Journal of Asian Earth Sciences 49 (2012) 7–19

Contents lists available at SciVerse ScienceDirect

Journal of Asian Earth Sciences

journal homepage: www.elsevier.com/locate/jseaes

Metasedimentary rocks of the Angara-Kan granulite-gneiss block (Yenisey Ridge, south-western margin of the Siberian Craton): Provenance characteristics, deposition and age

L.N. Urmantseva [a,*], O.M. Turkina [a], A.N. Larionov [b]

[a] Institute of Geology and Mineralogy, Siberian Branch, Russian Academy of Science, 3, Akad. Koptyug Av., 630090 Novosibirsk, Russia
[b] Center of Isotopic Research of the Russian Geological Research Institute, 74, Sredny Prospect, 199106 St. Petersburg, Russia

ARTICLE INFO

Article history:
Available online 25 November 2011

Keywords:
Paleoproterozoic
Siberian Craton
Sedimentary rocks
Geochemistry
Zircon
U–Pb SHRIMP dating

ABSTRACT

The Angara-Kan granulite-gneiss block (Yenisey Ridge) is one of the main basements uplift within the south-western margin of the Siberian Craton. The major part of the Angara-Kan block is composed of Early Precambrian high-grade metamorphic rocks. Metasedimentary association of the Kan granulitic complex is composed of garnet-bearing, garnet-orthopyroxene and orthopyroxene-bearing gneisses, garnet- and orthopyroxene-bearing gneisses with cordierite and sillimanite. Studied paragneisses were formed at the expense of granulite metamorphism of terrigenous rocks, ranging from graywacke to pelitic rock or mudstone. To estimate the time of sedimentation and metamorphism of the terrigenous deposits, the U–Pb zircon dating has been performed using the SHRIMP II ion microprobe. Detrital zircon cores from the biotite-orthopyroxene and high-alumina gneisses yield ages of 2.6–1.94 and 2.4–1.94 Ga, respectively. Together with the age of the magmatic zircons formed during high-grade metamorphism and partial melting (~1.89 Ga) and metamorphic rims (~1.87 Ga) it defines the time of sedimentation between 2.0–1.94 and 1.89–1.87 Ga. Detrital zircon ages indicate both Archean and Paleoproterozioc rocks in provenance source, that agrees with the Nd model ages of metasediments ranging in interval 2.4–2.8 Ga. Potential source of the Archean detrital zircons was the exposed basement of the southwestern Siberian Craton, whereas the Paleoproterozoic juvenile crustal source seems to be buried basement of the Tungus province of the Siberian Craton. Deposition of the Kan terrigeneous rocks was coeval with sedimentation in the southeastern part of the Sharyzhalgay uplift, where ages of detrital zircon cores and metamorphic rims from paragneisses bracket sediment deposition between 1.95 and 1.85 Ga.

1. Introduction

The Siberian Craton is the Paleoproterozoic collage of the mostly Archean granulite-gneiss and granite-greenstone terranes (provinces) (Rosen, 2003), which are surrounded by major Phanerozoic suture zones and covered largely by the Mesoproterozoic to Phanerozoic sediments. The oldest rock assemblages are exposed in the Aldan and Anabar shields and in the southwestern part of the craton mainly within the Sharyzhalgay and Angara-Kan uplifts (Rosen and Turkina, 2007) (Fig. 1). The basement of the Siberian Craton is subdivided into several geological provinces (Rosen et al., 1994). The Sharyzhalgay block is the main basement uplift within the southwestern margin of the Tungus province. The Tungus province is poorly exposed and identified mostly in deep boreholes and by geophysical surveys. The Angara-Kan block is exposed part of the Paleoproterozoic Angara orogenic belt, which extends along the western margin of the Tungus province and comprises mainly a deformed Early Precambrian metavolcanic-sedimentary associations and high-grade metamorphic complex intruded with granitoids (Rosen et al., 1994).

The Early Precambrian metasedimentary complexes are widespread within all granulite-gneiss basement terranes of the Siberian Craton. Until recently, all these metasedimentary complexes were considered to be Archean mainly based on their high-grade metamorphism, regional correlations and imprecise geochronological data. Alternatively, Kovach et al. (1999) firstly have suggested based on whole-rock Sm–Nd isotope data that several high-grade metasedimentary complexes of the Central Aldan superterrane of the Aldan shield formed during Paleoproterozoic. The Nd model ages of these rocks range between 2.1 and 2.5 Ga providing an upper limit for the sedimentation. Similar, the metasedimentary rocks of the Hapchan Group of the Anabar shield have $T_{Nd}(DM)$ values of 2.3–2.4 Ga (Rozen et al., 2000b). The paragneisses of the Angara-Kan block also were considered to be Archean in age based on their similarity in composition and metamorphic grade to the

* Corresponding author. Tel.: +7 383 3356419; fax: +7 383 3332792.
E-mail address: urmantseva@gmail.com (L.N. Urmantseva).

