INTERPRETATION OF GALENA LEAD ISOTOPES FROM TEXADA ISLAND* (92F)

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INTRODUCTION

This paper demonstrates how a galena lead isotope model can be used to interpret the origin of mineralization on Texada Island, southwestern British Columbia. The showings analyzed do not contain micas or other materials suitable for traditional geochronometry, such as K-Ar or Rb-Sr dating. The speculation that some precious metal mineralization on northern Texada Island might be Tertiary in age motivated collection of some of the samples.

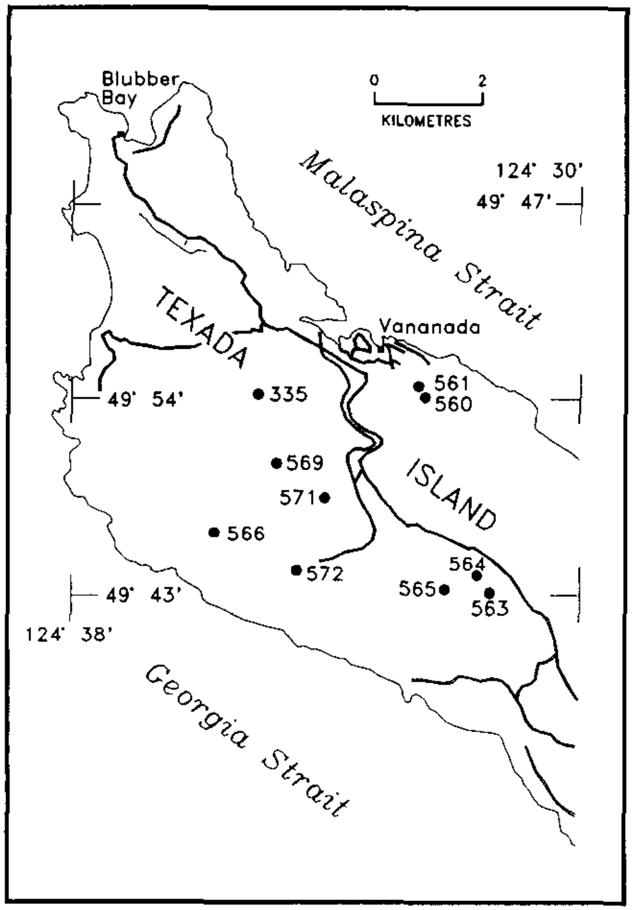

Figure 2-5-1. Northern Texada Island, showing the locations of showings with galena that were analyzed (codes for showings are prefixed by 30 in the tables that follow). Geology of the showings is described in Table 2-5-1. Data, listed in Table 2-5-2, are plotted in Figure 2-5-2.

GENERAL GEOLOGY

Texada Island (Figure 2-5-1) is within Wrangellia. Calc-alkaline plutonism of the Coast plutonic complex is superimposed on this terrane.

The northern part of the island is made up mainly of basaltic amygdaloidal flows and pillow lavas of the Texada Formation (Karmutsen Formation) overlain by massive grey limestone and white marble of the Marble Bay Formation (Quatsino Formation). These Upper Triassic formations have been intruded by diorite to quartz monzonite stocks and dikes of Jurassic age [Ettlinger and Ray, 1989; the Gillies stock, about 2 kilometres south of sample site 30565, Figure 2-5-1, has had zircons dated at Middle Jurassic (178-180 Ma years)]. Tertiary intrusions have not been identified.

Geological details of the showings are in Table 2-5-1. Most of the showings examined here are associated with sulphide-rich veins that commonly are gold and silver rich. These sulphide-rich deposits generally contain traces of galena, which facilitated this study. Exploration is currently in progress on some of these precious metal occurrences.

THE PLUTONOGENIC MODEL

Mixing-line isochrons as defined by Andrew *et al.* (1984), have been used by Reddy (1989), Leitch (1989) and Leitch *et al.* (in press) to describe linear arrays of galena lead data obtained from showings generated by plutons related to the Coast plutonic complex. Reddy (1989) called such showings "plutonogenic" to clearly draw attention to the close temporal and spatial relationships between granitic plutons and the deposits.

