PRELIMINARY REPORT ON THE SILVANA MINE AND OTHER Ag-Pb-Zn VEIN DEPOSITS, NORTHERN KOKANEE RANGE, BRITISH COLUMBIA (82F, 82K)

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INTRODUCTION

More than 100 years ago, the Bluebell deposit was located by R.E. Sproule on the east shore of Kootenay Lake. This drew interest to the area and led, in 1883, to the staking of silver-lead prospects around Ainsworth. The discovery of the Payne vein in 1891, by Eli Carpenter and John L. Seaton, was followed by a staking rush and the development of the Sandon and Slocan areas into one of the more prominent mining districts in Canada at the turn of the century.

All but a few of the deposits selected for study in this project are located in the northern Kokanee Range; the remainder are in the southern Goat Range. The study area is north of Nelson, and is bounded on the west by Slocan Lake and on the east by Kootenay Lake (Figure 2-3-1). There are 370 silver-lead-zinc vein and replacement deposits within this area, the majority of which are clustered in three former mining camps: Slocan (Sandon area), Slocan City and Ainsworth (Sinclair, 1979). Although most of the deposits yielded low tonnages of high-grade ore, 39 of them produced over 10 000 tonnes of ore. At present, only the Silvana Division of Dickenson Mines Limited is operating. The deposits have a wide distribution, occurring both within the Nelson batholith and surrounding Phanerozoic sedimentary and volcanic rocks up to 12 kilometres from surface exposures of the batholith.

Regional mapping and mineral deposit investigations in the study area began in the late 1880s (Dawson, 1890) and have been described in numerous reports by the British Columbia Geological Survey Branch and the Geological Survey of Canada (Schofield, 1920; Cairnes, 1934, 1935; Maconachie, 1940; Hedley, 1945, 1952; Little 1960; Fyles, 1967; Höy, 1980). These reports comprise regional geological maps and extensive mineral deposit descriptions which remain the basic source of information on Kokanee Range geology and mineral deposits. More recently, Brown and Logan (1988) mapped the geology of Kokanee Glacier Park area and evaluated its mineral potential.

The spatial distribution of the deposits led previous geologists to almost unanimously link mineralization genetically with emplacement of the Nelson batholith (c. 165 Ma). However, geological evidence in the Ainsworth area indicates mineralization is younger than mid-Cretaceous (95 Ma) metamorphism and deformation (Fyles, 1967; Archibald *et al.*, 1984). A fluid inclusion Rb-Sr isochron at Bluebell suggests that the mineralizing event is Miocene (c. 19 Ma; Changkakoti *et al.*, 1988). Although granite-related silver-lead-zinc vein systems commonly display some zoning outward from a nearby intrusion, previous attempts to define such zoning in the study area resulted in conflicting zoning patterns (Sinclair, 1967; LeCouteur, 1973; Lynch, 1988).

The large number and areal distribution of deposits, all of which are described and coded in the MINFILE database, provide a good opportunity for a regional research project. The intent of the project is to investigate zoning patterns of metals and metal ratios, minerals, fluid inclusion temperatures and salinities, and stable and radiogenic isotopes, between the deposits and relative to the Nelson batholith, and to determine age(s) of mineralization.

METHODOLOGY

Because the study area covers parts of six 1:50 000 map sheets (82F/10, 11, 14, 15; 82K/2, 3), there is no single geological map covering the area at this scale (1:50 000). This has impeded the investigation and comparison of mineral deposits on a regional basis. Consequently, as part of this project, a new 1:50 000 regional geology map of the study area has been compiled from previous work and will be available as an Open File (Beaudoin, in prep.).

During six months of field work in the summers of 1988 and 1989, 55 deposits (Figure 2-3-1, Table 2-3-1) were selected for study. These included the 39 deposits with more than 10 000 tonnes production each: the remainder were chosen either because they were a focus of exploration activity during the project or were required to produce a more even sampling distribution for zoning studies. Samples were selected to represent the deposit paragenesis observed in outcropping veins or reported by previous investigators. In many instances, outcropping mineralization has been mined out and samples from the dump are the only material available. Alteration is rare in sedimentary but common in granitic hostrocks. Where present, alteration zones were sampled for petrographic and chemical analyses. Five weeks of detailed underground mapping and sampling were carried out in the Silvana mine (No. 50, Figure 2-3-1) over the two field seasons.

