# Ore and Alteration Textures from Co-Bearing Iron Skarns: Examples from Vancouver and Texada Islands

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## Introduction

Skarns are one of the largest groups of limestone-hosted base and precious metal deposits (Meinert et al., 2005), and are a particularly abundant deposit type in British Columbia (Ray, 2013). In recent years skarn deposits have received renewed attention from the mineral exploration industry as they commonly contain critical minerals, such as Zn, W, Sn, Mo, Cu, **Co**, Ni, Bi, and In. Vancouver Island, Texada Island, and the southern portion of Haida Gwaii contain numerous Cu- and Au-bearing **iron skarns**, with >89 occurrences (MINFILE, 2006), all of which occur along the interface between **Jurassic-aged intrusions, massive carbonate rocks, and arc volcanic rocks** (Ray, 2013). These occurrences were primarily developed or prospected for Fe, Cu, Au, and Ag, but are also **the most common host of known Co mineralization in the Wrangel terrane**. Of the occurrences with known Co mineralization, nine are developed prospects and past-producing mines, the largest of which include the **Merry Widow and Texada deposits**.

## Skarns

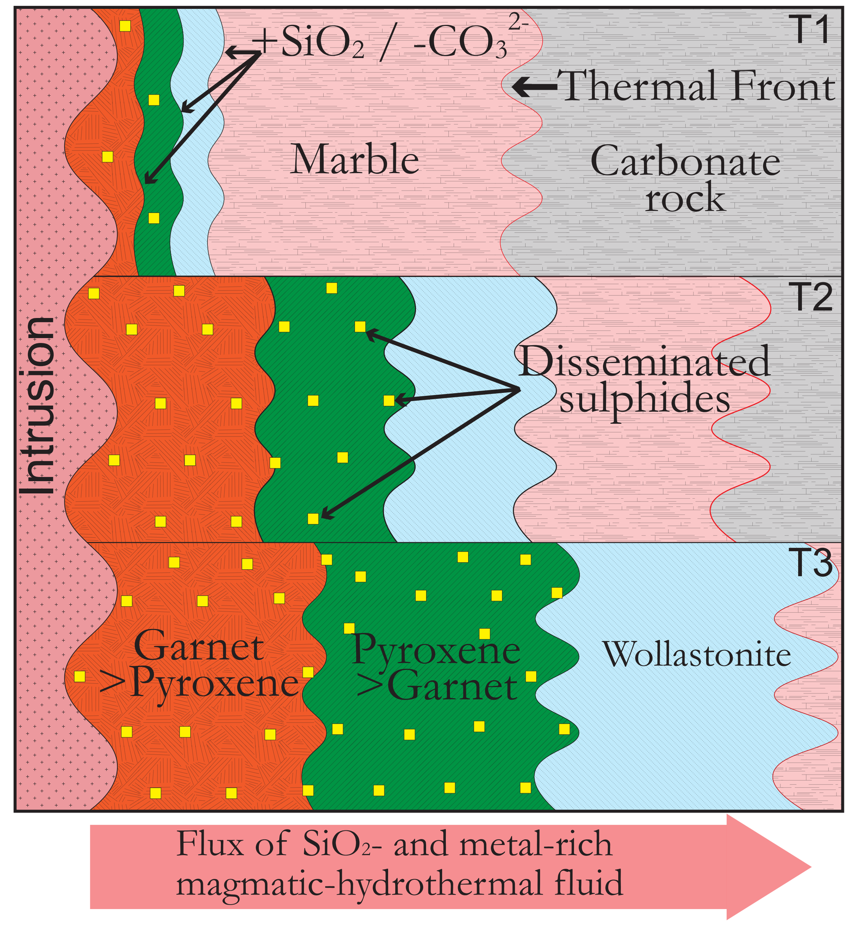


Fig. 1. Time-iterative diagram of magmatic-hydrothermal skarn formation Modified from Meinert et al., 2005.

