GEOLOGIC REPORT

ON THE

SOUTHERN HALF OF THE AURORA MINING DISTRICT

MINERAL COUNTY, NEVADA

by

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Reno, Nevada

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GEOLOGIC REPORT

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INTRODUCTION

Purpose of Report

A detailed report, dated March 25, 1975, was made on the geology of the Hornet and Wasp mining claims in the Aurora Mining District. That report described the general geology of the district, the mineralogy and paragenesis of the veins, the underground geology, the results of the sampling program along the various veins both on the surface and underground, and attempted to correlate all geologic, geochemical, and geophysical data up to 1975.

Subsequent to that time further geologic, geochemical, and geophysical surveys were made at the request of Mr. Alexander von Hafften. Significant new data was discovered during geological mapping including petrological and structural relationships. Certain intrusives appear to have a genetic relationship to mineralization. For the first time a northwesterly-striking set of faults related to the Walker Lane were mapped in fair detail and their relationship to the predominant east-northeasterly set of faults and veins were delineated. Mapping along the Prospectus fault revealed new data on the Juniata, Wide West, Humboldt and Propectus veins. Geochemical samples were taken on Silver Hill and Middle Hill to determine if antimony, arsenic, mercury, and/or tungsten could be used as trace elements in exploration for new ore shoots in the district. Geophysical surveys by VLF-EM methods using the Scintrex SE-81 Scopus EM receiver were made by Wade A. Hodges of Carson City, Nevada. This report is an attempt to correlate all new data collected since 1975 with all earlier reports.

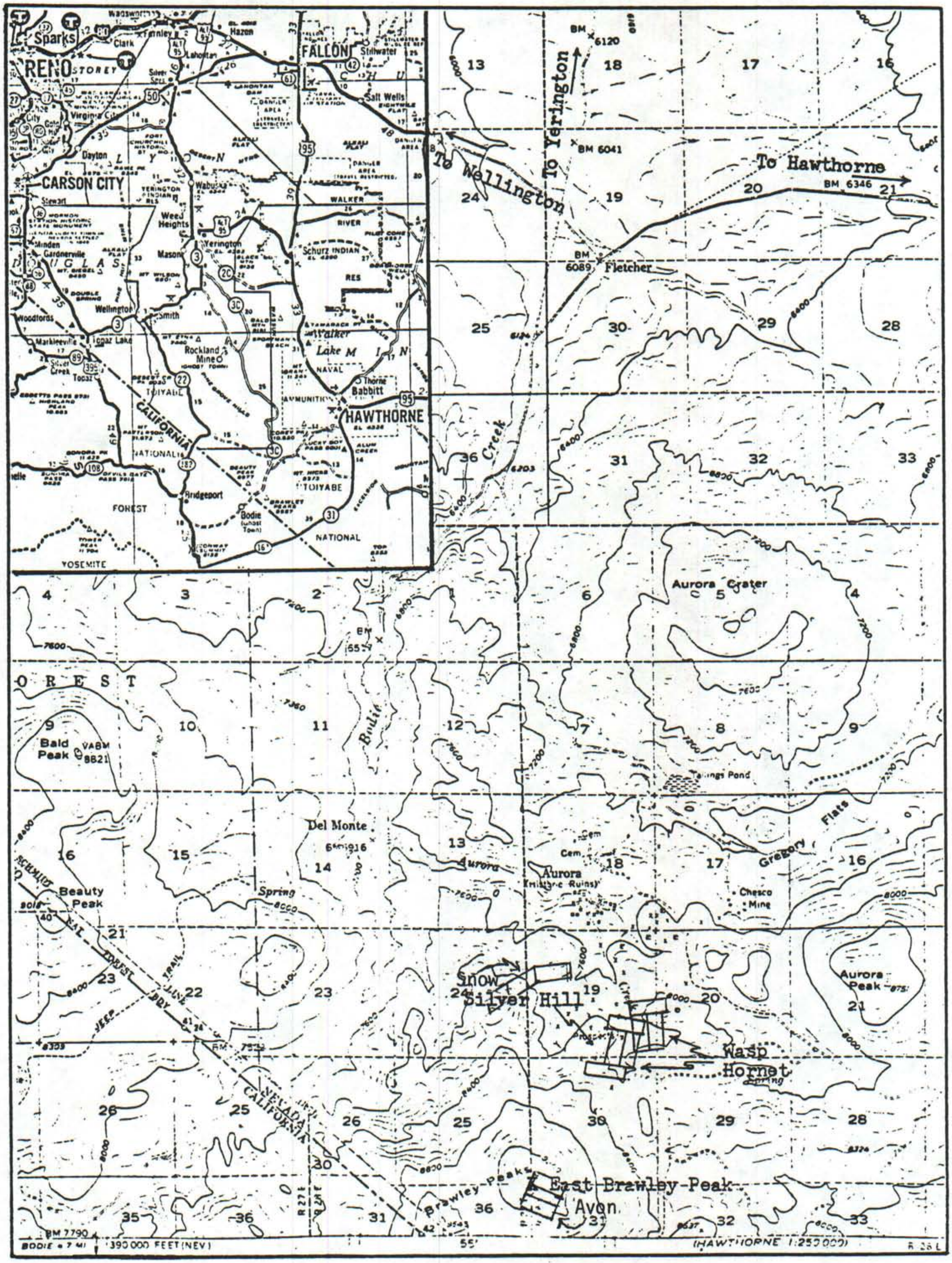


FIGURE 1. Index map of the Aurora area showing the Hornet-Wasp claims.

Location

The Hornet and Wasp lode mining claims are situated in Sections 19, 20, and 30, T.5 N., R.28 E., MDBM in the Aurora Mining District, Mineral County, Nevada. They are located on the flanks of Silver Hill and Middle Hill in Brewery Gulch along the upper drainage of Aurora Creek at an elevation of 7600 to 8000 feet, approximately 28 miles southwest of Hawthorne, Nevada. The Aurora 15-minute USGS topographic quadrangle map covers the area.

Accessibility

Aurora may be reached by taking State Route 31 south from Hawthorne for 4 miles, thence via a good dirt road westerly over Lucky Boy Pass for 17 miles to Fletcher, thence southerly for 6 miles over a dirt road to the old town site of Aurora, and then southerly up Brewery Gulch for 0.6 miles to the claims.

It also may be reached by taking State Route 22 for 18 miles south from Wellington to Sweetwater at the East Walker River, thence 12 miles easterly on a narrow dirt road to Fletcher, thence 6 miles up a dirt road to Aurora, and then up Brewery Gulch to the claims.

A third route is State Route 3 and 3-C south from Yerington for 54 miles to Fletcher, thence 6 miles to Aurora, and thence 0.6 miles up Brewery Gulch to the claims. This road is usually rough and tedious. The roads to Fletcher from Hawthorne, Wellington and Yerington are passable most of the year but the dirt road from Fletcher to Aurora is impassable in the winter months and after heavy rainstorms. Although rough, these roads may be traversed in a passenger car as far as Aurora.

Natural Conditions

The Hornet group of claims are in an area of high relief with most of the area covered by sage, juniper, aspen, and pinyon pine. The elevation ranges from 7600 to 8000 feet. The terrain is rough and the slopes on each side of Brewery Gulch are steep. One spring on the Hornet 2 claim at the site of the old brewery runs all year and is used for watering sheep. The humidity is low and the annual rainfall is approximately 10 inches, divided between rain and snow. Snow usually accumulates early in the fall and may be several feet deep in the middle of winter. The temperature varies in the summer from a high of 90° F in the daytime to a low of 50° F at night with a mean annual temperature of approximately 40° F.

Operating Conditions

The roads from Fletcher to Aurora could be improved and maintained at a reasonable cost for haulage of supplies from Hawthorne. The Southern Pacific Railroad serves Hawthorne and the Naval Ordnance Depot via a station at Thorne, four miles east of Hawthorne. Any mining operation at Aurora would require a mining camp near the mine.

Water for mining and milling was available on Gregory Flats, Aurora Creek, and Bodie Creek during earlier operations. Charles Kirby Fox (1935, private report) reported that the Aurora well went dry in late summer and that Fletcher Springs had a flow of 60 gallons per minute. He estimated a surface run-off of 2 to 3 inches per year. Brewery Springs and Tamarack Springs were described as too small to furnish much water for mill use. L. B. Spencer estimated the flow at Tamarack Springs near the quarter corner of Sections 24 and 25, T.5 N., R.27 E., MDBM, to be approximately 60 gallons per minute. Goldfield Consolidated Mines Company developed water for their mill on Gregory Flats. The surface flow there has been measured at 60 gallons per minute. In addition, the Real Del Monte shaft made a large quantity of water on the 800-foot level. A water survey would be necessary to ascertain the present water supply but it does not appear to present a major problem. Power has been available for past operations from a line of the Mineral County Power System.

Past History

The Aurora (Esmeralda) mining district was established in 1860. The first discovery was made on August 22, 1860 by E. R. Hicks while hunting. He and two other prospectors, J. M. Brawley and J. M. Cory were prospecting for silver and were camped at a spring in Esmeralda Gulch, near the later site of the brewery. They identified a gray mineral as argentite (acanthite) and proceeded to locate four lode mining claims, including the Esmeralda and Winnemucca claims on Silver Hill (Hill, 1915, p. 141). The Winnemucca claim is probably the same as the Spotted Tiger. The samples were assayed in Virginia City, resulting in a "rush" to the new tent city of Esmeralda in Brewery Gulch below the bold outcrop of the Esmeralda vein. The population soon increased to over 1,000 persons and by the end of October 357 mining claims had been located. Later in 1860 the town site of Aurora was laid out along Aurora Creek 0.6 miles north of Esmeralda. The population increased to 10,000 persons and became the county seat of Mono County, California. Later, a survey was made and it was discovered that Aurora was situated in Nevada. By an act of the First Territorial Legislature, November 25, 1861, Esmeralda was made one of the original nine counties of Nevada, with Aurora as the county seat (Vanderburg, 1937, p. 14). Esmeralda County was later split and Aurora became a part of Mineral County on February 10, 1911 (Lincoln, 1923, p.137). The first mill was built by Edmund Green in 1861 and was followed by several arrastres and mills. By 1864 there were 17 amalgamation mills in the district including the Real Del Monte 30-stamp mill in Bodie Canyon.

The rich bonanza ore near the surface was soon exhausted and by 1869 a decline started with most of the miners and prospectors drifting to Virginia City, although the district was still active up to 1882. An English company acquired ground on Last Chance Hill in 1880, and in 1887 started sinking the Real Del Monte shaft on Middle Hill but suspended work in 1892 because of water. J. S. Cain operated a 60-ton custom mill from 1906 to 1911 using amalgamation followed by cyanide leaching of the amalgamation tailings. Goldfield Consolidated Mines Company operated a 40-stamp mill from 1914 to 1918 when the mill was dismantled and the stamps were shipped to Goldfield. The district was again reactivated in 1949-1950 by Siskon Corporation under the supervision of H. B. Chessher of Reno. They operated the Chessco mine for only two years. Great Basin Exploration Company located the Hornet and Wasp claims in 1964 and leased two other properties to consolidate their position on Silver Hill. Under the direction of Anthony Payne, they obtained a loan from the Office of Mineral Exploration (OME) to explore anomalies resulting from geochemical surveys conducted in 1964. The Blackhawk adit was extended and holes were drilled beneath the anomalies in 1966. Jesse R. Wilson of Reno tried unsuccessfully to reopen an adit in Brewery Gulch in 1968.

Homestake Mining Company acquired an option on the Siskon property in 1976, and in 1977 drilled five diamond drill holes at -50^{o} angles across the Prospectus and Humboldt veins to a depth of 331 feet. They also drilled twelve vertical rotary holes on the southwestern end of the Prospectus vein and on Last Chance Hill, with the deepest hole being 300 feet on the Humboldt vein. Seven of these holes were drilled on a north-south line in an attempt to make a cross-section across the supposed westerly extension of the Juniata vein. Subsequently they dropped the property.

Houston Oil and Minerals acquired the Mida, Humboldt East and Curry No. 2 patented mining claims in the northeast corner of the Siskon group of claims. Electra Resources Corporation leased these claims around 1981 and commenced a surface sampling and drilling program which reportedly outlined a few hundred thousand tons of ore averaging 0.2 ounces per ton in gold. Subsequently a small

Aurora Partnerships

mining operation was started and heap-leaching was done at the mine site. In 1985 and 1986 the ore heaps were moved to new pads across the valley in Gregory Flat, where water was more available.

Siskon Mining Company was bought out by Hanna Mining Company in 1981. An intensive exploration program was designed within the district to locate 1,300,000 tons of ore reserves averaging 0.2 ounces of gold per ton. Some geological mapping and a VLF-EM survey were done by staff geologists. At least sixty holes were drilled to a maximum depth of 500 feet between January, 1981 and July, 1982. Some ore reserves were delineated especially along the Humboldt vein and in the area of the New Esmeralda vein to the east. A detailed study of the wallrock alteration, vein mineralogy, and paragenesis, including fluid inclusion data, by Marla A. Osborne (1985) for a master thesis was supported by Hanna Mining Company.

Reportedly in 1986 these properties were leased or sold to the Golconda mining group. Further drilling along the Humboldt vein was done in 1986 by this group. Some exploration and drilling has been done recently by other companies on Brawley Peaks on the south margin of the district.

Mining and Milling

The mineralized belt at Aurora is approximately two miles long and one mile wide, with the mines being concentrated on Silver, Middle, Humboldt and Last Chance Hills. Some of the richest ore was mined on Silver Hill where the first discovery was made. The largest production in the district also came from this area. The leading producers in Aurora were listed by Hill (1915, Plate 14) as follows:

Silver Hill	Middle Hill
Antelope	Durant
Bald Eagle - Spotted Tiger	Live Yankee
Old Esmeralda	Summit
Radical	
Utah - Cortez	
Sonora	

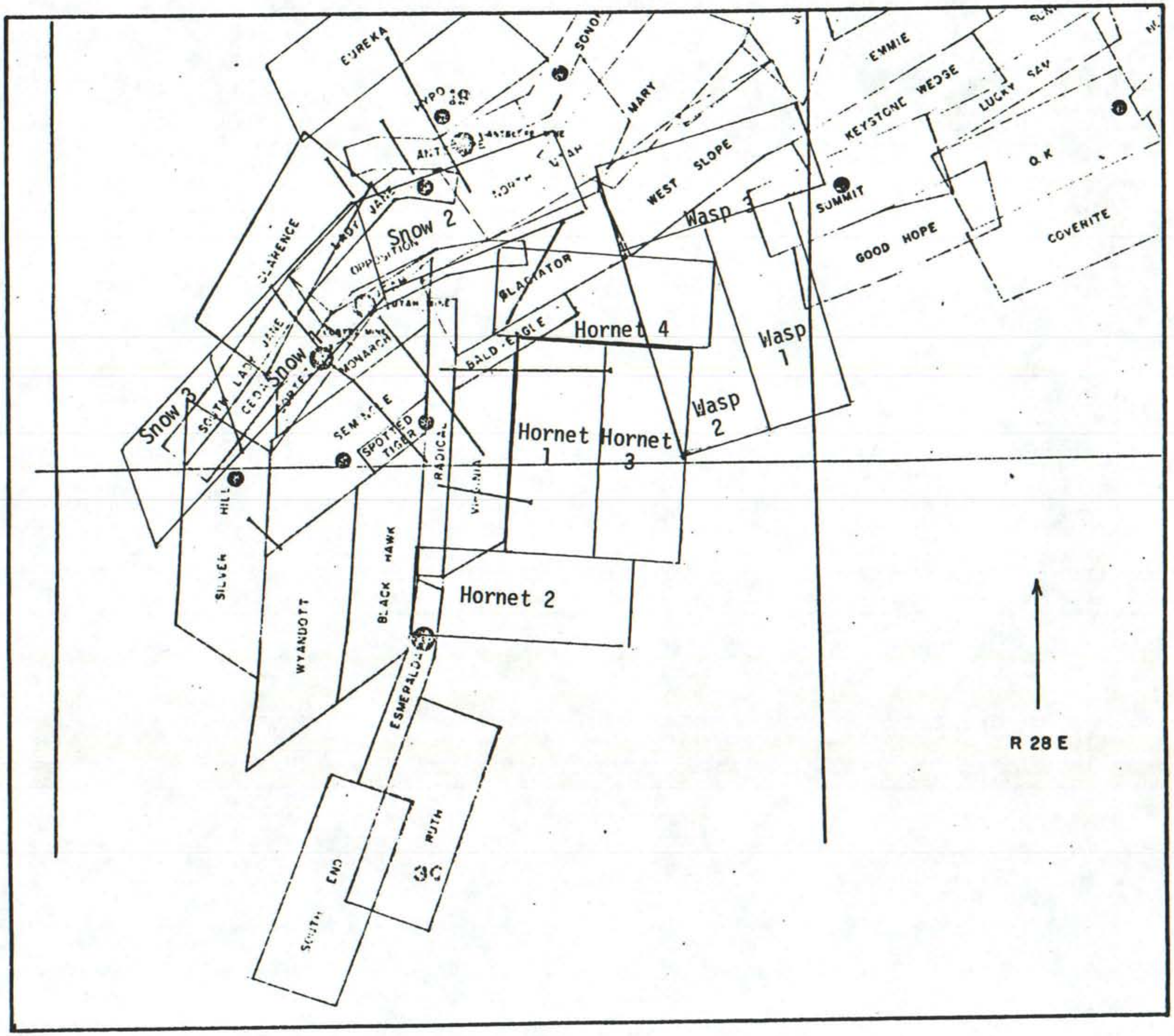


FIGURE 2. CLAIM MAP OF THE SILVER HILL AREA OF AURORA

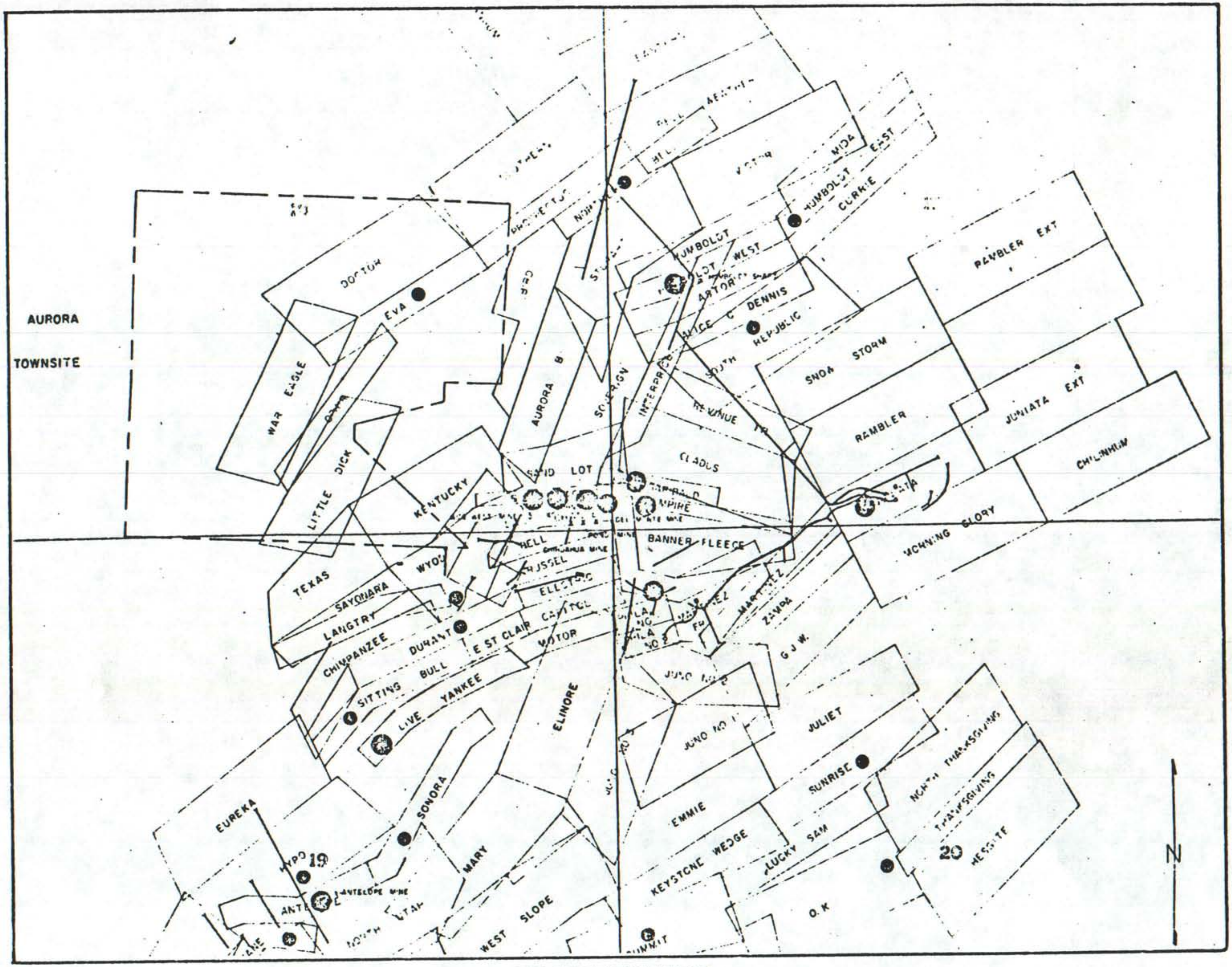


FIGURE 3. CLAIM MAP OF THE NORTHERN PART OF THE AURORA DISTRICT

Humboldt	Last Chance
Humboldt - Silver Lining	Prospectus
Martinez - Juanita (Juniata?)	Real Del Monte
	Wide West - Last Chance

The various mining claims were worked individually and often each claim would have its own stamp mill. The State Mineralogist reported 11 mills with 129 stamps and 140 pans in 1867 on the following claims:

Name of Mill	No. of Stamps	No. of Pans
Aurora	10	20
Antelope	8	16
Pioneer	8	6
Independence	16	12
Real Del Monte	30	30
Pine Creek	10	4
Union	8	6
Wide West	22	40
Gibbons	4	-
Napa	8	-
Alturas	7	6

Gradually claims were consolidated. In July, 1913 most of the claims in Aurora were owned by two companies, the Aurora Mines Company and the Cain Consolidated Company. Aurora Mines Company and its subsidiaries reported production to 1869 of $29,366,968. Considerable money was spent acquiring eleven other claims on Silver Hill and in cleaning out and extending the lower workings of these claims:

Black Hawk	Wyandotte
Gladiator	Seminole
Monarch	Virginia
Radical	Silver Hill
Spotted Tiger	Clarence
Bald Eagle	

In addition, five other claims were acquired on Aurora Hill. Disagreement arose over management and the company was tied up in litigation before machinery could be installed (J. Albert Harle, 1936, private report; Hill, 1915 p.142) and evidently no production was made during that period. Harle reported in 1936 that the title had been cleared and that these claims had been combined as the Black Hawk group.

In July, 1913, the Cain Consolidated Company held 40 claims on Last Chance and Humboldt Hills, including some of the most productive in the district (Hill, 1915, p. 142). These claims were sold to the Aurora Consolidated Mining Company which had been organized in 1912. This property was purchased in 1914 by Goldfield Consolidated Mines Company and a 500-ton mill with 40 stamps and countercurrent cyanidation was erected. One million tons of ore, averaging $5.00 per ton was blocked out in the Humboldt and Prospectus claims. Efforts were made to develop more ore by extending the haulage level under the old Juniata workings. This operation lasted three years, producing 490,168 tons of ore with a total value of $1,435,415.66 between 1915 and 1917 (Vanderburg, 1937, p.15). The mill was dismantled and the stamps were shipped to Goldfield in 1918 (Lincoln, 1923, p. 137).

The Antelope, Lady Jane, Cortez, and Hypo claims on Silver and Middle Hills were described as a group by Lloyd Root (1933, private report). Some of these were later leased to the Aurora Consolidated Mining Company.

Fred Meinecke and Horace B. Wyman (1935, private report) made an examination of the properties of Aurora Consolidated Mining Company which included the following claims on Silver and Middle Hills:

Bell	Emmy (Emmie)
Bell No. 1	South End (Bend?)
Bell No.2	Good Hope
Bell No. 3	Ruth
Keystone Wedge	East St. Claire
Thanksgiving	War Eagle
Lucky Sam	Provo

In addition, it held under lease the Black Hawk group and other claims as follows:

<u>Black Hawk Group</u>

Black Hawk	Wyandotte
Gladiator	Seminole
Monarch	Virginia
Radical	Silver Hill
Spotted Tiger	Clarence
Bald Eagle	

Summit - lease and option

Langtry - lease and option

Antelope - under lease for dumps only

Hypo - under lease for dumps only

Lady Jane - under lease for dumps only

A 75-ton mill was under construction at the time. They recommended further exploration and development of these properties.

Vanderburg (1937, p. 15) reported the principal holdings in the district to be held by the Goldfield Consolidated Mines Company, West End Mines Company, Aurora Consolidated Mines Company, and W. J. McKeough of Aurora. There were only two small mills left in the district, one a 10-stamp mill owned by W. J. McKeough of Aurora, and the other a 2-ton/day Kincaid mill owned by Freid Walker of Aurora.

H. B. Chessher and the Siskon Corporation operated the Chessco mine and mill on the Juniata claim in 1949 and 1950. Production figures are not available but reportedly a small production was made. The mill was dismantled, but the company maintained their holdings. In 1981 Siskon was acquired by Hanna Mining Company.

Jesse Wilson obtained the Live Yankee and Langtry claims and in 1968 made an unsuccessful attempt to mill some of the ore left in the stopes. Later another group sank a shaft on the Live Yankee vein to intersect the supposed ore in the stopes but failed to find it. Later they attempted to clean out the Live Yankee adit, but ceased operations when the foreman was seriously injured by falling rocks.

Electra Resources Corporation leased the Mida, Humboldt and Curry No. 2 claims in 1981, and a small mining operation was started in 1983. An unknown amount of gold was produced by heap leaching. The ore heaps were moved across the valley to Gregory Flats in 1985 and 1986, and mining operations resumed.

Production

Couch (1943, p. 99) reported a total production of 669,962 tons of ore that yielded $31,409,013. The yearly production has been:

	Gold, Silver			Gold, Silver	
Year	Tons	Gross Yield	Year	Tons	Gross Yield
1859-69	-	$29,366,968	1901	3,443	10,157
1881	-	20,000	1902	1,469	7,498
1884	280	7,972	1903	-	22,674
1885	128	5,631	1914	41,485	157,073
1886	2,984	24,094	1915	138,399	428,215
1887	1,432	16,447	1916	172,270	498,009
1888	1,147	44,147	1917	175,424	402,722
1897	-	5,964	1918	131,449	361,921
1898	-	4,500	2940	52	11,011
				669,962	$31,409,013

Reliable figures are not available for the period since 1940. Properties reporting a total of $5,000 or more are as follows:

	Period	Tons	Gross Yield
Antelope Mine	1887	1,107	$ 11,679
Aurora Mines Co. (Subsidiaries)	to 1869	-	29,366,968
Aurora Consolidated Mining Co.	1914-1918	659,027	1,847,940
Consolidated Esmeralda	1886-1888	3,504	48,227
Delmonte Plant	1899-1903	-	66,119
Diamond Mine	1897-1898	-	10,464
Durand Mine	1888	228	17,557
Green	1899-1900	-	13,045
Silver Lining Mine	1884	280	7,972

Hill (1915,p.142) reported bullion shipped from Aurora through Wells Fargo and Company up to 1869 had a value of $27,000,000. In addition, $2,365,968.82 was shipped without insurance between 1861 and 1869 for a total of $29,365,968. Joseph Wasson (1878, Mining and Scientific Press) also stated that 7 to 8 million dollars' worth of gold was shipped by express in 1864 alone, and that a total of $12,000,000 was shipped by express between 1861 and 1869. Vanderburg (1937, p. 15) reported a total production of $31,340,259.

Property

Alexander von Hafften (dba Great Basin Exploration Company) owns thirteen unpatented lode mining claims in the Aurora Mining District.

Name of Claim	Located	Location
Hornet No. 1	October 16, 1976	Silver Hill
Hornet No. 2	October 16, 1976	" "
Hornet No. 3	May 18, 1965	" "
Hornet No. 4	October 16,1976	" "
Wasp No. 1	June 25, 1964	Middle Hill
Wasp No. 2	May 18,1965	" "
Wasp No. 3	September 24, 1981	" "
Snow No. 1	November 20, 1981	Silver Hill
Snow No. 2	November 21, 1981	" "
Snow No. 3	November 21,1981	" "
Avon No. 1	September 2, 1975	Brawley Peaks
Avon No. 2	September 2, 1975	" "
Avon No. 3	September 2, 1975	" "

The Hornet No. 1, 2, and 4 claims are contiguous and partially overlie the Esmeralda, Black Hawk, Radical, Virginia, Bald Eagle, and Gladiator claims on Silver Hill. The Hornet No. 4 and Wasp No. 1 through 3 claims overlie the Summit, Good Hope, and West Slope claims on Middle Hill (Plate 5).

In 1965, Great Basin Exploration Company leased two groups of claims on Silver Hill in order to consolidate their position.

Relich Group

Spotted Tiger	Survey No.	38
Black Hawk	" "	4220
Wyandotte	" "	4220
Gladiator	" "	4220
Silver Hill	" "	4220
Virginia	" "	4221

Junquist Group

Radical	Survey No.	37
Bald Eagle	" "	39
Monarch	" "	4220
Seminole	" "	4220

Both of these groups were dropped upon completion of the exploration program under the OME project of 1966.

Snow No. 1 through 3 claims are located on the lower northerly slope of

Silver Hill and partially overlie the Cortez, Utah, Lady Jane and Clarence claims. Avon No. 1 through 3 claims are located in the saddle between East Brawley Peak and West Brawley Peak.

Previous Work

A geological reconnaissance of the Aurora district was made by J. M. Hill in 1913 and a geological sketch map of the area was published along with a description of the geology, (Hill, 1915, p. 141-150). Numerous private reports resulted from mine examinations by consulting mining engineers and geologists. Lincoln (1923, p. 137-138) gives a short description and bibliography of the district. Vanderburg (1937, p.13-16) updated the mining history and operations at the time. Production data for the district and for individual mining companies were published by Couch (1943, p. 99-104). The regional structural geology was published by Ferguson and Muller (1949). Lundby (1957) described the geology of the northern part of the Aurora district. A description of the geology and mineral deposits of Mineral County was given by Ross (1961). Green (1964) attempted to interpret the structural control of mineralization at Aurora. Payne and Hughes gave a detailed report of the Silver Hill area in 1965 in anticipation of a loan for mineral exploration from the Office of Mineral Exploration (OME). The importance of arsenic in geochemical precious metals exploration was outlined by Payne (1967), and later that year he submitted a geologic report on the Wasp and Hornet claims in the Aurora district. In 1968, Chesterman described the volcanic geology of the Bodie Hills and published a Bouguer gravity map which included the Aurora area. Kleinhampl (1969) reported on geochemical prospecting for gold and silver at Bodie and Aurora, described a possible breccia pipe, and gave age determinations for the mineralization. Silberman, (et.al., 1972) listed K-Ar ages of volcanic rocks and gold-bearing quartz-adularia veins in the Bodie district and published a geologic map that included the Aurora Mining

District. O'Neil, et. al., (1973) gave stable isotope data and chemical relations during mineralization at Bodie, California, and gave some data on Aurora, Nevada. Silberman and McKee (1974) described the ages of Tertiary volcanic rocks and hydrothermal precious metal deposits in western Nevada including Aurora and Bodie.

