GEODYNAMICS & TECTONOPHYSICS

PUBLISHED BY THE INSTITUTE OF THE EARTH'S CRUST
SIBERIAN BRANCH OF RUSSIAN ACADEMY OF SCIENCES

2017 VOLUME 8 ISSUE 3 PAGES 455–459 ISSN 2078-502X

https://doi.org/10.5800/GT-2017-8-3-0261

Proceedings of the Second Russia–China International Meeting on the Central Asian Orogenic Belt (September 6–12, 2017, Irkutsk, Russia)

Geochronology and Sr-Nd isotope geochemistry of Late Paleozoic collisional granitoids of Undinsky complex (Eastern Transbaikal region)

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For citation: *Dril S.I., Noskova Yu.V., Wang K.-L., Belyaev V.A., Skuzovatov S.Yu., Grigoriev D.A., Belkov D.A.*, 2017. Geochronology and Sr-Nd isotope geochemistry of Late Paleozoic collisional granitoids of Undinsky complex (Eastern Transbaikal region). *Geodynamics & Tectonophysics* 8 (3), 455–459. doi:10.5800/GT-2017-8-3-0261.

There are several geodynamic models of the Central Asian Orogenic Belt (CAOB) development [*Şengör et al., 1993, Zorin, 1999; Parfenov et al., 1999, 2003; Willem et al., 2012; and others*]. The Mongol-Okhotsk Orogenic Belt (MOB) represents important part of CAOB. All geodymanic models of Late Riphean to Paleozoic structures of CAOB emphasize significance of subduction processes along Northern Asian craton margin at that time. Collage of CAOB terrains formed as a result of accretion of island arc, accretionary wedge, turbidite, and continental margin terrains to the Siberian paleocontinent. These terrains became a substrate for the further granitoid magmatism. Formation of large volumes of the granite magmas within orogenic belts is often related to widespread terrain displacement, when the settings of active continental margin and collision turn into transform margin of lithospheric plates. Such geodynamic change probably occurred within MOB during Permian to Early Triassic [*Parfenov et al., 2013*]. At that time, extended Gobi-Khingan belt of palingenic granitoids, attributed to the Undin complex in Eastern Transbaikalia, formed along northern margin of the Argun superterrain [*Kozlov et al., 2003; Parfenov et al., 2003*]. Numerous massifs of these granitoids of granodiorite-granite series and genetically related small leucogranite intrusions are located both within the Onon accretionary wedge terrain of the MOB and the Argun superterrain (Fig. 1). New Rb-Sr and U-Pb geochronological data specify the age of the Undin complex. Based on Sr-Nd isotope systematics, involvement of different crustal protoliths into petrogenesis of collisional granitoids is evaluated.

