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NEWMONT EXPLORATION LIMITED

THE EARLY HISTORY OF THE CARLIN TREND AND THE DISCOVERY OF THE CARLIN MINE

BY

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INTRODUCTION

The Carlin Mine, owned by Newmont Gold Company and located in the northern part of Eureka County, Nevada (Fig. 1), commenced production in April 1965. Ore reserves at the beginning of operations were 11 million tons averaging 0.32 oz. Au/ton. Mining was suspended in 1986 following the production of a total of 3.2 million ounces of gold.

The deposit is of Oligocene (±35 my) age and is hosted in the Silurian-Devonian Roberts Mountains Formation. This well-bedded carbonate unit is part of a lower and mid-Paleozoic miogeosynclinal sequence exposed within the Lynn tectonic window. The window is surrounded on three sides by eugeosynclinal rocks of Ordovician Silurian and Devonian age which were thrust into position along the major Roberts Mountains Thrust during the late Paleozoic Antler orogeny.

The mine was the first large development along the Carlin Trend--a northwesterly trending mineral belt over 50 miles long and 5 miles wide extending through northern Eureka County into Elko County on the northwest and southeast (Fig. 2). Subsequent discoveries and developments along the Trend have led to the

identification of over 20 deposits with existing geological resources of gold estimated at approximately 67 million ounces and mineable reserves of 40 million ounces. The Carlin Trend has the potential of becoming the largest gold producing district in North America.

The Newmont gold exploration program in Nevada that eventually led to the discovery of the Carlin Mine began in early 1961.

Early prospecting in the 1870s led to the location of the Good Hope claims in the Maggie Creek district 11 miles northwest of Carlin. The most important metals mined from the vein structures on these claims were lead and silver in association with barite and minor gold.

PLACER GOLD

The first principal gold discovery in the region was made by Fred Lynn in placers on Lynn Creek in 1907 at a location approximately 1.5 miles north of the present site of the Carlin Mine.[1] Subsequent work led to the discovery of additional placer gold in Sheep, Rodeo and Simon Creeks (Fig. 3). The major production occurred prior to the Second World War but some of the last placer miners were still at work in the early 1960s. Total gold production from the placers is estimated to be at least 7500 ounces and may have reached 10,000 ounces.[1,2] The bedrock source of this gold has been traced to a series of narrow quartz veins and

stringers in shattered zones sporadically distributed within the drainage areas. The best known of these bedrock occurrences is the Big Six Mine in the headwaters of Lynn and Sheep Creeks.[2] Despite several attempts continuing to this day, only very limited production has been won from any of these lode occurrences.[3]

INVISIBLE GOLD

In marked contrast to the nature of these early gold discoveries, the Carlin Trend deposits that are currently being extensively mined are characterized by very fine gold -- sometimes referred to as "micron-sized gold" or, more topically, "invisible gold."

Virtually all the gold in these more recently discovered deposits is so fine that it cannot be concentrated by panning. The old-timers who worked solely with the gold pan were therefore at a distinct disadvantage, and although they must have panned most of the creeks draining the Tuscarora Range north and south of the Lynn District placers, they failed to detect any significant indications of the millions of ounces of Carlin Trend gold that have been discovered by more appropriate or more sophisticated methodology during the past 45 years. Not that they did not find the occasional color--there was some placer activity in the Maggie Creek area in these early years--but the amounts recovered were minor and totally disproportionate to the presently known resources in the Gold Quarry-Maggie Creek region.[1]

Many people are under the misapprehension that Newmont geologists were the discoverers of "invisible gold" in the early 1960s. This is untrue. The earliest records of very fine gold in the western U.S.A. come from the Mercur Mine located just a few miles south of the Bingham Canyon copper mine in Utah. Originally located for silver, the gold in the Mercur district was first detected by fire assaying in the 1880s.

Ironically but significantly, in the early history of this camp there is a record of legal action against an assayer in Salt Lake City brought about by miners who could not confirm the presence of gold on the property using the gold pan (L. Kornze, pers. comm.).

In Nevada, invisible gold was recognized at Gold Acres in Lander County several years prior to the initial production from this property in 1936.[4] The first gold discoveries at Maggie Creek (The Maggie Group) in Eureka County were made in 1925, and 6 cars of ore averaging 0.42 oz Au/ton were shipped in 1936.[3] The Potosi Mining District in Humboldt County was established in the 1870-1880 period and some minor tungsten production was achieved in 1917-1918. It was not until 1934 that prospectors fire assayed samples from the siliceous outcrops and discovered gold at the present site of the Getchell Mine. As reported by Roy A. Hardy,[5] this gold was found to be invisible and refractory and undetectable by panning

although detailed work by Joralemon[6] records coarser gold in the deposit. At the Gold Standard Mine in Pershing County, fine grained gold was also discovered in 1934. An earlier discovery of invisible gold may have been made at the Buffalo Valley Mines Co. property in Lander County. Prospectors passed through this district in the 1860s but the gold was not identified until outcrops were sampled at the property in 1912.

During the 1930s, W.O. Vanderburg, a mining engineer with the U.S. Bureau of Mines and Geology began documenting activity in hardrock gold and placer mining in northeast and central Nevada.[1,3,4] It was Vanderburg's published observations that stimulated the initial inquisitiveness that eventually led to Newmont's participation in the rebirth of gold mining in the state of Nevada.

Vanderburg, in his Lander County report published in February 1939, noted that at Gold Acres it was "impossible to distinguish between ore and waste except by assay, and gold is present in such a state that it is impossible to obtain a single color by panning."[4] In the final paragraph of the report, Vanderburg re-emphasized that "sedimentary gold deposits do not possess easily recognizable indications" and would have been passed over in former years by prospectors who depended largely on panning.[4] In addition to citing the Gold Acres Mine as one of these sedimentary deposits, he also referred to the Getchell Mine in Humboldt County, the Standard Mine in Pershing County and additional deposits, some of

which are now known to have yielded coarser gold. He predicted, however, that other deposits similar to Gold Acres remained "to be discovered in Lander County and other areas in the State, where sedimentary formations, like shale and limestone lying in proximity to acid intrusives, are common."[4]

John Livermore, a geology graduate from Stanford, first read Vanderburg's predictions in the late 1940s and was deeply impressed by the exploration possibilities.

NEWMONT'S GOLD EXPLORATION PROGRAM

Although gold was not in vogue as an exploration and mining target in the 1950s, the search for and development of base metals, particularly porphyry-copper deposits in the western United States, was intensely competitive. This industry, over the years, has been revolutionized by new technology and the development of new mining and metallurgical methods, and the grades of copper that could be profitably mined progressively decreased as the scale of operations grew. Newmont actively participated in these porphyry copper developments, and Newmont executives, particularly Robert (Bob) B. Fulton, Fred Searls, Jr. and Plato Malozemoff, began to think of a similar evolution in the gold industry through open pit mining followed by relatively cheap but highly efficient cyanide extraction.

Concurrently with these developing ideas, the U.S. Geological Survey was advancing its regional geological mapping and related studies of Nevada stratigraphy and structure.

Ralph J. Roberts and other USGS geologists commenced regional synthesis and mapping studies in Nevada in 1939. The Roberts Mountains Thrust was first recognized by Merriam and Anderson in the Roberts Mountains area northwest of Eureka and was reported in a paper published in 1942.[7] By the late 1940s and the early 1950s, the USGS mapping program had been extended to cover several quadrangles in the Winnemucca, Golconda, Mount Tobin, Mount Moses and the Antler Peak areas of central and northeastern Nevada.[8]

Roberts' work at Antler Peak[9] led to the recognition of the Antler Orogeny, and later regional correlations permitted the USGS to extend the Roberts Mountains Thrust from Eureka on the east to Manhattan on the south and to Mountain City on the north.[8] The Carlin, Lynn and Bootstrap windows were mapped by Roberts and Lehner in 1954, and they presented their interpretations at the Geological Society of America Meeting in 1955.[10] It was during this presentation that they identified the northwestern alignment of the lower plate carbonate windows between Eureka and Battle Mountain and the Bootstrap and the Copper King -- now more popularly referred to as the Battle Mountain and the Carlin Trends. A comprehensive summary of the USGS mapping program through north and central Nevada was published in the American Association of

Petroleum Geologists Bulletin in 1958.[11] Figure 4, which depicts the extent of the Roberts Mountains Thrust, the distribution of the upper plate rocks and the alignment of the lower plate windows, is reproduced from this 1958 paper.

Ralph Roberts' note on the alignment of base and precious metal mineral districts in north-eastern Nevada was published in the summary of USGS geological research investigations for 1960 (Fig. 5),[12] and, following the publication of this Professional Paper, Newmont geologists began to take full advantage of the USGS mapping and geological interpretations.

In early 1961, John Livermore of Newmont was managing a drilling program on the silver-base metal deposit at Ruby Hill in Eureka on behalf of a syndicate of mining companies. Through various contacts and periodic examination of the Eureka Courthouse records, Livermore was able to monitor the various prospecting and mining developments in the State. Contact was made with USGS personnel active in the mapping programs. He also visited the "Big" Gold Acres Mine in Lander County and spoke with the Manager, Mr. Harry Bishop. Bishop expressed the opinion that a favorable area for the discovery of additional invisible gold deposits was not in nearby Lander County but in northern Eureka County.

In the spring of that year, Ralph Roberts delivered several talks throughout the state on the regional stratigraphy and

structure in northeastern Nevada and the alignment of the mineral districts. John Livermore attended one of these talks in Ely and, afterwards, met with Roberts to discuss these geological relationships in more detail.

