Regions and Themes / Régions et thèmes

Articles

Geological Survey of Canada

CURRENT RESEARCH
2006-A7

Two turbidite sequences in the Russell Lake–Mosher Lake area: SHRIMP U-Pb detrital zircon evidence and correlations in the southwestern Slave craton, Northwest Territories

L. Ootes, W.J. Davis, and V.A. Jackson

2006

Natural Resources Canada Ressources naturelles Canada

Canada

CURRENT RESEARCH

ISSN 1701-4387
Catalogue No. M44-2006/A7E-PDF
ISBN 0-662-43527-3

A copy of this publication is also available for reference by depository libraries across Canada through access to the Depository Services Program's Web site at http://dsp-psd.pwgsc.gc.ca

A free digital download of this publication is available from GeoPub: http://geopub.nrcan.gc.ca/index_e.php

Toll-free (Canada and U.S.A.): 1-888-252-4301

Critical reviewer
O. van Breemen

Authors' addresses

Luke Ootes (***luke_ootes@gov.nt.ca***)
Valerie A. Jackson (***valerie_Jackson@gov.nt.ca***)
Northwest Territories Geoscience Office
Box 1500, 4601b – 52nd Avenue
Yellowknife, Northwest Territories
X1A 2R3

William J. Davis
(***bidavis@nrcan.gc.ca***)
Geological Survey of Canada
601 Booth Street
Ottawa, Ontario K1A 0E8

Publication approved by Central Canada

Original manuscript submitted: 2006-03-10
Final version approved for publication: 2006-03-13

Correction date:

Two turbidite sequences in the Russell Lake–Mosher Lake area: SHRIMP U-Pb detrital zircon evidence and correlations in the southwestern Slave craton, Northwest Territories

L. Ootes, W.J. Davis, and V.A. Jackson

Ootes, L., Davis, W.J., and Jackson, V.A., 2006: Two turbidite sequences in the Russell Lake–Mosher Lake area: SHRIMP U-Pb detrital zircon evidence and correlations in the southwestern Slave craton, Northwest Territories; Geological Survey of Canada, Current Research 2006-A7, 15 p.

Abstract: Detrital zircon age data indicate a temporal separation of two distinct turbidite packages in the Russell Lake–Mosher Lake area of the southwestern Slave craton, Northwest Territories. The Mosher Lake package consists of monotonous greywacke-mudstone turbidites intercalated with mafic volcanic rocks and is inferred to overlie a previously dated 2658 ± 3 Ma felsic volcanic centre. These turbidites have a maximum depositional age of 2651 ± 5 Ma and are tentatively correlated with the ca. 2661 Ma Burwash Formation east of Yellowknife. The Russell Lake package consists of greywacke-mudstone turbidites with abundant interbedded iron-formation. It has a maximum depositional age of 2625 ± 6 Ma and is correlated with the previously dated <2629 ± 2 Ma Damoti formation. Turbidites of both the Russell Lake package and Damoti formation contain abundant iron-formation, which hosts numerous gold showings (e.g. Bugow, Horseshoe). These younger turbidites define a post-2630 Ma iron-formation-associated gold metallotect in the southwestern Slave craton.

Résumé : Une datation sur zircons détritiques montre qu'un intervalle de temps sépare deux assemblages distincts de turbidites dans la région des lacs Russell et Mosher, dans le sud-ouest du craton des Esclaves (Territoires du Nord-Ouest). L'assemblage du lac Mosher se compose de turbidites monotones de grauwacke et de mudstone intercalées avec des roches volcaniques mafiques; il recouvrirait un centre volcanique felsique antérieurement daté à 2658 ± 3 Ma. Ces turbidites remontent au plus à 2651 ± 5 Ma et sont provisoirement mises en corrélation avec la Formation de Burwash, qui date d'environ 2661 Ma et se trouve à l'est de Yellowknife. L'assemblage du lac Russell est constitué de turbidites de grauwacke et de mudstone et de nombreuses formations de fer interstratifiées. Il remonte au plus à 2625 ± 6 Ma et a été mis en corrélation avec la formation de Damoti, qui a été daté antérieurement à moins de 2629 ± 2 Ma. Les turbidites de l'assemblage du lac Russell et de la formation de Damoti renferment de nombreuses formations de fer, qui contiennent elles-mêmes de nombreux indices d'or (p. ex. Bugow et Horseshoe). Ces turbidites plus récentes délimitent un métallotecte aurifère associé à des formations de fer qui ont moins de 2630 Ma, dans le sud-ouest du craton des Esclaves.

INTRODUCTION

The Slave Province is a well exposed Archean craton in the northwestern Canadian Shield. It comprises mainly Neoarchean supracrustal sequences and plutonic rocks, and localized Mesoarchean basement (Fig. 1; Bleeker and Davis, 1999). Younger supracrustal rocks, which in southern parts of the craton make up the Duncan Lake Group (Henderson, 1985), include greywacke-mudstone turbidites that overlie the predominantly volcanic rocks of the ca. 2660 to 2690 Ma Banting and >2700 Ma Kam groups (Henderson, 1985; Isachsen, 1992; Isachsen and Bowring, 1997). Recent zircon geochronology studies demonstrate that at least three turbidite-dominated sequences occur in the Slave Province (Mortensen et al., 1992a, b; van Breemen et al., 1992; Bleeker and Villeneuve, 1995; Pehrsson and Villeneuve, 1999; Villeneuve et al., 2001; Bennett et al., 2005). The minimum depositional age of the George Lake turbidites, in the eastern Slave Province (Fig. 1), is constrained by a crosscutting quartz-feldspar porphyry dyke that has a crystallization age of ca. 2682 Ma (van Breemen et al., 1992). The depositional age of the Burwash Formation, east of Yellowknife (Fig. 1), is constrained by a ca. 2661 Ma U-Pb zircon crystallization age for intercalated felsic volcanic flows and tuffaceous horizons within the turbidites (Mortensen et al., 1992a; Bleeker and Villeneuve, 1995). The Damoti formation (informal name), in the western Slave Province (Fig. 1), has maximum depositional ages of 2629 Ma (Pehrsson and Villeneuve, 1999) and ca. 2635 Ma (Bennett et al., 2005), as determined by U-Pb ages of detrital zircon.

In some areas of the craton, turbidites are interbedded with abundant silicate-, sulphide-, and carbonate-facies iron-formation units that locally host gold showings and deposits (e.g. Lupin, Bugow; Bostock, 1980; Henderson, 1985; Jefferson et al., 1989; Brophy, 1992; Padgham, 1992; Kerswill, 1996; Jackson, 2001, 2003; Lambert, 2004; NORMIN database [www.nwtgeoscience.ca/normin]).

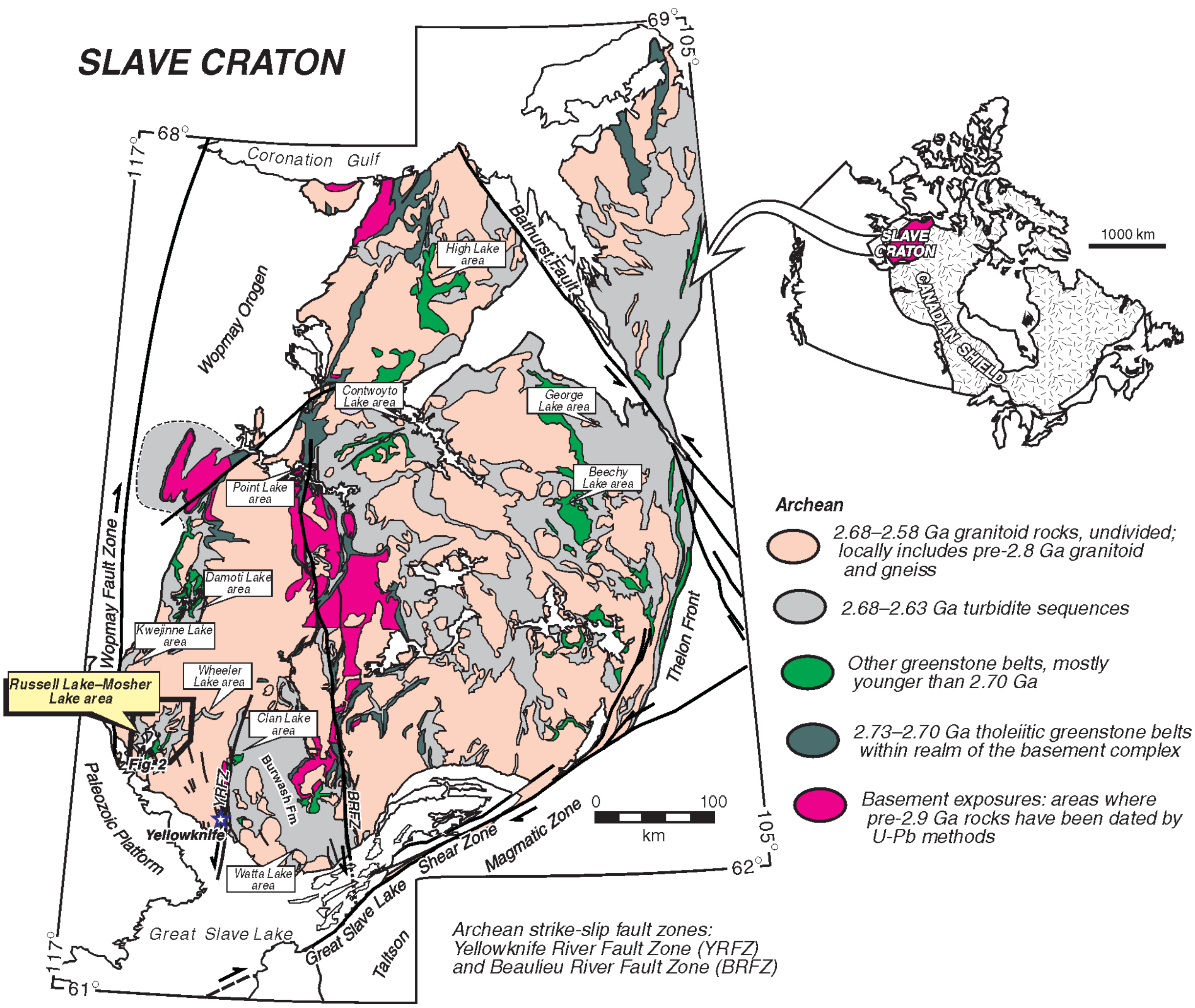

Figure 1. Geology of the Slave craton. Highlighted locations are discussed in text. *Modified from* Bleeker and Davis (1999).

Henderson (1985) suggested that these turbidites are dissimilar to those in the Burwash Formation, which lack iron-formation. Elsewhere in the Slave Province, the presence or absence of iron-formation was used to subdivide the monotonous greywacke-mudstone sequences (Bostock, 1980; Jefferson et al., 1989; Padgham, 1992; Henderson, 1998). Although van Breemen et al. (1992) provided evidence that some iron-formation-associated turbidites in the George Lake area are older than 2680 Ma, recent U-Pb zircon studies from the Damoti Lake and Beechy Lake areas of the craton (Fig. 1) indicate that some iron-formation-bearing turbidites are part of a younger, post-2630 Ma sedimentary package (Isachsen and Bowring, 1994; Pehrsson and Villeneuve, 1999; Villeneuve et al., 2001), which includes turbidites that do not contain iron-formation (Bennett et al., 2005).

