CHAPTER 6
CENTRAL SLIDE MOUNTAIN TERRANE
BARKERVILLE GOLD CAMP

INTRODUCTION

The Barkerville gold camp in east-central British Columbia (Figure 6.1) is historically the largest placer gold-producing district in the province. Conservative estimates place placer gold production at 4 million ounces (124 tonnes; Schroeter and Lane, 1991). The initial discovery of gold on Lightning and Williams Creeks in 1861 is attributed to Billy Barker after whom the historic town of Barkerville is named. Gold-quartz veins were identified in the area shortly after the discovery of placer gold in 1861 but did not attract much attention until the yield of alluvial gold began to seriously diminish in 1875-76 (Johnston and Uglow, 1926). From this period many repeated unsuccessful attempts were made to profitably mine the veins. It was not until 1933 that profitable mining was initiated and attributed to the enthusiasm and persistent endeavor of Fred M. Wells (Skerl, 1948), presumably the namesake of the local community of Wells. Schroeter and Pinsent (2000) report that the total lode gold produced from the camp is 38,321,529 grams (1,226,289 ounces).

Placer gold in the camp occurs in the same area as two distinct styles of lode gold mineralization: massive pyritic lenses referred to as ‘replacement ore’ and gold-quartz veins. In both deposit types native gold occurs as fine blebs and fracture fillings in pyrite but the gold in the bedrock deposits is not similar to the coarse nugget gold historically recovered from placers. This disparity between the textural style of free, coarse gold found in the placers compared to the predominantly fine flour gold found in lodes was recognized in early studies of the camp (Johnston and Uglow, 1926):

page 224, “The occurrence of large amounts of coarse, nuggety gold, gold crystals, and mammillary gold in the placers and the apparent general absence of coarse gold in the auriferous veins of Barkerville area are the main apparent difficulties in the way of accepting the view that the placer gold is detrital.

page 216, “There can be little doubt, therefore, that the gold of the placers was derived from the auriferous quartz veins, the main problem being to determine how the placer gold could have been derived from quartz veins of such character as those found in the Barkerville area”.

In an attempt to explain this enigma, these authors proposed that the increased grain size of the placer gold resulted from oxidation and dissolution of gold in the quartz veins, followed by its redeposition in placer gravels near the base of the zone of oxidation. Eyles and Kocsis (1988) proposed a mechanism of supergene reprecipitation to account for the increased size of the placer grains. They suggested that gold in quartz veins was affected by deep, tropical weathering in the Tertiary and was concentrated in the near-surface environment by supergene enrichment. Knight and McTaggart (1989) analyzed fine-grained gold from both lodes and placers and demonstrated that the composition of the two gold types is more or less the same, indicating that supergene enrichment, which should have produced pure or near-pure gold, was not the operative process. They offered no alternative explanation.

In this chapter we discuss the regional geological setting of the Cariboo-Barkerville area and relate characteristics of the individual deposit types to the regional tectonic framework. We present an alternative view for the source of the coarse, nugget gold in the placers, and offer an explanation for the difference in its physical character in contrast to that found in associated lodes. Aspects of the regional geology and deposit characteristics are extracted primarily from published sources. Refinements for the lithotectonic setting of the Barkerville area and related lode gold deposits are introduced.

PREVIOUS WORK

The regional geology of the Cariboo area has been documented by Struik (1981, 1986, 1988a,b). Published descriptions of the camp geology and associated lode gold deposits include those of Johnston and Uglow (1926), Hanson (1935), Skerl (1948) and Sutherland Brown (1957). Later studies have focused largely on the Mosquito Creek mine (Andrew, 1982; Andrew et al., 1983; Alldrick, 1983; Robert and Taylor, 1989). More recent deposit studies focused on comparing the geochemical signatures of the individual deposits (Ray et al., 2001) and characterizing the nature of the vein fluids (Dunne and Ray, 2001).

The placer geology of the camp was initially described by Bowman (1889, 1895) and has more recently been studied by Levson and Giles (1993).