Meanwhile, Newmont's Nevada gold exploration program was underway in the Battle Mountain region where Alan Coope was investigating the potential of the Marigold and the Buffalo Valley properties near Valmy. These investigations revealed that neither of these properties had mine potential at $35.00 gold. Based on a recommendation by John Livermore, Newmont had decided to proceed with an exploration program in Eureka and Elko counties to prospect the Roberts Mountains Thrust zone for invisible gold deposits and, in an initial move, had secured verbal permission to examine the Maggie Creek property, 8 miles northwest of Carlin (also known at that time as the Maggie Group and/or the Gold Quarry property), in May 1961.

When the Ruby Hill drilling was completed, Livermore and Coope were instructed to meet in Carlin and proceed with the Eureka-Elko Counties program. The date was June 1961.

At this time, there was only limited mining activity in the area north of Carlin, principally at the Bootstrap and the Blue Star mines (Fig. 6). Since the early history of these properties chronicles numerous events and discoveries relevant to the

commercial evolution of the Carlin Trend, a brief review of these historical developments is appropriate.

Antimony was discovered at the Bootstrap property in 1918,[13] but it was not until 1946 that Frank Maloney collected samples for fire assay and identified gold on this property. The first gold production (100 tons averaging 0.65 oz Au/ton) was achieved in 1948. When Mr. Marion Fisher of Battle Mountain acquired a lease and option on the property in October 1955 from the Modoc Mine and Exploration Company, workings included a 535 foot tunnel driven by the Getchell Mining Company in 1949 which failed to intersect any ore of commercial value, a 24 foot shaft and two deep open cuts. Mr. Fisher invited Robert Taylor of Battle Mountain and Harry Treweek of Gold Acres into equal partnership in his Bootstrap lease and an agreement was negotiated with the Homestake Mining Company which conducted additional exploration in the summer of 1956. Homestake terminated this agreement and subsequently 13 other companies declined the invitation to participate in further work on the property before a mining and milling agreement was concluded with R. R. Reed of Fallon, Nevada in January 1957.

During the next 3 years a 100 ton plant was completed and, despite numerous difficulties, total production from the Bootstrap through early 1960 was 40,000 tons of $11.00 rock - for approximately 10,000 ounces of gold. (Marion Fisher - pers. comm.) This was, by far, the largest gold production from a lode deposit

along the Carlin Trend to that time. In June 1961, the property was under option to a construction contractor from San Francisco. However, there were operational difficulties and the property was idle.

Initial development at the Blue Star (also known as the No. 8 Mine) was for turquoise in the 1920s.[13] Open pit and shallow underground production of good quality turquoise continued intermittently for several years until the property's added potential was discovered by Marion Fisher who first identified gold in the workings in 1957. By 1961, the property had been optioned from the owners, the Edgar brothers of Battle Mountain, by a Carson City-based company called M M and S Mining. In turn, M M and S had leased the property to Combined Production Associates, an operating company financed by Mr. Blake Thomas of Salt Lake City.

Bill Lage, Bob Morris and Ralph Scott of M M and S had drilled some holes into the Blue Star turquoise workings in 1960 and obtained values up to 0.44 oz Au/ton over 10 feet in percussion samples. Channel samples from some of the deeper workings assayed up to 0.65 oz. Au/ton over five feet. None of this gold was pannable (W. Lage, pers. comm.).

Combined Production established a 200 ton cyanide mill on the property after acquiring used equipment from a number of nearby mining locations. Unfortunately, they encountered serious

operating problems with slimes in the ore, and their production totalled only four 200-ounce doré bars. Several major mining companies were contacted but none expressed any interest in the property. John Livermore visited the Blue Star after his conversation with Harry Bishop at Gold Acres. Following an examination and a discussion with Bill Lage, Livermore recommended to Fred Searls, Jr. that Newmont should make a careful evaluation of the Blue Star property. Fred Searls contacted Blake Thomas and the arrangements were made. So when Livermore and Coope arrived in Carlin in June 1961, they had the Maggie Creek claims to explore and the Blue Star Mine to examine.

The Blue Star examination extended over three weeks and consisted of detailed geological mapping and extensive sampling. All samples were fire assayed by Harry Treweek, an experienced assayer with a laboratory in Gold Acres, some 50 miles from Carlin. The results were favorable. At least 500,000 open-pittable tons averaging 0.15-0.20 oz Au/ton were estimated to occur in the deposit, and Livermore and Coope recommended to Fred Searls, Jr. that Newmont acquire the property. Fred Searls negotiated with Combined Production but was unable to conclude an agreement.

Livermore and Coope were able to use their newly acquired knowledge of the Blue Star occurrence in their evaluation of the surrounding area. A simple geological model for the Blue Star deposit had been developed in which upward-migrating hydrothermal

fluids had been ponded beneath a low-dipping thrust structure leading to the precipitation of major concentrations of fine-grained gold. The surface trace of the Roberts Mountains Thrust was readily mappable over the greater part of the Lynn Window due to the marked difference in lithologies in the lower and upper plate rocks, and a systematic prospecting program examining the outcrops and float along this tectonic contact was initiated.

Within a few weeks, anomalous gold values (in excess of 0.03 oz Au/ton) were encountered along the trace of the thrust in strongly silicified (jasperoidal) and barite-veined exposures approximately 2-3/4 miles southeast of the Blue Star. A return visit to the area confirmed these initial indications with several grab and channel samples assaying in the 0.03 to 0.20 oz Au/ton range. Detailed geological mapping was carried out and, at separate times, USGS geologists Ralph J. Roberts and Hal Mazursky were invited to visit the area to assist in the identification of the geological formations and collect graptolite fossils. Fred Searls and Bob Fulton returned to the area in late September 1961 and a decision was made to stake some claims. With the assistance of Mort White, a Newmont surveyor, seventeen 20 acre claims were located in October of that year positioned over what eventually became the site of the Main Pit of the Carlin Mine.

A bulldozer was contracted to excavate trenches for the discovery work that followed, and one trench (Trench B, Fig. 7) was

sited across a N.N.W. trending quartz porphyry dyke which was thought to be related to the gold mineralization. Assaying of the exposures in the trench proved the dyke material to be low in gold, but the mildly hornfelsed sediments adjacent to the eastern contact assayed 0.20 oz Au/ton over 80 feet. This was the first significant discovery of gold in the Carlin Mine area.

Heavy snows in late November ended the prospecting season soon after this discovery. John Livermore was promoted to Manager of Exploration, Newmont Mining Corporation of Canada, effective January 1962, and Alan Coope and Mort White spent the winter on an exploration project near Pioche, Nevada.

The 1962 season at Carlin began in late April. Initial work consisted of bulldozer trenching and road building for drilling programs at both Maggie Creek and the Carlin prospect. It was at this time that Bob Morris approached Alan Coope and advised that M M and S had negotiated an agreement on the Popovich homestead property adjacent the Newmont group of 17 claims (Fig. 7). Morris offered the property to Newmont and, based on favorable geological knowledge of the property from the 1961 mapping coverage, Coope recommended to Bob Fulton that Newmont acquire the Popovich 80 acres.

An agreement was negotiated with M M and S requiring a down payment followed by a second, more substantial, cash payment in the fall of the year.

Trenches and drill sites at Maggie Creek and Carlin were selected based on the previous year's geological work and were surveyed in by Mort White. The bulldozer created many new exposures on the 17 Carlin claims and these were mapped and sampled giving results as high as 0.74 oz. Au/ton. These results prompted additional property acquisition to cover virtually all the land in Section 14, T.35 N., R. 50 E. where the original 17 claims had been staked.

Pete Loncar, a long-time Newmont employee, joined the exploration team to supervise the summer's drilling. Percussion drilling was selected as the most appropriate technique for the sampling challenge. Loncar secured an Ingersoll-Rand down-the-hole hammer drill from a contractor working on the highway near Reno. The drill, which worked exceptionally well, operated only with compressed air and had a depth capacity of approximately 130 feet. Satisfactory sample recovery was not possible below the water table, but the local conditions were such that this was not a major problem during the initial drilling program. Bill Mounts, presently Drilling Services Supervisor with Newmont based at Carlin, was an original member of the drill sampling crew.

Drilling first began at Maggie Creek. Results, based on the economics of the time, were not too exciting but narrow intersections of 5 feet and 10 feet grading 0.15 oz Au/ton were encountered. (Follow-up drilling by Newmont in the late 1970s,

when the gold price was considerably higher, proved these narrow intersections to occur on the northeastern edge of the major Gold Quarry orebody.)

While the Maggie Creek drilling was in progress, Alan Coope was mapping the Popovich 80 acres in detail. This work, which was quite complex due to the intensive silicification of many of the outcrops, included considerable grab and channel sampling. One feature sampled extensively was an exposed, northwesterly trending, iron-stained and slickensided fault surface crossing the south boundary of the 80 acres which consistently returned assays of 0.07 and 0.08 oz Au/ton. The rocks in the footwall of this fault were exposed only as float. Primarily through curiosity, this float material was sampled despite its plain unmineralized--looking grey color. The feature that aroused the curiosity was the rock's finely porous appearance caused by the leaching of carbonate matrix from a silty limestone. The porous, unmineralized-looking rock assayed a surprising 0.22 oz. Au/ton. A section line of eleven drill sites was located by Alan Coope across the strike of this fault, 50 feet north and parallel to the boundary of the 80 acres and the neighboring TS Ranch land.

Because of the fall payment date in the M M and S option agreement, the Carlin area drilling program commenced on the 80 acres. For expediency, drilling began at the base of the slope near Simon Creek and progressed upslope across the property. The

third hole drilled, located in the immediate footwall of the fault where the 0.22 oz. Au/ton float was collected, intersected approximately 100 feet of highly sheared and altered carbonate rocks averaging $36.00 (1.03 oz. Au/ton). This was the second significant, and most spectacular, discovery in the Carlin area (Fig. 7). The date was September 1962.

