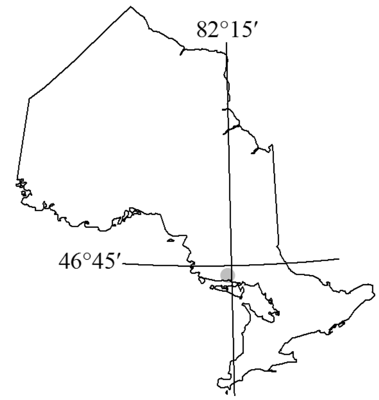
ISSN 1916-6117 (online)
ISBN 978-1-4606-6803-0 (PDF)
(for entire OFR 6313)

ISSN 0826-9580 (print)
ISBN 978-1-4606-6802-3 (print)
(for entire OFR 6313)



22. Project Unit 09-004. Mineralogical and Geochemical Studies of Rocks from the Pecors Magnetic Anomaly East of Elliot Lake, Southern Province

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INTRODUCTION

Pecors Magnetic Anomaly

The Pecors magnetic anomaly is a northwest-oriented aeromagnetic high, approximately 10 km long by 4 km wide, located on the east-northeast side of Pecors Lake in Joubin Township to the east of Elliot Lake (Figure 22.1). Its southern end, which is approximately 3.5 km long by 1.5 m wide, has been the site of active mineral exploration. Here, the surface geology over the anomaly consists of metasedimentary rocks of the Huronian Supergroup and sills of Nipissing gabbro (Easton 2013b). Easton (2009) drew attention to the fact that this anomaly was oriented at a high-angle to the Archean Whiskey Lake greenstone belt to the south and that high-resolution aeromagnetic surveys over the southern margin of the Quirke Lake syncline (Ontario Geological Survey 2011) indicated that the magnetic anomaly was deep seated and not the near-surface feature that would be expected if it were iron formation. Easton (2009) also noted that the Pecors magnetic anomaly coincided with an area of non-deposition of metavolcanic rocks of the Thessalon Formation and metaconglomerate of the Matinenda Formation (Roscoe 1969), suggesting a paleotopographic high was present atop the magnetic anomaly. Furthermore, he noted that uranium mineralization in the Matinenda Formation was located in northwest-oriented channels on the flanks of the paleotopographic high. On the basis of the paleotopographic high, an abundance of Matachewan mafic dikes in the adjacent Archean basement, and the presence of large mafic intrusions, such as the East Bull Lake intrusion, to the east, Easton (2009) suggested that the source of the Pecors magnetic anomaly may be a subsurface mafic intrusion(s) of early Paleoproterozoic age.

Since 2007, International Montoro Resources Inc. has been conducting exploration in Joubin Township, initially for uranium and more recently for nickel-copper-platinum group element (PGE) mineralization. Geophysical modelling of the Pecors magnetic anomaly, done on behalf of the company, suggested that it was most likely a buried mafic intrusion with a north-plunging keel, a main upper contact located 300 to 450 m below surface, and with the thickest part of the intrusion being 1000 to 1300 m thick (Reed 2011, 2014). This interpretation was supported by 3 previous diamond-drill holes that encountered mafic intrusive rocks a short distance below the Matinenda Formation (Reed 2011).

To further investigate the anomaly, International Montoro Resources Inc. undertook a drilling program over the Pecors magnetic anomaly in April and May 2015. The first diamond-drill hole, PDH-1 (also known as P15-22), reached a depth of 996 m, and transected the upper and lower contacts of a gabbro body, which is almost 380 m thick in this diamond-drill hole. The upper contact of the gabbro is at

Summary of Field Work and Other Activities 2015,
Ontario Geological Survey, Open File Report 6313, p.22-1 to 22-14.

the base of an approximately 90 m thick sequence of Thessalon Formation metavolcanic rocks. The upper contact is located between 595.5 and 600 m depth, depending on the interpretation of the affinity of finer grained rock present at the contact. The lower contact of the gabbro cuts Archean mafic metavolcanic rocks at 989 m depth. The second drill hole, PDH-2 (or P15-23), ended at 1317 m depth still in the gabbro, which was the limit of the capability of the diamond drill. In this hole, the gabbro was over 667 m thick. The company has reported encouraging copper-PGE results from sulphide-rich zones near the bottom of PDH-1 (International Montoro Resources Inc. 2015a, 2015b).

This Study

In late April 2015, International Montoro Resources Inc. invited Ontario Geological Survey (OGS) staff to view the drill core obtained from diamond-drill hole PDH-1. The scanning electron microscope studies reported herein were conducted to determine if U/Pb geochronology on the metagabbro present in the drill core was feasible. Geochemical work (Table 22.1) was conducted as a possible alternative in case it was not possible to obtain an age on the intrusion. As described in detail below, the scanning electron microscope work established the presence of baddeleyite, zircon and titanite in a sample from the upper part of the intrusion and, subsequently, International Montoro Resources Inc. supplied the OGS with a 1.45 m section of split core from PDH-1, from 650.45 to 651.90 m depth, as a geochronology sample.

Diamond drilling of the Matinenda Formation conducted in 2007 by International Montoro Resources Inc. over the Pecors magnetic anomaly found thin, fine-grained granitoid veins (aplites) cutting the Matinenda Formation (Hawke 2008, 2010). Given the proximity of these veins to the Pecors magnetic anomaly, the possibility exists that they might be related to the gabbro body, because aplite veins have not been reported elsewhere in the Matinenda Formation. As with the gabbro, scanning electron microscope and geochemical studies (Table 22.2) were conducted on the aplite veins to determine if they were suitable for U/Pb geochronology. Zircon was present, and several aplite veins from diamond-drill hole P7-04 from 174.0 to 178.12 m depth were sampled for U/Pb geochronology. An earlier study of the geochemistry of the aplite veins (Finlayson and Rooney 2009) was inconclusive with respect to their origin.

Energy dispersive X-ray acquisition and backscattered electron (BSE) imaging was performed using a Zeiss EVO-50 scanning electron microscope (SEM) equipped with an Oxford thin window, 50 mm^2 silicon drift (SDD) energy dispersive spectrometer. This work was carried out at the OGS Geoscience Laboratories in Sudbury.

