Baikal–Vilyui Paleoproterozoic Belt of The Siberian Platform: Regional Gold-Controlling Structure

V. V. Stogny^a, * and G. A. Stogny^a

^a *Kuban State University, Krasnodar, 350040 Russia*

**e-mail: stogny_vv@mail.ru*

Received November 20, 2020; revised February 9, 2021; accepted April 16, 2021

Abstract—The article demonstrates that the placer gold content of the Vilyui Syncline is governed by the regional structure of the crystalline basement of the Siberian Platform—the Baikal–Vilyui Paleoproterozoic belt, the boundaries and tectonics of which are substantiated by analysis of the gravitational field structure. The belt includes a system of basement blocks with a common northeastern strike, which form horsts (of the Suntar type) and grabens (of the Kempendyai type). The gold-bearing placers of the Vilyui Syncline are mainly confined to the Suntar, Tyukyan, and Chybyda blocks of the belt, the metamorphic and igneous rocks of which were the primary gold sources in the sedimentary cover. The suture zone of the Baikal–Vilyui belt was very permeable to deep fluids responsible for gold migration. The types of possible primary gold sources (gold–platinoid, low-sulfidation gold–quartz, and gold–silver) reflect the peculiarities in the evolution of Early Precambrian gold during sedimentation in the Vilyui Syncline. The areas controlled by the Suntar, Kempendyai, Tyukyan, Chybyda, and Khapchagai blocks of Early Precambrian rocks, which may contain gold objects, should be considered promising for buried gold placers in the Vilyui Syncline.

Keywords: Siberian Platform, Vilyui Syncline, Baikal–Vilyui Paleoproterozoic belt, crystalline basement, gravitational field, gold content

DOI: 10.1134/S1075701521060064

INTRODUCTION

The Baikal–Vilyui Paleoproterozoic belt of the crystalline basement of the Siberian Platform and Baikal–Patom fold belt extends northeast from Lake Baikal to the eastern boundary of the platform (Kushev, 1985). In successive regionalization schemes of the crystalline basement of the Siberian Platform, the Baikal–Vilyui belt bears different names: Vitim–Vilyui (Mishnin et al., 1987), Akitkan (Rosen, 2003) (Fig. 1), and Nyurba (Smelov et al., 2001). Within the Siberian Platform, the belt is overlain by the sedimentary cover of the Vilyui Syncline, which is more than 10 km thick. Early Precambrian metamorphic rocks of the belt outcrop within the Sarma–Tonod zone of highs in the Baikal–Patom fold belt and have been exposed at a depth of 368 m by the Suntar reference borehole under Lower Jurassic deposits of the Vilyui Syncline.

The sedimentary deposits of the Vilyui Syncline, which overlie the Baikal–Vilyui belt of the crystalline basement, contain gold placers, which are combined in the Vilyui gold-bearing region (Timofeev et al., 1970) or in the promising Nahar–Kepta gold placer zone of the East Siberian metallogenic province (*Mineragenicheskaya* ..., 2008). The Vilyui Syncline has also been evaluated as promising for Precambrian

gold-bearing conglomerates that formed during breakup of the Suntar uplift (Chersky, 1971; Trushkov et al., 1975), and high-grade flake gold in conglomerates of the basal part of the Lower Jurassic Ukugut Formation and Vilyui-type sandstones (Timofeev, 1965).

Z.S. Nikiforova et al. (2013, 2018), based on the mineralogical and geochemical features of gold, demonstrated a relationship between gold of the Vilyui Syncline and primary sources of gold–platinoid, low-sulfidation–gold–quartz, and gold–silver types. It has also been established that gold is represented by two types: Precambrian and Mesozoic. Precambrian gold is characterized by a fine fraction (0.1–0.25 mm) and high fineness (900–999‰).

