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Alteration zones in the Wolverton Lake area, near Snow Lake, Manitoba

Edgar Froese

ABSTRACT

North of Snow Lake, Manitoba, volcanic rocks and granitic intrusions, older than 1.87 Ga, have been metamorphosed to a grade corresponding to the biotite-sillimanite-almandine zone. The volcanic rocks, predominantly of felsic composition, include sulphide occurrences, as well as ferromagnesian and aluminous alteration, characterized, respectively, by orthoamphibole-bearing and sillimanite-bearing assemblages. The distribution of alteration types, particularly in the Wolverton Lake area, is shown.

INTRODUCTION

In volcanic rocks of the Snow Lake area, Manitoba, metamorphosed equivalents of hydrothermal alteration products are common. The resulting mineral assemblages are found only in altered rocks and such occurrences may be regarded as "mineralogical anomalies" (Allard and Carpenter, 1988; Froese, 1998) and taken as evidence of premetamorphic alteration. Occurrences in the Snow Lake area, particularly near Wolverton Lake, at a grade of metamorphism higher than that of the biotite-sillimanite-almandine isograd, are examined here. By considering rocks of approximately the same grade, mineral assemblages can be represented on one phase diagram. The distribution of two alteration types are shown on geological sketch maps.

A special significance of the Wolverton area stems from the fact that it is underlain by rocks of recognizable volcanic origin and forms part of the Herblet Lake dome. This feature suggests the possibility that more problematic rocks of similar composition in the centre of the Herblet Lake and Pulver domes may have a volcanic origin.

GEOLOGICAL SETTING

Figure 1 is a simplified and somewhat modified sketch map of the regional geology, taken essentially from the map prepared by the NATMAP Shield Margin Project Working Group (1998). Rocks have been assigned to four main subdivisions:

1. Pre-Burntwood Group rocks: assemblages of mainly metavolcanic rocks and subvolcanic intrusions formed in the interval of 1.92-1.87 Ga. Most of these rocks were formerly included in the Amisk Group. Because this designation has been abandoned, it is convenient to use pre-Burntwood Group rocks as a collective term.
2. Intrusive rocks (1.88-1.83 Ga)
3. The Burntwood Group of metagreywacke (1.85-1.84 Ga).
4. The Missi Group of metamorphosed lithic arenite, and metavolcanic rocks (1.85-1.83 Ga).

The ages come from the same publication. The biotite-sillimanite-almandine isograd has been taken from Froese and Moore (1980). In the northern part of the area shown in Figurre 1, pre-Burntwood rocks have formed two domes (Herblet Lake dome and Pulver Lake dome). Felsic volcanic rocks of uncontroversial origin form a unit along the southwestern and northern margins of the Herblet Lake dome (Bailes, 1975; Froese and Moore, 1980). The Wolverton Lake area forms part of this unit and the Wim massive sulphide deposit is located in this unit. However, the origin of grey quartz-oligoclase gneiss in the interior of the Herblet Lake and Pulver Lake domes (unit C1 of Bailes, 1975) is a matter of considerable uncertainty. Bailes (1975) considered it to be a granitoid gneiss but mentioned the possibility that some of the rocks in the vicinity of Dowling Lake and a narrow layer along the margin of the Pulver Lake dome could be felsic volcanic rocks and gave a chemical analysis from Stack Lake that "compares favourably with that of felsic volcanic rocks", largely because of its low TiO_2 content. The problem was again discussed by Fedikow and Malis (1988), Fedikow et al. (1989), and Fedikow and Trembath (1991), supporting the view that at least some rocks of unit C1 are coarsely recrystallized felsic volcanic rocks. On the NATMAP map, the rocks at Dowling Lake and the thin layer at the margin of the Pulver Lake dome are shown as felsic volcanic rocks. In Figure 1, this interpretation is extended to all of unit C1. Amphibolite, as unit C2 of Bailes (1975), is interlayered with rocks of unit C1 in the interior of the domes and occurs, as unit 6 of Bailes (1975), at the margins of the domes. Bailes (1975) interpreted these rocks as metamorphosed gabbroic sills. However, their association with felsic volcanic rocks and prominent layering in some occurrences (e.g. Bailes, 1975, Fig. 11) seem to point to mafic volcanic precursors. Two zircons from unit C2 have been dated at 1901 +/- 4 Ma and 1884 +/- 6 Ma (David et al., 1996). Granodiorite, unit C3 of Bailes (1975), intrusive into units C1 and C2, has been dated at 1890 +8/-6 Ma (Gordon et al., 1990). There will be a reference here to the work of Whalen and Rainer.

