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Mining District File Summary Sheet

DISTRICT	Independence Mountains
DIST_NO	2420
COUNTY If different from written on document	Elko
TITLE If not obvious	The Geology and Development of the Big Springs Project, Elko County, Nevada
AUTHOR	Collord, J; Hart D; Partika, B
DATE OF DOC(S)	1987
MULTI_DIST Y / [✓ N?] Additional Dist_Nos:	
QUAD_NAME	McAfee Peak 7½'
P_M_C_NAME (mine, claim & company names)	Big Springs Gold Project; Mac Ridge; Freeport-McMoRan Gold Co.; North Sammy Creek; South Sammy Creek Sammy Creek zones; Bull Run Gold Mines, Ltd
COMMODITY If not obvious	Gold
NOTES	Property report; geology; reserves; cross section; process flow sheet; mine map; stratigraphic column; Coats donation 27p.

Keep docs at about 250 pages if no oversized maps attached (for every 1 oversized page (>11x17) with text reduce the amount of pages by ~25)

SS: DD 12/16/08
Initials Date
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Initials Date

Revised: 1/22/08

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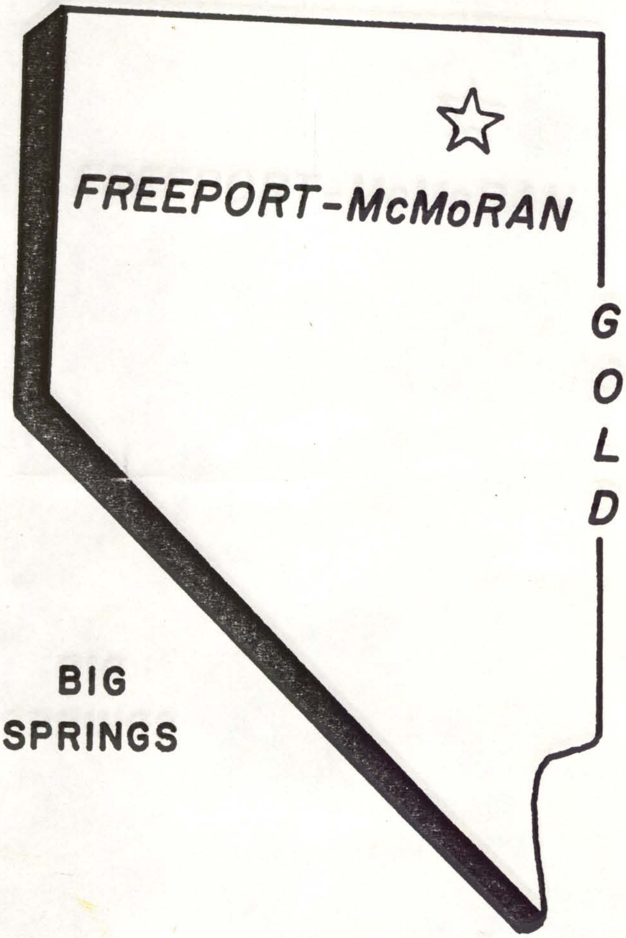


FREEPORT-McMoRAN GOLD

BIG SPRINGS

THE GEOLOGY AND DEVELOPMENT OF THE BIG SPRINGS PROJECT
Elko County, Nevada

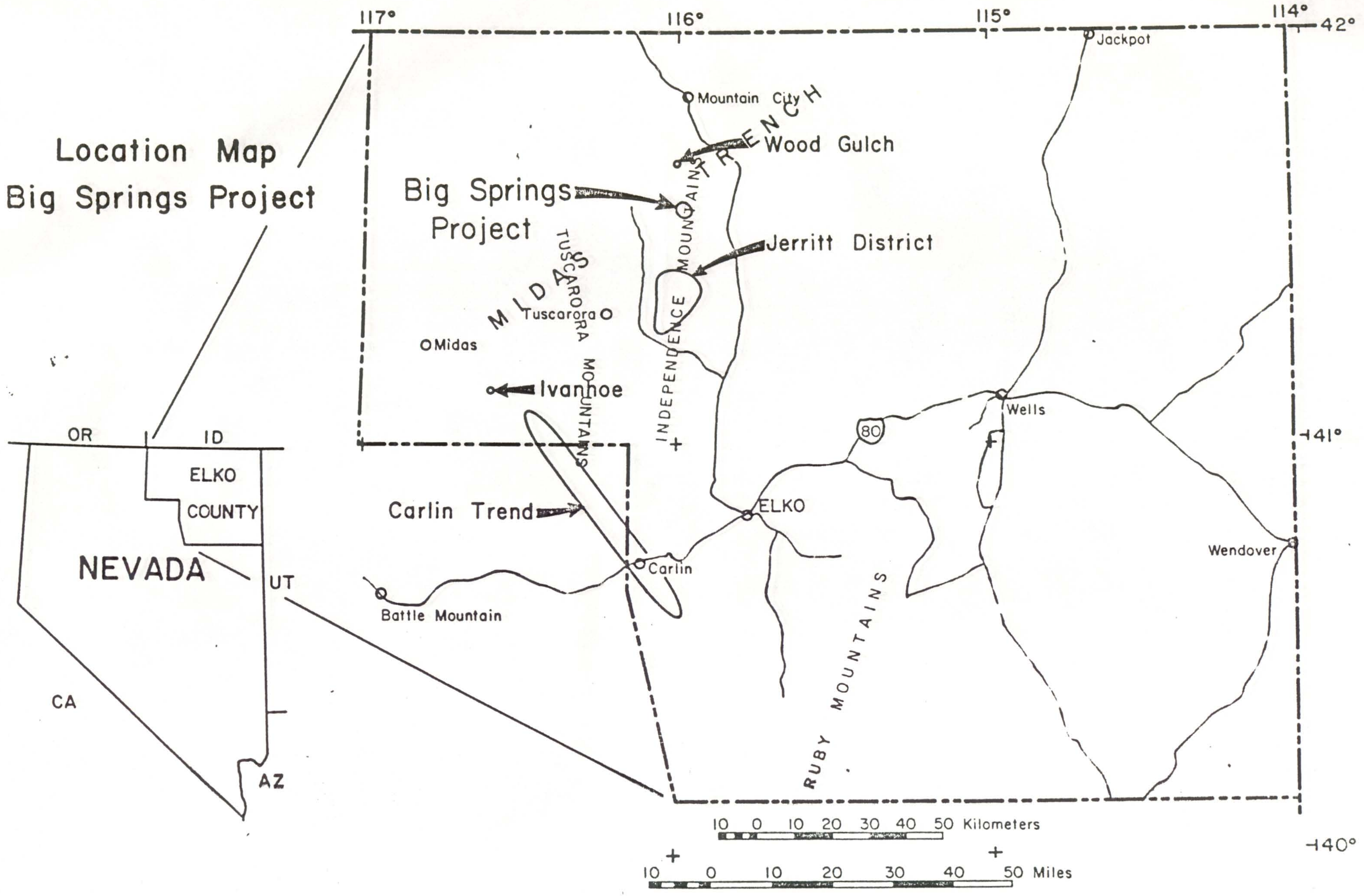
Jim Collord, Dan Hart, Brien Partika
Freeport-McMoRan Gold Company
Elko, Nevada

The Big Springs Gold Project is located in the northernmost portion of the Independence Mountain Range, Elko County, Nevada, about 65 miles north of Elko and 10 miles north of Freeport-McMoRan's Jerritt Canyon (Enfield Bell) Mine. The project is a joint venture between Freeport-McMoRan Gold and Bull Run Gold Mines, Ltd. Big Springs is comprised of 3 separate orebodies: North Sammy Creek, South Sammy Creek and Mac Ridge. Gold mineralization was first discovered on Mac Ridge in 1976 by Superior Oil Company. Freeport undertook a regional reconnaissance program in the area in 1981, and discovered the North and South Sammy Creek orebodies in 1982. Delineation drilling continued until a production decision was made in 1986.

The total mineable reserve (mill and leach) for the 3 deposits is 3.88 million tons grading 0.139 oz/ton gold. Mining is done by conventional open pit methods at a rate of about 22,000 tpd of ore and waste. A heap leach facility was constructed in 1987, and the first gold was poured in September. A roaster and mill facility is scheduled for start-up in late 1988 - early 1989. Big Springs will be one of the first applications of fluid-bed roasting technology to the treatment of refractory sulfide gold ore.

