VOLCANIC HOSTED GOLD/SILVER DEPOSITS IN THE ELDORADO CANYON MINING DISTRICT

CLARK COUNTY, NEVADA

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Introduction

Gold was discovered in the Eldorado Canyon some time in the 1700's by the Spanish who named the canyon. This early discovery came to nothing as the area was very remote from civilization at that time, and the region was inhabited by hostile bands of Mohave Indians.

The first effective discovery was in 1857 at the Honest Miner, a small deposit about two miles west of Nelson. The Eldorado Mining District was organized in 1861 and several mines came into production shortly after.

The early history of the district saw construction of a mill on the Colorado River where steamboats provided access for supplies and communication with the world. At the time of organization this area was in New Mexico territory, later to become part of Arizona territory and eventually part of Nevada. Before 1909 the district was part of Lincoln County, whose sheriff was headquartered at Pioche, nearly 300 miles away by horseback, and offered no protection. The mining town of Nelson was lawless, and noted for the law of the Colt 45.

In the period before 1897 little is known of the production of the district, but it may have been over 100,000 ounces. Much of the production came from the Techatticup ("enough for everybody" in Piute) operated by Southwestern Mining Co. Ore grades were several ounces of gold per ton.

Later production from the district was episodic, related to changes in the prices of gold and silver and the discovery of new ore bodies. From 1942 to 1962 there was little or no production. In recent years there has been steady production from the Mocking Bird and significant "heap leach" production from the Wall Street from 1974 to 1984 by Consolidated Eldorado Mining Company and Intermountain Exploration Company.

General Geologic Setting

The McCullough and Eldorado Ranges form part of an extensive mid-Tertiary volcanic terrane that extends into the Mohave Desert area of California and western Arizona. The area is characterized by andesite-dacite stratovolcanoes lying directly on Precambrian basement (Fig. 1). Basalt forms shields and extensive flows, but is a subordinate rock type. Rhyolite domes and flows are locally common in the McCullough and Eldorado ranges (Anderson, 1971; Smith and others, 1986). The area is unique in many respects. It is one of the few areas of the Great Basin where volcanic rocks are associated with exposed cogenetic plutons (Boulder City and Wilson Ridge). It is also unique in its lack of extensive locally derived ash-flow sheets.

The Tuff of Bridge Spring, exposed in the Eldorado and McCullough ranges probably originated in the Mojave Desert of southern California. An unnamed tuff at the base of the volcanic section in the McCullough Range may be equivalent to the Peach Springs Tuff, an ash-flow tuff of unknown source that is exposed over a wide area of southern California and western Arizona (Young and Brennan, 1974; Glazner and others, 1986). Volcanic rocks in the area vary continuously in SiO_2 content from 50 to 70%. Basalts (SiO_2 <50%) and rhyolites (SiO_2 >70%) erupted during the waning stages of extension (post 12 Ma). Petrochemical modeling studies suggest that basalt was derived by partial melting of a granulite or amphibolite in the lower crust.

Structurally, the area is part of a zone of major mid-Tertiary detachment faulting that extends from the Lake Mead area southward to the Whipple, Buckskin and Rawhide Mountains (Anderson, 1971; Spencer and Welty, 1986). Studies of the Eldorado, River and McCullough Mountains demonstrated that extension was important in the structural development of each range (Anderson, 1971; Smith, 1982 and 1984; Weber and Smith, 1986), and that each range was subjected to varying amounts of extension. Normal- and strike-slip faulting occurred contemporaneously in the area. Normal faulting related to the main phase of extension occurred after 13.4 Ma in the River Mountain and after about 14.5 Ma in the Eldorado and McCullough Ranges.

District Geology

The geology of the Eldorado Canyon Mining District has been described by Hansen (1962) and by Longwell, et al (1965). The district lies in the central part of the Eldorado Range. Tuffs of the Patsy Mine volcanic series are intruded by quartz monzonite described by Hansen (1962) (Fig. 2). This is referred to locally as the Nelson quartz monzonite, and is also known as the Techatticup Pluton (Anderson, 1971). There are no known volcanics related to this so the magma probably never reached the surface. South of Nelson a separate pluton of granite intrudes Precambrian schists in Aztec Wash.

The Precambrian basement consists of quartz-biotite schists, biotite-chlorite schist and gneiss, and garnetiferous granite gneiss cut by many small quartz-muscovite pegmatites. The general foliation is north and northeast trending.

This is overlain by a stratovolcano complex composed of over 4,000 meters of andesite flows and breccias and locally distributed flows of dacite and rhyolite formed between 21 and 12 Ma in the Eldorado Range (Anderson, 1971; Anderson and others, 1972). The Tuff of Bridge Spring (14.7 Ma, Anderson and others, 1972) separates Mt. Davis volcanics (12 to 15 Ma) from Patsy Mine volcanics (15 to 21 Ma).

