Carbonate-hosted sulphide and nonsulphide Pb-Zn mineralization, Cariboo terrane, BC, Canada

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Extended Abstract

Under favourable geological, climatic, topographic and hydrological conditions, the weathering of carbonate-hosted, sulphide deposits may result in the formation of economically significant direct replacement and/or wallrock replacement nonsulphide base metal deposits (Hitzman et al, 2003; Simandl and Paradis, 2009; Paradis et al. 2010).

Nonsulphide deposits were the main source of zinc in the 19th century. Due to the development of differential flotation and other metallurgical innovations during the early 20th century, the interest of explorationists shifted to sulphide ores. For a variety of environmental and economic reasons, nonsulphide deposits are again representing attractive exploration targets; however, they are commonly overlooked. The discovery rate of nonsulphide deposits in British Columbia will depend largely on the ability of the explorationists to recognize nonsulphide zinc and lead minerals, and to understand the mobility of base metals in near surface environments and the parameters that cause their precipitation as base metal carbonates, silicates or oxides.

The Cariboo terrane of central BC (Figures 1 and 2) hosts several well known base metal mineral deposits, including polymetallic Ag-Pb-Zn (±Au) veins, carbonate and sediment-hosted massive sulphides [i.e., Zn-Pb Mississippi Valley-type (MVT), sedimentary exhalative Zn-Pb-Ag (SEDEX), Besshi-type massive sulphides (VHMS)], and gold placers. Carbonate-hosted nonsulphide base metal deposits are commonly overlooked.

Excellent examples of Zn-Pb sulphides and “mixed ores” (rocks consisting of sulphide and nonsulphide minerals) crop out on the Cariboo Zinc property (Figures 2 and 3). Mineralization is concentrated along a favourable northwest-trending, dolomitic belt about 8 km long (Figure 3). It consists of pervasive fine-grained sulphide and nonsulphide disseminations and aggregates forming pods and masses, sulphide- and nonsulphide-bearing quartz (±calcite) veins, and crackle breccias. Sulphides are galena, sphalerite, and trace amounts of pyrite. Nonsulphides are smithsonite, hemimorphite, cerussite, hydrozincite, and possibly anglesite. The main showings, from west to east, are Canopener, DeBasher, Flipper Creek, Dolomite Flats, Main, Gunn and Que (Figures 4, 5, 6, 7, 8 and 9).

In most occurrences, the spatial continuity and/or the close spatial relationships in combination with morphological similarities between sulphide and associated nonsulphide zones suggest direct-replacement of sulphides by nonsulphide base-metal-bearing minerals. The main exposure at the Gunn showing is an excellent example of a carbonate-hosted, nonsulphide, base-metal deposit formed by the direct replacement of sulphides.

The area was covered by detailed gravity survey (Luckman, 2008). The determination of physical characteristics of mineralized (Pb-Zn sulphide and nonsulphide) rocks will be useful for the design of future exploration programs and for re-interpretation of existing gravity surveys. Mineralogical, geochemical and isotope studies are underway.

