INTERPRETATION OF LEAD ISOTOPE DATA SOUTHERN COAST MOUNTAINS

By A. J. Sinclair and C. I. Godwin
Department of Geological Sciences, University of British Columbia

INTRODUCTION

Lead isotopic data for galena-bearing deposits and showings in the southern end of the Coast Crystalline Belt have been discussed in a regional context by Godwin, *et al.* (1980) as part of an evaluation of lead isotopic data in British Columbia. Here we consider in more detail the geological implications of these data. General characteristics of the mineral deposits in question are summarized in Table 1 and locations are shown on Figure 64.

The area is underlain principally by intrusive dioritic bodies of the Coast Crystalline Belt with potassium-argon model ages commonly in the range 80 to 120 Ma. Older sedimentary and volcanic sequences occur as local pendants or larger bodies at the margins of the Coast Crystalline Belt, and most are Jurassic or Cretaceous in age. The area is cut by Tertiary rocks including stocks and dykes of the Garibaldi volcanic suites, some of which represent volcanic feeders. Ages are commonly in the range 1 to 10 Ma (Woodsworth, *et al.*, 1978). Mineral deposits in the area are concentrated in and near pendants of volcanic sequences (Ditson, 1978; Ditson and Sinclair, this report).

LEAD ISOTOPE ANALYSES

Lead isotope data for the area were obtained in the lead isotope laboratory of the Department of Geophysics and Astronomy, University of British Columbia, as described by Godwin, *et al.* (1980). The data are published elsewhere (Godwin, *et al.*, 1980) and are presented here on Figures 65 and 66. Precision of analysis (laboratory reproducibility as one standard deviation) is about 0.1 per cent or less for the ratios reported.

INTERPRETATION OF LEAD ISOTOPE DATA

The lead isotopic data that are plotted on Figures 65 and 66 on standard diagrams used as a basis for interpretation, are characterized by a restricted range. Model ages, calculated for average values of individual deposits using the model of Stacey and Kramers (1975), are consistently too young for samples where independent age data exists, but are within the 100-million-year error traditionally assigned to such model ages. The cluster of points is within the general range shown by crustal leads but slightly on the low side, indicating development of isotopic ratios in environments that on average have a slightly lower uranium/lead ratio than the crustal average. This result, combined with the model ages that are consistently too young, indicate a multistage origin for the leads. That is to say, the present isotopic ratios developed in more than two separate uranium-thorium-lead environments. The nature or duration of these individual environments is uncertain but the multistage histories of development show crustal derivation of a significant component of the lead.

The two samples analysed from the Seneca deposit represent both the feeder pipe and the overlying layered sequence (Fig. 67) of what has been interpreted as a Kuroko-type volcanogenic deposit (Pride, 1973). Both isotopic results are identical as would be expected in such a case.

Six samples were analysed from various deposits of the Britannia area (Fig. 68). Within experimental limits all are identical. The deposits, which are now dispersed along the Britannia shear zone, are thought to have originated as two deposits (Payne, *et al.*, 1980) of volcanogenic origin. The uniformity of local isotopic ratios is consistent with a volcanogenic origin involving derivation of metals from a common or similar source. For example, the derivation of metals from the underlying volcanic suite, an implicit part of the genetic model for these deposits, is certainly consistent with the isotopic data.

Lead isotopic data from the Northair and Van Silver deposits are of particular interest from a genetic point of view. The samples include deformed, 'layered' sulphides in quartz-carbonate rock and anhedral sulphides from post-deformation, sulphide-bearing carbonate veins at Northair; intensely deformed, layered sulphides from the Tedi pit of Van Silver; and thin sulphide veinlets cutting Garibaldi volcanic rocks between the Tedi and Silver Tunnel (Blue Jack) deposits. All these varieties of mineralization have lead isotopic compositions that are identical within experimental error, a fact in accord with a complex origin for deposits in the area. Miller and Sinclair (1979) suggested that an early exhalative phase of mineralization was followed by remobilization about 80 Ma ago when nearby plutons were emplaced.

A few lead isotope data represent isolated mineral occurrences for which no detailed geological studies are available. Consequently, little can be said about them in detail. As a generalization, however, one might expect such leads to have had an important residence time in volcanic rocks, in common with associated volcanogenic deposits of Middle to Late Mesozoic age. This conclusion arises because of their similarity in isotopic composition to deposits that have demonstrable volcanogenic, particularly exhalative, origins.

