Reid Township and Kamiskotia areas Geochronology, Stratigraphy and VMS Potential

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Introduction

Geochronology samples were collected during the summer of 2014 for International Explorers and Prospectors Inc. (IEP) of Timmins, Ontario in the Kamiskotia and Reid Township areas. Identification of the best areas for sample collection was provided by 2 days of consultations by John Ayer, Ben Berger and Greg Stott. Analysis and results on the geochronology samples was provided by Mike Hamilton of the Jack Satterly Geochronological Laboratory (JSL) in 2016.

The Abitibi greenstone belt (AGB) is a difficult area to explore for Volcanogenic Massive Sulfide (VMS) deposits because of the structural complications related to multiple episodes of folding and faulting, metamorphism locally up to amphibolite facies and extensive overburden thickness of glacial till and lacustrine clay. Geophysics, as well as lithogeochemistry, alteration studies and an understanding of the stratigraphic location of favourable horizons for VMS deposition are thus valuable tools in the search for new deposits. In order to better understand the distribution of key base metal bearing stratigraphic assemblages to aid in future exploration for VMS deposits on IEP's claim holdings, geochronological samples were collected in strategic areas based on previous geochronological and lithogeochemical results. In total, 4 new samples of felsic volcanic rock were collected from diamond drill core in Turnbull, Bristol and Reid townships, while an additional rhyolite from SE Reid Township, studied previously (Barrie and Davis, 1990), was reanalyzed using modern methods.

Analytical Methods

U-Pb work was carried out at the Jack Satterly Geochronology Laboratory at the University of Toronto. New rock samples were crushed using a jaw crusher, and ground with a disk mill. Initial separation of heavy minerals was carried out via multiple passes on a Wilfley table to concentrate zircon. Subsequent work included density separation using methylene iodide, followed by magnetic separations with a Frantz isodynamic separator. Final sample selection was achieved by hand picking under a microscope, choosing the highest optical quality euhedral zircon grains (as inclusion-, crack-, alteration-free as possible). Grains with obvious cores were avoided.

Chemical abrasion (CA, Mattinson, 2005) pre-treatment methods were used to improve concordance of zircon analyzed subsequently by isotope dilution – thermal ionization mass spectrometry (ID-TIMS). Selected single grain zircon fractions were annealed in a quartz crucible at 1000°C for a period of 48 hours. Crystals were then leached in hydrofluoric acid (HF) at 200°C in Teflon bombs (Krogh, 1973) for up to 6 hours.

Weights of zircon grains were estimated from photomicrographs and the density of zircon. Mineral grains were washed prior to loading for dissolution. Zircon was dissolved using concentrated HF in Teflon bombs at 200°C (Krogh, 1973), to which a ^{205}Pb-^{235}U spike was added. Samples were dried and subsequently re-dissolved in 3N HCl overnight to promote equilibration with the spike. U and Pb were separated from the solutions using 50 microliter anion exchange columns (Krogh, 1973). Mixed, purified U and Pb solutions were loaded directly onto Re filaments using silica gel and analyzed with a VG354 mass spectrometer in single (Daly) collector, pulse-counting mode. Deadtimes of the measuring system for Pb and U during this period were 15 ns. The mass discrimination correction for the Daly detector was constant at 0.07%/AMU. Daly characteristics were monitored using the SRM982 Pb standard. Thermal mass discrimination corrections were 0.10 ± 0.03% /AMU.

The new zircon chemical abrasion methods, combined with spike refinements and increased instrumental sensitivities, result in more accurate and more precise age determinations than initially possible during earlier studies of the volcanostratigraphy in the AGB. An illustration of this is provided by the re-analysis of the age of an additional sample from SE Reid Township, using leftover zircon separates from the JSL mineral separates archive at the University of Toronto (JAA-14-05; see below).

Blake River Assemblage

The Kamiskotia Volcanic Complex (KVC) consists of an extensive bimodal sequence of tholeiitic basalts and high silica rhyolites located about 20 km northwest of Timmins in the Kamiskotia area of the Abitibi greenstone belt(AGB). The KVC is part of the Blake River assemblage, the youngest volcanic-dominated assemblage within the AGB with ages ranging from 2704 to 2697 Ma (Ayer et al., 2002, 2005). The KVC has a broad northerly strike, extending from a faulted contact with the Kidd Munro assemblage in northern Bristol Township to a second faulted contact with the Kidd Munro assemblage in northern Robb and Jamieson townships (Fig. 1). Extending for over a strike length of 25 km, the KVC represents the second largest accumulation of rhyolites in the AGB, following the ~50 km strike length of felsic volcanics hosting the Matagami VMS camp in Quebec. To the west, the KVC is underlain by the Kamiskotia Gabbroic Complex (KGC), an extensive mafic intrusion with ages ranging from 2707 ± 2 to 2705 ± 2 Ma (Fig. 1). To the east, the KVC is truncated by the Matagami River fault, a north striking Proterozoic-aged fault in which the older Archean rocks of the AGB are sinistrally offset by up to 10 km. A reversal in facing directions indicates a broad northerly trending syncline occurs about 3 km west of the faulted eastern margin (Fig. 1).

Geochronology

U-Pb zircon geochronology by Barrie and Davis (1990) yielded an of age of 2707 ± 2 Ma for a pegmatitic quartz gabbro from the Middle Zone of KGC in southern Turnbull Township and 2705 ± 2 Ma for rhyolite in southwestern Godfrey Township (Fig. 1).

Subsequent higher precision U-Pb zircon geochronology (Hathway et. al., 2008) yielded an age of 2704.8 ± 1.4 Ma from a granophyre sample in the Upper Zone of the KGC in central Robb Township. Their 4 new KVC rhyolite ages ranged from an age of 2703.1 ± 1.2 Ma in the lower part of the KVC in Turnbull Township to 3 rhyolite ages ranging from 2701.1 ± 1.4 to 2698.6 ± 1.3 Ma in the upper stratigraphic part, thus indicating that the KVC is part of the Blake River assemblage (2704–2697 Ma) (Ayer et al., 2005). The upper part of the KVC is more favourable for VMS mineralization containing 5 known VMS deposits extending over 15 km from the Half Moon deposit in Robb Township to the Genex mine in Godfrey Township (Fig. 1).

The IEP geochronological sampling

The program was initiated in 2014 and was focused on extending the extent of known KVC units, the VMS-bearing stratigraphy and to better define the location of the boundaries with the Kidd Munro assemblage. The results of the new dating are discussed below, with U-Pb isotopic data provided in Table 1, and presented graphically Concordia plots with paired zircon population images in Figure 2; new sample locations are shown as white squares in Figure 1.

