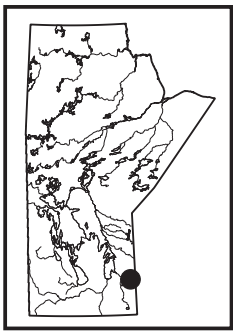
GS-4 Rare metals in southeastern Manitoba: pegmatites from Bernic Lake and Rush Lake (parts of NTS 52L6)

by T. Martins and P.D. Kremer



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Summary

Preliminary results of field work and whole rock geochemistry are presented for the Bernic Lake and Rush Lake pegmatite groups. These pegmatites are part of the Cat Lake–Winnipeg River district located in the Bird River greenstone belt, southeastern Manitoba. The studied pegmatites are part of the Bernic Lake and Rush Lake pegmatite groups, and intrude a variety of volcanic and metasedimentary rocks belonging to the south panel of the Bird River Belt. The pegmatites of the two groups differ in terms of contacts, mineralogy and degree of fractionation. Pegmatites from the Bernic Lake pegmatite group have sharp, irregular contacts; have Li, Ta, Nb, Sn and P enrichment; and some are zoned and have quartz cores. The pegmatites of the Rush Lake pegmatite group are less fractionated with generally sharp, straight contacts and graphic textures. Enrichment in rare metals, such as Li, Ta and Cs, suggests that these pegmatites have a great potential for rare-metal enrichment in an area that is already famous for its Tanco pegmatite, a prime Ta-Li-Cs deposit and one of the largest pegmatites in the world.

Introduction

This report presents part of the results from a more extensive project designed to investigate existing and new discoveries of rare metals throughout Manitoba (Martins et al., GS-10, this volume). It summarizes the findings of four days of field work and preliminary geochemical results from pegmatites in the Bernic Lake and Rush Lake areas, part of the Cat Lake–Winnipeg River pegmatite district defined by Černý et al. (1981). This pegmatite district consists of nine distinct pegmatite groups, which exhibit wide variations in mineralogy and degree of fractionation. The pegmatites belonging to the Bernic Lake pegmatite group in particular, of which the world famous Tanco pegmatite is most noteworthy, have been studied previously by several authors (e.g., Lenton, 1979; Černý et al., 1981, 1996; Bannatyne, 1985; Anderson et al., 1998; van Lichtervelde et al., 2006; Kremer, 2010).

Geological setting

The Bernic Lake and Rush Lake pegmatite groups are located in the Bird River greenstone belt, which is part of the Bird River Subprovince of the Archean Superior Province (Figure GS-4-1). The Bird River greenstone belt is composed of metavolcanic and metasedimentary rocks that have been subdivided into the north and south panels based on geochemical and geochronological variations (Gilbert, 2006; Gilbert et al., 2008). The north and south panels are separated by the Booster Lake Formation, a turbiditic sequence with characteristics of a classic Bouma-type sequence, and unconformably overlain by clastic sedimentary rocks of the Flanders Lake Formation (Gilbert, 2006).

The pegmatites of the Bernic Lake and Rush Lake pegmatite groups intrude rocks from the south panel of the Bird River Belt, specifically the Bernic Lake Formation, the Southern MORB-type formation and the Booster Lake Formation as described by Gilbert et al. (2008). The Bernic Lake Formation is mostly composed of felsic, and mafic to intermediate arc-volcanic rocks in the east, and mafic volcanic rocks in the west. The Southern MORB-type formation is composed of aphyric pillowed basalt and related gabbro, and minor siltstone-chert.

Geology of the pegmatites

Field observations were limited by poor exposure and moss coverage making it challenging to revisit some of the pegmatites previously described by other authors.