A metallogenic scheme for the area (Fig. 69) incorporates an initial episode of volcanogenic mineralization which segregated lead from uranium by formation of galena. During subsequent thermal events this lead was locally remobilized to form the various post-deformation sulphide-bearing vein deposits recognized in the area.

CONCLUSIONS

Lead isotopic data are surprisingly uniform for a variety of mineral occurrences in and about the south end of Coast Crystalline Belt. Where geological controls exist it appears that this uniformity resulted because lead was derived from a thick volcanic sequence. An important implication of this data is that lead in all the deposits studied probably had the same general origin, that is, they were derived from the spatially related volcanic pile.

ACKNOWLEDGMENTS

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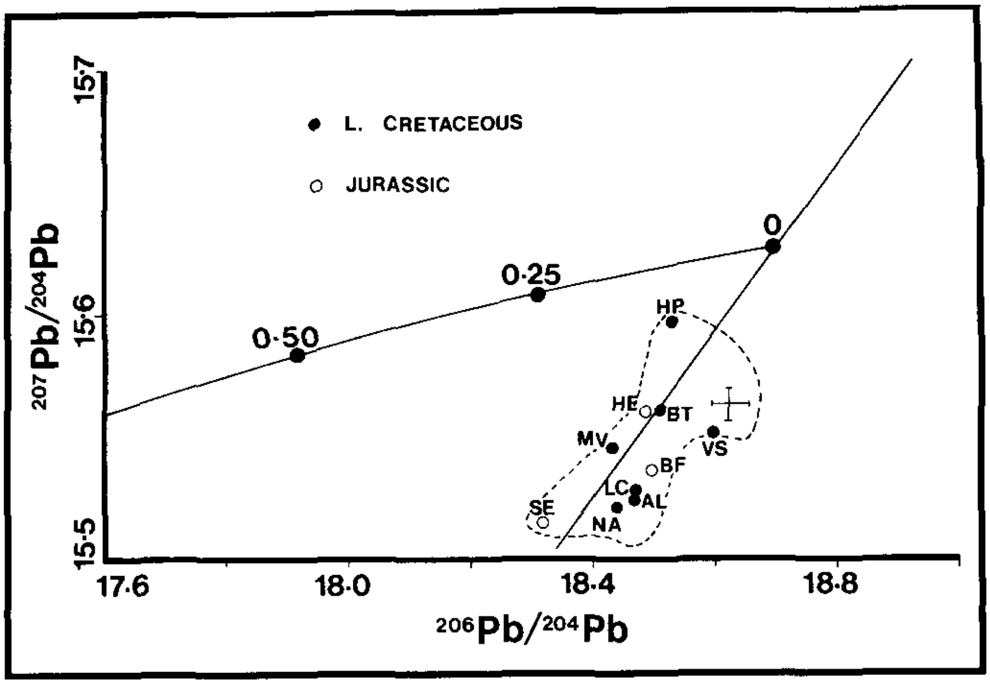

Figure 65. ^{207}Pb/^{204}Pb versus ^{206}Pb/^{204}Pb plot of average isotopic compositions for lead from deposits listed in Table 1.