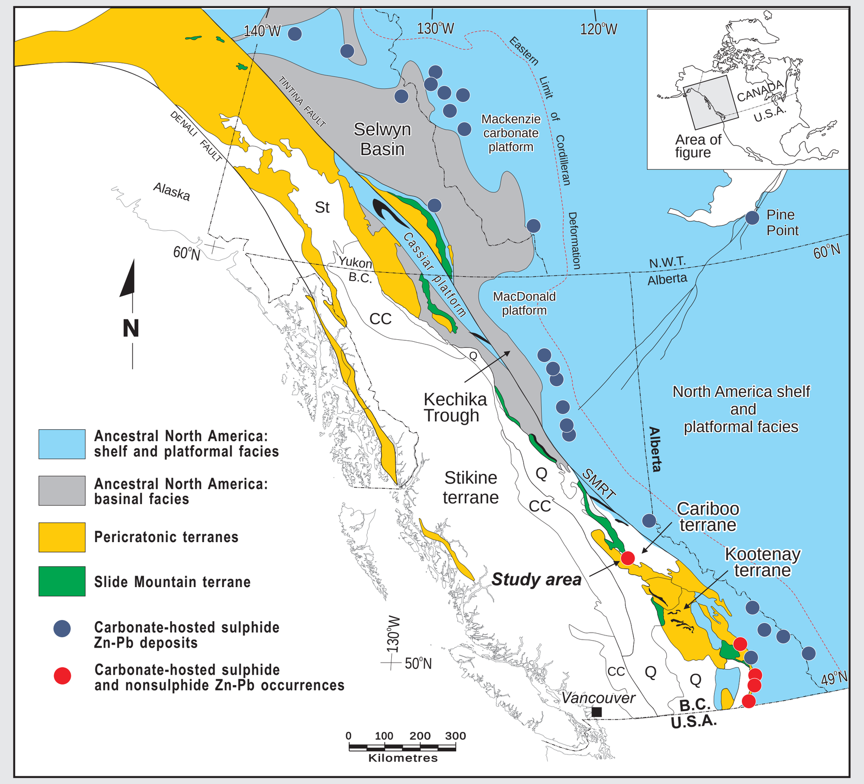

Figure 1. Location of the Cariboo terrane and the study area (Cariboo Zinc property) with respect to other significant carbonate-hosted sulphide and nonsulphide occurrences in the northern cordillera (modified from Nelson et al., 2002, 2006). Abbreviations: St - Stikine terrane, CC - Cache Creek, Q - Quesnel terrane, SMRT - southern Rocky Mountain trench.

