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# Uranium-lead geochronological results from the Churchill River–Southern Indian Lake transect, northern Manitoba[1,2]

N. Rayner and D. Corrigan

*Rayner, N. and Corrigan, D., 2004: Uranium-lead geochronological results from the Churchill River–Southern Indian Lake transect, northern Manitoba; Geological Survey of Canada, Current Research 2004-F1, 14 p.*

**Abstract:** Uranium-lead geochronological results are presented from northwestern Manitoba. A rhyolite porphyry from the Rusty Lake Belt was dated by thermal ionization mass spectrometry (TIMS) at 1883 ± 2 Ma. Sensitive High Resolution Ion Microprobe (SHRIMP) analysis of detrital zircons from the overlying Powder Magazine turbidite suggests a single volcanic provenance and a maximum age of deposition of 1880 ± 4 Ma. Detrital zircons from a Partridge Breast Belt conglomerate indicate a largely arc source (ca. 1.9 Ga), but contain a large proportion of 2.3 to 2.5 Ga zircons. The maximum age of deposition is 1886 ± 4 Ma. SHRIMP dating of a quartz diorite in the Southern Indian Domain yields a crystallization age of 1889 ± 11 Ma, but the quartz diorite contains numerous 2.4 to 2.5 Ga inherited zircons. A megacrystic granite and a monzodiorite from the Southern Indian Domain give indistinguishable TIMS ages of 1829 ± 1 Ma and 1829 ± 2 Ma, respectively, whereas a monzogranite yielded a ca. 1850 Ma (TIMS) age.

**Résumé :** Des données géochronologiques U-Pb sont présentées pour le nord-ouest du Manitoba. Un porphyre rhyolitique de la ceinture de Rusty Lake a été daté par spectrométrie de masse à thermoionisation (TIMS) à 1883 ± 2 Ma. L'analyse à la microsonde ionique à haute résolution et à haut niveau de sensibilité (SHRIMP) de zircons détritiques provenant de la turbidite sus-jacente de la formation de Powder Magazine indique que ces zircons sont d'origine exclusivement volcanique et que l'âge maximal de dépôt est de 1880 ± 4 Ma. Des zircons détritiques d'un conglomérat de la ceinture de Partridge Breast proviennent principalement d'un arc (environ 1,9 Ga), mais le conglomérat contient aussi une grande proportion de zircons de 2,3 à 2,5 Ga. L'âge maximal de dépôt est de 1886 ± 4 Ma. La datation à la microsonde SHRIMP d'une diorite quartzique dans le domaine de Southern Indian donne un âge de cristallisation de 1889 ± 11 Ma; cependant, la diorite quartzique contient de nombreux zircons hérités datant de 2,4 à 2,5 Ga. La datation par spectrométrie TIMS d'un granite mégacristallin et d'une monzodiorite provenant du domaine de Southern Indian a donné des âges indifférenciables de 1829 ± 1 Ma et de 1829 ± 2 Ma, respectivement, tandis que la datation par la même méthode d'un monzogranite a livré un âge de 1850 Ma environ.

[1] Contribution to the Targeted Geoscience Initiative (TGI)
[2] Contribution to the Northern Resources Development Program

## INTRODUCTION

The Churchill River–Southern Indian Lake transect is part of a Targeted Geoscience Initiative in the Granville Lake–Southern Indian Lake area, northern Manitoba; it is a multidisciplinary geoscience project undertaken in partnership with the Manitoba Geological Survey (Fig. 1). The overall objective of this project is to provide an integrated and updated view of the geological and tectonostratigraphic framework as well as the economic potential of the Lynn Lake–Leaf Rapids area. In this paper, we present results from U-Pb dating of plutonic, volcanic, and sedimentary protoliths that provide constraints on the timing of protolith formation and sediment deposition. The samples presented herein form a part of a suite collected during the first full field season in 2001 in the Southern Indian Domain and Ruttan mine area (*see* Fig. 1, 2).

## REGIONAL GEOLOGY

Supracrustal and associated plutonic rocks along the northern flank of the Trans-Hudson Orogen in Manitoba have been previously assigned to three main lithological packages, the Kisseynew, Lynn Lake–Leaf Rapids, and Southern Indian domains (Hoffman, 1988). The Kisseynew Domain comprises mainly upper-amphibolite- to granulite-facies metaturbidite of the Burntwood Group, which is unconformably overlain to the north by molassic sedimentary rocks of the Sickle Group. In Manitoba, the Kisseynew Domain is flanked to the north by the Lynn Lake–Leaf Rapids Domain (Fig. 1), which comprises ca. 1.90 to 1.88 Ga (Baldwin et al., 1987) volcanic rocks and associated sedimentary rocks (Syme, 1985; Ames and Taylor, 1996; Zwanzig et al., 1999). The Southern Indian Domain flanks the Lynn Lake–Rusty Lake Belt to the north and for the most part correlates with the Rottenstone Domain in Saskatchewan (Fig. 1). It is dominated by granitoid orthogneiss and sedimentary rocks, as well as subordinate volcanic rocks. Recent work on Reindeer Lake in Saskatchewan has led to the recognition of at least two distinct sedimentary basins in the Rottenstone Domain, the Milton Island assemblage, interpreted as a forearc or accretionary complex formed north of the advancing La Ronge–Lynn Lake arc, and the Park Island assemblage, interpreted as forming part of a foreland or molasse-type basin (Corrigan et al., 1999b). Both assemblages are continuous in the Southern Indian Domain. The Pukatawakan Bay area contains minor mafic volcanic rocks as well as sedimentary rock historically linked to the Sickle Group. Plutons were examined to provide constraints on the local and regional magmatic evolution. The Partridge Breast

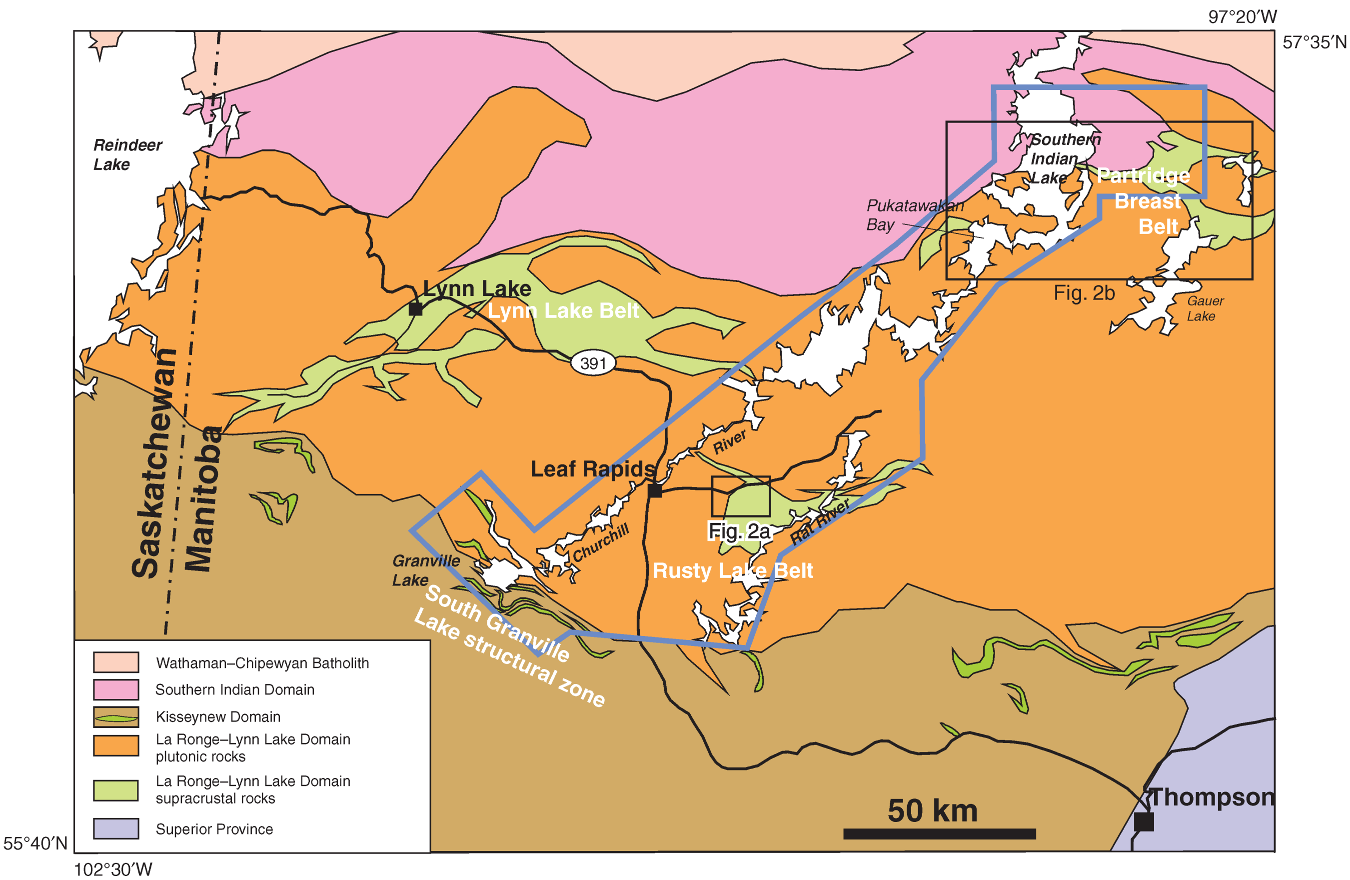


***Figure 1.*** *Main geological domains along the northern flank of the Trans-Hudson Orogen. The scope of the GSC's contribution to the Granville Lake–Southern Indian Lake TGI is outlined in blue.*

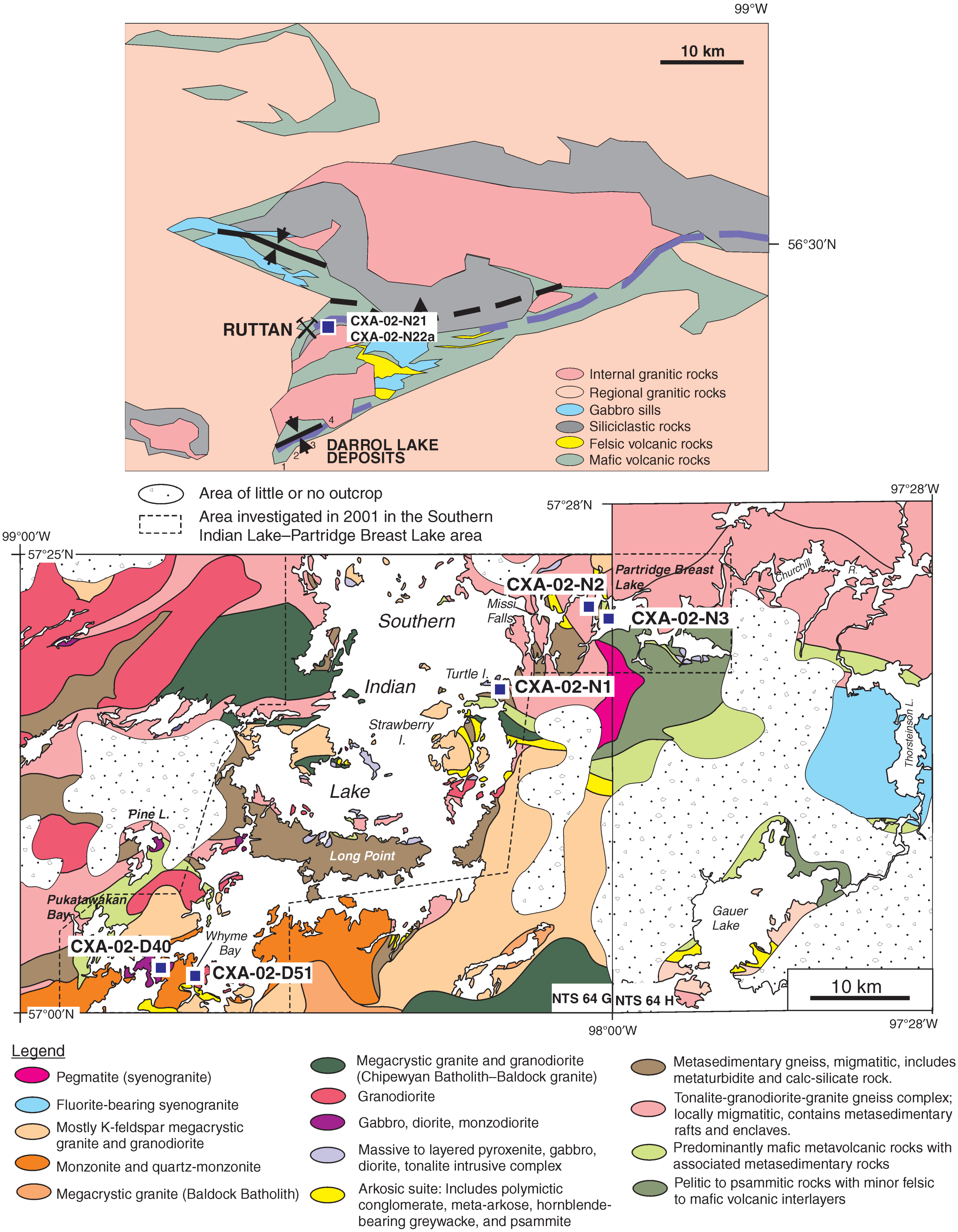


***Figure 2. a**) Simplifed bedrock geology map of the Ruttan mine area (*modified from *Ames and Taylor, 1996) showing the U-Pb geochronology sampling localities.* See *Figure 1 for location.* ***b**) Simplified geological map of the Southern Indian Lake–Partridge Breast Belt area (Corrigan et al., 2002) showing the main sampling localities for U-Pb geochronology.*

