182462: garnetiferous metagabbro, Splinter prospect

(Recherche Supersuite, Albany–Fraser Orogen)

Location and sampling

Norseman (SI 51-2), Mount Andrew (3432)
MGA Zone 51, 478406E 6351491N

Sampled on 16 August 2010

This sample was collected from the 142.2 – 142.7 m depth interval of diamond drillcore NSD001, an exploration hole drilled in 2006 at the Splinter prospect by Azure Minerals Ltd. The drillhole is located about 58 km east-northeast of Dingo Rock, 43.5 km north of Mount Beaumont, and 36.6 km south-southwest of Mount Andrew.

Tectonic unit/relations

The unit sampled is a metagabbro assigned to the Recherche Supersuite (Smithies et al., 2015). Intrusions of the 1330–1280 Ma Recherche Supersuite represent a major magmatic event coinciding with Stage I of the Albany–Fraser Orogeny (Spaggiari et al., 2014). These rocks are typically foliated or gneissic, and were metamorphosed to amphibolite or granulite facies during either Stage I or II (or both) of the Albany–Fraser Orogeny (Spaggiari et al., 2014). The drillcore contains a mixture of amphibolite to granulite facies, mafic to intermediate composition gneiss interlayered with metagabbro, some of which is gneissic, and of which this sample is representative. A granodiorite gneiss from lower in this drillcore yielded a crystallization age of 1666 ± 6 Ma (GSWA 182464, Wingate et al., 2016b), and a metatonalite higher in this core yielded a crystallization age of 1156 ± 5 Ma (GSWA 182459, Wingate et al., 2016a). Metamorphic rims on zircons in GSWA 182464 are dated at 1168 ± 6 Ma (Wingate et al., 2016b). A similar age of 1178 ± 6 Ma was determined for crystallization of gabbro in drillcore NSD002, located about 1.0 km to the northeast (GSWA 182465, Wingate et al., 2016c).

Petrographic description

The sample is a garnetiferous metagabbro (Fig. 1), containing about 35% plagioclase, 20% amphibole, 20% garnet, 15% clinopyroxene, 10% opaque oxide minerals, and accessory apatite, epidote, and zircon. The sample consists of anhedral to subhedral poikiloblastic garnets (up to 2 mm across), that encloses microcrystalline quartz and iron–titanium oxide minerals, and are set in a fine-grained (up to 2 mm grain size) equigranular groundmass of pale green clinopyroxene, brown amphibole, and plagioclase. Primary diopside and plagioclase in this rock have been replaced by amphibole and garnet.

Zircon morphology

Zircons isolated from this sample are colourless to dark brown, subhedral to euhedral, and variably rounded. The crystals are up to 600 μm long, and elongate, with aspect ratios up to 8:1. In cathodoluminescence (CL) images, most zircons exhibit concentric and/or sector zoning, and some crystals are overgrown by homogeneous zircon rims. A CL image of representative zircons is shown in Figure 2.

Analytical details

This sample was analysed on 8–9 August 2013, using SHRIMP-A. Twenty analyses of the BR266 standard were obtained during the session, of which 18 analyses indicated an external spot-to-spot (reproducibility) uncertainty of 1.04% (1σ) and a $^{238}U/^{206}Pb^*$ calibration uncertainty of 0.26% (1σ). Calibration uncertainties are included in the errors of $^{238}U/^{206}Pb^*$ 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

Eighty-four analyses were obtained from 65 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). The analyses yield $^{207}Pb^*/^{206}Pb^*$ dates that correlate with their common-Pb contents ($f204$), indicating that corrections using ^{204}Pb are inaccurate for some or all of these analyses. The date for this sample is therefore determined from 207-corrected $^{238}U/^{206}Pb^*$ ratios (Fig. 3), assuming contemporaneous initial Pb compositions (Stacey and Kramers, 1975). The analyses define four groups, based on their $^{207}Pb/^{206}Pb$, $^{238}U/^{206}Pb$ and Th/U ratios, and positions within the crystals.

