

# Ganderia-Laurentia collision in the Caledonides of Great Britain and Ireland.

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## ***Analytical procedures and results: U-Pb detrital zircon geochronology***

Detrital zircons were analysed at the University of Alberta Radiogenic Isotope facility. Samples were crushed and zircons were separated and concentrated by standard techniques using a Wilfley table, heavy liquids and magnetic separator. The grains were ablated using a New Wave Research UP213 Nd:YAG with aperture imaging system. The wavelength was 213 nm, with a fluence of  $3 \text{ J cm}^{-2}$ , a 4 Hz pulse rate and a spot size of 40  $\mu\text{m}$ . Ablated ions were analysed with a NuPlasma multicollector ICP-MS with plasma power, gas flows, detector configuration and isotope measurements as described by Simonetti et al. (2005). Results from each sample site were recorded in 30 one-second integrations after a settling time of 3 s. Blanks and standards were recorded for the same duration as unknowns.

For the Southern Uplands samples, analysed first, separated zircons were picked, avoiding cracked or altered grains, and ~200 grains were mounted in an epoxy mount and polished to a depth required to approximately expose grain centres. Ablation points were selected using a combination of electron backscatter images, reflected, and transmitted light, so as to avoid obvious inclusions, discontinuities and cracks. Grains were analysed in sequences of 10 or 12, preceded and followed by at least two analyses of standards. Results were normalized using the in-house standard LH94-15 with isotopic ratios determined by thermal ionization mass-spectrometry (TIMS) as quoted by Simonetti et al. (2005), yielding a concordant age of 1830 Ma.

A variant of this procedure was used for the peri-Gondwanan samples, containing larger proportions of Neoproterozoic and younger grains. We prepared a random group of >300 grains from the mineral separation process, using picking to remove only obvious pyrite and other non-zircon grains. We identified zircon amongst the mounted grains using microprobe imaging. This process ensured an unbiased sampling of grains, although it probably resulted in a higher proportion of discordant and reset grains, as cloudy, metamict grains were not excluded. In addition, we included a secondary in-house standard GJ1-32 with a TIMS age of 606 Ma. Younger grains, with raw  $^{207}\text{Pb}/^{206}\text{Pb}$  ratios less than or equal to 0.0658, corresponding to an age of 800 Ma, were normalized with this standard; grains with higher raw  $^{207}\text{Pb}/^{206}\text{Pb}$  ratios were normalized with LH94-15. Age uncertainties are reported at  $2\sigma$ ; the  $^{207}\text{Pb}/^{206}\text{Pb}$  age is reported for grains with  $^{207}\text{Pb}/^{206}\text{Pb}$  age older than 800 Ma; the  $^{206}\text{Pb}/^{238}\text{U}$  age is reported for younger grains.

Data reduction was carried out using the procedure of Simonetti et al. (2005) using the same decay constants and error propagation as contained therein. All errors are quoted at 2-sigma level, equivalent to ~95% confidence that the actual value lies between the stated error limits. Analysis of each sample was completed in one day. For runs where analyses of standards showed significant variations in apparent isotopic ratios during the day, grains were normalized in 2-3 groups, bracketed by the appropriate analyses of standards. Data were collected to enable  $^{204}\text{Pb}$ -correction. However, excess ion signal at atomic mass 204, described by Simonetti et al. (2005), varied during the course of the sampling runs. The  $^{204}\text{Pb}$ -correction was therefore applied only for the minority of grains where the signal at atomic mass 204 was above 500 counts per second, indicating the presence of significant amounts of actual  $^{204}\text{Pb}$ .

Simonetti, A., Heaman, L. M., Hartlaub, R. P., Creaser, R. A., MacHattie, T. G., and Böhm, C., 2005, U-Pb zircon dating by laser ablation-MC-ICP-MS using a new multiple ion counting Faraday collector array: *Journal of Analytical Atomic Spectrometry*, v. 20, p. 677-686.





AX2661A British Grid NX 23578 57529

Isotopic ratios										Apparent age summary							
sample name	<sup>206</sup> Pb (cps)	<sup>204</sup> Pb (cps)	<sup>207</sup> Pb/ <sup>206</sup> Pb	2 σ	<sup>207</sup> Pb/ <sup>235</sup> U	2 σ	<sup>206</sup> Pb/ <sup>238</sup> U	2 σ	ρ	Com Pb corrected?	age (Ma) <sup>207</sup> Pb*/ <sup>206</sup> Pb*	error (Ma) 2 σ	age (Ma) <sup>207</sup> Pb*/ <sup>235</sup> U	error (Ma) 2 σ	age (Ma) <sup>206</sup> Pb*/ <sup>238</sup> U	error (Ma) 2 σ	discordance %
AX 2661 -117 40um	41516	99	0.07724	0.00091	1.82093	0.09525	0.17098	0.00871	0.974	no	1127	23	1053	34	1017	48	10.5
AX 2661 -119 40um	60559	113	0.05796	0.00071	0.58372	0.02977	0.07304	0.00361	0.970	no	528	27	467	19	454	22	14.5
AX 2661 -120 40um	22851	135	0.08018	0.00158	1.79439	0.09614	0.16231	0.00808	0.930	no	1201	38	1043	34	970	45	20.8
AX 2661 -121 40um	35532	154	0.08644	0.00191	1.85403	0.10127	0.15557	0.00777	0.914	no	1348	42	1065	35	932	43	33.1
AX 2661 -123 40um	40069	129	0.07637	0.00119	1.65801	0.08587	0.15746	0.00778	0.954	no	1105	31	993	32	943	43	15.8
AX 2661 -126 40um	81558	158	0.07879	0.00103	1.83330	0.09411	0.16876	0.00838	0.967	no	1167	26	1057	33	1005	46	15.0
AX 2661 -127 40um	80800	139	0.05900	0.00074	0.59029	0.03035	0.07256	0.00362	0.970	no	567	27	471	19	452	22	21.1

**Results from repeat analyses of standards**

\*Values marked as outliers were excluded in the calculation of calibration values