O'Neil and Silberman (1974) reported that meteoric water was a major component, and integrated water/rock ratios were very high at Aurora based on oxygen and hydrogen isotopes of vein samples. Kleinhampl (et. al., 1975) published aeromagnetic and gravity, and geologic maps of the Bodie-Aurora area, and gave an age data of 10.3 million years on vein adularia from Aurora.

Lawrence (1975) submitted a geologic report to his client on the Hornet and Wasp claims. Marla A. Osborne (1985) finished a master thesis describing the geology, wallrock alteration, structure, vein mineralogy, paragenesis, fluid inclusions studies and assay data on the northern half of the Aurora District.

GEOLOGY

General

The geology of the Aurora mining district was first described by Hill (1915). He mapped a coarsely porphyritic granite overlain by Tertiary volcanics. These were divided into three units: (1) grayish-green altered biotite-quartz latites and andesite, (2) light gray to brownish-gray rhyolites, and (3) black vesicular basalts. Ferguson and Mueller (1949), Lundby (1957), Ross (1961), Green (1964), Chesterman (1968), and Silberman (et. al., 1972) have extended and modified the very good work by Hill.

Mesozoic Rocks

The oldest rocks in the Aurora Mining District consists of a metamorphic assemblage assigned to the Excelsior formation by Ferguson and Mueller (1949, pl. 1). Ross (1961, pl. 2) mapped these as part of the middle Triassic Excelsior formation. These metavolcanic rocks are dark green in color, and occur as a roof pendant in a granitic intrusive. Hill (1915, p. 144) described this as a coarsely porphyritic granite containing large pink orthoclase crystals with a maximum length of 50 millimeters in an inequigranular groundmass of orthoclase, quartz, microperthite, green hornblende, brown biotite, microcline, muscovite, and oligoclase. Accessory minerals were titanite, magnetite, and apatite. These rocks have been partially chloritized and argillized. Green (1964, p. 14) presumed this rock to be a part of the Sierra Nevada batholitic complex intruded along the western margin of the Great Basin in Cretaceous time. Similar rocks southwest of Bodie were found to be Cretaceous on the basis of a potassium-argon date of 92.9 $\pm$ 3.1 million years (Chesterman, 1968, p. 48). Apparently this porphyritic granite is the basement rock beneath Aurora.

Aurora Volcanics

The Mesozoic basement complex is uncomformably overlain by siliceous to intermediate altered volcanics of the Aurora formation (Green, 1964). These rocks are commonly dark gray to greenish-brown, with numerous white plagioclase phenocrysts in an aphanitic groundmass. Green mapped one outcrop in the northern part of the Aurora townsite as moderately fresh andesite, possibly intrusive in character. Payne (1965, p. 18; 1967, p. 15) described an outcrop on Hornet No. 3 claim in Esmeralda Gulch as a porphyritic andesite showing incipient propylitization.

Osborne (1985) mapped the andesite porphyry, andesite agglomerate and porphyritic andesite in the northern half of the Aurora district as the Aurora Sequence with a K-Ar age of 13.5 to 15.4 million years. This sequence appears to be valid for the whole district, and is equivalent to the Aurora Volcanics as defined by Green (1964).

The Aurora Volcanics were described by Osborne as a lower unit of andesite porphyry which is overlain by an andesite agglomerate and porphyritic andesite. The andesite porphyry is exposed on the southwest flank of Last Chance Hill and around the Juniata mine area and hosts the Juniata veins. It is up to 325 feet in thickness at the mine, but the bottom was not observed by Osborne. She described the andesite agglomerate as being dark reddish-brown, with fragments up to 4 inches in diameter set in a fine-grained andesitic matrix. This unit is at least 300 feet thick in the area of the Humboldt and Prospectus veins. The porphyritic andesite was described as a thin veneer up to 10 feet thick, exhibiting sparse hornblende and biotite phenocrysts in a very fine-grained matrix of andesine (?) microlites.

No attempt has been made in the southern half of the district to see if this sequence is consistant, or if it may only represent variations in the andesitic flows. The textural differences may be due either to compositional differences at the time of extrusion of the lava or may be due to local physical conditions as the lava flowed over the surface. Some of the andesite porphyry that appears to be intrusive may also be flows that merely broke through earlier cooling flows. The thicknesses given by Osborne may be close to a maximum thickness for the Aurora Volcanics.

Hill (1915, p. 143) mapped these rocks as predominatly quartz latite with some andesite, and assigned a thickness of 900 feet extending over Silver, Middle, Last Chance, and Humboldt Hills, and southerly up Willow Creek. Petrographical studies by Hill showed these rocks to be biotite quartz latite that originally consisted of phenocrysts of andesine and pyroxene in an aphanitic groundmass of andesine and ferromagnesian minerals. The phenocrysts are altered to an aggregate of sericite, quartz, and chlorite, while the groundmass has been altered to an aggregate of sericite, chlorite and quartz. These rocks have been highly silicified, especially on Silver and Middle Hills. All of the veins and mineralization at Aurora are contained in these rocks.

Ross (1961, pl. 2) showed these rocks as Pre-Esmeralda volcanics, a general term used to describe all pre-mineralization early Tertiary rocks in Mineral County. Kleinhampl and Silberman (1969) described these rocks as a basal andesite of unknown age. Silberman et. al. (1972, fig. 1A) dates this formation as 11 to 29 million years in age.

Felsic to Intermediate Intrusives

The Aurora Volcanics have been intruded by dikes, plugs, and stocks of rhyolitic to latitic composition. There are several prominent dikes across the Live Yankee, Sonora and Utah claims, and there are other less prominent intrusives on the Snow No. 1 and other claims. One such dike cuts the Aurora Volcanic in an easterly-westerly direction across the south end of the Esmeralda vein on the Ruth and South End claims. A large plug of quartz porphyry cuts the quartz monzonite and Aurora Volcanics on the southeast end of Middle Hill. This rock has been highly argillized and silicified, and is spatially, if not genetically, associated with the highly productive Summit vein.

Osborne (1985) reported "Older" rhyolite plugs (11.0 million years) along the northern edge of the district. Her map shows "Older" rhyolite 250 feet north of the Humboldt vein and within 80 feet of the Prospectus vein. This spatial association of these intrusives with the various veins may suggest a genetic relationship. These plugs and stocks are fairly extensive along the northern edge of the district, and extend off to the east to the New Esmeralda vein.

Bodie Canyon Volcanics

The Aurora volcanics and the felsic to intermediate intrusives are overlain unconformably by rhyolitic flows and tuffs with lesser amounts of interbedded and possible intrusive andesite of Bodie Canyon volcanics. The period of erosion between the deposition of these two formations is equivalent in age to the deposits of the Esmeralda formation in this region (Green, 1964, p. 15). Payne (1965, p. 19) has suggested that the Comstock, Goldfield, Aurora, and many other important precious metal districts in western Nevada were mineralized contemporaneously with the deposition of the Esmeralda formation. Similarly, Ross (1961) dated the Tertiary rocks in Mineral County as Pre-Esmeralda, Esmeralda, and Post-Esmeralda.

The Bodie Canyon volcanics are predominately rhyolitic flows and associated tuffaceous rocks with lesser amounts of andesite (Green, 1964, p.15). Biotite-hornblende andesite which occurs on Aurora Peak immediately east of the district closely resembles that of an intrusive three miles northwest of the district mapped by Lundby (1957, p.13). A porphyritic andesite is exposed along the western margin of the district. Ross (1961, pl.2) mapped this unit as "Post-Esmeralda felsic volcanic rock".

Lundby (1957, p. 8) mapped an area two miles north of Aurora that had a Tertiary section with a lower portion, 400 feet in thickness, of greenish-gray, pink and white rhyolitic tuffs, capped by glassy, brown to purple rhyolitic flows that have been partially devitrified. After a short period of erosion, these tuffs were overlain uncomformably by augite andesite flows and ash. The rhyolitic tuff have been intruded by acid intrusives, including perlite. Biotite-hornblende andesite has intruded the tuff and is closely associated with andesite flows. No correlation has been made between the areas mapped by Lundby and Green.

Osborne (1985) include these rocks in her "Younger" rhyolite and shows dates of 2.5 million years. A gray glassy biotite rhyolite plug on Martinez Hill has been given an age date of 2.5 million years.

Quanternary Rocks

Following a period of erosion and tilting, olivine basalt was extruded from a crater on Beauty Peak (Lundby, 1957, p.7) and from Aurora crater, two miles north of the district (Green, 1964, p. 17). The flows are dark green to grayish black in color and are commonly vesicular at their base. This basalt has been eroded only slightly.

There are deposits of volcanic ash in several locations on Last Chance Hill varying in thickness up to 20 feet, and consisting of fine-grained unconsolidated material. Lundby (1957, p. 7) has mapped similar rhyolitic ash in the area north of Aurora. Alluvium covers the valley floors.

Lawrence, Chesterman, and others have suggested large calderas in the Bodie-Aurora area. Gravity data supports the postulated caldera on the flat approximately two miles northwesterly from Aurora Crater. Both this caldera and the Aurora Crater may be along the northern margin of a much larger caldera that would include the whole Aurora district.

Structural Geology

Faulting has been the major structural element in the Aurora district and has been the principal control in the localization of ore shoots. Folding has been negligible, although Al-Rawi (1970) reported a broad regional post-mineralization N65^{o}E - trending upwarp that has apparently tilted the district at least 20 degrees to the northwest. There are four systems of faulting in the Aurora district. In order of importance, they strike N 45^{o} to 70^{o} E, north-south, N 10^{o} to 30^{o} W, and N 70^{o} W.

The older northeast system of normal faults strike N 45^{o} E to N 70^{o} E and have dips from 20^{o} SE to 75^{o} NW and exhibit great continuity, Most of the ore bodies of the district have been found in these northeasterly striking faults.

Brecciation of vein-filling and the presence of slickensides and fault gouge indicate some post-mineral and intra-mineralization movement. This faulting is part of the regional tectonic patterns in western Nevada, and appears to be the westerly extension of the Southern Nevada (Pancake) structural zone.

The north-south system of faults generally have steep dips and persist with continuity along strike. They show both right-lateral and left-lateral displacement. The fault zones are usually 10 to 20 feet wide, but the Prospectus fault zone has a width of 100 feet (Green, 1964, p. 21). These faults show 10 to 50 feet of displacement but the Prospectus fault has an apparent right-lateral strike-slip displacement of 1400 feet

The Esmeralda lode on Silver Hill was deposited in a north-south fracture. Movement continued during the period of mineralization. Green (1964, p. 22) projected this fault to the north, however, detailed underground and surface mapping failed to show the northerly extension of the Esmeralda fault as shown on his map. This fault appears to be cut off by the Spotted Tiger-Bald Eagle vein (fault).

The Propectus fault in the northern half of the district has been mapped by Green (1964), and Osborne (1985) as a strong through-going fault. Green describes this fault as up to 100 feet in width and with a right-lateral strike-slip displacement of 1400 feet, based on the supposed displacement of the Humboldt-Prospectus veins. He reports a N 20° E to N 20° W strike, nearly vertical dips, and a surface continuity of over two miles in length for this fault, however, it is shown as a dashed line on his map. He reports that continued movement along this fault offsets the Bodie Canyon Volcanics of Late Tertiary age in the northern part of the district. Osborne (1985, p. 19) suggests at least 1800 feet of right-lateral offset along the Prospectus fault as evidenced by the separation of the Juniata fault and veins, and the Prospectus and Humboldt veins, "which have very similar characteristics and which were probably originally one structure".

Green (1964, p. 21) and Payne (1965, p. 21; 1969, p. 19) emphasized the importance of the north-south system of faults as defined by the Prospectus, Johnson, and Esmeralda faults. Later mapping by Lawrence (1975, p. 18) failed to find evidence for the Esmeralda fault beyond the Spotted Tiger-Bald Eagle vein (fault). Similarly, mapping by Lawrence in 1986 failed to find any evidence for the southerly extension of the Prospectus fault beyond the easterly extension of the Spotted Tiger-Bald Eagle structural zone. This suggests two possibilities. The Esmeralda vein may be the southerly extension of the Prospectus fault with right-lateral offset along the Spotted Tiger-Bald Eagle structural zone, however, the preferred explanation may be that the north-south system of faults and veins were formed as a result of movement along the predominant northeasterly system of faults. The latter explanation appears to fit the relationships as observed in the field.

The N 10^o - 30^o W striking faults in Aurora have not been described previously by other writers. These faults are part of the Walker Lane structural zone and may mark the western boundary of the Walker Lane. Although not previously noted, they are quite prominent once observed. Detailed mapping, especially on Middle Hill, reveals offsets on both the northeasterly and north-south veins. In places the faults are as closely spaced as a few feet with up to twelve off-setting faults in a hundred feet. There is some evidence that Middle Hill may be a down-dropped block between Silver and Last Chance Hill along north-northwest faults. If this is correct, there may be economic ore shoots beneath Middle Hill.

The north 70^o west faults are less obvious, but occur throughout the Aurora district. They appear to be more prominent on East Brawley and West Brawley Peaks, immediately south of Silver Hill.

Rowan (1981, p. 1416) and others have described the Southern Nevada structural zone which transects the Walker Lane in the vicinity of Luning, Nevada. This zone appears to extend over Luck Boy Summit and westerly through Aurora and Bodie to Mono Lake area. Rowan (1981, p. 1414) states that the Southern Nevada structures zone, the Walker Lane, and the Humboldt structural zone in northern Nevada "are conjugate shears formed during and after middle Miocene extension of the Great Basin". These lineaments reflect only the most recent movement along broad crustal zones that may be early Tertiary to Mesozoic in age. Deformation within these structural zones (Shawe, 1965) apparently occurred in response to two different regional stress patterns, one active prior to 14.5 million years ago, and the other active from 14.5 m.y. to the present time. Under these conditions the two primary shear directions should be northeasterly with left lateral shear, and north-northeasterly with right lateral shear. The earlier stress pattern should be similar but rotated slightly to the east. The four systems of faulting at Aurora appear to fit into the tectonic pattern described by Rowan and Shawe for western Nevada.

MINERAL DEPOSITS

Gold and silver occur in anastamosing quartz veins in the Aurora Mining District as native gold and acanthite (argentite). The total production was 669,962 tons that yielded $31,409,013. The gold to silver ratio was reported by Hill (1915) to be from 1:5 to 4:2 but was recorded as 1:14 by Ferguson (1929, p. 138). These veins occur in the northeasterly fractures, with the richest ore occurring near their intersection with north-south faults over an area 2 miles in length by 1¼ miles in width. The veins are in Aurora volcanic rocks and vary in thickness from a few inches to 100 feet. The ore shoots are marked by irregular wavy streaks of quartz, adularia, argentiferous tetrahedrite, traces of pyrite and chalcopyrite, and a soft bluish-gray mineral containing gold, silver and selenium. These veins are epithermal and have been clsssified by Payne (1967, p. 23) as gold-selenide epithermal according to the Lindgren scheme of classification. However, there is some question as to the occurrence of selenium in the ore.

Vein Distribution

Hill (1915, p. 147) described 14 major veins at Aurora, all except one occurring in the northeasterly fractures. The Old Esmeralda-Radical vein is in a north-south fracture at the extreme southwest corner of the district. On Silver and Middle Hills, the Eureka, Antelope-Lady Jane, Cortez-Utah, and Spotted-Tiger-Bald Eagle veins are the largest and strongest veins, and all dip to the southeast at 45^o to 50^o into the hill. The old Esmeralda-Radical is an exceptionally strong vein, striking N 10^o E and standing nearly vertical. It is 20 to 80 feet in thickness and is the most prominent vein in the district. The original discovery at Aurora was made here and the original townsite of Esmeralda was located at the foot of the hill below this bold outcrop.

On Last Chance and Humboldt Hills, the veins strike more nearly east-west. The Durant, Humboldt-Silver Lining, Live Yankee, Martinez-Juniata, Prospectus, Real Del Monte, Sonora, Summit, and Wide West-Last Chance are the most prominant veins in this area. These veins have been displaced by the Prospectus fault at least 600 feet (Hill, 1915, p. 147) to 1400 feet (Green, 1964, p. 21). Osborne (1985, p. 19) mapped the veins on Last Chance and Humboldt Hills in the northern half of the Aurora district. She postulated that the vein structures could be divided into the Prospectus-Humboldt system and the Wide West-Sandlot-Philadelphia(?)-Juniata set. These veins are believed to be 10.3 m.y. old She suggested that these veins have been off-set 1800 feet along the Prospectus fault although "the Wide West-Sandlot-Philadelphia(?)-Juniata veins are less clearly identified as a simple structure, but do occur along a linear zone which appears to have been disrupted by north-south right lateral faults.

Description of Veins

The veins vary in thickness from a fraction of an inch to 100 feet with an average thickness of approximately 4 feet. Horsetail zones are usually present at intersections with other veins and faults. Most have good continuity and can be traced for several hundred feet and some have lengths up to 7000 feet along strike and 500 feet down dip. In most of the district, the veins have been offset by barren north-south faults, however, the strong north-south Old Esmeralda vein has been cup off on its south end by a barren northeasterly fault. The segment of the Old Esmeralda vein south of this fault has never been found. Perhaps it was never mineralized. Usually the offsets are from a few inches up to 60 feet, but reportedly the Humboldt and Prospectus are the same vein that has been offset by right lateral movement along the Prospectus fault for a distance of 1400 feet (Green, 1964) p. 21) to 1800 feet (Osborne, 1985, p. 17)

These veins are not simple, clean-cut veins but are composite veins that send out numerous interlacing branches into the walls, particularly on the footwall side. Some veins consist of strong stringer zones with veinlets from ½ to 12 inches, and in places these may come together to form a single quartz vein. Stringer zones are especially strong near intersections with other veins.

Usually these veins show strong continued movement during the period of mineralization with numerous parallel adjacent veinlets forming composite veins. Sometimes the movement would break across veinlets previously formed, giving cross-cutting relationships in the same vein which might lead an unsuspecting geologist to suggest two periods of mineralization rather than one long period of mineralization with continued movement and breaking. The bold outcrop of the Radical-Old Esmeralda veins is an excellent example of this process of vein formation, which is much more common in the field than in the literature.

The principal gangue minerals are quartz and adularia, with occasional calcite. The quartz is usually finely granular, white, and barren-looking, and sometimes has a porcelain-like appearance. Crustification is common, usually with numerous vugs lined with quartz crystals. Some vugs have quartz crystals up to 50 millimeters long, and occasionally have double terminated crystals. Banding is common, caused by crustification, with bands consisting of variations in grain size of the quartz. Some ribbon quartz was formed due to rebreaking of the walls during mineralization, allowing thin seams and septa of wallrock to be enclosed in the quartz veins. Usually this material has been altered to kaolinite or sericite. The adularia is commonly found as irregular grains and pods in the quartz veins, but occasionally is found as subhedral to euhedral crystals. Usually it is found along narrow seams with kaolinite and sericite.

Mineralogy

The principal ore minerals are native gold and acanthite (argentite), with small to trace amounts of argentiferous tetrahedrite, pyrite, chalcopyrite, and reportedly a bluish-gray mineral containing gold, silver and selenium. Acanthite was the principal mineral in the rich Esmeralda ore shoot, and was reported in the Lady Jane and Antelope veins in Silver Hill. Trace amounts of antimony, arsenic, and mercury have been reported. The rich ore is always marked by irregular wavy streaks and containing tetrahedrite, pyrite, and chalcopyrite (Hill, 1915, p. 148). Flourite is common in the veins on Middle and Last Chance Hills. Sericite and adularia are usually associated with the high grade streaks.

Tenor of ore

Crouch (1943, p.99) reported a total production of $31,409,013 recovered from 669,962 tons which average $46.88 per ton. Reportedly the average grade of the ore was $6,00 to $8.00 per ton but some ore ran as high as $1,000.00 per ton. The gold to silver ration was 1:2 to 1:5 (Hill, 1915, p. 150). Some of the ore ran high in silver and possibly should be classified as silver-gold veins. Osborne (1985, p. 90) tabulated gold-silver values and ratios for the Prospectus and Humbolt veins of 0.5 to 0.69. The average Au:Ag ratio of the Prospectus vein is 0.36. Her data shows that the ratios appear to decrease with depth.

Alteration

There appears to be an indistinct alteration zoning in the Aurora district with propylitization over most of the area, argillization along the northern edge of Aurora townsite, and strong silification in the southern part. Sericitization is common along the veins, decreasing away from the veins, and is present over most of the district. The country rock on Silver and Middle Hills in the southern part of the district has been intensely silicified, with numerous quartz veinlets in stringer zones between veins. This same condition prevails in the Clarence adit, 538 feet below the surface of Silver Hill. The silicified craggy outcrops on the northeast slopes have resisted erosion and form a steep slope. The Aurora volcanics show propylitic alteration to chlorite, calcite, zoisite, epidote, quartz, and pyrite, the intensity of alteration increasing toward the veins. The overlying Bodie Canyon volcanics have not been altered.

Ore Shoots

The richest ore occurs in ore shoots in the various veins where localization appears to be controlled by structures, and possibly is relatable to a late near-surface boiling stage. These shoots, occurring in large barren veins, are relatively small, and usually a fraction of an inch to 6 inches in width; and they occurred near the walls, usually the hanging wall (Hill, 1915; Meinecke, 1935, p. 5). The importance of hanging wall branches of the vein as a "favored place for ore deposition just above the vein intersection" was emphasized by Payne (1965, p, 23: 1967, p. 20). He concluded "this structural situation is very productive in other Great Basin precious metal camps".

The richest and largest ore shoots occurred along a 1000-foot segment of the Wide West vein where the stopes were as wide as 60 feet, but the leaner portion of the vein along strike between the shoots were only 6 to 10 feet in width (Meinecke, 1935, p. 5). Five ore shoots were stoped along this vein at the Wide West, Johnson, Chihuahua, Pond, and Real Del Monte mines. The top of these shoots were about 60 feet below the surface and the bottoms were at a vertical depth of approximately 120 feet. They were 16 to 36 feet, and in one place 60 feet in width, and 100 to 200 feet in length.

A particularly rich shoot averaging $300.00 per ton in silver and a very small amount of gold, was found in a chimney about 2½ feet wide and 70 feet long, extending to a depth of 70 feet (White, 1869, p. 93) in 50 feet of otherwise barren quartz in the Esmeralda vein. This was the point of orginal discovery in the Aurora district. Other veins on Silver Hill were mined from 2 to 8 feet wide to a depth of 100 to 200 feet for several hundred feet along strike. The Cortez-Utah vein produced several good ore shoots. One shoot on the Cortez claim, 20 to 25 feet wide, 50 to 75 feet long, and 150 feet down-dip yielded approxmately 20,000 tons at a value of $2,000,000 for an average value of $100.00 per ton. Five bonanzas were found along a 1,500-foot segment of this same vein on the Utah claim which produced a total of 5 million dollars from rich ore. Ore from the Antelope vein averaged $150.00 to $300.00 per ton (Payne, 1965, p. 11).

Green has indicated a close connection between ore deposits and north-south faults, and "nearly all production of gold rich ore came from mines located within 500 feet of this system". He thought that the north-south faults provided "conduits for the mineralizing solutions, but because of their comparatively tight nature, did not, for the most part, provide favorable loci for ore deposition" (Green, 1964, p. 31, 34).

Recent mapping has shown a close spatial and probable genetic relationship between dikes, plugs and stocks of rhyolitic to latitic composition. There is a large stock of quartz porphyry outcropping on the east end of Middle Hill, which is closely associated with the Summit and other veins. There are numerous dikes on the north flank of Silver Hill that are associated spatially with the Antelope, Lady Jane, Cortez, Utah and other highly productive veins. A dike of white quartz porphyry, striking east-northeastly, cuts across the south end of the Old Esmeralda vein. Felsic to intermediate intrusives also occur along the Prospectus and Humboldt veins. Further detailed mapping may reveal simular intrusives around the Juniata and other veins.

Supergene Mineralization

White (1869, p. 92) reported a vein of silver ore in the Antelope vein that is "blade-like in form, and which increased to an inch and one-half in thickness. It is very rich in chloride". Green (1964, p. 33), in an attempt to explain a supposed vertical zoning of gold-silver values first proposed by White (1869, p. 94), suggested that supergene processes were an important factor in the formation of the ore deposits. He wrote:

> Silver, and perhaps gold, was leached from the surface deposits by acidic ground water, carried downward by the decending water, and redeposited at or near the water table. The primary ore was enriched by this process. As several hundred feet of the Aurora volcanics were eroded, the surface, as well as the water table, was continually being lowered. In this manner, the enriched ore was eventually leached and redeposited at a new water table, so that the high-grade deposits consisted of a concentration of the values originally contained in several hundred feet of vein.
>
> A primary requirement for supergene enrichment is a permeable host rock through which fluids can pass easily. The quartz veins of Aurora are, in most locations, dense and impervious. However, the continued movement along the north-south faults shattered and re-opened the veins so that zones were created along which the downward-moving solutions could travel. Here then, permeable zones coincide with areas of hypogene enrichments, and extremely rich shoots such as those on Last Chance Hill resulted.

Extensive underground mapping of the veins on Silver Hill has failed to indicate any evidence of supergene mineralization. Any vertical zoning present is probably a result of hypogene processes.

Stable Isotope and Fluid Inclusion Studies

Taylor (1973, p. 762) made extensive O^{18}/O^{16} isotope analyses of samples from epithermal precious metal deposits at Tonopah, Goldfield, and the Comstock Lode. He concluded that the data "conclusively demonstrate that heated meteoric ground waters were dominantly or perhaps wholly the source of the H_2O in the hydrothermal fluids involved in alteration and ore deposition at these camps". He further states:

> It is usually dangerous to make sweeping generalizations. Nevertheless, it is now probably safe to conclude that essentially all epithermal precious metal deposits throughout the world must have formed from hydrothermal solutions that were dominantly composed of heated meteoric ground waters, if they meet the following conditions: (1) They lie in highly faulted, essentially flat-lying piles of volcanic rocks that were erupted in a continental environment; (2) Epizonal igneous intrusions, roughly comparable in age to the volcanic rocks, are either exposed in the area or may be inferred to exist at depth; commonly these will represent volcanic centers or intrusions along the ring fractures of a caldera; (3) Intense hydrothermal alteration of the volcanic rocks has occorred, involving propylitization, kaolinization, sericitization and/or alunitization; (4) The alteration or mineralization is younger but roughly comparable in age to that of the epizonal intrusions and to the volcanic pile itself.

Included in his list of other camps that would appear to meet these requirements are Aurora and Bodie

O'Neil (et.al., 1973, p. 765) made stable isotope analyses of unaltered rocks, altered host rocks, vein material (quartz, calcite and adularia), phenocryst-whole rock pairs, modern spring water, and fluid inclusions. They concluded:

> The water in the ore fluid was certainly derived from local meteoric water. This water was able to travel to depth by convective flow, driven by a hot intrusion, to a source material

rich in leachable K, Rb, SiO_2, Au and Ag as well.

They proposed a magmatic source for the ore constituents, and a temperature of deposition of 215-245°C.

Hanna Mining Company (Osborne, 1985, p. 31) conducted a fluid inclusion study of the Aurora veins. Homogenization temperatures ranged from 130° C to 325° C, averaging about 232-250° C. Salinities ran from 2 to 6% NaCl equivalent, and less than 7 percent of the samples showed evidence of boiling.

Paragenesis

The veins at Aurora were formed in open fissures by hot ascending siliceous solutions. Hill (1915, p. 150) indicates early deposition of calcite, with later replacement by quartz and adularia, although he suggested only a short lapse of time between the deposition of these minerals. Green (1964, p. 31) suggested "several successive periods of mineralization with gold content increasing in the later solutions" and also "indicated that there were at least two phases of quartz filling and that the later phase contained the higher grade ore". Osborne (1985, p. 25) suggested that the Juniata vein deposition occurred in three general stages:

Stage 1. Early barren stage

Stage 2. Ore stage

Stage 3, Post-ore barren stage

The Propectus vein is grossly similar to the Juniata vein in mineralogy and texture.

Detailed mapping of the veins on Silver Hill, both underground and surface, has indicated one long continuous period of quartz mineralization with re-breaking of earlier quartz by continued movement and continued deposition of quartz in these new fractures. Any one hand-specimen might indicate several periods of quartz deposition, but the vein would indicate only one continued period of mineralization. Gold and silver probably came in together but logically could be expected to vary in ratio over a large area. Recent microprobe work has indicated greater lateral variations in one grain than the lateral variation over the Aurora area. The apparent vertical zoning might be relatable to a late near-surface boiling stage, variations in the availability of silver to gold at depth, or variations in temperature of ore fluids near the time of deposition.

Mineralographic studies have not been made of the ore from Aurora, therefore, no conclusions can be made as to the age relationship of the gold, silver, tetrahydrite, chalcopyrite, pyrite, and selenium(?) minerals. However, these minerals show a close spatial relationship and are probably closely related genetically.

Kleinhampl and Silberman (1969, p. 19) describes anomalously high values of molybdenum in quartz veins and limonite-coated fractures in the northern part of the district. Some values were as high as 2 percent. They suggested that it might be related to the Mesozoic granite beneath the Aurora volcanics. Dickson (F. W. Dickson, 1975, verbal communication) has suggested that the spatial relationship of many of the epithermal gold deposits to granitic masses may indicate a convection system with leaching of gold from the granitic rocks as a source for the gold in these deposits.

Perhaps the Aurora gold-silver deposits were formed as the result of a large convection system consisting dominantly of meteoric waters being heated by the volcanics and during or immediately after the intrusion of the felsic to intermediate rocks. This was preceded by extensive north-south and northeasterly fracturing. The hot ascending hydrothermal fluids deposited quartz over a long continuous period of time, forming composite veins as a result of recurrent movement along the faults during mineralization. The source of the ore constituents was partially magmatic and/or leaching of the underlying granitic and volcanic rocks. The surrounding Aurora volcanics were altered by these fluids. Possibly the lateral and vertical variations in gold-silver ratios are related to late near-surface boiling stages of the fluids.

