

## 206150: mylonitic quartzofeldspathic rock, Bullaman Rockhole

(Ding Dong Downs Volcanics, Sophie Downs Suite, Eastern Zone,  
Lamboosie Province, Halls Creek Orogen)

### Location and sampling

GORDON DOWNS (SE 52-10), HALLS CREEK (4461)  
MGA Zone 52, 386980E 7995934N

Sampled on 14 August 2012

This sample was collected from a prominent outcrop on Sophie Downs station, about 4.7 km northeast of The Brim Rockhole, 3.9 km northwest of Bertha Peak, and 3.4 km southwest of Bullaman Rockhole.

### Tectonic unit/relations

The unit sampled is a mylonitized quartzofeldspathic rock — probably a felsic metavolcanic rock — of the c. 1910 Ma Ding Dong Downs Volcanics of the Sophie Downs Suite. The Sophie Downs Suite includes coeval metagranite of the Esaw Monzogranite, Junda Microgranite, and the Sophie Downs Granite, and is unconformably overlain by the 1880–1845 Ma Halls Creek Group (Griffin and Tyler, 1992; Tyler et al., 1995; Hollis et al., 2014). The Ding Dong Downs Volcanics comprises a succession of mafic and felsic metavolcanic rocks including amygdaloidal metabasalt and amphibolite, metagabbro and meta-anorthosite, cordierite-bearing pelitic metasedimentary rocks, metadolerite sills, and minor metarhyolite. A SHRIMP U–Pb zircon crystallization age of  $1907 \pm 6$  Ma has been reported for a felsic metavolcanic rock of the Ding Dong Downs Volcanics (GA sample 88598005, unpublished).

### Petrographic description

This sample is a fine-grained, mylonitic quartzofeldspathic rock (Fig. 1) that contains about 60% quartz, 25% sericite, 10% iron–titanium oxide minerals, 4% opaque pseudomorphs of an unknown mineral, and accessory zircon. Quartz is microcrystalline and granular. Sericite is microcrystalline and defines a strong foliation. The iron–titanium oxide minerals form foliation-parallel strings of granular crystals, some displaying euhedral crystal outlines.

### Zircon morphology

Zircons isolated from this sample are colourless, and subhedral to euhedral. The crystals are up to 250  $\mu\text{m}$

long, and equant to elongate, with aspect ratios up to 5:1. Many crystals are broken. In cathodoluminescence (CL) images, concentric zoning is ubiquitous. A CL image of representative zircons is shown in Figure 2.

### Analytical details

This sample was analysed on 5–6 September 2014, using SHRIMP-B. Twelve analyses of the BR266 standard were obtained during the session, of which 10 analyses indicated an external spot-to-spot (reproducibility) uncertainty of 0.76% ( $1\sigma$ ) and a  $^{238}\text{U}/^{206}\text{Pb}^*$  calibration uncertainty of 0.31% ( $1\sigma$ ). 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 isotopic compositions determined according to the model of Stacey and Kramers (1975).

### Results

Fifty-two analyses were obtained from 52 zircons. Results are listed in Table 1, and shown in a concordia diagram (Fig. 3).

### Interpretation

The analyses are concordant to strongly discordant (Fig. 3). Three analyses are >5% discordant. The dates obtained from these three analyses (Group D; Table 1) are unreliable, and are considered not to be geologically significant. The remaining 49 analyses define a single group, based on their  $^{207}\text{Pb}^*/^{206}\text{Pb}^*$  ratios.

Group I comprises 49 analyses (Table 1), which yield a concordia age of  $1904 \pm 5$  Ma (MSWD = 1.1).

The date of  $1904 \pm 5$  Ma for the 49 analyses in Group I is interpreted as the magmatic crystallization age of a volcanic rock. This result is similar to a previous age of  $1912 \pm 3$  Ma for a felsic metavolcanic rock of the Ding Dong Downs Volcanics.



Figure 1. Outcrop photograph for sample 206150: mylonitic quartzofeldspathic rock, Bullaman Rockhole.