After the eruption of the Tuff of Bridge Spring and possibly coincident with emplacement of the Boulder City and Nelson Plutons, the Tertiary volcanic and plutonic section and underlying Precambrian basement were disrupted and extended more than 100% in a west-southwest direction by a series of west-dipping listric-normal faults that are normal to bedding (Anderson, 1971; Anderson, 1982).

In the mining district the Patsy Mine volcanics series consist of the following three units (Hansen, 1962; Longley, 1982).

Patsy Mine Lower Unit:	(Over 3,000 meters thick) Basal conglomeratic limestone lies on an angular unconformity with the Precambrian metamorphic complex. This grades upward into explosion breccias and agglomerates with a few rare interbedded sediments, and overlain by several hundred meters of brownish-weathering andesite flows and flow breccias.
Patsy Mine Middle Unit:	(Over 300 meters thick) Yellow to buff rhyolite flows, tuffs and vitrophyre. This member was sometimes mistaken for a separate formation known as Golden Door volcanics.
Patsy Mine Upper Unit:	(600 meters thick) Interlayered vesicular flows of olivine basalt and hornblende andesite porphyry.

The Patsy Mine volcanic series is overlain by the Tuff of Bridge Spring described above. None of the formations above the lower member of Patsy Mine volcanics has been mineralized.

Ore Deposits

Gold-Silver Deposits:

The principal mineral deposits of the district have been silver-gold ore deposits with a ratio of approximately 15 Ag/1 Au. Principal producers have been the Techatticup, Duncan, Wall Street, Rand and Carnation mines. Other smaller producers include the Magnolia, Poppy, Jubilee and Crown.

All of the ore deposits thus far discovered in the district occur either within the aureole of the Nelson pluton or in the lower member of the Patsy volcanic series. This may indicate that upper members were not yet in place at the time of mineralization or that ore solutions never reached the higher elevations. Because of post-mineral faulting we know that the mineralization was complete before the end of Patsy Mine time (15 Ma) indicating a depth of emplacement not more than 4,000 meters.

Hansen (1962) divided the ore deposits into two general types on the basis of structure and mineralogy. These are steeply dipping veins and flat dipping veins. Longley (1982) recognized a third type of breccia vein.

Steeply dipping veins (over 60°) strike generally east-west and demonstrate continuity both along strike and down dip. They are narrow (2-3 meters) and contain significant amounts of base metals in a gangue of quartz and calcite and a lower Ag/Au ratio (Techatticup Type).

Flat dipping veins (20° to 40°) contain less base metal sulfides, more calcite and are wider (6 to 10 meters) and less continuous. Calcite exceeds quartz as a gangue and sulfides rarely exceed 1%. The Ag/Au ratio is higher in these veins (Wall Street type).

A third type of ore deposit was recognized by Longley (1982) as irregular crackle breccias near the contact of the quartz monzonite with lower Patsy Mine volcanic series. These zones are irregular and without definite walls. Lower grade mineralization is mainly a reflection of the large amount of volcanic material included in the ore.

Structurally the channelways for all orebodies were prepared during the final upward expansion and hydrothermal fracturing of the margin of the pluton. All of the gold/silver ore deposits are spatially related to the Nelson quartz monzonite, either within the border area or in the lower Patsy Mine volcanics which are intruded by the quartz monzonite. Typically the ore deposits are offset by post-mineral normal and strike-slip faults.

Several ore deposits are in roof pendants of volcanic rocks included within the quartz monzonite, especially in the limestone conglomerate basal member of the Patsy Mine volcanics. Many of these pendants have never been explored.

Hydrothermal alteration related to ore deposits is principally propylitic (pyrite, chlorite, epidote) and is pervasive in the area west of Nelson within the quartz monzonite. Argillic alteration of volcanics near the Carnation mine reduced the volcanic rock to clay, which has been mined locally. Silicification is prominent only in the deeper ores and especially at the Duncan mine.

Base Metal Ores

In the central part of the Nelson Pluton in Copper Canyon there is a shattered zone containing chalcopyrite and tetrahedrite veinlets. Weak silicification is related to ore deposition, causing prominent weathered outcrops on the ridge south of the canyon. A small (250,000 ton) copper ore deposit has been developed containing over 1% copper plus gold and silver, but no molybdenum. It probably represents the eroded roots of a larger gold/silver deposit similar to those found along the margins of the pluton. The quartz monzonite in this vicinity is cut by later latite dikes of small dimensions, which are unaltered and are post-mineralization.

