**DR2005036**

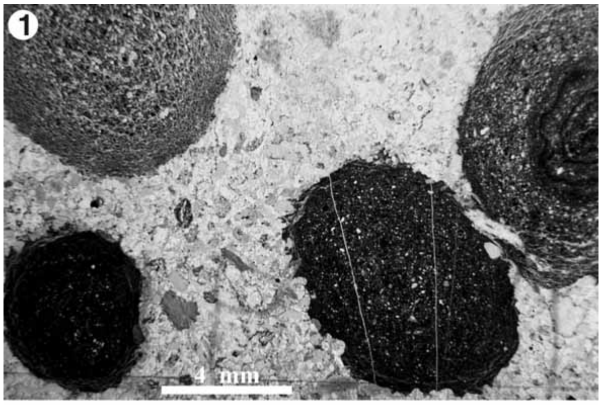
# Appendix DR1, Addison et al., Sudbury distal ejecta

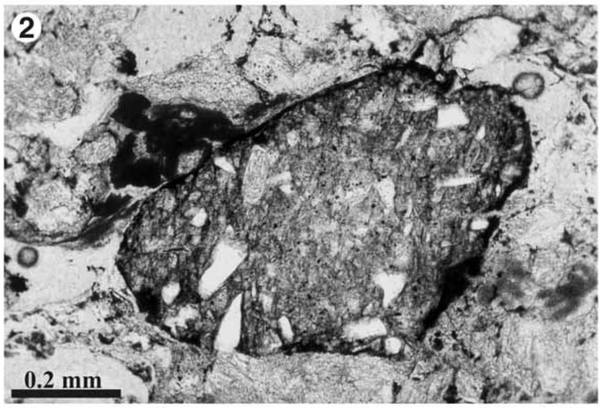
**Table DR1. Co-ordinates for Diamond Drill Cores.**

| Drill Core and Drilling Agent | Latitude | Longitude |
|---|---|---|
| LWN99-2<br>VHB00-1<br>BHP Billiton Ltd. | 47° 25.7' N<br>47° 28.3' N | 92° 35.6' W<br>92° 35.4' W |
| PR98-1<br>Falconbridge Ltd. | 48° 03.4' N | 89° 30.8' W |
| BP99-2<br>North Atlantic Nickel Corp. | 48° 04.7' N | 89° 43.8' W |
| MC95-1<br>M. Chaschuk | 48° 11.6' N | 89° 28.7' W |

**Photographs of Selected Ejecta Features.**

**(next page)**



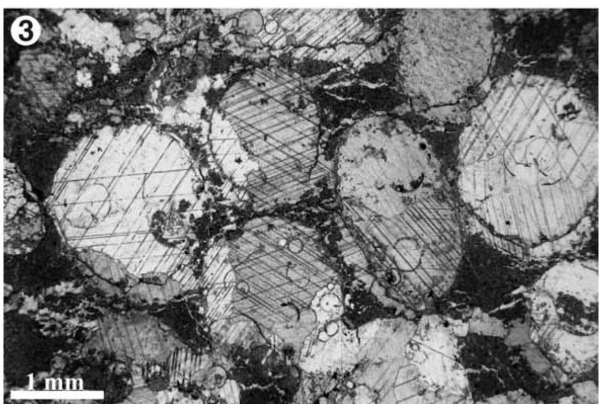
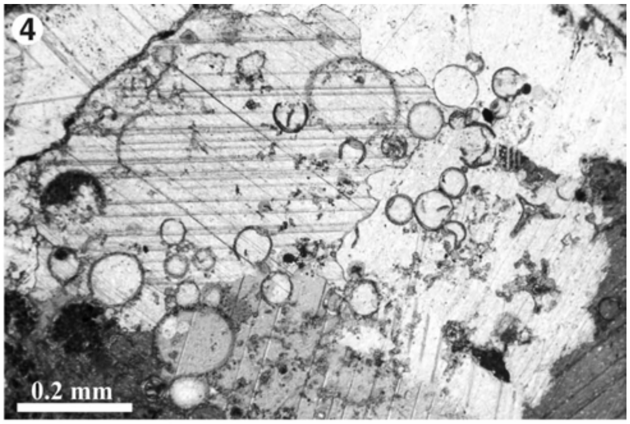
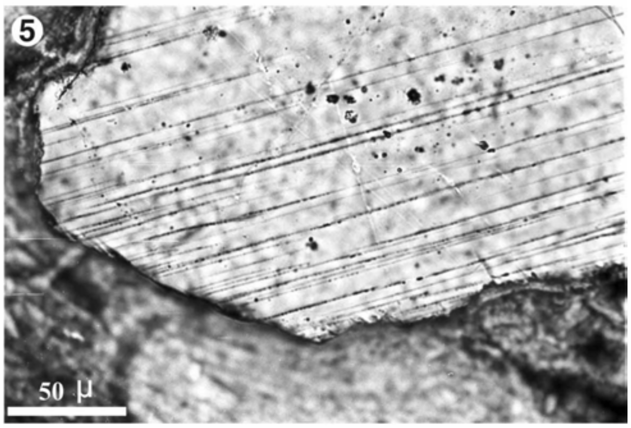




**Fig. DR1.** Accretionary lapilli in carbonate matrix, primarily dolomite (Core BP99-2, Slide JN29B-1).

**Fig. DR2.** Accreted grain cluster with coarse quartz and feldspar grains. Finer interior matrix is mainly secondary replacement carbonate and silicate minerals, while exterior material is primarily carbonate and smectite-illite replacement (Core PR98-1, Slide 5D).

