168909: vitric tuff, Gilbert Cairn

Location and sampling

MARBLE BAR (SF 50-8) MGA Zone 50, 806710E 7602440N

Sampled on 19 September 1999

The sample was taken from a 0.5 m-diameter boulder located 20 m east of a gully on the northern side of a small creek bed and 2 km north of Gilbert Cairn.

Tectonic unit/relations

This sample is from a pale grey-green, fine-grained volcanic rock in which layering of varying grain sizes is interpreted as bedding. The volcanic rock occurs within a 30 m-thick unit of volcaniclastic, siltstone, and chert lithologies that are interbedded with monotonous basaltic rocks, within the uppermost part of the Euro Basalt, or lowermost part of the Wyman Formation. The unit sampled is interpreted to stratigraphically underlie a volcaniclastic unit, of which sample 168910 is representative.

Petrographic description

This is a homogeneous vitric tuff, or possible volcaniclastic sandstone derived from vitric tuff. It is composed of a homogeneous, fine-grained aggregate of sericite and quartz, including diffuse probable leucoxene outlining shards and grains from 0.1 to 0.4 mm in diameter, which may have been volcanic glass. Leucoxene has also replaced small opaque oxide crystals, rarely ≥20 mm in diameter, largely within the glass fragments but also between them. Some of the fragments are richer in sericite than the host rock, but some are quartz rich. No other evidence of crystalline material was seen. This rock is of acid volcanic origin and could be a vitric tuff or a volcaniclastic sandstone derived from a vitric tuff. The rounded nature of the clasts suggests some sedimentary reworking.

Zircon morphology

The zircons isolated from this sample are commonly pale pink, dark yellow-brown or black, subhedral, commonly slightly elongate with subrounded terminations, and are typically between 40 × 100 μm and 60 × 200 μm in size. Some grains are structureless but many are strongly zoned, and many grains contain irregular opaque spots and inclusions or are black and highly metamict. Fluid and mineral inclusions are common.

Analytical details

The sample was analysed on 31 January 2000. The counter deadtime was 32 ns. Twelve analyses of the CZ3 standard were obtained during the analysis session. Following deletion of three standard analyses as outliers, the remaining nine standard analyses indicated a Pb^*/U calibration error of 3.72 (1σ%). Common-Pb corrections were applied assuming Broken Hill common-Pb isotopic compositions for all analyses, with the exception of analyses 4.1 and 17.1, for which isotopic compositions determined using the method of Cumming and Richards (1975) were assumed.

Table 41. Ion microprobe analytical results for sample 168909: vitric tuff, Gilbert Cairn

