Anna Pietranik

Institute of Geological Sciences, University of Wrocław,
email: anna.pietranik@ing.uni.wroc.pl

Dating zircon from the Gęsiniec Intrusion by LA-ICPMS (Laser Ablation — Inductively Coupled Plasma Mass Spectrometry)

Abstract

New U-Pb ages for zircon from the dominating quartz diorite type in the Gęsiniec Intrusion were obtained using LA ICPMS (laser ablation inductively coupled plasma mass spectrometry). The concordant age for a tight population of 11 grains is 294.1 ± 2.0 Ma, which is similar to the other ages of this intrusion reported in literature.

Streszczenie

Nowe datowania U-Pb dla cyrkonu z dominującego typu diorytu kwarcowego występującego w intruzji Gęsinica zostały uzyskane za pomocą LA ICPMS (ablacji laserowej sprzężonej ze spektrometrem mas z jonizacją w plazmie indukcyjnie sprzężonej). Konkordantny wiek został uzyskany dla 11 ziarn i wynosi 294.1 ± 2.0 milionów lat i tym samym jest podobny do innych wieków tej intruzji opublikowanych w literaturze naukowej.

Keywords: zircon ages, LA-ICPMS, Gęsiniec Intrusion

1. Introduction/Geological Setting

In this contribution I present new U-Pb ages of zircon measured by LA ICPMS (laser ablation inductively coupled plasma mass spectrometry) from the dominating tonalite-quartz diorite type in the Gęsiniec Intrusion.

The Gęsiniec Intrusion is located in the northern part of the Strzelin Massif, the NE Bohemian Massif (SW Poland). It is dominated by tonalite and quartz diorite with subordinate granodiorite and two-mica granite and was formed in three main magma pulses: tonalitic-dioritic, granodioritic-tonalitic and granitic (Oberc-Dziedzic 1999; Pietranik and Waight 2008). The dioritic rocks were dated by (a) Rb-Sr method on mineral separates (plagioclase + biotite + whole rock) giving the age of 294 ± 0.6 Ma for the most isotopically homogenous sample (Pietranik and Waight 2008) and (b) SHRIMP method on zircon giving the age of 295 ± 3 Ma (Oberc-Dziedzic and Kryza 2012). Therefore, the intrusion belongs to the youngest of the three magmatic episodes that affected the Strzelin Massif: tonalitic at ca. 324 Ma, granodioritic at ca. 305 Ma, and tonalitic/granitic at ca. 295 Ma (Oberc-Dziedzic et al. 2010).

2. Sample characteristic and analytical methods

The dating was done on the sample described as leucocratic, poikilitic quartz diorite in Pietranik and Waight (2008). The sample was chosen because both plagioclase and zircon are isotopically homogenous (for Sr and Hf isotopes respectively), and therefore the obtained Rb-Sr ages should not be affected by mixing of magmas with different isotope composition (Pietranik and Waight 2008; Pietranik et al. 2011). Zircon grains were handpicked from heavy minerals separates after approximately 2 kg of the rock was crushed, sieved and panned. Then zircon were mounted in epoxy and polished to show their interiors. The zircon grains were imagined by charge contrast images to reveal their internal microstructures. Zircons from the analysed sample were approximately 200 ± 50 μm wide (Figure 1) and showed slightly oscillatory zonation and contained rare inclusions of apatite and quartz.

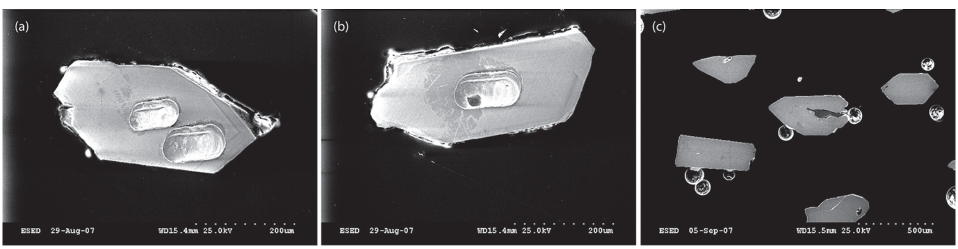

Figure 1. Charge contrast images of zircons from the dated sample, pits in (a) and (b) are after laser ablation analyses

U-Pb dating of zircon were carried out at the University of Bristol using a Thermo-Scientific Element single-collector ICP–MS (Inductively Coupled Plasma — Mass Spectrometry) coupled to a New Wave 193HE laser ablation sampling system, following measurement details described in Pietranik et al. (2013). Twelve Plešovice zircon analyses were done during the session to correct for

U-Pb fractionation and instrumental mass bias and yielded the $^{206}Pb/^{238}U$ age of 337.9 ± 1.6 Ma, which is in excellent agreement with an accepted Plešovice zircon $^{206}Pb/^{238}U$ age of 337.13 ± 0.37 Ma (Sláma et al., 2008). Data reduction was carried out with the software package GLITTER® (GEMOC — The ARC National Key Centre for Geochemical Evolution and Metallogeny of Continents). The plotting and concordia age calculation was done by Isoplot (Ludwig 1999), all errors are showed at the 2σ uncertainty level. Measurements of ^{204}Pb were carried out and 204 mass signal was corrected for the presence of ^{204}Hg. After correction ^{204}Pb concentration was below detection limit and no ^{204}Pb correction was applied to the data.

