



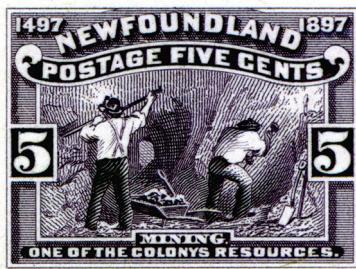
EXPLORE  
DISCOVER  
DEVELOP

# VMS

Well-preserved volcano-sedimentary terranes that constitute much of central Newfoundland comprise a highly prospective, base-metal-rich greenstone belt of early Paleozoic age. This part of Newfoundland includes well-known mining camps dating back to the mid-19th century, as well as deposits in or nearing production, and an array of advanced base-metal exploration projects.

Production has been derived from volcanic-hosted massive sulphide deposits (VMS) formed in a variety of paleotectonic settings. Polymetallic (Zn-Pb-Cu-Au-Ag) deposits occur in calc-alkalic rocks in more mature arc environments, whereas copper-dominated deposits are hosted by primitive ophiolitic and tholeiitic rocks. Although VMS deposits are relatively small, there are two world-class VMS mining camps in the northeast Appalachians: the giant Bathurst camp and the very high-grade Buchans orebodies. Many of those in central Newfoundland are high-grade and/or gold-rich (e.g., Rambler camp). Thus, they are attractive exploration targets. Mineral resources are being defined in these prolific volcanic terranes, and active exploration projects are yielding positive drill results.

# VMS IN CENTRAL NEWFOUNDLAND



**The Appalachian Orogen in Newfoundland comprises four tectonostratigraphic zones, having distinct geological histories that record the formation and destruction of the early**

**Paleozoic Iapetus Ocean. Well-preserved relics of that ancient ocean occur in the central Newfoundland Dunnage Zone, and elements of its opposing continental margins are preserved in Paleozoic rocks of the Gander and Humber zones. Proterozoic rocks of the Humber and Avalon zones are remnants of larger, unrelated Proterozoic terranes that once bordered Iapetus.**

## Buchans Area

The Early Ordovician Buchans-Roberts Arm belt is characterized by bimodal calc-alkaline volcanic rocks of mature-arc character. It contains the former-producing Buchans Mine (1928–1984)—one of Canada's richest base-metal mines—as well as recently defined resources and a number of prospects.



*Zn-Pb-Cu breccia (transported) ore with clasts of massive sulphides (Buchans Mine)*

The world-class Buchans deposits were very high-grade polymetallic (Zn, Pb, Cu, Ag and Au) orebodies. Most of the mineralization is associated with submarine felsic volcanic rocks, and conforms to the classic 'Kuroko' model for VMS deposits. Three distinct ore types, termed in-situ, transported and stockwork,

have been mined at Buchans. The historic Lundberg Prospect has been delineated and is in the early stages of development. In addition, prospects like Clementine West and Buchans North have revealed potential for Buchans-style orebodies.

## Rambler Area

Significant VMS deposits occur within the Early Ordovician Pacquet Harbour Group, a strongly deformed mafic-dominated volcanic



*Massive sulphides (Ming Mine)*

sequence of primitive-arc affinity. This area is host to the Rambler mine camp, which produced Cu ± Au from five mines between 1964 and 1982. Some of the deposits are stratiform massive sulphide lenses associated with a felsic dome, whereas others are of stockwork or

VMS deposits in Newfoundland are predominantly located in the Dunnage Zone, and hosted by a series of Cambro-Ordovician arc and back-arc basin assemblages and ophiolites. The deposits are classified based on their tectonic setting and host-rock types into two broad groups: deposits hosted mainly in ophiolitic rocks, which are generally Cu-dominated (e.g., Little Deer and Betts Cove); and those hosted by bimodal volcanic sequences, which are generally polymetallic (Zn, Pb, Cu, Au and Ag). The bimodal volcanic sequences can be dominated by either mafic (e.g., Rambler) or felsic rocks (e.g., Buchans, Duck Pond). Deposits elsewhere on the island are either in ophiolites thrust onto the Humber Zone platform rocks or in Proterozoic arc complexes within the Avalon Zone.

Central Newfoundland VMS deposits can be readily described in terms of a four-fold geographical framework; grades and tonnages of many of these deposits can be found in the table overleaf.

disseminated character. Production at the Ming Mine began in 2012 from high-grade massive sulphides, with subsequent production from a lower grade stringer zone to extend the life of the mine.

