A Paleoproterozoic detrital zircon age for a key conglomeratic horizon within the Rankin Inlet area, Kivalliq Region, Nunavut: implications for Archean and Proterozoic evolution of the area

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Abstract: A maximum depositional age of 2.155 ± 0.017 Ga is reported for a conglomerate unit at the interval between the upper and lower volcanic cycles in the Rankin Inlet greenstone belt. The age of the upper volcanic cycle is revised to Paleoproterozoic as it is interpreted to unconformably overlie the conglomerate unit. The lower volcanic cycle is Archean based on previous geochronology. Four generations of deformational structures recorded in the upper volcanic cycle and the associated sedimentary rocks must also be Paleoproterozoic.

Résumé : On évalue à 2,155 ± 0,017 Ga l'âge maximal de dépôt d'une unité de conglomérat occupant l'intervalle entre les cycles volcaniques supérieur et inférieur de la ceinture de roches vertes de Rankin Inlet. Le cycle volcanique supérieur est dorénavant daté du Paléoprotérozoïque car l'interprétation veut qu'il repose en discordance sur l'unité de conglomérat. Selon les résultats d'études antérieures de géochronologie, le cycle volcanique inférieur date de l'Archéen. Quatre générations de structures de déformation relevées dans les roches du cycle volcanique supérieur et les roches sédimentaires associées doivent également dater du Paléoprotérozoïque.

INTRODUCTION

The Rankin Inlet greenstone belt, exposed in the vicinity of Rankin Inlet on the west coast of Hudson Bay, Nunavut (Fig. 1) occupies a critical position along the inferred boundary between the central and northwestern Hearne subdomains (Tella et al., 2007), and is the location of the only past-producing nickel mine in Nunavut. Tella et al. (1986) divided the volcano-sedimentary Rankin Inlet Group into a lower volcanic cycle characterized by a mixed assemblage of volcano-sedimentary rocks, and an upper volcanic cycle characterized by thick pillowed volcanic flows, with minor intercalated sedimentary layers (Fig. 2). The two cycles locally are separated by a clastic sedimentary horizon dominated by a polymictic conglomerate. A single Neoarchean age of 2663 ± 3 Ma has been reported for a felsic volcanic rock within the lower cycle (Tella et al., 1996), identical, within error, for an age of 2662 ± 2 Ma for a proximal tonalite stock (Carpenter, 2003). Precise ages for the upper cycle have not been determined, largely owing to the absence of datable horizons (e.g. felsic volcanic rocks). In the absence of direct age data, Tella et al. (1986, 1996) interpreted the upper cycle to be Archean based on similar physical characteristics to other Neoarchean volcanic sequences in the Hearne domain.

The upper volcanic cycle is overlain by sedimentary rocks dominated by massive, crossbedded impure quartzite, and ripple-bedded orthoquartzite. The orthoquartzite has been correlated on the basis of lithological similarity with the Kinga Formation (Whiterock member) of the lower Hurwitz Group (Tella et al., 1986). The stratigraphic age and position of the impure quartzite units is less certain, and was interpreted to be Archean by Tella et al. (1986).

Uranium-lead ages were determined from detrital zircon from a sandy horizon in the distinctive conglomerate unit that marks the boundary between the two cycles. The youngest zircon analyzed at 2.155 ± 0.017 Ga provides a maximum depositional age for the conglomerate, and suggests that at least part of the overlying upper volcanic cycle is Paleoproterozoic and not Archean. This conclusion necessitates a re-evaluation of the stratigraphic and structural history of the Rankin Inlet area.

GEOLOGICAL SETTING

The upper volcanic cycle is exposed on Tudlik and Kudlulik peninsulas, and on the numerous islands in the vicinity of Rankin Inlet (Fig. 2). It is dominated by thick pillow basalts, with subordinate interflow pillow breccia units and epiclastic horizons, as well as rare turbidite horizons comprising rhythmically layered sandstone and shale (including black shale). The lower cycle is dominated by rhythmically layered, turbiditic, volcanic-derived sedimentary rocks, and abundant mafic hypabyssal intrusions. Volcanic rocks are uncommon and restricted to the bottom part of the lower cycle. The sedimentary rocks also include horizons of banded iron-formation, chert, greywacke, and volcanic conglomerate.

The upper and lower volcanic cycles are separated by a sedimentary horizon of coarse-grained, polymictic, conglomerate interstratified with sandstone beds and less well bedded, poorly sorted conglomerate. Clast composition includes granitoid rocks (commonly blue quartz-eye-bearing), with less common quartzite and carbonate. The source of the granitoid cobbles remains enigmatic because granitic rocks are rare in the neighbouring lower volcanic cycle. Blue quartz granules are a common matrix constituent of the conglomerate, and could be derived from the same source as the granitoid cobbles.