Bedrock mapping in the vicinity of Russell and Mosher lakes, in the southwestern part of the craton (Fig. 2; Henderson, 1985; Jackson 2001, 2003; Ootes and Pierce, 2005), has outlined two distinct turbidite packages: the iron-formation-bearing Russell Lake turbidites and the iron-formation-free Mosher Lake turbidites (Fig. 2). Iron-formation within the Russell Lake turbidites hosts a number of gold showings similar to those in other parts of the craton. We have undertaken a U-Pb detrital zircon study of two greywacke samples, one from the Mosher Lake turbidites and the other from the Russell Lake turbidites. These are used to compare maximum depositional ages of iron-formation-bearing and iron-formation-free turbidites and to link these with other turbidite sequences of the southwestern Slave craton.

GEOLOGY OF THE RUSSELL LAKE–MOSHER LAKE AREA

The bedrock geology of the Russell Lake–Mosher Lake area (Fig. 2) is derived from the reconnaissance mapping of Lord (1942) and Henderson (1985) and the more detailed studies of Jackson (2001, 2003) and Ootes and Pierce (2005). A brief summary of the geology of the area is provided below.

The Mosher Lake turbidites, as defined here, occur between Mosher and Inglis lakes (Fig. 2) and are intruded to the north, south, and east by ca. 2605 to 2580 Ma metaluminous and peraluminous granitoid rocks (Henderson et al., 1987; S. Buse, pers. comm., 2005). The turbidites are generally homogeneous but locally contain calcareous beds. Bedding thickness ranges from 1 to 2 cm in mudstone to 1.5 m in arenite. Primary depositional features such as flames and grading are locally well preserved. The Mosher Lake turbidites have one known quartz vein-hosted gold showing in highly deformed pelite at Gold Island in Mosher Lake; in addition, a few mafic volcanic-hosted gold showings occur in the vicinity of Mosher Lake (Fig. 2). Few other prospective zones for mineralization have been identified within the turbidites (Ootes and Pierce, 2005; NORMIN database).

The Russell Lake turbidites, as defined here, lie west and north of Russell Lake (Fig. 2) and extend to the northeast along the Bousso River, and to the northwest through Slemon Lake (Fig. 2) to the Damoti Lake area (Fig. 1; Jackson, 2003; Pehrsson and Villeneuve, 1999). They consist of interbedded greywacke and mudstone turbidites, with bed thickness ranging from finely laminated to 50 cm (*see also* Fyson and Jackson, 1991, Fig. 9), and are intruded by ca. 2610 to 2585 Ma granitic plutons (Henderson et al., 1987; Bennett et al., 2005). The Russell Lake turbidites are characterized by abundant horizons of silicate-, sulphide-, and lesser amounts of carbonate-facies iron-formation (Fig. 2; Henderson, 1985; Jackson, 2001, 2003). The iron-formation generally is preserved as less than 5 m thick, conformable layers. At amphibolite grade, silicate-facies iron-formation consists of interbedded garnet- and amphibole-rich beds that locally contain chert nodules (Fig. 3; *see also* Henderson, 1985, p. 55), reflecting a history of boudinaged chert beds. Iron-formation occurrences in the Russell Lake area host numerous gold showings such as Bugow and SP (Fig. 2; NORMIN database).

A thick package of rhyolitic and dacitic volcanic rocks occurs southeast of Russell Lake. Major- and trace-element geochemical data indicate that these felsic volcanic rocks are similar to the ca. 2670 Ma Banting Group (Cousens et al., 2006); however, an age of 2658 ± 1 Ma (Mortensen et al., 1992a) indicates that these rocks are slightly younger than the Banting Group (Isachsen, 1992). The exact relationship of the volcanic sequence with the adjacent turbidites is not entirely clear. Locally preserved younging indicators in the felsic volcanic rocks, facing toward the northwest, suggest that Russell Lake turbidites overlie the volcanic package along its western contact (Fig. 2). Relative age relationships along the eastern margin of the volcanic belt are poorly understood; Henderson (1985) suggested that the volcanic rocks young to the northwest, implying that the Mosher Lake turbidites stratigraphically underlie them. However, the more detailed work of Jackson (2001) suggested that turbidites gradationally overlie the felsic volcanic rocks to the east, which is supported by the geochronological data presented herein. Therefore, it is likely that the volcanic rocks underlie both the Mosher Lake and Russell Lake turbidites (Fig. 2). The Mosher Lake mafic volcanic belt (Fig. 2) consists of highly flattened and lineated rocks that are gneissic near the belt margins. Pillow selvages are locally preserved although younging directions cannot be determined. It is interpreted that these mafic volcanic rocks lie within the Mosher Lake turbidites, but this stratigraphic relationship is not thoroughly constrained (Fig. 2).

Metamorphic grade through most of the study area ranges from biotite to cordierite facies and the biotite-cordierite isograd generally mimics the intrusive contact of the Neoarchean plutons (Fig. 2). Sillimanite-facies and migmatitic pelitic rocks are locally preserved near the Inglis Lake area and in the northeasternmost part of the study area (Fig. 2). Folds and associated fabrics can be linked to three generations of Archean structures (Fyson and Jackson, 1991; Ootes and

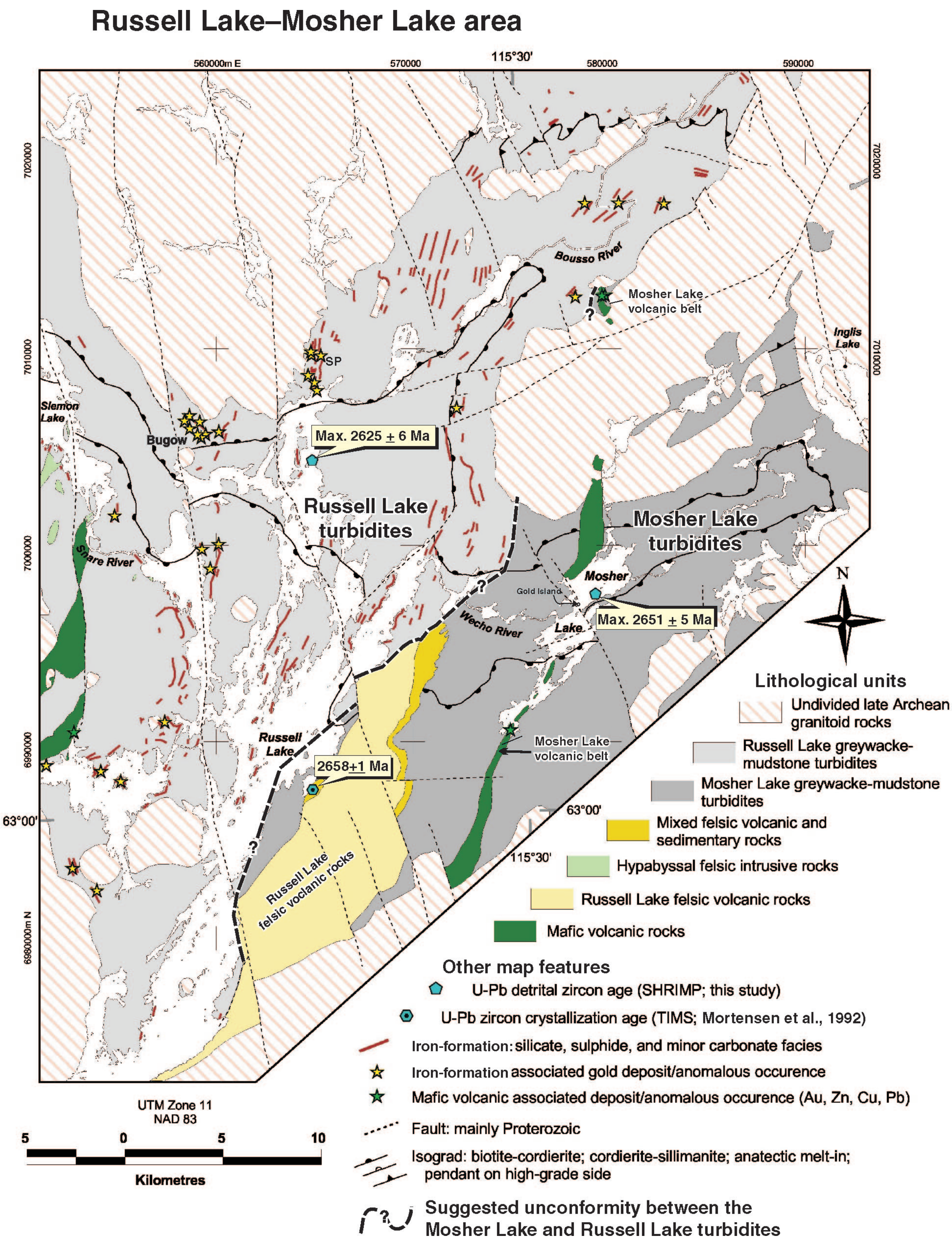

Figure 2. Geology of the Russell Lake–Mosher Lake area. Russell Lake–Mosher Lake turbidite packages defined by iron-formation and detrital zircons. Geology *modified from* Henderson (1985), Jackson (2001, 2003), and Ootes and Pierce (2005). Mineral showings are from the NORMIN database.

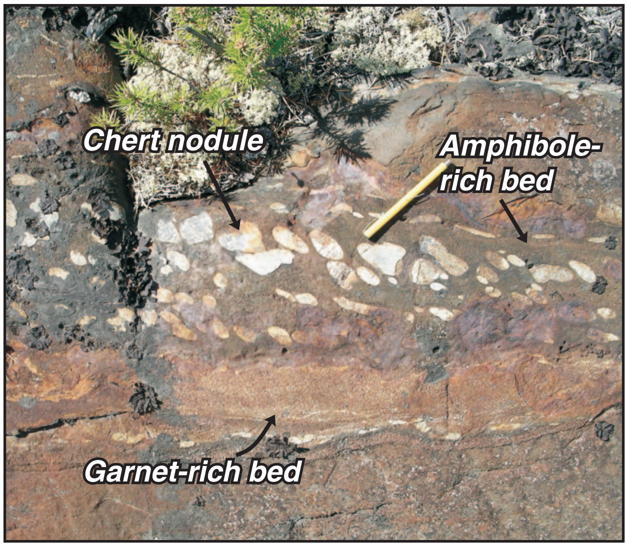

Figure 3. Outcrop example of silicate-facies iron-formation, northeast of Russell Lake. Interbedded garnet- and amphibole-rich beds, with large chert nodules in the amphibole-rich layers.

Pierce, 2005), but different generations are not distinguished in the two turbidite packages at this time. First-generation folds (F_1) are preserved as high-amplitude isoclines that account for frequent reversals in younging direction in the turbidites. Later deformation in the study area resulted in smaller scale folds (F_2, F_3) and the development of regionally penetrative foliations (S_2, S_3; Fyson and Jackson, 1991; Ootes and Pierce, 2005), similar to those documented for the Burwash Formation east of Yellowknife (Bleeker and Beaumont-Smith, 1995). Proterozoic brittle faults trend northwest and northeast and offset all major rock types (Fig. 2).

ANALYTICAL TECHNIQUES

Analytical procedures for U-Pb zircon analyses using the SHRIMP II microprobe at the Geological Survey of Canada followed those described by Stern (1997), with standards and U-Pb calibration methods following Stern and Amelin (2003). Zircon grains were not sieved and were separated at 10° slide slope and 1.8 A using a Frantz magnetic separator, to minimize introducing sample bias based on magnetic properties commonly associated with degree of alteration (*see* Sircombe and Stern, 2002). A random selection of approximately 120 grains per sample were cast in 2.5 cm diameter epoxy mounts (GSC no. 318) along with fragments of the GSC laboratory standard zircon (z6266, with $^{206}Pb/^{238}U$ age = 559 Ma). The internal features of the zircons were imaged using a SEM in backscattered electron (BSE) mode. Grains were randomly selected for analyses by following a grid pattern. Some grains were not analyzed if alteration or degree of fracturing was too extensive. Analyses were conducted using an $^{16}O^-$ primary beam and two different sized spots, one approximately 15 µm in diameter and another approximately 9 µm in diameter, with a beam current of approximately 3.5 nA and 1 nA, respectively. The 1σ external errors of Pb/U ratios incorporate a ± 1.0% error in the standard calibration. Isoplot v. 3.00 (Ludwig, 2003) was used to generate concordia plots and calculate weighted means. Analytical results are presented in Table 1.

