

177907: quartzite, Noondeening Hill

(*Jimperding Metamorphic Belt, South West Terrane, Yilgarn Craton*)

Location and sampling

PERTH (SH 50-14), NORTHAM (2234)
MGA Zone 50, 457913E 6500201N

Sampled on 29 January 2004

The sample was obtained from a 0.5 m diameter block on the south side of a ridge, 15 m south of the access track, and 1.7 km southeast of the Noondeening Hill survey marker.

Tectonic unit/relations

The unit sampled is a pink-yellow-white, coarse-grained, recrystallized quartzite that occurs within a succession of metamorphosed supracrustal rocks on the eastern slope of Noondeening Hill. This succession is part of the Jimperding Metamorphic Belt, within the South West Terrane of the Yilgarn Craton (Wilde, 2001; Cassidy et al., 2006). Pelites interbedded with the metamorphosed quartz sandstone contain cordierite, prismatic sillimanite, and garnet-bearing leucosomes. Intercalated metamorphosed mafic rocks are dominated by coarse-grained hornblende and plagioclase; indicating metamorphism under uppermost amphibolite facies conditions (Rennie, 1998).

The quartzite was sampled to constrain the maximum age of deposition for the precursor quartz sandstone, and the timing of high-grade metamorphism in this part of the Jimperding Metamorphic Belt. Data for three additional samples (GSWA 177901, 177904, 177908) from this succession are reported by Bodorkos et al. (2006) and Wingate et al. (2008a–c).

Petrographic description

The sample is a massive quartzite, containing coarse to very coarse lobate and randomly interlocking quartz grains (99%) up to 30 mm in diameter. The quartz has ragged grain boundaries and undulose extinction, but is not highly deformed. Sparse, randomly oriented and distributed very small flakes of pale greenish phengitic mica are partly altered to clay and/or limonite. Small opaque grains may be primary opaque oxide minerals or limonite after pyrite. Very minor clay–limonite patches may represent former feldspar, but this is not certain. Trace zircon grains measure 20–100 μm in size, and include euhedral and angular grains, none of which are metamict. Limonite occurs on some grain boundaries and fractures, although several do not contain any filling. The exaggerated grain growth suggests amphibolite facies metamorphism of a medium-grained sandstone protolith.

Zircon morphology

Zircons from this sample are mainly clear and colourless to pale brown, and range from subhedral and variably rounded to euhedral. The zircons are up to 250 μm long and equant to elongate (aspect ratios up to 5:1). Most zircons display concentric growth zoning which, in many cases, is truncated at (abraded) grain edges. A cathodoluminescence image of representative zircons is shown in Figure 1.

Analytical details

This sample was analysed on 26–27 March 2006 and 5–6 September 2006, using SHRIMP-A. Analyses 1.1 to 51.1 (spot numbers 1–60 inclusive) were obtained during the first session, together with 14 analyses of the CZ3 standard, which indicated an external spot-to-spot (reproducibility) uncertainty of 0.74% (1σ), and a $^{238}\text{U}/^{206}\text{Pb}^*$ calibration uncertainty of 0.28% (1σ). Analyses 51.2 to 88.1 (spot numbers 61–101 inclusive) were obtained during the second session, together with 17 analyses of the CZ3 standard, which indicated an external spot-to-spot (reproducibility) uncertainty of 0.78% (1σ), and a $^{238}\text{U}/^{206}\text{Pb}^*$ calibration uncertainty of 0.23% (1σ). Calibration uncertainties are included in the errors of $^{238}\text{U}/^{206}\text{Pb}^*$ ratios and dates listed in Table 1. Common-Pb corrections were applied to all analyses using contemporaneous common-Pb isotopic compositions determined according to the model of Stacey and Kramers (1975).

Results

A total of 101 analyses were obtained from 88 zircons. Results are listed in Table 1, and shown in a concordia diagram (Fig. 2) and a probability density diagram (Fig. 3).

Interpretation

Most analyses are concordant to slightly discordant. Three analyses are characterized by slight discordance ($>5\%$). The dates obtained from these three analyses (Group D; Table 1) are unreliable, and are not considered geologically significant. The remaining 98 analyses can be divided into four groups, based on their $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ ratios.

Group 1 comprises a single analysis (46.1; Table 1) of a low Th/U (0.03) zircon rim which yields a $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 2658 ± 6 Ma (1σ).

