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GEOLOGY

New SHRIMP U–Pb Age Data on Zircons from Plagiogranites in the Ophiolites of the Kamchatsky Mys Peninsula, Eastern Kamchatka

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The dating of ophiolite complexes is strongly complicated, since they are typically disintegrated and not always represented by a complete rock succession. The radiometric dating of the ophiolites is typically conducted on plagiogranites, which are present as a subordinate component in the ophiolite sequence, the gabbroic section, and the sheeted diabase dike complex [1, 2]. The plagiogranites are commonly dated by the U–Pb zircon method.

Three ophiolite complexes of different ages and paleotectonic settings were recognized at the Kamchatsky Mys Peninsula, eastern Kamchatka [3]. Their age was determined from geological data and the microfaunal assemblage of the upper siliceous sediments associated with volcanic rocks. SHRIMP U–Pb zircon dating was conducted for plagiogranites to confirm the geological age of the ophiolites. The plagiogranites pertain to the Upper Cretaceous ophiolite complex, which consists of depleted peridotites, gabbroids cut by dikelike plagiogranite bodies, island-arc tholeiites, and boninites.

The Kamchatsky Mys peninsula is composed of tectonic plates of ultramafic rocks of Mt. Soldatskyaya Massif, serpentinite melange, and Cretaceous and Paleogene volcanogenic–siliceous and terrigenous rocks, which make up a nappe overthrusted onto the gabbroids of the Olenegorsk Massif [4].

The studied zircons were taken from plagiogranite bodies that crosscut gabbroids, which compose a large block (1.5 × 2 km in size) in the upper reaches of the Pervaya Ol'khovoya River. This block is a fragment of the tectonic plate of the serpentinite melange, which separates serpentinized peridotites of the Soldatskaya Massif and Upper Cretaceous volcanogenic–terrigenous island-arc rocks of the Pikezh Complex [5]. In addition to gabbroids, large blocks and boulders of ultramafic and metamorphic rocks, Albian–Cenomanian siliceous–carbonate rocks, as well as tuffaceous and terrigenous rocks of the Pikezh Complex, are present in the plate. The gabbroid block is confined to the northeastern part of the serpentinite melange and is overlain by Pliocene–Quaternary terrigenous rocks of the Ol'khovka Formation in the north [6]. In the south, the block is separated by faults, often marked by serpentinite melange, from the volcanogenic and siliceous–carbonate rocks of the Pikezh Complex.

The gabbroids are fine-grained hornblende gabbros and gabbronorites, which are cut by dolerite dikes. Plagiogranites form a network of irregular veins (1 to 5–7 cm thick) and dikes (1.5–2.0 m thick) in the fine-grained hornblende gabbro and contain angular xenoliths of the host rocks.

As was shown previously [3, 5], the chemical composition of gabbros (low contents of TiO_2, Zr, and Y) is similar to that of gabbroids of the Philippine Sea, which belong to boninite series and formed in suprasubduction conditions. Major and trace element compositions of the plagiogranites also testify to the suprasubduction origin [5].

Based on major and trace element compositions and mineralogical data, the gabbroids and plagiogranites were presumably derivatives of island-arc tholeiites. The plagiogranite melt was a residual left after fractionation of the parental mafic magma. The gabbro–plagiogranite pluton was a fragment of the basement of the Upper Cretaceous Kronotsky primitive island arc.

Analytical method. SHRIMP II U–Pb zircon dating was carried out at the Center of Isotopic Research, Karpinskii All-Russia Research Institute of Geology (S. L. Presnyakov, analyst).

