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Mesozoic granitoids in the structure of the Bezymyannyi metamorphic-core complex (*western Transbaikalia*)

T.V. Donskaya [a,*], D.P. Gladkochub [a], A.M. Mazukabzov [a], T. Wang [b,c], L. Guo [b], N.V. Rodionov [d], E.I. Demonterova [a]

[a] *Institute of the Earth's Crust, Siberian Branch of the Russian Academy of Sciences, ul. Lermontova 128, Irkutsk, 664033, Russia*
[b] *Institute of Geology, Chinese Academy of Geological Sciences, Baiwanzhuang Road 26, Beijing, 100037, China*
[c] *Beijing SHRIMP Center, Chinese Academy of Geological Sciences, Beijing, 100037, China*
[d] *A.P. Karpinsky Russian Geological Research Institute, Srednii pr. 74, St. Petersburg, 199106, Russia*

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Abstract

We performed geological, geochronological, and isotope-geochemical studies of two tectonized-granite bodies intruding the rocks of the lower plate of the Bezymyannyi metamorphic-core complex (MCC) (western Transbaikalia). The U–Pb zircon age of sheared granites sampled on the periphery of the Bezymyannyi MCC near the detachment zone is 202 ± 2 Ma (LA–ICP-MS). The U–Pb dating (SHRIMP-II) of zircon grains from gneissic granite intruding the rocks of the lower plate in the central zone of the Bezymyannyi MCC has yielded an age of 165 ± 2 Ma. The sheared granites dated at 202 Ma (Late Triassic) have low contents of Nb and Ta and high contents of Sr and Ba, probably inherited from magmatic subduction-related sources. These granites are characterized by $\varepsilon_{Nd}(T) = -3.7$, which, along with the high contents of K_2O and medium contents of Th, testifies to the presence of continental-crust material in their source. Thus, they formed, most likely, from a mixed mantle–crust source. The studied granites, like other Triassic igneous rocks in Transbaikalia, might have originated in the suprasubduction setting during the evolution of the active continental margin of the Siberian continent. The gneissic granites dated at 165 Ma (Middle Jurassic) have high contents of K_2O, Rb, and Th, are depleted in Nb, and are characterized by $\varepsilon_{Nd}(T) = 0$ and a negative Eu anomaly on the REE patterns. They formed, most likely, from an intermediate–felsic crustal source. These Middle Jurassic granites, like other small Jurassic granitoid massifs spatially associated with MCCs in western Transbaikalia, intruded in the western part of the Mongol–Okhotsk Ocean after its closure, during the change of the subduction regime for the collisional one. The studied Late Triassic granites of the Bezymyannyi MCC cannot be associated with MCCs in Transbaikalia because their intrusion was related to the subduction of the oceanic plate of the Mongol–Okhotsk Ocean beneath the Siberian continent. The Middle Jurassic granites of the Bezymyannyi MCC, together with other small Jurassic granitoid massifs, can be classified as prekinematic intrusions formed earlier than MCCs in western Transbaikalia. However, it is unlikely that their intrusion caused a large-scale crustal extension in Transbaikalia.

Keywords: granites; U–Pb zircon age; metamorphic-core complexes; Mesozoic; western Transbaikalia

Introduction

Early Cretaceous metamorphic-core complexes (MCCs) are widespread in East Asia. They mark global intracontinental extensions in the Asian region (Wang et al., 2011, 2012). There is a common viewpoint that the formation of an MCC is directly related to magmatic activity, including intrusion of small granitoid bodies (Anderson et al., 1988; Hill et al., 1995; Lister and Baldwin, 1993). In the comprehensively studied Early Cretaceous MCCs in Mongolia and China, intrusion of granitoids took place in the period 170–110 Ma. The intrusions mark different stages of the MCC formation (Daoudene et al., 2009, 2013; Wang et al., 2012) and are subdivided into prekinematic (170–140 Ma), synkinematic (150–125 Ma), and postkinematic (125–110 Ma) (Wang et al., 2012). The age of the granitoid intrusions confined to MCCs in western Transbaikalia does not provide a holistic view of the Late Mesozoic granitoid magmatism responsible for the MCC formation (Donskaya et al., 2008; Ripp et al., 2013; Sklyarov et al., 1997; Wang et al., 2012). Note that the $^{40}Ar/^{39}Ar$ amphibole and mica ages of these intrusions overlap with the ages of MCC intrusions spread throughout the East Asian area, including Transbaikalia (140–105 Ma) (review in Wang et al.