GEOLOGY AND ALTERATION IN THE WOLVERTON LAKE AREA

The geology of the Wolverton Lake area, taken from Froese (1989), is shown in Figure 2. The unaltered felsic volcanic rocks consist of quartz, plagioclase, biotite and, in some localities, almandine. Quartz phenocrysts, several mm across, are a typical feature. The texture in some outcrops suggest a fragmental nature of the rock. Some layers of mafic volcanic rocks, consist of quartz, plagioclase, hornblende, and epidote. In similar rocks, north of Wolverton Lake, Bailes (1975) reported the assemblage hornblende-epidote-clinopyroxene. More felsic fragments, up to 10 cm in length, are preserved in some outcrops. In some mafic rocks, the assemblage cummingtonite-hornblende-almandine is present and, in some instances, is accompanied by orthoamphibole. More rarely, the assemblage hornblende-orthoamphibole-almandine is observed. In a mafic rock 3 km north of the area shown in Figure 1, Bailes (1975) noted the assemblage cummingtonite-hornblende-orthopyroxene.

Particularly in felsic volcanic rocks, metamorphosed alteration zones are common. Two alteration types are recognized. Ferromagnesian alteration is characterized by orthoamphibole, commonly accompanied by almandine and, more rarely, by cordierite. Aluminous alteration, more restricted in occurrence, is characterized by sillimanite, typically accompanied by cordierite and, more rarely, by almandine as well. Green spinel is a common accessory and staurolite relics are present in many cordierite grains. Quartz and plagioclase are commonly present in both alteration types. The two alteration types may alternate over a distance of a few metres.

Mineral assemblages in unaltered and altered rocks, in the presence of quartz, plagioclase, magnetite, and ilmenite, can be represented in the system

$A = Al_2O_3 – (CaO + Na_2O)$

$F = FeO – (Fe_2O_3 + TiO_2)$

$M = MgO$

Observed mineral assemblages above the biotite-sillimanite-almandine isograd and to the right of the reaction

staurolite = cordierite + sillimanite + almandine

area are shown in Figure 3. The compositions are based on analyses of coexisting minerals taken from and James et al. (1978), and Jen and Kretz (1981). An epidote composition of $Ca_2Al_{2.5}Fe_{0.5}Si_3O_{12}(OH)$ has been assumed. The metamorphic conditions indicated by the mineral assemblages (Fig. 4) are shown on part of a reaction grid taken from Froese (2010).

ALTERATION TYPES IN OTHER AREAS

Alteration types above the biotite-sillimanite almandine are shown in Figure 1. They have been compiled from various sources: Froese and Moore (1980), Bristol and Froese (1989), Fedikow and Malis (1988), Fedikow et al. (1989), Fedikow and Trembath (1991), Fedikow and Ziprick (1991), Fedikow et al. 1991, Fedikow et al. (1993), Fedikow and Kowalyk (1993), and Prouse et al. (2000).

OTHER FELSIC GNEISSES OF PROBLEMATIC ORIGIN

At higher grades of metamorphism, felsic volcanic rocks may lose their primary texture and recrystallize to medium grained quartz-plagioclase gneisses. Consequently, consideration of their origin becomes a matter of conjecture. Because massive sulphide mineralization is common in felsic volcanic rocks, sulphide occurrences and metamorphosed equivalents of alteration zones support the interpretation of some gneisses as metamorphosed felsic volcanic rocks. The quartz-plagioclase gneisses in the interior of the Herblet Lake and Pulver domes are an example of the difficulty of establishing a reasonable origin. In this case, the effort was somewhat facilitated by the presence of recognizable felsic volcanic rocks along the margin of the Herblet Lake dome.

