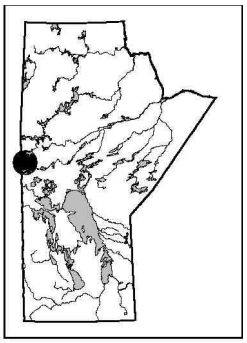
GS-4 PLATINUM-GROUP ELEMENT INVESTIGATIONS IN THE FLIN FLON GREENSTONE BELT: MCBRATNEY LAKE OCCURRENCE AND JOSLAND LAKE INTRUSION (PARTS OF NTS 63K/9, /13)

by P. Theyer



Theyer, P. 2001: Platinum-group element investigations in the Flin Flon greenstone belt: McBratney Lake occurrence and Josland Lake intrusion (parts of NTS 63K/9, /13); *in* Report of Activities 2001, Manitoba Industry, Trade and Mines, Manitoba Geological Survey p. 33-39.

SUMMARY

The recently discovered McBratney Lake platinum-group element (PGE) occurrence, located approximately 7 km east of Flin Flon in the Flin Flon greenstone belt, highlighted the potential for 'contact-type' PGE mineralization that is assumed to be due, in this case, to the physical and chemical interaction between a mafic to intermediate magma and sulphide-bearing mafic volcanogenic host rocks.

Drilling by Fort Knox Gold Resources Inc. yielded a 16.8 m section of massive sulphide mineralization assaying a remarkable 8.9 g/t Pd, 1.8 g/t Pt, 1.1% Cu and 0.6% Ni; highest concentrations of 15.4 g/t Pd, 1.9 g/t Pt, 1.6% Cu and 1.2% Ni were encountered in a 7.3 m portion of this section.

Overburden stripping in 2001 exposed a structurally enhanced, massive-sulphide body that straddles the southern contact between a gabbroic lens and mafic volcanogenic rocks of the Bear Lake basaltic andesite suite. Cursory prospecting of a segment of this contact in the vicinity of the McBratney Lake occurrence led to the discovery of two additional sulphide concentrations in a comparable geological environment. A third sulphide occurrence, known to contain significant PGE concentrations and also located at the contact between gabbro and the Bear Lake basaltic andesite (P. Lewis, pers. comm., 2001), suggests that this geological setting may yield further sulphide concentrations. The McBratney Lake PGE discovery is significant because of the exceptionally high PGE concentrations and because there may be significant potential for additional similar mineralization, due to the approximately 50 km long contact of the gabbro intrusive rocks with the Bear Lake basaltic andesite suite.

The Josland Lake intrusion is a layered, differentiated gabbroic body that intruded volcanic rocks of Early Proterozoic age in the vicinity of Snow Lake. The presence of PGE-enriched and -depleted domains in the Josland Lake intrusion suggests that economic PGE concentrations may have formed in this igneous body. Sulphide concentrations of up to 5% pyrrhotite were sampled at several localities within this differentiated body.

MCBRATNEY LAKE AND RELATED PGE OCCURRENCES

Part of the summer was spent investigating the McBratney Lake occurrence, located approximately 7 km east of the town of Flin Flon. A September 2000 press release by Fort Knox Gold Resources Inc. focused the attention of the exploration community on a new and significant PGE exploration project. This announcement reported an option agreement to explore a mineral prospect that Hudson Bay Exploration and Development Co. Ltd. (HBED) had originally drilled in 1991 and in which significant PGE and Ni-Cu concentrations were discovered. Fort Knox Gold redrilled this target, intersecting 16.8 m of massive-sulphide mineralization that returned 8.9 g/t Pd, 1.8 g/t Pt, 1.1% Cu and 0.6% Ni. This intersection included 7.3 metres that assayed 15.4 g/t Pd, 3.2 g/t Pt, 1.6% Cu, 1.2% Ni and 21.5 g/t Au. A magnetometer survey over the target area suggested that the mineralization is controlled by the intersection of a southwest-trending fault and the south-trending contact between the Big Island gabbro and the Bear Lake basaltic andesite suite. Fort Knox Gold continued exploration of this property in the summer of 2001 by stripping the target area of more than 8 m of glacial overburden and conducting geological mapping and channel sampling in the pit.

The author, in cooperation with Fort Knox Gold, mapped and sampled exposures in the pit and investigated the geology of comparable geological environments in the vicinity.