GEOLOGICAL SETTING

The Barkerville Camp consists of deformed and variably metamorphosed Proterozoic to late Paleozoic continental slope and rise sedimentary rocks that are tectonically overlain by a relatively undeformed, flat-lying imbricated succession of late Paleozoic ophiolitic assemblage rocks (Figure 6.2). The underlying North American strata comprise late Proterozoic to Paleozoic Barkerville (Kootenay) and Cariboo (Cassiar) terranes (Struik, 1988a). Variably metamorphosed, deformed and folded clastic sedimentary rocks dominate both these terranes. The Cariboo Terrane has two main subdivisions: a lower sequence of Proterozoic and Cambrian grit, limestone, sandstone and shale and an
Figure 6.1. Regional geological setting of the Cariboo placer gold camp (after Wheeler and Mcfeely, 1991).
unconformably overlying sequence of basinal shale, dolostone, wacke and limestone. Barkerville Terrane rocks, which host the majority of the lode-gold occurrences in the region, are generally of higher metamorphic grade and are dominated by variably metamorphosed, commonly schistose varieties of grit, quartzite, pelite and subordinate limestone.

Sutherland Brown (1957) describes the structure of these bedded sediments as being closely compressed into north westerly-trending, complex folds that are overturned to the southwest and plunge at shallow angles to the northwest. Within the Barkerville camp he defines the Snowshoe synclinorium which is flanked by the Island Mountain and Cunningham anticlinoria to the west and east respectively. Metamorphosed limy shales and siliceous mudstones that comprise black siliceous phyllite, slate, argillite and limestone in the Island Mountain anticlinorium are the primary hostrocks for lode gold deposits.

Ophiolitic rocks of the central Slide Mountain Terrane consist of two lithotectonic elements in the Cariboo area (Figure 6.2). The larger bodies are to the immediate east of the Barkerville camp. Twenty kilometres west of the camp, the Crooked amphibolite (Struik, 1986; Panteleyev et al., 1996) occurs as relatively thin, discontinuous tectonic slices of ultramafic and mafic volcanic rocks along the Eureka thrust fault. This is a west-dipping structure that separates

\*Use of the term Antler assemblage as opposed to Antler Formation is suggested using the rationale discussed in Chapter 1.
Figure 6.3. Simplified geology of the Wells area, from Alldrick (1983) as modified after Struik (1982).

Quesnel arc volcanic and derived sedimentary rocks in the hangingwall to the west, from footwall North American rocks of the Barkerville subterrane (Struik, 1986).

East of Barkerville, Slide Mountain Terrane rocks are locally assigned to the Antler assemblage* and comprise a series of internally imbricated early Mississippian to Early Permian oceanic crustal volcanic and pelagic sedimentary rocks, which sit structurally above displaced North American rocks of both the Barkerville and Cariboo terranes along the Pundata thrust (Struik, 1981). Struik and Orchard (1985) have established from fossil evidence that at least three thrust imbricates are present within the overlying Antler ophiolitic assemblage. Ophiolitic rocks are dominated by metabasalt and pelagic sediments with lesser mafic plutonic and ultramafic rocks. Sedimentary units commonly include interbedded chert and argillite with lesser slate and greywacke (Sutherland Brown, 1957; Struik, 1986, 1988a, b). Struik (1988a) has correlated the Crooked amphibolite with the Antler assemblage and suggests that both the Pundata and Eureka thrust faults are most likely part of a continuous structure now separated by erosion (Figure 6.2). This interpretation is consistent with that of earlier workers. Hodgson et al. (1982) write:

“...in the Cariboo Camp Sutherland Brown (1957) has suggested that the outcrop of Slide Mountain to the east of the camp is the erosional remnant of a thrust slice which was transported from the west, which suggests that Slide Mountain volcanic rocks may have been present structurally not far above the Cariboo deposits at the time they formed.”