rocks within the Southern Indian Domain. Geologically, it can be subdivided into the following three rock associations of different composition and age: 1) the Missi Falls gneiss association; 2) mafic volcanic rocks with minor intermediate and felsic components, associated with clastic sedimentary rocks; and 3) plutons that intrude the Missi Falls gneiss association and Partridge Breast Belt supracrustal rocks (Corrigan et al., 2002). To the north, supracrustal rocks of the Southern Indian Domain are intruded by the Chipewyan Batholith, equivalent to the Wathaman Batholith in Saskatchewan.

## ANALYTICAL PROCEDURES

Ages were determined from a total of seven samples, four using the thermal ionization mass spectrometry (TIMS) technique and three using the Sensitive High Resolution Ion Microprobe (SHRIMP) at the Geological Survey of Canada.

Heavy minerals were separated from the rock samples by standard crushing, grinding, and heavy liquid techniques, then were sorted using a Frantz isodynamic separator. Samples analyzed by TIMS were heavily abraded before being submitted for U-Pb chemistry. Dissolution in concentrated HF, extraction of U and Pb, and mass spectrometry followed the methods described by Parrish et al. (1987). Analytical blanks for Pb were 2 to 5 pg. Results are presented in Table 1.

SHRIMP analytical procedure and U-Pb calibration details are given in Stern (1997) and Stern and Amelin (2003). The internal features of the zircons (zoning, structures, alteration, etc.) were characterized with backscattered electrons using a Cambridge Instruments scanning electron microscope. Prior to analysis, mount surfaces were evaporatively coated with 10 nm of high-purity gold. For the detrital zircon portion of this study, a 17 x 23 µm spot was used, with an $O^-$ primary beam strength of 13 nA, operating at a mass resolution of 5350. A second phase of SHRIMP study involved dating a complex igneous body. In this phase, two spot sizes were used. A 26 µm x 36 µm spot with an $O^-$ beam strength of 11 nA was used to target large, low-U domains. A smaller 13 µm x 16 µm spot (3.3 nA) was used to analyse thin, high-U rims. For both phases of the study, the count rates of ten isotopes of $Zr^+$, $U^+$, $Th^+$, and $Pb^+$ in zircon were sequentially measured (four scans for the analysis of detrital zircon and six scans for the analysis of igneous zircon) with a single electron multiplier and a pulse-counting system with dead time of 24 ns. The 1$\sigma$ external errors of $^{206}Pb/^{238}U$ ratios reported in Table 2 incorporate a ±1.0 % error in calibrating the standard zircon (Stern and Amelin, 2003). No fractionation correction was applied to the Pb-isotope data; common Pb correction used the measured $^{204}Pb/^{206}Pb$ and compositions modelled after Cumming and Richards (1975). Isoplot v. 2.49 (Ludwig, 2001) was used to generate concordia plots and calculate weighted means. All errors quoted in the text are given at 2$\sigma$ uncertainty.

## GEOCHRONOLOGY SAMPLES AND RESULTS

The samples were collected from a range of tectonostratigraphic settings and provide constraints on the age of volcanism and sedimentation in the Rusty Lake Belt, on the deposition of fluvial to littoral facies sediments in the Partridge Breast Belt, and on the emplacement of orthogneiss and plutonic rocks.

### *TIMS*

#### CXA-01-N21 (z7033)

A quartz-porphyry rhyolite was collected from the Ruttan mine site (Fig. 2a, UTM 461379, 6259218) and is considered part of the upper felsic volcanic unit of Ames and Taylor (1996). This fine-grained rhyolite contains blue quartz eyes up to 4 mm in diameter. This sample provides additional age constraints on volcanism in the Rusty Lake Belt, with currently only one known age (1878 ± 3 Ma) from a rhyolite in the stratigraphically higher Karsakuwigamak block (Baldwin et al., 1987). Zircon recovery from the Ruttan rhyolite was excellent. Fractions were selected from the diamagnetic mineral separate. The zircons were generally clear, colourless, stubby prisms with an aspect ratio of 2:1 and very sharp terminations. Most grains were moderately to highly fractured but contained few inclusions. Four fractions, one concordant and three slightly discordant, yielded an upper intercept age of 1883 ± 2 Ma, interpreted as the age of crystallization (Fig. 3a). This age is slightly older than that obtained by Baldwin et al. (1987) from the Karsakuwigamak block and is consistent with its relative stratigraphic position.

#### CXA-01-D51 (z7034)

A sample of undeformed K-feldspar megacrystic monzogranite, megascopically indistinguishable from the 1.86 to 1.85 Ga Wathaman-Chipewyan Batholith, was collected from the west shore of Whyme Bay, Southern Indian Lake (Fig. 2b, UTM 517450, 6321100). The monzogranite contains rafts of folded arenite, historically linked to the Sickle Group (Frohlinger and Cranstone, 1972). The age of this unit constrains timing of plutonism and provides a maximum age of folding in the sedimentary rocks. Zircon recovery from the monzogranite was excellent. All fractions submitted for dating were picked from the diamagnetic separate. Zircon morphologies ranged continuously from equant and stubby prisms through to needles. All zircons were clear and colourless with few visible inclusions or fractures. Three concordant fractions and one slightly discordant fraction yielded a crystallization age of 1829 ± 1 Ma (Fig. 3b). This surprising result may indicate that the age range of the Wathaman Batholith is broader than previously known or that a separate igneous event produced plutons of similar composition. Pending results from whole-rock geochemical analysis may shed some light on this question.

**Table 1.** TIMS data.

| | | | | | | | | | | | | | | | | | Apparent Ages (Ma) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fraction** | **No. grains** | **Wt. ($\mu$g)** | **$U^2$ (ppm)** | **$Th^m$ (ppm)** | **$\frac{Th^m}{U}$** | **$Pb^{*2}$ (ppm)** | **$Pb^{c1}$ (pg)** | **$\frac{^{206}Pb^1}{^{204}Pb}$** | **$\frac{^{208}Pb^2}{^{206}Pb}$** | **$\frac{^{207}Pb^2}{^{235}U}$** | **$\pm\frac{^{207}Pb}{^{235}U}$** | **$\frac{^{206}Pb^2}{^{238}U}$** | **$\pm\frac{^{206}Pb}{^{238}U}$** | **Corr Coeff** | **$\frac{^{207}Pb^2}{^{206}Pb}$** | **$\pm\frac{^{207}Pb}{^{206}Pb}$** | **$\frac{^{206}Pb}{^{238}U}$** | **$\pm\frac{^{206}Pb}{^{238}U}$** | **$\frac{^{207}Pb/}{^{235}U}$** | **$\pm\frac{^{207}Pb}{^{235}U}$** | **$\frac{^{207}Pb}{^{206}Pb}$** | **$\pm\frac{^{207}Pb}{^{206}Pb}$** | **Disc. (%)** |
| **CXA-01-N21 Ruttan rhyolite (z7033)** | | | | | | | | | | | | | | | | | | | | | | | |
| A (Z)* | 19 | 6 | 165 | 63 | 0.38 | 59 | 2 | 13651 | 0.11 | 5.34 | 0.0075 | 0.3358 | 0.00044 | 0.940313 | 0.11535 | 5.77E-05 | 1866.3 | 4.1 | 1875.3 | 2.5 | 1885 | 2.0 | 1.16 |
| B (Z) | 25 | 6 | 224 | 86 | 0.38 | 80 | 1 | 13299 | 0.11 | 5.394 | 0.0102 | 0.3397 | 0.00061 | 0.936741 | 0.11518 | 8.06E-05 | 1885.2 | 5.8 | 1884.0 | 3.2 | 1883 | 2.0 | -0.16 |
| C (Z) | 32 | 9 | 136 | 128 | 0.94 | 48 | 1 | 18050 | 0.11 | 5.352 | 0.0075 | 0.3368 | 0.00040 | 0.941719 | 0.11526 | 5.76E-05 | 1871.1 | 3.8 | 1877.2 | 2.3 | 1884 | 2.0 | 0.79 |
| D (Z) | 36 | 10 | 238 | 96 | 0.40 | 85 | 3 | 13764 | 0.12 | 5.32 | 0.0090 | 0.3347 | 0.00050 | 0.952634 | 0.11528 | 5.76E-05 | 1861.1 | 4.9 | 1872.0 | 2.8 | 1884 | 2.0 | 1.42 |
| **CXA-01-D51 megacrystic monzogranite (z7034)** | | | | | | | | | | | | | | | | | | | | | | | |
| A (Z) | 4 | 10 | 233 | 72 | 0.31 | 79 | 5 | 9262 | 0.09 | 5.056 | 0.0076 | 0.3281 | 0.00043 | 0.940361 | 0.11176 | 5.59E-05 | 1829.1 | 4.1 | 1828.7 | 2.5 | 1828 | 2.0 | -0.05 |
| A2 (Z) | 3 | 11 | 131 | 43 | 0.33 | 45 | 6 | 4865 | 0.1 | 5.043 | 0.0066 | 0.3271 | 0.00036 | 0.899167 | 0.11182 | 6.71E-05 | 1824.2 | 3.5 | 1826.5 | 2.3 | 1829 | 2.0 | 0.31 |
| B (Z) | 11 | 8 | 150 | 48 | 0.32 | 51 | 4 | 6736 | 0.09 | 5.03 | 0.0075 | 0.3263 | 0.00042 | 0.95136 | 0.1118 | 5.59E-05 | 1820.3 | 4.2 | 1824.3 | 2.6 | 1829 | 2.0 | 0.54 |
| D1 (Z) | 1 | 8 | 192 | 77 | 0.40 | 66 | 9 | 3124 | 0.12 | 5.046 | 0.0071 | 0.3273 | 0.00036 | 0.910557 | 0.11182 | 6.71E-05 | 1825.1 | 3.6 | 1827.0 | 2.4 | 1829 | 2.0 | 0.25 |
| **CXA-01-D40 monzodiorite (z7036)** | | | | | | | | | | | | | | | | | | | | | | | |
| A1 (Z) | 9 | 12 | 471 | 132 | 0.28 | 159 | 7 | 16714 | 0.08 | 5.074 | 0.0203 | 0.3291 | 0.00128 | 0.994324 | 0.11182 | 4.47E-05 | 1834 | 12.4 | 1831.7 | 6.7 | 1829 | 2.0 | -0.3 |
| B1 (Z) | 7 | 8 | 301 | 99 | 0.33 | 102 | 3 | 18180 | 0.1 | 5.031 | 0.0060 | 0.3265 | 0.00033 | 0.944539 | 0.11173 | 4.47E-05 | 1821.6 | 3.2 | 1824.5 | 5.2 | 1828 | 2.0 | 0.39 |
| C1 (Z) | 7 | 10 | 371 | 101 | 0.27 | 124 | 2 | 40145 | 0.08 | 5.048 | 0.0076 | 0.3275 | 0.00043 | 0.951916 | 0.11177 | 5.59E-05 | 1826.5 | 4.2 | 1827.4 | 2.5 | 1828 | 2.0 | 0.12 |
| D1 (Z) | 3 | 9 | 593 | 297 | 0.50 | 209 | 2 | 32805 | 0.15 | 5.022 | 0.0065 | 0.326 | 0.00036 | 0.951951 | 0.11173 | 4.47E-05 | 1819.1 | 3.5 | 1823.1 | 2.2 | 1828 | 2.0 | 0.54 |
| **CXA-01-N2 Missi Falls monzogranite (z7032)** | | | | | | | | | | | | | | | | | | | | | | | |
| A2 (Z) | 21 | 7 | 1517 | 406 | 0.27 | 516 | 29 | 7041 | 0.08 | 5.237 | 0.0073 | 0.332 | 0.00040 | 0.949504 | 0.1144 | 5.72E-05 | 1848 | 3.8 | 1858.6 | 2.4 | 1871 | 2.0 | 1.38 |
| B2 (Z) | 5 | 1 | 1116 | 309 | 0.28 | 378 | 18 | 1394 | 0.08 | 5.13 | 0.0077 | 0.3297 | 0.00033 | 0.794824 | 0.11287 | 0.000102 | 1836.7 | 3.3 | 1841.1 | 2.6 | 1846 | 3.0 | 0.59 |
| B3 (Z) | 4 | 1 | 1410 | 520 | 0.37 | 483 | 7 | 5421 | 0.11 | 5.074 | 0.0066 | 0.3265 | 0.00036 | 0.89666 | 0.11271 | 6.76E-05 | 1821.6 | 3.4 | 1831.8 | 2.2 | 1844 | 2.0 | 1.37 |
| B4 (Z) | 1 | 1 | 1210 | 363 | 0.30 | 422 | 3 | 4534 | 0.09 | 5.394 | 0.0065 | 0.3372 | 0.00034 | 0.913471 | 0.11601 | 5.8E-05 | 1873.3 | 3.1 | 1883.9 | 2.1 | 1896 | 2.0 | 1.36 |
| M1 (M) | 1 | 1 | 10710 | 107528 | 10.04 | 12124 | 3 | 65126 | 2.92 | 4.968 | 0.0060 | 0.3244 | 0.00029 | 0.947699 | 0.11108 | 4.44E-05 | 1811.1 | 2.9 | 1813.9 | 2.0 | 1817 | 2.0 | 0.38 |
| M2 (M) | 1 | 2 | 13066 | 165285 | 12.65 | 17726 | 9 | 56777 | 3.68 | 5.046 | 0.0061 | 0.3272 | 0.00029 | 0.94895 | 0.11186 | 4.47E-05 | 1824.7 | 3 | 1827.1 | 2.0 | 1830 | 2.0 | 0.32 |
| M3 (M) | 1 | 4 | 768 | 37647 | 49.02 | 3381 | 4 | 18476 | 14.24 | 5.138 | 0.0062 | 0.3309 | 0.00033 | 0.918166 | 0.11263 | 5.63E-05 | 1842.7 | 3.2 | 1842.5 | 2.0 | 1842 | 2.0 | -0.03 |

