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SCINTREX LIMITED
GEOPHYSICAL CONSULTANTS & CONTRACTORS

J. E. K.

JUN 06 1973

CASE HISTORY #5*

SOUTH AFRICAN MERCURY GEOCHEMICAL SURVEYS

During the late Fall of 1972 a series of mercury soil and mercury soil gas geochemical surveys were carried out over areas in South Africa.

The results of one of these soil gas surveys is presented here. The Scintrex HGG-3 Portable Mercury Spectrometer was employed and observations were taken by simply inserting the probe 20 to 30 cm deep in the soil.

The grid (see Figure 1) covers a section of a copper deposit being prepared for production. The mineralization is considered syngenetic (probably volcanic) in Precambrian amphibolitic host rock. The ore body has a shallow dip to the northwest and is capped by competent mica schists. A soil cover is present except over the gossan, directly above the ore zone.

The soil gas results show a strong anomaly, of up to 1000 nanograms/m³, towards the northeast end of the gossan outcrop over a general background of 10 to 20 nanograms/m³. The length of the anomaly is 300 meters and its width is 40 meters.

Figure 2 shows one of the traverses and the extent of the gossan.

Many Canadian Precambrian copper-zinc deposits have mercury associated with them, e.g. Noranda-camp, and mercury soil gas measurements should not be overlooked as one useful exploration tool for these valuable deposits.

* For Case Histories 1 to 4 see Scintrex Applications Brief 72-3, "Mercury Vapour Analysis in Exploration".



SCINTREX

earth science division

mercury spectrometer

J.E.K.
JUN 06 1973

HGG-3

features

Sensitivity is better than 40×10^{-12} grams mercury.

Specific readings of trace quantities of mercury are achieved by atomic absorption measurements using the intense 2537° A mercury spectral line.

To reject other ultra-violet absorbing gases and vapours, a Zeeman spectral line-splitting technique is used to create reference wavelengths on either side of the parent line.

A robust, modular construction combines the HGG-3 optics, which have no moving parts, and fully solid-state electronics with an easily replaceable lead-silica gel battery pack and charger.

As a line-operated unit in a vehicle, camp or laboratory, the HGG-3 yields sensitivities and sample throughputs significantly beyond those achievable by conventional instruments.

Versatility of approach is assured by the compatibility of the HGG-3 with most sampling accessories including soil gas kits, organic convertors, pyrolisers, wet chemical kits and silver foil collectors.



The Scintrex HGG-3 mercury spectrometer is a field-portable unit which provides a rapid and economical geochemical technique for on-the-spot determinations of mercury in soils, soil gases, rocks, water and sediments.

Its high sensitivity and selectivity permit unambiguous mercury analyses to previously unobtainable detection limits.



SCINTREX MINERAL SURVEYS, INC.
3215 OAKCLIFF DRIVE
SALT LAKE CITY, UTAH 84117
PHONE (801) 272-2801

SCINTREX MINERAL SURVEYS, INC.
 165 WEST 2950 SOUTH
 SALT LAKE CITY, UTAH 84115
 PHONE (801) 484-5297



SCINTREX
 J. E.

JUN 06 1973



MERCURY ANALYSIS SYSTEMS

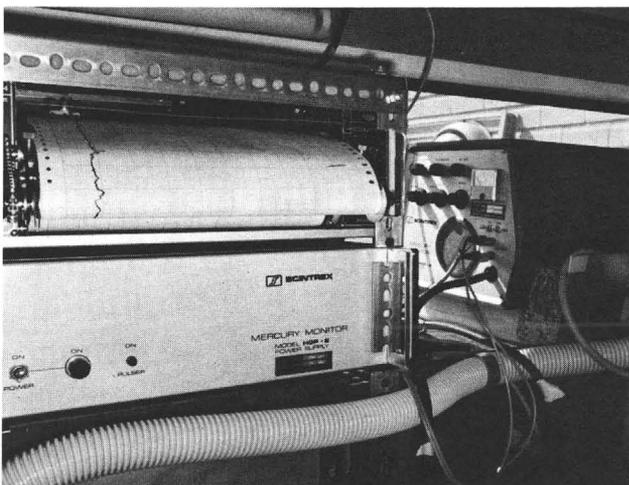
FOR POLLUTION CONTROL AND MINERAL EXPLORATION

The Scintrex range of mercury vapour measurement equipment represents a significant advance in the detection of trace quantities of this element, using the latest electro optical technology. These systems have demonstrated world-wide reliability in a variety of applications, including geological and pollution, in airborne, portable and stationary monitoring forms.

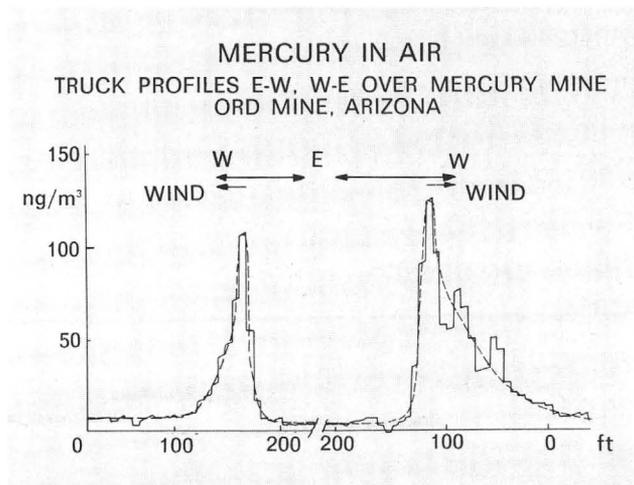
The four basic models described in this brochure have been designed to meet most common and specialized detection problems precisely and economically. The HGP-2 is a medium sensitivity system intended primarily for pollution control studies. The HGM-2 is a higher sensitivity ver-

sion, for use where the utmost sensitivity is required. The HGL-3 is a compact, low-cost, laboratory mercury analyzer and the HGG-3 is a portable unit for many types of field measurement. All four mercury systems incorporate specialized atomic absorption spectrometers, using the intense 2537^oA mercury resonance line. To reject other UV absorbing gases and vapours, a proprietary Zeeman spectral line-splitting technique has been developed to create reference wavelengths on either side of the parent line.

With no moving parts in the optics, and fully solid-state electronics, these systems combine extreme sensitivity with trouble free operation.



MOBILE HGP-2 INSTALLATION



HGP-2

The Scintrex HGP-2 is a medium sensitivity unit intended for a wide range of measurement applications. Intended primarily for pollution control work, it may however be used wherever the high sensitivity and faster response time of the HGM-2 are not required.

The HGP-2 systems consists of three units, sensor, filter unit and power supply. The sensor contains the spectrometer/sample cell and the signal processing electronics. Apart from the power switch on the power supply unit, all controls are mounted on the sensor unit.

The air sample to the spectrometer is supplied from a blower in the filter unit. This air passes through either a plain filter or a similar filter activated with palladium chloride to enable a 'zero-mercury' line to be established. Sample or zero modes are electrically selected either on command or by an internal programmer.

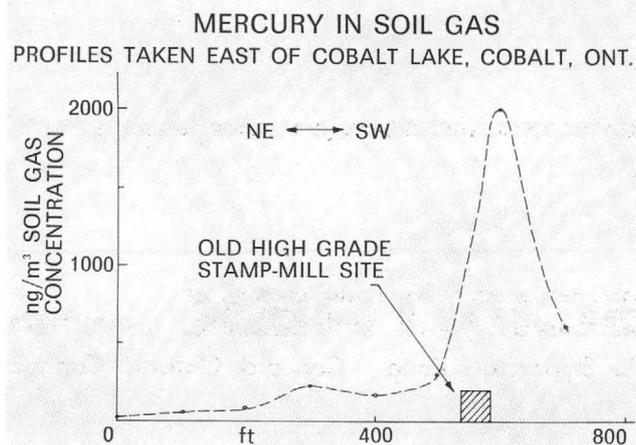
Sampling accessories are available to enable the HGP-2 system to be used for soil gas and solid/liquid sample analysis with a detection limit of less than 100 picograms. A battery pack is also available where the equipment is to be operated remote from line power.

HGG-3

The HGG-3 is a totally new instrument for high sensitivity measurements of mercury vapor in soil gas i.e., the gas that can be drawn through the top few feet of the earth's surface. The geo-chemistry of mercury and its compounds, with its high mobility and its ability to form dispersion halos around some types of mineralized areas is well known. However exploitation has been mainly limited to conventional wet chemical methods, as until now, direct vapor measurements have been limited by lack of practical instrumentation.

Now, for the first time, a portable back-pack instrument is available for fast accurate measurement over most types of terrain. A small diameter hole is made with a spike or hand auger and the air from the hole, which is sealed at the top, is pumped through the instrument. Readout is linear, in nano-grams/cubic meter.

The HGG-3 will also find wide application in atmospheric monitoring of industrial areas, chemical plants etc. etc.



HGM-2

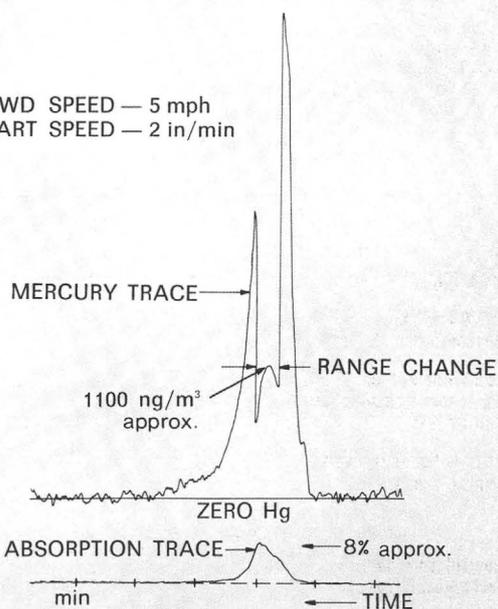
The HGM-2 is the high sensitivity version of the HGP-2 and uses the same Zeeman modulation technique. The absorption pathlength of the spectrometer has been increased to make it the most powerful system today. Designed particularly for geological exploration, other uses include airborne pollution monitoring, plume studies etc. A special feature is a second output channel monitoring the total UV absorption which can be calibrated in terms of SO₂ or any other UV absorber. Particularly useful in locating otherwise invisible plumes, this channel may be used to calculate interference cross-coefficients to yield an additional degree of confidence in the data.

Accessories are available for the analysis of most types of sample, both liquid and solid. Binary or BCD outputs are available as well as an optional battery pack using sealed rechargeable batteries.

INCINERATOR PLUME

JULY 16, 1971

A/C FWD SPEED — 5 mph
CHART SPEED — 2 in/min



HGL-3

The Scintrex HGL-3 is a compact bench top unit for the analysis of mercury in all types of samples, using any of the recommended sample preparation procedures. The greatly improved sensitivity and selectivity of the Zeeman modulated spectrometer, as compared to conventional atomic absorption, can be realised in lower detection limits, much smaller samples or increased through-put. In many cases, direct pyrolysis of the sample into the spectrometer sample cell is possible, due to the instrument's inherent rejection of the otherwise interfering vapors.

Where required, sample pumps and lines, filters, flasks etc. can be supplied as optional accessories. The basic spectrometer would also be compatible with commercially available automatic sample handling equipment. A battery operated power supply is also now available for equipment operation at remote locations.

J. E. K.
JUN 06 1973

Mercury Vapour Analysis In Exploration

Published By



SCINTREX LIMITED

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CONCORD, ONTARIO, CANADA.

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Vancouver, Salt Lake City, Mexico City,
Caracas, Rio de Janeiro, Johannesburg,
Tehran, London, Perth, Sydney

MERCURY VAPOUR ANALYSIS IN EXPLORATIONINTRODUCTION

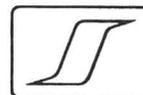
The suggestion of the use of measurements of trace amounts of mercury as a guide to the location of sulphide ore deposits was first made by the Russian, A. A. Saukov (1), in 1946. Since Saukov's original work, many others have studied the abundance of mercury in nature, the association of mercury with sulphide ores and methods by which very minute quantities of mercury can be measured in air, soil, rocks, water and plants.