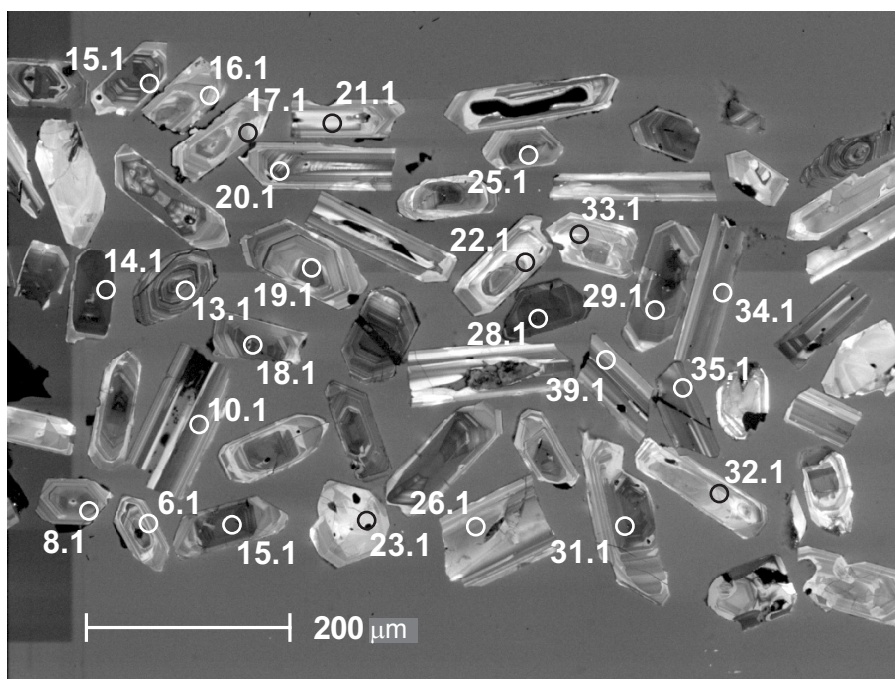


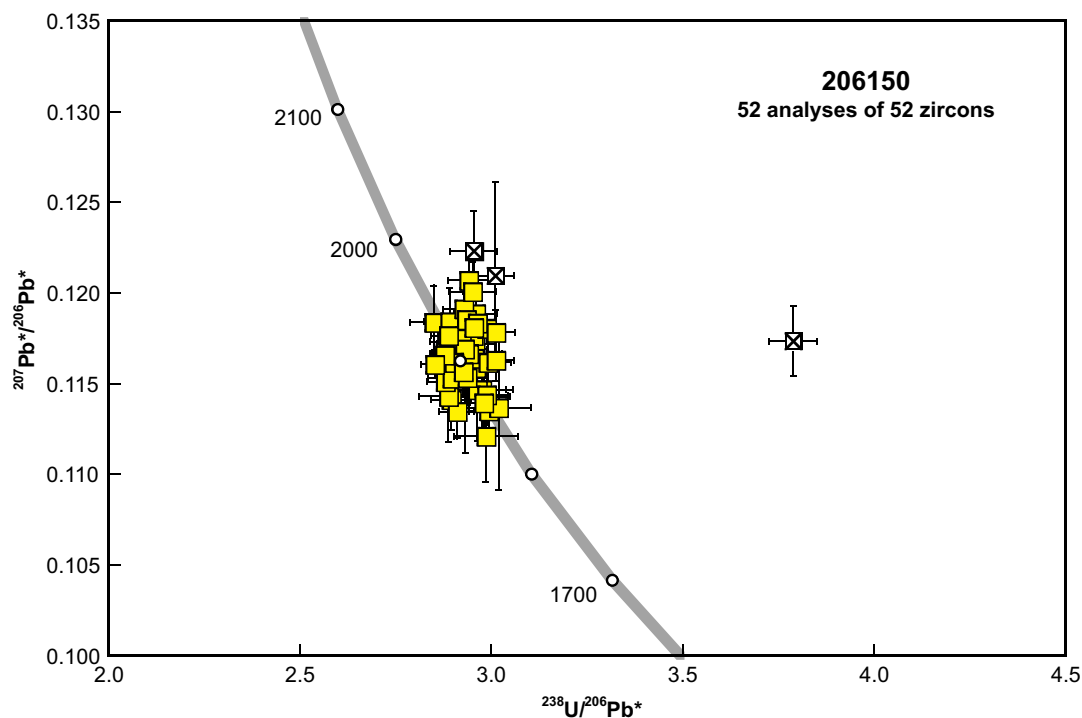
Figure 2. Cathodoluminescence image of representative zircons from sample 206150: mylonitic quartzofeldspathic rock, Bullaman Rockhole. Numbered circles indicate the approximate locations of analysis sites.