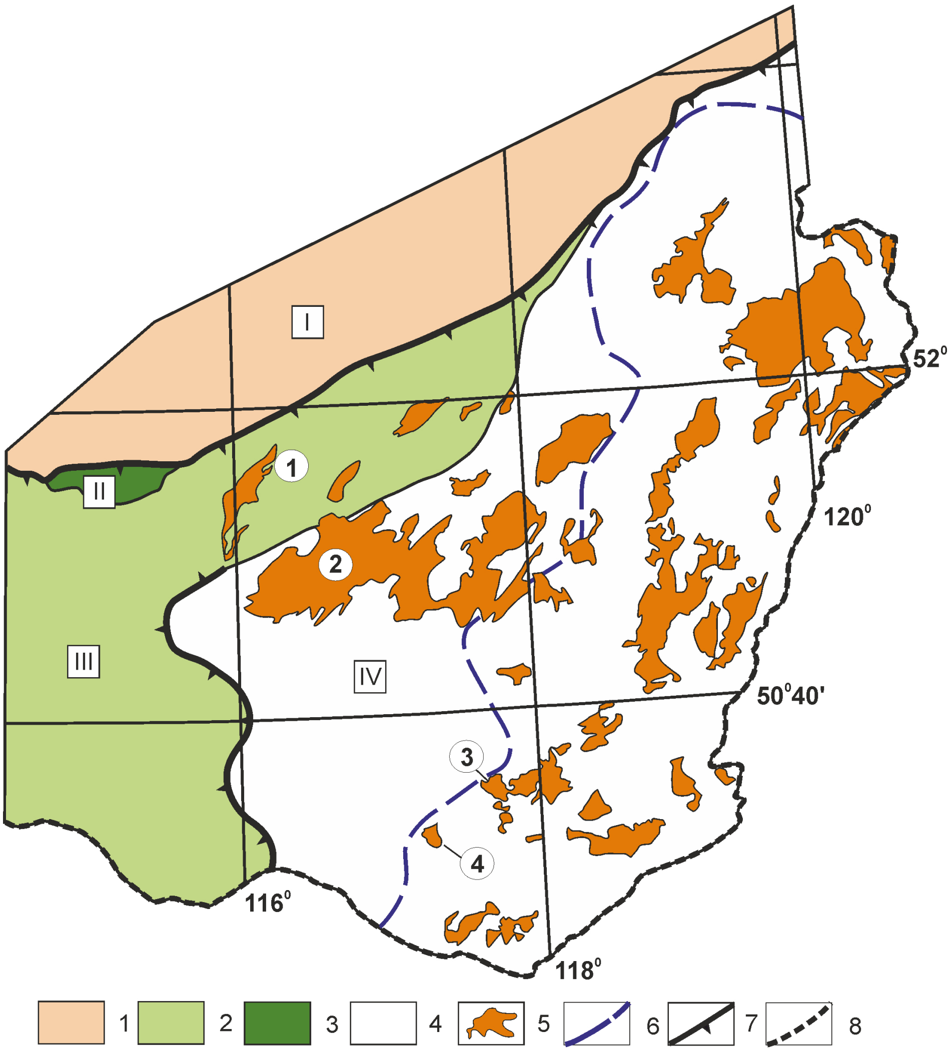

Fig. 1. Geological scheme of the Undin complex location in the Transbaikalian sector of the Mongol-Okhotsk Belt (MOB).

1 (I) – Western Stanovoi metamorphic terrain of MOB; *2* (II) – Kamensk island arc terrain (MOB); *3* (III) – Onon accretionary wedge terrain (MOB); *4* (IV) – Argun terrain of the MOB passive margin; *5* – massifs of the Undin complex; *6* – limit of the Vend-Cambrian carbonate cover of the Argun terrain; *7* – faults bordering Mongol-Okhotsk suture zone; *8* – state border. Numbers in circles denote granitoid massifs: 1 – Ust-Telegnui, 2 – Verkhneundinsk, 3 – Margutseksk, 4 – Krasnokovylin.

Geochronology and Sr-Nd isotope geochemistry. The four studied massifs of the Undin complex are located in different parts of MOB (Fig. 1). The Ust-Telegnui massif (# 1 on Fig. 1) is located within the Onon accretionary wedge terrain. The Verkhneundin massif (# 2 on Fig. 1) is located in marginal part of the Argun superterrain adjacent to the Onon terrain. The Margutseksk and Krasnokovylin massifs of leucocratic granites (# 3 and 4 on Fig. 1) are located within internal part of the Argun superterrain nearby its Vendian-Cambrian carbonate cover. Isotope Rb-Sr (TIMS) dating of the granitoids yielded following results: 1) The Ust-Telegnui massif: 257±3 Ma, I(0)Sr=0.70598±6, MSWD=3.6; 2) The Krasnokovylin massif: 244±35 Ma, I(0)Sr=0.7047±0.0047, MSWD=14; 3) The Margutseksk massif: 248±3 Ma, I(0)Sr=0.70535±0.00022, MSWD=0.64. Zircon from the Verkhneundin massif was dated by U-Pb method. Zircon is represented by idiomorphic elongated grains of hyacinth habit 150–600 μm in size. Crystals are transparent to semi-transparent and light-yellow-colored. CL-images of selected zircons presented in Fig. 2 demonstrate oscillatory and sectorial zoning. U-Pb isotope studies were conducted by LA-ICP-MS with Photon Machines Geolas ArF 193 nm laser ablation system connected to Agilent-7900 mass-spectrometer installed at the Institute of Earth Sciences (IES) in Taipei, Taiwan. 36 zircon grains were analyzed. For most concordant analyses (discordance <5 %) $^{206}Pb/^{238}U$ age is 249±4 Ma (MSWD=0.75) (Fig. 3). Similar age estimate of 254±2 Ma (MSWD=1.2) is calculated for all concordant (within uncertainty) results (n=21). Hf isotope analyzes of these zircons obtained by MS-LA-ICP-MS using Photon Machines Analyte G2 193 nm excimer laser connected to Nu Plasma multi-collector