Sample JAA-14-01 was collected at 97.5 m to 99.0 m from core in DDH ETC-07-5. The DDH is located in southern Turnbull township (UTM Z17; E453556, N5366662). The sample is a felsic lapillistone with heterolithic clasts to 2 cm, with many quartz rich clasts and with minor quartz phenocrysts and moderate but pervasive sericite alteration. Five single zircon fractions from this sample were analyzed. The reported age is based upon the 3 best fractions (Z2, Z4 & Z5 – Fig. 2B). These 3 zircons are all concordant, straddling the concordia band (includes U decay constant uncertainties), yielding a weighted average $^{207}Pb/^{206}Pb$ age of 2703.4 ± 1.3 Ma (MSWD = 0.03; 97% fit). Results for the other two fractions (not shown) are more reversely discordant, one of which gives a $^{207}Pb/^{206}Pb$ age of 2701 Ma, while the other likely reflects minor inheritance, having a $^{207}Pb/^{206}Pb$ age of 2711 Ma (Table 1).

Sample JAA-14-02 was collected from 113.8 m to 115.3 m in DDH ERN-01-01. The DDH is located northwestern Robb Township. The sample is a white to grey rhyolite flow with minor flow breccia with small quartz phenocrysts. No suitable zircons were recovered for analysis from this sample and its location is therefore not displayed on Figure 1.

Sample JAA-14-03 was collected over the depth interval 236.7 m to 238.2 m in DDH EBW-00-01. The DDH is located NW Bristol Township (UTM Z17; E460926, N5366424). The sample is grey to dark grey heterolithic lapilli tuff to tuff breccia with sub-angular to sub-rounded fragments up to 15 cm in a tuffaceous to graphitic matrix with numerous sulfide fragments and secondary sulfide accumulations. Four single zircons were analyzed and yielded two apparent age populations. The youngest population is defined by two fractions (Z2, Z4), and within this, fraction (Z2) is concordant. A free regression of these two points yields an upper intercept age of 2699.3 ± 1.7 Ma, with a lower intercept near 415 Ma (Fig. 2C). The other two single-grain zircon fractions (Z1, Z3) have similar, older $^{207}Pb/^{206}Pb$ ages of 2703.0 and 2705.2 Ma, and regress to give an intercept age of 2706.5 ± 3.7 Ma. The younger age of 2699.3 ± 1.7 Ma is considered the best age of volcanism, while the other two zircons are interpreted as containing an inherited, xenocrystic component.

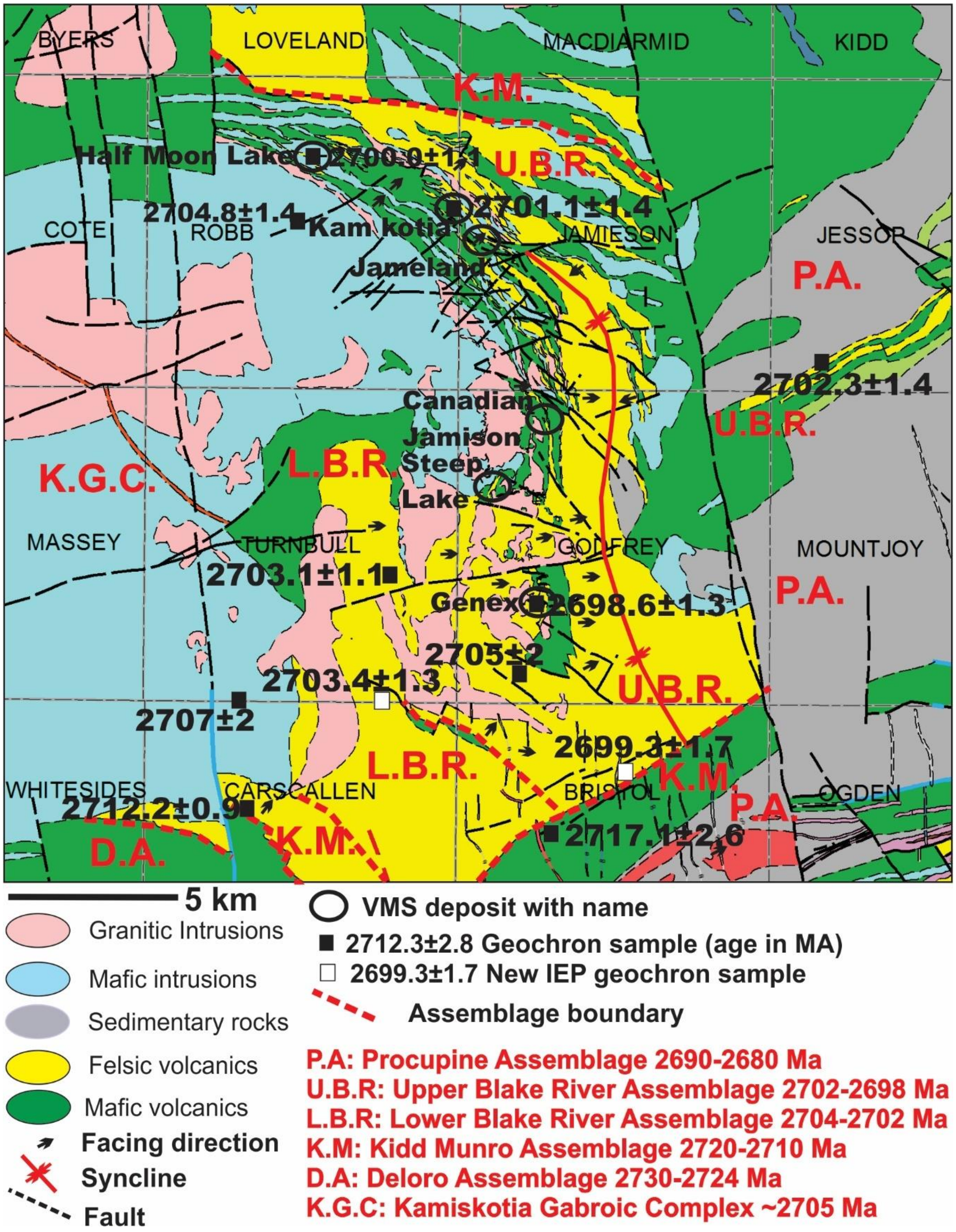

Figure 1. Kamiskotia area general geology with U-Pb zircon ages in MA VMS deposit locations and assemblage boundaries.

