



GOLD ASSOCIATED WITH A REGIONALLY DEVELOPED MID-TERTIARY PLUTONIC EVENT IN THE HARRISON LAKE AREA SOUTHWESTERN BRITISH COLUMBIA (92G/9; 92H/3, 4, 5, 6, 12)

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INTRODUCTION

Recent studies by the British Columbia Ministry of Energy, Mines and Petroleum Resources indicate that a regional episode of *Mid-Tertiary plutonism in the Harrison Lake area*, approximately 100 kilometres east of Vancouver, is associated with widespread vein-type gold mineralization. This magmatic event was structurally controlled and resulted in the emplacement of numerous, variably sized plutons along a major, northwesterly trending lineament (Fig. 10-1). These plutons intrude a variety of sedimentary and volcanic rocks that range in age from Pennsylvanian to Cretaceous; the plutons are diorite to quartz diorite to granodiorite in composition and yield K/Ar (biotite) ages between 19 and 26 Ma (Table 10-1). In part, the lineament follows the Harrison Lake fracture system, which is associated with regional hot spring activity (Fig. 10-1); the location of its northwesterly continuation beyond Harrison Lake is uncertain. Southeastward, it is traceable to the 48th parallel in Washington State where it is probably marked by the 20 to 22-Ma-old Cloudy Pass and Cascade Pass plutons (Crowder, *et al.*, 1966; Misch, 1966; Grant, 1969).

The largest pluton along the lineament, the composite Chilliwack batholith, straddles the Canada-United States border approximately 125 kilometres east-southeast of Vancouver (Fig. 10-1); it yields K/Ar ages between 16 and 35 Ma (Richards and White, 1970; Richards and McTaggart, 1976; Vance, 1985). This batholith exceeds 950 square kilometres in area, and is spatially associated with at least 10 separate gold-bearing properties, including two former producing gold mines (Boundary Red Mountain and Lone Jack). Further north, numerous smaller bodies of similar age and mineralogy to the Chilliwack batholith occur sporadically along the lineament for more than 100 kilometres. The two most northern areas of Mid-Tertiary, diorite-related gold mineralization occur on Harrison Lake at Doctors Point and at the RN-Geo property; both lie close to the Harrison Lake fracture, being situated 95 kilometres northeast and 100 kilometres east of Vancouver respectively (Fig. 10-1). The Doctors Point property is being explored by Rhyolite Resources Inc. and Harrison Lake Gold Mines Ltd., while the RN-Geo property was recently optioned by Abo Oil Corporation to Kerr Addison Mines Ltd.

THE GEOLOGY OF GOLD PROPERTIES ASSOCIATED WITH THE MID-TERTIARY PLUTONISM

The Rhyolite Resources Inc.-Harrison Lake Gold Mines Ltd. property at Doctors Point, on the western shore of Harrison Lake (Fig. 10-1), represents the most northerly example of Mid-Tertiary, diorite-related precious metal mineralization yet identified along the Harrison Lake lineament. Drilling has outlined approximately 132 300 tonnes grading 3.5 grams gold per tonne on the property. The area is underlain by a variety of intermediate to basic volcanic and volcanoclastic rocks, together with some metasedimentary rocks of Early Cretaceous (Middle Albian) age. These are intruded by five diorite-quartz diorite plutons that range from less than 50

metres to more than 1 kilometre in diameter. The plutons are surrounded by hornfelsic envelopes up to 250 metres in width. The gold and silver is hosted in long, narrow, gently dipping mineralized veins that contain abundant quartz, pyrite, and arsenopyrite; geochemically they are sporadically enriched in bismuth, antimony, and mercury. The veins show an overall spatial association to the pluton margins, and some pass without interruption from diorite out into the hornfels. The veins were apparently controlled by, and injected along low angle, cone sheet fractures developed during the later stages of the diorite intrusion. K/Ar ages obtained from biotite and hornblende samples suggest the diorites were emplaced between 19 and 25 Ma ago, while K/Ar analysis on muscovite taken from a gold-bearing vein suggests the mineralization took place 22 Ma ago (Table 10-1).