Geology

Volcanogenic massive-sulphide deposits in the Flin Flon metavolcanic belt occur, according to Syme and Bailes (1993), in an Early Proterozoic island-arc setting. North- to northeast-trending, postmetamorphic, brittle to ductile faults and shear zones subdivide the supracrustal rocks into tectonic blocks. The McBratney Lake occurrence is located in the arc-tholeiitic Bear Lake Block (Fig. GS-4-1). The Bear Lake Block is dominated by basaltic andesite, in a 3.3 km thick sequence of mafic volcanogenic rocks that includes aphyric to pyroxene±plagioclase–phyric lava flows, pillow-fragment breccias, synvolcanic dykes and sills, and minor interflow mafic tuff (Syme and Bailes, 1993). The volcanic rocks of the Bear Lake Block are intruded by a suite of gabbro, diorite and quartz diorite. These intrusions are parallel to the host-rock fabric and tend to have ovoid to elongate septae-like shapes with length to width ratios exceeding 1:100 in some instances. Bailes and Syme (1989) classified these rocks as 'Pre-Missi Intrusive rocks, intrusions of unknown age' and named one of the intrusions the 'Wonderland Lake gabbro' and its southern prolongation the 'We Lake sill' (Fig. GS-4-1).

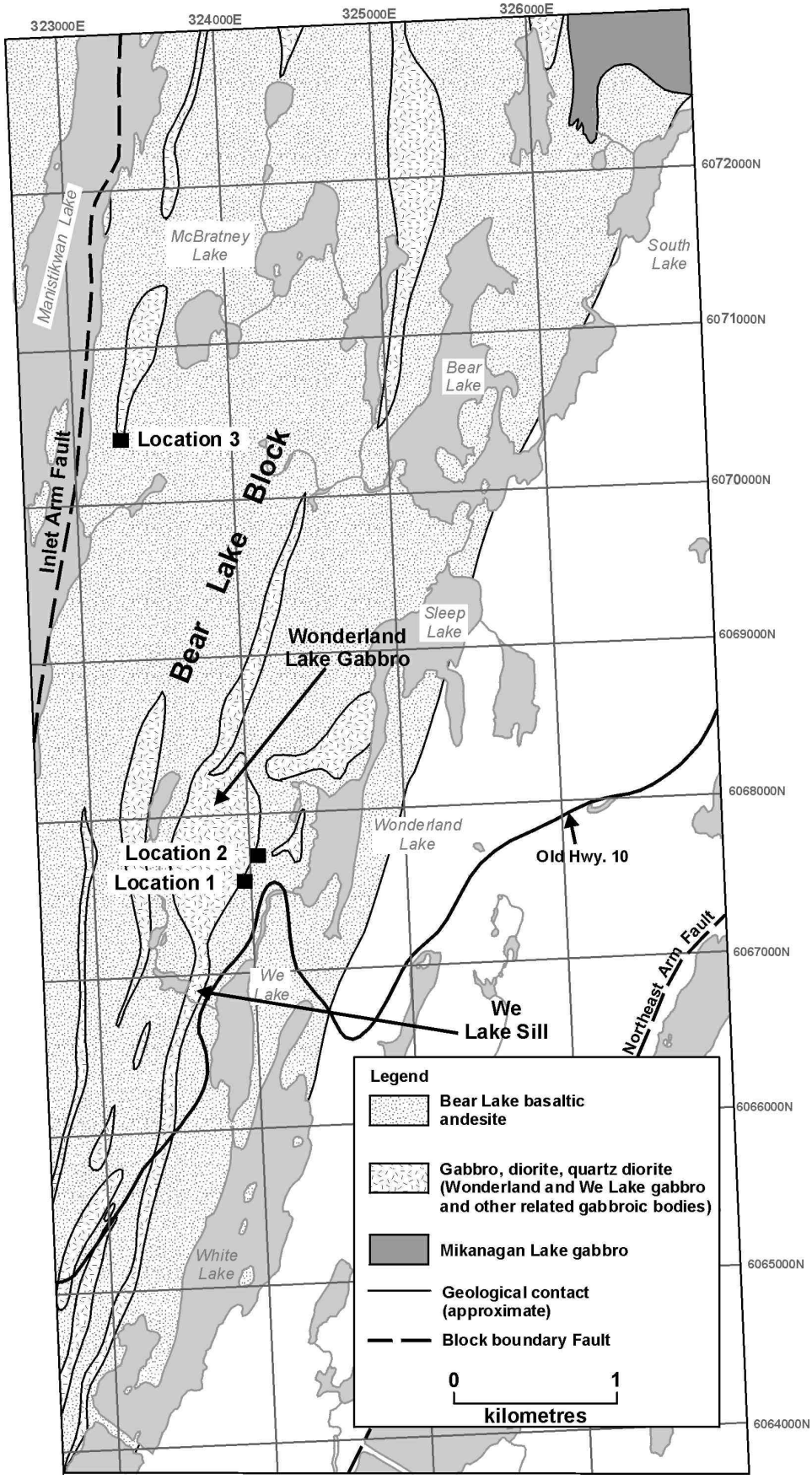


Figure GS-4-1: Simplified geology of the McBratney Lake occurrence and its vicinity, showing locations of the mineral occurrences discussed in the text.

A traverse across the thickest part of the Wonderland Lake gabbro displayed a well-differentiated igneous body consisting, from east to west, of gabbro grading, within approximately 10 m, into quartz diorite that constitutes the approximately 350 m thick bulk of this body. The western edge of this intrusive body consists of gabbro, which grades into peridotite that is at least 12 m thick. The transition from gabbro into peridotite is not consistent with the observations of Bailes and Syme (1989), who classified this peridotite as part of the Whitefish Lake intrusion, a multiphase mafic intrusion that also includes wehrlite and pyroxenite. The contact of the peridotite with Bear Lake basaltic andesite to the west (Bailes and Syme, 1989) was not observed in this traverse.

Mineral Occurrences

McBratney Lake occurrence