The conglomerate unit is discontinuous along strike, and is best exposed only at two localities. It has undergone significant internal strain, as indicated by the strongly flattened and stretched clasts. The conglomerate fines upward toward the contact with the upper volcanic cycle, and locally pillows lie directly on a chloritic phyllite. At the geochronology sample site (Fig. 2), volcanic rocks of the upper cycle have been interpreted to conformably overlie the conglomerate (Tella et al., 1986; Ryan et al., 1999a). Tella et al. (1986) interpreted a thrust fault contact between the conglomerate

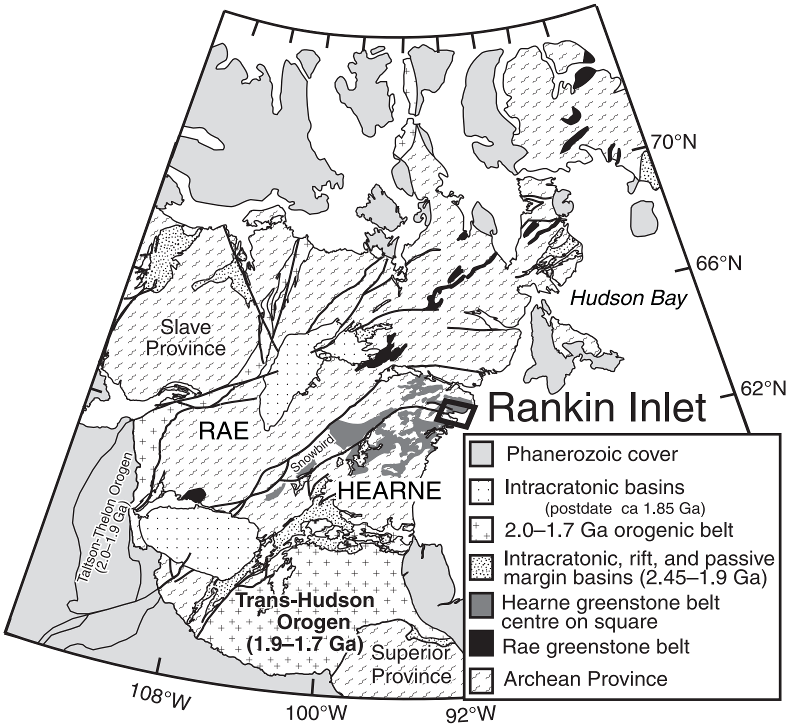

Figure 1. Geological map of western Laurentian craton with location inset box of the Rankin Inlet area. Snowbird = Snowbird tectonic zone.