**Fig. DR3.** Sphere-in-sphere features, devitrified and secondarily replaced by carbonate (primarily dolomite), which has destroyed most interior detail (Core LWN99-2, Slide H1-3-6).



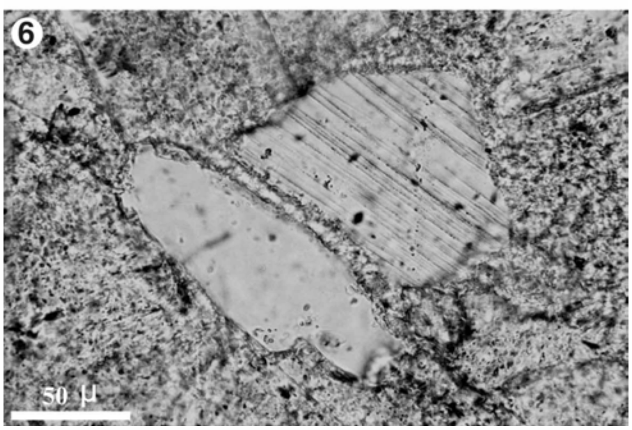
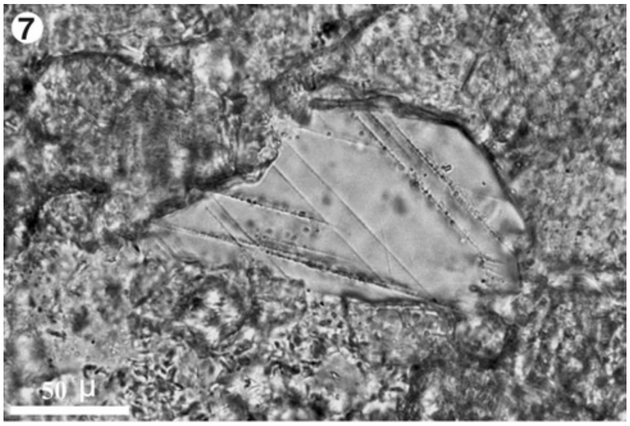




**Fig. DR4.** Devitrified spherules secondarily replaced by carbonate. Faint ‘ghost’ spherules indicate most original detail was destroyed during replacement. (Core LWN 99-2, Slide H1-3-5).

**Fig. DR5.** Shocked quartz grain with a single set of decorated planar deformation features (PDFs) (Core VHB 00-1, Slide H3-51).

**Fig. DR6.** Shocked quartz grain with a single set of decorated planar deformation features (PDFs) alongside an unshocked quartz grain (Core BP99-2, Slide JN35A).



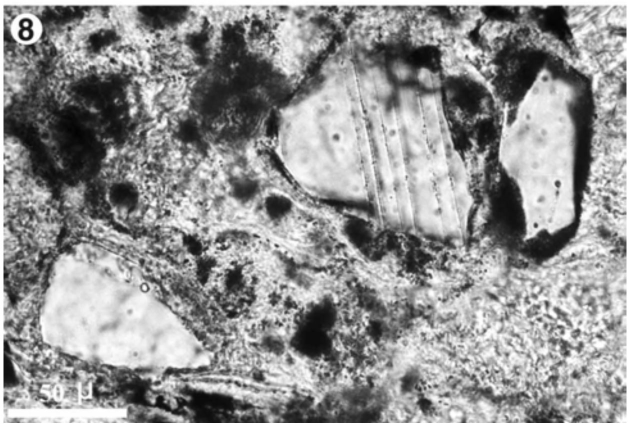




**Fig. DR7.** Shocked quartz grain with two set of crossed planar features, some decorated, some undecorated (Core BP99-2, Slide JN35B).

**Fig. DR8.** Shocked quartz grain with likely planar fractures (Core PR98-1, Slide 5D).

## DR – SHRIMP Procedures

Zircons were separated from small samples of friable tuff from drill-hole PR98-1 (688.24 m depth) using standard heavy liquid and magnetic separation techniques, and were hand picked from VHB-001 (255.29 m depth). Zircons from both samples were mounted in epoxy resin with several chips of the CZ3 standard zircon (Nelson, 1997). The mount was polished to expose the longitudinal mid-section of the zircon grains. Figures 1 and 2 show Back Scattered Electron (BSE) images, taken using the Scanning Electron Microscope (SEM), of the zircon grains analysed on the Sensitive High Resolution Ion Microprobe (SHRIMP), with analysis spots labelled. Zircon grains from the tuff in drill-hole PR98-1 consist of (i) thin, euhedral, needle-like zircons, ~250-350 µm in length and (ii) ~100-250 µm long "blocky' zircons with euhedral margins. Zircon grains from the tuff in VHB-001 are present as (i) euhedral, needle-like zircons, ~100-150 µm in length and (ii) ~150-250 µm long "blocky" grains with euhedral rims. Cathodoluminescence (CL) imaging shows fine magmatic growth zonation in the larger grains, with occasional truncations across zones. Within each zircon population, zircons with slightly rounded, irregular rims were not analyzed because of their potential to be detrital in origin.