The U/Pb geochronology analysis, using isotope-dilution thermal ionization mass spectrometry (ID-TIMS), is currently underway at the Jack Satterly Laboratory at the University of Toronto by S.L. Kamo.

RESULTS

Pecors Magnetic Anomaly Gabbro

The approximately 380 m thick section of gabbro in diamond-drill hole PDH-1 is a greenish, mostly medium-grained, texturally and mineralogically homogeneous, metagabbro. No obvious igneous layering was observed in this section, although it is possible that some minor cryptic layering is present. Leucogabbro and/or gabbronorite with preserved orthopyroxene, typical features of East Bull Lake intrusive suite bodies, were not observed in the section. The macroscopic features present in the section provide no clues as to the possible affinity of the gabbro, other than the fact that the absence of leucogabbro suggests that the gabbro is not a layered East Bull Lake suite intrusion akin to either the East Bull Lake or Agnew intrusions (James et al. 2002).

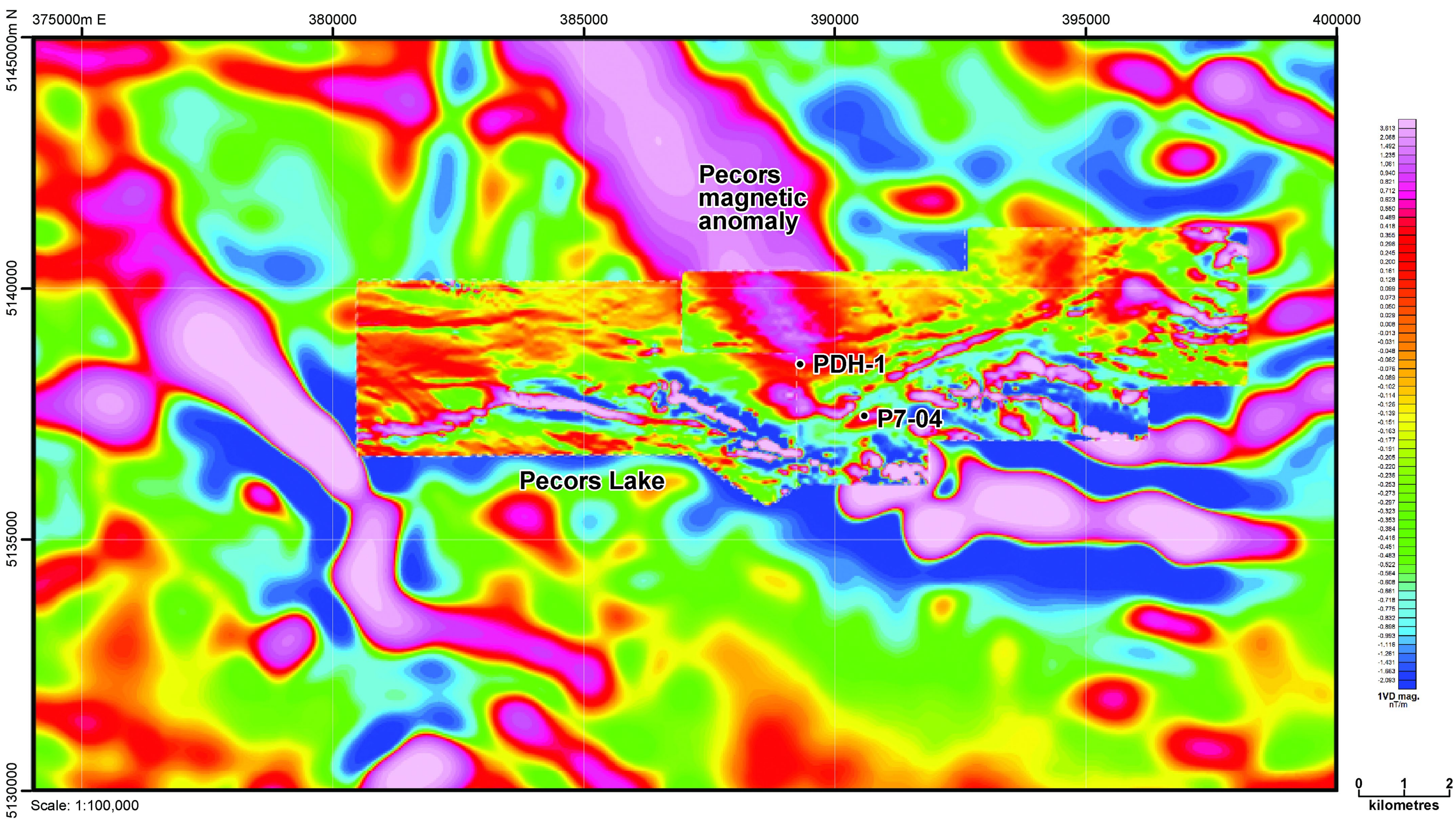


Figure 22.1. Location of the Pecors magnetic anomaly and sample diamond-drill holes PDH-1 and P7-04, superimposed on the airborne first vertical derivative of the total magnetic field. Figure *from* Easton (2013b). High-resolution aeromagnetic data in the centre of the figure *from* Ontario Geological Survey (2011), lower resolution data *from* Geological Survey of Canada (2010).

Table 22.1. Geochemical data for gabbro samples from the Pecors magnetic anomaly and samples from other mafic intrusive units in the Elliot Lake area. Data for the Pecors magnetic anomaly (PMA) samples are *from* this study; all other data are *from* Easton (2013a). All analyses were performed at the OGS Geoscience Laboratories, Sudbury. All UTM co-ordinates are NAD83 in Zone 17.

