#### DESCRIPTIVE NOTES

The Weldon Bay–Syme Lake area, located 40 km northeast of Flin Flon, Manitoba (Fig. 1), straddles the boundary between the Flin Flon volcanic belt and the southern flank of the Kisseynew gneiss belt (Zwanzig et al., 1995; Zwanzig, 1999). The southern flank, in contrast to the central region of the Kisseynew gneiss belt, includes considerable areas of volcanic rocks and these are currently regarded as an extension of the Flin Flon volcanic belt (H.V. Zwanzig, pers. comm., 2007). Figure 1 shows a portion of the regional geology, taken essentially from the map prepared by the NATMAP Shield Margin Project Working Group (1998). Rocks have been assigned to five main subdivisions:

1. Pre-Burntwood Group rocks: assemblages of mainly metavolcanic rocks 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. Tonalite and granodiorite (1.88–1.84 Ga)

3. The Burntwood Group of metagreywacke (1.85–1.84 Ga).

4. The Missi Group of metamorphosed lithic arenite, conglomerate, and felsic volcanic rocks

The rocks of all five subdivisions have been metamorphosed at 1.82–1.80 Ga. The ages cited come from the same publication. Additional age determinations are given by Machado et al. (1999).

The Weldon Bay–Syme Lake area covers parts of four map sheets: Collins Point (Frarey, 1961), Sherridon (Bateman and Harrison, 1946), Weldon Bay (Kalliokoski, 1952), and Heming Lake (McGlynn, 1959). Brief notes on the geology were published by Robertson (1951), McRitchie (1980), and Froese (1984). Part of the Weldon Bay–Syme Lake area was included in a study of metamorphism by James (1983). The Collins Point and Sherridon map sheets, as well as an area around Lobstick Narrows, have been mapped by Zwanzig and Schledewitz (1992). Structural studies in the Lobstick Narrows area have been carried out by Norman et al. (1995) and Ansdell and Norman (1995). The Fay Lake area, east of Syme Lake, and a small area near Syme Lake have been investigated by Schledewitz (1993, 1994).

## LITHOLOGY

(1.85-1.83 Ga).

5.Gabbro (1.84-1.83 Ga)

The older volcanic rocks south of Weldon Bay are shown as juvenile arc rocks on the NATMAP map. However, Gilbert (2004) regarded them as a type transitional between arc and ocean-floor basalt. The dominant rock type is a greenish grey amphibolite containing hornblende crystals up to one mm long. Garnet is a common accessory. Deformed pillow rims can be recognized in a few places. The thin layer of amphibolite along the south shore of Weldon Bay includes coarser rocks, having a grain size of several mm, and contains lenses of calc-silicate rock, probably reflecting pre-metamorphic carbonatization. In some rocks, the assemblage cummingtonite-hornblende is present.

A narrow unit of grey, medium-grained felsic gneiss, present south of Weldon Bay and extending to

Syme Lake, commonly consists of quartz, plagioclase, biotite, almandine, and magnetite. Locally, poorly preserved fragments suggest a volcaniclastic origin. Gale and Norquay (1996) reported some occurrences of rhyolitic rocks with quartz phenocrysts in this unit. The east end of the Defender Lake gneiss dome, exposed southwest of Lobstick Narrows, is composed of medium-grained felsic gneiss. Quartz phenocrysts 5 mm in size are present. Similar rocks at the west end of Kisseynew Lake were regarded as volcaniclastic rocks by Ashton (1989). Within the unit of felsic volcaniclastic rocks, there are some occurrences of sillimanite, staurolite, and orthoamphibole. These minerals give some indication of pre-metamorphic hydrothermal alteration, aluminous and ferromagnesian in character (Froese, 1998), which may be related to copper-zinc mineralization. Mineral occurrences in mafic and felsic volcanic rocks south of Weldon Bay have been described by Gale and Norquay (1996). Small amounts of chalcopyrite and sphalerite are present in some of these.

A small unit of amphibolite and metagabbro north of Lobstick Narrows is considered by Zwanzig

(1999) to represent arc-rift basalt and gabbro. It includes rocks with a high garnet content and some calc-silicate lenses. Zwanzig and Schledewitz (1992) and Gale and Norquay (1996) reported the occurrence of Fe-As-Au in these rocks.

Granitic intrusions include tonalite and granodiorite. The bodies south of Weldon Bay and in the northeast corner are part of larger masses extending beyond the map area. They belong to the pre-Missi plutons 1.88–1.84 Ga in age (NATMAP Shield Margin Project Working Group, 1998).