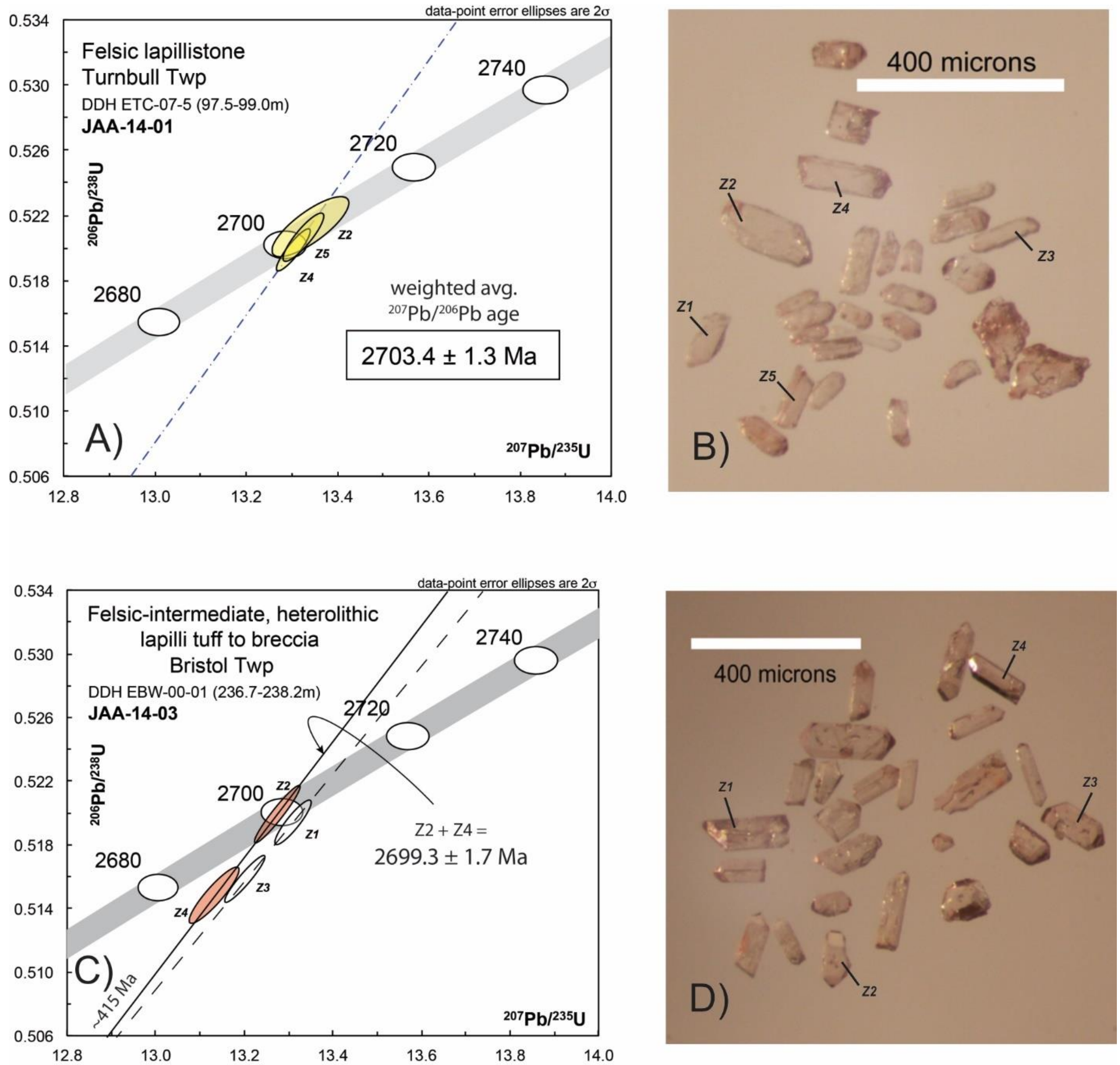

Figure 2. Concordia plots and images of selected zircons from the Kamiskotia area. A & B) Sample JA-14-01, C & D) Sample Ja-14-03.

In addition to being older, rhyolites from the lower stratigraphic part of the KVC have geochemical differences from the upper part as indicated by Hathway et. al., (2008) below:

Rhyolites from the lower part of the Kamiskotia Volcanic Complex, stratigraphically beneath the Genex VMS deposit, have high silica contents (74-82 wt.% SiO^2) and low TiO^2 contents (0.09-0.4 wt. %). REE patterns typically show gentle negative slopes and strong negative Eu anomalies; however, rocks from the lowermost part of the succession (Fig. 3A) have weaker Eu anomalies. In the $[La/Yb]_{CN}$ versus $[Yb]_{CN}$ diagram (Fig. 3C), these rhyolites cluster in the FII field and the low Yb part of the FIIIb field, with most having slightly higher $[La/Yb]_{CN}$ and lower $[Yb]_{CN}$ than the rhyolites of the Kidd-Munro assemblage. In the stratigraphically higher eastern part of the area, but still beneath the Genex deposit, rhyolites

are distinctly enriched in HREE, plotting well into the FIIIb field in the *[La/Yb]$_{CN}$ versus [Yb]$_{CN}$* ***diagram (Fig. 3C). Rhyolites in drill core along strike to the southeast of the Kam Kotia deposit fall in the FIIIb field, and a rhyolite from the felsic lens hosting the Halfmoon Lake deposit falls in the FII field.*** *Rhyolites from the Ski-Hill and Godfrey Creek units in the upper part of the Kamiskotia Volcanic Complex, above the VMS deposits, contain 75 to 82 wt. percent SiO^2 with TiO^2 ranging from 0.15 to 0.4 wt. percent. These rocks show flat REE patterns with strong negative Eu anomalies (Fig. 2B) and plot well into the FIIIb field in the[La/Yb]$_{CN}$ versus [Yb]$_{CN}$ diagram (Fig. 3C). Thus, rhyolites in the lower part of the Kamiskotia Volcanic Complex and at the level of the VMS deposits include FII and low Yb FIIIb types, with minor high Yb FIIIb rocks, whereas rhyolites in the upper part of the Kamiskotia Volcanic Complex are uniformly of the high Yb FIIIb type (Figs. 3C & 3D).*