Sample Number	15RME-8001	15RME-8002	10RME-1003	10RME-1006	09RME-0335	10RME-2065	10RME-0348	11RME-3388
Easting (m)	389335	389335	379690	379670	373728	408172	361800	383630
Northing (m)	5138850	5138850	5129283	5129250	5134727	5133868	5165105	5138936
Rock Name	Gabbro	Gabbro	Gabbro	Gabbro	Norite	Gabbronorite	Gabbro	Gabbro
Intrusion	PMA	PMA	Matachewan	Matachewan	Stone Ridge	Tennyson	Nipissing	Nipissing
SiO_2 (wt %)	49.88	49.39	50.89	50.36	51.44	48.32	50.43	48.35
TiO_2	1.40	0.89	1.40	1.20	0.44	0.44	0.62	1.51
Al_2O_3	15.93	14.93	12.77	13.33	16.29	15.95	17.06	13.39
Fe_2O_3	3.56	4.13	4.18	3.80	1.31	2.19	3.22	4.22
FeO	11.23	9.49	11.30	10.22	6.30	10.34	6.12	8.80
MnO	0.191	0.192	0.20	0.22	0.15	0.21	0.16	0.23
MgO	3.41	5.30	4.77	5.88	8.49	8.15	5.31	6.74
CaO	5.32	8.76	9.01	10.09	13.02	10.04	10.39	9.73
Na_2O	3.79	2.20	2.16	1.88	1.48	1.56	2.01	1.89
K_2O	1.43	1.64	1.35	0.70	0.36	0.40	1.32	0.95
P_2O_5	0.21	0.12	0.18	0.14	0.04	0.05	0.06	0.21
CO_2	0.30	0.12	0.04	0.08	0.10	0.10	0.07	0.23
LOI	2.45	1.92	1.07	1.59	0.43	1.87	2.77	2.69
Total	100.09	100.05	100.54	100.55	100.45	100.68	100.15	99.70
Mg Number	29.64	41.70	36.1	43.5	66.9	54.1	51.2	48.82
CIA	60.18	54.24	50.6	51.4	52.5	57.3	55.6	52.0
As (ppm)	<6	9	2	2	2	<1	2	4
Co	48	54	55	64	41	73	39	57
Cr	46	117	133	65	435	142	212	61
Cu	349	131	177	127	100	45	132	131
Ni	43	100	54	102	129	148	70	30
Pt (ppb)	19	17	4.0	<0.4	22.2	15	7.5	<0.4
Pd (ppb)	24	19	2.3	<1.3	19.7	11.8	3.7	<1.3
Nb (ppm)	24.68	14.12	6.56	13.84	1.36	1.32	2.25	6.45
Y	33.89	22.27	34.39	24.41	11.55	10.71	16.20	36.85
Zr	161	91	124	108	33	36	52	141
La	22.16	12.64	16.41	11.59	4.20	4.95	6.36	18.96
Ce	45.86	26.2	35.89	25.57	8.97	10.58	13.53	41.22
Pr	5.941	3.346	4.789	3.467	1.15	1.372	1.75	5.331
Nd	24.68	14.12	20.82	15.34	4.99	5.79	7.43	22.56
Sm	5.822	3.21	5.084	3.957	1.37	1.446	2.022	5.074
Eu	2.0614	1.0611	1.541	1.236	0.508	0.613	0.699	1.523
Gd	6.222	3.589	5.647	4.618	1.664	1.638	2.331	4.925
Tb	1.0247	0.5931	0.946	0.786	0.295	0.281	0.407	0.759
Dy	6.752	3.866	6.287	5.339	1.976	1.922	2.693	4.603
Ho	1.3711	0.8175	1.308	1.108	0.431	0.41	0.572	0.927
Er	4.028	2.428	3.975	3.335	1.256	1.221	1.75	2.652
Tm	0.5991	0.3593	0.576	0.479	0.181	0.177	0.250	0.377
Yb	3.944	2.346	3.745	3.155	1.182	1.165	1.616	2.422
Lu	0.6008	0.3581	0.567	0.480	0.177	0.18	0.247	0.36
Total REE	131.1	74.93	107.6	80.5	28.4	31.8	41.7	111.7

Notes: *Major element oxides are in weight %; trace element data are in ppm except for Pd and Pt, which are in ppb; Mg number = atomic Mg/Mg + Fe, where Fe = total Fe expressed as ferrous iron. Mg number and CIA are dimensionless.*
Abbreviations: *CIA, chemical index of alteration; LOI, loss-on-ignition; n/a, not applicable; REE, rare earth element.*

Two samples were collected from International Montoro Resources diamond-drill hole PDH-1 (P15-22) for detailed study. The first, sample 15RME-8001, was collected at 651.0 m depth, approximately 50 m below the roof of the intrusion. The second, sample 15RME-8002, was collected at 897.0 to 897.07 m depth, approximately 92 m above the floor of the intrusion.

Table 22.2. Geochemical data for aplite (albitite) dike samples from the Pecors magnetic anomaly. All analyses were performed at the OGS Geoscience Laboratories, Sudbury. Albite samples for comparison are *from* Deer, Howie and Zussman (1966, p.324). All UTM co-ordinates are NAD83 in Zone 17.

Sample Number	15RME-8004	15RME-8003	Albite 1	Albite 2
Easting (m)	390733	390733	n/a	n/a
Northing (m)	5137277	5137277	n/a	n/a
Rock Name	Albitite with quartz	Albitite	Albite	Albite
SiO_2 (wt %)	74.25	67.77	67.84	67.41
TiO_2	0.38	0.41	0.00	nr
Al_2O_3	15.05	19.76	19.65	20.50
Fe_2O_3	0.35	0.01	0.03	0.07
FeO	0.24	0.16	0.02	nr
MnO	0.004	0.004	nr	nr
MgO	0.20	0.06	0.04	0.10
CaO	0.19	0.18	0.00	0.81
Na_2O	8.37	11.35	11.07	10.97
K_2O	0.06	0.09	0.29	0.36
P_2O_5	0.01	0.00	nr	nr
CO_2	0.04	0.06	nr	nr
LOI	0.61	0.44	nr	nr
Total	100.25	99.77	99.80	100.37
Au (ppm)	<8	<8	nr	nr
Th	21.3	20.0	nr	nr
U	6.7	6.6	nr	nr
Hf	3.92	3.86	nr	nr
Nb	2.57	5.41	nr	nr
Y	19.4	27.4	nr	nr
Zr	141	138	nr	nr
La	5.27	2.25	nr	nr
Ce	10.86	5.15	nr	nr
Pr	1.318	0.634	nr	nr
Nd	5.41	2.57	nr	nr
Sm	1.613	0.82	nr	nr
Eu	0.3433	0.1958	nr	nr
Gd	2.612	1.455	nr	nr
Tb	0.5401	0.3523	nr	nr
Dy	4.025	2.869	nr	nr
Ho	0.9075	0.675	nr	nr
Er	2.753	2.176	nr	nr
Tm	0.3979	0.3281	nr	nr
Yb	2.501	2.13	nr	nr
Lu	0.3749	0.3307	nr	nr
Total REE	38.93	21.94	nr	nr