## Victoria Lake Area

The Victoria Lake area contains two large volcano-sedimentary terranes termed the Tulks and Tally Pond belts. The Cambrian Tally Pond belt hosts



*Zn-Cu-Pb-pyrite breccia ore (Duck Pond Mine)*

the former Duck Pond Mine.

Mineralization occurred as laminated massive sulphide, sulphide debris flows and replacement sulphides and was hosted in quartz-phyric tuffs. The area remains highly prospective with numerous under-explored targets.

Promising exploration results have been obtained at the Lemarchant Prospect (South Tally Pond), approximately 20 km southwest of the former Duck Pond Mine. Drilling has intersected high-grade semi-massive to massive sulphide mineralization over significant widths. Subsequent exploration has expanded resources and has identified barite as a potential by-product.



*Zn-Pb-Cu massive sulphides (Lemarchant Prospect)*

The Early Ordovician Tulks belt contains a number of historic resources including the Tulks Hill, Bobbys Pond, Long Lake and the Boomerang-Domino prospects (see table overleaf). The latter is a cluster of high-grade sulphide lenses hosted in altered felsic volcanic rocks.

## Western Notre Dame Bay

In this area, VMS deposits are hosted by ophiolitic rocks of the Middle Ordovician Betts Cove Complex and the Cambro-Ordovician Lushs Bight



Cu-rich stockwork mineralization (Little Deer)

Group. These Cyprus-type deposits are characterized by Cu ± Zn mineralization in stringer and stockwork zones and in massive sulphide lenses. Examples of historical producers in the Betts Cove Complex include the Tilt Cove and Betts Cove mines. Tilt Cove (1864–1917; 1957–1967) was the largest deposit of its

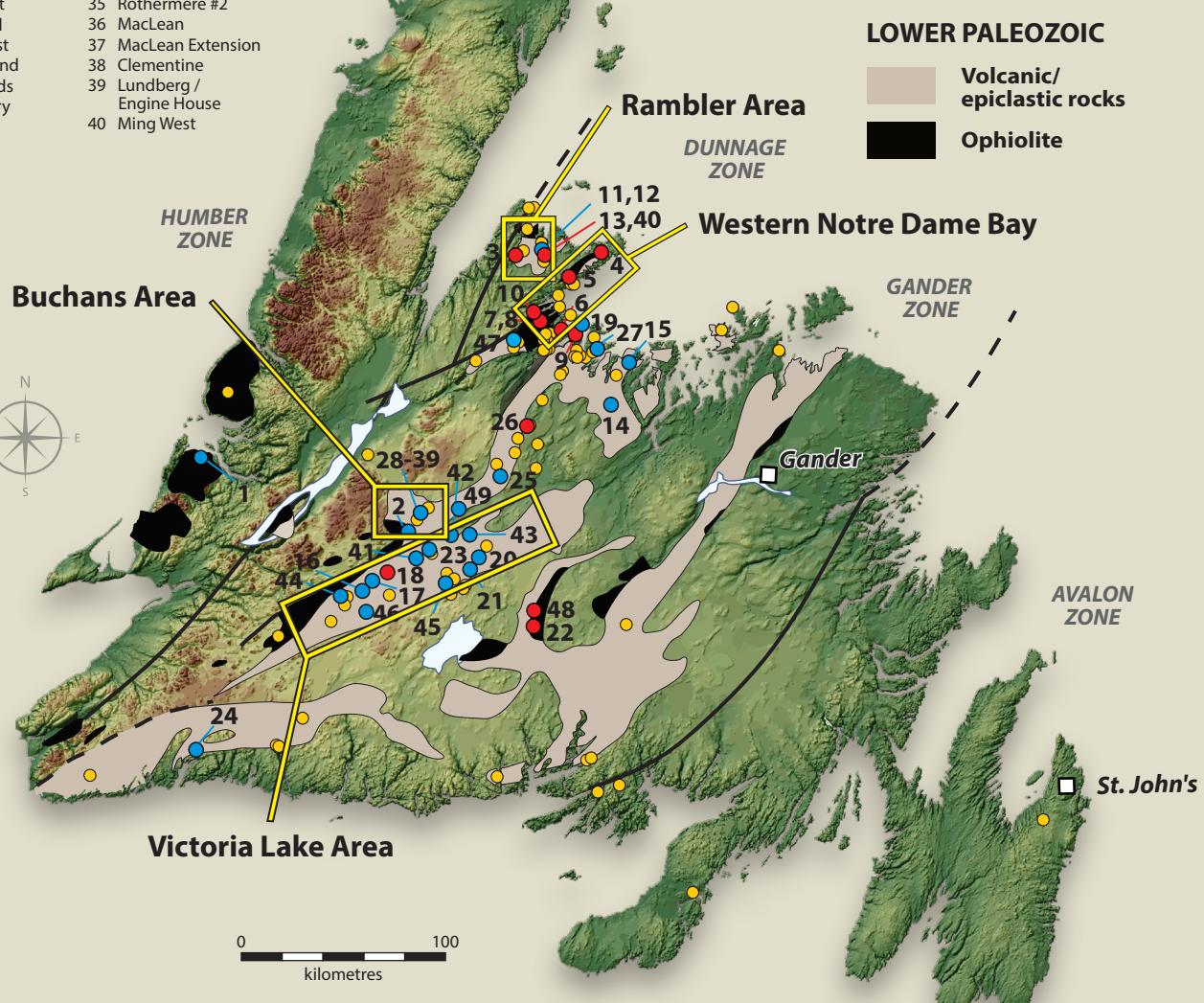
type in the Appalachian Orogen. Early producers in the Lushs Bight Group include Little Bay (1878–1892; 1952–1969) followed by Whalesback and Little Deer in the 1960s.