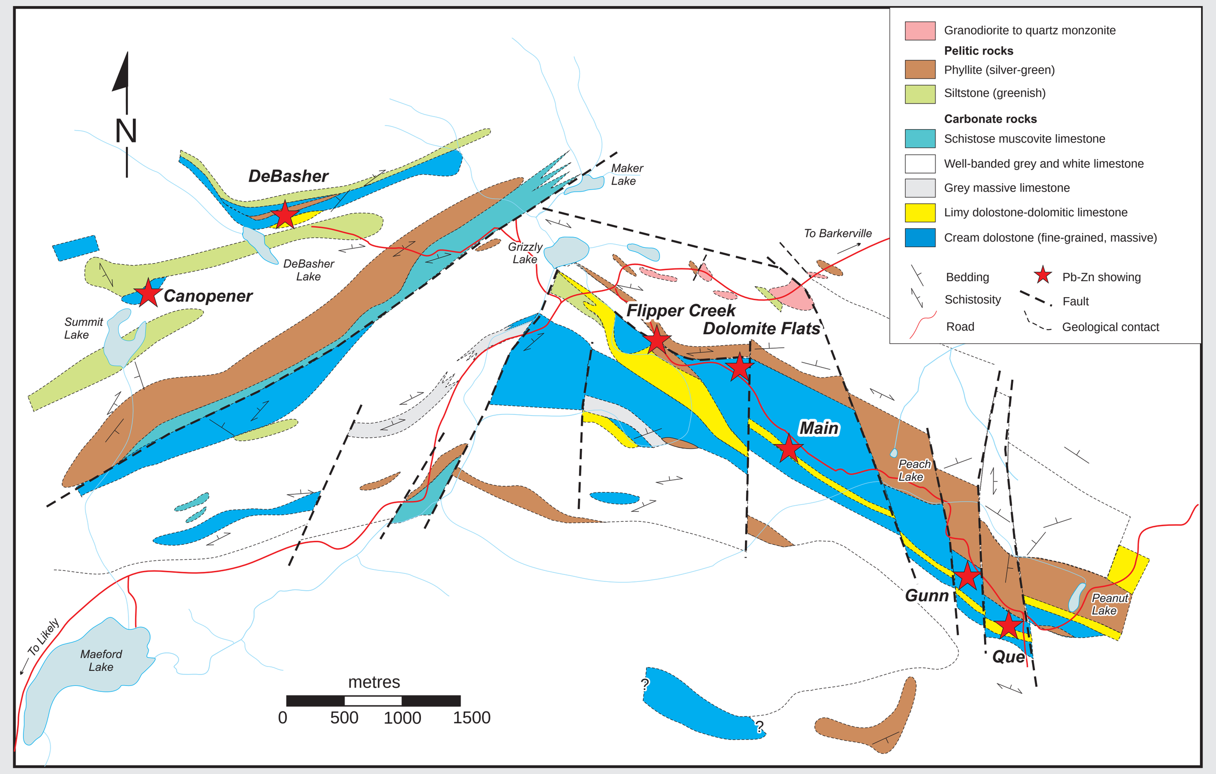

Figure 3. Geology of the Cariboo Zinc property area showing the location of the Canopener, DeBasher, Flipper Creek, Dolomite Flats, Main, Gunn, and Que showings (from Lormand and Alford, 1990).

