GALENA LEAD ISOTOPES OF THE TOODOGGONE EPITHERMAL GOLD CAMP, NORTH-CENTRAL BRITISH COLUMBIA* (94E)

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INTRODUCTION

The Toodoggone gold camp in central British Columbia hosts epithermal mineralization in Late Triassic rocks of the Takla Group, and in Early to Middle Jurassic rocks of the Toodoggone volcanics. The object of this lead isotope study was to: (1) determine if the deposits are coeval with the Toodoggone volcanic host rocks, as generally supposed; (2) compare the isotope signature to deposits of approximately equivalent age that are hosted in the Hazelton Group; (3) define the lead isotope fingerprint for Jurassic lead in Stikinia; and (4) determine if there are differences between the Takla-hosted and Toodoggone-hosted deposits.

DATA

Data for 26 analyses of 20 samples from 13 deposits in the Toodoggone epithermal gold camp are listed in Table 2-7-1 and plotted in Figure 2-7-1. Two of the analyses (30406-AVG and 30815-001) are probably unsatisfactory, as explained in the footnote in Table 2-7-1, and are omitted in this interpretation. Analytical details are available in Godwin *et al.*, (1988).

All galena lead isotope data from the Toodoggone epithermal gold camp plot tightly in Figure 2-7-1 about a mean of $^{206}Pb/^{204}Pb = 18.79$, $^{207}Pb/^{204}Pb = 15.59$, and $^{208}Pb/^{204}Pb = 38.32$ (Tables 2-7-1 and 2-7-2). The cluster defining the Toodoggone camp as a whole plots with, and slightly below, the lowest values in the Early to Middle Jurassic Hazelton Group cluster defined by Alldrick *et al.* (1987: their Cluster 1 with additional unpublished data).

TABLE 2-7-1
GALENA LEAD ISOTOPE DATA[1] FROM DEPOSITS IN THE TOODOGGONE AREA, CENTRAL BRITISH COLUMBIA (094E)

Sample Number[2]	Source[3]	Deposit Name	Figure Number	Lat. North (decimal deg.)	Long. West (decimal deg.)	Lead Isotope Ratios $^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$
Host Rock: Toodoggone Volcanics								
[30406-AVG[4]	1	Silver Creek (n = 2)	1	57.31	127.22	18.866	15.632	38.497]
30475-001	2	JD (Schmidt)	2	57.45	127.17	18.803	15.591	38.325
30476-001	4	AL (Bonanza)	3	57.45	127.38	18.789	15.585	38.305
30603-001	3	Norod Lake	4	57.13	126.73	18.789	15.600	38.311
30604-AVG	3,4	Metsantan (n = 3)	5	57.42	127.31	18.811	15.592	38.341
[30815-001[4]	4	Marmot Lake	6	57.38	127.18	18.837	15.607	38.425]
30877-AVG[4]	4	Shas (n = 2)	7	57.44	127.08	18.797	15.595	38.332
30878-AVG	4	JD (n = 2)	8	57.44	127.17	18.812	15.592	38.343
30880-AVG	4	Golden Lion (n = 2)	9	57.57	127.29	18.775	15.588	38.300
30881-001	4	Moose	10	57.47	127.21	18.794	15.589	38.316
AVERAGES AND STANDARD DEVIATIONS FOR TOODOGGONE VOLCANICS (n = 8)[5]						18.796±0.012	15.592±0.005	38.322±0.016
Host rock: Takla Volcanics								
30601-AVG	3,4	Baker (n = 2)	A	57.29	127.11	18.763	15.594	38.310
30602-001	3	Claw Mountain	B	57.27	127.58	18.773	15.589	38.311
30879-001	4	Shas (South)	C	57.20	126.95	18.768	15.589	38.287
AVERAGES AND STANDARD DEVIATIONS FOR TAKLA VOLCANICS (n = 3)						18.770±0.008	15.591±0.003	38.303±0.014
AVERAGES OF ALL DEPOSITS ANALYSED IN THE TOODOGGONE CAMP (n = 11)						18.789	15.591	38.316

[1] All analyses are by J. Gabites, Geochronology Laboratory, The University of British Columbia.
[2] Sample numbers with the suffix -AVG are average values; all others are single analyses. (*See* also listings in Godwin *et al.*, 1988, tables 5.5N and 5.6N.)
[3] 1 = sample from G. Gibson; 2 = sample from C. Scott; 3 = sample from L. Diakow and A. Panteleyev; 4 = sample from T. Schroeter.
[4] Analysis is not of galena; it is either of sphalerite or pyrite.
[5] Analyses in square brackets are excluded from the calculations because analyses of sulphides other than galena are commonly (but not necessarily) erratic.