Since in earlier work, the possibility of felsic volcanic rocks as precursors of gneisses was not even considered, it is not surprising that there are other examples of gneisses of problematic origin in the Flin Flon volcanic belt. These will be discussed; their location is best seen on the map in the publication of Zwanzig and Bailes (2010).

The area which includes the Defender Lake dome was mapped by Bateman and Harrison (1943). The main rock type of the dome is a grey quartz-plagioclase gneiss which they considered to be of sedimentary origin. This rock extends beyond their map sheet to the west, where it was mapped by Ashton (1989) as a felsic volcanic rock on the basis of similarities with rocks in the Wildnest Lake area, Saskatchewan. In particular, he noted the presence of sulphide mineralization and ferromagnesian alteration. The eastern end of the dome was also regarded as a having felsic volcanic precursors by Froese (2011). Zwanzig and Bailes (2010) showed the main portion of the dome as a quartz-rich trondjhemitic orthogneiss, possibly including some felsic supracrustal rocks.

In the Sherridon-Batty Lake region, Bateman and Harrison (1946) and Robertson (1953) considered three areas of quartz-rich gneisses to be of sedimentary origin:

a) Northeast of Sherridon

b) Northeast of Nokomis Lake and

c) Extending from Batty Lake to Limestone Point Lake

Sulphide mineralization and ferromagnesian alteration in these areas have been described by Ostry and Trembath (1992) and Ostry et al. (1998). Ashton and Froese (1988) suggested a volcanic origin for the rocks at Sherridon and, on the map of Zwanzig and Bailes (2010), the first two areas are shown as felsic gneisses of volcanic origin and the third area is shown as quartz-rich trondhjemitic gneiss with screens of supracrustal rocks.

REFERENCES

Allard, G.O. and Carpenter, R.H., 1988. Mineralogical anomalies in metamorphosed terrains; a neglected but promising exploration tool; International Conference – Geochemical Evolution of the Continental Crust, Pocos de Caldas, Brazil, Abstracts Volume, p. 229-236.

Ashton, K.E., 1989. Kisseynew project: Kisseynew-Florence Lake area; Manitoba Energy and Mines, Report of Field Activities 1989. p. 65-71

Ashton, K.E. and Froese, E., 1988. Could the Sherridon Group at Sherridon be a high-grade equivalent of the Amisk Group? Manitoba Energy and Mines, Report of Field Activities 1988. p. 183-184.

Bailes, A.H., 1975. Geology of the Guay-Wimapedi lakes area; Manitoba Mineral Resources Division, Geological Services Branch,Publication 75-2, 104 p.

Bateman, J.D. and Harrison, J.M., 1943. Mikanagan Lake, Manitoba; Geological Survey of Canada, Map 832A with descriptive notes.

Bateman, J.D. and Harrison, J.M., 1946. Sherridon, Manitoba; Geological Survey of Canada, Map 862A with descriptive notes.

Bristol, C.C. and Froese, E., 1989. Highly metamorphosed altered rocks associated with the Osborne Lake massive sulfide deposit, Snow Lake area, Manitoba; Canadian Mineralogist, v. 27, p. 593-600.

David, J., Bailes, A.H. and Machado, N., 1996. Evolution of the Snow Lake portion of the Paleoproterozoic Flin Flon and Kisseynew belts, Trans-Hudson Orogen, Manitoba, Canada; Precambrian Research, v. 80, p. 107-124.

Fedikow, M.A.F. and Malis, C.,1988. Mineral occurrence documentation – Herblet Lake and Pulver Lake gneiss dome complexes, Snow Lake area; Manitoba Energy and Mines, Report of Activities 1988, p. 84-94.

Fedikow, M.A.F., Malis, C. and Lebedynski, A., 1989. Preliminary observations on the metallogeny of the Herblet Lake and Pulver Lake gneiss dome complexes, Snow Lake area, Manitoba Energy and Mines Report of Field Activities 1989, p. 44-53.

