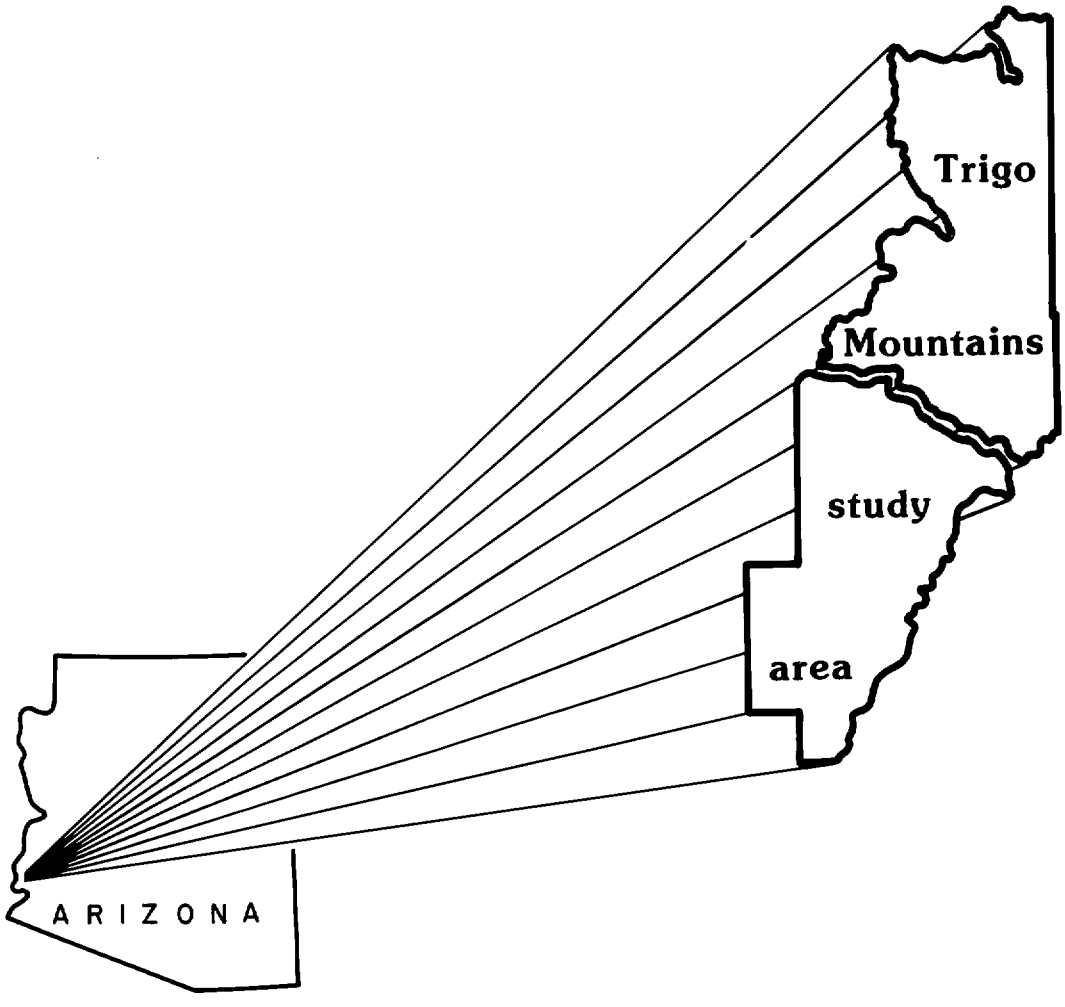
MLA 20-89

Mineral Land Assessment
Open File Report/1989

Mineral Resources of a Part of the Trigo Mountains Wilderness Study Area (AZ-050-023B), La Paz County, Arizona



BUREAU OF MINES
UNITED STATES DEPARTMENT OF THE INTERIOR

MINERAL RESOURCES OF A PART OF THE TRIGO MOUNTAINS WILDERNESS STUDY AREA (AZ-050-023B), LA PAZ COUNTY, ARIZONA

by

Robert H. Wood II

MLA 20-89
1989

Intermountain Field Operations Center
Denver, Colorado

UNITED STATES DEPARTMENT OF THE INTERIOR
Manuel Lujan, Jr., Secretary

BUREAU OF MINES
T S Ary, Director

PREFACE

The Federal Land Policy and Management Act of 1976 (Public Law 94-579) requires the U.S. Geological Survey and the U.S. Bureau of Mines to conduct mineral surveys on certain areas to determine the mineral values, if any, that may be present. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a mineral survey of a part of the Trigo Mountains Wilderness Study Area (AZ-050-023B), La Paz County, Arizona.

This open-file report summarizes the results of a Bureau of Mines wilderness study. The report is preliminary and has not been edited or reviewed for conformity with the Bureau of Mines editorial standards. This study was conducted by personnel from the Resource Evaluation Branch, Intermountain Field Operations Center, P.O. Box 25086, Denver Federal Center, Denver, CO 80225.

CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS--Continued

ILLUSTRATIONS--Continued

TABLES

UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

ft^3/st	cubic foot per short ton (2,000 pounds)
yd^3	cubic yard
in.	inch
lt	long ton (2,240 pounds)
ltu	long ton unit
mi	mile
ppm	part per million
%	percent
lb	pound
st	short ton (2,000 pounds)
oz/st	troy ounce per short ton
oz	troy ounce

MINERAL RESOURCES OF A PART OF THE TRIGO MOUNTAINS WILDERNESS STUDY AREA (AZ-050-023B), LA PAZ COUNTY, ARIZONA

by

Robert H. Wood II, Bureau of Mines

SUMMARY

In March and April 1987, the Bureau of Mines conducted a mineral investigation of a part of the Trigo Mountains Wilderness Study Area, La Paz County, Arizona, on land administered by the Bureau of Land Management. The wilderness study area comprises 36,870 acres; the Bureau studied the 29,095 acres deemed preliminarily suitable for inclusion in the National Wilderness Preservation System. The mineral investigation was requested by the Bureau of Land Management and authorized by the Federal Land Policy and Management Act of 1976 (Public Law 94-579).

The region is in the Sonoran Desert section of the Basin and Range physiographic province. Rocks exposed in the study area are predominantly Precambrian-age paragneiss and amphibolite, Mesozoic-age granitic rocks and gneiss, and Tertiary-age volcanic and sedimentary rocks. The principal structural feature is a low-angle normal fault that separates the Tertiary rocks from the Precambrian and Mesozoic rocks. Mineral occurrences in the area are all fault related.

The study area includes portions of the Trigo and Silver mining districts. The Trigo mining district includes the central and northern parts of the study area and the Silver mining district is adjacent to the southern part of the study area. Approximately 25,000 lt of rock containing 20-40 % manganese and about 323 oz of placer gold have been produced from deposits in the Trigo district inside the study area. Silver, lead, gold, zinc, and

copper have been produced from deposits southeast of the study area in the Silver mining district.

Gold occurs in placers and narrow quartz veins along the northern boundary of the study area. Inferred subeconomic gold resources are calculated for quartz veins and associated faults in the two adits in the Hart Mine area, about 1/2 mi north of the study area boundary. A resource of about 10,000 st having a grade of 0.131 oz/st is in the lower adit. A resource of about 150 st having a grade of 0.22 oz/st of gold is in the upper adit. Four of the 11 drainages in the northern part of the study area contain detectable amounts of gold in panned-concentrate samples; however, the presence of the gold only suggests areas where additional sampling is needed.

In the central and southern parts of the study area, manganese minerals occur in Tertiary volcanic rocks as fillings along faults, in associated fractures, and between breccia clasts along faults. Inferred subeconomic resources of about 100,000 lt averaging nearly 13 % manganese and 110,000 lt averaging about 9 % manganese were along two faults in the central part of the study area.

An indicated subeconomic silver resource of 70,000 st having a grade of 5.0 oz/st of silver was calculated for workings along a fault to the southeast of the study area. Barium, gold, lead, molybdenum, silver, vanadium, and zinc were also detected in samples from other faults southeast of the study area. The faults trend toward the study area, but could not be traced into the study area.

Common variety sand and gravel and andesite volcanic rock suitable for crushing are in the study area; but the materials have no unique qualities to make them more valuable than the vast quantities in the surrounding area.

INTRODUCTION

In March and April 1987, the Bureau of Mines, in a cooperative program with the U.S. Geological Survey (USGS), conducted a mineral investigation of a part of the Trigo Mountains Wilderness Study Area (WSA), La Paz County, Arizona, on lands administered by the Bureau of Land Management (BLM). The WSA comprises 36,870 acres; the Bureau studied the 29,095 acres deemed preliminarily suitable for inclusion in the National Wilderness Preservation System. "Study area" as used in this report refers only to the smaller area. The Bureau surveys and studies mines, prospects, and mineralized areas to appraise reserves and identified subeconomic resources. The USGS assesses the potential for undiscovered mineral resources based on regional geological, geochemical, and geophysical surveys. This report presents the results of the Bureau of Mines study. The USGS will publish the results of its studies. A joint USGS-Bureau report, to be published by the USGS, will integrate and summarize the results of both surveys.

Geographic setting

The Trigo Mountains study area is in southwestern Arizona, about 25 mi north of Yuma, Arizona, and 21 mi south of Blythe, California (fig. 1). The Trigo Mountains are in La Paz County, which was formed from the northern part of Yuma County in 1983. The study area is between the U.S. Army's Yuma Proving Ground to the east and the Imperial and Cibola National Wildlife Refuges to the west. Secondary roads from U.S. Highway 95 and California State Road 78 provide access to unpaved roads or trails, which provide limited access to the study area.

The study area is in the southern part of the Trigo Mountains and is part of the Sonoran Desert section of the Basin and Range physiographic province.

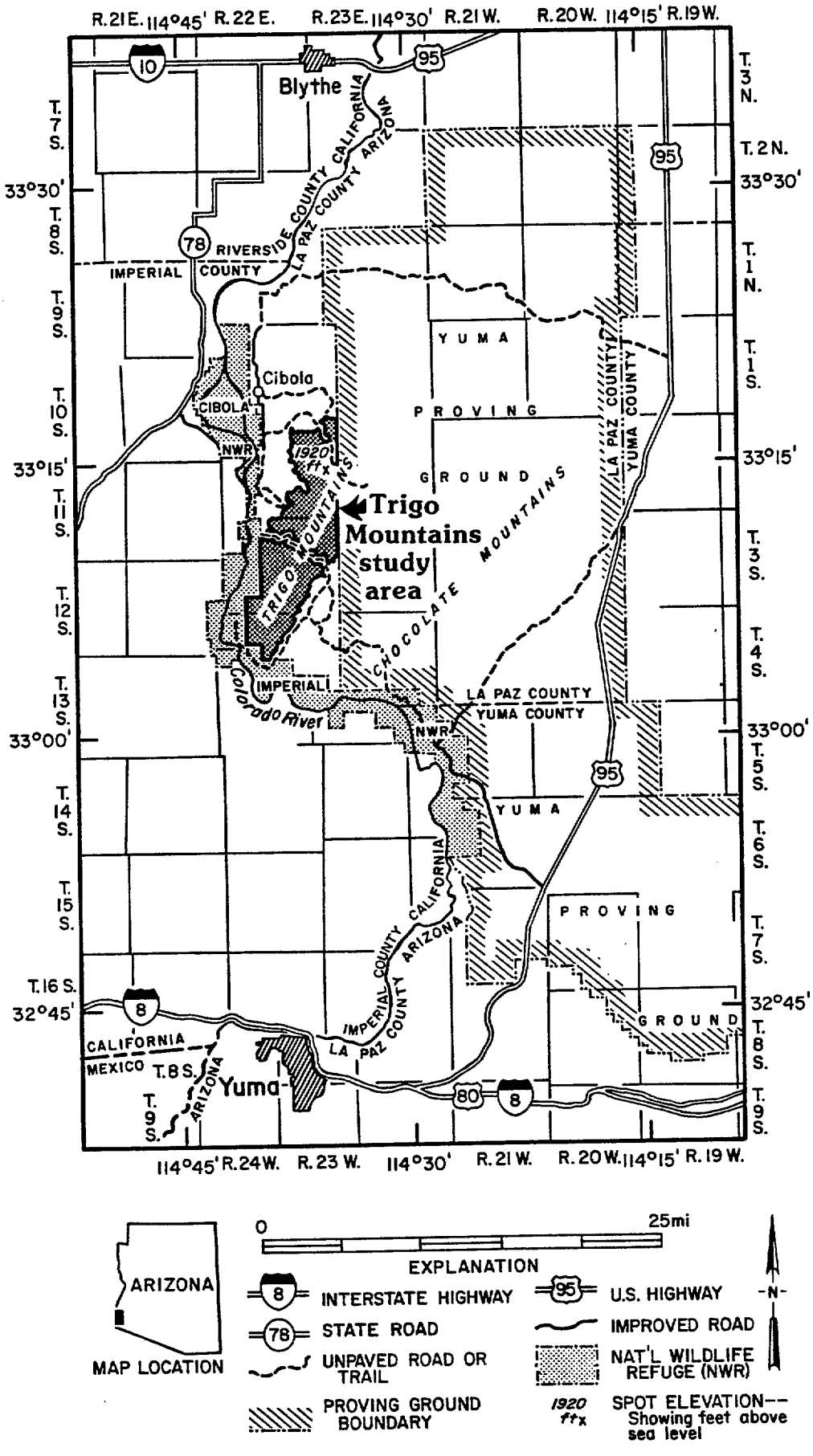


Figure 1.--Index map of the Trigo Mountains study area, La Paz County, Arizona.

Elevations range from approximately 220 ft above sea level along the western boundary to 1,920 ft on an unnamed peak near the Black Diamond Mine in the northwestern part of the area (pl. 1). Intermittent streams have dissected the area into rounded hills, sharp ridges, steep-sided canyons, and deep washes. Vegetative cover is mostly ocotillo, creosote, paloverde, mesquite, and cactus.

Previous investigations

The geology and mineral deposits of Yuma County, including La Paz County, were studied by Wilson (1933) and Keith (1978). Arizona lode-gold mining was studied by Wilson and others (1934). The Silver and Eureka mining districts were studied by Wilson (1951), Parker (1966), and Bradley (1986). Manganese deposits in western Arizona were studied by Farnham and Stewart (1958). Arizona placer gold deposits were studied by Johnson (1972). Detachment faulting and related mineralization in the Trigo Mountains were studied by Garner and others (1982). A mineral resource evaluation, which included the Trigo Mountains, was completed by Krason and others (1982) for the BLM. The oil and gas potential of the study area was reviewed by Ryder (1983).

Methods of Investigation

Bureau personnel reviewed various sources of minerals information regarding the study area, including published and unpublished literature. Mining claim and oil and gas lease information were obtained from the BLM State Office in Phoenix, Arizona.

A total of 40 employee days, starting March 20, 1987 and ending on April 30, 1987, was spent conducting field work. The Bureau's field study concentrated on the examination of known mines, prospects, and mineralized areas inside and within about 1 mi of the study area boundary; peripheral

mineral occurrences were examined to determine whether they might extend into, or are similar to those within the study area. Accessible mine workings were mapped using compass and tape and were sampled. A helicopter overflight of the area was provided by the U.S. Army.

A total of 205 samples, including 194 rock and 11 panned concentrates, was taken for analysis. Rock chip samples were taken across veins and other mineralized structures. Panned-concentrate samples, consisting of a concentrate of heavy minerals from a heaped 16-in. diameter pan of minus 1/2-in. material (about 20 lb), were collected from drainages in the area. A limestone sample was analyzed by inductively coupled plasma-atomic emission spectrometry for barium and chromium, and for oxides of aluminum, calcium, iron, manganese, magnesium, phosphorus, potassium, silica, sodium, and titanium; loss on ignition was determined gravimetrically, and sulfur was determined instrumentally. The remaining 204 samples were analyzed by fire assay (FA) for gold and silver. Sixty of the samples from the central part of the study area were analyzed by atomic absorption spectrocopy (AA) for manganese, and 8 of these samples were also analyzed by AA for iron. One hundred and sixteen samples from the southern part of the area were analyzed by AA for lead, molybdenum, vanadium, and zinc, and 15 of these samples also were analyzed gravimetrically for barium, and 26 were analyzed for silver. The fire assay analyses were performed by the Bureau's research center in Reno, Nevada; all other analyses were performed by Bondar-Clegg, Inc., Lakewood, Colorado.

Geologic setting

The oldest rocks exposed in the Trigo Mountains are Precambrian in age and consist of paragneiss and amphibolite that are exposed in the southern

part of the study area. These rocks are intruded by Mesozoic-age granitic rocks that are locally converted to gneiss.

Tertiary-age rocks, consisting largely of volcanic flows, tuffaceous rocks, fanglomerates, debris flow deposits, and lacustrine sediments, unconformably overlie the Precambrian and Mesozoic crystalline rocks. (See Garner and others, 1982, p. 162-163.)

The principal structural feature in the Trigo Mountains is a regionally developed low-angle normal fault (detachment fault) of middle Tertiary age; the fault separates an upper plate of Tertiary volcanic and sedimentary rocks from a lower plate of Precambrian and Mesozoic gneiss and granitic rocks. The Trigo Mountains are cut by a series of predominantly northwest-striking normal faults that repeat the Tertiary rock sections many times and are assumed to reflect the northeast-to-southwest extensional tectonics in this area. Mineral deposits in the Silver mining district southeast of the study area apparently are related to the extensional regime as suggested by the brecciated and mineralized fault zones near the Precambrian-volcanic rock contact. (See Garner and others, 1982, p. 164-165.)