Notes: *Major element oxides are in weight %, trace element data are in ppm.*
Abbreviations: *LOI, loss-on-ignition; n/a, not applicable; nr, not reported; REE, rare earth element.*

In hand sample, sample 15RME-8001 is a medium-grained, green-grey metagabbro (Photo 22.1A). In thin section, it is an albite-epidote-chlorite rock with clay mineral alteration (smectite, vermiculite) and minor blue-green hornblende. It appears to be a gabbro that has been affected by intense greenschist-facies metamorphism and/or hydrothermal alteration. Sulphide minerals consist mainly of chalcopyrite and fine-grained cobaltite, with minor pyrite, and rare sphalerite and galena. Ronacher (2015) reported similar observations from a several other gabbro samples collected throughout diamond-drill hole PDH-1.

Photo 22.1. A) Close-up view of diamond-drill core from PDH-1 showing texture in gabbro (wet and dry) from part of the section sampled for geochronology. **B**) Close-up view of albitite sample 15RME-8003 from diamond-drill hole P7-04.

Cobaltite is abundant under the SEM, but its presence is not sufficient to noticeably affect either the cobalt or arsenic content of the sample (*see* Table 22.1). Examination by SEM identified the following phases of geochronological interest: small baddeleyite grains (<30 µm), typically rimmed by zircon (Photo 22.2A); small zircon grains (<70 µm); and large (up to 1 mm) titanite grains, some of which engulf epidote grains (Photo 22.2B). This mineralogy, and the textural relationships between these 3 phases, indicates a complex history for the gabbro. The baddeleyite grains are the phase most likely to yield the emplacement age of the intrusion. The zircon overgrowths, and possibly the titanite grains, may date the timing of metamorphism and/or hydrothermal alteration that has altered the primary mineralogy of the gabbro.

A thin section from lower in the gabbro, at 897 m depth, was also examined (sample 15RME-8002). It also is an albite-epidote-chlorite rock with clay mineral alteration (smectite, vermiculite) and minor blue-green hornblende. This sample contained no baddeleyite and only a few zircon grains, but did contain titanite. It may be slightly more primitive than sample 15RME-8001, based on magnesium number and lower high-field strength element and rare earth element contents (*see* Table 22.1).

Aplite (Albitite) Veins

Samples from 2 aplite veins were examined by SEM and submitted for geochemical analysis (*see* Table 22.2). Sample 15RME-8003 was collected from a pink, fine-grained, homogeneous veinlet cutting Matinenda Formation sandstone in International Montoro Resources diamond-drill hole P7-04, at 152.07 to 152.17 m depth (Photo 22.1B). Sample 15RME-8004 was collected from the same diamond-drill hole from 152.17 to 152.26 m, and differs from the first sample in containing greyish quartz veins. The quartz contains abundant fine-grained rutile, as determined through SEM examination (Photo 22.3A). In terms of major element chemistry, quartz-poor sample 15RME-8003 has a composition nearly identical to that of pure albite (*see* Table 22.2), consistent with the mineralogy of the sample as determined by SEM examination. Thus, albitite is a more appropriate rock name for these veins than aplite. Sample 15RME-8004 has similar major element chemistry, but with a higher silica content reflecting the presence of visible quartz. Finlayson and Rooney (2009) also noted that the aplite veins they examined had moderate silica contents (up to 72 weight %) and were sodic (10 to 11 weight % Na_2O).

Trace elements, with the exception of uranium and thorium, are low in both samples (*see* Table 22.2). Uranium (6.6 to 6.7 ppm U) and thorium (20 to 21.3 ppm Th) are higher than would be expected, and may reflect inclusion of radioactive minerals from the host Matinenda Formation. The uranium and thorium in sample 15RME-8004 may be, in part, the result of the presence of several spheres of thucholite in the sample (*see* Photo 22.3B). Thucholite—the name is derived from the chemical symbols for thorium, uranium, carbon and hydrogen (Th, U, C, H)—has been previously reported from the Matinenda Formation (Roscoe 1969). Thucholite can also be described as a radioactive pyrobitumen mineral.

The rare earth element patterns (*see* Figure 22.2B) are not what would be expected for a rock consisting of igneous-derived albite. Both samples have relatively low total rare earth element abundances, but with enrichment in the heavy rare earth elements. The rare earth element patterns are atypical of any felsic magma, and suggest that the albitite veins are of probable hydrothermal origin.

Zircon was relatively abundant in both albitite samples, and consisted of 2 distinct morphologies. The first consisted of zircons with subrounded to rounded cores rimmed by overgrowths of zircon (*see* Photo 22.3C). These may be detrital grains inherited from the Matinenda Formation, with the zircon overgrowth resulting from subsequent hydrothermal alteration or interaction with the fluid that produced the aplite. The second morphology consisted of euhedral zircon crystals (*see* Photo 22.3D). Grains of the latter morphology were selected for U/Pb geochronology to determine the emplacement age of the albitite veins. Monazite, apatite and xenotime were all observed under the SEM (*see* Photo 23E), but their small grain size precluded their use for geochronology.