Fedikow, M.A.F, and Trembath, G.D., 1991. Mineral deposits and occurrences in the Wimapedi Lake area, NTS 63O/4; Manitoba Energy and Mines, Mineral Deposit Series Report No. 25, 131 p.

Fedikow, M.A.F. and Ziprick, D.V., 1991. The geological setting of the Wim massive sulphide type Cu deposit, Snow Lake area; Manitoba Energy and Mines, Report of Activities 1991, p. 40-42.

Fedikow, M.A.F., Ziehlke, D.V and Ziprick, D., 1991. Geology and alteration at the Wim massive sulphide type Cu deposit, part of NTS 63N/1; Manitoba Energy and Mines, Preliminary Map 1991-S, scale 1 : 5 000.

Fedikow, M.A.F., Athayde, P. and Galley, A.G., 1993. Mineral deposits and occurrencesin the Wekusko Lake area, NTS 63J/13; Manitoba Energy and Mines, Mineral Deposit Series Report No. 14

Fedikow, M.A.F. and Kowalyk, E., 1993. The Osborne Cu-Zn deposit project; Manitoba Energy and Mines, Report of Activities 1993, p. 97-99.

Froese, E., 1989. Alteration in the vicinity of Wolverton Lake, Snow Lake area; Geological Survey of Canada, Open File 2133, p. 4-6.

Froese, E., 1998. Metamorphism of hydrothermally altered rocks; Geological Survey of Canada, Current Research 1998-E, p.193-196.

Froese, E., 2010. A reaction grid for pelitic and mafic rocks; Geological Survey of Canada, Current Research 2010-13, 13 p.

Froese, E., 2011. Geology of the Weldon Bay – Syme Lake area, Manitoba; Geological Survey of Canada, Open File 5983.

Froese, E. and Moore, J.M., 1980. Metamorphism in the Snow Lake area, Manitoba; Geological Survey of Canada, Paper 78-27, 16 p.

Gordon, T.M., Hunt, P.A., Bailes, A.H. and Syme., E.C., 1990. U-Pb ages from the Flin Flon and Kisseynew belts, Manitoba: Chronology of crust formation at an Early Proterozoic accretionary margin; *in* The Early Proterozoic Trans-Hudson Orogen of North America, (ed.) J.F. Lewry and M.R. Stauffer Geological Association of Canada, Special Paper 37, p. 177-199.

James, R.S., Grieve,, R.A,F. and Pauk L., 1978. The petrology of cordierite-anthophyllite gneisses and associated mafic and pelitic gneisses at Manitouwadge, Ontario; American Journal fo Science, v. 278, p. 41-63.

Jen, L.S. and Kretz, R., 1981. Mineral chemistry of mafic granulites from the Adirondack region; Canadian Mineralogist, v. 19, p. 479-491.

NATMAP Shield Margin Project Working Group, 1998. Geology, NATMAP Shield Margin Project Area (Flin Flon Belt), Manitoba-Saskatchewan; Geological Survey of Canada Map 1968A, Manitoba Energy and Mines Map A-98-2, Sheets 1 to 7, Saskatchewan Energy and Mines Map 258-3, scale 1 : 100 000.

Ostry, G. and Trembath G.D., 1992. Mineral deposits and occurrences in the Batty Lake area, NTS 63N/2; Manitoba Energy and Mines, Mineral Deposit Series, Report No. 19, 264 p.

Ostry, G., Athayde, P.A. and Trembath G.D., 1998. Mineral deposits and occurrences in the Sherridon area, NTS 63N/3; Manitoba Energy and Mines, Mineral Deposit Series, Report No. 17, 157 p.

Prouse, D.E., Fedikow, M.A.F. Fedikow and Ostry, G., 2000. Mineral deposits and occurrences in the Nightingale Lake area, NTS 63N/1; Manitoba Industry, Trade and Minerals, Mineral Deposit Series Report No. 24,

Robertson, D.S., 1953., Batty Lake map-area; Geological Survey of Canada, Memoir 271,

Zwanzig, H.V. and Bailes A.H., 2010. Geology and geochemical evolution of the northern Flin Flon and southern Kisseynew domains, Kississing-File lakes area, Manitoba (parts of NTs 63K, N5); Manitoba Geological Survey, Geoscientific Report GR2010-1, 135 p.