This sulphide occurrence is located at the southern end of a septum-like gabbroic intrusion (Fig. GS-4-1) that is interpreted as being related to the Wonderland Lake intrusion and the Bear Lake basaltic andesite suite. It is structurally controlled by the intersection of a southwest-trending fault and the south-striking contact between gabbro and basaltic andesite. This mineral occurrence, first drilled by HBED in 1991, was redrilled by Fort Knox Gold in 2000. In 2001, the occurrence was exposed by stripping approximately 9 m of glacial sediments (Fig. GS-4-2).

The McBratney Lake occurrence consists of a massive-sulphide body that was tectonically emplaced at the contact between gabbro and basaltic andesite. The sulphide mineralization is strongly banded, probably due to deformation that resulted in the separation of sulphide minerals of differing competence into centimetre-thick bands of varying compositions. Polished slabs display distinct bands of pyrrhotite, chalcopyrite, talnakhite andcubanite, as well as blebs of pentlandite. A metre-sized, vaguely defined domain of disseminated pyrrhotite, trending in a northerly direction, adjoins the massive sulphide accumulation.

The north-trending contact between the gabbro and basaltic andesite, exposed in the pit for approximately 8 m in a northerly direction, was tested by two channel samples. Sulphide concentrations in this segment were scarce, consisting of pyrrhotite that is concentrated mainly at the contact, and within centimetres of the contact, of the two rock units (Fig. GS-4-3).

Geological traverses in the vicinity of the pit showed that both the Bear Lake basaltic andesite suite and the gabbro are well exposed, and that almost ubiquitous rust staining characterizes most of the contacts. Outcrops of the Bear Lake suite, in the vicinity of the pit, contain sporadic occurrences of sulphide. At one locality, up to 10% coarse-grained pyrite occurs in a layered, aphanitic, basaltic rock that may have been an interflow sediment.

Figure GS-4-2: McBratney Lake pit, showing massive sulphide mineralization and thickness of glacial coverage.

Kennel occurrence

Interest focused on the contact between the Bear Lake basaltic andesite and the gabbro intrusions, in view of the fact that the McBratney Lake sulphide occurrence is located at this contact.

The ‘Kennel’ occurrence is an analogous sulphide occurrence named after a kennel located at the side of a gravel road leading to the occurrence. Sulphide mineralization occurs on an approximately 35 m long section of the north-trending contact between the Wonderland Lake gabbro and the Bear Lake basaltic andesite (Fig. GS-4-1, location 2; Fig. GS-4-4).