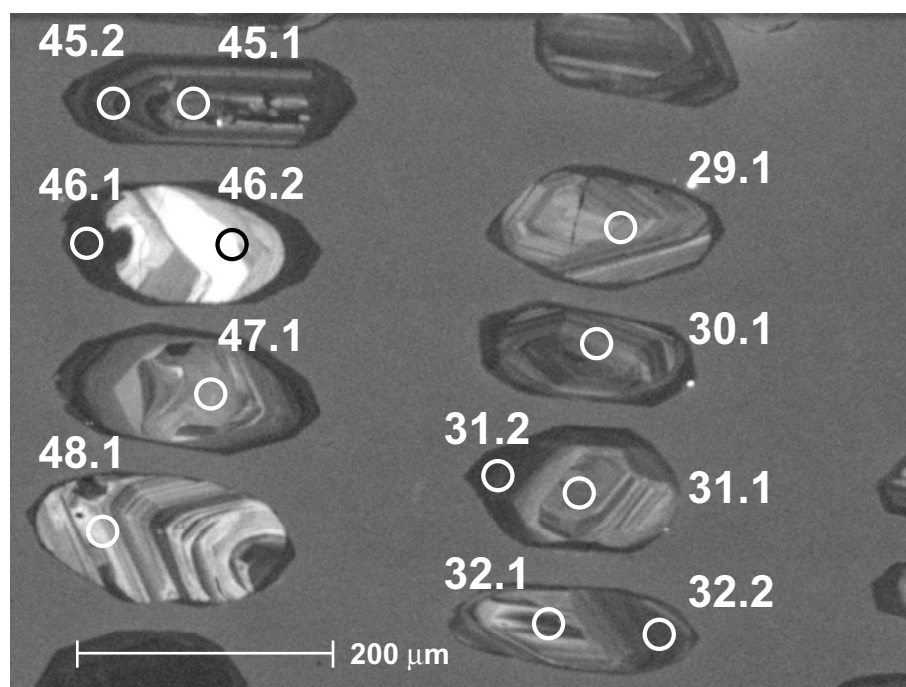


Figure 1. Cathodoluminescence image of representative zircons from sample 177907: quartzite, Noondeening Hill. Numbered circles indicate approximate locations of analysis sites

Group 2 comprises two analyses of two zircons (Table 1) which yield $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ dates (1σ) of 2990 ± 18 and 2950 ± 6 Ma.

Group 3 comprises five analyses of five zircons (Table 1) which yield a weighted mean $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of 3068 ± 6 Ma (MSWD = 1.03).

Group 4 comprises 90 analyses of 82 zircons (Table 1) which yield $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ dates of 3614–3167 Ma.

The date of 2658 ± 6 Ma (1σ) for the single zircon rim analysis (46.1) in Group 1 is interpreted as the age of a metamorphic episode that affected this rock.

The significance of the dates of 2990 and 2950 Ma for the two analyses (44.1, 31.2, respectively) in Group 2 is uncertain. Analysis 44.1 is from a zircon core, whereas analysis 31.2 is of a zircon rim (Fig. 1), which encloses a core dated at 3270 Ma (analysis 31.1). Both analyses are slightly discordant, suggesting that their relatively young dates reflect minor loss of radiogenic Pb, or, in the case of 31.2 (Fig. 1), potentially a mixture between core and rim domains.

It is possible that the five analyses in Group 3 are of unmodified detrital zircons, in which case the date of 3055 ± 8 Ma (1σ) for analysis 88.1 represents a maximum depositional age for the protolith of this metasedimentary rock. Alternatively, a more conservative estimate of the maximum depositional age, based on the weighted mean $^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date of the five zircons in Group 3, is 3068 ± 6 Ma.

The 90 analyses in Group 4 define major age components (based on three or more data points) at c. 3252, 3264, 3308, 3319, 3361, 3389, 3431, 3444, 3481, and 3499 Ma (Fig. 3), and several minor components spanning the range 3614–3167 Ma. These are interpreted as the ages of zircon-crystallizing rocks in the detrital source region(s), or the ages of detrital components within sediments which have been reworked.

References

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- Rennie, RF, 1998, Structural and metamorphic history of the Jimperding Metamorphic Belt at Noondeening Hill, Western Australia: Curtin University of Technology, BSc(Hons) thesis (unpublished).
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Table 1. Ion microprobe analytical results for zircons from sample 177907: quartzite, Noondeening Hill

