CHAPTER 7
GEOCHRONOLOGY

Radiometric dating using the U-Pb method was conducted on zircon grains extracted from selected samples of the felsic granulite (charnockite and monzosyenite) and mafic granulites of the study area using Laser Ablated Inductively Coupled Plasma Mass Spectrometer (LA-ICPMS). The details are discussed below.

7.1 Felsic granulites

7.1.1 Charnockite:

BSE and CL imaging technique is used to observe various shape, growth pattern and texture of the zircon grains. They are characterized by interior domain and patchy or overgrowth domain. The analyze zircon grains are subhedral to euhedral crystals with high aspect ratio and having prismatic habit. They contain a thick internal domain that preserve well developed oscillatory/ growth zoning. This is identified by a concentric feature accompanied by fluctuations in brightness. Occasionally this internal domain is further surrounded by a thin featureless, bright CL overgrowth along with some occasionally sector zoned overgrowth domain. A few zircon grains have well preserved irregularly shaped xenocrystic core appears dark under CL. On the other hand, a few develop patches on the oscillatory zoned internal domain. Occasionally, zircon crystal that has undergone metamorphism, featured a centrally zoned igneous core and surrounded metamorphic bands lacking zoning. Internal attributes such as mosaic or patchy textures are distinctive in few grains. By applying EDS spectral analysis numerous monophase and multiphase inclusion of quartz, k-feldspar, plagioclase, orthopyroxene, biotite and apatite has been observed in zircons. The details about zircon U, Th contents and age data are presented in Table 7.1 and grains morphology, internal structure are discussed in details below. The CL image of representative samples is depicted in Figure (7.1).

Sample 17EG07: Zircon grains predominantly exhibit an elongated morphology (ranging from 200 to 350 µm in length and 70 to 150 µm in width), with a minority displaying equant to oblate shapes (Fig 7.1a). CL imaging reveals a consistent pattern across all grains: a substantial oscillatory-zoned internal domain. This domain may or may not include a bright-CL xenocrystic core. Additionally, some grains exhibit a low to moderate-CL, featureless, patchy overgrowth with a thickness of 20 to 30 µm. Among the nineteen analyzed spots, a majority of eleven were derived from the overgrowth and patchy domains, while the remaining were from the oscillatory-zoned domains. The oscillatory-zoned domains exhibit U and Th concentrations ranging between 233-1093 ppm and 253-1257 ppm, respectively, resulting in Th/U ratios spanning from 0.28 to 1.43 (Table 7.1). The group age has been calculated from six out of eight spots that yield a weighted mean age of 939±27 Ma using the $^{206}Pb/^{238}U$ method, although this data displays a modest MSWD of 2.8 (Fig 7.2a). Meanwhile, the oscillatory-zoned cores produce two nearly concordant ages of 1016±25 Ma and 1020±53 Ma. For the patchy domains and overgrowth areas (with Th/U ratios ranging from 0.33 to 1.26), the $^{206}Pb/^{238}U$ dating method indicates dates within the range of approximately 879 to 754 Ma.

Sample 17EG10: The zircon crystals primarily exhibit a euhedral to subhedral morphology, characterized by a high aspect ratio (ranging from 100 to 350 µm in length and 50 to 100 µm in width). There are also a few grains that assume a circular to oval form. Notably, all of these grains display a faint CL response, which preserves delicate indications of finely detailed oscillatory zoning (Fig 7.1b). In certain grains, a thin sector-zoned overgrowth exhibiting a bright-CL response can also be observed. Out of the seventeen spots subjected to analysis, fifteen originate from the oscillatory-zoned domain, while the remaining two are from the overgrowth domain. The U concentrations range from 152-5937 ppm, while the Th concentrations span from 66-1910 ppm. This wide variation in U and Th content results in Th/U ratios ranging from 0.03 to 1.32. Within the oscillatory-zoned domain, eight grains collectively provide a weighted mean age of 1002±13 Ma using the $^{206}Pb/^{238}U$ dating method, which displays a relatively low MSWD of 1.2 (Fig 7.2b). Meanwhile, the two spots originating from the overgrowth domain yield $^{206}Pb/^{238}U$ dates of 803±24 Ma and 886±18 Ma.

Sample 17EG17: Zircon grains having subhedral to euhedral shapes and 150-270 µm in length. There are also a few equants to oblate grains present. All grains display a thick inner region, which retains the traces of oscillatory zoning, indicated by a weak CL response (Fig 7.1c). Some grains show a thin, featureless overgrowth with a moderate to bright CL response. A total of twenty-four spots were examined, with twelve belonging to the overgrowth and patchy regions, while the remaining spots are from the oscillatory-zoned area. The U and Th contents within the oscillatory-zoned region exhibit noteworthy variation, ranging from 342 to 1458 ppm for U and 137 to 988 ppm for Th, with a Th/U ratio ranging from 0.23 to 1.07. Total nine spots provide a weighted mean age of 951 ± 9 Ma using the $^{206}Pb/^{238}U$ dating method (with a MSWD of 1.4; Fig 7.2c). In the overgrowth and patchy regions, the Th and U contents display variability, measuring between 140 and 4799 ppm for Th and 145 and 706 ppm for U, with a Th/U ratio ranging from 0.16 to 0.89. Analyzing these regions yields $^{206}Pb/^{238}U$ ages spanning approximately from 931 to 819 Ma.

Sample PH9A: Zircons found in the sample exhibit well-defined euhedral geometric shapes and elongation, with dimensions of approximately 360 µm in length and 100 µm in width. The majority of these grains show distinct concentric patterns in their internal structure (Fig 7.1d). Some grains possess a less distinct luminescence under CL with a faint xenocrystic core, while others have a featureless, bright CL overgrowth layer that is relatively thin, measuring less than 30 µm. In terms of the analysis, a total of twenty spots were investigated. Among these, two were selected from the xenocrystic core, three from the overgrowth layer, and the remaining locations were chosen from the oscillatory-zoned area. The zircons' U and Th content varies considerably, ranging from 395 to 2300 ppm for uranium and 178 to 945 ppm for thorium. The ratio of Th to U (Th/U) also displays a range of 0.30 to 0.62. Examining the dating results, two spots within the xenocrystic core indicate $^{206}Pb/^{238}U$ ages of 1105 ± 34 Ma and 1132 ± 49 Ma, respectively. Moving to the oscillatory-zoned domain, ten analyses yield an average $^{206}Pb/^{238}U$ age of 1020 ± 16 Ma (MSWD -1.5, Fig 7.2d). Regarding the overgrowth layer, the determined $^{206}Pb/^{238}U$ ages span the range of approximately 949 to 927 Ma.