SHRIMP analyses were obtained during two analytical sessions. Analytical procedures follow those published in Smith et al. (1998). Zircon $^{207}Pb/^{206}Pb$ data are used for age calculations. Data that are >5% discordant are not considered sufficiently reliable and are not used in age calculations. In both sets of zircon suites, discordant analyses usually are accompanied by higher uranium contents, signifying partial Pb loss. In the session for the zircons from PR98-1, the $^{207}Pb/^{206}Pb$ age was particularly sensitive to the common Pb correction. To minimize the effect of this, all analyses (6) with common Pb values >0.25 % were not used in the age calculation.

References

D.R. Nelson, *Geological Survey of Western Australia Record* **1997/2**, 189 (1997).
J.B. Smith et al., *Precambrian Research* **88**, 143 (1998).

**Table DR2a. Zircon SHRIMP Data, drill core PR98-1 (688.24 m), Ontario, about 5.8 m above top of ejecta layer.**

| Analysis spot† | U (ppm) | Th (ppm) | 4f206 (%)* | 207Pb/206Pb | ±€ | 206Pb/238U | ± | 207Pb/235U | ± | 208Pb/232Th | ± | %conc.§ | 207Pb/206Pb Age(Ma) | ± |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <5% discordant | | | | | | | | | | | | | | |
| 1 | 118 | 31 | **0.32** | 0.1110 | 0.0012 | 0.3239 | 0.0050 | 4.96 | 0.0937 | 0.0896 | 0.0030 | 100 | 1815 | 20 |
| 2 | 171 | 42 | -0.02 | 0.11240 | 0.0007 | 0.3353 | 0.0050 | 5.20 | 0.0841 | 0.0953 | 0.0018 | 101 | 1839 | 12 |
| 3-1 | 94 | 27 | 0.08 | 0.11127 | 0.0014 | 0.3296 | 0.0053 | 5.06 | 0.1024 | 0.0943 | 0.0035 | 101 | 1820 | 23 |
| 3-2 | 82 | 22 | **0.29** | 0.10887 | 0.0018 | 0.3211 | 0.0053 | 4.82 | 0.1125 | 0.0879 | 0.0043 | 101 | 1781 | 30 |
| 4 | 68 | 13 | 0.11 | 0.11161 | 0.0019 | 0.3175 | 0.0053 | 4.8 | 0.1170 | 0.0909 | 0.0040 | 97 | 1826 | 31 |
| 5 | 153 | 43 | 0.13 | 0.11065 | 0.0008 | 0.3218 | 0.0049 | 4.91 | 0.0830 | 0.0917 | 0.0019 | 99 | 1810 | 13 |
| 6-1 | 185 | 42 | 0.09 | 0.1117 | 0.0007 | 0.3331 | 0.0049 | 5.13 | 0.0830 | 0.0951 | 0.0021 | 101 | 1828 | 12 |
| 6-2 | 120 | 27 | **0.41** | 0.1092 | 0.0016 | 0.3112 | 0.0060 | 4.68 | 0.1123 | 0.0857 | 0.0047 | 98 | 1786 | 26 |
| 7 | 80 | 15 | **0.36** | 0.1084 | 0.0013 | 0.3273 | 0.0054 | 4.89 | 0.0996 | 0.0836 | 0.0036 | 103 | 1773 | 22 |
| 8 | 174 | 39 | 0.22 | 0.1116 | 0.0009 | 0.3290 | 0.0049 | 5.06 | 0.0860 | 0.0946 | 0.0028 | 100 | 1826 | 15 |
| 9 | 167 | 51 | 0.01 | 0.1122 | 0.0008 | 0.3146 | 0.0046 | 4.87 | 0.0799 | 0.0867 | 0.0019 | 96 | 1835 | 13 |
| 10 | 140 | 47 | 0.16 | 0.1106 | 0.0010 | 0.3236 | 0.0049 | 4.94 | 0.0872 | 0.0905 | 0.0022 | 100 | 1809 | 17 |
| 11 | 144 | 35 | -0.01 | 0.1111 | 0.0008 | 0.3267 | 0.0049 | 5.00 | 0.0833 | 0.0950 | 0.0021 | 100 | 1818 | 13 |
| 12 | 107 | 22 | 0.04 | 0.1132 | 0.0012 | 0.3277 | 0.0051 | 5.12 | 0.0962 | 0.0975 | 0.0036 | 99 | 1851 | 19 |
| 13 | 91 | 23 | **0.33** | 0.1112 | 0.0016 | 0.3272 | 0.0052 | 5.02 | 0.1073 | 0.0874 | 0.0043 | 100 | 1819 | 26 |
| 14 | 187 | 44 | 0.05 | 0.1113 | 0.0012 | 0.3225 | 0.0047 | 4.95 | 0.0894 | 0.0931 | 0.0024 | 99 | 1821 | 19 |
| 15 | 151 | 43 | 0.10 | 0.1135 | 0.0010 | 0.3302 | 0.0050 | 5.17 | 0.0904 | 0.0904 | 0.0036 | 99 | 1856 | 16 |
| 16 | 208 | 56 | 0.12 | 0.1110 | 0.0008 | 0.3218 | 0.0047 | 4.92 | 0.0800 | 0.0910 | 0.0023 | 99 | 1816 | 13 |
| 17 | 143 | 36 | **0.30** | 0.1098 | 0.0012 | 0.3199 | 0.0052 | 4.84 | 0.0946 | 0.0881 | 0.0032 | 100 | 1797 | 20 |
| 18 | 196 | 53 | -0.01 | 0.1114 | 0.0007 | 0.3177 | 0.0046 | 4.88 | 0.0765 | 0.0923 | 0.0017 | 97 | 1823 | 11 |
| 19 | 70 | 14 | 0.05 | 0.1127 | 0.0011 | 0.3272 | 0.0055 | 5.09 | 0.0998 | 0.0906 | 0.0026 | 99 | 1844 | 18 |
| >5% discordant | | | | | | | | | | | | | | |
| 20 | 135 | 30 | 0.23 | .1107 | 0.0011 | .3006 | 0.0046 | 4.59 | 0.0842 | .0704 | 0.0028 | 93 | 1810 | 18 |
| 21 | 54 | 15 | 0.21 | .1108 | 0.0018 | .3470 | 0.0063 | 5.30 | 0.1288 | .0970 | 0.0051 | 106 | 1812 | 29 |
| 22 | 216 | 91 | 0.35 | .1087 | 0.0015 | .1910 | 0.0028 | 2.86 | 0.0585 | .0335 | 0.0012 | 42 | 1778 | 26 |
| 23 | 294 | 84 | 0.07 | .1125 | 0.0006 | .3075 | 0.0035 | 4.77 | 0.0598 | .0916 | 0.0015 | 94 | 1840 | 10 |

