

# Geology of the Pinson and Preble Gold Deposits, Humboldt County, Nevada

Edward L. Kretschmer  
Pinson Mining Company, Winnemucca, Nevada 89445

## INTRODUCTION

The Preble and Pinson gold deposits are located 30 and 40 miles respectively northeast of Winnemucca, northern Nevada, and about 200 miles northeast of Reno (Figure 1).

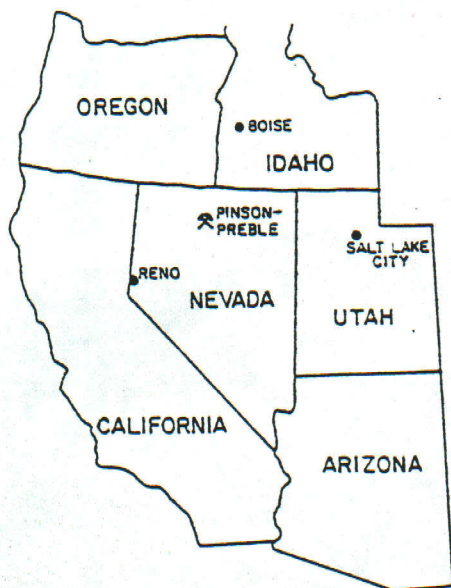


Figure 1.

The deposits are situated on the east flank of the Osgood Mountains in what is known as the Potosi Mining District. The importance of this district was established with the discovery of the Getchell Mine in 1934. A mill was erected and gold production began in 1938. This facility operated periodically until 1967. The Potosi District also produced tungsten from numerous small tactite deposits during W.W. II and the Korean War periods (Figure 2).

In order to present a clear and up-to-date picture of the general geologic features of the Pinson and Preble gold deposits, a composite of a number of published articles and unpublished company data are presented here.

## HISTORY

Paul A. Pinson was 8 years old when he arrived in San Francisco from France in 1853. As a young man he worked as a scout for early exploration expeditions in California and Nevada, including Clarence King's first ascent of Mount Whitney. Pinson also did some prospecting in the early mining camps of Nevada. He moved into the Golconda area around 1885 and established what is now known as the

Pinson Ranch. One of his eight children, Clovis, managed ranches in the vicinity but also had a love of prospecting.

Clovis Pinson and partner, Charles Ogee, found small siliceous outcrops that resembled early Getchell ore and staked the area in 1945. Getchell Mines Inc. leased the claims and mined approximately 50,000 tons in 1949 and 1950. That activity appeared to exhaust the ore body, and

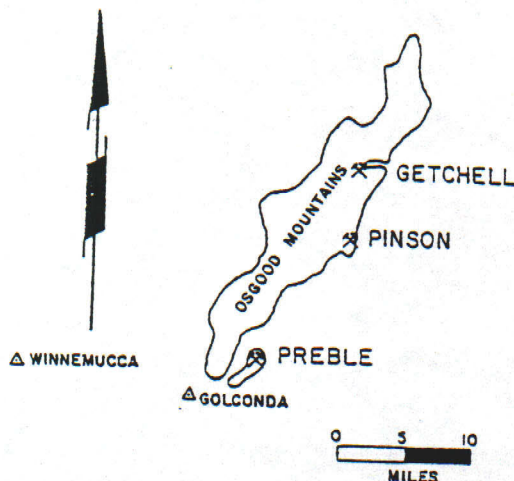


Figure 2.

the claims lay dormant until the late 1960's when some exploration work was conducted on them.

In 1970, the Cordex I Syndicate leased the property. The area was recognized as being on the Getchell structural zone, and it appeared that there were good possibilities of finding other ore bodies along the trend. After geologic mapping and geochemical sampling, a program of rotary drilling was started in 1971. The first 17 holes were drilled mainly around the old Pinson pit and encountered low-grade values. But on the 18th hole drilled to test a possible northeast extension, 90 feet of good mineralization was encountered. This is referred to as the Pinson "A" zone ore body, which is 1,000 feet long, averages 60 feet in thickness, and contains 1.5 million tons averaging 0.18 ounces of gold per ton. It is obscured by 10 to 50 feet of alluvium and thus was not recognized during the previous mining. Further drilling indicated 1.7 million tons averaging 0.15 ounces of gold per ton plus an additional tonnage of low-grade ore in the "B" zone ore body, which occurs in the vicinity of the old pit.

In 1972, further prospecting and geochemical sampling 15 miles south of Pinson led to a virgin discovery known as the Preble deposit in which 1.5 million tons averaging 0.07 ounces of gold per ton were indicated. However, this deposit was not economically viable at the then-existing gold price of \$65 per ounce.