Mining and leasing activity

The study area includes portions of the Trigo (Cibola) mining district and is adjacent to the Silver mining district (pl. 1). The Trigo district is in the central part of the Trigo Mountains and includes the central and northern part of the study area. The Silver district is in the southern Trigo Mountains and is adjacent to the southeastern part of the area. The Eureka district is south of the Silver district, but generally is included with discussions on the Silver district because of the arbitrary boundaries between them. (See Keith, 1978, p. 73 and 78.)

Gold has been reported in veins and placers in the northern part of the Trigo mining district in and near the northern part of the study area. Gold production from placers in the Trigo district is estimated to be as much as 323 oz of gold and a few ounces of silver (Keith, 1978, p. 181). No gold production has been reported from quartz veins.

Eleven manganese occurrences are in the study area in the central and southern parts of the Trigo district. Approximately 25,000 lt of 20% to 40% manganese was mined from several mines and claims in and near the study area in the 1950's when the government was purchasing low-grade manganese ore in Wenden, Arizona (Krason and others, 1982, p. 158). Manganese mines and claims that are described by Farnham and Stewart (1958, p. 77-81) and Keith (1978, p. 180-181) and in the study area include the Black Diamond Mine (Black Jack Mine), Cibola claims, Power No. 1 Mine, and Triple H claims (fig. 6A). None of the claims are currently on file with the BLM.

Mineral deposits in the Silver mining district occur as veins along north-trending faults (Bradley, 1986, p. 457). Production reported from the Silver and Eureka districts from about 1879, when the districts were organized, is estimated to be 1.6 million oz of silver, 1,457 tons of lead, 940 oz of gold, 15 st of zinc, and 3/4 st of copper (Keith, 1978, p. 73-76). The largest mines in the Silver district are the Red Cloud, Clip, and Black Rock (pl. 1). Extensive drilling by Gulf and Western Resources in the vicinity of the Clip, Black Rock, and Geronimo Mines in the early 1970's delineated near surface subeconomic resources of at least 5 million st having a grade of 4 oz/st of silver and significant fluorite, barite, lead, and zinc (U.S. Bureau of Land Management, 1985, p. 199). None of the mines in the Silver district are inside the study area.

According to BLM records, as of January 1988, only two unpatented mining claims are in the southern part of the study area (fig. 2). There are no patented mining claims in the study area. No production or workings are reported on the claims.

According to BLM records, as of February 1987, about 5,000 acres in the northern part of the study area are under lease for oil and gas (fig. 3). Based on the geology of the area, Ryder (1983, p. 19-20) rated the hydrocarbon potential of the WSA as low to zero.

RESULTS OF INVESTIGATION

Results of the literature search indicated that gold and manganese were mined in the study area, and silver, lead, and zinc were mined near the southern part of the study area. Stream beds in the northern part of the area, where the Trigo gold placers were reported, were investigated for placer gold. Prospects in the central and southern parts of the area were evaluated for manganese. Base- and precious-metal occurrences near the southeastern part of the area were investigated for their possible relationship to the study area. The order of the discussion of gold, manganese, and silver is from north to south.

Gold

Gold in the northern part of the Trigo mining district occurs in placers and narrow quartz veins. The veins were emplaced along faults in Mesozoic metamorphic rocks. The source of the placer gold is attributed to the weathering of gold-bearing quartz veins in the area (Johnson, 1972, p. 75-76). Gold-bearing quartz veins were developed at the Hart (Hardt, Grand Central) Mine area, Jupiter claim, and the Boardway prospect. The Hart Mine is about 1/2 mi north of the study area (pl. 1). The Jupiter claim and

Boardway prospect are reported to be about 1 1/2 and 2 mi south of the Hart Mine (Wilson, 1933, p. 72-73), but were not found during the Bureau's field investigation.

Workings in the Hart Mine area consist of an upper and lower adit (figs. 4, 5), an inaccessible shaft, and a prospect pit (pl. 1, samples 7-23). The shaft may connect with a stope in the lower adit. About 290 ft of the lower adit and all of the upper adit follow faults with associated quartz veins and limonitic and chloritic gouge. Limonite pseudomorphs after pyrite were noted in the upper adit and pyrite was noted on the dump in the lower adit. Fifteen of sixteen samples collected along the structures in the adits contained gold (figs. 4, 5). The highest gold concentrations in the Bureau samples were 0.57 oz/st in the lower adit and 0.61 oz/st in the upper adit. Minerals associated with the structures include pyrite, hematite and chlorite. A small prospect pit east of the Hart Mine had a stockpile of vein quartz (none in place) with hematite coatings that assayed a trace of gold (pl. 1, sample 23).

Gold resources were estimated for the 290-ft-long structure exposed in the lower adit and for the structure in the 57-ft-long upper adit. Half of the strike length of each fault and a tonnage factor of 12.2 ft^3/st were used to calculate tonnages. Average gold concentrations were calculated to be 0.13 oz/st over an average thickness of 1.9 ft, which amounts to about 10,000 st of material, in the lower adit (fig. 4). Average gold concentrations are 0.22 oz/st over an average thickness of 0.75 ft, which amounts to about 150 st of material, in the upper adit (fig. 5). The Hart Mine is about 1/2 mi north of the study area, the structures trend toward the study area and similar Mesozoic rocks are exposed inside the study area, but no structures were found. Panned-concentrate samples of stream sediments were taken from dry

washes draining the northern part of the study area (T. 2 S., R. 23 W.), which Krason (1982, p. 47) identified as the location of the Trigo placers. No evidence of past or current placer mining was seen during the Bureau's field reconnaissance of this area. Concentrates from screened minus 1/2 in. material contained from a trace to 0.50 oz/st of gold. This would be as much as $0.69/yd^3$ of screened minus-1/2-in. material using a January 1989 price of $410/oz. Gold was detected in panned-concentrate samples from 4 of the 11 drainages sampled. The presence of placer gold in the panned-concentrate samples does not define a resource because of the small amount of gold detected, no visible gold was seen in the samples, and the occurrences were scattered. The presence of the gold in the samples does suggest areas where additional study is needed.

Manganese

Manganese minerals have been mined in the Trigo mining district in the central and northern part of the study area. Manganese minerals, mostly pyrolusite and psilomelane, occur in andesitic volcanic rocks as fillings along faults, in associated fractures, and between breccia clasts along the faults. The manganese ore was mined from surface cuts and underground stopes (fig. 6A-I). The highly brecciated zones were the most extensively mined.

Manganese concentrations in Bureau samples were variable, ranging from 0.27% to 35.6% (table 2; fig. 6B-I). The higher manganese concentrations are in the discontinuous, irregularly shaped, and more intensely brecciated zone above the footwall of some of the larger faults in the area. Judging from the equipment left at some of the mines, mine configurations, and the occurrence of manganese as fracture and fault fillings, it appears that selective mining, crushing, screening, and possibly hand sorting were done to concentrate the manganese prior to shipping.

Workings near Lopez Wash consist of 10 adits, 5 shafts, 3 trenches, and at least 3 prospects (fig. 6A). The workings are most concentrated along fault A, which crosses Lopez Wash and fault B, south of Lopez Wash. Fault A includes the Cibola No. 8 claim and Power No. 1 Mine (fig. 6A-F, samples 39-62), and fault B includes the Cibola No. 1 claim (fig. 6A & G, sample sites 63-70). Both faults are exposed by underground workings that were not accessible for sampling and appeared to have been extensively worked.

Manganese resources were estimated for faults A and B. The weighted average along the total known strike length of the faults, 1.5 times the strike length of each fault, and a tonnage factor of 11.2 were used to calculate tonnages. Because of the topography, previous mining, and the fact that manganese deposits of this type are generally shallow, half of the vertical distance (120 ft for fault A and 90 ft for fault B) between the highest and lowest workings was used as the up and down dip projection. Fault A has an average thickness of 4.4 ft, strike length of 1,350 ft, and an average manganese concentration of 12.78%. Fault B has an average thickness of 6.3 ft, strike length of 1,500 ft, and an average manganese concentration of 9.22%.

The amount of inferred subeconomic resources of manganese are about 100,000 lt averaging nearly 13% manganese for fault A, and 110,000 lt averaging about 9% manganese for fault B. The total resource is about 210,000 lt containing about 11% manganese. The in-place value of the inferred subeconomic manganese resources for the two faults is calculated to be about $3 million using an average manganese price of $1.27/ltu (ltu = 22.4 lb) (U.S. Bureau of Mines, 1988, p. 98). Bulk sampling and metallurgical testing would be required to determine if the manganese can be concentrated to a 46%-48% level required to make a salable product.

Silver and associated elements

North-trending faults and associated barite, quartz, and calcite veins in the northern part of the Silver mining district trend toward the southeastern part of the study area. The faults are in the vicinity of the Clip Mine (fig. 7A) in an area that includes the Geronimo Mines (fig. 8A). Although the faults trend toward the study area, they could not be traced into it, and no resources could be identified inside the study area.

Clip Mine area

Faults in the vicinity of the Clip Mine are in Tertiary volcanic rocks and do not extend northward into the Mesozoic granitic rocks (fig. 7A). Minerals associated with these structures include hematite, fluorite, and minor limonite, and malachite. Discontinuous barite and calcite veins and lenses occur along the faults. The largest and most continuous barite and calcite vein sampled is west of the Clip Mine (fig. 7A, samples 134-136), and is as wide as 6 ft, and about 500 ft long. Workings in the vicinity of the Clip Mine were sampled by the Bureau, and included numerous prospects, five shafts, and three adits (figs. 7A-B). Of 28 samples taken along fault A, which extends north from the Clip Mine (fig. 7A, samples 91-118), 7 contained from a trace to 0.06 oz/st of gold. Sample results also show 0.1 ppm (0.003 oz/st) to 5.2 oz/st of silver, 2 to 9 ppm of molybdenum, 26 to 305 ppm of vanadium, 15 to 1,900 ppm of lead, and 5 to 880 ppm of zinc (table 3, fig. 7B). Barite was seen at all but one of the sample localities along fault A. Four samples tested contained from 19.24% to 36.68% barium. Samples taken along fault B, west of the Clip Mine (fig. 7A, samples 119-136) contained 0.1 ppm (0.003 oz/st) to 8.0 oz/st of silver, 4 to 14 ppm of molybdenum, 38 to 465 ppm of vanadium, 72 ppm (0.0072%) to 1.58% lead, and 40 to 680 ppm of zinc

(table 3; fig. 7B). Barite was seen at all of the sample locations along fault B. Five of the samples contained from 3.11% to 37.12% barium. Sample results indicate that concentrations of gold and molybdenum are low and that concentrations of barium, silver, vanadium, lead, and zinc are variable. Thus, resources were not calculated.

Geronimo Mine area

Fault C, northeast of the Geronimo Mines (fig. 8A, samples 140-153), is in Tertiary volcanic rock. Barite, calcite, quartz, and fluorite veins occur within the fault zone, which varies in thickness from 1 ft to 25 ft. The fault zone was traced for almost 1/2 mi toward the study area where it was covered and couldn't be traced any further. One working, a 65-ft-long adit (fig. 8B), was found along the fault. Samples taken along the fault contained between 0.1 oz/st and 2.2 oz/st silver, 2 to 17 ppm molybdenum, 54 to 460 ppm vanadium, 51 to 2,050 ppm lead, and 12 to 2,800 ppm zinc (table 3; fig. 8B). The fault contained barite in the vicinity of each sample location, but only 3 samples were tested for barium and contained between 25.48% and 45.82% (table 3, samples 145, 146; fig. 8B, sample 151). A trace of gold was detected in one sample (table 3, sample 145). Sample results indicate that concentrations of gold and molybdenum were low and that barium, silver, vanadium, lead, and zinc were variable.

Fault D, which includes the North Geronimo Mine (fig. 8A, samples 172-184), was traced and sampled by the Bureau for about 1/2 mi toward the study area where it was covered by colluvium. Parker (1966, pl. 15), projected the fault for a distance in excess of 3 mi to the south which includes the Red Cloud and Papago Mines (pl. 1), and according to his map, the fault could extend into the study area. The northern part of the fault is in

Tertiary volcanic rocks. Barite, calcite, and quartz veins occur within the fault zone, which varies in thickness from less than 1 ft to over 16 ft. Minerals identified include hematite, fluorite, wulfenite and vanadinite. Workings sampled along the fault zone include numerous prospects and a 25-ft-long adit (fig. 8C). At least two smaller, parallel faults have been prospected near the northern portion of the main fault (fig. 8A, samples 155-171). Rock samples taken along the fault contain as much as 0.02 oz/st of gold, 0.4 ppm (0.012 oz/st) to 6.9 oz/st of silver, 7 to 1,300 ppm of molybdenum, 43 to 445 of vanadium, 95 ppm to 2.38% lead, and 28 to 8,000 ppm of zinc (table 3, fig. 8C). Barite was seen at all of the sample localities along fault D. The sample with the most barite visible ran 12.71%. Sample results indicate that the concentration of gold is low, and silver, molybdenum, vanadium, lead, and zinc concentrations are variable, and resources were not calculated.

Fault E, in the South Geronimo Mine area (fig. 8A, samples 187-204), is in Mesozoic granitic and metamorphic rocks, and Tertiary volcanic rocks. Workings along the fault include two adits (fig. 8D), two shafts, and several prospect pits and open cuts. This fault zone, which contains calcite and quartz veins, were traced for about 700 ft to about 1/2 mi from the study area boundary (pl. 1; fig. 8A) and attains a maximum width of about 80 ft. Minerals noted include hematite, wulfenite, barite, and limonite. Rock samples taken along the fault contained as much as 0.06 oz/st of gold, 0.12 oz/st (0.03 ppm) to 11.4 oz/st of silver, 4 to 610 ppm of molybdenum, 10 to 132 ppm of vanadium, 560 ppm (0.056%) to 4.18% of lead, and 380 to 8,600 ppm of zinc.

Indicated subeconomic silver resources of 70,000 st averaging 5.0 oz/st of silver, which may be mined by open pit methods, were estimated for fault E

in the South Geronimo Mine area (figs. 8A, D; table 3, samples 188-191, 195-204).The resource estimate was based on a weighted average along a 300-ft strike length. Eighty feet, the length of the upper adit (samples 195-199) near the center of the area, was used to calculate the width of the lower 185 ft of the resource which tapers down to a 25-ft-width for the remaining upper 115 ft of the resource (samples 188-189). Half of the length (40 ft) of the upper adit (fig. 8D) was used to estimate the depth of the resource which could be mined by open-pit methods. A tonnage factor of 12.0 ft^3 was used. The in-place value of the silver resource was calculated to be about $2 million using a current (August 1988) silver price of $6.70/oz. Because fault E was not traced into the study area, which is about 1/2 mi away, no resource estimations could be calculated for the study area.

Industrial rocks

At the time of the Bureau's field investigations, sand and gravel were being mined and andesitic volcanic rock was being quarried and crushed near the northern part of the study area (pl. 1). The sand and gravel and crushed rock were being used along the Colorado River for road and levee construction on the nearby Imperial and Cibola National Wildlife Refuges. Study area drainages and alluvial fans contain large quantities of common variety sand and gravel and andesitic volcanic rocks. The material in the study area appears to be of similar quality to the sand and gravel and rock being moved nearby. The sand and gravel and andesitic rock in the study area have no unique qualities to make them more valuable than the material available in the surrounding area.

Tertiary-age lacustrine limestone crops out adjacent to, and could underlie, the northwestern boundary of the study area (pl. 1, sample 2).

Calcium carbonate content of a 7-ft-long chip sample across nearly flat lying beds of the limestone was 69.1%. Impurities in the limestone sample included 3.05% Al_2O_3, 0.06% Ba, 1.07% Fe_2O_3, 0.60% K_2O, 0.75% MgO, 0.10% MnO, 0.20% Na_2O, 0.09% P_2O_5, 21.65% SiO_2, 0.01% Cr, 0.18% TiO_2, and 0.06% S. Loss on ignition was 32.71. These results indicate that the calcium carbonate content is well below percentages needed for industrial applications. The limestone is therefore not considered a resource.

COMMODITY HIGHLIGHTS

The principal commodities in and near the study area are gold, manganese, and silver. Domestic production, consumption, and percentage imported are shown on table 4.

CONCLUSIONS

Gold-bearing faults and associated quartz veins about 1/2 mi north of the study area contain inferred subeconomic resources of gold and trend toward, but could not be traced into, the study area. Subeconomic gold resources amounting to about 10,000 st having a grade of 0.13 oz/st, and about 150 st having a grade of 0.22 oz/st were calculated for quartz veins in the Hart Mine area. Other gold-bearing quartz veins reported to be in the northern part of the study area were not found during the Bureau's field investigation. Gold was detected in panned-concentrate samples from 4 of 11 drainages in the northern part of the area. The presence of the gold does not define a resource, but suggests where additional study, which would include trenching to bedrock and drilling, is needed.

Inferred subeconomic resources of manganese at two faults in the Lopez Wash area inside the study area are about 100,000 lt averaging nearly 13% manganese for fault A, and 110,000 lt averaging about 9% manganese for fault B. The total resource is about 210,000 lt containing about 11% manganese.

