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Provenances of the Paleozoic Terrigenous Sequences of the Oldoi Terrane of the Central Asian Orogenic Belt: Sm–Nd Isotope Geochemistry and U–Pb Geochronology (LA–ICP–MS)

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Abstract—The results of Sm–Nd isotope geochemical investigations of the Paleozoic terrigenous sequences of the Oldoi terrane and U–Pb dating of detrital zircons by the LA–ICP–MS technique showed that the clastic material was mainly derived from Late Precambrian granitoids and Early to Middle Paleozoic granitoids and volcanics, which were formed owing to the reworking of the Late Precambrian continental crust. During the Silurian, the main source of terrigenous material in the sedimentation basin was the erosion of Late Precambrian and Early Paleozoic granitoids. In the Devonian, provenances became more diverse, and the sedimentation basin was additionally supplied by the decomposition products of Middle Paleozoic granitoids and silicic volcanics. The age ranges obtained for detrital zircons from the sandstones of the Middle–Late Devonian Oldoi Formation and the Early Carboniferous Tipara Formation are almost identical to the stratigraphic ages of the formations, which indicates that terrigenous sedimentation in the Oldoi terrane had been accompanied, at least since the Middle Devonian, by vigorous magmatic activity and occurred in an environment of a mature island arc or an active continental margin.

Keywords: Central Asian orogenic belt, Oldoi terrane, terrigenous sediments, detrital zircons, Sm–Nd, LA–ICP–MS

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INTRODUCTION

The Central Asian orogenic belt is one of the most important and structurally most complex tectonic units of Eurasia (Mossakovsky et al., 1993; Didenko et al., 1994; Parfenov et al., 2003; Khanchuk, 2006; Li et al., 2003; etc.) located between the North Asian craton in the north and the Sino–Korean craton and Tarim block in the south (Fig. 1). Although the history of the belt has long attracted the attention of researchers, the existing geodynamic models are still controversial. One of the most poorly understood aspects of this complex and diverse problem concerns the composition of sedimentary complexes. In the modern structural pattern, these complexes are fragments of large basins, and their geochemical features are sensitive indicators of the geodynamic settings of sedimentation.

The experience of the investigation of sedimentary complexes of mobile belts (Maslov et al., 2003, 2006, 2008, 2013; Han et al., 2011; Long et al., 2010, 2012; etc.) shows that the most convenient objects for the reconstruction of geodynamic settings of their formation are large terrigenous sequences, which provide insight into the main stages of the history of sedimentary basins and, consequently, the evolution of geodynamic settings during long sedimentation periods. One of such objects in the eastern part of the Central Asian orogenic belt is the Oldoi terrane (Fig. 1) in the northeastern part of the Argun (Argun–Idermeg) superterrane directly adjoining the Mongolia–Okhotsk orogenic belt in the south. It is composed of dislocated Paleozoic terrigenous and terrigenous–carbonate sequences and is usually considered as a fragment of a