Similar tectonic relationships in which Antler ophiolitic assemblage rocks form klippen on areas of high ground to the west of, and locally within the camp is considered highly likely. The strongest case can be made for the amphibolite unit capping Island Mountain, 2 kilometres west of and structurally above sedimentary host rocks of the Mosquito Creek mine (Figures 6.2 and 6.3; Photo 6.1). At this location the amphibolite forms a well-defined klippe that truncates steeply folded bedding in the underlying sedimentary rocks (Alldrick, 1983 and personal communication 2000). Struik (1982, 1988a) called this unit the Island Mountain amphibolite and designated it to be part of the upper Paleozoic Snowshoe Group of the Barkerville Terrane, however an alternate correlation with the Crooked Amphibolite was also considered a possibility. Amphibolite is lithologically distinct from local Barkerville rocks which consist almost entirely of metasediments. This amphibolite is, however, directly correlative with metamorphosed igneous lithologies of Slide Mountain ophiolitic crustal rocks.

The suggestion that the Island Mountain amphibolite is metamorphosed Slide Mountain Terrane is further supported by comparable structural settings of the amphibolite units and Antler ophiolitic rocks east and north of the camp.

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* Antler assemblage refers to a tectonic assemblage characterized by the presence of ophiolitic rocks and associated sediments.
In a regional context the footwall contact of the amphibolite and the trace of the Eureka thrust appear to be part of the same shallowly northward-dipping, terrane bounding suture. The dip of the structure is also consistent with the shallow northwest plunge of major folds in the underlying deformed metasedimentary rocks (Sutherland Brown, 1957).

Immediately northwest of the camp listwanite alteration at Mount Tom is associated with the amphibolite (Struik, 1988a) (Figure 6.4). The lithotectonic setting of the listwanite is consistent with that of the nearby Antler assemblage rocks and suggests the outcrop is an altered remnant of this unit, within and possibly above the Pundata-Eureka thrust. It is also significant that this rare remnant of the carbonate altered hangingwall is directly on trend with the Barkerville gold belt.

Recently obtained petrochemical data for the amphibolite unit on Island Mountain (Ray et al., 2001) supports the above contention. These rocks have a compositional range consistent with that of tholeiitic ocean-floor basalts which is consistent with the distinctive abyssal character of Slide Mountain Terrane ophiolitic rocks in general (see Chapter 1).

This reinterpretation of the Island Mountain amphibolite places the position of the terrane collisional suture directly above the known zone of lode gold mineralization. It also suggests this thrust contact originally was above areas of historic placer gold creeks, which now occur in erosional windows through this flat-lying terrane-bounding suture zone (Figure 6.2).

**LODE GOLD DEPOSITS**

Lode gold has been recovered from two distinctive styles of mineralization in the Barkerville camp: gold-quartz veins and massive pyritic lenses. In both deposit types gold occurs primarily as fine disseminations and as fracture fillings in pyrite. Although free gold has been documented (Skerl, 1948) it is not common and usually occurs erratically as fine particles. Both styles of gold mineralization are intimately associated and occur within a narrow northwest-trending belt along the high ground on the east-facing slope of Pleasant Valley. Both styles of gold mineralization are confined to metamorphosed sedimentary rocks of the Barkerville Terrane and are hosted within an overturned anticline of the Snowshoe Group, immediately below the Pundata thrust fault.

Hanson (1935) introduced the term ‘Barkerville Gold Belt’ to describe this zone of intermittent mineralization which he defines as being less than 1.5 kilometres wide and extending over a distance of 15 kilometres. Gold has been mined from both the Cariboo Gold Quartz and Mosquito Creek (formerly Island Mountain) mines. Skerl (1948) described these deposits as consisting of numerous small, steeply inclined north trending quartz veins grouped into various zones, each of which is centered on a north-south fault. Massive pyritic lenses occur together with the veins...
and are arranged like wings on each side of veins where they pass through carbonate horizons (Skerl, 1948; Sutherland Brown, 1957). The mined zone has a vertical extent of around 300 metres but veins are developed intermittently along a northwesterly-trending ridge for over 5 kilometres. A projected east-west section (Figure 6.5) shows the restricted vertical extent of ore and clearly mimics the redefined position of the Pundata-Eureka thrust fault. In some of the zones the amount of gold mined and estimated to be present was recognized to steadily diminish with depth. In the No. 3 zone, for example, a gold content of 933 kilograms (30 000 ounces) at the top level diminished down to 187 kilograms (6000 ounces) in the bottom level. Similarly in zone No. 4 the ore grade was better than average near surface but dwindled down to non-economic amounts at 120 metres below the surface.