This contact is exposed on the flanks and at the top of an approximately 20 m high escarpment. Pyrrhotite of highly variable tenor (trace to >40%) occurs over widths ranging from less than 1 cm to 40 cm. The sulphide minerals occur mainly within the basaltic andesite. Both the gabbro and the andesite show evidence of alteration, in the form of intense bleaching and chloritization of mafic minerals. Gabbro in the vicinity of the contact, is locally altered to an aphanitic, shaly fault gouge. Further evidence of intensive faulting consists of tectonically rounded basaltic-andesite fragments that were entrained in the fault gouge. Gabbro, at or near the contact with the Bear Lake suite, shows evidence of late brittle fracturing, concurrent with the circulation of fluids that

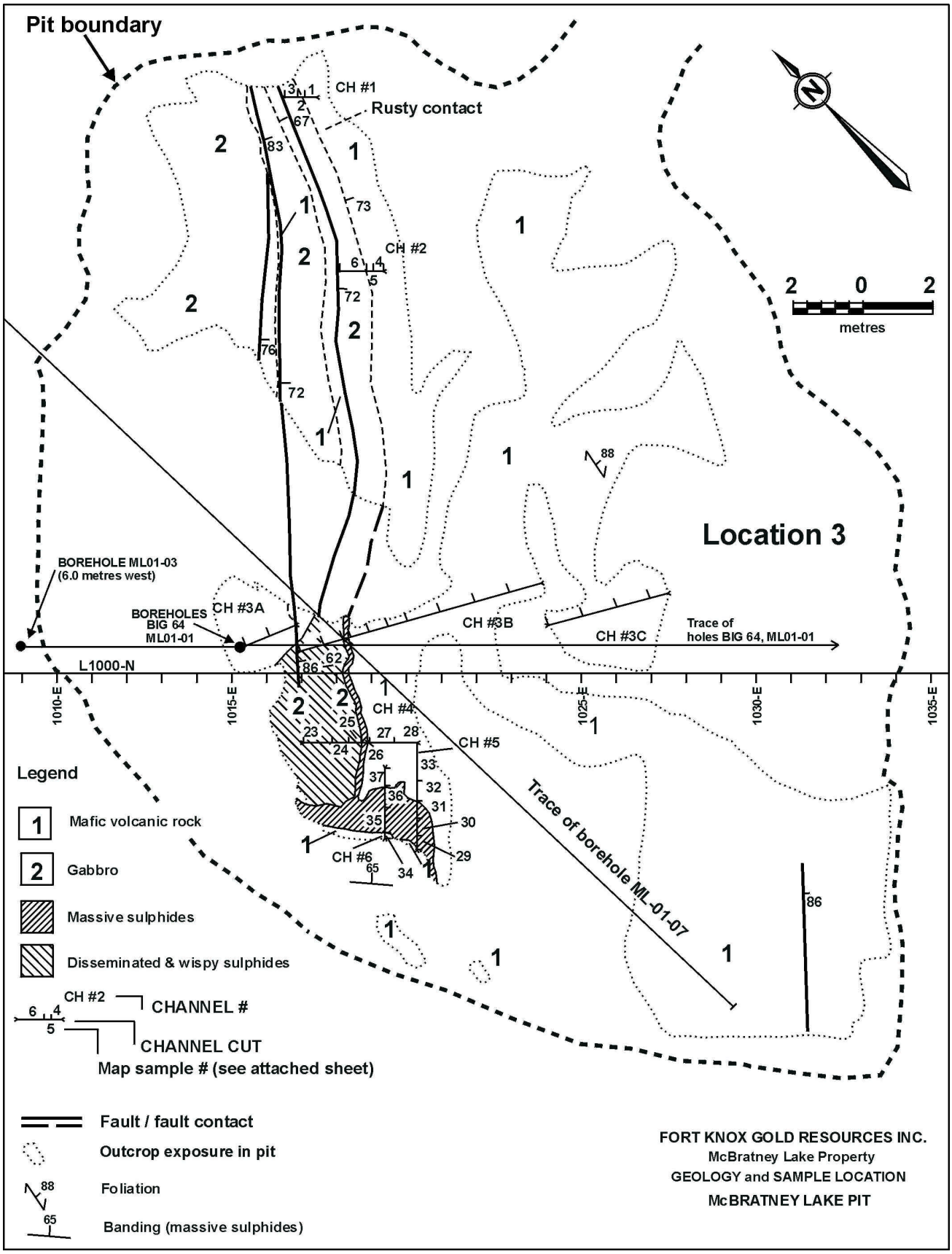
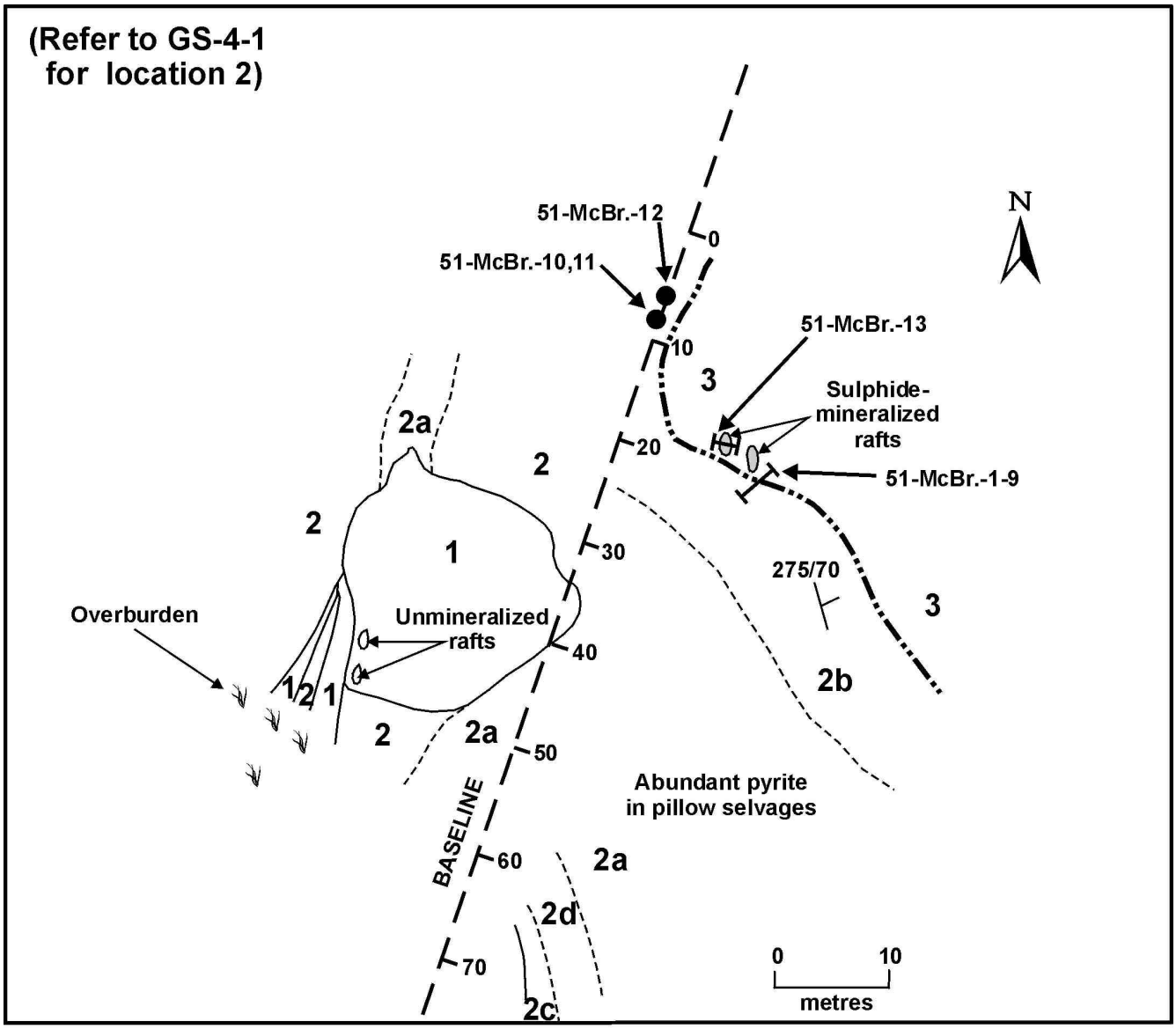