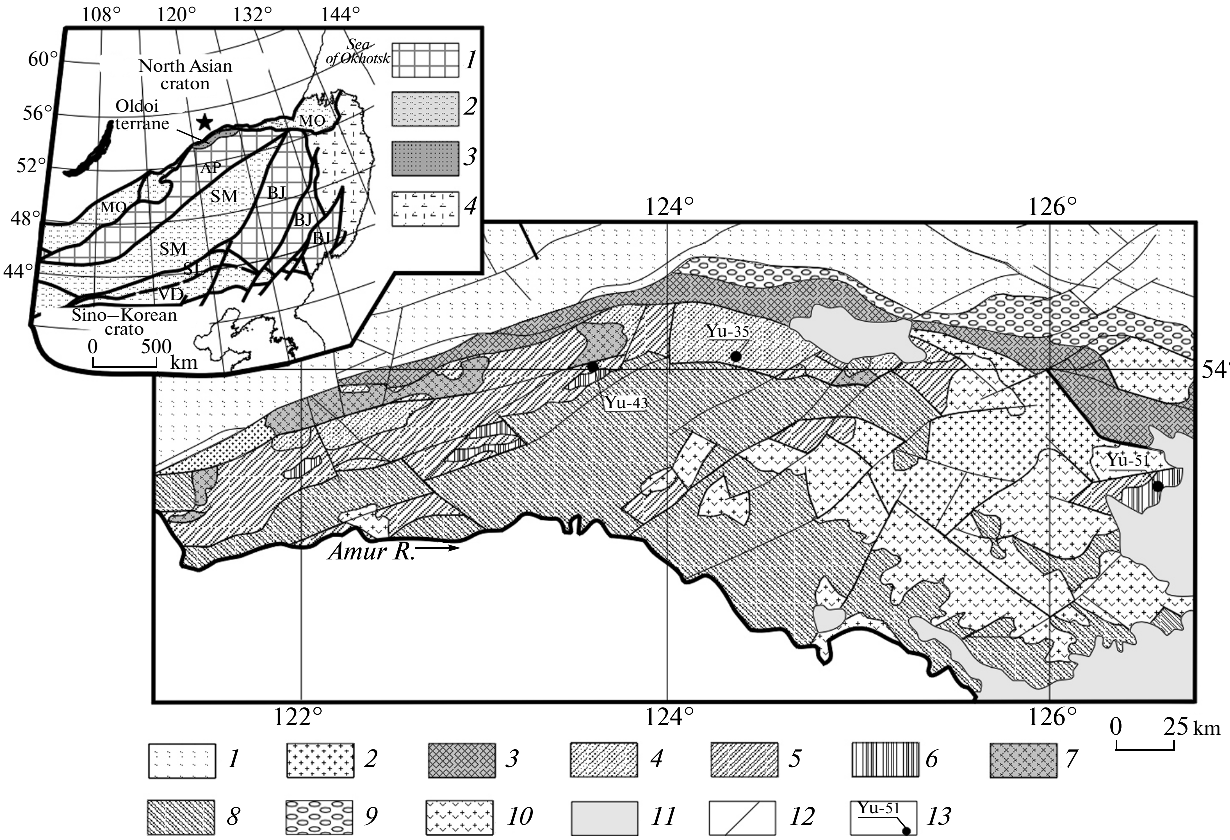

Fig. 1. Geological sketch map of the Upper Amur region, simplified after *Geological Map*... (1999).
(*1*) Southern margin of the North Asian craton; (*2*) supposedly Precambrian magmatic and metamorphic complexes of the Argun terrane; (*3*) Paleozoic oceanic complexes of the Mongolia–Okhotsk orogenic belt; (*4–6*) terrigenous–carbonate sediments of the Oldoi terrane: (*4*) Silurian, (*5*) Devonian, and (*6*) Early Carboniferous; (*7*) Late Paleozoic intrusive complexes; (*8*) Mesozoic flyschoid sequences of the Upper Amur basin; (*9*) Middle–Late Jurassic sediments, mostly coarse clastic; (*10*) Early Cretaceous intrusive and volcanic complexes; (*11*) unconsolidated Cenozoic sediments; (*12*) fault; and (*13*) sampling site for U–Pb geochronology and sample number. The inset shows the position of the Oldoi terrane in the structure of the eastern part of the Central Asian orogenic belt (tectonic background is after Parfenov et al., 2003): (*1*) continental massifs: AR, Argun (Argun–Idermeg) and BJ, Bureya–Jiamusi; (*2*) Paleozoic–Early Mesozoic orogenic belts: MO, Mongolia–Okhotsk, SM, Southern Mongolia; SL, Solonker; and VD, Vundurmiao; (*3*) Oldoi terrane; and (*4*) Late Jurassic–Early Cretaceous orogenic belts.

passive continental margin (e.g., Parfenov et al., 2003; Khanchuk, 2006). However, our recent geochemical data (Sorokin et al., 2010b, 2012; Smirnova et al., 2013) are at odds with this interpretation and indicate that the sediment were accumulated in a passive continental margin during the early stages of formation of the Oldoi terrane and in an island arc or active continental margin setting during the late stages. In this paper, we report the results of Sm–Nd isotope geochemical and U–Pb geochronological (LA–ICP–MS) investigations of the terrigenous sequences of the Oldoi terrane, which allowed us to identify the source rocks and, to a first approximation, regions from which the sediments were derived and, thus, refine the existing models of the geodynamic settings of their formation.

GEOLOGIC STRUCTURE OF THE OLDOI TERRANE

The Oldoi terrane is a narrow (30 to 60 km wide) arcuate block extending approximately E–W over more than 500 km (Fig. 1) from the lower reaches of the Amazar River in the west to the Zeya River in the east. The geology of the terrane has been extensively discussed in the literature (Parfenov et al., 2003; Khanchuk, 2006; Nagibina, 1963, 1969; Popeko et al., 1993; etc.). The following sequence of sedimentary complexes was distinguished in its geologic structure (Khanchuk, 2006; *Decisions of...,* 1994; Kozak and Vakhtomin, 2000a, 2000b; Kozak et al., 2002a, 2002b): (1) Silurian quartz sandstones and quartzites with interbeds of shales and siltstones and basal gravelstones and conglomerates (Omutnaya Formation, 1300–2500 m);

(2) Early Devonian sandstones, siltstones, and limestones (Bolshoy Never Formation, 950–1300 m); (3) Early–Middle Devonian calcareous siltstones, limestones, and calcareous sandstones (Imachi Formation, 750–950 m); (4) Middle–Late Devonian and Late Devonian sandstones, siltstones, and occasional limestones (Oldoi and Teplovka formations, more than 1700 m); and (5) Early Carboniferous sandstones and siltstones with interbeds of limestones and basal conglomerates (Tipara Formation, 800–900 m). It is noteworthy that already Nagibina (1969) described layers of ash tuffs and tuffites of silicic composition in the Devonian and Carboniferous terrigenous sequences of the Oldoi terrane.

The Paleozoic sequences of the Oldoi terrane are deformed into a system of large linear upright open folds trending NE and NW (Kozak and Vakhtomin, 2000a, 2000b; Kozak et al., 2002a, 2002b) and host tectonic blocks composed of Cambrian, Ordovician, and Early to Middle Devonian granitoids (Sorokin et al., 2002, 2004, 2009; Sorokin and Kudryashov, 2004). The whole ensemble of the Silurian, Devonian, and Early Carboniferous sequences of the Oldoi terrane is cut by numerous gabbro–diorite–granodiorite–granite intrusions of the Urusha complex (*Geological Map…,* 1999; Kozak and Vakhtomin, 2000a, 2000b; Kozak et al., 2002a, 2002b; Martynyuk et al., 1990) with ages of 278–274 Ma (Sorokin et al., 2005; Sorokin and Kudryashov, 2004).

ANALYTICAL METHODS

Sm–Nd isotope geochemical data were obtained at the Institute of Precambrian Geology and Geochronology, Russian Academy of Sciences (St. Petersburg) using methods described by Kotov et al. (1995). The isotopic compositions of Sm and Nd were measured on a multicollector TRITON TI mass spectrometer in a static mode. The measured $^{143}Nd/^{144}Nd$ ratios were normalized to $^{146}Nd/^{144}Nd = 0.7219$ and adjusted to $^{143}Nd/^{144}Nd = 0.511860$ in the La Jolla Nd standard. The weighted mean $^{143}Nd/^{144}Nd$ value of the La Jolla Nd standard was 0.511844 ± 10 ($n = 12$) during our measurements. The precision of measurements (2σ) was ±0.5% for Sm and Nd contents, ±0.5% for $^{147}Sm/^{144}Nd$, and ±0.005% for $^{143}Nd/^{144}Nd$. The blanks were no higher than 0.05–0.2 ng Sm and 0.1–0.5 ng Nd. The calculation of $\varepsilon_{Nd}(t)$ and model ages $t_{Nd(DM)}$ was based on recent estimates for CHUR (Jakobsen and Wasserburg, 1984): $^{143}Nd/^{144}Nd = 0.512638$ and $^{147}Sm/^{144}Nd = 0.1967$ and DM (Goldstein and Jacobsen, 1988): $^{143}Nd/^{144}Nd = 0.513151$ and $^{147}Sm/^{144}Nd = 0.21365$.