Fig. 2. Coarse-grained garnet-quartz-scheelite skarn, Dimac Mine, Clearwater, BC. From Ray, 2013

Skarns are characterized by broad zones of garnet-rich calc-silicate alteration and sulfide mineralization that extend outward from felsic-intermediate intrusions and replace carbonate sedimentary host rocks (Meinert et al., 2005).

The **magmatic-hydrothermal model** for skarn formation involves:

1. Exsolution of metal-rich, $SiO_2$- charged hydrothermal fluids from a crystallizing intermediate to felsic intrusion and its outward flux into carbonate sedimentary host rocks
2. Calc-silicate formation via the loss of $CO_3^{2-}$ from carbonate sedimentary rocks and its replacement with $SiO_2$
3. Precipitation of sulfide and oxide minerals in response to fluctuations in pressure, temperature, or pH.

**Iron skarns** are distinct from other skarn varieties in that they are associated with **gabbroic intrusions**, host **massive magnetite** with variable **Co-bearing massive sulphide mineralization**, and **lack hydrothermal quartz** (Ray, 2013). These features likely relate to genetic processes that differ from those involved in the formation of conventaional base-metal skarns, and that drive enrichment in Fe and critical minerals.

## Co-bearing iron skarns: Distinctive textures of ore and alteration

Co-bearing iron skarns are the subject of ongoing research by the British Columbia Geological Survey focused on characterizing the distribution and occurrence of critical mineral deposits in the province. The Co-bearing iron skarns of Vancouver and Texada islands (**Fig. 3**) are characteristic examples of this deposit type, and share distinctive textural and mineralogical features that differentiate them from other skarn varieties. These include 1) massive magnetite orebodies comprised of euhedral magnetite and calcite crystals (**Fig. 4**); 2) Cu-Au-Co-bearing massive sulphide orebodies enveloped by course-grained (5->10 cm) euhedral calcite (**Fig. 5**); 3) carbonate and calc-silicate alteration formed primarily in igneous silica-rich host rocks (**Fig. 6**); 4) magnetite-calcite ores with unidirectional actinolite and magnetite crystals.

## Vancouver and Texada islands

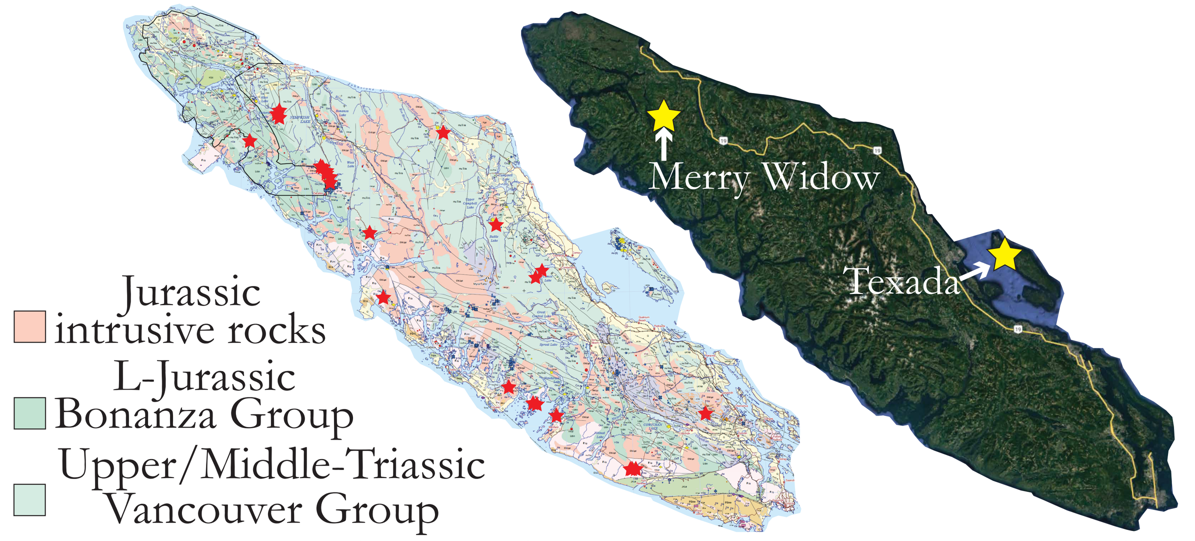


Fig. 3. Geologic map and corresponding satellite image of Vancouver and Texada islands showing the locations of irons skarns (red stars), and the Merry Widow and Texada deposits (yellow stars). Geologic map from Geoscience BC map 2013-NVI-1-2

