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GEOLOGY AND GEOCHEMISTRY OF CARBONATE-HOSTED LEAD-ZINC DEPOSITS OF THE KOOTENAY ARC (82F/East Half)

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INTRODUCTION

Fieldwork for this study consisted of a preliminary investigation and sampling of carbonate-hosted lead-zinc deposits within the Kootenay arc. Lead isotope data from galena were also determined at The University of British Columbia.

Carbonate-hosted lead-zinc deposits in the Kootenay arc have been characterized as either concordant or transgressive types based on field characteristics (Fyles, 1966). In general, the transgressive mineralization occurs as vein or replacement deposits that are enriched in silver. The concordant deposits are stratiform and contain a simple base metal sulphide mineral suite with little or no precious metals. The concordant deposits have also been referred to as the Salmo or Remac-type, after several large deposits in the Salmo camp.

Lead isotope data from deposits in the Kootenay arc have been used to interpret and explain the source of lead and the ore-forming processes responsible for these deposits. Lead isotope plots for the Remac-type deposits do not conform to lead growth curves constructed for lead-zinc deposits from this region, nor can they be adequately interpreted as the result of lead mixing or lead inheritance.

A thorough analysis and comparison of the ore and gangue mineralogy, stratigraphy, and trace element and isotope geochemistry from these conformable Remac-type deposits and the younger Metaline-type deposits will provide an improved understanding of the regional ore-forming process.

BACKGROUND

The Kootenay arc is a thin, arcuate band of complexly deformed and metamorphosed volcanic and sedimentary rocks. It extends from Revelstoke, British Columbia, south along Kootenay Lake, and into Washington State, where it is covered by the Columbia Plateau flood basalts (Figure 5-11-1). The arc forms a portion of the Omineca crystalline belt.

Carbonate-hosted lead-zinc deposits are contained in Lower Cambrian Reeves/Badshot and Middle Cambrian Metaline limestone. These strata have been described as both platformal and deep-water carbonate deposits; their base metal mineralization has been variously attributed to Mississippi Valley-type processes, to exhalative processes, and to epigenetic processes superimposed on previously exhaled, stratiform sulphide accumulations (Fyles, 1966; Sangster, 1970; Höy, 1982).

LEAD ISOTOPE RESEARCH

Lead isotope analyses of galena from these deposits were investigated from the 1960s onward (Russell and Farquhar, 1960; Sinclair, 1966; P.C. LeCouteur, unpublished report, 1973; Godwin and Sinclair, 1982; Andrew *et al.*, 1984; C.I. Godwin *et al.*, unpublished report, 1987). Recent applications of lead isotopes, utilizing the ideas of "plumbotectonics", have elucidated regional lead isotope relationships. The theory of plumbotectonics is that a deposit's lead isotopic systematics are, to a degree, a function of its tectonic setting (Doe and Zartman, 1979).

Godwin and Sinclair (1982) established a "shale curve" using lead isotope data derived from stratiform, shale-hosted, massive base metal sulphide deposits in British Columbia and the Yukon Territory (Figure 5-11-2). It is assumed that lead isotope ratios that plot on this curve evolved in a similar tectonic environment; the shale curve can be a useful reference for upper continental and upper crustal lead in the Canadian Cordillera (C.I. Godwin *et al.*, unpublished report, 1987).

Andrew *et al.* (1984) noted that lead isotopic ratios from the Bluebell deposit plot below the shale curve and describe what has been called the "Bluebell curve". They interpreted this curve to represent a mixing of upper crustal (that is, shale-curve lead) with lower crustal lead.

Current investigations by C.I. Godwin, A. Andrew, J. Gabites and others at The University of British Columbia are focusing on lead isotope analyses of western Canadian tectonic belts. Remac-type deposits and the silver-rich transgressive deposits, such as those in the Ainsworth-Bluebell camp, all lie within the Omineca Belt.

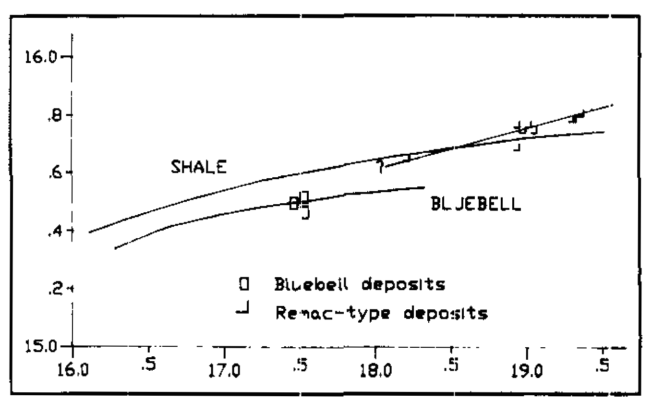

Figure 5-11-2. Lead isotope data: Bluebell curve, shale curve, and Kootenay arc, carbonate-hosted lead-zinc deposit data.

