

168908: crystal-lithic tuff, Copper Hills

Location and sampling

MARBLE BAR (SF 50-8)

MGA Zone 50, 808680E 7600840N

Sampled on 19 September 1999

The sample was taken from a 1 m-diameter boulder located on the northern side of a small rocky hill, 30 m south of a large rock pavement and 0.5 km east of the Copper Hills mine (abandoned).

Tectonic unit/relations

This sample is from a phenocryst-rich, quartzofeldspathic rock that contains 2 cm-diameter chert fragments of the Budjan Creek Formation.

Petrographic description

This sample is of a crystal-lithic tuff with coarse ash and lapilli of quartz–plagioclase–biotite–porphyritic acid volcanic origin. It is of pyroclastic origin, with clasts from 2 to 7 mm in diameter, including coarse ash and small lapilli. One fragment is pyrite rich. Separate crystal fragments are also abundant. Most of the lithic fragments have a schistose groundmass that has been altered to quartz and sericite, but one fragment, which encloses most of the pyrite in the rock, is of an altered, flow-layered acid volcanic rock. Quartz phenocrysts are abundant (20 vol.%), up to 3 mm in diameter, variously angular, rounded, amoeboid, and resorbed, occurring partly within clasts and partly as separate fragments. Some have been fractured or fragmented with infills of altered groundmass of quartz and sericite, rarely with carbonate. The rock has been locally altered to an assemblage of quartz, sericite, chlorite, carbonate, and leucoxene. There are albitized plagioclase phenocrysts (10–15 vol.%) up to 2 mm long, commonly with minor carbonate as patches or in veins. Some of these are fractured and/or fragmented, with the fragments enclosed in carbonate or in quartz–sericite aggregates. Former biotite phenocrysts are disseminated and have been altered to chlorite and leucoxene. Leucoxene also occurs within irregular quartz and carbonate patches up to 2 mm long, apparently derived from mafic phenocrysts other than biotite, possibly hornblende. Many of the lithic fragments have groundmasses altered to sericite-rich assemblages, but some are more quartz rich and the matrix is also quartz rich, with minor carbonate and sericite. The pyrite-rich fragment is rich in microcrystalline quartz, with decussate sericite and irregular patches of carbonate. The pyrite occurs as crystals up to 1.5 mm long. The only other pyrite in the thin section occurs in a small, albite- and carbonate-altered plagioclase phenocryst.

Zircon morphology

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

Table 40. Ion microprobe analytical results for sample 168908: crystal-lithic tuff, Copper Hills

<i>Grain .spot</i>	<i>U (ppm)</i>	<i>Th (ppm)</i>	<i>Pb (ppm)</i>	<i>f206%</i>	<i>²⁰⁷Pb/²⁰⁶Pb</i>	<i>±1σ</i>	<i>²⁰⁸Pb/²⁰⁶Pb</i>	<i>±1σ</i>	<i>²⁰⁶Pb/²³⁸U</i>	<i>±1σ</i>	<i>²⁰⁷Pb/²³⁵U</i>	<i>±1σ</i>	<i>% concordance</i>	<i>²⁰⁷Pb/²⁰⁶Pb age</i>	<i>±1σ</i>
1.1	290	200	232	0.469	0.25696	0.00104	0.17899	0.00166	0.6387	0.0239	22.631	0.862	99	3 228	6
2.1	306	210	262	0.550	0.26441	0.00098	0.17985	0.00156	0.6780	0.0253	24.718	0.940	102	3 273	6
3.1	143	95	126	0.194	0.26836	0.00133	0.17811	0.00179	0.7043	0.0265	26.058	1.003	104	3 296	8
4.1	253	124	210	0.281	0.26710	0.00100	0.12620	0.00126	0.6865	0.0257	25.282	0.962	102	3 289	6
5.1	152	88	127	0.399	0.27059	0.00136	0.15327	0.00195	0.6771	0.0254	25.260	0.972	101	3 309	8
6.1	266	282	246	0.056	0.27177	0.00091	0.27812	0.00129	0.6923	0.0259	25.940	0.985	102	3 316	5
7.1	143	76	124	0.645	0.27067	0.00146	0.13800	0.00218	0.6983	0.0262	26.059	1.006	103	3 310	8
8.1	212	118	180	0.087	0.27141	0.00101	0.14748	0.00109	0.6922	0.0259	25.903	0.987	102	3 314	6
9.1	183	125	153	0.918	0.26971	0.00141	0.16577	0.00238	0.6614	0.0248	24.596	0.947	99	3 304	8
10.1	182	100	151	0.649	0.26155	0.00125	0.14159	0.00197	0.6739	0.0253	24.303	0.933	102	3 256	8
11.1	158	63	138	0.541	0.26829	0.00143	0.09553	0.00198	0.7292	0.0274	26.975	1.040	107	3 296	8
12.1	360	362	324	0.164	0.27070	0.00080	0.26596	0.00115	0.6775	0.0253	25.289	0.957	101	3 310	5
13.1	107	57	89	0.222	0.27116	0.00153	0.14165	0.00195	0.6847	0.0258	25.599	0.993	101	3 313	9
14.1	104	56	92	0.153	0.27143	0.00151	0.14042	0.00178	0.7230	0.0272	27.058	1.049	106	3 314	9
15.1	231	165	202	0.166	0.26951	0.00101	0.18961	0.00133	0.6929	0.0259	25.747	0.980	103	3 303	6
16.1	125	106	117	0.678	0.26963	0.00167	0.22567	0.00278	0.7141	0.0269	26.548	1.033	105	3 304	10
17.1	179	92	155	0.109	0.27127	0.00115	0.13558	0.00131	0.7089	0.0266	26.515	1.014	104	3 313	7
18.1	96	69	86	0.188	0.26870	0.00165	0.18796	0.00228	0.7159	0.0270	26.522	1.034	106	3 298	10
19.1	301	123	251	0.449	0.26788	0.00097	0.10422	0.00134	0.6977	0.0261	25.771	0.979	104	3 294	6
20.1	152	150	143	0.049	0.27293	0.00122	0.26243	0.00164	0.7103	0.0267	26.728	1.025	104	3 323	7