The estimated inplace value is about $3 million. Bulk sampling and metallurgical testing would be required to determine if the manganese can be concentrated to 47% required by industry to make a salable product.

Indicated subeconomic resources of silver amounting to 70,000 st having a grade of 5.0 oz/st were estimated for workings along a fault southeast of the study area. The fault trends toward the study area, but was only traced to within about 1/2 mi of the boundary. Gold, barium, molybedenum, vanadium, lead, and zinc were also detected south of the study area, but none of the occurrences could be traced into the study area.

Large quantities of common variety sand and gravel and andesitic volcanic rock occur in the study area, which are similar in quality to those being mined nearby. The sand and gravel and andesitic rock have no unique qualities to make them more valuable than the vast quantities in the surrounding area, and are not likely to be developed in the near future.

REFERENCES

Bradley, M. A., 1986, Vein mineralogy, paragenesis, and fluid inclusion study of the Silver District, La Paz County, Arizona, in Beatty, Barbara, and Wilkinson, P. A. K., eds., Frontiers in geology and ore deposits of Arizona and the southwest: Arizona Geological Society Digest, v. XVI, p. 457-459.

Farnham, L. L., and Stewart, L. A., 1958, Manganese deposits of western Arizona: U.S. Bureau of Mines IC 7843, 87 p.

Garner, W. E., Frost, E. G., Tanges, S. E., and Germinario, M. P., 1982, Mid-Tertiary detachment faulting and mineralization in the Trigo Mountains, Yuma County, Arizona, in Frost, E. G., and Martin, D. L., eds., Mesozoic-Cenozoic Tectonic evolution of the Colorado River region, California, Arizona, and Nevada: Anderson-Hamilton Volume, San Diego, California, Cordilleran Publishers, p. 159-172.

Johnson, M. G., 1972, Placer gold deposits of Arizona: U.S. Geological Survey Bulletin 1355, 103 p.

Keith, S. B., 1978, Index of mining properties in Yuma County, Arizona: Arizona Bureau of Geology and Mineral Technology Bulletin 192, 185 p.

Krason, Jan, Wodzicki, Antoni, and Cruver, S. K., 1982, Geology, energy, and mineral resources assessment of the Kofa area, Arizona: unpublished Bureau of Land Management administrative report, Yuma, Arizona, 207 p.

Parker, F. Z., 1966, The geology and mineral deposits of the Silver District, Trigo Mountains, Yuma County Arizona: San Diego State College, unpublished M.S. thesis, 184 p.

Ryder, R. T., 1983, Petroleum potential of wilderness lands in Arizona, in Miller, B. M., ed., Petroleum potential of wilderness lands in the western United States: U.S. Geological Survey Circular 902-A-P, p. C1-22.

Wilson, E. D., 1933, Geology and mineral deposits of southern Yuma County, Arizona: Arizona Bureau of Mines Bulletin 134, 234 p.

_____ 1951, Silver and Eureka districts, in Arizona zinc and lead deposits, pt. 2: Arizona Bureau of Mines Bulletin 158, p. 83-97.

Wilson, E. D., Cunningham, J. B., and Butler, G. M., 1934, Arizona lode gold mines and gold mining: Arizona Bureau of Mines Bulletin 137, 254 p.

U.S. Bureau of Land Management, 1985, Final Yuma District resource management plan and environmental impact statement, prepared by U.S. Department of the Interior, Bureau of Land Management, Yuma District, 310 p.

U.S. Bureau of Mines, 1988, Mineral commodity summaries 1988, 193 p.

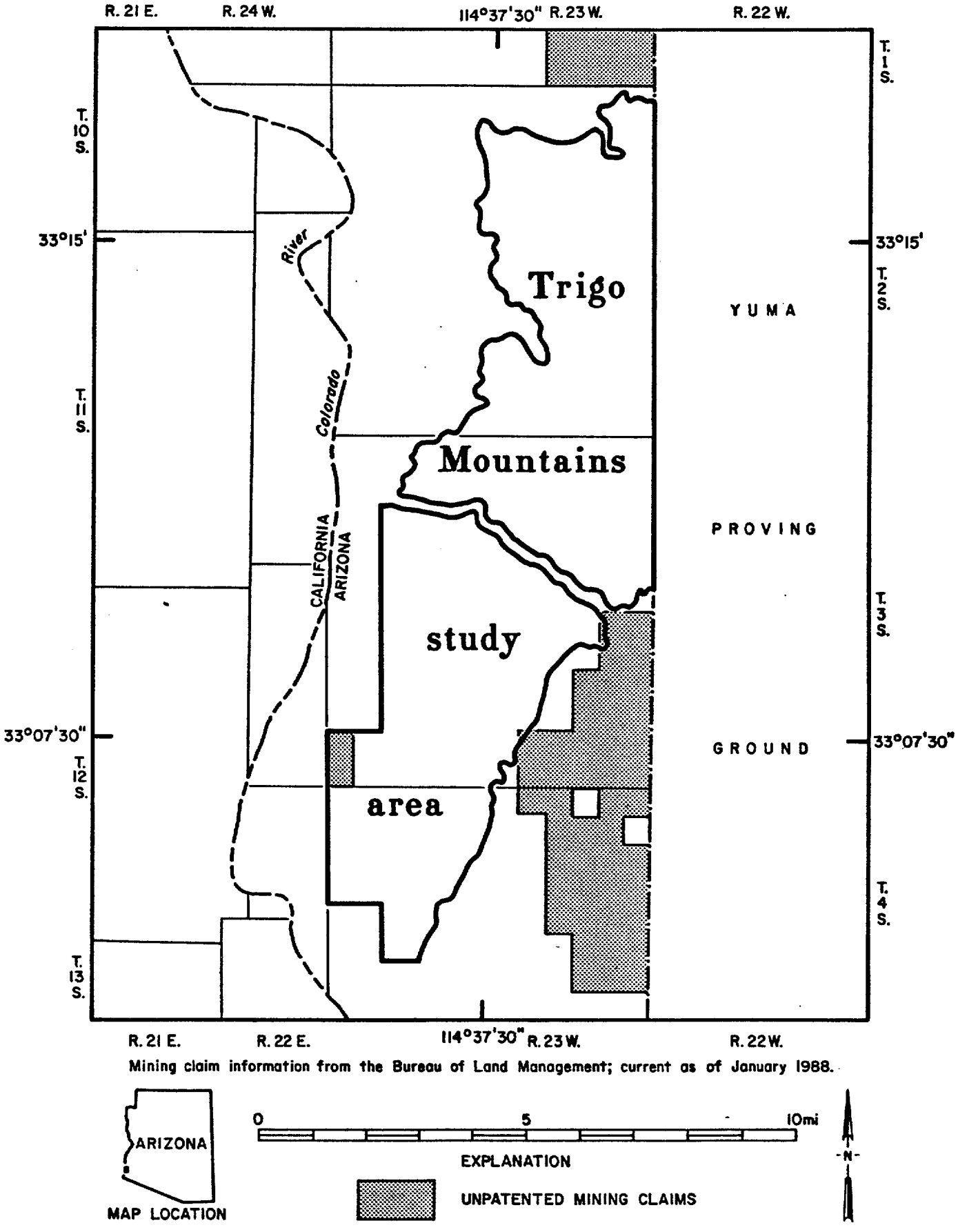


Figure 2.--Unpatented mining claims in and near the Trigo Mountains study area.

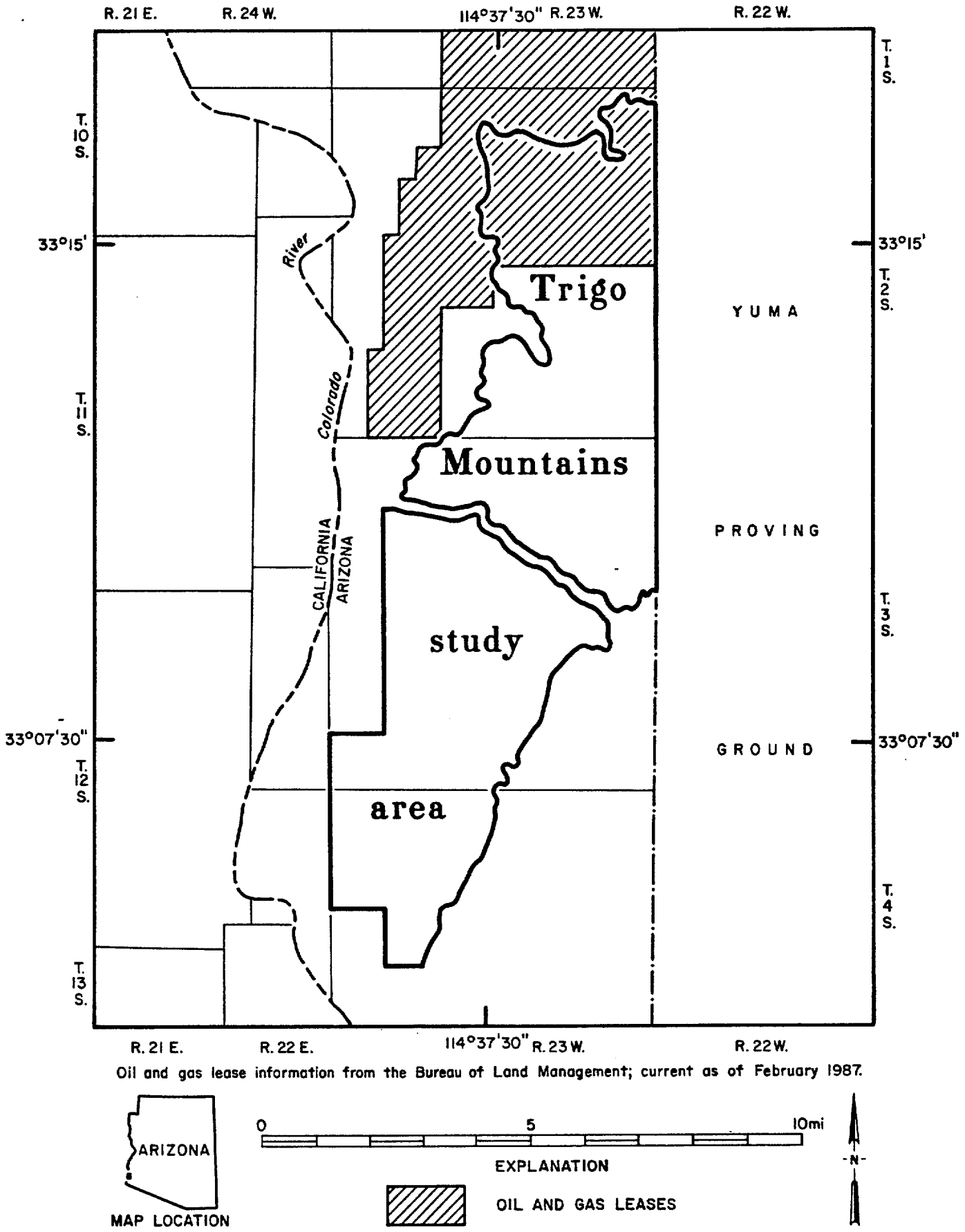
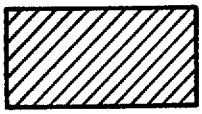


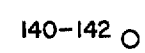
Figure 3.--Oil and gas leases in and near the Trigo Mountains study area.

EXPLANATION OF SYMBOLS FOR FIGURES 4-8

APPROXIMATE BOUNDARY OF THE TRIGO MOUNTAINS STUDY AREA



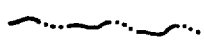
PATENTED MINING CLAIM



LOCALITY OF SAMPLED OUTCROP--Showing sample number(s)

U.S. LOCATION MONUMENT

TOPOGRAPHIC CONTOUR--Showing elevation in feet above sea level



INTERMITTENT STREAM

FAULT--Dashed where approximate

SURFACE OPENINGS--Showing sample number(s); symbol may represent more than one working

Shaft

Adit

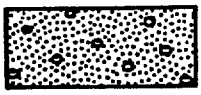
Inaccessible adit

Prospect, pit or opencut

Trench

Mine

GNEISS



ALLUVIUM

ANDESITE

BRECCIA

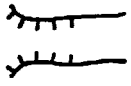
EXPLANATION OF SYMBOLS FOR FIGURES 4-8--Continued

CONGLOMERATE

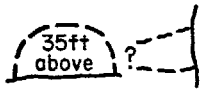
METASEDIMENT

SAMPLE LOCALITY--Showing sample number

PORTAL



TRENCH OR OPENCUT AT PORTAL



STOPED ABOVE LEVEL--Showing approximate height; queried where uncertain

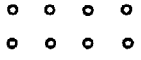
RAISE

WINZE

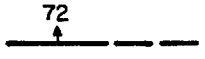
INCLINED SHAFT EXTENDING THROUGH A LEVEL

ORE CHUTE

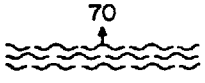
INCLINED WORKING--Showing degree of inclination; chevrons pointing down



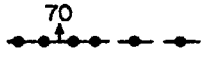
TIMBERING



FAULT--Showing strike and dip; dashed where approximate



FAULT OR SHEAR ZONE--Showing strike and dip



QUARTZ VEIN--Showing strike and dip; dashed where approximate

[Detection limits: Au, 0.005 oz/st; Ag 0.1 oz/st.
Symbols used: --, not detected; tr, trace.]

Sample No.	Chip length (ft)	Analytical data Au (oz/st)	Analytical data Ag (oz/st)	Remarks
7	0.8	--	0.2	Chlorite and limonite fracture fillings.
8	.4	0.01	.2	Quartz vein, 0.2 ft wide; chlorite and limonite fracture fillings.
9	.8	.02	.2	Quartz vein, 0.8 ft wide; chlorite and limonite fracture fillings.
10	1.2	.08	.3	Chlorite and limonite fracture fillings.
11	6	.16	.1	Quartz lenses; chloritic gouge; minor limonite fracture fillings.
12	1.4	.01	.1	Quartz lens, 1 in. wide; chloritic gouge.
13	1.8	tr	.1	Chlorite and limonite fracture fillings.
14	2.3	.57	.4	Clay gouge, 0.5 in. wide; limonite fracture fillings; minor malachite.
15	3	.04	.2	Quartz vein, 0.5 in. wide, chlorite and limonite fracture fillings.
16	1	.09	.1	Quartz lens, 6 in. wide; chlorite and limonite fracture fillings.
17	.5	.28	.1	Chlorite and limonite on fracture fillings.
18	4	.01	--	Fractured wallrock; clay gouge.