The Burntwood Group consists mainly of biotite-garnet gneiss, probably derived from greywacke. The rock is grey, has a relatively high biotite content of about 15–30 per cent and is characterized by

euhedral garnets several mm across. Sillimanite is common. Staurolite is stable in muscovite-free rocks and occurs as relics in muscovite-bearing rocks. The dominant rock type of the Missi Group is a fine-to medium-grained quartzofeldspathic gneiss of variable composition, considered to be metamorphosed lithic arenite. Some rocks are quartz-rich and display quartz ridges on the weathered surface. Others contain hornblende and exhibit compositional layering on a scale of several cm, marked by biotite-rich and hornblende-rich layers. Clinopyroxene is present in some hornblende-bearing rocks. Quartz-sillimanite nodules occur in some localities. Norman et al. (1995) and Ansdell and Norman (1995) reported corundum-bearing layers from the Cleunion Lake area. Conglomerate consisting of volcanic and granitic fragments and very characteristic grey, magnetite-bearing chert pebbles is common. Kyanite was noted in one sample. Particularly well preserved conglomerate in a hinge zone of a fold three km north of Lobstick Narrows was described by McRitchie (1980). This conglomerate was traced by Zwanzig (1983) as a thin and highly deformed unit along the contact with amphibolite to Lobstick Narrows. Pink leucocratic gneiss forms a unit from Lobstick Narrows to Syme Lake and some smaller bodies north of Weldon Bay. This is a fine-grained rock consisting of quartz, microcline, plagioclase, traces of muscovite, epidote, and biotite. A faint colour banding is typical. The presence of quartz eyes and feldspar phenocrysts, first noted by Zwanzig (1983), probably indicates a volcaniclastic origin. A sample of quartz porphyry from Thunderhill Lake, believed to be either a rhyolite ash flow or subvolcanic intrusive rock, has been dated at 1826 + 11/-5 Ma (Hunt and Schledewitz, 1992). Smaller bodies of gabbro intrude Burntwood and Missi rocks and probably belong to the 1.84–1.83

# STRUCTURE The southern flank of the Kisseynew gneiss belt is characterized by recumbent folds and thrusts (Zwanzig, 1999). This has resulted in an interleaving of tectonic slices of rock units from the Burntwood and Missi groups and older volcanic rocks. Commonly, these units show extreme attenuation and pointed terminations. The body of Burntwood gneiss north of Lobstick Narrows, with a thin layer of volcanic rock on the east, is completely surrounded by Missi rocks and appears to be a tectonic slice. However, Zwanzig and Schledewitz (1992) regarded the Missi conglomerate to the east as a basal conglomerate marking an unconformity.

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The earliest observed foliation, S<sub>1</sub>, is parallel to lithologic contacts and probably was developed during a phase of isoclinal folding. Lithologic layering and S<sub>1</sub> were deformed into folds ranging from open to isoclinal during a second phase of deformation. A prominent S<sub>2</sub> foliation and L<sub>2</sub> stretching lineation were regionally developed; these are shown on the map. The usage is consistent with that of Norman et al. (1995).

North of Lobstick Narrows, the regional foliation S<sub>2</sub> cuts across lithologic layering. Elsewhere, the S<sub>2</sub> foliation is axial planar to small isoclinal folds 10–100 cm in size. The S<sub>2</sub> foliation is represented by

compositional layering on a scale of 1–100 cm, by flattened fragments and mineral aggregates, and by a parallel orientation of biotite. In areas of extreme attenuation, along the south shore of Weldon Bay

and north of Syme Lake, the  $S_2$  foliation is marked by paper-thin layers of biotite spaced several mm apart; this imparts a platy character to the rock. The  $L_2$  lineation is defined by stretched fragments, elongated mineral aggregates, and oriented sillimanite and hornblende crystals.

The  $S_2$  foliation has been deformed into open folds with axes parallel to the  $L_2$  stretching lineation without the development of an  $S_3$  foliation. The folds are outlined by the  $S_2$  foliation characterized by highly variable dips which include shallow dips in the direction of the  $L_2$  lineation. As in the Puffy Lake area further east (Zwanzig and Schledewitz, 1992), these folds die out in the steeply-dipping volcanic

# METAMORPHISM The metamorphism of the Weldon Bay–Syme Lake area has been discussed by Froese (1997). The

Ga group of intrusions.