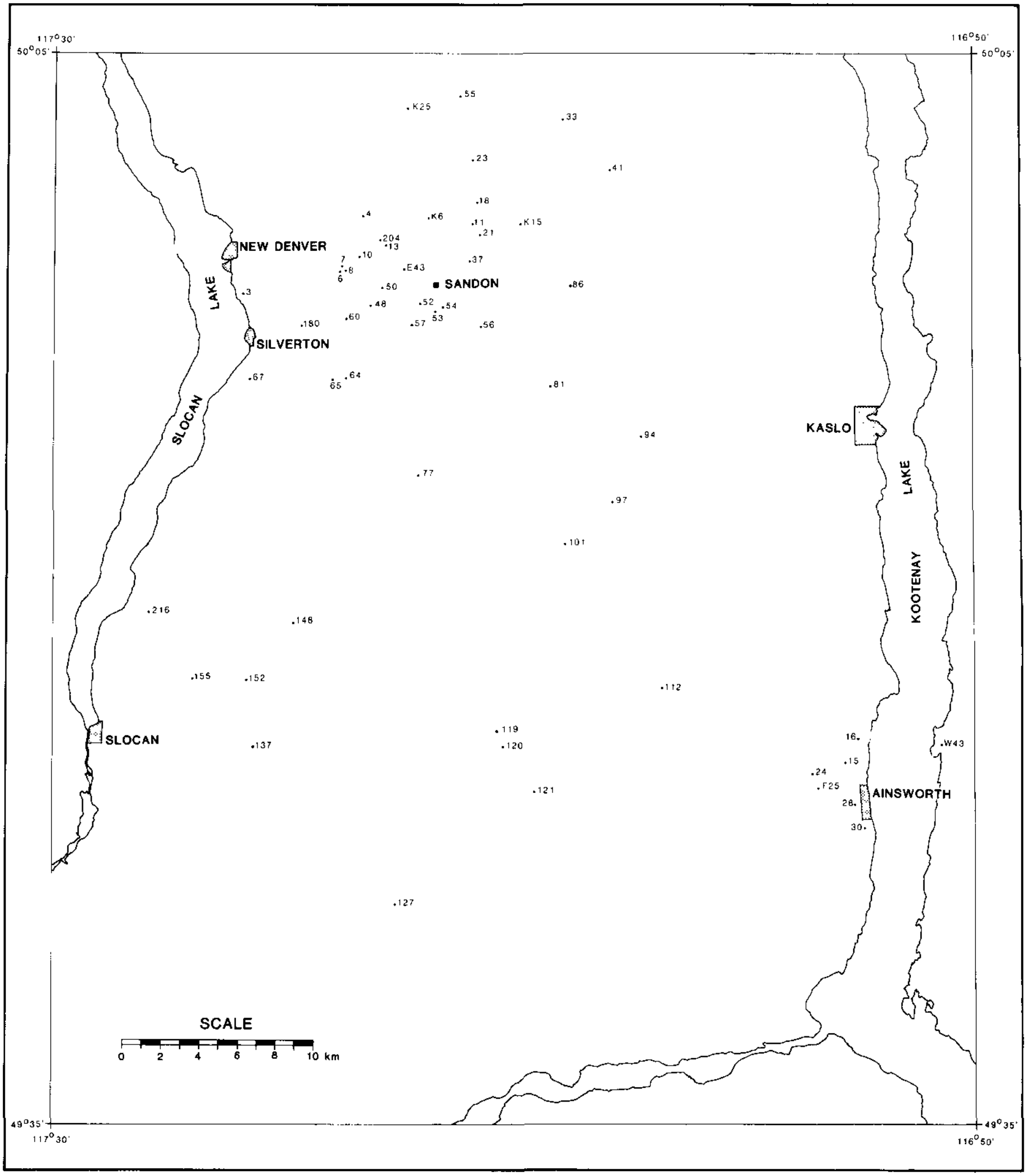

Figure 2-3-1. Location of deposits selected for the study. Numbers refer to deposits indexed in Table 2-3-1.