Various evaluations were made of the Pinson deposit over a period of several years, and in 1975 a 330-foot adit was driven to obtain a bulk sample of the gold ore for mill testing. In early 1979, when the price of gold had reached \$250 per ounce and over \$1 million had been expended on the properties, a new feasibility study was undertaken. This indicated that the project would be profitable. The Cordex I Syndicate was reorganized into a partnership called Pinson Mining Co. and plans were made to put the property into production. Ten years after the discovery of the new ore body, the first gold bullion was produced.

### Regional Geology

The geology of the region has been well described by Hotz & Willden, 1964; and Erickson & Marsh, 1974. The oldest rocks in the area are the lower Cambrian Osgood Mountain Quartzite. It is exposed in the southern one-half of the Osgood Mountains. In most places, it is a pure cross-bedded quartzite with a few thin shaley partings.

The Osgood Mountain Quartzite is overlain in sedimentary and in places structural contact by the middle to upper Cambrian Preble Formation. This formation is characterized by shale.

The Preble can be broken down into three distinct units. The lower unit consists of sandy shale, quartzitic sandstone and phyllitic shale.

The middle member is the host for the Preble deposit. It consists of a sequence of limestone, carbonaceous shale, and calcareous shale along with phyllitic shale and quartzitic sandstone.

The upper member of the Preble Formation consists of a monotonous grouping of phyllitic shale with some sandy shale and carbonaceous beds.

The Preble Formation is overlain by the Ordovician Comus Formation. The age of this formation is from upper Cambrian to middle Ordovician (Ketner, 1983) and from our studies in the Pinson Mine area, appears to be a conformable sedimentary sequence resting on the Preble Formation.

The Comus is a thin-bedded carbonate and shale unit with dolomite siltstone and some chert. Rhythmic interbedding of carbonate and shaley rocks are often seen. Sometimes they occur as fine laminations. Intraformational conglomerate occurs in the section near the intercalated limestone and cherty beds and is gaining importance in our study of the Pinson Mine area. It is entirely calcareous, containing fragments or plates of medium dark gray to grayish-black limestone in a limestone or sugary textured dolomite.

Other Ordovician rocks are present in the Osgood Mountains and have been described as Valmy (or Vinini?) Formation (Hotz & Willden, 1964, p.21 and 24; Erickson & Marsh, 1974, p.333) and emplaced structurally by thrusting from the west during the Antler orogeny of late Devonian or Early Mississippian.

Resting unconformably on the older Paleozoic rocks is an autochthonous block known as the Antler Sequence.

The lower most unit of this sequence is the middle Pennsylvanian Battle Formation, a siliceous and calcareous conglomerate or fanglomerate. The Battle Formation rests on the Osgood Mountain quartzite in most places and on the Preble Formation locally.

Overlying the Battle Formation are limestones with local names which are roughly correlative with the Antler Peak Formation and Edna Mt. Formation (Roberts, 1964).

Upper Pennsylvanian and Permian rocks of the Havallah Sequence overlie the autochthonous Antler Sequence in the northern part of the Osgood Mountains. This sequence is believed to be a thrust plate of the Permian - early Triassic Sonoma Orogeny (Roberts, 1964).

The Paleozoic rocks are intruded by a late Cretaceous granodiorite stock which has been dated at 85-90 M.Y. (Silberman, et al, 1974). The mass of the granodiorite occurs as 2 large lobes which make up the central part of the Osgood Mountains.

Dikes and sills of granodiorite, andesite porphyry, dacite porphyry, and aplites are related to this intrusive.

It is generally medium-coarse equigranular and except for the margins, very uniform.

Remnants of Middle Tertiary volcanic rocks occur in scattered patches over the quadrangle. They are generally tuffs and flows of intermediate and rhyolitic composition.

Olivine basalt and ash related to Basin and Range faulting (approximately 17 M.Y., B.P.) occurs in the southern portion of the range.

A conspicuous contact metamorphic aureole surrounds the granodiorite stock. It extends irregularly up to 10,000 feet from the margins of the intrusive. Mostly rocks of the Preble are affected. Biotite-Cordierite hornfels are the most common rocks within the metamorphic halo. Andalusite (chiastolite) with accompanying muscovite hornfels are also common, particularly in the Ordovician rocks.

The carbonate rocks were converted to marble, light colored wollastonite bearing calc-silicate rocks, and dark tectite. A number of tungsten bearing tectite deposits rim the granodiorite, forming wherever a calcareous bed was present.

Pinson and Getchell lie within the contact metamorphic aureole.

The gold deposits occur along a structural belt known as the Getchell Fault System. The system bounds the eastern flank of the range. It is believed to be an older fault system, at least late Cretaceous in age (Berger & Taylor, 1980). The fault system is similar to, and in many cases becomes a basin and range fault, parts of which have been active until present.



The fault system is a series of sub-parallel, en echelon faults, and often broad shear zones, that dip at moderate angles to the east and striking northwesterly at Getchell, to northeasterly at Pinson. Bedding is roughly parallel to faulting making displacement difficult to measure. In many places, dacite porphyry or andesite porphyry is seen intruding the structure.