AGE OF DETRITAL ZIRCONS

Mosher Lake greywacke – 04lo1315 (lab no. z8494)

The sample is a homogenous biotite-facies greywacke collected from the southeast side of an island in the northern part of Mosher Lake (Fig. 2, 4a). The greywacke bed dips and youngs to the east and is interbedded with mudstone. Bed thickness varies from 5 cm in the mudstone to 50 cm in the greywacke. Primary sedimentary features, including load structures and rip-up clasts of mudstone and arenite, are well preserved (Fig. 4a).

The sample yielded zircon grains of various morphologies, from long prismatic to equant grains, the majority with minimal evidence of mechanical abrasion by sedimentary processes (e.g. preservation of facets, low degree of rounding). One hundred and twenty grains were mounted and 59 grains were analyzed. The majority of the zircon grains have ages between 2675 and 2750 Ma (n = 50), with four grains older than 2800 Ma, one of which is older than 3100 Ma (Fig. 5a; Table 1). The youngest grain yielded a weighted mean age of 2651 ± 5 Ma (n = 8; Fig. 5a; Table 1), which is considered the maximum depositional age of the greywacke (Fig. 5a).

Russell Lake greywacke – 04RLG-1 (lab no. z8495)

The sample is a biotite-facies greywacke collected from an island in the northern part of Russell Lake, approximately 10 m east of a small cabin (Fig. 2, 4b). Interbedded mudstone and greywacke vary in thickness from 0.5 to 50 cm, and well exposed sections on the island show F_1 isoclinal folds that are transected by a later S_2 slaty cleavage, which is in turn locally crenulated by a late foliation (S_3; Fig. 4b). A conglomerate bed (Fig. 4b) occurs on the island and contains boulders and pebbles of sedimentary and plutonic rocks (mainly granodiorite in composition). Well preserved younging features indicate that the conglomerate and overlying turbidites young eastward at this location. The greywacke sample collected for this detrital study occurs 7 m stratigraphically above the conglomerate bed (Fig. 4b).

The sample yielded zircon grains of various morphologies, from long prismatic to equant grains, the majority with minimal evidence of mechanical abrasion by sedimentary processes (e.g. preservation of facets, low degree of rounding).

Table 1.U-Pb analytical results.

Analyses	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. (%)
Sample 04lo1315 - Lat/Long: 63°5.91' N, 115°25.71 W; UTM (Zone 11, NAD 83): 579 286m E, 6 997 535m N																						
8494-13.1	58	32	0.57	42	1	0.00003	0.00004	0.0005	0.143	0.013	20.45	0.44	0.6149	0.0117	0.9327	0.2412	0.0019	3090	47	3128	12	1.2
8494-65.1	91	101	1.15	69	8	0.00018	0.00005	0.0031	0.310	0.007	16.98	0.35	0.5797	0.0106	0.9382	0.2125	0.0015	2947	44	2924	12	-0.8
8494-83.1	105	56	0.55	67	5	0.00011	0.00005	0.0019	0.147	0.006	15.08	0.35	0.5459	0.0105	0.8853	0.2004	0.0022	2808	44	2829	18	0.7
8494-108.1	364	321	0.91	251	9	0.00005	0.00001	0.0009	0.255	0.005	15.13	0.26	0.5494	0.0091	0.9777	0.1997	0.0007	2823	38	2824	6	0
8494-93.1	103	46	0.47	61	6	0.00014	0.00006	0.0024	0.130	0.007	13.65	0.32	0.5216	0.0094	0.8336	0.1898	0.0025	2706	40	2740	22	1.3
8494-61.1	28	15	0.56	17	3	0.00025	0.00018	0.0044	0.159	0.011	13.44	0.45	0.5165	0.0120	0.7761	0.1887	0.0040	2684	51	2731	35	1.7
8494-26.1	166	79	0.50	99	5	0.00006	0.00002	0.0011	0.135	0.008	13.66	0.28	0.5248	0.0104	0.9752	0.1887	0.0009	2720	44	2731	8	0.4
8494-40.1	94	64	0.70	59	3	0.00006	0.00004	0.0011	0.184	0.011	13.65	0.27	0.5248	0.0093	0.9441	0.1887	0.0012	2719	39	2731	11	0.4
8494-106.1	239	229	0.99	153	4	0.00003	0.00005	0.0006	0.274	0.005	13.23	0.27	0.5095	0.0091	0.9314	0.1884	0.0014	2655	39	2728	12	2.7
8494-09.1	243	192	0.82	155	4	0.00004	0.00002	0.0007	0.225	0.006	13.52	0.25	0.5233	0.0092	0.9718	0.1874	0.0008	2713	39	2720	7	0.2
8494-10.1	64	63	1.02	43	3	0.00009	0.00011	0.0016	0.281	0.011	13.62	0.32	0.5275	0.0101	0.8721	0.1873	0.0022	2731	43	2718	19	-0.5
8494-75.1	78	42	0.57	47	5	0.00015	0.00005	0.0026	0.151	0.006	13.56	0.30	0.5256	0.0097	0.8985	0.1871	0.0018	2723	41	2717	16	-0.2
8494-95.1	100	45	0.46	58	11	0.00025	0.00006	0.0044	0.140	0.011	13.11	0.36	0.5085	0.0116	0.8964	0.1869	0.0023	2650	50	2715	20	2.4
8494-16.1	126	99	0.82	78	2	0.00004	0.00003	0.0007	0.217	0.005	13.15	0.28	0.5111	0.0091	0.8902	0.1866	0.0018	2661	39	2712	16	1.9
8494-103.1	30	17	0.58	18	6	0.00048	0.00034	0.0083	0.168	0.016	13.13	0.57	0.5115	0.0122	0.6473	0.1862	0.0062	2663	52	2709	56	1.7
8494-56.1	49	26	0.54	29	8	0.00034	0.00011	0.0059	0.139	0.016	13.41	0.40	0.5229	0.0114	0.8004	0.1860	0.0034	2712	48	2707	30	-0.2
8494-86.1	60	41	0.70	36	5	0.00018	0.00008	0.0032	0.195	0.007	12.93	0.31	0.5043	0.0096	0.8548	0.1859	0.0023	2632	41	2706	21	2.7
8494-88.1	29	30	1.04	19	5	0.00038	0.00013	0.0065	0.285	0.013	13.13	0.49	0.5124	0.0148	0.8480	0.1859	0.0037	2667	63	2706	33	1.4
8494-98.1	101	72	0.74	62	4	0.00008	0.00006	0.0015	0.201	0.007	13.23	0.28	0.5169	0.0098	0.9264	0.1856	0.0015	2686	42	2704	14	0.7
8494-84.1	153	56	0.38	88	3	0.00004	0.00004	0.0007	0.106	0.003	13.17	0.27	0.5158	0.0097	0.9574	0.1852	0.0011	2681	41	2700	10	0.7
8494-72.1	33	40	1.24	23	6	0.00044	0.00021	0.0076	0.379	0.016	13.05	0.41	0.5114	0.0109	0.7556	0.1850	0.0039	2663	47	2699	35	1.3
8494-109.1	87	64	0.76	53	11	0.00028	0.00008	0.0048	0.202	0.014	13.02	0.29	0.5106	0.0093	0.8899	0.1850	0.0019	2659	40	2698	17	1.4
8494-101.1	119	65	0.56	69	9	0.00017	0.00008	0.0029	0.147	0.009	12.85	0.32	0.5040	0.0102	0.8673	0.1849	0.0023	2631	44	2697	21	2.5
8494-77.1	248	111	0.46	142	9	0.00009	0.00002	0.0015	0.124	0.003	12.97	0.23	0.5090	0.0085	0.9711	0.1848	0.0008	2652	36	2697	7	1.6
8494-23.1	112	88	0.82	71	3	0.00007	0.00006	0.0012	0.241	0.011	13.25	0.30	0.5200	0.0102	0.9262	0.1848	0.0016	2699	43	2697	14	-0.1
8494-52.1	19	8	0.41	11	3	0.00032	0.00041	0.0056	0.121	0.018	13.15	0.69	0.5162	0.0143	0.6267	0.1848	0.0076	2683	61	2696	70	0.5
8494-21.1	234	155	0.69	141	1	0.00001	0.00001	0.0002	0.181	0.006	13.09	0.23	0.5137	0.0086	0.9693	0.1848	0.0008	2673	37	2696	7	0.9
8494-79.1	195	119	0.63	117	7	0.00008	0.00003	0.0013	0.175	0.004	13.13	0.25	0.5155	0.0093	0.9643	0.1847	0.0010	2680	39	2695	9	0.6
8494-54.1	156	156	1.03	100	10	0.00015	0.00005	0.0025	0.291	0.014	12.88	0.28	0.5063	0.0099	0.9456	0.1845	0.0013	2641	43	2694	12	2
8494-50.1	481	765	1.64	352	7	0.00003	0.00001	0.0006	0.448	0.004	13.24	0.22	0.5207	0.0085	0.9876	0.1845	0.0005	2702	36	2694	4	-0.3
8494-01.1	243	279	1.18	166	2	0.00002	0.00002	0.0004	0.325	0.011	13.36	0.26	0.5252	0.0092	0.9348	0.1845	0.0013	2721	39	2694	12	-1
8494-05.1.2	53	36	0.70	33	8	0.00032	0.00008	0.0056	0.192	0.009	13.14	0.32	0.5169	0.0106	0.8925	0.1844	0.0021	2686	45	2693	19	0.3
8494-100.1	47	52	1.14	31	7	0.00036	0.00011	0.0062	0.328	0.022	13.01	0.32	0.5119	0.0101	0.8523	0.1844	0.0024	2665	43	2693	22	1
8494-27.1	68	86	1.31	47	6	0.00018	0.00006	0.0032	0.353	0.021	13.31	0.27	0.5239	0.0092	0.9077	0.1843	0.0016	2715	39	2692	15	-0.9
8494-39.2	135	128	0.98	83	12	0.00022	0.00004	0.0038	0.275	0.005	12.47	0.25	0.4911	0.0085	0.9242	0.1842	0.0014	2575	37	2691	13	4.3
8494-76.1	66	66	1.03	44	6	0.00021	0.00012	0.0036	0.279	0.010	13.23	0.34	0.5212	0.0098	0.8116	0.1841	0.0028	2704	42	2690	25	-0.5
8494-02.1	70	43	0.63	42	2	0.00006	0.00006	0.0010	0.154	0.006	13.19	0.31	0.5198	0.0108	0.9368	0.1841	0.0015	2698	46	2690	14	-0.3
8494-47.1	156	61	0.40	89	9	0.00014	0.00005	0.0024	0.107	0.004	13.00	0.29	0.5125	0.0095	0.8954	0.1840	0.0018	2667	40	2689	16	0.8
8494-112.1	303	131	0.45	174	8	0.00006	0.00002	0.0010	0.124	0.003	12.92	0.24	0.5095	0.0087	0.9667	0.1839	0.0009	2655	37	2688	8	1.2
8494-97.1	102	108	1.09	68	10	0.00021	0.00005	0.0036	0.315	0.007	13.11	0.27	0.5172	0.0092	0.9182	0.1839	0.0015	2687	39	2688	14	0
8494-30.1	55	44	0.82	35	3	0.00012	0.00011	0.0021	0.216	0.009	13.35	0.37	0.5272	0.0101	0.7776	0.1837	0.0032	2730	43	2687	29	-1.6
8494-08.1	161	110	0.71	95	9	0.00013	0.00004	0.0023	0.192	0.005	12.61	0.28	0.4988	0.0089	0.8746	0.1834	0.0020	2608	38	2684	18	2.8
8494-38.1.2	130	94	0.75	78	9	0.00017	0.00003	0.0029	0.202	0.005	12.80	0.27	0.5064	0.0090	0.9004	0.1834	0.0017	2641	39	2684	15	1.6
8494-35.1	284	180	0.66	173	11	0.00008	0.00002	0.0015	0.176	0.004	13.15	0.25	0.5202	0.0087	0.9157	0.1834	0.0014	2700	37	2683	13	-0.6
8494-64.1	271	217	0.83	169	6	0.00005	0.00002	0.0009	0.223	0.004	12.99	0.26	0.5141	0.0095	0.9535	0.1832	0.0011	2674	41	2682	10	0.3
8494-39.1	134	117	0.90	86	10	0.00017	0.00004	0.0029	0.248	0.013	13.10	0.29	0.5186	0.0104	0.9428	0.1832	0.0014	2693	44	2682	12	-0.4
8494-66.1	56	26	0.49	32	6	0.00023	0.00021	0.0041	0.142	0.010	12.94	0.39	0.5123	0.0100	0.7360	0.1832	0.0037	2666	43	2682	34	0.6
8494-17.1	150	121	0.84	95	4	0.00007	0.00002	0.0012	0.241	0.005	13.05	0.27	0.5172	0.0094	0.9347	0.1830	0.0013	2687	40	2680	12	-0.3
8494-39.2.2	123	116	0.97	74	7	0.00014	0.00008	0.0025	0.259	0.007	12.28	0.27	0.4870	0.0093	0.9171	0.1830	0.0016	2558	40	2680	15	4.6
8494-87.1	229	350	1.57	165	8	0.00008	0.00005	0.0014	0.436	0.006	13.01	0.25	0.5161	0.0088	0.9348	0.1829	0.0013	2683	38	2679	11	-0.1
8494-82.1	73	77	1.09	47	6	0.00019	0.00008	0.0033	0.296	0.014	12.72	0.29	0.5052	0.0094	0.8846	0.1827	0.0019	2636	40	2677	18	1.5
8494-28.1	315	238	0.78	186	11	0.00008	0.00003	0.0014	0.208	0.003	12.42	0.23	0.4933	0.0082	0.9494	0.1826	0.0011	2585	35	2677	10	3.4
8494-05.1	57	38	0.70	35	6	0.00023	0.00040	0.0040	0.189	0.017	12.94	0.58	0.5141	0.0120	0.6231	0.1825	0.0064	2674	51	2676	59	0.1
8494-89.1	122	79	0.67	71	10	0.00019	0.00004	0.0034	0.174	0.009	12.57	0.24	0.4994	0.0087	0.9454	0.1825	0.0012	2611	37	2676	10	2.4
8494-03.1	140	210	1.55	97	4	0.00006	0.00003	0.0011	0.428	0.011	12.61	0.30	0.5013	0.0104	0.9243	0.1825	0.0017	2619	45	2676	15	2.1
8494-32.1	246	182	0.76	152	4	0.00003	0.00001	0.0006	0.206	0.008	12.99	0.23	0.5164	0.0085	0.9602	0.1825	0.0009	2684	36	2675	8	-0.3