Group I comprises 64 analyses of 55 zircons (Table 1), which yield a weighted mean $^{238}U/^{206}Pb^*$ date of 1276 ± 6 Ma (MSWD = 1.3). These analyses indicate moderate Th/U ratios (median 0.58).

Figure 1. Drillcore photograph for sample 182462: garnetiferous metagabbro, Splinter prospect.

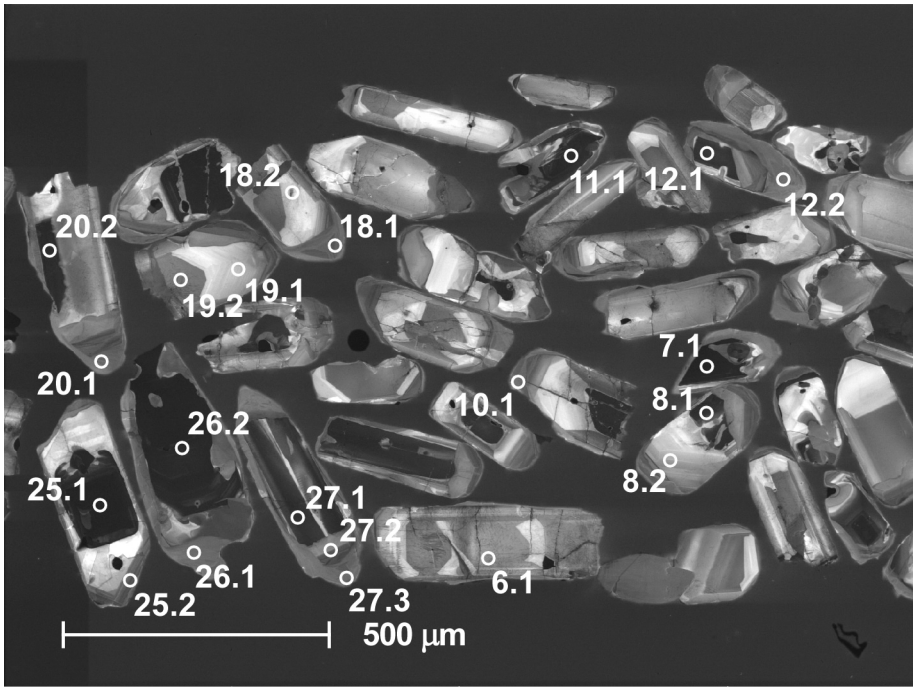

Figure 2. Cathodoluminescence image of representative zircons from sample 182462: garnetiferous metagabbro, Splinter prospect. Numbered circles indicate the approximate locations of analysis sites.

Table 1. Ion microprobe analytical results for zircons from sample 182462: garnetiferous gneiss, Splinter prospect