Table 1. Ion microprobe analytical results for zircons from sample 206150: mylonitic quartzofeldspathic rock, Bullaman Rockhole

Group ID	Spot no.	Grain. spot	$^{238}\text{U}$ (ppm)	$^{232}\text{Th}$ (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) $\pm 1\sigma$	Disc. (%)				
I	36	36.1	39	22	0.58	0.141	2.981	0.084	0.11334	0.00222	2.986	0.084	0.11210	0.00254	1834	41	-1.6
I	46	46.1	155	120	0.80	0.375	2.899	0.047	0.11675	0.00110	2.910	0.047	0.11347	0.00149	1856	24	-2.6
I	31	31.1	139	125	0.92	0.195	2.987	0.050	0.11518	0.00144	2.993	0.050	0.11348	0.00163	1856	26	-0.1
I	23	23.1	42	86	2.14	1.204	2.983	0.083	0.12421	0.00246	3.019	0.085	0.11368	0.00451	1859	72	0.8
I	6	6.1	89	72	0.83	0.299	2.972	0.059	0.11654	0.00147	2.981	0.059	0.11392	0.00189	1863	30	-0.1
I	47	47.1	120	84	0.73	0.278	2.887	0.051	0.11654	0.00130	2.895	0.052	0.11412	0.00164	1866	26	-2.5
I	49	49.1	70	80	1.17	0.336	2.972	0.066	0.11723	0.00174	2.982	0.066	0.11429	0.00229	1864	37	0.2
I	45	45.1	47	28	0.61	0.238	2.881	0.076	0.11640	0.00207	2.888	0.077	0.11432	0.00255	1917	45	-2.6
I	7	7.1	93	77	0.86	0.210	2.981	0.056	0.11622	0.00137	2.987	0.056	0.11438	0.00165	1862	31	0.5
I	42	42.1	79	68	0.89	0.358	2.966	0.062	0.11779	0.00162	2.976	0.062	0.11466	0.00215	1867	35	0.4
I	27	27.1	33	21	0.66	0.164	2.959	0.092	0.11610	0.00242	2.964	0.092	0.11466	0.00282	1874	52	0.0
I	44	44.1	127	121	0.99	0.130	2.877	0.050	0.11626	0.00125	2.880	0.050	0.11513	0.00141	1921	29	-2.1
I	17	17.1	74	47	0.66	0.223	2.891	0.062	0.11725	0.00164	2.897	0.062	0.11530	0.00199	1911	36	-1.4
I	9	9.1	105	168	1.65	0.140	2.933	0.053	0.11657	0.00131	2.937	0.053	0.11534	0.00149	1889	30	-0.2
I	34	34.1	161	170	1.09	0.033	2.931	0.046	0.11584	0.00436	2.932	0.046	0.11555	0.00437	1892	26	-0.2