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British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1988, Paper 1989-1.

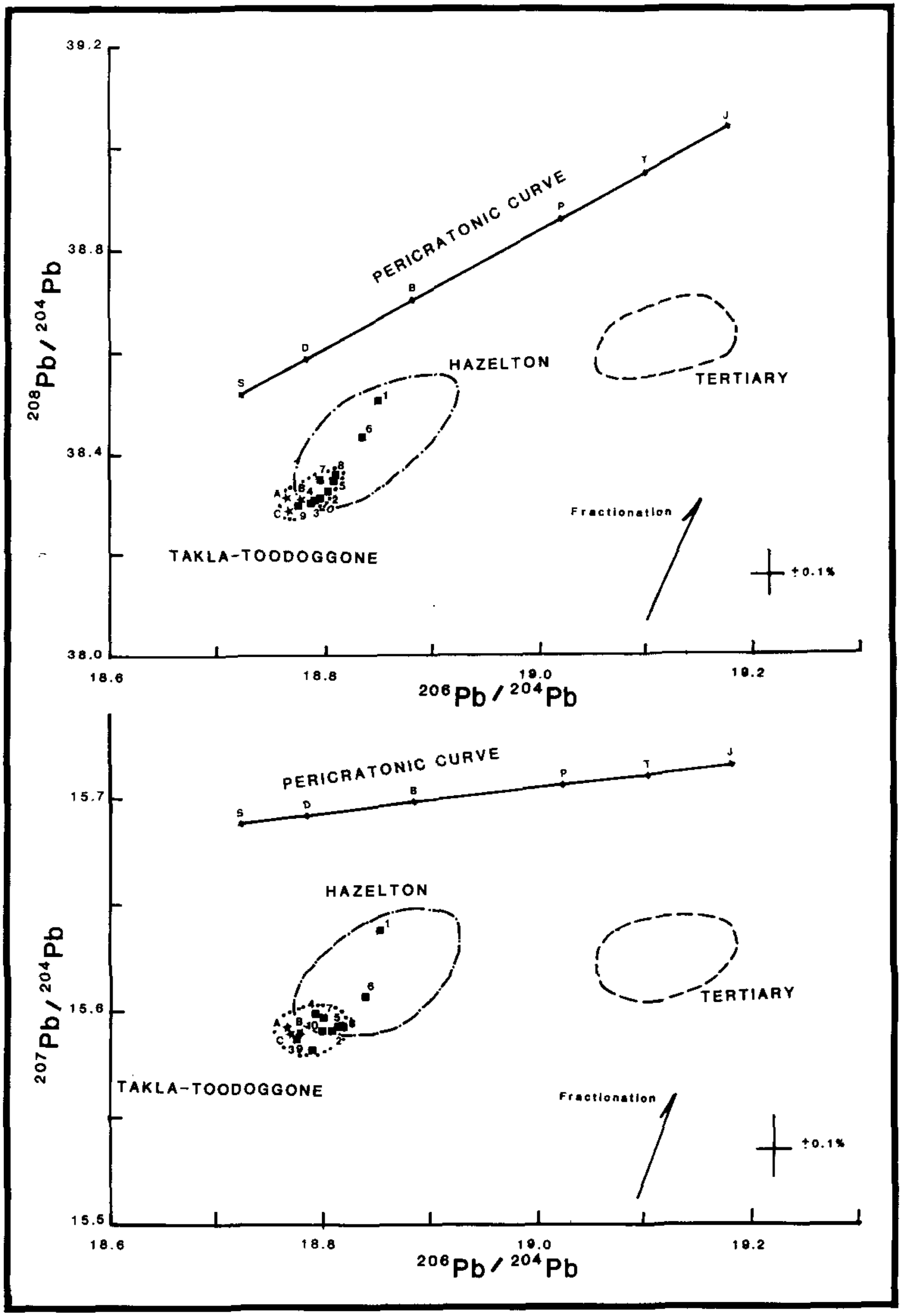

Figure 2-7-1. Lead-lead plots of galena lead isotopes from epithermal gold deposits hosted in Takla Group and Hazelton volcanics, Toodoggone Camp, central British Columbia. Data and codes identifying deposits plotted are in Table 2-7-1. Shown for comparison are part of the pericratonic curve (Goutier, 1986; Godwin *et al.*, 1988; *cf.* Godwin and Sinclair, 1982), and the clusters from the Stewart area (Alldrick, 1987: plus additional data) for Hazelton volcanics and Tertiary intrusive associated veins. The Takla — Toodoggone cluster is well defined at the lower border of the Hazelton cluster. S = Silurian, D = Devonian, B = Carboniferous, P = Permian, T = Triassic and J = Jurassic.