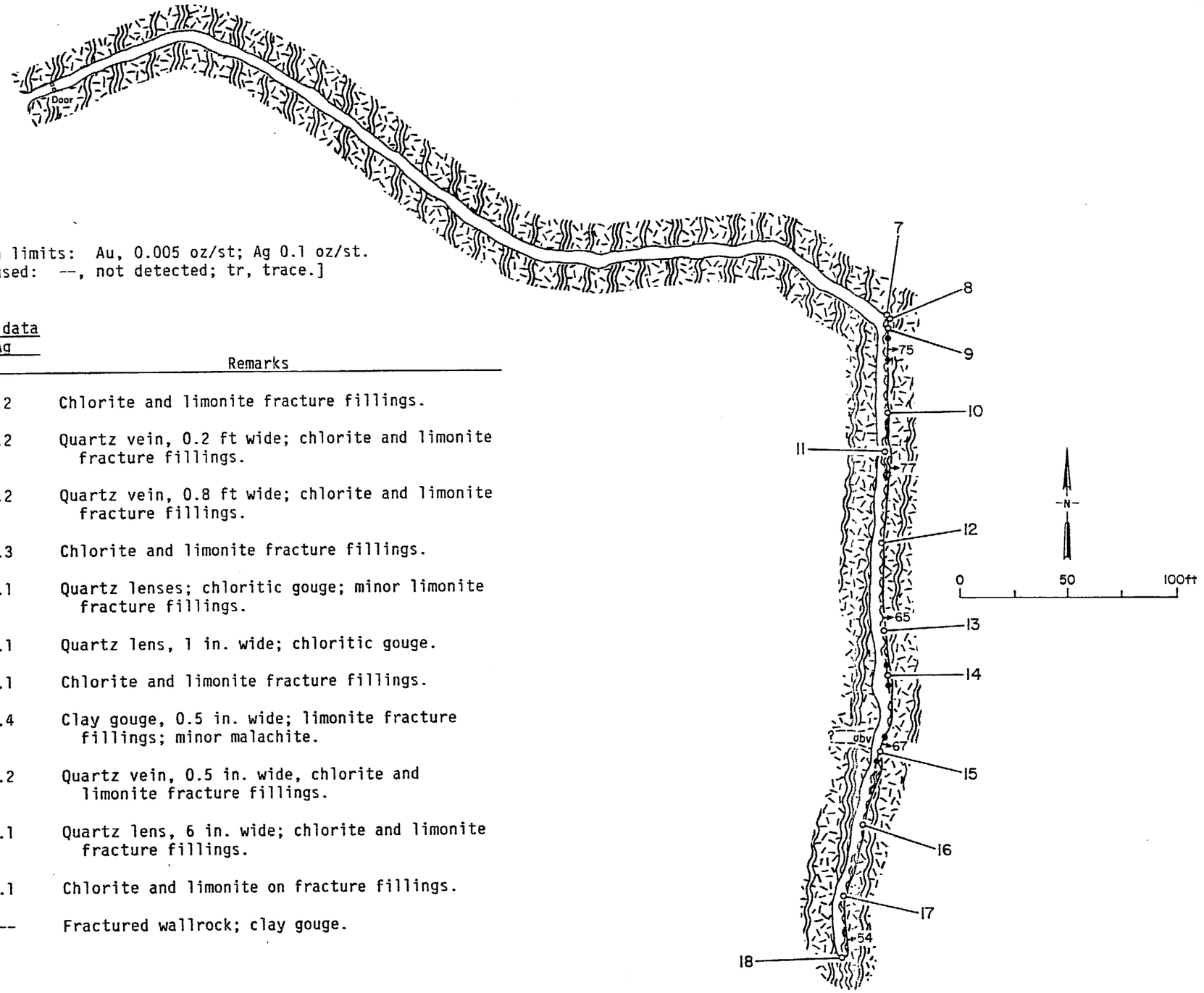
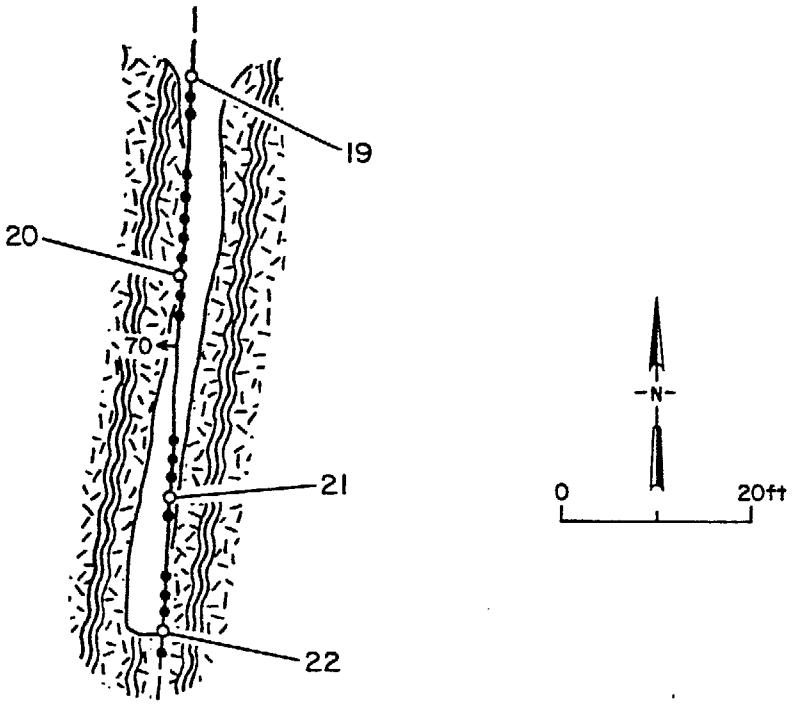


Figure 4.--Hart Mine lower adit showing sample localities 7-18; table shows sample data.



[Detection limit: Ag, 0.1 oz/st.
Symbol used: -- not detected.]

Sample No.	Chip length (ft)	Analytical data Au oz/st	Analytical data Ag oz/st	Remarks
19	1	0.30	0.1	Limonite and chlorite fracture fillings.
20	.5	.61	.2	Quartz vein, 0.5 ft wide, limonite cubes after pyrite to 1 in.; limonite and chlorite fracture fillings.
21	1	.01	.1	Quartz vein, 3 in. wide; limonite and chlorite fracture fillings.
22	.5	.07	--	Quartz vein, 1 in. wide; limonite and chlorite fracture fillings.

Figure 5.--Hart Mine upper adit showing sample localities 19-22; table shows sample data.

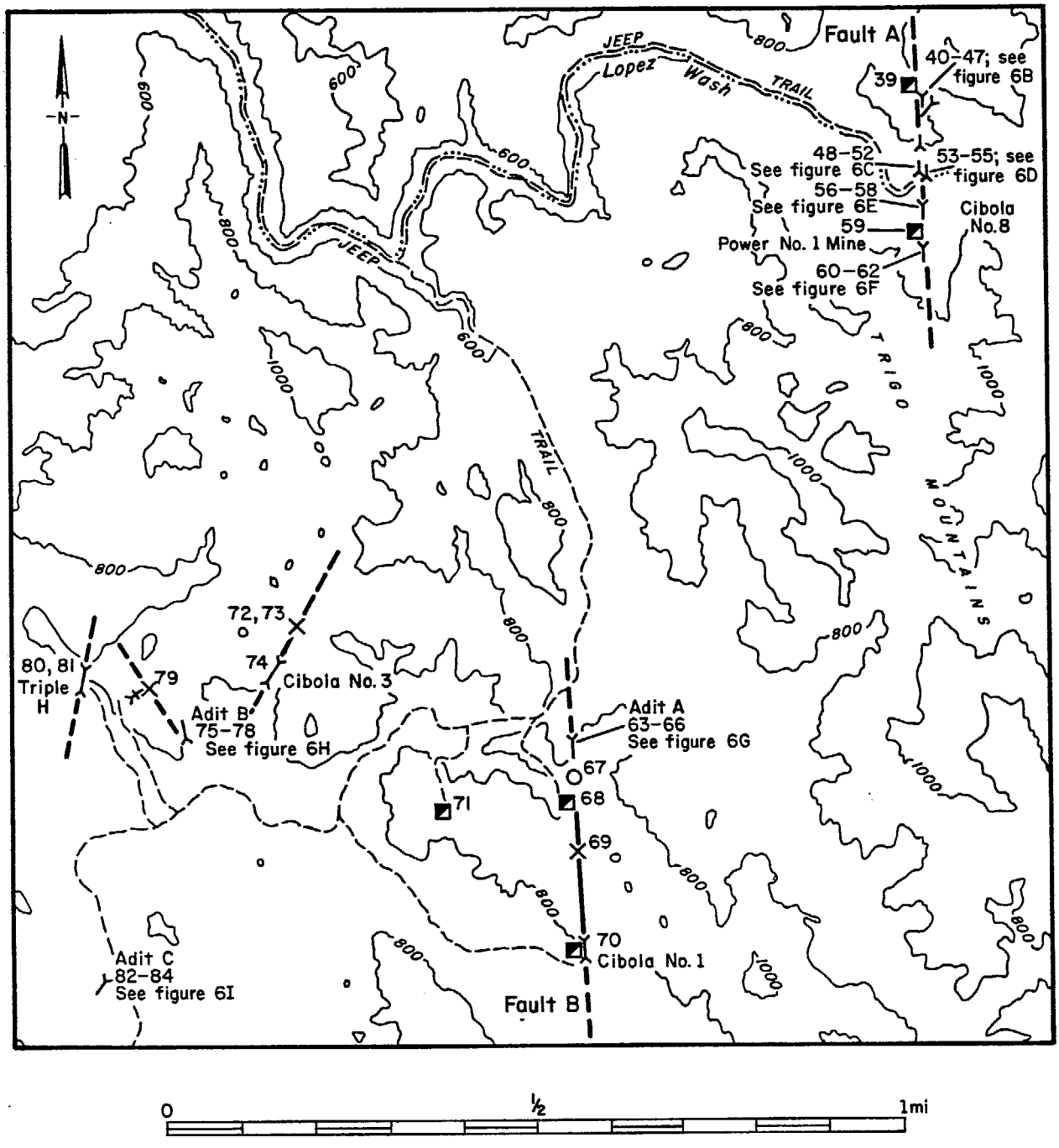
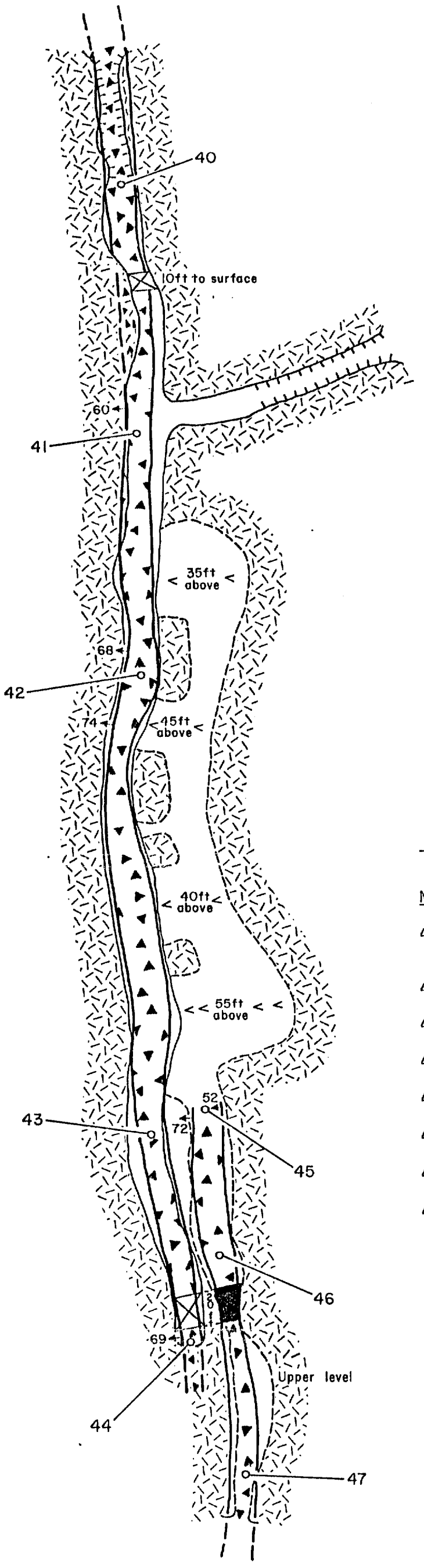
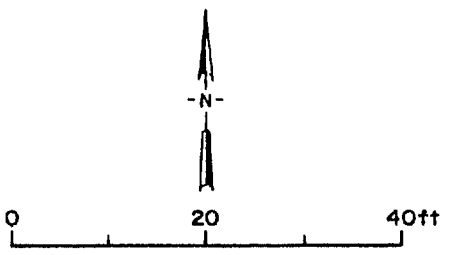


Figure 6A.--Manganese prospects in the central part of the study area showing sample localities 39-84. Sample data on figures 6B-I and table 2.

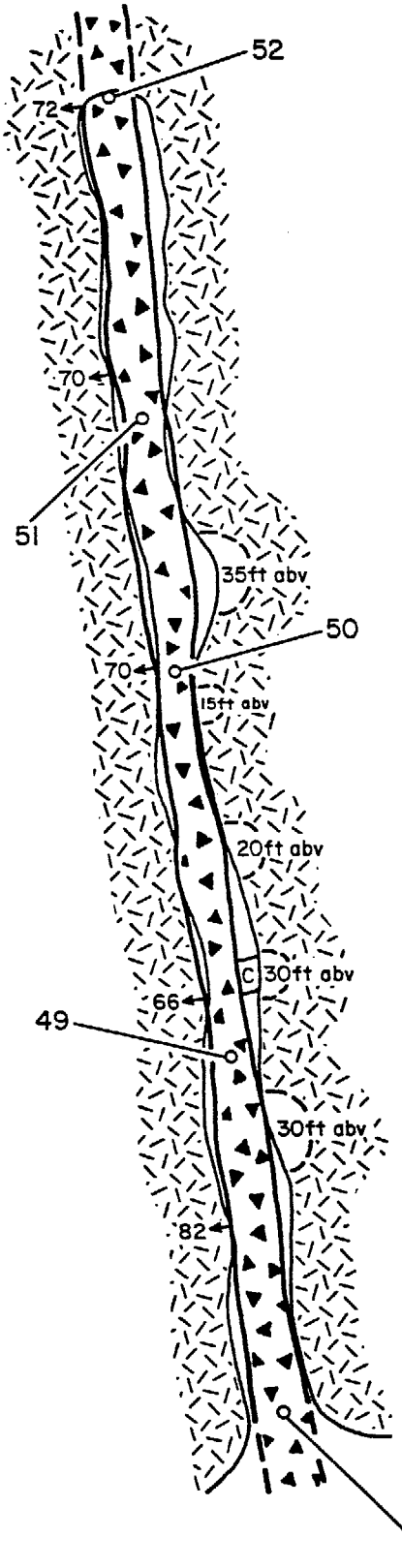




[All samples were analyzed for Au but none was detected. Detection limits: Au, 0.005 oz/st; Ag, 0.1 oz/st. Symbol used: --, not detected.]

Sample No.	Chip length (ft)	Analytical data Ag oz/st	Analytical data Mn %	Remarks
40	5	0.1	4.15	Psilomelane and pyrolusite fracture fillings.
41	4	--	12.10	Do.
42	6	--	8.90	Do.
43	4	.1	8.00	Do.
44	5	.2	17.60	Do.
45	6	--	4.85	Do.
46	7	.1	7.70	Do.
47	4	.1	10.00	Do.

Figure 6B.--Upper adit on north side of Lopez Wash showing sample localities 40-47; table shows sample data.



[All samples were analyzed for Au but none was detected. Detection limits: Au, 0.005 oz/st, Ag, 0.1 oz/st. Symbol used: --, not detected.]

Sample No.	Chip length (ft)	Analytical data Ag oz/st	Analytical data Mn %	Remarks
48	6	--	10.50	Psilomelane and pyrolusite fracture fillings.
49	6	--	5.60	Do.
50	5	0.2	13.80	Do.
51	4	.2	21.80	Do.
52	5	.2	11.40	Do.

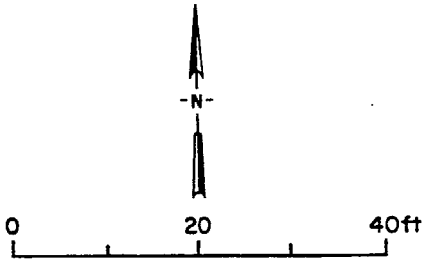
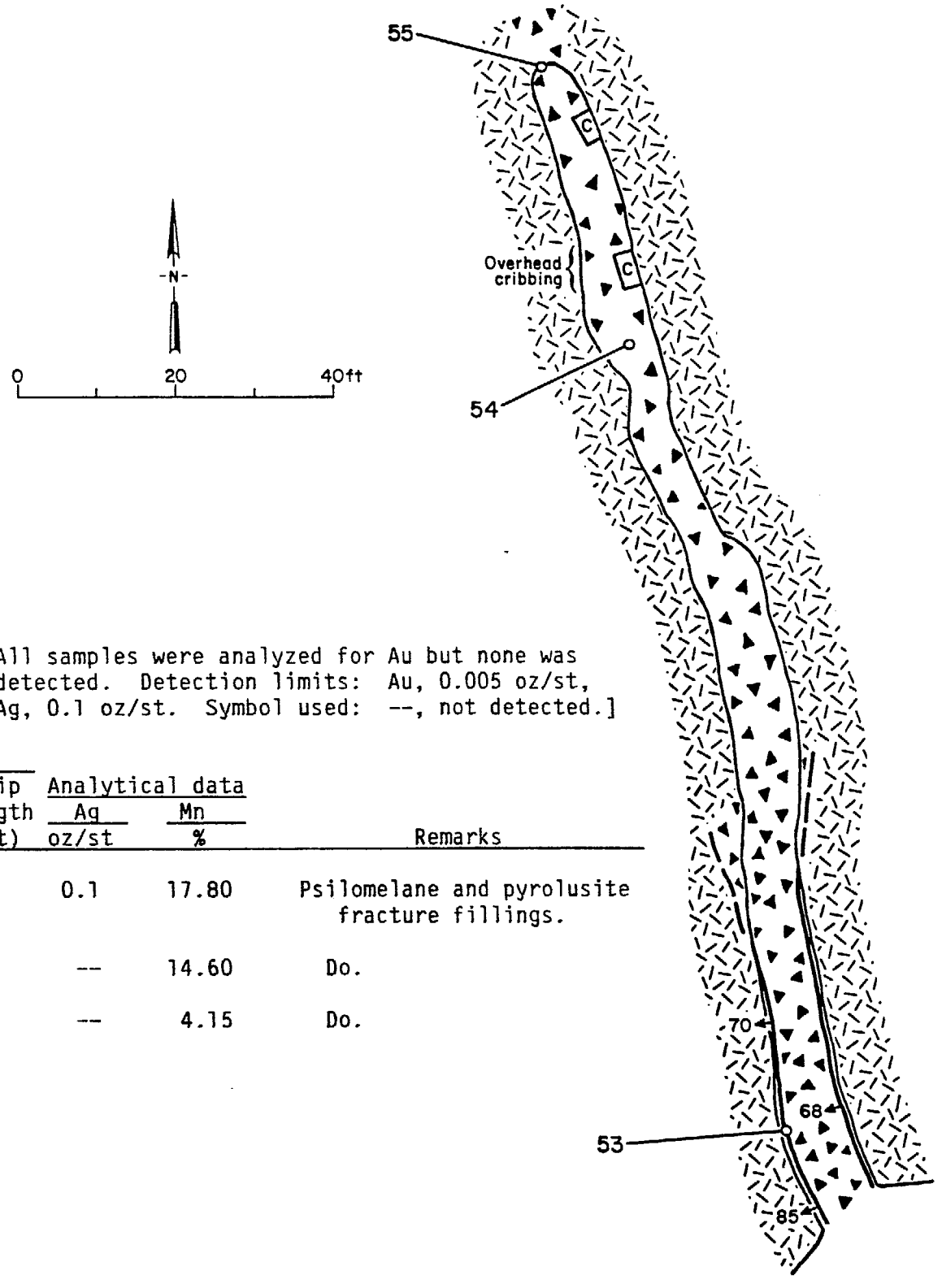


