Geologic Overview of the Getchell Gold Mine Geology, Exploration, and Ore Deposits, Humboldt County, Nevada

VIC CHEVILLON,† ERIC BERENTSEN, MARK GINGRICH, BILL HOWALD, AND ELIZABETH ZBINDEN

Getchell Gold Mine, Placer Dome Exploration, HC66, Box 220, Golconda, Nevada 89414

Introduction

THIS SUMMARY focuses on the past history of the Getchell property, its general geology, and current published information relative to gold mineralization. It should provide background and a geologic context for the field tour of Getchell. The Getchell property dates to 1934 gold discoveries, and its history includes some of the earliest open-pit oxide and sulfide gold production in Nevada. In retrospect, the early gold discoveries were some of the first discoveries of what is now known as sediment hosted, micron gold, Carlin-type deposits. Several other open-pit mines were developed on similar deposits in what is now Nevada's Getchell gold trend.

Current Getchell Gold Corporation land holdings in the Getchell Trend cover 50 mi^2 at the northern end of the Osgood Mountains and the Dry Hills. With the 1991 discovery of the high-grade underground orebodies from the Getchell main (sulfide) open pit and the 1994 discovery and initial shaft development of the underground Turquoise Ridge Deposit, the Getchell Trend is entering a new era of bulk tonnage underground gold mining (Table 1).

Placer Dome merged with the Getchell Gold Corporation in the spring of 1999. Getchell Gold is the mine operator and is currently optimizing the Turquoise Ridge and Getchell mines through predevelopment work for bulk tonnage underground production. Placer Dome is conducting exploration aimed at reserve and resource expansion and the discovery of new deposits in outlying areas of the property.

Our tour of the property will examine the surface geology of the existing open pits where the styles of gold mineralization are exposed, along with some key structural, alteration and stratigraphic features that relate to understanding the underground gold orebodies.

The regional geology of the property is shown in Figure 1. A geographic index of named sites we'll visit on our tour is shown in Figure 2.

On behalf of Placer Dome and Getchell Gold Corporation, welcome to Getchell.

Recent History and Status

The Getchell property has, in the past, been explored over much of its area mostly for open-pit oxide gold deposits. The more recently recognized potential of the property for high-grade underground deposits has been drill tested only in the 2.5 mi^2 area centered on the discoveries of Getchell underground and Turquoise Ridge deposits. The underground potential on the rest of the property remains largely untested and is the focus of current exploration.

Getchell underground mine

When Getchell Gold Corporation was formed in 1996 they were faced with depleted open-pit sulfide reserves along the Getchell fault and responded by accelerating the exploration campaign for underground deposits. Drilling downdip of the Getchell main open-pit orebodies led to the discovery of several orebodies in the Getchell fault and in its hanging wall and footwall. The first portal of the Getchell underground mine was excavated from the lowest benches at the northern end of the Getchell open pit in 1994. Exploration continued from underground and surface drilling, and underground production expanded as new resources and reserves were added in the northwest and 186 orebodies. In late 1996 and early 1997 the high-grade 194 orebody was discovered by surface drilling northwest of the northernmost Getchell underground mine workings. Initial bulk tonnage trackless mining of the 194 soon followed.

Turquoise Ridge underground mine

In 1986 open-pit resources were discovered above what is now the Turquoise Ridge underground mine. The pits were developed by 1993 and mining was completed by 1995. As open-pit mining proceeded, several drill holes intersected some gold-bearing veins and stockwork zones in a "traditionally" barren pillow basalt unit in which the shallow holes were generally terminated. The concept that the open-pit deposits might be leakage above a blind higher-grade deposit was derived and deep holes were designed by Eric Berentsen, exploration geologist, under the direction of Dick Nanna, then vice president of exploration.

TABLE 1. Proven and Probable Mineable Reserves, December 31, 1998 (Getchell Gold Corporation news release)

	Average		
Area	Ore tons	Grade (oz/ton)	Contained oz
Underground reserves			
Turquoise Ridge	7,155,800	0.365	2,608,600
North zone	5,279,800	0.425	2,242,360
Getchell underground	4,700,900	0.358	1,682,330
Total underground reserves	17,136,500	0.381	6,533,290
Surface reserves			
Hansen Creek (Sulfide)	85,500	0.138	11,800
Section 13	1,139,700	0.044	50,240
Stockpile	138,500	0.085	11,770
Total surface reserves	1,363,700	0.054	73,810
Total proven and probable			6,607,100

At December 31, 1998, resources total an additional 9.4 million contained ounces of gold