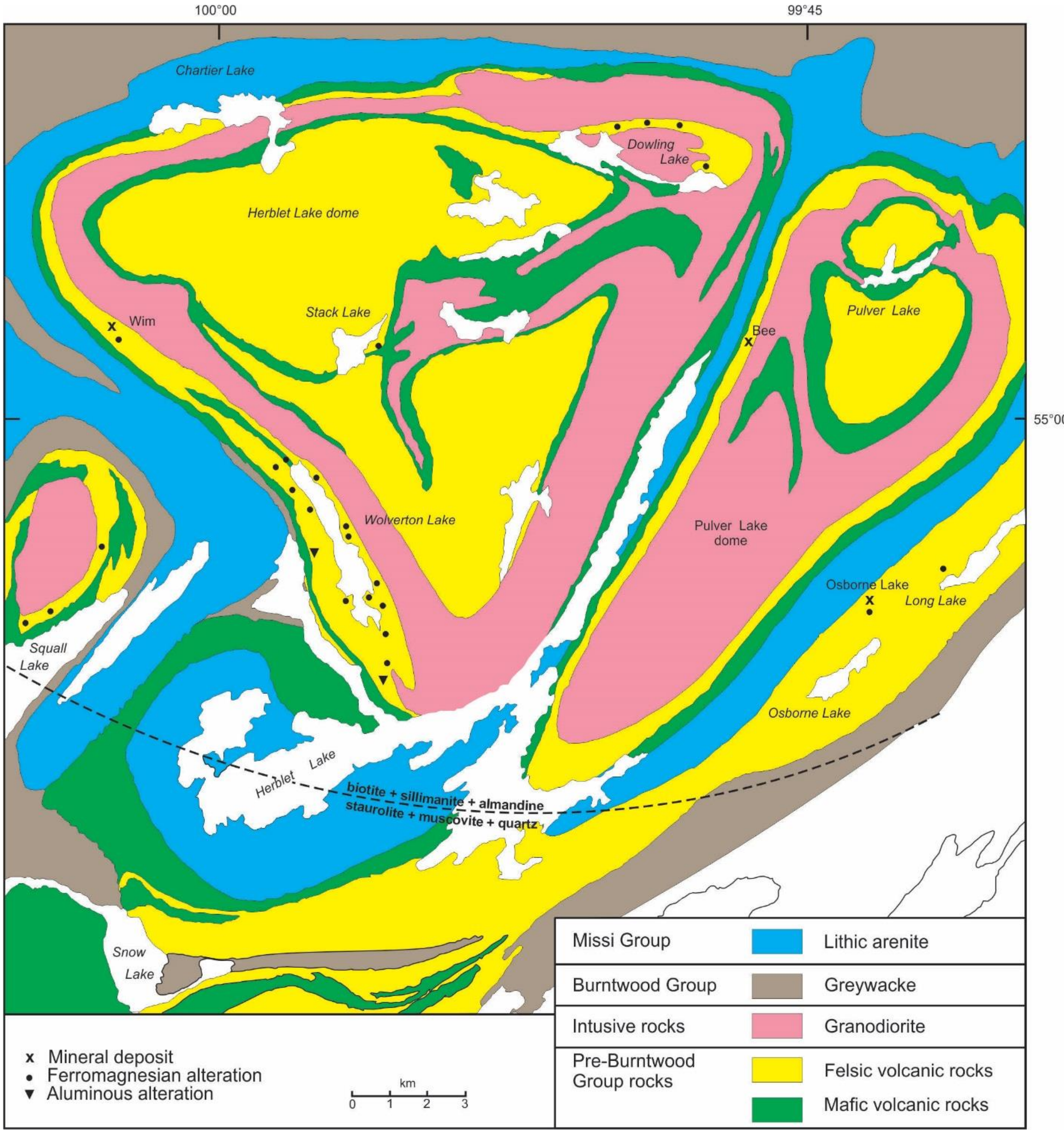

Fig. 1. Geology of an area northeast of Snow Lake, Manitoba.