Deposits defined as plutonogenic by Reddy are in the Harrison Lake–Whistler–Squamish–Sechelt area of southwestern British Columbia (92G and the south-central part of 92J). These deposits, generally veins in Jurassic to Cretaceous granitic plutons or veins in adjacent country rock, yielded galena lead isotopes that plot as linear arrays on $^{207}Pb/^{204}Pb$ versus $^{206}Pb/^{204}Pb$, and $^{208}Pb/^{204}Pb$ versus $^{206}Pb/^{204}Pb$ plots. A line that approximates this trend is

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TABLE 2-5-1
GEOLOGY OF TEXADA ISLAND SHOWINGS
ANALYSED IN TABLE 2-5-2

30335 NUTCRACKER (known as the GEM mine since at least the early 1920s) comprises quartz veins and veinlets within a shear zone that is about a metre wide. The mineralization is hosted by brownish feldspar-porphyritic and amygdaloidal volcanics of the Texada Formation. The veins and veinlets reportedly carried good gold values near the surface.

30560 SHOWING is a steeply dipping massive sulphide vein in Marble Bay limestone. Mineralogy of the vein is mainly pyrite, sphalerite, galena and chalcopyrite.

30561 SHOWING has the same geological character as 30560 SHOWING — it is possibly an extension of it.

30563 ALLADIN is a showing in a 400 by 200 metre zone of hydrothermal breccia in Marble Bay limestone. Galena and pyrite occur as veinlets and disseminations.

30564 SENTINEL is a banded and brecciated polymetallic quartz vein in Marble Bay limestone. Mineralogy of the vein is mainly pyrite, sphalerite, galena and tetrahedrite.

30565 SANDY is a steeply dipping massive sulphide vein, up to a metre wide, in Marble Bay limestone. Mineralogy includes: pyrite, arsenopyrite, sphalerite, galena and tetrahedrite.

30566 SILVER TIP is a northwesterly striking subvertical quartz-carbonate vein in a shear zone that is up to a metre wide. It is hosted by feldspar-porphyritic volcanics of the Texada Formation. Mineralization includes sphalerite, pyrite, chalcopyrite, galena and gold.

30569 VICTORIA is a quartz and carbonate vein system occurring at the intersection of the Holly and Kirk Lake faults. It is hosted by amygdaloidal basalts of the Texada Formation. Mineralization includes pyrite, sphalerite, galena and gold.

30571 HOLLY FAULT mineralization occurs on the north side of the Holly fault in brecciated limestone of the Marble Bay Formation. Mineralization from the old workings carries pyrite, galena and malachite.

30572 RETRIEVER is a wide, west-striking, quartz-bearing shear zone in amygdaloidal basalt of the Texada Formation. Mineralization associated with the quartz includes: pyrite, disseminated chalcopyrite, galena and gold.