Grp no.	Spot no.	Grain .spot	^{238}U (ppm)	^{232}Th (ppm)	$\frac{^{232}\text{Th}}{^{238}\text{U}}$	f_{204} (%)	$^{238}\text{U}/^{206}\text{Pb}$ $\pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb}$ $\pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}$ $\pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb}$ $\pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}$ date (Ma) $\pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb}$ date (Ma) $\pm 1\sigma$	D_{isc} (%)
1	52	46.1	651	21	0.03	0.014	1.978 \pm 0.019	0.18071 \pm 0.00063	1.978 \pm 0.019	0.18058 \pm 0.00064	2637 \pm 21	2658 \pm 6	0.8
2	32	31.2	387	48	0.13	0.027	1.789 \pm 0.018	0.21608 \pm 0.00082	1.789 \pm 0.018	0.21585 \pm 0.00083	2862 \pm 23	2950 \pm 6	3.0
2	49	44.1	265	55	0.21	0.022	1.804 \pm 0.021	0.22151 \pm 0.00252	1.804 \pm 0.021	0.22132 \pm 0.00252	2843 \pm 27	2990 \pm 18	4.9
3	101	88.1	196	112	0.59	0.076	1.657 \pm 0.017	0.23106 \pm 0.00107	1.658 \pm 0.017	0.23039 \pm 0.00110	3042 \pm 25	3055 \pm 8	0.4
3	44	42.1	264	170	0.67	0.025	1.674 \pm 0.018	0.23200 \pm 0.00105	1.674 \pm 0.018	0.23178 \pm 0.00105	3019 \pm 26	3064 \pm 7	1.5
3	41	39.1	268	196	0.76	0.018	1.669 \pm 0.018	0.23282 \pm 0.00103	1.669 \pm 0.018	0.23266 \pm 0.00103	3026 \pm 26	3070 \pm 7	1.4
3	77	64.1	335	262	0.81	0.056	1.657 \pm 0.019	0.23325 \pm 0.00081	1.658 \pm 0.019	0.23275 \pm 0.00084	3042 \pm 27	3071 \pm 6	0.9
3	39	37.1	275	172	0.65	0.027	1.686 \pm 0.018	0.23328 \pm 0.00103	1.687 \pm 0.018	0.23304 \pm 0.00104	3001 \pm 26	3073 \pm 7	2.3
4	92	78.1	167	78	0.48	-0.006	1.594 \pm 0.017	0.24717 \pm 0.00111	1.594 \pm 0.017	0.24722 \pm 0.00111	3140 \pm 27	3167 \pm 7	0.9
4	99	86.1	79	55	0.72	0.084	1.518 \pm 0.021	0.25248 \pm 0.00282	1.520 \pm 0.021	0.25174 \pm 0.00283	3260 \pm 35	3196 \pm 18	-2.0
4	79	66.1	289	157	0.56	0.065	1.573 \pm 0.016	0.25713 \pm 0.00085	1.574 \pm 0.016	0.25655 \pm 0.00089	3170 \pm 25	3226 \pm 5	1.7
4	43	41.1	226	137	0.63	0.028	1.595 \pm 0.018	0.25723 \pm 0.00117	1.596 \pm 0.018	0.25699 \pm 0.00117	3137 \pm 28	3228 \pm 7	2.8
4	4	4.1	303	279	0.95	0.091	1.576 \pm 0.016	0.25875 \pm 0.00100	1.578 \pm 0.016	0.25796 \pm 0.00106	3165 \pm 26	3234 \pm 7	2.2
4	90	76.1	139	24	0.18	0.047	1.527 \pm 0.016	0.25905 \pm 0.00121	1.528 \pm 0.016	0.25864 \pm 0.00124	3246 \pm 27	3238 \pm 8	-0.2
4	20	20.1	323	219	0.70	0.034	1.526 \pm 0.015	0.25903 \pm 0.00092	1.527 \pm 0.015	0.25874 \pm 0.00094	3247 \pm 26	3239 \pm 6	-0.3
4	7	7.1	367	296	0.83	0.082	1.554 \pm 0.016	0.25948 \pm 0.00093	1.555 \pm 0.016	0.25876 \pm 0.00095	3200 \pm 25	3239 \pm 6	1.2
4	100	87.1	120	381	3.28	0.036	1.543 \pm 0.018	0.25954 \pm 0.00142	1.544 \pm 0.018	0.25923 \pm 0.00144	3220 \pm 29	3242 \pm 9	0.7
4	50	45.1	234	95	0.42	0.158	1.599 \pm 0.018	0.26156 \pm 0.00119	1.602 \pm 0.018	0.26018 \pm 0.00123	3127 \pm 27	3248 \pm 7	3.7
4	74	62.1	313	140	0.46	0.046	1.568 \pm 0.015	0.26071 \pm 0.00088	1.569 \pm 0.015	0.26031 \pm 0.00089	3179 \pm 25	3249 \pm 5	2.1
