

ANTHONY PAYNE
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Geologic Report

on the

OLYMPIC GOLD MINE

Bell Mining District

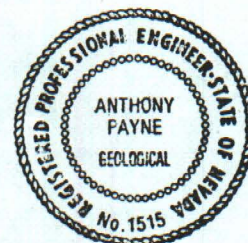
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Mineral County, Nevada

15 September 1988

by

Anthony Payne



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INTRODUCTION

In the past few years underground exploration at Olympic and FMC Corporation's discovery of the Paradise gold-silver mine have focused attention on the possibility of bulk-mineable precious metal ore at Olympic.

This report summarizes the history of the Olympic mine, describes the geology of the district, outlines exploration potential, and makes recommendations for drilling twenty vertical drill holes. The object of the proposed program is discovery of a volcanic-hosted gold-silver ore deposit that can be mined by open pit methods and treated by cyanidation.

Copies of old maps, several private reports, all relevant published reports, property information, and other data are contained in a loose-leaf "Olympic facts file" available for inspection in Reno.

The geology of the district was mapped in late August and early September, 1988, and is shown on the geologic map (in pocket).





Photograph 1. Looking south-southeast at Olympic Mine.

Center: headframe.

Left Center: cyanide plant foundation.

Left Foreground: tailings dam.

Right Foreground: decline dump. Red mineral in pile on top.

Right: old camp site.

Upper Right: FMC drill site on Main Ridge. No hole drilled here.

Taken from 10,520 N, 9,920 E.

LOCATION

The Olympic mine is situated low on the northernmost end of the Cedar Mountains, in Mineral County, Nevada, in Sections 29 and 30, T. 9 N., R. 37 E., MDM. It is 30 km airline northeast of Luning and 27 km south of Gabbs. It may be reached from Luning, on U. S. Highway 95, by driving 33 km northeast on paved State Route 23 to Stinson Well, thence southeast up Finger Rock Wash on graded USBLM road 12 km to jeep trail turn-off, east 8 km to the mine. From Gabbs, on State Route 23, Olympic is reached by driving 6 km southwest to the turn-off at Kelley's Well, thence 6 km southeast on graded State Route 89 to the turn-off near Indian Wells, thence 11 km south to the mine. These roads and topographic features are shown on the Ione Valley 1:100,000 topographic map (in pocket).

PHYSICAL FEATURES

The north end of the Cedar Mountains is shown on the Stewart Spring 7½-minute quadrangle (in pocket). Low rounded ridges of pre-ore Tertiary volcanics are flanked to the west, north, and east by post-ore fluvial and lacustrine sediments and by post-ore volcanics. To the south, post-ore basalt flows overlie the mineralized terrain. A badlands topography is developed on the Tertiary lake beds, where dissected fanlomerate-capped terraces slope northward away from the mountains. The arroyos drain into the large playa basin of Gabbs Valley 30 km to the north, contained within the 1450 m closed contour. The Olympic mine area is at 1750 to 1950 m elevation.

Vegetation is the northern desert shrub "Little Greasewood-Shadscale" association once called "the fag end of vegetable creation" by Mark Twain. Scattered Utah Juniper (*Juniperus osteosperma*) are often found as lone individuals, but more commonly in groves of a hundred or more trees. The shrubs and grasses are: Sagebrush (*Artemisia arbuscula*), Rabbitbrush (*Chrysothamnus nauseosus*), Shadscale (*Atriplex confertifolia*), Little Greasewood (*Sarcobatus baileyi*), Mormon Tea (*Ephedra nevadensis*), Indian Rice Grass, etc.

The nearest important volcanic-hosted gold-silver mining districts are; Paradise and Rawhide to the north, Round Mountain to the east, Tonopah to the south, and Aurora and Borealis to the west. They are shown on the index map on page 2.

No adequate local water supply was developed near the mine during the productive years. In 1917-1921 water was piped by gravity line from springs near Little Pilot Peak, 10 km to the southeast. In the 1930's water was obtained from the Simon Shaft, 5 km to the south-southeast. The pipe was taken up as scrap during World War II. It would be necessary to drill a well into the lake beds north of the mine. Some idea of the depth to water can be learned by researching State records for Granny Goose, Indian, and Antone wells. The nearest power is the line from Luning to the Paradise mine, which crosses Finger Rock Wash 15 km northwest of Olympic.

There are no permanent inhabitants at or near Olympic-- the mine and nearby properties have been abandoned since the World War II years. The area is remote and desolate. Limited facilities are available in Gabbs, but a large work force would commute from Hawthorne.

The USBLM has identified no particular scenic, recreational, or historical values. The land is marginal for cattle raising. Mining is designated as an approved use.

PRODUCTION

About 35,000 metric tons of ore was mined at Olympic, most of it by Olympic Mines Company during the years 1917-1921. The remainder was taken by leasers, mainly during the period 1931-1942 after the Roosevelt gold price increases. The ore averaged about 30 grams of gold and 30 grams of silver, recovered, per metric ton, for a total of a little more than 2 tons of bullion, half gold, half silver. At present prices, Olympic's gross production is worth about \$15 million in gold and a quarter of a million dollars in silver*. At the time of production the gross value was about \$800,000.

The last mining at Olympic was in early 1942, when leasers shipped 80 metric tons of ore to a custom cyanide plant, from which 2.5 kg of gold and 2 kg of silver was recovered.

*Note: See appended metric-troy gold and silver price conversion tables.

HISTORY

Discovery (1915)

The Olympic ore shoot was discovered in May of 1915 by the careful prospecting of James P. Nelson, who had located the Royal George lode mining claims over the showings six months earlier (Siebert, 1917). During the excitement in central Nevada following the discovery of Tonopah and Goldfield, the ground at Olympic had been located several times before, but the rights had been allowed to lapse. After doing initial development work underground on the ore shoot, Nelson optioned the claims to Fred J. Siebert, Goldfield mining engineer and promoter.

Olympic Mines Company (1917-1921)

Siebert formed the Olympic Mines Company, which was mainly financed by San Franciscans Andrew Carrigan, E. G. McConnell, and G. J. Panario. The mine was developed in 1916 and a 65 mtpd counter current decantation cyanide plant put into operation in 1917. The mill burned down in 1919 and was replaced by a slightly larger one of similar design in 1920. The mine was shut down in 1921 when the ore was worked out. During the period of Olympic Mines Company operation, a few shipments of high grade ore were sent to smelter.

Leasers (1921-1942)

During the 1920's Olympic Mines Company attempted to interest an established mining company in taking over the property. Nothing came of this, for it was essentially an exploration proposition. A number of reports by mining experts such as Hershey, Fredrickson, Fred Searles Jr., Simpkins, Clark, and Grant were written 1916-1921. They focused on the possibility of finding the offset vein, which had been lost on a fault. Little exploration was done at the time, except for crosscutting into hanging and foot wall with the idea of finding an entirely new vein. Recent geologic work indicates that the heading in the foot wall on the 200 level may have gone into Tertiary lake beds where they are downthrown on a post-ore fault (see 1:1,000 map and sections, in pocket). The crosscut into the hanging wall on the 150 level was apparently stopped just short of a separate vein which has been mapped on the surface. The

property was given over to a series of leasers until 1929, when it was sold at tax sale by Mineral County. From 1929 to early 1942 leasers continued to rob pillars, draw fill from old stopes, and mine low grade left by early operators. An unknown but apparently considerable amount of dead work was done underground at this time. These workings are not shown on any of the maps which have been found to date. Contemporary accounts indicate that leasing was profitable neither for owner nor for leaser.

The underground workings were damaged slightly and the mill was badly damaged during an intense earthquake on 20 December 1932 (Gianella and Callaghan, 1934, p. 370). During the 1930's and likely again on later occasions, cloudbursts washed surface debris into the mine through raises where dirt had been passed underground for use as stope fill. At the outbreak of World War II the workings were described as requiring major rehabilitation if underground exploration was to be done. The main shaft and raises to the surface are now caved, no entry underground has been made for 20 years or more.

Inactive Years (1942-1979)

There is no record of significant exploration, development, or production at Olympic during the period 1942-1979. The mine could not have operated during World War II under the constraints of War Production Board limiting order LP-208. Constant inflation of operating costs in the postwar period made gold mining ever less attractive under the fixed U.S. Government \$35 gold price.

Alexander von Hafften

In 1965 Alexander von Hafften of San Francisco staked claims in the upland bed rock area southwest of the Olympic mine. At that time, the Royal George claim group over the old mine was claimed by an individual from Fallon. Beginning about 10 years ago, when higher precious metal prices renewed interest in Nevada gold and silver, a series of corporate claimants have staked east, south, and west of the

von Hafften ground. Because Mark A. Steen (see below) had optioned the claims over the Olympic mine and had staked the adjacent ground to the west, north, and east, these corporations were unable to put the complete property package together and abandoned their claims without drilling. Some of this ground was acquired by von Hafften. He now holds mineral title to most of the ground immediately south-east of the Olympic mine and for some distance to the south and southwest. He has done no exploration work for his own account.

Peterson-Shuey Ground

In 1974 the Royal George claims were allowed to lapse. John A. Peterson, James A. Peterson, and Norman Shuey of Fallon staked the Desert Fox Nos. 1, 2, and 3 claims over the Olympic mine area. They have done no major exploration work for their own account on the Desert Fox claims.

Mark A. Steen.

In 1978 Mark. A. Steen of Reno became interested in the district after reading old reports. Most of the engineers and geologists who examined the property during the operating years believed that a normal fault had cut the vein off, and that the ~~upthrown~~ footwall vein segment had been removed by erosion.

In 1920 Mr. Oscar Hershey proposed that the relationship was more complex, that two faults were involved and the net fault movement reverse in character, so that the vein segment was faulted downward close in against the mine workings, but beneath the lowest level in the mine. In 1921 U.S.G.S. geologist Adolpf Knopf confirmed Hershey's concept. In 1941 three diamond drill holes were drilled from the surface to test the idea. The drilling seemed to prove the reverse nature of faulting, but no ore was found (Farrell, 1941). Farrell concluded that the drill holes were located too far from where the vein had been lost on the fault. He observed striae on the fault plane underground indicating strike-slip movement, so that the vein segment would be found to the north. He proposed drilling

two vertical holes to test his concept, shown as locations X-1 and X-2 on the 1:2,000 topographic map. In a 1963 memorandum supplemental to his earlier report, Farrell stated that the holes had never been drilled.

Steen put the property together by optioning the Desert Fox claims and staking the ground to the west, north, and east. He did not option the von Hafften claims because they were not thought essential to a test of the Farrell concept. The Steen claim block has subsequently been enlarged several times. He now holds mineral rights for a considerable distance west, northwest, north, and northeast of the Olympic mine, as shown on the 1:5,000 property map (in pocket).

Corporate Activity

Beginning about the time of Steen's entry into the district, a series of mining companies have staked ground peripheral to the Steen, Peterson-Shuey, and von Hafften claims. Most recently, in December and January last, Rocky Mountain Surveyors of Albuquerque located the Buff group of 170 claims northeast of Olympic. It appears that these claims are over a separate target area well to the northeast, not as a play adjoining the Olympic claims. At this time, it is not known in whose behalf the Buff group was located.

Inasmuch as the key properties have been held by Steen, the companies have not been able to put the property package together and have let their claims lapse without drilling. The one exception is FMC Corporation, which optioned the Peterson-Shuey claims when Steen's agreement expired, made a deal on the von Hafften ground, and attempted to option Steen's claims. FMC's exploration is described below (see p. 13).

Down-the-hole Hammer Drilling (1979)

Cosmos Resources, Inc., a Vancouver, B.C. junior mining company, became interested in the exploration proposal (Steen, 1978). They raised funds for ten vertical holes (Westervelt, 1978), which were drilled late April and early May, 1979, as shown on the accompanying maps and tabulated on the following page.

DOWN THE HOLE HAMMER DRILLING

22 March-02 April, 1979

Hole No.	-----Coordinates-----		Elevation	Total Depth	Sample From-To	--Assay, g/mt*--	
	North	East				Gold	Silver
1	10,070.22 m	9,930.11 m	1819.40 m	129 m	34 35 m	nil	nil
					41 42	nil	nil
					74 75	0.21	nil
					75 76	nil	nil
					80 81	0.14	nil
2	10,046.68	9,917.77	1822.56	100	43 44	nil	nil
					77 78	nil	nil
					82 83	0.14	nil
					83 84	0.14	nil
3	10,026.71	9,910.14	1824.36	100	80 81	nil	nil
					81 82	nil	nil
					82 83	0.18	nil
					84 85	nil	nil
4	10,001.35	9,907.04	1827.38	100	80 81	0.14	nil
					81 82	0.21	nil
5	9,977.25	9,912.03	1832.57	94	77 78	0.15	nil
6	9,934.64	9,937.98	1835.03	80	38 39	nil	nil
					64 65	nil	nil
7	10,044.90	9,935.48	1820.60	84	62 63	nil	nil
					69 70	nil	nil
					70 71	nil	nil
					72 73	0.13	nil
					73 74	nil	nil
8	10,108.61	9,926.28	1816.28	85	68 69	nil	nil
					69 70	0.13	nil
					70 71	0.16	nil
					71 72	nil	nil
					72 73	nil	nil
9	10,084.39	9,913.92	1818.31	85	72 73	nil	nil
					73 74	0.13	nil
10	10,063.94	9,898.33	1822.14	91	74 75	nil	nil
					75 76	nil	nil
					76 77	nil	nil
					77 78	nil	nil

*Note: Assays by Skyline Labs, Wheatridge, Colorado.

The large number of nil assays is due to the fact that samples were taken of the drill cuttings where any mineralization whatsoever was observed.

The hammer drilling was done with a Cyclone (IR) Model TH-60 reverse circulation drill with 12.5 cm bit. Sludge boards were made of the drill cuttings, each 1 m of drill sample shown as 1 cm (1:100 scale). The sludge boards are available for inspection in Reno. Interpretation of drilling results was fairly straightforward. A flat-lying zone of quartz mineralization two to five meters in thickness was found in the approximate position and attitude predicted by Farrell. Although most of the mineralization intercepted in the drill holes correlates well as a single tabular body, a number of mineralized zones were found at shallower depth in several of the holes. Hole No. 6 was terminated a few meters too soon, and the mineralized zone was not intercepted.

The mineralization in the drill holes is thoroughly leached. The drill bit was of intermediate diameter, and the tool arrangement such that the drill cuttings passed upward 130 cm in open hole between the face of the bit and the point where the sample went into the drill tube. These drill deficiencies, together with the notorious difficulty in sampling mineralization of this type, made it advisable to obtain more and larger samples of the mineralized zone. The drilling of 20 cm diameter drill holes was given careful consideration. However, the greater cost per meter and large number of holes required resulted in such a high estimate of costs that the idea was abandoned. The mineralization was found at a somewhat shallower depth and is flatter than expected. The ground was proven to be completely dry to a depth of at least 100 m. It was concluded that large samples could best be obtained by driving a steep decline, using rubber-tired LHD, clear of the old mine workings. It was planned to pass beneath the mineralized zone, crosscut horizontally under a sufficiently large area, then raise at intervals to inspect and channel sample the mineralization (Bright, 1979).

This approach had the advantage that if a small shoot of high grade ore was found, it could be mined by working through the decline and shipping to a regional custom cyanide plant such as Sunshine Mining Company's mill at Silver Peak, 75 km to the southeast.

