THE BRITISH COLUMBIA SEDIMENT-HOSTED GOLD PROJECT

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INTRODUCTION

In 1997 the British Columbia Geological Survey (BCGS) initiated a project to identify prospective areas for sediment-hosted gold mineralization. The inspiration for the project came from presentations and articles by Howard Poulsen of the Geological Survey of Canada (1996a, 1996b). He pointed out that there is potential to find hypogene, sediment-hosted gold mineralization in Canada akin to deposits found in Nevada. He mentioned that if an intrusive association is important to generate the mineralization, then two different geological environments might host this style of mineralization. Accreted terranes with a basement containing carbonate lithologies intruded by Mesozoic or Cenozoic plutonism would be a prospective geological setting, specifically the Stikine and Quesnel terranes. The second favourable environment is within the sediments deposited along the continental margin of ancestral North America which have been cut by Mesozoic magmas, such as are found in the Kootenay Arc and Selwyn Basin (Figure 1).

Others have considered British Columbia as prospective territory for sediment-hosted gold. Early work by companies focused on the Insular Belt rocks exposed on Vancouver Island and the Queen Charlottes. These exploration programs were based largely on an epithermal-style model for the mineralization which was in favour at the time. The discovery of the Babe deposit (now called the Specogna or Cinola) in the Queen Charlotte Islands in 1970 increased the interest in this model because it was initially identified as a Carlin-type deposit (Richards *et al*., 1976; Champigny and Sinclair, 1982). Subsequent

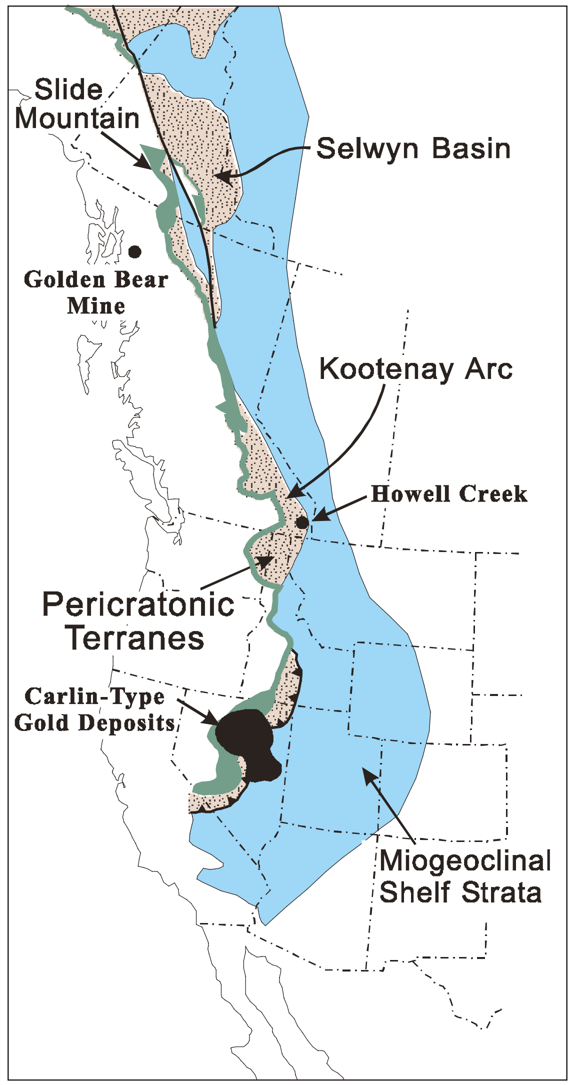

Figure 1. Map of western North America showing the sedimentary rocks deposited along the ancestral continental margin and the accreted terranes to the west (derived from Poulsen, 1996b). The Slide Mountain terrain consists of miogeoclinal sediments.

work showed that the Babe is a classic hot spring deposit and although some jasperoid occurrences were discovered on the Queen Charlottes, these programs did not result in any major sediment-hosted gold discoveries (Lefebure, 1998). Also in the early 1970s, Harry Warren of the

University of British Columbia became interested in exploring for Carlin-Cortez type deposits in the province (Warren and Hajek, 1973). He made the prophetic statement that the initiation of gold production at the Carlin deposit might prove to be as important a milestone for gold production as the first exploitation of a copper porphyry deposit was for copper.

A number of companies have carried out reconnaissance programs for sediment-hosted gold in British Columbia; but these are not part of the public record. In the early 1980s, Chevron searched for Carlin-type deposits in the Stikine terrane in the northwestern part of the province and found the Golden Bear deposit. Although initially discovered using exploration techniques applicable to Carlin-type deposits, the refractory style of mineralization and predominance of volcanic host-rocks delayed confirmation as this deposit type (Oliver, 1996).

During the first year (1997) of the BCGS project, Gerry Ray visited a number of gold occurrences, including Golden Bear, Watson Bar and Summit in British Columbia and Brewery Creek in the Yukon. The following year, Derek Brown took over leadership of the project and carried out detailed studies of the Golden Bear and Howell Creek areas.

BACKGROUND

The State of Nevada has become the world's fourth largest gold producer after South Africa, Australia and the CIS. Much of this gold is being produced from sediment-hosted disseminated gold deposits. Many geologists call these deposits Carlin-type (Berger and Bagby, 1991) after the mine of the same name in Nevada. The Carlin mine was discovered in 1961 by Newmont Exploration Limited (Roberts, 1986) and subsequently was used to characterize a new class of deposits that are now identified as sediment-hosted deposits with microscopic gold. Subsequent discoveries around Carlin are now being mined and have made it the most prolific gold belt in North America with a current resource of more than 100 million ounces (Teal and Jackson, 1997). This belt, known as the