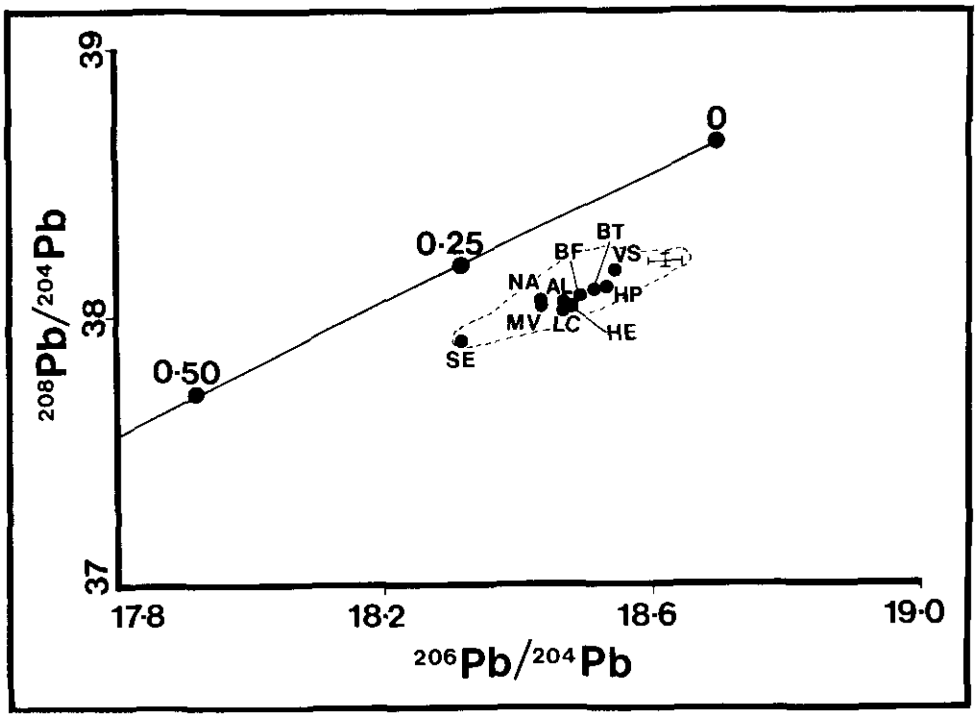

Figure 66. ^{208}Pb/^{204}Pb versus ^{206}Pb/^{204}Pb plot of average isotopic compositions for lead from deposits listed in Table 1.

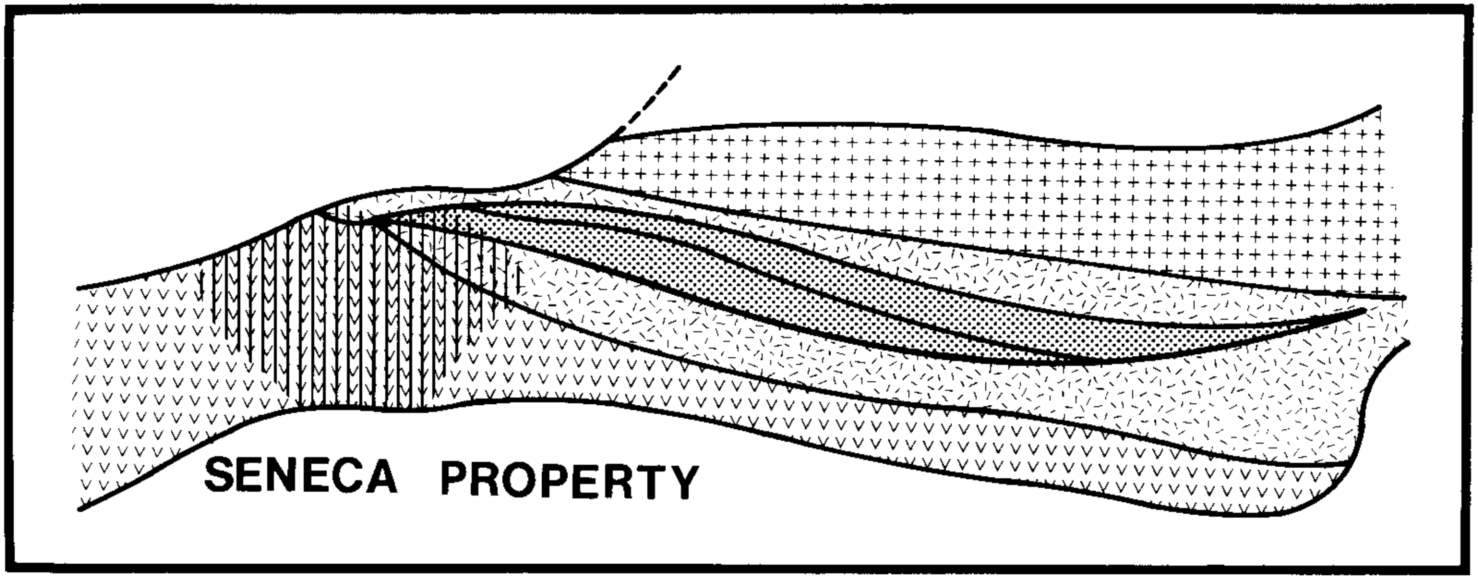

Figure 67. Schematic cross-section of Seneca deposit shows layered ore in a transition zone between underlying acidic fragmental rocks and andesitic-dacitic flows that form part of the Middle Jurassic Harrison Lake Group. A pipe zone is illustrated on the left.