Gold mineralization at Big Springs is hosted mainly in sediments of the Permian Overlap Sequence. These silty sediments were deposited unconformably on rocks of both the upper and lower plates of the Roberts Mountain Thrust in a nearshore to slope facies environment. The stratigraphy in North Sammy Creek has been locally subdivided. Due to structural complications, facies changes and a lack of marker beds, correlation of these cannot be made with sediments exposed in other areas of the project. The Mississippian to Permian Age Schoonover Formation, consisting of eugeosynclinal assemblage chert, argillite, and greenstone lithologies, was thrust over the Permian Overlap Sequence during the Sonoma Orogeny. Ore in North and South Sammy Creek occurs at or near the thrust and in related faults. In North Sammy Creek, the largest of the three deposits, ore occurs as east-west striking, north-dipping en echelon zones between the northwest dipping Schoonover Thrust and a subparallel structure within the underlying Permian sediments. Jasperoid was developed beneath and parallel to this structure. Alteration consists of partial silicification and sericitization in the siltstone. Gold occurs as free grains less than 4 microns in size as inclusions within and bordering pyrite or enclosed by goethitic aggregates where oxidized.

Location Map
Big Springs Project



THE BIG SPRINGS PROJECT

FREEPORT McMoRAN GOLD CO.

Jim Collord, Dan Hart, Brien Partika

GENERAL FACTS

SIGNIFICANT HISTORY

1975-77: Superior Oil/Falconbridge explored Northern Independence Range using wide spaced ridge & spur sampling. Arsenic & gold anomaly identified on Mac Ridge. Helicopter supported core drilling in 76-77 identified significant mineralization on Mac Ridge.

1980: Superior drops claims; Bull Run Gold Mines relocates.

1981: Bull Run completes exploration drilling on Mac Ridge and other areas. Freeport Exploration identified potential of North Sammy Creek area during a regional reconnaissance program. Initiated talks with Bull Run.

1982: First discovery hole (SC 82-1) drilled in September after sampling and mapping program was completed on the Sammy Creek area.

1982-1985: Exploration and delineation drilling completed resulting in the definition of 3 separate mineable ore zones. Metallurgical tests on sulfide ore conducted.

1986: Production decision made by FMGC board of directors. Environmental Assessment initiated.

1987: Construction started on mill site in April and minesite in early May upon approval of EA. First ore delivered to leach pads from Mac Ridge on August 20.

MINE PRODUCTION INFORMATION

Strip Ratio: 10.3:1

Mining Rate: 27100 TPD (mill + leach), 250 days per year (1987, 1988)

Delineation Drill Spacing: 100′ general, 50′ in higher grade zones. Approximately 800 drill holes used in North and South Sammy Creek and 80 on Mac Ridge.

Ore Reserves Estimation: Minepak software using polygon interpretation restricted by geological parameters.

Contractor Information: Gibbons and Reed, Salt Lake City, Utah, selected as Mining Contractor for a two year period. Haulroad subcontracted by Ruby Dome, Inc., Elko, Nevada. Ore haul from mine to mill subcontracted by Tom Peck Trucking, Lehi, Utah.

Mining Fleet:
1 - UH 501 Hitachi Front Shovel
1 - 992 Cat Loader
1 - 988 Cat Loader
3 - D8 Class Dozer
1 - 834 Rubber Tired Dozer
1 - 14G Cat Blade
1 - 12F Cat Blade
1 - Hitachi 172 Backhoe
1 - DM45E I.R. Blasthole Rig
2 - DK25 Drilltek Blasthole Rigs
7 - 50 Ton Cat Trucks
2 - 4000 gallon Water Trucks
7 - Semi-end Dump Trucks (35 ton)
5 - Belly Dumps (50 ton)

BIG SPRINGS ORE RESERVES **

END OF 1987 - TONS IN THOUSANDS

	OXIDE		SULFIDE		LEACH		WASTE
NSC	436.3	.304	1,306.0	.158	611.6	.063	22,499.9
SSC	83.7	.183	937.5	.113	354.8	.054	13,828.9
MAC RIDGE	68.3	.212			61.0	.064	120.6
STOCKPILE			21.1	.115			
TOTAL	588.3	.276	2,264.6	.139	1,027.4	.060	36,449.4

January 1988 10-K Study

MILL

Heap leaching will be used during the 1987 production season. Higher grade oxide ore (+.170 opt) will be placed onto a separate pad for later rehandle, if economic. Eighty percent recovery is anticipated.

Construction of a roaster to handle the sulfide and higher grade oxide ores is planned for 1988. Current engineering studies are directed towards a 1000 tpd fluid bed roaster system. The roaster would be followed by a CIL circuit. Recoveries are projected at 90+ percent.

GEOLOGICAL DISCUSSION

LOCATION

The Big Springs Project is situated in the northernmost portion of the Independence Mountains about 65 miles north of Elko, Nevada. It is approximately 10 miles north of Freeport's Jerritt Canyon (Bell) Mine. Big Springs is on the headwaters of the North Fork of the Humboldt River and in the Humboldt National Forest. The project is comprised of three separate orebodies: Mac Ridge, North and South Sammy Creek. Gold mineralization was first discovered on Mac Ridge in 1976 by Superior Oil. Freeport discovered North and South Sammy Creek during a 1982 drilling program, and delinated mineable reserves on Mac Ridge during 1984.

REGIONAL GEOLOGIC SETTING

Northern Nevada west of about 117° longitude, during most of the Paleozoic, was the site of an eugeosyncline which accumulated dominately siliceous sediments. Shallow water carbonate sediments were deposited in the miogeosyncline to the east.

The eastern part of the geosyncline was subjected to east-directed thrust faulting in the late Devonian Antler Orogeny. The western assemblage siliceous sediments were emplaced over the eastern assemblage carbonates along the Roberts Mountains Thrust Fault.

Following the Antler Orogeny, siliclastic rocks again accumulated in the Antler foredeep basin forming the Schoononver sequence. By Permian time, several depocenters along the eastern edge of the Schoonover trough were accumulating carbonate sediments (Permian Overlap Sequence) which hosts most of the mineralization in the Big Springs Project area. During the Sonoma Orogeny of mid to late Permian age, the Schoonover sequence was emplaced over rocks in the Permian basins along the east directed Schoonover Thrust Fault, which is composed of numerous imbricate thrust slices.

Subaerial volcanic rocks of Tertiary Age were erupted onto an erosional surface developed on this part of the Great Basin during Cretaceous time. Generally north striking (north-northeasterly in the project area) Basin and Range normal faulting of late Tertiary Age has dissected the older complex. Another dominant feature in Northeastern Nevada is a set of northeast-southwest high angle faults associated with the Midas Trench.

Numerous alpine glaciers existed in the Independence Mountains during the Pleistocene. Areas of thick glacial till are present in the project area.

PROJECT GEOLOGY

Stratigraphy

Within the project area, Permian Overlap rocks may be found in depositional contact with both the cambrian and ordovician lower plate rocks, and in fault contact with upper plate rocks of the Antler allochthon.

The Permian Overlap Sequence consists of marine sandstone, and siltstone which may be calcareous, carbonaceous, and/or fossiliferous to varying degrees. Due to poor exposure, structural complications, and lateral facies changes, the correlation of host rocks between deposits and other areas is not fully understood.

In the North Sammy Creek area, the Permian section from bottom to top, consists of Unit "A"-interbedded tan and brown calcareous sandstone and carbonaceous siltstone which grades through a fossiliferous and more or less carbonaceous zone (Unit "B") to Unit "C" - a black highly carbonaceous siltstone. Unit "C" is highly variable in thickness apparently due to structural thinning. This unit grades upward into Unit "D" - a medium orange-brown (where oxidized) to medium gray flaser bedded locally slightly calcareous, sandy siltstone. Unit "D" is characteristically oxidized due to its generally permeable sandy nature. The portion of the Permian Section from the top of Unit A to the base of Unit D is complicated by the Argillic Fault (discussed later).

In the South Sammy Creek area, about 3000′ south of the North Sammy Creek area, the Permian sediments generally consist of unoxidized medium to dark gray, carbonaceous sandy siltstones.

Two distinctive Permian units occur in the Mac Ridge area. A very thick lower unit exposed on the west side of the ridge is a medium to thick bedded, locally sandy silty limestone to silty dolomite. This unit is similiar to the "A" unit in North Sammy Creek. A thin upper unit is exposed on the east side of the ridge. This unit is a medium orange-brown flaser-bedded and bioturbated siltstone, very similiar to Unit "D" in the North Sammy Creek area. This is the main host to Mac Ridge ore.

The allochthonous Schoonover Formation in the project area consists of chert, quartz arenites and conglomerates, siliceous argillaceous lutites (argillites), carbonaceous siltstones, limestones, and thin intercalated vesicular mafic volcanic flows and associated tuffs and epiclastic sediments. At least two types of intrusive rocks of uncertain age occur in the project area. One is of an intermediate to mafic composition and may have a variety of textural characteristics. It has been, and continues to be, confused with vesicular greenstone and associated rocks found in the Schoonover Formation. Another intrusive rock type is a porphyritic rhyolite which is strongly quartz veined and variably sericitized and argillized.