British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1987, Paper 1988-1.

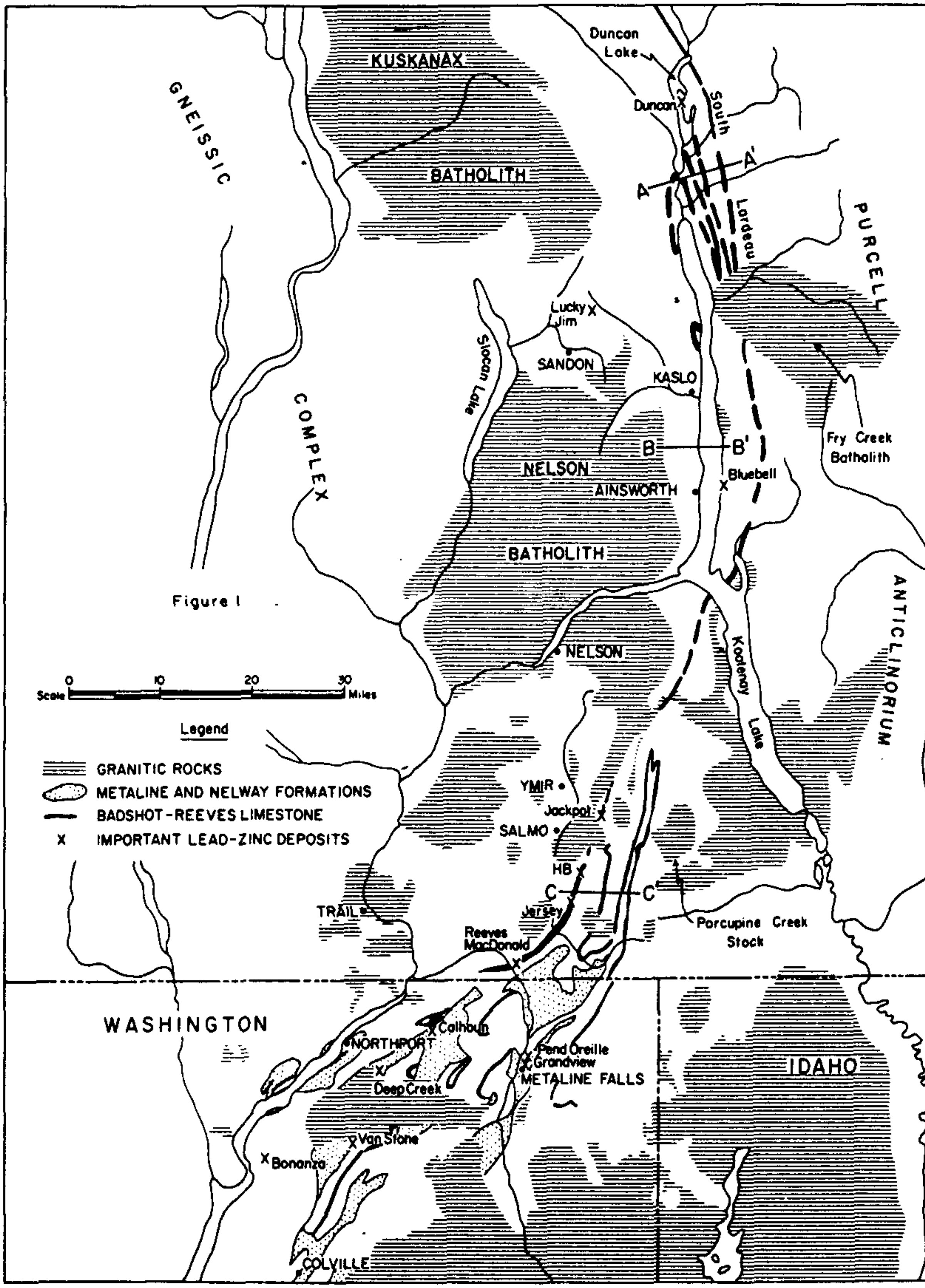

Figure 5-11-1. Geologic map of the southern Kootenay arc (after Fyles, 1970).