In 1983 and 1984, Abo Oil Corporation completed a drilling and bulk sampling program on their RN-Geo property, at the southern end of Harrison Lake (Fig. 10-1); this yielded some promising gold values (Huber, 1983); the property is currently being explored by Kerr Addison Mines Ltd. The area is underlain by deformed and hornfelsed metapelites of presumed Mesozoic age; these are intruded by several, small diorite-quartz diorite plutons between 50 and 200 metres in diameter. Gold is hosted in quartz veins and stringers that intersect the plutons; the veins consist of several variably orientated sets; locally they form closely spaced stockworks which may be suitable for bulk mining. The veins carry visible gold together with pyrite and pyrrhotite; there is sporadic geochemical enrichment of arsenic and bismuth but no mercury enhancement. A K/Ar analysis on hornblende suggests the diorites were emplaced 26 Ma ago, while analysis on sericite taken from a gold-bearing quartz vein indicates that mineralization occurred 24.5 Ma ago (Table 10-1). This is essentially synchronous with the plutonism and mineralization at Doctors Point.

The Laidlaw gold property, which is about 14 kilometres southwest of Hope (Fig. 10-1), is described by McClaren (1971). A sequence of deformed metasedimentary rocks are intruded by several small, elongate diorite-quartz diorite bodies that are less than 75 metres in width. These bodies are probably related to the Mount Barr batholith which lies 6 kilometres further south (Fig. 10-1); this batholith covers 160 square kilometres and has yielded K/Ar biotite ages between 16 and 24 Ma (Richards and White, 1970; Richards and McTaggart, 1976). Native gold at the Laidlaw property is hosted in two quartz vein sets which cut the diorite bodies; these veins also carry pyrrhotite, arsenopyrite, chalcopyrite, and secondary narcissite, as well as traces of bismuth tellurides.

The remaining 10 properties containing probable Mid-Tertiary gold mineralization lie close to the main Chilliwack batholith in both Canada and the U.S.; details on the U.S. properties is given by Moen (1969). The Lone Jack and Boundary Red Mountain properties (Fig. 10-1) were producing mines during the early part of this century. At the Boundary Red Mountain mine, gold-bearing quartz veins follow the sheared intrusive contact between a diorite body and older metasedimentary rocks. The veins contain minor amounts of pyrite, chalcopyrite, and pyrrhotite, and traces of bismuth tellurides.