Age of Mineralization

Hill (1915, p. 150) indicated that the mineral deposits at Aurora were deposited after the eruption of the biotite quartz latite and before the succeeding rhyolitic flows. Green (1964, p. 35) assigned the age of mineralization to middle to late Miocene time, after the deposition of the Aurora volcanics and prior to the following period of erosion and formation of the Bodie Canyon volcanics. Payne (1965, p. 26) stated that they were formed in mid to late Tertiary. He suggested:

> The hiatus at the base of the Bodie Canyon sequence probably represents the interval of time during which the Esmeralda formation was being deposited elsewhere in the region. The Esmeralda formation, of Miocene and Pliocene age, is a lacustrine and continental sedimentary deposit widespread throughout western Nevada. The complete absence of the formation in the Aurora district is indirect support for the concept of Wisser (1960) that doming immediately preceeds and accompanies mineralization in most important Cordilleran precious metal mining districts. Similar doming nearby at Goldfield causes the Esmeralda formation (called Siebert formation in this district) to wedge out over the most productive central portion of the camp.
>
> There is mounting evidence to suggest that, in western Nevada precious metal districts from the Comstock Lode to southern part of the state, the vein systems were mineralized contemporaneously with the deposition of the Esmeralda formation. Actually, the "formation" is a series of different deposits lain down in isolated basins at about the same general time and under the same climatic conditions during the Miocene and Pliocene. The relatively unaltered flow rocks of the Bodie Canyon volcanic sequence were deposited directly on the old, uneven topographic surface eroded on the Aurora volcanics. The Bodie Canyon volcanics are predominately rhyolitic flows and associated tuffaceous rocks, but minor amounts of extrusive, and possibly intrusive andesite are also found.
>
> No known mineralization occurs in the Bodie Canyon sequence, and further doming after its deposition re-exposed the underlying mineralized Aurora volcanics in a distinct three-sided "window" or "keyhole", with unmineralized Bodie volcanics flanking the district to the west, north, and east. Several vein systems simply go right under the younger volcanics at the contact. Casual discussions often turn to hidden exploration possibilities under the younger cover at Aurora. It is interesting to note that the nearest exposure of pre-Esmeralda rocks to the west happens to the the dome-like exposure of andesites which embrace the veins at Bodie, the nearest important precious metal mining district in this direction.

The oldest Tertiary volcanics (Silberman and McKee, 1972) in the Aurora area are 13.5 to 15.4 m.y. old adesitic agglomerates and flows, which rest on the Mesozoic intrusives. Kleinhampl and Silberman (1969, p. 19) wrote that the ore-bearing rocks at Aurora are "andesites of unknown age, overlapped and intruded by younger andesitic and ryolitic rocks". C. M. Gilbert and others (1968) got a potassium-argon date of 12.4 m.y. on an andesite flow overlying the mineralized andesite. Silberman and McKee (1974, p. 71) obtained a potassium-argon date of 10.0 m.y. on adularia from a vein at Aurora. Kleinhampl and others (1975) obtain a date of 10.3 m.y. on adularia from the veins. Rhyolitic flows and plugs were dated at 11.0 m.y. Other rhyolitic to rhyodacitic flows and plugs were dated at 2.5 to 5.3 m.y. The Aurora Crater was dated at 0.25 m.y. This data suggests that the mineralization at Aurora is post-Aurora volcanics, and comtemporaneous with, or slightly later, than the felsic to intermediate intrusives.

GEOCHEMICAL SURVEYS

Great Basin Geochemical Surveys

Based on a premise that arsenic was the best geochemical guide to gold deposits, Payne recommended and supervised extensive geochemical surveys in numerous epithermal precious metal districts in Nevada, of which Aurora presented some of the most interesting anomalies. A reconnaissance sampling program was laid out in a 500-foot grid and 259 samples were collected. Anomalies were encountered on Last Chance, Middle and Silver Hill. Subsequently, detailed geochemical surveys on a 50-foot grid were accomplished, including arsenic, gold, and silver. Strong arsenic anomalies were delineated over the Black Hawk claim on Silver Hill and over the Wasp claim on Middle Hill. The The Wasp anomaly was eliminated for geologic and economic reasons (Payne, 1965, p. 33), and it was decided to concentrate on the two Silver Hill anomalies (Payne, 1965, pl. 4, 5). He concluded:

> It can be presumed that, if this arsenic anomaly is related

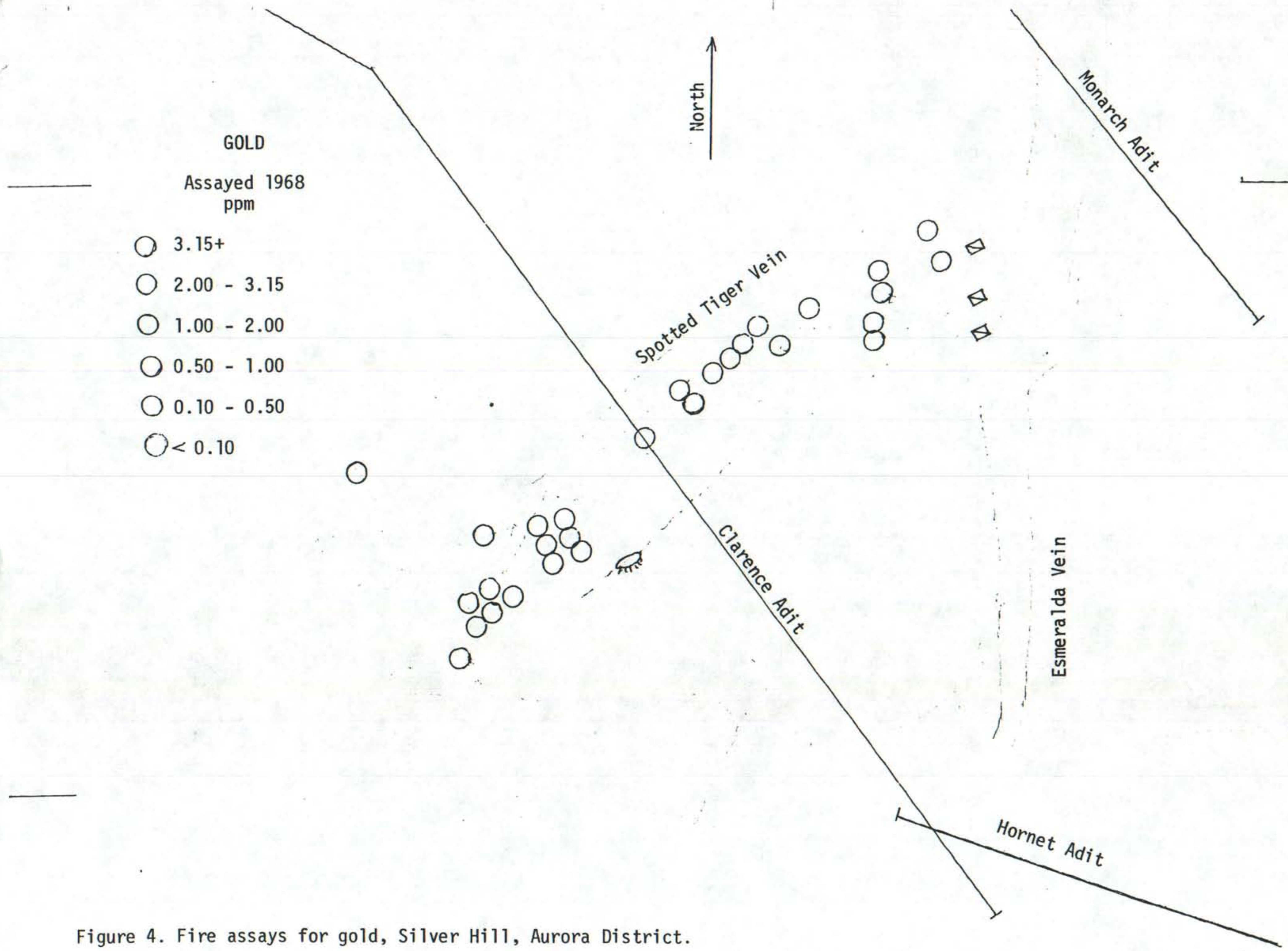


Figure 4. Fire assays for gold, Silver Hill, Aurora District.

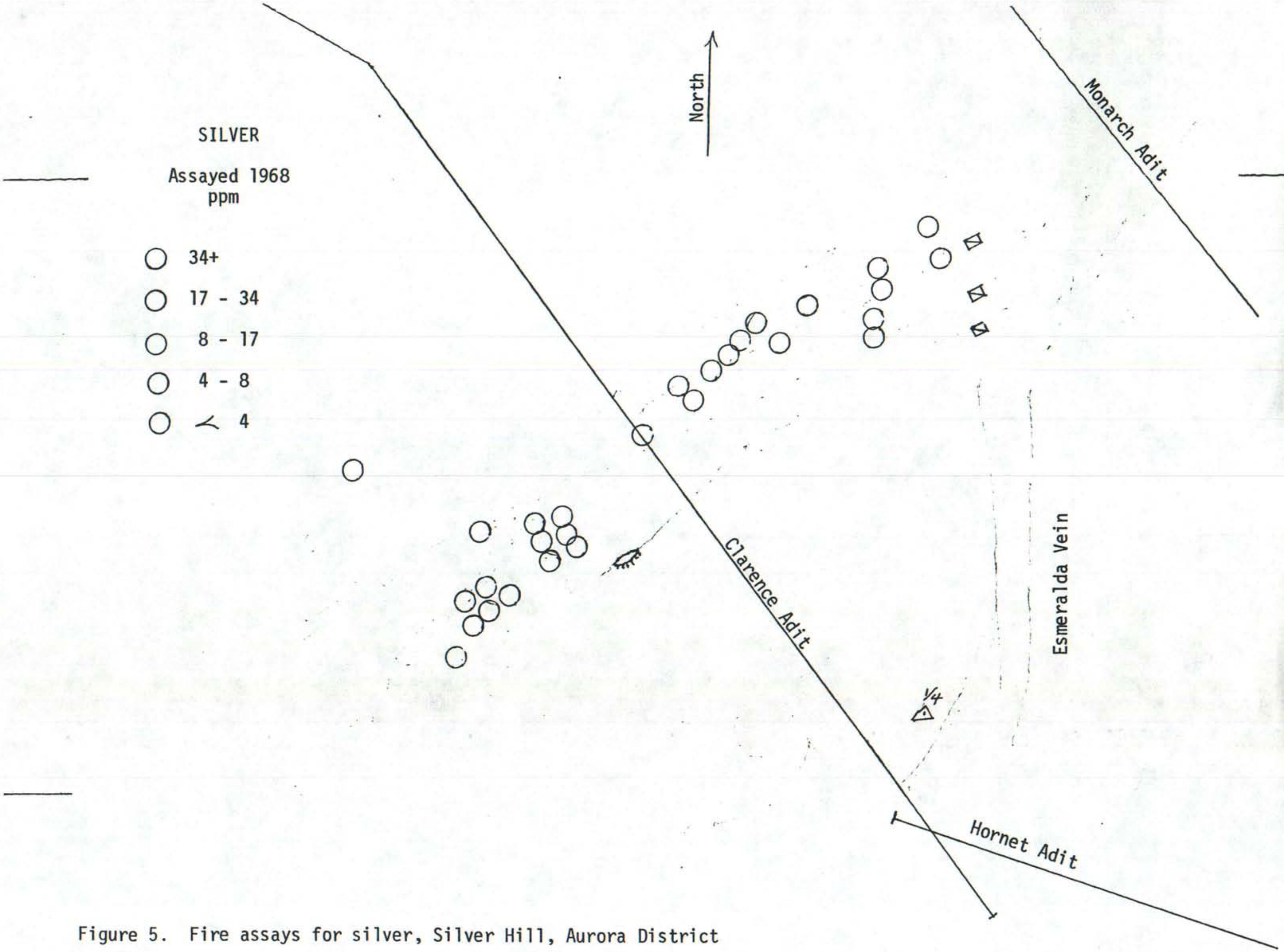


Figure 5. Fire assays for silver, Silver Hill, Aurora District

to undiscovered ore, such ore must lie at depth or it would certainly have been developed long before now. Such an inferred relationship of broad arsenic halo to "blind" precious metal ore shoot is consistent with previous experience with arsenic as a pathfinder, and is in fact just the sort of relationship which invites use of the method.

The geochemical data was correlated with geologic data and Payne (1965, p. 37) evaluated the exploration possibilities as follows:

The geochemical anomaly at the surface lies in the hanging wall of the Spotted Tiger vein, and in the footwall of the Black Hawk vein, a distance of 400 ft. across the top of Silver Hill. Several interesting vein structures crop out in this interval, all of them more or less parallel to the Black Hawk vein. As can be seen on the geologic cross section, the Spotted Tiger vein has a much more gentle dip (30^{o} - 50^{o}) under Silver Hill than one might judge from outcrop behavior. The flat dip takes this vein under the Black Hawk vein and related structures in such a manner as to suggest that they are hanging wall branches of the Spotted-Tiger lode. Such hanging wall splits from prominent, gentle dipping main lodes, are a common locus for bonanza ores.

There is a good chance then, that the geochemical anomaly on Silver Hill is due to bonanza mineralization in steep hanging wall splits from the Spotted Tiger lode under Silver Hill. Erosion has not progressed far enough to quite expose these shallow zones, except for the one over the brow of the hill at the Spotted Tiger mine at the north edge of the anomaly.

An exploration program was submitted to the Office of Mineral Exploration (OME) and a loan was approved for extension of the old Black Hawk adit to the center of the anomaly, with north and south drifts down the center, so that 100-foot drill holes could be fanned out at intervals horizontally. Several vein structures were found, but only one small area showed precious metal values of interest. Payne concluded that there was "no basis for comparing the Middle Hill arsenic anomaly to the Silver Hill anomaly, or to decide which might be the more inviting exploration bet".

U.S.G.S. Geochemical Surveys

Geochemical surveys were conducted over the Aurora and Bodie areas by the U.S. Geological Survey in 1967-1969. Preliminary data was published by Kleinhampl and Silberman (1969, p. 19) as follows:

The ore-bearing rock in the Aurora disctict, Mineral County is andesite of unknown age, overlapped and intruded by younger andesitic to rhyolitic volcanic rocks. Some of these younger rocks appear to be post-mineralization in age. Approximately 800 samples of altered (argillized, propylitized, and silicified) rock and quartz veins were collected in 1968 for spectrographic analysis and chemical analysis for gold, silver, arsenic, antimony, zinc, tellurium, molybdenum, and mercury. Approximately 200 samples of altered rocks from outside the main Aurora district will be analyzed to evaluate the potential for additional ore deposits outside the main district. About one-half of the Aurora samples have been analyzed. Preliminary geochemical anomaly maps for gold, silver and molybdenum indicate the following:

1. Silver and gold values are highest in the northern part of the district and are concentrated around a small rhyodacite intrusive. A secondary and a really smaller concentration occurs on Silver Hill in the southern part of the district.
2. No low-grade wallrock mineralization has been found in the district. Quartz veins yield spotty assay results, although gray-streaked quartz, which is mentioned as a guide to ore in numerous old reports, generally contains several parts per million gold, and as much as ten times greater amounts of silver.
3. Background values of 0.02 to 0.06 ppm gold and 0.5 ppm silver in the propylitized, argillized, and silicified rocks of the district are anomalously high when compared to the average for the particular rock type in question. The values approach the detectability limits for these elements and may not be reliable.
4. Anomalously high values of molybdenum (up to 2 percent) have been found in quartz veins and limonite-coated fractures in a small area in the northern part of the district. Molybdenum apparently is not found elsewhere in the district in anomalous amounts, nor in the surrounding region. It may be related to a Mesozoic(?) granite lying beneath the basal andesite of Aurora, which is approximately 1,000 feet thick.
5. A possible breccia pipe complex crops out on the summit and southern flank of "East" Brawley Peak, approximately 1 mile south of the main part of the district. The outcrops consist for the most part of dense, silicified, extremely brecciated rock. The rock is commonly bleached white and has scattered hematite-and limonite-stained patches as well as a few concentrations of sulfides. Chemical analyses of samples are as yet incomplete, but samples not particularly rich in sulfides show a low but anomalous silver content, averaging 0.4 ppm. The presence of sulfides and the brecciated rock, which might produce a good host for ore at depth beneath the oxidized zone, make this an interesting area for further exploration.

Several volcanic units of basic to felsic composition intrude and overlap the mineralized andesite at Aurora. Potassium-argon analysis by Gilbert and others (1968) on an andesite flow overlying the mineralized andesite yielded an age of 12.4 m.y., indicating that mineralization occurred before that date. Potassium Argon on biotite and hornblende, 2.6 and 2.5 m.y. were obtained on a latite plug that forms a part of the eastern margins of the district.

These dates indicate that volcanism was continous in the Aurora district over a period of at least 10 million years and that ore mineralization was early in the sequence of events. (F. J. Kleinhampl and M. L. Silberman, Menlo Park)

Geochemical Surveys

Lawrence took suites of samples over two areas on Silver and Middle Hills, and had them analyzed for gold, silver, antimony, arsenic, mercury and tungsten by Skyline Labs, Inc. of Tucson, Arizona. The samples on Silver Hill were taken over and near the Spotted Tiger vein, and the samples on Middle Hill were taken along the ridge line near the north end of Wasp No. 1 and 2 mining claims. The results are shown on Figures 6a through 6g and 7a through 7g, and the analyses are attached in the appendix. The results of samples taken in 1968 for gold-silver by fire assay have been recalculated to parts per million (ppm) and are shown on Figure 4 and 5. The arsenic anomalies obtained by Payne (1964) have been plotted on Figure 6a to show the relationship of the present survey to the old geochemical surveys by Payne. Examination of this data shows 6 samples with more than 3 ppm in gold by fire assay and 14 samples with more than 1 ppm. Samples over the same area in 1983 revealed 6 samples with more than 1 ppm and 16 samples with more than 8 ppm silver. In these same samples 8 contain more than 50 ppm antimony; 16 samples had over 100 ppm arsenic; 12 had over 20 ppb mercury; and 6 had at least 10 ppm tungsten. All of these elements might be useful for locating further ore shoots in the Aurora district.

Sixty-six samples were taken near the north end of Wasp No. 1 and 2 claims. They were selected to show leakage through the Aurora volcanics. Examination of the data (Figure 6a - 6g) shows five samples with more than 1 ppm gold; eight samples with more than 8 ppm silver; two samples with more than 20 ppm antimony; ninteen samples over 100 ppm arsenic; three had at least 25 ppb mercury; and eight had more than 10 ppm tungsten. Again ther appears to be some correlation between these elements and the gold-silve mineralization.

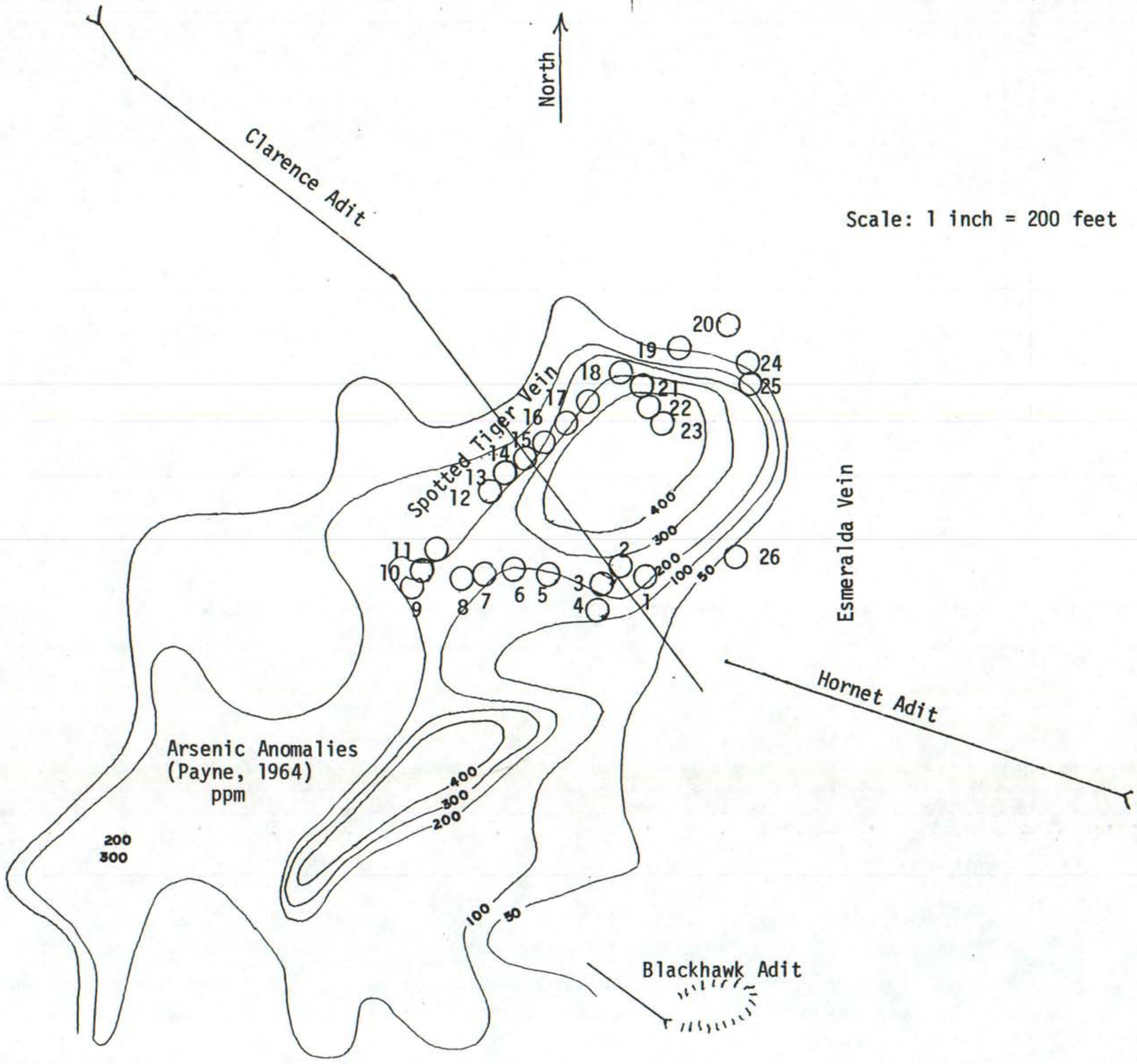


Figure 6a. Geochemical map showing sample numbers and arsenic anomalies

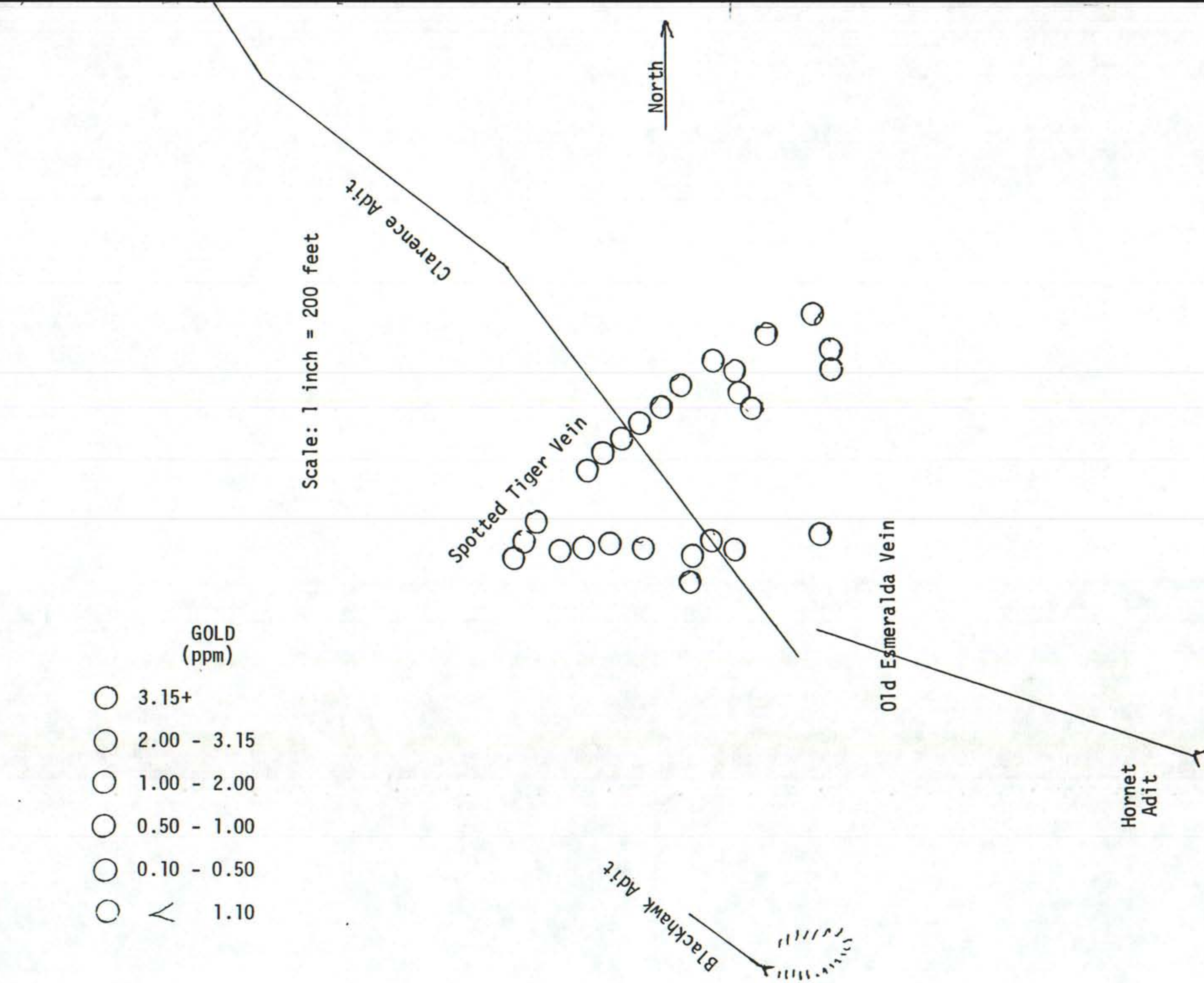


Figure 6b. Geochemical map - Gold, Silver Hill, Aurora district.