Underground Exploration (1981)

Cosmos Resources secured additional funds and the decline was started 04 May 81 (see 1:1,000 map and sections). It was driven on a -32% grade for 190 m, where it passed through the mineralized zone not far from the intercept in DHH No. 7. From the foot of the decline, under the mineralized zone, horizontal headings were driven to the northwest, west, and south. The heading to the south remained under the mineralized zone and raises were put up to cut the vein. The heading to the west passed into the mineralized zone, and it was necessary to decline to stay in it. The heading to the northwest passed over the top of the zone and two steep declines were driven eastward back down into mineral. The mineralization strikes northeasterly and dips very gently to the northwest. Because of the vague contacts with the wall rock, and the thickening of the zone to more than the average two-meter height of the underground openings, the exact thickness and attitude of the zone was not determined in the northwest and north faces. The hammer drilling from the surface indicates a maximum three to five meters thickness, and essentially horizontal attitude. Just as this problem became evident, funds were exhausted and the poor assay returns discouraged further financing. Otherwise, a small amount of raising and winzing would have quickly exposed the contacts. It was concluded that an adequate test had been made of Farrell's exploration concept, and that no ore shoot had been found.

One perplexing aspect of the underground work is that the post-ore faulting essential to the Hershey-Farrell concept was not observed, as it should have been, in the decline. The decline passed downward through the base of the Tertiary sediments at 68 m, into strongly altered older volcanics, through and beneath the mineral zone, with no evidence of the kind of faulting described in the mine where the ore shoot was lost.

Although the assays of the samples taken underground off the decline showed slight improvement over the drill hole samples, and

silver was reported, no ore was developed. The tabular zone, of irregular and partly unknown thickness, is hosted in strongly altered porphyry which is crushed and thoroughly oxidized. Orange, brick red, and black iron and manganese oxides stain the mineralization and wall rock. This broken mineral was placed in a separate pile on top of the dump and can be inspected, although it is rapidly becoming picked over by visiting geologists. It can plainly be seen in Photograph 1, p. 3. The mineral zone is exposed underground in all headings at the foot of the decline, and appears to extend in every direction, including to the east and southeast beneath the old mine workings. The strongest mineral showings are in the west, northwest, and north faces. Toward the south the zone is thinner and does not assay as well.

For these reasons the project was terminated early in 1982. Although no high grade ore shoot had been found, the potential for low-grade nearby was recognized (Westervelt, 1984). Cosmos Resources has done no further work at Olympic and has released the property.

FMC Corporation Paradise Mine (1982-present)

Although the Paradise mine is not in the Bell Mining District, its discovery and development 17 km north of Olympic has intensified interest in gold and mercury prospects and mines in the region, particularly to the south of Paradise. There are few bedrock exposures to the north, where Gabbs Valley is filled with lake beds and alluvium. Outcrops in the area between Paradise and Olympic are almost entirely post-ore sediments and volcanics. Olympic is the nearest epithermal deposit with a substantial record of gold production.

Paradise is a major gold-silver volcanic hot spring deposit. It was discovered in October, 1982 at an old mercury prospect by FMC personnel during field examination of an adjoining property. A cyanide mill and heap leaching operation went on stream in May, 1985. In September, 1986 FMC stated ore reserves at 11 million metric tons of ore averaging 3 grams of gold and 110 grams of silver. The deposit is approximately 40% worked out, and much drilling is being done in an attempt to find additional reserves close to the treatment complex, which will run out of ore in about four years if no new reserves are found.

FMC Corporation Drilling at Olympic (1987)

FMC Corporation optioned the Peterson-Shuey and von Hafften claims in 1986. They approached Mr. Steen about his property, but he was not agreeable to the terms of their proposal. FMC drilled more than twenty 12.5 cm diameter vertical and angle holes in 1987, as shown on the 1:5,000 geologic map. It is not certain that all of the FMC holes were located in the field. They did not mark or protect the drill collars. Where several holes were drilled from the same set-up, all but the last drill collar was obliterated. In addition, they drilled about six shallow holes into the decline dump. FMC did not re-open the decline, which has been allowed to cave at the portal to avoid public liability. Most of FMC's drilling was done on the von Hafften ground, probably half of it in a cluster of closely spaced holes about 1½ km south of the Olympic shaft.

Inspection of the FMC drill sites shows that most of the holes were near outcrops of fracture-controlled mineralization. Angle holes in particular were collared so as to intersect surface mineral showings at shallow depth. However, the general objective of the program was obviously the discovery of a large, low-grade precious metal deposit.

Three holes were drilled from one site just barely on the Olympian Extension claim, without Steen's permission, at coordinates 10,080 north, 9,610 east. FMC furnished Steen geologic and geochem logs for the three holes. They were drilled 13-17 October 87. The elevation of the drill pad is 1809 m.

<u>Hole</u>	<u>Bearing</u>	<u>Angle</u>	<u>Depth to Ts-Tov contact</u>	<u>Total Depth</u>
OL-19	N 46° E	-45°	53 m	180 m
OL-20	N 46° E	-71°	44	189
OL-21	N 14° E	-45°	50	195

The drill logs indicate that two rock types were encountered, rhyolite porphyry and quartz porphyry. Irregular quartz veining was seen in much of the cuttings, but mineralization was particularly strong in

a zone intercepted beginning at 109, 102, and 102 m, respectively, in the holes (see below). Samples were collected for each 1.5 m (5 ft) of advance. All samples below the Ts-Tov contact were sent for analysis of gold and silver. No mention is made of standing water deep in the holes. The driller arbitrarily went over to mud at 50 m in hole 19, and at 107 m in hole 21 where circulation was lost. Hole 20 was drilled dry.

Drill hole 19 intercepted strong alteration and multi-stage quartz veining (10-100%) in quartz porphyry from 109 to 165 m. This zone is stained and cemented by iron oxides and is weakly oxidized. Possible arsenopyrite and marcasite was noted. Gold content ranges from below limit of detection (0.01 g/t Au) to 0.10 g/t Au. Silver values were reported from 0.2 to 4.5 g/t, with a limit of detection of 0.1 g/t Ag. A 6 m zone from 154 to 160 m returned the best assays, where pyrite and possible arsenopyrite and marcasite are noted in the log, along with microbreccia and iron oxide cementation. The lower part of the hole is in relatively fresh rock that contains only trace amounts of precious metal.

Drill hole 20 shows about the same geology as hole 19, with strongly altered quartz porphyry and quartz veining at 102 to 158 m. Gold values range from limit of detection to 0.07 g/t Au. Silver was reported from below limit of detection to 2.6 g/t Ag. The best zone in the hole was 6 m from 151 to 157 m, where the log notes quartz veining, pyritic quartz and pyrite disseminated in wall rock, where the feldspar phenocrysts are sericitized. The last 15 m of the hole is in a relatively fresh green rhyolite virtually barren of precious metal.

Drill hole 21 intercepted the mineral zone at 102 to 140 and 150 to 160 m, the logs noting iron-stained, brecciated veining and multi-stage quartz in gray quartz porphyry. Gold values were reported from below limit of detection to 0.165 g/t Au. Silver values were from below limit of detection to 3.0 g/t Ag.

As was the experience with the samples taken off the foot of the decline, it must have been discouraging to have these geochem values returned after logging such visually impressive showings in the drill holes.

The contact between Tertiary lake sediments and underlying older volcanics was clearly seen in the three FMC holes. A simple three-point solution gives a N 85° E strike and 12° southeast dip. The Ts-Tov contact lies 40 m vertically beneath the drill pad. The apparent reversal of dip, back toward the mountain, may be (1) the result of drag along the frontal fault immediately to the east, (2) more faulting than can be seen at the surface, or (3) relief on the old bedrock surface.

Not enough information is available yet to begin contouring the Ts-Tov contact. However, the depth of 40 m (1770 m) in the FMC drill holes and 27 m (1787 m) in the decline gives a good idea of the thickness of the lake beds at the northernmost end of the Cedar Mountains.

There may be a crude correlation between the mineralized zone in the decline and the mineral intercepts in FMC's three drill holes. The two showings are about 300 m apart. Exposures in the decline and hammer holes are at about 1745 m elevation, and the zone appears to lie essentially horizontal. Between the decline and the drill holes, the mineral zone should be dropped down several tens of meters on the frontal fault at the edge of the bedrock exposures. The top of the mineral zone in the drill holes is at 1705 m elevation. The mineral zone in the drill holes is thicker and is less thoroughly oxidized than the exposures in the decline.

As was the case in the Olympic mine and in the decline, the FMC drill holes suggest a rude horizontal control to mineralization. If steep fracturing was the important ore control, mineral intercepts would be relatively narrow and in a more random pattern.

FMC turned the Desert Fox claims back to Petersons and Shuey. They still hold the von Hafften ground. At this writing, no exploration is underway at Olympic.

Tailings Dam

There is confusion regarding the old mill tailings at Olympic. Some Olympic ore was shipped directly to out of state smelter and to regional custom mills. A considerable amount of tailings has washed down the arroyo and cannot be recovered. Probably less than 30,000 metric tons remain impounded (see Photograph 1, p. 3). FMC geologists apparently sampled the surface of the tailings and became interested. They drilled the dam on a close-spaced pattern of holes.

Recovery of gold was good in the Olympic plant, reported to have been better than 90% (Vanderburg, 1937, p. 19). Silver recovery is estimated at about 70% (see p. 40). This leaves something less than 3 grams of gold and about 12 grams of silver un-recovered in each ton of tailings. This metal was not completely amenable to cyanidation; otherwise it would have been recovered when milled. Over the years, the tailings are subjected to repeated cycles of wetting and drying as they lie in the sun. Capillarity brings some of the soluble gold and silver to the surface, where it is concentrated as a soft incrustation. The old timers knew this, and periodically harvested tailings dams with horse-drawn Fresno scrapers, leaching the material on site in simple home-made plants made from old cyanide drums.

Sampling old cyanide tailings is difficult. Most attempts at re-treatment of tailings have met with failure.

PROPERTY

There is no patented land at the north end of the Cedar Mountains. All of the ground at and near Olympic is Federal domain, open to entry under the general mining laws of the United States.

There are four principal claim blocks at Olympic at this time, (1) the Desert Fox Nos. 1, 2, and 3 claims over the old mine, owned by the Petersons and Shuey of Fallon, (2) claims to the west, northwest, north, and northeast owned by Mark A. Steen of Reno, (3) claims generally to the south of Olympic owned by Alexander von Hafften of San Francisco, and (4) the 170 Buff claims recently located northeast of Olympic by Rocky Mountain Surveyors of Albuquerque NM for an as yet unknown client.

The 1:5,000 property map accompanying this report is based on the maps furnished by locators at the time the claims were recorded at Mineral County and U.S.B.L.M. offices. The individual Steen claims are shown on the map. The three Desert Fox and Buff claims are individually shown. The Desert Fox claims are recorded at pages 798 to 800 in Book 41 at Hawthorne, and as N-MC 59750 to 59752 with the U.S.B.L.M. in Reno. The general location of the von Hafften ground is indicated on the property map.

The location and recordation details of the Steen claims are summarized in the table on the following page.

ENGINEERING

The underground maps of the Olympic mine were apparently made using standard transit and steel tape surveying methods.

The down-the-hole hammer drill holes were surveyed by transit and stadia from a nail driven in the center of the sill set at the collar of the Olympic shaft. Elevation of the shaft collar was interpolated at 1829 m mean sea level from U.S.G.S. topographic maps. Coordinates of the shaft point were assumed at 10,000 north, 10,000 east. A backsight on Pilot Knob at Rawhide gave approximate meridian.

The decline portal was surveyed from the shaft by brunton and tape traverse. The centerline of the decline was established by sighting directly from the portal site to the collar of DHH No. 7. Surveys underground in the decline were made by brunton and tape traverse.

A triangulation net was established 13-14 August 87 using Wild T1 Micrometer Theodolite. Concrete and brass monuments Alpha and Bravo were set as a base line, and the horizontal distance between them measured using Wild 2-meter Invar subtense bar, auxiliary angle method. Meridian was established by direct observation of the sun using Roelof's solar prism, hour angle method. From base line Alpha-Bravo 4 points were triangulated as the corners of a photogrammetric model of the mine area. Points 1 through 4 are Copperweld brass-capped stakes driven into the ground so that the face of the cap is approximately 15 cm above the

MARK A. STEEN LODGE MINING CLAIMS

<u>Claim</u>	<u>Date Located</u>	<u>Date Amended</u>	<u>County Book/Page</u>	<u>USBLM NMC No.</u>
1. Desert Fox No. 4	19 Oct 81	--	81/805	225216
2. Desert Fox No. 5	19 Oct 81	--	81/806	225217
3. Desert Fox No. 6	19 Oct 81	--	81/807	225218
4. Desert Fox Extension	21 Apr 79	--	63/044	76637
5. Farrell's Extension	11 Aug 78	--	60/116	39261
6. Farrell's Extension No. 1	18 Jul 77	--	56/150	9544
7. Farrell's Extension No. 2	18 Jul 77	--	56/151	9545
8. Farrell's Extension No. 3	18 Jul 77	--	56/152	9546
9. Gold Reef	19 Feb 84	--	95/550	305208
10. Gold Reef No. 1	19 Feb 84	--	95/551	305209
11. Gold Reef No. 2	19 Feb 84	--	95/552	305210
12. Gold Reef No. 3	19 Feb 84	--	95/553	305211
13. Gold Reef No. 4	19 Feb 84	--	95/554	305212
14. Gold Reef No. 5	19 Feb 84	--	95/555	305213
15. Hobart No. 1	18 Jul 77	--	56/144	9550
16. Hobart No. 2	18 Jul 77	--	56/145	9551
17. Hobart No. 3	18 Jul 77	--	56/146	9552
18. Olympian Extension	11 Aug 78	--	60/115	39262
19. Olympian Extension No. 1	18 Jul 77	--	56/147	9541
20. Olympian Extension No. 2	18 Jul 77	--	56/148	9542
21. Olympian Extension No. 3	18 Jul 77	--	56/149	9543
22. Olympic No. 1	03 Sep 88	--	--	--
23. Olympic No. 2	03 Sep 88	--	--	--
24. Olympic No. 3	03 Sep 88	--	--	--
25. Olympic No. 4	03 Sep 88	--	--	--
26. Olympic No. 5	03 Sep 88	--	--	--
27. Olympic No. 6	03 Sep 88	--	--	--
28. Olympic No. 7	02 Sep 88	--	--	--
29. Olympic No. 8	02 Sep 88	--	--	--
30. Olympic No. 9	02 Sep 88	--	--	--
31. Olympic No. 10	02 Sep 88	--	--	--
32. Olympic No. 11	02 Sep 88	--	--	--
33. Olympic No. 12	02 Sep 88	--	--	--
34. Olympic No. 13	02 Sep 88	--	--	--
35. Olympic No. 14	02 Sep 88	--	--	--
36. Olympic No. 15	02 Sep 88	--	--	--
37. Nelson	22 Apr 79	--	62/943	73861
38. Nelson No. 1	22 Apr 79	--	69/944	73862
39. Nelson No. 2	01 Nov 81	--	81/850	225213
Nelson No. 2	--	20 Mar 84	95/547	225213
40. Nelson No. 3	01 Nov 81	--	81/851	225214
Nelson No. 3	--	20 Mar 84	95/548	225214
41. Nelson No. 4	01 Nov 81	--	81/852	225215
Nelson No. 4	--	20 Mar 84	95/549	225215
42. Siebert	22 Apr 79	--	62/945	73856
43. Siebert No. 1	22 Apr 79	--	62/946	73857
44. Siebert No. 2	22 Apr 79	--	62/947	73858
45. Siebert No. 3	22 Apr 79	--	62/948	73859
46. Siebert No. 4	22 Apr 79	--	62/949	73860
47. Springer No. 1	18 Jul 77	--	56/141	9547
48. Springer No. 2	18 Jul 77	--	56/142	9548
49. Springer No. 3	18 Jul 77	--	56/143	9549

surface of the ground. Differences in elevation were obtained using the vertical angle 3-wire method, making observations at various instrument heights at both stations on each sighting. The point at the shaft collar was also triangulated, carrying elevations through the net. The six points comprising control for the photogrammetric model (Alpha, Bravo, 1, 2, 3, & 4) were panelled using white and black polyethylene sheeting to form a cross on each point of appropriate size and proportion for the scale of the aerial photograph pair. A plan of the triangulation net, coordinates, bearings, calculations, and other surveys are in the Olympic facts file.