Bernic Lake pegmatite group

Pegmatites from this group include Tanco, Oompa Loompa, Coe, Buck and Pegli. These pegmatites are intruded along the sheared contact between and within the southern MORB-type and Bernic Lake formations. Garnet occurs regularly as a metasomatic alteration phase in the country rock adjacent to the contact with the pegmatite. Tourmaline is also observed both in the margins of the pegmatite and the country rock. Pegmatite contacts, when possible to observe, are usually bulbous and irregularly shaped (Figure GS-4-2a). Internal zonation within pegmatites is present but is not always easy to define due to poor exposure. At one of the few outcrops where exposure made describing the pegmatite possible, the irregularly shaped pegmatite cuts the country rock exhibiting a quartz core of about 2 meters wide. Other layers or lenses that could be used to define internal zonation in this pegmatite include a zone of quartz and amblygonite, surrounded by feldspar and beryl (locally partially surrounded by Nb-Ta oxides).

Mineralogy is variable but generally it is possible to identify quartz, K-feldspar, spodumene, cassiterite, beryl,

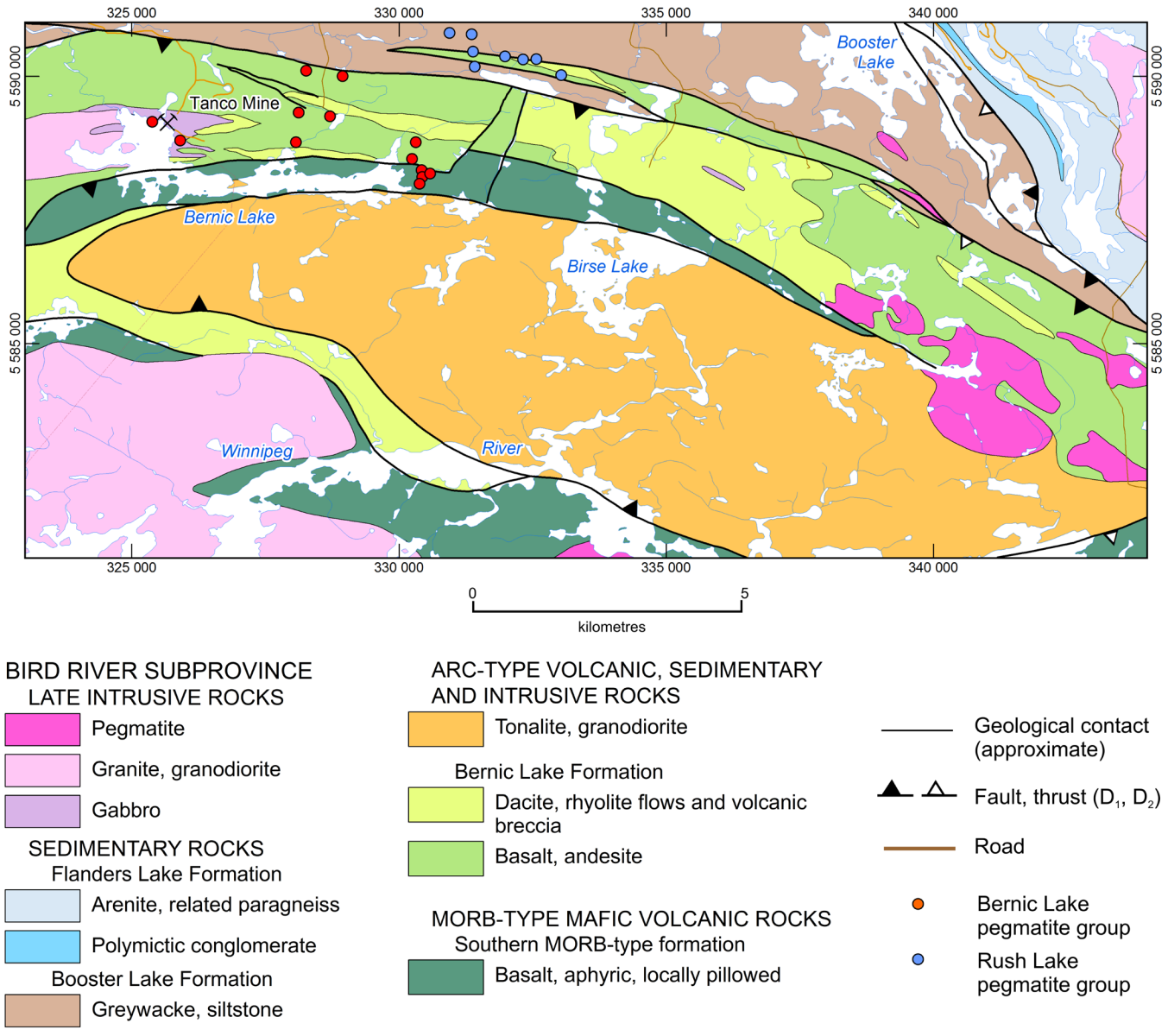

Figure GS-4-1: *Simplified geology of the Bird River greenstone belt including locations of the Bernic Lake and Rush Lake pegmatite groups, after Gilbert et al. (2008).*