Notes (*see* Stern, 1997):
Analyses code = lab number-grain number.spot number.replicate number (e.g. 8495-01.1.2)
Uncertainties reported at 1s (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
(4/6: 0.05770; 7/6: 0.89500; 8/6: 2.13840)
* refers to radiogenic Pb (corrected for common Pb)
Discordance relative to origin = 100 * (1-(^{206}Pb/^{238}U age)/(^{207}Pb/^{206}Pb age))
Standard 6266: U = 910 ppm; ^{206}Pb/^{238}U age = 559.0 Ma; ^{206}Pb/^{238}U = 0.09059

Table 1 (cont.)

Analyses	U (ppm)	Th (ppm)	Th/U	Pb* (ppm)	^{204}Pb (ppb)	$^{204}Pb/^{206}Pb$	$\pm\ ^{204}Pb/^{206}Pb$	f(206)[20]	$^{208*}Pb/^{206*}Pb$	$\pm\ ^{208}Pb/^{206}Pb$	$^{207*}P/^{235}U$	$\pm\ ^{207}Pb/^{235}U$	$^{206*}Pb/^{238}U$	$\pm\ ^{206}Pb/^{238}U$	Corr coeff	$^{207*}Pb/^{206*}Pb$	$\pm\ ^{207}Pb/^{206}Pb$	Apparent ages (Ma) $^{206}Pb/^{238}U$	$\pm\ ^{206}P/^{238}U$	$^{207}Pb/^{206}Pb$	$\pm\ ^{207}Pb/^{206}Pb$	Disc. (%)
Sample 04lo1315 - Lat/Long: 63°5.91' N, 115°25.71 W; UTM (Zone 11, NAD 83): 579 286m E, 6 997 535m N (cont.)																						
8494-12.1	351	341	1.00	222	4	0.00003	0.00001	0.0005	0.275	0.009	12.67	0.23	0.5039	0.0084	0.9612	0.1823	0.0009	2631	36	2674	8	1.6
8494-38.1	133	96	0.74	82	3	0.00005	0.00002	0.0008	0.198	0.004	13.01	0.24	0.5180	0.0089	0.9612	0.1822	0.0009	2691	38	2673	9	-0.7
8494-91.1	41	9	0.23	22	11	0.00063	0.00013	0.0109	0.051	0.007	12.64	0.35	0.5050	0.0102	0.7976	0.1816	0.0031	2635	44	2667	28	1.2
8494-48.1.3	357	181	0.52	200	7	0.00005	0.00001	0.0008	0.152	0.004	12.19	0.27	0.4898	0.0104	0.9899	0.1805	0.0006	2570	45	2657	5	3.3
8494-48.2.2	280	119	0.44	144	11	0.00010	0.00002	0.0017	0.127	0.003	11.41	0.21	0.4587	0.0080	0.9786	0.1804	0.0007	2434	35	2656	6	8.4
8494-110.1	128	115	0.93	81	7	0.00012	0.00004	0.0022	0.253	0.006	12.74	0.30	0.5129	0.0093	0.8255	0.1801	0.0025	2669	40	2654	23	-0.6
8494-48.2.4	233	103	0.46	115	9	0.00010	0.00002	0.0017	0.131	0.003	10.83	0.28	0.4367	0.0110	0.9898	0.1799	0.0007	2336	49	2652	6	11.9
8494-48.2	293	124	0.44	152	13	0.00012	0.00002	0.0020	0.125	0.004	11.46	0.20	0.4622	0.0076	0.9592	0.1799	0.0009	2449	34	2652	8	7.6
8494-48.1	316	134	0.44	181	2	0.00002	0.00002	0.0003	0.119	0.005	12.70	0.37	0.5123	0.0089	0.6855	0.1799	0.0039	2666	38	2652	36	-0.6
8494-48.1.4	301	155	0.53	168	8	0.00006	0.00002	0.0011	0.150	0.003	12.06	0.31	0.4870	0.0121	0.9814	0.1796	0.0009	2558	53	2649	8	3.4
8494-48.2.3	262	114	0.45	132	7	0.00007	0.00002	0.0013	0.129	0.005	11.04	0.25	0.4471	0.0098	0.9806	0.1791	0.0008	2382	44	2644	8	9.9
8494-48.1.2	371	175	0.49	211	9	0.00005	0.00001	0.0009	0.136	0.002	12.39	0.23	0.5039	0.0090	0.9774	0.1783	0.0007	2631	39	2637	7	0.3
8494-20.1	1534	687	0.46	875	24	0.00004	0.00001	0.0006	0.125	0.002	12.45	0.21	0.5087	0.0083	0.9906	0.1775	0.0004	2651	36	2630	4	-0.8
Sample 04RLG-1 - Lat/Long - 63°9.79' N, 115°42.81 W; UTM (Zone 11, NAD 83): 564 808m E; 7 004 419m N																						
8495-46.1	111	58	0.54	71	3	0.00005	0.00003	0.0008	0.148	0.004	15.31	0.22	0.5486	0.0066	0.8750	0.2024	0.0015	2819	27	2846	12	0.9
8495-19.1	57	18	0.32	34	4	0.00014	0.00010	0.0025	0.084	0.009	14.62	0.27	0.5366	0.0071	0.7956	0.1976	0.0022	2769	30	2806	18	1.3
8495-12.1	338	224	0.68	220	5	0.00003	0.00001	0.0005	0.190	0.003	14.83	0.20	0.5446	0.0066	0.9440	0.1975	0.0009	2803	27	2806	7	0.1
8495-83.1	164	46	0.29	98	8	0.00010	0.00003	0.0018	0.074	0.004	14.64	0.26	0.5468	0.0073	0.8184	0.1942	0.0020	2812	30	2778	17	-1.2
8495-77.1	151	193	1.32	108	4	0.00006	0.00003	0.0011	0.358	0.006	14.09	0.18	0.5350	0.0060	0.9269	0.1910	0.0009	2763	25	2750	8	-0.4
8495-94.1	46	22	0.50	26	5	0.00026	0.00016	0.0044	0.121	0.011	13.48	0.42	0.5123	0.0119	0.8212	0.1909	0.0034	2666	51	2750	30	3
8495-13.1	171	121	0.73	109	1	0.00002	0.00003	0.0003	0.209	0.004	13.99	0.20	0.5317	0.0060	0.8652	0.1908	0.0014	2749	25	2749	12	0
8495-48.1	215	139	0.67	135	3	0.00003	0.00002	0.0006	0.185	0.003	13.85	0.21	0.5277	0.0074	0.9646	0.1903	0.0008	2732	31	2745	7	0.5
8495-25.1	255	271	1.10	171	4	0.00003	0.00003	0.0006	0.286	0.009	13.75	0.21	0.5278	0.0068	0.9090	0.1889	0.0012	2732	29	2732	10	0
8495-21.1	91	66	0.75	57	4	0.00011	0.00004	0.0019	0.205	0.012	13.57	0.28	0.5216	0.0095	0.9409	0.1886	0.0013	2706	40	2730	11	0.9
8495-05.1	289	144	0.52	173	6	0.00005	0.00002	0.0008	0.138	0.004	13.67	0.17	0.5265	0.0057	0.9318	0.1883	0.0009	2727	24	2727	7	0
8495-32.1	115	135	1.21	82	4	0.00007	0.00003	0.0012	0.341	0.016	14.03	0.26	0.5425	0.0076	0.8386	0.1876	0.0019	2794	32	2721	17	-2.7
8495-69.1	133	87	0.68	81	5	0.00009	0.00003	0.0015	0.177	0.006	13.35	0.22	0.5172	0.0071	0.8964	0.1873	0.0014	2687	30	2718	12	1.1
8495-02.1	302	271	0.93	196	3	0.00003	0.00001	0.0004	0.252	0.006	13.55	0.20	0.5251	0.0070	0.9425	0.1872	0.0009	2721	30	2718	8	-0.1
8495-11.1	359	100	0.29	204	2	0.00001	0.00001	0.0002	0.078	0.002	13.47	0.16	0.5219	0.0056	0.9606	0.1872	0.0006	2707	24	2718	5	0.4
8495-07.1	131	103	0.81	83	5	0.00008	0.00003	0.0014	0.227	0.011	13.47	0.24	0.5218	0.0062	0.7533	0.1872	0.0022	2707	26	2717	19	0.4