The most abundant of the mercury bearing minerals is cinnabar (HgS). Native mercury is also found and sulpho-salts like tetrahedrite are known to have important mercury contents. Other sulphides of base metal deposits contain mercury in amounts ranging from parts per million to as much as one or two percent. (2) The mercury content of sulphide-free rocks is usually less than a few hundred parts per billion (1 ppb = 10^{-9}). Soils usually contain less than 100 ppb and water less than 1 ppb of mercury. Normal atmospheric air contains about 1 nanogram (10^{-9} grams) of Hg per cubic metre although higher concentrations can be observed near mercury occurrences, sulphide deposits and volcanic exhalations.

Given that sulphide ore bodies contain much higher concentrations of mercury than host rocks, the success of the use of mercury as a trace element for the discovery of such deposits still requires some mobility of the mercury outwards from the deposits to form a "halo".

The chemical and physical details of the migration processes of mercury are not yet fully understood. At the time of deposition of a hydrothermal ore body or during metamorphism of either hydrothermal or syngenetic ore deposits, mercury may migrate upwards into the adjacent host rocks. There is also evidence that mercury can be liberated during tectonic activity. During weathering and oxidation, mercury ions, metallic mercury or mercury vapour may be liberated from the sulphides. A theoretical understanding of the oxidation processes, transport in ground waters and subsequent deposition requires a thorough knowledge of the aqueous chemistry of mercury, which, indeed, is still at the basic research stage.

An ideal pathfinder element for geochemical exploration is one which (i) occurs in anomalous quantities in many types of deposits and (ii) has sufficient mobility to result in a 'halo' of anomalous concentration much



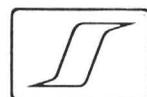
The next stage in mercury spectrometer design was developed in the late 1960's and involved the use of twin cell circuits to overcome the above mentioned problems. These instruments divide the sample in half, remove the mercury from one half by chemical means and compare the outputs of the two absorption cells. In this way, both lamp fluctuations and absorption from interfering substances are overcome and sensitivities of one part per billion could be obtained for gases or for solid samples from which the mercury was vaporized by heating.

It was recognized that further sensitivity in the twin cell approach was limited by the necessity to divide the sample and that further precision could be had by using two wavelengths in the same sample. While mercury has a very sharp absorption spectrum (at 2537 Angstroms, the wavelength of a mercury vapour lamp) other interfering gases have much broader absorption spectra.

Barringer (6) has described one approach to the dual wavelength technique. In this method a mercury lamp is heated to provide a broad wavelength source. Part of the radiation is split off and passed through a cell containing saturated mercury vapour. After passage through the cell the centre of the thermally broadened line is effectively absorbed yielding a filtered beam having no 2537 Angstrom component. Mechanical means are used to recombine the beams for passage through the absorption chamber. By comparing the photocell output for the filtered beam with that of the broad beam, a differential measurement can be made so that the absorption due to mercury alone is apparent. This is a useful technique but is limited in precision because of the use of moving parts.

Scintrex Limited developed and has applied for a patent covering the application of the "Zeeman Effect" for modulating the emission of the light source in gas spectrometers. The Zeeman Effect describes the shift in wavelength of a monochromatic light source when placed in a magnetic field. In the Scintrex Mercury Spectrometers a powerful electromagnet is placed around an unheated mercury lamp which naturally emits light having a wavelength of 2537 Angstroms. The magnet is cycled off and on to provide 2537 Angstrom light for one half cycle and a slightly different wavelength for the other half cycle. A measurement is made to differentiate total absorption made at 2537 Angstroms from non-mercury absorption at the shifted wavelength.

Using Zeeman modulation the wavelength shift can be made very rapidly and without any moving parts, thus allowing sensitivities better than one part in 10^{12} . In Scintrex Mercury Spectrometers, lamp intensity changes are controlled by using modern electronics for stability. In addition, reference photocells reacting to part of the light beam provide electronic scaling. The use of Zeeman modulation has allowed Scintrex to design precise, portable and less expensive Mercury Absorption Spectrometers.



THE APPLICATION OF SCINTREX MERCURY SPECTROMETERS
IN EXPLORATION

Atmospheric Air Sampling

The Scintrex HGM-2 instrument is a continuously sampling atmospheric air Mercury Spectrometer having a sensitivity of 1 nanogram of Hg in one cubic metre of air. The analogue output is displayed on a chart recorder and has a three second time constant. The HGM-2 is normally installed in a vehicle or aircraft when used for exploration purposes.

It appears that exploration surveys using atmospheric air mercury sampling are best carried out in locations where hot arid conditions prevail since these conditions are most amenable to liberation of mercury vapour from the soil. Wind dispersion can be a problem, particularly for airborne surveys.

To date, atmospheric gas mercury anomalies detected at ground level, while they are several times background, are not sufficiently large that one would expect to detect them from the air using a 1 nanogram per cubic metre instrument. Using the Scintrex technique future improvement in sensitivity is quite possible.

Airborne or vehicle-borne mercury surveys offer the possibility of covering large areas at a low unit cost so that they are a very appealing exploration technique.

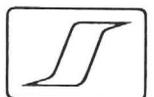
Soil Gas Sampling

The Scintrex HGG-3 instrument is a portable mercury spectrometer capable of instantaneous sampling of the mercury vapour in soil gas to an accuracy of .05 nanogram in a 1/4 litre sample. The field procedure involves an assistant who makes holes in the soil up to 30 cm deep using a stake. The operator then inserts a probe (tapered to keep atmospheric air out) into the hole, pumps a sample into the spectrometer and takes a reading instantaneously.

Where soil conditions permit proper sampling, soil gas mercury surveys are more effective than atmospheric gas surveys. Soil gas surveys allow better repeatability as well as operation under a variety of atmospheric and topographic conditions. Using the HGG-3 with stations each 30 metres along grid lines, as much as 5 line kilometres of soil gas sampling can be carried out in one day.

Soil, Rock and Plant Samples

Samples of soil, rock and plant matter can be analyzed for mercury content using either of the HGM-2 or the HGG-3 spectrometers, although the latter is more portable and simpler to use in the field.



To avoid organic substances, soil samples are collected from the 'B' or 'C' horizons, placed in plastic bags and transported to the spectrometer within a reasonable short time so that there are neither losses nor contamination by mercury. Rock samples must be crushed while plant material must be dried and then ground. The samples can then be treated by direct pyrolysis although in some cases a simple chemical digestion may be advantageous. Using this method, an average of 150 samples can be treated in a normal working day.

CASE HISTORIES

Mercury Vapour in Soil Gas Survey, Clyde Forks, Ontario, Canada

Figure 1 shows the results of two profiles surveyed for mercury in soil gas using the Scintrex HGG-3 Mercury Spectrometer.

The test area is a known mercury prospect near Clyde Forks, Ontario. The host rock is Precambrian sediments of Grenville Age and the mineralization consists of disseminated tetrahedrite, chalcopyrite, pyrite and cinnabar in a narrow vein dipping at about 30° . It is noted that tetrahedrite contains about 4% by weight of Hg.

The profiles speak for themselves. Background levels are very low and distinctly anomalous observations are seen in the area where the mineralization outcrops.

Mercury Vapour in Soil Gas Survey, Keel, Ireland

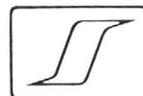
The Scintrex HGG-3 Portable Mercury Spectrometer has now been used extensively in Ireland. Figure 2 shows some profiles taken over the Keel lead-zinc deposit.

Low background values of a few millivolts are seen in areas away from the deposit which are not shown on the plan. Anomalous concentrations of mercury in the soil gas are seen in the area of mineralized faults, however, in the western profiles, low values are seen in an area where a peat bog overlies the deposit.

Mercury Vapour in Atmospheric Air Surveys, West Pilbara, Australia (7)

Figures 3 and 4 show the results of work carried out with the Scintrex HGM-2 Mercury Vapour Spectrometer installed in a Land Rover truck.

Surveys carried out in areas where no sulphide mineralization is known showed backgrounds of 1 to 2 nanograms per cubic metre. In the case of the showing and gossan at Lulu Creek and Sherlock Station respectively, the



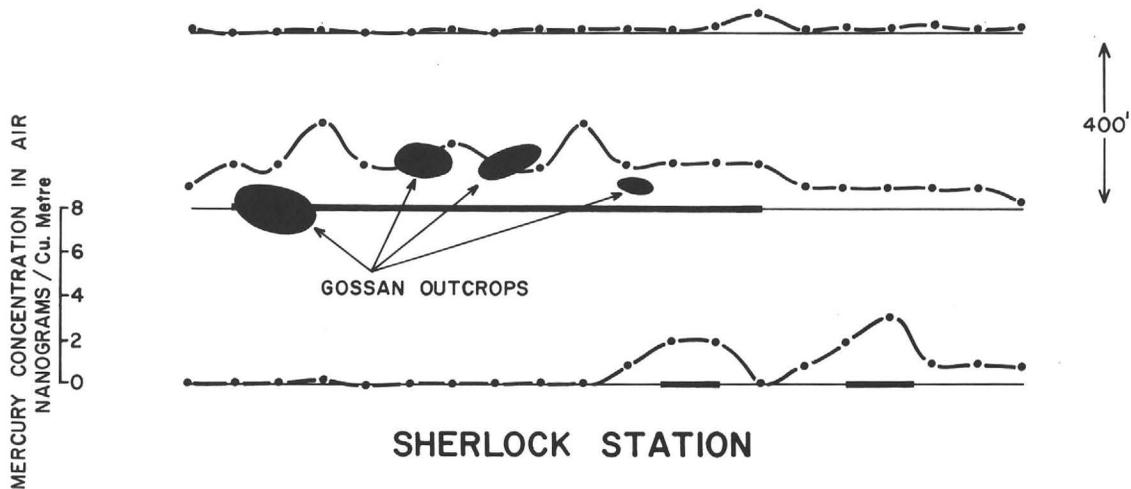
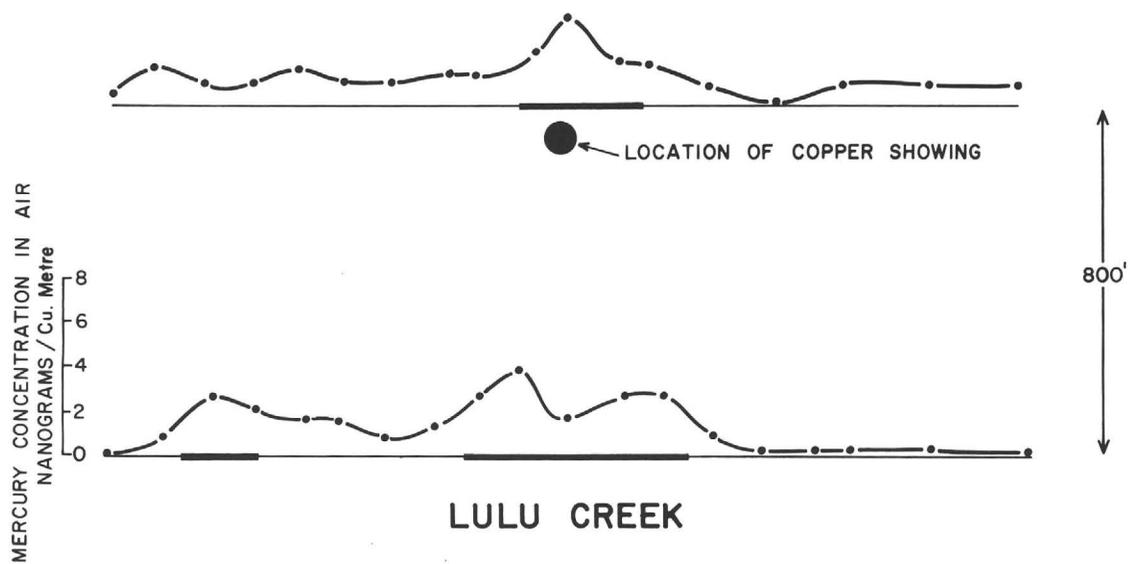


