Natural Resources Canada   Ressources naturelles Canada

GEOLOGICAL SURVEY OF CANADA
OPEN FILE 8807

U-Pb zircon age data for supracrustal samples from the White Hills Lake to Amer Lake area, Rae Province, Nunavut, Canada

W.J. Davis

2021

Canada

GEOLOGICAL SURVEY OF CANADA
OPEN FILE 8807

U-Pb zircon age data for supracrustal samples from the White Hills Lake to Amer Lake area, Rae Province, Nunavut, Canada

W.J. Davis

2021

Permanent link: https://doi.org/10.4095/328453

This publication is available for free download through GEOSCAN (https://geoscan.nrcan.gc.ca/).

Recommended citation
Davis, W.J., 2021. U-Pb zircon age data for supracrustal samples from the White Hills Lake to Amer Lake area, Rae Province, Nunavut, Canada; Geological Survey of Canada, Open File 8807, 1 .zip file. https://doi.org/10.4095/328453

Publications in this series have not been edited; they are released as submitted by the author.

Introduction

This multi-component Open File report releases U-Pb isotopic age data from nine samples (Table 1) from the White Hills Lake to Amer Lake area, north of Baker Lake, Nunavut. Zircon from eight of the samples were analysed by Sensitive High Resolution Ion Microprobe (SHRIMP, Appendix 1 and 2 and four samples include Isotope Dilution Thermal Ionisation Mass Spectrometry (ID-TIMS) data (Appendix 3). The data were collected between 1998 and 2012 as part of the NATMAP and GEM1 programs of the GSC. The majority of the data are from detrital zircon grains from metasedimentary rock samples. Additional samples include a cobble from the basal unit of the Ketyet River Group (Z8405) and a volcanic rock from north of the Bong deposit (Z10802), for which age picks are provided below.

Information on the geological setting of these samples are provided in Jefferson et al., (in prep). Additional information can be found in Pehrsson et al. (2013), Zaleski (2005), Zaleski and Pehrsson (2005), Zaleski et al. (2005), Zaleski et al. (2001), and Zaleski et al. (1999a, b).

This release contains three Excel spreadsheets containing the U-Pb SHRIMP analytical data (Appendix 1 and 2) and ID-TIMS analytical data (Appendix 3). The purpose of this report is to make the U/Pb dataset publically available for evaluation and interpretation, not to provide interpretation herein.

Table 1. Sample Summary

Lab Number	Sample Number	Lithological Description[1]	Latitude (NAD83)	Longitude (NAD83)	SHRIMP	TIMS
Z4412	ZB96-186AZ	Extremely pure orthoquartzite; slight blueish tint, Ketyet River Group	65.2004	-95.9791	Yes	Yes[2]
Z5554	ZB98-D219DZ	Basal heterolithic conglomerate to Ketyet River Group	65.2989	-96.4303	Yes	Yes
Z5555	ZB98-132CZ	Lithic-feldspathic wacke, sequence 3 of Amarulik assemblage (#33)	64.8823	-96.2642	Yes	Yes
Z5556	ZB98-455AZ	Lithic quartz-feldspar wacke, undivided Amarulik assemblage (#15)	64.7572	-95.8937	No	Yes
Z10511	10JP009A	Brown and beige graded-bedded sandstone, Tahiratuaq Group (Ps4), northeastern Amer Belt (#41)	65.5016	-96.4238	Yes	No
Z10512	08JP66D1	Upper polymictic conglomerate in Ps1 quartzite, Ketyet River group, Forum graphite zone. (#35)	64.5074	-97.0287	Yes	No

Z10513	10JP056A	Tahiratuaq Group (Ps4), Amer belt near Amer mylonite zone (#41)	65.5048	-98.3103	Yes	No
Z10802	11JP373B03	Quartz-feldspar porphyritic rhyolite, highly strained, Pukiq Lake Formation, near Bong deposit (#32)	64.4281	-97.7574	Yes	No
Z8405	PQB-37-04A	Granite clast within basal Ps1 conglomerate, Ketyet River group, unconformably overlying Pipedream assemblage in the core of the Ukalik Lake synform (#34)	65.2337	-95.9612	Yes	No

[1]Number in parenthesis at end of lithological description cross-references Table 2 in Jefferson et al. (in prep)

[2]TIMS data published in Davis and Zaleski (1998)

Analytical Methods

All samples were disaggregated using standard crushing/pulverizing techniques followed by density separation using the Wilfley table and heavy liquids.