Aerial photography was flown 26 August 87, on a scale of 1:10,000 by Great Basin Aerial Surveys, their project number 156-009, using Wild RC-10 camera mounted in a Cessna 206. Six flight lines were flown over an area 5 km north-south by 10 km east-west. The southwest corner of this area is at Stewart Spring. A single stereo pair was photographed directly over the mine area, on scale 1:18,000 for use in preparing the photogrammetric map. A 1:24,000 plot of the photo centers of all of the aerial photographs is in the Olympic facts file, along with black and white contact prints of the photography and several 1:5,000 and 1:6,000 black and white enlargements of the central mine area.

A topographic map was prepared by Great Basin Aerial Surveys on 02 September 87 using Wild Aviolyt BC-2/Aviotar TA-10 photogrammetric plotter, on a manuscript scale of 1:2,000, contour interval 2 meters. It covers an area of approximately 400 hectares, 9,200 to 11,000 north, 8,600 to 10,800 east. The manuscript is in the Olympic facts file. Great Basin Aerial Survey's plotting equipment is computer driven. The data are stored so that maps of any scale, contour interval, etc., can be made using either English or metric units.

On 18 August 88 a fifth survey point was set near the decline portal and triangulated from Alpha and Bravo. The decline portal was surveyed from point 5 by transit and stadia.

A 1:2,000 topographic map, contour interval 2 m, covers the area northwest of the Olympic shaft where drilling is recommended (in pocket).

GEOLOGY
Stratigraphy and Volcanism
Pre-Tertiary "basement"

No rocks older than mid-Tertiary are exposed in the northern Cedar Mountains. However, the older rocks crop out extensively in the surrounding region, permitting a general account of the earlier geologic history.

Underlying the northern Cedar Mountains at unknown depth is a complex sequence of Permian and Mesozoic pre-orogenic sediments and volcanics, and Jurassic to Cretaceous orogenic volcanics and intrusive igneous rocks. Still older Paleozoics may underlie the Mesozoic rocks, but so little is known concerning them that they will not be taken into account in this report.

The nearest exposures of basement are to the south-southeast of Olympic 5 km, at Simon, where Permian greenstone and Triassic limestone is intruded by Jurassic-Cretaceous granitic plutons. To the southwest of Olympic 14 km, in the Gabbs Valley Range, exposures of basement lie west of Black Cabin Well, where Triassic limestone is intruded by Jurassic-Cretaceous granitic intrusives. The nearest exposure of basement to the north is 18 km from Olympic, along the southern foot of Paradise Peak, north of Goldyke, where Triassic limestone is intruded by the Jurassic-Cretaceous granitics. Because the basement in all of the surrounding region is identical, it may be assumed that these rocks lie at depth beneath Olympic.

The Triassic carbonates in west-central Nevada are called Luning Formation, for the type locality not far west of Olympic near the small town of this name. The Luning Formation is about 800 m thick. It overlies a Permo-Triassic sequence of basalt, andesite, and rhyolite which was deposited in a broad magmatic arc along the margin of the pre-rift crustal plate. Silver mineralization is related to this old magmatic arc, as developed at Candelaria, Berlin, and elsewhere in western Nevada. The continental margin was then approximately meridional, lying a few kilometers east of Olympic. The Luning Formation was deposited on the eroded remnants of the Permo-Triassic magmatic arc,

in marine shelf and basin environments along the edge of the continent. The Luning was in turn overlain by a thick sequence of Triassic clastics, deposited under shallow marine and marginal marine conditions, on and around huge prograding deltas at the mouths of major rivers draining the arid Colorado Plateau continental terrain lying to the east. Following deposition of the Triassic clastics, a complex sequence of sedimentary and volcanic rocks was deposited, well into the Jurassic. The Jurassic volcanism probably represents precursor magmatic activity to the orogenic plutonism of the Cordillera.

The Permian, Triassic, and Jurassic sedimentary and volcanic rocks were folded, faulted, and subjected to dynamic and thermal metamorphism during orogenesis and intrusion of the Jurassic and Cretaceous plutons. The isolated igneous bodies in the region surrounding Olympic are considered to be the eastern edge of the Sierra "batholith", which is actually a complex of coalescing igneous bodies, rather than a single elongate batholith. A major tungsten metallogenic province is developed along the eastern margin of the orogenic belt, where numerous scheelite-molybdenite skarns were formed within the intrusives and their contact aureoles. Some of the dioritic intrusives developed skarn magnetite deposits, several of which were mined in the post-World War II period. Less important mesothermal silver-lead veining was developed in the aureoles of some of the orogenic intrusives, as at nearby Simon.

During orogenesis the metamorphosed, intruded terrain was accreted to the western margin of North America. The orogenic belt was uplifted as much as 10 km in late Cretaceous and early Tertiary time. As post-orogenic erosion continued, wearing the ancestral Sierra down, slow-moving streams finally developed on a fully mature drainage surface. The crest of the range was a broad highland, perhaps 1,000 m above sea level. The lowlands of western Nevada were at 700 to 800 m above sea level. The major rivers flowed westward, through broad canyons cutting the range from east to west, into the Pacific Ocean, the shoreline then being at approximately the longitude of Sacramento.

Remnants of this old erosion surface are preserved in the higher parts of the Cedar Mountains. An old mature topography approaches a peneplane in regularity. In detail the surfaces of the bedrock are rough, but there is a tendency toward regular, smooth flanks to the range. The higher peaks, such as Little Pilot Peak, surmount the smooth surface, which cuts hard and soft rocks indiscriminately. The old Cedar Mountain surface is now tilted gently toward the northwest.

This deeply eroded mature surface of erosion remained fairly stable into mid-Tertiary time. Any stratified rocks deposited upon it during the interval mid-Jurassic to mid-Tertiary were eroded not long after they were laid down, for no rocks of this age are found in west-central Nevada.

Tertiary

The peneplane remained intact into Oligocene time when, after the North American plate passed over the East Pacific rise, extensional faulting began breaking the terrain into the fault-block ranges characteristic of the province today. Post-orogenic volcanism erupted through numerous individual vents and calderas, resulting in hundreds of different flow sequences that generally cannot be correlated from range to range.

The lowermost Tertiary volcanics in west-central Nevada are dated at about 28 million years, late Oligocene if an Oligocene-Miocene boundary age of 26 million years is used. The nearest known Oligocene volcanics crop out 8 km east of Olympic at Pactolus, where the base of a series of lithic-rich andesite tuffs of this age is not exposed. West of Olympic 18 km at Giroux Valley in the Gabbs Valley Range, various Oligocene tuffs rest on Triassic Luning Formation which has been intruded by granitic igneous rocks.

The lowermost post-orogenic rocks in west-central Nevada are usually not Oligocene. More often, Miocene rhyolites and quartz latite are found resting upon the pre-Tertiary basement, as may be the case at Olympic. The erosional hiatus between latest orogenic plutonism and earliest post-orogenic volcanism is a minimum 40 million years-- half again this long at some localities. McKee and John (1987) dated older volcanics a few kilo-

meters south of Olympic, using biotite from a crystal-rich rhyolitic ash-flow tuff, at 26.0 ± 0.8 Ma. The volcanic rocks at the northern end of the Cedar Mountains are shown as 34 to 17 million-year-old on Sheet 2 of Stewart and Carlson's (1976) map of Cenozoic rocks in Nevada.

Older Tertiary Volcanics (Tov).--The oldest rocks at Olympic are altered rhyolitic flows of probable early Miocene age. Although the base of the sequence is not exposed in the Olympic mine area, and drilling and mine workings have not penetrated it, the rhyolite may lie directly on the pre-Tertiary basement. These volcanics are host to the mineralization of the Olympic mine and other nearby epithermal mines and prospects. The mineralized volcanics crop out over an area of about 4 km^2 south, southwest, and west of the Olympic shaft, and are completely surrounded by post-ore cover of various kinds (see 1:5,000 geologic map). The rhyolitic rocks are tuffaceous in character, and their source vent is not known.

Knopf (1921, p. 378) described three volcanic units at the Olympic mine-- two rhyolite flows separated by a trachyte flow and associated tuff. The three are described as cropping out on the western slope of Main Ridge, southwest of the mine. The lower rhyolite is described as white, rich in phenocrysts of quartz and sanadine, with quartz crystals being especially conspicuous. Biotite and sanadine phenocrysts are completely sericitized. The trachyte contains numerous feldspar phenocrysts which are kaolinized or sericitized, bleached biotite, and sporadic quartz crystals in a gray groundmass that appears dark colored in contrast to the rhyolite. Near the top of the trachyte flow abundant spherulites are found, the largest the size of a pea, some of which are concentrically banded. This spherulitic facies becomes indistinguishable from the white tuff that makes up the upper part of the trachyte unit, which is about 50 m in total thickness. Sericitization is intense. The trachyte tuff is composed of glassy clasts indicative of explosive origin. Knopf (1921, p. 380) suggests that the trachyte could be a quartz latite whose plagioclase phenocrysts have been sericitized. This now appears to be precisely the case. Some of the company geologists have called the trachyte "andesite". Knopf's upper rhyolite is similar in appearance to the lower rhyolite, but

is described as having many lithic fragments, giving it a mottled appearance. The vein at Olympic occurs in the upper rhyolite. The upper rhyolite is exposed in the upper mine workings, at the surface near the shaft collar, in the old mine camp area, and in the decline.

These rock subdivisions could not be distinguished in the nearly thousand meters of hammer drilling done in 1979. Almost three hundred meters of new underground work in the decline failed to reveal rock types that could be separated with confidence. Recent geologic mapping, although not detailed enough to be completely definitive, failed to substantiate earlier division of rock types.

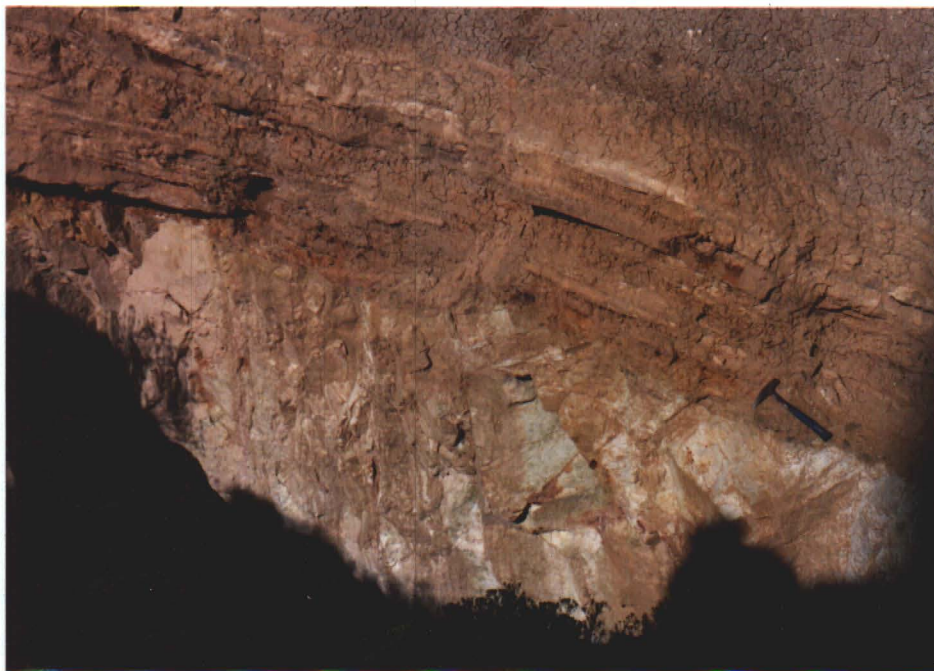
Drilling, new underground openings in the decline, and recent geologic mapping suggest that in a few respects the picture may be more simple than visualized by earlier workers, but for the most part it is far more complicated. Four principal factors are involved:

1. There are several rock types in the extrusive sequence, and hypabyssal dikes and stocks may intrude them.
2. Faulting and brecciation is much more extensive than previously thought. Faulting preceded, accompanied, and followed the episode of mineralization.
3. Hydrothermal wall rock alteration is pervasive and locally intense, although irregular masses of fairly fresh rhyolite survive where less broken by faulting and fracturing. Propylitic, argillic, and sericitic alteration facies are well-developed, obscuring original wall rock differences.
4. Oxidation is unusually intense, perhaps because of the broken character of the ground and the strength of hypogene alteration. Some of the oxidation may be hypogene. Oxidation bleaches most of the volcanics, but variable iron and manganese oxide stain permeates the rock matrix and coats fractures, further obscuring primary wall rock characteristics. Hammer drilling and work in the decline show that oxidation extends well below the 200 level in the Olympic mine. It is unlikely that earlier workers ever saw fresh rock except in isolated small masses.

Vagaries of wall rock alteration are thought particularly likely to have confused earlier workers. Although alteration was just



Photograph 2. Altered older volcanics (Tov). Host to mineralization at Olympic. Argillized rhyolite porphyry. Taken from 9,710 north, 9,330 east.



Photograph 3. Base of Tertiary sediments (Ts) resting unconformably on altered rhyolite porphyry (Tov) and vein. Exposed where a raise on the vein comes to the surface near Nelson's original discovery site, 30 m northwest of Olympic shaft. Taken from 10,025 north, 9,975 east.

becoming recognized in the early 1920's as a major feature of many western U.S. mining districts, most engineers and geologists had trouble dealing with it. Even today, some geologists confuse descriptions of field-mappable rocks with characteristics learned from study of specimens in the laboratory. At one moment the rocks are described as they were when originally deposited-- at the next present characteristics are emphasized, which have been imposed by alteration and oxidation.

The older volcanics were for the most part originally rhyolite and quartz latite. Lithic and crystal inclusions are more variable than previously described. Much evidence of welding is seen. Several ash-fall tuffs are found within the sequence. It is possible that dikes and/or small stocks, apparently more andesitic in character, have intruded the tuffs. Most specimens of the rhyolite and quartz latite contain visible quartz phenocrysts. Feldspars and ferromagnesian minerals are usually destroyed by alteration. Many outcrops and float specimens exhibit a distinctive texture. Large feldspar phenocrysts or lithic inclusions, sometimes distorted by flowage, are altered so that they weather out of the matrix, leaving a pitted surface of rectangular or irregular elongate cavities.

Structural complexity and pervasive alteration are, of course, favorable insofar as potential for ore is concerned. It may be desirable sometime in the future to map the rock types and wall rock alteration in detail. For now, the time required for field work and the expense of microscopic and chemical study in the laboratory are not thought justified. The older volcanics have been mapped as a single unit, containing most of the potential for discovery of low-grade mineralization at Olympic.

It is not known whether a caldera is present at or near Olympic. The extensive cover near the mine and in all directions away from it makes it impossible to answer the question now. However, some of the rocks and mineral textures at Olympic and Pactolus are permissive of a caldera environment, and this may be an important aspect of the geology of the district.

The most simple relationship between older volcanics and the overlying Tertiary sediments is the assumption that the older volcanics were deposited, faulted, altered, mineralized, faulted again, weathered, and perhaps deeply eroded before the Tertiary fluvio-lacustrine sedimentation began. Where exposed at the surface and seen in underground workings (see Photograph 3, p. 26) this is the relationship observed. If this is the case, considerable erosion could have removed the shallower portions of the hydrothermal mineral system. This may not be important, for in some of the districts, as at Republic WA, the volcanic hot spring low-grade gold mineralization is somewhat younger than the epithermal veins mined in the early days, and erosion cut deeply into the older mineralization in the interval between the two mineralization episodes.