Analysis	Outlier	<sup>207</sup> Pb/ <sup>206</sup> Pb	1 se	<sup>206</sup> Pb/ <sup>238</sup> U	1 se
LH94-15 -1 40um		0.111855	0.000094	0.368532	0.001992
LH94-15 -2 40um		0.112084	0.000083	0.356584	0.002136
LH94-15 -3 40um		0.111852	0.000126	0.352587	0.002318
LH94-15 -4 40um		0.111920	0.000118	0.350571	0.002522
LH94-15 -5 40um		0.112335	0.000114	0.338181	0.001951
LH94-15 -6 40um		0.111897	0.000075	0.339800	0.002559
LH94-15 -7 40um		0.112130	0.000087	0.334634	0.002129
LH94-15 -8 40um		0.111898	0.000089	0.334024	0.001660
LH94-15 -9 40um		0.112381	0.000132	0.340182	0.002779
LH94-15 -10 40um		0.112183	0.000115	0.337406	0.002446
LH94-15 -11 40um		0.112172	0.000090	0.335009	0.002621
LH94-15 -12 40um		0.112063	0.000083	0.333932	0.002442
LH94-15 -13 40um		0.112091	0.000111	0.327226	0.001684
LH94-15 -14 40um		0.112511	0.000111	0.336128	0.002562
LH94-15 -15 40um		0.112243	0.000099	0.336385	0.002235
LH94-15 -16 40um		0.113005	0.000132	0.329235	0.002182
LH94-15 -17 40um		0.112769	0.000119	0.332482	0.002470
LH94-15 -18 40um		0.112332	0.000099	0.331767	0.002495
LH94-15 -19 40um		0.112675	0.000108	0.326933	0.002138
LH94-15-20 40um		0.113155	0.000115	0.324034	0.002447
LH94-15-21 40um		0.112855	0.000145	0.322391	0.002323
LH94-15 -22 40um		0.112789	0.000108	0.322914	0.002242
LH94-15 -23 40um		0.113475	0.000137	0.327687	0.003098
LH94-15 -24 40um		0.113096	0.000169	0.324819	0.002271
LH94-15 -25 40um		0.113296	0.000141	0.322904	0.002552
LH94-15 -26 40um		0.112579	0.000114	0.330116	0.001797
LH94-15 -27 40um		0.112413	0.000104	0.322444	0.002216
LH94-15 -28 40um		0.112572	0.000104	0.320374	0.002101
LH94-15 -29 40um		0.112311	0.000084	0.324303	0.002110
LH94-15 -30 40um		0.112444	0.000062	0.328168	0.001959
LH94-15 -31 40um		0.112719	0.000130	0.323519	0.001748



FN033 British Grid NX 5856 4868

Isotopic ratios										Apparent age summary							
sample name	<sup>206</sup> Pb (cps)	<sup>204</sup> Pb (cps)	<sup>207</sup> Pb/ <sup>206</sup> Pb	2 σ	<sup>207</sup> Pb/ <sup>235</sup> U	2 σ	<sup>206</sup> Pb/ <sup>238</sup> U	2 σ	ρ	Com Pb corrected?	age (Ma) <sup>207</sup> Pb*/ <sup>206</sup> Pb*	error (Ma) 2 σ	age (Ma) <sup>207</sup> Pb*/ <sup>235</sup> U	error (Ma) 2 σ	age (Ma) <sup>206</sup> Pb*/ <sup>238</sup> U	error (Ma) 2 σ	discordance %
<b>Discordance &gt;10% or &lt;-10%</b>																	
FN033-1 40um	152138	82	0.05670	0.00075	0.53214	0.01981	0.06807	0.00237	0.934	no	480	29	433	13	425	14	11.9
FN033-2 40um	238514	289	0.05976	0.00119	0.56614	0.02396	0.06871	0.00257	0.883	no	595	42	456	15	428	15	28.9
FN033-4 40um	58084	131	0.06625	0.00201	0.75640	0.03536	0.08280	0.00294	0.760	no	814	62	572	20	513	17	38.5
FN033-14 40um	60745	78	0.05839	0.00140	0.55702	0.02438	0.06919	0.00254	0.837	no	544	51	450	16	431	15	21.5
FN033-18 40um	32189	60	0.07205	0.00123	1.82150	0.07203	0.18336	0.00654	0.902	no	987	34	1053	26	1085	36	-10.8
FN033-19 40um	23218	71	0.07867	0.00274	1.78322	0.09005	0.16439	0.00602	0.725	no	1164	67	1039	32	981	33	16.9
FN033-20 40um	172251	77	0.05734	0.00089	0.57686	0.02452	0.07296	0.00289	0.931	no	505	34	462	16	454	17	10.4
FN033-23 40um	23939	54	0.07027	0.00130	1.76123	0.07066	0.18179	0.00648	0.888	no	936	37	1031	26	1077	35	-16.3
FN033-28 40um	210686	157	0.06088	0.00117	0.52064	0.02649	0.06203	0.00292	0.926	no	635	41	426	18	388	18	40.1
FN033-37 40um	337116	14	0.10380	0.00109	3.17534	0.11406	0.22187	0.00762	0.957	no	1693	19	1451	27	1292	40	26.1
FN033-38 40um	113490	23	0.16217	0.00215	8.51498	0.39123	0.38081	0.01675	0.957	no	2478	22	2288	41	2080	78	18.8
FN033-40 40um	1063154	2044	0.19271	0.00347	3.54505	0.16438	0.13342	0.00570	0.921	yes	2765	29	1537	36	807	32	75.1
FN033-41 40um	168552	23	0.09170	0.00100	2.79310	0.10033	0.22091	0.00756	0.953	no	1461	21	1354	27	1287	40	13.2
FN033-47 40um	204311	77	0.07494	0.00143	1.66268	0.06656	0.16092	0.00567	0.880	no	1067	38	994	25	962	31	10.6
FN033-51 40um	379169	35	0.08784	0.00105	2.08366	0.07092	0.17204	0.00549	0.937	no	1379	23	1143	23	1023	30	27.9
FN033-52 40um	185515	66	0.07622	0.00114	1.65995	0.06232	0.15796	0.00544	0.917	no	1101	30	993	24	945	30	15.2
FN033-57 40um	48167	43	0.05902	0.00129	0.61559	0.02644	0.07564	0.00280	0.861	no	568	47	487	16	470	17	17.9
FN033-58 40um	454297	257	0.06198	0.00162	0.61291	0.03038	0.07172	0.00302	0.849	no	674	55	485	19	446	18	34.9
FN033-61 40um	353606	126	0.05842	0.00110	0.55177	0.02588	0.06850	0.00294	0.915	no	545	41	446	17	427	18	22.4
FN033-74 40um	132821	213	0.08028	0.00239	1.92648	0.08987	0.17404	0.00625	0.769	no	1204	58	1090	31	1034	34	15.2