LEAD ISOTOPE DATA

Tables 5-11-1 and 5-11-2 are compilations of much of the data used to construct the Bluebell and shale curves. Shale curve data are applicable to the Omineca, Foreland and Selwyn belts of the Canadian Cordillera (C.I. Godwin *et al.*, unpublished report, 1987).

Table 5-11-3 is a compilation of lead isotope data from carbonate-hosted lead-zinc deposits in the Kootenay arc; Figure 5-11-2 illustrates the poor fit for the Remac-type deposits compared to the shale and Bluebell curves.

All data were precisely plotted using a Calmtech computer-aided drafting system. This system allows for easily accessed and reproducible data; all future data will be stored and plotted using this system.

PURPOSE OF STUDY

The purpose of this research is to investigate the geology of several carbonate-hosted lead-zinc deposits in the Kootenay arc, in order to identify and assess similar and contrasting geologic and geochemical features. As illustrated in Figure 5-11-2, lead data from Remac-type deposits do not fit established growth curves representative of deposits in the Omineca Belt. Relationships of Remac-type lead isotopic data with other data from the belt will be investigated.

It has been suggested that the Remac-type deposits (Jersey, Reeves MacDonald, HB, Duncan Lake and others) may be of sedimentary exhalative origin. This research will investigate the probability that they are exhalative, or at least closely associated with exhalative processes, and whether a quantification of geologic and geochemical features supports this contention. A carbonate-hosted lead-zinc exhalite analogue has been described by Russell (1978, 1986), and Hitzman and Large (1986) among others.

TABLE 5-12-1

LEAD ISOTOPE DATA: BLUEBELL CURVE[1]

	Normalized Pb Ratios		
206/204	207/204	207/206	208/206
18.347	15.532	0.847	2.130
18.144	15.522	0.855	2.139
17.982	15.513	0.863	2.146
17.817	15.503	0.870	2.154
17.695	15.496	0.876	2.160
17.587	15.488	0.881	2.166
17.288	15.465	0.895	2.181
16.694	15.436	0.910	2.200
16.630	15.401	0.926	2.219
16.285	15.358	0.943	2.241

[1] C.I. Godwin *et al.*, unpublished report, 1987.

TABLE 5-12-2

LEAD ISOTOPE DATA: SHALE CURVE[1]

	Normalized Pb Ratios		
206/204	207/204	207/206	208/206
16.101	15.385	0.956	2.222
16.341	15.425	0.944	2.206
16.809	15.494	0.922	2.176
17.263	15.551	0.901	2.148
17.704	15.598	0.881	2.123
18.132	15.636	0.863	2.101
18.402	15.657	0.851	2.089
18.525	15.666	0.846	2.082
18.667	15.676	0.840	2.076
18.728	15.680	0.837	2.073
18.828	15.686	0.833	2.069
18.967	15.694	0.827	2.063
19.045	15.699	0.824	2.059
19.123	15.703	0.821	2.056
19.259	15.710	0.816	2.050
19.394	15.717	0.810	2.045
19.526	15.723	0.805	2.040

[1] C.I. Godwin *et al.*, unpublished report, 1987.

TABLE 5-12-3

LEAD ISOTOPE DATA FROM CARBONATE-HOSTED KOOTENAY ARC LEAD-ZINC DEPOSITS[1]

Sample			Normalized Pb Ratios			
No.	Deposit	Host Rock	206/204	207/204	207/206	208/206
448	Reeves MacDonald	Reeves	19.072	15.731	0.825	2.06[illegible]
623	Bluebell	Badshot	17.478	15.481	0.886	2.170
639	HB	Reeves	19.085	15.720	0.824	2.067
640	Jackpot	Reeves	18.988	15.737	0.829	2.069
641	Jersey	Reeves	19.089	15.729	0.824	2.065
827	Blue Star	carbonate	17.529	15.642	0.892	2.178
828	Highlander	Reeves(?)	17.553	15.504	0.883	2.177
842	Rainbow	Reeves	19.277	15.749	0.817	2.149
651	Wigwam	Badshot	18.236	15.623	0.857	2.093
653	Duncan Lake	Badshot	19.413	15.779	0.813	2.055
655	Sal A	Badshot	19.343	15.760	0.815	2.052
[2]	Van Stone	Metaline	19.390	15.791		
[2]	Pend d'Oreille	Metaline	19.486	15.789		

[1] C.I. Godwin *et al.*, unpublished report, 1987; this is a compilation of Pb isotope data with text; designed for Canadian Cordillera exploration activities.

[2] From P.C. LeCouteur, unpublished report, 1973; data normalized to absolute ratios of the Broken Hill standard.

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