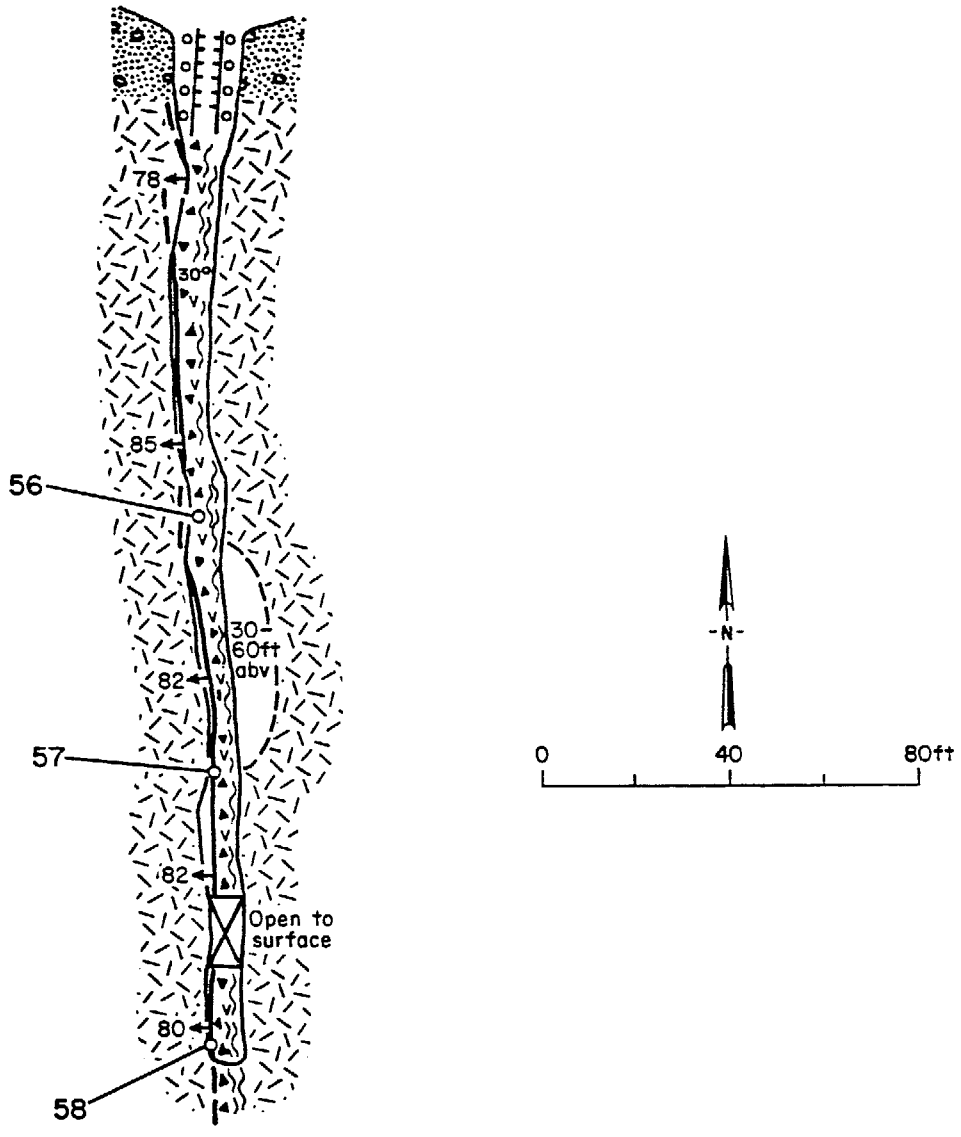
Figure 6C.--Middle adit on north side of Lopez Wash showing sample localities 48-52; table shows sample data.



[All samples were analyzed for Au but none was detected. Detection limits: Au, 0.005 oz/st, Ag, 0.1 oz/st. Symbol used: --, not detected.]

Sample No.	Chip length (ft)	Analytical data Ag oz/st	Analytical data Mn %	Remarks
53	2	0.1	17.80	Psilomelane and pyrolusite fracture fillings.
54	7	--	14.60	Do.
55	4	--	4.15	Do.

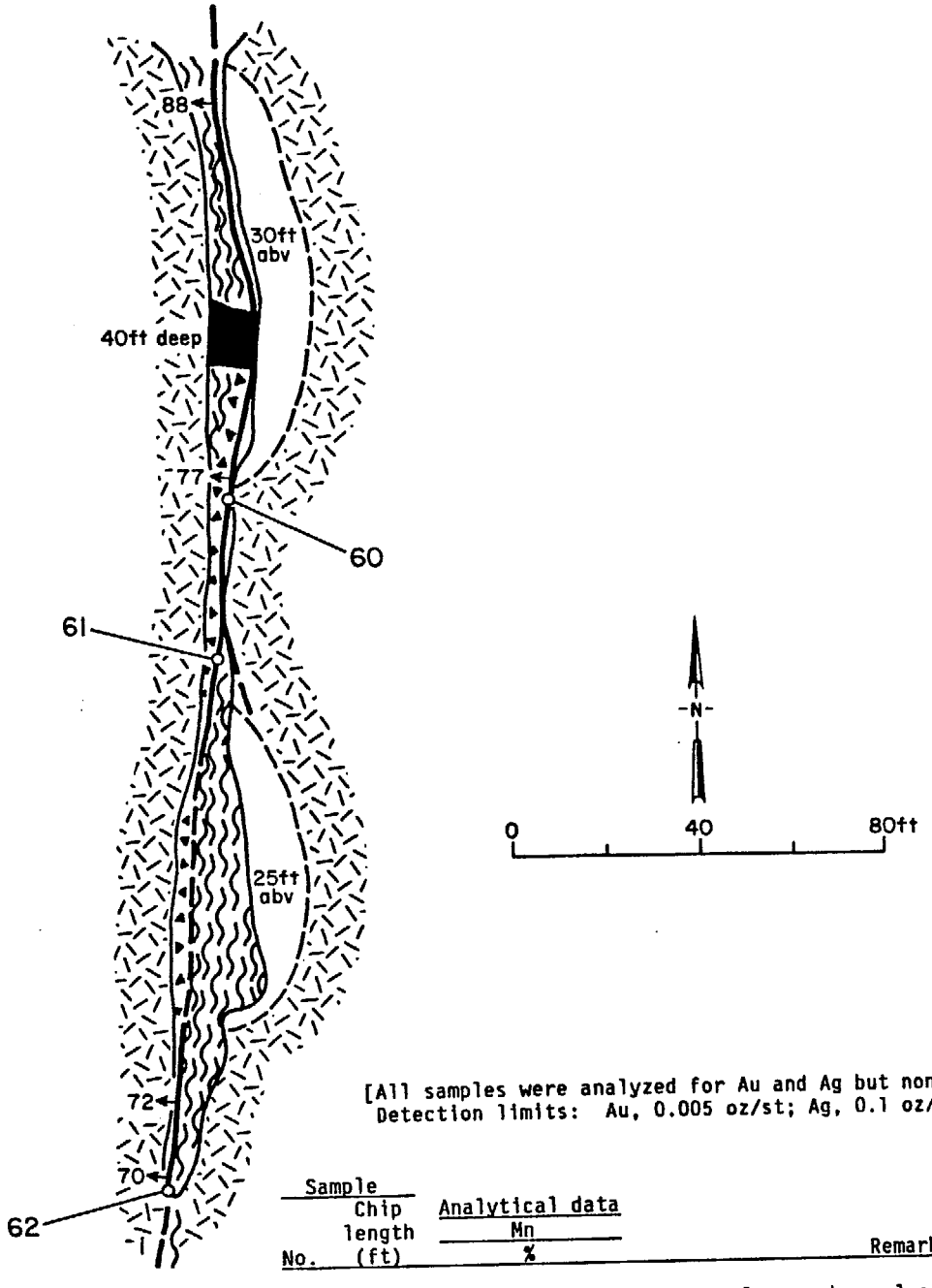
Figure 6D.--Lower adit on north side of Lopez Wash showing sample localities 53-55; table shows sample data.



[All samples were analyzed for Au but none was detected.
Detection limits: Au, 0.005 oz/st, Ag, 0.1 oz/st.
Symbol used: --, not detected.]

Sample No.	Chip length (ft)	Analytical data Ag oz/st	Mn %	Remarks
56	2.5	--	18.40	Psilomelane and pyrolusite fracture fillings.
57	2	0.2	28.00	Do.
58	1	.1	11.00	Do.

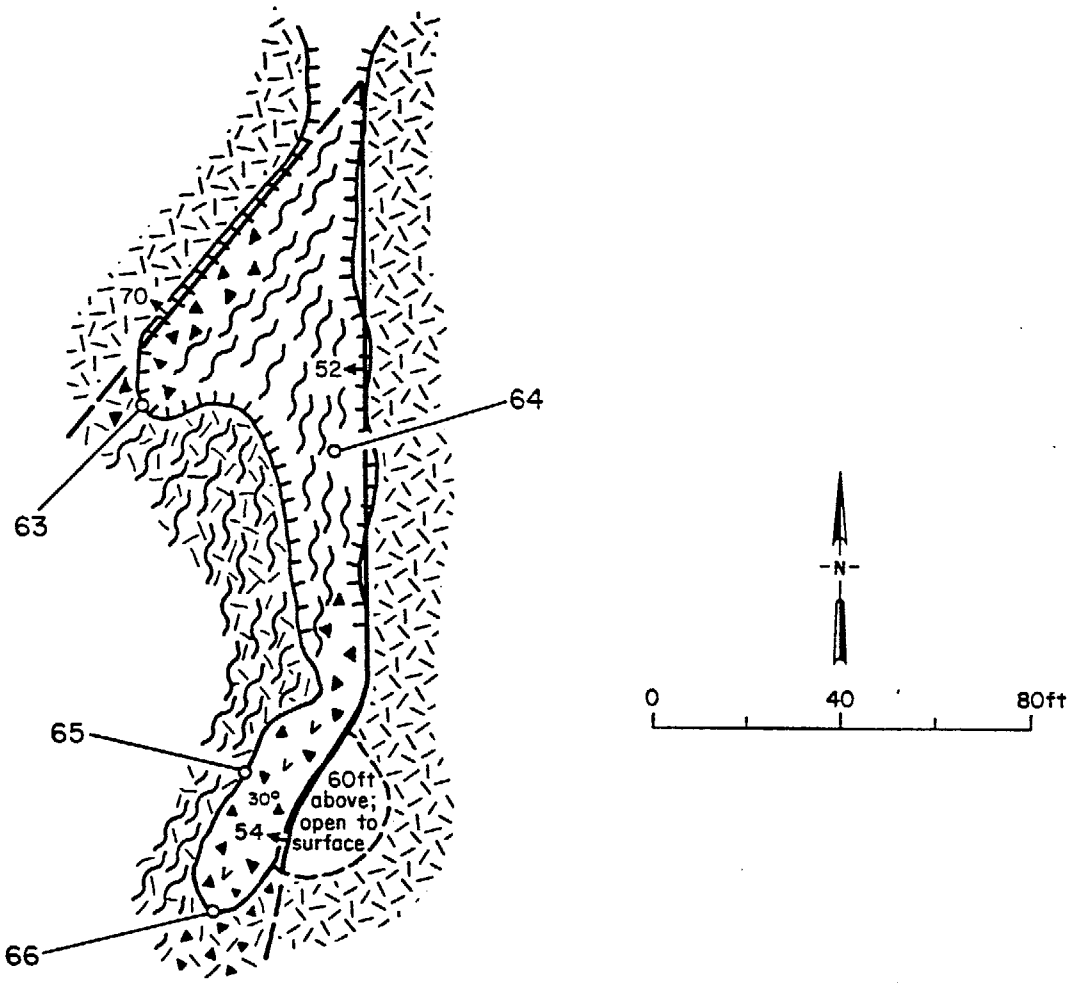
Figure 6E.--Lower adit on south side of Lopez Wash showing sample localities 56-58; table shows sample data.



[All samples were analyzed for Au and Ag but none was detected.
Detection limits: Au, 0.005 oz/st; Ag, 0.1 oz/st.]

Sample No.	Chip length (ft)	Analytical data Mn %	Remarks
60	3	19.70	Psilomelane and pyrolusite fracture fillings.
61	3.5	31.20	Psilomelane and pyrolusite fracture fillings, minor calcite.
62	3	5.80	Psilomelane and pyrolusite fracture fillings, minor calcite; 3.50% Fe.

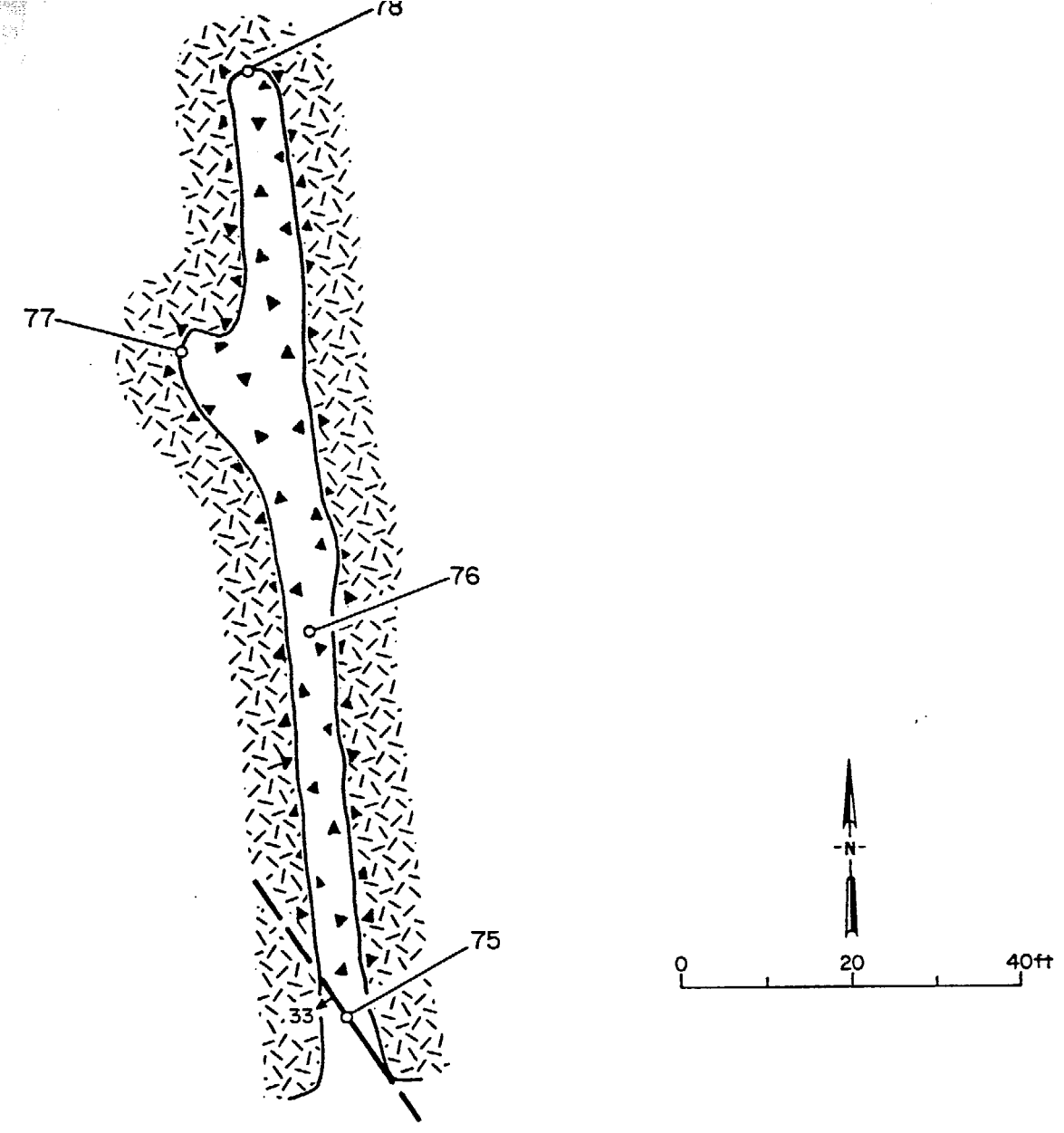
Figure 6F.--Upper adit on south side of Lopez Wash showing sample localities 60-62; table shows sample data.



[All samples were analyzed for Au but none was detected.
Detection limits: Au, 0.005 oz/st; Ag, 0.1 oz/st.
Symbols used: --, not detected; na, not analyzed.]

Sample No.	Chip length (ft)	Analytical data Ag oz/st	Fe %	Mn %	Remarks
63	10	--	1.35	18.50	Psilomelane and pyrolusite fracture fillings; minor calcite.
64	5	--	na	10.20	Do.
65	3	0.2	na	25.40	Do.
66	6	.1	1.30	15.60	Do.