SHRIMP analytical procedures followed those described by Stern (1997). Briefly, zircons were cast in 2.5 cm diameter epoxy mounts along with fragments of the reference zircon. The mid-sections of the zircons were exposed using 9, 6, and 1 μm diamond compound, and the internal features of the zircons (such as zoning, structures, alteration, etc.) were characterized in back-scattered electron mode (BSE) utilizing scanning electron microscope. Data for samples on sample mount IP189 and IP355 were processed using the Prawn and Lead software (Stern, 1997). Off-line data processing for the remaining samples used SQUID2 (version 2.22.08.04.30, rev. 30 Apr 2008). The 1σ external errors of $^{206}Pb/^{238}U$ ratios reported in the data table incorporate the error in calibrating the reference material. Common Pb correction utilized the Pb composition of the surface blank (Stern, 1997). Analyses of a secondary zircon reference material z1242 were interspersed between the sample analyses on mounts 607 and 672 to assess the requirement of an isotopic mass fractionation correction for the $^{207}Pb/^{206}Pb$ age. The accepted $^{207}Pb/^{206}Pb$ age of z1242 is 2679.7±0.2 Ma, based on 59 isotope dilution fractions (Davis et al, 2019). Details of the analytical session, including spot size, calibration error and the any application of the isotopic mass fractionation correction are given in the footnotes of Appendices 2 and 3.

ID-TIMS data were collected in the late 1990's and early 2000's. Sample dissolution and chemical methods are described in Parrish et al. (1987). Individual crystals were selected under binocular microscope to avoid inclusions and other imperfections, mechanically abraded (Krogh, 1982) and spiked with a mixed ^{205}Pb-^{233}U-^{235}U tracer solution calibrated to ±0.1% against a gravimetric solution, and dissolved in high-pressure bombs in HF-HNO3. Data reduction and error propagation follow methods outlined in Roddick (1987). U and Pb isotopic ratios were measured using a Finnigan Mat 261 mass spectrometer operated in either static multi-collection mode or using a secondary electron multiplier. The

^{205}Pb, ^{206}Pb, ^{207}Pb, and ^{208}Pb isotopes were measured simultaneously in Faraday collectors, with ^{204}Pb in an axial secondary electron multiplier. Faraday-multiplier gain was monitored and corrected by peak jumping ^{205}Pb into the axial cup. A Pb mass fractionation correction of 0.09± 0.04%/amu was applied as determined by replicate analyses of the NBS981 standard. U fractionation was corrected using the ^{233}U-^{235}U double spike and was typically in the range of 0.12%/amu

Age Interpretations for Sedimentary Rocks

Probability density plots of zircon $^{207}Pb/^{206}Pb$ ages for samples analysed by SHRIMP are shown in Figure 1. The ID-TIMS results presented in Appendix 3 are not included in the plot but included as an Appendix in this report for completeness. The ID-TIMS data also include titanite analyses from sample ZB98-132cz. The titanite analyses are all significantly discordant (3-35%), with variable Neoarchean ages, making it difficult to interpret the results geologically.