Mapping indicates that faulting took place in the interval between mineralization and deposition of the Tertiary sediments, further complicating the picture. At Paradise, a post-mineral fault drops the ore deposit down so that it has been protected from erosion.

A large sample of adularia from the vein material lying on the old mine dump will be collected and separated so that a potash argon age date for the veining can be determined.

Tertiary sediments (Ts).--Early private reports on the Olympic mine invariably refer to the lacustrine sediments as Siebert Formation, apparently in deference to Mr. Siebert, for whom this formation at Tonopah was named. However, this name in central Nevada has come to be used in a very strict sense in terms of the age and character of precious metal ores at Round Mountain, Tonopah, Divide, and other nearby, less important gold and silver mining districts. Although recent age dating establishes that the Siebert Formation at Tonopah and the Tertiary sediments at Olympic were deposited at about the same time, they cannot be traced continuously across the intervening 70 km.

In mapping the Tertiary lacustrine sediments of Mineral County, Ross (1961) found it convenient to refer them all to the Esmeralda Formation. Some of them can be traced with reasonable continuity to the type locality of that formation at the north end

of the Silver Peak Range, in Esmeralda County, as first described by Turner (1900, p. 197-208). Buwalda (1914) called the Stewart Valley Tertiary beds Esmeralda. However, Axelrod (1956), who has made the most thorough study of Tertiary lake basins in western Nevada, observed:

".....the late Tertiary continental basins in this area were relatively local in extent. The common practice of indiscriminate application of such formational names as Esmeralda, Truckee, and Humboldt over wide areas in Nevada finds little support in field evidence. Each basin appears to record a different history, not only in terms of the type of rock represented, but also in a structural sense....."

Because of these considerations, and the fact that no particular convenience is gained at Olympic by using an established name, the lake beds will simply be called "Tertiary sediments" in this report. Because they are so much involved in exploration potential at Olympic, it is advisable to retain an open mind about the exact age, stratigraphic position, relationship to volcanic units, role as host rock or cover rock, etc., rather than arbitrarily impose a name which implies more knowledge and geologic insight than has thus far been gained.

Immediately to the northwest, Ekren and Byers (1985) found rhyolite Apache Tears in gravels near the base of the Tertiary sediments which gave an age of 15.6 ± 0.5 Ma, or Miocene.

The Tertiary sediments are for the most part white, cream, tan, and yellowish-brown thin-bedded fluvial and lacustrine tuffaceous mudstone, siltstone, and sandstone. Thin conglomerate units grade rapidly upward into fine-grained clastics. The sand grains, pebbles, and cobbles are mainly of Tertiary volcanic rock. Deep fluvial scouring and channelling is not seen. Thin (less than 1 m) beds of diatomite are present. A few thin (1 to 2 m) beds of fresh water limestone occur. Thin beds of pure selenite (up to 10 cm) are seen at several horizons. Petrified wood is abundant at least in two horizons, in (10 x 30 cm) fragments of large trees, which have been washed into place. Buwalda (1914, p. 343) found a 170 cm diameter

tree trunk lying on the surface about 1½ km southeast of Stewart Spring, south of the mapped area. No lignite or coal beds were found, and none of the shales or sands appear to be petroliferous.

Mammalian remains are ungulate, carnivore, and rodent forms (Buwalda, 1914, p. 350). Remains of species of horses and camels are most common. Deer, mastodon, and rhinoceros have also been found. Four species of fresh water molluscs were collected. Near the Olympic shaft, a persistent 10 cm layer of fossil snails (2 to 3 cm in diameter) is found in iron-stained clastics near the old strand.

At least two thin (2 to 3 m) beds consist of a thick jumble of small (up to 50 x 50 cm) tufa domes and branched tufa tubes (up to 15 cm diameter) lying on their sides. A few of the domes and tubes appear to remain standing upright in their original position. The tufa is mouse gray in color, is resistant to erosion, and was probably formed at lake-bottom springs during quiescent periods in lake depositional history.

At several places, pronounced angular unconformity reflects relative uplift of the bedrock highland, smooth truncation of the beveled edges of the lake beds, followed by resumption of lacustrine deposition. At a number of localities the lake beds are highly contorted, and structures are suggestive of strong seismic activity. Rapid transition from sediments to pumice and ash, then back again to sedimentation, is evidence of episodic volcanism nearby.

At two places the base of the Tertiary sediments is particularly well exposed; (1) where a raise on the Olympic vein comes through to the surface just northwest of the shaft (see Photograph 3, p. 26), and (2) at the 68 meter mark in the decline. In both exposures the sediments are unconformable on the underlying older volcanics. Sub-rounded fragments of epithermal quartz are found in a poorly-sorted, iron-stained basal conglomerate, indicating the Tertiary sediments to be post-mineral, at least at this level of lake sedimentation. Ferro-conglomerate at the base of the Tertiary sediments near the Olympic mine may be the result of weathering of the mineralized older volcanics at the time the basal Tertiary sediments were deposited. It is also possible that the discoloration is related to ascending waters which formed the peculiar spring deposits which are in turn related to north-trending faults (see p. 36).



Photograph 4. Looking southeast at fanglomerate-capped terrace at foot of range. Main Ridge on skyline. Terrace cut on Tertiary sediments (Ts). Taken from 10,310 north, 8,955 east.



Photograph 5. Basaltic lahar (Tba) resting on Tertiary sediments (Ts) on top of The Cuesta. Taken from 10,100 north, 8,250 east.

The pre-lake topographic surface slopes off the north end of the Cedar Mountains, perhaps slightly more steeply than the present surface. There is at least as much topographic relief on this old surface as on the modern terrain. There is evidence of major faulting along the margin of the northern Cedar Mountains, which accounts at least in part for the depression filled by the lake beds, in spite of Buwalda's (1914, p. 355) conclusion that sub-regional warping of the basement alone accounts for the depression of the lake basin. Some of the Miocene sediments interbedded with volcanics in nearby ranges are deposited where magma has been withdrawn beneath during volcanism.

At several localities in the surrounding region, islands of older volcanics protrude through the lake beds, indicating a topographic surface of moderate relief, and relatively shallow depth of the lake basin. Trafalgar Hill is such a feature. The Tertiary sediments thin approaching it. There is no evidence that the lake beds thicken rapidly from Olympic basinward. The relatively steep dips near the bedrock reflect continued uplift rather than steep initial dips. Differential compaction and drag along frontal faulting probably also contribute to some degree.

The general lithologic character of the lacustrine sequence indicates that the lake beds once lapped the Cedar Mountains to a much higher level than is seen today. If the district had been eroded only a few meters less, the Olympic ore shoot would remain hidden under the Tertiary sediments (see Photograph 3, p. 26; 1:5,000 geologic map).

There is a possibility that mineralization may have taken place during the initial deposition of the lake beds, near the then shoreline of the lake, north of Olympic. Mineralization at Paradise has been dated at about 18.5 Ma. Mineralization at Tonopah took place between 20.5 and 17 Ma. If the mineralization at Olympic is roughly contemporaneous, about 18 Ma, initial lake deposition and ore deposition cannot be far separated in time. If mineralization began after initial sedimentation, at some point hydrothermal activity would cease and fluviolacustrine sedimentation continue, transgressing the bedrock highland to the south. The later sediments would show no sign of epithermal mineralization. Caution should be exercised during drilling,

a kind of lag gravel at the surface. If the basalt is intrusive, it may be related to precious metal mineralization. Although not given prominent mention in the geologic literature, many Nevada volcanic epithermal precious metal veins (Comstock, Seven Troughs, Beatty, etc.) are intimately related to small intrusions of basalt. A proton magnetometer survey will be run over one or more of these spring deposits to determine if they are connected with basaltic intrusions.

Spring sinter (Qss).--Siebert (1917, p. 449) describes spring deposits on strike projection of the Olympic vein, 285 m southeast of the Olympic shaft where:

*".....remnants of outcrop are imbedded in
a hot spring deposit that shows gold quite
plentifully by panning....."*

On the ground, calcareous deposits are found that in some respects resemble spring sinter. The material may be tufa in the Tertiary sediments. Here, a prominent north-trending fault brings Tertiary sediments on the east down against altered, mineralized older volcanics on the west. Several rock chip samples were found to contain no detectable gold. In no particular order of preference, the showings can be interpreted in a number of ways:

1. Fragments of epithermal vein may have been caught up as drag in the fault, then overgrown by spring sinter.
2. Gold may have been deposited in spring sinter along the fault.
3. Mineralized float on the surface may have been enclosed within tufa deposited along the old lake shore line, then later faulted.
4. Hypogene gold may have been deposited in the fault or adjoining wall rock, having no direct connection with spring sinter or tufa.
5. Gold may have been re-mobilized by spring water from mineralization at depth along the walls of the fault.

Obviously these interpretations bear upon exploration potential, either for high-grade shoots or for low-grade disseminated mineralization. No drilling has been done south or southeast of the old mine, either for high grade or for low grade mineralization.

for a hole might go through un-mineralized lake beds, then abruptly penetrate the upper part of a volcanic hot spring system before passing into the older volcanics.

There is a possibility that the Tertiary sedimentary sequence may interfinger with volcanic flows, which could complicate interpretation of drilling results.

There are a hundred or more separate mid-Tertiary lake basins in western Nevada. A few of them have been folded, faulted, and eroded, exposing the basal sediments in the deeper parts of the basin. In a large number of such cases, a still older lacustrine sequence is found beneath the lake beds. The older sediments are often folded, faulted, tilted, and beveled by erosion before the deposition of the younger beds, which lie relatively undisturbed in pronounced unconformity. Typically the earlier sediments are Hemingfordian (early Miocene) and the later beds Barstovian and Clarendonian (middle Miocene). Because a large number of western Nevada epithermal ores were deposited during this time interval, the relationship is profoundly important to mineral exploration, both on a district and regional scale. Wolfe (1964) identified two separate flora west and northwest of Olympic, an older one at Finger Rock and a younger one near Stewart Spring, suggesting that there may be two lake bed sequences north of Olympic. The Finger Rock sequence may pre-date or be contemporaneous with mineralization.

Aside from whether or not a low-grade deposit is present at Olympic, the major geologic question bearing upon drilling is the thickening of post-ore Tertiary sediments basinward to the north. More will be said of this in discussing exploration potential in a later section of this report.

West of Olympic, along the eastern foot of the Gabbs Valley Range, Ekren and Byers (1985) have mapped a thin (1-100 m) loess-like sandstone at the base of the Tertiary sediments. They describe it as a pale brown thick-bedded tuffaceous sandstone, locally cross-bedded, derived almost entirely from re-worked quartz latite ash. This unit has not been identified at Olympic, but may underlie the Tertiary sediments to the north, and be encountered in drilling.

It was not possible to measure maximum thickness of the Tertiary sediments anywhere in the mapped area. Estimates by Buwalda (1914, p. 347) and mappers of adjoining quadrangles range from 300 to 1,000 m.

At several places, as for example on The Cuesta (see geologic map), a basaltic lahar (Photograph 5, p. 31) is seen resting conformably on the Tertiary sediments, perhaps at the top of the lake bed sequence. The lahar gives way upward to basalt, basaltic andesite, and andesite flows and intrusives, which are particularly well exposed along the western edge of the mapped area, north of Stewart Spring.

Basalt and andesite flows and intrusives (Tba).--The basaltic lahar on The Cuesta is overlain by basalt and andesite flows. They are mostly dark-colored. A purple gray color in outcrop predominates, and a smoky blue soil is common. They are mainly aphanitic to medium-grained basalt and andesite. Porphyritic rocks contain 1 to 20 percent phenocrysts of plagioclase, pyroxene, and olivine or hornblende. Some of the unit may be intrusive. Minor quartz latite is found within the sequence, a light-colored flow or tuff with quartz and hornblende phenocrysts.

At several places the basalt and andesite unit rests directly on a deeply weathered surface developed on the Tertiary sediments. Near Trafalgar Hill the Tertiary sediments thin, perhaps partly due to post-depositional erosion. Some of the Tba flows south of Trafalgar Hill appear to rest directly on the older volcanics.

The basalt and andesite may in part interfinger with the Tertiary sediments. It is not possible to measure the maximum thickness of the unit anywhere in the mapped area.

Extrusive basalt flows and dikes (Tyb, Tybi).--A younger basalt flow unit rests on the older rocks across the width of the northern Cedar Mountains 2 km south of Olympic. The rock is dark, dense, and fresh. It generally resembles the late Tertiary to Quaternary basalt flows so commonly found in the region. Lenticular dikes of basalt intrude northwest-trending faults and may correlate with the surface flows.

Tertiary and Quaternary fanglomerate (TQfg).--The north end of the Cedar Mountains is flanked by successive layers (2 to 30 m thick) of fanglomerate (see Photograph 4, p. 31). These gravels are found at one place or another lying on all of the older rocks. As many as three layers are seen at different elevations in a relatively small area. None of the fanglomerate beds extend far up the bedrock flanks of the range for any distance, except along Olympic Wash in the southeast mapped area, where prominent stream terraces along either side of the arroyo are capped by fluvial conglomerate, extending well back into the range, indicating this to have been a major drainage system from at least Pleistocene time.

These terraces are a series of stream deposits, identical to those flooring the modern arroyo bottoms. The lower fanglomerates are younger than the higher ones capping the interfluvial mesas. The mesas are developed where the porous fanglomerate is underlain by Tertiary sediment, which is soft and undercuts readily, making the mesa edges stand out sharply. The fanglomerate is resistant to erosion, the surfaces being formed of "desert pavement" where the finer matrix has been washed or blown from the pebbles, cobbles, and boulders. The pavement is sometimes varnished. The fanglomerates contain all of the lithologies known to crop out in the Cedar Mountains. The fanglomerate northeast and east of Olympic, coming from Olympic Wash, is particularly rich in fragments of Luning limestone, which crop out extensively at the Simon Mine. Many of the limestone cobbles are veined with mineralization of a mesothermal character, further linking the gravel to a source near the Simon mine.

Fragments of epithermal quartz veining also survive this fluvial environment, much better than the Tertiary sediments or altered older volcanics. The quartz still further resists later weathering after it has been laid down in the fanglomerate. In this fashion, lag gravels rich in quartz cobbles are seen in the soil down-slope from relatively feeble epithermal mineralization in the older volcanics. For example, prominent quartz float is seen at the base of the range 500 to 700 m southeast of the Olympic shaft, weathering from the soil on a fanglomerate just downslope from a single narrow vein in the bedrock.

There is a tendency for the cobbles and boulders in the fanglomerate to become larger, and for the slope of the terraces to steepen approaching the bedrock at the base of the range (see Photograph 4, p.31). The fanglomerate is still forming today, and is a response to a change in climate to cool, dry conditions, rather than structural activity. The fanglomerate is found at many places in west-central Nevada and is Pleistocene and Recent in age. Buwalda (1914, p. 353) found no fossils in it.

Some of the drill holes recommended in the proposed exploration program will collar in fanglomerate. The hard boulders in loose matrix may cause drilling problems in the first few meters. The transported mineral fragments should be recognized for what they are in drill cuttings.

Quaternary

Spring deposits (Qs).--Zones of brown soil are found in a curving belt around the northern end of the range, from just southeast of the Olympic shaft northwestward to Trafalgar Hill. The brown color is caused by iron staining. The soil is frothy, indicating montmorillonite. No outcrops are seen. The float in the soil contains small chips of brown-stained Tertiary sediment, thin plates of ferroconglomerate, and selenite crystals. The brown zones are practically barren of vegetation, except for a thick growth of Indian Pipeweed (*Eriogonum inflatum*), uncommon elsewhere in the district.