## Euhedral magnetite in massive ore

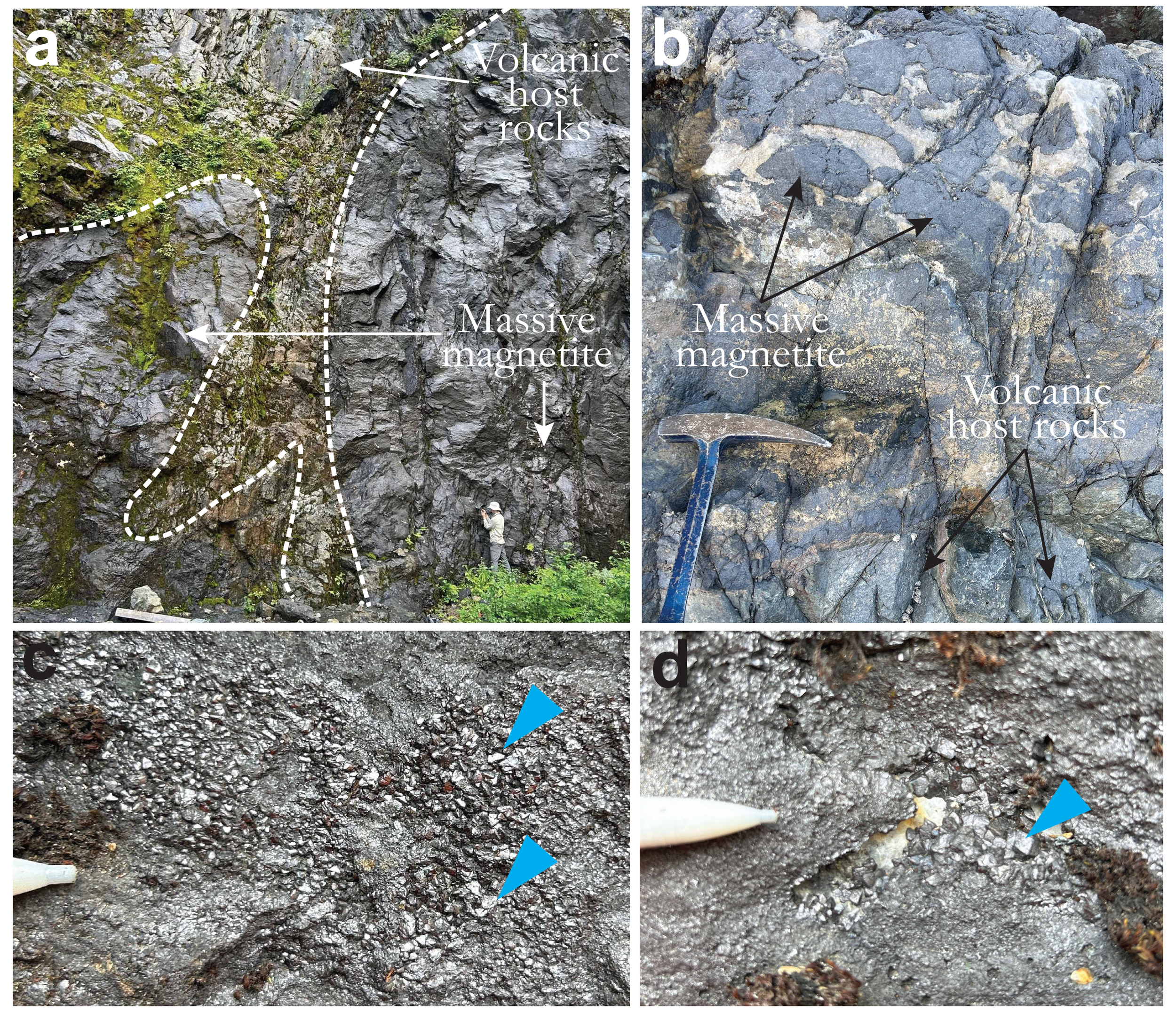


Fig. 4. Massive magnetite-calcite orebodies at the Merry Widow (a, c, d) and Texada (b) deposits. At the outcrop scale, the orebodies comprise aggregates of coarse euhedral magnetite crystals (blue arrows) like those shown in panels (c) and (d).