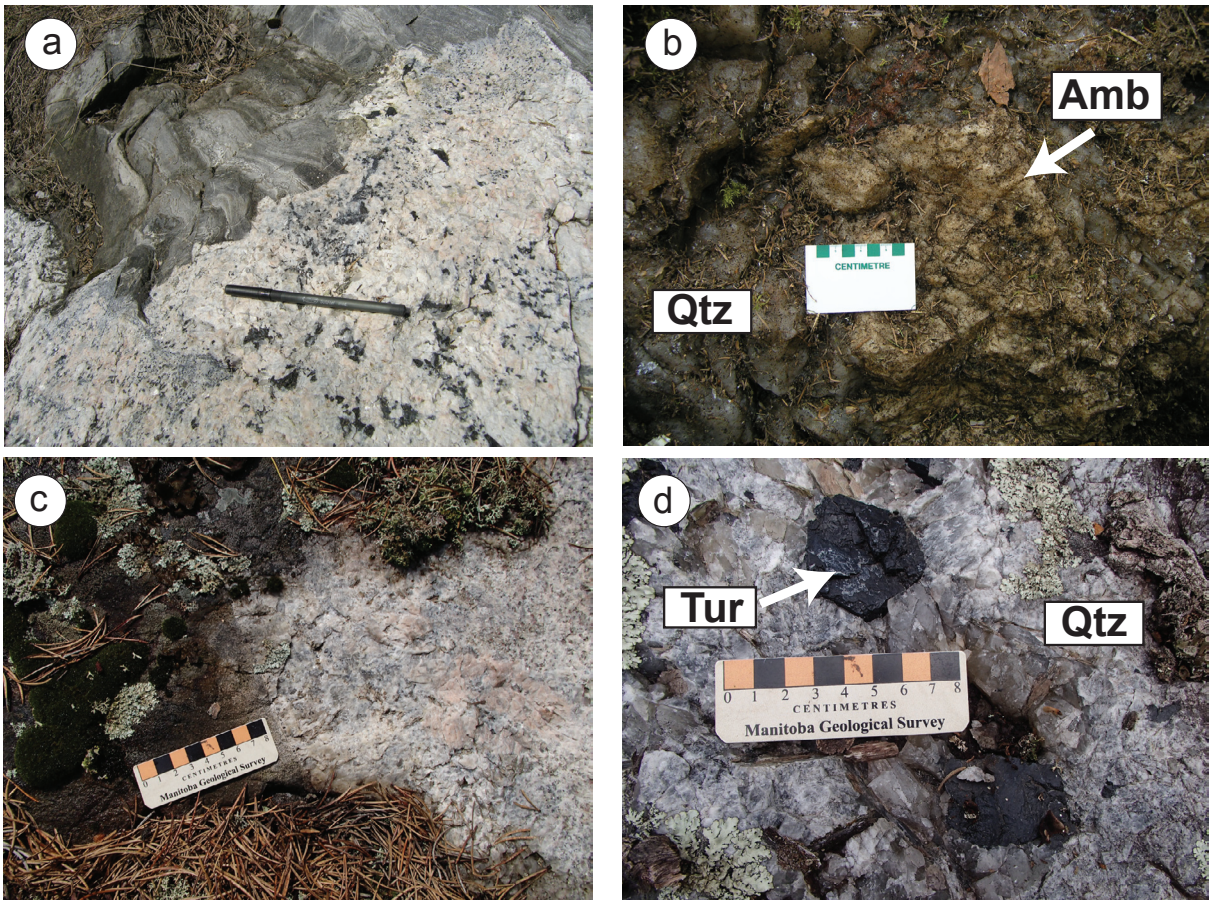

Figure GS-4-2: *Pegmatites from the Bernic Lake and Rush Lake pegmatite groups, southeastern Manitoba:* ***a)*** *bulbous contact of the Oompa Loompa pegmatite intruding into the Southern MORB-type formation, Bernic Lake pegmatite group;* ***b)*** *Coe pegmatite exhibiting a mass of amblygonite (Amb) surrounded by quartz (Qtz), Bernic Lake pegmatite group;* ***c)*** *sharp contact of a pegmatite from the Rush Lake group;* ***d)*** *detail of a basal section of tourmaline (Tur) from one of the pegmatites of the Rush Lake pegmatite group.*

Nb-Ta oxides, tourmaline, albite, muscovite, pollucite, apatite, zircon and minerals of the amblygonite-montebrasite series (Figure GS-4-2b), and of the triphylite-lithiophilite series. Preliminary whole rock geochemistry shows enrichment in Nb, Ta, Rb, Sn, Li, B, Be and Cs (Table GS-4-1).

Rush Lake pegmatite group

Pegmatites from the Rush Lake pegmatite group appear to be mineralogically and geochemically simpler than the pegmatites of the Bernic Lake pegmatite group (Table GS-4-1). These pegmatites intrude the Bernic Lake Formation, the Southern MORB-type formation and the Booster Lake Formation. Pegmatites are heterogeneous but zoning is difficult to define with the exception of a few examples where a distinct quartz core is present. Contacts are usually straight and sharp (Figure GS-4-2c), and crosscut the regional foliation. Commonly the pegmatite bodies contain both aplitic and pegmatite phases. Graphic texture is observed in some dikes. Mineralogy observed is generally quartz, K-feldspar, albite, muscovite, apatite, tourmaline (Figure GS-4-2d), garnet and zircon. Preliminary results of whole rock geochemistry show mainly enrichment in Rb and B.

Economic considerations

Rare metals define a large group of elements that can be found in very different environments and associated with very distinct types of rocks. Granitic pegmatites are important sources of rare metals such as Nb, Ta, Be, Sn, Li, Rb, Cs and Ga. They also host a variety of important industrial minerals, precious and semiprecious gems, and mineral specimens.

Pegmatites from the Cat Lake–Winnipeg River district are usually enriched in some of the rare metals associated with granitic pegmatites. Although this is not true for all the pegmatite bodies found in this district, most of them belong to the rare-element class, LCT (lithium, cesium, tantalum) group (as defined by Černý and Ercit, 2005), and are enriched in Li, Cs and Ta making the Bird River greenstone belt an outstanding target for rare-metal exploration.

Table GS-4-1: Preliminary whole rock geochemistry results for pegmatites from the Bernic Lake and Rush Lake pegmatite groups, southeastern Manitoba.