8495-03.1	94	30	0.33	55	3	0.00007	0.00011	0.0012	0.095	0.006	13.60	0.31	0.5278	0.0083	0.7702	0.1868	0.0027	2732	35	2714	24	-0.7
8495-95.1	139	104	0.77	84	6	0.00010	0.00004	0.0017	0.206	0.005	12.89	0.24	0.5030	0.0086	0.9452	0.1858	0.0012	2627	37	2706	10	2.9
8495-31.1	141	73	0.54	85	5	0.00007	0.00003	0.0013	0.145	0.006	13.47	0.21	0.5262	0.0070	0.9197	0.1857	0.0011	2725	30	2705	10	-0.8
8495-40.1	246	91	0.38	143	5	0.00005	0.00001	0.0008	0.104	0.005	13.41	0.18	0.5243	0.0058	0.8718	0.1855	0.0012	2718	24	2703	11	-0.5
8495-16.1	87	60	0.71	53	3	0.00008	0.00005	0.0014	0.193	0.006	13.18	0.23	0.5154	0.0064	0.7903	0.1854	0.0020	2680	27	2702	18	0.8
8495-68.1	120	69	0.59	73	6	0.00011	0.00004	0.0019	0.155	0.004	13.36	0.18	0.5229	0.0060	0.8972	0.1853	0.0011	2711	26	2701	10	-0.4
8495-66.1	171	103	0.62	102	3	0.00004	0.00002	0.0008	0.163	0.004	13.09	0.20	0.5126	0.0071	0.9372	0.1852	0.0010	2668	30	2700	9	1.2
8495-04.1	142	160	1.17	94	2	0.00004	0.00003	0.0007	0.317	0.006	13.11	0.24	0.5139	0.0074	0.8430	0.1850	0.0019	2673	32	2698	17	0.9
8495-33.1	73	50	0.70	45	3	0.00008	0.00005	0.0015	0.194	0.008	13.14	0.21	0.5152	0.0067	0.8701	0.1849	0.0015	2679	28	2698	13	0.7
8495-01.1	169	145	0.88	108	1	0.00002	0.00002	0.0003	0.238	0.006	13.33	0.27	0.5235	0.0093	0.9154	0.1847	0.0015	2714	40	2695	14	-0.7
8495-27.1	214	148	0.71	135	6	0.00006	0.00002	0.0011	0.198	0.004	13.46	0.18	0.5291	0.0063	0.9420	0.1845	0.0008	2738	26	2693	7	-1.6
8495-09.1	105	93	0.92	68	2	0.00005	0.00006	0.0009	0.247	0.015	13.35	0.21	0.5250	0.0066	0.8671	0.1844	0.0014	2720	28	2693	13	-1
8495-29.1	133	82	0.63	82	7	0.00012	0.00003	0.0021	0.170	0.005	13.34	0.26	0.5249	0.0071	0.7707	0.1844	0.0023	2720	30	2693	21	-1
8495-93.1	220	111	0.52	126	6	0.00006	0.00003	0.0011	0.143	0.003	12.72	0.25	0.5012	0.0089	0.9377	0.1841	0.0013	2619	38	2690	12	2.6
8495-17.1	102	64	0.64	61	2	0.00005	0.00004	0.0009	0.167	0.005	13.07	0.22	0.5150	0.0078	0.9288	0.1840	0.0012	2678	33	2690	11	0.4
8495-70.1	88	73	0.86	54	2	0.00005	0.00006	0.0009	0.235	0.006	12.78	0.25	0.5043	0.0077	0.8420	0.1839	0.0020	2632	33	2688	18	2.1
8495-82.1	147	38	0.27	83	4	0.00005	0.00004	0.0009	0.073	0.003	13.25	0.22	0.5231	0.0072	0.8988	0.1837	0.0013	2712	30	2687	12	-1
8495-20.1	238	120	0.52	140	2	0.00002	0.00002	0.0003	0.145	0.004	13.02	0.17	0.5147	0.0060	0.9483	0.1835	0.0008	2677	26	2685	7	0.3
8495-41.1	539	131	0.25	303	6	0.00002	0.00001	0.0004	0.066	0.003	13.24	0.61	0.5235	0.0155	0.7305	0.1835	0.0058	2714	66	2684	53	-1.1
8495-47.1	260	163	0.65	155	3	0.00002	0.00003	0.0004	0.169	0.003	12.93	0.19	0.5113	0.0065	0.9241	0.1834	0.0010	2662	28	2684	9	0.8
8495-55.1	531	379	0.74	333	2	0.00001	0.00001	0.0001	0.202	0.002	13.23	0.15	0.5265	0.0055	0.9704	0.1822	0.0005	2727	23	2673	4	-2
8495-39.1	248	138	0.57	150	3	0.00002	0.00002	0.0004	0.160	0.003	13.12	0.19	0.5234	0.0062	0.8846	0.1818	0.0012	2713	26	2669	11	-1.7
8495-14.1	63	65	1.06	42	8	0.00029	0.00008	0.0051	0.295	0.023	13.00	0.31	0.5190	0.0082	0.7492	0.1817	0.0029	2695	35	2668	27	-1
8495-24.1	315	105	0.34	178	2	0.00002	0.00002	0.0003	0.091	0.005	12.92	0.16	0.5181	0.0059	0.9387	0.1809	0.0008	2691	25	2661	7	-1.1
8495-58.1	229	257	1.16	151	6	0.00006	0.00002	0.0011	0.323	0.005	12.57	0.24	0.5076	0.0075	0.8457	0.1796	0.0018	2646	32	2649	17	0.1
8495-64.1	81	64	0.81	51	7	0.00020	0.00007	0.0035	0.226	0.009	12.71	0.20	0.5140	0.0064	0.8499	0.1793	0.0015	2674	27	2646	14	-1
8495-58.2	130	119	0.95	80	8	0.00015	0.00003	0.0026	0.255	0.007	12.36	0.28	0.5006	0.0098	0.9238	0.1792	0.0016	2616	42	2645	14	1.1
8495-08.1	139	43	0.32	76	1	0.00001	0.00004	0.0003	0.082	0.003	12.30	0.24	0.5019	0.0084	0.8986	0.1778	0.0016	2622	36	2632	15	0.4
8495-08.1.2	135	38	0.29	73	9	0.00016	0.00005	0.0028	0.084	0.003	12.09	0.28	0.4932	0.0104	0.9607	0.1778	0.0011	2584	45	2632	11	1.8
8495-30.2	303	187	0.64	168	8	0.00006	0.00002	0.0011	0.171	0.004	11.71	0.14	0.4776	0.0054	0.9587	0.1778	0.0006	2517	23	2632	6	4.4
8495-30.1	264	151	0.59	155	2	0.00001	0.00002	0.0002	0.171	0.004	12.42	0.16	0.5068	0.0058	0.9241	0.1777	0.0009	2643	25	2631	8	-0.4
8495-08.2.2	116	53	0.47	60	6	0.00012	0.00003	0.0021	0.130	0.007	11.28	0.26	0.4609	0.0094	0.9351	0.1775	0.0015	2444	41	2629	14	7.1
8495-08.2.3	94	41	0.45	47	7	0.00020	0.00007	0.0035	0.116	0.006	10.87	0.28	0.4457	0.0106	0.9538	0.1770	0.0014	2376	47	2625	13	9.5
8495-30.1.3	219	118	0.56	122	4	0.00005	0.00002	0.0008	0.158	0.003	11.84	0.25	0.4858	0.0099	0.9770	0.1768	0.0008	2553	43	2623	8	2.7
8495-30.2.2	268	160	0.62	147	4	0.00004	0.00002	0.0006	0.177	0.004	11.45	0.17	0.4709	0.0066	0.9674	0.1764	0.0007	2487	29	2619	6	5
8495-08.2	135	69	0.53	72	8	0.00015	0.00004	0.0027	0.143	0.006	11.46	0.23	0.4718	0.0085	0.9385	0.1761	0.0012	2491	37	2617	12	4.8
8495-30.1.2	219	119	0.56	126	12	0.00012	0.00002	0.0021	0.153	0.003	12.22	0.20	0.5037	0.0073	0.9345	0.1760	0.0010	2630	32	2615	10	-0.5

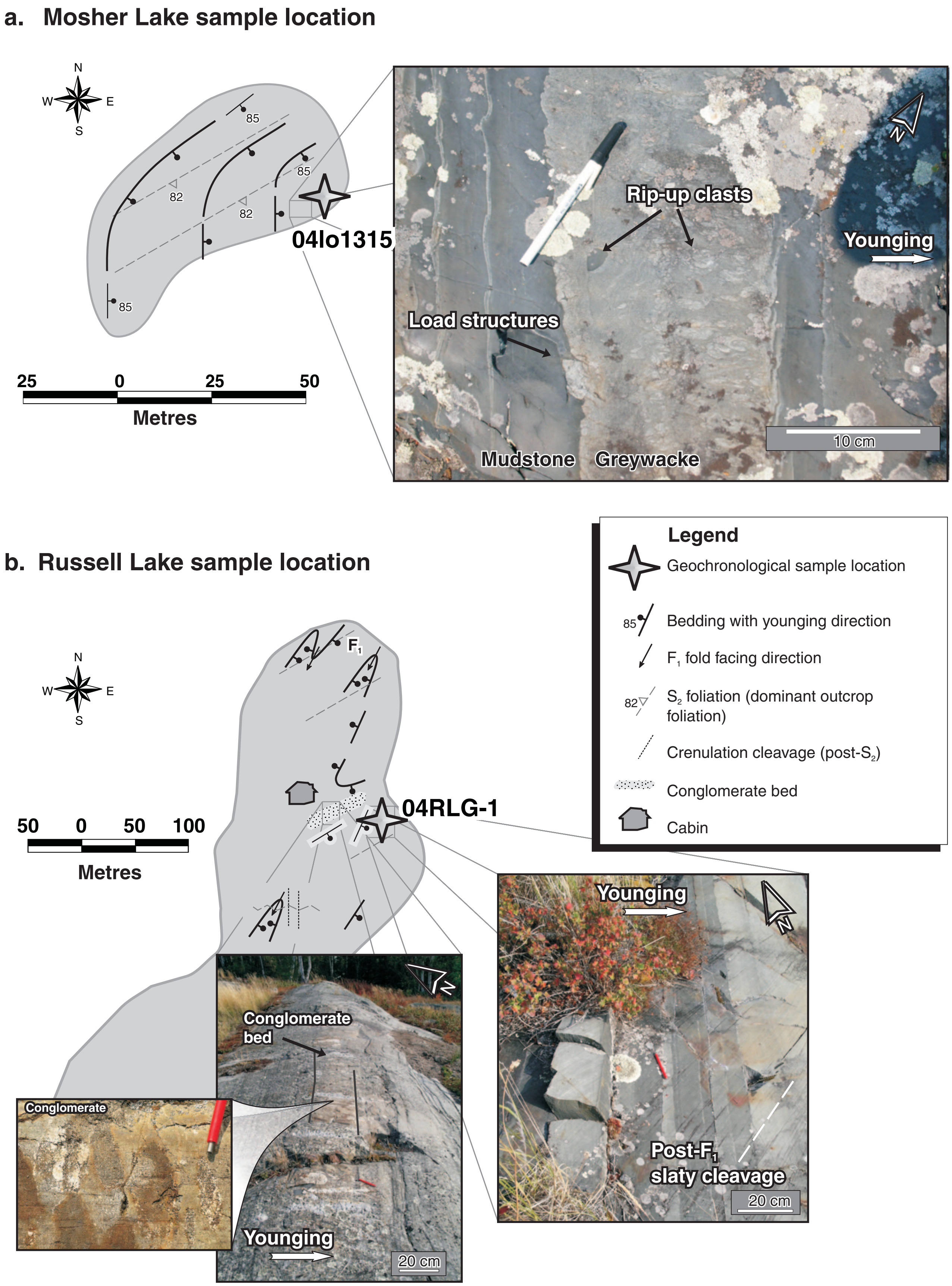

Figure 4. a) U-Pb detrital zircon sample location and local geology from the island in the northern part of Mosher Lake. **b**) U-Pb detrital zircon sample location and local geology from the island in Russell Lake.