The confinement of Vilyui Syncline gold placers to the Suntar uplift in the Baikal–Vilyui Paleoproterozoic belt steered the objective of the article: to assess the relationship between the gold content of the sedimentary cover and tectonic elements of the crystalline basement. The Baikal–Vilyui belt is one of the largest regional linear structures of the basement of the Siberian Platform; therefore, the study of its structure is an integral problem. The contours of the belt in (Kushev, 1985; Rosen, 2003; Smelov et al., 2001) have been delineated in the zone with a reduced anomalous magnetic field level. In this study, the boundaries and tec-

Fig. 1. Sketch map of crystalline basement of eastern part of Siberian Platform and Baikal–Patom fold belt after (Rosen, 2003), simplified. (1) areas of development of Early Precambrian metamorphic rocks; (2) Paleozoic–Mesozoic foreland fold belts; (3) major fault zones within platform (sutures).

tonic structure of the Baikal–Vilyui Paleoproterozoic belt are substantiated from an analysis of the gravitational field structure.

ANALYSIS OF GEOLOGICAL AND GEOPHYSICAL MATERIALS

In order to substantiate the tectonic structure of the Baikal–Vilyui belt of the basement of the Siberian Platform, the authors analyzed geological and geophysical materials in an area bounded by 108° and 140° E and 60° and 68° N (Fig. 2a). For effective analysis of gravimetric (1 : 200 000–1 : 1 000 000) and magnetic (1 : 25 000–1 : 50 000, 1 : 200 000) maps, digital models were subjected to spectral-statistical processing with separation into high-, mid-, and low-frequency components corresponding to the upper and lower levels of the Earth's crust and lithosphere. The geological and geophysical materials were interpreted according to the concept of divisibility of the crust into blocks (geo-

block, megablock, and first- and second-order blocks).

The gravitational and magnetic fields of the Siberian Platform are, to varying degrees, spatiotemporally informative about geological processes (Stogny, G.A. and Stogny, V.V., 2005). The gravitational field mainly reflects the tectonic structure of the crust and can be used as an indicator in developing geodynamic models. The magnetic field largely characterizes the material composition of Early Precambrian rocks and their metamorphic conditions.

Gravitational Field

The structure of the gravitational field of the studied area is considered at the following hierarchical levels: anomalous area, anomalous zone, and regional and local maxima and minima. Anomalous areas are large (more than 1000 km in diameter) sections of the gravitational field with a mosaic-block structure,

Fig. 2. Sketch map of studied area (a) and Baikal–Verkhoyansk anomalous zone in the gravitational field structure (EGM2008 model, Bouguer anomaly) (b). (1) Eastern boundary of Siberian Platform; (2) contours of Baikal–Verkhoyansk anomalous zone; (3) axes of linear maxima of anomalous magnetic field. Anomalies of gravitational field are indicated: maxima (U, Urin; S, Suntar; T, Tyukyan; Ch, Chybyda; Kh, Khapchagai; P, Tompo); minima (N, Nyuya; K, Kempendyai; A, Lower Aldan). Inset: BP, Baikal–Patom fold belt.

which, depending on the adopted tectonic concept, correspond to geoblocks, terranes, or granite-greenstone and granulite-gneiss areas. Anomalous gravitational zones are extended (over 1000 km long and 100–300 km wide) field elements, including linear negative and positive anomalies with a common strike. The zones correspond to intergeoblock faults or granulite-gneiss belts of the basement. According to this criterion, the regional Baikal–Verkhoyansk anomalous zone has been delineated in the gravitational field of the Siberian Platform (Fig. 2b). The southwestern part of the Baikal–Verkhoyansk anomalous gravitational zone within the Baikal–Patom fold belt is considered in (Stogny, G.A. and Stogny, V.V., 2016).

Within the boundaries of the Baikal–Verkhoyansk anomalous zone of the Siberian Platform, the following gravity anomalies with a common northeastern strike are combined: the Urin, Suntar, Tyukyan, Chybyda, Khapchagai, and Tompo maxima and the Nyuya,

Kempendyai, and Lower Aldan minima. The Urin gravity maximum, with an amplitude of more than 30 mGal in plan view, corresponds to the Predpatom foredeep. From the west, the Urin maximum is conjugate with the Nyuya minimum with an amplitude more than 25 mGal and size 25–150 km. In the contours of the maximum, Paleozoic sediments of the Predpatom trough and Early Precambrian metamorphic rocks of the Sarma–Tonod zone are widespread.