FIGURE 3
 ATMOSPHERIC AIR SAMPLING FOR MERCURY VAPOUR
 WEST PILBARA, AUSTRALIA
 SCINTREX HGM-2 MERCURY SPECTROMETER

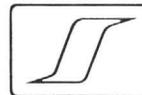
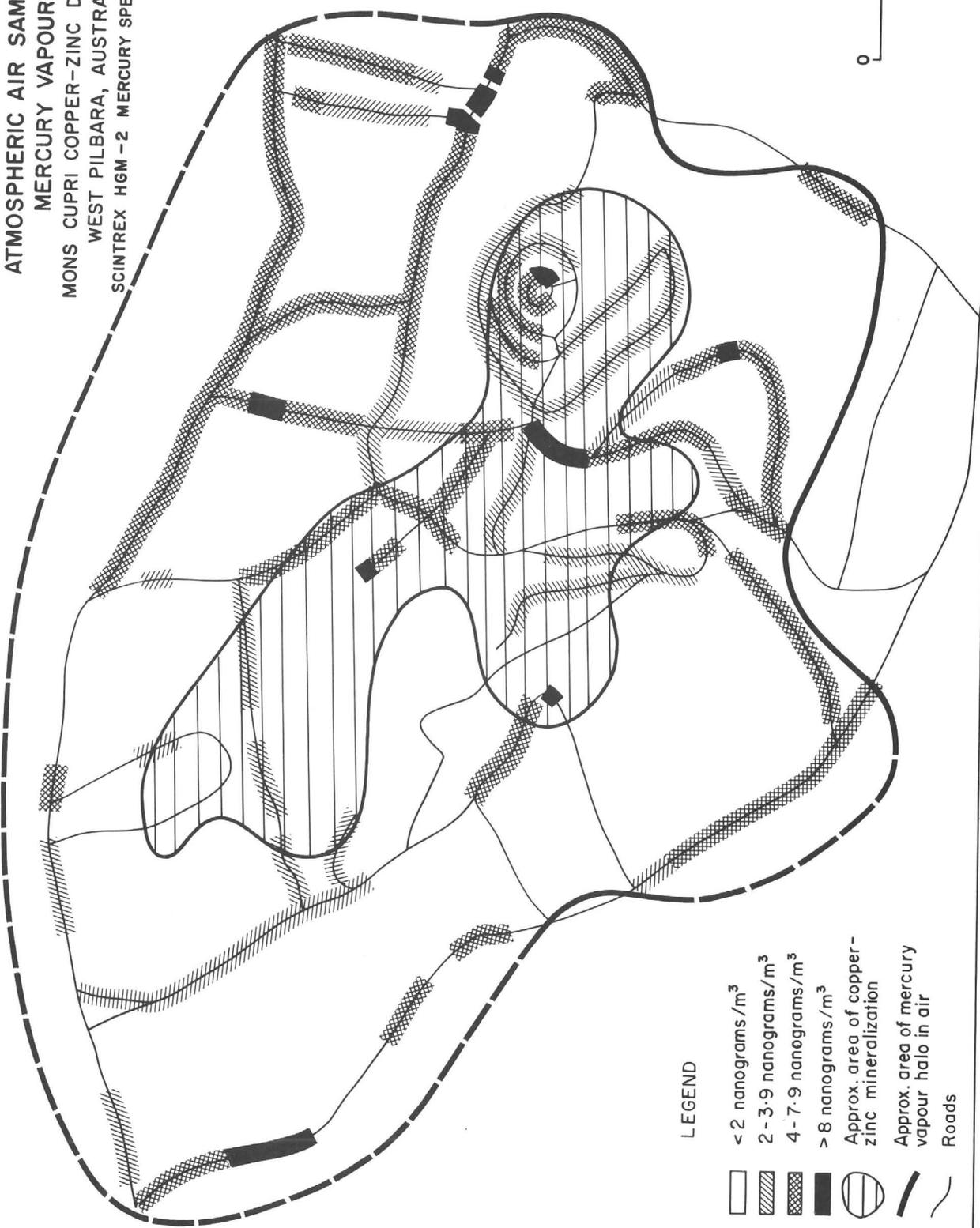


FIGURE 4

ATMOSPHERIC AIR SAMPLING OF
MERCURY VAPOUR
MONS CUPRI COPPER-ZINC DEPOSIT
WEST PILBARA, AUSTRALIA
SCINTREX HGM-2 MERCURY SPECTROMETER



LEGEND

-  < 2 nanograms/m³
-  2 - 3.9 nanograms/m³
-  4 - 7.9 nanograms/m³
-  > 8 nanograms/m³
-  Approx. area of copper-zinc mineralization
-  Approx. area of mercury vapour halo in air
-  Roads

0 500 FEET

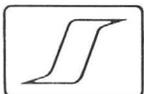
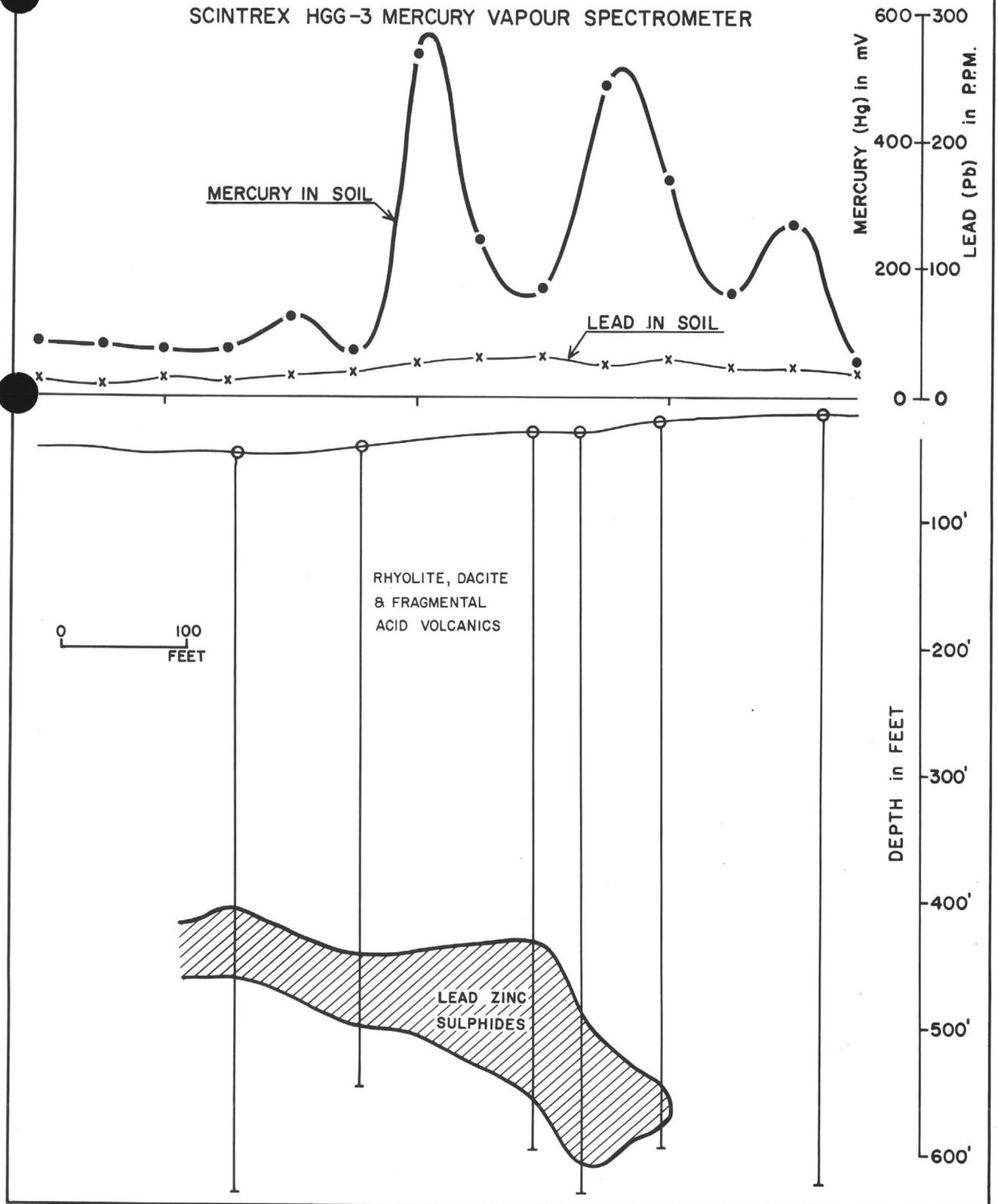


FIGURE 6

MERCURY SOIL GEOCHEMICAL SURVEY

LEAD - ZINC DEPOSIT, EASTERN CANADA

SCINTREX HGG-3 MERCURY VAPOUR SPECTROMETER



John E. Kinnison
Tucson, Arizona

December 5, 1972

John Sandy
Tucson, Arizona

File
Blue
John Sandy

Procurement of Recording
Barometer and Thermometer for use
with Mercury Vapor Surveys

Following our discussion last week concerning recording barometers and thermometers, I made a survey of such equipment. I contacted all of the electronic and instrument companies in Tucson, Scientific Devices Southwest (Albuquerque), Tektronix (Phoenix), and JACO Electronics (Woodland Hills, California). None of these companies sell portable field thermometers or barometers. Therefore, as discussed, Wards Natural Science Establishment appears to be our only easy, and readily available, source. They list two types of recording barometers and thermometers, 110 volt electric-powered models at \$80 each, and wind-up models at \$520 for the barograph and \$260 for the thermograph. Xerox copies of these listings are enclosed.

I recommend that we purchase the 110 volt models and a portable generator (Honda, Model E400, 110 volt, 400 watts, 8 amps, \$215), which will result in a savings of \$400.

/fn
Attachments

Mercury Vapor

J. E. K.

MAR 24 1972

According to Bruce Bell - local Mgr of McPhar -

Jim Barnes Barnes is a consultant who does Hg-Vapor surveys, using plastic pipe insert in ground, 24 hr collection. Work may have been done on some por Cu deposits but Bell is not sure.

Barnes Technical Enterprises

2130 Yuma Lane

~~to~~ Reno Nev 89502

329-9341

McCarthy Tel Coll
5Kylins Labs
12090 W 50th Place
Wheat Ridge, Colo
80033
303-424-7718

Suggested by McCarthy
for Commercial Ag Screen Hazard.

U.S. G.S. will help standards
with a few samples

J. E. K.

NOV 3 1970

For ASARCO PROPOSAL

<u>Prospect</u>	<u>Samples</u>	<u>Map</u>
Copper Mountain	28 Sample sites*	AH. A
Lakeshore	15 17 " "	B
Poston Butte	26 " "	C
Reward	20 " "	D
Jacaton	42 " "	E
San Xavier	28 " "	F
Silver Bell	15 " "	No sketch
	<u>7</u>	
	166	
	176	

*Includes control sites

	CLF	JEK	Silver Bell	2 day	(1)
Asarco helper	CLF	JEK	- Sacaton	1 day	(2) hr travel + exp
	CLF + EB		- Sacaton	1 day	+ Exp hr Travel
	Reward	(CLF)	helper	1 day	
	Lakeshore	(JEK)	helper	1 day	
	Posson Butte	CLF	+ helper	2 days	
	San Xavier	JEK	+ Asarco helper	1 day	
	Copper Mtn	JEK	+ helper	2 days	

11 days

hemispheres \$ 500
 Silver Screen 300
 800

CLF 7 JEK 7
 helper 7 days
 x \$ 30
 \$ 210

expenses \$ 75/day
 14

14
 x 175
 = 2450 labor
 210

 \$ 2660
 1950

 4610
 2 days office 350

 4960

175
 2
 350

\$ 5000 basic labor
 800 Supplies

 \$ 5800

Hg Sniff Test Areas

1. A. Sacaton "Impermeable" Sacaton congl.
B. Santa Cruz Deep cover, water table

2. A. N.E. area Mission ore zone - Eisenhower -
south San Xavier

B. San Xavier North

3. Poston Butte - Partly under water table

4. Silver Bell - "Typical" porphyry Cu

A. Capping between oxide and El tiro

B. Capping north of El Tiro

4. Reward

5. Lakeshore

Deep western sulphides and
some hard (impermeable? cgl)