The high value in the unmineralized-looking float prompted a more extensive sampling of float and outcrops that were, at that time, regarded as geologically unspectacular. This program identified gold values in float up to 2.0 oz Au/ton and culminated in the rapid outlining of the exposed sections of the Carlin orebody.

The drilling program intensified on the Carlin property. Pete Loncar played a prominent role in the development through into production and Byron S. Hardie supervised the geological work on the project and in the surrounding area from early 1963 onwards. Robert F. Sheldon calculated the ore reserves and Frank W. McQuiston and Paul E. Stucker were responsible for the construction of the mill which was designed and built by the Bechtel Corporation of San Francisco. Eventually 11 million tons of open-pittable ore were outlined averaging 0.32 oz Au/ton in a stratabound deposit (Fig. 8). The Carlin Mine commenced production in April 1965 at the rate of 2000 tons per day. Total project costs through to production were $10 million.

SUBSEQUENT YEARS

Although not the first gold discovery, the Carlin Mine was the first major development along the Carlin Trend. Operations at the mine were suspended in 1986 following the production of 3.2 million ounces of gold over a 21 year period. The geology and mineralization of the mine has been described in several publications.[14,15,16,17,18,19] The exploration and operational success of the Carlin mine together with (a) the cumulative geological appreciation of the tremendous potential of the Carlin Trend, (b) increases in the price of gold and (c) improvements in mining and metallurgical technology in subsequent years has led to additional major discoveries and developments by Newmont and other companies (Fig. 9), and the Carlin Trend production, gold reserves and resources are now challenging the Porcupine Mining District of Ontario as potentially the largest gold producing district in North America. The Porcupine camp has produced approximately 59 million ounces of gold over the past 80 years. The Carlin Trend currently hosts an estimated 67 million ounces in geological resource of which 60% are classified as mining reserves (Table 1). Production from the Trend at the end of 1989 totalled slightly more than 8 million ounces.

Several styles of mineral occurrences have been identified (Fig 10) and the graphical representations in Figs. 11, 12 and 13 portray annual total ore reserves, annual average reserve grade and

yearly gold production of the Carlin Trend mines since 1965.

Discoveries are still being announced, and it is clear that further development along the Trend will be faced with the challenges of developing and mining deeper mineralization and also overcoming the metallurgical complexities of refractory ores.

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Table 1: Carlin Gold Belt Geologic and Mining Reserves, 1990

Deposit	Total Geologic Gold Resources Ms.tons	Oz/s.ton	Ounces	Reserves Ounces
Newmont[1]				
Gold Quarry / Maggie Creek	534.333	0.037	19,553,000	10,027,000
Genesis	33.373	0.045	1,516,000	846,000
Post	195.945	0.062	12,077,000	6,075,000
Rain	22.570	0.052	1,167,000	821,000
Pete	15.747	0.030	470,000	153,000
Blue Star	21.902	0.030	655,000	601,000
Carlin	20.787	0.029	610,000	134,000
North Star	6.941	0.052	359,000	204,000
Capstone/Bootstrap	25.112	0.039	974,000	758,000
Tusc	15.823	0.059	933,000	907,000
Lantern	15.451	0.028	433,000	
Bobcat	17.679	0.029	516,000	
Emigrant Springs	11.511	0.024	282,000	
Gnome	2.700	0.048	130,000	
SMZ	1.589	0.019	30,000	
	941.463	0.042	39,705,000	20,526,000

	Ore Reserves Ms.tons	Oz/s.ton	Geologic Resources Ounces	Reserves Ounces
American Barrick				
Goldstrike Mine[2]				
Oxide	80.859	0.029		2,322,000
Sulphide	94.608	0.17		16,051,000
			24,159,000[3]	18,373,000
Dee Mining Co.[4]				
Dee				
Mill ore	2.312	0.090		208,046
Heap Leach ore	2.225	0.025		55,616
			690,500	263,662
Galactic/Cornucopia				
Hollister (Ivanhoe)	18.400	0.035	645,500	645,500
	(oxide ore reserve)			
	47.600	0.035	1,666,000	
	(sulphide geologic resource)			
Goldnev Resources Inc./Barrick Gold				
Maggie Creek	2.500	0.021	52,500	
	(geologic resource)			
			66,918,500	39,808,162

(1) Resource calculation at December 27, 1989; cut-off grade is 0.010 oz/s.ton. Data derived from Newmont's December 1989 News Release.
(2) Data courtesy of American Barrick.
(3) This geologic resource figure does not include the Screamer, Rodeo and Purple Vein discoveries.
(4) Data courtesy of Dee Mining Co.

Modified after Thorstad.[20]

Captions for Figures

Fig 1 Location of the Carlin Mine, Eureka County, Nevada

Fig 2 Locations of mines and other significant deposits along the Carlin Tend, Eureka and Elko Counties, Nevada

Fig 3 Map showing the present location of the Carlin Mine and the Lynn, Rodeo, Sheep and Sunon Creeks which were worked for placer gold prior to the Carlin Mine discovery

Fig 4 Map of north-central Nevada showing outcrop areas of Western assemblage (upper plate), Eastern assemblage (lower plate) and transitional assemblage rocks and the extent of the Roberts Mountains Thrust (reproduced from Roberts, et al., 1958")

Fig 5 Map showing distribution and alignment of Paleozoic facies, granitic rocks, and principal mining districts in Eureka County, Nevada, and adjacent areas (reproduced from Roberts[12])

Fig 6 Reconnaissance geological map of the Bootstrap, Lynn and Carlin Windows prepared by J.S. Livermore and J.A. Coope in October 1961 showing the location of active and dormant mines and prospects

Fig 7 Property map of Sections 13 and 14, T35N, R50E showing the location of the original 17 Alan claims, the Popovich 80 acres and the sites of the significant gold discoveries of the Carlin Mine deposit

Fig 8 Idealized cross-section of the Carlin Mine deposit within the Roberts Mountains Formation

Fig 9 1989 photograph of the North Area of the Carlin Trend looking south. The Post and Goldstrike Mine areas are located in the west-central part of the picture with the Genesis and Blue Star operations further distant. The workings of the Carlin Mine are visible in the far south-eastern sector. Mills and leach pads of Newmont and American Barrick are located in the east-central and northern (foreground) sectors