I	5	5.1	202	179	0.92	0.310	2.918	0.043	0.11839	0.00102	2.927	0.043	0.11567	0.00131	1895	25	-0.2
I	37	37.1	94	64	0.70	0.057	2.958	0.058	0.11638	0.00143	2.960	0.058	0.11589	0.00152	1876	32	0.9
I	43	43.1	161	142	0.91	0.097	2.943	0.046	0.11683	0.00108	2.946	0.047	0.11599	0.00119	1884	26	0.6
I	39	39.1	95	81	0.89	0.112	2.949	0.056	0.11703	0.00143	2.952	0.056	0.11605	0.00159	1880	32	0.8
I	12	12.1	308	404	1.36	0.000	2.852	0.037	0.11608	0.00077	2.852	0.037	0.11608	0.00077	1937	22	-2.1
I	22	22.1	152	182	1.24	0.139	2.909	0.047	0.11735	0.00113	2.913	0.047	0.11613	0.00129	1902	27	-0.3
I	15	15.1	355	657	1.91	0.000	2.902	0.036	0.11618	0.00073	2.902	0.036	0.11618	0.00073	1909	21	-0.6
I	18	18.1	93	90	1.00	0.058	2.990	0.059	0.11669	0.00145	2.992	0.059	0.11619	0.00153	1859	32	2.1
I	4	4.1	182	190	1.08	-0.033	3.013	0.046	0.11601	0.00108	3.012	0.046	0.11629	0.00112	1848	25	2.7
I	28	28.1	376	365	1.00	0.061	2.952	0.037	0.11693	0.00075	2.954	0.037	0.11640	0.00080	1879	21	1.2
I	14	14.1	694	1093	1.63	0.022	2.877	0.031	0.11678	0.00052	2.878	0.031	0.11659	0.00053	1923	18	-1.0
I	21	21.1	36	19	0.56	-0.459	2.955	0.087	0.11265	0.00231	2.941	0.087	0.11667	0.00326	1887	50	1.0
I	24	24.1	287	415	1.49	0.000	2.879	0.039	0.11670	0.00084	2.879	0.039	0.11670	0.00084	1922	23	-0.8
I	33	33.1	285	360	1.30	0.020	2.918	0.038	0.11704	0.00086	2.919	0.039	0.11687	0.00087	1899	22	0.5
I	16	16.1	83	58	0.72	0.124	2.926	0.059	0.11798	0.00151	2.930	0.059	0.11690	0.00170	1893	34	0.9
I	41	41.1	108	102	0.98	0.200	2.952	0.054	0.11895	0.00137	2.958	0.054	0.11719	0.00163	1877	30	1.9
I	30	30.1	182	209	1.19	0.030	2.903	0.045	0.11749	0.00105	2.904	0.045	0.11723	0.00109	1908	26	0.4
I	52	52.1	215	260	1.25	0.050	2.908	0.042	0.11770	0.00096	2.910	0.042	0.11726	0.00101	1904	24	0.6