## Co-bearing sulphides and euhedral calcite

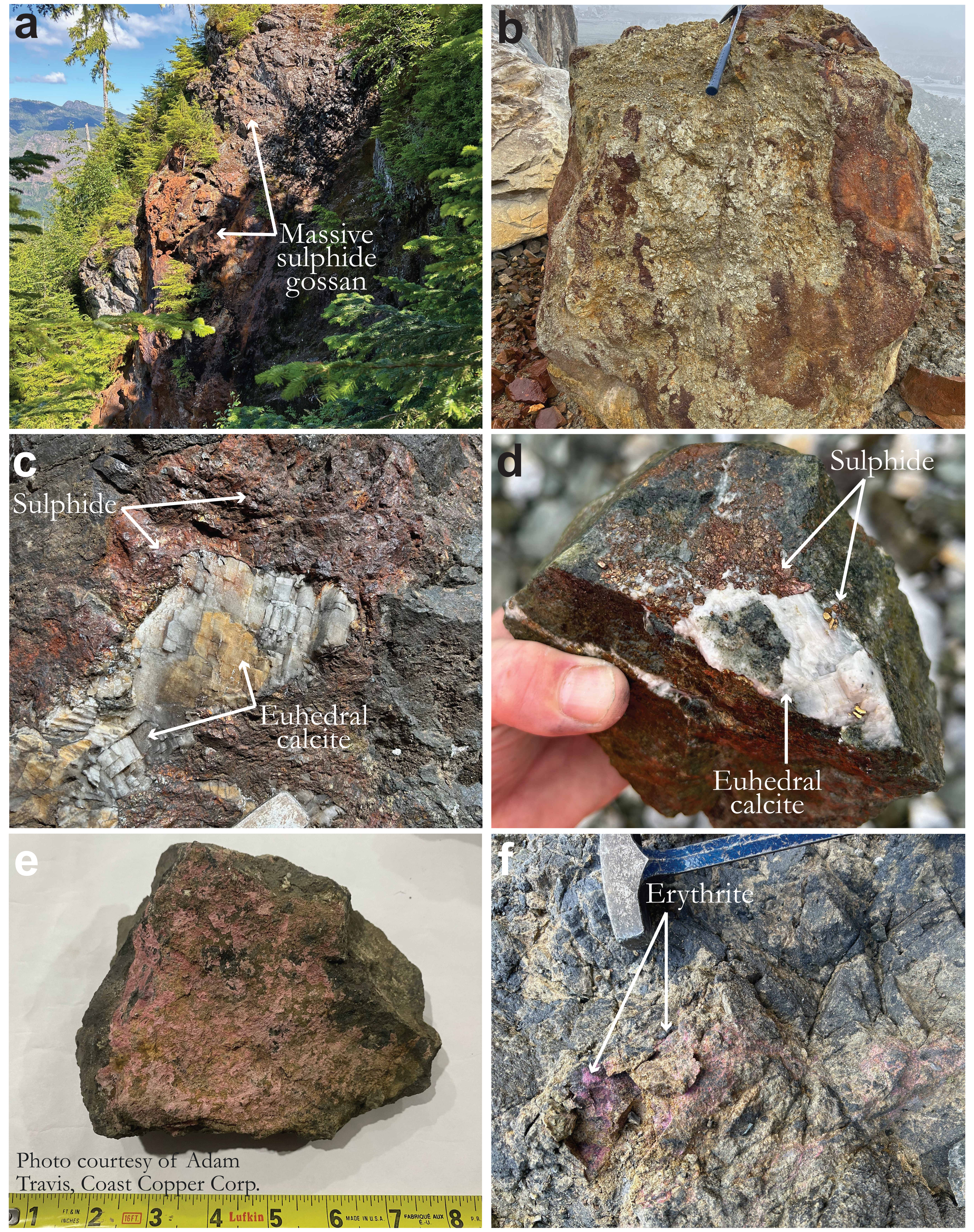


Fig. 5. a-d) Massive sulphide from the Merry Widow (a, c) and Texada (b, d) deposits. Euhedral calcite, like that shown in (c) and (d) is always associated with sulphide mineralization. e, f) Erythrite (Co arsenate) from the Merry Widow (e) and Texada (f) deposits formed via weathering of primary Co- and As-sulphide.