Fig 10 Carlin Trend Gold Deposits - Styles of Mineralization

Fig 11 Carlin Trend, Nevada - Plot of annual total ore reserves 1965-1988

Fig 12 Carlin Trend, Nevada - Plot of annual average reserve grade 1965-1988

Fig 13 Carlin Trend, Nevada - Plot of annual gold production 1965-1989

FIGURE 1

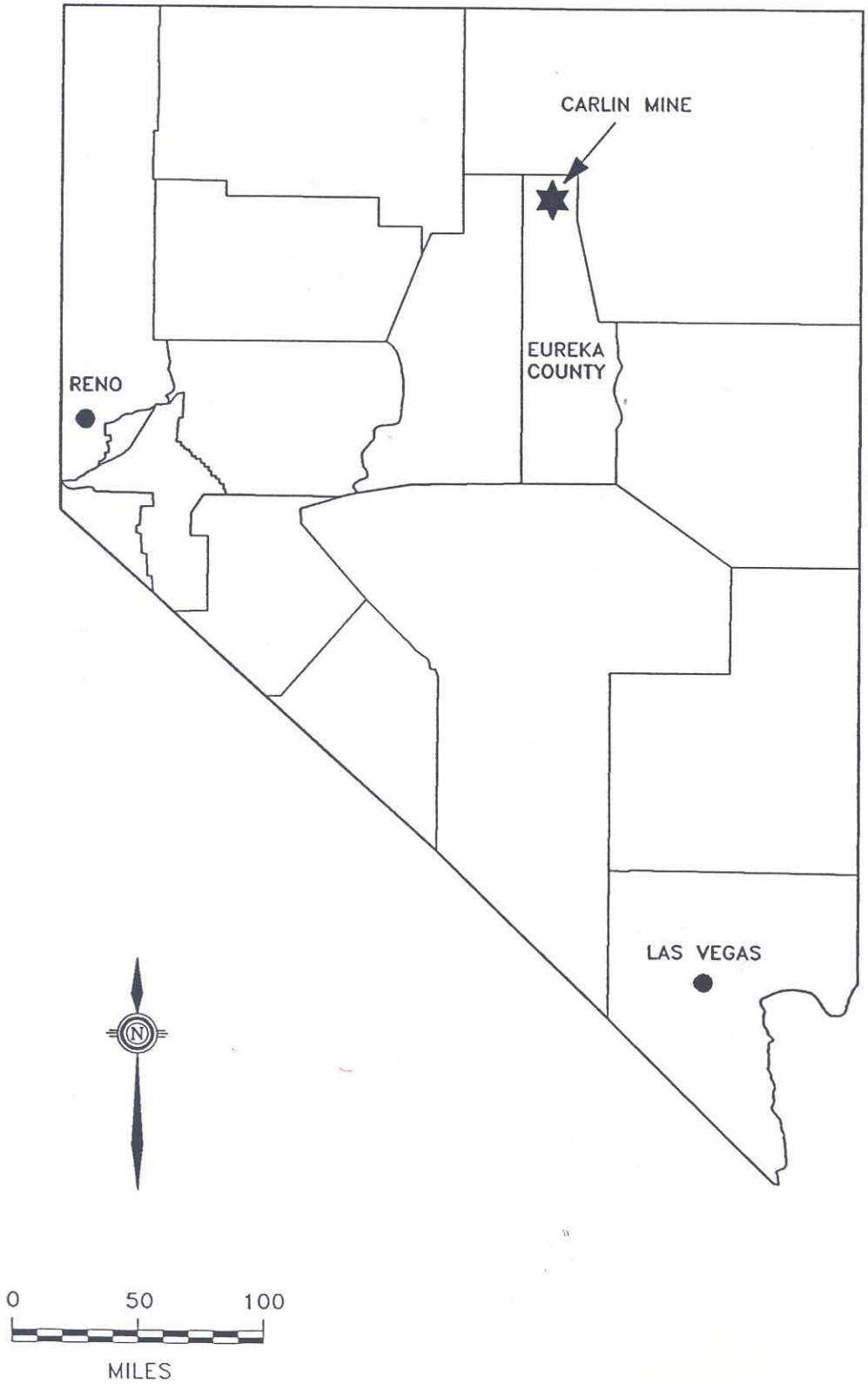


FIGURE 2

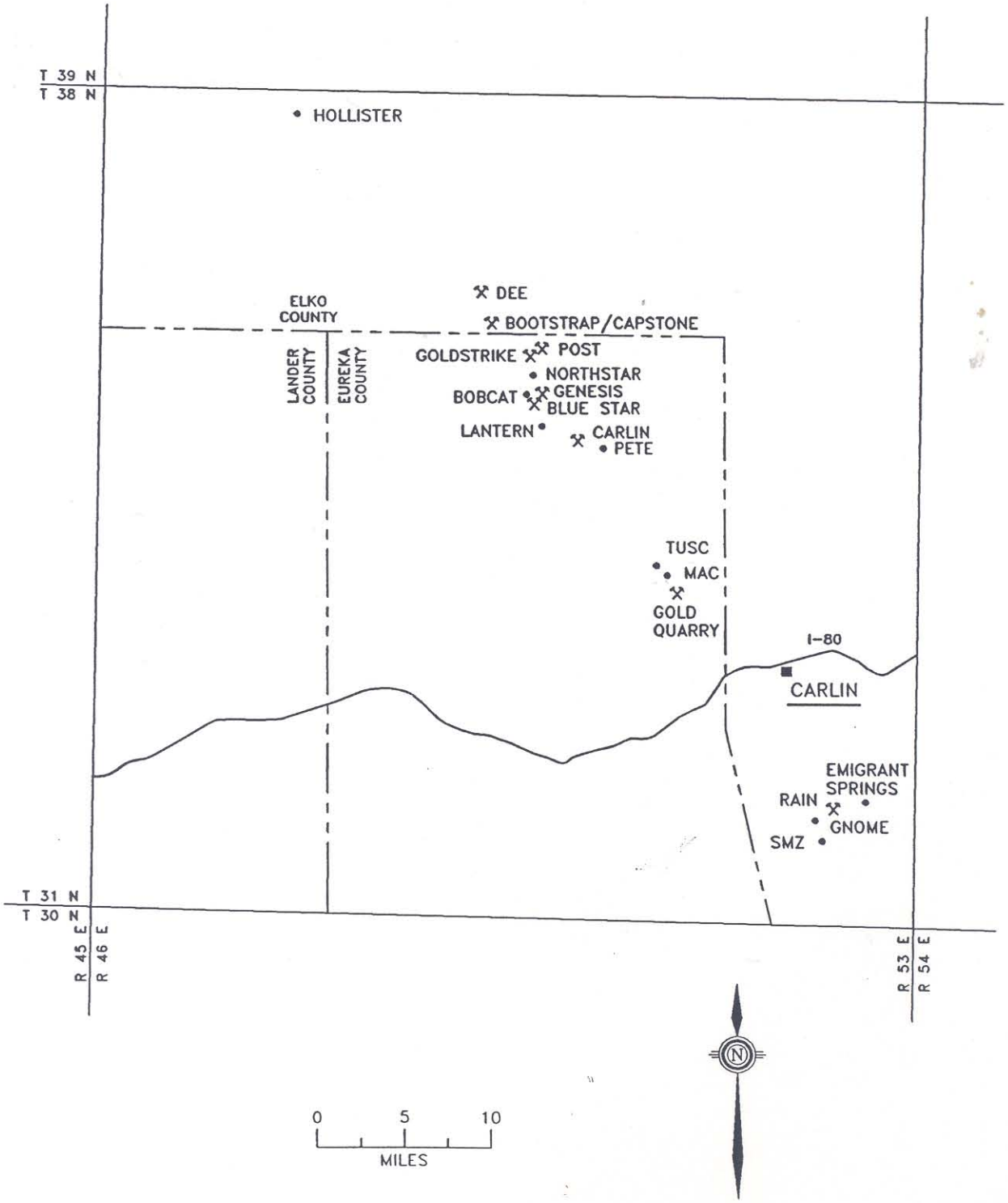
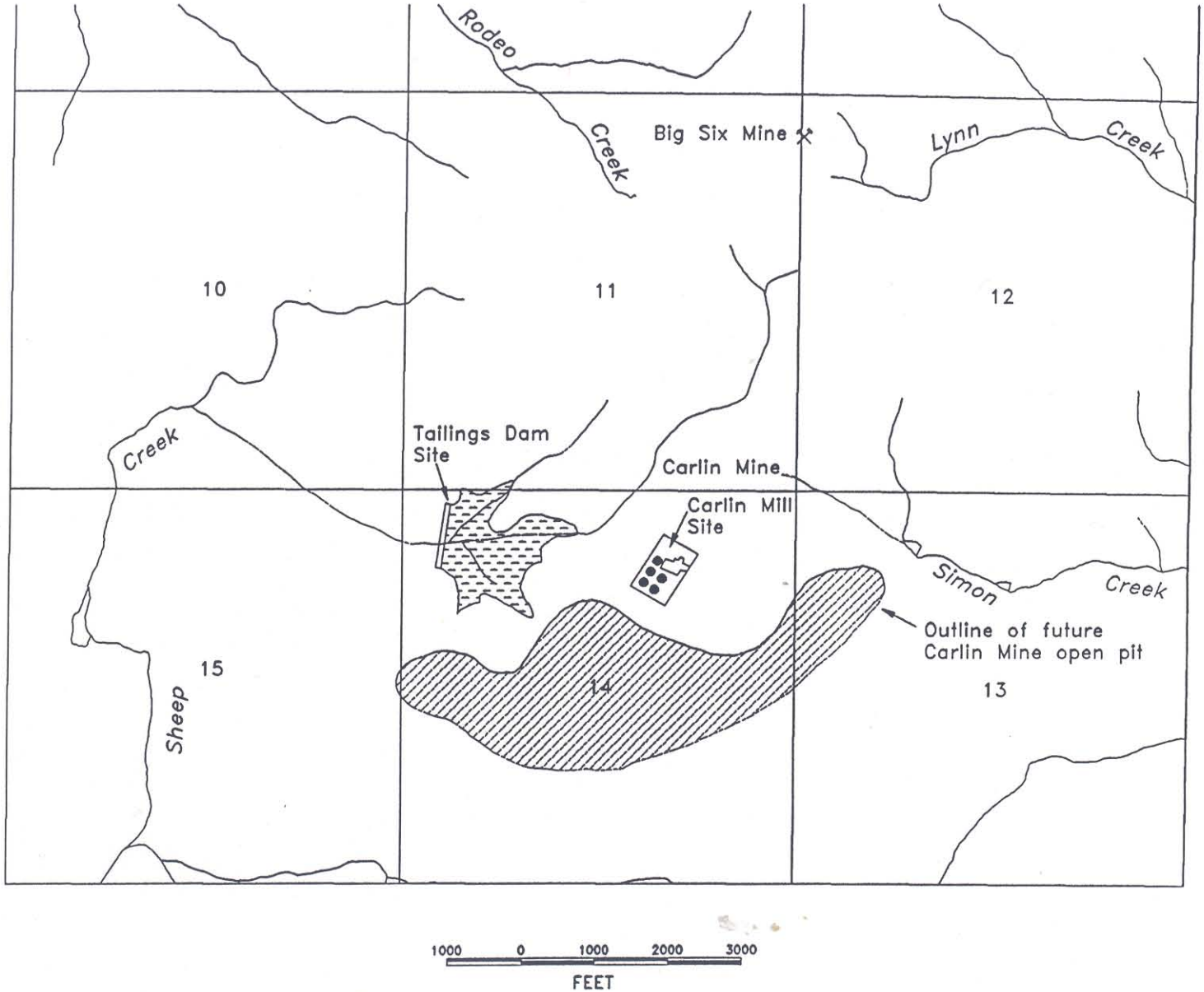

T 39 N
T 38 N
HOLLISTER
DEE
ELKO COUNTY
BOOTSTRAP/CAPSTONE
LANDER COUNTY
EUREKA COUNTY
GOLDSTRIKE
POST
NORTHSTAR
BOBCAT
GENESIS
BLUE STAR
LANTERN
CARLIN
PETE
TUSC
MAC
GOLD QUARRY
I-80
CARLIN
EMIGRANT SPRINGS
RAIN
GNOME
SMZ
T 31 N
T 30 N
R 45 E
R 46 E
R 53 E
R 54 E
N
0
5
10
MILES

FIGURE 3


Rodeo
Creek
Big Six Mine
Lynn
Creek
10
11
12
Creek
Tailings Dam
Site
Carlin Mine
Carlin Mill
Site
Simon
Creek
Outline of future
Carlin Mine open pit
15
14
13
Sheep
1000
0
1000
2000
3000
FEET