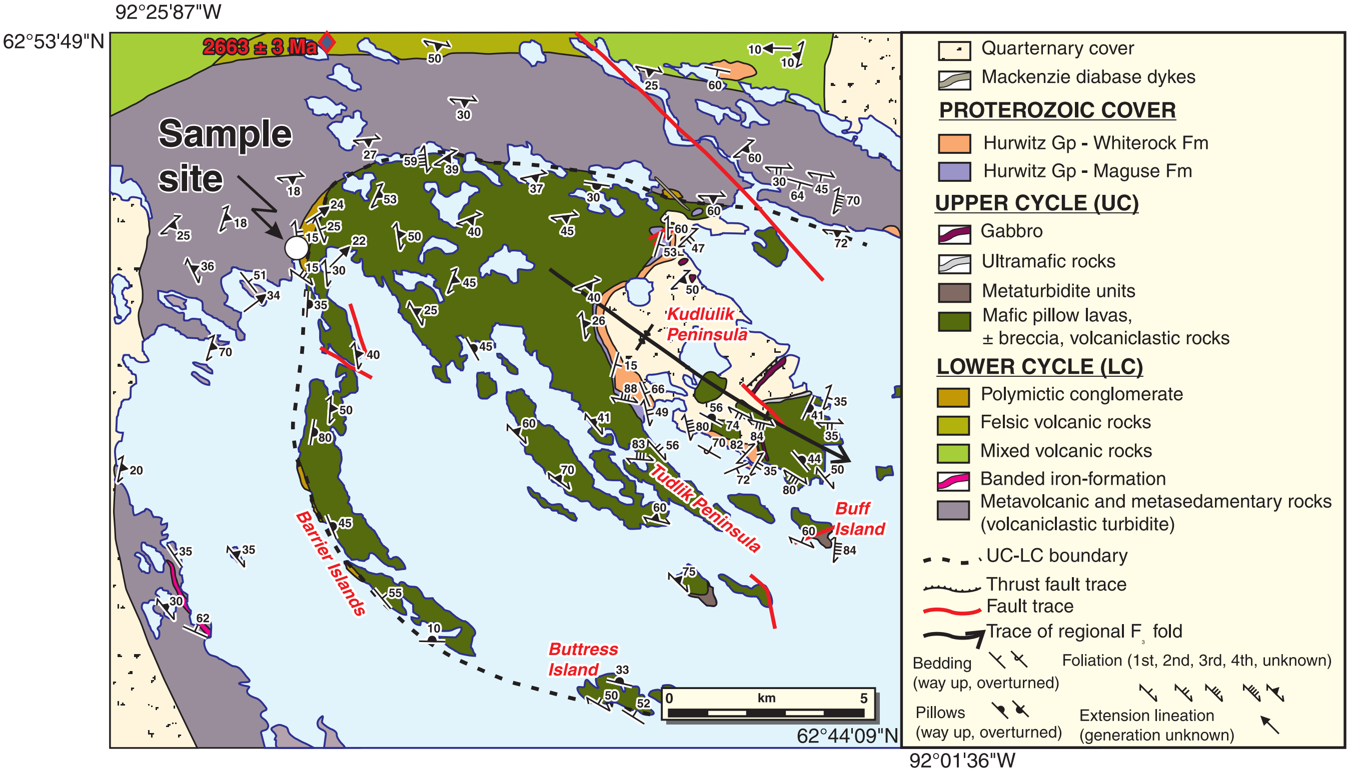

Figure 2. Simplified geological map of the Rankin Inlet area from Tella et al. (1986) and Ryan et al. (1999b). The location of the sample site is indicated by a circle.

and the underlying volcanic units. This contact is not exposed at the sample site, and the present authors cannot conclude whether that contact is stratigraphic or faulted.

Four generations of deformational fabrics are recorded in the Rankin Inlet area, including the Paleoproterozoic sedimentary rocks (Ryan et al., 1999a). S_1 is observed only in phyllitic beds, where it is subparallel to bedding. S_2 is more pervasively developed, commonly forms a fabric axial-planar to 0.5–10 m scale folds having shallow axial surfaces, and at least locally, has opposite vergence to S_1. An upright S_3 fabric is axial-planar to the large, open F_3 fold that controls the structural geometry at Rankin Inlet. S_3 varies from an open crenulation cleavage in schistose rocks to pervasive grain-shape fabric in the quartzite units. S_4 is a northerly trending, finely spaced crenulation cleavage that is regionally widespread, but has no associated macroscopic folds. A suite of crosscutting, undeformed south- to southeast-trending lamprophyre dykes, correlated with the time of ca. 1.83 Ga Christopher Island Formation volcanic event (Rainbird et al., 2006), constrains the lower age of deformation.

GEOCHRONOLOGY RESULTS

The sample (99TXC239b) was collected from a sandstone layer within the conglomerate unit 4 m below the base of the overlying upper volcanic cycle (Fig. 2, 3). The bed is relatively homogeneous, weakly normally graded, 30 cm thick, and has a strike length of more than 50 m, despite obvious high strain demonstrated by a dismembered quartz vein (Fig. 3). The sandstone contains abundant grey to blue quartz granules.

Zircon was separated by standard techniques and mounted in an epoxy puck, polished to half grain thickness, and imagined using a backscatter electron detector on a scanning electron microscope prior to analyses. A primary beam diameter of approximately 25 µm was used for ion probe analyses (SHRIMP). Geological Survey of Canada zircon standard 6266 (^{206}Pb/^{238}U age = 559 Ma) was used to calibrate Pb/U ratios according to the method described in Stern and Amelin (2003). A measured uncertainty of 1% in the calibration was propagated to unknowns. Details of the SHRIMP analytical methods can be found in Stern (1997) and Stern and Amelin (2003).

Zircon grains include a range of morphological types ranging from euhedral prisms (grain 57; Fig. 4) to rounded grains indicative of mechanical abrasion during sedimentary transport (grains 62, 33; Fig. 4). Many of the larger grains (>150 µm) are fragments of larger crystals. The degree of rounding does not correlate directly with age (e.g. grains 62 and 57; Fig. 4), however, in general, the Paleoproterozoic grains are less rounded than the Archean grains (grains 1, 4, 69, 110–112). A total of 50 zircon grains encompassing the entire range of morphological varieties were analyzed (Table 1). The majority of zircon grains have Neoarchean