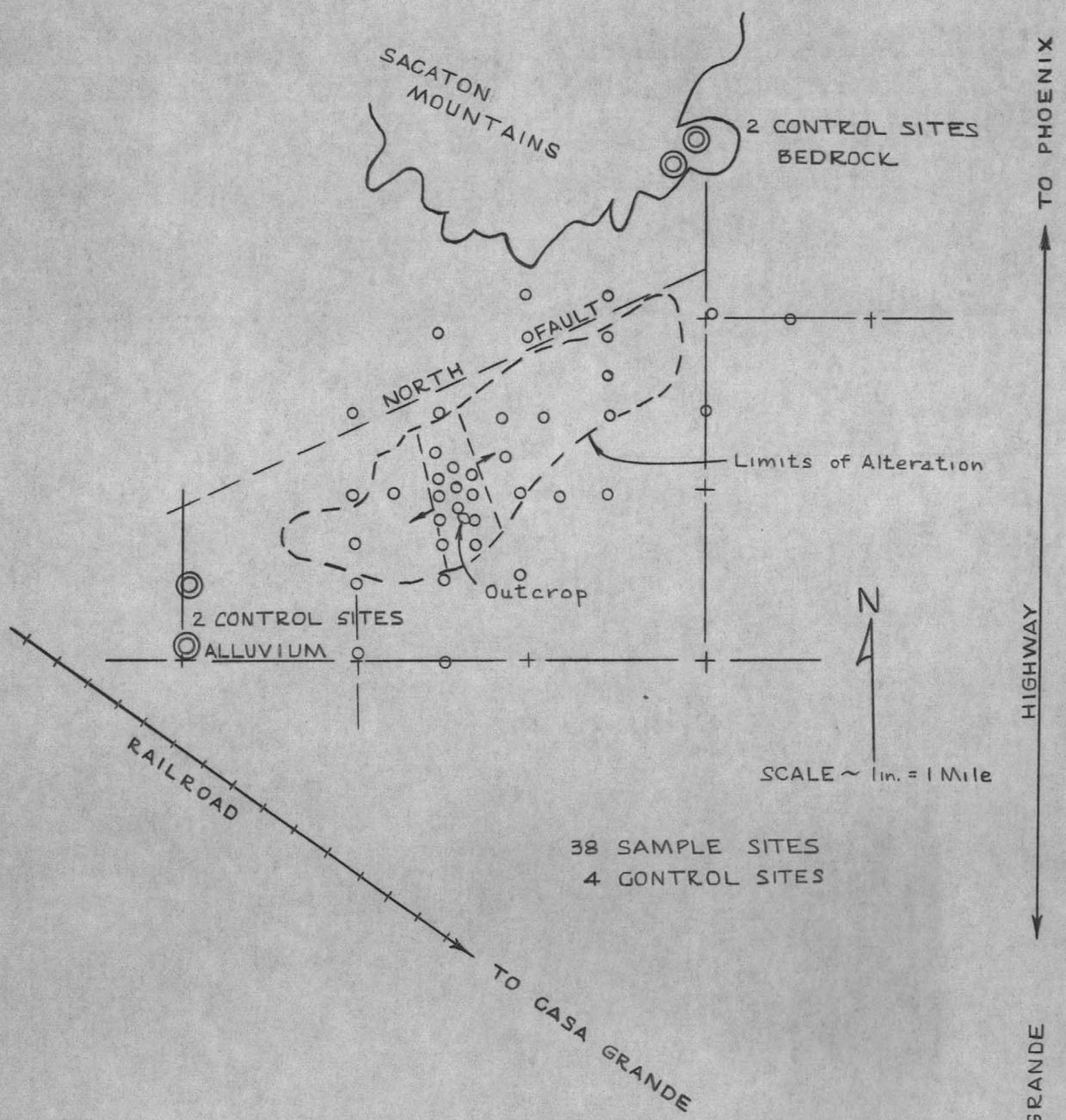
6. Copper Mountain

7. ~~Phelps Dodge at Safford~~
and also San Juan

hard
Deep capping

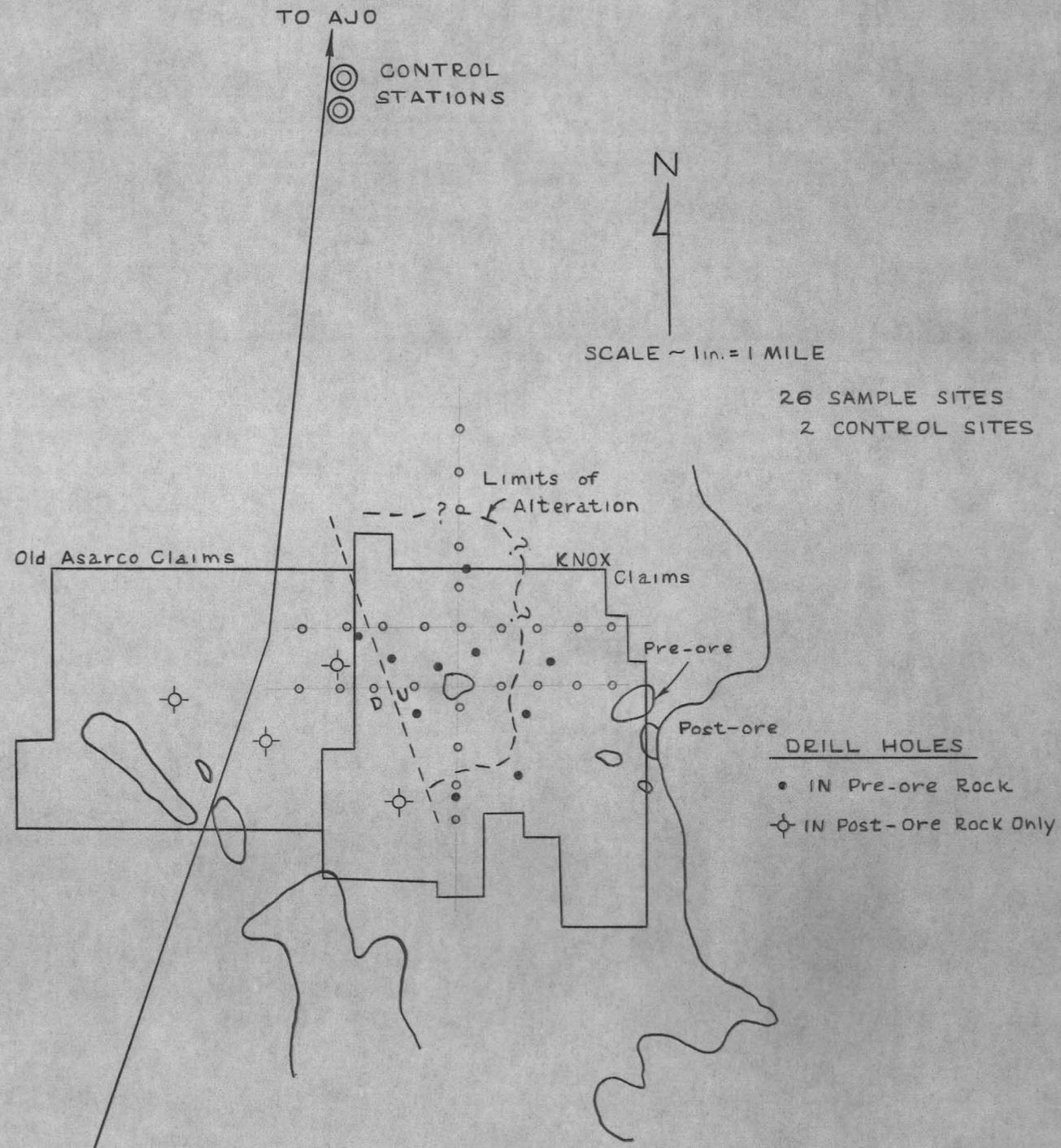
medium depth hard capping.

→ Additional control.