Although no spring sinter is seen, these features are thought to be spring vents or orifices. Some of them appear to align with faulting mapped in the bedrock. The iron, calcium sulphate, etc., may be brought up from depth from mineralization in the older volcanics and from selenite beds in the Tertiary sediments. The brown zones usually lie upon Tertiary sediments, but at Trafalgar Hill they are at the contact with the underlying older volcanics. At about half of the brown zones, abundant sub-rounded to rounded boulders of basalt (10 to 30 cm) are seen lying in the soil. Basalt boulders of this size and character are not found in the Tertiary sediments, nor are they contained in the fanglomerate nearby. They cannot have been washed into place by Recent alluvial processes, for they show no relationship to modern alluvial channels. It is possible that they are derived from small basaltic intrusions within spring vents. They might be resistant boulders from wall rock at depth brought to the surface during surges, forming

Neither spring sinter nor opal (prominent in some hot spring ore deposits, including Paradise) was observed anywhere else in the area mapped, although a careful watch was kept for them, particularly in the older volcanics.

Land slides (Qls).--At several places soft Tertiary sediments have been eroded laterally on the sides of arroyos, too rapidly for the steepened face to be taken away by normal erosion. Cognate blocks of bedrock have slumped into the drainage. It is not thought that such slumping will be encountered in the exploration drilling.

Alluvium (Qal).--Alluvium was mapped wherever loose silt, sand, and gravel move during modern rainstorm and snowmelt run-off. In many places this alluvial action re-works fanglomerates which underlie the arroyo bottoms, so that no sharp distinction can be made between alluvium and fanglomerate.

Structure

The general structural framework of the pre-Tertiary basement was discussed in the section dealing with stratigraphy and volcanism of the Paleozoic and Mesozoic (see p. 20). This early structural activity does not bear directly on epithermal mineralization at Olympic and will not be taken up further here.

The older volcanics (Tov) were erupted on an old peneplane that extended over much of what is now western Nevada and eastern California in the Miocene. These extrusives were faulted, altered, and mineralized not long after being deposited. Most of the epithermal veining strikes northwest and dips steeply to the southwest. After mineralization, the older volcanics were again subjected to faulting. The post-ore faults are more subtle than might be expected-- many of them were probably not detected during the course of geologic mapping. No generalization can be made concerning the trend or attitude of the post-ore faulting.

The altered, mineralized, and faulted volcanic terrain was weathered, uplifted, and eroded to an unknown extent, perhaps before lake sediments were deposited in the Gabbs Valley basin, roughly 18 to

to 15 million years ago. Sedimentation may have begun before the epoch of mineralization, which would restrict possible erosion of the mineralized volcanics to a relatively short time interval.

There is suggestion of a district-scale doming of the kind described by Wisser (1960) and others in connection with Cordilleran epithermal precious metal ores hosted in Tertiary volcanics. Such doming precedes, accompanies, and follows mineralization, as may be the case at Olympic. Because of the extent of post-ore cover, and the general character of the Cedar Mountains themselves as an uplift, the geometry of possible district-scale doming at Olympic cannot be determined at this time.

As erosion and uplift continued, and marginal faulting blocked out the bedrock highland of the Cedar Mountains and adjacent ranges, regional external drainage became deranged. A broad, irregular basin was formed in Gabbs Valley to the north, which began filling with loess, volcanic ash, and detritus from the adjoining uplands.

Uplift and faulting on a general northerly trend continued as the lake basin filled. Episodes of upland volcanism are evidenced by ash and pumice layers in the lake beds. Volcanic flow units may have interfingered with the lacustrine sequence at intervals. Faulting along the margins of the bedrock continued as sedimentation progressed. Most of the contacts between the older volcanics and lake sediments are faults. From about Miocene time, faulting has continued to the present along northerly trend. Olympic lies within the relatively narrow "118th meridian seismic zone", one of the most active earthquake belts in North America. During the 20 December 1932 earthquake, the second most intense of historical record in Nevada, the epicenter was more or less centered on the Olympic Mine. Fissuring was observed 200 meters west of Stewart Spring, along the western side of Trafalgar Hill, and parallel to the road at about 11,000 north, 8,000 east. All of this fissuring was on the northerly fault trend and was unusual in that it indicated right-lateral strike-slip motion.

Mineralization

Olympic Mine

The ore shoot in the Olympic mine averages 120 cm width. It is white, fine-grained, and crushed. Numerous small stringers branch out into

the walls of the vein. The quartz carries electrum in fine particles that can only rarely be seen in hand specimen. Most early workers commented that visual inspection provided no clue as to grade, even though some of the samples assayed 100 grams and more of gold per ton. Broken fragments of rhyolite wall rock are often found incorporated in the vein. Lamellar quartz is prominent (see below).

About 30 grams of gold and 30 grams of silver were recovered from each ton of ore treated in the cyanide plant. Gold extraction was reported at better than 90%. An engineer who sampled the mine at an early stage in development (Grant, 1916) cut one hundred channel samples on the ore shoot. His assays indicate a 1:1.3 ratio Au:Ag in the ore in place. This indicates about 70% recovery of silver, slightly better than average at this period for ores of this type.

The shaft was started on ore at the surface, inclined at an angle of -40° . As sinking progressed, the ore shoot flattened until it was horizontal on the 150 level, and the shaft far into the footwall. The engineers and geologists who inspected the shoot here thought that the mineral had turned so that it lay parallel to the volcanic strata. From the 150 level, the ore and wall rock inclined upward toward the southwest, and was cut off by a fault just before reaching the 100 level. The ore shoot, as mined, is a synclinal shape 200 m along strike and about 60 m across (see 1:1,000 scale map and sections, 1:2,000 scale map). The apparent trend of the trough-like shoot is north-northwest, and it plunges gently to the southeast. It should be noted that the real trend may be in any direction, for the eastern edge of the vein is cut by the pre-lake bed erosion surface and the western edge by the post-ore fault. Development headings to the north and south show the vein to pinch and to contain less gold and silver. One of the old assay maps (in facts file) indicates that some of the richest ore was at the northwest part of the shoot, near where it was cut off by the fault.

Olympic District

Several veins to the south, west, and northwest of the Olympic shaft were explored in the early days by shallow underground workings,

probably before Nelson's discovery of the Olympic ore shoot. Some of these veins should have been more aggressively explored, for there is a chance of ore shoots, judging from surface indications and considering the behavior of this ore type. No specific recommendations are made for exploring for small, high-grade ore shoots. The best possibilities are on the von Hafften ground.

Mineralization at Olympic conforms in every major respect to an epithermal silver-gold ore type that occurs at many places in the circum-Pacific belt of Tertiary volcanism. It is particularly well developed in Nevada, where it is exemplified by districts such as Tonopah, the Comstock, Aurora, Tuscarora, Delamar ID, etc. Electrum (Au,Ag) and argentite (Ag_2S) are the principal ore minerals. The ore occurs in rich shoots in and near otherwise barren quartz veins that usually crop out boldly, drawing the attention of the early prospectors.

A peculiar texture is characteristic, where "lamellar" quartz results from silica and adularia replacement of early-form calcite along cleavage planes, producing a distinct ribbed appearance easily seen in hand specimen. Nevada miners called the texture "fish scale", although the term is not particularly apt. Silver exceeds gold by weight, ratios ranging from 1:1 to 1:100. Certain ore and gangue minerals, trace metal associations, and a distinctive wall rock alteration suite distinguish the ore type. At Olympic the only departure from the model for the ore type is the relatively low silver content and absence of small amounts of silver sulphosalts and gangue base metal sulphide. The unusually thorough crushing and oxidation is thought responsible. In addition to flushing some of the silver (in primary argentite and sulphosalts) from the near-surface zone, the small quantities of base metal sulphides normally present have apparently been cleanly leached from the ore, rendering it unusually amenable to cyanidation. Several other Tonopah-type districts have been similarly impoverished of silver, as at Seven Troughs and Beatty, where thorough oxidation produces gold:silver ratios near 1:1.

This silver-gold ore type is found in the same regional belt as the volcanic hot spring gold-silver deposits now being discovered

and developed in western Nevada. The two ore types occur in the same rocks, were deposited at the same time, and share a number of other characteristics. In some cases, as for example at Aurora, Tuscarora, Rhyolite, Delamar ID, and Republic WA, the two ore types are found in the same district. Some geologists think that they may simply be different parts of the same hydrothermal convective cell. Others observe that some of the hot springs deposits are younger than nearby veining, and that the two may be slightly different manifestations of the same basic hydrothermal process.

The hammer drilling and underground work done during 1979-1982 was aimed at finding the faulted extension of the Olympic ore shoot. It immediately became apparent that perhaps this was not what had been done. The mineral zone at the foot of the decline is thicker, its contacts with the enclosing wall rock are more irregular, and it contains more of a variety of mineral textures. Stockworking, porcelaneous quartz, hydrothermal breccias, and other features characteristic of hot spring mineralization are common. Most of the quartz is completely crushed. Instead of being bleached white, the decline mineral zone is heavily stained by iron and manganese oxides. The zone is thoroughly oxidized, further obscuring the original character of the mineralization. Many who have inspected it comment that it looks better than much of the ore being mined at nearby open pits.

The ore of the Olympic mine, the mineralization developed in the decline, the mineral showings at the surface, and the intercepts in FMC's drill holes may be related to a larger hydrothermal system which lies under cover nearby. The general strength of alteration and mineralization improves toward the north. Exploration potential here is summarized in a later section of this report.

No fluid inclusion work has been done at Olympic. There is no question about the epithermal character of mineralization. The ore developed in the Olympic mine is clearly within the vertical range of veining and stockworking in the typical epithermal model. Chances of low-grade hot spring mineralization beneath the old mine is not as promising as exploring laterally out under cover for shallower volcanic hot spring mineralization.

Nearby prospects and mines

In the area to the east of Olympic, along the county line, several precious metal and mercury prospects and small mines have been developed in low outcrops of older volcanics protruding through the Tertiary lake beds. The Nye County geologic map (Kleinhampl and Ziony, 1985) shows the rocks as Miocene rhyolite. The Mineral County geologic map (Ross, 1961) shows the wall rocks as "pre-Esmeralda" intermediate to felsic volcanics. The entire area between the Olympic mine and these epithermal showings is Tertiary sedimentary cover. In this same general area there has been extensive trenching for diatomite in the Tertiary sediments. The gold and silver development was during and just after World War I. The mercury activity was during the early World War II years. The trenching of diatomite was in the 1950's.

Trojan (Dunham) Mercury Prospects.--East-northeast of Olympic about 6½ km, in Nye County, cinnabar showings have been extensively trenched. The rhyolitic wall rock, a biotitic welded tuff, is older than the Tertiary sediments. The tuff is sheared and bleached, with limonite seaming and veinlets along the shears. There is no record of mercury production.

Warrior Mine.--5 km east of Olympic, in Nye County, extensive prospects and shallow mine workings explore epithermal quartz veins in shear zones. The wall rock is intensely bleached welded tuff of rhyolitic character. The major shear contains veining almost a meter in width, which strikes northwest and dips 35° to 55° to the southwest. Post-ore faulting is conspicuous. A few hundred tons of ore were mined, from which a few thousand dollars of gold and silver were recovered. The principal development was in 1921, when Olympic Mines Company operated the property.

Cute Maid.--4½ km east-southeast of Olympic, in Mineral County, epithermal quartz veining is found in pre-lake volcanics. The veins strike N 25°W and dip 70° to the southwest. The wall rocks are thoroughly bleached, and no sulphides are seen in the vein. Although a shallow shaft was sunk, and some stoping was done on the vein, there is no formal record of production.

Saddleback (Lou).--4½ km southeast of Olympic, in Mineral County, pyrite-bearing epithermal quartz veins have been explored for gold and silver. Later mining developed cinnabar in a vertical north-trending fault in altered and silicified volcanics. About 100 kg of mercury was retorted on the property. There is no record of precious metal production.

Mina Gold.--5 km south of Olympic a west-northwesterly trending zone of epithermal gold silver mineralization was worked on a limited scale in the early days. It is hosted by Tertiary volcanics. The property was recently drilled by FMC Corporation and turned back to owner Frank Lewis of Reno.

Simon.--5 km south-southeast of Olympic a mesothermal argentiferous lead-zinc jasperoid has been mined at Simon. A pipe-like shoot of jasperoid formed along the walls of a felsic porphyry dike which intrudes limestone of the Triassic Luning Formation. The dike strikes northwest and dips 70° northeast, and is 3 to 10 m in width. It is probably a daughter differentiate from the nearby orogenic granitic pluton which crops out to the southeast. Oxidized lead carbonate (cerussite) ore was mined from the gossan in the early days. Oxidation extends to a depth of 50 m. The ore shoot is as much as 20 m in width and 70 m along strike, pitching steeply toward the northwest. The sulphide ore consists of galena and brown sphalerite in a gangue of dark-gray jasperoid with minor pyrite. The sulphide ore averaged about 100 g/t Ag, 8% Pb, and 9% Zn. Gross value of production to date, priced at the time of mining, is about \$500,000.

Numerous small scheelite-molybdenite skarns have been prospected in the contact zone of the granitic intrusives southeast of the Simon mine. The best tungsten showings are in limestone of the Triassic Luning Formation. There has been no significant production of tungsten.

GEOPHYSICS

Geophysics is not recommended in exploring for ore at Olympic. As already mentioned, application of seismic or gravity methods would

probably not be helpful in determining the thickness of the lake beds. The Tertiary sediments are easily drilled, which will quickly determine the depth to underlying older volcanics.

Because the entire target area is concealed beneath post-mineral cover of various kinds, direct geophysical exploration for ore is not likely to be successful. Lacustrine and fluvial sediments are involved, perhaps in two separate sequences. Alluvium, volcanic flows, and possibly loess may be present. The terrain is faulted, and faulting continued as lake sedimentation proceeded. Irregular wall rock alteration in the older volcanics was weathered to an unknown degree prior to lake deposition. Oxidation effects are thorough near surface, may extend to considerable depth, and appear to be ragged and irregular at depth in the FMC drilling. Under the best of conditions, direct geophysical exploration methods have failed in exploring for gold and silver in Nevada. The added complications at Olympic very much limit chances of success with the method.

GEOCHEMISTRY

Because of the thickness, variety, and character of post-ore cover rocks in the exploration target area, rock chip, soil, and stream sediment sampling methods of direct geochemical exploration cannot be applied. The cover rocks are all of transported character, and some indirect method would be necessary. "Soil gas" and "sulfur gas" methods have been tried without success elsewhere in Nevada. Mercury vapor, sulfur dioxide, carbon disulfide (CS_2), carbonyl sulfide (COS), methane (CH_4), etc. have been attempted. Antithetic CO_2 (enriched) and O_2 (depleted) methods have been tried. Bacteria methods furnished a flurry of excitement two years ago. None of these methods of exploring through cover has resulted in ore discovery in Nevada, even in simple situations such as prospecting through thin alluvial veneer on pediments.

Today rock chip sampling is the prime exploration method in Nevada for bulk-mineable gold-silver ore. As the bedrock terrain is more and more thoroughly prospected, the method will become less useful in the years just ahead. At Olympic tens, if not hundreds of companies

have sampled the showings during the past eight or ten years. The surface mineral showings and dumps at old prospect pits are literally festooned with flagging and sample tags of every color and description. Thousands of rock chip samples have been collected. The results of this work are, of course, unknown. However, the major exploration potential described in this report is principally based on blind showings underground which project horizontally under post-ore cover. Therefore rock chip sampling, regardless of how thoroughly done, will not help in laying out exploration drilling. The considerable expense of such work is also taken into consideration in the decision not to undertake rock chip sampling at Olympic at this time.