† SHRIMP spot analysis number refers to the grain identification; grains with multiple spots have a second identification number. Mount 03-51 analyzed in 13/07/2003 session.

* 4f206(%)= % of $^{206}$Pb which is due to common Pb; All Pb isotope data are corrected for common Pb, using measured $^{204}$Pb and the composition of Broken Hill galena. Analyses with 4f206 values >0.25 % (in **bold)** were not used in the calculation of the weighted mean age.

€ Precisions are 1σ; U/Pb systematic reproducibility propagated from CZ3 standards is 0.5 % (n = 12) for Mount 03-51.

§ % concordance, as 100 x [t($^{206}$Pb/$^{238}$U)/t($^{207}$Pb/$^{206}$Pb)].

## Table DR2b. Zircon SHRIMP Data, drill core VHB00-1 (255.29 m), Minnesota, about 5.1 m above top of ejecta layer.

| Analysis spot[†] | U (ppm) | Th (ppm) | 4f206 (%)* | 207Pb/206Pb | ±[€] | 206Pb/238U | ± | 207Pb/235U | ± | 208Pb/232Th | ± | %conc.[§] | 207Pb/206Pb Age(Ma) | ± |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| <5% discordant | | | | | | | | | | | | | | |
| 1-1 | 367 | 71 | 0.00 | 0.1123 | 0.0004 | 0.3296 | 0.0040 | 5.10 | 0.0636 | 0.0977 | 0.0014 | 100 | 1837 | 6 |
| 1-2 | 388 | 108 | 0.03 | 0.1123 | 0.0004 | 0.3171 | 0.0038 | 4.91 | 0.0621 | 0.0934 | 0.0014 | 97 | 1837 | 7 |
| 1-3 | 422 | 89 | 0.08 | 0.1116 | 0.0005 | 0.3164 | 0.0038 | 4.87 | 0.0624 | 0.0933 | 0.0017 | 97 | 1825 | 8 |
| 2 | 213 | 59 | 0.04 | 0.1114 | 0.0006 | 0.3073 | 0.0039 | 4.72 | 0.0651 | 0.0910 | 0.0015 | 95 | 1823 | 10 |
| 3-1 | 350 | 93 | 0.05 | 0.1122 | 0.0004 | 0.3219 | 0.0040 | 4.98 | 0.0642 | 0.0950 | 0.0029 | 98 | 1835 | 7 |
| 3-2 | 617 | 201 | 0.01 | 0.1120 | 0.0003 | 0.3141 | 0.0038 | 4.85 | 0.0603 | 0.0889 | 0.0020 | 96 | 1832 | 5 |
| 4 | 629 | 165 | 0.00 | 0.1123 | 0.0003 | 0.3222 | 0.0038 | 4.99 | 0.0602 | 0.0931 | 0.0014 | 98 | 1836 | 5 |
| 5-1 | 569 | 165 | 0.03 | 0.1118 | 0.0003 | 0.3190 | 0.0038 | 4.92 | 0.0599 | 0.0937 | 0.0013 | 98 | 1829 | 5 |
| 5-2 | 598 | 173 | -0.01 | 0.1119 | 0.0003 | 0.3158 | 0.0037 | 4.87 | 0.0593 | 0.0929 | 0.0013 | 97 | 1830 | 5 |
| 6-1 | 800 | 101 | 0.03 | 0.1121 | 0.0003 | 0.3238 | 0.0038 | 5.00 | 0.0596 | 0.0902 | 0.0014 | 99 | 1833 | 5 |
| 6-2 | 507 | 90 | -0.01 | 0.1115 | 0.0003 | 0.3167 | 0.0037 | 4.87 | 0.0595 | 0.0932 | 0.0013 | 97 | 1823 | 6 |
| 6-3 | 680 | 205 | 0.00 | 0.1120 | 0.0003 | 0.3187 | 0.0037 | 4.92 | 0.0587 | 0.0935 | 0.0012 | 97 | 1832 | 5 |