The following deposit descriptions are summarized primarily from Skerl (1948) and Sutherland Brown (1957).

**GOLD-QUARTZ VEINS**

Most quartz veins are steep to vertical and generally less than 50 centimetres wide, however, veins up to several metres in width are not uncommon. Stopes consist of many sub-parallel veins and averaged from 15 to 60 metres in width. Ankerite is present in many veins and is a dominant alteration mineral in the calcareous wall rocks, whereas alteration of slate is commonly limited to disseminated euhedral pyrite. Veins of economic grade contain considerable pyrite which is the host to most of the gold. Skerl (1948) reported that the veins contain from 5 to 15% pyrite. Sutherland Brown (1957) indicates a somewhat higher value of 15 to 25% pyrite for “ore grade” with veins assaying from 30 to 60 g/t (1 to 2 oz/ton) gold. Pyrite is either the only sulphide mineral or is the dominant sulphide in association with minor galena, sphalerite, schelite, pyrrhotite, arsenopyrite, chalcopyrite and lead bismuth sulphides. Pyrite forms scattered euhedral disseminations or occurs as streaks (ribboned structures) along the margins or in the center of quartz veins. Visible gold occurs as fine particles and is erratically distributed throughout the veins. Skerl (1948) reports that free gold at the Cariboo Gold Quartz mine was mainly associated with hair-like crystals of the lead and bismuth sulphide cosalite (2PbS, Bi₂S₃) and less commonly with more massive galeno-bismutite (PbS, Bi₂S₃).

**AURIFEROUS PYRITIC LENSES**

Due to uncertainty as to the origin of these deposits a more descriptive and less generic term is adopted to describe the massive pyritic lenses. The auriferous lenses were first described in 1933 (Hanson 1935) as stratabound, being restricted to the Snowshoe limestone between the Baker and underlying Rainbow members of the Barkerville Terrane. The shape of these lenses range from tabular to cylindrical depending on the folded character of the altered sedimentary host rocks.
Pyritic ore lenses are massive to semi-massive with associated fine-grained gold. Free gold, or lead and bismuth minerals have not been found in the massive pyritic lenses. Lenses can be as much as several hundred metres long by several metres in cross-section. The grain size within the massive crystalline sulphides is variable and generally the finer-grained the better the gold grade. Finer-grained pyrite may contain gold values up to 170 g/t (5 oz/ton) whereas the coarser ore, greater than 0.7 millimetres, has comparatively low gold content around 3.5 g/t (0.10 oz/ton).

Lenses are commonly enveloped by coarse grey ankerite in which pyrite is sporadic and coarser-grained relative to that in the massive pyrite zones. Within these ankeritic envelopes minor galena, sphalerite and scheelite can be present. Quartz is not normally identified within the pyritic lenses but bands of ankerite are common.

The auriferous pyritic lenses were considered by most workers to have formed by hydrothermal replacement of limestone during the mineralizing event that produced the gold-quartz veins and were referred to as “pyritic replacements” (Hanson, 1935), or “replacement ore” (Skerl, 1948; Sutherland Brown 1957; Alldrick, 1983). Structural mapping (Robert and Taylor, 1989; Robert, 1996), suggests that the massive pyritic ore was deformed prior to formation of the gold quartz veins and is therefore considered earlier. However, the geometry and overall distribution of the ‘wings’ of massive pyrite on the sides of veins in preferred calacareous lithologies, tends to favor a hydrothermal replacement origin contemporaneous with quartz vein development. If the sulphide lenses were primary there would be some degree of randomness in the distribution of the lenses. In addition, the ankerite alteration envelopes surrounding the tails of the pyritic lenses where they peter out appear to represent a hydrothermal front diminishing away from the fluid conduit (current vein). Sulphide replacement of the limestone may have preserved a pre-existing structural fabric during metasomatism. Detailed examination of metal content and alteration mineralogy in both the massive pyritic lenses and quartz veins might shed light on their origin.