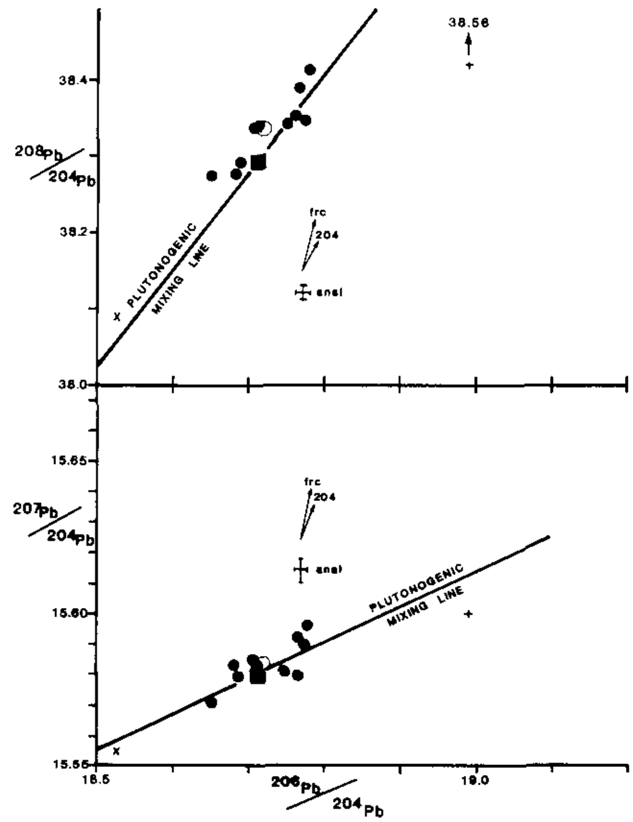

Figure 2-5-2. Lead-lead plots of galena lead isotopes from mineral deposits on northern Texada Island. The slightly elongate trend to the data plots along the "plutonogenic" trend of Reddy (1989). This implies a close temporal and genetic relationship to the plutons of the Coast plutonic complex. Data, from Table 2-5-2, are represented as follows: dot = analyses from showings on Texada Island, circle = average of analyses from Texada Island, solid square = average of plutonogenic data from Reddy (1989), cross = average of Vancouver Island Jurassic mineralization, plus = average of Tertiary Catface intrusion related mineralization from Vancouver Island.

drawn on Figure 2-5-2 and is labelled "plutonogenic mixing line". Leitch (1989), and Leitch *et al.* (in press), evaluated a similar line that was obtained from analysis of galena from showings in the Bridge River (92J) and Black Dome Mountain gold camps (92O). They concluded that the line represented a mixture of mantle and upper crustal reservoirs (compare to: Doe and Zartman, 1979, and Godwin *et al.*, 1988). They also showed that mineralization represented by this line was generated by Cretaceous to Tertiary plutons. These plutons formed near to and young away from the eastern margin of the Coast plutonic complex. Galena lead from the younger deposits generally plots in the more radiogenic portions of the line.

The lead-lead isotopic fingerprint of the galena collected from northern Texada Island is shown in Figure 2-5-2. The average for galena from Texada Island matches almost exactly the average from Reddy's plutonogenic data. The data from Texada Island are also aligned along the plutonogenic mixing line. It is significant that the area studied by Reddy is adjacent to, but east of Texada Island.

DISCUSSION

The tight cluster of galena lead isotope data for the deposits analyzed on Texada Island indicates that all the deposits are closely related. They were generated from a similar source – all at about the same time.

The plutonogenic model, and data from the Harrison Lake–Whistler–Squamish–Sechelt areas, closely describe the data obtained from Texada Island. Because the means are indistinguishable statistically, the deposits are probably the same age as those studied by Reddy (1989). The Texada mineralization therefore is Jurassic to Cretaceous in age; because several granitic bodies on Texada Island have been dated as Jurassic, this date is preferred.

The galena lead isotope model for Vancouver Island by Andrew and Godwin (1989) does not apply directly to data presented here for Texada Island. However, this model confirms that the Texada Island galena lead: (1) is not related to the Paleozoic Sicker Group, because it has a $^{206}Pb/^{204}Pb$ ratio that is greater than 18.64, and (2) has $^{206}Pb/^{204}Pb$ ratios that