The Suntar, Chybyda, and Khapchagai maxima and Kempendyai and Lower Aldan minima are localized within the southern part of the Vilyui Syncline. The Suntar maximum, with an amplitude of more than 65 mGal, reflects the uplifted block of the same name in the crystalline basement, the Early Precambrian metamorphic rocks of which were exposed at a depth of 368 m by a borehole under Cretaceous deposits of the Vilyui Syncline (Mokshantsev et al., 1964). In (Isakov et al., 2012), the Suntar gravity maximum is

Fig. 3. Position of Baikol–Verkhoyansk anomalous zone on diagram of low-frequency component of gravitational field of Siberian Platform. (1) Early Precambrian Shield of Siberian Platform; (2) boundary of Siberian Platform; (3) contour of Baikol–Verkhoyansk anomalous gravitational zone (BVZ); (4) isoanomalies of gravitational field. Anomalous areas of low-frequency component of gravitational field: positive (Ln, Lena; Yak, Yakutsk), negative (Al, Aldan; Vr, Verkhoyansk).

explained by the massif of mafic rocks of the Chinei Complex. The Kempendyai gravity minimum, with an amplitude of more than 60 mGal, is confined to the basin of the same name up to 10 km deep, consisting mainly of Mesozoic and Paleozoic terrigenous–carbonate deposits (Gaiduk, 1988). The Tyukyan and Chybyda gravity maxima form a NW-trending transverse zone, which corresponds to the uplift of the Vilyui Syncline. The Tompo maximum (with an amplitude of up to 50 mGal) of the Verkhoyansk–Kolyma fold area closes the Baikol–Verkhoyansk anomalous zone of local maxima and minima. The local gravity anomalies of the Baikol–Verkhoyansk zone reflect the total effect of density inhomogeneities in the crystalline basement and its relief. The basement relief in this area is fairly well studied (Gaiduk, 1988; *Tektonika* ..., 2001).

The Baikol–Verkhoyansk anomalous zone in the low-frequency component of the gravitational field corresponds to the boundary of the Lena and Yakutsk anomalous regions (Fig. 3), which reflect the level of the upper mantle and are identified with lithospheric

segments of the Siberian Platform up to 250 km thick: the Lena and Yakutsk lithospheric roots.

Magnetic Field

Regionally, the structure of the anomalous magnetic field in the eastern part of the Siberian Platform is represented by a system of linear maxima up to 900 km long and more than 30 km wide (Fig. 4). The linear magnetic maxima of the eastern part of the Siberian Platform are predominantly oriented to the northwest, orthogonal to the Baikol–Verkhoyansk gravitational zone. In the northeast of the Anabar–Zhigan, Olenek–Lena, and Magan–Nepsey platforms, the linear maxima of the Anabar Anticline converge within the Anabar Shield into a complexly differentiated anomalous region created by subvertical bodies of magnetite-bearing rocks up to 2 km thick (Stogniy and Stogniy, 2006). The Yakutsk linear maximum is expressed as a deep-seated fault in the Aldan Anticline (Istomin and Mishnin, 2003).

The Baikol–Verkhoyansk gravitational zone corresponds to the area of the mosaic magnetic field (see

Fig. 4. Anomalous magnetic field of studied area after (Karta ..., 1995), simplified. (1) Isodynamics of magnetic field; (2) eastern boundary of Siberian Platform; (3) boundaries of Baikalsk–Verkhoyansk gravitational anomalous zone (see Fig. 2). Letters indicate magnetic field anomalies of various rank: regional linear maxima (An, Anabar–Zhigansk; Ol, Olenek–Lena; Mg, Magan–Nepsey; Yak, Yakutsk); large anomalous areas of mosaic structure of positive values (Tn, Tyung; Bp, Bappagai); large anomalous areas of mosaic structure of negative values (Ln, Linden; Km, Kempendyai); local maxima (Uk, Ukugut; Tg, Tongo; Ks, Kysylsy).

Fig. 4). In the west and east, it is crosscut by the Olenek–Lena and Yakutsk linear maxima, respectively. The central part of the Baikalsk–Verkhoyansk gravitational zone is represented by the Kempendyai region of negative magnetic field values, to the north of which the Linden region of negative values is located.

