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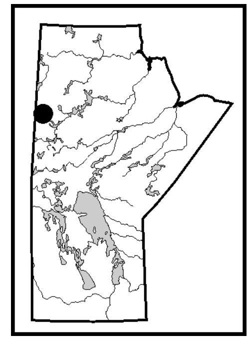
GS-8 Trace-element signatures of massive sulphides from the Fox mine, Lynn Lake (NTS 64C12)

by S.H. McClenaghan[1], G.H. Gale and D.R. Lentz[1]



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Summary

A study of the Fox mine has been initiated to examine the systematics of rare earth elements and other trace elements in the sulphide ores and hostrocks. Collected samples have been prepared for analysis by several different analytical techniques to determine both whole-rock and mineral compositions. Comparison of data from this deposit with other massive sulphide deposits will determine if there is a correlation between deposit size and rare earth element systematics.

Introduction

Despite current knowledge of trace-element systematics for distal exhalites and alteration zones beneath volcanogenic massive sulphide (VMS) deposits, there are few complementary studies on rare earth element (REE) and trace-element systematics in the VMS ores. The REE signature within VMS orebodies may provide important information on the evolution of both the hydrothermal fluids and the sulphide mounds that precipitate from them, and on the extent of zone refining within the sulphide deposits. Furthermore, the REE signature and, in particular, the magnitude of any Eu anomaly and the degree of light REE enrichment may be an indicator of deposit size; similar relationships were observed between Sn and contained base-metal tonnages (Boyle and Peter, in press). There is considerable literature on this in other areas of the world, but few studies are sufficiently detailed to ascertain if they can be applied to exploration for VMS-type deposits.

Geological setting

The Fox Lake VMS deposit is situated in northwestern Manitoba, 20 km east of the Manitoba-Saskatchewan boundary and 45 km southwest of Lynn Lake (Fig. GS-8-1). The deposit is hosted by volcanic, volcaniclastic and sedimentary rocks of the Wasekwan Group, which is located within the Lynn Lake greenstone belt of the Trans-Hudson Orogen. Massive sulphides totalling 11 958 182 t and grading 1.82% Cu and 1.78% Zn were extracted from the Fox mine between 1970 and 1985 by Sherritt Gordon Mines Limited. The deposit consists of two stratiform sulphide lenses (Main and West zones), with a combined strike length of 425 m, that are underlain by stockwork sulphides with an associated hydrothermal-alteration envelope.

Mapping of the Granville Lake area by Stanton (1949) and Milligan (1960) was followed by mineral-deposit investigations (Obinna, 1974; Zwanzig, 1978; Lustig, 1979; Gale et al., 1980; Gilbert et al., 1980; Olsen, 1987; Ferreira, 1993). These authors indicated that the Fox mine is a VMS deposit consisting of several solid sulphide lenses with both an underlying footwall alteration zone and an overlying layered alteration (tuffaceous exhalite?). The intact nature of the Fox mine stratigraphy makes this deposit an ideal setting for a trace-element study to vector VMS deposits (*see* Gale et al., 1999). Furthermore, the mine stratigraphy and lateral extent of alteration surrounding the Fox mine were described by Olsen (1987), based on underground mapping and examination of surface and underground diamond-drill core.

Sampling program

Rock samples were retrieved from surface-exploration and underground diamond-drill core that are stored at a small drillcore repository, north of the abandoned Fox mine infrastructure. Drillholes of interest were transported from the minesite to the Lynn Lake core repository for restoration and future storage. Over 60 samples of massive sulphide and altered hostrocks were collected from 11 drillcores from the Main and West zones on the 200, 2000 and 2800 levels of the Fox mine. An additional three drillcores along the strike of the orebody were also studied and sampled to monitor chemostratigraphic variations in volcanic and sedimentary rocks of the Wasekwan Group. Samples collected for geochemical analysis consisted of 3- to 5-foot sections of compositionally and texturally uniform rocks and ores.