| 7-1 | 356 | 91 | 0.20 | 0.1112 | 0.0005 | 0.3162 | 0.0038 | 4.85 | 0.0626 | 0.0861 | 0.0016 | 97 | 1820 | 9 |
| 7-2 | 361 | 90 | 0.12 | 0.1120 | 0.0006 | 0.3266 | 0.0039 | 5.05 | 0.0665 | 0.0811 | 0.0021 | 99 | 1833 | 10 |
| 7-3 | 498 | 93 | 0.02 | 0.1122 | 0.0003 | 0.3205 | 0.0038 | 4.96 | 0.0603 | 0.0955 | 0.0016 | 98 | 1835 | 5 |
| 7-4 | 390 | 70 | -0.02 | 0.1123 | 0.0004 | 0.3152 | 0.0038 | 4.88 | 0.0614 | 0.0940 | 0.0018 | 96 | 1837 | 7 |
| 8-1 | 486 | 178 | 0.01 | 0.1123 | 0.0003 | 0.3175 | 0.0038 | 4.92 | 0.0600 | 0.0940 | 0.0015 | 97 | 1837 | 6 |
| 8-2 | 568 | 206 | 0.13 | 0.1128 | 0.0005 | 0.3162 | 0.0037 | 4.92 | 0.0610 | 0.0777 | 0.0012 | 96 | 1845 | 7 |
| 8-3 | 557 | 179 | 0.12 | 0.1121 | 0.0004 | 0.3347 | 0.0039 | 5.18 | 0.0639 | 0.0861 | 0.0015 | 101 | 1834 | 7 |
| 9 | 206 | 53 | 0.01 | 0.1123 | 0.0005 | 0.3287 | 0.0042 | 5.09 | 0.0692 | 0.0950 | 0.0016 | 100 | 1837 | 9 |
| 10-1 | 379 | 82 | 0.15 | 0.1105 | 0.0006 | 0.3304 | 0.0039 | 5.03 | 0.0654 | 0.0828 | 0.0022 | 102 | 1807 | 9 |
| 10-2 | 313 | 53 | 0.03 | 0.1120 | 0.0005 | 0.3271 | 0.0041 | 5.05 | 0.0673 | 0.0974 | 0.0025 | 100 | 1832 | 8 |
| 11 | 339 | 56 | 0.03 | 0.1111 | 0.0004 | 0.3317 | 0.0040 | 5.08 | 0.0646 | 0.0954 | 0.0020 | 99 | 1818 | 7 |
| >5% discordant | | | | | | | | | | | | | | |
| 12 | 379 | 69 | 0.05 | .1127 | 0.0005 | .2652 | 0.0034 | 4.12 | 0.0562 | .0811 | 0.0016 | 78 | 1844 | 8 |
| 13 | 776 | 150 | 0.17 | .1106 | 0.0007 | .1942 | 0.0041 | 2.96 | 0.0648 | .0756 | 0.0019 | 42 | 1809 | 12 |
| 14 | 637 | 235 | 0.34 | .1097 | 0.0007 | .1897 | 0.0055 | 2.87 | 0.0849 | .0770 | 0.0025 | 40 | 1795 | 11 |
| 15 | 449 | 104 | 0.10 | .1109 | 0.0005 | .2512 | 0.0030 | 3.84 | 0.0490 | .0826 | 0.0014 | 74 | 1813 | 8 |
| 16 | 502 | 179 | 0.02 | .1123 | 0.0004 | .3040 | 0.0036 | 4.70 | 0.0580 | .0875 | 0.0012 | 93 | 1836 | 6 |
| 17 | 504 | 176 | 0.03 | .1112 | 0.0005 | .3009 | 0.0042 | 4.62 | 0.0680 | .0927 | 0.0014 | 93 | 1820 | 9 |
| 18 | 728 | 90 | 0.01 | .1124 | 0.0003 | .2828 | 0.0033 | 4.38 | 0.0527 | .0910 | 0.0023 | 85 | 1838 | 5 |
| 19 | 518 | 151 | 0.10 | .1115 | 0.0005 | .3051 | 0.0036 | 4.69 | 0.0592 | .0923 | 0.0014 | 94 | 1825 | 7 |
| 20 | 624 | 218 | 0.01 | .1120 | 0.0003 | .2994 | 0.0038 | 4.62 | 0.0606 | .0847 | 0.0012 | 92 | 1832 | 5 |
| 21 | 631 | 209 | -0.01 | .1107 | 0.0004 | .2674 | 0.0032 | 4.08 | 0.0512 | .0894 | 0.0032 | 81 | 1811 | 6 |
| 22 | 282 | 33 | 0.04 | .1122 | 0.0005 | .3097 | 0.0038 | 4.79 | 0.0628 | .0896 | 0.0028 | 94 | 1836 | 8 |