The Ukugut, Tongo, and Kysylsy local magnetic maxima form a chain along the northern boundary of the Baikalsk–Verkhoyansk gravitational zone, which separates the Kempendyai and Linden regions of negative values. The Ukugut and Tongo magnetic maxima, localized within the contours of the Suntar block of the crystalline basement, reflect blocks of magnetite-bearing Early Precambrian rocks. It is possible that the Kysylsy magnetic maximum and Bappagai region of positive magnetic field values have a similar nature.

The boundaries of the Akitkan (see Fig. 1) and Nyurba (Smelov et al., 2001) belts of the basement have been delineated along the zone of low anomalous magnetic field values, which includes the Kempendyai and Linden regions of negative values. The Linden area of negative magnetic field values, corresponding in plan view to the northern limb of the Vilyui Syncline, is located north of the Baikalsk–Verkhoyansk

anomalous gravitational zone, the contours of which determine the position of the Baikalsk–Vilyui Paleoproterozoic belt in the structure of the basement of the Siberian Platform.

Thus, the Baikalsk–Vilyui belt of the basement in the structure of the gravitational field of the Siberian Platform is represented by a chain of local NE-trending anomalies, which are combined into the Baikalsk–Verkhoyansk anomalous zone. Crystalline basement rocks outcrop within the contours of the Suntar gravity maximum. The gravity maxima of the Baikalsk–Verkhoyansk anomalous zone are comparable in size and amplitude to those of the Stanovoy megablock of the Aldan–Stanovoy shield, reflecting blocks (Zverev, Upper Timp-ton, Sutam, Dambuka, and Chogar) of high-grade granulites (Stogny, G.A. and Stogny, V.V., 2005), which makes it possible to interpret the Kempendyai, Suntar, Tyukyan, Chybyda, and Khapchagai maxima as high-pressure granulites of the Early Precambrian crust.

BAIKAL–VILYUI PALEOPROTEROZOIC BELT: GOLD-CONTROLLING STRUCTURE OF THE VILYUI SYNECLISE

At the regional level, the structure of the Baikalsk–Vilyui Paleoproterozoic belt is represented by a system

Fig. 5. Sketch map of tectonic structure of Baikal–Vilyui ore-controlling structure of crystalline basement of Siberian Platform based on analysis of geological and geophysical materials. (1) Eastern boundary of Siberian Platform; (2–3) faults: (2) intergeoblock; (3) interblock; (4) granulite blocks forming horsts; (5) tectonic faults identified within contours of linear magnetic maxima; (6) magnetite-bearing objects of crystalline basement; (7) gold alluvial zones and areas after (*Mineragenicheskaya ...*, 2008): NPZ, Nakhar–Kepta prospective zone; KhPR, Khoryntsynsky prospective ore district; (8) gold–platinum-bearing placers after (Okrugin; 2005): (1) Vilyuy River; (2) Kempendyai River; (3–5) headwaters of Namana–Tongo–Chybyda rivers; (6) Kenkeme River; (9) formational types of primary gold sources of after (Nikiforova, 2018): *a*, gold–platinoid; *b*, low-sulfidation gold–quartz; *c*, gold–silver. Letters indicate blocks of Baikal–Vilyui belt of crystalline basement: Ns, Nyuya; Ur, Urin; Sn, Suntar; Km, Kempendyai; Tk, Tyukyan; Chb, Chybyda; Khp, Khapchagai; Nzh, Lower Aldan; Tm, Tompo.

of crystalline basement blocks with a common north-eastern strike (Fig. 5), which forms horsts (of the Suntar type) and grabens (of the Kempendyai type). The deep structure of the crust of the Baikal–Vilyui belt along the Berezovo–Ust’-Maya geotraverse, which crosscuts the Tyukyan and Khapchagai blocks in the southeastern direction, is described in (Egorkin et al., 1988; Egorov, 2004). The thickness of the crust of the belt, in comparison to the Anabar and Aldan antecises, decreases to 35 km, which is the thickness of the lithosphere, to 75 km. A.S. Egorov (2004) represented the structure of the earth’s crust along the geotraverse in this section as a rift structure bounded by deep-seated faults to the level of the Moho.