1367-9120/$ - see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jseaes.2011.10.008

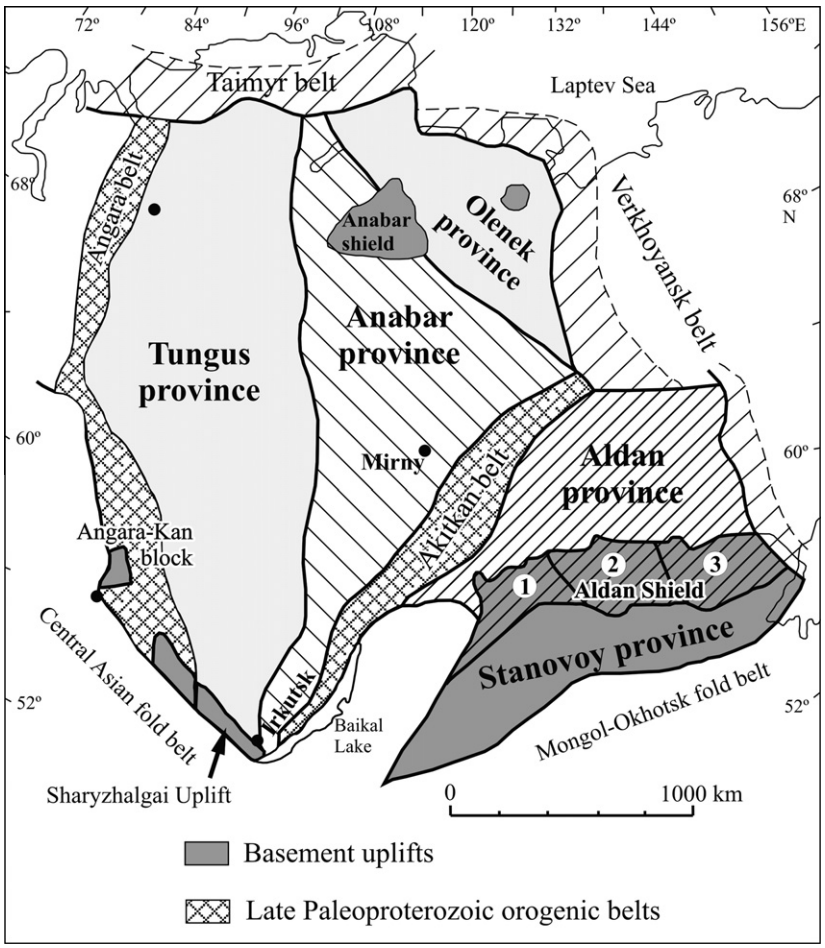

Fig. 1. Major tectonic elements of the Siberian Craton (modified after Rosen et al., 1994). Terranes of the Aldan Shield: (1) West Aldan; (2) Central Aldan; (3) East Aldan.

metasediments of the Sharyzhalgay uplift (Nozhkin and Turkina, 1993; Rosen et al., 1994). Lately Nozhkin et al. (2008) reported that the high-grade metasedimentary rocks of the Angara-Kan block are characterized by T_{Nd}(DM) values of ca. 2.5 Ga that contradicts to suggestion of their Archean age. In addition recent research of high-grade rocks from the Irkut terrane of the Sharyzhalgay uplift revealed that the terrigenous sediments have been formed in Paleoproterozoic and underwent granulite metamorphism at ~1.85 Ga (Urmantseva and Turkina, 2009; Turkina et al., 2010). These metasedimentary rocks have the T_{Nd}(DM) values of 2.4–3.1 Ga and contain the detrital zircons ranging from 2.7 to 1.95 Ga. These data limit the deposition of the sedimentary protoliths between 1.95 and 1.85 Ga, i.e., in Late Paleoproterozoic.

With the exception of the Irkut terrane, the exact timing of formation of high-grade metasedimentary rocks of the Siberian Craton are poorly constrained that in turn complicates the geological correlations and geodynamic reconstruction of the Early Precambrian sedimentary processes of this huge region. In order to clarify the time of sedimentation and trace a spreading of the Paleoproterozoic metasedimentary rocks through the southwestern part of the Siberian Craton we investigated zircons from the high-grade rocks of the Angara-Kan block.

Zircon is common in clastic sedimentary rocks and U–Pb dating of detrital zircon is an excellent tool for determination of maximum deposition age and for estimation of zircon age distribution in the source provenance. In high-grade paragneisses zircons are composed domains with different origin such as detrital cores inherited from source provenance and metamorphic rims. Dating of zircon cores and rims constrains a time of sedimentation. Trace element composition of zircons is sensitive to their magmatic and metamorphic origin (Hoskin and Schaltegger, 2003). Consequently, the trace element compositions of detrital zircons give evidences on magmatic and metamorphic events in a source provenance.

In this paper, we report SHRIMP zircon U–Pb ages of metasedimentary rocks of the Angara-Kan block and their trace element compositions. We apply new information to address some key questions such as formation time of the protoliths of the metasedimentary rocks, age and origin of rocks in source provenance and correlation of the Paleoproterozoic metasediments through southwestern margin and others parts of the Siberian Craton.

2. Geological background

The Angara-Kan block is located in the southern part of the Yenisey Ridge which extends along the right bank of the Yenisey River for more than 700 km from the Kan River in the south to the Podkamennaya Tunguska River in the north (Fig. 2). The major part of the Angara-Kan block is composed by the Early Precambrian Kan granulite-gneiss and Yenisey amphibolite-gneiss complexes. These complexes are characterized by different types of folding, deformations and metamorphic grade (Smit et al., 2000). The Kan complex underwent upper amphibolite to granulite facies metamorphism while the Yenisey one was metamorphosed up to amphibolite facie. The exposed contacts between the Kan granulite-gneiss and Yenisey amphibolite-gneiss complexes are tectonic with mylonite zones.