The Getchell Fault System is the main control for the gold deposition in the Osgood Mountains. Its strike length is approximately 25 miles.

At Getchell and Pinson, the fault system consists of a 50 to 100 foot wide zone with persistent footwall and hangingwall strands. Economic gold mineralization occurs where the structure cuts calcareous rocks of the Preble and Comus Formations.

#### Preble Gold Deposit

The Preble deposit was discovered by G. W. "Whit" DeLaMare in 1972 while prospecting the low hills north of the Humboldt River. One sample assayed low gold values and no silver (.03 oz/ton). This particular sample attracted attention because it was described as a calcareous siltstone which was a favorable host for Carlin-type mineralization. More detailed sampling verified the disseminated nature of the occurrence. Bulldozer trenching over the anomalous area produced continuous low values for over 300 feet.

The first holes were then drilled in the middle of the anomalous area which was near the footwall of the ore zone. It was then a simple matter of blocking out the ore by pattern rotary drilling. This was done at a cost of about \$50,000.

The Preble deposit is wholly within carbonaceous shales and silty limestones of the middle member of the Cambrian Preble Formation. Ore occurs along a broad shear zone parallel to bedding which strikes northeasterly and dips 30 degrees to the southeast. The orebody is oxidized to approximately 200 feet in depth. This orebody is characterized by very uniform dissemination and grade terminating in sharp cutoffs at the foot and hanging walls. This cutoff may be related to chemical boundaries.

The shale has been subtly silicified and the rock retains its fissile texture. Gold is strongly associated with replacement quartz (Kemp 1974). Arsenic, to a lesser extent, mercury, barium, and antimony are associated with silicification and mineralization. Beneath the zone of oxidation, the ore becomes highly refractory.

A small, highly argillically altered sill occurs along the footwall shear in the center of the deposit. Some higher grade ore occurs along the footwall of the shear zone in the vicinity of the sill.

Thin-bedded carbonaceous, calcareous, and silty shale is the host for mineralization. These beds