Table 1. continued

Group ID	Spot no.	Grain. spot	$^{238}\text{U}$ (ppm)	$^{232}\text{Th}$ (ppm)	$\frac{^{232}\text{Th}}{^{238}\text{U}}$	$f_{204}$ (%)	$^{238}\text{U}/^{206}\text{Pb} \pm 1\sigma$	$^{207}\text{Pb}/^{206}\text{Pb} \pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^* \pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^* \pm 1\sigma$	$^{238}\text{U}/^{206}\text{Pb}^* \text{ date (Ma)} \pm 1\sigma$	$^{207}\text{Pb}^*/^{206}\text{Pb}^* \text{ date (Ma)} \pm 1\sigma$	Disc. (%)						
I	35	35.1	189	183	1.00	0.027	2.881	0.043	0.11756	0.00100	2.882	0.043	0.11732	0.00103	1920	25	1916	16	-0.2
I	20	20.1	144	172	1.24	0.078	2.919	0.049	0.11817	0.00120	2.921	0.049	0.11749	0.00129	1898	28	1918	20	1.1
I	38	38.1	477	864	1.87	0.050	2.905	0.033	0.11804	0.00061	2.907	0.033	0.11760	0.00064	1906	19	1920	10	0.7
I	29	29.1	164	129	0.81	0.096	2.949	0.046	0.11851	0.00111	2.952	0.046	0.11766	0.00122	1881	26	1921	19	2.1
I	8	8.1	163	147	0.94	0.061	2.887	0.045	0.11820	0.00106	2.888	0.045	0.11766	0.00113	1916	26	1921	17	0.2
I	10	10.1	138	165	1.24	0.100	3.009	0.049	0.11872	0.00112	3.012	0.049	0.11784	0.00122	1848	27	1924	19	3.9
I	25	25.1	314	537	1.77	-0.052	2.990	0.039	0.11759	0.00080	2.988	0.039	0.11804	0.00084	1861	21	1927	13	3.4
I	1	1.1	191	254	1.37	-0.030	2.955	0.044	0.11785	0.00107	2.954	0.044	0.11811	0.00110	1880	25	1928	17	2.5
I	2	2.1	572	687	1.24	-0.009	2.963	0.033	0.11826	0.00060	2.963	0.033	0.11834	0.00060	1875	18	1931	9	2.9
I	50	50.1	72	42	0.59	-0.228	2.856	0.062	0.11639	0.00168	2.849	0.062	0.11839	0.00203	1939	37	1932	31	-0.4
I	32	32.1	61	38	0.65	0.000	2.891	0.067	0.11842	0.00187	2.891	0.067	0.11842	0.00187	1915	39	1933	28	0.9
I	13	13.1	246	241	1.01	0.039	2.935	0.040	0.11887	0.00109	2.936	0.040	0.11852	0.00111	1890	22	1934	17	2.3
I	26	26.1	97	66	0.70	0.000	2.959	0.057	0.11889	0.00146	2.959	0.057	0.11889	0.00146	1877	32	1940	22	3.2
I	19	19.1	104	86	0.86	-0.109	2.931	0.056	0.11817	0.00144	2.928	0.056	0.11913	0.00159	1894	32	1943	24	2.5
I	11	11.1	77	47	0.63	-0.062	2.952	0.061	0.11954	0.00153	2.951	0.061	0.12009	0.00162	1881	34	1958	24	3.9
I	48	48.1	104	68	0.68	-0.051	2.942	0.055	0.12025	0.00178	2.941	0.055	0.12070	0.00183	1887	31	1967	27	4.1
D	51	51.1	145	418	2.99	0.507	3.769	0.061	0.12180	0.00133	3.788	0.062	0.11736	0.00190	1510	22	1916	29	21.2
D	40	40.1	141	146	1.07	-0.077	3.012	0.049	0.12027	0.00517	3.010	0.049	0.12095	0.00518	1849	27	1970	76	6.1
D	3	3.1	84	59	0.73	-0.557	2.970	0.060	0.11741	0.00152	2.954	0.060	0.12231	0.00222	1880	34	1990	32	5.6



**Figure 3.** U–Pb analytical data for zircons from sample 206150: mylonitic quartzofeldspathic rock, Bullaman Rockhole. Yellow squares indicate Group I (magmatic zircons); crossed squares indicate Group D (discordance >5%).

## References

- Griffin, TJ and Tyler, IM 1992, Geology of the southern Halls Creek Orogen – a summary of field work in 1992: Geological Survey of Western Australia, Record 1992/17, 28p.
- Hollis JA, Kemp, AIS, Tyler, IM, Kirkland CL, Wingate MTD, Phillips, C, Belousova, EA and Greau, Y 2014, Basin formation by orogenic collapse: U–Pb–Hf isotope evidence from the Kimberley and Speewah Groups, northern Australia: Geological Survey of Western Australia, Report 137, 52p.
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## Recommended reference for this publication

- Kirkland, CL, Wingate, MTD, Hollis, J and Phillips, C 2015, 206150: mylonitic quartzofeldspathic rock, Bullaman Rockhole; Geochronology Record 1242: Geological Survey of Western Australia, 5p.

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