TABLE 2-5-2
GALENA LEAD ISOTOPE ANALYSES[1] FROM SHOWINGS, TEXADA ISLAND

Lab Number[2]	Deposit Name	Lat. N	Long. W	$^{206}Pb/^{204}Pb$(er%)	$^{3207}Pb/^{204}Pb$(er%)	$^{208}Pb/^{204}Pb$(er%)	$^{207}Pb/^{206}Pb$(er%)	$^{208}Pb/^{206}Pb$(er%)
30335-001	NUTCRACKER	49.72	124.55	18.704 (0.017)	15.573 (0.019)	38.294 (0.031)	0.832610 (0.006)	2.047403 (0.023)
30335-001	NUTCRACKER	49.72	124.55	18.722 (0.019)	15.596 (0.021)	38.376 (0.025)	0.833066 (0.005)	2.049843 (0.010)
30335-001	NUTCRACKER	49.72	124.55	[18.712 (0.018)]	[15.584 (0.020)]	[38.339 (0.028)]	[0.832859 (0.006)]	[2.049121 (0.017)]
30560-001	SHOWING	49.75	124.53	18.777 (0.041)	15.606 (0.041)	38.430 (0.047)	0.831114 (0.009)	2.046621 (0.021)
30560-001AD	SHOWING	49.75	124.53	18.763 (0.011)	15.587 (0.014)	38.371 (0.020)	0.830709 (0.006)	2.045029 (0.011)
30560-AVG2	SHOWING	49.75	124.53	[18.766 (0.026)]	[15.592 (0.026)]	[38.388 (0.034)]	[0.830868 (0.008)]	[2.045585 (0.016)]
30561-001	SHOWING	49.75	124.54	18.776 (0.017)	15.596 (0.019)	38.415 (0.024)	0.830637 (0.006)	2.045942 (0.013)
30563-001	ALADDIN	49.72	124.52	18.791 (0.057)	15.605 (0.039)	38.381 (0.071)	0.830447 (0.042)	2.042543 (0.041)
30563-001AD	ALADDIN	49.72	124.52	18.766 (0.018)	15.583 (0.020)	38.330 (0.023)	0.830425 (0.006)	2.042556 (0.009)
30563-AVG2	ALADDIN	49.72	124.52	[18.772 (0.038)]	[15.590 (0.030)]	[38.343 (0.047)]	[0.830428 (0.024)]	[2.042554 (0.025)]
30564-001	SENTINEL	49.72	124.53	18.748 (0.019)	15.580 (0.021)	38.351 (0.024)	0.831034 (0.005)	2.045651 (0.009)
30564-001AD	SENTINEL	49.72	124.53	18.749 (0.015)	15.582 (0.015)	38.341 (0.027)	0.831039 (0.011)	2.044897 (0.018)
30564-AVG2	SENTINEL	49.72	124.53	[18.749 (0.017)]	[15.581 (0.018)]	[38.346 (0.026)]	[0.831036 (0.008)]	[2.045403 (0.014)]
30565-001	SANDY	49.72	124.53	18.763 (0.023)	15.579 (0.024)	38.365 (0.030)	0.830299 (0.009)	2.044785 (0.014)
30565-001AD	SANDY	49.72	124.53	18.761 (0.014)	15.581 (0.017)	38.344 (0.021)	0.830537 (0.005)	2.043874 (0.010)
30565-AVG2	SANDY	49.72	122.53	[18.762 (0.019)]	[15.580 (0.021)]	[38.353 (0.026)]	0.830452 (0.007)]	[2.044254 (0.012)]
30566-001	SILVER TIP	49.73	124.59	18.650 (0.017)	15.571 (0.019)	38.276 (0.030)	0.834919 (0.007)	2.052344 (0.022)
30566-001AR	SILVER TIP	49.73	124.59	18.650 (0.018)	15.571 (0.020)	38.273 (0.023)	0.834936 (0.005)	2.052215 (0.009)
30566-AVG2	SILVER TIP	49.73	124.59	[18.650 (0.018)]	[15.571 (0.020)]	[38.274 (0.027)]	[0.834929 (0.006)]	[2.052253 (0.016)]
30569-001	VICTORIA	49.76	124.56	18.680 (0.013)	15.583 (0.016)	38.277 (0.021)	0.834248 (0.006)	2.049160 (0.010)
30571-001	HOLLY FAULT	49.73	124.56	18.676 (0.015)	15.564 (0.016)	38.261 (0.023)	0.833359 (0.010)	2.048645 (0.012)
30571-001AR	HOLLY FAULT	49.73	124.56	18.689 (0.019)	15.572 (0.019)	38.291 (0.029)	0.833231 (0.011)	2.048893 (0.018)
30571-001BD	HOLLY FAULT	49.73	124.56	18.690 (0.017)	15.597 (0.019)	38.307 (0.022)	0.833509 (0.006)	2.049574 (0.009)
30571-AVG3	HOLLY FAULT	49.73	124.56	[18.684 (0.017)]	[15.577 (0.018)]	[38.286 (0.025)]	[0.833397 (0.009)]	[2.049105 (0.013)]
30572-001	RETRIEVER	49.71	124.56	18.707 (0.018)	15.585 (0.020)	38.339 (0.024)	0.833119 (0.007)	2.049458 (0.009)
TEXADA: OVERALL AVERAGE[3] (N=10)		49.72	124.55	[18.720 (0.228)]	[15.583 (0.045)]	[38.334 (0.102)]	[0.832399 (0.194)]	[2.047553 (0.138)]
PLUTONOGENIC[4]: OVERALL AVERAGE[3] (N=10)		—.—	—.—	[18.71]	[15.58]	[38.29]	[0.8327]	[2.0465]
VANCOUVER ISLAND JURASSIC[4] OVERALL AVERAGE[3] (N=2)		—.—	—.—	[18.53]	[15.53]	[38.06]	[0.8381]	[2.0539]
VANCOUVER ISLAND TERTIARY[4] OVERALL AVERAGE[3] (N=10)		—.—	—.—	[18.99]	[15.60]	[38.56]	[0.8215]	[2.0305]