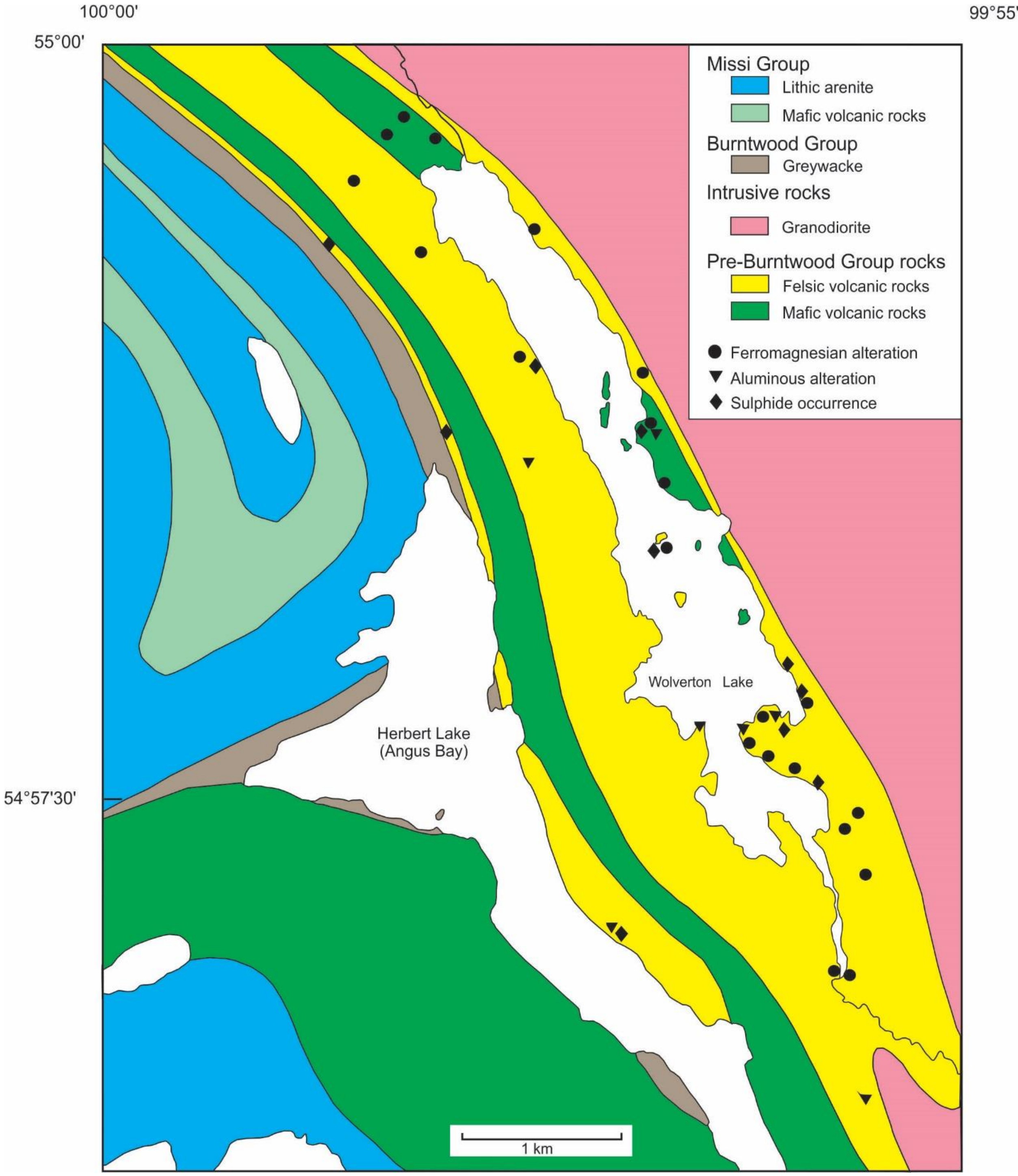

Fig. 2 Geology and alteration in the Wolverton Lake area, northeast of Snow Lake, Manitoba.