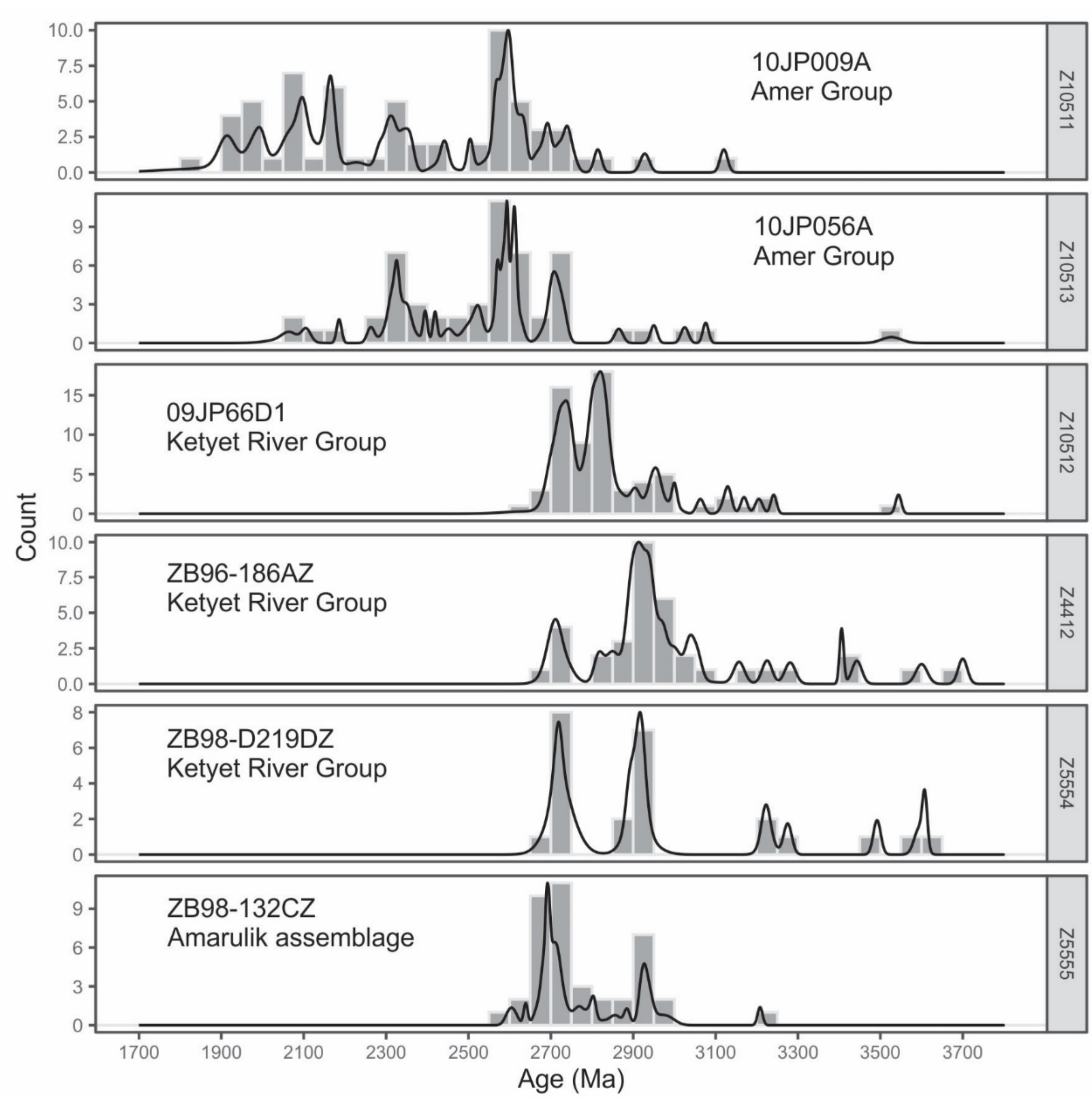

Figure 1. Combined probability density plots and frequency histogram using Detzrcr software (Andersen et al. 2018). Bin width = 50 Ma. Samples stacked in approximate stratigraphic position

Age Interpretations for Igneous Rock Samples

Z10802: An igneous crystallization age of 2603.5 ± 2.7 Ma is interpreted for the rhyolite based on the weighted mean $^{207}Pb/^{206}Pb$ age of fifteen analyses (Figure 2). Five analyses were excluded from the calculation owing to high common Pb values and/or discordance (brown ellipses in Figure 2).