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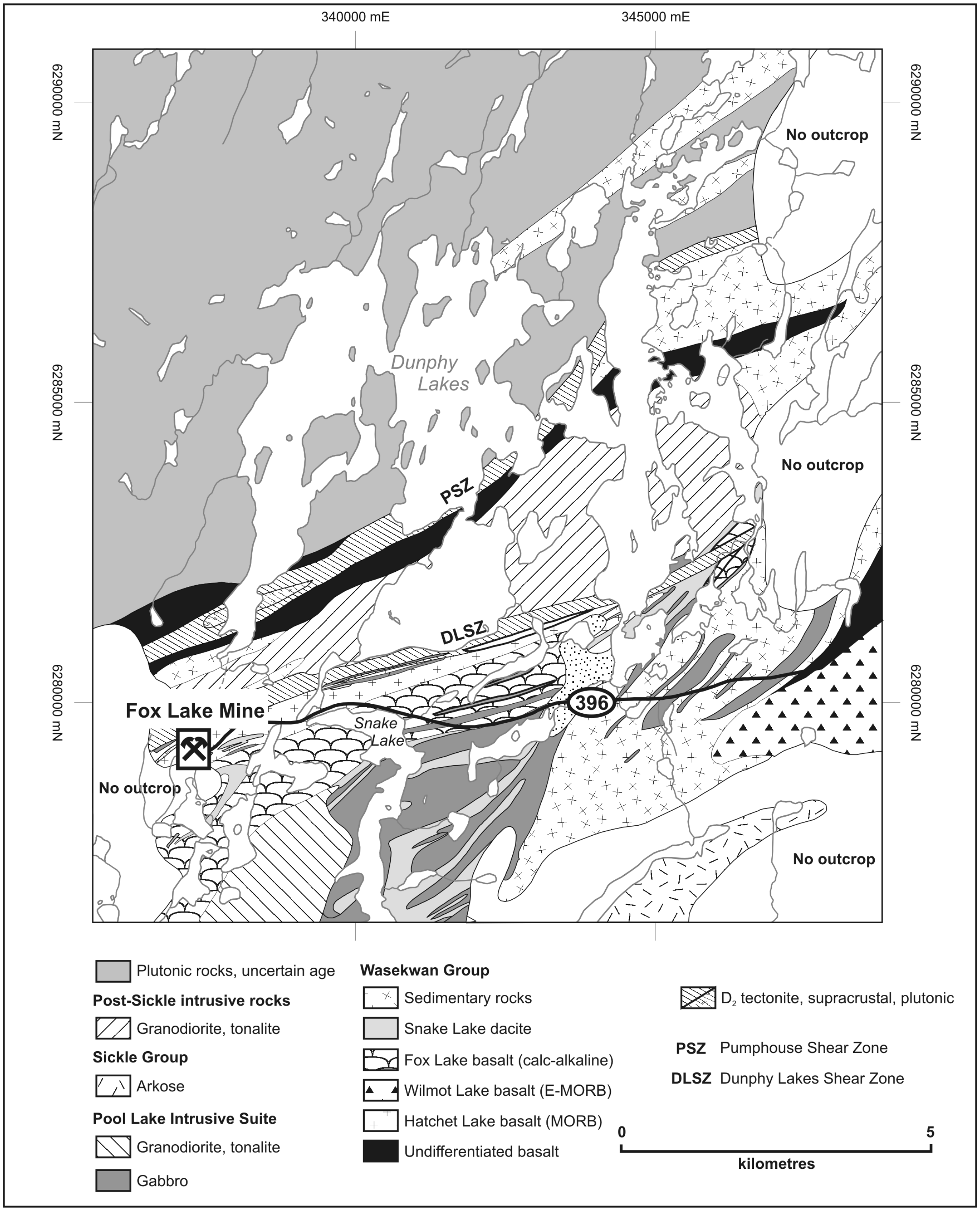

Figure GS-8-1: Location and geological setting of the Fox mine.

Representative slabs were collected with each sample for archives and polished sections, to be prepared at the University of New Brunswick.

Analytical program

Samples were crushed in a steel jaw crusher and a portion pulverized in a soft iron swing mill. Samples and a massive sulphide standard will be submitted for major-, trace- and rare earth element analysis by instrumental neutron activation analysis, inductively coupled plasma–mass spectrometry and inductively coupled plasma–emission spectrometry. Rare earth element signatures may be affected by a variable amount of terrigenous components, which masks low-abundance hydrothermal components like the REE. Therefore, chemostratigraphic analysis of host volcanic and sedimentary successions will provide background signatures for any terrigenous component. Immobile elements (Al_2O_3, TiO_2, Zr, Sc, Th, Hf and Nb) will be used to monitor the mass contribution from intercalated terrigenous sediments; this will permit calculations to be made to account for material stripped out of the protolith and determine the net hydrothermal contribution to the exhalative massive sulphides. Polished sections of rocks with anomalous REE contents will be further characterized by electron microprobe analysis. The REE contents of sulphides and common accessory minerals, such as xenotime, monazite, apatite, barite and calcite, will be quantified to elucidate the main REE-bearing phases.

Economic significance

Trace and rare earth element characterization of the hostrocks and ores at the Fox mine will assist exploration for similar base-metal deposits in the immediate vicinity of the Fox mine and elsewhere in the Lynn Lake greenstone belt.

Acknowledgments

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