**AGE OF MINERALIZATION AND RELATIONSHIP TO TECTONISM**

Current constraints for the timing of gold-quartz vein mineralization in the Barkerville camp is provided by two independent conventional K-Ar isotopic age dates on sericite obtained from quartz-carbonate-sericite vein material at the Mosquito Creek mine. Alldrick (1983) reported an age 139±5 Ma which is coeval with a 141±5 Ma date provided by Andrew et al. (1983). This apparent Early Cretaceous age is considerably younger, by at least 30 Ma than the period of Middle Jurassic tectonism (Figure 6.6).

The timing of obduction of the oceanic Antler assemblage onto the North American margin is not well constrained as discussed in the first chapter. Evidence of the regionally well-defined Middle Jurassic tectonic event (Murphy et al., 1995) is indicated by metamorphic ages (Figure 6.6). Metamorphic sphene in Barkerville Terrane orthogneiss to the south-southeast of the camp has been dated by U-Pb at 174±4 Ma (Mortensen et al., 1986). A K-Ar metamorphic whole-rock age on phyllite is coeval with the sphene age at 179±8 Ma (Andrew et al., 1983). The Ste. Marie pluton north-northwest of the camp (Figure 6.1) is an undeformed multiphase intrusion which has been dated by U-Pb zircon methods at 167±2 Ma and is interpreted to pierce the Eureka thrust fault at depth (Struik et al., 1992). This Middle Jurassic intrusive date therefore provides a minimum age for the development of the
terranebounding suture. However, as indicated in Figure 6.6, and discussed elsewhere, it is considered more likely that the Slide Mountain Terrane was obducted onto the North American margin in Late Permain to Early Triassic time. It is possible that earlier obducted ophiolitic Slide Mountain rocks and underlying continental margin rocks underwent fore-arc extension during middle to Late Triassic subduction. This resulted in the development of Quesnellia arc volcanic complexes and deposition of regionally extensive basinal shale sequences. This basin then collapsed during regionally extensive Middle Jurassic orogenic activity.

ASSOCIATED FELSIC INTRUSIONS

No major plutons occur locally in the area of the Barkerville gold camp, however, a suite of intensely carbonate-altered felsic dikes, referred to as the ‘Proserpine dikes’, occur throughout the camp (Johnston and Uglow, 1926; Sutherland Brown, 1957; Struik, 1988a). These dikes are exposed in prospect trenches and underground workings, commonly in association with gold-quartz veins, and in some instances altered dikes host the veins. Johnston and Uglow (1926, page 15) described these dikes:

“...A large number of brownish weathering sills and a few dykes occur cutting the various members of the Cariboo series. They are usually not more than a few feet thick but in two or three places a thickness of 30 or 40 feet was observed. Owing to the covering of glacial drift and vegetation it was impossible to follow them along their strike, except for a very short distance. Quartz porphyry, felsite, aplite, and quartz trachyte are prevalent types. Their outcrops are characteristically iron-stained, due to the oxidation of disseminated pyrite and siderite. Since they occur to a very large extent as sills and since the intruded rocks are equally oxidized in most cases, their outcrops and boundaries are not very clearly delineated. A noteworthy characteristic of almost all of these intrusives is their irregular spotty replacement by siderite; and it is largely due to the oxidation of this mineral that they owe their typical brownish colour. In many cases, as at the Waverly pit just mentioned, the felsite is so completely replaced by siderite that specimens of it closely resemble ferriferous crystalline limestone. Many of the sills are seamed with a network of quartz veins, some of which carry iron and lead sulphides with gold values.”

and Sutherland Brown (1957):

“...The Proserpine dikes are felsites that in general are so ankeritized that they weather a characteristic reddish-brown. They are usually aphanitic but may be microporphyritic. No dike is fresh; most are highly ankeritized, and many are schistose. Commonly the dikes and their adjacent wall rocks are so highly ankeritized it is difficult to distinguish one from the other in the field. The feldspars are highly sericitized and the mafic minerals entirely altered. The original fine-grained texture has been largely obliterated by the development of large ankerite porphyroblasts and by muscovite or fuchsite, and quartz, and are indistinguishable from similar altered sedimentary rocks.”