The U–Pb geochronology of detrital zircons (approximately 100 grains from every sample) was studied at Apatite to Zircon Inc. (Idaho, United States) using an ELEMENT 2 ICP mass spectrometer equipped with a New Wave YAG 213 nm laser ablation (LA) system; the internal structure of zircon crystals was preliminarily examined by the cathode luminescence technique. The ablation pit diameter was no larger than 20 μm. Calibration was performed against the FC, F5, TR, R3, T2, and MD standards. The precision of U and Pb contents was ± 0.5%. Experimental data were processed using the ISOPLOT program (Ludwig, 1999). Recommendations of Gehrels (2011) and Whitehouse et al. (1999) were followed during interpretation. In particular, we used only those age estimates whose discordance was no higher than 10%. Age was estimated from the $^{207}Pb/^{206}Pb$ ratio for zircons older than 1.0 Ga and from the $^{206}Pb/^{238}U$ ratio for younger zircons.

RESULTS OF Sm–Nd ISOTOPE GEOCHEMISTRY

The Sm–Nd isotope systematics were studied in the geochemically most typical sandstone samples (Smirnova et al., 2013) from the Omutnaya (S), Bolshoy Never (D_1), Imachi (D_{1-2}), Oldoi (D_{2-3}), and Tipara (C_1) formations. The results are shown in Table 1.

The oldest Nd model ages, $t_{Nd(DM)} = 1.5$–1.4 Ga and $\varepsilon_{Nd}(t)$ from –4.4 to –3.5, were obtained for the quartz sandstones of the Omutnaya Formation (S). The $t_{Nd(DM)}$ values of the quartz–feldspar sandstones of the Bolshoy Never (D_1) and Imachi (D_{1-2}) formations fall within 1.3–1.1 Ga ($\varepsilon_{Nd}(t)$ from –1.9 to –0.4 and 1.4–1.3 Ga ($\varepsilon_{Nd}(t)$ from –2.7 to –2.5), respectively. The quartz–feldspar sandstones of the Oldoi Formation (D_{2-3}) have Nd model ages of 1.1–1.0 Ga and positive $\varepsilon_{Nd}(t)$ values from +0.6 to +1.7. Finally, the $t_{Nd(DM)}$ values of the quartz–feldspar sandstones of the Tipara Formation (C_1), which crowns the section of the Paleozoic terrigenous sequences of the Oldoi terrane, are approximately 1.2 Ga ($\varepsilon_{Nd}(t)$ from –1.4 to –0.8).

RESULTS OF U–Pb GEOCHRONOLOGY

Detrital zircons for U–Pb geochronological investigations (LA–ICP–MS) were collected from the sandstones of the Omutnaya (S), Oldoi (D_{2-3}), and Tipara (C_1) formations, corresponding to the lower, middle, and upper parts of the generalized section of Paleozoic sediments of the Oldoi terrane, respectively. The results are shown in Figs. 2–5.

Among the detrital zircons (105 grains) from the quartz sandstone of the Silurian Omutnaya Formation (sample Yu-35), 56 grains gave concordant ages (Figs. 2, 3). Among them, 90% yielded Early Paleozoic (438–545 Ma, 59%) and Late Precambrian (1.6–0.8 Ga, 30%) ages. A smaller number (11%) of zircon grains showed Early Precambrian ages of 2.7–1.8 Ga. Most of the age estimates of Late Precambrian zircons fall within 950–780 Ma (Figs. 2, 3) clustering mainly around 935 Ma (Fig. 3).

Among 102 detrital zircons analyzed in the quartz–feldspar sandstone of the Middle–Late Devonian Oldoi Formation (sample Yu-43), concordant ages were obtained only for 23 grains. Most of them gave Middle Paleozoic (398–373 Ma, 12 grains) and Early Paleozoic (507–407 Ma, four grains) ages (Figs. 2, 4). Approximately 30% of the zircon grains are Late Precambrian (0.9–0.8 Ga) and Early Precambrian (2.7–1.9 Ga) in age (Figs. 2, 4).

Twenty five concordant ages were obtained for detrital zircons (100 grains) from the quartz–feldspar sandstone (sample Yu-51) of the Early Carboniferous Tipara Formation (Fig. 5). Approximately half of them (52%) correspond to the Middle (385–343 Ma, seven grains) and Early (514–457 Ma, six grains) Paleozoic, and the ages of the other grains are Late (1.5–0.6 Ga, 28%) and Early (2.4–1.9 Ga, 20%) Precambrian. It should be pointed out that part of the Late Precambrian zircons have ages within 970–640 Ma (Figs. 2, 5).

DISCUSSION

The results of the Sm–Nd isotope geochemical study reported in this paper show that the Paleozoic terrigenous rocks of the Oldoi terrane are characterized by $t_{Nd(DM)}$ = 1.0–1.5 Ga (table). This suggests that their main sources were the rocks of the Precambrian continental crust and (or) pre-Late Carboniferous igneous rocks whose initial melts were formed owing to the reworking of the Precambrian continental crust, probably with a minor fraction of a younger juvenile component, which is indicated by the positive $\varepsilon_{Nd}(t)$ values of the quartz–feldspar sandstones of the Middle–Late Devonian Oldoi Formation.