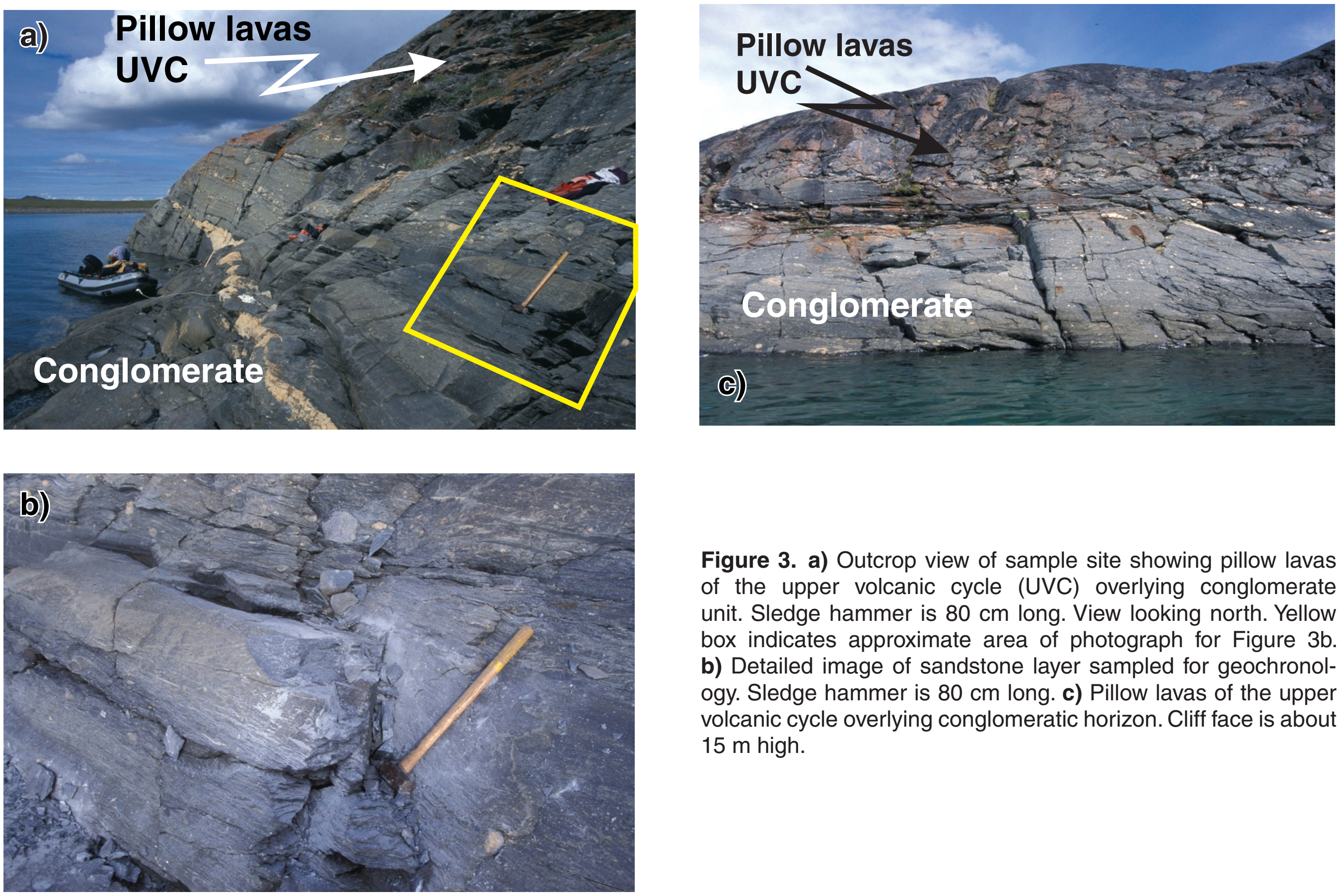

Figure 3. a) Outcrop view of sample site showing pillow lavas of the upper volcanic cycle (UVC) overlying conglomerate unit. Sledge hammer is 80 cm long. View looking north. Yellow box indicates approximate area of photograph for Figure 3b. **b)** Detailed image of sandstone layer sampled for geochronology. Sledge hammer is 80 cm long. **c)** Pillow lavas of the upper volcanic cycle overlying conglomeratic horizon. Cliff face is about 15 m high.

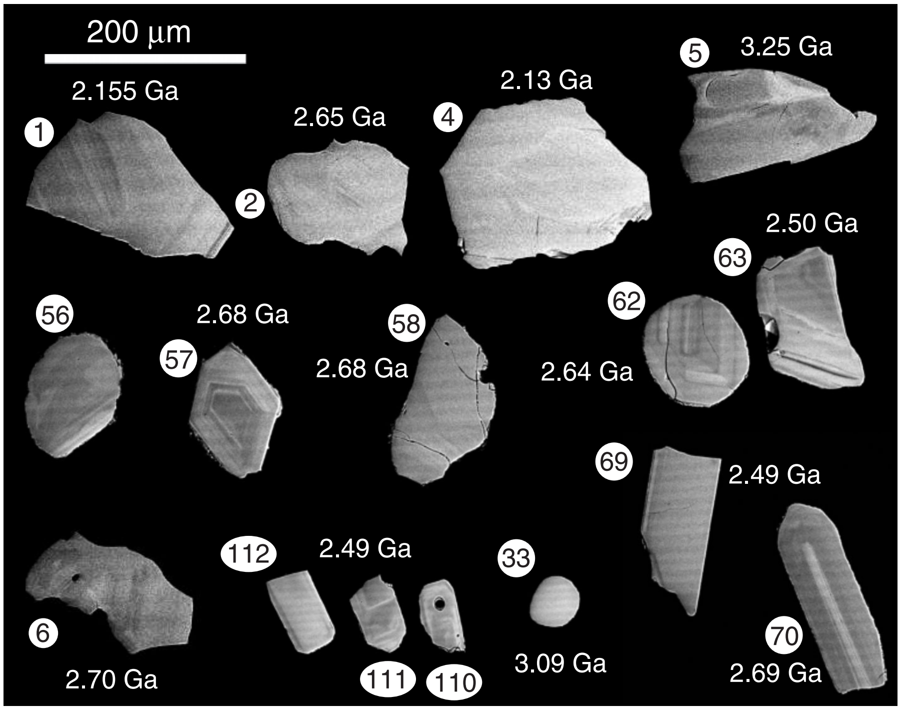

Figure 4. Backscatter electron images of zircon recovered from the conglomerate. Images taken at operating voltage of 20 kV using a Cambridge scanning electron microscope. Numbers are crossreferenced to Table 1 with $^{207}Pb/^{206}Pb$ ages reported in Gigayears.