1 SE % on ratios
2 SE Ma on ages
* (Z) = zircon, (M) = monazite
1 = spike and fractionation corrected only
2 = spike, fractionation and blank corrected
m = model value calculated from assuming concordance between the $^{232}Th/^{208}Pb$ and $^{238}U/^{206}Pb$.
Blank composition $^{206}Pb/^{204}Pb$ = 18.2, $^{207}Pb/^{204}Pb$ = 15.37, $^{208}Pb/^{204}Pb$ = 37.8

**Table 2.** SHRIMP data.

| Fraction | U (ppm) | Th (ppm) | Th/U | Pb* (ppm) | $^{204}Pb$ (ppb) | $^{204}Pb/^{206}Pb$ | ± $^{204}Pb/^{206}Pb$ | $f(206)^{204}$ | $^{208*}Pb/^{206*}Pb$ | ± $^{208}Pb/^{206}Pb$ | $^{207*}Pb/^{235}U$ | ± $^{207}Pb/^{235}U$ | $^{206*}Pb/^{238}U$ | ± $^{206}Pb/^{238}U$ | Corr Coeff | $^{207*}Pb/^{206*}Pb$ | ± $^{207}Pb/^{206}Pb$ | Apparent Ages (Ma) $^{206}Pb/^{238}U$ | ± $^{206}Pb/^{238}U$ | $^{207}Pb/^{206}Pb$ | ± $^{207}Pb/^{206}Pb$ | Disc. (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CXA-01-N1 Turtle Island quartz diorite** | | | | | | | | | | | | | | | | | | | | | | |
| 7031-49.2 | 1030 | 21 | 0.02 | 289 | 6 | 2.51E-05 | 1.29E-05 | 0.00044 | 0.00566 | 0.00063 | 4.374 | 0.055 | 0.29238 | 0.00323 | 0.9297 | 0.10849 | 0.00050 | 1653 | 16 | 1774 | 8 | 6.8 |
| 7031-28.2 | 99 | 51 | 0.53 | 36 | 4 | 1.25E-04 | 4.83E-05 | 0.00216 | 0.14757 | 0.00614 | 5.241 | 0.144 | 0.33784 | 0.00473 | 0.6085 | 0.11252 | 0.00248 | 1876 | 23 | 1840 | 40 | -1.9 |
| 7031-51.1 | 208 | 63 | 0.32 | 70 | 11 | 1.80E-04 | 6.58E-05 | 0.00312 | 0.08277 | 0.00374 | 5.105 | 0.092 | 0.32813 | 0.00406 | 0.7684 | 0.11284 | 0.00131 | 1829 | 20 | 1846 | 21 | 0.9 |
| 7031-27.1 | 41 | 15 | 0.38 | 14 | 4 | 3.51E-04 | 1.00E-04 | 0.00608 | 0.10549 | 0.00531 | 5.002 | 0.133 | 0.32037 | 0.00571 | 0.7556 | 0.11323 | 0.00198 | 1792 | 28 | 1852 | 32 | 3.3 |
| 7031-22.1 | 103 | 43 | 0.43 | 37 | 4 | 1.18E-04 | 4.10E-05 | 0.00204 | 0.12306 | 0.00642 | 5.317 | 0.090 | 0.33726 | 0.00456 | 0.8654 | 0.11435 | 0.00097 | 1874 | 22 | 1870 | 15 | -0.2 |
| 7031-22.2 | 134 | 62 | 0.48 | 49 | 1 | 2.57E-05 | 2.36E-05 | 0.00045 | 0.14484 | 0.00265 | 5.397 | 0.126 | 0.34096 | 0.00738 | 0.9604 | 0.11480 | 0.00075 | 1891 | 36 | 1877 | 12 | -0.8 |
| 7031-28.1 | 367 | 214 | 0.60 | 137 | 4 | 3.59E-05 | 1.46E-05 | 0.00062 | 0.17446 | 0.00366 | 5.351 | 0.071 | 0.33635 | 0.00388 | 0.9196 | 0.11537 | 0.00061 | 1869 | 19 | 1886 | 9 | 0.9 |
| 7031-56.2 | 152 | 49 | 0.33 | 53 | 8 | 1.78E-04 | 5.84E-05 | 0.00309 | 0.09232 | 0.00542 | 5.371 | 0.102 | 0.33551 | 0.00442 | 0.7713 | 0.11610 | 0.00142 | 1865 | 21 | 1897 | 22 | 1.7 |
| 7031-24.1 | 140 | 86 | 0.64 | 54 | 1 | 1.36E-05 | 3.39E-05 | 0.00024 | 0.18791 | 0.00467 | 5.439 | 0.092 | 0.33945 | 0.00489 | 0.9046 | 0.11622 | 0.00084 | 1884 | 24 | 1899 | 13 | 0.8 |
| 7031-36.1 | 144 | 76 | 0.55 | 53 | 3 | 6.21E-05 | 2.79E-05 | 0.00108 | 0.15756 | 0.00252 | 5.347 | 0.087 | 0.33310 | 0.00444 | 0.8798 | 0.11642 | 0.00091 | 1853 | 21 | 1902 | 14 | 2.6 |
| 7031-21.1 | 61 | 22 | 0.36 | 22 | 1 | 7.97E-05 | 6.46E-05 | 0.00138 | 0.10818 | 0.00415 | 5.478 | 0.116 | 0.34101 | 0.00557 | 0.8382 | 0.11651 | 0.00136 | 1892 | 27 | 1903 | 21 | 0.6 |
| 7031-31.1 | 161 | 101 | 0.65 | 60 | 2 | 3.77E-05 | 3.75E-05 | 0.00065 | 0.18822 | 0.00292 | 5.348 | 0.081 | 0.33281 | 0.00414 | 0.8822 | 0.11655 | 0.00084 | 1852 | 20 | 1904 | 13 | 2.7 |
| 7031-41.1 | 91 | 73 | 0.82 | 36 | 0 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.23718 | 0.00985 | 5.383 | 0.142 | 0.33432 | 0.00592 | 0.7536 | 0.11678 | 0.00204 | 1859 | 29 | 1908 | 32 | 2.5 |
| 7031-49.1 | 90 | 41 | 0.46 | 32 | 3 | 1.12E-04 | 3.94E-05 | 0.00195 | 0.13165 | 0.00321 | 5.314 | 0.114 | 0.32884 | 0.00516 | 0.8078 | 0.11720 | 0.00149 | 1833 | 25 | 1914 | 23 | 4.2 |
| 7031-43.2 | 355 | 105 | 0.31 | 125 | 13 | 1.26E-04 | 6.59E-05 | 0.00219 | 0.09732 | 0.00340 | 5.469 | 0.112 | 0.33697 | 0.00450 | 0.7366 | 0.11772 | 0.00164 | 1872 | 22 | 1922 | 25 | 2.6 |
| 7031-53.2 | 380 | 209 | 0.57 | 134 | 5 | 5.19E-05 | 3.31E-05 | 0.00090 | 0.15733 | 0.00538 | 5.209 | 0.077 | 0.32026 | 0.00380 | 0.8677 | 0.11796 | 0.00087 | 1791 | 19 | 1926 | 13 | 7 |
| 7031-33.1 | 306 | 369 | 1.25 | 138 | 1 | 7.12E-06 | 1.17E-05 | 0.00012 | 0.35594 | 0.00416 | 5.928 | 0.079 | 0.35342 | 0.00416 | 0.9305 | 0.12166 | 0.00060 | 1951 | 20 | 1981 | 9 | 1.5 |
| 7031-53.1 | 85 | 59 | 0.72 | 36 | 3 | 1.09E-04 | 3.97E-05 | 0.00189 | 0.19816 | 0.00375 | 6.617 | 0.134 | 0.37064 | 0.00626 | 0.8912 | 0.12947 | 0.00120 | 2032 | 29 | 2091 | 16 | 2.8 |
| 7031-50.1 | 263 | 92 | 0.36 | 101 | 3 | 3.41E-05 | 2.04E-05 | 0.00059 | 0.09861 | 0.00159 | 6.522 | 0.096 | 0.36464 | 0.00483 | 0.9444 | 0.12971 | 0.00063 | 2004 | 23 | 2094 | 9 | 4.3 |
| 7031-32.1 | 214 | 132 | 0.64 | 104 | 3 | 4.08E-05 | 2.18E-05 | 0.00071 | 0.17627 | 0.00212 | 8.674 | 0.116 | 0.42846 | 0.00498 | 0.9208 | 0.14682 | 0.00077 | 2299 | 23 | 2309 | 9 | 0.5 |
| 7031-34.1 | 334 | 129 | 0.40 | 145 | 5 | 4.11E-05 | 1.94E-05 | 0.00071 | 0.10535 | 0.00396 | 8.139 | 0.109 | 0.40182 | 0.00456 | 0.9029 | 0.14690 | 0.00085 | 2177 | 21 | 2310 | 10 | 5.7 |
| 7031-50.2 | 181 | 63 | 0.36 | 85 | 3 | 4.16E-05 | 2.84E-05 | 0.00072 | 0.09937 | 0.00189 | 8.921 | 0.165 | 0.43812 | 0.00746 | 0.9594 | 0.14768 | 0.00077 | 2342 | 34 | 2319 | 9 | -1 |
| 7031-35.2 | 389 | 185 | 0.49 | 174 | 11 | 7.86E-05 | 2.35E-05 | 0.00136 | 0.14204 | 0.00293 | 8.285 | 0.109 | 0.40361 | 0.00458 | 0.9156 | 0.14888 | 0.00079 | 2186 | 21 | 2333 | 9 | 6.3 |
| 7031-35.1 | 180 | 136 | 0.78 | 91 | 2 | 2.67E-05 | 1.96E-05 | 0.00046 | 0.21885 | 0.00268 | 8.866 | 0.133 | 0.42768 | 0.00541 | 0.8987 | 0.15035 | 0.00100 | 2295 | 24 | 2350 | 11 | 2.3 |
| 7031-4.1 | 95 | 44 | 0.48 | 48 | 4 | 1.02E-04 | 4.02E-05 | 0.00177 | 0.12964 | 0.00445 | 9.578 | 0.190 | 0.45450 | 0.00692 | 0.8365 | 0.15284 | 0.00167 | 2415 | 31 | 2378 | 19 | -1.6 |
| 7031-47.1 | 53 | 34 | 0.66 | 26 | 2 | 8.28E-05 | 6.12E-05 | 0.00144 | 0.17598 | 0.00446 | 9.156 | 0.172 | 0.43149 | 0.00664 | 0.8790 | 0.15390 | 0.00139 | 2312 | 30 | 2390 | 15 | 3.2 |
| 7031-56.1 | 197 | 121 | 0.64 | 100 | 3 | 3.82E-05 | 3.02E-05 | 0.00066 | 0.18076 | 0.00242 | 9.359 | 0.138 | 0.43996 | 0.00544 | 0.8941 | 0.15429 | 0.00103 | 2350 | 24 | 2394 | 11 | 1.8 |
| 7031-20.1 | 287 | 167 | 0.60 | 146 | 9 | 8.61E-05 | 1.89E-05 | 0.00149 | 0.16743 | 0.00178 | 9.577 | 0.124 | 0.44770 | 0.00497 | 0.9110 | 0.15514 | 0.00083 | 2385 | 22 | 2403 | 9 | 0.8 |
| 7031-13.1 | 91 | 38 | 0.43 | 44 | 2 | 5.17E-05 | 3.59E-05 | 0.00090 | 0.12064 | 0.00302 | 9.360 | 0.150 | 0.43751 | 0.00615 | 0.9234 | 0.15517 | 0.00096 | 2340 | 28 | 2404 | 11 | 2.7 |
| 7031-17.1 | 222 | 120 | 0.56 | 114 | 3 | 3.36E-05 | 1.54E-05 | 0.00058 | 0.15653 | 0.00197 | 10.141 | 0.153 | 0.45481 | 0.00552 | 0.8678 | 0.16171 | 0.00122 | 2417 | 25 | 2474 | 13 | 2.3 |
| 7031-40.1 | 453 | 217 | 0.49 | 239 | 1 | 3.77E-06 | 7.85E-06 | 0.00007 | 0.14035 | 0.00130 | 10.609 | 0.139 | 0.46974 | 0.00550 | 0.9362 | 0.16380 | 0.00076 | 2482 | 24 | 2495 | 8 | 0.5 |
| 7031-43.1 | 164 | 77 | 0.48 | 85 | 3 | 4.63E-05 | 1.91E-05 | 0.00080 | 0.13593 | 0.00201 | 10.534 | 0.171 | 0.46369 | 0.00667 | 0.9306 | 0.16476 | 0.00099 | 2456 | 29 | 2505 | 10 | 2 |