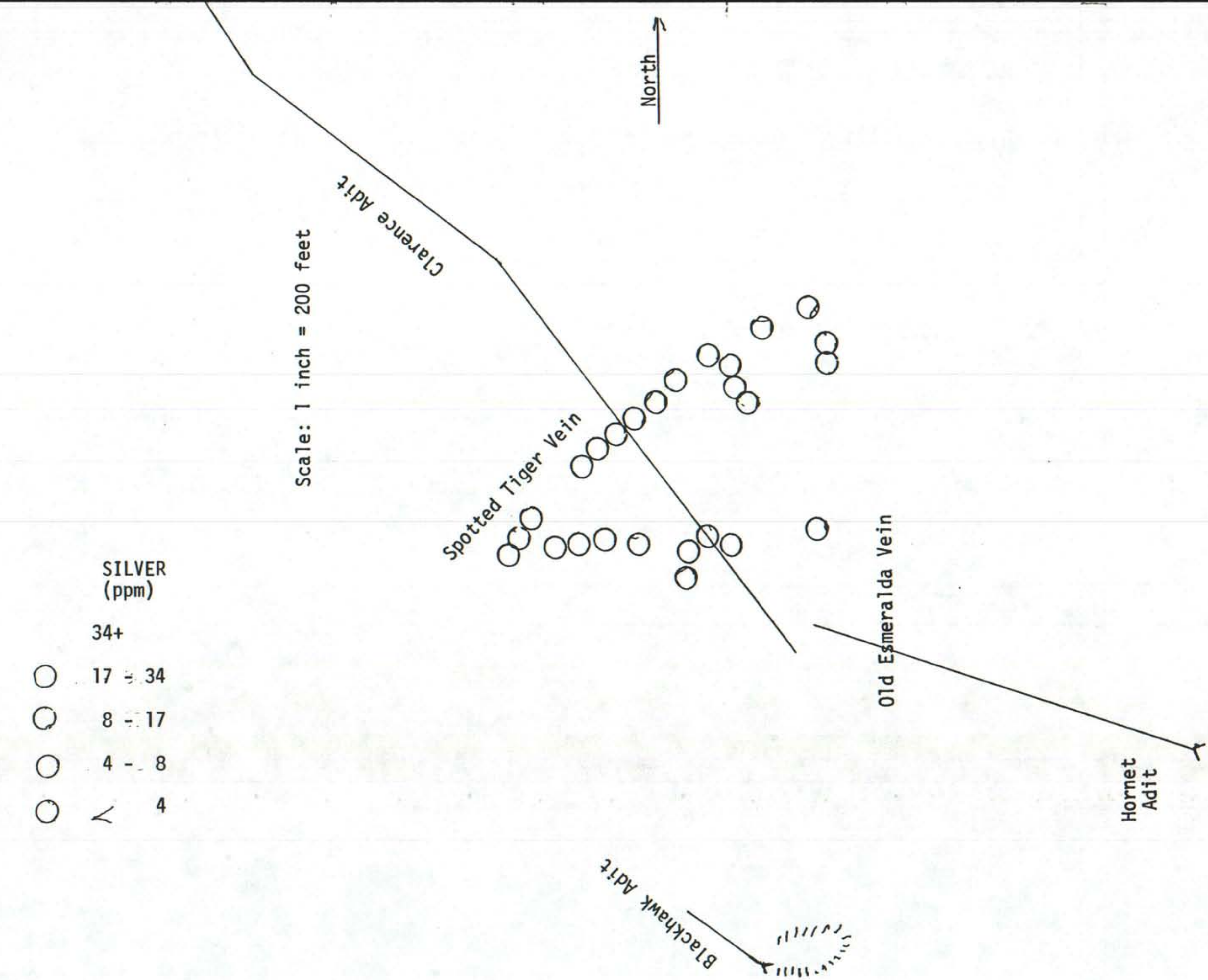


Figure 6c. Geochemical map - Silver, Silver Hill, Aurora District

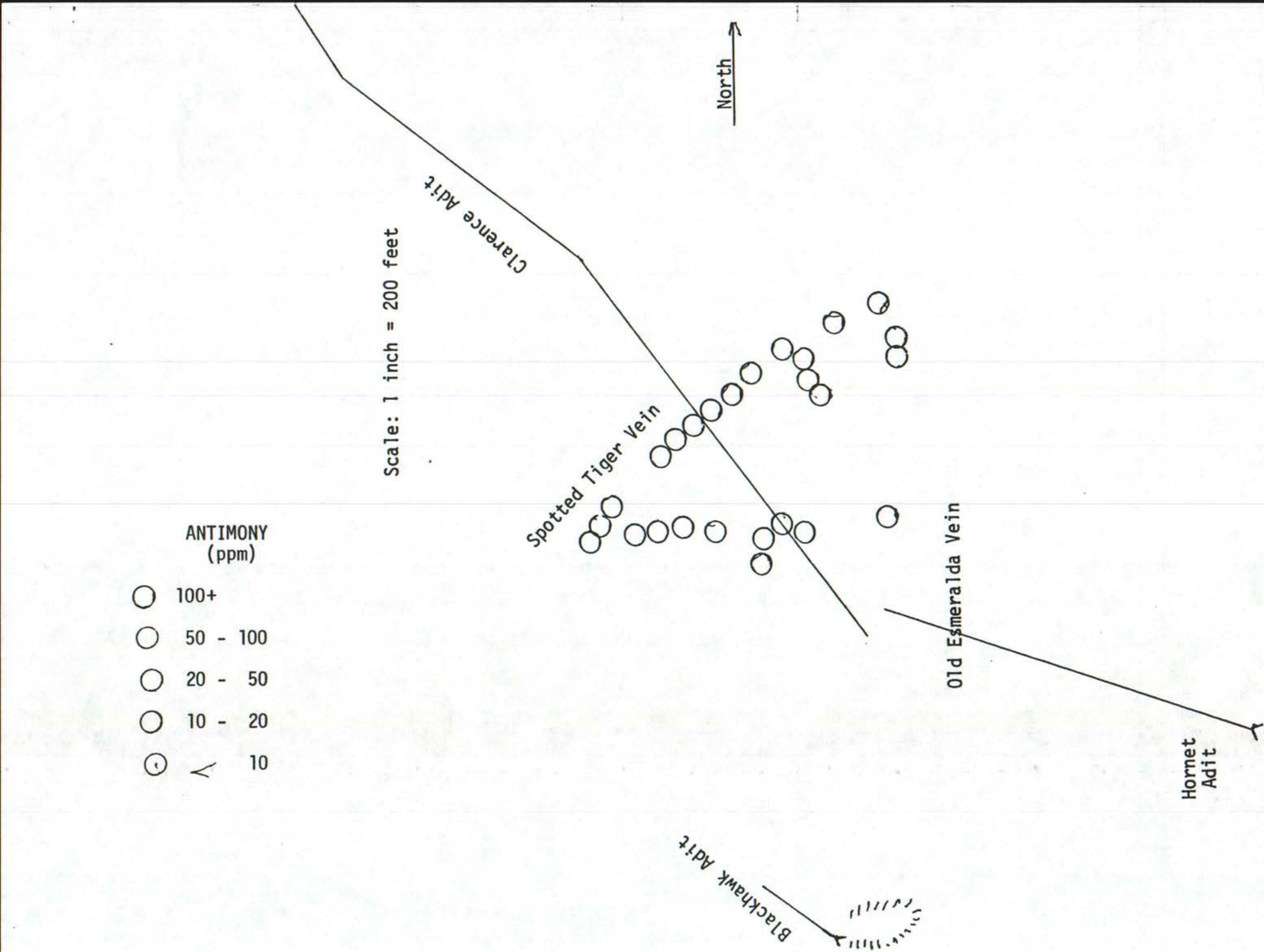


Figure 6d. Geochemical map - Antimony, Silver Hill, Aurora district-

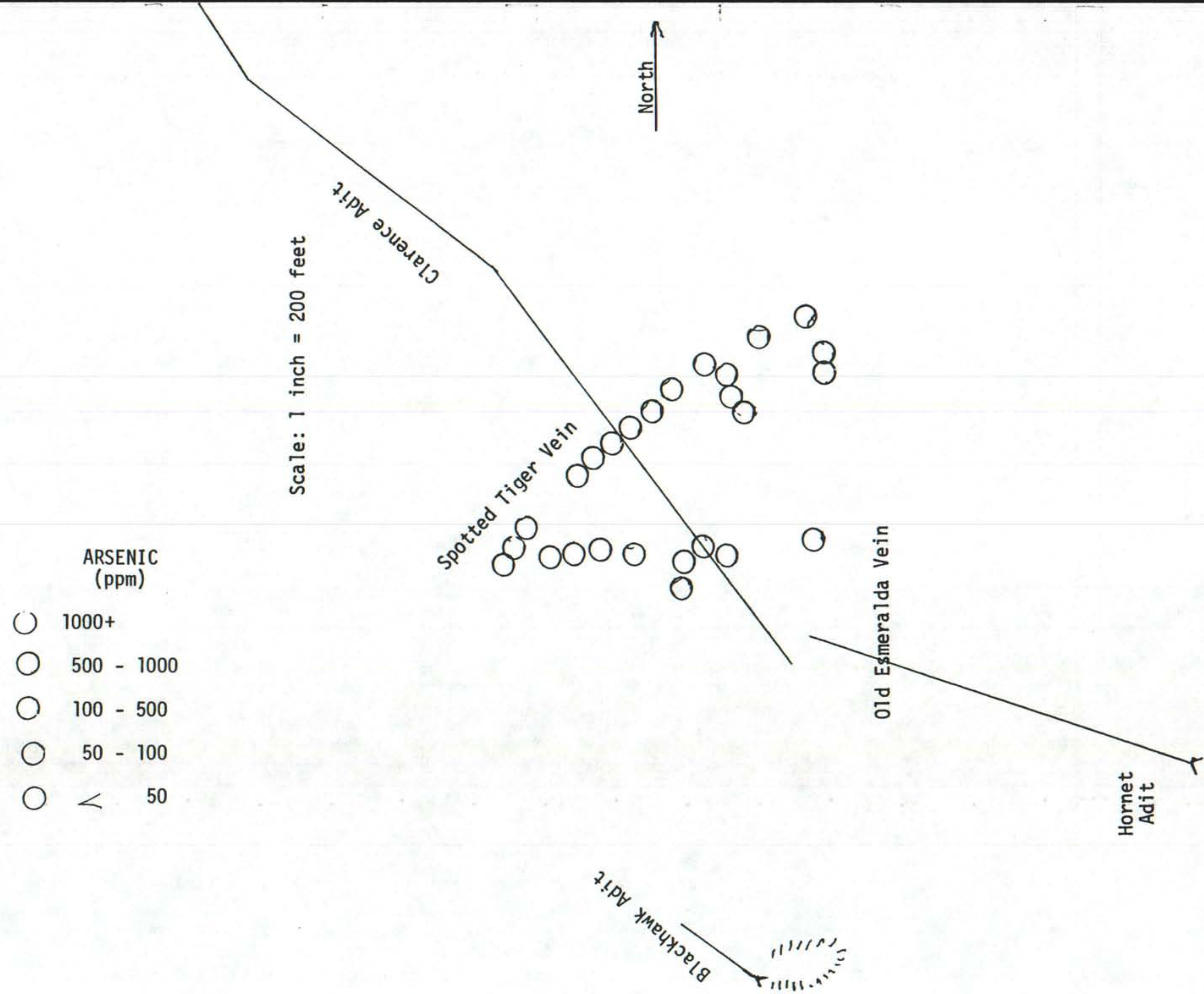


Figure 6e. Geochemical map - Arsenic, Silver Hill, Aurora district

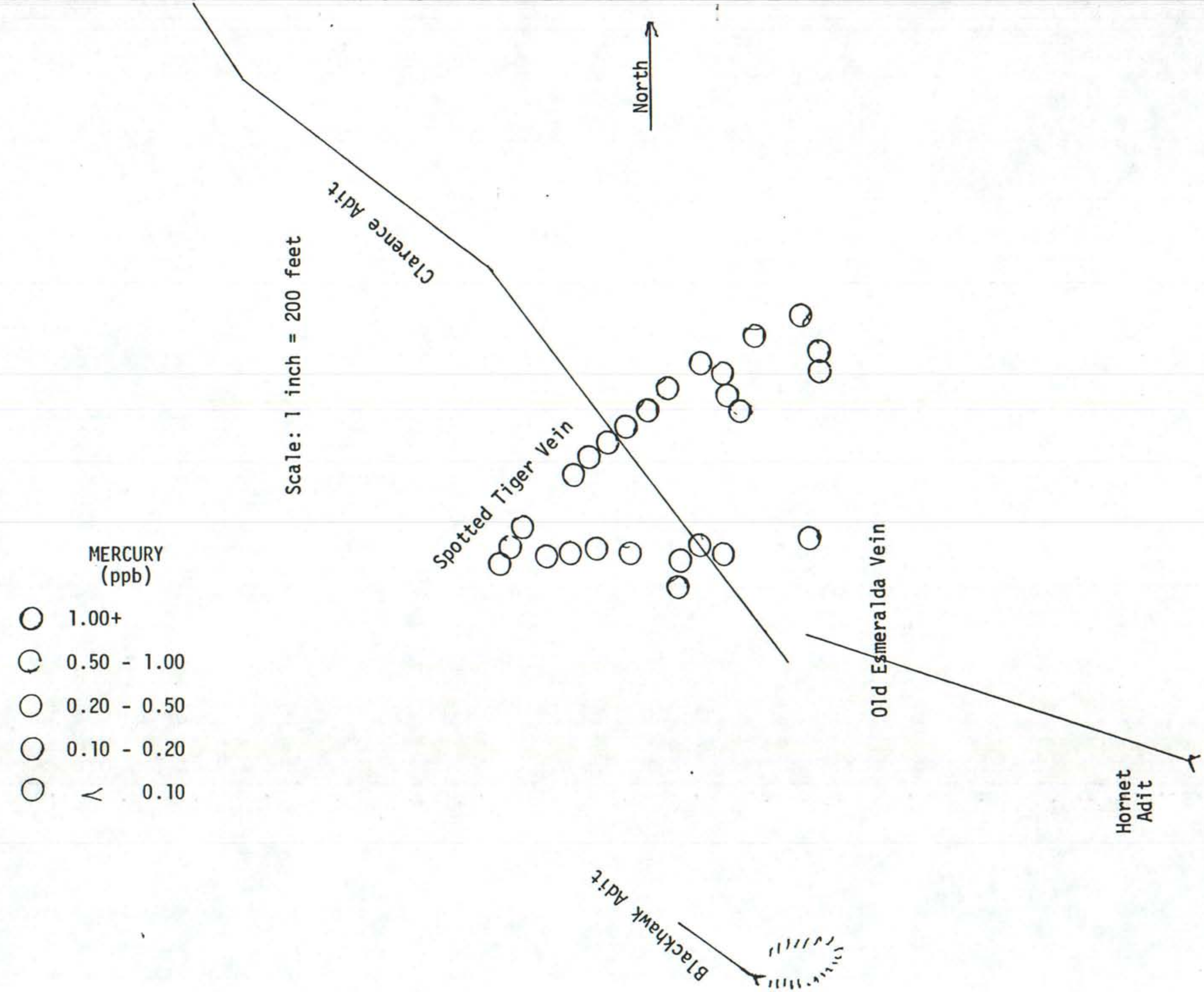


Figure 6f. Geochemical map - Mercury, Silver Hill

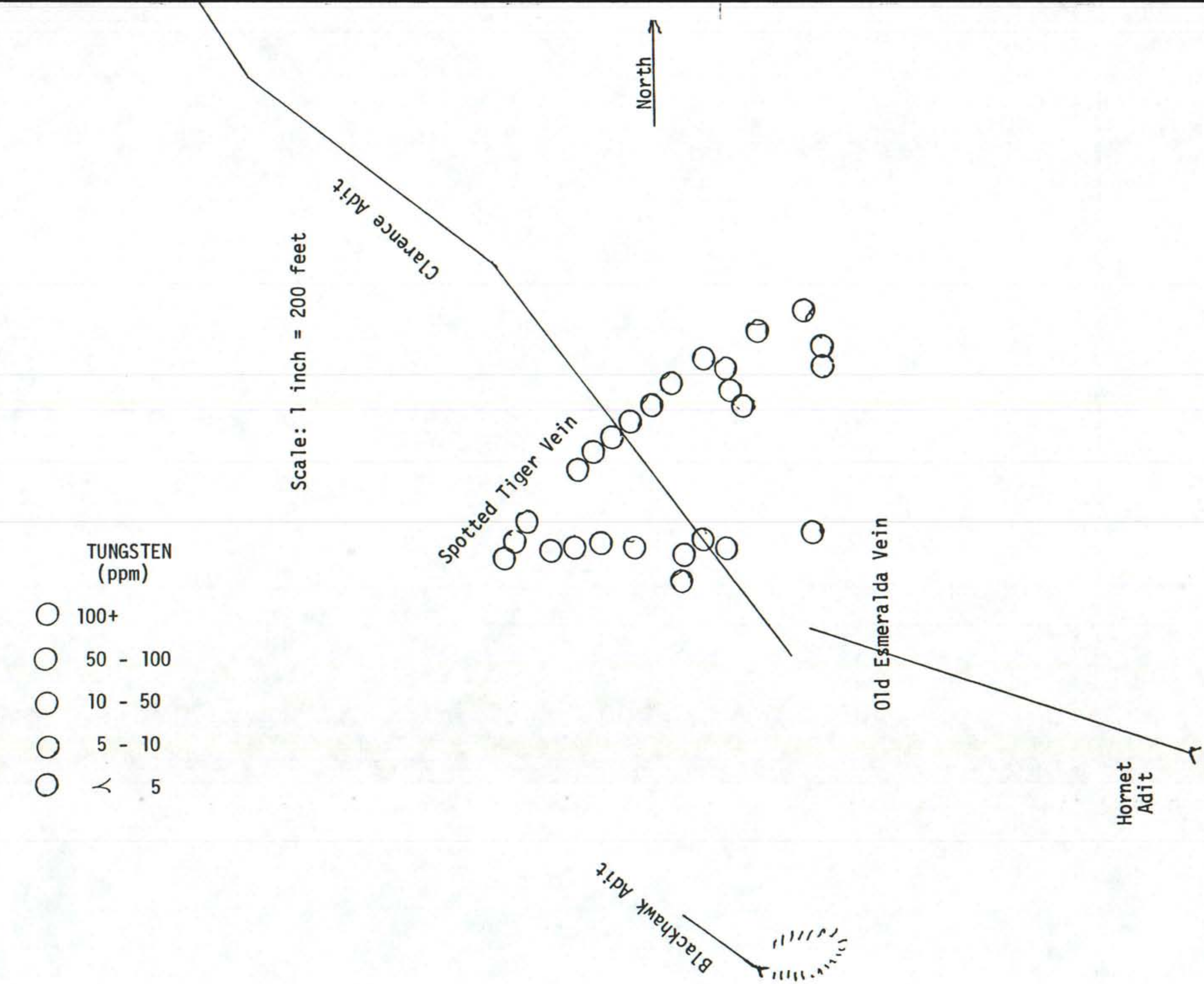


Figure 6g. Geochemical map - Tungsten, Silver Hill, Aurora district.

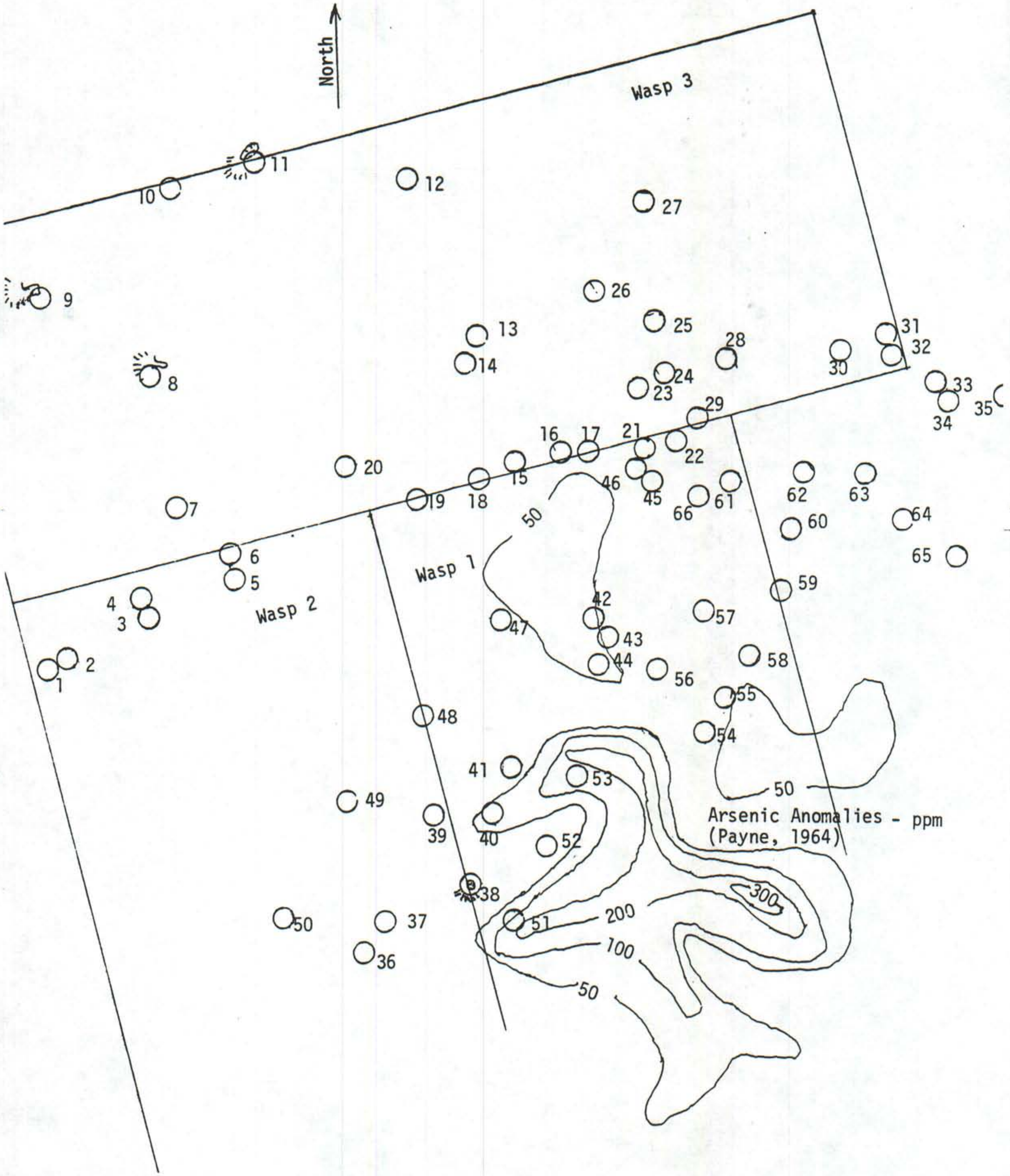


Figure 7a. Geochemical map showing sample numbers, Wasp claims, Middle Hill.

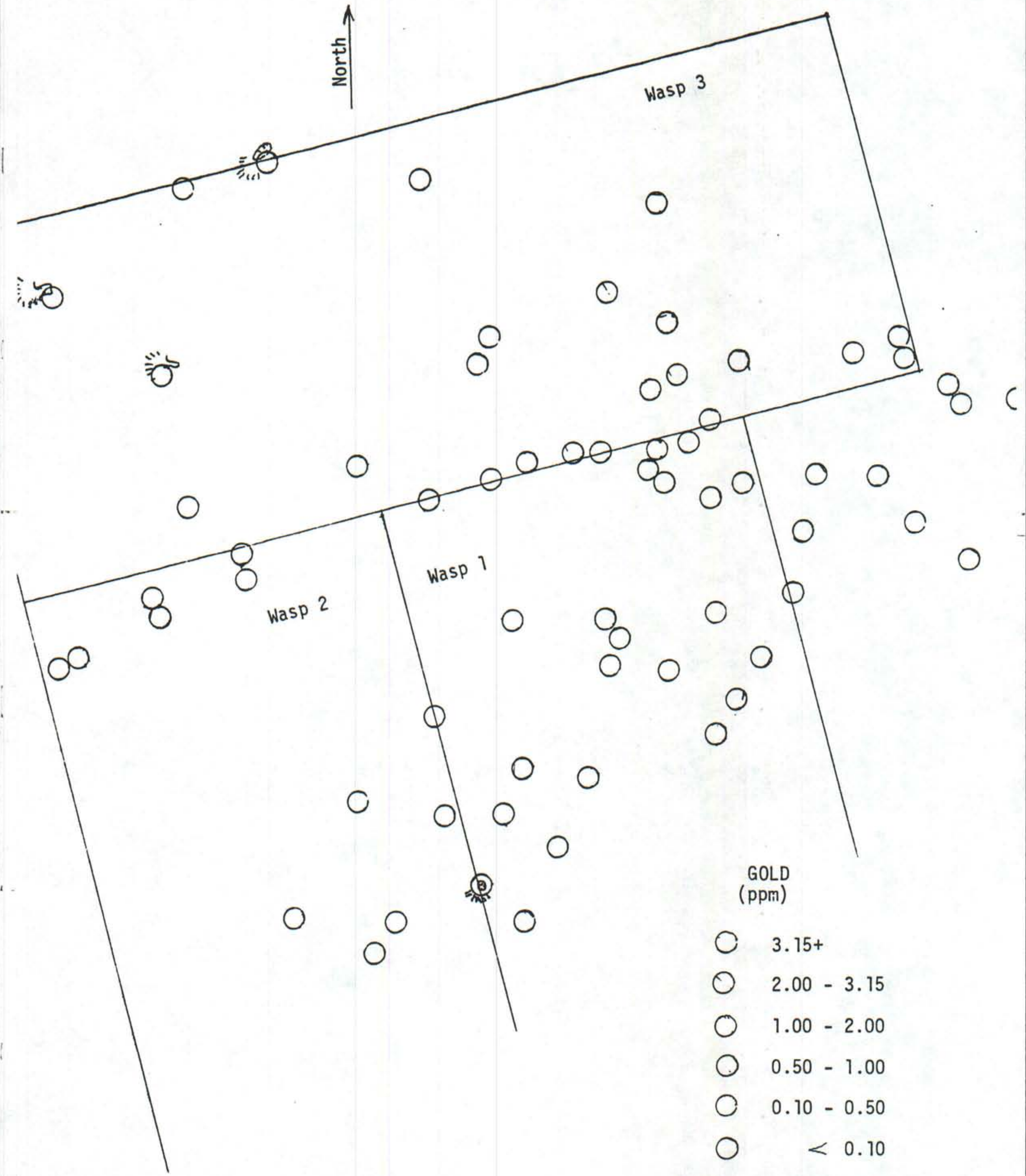


Figure 7b. Geochemical map - Gold, Middle Hill, Aurora district.

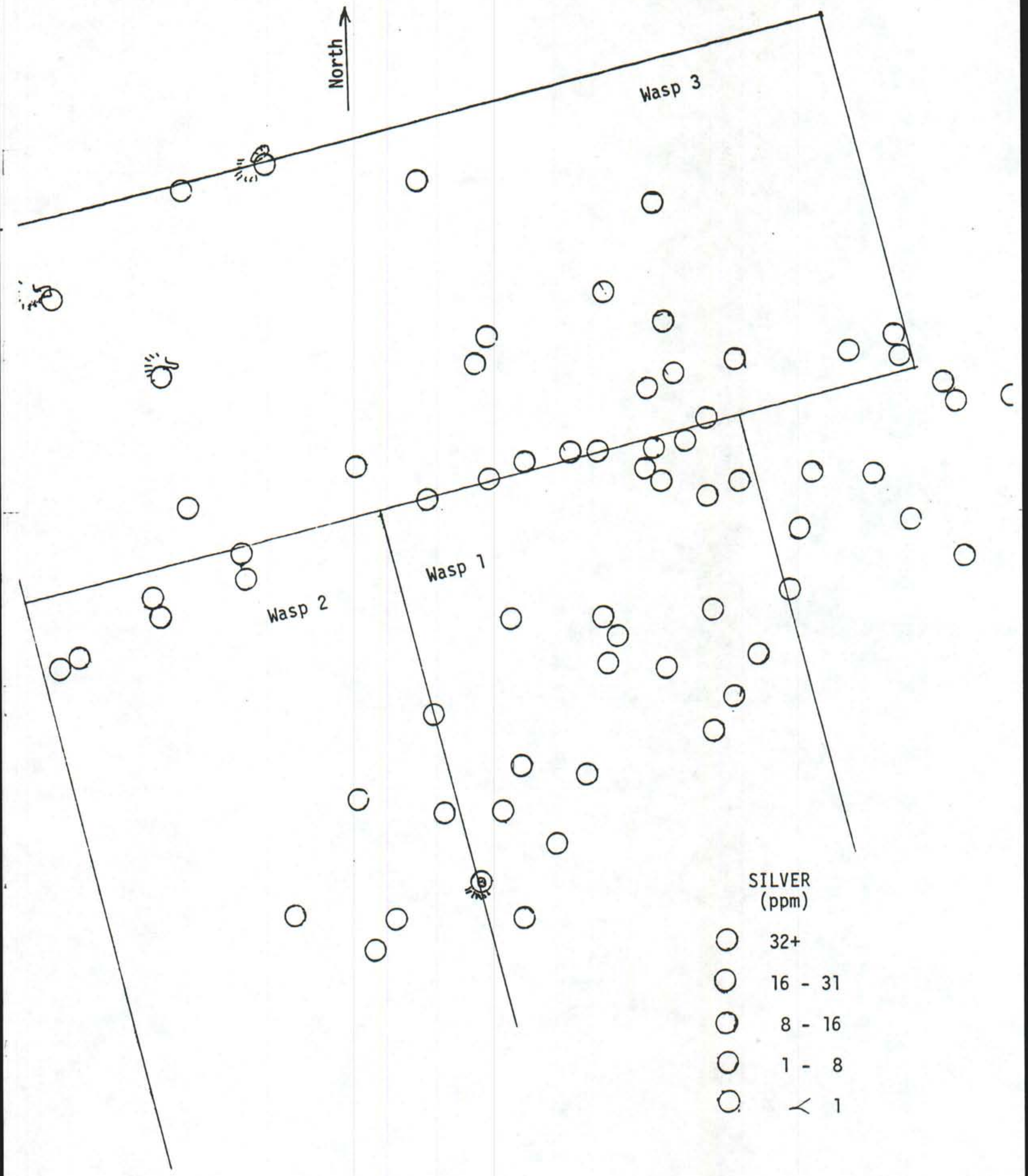


Figure 7c. Geochemical map - Silver, Middle Hill, Aurora district

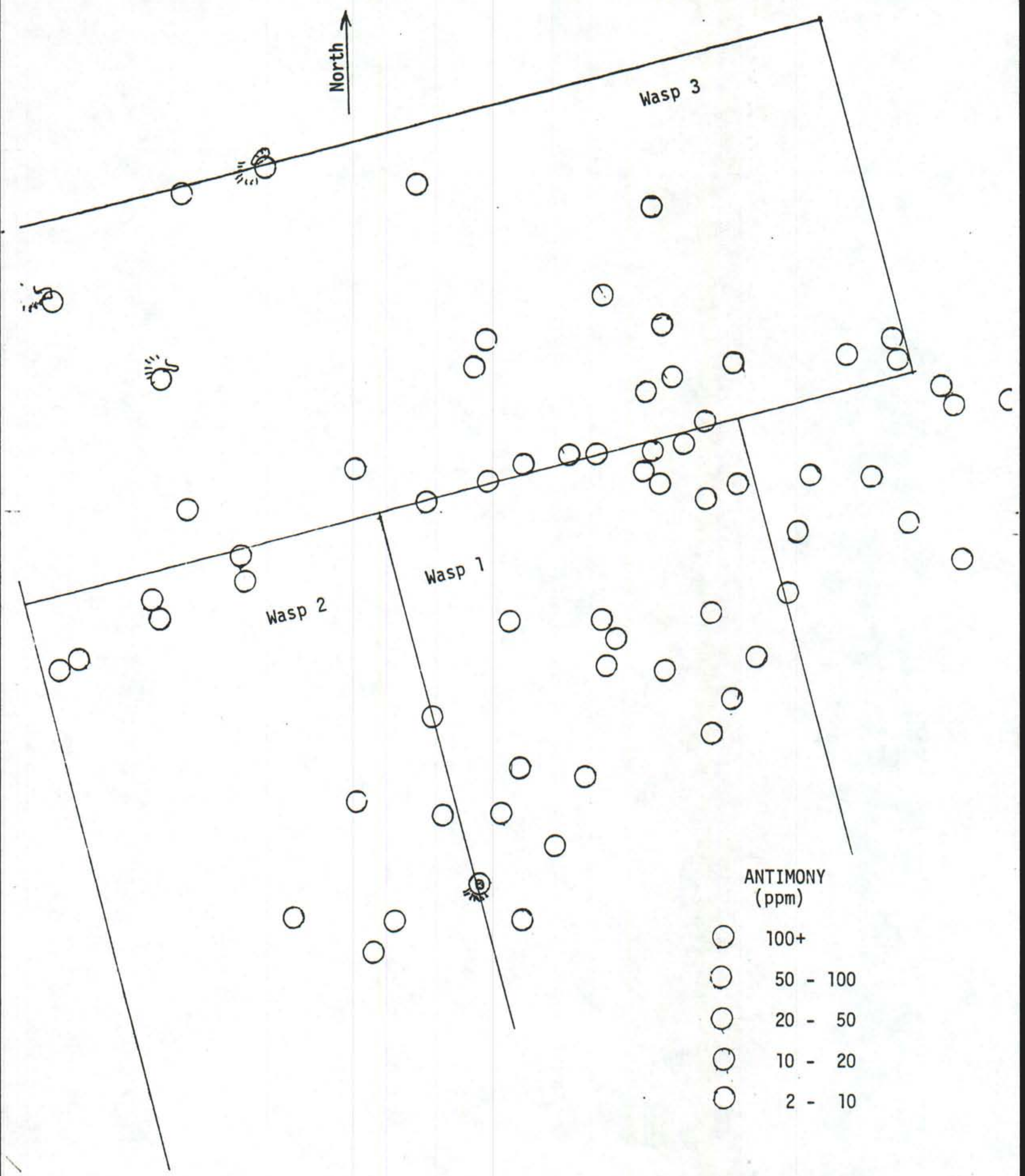


Figure 7d. Geochemical map - Antimony, Middle Hill, Aurora district.

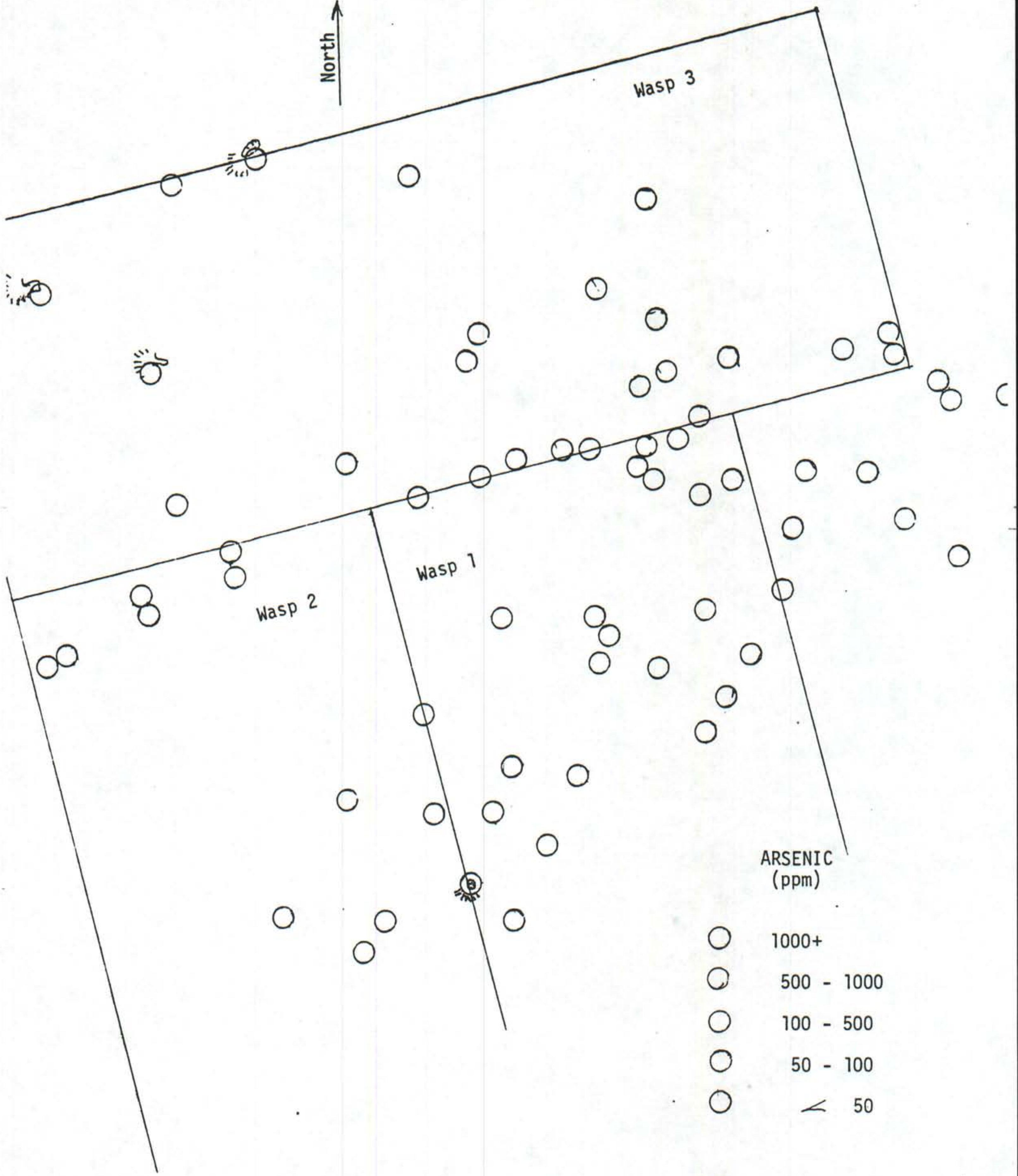


Figure 7e. Geochemical map - Arsenic, Middle Hill, Aurora District.

