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Cretaceous granitoid magmatism of North-East Asia: tectonic setting, rock chemistry, isotopy and P-T conditions of formation

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Cretaceous granitoid magmatism of NE Asia is considered on the example of Western Koryak fold system (Taigonos segment, Eastern- and Prybrezhno-Taigonos granitoid belts), Okhotsk–Chukotka volcanic belt (Tanyurer pluton), and Chaunskaya zone of the Verkhoyansk–Chukotka fold area (Peekiney, Moltykan, and Telekaisky massifs).

Within the Taigonos segment of the Western Koryak fold system (1) Central Taigonos and Beregovoy terranes are distinguished. The Central Taigonos terrane is composed of sedimentary-volcanic complexes, generated in the framework of the Koni–Taigonos (P-Mz_1) and the Uda–Murgal (J_3–K_1) island arcs (2). Central Taigonos terrane is cut through by Albian granitoids of the Eastern Taigonos pluton. The Beregovoy terrane displays imbricate thrust structure, and is interpreted as the accretionary prism of the Uda–Murgal arc (1), stitched by granitoids of the Prybrezhny Taigonos belt. The Chaunskaya fold zone is dominated by Mz_1 rock assemblages of the passive margin of the Chukotka microcontinent (3). The western part of this zone is overprinted by the Rauchuan basin, filled in with slightly deformed sediments of J_3–K_1nc age. The northern part comprises several uplifts with outcrops of D–C sedimentary rocks. Pz–Mz_1 deposits are folded into gentle folds and cut through by a series of K_1 granitoid plutons. K_1ab$_2$–K_2cp Campanian Okhotsk-Chukotka volcanic belt (OCVB) overlies Verkhoyansk-Chukotka Mesozoic structures and the Western Koryak thrust-fold belt structures with angular unconformity (4). The Tanyurer pluton is located in the transitional zone between the Central Chukotka sector and the Eastern Chukotka flank zone (5) of the volcanic belt.

The Eastern Taigonos pluton (ETP) is dominated by granodiorite and tonalite. Marginal parts of the massif consist of more mafic rocks: gabbro-diorite, diorite, and quartz diorite. Amphibole–biotite granite and leucogranite are encountered in subordinate amounts. The studied intrusion of the Prybrezhny Taigonos belt (PTB) comprises a full spectrum of rocks from gabbro to diorite to quartz diorite through tonalite. The Peekiney and Moltykan massifs are dominated by massive porphyritic granodiorite and quartz syenite. The southern part of the Telekaisky pluton is composed of massive medium-grained amphibole–biotite granite and granodiorite. The massive porphyritic leucogranite is the main emplacement phase of the northern part of the Telekaisky pluton. The dominant rock variety of Tanyurer massif is medium-grained granodiorite. The rocks of all the studied massifs host fine-grained mafic enclaves, whichr origin may be considered as a result from processes of mechanical mixing of melts of different compositions (6).

U-Pb SHRIMP datings of ETP are 103.4$\pm$1.7, 97.0$\pm$1.1, 104.6$\pm$1.0 Ma; those of PTB granitoids - 106.5$\pm$0.9, 105.5$\pm$0.9 Ma (7; 8). K-Ar datings of Moltykan massif are 117–109 Ma (9). Ar-Ar datings of Tanyurer pluton are 79.2$\pm$1.9, 79.7$\pm$0.4, 82.9$\pm$0.7, 77.3$\pm$0.4 Ma (10).

The K/Na ratio and total alkalinity of the granitoids increase systematically through the range of plutons: PTB–ETP–Tanyurer–southern part of the Telekaisky massif–other intrusions of the Chaunskaya zone. Average values of the K/(K+Na) index range from 0.1 (PTB) to 0.54 (Peekiney massif). PTB granitoids have the highest CaO content and the lowest alumina content. $(Nb/Zr)_n$ vs Zr and Rb vs Y+Nb, LILE enrichment and HFSE depletion, distinct Ta and Nb depletion show that granites of Taigonos granitoid belts are subduction-related rocks. Granites of ETb are more enriched in LREE, with more fractionated REE patterns. In comparison to granitoids of OCVB Tanyurer pluton and Chaunskaya zone massifs those of PTB are the most depleted, distinguished by the lowest La/Yb ratios, relatively weak Ta–Nb minima, and elevated contents of Y and heavy REEs, trace-element composition is close to the inferred average composition of the lower continental crust (11). The Tanyurer pluton and the southern part of the Telekaisky massif display moderate contents of the incompatible elements. They are close in composition to the upper continental crust (UCC) average. Gabbroics of the early emplacement phases of the Tanyurer intrusion are chemically similar to the granitoids, differing from them by their relative depletion and lack of Eu anomaly. The Peekiney and Moltykan massif are enriched in LILE and the LREE, their La/Yb ratio is twice higher than the UCC average value. Their spidergrams retain the Nb, Ta, and P minima, common to all the studied rocks. The rocks of the northern part of the Telekaisky massif stand alone due to the geochemical signatures of some of their leucogranites and alaskites. High contents of the majority of incompatible LILEs in these rocks are combined with sharp Ba, Sr, P, and Eu minima and considerable enrichment of the heavy REE. On the discriminant diagram most of the granitoids plot in the region of granitoids of active continental margins. Leucogranites of the northern part of the Telekaisky intrusion are close to post-orogenic intraplate rocks. Position of the Peekiney and Moltykan plutons is less clear: their geochemical signatures are transitional between granitoids from supra-subduction zones, postcollisional uplifts, and late orogenic settings.