Other examples of VMS deposits in central Newfoundland include the large, low-grade, Cu-Zn-dominated Point Leamington deposit hosted in volcaniclastic rocks of the Wild Bight Group, and the Zn-Pb-rich Strickland deposit, which occurs in felsic volcanic rocks along the southern margin of the Dunnage Zone.

### Selected VMS base-metal deposits:

1 York Harbour	21 Duck Pond
2 Skidder	22 Great Burnt Lake
3 Terra Nova	23 Bobby's Pond
4 Tilt Cove	24 Strickland
5 Betts Cove	25 Lake Bond
6 Little Bay	26 Gullbridge
7 Whalesback	27 Pilley's Island
8 Little Deer	28 Oriental #1
9 Miles Cove	29 Oriental #2
10 Colchester	30 Lucky Strike - Main
11 Rambler	31 Lucky Strike - New Year
12 Ming	32 Lucky Strike - North
13 East Mine	33 Two Level
14 Point Leamington	34 Rothermere #1
15 Lockport	35 Rothermere #2
16 Tulks Hill	36 MacLean
17 Tulks East	37 MacLean Extension
18 Jacks Pond	38 Clementine
19 Oil Islands	39 Lundberg / Engine House
20 Boundary	40 Ming West

- Polymetallic
- Cu-dominated
- Other VMS occurrences



Owner/Operator	Property	Resource/Drill Intersection
<b>REPRESENTATIVE CURRENT AND PAST PRODUCERS</b>		
Consolidated Rambler Mines Limited / Rambler Metals and Mining plc (1)	Rambler (PP)	(Ming) (1972-2023) 6,700,000 t @ 2.0% Cu + Au (Ming) (pre-2012) 1,991,592 t @ 3.7% Cu, 22 g/t Ag and 2.4 g/t Au (Main) 399,000 t @ 1.3% Cu, 5.1 g/t Au
Teck Resources Limited	Duck Pond (PP)	4,100,000 t @ 5.7% Zn, 3.3% Cu, 59 g/t Ag and 0.9 g/t Au
Asarco Inc. (2)	Buchans (PP)	16,196,876 t @ 14.5% Zn, 7.6% Pb, 1.3% Cu, 126 g/t Ag and 1.4 g/t Au
Atlantic Coast Copper (3)	Little Bay (PP)	180,000–545,000 t @ 2.5% Cu; 2,571,964 t @ 0.8–2% Cu + 6,271 oz. Au
First Maritime Mining Corporation (1)	Tilt Cove (PP)	8,160,000 t @ 1–12% Cu + 42,425 oz. Au
<b>SELECTED DEPOSITS WITH RESOURCE ESTIMATES</b>		
FireFly Metals Ltd	Green Bay	(Ming Mine) 47,500,000 t measured and indicated* @ 1.7% Cu, 0.4 g/t Au and 3.1 g/t Ag; 23,100,000 t inferred* @ 2.0% Cu, 0.7 g/t Au and 5.9 g/t Ag; (Little Deer) 2,883,000 t indicated* @ 2.13% Cu, 3.43 g/t Ag, 0.10 g/t Au and 0.02% Co; 6,176,000 t inferred* @ 1.79% Cu, 2.17 g/t Ag, 0.05 g/t Au and 0.02% Co