	Coe (aplitic)	Coe (peg.)	Rush L. (007)	Rush L. (010)	Rush L. (011)	Rush L. (012)	Rush L. (014)	Rush L. (017)
Oxide (wt.%)								
SiO_2	70.08	63.43	74.07	73.63	74.59	74.7	75.51	73.94
Al_2O_3	17.59	18.01	14.28	14.39	14.9	14.36	13.86	15.83
Fe_2O_3	0.68	0.47	1.63	0.46	0.9	0.3	1.06	0.64
MnO	0.113	0.224	0.126	0.079	0.211	0.018	0.028	0.068
MgO	0.04	0.04	0.11	0.03	0.05	0.02	0.14	0.03
CaO	1.44	2.77	0.21	1.24	0.24	0.62	0.32	0.5
Na_2O	9.03	9.01	4.15	3.75	3.37	6.82	5.61	7.9
K_2O	0.46	0.95	2.79	3.36	3.85	0.63	1.53	1.06
TiO_2	0.02	0.014	0.021	0.008	0.017	0.003	0.018	0.003
P_2O_5	1.25	2.45	0.36	1.24	0.36	0.76	0.27	0.45
LOI	0.05	0.42	0.75	1.06	1.02	0.74	0.59	0.5
Total	100.7	97.81	98.49	99.24	99.52	98.97	98.93	100.9
Element (ppm)								
F	0.06	0.12	0.02	0.02	0.02	0.02	0.01	bdl
Sc	3	5	3	bdl	2	bdl	3	2
Be	190	403	3	6	4	5	2	2
Ba	15	23	6	11	34	8	17	14
Sr	15	22	67	122	34	595	13	23
Zr	51	63	24	5	29	4	8	8
Zn	120	40	120	40	bdl	bdl	70	bdl
Ga	73	62	34	44	40	30	27	31
Ge	11	11	4	5	5	5	3	4
Rb	22	304	433	812	562	153	118	101
Nb	131	1920	101	66	58	36	33	4
Sn	2720	426	32	67	55	27	16	10
Cs	23.8	66.5	22.3	20	14.9	31	10	20.1
Hf	6	6.7	1.4	0.3	2.1	bdl	0.4	0.5
Ta	242	1010	38.9	29.9	39.4	25.3	12.1	2.5
Li	140	179	28	20	18	179	19	42
B	936	138	1940	28	58	99	1710	342
La	1.4	5.3	0.5	3.1	1.5	0.3	1.2	0.8
Ce	2.6	10.6	1.1	3.3	2.5	0.5	2.6	1.8
Pr	0.29	1.18	0.14	0.29	0.25	bdl	0.29	0.22
Nd	1.2	3.8	0.5	1	1	0.2	1.2	0.9
Sm	0.3	1.9	0.4	0.2	0.4	0.1	0.4	0.3
Eu	0.09	0.11	bdl	bdl	bdl	bdl	0.06	bdl
Gd	0.3	2.2	0.5	0.2	0.4	0.1	0.5	0.3
Tb	bdl	0.7	0.1	bdl	bdl	bdl	0.1	bdl
Dy	0.4	3.9	0.7	0.2	0.6	0.2	0.5	0.3
Ho	bdl	0.6	bdl	bdl	bdl	bdl	bdl	bdl
Er	0.2	1.4	0.2	bdl	0.2	bdl	0.2	0.1
Tm	bdl	0.25	bdl	bdl	bdl	bdl	bdl	bdl
Yb	0.2	1.6	0.2	bdl	0.2	bdl	0.2	bdl
Lu	bdl	0.17	bdl	bdl	bdl	bdl	bdl	bdl

Abbreviations: bdl, below detection limit; L., Lake; LOI, loss on ignition; peg., pegmatitic

A systematic re-examination of the pegmatite groups in the Cat Lake–Winnipeg River pegmatite field is an important step in determining a) the temporal and genetic relationship between the various pegmatite groups, b) their fractionation histories, and c) their associated rare-metal endowments. A better understanding of these pegmatite bodies requires development of a model that integrates conditions for emplacement of the pegmatites, regional geology, geochronology, structural data and updated geochemistry. Integration of these data will further our understanding of pegmatites in the Cat Lake–Winnipeg River district and help focus exploration for these desirable commodities.

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