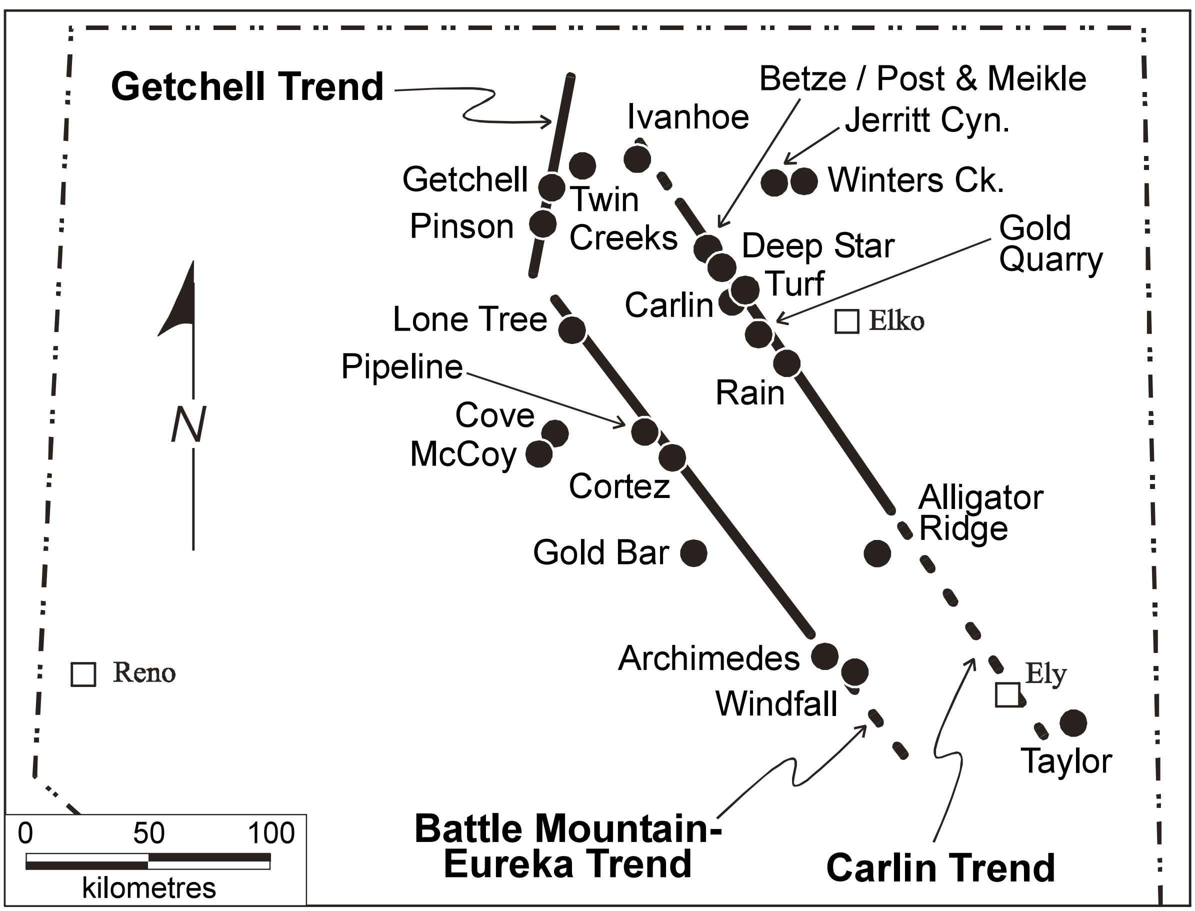

Figure 2. Location of Carlin-type gold deposits in Nevada showing the major trends.

Carlin Trend, is just one of the areas in Nevada with these types of deposits (Figure 2).

Since the gold mineralization is microscopic and associated features are often visually unspectacular at outcrop scale, these deposits are poorly understood and the mineralization is difficult to recognize. Fortunately, more than thirty years of exploration and mining in Nevada have resulted in a number of well described mines and documented the wide range of styles of mineralization. Some general information about Carlin-type deposits is presented in this article. For a more complete description of these deposits the reader is referred to the numerous articles published over the last ten years, including overviews by Arehart (1996), Teal and Jackson (1997) and Vikre *et al*. (1997) and numerous publications by the Nevada Geological Society (for example, Green and Struhsacker, 1996).

SEDIMENT-HOSTED DISSEMINATED GOLD DEPOSITS (CARLIN-TYPE)

Although initially called *Carlin-type*, many geologists have adopted other terms to facilitate developing a deposit model that is more generic, such as *disseminated gold* (Roberts, Radtke and Coats, 1971), *sediment-hosted disseminated gold*, *sediment-hosted micron gold*, *siliceous limestone replacement gold* and *invisible gold* (Schroeter and Poulsen, 1996). In this paper we use the terms *sediment-hosted disseminated gold* and *Carlin-type* interchangeably. With the discovery of many more mines over the last 20 years, a broader definition of Carlin-type deposits has emerged. They are now identified as 'sediment-hosted, disseminated, stratabound yet structurally controlled precious metal mineralization' (Ralph J. Roberts Research for Research in Economic Geology, web page, 1998).

Key Features

Carlin-type deposits contain micron-sized gold within very fine-grained disseminated sulphides in stratabound zones and in discordant breccias. The most common host rocks are impure carbonates, however, other sedimentary and igneous lithologies can host mineralization. Christensen (1993, 1996) points out that the gold mineralization appears to be disseminated at the deposit scale, however, gold is structurally controlled at all scales. For a deposit to be considered a sediment-hosted disseminated gold deposit it usually has many of the following features:

- non-visible, micron gold within arsenicalpyrite or pyrite (refractory ore)
- non-visible, extremely fine native gold within iron oxide or attached to clay (oxide ore)
- anomalous values of silver, arsenic,mercury, and antimony and low base metals
- associated realgar, orpiment and/or stibnite sedimentary host sequences containing silty carbonate or calcareous siltstone
- intensely silicified zones, commonly called jasperoid
- carbonate dissolution (decalcification)
- associated brittle structures

Carlin-type deposits are difficult to find for a number of reasons. The gold is microscopic; visible gold is only very rarely reported from the highest grade zones. The lower grade deposits have low sulphide contents and even in higher grade hypogene deposits the gold is typically associated with a very fine-grained, black, sooty pyrite that can be difficult to identify macroscopically. Furthermore, surface weathering can convert all sulphides to iron oxides, such as hematite and limonite, and rarely produces significant gossans. Exploration for these deposits has tended to draw on empirical relationships observed in Nevada, such as the presence of thick sedimentary sequences along a paleo-continental margin, the presence of significant beds of impure carbonate, identification of jasperoids, and the presence of realgar, orpiment and stibnite. Yet even with the identification of these favourable features, it has taken numerous, systematic geochemical and drilling programs along known mineralized trends in Nevada to make new discoveries.