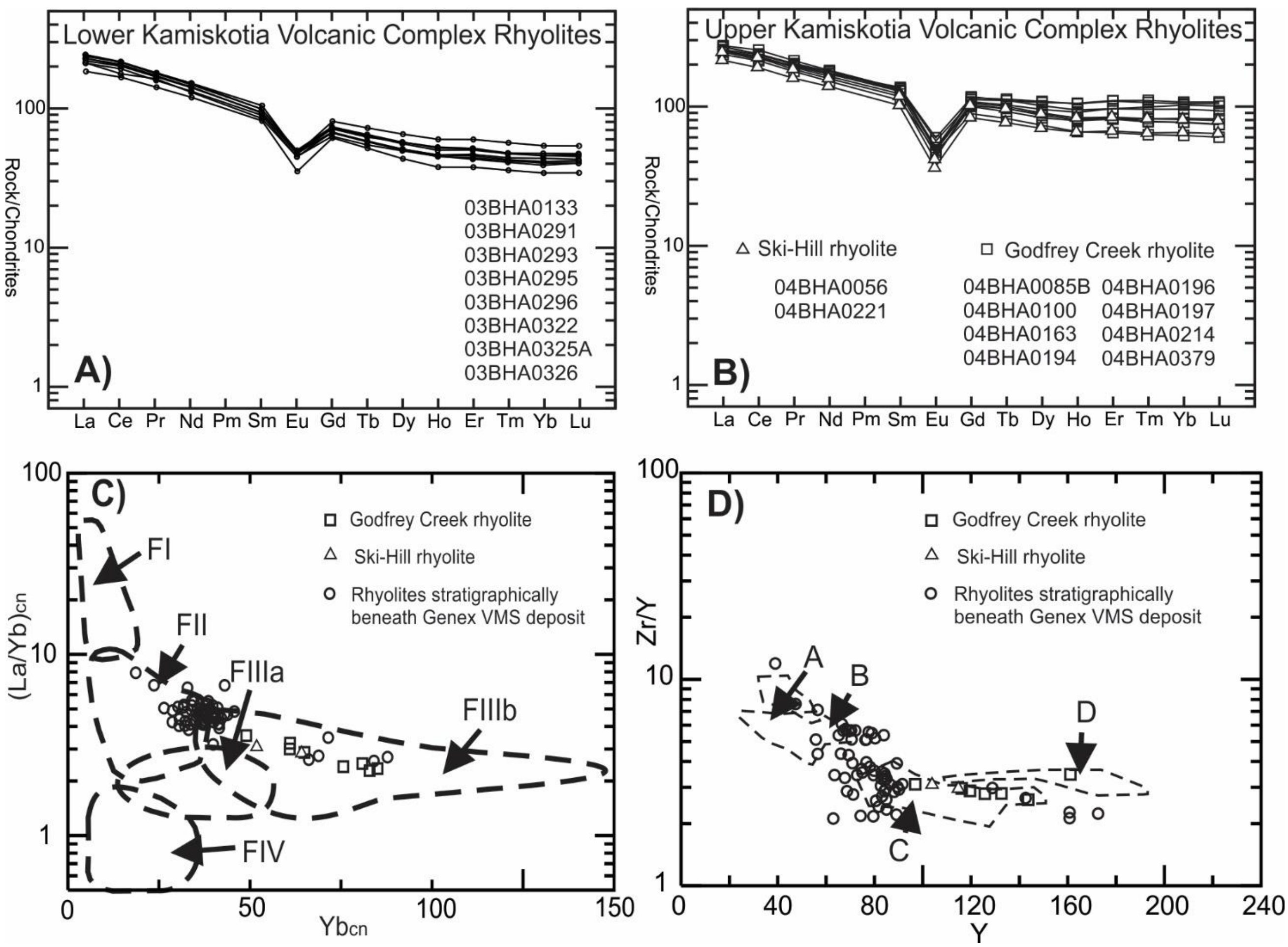

Figure 3. Lithogeochemical plots of rhyolites from the Kamiskotia area as discussed in the text. (After Hathway et al., 2008).

The ages and rhyolite chemistry of Kamiskotia Volcanic complex demonstrate correlation with the Blake River Group located about 100 km to the southeast and extending about 100 km into Quebec. Both volcanic sequences are considered to be part of a more extensive Blake River assemblage (2704-2697 Ma) (Thurston et al., 2008). Both of these Blake River assemblage sequences also have significant VMS deposits located at specific stratigraphic intervals. The ages and rhyolite chemistry of Kamiskotia Volcanic complex demonstrate correlation with the Blake River Group located about 100 km to the southeast and extending about 100 km into Quebec. Both volcanic sequences are considered to be part of a more extensive Blake River assemblage (2704-2697 Ma) (Thurston et al., 2008). Both of these Blake River assemblage sequences also have significant VMS deposits located at specific stratigraphic intervals.

Extensive geochronological studies in the Blake River Group demonstrate the range in timing and metal endowment of the Blake River Group VMS deposits (Fig. 4) as is quoted below from McNicol et. al. (2014) “Ages on host rocks of the Horne (2702.2 ± 0.9 Ma), Quemont (2702.0 ± 0.8 Ma), and Fabie (2701.9 ± 0.9 Ma) deposits reveal that they are among the oldest VMS deposits in the Blake River Group. The giant Horne Au-rich VMS deposit had already formed when the Cu-Zn deposits of the Noranda mine sequence, including Millenbach and Amulet, were generated at ~2698 Ma and is thus unrelated, consistent with its different volcanological setting and metal content. Large Au-rich VMS deposits of the Bousquet Formation, including LaRonde - Penna and Bousquet 2 - Dumagami, were formed at 2698 to 2697 Ma and are distinctly younger than the Horne and Quemont deposits. There were, therefore, two major time-stratigraphic intervals within the Blake River Group that were favorable for the formation of Au-rich VMS deposits. Rhyolite hosting the large Bouchard-Hébert VMS deposits yielded an age of 2695.8 ± 0.8 Ma.”

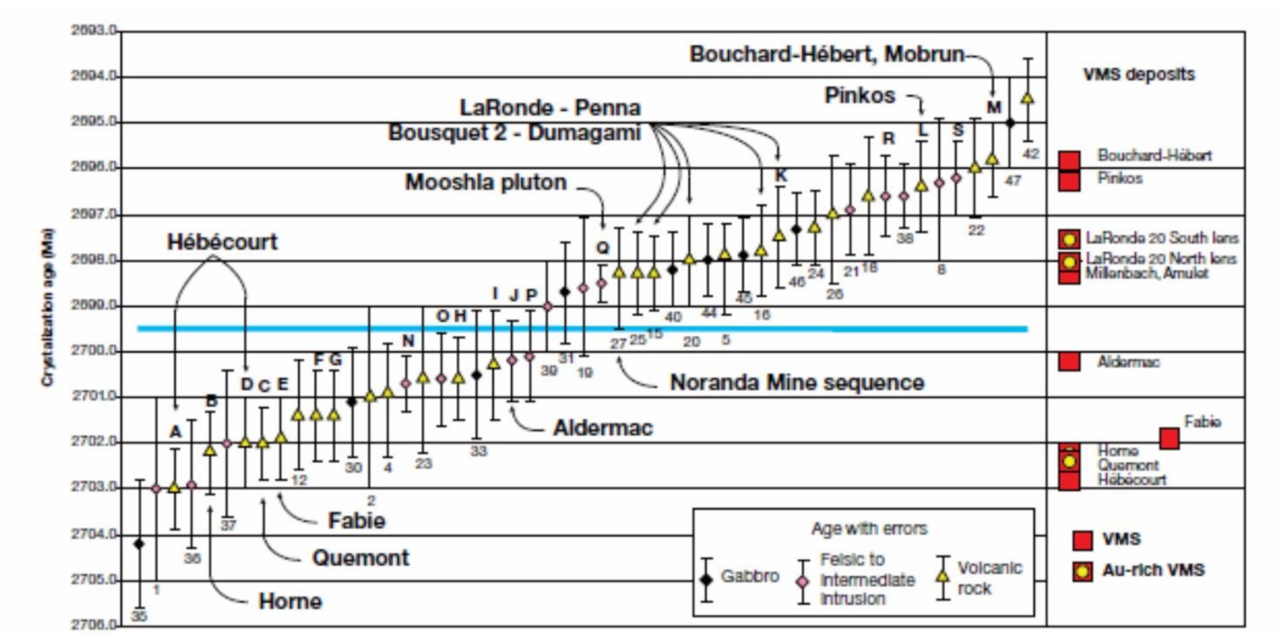

Figure 4. Distibution of U-Pb ages from the Blake River group in Quebec correlated with the timing of VMS deposits (McNicoll et al., 2014)