**Results from repeat analyses of standards**

\*Values marked as outliers were excluded in the calculation of calibration values

Analysis	Outlier	<sup>207</sup> Pb/ <sup>206</sup> Pb	1 se	<sup>206</sup> Pb/ <sup>238</sup> U	1 se
LH94-15-19 40um	*	0.115062	0.000158	0.307886	0.002507
LH94-15-20 40um		0.114325	0.000146	0.308400	0.002538
LH94-15-21 40um		0.114174	0.000144	0.304607	0.002169
LH94-15-22 40um		0.114043	0.000149	0.299835	0.001918
LH94-15-23 40um		0.114074	0.000094	0.303292	0.001915
LH94-15-24 40um		0.113939	0.000097	0.302587	0.001722
LH94-15-25 40um		0.114334	0.000152	0.304271	0.002294
LH94-15-26 40um		0.114532	0.000131	0.307327	0.001778
LH94-15-27 40um		0.114089	0.000110	0.299595	0.002033
LH94-15-28 40um		0.113549	0.000134	0.304352	0.002300
LH94-15-29 40um		0.114237	0.000189	0.302004	0.002256
LH94-15-30 40um		0.114912	0.000157	0.303859	0.001774
LH94-15-31 40um		0.114722	0.000144	0.303918	0.002013
LH94-15-32 40um		0.114586	0.000149	0.304485	0.002314
LH94-15-33 40um		0.114536	0.000143	0.302070	0.002019
LH94-15-34 40um		0.114669	0.000153	0.304658	0.001724





















LS004A British Grid NX 6843 4379

Isotopic ratios

Apparent age summary

sample name	<sup>206</sup> Pb (cps)	<sup>204</sup> Pb (cps)	<sup>207</sup> Pb/ <sup>206</sup> Pb	2 σ	<sup>207</sup> Pb/ <sup>235</sup> U	2 σ	<sup>206</sup> Pb/ <sup>238</sup> U	2 σ	ρ	Com Pb corrected?	age (Ma)	error (Ma)	age (Ma)	error (Ma)	age (Ma)	error (Ma)	discordance %
											<sup>207</sup> Pb*/ <sup>206</sup> Pb*	2 σ	<sup>207</sup> Pb*/ <sup>235</sup> U	2 σ	<sup>206</sup> Pb*/ <sup>238</sup> U	2 σ	
LS004A-22 40um	314419	1492	0.14792	0.00691	4.83753	0.33476	0.23718	0.01211	0.738	no	2322	78	1791	57	1372	63	45.3
LS004A-23 40um	33284	46	0.05752	0.00117	0.57412	0.03577	0.07239	0.00426	0.945	no	512	44	461	23	451	26	12.4
LS004A-27 40um	171694	56	0.05691	0.00071	0.52551	0.02525	0.06697	0.00311	0.966	no	488	27	429	17	418	19	14.9
LS004A-29 40um	160381	55	0.05722	0.00072	0.53178	0.02723	0.06740	0.00334	0.969	no	500	28	433	18	421	20	16.4
LS004A-30 40um	332433	76	0.07225	0.00080	1.42733	0.07607	0.14328	0.00747	0.978	no	993	22	900	31	863	42	14.0
LS004A-31 40um	52524	47	0.07999	0.00197	1.99872	0.10939	0.18123	0.00886	0.893	no	1197	48	1115	36	1074	48	11.2
LS004A-34 40um	348726	128	0.19152	0.00204	12.24043	0.74234	0.46353	0.02767	0.984	no	2755	17	2623	55	2455	121	13.1
LS004A-36 40um	421039	209	0.09952	0.00110	3.35153	0.18177	0.24424	0.01297	0.979	no	1615	20	1493	42	1409	67	14.2
LS004A-39 40um	664368	354	0.19608	0.00210	11.94929	0.57048	0.44198	0.02056	0.974	no	2794	17	2600	44	2359	91	18.5
LS004A-40 40um	661348	210	0.10131	0.00120	3.62459	0.19108	0.25949	0.01333	0.974	no	1648	22	1555	41	1487	68	10.9
LS004A-41 40um	471007	73	0.11698	0.00118	4.93593	0.29651	0.30601	0.01812	0.986	no	1911	18	1808	49	1721	89	11.3
LS004A-50 40um	603411	212	0.07603	0.00097	1.63045	0.08223	0.15553	0.00759	0.968	no	1096	25	982	31	932	42	16.1
LS004A-51 40um	417869	215	0.11420	0.00136	3.39168	0.18950	0.21540	0.01176	0.977	no	1867	21	1502	43	1258	62	35.9
LS004A-53 40um	75284	74	0.06302	0.00156	0.63079	0.03856	0.07260	0.00405	0.914	no	709	52	497	24	452	24	37.5
LS004A-54 40um	29696	62	0.06115	0.00115	0.59721	0.03284	0.07083	0.00366	0.940	no	645	40	475	21	441	22	32.7
LS004A-59 40um	15856	54	0.06034	0.00131	0.58441	0.03165	0.07024	0.00349	0.916	no	616	46	467	20	438	21	29.9
LS004A-61 40um	217408	467	0.08332	0.00275	0.82890	0.04029	0.07215	0.00257	0.734	no	1277	63	613	22	449	15	67.1
LS004A-66 40um	632773	1733	0.12613	0.00506	4.57658	0.24741	0.26317	0.00954	0.671	no	2045	69	1745	44	1506	49	29.5
LS004A-69 40um	33087	84	0.05676	0.00096	0.54596	0.02273	0.06976	0.00265	0.914	no	482	37	442	15	435	16	10.2
LS004A-76 40um	93884	123	0.05888	0.00079	0.64445	0.02849	0.07938	0.00334	0.953	no	563	29	505	17	492	20	13.0
LS004A-80 40um	339857	472	0.10308	0.00156	3.62222	0.17385	0.25485	0.01161	0.949	no	1680	28	1554	37	1463	59	14.4

LS004A

Results from repeat analyses of standards

\*Values marked as outliers were excluded in the calculation of calibration values