Group ID	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	$\frac{^{232}Th}{^{238}U}$	ƒ204 (%)	$^{238}U/^{206}Pb$ ± 1σ		$^{207}Pb/^{206}Pb$ ± 1σ		$^{238}U/^{206}Pb^*$ ± 1σ		$^{207}Pb^*/^{206}Pb^*$ ± 1σ		$^{238}U/^{206}Pb^*$ date (Ma) ±1σ		$^{207}Pb^*/^{206}Pb^*$ date (Ma) ±1σ		Disc. (%)
I	72	53.1	21	14	0.66	0.650	4.770	0.127	0.08258	0.00218	4.801	0.129	0.07710	0.00387	1220	31	1124	100	-8.5
I	42	28.1	28	20	0.71	0.545	4.744	0.107	0.08255	0.00172	4.770	0.109	0.07796	0.00289	1227	26	1146	74	-7.1
I	48	32.1	11	6	0.53	-0.805	4.807	0.170	0.07960	0.00299	4.768	0.170	0.08647	0.00566	1227	41	1349	126	9.0
I	58	41.1	12	7	0.57	1.139	4.698	0.152	0.07748	0.00272	4.752	0.157	0.06803	0.00617	1231	38	869	188	-41.6
I	13	11.1	135	101	0.78	0.085	4.743	0.210	0.08365	0.00080	4.747	0.210	0.08292	0.00091	1232	52	1267	21	2.8
I	55	38.1	46	21	0.46	-0.324	4.758	0.088	0.07974	0.00134	4.743	0.088	0.08249	0.00191	1233	21	1257	45	1.9
I	50	34.1	112	44	0.41	-0.033	4.715	0.069	0.08234	0.00086	4.714	0.069	0.08262	0.00090	1240	17	1260	21	1.6
I	29	21.2	182	97	0.55	0.021	4.710	0.062	0.08291	0.00068	4.711	0.062	0.08273	0.00070	1241	15	1263	17	1.7
I	56	39.1	19	12	0.69	-0.181	4.692	0.121	0.08625	0.00210	4.683	0.121	0.08780	0.00260	1248	30	1378	57	9.5
I	19	16.1	101	87	0.89	0.205	4.672	0.069	0.08631	0.00090	4.682	0.069	0.08456	0.00115	1248	17	1306	26	4.4
I	3	3.1	112	98	0.90	-0.261	4.676	0.259	0.08474	0.00101	4.663	0.258	0.08697	0.00135	1252	66	1360	30	7.9
I	32	23.1	32	13	0.40	-0.220	4.670	0.097	0.08033	0.00154	4.660	0.097	0.08219	0.00202	1253	24	1250	48	-0.2
I	57	40.1	24	17	0.73	-0.312	4.672	0.113	0.08573	0.00194	4.657	0.113	0.08839	0.00270	1254	28	1391	59	9.9
I	26	20.2	161	132	0.85	0.097	4.646	0.063	0.08405	0.00075	4.651	0.063	0.08322	0.00085	1256	16	1274	20	1.5
I	34	24.2	23	8	0.36	-0.160	4.654	0.111	0.08604	0.00194	4.646	0.111	0.08740	0.00237	1257	28	1369	52	8.2
I	68	50.1	545	249	0.47	0.000	4.644	0.055	0.08246	0.00041	4.644	0.055	0.08246	0.00041	1257	14	1257	10	-0.1
I	49	33.1	94	84	0.92	0.075	4.638	0.070	0.08498	0.00419	4.642	0.070	0.08434	0.00421	1258	17	1301	97	3.3
I	60	43.1	71	44	0.64	0.111	4.634	0.076	0.08395	0.00113	4.639	0.076	0.08300	0.00132	1258	19	1269	31	0.9