Some companies have developed elaborate geochemical models for volcanic hot spring mineralization. Metal zonation, trends, sizes, shapes, etc., are involved. The models emphasize horizontal and to some extent vertical geochemical patterns beyond ore limits-- even beyond where the outcrops may be expected to contain detectable gold values. For the most part this work is proprietary. It involves much sampling and requires the determination of a large number of metals. Elaborate analysis of data is required. Major follow-up sampling is usually necessary. No case is known where such indirect geochemical work has resulted in the discovery of a gold-silver mine in Nevada. At least for the present, the money and effort might better be spent drilling.

One small area will be sampled at the earliest opportunity. At the northeast foot of Trafalgar Hill several old shafts and adits explored a thoroughly altered and irregularly mineralized zone centering on coordinates 10,140 north, 8,860 east. A small open pit was excavated on these prospects in the early days. Perhaps a hundred tons was removed from the site, possibly for a test run in the Olympic cyanide plant. There is little evidence of recent rock chip sampling here. Ten rock chip samples will be collected to determine if anomalous gold can be found, here at the northernmost exposure of older volcanics, at the southwest edge of the exploration target area.

EXPLORATION POTENTIAL

Several recent discoveries of major precious metal mines have been made by drilling through post-ore cover a short distance from relatively modest mineral showings in bedrock outcrop. Gold Quarry, Sleeper, Chimney Creek, Getchell, Dexter, Bullfrog, and others were found in this manner. At several mines, better ore was found in separate deposits, blind laterally away from the mineralization upon which the original operation was predicated. Borealis, Alligator Ridge, and others have this kind of history. An ever increasing proportion of Nevada exploration will be done through cover as the bedrock areas are more and more thoroughly tested.

There is obvious potential for volcanic-hosted disseminated gold-silver mineralization at Olympic. The alteration and mineralization generally improves to the north-- on the surface, in the underground workings, and in the holes recently drilled by FMC. The alteration and mineralization is characteristic of showings near low-grade precious metal deposits in the region. A large area to the north of Olympic is concealed beneath post-ore cover. It is easy of access. Most of the promising ground has been acquired. The cover rock is known to drill well, at least in the dry conditions thus far encountered.

The size and grade of the volcanic-hosted deposits now being discovered and developed in Nevada make them attractive exploration targets. The prime exploration method is drilling vertical holes from the surface, which is relatively inexpensive and efficient. These ore deposits require small capital investment, can be developed quickly, and employ proven mining and metallurgical techniques and machinery. There is no problem in marketing the mine product, for bullion can be produced on site and sold to any number of competitive buyers. These factors combine to invite aggressive exploration of good prospects.

A brief analysis was made of several recently discovered Nevada volcanic hot spring precious metal ore deposits to determine their general characteristics-- most particularly their geometry (Sleeper, Paradise, and Borealis). The average gross value, at present prices, is well into the

range hundreds of millions of dollars. Round Mountain, which because of its size was not included in the averages, will probably gross over a billion dollars.

The ore bodies are elongate in plan. The average size is 125 x 375 x 80 m: width x length x thickness. The elongation trend of individual ore bodies is variable. Where an elongation trend is known or suspected, the size and shape of the average deposit indicates that an efficient drill hole lay-out would be holes 100 m apart on fences perpendicular to the trend, the fences spaced 200 m apart. Where no trend is known, a square 150 m grid is indicated. If a hole is drilled 50 m into older volcanics without intercepting interesting mineralization, the chance of finding ore at greater depth is not good. There is a trade-off between spacing the holes close enough to be sure of finding the ore deposit-- and the need to test as much of the target area as possible with available funds. As holes deepen, drilling often slows and sample quality deteriorates. Carrying holes to depths beyond 180 to 200 m can escalate costs rapidly. It usually makes more sense to use the funds to drill more holes over a broader area.

The principal negative factors affecting exploration northwest of Olympic are summarized as follows:

1. The principal unknown is, of course, whether or not a volcanic hot spring deposit ever formed at Olympic.
2. If a deposit was formed, there is a chance that it was removed by mid-Miocene erosion.
3. The lake beds may deepen rapidly basinward to the north, putting the volcanic host rock beyond economic exploration and development depth.
 - a. The basin may be deeper than expected. Pre-lake topography may fall away from the mountains more rapidly than surface evidence indicates.
 - b. Continued uplift of the Cedar Mountains during lake sedimentation may have tilted the pre-lake surface beneath the lake beds.
 - c. Faulting at the northern base of the Cedar Mountains may downthrow the lake beds more than is apparent at the surface.
 - d. There may be considerable Miocene relief on the old erosion surface on the rhyolitic volcanics underlying the lake beds.



Photographs 6 and 7. View northwest and north-northwest of exploration target area. Most proposed drilling is toward right. Left middle ground: Trafalgar Hill. Center: Stewart Valley, cream-colored outcrops are Tertiary sediments (Ts). Left background: Gabbs Valley Range. At upper right are hills where Paradise Mine is located, just off right edge of photograph. In distance, Koegel Hills and Rawhide mining district. Taken from 10,030 north, 9,770 east.

RECOMMENDATIONS

Photographs 6 and 7, on the preceding page, show the exploration target area northwest of Olympic. The 1:2,000 topographic map and clear overlay to the 1:5,000 maps show the position of fourteen drill sites "A" through "P". Six additional holes will fill in the drill pattern where favorable results have been obtained in the first fourteen holes, or may be used to extend the drill pattern farther out in the target area. The coordinates of the fourteen initial drill holes are:

<u>Site</u>	<u>-Coordinates-</u>		<u>Site</u>	<u>-Coordinates-</u>	
	<u>North</u>	<u>East</u>		<u>North</u>	<u>East</u>
A	10,161	9,866	H	10,270	9,343
B	10,351	9,752	J	10,565	9,682
C	10,278	9,641	K	10,660	9,754
D	10,188	9,524	L	10,654	9,375
E	10,490	9,832	M	10,543	9,253
F	10,470	9,480	N	10,748	9,480
G	10,378	9,480	P	10,748	9,480

The first hole will be drilled at site "A" not far from the northernmost face underground off the foot of the decline. This hole will establish the thickness of the lake beds here, and be a check of continuity of the mineralization found in the decline and FMC's drilling. Holes "B", "C", "D", etc. will be drilled, each in order, stepping off to the northwest over probable thickening lake beds. The holes will be taken a minimum 50 m into the older volcanics, or at least 150 m total depth, whichever is deeper. The actual terminal depth of each hole will be determined by individual circumstances.

Experience at Olympic has demonstrated the difficulty in visual estimation of strength of precious metal mineralization. The ore mined in the early days, the exposures in the decline, and FMC's drill hole samples all show that visual appearances are deceiving. For this reason, all cutting will be sampled and analyzed after passing through the base of the Tertiary sediments. Samples will be taken for each one meter (third of a ten foot steel), which introduces a small discrepancy which is of no consequence in the exploration phase.

If English units are used, a 5 ft (1½ m) sample will be taken for logging and analysis. If English units are used on the

drill program, no mixture of English and metric units will be allowed. All field records, surveys, notes, logs, reports, etc. will use one system of measurement or the other. The one exception is the use of ppm in reporting geochem results, where one part per million = one gram per metric ton. If English units are to be used, a new topographic map will be prepared photogrammetrically on 1:2,400 scale (1 inch = 200 feet), 5 ft contour interval, to replace the 1:2,000 map used in this report for planning.

A slow turn-around of assay or geochem results may be anticipated at this time when dealing with a reliable analyst such as Skyline Labs in Colorado. Skyline has established a sample receiving and preparation facility in Reno which has cut time by a day or two. The use of local laboratories which promise faster results is a temptation, but has caused difficulty in recent drilling projects. Some geologists send duplicates out. This solves nothing, for erroneous first results can still mislead planning, and the added cost can amount to thousands of dollars in a project of this kind.

All fourteen initial holes will be drilled, in order, at sites "A" through "P". Then, using all information available, the six follow-up holes will be sited. It should be anticipated that complete analytical results from the first fourteen holes will not be available at that time.

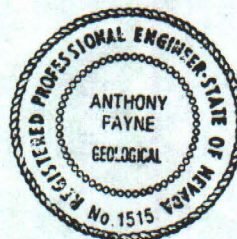
The drill pads will be sited to take advantage of local terrain. A departure of a few meters from the listed coordinates may result. After the pads have been prepared, the drill pads will be accurately surveyed, determining drill collar elevations so that large scale working cross sections can be prepared as the work progresses.

The 1:2,000 topographic map showing drill sites may be used in filing the U.S.B.L.M. Notice of Intent to Operate (43 CFR 3809). This should help secure approval without unduly strict surface restoration requirements or performance bond.

Reno, Nevada

15 September 1988

Anthony Payne
Anthony Payne
Mining Geologist
P.E. Nevada 1515



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USGS TOPOGRAPHIC MAPS

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- Ione Valley 1:100,000 metric topographic map, 30' x 60' quadrangle, 38117-E1-TM-100, 1985.
- Stewart Spring 1:24,000 topographic map, 7½-minute quadrangle, N3830-W11752.5/7.5, 1979.

Gold and Silver Price Conversion Table

Metric-Troy

GOLD

<u>US \$ per gram</u>	<u>US \$ per ounce</u>
\$20	\$622
19	591
18	560
17	529
16	497
15	466
14	435
13	404
12	373
11	342
10	311

SILVER

<u>US ¢ per gram</u>	<u>US ¢ per ounce</u>
50¢	1555¢
45	1400
40	1244
35	1089
30	933
25	778
20	622
15	467
10	311

To convert dollar prices per troy ounce to dollar per gram multiply by 0.032151

To convert dollar prices per gram to dollar per troy ounce multiply by 31.10349

Professional Qualifications

Anthony Payne, Geologist. Born Delta, Utah 25 Dec 1927.

Education:

B.S. in Geology, University of Utah, 1949.

M.S. in Mineralogy, Geophysics, and Mining Engineering, U. of U., 1950

Ph.D. in Economic Geology, Stanford University, 1959.

Experience:

1959-present, Independent Geologist. Exploration and development of silver and gold in Nevada, California, Oregon, and Utah.

1959-present, Consulting Geologist. Consultant to mining and petroleum companies, individual investors, state and federal agencies, government and legislative committees, the National Academy of Sciences. Western U.S., Southeastern U.S., Alaska, Canada, Mexico, the Caribbean, and South America.

1959-1979, Professor of Economic Geology, Professor of Mining Engineering. Mackay School of Mines, University of Nevada. Teaching and research in ore deposits, mineral exploration, evaluation of ore deposits, mining law. Chairman of Department of Mining Engineering, 1966-1973.

1955-59, Mining Geologist. Shenon and Full, Salt Lake City consulting mining geologists. Exploration and evaluation of mineral deposits in Colorado, New Mexico, Arizona, and Utah.

1952-54, Mining Geologist. Matahambre Copper Mine. Pinar del Rio province Cuba. Geologic mapping, exploration, evaluation, and engineering work at mine. Evaluation of mines and prospects in western Cuba.

1951-52, Exploration Geologist. Regional exploration in southwestern United States for the American Smelting and Refining Company.

1950-51, Resident Geologist. Quiruvilca copper-silver mine, Libertad province, Peru. Geological and engineering work at mine. Evaluation of ore reserves. Exploration of surrounding mining district. Evaluation of mineral prospects in northern Peru. Northern Peru Mining and Smelting Company, a wholly-owned subsidiary of American Smelting.

1948 & 1949 (summers) Junior Geologist. Section of Mineral Deposits, United States Geological Survey. Evaluation of phosphate deposits in Idaho and Montana. Geological mapping of the area between the Climax, Leadville, and Gilman mining districts in central Colorado.

1947 (summer) Geologic Field Assistant (sampler). Section of Mineral Deposits, United States Geological Survey, sampling and evaluation of phosphate deposits in southeastern Idaho.

Military Service:

Naval Aviation V-5 Cadet in flight training at close of World War II, Corpus Christi Naval Air Training Station, Texas. Commissioned Ensign U.S. Naval Reserve. Veteran of World War II. Victory ribbon American Theatre Ribbon.

Registered Professional Geological Engineer, Nevada 1515.

Member: American Association of Petroleum Geologists, American Institute of Mining Engineers, Society of Economic Geologists, Society of Applied Geology in Ore Deposits.

Senior Editor and principal author of "Exploration for Mineral Deposits in Mineral Engineering Handbook, 2 vols., A.I.M.E. New York, 1973.

Author of numerous papers, reports on exploration and mineral evaluation.

FAA Licensed Commercial Pilot and Instrument Ground and Flight Instructor.

FILE MEMORANDUM

Subject: Olympic Nos. 1 thru 36 mining claims.

Date: 01 Jan 89

On page 19 of my report on the Olympic Gold Mine dated 15 September 1988, no recordation data were given for the Olympic Nos. 1 thru 15 mining claims. In November of 1988, the Olympic Nos. 16 thru 36 mining claims were staked to the west and north of the claim block.

The recordation data for these 36 new mining claims, located by Mark A. Steen, are tabulated below. This memo should be appended to my report of 15 September 1988.

<u>Claim</u>	<u>Date Located</u>	<u>County Book/page</u>	<u>USBLM NMC No.</u>
Olympic No. 1	03 Sep 88	127/284	527545
Olympic No. 2	03 Sep 88	127/285	527546
Olympic No. 3	03 Sep 88	127/286	527547
Olympic No. 4	03 Sep 88	127/287	527548
Olympic No. 5	03 Sep 88	127/288	527549
Olympic No. 6	03 Sep 88	127/289	527550
Olympic No. 7	02 Sep 88	127/290	527551
Olympic No. 8	02 Sep 88	127/291	527552
Olympic No. 9	02 Sep 88	127/292	527553
Olympic No. 10	02 Sep 88	127/293	527554
Olympic No. 11	02 Sep 88	127/294	527555
Olympic No. 12	02 Sep 88	127/295	527556
Olympic No. 13	02 Sep 88	127/296	527557
Olympic No. 14	02 Sep 88	127/297	527558
Olympic No. 15	02 Sep 88	127/298	527559
Olympic No. 16	11 Nov 88	127/299	527560
Olympic No. 17	11 Nov 88	127/300	527561
Olympic No. 18	11 Nov 88	127/301	527562
Olympic No. 19	11 Nov 88	127/302	527563
Olympic No. 20	11 Nov 88	127/303	527564
Olympic No. 21	11 Nov 88	127/304	527565
Olympic No. 22	11 Nov 88	127/305	527566
Olympic No. 23	11 Nov 88	127/306	527567
Olympic No. 24	11 Nov 88	127/307	527568
Olympic No. 25	11 Nov 88	127/308	527569
Olympic No. 26	11 Nov 88	127/309	527570
Olympic No. 27	11 Nov 88	127/310	527571
Olympic No. 28	11 Nov 88	127/311	527572
Olympic No. 29	11 Nov 88	127/312	527573
Olympic No. 30	11 Nov 88	127/313	527574
Olympic No. 31	11 Nov 88	127/314	527575
Olympic No. 32	11 Nov 88	127/315	527576
Olympic No. 33	11 Nov 88	127/316	527577
Olympic No. 34	11 Nov 88	127/317	527578
Olympic No. 35	11 Nov 88	127/318	527579
Olympic No. 36	11 Nov 88	127/319	527580

