ft. in width. The ore reserve data along with certain operating and price assumptions were used in conjunction with the Lerchs-Grossmann two dimensional computer program in developing the optimum pit design.

As indicated above, the gold particles are of micron size and the ore cannot be visually sorted. Grade control is accomplished by sampling and assaying blasthole drill cuttings. The resultant information is used to prepare a digging plan which is relayed to the shovel operator by flagging the shot pile with appropriate colors for waste and ore. The pit is being mined in 20 ft. benches and has a wall slope of 50 degrees. Elevation of the highest point is 5,400 ft. with the ultimate mining depth presently designed to reach an elevation of 4,740 ft. The crusher is set on an elevation of 5,000 ft.

Two bulldozers used for pioneering work handle pit clean-up and dump maintenance. Blasthole drilling on a 12 ft. by 13 ft. hole pattern is accomplished by two 6 in. rotary/down-the-hole drills. Explosives are dispensed into dry holes from a truck-mounted ANFO mixing unit by one man, with shot detonation by primacord. Two shovels (5 c.y. and 3 1/2 c.y. respectively) maintain a production rate of 12,500 tons per day, operating one shift. A 5 c.y. front-end

loader is used for various pit jobs and supports the primary loading equipment. Eight 35-ton end-dump trucks handle the hauling requirements. A 4 c.y. front-end loader moves stockpiled pit-run ore to the crusher as required. The usual supporting equipment and vehicles round out the mining plant.

MILLING

The Cortez concentrator is a standard counter-current decantation plant with a rated capacity of 1,700 tons per day. The crushing plant consists of a 42 in. x 48 in. jaw crusher fed by a 4 ft. x 16 ft. hydrostroke feeder and a 5 1/2 ft. short head, heavy duty cone crusher in closed circuit with a 6 ft. x 16 ft. doubledeck vibrating screen.

The - 3/4 in. product from the crushing plant is conveyed to a 21,000 ton open stockpile. From the stockpile reclaim tunnel the crushed ore passes over a weightometer and into the 9 1/2 ft. x 14 ft. rod mill. Cyanide and lime are added in the rod mill, which is in open circuit with the cyclone classifiers. Underflow sands from the classifier go to the 11 ft. x 14 ft. ball mill for additional grinding. At present the grind is averaging about 70% - 200 mesh.

The classifier overflow is pumped to a series of three agitators having a total retention time of 13 1/2 hours. Discharge from the agitators is then pumped to a series of five 80 ft. counter-current thickeners each of which has a repulper at its underflow to provide for further agitation and washing. In the thickener circuit the solid portion of the mixture of solids and gold-bearing solution (pulp) is contacted with solutions of decreasing gold content. The solids settle and are transferred by pump to the succeeding repulper and thickener for washing with a solution of lower gold content. After five such repulping and thickening stages of dilution the solid portion of the pulp is washed practically free of dissolved gold value. The final underflow of the No. 5 thickener flows by gravity through a 6 in. line to the tailings pond.