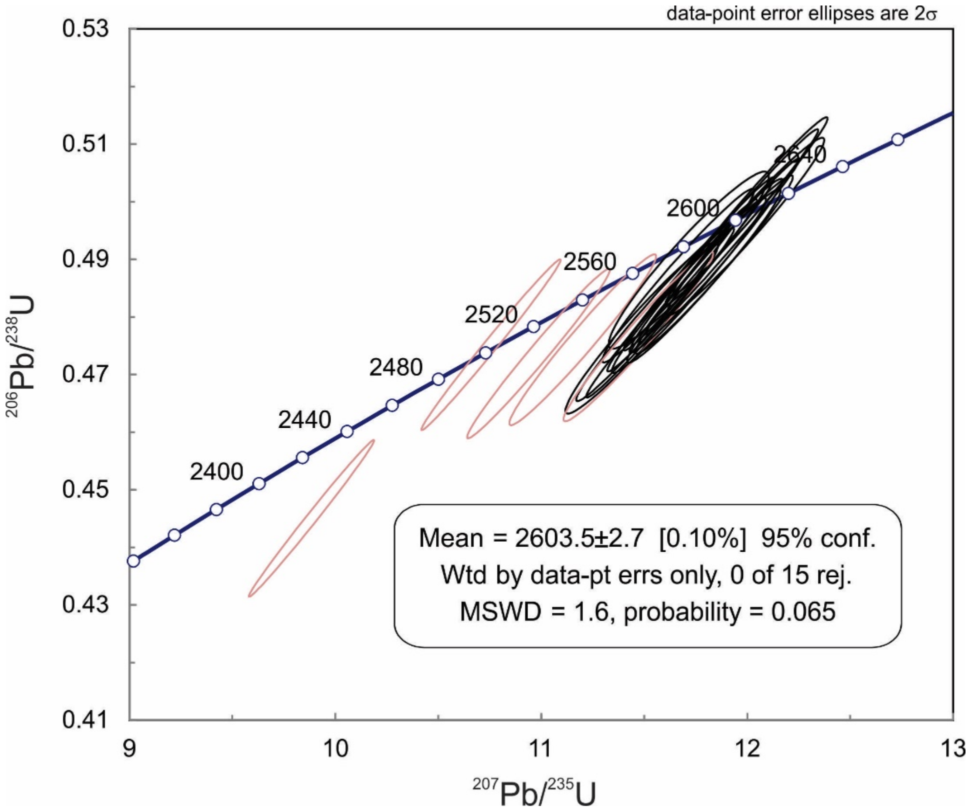

Figure 1. SHRIMP U-Pb concordia plot for sample 10802. Black ellipses were included in weighted mean calculation, brown ellipses excluded from weighted mean calculation. Age in Ma.

Z8405: Zircon in this sample were of very poor quality and exhibit significant metamictization. As such there were a limited number of targets suitable for SHRIMP analysis. An igneous crystallization age of 2623.3 ± 5.0 Ma is interpreted for the protolith to the cobble, based on the weighted mean $^{207}Pb/^{206}Pb$ ages of 12 analyses from 6 zircon grains (Appendix 1, Figure 3). This age is interpreted as the maximum age for deposition of the conglomerate unit. A single grain with high uranium content (~700-800 ppm) yielded slightly younger ages of 2593 to 2576 Ma and was excluded from the age calculation, as was one replicate analysis with Pb-loss. The sample also includes inherited zircon grains with ages ranging from 2678 Ma to 2900 Ma.

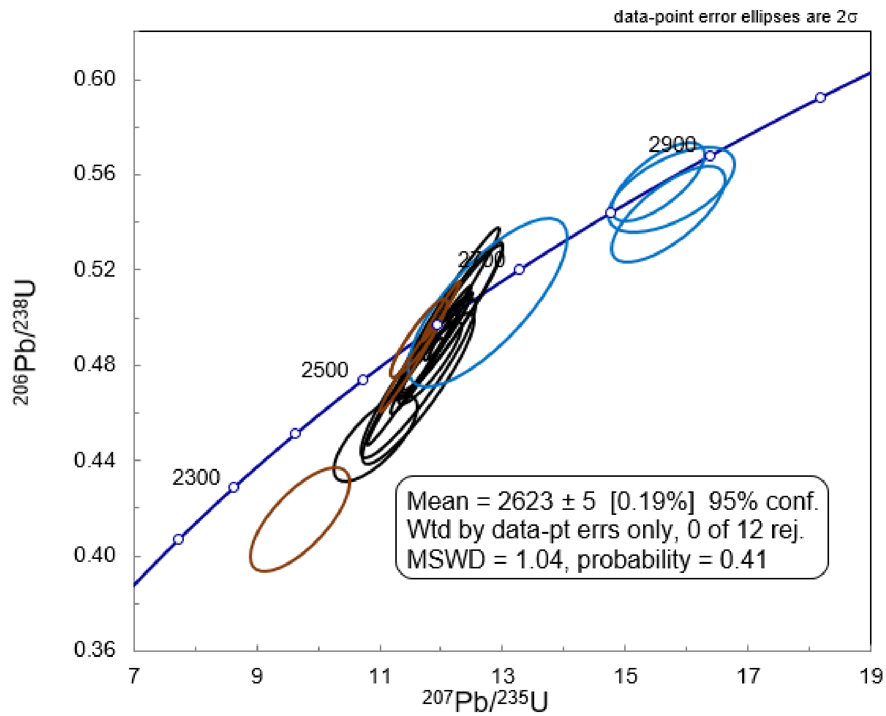

Figure 3. SHRIMP U-Pb concordia diagram for sample 8405. Age in Ma. Brown ellipses were excluded from the age calculation represent analyses with Pb-loss. Blue analyses are interpreted as inherited.