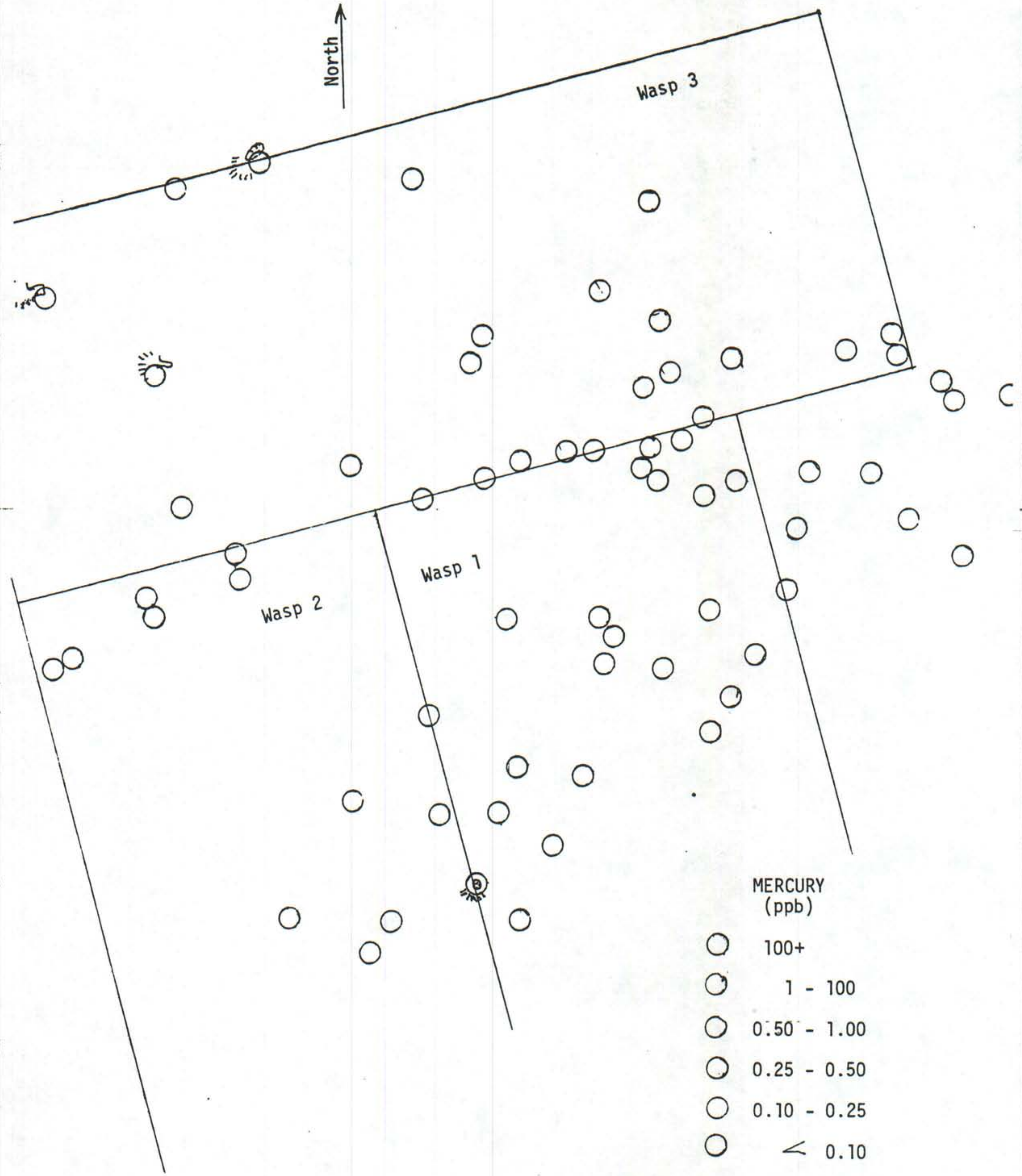


Figure 7f. Geochemical map - Mercury, Middle Hill, Aurora district.

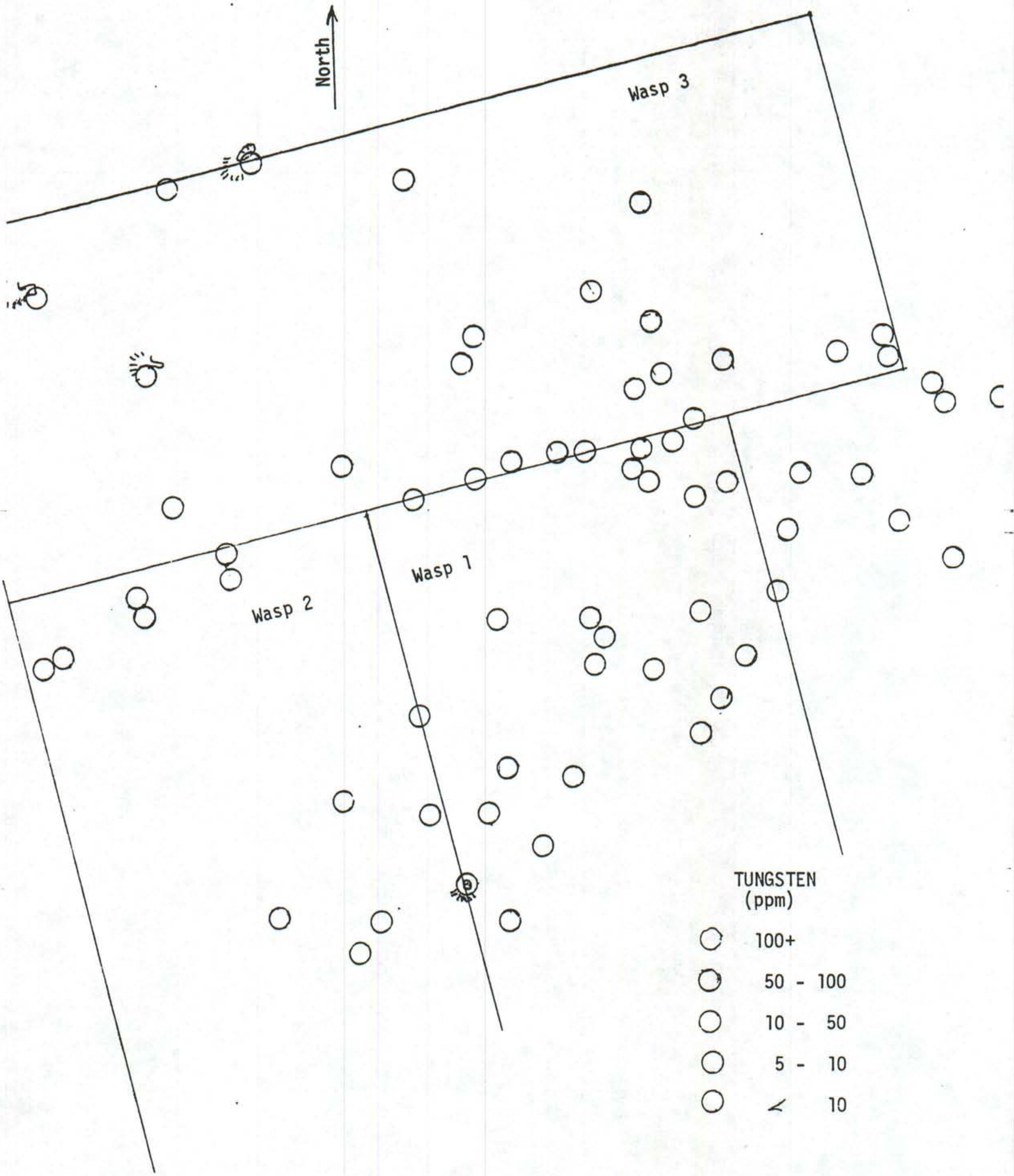


Figure 7g. Geochemical map - Tungsten, Middle Hill, Aurora district.

GEOPHYSICAL SURVEYS

Aeromagnetic Surveys

Aeromagnetic surveys have been made over most of Nevada and California by U.S. Geological Survey (Figure 7). This map reveals a magnetic low over the Bodie mining district, which is probably caused by the prevasive alteration of the volcanics around the mineral deposits.

Magnetic highs are shown over the Beauty Peak and Aurora craters and their flows of olivine basalt. A magnetic low occurs over Aurora Peak which is shown on Hill's geologic map (195, pl. 14) as basalt. Silver Hill lies along a magnetic-low trough, which increases to the northern part of the Aurora district, possibly because of the proximity of the Aurora crater and the outcrops of the Mesozoic basement in Willow Canyon. This magnetic trough may actually represent somewhat of an elongated structure, extending from a point northwest of Bodie to a point northeast of Aurora. This trough exhibits a low approximately ½ mile northwest of East Brawley Peak. The Hornet and Wasp mining claims on Silver Hill are 1 mile northeast of East Brawley Peak. Kleinhampl and Silberman (1969, p. 19) described a possible breccia pipe and an accompanying geochemical anomaly on the top and southern flank of this peak a quarter mile southeast of this magnetic low. A magnetic high, shown over West Brawley peak, curves around the south flanks of East Brawley Peak and off to the east over the outcrops of Mesozoic basement rocks.

Gravity Surveys

Gravity surveys have been made by Roger H. Chapman (Figure 8 over the Bodie Hills, and extended to a point slightly east of Aurora (Chesterman, 1968, p. 62). They concluded:

> A gravity high extends in a northeasterly direction from Conway

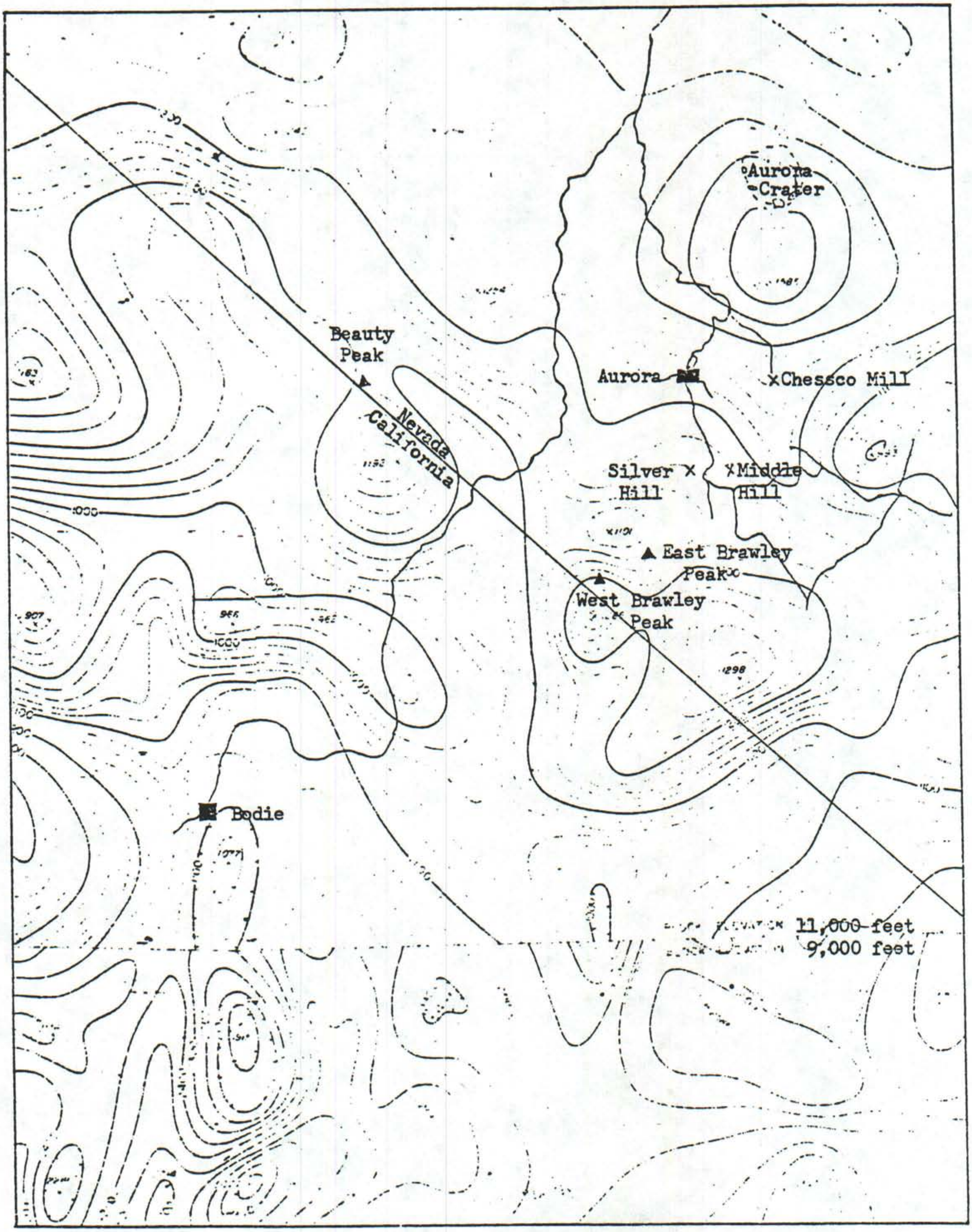
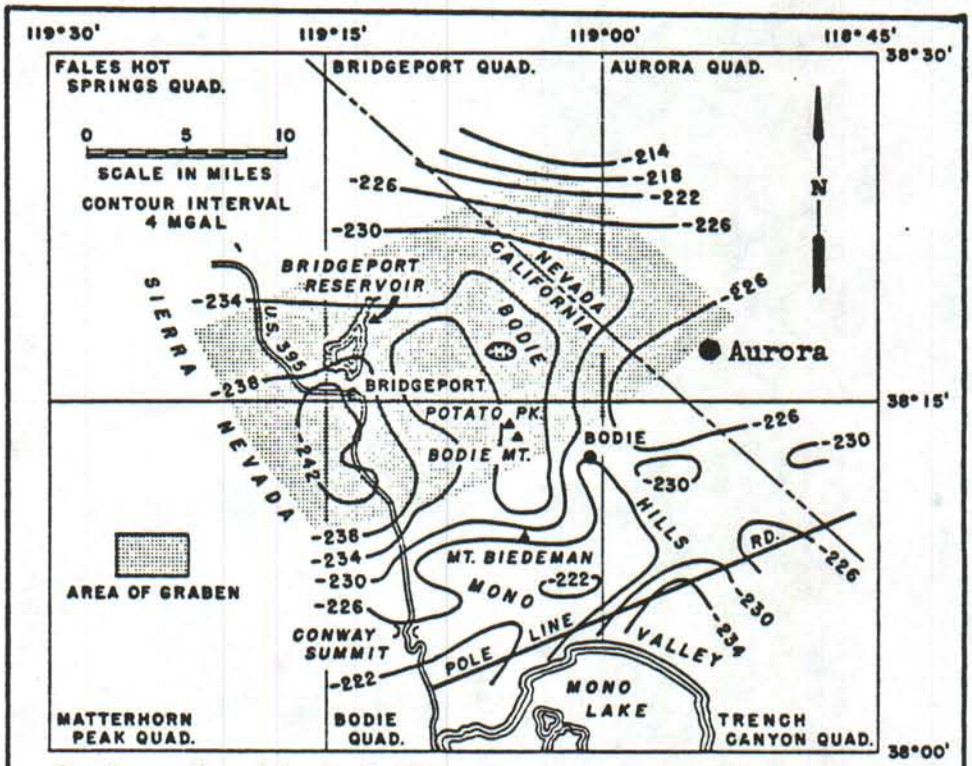


Figure 8 Aeromagnetic map of the Aurora-Bodie Area, Nevada and California, flown at 11,000 and 9,000 feet (U.S. Geol. Survey). Contour interval - 20 gammas; Scale: 1:62,500



Gravity studies of the Bodie Hills and surrounding areas (Chapman, R. H., oral commun., December, 1966) reveal several significant features. A gravity high extends in a northeasterly direction from Conway Summit for about 13 miles to a point a few miles south of Bodie, whence a nose extends northward about three miles to include Bodie Bluff. The gravity high that is east of Conway Summit (Fig. 2) appears to represent the high density basement rocks which have been uplifted by faulting and exposed at the surface. That portion of this gravity high, which appears as a nose in the Bodie mining district, may indicate an intrusive body beneath the mineralized lavas. A steep gradient along the north boundary of the gravity high may reflect a northeast fault in the basement rock. North of this possible fault, a marked northeast-

Figure 9. Bouguer gravity map (with partial terrain corrections) of the Bodie Hills area, Mono County, California by Roger Chapman (Chesterman, 1968, Fig. 2)

> Summit for about 13 miles to a point a few miles south of Bodie, whence a nose extends northward about three miles to include Bodie Bluff. The gravity high that is east of Conway Summit appears to represent the high density basement rocks which have been uplifted by faulting and exposed at the surface. That portion of this gravity high, which appears as a nose in the Bodie mining district, may indicate an intrusive body beneath the mineralized lavas. A steep gradient along the north boundary of the gravity high may reflect a northeast fault in the basement rock. North of this possible fault, a marked northeast-trending gravity low is believed to represent a graben filled with Tertiary volcanic rocks or sediments of low density. The Big Alkali caldera and the Bridgeport Valley block lie within the graben or trough.

The proposed graben outlined by the Bouguer anomaly passes just north of Bodie and Aurora. Additional gravity stations have been established to help delineate these anomalies, including more stations in the Aurora area. This more recent Bouguer Anomaly map definitely outlines a gravity high passing through Bodie and extending to the east along the top of Brawley Peaks (Roger H. Chapman, 1975, oral communication). The Aurora mining district lies along the northern flank of this anomaly. It may represent the basement rocks which are seen outcroping in Willow Canyon and at a point 2 miles east of Brawley Peaks along the axis of this anomaly. Possibly at Aurora it may also partially represent intrusive rocks beneath the mineralized and altered rocks, similar to the interpretation at Bodie, The possible breccia pipe and geochemical anomaly on the top and southern flank of East Brawley Peak would lie along the center of this gravity high. Recent gravity surveys by Chapman (1985) just north of Aurora have revealed the presence of an apparent caldera just to the west of Fletcher. This confirms the caldera postulated by Lawrence (1975) and Roger Chapman.

VLF-EM Surveys

Extensive VLF geophysical work was initiated by Hanna Mining Company in 1981, and finished in 1982. Reportedly this survey indicated the extension of the known gold-bearing veins beneath over-lying post-mineral volcanic rocks. The accuracy of the VLF technique was verified by later drilling. Based on this information, Alexander von Hafften contracted with Wade A. Hodges, consulting geologist, of Carson City, Nevada to conduct a VLF-EM survey over the southern half of the Aurora district using the Scintrex SE-81 Scopus EM receiver. The lines were run on 200 foot centers. The results of this survey are shown on Plate 4, which may be used as an overlay on the geologic map (Plate 1).

There appears to be a low angle intersection of two VLF anomalies between the Juniata and Philadephia veins. Other than this, the responses appear to be weak in this area. This anomaly crosses over the Prospectus fault with no apparent displacement, which might lend some credence to the suggestion that the offset along the Prospectus fault is quite small.

Another strong VLF anomaly occurs on the southwest flank of Martinez Hill. It intersects a fairly strong vein that has been productive.

The strongest VLF anomaly occurs on the east end of Middle Hill, and coincides with the outcrop of a felsic (quartz porphyry) instrusive. The highly productive Summit vein occurs along the north side of this intrusive. There appears to be a low-angle intersection of two anomalies near the Summit shaft.

Another low-angle intersection of two VLF anomalies occurs at the "spot-height" on Middle Hill. The main anomaly extends westerly along the ridge line and crosses Whiskey Gulch, where there appears to be another low-angle intersection of two anomalies. It is suspected that the mineralization may be deeper here because of the down-dropping of the Middle Hill block along northwest structures.

There are several strong VLF anomalies extending southwesterly across the top of Silver Hill. These are parallel to the Spotted Tiger and Blackhawk veins. One of the more interesting VFL anomalies extends southwesterly across the south end of the Esmeralda vein. Another smaller anomaly strikes southwesterly across the "white" dump and along a dike of felsic (quartz porphyry) rock, and extends beyond the area of survey. These two anomalies may be indicative of an area favorable to ore deposition.

SUMMARY

1. The Aurora mining district was discovered on August 22, 1860 and subsequently produced $31,409,013 in gold and silver.
2. The area is underlain by a metamorphic assemblage of the Excelsior formation that has been intruded by a coarse porphyritic granite of Cretaceous age. These are unconformably overlain by siliceous to intermediate altered volcanic rocks of the Aurora formation consisting of biotite quartz latite and andesites. The Aurora volcanics have been intruded by dikes and plugs of felsic to intermediate rocks. These rocks are overlain uncomformably by rhyolitic flows and tuffs with lesser amounts of interbedded and possibly intrusive andesites of the Bodie Canyon volcanics. Following a period of erosian and tilting, olivine basalt was extruded over the area.
3. Faulting has been the major structural element in the Aurora mining district, and has been the principal control in localization of ore shoots. There are four major systems of faults, consisting of the east-northeasterly, north-south, northwest and westerly systems. Faults of each system appear to off-set each other.
4. Gold and silver occur in anastomosing quartz veins as native gold and acanthite (argentite), accompanied by argentiferous tetrahedrite, traces of pyrite, and chalcopyrite. The gangue minerals are quartz with lesser amounts of calcite, andularia and florite.
5. The veins are epithermal in character and occur in the Aurora volcanics. They vary in thickness from a few inches to 100 feet. There are 14 major veins at Aurora, all except one accurring in northeasterly

fractures. Freguently they show minor offsets of a few inches up to 60 feet, but occasionally show major offsets, The Prospectus and Humboldt veins may be the same vein, that reportedly has been off-set 1,400 to 1,800 feet,however, detailed mapping appear to indicate only slight offsets along the Prospectus fault. If correct, the Humblodt and Prospectus are separate veins.

6. The ore usually ran \$6.00 to \$8.00 per ton, and some ran as high as \$1,000.00, but the average grade of all ore mined and milled at Aurora was \$46.88 per ton. Ore shoots were relatively small, a typical ore shoot on the Cortez vein being 20 to 25 feet wide, 50 to 75 feet long, and 150 feet down-dip, yielding 20,000 tons at a value of \$2,000,000 for an average value of \$100.00 per ton.

7. Alteration consists of propylitization over most of the area, argillization along the northern edge of the Aurora townsite, and strong silification in the southern part. Sericitization is common along the veins.

8. There is no evidence for any supergene mineralization at Aurora. Any vertical zoning present is probably a result of hypogene processes.

9. Stable isotopes studies indicate thet "the water in the ore fluid was certainly derived from local meteoric water". The ore constituents came from a magmatic source, and the temperature of deposition was 215°-245°C. Other data indicated temperatures of 130°C to 325°C, averaging about 232-250°C. Salinities ran from 2 to 6% NaCl equivalent, and less than 7 percent showed evidence of boiling.

10. The veins at Aurora were formed in open fissures by hot ascending solutions during one long period of mineralization, forming composite veins as a result of recurrent movement along the fault during mineralization. Perhaps the Aurora gold-silver deposits were formed as a

result of a large convection system consisting dominantly of meteoric waters being heated by the volcanic complex after the deposition of the Aurora volcanics and during or slightly after the intrusion of the felsic to intermediate rocks. Possibly the lateral and vertical variations in the gold-silver ratios are related to late near-surface boiling stages of the fluids.

11. Potassium-argon data indicates an age of approximately 10.3 m.y. for the mineralization at Aurora. An overlying andesite flow was dated at 12.4 m.y. The Aurora volcanics which hosts the mineralization are 13.5 m.y. to 15.4 m.y. in age.

12. Geochemical surveys by Payne and Hughes indicated several strong arsenic anomalies over the district. One of these was explored by underground drifting and drilling but failed to develop an economic deposit.

13. Geochemical surveys by the U. S. Geological Survey have indicated an area of potential interest on the flank of East Brawley Peak where an area of anomalous silver values correlates with a possible altered breccia pipe.

14. Geochemical surveys by Lawrence for gold, silver, antimony, arsenic, mercury and tungsten on Silver Hill and across the top of Middle Hill have indicated that these elements may be useful in exploration for further ore shoots in the Aurora district.

15. Recent mapping by Lawrence revealed numerous felsic to intermediate dikes and plugs, several of which appears to be quartz porphyry. These intrusives are spatially, if not genetically, associated with productive veins in the district.

16. Aeromagnetic surveys over the area indicate a magnetic low along the northern flank of East Brawley Peak near the geochemical anomaly.

There is a general magnetic-low trough beneath Silver Hill.

17. Gravity surveys indicate a gravity-high passing through the Brawley Peak area, with the Aurora district along its northern flank. This is similar to the gravity-high found at Bodie.

18. VLF surveys were conducted over the southern half of the Aurora district. Several strong anomalies were delineated, especially in the Middle Hill and Silver Hill areas. These areas should be explored.

19. Silver Hill has been explored by 14 crosscut adits that total over 11,310 feet in length, not counting numerous shafts, short adits, drifts, crosscuts, winzes, raises, stopes, and surface trenches.

20. Approximately 174 samples were taken from the Silver Hill area. These assays have been tabulated by veins, and in addition are shown in the appendix with a complete description. Three of the samples assayed more than an ounce of gold per ton, 23 ran over 0.1 ounces per ton, and 24 ran more than 0.05 ounces per ton.

21. Several areas on Middle and Silver Hills should be explored further for gold-silver deposits of economic significance.

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A P P E N D I X

	S/D	W/S
≤0.020 11	2 2 14 6 2 1 7 2 1 1 1 39	15 12 17 2 2 11 3 3 2 67
0.021-0.099 2	14 4 4 4 2 1 2 31	13 1 3 3 20
0.1-0.499 2	4 2 1 3 1 2 2 15	4 1 1 6
>0.50 0	1 1 1 3	1 1
15	88	94

11

SILVER HILL

Silver Hill has been explored by 14 crosscut adits that total more than 11,310 feet. In addition, there are numerous shafts, short adits, drifts, crosscuts, winzes, raises, and surface trenches (Plate 1).

Black Hawk Adit	730 Feet
Clarence Adit	2,340 "
Cortez Adit	1,050 "
Dream Adit	1,240 "
Eureka Adit	1,260 "
Gladiator Adit	990 "
Hornet Adit	630 "
Lady Jane Adit	450 "
Middle Adit	220 "
Monarch Adit	1,390 "
Monarch No. 2 Adit & Winze	700 "
134 Adit	110 "
North Adit	80 "
South Adit	120 "
	11,310 "

An attempt was made to map and sample every major underground working which often involved digging out caved portals. Geologic mapping was done at a scale of 1 inch = 40 feet, and the data was compiled (Plate 2) on a scale of 1 inch = 200 feet. The surface geology was also compiled at the same scale. The detailed underground geologic maps have been filed in a supplemental portfolio and are listed in the table of illustrations.

Black Hawk Adit

The Black Hawk adit was originally driven to intersect the Black Hawk vein at 175 feet. In 1966 it was extended to 430 feet and drifts were run northeasterly and southwesterly, from which 18 drill holes were drilled to explore for possible ore shoots beneath an arsenic anomaly. These drill holes cut the southwesterly extension of the Spotted Tiger vein. In 1974 this adit was partially caved at the Black Hawk vein, but accessible although the air was bad.

Clarence Adit

The Clarence adit is 1,840 feet in length and is in good condition except for some caving at the portal and at the extreme southeast end where it is caved at the face. It cuts the Lady Jane vein at 180 feet, the Opposition vein at 740 feet, the Cortez vein at 800 feet, the Monarch vein at 1,060 feet, and the Black Hawk vein at 1,520 feet. There is a strongly silicified zone 470 feet in width, extending outwards from the face, which contains numerous quartz veins and veinlets. This zone probably represents the same intersection of the Black Hawk and Radical veins which was cut 212 feet vertically above in the Hornet adit.

Cortez Adit

The Cortez adit, 250 feet in length, cuts the Opposition vein at 160 feet and the Cortez vein at 240 feet. A raise on the Cortez vein in the Clarence adit connects with the west drift of the Cortez adit. This vein has 30 to 60 inches of quartz. All workings are in fair condition.

Dream Adit

The Dream adit crosscuts the Hornet vein at 30 feet, the Bald Eagle vein at 500 to 650 feet, the Radical vein at 800 feet, and the Monarch at 930 feet. The Hornet vein is strong with considerable gouge and breccia, but very little mineralization. The Bald Eagle vein is broken into several fairly strong veins, one with 25 feet of quartz stringers and another with 18 feet of quartz stringers. The Radical vein is 40 feet wide, and shows very little mineralization. The Monarch vein has 24 inches of quartz. This adit is 1240 feet in length and is in fair condition except at the portal.

Eureka Adit

The Eureka adit is 1,150 feet in length, cutting the Eureka vein at 50 feet, the Hypo vein at 400 feet, and the Antelope vein at 990 feet. The Antelope vein was drifted on for 110 feet, and a raise was driven on it in the northeast drift where the vein is 24 to 36 inches in width. Except for the portal and the Antelope raise, this adit is in good condition.

Gladiator Adit

The Gladiator adit is 990 feet in length. One drift at 385 feet on a vein, which strikes N 60°W and dips 20° southwesterly, cuts the apparent north extension of the Old Esmeralda-Radical fault. This zone is at least 35 feet wide and contains only minor quartz. The Gladiator vein was intersected at 620 feet where it strikes N 50°E and dips 70° southeasterly. It contains 14 to 24 inches of quartz. The South Gladiator vein was cut at 820 feet. It consists of a stringer zone 30 feet wide, striking N 60°E and dipping 25° to 70° southerly. This adit is accessible and in good condition.

Hornet Adit

The Hornet adit was driven westerly 630 feet to explore the intersection of the Radical, Black Hawk, and Spotted Tiger veins. It cut the Hornet vein at 350 feet, the Radical vein at 470 feet, and the Black Hawk vein at 500 feet. The stringer zone at the intersection of the Radical and Black Hawk veins is more than 160 feet wide, containing 30 to 50 per cent quartz, and the wallrock has been propylitized, argillized, and silicified. The portal is partially caved, but the access is good.

Lady Jane (33) Adit

The Lady Jane (33) adit intersects the Lady Jane vein at 210 feet where the vein is 12 to 60 inches in width. It strikes N 50°E and dips 25° to 60° southeasterly. A raise was driven to connect with the bottom of a 20-foot vertical shaft at the surface. The vein is 18 to 24 inches wide along this raise. A winze was sunk on the vein for a distance of 50 feet along the dip. These workings are in fair condition.