Conclusions

Most ore deposits discovered have been in the 100,000 ton range, with high-grade ore mined by underground methods. From the standpoint of bulk mineable gold/silver deposits, no deposits have yet been found of the dimensions and grade of the recent discoveries in northern Nevada. There are however, untested possibilities in the district within roof pendants contained in the quartz monzonite, and crackle breccias near the quartz monzonite contact. Possible mineralization of a later age may have been mobilized along listric-normal faults that cut many deposits at shallow depth.

Acknowledgement

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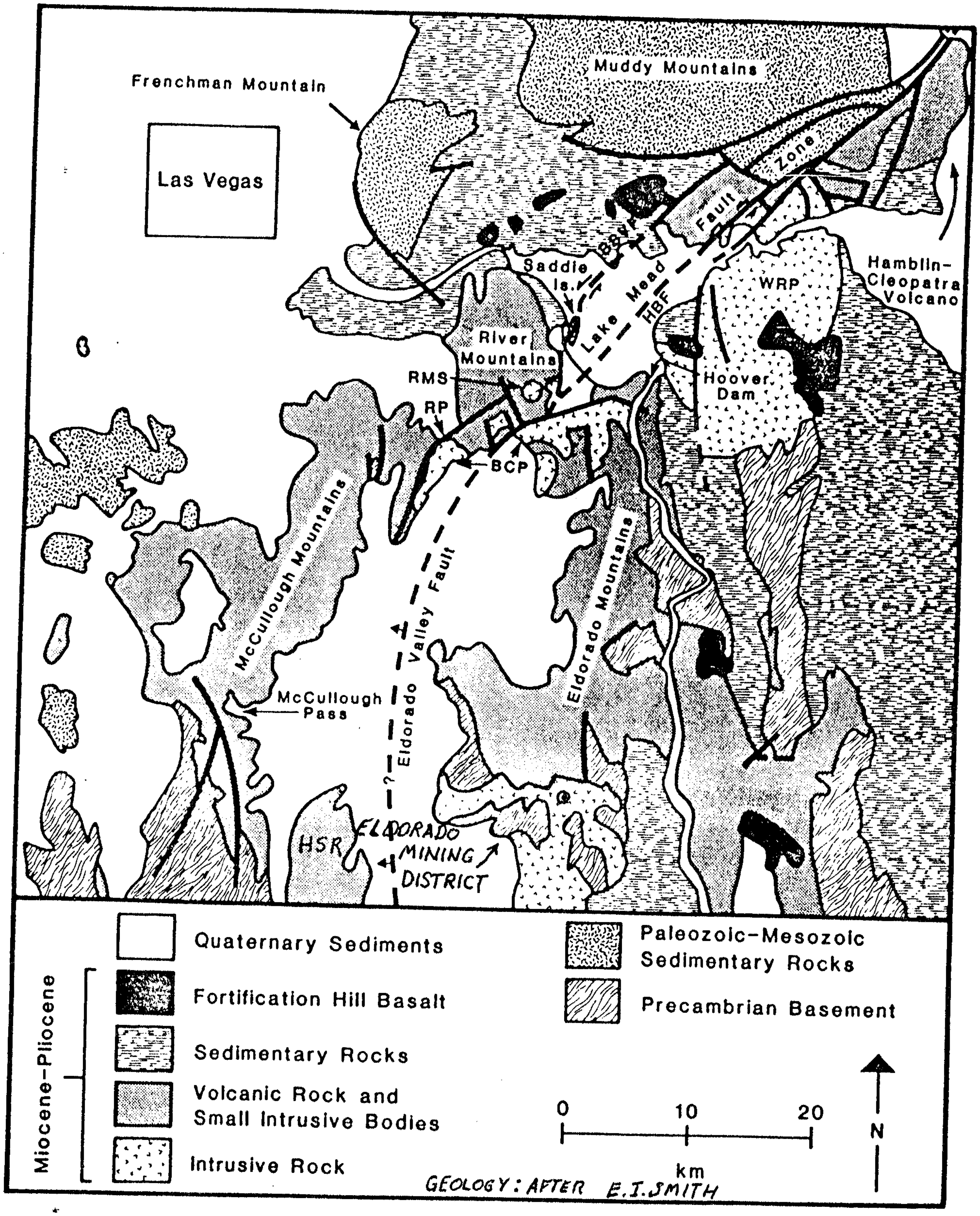
Fig. 1