Acknowledgements

Geological fieldwork and sample collection by Eva Zaleski, Sally Pehrsson and Charlie Jefferson underpin this report. Thanks to staff at the Geochronology laboratory for sample preparation (Gerry Gagnon, Ron Christie, Ray Chung) and analytical support (Tom Pestaj, Julie Peressini, Dianne Bellerive and Carole Lafontaine). Pat Hunt undertook the SEM imaging. Quin Emon is thanked for his help in preparing data tables. Nicole Rayner reviewed the manuscript.

References

Andersen, T., Kristoffersen, M., and Elburg, M.A., 2018. Visualizing, interpreting and comparing detrital zircon age and Hf isotope data in basin analysis – a graphical approach: Basin Research, v. 30, p. 132-147, doi: 10.1111/bre.12245.

Davis, W J., and Zaleski, E., 1998. Geochronological investigations of the Woodburn Lake group, western Churchill Province, Northwest Territories: preliminary results. In Radiogenic age and isotopic studies: Report 11; by Geological Survey of Canada; Geological Survey of Canada, Current Research no. 1998-F, 1998 p. 89-97, https://doi.org/10.4095/210060 (Open Access)

Davis, W.J., Pestaj, T., Rayner, N., McNicoll, V.M., 2019. Long-term reproducibility of 207Pb/206Pb age at the GSC SHRIMP lab based on the GSC Archean reference zircon z1242. Geological Survey of Canada, Scientific Presentation 111, 1 poster, https://doi.org/10.4095/321203

Pehrsson, S.J., Berman, R., and Davis, W.J., 2013. Paleoproterozoic orogenesis during Nuna aggregation: a case study of reworking of the Archean Rae craton, Woodburn Lake, Nunavut. Precambrian Research, 232, 167-188. http://dx.doi.org/10.1016/j.precamres.2013.02.010

Krogh, T.E., 1982. Improved accuracy of U-Pb ages by the creation of more concordant systems using an air abrasion technique. Geochimica et Cosmochimica Acta, 46: 637-649.

Parrish, R.R., Roddick, J.C., Loveridge, W.D., and Sullivan, R.W., 1987. Uranium-lead analytical techniques at the geochronology laboratory, Geological Survey of Canada; In: Radiogenic Age and Isotopic Studies: Report 1, Geological Survey of Canada, Paper 87-2, 3-7.

Roddick, J.C., 1987. Generalized numerical error analysis with applications to geochronology and thermodynamics. Geochimica et Cosmochimica Acta, v. 51, p. 2129-2135.

Stacey, J.S., and Kramers, J.D., 1975. Approximation of terrestrial lead isotope evolution by a two-stage model: Earth and Planetary Science Letters, v. 26, p. 207-221.

Stern, R.A., 1997. The GSC Sensitive High Resolution Ion Microprobe (SHRIMP): analytical techniques of zircon U-Th-Pb age determinations and performance evaluation: in Radiogenic Age and Isotopic Studies, Report 10, Geological Survey of Canada, Current Research 1997-F, p. 1-31.

Stern, R.A., and Amelin, Y., 2003. Assessment of errors in SIMS zircon U-Pb geochronology using a natural zircon standard and NIST SRM 610 glass; Chemical Geology, v. 197, p. 111-146.

Zaleski, E., 2005. Geology, Meadowbank River area, Nunavut; Geological Survey of Canada, "A" Series Map 2068A, scale 1:50000.

Zaleski, E. and Pehrsson, S., 2005. Geology, Half Way Hills and Whitehills Lake area, Nunavut; Geological Survey of Canada, "A" Series Map 2069A scale 1:50000.

Zaleski, E., Pehrsson, S., and Wilkinson, L., 2005. Geology, Amarulik and Tehek lakes area, Nunavut; Geological Survey of Canada, "A" Series Map 2070A, scale 1:50000.

Zaleski, E., Pehrsson, S.J., Davis, W.J., Greiner, E., L'Heureux, R., Duke, N., and Kerswill, J.A., 2001. Geology, Half Way Hills to Whitehills Lake area, Nunavut; Geological Survey of Canada, Open File 3697 scale 1:50000.

Zaleski, E., Duke, N., L'Heureux, R., and Wilkinson, L., 1999a. Geology, Woodburn Lake group, Amarulik Lake to Tehek Lake, Kivalliq region, Nunavut; Geological Survey of Canada, Open File 3743, scale 1:50000.

Zaleski, E., L'Heureux, R., Duke, N., Wilkinson, L., and Kerswill, J.A., 1999b. Geology, Woodburn Lake group, Meadowbank River area, Kivalliq region, Nunavut; Geological Survey of Canada, Open File 3709, scale 1:50000.