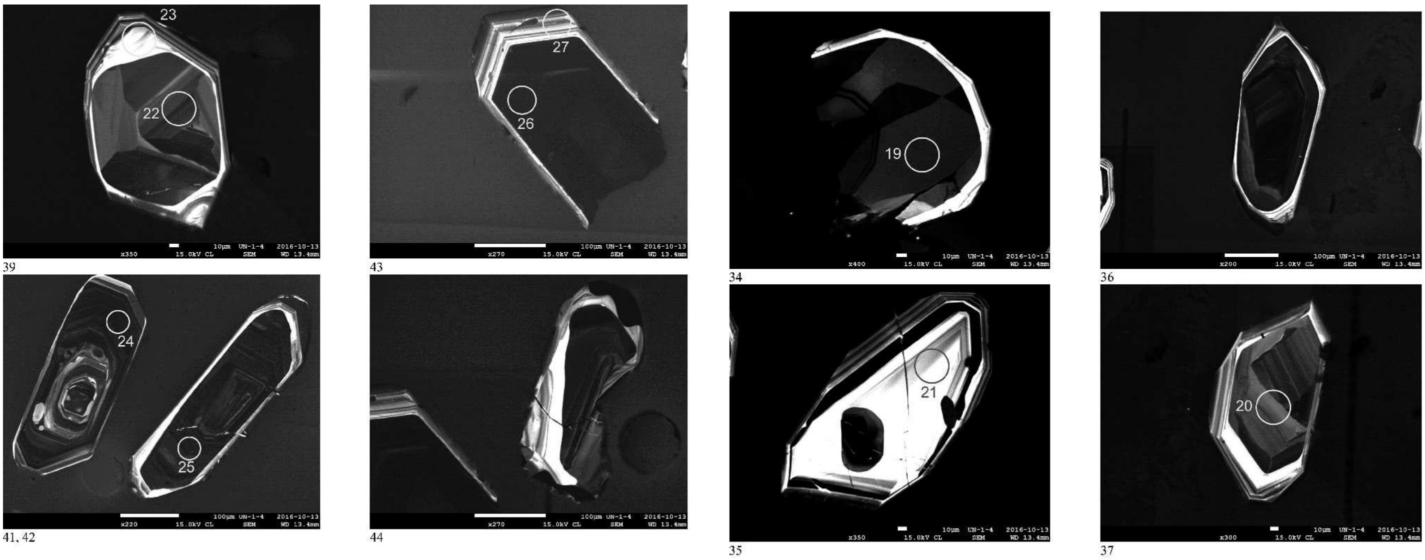

Fig. 2. Selected cathodoluminiscence (CL) zircon images of UN-1-4 granite from Verkhneundin massif.

mass-spectrometer at IES yielded εHf(T)= –2.5 to +3.6 and T_{DM}=1050–1410 Ma.

Therefore, time period of granitoid formation covers Late Permian to Early Triassic. Notable, age of regional metamorphism in the Onon accretionary wedge terrain of MOB was regarded as Permian [*Rutshtein, 1997*]. Probably, granitoid massifs of the Undin complex intruding the Onon terrain formed during retrogressive stage of the regional metamorphism. The origin of the Krasnokovylin and Margutseksk massifs located within internal part of the Argun terrain is less evident. This part of the Argun superterrain is supposed to be stable in Paleozoic and was not affected by the processes which took place in Mongol-Okhotsk suture during Late Paleozoic. The magma generation processes in this stable part probably were influenced by transpression-transtension regime characteristic of transform margin of lithospheric plates [*Khanchuk, 2006*]. In this case the sources of melts formed within metamorphosed accretionary wedge (Onon terrain) and stable block (Argun terrain) should be different.

Granitoids of the massifs located within the Onon acretionary wedge terrain and periphery of the Argun superterrain have moderately negative $\varepsilon Nd_{(257MA)}$= –4.3