KINNAIR ASSOCIATES

SACATON
 PROPOSED MERCURY VAPOR SURVEY



26 SAMPLE SITES
2 CONTROL SITES

DRILL HOLES
 • IN Pre-ore Rock
 ⊕ IN Post-Ore Rock Only

KINNAIR ASSOCIATES

PROPOSED MERCURY VAPOR SURVEY
 COPPER MOUNTAIN PROSPECT
 BIG AJO MOUNTAINS

TO LUKEVILLE

TO AJO

CONTROL STATIONS

N

SCALE ~ 1 in. = 1 MILE

Old Asarco Claims

KNOX Claims

Limits of Alteration

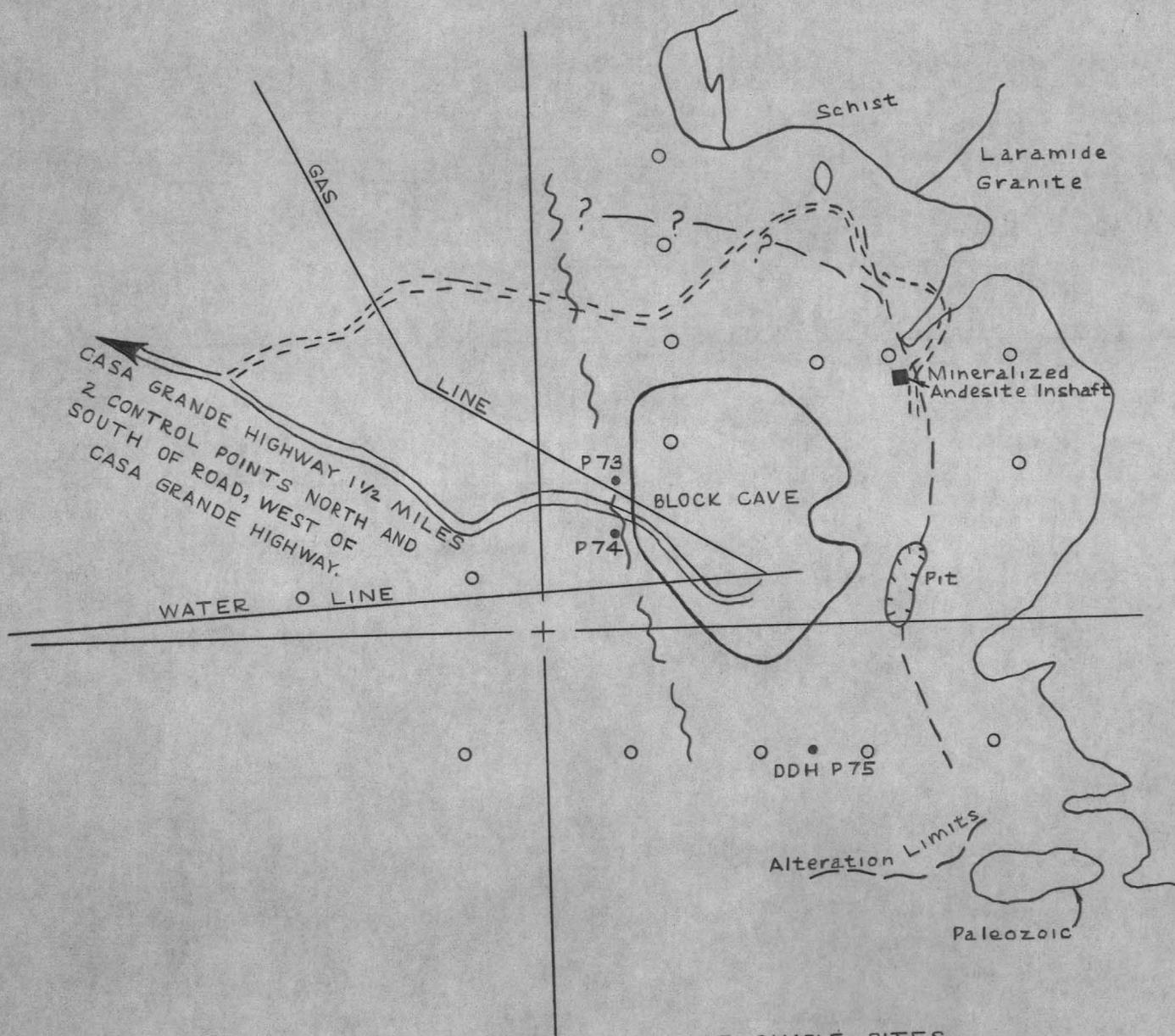
Pre-ore

Post-ore

DU

N

SCALE ~ 4 in. = 1 MILE



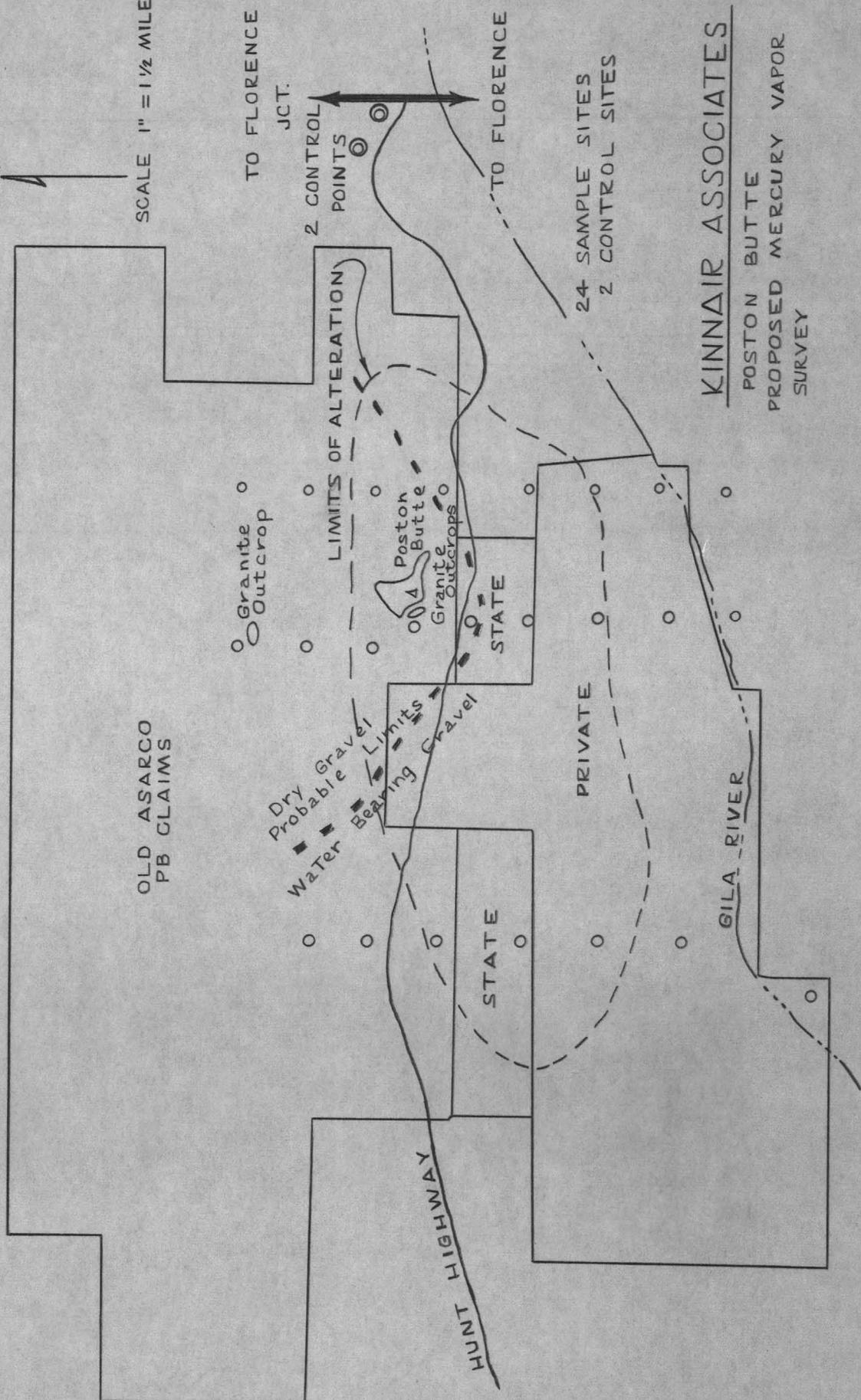
15 SAMPLE SITES
(Or More Depending On
Access To Property)

KINNIAR ASSOCIATES

PROPOSED MERCURY VAPOR SURVEY
LAKESHORE MINE



SCALE 1" = 1 1/2 MILE



TO FLORENCE
JCT.