4	85	71.1	357	237	0.69	0.055	1.582 \pm 0.015	0.26084 \pm 0.00083	1.583 \pm 0.015	0.26036 \pm 0.00086	3157 \pm 23	3249 \pm 5	2.8
4	94	81.1	296	155	0.54	0.020	1.502 \pm 0.014	0.26056 \pm 0.00077	1.502 \pm 0.014	0.26038 \pm 0.00077	3290 \pm 24	3249 \pm 5	-1.3
4	51	45.2	358	86	0.25	0.068	1.550 \pm 0.016	0.26125 \pm 0.00096	1.551 \pm 0.016	0.26066 \pm 0.00099	3208 \pm 26	3251 \pm 6	1.3
4	17	17.1	257	115	0.46	0.042	1.525 \pm 0.016	0.26105 \pm 0.00103	1.525 \pm 0.016	0.26069 \pm 0.00104	3250 \pm 27	3251 \pm 6	0.0
4	34	32.2	282	105	0.39	0.022	1.537 \pm 0.016	0.26098 \pm 0.00108	1.537 \pm 0.016	0.26079 \pm 0.00108	3230 \pm 27	3252 \pm 7	0.7
4	27	27.1	75	34	0.47	-0.020	1.550 \pm 0.024	0.26094 \pm 0.00219	1.550 \pm 0.024	0.26111 \pm 0.00219	3209 \pm 39	3253 \pm 13	1.4
4	25	25.1	288	153	0.55	-0.009	1.544 \pm 0.016	0.26169 \pm 0.00101	1.543 \pm 0.016	0.26178 \pm 0.00101	3220 \pm 26	3257 \pm 6	1.1
4	19	19.1	281	131	0.48	0.041	1.597 \pm 0.017	0.26230 \pm 0.00101	1.597 \pm 0.017	0.26194 \pm 0.00102	3134 \pm 26	3258 \pm 6	3.8
4	97	84.1	315	220	0.72	0.009	1.572 \pm 0.015	0.26203 \pm 0.00085	1.572 \pm 0.015	0.26196 \pm 0.00085	3174 \pm 24	3259 \pm 5	2.6
4	8	8.1	383	213	0.57	0.009	1.522 \pm 0.015	0.26209 \pm 0.00086	1.522 \pm 0.015	0.26201 \pm 0.00086	3255 \pm 25	3259 \pm 5	0.1
4	35	33.1	114	19	0.17	0.051	1.530 \pm 0.020	0.26280 \pm 0.00292	1.531 \pm 0.020	0.26235 \pm 0.00292	3240 \pm 34	3261 \pm 18	0.6
4	18	18.1	184	85	0.48	0.026	1.614 \pm 0.018	0.26314 \pm 0.00128	1.614 \pm 0.018	0.26291 \pm 0.00130	3108 \pm 28	3264 \pm 8	4.8
4	93	80.1	402	398	1.02	0.179	1.606 \pm 0.015	0.26452 \pm 0.00065	1.609 \pm 0.015	0.26296 \pm 0.00069	3116 \pm 23	3265 \pm 4	4.5
4	61	51.2	163	131	0.83	-0.004	1.517 \pm 0.015	0.26300 \pm 0.00110	1.517 \pm 0.015	0.26303 \pm 0.00110	3264 \pm 26	3265 \pm 7	0.0
4	95	82.1	437	315	0.74	0.004	1.503 \pm 0.014	0.26317 \pm 0.00070	1.503 \pm 0.014	0.26314 \pm 0.00070	3289 \pm 24	3266 \pm 4	-0.7
4	89	75.1	410	257	0.65	0.030	1.478 \pm 0.013	0.26344 \pm 0.00072	1.479 \pm 0.013	0.26318 \pm 0.00073	3330 \pm 24	3266 \pm 4	-2.0
4	91	77.1	281	154	0.57	0.006	1.526 \pm 0.014	0.26340 \pm 0.00084	1.526 \pm 0.014	0.26335 \pm 0.00084	3249 \pm 24	3267 \pm 5	0.5
4	96	83.1	148	89	0.62	0.044	1.599 \pm 0.018	0.26383 \pm 0.00098	1.600 \pm 0.018	0.26345 \pm 0.00098	3130 \pm 28	3267 \pm 24	4.2
4	31	31.1	142	128	0.93	-0.008	1.518 \pm 0.019	0.26394 \pm 0.00146	1.518 \pm 0.019	0.26401 \pm 0.00146	3262 \pm 32	3271 \pm 9	0.3
4	60	51.1	74	53	0.73	0.000	1.549 \pm 0.025	0.26431 \pm 0.00215	1.549 \pm 0.025	0.26431 \pm 0.00216	3211 \pm 41	3273 \pm 13	1.9
4	62	51.3	90	41	0.47	-0.021	1.510 \pm 0.019	0.26417 \pm 0.00150	1.510 \pm 0.019	0.26436 \pm 0.00151	3276 \pm 32	3273 \pm 9	-0.1
4	38	36.1	160	70	0.45	0.000	1.511 \pm 0.018	0.26440 \pm 0.00139	1.511 \pm 0.018	0.26440 \pm 0.00139	3274 \pm 31	3273 \pm 8	0.0