Since the gold is micron-sized, it cannot be identified by panning and Carlin-type deposits are normally not associated with placer gold workings. The alteration associated with these deposits is often inconspicuous (Christensen, 1994). It consists of carbonate dissolution (decalcification), pervasive silica replacement and deposition, alteration of aluminosilicates to clay and sulphidation of iron to form pyrite. Gold is usually the only metal recovered from Carlin deposits. While minor sphalerite and galena are noted in some zones, the deposits rarely have any copper minerals. A more complete listing of the geological characteristics of Carlin-type deposits is given in Table 1.

The sediment-hosted microscopic gold deposits in Nevada are well known for the intense supergene alteration that occurs near surface. This feature is directly responsible for making heap leaching a viable process for treating low grade ores. It is generally attributed to the prolonged arid weathering of rocks in Nevada. It has been noted that oxidation features associated with the supergene alteration extend further below the surface in many deposits than in the surrounding areas (Christensen, 1994). Christensen postulates that this is because the host rock for these deposits has been structurally prepared and altered.

In the last ten years a number of deep deposits with higher grades have been discovered along the Carlin Trend. These high grade orebodies exhibit breccia features and vein-like ores (Figure 3) as well as low grade, stratabound replacement mineralization like the Carlin mine (Christensen *et al*., 1996; Groves, 1996). The initial underground mining of these ore zones started with declines from open pit workings, such as are used for the Deep Star and Carlin East deposits. However, in 1996 the Meikle mine started production utilizing a conventional shaft and has become the largest underground gold producer in the United States. These deep deposits are below the Miocene surface weathering and the ore is commonly refractory. Analysis of the orebodies along the Carlin Trend shows that stratabound replacement orebodies are less common than the vein-like and breccia mineralization styles.

Stratabound replacement mineralization is exemplified by the Carlin deposit. Large volumes of altered rock contain relatively low grade gold zones which have had minor structural disruption. Stratabound replacement deposits found at, or near surface, in Nevada are particularly amenable to heap leaching because the primary refractory ore has been oxidized by the arid climate that has existed since the Cretaceous. Using bulk mining techniques, relatively low grade surface material can be mined. Other examples of the stratabound replacement style of mineralization are the Pete, Deep West portion of Gold Quarry, West Leeville, Hardie Footwall, Goldbug and Screamer (Christensen *et al*., 1996; Teal and Jackson, 1997).

The second style of mineralization is called stockwork (Christensen, 1993) or breccia ore (Groves, 1996) and is found near structural intersections which can produce complex relationships. An example of this deposit type is the

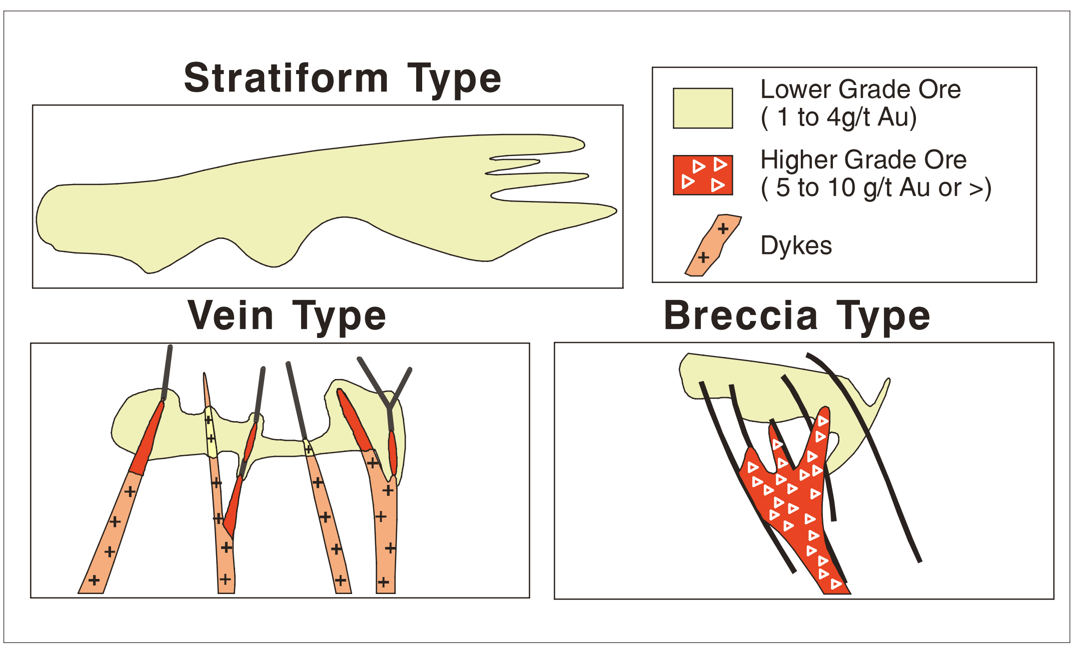

Figure 3. Different styles of Carlin-type mineralization (modified from Christensen, 1993, 1996). The heavy solid lines are faults.

Table 1. Geological Characteristics of Carlin-type Deposits.

TECTONIC SETTINGS: Passive continental margins with subsequent deformation and intrusive activity and island arc terranes.

DEPOSITIONAL ENVIRONMENT / GEOLOGICAL SETTING: Host rocks to the Nevadan deposits were deposited in shelf-basin transitional (somewhat anoxic) environments, formed mainly as carbonate turbidites (up to 150 m thick), characterized by slow sedimentation. These rocks are presently allochthonous in thrust fault slices and have been overprinted by Miocene basin and range extension. There are Mesozoic to Tertiary felsic plutons near many deposits.

AGE OF MINERALIZATION: Mainly Tertiary, but can be any age.