Tertiary subaerial volcanic rocks which once covered the northern Independence Mountains have been largely stripped from the project area by erosion.

The ridge between Water Canyon and Beadles Creek is a glacial moraine locally exceeding 250′ in thickness. Rock slides and landslides are present on some steep slopes and within cirques.

Structure

The base of the northwest dipping Schoonover Thrust is exposed mainly along the west flank of Sammy Creek Ridge. Normal faults generally occupy most other contacts between upper plate and Permian rocks in the project area. The "Argillic Fault Zone" is a thrust fault, subparallel to the Schoonover Thrust, but contained within the Permian section. The fault occupies mainly the zone from Unit "A" to Unit "C" but may juxtapose Units "A" and "D" in places. The fault zone may include felsic to intermediate intrusive rocks and is characterized by a high degree of brecciation and shearing (cataclasis) and silicic and sericitic alteration. Intrusion and reactivation of this structure and mineralization are believed to have occurred during the Tertiary.

In North Sammy Creek, Permian bedding attitudes strike N 30° E and dip 60° to the northwest. Upper plate bedding attitudes in the immediate deposit area strike approximately N 48° E with steep, highly variable dip. Regionally, upper plate bedding strikes northeasterly with a northwest dip. In South Sammy Creek, Permian bedding has a similiar strike, but a somewhat flatter dip, about 20-30° to the west-northwest. The Permian bedding attitude at Mac Ridge is variable, but generally east-west with steep south to southeast dips in the mine area.

Other than the thrust faults, the most important structures in the project area are the high angle normal faults. Three main sets of normal faults affect the project area. An older east-west fault zone is exposed in the Sammy Creek and Mac Ridge areas ("Headwall Fault"). It separates upper plate quartzites (Roberts Mountains allochthon) on the south from Permian and Cambrian sediments on the north. A northeasterly striking set of faults in the Sammy Creek area is probably associated with the Midas Trench. A more northerly striking set of faults of late Tertiary Basin and Range association affects the entire region.

Alteration

Diagenesis and regional greenschist facies metamorphism have affected all pre-Tertiary rocks in the project area. Mineralization within the project area is associated with late Tertiary hydrothermal alteration whose distribution is influenced by all older structures, in particular the thrust faults, Basin and Range faults, and the stratigraphic framework. Pervasive silicification and/or quartz veining is the most conspicuous type of hydrothermal alteration. It has resulted in the prominent jasperoid outcrops evident on Sammy Creek Ridge and elsewhere. Rocks of an originally siliceous nature (such as sandstones and siltstones are most affected by pervasive-type silicification. Mineralized rocks are characterized by partial silicification, strong quartz veining and sericitization. Peripheral to mineralization, alteration consists of varying degrees of decarbonatization (?), calcite veining, dolomitization, silicification, quartz veining, and argillization (mainly in mafic igneous rocks and fault zones). Other introduced minerals of local importance include barite, limonite, sulfides (mainly pyrite), clays, and carbon.

Mineralization

The North Sammy Creek ore deposit is hosted mainly by the Permian Units "C" and "D" in that area and is sandwiched between the Argillic Fault and the Schoonover Thrust. Some ore is contained in the upper plate at the north end of the deposit. In detail, the deposit is composed of seven en echelon, generally east-west striking, steeply north dipping, individual ore zones which are discordant with the host strata.

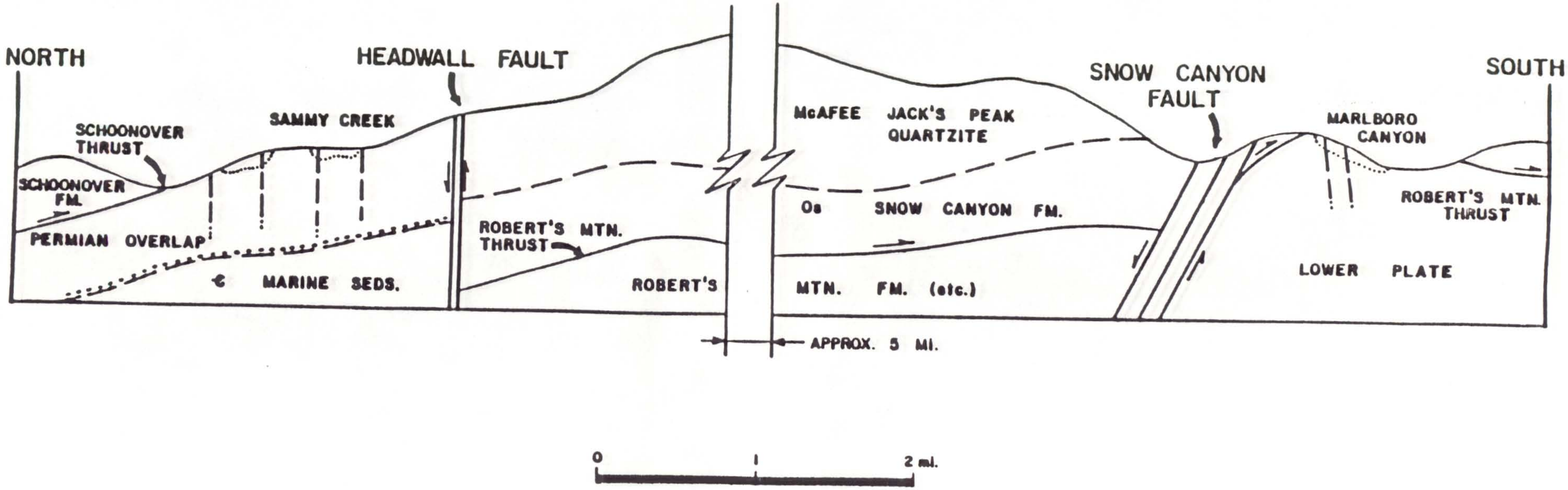
The South Sammy Creek deposit is less well understood. Mineralization seems to form one, albeit discontinuous, ore zone concordant with the Permian host rocks.

The Mac Ridge deposit forms more or less a dip slope, generally within 50 feet of the surface on the southeast face of Mac Ridge. Bedding attitude is steeper than the dip of the ore zone.

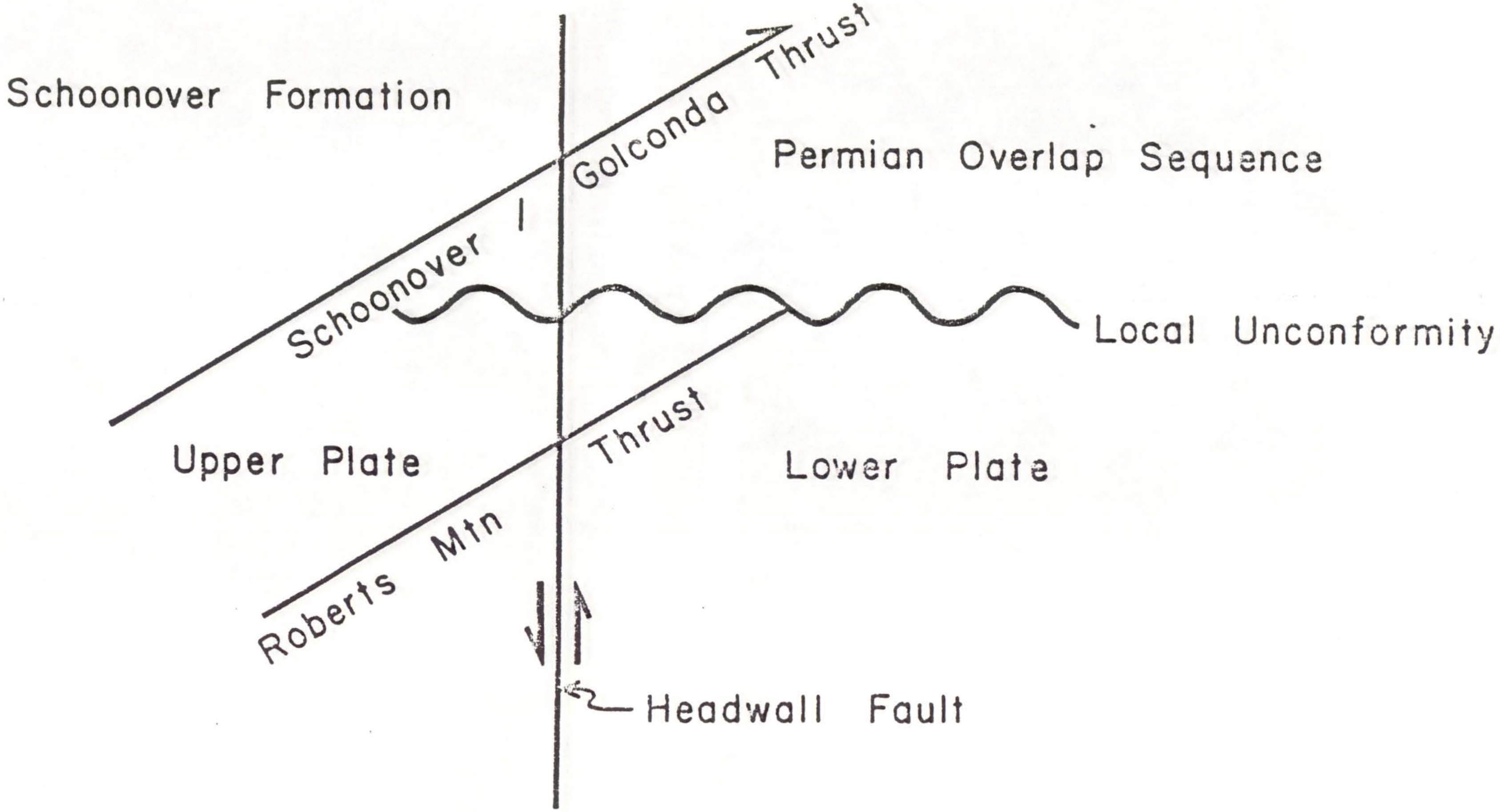
Gold occurs in altered rocks. as previously discussed, as grains of less than 4 microns in diameter, as inclusions in and bordering pyrite, enclosed by geothitic oxidation aggregates after pyrite, as inclusions in quartz replacing altered siltstone, and free in the altered siltstone matrix.