Table 1. (continued)

Grp no.	Spot no.	Grain .spot	^{238}U (ppm)	^{232}Th (ppm)	$^{232}\text{Th}/^{238}\text{U}$	f_{204} (%)	$^{238}\text{U}/^{206}\text{Pb}$ $\pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb}$ $\pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^*$ $\pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^*$ $\pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^*$ date (Ma) $\pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date (Ma) $\pm 1\sigma$	Disc (%)
4	33	32.1	189	283	1.55	0.506	1.505 \pm 0.017	0.26890 \pm 0.00126	1.513 \pm 0.017	0.26449 \pm 0.00145	3271 \pm 30	3274 \pm 9	0.1
4	30	30.1	150	62	0.43	0.000	1.533 \pm 0.019	0.26475 \pm 0.00187	1.533 \pm 0.019	0.26475 \pm 0.00187	3236 \pm 31	3275 \pm 11	1.2
4	88	74.1	152	87	0.59	0.178	1.503 \pm 0.015	0.26713 \pm 0.00113	1.505 \pm 0.015	0.26558 \pm 0.00120	3284 \pm 26	3280 \pm 7	-0.1
4	69	57.1	340	293	0.89	0.028	1.532 \pm 0.014	0.26601 \pm 0.00082	1.532 \pm 0.014	0.26577 \pm 0.00084	3238 \pm 24	3281 \pm 5	1.3
4	15	15.1	172	75	0.45	-0.030	1.528 \pm 0.022	0.26657 \pm 0.00130	1.528 \pm 0.022	0.26683 \pm 0.00130	3246 \pm 37	3287 \pm 8	1.3
4	67	55.1	128	100	0.81	0.274	1.501 \pm 0.018	0.26938 \pm 0.00133	1.505 \pm 0.018	0.26700 \pm 0.00146	3285 \pm 30	3288 \pm 9	0.1
4	78	65.1	194	271	1.44	0.091	1.558 \pm 0.016	0.26832 \pm 0.00107	1.560 \pm 0.016	0.26752 \pm 0.00110	3194 \pm 25	3292 \pm 6	3.0
4	14	14.1	69	55	0.83	0.075	1.536 \pm 0.024	0.26832 \pm 0.00202	1.537 \pm 0.024	0.26767 \pm 0.00206	3231 \pm 40	3292 \pm 12	1.9
4	2	2.1	320	144	0.46	0.032	1.545 \pm 0.016	0.26878 \pm 0.00099	1.546 \pm 0.016	0.26850 \pm 0.00100	3216 \pm 25	3297 \pm 6	2.5
4	83	69.1	158	83	0.54	0.078	1.537 \pm 0.017	0.26993 \pm 0.00117	1.539 \pm 0.017	0.26924 \pm 0.00119	3228 \pm 28	3302 \pm 7	2.2
4	9	9.1	270	185	0.71	0.013	1.493 \pm 0.016	0.26965 \pm 0.00105	1.493 \pm 0.016	0.26953 \pm 0.00105	3305 \pm 27	3303 \pm 6	0.0
4	16	16.1	239	241	1.04	0.000	1.502 \pm 0.016	0.27005 \pm 0.00107	1.502 \pm 0.016	0.27005 \pm 0.00107	3289 \pm 28	3306 \pm 6	0.5
4	71	59.1	195	124	0.66	0.048	1.494 \pm 0.015	0.27056 \pm 0.00110	1.495 \pm 0.015	0.27014 \pm 0.00111	3302 \pm 26	3307 \pm 6	0.2
4	54	47.1	103	13	0.13	-0.023	1.532 \pm 0.022	0.26994 \pm 0.00181	1.532 \pm 0.022	0.27014 \pm 0.00182	3239 \pm 36	3307 \pm 11	2.1
4	1	1.1	465	204	0.45	-0.005	1.496 \pm 0.015	0.27112 \pm 0.00082	1.496 \pm 0.015	0.27116 \pm 0.00082	3299 \pm 26	3313 \pm 5	0.4
4	55	48.1	121	107	0.92	0.081	1.505 \pm 0.021	0.27223 \pm 0.00167	1.506 \pm 0.021	0.27153 \pm 0.00170	3282 \pm 35	3315 \pm 10	1.0
4	64	53.1	94	49	0.54	-0.023	1.502 \pm 0.017	0.27198 \pm 0.00151	1.501 \pm 0.017	0.27218 \pm 0.00152	3291 \pm 30	3319 \pm 9	0.8
4	65	53.2	128	104	0.84	0.116	1.547 \pm 0.018	0.27332 \pm 0.00132	1.549 \pm 0.018	0.27231 \pm 0.00135	3211 \pm 29	3319 \pm 8	3.3
4	28	28.1	275	286	1.08	0.013	1.486 \pm 0.016	0.27275 \pm 0.00105	1.486 \pm 0.016	0.27264 \pm 0.00106	3317 \pm 27	3321 \pm 6	0.1
4	86	72.1	330	378	1.18	0.012	1.506 \pm 0.014	0.27296 \pm 0.00076	1.506 \pm 0.014	0.27286 \pm 0.00077	3282 \pm 24	3323 \pm 4	1.2