HOST/ASSOCIATED ROCK TYPES: Host rocks are most commonly thin-bedded silty or argillaceous carbonaceous limestone or dolomite, commonly with carbonaceous shale. Although less productive, non-carbonate siliciclastic and rare metavolcanic rocks are local hosts. Felsic plutons and dikes are also mineralized at some deposits.

DEPOSIT FORM: Generally tabular, stratabound bodies localized at contacts between contrasting lithologies. Bodies are irregular in shape, but commonly straddle lithological contacts which, in some cases, are thrust faults. Some ore zones (often higher grade) are discordant and consist of breccias developed in steep fault zones. Sulphides (mainly pyrite) and gold are disseminated in both cases.

TEXTURE/STRUCTURE: Silica replacement of carbonate is accompanied by volume loss so that brecciation of host rocks is common. Tectonic brecciation adjacent to steep normal faults is also common. Generally less than 1% fine-grained sulphides are disseminated throughout the host rock.

ORE MINERALOGY [Principal and *subordinate*]: Native gold (micron-sized), *pyrite with arsenian rims, arsenopyrite, stibnite, realgar, orpiment, cinnabar, fluorite, barite, rare thallium minerals*.

GANGUE MINERALOGY [Principal and *subordinate*]: Fine-grained quartz, barite, clay minerals, carbonaceous matter and late-stage calcite veins.

ALTERATION MINERALOGY: Strongly controlled by local stratigraphic and structural features. Central core of strong silicification close to mineralization with silica veins and jasperoid; peripheral argillic alteration and decarbonation (“sanding”) of carbonate rocks common in ore. Carbonaceous material is present in some deposits.

WEATHERING: Nevada deposits have undergone deep supergene alteration due to Miocene weathering. Supergene alunite and kaolinite are widely developed and sulphides converted to hematite. Such weathering has made many deposits amenable to heap-leach processing.

ORE CONTROLS: 1. Selective replacement of carbonaceous carbonate rocks adjacent to and along high-angle faults, regional thrust faults or bedding. 2. Presence of small felsic plutons (dikes) that may have caused geothermal activity and intruded a shallow hydrocarbon reservoir or area of hydrocarbon-enriched rocks, imposing a convecting geothermal system on the local groundwater. 3. Deep structural controls are believed responsible for regional trends and may be related to Precambrian crystalline basement structures and/or accreted terrane boundaries.

from Schroeter and Poulsen, 1996

Main Gold Quarry deposit which has a variety of lithologies, including thin-bedded siltstone, shale, chert and limestone (Christensen *et al*., 1996). Teal and Jackson (1997) also identify Meikle and Deep Star as deposits with significant breccia-style mineralization.

Vein-like mineralization occurs within and adjacent to high-angle faults. The structures contain intensely altered, igneous dikes and relatively high grade gold. The gold is largely restricted to the fault. Examples of this style of mineralization are the Turf, Sleeper, Boot Strap and Capstone (Teal and Jackson, 1997).

Median tonnages and grades for forty-three low-grade oxide and higher grade hypogene deposits in Nevada are 20 Mt grading 1.2 g/t Au and 6 Mt containing 4.5 g/t Au, respectively (Schroeter and Poulsen, 1996). Supergene deposits amenable to heap leaching typically grade 1-2 g/t Au; whereas, production grades for deposits with hypogene ore typically grade 5 to 10 g/t or greater.

Global Distribution

There have been remarkably few Carlin-type deposits found outside the western United States. This could reflect the existence of special geological conditions in Nevada not found elsewhere or insufficient exploration in other parts of the world. Given the microscopic nature of the gold and the nondescript alteration features, it is likely that undiscovered deposits occur in areas not previously considered prospective for this type of deposit. This was the case in Nevada before mapping by the United States Geological Survey led Newmont Exploration Limited to carry out the exploration program which led to the discovery of the Carlin deposit in an area which had a long previous history of prospecting and mining.

Deposits with Carlin-type characteristics have been reported from Utah, South Dakota, southeast Asia, Mexico, South America and Canada (Figure 4). There are also a large number of these deposits in the southwest Guizhou and western Hunan regions of southeastern China (Cunningham *et al*., 1988). The setting for these mines is generally similar to Nevada. The Chinese gold mineralization is hosted by Upper Permian to Middle Triassic shelf carbonates which have experienced broad, open folding and some high angle faulting (Christensen *et al*.,