†Corresponding author: e-mail, Vic_Chevillon@placerdome.com

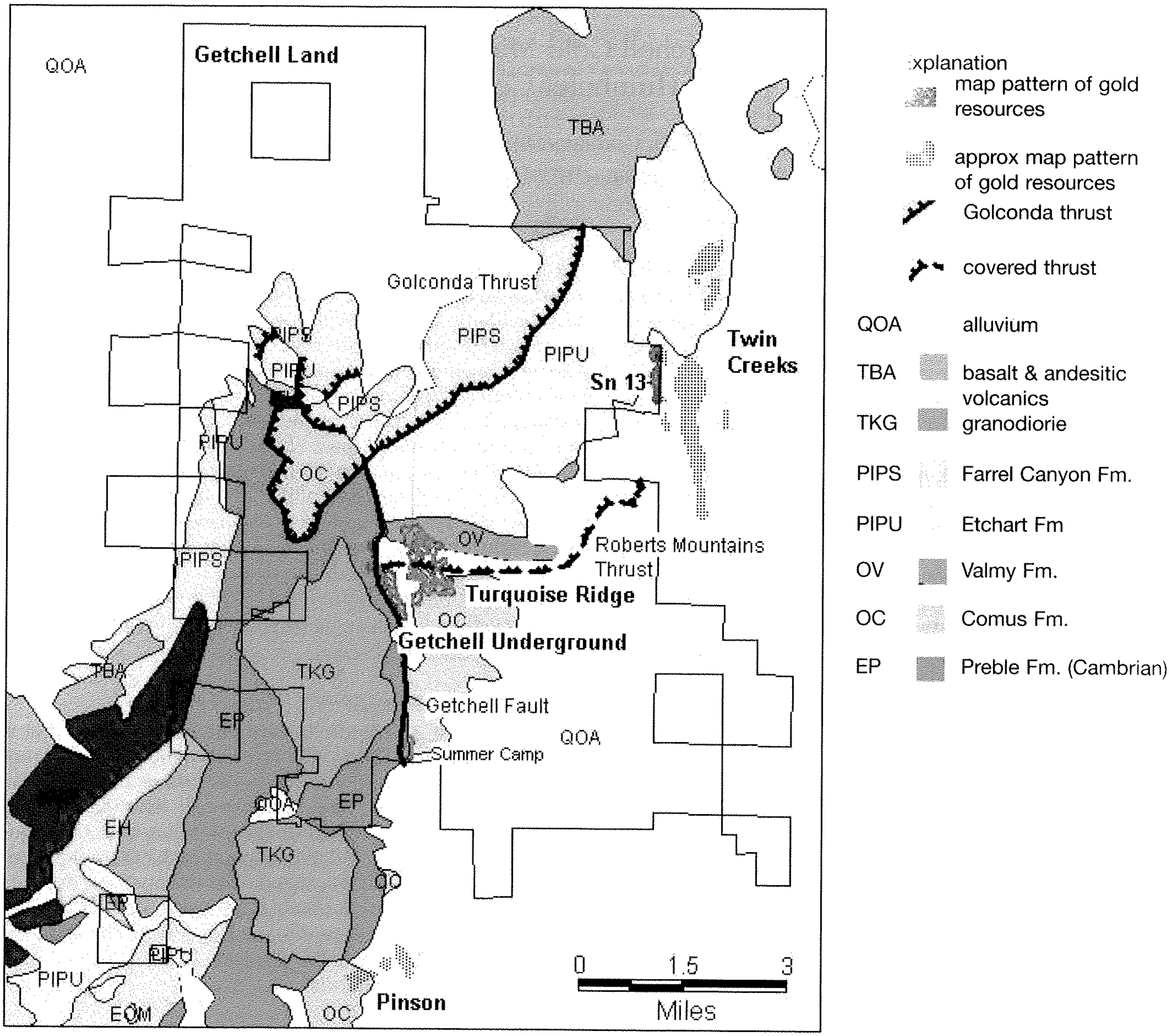

FIG. 1. Regional geology of the Getchell gold mine property.

In 1993, hole 93-160-RC penetrated footwall rocks of the pillow basalt and cut 90.0 ft grading 0.522 opt Au in hornfels mudstones. Subsequent offset and exploration drilling led to the Turquoise Ridge discovery. The Turquoise Ridge mine name was coined on the basis of narrow turquoise veins that cropped out on the hill mined by the open pits. By 1994 the A zone was delineated and a feasibility study was commissioned as exploration drilling continued on the deposit. On positive feasibility, the sinking of shaft 1 started in early 1996. A pilot hole had previously cut narrow gold intercepts (hole 95-094-CO, 15 ft grading 0.296 opt Au). As shaft 1 was sunk, it cut a wide zone of ore-grade gold and the Shaft zone was discovered for later definition. Getchell Gold Corporation continued accelerated exploration of the deposit and expanded resources and reserves in several orebodies, including the A zone and the Shaft zone. As drill results expanded reserves, the production shaft was started by late 1996, underground production and concurrent surface and underground exploration continued to expand the resources and reserves. New discoveries were made by surface drill holes south of the deposit (Powder Hill discovery) and north of the deposit (North zone discovery). Excavation of the production shaft was completed in 1998 and it was put into service by December 1998.