4	29	29.1	76	42	0.57	0.093	1.526 \pm 0.023	0.27428 \pm 0.00202	1.527 \pm 0.023	0.27348 \pm 0.00206	3247 \pm 39	3326 \pm 12	2.4
4	53	46.2	15	5	0.33	-0.190	1.409 \pm 0.046	0.27190 \pm 0.00468	1.406 \pm 0.046	0.27355 \pm 0.00492	3463 \pm 87	3327 \pm 28	-4.1
4	47	43.2	100	98	1.02	0.093	1.508 \pm 0.021	0.27554 \pm 0.00181	1.510 \pm 0.021	0.27473 \pm 0.00185	3277 \pm 37	3333 \pm 11	1.7
4	84	70.1	439	296	0.70	0.843	1.543 \pm 0.015	0.28248 \pm 0.00077	1.556 \pm 0.015	0.27518 \pm 0.00110	3199 \pm 24	3336 \pm 6	4.1
4	21	21.1	43	9	0.21	0.147	1.544 \pm 0.029	0.27669 \pm 0.00263	1.546 \pm 0.029	0.27541 \pm 0.00264	3215 \pm 47	3337 \pm 15	3.6
4	11	11.1	116	41	0.36	-0.032	1.492 \pm 0.020	0.27547 \pm 0.00160	1.491 \pm 0.020	0.27575 \pm 0.00162	3308 \pm 34	3339 \pm 9	0.9
4	12	12.1	171	96	0.58	0.028	1.461 \pm 0.017	0.27682 \pm 0.00135	1.461 \pm 0.017	0.27658 \pm 0.00135	3361 \pm 31	3344 \pm 8	-0.5
4	48	43.3	222	97	0.45	0.039	1.514 \pm 0.017	0.27867 \pm 0.00124	1.514 \pm 0.017	0.27833 \pm 0.00125	3268 \pm 29	3354 \pm 7	2.5
4	70	58.1	433	188	0.45	0.087	1.503 \pm 0.014	0.28064 \pm 0.00075	1.504 \pm 0.014	0.27989 \pm 0.00077	3286 \pm 24	3362 \pm 4	2.3
4	46	43.1	155	106	0.70	0.021	1.506 \pm 0.019	0.28048 \pm 0.00148	1.506 \pm 0.019	0.28030 \pm 0.00148	3283 \pm 32	3365 \pm 8	2.4
4	81	67.2	262	322	1.27	0.181	1.502 \pm 0.014	0.28615 \pm 0.00096	1.505 \pm 0.014	0.28458 \pm 0.00101	3285 \pm 25	3388 \pm 6	3.0
4	5	5.1	46	23	0.51	0.078	1.420 \pm 0.026	0.28546 \pm 0.00267	1.421 \pm 0.026	0.28479 \pm 0.00268	3435 \pm 49	3389 \pm 15	-1.3
4	63	52.1	75	46	0.64	0.003	1.473 \pm 0.018	0.28519 \pm 0.00169	1.473 \pm 0.018	0.28516 \pm 0.00171	3341 \pm 32	3391 \pm 9	1.5
4	36	34.1	466	383	0.85	0.051	1.457 \pm 0.014	0.29259 \pm 0.00087	1.458 \pm 0.014	0.29215 \pm 0.00087	3368 \pm 25	3429 \pm 5	1.8
4	26	26.1	161	128	0.82	0.027	1.438 \pm 0.017	0.29253 \pm 0.00140	1.438 \pm 0.017	0.29229 \pm 0.00140	3403 \pm 32	3430 \pm 7	0.8
4	80	67.1	272	23	0.09	0.022	1.458 \pm 0.014	0.29258 \pm 0.00093	1.458 \pm 0.014	0.29239 \pm 0.00094	3367 \pm 26	3430 \pm 5	1.8
4	58	50.1	75	66	0.91	0.000	1.428 \pm 0.023	0.29348 \pm 0.00220	1.428 \pm 0.023	0.29348 \pm 0.00220	3422 \pm 43	3436 \pm 12	0.4
4	72	60.1	142	103	0.75	0.042	1.441 \pm 0.015	0.29395 \pm 0.00132	1.442 \pm 0.015	0.29359 \pm 0.00133	3396 \pm 28	3437 \pm 7	1.2
4	76	63.2	398	175	0.45	0.040	1.432 \pm 0.014	0.29519 \pm 0.00078	1.433 \pm 0.014	0.29485 \pm 0.00078	3413 \pm 25	3443 \pm 4	0.9
4	3	3.1	99	34	0.36	0.017	1.460 \pm 0.022	0.29554 \pm 0.00182	1.461 \pm 0.022	0.29540 \pm 0.00182	3362 \pm 39	3446 \pm 10	2.4
4	82	68.1	274	167	0.63	0.037	1.427 \pm 0.014	0.29576 \pm 0.00096	1.428 \pm 0.014	0.29544 \pm 0.00097	3422 \pm 25	3446 \pm 5	0.7
4	59	50.2	153	256	1.73	0.057	1.440 \pm 0.018	0.29620 \pm 0.00156	1.441 \pm 0.018	0.29571 \pm 0.00157	3397 \pm 33	3448 \pm 8	1.5
4	6	6.1	128	47	0.38	0.005	1.411 \pm 0.018	0.29639 \pm 0.00162	1.412 \pm 0.018	0.29635 \pm 0.00162	3453 \pm 34	3451 \pm 8	0.0