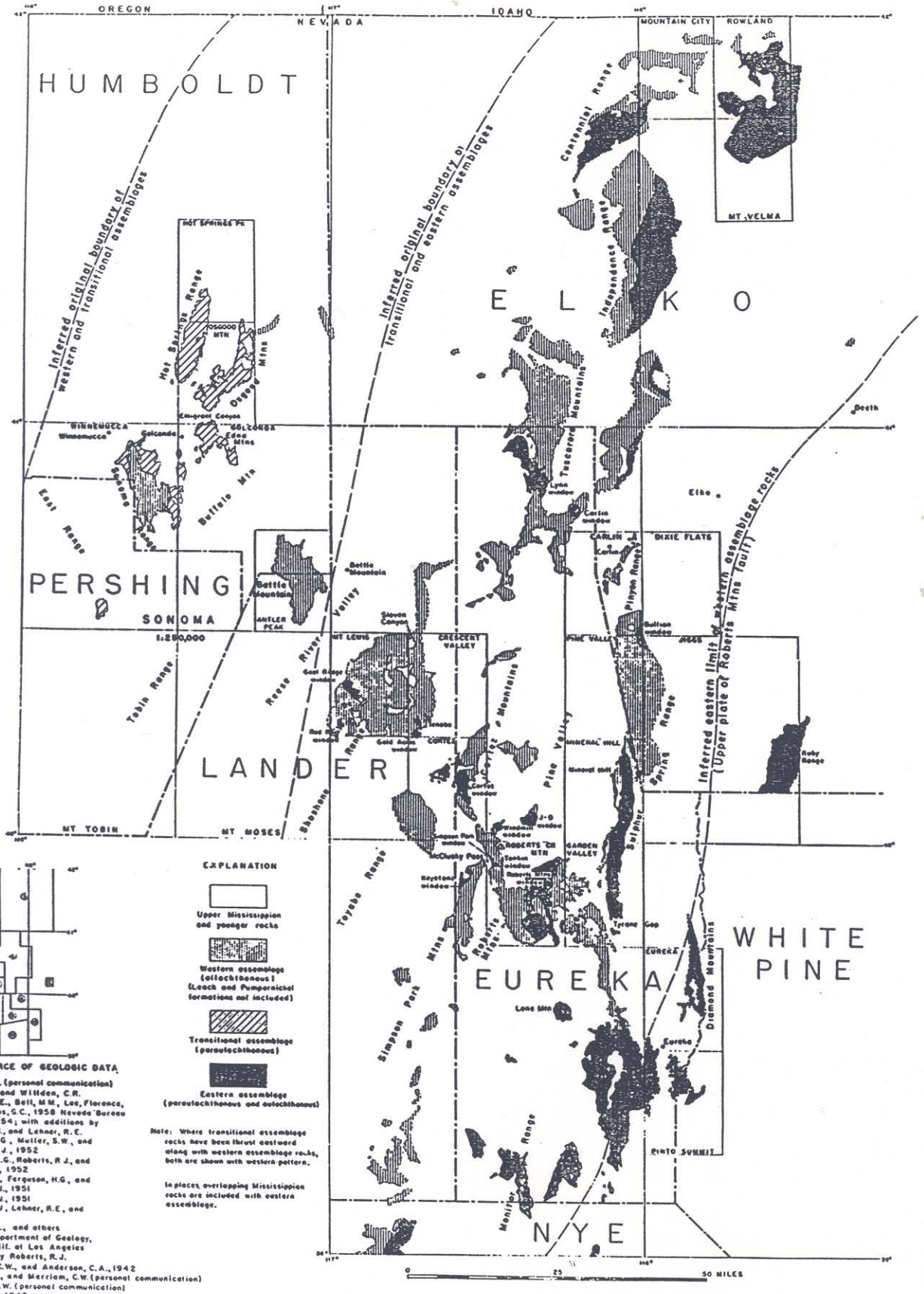

OREGON
NEVADA
IDAHO
HUMBOLDT
ELKO
PERSHING
SONOMA
LANDER
EUREKA
WHITE PINE
NYE
MOUNTAIN CITY
ROWLAND
MT. VELMA
HOT SPRINGS PK
Hot Springs Range
Osgood Mts
Emigrant Canyon
GOLCONDA
Edna Mtns
WINNEMUCCA
Winnemucca
Golconda
Sonoma Range
Buffalo Mtn
East Range
Bottle Mountain
ANTLER PEAK
Bottle Mountain
Valley
River
Reese
Tobin Range
MT LEWIS
Gold Range window
Red Rock window
Gold Acres window
CRESCENT VALLEY
Cortez Mountains
Cortez window
Pine Valley
MINERAL HILL
Mineral Hill
Sulphur
Spring Range
Pinyon Range
Sulphur window
DIXIE FLATS
Elko
Tuscarora Mountains
Lynn window
Carlin window
CARLIN
Carlin
Independence Range
Centennial Range
Beech
Ruby Range
Infered eastern limit of western assemblage rocks (Upper plate of Roberts Mtns fault)
Infered original boundary of transitional and eastern assemblages
Infered original boundary of western and transitional assemblages
1:250,000
MT TOBIN
MT MOSES
Shoshone
Toiyabe Range
Simpson Park Mtns
Roberts Mtns
Roberts Mtns.
McClusky Pass
Keystone window
Cornucopia window
Windmill window
J-O window
ROBERTS CR MTN
Tenabo window
Roberts Mtns window
GARDEN VALLEY
Tenabo
Eureka
EUREKA
Diamond Mountains
Lone Mtn
Eureka
Monitor Range
PINTO SUMMIT
0
25
50 MILES
EXPLANATION
Upper Mississippian and younger rocks
Western assemblage (allochthonous) (Leach and Pumpernickel formations not included)
Transitional assemblage (parautochthonous)
Eastern assemblage (parautochthonous and autochthonous)
Note: Where transitional assemblage rocks have been thrust eastward along with western assemblage rocks, both are shown with western pattern.
In places overlapping Mississippian rocks are included with eastern assemblage.
INDEX OF SOURCE OF GEOLOGIC DATA
1 *Willden, C.R. (personal communication)
2 Holz, P.E., and Willden, C.R.
3. Granger, A.E., Bell, M.M., Lee, Florence, and Simmons, G.C., 1958 Nevada Bureau Mines Bull. 54; with additions by Roberts, R.J., and Lehner, R.E.
4 Ferguson, H.G., Muller, S.W., and Roberts, R.J., 1952
Ferguson, H.G., Roberts, R.J., and Muller, S.W., 1952
Muller, S.W., Ferguson, H.G., and Roberts, R.J., 1951
5 Roberts, R.J., 1951
6. Roberts, R.J., Lehner, R.E., and Bell, M.M.
7. Gilluly, J., and others
8. *Staff of Department of Geology, Univ. of Calif. at Los Angeles modified by Roberts, R.J.
9. Merriam, C.W., and Anderson, C.A., 1942
10 *Nolan, T.B., and Merriam, C.W. (personal communication)
11. *Merriam, C.W. (personal communication)
12. Shoro, R.P., 1942
* Published with permission