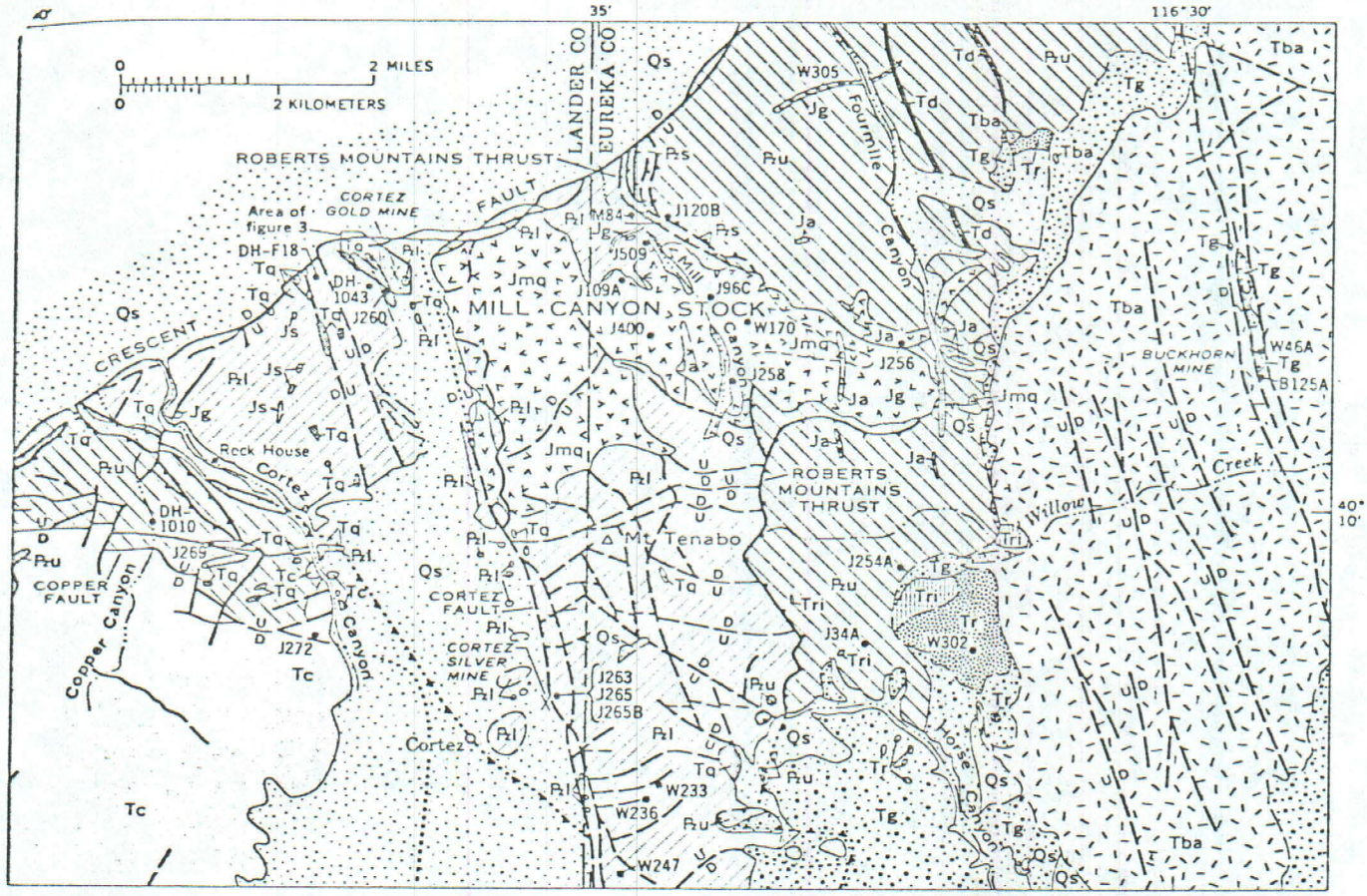
The gold-bearing solutions overflow from No. 5 to No. 1 thickener with increasing concentrations of gold. The solution from No. 1 thickener (closest to the mill building), which has the highest gold content, is pumped through a clarifying filter. The clarified pregnant (gold-bearing) solution is then de-aerated by means of a high vacuum to enhance gold precipitation when zinc dust is added. The solution is then pumped through the filter presses where the mixture of gold and zinc dust is separated from

the barren solution. The gold-bearing precipitate is periodically removed from the presses and then melted, refined and poured into bars for shipment to market.

Feed rate to the rod mill is automatically controlled, as is the underflow density of the thickeners. Torque indicators, high and low level indicators, vacuum and pressure gauges and other control instruments are set in two central panels for ease of operation.

Cortez Gold Mines Staff

March 20, 1969
Cortez, Nevada



EXPLANATION

Qs — Quaternary surficial deposits

Tri, Tr — Rhyolite
Tri, *plugs*
Tr, *flows*

Tba, Td — Flows and dikes
Tba, *basaltic andesite flows*
Td, *diabase dikes*

Tg — Gravel

Tc, Tq — Volcanic rocks
Tc, *Caetano Tuff*
Tq, *quartz porphyry dikes*

TERTIARY

Jmq, Jmg, Ja, Jg, Js — Jurassic volcanic rocks
Jmq, *quartz monzonite of Mill Canyon stock*
Jmg, *granodiorite of Mill Canyon stock*
Ja, *alaskite*
Jg, *granodiorite*
Js, *augite syenite*

Pzl, Pzu, Pzs — Paleozoic rocks
Pzl, *lower plate eastern carbonate facies; includes Wenban Limestone, Roberts Mountains Formation, Hanson Creek Formation, Eureka Quartzite, and Hamburg Dolomite*
Pzu, *upper plate western siliceous facies; includes Slaven Chert, Fourmile Canyon Formation, Valmy Formation, and Vinini Formation*
Pzs, *sedimentary rocks undifferentiated; in thrust fault zone*