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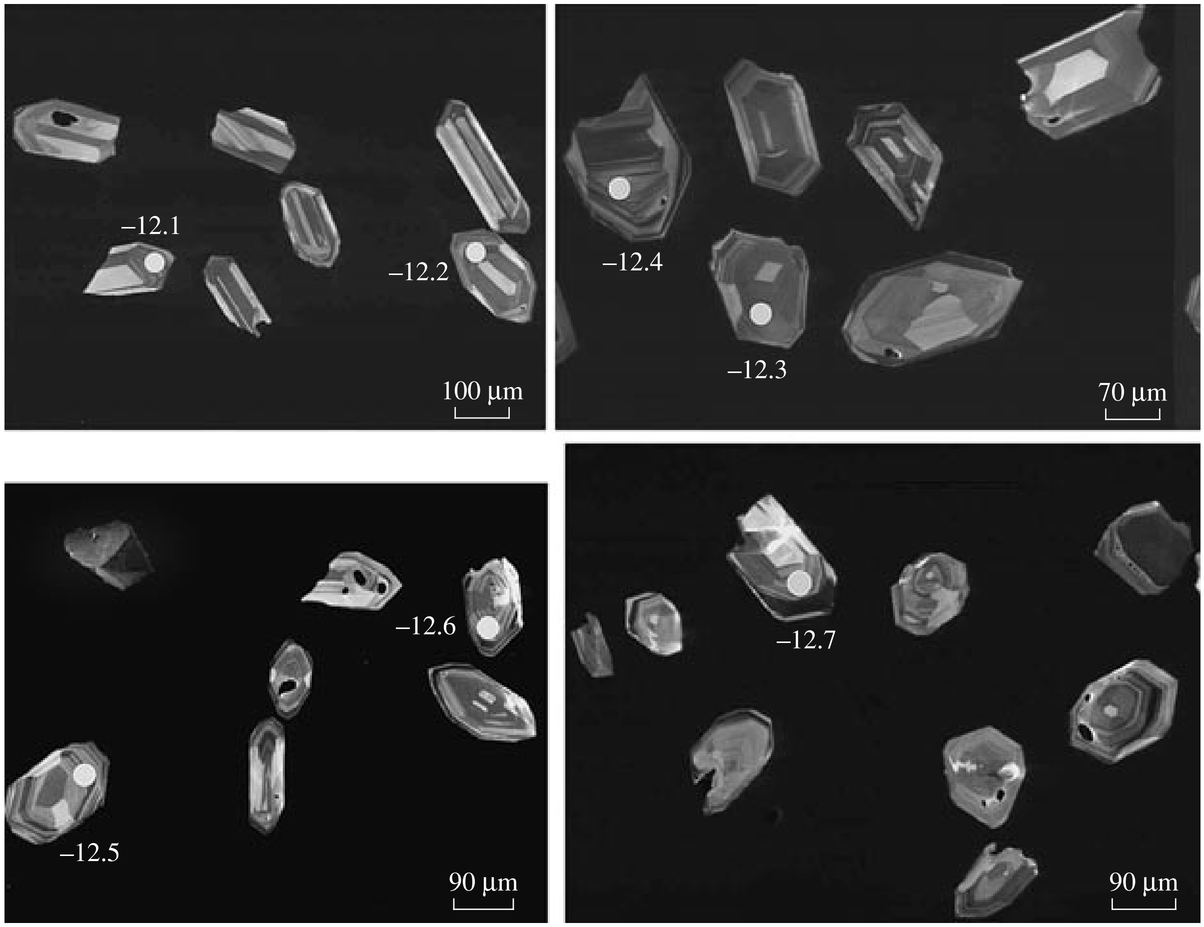

Fig. 1. Cathodoluminescence images of the zircons from plagiogranites of the ophiolite complex of the Kamchatsky Mys Peninsula. Empty circles show the measurement points.

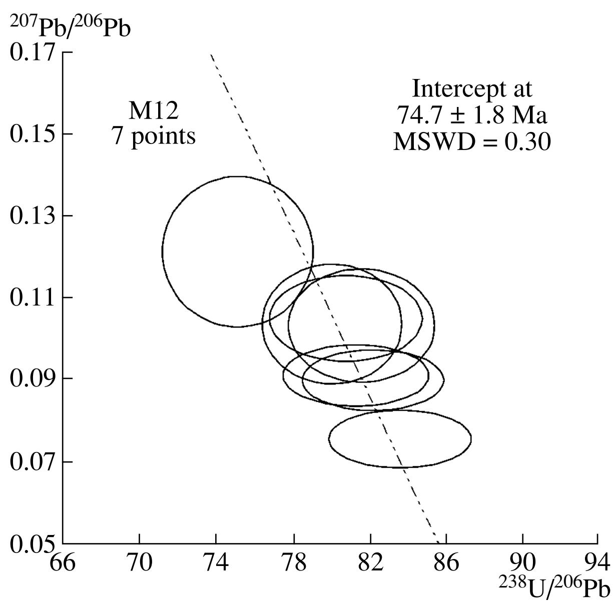

Fig. 2. The Tera–Wasserburg concordia plot for SHRIMP U–Pb data.

Hand-picked zircon grains implanted in an epoxy resin, together with TEMORA and 91500 standard zircons, were polished until their exposure to approximately half-thickness. The optical (transmitted and reflected) and cathodoluminescence images, which reveal the internal structure and zoning of zircons, were used to choose dating points on the surface of grains.

The U–Pb ratios were determined by the SHRIMP II method using the technique described in [7]. The samples were bombarded with a primary beam of the negatively charged oxygen ions (current 2 nA, crater diameter 15 μm). The obtained data were treated with the SQUID program [8]. The U–Pb ratios were normalized to the TEMORA standard ratio of 0.0668, which corresponds to an age of 416.75 Ma [9]. The errors of single analyses (ratios and ages) are quoted at a 1σ level. The errors of calculated concordant ages and intercepts with concordia are given at a 2σ level. Concordia diagrams were plotted using ISOPLOT/EX programs [11].