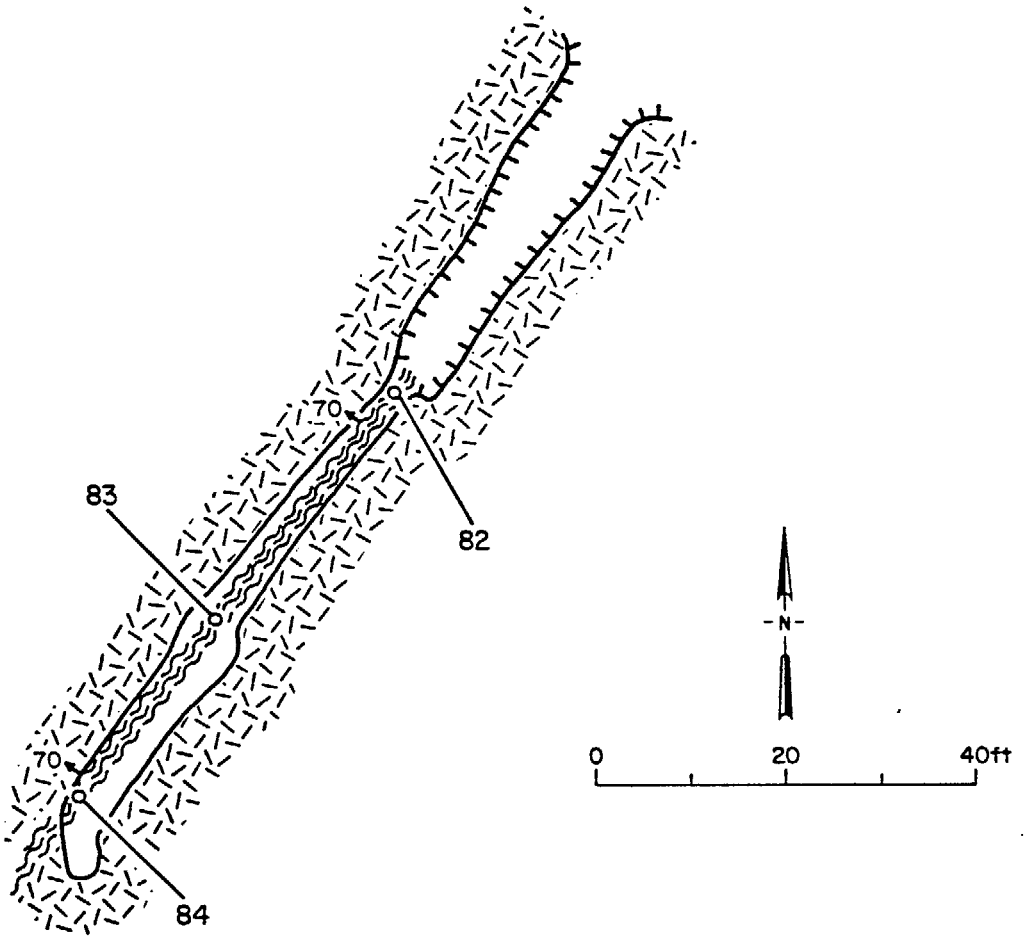
Figure 6G.--Adit A south of Lopez Wash showing sample localities 63-66; table shows sample data.



[All samples were analyzed for Au and Ag but none was detected. Detection limits: Au, 0.005 oz/st; Ag, 0.1 oz/st.]

Sample No.	Chip length (ft)	Analytical data Mn %	Remarks
75	1	0.34	Limonite in 3- to 4-in.-thick gouge.
76	3	.24	Limonite fracture fillings.
77	5	.12	Do.
78	4	.11	Do.

Figure 6H.--Adit B south of Lopez Wash showing sample localities 75-78; table shows sample data.



[All samples were analyzed for Au but none was detected.
Detection limits: Au, 0.005 oz/st; Ag, 0.1 oz/st.
Symbol used: --, not detected.]

Sample No.	Chip length (ft)	Analytical data Ag oz/st	Mn %	Remarks
82	2	--	12.80	Psilomelane and pyrolusite fracture fillings, limonite.
83	1.5	0.4	17.00	Banded chalcedony, psilomelane, pyrolusite, and limonite fracture fillings.
84	2	--	15.00	Do.

Figure 6I.--Adit C south of Lopez Wash showing sample localities 82-84; table shows sample data.

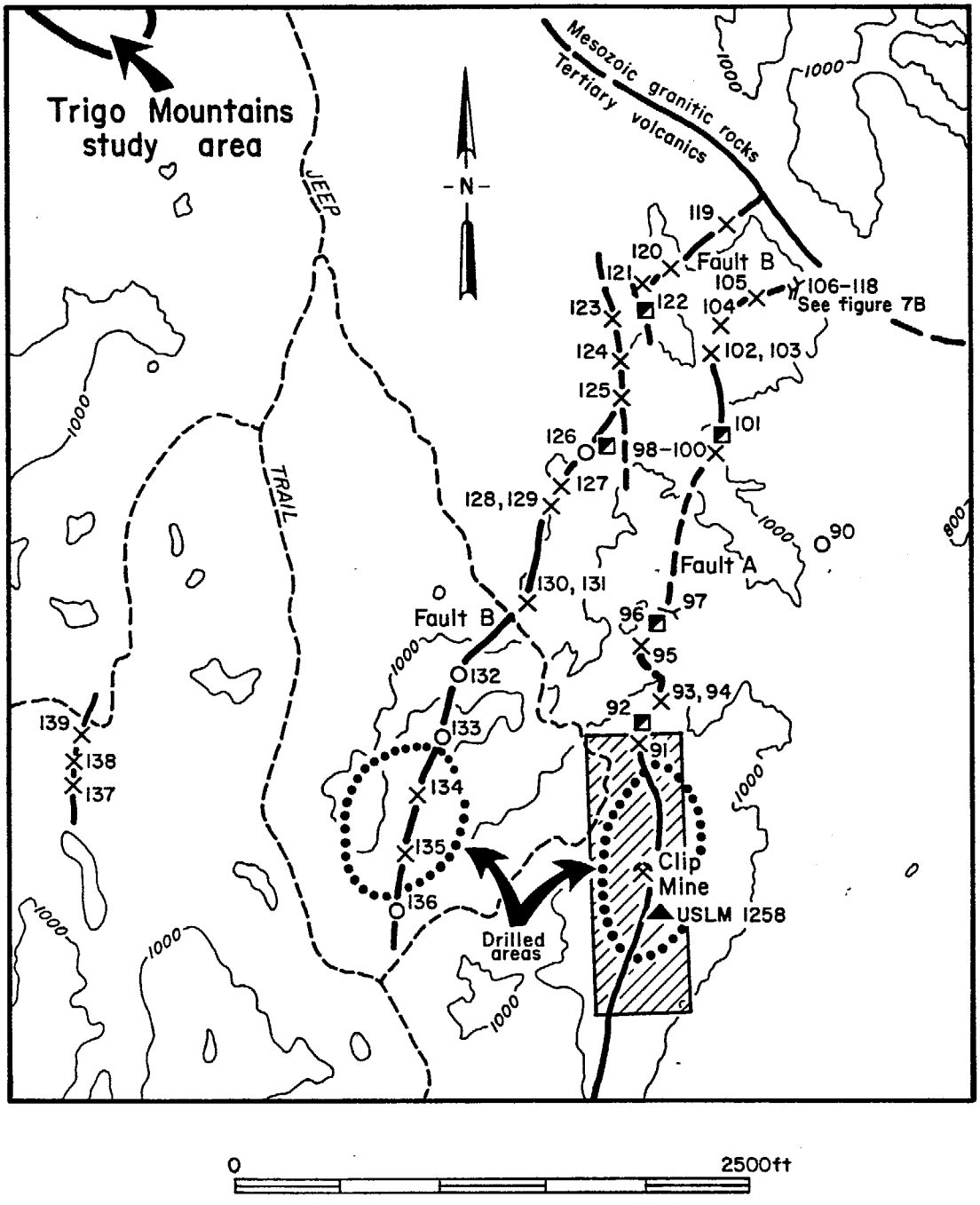
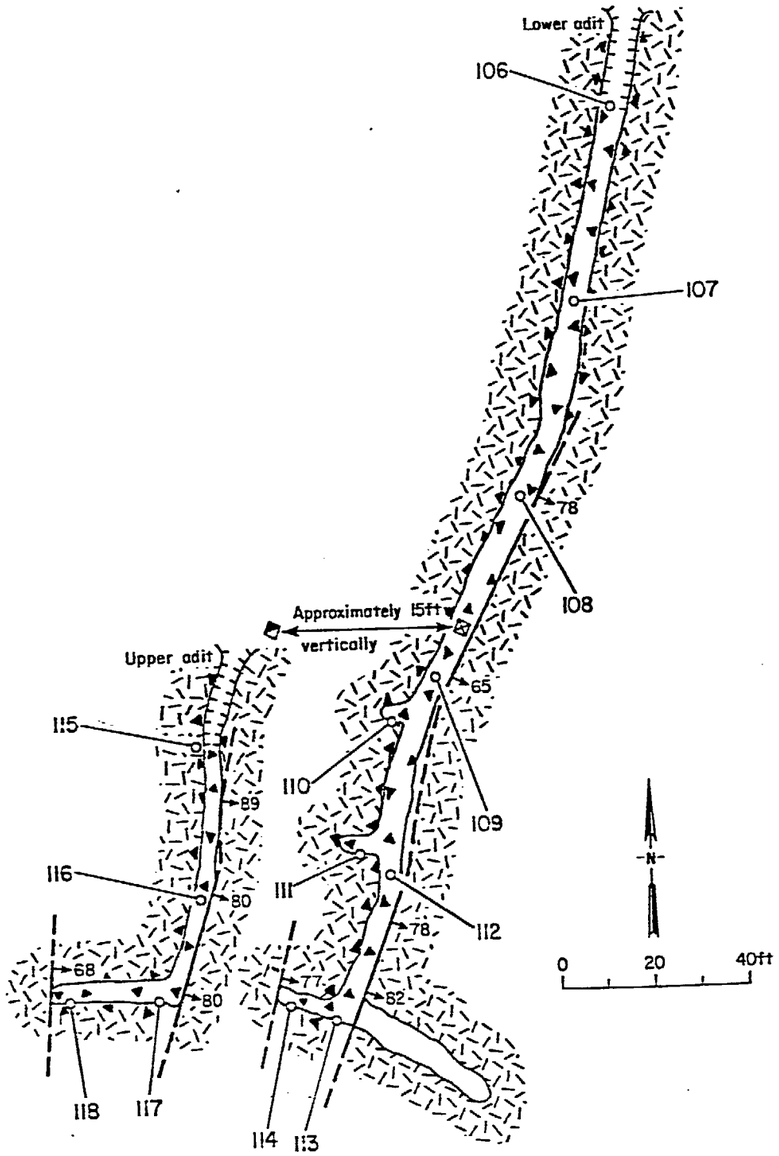


Figure 7A.--Workings in the vicinity of the Clip Mine southeast of the study area showing sample localities 90-139. Sample data on figure 7B and table 3.



[All samples were analyzed for Au but only a trace was detected in sample no. 115. Detection limit: Au, 0.005 oz/st.

Sample No.	Chip length (ft)	Analytical data: Ag oz/st	Mo ppm	V ppm	Pb ppm	Zn ppm	Remarks
106	5	0.7	3	65	33	480	Minor barite, calcite, quartz, and hematite.
107	5	2.9	4	30	20	150	Do.
108	5	2.1	5	74	52	360	Do.
109	5	2.3	2	49	47	390	Minor barite, calcite, quartz, and fluorite fracture fillings.
110	5	.8	4	120	124	880	Hematite fracture fillings; minor barite and calcite.
111	7	.7	2	42	57	112	Barite veins, as thick as 2 in.; minor fluorite.
112	4	.4	3	33	22	75	Barite veins, as thick as 6 in.; minor fluorite.
113	8	.6	3	38	70	48	10% barite veins and lenses; minor fluorite, and calcite.
114	6	.7	3	39	154	60	Barite veins and fillings, as thick as 3 in.; reddish-brown silicified fault gouge; minor calcite and quartz.
115	11	4.0	4	76	1,100	760	Minor hematite, calcite, and barite fracture fillings.
116	4	.9	4	35	47	76	Silicified breccia, barite, calcite, and hematite fracture fillings.
117	8	2.0	4	39	92	110	Barite and calcite fracture fillings, hematite.
118	8	2.0	4	63	65	262	Do.

Figure 7B.--Upper and lower adits north of the Clip Mine near granite contact showing sample localities 106-118; table shows sample data.

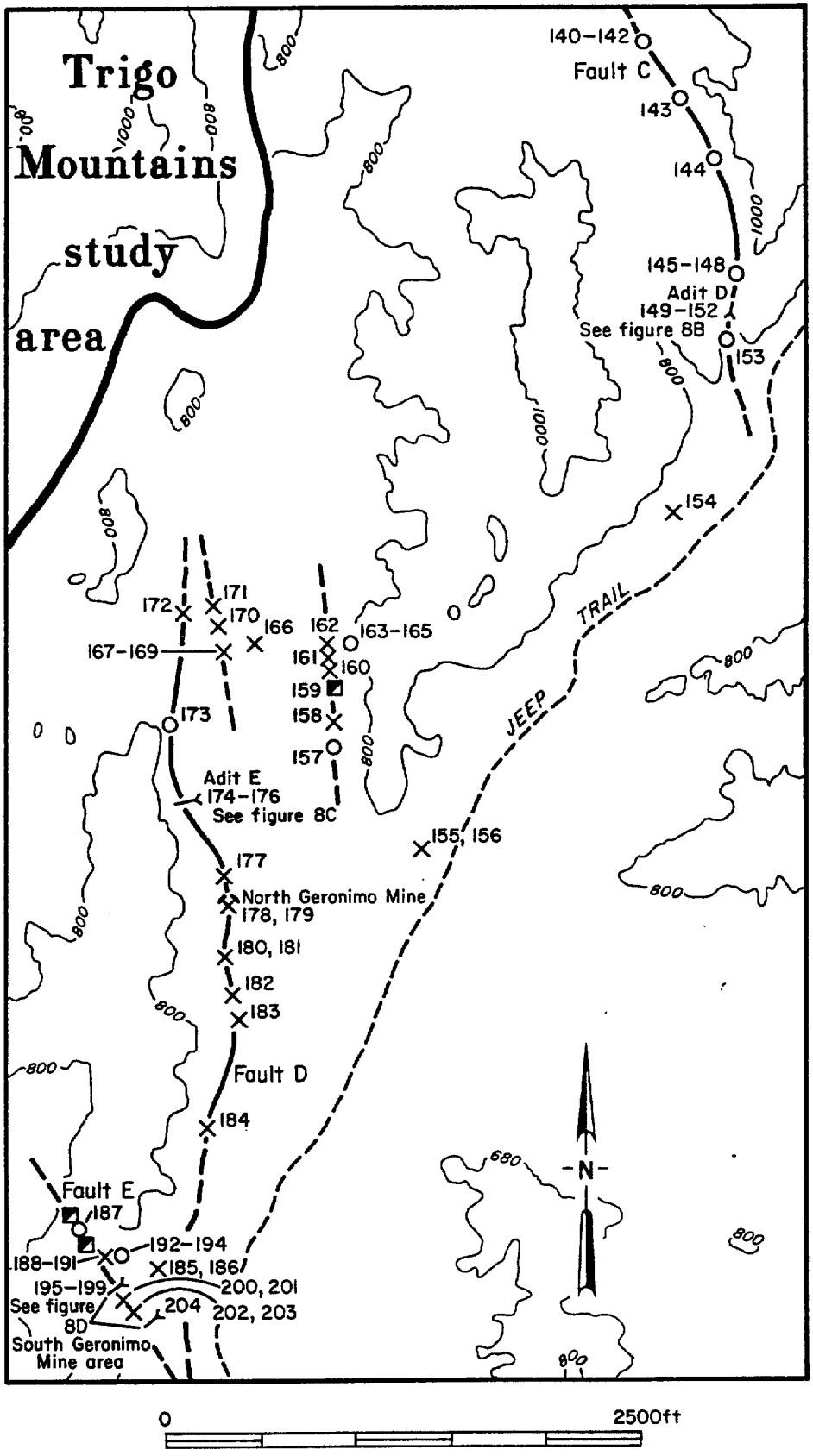
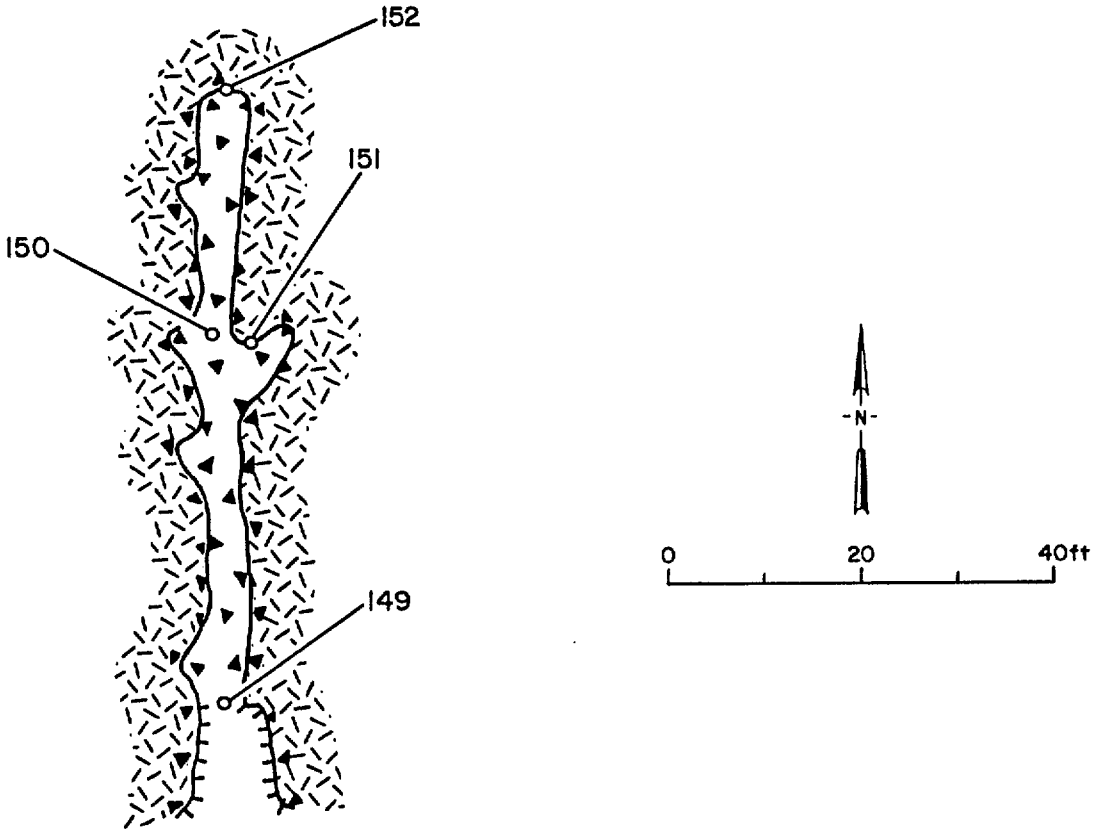