ETP and PTB granitoids have high positive ε_{Nd}(T) values and low $(^{87}Sr/^{86}Sr)_0$. (12). In comparison to other Cretaceous granitoids of Pacific belt they have the most “primitive”, “mantle” isotopic characteristics. Details in Sr and Nd isotopic compositions of ETP and PTB granitoids indicate their origin from two different sources.

The studied granitoid plutons were generated through melting of compositionally heterogeneous crustal source, with direct contribution from mafic melts produced in the mantle wedge area above Benioff zone. Variations of the trace-element composition of granites are controlled by local compositional peculiarities of the source regions to a greater extent than by the geodynamic regime as such. Final crystallization of the studied plutons occurred at comparatively small depths, between 1–2 and 6–7 km, in a temperature interval of 700–770˚C. The depth of emplacement of the bodies decreases with increasing distance from the areas with oceanic and transitional type crust, whereas, the degree of incompatible element enrichment of the mantle and crustal sources of melts increases in the same direction. For Taigonos ETP and PTB granitoids on the basis of Sr and Nd isototpy it is proved that material of pre-Riphean continental crust did not participate in their formation. Variations in fo_2values at the late stages of crystallization of the massifs reach 3–4 orders of magnitude, exceeding the limits of the QFM and NNO buffer equilibrium, which is due likely to the local peculiarities of the source composition.

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References:

1) Sokolov, S.D., Bondarenko, G.E., Morozov, O.L., and Luchitskaya, M.V. The tectonics of the junction zone between the Verkhoyansk–Chukotka and Koryak–Kamchatka fold areas // Byull. Mosk. O-va Ispyt. Prirody. Otd. Geol. 2001. V. 76. Is 6. P. 24–37 (in Russian).

2) Sokolov, S.D. Accretionary tectonics of the Koryak–Chukotka segment of the Pacific belt. Moscow., 1992. 181 pp. (in Russian).

3) Parfenov, L.M., Natapov, L.M., Sokolov, S.D., and Tsukanov, N.V. Exotic terranes and accretionary tectonics of the northeast of Asia // Geotectonics. 1993. No. 1. P.

68-78. (in Russian)

4) Filatova N.I., *Peri-Oceanic volcanic belts*, 262 pp., Nedra Publ., 1988 (in Russian)

5) Belyi, V.F. Stratigraphy and structures of the Okhotsk–Chukotka volcanic belt. Moscow, Nauka, 1977. 171 pp. (in Russian).

6) Vernon, R.H. Microgranitoid enclaves in granites – globules of hybrid magma quenched in a plutonic environment // Nature. 1991. V. 309. P. 438-439

7) Hourigan J. Mesozoic-Cenozoic tectonic and magmatic evolution of the Northeast Russian margin. PhD Thesis. 2003. 218 p.

8) Luchitskaya, M.V., Hourigan, G., Bondarenko, G.E., and Morozov, O.L. New data of SHRIMP U–Pb study on zircons from granitoids of the Prybrezhny- and Eastern Taigonos belts, southern part of the Taigonos Peninsula // Dokl. Akad. Nauk. 2003. V. 389. No. 6. P. 763-769 (in Russian)

9) Tikhomirov, P.L. Petrology of granitoids of the Telekaisky ore district (central Chukotka). Author's abstract of Cand. Sci. (Geol. and Mineral.) dissertation, St. Petersburg, 1998 (in Russian).

10) Tikhomirov P.L., Akinin V.V., Ispolatov V. O., Aleksander P., Cherepanova I.Yu., Zagoskin V.V. Age of northern part of Okhotsk-Chukotka volcanic belt: new data of Ar-Ar and U-Pb geochronology // Stratigrafiya I geologicheskaya korrelyatsiya. 2006. V. 14. N.5. P.67-82 (in Russian).

11) Taylor, S.R., and McLennan, S.M. The Continental Crust: its Composition and Evolution, 312 pp., Blackwell Scientific, Oxford, 1985

12) Luchitskaya M.V., Shatagin K.N. First Sr-Nd isotope data on granitoids of the Eastern and Coastal Taigonos belts (southern part of Taigonos Peninsula, Northeast Russia) // Dokl. Akad Nauk. 2006. V. 411. N 8. P. 1174–1177