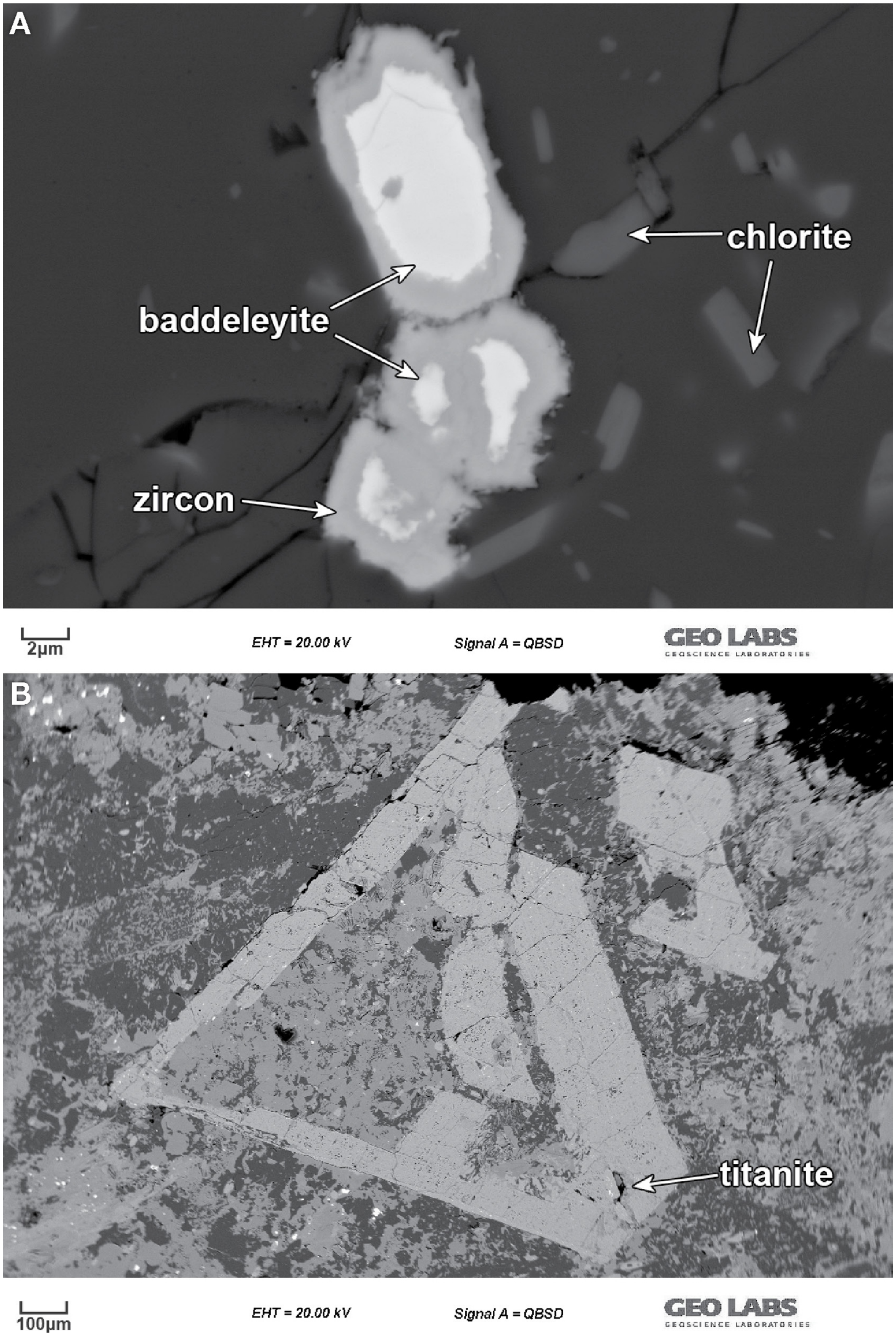


Photo 22.2. Backscattered electron images of minerals in sample 15 RME-8001, diamond-drill core PDH-1. **A**) Baddeleyite grain (light colour) rimmed by zircon (medium-grey). Note small size of the baddeleyite grain. **B**) Titanite grains (elongate, homogeneous grey) surrounding an epidote grain. Note the very large size of titanite grain. Abbreviations: EHT, electrical high tension; kV, kilovolts; QBSD, quadrant backscatter detector; Signal A means Signal A.