Middle Adit

The Middle adit is 220 feet long, cutting the Hornet vein at 195 feet. Here the Hornet vein is a minimum of 45 feet wide, consisting of quartz stringers and veins with 20 to 50 per cent quartz. The adit is in good condition, although the portal has a tendency to slough closed.

Monarch Adit

The Monarch adit was driven 920 feet to intersect the Monarch vein at 210 feet, the Seminole vein at 540 feet, the South Seminole vein at 760 feet, the Black Hawk vein at 780 feet, and the Radical vein at 820 feet. It explores the intersection of the Radical and Black Hawk vein beneath the Spotted Tiger vein. The Radical vein is 50 feet wide with a 20-foot stringer zone containing 80 per cent quartz. The Black Hawk vein is over 70 feet wide and has one zone with 9 feet of quartz. This adit is in fair condition, but is wet and caving in the back drifts and crosscuts at the Black Hawk and Radical veins.

Monarch No. 2 (Cortez No. 2) Adit

The Monarch No. 2 (Cortez No. 2) adit is 150 feet in length, but has a winze on the Monarch vein that extends at an average dip of -15° for 454 feet. The bottom of the winze is at 7,900 feet. Here the vein strikes N 60°E and dips 25°SE, and contains 24 to 30 inches of quartz. The air is short of oxygen near the bottom but otherwise the winze is accessible.

134 Adit

The 134 adit is 110 feet in length and cuts the South Gladiator vein at 120 feet where it has been cut off by a north-south fault. The veinlets here are 9 inches and 16 inches wide. This adit is accessible.

VEINS ON SILVER HILL

The principal veins on Silver Hill are the Old Esmeralda-Radical, Spotted Tiger, Bald Eagle, Black Hawk, Virginia-Hornet, Seminole, Monarch, Cortez-Utah, Opposition, Lady Jane, Antelope, Hypo-Clarence, Eureka, and Gladiator. In addition, there are numerous splits off of these veins, as well as faulted segments. There may be considerable displacement of some of these veins along the Old Esmeralda-Radical fault, therefore, it is difficult to project veins across this fault.

Old Esmeralda-Radical Vein

The Old Esmeralda-Radical vein strikes N 5°E to N 30°E and dips generally at 65° to 88° to the east although locally it may show reversals. The Old Esmeralda vein is up to 50 feet in width, and consists mostly of massive quartz with smaller amounts of calcite and adularia. The vein shows left-lateral offsets along two northeasterly striking faults and some right-lateral offset on a northwesterly striking fault. To the south, it has been cut off completely, and the south segment, if it ever existed, has not been found. North of the

Black Hawk road this vein, called the Radical vein, widens to 60 feet and shows a definite composite structure that demonstrates a continued movement and rebreaking during a long single period of quartz mineralization. The Black Hawk veins and fractures partially breaks across the Radical vein and extends northeasterly as the Virginia and Hornet veins. The Radical fault continues through the Spotted Tiger vein and is seen in the west drift of the Gladiator adit as a shear zone with minor quartz. It was cut in the southeast end of the Monarch adit, at 250 feet from the face in the Dream adit, and at 470 feet in the Hornet adit. At the lower depths, the structure shows considerable shearing with heavy gouge and breccia, and only moderate amounts of quartz mineralization. This may be indicative of a nearer-surface deposition of quartz which would limit any possible depth-extension of gold mineralization along this vein. The following samples were taken along the Radical vein and assayed for gold and silver:

Sample No.	Adit	Level	Width	Ounces/ton Au	Ounces/ton Ag
Am-4	Monarch	8027	5.0 feet	0.005	0.21
5	"	"	5.0 "	tr	0.08
6	"	"	5.0 "	tr	0.10
A-138	Hornet	7994	10.0 "	0.01	0.18
139	"	"	10.0 "	tr	0.14
140	"	"	10.0 "	tr	0.16
141	"	"	10.0 "	tr	0.20
142	"	"	10.0 "	tr	0.24
143	"	"	10.0 "	tr	0.26
144	"	"	6.0 "	tr	0.43
145	"	"	11.0 "	0.02	0.38
146	"	"	4.0 "	0.01	0.16
147	"	"	4.5 "	0.01	0.18
148	"	"	5.0 "	0.005	0.21
149	"	"	2.0 "	0.02	0.65

Black Hawk Vein

The Black Hawk vein at the raise in the Black Hawk adit strikes N 30°E and dips 55° to 65° easterly. Here it contains 72 inches of quartz on the footwall, 60 to 86 inches of clay and gauge, and 60 inches of quartz on the hanging wall for a total width of 17 feet. There is a shear zone, 220 feet wide, with numerous quartz veins and veinlets extending from the portal to a point 40 feet beyond the raise. This wide shear zone probably represents the true Black Hawk fissure system which can be seen on the surface (Plate 1) where it is 250 feet wide. This zone was cut at 500 feet in the Hornet adit and extends to 626 feet. The Monarch adit crosscuts this zone at 780 feet at the intersection of the Black Hawk and Radical veins. A drift and crosscut off of the main Monarch adit cuts 100 feet of the Black Hawk fissure zone.

The Clarence adit was driven 1,830 feet under the Spotted Tiger and Black Hawk veins to a point vertically under the Radical vein. There is 20 inches of gouge along a north-south fault at the face that probably represents the downward extension of the Radical vein. There is a 470-foot highly silicified zone with numerous quartz veins and stringers that extends back from the face to a point vertically beneath the surface outcrop of the Spotted Tiger vein. A part of this zone probably represents the Black Hawk vein. Payne (1966) sampled the Black Hawk adit extensively. Additional samples have been taken and assayed as follows:

Sample No.	Adit	Level	Width	Ounces/ton Au	Ag
A-1	Black Hawk	8179	2.0 feet	0.01	0.24
2	" "	"	2.5 "	0.02	0.38
3	" "	"	2.5 "	0.005	0.29
4	" "	"	2.0 "	0.005	1.49
5	" "	"	2.0 "	tr	0.55
6	" "	"	0.5 "	tr	0.28
7	" "	"	Grab	tr	1.16
8	" "	"	0.3 "	tr	0.08
9	" "	"	1.5 "	tr	0.10
Loose 1	" "	Dump	Grab	0.005	0.04
Conglom 2	" "	"	Grab	0.005	0.05
A-29	Monarch	8027	54 inches	tr	tr
30	"	"	54 "	tr	tr
31	"	"	90 "	tr	0.07

Sample No.	Adit	Level	Width	Ounces/ton Au	Ag
A-32	Clarence	7782	50 inches	tr	0.08
92	Black Hawk	Surface	36 "	tr	0.33
93	" "	"	Grab	0.01	0.28
150	Clarence	7782	20.0 feet	0.01	0.30
151	"	"	20.0 "	tr	0.20
152	"	"	20.0 "	tr	0.19
153	"	"	20.0 "	tr	0.20
154	"	"	20.0 "	tr	0.20
155	"	"	20.0 "	tr	0.17
156	"	"	20.0 "	tr	0.14
157	"	"	20.0 "	tr	0.15
158	"	"	20.0 "	tr	0.13
159	"	"	20.0 "	tr	0.16
160	"	"	20.0 "	tr	0.15
161	"	"	20.0 "	0.005	0.10
162	"	"	20.0 "	0.005	0.14
163	"	"	20.0 "	tr	0.16
164	"	"	20.0 "	0.005	0.14
165	"	"	20.0 "	tr	0.06

Spotted Tiger-Bald Eagle Vein

The Spotted Tiger-Bald Eagle fissure zone strikes N 30°E and dips 30° to 70° southeasterly. It is made up of several veins that vary in thickness from 12 to 60 inches, and from 5 to 70 feet where they become composite veins. The Spotted Tiger vein splits into at least five separate veins to the southwest. This vein has been cut by the Old Esmeralda-Radical fault, with some apparent left-lateral offset. To the northeast, this vein is known as the Bald Eagle, where it is up to 24 feet wide. There are numerous north-south faults cutting the Bald Eagle, usually with only a small amount of offset. This vein extends northeast across Esmeralda Gulch and up Middle Hill.

The Spotted Tiger vein was cut in the two back drifts of the Black Hawk adit and by the northwesterly drill holes from these drifts. The Monarch adit explored the intersection of the Black Hawk and Radical veins just beneath the Spotted Tiger vein.

Samples were cut and assayed as follows:

Spotted Tiger Vein

Sample No.	Adit	Level	Width	Ounces/ton Au	Ag
A-43	Dump	Surface	Grab	0.01	0.63
44	Vein	"	70 inches	tr	0.26
45	Shaft	"	36 "	0.01	0.96
46	Dump	"	Grab	0.16	1.59
47	"	"	"	0.025	1.57
48	Shaft	"	40 inches	0.02	1.08
49	Vein	"	120 "	0.02	1.10
50	"	"	24 "	0.01	0.78
51	Dump	"	Grab	0.01	0.47
52	Shaft	"	36 inches	0.04	0.79
57	Vein	"	64 "	0.18	2.65
58	"	"	64 "	0.02	0.44
59	Dump	"	Grab	0.05	0.44
60	"	"	"	0.015	0.70
61	Vein	"	60 inches	0.01	0.33
62	"	"	48 "	0.03	0.86
63	Dump	"	Grab	0.055	0.38
64	"	"	"	0.01	0.29
80	Vein	"	58 inches	0.03	0.21
81	"	"	44 "	0.04	0.17
82	"	"	60 "	0.05	2.06
83	"	"	24 "	0.05	2.38
84	"	"	28 "	2.02	6.40
85	"	"	30 "	0.04	0.55
86	Dump	"	Grab	0.03	1.59
87	Vein	"	42 inches	0.02	0.45
88	"	"	48 "	0.03	0.97
89	Shaft	"	58 "	0.03	1.71
90	Vein	"	72 "	0.03	1.01
91	"	"	Grab	0.15	3.70
113	"	"	41 inches	0.005	0.47
114	"	"	42 "	0.13	0.86
115	"	"	38 "	0.005	0.61

3-6' widths

33 samples 0.100 oz/t (incl. the 2.oz)
32 " 0.041 oz/t (excl. " ")

Bald Eagle Vein

Sample No.	Adit	Level	Width	Ounces/ton Au	Ag
A-53	Dump	Surface	Grab	0.06	1.67
54	Stope	"	48 inches	0.015	0.82
55	Vein	"	12 feet	0.01	0.25
56	Dump	"	Grab	0.055	0.77
71	Vein	"	54 inches	0.005	0.23
72	"	"	26 "	0.085	0.26
73	"	"	60 "	tr	0.18
74	Dump	"	Grab	0.02	0.53
75	Shaft	"	45 inches	2.40	7.85
116	"	"	31 "	0.005	0.23
117	"	"	32 "	0.03	0.69

Seminole Vein

The South Seminole vein crops out 300 feet northwest of the Spotted Tiger where it strikes N 40°E and dips 35° to 50° southeasterly. It varies in thickness from 30 to 60 inches. It has been cut underground by the Clarence adit at 1,350 feet at the beginning of the silicified zone and by the Monarch adit at 760 feet. The North Seminole vein strikes N 55°E and dips 43° to 52° southeasterly. It varies in thickness from a few inches up to 48 inches. It has been crosscut by the Monarch adit at 540 feet where it has 16 inches of quartz. The following samples were taken and assayed:

North Seminole Vein

Sample No.	Adit	Level	Width	Ounces/ton Au	Ag
Am-3	Monarch	8027	60 inches	tr	0.06
9	"	"	36 "	0.005	0.42
A-94	Dump	Surface	Grab	0.015	0.44
95	"	"	"	0.005	0.20

South Seminole Vein

Sample No.	Adit	Level	Width	Ounces/ton Au	Ag
Am-7	Monarch	8027	48 inches	0.005	0.29
8	"	"	72 "	tr	0.04
A-65	Dump	Surface	Grab	0.25	1.59
66	Vein	"	50 inches	0.04	1.23
67	Dump	"	Grab	0.055	1.36
96	Stope	"	30 inches	0.05	1.69
97	"	"	45 "	0.025	1.26
98	"	"	24 "	0.16	3.68
99	Cut	"	60 "	0.01	0.52

Monarch Vein

The Monarch vein is 550 feet northwest of the Spotted Tiger and strikes N 50°E, dipping 30°-40° SE. It varies in thickness from 36 to 60 inches. Several shallow shafts have explored the quartz vein from the surface. The Monarch adit cuts it at 210 feet where it has 18 to 48 inches of quartz. It was cut again by the Monarch No. 2 adit at 100 feet, and a winze was sunk at an average inclination of -15° for 454 feet to the 7900 level. Here, the vein strikes N 60°E and dips 25°SE, and contains 24 to 30 inches of quartz. The Clarence adit also crosscuts it at 1,060 feet where it is weak. Samples were taken and assayed as follows:

Sample No.	Adit	Level	Width	Ounces/ton Au	Ag
Am-1	Dump	Surface	Grab	tr	0.03
2	Monarch	8027	24 inches	tr	1.24
12	"	"	54 "	0.045	1.72
13	"	"	54 "	0.02	0.10
14	"	"	72 "	0.03	0.22
15	"	"	18 "	0.065	0.61
A-17	Monarch No. 2	8011	60 "	0.04	1.69
18	"	"	30 "	0.04	2.17
19	"	"	36 "	0.085	1.04
20	"	"	36 "	0.065	0.52
21	Monarch Winze	"	42 "	1.19	8.86
22	" "	"	24 "	0.29	3.06
23	" "	"	30 "	0.025	1.36
24	" "	"	38 "	0.025	0.90
25	" "	"	40 "	0.01	0.09
26	" "	"	36 "	0.11	1.82
27	" "	"	36 "	0.01	0.48
28	" "	7900	24 "	0.05	0.28
35	Dream	7810	60 "	0.01	1.01
36	"	"	24 "	0.02	tr
37	"	"	24 "	0.05	0.02
68	Dump	Surface	Grab	0.05	0.51
69	Vein	"	18 inches	0.11	1.52
70	Dump	"	Grab	0.07	0.94
100	Incline Shaft	"	40 inches	0.01	0.57
101	Shaft	"	60 "	0.01	0.14
102	Stope	"	40 "	tr	0.18
103	Incline Shaft	"	26 "	0.02	1.35
104	" "	" (-25')	32 "	0.01	1.04
105	" "	" (-50')	42 "	0.53	5.30
106	" "	" (-75')	77 "	0.02	0.70
107	" "	" (-100')	46 "	0.07	1.23
108	Shaft	"	66 "	0.03	0.48
109	Monarch Winze	8011	36 "	0.05	1.06
110	" "	"	33 "	0.02	2.20
111	Monarch No. 2	"	36 "	0.125	1.92
112	"	"	60 "	0.02	1.56
127	"	"	30 "	0.02	0.35
128	"	"	48 "	0.02	0.26
129	"	"	48 "	0.01	0.81
130	"	"	24 "	0.03	0.97
131	"	"	41 "	0.10	0.48
132	"	"	36 "	0.06	0.93

Cortez-Utah Vein

The Cortez-Utah vein lies 250 feet north of the Monarch and 820 feet north of the Spotted Tiger. It strikes N 45°E and dips 40°-56° SE and is 24 to 36 inches in thickness, but in places opens up to 25 feet wide to form rich ore shoots. It was on this vein that one ore shoot, 20 to 25 feet wide, 50 to 75 feet long, and 150 feet down dip yielded approximately 20,000 tons at a value of $2,000,000 for an averaged value of $100.00 per ton. Five bonanzas were found along a 1500-foot segment of this same vein on the Utah claim which produced 5 million dollars from rich ore.

The Cortez vein was exposed at 240 feet in the Cortez adit where it is 30 to 60 inches in thickness and dips 40°SE. This vein was also cut in the Clarence adit at 800 feet where it was drifted on for 230 feet to the southwest and 220 feet northeasterly. The vein here dips 35° to 45° SE and is 24 to 42 inches wide. A raise was driven to connect with the Cortez 2 NE drift. Some stoping was done. Samples were taken and assayed as follows:

Sample No.	Adit	Level	Width	Ounces/ton Au	Ag
A-118	Utah Dump	Surface	Grab	0.02	0.30
119	" "	"	"	0.17	1.49
120	" "	"	"	0.32	2.52
121	" "	"	"	0.10	1.87
122	" "	"	"	0.01	0.69

Opposition Vein

The Opposition vein strikes N 50°E and dips 30°-35° SE, approximately 220 feet northwest of the Cortez-Utah and 1,100 feet north of the Spotted Tiger. It is 24 to 36 inches in thickness. The Cortez adit cuts this vein at 160 feet where it is 36 to 60 inches wide and dips 45°SE. Samples taken from the vein assayed as follows:

Sample No.	Adit	Level	Width	Ounces/ton Au	Ag
A-123	Vein	Surface	48 inches	0.02	0.30
124	"	"	38 "	0.025	0.16
125	Adit	"	36 "	0.14	0.37
126	Dump	"	Grab	0.045	0.28

Lady Jane Vein

The Lady Jane vein lies 240 feet north of the Opposition vein and 1,320 feet northwest of the Spotted Tiger. It strikes N 45°E but bends to the northeast to strike N 80°E and merges with the Opposition vein at the east endline of the Lady Jane claim. The Lady Jane adit crosscuts this vein at 210 feet where it is 12 to 60 inches in width. It strikes N 50°E and dips 25° to 60° southeasterly. The vein is 18 to 24 inches wide along the raise. Samples were taken and assayed as follows:

Sample No.	Adit	Level	Width	Ounces/ton Au	Ag
A-38	Lady Jane	7790	40 inches	tr	0.26
39	" "	"	54 "	tr	0.10
40	" "	"	42 "	0.03	1.92
41	" "	"	30 "	0.005	0.08
42	" "	"	30 "	0.28	5.37
133	Shaft	Surface(-5')	52 "	tr	0.16

Antelope Vein

The Antelope vein strikes N 88°E and dips 70° southerly. It varies in thickness up to 42 inches, but in places produce bonanza ore shoots averaging $150 to $300 per ton (Payne, 1965, p. 11). It splits into two veins along its eastern end, with the northern split striking N 45°E before curving around to N 88°E. It is exposed in the Eureka adit at 990 feet where it strikes N 70°E and dips 45°SE, and is 24 to 36 inches in thickness. Samples were taken and assayed:

Sample No.	Adit	Level	Width	Ounces/ton Au	Ag
A-134	Open stope	Surface	41 inches	0.04	1.28
135	" "	"	39 "	0.44	10.89
136	" "	"	18 "	0.005	0.43
137	Dump	"	Grab	0.20	1.51
166	Eureka	7603	10 inches	tr	0.21
167	"	"	63 "	0.01	0.27
168	"	"	20 "	0.05	0.42
169	"	"	29 "	0.06	0.89
170	"	"	24 "	0.01	0.11
171	"	"	18 "	0.05	0.84

Hypo Vein

The Hypo vein was cut in the Eureka adit at 400 feet. It strikes N 60°E and dips 45°SE and is 24 to 42 inches in thickness. Samples were taken and assayed as follows:

Sample No.	Adit	Level	Width	Ounces/ton Au	Ag
A-172	Eureka	7603	36 inches	0.045	0.50
173	"	"	45 "	0.03	0.61
174	"	"	18 "	0.22	1.09

Gladiator Vein

The North Gladiator vein lies 250 feet north of the Bald Eagle vein and east of the Radical fault. It curves southeasterly and easterly, dips 30° to 35° southerly, and is up to 42 inches in width. The Gladiator adit cuts it at 620 feet where it strikes N 50°E and dips 70° southeasterly. It contains 14 to 24 inches of quartz.

The South Gladiator vein lies 130 feet north of the Bald Eagle vein, and east of the Radical fault. It strikes N 70°E and dips 56°S, and is 20 inches wide. The Gladiator adit cuts this vein at 820 feet where it strikes N 60°E, dips 25° to 70° southerly, and consists of a stringer zone 30 feet wide. These two veins may be the faulted segments of the Seminole veins. Samples were taken and assayed as follows:

North Gladiator

Sample No.	Location	Level	Width	Ounces/ ton Au	Ag
A-76	Shaft	Surface	42 inches	0.12	0.32
77	Dump	"	Grab	0.15	0.62
78	Vein	"	32 inches	0.05	0.31
79	Dump	"	Grab	0.06	0.29