December 1998 announced reserves at the Getchell Property by area are as follows:

In 1998 Getchell Gold Corporation sought a partner in developing and exploring the property. On May 27, 1999, Getchell Gold Corporation and Placer Dome U.S. merged.

In 1999 Getchell Gold Corporation suspended underground production to pursue optimizing the mine and support underground exploration, as surface and underground

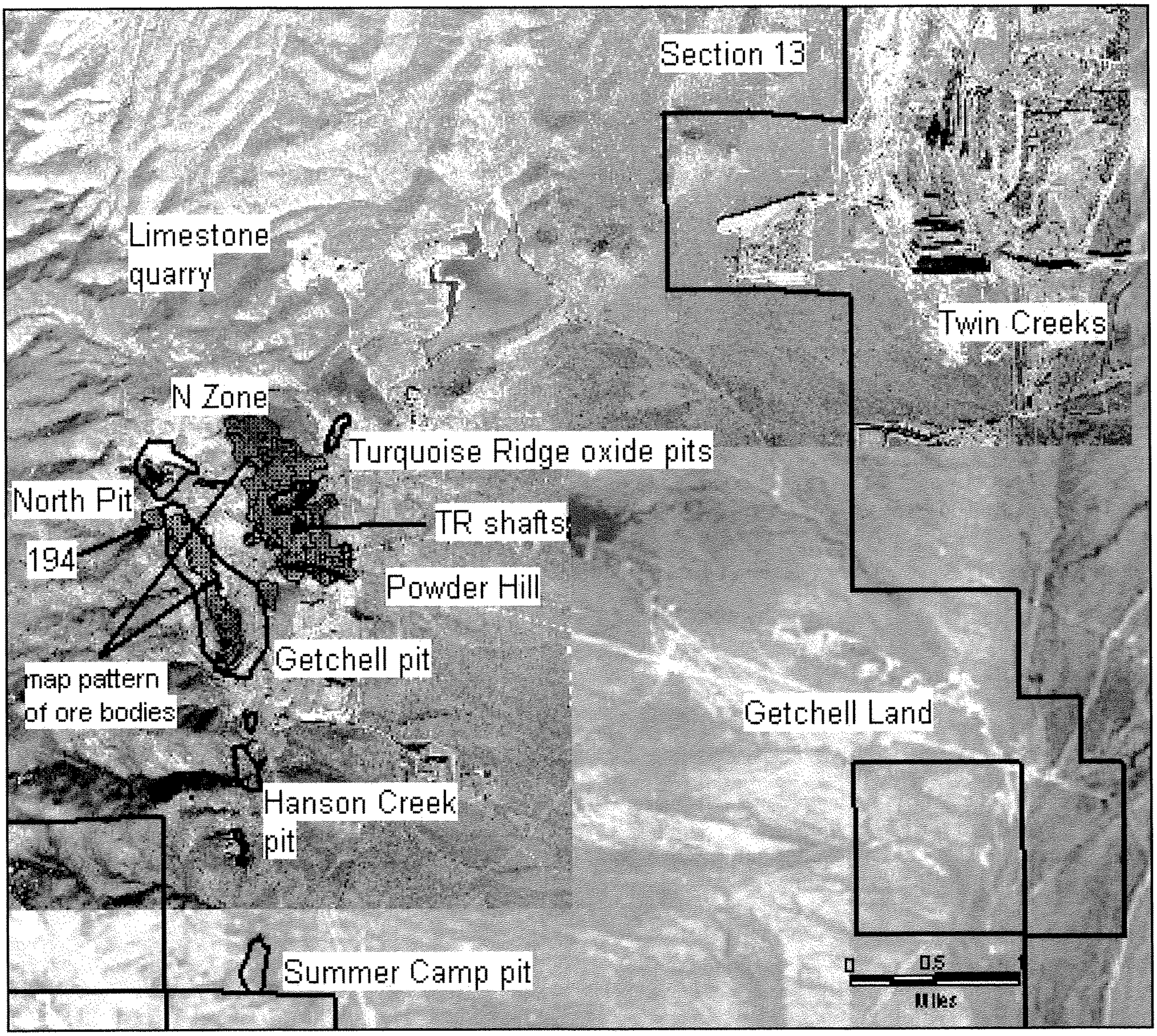

FIG. 2. Geographic index of named sites on the field trip.

exploration continued to delineate and expand the resources in the Turquoise Ridge and Getchell deposits. Turquoise Ridge remains open away from the shafts. Step-out and exploration drilling continue. Exploration drilling now indicates that the southern strike extension of the Turquoise Ridge North zone orebody may extend beneath the A zone and underground mine infrastructure. Underground exploration and development headings are being excavated southward from the shafts to access Powder Hill and northward to access North zone. Surface delineation and exploration drilling to expand the deposit continues. Outlying surface exploration is focusing on discovery of underground deposits elsewhere on the property.