FIGURE 4

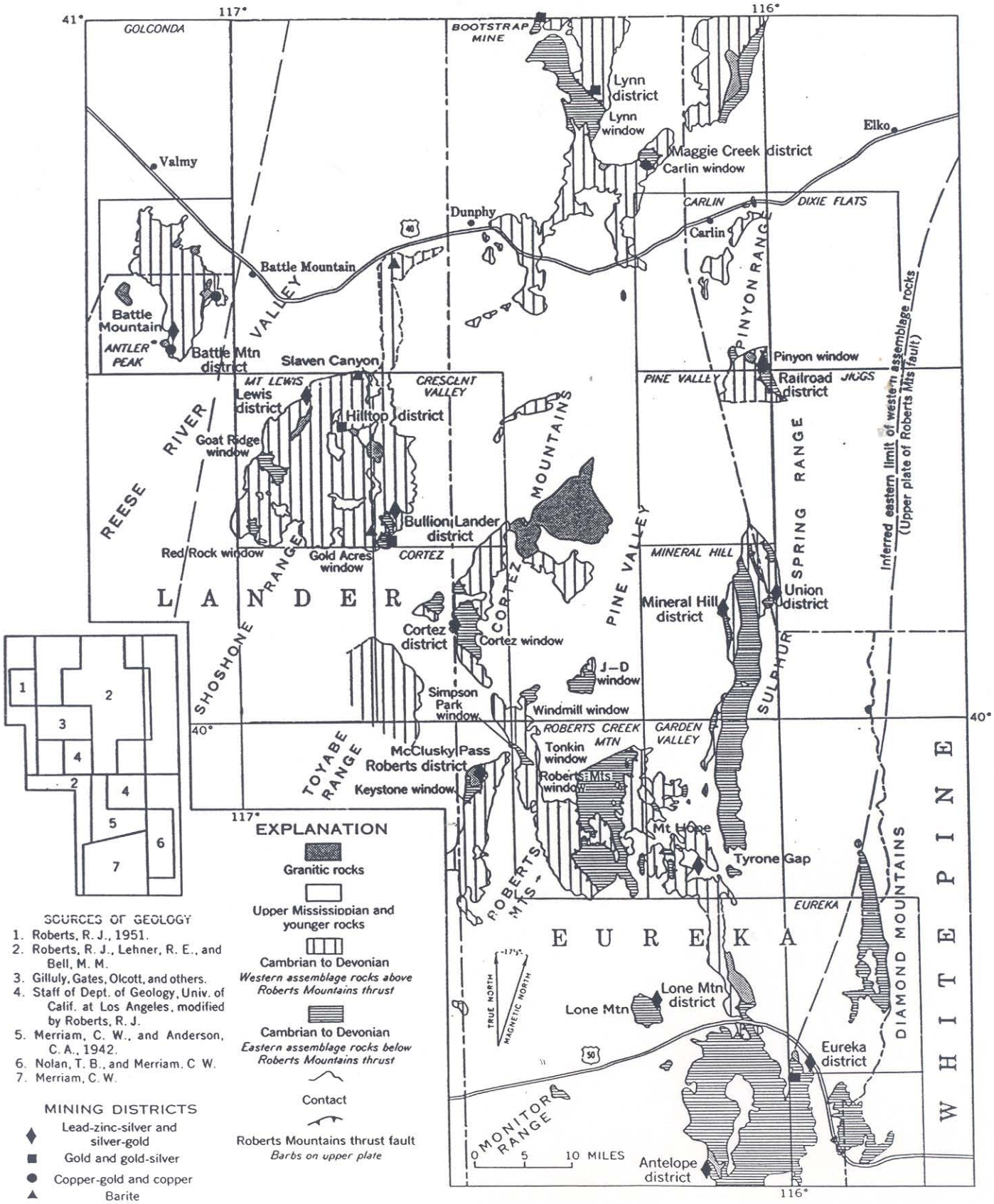

41°
117°
116°
40°
GOLCONDA
BOOTSTRAP MINE
Lynn district
Lynn window
Elko
Maggie Creek district
Carlin window
Valmy
CARLIN
DIXIE FLATS
Carlin
Dunphy
Battle Mountain
VALLEY
Battle Mountain
ANTLER PEAK
Battle Mtn district
Slaven Canyon
PINYON RANGE
Pinyon window
MT LEWIS
Lewis district
CRESCENT VALLEY
PINE VALLEY
Railroad district
JIGGS
Hilltop district
Goat Ridge window
REESE RIVER
MOUNTAINS
Bullion Lander district
Red Rock window
Gold Acres window
CORTEZ
RANGE
SPRING
Inferred eastern limit of western assemblage rocks (Upper plate of Roberts Mts fault)
MINERAL HILL
Union district
L A N D E R
Mineral Hill district
Cortez district
Cortez window
CORTEZ
PINE VALLEY
SHOSHONE
J—D window
SULPHUR
Simpson Park window
Windmill window
ROBERTS CREEK MTN
GARDEN VALLEY
TOYABE RANGE
McClusky Pass
Roberts district
Tonkin window
Roberts Mts window
Keystone window
Mt Hope
Tyrone Gap
ROBERTS MTS
EUREKA
E U R E K A
DIAMOND MOUNTAINS
W H I T E P I N E
TRUE NORTH
MAGNETIC NORTH
Lone Mtn district
Lone Mtn
Eureka district
MONITOR RANGE
0 5 10 MILES
Antelope district
EXPLANATION
Granitic rocks
Upper Mississippian and younger rocks
Cambrian to Devonian
Western assemblage rocks above Roberts Mountains thrust
Cambrian to Devonian
Eastern assemblage rocks below Roberts Mountains thrust
Contact
Roberts Mountains thrust fault
Barbs on upper plate
SOURCES OF GEOLOGY
1. Roberts, R. J., 1951.
2. Roberts, R. J., Lehner, R. E., and Bell, M. M.
3. Gilluly, Gates, Olcott, and others.
4. Staff of Dept. of Geology, Univ. of Calif. at Los Angeles, modified by Roberts, R. J.
5. Merriam, C. W., and Anderson, C. A., 1942.
6. Nolan, T. B., and Merriam, C. W.
7. Merriam, C. W.
MINING DISTRICTS
Lead-zinc-silver and silver-gold
Gold and gold-silver
Copper-gold and copper
Barite

FIGURE 5

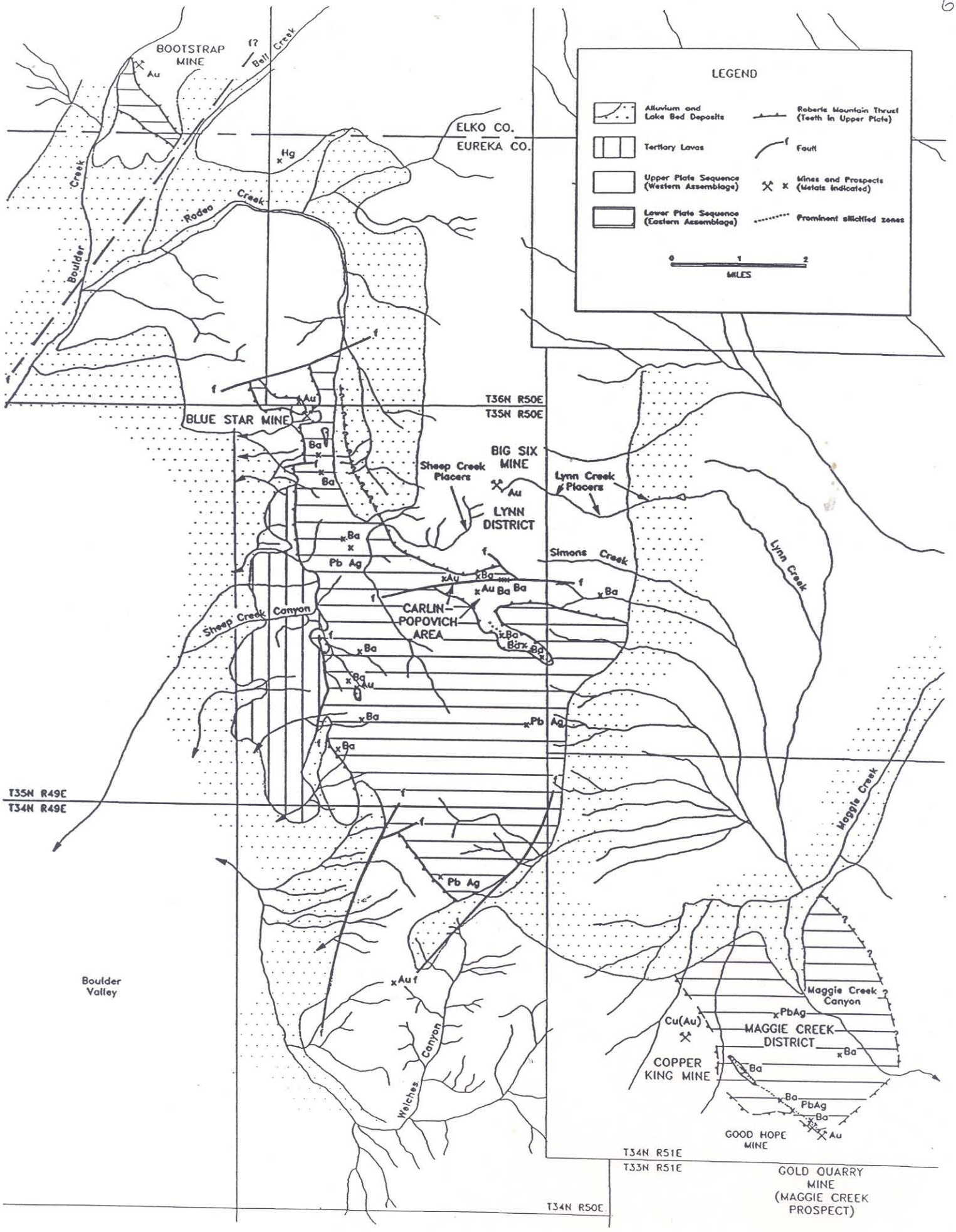
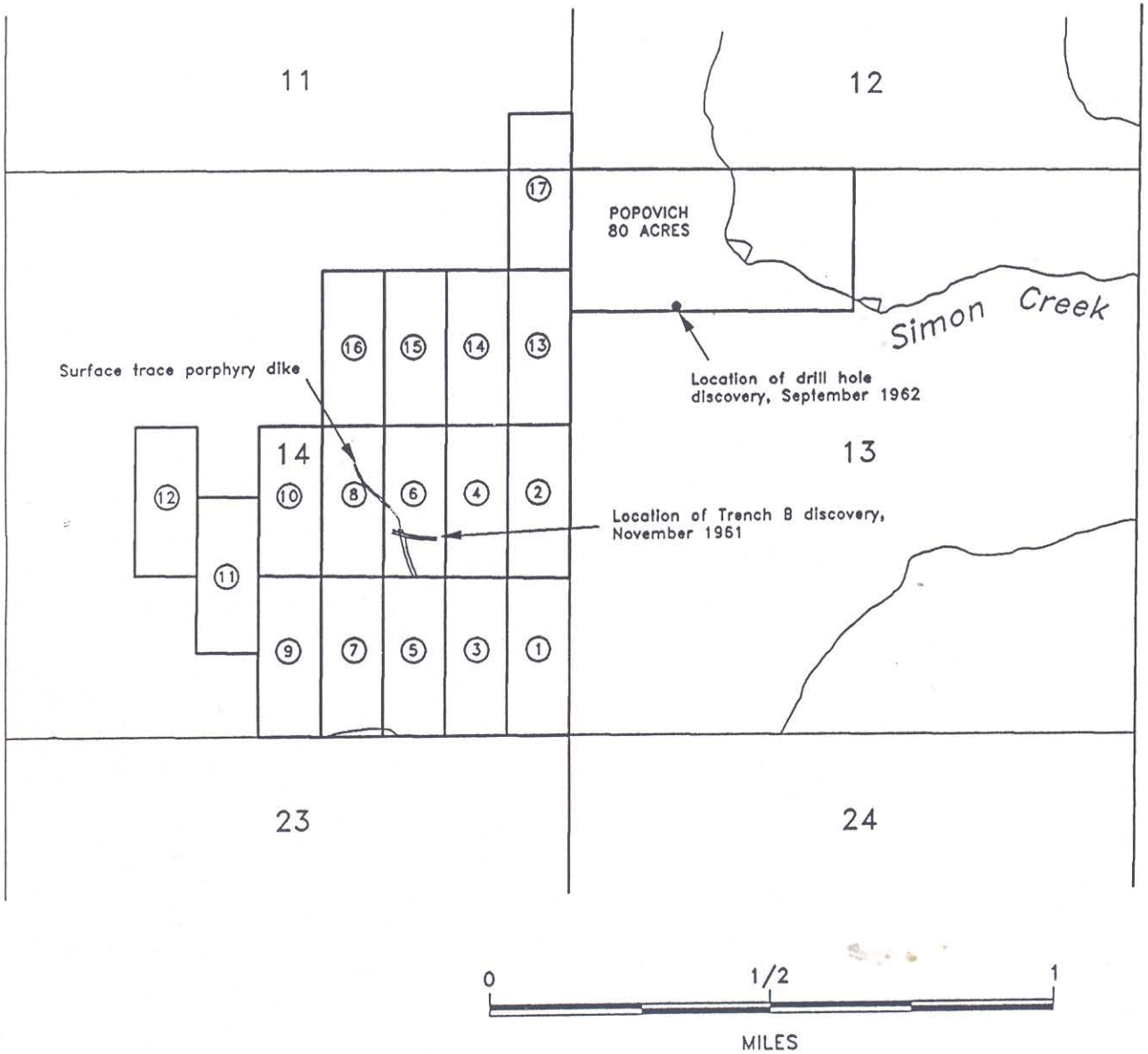
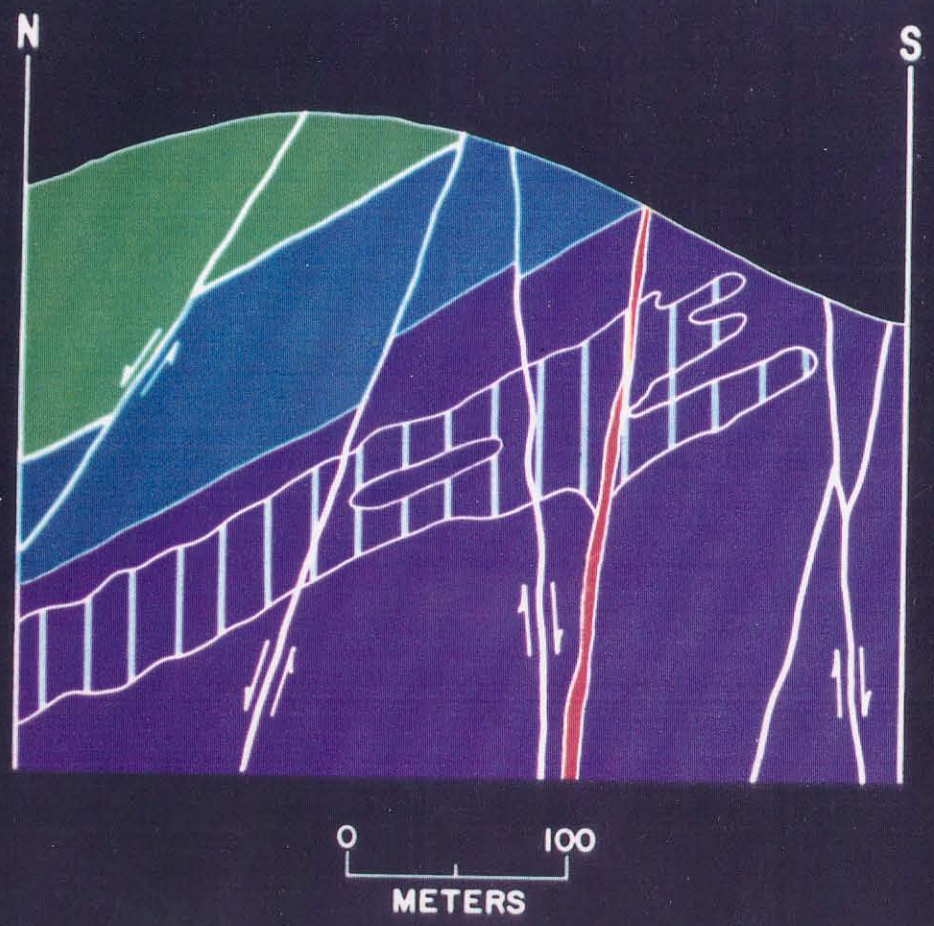