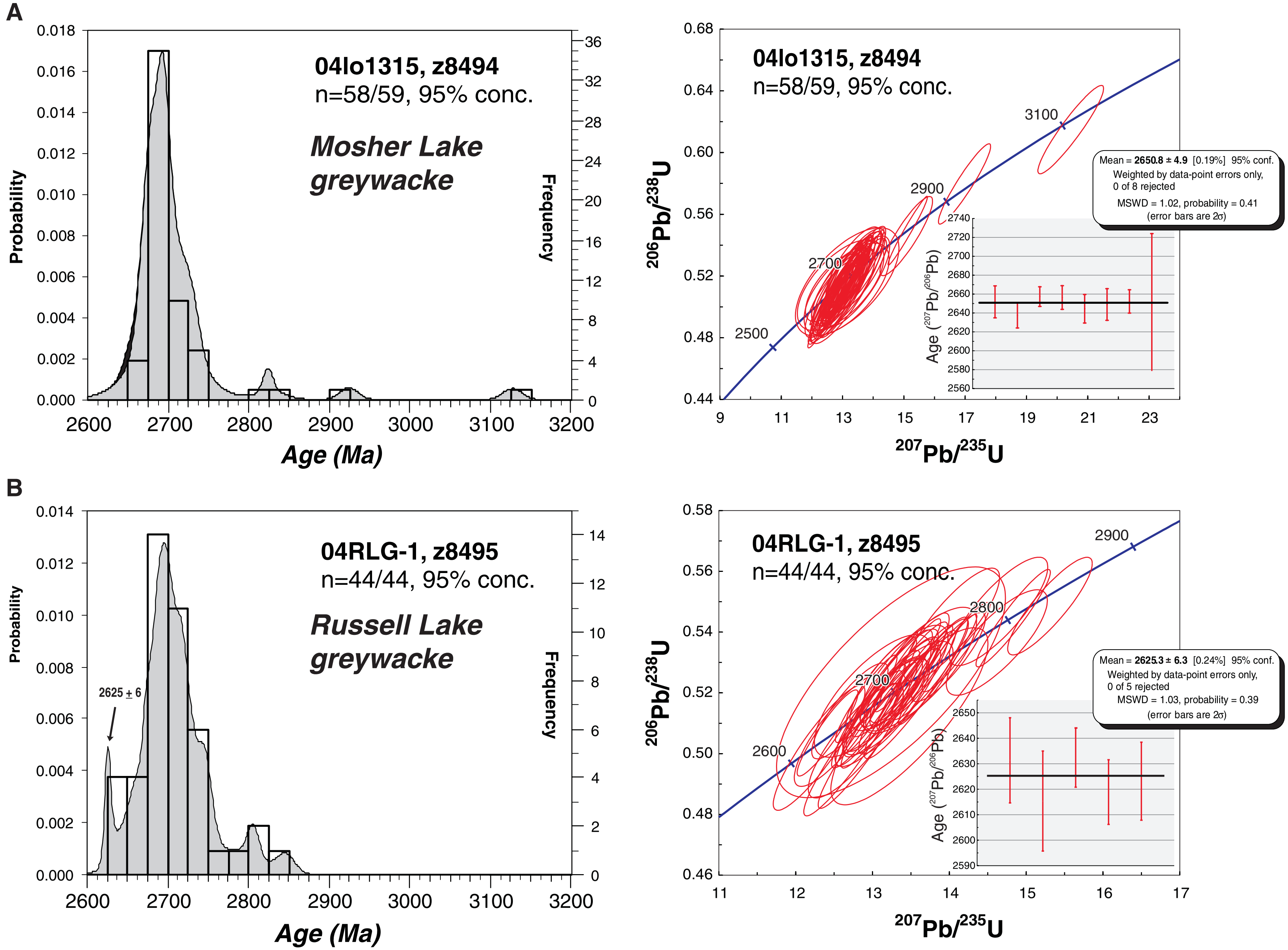

Figure 5. a) Histogram and probability curve and Concordia diagram of Mosher Lake greywacke results. Data-point error ellipses on Concordia diagram are 2σ. Inset is weighted mean age of the youngest grain identified. **b**) Histogram and probability curve and Concordia diagram of Russell Lake greywacke results. Data-point error ellipses on Concordia diagram are 2σ. Inset is weighted mean age of the youngest grain identified. MSWD = mean square of the weighted deviates; 95% conc. = all analyses are greater than 95% concordant; and 2σ = two standard deviation error.

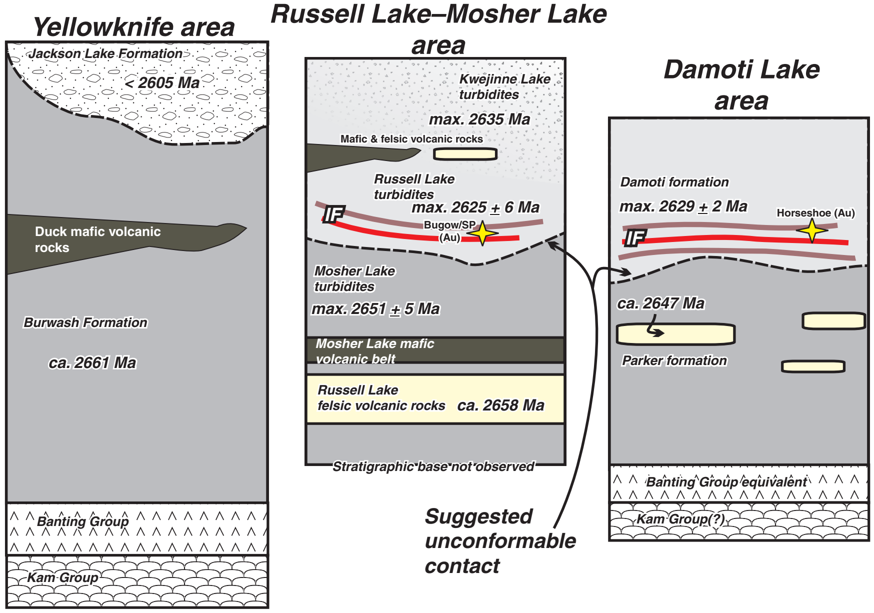

Figure 6. Schematic representation and comparison of stratigraphy in the Yellowknife, Russell Lake–Mosher Lake, and Damoti Lake areas. Yellowknife area *modified from* Bleeker et al. (1999); Damoti area *modified from* Pehrsson and Villeneuve (1999). IF = iron-formation. Ages discussed and referenced in text, except Jackson Lake Formation conglomerate (Isachsen, 1992).

One hundred and twenty grains were mounted and 44 grains were analyzed. The majority of the zircon grains have ages between 2675 and 2700 Ma (n = 31), with three grains older than 2800 Ma and younger than 2850 Ma (Fig. 5b; Table 1). The youngest zircon grain yielded a weighted mean age of 2625 ± 6 Ma (n = 5; Fig. 5b; Table 1), which is considered the maximum depositional age of the greywacke.

DISCUSSION

The depositional age of the Mosher Lake turbidites is determined to be less than or equal to 2651 ± 5 Ma. This maximum depositional age is only slightly older than the Grid Rhyolite (Parker formation) in the Damoti Lake area, which yielded a crystallization age of 2647 ± 2 Ma (Fig. 6; Pehrsson and Villeneuve, 1999), but is younger than the ca. 2658 Ma Russell Lake felsic volcanic rocks (Mortensen et al., 1992a) and the ca. 2661 Ma Burwash Formation turbidites east of Yellowknife (Fig. 6; Bleeker and Villeneuve, 1995). In contrast, the maximum 2625 ± 6 Ma depositional age of the iron-formation-bearing Russell Lake turbidites is at least 30 Ma younger than either the Russell Lake felsic volcanic rocks or the Burwash Formation (Fig. 6; Table 2). This age indicates a distinct, younger supracrustal package in the Russell Lake– Mosher Lake area.

Using the maximum depositional ages from the detrital zircon data combined with the presence or absence of iron-formation, we suggest that two temporally distinct turbidite sequences occur within the Russell Lake–Mosher Lake area. The contact between the two sequences is not recognized in the field; however, a suggested boundary between them is shown in Figure 2. This is based on the presence of iron-formation above the contact, which is currently inferred here to be an unconformity (Fig. 2). Our data suggest that the Mosher Lake turbidites, although slightly younger, may be tentatively correlated with the Burwash Formation east of Yellowknife (Fig. 1, 6). The similarity in ages and iron-formation association allows the Russell Lake turbidites to be correlated with Damoti formation turbidites to the north, at Damoti Lake (Fig. 1, 6). Figure 6 shows the Russell Lake turbidites grading into similar-aged turbidites that lack iron-formation in the Kwejinne Lake area, which has a maximum depositional age of 2635 ± 8 Ma (Bennett et al., 2005; Table 2), indicating that young turbidites occur in the southwestern part of the craton that do not contain iron-formation.

Locally, throughout the craton, gold deposits are hosted in iron-formation-bearing turbidites (Jefferson et al., 1989; Brophy, 1992; Padgham, 1992; Kerswill, 1996; Pehrsson and Villeneuve, 1999; Jackson, 2003; Ootes and Pierce, 2005; NORMIN database). These iron-formation-bearing turbidites are now locally well constrained to at least two time frames, the >2680 Ma turbidites (e.g. George Lake; Table 2; van Breemen et al., 1992) and the post-2630 Ma turbidites (e.g. southwestern part of the craton and the Beechy Lake area; Table 2; Pehrsson and Villeneuve, 1999; Villeneuve et al., 2001). Because of the number of gold showings hosted by the young, iron-formation-bearing turbidites, this may

Table 2. Summary of available age constraints on timing of turbidite deposition in the Slave craton.