Geologic Setting

The Getchell deposits are sediment-hosted, micron-gold deposits of the Carlin type. Getchell deposits are generally controlled by the intersection of mineralized high- and low-angle faults and favorable stratigraphic units. Mineralized sedimentary units within the Getchell Trend include Cambrian Preble formation, Ordovician Comus and Valmy formations, and Pennsylvanian-Permian Etchart limestones (Fig. 1).

The Osgood Mountains and the Dry Hills formed during Basin-and-Range age extensional faulting. Some of these fault blocks are capped by Miocene andesitic basalt and the volcanic rocks are tectonically tilted and surrounded by Quaternary alluvial gravel-filled, fault-bounded basins. Geologic mapping of the mountain ranges (Hotz and Willden, 1964; Jones, 1991) documents Cambrian through Pennsylvanian-Permian metamorphic and sedimentary rocks, which are cut by Cretaceous stocks. These units are unconformably overlain by the Miocene volcanics. The Cretaceous (92 Ma) Osgood Mountains granodiorite stock (Groff, 1996; Silberman et al., 1974) cores the Osgood Mountains and is exposed within a horst of metamorphic and sedimentary country rocks. The horst in the core of the Osgood Mountains plunges north to the north end of the range.

On the east flank of the Osgood Mountains, in the vicinity of the Getchell and Twin Creeks mines, the rocks, low-angle structures and internal unconformities generally have shallow (15° N) dips and northeast strikes. Major offset of the composite stratigraphic section has occurred only along a few major north-south, northeast and northwest faults (e.g. north-south Getchell fault). Mapped formations (Groff, 1996; Hotz and Willden, 1964; Jones, 1991; compiled and ongoing Placer Dome mapping) include the Cambrian Preble, Ordovician Comus and Valmy, and Pennsylvanian-Permian Etchart limestone (Antler Limestone equivalent), and the allochthonous Goughs Canyon and Farrel Canyon formations. Rocks of the Comus and Valmy are locally juxtaposed by the Roberts Mountain thrust (1999 Placer Dome drill holes).

At a more detailed scale the property geology is more complex. The Osgood stock and other associated poorly exposed and projected blind intrusives (indicated by geophysical survey data) have locally strong and wide contact metamorphic aureoles that overprint metamorphic and sedimentary country rock fabrics. The contact metamorphic aureoles include garnetite and wollastonite gneiss and porphyroblastic schist, porphyroblastic phyllite, phyllite, spotted hornfels, biotite, and chlorite hornfels. In the vicinity of major known gold deposits at Getchell, this contact metamorphic overprint is in turn cut by gold-related hydrothermal alteration assemblages and often well-developed varieties of tectonites. Most gold host rocks are fine-grained sedimentary rocks. Metamorphic, alteration, and tectonic overprints have degraded microfossils, and exact ages and formational correlations and stratigraphic and structural relationships are interpretive and equivocal. This small-scale geologic complexity and questions raised by key drill hole exposures have prompted a geologic remapping campaign over the entire property that is underway and will be reported in the future.

Many of you will be familiar with the published Lower Paleozoic and Mesozoic history of north-central Nevada. Shallow-water carbonate-dominated sedimentary rocks originated on a continental shelf to the east; more siliceous sedimentary rocks (chert, shale, quartzite) to the west are interbedded with mafic volcanics and thinner calcareous units (Hotz and Willden, 1964; Jones, 1991; Groff, 1996). A transitional facies was deposited on the continental slope between the western and eastern facies, perhaps where the Osgood Mountains are now (Hotz and Willden, 1964). This interpretation is consistent with both the depositional style of the sedimentary rocks, and the location of the ($^{87}Sr/^{86}Sr$) = 0.706 isopleth marking the ancient continental margin in this region (Solomon and Taylor, 1989; Groff, 1996).

The Antler orogeny of late Devonian to Early Mississippian time thrust the western siliceous rocks over the eastern carbonate rocks; the transitional facies in the Osgoods may have moved only a short distance or not at all (Hotz and Willden, 1964). Current drill results indicate the Roberts Mountains thrust is locally present, placing Ordovician Valmy formation over Ordovician Comus formation rocks. The exact map and cross section pattern of the Roberts Mountains thrust at the property is one issue being addressed by current mapping and hole logging.