* Corresponding author.
E-mail address: tanlen@crust.irk.ru (T.V. Donskaya)

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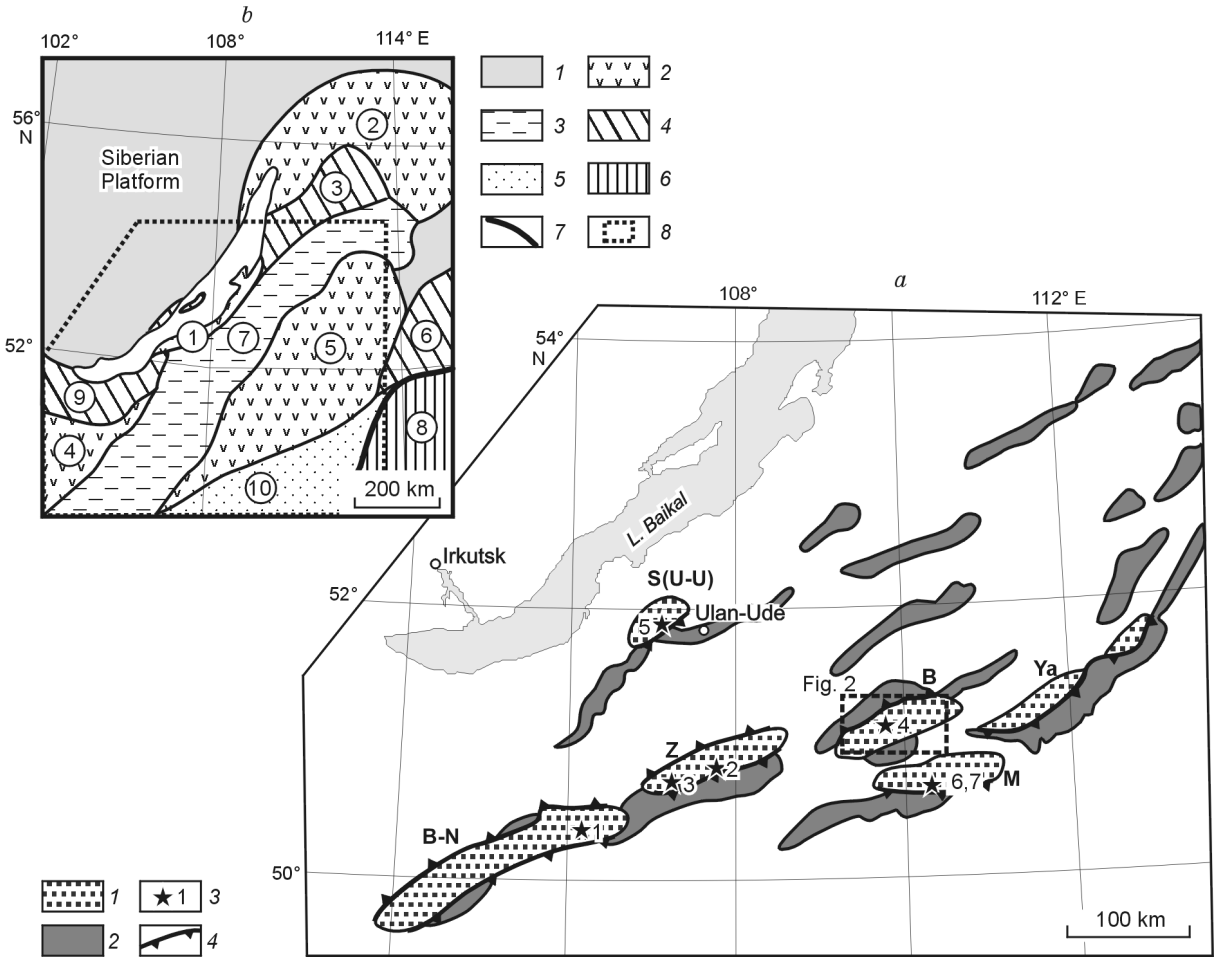