South Gladiator

A-33	134 Adit	7985	16 inches	0.01	9.93
34	" "	"	9 "	tr	0.05

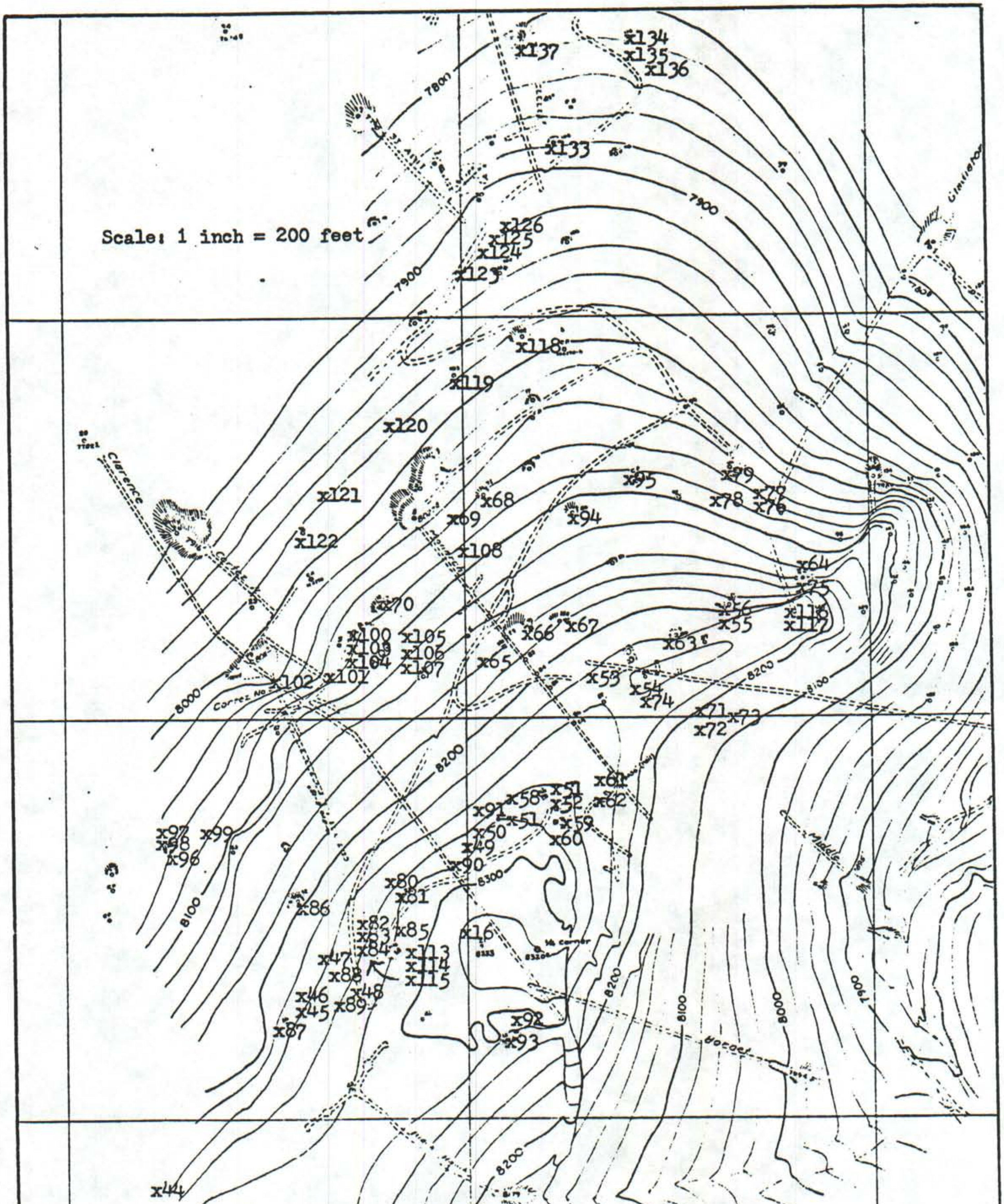

Figure 10 Assay map, surface of Silver Hill, Aurora, Nevada

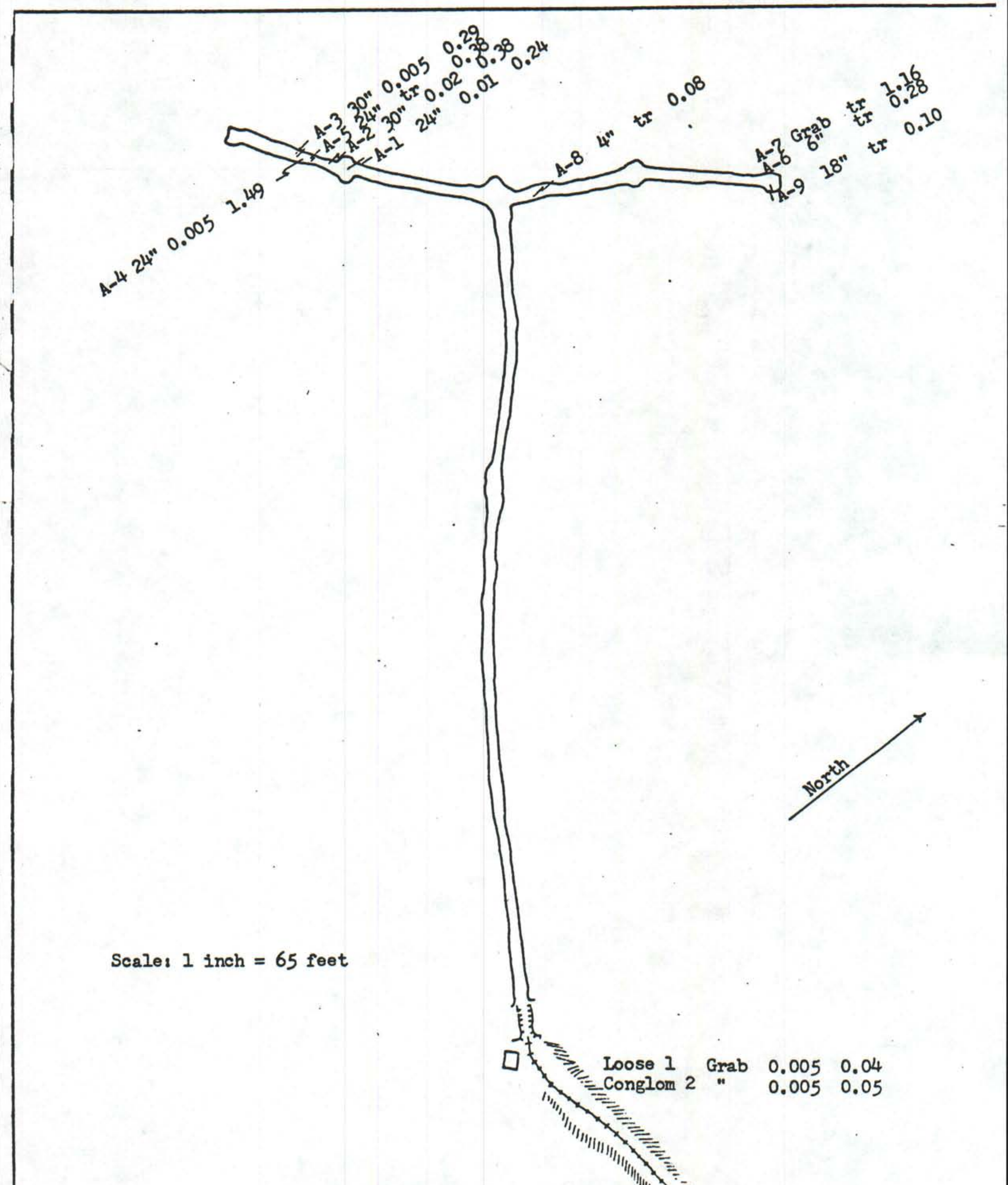

Figure 11 Assay map, Black Hawk adit

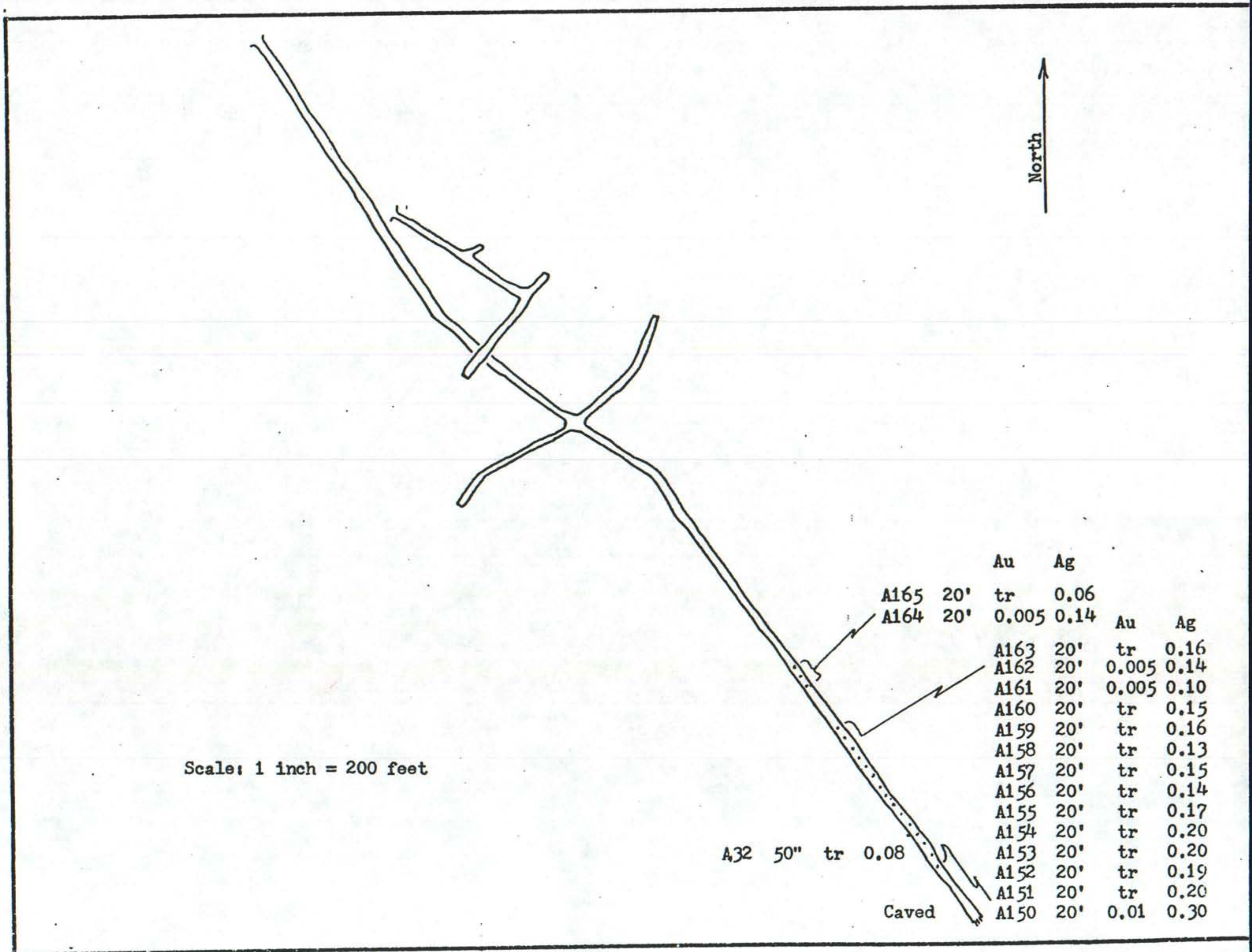

Figure 12 Assay map, Clarence Adit

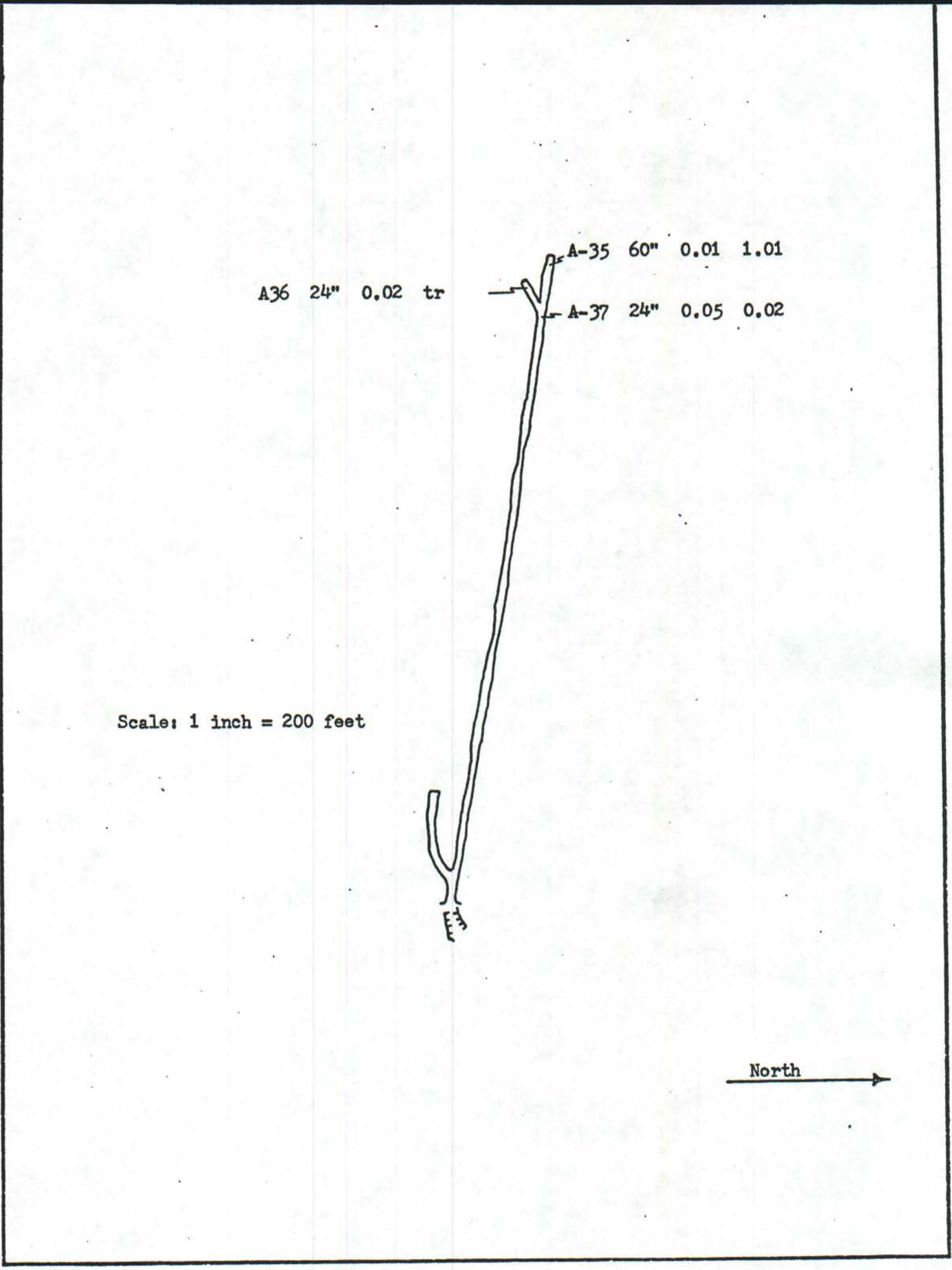

Figure 13 Assay map, Dream Adit

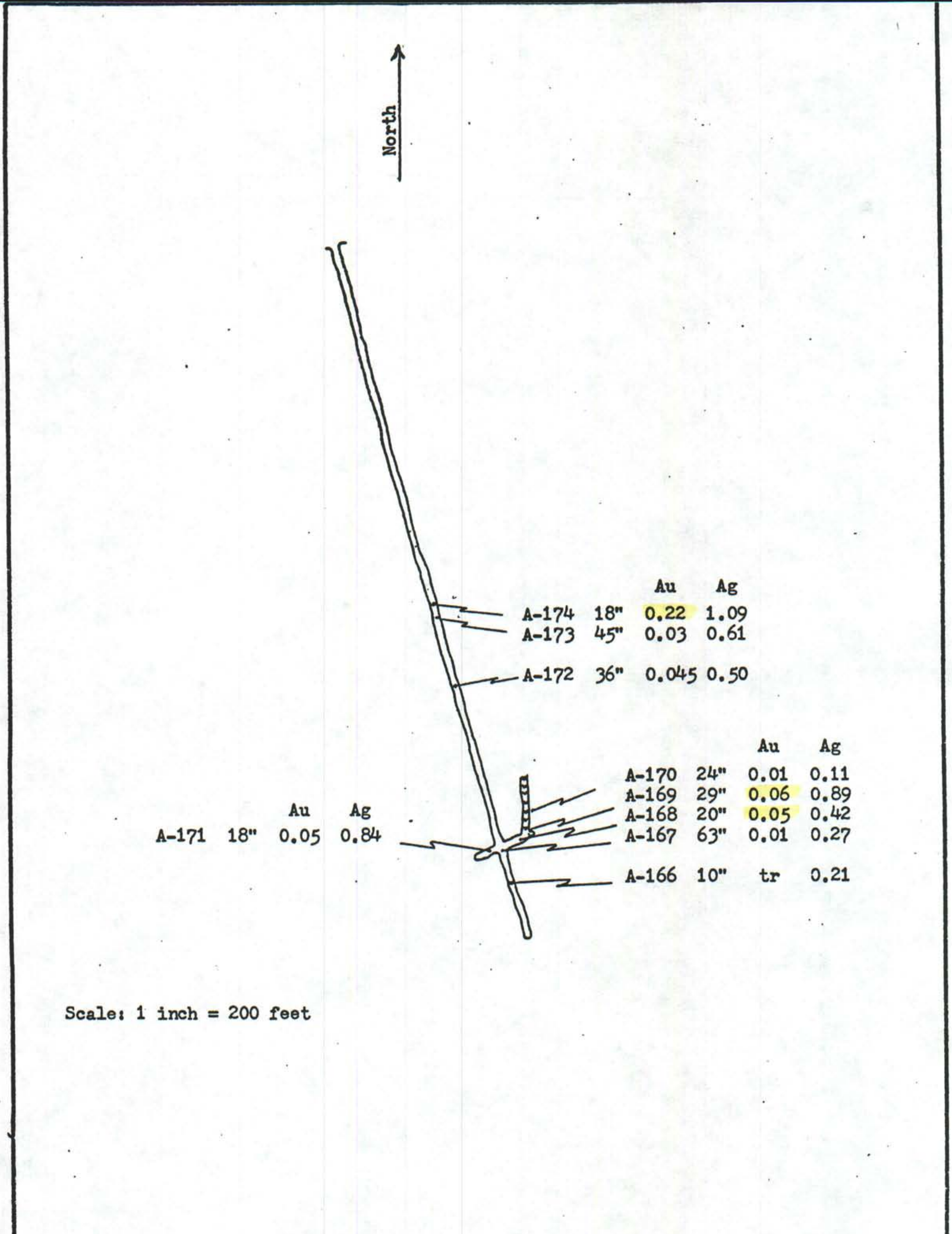

Figure 14 Assay map, Eureka Adit

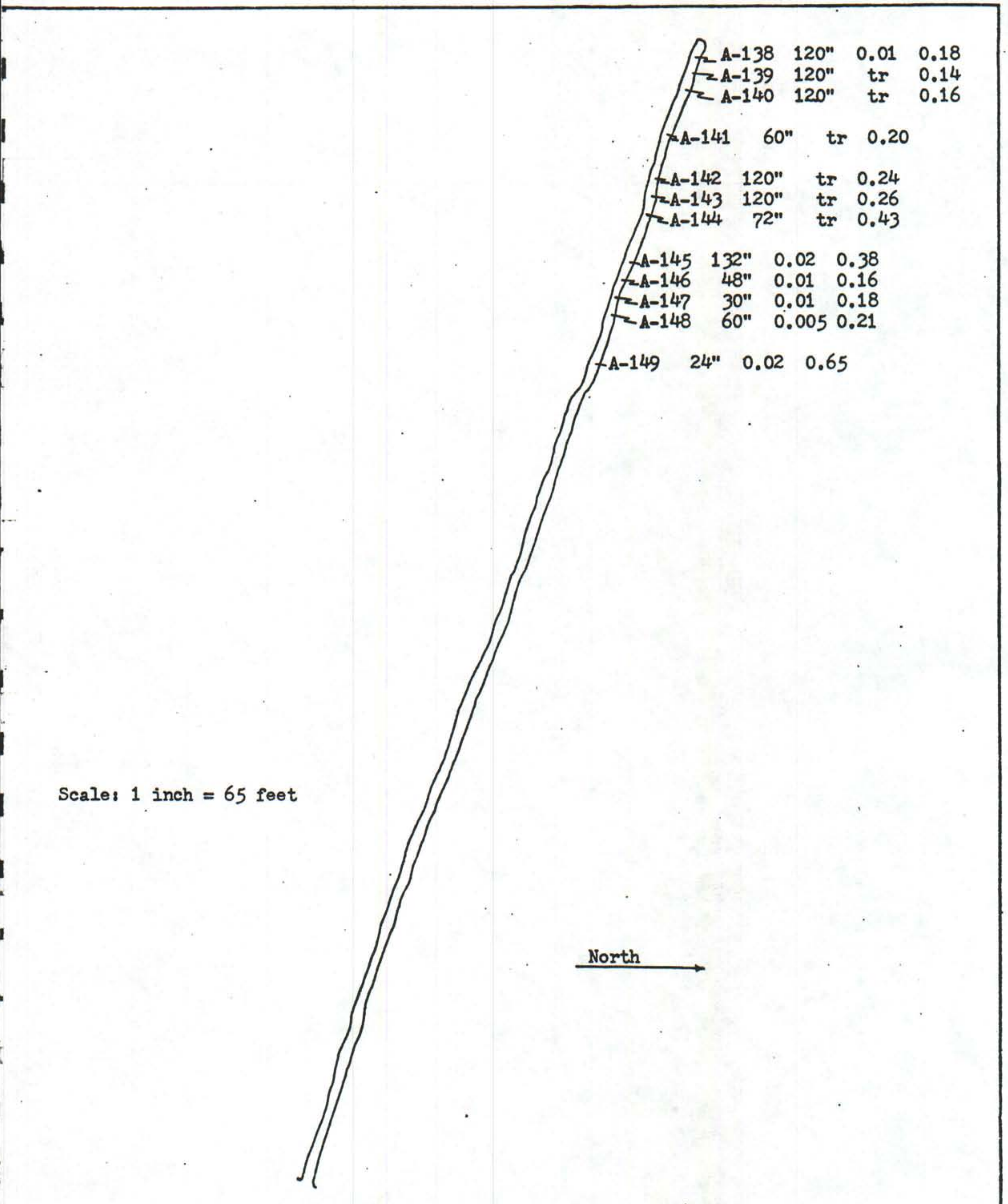

Figure 15 Assay map, Hornet Adit

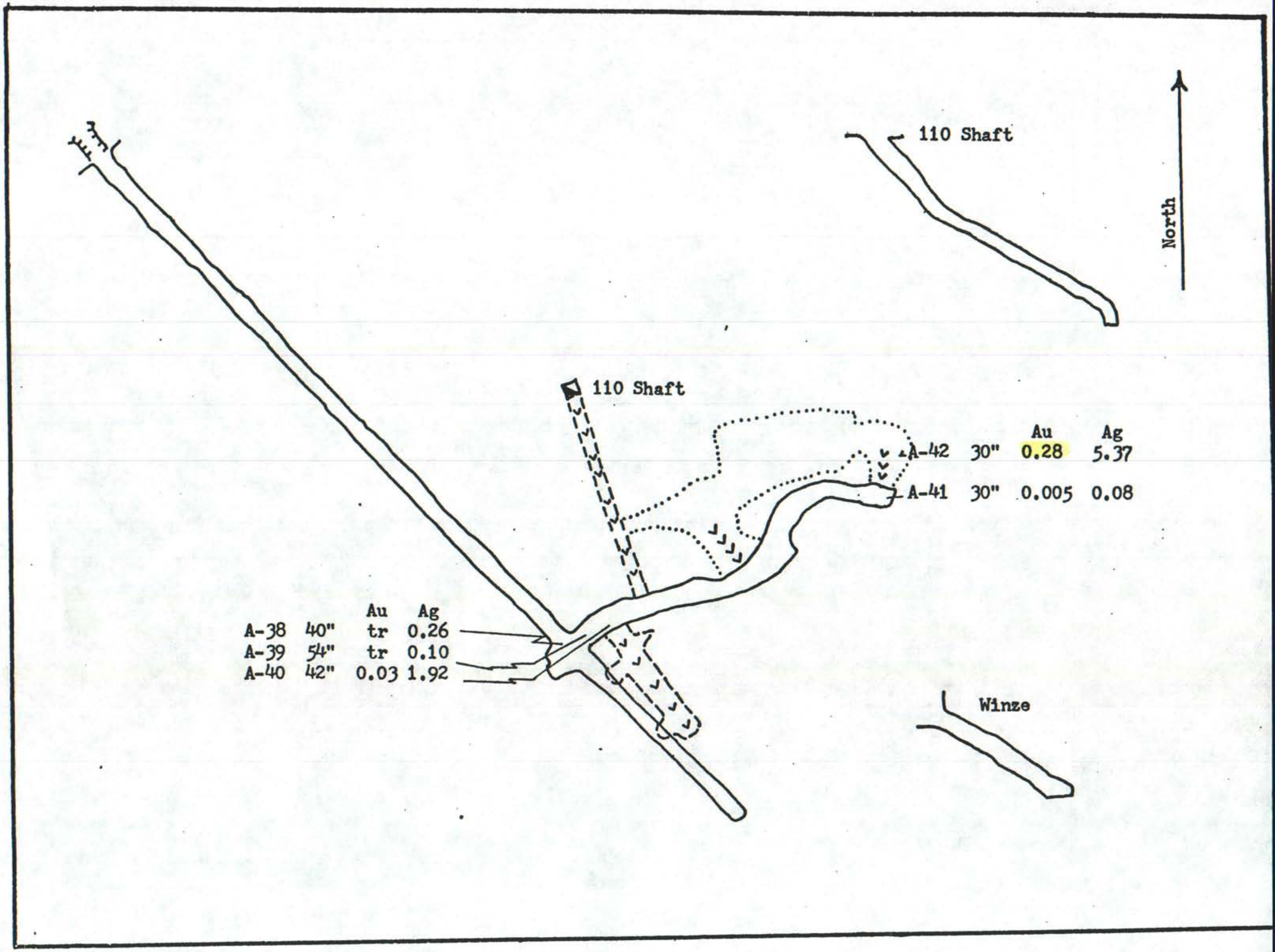

Figure 16 Lady Jane (33) Adit Assay Map

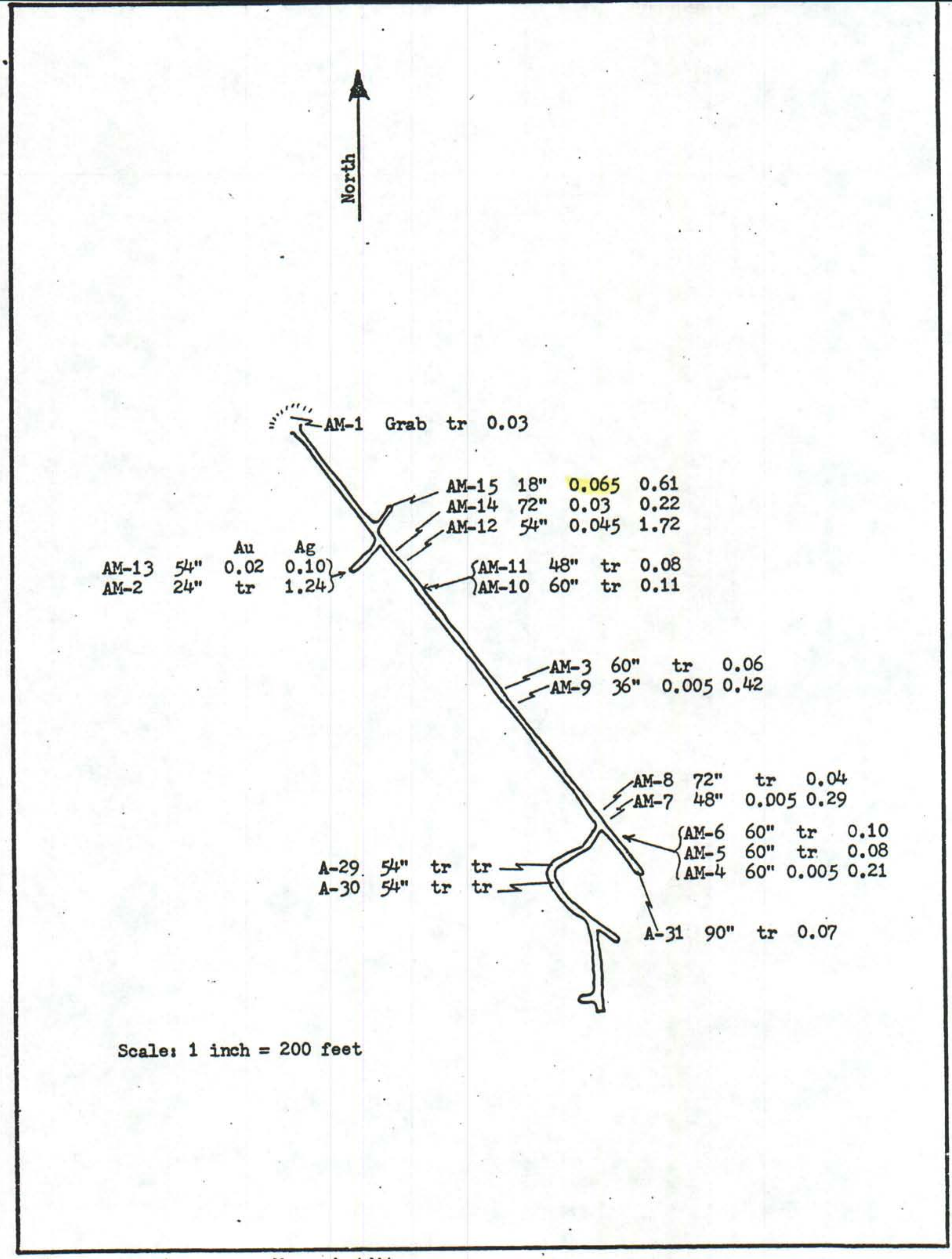

Figure 17 Assay map, Monarch Adit

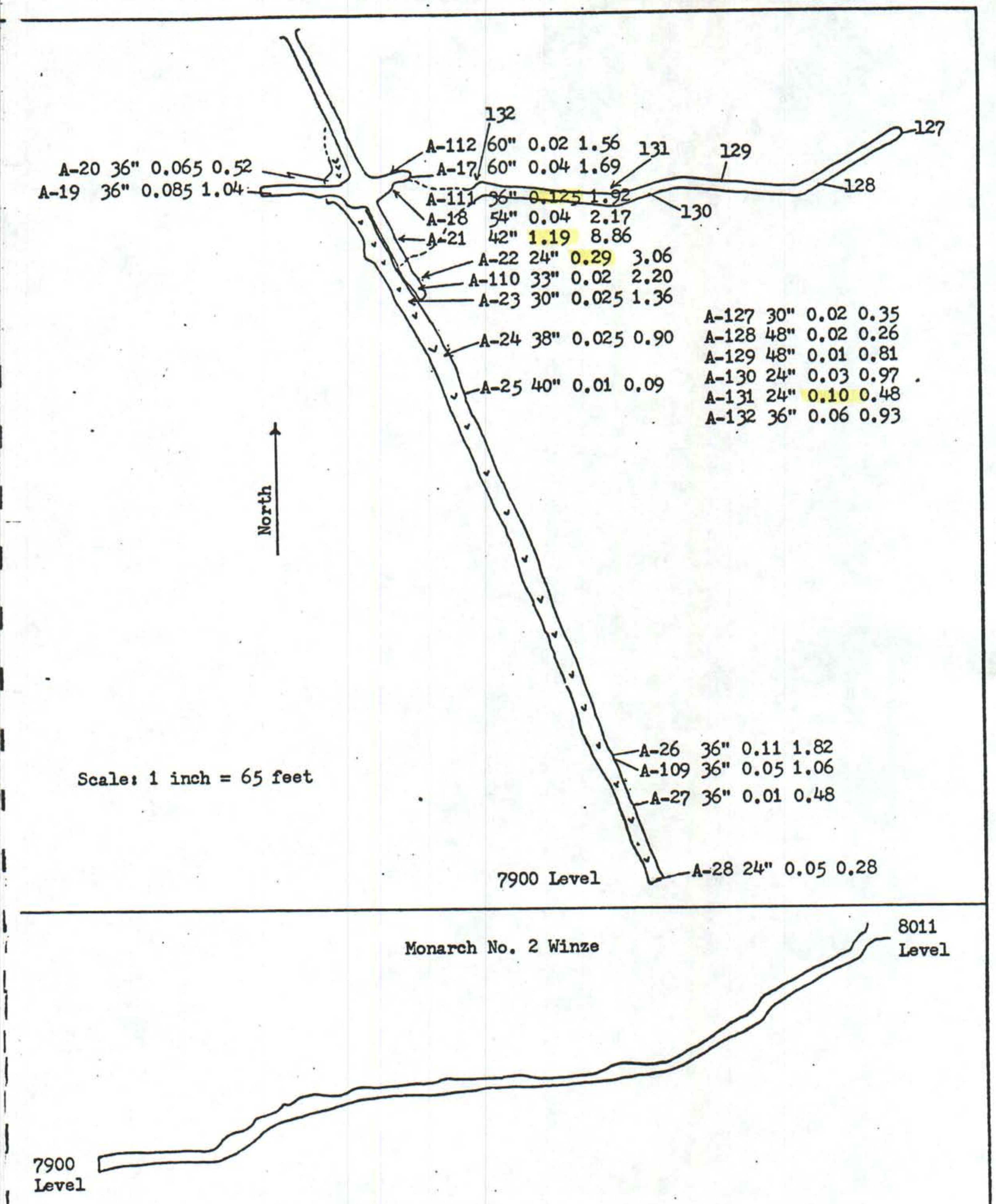

Figure 18. Assay Map, Monarch No. 2 (Cortez No. 2) Adit

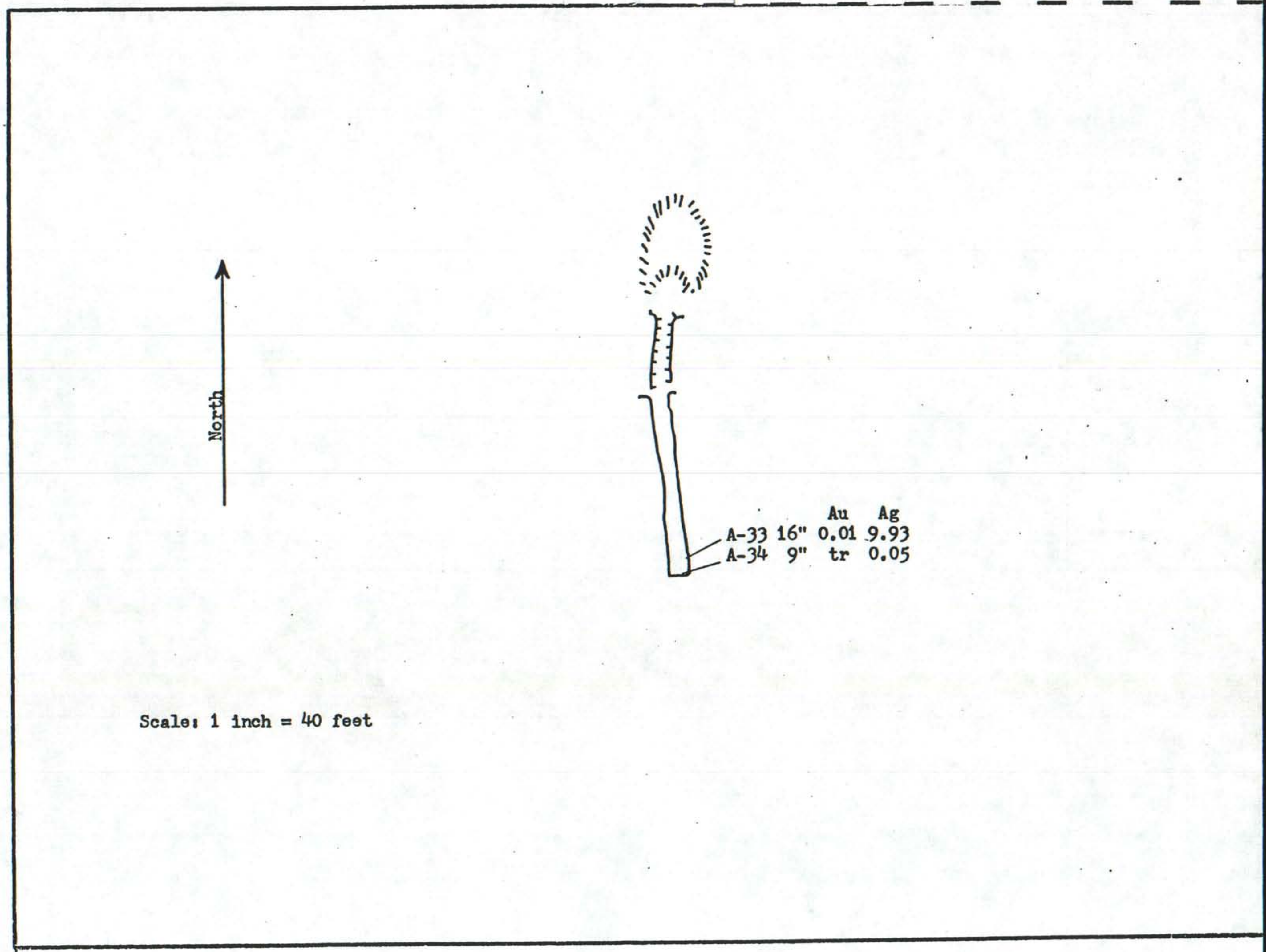

Figure 19. Assay map, 134 Adit

ASSAYS ON AURORA SAMPLES

Sample No.	Description	Ounces/ton Au	Ounces/ton Ag
A-1	2.0' sample from vein in Black Hawk tunnel @ site of holes 5, 6, 7 and 8	0.01	0.24
A-2	2.5' sample above vein, Black Hawk tunnel, 10' west of A-1	0.02	0.38
A-3	Sample of above vein 10' west of above site, Black Hawk tunnel	0.005	0.29
A-4	South half of vein exposed in back of Black Hawk tunnel, 15' west of drill sites 5, 6, 7 and 8	0.005	1.49
A-5	North half of above vein at same location	tr	0.55
A-6	6" vein sample, 25' from east face Black Hawk tunnel	tr	0.28
A-7	Sample of shear zone, 35' from east face Black Hawk tunnel	tr	1.16
A-8	4" sample of vein, 10' east of Black Hawk tunnel	tr	0.08
A-9	1.5' sample of vein @ east face of Black Hawk tunnel	tr	0.10
Am-1	Sample of pyritic quartz from Monarch tunnel dump	tr	0.03
Am-2	2.0' sample of Monarch vein @ face of west drift, Monarch tunnel	tr	1.24
Am-3	5.0' sample of vein on right rib of Monarch tunnel, 550' from portal	tr	0.06
Loose 1	Black Hawk tunnel, dump sample	0.005	0.04
Conglom 2	Black Hawk tunnel, dump sample	0.005	0.05
Am-4	5.0' sample of vein at point 16+74.3, Monarch tunnel	0.005	0.21
Am-5	5.0' sample of vein at point 16+74.3, Monarch tunnel	tr	0.08
Am-6	Same	tr	0.10
Am-7	4.0' sample of vein at point 16+50, Monarch tunnel	0.005	0.29
Am-8	6.0' sample of vein at point 16+45, Monarch tunnel	tr	0.04

Sample No.	Description	Ounces/ton Au	Ag
Am-9	3.0' sample of vein at point 14+50, Monarch tunnel	0.005	0.42
Am-10	5.0' sample of vein at point 12+10, Monarch tunnel	tr	0.11
Am-11	4.0' sample of vein at point 12+5, Monarch tunnel	tr	0.08
Am-12	4.5' sample of faulted Monarch vein at point 11+12, Monarch tunnel	0.045	1.72
Am-13	4.5' sample of Monarch vein at face of west drift, Monarch tunnel	0.02	0.10
Am-14	6.0' sample of vein at point 10+92, Monarch tunnel	0.03	0.22
Am-15	1.5' sample of Monarch vein at face of east drift	0.065	0.61
A-16	Sample of dump on shaft on Silver Hill between arsenic anomalies	0.00	0.04
A-17	5.0' sample of Monarch vein at face of east drift, Monarch No. 2 tunnel	0.04	1.69
A-18	2.5' sample of Monarch vein at water filled shaft east drift, Monarch No. 2 tunnel	0.04	2.17
A-19	3.0' sample of Monarch vein, 3' from face of west drift, Monarch No. 2 tunnel	0.085	1.04
A-20	3.0' sample of Monarch vein, west rib overhand stope, Monarch No. 2 tunnel	0.065	0.52
A-21	42" sample of Monarch vein top of stope off winze, Monarch No. 2 tunnel	1.19	8.86
A-22	24" vert. sample of Monarch vein at bottom of stope off winze, Monarch No. 2 tunnel	0.29	3.06
A-23	30" sample of Monarch vein 50' below stope, Monarch No. 2 winze	0.025	1.36
A-24	38" sample of Monarch vein approx. 40' below A-23, Monarch No. 2 winze	0.025	0.90
A-25	40" sample of Monarch vein at flattening of vein, Monarch No. 2 winze, below sample A-24	0.01	0.09
A-26	36" sample of Monarch vein at top of steepening of vein, below A-25, Monarch No. 2 winze	0.11	1.82