Table 1. (continued)

Grp no.	Spot no.	Grain .spot	^{238}U (ppm)	^{232}Th (ppm)	$\frac{^{232}\text{Th}}{^{238}\text{U}}$	f_{204} (%)	$^{238}\text{U}/^{206}\text{Pb}$ $\pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb}$ $\pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^*$ $\pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^*$ $\pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^*$ date (Ma) $\pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^*$ date (Ma) $\pm 1\sigma$	D_{isc} (%)
4	57	49.2	161	86	0.55	0.084	1.413 \pm 0.019	0.29886 \pm 0.00157	1.414 \pm 0.019	0.29815 \pm 0.00159	3448 \pm 36	3461 \pm 8	0.4
4	22	22.1	88	66	0.78	0.000	1.413 \pm 0.020	0.30118 \pm 0.00190	1.413 \pm 0.020	0.30118 \pm 0.00190	3449 \pm 39	3476 \pm 10	0.8
4	40	38.1	723	544	0.78	-0.001	1.429 \pm 0.013	0.30170 \pm 0.00071	1.429 \pm 0.013	0.30170 \pm 0.00071	3420 \pm 24	3479 \pm 4	1.7
4	68	56.1	353	201	0.59	0.010	1.390 \pm 0.013	0.30278 \pm 0.00083	1.390 \pm 0.013	0.30270 \pm 0.00083	3494 \pm 26	3484 \pm 4	-0.3
4	13	13.1	82	41	0.51	0.026	1.407 \pm 0.023	0.30406 \pm 0.00195	1.407 \pm 0.023	0.30384 \pm 0.00196	3461 \pm 43	3490 \pm 10	0.8
4	37	35.1	81	42	0.53	0.040	1.416 \pm 0.021	0.30473 \pm 0.00204	1.417 \pm 0.021	0.30439 \pm 0.00204	3442 \pm 40	3493 \pm 10	1.4
4	56	49.1	578	295	0.53	0.007	1.424 \pm 0.013	0.30527 \pm 0.00101	1.424 \pm 0.013	0.30521 \pm 0.00101	3429 \pm 25	3497 \pm 5	1.9
4	10	10.1	270	203	0.78	0.023	1.445 \pm 0.015	0.30557 \pm 0.00156	1.446 \pm 0.015	0.30537 \pm 0.00156	3389 \pm 28	3498 \pm 8	3.1
4	42	40.1	216	182	0.87	0.010	1.399 \pm 0.017	0.30717 \pm 0.00127	1.399 \pm 0.017	0.30708 \pm 0.00127	3477 \pm 33	3506 \pm 6	0.8
4	23	23.1	127	105	0.85	0.004	1.407 \pm 0.020	0.30751 \pm 0.00160	1.407 \pm 0.020	0.30747 \pm 0.00160	3462 \pm 37	3508 \pm 8	1.3
4	98	85.1	269	87	0.34	0.016	1.374 \pm 0.013	0.30816 \pm 0.00105	1.374 \pm 0.013	0.30802 \pm 0.00106	3525 \pm 26	3511 \pm 5	-0.4
4	66	54.1	180	165	0.95	0.026	1.371 \pm 0.014	0.31441 \pm 0.00119	1.371 \pm 0.014	0.31419 \pm 0.00119	3531 \pm 28	3542 \pm 6	0.3
4	73	61.1	106	81	0.80	0.047	1.370 \pm 0.017	0.32037 \pm 0.00161	1.371 \pm 0.017	0.31998 \pm 0.00163	3531 \pm 34	3570 \pm 8	1.1
4	24	24.1	432	399	0.96	0.007	1.344 \pm 0.013	0.32943 \pm 0.00090	1.344 \pm 0.013	0.32937 \pm 0.00090	3586 \pm 27	3614 \pm 4	0.8
D	75	63.1	289	139	0.50	0.397	1.653 \pm 0.020	0.27182 \pm 0.00090	1.659 \pm 0.020	0.26837 \pm 0.00144	3041 \pm 29	3297 \pm 8	7.8
D	87	73.1	117	100	0.88	0.256	1.718 \pm 0.018	0.26233 \pm 0.00134	1.722 \pm 0.018	0.26009 \pm 0.00144	2951 \pm 25	3247 \pm 9	9.1
D	45	42.2	311	195	0.65	0.065	1.916 \pm 0.021	0.22085 \pm 0.00101	1.917 \pm 0.021	0.22028 \pm 0.00103	2706 \pm 25	2983 \pm 7	9.3