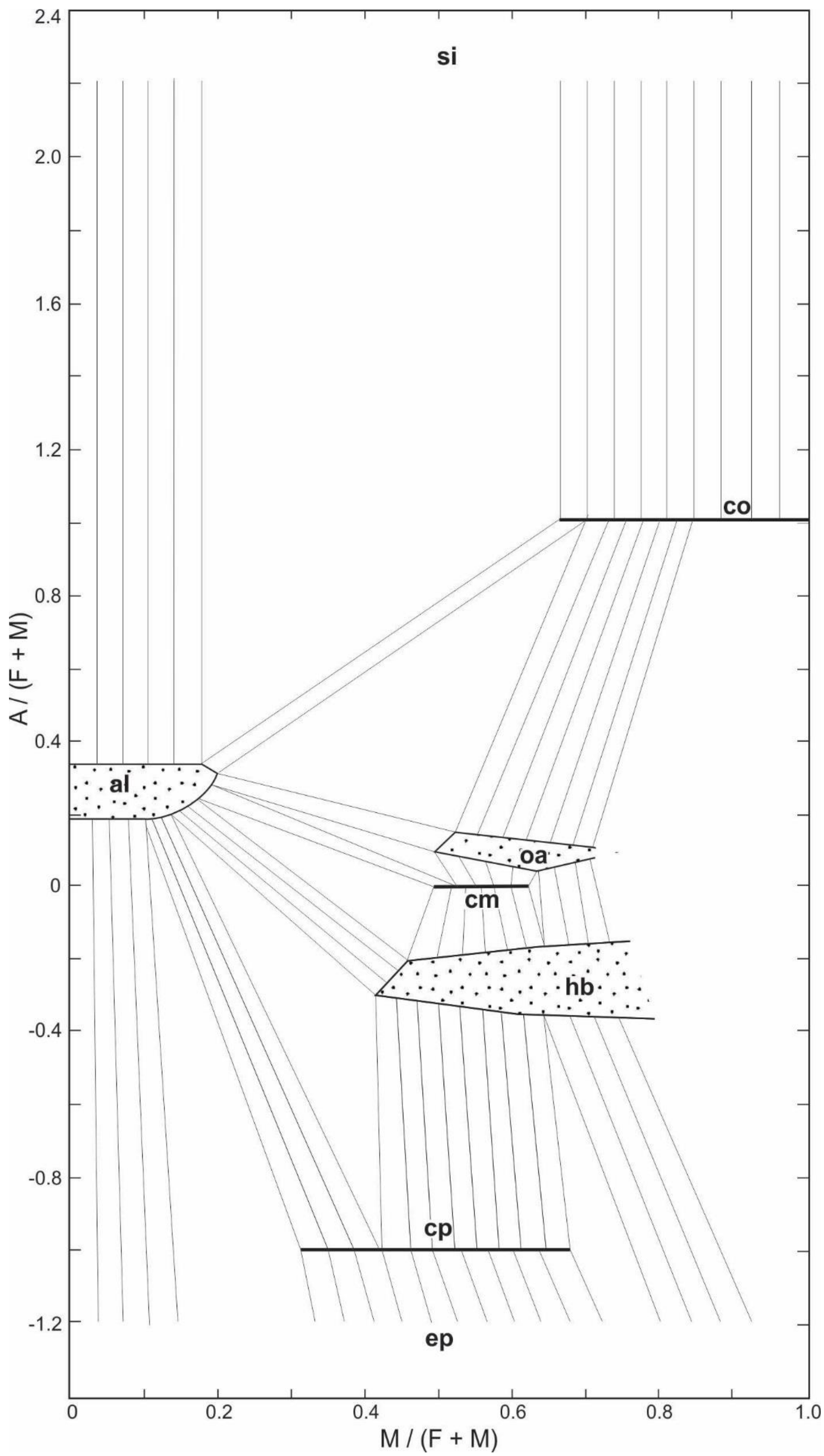

Fig. 3. Mineral assemblages from the Wolverton Lake area.