Sample No.	Description	Ounces/ton Au	Ag
A-27	36" sample of Monarch vein at bottom of steepening of vein, below A-26, Monarch No. 2 winze	0.01	0.48
A-28	2.0' sample of Monarch vein at bottom of Monarch No. 2 winze	0.05	0.28
A-29	4.5' sample of vein at turn in southwest drift, Monarch tunnel	tr	tr
A-30	4.5' sample, continuation of above sample	tr	tr
A-31	7.5' sample from face of SE crosscut, Monarch tunnel	tr	0.07
A-32	50" sample of vein, 155' from face of Clarence tunnel	tr	0.08
A-33	16" sample of vein, 6' from face of 134 adit	0.01	9.93
A-34	9" sample of vein at face of 134 adit	tr	0.05
A-35	Lawrence sample 316, from face of Dream tunnel	0.01	1.01
A-36	Lawrence sample 318 from Dream tunnel	0.02	tr
A-37	Lawrence sample 319 from Dream tunnel	0.05	0.02
A-38	40" horizontal sample from Lady Jane at intersection adit and drift, Lady Jane tunnel	tr	0.26
A-39	54" sample from Lady Jane vein at intersection drift and adit	tr	0.10
A-40	42" sample of Lady Jane vein from Lady Jane drift	0.03	1.92
A-41	30" sample of Lady Jane vein at face of Lady Jane drift	0.005	0.08
A-42	Sample of Lady Jane vein, east rib of stope off Lady Jane drift	0.28	5.37
A-43	Sample from dump of inclined shaft located on extreme SW crest of Silver Hill	0.01	0.63
A-44	70" sample of Spotted Tiger vein at extreme SW end	tr	0.26
A-45	36" sample of Spotted Tiger vein 10' below collar of shaft located 70' NE of station 46	0.01	0.96
A-46	Dump sample from above shaft	0.16	1.59
A-47	Dump sample from dump of shaft on Spotted Tiger vein, 160' NE of Station 46	0.025	1.57

Sample No.	Description	Ounces/ton Au	Ag
A-48	40" sample of Spotted Tiger vein, 6' below collar of shaft located 160' NE of Station 46	0.02	1.08
A-49	10' vein sample from Spotted Tiger vein, approx. 95' west of Station 2	0.02	1.10
A-50	24" sample through hanging wall vein off Spotted Tiger vein, approx. 15' south of Station 2	0.01	0.78
A-51	Dump sample, dump at shaft located 125' east of Station 2	0.01	0.47
A-52	36" sample through Spotted Tiger vein at top of inclined shaft 125' east of Station 2	0.04	0.79
A-53	Sample of dump from stope on east Spotted Tiger vein at Station 87	0.06	1.67
A-54	48" sample of Spotted Tiger vein in stope at Station 87	0.015	0.82
A-55	12' chip sample of vein at Station 96	0.01	0.25
A-56	Dump sample at Station 96	0.055	0.77
A-57	64" sample of Spotted Tiger vein, 50' NE of Station 2	0.18	2.65
A-58	Same	0.02	0.44
A-59	Sample of dump of north shaft at intersection of Radical and Spotted Tiger veins, 160' east of Station 2	0.05	0.44
A-60	Sample from south dump, same location as A-59	0.015	0.70
A-61	60" sample of Spotted Tiger vein at workings, 250' NE of Station 2	0.01	0.33
A-62	48" sample of vein 10' below collar of shaft located 240' N 80°E from Station 2	0.03	0.86
A-63	Sample of dump at Station 90	0.055	0.38
A-64	Sample of dump located 35' NE of NW corner Hornet No. 1 mining claim	0.01	0.29
A-65	Sample of dump from shaft to Seminole vein, 90' SW of Station 83	0.25	1.59
A-66	50" sample of Seminole vein, 50' east of Station 23	0.04	1.23
A-67	Sample of dump on Seminole vein, 130' east of Station 23	0.055	1.36

Sample No.	Description	Ounces/ton Au	Ag
A-68	Dump sample on Monarch vein, 160' ESE of Station 7	0.05	0.51
A-69	18" sample of Monarch vein, 170' SE of Station 7	0.11	1.52
A-70	Dump sample on Monarch vein at Station 74	0.07	0.94
A-71	54" vein sample from massive shallow dipping Spotted Tiger vein on SE slope of Silver Hill	0.005	0.23
A-72	26" vein sample, Spotted Tiger, approx. 45' south of A-71	0.085	0.26
A-73	60" sample of Spotted Tiger vein, 45' NE of sample A-71	tr	0.18
A-74	Sample of dump from stope of Spotted Tiger vein, 60' SSE of Station 88	0.02	0.53
A-75	45" sample of 2 sections of vein, 10' below collar of shaft, 50' south of NW corner of Hornet No. 1 claim	2.40	7.85
A-76	42" sample of vein at top of inclined shaft on Gladiator claim between Stations 99 and 100	0.12	0.32
A-77	Sample of dump from shaft at sample A-76	0.15	0.62
A-78	32" sample through vein at winze, 70' south of Station 100	0.05	0.31
A-79	Dump sample at Station 100	0.06	0.29
A-80	58" sample Spotted Tiger vein, 30' north of Station 22	0.03	0.21
A-81	44" sample of Spotted Tiger vein, 20' north of Station 22	0.04	0.17
A-82	60" sample of footwall portion of Spotted Tiger vein at Station 41	0.05	2.06
A-83	24" sample of center portion of Spotted Tiger vein at Station 41	0.05	2.38
A-84	28" sample of hanging wall portion of Spotted Tiger vein at Station 41	2.02	6.40
A-85	30" sample through vein between Station 41 and Station 21	0.04	0.55
A-86	Dump sample at Station 52	0.03	1.59
A-87	42" sample of Spotted Tiger vein, 30' west of Station 46	0.02	0.45

Sample No.	Description	Ounces/ton Au	Ag
A-88	48" sample of Spotted Tiger vein between two shafts located between Stations 41 and 46	0.03	0.97
A-89	58" sample of Spotted Tiger vein, 20' below collar of shaft nearest Station 41	0.03	1.71
A-90	72" sample of footwall portion of Spotted Tiger vein midway between Stations 22 and 2	0.03	1.01
A-91	Grab sample of loose manganiferous, vuggy material from Spotted Tiger vein, 40' east of Station 2	0.15	3.70
A-92	36" sample of Black Hawk vein at shaft near Radical vein	tr	0.33
A-93	Dump sample from dump of above shaft, Black Hawk vein	0.01	0.28
A-94	Dump sample at Station 80	0.015	0.44
A-95	Dump sample, 150' east of Station 80	0.005	0.20
A-96	30" sample of vein, 10' below collar of stope at Station 64, Silver Hill claim (mine)	0.05	1.69
A-97	45" sample of vuggy footwall vein at east edge of stope at Station 64, Silver Hill claim	0.025	1.26
A-98	24" sample of hanging wall vein at Station 64	0.16	3.68
A-99	60" sample of vein in small cut, 60' east of Station 64	0.01	0.52
A-100	40" sample of Monarch vein at collar of incline shaft at Monarch claim discovery monument (D.M.)	0.01	0.57
A-101	60" sample of Monarch vein, 10' below collar of small shaft located between Monarch 2 tunnel and D.M.	0.01	0.14
A-102	40" sample of Monarch vein at surface above Monarch No. 2 tunnel (stope)	tr	0.18
A-103	26" sample of Monarch vein, 25' below collar of inclined shaft at Monarch claim D.M.	0.02	1.35
A-104	32" sample of Monarch vein at bottom of inclined shaft at Monarch claim D.M.	0.01	1.04
A-105	42" sample of Monarch vein at bottom of 1st drift off inclined shaft at Station 74 (50' below collar)	0.53	5.30
A-106	77" sample of Monarch vein, 5' below small stope off inclined shaft at Station 74 (75' below collar)	0.02	0.70

Sample No.	Description	Ounces/ton Au	Ag
A-107	46" sample through Monarch vein, 100' below collar of inclined shaft at Station 74	0.07	1.23
A-108	66" sample of Monarch vein at bottom of small shaft above Monarch tunnel	0.03	0.48
A-109	Sample of Monarch vein from Monarch No. 2 winze, 3' from sample A-26	0.05	1.06
A-110	33" sample through Monarch vein, 12' below A-22, Monarch No. 2 winze	0.02	2.20
A-111	36" sample of Monarch vein, bottom of east rib of stope, Monarch No. 2 tunnel	0.125	1.92
A-112	60" sample of Monarch vein at end of 10' drift off NE corner stope Monarch No. 2 tunnel	0.02	1.56
A-113	41" sample of hanging wall of Spotted Tiger vein, 15' west of Station 46	0.005	0.47
A-114	42" sample of center portion of Spotted Tiger vein, 15' west of Station 46	0.13	0.86
A-115	38" sample of footwall portion of Spotted Tiger vein, 15' west of Station 46	0.005	0.61
A-116	31" sample of hanging wall portion of vein at sample A-75, west rib of shaft, 15' below collar	0.005	0.23
A-117	32" sample of footwall portion of vein at above sample (A-116)	0.03	0.69
A-118	Utah vein dump sample at Station 102	0.02	0.30
A-119	Utah vein dump sample (map)	0.17	1.49
A-120	Utah vein dump sample (map)	0.32	2.52
A-121	Utah vein dump sample (map)	0.10	1.87
A-122	Cortez-Utah vein dump sample at Station 76	0.01	0.69
A-123	48" sample of Opposition vein, 100' west of Station 105 at portal of small drift	0.02	0.30
A-124	38" sample of Opposition vein, approx. 30' north of Station 105	0.025	0.16
A-125	36" sample of Opposition vein 15' inside portal of small drift midway between and 30' north of Stations 105 and 106	0.14	0.37
A-126	Dump sample, approx. 150' N 68°W from Station 106, Opposition vein	0.045	0.28

Sample No.	Description	Ounces/ton Au	Ag
A-127	30" sample of Monarch vein at end of drift off Monarch No. 2 tunnel stope	0.02	0.35
A-128	48" sample of Monarch vein, 50' from face of above drift	0.02	0.26
A-129	48" sample of Monarch vein, 100' from face of above drift	0.01	0.81
A-130	24" sample of Monarch vein, 150' from face of above drift	0.03	0.97
A-131	41" sample of Monarch vein, 200' from face of above drift	0.10	0.48
A-132	36" sample of Monarch vein, 250' from face, 20' from stope, above drift	0.06	0.93
A-133	52" sample of Lady Jane vein, 5' below collar of shaft at Station 108	tr	0.16
A-134	41" sample of hanging wall portion of Antelope vein, east side of road at edge of stope	0.04	1.28
A-135	39" sample of footwall portion of Antelope vein at above location	0.44	10.89
A-136	18" sample of hanging wall vein, Antelope stope, east side of road	0.005	0.43
A-137	Antelope dump sample	0.20	1.51
A-138	10' sample from south rib of Hornet tunnel, 0' - 10' from face	0.01	0.18
A-139	Sample from south rib of Hornet tunnel, 10' - 20' from face	tr	0.14
A-140	Sample from south rib of Hornet tunnel, 20' - 30' from face	tr	0.16
A-141	Sample from south rib of Hornet tunnel, 55' - 60' from face	tr	0.20
A-142	Sample from south rib of Hornet tunnel, 73' - 83' from face	tr	0.24
A-143	Sample from south rib of Hornet tunnel, 83' - 93' from face	tr	0.26
A-144	Sample from south rib of Hornet tunnel, 93' - 99' from face	tr	0.43
A-145	Sample from south rib of Hornet tunnel, 119' - 130' from face	0.02	0.38

Sample No.	Description	Ounces/ton Au	Ag
A-146	Sample from south rib of Hornet tunnel, 136' - 140' from face	0.01	0.16
A-147	Sample from south rib of Hornet tunnel, 145.5' - 148' from face	0.01	0.18
A-148	Sample from south rib of Hornet tunnel, 156' - 161' from face	0.005	0.21
A-149	Sample from south rib of Hornet tunnel, 201' - 203' from face	0.02	0.65
A-150	Clarence tunnel, 83 - 103' from tunnel face	0.01	0.30
A-151	Clarence tunnel, 103 - 123' from face	tr	0.20
A-152	Clarence tunnel, 123 - 143' from face	tr	0.19
A-153	Clarence tunnel, 143 - 163' from face	tr	0.20
A-154	Clarence tunnel, 163 - 183' from face	tr	0.20
A-155	Clarence tunnel, 183 - 203' from face	tr	0.17
A-156	Clarence tunnel, 203 - 223' from face	tr	0.14
A-157	Clarence tunnel, 223 - 243' from face	tr	0.15
A-158	Clarence tunnel, 243 - 263' from face	tr	0.13
A-159	Clarence tunnel, 263 - 283' from face	tr	0.16
A-160	Clarence tunnel, 283 - 303' from face	tr	0.15
A-161	Clarence tunnel, 303 - 323' from face	0.005	0.10
A-162	Clarence tunnel, 323 - 343' from face	0.005	0.14
A-163	Clarence tunnel, 343 - 363' from face	tr	0.16
A-164	Clarence tunnel, 443 - 463' from face	0.005	0.14
A-165	Clarence tunnel, 463 - 483' from face	tr	0.06
A-166	Eureka adit, 10" sample of vein in ext. of adit, 60' south of drift on Antelope vein	tr	0.21
A-167	Eureka adit, 63" sample of Antelope vein at intersection of drift and adit	0.01	0.27
A-168	Eureka adit, 20" sample of Antelope vein midway between intersection and foot of raise	0.05	0.42
A-169	Eureka adit, 29' sample of Antelope vein at foot of raise	0.06	0.89

Sample No.	Description	Ounces/ton Au	Ag
A-170	Eureka adit, 24" sample of Antelope vein, approx. 50' above drift (from raise)	0.01	0.11
A-171	Eureka adit, 18" sample of Antelope vein, 20' west of drift - adit intersection	0.05	0.84
A-172	Eureka adit, sample of small vein, 250' north of drift - adit intersection	0.045	0.50
A-173	Eureka adit, 45" sample of vein, west rib of winze, 350' north of drift - adit intersection	0.03	0.61
A-174	Eureka adit, 18" sample of above vein, east rib of adit	0.22	1.09

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REPORT OF ANALYSIS

JOB NO. UPK 001
January 5, 1984
EDMOND F. LAWRENCE
ST-1 TO OMCO-6
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Mr. Edmond F. Lawrence
301 Whispering Hills North
Hot Springs, Arkansas 71901

Analysis of 99 Rock Chip Samples

ITEM	SAMPLE NUMBER	Au (ppm)	Ag (ppm)	Sb (ppm)
1	ST-1	.11	17.0	75.
2	ST-2	.14	13.0	55.
3	ST-3	.03	1.8	14.
4	ST-4	.08	1.0	<2.
5	ST-5	.10	2.6	100.
6	ST-6	.20	9.2	350.
7	ST-7	.07	1.8	40.
8	ST-8	.12	3.2	65.
9	ST-9	4.30	26.0	415.
10	ST-10	.13	13.0	18.
11	ST-11	1.60	44.0	280.
12	ST-12	.07	2.6	34.
13	ST-13	.18	14.0	44.
14	ST-14	.20	12.0	2.
15	ST-15	.14	9.8	2.
16	ST-16	.26	32.0	24.
17	ST-17	.17	6.6	2.
18	ST-18	1.50	50.0	4.
19	ST-19	1.80	65.0	4.
20	ST-20	.11	18.0	2.
21	ST-21	.29	11.0	2.
22	ST-22	.03	1.8	2.
23	ST-23	.05	1.8	14.
24	ST-24	2.40	34.0	10.
25	ST-25	.14	18.0	2.

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ITEM	SAMPLE NUMBER	Au (ppm)	Ag (ppm)	Sb (ppm)
26	ST-26	1.20	40.0	70.
27	W-1	2.80	6.6	6.
28	W-2	.17	.4	2.
29	W-3	.04	1.2	<2.
30	W-4	.03	1.2	<2.
31	W-5	<.02	.2	<2.
32	W-6	.08	.2	<2.
33	W-7	.06	.4	<2.
34	W-8	.04	.4	<2.
35	W-9	.10	3.4	2.
36	W-10	<.02	.2	2.
37	W-11	.08	2.8	2.
38	W-12	<.02	.4	2.
39	W-13	.18	.8	<2.
40	W-14	.13	.6	<2.
41	W-15	.03	.6	<2.
42	W-16	.30	3.4	<2.
43	W-17	.32	1.2	2.
44	W-18	<.02	.2	<2.
45	W-19	<.02	.6	<2.
46	W-20	<.02	.2	<2.
47	W-21	.10	.4	<2.
48	W-22	.13	1.2	2.
49	W-23	.03	1.2	<2.
50	W-24	.04	.6	<2.

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ITEM	SAMPLE NUMBER	Au (ppm)	Ag (ppm)	Sb (ppm)
51	W-25	.14	2.0	20.
52	W-26	.33	11.0	<2.
53	W-27	1.00	3.4	<2.
54	W-28	.27	8.4	<2.
55	W-29	.03	.8	<2.
56	W-30	.12	1.0	<2.
57	W-31	<.02	.2	<2.
58	W-32	.54	8.4	8.
59	W-33	.05	1.8	2.
60	W-34	.03	.4	<2.
61	W-35	9.90	55.0	14.
62	W-36	.10	1.0	<2.
63	W-37	.03	1.0	<2.
64	W-38	.04	6.8	4.
65	W-39	<.02	1.4	<2.
66	W-40	.03	.8	<2.
67	W-41	.04	.8	<2.
68	W-42	.13	<.2	<2.
69	W-43	.06	.4	<2.
70	W-44	<.02	.4	<2.
71	W-45	.15	.8	<2.
72	W-46	.19	1.8	2.
73	W-47	.30	.2	<2.
74	W-48	.28	.2	<2.
75	W-49	<.02	1.4	<2.

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ITEM	SAMPLE NUMBER	Au (ppm)	Ag (ppm)	Sb (ppm)
76	W-50	.14	28.0	6.
77	W-51	2.10	10.0	2.
78	W-52	.10	.4	4.
79	W-53	.35	2.0	190.
80	W-54	<.02	.2	<2.
81	W-55	.04	2.0	<2.
82	W-56	.09	.6	<2.
83	W-57	.07	.6	<2.
84	W-58	<.02	.4	<2.
85	W-59	<.02	.4	<2.
86	W-60	<.02	1.4	<2.
87	W-61	1.30	6.2	<2.
88	W-62	.37	14.0	16.
89	W-63	.69	16.0	10.
90	W-64	.18	.4	<2.
91	W-65	.23	4.6	<2.
92	W-66	.13	2.4	<2.
93	OMCO-2-1	.03	1.8	46.
94	OMCO-2-2	<.02	.2	32.
95	OMCO-2-3	.05	.2	8.
96	OMCO-2-4	<.02	.2	8.
97	OMCO-2-5	<.02	.2	2.
98	OMCO-2-6	.37	.4	10.
99	RED-1	.83	20.0	2.

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ITEM	SAMPLE NUMBER	As (ppm)	Hg (ppm)	W (ppm)
1	ST-1	630.	.55	4.
2	ST-2	470.	.55	4.
3	ST-3	130.	.40	2.
4	ST-4	20.	.02	8.
5	ST-5	1600.	.85	2.
6	ST-6	2400.	2.80	2.
7	ST-7	900.	.55	12.
8	ST-8	9600.	.19	10.
9	ST-9	1100.	>5.00*	10.
10	ST-10	100.	.14	8.
11	ST-11	2700.	4.10	8.
12	ST-12	460.	.36	6.
13	ST-13	70.	.22	8.
14	ST-14	40.	.16	290.
15	ST-15	90.	.02	6.
16	ST-16	110.	.26	8.
17	ST-17	130.	.08	6.
18	ST-18	20.	.07	6.
19	ST-19	20.	.02	10.
20	ST-20	30.	.03	8.
21	ST-21	30.	.06	6.
22	ST-22	290.	.13	6.
23	ST-23	690.	.11	8.
24	ST-24	30.	.04	4.
25	ST-25	50.	.03	10.

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Arizona Registered Assayer No. 9427

William L. Lehmbeck
Arizona Registered Assayer No. 9425

James A. Martin
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ITEM	SAMPLE NUMBER	As (ppm)	Hg (ppm)	W (ppm)
26	ST-26	550.	.55	2.
27	W-1	660.	.12	6.
28	W-2	<10.	.01	2.
29	W-3	<10.	.07	4.
30	W-4	20.	.02	2.
31	W-5	20.	.03	2.
32	W-6	<10.	.05	2.
33	W-7	20.	.05	2.
34	W-8	50.	.04	6.
35	W-9	50.	.09	8.
36	W-10	40.	.03	4.
37	W-11	60.	.05	4.
38	W-12	10.	.04	<2.
39	W-13	60.	.03	4.
40	W-14	90.	.04	4.
41	W-15	100.	.10	2.
42	W-16	40.	.05	6.
43	W-17	150.	.03	4.
44	W-18	20.	.01	2.
45	W-19	90.	.09	8.
46	W-20	<10.	.02	6.
47	W-21	90.	.09	4.
48	W-22	160.	.01	16.
49	W-23	20.	.02	6.
50	W-24	80.	.02	12.

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ITEM	SAMPLE NUMBER	As (ppm)	Hg (ppm)	W (ppm)
51	W-25	670.	.07	6.
52	W-26	30.	.40	2.
53	W-27	130.	.01	8.
54	W-28	150.	.05	4.
55	W-29	50.	.03	4.
56	W-30	50.	.05	2.
57	W-31	30.	.09	2.
58	W-32	190.	.44	4.
59	W-33	160.	.05	12.
60	W-34	20.	.03	2.
61	W-35	160.	.06	2.
62	W-36	50.	.06	4.
63	W-37	80.	.02	2.
64	W-38	90.	.12	6.
65	W-39	40.	.03	12.
66	W-40	70.	.02	6.
67	W-41	80.	.03	6.
68	W-42	40.	.02	2.
69	W-43	90.	.02	2.
70	W-44	60.	.14	2.
71	W-45	190.	.05	6.
72	W-46	220.	.05	8.
73	W-47	40.	.10	4.
74	W-48	10.	.09	2.
75	W-49	20.	.03	10.

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ITEM	SAMPLE NUMBER	As (ppm)	Hg (ppm)	W (ppm)
76	W-50	80.	.06	8.
77	W-51	230.	.09	8.
78	W-52	340.	.05	12.
79	W-53	4400.	.04	14.
80	W-54	50.	.03	4.
81	W-55	60.	.03	6.
82	W-56	90.	.09	10.
83	W-57	110.	.05	6.
84	W-58	20.	.10	4.
85	W-59	30.	.06	4.
86	W-60	50.	.05	<2.
87	W-61	120.	.03	4.
88	W-62	320.	.06	2.
89	W-63	220.	.55	2.
90	W-64	30.	.03	2.
91	W-65	60.	.02	2.
92	W-66	110.	.10	2.
93	OMCO-2-1	1000.	.09	8.
94	OMCO-2-2	540.	.03	4.
95	OMCO-2-3	60.	.03	4.
96	OMCO-2-4	140.	.09	4.
97	OMCO-2-5	50.	.06	4.
98	OMCO-2-6	280.	.01	6.
99	RED-1	20.	.50	2.

*NOTE: Greater than normal geochemical range.
Please advise if further assay is needed.

cc: Mr. Alexander von Hafften
3898 Washington Street
San Francisco, California 94118

SUPPLEMENTAL MAP PORTFOLIO

Detailed underground geologic mapping was accomplished in most of the adits on Silver Hill. These maps have been filed in a separate supplemental portfolio, copies of which are available upon request. These maps are as follows:

1 inch = 40 feet

Black Hawk Adit
Dream Adit
Gladiator Adit
Hornet Adit
Lady Jane (33) Adit
Middle Adit
Monarch Adit
Monarch No. 2 (Cortez No. 2) Adit
134 Adit
North
South

1 inch = 200 feet

Clarence Adit
Cortez Adit
Eureka Adit

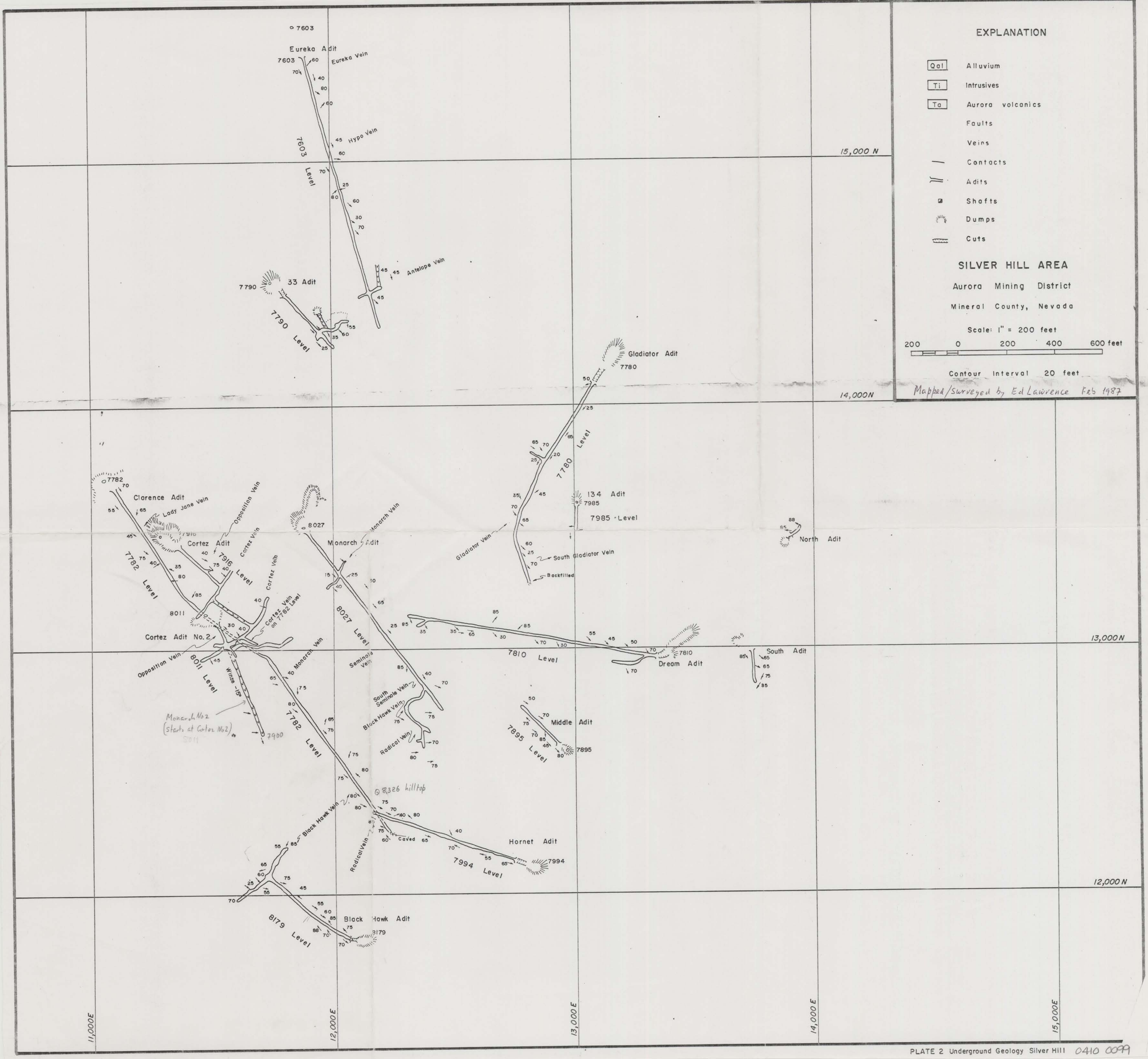
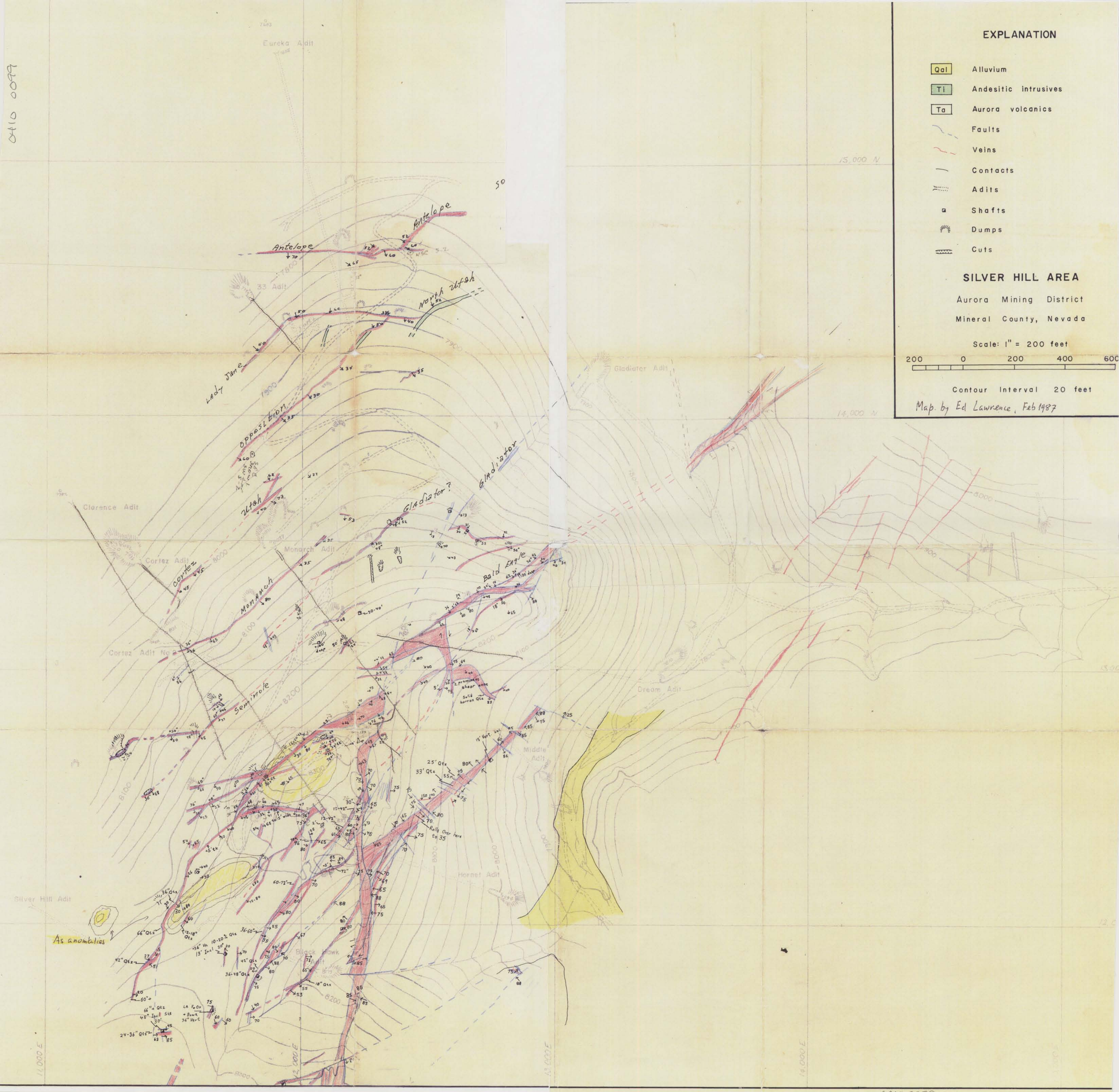


PLATE 2 Underground Geology Silver Hill 0410 0099



0410 0099 Plate I Geologic Map