Sample 19EG06: Zircon crystals within this sample exhibit an elongated and prismatic morphology, ranging in size from 200 to 580 µm in length and 50 to 120 µm in width, displaying a high aspect ratio. CL imaging of these zircons reveals an internal region marked by clearly defined oscillatory zoning, which occasionally encloses a central xenocrystic core (Fig 7.1e). Some grains also feature an outer overgrowth zone with distinct planar zoning. The analysis encompassed a total of eighteen specific locations. Among these, three were selected from xenocrystic cores, six from the overgrowth/patchy zone, and the remaining spots were chosen from the oscillatory-zoned region. Notably, the three examined xenocrystic cores displayed a subtle CL response. The chronological assessment of these spots indicates ^{206}Pb-^{238}U ages within the range of approximately 1064 to 910 Ma. As for the elemental composition, the oscillatory-zoned domain reveals considerable variation in U and Th content, spanning from 591- 6813 ppm and 176 - 771 ppm, respectively, resulting in Th/U ratios ranging from 0.03 - 0.98. Among the grains within this category, nine crystals contribute to a calculated weighted mean age of 954 ± 8 Ma for $^{206}Pb/^{238}U$ dating (MSWD - 1.01, Fig 7.2e). In terms of the overgrowth and patchy domains, the analyses yield $^{206}Pb/^{238}U$ ages within the interval of around 909 to 871 Ma.

Sample PLB71B: The zircons in this sample primarily exhibit well-formed, prismatic grains with lengths typically reaching up to 280 µm. These zircons possess a central region characterized by distinctive oscillatory zoning (Fig. 7.1f). Surrounding this central zone is an outer layer, measuring less than 30 µm in thickness. Occasionally, these zircons contain a central, dark-CL xenocrystic core. In total, eighteen sample locations were subjected to analysis, with three originating from the outer layer, two from the core, and the remaining spots taken from the oscillatory-zoned central region. Analyzing the outer layers yielded $^{206}Pb/^{238}U$ dates spanning approximately 931 - 896 Ma. In contrast, the central oscillatory-zoned domain exhibited variable U and Th contents, ranging from 144 - 5571 ppm and 113 - 2993 ppm, respectively, with Th/U ratios ranging from 0.13 to 0.78. From this domain, ten sampled spots produced a weighted mean $^{206}Pb/^{238}U$ age of 951 ± 13 Ma, as shown in Figure 7.2f. The two xenocrystic cores provided $^{206}Pb/^{238}U$ dates of 1039 ± 28 Ma and 1156 ± 23 Ma, respectively.

Sample PLB82A: The zircons in this sample primarily exhibit well-formed to somewhat irregular shapes, occasionally appearing equant to oblate, with lengths ranging from 200 to 300 µm. When observed under CL imaging, the majority of these zircons exhibit a distinct region of well-defined oscillatory zoning (Fig. 7.1g). This zoning is encircled by a 30–50 µm thick overgrowth. Out of the fifteen spots subjected to analysis, five were selected from the overgrowth and patchy regions, while the remaining spots were taken from the oscillatory-zoned central area. The oscillatory-zoned region displayed significant variability in U and Th contents, ranging from 1307 - 7268 ppm and 174 - 953 ppm, respectively, resulting in Th/U ratios spanning from 0.10 to 0.33. From this region, eight analyzed spots produced a weighted mean $^{206}Pb/^{238}U$ age of 968 ± 22 Ma (Fig. 7.2g). In contrast, the overgrowth and patchy areas exhibited a narrower range of U and Th contents, varying from 1597 to 4356 ppm and 178 to 590 ppm, respectively, with Th/U ratios in the range of 0.08 to 0.16. Samples from these regions provided $^{206}Pb/^{238}U$ dates ranging from 925 to 813 Ma.

Sample PLB89A: The majority of grains in this sample are elongated, prismatic, and euhedral, with lengths extending up to 300 μm. These grains exhibit well-defined oscillatory zoning at their central regions (Fig. 7.1h), and are surrounded by a patchy overgrowth. A total of eighteen locations were subjected to analysis, with six taken from the overgrowth and the remainder collected from the oscillatory-zoned central domain. In the oscillatory-zoned domain, there is notable variation in both U and Th contents, spanning from 411 to 5592 ppm and 213 to 957 ppm, respectively, resulting in Th/U ratios ranging from 0.12 to 0.58. Among these analyses, ten from this domain provided a weighted mean $^{206}Pb/^{238}U$ age of 978 ± 16 Ma (Fig. 7.2h). In the overgrowth domain, U and Th contents also exhibit substantial variability, ranging from 501 to 5815 ppm and 272 to 2208 ppm, respectively, with Th/U ratios in the range of 0.19 to 0.67. Analyzing these overgrowths yielded $^{206}Pb/^{238}U$ dates falling within the approximate range of 915–859 Ma.

7.1.2 Monzosyenite

The zircon grains within this sample are predominantly elongated, displaying a high aspect ratio, which can reach up to 3.0. These grains having a cross-sectional shape that varies between prismatic and oval. Most of these grains measure between 100 and 150 μm in length, with widths ranging from 30 to 50 μm. An interesting characteristic is that nearly all these grains exhibit a consistent internal structure featuring a central dark-CL region surrounded by a bright-CL outer part (Fig. 7.1i). These outer regions display subtle, planar to faint oscillatory zoning. A total of 28 spots were analyzed, each corresponding to an individual grain and presented in Table 7.2. When examining the Wetherill plot of all the data points, a distinct cluster of data points emerges around the vicinity of approximately 500 Ma, while 7 data points appear discordant. Among the remaining near-concordant data (21 points), a weighted average of $^{206}Pb/^{238}U$ dates was determined to be 490 ± 3 Ma, with a MSWD value of 1.03 (Fig. 7.2i). The majority of these spots exhibit a consistent Th/U ratio, ranging from 0.05 to 0.64, with only 3 spots displaying slightly elevated Th/U ratios (1.07–1.49). A probability density plot of all the data points reveals a sharp peak at approximately 490 Ma.