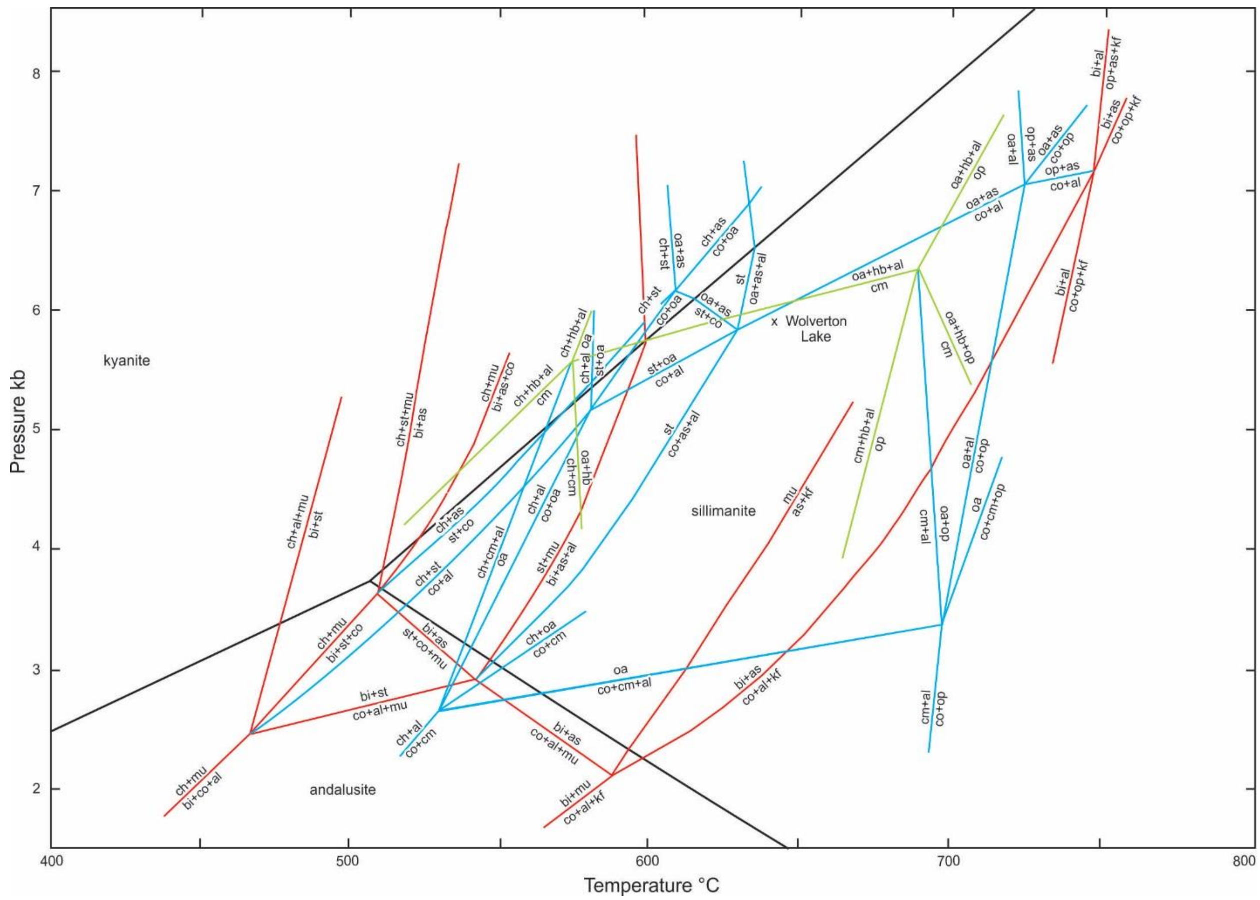

Fig. 4. Metamorphic conditions in the Wolverton Lake a