† SHRIMP spot analysis number refers to the grain identification; grains with multiple spots have a second identification number. Mount 0401 analyzed in 24/01/2004 session.

* 4f206(%)= % of $^{206}$Pb which is due to common Pb; All Pb isotope data are corrected for common Pb, using measured $^{204}$Pb and the composition of Broken Hill galena.

€ Precisions are 1$\sigma$; U/Pb systematic reproducibility propagated from CZ3 standards is 0.42 % (n = 12).

§ % concordance, as 100 x [t($^{206}$Pb/$^{238}$U)/t($^{207}$Pb/$^{206}$Pb)].

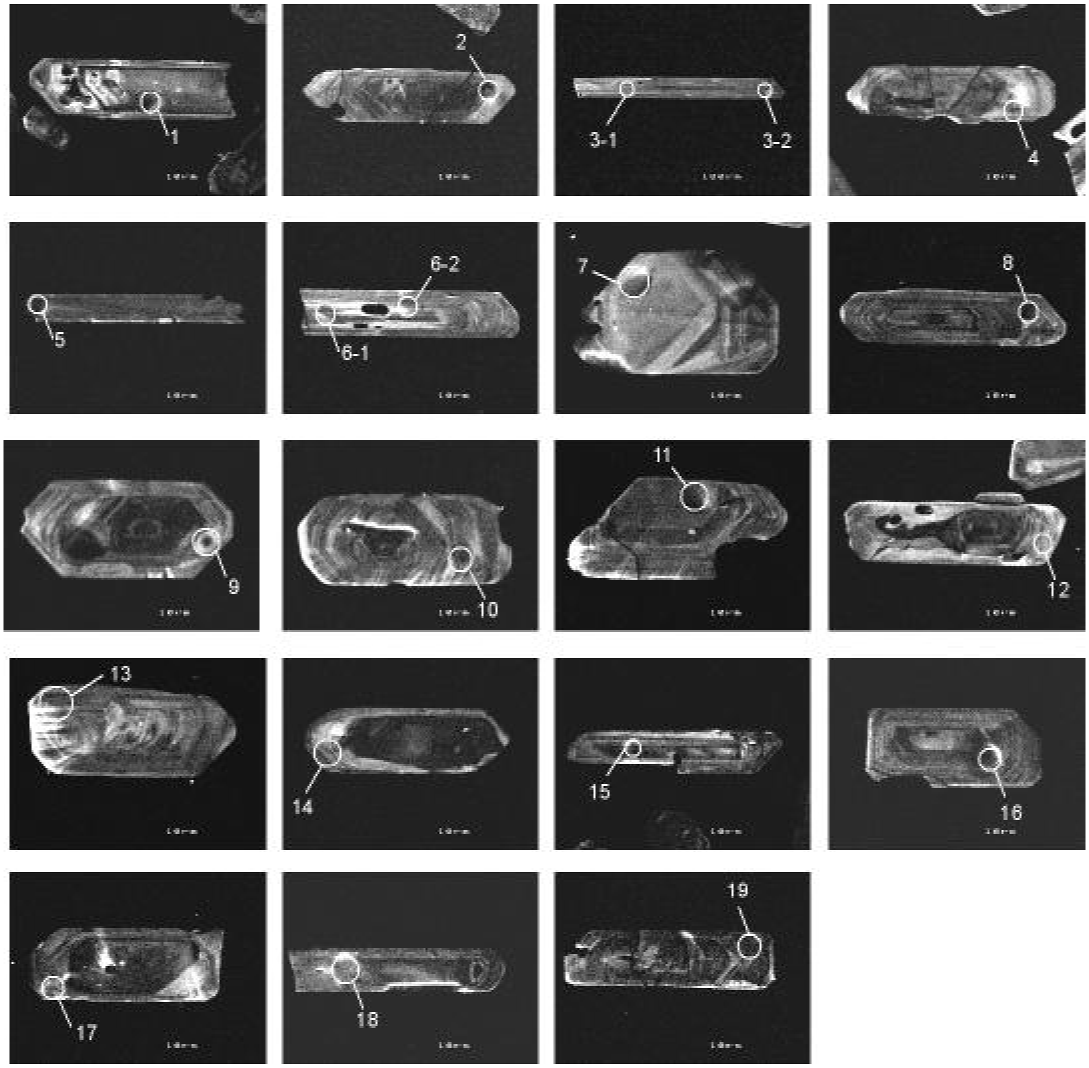



**Fig. DR9.** SHRIMP dated Rove Formation zircons from drill core PR98-1 (688.24 m) Ontario, ~ 5.8 m above top of ejecta layer.