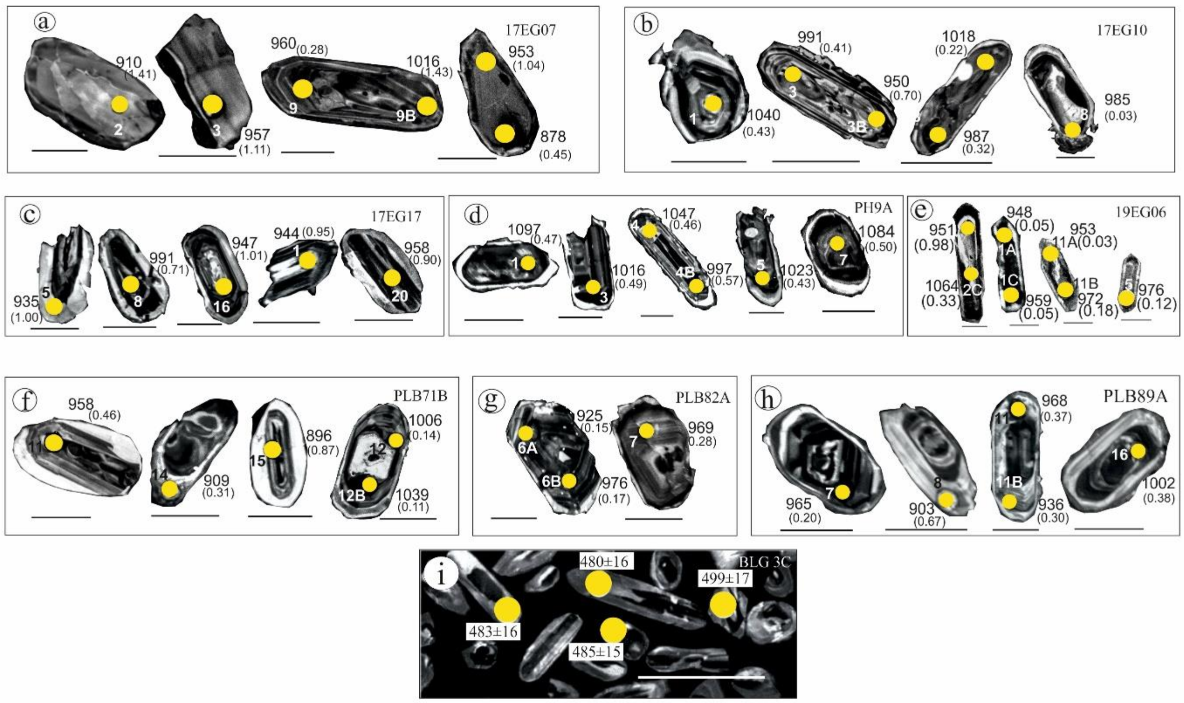

Fig. 7.1. CL images of representative zircon grains with $^{206}Pb/^{238}U$ dates in different samples. Spot numbers are also shown along with Th/U ratio (in parenthesis). The scale for each grain has a length of 100 μm. (a) Sample 17EG07. (b) Sample 17EG10. (c) Sample 17EG17. (d) Sample PH9A. (e) Sample 19EG06. (f) Sample PLB71B. (g) Sample PLB82A. (h) Sample PLB89A (i) Sample BLG3C.