At least three younger orogenic events in the region complicate the geology: the Sonoma orogeny of Late Permian to Early Triassic time: the Sevier orogeny of Late Jurassic to Middle Cretaceous time, and Basin and Range extension beginning in the Cenozoic and continuing to present (Hotz and Willden, 1964; Bloomstein et al., 1991; Jones, 1991; Shigehiro, 1999; Cline and Hofstra, 2000). These orogenies produced the present complex (at a detailed scale) interference pattern of faults and folds, many of which show evidence of multiple deformations, including refolding and recurrent faulting.

Stratigraphy

Getchell gold deposits are within rocks that in the past have been mapped as Cambrian Preble formation, Ordovician Comus formation and Ordovician Valmy formation. Exact and unequivocal correlations among the Preble, Comus, and Valmy rocks are the subject of ongoing interpretation.

Informal mine nomenclature has adopted a lithologic terminology, (Berentsen et. al. 1998) based on the distribution of rock packages within and around the discoveries. Lower sediments are black carbonaceous, siliceous mudstones, and local silty limestone. Overlying the Lower sediments are brown Middle sediments, consisting of biotite hornfels and phyllite mudstone (often calcareous) and limestone (Berentsen et. al., 1998; Shigehiro, 1999). Lower sediments have been correlated with Comus formation and Middle sediments with Preble formation, though these correlations have been questioned (Shigehiro, 1999). The reversed stratigraphy (Cambrian Preble over Ordovician Comus) has been explained either as a thrust or an overturned fold (Shigehiro, 1999). Above the Lower and Middle sediments are basaltic flows and tuffs and interbedded sedimentary rocks including shales, cherts, and quartzites that have been mapped as the Valmy formation (Hotz and Willden, 1964). Current Placer Dome geology is revising this nomenclature and extending the documentation and understanding of the stratigraphy and structure.

From the literature, the Preble formation consists of a lower phyllitic member, a middle calcareous member, and an upper phyllitic member. These are tightly folded with a westward vergence and are evidence that the Preble formation is a regionally metamorphosed package of rocks (Madden-McGuire and Marsh, 1991).

The Comus formation includes calcareous rocks, argillaceous rocks, pillow basalts, and mafic tuffs, and is lithologically distinct from the type locality of Comus (Madden-McGuire and Marsh, 1991). Hotz and Willden (1964) consider the Comus formation to be part of the transitional facies and to be autochthonous; e.g., not moving during the Antler orogeny.

The Valmy formation consists of pillow basalts, radiolarian ribbon cherts, argillites, quartzites, and minor limestones. The Valmy and Comus formations are more or less coeval and were deposited in different portions of the Ordovician basin along the continental margin. The Valmy was thrust over the Comus during the Devonian to early Mississippian Antler orogeny. The contact between the Valmy and Comus is reported by Groff (1996) and Berentsen (1998) to be locally depositional rather than entirely structural. The nature of this contact is not entirely certain and is limited by sparse surface exposures.

Further north, the entire sequence is overlain by the Pennsylvanian-Permian Etchart limestone, which is in both high-angle fault and unconformable contact with the Ordovician sequence.

The allochthonous Farrel Canyon formation (Hotz and Willden, 1964) overlies the Etchart to the north and is unconformably overlain by Miocene volcanics.

The Cretaceous Osgood granodiorite stock and other lithologically similar and presumed correlative stocks have associated pegmatite, aplite, and dacite dikes. There is also a suite of porphyritic andesitic dikes younger than the granodiorite suite (Hotz and Willden, 1964; Gingrich, pers. commun., 1998).

Structure

The structural geology of the Osgood Mountains includes several terranes and subterrranes juxtaposed as a result of translational, compressional, and extensional tectonic movements over time (Jones, 1991). As a result, it is not surprising that faults locally show evidence of reactivation and more than one sense of motion. As with so much of the Basin and Range province, faults can be grouped into domain-related, families of faults as follows.

The mineralized Getchell fault is currently a Basin and Range extensional fault, and has been active at least since the Cretaceous emplacement of the Osgood Mountains stock. The eastern margin of the stock is locally controlled by this fault. Kinematic indicators on the fault show early right-lateral strike-slip motion, rotating through oblique motion to later normal motion (Berentsen et al., 1996; Boskie, 2000). The Getchell fault strikes approximately north to northwest parallel to the range front, dips eastward, and is the dominant structure on the property. Orebodies occur both in the footwall (Getchell main underground) and in the hanging wall (both Getchell main underground and Turquoise Ridge) of the Getchell fault. It is also a master fault to a series of steeply dipping north-striking faults east of and antithetic to it (Berentsen et al., 1998).