Figure GS-4-3: Geology of the pit at the McBratney Lake occurrence, showing the location and extent of channel samples (mapping by P. Lewis, 2001; published with permission of Fort Knox Gold Resources Inc.).



Legend

1	Granodiorite
2	Basalt
2a	Pillowed basalt
2b	Aphyric basalt
2c	Amygdaloidal basalt
2d	Mega-amygdaloidal basalt
3	Gabbro

Symbols

- Geological boundary (known, approximate)
- 275/70 — Bedding (strike, dip)
- Sulphide mineralization
- Xenolithic rafts
- Channel sample location

Figure GS-4-4: Geology of the 'Kennel' occurrence.

caused silica and carbonate (±sulphide±magnetite) mineralization.

Rocks in contact with gabbro are aphanitic massive basalt; however, in the vicinity of the contact, there occurs a variety of related rocks, such as pillowed basalt, amygdaloidal basalt and basalt layers with centimetre-sized gas cavities. Many pillows display centimetre-thick hyaloclastite rims that contain up to 3% pyrite.

Other mineral occurrences comparable to the Kennel occurrrence

Geological prospecting along the margin of the gabbro intrusion, approximately 150 m west of and subparallel to the Wonderland Lake gabbro and the Bear Lake basaltic andesite suite, produced evidence of intense faulting, accompanied by mylonitization and brecciation. The author also discovered evidence of previous sampling at pyrrhotite concentrations located at the contact of these units. (Fig GS-4-1, location 3).

Another pyrrhotite occurrence in an analogous geological setting (i.e., at or near the contact between the Wonderland Lake gabbro and the Bear Lake basaltic andesite) is reported approximately 150 m south of the Kennel occurrence (P. Lewis, pers. comm., 2001) This occurrence was trenched and sampled in the search for Ni-Cu mineralization, but was not assayed for PGEs (Fig. GS-4-1, location 1; G. Gale, pers. comm., 2001).

JOSLAND LAKE INTRUSION

The Josland Lake intrusion is part of a suite of layered, well-differentiated bodies of tholeiitic gabbro and derived amphibolitic rocks that intruded Early Proterozoic volcanic rocks. The petrography of the Josland Lake gabbro was described in detail by Bailes (1980). The most recent publication on the geology of the Josland Lake gabbro is by Syme et al. 1995. Zwanzig et al. (GS-3, this volume) published a recently determined U-Pb zircon age for the Josland Lake sills of 1886 ± 3 Ma (95% confidence level). These sills, together with the 1881 +3/–2 Ma Mikanagan Lake sill near Flin Flon, are interpreted to be part of a major igneous province, linked to arc rifting, that intruded the Flin Flon belt at the close of juvenile-arc volcanism.

Following the suggestion of a colleague (Bailes, pers. comm., 2001) several days were spent investigating the Josland Lake layered intrusive body. Nearly continuous outcrops along an abandoned CN Rail right-of-way greatly facilitated sample collection in an easterly direction, starting at Krug Lake (Fig. GS-4-5).

Sample Descriptions

The rock types encountered on this traverse are comparable to units described by Syme et al. (1995). Ferrodiorite devoid of sulphide minerals occurs east of Krug Lake. An approximately 1 m wide mylonitized rock at the eastern edge of the depression approximately 170 m east of Krug Lake suggests that the contact between the ferrodiorite and the gabbro is a major fault. The outcrop consists of interlayered bands of gabbro and ferrodiorite, 1 to 5 cm thick, with several centimetre-thick quartzofeldspathic lenses that are characterized by graphic intergrowths of quartz and feldspar. A few aphanitic, glassy, centimetre-thick veins and lenses are interpreted to be ultramylonite. West of the tectonized outcrop, a megacrystic ‘harrisitic’ gabbro is characterized by centimetre-sized amphibole (?after pyroxene) laths intergrown with plagioclase and sulphide-bearing domains. Exposed on an escarpment is a coarsely crystalline ‘harrisitic’ gabbro that contains up to 5% disseminated pyrrhotite. The tenor of the mineralization tends to be higher near faults, but domains of metre-sized disseminated sulphides have also been observed in localities several metres distant from faults.

Other zones of sulphide mineralization that were observed in the Josland Lake gabbro include

- medium-grained gabbro containing approximately 2% pyrrhotite as fracture fills, 185 m east of Krug Lake;
- very fine grained quartzofeldspathic rock containing 2% disseminated pyrrhotite, approximately 190 m east of Krug Lake;
- fine-grained homogeneous ferrogabbro containing approximately 1% disseminated pyrrhotite, 480 m east of Krug Lake; and
- fine- to medium–grained, inhomogeneous, dark grey- to black-weathering ferrogabbro containing up to 3% disseminated pyrrhotite; higher concentrations of pyrrhotite were observed as fracture fills approximately 950 m east of Krug Lake.

The balance of the outcrops of this sill along the CN Rail right-of-way, as far as 2.8 km east of Krug Lake, were investigated but were generally found to be devoid of significant sulphide occurrences.