Table 1. Uranium-lead analytical data.

Spot name	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	Discordance (%)
6128-1.1	252	108	0.443	104	9	0.00011	0.00003	0.00193	0.1242	0.0061	7.06	0.13	0.3803	0.0059	0.9163	0.13458	0.00098	2077	28	2159	13	3.8
6128-1.2	111	49	0.451	47	10	0.00028	0.00006	0.00487	0.1292	0.0091	7.15	0.18	0.3865	0.0073	0.8104	0.13418	0.00203	2106	34	2153	27	2.2
6128-1.2.2	111	48	0.446	46	12	0.00032	0.00005	0.00550	0.1342	0.0057	7.07	0.27	0.3815	0.0099	0.7669	0.13446	0.00327	2083	46	2157	43	3.4
6128-1.3	112	45	0.416	48	9	0.00024	0.00005	0.00410	0.1278	0.0047	7.31	0.17	0.3985	0.0069	0.8355	0.13309	0.00167	2162	32	2139	22	-1.1
6128-1.3.2	112	45	0.416	48	15	0.00039	0.00005	0.00680	0.1168	0.0046	7.36	0.15	0.3962	0.0063	0.8638	0.13471	0.00135	2152	29	2160	18	0.4
6128-2.1	187	155	0.856	116	8	0.00010	0.00002	0.00173	0.2313	0.0042	13.01	0.23	0.5094	0.0077	0.9025	0.18525	0.00143	2654	33	2700	13	1.7
6128-4.1	139	66	0.489	59	6	0.00012	0.00011	0.00216	0.1307	0.0238	7.08	0.17	0.3871	0.0060	0.7495	0.13261	0.00207	2109	28	2133	28	1.1
6128-5.1	92	118	1.323	83	3	0.00007	0.00003	0.00117	0.3448	0.0073	23.63	0.42	0.6518	0.0104	0.9446	0.26294	0.00154	3235	41	3264	9	0.9
6128-6.1	101	59	0.602	61	7	0.00015	0.00006	0.00262	0.1604	0.0086	13.26	0.26	0.5189	0.0084	0.8693	0.18531	0.00184	2695	36	2701	17	0.2
6128-8.1	184	108	0.604	125	10	0.00011	0.00003	0.00197	0.1655	0.0079	17.09	0.31	0.5716	0.0096	0.9613	0.21682	0.00110	2914	40	2957	8	1.5
6128-9.1	57	73	1.312	38	9	0.00035	0.00009	0.00607	0.3570	0.0126	12.90	0.49	0.5031	0.0133	0.7748	0.18592	0.00451	2627	57	2706	41	2.9
6128-10.1	85	56	0.677	51	7	0.00018	0.00010	0.00308	0.1874	0.0074	13.01	0.31	0.5084	0.0094	0.8397	0.18556	0.00244	2650	40	2703	22	2.0
6128-12.1	156	105	0.697	94	8	0.00012	0.00003	0.00205	0.1930	0.0044	12.80	0.23	0.5111	0.0078	0.9129	0.18160	0.00132	2661	33	2668	12	0.2
6128-13.1	57	52	0.948	37	5	0.00020	0.00011	0.00340	0.2718	0.0091	13.29	0.31	0.5160	0.0085	0.7912	0.18680	0.00267	2682	36	2714	24	1.2
6128-14.1	91	58	0.656	54	6	0.00014	0.00020	0.00244	0.1798	0.0092	12.42	0.34	0.5028	0.0083	0.6982	0.17916	0.00351	2626	36	2645	33	0.7
6128-17.1	72	54	0.773	44	9	0.00028	0.00006	0.00477	0.2116	0.0069	13.09	0.33	0.5082	0.0092	0.7932	0.18685	0.00290	2649	39	2715	26	2.4
6128-20.1	84	45	0.552	56	6	0.00014	0.00007	0.00240	0.1477	0.0129	16.76	0.34	0.5738	0.0093	0.8607	0.21181	0.00222	2923	38	2919	17	-0.1
6128-21.1	98	53	0.557	59	3	0.00006	0.00005	0.00102	0.1542	0.0157	13.43	0.40	0.5232	0.0140	0.9398	0.18612	0.00191	2713	59	2708	17	-0.2
6128-22.1	106	62	0.602	64	14	0.00029	0.00005	0.00508	0.1657	0.0050	13.18	0.31	0.5177	0.0080	0.7478	0.18464	0.00287	2690	34	2695	26	0.2
6128-23.1	108	157	1.504	77	23	0.00048	0.00052	0.00835	0.4163	0.0210	13.49	0.70	0.5213	0.0111	0.5201	0.18770	0.00837	2705	47	2722	75	0.6
6128-25.1	56	40	0.727	33	6	0.00025	0.00012	0.00431	0.1912	0.0082	12.57	0.30	0.4952	0.0089	0.8148	0.18415	0.00261	2593	38	2691	24	3.6
6128-27.1	24	12	0.488	14	6	0.00052	0.00022	0.00909	0.1498	0.0138	12.79	0.47	0.5036	0.0124	0.7514	0.18419	0.00453	2629	54	2691	41	2.3
6128-29.1	104	58	0.576	62	2	0.00005	0.00006	0.00094	0.1570	0.0052	13.38	0.30	0.5192	0.0091	0.8425	0.18691	0.00230	2696	39	2715	20	0.7
6128-30.1	128	174	1.402	85	7	0.00013	0.00003	0.00219	0.3879	0.0067	11.94	0.21	0.4923	0.0074	0.9160	0.17592	0.00124	2581	32	2615	12	1.3
6128-31.1	97	76	0.808	61	6	0.00014	0.00008	0.00239	0.2438	0.0065	12.93	0.25	0.5095	0.0079	0.8664	0.18399	0.00179	2655	34	2689	16	1.3
6128-33.1	92	75	0.836	73	5	0.00010	0.00005	0.00173	0.2277	0.0063	20.26	0.41	0.6242	0.0101	0.8706	0.23543	0.00235	3127	40	3089	16	-1.2
6128-34.1	58	20	0.364	31	19	0.00078	0.00017	0.01347	0.0818	0.0082	12.65	0.36	0.4909	0.0098	0.7861	0.18684	0.00329	2575	43	2715	29	5.2