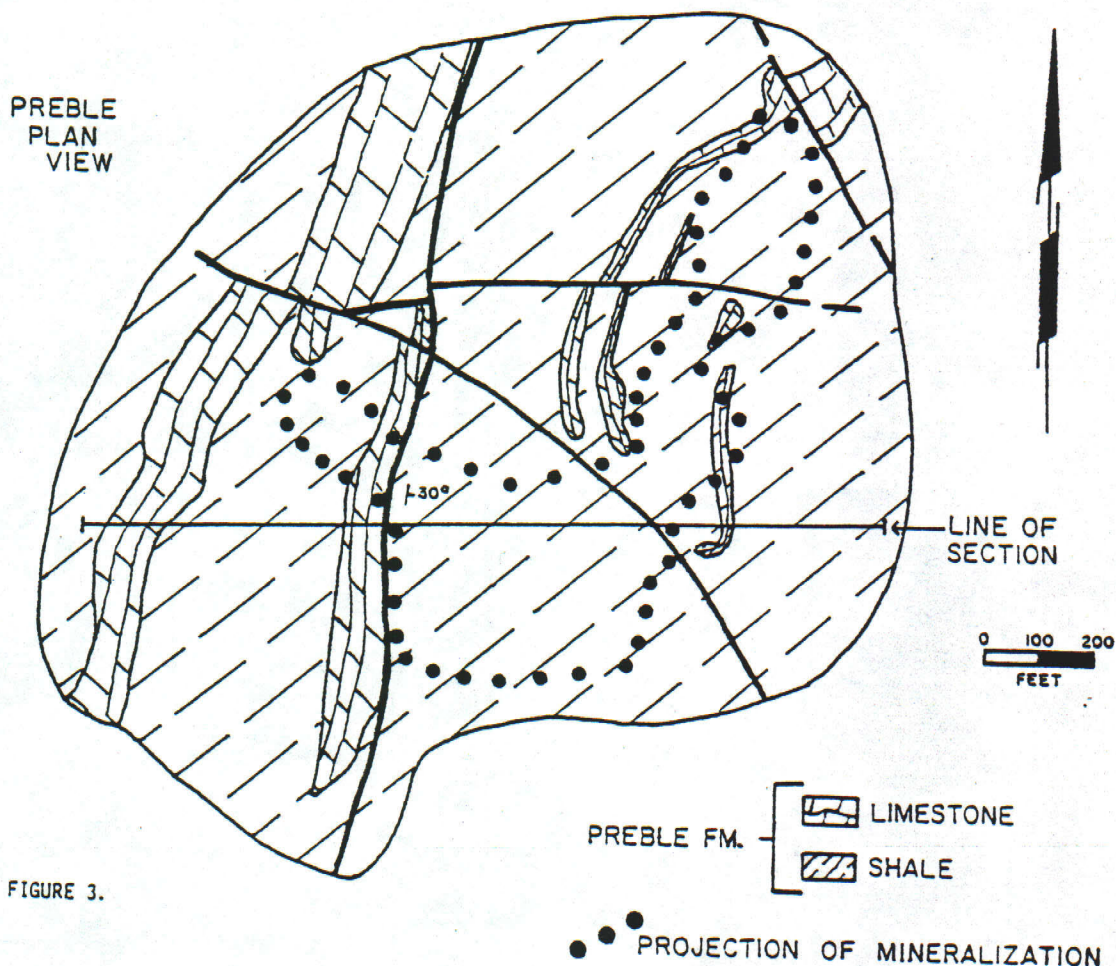


FIGURE 3.



a limonitic shale which has a very platy phyllitic texture which is characteristic even when highly silicified.

The limonite is composed of intergrowths of goethite and lepidochrosite. (Kemp, 1973.)

Removal of carbon matter by oxidation has been documented previously (Leythaeuser, 1973) and may, in the case of Preble, have been enhanced by acid from the oxidizing sulfides.

In the unoxidized portion of the orebody, the rock becomes sooty black with 2-3% pyrite and minor chalcopyrite. Drilling outside the orebody indicates that most of the sulfides are of syngenetic origin. Two types of pyrite have been noted: crystalline and framboidal (botryoidal).

The gold that has been seen in the unoxidized zone has been restricted to quartz grains, and tentatively identified as a thin rim on a pyrite grain.

Crystalline pyrite is seen in three rock types of the unoxidized zone which are siliceous carbonaceous and calcareous. The framboidal variety pyrite was observed in carbonaceous rock suggesting a syngenetic origin. Minor amounts of arsenopyrite, marcasite, chalcopyrite, and sphalerite have been silicified in varying degrees, silicification occurs within the ore horizon and extends out laterally from it. (Figure 3)

The gold is fairly uniformly distributed except for very near the surface where some of the gold is apparently leached. The remainder of the oxidized portion of the ore zone exhibits more silicification and 50% higher grade than the near surface material.

In the oxidized zone, gold, limonite, and minor pyrite are seen in the silicified shale. The gold that has been seen in polished sections occurs at an average size of 2 microns. It is always associated with silica (Kemp, 1973).

Oxidation extends to a depth of approximately 200 feet. Carbon and sulfides are removed leaving identified (Kemp, 1973).

Drill cuttings from the varying conditions of silicification, mineralization, oxidation and rock types were analyzed for trace elements of gold, silver, arsenic, antimony, copper, lead, zinc and mercury. The unoxidized portions were also analyzed for percent sulfur and percent organic carbon.

The results showed that arsenic and to a lesser extent, mercury, are associated with the silicification and gold mineralization. (Figure 4)

Sulfur analyses indicated a range of two to five percent pyrite content throughout the area.

More recently, results from surface geochemical sampling (Crone, 1982), has added arsenic, barium (Van den Boom, 1982), thallium and fluorine (Connors 1982), to the suite of trace elements occurring with the gold mineralization.

#### Pinson Gold Deposits

Rocks in the vicinity of the Pinson Mine consist of Paleozoic sedimentary rocks intruded by a Cretaceous granodiorite stock. The oldest rocks are Middle to Late Cambrian Preble Formation, which can be separated into three distinct members. The lower member consists of sandy shale, quartzitic sandstone, and phyllitic shale. A sequence of limestone, carbonaceous shale, calcareous shale, and subordinate phyllitic shale and quartzitic sandstone make up the middle member. The upper member comprises phyllitic shale, sandy shale, and a few carbonaceous beds.

The Cornus Formation, a thin-bedded carbonate and shale unit of Ordovician age, overlies the Preble Formation and is the host rock for the Pinson ore. Rhythmic interbedding of the carbonates and shaly beds are often seen