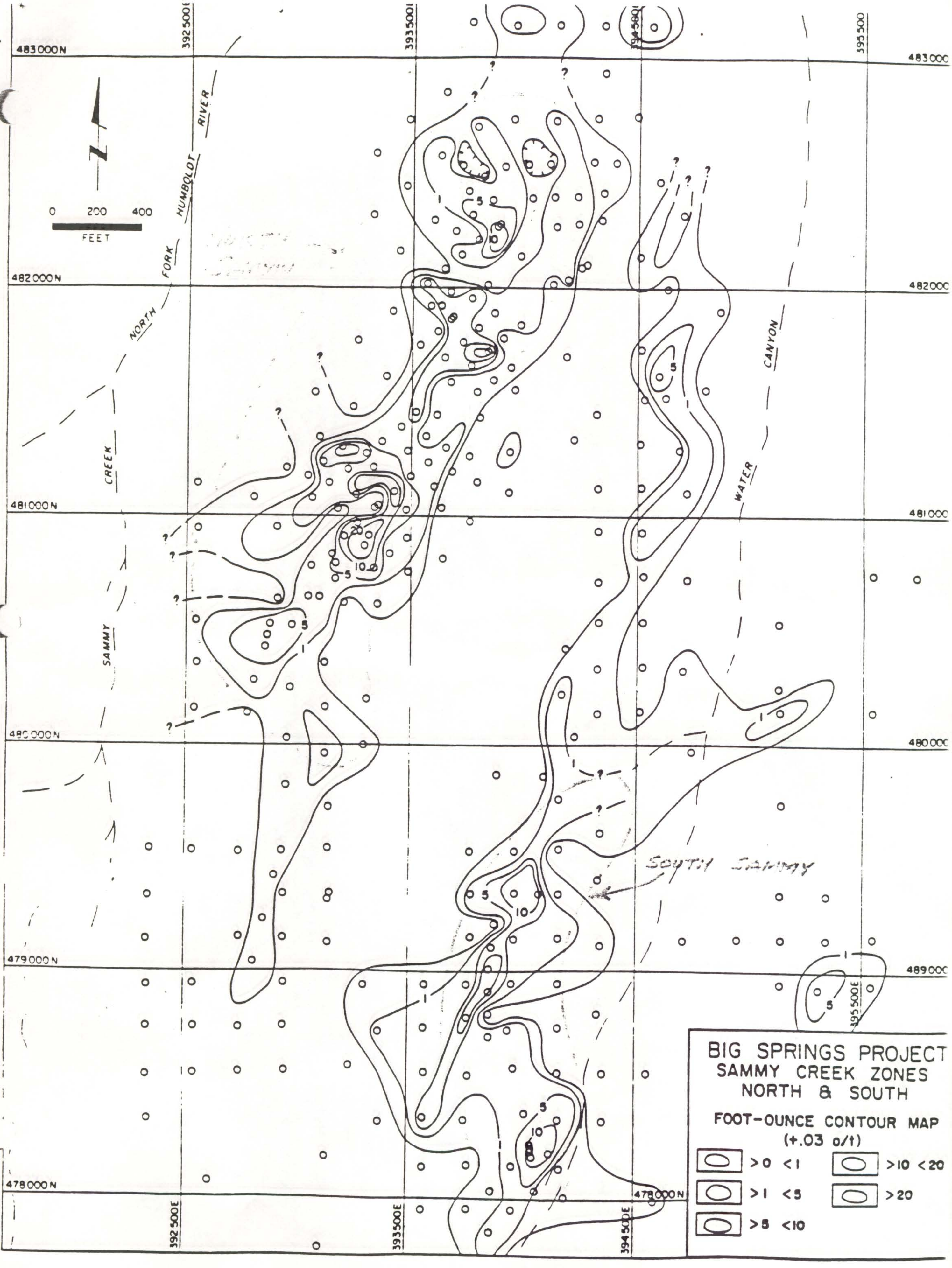
Mineralization in upper plate rocks seems to be more structurally controlled, and more erratic and discontinuous in distribution than in Permian rocks. It occurs in altered mafic intrusive and/or pyroclastics, fault gouge zones, and in structurally prepared cherts and argillites.