In the $\varepsilon_{Nd}(t)$–age diagram (Fig. 6), the fields of Nd isotopic evolution of Paleozoic sandstones from different formations of the terrigenous sedimentary section of the Oldoi terrane are almost nonoverlapping. There is a weak tendency of an increase in $\varepsilon_{Nd}(t)$ with decreasing stratigraphic age, from the Silurian to the Early Carboniferous. The only exception is the quartz–feldspar sandstones of the Middle–Late Devonian Oldoi Formation, which have, as noted above, positive $\varepsilon_{Nd}(t)$ values. This is probably related to the fact that the terrige-

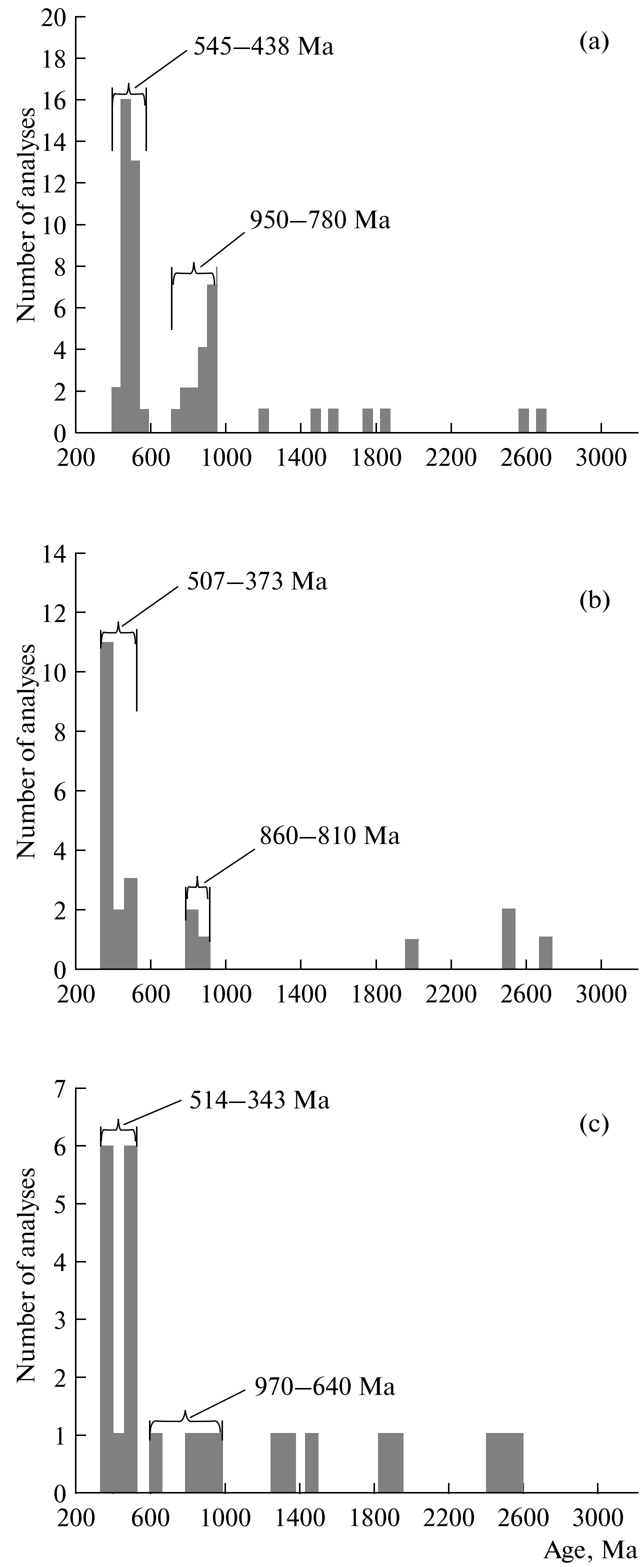

Fig. 2. Histograms of age estimates for detrital zircons from the terrigenous sediments of the Oldoi terrane: (a) Silurian Omutnaya Formation (sample Yu-35), (b) Middle–Late Devonian Oldoi Formation (sample Yu-43), and (c) Early Carboniferous Tipara Formation (sample Yu-51).