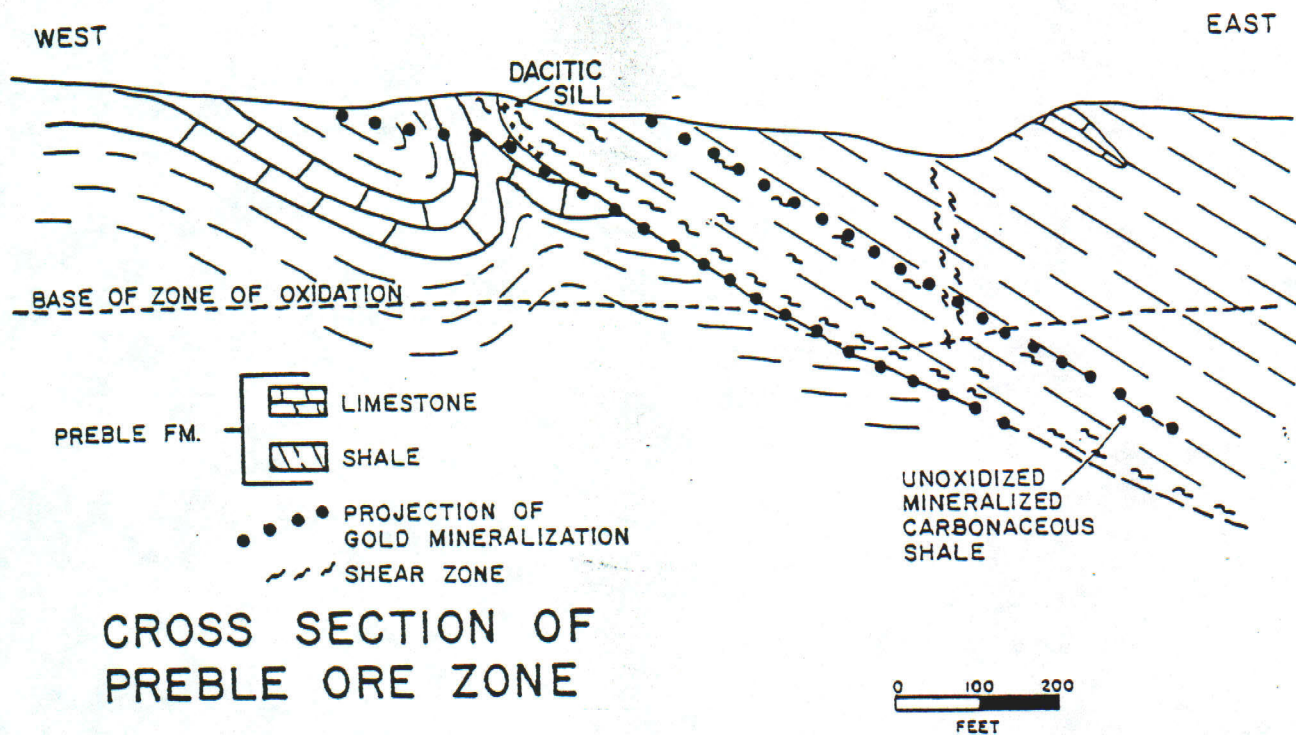


FIGURE 4.



and sometimes occur as fine laminations (J. Graney, oral commun. and unpublished company reports, 1983). The sedimentary rocks have been intruded by a medium- to coarse-grained, granular granodiorite stock which has been dated (Silberman, Berger, and Koski, 1974) at 85–90 m.y. (Cretaceous). Aplite, pegmatite, and porphyritic dikes and sills of intermediate composition are associated with the stock, which crops out approximately 1,200 feet north of the mine. The mine lies within a conspicuous contact metamorphic aureole that extends irregularly up to 10,000 feet from the margins of the stock. Within the contact aureole shale is metamorphosed to chistalite/andalusite-biotite or cordierite-muscovite hornfels, and carbonate rocks are metamorphosed to marble, light-colored calc-silicate rocks, and dark garnet tectite. The tectite deposits contain scheelite and many of them were mined for tungsten during the period 1942–57 (Hotz and Willden, 1964).

The major structure of the area is a prominent northeast-trending normal fault which has controlled the gold mineralization. This structure has been traced by drilling for 8,000 feet northeast along strike and shows a uniform dip of 40°–50° SE. For half the mapped distance, the fault forms the contact between the Preble and Comus Formations; for the remainder of the distance it cuts the Comus and offsets limestone and intercalated units (fig. 5). Where the structure occupies the contact zone, it is 50–70 feet wide, sheared, and brecciated.

Two main types of ore are present and related to silicification produced in a shallow, hydrothermal system. The "A" ore body is localized along the 70-foot-wide northeast-trending shear zone bounded by a definite hanging wall and footwall strand (fig. 5). The "A" ore body is characterized by intense silicification, in which intercalated limestone and siltstone beds of the Comus Formation are completely replaced by a dense jasperoid that locally carries gold values from 0.20 ounces up to several ounces per