Another group of faults strikes northeast and dips steeply northwest, as marked by the Turquoise Ridge fault and fracture zone. Several Turquoise Ridge orebodies are present within and along the fault and nearby parallel faults and fractures. These high-angle normal faults cut the granodiorite stock and offset gold mineralization, indicating reactivation of the fault after gold mineralization (Shigehiro, 1999). There are high-grade portions of the orebodies in the Getchell main pit are at the intersections of these northeast faults with the Getchell fault. However, the northeast faults truncate orebodies in the Getchell underground mine (Tretbar, 2000). These northeast shears accompany a regional set of N 30° E folds and fractures interpreted to date from the Antler orogeny (Berentsen et al., 1996).

A later set of N 35° W folds and faults is interpreted to date from a Jurassic event (Berentsen et al., 1996, 1998). This set, along with the northeast faults, acted as pseudoconjugate faults during later deformation. The intersections of the folds created domes that locally control gold mineralization.

A series of low-angle breccia zones may correlate with thrust faults (Berentsen et al., 1998) or tectonized stratigraphic units. For the most part these do not outcrop; they are known from mine workings and drill holes.

A set of east-west folds, fractures, and minor faults (Boskie, 2000; Tretbar, 2000) truncate and offset some orebodies in the Getchell main underground.

Dacite dikes and sills associated with the granodiorite stock intruded several of the faults and fracture sets. In particular, the low-angle shears and the higher-angle pseudoconjugate northeast and northwest structures (Berentsen et al., 1998) often controlled the intrusion of dikes and sills.

Boskie (2000) documented three folding events that predate most of the surface-exposed faults. The oldest has northerly trending fold hinges. The second has east-trending fold axes, plunging moderately (30°–40°) to the east, and reclined. This generation of folding is better developed and more obvious. The third generation trends northeast to Nnortheast, also plunges moderately, and is upright. Additional work will correlate these folds with regional deformation events.

Gold Ore Deposit Geology

Getchell gold deposits are associated with north-south, northeast and northwest high-angle faults and fracture zones particularly where the mineralized high-angle faults cut across favorable lithologic units and low-angle fault and fracture zones. The best ore grades and continuities are in areas where all these features intersect, particularly in the hinges of northeast- and northwest-trending faulted anticlines. With this array of gold controls, the orebodies resemble the map and cross sectional patterns typical of composite structural and stratigraphic oil traps within oil fields in faulted and folded sedimentary basins.

Gold in the deposits is typically submicroscopic with the best grades associated with very fine grained, auriferous, arsenical pyrite that often grows on barren, premineral pyrite grains (Bowell et.al., 1999; Cline and Hofstra, 2000). Younger realgar and orpiment (see below), for which Getchell is famous, generally carry only trace quantities of gold.

Often, high-grade ores are black and highly carbonaceous with abundant very fine grained pyrite and arsenical (auriferous) pyrite. The arsenical pyrite sometimes exhibits megascopic orthorhombic cross sections and resembles marcasite. Another type of ore-grade material, sometimes loosely described as grey ore, is fault controlled (e.g. Powder Hill orebody at south Turquoise Ridge) and is not associated with carbonaceous alteration.

Turquoise Ridge mine

The Turquoise Ridge deposit includes four main orebodies about 3,500 ft east of the Getchell main pit in a down faulted structural block east of the Getchell fault. From south to north they are Powder Hill, Shaft zone, A zone, and North zone. The mutual geologic relationships among these orebodies continues to be defined as development and exploration drilling continues. The orebodies cluster within a north-dipping (15°) mineralized zone that is now about 3,500 ft long north to south and 2,000 ft wide east to west in plan view, through a vertical range of about 3,000 ft.

Host rocks are correlated with the Comus formation and include mudstone, calcareous mudstone, carbonaceous and calcareous silty limestone, calcarenite and breccia. In addition, some ore-grade intervals are present along mineralized faults that cut interbedded pillow basalt. Dacite and dacite porphyry dikes often control the distribution of ore-grade gold particularly where they are cut by high-angle mineralized faults.

Getchell underground

Getchell underground mine deposits are typically within or very near the Getchell fault. Past open-pit mining developed orebodies within the fault and within its hanging wall and footwall. Underground production and current reserves are in the footwall of the fault in metamorphosed equivalents of the Comus formation. The 194 orebody at the north end of the present Getchell underground workings is about 800 ft into the footwall of the Getchell fault and consists of mineralized breccias at fault and fracture intersections. Cross cutting relationships within the orebody indicate several generations of breccia, the youngest being developed in a cave collapse environment. Cave-fill sediments are not completely lithified and are occasionally ore grade since they include ore-grade fragments that apparently collapsed and were deposited on the cave floor (Tretbar, 2000).