Notes (*see* Stern, 1997):
Uncertainties reported at 1σ (absolute) and are calculated by numerical propagation of all known sources of error
$f206^{204}$ refers to mole fraction of total $^{206}Pb$ that is due to common Pb, calculated using the $^{204}Pb$ method; common Pb composition used is the surface blank
Discordance relative to origin = 100 * (1-($^{206}Pb/^{238}U$ age)/($^{207}Pb/^{206}Pb$ age))
* = radiogenic Pb

**Table 2.** (cont.)

| | | | | | | | | | | | | | | | | | | Apparent Ages (Ma) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction | U (ppm) | Th (ppm) | Th/U | Pb* (ppm) | $^{204}Pb$ (ppb) | $^{204}Pb/^{206}Pb$ | ± $^{204}Pb/^{206}Pb$ | $f(206)^{204}$ | $^{208*}Pb/^{206*}Pb$ | ± $^{208}Pb/^{206}Pb$ | $^{207*}Pb/^{235}U$ | ± $^{207}Pb/^{235}U$ | $^{206*}Pb/^{238}U$ | ± $^{206}Pb/^{238}U$ | Corr Coeff | $^{207*}Pb/^{206*}Pb$ | ± $^{207}Pb/^{206}Pb$ | $^{206}Pb/^{238}U$ | ± $^{206}Pb/^{238}U$ | $^{207}Pb/^{206}Pb$ | ± $^{207}Pb/^{206}Pb$ | Disc. (%) |
| 7031-60.1 | 86 | 62 | 0.75 | 47 | 1 | 2.48E-05 | 5.53E-05 | 0.00043 | 0.20792 | 0.00387 | 10.525 | 0.183 | 0.46046 | 0.00646 | 0.8695 | 0.16578 | 0.00143 | 2442 | 29 | 2516 | 15 | 2.9 |
| **CXA-01-N22A Powder Magazine formation** | | | | | | | | | | | | | | | | | | | | | | |
| 7030-111.1 | 61 | 93 | 1.57 | 27 | 0 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.47016 | 0.02192 | 4.995 | 0.121 | 0.32528 | 0.00621 | 0.8533 | 0.11137 | 0.00142 | 1815 | 30 | 1822 | 23 | 0.4 |
| 7030-159.1 | 112 | 38 | 0.35 | 39 | 2 | 5.40E-05 | 2.99E-05 | 0.00094 | 0.10284 | 0.00376 | 5.187 | 0.098 | 0.33367 | 0.00477 | 0.8282 | 0.11274 | 0.00120 | 1856 | 23 | 1844 | 19 | -0.7 |
| 7030-222.1 | 249 | 138 | 0.57 | 91 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.16702 | 0.00285 | 5.174 | 0.087 | 0.33073 | 0.00462 | 0.8855 | 0.11345 | 0.00090 | 1842 | 22 | 1855 | 14 | 0.7 |
| 7030-145.1 | 169 | 44 | 0.27 | 58 | 1 | 1.40E-05 | 3.48E-05 | 0.00024 | 0.07964 | 0.00259 | 5.262 | 0.090 | 0.33588 | 0.00445 | 0.8453 | 0.11363 | 0.00104 | 1867 | 22 | 1858 | 17 | -0.5 |
| 7030-248.1 | 122 | 52 | 0.44 | 44 | 0 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.13181 | 0.00708 | 5.326 | 0.134 | 0.33893 | 0.00745 | 0.9220 | 0.11398 | 0.00112 | 1882 | 36 | 1864 | 18 | -1 |
| 7030-264.1 | 292 | 128 | 0.45 | 108 | 0 | 3.82E-06 | 1.26E-05 | 0.00007 | 0.13306 | 0.00281 | 5.432 | 0.078 | 0.34549 | 0.00423 | 0.9070 | 0.11404 | 0.00069 | 1913 | 20 | 1865 | 11 | -2.6 |
| 7030-212.1 | 147 | 53 | 0.38 | 51 | 1 | 3.31E-05 | 1.49E-05 | 0.00057 | 0.11027 | 0.00298 | 5.234 | 0.087 | 0.33283 | 0.00431 | 0.8462 | 0.11405 | 0.00102 | 1852 | 21 | 1865 | 16 | 0.7 |
| 7030-255.1 | 213 | 68 | 0.33 | 75 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.09915 | 0.00252 | 5.291 | 0.090 | 0.33548 | 0.00428 | 0.8199 | 0.11438 | 0.00112 | 1865 | 21 | 1870 | 18 | 0.3 |
| 7030-260.1 | 254 | 95 | 0.39 | 88 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.11458 | 0.00228 | 5.185 | 0.076 | 0.32834 | 0.00399 | 0.8833 | 0.11454 | 0.00080 | 1830 | 19 | 1873 | 13 | 2.3 |
| 7030-269.1 | 163 | 67 | 0.42 | 58 | 0 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.12663 | 0.00644 | 5.287 | 0.100 | 0.33479 | 0.00531 | 0.8949 | 0.11454 | 0.00097 | 1862 | 26 | 1873 | 15 | 0.6 |
| 7030-204.1 | 254 | 99 | 0.40 | 91 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.11887 | 0.00493 | 5.329 | 0.079 | 0.33735 | 0.00406 | 0.8776 | 0.11457 | 0.00082 | 1874 | 20 | 1873 | 13 | 0 |
| 7030-132.1 | 126 | 47 | 0.39 | 45 | 0 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.11474 | 0.00364 | 5.392 | 0.092 | 0.34106 | 0.00460 | 0.8526 | 0.11467 | 0.00104 | 1892 | 22 | 1875 | 16 | -0.9 |
| 7030-268.1 | 499 | 187 | 0.39 | 175 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.11422 | 0.00167 | 5.255 | 0.069 | 0.33223 | 0.00382 | 0.9245 | 0.11473 | 0.00058 | 1849 | 19 | 1876 | 9 | 1.4 |
| 7030-206.1 | 827 | 601 | 0.75 | 322 | 2 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.21903 | 0.00207 | 5.360 | 0.067 | 0.33862 | 0.00368 | 0.9236 | 0.11479 | 0.00055 | 1880 | 18 | 1877 | 9 | -0.2 |
| 7030-123.1 | 157 | 54 | 0.35 | 56 | 0 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.10684 | 0.00267 | 5.329 | 0.105 | 0.33649 | 0.00489 | 0.8109 | 0.11486 | 0.00134 | 1870 | 24 | 1878 | 21 | 0.4 |
| 7030-244.1 | 179 | 55 | 0.32 | 63 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.09411 | 0.00278 | 5.373 | 0.085 | 0.33892 | 0.00423 | 0.8567 | 0.11498 | 0.00094 | 1881 | 20 | 1880 | 15 | -0.1 |
| 7030-250.1 | 263 | 111 | 0.44 | 94 | 1 | 8.77E-06 | 9.26E-06 | 0.00015 | 0.12429 | 0.00310 | 5.327 | 0.088 | 0.33583 | 0.00488 | 0.9234 | 0.11503 | 0.00074 | 1867 | 24 | 1880 | 12 | 0.7 |
| 7030-253.1 | 222 | 54 | 0.25 | 76 | 2 | 3.34E-05 | 2.64E-05 | 0.00058 | 0.07683 | 0.00281 | 5.288 | 0.083 | 0.33317 | 0.00413 | 0.8566 | 0.11511 | 0.00094 | 1854 | 20 | 1882 | 15 | 1.5 |
| 7030-185.1 | 125 | 50 | 0.41 | 44 | 0 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.11897 | 0.00607 | 5.255 | 0.093 | 0.33097 | 0.00422 | 0.7995 | 0.11517 | 0.00123 | 1843 | 20 | 1882 | 19 | 2.1 |
| 7030-216.1 | 238 | 69 | 0.30 | 81 | 1 | 1.36E-05 | 1.94E-05 | 0.00024 | 0.08515 | 0.00212 | 5.256 | 0.076 | 0.33103 | 0.00396 | 0.8811 | 0.11517 | 0.00080 | 1843 | 19 | 1883 | 13 | 2.1 |
| 7030-120.1 | 295 | 174 | 0.61 | 108 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.17642 | 0.00256 | 5.217 | 0.070 | 0.32823 | 0.00391 | 0.9319 | 0.11527 | 0.00057 | 1830 | 19 | 1884 | 9 | 2.9 |
| 7030-161.1 | 245 | 100 | 0.42 | 88 | 1 | 1.36E-05 | 1.55E-05 | 0.00024 | 0.11730 | 0.00232 | 5.396 | 0.075 | 0.33937 | 0.00399 | 0.9026 | 0.11533 | 0.00069 | 1884 | 19 | 1885 | 11 | 0.1 |
| 7030-236.1 | 50 | 11 | 0.24 | 16 | 0 | 1.61E-05 | 8.74E-05 | 0.00028 | 0.06887 | 0.00560 | 5.177 | 0.223 | 0.32543 | 0.01215 | 0.9179 | 0.11537 | 0.00198 | 1816 | 59 | 1886 | 31 | 3.7 |
| 7030-266.1 | 693 | 273 | 0.41 | 252 | 1 | 3.82E-06 | 4.70E-06 | 0.00007 | 0.11979 | 0.00141 | 5.443 | 0.065 | 0.34175 | 0.00370 | 0.9430 | 0.11551 | 0.00047 | 1895 | 18 | 1888 | 7 | -0.4 |
| 7030-152.1 | 143 | 42 | 0.31 | 49 | 2 | 5.61E-05 | 4.81E-05 | 0.00097 | 0.08849 | 0.00565 | 5.266 | 0.100 | 0.33051 | 0.00497 | 0.8543 | 0.11556 | 0.00116 | 1841 | 24 | 1889 | 18 | 2.5 |
| 7030-168.1 | 785 | 364 | 0.48 | 292 | 1 | 2.87E-06 | 7.46E-06 | 0.00005 | 0.14236 | 0.00165 | 5.482 | 0.065 | 0.34394 | 0.00367 | 0.9453 | 0.11560 | 0.00045 | 1906 | 18 | 1889 | 7 | -0.9 |
| 7030-130.1 | 2593 | 3215 | 1.28 | 1139 | 0 | 3.60E-07 | 1.66E-06 | 0.00001 | 0.37043 | 0.00635 | 5.479 | 0.087 | 0.34319 | 0.00443 | 0.8755 | 0.11579 | 0.00089 | 1902 | 21 | 1892 | 14 | -0.5 |
| 7030-233.1 | 358 | 114 | 0.33 | 122 | 1 | 1.01E-05 | 1.02E-05 | 0.00018 | 0.10455 | 0.00339 | 5.184 | 0.072 | 0.32458 | 0.00370 | 0.8822 | 0.11583 | 0.00076 | 1812 | 18 | 1893 | 12 | 4.3 |
| 7030-207.1 | 280 | 109 | 0.40 | 98 | 2 | 2.17E-05 | 1.14E-05 | 0.00038 | 0.11883 | 0.00222 | 5.277 | 0.104 | 0.32948 | 0.00596 | 0.9572 | 0.11616 | 0.00067 | 1836 | 29 | 1898 | 10 | 3.3 |
| 7030-263.1 | 105 | 28 | 0.28 | 36 | 1 | 2.39E-05 | 3.74E-05 | 0.00041 | 0.08304 | 0.00359 | 5.393 | 0.156 | 0.33576 | 0.00857 | 0.9277 | 0.11650 | 0.00127 | 1866 | 42 | 1903 | 20 | 1.9 |