Grain .spot	*U (ppm)*	*Th (ppm)*	*Pb (ppm)*	*f206%*	$^{207}Pb/^{206}Pb$	*±1σ*	$^{208}Pb/^{206}Pb$	*±1σ*	$^{206}Pb/^{238}U$	*±1σ*	$^{207}Pb/^{235}U$	*±1σ*	*% concordance*	$^{207}Pb/^{206}Pb$ *age*	*±1σ*
1.1	65	52	59	0.200	0.27630	0.00204	0.20225	0.00264	0.7126	0.0271	27.147	1.075	104	3 342	12
2.1	81	40	70	0.215	0.27730	0.00182	0.12957	0.00239	0.7157	0.0271	27.363	1.072	104	3 348	10
3.1	247	185	251	0.038	0.33920	0.00099	0.19263	0.00101	0.7698	0.0288	36.005	1.364	101	3 659	4
4.1	64	37	64	4.664	0.27594	0.00367	0.14650	0.00768	0.7162	0.0273	27.251	1.142	104	3 340	21
5.1	49	39	44	0.128	0.27895	0.00221	0.20744	0.00300	0.6961	0.0266	26.772	1.070	101	3 357	12
6.1	101	54	86	0.161	0.26902	0.00152	0.14215	0.00183	0.6933	0.0261	25.717	0.998	103	3 300	9
7.1	89	58	79	0.072	0.27688	0.00164	0.17409	0.00196	0.7082	0.0268	27.035	1.054	103	3 345	9
8.1	857	157	137	0.038	0.07225	0.00054	0.05017	0.00087	0.1659	0.0062	1.653	0.064	100	993	15
9.1	157	113	132	0.214	0.27288	0.00126	0.18148	0.00165	0.6676	0.0251	25.121	0.964	99	3 323	7
10.1	102	83	101	0.155	0.27705	0.00190	0.21878	0.00296	0.7659	0.0289	29.258	1.146	110	3 346	11
11.1	569	296	259	0.192	0.17865	0.00067	0.14104	0.00102	0.3988	0.0149	9.823	0.373	82	2 640	6
12.1	77	76	72	0.071	0.27780	0.00195	0.25777	0.00309	0.7089	0.0268	27.153	1.068	103	3 351	11
13.1	197	93	163	0.083	0.27178	0.00108	0.12575	0.00112	0.6840	0.0256	25.631	0.978	101	3 316	6
14.1	53	30	47	0.131	0.27733	0.00222	0.14853	0.00274	0.7177	0.0274	27.443	1.096	104	3 348	12
15.1	80	43	70	0.293	0.27715	0.00195	0.14153	0.00282	0.7080	0.0268	27.057	1.064	103	3 347	11
16.1	126	96	115	0.152	0.28005	0.00144	0.21211	0.00189	0.7047	0.0265	27.210	1.050	102	3 363	8
17.1	194	135	169	0.978	0.26964	0.00134	0.19241	0.00234	0.6762	0.0253	25.140	0.965	101	3 304	8
18.1	41	45	48	0.239	0.27768	0.00240	0.26587	0.00364	0.8889	0.0341	34.031	1.373	122	3 350	14
19.1	102	90	95	0.050	0.27589	0.00151	0.23040	0.00207	0.7120	0.0269	27.084	1.051	104	3 340	9
20.1	141	80	123	0.148	0.26977	0.00132	0.14816	0.00165	0.7133	0.0268	26.531	1.021	105	3 305	8
21.1	62	37	56	0.143	0.27588	0.00227	0.15533	0.00350	0.7241	0.0276	27.543	1.100	105	3 340	13
22.1	127	50	108	0.144	0.27027	0.00139	0.10172	0.00153	0.7174	0.0270	26.736	1.031	105	3 308	8
23.1	126	88	116	0.122	0.28000	0.00140	0.18829	0.00186	0.7224	0.0272	27.890	1.075	104	3 363	8
24.1	88	50	78	0.003	0.27794	0.00152	0.15189	0.00140	0.7171	0.0271	27.480	1.068	104	3 351	9
25.1	100	73	91	0.108	0.27608	0.00157	0.19138	0.00205	0.7157	0.0270	27.243	1.058	104	3 341	9

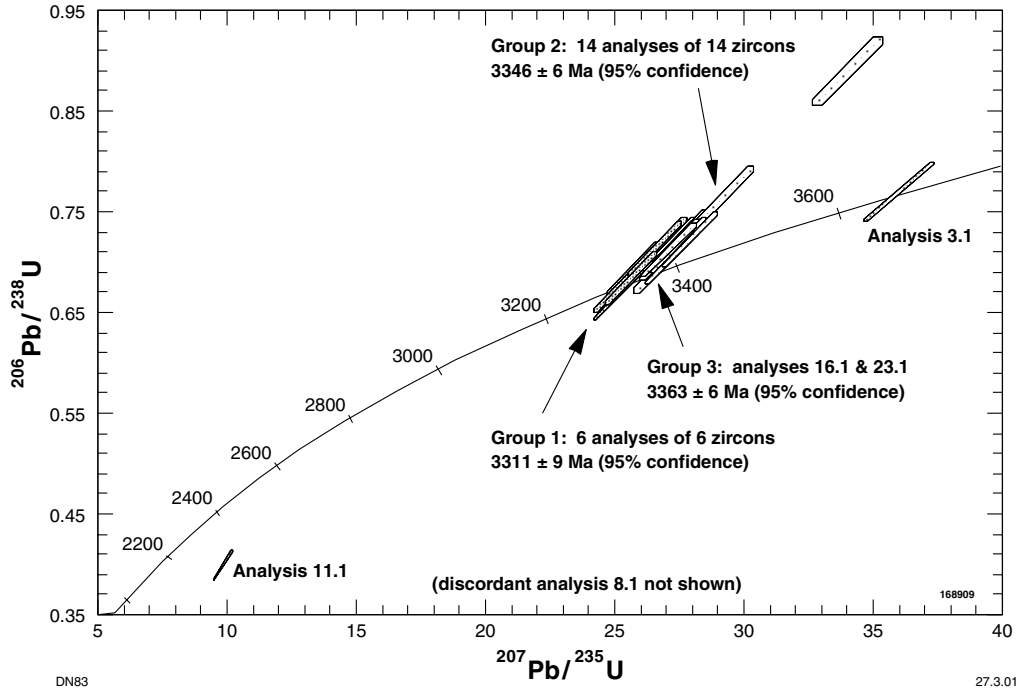

Figure 45. Concordia plot for sample 168909: vitric tuff, Gilbert Cairn

Results

Twenty-five analyses were obtained from 25 zircons. Results are given in Table 41 and shown on a concordia plot in Figure 45.