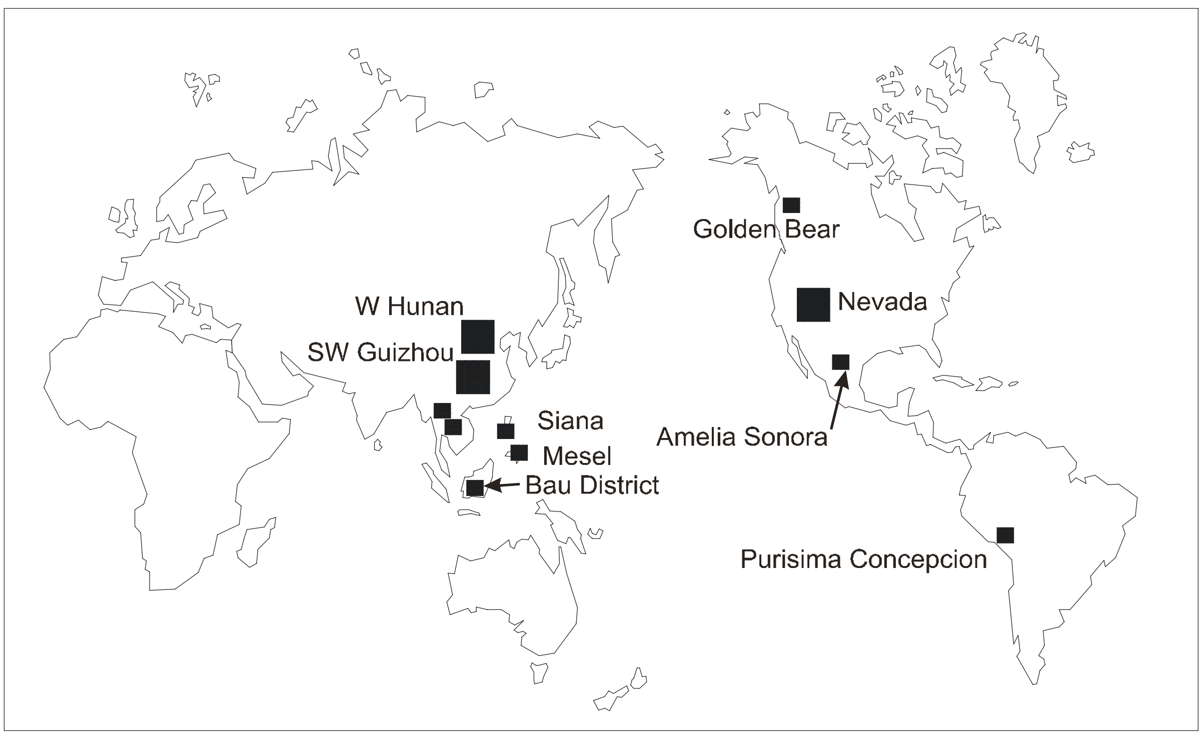

Figure 4. Global distribution of Carlin-type deposits (modified from Christensen *et al*., 1996).

1996). Although the Guizhou area apparently lacks igneous rocks, they are reported at some other Chinese deposits (Griffin, personal communication, 1998).

There are relatively few Carlin-type deposits hosted by volcanic rocks (Lefebure and Ray, 1998). The best known examples are the Bau District of Sarawk, Malayasia (Sillitoe and Bonham, 1990) and the Mesel deposit of North Sulawasi, Indonesia (Turner *et al*., 1994; Garwin *et al*., 1995). The Mesel deposit, discovered in 1988, contains a reserve of 7.8 Mt grading 7.3 g/t Au and is currently in production. The Mesel deposit exhibits many characteristics of Carlin-type deposits, including decalcification, dolomitization and jasperoid development, accompanied by gold in disseminated fine-grained arsenian pyrite (Sillitoe, 1995).

In British Columbia, recent work by Jim Oliver as part of his Ph.D. thesis (1996) and field investigations by Howard Poulsen of the GSC and the authors have shown that the Golden Bear mine is a Carlin-type deposit.

Genesis

Currently, there is no clear understanding of the genesis of sediment-hosted microscopic gold deposits. Three general models have been proposed to explain the origin of the ore-forming fluids - magmatic, metamorphic and amagmatic. All three models involve generation of hydrothermal fluids at temperatures of 160 to 250 °C with low salinities and significant CO2 contents, as found in fluid inclusions in Carlin-type deposits (Arehart, 1996; Ilchik and Barton, 1997). A more detailed listing of geological processes that could form sediment-hosted disseminated gold deposits is given by Adams and Putnam III (1992).

Carlin-type deposits were initially considered to be sediment-hosted, epithermal deposits (Radtke *et al*., 1980; Radtke, 1985; Rye, 1985) because of a number of similar features including high gold, silver, arsenic, antimony and mercury values in mineralized zones, prevalence of silicification, presence of alunite, and spatial association with antimony and mercury occurrences. Given the abundance of epithermal gold-silver deposits hosted by volcanic rocks in Nevada, it seemed logical to assume that Carlin-type deposits formed at the roots of hot spring systems related to shallow Miocene magmatism and basin and range extension (Figure 5). The subsequent discovery of deep orebodies and the documentation of overprinting of mineralization by basin and range deformation led most geologists to consider alternative models which are consistent with a deeper and older environment of formation (Arehart, 1996).

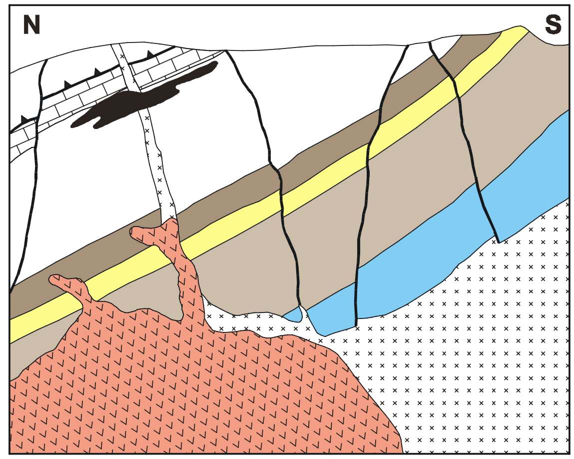

Figure 5. Early interpretations of Carlin-type deposits suggested that they were epithermal deposits that formed in sedimentary sequences (from Radtke, 1985).

Magmatic systems are considered by many exploration and research geologists to play a key role in the formation of Carlin-type deposits (Arehart *et al*., 1993). This model has been clearly conceptualized by Sillitoe and Bonham (1990). They suggested that hydrothermal fluids related to porphyry-type magmatic systems generated sediment-hosted disseminated gold deposits, somewhat akin to distal skarns (Figure 6). Some deposits, such as Post-Betze, Getchell, Bald Mountain and Archimedes, do occur near Jurassic or Cretaceous intrusions. Others are associated with, and partially hosted by, altered dikes that are controlled by faults. However, this model cannot explain all deposits because several districts (e.g. Jerritt Canyon) have no known related magmatism. Furthermore, in some locations the gold mineralization is a different age to the spatially associated intrusions.