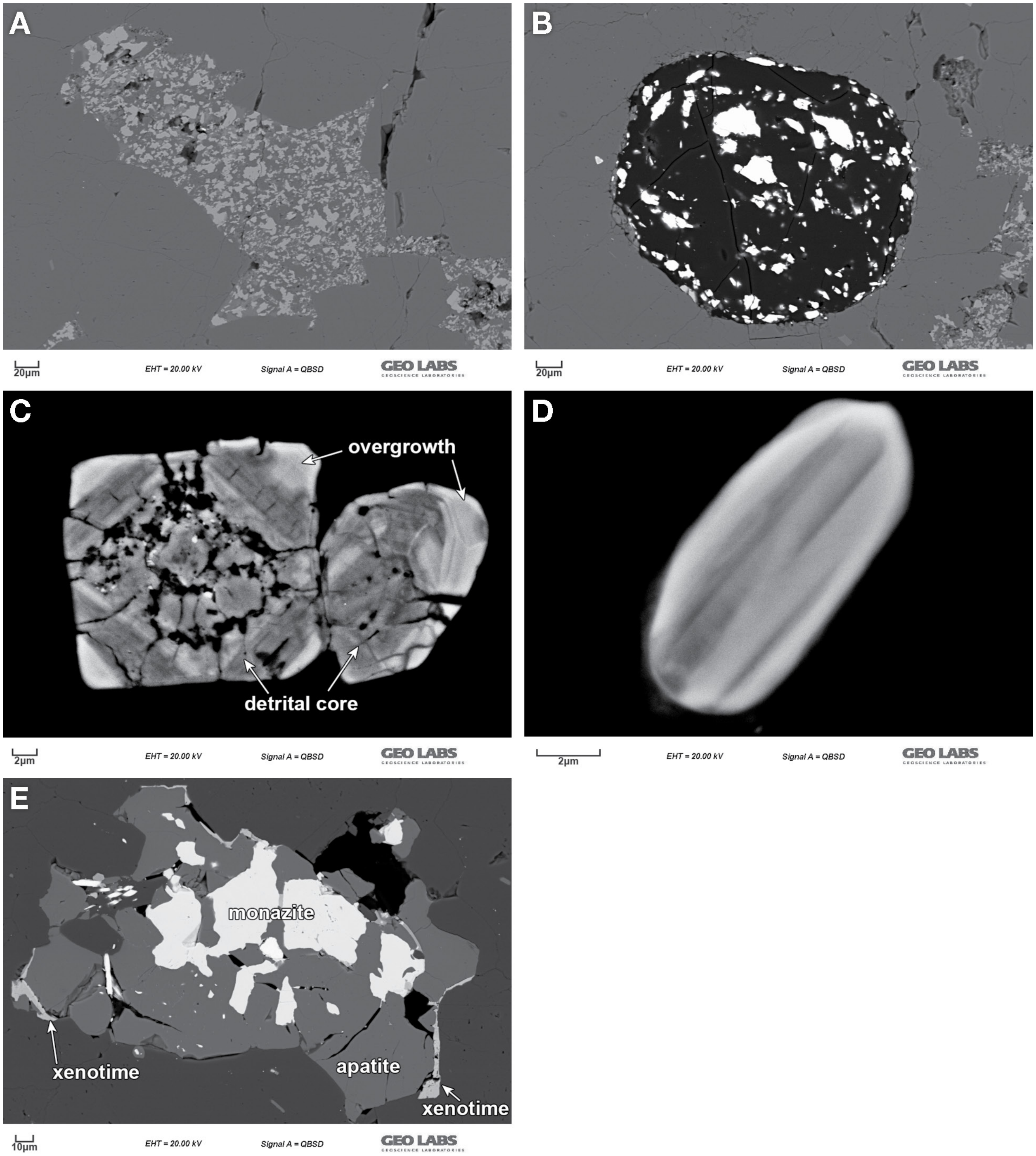


Photo 22.3. Backscattered electron images of minerals in diamond-drill core P07-04. All images are from sample 15RME-8003, except for image B, which is from 15RME-8004. **A**) Intergrown quartz and rutile surrounded by albite. **B**) Sphere of thucholite in sample 15RME-8004. Dark material is hydrocarbon. Light materials are uranium and thorium mixtures. **C**) Zircon grain with a rounded core (detrital grain) rimmed by zircon overgrowth. **D**) Euhedral zircon grain that may have formed during emplacement of the aplite vein. **E**) Apatite (medium-grey), monazite (light-grey), both rimmed by xenotime (light grey). Abbreviations: EHT, electrical high tension; kV, kilovolts; QBSD, quadrant backscatter detector; Signal A means Signal A.

DISCUSSION

Table 22.3 summarizes the main mafic intrusive events present in the Elliot Lake area, one of which may be contemporaneous with the emplacement of the Pecors magmatic anomaly gabbro intrusion. As each of these mafic intrusive events has differing nickel-copper-PGE potential, determining the age and affinity of the gabbro intrusion has important exploration implications.

Table 22.3. Summary of major Proterozoic mafic magmatic events in the Elliot Lake area. Data *from* Easton, James and Jobin-Bevans (2010), Easton (2013a), Bleeker et al. (2015), Lightfoot and Naldrett (1996).

Magmatic Event	Age (in Ma)	Mineralization	Geochemical Characteristics	Comment
Huronian Supergroup mafic volcanism	2490–2455	Possible base metals	Continental flood basalt, within-plate basalt, subalkalic	Thessalon Fm, Elsie Mountain Fm, Stobie Fm and other mafic volcanic units
"Pyroxenite" dike	*circa* 2507	No reported mineralization	Not characterized	Sudbury area, *see* Bleeker et al. (2015)
East Bull Lake intrusive suite, layered intrusions	2490–2475	Contact-style Cu-PGE	Low-Ti, high-Al magmas, E-MORB character, low HFSE and REE	East Bull Lake, Agnew, and River Valley intrusions, cut by Matachewan diabase dikes
East Bull Lake intrusive suite, sill-like intrusions	No ages, but likely 2490–2465	No reported mineralization	Low-Ti, high-Al magmas, E-MORB character	Stone Ridge, Tennyson intrusions
Matachewan dike swarm	2473–2446, but main swarm *circa* 2460 (Bleeker et al. 2015)	No reported mineralization, but typically contain detectable PGE	Continental flood basalt, within-plate basalt, subalkalic to alkalic basalt	Abundant in Elliot Lake area, with dikes cutting dikes
Nipissing gabbro	2219–2210, with most ages *circa* 2217	Contact-style Ni-Cu-PGE	Continental flood basalt, silica-rich magma with negative Ta, Nb, Ti and P anomalies	Higher MgO gabbros may be hard to distinguish from some East Bull Lake suite rocks
Marathon igneous province (former Preissac dike swarm)	*circa* 2215 for Senneterre dikes, *circa* 2167 for Biscotasing dikes	No reported mineralization	Quartz tholeiite	Former Preissac dike swarm
Marathon igneous province ("trap dikes")	*circa* 2116–2105	No reported mineralization	Quartz tholeiite	East-trending dikes affected by Sudbury breccia
Northwest-trending diabase dikes	*circa* 1950–1900	No reported mineralization	Quartz tholeiite	Northwest-trending dikes affected by Sudbury breccia
East-trending post-Sudbury diabase dikes ("trap" dikes)	*circa* 1830–1770	No reported mineralization	Quartz tholeiite	East-trending dikes that are post-Sudbury, but metamorphosed
Sudbury dike swarm and related troctolite intrusions	*circa* 1238	Fe-Ti mineralization in troctolite intrusions	Continental flood basalt, alkalic basalt, high Ti, Ba, Zr	Olivine-bearing, magnetic, unmetamorphosed
Pecors magnetic anomaly gabbro intrusion	In progress	Cu-PGE near base of intrusion	Continental flood basalt, within plate basalt, subalkalic to alkalic basalt	Affinity and age to be determined

Abbreviations: *E-MORB, enriched mid-ocean basalt; Fm, Formation; HFSE, high-field strength elements; PGE, platinum group elements; REE, rare earth elements.*

An Archean age for the gabbro intrusion is considered unlikely, in part because of the previously described relative age relationships observed at the contacts of the gabbro in diamond-drill hole PDH-1. The gabbro clearly intruded Archean mafic metavolcanic rocks, based on its lower contact. Although the upper contact is somewhat cryptic, emplacement of the gabbro into the Thessalon Formation, either coeval with, or immediately after volcanism, is probable.

