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Review

Geodynamic framework of large unique uranium orebelts in Southeast Russia and East Mongolia

Vadim G. Khomich [a,c,*], Natalia G. Boriskina [a,c], M. Santosh [b]

[a] Far East Geological Institute, Far East Branch of Russian Academy of Sciences, 159 Prospect 100 let Vladivostoku, Vladivostok 690022, Russia
[b] School of Earth Sciences and Resources, China University of Geosciences Beijing, 29 Xueyuan Road, Beijing 100083, China
[c] School of Engineering, Far Eastern Federal University, 8 Suhanova St., Vladivostok 690950, Russia

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ABSTRACT

Some of the largest uranium orebelts and deposits of Asia occur in Southeast Russia and East Mongolia. In Russia, the Elkon and Streltsovka belts are located in the Aldan (South Yakutia) and Urulyungui (Southeast Trans-Baikal area) districts, covering a distance of more than 1200 km. The superlarge Dornod deposit occurs in the North Choibalsan district of East Mongolia, ca. 300 km to the southwest of Streltsovka. These uranium occurrences are distributed in the Central Aldan and Kerulen-Argun cratonic domains, separated by the Selenga–Stanovoi (Yenisei-Trans-Baikal) and Mongol–Okhotsk orogenic belts. A synthesis of the characteristics and the timing of mineralization suggest that all of these occurrences were generated synchronously. Seismic tomography data show that these deposits are mostly located above the frontal part of a stagnant oceanic slab. We envisage that slab dehydration and influx of fluids into the asthenospheric mantle and their subsequent interaction with the lithosphere aided the localization of these unique-scale uranium concentrations.

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1. Introduction

Within South-East Russia and East Mongolia, hundreds of uranium mineral occurrences, tens of major deposits of different types, and a significant number of prospects occur with a

* Corresponding author at: Far East Geological Institute, Far East Branch of Russian Academy of Sciences, 159 Prospect 100 let Vladivostoku, Vladivostok 690022, Russia.
E-mail address: khomich79@mail.ru (V.G. Khomich).

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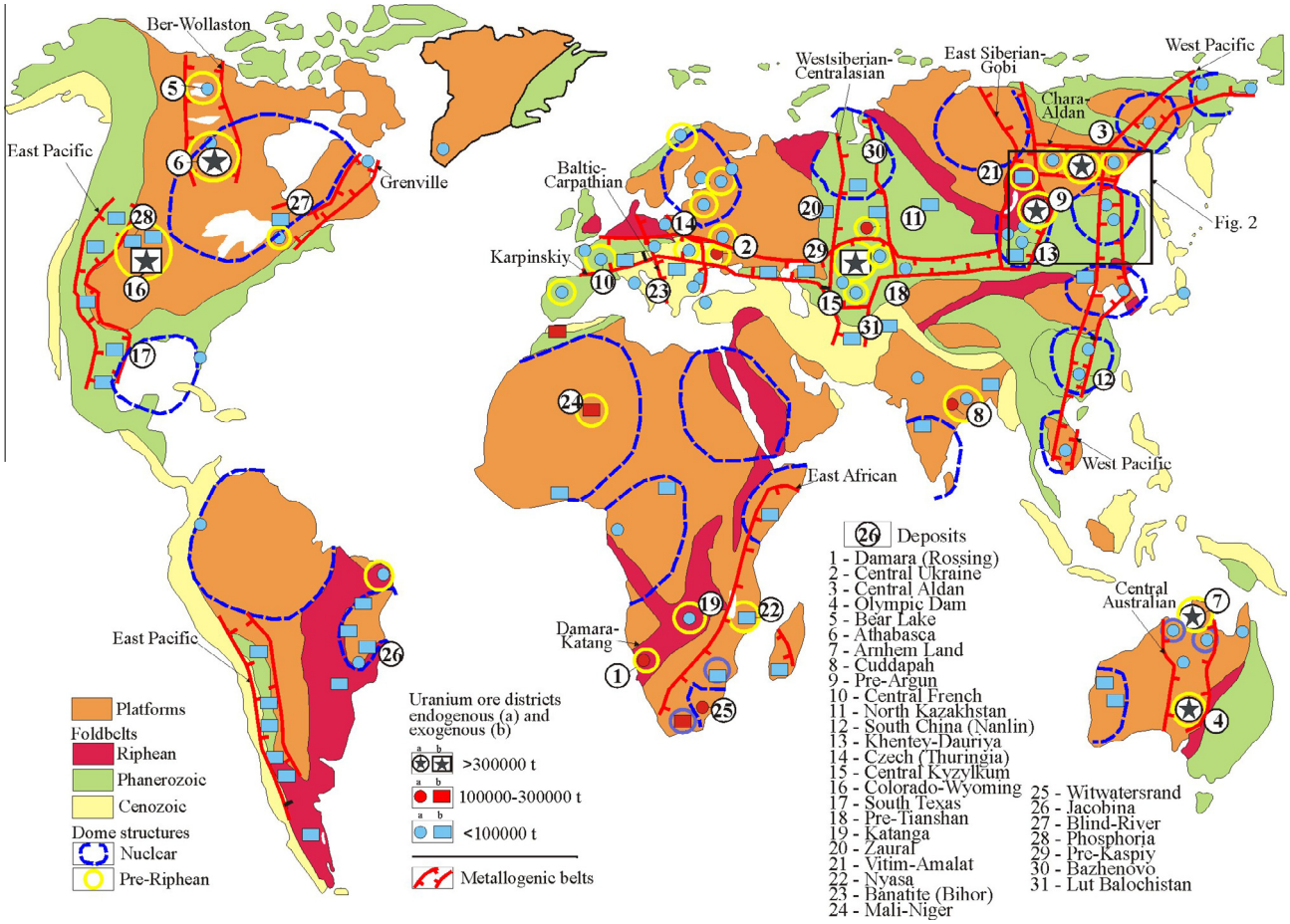