Notes (*see* Stern, 1997):
Uncertainties reported at 1σ (absolute) and are calculated by numerical propagation of all known sources of error
$f206^{204}$ refers to mole fraction of total $^{206}Pb$ that is due to common Pb, calculated using the $^{204}Pb$ method; common Pb composition used is the surface blank
Discordance relative to origin = 100 * (1-($^{206}Pb/^{238}U$ age)/($^{207}Pb/^{206}Pb$ age))
* = radiogenic Pb

**Table 2.** (cont.)

| | | | | | | | | | | | | | | | | | | Apparent Ages (Ma) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction | U (ppm) | Th (ppm) | Th/U | Pb* (ppm) | $^{204}Pb$ (ppb) | $^{204}Pb/^{206}Pb$ | ± $^{204}Pb/^{206}Pb$ | $f(206)^{204}$ | $^{208*}Pb/^{206*}Pb$ | ± $^{208}Pb/^{206}Pb$ | $^{207*}Pb/^{235}U$ | ± $^{207}Pb/^{235}U$ | $^{206*}Pb/^{238}U$ | ± $^{206}Pb/^{238}U$ | Corr Coeff | $^{207*}Pb/^{206*}Pb$ | ± $^{207}Pb/^{206}Pb$ | $^{206}Pb/^{238}U$ | ± $^{206}Pb/^{238}U$ | $^{207}Pb/^{206}Pb$ | ± $^{207}Pb/^{206}Pb$ | Disc. (%) |
| 7030-202.1 | 242 | 80 | 0.34 | 85 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.09323 | 0.00277 | 5.426 | 0.129 | 0.33696 | 0.00688 | 0.9125 | 0.11678 | 0.00114 | 1872 | 33 | 1908 | 18 | 1.9 |
| 7030-226.1 | 107 | 28 | 0.27 | 36 | 0 | 4.02E-06 | 4.99E-05 | 0.00007 | 0.08203 | 0.00427 | 5.344 | 0.105 | 0.33049 | 0.00476 | 0.8089 | 0.11727 | 0.00136 | 1841 | 23 | 1915 | 21 | 3.9 |
| 7030-245.1 | 222 | 111 | 0.52 | 81 | 0 | 5.62E-06 | 1.05E-05 | 0.00010 | 0.14990 | 0.00586 | 5.429 | 0.084 | 0.33578 | 0.00425 | 0.8800 | 0.11728 | 0.00087 | 1866 | 21 | 1915 | 13 | 2.5 |
| 7030-271.1 | 310 | 120 | 0.40 | 108 | 0 | 1.28E-06 | 8.18E-06 | 0.00002 | 0.11371 | 0.00209 | 5.337 | 0.078 | 0.32983 | 0.00391 | 0.8683 | 0.11736 | 0.00086 | 1838 | 19 | 1916 | 13 | 4.1 |
| 7030-234.1 | 278 | 96 | 0.36 | 97 | 3 | 3.27E-05 | 1.52E-05 | 0.00057 | 0.10470 | 0.00233 | 5.355 | 0.084 | 0.33036 | 0.00415 | 0.8631 | 0.11756 | 0.00094 | 1840 | 20 | 1919 | 14 | 4.1 |
| 7030-241.1 | 183 | 57 | 0.32 | 63 | 0 | 7.55E-06 | 2.30E-05 | 0.00013 | 0.09465 | 0.00319 | 5.340 | 0.089 | 0.32849 | 0.00442 | 0.8663 | 0.11790 | 0.00099 | 1831 | 21 | 1925 | 15 | 4.9 |
| **CXA-01-N3 Partridge Breast conglomerate** | | | | | | | | | | | | | | | | | | | | | | |
| 7029-232.1 | 528 | 437 | 0.85 | 211 | 3 | 1.69E-05 | 8.84E-06 | 0.00029 | 0.25061 | 0.00247 | 5.301 | 0.073 | 0.33936 | 0.00384 | 0.8762 | 0.11328 | 0.00076 | 1884 | 18 | 1853 | 12 | -1.7 |
| 7029-281.1 | 247 | 180 | 0.75 | 96 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.22064 | 0.00682 | 5.277 | 0.089 | 0.33699 | 0.00437 | 0.8407 | 0.11356 | 0.00104 | 1872 | 21 | 1857 | 17 | -0.8 |
| 7029-276.1 | 320 | 169 | 0.54 | 119 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.15906 | 0.00237 | 5.322 | 0.081 | 0.33959 | 0.00399 | 0.8437 | 0.11366 | 0.00093 | 1885 | 19 | 1859 | 15 | -1.4 |
| 7029-270.1 | 236 | 189 | 0.83 | 92 | 2 | 2.68E-05 | 2.36E-05 | 0.00046 | 0.24729 | 0.00453 | 5.229 | 0.100 | 0.33233 | 0.00472 | 0.8141 | 0.11412 | 0.00128 | 1850 | 23 | 1866 | 20 | 0.9 |
| 7029-136.1 | 553 | 297 | 0.56 | 205 | 2 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.16223 | 0.00187 | 5.311 | 0.071 | 0.33725 | 0.00391 | 0.9185 | 0.11421 | 0.00061 | 1873 | 19 | 1867 | 10 | -0.3 |
| 7029-143.1 | 597 | 347 | 0.60 | 225 | 2 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.17408 | 0.00198 | 5.355 | 0.087 | 0.33934 | 0.00373 | 0.7576 | 0.11444 | 0.00123 | 1884 | 18 | 1871 | 19 | -0.7 |
| 7029-151.1 | 522 | 374 | 0.74 | 206 | 0 | 8.10E-07 | 7.02E-06 | 0.00001 | 0.22366 | 0.00240 | 5.408 | 0.105 | 0.34241 | 0.00396 | 0.6879 | 0.11456 | 0.00163 | 1898 | 19 | 1873 | 26 | -1.4 |
| 7029-249.1 | 860 | 508 | 0.61 | 323 | 2 | 8.76E-06 | 4.39E-06 | 0.00015 | 0.17825 | 0.00165 | 5.328 | 0.066 | 0.33729 | 0.00370 | 0.9292 | 0.11457 | 0.00053 | 1874 | 18 | 1873 | 8 | 0 |
| 7029-292.1 | 319 | 168 | 0.54 | 117 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.16359 | 0.00283 | 5.280 | 0.105 | 0.33420 | 0.00494 | 0.8150 | 0.11458 | 0.00133 | 1859 | 24 | 1873 | 21 | 0.8 |
| 7029-106.1 | 226 | 106 | 0.48 | 83 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.14526 | 0.00267 | 5.343 | 0.084 | 0.33805 | 0.00451 | 0.9010 | 0.11463 | 0.00079 | 1877 | 22 | 1874 | 12 | -0.2 |
| 7029-205.1 | 793 | 434 | 0.57 | 287 | 2 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.16438 | 0.00169 | 5.197 | 0.066 | 0.32859 | 0.00363 | 0.9166 | 0.11470 | 0.00059 | 1832 | 18 | 1875 | 9 | 2.3 |
| 7029-266.1 | 379 | 236 | 0.64 | 142 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.18722 | 0.00277 | 5.293 | 0.076 | 0.33458 | 0.00394 | 0.8812 | 0.11474 | 0.00078 | 1861 | 19 | 1876 | 12 | 0.8 |
| 7029-101.1 | 270 | 186 | 0.71 | 103 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.20773 | 0.00312 | 5.326 | 0.077 | 0.33650 | 0.00415 | 0.9093 | 0.11479 | 0.00069 | 1870 | 20 | 1877 | 11 | 0.4 |
| 7029-218.1 | 353 | 209 | 0.61 | 130 | 0 | 3.43E-06 | 1.12E-05 | 0.00006 | 0.17740 | 0.00245 | 5.252 | 0.077 | 0.33136 | 0.00383 | 0.8550 | 0.11496 | 0.00088 | 1845 | 19 | 1879 | 14 | 1.8 |
| 7029-268.1 | 998 | 725 | 0.75 | 381 | 9 | 3.22E-05 | 8.62E-06 | 0.00056 | 0.22778 | 0.00370 | 5.242 | 0.107 | 0.33047 | 0.00356 | 0.6254 | 0.11505 | 0.00185 | 1841 | 17 | 1881 | 29 | 2.1 |
| 7029-115.1 | 920 | 548 | 0.62 | 342 | 3 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.18214 | 0.00170 | 5.281 | 0.079 | 0.33290 | 0.00412 | 0.8845 | 0.11506 | 0.00081 | 1852 | 20 | 1881 | 13 | 1.5 |
| 7029-286.1 | 244 | 82 | 0.35 | 84 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.10605 | 0.00321 | 5.225 | 0.074 | 0.32922 | 0.00388 | 0.8900 | 0.11511 | 0.00075 | 1835 | 19 | 1882 | 12 | 2.5 |
| 7029-296.1 | 495 | 331 | 0.69 | 189 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.20509 | 0.00259 | 5.342 | 0.076 | 0.33623 | 0.00392 | 0.8770 | 0.11522 | 0.00080 | 1869 | 19 | 1883 | 13 | 0.8 |
| 7029-236.1 | 368 | 197 | 0.55 | 134 | 1 | 8.02E-06 | 1.20E-05 | 0.00014 | 0.15963 | 0.00260 | 5.274 | 0.067 | 0.33191 | 0.00365 | 0.9182 | 0.11524 | 0.00058 | 1848 | 18 | 1884 | 9 | 1.9 |
| 7029-148.1 | 440 | 177 | 0.42 | 161 | 3 | 2.13E-05 | 8.18E-06 | 0.00037 | 0.12451 | 0.00203 | 5.456 | 0.072 | 0.34323 | 0.00401 | 0.9294 | 0.11528 | 0.00057 | 1902 | 19 | 1884 | 9 | -1 |
| 7029-216.1 | 287 | 217 | 0.78 | 109 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.23131 | 0.00312 | 5.209 | 0.070 | 0.32767 | 0.00376 | 0.9065 | 0.11529 | 0.00066 | 1827 | 18 | 1884 | 10 | 3 |
| 7029-291.1 | 286 | 188 | 0.68 | 110 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.20002 | 0.00284 | 5.394 | 0.081 | 0.33913 | 0.00408 | 0.8630 | 0.11535 | 0.00088 | 1882 | 20 | 1885 | 14 | 0.2 |
| 7029-298.1 | 243 | 60 | 0.26 | 83 | 0 | 6.19E-06 | 1.75E-05 | 0.00011 | 0.07329 | 0.00191 | 5.344 | 0.077 | 0.33559 | 0.00402 | 0.8941 | 0.11549 | 0.00075 | 1865 | 19 | 1888 | 12 | 1.2 |
| 7029-302.1 | 138 | 74 | 0.55 | 50 | 0 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.16680 | 0.00459 | 5.235 | 0.099 | 0.32845 | 0.00490 | 0.8564 | 0.11560 | 0.00113 | 1831 | 24 | 1889 | 18 | 3.1 |
| 7029-227.1 | 1864 | 1975 | 1.09 | 763 | 2 | 4.07E-06 | 4.55E-06 | 0.00007 | 0.30987 | 0.00193 | 5.313 | 0.067 | 0.33329 | 0.00370 | 0.9300 | 0.11562 | 0.00054 | 1854 | 18 | 1890 | 8 | 1.9 |