TABLE 2-3-1
DEPOSITS SELECTED FOR THIS STUDY
(for locations, *see* Figure 2-3-1)

No.	Name	MINFILE No.
3	BOSUN	082FNW003
4	MONITOR	082KSW004
K6	PAYNE	082KSW006
F6	SILVER BELL	082FNW006
7	IDAHO	082FNW007
8	ALAMO	082FNW008
10	QUEEN BESS	082FNW010
11	ANTOINE	082KSW011
13	HINCKLEY	082FNW013
15	HIGHLAND	082FNE015
K15	NORTHERN BELLE	082KSW015
16	FLORENCE	082FNE016
18	RAMBLER	082KSW018
21	SURPRISE	082FSW021
23	LUCKY JIM	082KSW023
24	SILVER HOARD	082FNE024
K25	McALLISTER	082KSW025
F25	NUMBER ONE	082FNE025
28	SPOKANE	082FNE028
30	HIGHLANDER	082FNE030
33	WHITEWATER	082KSW033
37	NOBLE FIVE	082FNW037
41	*CALEDONIA*	*082KSW041*
W43	WONDERFUL	082FNW043
E43	BLUEBELL	082FNE043
48	CARNATION	082FNW048
50	SILVANA	082FNW050
52	RUTH-HOPE	082FNW052
53	SILVERSMITH	082FNW053
54	RICHMOND-EUREKA	082FNW054
55	PANAMA	082KSW055
56	NOONDAY	082FNW056
57	IVANHOE	082FNW057
60	MAMMOTH	082FNW060
64	VAN ROI	082FNW064
65	HEWITT	082FNW065
67	GALENA FARM	082FNW067
77	COMSTOCK	082FNW077
81	MOUNTAIN CON	082FNW081
86	UTICA	082FNW086
94	CORK-PROVINCE	082FNW094
97	WINTROP	082FNE097
101	*INDEX*	*082FNE101*
112	SCRANTON	082FNW112
119	SLOCAN CHIEF	082FNW119
120	SMUGGLER	082FNW120
121	MOLLY GIBSON	082FNW121
127	ALPINE	082FNW127
137	METEOR	082FNW137
148	ENTERPRISE	082FNW148
152	ARLINGTON	082FNW152
155	OTTAWA	082FNW155
180	STANDARD	082FNW180
204	VICTOR	082FNW204
216	MORNING STAR	082FNW216

A major problem to be addressed in this metallogenic study is the age(s) of the mineralizing event. This is being investigated by Ar-Ar dating of micas from mineralized veins and sericitic alteration in adjacent wallrocks. Further constraints on the age(s) of mineralization are being sought by K-Ar dating of lamprophyric and gabbroic dikes, some of which are younger, and others older, than the veins.

GEOLOGY OF THE SILVANA MINE

The Silvana mine is located near Sandon, about 10 kilometres east of New Denver. Cumulative production as of June 1988 was 376 750 tonnes of ore from which 194 million grams of silver (514.7 g/t), 21.7 million kilograms of lead (5.8% Pb), and 19.3 million kilograms of zinc (5.1% Zn) were recovered.

The mine is situated in about the middle of the Main Lode fault zone which has been traced from the Standard deposit on the west (No. 180, Figure 2-3-1) to the Richmond-Eureka deposit on the east (No. 54, Figure 2-3-1). The Main Lode is a zone of faulting and brecciation up to 50 metres wide. In the currently producing eastern part of Silvana orebody, it is a rather narrow and well-defined fault zone with little, if any, penetrative fabric at its margins. The western part of the orebody, now mostly inaccessible, consists, in contrast, of a wide zone of sheared graphitic rocks. The Main Lode strikes east with a shallow dip to the south, averaging 45°; the average dip of the Silvana orebody, within the Main Lode, is about 35°. The Main Lode fault zone displays a normal and left-handed sense of movement but the amount of displacement is poorly constrained because of a lack of markers (Hedley, 1952). Although a normal and left-handed sense of shear was also determined in many locations in the eastern part of the Silvana orebody, using shear bands, the displacement could not be estimated.

DESCRIPTION OF MINERALIZATION

The orebody consists of siderite, galena and sphalerite lenses which rapidly pinch and swell in all directions. The lenses are within, and parallel with, the Main Lode fault zone. The footwall of the fault zone commonly contains subvertical siderite-sphalerite tension veins with minor galena. Hangingwall rocks rarely contain mineralized tension veins.

Plate 2-3-1. Siderite (SD) vein (about 30 cm thick) with a band of sphalerite (SP) at the upper margin. Contained within the siderite are scattered grains of sphalerite and galena. The lower part of the sphalerite band is cut by a fault (F) subparallel to the vein wall. An s-shaped tension opening in the siderite vein is filled by coarse-grained galena (GN). The galena is sheared (SGN) close to the fault plane. (GSC photo 205017).

Plate 2-3-2. Vein of strongly foliated massive galena (GSC photo 205016).