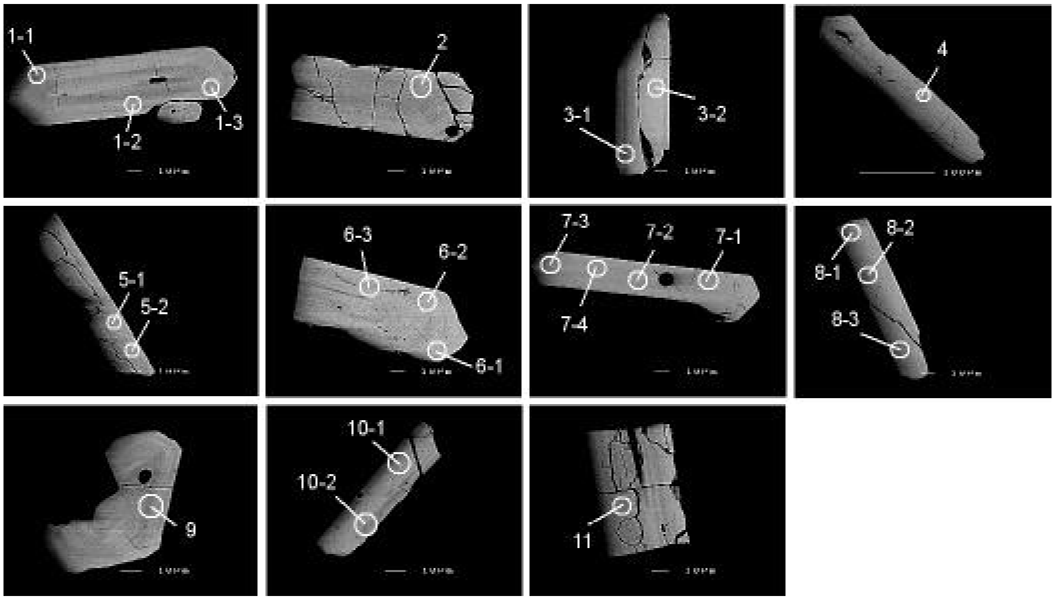



**Fig. DR10.** SHRIMP dated Virginia Formation zircons from drill core VHB00-1 (255.29 m) Minnesota, ~ 5.1 m above top of ejecta layer.

**Table DR3a. Zircon ID-TIMS Data, drill core PR98-1 (688.24 m), Ontario, about 5.8 m above top of ejecta layer.**

| No. | Description | Wt. (mg) | U (ppm) | Th/U | Pbtot (pg) | PbCom (pg) | $^{207}Pb$ / $^{204}Pb$ | $^{206}Pb$ / $^{238}U$ | 2 sig | $^{207}Pb$ / $^{235}U$ | 2 sig | $^{207}Pb$ / $^{206}Pb$ Age (Ma) | 2 sig | Disc. % | Error Correl. | Lab No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 Ab zr, pale brn, incl | 0.0002 | 197 | 0.26 | 13.3 | 0.36 | 276.8 | 0.3303 | 0.0019 | 5.109 | 0.031 | 1835.3 | 6.6 | -0.3 | 0.8046 | dwd4420 |
| 2 | 1 Ab zr, pale brn | 0.0006 | 113 | 0.25 | 22.5 | 0.46 | 361.9 | 0.3249 | 0.0013 | 5.026 | 0.022 | 1835.3 | 4.3 | 1.4 | 0.8335 | dwd4419 |
| 3 | 1 Ab zr, pale brn, incl | 0.0009 | 163 | 0.25 | 46.6 | 0.57 | 587.9 | 0.3124 | 0.0010 | 4.816 | 0.017 | 1829.2 | 3.0 | 4.8 | 0.8804 | dwd4418 |
| 4 | 1 Ab zr, pale brn | 0.0002 | 125 | 0.24 | 7.7 | 0.39 | 157.5 | 0.3050 | 0.0017 | 4.701 | 0.034 | 1828.5 | 8.1 | 7.0 | 0.7832 | dwd4421 |

FOOTNOTES TO TABLE

Fractions are ordered from highest to lowest 207Pb/206Pb age

brn - brown, incl - black inclusions

Pbtot is total radiogenic lead in sample

Pbcom is total measured common Pb assuming the isotopic composition of laboratory blank:
206/204 - 18.221; 207/204 - 15.612; 208/204 - 39.360 (errors of 2%).