Notes (*see* Stern, 1997):
Uncertainties reported at 1σ (absolute) and are calculated by numerical propagation of all known sources of error
$f206^{204}$ refers to mole fraction of total $^{206}Pb$ that is due to common Pb, calculated using the $^{204}Pb$ method; common Pb composition used is the surface blank
Discordance relative to origin = 100 * (1-($^{206}Pb/^{238}U$ age)/($^{207}Pb/^{206}Pb$ age))
* = radiogenic Pb

**Table 2.** (cont.)

| Fraction | U (ppm) | Th (ppm) | Th/U | Pb* (ppm) | $^{204}Pb$ (ppb) | $^{204}Pb/^{206}Pb$ | ± $^{204}Pb/^{206}Pb$ | $f(206)^{204}$ | $^{208*}Pb/^{206*}Pb$ | ± $^{208}Pb/^{206}Pb$ | $^{207*}Pb/^{235}U$ | ± $^{207}Pb/^{235}U$ | $^{206*}Pb/^{238}U$ | ± $^{206}Pb/^{238}U$ | Corr Coeff | $^{207*}Pb/^{206*}Pb$ | ± $^{207}Pb/^{206}Pb$ | Apparent Ages (Ma) $^{206}Pb/^{238}U$ | ± $^{206}Pb/^{238}U$ | $^{207}Pb/^{206}Pb$ | ± $^{207}Pb/^{206}Pb$ | Disc. (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7029-245.1 | 452 | 259 | 0.59 | 167 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.17078 | 0.00211 | 5.317 | 0.072 | 0.33335 | 0.00377 | 0.8913 | 0.11568 | 0.00072 | 1855 | 18 | 1890 | 11 | 1.9 |
| 7029-148.2 | 128 | 40 | 0.32 | 46 | 0 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.09696 | 0.00292 | 5.496 | 0.096 | 0.34427 | 0.00462 | 0.8401 | 0.11579 | 0.00110 | 1907 | 22 | 1892 | 17 | -0.8 |
| 7029-300.1 | 795 | 438 | 0.57 | 296 | 2 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.16808 | 0.00267 | 5.374 | 0.067 | 0.33641 | 0.00361 | 0.9094 | 0.11586 | 0.00061 | 1869 | 17 | 1893 | 9 | 1.3 |
| 7029-207.1 | 1893 | 1125 | 0.61 | 727 | 6 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.17823 | 0.00111 | 5.513 | 0.069 | 0.34496 | 0.00395 | 0.9549 | 0.11590 | 0.00043 | 1911 | 19 | 1894 | 7 | -0.9 |
| 7029-285.1 | 301 | 158 | 0.54 | 113 | 1 | 1.13E-05 | 1.16E-05 | 0.00020 | 0.15521 | 0.00406 | 5.487 | 0.083 | 0.34287 | 0.00416 | 0.8652 | 0.11606 | 0.00089 | 1900 | 20 | 1896 | 14 | -0.2 |
| 7029-303.1 | 297 | 206 | 0.72 | 114 | 2 | 1.82E-05 | 2.23E-05 | 0.00032 | 0.21177 | 0.00341 | 5.380 | 0.088 | 0.33616 | 0.00447 | 0.8751 | 0.11608 | 0.00092 | 1868 | 22 | 1897 | 14 | 1.5 |
| 7029-121.1 | 469 | 176 | 0.39 | 166 | 44 | 3.28E-04 | 2.93E-05 | 0.00569 | 0.12227 | 0.00252 | 5.327 | 0.075 | 0.33266 | 0.00380 | 0.8705 | 0.11614 | 0.00081 | 1851 | 18 | 1898 | 13 | 2.4 |
| 7029-248.1 | 1154 | 506 | 0.45 | 425 | 3 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.13161 | 0.00138 | 5.493 | 0.069 | 0.34290 | 0.00373 | 0.9193 | 0.11618 | 0.00058 | 1901 | 18 | 1898 | 9 | -0.1 |
| 7029-280.1 | 341 | 196 | 0.59 | 125 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.17383 | 0.00246 | 5.310 | 0.083 | 0.33120 | 0.00427 | 0.8830 | 0.11628 | 0.00086 | 1844 | 21 | 1900 | 13 | 2.9 |
| 7029-279.1 | 752 | 456 | 0.63 | 281 | 0 | 5.00E-08 | 1.32E-05 | 0.00000 | 0.18542 | 0.00178 | 5.357 | 0.069 | 0.33389 | 0.00360 | 0.8924 | 0.11637 | 0.00068 | 1857 | 17 | 1901 | 11 | 2.3 |
| 7029-163.1 | 232 | 132 | 0.59 | 90 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.17465 | 0.00791 | 5.632 | 0.111 | 0.35046 | 0.00514 | 0.8164 | 0.11656 | 0.00134 | 1937 | 25 | 1904 | 21 | -1.7 |
| 7029-116.1 | 101 | 28 | 0.29 | 35 | 0 | 7.88E-06 | 4.60E-05 | 0.00014 | 0.08982 | 0.00908 | 5.400 | 0.107 | 0.33555 | 0.00484 | 0.8008 | 0.11672 | 0.00140 | 1865 | 23 | 1907 | 22 | 2.2 |
| 7029-289.1 | 148 | 76 | 0.53 | 56 | 4 | 9.66E-05 | 4.33E-05 | 0.00167 | 0.16749 | 0.01107 | 5.470 | 0.103 | 0.33970 | 0.00486 | 0.8276 | 0.11678 | 0.00125 | 1885 | 23 | 1907 | 19 | 1.2 |
| 7029-242.1 | 1298 | 27 | 0.02 | 427 | 4 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.00601 | 0.00045 | 5.493 | 0.067 | 0.34114 | 0.00370 | 0.9350 | 0.11678 | 0.00051 | 1892 | 18 | 1908 | 8 | 0.8 |
| 7029-238.1 | 142 | 59 | 0.43 | 52 | 1 | 2.49E-05 | 3.63E-05 | 0.00043 | 0.12715 | 0.00389 | 5.562 | 0.110 | 0.34245 | 0.00481 | 0.7882 | 0.11779 | 0.00144 | 1898 | 23 | 1923 | 22 | 1.3 |
| 7029-224.1 | 119 | 70 | 0.61 | 43 | 0 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.18733 | 0.00520 | 5.296 | 0.115 | 0.32452 | 0.00460 | 0.7359 | 0.11836 | 0.00176 | 1812 | 22 | 1932 | 27 | 6.2 |
| 7029-231.1 | 153 | 56 | 0.38 | 69 | 7 | 1.30E-04 | 4.25E-05 | 0.00225 | 0.10874 | 0.00303 | 8.196 | 0.163 | 0.41531 | 0.00546 | 0.7444 | 0.14313 | 0.00192 | 2239 | 25 | 2265 | 23 | 1.2 |
| 7029-217.1 | 116 | 281 | 2.50 | 78 | 0 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.70641 | 0.00779 | 8.383 | 0.135 | 0.41830 | 0.00535 | 0.8595 | 0.14535 | 0.00120 | 2253 | 24 | 2292 | 14 | 1.7 |
| 7029-120.1 | 367 | 195 | 0.55 | 172 | 1 | 5.08E-06 | 7.77E-06 | 0.00009 | 0.15683 | 0.00348 | 8.437 | 0.114 | 0.41885 | 0.00486 | 0.9083 | 0.14610 | 0.00084 | 2255 | 22 | 2301 | 10 | 2 |
| 7029-110.1 | 180 | 127 | 0.73 | 88 | 2 | 3.42E-05 | 2.04E-05 | 0.00059 | 0.20946 | 0.00435 | 8.505 | 0.140 | 0.42005 | 0.00548 | 0.8577 | 0.14684 | 0.00125 | 2261 | 25 | 2309 | 15 | 2.1 |
| 7029-225.1 | 286 | 162 | 0.59 | 142 | 0 | 1.08E-06 | 1.07E-05 | 0.00002 | 0.16411 | 0.00321 | 8.925 | 0.166 | 0.44052 | 0.00731 | 0.9345 | 0.14693 | 0.00098 | 2353 | 33 | 2311 | 12 | -1.8 |
| 7029-283.1 | 966 | 152 | 0.16 | 415 | 3 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.05050 | 0.00087 | 8.473 | 0.105 | 0.41710 | 0.00466 | 0.9433 | 0.14734 | 0.00061 | 2247 | 21 | 2315 | 7 | 2.9 |
| 7029-222.1 | 116 | 74 | 0.66 | 57 | 0 | 3.51E-06 | 2.31E-05 | 0.00006 | 0.18577 | 0.00465 | 8.652 | 0.143 | 0.42538 | 0.00538 | 0.8346 | 0.14752 | 0.00135 | 2285 | 24 | 2317 | 16 | 1.4 |
| 7029-104.1 | 571 | 71 | 0.13 | 256 | 2 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.03711 | 0.00189 | 9.006 | 0.116 | 0.43896 | 0.00487 | 0.9133 | 0.14880 | 0.00079 | 2346 | 22 | 2332 | 9 | -0.6 |
| 7029-161.1 | 1076 | 114 | 0.11 | 476 | 4 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.03400 | 0.00072 | 8.957 | 0.158 | 0.43487 | 0.00507 | 0.7438 | 0.14938 | 0.00178 | 2328 | 23 | 2339 | 21 | 0.5 |
| 7029-147.1 | 115 | 43 | 0.39 | 54 | 0 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.10839 | 0.00320 | 9.029 | 0.154 | 0.43827 | 0.00653 | 0.9220 | 0.14942 | 0.00100 | 2343 | 29 | 2339 | 11 | -0.2 |
| 7029-140.1 | 341 | 109 | 0.33 | 156 | 1 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.09847 | 0.00242 | 8.837 | 0.155 | 0.42590 | 0.00519 | 0.7737 | 0.15048 | 0.00169 | 2287 | 23 | 2351 | 19 | 2.7 |
| 7029-246.1 | 362 | 192 | 0.55 | 179 | 2 | 1.80E-05 | 1.40E-05 | 0.00031 | 0.15541 | 0.00200 | 9.361 | 0.133 | 0.43983 | 0.00533 | 0.9082 | 0.15436 | 0.00092 | 2350 | 24 | 2395 | 10 | 1.9 |
| 7029-118.1 | 166 | 118 | 0.74 | 87 | 0 | 6.00E-08 | 3.17E-05 | 0.00000 | 0.21106 | 0.00388 | 9.546 | 0.177 | 0.44774 | 0.00630 | 0.8294 | 0.15464 | 0.00161 | 2385 | 28 | 2398 | 18 | 0.5 |
| 7029-128.1 | 80 | 52 | 0.66 | 44 | 0 | 8.79E-06 | 3.02E-05 | 0.00015 | 0.19269 | 0.00888 | 10.103 | 0.227 | 0.46862 | 0.00904 | 0.9105 | 0.15637 | 0.00146 | 2478 | 40 | 2417 | 16 | -2.5 |
| 7029-243.1 | 374 | 169 | 0.47 | 189 | 1 | 4.24E-06 | 1.15E-05 | 0.00007 | 0.13293 | 0.00189 | 9.853 | 0.133 | 0.45526 | 0.00528 | 0.9116 | 0.15696 | 0.00088 | 2419 | 23 | 2423 | 10 | 0.2 |
| 7029-126.1 | 75 | 49 | 0.67 | 42 | 2 | 5.91E-05 | 5.39E-05 | 0.00102 | 0.18695 | 0.00639 | 10.779 | 0.261 | 0.47758 | 0.00895 | 0.8413 | 0.16370 | 0.00216 | 2517 | 39 | 2494 | 22 | -0.9 |
| 7029-112.1 | 79 | 37 | 0.48 | 41 | 0 | 1.00E-05 | 1.00E-05 | 0.00017 | 0.14464 | 0.00410 | 10.373 | 0.227 | 0.45868 | 0.00802 | 0.8615 | 0.16401 | 0.00184 | 2434 | 36 | 2497 | 19 | 2.6 |
| 7029-228.1 | 711 | 45 | 0.07 | 342 | 34 | 1.17E-04 | 1.93E-05 | 0.00202 | 0.01860 | 0.00088 | 10.955 | 0.141 | 0.47136 | 0.00539 | 0.9342 | 0.16856 | 0.00078 | 2490 | 24 | 2543 | 8 | 2.1 |