LEGEND
Alluvium and Lake Bed Deposits
Tertiary Lavas
Upper Plate Sequence (Western Assemblage)
Lower Plate Sequence (Eastern Assemblage)
Roberts Mountain Thrust (Teeth in Upper Plate)
Fault
Mines and Prospects (Metals indicated)
Prominent silicified zones
0 1 2
MILES
BOOTSTRAP MINE
Au
Bell Creek
Hg
ELKO CO.
EUREKA CO.
Rodeo Creek
Boulder Creek
T36N R50E
T35N R50E
BLUE STAR MINE
Ba
BIG SIX MINE
Au
Sheep Creek Placers
Lynn Creek Placers
LYNN DISTRICT
Simons Creek
Lynn Creek
Pb Ag
CARLIN-POPOVICH AREA
Sheep Creek Canyon
T35N R49E
T34N R49E
Maggie Creek
Boulder Valley
Welches Canyon
Maggie Creek Canyon
Cu(Au)
MAGGIE CREEK DISTRICT
COPPER KING MINE
GOOD HOPE MINE
T34N R51E
T33N R51E
GOLD QUARRY MINE (MAGGIE CREEK PROSPECT)
T34N R50E

FIGURE 6

FIGURE 7


11
12
POPOVICH
80 ACRES
Simon Creek
Location of drill hole
discovery, September 1962
Surface trace porphyry dike
14
13
Location of Trench B discovery,
November 1951
23
24
0
1/2
1
MILES



CARLIN MINE

IDEALIZED CROSS-SECTION

T DIKES

UPPER PLATE

O VINI NI FORMATION

LOWER PLATE

D POPOVICH LIMESTONE

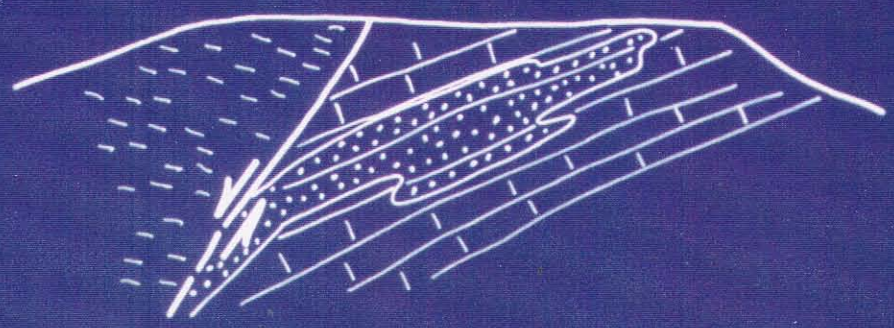
SD ROBERTS MOUNTAINS FORMATION

9

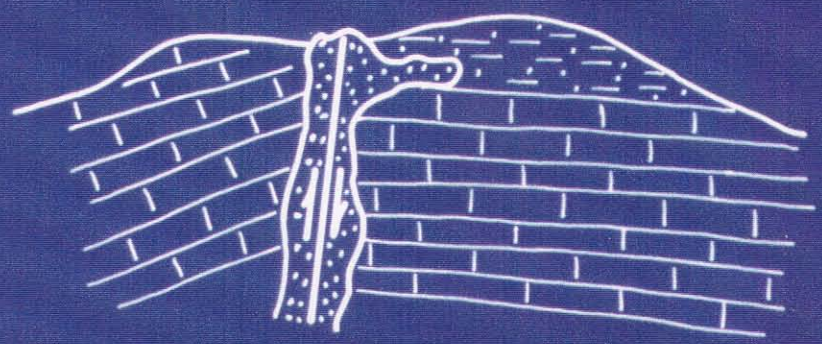
CARLIN TREND GOLD DEPOSITS

STYLES OF MINERALIZATION

1. STRATABOUND (CARLIN, DEEP WEST)



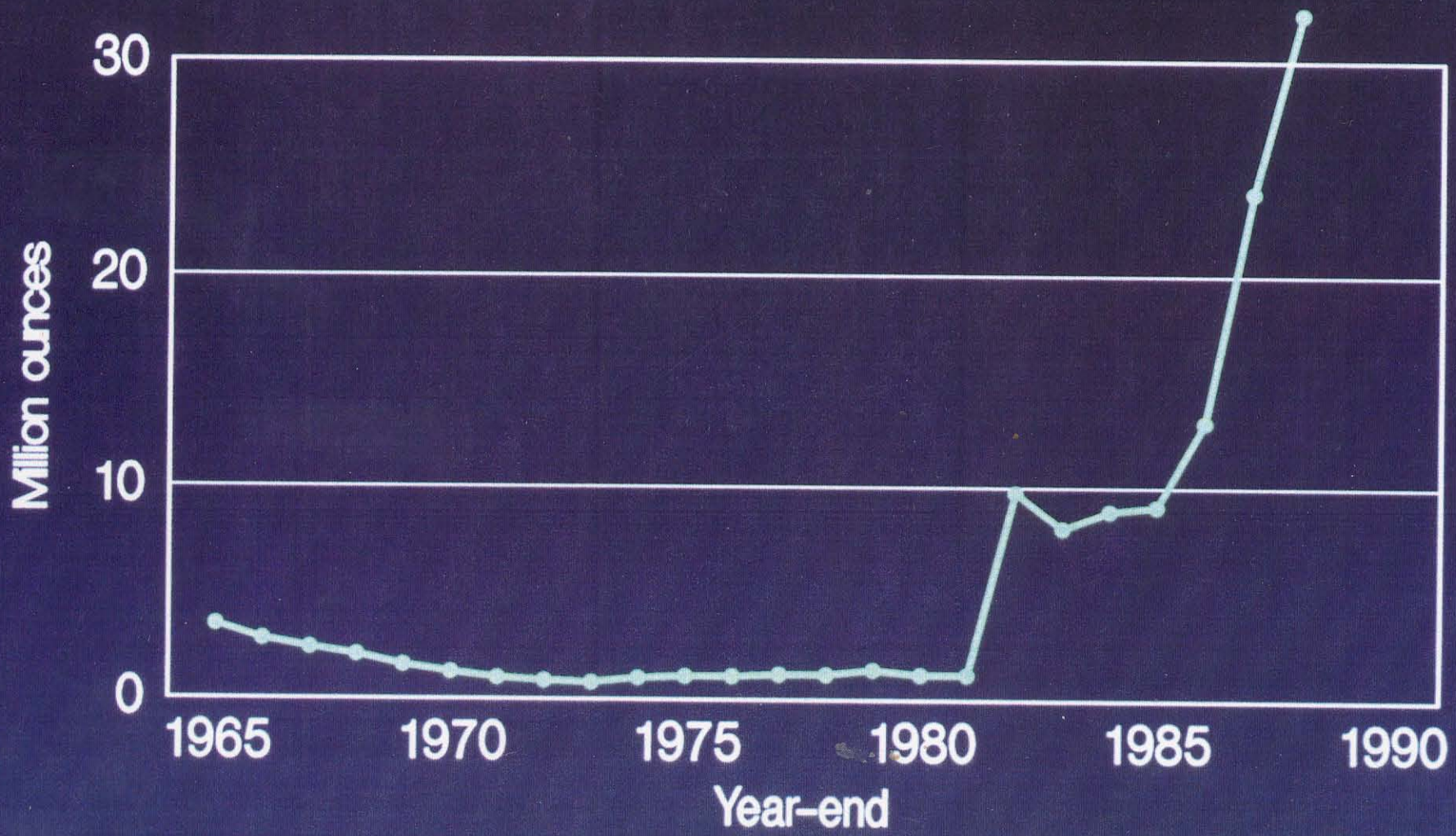
2. STRUCTURAL "VEIN-LIKE" (BOOTSTRAP-CAPSTONE)