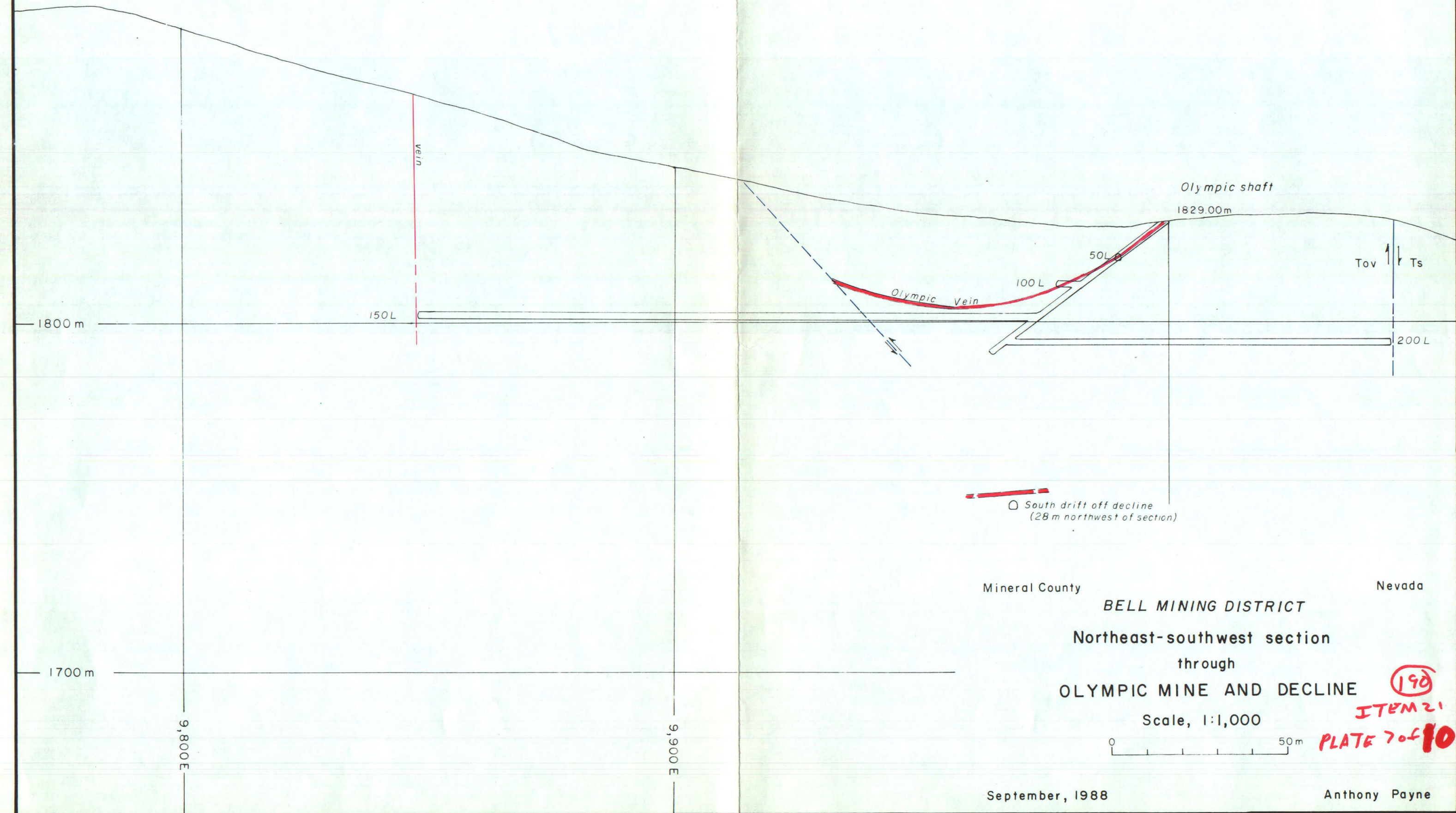
Anthony Payne
Anthony Payne

<u>Mining Claim</u>	<u>Date Located</u>	<u>Mineral County Book/Page</u>	<u>U.S.B.L.M. NMC No.</u>
Olympic No. 37	08 Apr 89	130/575	551023
Olympic No. 38	08 Apr 89	130/576	551024
Olympic No. 39	09 Apr 89	130/577	551025
Olympic No. 40	09 Apr 89	130/578	551026
Olympic No. 41	09 Apr 89	130/579	551027
Olympic No. 42	09 Apr 89	130/580	551028
Olympic No. 43	09 Apr 89	130/581	551029
Olympic No. 44	09 Apr 89	130/582	551030
Olympic No. 45	09 Apr 89	130/583	551031
Olympic No. 46	09 Apr 89	130/584	551032
Olympic No. 47	09 Apr 89	130/585	551033
Olympic No. 48	09 Apr 89	130/586	551034
Olympic No. 49	09 Apr 89	130/587	551035
Olympic No. 50	09 Apr 89	130/588	551036
Olympic No. 51	09 Apr 89	130/589	551037
Olympic No. 52	09 Apr 89	130/590	551038
Olympic No. 53	09 Apr 89	130/591	551039
Olympic No. 54	09 Apr 89	130/592	551040
Olympic No. 55	09 Apr 89	130/593	551041
Olympic No. 56	09 Apr 89	130/594	551042
Olympic No. 57	09 Apr 89	130/595	551043
Olympic No. 58	09 Apr 89	130/596	551044
Olympic No. 59	15 Apr 89	130/597	551045
Olympic No. 60	16 Apr 89	130/598	551046
Olympic No. 61	16 Apr 89	130/599	551047
Olympic No. 62	16 Apr 89	130/600	551048
Olympic No. 63	16 Apr 89	130/601	551049
Olympic No. 64	16 Apr 89	130/602	551050
Olympic No. 65	16 Apr 89	130/603	551051
Olympic No. 66	16 Apr 89	130/604	551052
Olympic No. 67	16 Apr 89	130/605	551053
Olympic No. 68	16 Apr 89	130/606	551054
Olympic No. 69	16 Apr 89	130/607	551055
Olympic No. 70	16 Apr 89	130/608	551056
Olympic No. 71	16 Apr 89	130/609	551057
Olympic No. 72	17 Apr 89	130/610	551058
Olympic No. 73	17 Apr 89	130/611	551059
Olympic No. 74	17 Apr 89	130/612	551060
Olympic No. 75	17 Apr 89	130/613	551061
Olympic No. 76	17 Apr 89	130/614	551062
Olympic No. 77	17 Apr 89	130/615	551063

← 250°

Looking northwest (350°)

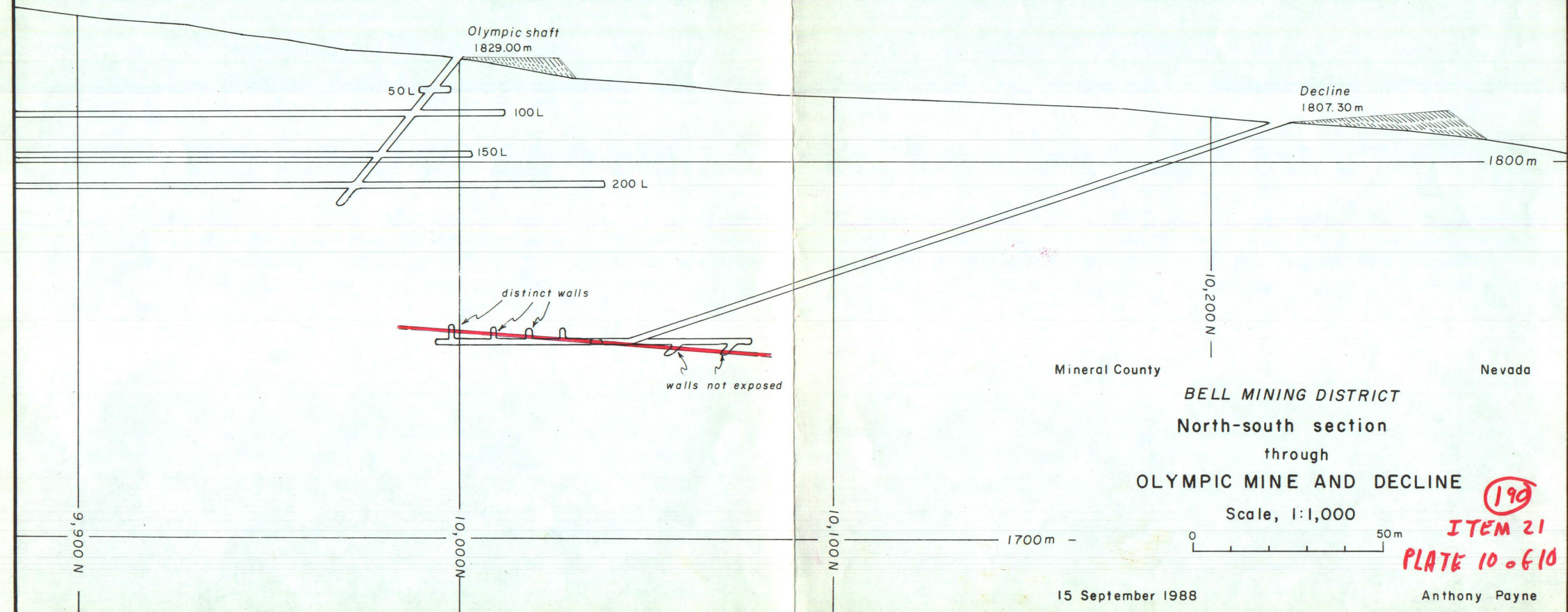
050° →



← 205°

LOOKING West-northeast (305°)