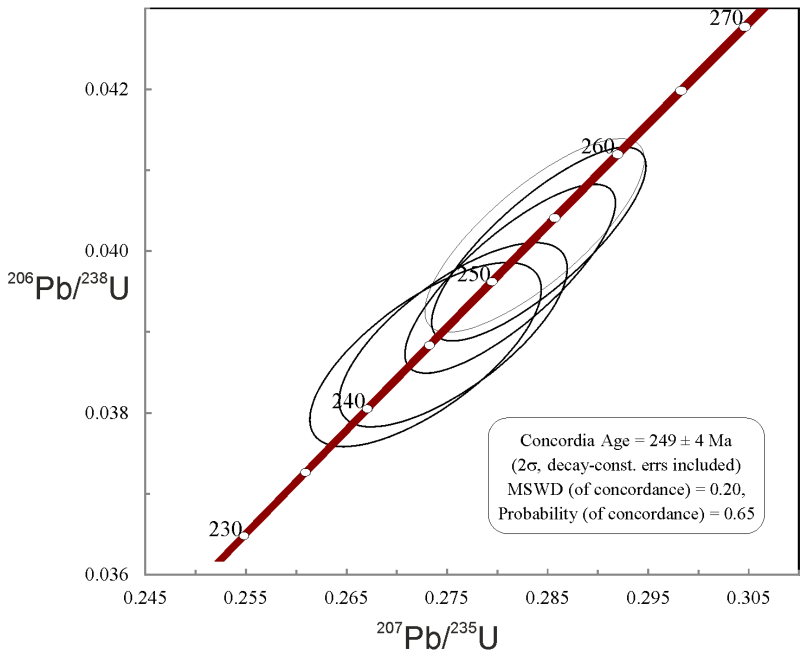

Fig. 3. Concordia diagram for zircons of UN-1-4 granite from the Verkhneundin massif. Concordant age is 249±4 Ma.

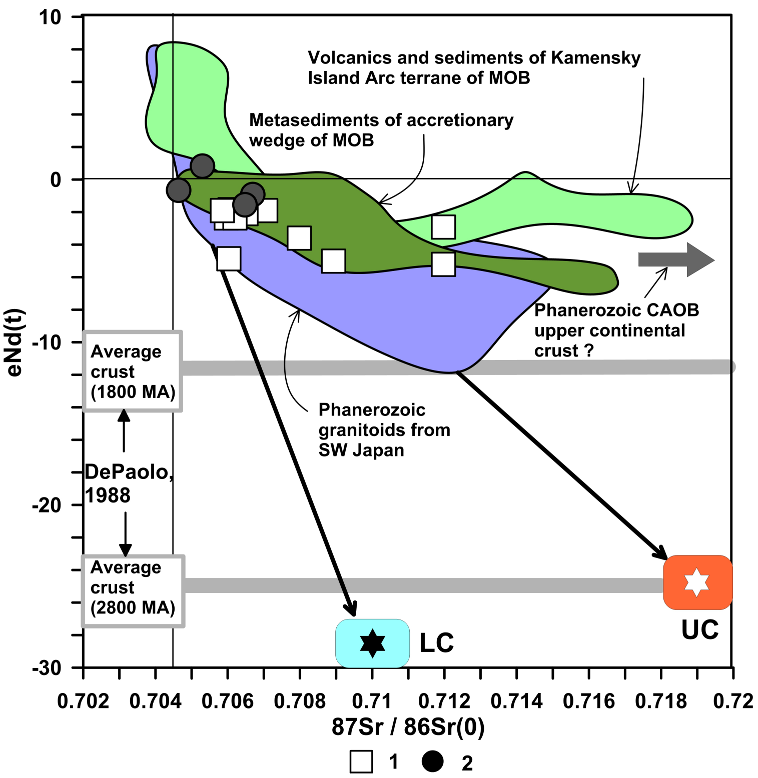

Fig. 4. Sr-Nd isotope diagram for the Undin complex granitoids from the Eastern Transbaikalia. *1* – Ust-Telegnui and Verkhneundinsk granitoid massifs; *2* – Margutseksk and Krasnokovylin granitoid massifs.

(Ust-Telegnui massif) и $\varepsilon Nd_{(254MA)}$ = –5.0 to –1.9 (Verkhneundin massif). These characteristics correspond to those of metaterrigenous rocks of the MOB accretionary wedge with $\varepsilon Nd_{(385–475)}$ = –6.3 to +2.8 which can be considered as a protolith for the granite magmas generation. This conclusion is supported by the model ages of granitoids T_{Nd}(DM-2)=1210-1460 Ma corresponding to those of metasediments of Kulinda and Onon formations with T_{Nd}(DM-2)=1161-1575 Ma. Granitoids of the massifs located within internal part of the Argun terrain have more contrast isotope characteristics. Granites of the Margutseksk and Krasnokovylin massifs have $\varepsilon Nd_{(250MA)}$ = –8.9, T_{Nd}(DM-2)=1775 Ma, and $\varepsilon Nd_{(245MA)}$ = +1.3, T_{Nd}(DM-2)=926 Ma, respectively.