Notes (*see* Stern, 1997):
Uncertainties reported at 1σ (absolute) and are calculated by numerical propagation of all known sources of error
$f206^{204}$ refers to mole fraction of total $^{206}Pb$ that is due to common Pb, calculated using the $^{204}Pb$ method; common Pb composition used is the surface blank
Discordance relative to origin = 100 * (1-($^{206}Pb/^{238}U$ age)/($^{207}Pb/^{206}Pb$ age))
* = radiogenic Pb

**CXA-01-D40 (z7036)**

A gabbroic to monzodioritic intrusion from the Pukatawakan Bay area, interpreted in the field to be related to a ca. 1855 Ma Chipewyan suite, was sampled for U-Pb geochronology (Fig. 2b, UTM 518996, 6319235). The intrusion locally contains up to 1% disseminated chalcopyrite and pyrite. Zircon recovery was adequate and grains were selected from the diamagnetic separate. Zircons were subdivided by morphology into four groups, the first composed of anhedral to subequant fragments, the second, of elongate and splintery fragments, the third, of well terminated prisms, and the fourth, of platy fragments. All were clear and colourless with few inclusions or fractures. Four fractions yielded concordant or slightly discordant ages with an upper intercept of 1829 +5/-2 Ma (Fig. 3c), an age identical to that of the nearby K-feldspar megacrystic granite.

**CXA-01-N2 (z7032)**

This sample from the Missi Falls gneiss association (Corrigan et al., 2002) is a homogeneous, one-mica tonalite to monzogranite, with minor garnet. Collected along the Churchill River (Fig. 2b, UTM 558099, 6359186), it was inferred from field relationships to be a homogeneous equivalent of the oldest plutons in the area, which are characterized by strong foliation and migmatic fabrics. Few zircons were recovered from the diamagnetic and least magnetic fractions. Zircons were selected from the magnetic at 1° side slope, maximum Amp fraction as well as from the magnetic at 3° side slope, maximum Amp fraction. The grains selected for analysis were generally elongate prisms, well faceted, and with sharp terminations, and contained few inclusions or fractures. Some cores were observed; however, care was taken to ensure that these were not submitted for TIMS analysis. Monazite was recovered from the magnetic at 0.5 Amp/10° side slope

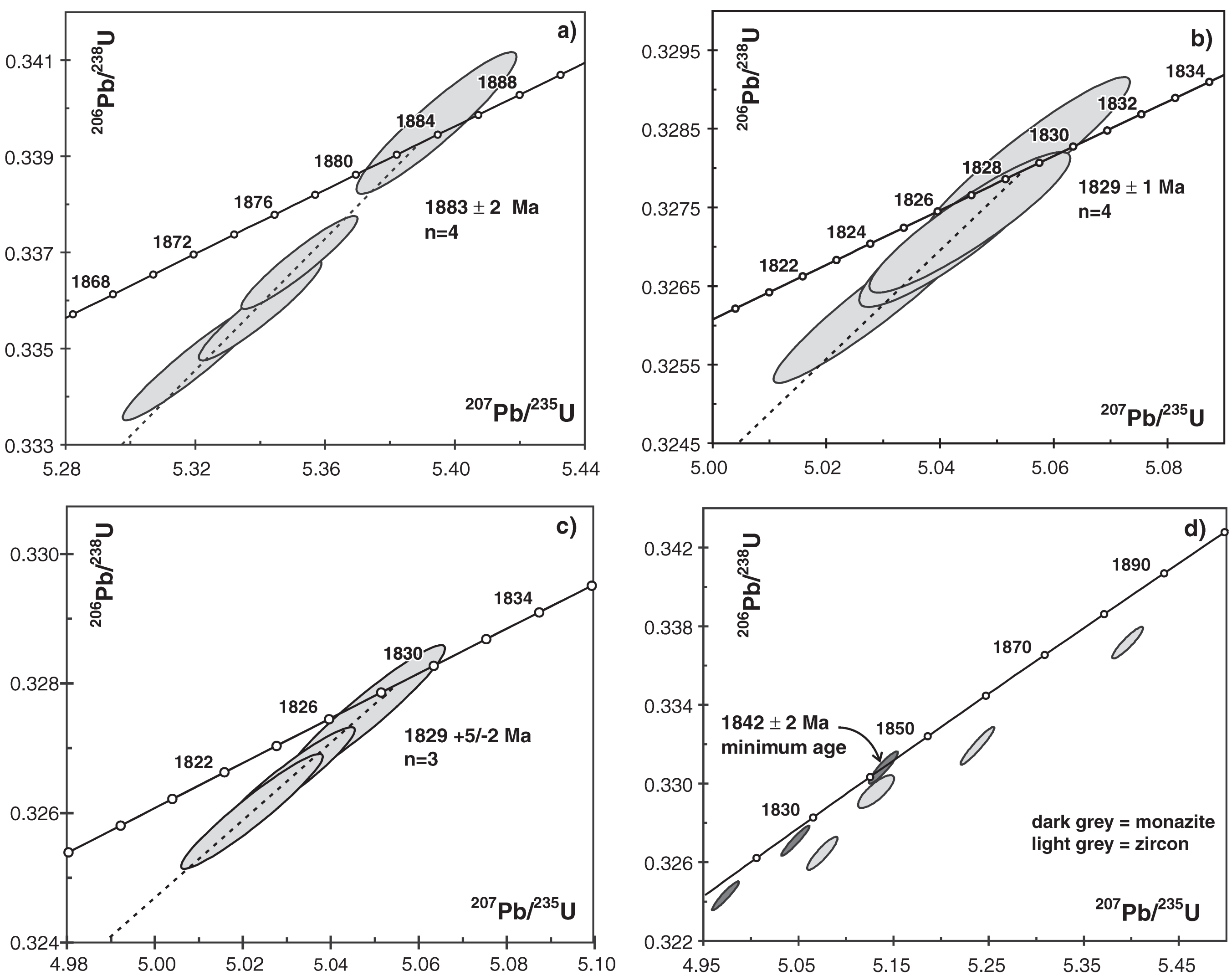


*__Figure 3.__ Uranium-lead concordia diagrams of TIMS data. All ellipses are plotted at 2☞ uncertainty. __a)__ Ruttan rhyolite CXA-01-N21. __b)__ Puckatawakan Bay megacrystic monzogranite CXA-01-D51. __c)__ Puckatawakan Bay monzodiorite CXA-01-D40. __d)__ Churchill River monzogranite CXA-01-N2.*

fraction, and three single grain fractions were submitted. Four zircon fractions plotted below concordia, with the least discordant fraction giving a $^{207}Pb/^{206}Pb$ age of 1846 ± 3 Ma (Fig. 3d). Discordant fractions A2 (multigrain fraction) and B4 (single-grain fraction) have older $^{207}Pb/^{206}Pb$ ages and are interpreted to contain inherited cores (*see* Table 1). Concordant or nearly concordant monazite ages range from 1817 Ma to 1842 Ma. The oldest monazite age can be considered a minimum crystallization age. Although the age is poorly constrained, this unit is likely related to Chipewyan Batholith emplacement with an inherited component and is likely not, as interpreted in the field, a homogeneous equivalent of older, pre-Chipewyan intrusions.

## *SHRIMP*

### CXA-01-N1 (z7031)

A layered igneous intrusion composed of ultramafic to tonalitic magmas is exposed on the north shore of Turtle Island in Southern Indian Lake. A sample of foliated quartz diorite from this intrusion was collected for U-Pb geochronology (Fig. 2b, UTM 547812, 6351095). Most zircons recovered from the diamagnetic separate were prismatic, pale brown, and contained few inclusions but numerous fractures. Many grains appear to have overgrowths, but because of their fractured appearance, these overgrowths can be difficult to observe. A second, less common, morphology consisted of pale brown fragmental zircons, with few facets, minor clear inclusions, and few fractures. Four fractions were analyzed by TIMS and the results indicate the presence of an inherited component (*see* Fig. 4). The scatter of the TIMS data made it difficult to determine precisely the igneous age or the age of the inherited material. A SHRIMP study was undertaken to resolve these questions. Detailed scanning electron microscope (SEM) images of the zircons indicated that many grains were composed of a single generation of zircon, usually with well developed oscillatory or sector zoning (Fig. 4, inset). A significant minority of grains also contained a thin, unzoned, high-U rim, with the zoned material as a core (Fig. 4a). Spot analyses of zoned regions (either cores or single-generation zircon) fall in three clusters: near 2500 Ma, between 2300 and 2400 Ma, and near 1900 Ma. Although they are not easily distinguishable on the basis of their morphology and zonation, we interpret the 2.3 to 2.4 Ga and 2.5 Ga zircons to be inherited, whereas the ca. 1.9 Ga zircons represent the igneous component. Figure 4(b, c, d) shows the similarity in appearance of both the 2.4 and 1.9 Ga zircons. Three analyses from zoned zircons gave intermediate $^{207}Pb/^{206}Pb$ ages of 1981 Ma, 2091 Ma, and 2094 Ma. These ages cannot be interpreted as resulting from mixing, as the SHRIMP spot was carefully placed on only one phase of zircon. Rather, this result may represent 2.3 or 2.5 Ga inherited zircon that was disturbed during the igneous event at ca. 1.9 Ga. Alternatively, it could represent other inherited components of distinct age. Analyses of the thin rims gave $^{207}Pb/^{206}Pb$ ages ranging from 1926 Ma to 1774 Ma, overlapping the range of ages obtained for the youngest zoned zircons (1914–1840 Ma). Two analyses (Table 2; spots 34.1 and 35.2) that provided much older ages represent mixing of the inherited and igneous components. The best estimate of the igneous age of the Turtle Island quartz diorite is 1889 ± 11 Ma (mean standard weighted deviation = 1.3, probability of fit = 23%), calculated from the weighted mean $^{207}Pb/^{206}Pb$ ages from 14 analyses of young zoned zircons and rims. Excluded from this calculation were two discordant analyses (1774 Ma and 1926 Ma). Corrigan et al. (1999b) identified an 1894 to 1886 Ma calc-alkaline plutonic suite named the 'Crowe Island Complex' in the Reindeer Lake area of Saskatchewan and interpreted it to be the plutonic root of the La Ronge island arc. These new data indicate that the Crowe Island Complex extends into Manitoba. Of economic interest, the Rottenstone Ni-PGE deposit is along strike with the Turtle Island diorite and could potentially be part of this suite; however, its age is unknown.