## Calc-silicate alteration

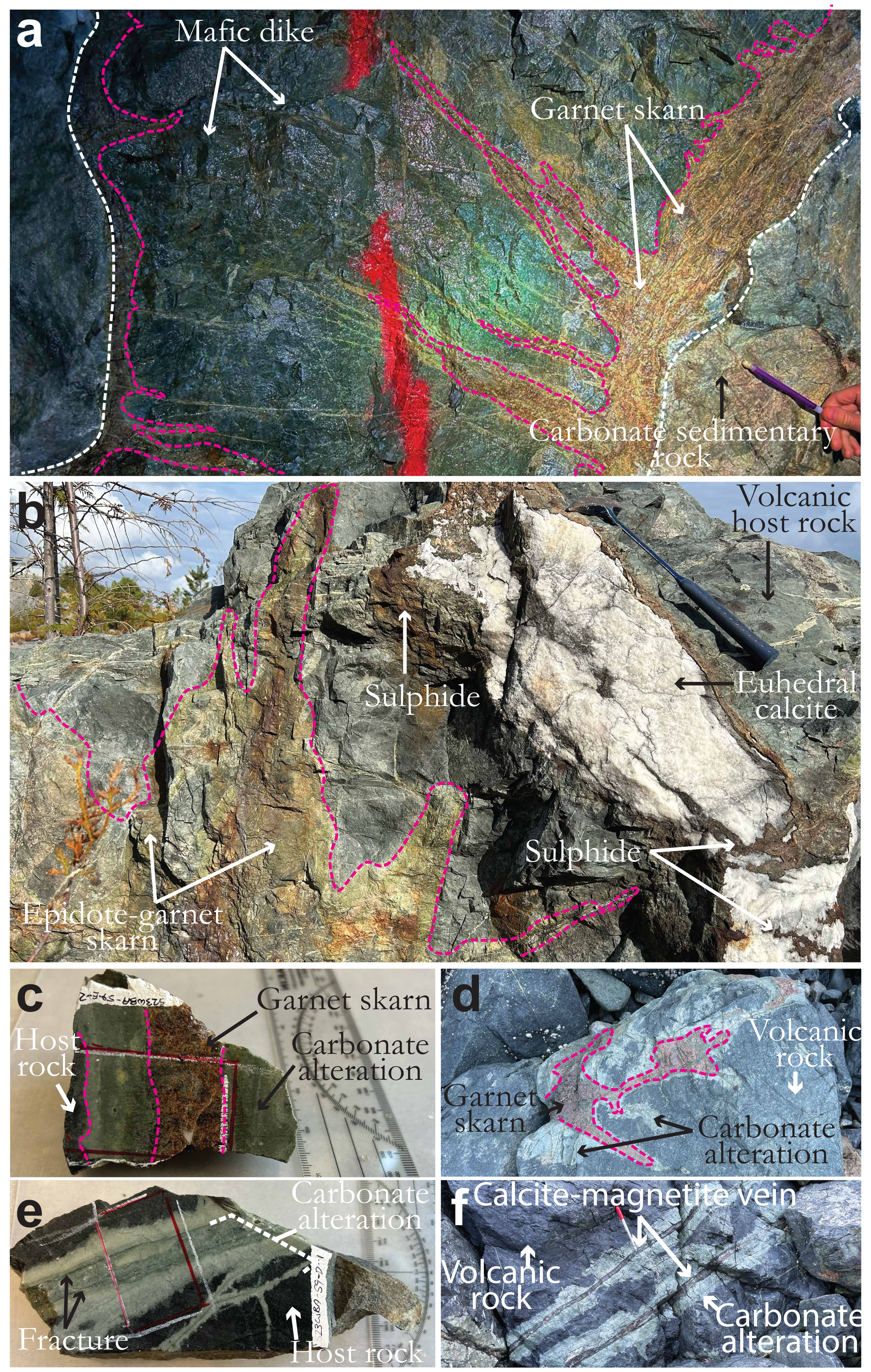


Fig. 6. a,b) Calc-silicate alteration in mafic igneous rocks from the Merry Widow (a, c, e) and Texada (b, d, f) deposits. c, d) Carbonate alteration surrounding zones of calc-silicate alteration and calcite-magnetite veins formed along fractures in host rock.

## Exploration

The formation of calc-silicate alteration primarily in igneous host rocks is a feature that **departs from what is predicted in the classic magmatic-hydrothermal skarn model**. This, along with the euhedral habit of magnetite crystals in massive ores, and the zones of coarse euhedral calcite that surround massive sulphide and magnetite mineralization (**Fig. 7**), can all be used to recognize Co-bearing iron skarns and differentiate them from other base- and precious-metal skarn varieties in an exploration setting.

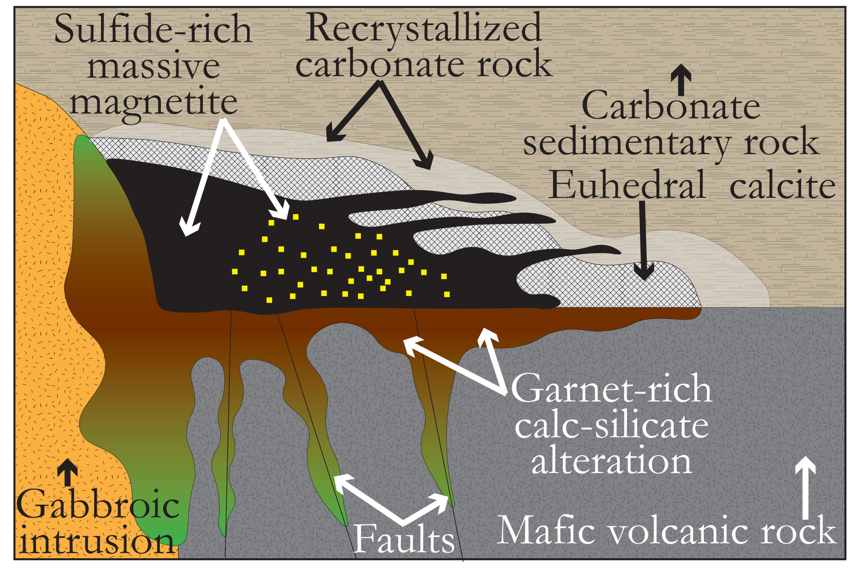


Fig. 7. Schematic diagram of an iron skarn in carbonate and volcanic host rocks along the periphery of a gabbroic intrusion. Note the distribution of calc-silicate alteration in igneous rock types and the zone of euhedral calcite enveloping the sulphide-bearing magnetite orebody.

## References cited

Meinert, L.D., Dipple, G.M., and Nicolescu, S., 2005. World Skarn Deposits. In: Hedenquist, J.W., Thompson, J.F.H., Goldfarb, R.J., and Richards, J.P., (Eds.), Economic Geology 100th Anniversary Volume. Society of Economic Geologists Special Publication, pp. 299-336.

MINFILE, 2006. Fe Skarn; BC Ministry of Energy and Mines, MINFILE digital data, posted April 2006, URL <http://minfile.gov.bc.ca/Summary.aspx?minfilno=104K++002>

Ray, G.E., 2013. A review of skarns in the Canadian Cordillera. British Columbia Ministry of Energy and Mines, British Columbia Geological Survey Open File 2013-08, 50p

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