Geochemistry

A review of the chemical database available in Peck et al. (2000) shows that samples of the Josland Lake gabbro collected by Bailes (1980) are characterized by zones of PGE enrichment and depletion. These data suggest that there is a possibility for economically viable PGE concentrations.

At the time of writing, none of the samples collected and discussed in this report had been analyzed.

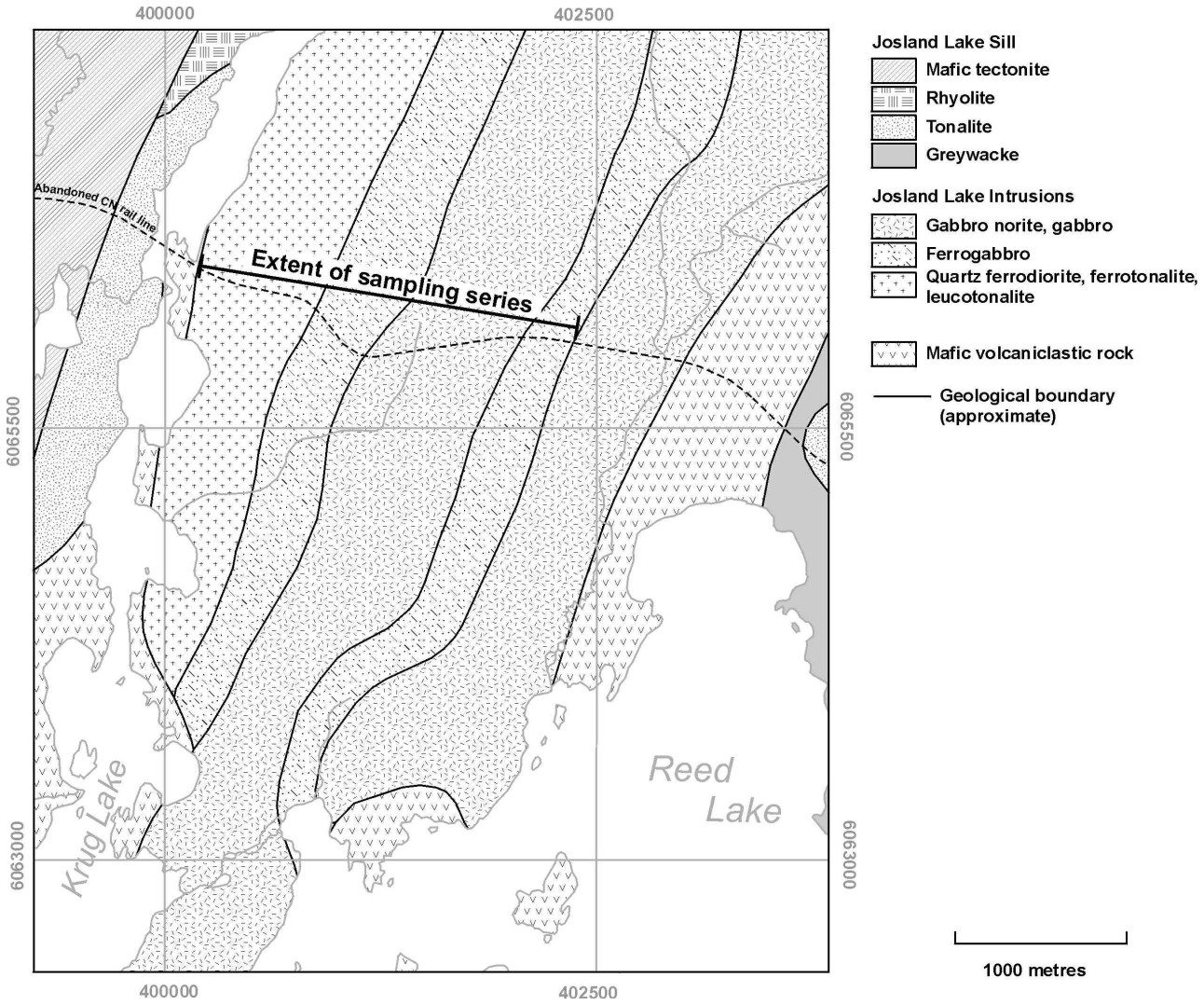


Figure GS-4-5: Location of the Josland Lake intrusion sampling traverse.

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