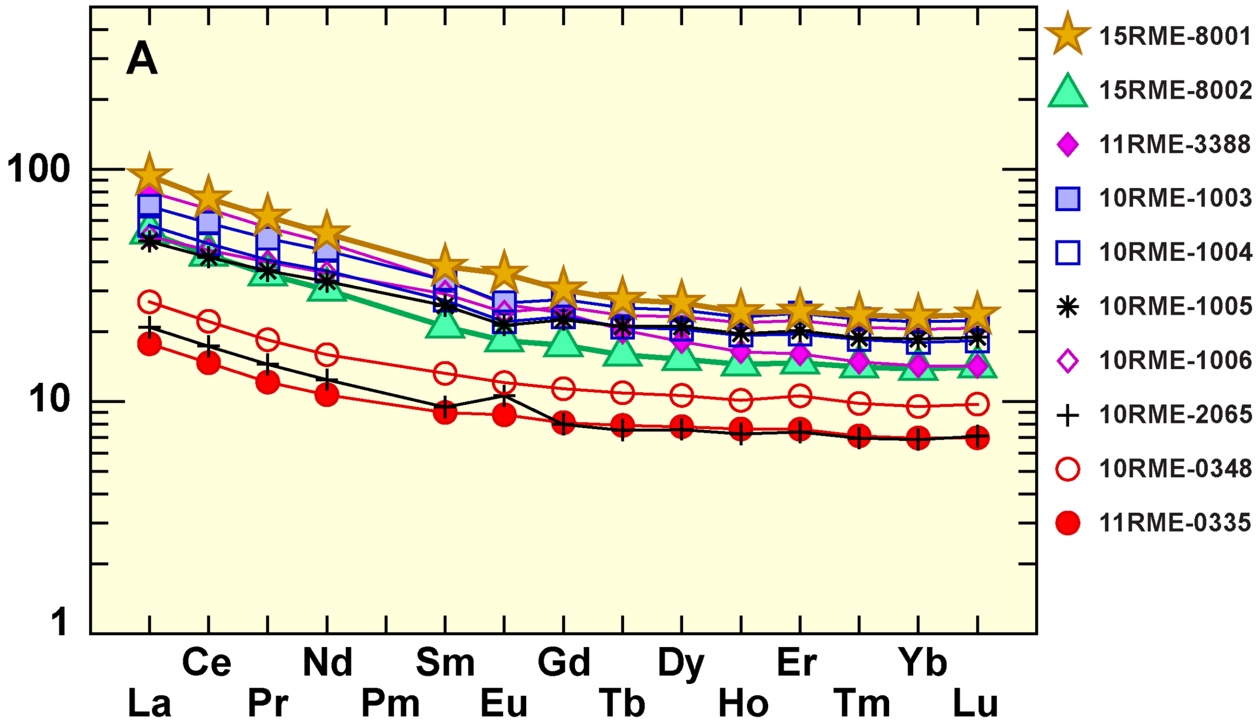
To constrain possible Paleoproterozoic or Mesoproterozoic events to which the gabbro intrusion could belong, geochemical data from samples 15RME-8001 and 15RME-8002 are presented in Table 22.1 and in Figure 22.2A. Table 22.1 also contains representative samples of other mafic intrusions from the Elliot Lake area for comparison. Representative samples from the Elliot Lake area from Easton (2013a) are used in Table 22.1, rather than regional averages from the literature. This is because the samples are more proximal to the Pecors magnetic anomaly and all the data were obtained from the OGS Geoscience Laboratories.

In terms of geochemical signature, samples 15RME-8001 and 15RME-8002 classify on most standard basalt discrimination diagrams as continental tholeiites, within-plate basalts or enriched mid-ocean ridge basalts (E-MORB), and straddle the boundary between subalkalic to alkalic basalt. Layered East Bull Lake suite intrusions, such as the East Bull Lake or Agnew intrusions, are characterized by low-titanium and high-aluminum contents (James et al. 2002). Similarly, homogeneous sill-like intrusions of the East Bull Lake suite, such as the Stone Ridge (Easton 2009) and Tennyson intrusions (Easton 2013a), also are characterized by low-titanium contents, as well as low Hf, Nb, Ta, Y, Zr and REE (samples 09RME-0335 and 10RME-2065, respectively, Table 22.1). East Bull Lake suite intrusions are subalkalic basalts, classify as E-MORB, and many samples plot as high-magnesium tholeiites on the Jensen (1976) discrimination diagram. The geochemistry of samples 15RME-8001 and 15RME-8002, in conjunction with the lack of leucogabbro and/or preserved orthopyroxene in the drill core, suggests that the gabbro in PDH-1 is not part of the East Bull Lake suite.

As shown in Table 22.1 and Figure 22.2A, Nipissing gabbro intrusions (samples 10RME-0348 and 11RME-3388) have a broad compositional range. Some (sample 10RME-0348) are geochemically similar to the Stone Ridge and Tennyson intrusions, whereas others (sample 11RME-3388) are more akin to samples 15RME-8001 and 15RME-8002 and the Matachewan dike samples, as included in Table 22.1. Consequently, the possibility that the Pecors magnetic anomaly gabbro intrusion is a Nipissing intrusion cannot be ruled out solely on the basis of geochemistry. A Nipissing age (*circa* 2217 Ma) for the gabbro would seem unlikely, however, based on its apparent effect on deposition of Huronian Supergroup units and the complex history recorded by baddeleyite and zircon in sample 15RME-8001.