[1] All analyses have been normalized to the National Bureau of Standard sample NBS981 with accepted values (absolute error) of: $^{206}Pb/^{204}Pb = 16.004$ (0.006); $^{207}Pb/^{204}Pb = 15.390$ (0.007); $^{208}Pb/^{204}Pb = 35.651$ (0.017), $^{207}Pb/^{206}Pb = 0.961635$ (0.000567); $^{208}Pb/^{206}Pb = 2.227631$ (0.001351).

[2] Suffixes on Laboratory Number: (1) A and B are additional analyses, (2) R is a repeated analysis from the specimen, (3) D is a duplicate analysis of the solution of a sample.

[3] Averages are weighted by analytical error; N = number of analyses in average. Errors quoted are expressed in per cent; er% = analytical error, except for "overall averages" where the error is one standard deviation of ratios used in average.

[4] Plutonogenic data are from Reddy (1989); Vancouver Island Jurassic data are from Godwin *et al.* (1988) for 30432 – Utluh Creek and 30699 – Island Copper; Vancouver Island Tertiary data are the average of the gold-quartz veins related to the Zeballos Tertiary intrusions (Godwin and Andrew, 1988).

are markedly lower than those from Tertiary galena deposits on Vancouver Island, which have $^{206}Pb/^{204}Pb$ ratios that are greater than 18.8. The galena lead isotope ratios for the Jurassic deposits on Vancouver Island (Table 2-5-2) plot close to the plutonogenic mixing line in Figure 2-5-2, but at a point that is less radiogenic. Tertiary galena lead isotopes from Vancouver Island plot along the more radiogenic extension of the plutonogenic mixing line at a point that is apparently younger. This position is analogous to the position of Tertiary lead on the Bralorne–Pioneer to Black Dome mixing line (Leitch, 1989; Leitch *et al.*, in press).

The spread of data along the mixing line is not related simply to the age of the deposits analyzed, although Tertiary deposits cluster near the more radiogenic end of the line.

Variations in the values for Jurassic and Cretaceous lead isotopes apparently reflect the relative abundance of upper crustal component involved in generation of the plutons that generated the mineralization. Consequently, different metallogenic characteristics might be reflected by the variations in lead isotopes. This is under investigation.

CONCLUSIONS

The galena lead isotope compositions from vein showings on Texada Island show that they all originated at the same time, from a common source. The deposits are plutonogenic: they are related genetically to intrusions of the Coast plutonic complex. The age of the mineralization is probably Jura-Cretaceous Tertiary ages are unlikely.

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