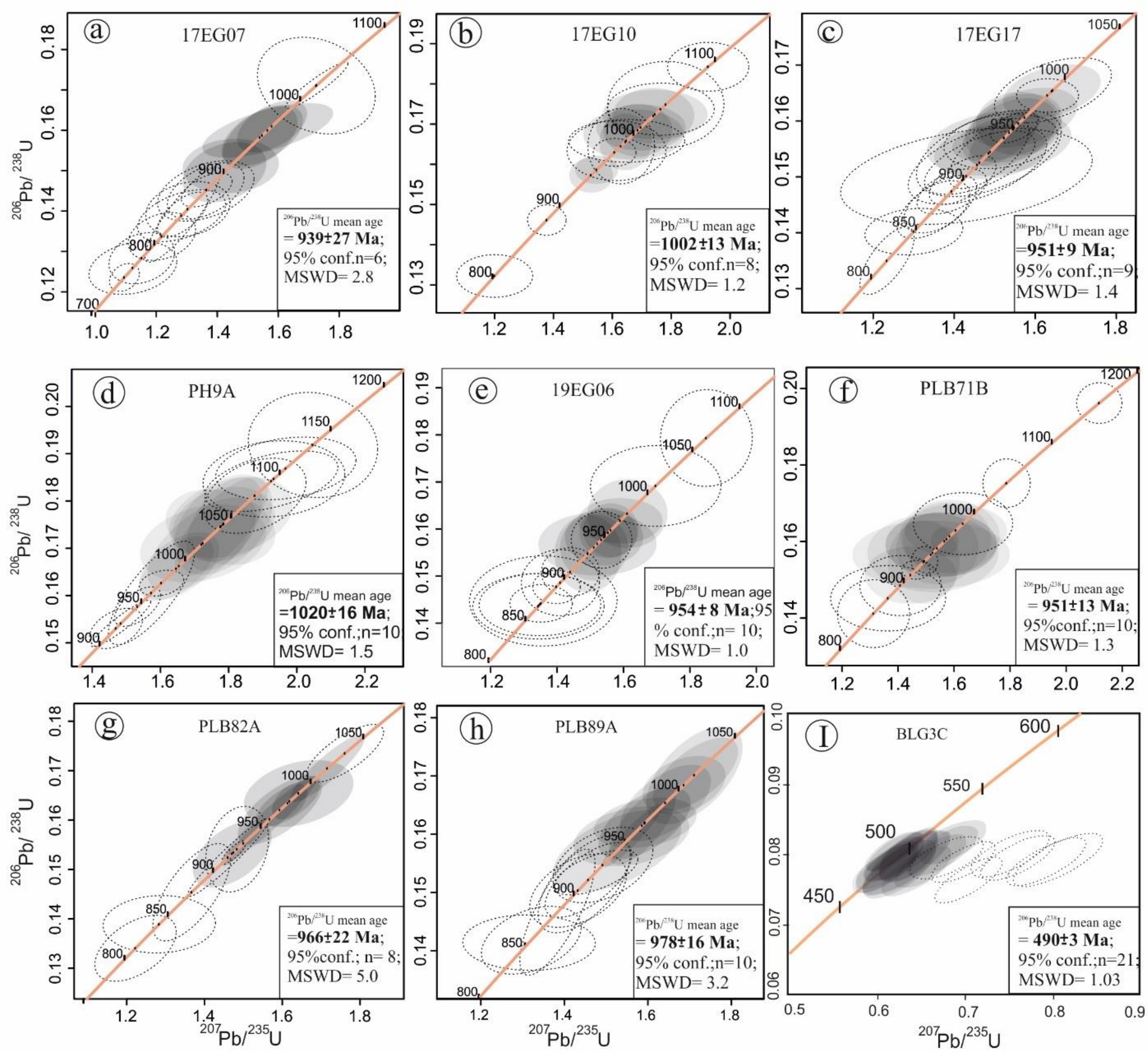

Fig.7.2. Wetherill concordia plots for analyzed zircon grains from the studied charnockite samples. 206Pb/238U weighted average age for group of data showing oscillatory zoning is shown for each sample. (a) Sample 17EG07. (b) Sample 17EG10. (c) Sample 17EG17. (d) Sample PH9A, (e) Sample 19EG06. (f) Sample PLB71B. (g) SamplePLB82A. (h) Sample PLB89A (i) Sample BLG3C. For each sample, all data are plotted. Those used for group age calculations are shown as grey filled ellipses, while rest of the data are presented as open stippled ellipses.

Table 7.1. Zircon U-Pb data obtained from representative charnockite samples.