Plate 2-3-3. Polished hand-sized specimen of a vein, the top third of which is comprised of coarse-grained euhedral siderite rhombs (light grey) growing from the vein wall, intergrown with, and molded by, sphalerite (medium grey). The siderite-sphalerite zone is molded on the bottom by a narrow band of foliated galena (black). The rest of the vein consists of a chaotic aggregate of strongly deformed galena, sphalerite and siderite (scale bar is 1 cm) (GSC photo 205014).

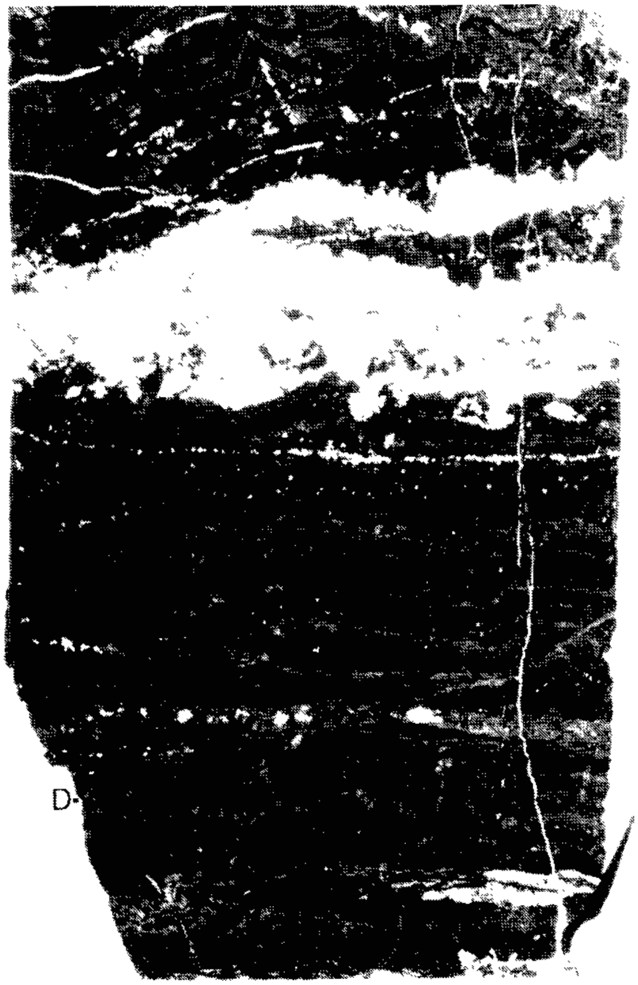

Plate 2-3-4. Photograph of a thin section of finely banded, light to dark brown sphalerite cut by a vein of carbonate (white). The lower part of the plate shows a zone of fine bands of clear sphalerite cut by a dissolution surface (D). The dissolution surface is molded by a zone of thicker and darker bands of sphalerite. The banded sphalerite is cut by veins of clear sphalerite (V) (GSC photo 205015).

The ore lenses are usually less than 2 metres thick with down-dip and strike lengths up to tens of metres. They are separated by thin (<10 cm) intervals of weakly mineralized to barren fault zones of variable length. The core of a lens may consist of massive siderite with scattered grains of sphalerite and galena (Plate 2-3-1) or massive galena (Plate 2-3-2), whereas the margins of the ore lenses are commonly composed of alternating or intergrown centimetre-wide bands of siderite and sphalerite (Plate 2-3-3). Paragenetic sequences are difficult to decipher because late movement in the fault zone has resulted in deformation of the ore lenses. Particular examples, such as illustrated in Plate 2-3-1, suggest that an initial stage of scattered galena in siderite was followed by opening of the lens and precipitation of coarse-grained galena. Late deformation resulted in sheared galena near the plane of movement, but not in areas sheltered by massive siderite and sphalerite. Foliation in galena wraps around siderite-sphalerite fragments ripped from the lens and which now "float" in foliated galena. In hand specimen, foliated galena may mold undeformed euhedral siderite prisms intergrown with, and overgrown by, sphalerite, or contain chaotic aggregates of dislocated grains of sphalerite and siderite (Plate 2-3-3). The foliation in galena is consistent with oblique normal and left-handed movement, similar to the direction of movement on the Main Lode fault zone.

Sphalerite is finely banded (Plate 2-3-4) whether it forms bands or intergrowths with siderite. Colour banding in sphalerite, oriented parallel to the vein walls, is common not only in Silvana but has been noted in other deposits in the study area, a feature not previously reported in the literature. Preliminary investigation of sphalerite banding has revealed the existence of precipitation cycles, dissolution surfaces and fracturing and veining by neosphalerite. Attempts will be made to define a local and, if possible, district-wide "sphalerite stratigraphy".

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