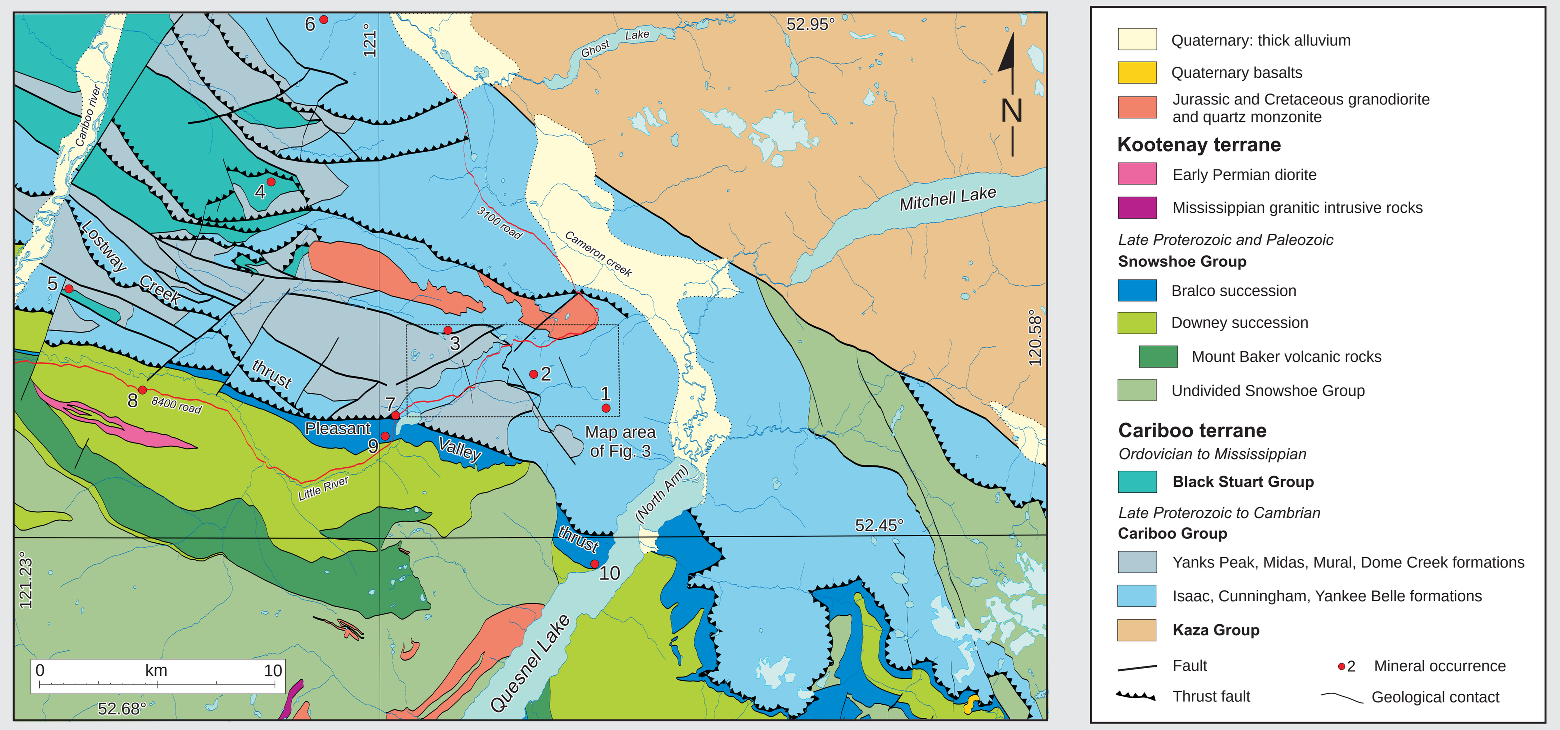

Figure 2. Regional geological setting of the study area (after Campbell, 1978; Struik, 1983a, b, 1988; Ferri and O'Brien, 2003), east-central BC. The dotted rectangle is the area covered by Figure 3. Mineral occurrences, according to BC MINFILE (BCGS, 2009): 1 - Sil (corresponds to the Gunn and Que showings in this study), 2 - Grizzly Lake (corresponds to the Flipper Creek, Dolomite Flats, and Main showings in this study), 3 - Lam (corresponds to the DeBasher showing in this study), 4 - Comin Throu Bear, 5 - Maybe, 6 - Mt Kimball, 7 - Maeford Lake, 8 - Ace, 9 - Mae, 10 - Cariboo Scheelite. Occurrences 1, 2, and 3 form the Cariboo Zinc property.

Characteristics of Cariboo zinc occurrences

Host rocks: Fine-grained cream-coloured dolostone and limy dolostone.

Texture/structure:
Sulphide and nonsulphide Pb-Zn minerals occur as disseminations, replacement zones, and fracture-, vein- and breccia-fillings.

Ore mineralogy:
Sulphides = galena, sphalerite and trace amounts of pyrite.
Nonsulphides = smithsonite, hemimorphite, cerussite, hydrozincite and anglesite (?).
Gangue minerals = dolomite, calcite, quartz, and locally barite.

Alteration: Dolomitization and silicification pre-dating, or contemporaneous with sulphides and pre-dating Pb-Zn nonsulphides.

Ore controls:

- Pb-Zn occurs along a SE-trending belt about 8 km long. It is confined to a stratabound zone restricted to dolomitic carbonates, adjacent to phyllite.
- Historical reports suggest that Pb-Zn mineralization is largely fault-controlled; however we were unable to confirm this control during our short visit.
- Nonsulphides are derived from sulphide mineralization in the near surface environment. At depth, nonsulphide mineralization may be limited by the level of the water table. Karst may be present in the area; however, its importance as an ore control remains to be confirmed.