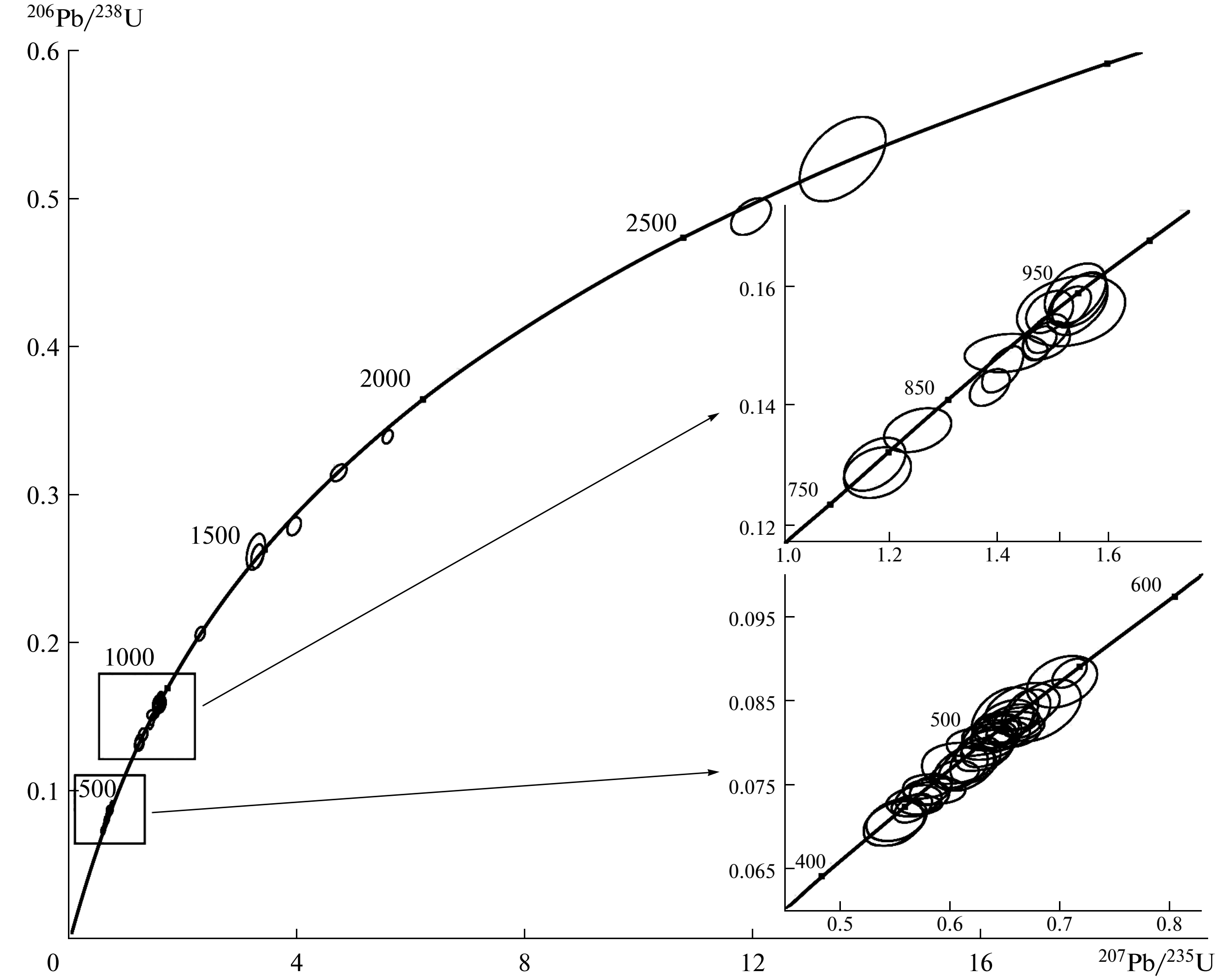

Fig. 3. Concordia diagram for detrital zircons from the quartz sandstone of the Silurian Omutnaya Formation (sample Yu-35).

nous sequences of the Oldoi terrane were formed at the expense of different contrasting sources of sedimentary material, the relative contributions of which changed during the evolution of the sedimentary basin. In addition, it is possible that new sources of terrigenous material appeared in the provenances during sedimentation, which could also result in both gradual and abrupt changes in $t_{Nd(DM)}$ and $\varepsilon_{Nd}(t)$.

According to the U–Pb geochronological results, detrital zircons of Paleozoic and Late Precambrian age are most abundant in the terrigenous rocks of the Oldoi terrane. Paleozoic detrital zircons show ages within the ranges 545–407 and 398–343 Ma and can therefore be assigned to two age groups, Early Paleozoic and Middle Paleozoic. The main feature of the distribution of detrital zircons of different age in the section of terrigenous sediments of the Oldoi terrane is that Early Paleozoic detrital zircons occur in all the sandstone samples independent of their stratigraphic position, whereas Middle Paleozoic detrital zircons were found only in the Devonian quartz–feldspar sandstone of the Oldoi Formation and the Early Carboniferous quartz–feldspar sandstone of the Tipara Formation.

Taking into account previous geochronological data (Sorokin et al., 2002, 2004, 2009; Sorokin and Kudryashov, 2004), it can be suggested that one of the sources of the Early Paleozoic detrital zircons was the Cambrian (between 510 ± 2 and 495 ± 2 Ma) and Ordovician (472 ± 2 Ma) granitoids that occur as tectonic blocks among the Early Paleozoic terrigenous sequences of the Oldoi terrane. The Nd model age of these granitoids is 1.6–1.4 Ga, and $\varepsilon_{Nd}(t)$ is from –5.2 to –2.4; these estimates are in good agreement with the Nd isotopic characteristics of the quartz sandstones of the Silurian Omutnaya Formation, which are free of Middle Paleozoic detrital zircons, $t_{Nd(DM)}$ = 1.5–1.4 Ga and $\varepsilon_{Nd}(t)$ from –4.4 to –3.5. Another possible source of the Early Paleozoic detrital zircons is the numerous massifs of Cambrian and Ordovician granitoids which were