Other workers have suggested models involving fluids generated either by deep-seated metamorphism (Seedorff, 1991), crustal extension (Ilchik and Barton, 1997), or the ancestral Yellowstone hotspot (Oppliger *et al*., 1997). The regional metamorphic model derives the H_2O

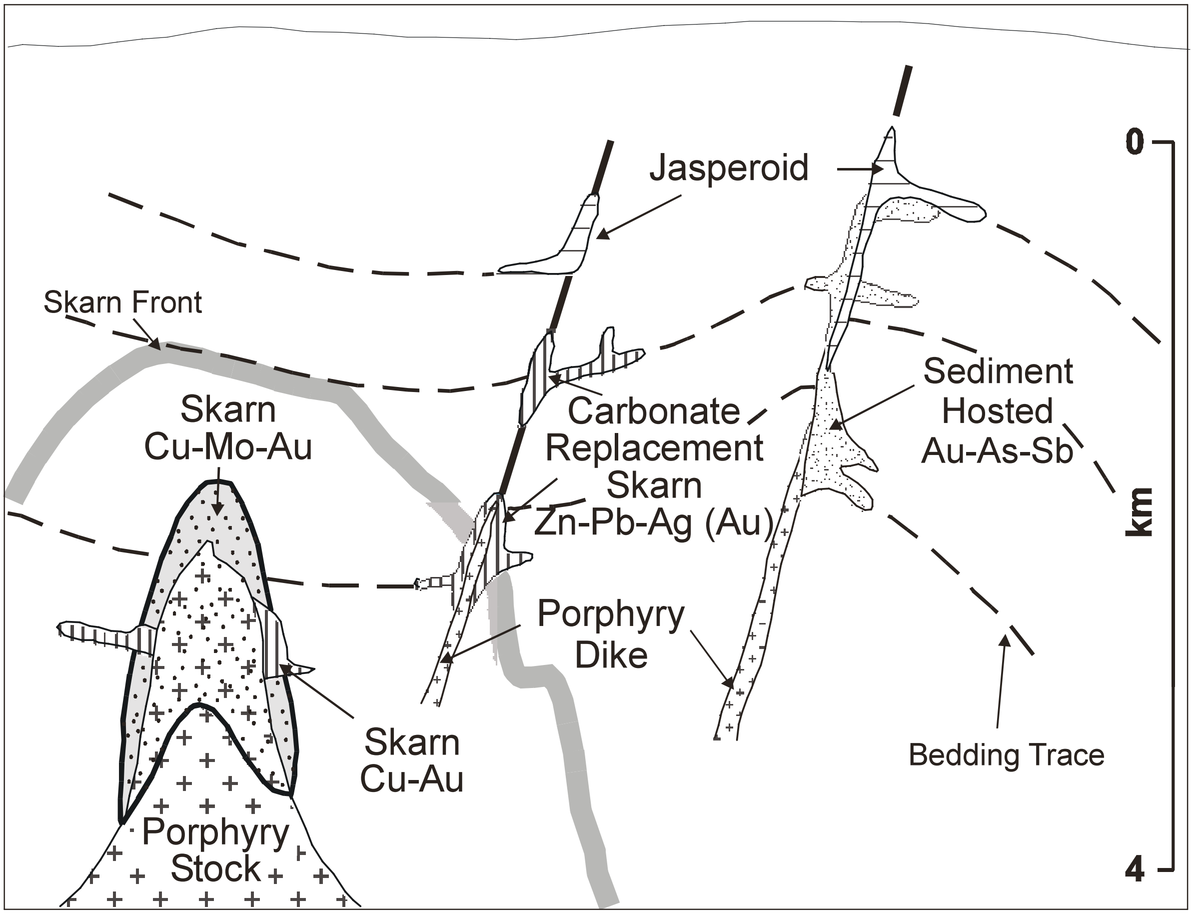

Figure 6. Magmatic systems are believed by some to play a major role in the formation of sediment-hosted microscopic gold deposits. Sillitoe and Bonham (1990) envisioned fluids emanating from porphyry-type magmatic systems.

and CO_2 from devolatilization of metasedimentary rocks which are also the source of metals and sulphur. While there may be associated magmatic activity, it is not a critical element to the model which emphasizes some of the similarities between mesothermal gold and Carlin-type deposits (Phillips and Powell, 1993).

More recently, Ilchik and Barton (1997) have proposed an amagmatic model with an anomalous thermal gradient caused by bringing more deeply buried, hotter rocks closer to the surface and allowing meteoric waters to penetrate to depths of ten to twenty kilometres before rising along major faults during mid-Tertiary extension in the Basin and Range province (Figure 7).

Another postulated source is metals derived from the core-mantle boundary and carried up into the crust by the plume associated with the ancestral Yellowstone hotspot (Oppliger *et al*., 1997). The hotspot may have underlain the Great Basin of Nevada ca. 43-34 Ma and produced hydrothermal fluids that formed the gold deposits. While these three models may explain some of the characteristics of the Carlin-type deposits, they also have some inconsistencies with published data. As well, all three models are tied to one geological event; therefore, they cannot explain deposits with significantly different ages. This is inconsistent with the widely held belief of many geologists working in the Great Basin that there are both Cretaceous (110-76 Ma) and Eocene (42-30 Ma) age deposits (Tosdal, personal communication, 1998).

Exploration Techniques

Geology is used to identify favourable stratigraphic units, related alteration zones and possible structural controls. Bedded silty carbonate and calcareous siltstone to dolomitic limestone are the most common hosts; although some deposits occur within sandstone, conglomerate, intrusive units and even volcanic rocks. In