INTERPRETIVE SECTION — NORTHERN INDEPENDENCE RANGE



Relationships of Major Formation - Sequences in the Big Springs Project Area

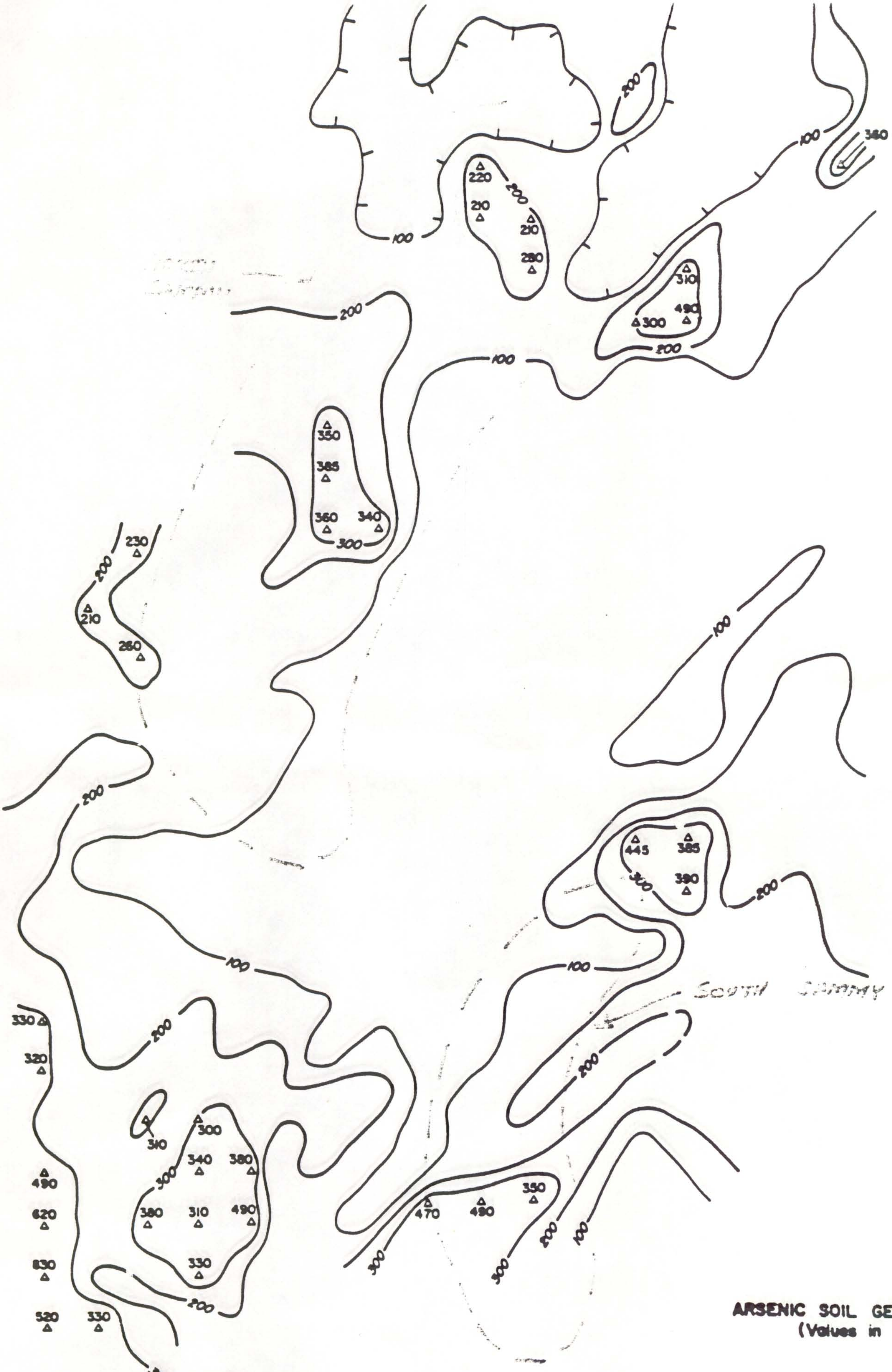




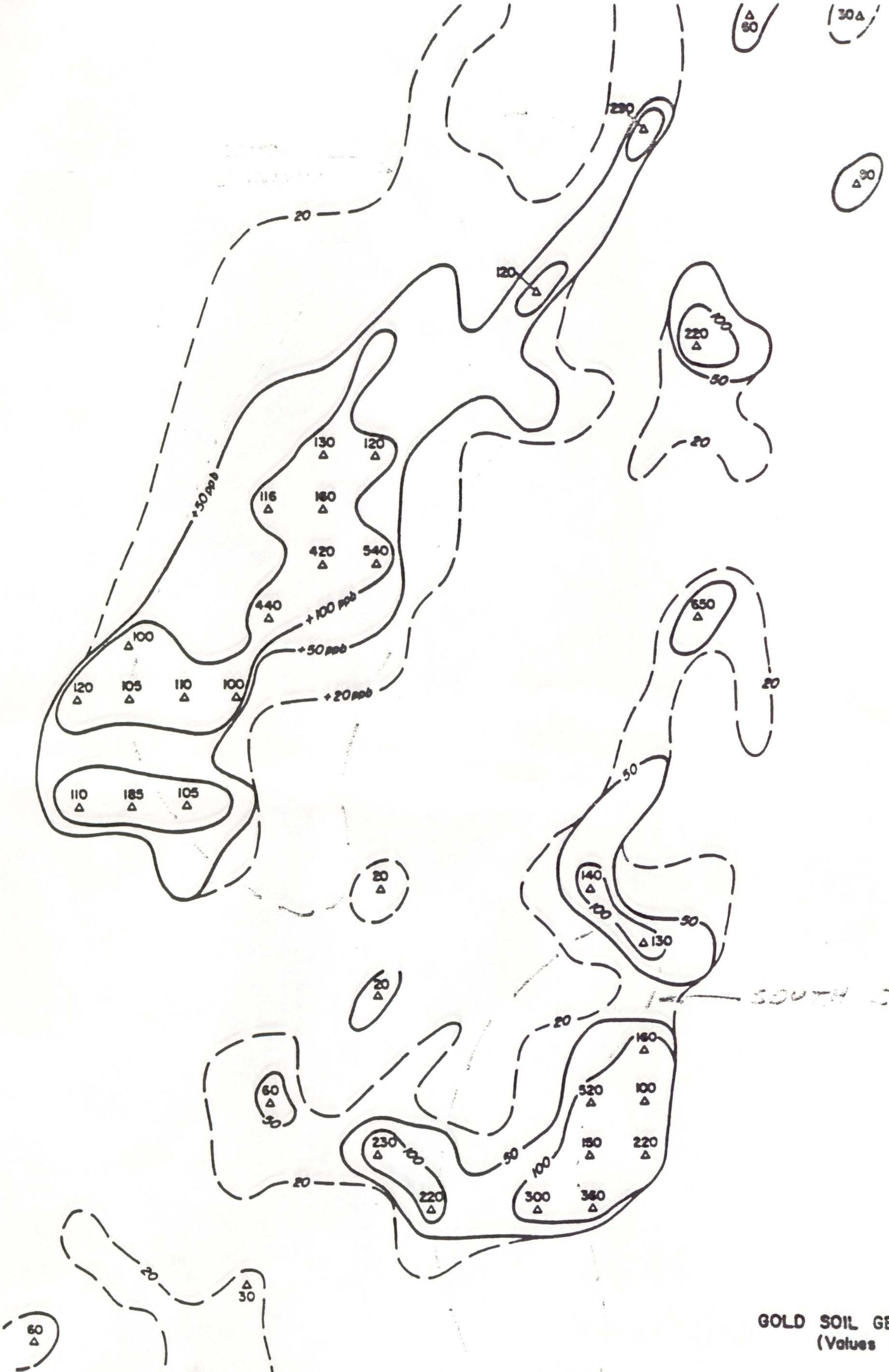
BIG SPRINGS PROJECT
SAMMY CREEK ZONES
NORTH & SOUTH

FOOT-OUNCE CONTOUR MAP
(+.03 o/t)

(MARCH 1985 BASE)



ARSENIC SOIL GEOCHEMISTRY
(Values in ppm)