Outlying deposits

Summer Camp, Hansen Creek and Section 13 open-pit resources exhibit similar fault- and fracture-dominated controls with some stratabound components. Summer Camp and Hansen Creek pits have been mined in the past for oxide deposits along the hanging wall of the Getchell fault and along intersecting northeast fracture and fault sets and some low-angle faults. Host rocks are generally tectonized Comus? carbonaceous mudstone and calcareous mudstone that have been strongly silicified after decalcification. Section 13 resources are exposed exclusively in drill holes and are fault controlled with a projected stratabound component in cross section within tectonized mudstone and altered and tectonized siltstone in the Valmy formation.

Gold Mineralization

There have been at least two episodes of gold mineralization (Groff, 1996; Cline and Hofstra, 2000), a minor one after the emplacement of the granodiorite stock around 83 Ma, and the main mineralization much later, during Eocene time. There may have been as many as five mineralizing episodes (Groff, 1996), but only these two contributed substantial gold.

Tretbar (2000) has made a particularly interesting contribution to determining the age of gold deposition. He worked with galkhaite, $(Cs,Tl)(Hg,Cu,Zn)_6(As,Sb)_4S_{12}$, a rare mercury sulfosalt that is found at the Getchell mine. It contains Rb but not Sr, and is therefore a good candidate for Rb/Sr dating. The readiometric age is 39.5 ± 3 Ma from Rb/Sr dating. The notable feature of this date is that it is a direct age of gold deposition, not an upper or lower boundary. Galkhaite contains gold up to 117 ppm, as submicron inclusions or lattice constituents. In addition, it occurs in higher-grade ore, concentrated along ore-waste contacts and structural intersections, and is frequently enclosed within gold-bearing silica. Thus it is part of an ore-forming event, not a preore or postore event.

Gold occurs in two major associations on the property: micron to submicron inclusions in quartz, and chemically held gold in arsenian pyrite (Bowell et al., 1999). The first is common in near-surface ore (especially from the open pits) and in veins; the second in deeper refractory ore. Gold also has been rarely found as discrete free grains in breccias in the Getchell main underground mine (Bowell et al., 1999).

The Turquoise Ridge deposits were formed deeper than the Getchell underground deposits, as well as occurring at greater depth below the present erosion surface (Berentsen et al., 1996; Groff, 1996). Turquoise Ridge and Getchell underground deposits therefore have slightly different mineral paragenesis, fluid compositions, temperature and pressure of formation.

Shigehiro (1999) and Cline and Hofstra (2000) outline the following sequence of alteration and mineralization events synthesized for the property:

Preore fluids associated with the emplacement of the stock dissolved carbonate, preparing the rock for later mineral deposition. The preore fluids deposited quartz-pyrite veins with very low gold. Gold concentations, temperatures and compositions of the mineralizing fluids were highly variable: (120° to >360°C; 1% to 21 wt % NaCl equiv).

Main ore-stage fluids contain CO_2, allowing them to continue to dissolve carbonate in host rock, and H_2S, allowing them to transport gold. These fluids had moderate salinity and temperature (180°–220°C; 4–5 wt% NaCl equiv), with a pressure of around 330 bar (corresponding to >1.2 km depth). Reactions between sulfur in the fluids and iron in the host rock caused gold-bearing pyrite to precipitate in the prepared pore spaces. The range in isotopic values in ore-stage fluids imply that they are not purely magmatic, but have a deep metamorphic and/or magmatic origin, variably diluted with evolved meteoric fluid.

Cline and Hofstra (2000) suggest that the main ore stage was the mid-Tertiary event, significantly separated in time from the preore ground-preparation event. Later ore-stage fluids did not react with host rock as extensively; instead, coarse realgar and calcite precipitated in open space in response to cooling. These fluids had temperatures of 115°–155°C, with salinity similar to the main ore-stage fluid; they had less CO_2 than the main ore-stage fluid. Stable-isotope composition implies that late ore-stage fluid was diluted with variably exchanged meteoric water (Cline and Hofstra, 2000).

A postore event deposited coarse calcite in open fractures, probably from much later meteoric water.

The Getchell property is famous for its arsenic sulfides. Orpiment grew late in the main-ore stage, probably as it was cooling. Realgar grew in the late-ore stage, after orpiment (Groff, 1996; Shigehiro, 1999; Cline and Hofstra, 2000).

A feature of the Getchell deposits that is not yet fully incorporated into this geochemical picture is the strong spatial association between gold and hydrocarbons (Berentsen et al, 1996).

Conclusions

The Getchell mine history dates back to the 1930s and included sulfide and oxide gold ore production from several open pits.

Underground gold deposits were discovered and partially developed beginning in 1996 beneath Getchell open-pit orebodies. Drilling beneath oxide pits to the east lead to the discovery of the Turquoise Ridge underground deposit in 1994, which was explored and initially developed with two shafts by 1998.