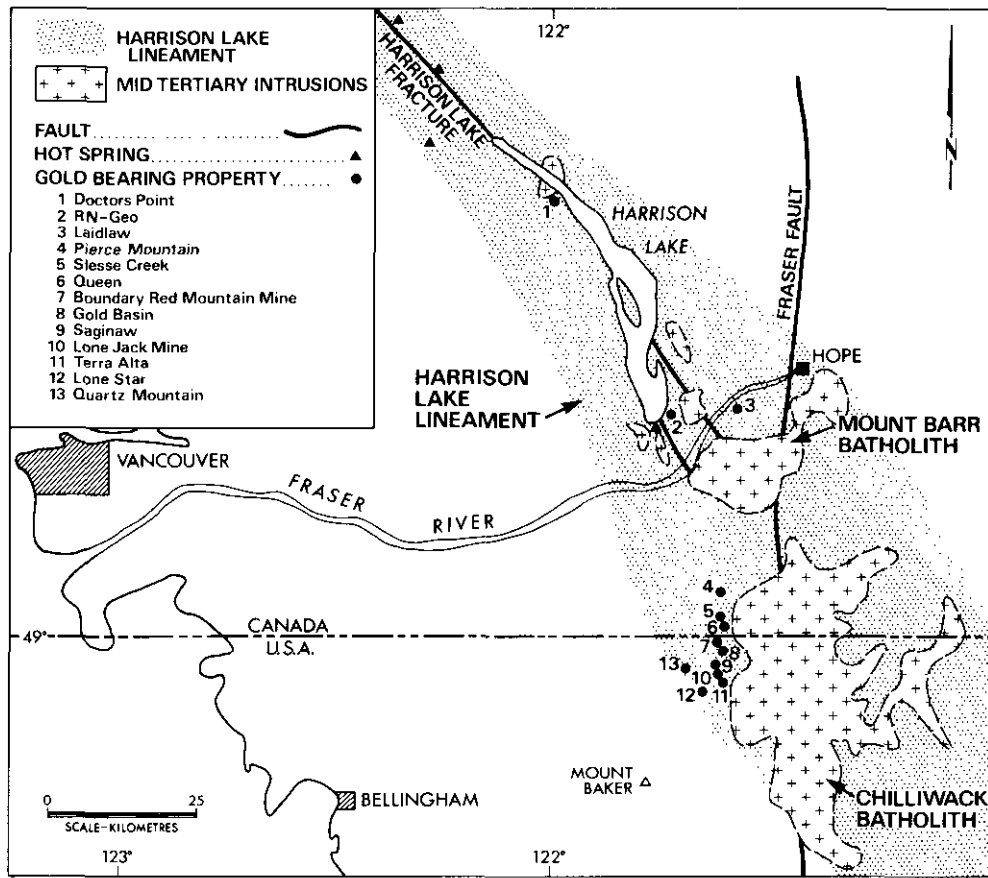


Figure 10-1. Location of gold occurrences and related Mid-Tertiary plutons along the Harrison Lake lineament.

TABLE 10-1
K/Ar AGES FROM THE HARRISON LAKE AREA

SAMPLE NO.	UTM CO-ORDINATES	MINERAL	%K	Ar ^{40*} 1	COMMENTS	AGE (Ma)
RR 54	591200E; 5465100N	Hornblende	0.19 ± 0.002	0.1915	Taken from diorite pluton at the RN mine exploratory adit, Harrison Lake	25.7 ± 1.0
RR 55	591200E; 5465100N	Sericite	8.38 ± 0.13	8.021	Taken from a gold-bearing quartz-sericite-pyrrhotite vein, RN mine exploratory adit, Harrison Lake	24.5 ± 1.0
RR 56	573100E; 5500100N	Biotite	6.91 ± 0.02	6.268	Drill core from the Doctors Bay pluton (diorite)	23.2 ± 0.8
RR 56	573100E; 5500100N	Hornblende	1.112 ± 0.01	1.083	Drill core from the Doctors Bay pluton (diorite)	24.7 ± 1.0
RR 64A	573250E; 5499950N	Muscovite	8.65 ± 0.03	7.695	Taken from kaolin-muscovite alteration halo adjacent to a gold-bearing quartz sulphide vein that cuts the Doctors Bay pluton	22.7 ± 0.8
RR 127	572300E; 5501600N	Biotite	7.40 ± 0.02	5.907	Taken from the Doctors Point pluton (quartz diorite)	20.4 ± 0.8
RR 127	572300E; 5501600N	Hornblende	0.391 ± 0.002	0.295	Taken from the Doctors Point pluton (quartz diorite)	19.3 ± 0.8

¹x 10⁻⁶ cc/gm

All samples collected by G. E. Ray.

Potassium analyses completed at the British Columbia Ministry of Energy, Mines and Petroleum Resources Laboratory.

Argon analyses completed by J. Harakal, Geochronology Laboratory, University of British Columbia.

uride. In 1916 the Boundary Red Mountain mine produced 11 460 tonnes of ore grading 24 grams gold per tonne, while total gold production between 1913 and 1946 was valued at just under 1 million U.S. dollars.

At the Lone Jack mine, the quartz veins occupy fissures in phyllitic schists; no dioritic rocks are seen at the mine, but outcrops of the main Chilliwack batholith lie only 1.5 kilometres east of the property. The veins carry visible gold with pyrite, pyrrhotite, and traces of bismuth tellurides. Moen (1969) estimates that gold production from the Lone Jack mine between 1902 and 1924 valued approximately 555 000 U.S. dollars.

Gold-bearing veins at the Pierce Mountain, Slesse Creek, Gold Basin, and Quartz Mountain properties (Fig. 10-1) are all spatially associated with dioritic bodies that intrude metasedimentary rocks; the veins at the Lone Star property carry bismuth tellurides.