The samples that most closely match the Pecors magnetic anomaly gabbro intrusion are samples of Matachewan dikes from the Elliot Lake area (samples 10RME-1003 and 10RME-1006 in Table 22.1 and Figure 22.2A, as well as other samples in Easton 2013a). Sample 10RME-1003 is more alkali rich than most Matachewan dikes, and most closely matches sample 15RME-8001. Sample 10RME-1006 is more typical of the Matachewan dikes, and closely matches sample 15RME-8002. The Matachewan dike samples also classify on most standard basalt discrimination diagrams as continental tholeiites, within-plate basalts or enriched mid-ocean ridge basalts (E-MORB), and straddle the boundary between subalkalic to alkalic basalt.

If, in addition to this geochemical similarity, the Pecors magnetic anomaly gabbro intrusion and the Matachewan dikes are also similar in age, then it would be the first known example of an intrusion that might be part of the feeder system for the Matachewan dike swam. Mafic intrusions of the East Bull Lake suite are typically cut by Matachewan dikes, and are slightly older (*circa* 2475 Ma) (James et al. 2002) than the age of *circa* 2460 Ma now attributed to the main pulse of the Matachewan dike swam (Bleeker et al. 2015). This would represent an entirely new nickel-copper-PGE exploration target in the region. Thus, the age determination on the Pecors magnetic anomaly gabbro intrusion has significant geological implications.



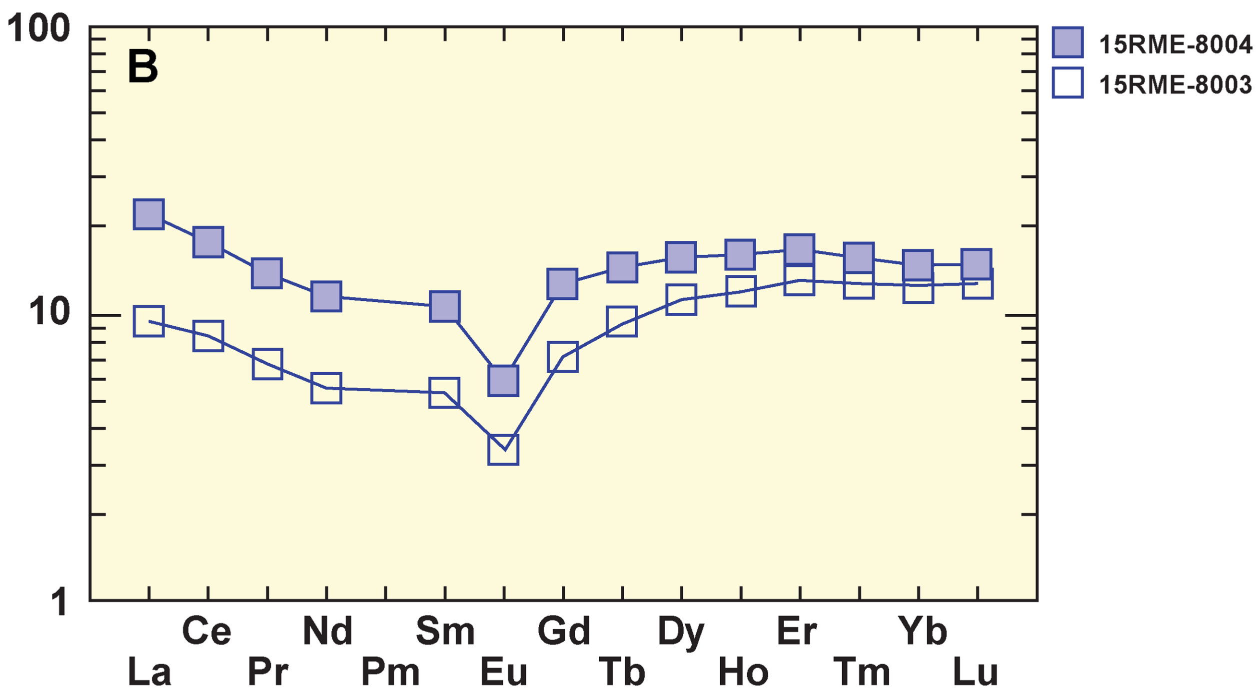


Figure 22.2. **A**) Chondrite-normalized rare earth element diagram for samples from the gabbro intrusion at the Pecors magnetic anomaly (samples 15RME-8001 and 15RME-8002). Samples from the Stone Ridge intrusion (09RME-0335), the Tennyson intrusion (10RME-2065), Nipissing gabbro (10RME-0348 and 11RME-3388), and Matachewan swarm dikes from the Elliot Lake area (samples 10RME-1003 to 10RME-1006) are shown for comparison. Data for samples 15RME-8001 and 15RME-8002 are *from* this study. Data for all other samples are *from* Easton (2013a). **B**) Chondrite-normalized rare earth element diagram for albitite dike samples (15RME-8003 and 15-RME-8004) cutting the Matinenda Formation proximal to the Pecors magnetic anomaly. Data are *from* this study. Both diagrams use the normalizing factors of Sun and McDonough (1989).

Similarly, the age determination on the aplite veins could also be critical, especially if the veins are related to emplacement of the gabbro intrusion. This is because the aplite veins cut the Matinenda Formation and, thus, they could provide a critical age constraint on the timing of deposition of the Matinenda Formation.

Finally, the intense recrystallization that the gabbro has undergone suggests that the mineralization present may have been remobilized during a hydrothermal alteration event. Regionally, potassium and sodium metasomatism occurred at *circa* 1700 to 1740 Ma throughout the Southern Province (Fedo et al. 1997; Roscoe, Thériault and Prasad 1992). From an exploration perspective, it would be important to know if the alteration seen in the gabbro is related to this event, or if it represents another event.

ACKNOWLEDGMENTS

International Montoro Resources Inc., D.R. Hawke and D. Patrie are thanked for allowing access to drill core for observations and sampling. D.R. Hawke assisted in the collection of the geochronology sample from diamond-drill hole P15-22 (PDH-1). J.L. Webb assisted in the collection of the geochronology sample from diamond-drill hole P07-04. S.A. Clarke and D.C. Crabtree of the OGS Geoscience Laboratories, Sudbury, assisted in the acquisition of SEM imagery.

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