Muddy Mountains
Frenchman Mountain
Las Vegas
Zone
Fault
BBV
Saddle Is.
Lake Mead
HBF
WRP
Hamblin-Cleopatra Volcano
River Mountains
RMS
RP
BCP
Hoover Dam
McCullough Mountains
Eldorado Valley Fault
Eldorado Mountains
McCullough Pass
Eldorado
HSR
ELDORADO MINING DISTRICT
Quaternary Sediments
Miocene-Pliocene
Fortification Hill Basalt
Sedimentary Rocks
Volcanic Rock and Small Intrusive Bodies
Intrusive Rock
Paleozoic-Mesozoic Sedimentary Rocks
Precambrian Basement
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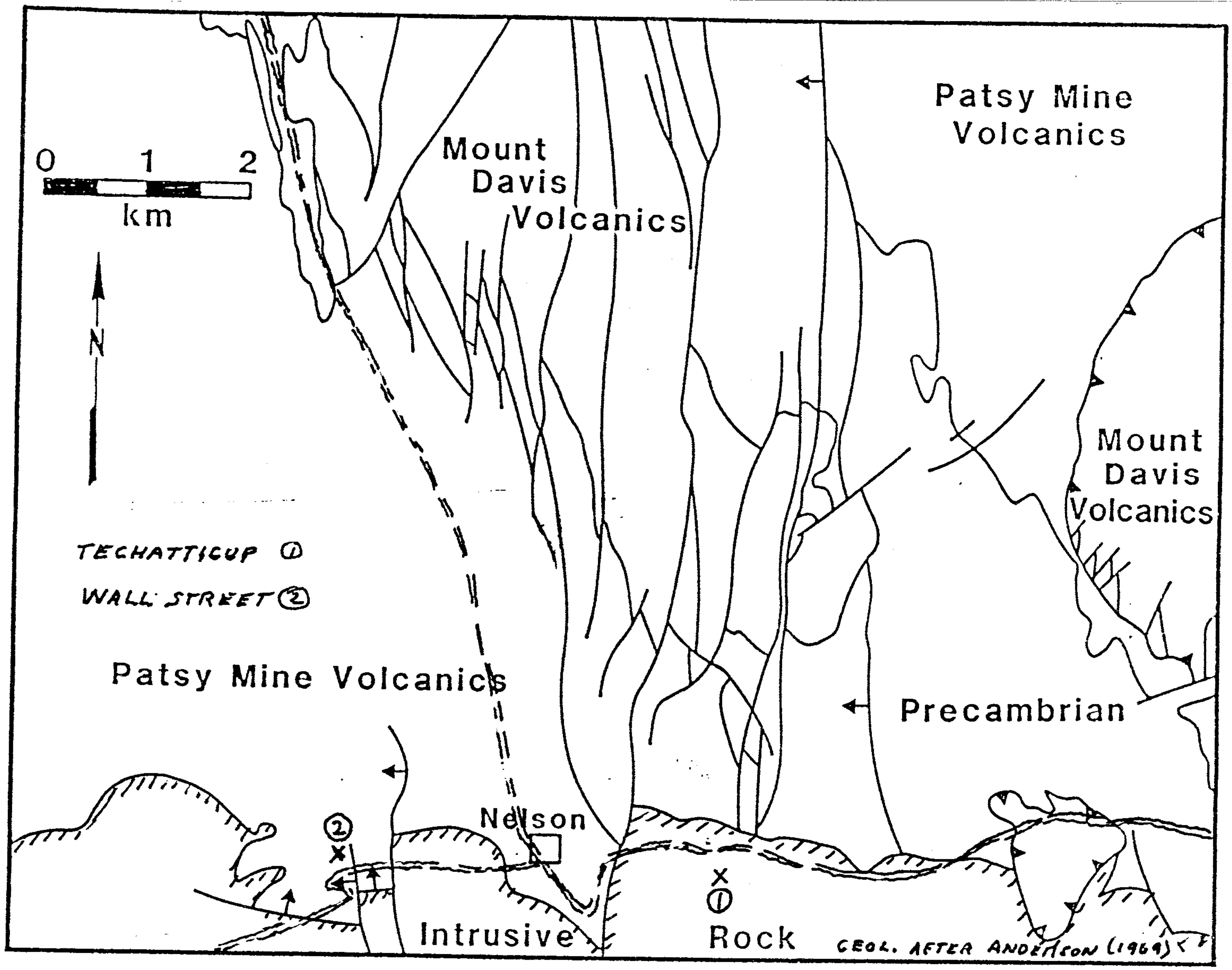
GEOLOGY: AFTER E.I. SMITH

Fig 2.



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TECHATTICUP ①
WALL STREET ②
Mount Davis Volcanics
Patsy Mine Volcanics
Patsy Mine Volcanics
Mount Davis Volcanics
Precambrian
Nelson
Intrusive
Rock
GEOL. AFTER ANDERSON (1969)