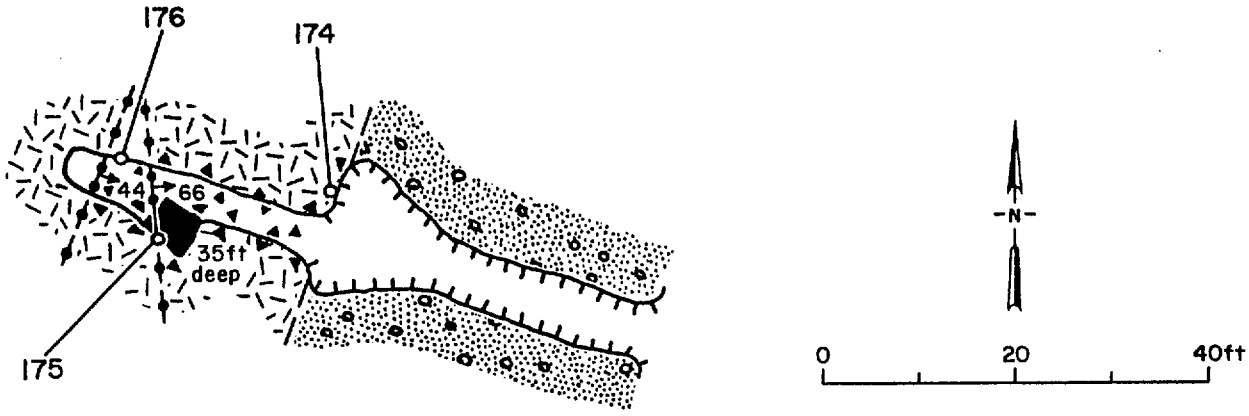
Figure 8A.--Workings in the Geronimo Mine area southeast of the study area showing sample localities 140-204. Sample data on figures 8B-D and table 3.



[All samples were analyzed for Au but none was detected. Detection limit: Au, 0.005 oz/st. Symbol used: na, not analyzed.]

Sample No.	Chip length (ft)	Analytical data Ag oz/st	Mo ppm	V ppm	Pb ppm	Zn ppm	Ba %	Remarks
149	6	0.4	6	131	760	138	na	Calcite, barite, quartz, and hematite.
150	3	1.6	17	87	1,300	180	na	Do.
151	6	.6	4	136	710	110	25.48	Barite, calcite, and quartz fracture fillings and veinlets, hematite coatings.
152	3	.7	3	170	1,950	2,800	na	Do.

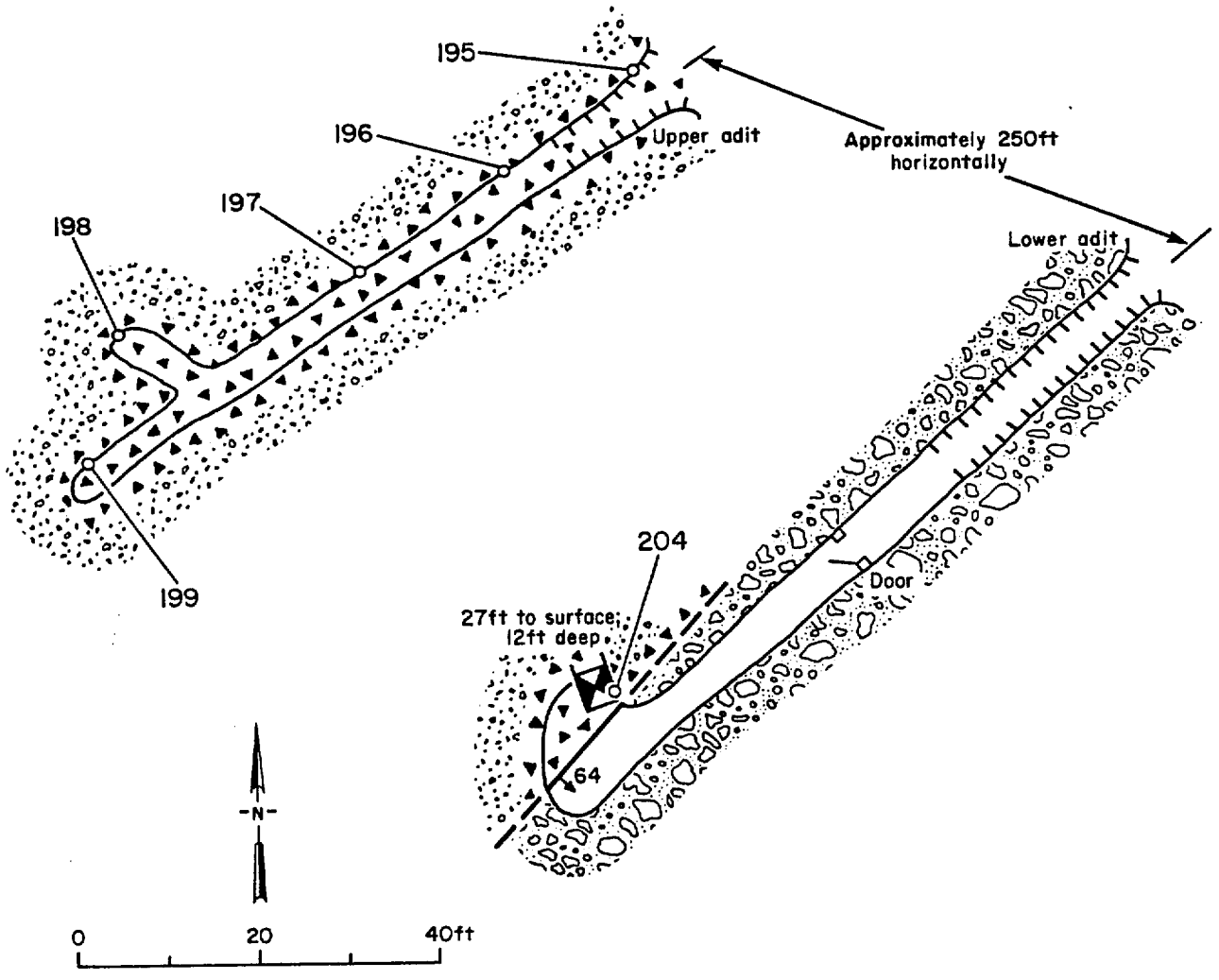
Figure 8B.--Adit D showing sample localities 149-152; table shows sample data.



[Detection limit: Au, 0.005 oz/st. Symbols used: --, not detected; tr, trace.]

Sample No.	Chip length (ft)	Analytical data Au (oz/st)	Ag (oz/st)	Mo (ppm)	V (ppm)	Pb (ppm)	Zn (ppm)	Remarks
174	4	tr	1.8	10	210	2,300	540	Barite, calcite, and quartz veins.
175	1	--	.1	8	77	285	28	Do.
176	2.6	--	1.5	7	138	390	145	Calcite vein; minor quartz and hematite.

Figure 8C.--Adit E showing sample localities 174-176; table shows sample data.



[All samples were analyzed for Au but none was detected. Detection limit: Au, 0.005 oz/st.]

Sample No.	Chip length (ft)	Analytical data Ag oz/st	Mo ppm	V ppm	Pb ppm	Zn ppm	Remarks
195	5	1.6	16	130	1,300	1,140	Quartz veinlets, as thick as 2 in.; hematite.
196	5	1.6	4	52	3,050	2,700	Hematite and minor quartz fracture fillings.
197	5	5.8	610	24	1.28%	4,600	Hematite and calcite fracture fillings.
198	4	6.0	7	10	1.38%	940	Quartz veinlets, as thick as 1/2 in.; hematite, barite.
199	5	6.2	66	26	4,800	2,500	Quartz veinlets, as thick as 1/2 in.; hematite.
204	4	2.5	8	132	4,400	5,000	Calcite and quartz veinlets; hematite, limonite.

Figure 8D.--Upper and lower adits in the South Geronimo Mine area showing sample localities 195-199 and 204; table shows sample data.

Table 1.--Analytical data for panned-concentrate samples from in and near the Trigo Mountains study area.

[Detection limits: Au, 0.005 oz/st; Ag, 0.1 oz/st. Symbols used: --, not detected; tr, trace.]

Sample no.	Analytical data	
	Au	Ag
	oz/st	
1	--	0.1
3	tr	.1
4	0.50	9.8
5	--	--
6	--	--
24	--	.2
25	--	.3
26	--	--
27	.38	.1
28	--	.1
29	tr	--

Table 2.--Data for manganese occurrences not shown on figures 6B-I.

[All samples were analyzed for Au but only a trace was detected in samples 31 and 33. Detection limits: Au, 0.005 oz/st; Ag, 0.1 oz/st. Symbols used: --, not detected; na, not analyzed.]

Sample No.	Chip length (ft)	Analytical data Ag oz/st	Fe %	Mn %	Description
30	9	--	0.90	6.90	Opencut, 275 ft long, Black Diamond Mine; fault zone, 75 ft wide, strike N. 5° W., dip 68° SW.; andesite; psilomelane and pyrolusite fracture fillings; sample from west side.
31	18	--	1.35	1.06	Outcrop, contiguous to sample no. 30.
32	8	--	na	2.30	Outcrop, contiguous to sample no. 31.
33	3	0.1	na	14.10	Pit; fault, strike N. 25° E., vertical dip; andesite; psilomelane and pyrolusite fracture fillings.
34	4	.1	na	15.20	Opencut, 25 ft long, 25 ft wide, as deep as 25 ft; fault, strike N. 7° E., dip 68° SE.; andesite; psilomelane and pyrolusite fracture fillings.
35	3	--	.35	24.00	Trench, 150 ft long, 45 ft wide, as deep as 50 ft; fault zone, strike N. 30° E., vertical dip; andesitic lapilli tuff; psilomelane and pyrolusite fracture fillings as thick as 1 in., minor calcite.
36	3.5	.2	na	19.10	Do.
37	6	--	na	4.68	Do.
38	15	.2	na	10.70	Opencut, 80 ft long, 60 ft wide; andesite; psilomelane and pyrolusite fracture fillings.

Table 2.--Data for manganese occurrences not shown on figures 6B-I--Continued

Sample No.	Chip length (ft)	Analytical data Ag oz/st	Fe %	Mn %	Description
39	5	0.1	na	8.00	Shaft, 9 ft deep; fault, strike N. 10° E., dip 67° SE.; andesite; psilomelane and pyrolusite fracture fillings.
59	5	.1	na	35.60	Outcrop next to shaft; fault, strike N. 5° W., dip 80° SW.; andesite; psilomelane and pyrolusite fracture fillings.
67	7	--	na	4.70	Outcrop; fault, strike N. 5° W., dip 80° SW.; andesite; psilomelane, pyrolusite, and calcite fracture fillings.
68	3	--	na	3.74	Outcrop next to shaft; fault, strike N. 5° W., dip 80° SW.; andesite; psilomelane, pyrolusite, and calcite fracture fillings.
69	5	.1	na	20.40	Pit; fault, strike N. 17° E., dip 45° SE.
70	15	--	na	2.58	Trench; shaft in center; fault, strike N., dip 60° W.; andesite; psilomelane and pyrolusite fracture fillings.
71	5	--	na	22.00	Outcrop next to shaft; fault, strike N. 5° W., dip 60° SW.; andesite breccia; psilomelane, pyrolusite, and calcite fracture fillings.
72	5	1.6	na	25.30	Opencut 25 ft long, 26 ft deep, north side; fault, strike N. 20° E., dip 40° NW.; andesite breccia; psilomelane and pyrolusite fracture fillings.
73	4	--	1.00	21.60	Same as sample 72, south side of opencut.

Table 2.--Data for manganese occurrences not shown on figures 6B-I--Continued

Sample No.	Chip length (ft)	Analytical data Ag oz/st	Fe %	Mn %	Description
74	15	--	0.95	12.10	Trench, 90 ft long, 25 ft wide, as deep as 40 ft; same fault as samples 72 and 73; psilomelane and pyrolusite fracture fillings.
79	2	--	na	2.80	Opencut, 75 ft long, 10 ft wide, as deep as 20 ft; fault, strike N. 10° W., dip 50° NW.; andesite; psilomelane and pyrolusite fracture fillings.
80	5	--	na	15.55	Trench, 150 ft long, 20-30 ft wide, as deep as 50 ft; 20- to 30-ft-wide fault, strike N. 18° E., dip 45° SW.; andesite; psilomelane and pyrolusite fracture fillings.
81	5	--	na	5.90	Do.
85	2	0.1	na	10.30	Pit, 7 ft deep; fault, strike N. 35° W., dip 80° SW.; andesite; psilomelane and pyrolusite fracture fillings.
86	4	.1	1.80	8.20	Opencut, 10 ft long, as deep as 6 ft; fault, strike N. 20° E., dip 70° NW.; andesite; ramsdellite, psilomelane, pyrolusite, and hematite fracture fillings.
87	4	--	na	12.80	Opencut, 25 ft long, 6 ft wide, 15 ft deep; fault, strike N. 8° E., dip 53° NW.; andesite breccia; psilomelane and pyrolusite fracture fillings.
88	1	--	na	.27	Prospect, 15 ft long; fault, strike N. 5° E., dip 54° NW.; andesite; psilomelane and pyrolusite fracture fillings.
89	3	--	na	6.63	Opencut, 12 ft long; fault, strike N. 50° E., dip 85° SE.; andesite; psilomelane and pyrolusite fracture fillings.

Table 3.--Data for miscellaneous occurrences in the Silver mining district in the southern part of the Trigo Mountains study area.

[Detection limits: Au, 0.005 oz/st; Ag, 0.1 oz/st. Symbols used: --, not detected; na, not analyzed; tr, trace; xx, not applicable.]

Sample No.	Chip length (ft)	Analytical data: Au (oz/st)	Ag (oz/st)	Mo (ppm)	V (ppm)	Pb (ppm)	Zn (ppm)	Ba (%)	Description
90	4	--	0.2	4	27	18	10	na	Outcrop; barite vein, 2 ft thick, strike N. 9° W., dip 56° SW.; andesite.
91	3	--	.3	9	250	520	18	na	Opencut, 14 ft long; calcite vein, strike N. 45° E., dip 52° NW.; Tertiary volcanics.
92	10	--	.2	9	305	1,500	15	na	Shaft, 22 ft deep; calcite vein, strike N. 9° W., dip 56° SW.; Tertiary volcanics.
93	7	--	.9	6	168	485	18	na	Opencut, 14 ft long; calcite vein, 7 ft wide, strike N. 22° E., dip 55° NW.; Tertiary volcanics; limonite in fractures, minor barite.
94	7	--	.1	9	182	36	18	na	Do.
95	5	0.01	.3	4	46	47	12	28.28	Pit, 11 ft deep; barite vein, strike N. 5° E., dip 50° NW.; Tertiary volcanics; minor calcite.
96	3.5	.01	.1	5	61	15	20	na	Shaft, 26 ft deep; 25-ft-wide fault with 2-in.-wide barite veins, strike N. 48° E., dip 54° NW.; Tertiary volcanics ; minor calcite and malachite.
97	7	--	.1	7	35	23	5	na	Adit, 12 ft long; same fault as sample 96; Tertiary volcanics; barite, calcite, and fluorite.
98	1	tr	5.2	6	60	450	8	na	Opencut, 20 ft long; 20-ft-wide fault, strike N. 18° E., dip 65° NW.; sample from reddish silicified footwall of fault; Tertiary volcanics minor barite and calcite.
99	8	--	3.5	5	66	1,900	15	29.68	Opencut; contiguous to sample 98; mostly barite veins, 15% calcite veins, minor volcanic fragments.
100	6	--	1.6	4	69	215	42	na	Outcrop; contiguous to sample 99 to hanging wall of fault; two 2-in.-wide barite and calcite veins, 75% fractured volcanics.
101	10	tr	.8	7	88	275	15	19.24	Shaft, 23 ft deep; 60 ft from samples 98-100 on same fault; 85% barite and calcite veins; Tertiary volcanics, 1-in.-thick red silicified zone.
102	11	.01	.3	5	143	275	32	na	Opencut, 11 ft long; same fault as samples 98-101; Tertiary volcanics; barite, calcite, and hematite fracture fillings.