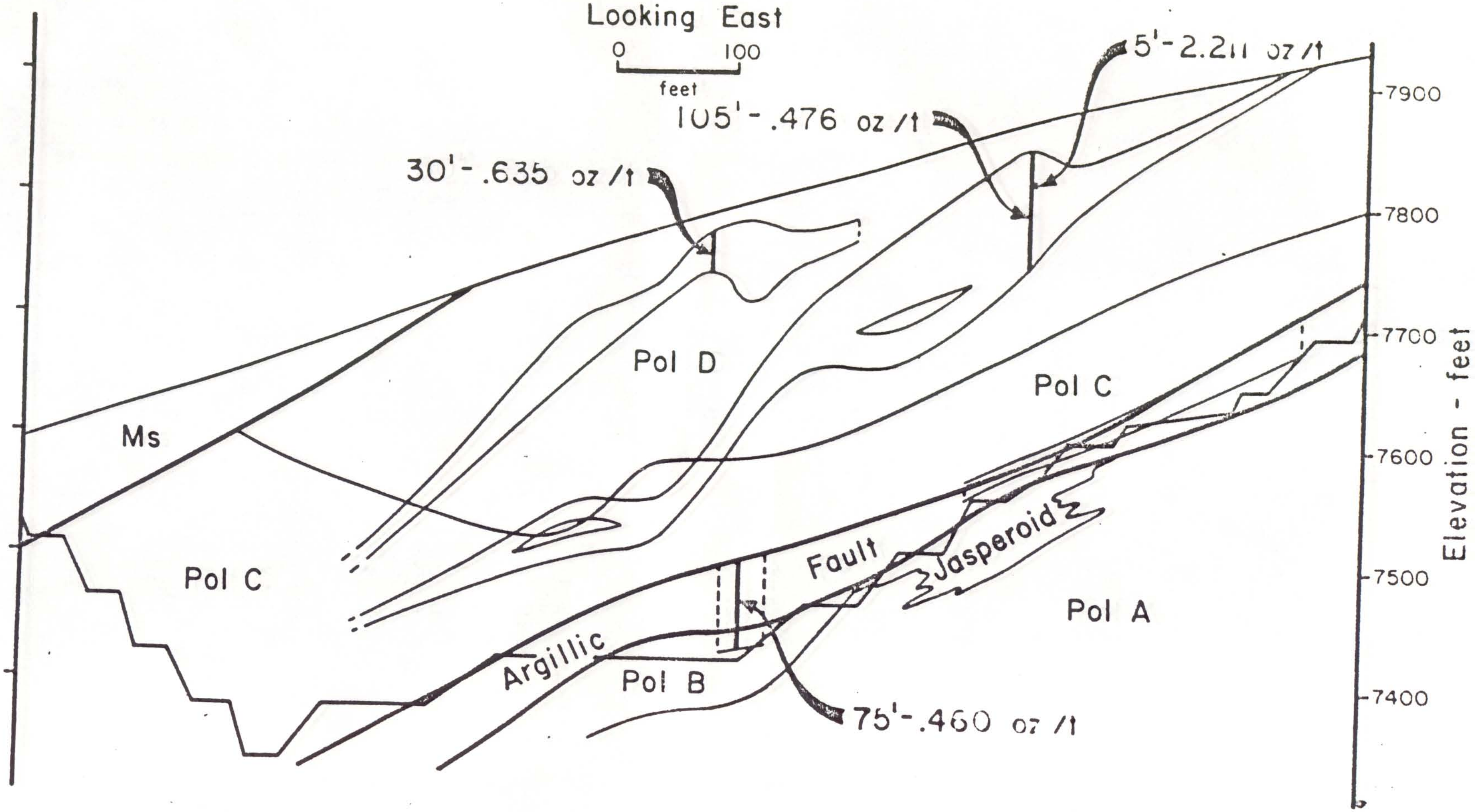


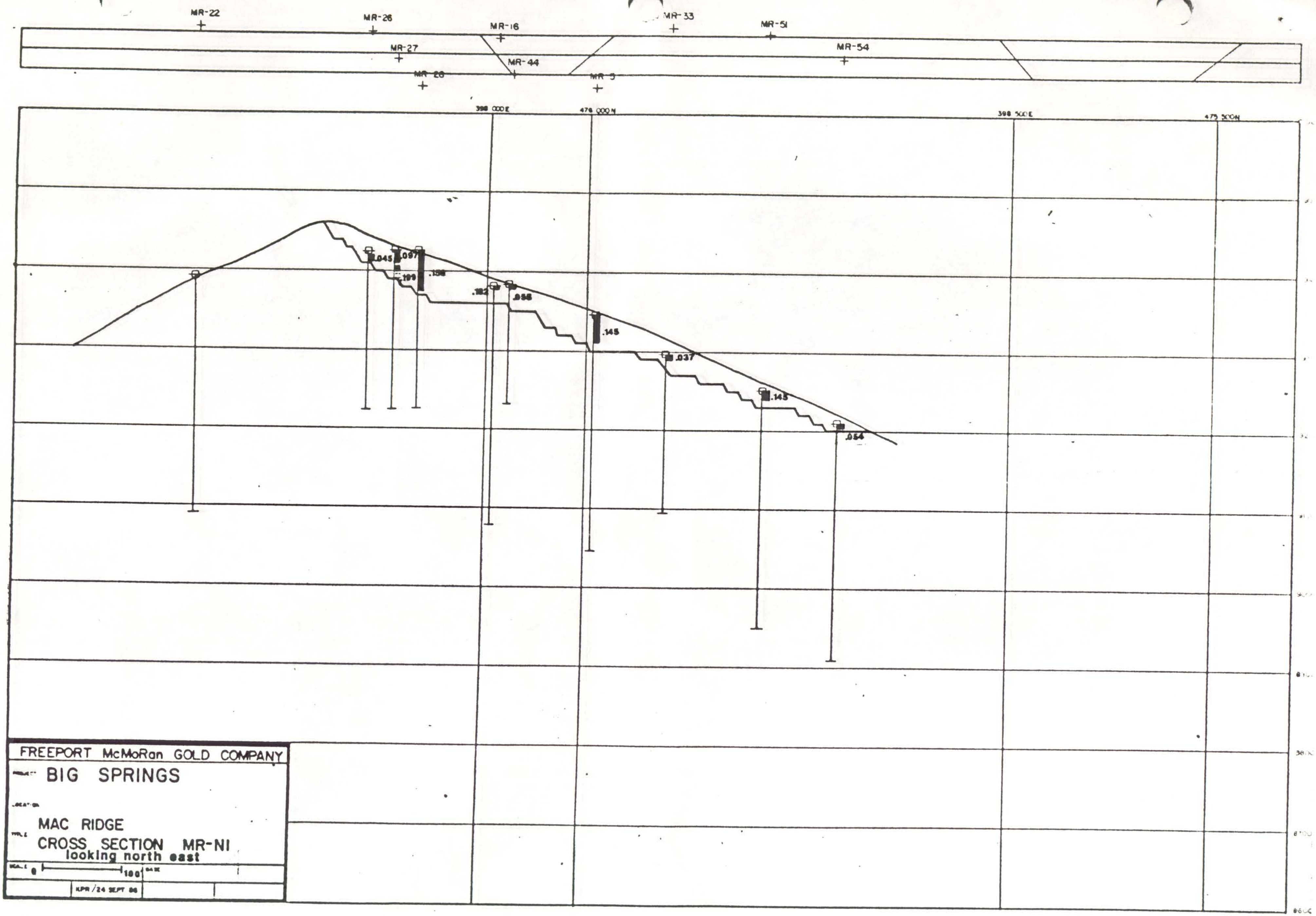
GOLD SOIL GEOCHEMISTRY
(Values in ppb)

NORTH SAMMY CREEK STRATIGRAPHIC SECTION

MISS.	SCHOONOVER FORMATION Chert, siliceous argillite, carbonaceous siltstone, siltstone, sandstone, conglomerate, volcaniclastic sediments, greenstone, and associated subvolcanic intrusives. Commonly foliated on bedding planes. Hosts some mineralization at North Sammy Creek.
	SCHOONOVER THRUST
PERMIAN	UNIT 'D' Tan and gray flaser bedded sandy siltstone. Gradational with UNIT 'C'. Blocky weathering. Weakly calcareous where unaltered. Alteration consists of decarbonatization, dolomitization, sericitization, silicification, and quartz veining. Rare occurrences of hydrothermal breccias. Principal ore host at North Sammy Creek. Similar unit hosts some ore at Mac Ridge.
	UNIT 'C' Black carbonaceous siltsone. Locally sandy or shaly. Maybe strongly deformed adjacent to the Argillic Fault. Alteration consists of silicification and quartz veining. Ore host at North Sammy Creek. ARGILLIC FAULT Rare surface exposures. Strongly brecciated and sheared, quartz veined, and gossaneous float may be found. In drill core and cuttings unit shows strong shearing and mylonitization of a largely sericitic matrix with quartz which encloses angular fragments of altered sedimentary and unidentified igneous rocks. Matrix and fragments are cut by veinlets containing sericite, dolomite, arsenopyrite, and pyrite. Clay minerals are minor or absent. Wall rocks may be deformed over a wide zone. Locally hosts ore at North Sammy Creek.
	JASPEROID Developed chiefly in the structural top of UNIT 'A' or 'B'(?) beneath the argillic fault, but may include basal portion of UNIT 'C'. Mostly pervasive, passive, total silicification with preservation of original bedding characteristics. Less common are solution collapse(?) breccias and structural breccias (and possibly hydrothermal breccias) with or without drusy quartz and/or barite filling cavities. Late quartz veinlets may also be present.
	UNIT 'B' Dark gray to black carbonaceous siltstone which locally contains crinoid fragments (discs 1mm dia.). Not recognized at surface and may be gradational with UNIT 'A' and UNIT 'C'. May be absent. Alteration as above.
	UNIT 'A' (undifferentiated) Light olive gray or light to medium gray sandy siltstone or fine to medium sandstone occassionally with medium dark gray to black cherty breccia fragments, nodules, and intercalations. Weakly to moderately calcareous where unaltered. May contain small crinoid, brachiopod, coral(?), bryozoa, and other fossil fragments near top. Sandy beds may be graded.
	PRE-A UNITS Stratigraphy not well understood. Carbonaceous siltstone, dark brown silty sandstone, carbonaceous siltstone. May be ore host at South Sammy Creek and deposit on east side of North Sammy Creek ridge.

North Sammy Creek Cross Section





FREEPORT McMoRan GOLD COMPANY

BIG SPRINGS

MAC RIDGE

CROSS SECTION MR-NI
looking north east

0 100

KPR /24 SEPT 86

BIG SPRINGS PROJECT

HEAP LEACH OPERATIONS

PROCESS DESCRIPTION

Ore crushing is conducted at the mine area by a contract crusher using a three (3) stage circuit. Ore is separated into high grade (oxide), low grade (leach) and sulfide stockpiles.

Ore is crushed to a minus 1/2 inch and agglomerated after additions of 5 lb/t cement, 2 lb/t pebble lime, and 4-6% water. Ore is transported to the mill site in 50 ton bottom trucks. The leach pad is 60 mill HDPE over a compacted natural clay and 8 oz geotextile. A2-3 foot layer of drain material and drain pipes are placed prior to ore stacking. The ore is dumped on the prepared base and stacked with a loader to a heap height of 12 feet.

Solution is sprayed on the ore using a yellow-a-mine piping system with wobblers (16) on 40 foot centers. Solution rates are about 0.004 gpm/sq ft with 0.5 - 1.0 lb/t cyanide solution at pH 10-10.5. Solution from the leach pads flows through 6 inch HDPE lines to parchall flumes. Flow measurement of solutions through the flumes along with sampling for Au concentration will enable inventory determination within the heaps and pregnant solution ponds.

The pregnant solution pond is 60 mil HDPE lined and sized to contain 4.25 million gallons of solution. This pond is sized to handle a 100 year, 24 hour storm run off condition in addition to normal operating solution flows. Total pond volume is 5:4 million gallons plus an emergency overflow catchment pond. Monitoring wells surround the solution storage area.