Analysis	Outlier	<sup>207</sup> Pb/ <sup>206</sup> Pb	1 se	<sup>206</sup> Pb/ <sup>238</sup> U	1 se
LH94-15-1 40um	*	0.114552	0.000217	0.318972	0.002757
LH94-15-2 40um		0.113893	0.000135	0.321445	0.002547
LH94-15-3 40um		0.113962	0.000094	0.318953	0.002592
LH94-15-4 40um		0.113720	0.000114	0.319271	0.001395
LH94-15-5 40um		0.113526	0.000126	0.310573	0.002279
LH94-15-6 40um		0.113487	0.000164	0.312201	0.002005
LH94-15-7 40um		0.113935	0.000177	0.306857	0.002040
LH94-15-8 40um		0.114312	0.000124	0.309054	0.002872
LH94-15-9 40um		0.114271	0.000144	0.301395	0.001911
LH94-15-10 40um		0.114140	0.000127	0.300372	0.002313
LH94-15-11 40um		0.114235	0.000124	0.307127	0.001806
LH94-15-12 40um		0.114266	0.000122	0.312303	0.002177
LH94-15-13 40um		0.114784	0.000130	0.297814	0.001601
LH94-15-14 40um		0.114857	0.000183	0.300964	0.002228
LH94-15-15 40um		0.114973	0.000168	0.294133	0.001522
LH94-15-16 40um		0.114943	0.000191	0.294162	0.001914
LH94-15-17 40um		0.115027	0.000148	0.297342	0.002044
LH94-15-18 40um		0.114390	0.000149	0.294155	0.001757













ML016A British Grid NY 15564 31567

Isotopic ratios										Apparent age summary							
sample name	<sup>206</sup> Pb (cps)	<sup>204</sup> Pb (cps)	<sup>207</sup> Pb/ <sup>206</sup> Pb	2 σ	<sup>207</sup> Pb/ <sup>235</sup> U	2 σ	<sup>206</sup> Pb/ <sup>238</sup> U	2 σ	ρ	Com Pb corrected?	age (Ma) <sup>207</sup> Pb*/ <sup>206</sup> Pb*	error (Ma) 2 σ	age (Ma) <sup>207</sup> Pb*/ <sup>235</sup> U	error (Ma) 2 σ	age (Ma) <sup>206</sup> Pb*/ <sup>238</sup> U	error (Ma) 2 σ	discordance %
ML016A-88	2265986	179	0.21860	0.00222	15.23376	0.73083	0.50542	0.02370	0.977	no	2970	16	2830	45	2637	101	13.7
ML016A-89	29221	160	0.06585	0.00158	0.78138	0.03311	0.08606	0.00301	0.825	no	802	49	586	19	532	18	35.0
ML016A-91	91050	147	0.06123	0.00069	0.79024	0.02804	0.09360	0.00315	0.948	no	647	24	591	16	577	19	11.4
ML016A-93	59149	163	0.06114	0.00075	0.79343	0.02911	0.09411	0.00325	0.942	no	644	26	593	16	580	19	10.5
ML016A-94	152916	140	0.06118	0.00071	0.77361	0.02628	0.09171	0.00293	0.939	no	646	25	582	15	566	17	12.9
ML016A-96	351209	296	0.08823	0.00113	2.33378	0.11068	0.19184	0.00876	0.963	no	1388	24	1223	33	1131	47	20.1
ML016A-99	809850	50	0.24213	0.00244	18.59253	0.93997	0.55692	0.02759	0.980	no	3134	16	3021	48	2854	113	11.0
ML016A-103	65194	27	0.05963	0.00073	0.69231	0.02315	0.08421	0.00262	0.930	no	590	26	534	14	521	16	12.2
ML016A-109	146841	158	0.06140	0.00071	0.77697	0.02829	0.09178	0.00317	0.948	no	653	25	584	16	566	19	14.0
ML016A-110	278709	182	0.06441	0.00092	0.96500	0.03498	0.10866	0.00362	0.919	no	755	30	686	18	665	21	12.6
ML016A-112	66880	149	0.05986	0.00079	0.70844	0.02491	0.08584	0.00280	0.927	no	598	28	544	15	531	17	11.8
ML016A-113	95950	157	0.06154	0.00070	0.79944	0.02688	0.09421	0.00298	0.942	no	658	24	597	15	580	18	12.4
ML016A-115	129144	167	0.08657	0.00095	2.49581	0.11420	0.20911	0.00929	0.971	no	1351	21	1271	33	1224	49	10.3
ML016A-118	54537	193	0.06347	0.00135	0.82338	0.03306	0.09409	0.00321	0.849	no	724	44	610	18	580	19	20.8
ML016A-119	109500	160	0.08232	0.00092	2.15845	0.09971	0.19016	0.00853	0.970	no	1253	22	1168	32	1122	46	11.4
ML016A-129	45469	139	0.06140	0.00098	0.80297	0.03701	0.09485	0.00410	0.938	no	653	34	599	21	584	24	11.1
ML016A-131	191514	146	0.06047	0.00077	0.67826	0.02594	0.08135	0.00293	0.943	no	620	27	526	16	504	17	19.5
ML016A-135	118430	122	0.05940	0.00071	0.68206	0.02337	0.08328	0.00268	0.938	no	582	26	528	14	516	16	11.8
ML016A-136	177013	135	0.06737	0.00167	1.02940	0.05382	0.11082	0.00511	0.881	no	849	51	719	27	678	30	21.3
ML016A-137	797420	98	0.12351	0.00125	5.53592	0.25616	0.32508	0.01468	0.976	no	2008	18	1906	39	1815	71	11.0
ML016A-138	43074	153	0.06487	0.00122	0.81514	0.03260	0.09114	0.00322	0.883	no	770	39	605	18	562	19	28.2
ML016A-140	67171	111	0.06140	0.00080	0.78473	0.02767	0.09270	0.00304	0.930	no	653	28	588	16	571	18	13.1
ML016A-141	79484	113	0.06497	0.00175	0.84606	0.03627	0.09445	0.00315	0.778	no	773	56	622	20	582	19	25.9
ML016A-142	210294	93	0.06025	0.00065	0.74441	0.02609	0.08961	0.00299	0.952	no	613	23	565	15	553	18	10.1

ML016A

Results from repeat analyses of standards

\*Values marked as outliers were excluded in the calculation of calibration values