Table 3.--Data for miscellaneous occurrences in the Silver mining district in the southern part of the Trigo Mountains study area--Continued

Sample No.	Chip length (ft)	Analytical data Au (oz/st)	Ag (oz/st)	Mo (ppm)	V (ppm)	Pb (ppm)	Zn (ppm)	Ba (%)	Description
103	4.5	--	0.8	3	76	71	22	na	Opencut; fault, same as sample 102; 15% volcanic breccia, 55% calcite, 30% barite.
104	7	--	2.7	7	41	1,350	316	na	Opencut, 12 ft long; calcite-barite vein, strike N. 28° E., dip 68° NW.; Tertiary volcanics; minor hematite on fractures.
105	15	0.06	5.1	4	26	905	150	36.68	Opencut, 15 ft long; barite veins with minor calcite, strike N. 25° E., dip 75° SE.; andesite.
119	2	--	1.1	5	205	280	420	na	Pit, 4 ft deep; fault, strike N. 6° E., dip 40° SE.; barite and calcite veining and fracture fillings as thick as 4 in; Tertiary volcanics.
120	3	--	.3	4	55	78	80	na	Opencut, 22 ft long; barite vein, strike N. 22° W., dip 73° SW.; reddish-brown silicified zones on sides of vein, 2 and 6 in. wide; Tertiary volcanics; hematite on fractures.
121	4	--	.1	5	61	72	170	na	Pit, 2 ft deep; fault, N. 25° W., dip 71° SW.; Tertiary volcanics, minor calcite and barite fracture fillings.
122	2	--	.8	4	155	102	224	na	Shaft; vuggy barite vein, strike N. 15° E., dip 58° NW.; Tertiary volcanics; hematite coatings.
123	9	--	2.1	5	87	1,450	118	32.23	Pit, 4 ft deep; barite vein, strike N. 20° E., dip 72° NW.; Tertiary volcanics; calcite.
124	3.5	--	1.3	14	240	2,450	280	na	Opencut, 14 ft long; calcite and barite veins in fault, strike N. 55° E., dip 86° NW.; Tertiary volcanics; hematite fractures fillings.
125	8	--	1.1	5	100	1,300	75	22.10	Pit, 7 ft deep; barite-calcite vein, strike N. 5° W., dip 58° SW.; Tertiary volcanics.
126	3	--	3.3	4	59	1,100	54	na	Outcrop near shaft 24-ft-deep; barite vein, strike N. 25° E., dip 89° NW.; Tertiary volcanics; calcite.
127	3	--	2.3	12	125	1,500	152	na	Opencut, 10 ft long; barite-calcite vein, strike N. 25° E., dip 32° NW.; volcanic host rock; hematite fracture fillings.
128	5.5	--	8.0	7	58	985	44	na	Opencut, 20 ft long; barite vein, strike N. 53° E., dip 60° NW.; Tertiary volcanics; sample from reddish brown jasperoid and calcite in footwall.
129	2	--	2.5	7	38	1.58%	68	37.77	Opencut same as sample 128, sample across vein; calcite, minor hematite coatings.
130	7	--	.8	6	370	196	40	na	Opencut, 11 ft long; calcite vein, strike N. 27° E., dip 45° NW.; Tertiary volcanics; minor barite.

Table 3.--Data for miscellaneous occurrences in the Silver mining district in the southern part of the Trigo Mountains study area--Continued

Sample No.	Chip length (ft)	Analytical data: Au (oz/st)	Ag (oz/st)	Mo (ppm)	V (ppm)	Pb (ppm)	Zn (ppm)	Ba (%)	Description
131	7	--	1.1	7	167	180	70	na	Taken from sample 130 to footwall of vein.
132	4	--	.1	7	325	79	40	na	Outcrop; calcite vein, strike N. 40° E., dip 50° NW.; Tertiary volcanics; minor barite.
133	6	--	4.0	11	465	3,750	152	3.11	Outcrop; calcite vein, strike N. 15° E., dip 53° NW.; Tertiary volcanics; reddish silicified footwall, 2-3 in. thick; barite.
134	3.5	--	2.2	6	194	890	660	na	Opencut, 12 ft long; barite and calcite vein, strike N. 3° E., dip 60° NW.; Tertiary volcanics; hematite.
135	4.5	--	5.4	4	50	5,700	680	37.12	Opencut, 8 ft long; barite and calcite vein, strike N. 12 E., dip 58° NW.; Tertiary volcanics; hematite.
136	6	--	.3	13	54	175	60	na	Outcrop; calcite vein, strike N. 5° E., dip 53° NW.; Tertiary volcanics; barite, fluorite.
137	4.5	tr	.3	11	139	400	40	na	Opencut, 18 ft long; calcite vein, strike N. 5° W., dip 45° NE.; Tertiary volcanics.
138	1	tr	--	11	49	26	8	na	Opencut, 15 ft long; same vein as sample 137.
139	6	--	.4	12	91	196	20	na	Opencut, 30 ft long; same vein as samples 137 and 138, strike N. 3° W., dip 54° NE.
140	3	--	2.0	5	245	990	156	na	Outcrop; fault zone with calcite, fluorite, and barite veining, strike N. 35° W., dip 65° SW.; Tertiary volcanics; sample from footwall.
141	.5	--	1.6	5	460	1,600	680	na	Outcrop; contiguous to sample 140; reddish brown zone; minor calcite.
142	9	--	.1	5	134	83	235	na	Outcrop; contiguous to sample 141 to hanging wall of fault; calcite, quartz, barite, and fluorite veinlets, as thick as 1 in..
143	1	--	--	8	115	51	44	na	Outcrop; calcite vein, strike N. 25° W., dip 70° SW.; Tertiary volcanics.
144	3	--	.3	6	250	875	96	na	Outcrop; calcite vein, strike N. 22° W., dip 66° SW.; Tertiary volcanics.
145	3	tr	1.7	3	174	2,050	108	45.82	Outcrop; barite vein in fault, strike N. 10° E., dip 80° NW.; Tertiary volcanics; minor calcite and quartz; sample from hanging wall.
146	6.5	--	2.2	2	153	2,100	160	28.99	Outcrop; contiguous to sample 145; brecciated volcanics, and barite and calcite fracture fillings.

Table 3.--Data for miscellaneous occurrences in the Silver mining district in the southern part of the Trigo Mountains study area--Continued

Sample No.	Chip length (ft)	Analytical data: Au (oz/st)	Ag (oz/st)	Mo (ppm)	V (ppm)	Pb (ppm)	Zn (ppm)	Ba (%)	Description
147	1	--	0.2	5	54	87	12	na	Outcrop; contiguous to sample 146; quartz vein.
148	1	--	.1	3	75	175	68	na	Outcrop; contiguous to sample 147; green, altered footwall of fault.
153	2.5	--	.6	5	360	725	660	na	Outcrop; barite, calcite, quartz veins in hanging wall of 25-ft-wide fault, strike N. 2° E., dip 65° NW.; Tertiary volcanics.
154	4	--	--	2	51	22	50	na	Pit, 4 ft deep; fault, strike N. 35° E, dip 45° SE.; Tertiary volcanics; minor calcite veining.
155	1.5	tr	.6	7	99	285	55	na	Opencut, 18 ft long; calcite vein, strike N. 60° W., dip 75° NE.; Tertiary volcanics; minor quartz and barite.
156	2.5	--	5.8	3	27	480	68	na	Outcrop next to opencut; vuggy quartz, barite, calcite vein, strike N. 21° W., dip 55° NE.; Tertiary volcanics.
157	1.9	--	.3	9	135	163	100	na	Outcrop; calcite vein, strike N. 18° W., dip 85° NE.; Tertiary volcanics; silicified hematite contact; minor barite.
158	1.5	--	.2	10	170	129	280	na	Pit, 3 ft deep; calcite vein, strike N. 21° W, dip 55° NE,; Tertiary volcanics; minor quartz.
159	3	tr	.1	7	180	1,700	30	na	Shaft, 16 ft deep; fault, N. 20° E., dip 45° SE.; Tertiary volcanics; calcite, barite, and hematite fracture fillings.
160	5	tr	.2	4	109	580	25	na	Opencut, 24 ft long; vuggy calcite vein, strike N. 20° E., dip 44° SE.; Tertiary volcanics; quartz, hematite.
161	4	--	.2	7	95	1,600	72	na	Pit, 7 ft deep; vuggy calcite vein, strike N. 10° E., dip 45° SE; volcanic host rock; barite, quartz, chlorite, minor hematite, and sparse wulfenite.
162	1.5	tr	.2	3	182	2,100	110	na	Opencut, 18 ft long; breccia zone, strike N. 14° W., dip 84° NE.; Tertiary volcanics; hematite, barite, calcite, quartz.
163	.7	--	1.2	5	250	1,550	20	35.65	Outcrop; banded vuggy barite vein exposed for about 50 ft, strike N. 23°-35° W., dip 78°-88° SW.; Tertiary volcanics; hematite, quartz.
164	3	--	4.5	12	170	2,000	43	na	Do.
165	3	tr	6.1	5	160	1,550	60	36.22	Do.
166	3.5	--	--	4	144	133	330	na	Pit, 8 ft deep; fault, strike N. 11° E., dip 67° NW.; Tertiary volcanics; calcite veinlets.

Table 3.--Data for miscellaneous occurrences in the Silver mining district in the southern part of the Trigo Mountains study area--Continued

Sample No.	Chip length (ft)	Analytical data: Au (oz/st)	Ag (oz/st)	Mo (ppm)	V (ppm)	Pb (ppm)	Zn (ppm)	Ba (%)	Description
167	2	tr	--	8	198	490	88	na	Opencut, 40 ft long; vuggy calcite veins in fault zone, strike N. 5°-10° W., dip 50°-85° SW.; Tertiary volcanics; quartz, hematite.
168	1.5	--	0.2	7	240	640	65	na	Do.
169	4.5	tr	3.9	6	181	1,050	64	na	Do.
170	1	--	2.7	6	230	930	400	na	Opencut, 10 ft long; quartz-calcite vein, strike N. 5° W., dip 85° SW.; Tertiary volcanics; barite, hematite.
171	.5	tr	.4	3	116	335	58	na	Pit, 5 ft deep; vuggy quartz, calcite vein, strike N. 4° W., dip 74° SW.; Tertiary volcanics; barite, hematite.
172	5	0.01	--	10	199	124	29	na	Pit, 9 ft deep; fault, strike N. 10° W., dip 58° NE.; Tertiary volcanics; calcite, minor quartz and barite, and hematite fracture fillings.
173	3.5	--	--	7	445	95	76	na	Outcrop; calcite vein, strike N. 5° W., dip 45° SW.; Tertiary volcanics; quartz, barite, hematite.
177	1.5	.01	2.6	19	86	1,850	1,000	na	Opencut, 18 ft long; barite-calcite vein, strike N. 5° W., dip 35° NE.; Tertiary volcanics; minor quartz and hematite.
178	1	--	.4	157	48	6,350	640	na	Opencut, 82 ft long, North Gerinomo Mine; calcite and quartz vein, strike N. 5° E., dip 38° SE.; Tertiary volcanics; barite, wulfenite, sparse vanadinite.
179	xx	--	--	230	86	5,250	900	na	Select stockpile sample from site 178.
180	2	.02	6.8	21	115	8,200	1,050	12.71	Pit, 8 ft deep; barite, quartz, and calcite vein, strike N. 20° E., dip 42° SE.; Tertiary volcanics; sample from hanging wall of vein.
181	2	--	2.8	10	108	2,650	280	na	Pit, contiguous to sample 180; silicified Tertiary volcanics.
182	1.5	--	6.9	30	46	6,900	1,040	na	Pit, 6 ft deep; barite and calcite vein, strike N. 19° W., dip 37° NE.; Tertiary volcanics; quartz, wulfenite, hematite.
183	1.5	.01	2.7	1,300	43	2.38%	1,350	na	Pit, 9 ft deep; barite and calcite vein, strike N. 19° W., dip 37° NE.; Tertiary volcanics; quartz, wulfenite, hematite.
184	1	--	2.9	1,000	280	1.40%	8,000	na	Pit, 6 ft deep; barite-calcite-quartz vein, strike N. 20° E., dip 87° SE.; metamorphosed sandstone and shale; hematite, wulfenite, vanadinite.

Table 3.--Data for miscellaneous occurrences in the Silver mining district in the southern part of the Trigo Mountains study area--Continued

Sample No.	Chip length (ft)	Analytical data: Au (oz/st)	Ag (oz/st)	Mo (ppm except where indicated)	V (ppm except where indicated)	Pb (ppm except where indicated)	Zn (ppm except where indicated)	Ba (%)	Description
185	7	--	0.1	5	103	575	1,000	na	Outcrop above no. 186; quartz and calcite veins, strike N. 31° W., dip 71° NE.; Tertiary volcanics; hematite.
186	10	--	.8	46	205	5,100	2,000	na	Opencut, 5 ft long; quartz and calcite veins, strike N. 40° W., dip vertical; Tertiary volcanics; sparse chrysocolla.
187	7.5	--	1.8	11	26	5,500	3,600	na	Outcrop between 2 shafts, 52 ft and 85 ft deep; quartz and calcite veins, strike N. 40° W., dip 85° NE.; sandstone and conglomerate on NE. side and granite on SW. side; hematite, sparse wulfenite.
188	15	--	7.4	139	26	5,200	830	na	Opencut, 25 ft long; quartz-calcite vein, strike N. 55° W., dip 75° NE.; granite; hematite, wulfenite; working adjacent to sample site 189.
189	10	--	1.9	102	28	1,800	440	na	Opencut; contiguous to sample 188; to granite contact.
190	2.5	--	5.1	460	61	5,950	800	na	Opencut, 12 ft long; quartz-calcite vein, strike N. 25° W., dip 75° NE.; hematite, wulfenite.
191	10	--	8.8	34	23	1.44%	3,400	na	Opencut, 12 ft long; quartz-calcite vein; strike N. 27° W., dip 84° NE.; hematite, yellow oxidized lead (?) mineral, barite, sparse wulfenite.
192	23	--	1.8	23	128	2,500	3,400	na	Outcrop; quartz veins, as thick as 3 ft, strike N. 38° W., dip 72° NE.; hematite.
193	15	--	.3	4	85	1,500	3,400	na	Outcrop; quartz and calcite veins, as thick as 1.5 ft, strike N. 60° W., dip 76° NE.; hematite-stained fault breccia.
194	13	--	--	4	107	560	380	na	Outcrop; fault breccia, mixed granite and metasediments; hematite.
200	6	--	2.9	8	29	4.18%	3,200	na	Opencut, 25 ft long; fault, strike N. 38° W., dip 54° NE.; granite; hematite, limonite.
201	8	0.06	5.6	14	47	6,850	8,600	na	Opencut, contiguous to sample 200; quartz, calcite, hematite, limonite.
202	6	--	3.9	9	29	1,850	8,000	na	Pit, 7 ft deep; fault, strike N. 45° W., dip 67° NE.; granite; quartz veinlets, calcite, hematite, limonite.
203	6	tr	11.4	23	28	9,650	3,200	na	Pit, 4 ft deep; fault, strike N. 45° W., dip 67° NE; granite; calcite, quartz, minor hematite and limonite.
205	3	tr	.2	6	98	375	1,000	na	Opencut, 23 ft long; fault, strike N. 55° W., dip 74° SW.; gneiss.

Table 4.--Commodity highlights.

[Principal metallic commodities in and near the study area are gold, manganese, and silver. Sand and gravel, also present, are difficult to assess in terms of marketability and price and not covered in the following summary. Commodity statistics are from the Bureau of Mines Mineral Commodity Summaries (1988).]

Commodity	Domestic mine production	Apparent consumption	Unit	Major import sources	Net import reliance (%)	Average 1988 domestic price (dollars)	Price unit	Expected U.S. demand through 1988	Major uses
Gold	4,900,000	2,800,000	troy oz	Canada Switzerland Uruguay	Not calculated	444.00	troy oz	Annual increase of 30%	Jewelry and arts, industrial (mainly electronic), and dental.
Manganese	none	690,000	long ton	Africa Brazil France	100	1.27	long ton unit	Slight annual increase of about 20 ltu	An alloy in steel production, in dry cell batteries, and for various chemical uses.
Silver	38,000,000	144,000,000	troy oz	Canada Mexico Peru United Kingdom	61	8.25	troy oz	Annual increase rate of 2.2%	Photography, electrical, sterling ware and electroplated ware, jewelry, brazing alloys, and solders.