3. Results

Data were analysed in two sessions: 10 grains in the first session and 12 grains in the second session (Table 1).

All analyses do not yield concordant age (Figure 2a), some of the analyses are slightly discordant and some are spread along the concordia line suggesting that the zircons were affected by Pb loss. Rejecting discordant analyses and those spread along the concordia from the dataset leaves 11 analyses, which yield concordant age 294.1 ± 2.0 Ma (MSWD = 0.01, Figure 2b).

The dates overlap with previous dating of the rocks from the intrusion by other techniques (Pietranik and Waight 2008; Oberc-Dziedzic and Kryza 2012).

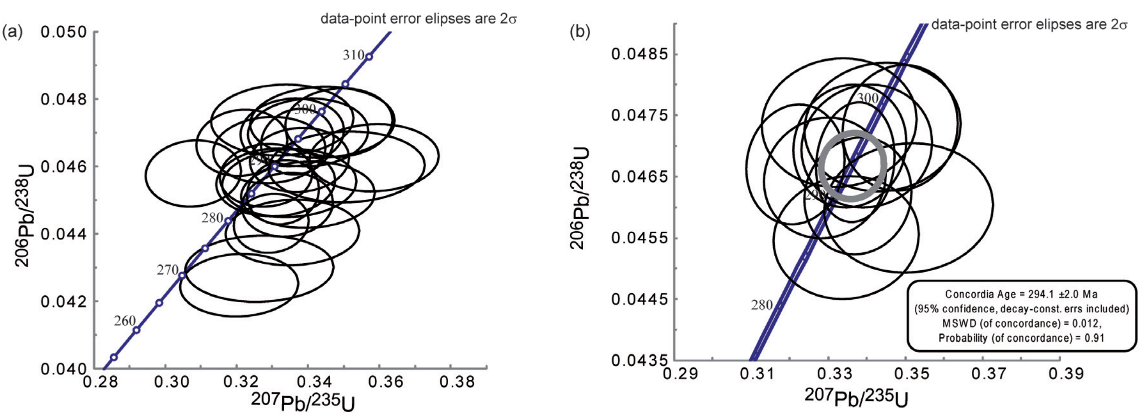

Figure 2. Conventional concordia diagrams for all zircons analysed in the Gęsiniec Intrusion (a) and those, which yield concordia age (b)

Table 1. U-Pb-Th isotope ratios and corresponding ages for the Gęsiniec Intrusion