Interpretation

The analyses are concordant or (in the case of analyses 8.1, 10.1, 11.1, and 18.1) normally and strongly reversely discordant, with the discordance pattern consistent with several episodes, including at least one a recent episode, of radiogenic-Pb redistribution. On the basis of their $^{207}Pb/^{206}Pb$ ratios, most analyses may be assigned to three groups. Six concordant analyses of six zircons (6.1, 9.1, 13.1, 17.1, 20.1, and 22.1), assigned to Group 1, have $^{207}Pb/^{206}Pb$ ratios defining a single population and indicating a weighted mean $^{207}Pb/^{206}Pb$ date of 3311 ± 9 Ma (chi-squared = 1.10). Fourteen analyses of 14 zircons (1.1, 2.1, 4.1, 5.1, 7.1, 10.1, 12.1, 14.1, 15.1, 18.1, 19.1, 21.1, 24.1, and 25.1), assigned to Group 2, have $^{207}Pb/^{206}Pb$ ratios defining a single population and indicating a weighted mean $^{207}Pb/^{206}Pb$ date of 3346 ± 6 Ma (chi-squared = 0.20). Analyses 16.1 and 23.1, assigned to Group 3, have $^{207}Pb/^{206}Pb$ ratios defining a single population and indicating a weighted mean $^{207}Pb/^{206}Pb$ date of 3363 ± 6 Ma. Concordant analysis 3.1 indicates a substantially older $^{207}Pb/^{206}Pb$ date of 3659 ± 4 Ma (±1σ error) than those of Groups 1 to 3, whereas the remaining analyses (8.1 and 11.1) are highly discordant or indicate considerably younger $^{207}Pb/^{206}Pb$ dates.

Some analyses (for example, highly discordant analyses 8.1 and 11.1) show clear evidence of ancient radiogenic-Pb loss and reversely discordant analysis 18.1 indicates that some recent redistribution of radiogenic Pb has also occurred. Analyses of Group 1 indicate generally higher U contents than those of Group 2, but Group 1 analyses show no correlation between U concentration and $^{207}Pb/^{206}Pb$ ratio. This suggests that the younger weighted mean $^{207}Pb/^{206}Pb$ dates indicated by the analyses of Group 1,

compared to those of Group 2, are not due to ancient radiogenic-Pb loss (from analyses originally belonging with Group 2, for example). The date of 3311 ± 9 Ma indicated by the weighted mean $^{207}Pb/^{206}Pb$ ratio of the six concordant analyses of Group 1, the date of 3346 ± 6 Ma indicated by the weighted mean $^{207}Pb/^{206}Pb$ ratio of 14 analyses of Group 2, the date of 3363 ± 6 Ma indicated by the weighted mean $^{207}Pb/^{206}Pb$ ratio of analyses 16.1 and 23.1, and the $^{207}Pb/^{206}Pb$ date of 3659 ± 5 Ma (± 1σ error) indicated by concordant analysis 3.1, are therefore interpreted to correspond to the dates of mixed igneous, probably reworked volcanogenic components present within the vitric tuff. The date of 3311 ± 9 Ma indicated by the the weighted mean $^{207}Pb/^{206}Pb$ ratio of six concordant analyses of Group 1 is interpreted as providing a maximum age for deposition of the vitric tuff.

STRATIGRAPHIC REFERENCE:

BAGAS, L., et al., in press, Geology of the Split Rock 1:100 000 sheet: Western Australia Geological Survey, 1:100 000 Geological Series Explanatory Notes.

Recommended reference for this publication:

NELSON, D. R., 2001, 168909: vitric tuff, Gilbert Cairn; in Compilation of geochronology data, 2000: Western Australia Geological Survey, Record 2001/2, p. 133–136.
OR
NELSON, D. R., 2001, 168909: vitric tuff, Gilbert Cairn; Geochronology dataset 223; in Compilation of geochronology data, June 2006 update: Western Australia Geological Survey.

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