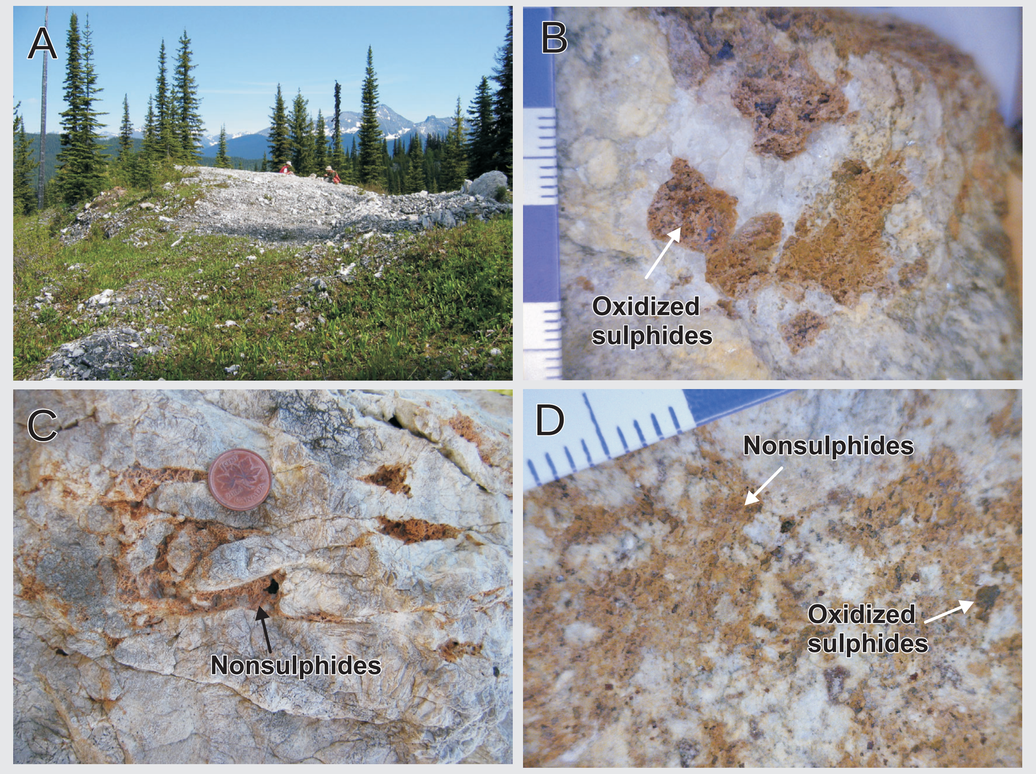

Figure 4. Dolomite Flats prospect. A) Typical outcrop exposure in the Dolomite Flats area. B) Orange-brown patches corresponding to oxidized sulphides disseminated in the dolostone. C) Fracture-filling oxidized sulphides (nonsulphide) forming boxwork texture in the dolostone. D) Close-up of fine grains and aggregates of nonsulphides and oxidized sulphides in the dolostone. Smallest subdivision on the scale corresponds to 1 mm.

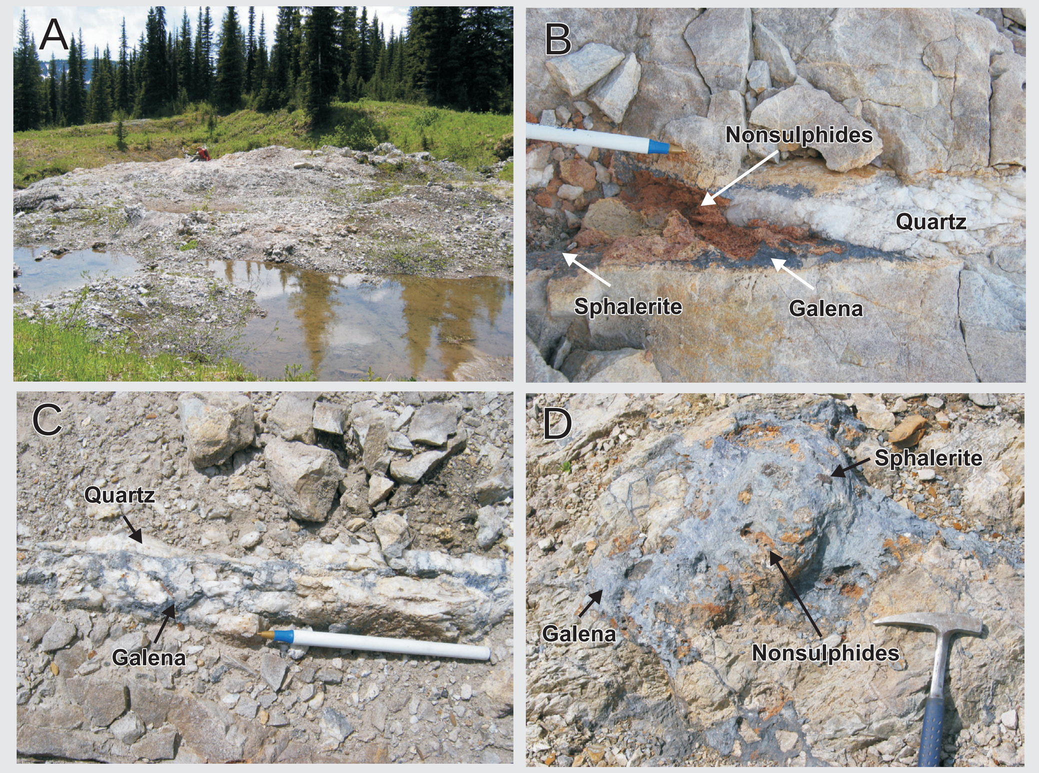

Figure 5. Main prospect. A) Main trench. B) Quartz-sphalerite-galena-nonsulphide (after sphalerite) vein. C) Quartz-galena vein. D) Pod of galena, nonsulphides (cerussite) and sphalerite that forms part of a vein-breccia system.