Spot no.	Domain	U (ppm)	Th (ppm)	Th/U	$^{207}Pb/^{206}Pb$	2σ	$^{206}Pb/^{238}U$	2σ	$^{207}Pb/^{235}U$	2σ	$^{207}Pb/^{206}Pb$ age (Ma)	2σ	$^{207}Pb/^{235}U$ age (Ma)	2σ	$^{206}Pb/^{238}U$ age (Ma)	2σ	Conc %
Sample PLB89A																	
4	Osc	878	492	0.56	0.0749	0.0048	0.1604	0.0041	1.5629	0.1051	1049	123	944	42	959	23	102
6B	Osc	5592	698	0.12	0.0815	0.0011	1.7574	0.0619	0.1618	0.0044	1231	27	1033	21	966	25	94
7	Osc	4687	957	0.20	0.0720	0.0020	0.1616	0.0053	1.5569	0.0622	986	60	950	25	965	29	102
10	Osc	648	378	0.58	0.0741	0.0042	0.1625	0.0034	1.6385	0.0971	1045	103	982	40	970	19	99
11	Osc	1005	368	0.37	0.0726	0.0032	0.1621	0.0049	1.6332	0.0887	1014	87	977	34	968	27	99
11B	Osc	1124	332	0.30	0.0851	0.0033	1.7586	0.0838	0.1563	0.0032	1313	78	1029	31	936	18	91
12	Osc	1464	481	0.33	0.0747	0.0031	0.1659	0.0052	1.7114	0.0877	1036	87	1007	33	989	29	98
12B	Osc	1656	564	0.34	0.0769	0.0027	1.7824	0.0815	0.1711	0.0050	1106	70	1036	29	1018	28	98
13	Osc	1049	445	0.42	0.0748	0.0033	0.1705	0.0067	1.7098	0.0902	1050	85	1005	35	1014	37	101
14	Osc	543	297	0.55	0.0764	0.0043	0.1559	0.0053	1.5560	0.0939	1146	100	956	35	934	29	98
15	Osc	411	213	0.52	0.0724	0.0048	0.1575	0.0056	1.5613	0.1230	976	137	956	44	942	31	99
16	Osc	1732	651	0.38	0.0715	0.0032	0.1682	0.0039	1.6499	0.0777	990	90	990	28	1002	22	101
1	Pa	1993	385	0.19	0.0720	0.0030	0.1526	0.0052	1.4654	0.0823	989	84	909	33	915	29	101
3	Ov	1524	459	0.30	0.0688	0.0034	0.1513	0.0067	1.4416	0.0889	857	100	900	36	907	37	101
6	Pa	5815	2208	0.38	0.0724	0.0028	0.1473	0.0088	1.3570	0.0708	983	79	867	31	895	46	103
8	Ov	529	356	0.67	0.0701	0.0041	0.1505	0.0051	1.4317	0.0922	907	127	922	46	903	29	98
9B	Ov	501	272	0.54	0.0740	0.0069	1.4509	0.1285	0.1425	0.0039	1200	154	904	58	859	22	95
10B	Ov	832	424	0.51	0.0774	0.0047	1.4485	0.0945	0.1435	0.0048	1121	119	908	39	864	27	95
Sample PLB82A																	
1A	Osc	7001	953	0.14	0.0714	0.0015	1.6839	0.0742	0.1701	0.0053	961	44	1002	29	1012	29	101
1B	Osc	5813	609	0.10	0.0724	0.0015	1.5485	0.0887	0.1529	0.0064	1004	43	942	35	916	36	97
1C	Osc	7268	816	0.11	0.0719	0.0017	1.6455	0.1016	0.1603	0.0070	976	49	995	40	957	39	96
2A	Osc	1683	549	0.33	0.0732	0.0023	1.7239	0.0785	0.1734	0.0047	1011	66	1012	29	1030	26	102
2B	Osc	1307	174	0.13	0.0753	0.0034	1.6334	0.0843	0.1542	0.0054	1090	99	981	32	924	30	94
6B	Osc	3806	652	0.17	0.0721	0.0021	1.7276	0.0689	0.1635	0.0037	989	58	1014	26	976	21	96
7	Osc	1367	386	0.28	0.0729	0.0028	1.6574	0.0883	0.1623	0.0055	989	79	993	32	969	30	98
8A	Osc	1653	444	0.27	0.0772	0.0048	1.7535	0.1129	0.1664	0.0054	1117	118	1023	41	992	30	97
8C	Osc	4326	743	0.17	0.0691	0.0014	1.6277	0.0357	0.1632	0.0028	899	42	981	14	975	15	99
9D	Osc	4361	654	0.15	0.0712	0.0007	1.5490	0.0447	0.1555	0.0036	961	20	948	17	931	20	98
6A	Ov	3352	519	0.15	0.0715	0.0039	1.4735	0.0634	0.1544	0.0070	955	113	918	25	925	39	101
8B	Pa	3109	508	0.16	0.0683	0.0040	1.2976	0.0874	0.1344	0.0054	918	121	841	38	813	31	97
9A	Pa	1597	178	0.11	0.0688	0.0064	1.3102	0.1157	0.1392	0.0047	933	167	841	52	840	26	100
9C1	Ov	4356	590	0.14	0.0706	0.0007	1.4876	0.0251	0.1536	0.0019	942	21	928	9	921	11	99
9C2	Ov	3263	266	0.08	0.0718	0.0032	1.5335	0.0888	0.1460	0.0080	994	79	938	37	877	45	94
Sample PLB71B																	
1	Osc	389	242	0.62	0.0640	0.0076	1.6216	0.1660	0.1443	0.0068	989	179	1007	63	868	38	86
2	Osc	438	120	0.27	0.0685	0.0066	1.9346	0.1769	0.1587	0.0066	1048	151	1093	62	948	37	**87**
4	Osc	5571	2993	0.54	0.0708	0.0027	2.0834	0.2029	0.1548	0.0086	941	81	1150	74	927	48	81
5	Osc	1501	261	0.17	0.0665	0.0060	1.8566	0.1909	0.1617	0.0053	880	156	1067	64	966	29	91
6	Osc	1211	605	0.50	0.0708	0.0078	2.0432	0.2452	0.1571	0.0081	1010	186	1115	84	940	45	84