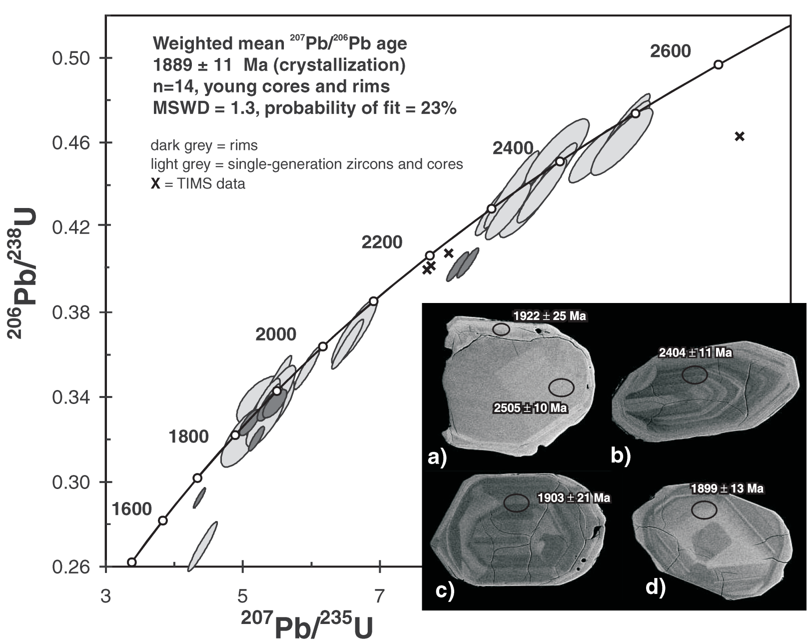


***Figure 4.***

*Uranium-lead concordia diagram of combined TIMS and SHRIMP results from the Turtle Island quartz diorite. Ellipses are plotted at 2☞ uncertainty. The inset contains images of representative zircons. Note the thin rim on grain 4a). Black ellipses on the backscattered-electron images represent approximate positions of the SHRIMP analyses. The ages provided by individual SHRIMP analyses are also shown (1☞ uncertainty). MSWD = mean square of weighted deviates*

Inherited early Paleoproterozoic ages obtained here are similar to ages of the Sask Craton, and their prevalence in this sample may suggest the presence nearby of basement.

### CXA-01-N22A (z7030)

This sample is a wacke of the Powder Magazine formation, collected at the Ruttan mine site (Fig. 2a, UTM 461844, 6259503). This formation represents turbidite units in the Rusty Lake Belt that overlie the mineralized volcanic sequence. The metamorphic grade of this sample is low; original sedimentary structures including crossbedding, graded bedding, and load structures are preserved. Zircons recovered from the nonmagnetic at 10° side slope separate are generally prismatic, clear, and colourless, with numerous fractures. Facets and terminations are generally very sharp, although some grains are moderately well rounded. Scanning electron microscope images indicate that most grains contain diffuse, oscillatory zoning. Thirty-six detrital zircons, with varying degrees of roundness and zoning, were analyzed and gave ages ranging from 1822 to 1925 Ma. Plotted on a cumulative probability curve, the data form a roughly Gaussian peak, centred at approximately 1880 Ma, with a small bulge toward slightly older ages (Fig. 5a). Most ages are within error of the typical age range of arc volcanism in the Trans-Hudson Orogen (i.e 1.87–1.9 Ga). Younger ages were obtained in a small number of cases (*see* Table 2, analyses 7030-11.1, 7030-159.1) and may be the result of minor amounts of lead loss. No older material was identified, although inherited zircons have been identified in material from the volcanic mine sequence (Ames et al., 2002). Thirty-one analyses gave ages ranging from 1822 to 1907 Ma and were pooled to yield a weighted mean $^{207}Pb/^{206}Pb$ age of 1880 ± 4 Ma, with a mean standard weighted deviation of 1.07 and a probability of fit of 37%. An MSWD near unity and the high percentage of probability of fit indicate that no detectable geological scatter

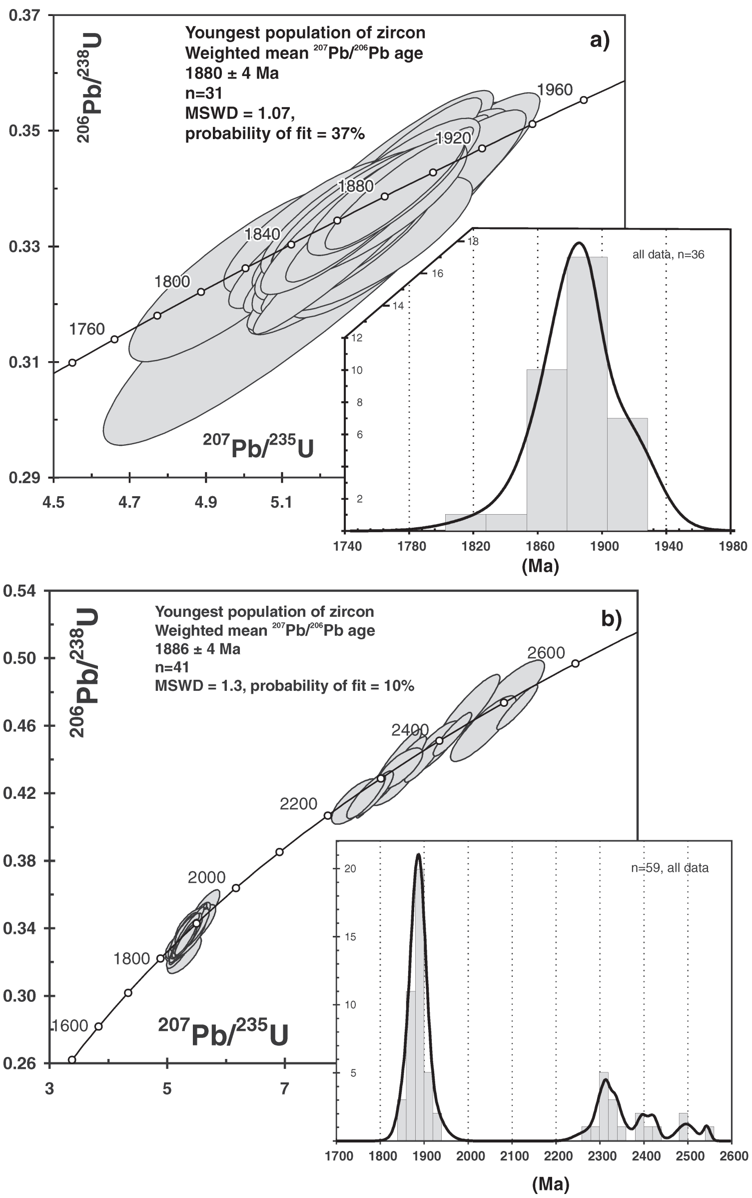


***Figure 5.***

*Uranium-lead concordia and cumulative probability curves of detrital zircon data collected using SHRIMP. Ellipses are plotted at 2☞ uncertainty.* ***a****) Powder Magazine formation CXA-02-N22A. All data are between 95% and 103% concordant and are plotted on the cumulative probability diagram. Bin width is 25 Ma.* ***b****) Partridge Breast conglomerate CXA-02-N3. All data are between 97% and 102% concordant and are plotted on the cumulative probability diagram. Bin width is 20 Ma. MSWD = mean standard weighted deviation* occurs in the data set. Since the youngest zircon was not statistically distinct from the rest of the analyzed zircons, no single youngest detrital grain was identified. Instead, the data set indicates a maximum age of deposition of 1880 ± 4 Ma.

**CXA-01-N3 (z7029)**

A sample of polymictic conglomerate from the Partridge Breast Lake area (Fig. 2a, UTM 560331, 6359272) was collected to constrain the age of deposition as well as indirectly date locally interbedded mafic volcanic rocks. Clasts in the conglomerate were subrounded to well rounded and strongly flattened oblique to bedding; they are interpreted as predominantly igneous in origin. The conglomerate grades stratigraphically upward into psammite then into semipelite–pelite, a transition interpreted to be a facies change. The sample was sorted using a Frantz isodynamic separator only to 5° side slope/max Amps in order not to bias the sample of detrital zircons picked for SHRIMP analysis. Zircons recovered from the magnetic and nonmagnetic at 5° side slope separates were commonly prismatic with fine oscillatory zoning and sharp terminations. Numerous grains had ragged, altered, high-U rims, too small for SHRIMP analysis. Other zircons were moderately rounded with diffuse concentric zoning. Fifty-eight zircons were analyzed by SHRIMP, one grain with a duplicate spot. Ages ranged from 1853 to 2543 Ma, with the majority of the analyses (n = 41) providing ages ranging from 1853 to 1932 Ma (Fig. 5b). This subset forms a single Gaussian peak with a weighted mean $^{207}Pb/^{206}Pb$ age of 1886 ± 4 Ma (MSWD = 1.3, probability of fit = 10%) interpreted as the maximum age of deposition. This age is consistent with the ages obtained from the Lynn Lake and Rusty Lake belts. The older component, with an age range of 2265 to 2543 Ma, is comparable to the inherited ages obtained for the Turtle Island diorite (CXA-01-N1). A similar assemblage from Saskatchewan that was identified and dated by Corrigan et al. (1999a) was tentatively interpreted as a foredeep or molasse basin.

## DISCUSSION AND CONCLUSIONS

This report presents a thorough description of the U-Pb results generated thus far from work carried out along the Churchill River-Southern Indian Lake transect. These new U-Pb results allow us to compare and contrast the Rusty Lake Belt, the Lynn Lake Belt, and smaller isolated supracrustal belts in the Southern Indian Domain, as well as develop ideas about the area's tectonostratigraphic evolution. Prior to the TGI study, a single age from each of the Rusty Lake (1878 Ma) and Lynn Lake (1910 Ma) belts had been used to suggest that the two belts were separate entities (Baldwin et al., 1987). New U-Pb ages from the Rusty Lake (1883 Ma, this study) and Lynn Lake (Bohm and Heaman, 2002) belts now suggest that the belts are coeval. The Powder Magazine formation, which overlies the Ruttan rhyolite in the Rusty Lake Belt, contains zircons of exclusively volcanic provenance and yields a maximum age of deposition of 1880 Ma. This sample does not give any indication of the presence of a nearby craton, although inherited zircons have been observed in other volcanic units (Ames et al., 2002). Detrital zircons from a conglomerate in the more northerly Partridge Breast Belt were also analyzed using SHRIMP. The sample was dominated by ca. 1885 Ma zircons, the same age as that obtained from the Rusty Lake Belt. However, the sample also contained a number of early Paleoproterozoic to late Archean zircons, suggesting a molasse or foredeep setting in proximity to the Sask Craton (Corrigan and Rayner, 2002).

A 1829 Ma megacrystic monzogranite, enclosing rafts of folded sedimentary rocks at Pukatawakan Bay, has been identified. Previous workers suggested that the sedimentary rocks were related to the Sickle Group (Cranstone, 1972), whereas others referred to them as the 'arkosic suite' until their origin could be determined (Lenton and Corkery, 1981). The Park Island assemblage in Saskatchewan, a sedimentary sequence cut by the 1.85 to 1.86 Wathaman Batholith and interpreted as a foredeep or molasse basin (Corrigan et al., 1999b), is similar in appearance to the sedimentary rocks enclosed by the megacrystic monzogranite. Had the sedimentary rocks at this locality been intruded by an older (ca. 1.85–1.86 Ga) Wathaman granite, it would have been possible to link them to the Park Island assemblage. However, the younger 1.83 Ga age for the megacrystic granite does not help resolve the affinity of these sedimentary rocks to either the Sickle Group or the Park Island assemblage. These ca. 1.83 Ga intrusions may represent a previously unrecognized later pulse of the Wathaman Batholith, or part of the 1.83 Ga Nueltin Suite (Peterson et al., 2002).

A homogeneous monzogranite from the Churchill River was sampled in the hope that it would represent basement to the supracrustal rocks. Uranium-lead TIMS results yielded a minimum crystallization age of 1842 Ma with some indication of inherited zircon. Older material was more clearly identified in the northern end of Southern Indian Lake. The 1889 Ma Turtle Island quartz diorite is interpreted as being associated with the Crowe Island Complex in Saskatchewan, and thus may represent the plutonic root of the La Ronge–Lynn Lake arc. However, it contains a significant number of 2.4 to 2.5 Ga inherited zircons. This is the first indication of the potential presence of Sask Craton-age crust in this area, which may be of interest to diamond explorationists.

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