	Age (Ma)	Name	Location on Figure 1	Latitude	Longitude	Iron-formation association	Description	Depositional age constraint	Method	Source
pre-2680 Ma	min. 2682.5 ± 1.5	George Lake turbidites	George Lake area, ~420 km northeast of Yellowknife	~65° 56′ 00″	~107° 29′ 00″	yes	quartz-feldspar porphyry crosscutting turbidites	minimum: crosscutting intrusion	TIMS-sg (n=3)	van Breemen et al. (1992)
	max. 2683 ± 2	George Lake turbidites	George Lake area, ~420 km northeast of Yellowknife	~65° 55′ 00″	~107° 29′ 00″	yes	detrital zircon from granulestone	maximum: youngest detrital grain	TIMS-sg (n=10)	van Breemen et al. (1992)
~2640 to <2680 Ma	max. 2677 ± 1	N/A	High Lake area, ~500 km north-northeast of Yellowknife	67° 14′ 56″	110° 41′ 50″	no	detrital zircon from greywacke	maximum: youngest detrital grain	TIMS(?) (n=9)	Henderson et al. (2000)
	max. ca. 2664 ± 6	N/A	Lac de Gras area, ~275 km northeast of Yellowknife	64° 36′ 51″	110° 26′ 18″	*no	detrital zircon from coarse greywacke	maximum: youngest detrital grain	TIMS-sg (n=9)	Yamashita et al. (2000)
	max. ca. 2664 ± 2	N/A	High Lake area, ~500 km north-northeast of Yellowknife	67° 2′ 48″	110° 57′ 0″	*no	detrital zircon from turbiditic greywacke	maximum: youngest detrital grain	TIMS-sg (n=8)	Yamashita et al. (2000)
	2661 ± 2	Burwash Formation	Watta Lake, ~70 km east of Yellowknife	62° 16′ 53″	113° 6′ 38″	no	interbedded felsic tuff within turbidites	depositional age: ash layer	TIMS-sg+mg	Bleeker and Villeneuve (1995)
	2661.3 +1.2/-1.1	Burwash Formation	Clan Lake, ~50 km north of Yellowknife	62° 56′ 54″	114° 14′ 54″	no	felsic volcanic rock within turbidites	depositional age: volcanic layer	TIMS (n=4)	Mortensen et al. (1992a)
	max. 2661 ± 1	Shallow Bay volcaniclastic	Contwoyto Lake area, ~350 km northeast of Yellowknife	65° 42′ 20″	111° 12′ 24″	yes	detrital zircon from volcaniclastic rock	maximum: youngest detrital grain	TIMS-mg (n=6)	Mortensen et al. (1992b)
	max. 2660(?)	Contwoyto Formation	Tree Bay, Point Lake, ~320 km north of Yellowknife	65° 21′ 40″	113° 2′ 32″	yes	detrital zircon from greywacke	maximum: youngest detrital grain	TIMS-sg	Schärer and Allègre (1982)
	2658 +0.8/-1.2	Russell Lake volcanic	Russell Lake, ~100 km west-northwest of Yellowknife	63° 0′ 42″	115° 43′ 6″	*yes	felsic volcanic rock within turbidites	depositional age: volcanic layer	TIMS-mg (n=3)	Mortensen et al. (1992a)
	max. 2651 ± 6	Mosher Lake turbidites	Mosher Lake, ~80 km west-northwest of Yellowknife	63° 5′ 55″	115° 25′ 43″	no	detrital zircon from greywacke	maximum: youngest detrital grain	SHRIMP (n=58)	*this study*
	2647± 2	Parker formation	Indin Lake supracrustal belt (Damoti Lake area), ~200 km northwest of Yellowknife	64° 15′ 51″	115° 15′ 35″	no	rhyolite volcanic breccia interbedded with turbidite	depositional age: volcanic layer	TIMS	Pehrsson and Villeneuve (1999)
	2637 +8/-6	Beechy Lake Group	Beechy Lake area, ~420 km northeast of Yellowknife	65° 2′ 53″	108° 36′ 41″	*yes	felsic sill in turbidites - minimum age of turbidites	minimum: crosscutting	TIMS-sg - 4 grains	Villeneuve et al. (2001)
post ~2635 Ma	max. 2635 ± 8	N/A	Kwejinne Lake area, ~150 km northwest of Yellwoknife	~63° 46′ 00″	~115° 47′ 55″	no	detrital zircon from greywacke	maximum: youngest detrital grain	LA-ICP-MS (n=100)	Bennett et al. (2005)
	max. 2629 ± 2	Damoti formation	Damoti Lake, ~200 km northeast of Yellowknife	64° 9′ 60″	115° 5′ 59″	yes	detrital zircon from greywacke	maximum: youngest detrital grain	TIMS-sg (n=15)	Pehrsson and Villeneuve (1999)
	max. 2625 ± 6	Russell Lake turbidites	Russell Lake, ~100 km west-northwest of Yellowknife	63° 9′ 47″	115° 42′ 49″	yes	detrital zircon from greywacke	maximum: youngest detrital grain	SHRIMP (n=44)	*this study*
	max. 2620 ± 5	Beechy Lake Group	Beechy Lake area, ~420 km northeast of Yellowknife	65° 5′ 29″	108° 14′ 43″	yes	detrital zircon from coarse wacke	maximum: youngest detrital grain	TIMS-sg (n=6)	Villeneuve et al. (2001); Lambert (2004)
	2616 ± 3	N/A	High Lake area, ~500 km north-northeast of Yellowknife	~67° 2′ 00″	~110° 54′ 20″	*yes	conformable dacitic porphyry between greywacke and slate	depositional age: volcanic layer	TIMS-sg (n=4)	Henderson et al. (1995)
	2612 ± 2	Wheeler Lake turbidites	Wheeler Lake, ~100 km north-northwest of Yellowknife	63° 18′ 29″	114° 47′ 53″	yes	interbedded felsic tuff within turbidites	minimum: crosscutting intrusion	TIMS	Isachsen and Bowring (1994)
	max. 2607 ± 4	N/A	High Lake area, ~500 km north-northeast of Yellowknife	67° 16′ 13″	110° 45′ 11″	*yes	volcaniclastic rock	depositional age: volcanic layer	TIMS(?) (n=8)	Henderson et al. (2000)

N/A = no name given
*no = not known from published data
*yes = although spatial association is implied, exact relationship is unclear from published data
~ = approximate location
TIMS = thermal ionization mass spectrometry; sg = single-grain analysis where known; mg = multigrain analysis where known; n = total number of analyses
SHRIMP = Sensitive High Resolution Ion Microprobe; n = number of grains analyzed
LA-ICP-MS = laser ablation inductively coupled plasma mass spectrometry; n = number of grains analyzed

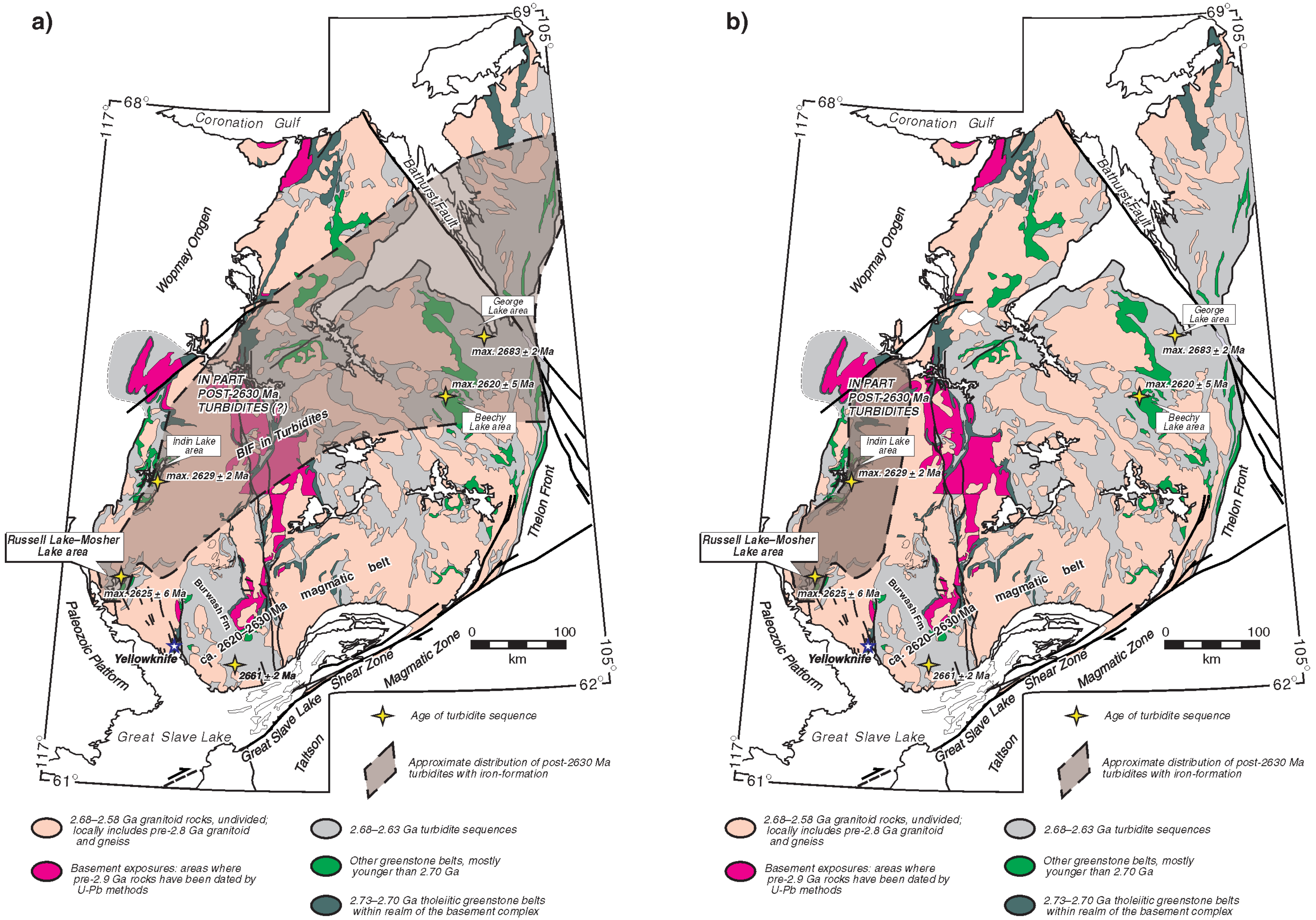

Figure 7. Geology of the Slave craton highlighting two possible post-2630 Ma metallotects. **a**) Turbidites with iron-formation occurring as pan-Slave metallotect, where many iron-formation-hosting turbidites are considered to be post-2630 Ma (iron-formation zone *modified from* Padgham, 1992). **b**) Turbidites with iron-formation occurring as western Slave metallotect, where only these iron-formation-hosting turbidites are post-2630 Ma (W. Bleeker, pers. comm., 2005). *See* text for discussion and Table 2 for turbidite age references. Defeat plutonic arc *modified from* Davis and Bleeker (1999) and Davis et al. (2003).

indicate a new, previously undocumented gold metallotect. Other iron-formation-bearing turbidites in the craton may or may not be part of this post-2630 Ma package; the majority have not been dated with the precision of modern detrital zircon studies (e.g. Contwoyto Formation; Table 2), or lack interbedded felsic tuffs (Bleeker and Villeneuve, 1995).

The post-2630 Ma turbidite packages (and possible iron-formation-associated gold metallotect) may correspond with the iron-formation zone of Padgham (1992) and Isachsen and Bowring (1994), which parallels the proposed ca. 2620 to 2630 Ma Defeat Suite magmatic belt (Fig. 7a; Davis and Bleeker, 1999; Davis et al., 2003). If so, these turbidites may have formed in a back-arc setting, concomitant with subduction and imbrication southeast or northwest of the currently preserved craton (Bleeker, 2002; Davis et al., 2003), or be localized in the western part of the craton (Fig. 7b) as part of a preserved fore-arc sequence as suggested by Pehrsson (2002). The identification of additional post-2630 Ma turbidite packages in the Slave craton will help distinguish between these tectonic models and may also be used as a fingerprint for Archean supercontinent reconstruction (Bleeker, 2003).

CONCLUSIONS

The Russell Lake–Mosher Lake area in the southwestern part of the Archean Slave craton hosts two distinct turbidite packages. Detrital zircon grains indicate that the maximum depositional age for the Mosher Lake turbidites is 2651 ± 5 Ma, whereas the maximum depositional age for the iron-formation-bearing Russell Lake turbidites is 2625 ± 6 Ma. The Mosher Lake turbidites, although slightly younger, are tentatively correlated with the Burwash Formation east of Yellowknife. The Russell Lake turbidites are comparable in age and character to the <2630 Ma Damoti formation at Damoti Lake (and possibly the turbidites in the Beechy Lake area in the eastern part of the craton). All of these young, iron-formation-bearing turbidites host gold mineralization. A post-2630 Ma, iron-formation-bearing turbidite package can be recognized in the southwestern Slave craton, and may extend northwestward across the Slave craton as suggested by Padgham (1992). Further identification and definition of this package will highlight the potential for iron-formation-hosted gold deposits and help elucidate the post-2630 Ma tectonic evolution of the Slave craton.