Kamiskotia Stratigraphic Interpretation

Good correlation between an age of 2703.1 ± 1.1 Ma in central Turnbull Township and the new age of 2703.4 ± 0.9 Ma in southern Turnbull Township provides further stratigraphic evidence that the western Kamiskotia Volcanic complex in this area is the lower member of KVC (Lower Blake River assemblage) (Fig. 1). A new age of 2699.3 ± 1.7 in northern Bristol Township correlates well with the age of 2698.6 ± 1.3 (Hathway et al., 2008) at the Genex mine, located about 6 km to the northwest. The new age data indicates that in the south, the KVC is a thick, dominantly felsic volcanic sequence which strikes southeasterly and faces to the northeast. The transition between the upper and lower members of the KVC appears to occur along a unit of high Nb basalts (Hathway et al., 2008) striking southeast from SE Turnbull into NW Bristol townships (Fig. 1). A conformable contact and an age of 2712.9 ± 0.9 in northern Carscallen Township suggests the lowermost contact of the KVC with the underlying Kidd-Munro assemblage represents a disconformity between the assemblages (see Thurston et al., 2008), in the southwest. However, the abrupt change from northeast-trending mafic volcanic rocks of the lower Kidd-Munro assemblage, with an age 2717.1 ± 2.6 Ma in an intercalated felsic volcanic unit, to lower KVC rhyolites with an age of 2699.3 ± 1.7 in northern Bristol Township Bristol indicates a fault contact between the assemblages. These newly identified upper KVC rhyolites in southern Godfrey and northern Bristol townships thus represent a good target area for discovery of VMS deposits, extending the favourable VMS stratigraphy of the upper KVC (i.e. 2700 ± 1 Ma) another 6 km south of Genex. An earlier age of 2705 ± 2 Ma from a sample located about 2.5 km southwest of the Genex Mine (Barrie and Davis, 1990) may represent some stratigraphic repetition or more likely inherited zircons in this sample. An unsuccessful attempt was made to find unanalyzed zircon fractions from this sample in the JSL archives to attempt to better understand this age; field resampling of this unit may thus be desirable.

Kidd-Munro Assemblage

The Kidd–Munro assemblage (2720–2710 Ma) is host to the Kidd Creek Mine, a giant volcanogenic massive sulfide (VMS) deposit that contains over 150 million tons of copper and zinc mineralization (Fig. 5). The assemblage extends continuously over 250 km from the Kamiskotia area into Quebec and also occurs in a number of isolated sequences throughout the Abitibi (Thurston et al., 2008). Berger et al., (2011) subdivided the Kidd–Munro assemblage into 4 distinct stratigraphic subdivisions as indicated below, based on mapping, geochemistry and an intensive campaign of high-precision U-Pb zircon geochronology. These stratigraphic subdivisions are 2720 to 2717 Ma, 2717 to 2715 Ma, 2715 to 2712 Ma and 2712 to 2710 Ma (Fig. 5). Each age is spatially restricted within the Kidd–Munro episode, has dominant rock types, volcanic morphologies, geochemical affinities and distinctive base metal prospectivity.

Rock units emplaced within the 2720 to 2717 Ma interval are composed of tholeiitic and transitional mafic, intermediate and rare felsic subaqueous metavolcanic flows and fragmental deposits that are intermixed with each other. Very little komatiite is reported within this cycle and most rocks of this age occur in Québec. Volcanic facies indicate deposition in a subaqueous environment medial to distal from volcanic vents, possibly as an oceanic plateau or back arc basin. Minor base metal mineralization is associated with rocks of this age.

The 2717 to 2715 Ma age interval is characterized by a bimodal suite of tholeiitic mafic and high silica felsic metavolcanic flows with lesser pyroclastic deposits, a komatiitic suite composed of subvolcanic dikes, sills and thick cumulate-textured flows, and a transitional suite of mafic, intermediate and felsic metavolcanic rocks. These rocks occur as intercalated units throughout the Kidd–Munro volcanic episode with the greatest concentration in the area of the Kidd Creek base metal deposit. Rare calc-alkalic rocks occur as spatially restricted mafic flows that are intercalated with mafic and intermediate tholeiitic flows.

Tholeiitic felsic metavolcanic rocks of this age are widespread and are host to VMS mineralization such as the giant Kidd Creek deposit and several smaller occurrences. Mafic magma that was erupted synchronous with the komatiite locally hosts potentially economic copper-zinc VMS mineralization (such as the Potter Mine deposit) and account for over 5 million tons of ore. This style of mineralization is poorly understood and under explored given that over 80% of the Kidd–Munro episode is composed of mafic metavolcanic rocks. Kambalda-style nickel-copper-(platinum group element) mineralization (over 500 000 tons) occurs in thick komatiite flows (sills) within footwall embayments produced by thermo-mechanical erosion and are spatially associated with peperitic komatiitic dikes and sills within this cycle. These prospective units appear to be under explored given the extent of komatiite magmatism of this age. The 2717 to 2715 Ma age bracket appears to be the most prospective for base metal mineralization in the Kidd–Munro episode.

The 2715 to 2712 Ma age interval is characterized mostly by the eruption of mafic tholeiitic lava flows with subordinate high- silica rhyolite subvolcanic sills, lava flows, autoclastic breccia and tuff. Calc-alkalic andesite and dacite pyroclastic and epiclastic deposits are restricted to a separate subunit at this interval but are still interpreted to form a single event of volcanism. A second generation of komatiite formed thin, organized lava flows typically with cumulate-textured bases and spinifex-textured tops. Kambalda-style nickel-copper-(PGE) deposits (such as the Marbridge deposit in Québec with >700 000 tons nickel-copper ore) indicate that the komatiite lava flows of this age are also fertile to host nickel sulfide mineralization. Zinc-rich VMS mineralization is hosted in some high-silica rhyolite units and calc-alkalic pyroclastic rocks and indicates a second generation of base metal mineralization, albeit minor, occurred within the Kidd–Munro episode.