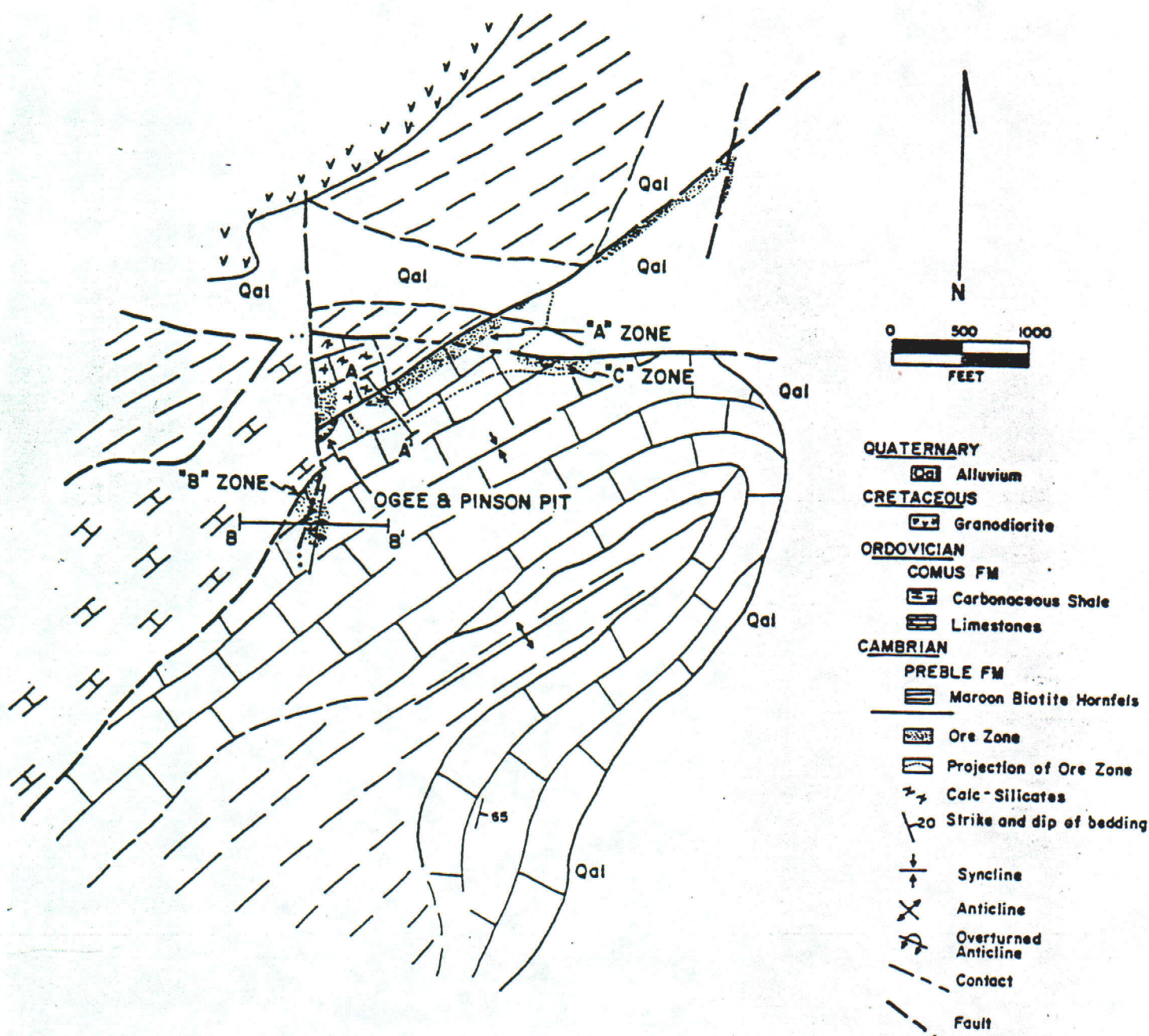


Figure 5.