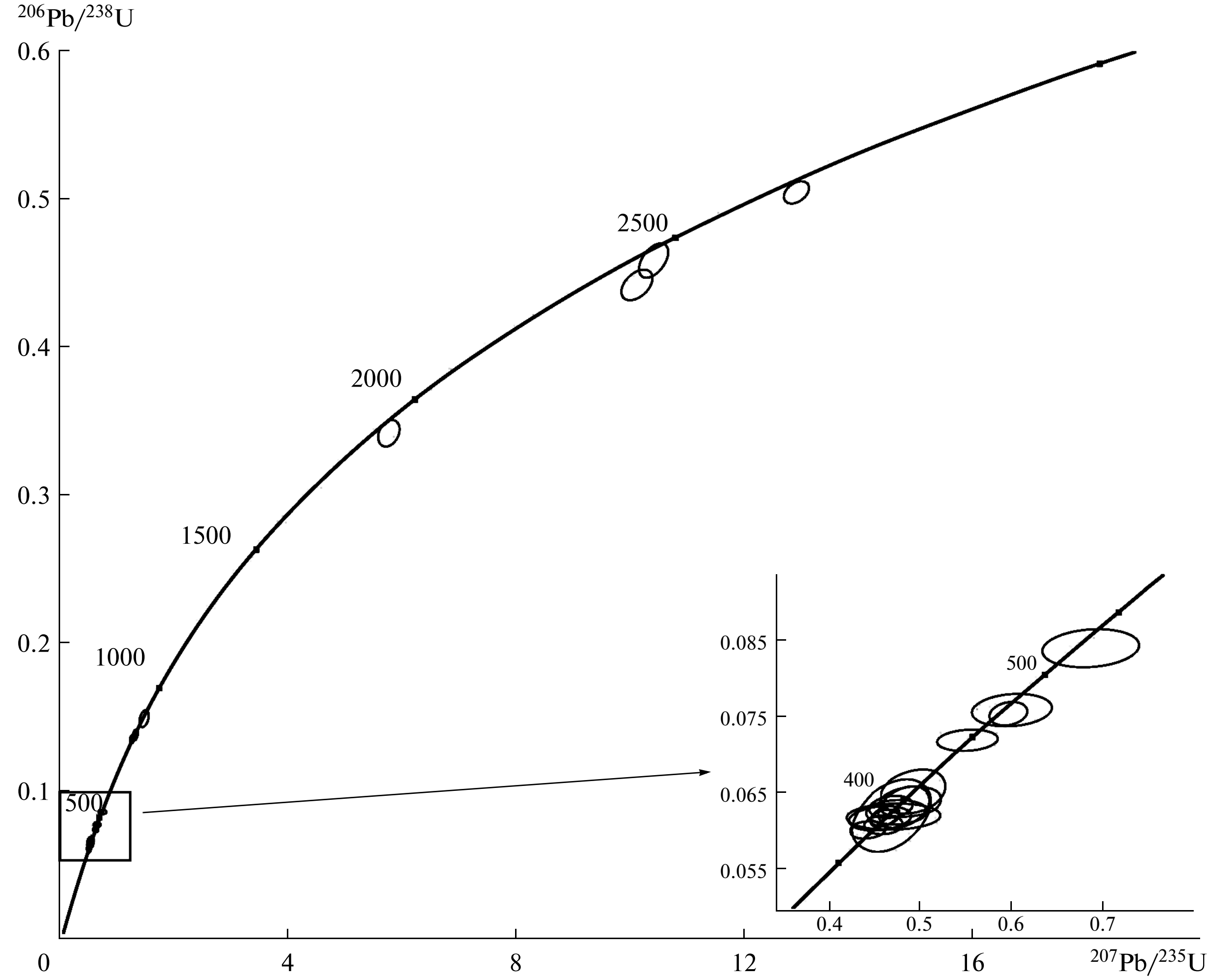

Fig. 4. Concordia diagram for detrital zircons from the quartz–feldspar sandstone of the Middle–Late Devonian Oldoi Formation (sample Yu-43).

recently described in the eastern part of the Argun superterrane (Wu et al., 2011).

The dominance of detrital zircons of Ordovician and Cambrian ages (545–438 Ma) in the Silurian quartz sandstones of the Omutnaya Formation indicates that these terrigenous sediments were derived mainly by the erosion of Early Paleozoic granitoids. Geochemical data (Sorokin et al., 2010b; Smirnova et al., 2013) indicate that sedimentation occurred in a passive continental margin environment.

The appearance of detrital zircons of Middle Paleozoic age in the quartz–feldspar sandstones of the Middle–Late Devonian Oldoi Formation and the Early Carboniferous Tipara Formation and a significant increase in $\varepsilon_{Nd}(t)$ between the sandstones of the Imachi Formation and the sandstones of the Oldoi Formation indicate that terrigenous material from new (additional) sources began to be supplied into the basin in the Devonian. Such sources could be the Middle Paleozoic granitoids (from 386 ± 10 to 371 ± 5 Ma) occurring as tectonic blocks among the Early Paleozoic terrigenous sequences of the Oldoi terrane (Sorokin et al., 2002; Sorokin and Kudryashov, 2004), as well as the ash tuffs and tuffites of silicic composition described in the section of the Devonian terrigenous sediments of the Oldoi terrane (Nagibina, 1969; *Decisions of...*, 1994; Kozak and Vakhtomin, 2000a, 2000b; Kozak et al., 2002a, 2002b). This suggestion is supported by the Sm–Nd isotope geochemical characteristics of the Middle Paleozoic granitoids of the Argun terrane: $t_{Nd(DM)}$ = 1.2–0.9 Ga and $\varepsilon_{Nd}(t)$ from –0.4 to +3.2 (our unpublished data).

It is interesting that the age of Middle Paleozoic detrital zircons (398–373 Ma) from the sandstone of the Middle–Late Devonian Oldoi Formation corresponds in general to its stratigraphic age (397–359 Ma). The same is true of the age of the youngest Middle Paleozoic detrital zircons (358–343 Ma) from the Tipara