Rock units with primary crystallization ages falling within the 2712 to 2710 Ma range are restricted to a few small areas and are composed mostly of tholeiitic and transitional felsic tuff, flows, epiclastic deposits and reworked metasedimentary rocks. Thin, discontinuous, spinifex- and cumulate-textured basaltic and peridotitic komatiite flows are intercalated with the felsic rocks, providing confirmation of a third komatiite generation in the Kidd–Munro volcanic episode. Minor base metal mineralization appears to be associated with this age.

Reid Township Geochronolgy

Previous geochronology samples in the Reid Township area are shown as black squares in Figure 5. They indicate that Kidd-Munro ages in Reid range from 2714.2 ± 0.5 to 2713.2 ± 1.8 Ma in the central part of the township which correlates well with the ages in the Kidd-Munro to the east. However, in the northern part of Reid and southern Mahaffy townships, ages range from 2703.0 ± 1.9 to 2700.5 ± 1.0 Ma indicating a younger stratigraphic unit which correlates with the Blake River assemblage (Ayer et al., 2005). In addition, a younger age of 2705 +5/-3 Ma in the southeastern corner of Reid Township suggested the presence of the Blake River assemblage in the southern part of Reid (Barrie and Davis, 1990). The Kidd-Munro assemblage also occurs west of the Matagami River fault in Reid, Loveland and Thornburn townships, with ages ranging from 2719.5 ± 1.7 to 2712.2 ± 2.0 Ma, but the southern contact between Kidd-Munro and the

Blake River assemblages is offset about 10 km to the south across this Proterozoic-aged sinsitral fault.

IEP geochronological samples

To better understand the boundaries of the Kidd-Munro and Blake River assemblages in northern Reid township, sample JAA-14-04 was collected from drill core at 60.8 m to 63.8 m in DDH AEM-90-03. The DDH is located northeastern Reid Township (UTN Z17; E464530, N5402050). The sample is a grey-green rhyolite flow breccia and tuff with quartz phenocrysts. Three single grain zircon fractions have been analyzed from this sample: two are in agreement on concordia (Z1, Z3), while a third (Z2) is slightly reversely discordant and younger (Fig. 6A & 6B). The two clustered analyses yield a weighted average $^{207}Pb/^{206}Pb$ age of 2701.7 ± 1.0 Ma (MSWD=1.5; p=23%), which is interpreted as the age of volcanism. The younger, reversely discordant analysis (2680 Ma) is believed to be a spurious, analytical artefact.

To better understand the Kidd-Munro and Blake River assemblage distribution in southern Reid Township, results for sample JAA-14-05 presents data from new zircon separates selected from archives stored at the JSL. The previously analyzed sample, identified as RR (and R-16), is a tuffaceous rhyolite with quartz and feldspar phenocrysts (Barrie and Davis, 1990; Barrie, 1990). On the basis of two air-abraded multigrain zircon fractions (7, 9 crystals each), and one unabraded 5-grain fraction, this sample yielded an age of 2705 +5/-3 Ma with a 90% probability of a fit. However, the model $^{207}Pb/^{206}Pb$ ages for these fractions ranged widely from 2700.7 – 2706.3 Ma and likewise showed a spread of discordance (0.15-4.3%). On the basis of the interpreted 2705 +5/-3 Ma age, the stratigraphy in this area of Reid Township was correlated with the Kamiskotia Volcanic complex located about 20 km to the southwest (Barrie and Davis, 1990). Analysis of four new zircon single grains, using modern chemical abrasion pre-treatment techniques, yields results that are more consistent, with $^{207}Pb/^{206}Pb$ ages ranging narrowly between 2700.6-2701.1 Ma (Table 1), and effectively concordant data (0.0 to -0.2% discordant). A weighted mean $^{207}Pb/^{206}Pb$ age calculated on the basis of these results is 2700.8 ± 0.8 Ma (MSWD = 0.09; prob. of fit = 96%) (Figures 6C & 6D).

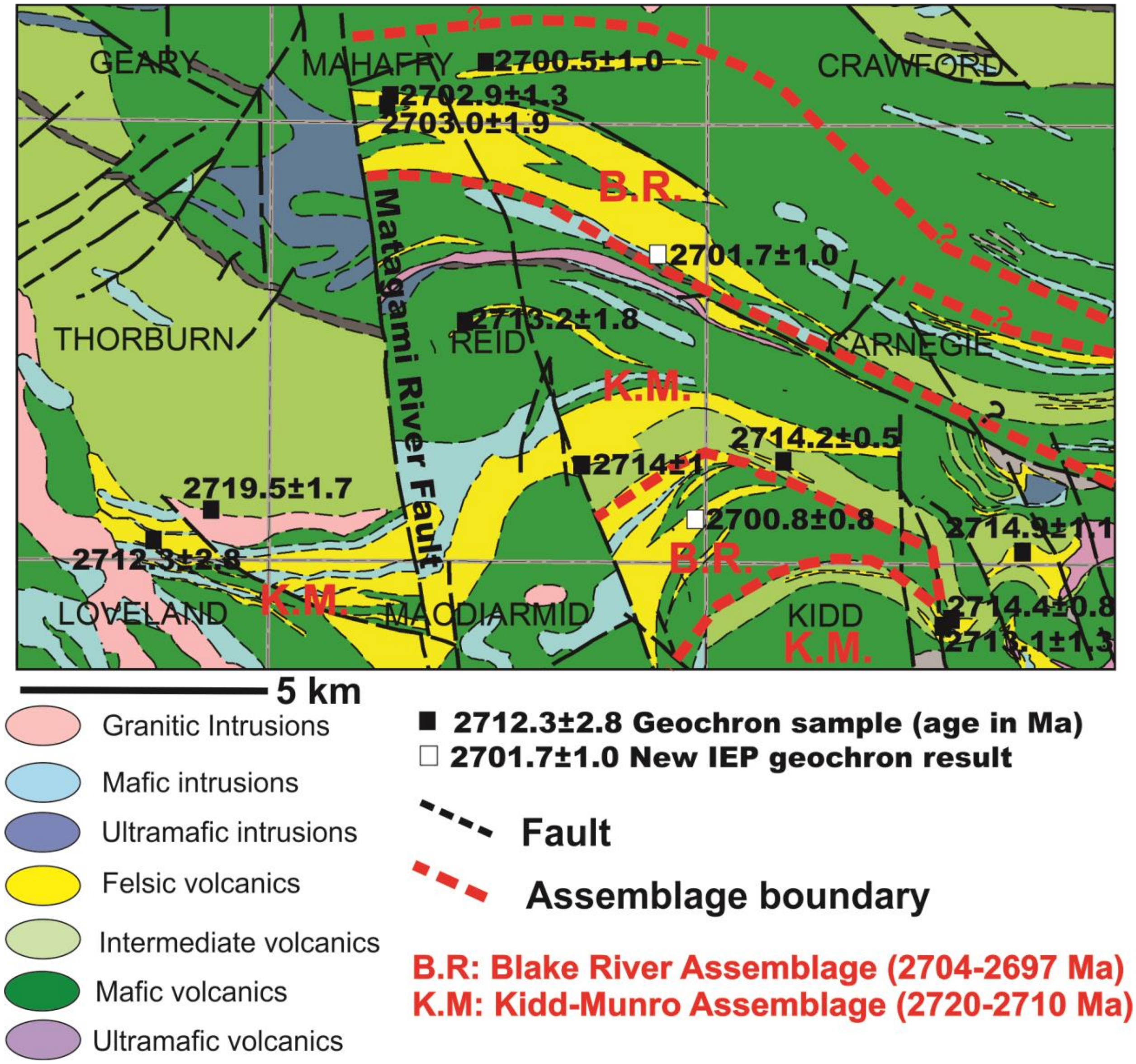

Figure 5. Reid Township area with U-Pb zircon geochronology ages (in Ma). Earlier sample locations shown in black squares, while those for new samples are shown in white squares.