Fig. 1. Schematic map of metamorphic-core complexes in western Transbaikalia (*a*), modified after Donskaya et al. (2008), Mazukabzov et al. (2011), and Sklyarov et al. (1997), and schematic map of terranes at the northern segment of the Central Asian Orogenic Belt (*b*), modified after Belichenko et al. (2006), Gladkochub et al. (2013), and Volkova and Sklyarov (2007). *a*: *1*, MCCs; *2*, Early Cretaceous depressions; *3*, Jurassic and Cretaceous granitoids (the numbers follow the numbers of massifs in Table 5); *4*, detachment zones. MCCs: B, Bezymyannyi, B-N, Butuliyn-Nur, Z, Zagan, M, Malkhan, S(U-U), Selenga (Ulan-Ude), Ya, Yablonovyi. *b*: *1*, Siberian Platform; *2–6*, terranes of the Central Asian Orogenic Belt: *2,* island-arc terranes, *3,* backarc-basin terranes, *4,* metamorphic terranes, *5,* turbidite basin terranes, *6,* accretionary-wedge terranes; *7*, Mongol–Okhotsk suture zone; *8*, contours of Fig. 1*a*. Encircled numerals mark terranes: 1, Anga–Talanchan; 2, Baikal–Muya; 3, Barguzin; 4, Dzhida; 5, Eravna; 6, West Stanovoi; 7, Ikat; 8, Onon; 9, Khamar-Daban–Ol'khon; 10, Hentiyn.

(2012)). To solve the above age problem, we attempted to investigate granite intrusions within the Bezymyannyi MCC in western Transbaikalia, which might have formed synchronously with it.

In this paper we present new data on the age of granites of the Bezymyannyi MCC, make their petrogeochemical description, and draw conclusions about their relationship with the MCC formation. We also analyze earlier published and new data on the Late Mesozoic granitoids associated with MCCs in western Transbaikalia.

Geologic location of the Bezymyannyi MCC

The Bezymyannyi MCC is confined to the southwestern flank of the Yablonovyi Ridge (Ungo River basin). It is located northeast of the Zagan MCC (Fig. 1*a*). According to different tectonic structural schemes of the northern segment of the Central Asian Orogenic Belt, the Bezymyannyi MCC is structurally superposed either on the rocks of the Early Paleozoic Eravna island-arc terrane (Fig. 1*b*) (Belichenko et al., 2006; Mazukabzov et al., 2010; Volkova and Sklyarov, 2007) or on the rocks of the Paleozoic Yablonovyi–Malkhan terrane of the back-arc basin (Gordienko et al., 2010). This complex, like other MCCs in East Asia, formed in the Early Cretaceous (Donskaya et al., 2013; Sklyarov et al., 1997; Wang et al., 2011) and consists of lower and upper plates and a detachment zone. The lower plate is formed by differently tectonized granitoids with both small bodies and large outcrops of metamorphic rocks (gneisses and amphibolites) (Fig. 2). The lower-plate rocks have not been dated until recently. According to the known geological maps, the granitoids are of Precambrian (Yanshin, 1983), Early Paleozoic (Rutshtein, 1992), or Carboniferous (Sizykh, 1966) age, and the metamorphic rocks are of Precambrian age. The upper plate is composed of igneous, volcanosedimentary, and sedimentary rocks of different ages (from Neoproterozoic(?) to Late Mesozoic) (Fig. 2). The majority of rocks of the plate, except