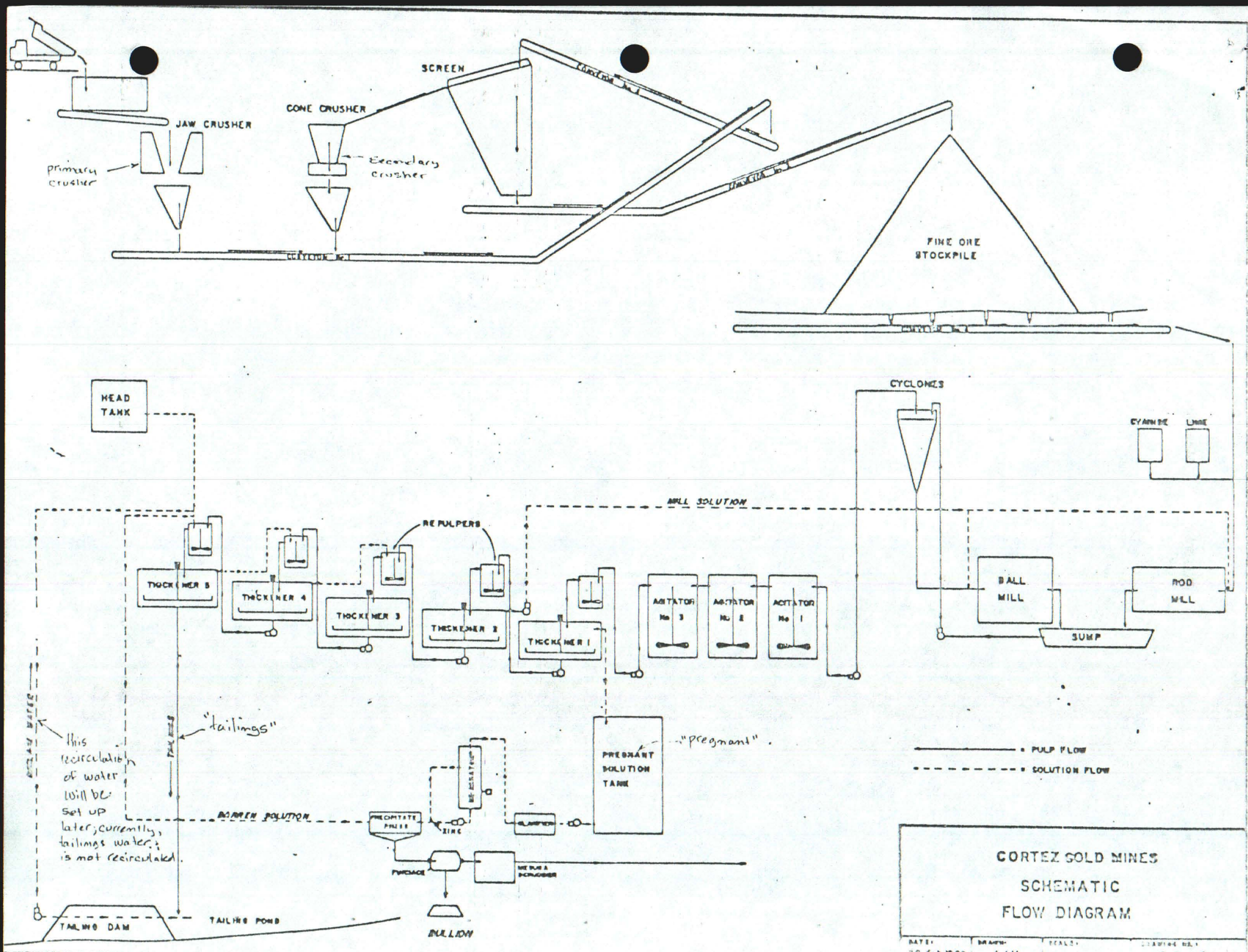
Contact
Dashed where approximately located; short dashed where gradational

U / D — High-angle fault
Dashed where approximately located; dotted where concealed. U, upthrown side; D, downthrown side

Thrust fault
Dashed where approximately located; dotted where concealed. Sawteeth on upper plate

DH-F18 — Sample locality

Figure 2.—Geologic map of the Cortez-Buckhorn area, showing sample localities. Modified from Wells, Elliott, and Obradovich (1971, fig. 2).



CORTEZ GOLD MINES

SCHEMATIC FLOW DIAGRAM

DATE:	DRAWN:	SCALE:	DRAWING NO.:
20 Feb 1968	A.J.M.	None	C-3-13-0

Shop & Warehouse

Assay Lab

Office

Wash House

Thickeners 1 2 3 4 5

Agitators

Water Tank

Fine Ore Stockpile

Crusher

COARSE ORE STOCKPILE

mill feed Conveyor

(4) Sample of Secondarily Crushed mill feed

(3)

HAUL ROAD No. 1

HAUL ROAD No. 2

38,000 N

37,000 N

3000 E

final bottom of pit?

quartz porphyry in this area

(1)

(2)

— Explanation: —
①, ②, etc. = Sample pts (also stop pts of mine tour)

CORTEZ GOLD MINES

MINE SITE MAP

Lander Co., Nev.

Notes by: SAT, Oct 18, 1961