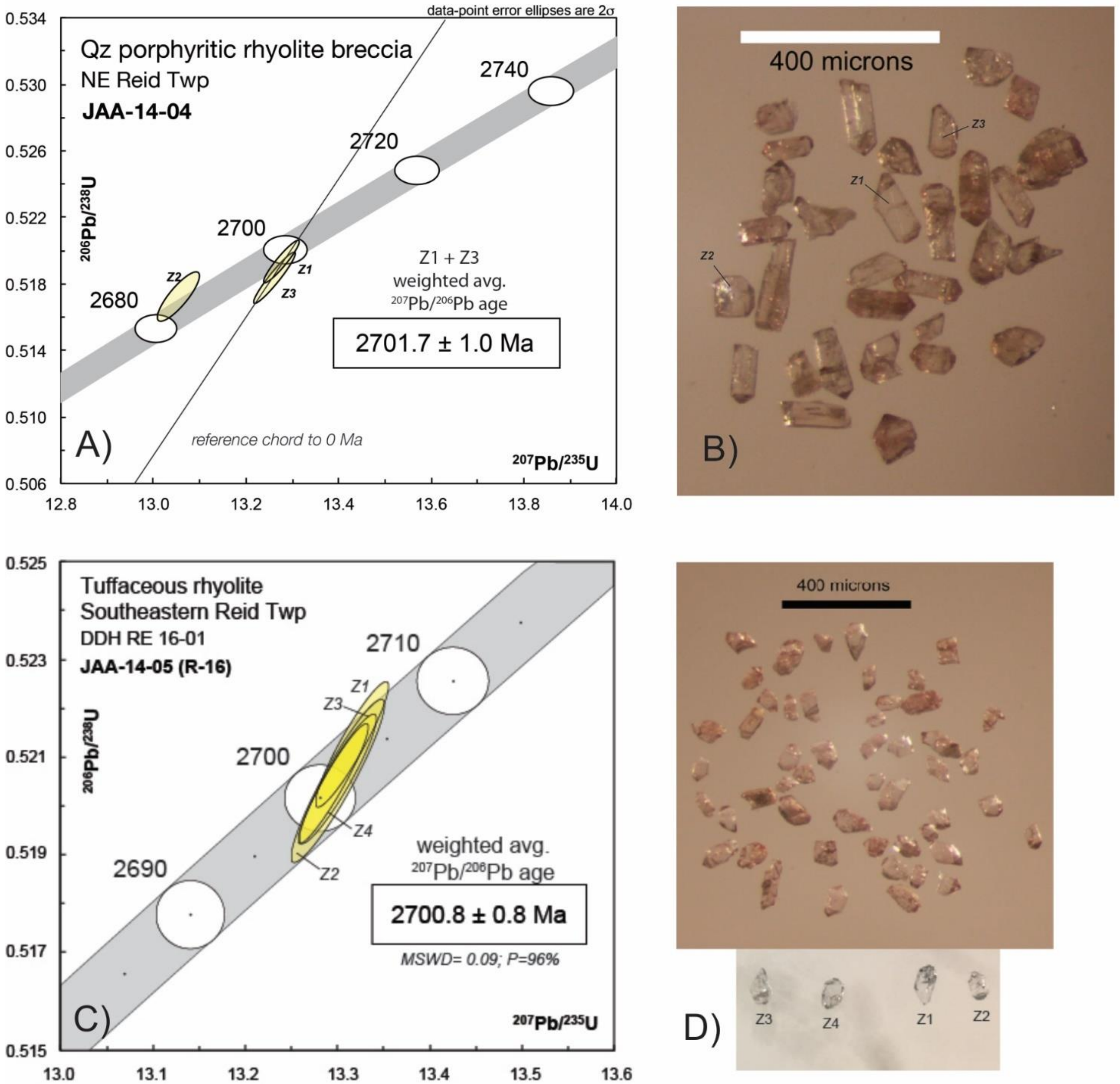

Figure 6. Concordia plots and images of selected zircons from the Reid Township area. A & B) Sample JA-14-04, C & D) Sample Ja-14-05.

Reid Township Stratigraphic Interpretation

The new ages confirm and expand the known boundaries of the Blake River assemblage in northern Reid Township (Fig. 5). A new age of 2701.7 ± 1.0 Ma in northeastern Reid indicates that the major rhyolite sequence in northern Reid and southern Mahaffy townships are part of the Blake River assemblage. In addition, slightly older ages of 2703.0 ± 1.9 and 2702.9 ± 1.3 Ma within this rhyolite sequence in southwestern Mahaffy Township, contrasting with the slightly younger upper Blake River assemblage ages of 2700.5 ± 1.0 Ma for a sample further to the north in Mahaffy, and the new sample age of 2701.7 ± 1.0 Ma in northeastern Reid, suggest an anticline occurs within this extensive sequence of rhyolites. In southeastern Reid Township the new age result of 2700.8 ± 0.8 Ma suggests in folding of the upper Blake River and the Kidd-Munro assemblages. These Blake River assemblage ages are compatible with the VMS bearing stratigraphy in the Blake River assemblage in the Kamiskotia area to the southwest (Hathway et al., 2008) and in the Blake River Group to the southeast in Québec (McNicol et. al., 2014).

The extent of Kidd-Munro assemblage in central Reid Township is now better constrained by the new Blake River assemblage ages. Ages of 2714 ± 1 and 2714.2 ± 0.5 Ma in SE Reid and SW Carnegie townships correlate well with an age of 2714.4 ± 0.8 from a rhyolite unit underlying the Chance VMS deposit in NW Kidd Township and an age of 2712.4 ± 1.9 Ma for the rhyolite unit hosting the Chance deposit (Bleeker et al., 1999) (Fig. 5). These ages, and an age of 2713.2 ± 1.8 Ma from central Reid Township indicates that this area is underlain by the 2715-2712 Ma stratigraphic subdivision of the Kidd-Munro assemblage which has good potential for zinc-rich VMS mineralization such as the Chance deposit and Kambalda-style nickel-copper-(PGE) deposits such as the Marbridge deposit in Québec (Berger et al., 2011).