Canterra Minerals Corporation	Lemarchant	2,420,000 t indicated* @ 6.15% Zn, 1.6% Pb, 0.68% Cu, 1.22 g/t Au, 64 g/t Ag and 23.5% barite; 560,000 t inferred* @ 4.68% Zn, 1.08% Pb, 0.45% Cu, 1.06 g/t Au, 44.7 g/t Ag and 13.1% barite
	Boomerang	1,364,600 t indicated* @ 7.09% Zn, 3% Pb, 0.51% Cu, 110.43 g/t Ag and 1.66 g/t Au; 278,100 t inferred* @ 6.72% Zn, 2.88% Pb, 0.44% Cu, 96.53 g/t Ag and 1.29 g/t Au (Domino) 411,200 t inferred* @ 6.3% Zn, 2.8% Pb, 0.4% Cu, 94 g/t Ag and 0.6 g/t Au
	Long Lake	407,000 t indicated* @ 7.82% Zn, 1.58% Pb, 0.97% Cu, 49 g/t Ag and 0.57 g/t Au; 78,000 t inferred* @ 5.77% Zn, 1.24% Pb, 0.70% Cu, 34 g/t Ag and 0.48 g/t Au
	Buchans	(Lundberg) 16,790,000 t indicated* @ 1.53% Zn, 0.64% Pb, 0.42% Cu, 5.69 g/t Ag and 0.07 g/t Au; 380,000 t inferred* @ 2.03% Zn, 1.01% Pb, 0.36% Cu, 22.35 g/t Ag and 0.31 g/t Au
	Bobby's Pond	1,095,000 t indicated* @ 4.61% Zn, 0.86% Cu, 0.44% Pb, 16.6 g/t Ag and 0.2 g/t Au; 1,177,000 t inferred* @ 3.75% Zn, 0.95% Cu, 0.27% Pb, 10.95 g/t Ag and 0.06 g/t Au
Benton Resources Inc. / Homeland Nickel Inc.	Great Burnt	881,000 t indicated* @ 2.74% Cu and 0.29 g/t Au; 627,000 t inferred* @ 2.05% Cu and 0.24 g/t Au
Visionary Copper and Gold Mines Inc.	Point Leamington	5,013,000 t indicated* @ 1.39% Zn, 0.54% Cu, 0.01% Pb, 12.2 g/t Ag and 0.9 g/t Au; 15,440,000 t inferred* @ 1.85% Zn, 0.36% Cu, 0.03% Pb, 15.3 g/t Ag and 0.85 g/t Au
<b>SELECTED VMS PROSPECTS WITH DRILL DATA</b>		
Canstar Resources Inc. / Glencore plc / VMS Mining Corporation	Buchans-Mary March	9.63 m @ 10.1% Zn, 1.68% Pb, 0.64% Cu, 122.1 g/t Ag and 4.2 g/t Au; 11.6 m @ 3.62% Zn, 0.1% Cu, 0.8% Pb, 25 g/t Ag and 1.5 g/t Au
Champion Iron Limited	Powderhorn/Gullbridge	2.76 m @ 10.20% Zn, 0.42% Cu, 10.7 g/t Ag and <0.1 g/t Au
Vulcan Minerals Inc.	Colchester/Springdale	5.8 m @ 2.81% Cu and 3.91 g/t Au; 4.5 m @ 2.3% Zn and 5.6 g/t Au
Naughty Ventures Corp. / Mammoth Minerals Limited	Skyline	44.93 m @ 1.292% Cu, 0.315% Zn, 2.014 g/t Ag and 123.577 g/t Co 8.97 m @ 4.727% Cu 10.195% Zn, 22.69 g/t Ag and 91.49 g/t Co

**KEY:** P=Producer PP=Past Producer \*43-101 compliant Resource Estimate

Current holder (1) FireFly Metals Ltd (2) Canterra Minerals Corporation (3) Vulcan Minerals Inc.



The Lucky Strike Glory Hole - Buchans Mine

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