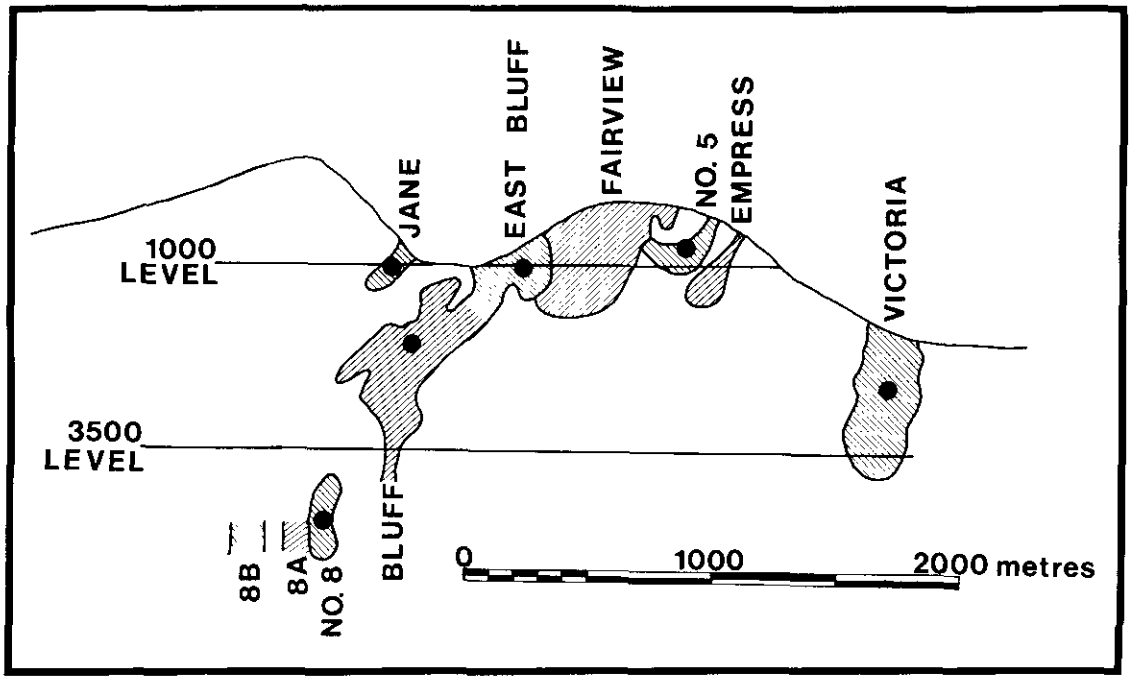

Figure 68. Longitudal section along the Britannia shear zone showing approximate outlines of individual ore zones and locations of six samples analysed for lead isotopic compositions. All six samples have identified ratios within experimental error.

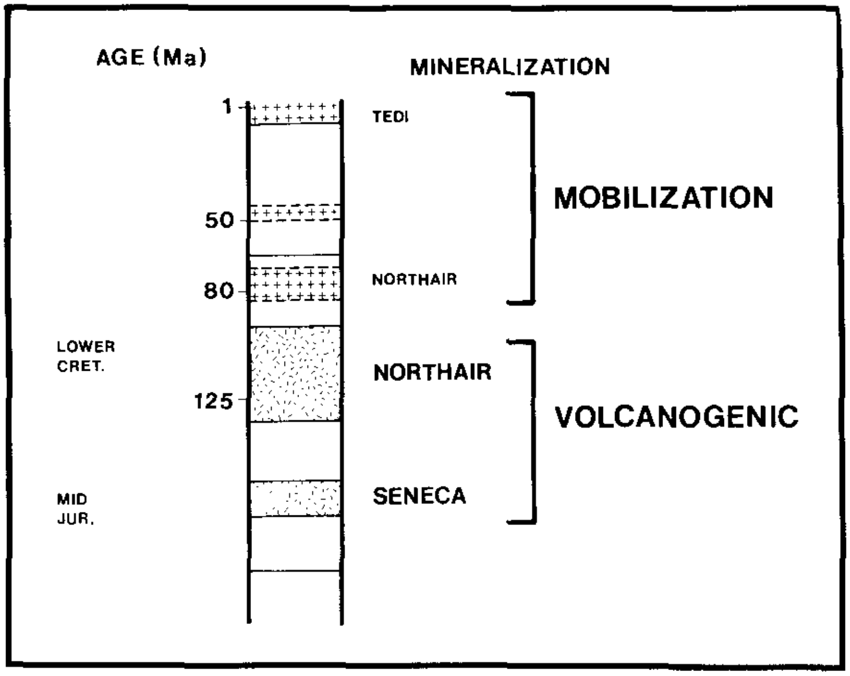

Figure 69. Outline of a general metallogeny for polymetallic sulphide deposits within volcanic rocks of the southern Coast Crystalline Belt. A volcanogenic phase of mineralization is identified in the Middle Jurassic and Lower Cretaceous. Subsequent mobilization of sulphides has occurred in response to local heat centres related to emplacement of intrusions at various times.