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Table 1. Zircon U-Pb isotopic data for felsic volcanic rocks from the Kamiskotia area.

Fraction	Description	Sample wt. (μg)	U (ppm)	Pb^T (pg)	Pb_C (pg)	Th/U	$^{206}Pb/^{204}Pb$	$^{206}Pb/^{238}U$	± 2s	$^{207}Pb/^{235}U$	± 2s	$^{207}Pb/^{206}Pb$	± 2s	Ages (Ma) $^{206}Pb/^{238}U$	± 2s	$^{207}Pb/^{235}U$	± 2s	$^{207}Pb/^{206}Pb$	± 2s	Disc. (%)
JAA-14-01 Felsic lapillistone, Turnbull Township. DDH ETC-07-5 (97.5-99.0m).																				
Z1	1 clr, cls sml brkn pr	0.51	39	11.90	0.50	0.518	1354	0.532527	0.003016	13.69155	0.08901	0.186470	0.000472	2752.1	12.7	2728.6	6.1	2711.3	4.2	-1.8
Z2	1 clr, cls lrg 2:1 pr, incl	1.10	58	34.68	2.05	0.513	968	0.521298	0.001496	13.33928	0.06974	0.185586	0.000639	2704.7	6.3	2704.0	4.9	2703.4	5.7	-0.1
Z3	1 clr, cls, el, sl flat	0.49	55	16.60	1.96	0.527	492	0.526241	0.002385	13.44741	0.11308	0.185333	0.001050	2725.6	10.1	2711.6	8.0	2701.2	9.4	-1.1
Z4	1 clr, cls, el, sq, brkn	0.82	56	28.29	0.78	0.799	1934	0.519887	0.001045	13.30156	0.03047	0.185560	0.000191	2698.7	4.4	2701.3	2.2	2703.2	1.7	0.2
Z5	1 clr, cls, el rect, brkn	0.63	50	18.35	0.84	0.624	1224	0.520655	0.001209	13.32412	0.03672	0.185605	0.000248	2702.0	5.1	2702.9	2.6	2703.6	2.2	0.1
JAA-14-03 Felsic-intermediate, heterolithic lapilli tuff to breccia, Bristol Township. DH EB [illegible]-00-01 (23[illegible].7-238.2m).																				
Z1	1 clr, cls, lrg 2.5:1 shrp pr, incl	0.95	122	75.05	0.66	0.685	6224	0.519552	0.001134	13.30875	0.03364	0.185783	0.000209	2697.3	4.8	2701.8	2.4	2705.2	1.9	0.4
Z2	1 clr, cls, brkn shrt shrp pr, incl	0.52	97	28.88	0.30	0.545	5326	0.520062	0.001457	13.27452	0.04183	0.185124	0.000181	2699.4	6.2	2699.4	3.0	2699.3	1.6	0.0
Z3	1 clr, cls, sl flat, 2:1 shrp pr, incl	1.03	75	44.36	0.51	0.548	4864	0.516022	0.001205	13.20084	0.03651	0.185538	0.000186	2682.3	5.1	2694.1	2.6	2703.0	1.7	0.9
Z4	1 clr, cls, 4:1 shrp brkn, incl	0.61	84	30.46	0.80	0.637	2113	0.515005	0.001432	13.13210	0.04559	0.184936	0.000284	2678.0	6.1	2689.2	3.3	2697.6	2.5	0.9
JAA-14-04 Quartz porphyritic rhyolite breccia, NE Reid Township.																				
Z1	1 gemmy, crkd, 2.5:1 sq pr	1.02	149	93.13	0.44	0.764	11321	0.519486	0.001030	13.27449	0.03156	0.185329	0.000164	2697.0	4.4	2699.4	2.2	2701.1	1.5	0.2
Z2	1 gemmy, crkd, brkn sq pr frag	0.98	105	62.71	1.32	0.554	2670	0.517392	0.001201	13.05411	0.03723	0.182989	0.000283	2688.1	5.1	2683.6	2.7	2680.2	2.6	-0.4
Z3	1 gemmy, crkd, 2:1 sq pr, incl	0.59	140	50.40	0.46	0.592	6129	0.518520	0.001253	13.26009	0.03725	0.185472	0.000173	2692.9	5.3	2698.3	2.7	2702.4	1.5	0.4
JAA-14-05 Quartz and feldspar phenocryst-bearing tuffaceous rhyolite, SE Reid Township.																				
Z1	1 clr, cls, 2:1 shrp pr, incl	1.15	126	75.87	0.61	0.573	6900	0.521284	0.001038	13.31619	0.03227	0.185270	0.000173	2704.6	4.4	2702.3	2.3	2700.6	1.5	-0.2
Z2	1 clr, cls, shrt pr, incl	0.85	114	34.55	0.57	0.608	3344	0.520546	0.001347	13.30108	0.04089	0.185322	0.000213	2701.5	5.7	2701.3	2.9	2701.1	1.9	0.0
Z3	1 clr, cls, 2:1 brkn pr	1.12	128	78.89	0.96	0.675	4468	0.520592	0.001067	13.30155	0.03398	0.185312	0.000187	2701.7	4.5	2701.3	2.4	2701.0	1.7	0.0
Z4	1 clr, cls, short, sl flat, shrp pr	1.05	180	113.69	0.48	0.823	12445	0.520488	0.000993	13.29576	0.03093	0.185268	0.000156	2701.3	4.2	2700.9	2.2	2700.6	1.4	0.0

Notes:

All analyzed fractions represent best optical quality (crack-, inclusion-, core-free), fresh (least altered) grains of zircon available. All zircons were chemically abraded.

Abbreviations: Z - zircon fraction; clr - clear; cls - colourless; fr - fragment; pr - prism/prismatic; el - elongate; sl - slightly; sml - small; lrg - large; sq - square x-section; shrp - sharp; brkn - broken; rect - rectangular; incl - inclusion-bearing.

Pb^T is total amount (in picograms) of Pb.

Pb_C is total measured common Pb (in picograms) assuming the isotopic composition of laboratory blank: 206/204 - 18.221; 207/204 - 15.612; 208/204 - 39.360 (errors of 2%). Pb/U atomic ratios are corrected for spike, fractionation, blank, and, where necessary, initial common Pb; 206Pb/204Pb is corrected for spike and fractionation.

Th/U is model value calculated from radiogenic 208Pb/206Pb ratio and 207Pb/206Pb age, assuming concordance. Disc. (%) - per cent discordance for the given 207Pb/206Pb age. Uranium decay constants are from Jaffey et al. (1971).