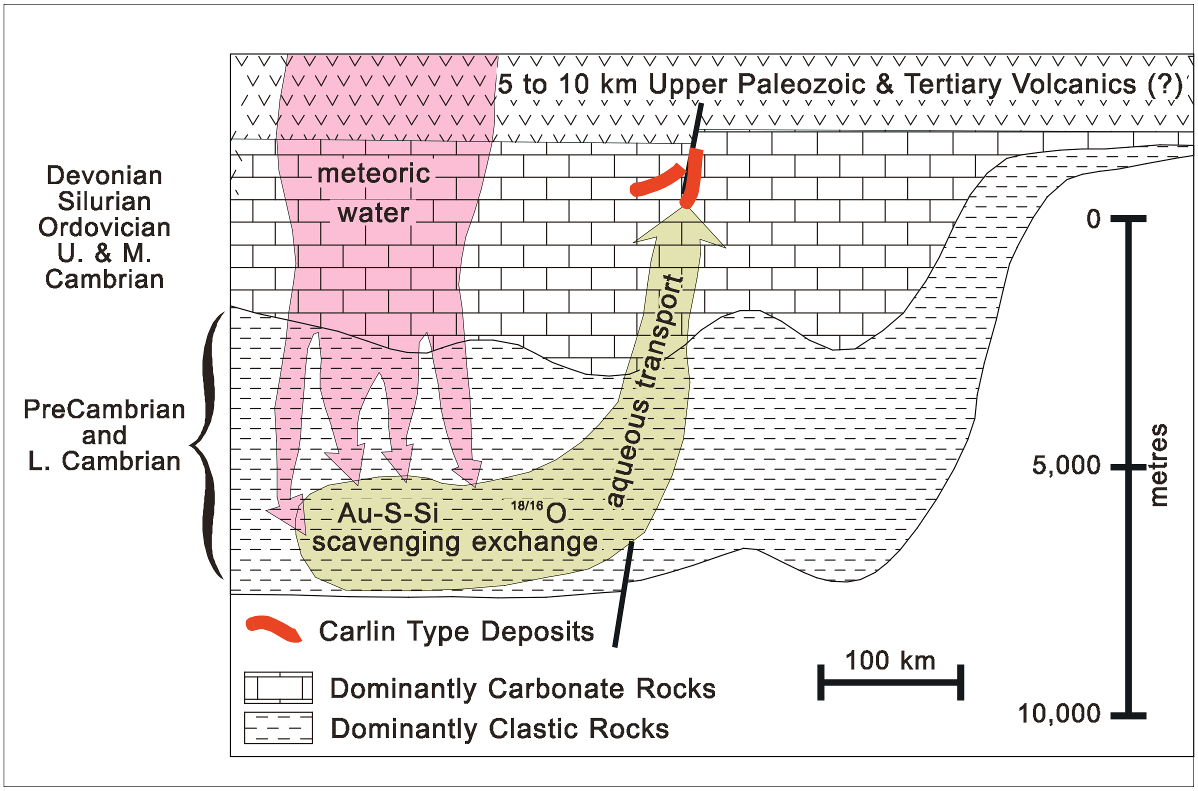

Figure 7. An amagmatic model to explain the genesis of sediment-hoisted microscopic gold deposits (from Ilchik and Barton, 1997).

Photo 1. Bedded Roberts Mountain Formation from the Jerritt Canyon area, Nevada.

Nevada, bedded units, particularly thinly bedded sediments (Photo 1), have been found to be more likely to host mineralization.

Geochemistry has been the most important exploration technique following identification of geologically prospective districts. Initial field work often involves systematic sampling of soil or rock. Gold has been the most important element used in exploration programs, although anomalous values for the pathfinder elements arsenic, antimony and mercury have led to some discoveries (e.g. Golden Bear, L. Dick, personal communication, 1998). Schroeter and Poulsen (1996) identify two geochemical asemblages - (1) gold, arsenic, mercury and tungsten with or without molybdenum and (2) arsenic, mercury, antimony and thallium or iron. Common anomalous values in rock are 100 to 1000 ppm arsenic, 10 to 50 ppm antimony and 1-30 ppm mercury. Other elements that occur in anomalous amounts are silver, barium and thallium. Gold:silver ratios are generally greater than 8:1 (Adams and Putnam III, 1992; Roberts *et al*., 1971).

Three principle alteration types are recognized: decarbonatization or decalcification of

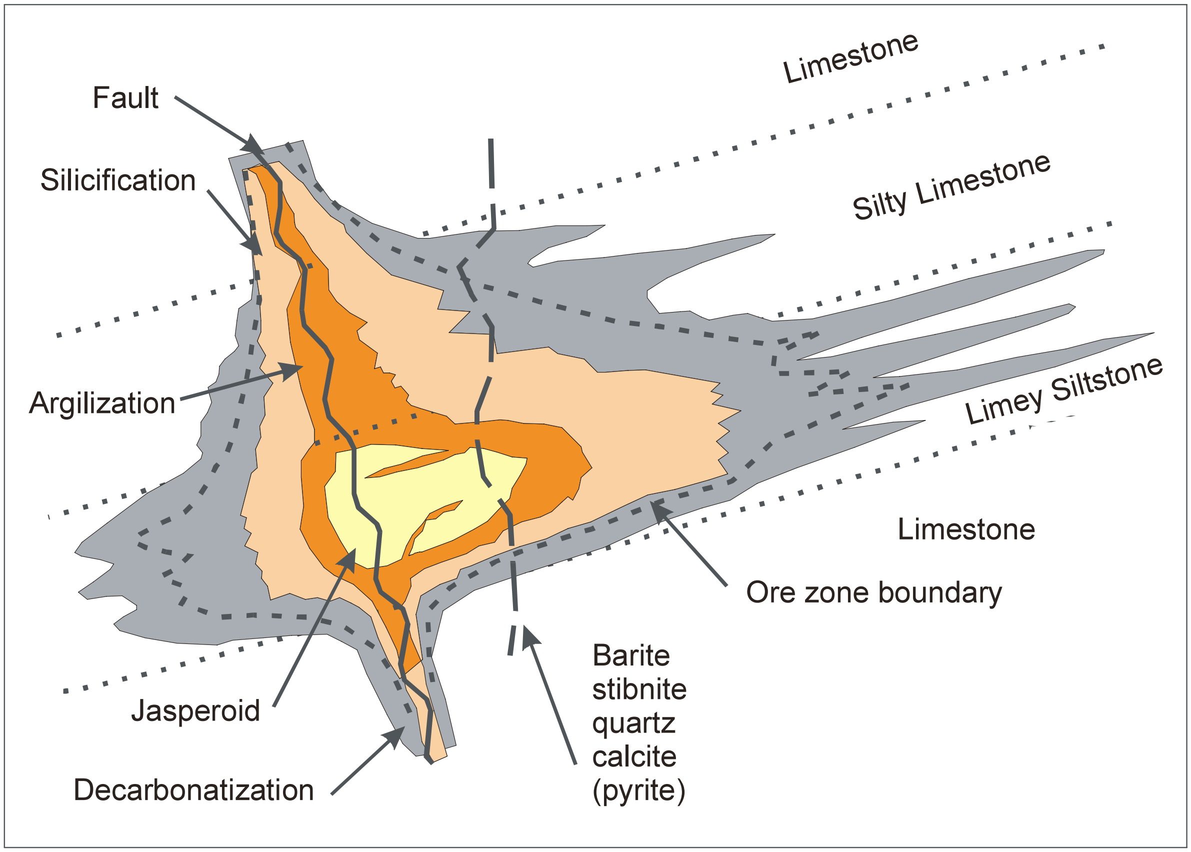

Figure 8. Schematic cross-section through a sediment-hosted disseminated gold deposit showing major alteration features adjacent to a fluid feeder structure (from Arehart, 1996).