I	61	43.2	18	10	0.58	0.236	4.621	0.126	0.08099	0.00229	4.632	0.127	0.07900	0.00304	1260	32	1172	76	-7.5
I	35	25.1	982	389	0.41	0.000	4.624	0.052	0.08340	0.00028	4.624	0.052	0.08340	0.00028	1262	13	1279	7	1.3
I	11	9.1	534	224	0.43	0.037	4.615	0.054	0.08361	0.00041	4.617	0.054	0.08329	0.00043	1264	14	1276	10	1.0
I	33	24.1	498	212	0.44	0.028	4.614	0.054	0.08457	0.00040	4.615	0.054	0.08433	0.00042	1264	14	1300	10	2.8
I	17	14.1	112	103	0.95	0.094	4.604	0.067	0.08458	0.00084	4.608	0.067	0.08379	0.00096	1266	17	1288	22	1.7
I	20	17.1	24	19	0.80	1.091	4.550	0.108	0.08585	0.00189	4.600	0.111	0.07667	0.00400	1268	28	1113	104	-14.0
I	75	56.1	21	16	0.80	0.583	4.552	0.122	0.08675	0.01154	4.579	0.124	0.08182	0.01196	1273	32	1241	286	-2.6
I	38	26.2	258	87	0.35	0.039	4.576	0.057	0.08284	0.00054	4.578	0.057	0.08251	0.00057	1274	15	1258	14	-1.3
I	39	27.1	115	98	0.89	-0.161	4.580	0.253	0.08295	0.00357	4.573	0.252	0.08432	0.00362	1275	67	1300	83	1.9
I	14	12.1	107	99	0.96	0.104	4.566	0.067	0.08490	0.00089	4.571	0.067	0.08401	0.00103	1275	17	1293	24	1.4
I	73	54.1	26	9	0.37	-0.178	4.577	0.113	0.08271	0.00199	4.569	0.113	0.08423	0.00250	1276	29	1298	58	1.7
I	18	15.1	23	11	0.48	0.461	4.546	0.108	0.08323	0.00187	4.567	0.109	0.07934	0.00293	1276	28	1181	73	-8.1
I	51	34.2	20	13	0.69	-0.887	4.607	0.117	0.08147	0.00200	4.566	0.118	0.08905	0.00390	1277	31	1405	84	9.2
I	47	31.1	657	293	0.46	0.000	4.566	0.053	0.08435	0.00036	4.566	0.053	0.08435	0.00036	1277	14	1301	8	1.8
I	24	19.2	26	16	0.66	-0.499	4.586	0.108	0.08331	0.00196	4.564	0.108	0.08757	0.00313	1277	28	1373	69	7.0
I	46	30.1	166	168	1.04	0.000	4.561	0.062	0.08315	0.00074	4.561	0.062	0.08315	0.00074	1278	16	1273	17	-0.4
I	6	5.1	97	73	0.78	0.425	4.528	0.068	0.08688	0.00096	4.547	0.069	0.08328	0.00145	1281	18	1276	34	-0.4
I	30	22.2	624	257	0.43	0.023	4.544	0.056	0.08428	0.00037	4.545	0.056	0.08408	0.00038	1282	14	1294	9	1.0
I	22	18.2	12	6	0.49	-0.489	4.566	0.163	0.07834	0.00321	4.544	0.163	0.08249	0.00522	1282	43	1257	124	-2.0
I	64	46.1	34	11	0.35	-0.340	4.549	0.108	0.08298	0.00161	4.534	0.108	0.08588	0.00231	1285	28	1335	52	3.8