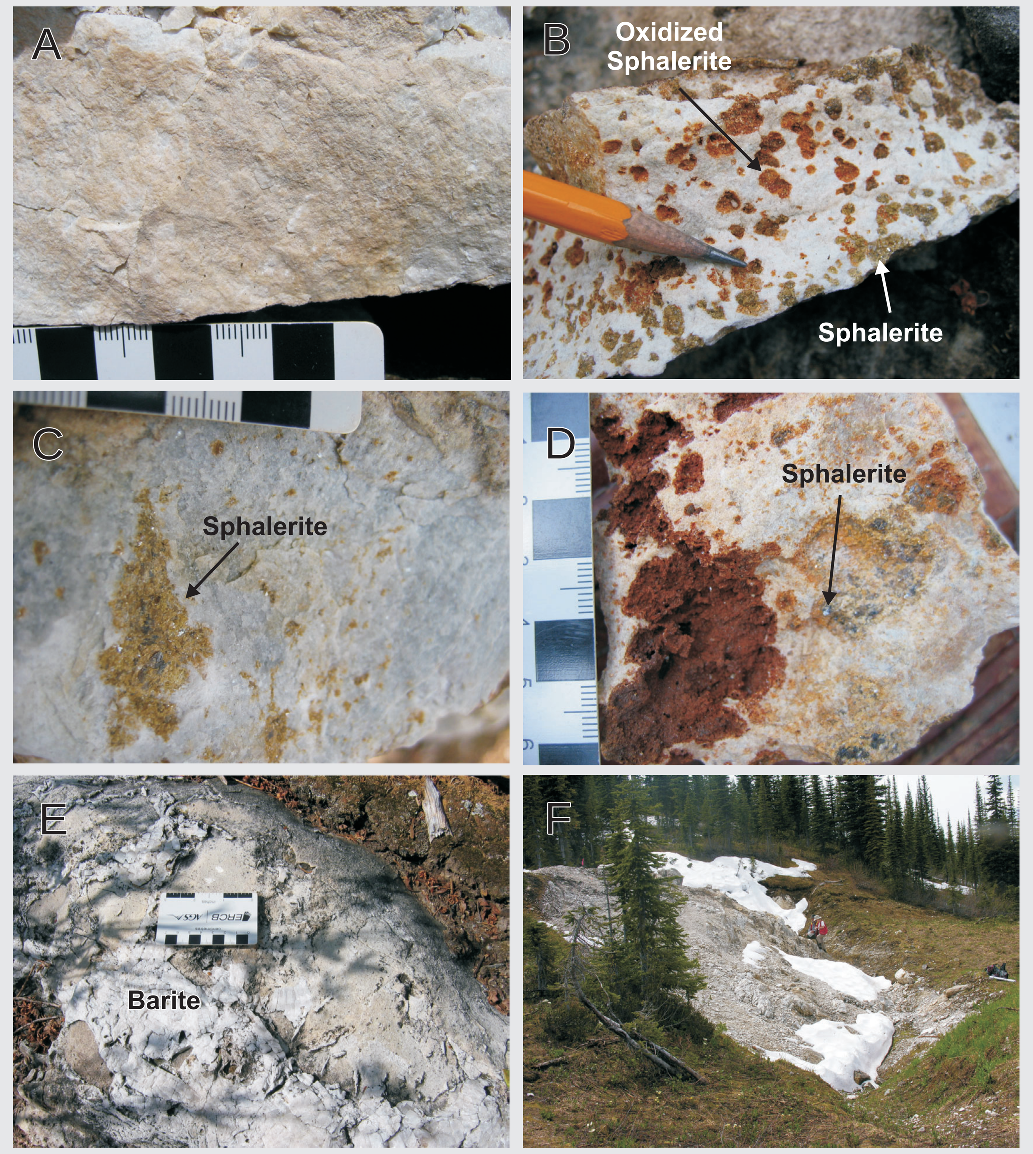

Figure 6. Gunn showing. A) Fine-grained recrystallized white dolostone. B) Disseminated oxidized (orange) and fresh (yellowish) sphalerite in the fine-grained dolostone. C) Aggregates of fresh yellow sphalerite in the fine-grained white dolostone. D) Oxidized reddish brown sulphides (presumably sphalerite) in the white dolostone. E) Barite-galena-sphalerite vein crosscutting the dolostone (only barite is clearly visible in the photograph). F) Main Gunn excavation partially covered by snow.

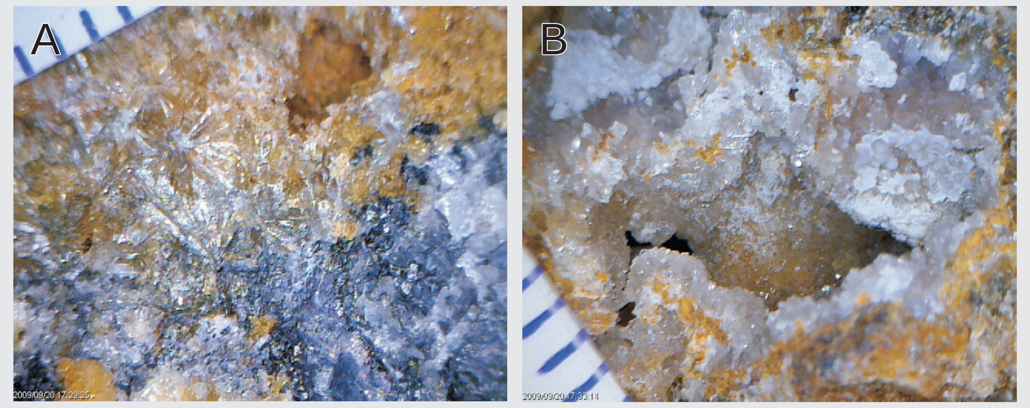

Figure 7. Gunn showing. A) White to grey, translucent to transparent radiating crystals, 2-3 mm in length (probably cerussite). B) Stubby white transparent crystals (probably anglesite) lining cavities. Scale is in millimetres.

Figure 8. Que showing. A) Shallow exploration trenches (arrow), stripped outcrops and subcrops. B) Close-up view of nonsulphide minerals (orange and white). C) Large angular nonsulphide-bearing blocks. D) Radiating tabular translucent crystals of cerussite in cavity. Scale is in millimetres.

Figure 9. Galena nodules discovered in a north-flowing stream less than 50 m upstream from high-grade nonsulphide boulders shown on Figure 8c (Que showing).

Summary

Carbonate-hosted nonsulphide Pb-Zn deposits of south-eastern BC (Figure 1) were covered by Simandl and Paradis (2009). This present study demonstrates that nonsulphide Pb-Zn deposits can be found much further north than previously anticipated. Results of ongoing mineralogical, geochemical, and isotopic studies will contribute to a better understanding of these deposits. Estimates of physical properties of nonsulphide-bearing rocks may help exploration programs and drill target selection.

Suggested reference:

Paradis, S., Simandl, G.J., Bradford, J., Leslie, C. and Brett, C. (2010): Carbonate-hosted sulphide and nonsulphide Pb-Zn Mineralization, Cariboo terrane, British Columbia; British Columbia Ministry of Energy, Mines and Petroleum Resources; Geofile 2010-4, poster.

References:

For complete list of references, please consult:
Paradis, S., Simandl, G.J., Bradford, J., Leslie, C. and Brett, C. (2010): Carbonate-hosted lead-zinc mineralization on the Cariboo zinc property, Quesnel Lake area, east-central British Columbia (NTS 093A/14E, 15W); in: Geological Fieldwork 2009, BC Ministry of Energy and Mines and Petroleum Resources, Paper 2010-1, p. 69-82.