Sr-Nd isotope systematics of the Undin complex granitoids is shown on Fig. 4. The granitoids emplaced into the accretionary wedge form rather extended trend of increasing radiogenic Sr isotope composition at nearly constant moderately negative εNd, corresponding to the trend of metasedimenary rocks of the MOB accretionary wedge, and to the granitoids of SW Japan, originated from subduction-accretionary complexes [*Jahn, 2010*]. This indicates participation of metasedimentary rocks in the granitoid genesis. Compositions of the leucogranites within the Argun terrain have lower Sr isotope ratios at moderately negative or close-to-zero εNd. This can argue for a mafic lower crustal source of these granites.

Conclusion. Collison in the Mongol-Okhotsk Orogen led to formation of the Gobi-Khingan belt of palingenic granitoids along northern margin of the Argun superterrain. In the Eastern Transbaikalia these granitoids, known as the Undin complex, formed in Late Permian to Early Triassic (from new Rb-Sr and U-Pb geochronological data), constraining time of collision in the Mongol-Okhotsk Orogenic Belt. Similar Sm-Nd and Sr-Nd isotope characteristics of the granitoids and Mongol-Okhotsk accretionary wedge metasediments indicate participation of the latter in the sources of granite magmas.

Acknowledgements. The study was supported by the Russian Foundation for Basic Research, Project 15-05-05079.

References

Jahn B.-M., 2010. Accretionary orogen and evolution of the Japanese Islands – implications from a Sr-Nd isotopic study of the Phanerozoic granitoids from SW Japan. *American Journal of Science* 310 (10), 1210–1249. https://doi.org/10.2475/10.2010.02.

Khanhuk A.I. (Ed.), 2006. Geodynamics, Magmatism and Metallogeny of the Russian East. In 2 books. Dalnauka, Vladivostok, Book 1, 572 p. (in Russian).

Kozlov V.D., Efremov S.V., Dril S.I., Sandimirova G.P., 2003. Geochemistry, isotopic geochronology, and genesis of the Verkhnyaya Unda granitoid batolith. *Geochemistry International* 41 (4), 364–378.

Parfenov L.M. (compiler), *Khanchuk A.I., Badarch G., Miller R.I., Naumova V.V., Nokleberg W.J., Ogasawara M., Prokopiev A.V., Yan H.*, 2013. Geodynamics map of northeast Asia. Scientific Investigations Map 3024. USGS Numbered Series. Scale: 5000000. 2 Sheets. https://doi.org/10.3133/sim3024.

Parfenov L.M., Berzin N.A., Khanchuk A.I., Badarch G., Belichenko V.G., Bulgatov A.N., Dril S.I., Kirillova G.L., Kuzmin M.I., Nokleberg W.J., Prokopyev A.V., Timofeev V.F., Tomurtogoo O., Yang H., 2003. A model for the formation of orogenic belts in Central and Northeast Asia. *Tikhookeanskaya Geologiya* 22 (6), 7–41 (in Russian).

Parfenov L.M., Popeko L.I., Tomurtogoo O., 1999. Problems of tectonics of the Mongol-Okhotsk folded belt. *Tikhookeanskaya Geologiya* 18 (5), 24–43 (in Russian).

Rutshtein I.G., 1997. The Agin–Borshchov diaphthorite–schist belt, Eastern Transbaikal region. *Transactions* (*Doklady*) *of the Russian Academy of Sciences* / *Earth Science Sections* 353 (2), 220–222.

Şengör A.M.C., Natal'in B.A., Burtman V.S., 1993. Evolution of the Altaid tectonic collage and Paleozoic crustal growth in Eurasia. *Nature* 364 (6435), 299–307. https://doi.org/10.1038/364299a0.

Willem C., Windley B.F., Stampfly G.M., 2012 The Altaids of Central Asia: A tectonic and evolutionary innovative review. *Earth-Science Reviews* 113 (3–4), 303–341. https://doi.org/10.1016/j.earscirev.2012.04.001.

Zorin Yu.A., 1999. Geodynamics of the western part of the Mongolia–Okhotsk collisional belt, Trans-Baikal region (Russia) and Mongolia. *Tectonophysics* 306 (1), 33–56. https://doi.org/10.1016/S0040-1951(99)00042-6.