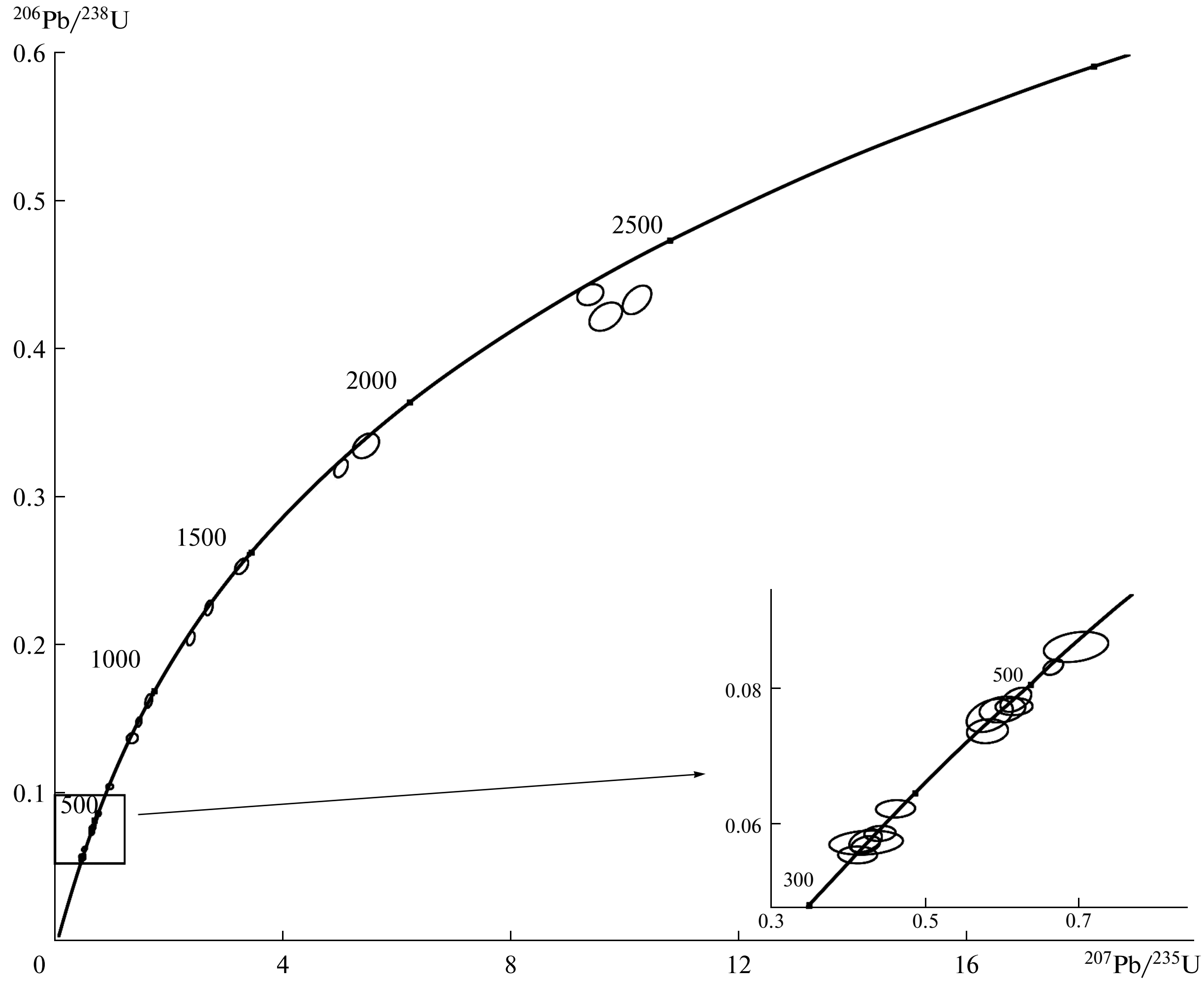

Fig. 5. Concordia diagram for detrital zircons from the quartz–feldspar sandstone of the Early Carboniferous Tipara Formation (sample Yu-51).

sandstone of the Lower Carboniferous (Tournaisian–early Visean). This implies that, since at least the Middle Devonian, the accumulation of terrigenous sediments in the Oldoi terrane had been accompanied by intense magmatic activity; i.e., it occurred in an environment of a mature island arc or an active continental margin rather than a passive continental margin, as was suggested by previous authors (Didenko et al., 1994; Khanchuk, 2006). This conclusion is corroborated by the geochemical systematics of terrigenous sediments from the Oldoi terrane (Sorokin et al., 2010b; Smirnova et al., 2013).

Using the character of changes in the abundance of detrital zircons of Middle Paleozoic age and $\varepsilon_{Nd}(t)$ variations as indicators of magmatic activity accompanying the accumulation of terrigenous sequences of the Oldoi terrane, it can be concluded that the magmatic activity was most intense in the Middle Devonian (Oldoi Formation) and declined in the Early Carboniferous (Tipara Formation). In other words, it is reasonable to suppose that the mature island arc or the active continental margin had existed for approximately 80 Myr.

In addition to the Paleozoic zircons, the detrital zircon population from the sandstone samples of the Oldoi terrane contains a significant amount (up to 30%) of Late Precambrian grains and a minor but persistent amount of Early Precambrian grains. The Late Precambrian detrital zircons were probably derived from Late Precambrian granitoids (927–792 Ma) recently detected in the southeastern Argun superterrane (Wu et al., 2011) and Late Precambrian volcanic complexes, the presence of which in this superterrane was supposed on the basis of geological and paleontological data (*Decisions of…*, 1994; *Geological Map…*, 1999; Khanchuk, 2006). The provenance of the Early Precambrian detrital zircons remains unknown, because there are currently no geochronological data supporting the contribution of Early Precambrian magmatic and meta-

Results of the Sm–Nd isotope geochemical investigation of the Paleozoic terrigenous sediments of the Oldoi terrane

Sample	Rock	Formation	Stag	Age, Ma*	Sm	Nd	$^{147}Sm/^{144}Nd$	$^{143}Nd/^{144}Nd$	$\varepsilon_{Nd}(0)$	$\varepsilon_{Nd}(t)$	$t_{Nd(DM)}$
Yu-35	Quartz sandstone	Omutnaya	late Llandovery–Pridoli	436–416	8.14	41.8	0.1176	0.5121941 ± 4	–8.7	–4.4	1516
Yu-8-4	Quartz sandstone	Omutnaya	late Llandovery–Pridoli	436–416	9.29	48.8	0.1150	0.512230 ± 2	–8.0	–3.5	1420
Yu-40	Quartz–feldspar sandstone	Bolshoy Never	Lochkovian–early Emsian	416–405	5.57	29.6	0.1136	0.512396 ± 2	–4.7	–0.4	1149
Yu-15-5	Quartz–feldspar sandstone	Bolshoy Never	Lochkovian–early Emsian	416–405	10.38	54.9	0.1143	0.512317 ± 3	–6.3	–1.9	1277
Yu-44	Quartz–feldspar sandstone	Imachi	Emsian–Eifelian	405–392	4.44	23.4	0.1144	0.512296 ± 2	–6.7	–2.5	1312
Yu-12-10	Quartz–feldspar sandstone	Imachi	Emsian–Eifelian	405–392	5.20	26.4	0.1189	0.512296 ± 2	–6.7	–2.7	1374
Yu-43	Quartz–feldspar sandstone	Oldoi	Givetian–late Frasnian	392–380	6.12	29.9	0.1237	0.512486 ± 4	–3.0	0.6	1125
Yu-11-3	Quartz–feldspar sandstone	Oldoi	Givetian–late Frasnian	392–380	5.80	29.1	0.1203	0.512532 ± 3	–2.1	1.7	1010
Yu-51	Quartz–feldspar sandstone	Tipara	Tournaisian–early Visean	359–330	5.68	28.6	0.1199	0.512422 ± 5	–4.2	–0.8	1184
Yu-21-5	Quartz–feldspar sandstone	Tipara	Tournaisian–early Visean	359–330	4.04	21.5	0.1135	1 0.512378 + 2	–5.1	–1.4	1176

The age of formations is given in accordance with the Geological Time Scale of the International Commission on Stratigraphy (http://www.stratigraphy.org). The $\varepsilon_{Nd}(t)$ values were calculated for the mean of the age range given in the table. The errors (2s) of $^{143}Nd/^{144}Nd$ are given in terms of the last significant digit.