TABLE 2-7-2
AVERAGE LEAD ISOTOPE DATA CLUSTERS FOR DEPOSITS OF DIFFERENT AGES AND TYPES IN THE STIKINE TERRANE, BRITISH COLUMBIA

Age	Description	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$
Tertiary-Cretaceous	Intrusive-related veins, Stewart area[1]	19.15	15.62	38.63
Jurassic	Volcanogenic deposits, Hazelton Group, Stewart area[1]	18.82	15.61	38.44
Jurassic	Average of all gold deposits, Toodoggone area[2]	18.79	15.59	38.32
Jurassic	Toodoggone volcanic hosted gold deposits, Toodoggone area[2]	18.80	15.59	38.32
Triassic-Jurassic	Takla Group hosted gold deposits, Toodoggone area[2]	18.77	15.59	38.30
Triassic	Kutcho volcanogenic deposits, Kutcho area[3]	18.45	15.53	37.92

[1] Average is from data in Aldrick *et al.*, 1987.
[2] Averages are from Table 2-7-1.
[3] Average is from data in Godwin *et al.*, 1988.

The three lead isotope analyses from deposits hosted in the Takla Group plot at the left side of the overall cluster for the Toodoggone camp (Figure 2-7-1). Lead isotopes for the Takla-hosted deposits compared to those in the Toodoggone volcanics are statistically indistinct for $^{208}Pb/^{204}Pb$ and $^{207}Pb/^{204}Pb$, but are probably significantly less for $^{206}Pb/^{204}Pb$. Students t-tests show the means for $^{206}Pb/^{204}Pb$ to be significantly different at the 0.05 level, but not at the 0.01 level.

CONCLUSIONS

Clearly the Toodoggone epithermal gold deposits in Late Triassic to Middle Jurassic rocks are all closely related genetically. Lead isotope ratios from deposits in the Toodoggone camp are similar to those from deposits that are most likely cogenetic with the Early to Middle Jurassic Hazelton Group in the Stewart area of northwestern British Columbia (Table 2-7-2 and Figure 2-7-1; Alldrick *et al.*, 1987). These values, on the other hand, are markedly different from deposits of other ages in Sitikinia. Specifically, Table 2-7-2 shows that they are not at all similar to Triassic lead from the Kutcho Creek deposit, or to lead from intrusive-related Tertiary deposits in the Hazelton Group of the Stewart area. The similarity in lead isotopes between the Hazelton and Toodoggone volcanics emphasizes their common tectonogenesis within the Stikine terrane. Furthermore, Jurassic lead isotope ratios in Stikinia are now defined within a narrow range.

The similar, but slightly lower, lead isotope ratios for deposits in the Toodoggone camp (Tables 2-7-1 and 2-7-2; Figure 2-7-1), compared to those hosted by the Hazelton Group in the Stewart camp suggest:

(1) Toodoggone volcanics (and possibly Takla Group) and Hazelton Group had a similar geochemical evolution;

(2) the age of most deposits in the Toodoggone camp is possibly slightly older, at Early Jurassic (slightly different geochemical evolutions of Hazelton Group and Toodoggone volcanics also could account for the minor differences in the lead isotopes);

(3) most deposits are cogenetic with their Toodoggone volcanic host.

Lead isotopes from epithermal deposits hosted in Takla Group rocks are marginally distinct statistically from those hosted in the Toodoggone volcanics. The difference may be due to a slightly older, Late Triassic age for the mineralization in the Takla Group. This would imply a very similar geochemical evolution for the Takla and Hazelton rocks. Alternatively, and favoured by the writers, the slightly lower $^{206}Pb/^{204}Pb$, if truly distinct statistically, could be due to mixing of lead from the Toodoggone volcanics with lead from the Takla host rocks. In this case all the deposits would be the same age as the Toodoggone volcanics. This conclusion agrees with the interpretation of Clark and Williams-Jones (1988) that all gold mineralization in the Toodoggone camp was emplaced during one restricted Jurassic episode. More lead isotope analyses of deposits in the Takla Group are desirable.

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