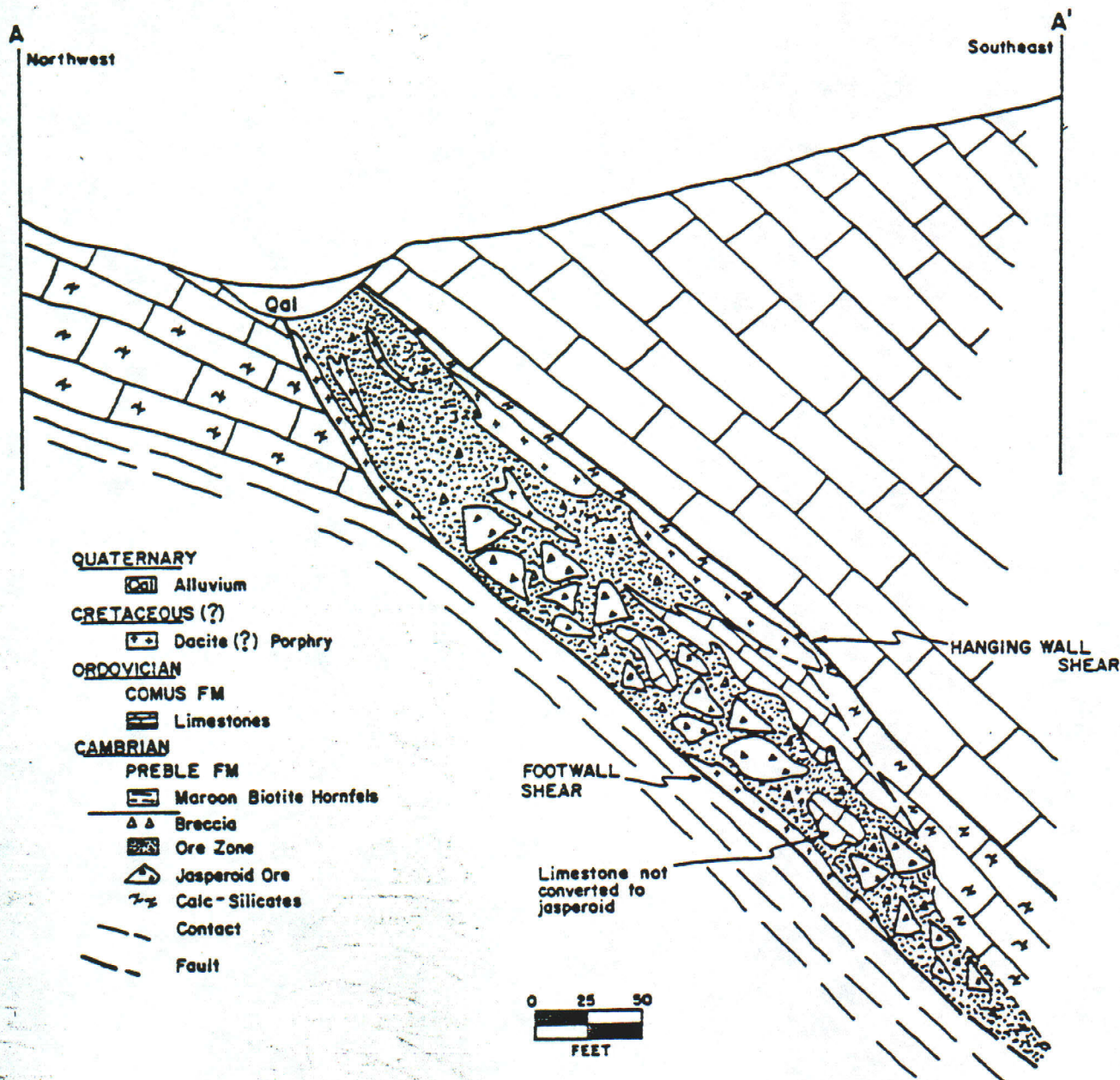


FIGURE 6 Cross section of Pinson ore zone, "A" ore body.

ton. The jasperoid is confined to a 60- to 70-foot-wide zone along the northeast-trending fault. Polished sections of the jasperoid reveal a relatively simple mineralogy: silica, goethite, lepidocrocite, and hematite, with sparse remnants of pyrite, marcasite, and gold (Powers, 1978). Gold size is less than 30 microns and most commonly less than 5 microns (W. R. Kemp, unpublished company report, 1973). Gold occurs as a free phase and has been seen as micron-size inclusions in arsenic-bearing pyrite (Wallace and Wirtkopp, 1983). The gold-silver ratio often approaches 100:1. Highly altered andesite or dacite porphyry sills and dikes lace the "A" ore body in irregular fashion (Hill, 1971). The dikes are argillized, sericitized, and contain low gold values near the ore zone (W. R. Kemp, unpublished company report, 1972).

The "B" ore body begins in the vicinity of the old Ogee and Pinson Mine workings and trends southward for

approximately 1,000 feet. The host rocks are a less-silicified shale and a punky, leached silty carbonate horizon of the Comus Formation. The "B" ore body occurs in a fold axis that has been sheared and brecciated along a north-trending shear zone (fig. 7) with influence from a northeast-trending fracture system that is sympathetic with the "A" ore body structure. Here, in the Comus Formation drilling indicates the carbonaceous shale above, below, and bounding the carbonate rocks on the west. The gold mineralization occurs with limonite and kaolinite along numerous fractures in a zone of subtle, pervasive silicification. This fracture system allows good dissemination and uniform grade. Though of lower grade than the "A" ore body, the "B" ore body is more extensive. In addition, fracturing and oxidation exposes the gold and allows the ore to be treated readily by cyanidation.



Modest tonnage has been developed from the "C" ore body, which occurs along a crosscutting normal fault that trends N50°E at the north end of the "A" ore body (fig. 5). The grade and mineralization is similar to that of the "A" ore body.

## GEOCHEMISTRY

Surface geochemical sampling and analysis of drill cuttings indicated an association of antimony, arsenic, and mercury with the mineralized zone, as is typical of most Carlin-type deposits (Hill, 1971; Crone, 1982). Analyses were also performed for copper, lead, silver, and zinc, but these elements showed no association with the gold mineralization (Hill, 1971). Barium and fluorine have recently been found associated with the gold mineralization (R. Connors, written commun., 1982).