formation of peak metamorphic assemblages probably coincided with the development of S<sub>2</sub> foliation and L<sub>2</sub> lineation because these structures are defined by the metamorphic minerals. In order to obtain an overview of assemblages formed in rocks of different composition, it is convenient to use some graphical representation (Fig. 2). At fixed values of pressure and temperature, and in the presence of quartz, plagioclase of constant composition, magnetite, ilmenite, and H<sub>2</sub>O vapour, non-potassic minerals can be represented in the system:

#### $A = Al_2O_3 - (CaO + Na_2O)$ $F = FeO - (Fe_2O_3 + TiO_2)$ M = MgO

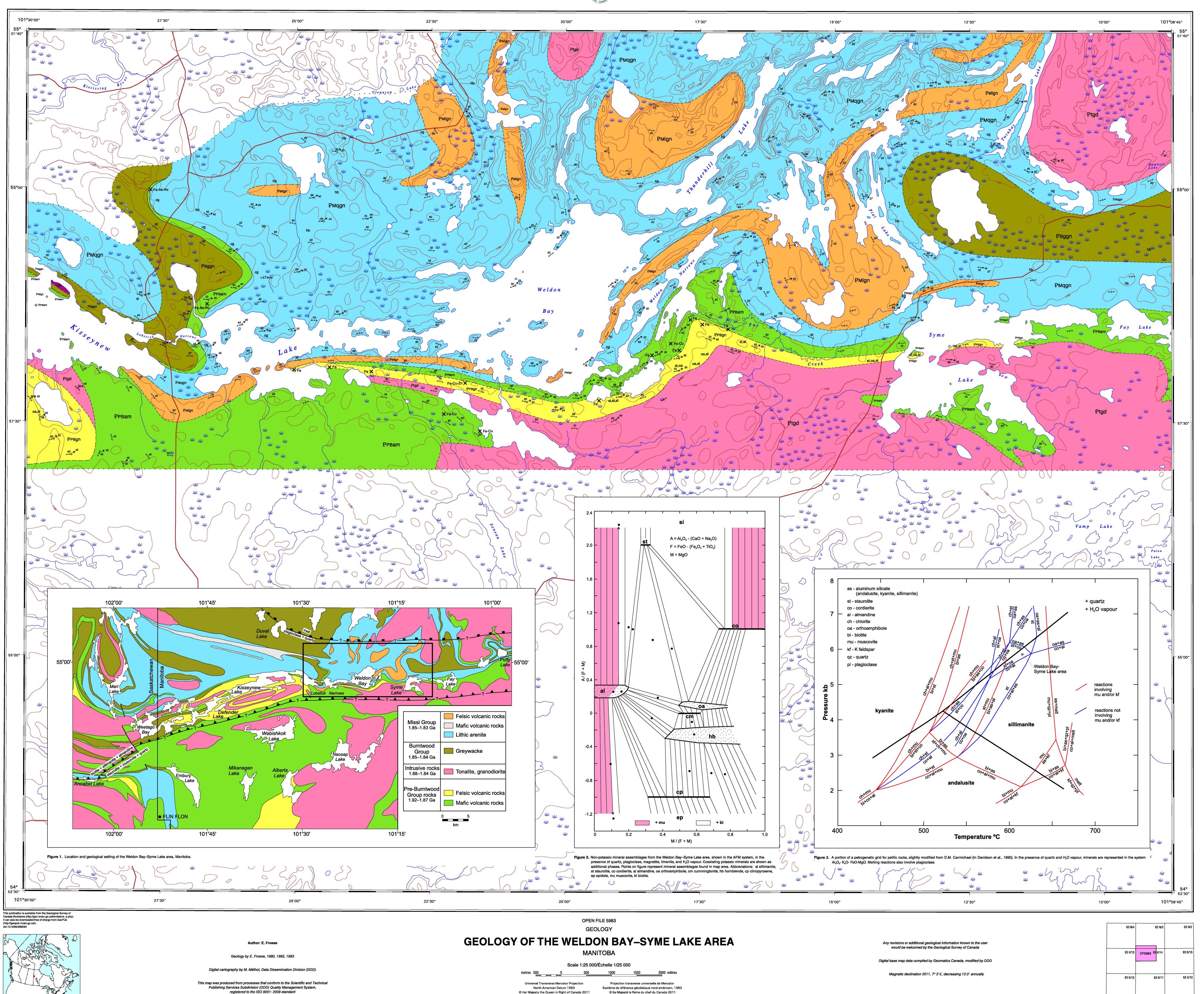
Potassic minerals, muscovite or biotite, coexisting with minerals in the AFM system can be shown as fields in the AFM diagram.