6128-35.1	36	39	1.119	25	3	0.00016	0.00011	0.00269	0.3541	0.0127	13.45	0.34	0.5211	0.0094	0.7952	0.18723	0.00286	2704	40	2718	25	0.5
6128-37.1	122	109	0.921	77	9	0.00016	0.00004	0.00283	0.2568	0.0072	12.67	0.33	0.5097	0.0105	0.8578	0.18029	0.00242	2656	45	2656	22	0.0
6128-38.1	83	45	0.562	49	6	0.00018	0.00004	0.00306	0.1481	0.0057	12.99	0.32	0.5122	0.0102	0.8773	0.18397	0.00217	2666	44	2689	20	0.9
6128-42.1	71	71	1.037	45	11	0.00037	0.00008	0.00634	0.2750	0.0081	12.52	0.36	0.5009	0.0097	0.7525	0.18134	0.00347	2618	42	2665	32	1.8
6128-70.1	44	37	0.880	28	6	0.00033	0.00008	0.00565	0.2431	0.0093	13.11	0.33	0.5169	0.0091	0.7828	0.18391	0.00289	2686	39	2688	26	0.1
6128-69.1	98	61	0.644	53	4	0.00011	0.00005	0.00189	0.1802	0.0065	10.43	0.31	0.4650	0.0100	0.7952	0.16264	0.00298	2461	44	2483	31	0.9
6128-67.1	62	34	0.565	37	0	0.00001	0.00001	0.00017	0.1582	0.0066	13.31	0.27	0.5165	0.0084	0.8664	0.18689	0.00189	2684	36	2715	17	1.1
6128-64.1	62	1	0.017	33	8	0.00030	0.00007	0.00519	-0.0012	0.0029	13.03	0.28	0.5173	0.0089	0.8678	0.18263	0.00194	2688	38	2677	18	-0.4
6128-63.1	204	144	0.730	103	7	0.00009	0.00002	0.00154	0.1711	0.0037	9.99	0.17	0.4405	0.0069	0.9432	0.16450	0.00096	2353	31	2502	10	6.0
6128-62.1	160	51	0.328	87	4	0.00006	0.00004	0.00103	0.0882	0.0031	12.23	0.24	0.4980	0.0077	0.8437	0.17813	0.00191	2605	33	2636	18	1.1
6128-61.1	84	66	0.810	54	7	0.00017	0.00004	0.00303	0.2225	0.0063	13.47	0.28	0.5360	0.0090	0.8731	0.18223	0.00185	2767	38	2673	17	-3.5
6128-60.1	132	96	0.753	78	9	0.00015	0.00010	0.00263	0.2080	0.0059	12.40	0.24	0.4969	0.0076	0.8478	0.18100	0.00189	2601	33	2662	17	2.3
6128-58.1	67	75	1.161	45	7	0.00025	0.00006	0.00435	0.3268	0.0103	12.93	0.53	0.5123	0.0121	0.6713	0.18304	0.00560	2666	52	2681	51	0.5
6128-57.1	103	65	0.648	62	4	0.00009	0.00004	0.00154	0.1727	0.0050	12.97	0.26	0.5137	0.0084	0.8839	0.18308	0.00171	2672	36	2681	16	0.3
6128-85.1	77	71	0.944	50	6	0.00017	0.00005	0.00302	0.2520	0.0202	13.51	0.26	0.5183	0.0082	0.8900	0.18902	0.00166	2692	35	2734	14	1.5
6128-83.1	80	52	0.669	48	7	0.00019	0.00006	0.00325	0.1672	0.0059	12.96	0.26	0.5135	0.0084	0.8783	0.18308	0.00176	2672	36	2681	16	0.3
6128-80.1	135	106	0.812	89	6	0.00010	0.00003	0.00175	0.2288	0.0124	14.49	0.31	0.5376	0.0101	0.9352	0.19547	0.00147	2773	42	2789	12	0.5
6128-87.1	112	141	1.298	74	8	0.00018	0.00005	0.00306	0.3608	0.0078	12.63	0.24	0.5008	0.0079	0.8835	0.18290	0.00165	2617	34	2679	15	2.3
6128-88.1	104	160	1.594	73	7	0.00015	0.00004	0.00256	0.4379	0.0113	12.86	0.24	0.5012	0.0080	0.8934	0.18604	0.00160	2619	34	2708	14	3.3
6128-90.1	117	98	0.870	73	7	0.00015	0.00003	0.00254	0.2389	0.0057	12.99	0.25	0.5073	0.0079	0.8819	0.18565	0.00167	2645	34	2704	15	2.2
6128-93.1	148	93	0.650	79	9	0.00016	0.00007	0.00274	0.1760	0.0134	10.32	0.44	0.4619	0.0132	0.7560	0.16211	0.00453	2448	58	2478	48	1.2
6128-94.1	176	109	0.640	119	4	0.00005	0.00002	0.00079	0.1683	0.0035	16.77	0.28	0.5718	0.0085	0.9360	0.21273	0.00126	2915	35	2926	10	0.4
6128-97.1	89	56	0.652	47	5	0.00013	0.00008	0.00228	0.1797	0.0078	10.44	0.25	0.4619	0.0082	0.8225	0.16393	0.00222	2448	36	2497	23	2.0
6128-100.1	92	83	0.931	56	7	0.00017	0.00007	0.00300	0.2584	0.0112	11.90	0.26	0.4912	0.0091	0.8959	0.17570	0.00174	2576	40	2613	17	1.4
6128-110.1	124	69	0.573	66	8	0.00017	0.00007	0.00287	0.1462	0.0057	10.70	0.24	0.4735	0.0085	0.8704	0.16385	0.00180	2499	37	2496	19	-0.1
6128-111.1	112	52	0.480	57	14	0.00031	0.00006	0.00530	0.1231	0.0057	10.37	0.20	0.4614	0.0073	0.8678	0.16302	0.00160	2446	32	2487	17	1.7
6128-112.1	165	113	0.704	87	10	0.00016	0.00003	0.00271	0.1935	0.0138	10.15	0.18	0.4502	0.0070	0.9083	0.16357	0.00125	2396	31	2493	13	3.9