SHRIMP U–Pb data. Zircon in the plagiogranites is represented by short- to long-prismatic euhedral zircons 90–270 μm in size. Cathodoluminescence images of zircon crystals indicated the presence of zoning par-

Results of U–Pb SHRIMP investigations of zircons from plagiogranites of the ophiolite complex of the Kamchatsky Mys Peninsula

Measurement point	$^{206}Pb_c$, %	U	Th	$^{232}Pb/^{238}U$	$^{206}Pb^*$, g/t	Age, ma		
		g/t				(1) $^{206}Pb/^{238}U$	(2) $^{206}Pb/^{238}U$	(3) $^{206}Pb/^{238}U$
M12.3.1	14.38	125	32	0.26	1.3	68 ± 6	74 ± 2	74 ± 3
M12.1.1	5.51	284	75	0.27	2.9	72 ± 3	74 ± 2	74 ± 2
M12.5.1	7.15	163	67	0.42	1.7	73 ± 4	73 ± 2	73 ± 3
M12.6.1	7.74	172	75	0.45	1.9	74 ± 3	74 ± 2	75 ± 3
M12.4.1	3.31	206	73	0.36	2.2	75 ± 4	74 ± 2	74 ± 3
M12.2.1	4.24	155	41	0.27	1.6	76 ± 3	75 ± 2	74 ± 3
M12.7.1	5.47	98	24	0.25	1.1	81 ± 5	77 ± 3	78 ± 3

Note: Errors are at a 1σ level. (Pb_c, Pb*) common and radiogenic Pb, respectively. The standard calibration error is 0.92%. (1) Common Pb corrected with the use of measured ^{204}Pb; (2) common Pb corrected with allowance for $^{206}Pb/^{238}U$–$^{207}Pb/^{235}U$ concordant age; (3) common Pb corrected with allowance for $^{206}Pb/^{238}U$–$^{208}Pb/^{232}U$ concordant age.

allel to crystallographic shapes (Fig. 1) and the absence of alien cores, indicating their magmatic origin. Seven data points define an age of 74.7 ± 1.8 Ma, MSWD = 0.3 (Fig. 2, table).

Thus, the SHRIMP U–Pb zircon data showed that plagiogranites were emplaced in the Campanian (74.7 ± 1.8 Ma).

In our earlier works based on petrological, geochemical, and mineralogical data, the strongly depleted Soldatskaya peridotites, the gabbroids and plagiogranites of the Pervaya Ol'khovaya melange, and the tectonic blocks of island-arc tholeiites and boninites in the Pikezh Complex were combined into a common ophiolite complex. The Campanian–Maestrichtian ages were constrained to radiolarians only for the rocks of the Pikezh Complex [4]. The obtained U–Pb datings on zircons from plagiogranites also reliably define the magmatic part of the ophiolite complex as Late Cretaceous formation. This ophiolite sequence formed within the Kronotsky paleoarc, which, based on the data obtained, began to form before the Campanian (Late Cretaceous).

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REFERENCES

1. R. G. Coleman and Z. E. Peterman, J. Geophys. Res. **80**, 1099 (1975).
2. R. G. Coleman and M. M. Donato, in *Trondhjemites, Dacites, and Related Rocks*, Ed. by E. Baker (Elsevier, Amsterdam, 1979; Mir, Moscow, 1983), pp. 149–167.
3. S. G. Skolotnev, W. Kramer, N. V. Tsukanov, et al., Dokl. Akad. Nauk **380**, 652 (2001) [Dokl. Earth Sci. **381**, 881 (2001)].
4. *Accretionary Tectonics of Eastern Kamchatka*, Ed. by Yu. M. Pushcharovsky (Nauka, Moscow, 1993) [in Russian].
5. N. V. Tsukanov, M. V. Luchitskaya, S. G. Skolotnev et al., Dokl. Akad. Nauk **397**, 243 (2004) [Dokl. Earth Sci. **397**, 632 (2004)].
6. M. E. Boyarinova, *Geological Map of the Kamchatsky Mys Peninsula. Scale 1 : 200 000*, (St. Petersburg, 1999) [in Russian].
7. I. S. Williams, Rev. Econ. Geol. **7**, 1 (1998).
8. K. R. Ludwig, Berkley Geochronol. Center Spec. Publ., No. 2, 2000.
9. L. P. Black, S. L. Kamo, C. M. Allen et al., Chem. Geol. **200**, 155 (2003).
10. G. W. Wetherill, Trans. Am. Geophys. Union **37**, 320 (1956).
11. K. R. Ludwig, Berkley Geochronol. Center Spec. Publ., No. 1a, 1999.