7	Osc	2135	365	0.17	0.0712	0.0041	2.0768	0.2296	0.1418	0.0072	949	112	1132	75	855	40	76
8	Osc	1628	214	0.13	0.0706	0.0056	2.0493	0.2446	0.1644	0.0065	899	163	1114	83	980	36	88
10	Osc	536	135	0.25	0.0736	0.0054	2.0197	0.2354	0.1618	0.0076	1045	127	1078	77	965	42	**89**
11	Osc	1592	725	0.46	0.0710	0.0045	1.8150	0.1472	0.1606	0.0076	1019	110	1030	53	958	42	93
11B	Osc	1025	180	0.18	0.0743	0.0011	1.6538	0.0398	0.1607	0.0029	1044	30	990	15	960	16	97
12	Osc	1199	163	0.14	0.0723	0.0042	1.7378	0.1731	0.1585	0.0074	999	123	1006	63	947	41	94
13	Osc	144	113	0.78	0.0700	0.0099	1.6122	0.2444	0.1565	0.0070	1342	230	946	86	935	39	99
14	Osc	396	121	0.31	0.0714	0.0056	1.6266	0.1615	0.1516	0.0059	1098	137	964	64	909	33	94
12B	XC	1128	128	0.11	0.0729	0.0018	1.8126	0.0800	0.1750	0.0051	1004	49	1047	29	1039	28	99
9B	XC	1096	636	0.58	0.0797	0.0017	2.2199	0.0847	0.1965	0.0043	1185	41	1185	26	1156	23	98
3B	Ov	829	164	0.20	0.0739	0.0017	1.5932	0.0344	0.1534	0.0020	1038	49	967	13	920	11	95
8B	Ov	1293	158	0.12	0.0729	0.0011	1.5820	0.0426	0.1554	0.0031	1018	30	961	17	931	17	97
15	Ov	940	818	0.87	0.0733	0.0049	1.5001	0.1110	0.1493	0.0064	1039	145	928	49	896	36	97
Sample PH9A																	
1	Osc	661	307	0.47	0.0735	0.0062	1.9129	0.1666	0.1862	0.0053	1067	141	1097	50	1100	29	100
2	Osc	1839	669	0.36	0.0682	0.0030	1.5943	0.0862	0.1648	0.0053	903	84	966	36	982	29	102
3	Osc	1942	945	0.49	0.0742	0.0042	1.8419	0.1344	0.1710	0.0079	1066	99	1052	49	1016	43	97
4	Osc	602	277	0.46	0.0746	0.0057	1.8577	0.1475	0.1766	0.0068	1140	141	1090	50	1047	37	96
4B	Osc	542	307	0.57	0.0775	0.0036	1.7507	0.0935	0.1673	0.0057	1107	90	1022	34	997	30	98
5	Osc	667	288	0.43	0.0739	0.0061	1.8759	0.1585	0.1712	0.0065	1113	132	1049	59	1023	37	97
5B	Osc	488	267	0.55	0.0749	0.0023	1.6599	0.0523	0.1633	0.0022	1062	67	991	20	975	12	98
6	Osc	1343	561	0.42	0.0752	0.0046	1.9942	0.1284	0.1811	0.0064	1125	123	1109	41	1071	35	97
7	Osc	1221	614	0.50	0.0718	0.0055	1.8901	0.1616	0.1832	0.0051	1022	160	1084	56	1084	28	100
11	Osc	2300	682	0.30	0.0714	0.0034	1.9601	0.0983	0.1746	0.0078	1018	83	1094	34	1036	43	95
12	Osc	766	423	0.55	0.0721	0.0050	2.0562	0.1401	0.1747	0.0062	972	126	1126	49	1037	34	92
13	Osc	648	330	0.51	0.0690	0.0044	1.9731	0.1324	0.1738	0.0083	945	118	1098	50	1031	46	94
14	Osc	1281	413	0.32	0.0715	0.0030	2.1014	0.1289	0.1741	0.0082	948	85	1151	38	1033	45	90
15	Osc	1253	521	0.42	0.0704	0.0029	1.8781	0.1217	0.1604	0.0088	937	90	1081	41	956	49	88
16	Osc	395	178	0.45	0.0721	0.0064	2.0359	0.1501	0.1741	0.0063	1070	158	1129	53	1033	35	92
8	XC	711	334	0.47	0.0828	0.0069	2.3138	0.1846	0.1862	0.0066	1236	170	1205	54	1105	34	92
10	XC	1178	693	0.59	0.0794	0.0071	2.2438	0.1631	0.1923	0.0090	1121	173	1183	50	1132	49	96
7B	Ov	1119	699	0.62	0.0742	0.0018	1.5795	0.0729	0.1549	0.0040	1040	48	959	27	928	22	97
11B	Ov	899	475	0.53	0.0786	0.0028	1.6481	0.0639	0.1547	0.0035	1143	69	986	24	927	19	94
12B	Ov	872	518	0.59	0.0760	0.0021	1.6297	0.0552	0.1587	0.0034	1085	57	980	21	949	19	97
Sample 19EG06																	
1A	Osc	6813	334	0.05	0.0742	0.0026	1.7033	0.0945	0.1584	0.0049	1036	71	1014	33	948	27	93
1C	Osc	6431	313	0.05	0.0743	0.0022	1.7065	0.0648	0.1604	0.0045	1039	61	1014	26	959	25	95
2B	Osc	789	771	0.98	0.0756	0.0037	1.8637	0.1480	0.1592	0.0048	1067	102	1051	49	951	27	91
3	Osc	4316	535	0.12	0.0745	0.0028	1.5629	0.0823	0.1569	0.0056	1040	76	959	30	939	31	98
5	Osc	2133	255	0.12	0.0739	0.0034	1.7999	0.1834	0.1637	0.0058	1033	92	1022	61	976	32	96
6B	Osc	4602	216	0.05	0.0707	0.0023	1.5186	0.0916	0.1549	0.0065	946	64	931	36	927	37	100
10	Osc	591	202	0.34	0.0718	0.0061	1.5383	0.1881	0.1571	0.0053	1038	156	943	72	940	30	100