Notes (*see* Stern, 1997):

Spot name follows the convention x-y.z. (where x = sample number, y = grain number, and z = spot number). Multiple analyses in an individual spot are labelled as x-y.z.z.

Uncertainties reported at 1σ (absolute) and are calculated by numerical propagation of all known sources of error.

f(206)^{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).

Corr Coeff = correlation coefficient

Discordance relative to origin = 100 * (1-(^{206}Pb/^{238}U age)/(^{207}Pb/^{206}Pb age)).

Calibration standard 6266, U = 910 ppm, Age = 559 Ma, ^{206}Pb/^{238}U = 0.09059.

Error in ^{206}Pb/^{238}U calibration 1.4%.

Th/U calibration: F = 0.03900UO +0.85600.

ages (2.75–2.6 Ga), with a minor component of Mesoarchean zircon (3.25–2.9 Ga) (Fig. 5a, b). Approximately 15% of the analyses have ages of ca. 2.5 Ga, and two grains (4%) have younger ages of ca. 2.15 Ga. Replicate analyses of the grain 1 (Table 1) yielded a weighted mean age of 2.155 ± 0.017 Ga, which represents the best estimate of the maximum depositional age of the sedimentary rock.

DISCUSSION

Provenance of the conglomerate

Neoarchean zircon is the most prominent age component in the conglomerate sample; however, zircon of this age is not diagnostic of a particular source region and could be locally derived. Similarly, Mesoarchean zircon is common within Paleoproterozoic cover sequences on the Western Churchill basement, although it is less prominent in the Hurwitz Group rocks in the central Hearne area (Davis et al., 2005). The primary source of this Mesoarchean zircon remains poorly defined, and it may represent multiply recycled grains. The source of the population of ca. 2.5 Ga zircon is also enigmatic. Zircon of this age is known to occur northwest of Rankin Inlet along Chesterfield Inlet within the Uvuak complex (Mills et al., 2007) and MacQuoid belt (Ryan et al., 2000), and further west-southwest at Yathkyed Lake (MacLachlan et al., 2005). Zircon described from these areas is dominantly metamorphic in origin and does not have the morphology or composition of the ca. 2.5 Ga grains within the conglomerate sample. Igneous rocks with ca. 2.5 Ga ages are documented in the Wollaston domain about 500 km to the south-southwest of Rankin Inlet and are recycled as detrital grains within sedimentary rocks of the less than 2.07 Ga Wollaston Supergroup (Yeo and Delaney, 2007). Similar sources may have contributed to the conglomerate at Rankin Inlet.