Table 1. continued

Group ID	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	$\frac{^{232}Th}{^{238}U}$	f204 (%)	$^{238}U/^{206}Pb$ ± 1σ		$^{207}Pb/^{206}Pb$ ± 1σ		$^{238}U/^{206}Pb^*$ ± 1σ		$^{207}Pb^*/^{206}Pb^*$ ± 1σ		$^{238}U/^{206}Pb^*$ date (Ma) ±1σ		$^{207}Pb^*/^{206}Pb^*$ date (Ma) ±1σ		Disc. (%)
I	36	25.2	40	16	0.41	0.264	4.512	0.087	0.08521	0.00142	4.524	0.087	0.08297	0.00193	1287	23	1268	45	-1.5
I	28	22.1	29	12	0.43	-0.119	4.527	0.096	0.08457	0.00214	4.522	0.096	0.08559	0.00237	1288	25	1329	54	3.1
I	43	29.1	95	78	0.85	0.122	4.503	0.069	0.08409	0.00096	4.509	0.069	0.08305	0.00114	1291	18	1270	27	-1.7
I	76	57.1	225	111	0.51	-0.061	4.511	0.060	0.08369	0.00069	4.509	0.060	0.08421	0.00075	1291	16	1297	17	0.5
I	81	62.1	237	100	0.44	0.218	4.496	0.060	0.08408	0.00067	4.506	0.060	0.08223	0.00087	1292	16	1251	21	-3.3
I	9	8.1	15	8	0.54	-0.465	4.518	0.127	0.08531	0.00235	4.497	0.127	0.08929	0.00365	1294	34	1410	78	8.2
I	1	1.1	23	18	0.81	-0.191	4.493	0.119	0.08377	0.00210	4.484	0.119	0.08539	0.00265	1298	32	1325	60	2.0
I	8	7.1	287	160	0.58	0.000	4.482	0.055	0.08443	0.00053	4.482	0.055	0.08443	0.00053	1298	15	1303	12	0.3
I	63	44.1	12	8	0.67	-0.325	4.491	0.147	0.08478	0.00276	4.477	0.147	0.08755	0.00390	1300	40	1373	86	5.3
I	84	65.1	103	82	0.83	-0.095	4.477	0.071	0.08438	0.00104	4.472	0.071	0.08518	0.00119	1301	19	1320	27	1.4
I	52	35.1	39	26	0.69	-0.380	4.483	0.089	0.08373	0.00147	4.466	0.089	0.08697	0.00218	1303	24	1360	48	4.2
I	69	51.1	88	76	0.88	0.188	4.457	0.071	0.08395	0.00104	4.466	0.071	0.08236	0.00131	1303	19	1254	31	-3.9
I	82	63.1	137	97	0.74	0.163	4.448	0.066	0.08572	0.00087	4.456	0.066	0.08434	0.00107	1305	18	1300	25	-0.4
I	77	58.1	21	15	0.71	0.000	4.454	0.126	0.08152	0.00221	4.454	0.126	0.08152	0.00221	1306	34	1234	53	-5.8
I	70	51.2	21	11	0.54	0.000	4.445	0.114	0.08451	0.00201	4.445	0.114	0.08451	0.00201	1308	31	1304	46	-0.3
I	78	59.1	208	193	0.96	-0.083	4.446	0.060	0.08465	0.00068	4.442	0.060	0.08535	0.00077	1309	16	1324	17	1.1
I	40	27.2	25	9	0.36	0.000	4.438	0.109	0.08124	0.00247	4.438	0.109	0.08124	0.00247	1310	30	1227	60	-6.7
I	79	60.1	35	25	0.75	0.133	4.419	0.099	0.08487	0.00175	4.424	0.099	0.08374	0.00209	1314	27	1287	49	-2.1
I	23	19.1	16	8	0.53	-0.503	4.444	0.127	0.08377	0.01582	4.422	0.127	0.08806	0.01603	1314	35	1384	350	5.0
I	67	49.1	60	48	0.82	0.191	4.402	0.079	0.08444	0.00120	4.411	0.079	0.08282	0.00152	1317	22	1265	36	-4.1
I	4	4.1	40	14	0.37	-0.729	4.415	0.097	0.08600	0.00171	4.383	0.098	0.09225	0.00305	1325	27	1473	63	10.0
I	2	2.1	6	3	0.45	-1.278	4.434	0.216	0.08238	0.00394	4.378	0.217	0.09336	0.00860	1326	62	1495	174	11.3
I	71	52.1	39	19	0.50	-0.413	4.389	0.091	0.08254	0.00153	4.371	0.091	0.08606	0.00232	1328	25	1340	52	0.8
I	80	61.1	34	14	0.41	-0.366	4.382	0.098	0.08087	0.00869	4.366	0.098	0.08398	0.00884	1330	28	1292	205	-2.9
I	44	29.2	30	18	0.63	-0.216	4.370	0.095	0.08740	0.00204	4.361	0.095	0.08925	0.00242	1331	27	1409	52	5.6
I	83	64.1	22	13	0.58	0.204	4.281	0.116	0.08454	0.00216	4.289	0.117	0.08280	0.00278	1351	34	1265	65	-6.8
X	10	8.2	20	11	0.54	0.215	4.179	0.112	0.08721	0.00273	4.188	0.112	0.08538	0.00329	1380	34	1324	75	-4.2
P	59	42.1	24	11	0.47	-0.170	5.047	0.119	0.08100	0.00192	5.039	0.119	0.08244	0.00240	1167	26	1256	57	7.1
P	16	13.1	25	14	0.57	0.174	5.028	0.121	0.07930	0.00197	5.037	0.121	0.07783	0.00246	1167	26	1143	63	-2.2
P	5	4.2	13	5	0.45	0.845	4.989	0.184	0.08368	0.00309	5.031	0.188	0.07657	0.00595	1169	41	1110	155	-5.3
P	62	45.1	29	12	0.43	0.140	5.005	0.111	0.07867	0.00170	5.012	0.111	0.07749	0.00207	1173	24	1134	53	-3.4
P	7	6.1	21	8	0.38	1.113	4.921	0.120	0.08573	0.00204	4.976	0.123	0.07637	0.00438	1180	27	1105	115	-6.9
P	53	36.1	47	18	0.39	0.346	4.914	0.090	0.07731	0.00167	4.931	0.091	0.07441	0.00222	1190	20	1053	60	-13.1
P	74	55.1	10	5	0.48	-0.450	4.951	0.180	0.08511	0.00323	4.929	0.181	0.08896	0.00501	1191	41	1403	108	15.1
P	65	47.1	12	6	0.52	0.409	4.895	0.168	0.08501	0.00312	4.915	0.170	0.08155	0.00468	1194	39	1235	113	3.3