Pregnant solution is drawn continuously from the pregnant solution ponds and pumped to two lines of six 1.5 ton carbon adsorption columns. Flow measurements and sampling prior to and after leaving the columns is made for gold inventory and metallurgical purposes.

Barren solution from the columns flows by gravity into the barren return sump where cyanide and caustic are added and then pumped to the barren solution pond.

Gold values are adsorbed by carbon to the 100-150 troy oz/t range in the lead carbon adsorption column and transferred to a strip vessel. The carbon in the successive carbon adsorption columns would be advanced accordingly, and fresh/regenerated carbon pumped into the last carbon adsorption column. Carbon transfer of 1-1.5 tons per train per day is expected.

Stripping of the loaded carbon is undertaken by passing a hot strip solution of caustic/cyanide at 180 degrees F through the strip vessel loaded with 4.5 tons of carbon. The strip liquor containing the gold values is circulated through electrowinning cells at a flow rate of 40 GPM. Two strips can be operated simultaneously.

The produced cathodes are removed from the electrowinning cell and charged into a mercury retort vessel. Mercury vapors are condensed within a closed circuit and collected for subsequent sale. The mercury free cathodes are then transferred to an induction furnace for dore production.

Barren carbon from the strip vessel is reactivated in a horizontal kiln and returned to the circuit in the last carbon adsorption columns. Acid washing of carbon with 5% HCl is planned as necessary.

Production of gold from leachable ores will continue year round. Solution heating is not planned in year one. Heaps will be raised in lifts as required and additional pad areas planned.

PROCESS DESCRIPTION AND DESIGN CRITERIA

1000 TPD OXYGEN FLUID BED ROASTER

PROCESS DESCRIPTION

Summary

Feed to the plant is crushed to minus 1" prior to being trucked from the mine site. Stockpiles will be segregated according to ore characterizics. Ore will be fed to the plant by front end loader.

Ore will first be dried in a rotary drier to facilitate subsequent dry grinding, crushed to minus 1/4" and stored in a 500 ton fine ore bin. Ore will be dry ground and, after further surge storage, fed to a two stage fluid bed roaster with air as the fluidizing medium.

Roasted ore will be quenched in an agitated tank and the resulting slurry thickened prior to CIL treatment. Roaster offgases will be cooled and scrubbed to remove arsenic and sulfur dioxide before being discharged to atmosphere. Leach tails will be disposed of in a tailings pond and drained supernated liquors returned to the plant for reuse and gold recovery.

Drying, Crushing and Grinding

Ore will be fed from the reclaim hopper to the dryer, which is sized for continuous operation, to reduce moisture content from 8% to 2%. From the dryer, ore will join the tertiary crusher discharge on a belt feeding a 5 ft x 16 ft screen. Screen undersize will be the ball mill feed, while screen oversize will return to the tertiary crusher.

The tertiary crusher selected will be a used 4-1/4 ft Symons short head. This will be capable of crushing the feed to minus 1/4" and may be capable of producing a finer product, say 4 mesh, depending on the proportion of fines in the dryer discharge, but at the expense of higher wear cost. A finer ball mill feed would enhance the mill capacity.

Crushed ore will be stored in a 500 ton fine ore bin. The bin size allows sufficient surge capacity for a complete bowl liner and mantle change on the tertiary crusher without interruption of ball mill feed. Provision is made for a second bin of similar size for the introduction of limestone should this prove to be beneficial for sulfur dioxide absorption in the roaster.

The ball mill used in this estimate is the recently purchased, used, Allis Chalmers 10-1/2 ft dia by 13 ft long mill.

The nominal capacity of this mill with an 800 hp motor and an F of 4 mesh and P of 149 micron is only 40 tph. It is expected that this mill will be resold and a mill of suitable size found for the 1000 TPD plant rate. Heat would be added to the dry grinding mill if necessary and ground ore sized using air classification. Dry ore will be stored in a bin before being fed to the roaster.

Roasting

The ore will be roasted in a two stage fluid bed roaster, using air as the fluidizing medium. The size of the roaster is predicated on throughput, residence time and fluidizing velocity, and has been determined at 9'6" inside diameter and 55 ft in height. Coal will be added to the ore as the fuel. The coal will be prepared in a separate pulverizer to about minus 8 mesh. Transfer of materials will be by pneumatic systems.

Calcine Handling

Calcine will be directly quenched in an agitated tank. The resulting slurry at 12% solids will be pumped to a thickener, the underflow of which will be fed to the CIL circuit.

Thickener overflow will be cooled in a cooling tower and recycled as cooling water.

Gas Handling

Big Springs ore differs from Jerritt Canyon ore in that it contains less carbonates, and more arsenic. The lower level of carbonates does not allow total absorption of sulfur dioxide in the calcine, and a higher concentration of sulfur dioxide is anticipated in the offgas than was considered for the Jerritt Canyon study. Arsenic will sublime as arsenic trioxide, and a separate scrubbing stage will be required to remove this from the gas stream. Mercury levels are such that scrubbing of mercury will not be required.

The gases will be initially cooled in a quench tower before being filtered in a high temperature baghouse. Further cooling is required for the arsenic trioxide to condense. A venturi scrubber is used to remove the resulting particulate arsenic trioxide from the gas stream.

Several methods of sulfur dioxide scrubbing were considered, including single alkali, double alkali and forced oxidation. Single alkali was selected as the basis for this estimate as the high capital cost of the forced oxidation or double alkali systems could not be balanced by the savings in reagent consumption.

CIL

Carbon in leach is based on 5 stages totaling 8-10 hours following one stage of leaching. Carbon and cyanide concentration will depend on ore characteristics. Carbon will be transferred by pumps. In tank rotary screens will be used as well as a tail safety screen.

The initial tailings embankment proposed will have a life of 2 years, at a throughput of 360,000 tons per year. The eventual dam raised through stage 3 will have a life of approximately 7-1/2 years.

Process Plant Design Criteria

Tertiary Crushing

Ore stockpile capacty	95,000 short tons
Bulk density	120 lb/cubic foot
Ore size	95% -1"
Moisture content	Seasonally variable - up to 8%
Moisture removed in dryer	105 lb/min
Operating period	24 hr/day - 365 days/year
Design crushing rate	50 stph
Circulating load	140%
Product size	80% -1/4"
Fine ore storage capacity	12 hours

Grinding

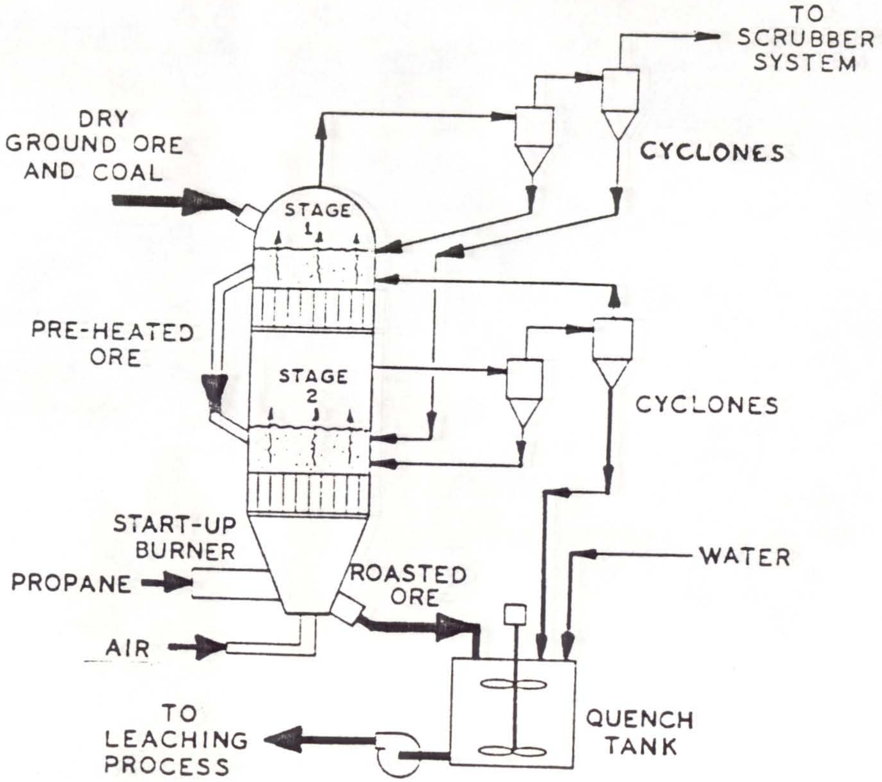
Ball mill feed rate	46.8 stph
Ball mill feed moisture content	2% max
Ball mill feed size, 80% passing	1/4"
Circulating load	200%
Classifier product size, 80% passing	150 mesh
Classifier product moisture content	1/2%
Bond work index	15.5 kwh/st