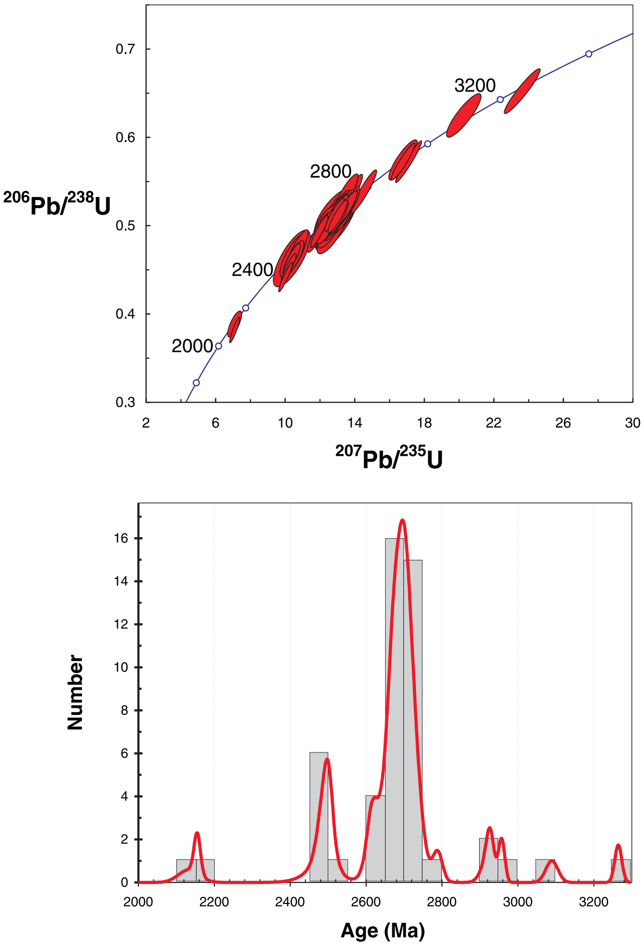

Figure 5. a) Concordia diagram of detrital zircon ages. **b)** Cumulative probability and histogram of less than 5% discordant analyses (Ludwig (2001), Isoplot 3.0).

Stratigraphic implications

The implications of a depositional age for the conglomerate younger than 2.155 Ga critically depend on the interpretation of a stratigraphic relationship between the conglomerate and overlying volcanic rocks. Accepting that rocks of the upper volcanic cycle were conformably deposited on the conglomerate (e.g. Tella et al., 1986; Ryan et al., 1999a, b) requires that at least parts of the upper volcanic rocks be younger than 2.155 Ga. Laporte (1975, 1983) suggested a Proterozoic age for all of the volcanic rocks at Rankin Inlet and correlated them with the Happotiyik member of the Ameto Formation of the Hurwitz Group (cf. Sandeman et al., 2003). This interpretation was not subsequently adopted by Tella et al. (1986). The Ameto Formation of the lower Hurwitz Group is older than 2.111 Ga, based on the age of crosscutting gabbro (Patterson and Heaman, 1991) and could overlap in age with upper volcanic cycle rocks at Rankin Inlet that are younger than 2.155 Ga; however, as no minimum age has been determined, the upper volcanic cycle could be significantly younger than the Ameto Formation.

Alternatively, if the deformed upper contact of the conglomerate with the upper volcanic cycle is a significant fault then the maximum depositional age of the conglomerate provides no information on the age of the structurally overlying upper volcanic cycle. It would, however, indicate significant structural imbrication younger than 2.155 Ga within the belt. The timing of this imbrication may be associated with ca. 1.9 Ga deformation documented to the north of Rankin Inlet in the Josephine River belt (Berman et al., 2002).

If the interpretation of a Paleoproterozoiic upper volcanic cycle is correct then the Neoarchean Re-Os isochron age reported for sulphide minerals associated with the ultramafic sill at North Rankin Nickel Mines (Hulbert and Gregoire, 1993) must be addressed. The relationship of the sill to adjacent upper volcanic cycle rocks is poorly described. It occurs at the contact between sedimentary rocks and mafic volcanic rocks of the upper volcanic cycle. Both contacts are described as tectonized by Bannantyne (1958). If the Archean age for the sill is accurate then the contact of the sill with Paleoproterozoic upper volcanic cycle units must be tectonic.

Timing of regional deformation

Although it can be assumed that there may be Archean deformation recorded in the Archean lower volcanic cycle, consistent with other Archean rocks in the central Hearne domain, all four generations of regional fabrics documented in the Rankin Inlet area are present in the upper volcanic cycle and the inferred Hurwitz Group rocks, indicating that the main structural pattern observed at Rankin Inlet is a consequence of Paleoproterozoic deformation between ca. 2.15 Ga and 1.83 Ga (Ryan et al., 1999a, b). This finding has significant implications for the regional deformation history in surrounding areas, most notably in the Meliadine gold camp where debate continues as to the timing of structurally hosted gold (cf. Carpenter et al., 2005).

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