Analysis	Isotope ratios.								Age estimates (Ma).							
	Pb^{207}/Pb^{206}	±1s	Pb^{206}/U^{238}	±1s	Pb^{207}/U^{235}	±1s	Pb^{208}/Th^{232}	±1s	Pb^{207}/Pb^{206}	±1s	Pb^{206}/U^{238}	±1s	Pb^{207}/U^{235}	±1s	Pb^{208}/Th^{232}	±1s
D061	0.05384	0.00127	0.04297	0.0004	0.32646	0.00848	0.01023	0.0001	364.2	52.3	271.2	2.5	286.9	6.5	205.8	2.1
D062	0.05203	0.00096	0.04648	0.0004	0.32916	0.00646	0.01114	0.00008	286.7	41.5	292.9	2.5	288.9	4.9	223.9	1.7
GES1	0.05293	0.001	0.047	0.00041	0.33999	0.0069	0.01153	0.00011	325.5	42.3	296.1	2.5	297.2	5.2	231.7	2.1
GES2	0.0535	0.00113	0.04551	0.00041	0.33474	0.00769	0.01088	0.0001	350.0	47.2	286.9	2.5	293.2	5.9	218.8	2.1
GES3	0.05286	0.00116	0.04731	0.00043	0.34406	0.00826	0.01117	0.00012	322.8	48.9	298.0	2.7	300.2	6.2	224.5	2.3
GES4	0.05551	0.00106	0.04626	0.00041	0.35863	0.0074	0.0127	0.00013	432.6	41.6	291.5	2.5	311.2	5.5	255.0	2.7
GES5	0.05323	0.00071	0.04431	0.00036	0.3297	0.00428	0.01073	0.00006	338.7	29.8	279.5	2.3	289.3	3.3	215.7	1.2
GES6	0.05279	0.00086	0.04619	0.00039	0.33765	0.00569	0.01031	0.00007	319.7	36.4	291.1	2.4	295.4	4.3	207.4	1.3
GES7	0.05303	0.0011	0.04516	0.0004	0.33995	0.00767	0.01212	0.0001	329.9	46.4	284.8	2.5	297.1	5.8	243.5	2.1
GES8	0.05124	0.00081	0.04574	0.00038	0.32828	0.00533	0.01244	0.00008	251.8	35.9	288.3	2.4	288.2	4.1	249.8	1.6
GES9	0.05566	0.00116	0.04404	0.0004	0.33568	0.00762	0.01359	0.00011	438.5	45.5	277.9	2.5	293.9	5.8	272.9	2.3
GES10	0.05539	0.00128	0.04599	0.00043	0.35082	0.00896	0.01348	0.00013	427.7	50.3	289.8	2.6	305.3	6.7	270.7	2.7
D061	0.04934	0.00113	0.04738	0.00043	0.33282	0.00819	0.01546	0.00013	163.8	52.6	298.4	2.7	291.7	6.2	310.0	2.6
D062	0.05173	0.00088	0.047	0.00041	0.33559	0.00596	0.01342	0.00009	273.4	38.3	296.1	2.5	293.8	4.5	269.4	1.8
D063	0.05271	0.00104	0.04247	0.00038	0.32071	0.00676	0.01262	0.00013	316.3	44.0	268.1	2.4	282.5	5.2	253.5	2.5
D064	0.04969	0.00079	0.0467	0.0004	0.32152	0.00523	0.01291	0.00008	180.3	36.5	294.2	2.5	283.1	4.0	259.3	1.6
D065	0.05139	0.00099	0.04553	0.00041	0.33094	0.00684	0.01215	0.0001	258.2	43.8	287.0	2.5	290.3	5.2	244.1	1.9
D066	0.05391	0.00081	0.04486	0.00039	0.33423	0.0052	0.01269	0.00008	367.1	33.8	282.9	2.4	292.8	4.0	254.8	1.6
D067	0.05205	0.00066	0.04674	0.0004	0.33698	0.00415	0.01256	0.00006	287.6	28.6	294.4	2.4	294.9	3.2	252.2	1.3
D068	0.04827	0.00082	0.04579	0.0004	0.30787	0.00547	0.01218	0.00008	112.4	39.7	288.6	2.5	272.5	4.3	244.8	1.6
D069	0.05319	0.00088	0.0473	0.00042	0.34866	0.00612	0.01225	0.00008	336.9	37.2	298.0	2.6	303.7	4.6	246.1	1.7
D0610	0.05178	0.00066	0.04523	0.00039	0.33299	0.00414	0.01225	0.00006	275.9	28.8	285.1	2.4	291.8	3.2	246.1	1.2

Acknowledgements

AP acknowledges grant no. N N307 105235 by the Polish Ministry of Science.

References

Ludwig K.R. 1999. *Using Isoplot/Ex Version 2.01: A geochronological toolkit for Microsoft Excel.* Berkeley Geochronology Center Special Publications, 1a.

Oberc-Dziedzic T. 1999. The geology of Strzelin Granitoids (Fore-Sudetic Block, SW Poland). *Mineralogical Society of Poland — Special Papers*, 14, pp. 22–32.

Oberc-Dziedzic T., R. Kryza. 2012. Late stage Variscan magmatism in the Strzelin Massif (SW Poland): SHRIMP zircon ages of tonalite and Bt-Ms granite of the Gęsiniec intrusion. *Geological Quarterly*, 56 (2), pp. 225–236.

Oberc-Dziedzic T., R. Kryza, J. Białek. 2010. Variscan multistage granitoid magmatism in Brunovistulicum: Petrological and SHRIMP U–Pb zircon geochronological evidence from the southern part of the Strzelin Massif, SW Poland. *Geological Quarterly*, 54, pp. 301–324.

Pietranik A., T.E. Waight. 2008. Processes and sources during late Variscan dioritic-tonalitic magmatism: Insights from plagioclase chemistry (Gesiniec Intrusion, NE Bohemian Massif, Poland). *Journal of Petrology*, 49 (9), pp. 1619–1645.

Pietranik A., C. Storey, B. Dhuime, R. Tyszka, M. Whitehouse. 2011. Decoding whole rock, plagioclase, zircon and apatite isotopic and geochemical signatures from variably contaminated dioritic magmas. *Lithos*, 127, pp. 455–467.

Pietranik A., C. Storey, J. Kierczak. 2013. Niemcza diorites and moznodiorites (Sudetes, SW Poland): Record of changing geotectonic setting at ca. 340 Ma. *Geological Quarterly*, 57 (in press).

Sláma J., J. Košler, D.J. Condon, J.L. Crowley, A. Gerdes, J.M. Hanchar, M.S.A. Horstwood, G.A. Morris, L. Nasdala, N. Norberg, U. Schaltegger, B. Schöne, M.N. Tubrett, M.J. Whitehouse. 2008. Plešovice zircon — a new natural reference material for U–Pb and Hf isotopic microanalysis. *Chemical Geology*, 249, pp. 1–35.