EXPLORATION GUIDES FOR MID-TERTIARY PRECIOUS METAL MINERALIZATION ALONG THE HARRISON LAKE LINEAMENT

Since many of the Mid-Tertiary plutons emplaced along the Harrison Lake lineament are associated with precious metal mineralization, a search for other intrusive bodies of this age should represent a viable exploration method for gold in the region. Furthermore, outlining possible northwesterly and southeasterly extensions of both the lineament and the Harrison Lake fracture system could result in the discovery of other mineralized plutons. For example, the Cascade Pass and Cloudy Pass plutons, and parts of the Snoqualmie batholith in Washington State (Baadsgaard, *et al.*, 1961; Crowder, *et al.*, 1966; Misch, 1966), probably belong to this intrusive suite, and thus could have associated vein-type gold mineralization. It should also be noted that the east-west dimension of the lineament is unknown; it may be considerably wider than shown on Figure 10-1. Many of the mineralized intrusive bodies located to date are relatively small; consequently the reconnaissance style of geological mapping completed in the region 30 or more years ago may have overlooked many small plutons. These could be located and outlined by prospecting followed by detailed geologic mapping and K/Ar analyses to determine their intrusive ages. The Geological Survey of Canada is currently conducting a mapping program in the Hope (west half) map sheet (J.W.H. Monger, personal communication, 1985) which will provide more geological data on the Harrison Lake area.

Many of the Mid-Tertiary gold-bearing veins in the region contain bismuth tellurides, consequently regional and detailed geochemical exploration for this type of mineralization could use bismuth (and gold) as pathfinder elements. The use of mercury, arsenic, and antimony could be successful locally. At Doctors Point the veins are geochemically enriched in these elements, while at the RN-Geo and Laidlaw properties, mercury is absent, and arsenic and antimony enrichment is weak and sporadic. Arsenic enrichment is not reported at either the Boundary Red Mountain or Lone Jack mines.

CONCLUSIONS

The Harrison Lake lineament and fracture system of southwestern British Columbia, and its southeastern extension into Washington State, is marked by a 19 to 26-Ma period of dioritic-quartz dioritic plutonism which is temporally and genetically related to 13 separate areas of gold mineralization. These Mid-Tertiary plutons vary in size from the composite Chilliwack batholith, which covers 950 square kilometres, down to small bodies less than 50 metres across. The gold \pm silver mineralization is generally hosted in quartz veins filling tension fractures and is commonly associated with bismuth tellurides; however, the degree of arsenic, mercury, and antimony geochemical enrichment associated with the miner-

alization is highly variable. Many mineralized veins in the region are hosted either within the diorite bodies or close to their intrusive margins, where competency differences resulted in brittle, open space fracturing. The morphology of the mineralized veins is highly variable; it includes shallow-dipping features controlled by cone sheet fracturing, stockwork and crackle breccia veinlets, and steeply dipping veins injected along the sheared margins of the plutons.

Exploration for this Mid-Tertiary precious metal mineralization should involve prospecting, geological mapping, and geochronology to locate and identify other plutons of this age in the Harrison Lake area and along projected northwesterly and southeasterly extensions of the lineament. Follow-up exploration using soil and silt sampling could use gold as well as bismuth, arsenic, antimony, and mercury as pathfinder elements.

ACKNOWLEDGMENTS

The author wishes to thank the management and staff of Kerr Addison Mines Ltd., Rhyolite Resources Inc., Harrison Lake Gold Mines Ltd., and A and M Exploration Ltd. for their assistance and cooperation. Useful discussions with M. McClaren of Trader Resource Corp., J.W.H. Monger of the Geological Survey of Canada, B. N. Church and W. J. McMillan of the British Columbia Ministry of Energy, Mines and Petroleum Resources, D. R. MacQuarrie of A and M Exploration Ltd., S. Coombe of Rhyolite Resources Inc., and R. Desjardin and A. Glendenan of Kerr Addison Mines Ltd. are gratefully acknowledged. Thanks are also expressed to the staff of the British Columbia Ministry of Energy, Mines and Petroleum Resources Laboratory and to J. Harakai of the University of British Columbia Geochronology Laboratory.

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