Roasting

Roaster feed rate	46.8 stph
Residence time per bed	5-10 min
Bed depth	3-6 ft
Bed temperature	1100 F
Vessel design temperature	1500 F
Air flow rate	7500 lb/hr

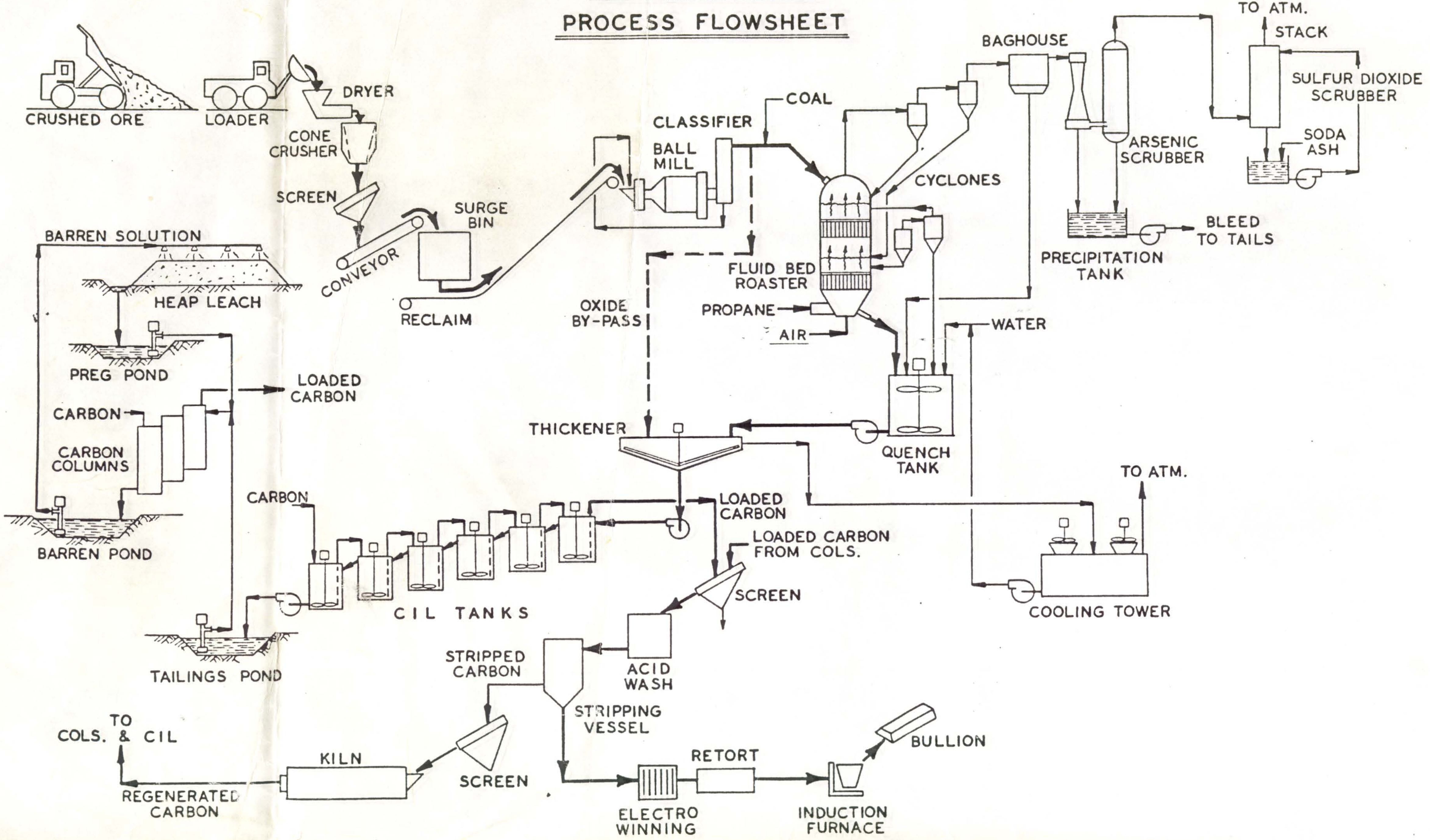
FREEPORT-McMORAN GOLD CO.
BIG SPRINGS PROJECT

FLUID BED ROASTER



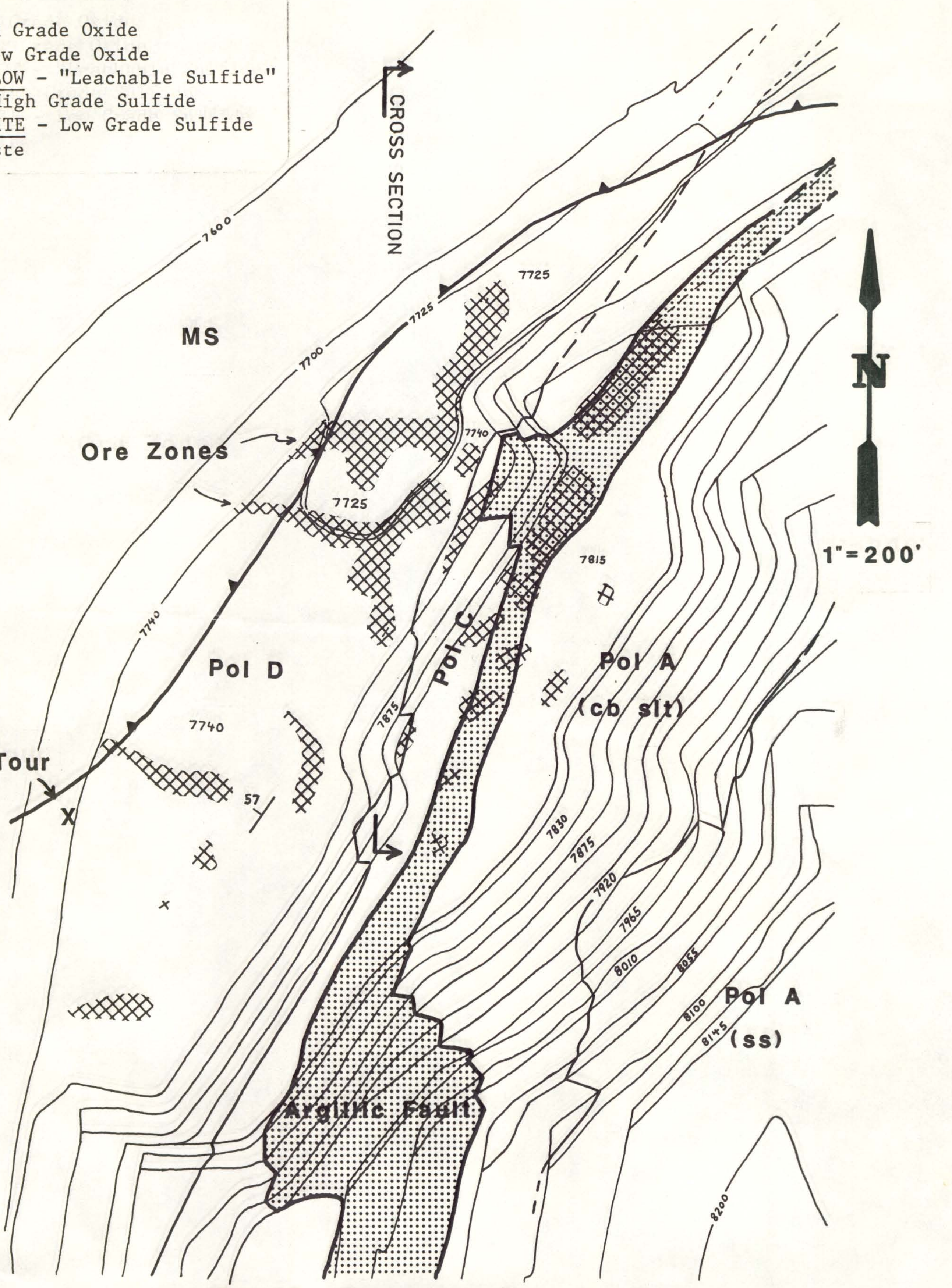
FREEPORT - McMORAN GOLD CO.
BIG SPRINGS PROJECT

PROCESS FLOWSHEET



KEY TO MUCK FLAGS

RED - High Grade Oxide
GREEN - Low Grade Oxide
GREEN/YELLOW - "Leachable Sulfide"
YELLOW - High Grade Sulfide
YELLOW/WHITE - Low Grade Sulfide
BLUE - Waste



North Sammy Creek Pit

GENERAL GEOLOGY