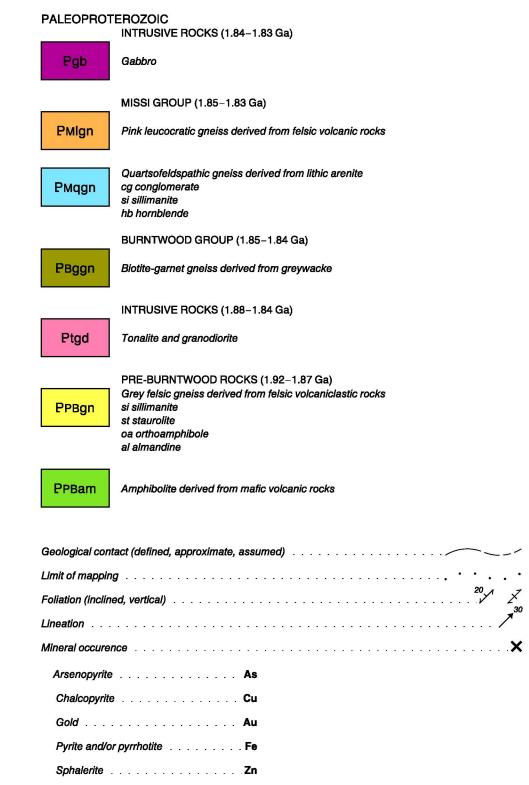
In the western (Amisk Lake) and eastern (File and Snow lakes) part of the Flin Flon volcanic belt, the biotite-sillimanite-almandine isograd, based on the reaction

staurolite + muscovite + quartz = biotite + sillimanite + almandine + H<sub>2</sub>O has been mapped and is shown at an estimated location in between, where rocks of an appropriate composition are absent (Plint et al., 1995). In the Annabel Lake area (Fig. 1), the isograd is taken from Ashton et al. (1992). Its extension to the east probably lies a short distance south of Weldon Bay. The biotite-sillimanite-almandine zone, north of the isograd, extends to the melt isograd in the Duval Lake area, based on the development of migmatite in Burntwood metagreywacke (Jungwirth, 1995). Muscovite in staurolite-bearing rocks in the Duval Lake area has been interpreted as retrograde and, consequently, these rocks were assigned to the biotite-sillimanite-almandine zone (Jungwirth, 1995, Jungwirth et al., 2000). The mineral assemblages in the Weldon Bay area (Fig. 2) indicate metamorphic conditions of the biotite-sillimanite-almandine zone. According to a petrogenetic grid (Fig. 3), prepared by D.M. Carmichael and published in Davidson et al. (1990), these are approximately 5.5 kb and 620C. The coexistence of staurolite and orthoamphibole require a minimum pressure of 5 kb.

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LEGEND

### REFERENCES

Ansdell, K.M. and Norman, A.R., 1995. U-Pb geochronology and tectonic development of the southern flank of the Kisseynew Domain, Trans-Hudson Orogon, Canada; Precambrian Research, v. 72, p. 147–167.
Ashton, K.E., 1989. Kisseynew project: Kisseynew Lake–Florence Lake area; Manitoba Energy and Mines, Report of Field Activities 1989, p. 65–71.
Ashton, K.E., Wheatley, K.J., Wilcox, K.H., Paul, D., Moser, D., and de Tombe, J., 1992. Geology, Mari Lake area, Saskatchewan; Geological Survey of Canada, Open File 2444, scale 1:50 000.
Bateman, J.D. and Harrison, J.M., 1946. Sherridon, Manitoba; Geological Survey of Canada, Map 862A, with descriptive notes.
Davidson, A., Carmichael, D.M., and Pattison, D.R.M., 1990. Metamorphism and geodynamics of the southwestern Grenville Province, Ontario; Field Trip Guidebook, IUGS/UNESCO International Geological Correlation Program, 235/304, 123 p.
Frarey, M.J., 1961. Collins Point, Manitoba; Geological Survey of Canada, Map 1068A, with descriptive notes.
Froese, E., 1984. Geology of the Weldon Bay—Fay Lake area, Manitoba; Geological Survey of Canada, Paper 84-1B, p.