Table 1. continued

Group ID	Spot no.	Grain. spot	^{238}U (ppm)	^{232}Th (ppm)	$\frac{^{232}Th}{^{238}U}$	f204 (%)	$^{238}U/^{206}Pb$ ± 1σ		$^{207}Pb/^{206}Pb$ ± 1σ		$^{238}U/^{206}Pb^*$ ± 1σ		$^{207}Pb^*/^{206}Pb^*$ ± 1σ		$^{238}U/^{206}Pb^*$ date (Ma) ±1σ		$^{207}Pb^*/^{206}Pb^*$ date (Ma) ±1σ		Disc. (%)
P	31	22.3	43	7	0.17	-0.089	4.855	0.092	0.08072	0.00138	4.851	0.092	0.08147	0.00158	1208	21	1233	38	2.0
P	54	37.1	43	23	0.54	-0.092	4.853	0.092	0.07917	0.00178	4.848	0.092	0.07995	0.00194	1209	21	1196	48	-1.1
P	27	21.1	23	12	0.51	0.000	4.846	0.116	0.08299	0.01205	4.846	0.116	0.08299	0.01205	1209	27	1269	283	4.7
P	66	48.1	82	58	0.72	0.196	4.812	0.076	0.08269	0.00104	4.821	0.076	0.08103	0.00133	1215	18	1222	32	0.6
M	41	27.3	38	3	0.07	-0.112	5.169	0.106	0.08081	0.00155	5.163	0.106	0.08177	0.00182	1141	22	1240	44	8.0
M	37	26.1	29	2	0.05	0.516	5.052	0.111	0.07978	0.00164	5.079	0.112	0.07545	0.00273	1159	24	1080	73	-7.2
M	15	12.2	38	3	0.07	-0.214	5.083	0.101	0.07839	0.00149	5.072	0.101	0.08021	0.00196	1160	22	1202	48	3.5
M	12	10.1	39	2	0.06	-0.341	5.064	0.100	0.07843	0.00154	5.047	0.100	0.08132	0.00227	1165	22	1229	55	5.2
M	21	18.1	37	2	0.07	0.000	5.034	0.100	0.07794	0.00148	5.034	0.100	0.07794	0.00148	1168	22	1145	38	-2.0
M	45	29.3	32	2	0.08	-0.131	5.037	0.108	0.07852	0.00167	5.030	0.108	0.07962	0.00200	1169	24	1188	50	1.6
M	25	20.1	37	4	0.10	-0.219	4.908	0.110	0.08196	0.00155	4.897	0.111	0.08381	0.00202	1198	25	1288	47	7.0

Group M comprises seven analyses of seven zircon rims (Table 1), which yield a weighted mean $^{238}U/^{206}Pb^*$ date of 1163 ± 17 Ma (MSWD = 0.49). These analyses indicate low Th/U ratios (median 0.07).