Spot no	Domain	U (ppm)	Th (ppm)	Th/U	$^{207}Pb/^{206}Pb$	2σ	$^{206}Pb/^{238}U$	2σ	$^{207}Pb/^{235}U$	2σ	$^{207}Pb/^{206}Pb$ age (Ma)	2σ	$^{207}Pb/^{235}U$ age (Ma)	2σ	$^{206}Pb/^{238}U$ age (Ma)	2σ	Conc %
11A	Osc	5971	176	0.03	0.0721	0.0025	1.5386	0.1015	0.1594	0.0042	986	68	939	39	953	23	101
11B	Osc	5971	176	0.03	0.0721	0.0025	1.5386	0.1015	0.1594	0.0042	986	68	939	39	953	23	101
1B	XC	3341	277	0.08	0.0847	0.0061	2.0516	0.1325	0.1716	0.0071	1287	141	1130	44	1020	39	90
2C	XC	937	311	0.33	0.0761	0.0029	1.8438	0.0908	0.1796	0.0083	1083	76	1065	35	1064	45	100
7	XC	3615	263	0.07	0.0863	0.0038	1.7812	0.1186	0.1518	0.0059	1337	91	1033	42	910	33	88
4C	Ov	469	512	1.09	0.0748	0.0076	1.3228	0.1280	0.1448	0.0057	1109	196	843	56	871	32	103
5C	Ov	1878	205	0.11	0.0793	0.0035	1.5903	0.0788	0.1462	0.0033	1173	90	965	31	880	18	91
6A	Ov	7294	393	0.05	0.0733	0.0028	1.4456	0.0506	0.1516	0.0042	994	79	905	21	909	24	100
8	Ov	233	166	0.71	0.0782	0.0082	1.4257	0.1547	0.1465	0.0079	1311	161	912	69	880	44	96
9	Ov	2599	272	0.10	0.0758	0.0025	1.5032	0.0743	0.1490	0.0029	1069	69	926	30	895	16	97
4	Pa	439	475	1.08	0.0746	0.0070	1.3043	0.1186	0.1451	0.0054	1149	166	845	56	873	31	103
Table 7.1 (contd.)																	
Sample 17EG17																	
8	Osc	1091	772	0.71	0.0741	0.0039	1.5987	0.0910	0.1657	0.0038	1059	103	969	34	991	22	102
6	Osc	819	482	0.59	0.0673	0.0039	1.2946	0.0807	0.1572	0.0048	889	110	856	33	941	27	110
5	Osc	400	400	1.00	0.0792	0.0052	1.5641	0.1029	0.1562	0.0039	1255	104	950	44	935	22	98
20	Osc	439	394	0.90	0.0749	0.0043	1.5648	0.0791	0.1603	0.0045	1136	104	951	30	958	25	101
19	Osc	1458	988	0.68	0.0769	0.0025	1.5370	0.0656	0.1582	0.0040	1115	71	942	26	950	21	101
16	Osc	402	405	1.01	0.0781	0.0043	1.6029	0.0978	0.1584	0.0033	1159	107	969	36	947	18	98
14	Osc	726	774	1.07	0.0727	0.0045	1.5191	0.1067	0.1656	0.0047	955	126	944	46	987	26	105
12	Osc	970	154	0.16	0.0740	0.0042	1.4993	0.0885	0.1593	0.0049	1043	116	924	37	953	27	103
10	Osc	576	137	0.24	0.0717	0.0043	1.5083	0.0982	0.1607	0.0042	1019	96	939	40	960	23	102
1	Osc	342	326	0.95	0.0796	0.0065	1.5525	0.1303	0.1578	0.0047	1265	138	945	54	944	26	100
31	Osc	613	275	0.45	0.0702	0.0029	1.5659	0.0606	0.1642	0.0024	932	88	955	24	980	13	103
25	Osc	783	177	0.23	0.0703	0.0019	1.5366	0.0473	0.1587	0.0022	936	58	943	19	949	12	101
2	Ov	1063	629	0.59	0.0710	0.0043	1.2986	0.0961	0.1528	0.0046	976	105	839	42	916	26	109
18	Pa	1184	707	0.60	0.0731	0.0032	1.4090	0.0783	0.1455	0.0046	1041	88	890	34	875	26	98
17	Pa	558	274	0.49	0.0715	0.0057	1.3653	0.1262	0.1525	0.0057	1066	116	864	56	914	32	106
15	Ov	1120	238	0.21	0.0742	0.0060	1.4564	0.1349	0.1550	0.0063	1013	156	900	55	928	35	103
13	Ov	140	363	2.59	0.0670	0.0114	1.2983	0.2336	0.1497	0.0069	1349	189	833	106	898	39	108
29	Ov	92	374	4.05	0.0659	0.0051	1.4063	0.1116	0.1554	0.0039	821	171	886	47	931	22	105
30	Ov	1139	225	0.20	0.0732	0.0029	1.5487	0.0813	0.1548	0.0051	1013	81	949	33	928	29	98
28	Ov	151	317	2.10	0.0684	0.0026	1.3787	0.0646	0.1493	0.0035	910	85	879	27	897	19	102
9	Pa	643	573	0.89	0.0737	0.0051	1.3341	0.0916	0.1413	0.0034	1046	138	857	41	851	19	99
7	Ov	1884	457	0.24	0.0725	0.0030	1.3563	0.0627	0.1454	0.0038	1012	76	870	28	875	21	101
4	Ov	4800	146	0.03	0.0695	0.0022	1.2328	0.0529	0.1355	0.0049	913	62	818	22	819	28	100
3	Ov	1206	347	0.29	0.0743	0.0030	1.3934	0.0649	0.1484	0.0033	1055	72	898	29	891	18	99
Sample 17EG10																	
8	Osc	5937	156	0.03	0.0754	0.0023	1.6366	0.1211	0.1652	0.0076	1074	62	980	47	985	42	101
7	Osc	713	203	0.28	0.0766	0.0039	1.8921	0.1500	0.1844	0.0049	1087	102	1081	47	1091	27	101
4	Osc	627	135	0.22	0.0697	0.0040	1.7660	0.1164	0.1712	0.0054	900	115	1028	45	1018	30	99
3	Osc	393	160	0.41	0.0745	0.0067	1.6463	0.1316	0.1663	0.0043	1032	171	988	48	991	24	100
20	Osc	483	507	1.05	0.0760	0.0048	1.8257	0.1203	0.1698	0.0045	1030	130	1050	45	1010	25	96
2	Osc	406	99	0.24	0.0722	0.0054	1.7448	0.1221	0.1635	0.0060	1105	134	1011	47	975	33	96
19	Osc	348	459	1.32	0.0729	0.0056	1.8091	0.1611	0.1723	0.0048	1064	158	1052	57	1024	27	97
18	Osc	375	169	0.45	0.0723	0.0057	1.8196	0.1528	0.1734	0.0052	1053	126	1054	51	1035	30	98
17	Osc	386	229	0.59	0.0737	0.0055	1.7234	0.1183	0.1677	0.0049	1037	142	1019	47	998	27	98
16	Osc	1403	376	0.27	0.0705	0.0033	1.6951	0.0757	0.1680	0.0051	940	88	1015	27	1000	28	99
1	Osc	152	66	0.43	0.0685	0.0055	1.7139	0.1843	0.1735	0.0085	916	167	1031	72	1040	50	101
3B	Osc	378	265	0.70	0.0716	0.0023	1.5932	0.0717	0.1588	0.0027	956	67	967	27	950	15	98
4B	Osc	1151	366	0.32	0.0718	0.0019	1.6178	0.0889	0.1655	0.0055	984	48	972	30	987	30	102
13	Osc	1738	1910	1.10	0.0774	0.0022	1.5854	0.0576	0.1586	0.0034	1135	58	963	23	949	19	99
11	Osc	566	114	0.20	0.0723	0.0023	1.5715	0.0608	0.1631	0.0028	1002	65	960	23	974	16	101
10B	Ov	1998	1749	0.88	0.0749	0.0022	1.4239	0.0464	0.1473	0.0031	1058	59	898	19	886	18	99
6	Ov	785	200	0.25	0.0693	0.0053	1.2389	0.0887	0.1328	0.0043	859	158	814	40	803	24	99
Sample 17EG07																	
9	Osc	1093	307	0.28	0.0703	0.0035	1.6306	0.0944	0.1608	0.0050	939	91	982	38	960	28	98
8	Osc	668	254	0.38	0.0707	0.0038	1.6519	0.1037	0.1582	0.0061	982	97	985	41	945	34	96
6	Osc	785	528	0.67	0.0711	0.0052	1.4992	0.1119	0.1500	0.0059	953	139	921	45	900	33	98
3	Osc	233	260	1.11	0.0721	0.0065	1.7036	0.1837	0.1602	0.0053	975	185	988	65	957	30	97
2	Osc	408	574	1.41	0.0723	0.0063	1.5988	0.1333	0.1517	0.0053	1087	170	957	53	910	30	95
13	Osc	441	384	0.87	0.0758	0.0086	1.5598	0.1351	0.1716	0.0097	1177	183	959	60	1020	53	106
11	Osc	375	390	1.04	0.0749	0.0042	1.5606	0.1025	0.1595	0.0060	1050	109	965	46	953	33	99
9B	Osc	878	1257	1.43	0.0716	0.0018	1.7103	0.0824	0.1708	0.0046	964	50	1012	29	1016	25	100
15	Pa	452	323	0.72	0.0676	0.0058	1.2084	0.1140	0.1449	0.0060	1032	151	789	52	871	34	110
14	Pa	473	186	0.39	0.0751	0.0046	1.4299	0.0992	0.1462	0.0057	1022	121	897	39	879	32	98
12	Ov	195	246	1.26	0.0609	0.0065	1.0313	0.1126	0.1252	0.0052	1014	120	707	57	759	30	107
1	Pa	1033	344	0.33	0.0662	0.0050	1.2548	0.0932	0.1285	0.0051	902	124	827	40	778	29	94
7	Ov	440	304	0.69	0.0681	0.0058	1.3853	0.1171	0.1406	0.0055	913	149	885	50	847	31	96
4B	Ov	735	512	0.70	0.0722	0.0026	1.3645	0.1046	0.1400	0.0096	996	67	899	38	843	55	94
8B	Ov	869	342	0.39	0.0678	0.0024	1.1045	0.0382	0.1241	0.0028	851	73	755	18	754	16	100
11B	Ov	898	400	0.45	0.0726	0.0029	1.4104	0.0663	0.1460	0.0034	988	82	897	26	878	19	98
23B	Ov	778	426	0.55	0.0699	0.0027	1.2897	0.0652	0.1396	0.0045	928	73	844	31	842	26	100
5	Ov	810	477	0.59	0.0691	0.0048	1.3164	0.0926	0.1342	0.0048	964	114	856	38	811	27	95
4	Ov	488	295	0.60	0.0703	0.0055	1.4652	0.1279	0.1394	0.0052	1004	152	901	51	840	30	93