ACKNOWLEDGMENTS

The staff at the Geological Survey of Canada's J.C. Roddick Ion Microprobe (SHRIMP) Laboratory provided expertise and assistance. Field assistance from S. Buse, V. Hachkewich, T. Brzozowski, B. Cousens, and B. Fyson helped outline this study; Kelly Pierce aided with GIS and figure production at the Northwest Territories Geoscience Office. Ongoing discussions with W. Bleeker, C. Relf, H. Falck, J. Ketchum, and V. Bennett are acknowledged. Figures 1 and 7 were used courtesy of W. Bleeker. Insightful and thoughtful reviews by J. Ketchum, O. van Breemen, and C. Relf thoroughly improved this paper. This is a contribution towards the Wecho River Bedrock Mapping Project by the Northwest Territories Geoscience Office (NTGO contribution no. 0022); the Slave Synthesis Project, Northern Resources Development Program and the Polar Continental Shelf Project (no. 514-04), Earth Sciences Sector, Natural Resources Canada. It was carried out under an Aurora Research Institute Science License (no. 13614).

REFERENCES

Bennett, V., Jackson, V.A., Rivers, T., Relf, C., Horan, P, and Tubrett, M.
2005: Geology and U–Pb geochronology of the Neoarchean Snare River terrane: tracking evolving tectonic regimes and crustal growth mechanisms; Canadian Journal of Earth Sciences, v. 42, p. 895–934.

Bleeker, W.
2002: Archaean tectonics: a review, with illustrations from the Slave craton; *in* The Early Earth: Physical, Chemical and Biological Development, (ed.) C.M.R Fowler, C.J. Ebinger, and C.J. Hawkesworth; Geological Society, London, Special Publications, v. 199, p. 151–181.
2003: The late Archean record: a puzzle in ca. 35 pieces; Lithos, v. 71, p. 99–134.

Bleeker, W. and Beaumont-Smith, C.
1995: Thematic structural studies in the Slave Province: preliminary results and implications for the Yellowknife Domain, Northwest Territories; *in* Current Research 1995-C; Geological Survey of Canada, p. 87–96.

Bleeker, W. and Davis, W.J.
1999: The 1991-1996 NATMAP Slave Province Project; Canadian Journal of Earth Sciences, v. 36, p. 1033–1042.

Bleeker, W. and Villeneuve, M.E.
1995: Structural studies along the Slave portion of the SNORCLE Transect; *in* Slave–NORthern Cordillera Lithospheric Evolution (SNORCLE), Report of 1995 Transect Meeting, April 8–9, University of Calgary, (comp.) F. Cook and P. Erdmer; Lithoprobe Report 44, p. 8–13.

Bleeker, W., Ketchum, J.W.F., Jackson, V.A., and Villeneuve, M.E.
1999: The Central Slave Basement Complex, Part 1: its structural topology and autochthonous cover; Canadian Journal of Earth Sciences, v. 36, p. 1083–1109.

Bostock, H.H.
1980: Geology of the Itchen Lake area, District of Mackenzie; Geological Survey of Canada, Memoir 391, 101 p.

Brophy, J.
1992: Geology and gold showings, Wheeler Lake basin, NTS 85O/7; Indian and Northern Affairs Canada, NWT Geology Division, EGS 1992-6, 1 map, scale 1:20 000.

Cousens, B., Falck, H., Ootes, L., Jackson, V., Mueller, W., Corcoran, P., Finnigan, C., van Hees, E., Facey, F., and Alcazar, A.
2006: Regional correlations, tectonic settings, and stratigraphic solutions in the Yellowknife greenstone belt and adjacent areas from geochemical and Sm-Nd isotopic analyses of volcanic and plutonic rocks; *in* Gold in the Yellowknife Greenstone Belt, Northwest Territories: Results of the EXTECH III Multidisciplinary Research Project, (ed.) L. Anglin, H. Falck, D.F. Wright, and E.J. Ambrose; Geological Association of Canada, Mineral Deposits Division, Special Publication no. 3, p. 70–94.

Davis, W.J. and Bleeker, W.
1999: Timing of plutonism, deformation, and metamorphism in the Yellowknife Domain, Slave Province, Canada; Canadian Journal of Earth Sciences, v. 36, p. 1169–1187.

Davis, W.J., Jones, A.G., Bleeker, W., and Grütter, H.
2003: Lithosphere development in the Slave craton: a linked crustal and mantle perspective; Lithos, v. 71, p. 575–589.

Fyson, W.K. and Jackson, V.A.
1991: Reorientation of structures near granitic plutons and orthogonal lineaments, Russell Lake supracrustal domain, southwestern Slave Province; Canadian Journal of Earth Sciences, v. 28, p. 126–135.
2004: Structures in supracrustal and plutonic rocks, Snare River, Archean Slave Province: problems of an interpretation and a tectonic model; Northwest Territories Geoscience Office, NWT Open File 2004-03, 35 p.

Henderson, J.B.
1985: Geology of the Yellowknife–Hearne Lake area, District of Mackenzie: a segment across an Archean basin; Geological Survey of Canada, Memoir 414, 135 p.
1998: Geology of the Keskarrah Bay area, District of Mackenzie, Northwest Territories; Geological Survey of Canada, Bulletin 527, 122 p.

Henderson, J.B., van Breemen, O., and Loveridge, W.D.
1987: Some U-Pb zircon ages from basement, supracrustal and intrusive rocks, Yellowknife–Hearne Lake area, District of Mackenzie; *in* Radiogenic Age and Isotopic Studies: Report 1; Geological Survey of Canada, Paper 86-2, p. 111–121.

Henderson, J.R., Henderson, M.N., Kerswill, J.A., and Dehls, J.F.
2000: Geology, High Lake greenstone belt, Nunavut; Geological Survey of Canada, Map 1945A, scale 1:100 000.

Henderson, J.R., Kerswill, J.A., Henderson, M.N., Villeneuve, M., Petch, C.A., Dehls, J.F., and Okeefe, M.D.
1995: Geology, geochronology, and metallogeny of High Lake greenstone belt, Archean Slave Province, Northwest Territories; *in* Current Research 1995-C; Geological Survey of Canada, p. 97–106.

Isachsen, C.E.
1992: U-Pb zircon geochronology of the Yellowknife volcanic belt and subjacent rocks, N.W.T., Canada: constraints on the timing, duration, and mechanics of greenstone belt formation; Ph.D. thesis, Washington University, St. Louis, Missouri, 164 p.

Isachsen, C.E. and Bowring, S.A.
1994: Evolution of the Slave craton; Geology, v. 22, p. 917–920.

Isachsen, C.E. and Bowring, S.A. (cont.)
1997: The Bell Lake Group and Anton Complex: a basement cover sequence beneath the Archean Yellowknife greenstone belt revealed and implicated in greenstone belt formation; Canadian Journal of Earth Sciences, v. 34, p. 169–189.

Jackson, V.A.
2001: Report on the geology of the northern Russell Lake area (85/04); Indian and Northern Affairs Canada, EGS 2001-03, 90 p.
2003: Preliminary compilation of the geology of the Snare River (1998-2002 results), Wijinnedi Lake, Labrish Lake, and Russell Lake areas; parts of 85O and 85N; NWT Open Report 2003-002, 1 map, scale 1:100 000.

Jefferson, C.W., Beaumont-Smith, C.J., and Lustwerk, R.L.
1989: Stratigraphic and structural settings of iron-formations and gold in the Back River area, District of Mackenzie, N.W.T.; *in* Current Research, Part C; Geological Survey of Canada, Paper 89-1C, p. 293–304.

Kerswill, J.A.
1996: Iron-formation-hosted stratabound gold; *in* Chapter 15 of Geology of Canadian Mineral Deposit Types, (ed.) O.R. Eckstrand, W.D. Sinclair, and R.I. Thorpe; Geological Survey of Canada, Geology of Canada, no. 8, p. 367–382 (*also* Geological Society of America, The Geology of North America, v. P-1).

Lambert, M.B.
2004: Geology, Back River volcanic complex, Nunavut-Northwest Territories; Geological Survey of Canada, Map 2041A, scale 1:50 000.

Lord, C.S.
1942: Snare River and Ingray Lake map areas Northwest Territories; Geological Survey of Canada, Memoir 235, 55 p.

Ludwig, K.R.
2003: User's manual for Isoplot/Ex rev. 3.00: a geochronological toolkit for Microsoft Excel; Berkley Geochronology Center, Berkley, California, Special Publication 4, 70 p.

Mortensen, J.K., Henderson, J.B., Jackson, V.A., and Padgham, W.A.
1992a: U-Pb geochronology of Yellowknife Supergroup felsic volcanic rocks in the Russell and Clan Lake areas, southwestern Slave Province, Northwest Territories; *in* Radiogenic Age and Isotopic Studies: Report 5; Geological Survey of Canada, Paper 91-2, p. 1–7.

Mortensen, J.K., Relf, C., Davis, W.J., and King, J.E.
1992b: U-Pb zircon ages from the Shallow Bay volcaniclastic belt, Contwoyto Lake area, Northwest Territories: age constraints for Lupin-type iron formation; Geological Survey of Canada, Paper 91-2, p. 9–15.

Ootes, L. and Pierce, K.
2005: Digital geological atlas of the Wecho River area; Northwest Territories Geoscience Office, NWT Open File 2005-03, CD-ROM with 1 map, scale 1:100 000.

Padgham, W.A.
1992: Mineral deposits of the Archean Slave Structural Province; lithological and tectonic setting; Precambrian Research, v. 58, p. 1–24.

Pehrsson, S.J.
2002: The 2.27–2.63 Ga Indin Lake supracrustal belt: an Archaean marginal basin–foredeep succession preserved in the western Slave Province, Canada; *in* Precambrian Sedimentary Environments: A Modern Approach to Ancient Depositional Systems, (ed.) W. Altermann and P. Corcoran; International Association of Sedimentologists, Special Prublication 33, p. 123–152.

Pehrsson, S.J. and Villeneuve, M.E.
1999: Deposition and imbrication of a 2670-2629 Ma supracrustal sequence in the Indin Lake area, southwestern Slave Province, Canada; Canadian Journal of Earth Sciences, v. 36, p. 1149–1168.

Schärer, U. and Allègre, C.J.
1982: Investigation of the Archaean crust by single-grain dating of detrital zircon: a greywacke of the Slave Province, Canada; Canadian Journal of Earth Sciences, v. 19, p. 1910–1918.

Sircombe, K.N. and Stern, R.A.
2002: An investigation of artificial biasing in detrital zircon U-Pb geochronology due to magnetic separation in sample preparation; Geochimica et Cosmochimica Acta, v. 66, p. 2379–2397.

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. 111–142.

van Breemen, O., Jefferson, C.W., and Bursey, T.
1992: Precise 2683 Ma age of turbidite-hosted auriferous iron formations in the vicinity of George Lake, eastern Slave Structural Province, NWT; Geological Survey of Canada, Open File 2484, p. 205–207.

Villeneuve, M., Lambert, L., van Breemen, O., and Mortensen, J.
2001: Geochronology of the Back River volcanic complex, Nunavut–Northwest Territories; Geological Survey of Canada, Current Research 2001-F2; Radiogenic Age and Isotopic Studies: Report 14, 8 p.

Yamashita, K., Creaser, R.A., and Villeneuve, M.E.
2000: Integrated Nd isotopic evidence and U-Pb detrital zircon systematics of clastic sedimentary rocks from the Slave Province, Canada: evidence for extensive crustal reworking in the early- to mid-Archean; Earth and Planetary Science Letters, v. 174, p. 283–299.

Geological Survey of Canada Project Y04