carbonate rocks, silicification, and argillization. These types of alteration can display different relationships to gold mineralization. Arehart (1996) suggests that the most common zonation is decarbonatization on the fringes through silicification to argillization in the core of the deposit (Figure 8). Gold ore occurs in all three alteration types. However, in most deposits it is better developed in argillically or intensely silicified zones in the core of the system, often associated with a structural feature. The decarbonatized rocks are difficult to recognize unless alteration has been intense enough to produce a light, friable unit. These rocks can be brecciated because the volume loss associated with decarbonatization results in structural collapse. The clays in the argillized rocks are typically fine-grained and not particularly abundant, therefore, the alteration can be difficult to identify. Near surface, these altered rocks may be oxidized and are commonly brown, beige or reddish-brown with residual limonite or hematite after weathered pyrite. In a number of open pit mines the higher grades are associated with reddish-brown tabular zones which lie along structures (Photo 2).

Photo 2. The Jackrabbit Zone in the south wall of the Twin Creeks megapit, Nevada. The zone consists of reddish-brown iron oxides. It is 6 to 24 metres thick, extends laterally and vertically hundreds of meters and averages 3 g/t gold, but can grade up to 34 g/t Au (Bloomstein *et al*., 1991).

One of the most obvious features of sediment-hosted disseminated gold deposits is an association with intensely silicified host rocks. In some cases the silicification contains little or no gold (Photo 3), however, it occurs proximal to a Carlin-type deposit. Frequently, the intense silicification is related to particular sedimentary bed or beds (Photo 4) or a fault zone. These rocks are particularly important exploration guide because they are a resistant lithology which is more likely to outcrop than other types of altered or unaltered host rocks (Photo 3). In Nevada, the intensely silicified rocks are commonly called jasperoid which is "an epigenetic siliceous replacement of a previously lithified host rock" (Lovering, 1972). This terminology has been rarely used in Canada, even for intensely silicified rocks. For this reason, there are few published references to jasperoid in the Canadian Cordillera.

Photo 3. Barren jasperoid boulders located approximately 100 metres from Gold Bar open pit in an area with no outcrop.

Photo 4. Jasperoid showing relict bedding, Jerritt Canyon, Nevada.

Many, if not all, sediment-hosted disseminated gold deposits are related to high-angle faults or shear zones (Adams and Putnam III, 1992) which acted as depositional sites for mineralization or provided a conduit for fluids to reach favourable lithological units. One aspect of Carlin-type deposits that receives considerable attention in Nevada is the alignment of known deposits along trends (Figure 2). The geological significance of these trends is not fully understood, however, they are widely used by the exploration community to promote properties and to identify prospective ground.

Geophysics are used, although usually as an indirect exploration method designed to provide information about structure and geology. Some deposits exhibit resistivity lows. Aeromagnetic surveys may identify associated intrusions and possibly regional trends (Schroeter and Poulsen, 1996). The high grade refractory ore zones should respond to electromagnetic techniques.

PROPERTIES EXAMINED

An initial investigation of the MINFILE database and discussions with government and industry geologists identified some possible occurrences which warranted investigation. In the last two years a number of mineral occurrences in British Columbia were examined and sampled, including the Greenwood Camp, Watson Bar, the Golden Bear mine, Slam and Howell Creek structure.

Information concerning the Watson Bar property is summarized by Cathro *et al*., 1998; it is not a Carlin-type deposit. Initial reports on the Howell Creek structure and Golden Bear deposits are presented in this volume (Brown and Cameron, 1999; Brown *et al*., 1999). The Slam property in northern British Columbia is located approximately eleven kilometers east-northeast of the Golden Bear mine. Gold mineralization is associated with a northeast-trending, silicified limestone unit which contains disseminations of fine, dark gray pyrite. Several rock samples from the silicified zone assayed over 1.0 g/t gold with anomalous values for mercury, arsenic and antimony (Walton, 1987). The Slam is similar to some of the Golden Bear deposits and is most likely a Carlin-type deposit. The Greenwood Camp does have a number of carbonate units with associated skarns which suggest the area is potentially prospective for sediment-hosted disseminated gold, however, no sediment-hosted disseminated gold deposits have been identified in the area.

CONCLUSIONS

Carlin-type deposits are difficult to find because their setting and genesis are so poorly understood. Therefore, it is difficult to determine the key features to use for exploration. Furthermore, the gold is microscopic and many deposits have low sulphide contents (<1%). Even in the higher grade deposits the gold is typically associated with a very fine-grained, black, sooty pyrite that can be difficult to identify macroscopically. Surface weathering can convert all sulphides to hematite and limonite, and rarely produces significant gossans. In Nevada, it took sustained exploration over 20 years along the major mineralization trends to identify many of the new sediment-hosted disseminated gold deposits and discoveries continue to be made.

In the Canadian Cordillera there has been relatively little exploration for these deposits despite some geological similarities with Nevada. Poulsen (1996b) noted that two different geological environments in British Columbia might host Carlin-type mineralization. These are: 1) accreted terranes with a basement containing carbonate lithologies intruded by Mesozoic or Cenozic plutonism, specifically the Stikine and Quesnel terranes, and 2) sediments deposited along the continental margin of ancestral North America which have been cut by Mesozoic magmas, such as are found in the Kootenay Arc and Selwyn Basin.

Initial results from the sediment-hosted gold project show that the Bear, Grizzly, Kodiak A, Kodiak B and Ursa are Carlin-type deposits and the Slam occurrence is similar. There is considerable potential to find other gold occurrences of this type in the Tatsamenie Lake region. Further work will probably identify other prospective regions in British Columbia.

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