005° →



10,000 E

o P

o L

o K

o J

o M

o E

o F

o N

o G

o B

o H

o C

o D

o A

Mineral County

Nevada

**BELL MINING DISTRICT
FOURTEEN HOLE DRILL LAYOUT
NORTHWEST OLYMPIC MINE AREA**

Scale, 1:5,000
0 100 200m

15 September 1988

Anthony Payne

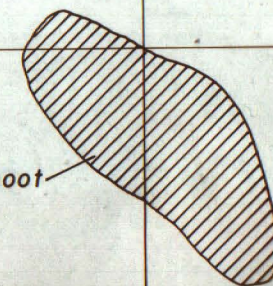
-10,000 N

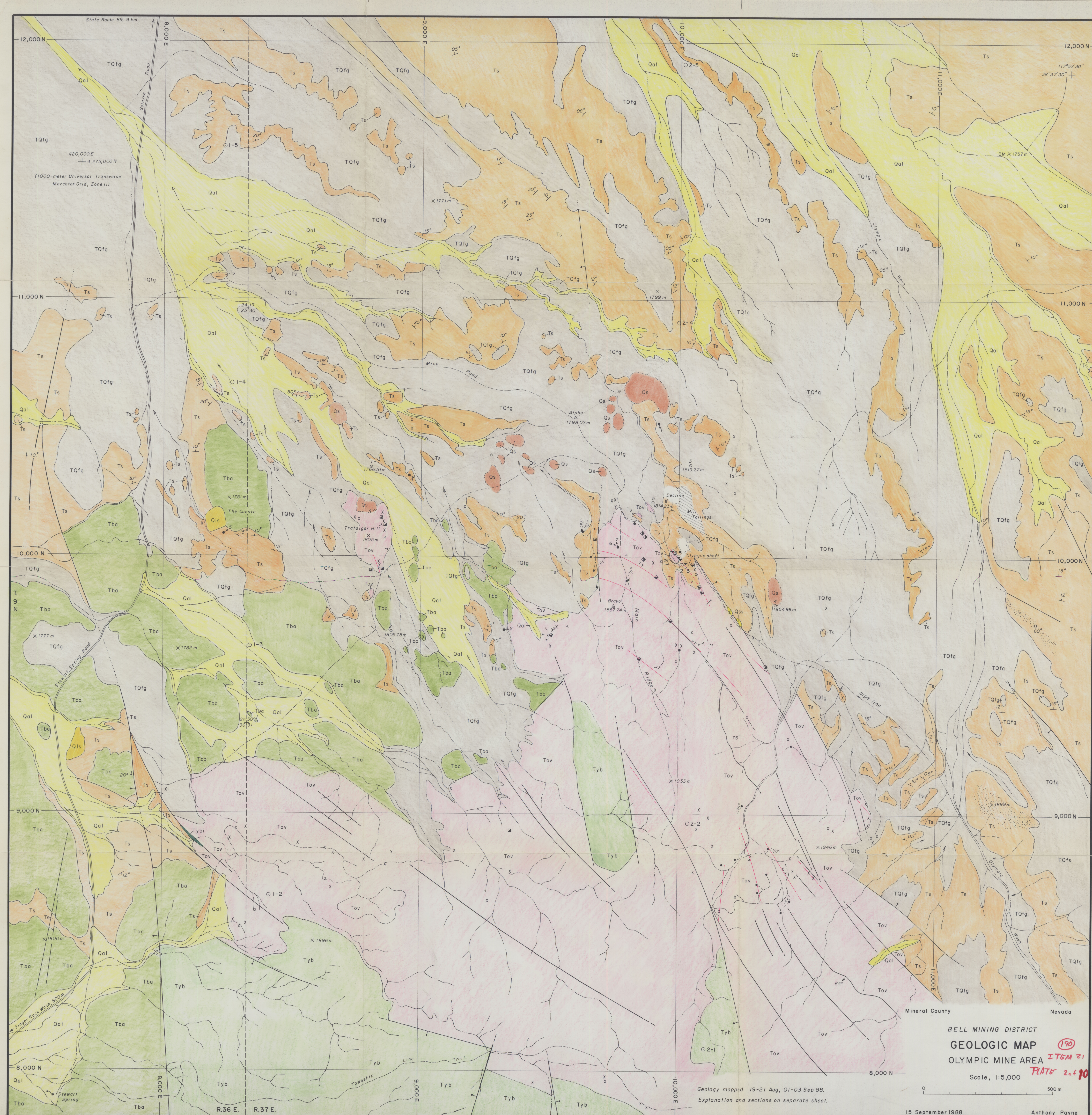
190

ITEM 21

PLATE 8 of 10

Olympic ore shoot





BELL MINING DISTRICT

GEOLOGIC MAP

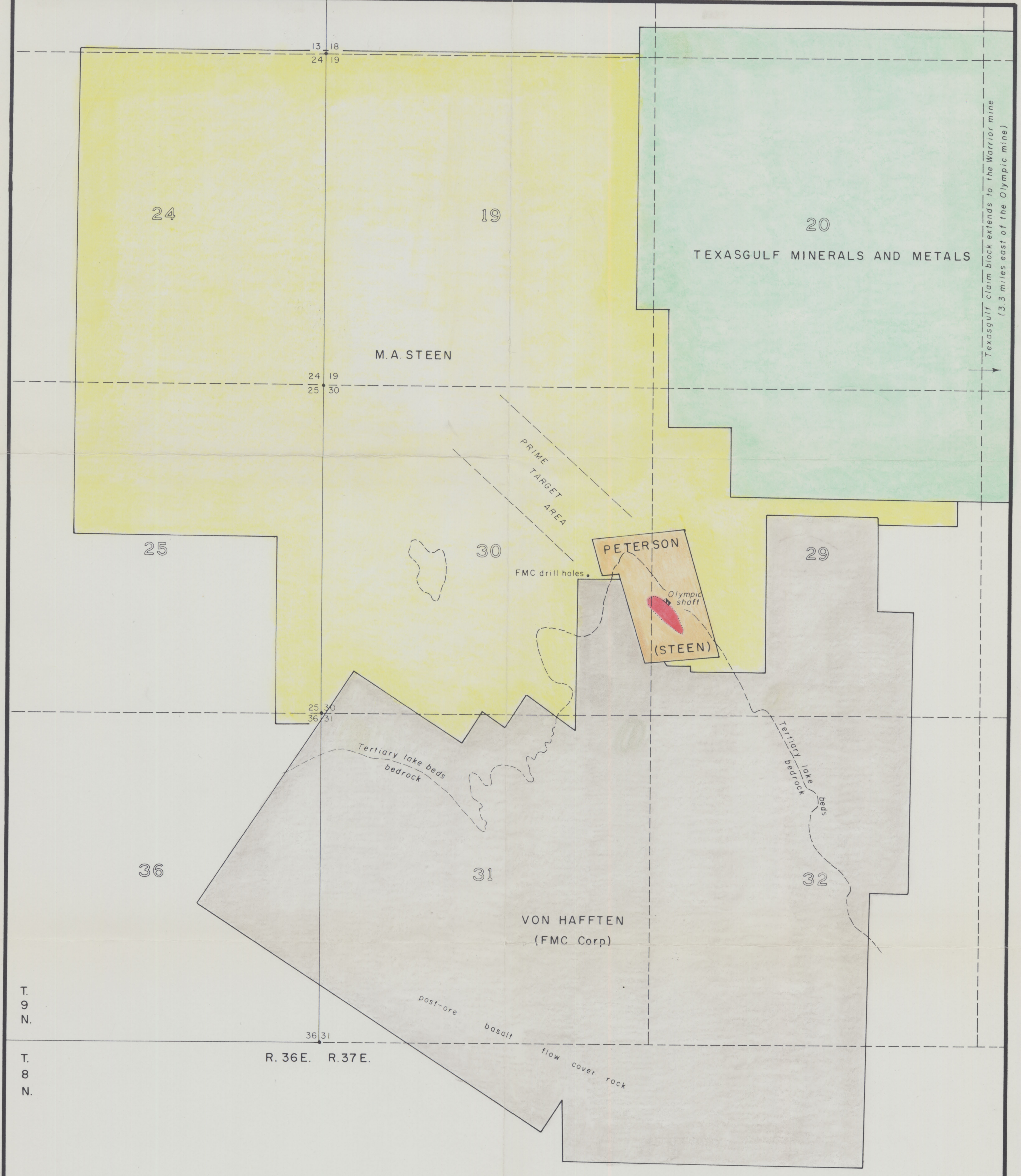
OLYMPIC MINE AREA

Scale, 1:5,000

15 September 1988

Anthony Payne

0500 002

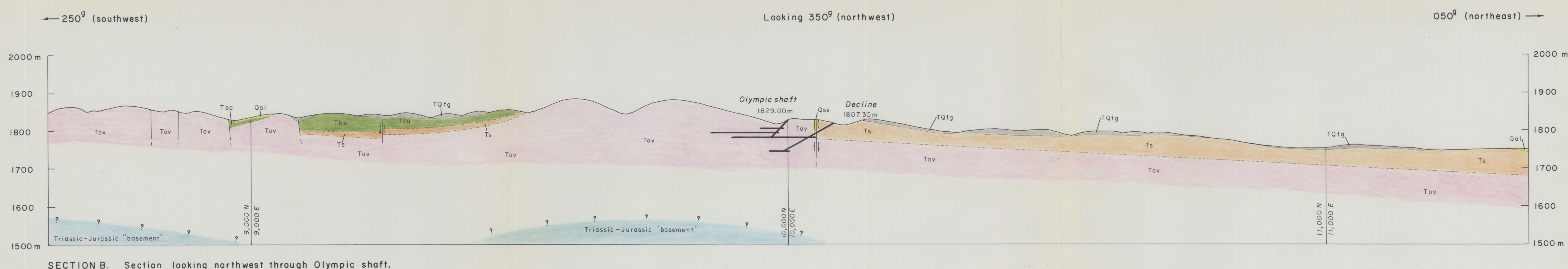
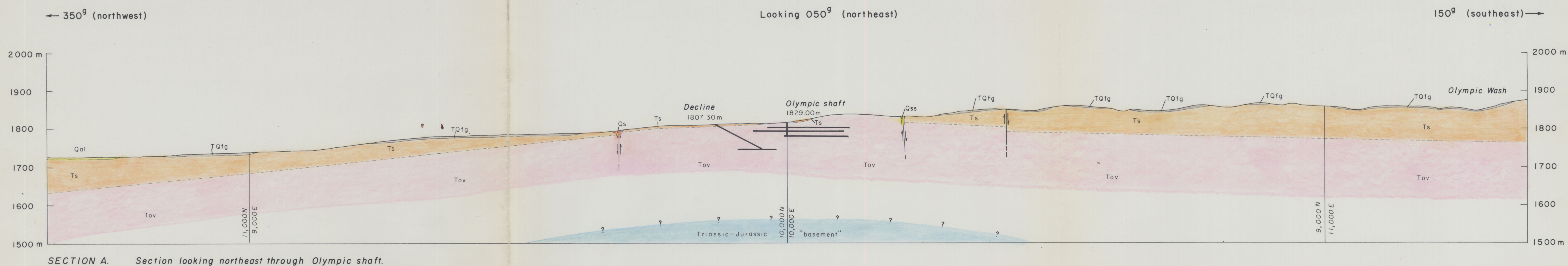


T. 9 N.
T. 8 N.

R. 36 E. R. 37 E.

Mineral County Nevada
BELL MINING DISTRICT
OLYMPIC MINE AREA
PROPERTY MAP
Scale, 1" = 1,000' (1:12,000)
190 ITEM 21
19 April 89 PLATE 9-10 Anthony Payne

0500 0021



EXPLANATION

- 50° strike and dip of fracturing
- ⊕ horizontal bedding
- 10° strike and dip of bedding
- 5 photo (in text of report)
- contact
- indefinite
- fault (plan), dashed where inferred, dotted where concealed.
- fault (section)
- 45° vein
- spring
- X spot photogrammetric elevation
- photocenter of aerial photograph
- survey point
- △ triangulation point
- + section corner
- FMC Corporation vertical drill hole
- 45° FMC Corporation angle drill hole
- X prospect pit
- shaft, raise
- adit
- trench
- discolored Tertiary sediments
- mine dump
- mill tailings
- building foundation
- dirt road
- jeep trail
- arroyo

LEGEND

- Qal Alluvium. Unconsolidated silt, sand, and gravel.
- Qls Landslide. Cognate slump blocks of Tertiary sediments.
- Qss Spring sinter. Tufa-like calcareous deposits along faults.
- Qs Spring deposits. Iron-stained soil over Ts and TQfg. Montmorillonitic gypsum, ferroconglomerate, rounded basalt boulders.
- TQfg Fanglomerate. Fluvial gravels on interfluvial mesas and arroyo floors.
- UNCONFORMITY
- Tybi Intrusive basalt dikes. Probable intrusive equivalent of Tyb.
- Tyb Extrusive basalt flows. Flows of fresh medium-grained basalt.
- UNCONFORMITY
- Tba Extrusive flows, basalt to andesite. Basalt to andesite flows, possible andesite intrusives.
- Ts Lacustrine deposits. Lacustrine mudstone, siltstone, sandstone, and conglomerate. Thin beds of selenite, limestone, pumice, ash, and tufa.
- UNCONFORMITY
- Tov Older volcanic flows and tuffs. Rhyolite and quartz latite flows, welded tuffs, and ash-tell tuffs. Variable propylitic, argillic, and sericitic alteration.
- UNCONFORMITY
- RJ Triassic and Jurassic. Metasediments, metavolcanic, and metaigneous rocks. Possible Jurassic-Cretaceous granitic intrusives. Inferred at depth. Shown only on cross sections.

Base map compiled from enlargements of aerial photographs flown 26 Aug 87, scale 1:10,000, by Great Basin Aerial Surveys, Reno, Nevada, Wild RC-10 camera, project number 156-009.

Mineral County Nevada

BELL MINING DISTRICT EXPLANATION AND SECTIONS to accompany GEOLOGIC MAP OLYMPIC MINE AREA

Scale, 1:5,000

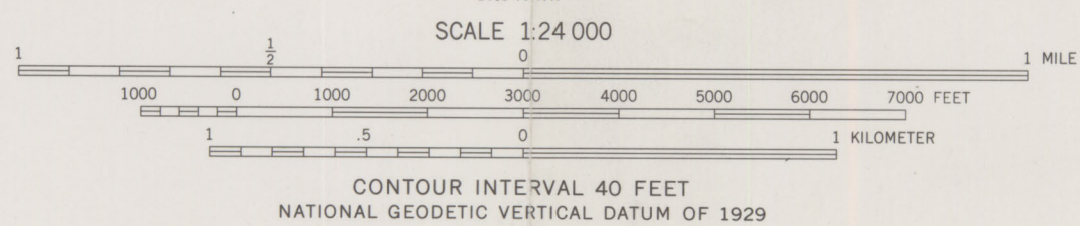
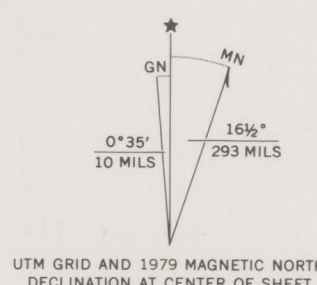
15 September 1988 170 JTM 21 Anthony Payne

PLATE 2 of 10

0500 0021



Mapped, edited, and published by the Geological Survey
Control by USGS and NOS/NOAA
Topography by photogrammetric methods from aerial
photographs taken 1974. Field checked 1975
Map edited 1979
Projection and 10,000-foot grid ticks: Nevada coordinate
system, west zone (transverse Mercator)
1000-meter Universal Transverse Mercator grid, zone 11
1927 North American Datum
To place on the predicted North American Datum 1983
move the projection lines 11 meters north and
82 meters east as shown by dashed corner ticks
Fine red dashed lines indicate selected fence and field lines where
generally visible on aerial photographs. This information is unchecked
Where omitted, land lines have not been established



ROAD CLASSIFICATION	
Primary highway, hard surface	Light-duty road, hard or improved surface
Secondary highway, hard surface	Unimproved road
Interstate Route	U. S. Route
	State Route

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

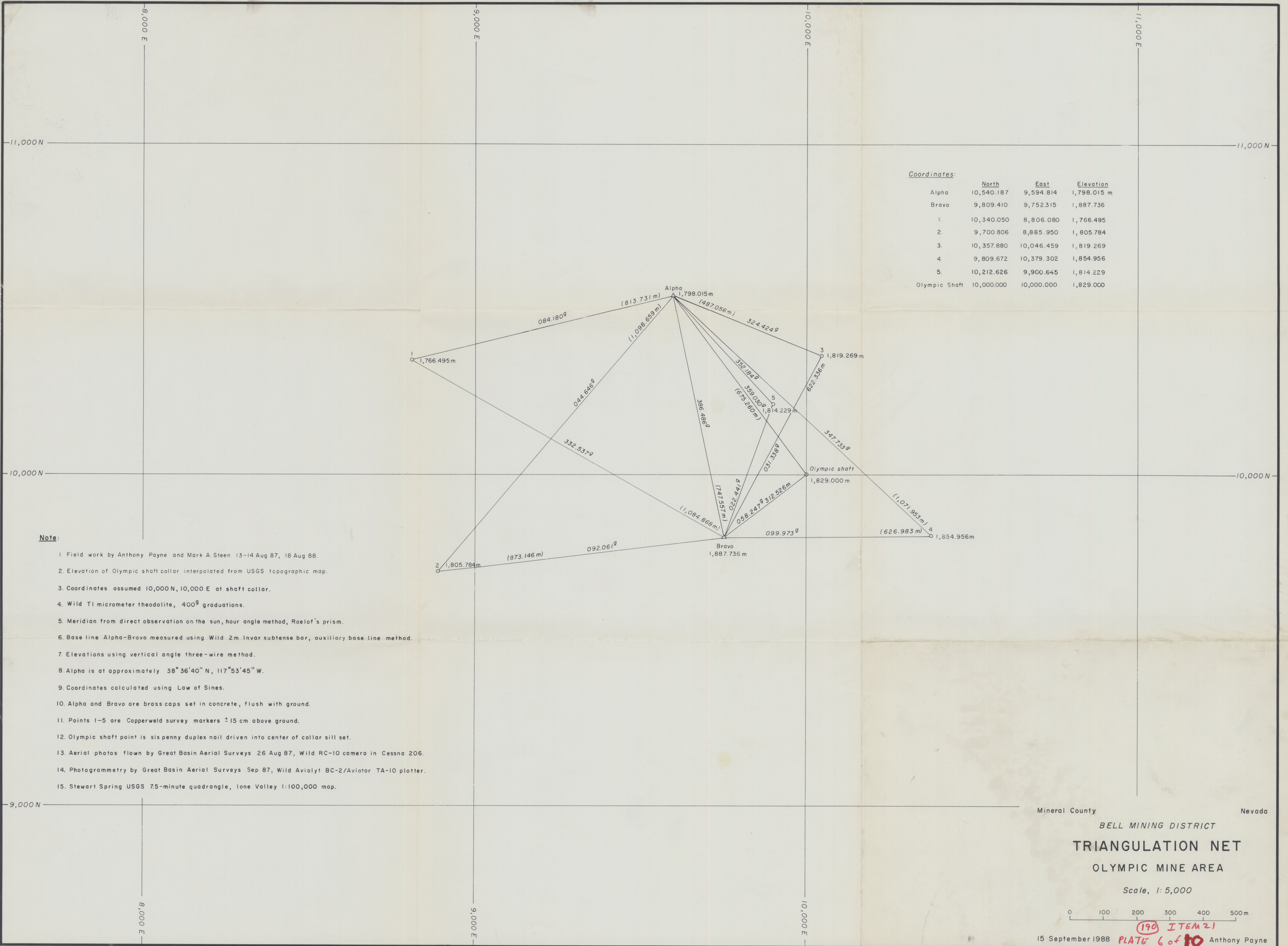
STEWART SPRING, NEV.
N3830-W11752.5/7.5

1979

DMA 2461 III SW-SERIES V898

190
ITEM 21
PLATE 1 of 10
01218

0500 0021



Coordinates:

	North	East	Elevation
Alpha	10,540.187	9,594.814	1,798.015 m
Bravo	9,809.410	9,752.315	1,887.736
1.	10,340.050	8,806.080	1,766.495
2.	9,700.806	8,885.950	1,805.784
3.	10,357.880	10,046.459	1,819.269
4.	9,809.672	10,379.302	1,854.956
5.	10,212.626	9,900.645	1,814.229
Olympic Shaft	10,000.000	10,000.000	1,829.000

- Note:**
- Field work by Anthony Payne and Mark A. Steen 13-14 Aug 87, 18 Aug 88.
 - Elevation of Olympic shaft collar interpolated from USGS topographic map.
 - Coordinates assumed 10,000 N, 10,000 E at shaft collar.
 - Wild T1 micrometer theodolite, 400^g graduations.
 - Meridian from direct observation on the sun, hour angle method, Roelof's prism.
 - Base line Alpha-Bravo measured using Wild 2m Invar subtense bar, auxiliary base line method.
 - Elevations using vertical angle three-wire method.
 - Alpha is at approximately 38°36'40" N, 117°53'45" W.
 - Coordinates calculated using Law of Sines.
 - Alpha and Bravo are brass caps set in concrete, flush with ground.
 - Points 1-5 are Copperweld survey markers ±15 cm above ground.
 - Olympic shaft point is sixpenny duplex nail driven into center of collar sill set.
 - Aerial photos flown by Great Basin Aerial Surveys 26 Aug 87, Wild RC-10 camera in Cessna 206.
 - Photogrammetry by Great Basin Aerial Surveys Sep 87, Wild Aviolyt BC-2/Aviator TA-10 plotter.
 - Stewart Spring USGS 7.5-minute quadrangle, Lone Valley 1:100,000 map.