These dikes as described, are comparable to dikes associated with gold-quartz veins at the Atlin, Bralorne and Fort St. James areas. Analogous features include; post-dating deformation, high level porphyritic textures, carbonate-sericite-pyrite alteration and locally elevated gold values. Isotopic dating of both primary magmatic and secondary alteration minerals from the dikes would clarify geological relationships. A genetic association between dikes and the gold veins is considered likely as has been previously suggested by Johnston and Uglow (1926):

“The mineralization of the veins, including the formation of the gold, cannot be definitely attributed to the effect of any observed petrological agent, but the mineralogy and structure of the deposits suggests that the metallic minerals owe their origin to emanations from intrusive rocks, whose location is inferred to be at comparatively short depths below the lowest exposed member of the Richfield formation, and of whose presence there the Proserpine quartz porphyry sills may be a manifestation.”

SOURCE OF PLACER GOLD

Gold in the Barkerville lode deposits is fine-grained compared to the coarse gold typical of the coincident Cariboo placer deposits. A suggestion offered here is that the coarse placer gold was derived from Slide Mountain
ophiolitic crustal rocks which had previously structurally overlain Barkerville rocks, similar to the geological setting to the immediate northeast of Barkerville (Struik, 1988a, Figure 6.3).

The type of gold-quartz vein mineralization in accreted oceanic rocks (pre-existing Slide Mountain rocks) are more likely to have generated the coarse, nugget gold as these rocks are characteristically hosts for this style of gold deposit elsewhere in the North American Cordillera.

Additional but indirect support for a gold source somewhere close to and structurally above the present topographic surface is provided by the physical character of the nuggets and their erratic distribution.

"The source of placer gold in Upper Antler Creek and its erratic distribution have been questions in dispute ever since the early discoveries." (Johnston and Uglow, 1926, page 59).

"An especially puzzling feature in the distribution of the placer gold on Upper Antler Creek is the fact that the rich pay streak commenced abruptly near the mouth of Victoria Creek and although diligent search has been made for its continuation in upper parts of the Creek and its tributaries, no gold lead at all comparable to it in richness has been found." (Johnston and Uglow, 1926, page 60).

"Many of the nuggets, also, are too large to be transported any great distance by streams, and it is probable that they have moved vertically downward nearly as far as they have been transported horizontally."

**SUMMARY**

Placer gold in the Barkerville camp occurs within an erosional window through a collisional suture zone that has emplaced Slide Mountain ophiolitic assemblage rocks onto deformed continental rise and slope sediments of the ancestral North American margin. This structure is regarded to be the transcristal suture that acted as a conduit or structural trap for the mineralizing fluids. Such a fault zone is fundamental to the development of gold-quartz vein deposits, previously thought to be uncharacteristically absent in this area (Robert and Taylor, 1989). In this respect, the concentration of placer gold can be regarded to be primarily the result of mechanical rather than chemical processes.

Lode gold mineralization in the Barkerville camp is hosted in metasedimentary rocks that form the footwall below the collisional suture zone. The laterally extensive, steeply dipping veined zones exhibit a limited vertical range of mineralization.

Differences in the physical character of placer gold compared to that in the lodes is attributed to differences between the hostrocks of the veins that determined the styles of vein mineralization. Veins hosted by footwall metasedimentary rocks below the pre-existing suture zone contain fine gold. It is inferred that ophiolitic rocks in and above the eroded suture carried coarse free gold that is characteristic of that found in the placers.

The observed spatial association of the co-structural, hydrothermally altered Proserpine felsic dikes with gold quartz veins suggests the two might be genetically related (Johnston and Uglow, 1926). The age of these dikes is unknown. Both late Early Cretaceous and Middle Jurassic plutonic rocks are known to occur regionally. One, or both, of these magmatic episodes may be related to Proserpine diking. Age determinations for both the magma crystallization (U-Pb zircon) and alteration (Ar-Ar sericite) of these dikes would help define possible temporal relationships between magmatism and gold mineralization.

A re-examination of rocks at the summit of Island Mountain, as well as other summits in the camp, may prove valuable in further constraining regional tectono-stratigraphic relationships. These would help broaden the regional exploration potential for similar styles of gold beyond the limits of the Barkerville camp.