Analysis	Outlier	<sup>207</sup> Pb/ <sup>206</sup> Pb	1 se	<sup>206</sup> Pb/ <sup>238</sup> U	1 se
LH94-15-1		0.110653	0.000108	0.375625	0.002542
LH94-15-2		0.110556	0.000120	0.374333	0.002850
LH94-15-3		0.110375	0.000108	0.370324	0.003736
LH94-15-4		0.110501	0.000118	0.368203	0.003416
LH94-15-5		0.110652	0.000135	0.372989	0.002545
LH94-15-6	*	0.110787	0.000121	0.387286	0.002454
LH95-15-07		0.110803	0.000129	0.369489	0.003223
LH94-15-08		0.111080	0.000120	0.362859	0.002132
LH94-15-9		0.111170	0.000067	0.360187	0.001795
LH94-15-10		0.111203	0.000097	0.365153	0.002071
LH94-15-11		0.110903	0.000070	0.359816	0.001740
LH94-15-12		0.111076	0.000111	0.359084	0.001794
LH94-15-13		0.111225	0.000130	0.347452	0.002154
LH94-15-14		0.111112	0.000078	0.356946	0.001917
LH94-15-16		0.111389	0.000092	0.354440	0.001398
LH94-15-17		0.111612	0.000085	0.351577	0.003633
LH94-15-18		0.111154	0.000168	0.357987	0.001901
LH94-15-19		0.111555	0.000134	0.361413	0.001449
LH94-15-20		0.111517	0.000116	0.353943	0.002133
LH94-15-21		0.111446	0.000144	0.357872	0.001490
LH94-15-22		0.110948	0.000148	0.350210	0.001445
LH94-15-23		0.111153	0.000117	0.349088	0.002032
LH94-15-24		0.111021	0.000130	0.355796	0.002117
LH94-15-25		0.111389	0.000140	0.353775	0.001894
LH94-15-26		0.111314	0.000105	0.357624	0.001588
LH94-15-27		0.111699	0.000135	0.361452	0.001509
LH94-15-28		0.111322	0.000121	0.352936	0.001591
LH94-15-29		0.111542	0.000134	0.357257	0.001640
GJ1-32-1		0.059965	0.000116	0.107528	0.001244
GJ1-32-2		0.059836	0.000137	0.107987	0.001167















ML109A British Grid SD 7816 7103

## Isotopic ratios

## Apparent age summary

sample name	<sup>206</sup> Pb (cps)	<sup>204</sup> Pb (cps)	<sup>207</sup> Pb/ <sup>206</sup> Pb	2 σ	<sup>207</sup> Pb/ <sup>235</sup> U	2 σ	<sup>206</sup> Pb/ <sup>238</sup> U	2 σ	ρ	Com Pb corrected?	age (Ma) <sup>207</sup> Pb*/ <sup>206</sup> Pb*	error (Ma) 2 σ	age (Ma) <sup>207</sup> Pb*/ <sup>235</sup> U	error (Ma) 2 σ	age (Ma) <sup>206</sup> Pb*/ <sup>238</sup> U	error (Ma) 2 σ	discordance %
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## Results from repeat analyses of standards

\*Values marked as outliers were excluded in the calculation of calibration values

Analysis	Outlier	<sup>207</sup> Pb/ <sup>206</sup> Pb	1 se	<sup>206</sup> Pb/ <sup>238</sup> U	1 se
LH9415-1		0.112935	0.000170	0.382398	0.003324
LH9415-2		0.113225	0.000219	0.399416	0.005885
LH9415-3		0.113136	0.000225	0.393216	0.005784
LH9415-4		0.112874	0.000172	0.384819	0.005234
LH9415-5		0.112651	0.000223	0.397254	0.007326
LH9415-6		0.113264	0.000152	0.372309	0.006799
LH9415-8		0.113528	0.000219	0.382459	0.003696
LH9415-9		0.113553	0.000143	0.387154	0.003484
LH9415-11		0.113637	0.000150	0.404372	0.004009
LH9415-12		0.114049	0.000206	0.381765	0.006089
LH9415-13		0.114442	0.000199	0.388660	0.003865
LH9415-14		0.114067	0.000193	0.375923	0.006166
LH9415-15		0.114376	0.000147	0.366465	0.004965
LH9415-16	*	0.114391	0.000186	0.372681	0.006566
LH9415-17	*	0.114581	0.000170	0.378671	0.005655
LH9415-17A		0.113542	0.000205	0.362274	0.004704
LH9415-18		0.113414	0.000223	0.370863	0.006270
LH9415-19		0.113393	0.000157	0.364860	0.003379
LH9415-20	*	0.112386	0.000161	0.369079	0.003828
LH9415-21	*	0.111685	0.000196	0.350695	0.006683
LH9415-22		0.112679	0.000215	0.345098	0.005354
LH9415-23		0.111920	0.000243	0.343435	0.004439
LH9415-25		0.112444	0.000245	0.330750	0.005017
LH9415-27		0.112896	0.000236	0.338413	0.007181
LH9415-28		0.111916	0.000182	0.322647	0.006453
LH9415-29		0.112100	0.000206	0.342665	0.003565
GJ132-1		0.061244	0.000196	0.114402	0.001674
GJ132-2		0.062464	0.000166	0.115970	0.000868
GJ132-3		0.060850	0.000148	0.114506	0.001266
GJ132-4		0.060025	0.000138	0.112342	0.002188
GJ132-6		0.062317	0.000399	0.118238	0.001536
GJ132-9		0.062029	0.000311	0.123702	0.001891
GJ132-10	*	0.061367	0.000326	0.122920	0.005509
GJ132-11		0.060393	0.000173	0.115570	0.001916
GJ132-12		0.061038	0.000243	0.108175	0.002255
GJ132-13		0.061048	0.000128	0.114569	0.001261
GJ132-14		0.061101	0.000206	0.110322	0.001257
GJ132-15		0.061432	0.000100	0.110120	0.001953
GJ132-17		0.060037	0.000279	0.110722	0.001836
GJ132-18		0.060096	0.000316	0.104961	0.001380
GJ132-19		0.059769	0.000297	0.105854	0.001176
GJ132-20	*	0.058109	0.000320	0.112569	0.002513
GJ132-21	*	0.057972	0.000507	0.105299	0.000939
GJ132-22		0.058997	0.000162	0.102988	0.001354
GJ132-23		0.058654	0.000350	0.100936	0.000733
GJ132-25		0.058565	0.000316	0.099584	0.000880
GJ132-27		0.058969	0.000279	0.101387	0.001194
GJ132-28		0.058663	0.000411	0.102623	0.001467
GJ132-29		0.057817	0.000237	0.100655	0.001577