3. STRUCTURAL STOCKWORK (GOLD QUARRY)

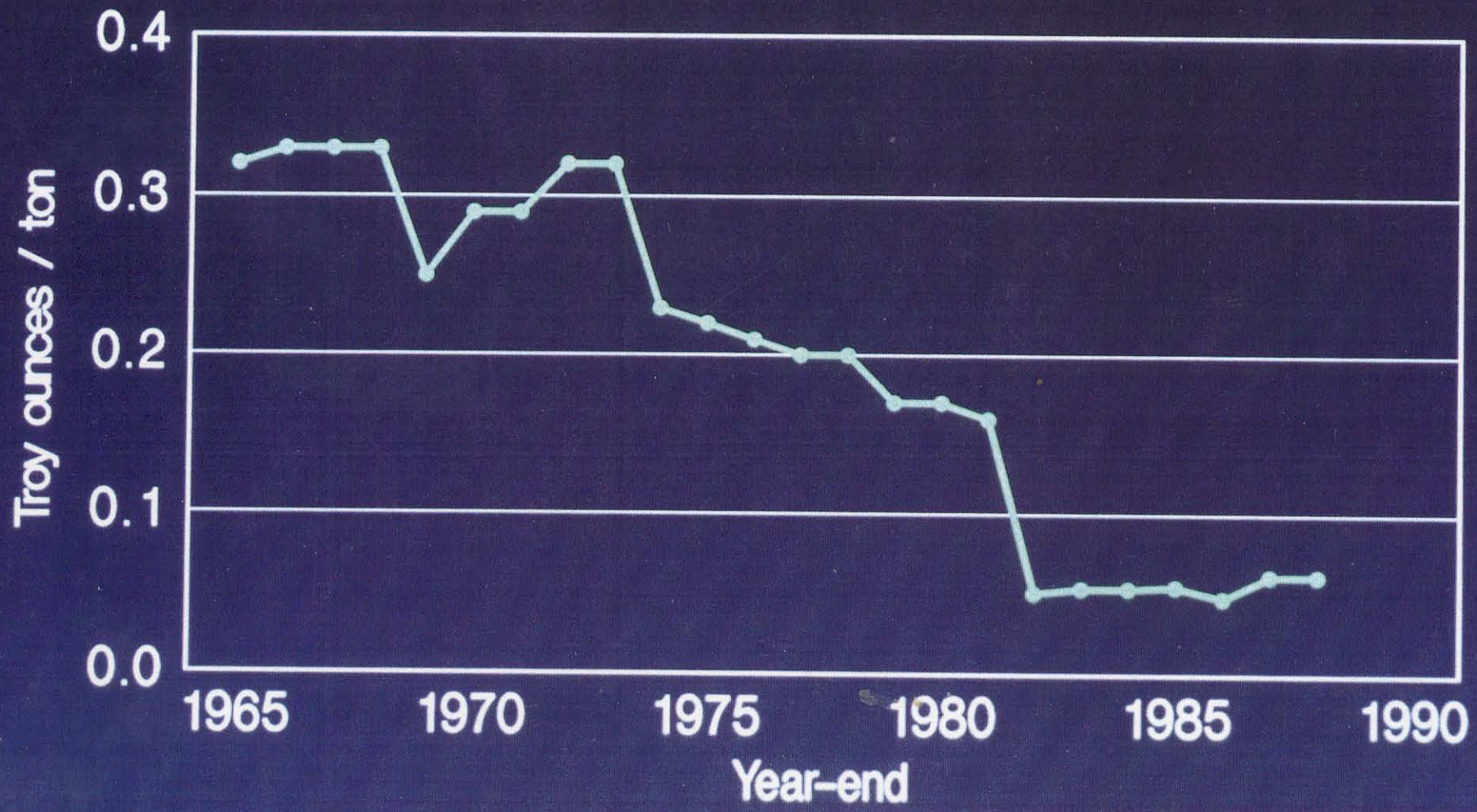
CARLIN TREND, NEVADA

TOTAL ORE RESERVES



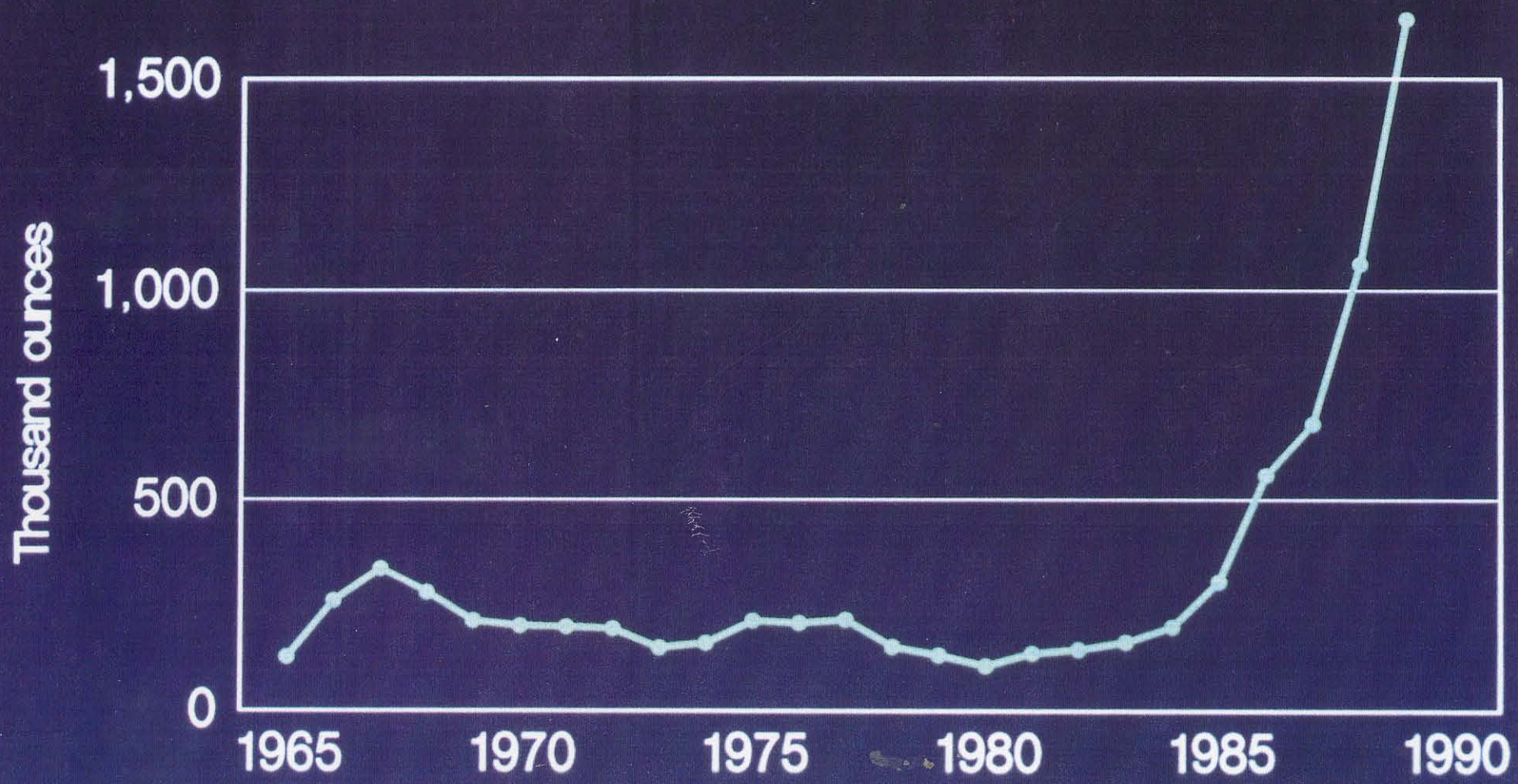
CARLIN TREND, NEVADA

AVERAGE RESERVE GRADE



CARLIN TREND, NEVADA

GOLD PRODUCTION



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