Osc- Oscillatory zoned domain, Ov- Overgrowth domain, Pa-Patchy domain, XC- Xenocrystic core

Table 7.2. Zircon U-Pb isotope data from monzosyenite. Calculated age values are also given.

		Data for Tera-Wasserburg				**Data for Wetherill plot**[2]				**Dates**[3] **(in Ma)**						
Spot label	Th/U	$^{238}U/^{206}Pb$	±2σ	$^{207}Pb/^{206}Pb$	±2σ	$^{207}Pb/^{235}U$	1σ%	$^{206}Pb/^{238}U$	1σ%	$^{207}Pb/^{206}Pb$	±2σ	$^{206}Pb/^{238}U$	±2σ	$^{207}Pb/^{235}U$	±2σ	% Disc.[4]
Sample BLG 03C																
BLG03C-1	0.117	12.847	0.450	0.057	0.002	0.612	4.8	0.078	3.5	492	75	483	16	485	18.7	0.3
BLG03C-2	0.365	12.599	0.416	0.069	0.002	0.759	4.5	0.079	3.3	910	65	492	16	574	19.9	16.5
BLG03C-3	1.066	12.639	0.493	0.074	0.003	0.805	5.2	0.079	3.9	1036	70	491	19	600	23.8	22.2
BLG03C-5	0.077	12.892	0.477	0.060	0.002	0.645	5.0	0.078	3.7	614	75	482	17	505	20.1	4.9
BLG03C-22	0.664	12.927	0.440	0.058	0.002	0.620	5.0	0.077	3.4	536	81	480	16	490	19.6	2.0
BLG03C-23	0.498	12.676	0.494	0.061	0.002	0.660	5.1	0.079	3.9	627	73	490	18	514	20.8	5.1
BLG03C-24	0.912	12.695	0.381	0.064	0.002	0.697	4.2	0.079	3.0	748	65	489	14	537	17.7	9.9
BLG03C-27	0.049	12.793	0.422	0.057	0.002	0.610	4.5	0.078	3.3	475	70	485	15	483	17.5	-0.4
BLG03C-33	0.078	12.878	0.438	0.057	0.002	0.606	4.6	0.078	3.4	477	70	482	16	481	17.8	-0.2
BLG03C-33b	0.488	12.450	0.448	0.061	0.002	0.672	5.1	0.080	3.6	628	80	498	17	522	21	4.8
BLG03C-38	1.318	12.506	0.425	0.068	0.002	0.750	4.9	0.080	3.4	871	74	496	16	569	21.6	14.6
BLG03C-15	0.273	12.591	0.390	0.062	0.002	0.679	5.0	0.079	3.1	673	86	493	15	526	20.7	6.8
BLG03C-21	0.064	12.472	0.337	0.056	0.002	0.619	4.4	0.080	2.7	453	80	497	13	489	17.2	-1.6
BLG03C-20	1.493	13.115	0.459	0.067	0.002	0.703	4.5	0.076	3.5	835	59	474	16	541	19	14.2
BLG03C-81	0.566	12.246	0.367	0.061	0.002	0.684	4.8	0.082	3.0	629	82	506	15	529	20	4.5
BLG03C-46	0.078	12.947	0.440	0.058	0.002	0.621	4.9	0.077	3.4	540	78	480	16	490	19.2	2.2
BLG03C-47	0.077	12.438	0.448	0.058	0.002	0.643	4.7	0.080	3.6	529	67	499	17	504	18.8	1.1
BLG03C-45re	0.134	12.484	0.375	0.056	0.002	0.622	4.6	0.080	3.0	466	80	497	14	491	18.1	-1.1
BLG03C-41	0.069	12.628	0.391	0.057	0.002	0.624	4.5	0.079	3.1	498	72	491	15	492	17.7	0.2
BLG03C-50	0.640	12.687	0.444	0.073	0.002	0.792	4.7	0.079	3.5	1011	64	489	17	592	21.3	21.1
BLG03C-52	0.094	12.609	0.391	0.058	0.002	0.632	4.7	0.079	3.1	523	79	492	15	498	18.7	1.1
BLG03C-43	0.086	12.977	0.467	0.059	0.002	0.624	5.0	0.077	3.6	556	78	479	17	492	19.7	2.9
BLG03C-51	0.061	12.873	0.438	0.057	0.002	0.609	5.0	0.078	3.4	486	84	482	16	483	19.4	0.1
BLG03C-69	0.110	12.561	0.465	0.059	0.002	0.646	4.8	0.080	3.7	560	69	494	18	506	19.3	2.4
BLG03C-72	0.067	12.541	0.477	0.057	0.002	0.623	5.2	0.080	3.8	480	79	495	18	492	20.5	-0.5
BLG03C-66	0.089	12.458	0.448	0.057	0.002	0.629	5.2	0.080	3.6	485	84	498	17	496	20.6	-0.4
BLG03C-65	0.074	12.531	0.451	0.057	0.002	0.632	4.9	0.080	3.6	509	74	495	17	497	19.5	0.5
BLG03C-58	0.071	12.873	0.425	0.058	0.002	0.626	4.8	0.078	3.3	548	78	482	15	494	18.9	2.4

[1]data corrected for common-Pb [2]data corrected for common-Pb [3]data corrected for common-Pb

[4]Discordance={($^{207}Pb/^{235}U$ age) - ($^{206}Pb/^{238}U$ age)-1] x 100 (%)