Fig. 1. Uranium provinces of the world. After Afanasiev et al. (2014), Dahlkamp, 2009.

significant resource potential (e.g., Mashkovtsev et al., 1995, 2010; Ishchukova et al., 1998; Kazansky, 2004; Goroshko et al., 2006; Mironov et al., 2009; Samovich et al., 2012). These occurrences mark this region as one of the largest uranium provinces of the world (Fig. 1).

The most known uranium deposits and prospects of the region are located to the east of Bailkal lake and to the south of the Siberian platform, and include the Elkon deposit in South Yakutia (on the Aldan River right bank), the Streltsovka (Urulyungui district) in South-East Trans-Baikal area, and the Dornod (North-Choibalsan district) in East Mongolia (Fig. 2).

The resource potential (includes both calculated and partially extracted uranium and the possibility of their increase with continued exploration in thousand tons of uranium) of these deposits ranges from 50 (Dornod) to 350 (Streltsovka) and even 600 (Elkon), classifying these as large, major, and unique ones (Kazansky, 2004). Spatially associated with these are several other deposits of brannerite (Yakutia) and molybdenum–uranium (Trans-Baikal area, Mongolia). In some cases, not only endogenous hydrothermal, but also supergene–epigenetic (hydrogenic–paleovalleys, roll front type and others) deposits have also been discovered.

The above uranium ore prospects occur within the Central-Aldan and Kerulen-Argun cratonic domains. The hydrothermal brannerite mineralization is concentrated in the Elkon horst within the Precambrian crystalline rocks which include intensely granitoids rocks of Yakokit-Yllymakh (Kazansky, 2004; Miguta, 1997, 2001). The molybdenum–uranium mineralization is located predominantly in the volcanic – depressions of the Mongol-Priargun volcano-plutonic belt such as the Tulukuev (SE Trans-Baikal area) and Dornod (East Mongolia). The metamorphic rocks of the crystalline basement of both depressions, similar to those in the Aldan region, underwent the intense anatexis, metasomatism. Within the aureoles, feldspathic, silicic, argillic, and other alterations are associated with isolated tabular and vein-like beds of uranium-bearing ores, together with large deposits with high concentrations of uraninite, pitchblende, coffinite, and brannerite (Ishchukova et al., 1998, 2007; Aleshin et al., 2007; Mironov et al., 2009; Laverov et al., 2012; Samovich et al., 2012). Isotopic dating using zircon U–Pb, Ar–Ar, K–Ar, Rb–Sr, Sm–Nd, and other methods reveal that the endogenous uranium mineralization was formed during the Cretaceous (Golubev et al., 1994; Chernyshov and Golubev, 1996; Boitsov and Pilipenko, 1998; Kazansky, 2004; Aleshin et al., 2007; Ishchukova et al., 2007; Mironov et al., 2009; Shatkov et al., 2010). The development of the uranium-ore-forming processes in the region has been broadly traced to the outer zone of the Circum-Pacific metallogenic belt with a distinct role for the Late Mesozoic tectonic-magmatic activity (Shatkov, 2013; Goryachev and Pirajno, 2014; Khomich et al., 2015). Integrated analysis of the geological–geophysical data from South-East Russia and East Mongolia makes it possible to estimate the role of deep-seated geodynamics in the formation and distribution of large uranium deposits and prospects. The structure and Late Mesozoic history of the cratonic domains which host the ore deposits and prospects together with data from seismic tomography (e.g., Zhao, 2001; Zorin et al., 2006; Maruyama et al., 2007; Zhao et al., 2009, 2010; Li and van der Hilst, 2010) can provide potential insights into the deep-seated geodynamics in the Late Mesozoic and Cenozoic.