2 CONTROL POINTS

TO FLORENCE

24 SAMPLE SITES
2 CONTROL SITES

OLD ASARCO
PB CLAIMS

Granite Outcrop

LIMITS OF ALTERATION

Poston Butte
Granite Outcrops

STATE

Dry Gravel
Probable
Water Bearing
Limits
Gravel

STATE

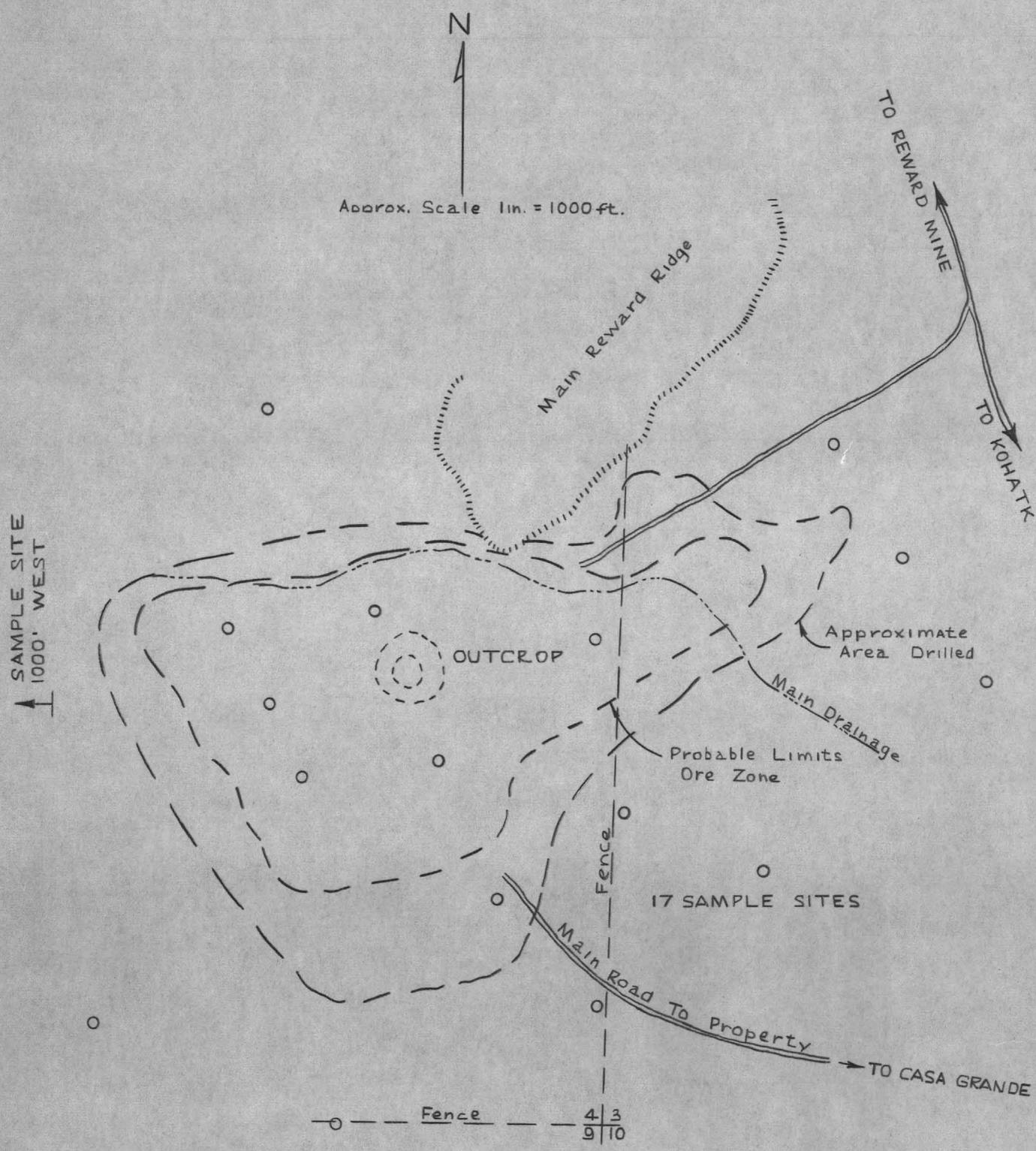
PRIVATE

GILA RIVER

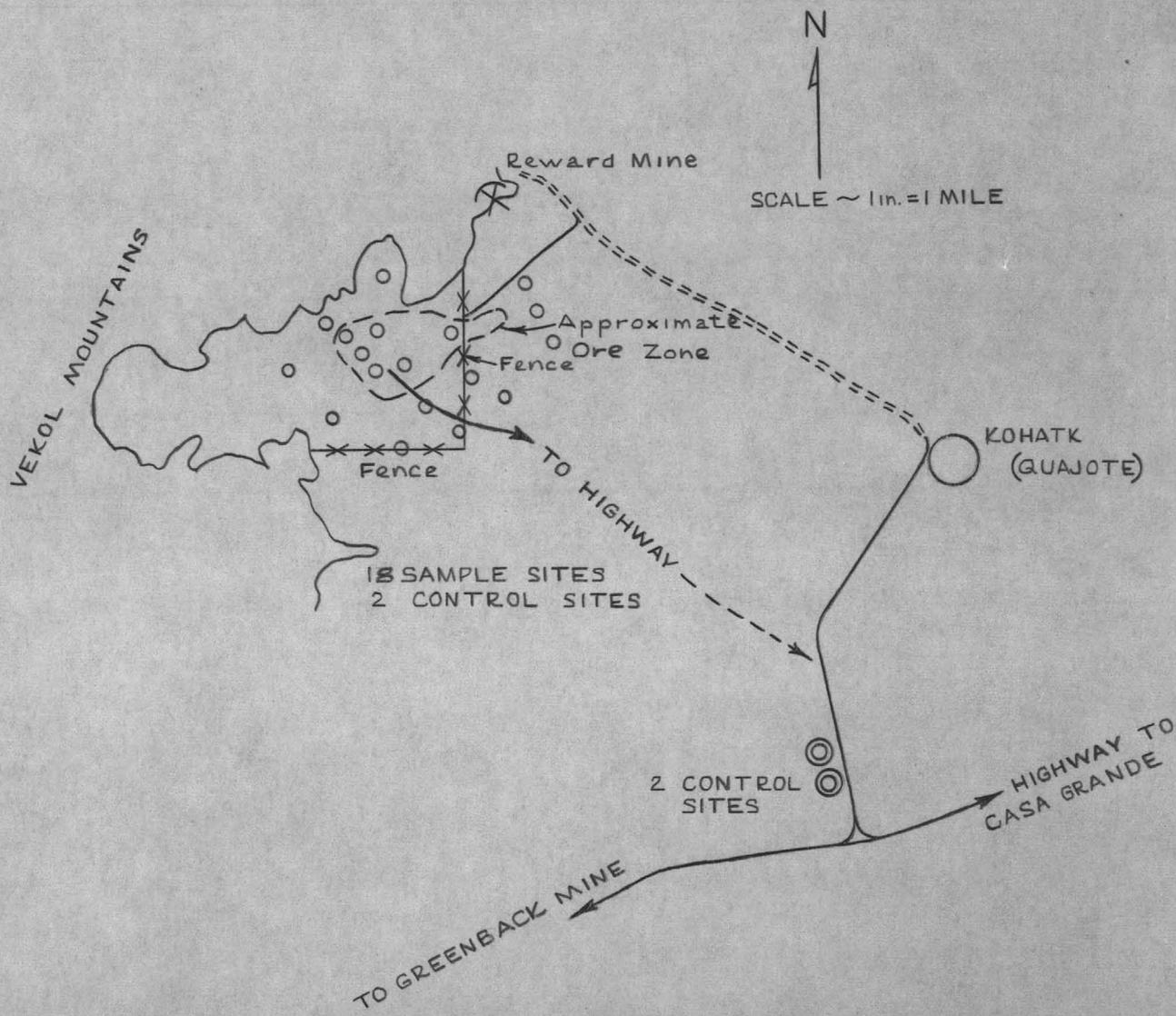
HUNTH HIGHWAY

KINNAIR ASSOCIATES

POSTON BUTTE
PROPOSED MERCURY VAPOR
SURVEY



KINNAIR ASSOCIATES
 NEWMONT'S REWARD PROSPECT
 PROPOSED MERCURY VAPOR SURVEY
 MAP NO. 1

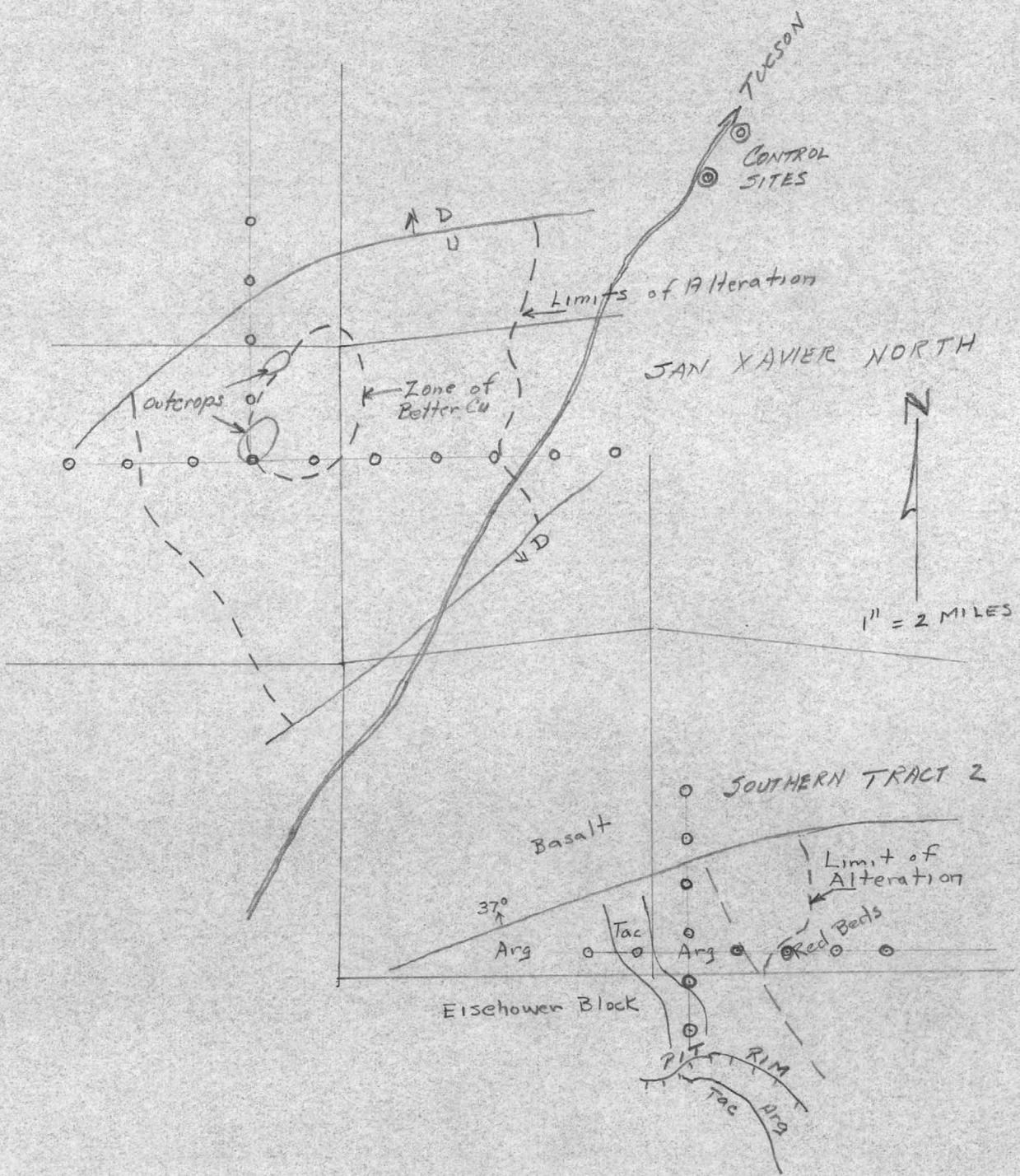


KINNAIR ASSOCIATES

NEWMONT'S REWARD PROSPECT
 PROPOSED MERCURY VAPOR SURVEY
 MAP NO. 2

IMPRINT HOOD

26 Sample sites
2 Control sites

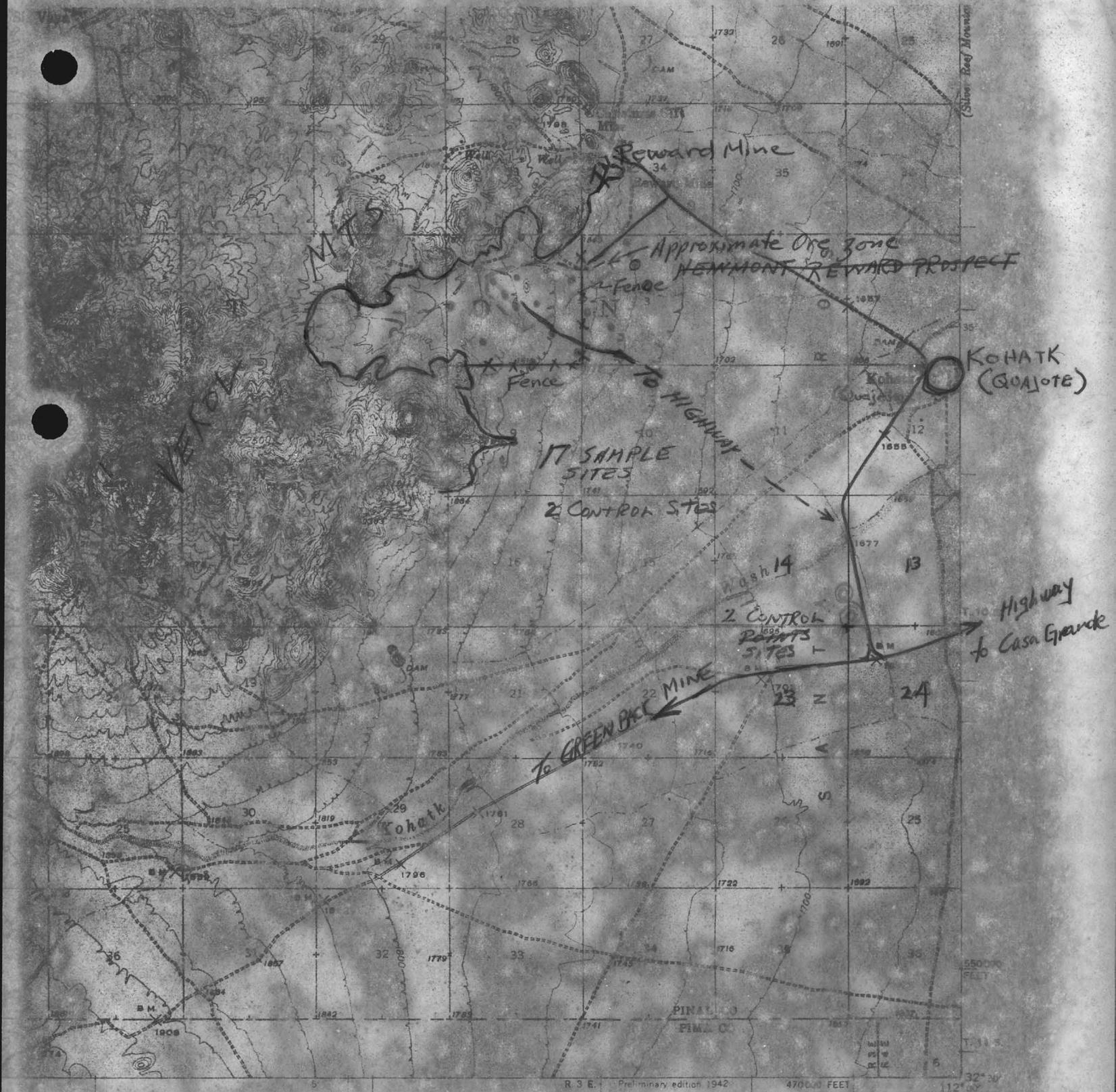


KINNAIR ASSOCIATES

PROPOSED MERCURY VAPOR SURVEY

SAN XAVIER

X



REWARD - MAP 2

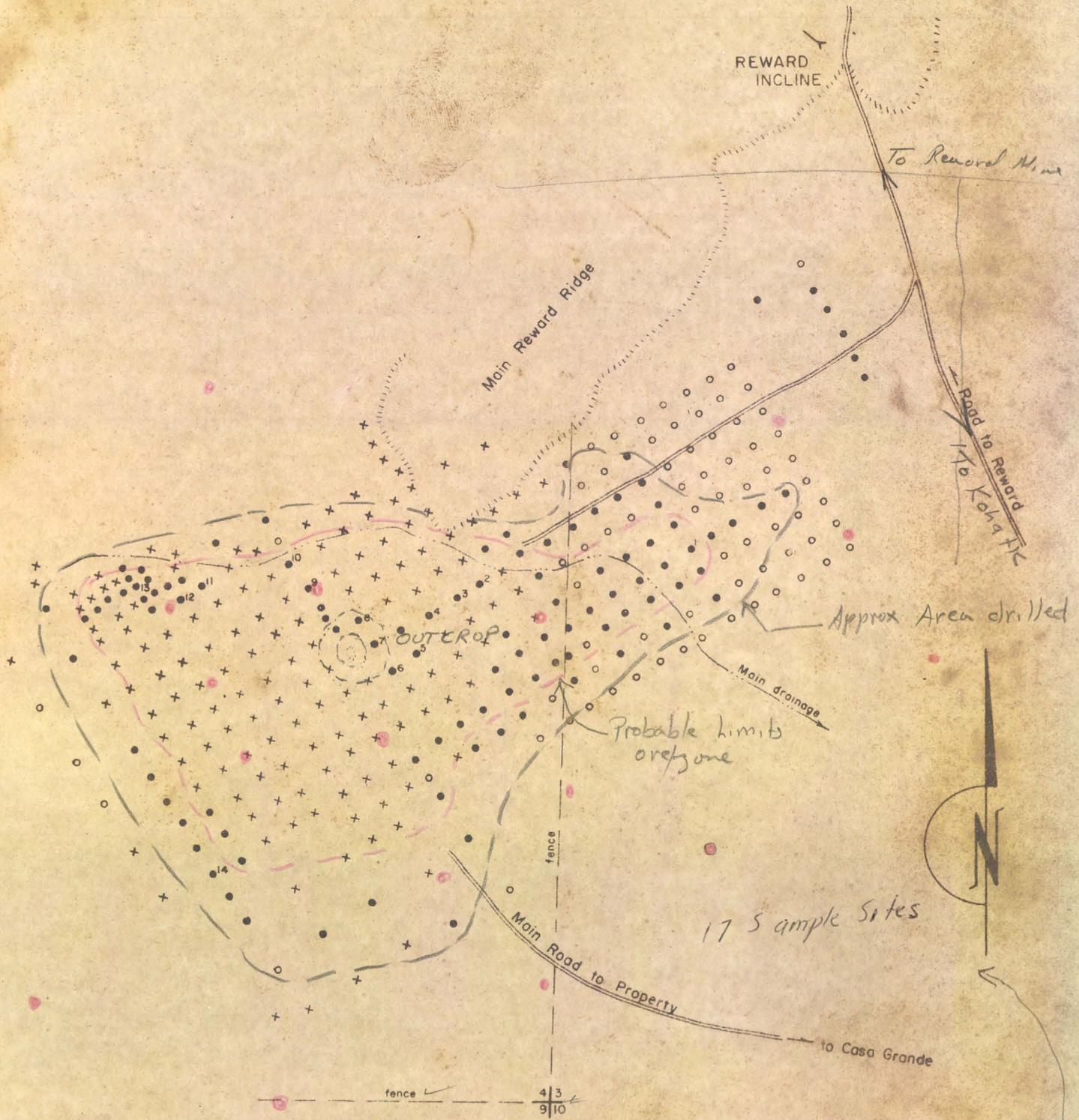
VEKOL MOUNTAINS, ARIZ.