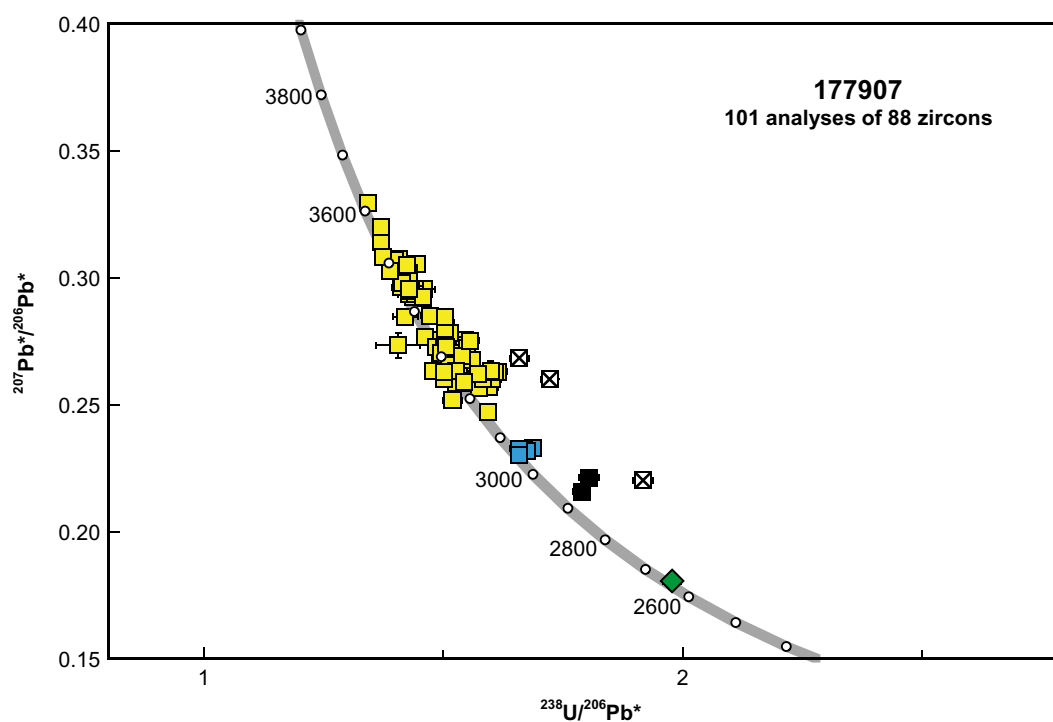


Figure 2. U-Pb analytical data for zircons from sample 177907: quartzite, Noondeening Hill. Green diamond indicates Group 1 (metamorphic zircon rim); black squares indicate Group 2 (probable radiogenic Pb loss or mixtures); blue squares indicate Group 3 (youngest detrital zircons); yellow squares denote Group 4 (older detrital zircons); crossed squares denote ungrouped analyses (discordance >5%)

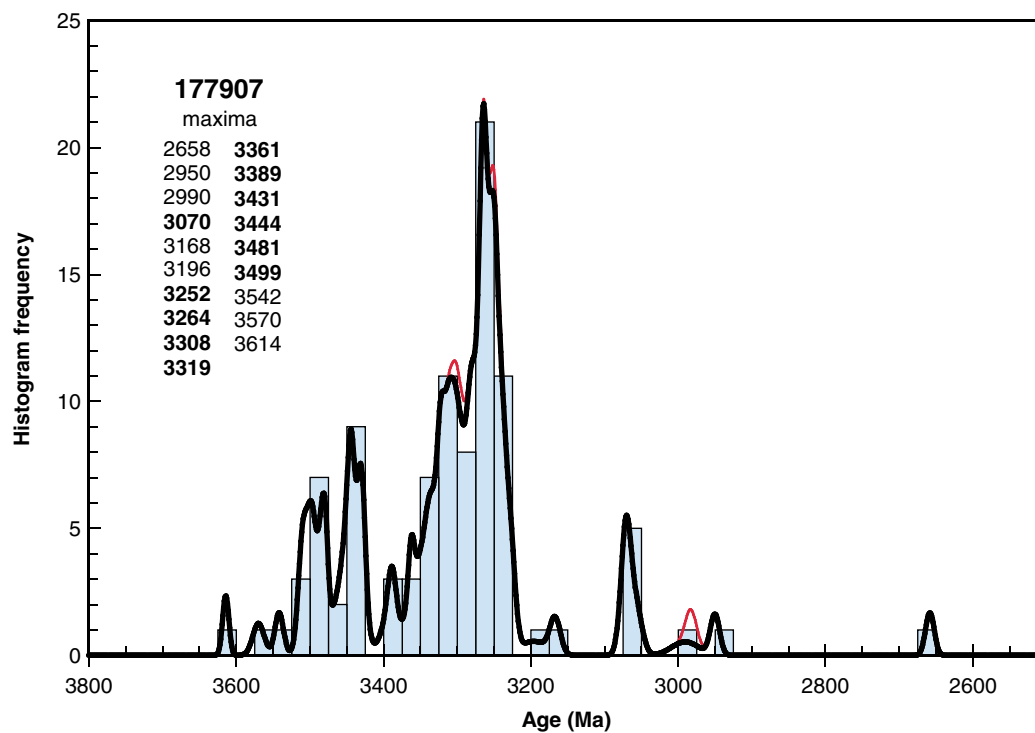


Figure 3. Probability density diagram and histogram for sample 177907: quartzite, Noondeening Hill. Heavy curve, maxima values, and frequency histogram (bin width 25 Ma) includes only concordant data (98 analyses of 87 zircons). Light curve includes all data (101 analyses of 88 zircons)

Wingate, MTD, Bodorkos, S, and Kirkland, CL, 2008b, 177904: quartzite, Windmill Hill; Geochronology dataset 740, *in* Compilation of geochronology data: Geological Survey of Western Australia.

Wingate, MTD, Bodorkos, S, and Kirkland, CL, 2008c, 177908: quartzite, Noondeening Hill; Geochronology dataset 742, *in* Compilation of geochronology data: Geological Survey of Western Australia.

Recommended reference for this publication

Wingate, MTD, Bodorkos, S, and Kirkland, CL, 2008, 177907: quartzite, Noondeening Hill; Geochronology dataset 741, *in* Compilation of geochronology data: Geological Survey of Western Australia.

Data obtained: 6 September 2006

Data released: 31 July 2008