Froese, E., 1984. Geology of the Weldon Bay–Fay Lake area, Manitoba; Geological Survey of Canada, Paper 84-1B, p. 355–358.
Froese, E., 1997. Metamorphism in the Weldon Bay–Syme Lake area, Manitoba; Geological Survey of Canada, Current Research 1997-E, p. 35–44.
Froese, E., 1998. Metamorphism of hydrothermally altered rocks; Geological Survey of Canada, Current Research 1998-E, p. 193–196.
Gale, G.H. and Norquay, L.I., 1996. Mineral deposits and occurrences in the Naosap Lake area, NTS 63 K/14;

Gale, G.H. and Norquay, L.I., 1996. Mineral deposits and occurrences in the Naosap Lake area, NTS 63 K/14; Manitoba Energy and Mines, Mineral Deposit Series Report No. 20, 91 p.
Gilbert, H.P., 2004. Geological investigations in the northern Flin Flon Belt, Manitoba (parts of NTS 63 K/13NE and 63K14NW); Manitoba Geological Survey, Report of Activities 2004, p. 9–23
Hunt, P.A. and Schledewitz D.C.P., 1992. U-Pb zircon age for a quartz porphyry in the Thunderhill Lake area, Kisseynew gneiss belt, Manitoba; *in* Radiogenic Age and Isotopic Studies: Report 5, Geological Survey of Canada, Paper 91-2, p. 51–54.
James, D.T., 1983. Origin and metamorphism of the Kisseynew gneisses, Kisseynew Lake–Cacholotte Lake area, Manitoba; M.Sc. thesis, Carleton University, Ottawa, 188 p.
Jungwirth, T., 1995. Metamorphism in the Duval Lake area, Kisseynew gneiss belt, Manitoba; M.Sc. thesis, University of Calgary, Calgary, 165 p.
Jungwirth, T., Gordon, T.M., and Froese, E., 2000. Metamorphism of the Burntwood Group in the Duval Lake area,

Manitoba, Canada; Canadian Mineralogist, v. 38, p. 435–442.

Kalliokoski, J., 1952. Weldon Bay map-area, Manitoba; Geological Survey of Canada, Memoir 270, 80 p.

Machado, N., Zwanzig, H., and Parent, M., 1999. U-Pb ages of plutonism, sedimentation, and metamorphism of the Paleoproterozoic Kisseynew metasedimentary belt, Trans-Hudson Orogen (Manitoba, Canada); Canadian Journal of Earth Sciences, v. 36, p. 1829–1842.

McGlynn, J.C., 1959. Elbow–Heming lakes area, Manitoba; Geological Survey of Canada, Memoir 305, 72 p.
McRitchie, W.D., 1980. Cacholotte Lake (parts of 63 K/13, 14, and 63 N/3, 4); Manitoba Energy and Mines, Report of Field Activities 1980, p. 65–69.
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 258A-7, scale 1: 100 000.
Norman, A.R., Williams, P.F., and Ansdell, K.M., 1995. Early Proterozoic deformation along the southern margin of the Kisseynew gnelss belt, Trans-Hudson Orogen: a 30 Ma progressive deformation cycle; Canadian Journal of Earth Sciences, v. 32, p. 875–894.
Plint, H.E., Gordon, T.M., Froese, E., and Berman. R.G., 1995. Metamorphic data, Flin Flon and Kisseynew belts, Saskatchewan–Manitoba; Geological Survey of Canada, Open File 3160, scale 1:400 000.

Robertson, D.S., 1951. The Kisseynew lineament, northern Manitoba; The Precambrian, v. 24, p. 8–11, 13, 23.
Schledewitz, D.C.P., 1993. Geology of the Webb Lake–Fay Lake area (NTS 63 K/14 NE and 63 K/15 NW); Manitoba Energy and Mines, Report of Activities 1993, p. 29–32.
Schledewitz, D.C.P., 1994. Geology of the Webb Lake–Fay Lake area (NTS 63 K/14 NE and 63 K/15 NW); Manitoba Energy and Mines, Report of Activities 1994, p. 42–46.
Zwanzig, H.V., 1983. Kisseynew project: Lobstick Narrows (parts of 63 K/13, 14, and 63 N/3, 4); Manitoba Energy and Mines, Report of Field Activities 1983, p. 15–22.
Zwanzig, H.V., 1999. Structure and stratigraphy of the south flank of the Kisseynew Domain in the Trans-Hudson Orogen, Manitoba: implications for 1.845–1.77 Ga collision tectonics; Canadian Journal of Earth Sciences, v. 36, p. 1859–1880.
Zwanzig, H.V. and Schledewitz, D.C.P., 1992. Geology of the Kississing–Batty lakes area: interim report; Manitoba Energy and Mines, Open File OF92-2, 87 p.

Zwanzig, H.V., Ashton, K.E., and Schledewitz, D.C.P., 1995. Geology, Flin Flon belt-Kisseynew belt transition zone, Manitoba-Saskatchewan; Geological Survey of Canada, Open File 3054, scale 1:100 000.

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