ML119A		Irish Grid		IS 8715 0778		Apparent age summary														
Isotopic ratios																				
sample name	<sup>206</sup> Pb (cps)	<sup>204</sup> Pb (cps)	<sup>207</sup> Pb/ <sup>206</sup> Pb	2 σ	<sup>207</sup> Pb/ <sup>235</sup> U	2 σ	<sup>206</sup> Pb/ <sup>238</sup> U	2 σ	ρ	Com Pb corrected?	age (Ma) <sup>207</sup> Pb*/ <sup>206</sup> Pb*	error (Ma) 2 σ	age (Ma) <sup>207</sup> Pb*/ <sup>235</sup> U	error (Ma) 2 σ	age (Ma) <sup>206</sup> Pb*/ <sup>238</sup> U	error (Ma) 2 σ	discordance %			
ML119A-094	38286	3	0.06183	0.00129	0.81086	0.04364	0.09511	0.00472	0.922	no	668	44	603	24	586	28	12.9			
ML119A-095	9461	4	0.05660	0.00455	0.71348	0.06697	0.09143	0.00442	0.515	no	476	169	547	39	564	26	-19.4			
ML119A-096	160482	2	0.14284	0.00261	6.53695	0.46420	0.33191	0.02278	0.966	no	2262	31	2051	61	1848	109	21.0			
ML119A-097	7663	0	0.05336		0.74401	0.04791	0.10113	0.00483	0.742	no	344	95	565	28	621	28	-84.5			
ML119A-110	11347	23	0.05635	0.00133	0.72903	0.04496	0.09383	0.00535	0.924	no	466	51	556	26	578	31	-25.1			
ML119A-116	58461	7	0.05936	0.00091	0.68084	0.03753	0.08319	0.00441	0.961	no	580	33	527	22	515	26	11.7			
ML119A-119	4990	14	0.04978	0.00248	0.64950	0.04395	0.09462	0.00433	0.677	no	185	112	508	27	583	25	-225.1			
ML119A-122	78543	11	0.09491	0.00104	3.02644	0.18435	0.23128	0.01386	0.984	no	1526	21	1414	45	1341	72	13.4			
ML119A-124	18695	24	0.07293	0.00139	0.73437	0.04677	0.07303	0.00444	0.954	no	1012	38	559	27	454	27	57.0			
ML119A-129	189349	73	0.10589	0.00167	2.67473	0.18967	0.18319	0.01267	0.975	no	1730	29	1321	51	1084	69	40.5			

### ML119A

#### Results from repeat analyses of standards

\*Values marked as outliers were excluded in the calculation of calibration values

Analysis	Outlier	<sup>207</sup> Pb/ <sup>206</sup> Pb	1 se	<sup>206</sup> Pb/ <sup>238</sup> U	1 se
LH9415-001	*	0.119527	0.000247	0.312957	0.005354
LH9415-002		0.117392	0.000218	0.320875	0.003728
LH9415-003		0.116956	0.000201	0.329189	0.002884
LH9415-004		0.116301	0.000114	0.320412	0.003539
LH9415-005		0.116330	0.000198	0.325101	0.004519
LH9415-006		0.116551	0.000134	0.316089	0.003502
LH9415-007		0.116519	0.000137	0.323671	0.004758
LH9415-009		0.117707	0.000416	0.325428	0.002786
LH9415-010		0.115944	0.000207	0.317952	0.004055
LH9415-011		0.117709	0.000277	0.311492	0.005391
LH9415-012		0.116509	0.000139	0.308814	0.003712
LH9415-013		0.117233	0.000117	0.311985	0.003005
LH9415-014		0.116356	0.000148	0.325189	0.006040
LH9415-015		0.116643	0.000153	0.302844	0.004874
LH9415-017		0.116591	0.000147	0.304622	0.003976
LH9415-018		0.116643	0.000192	0.325236	0.003208
LH9415-019		0.116475	0.000164	0.317444	0.002512
LH9415-020		0.117366	0.000217	0.319427	0.003337
LH9415-021		0.116566	0.000225	0.325499	0.004048
LH9415-022		0.117798	0.000510	0.319502	0.002853
LH9415-023		0.116854	0.000202	0.308371	0.005357
LH9415-024		0.117376	0.000348	0.308503	0.003411
LH9415-025		0.116426	0.000161	0.314958	0.003573
LH9415-026		0.116842	0.000224	0.315629	0.003352
LH9415-027		0.116165	0.000094	0.315553	0.004067
LH9415-028		0.117059	0.000192	0.329388	0.002360
LH9415-029		0.116444	0.000214	0.341328	0.003121
LH9415-030		0.117357	0.000356	0.331587	0.004203
LH9415-031		0.116670	0.000158	0.317765	0.003223
LH9415-032		0.117083	0.000220	0.305310	0.003491
LH9415-033		0.116605	0.000205	0.313246	0.003305
GJ132-001	*	0.062917	0.000188	0.097247	0.000722
GJ132-002		0.062839	0.000148	0.096663	0.001502
GJ132-007		0.062059	0.000230	0.094830	0.000674
GJ132-010		0.061979	0.000181	0.095348	0.001037
GJ132-012		0.063301	0.000288	0.091621	0.001137
GJ132-014		0.062619	0.000163	0.093081	0.000650
GJ132-017		0.063008	0.000332	0.094314	0.001172
GJ132-019		0.062302	0.000198	0.095369	0.001098
GJ132-021		0.062618	0.000171	0.094149	0.001111
GJ132-023		0.062365	0.000191	0.092770	0.001292
GJ132-025		0.062806	0.000182	0.092602	0.000811
GJ132-027		0.062179	0.000189	0.093759	0.001115
GJ132-029		0.062075	0.000271	0.097287	0.001074