Th/U 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).

Jaffey A. H., Flynn K. F., Glendenin L. E., Bentley W. C. and Essling A. M. (1971)
Precision measurement of half-lives and specific activities of 235U and 238U. Phys. Rev. C4, 1889-1906.

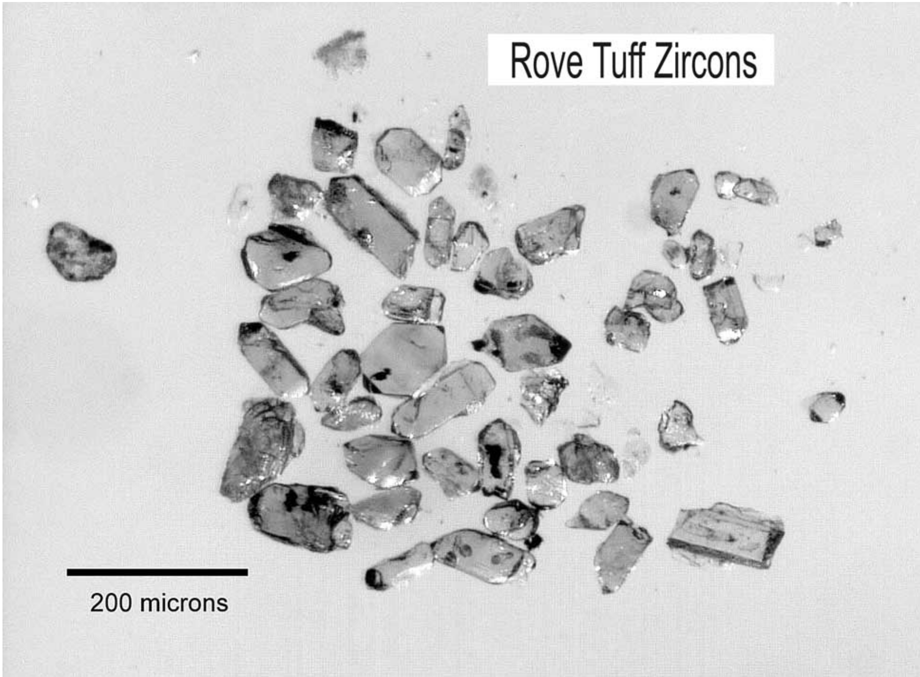



**Fig. DR11.** Raw zircon population from drill core PR98-1 (688.24 m), Ontario, about 5.8 m above top of ejecta layer. Selected zircons from this population were ID-TIMS dated.

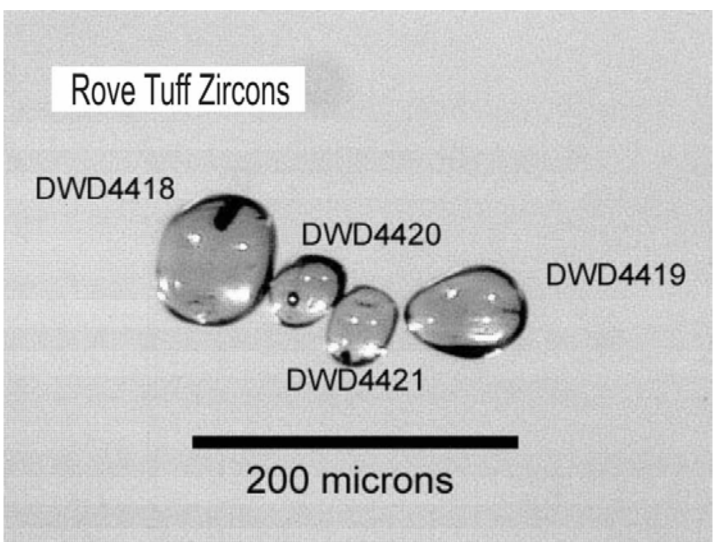



**Fig. DR12.** Selected air-abraded, ID-TIMS dated zircons from drill core PR98-1 (688.24 m), Ontario, about 5.8 m above top of ejecta layer.

## DR – SEM Methodology

The SEM used for oxide analyses was a JEOL JSM-5900LV equipped with an Oxford Instruments LINK ISIS EDXA analyzer. Instrument settings included a beam current of 0.475 nA, at 20 KV, with a beam take-off angle of 35 degrees. Two minute count times were used. Data were generated with LINK SemQuant software.

At the beginning of each session the instrument was calibrated with nickel and then standardized with a primary standard orthoclase (BM1923) and a secondary standard garnet (LU-RHM).

**Table DR4. SEM Analysis of SRF (Smectite-Illite Replacement Features).**

| Oxide | PR98-1, Slide 5A |
|---|---|
| n = | 12 |
| | |
| $SiO_2$ | 52.348 |
| $Al_2O_3$ | 22.623 |
| FeO | 2.24 |
| MgO | 5.097 |
| CaO | 0.189 |
| $Na_2O$ | 0.414 |
| $K_2O$ | 8.104 |
| $V_2O_3$ | 0.329 |
| | |
| Total | 91.567 |