Group X comprises one analysis (Table 1), which yields a $^{238}U/^{206}Pb^*$ date of 1380 ± 34 Ma (1σ).

Group P comprises 12 analyses of 12 zircons (Table 1), which yield $^{238}U/^{206}Pb^*$ dates of 1215–1167 Ma.

The date of 1276 ± 6 Ma for the 64 analyses in Group I is interpreted as the magmatic crystallization age of the gabbro. The date of 1163 ± 17 Ma for the seven analyses in Group M is interpreted as the age of high-grade metamorphism. The date of 1380 ± 34 Ma (1σ) for the single analysis in Group X is interpreted as the age of an inherited component.

The dates of 1215–1167 Ma for the 12 analyses in Group P are interpreted to reflect minor loss of radiogenic Pb. It is possible that some analyses in this group represent mixtures of core and rim material.

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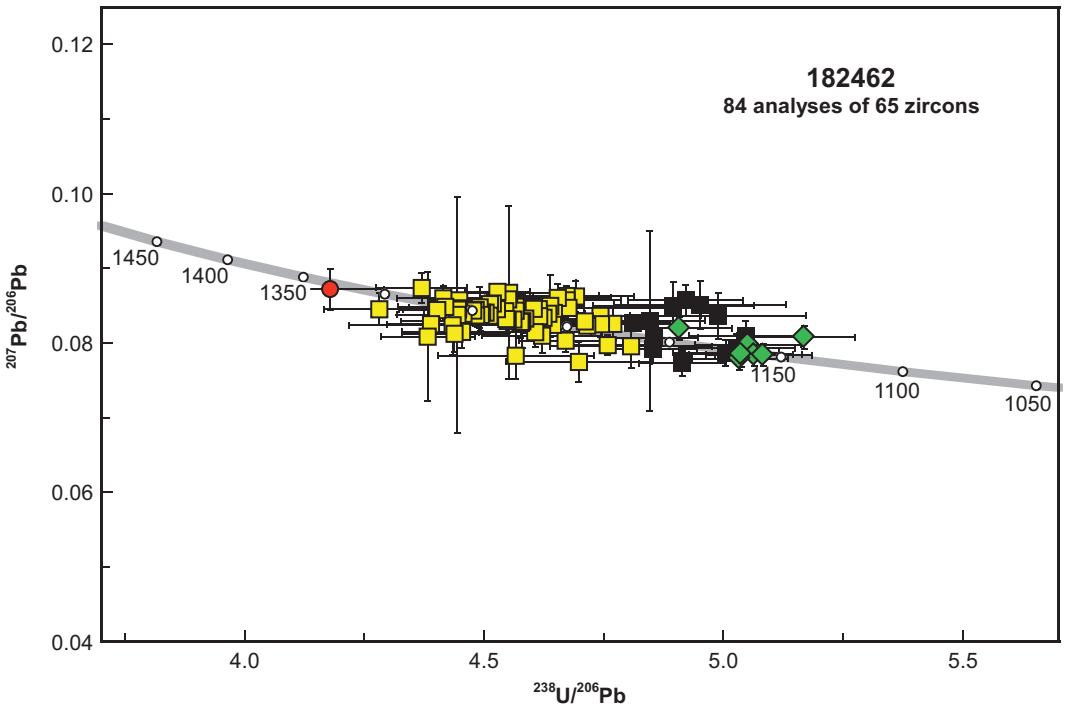

Figure 3. **U–Pb analytical data for sample 182462: garnetiferous metagabbro, Splinter prospect. Yellow squares indicate Group I (magmatic zircons); green diamonds indicate Group M (metamorphic zircon rims); black squares indicate Group P (radiogenic-Pb loss); red circle indicates Group X (xenocrystic zircon).**