Analysis	Outlier	207Pb/206Pb	1 se	206Pb/238U	1 se
LH9415-001	*	0.114311	0.000151	0.335725	0.002220
LH9415-002	*	0.113969	0.000123	0.338236	0.002585
LH9415-003		0.113736	0.000129	0.334608	0.002288
LH9415-004		0.113550	0.000093	0.335948	0.002893
LH9415-005		0.113462	0.000087	0.333471	0.002487
LH9415-006		0.113391	0.000107	0.331341	0.002103
LH9415-007		0.113774	0.000144	0.331622	0.002664
LH9415-008		0.113063	0.000067	0.344787	0.002475
LH9415-010		0.113795	0.000181	0.320421	0.003344
LH9415-011		0.113888	0.000122	0.323320	0.002779
LH9415-020		0.113925	0.000121	0.340858	0.003794
LH9415-021		0.113164	0.000130	0.326895	0.001727
LH9415-022		0.114813	0.000127	0.311332	0.002260
LH9415-023		0.113825	0.000087	0.316163	0.001876
LH9415-024		0.113276	0.000124	0.321698	0.003555
LH9415-025		0.113626	0.000130	0.296519	0.002233
LH9415-030		0.113104	0.000106	0.312821	0.000918
LH9415-031		0.112673	0.000101	0.316254	0.001129
LH9415-032		0.112647	0.000099	0.323847	0.002862
LH9415-033		0.113094	0.000142	0.312215	0.001501
LH9415-034		0.112961	0.000078	0.312891	0.003176
LH9415-035		0.112870	0.000138	0.310211	0.001521
LH9415-036		0.112863	0.000109	0.309111	0.002676
LH9415-037		0.112620	0.000098	0.310950	0.002883
LH9415-060		0.113005	0.000113	0.305445	0.001830
LH9415-062		0.113151	0.000118	0.313613	0.002836
LH9415-076		0.112905	0.000119	0.307901	0.002400
LH9415-077		0.112733	0.000078	0.306270	0.003383
LH9415-091		0.113251	0.000127	0.304819	0.002395
LH9415-092		0.112734	0.000092	0.306527	0.002083
LH9415-106		0.112695	0.000113	0.305733	0.002168
LH9415-107		0.112496	0.000104	0.305576	0.002991
LH9415-121		0.113040	0.000111	0.308056	0.003968
LH9415-122		0.112791	0.000116	0.306791	0.002270
LH9415-136		0.112995	0.000124	0.303849	0.002122
LH9415-137		0.112857	0.000095	0.301720	0.002257
LH9415-151		0.113207	0.000102	0.296976	0.003004
LH9415-152		0.112964	0.000127	0.301615	0.002666
GJ1-001	*	0.061471	0.000107	0.096206	0.000839
GJ1-002		0.061167	0.000114	0.094016	0.000600
GJ1-003		0.061274	0.000188	0.093140	0.001394
GJ1-004		0.061445	0.000167	0.093562	0.000943
GJ132-10		0.061240	0.000143	0.093656	0.000765
GJ132-020		0.061299	0.000108	0.091183	0.000469
GJ1-021		0.061534	0.000185	0.091656	0.001420
GJ1-022	*	0.061392	0.000153	0.097103	0.000850
GJ132-030	*	0.063007	0.000193	0.091365	0.000723
GJ132-031		0.061376	0.000129	0.090891	0.000748
GJ132-033		0.061349	0.000118	0.090921	0.000795
GJ132-034		0.060610	0.000128	0.093392	0.000739
GJ1-036		0.060644	0.000107	0.092586	0.000728
GJ1-037		0.060890	0.000142	0.090796	0.000584
GJ132-063		0.061035	0.000114	0.091364	0.000848
GJ132-064		0.060886	0.000097	0.090137	0.000676
GJ132-078		0.060951	0.000135	0.090546	0.000897
GJ132-079		0.060870	0.000104	0.090726	0.000620
GJ132-093		0.061152	0.000131	0.090491	0.000639
GJ132-094		0.061107	0.000098	0.090781	0.000793
GJ132-108		0.061040	0.000122	0.090075	0.000835
GJ132-109		0.060782	0.000090	0.090580	0.000797
GJ132-123		0.060805	0.000146	0.090508	0.000585
GJ132-124		0.060948	0.000089	0.089744	0.000863
GJ132-138		0.060961	0.000160	0.090986	0.000628
GJ132-139		0.060974	0.000092	0.090225	0.000688

GJ132-153  
GJ132-154

0.060964 0.000086  
0.061143 0.000129

0.090388 0.000708  
0.087936 0.000612





ML12A-119	56035	53	0.05960	0.00119	0.70121	0.02846	0.08534	0.00301	0.870	no	589	43	540	17	528	18	10.8
ML123A-122	438065	395	0.11197	0.00510	1.82129	0.15880	0.11797	0.00877	0.853	yes	1832	80	1053	56	719	50	64.1
ML123A-123	20300	35	0.05599	0.00135	0.70095	0.02985	0.09080	0.00318	0.823	no	452	53	539	18	560	19	-25.0
ML123A-124	32989	42	0.05669	0.00133	0.68559	0.03196	0.08771	0.00353	0.864	no	479	51	530	19	542	21	-13.6
ML123A-125	9580	39	0.05095	0.00156	0.74784	0.03971	0.10645	0.00462	0.818	no	239	69	567	23	652	27	-182.2
ML123A-126	28430	56	0.08892	0.00164	2.49905	0.23347	0.20383	0.01867	0.980	no	1402	35	1272	66	1196	99	16.1
ML123A-127	99316	140	0.07382	0.00144	0.91391	0.07482	0.08979	0.00714	0.971	no	1037	39	659	39	554	42	48.5
ML123A-129	13911	72	0.05728	0.00170	0.85654	0.04389	0.10845	0.00453	0.816	no	502	64	628	24	664	26	-33.8
ML123A-130	54824	86	0.07185	0.00098	1.37311	0.07836	0.13861	0.00768	0.971	no	982	28	877	33	837	43	15.7
ML123A-104	926	51	-0.00941	-0.01670	-0.14457	-0.25680	0.11146	0.00670	0.034	no	Discarded: not zircon						

## Results from repeat analyses of standards

\*Values marked as outliers were excluded in the calculation of calibration values