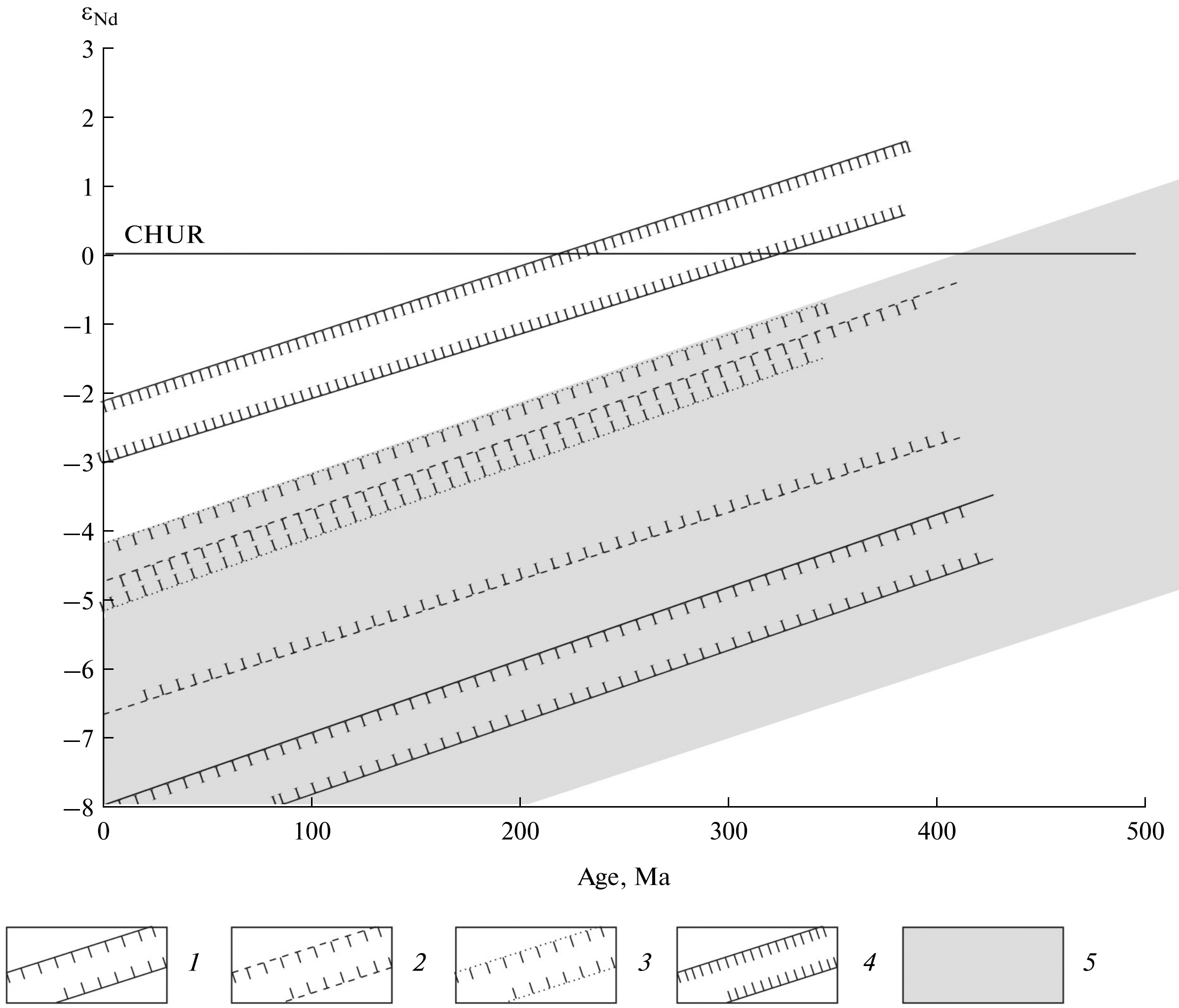

Fig. 6. Diagram ε_{Nd}(t)–age for the terrigenous rocks of the Oldoi terrane.
(*1–5*) Fields of the Nd isotopic composition of sandstones: (*1*) Silurian Omutnaya Formation, (2) Early Devonian Bolshoy Never Formation and the Early–Middle Devonian Imachi Formation, (*3*) Middle–Late Devonian Oldoi Formation, (*4*) Early Carboniferous Tipara Formation; (*5*) field of the Nd isotopic composition of the continental crust of the northern margin of the Argun terrane (Sorokin et al., 2004, 2005, 2010). CHUR is the chondritic undepleted reservoir.

morphic complexes to the geologic structure of the Argun superterrane.

CONCLUSIONS

Variations in Nd isotopic composition and distribution of detrital zircons of different age in the Paleozoic sandstones of the Oldoi terrane of the Argun superterrane in the eastern part of the Central Asian orogenic belt together with the results of previous geochemical studies (Sorokin et al., 2010b; Smirnova et al., 2013) have led to the following conclusions.

The Paleozoic terrigenous sediments of the Oldoi terrane were formed in different geodynamic settings. In the Silurian, they were accumulated in a passive continental margin, and the sedimentation environment changed in the Devonian to an active continental margin or a mature island arc.

The main sources of clastic material parental for the Paleozoic sandstones of the Oldoi terrane were Late Precambrian granitoids and Early to Middle Paleozoic granitoids, the formation of which was mainly related to the reworking of the Late Precambrian continental crust.

In the Silurian, terrigenous material was supplied into the sedimentation basin mainly at the expense of the erosion of Early Paleozoic and Late Precambrian granitoids. The number of eroded areas increased in the Devonian, when the decomposition products of Middle Paleozoic granitoids and volcanic rocks of silicic composition began to be transported into the sedimentary basin.

The most important point in the evolution of terrigenous sedimentation in the Oldoi terrane is that, starting from the Devonian, detrital zircons with ages coinciding with the age of sedimentation appeared in Middle Paleozoic sandstones; this indicates their formation in an active continental margin or mature island arc environment.

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