N 3230-W 11200/15

Polyconic projection, 1927 North American datum
 5000 yard grid based on U. S. zone system, F
 10000 foot grid based on Arizona (Central)
 rectangular coordinate system

1" = 1 mile

5179
 Sample Point
 1000 West



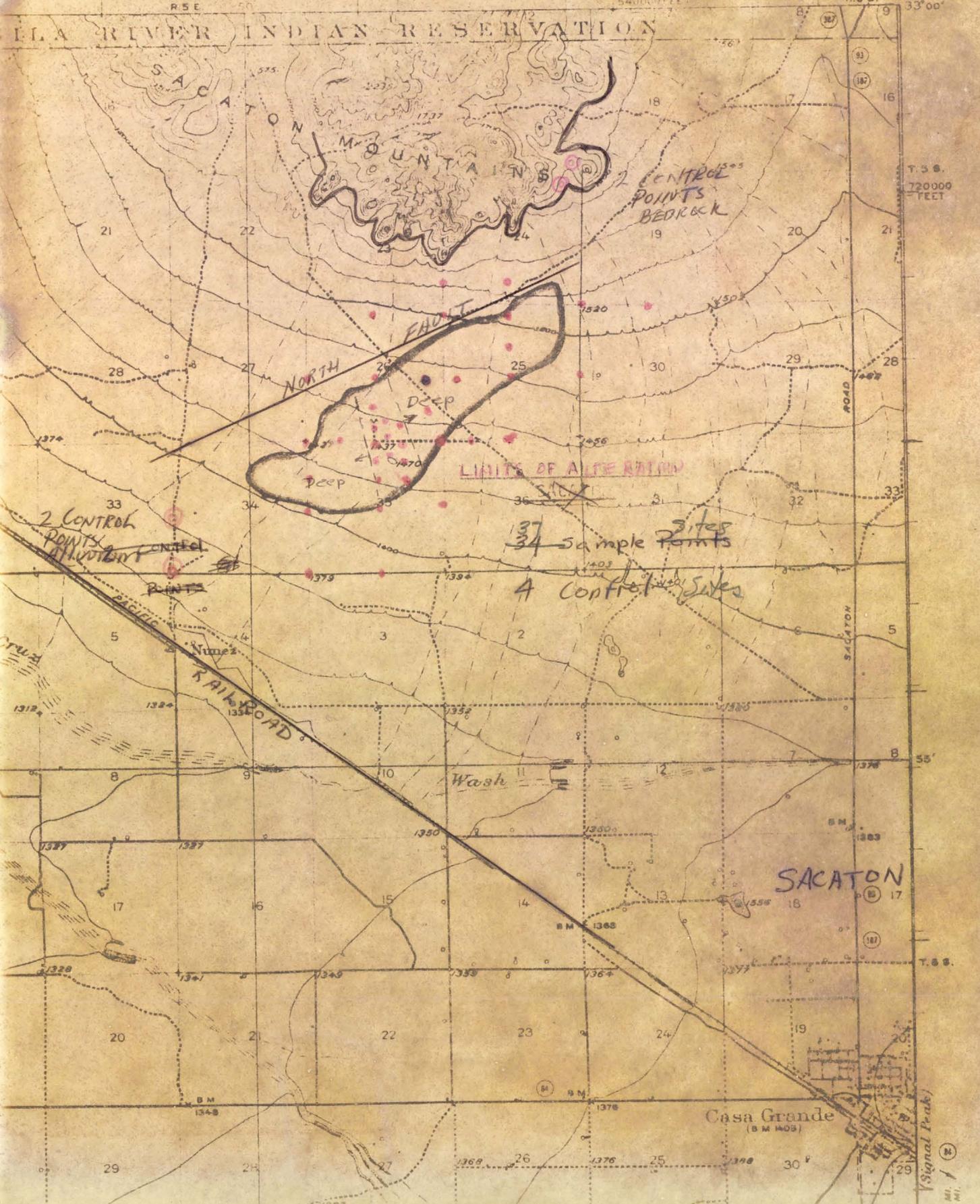
REWARD - MAP 1
 VEKOL MOUNTAINS

- Drilled Hole
- Hole NOT Drilled
- × Drill Site Not Visited
- "Outcrop Hill"
- ³ Drill Hole with Core Specimen Number

Approx. Scale
 1" = 1000'

MESA 32 MI.
17 MI TO ARIZ ST
FLORENCE 26 MI.
9 MI TO ARIZ ST

ARIZONA
(GUAL COUNTY)
CASA GRANDE QUADRANGLE
54000 FEET
R. 6 E. 11 1/2 E (Sacaton)
33° 00'



T. 5 S.
720000 FEET

(Signal Peak)
3 MI. / 1
87 MI.

Full Scale Hg - Reclamation evaluation

	Cost	Fringe 10%	Travel Exp
KINNISON	66	6	50
FAIR	77	7	50
Beery	54	5	50
Fink	38	4	50
Clark	25	3	
	<u>260</u>	<u>25</u>	
	<u>285</u>		

125
\$3504
1400

@ ~~23~~ 23 days/Mo

Say ~~12~~ 12 travel days/Mo for Fair and Kinnison 1200

Say ~~19~~ 19 travel days/Mo for Beery and Fink 1900
3100

Payroll = \$6550/Mo
Travel = 3100/Mo
\$9650/Mo

Drafting 500/Mo

AA-30/day @ 29 days @ 50 1700/Mo

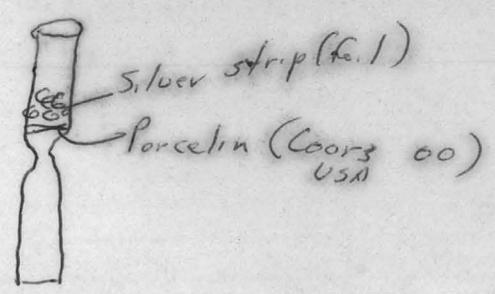
Rent 150
Office Supplies 50
Telephone 100
12150

Office equip Rental 150
\$12,300
Contingency 10% 1200
\$13,500

- Tyran
- Ajo
- Lowen
- Safford
- Miami (1Cus)
- Navamut -
- Socaston
- Cu Mtn
- hakoshore
- Poslan Reata
- Blackmoter

Can be run on 5KW generator
110V 60cy

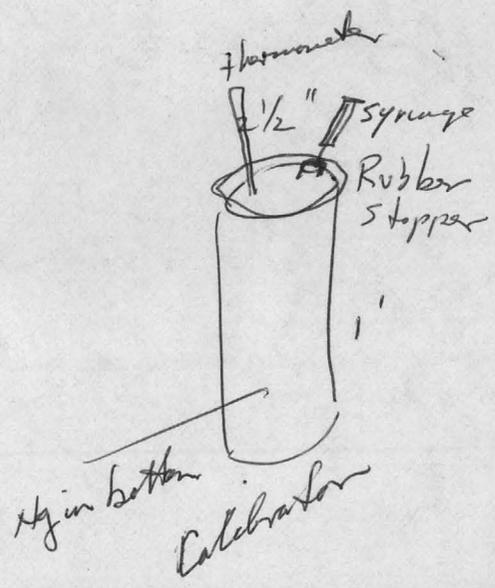
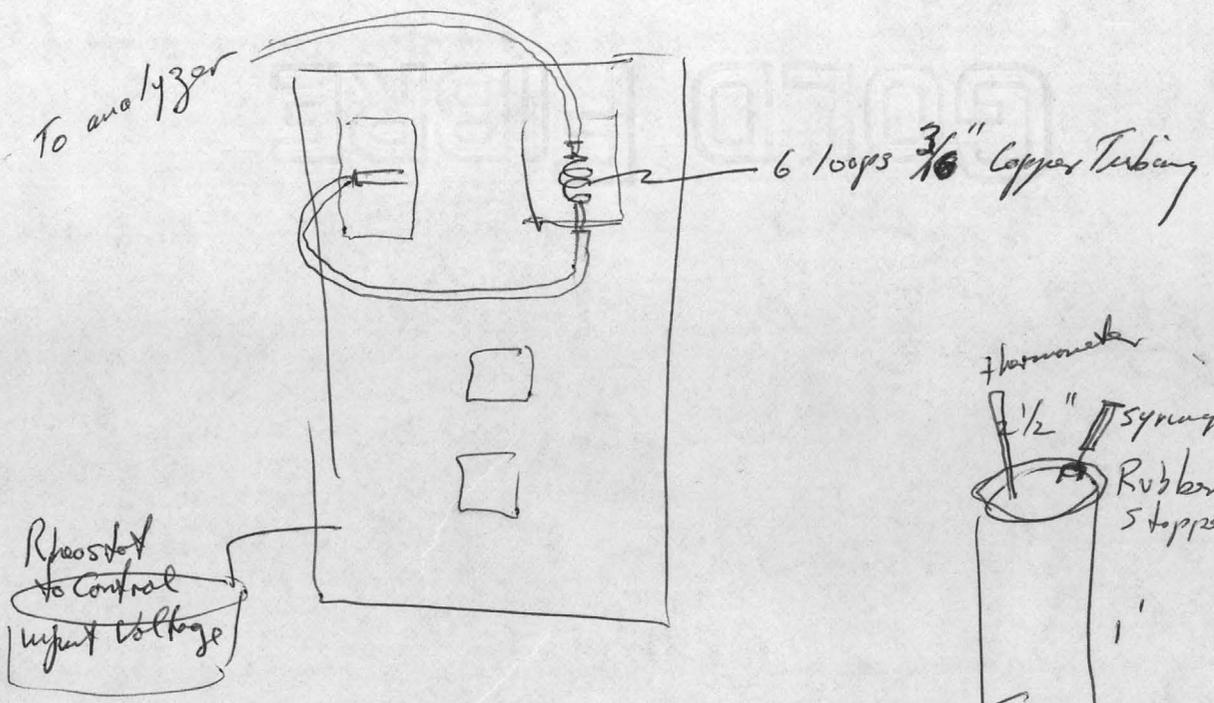
Quartz holder
for silver screen

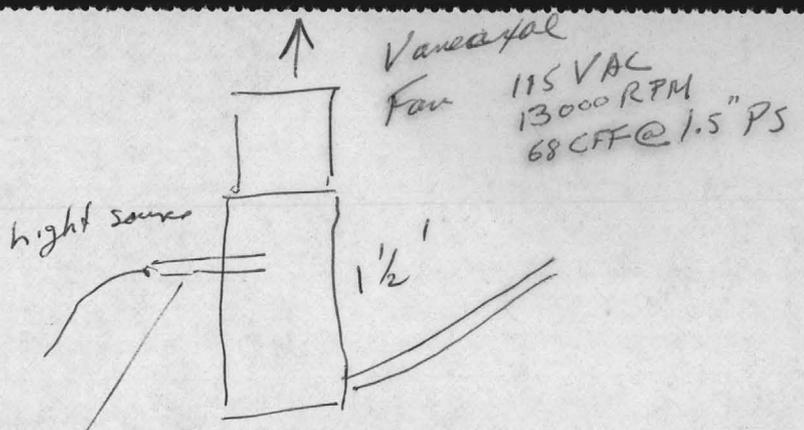


R.F. Heating Unit

Laboratory Equip. Co. (heco)
St Joseph, Michigan
Model ~~523~~ 523

asily 300 Ag screen/day.





Pen Ray Quartz Lamp
San Gabriel Calif
Ultra Violet Products Ewe.

LD FIBRE

INTERNAL USE ONLY

-M-E-M-O-

TO: THE FILES

May 21, 1970

FROM: JOHN KINNISON

SUBJECT: J.H. McCARTHY, MERCURY VAPOR GEOCHEMISTRY

J. Howard McCarthy gave a talk at the geology department, University of Arizona, April 24, 1970, on the subject heading. In attendance were myself, James Fink, and Peter Beery.