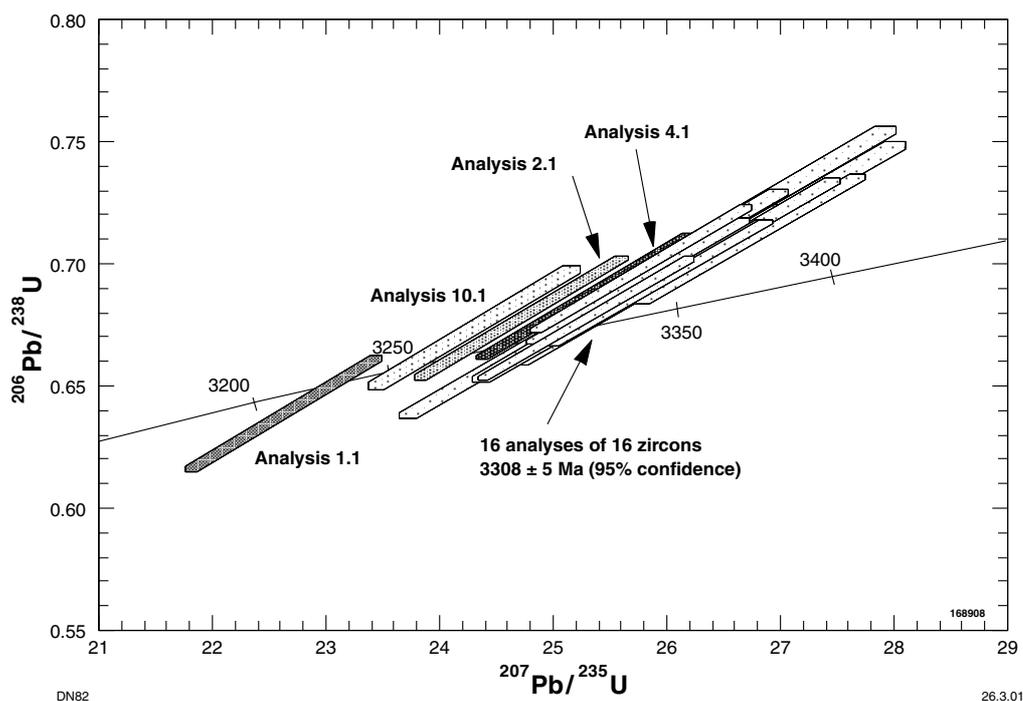


Figure 44. Concordia plot for sample 168908: crystal-lithic tuff, Copper Hills

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 (1 σ %). Common-Pb corrections were applied assuming Broken Hill common-Pb isotopic compositions for all analyses, with the exception of analyses 1.1, 2.1, 9.1, 10.1, and 19.1, for which isotopic compositions determined using the method of Cumming and Richards (1975) were assumed.

Results

Twenty analyses were obtained from 20 zircons. Results are given in Table 40 and shown on a concordia plot in Figure 44.

Interpretation

Most analyses are concordant or slightly reversely discordant, with the discordance pattern consistent with several episodes, including at least one recent episode, of radiogenic-Pb redistribution. Sixteen concordant and slightly discordant analyses of 16 zircons have $^{207}\text{Pb}/^{206}\text{Pb}$ ratios defining a single population and indicating a weighted mean $^{207}\text{Pb}/^{206}\text{Pb}$ date of 3308 ± 5 Ma (chi-squared = 0.92). The remaining analyses (1.1, 2.1, 4.1, and 10.1) are concordant, indicate generally lower $^{207}\text{Pb}/^{206}\text{Pb}$ dates than the main population, and cannot be grouped.

Several interpretations of these data are possible. A minority of analyses define a weak negative correlation between U concentration and $^{207}\text{Pb}/^{206}\text{Pb}$ ratio, suggesting that the younger $^{207}\text{Pb}/^{206}\text{Pb}$ dates indicated by analyses 1.1, 2.1, 4.1, and 10.1 may be due to ancient radiogenic-Pb loss. The younger $^{207}\text{Pb}/^{206}\text{Pb}$ dates may be of sites that

have lost some proportion of their accumulated radiogenic Pb during an ancient disturbance event. The date of 3308 ± 5 Ma indicated by the weighted mean $^{207}\text{Pb}/^{206}\text{Pb}$ ratio of 16 concordant and slightly discordant analyses of 16 zircons may, therefore, be interpreted as providing the time of igneous crystallization of the crystal-lithic tuff. An alternative interpretation is that most or all of the zircons within this sample are xenocrystic in origin. If this is the case, the youngest $^{207}\text{Pb}/^{206}\text{Pb}$ date of 3228 ± 6 Ma ($\pm 1\sigma$ error) indicated by analysis 1.1 provides a maximum date for deposition of the crystal-lithic 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, 168908: crystal-lithic tuff, Copper Hills; in *Compilation of geochronology data, 2000*: Western Australia Geological Survey, Record 2001/2, p. 129–132.

OR

NELSON, D. R., 2001, 168908: crystal-lithic tuff, Copper Hills; Geochronology dataset 222; in *Compilation of geochronology data, June 2006 update*: Western Australia Geological Survey.

Data obtained: 31/01/2000; Data released: 13/09/2001