Analysis	Outlier	207Pb/206Pb	1 se	206Pb/238U	1 se
LH9415-01	*	0.117452	0.000162	0.291343	0.004403
LH9415-02	*	0.116856	0.000214	0.289020	0.005901
LH9415-03	*	0.116646	0.000280	0.292429	0.003588
LH9415-04		0.116580	0.000256	0.292605	0.005331
LH9415-05		0.118094	0.000234	0.284753	0.005880
LH9415-06		0.117645	0.000207	0.287278	0.004297
LH9415-07		0.118003	0.000186	0.287163	0.005048
LH9415-08		0.118008	0.000252	0.280932	0.004474
LH9415-09		0.118174	0.000209	0.289868	0.005009
LH9415-11		0.118132	0.000203	0.283123	0.005322
LH9415-12	*	0.117930	0.000245	0.270706	0.011364
LH9415-13		0.118354	0.000216	0.288185	0.007004
LH9415-14		0.118042	0.000297	0.290793	0.004414
LH9415-15		0.118548	0.000208	0.279940	0.003171
LH9415-16		0.117864	0.000193	0.287917	0.003867
LH9415-17		0.118100	0.000294	0.274625	0.005139
LH9415-18		0.118184	0.000187	0.298226	0.004045
LH9415-19		0.117974	0.000247	0.295409	0.002802
LH9415-20		0.117823	0.000181	0.297610	0.003207
LH9415-21		0.118804	0.000213	0.301109	0.003823
LH9415-22		0.118560	0.000128	0.294408	0.004556
LH9415-23		0.118247	0.000193	0.318482	0.003128
LH9415-24		0.118018	0.000099	0.313192	0.003173
LH9415-25		0.117702	0.000260	0.308161	0.003770
LH9415-26	*	0.117732	0.000165	0.336024	0.005369
LH9415-27		0.118096	0.000209	0.315148	0.003301
LH9415-28		0.117596	0.000254	0.317496	0.003357
LH9415-29		0.117955	0.000206	0.314112	0.003199
LH9415-30		0.117796	0.000194	0.314142	0.003426
LH9415-31		0.117117	0.000198	0.309962	0.003490
LH9415-32		0.117292	0.000177	0.305322	0.005889
LH9415-33		0.117328	0.000148	0.295344	0.003205
LH9415-34		0.116841	0.000166	0.307858	0.006898
GJ1-1	*	0.062381	0.000212	0.083040	0.001910
GJ1-2		0.062058	0.000297	0.087503	0.001110
GJ1-3		0.061822	0.000409	0.088941	0.001821
GJ1-4		0.061685	0.000326	0.087282	0.001882
GJ132-05		0.061929	0.000335	0.086572	0.001890
GJ132-06		0.061910	0.000179	0.088077	0.001897
GJ132-07		0.062263	0.000273	0.086868	0.000983
GJ132-08		0.062494	0.000264	0.085737	0.002387
GJ132-09		0.062566	0.000213	0.085788	0.000915
GJ132-10		0.062521	0.000264	0.087713	0.001406
GJ132-11		0.062804	0.000256	0.089919	0.001965
GJ132-12		0.061780	0.000292	0.088479	0.001558
GJ132-13		0.062188	0.000392	0.087602	0.000888
GJ132-14		0.062281	0.000477	0.085425	0.000929
GJ132-15		0.062091	0.000269	0.088389	0.001831



GJ132-16	0.062270	0.000262	0.088147	0.001176
GJ132-17	0.062382	0.000226	0.087892	0.001128
GJ132-18	0.061882	0.000299	0.086133	0.000937
GJ132-19	0.062088	0.000239	0.086242	0.001126
GJ132-20	0.062252	0.000224	0.089389	0.000887
GJ132-21	0.063246	0.000187	0.088850	0.001447
GJ132-22	0.062908	0.000160	0.088252	0.001294
GJ132-23	0.063171	0.000166	0.087638	0.000945
GJ132-24	0.062550	0.000126	0.088943	0.000568
GJ132-25	0.062293	0.000273	0.088554	0.000883
GJ132-26	0.061725	0.000317	0.089661	0.001082
GJ132-27	0.062924	0.000325	0.088580	0.000677
GJ132-28	0.061485	0.000359	0.090757	0.000868
GJ132-29	0.062491	0.000303	0.088152	0.000684
GJ132-30	0.062431	0.000248	0.089262	0.000677
GJ132-31	0.062808	0.000351	0.090243	0.000910
GJ132-32	0.062185	0.000433	0.090000	0.001183
GJ132-33	0.062355	0.000471	0.089056	0.001309
GJ132-34	0.063286	0.000478	0.088310	0.001686





LH9415-21		0.116281	0.000238	0.292639	0.003411
LH9415-22		0.116706	0.000211	0.298589	0.003121
LH9415-23		0.116112	0.000154	0.299820	0.003296
LH9415-24		0.116575	0.000175	0.295557	0.003162
LH9415-25		0.115859	0.000154	0.299277	0.003273
LH9415-26		0.117498	0.000219	0.305767	0.002500
LH9415-27		0.116422	0.000182	0.303207	0.002077
LH9415-28		0.116644	0.000194	0.295848	0.003720
LH9415-29		0.116093	0.000189	0.299741	0.003399
LH9415-30		0.116411	0.000169	0.294057	0.003357
LH9415-31		0.116321	0.000155	0.297632	0.003191
LH9415-32		0.117006	0.000214	0.297226	0.002696
LH9415-33		0.116379	0.000143	0.297285	0.003177
LH9415-34		0.117957	0.000221	0.295204	0.003502
LH9415-35		0.116532	0.000118	0.301129	0.005494
GJ1-01	*	0.061853	0.000191	0.093579	0.001186
GJ1-02	*	0.061987	0.000136	0.096345	0.000907
GJ132-07		0.061655	0.000204	0.091775	0.001188
GJ132-09		0.061917	0.000172	0.087567	0.000853
GJ132-11		0.062000	0.000191	0.088366	0.001252
GJ132-013		0.061961	0.000222	0.087469	0.000799
GJ132-15		0.062009	0.000146	0.087983	0.001444
GJ1-17		0.063128	0.000240	0.090174	0.002127
GJ132-19		0.062325	0.000193	0.089198	0.000613
GJ132-21		0.062979	0.000240	0.089716	0.000733
GJ132-23	*	0.065355	0.000340	0.089796	0.000966
GJ132-25	*	0.061449	0.000355	0.135890	0.005633
GJ132-27		0.062549	0.000173	0.086980	0.000844
GJ132-29		0.063524	0.000417	0.089430	0.001054
GJ132-31		0.062331	0.000156	0.086195	0.000987
GJ132-33		0.062863	0.000202	0.088667	0.001410
GJ132-35		0.061984	0.000479	0.085191	0.001765