NOTES

1. Rock sampling at the Ely, Nevada porphyry copper deposit: sampling of rock chips shows that mercury extends in trace amounts approximately a mile from the copper deposit, forming a halo about the deposit. The central portion of the copper deposit appears to be depleted in mercury content.
2. At Park City, Utah, a "good" anomaly was found in soils.
3. At the Couer 'd' Alene district, Idaho, a "good" mercury anomaly was found in the soil.
4. At the Cortez, Nevada, disseminated gold deposit, gold occurs with arsenic, antimony, tungsten, and mercury. The quantities of the various elements were not stated but I presume he means in trace amounts associated with the gold.



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5. Mercury gas has been measured on the ground by the following means:

- a. Plastic Tent. This method has been described in Circular #609. Mercury was originally amalgamated from the gas arising in the closed plastic tent, on gold chips.
- b. Plastic Hemisphere. These are 12" diameter, fabricated in Denver. They contain about a 2" nozzle on the top which holds a round silver screen in present usage.
- c. A battery operated, rather small, auto vacuum cleaner purchased at Sears was used in some tests to accelerate passage of air through a silver screen. Samples were collected over a five minute run.

6. The efficiency of mercury amalgamation decreases with an increase in air velocity past the silver screen. The meaning of this is that there is an effective although gradational upper limit to the amount of air passed per unit of exposed screen in order to stay within limits of efficiency.

7. Mercury gas has been found in the following circumstances where the source is probably at depth and covered by unmineralized rock.

1. Volcanics up to 1000 feet thick, located north of Battle Mountain, Nevada, show an anomalous condition in one area. It is not known what lies below this area, but it could



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be theorized that a mineralized area is concealed here. There are faults and fractures in the volcanic series, and McCarthy believes that they are probably permeable to mercury vapor passage upwards.

8. In a Nevada mercury district, the amalgamating screen was placed on a pole 14 feet high and an anomaly was registered.

9. An automobile with a simple funnel scoop in the front, about 6", and connected to a small diameter hose leading to the amalgamating receptacle, was driven along a 50 mile traverse which included the Ivanhoe district. The mercury traps were changed every three miles. This traverse located an anomaly over the Ivanhoe district.

10. An airplane equipped with a simple scoop from above the plane feeding down into a silver screen trap, flown 200 feet above the ground, also correctly located the Ivanhoe district. Changing the silver screen mercury trap was facilitated by the use of a plastic wheel which contained 10 such screens, so arranged that the screen could be rotated in succession into the flowing air stream.

11. McCarthy believes that barometric pressure is the prime function in allowing mercury vapor to escape from the ground. According to experiments done to date, the mercury vapor increases as the barometric pressure falls, generally from that period of the day between 10:00 am and 4:00 pm. This suggests that the barometric pressure controls a "breathing" phenomenon within the earth.



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12. Daily temperature change does not really seem to effect the amount of mercury vapor expelled from the ground, according to experiments so far. However, the overall seasonal temperature does seem to have effect, as deduced from tests over a mercury deposit in the Dome Rock Mtns, Arizona. Limited checks so far suggest that from January to May the amount of mercury vapor released approximately doubles. The above relationships do not appear to be logical from what we know about the volatization of mercury, but imperically seem to exist.

13. The strength of the bond of mercury amalgam with silver apparently increases with time. To avoid this increase, and possible consequent difficulty in breaking up the amalgam for AA analysis, the U.S.G.S. has run their samples the same day they were collected.

14. Porphyry copper notes:

1. Kennecott Safford deposit, and also Phelps Dodge, are reported to be anomalous when traversed from the air. Circular 609 has reported Silverbell and Ajo to be anomalous. McCarthy also states that the Newmont deposit under gravel in the Vekol Mtns, and also the Lakeshore deposit, both show "small" anomalies from the air.

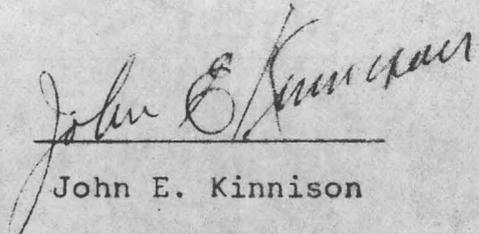
15. Laboratory experiments suggest that mercury vapor may be able to transmit through water. This would be an important consideration where a deposit under gravels is also beneath the



INTERNAL USE ONLY

water level. It also would be important in water soaked glacial till. Field work to test such situations has not been tried as yet.

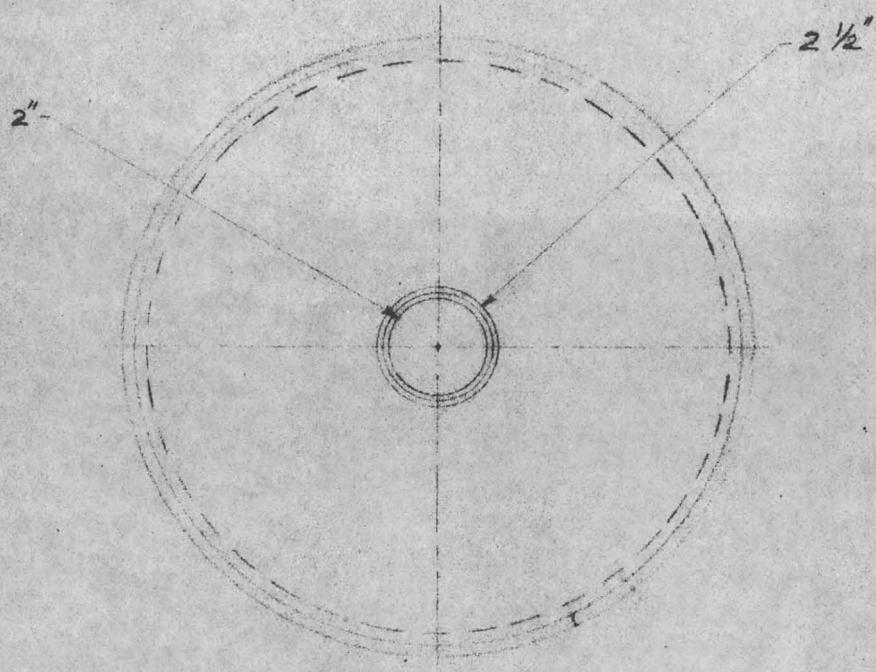
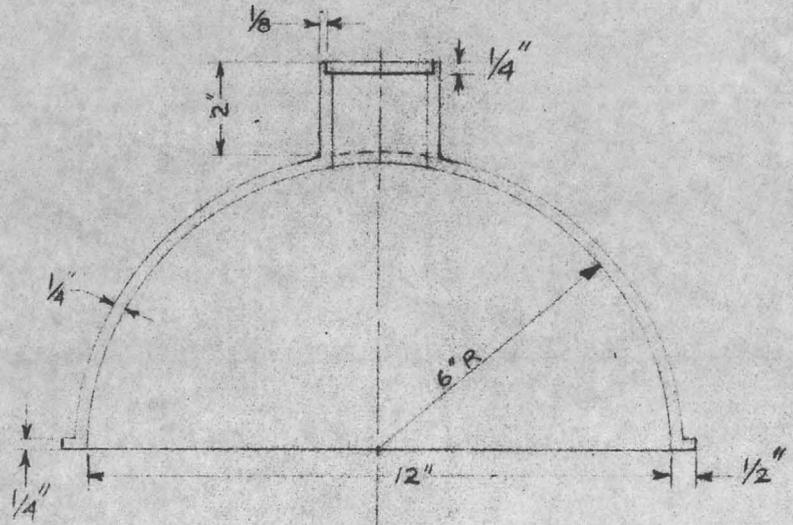
16. McCarthy feels that the measurements of mercury vapor at ground level, for example over the Cortez deposit where the deposit is overlain by gravel, and where the mercury vapor plastic tent collection showed an anomaly which correlated closely with the mineralization outline, is now beyond the experimental stage. He states that by using the plastic hemispheres, the results of mercury vapor collected at ground level are both definitive and reproducible. McCarthy also feels that it has been satisfactorily established that mercury so measured does not come from the gravels, but comes from bedrock at depth and has passed upward through the permeable gravel overburden.



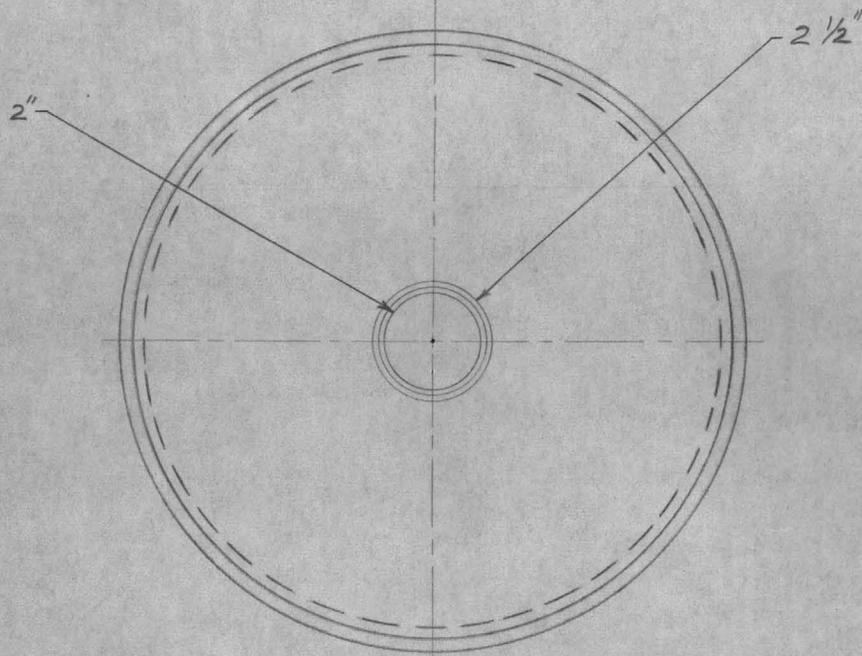
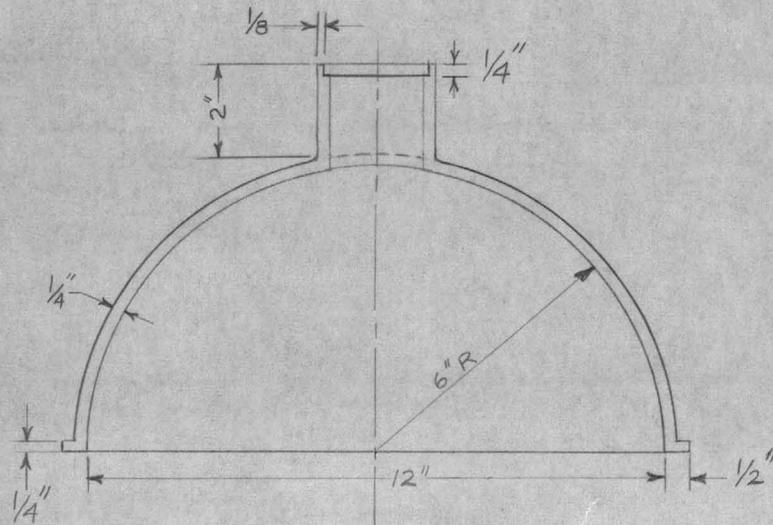
John E. Kinnison



GEO-COMP EXPLORATION, INC.



PLASTIC HEMISPHERE
 $\frac{1}{4}$ " SCALE



PLASTIC HEMISPHERE
 1/4" SCALE

Krusin

J. E. K.

MAY 11 1970

The Use of Mercury in Geochemical Exploration

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May 28, 1970

J. E. K
MAY 28 1970

John,

The sensitivity of the detector described in G.S. Circular 540 is as follows:

"As little as 1 part per billion of mercury can be detected in a 1-gram sample in a 1 minute analytical period."

"Normally the instrument,----, requires a 0.25 gram rock sample crushed to 80-mesh size."

In G.S. Circular 609 amounts as small as 2 nanograms for 2-hour periods were detectable.

Jim