Placer Dome merged with Getchell Gold Corporation in May of 1999 and curtailed production to optimize the property under low gold price market conditions. Placer Dome initiated an aggressive exploration program to expand reserves and resources and discover additional large scale deposits in outlying areas on the property. The program continues.

Getchell deposits are micron-gold, sediment-hosted, Carlin-type deposits.

Host rocks are Cambrian and Ordovician limestones, calcareous mudstones, and metamorphic equivalents. Microfossil evidence has been degraded, and correlations with the Preble and Comus formations are as yet based on regional lithologic similarities. Remapping and the search for definitive microfossils is ongoing.

Gold deposits are controlled by the intersections of faults and folds (structural conduits and traps) with favorable host lithologies as above.

Getchell's complex structural history results in complex ore geometry.

Fluids associated with Cretaceous intrusions prepared the rocks for ore deposition.

Later mineralizing fluids deposited Au together with Fe, and As in arsenian pyrite. The same event deposited Au encapsulated in quartz.

Work in progress is aimed at unraveling the age and correlations of the host rocks, better defining the structural history of ore deposition and identifying new orebodies you will learn about on your next field trip to Getchell.

REFERENCES

Berentsen, E.J., Nanna, R.F., Hazlitt, J.S., and Estes, L.D., 1996, Discovery and geology of the Turquoise Ridge gold deposit: Mining Engineering, v. 48, p. 31–35.

Berentsen, E.J., Nanna, R.F., Gingrich, M.K., and Estes, L.D., 1998, Geology and gold mineralization at the Turquoise Ridge project, Humboldt County, Nevada: Getchell Gold Corporation internal report, 15 p.

Bloomstein, E.I., Massingill, G.L., Parratt, R.L., and Peltonen, D.R., 1991, Discovery, geology, and mineralization of the Rabbit Creek gold deposit, Humboldt County, Nevada: Geology and ore deposits of the Great Basin, Geological Society of Nevada, p. 821–843.

Boskie, R., 2000, Preliminary results of detailed structural studies along the Getchell trend: 1999 year-end CREG report (unpublished), Reno, Nevada, Mackay School of Mines, 33 p.

Bowell, R.J., Baumann, M., Gingrich, M., Tretbar, D., Perkins, W.F., and Fisher, P.C., 1999, The occurrence of gold at the Getchell mine, Nevada: Journal of Geochemical Exploration, v. 67, p. 127–143.

Cline, J.S., and Hofstra, A.J., 2000, Ore fluid evolution at the Getchell Carlin-type gold deposit, Nevada, USA: European Journal of Mineralogy, v. 12, p. 195–212.

Groff, J., 1996, $^{40}Ar/^{39}Ar$ geochronology of gold mineralization and origin of auriferous fluids for the Getchell and Twin Creeks mines, Humboldt County, Nevada: Unpublished Ph.D. dissertation, New Mexico Institute of Mining and Technology, 290 p.

Hotz, P.E., and Willden, R., 1964, Geology and mineral deposits of the Osgood Mountains Quadrangle, Humboldt County, Nevada: U.S. Geological Survey Professional Paper 431, 128 p.

Jones, A.E., 1991, Tectonic Significance of Paleozoic and Early Mesozoic Terrane Accretion in Northern Nevada: Ph.D. dissertation, Berkeley, University of California. 256 p.

Madden-McGuire, D.J., and Marsh, S.P., 1991, Lower Paleozoic host rocks in the Getchell gold belt: Several distinct allochthons or a sequence of continuous sedimentation?: Geology, v. 19, p. 489–492.

Shigehiro, M., 1999, Mineral paragenesis and ore fluids at the Turquoise Ridge gold deposit, Nevada: Unpublished M.S. thesis, Las Vegas, University of Nevada, 151 p.

Silberman, M.L., Berger, B.R., and Koski, R.A., 1974, K-Ar age relations of granodiorite emplacement and W and Au mineralization near Getchell mine, Humboldt County, Nevada: Economic Geology, v. 69, p. 646–656.

Solomon, G.C., and Taylor, H.P., 1989, Isotopic evidence for the origin of Mesozoic and Cenozoic granite plutons in the northern Great Basin: Geology, v. 17, p. 591–594.

Tretbar, D.R., 2000, Controls on gold deposition in the 194 orebody, a collapse breccia in the Getchell Mine, Humboldt County, Nevada: 1999 year-end CREG report (unpublished), Reno, Nevada, Mackay School of Mines, 52 p.

Willden, R. 1964, Geology and mineral deposits of Humboldt County, Nevada: Nevada Bureau of Mines and Geology Bulletin 58.