Surface grid sampling of rock chips indicated that the mineralized zone could readily be found where it outcropped by its association with mercury, and to a lesser extent, with antimony and arsenic. However, where the zone extends to the northeast from the "A" ore body and is covered by transported material of decomposed granodiorite and some clay, use of these elements was ineffective.

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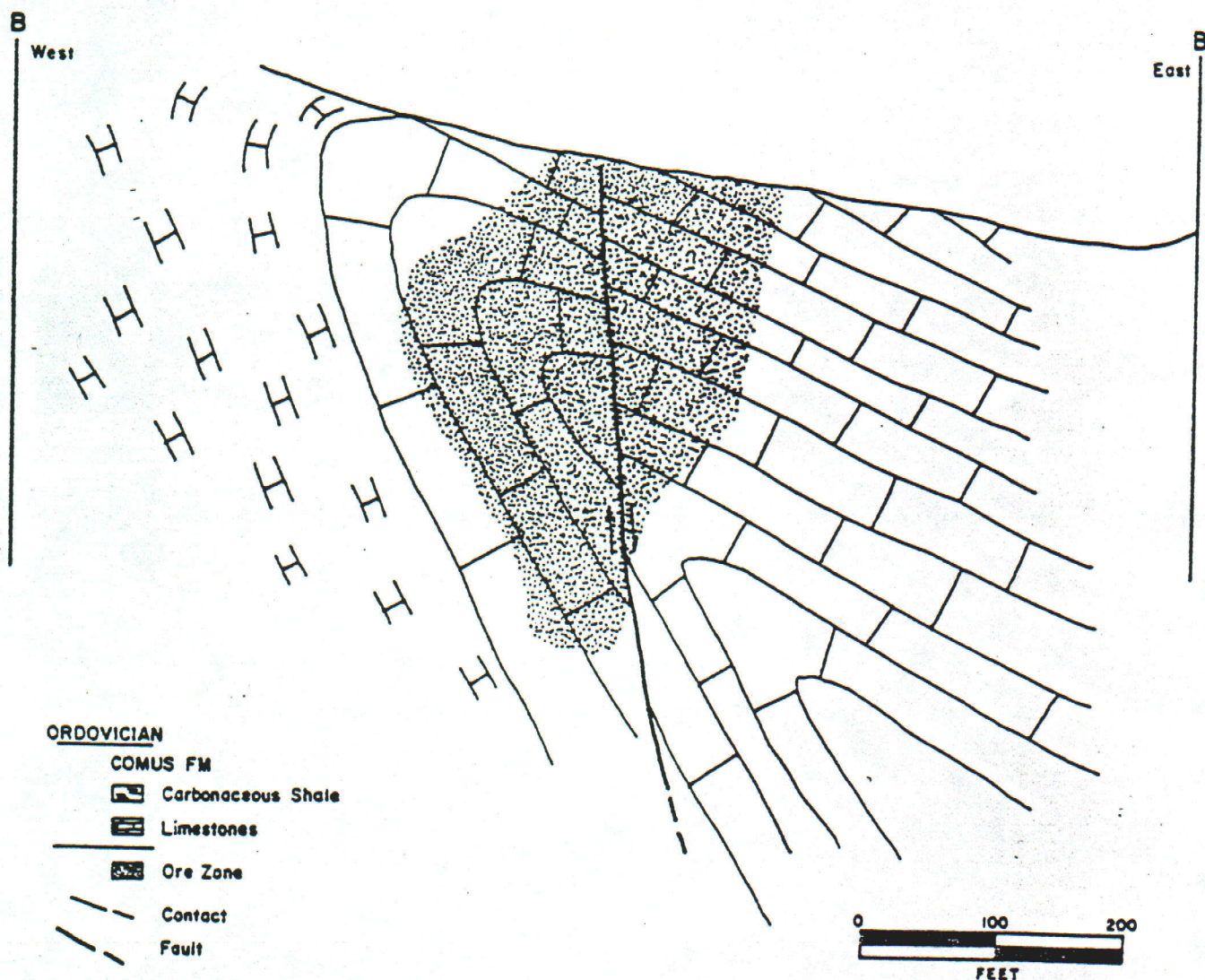


FIGURE 7 Cross section of Pinson ore zone, "B" ore body.



ORE RESERVES AT END OF YEAR  
PINSON MINING COMPANY

	<u>1988</u>	<u>1984</u>	<u>1981</u>
<u>Pinson Mine</u>			
Mill Ore			
Tons	4,414,300	3,593,100	2,859,000
Grade	0.090	0.087	0.114
Leach Ore			
Tons	2,215,500	2,004,570	2,993,600
Grade	0.029	0.026	0.028
<u>Preble Mine (including Kramer Hill)</u>			
Mill Ore			
Tons	5,140	89,000	
Grade	0.130	0.239	
Leach Ore			
Tons	624,530	1,670,030	1,340,000
Grade	0.051	0.053	0.080

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