The Baikal–Vilyui belt, in the form of a regional suture zone dividing the Anabar and Aldan–Stanovoy geoblocks of the crystalline basement, is expressed in the structure of the low-frequency component of the gravitational field of the Siberian Platform (see Fig. 3). The features of the belt formation regime as an intergeoblock structure are also indicated by its strike, which is orthogonal to that of regional tectonic faults in the basement of the Anabar and Aldan–Stanovoy geoblocks (see Fig. 5). O.M. Rosen et al. (2006) con-

sider the belt a Paleoproterozoic island arc, suturing together terranes of the south- and northeastern Siberian Platform.

The formation of the Baikal–Vilyui belt in the Paleoproterozoic, in our opinion, governed intraplate rifting processes, as a result of which granulite blocks were drawn from lower levels of the crust in extension–compression phases. Subsequently, the Baikal–Vilyui Paleoproterozoic belt controlled the sedimentation of the Vilyui Syncline. Paleozoic–Mesozoic rifting (Kiselev et al., 2002; Levashov, 1975; Masaitis et al., 1975) contributed to expansion and deepening of the Vilyui sedimentary basin. O.P. Polyansky et al. (2013) classify the Suntar, Tyukyan, and Chybyda blocks as stable and less subsided during rifting in the Devonian, or that they occurred during the extension stage.

Gold-bearing placers of the Vilyui Syncline are confined mainly to the Suntar, Tyukyan, and Chybyda blocks (see Fig. 5), which allows us to attribute Early Precambrian metamorphic and igneous rocks of the Baikal–Vilyui belt to a primary source. In metamorphic rocks of the Suntar block, the gold content was

determined at 0.1 g/t (Timofeev et al., 1970). It has been suggested that the granulite blocks of the Baikal–Vilyui belt, as they were pushed out from lower levels of the crust, underwent gold redistribution with the formation of gold–quartz and gold–pyrite–pyrrhotite veins, and the suture zone of the Baikal–Vilyui belt was well permeable to deep fluids, responsible for both gold migration and local metasomatism of sedimentary rocks with the formation of quartz veins bearing ore gold. V.A. Mikhailov (2000) associates ore-bearing fluids with fluid-explosive structures of the Vilyui Syncline sedimentary cover.

The destruction of metamorphic rocks of the uplifted blocks apparently began with the formation of the Baikal–Vilyui belt in the Paleoproterozoic. Subsequently, gold accumulated in sedimentary deposits with the formation of ancient buried placers in intermediate sources, mainly in conglomerate–sandy sediments of the Upper Triassic Tabysin Formation, basal horizons of the Lower Jurassic Ukugut Formation, and Cretaceous sandstones (Timofeev et al., 1970). Primary sources of gold–platinoid, low-sulfidation-gold–quartz, and gold–silver types, substantiated by Z.S. Nikiforova (2018) based on mineralogical and geochemical characteristics (see Fig. 5), reflect the evolution of Early Precambrian gold during sedimentation in the Vilyui Syncline. An insignificant amount of placer gold was transported with clastic material from breakup of highs of the Aldan–Stanovoy shield and the Yakutsk uplift.

The metabasite complexes of granulite blocks of the Baikal–Vilyui belt were also a platinum source. In gold-bearing placers, platinum is present from a few to several hundred mg/m³ or more (*Tektonika* ..., 2001). There are known gold–platinum-bearing placers on the Vilyui, Kempendyai, Namana, Tongo, and Chybyda rivers (see Fig. 5). It is considered that the primary source of platinum comprised Permian–Triassic trap gabbro–dolerites (Dodin et al., 1994), ultramafic massifs of basement highs (Okrugin, 2005), and the untapped Tyung intrusive located to the north within the Anabar geoblock (Istomin and Mishnin, 2003).

The Baikal–Vilyui belt of the crystalline basement in its geological and geophysical characteristics (length, width, chains of gravity maxima reflecting outcrops of Early Precambrian granulites) is similar to the Pristanovoy high-grade granulite belt of the Aldan–Stanovoy megablock described in (Glebovitskiy et al., 2009). Granulite blocks of Stanovoy megablock control the large Dambuka, Upper Timpon, Sutam, Preddzhugdzhur, and Chogar–Udykha gold placer districts. According to (Kogen, 1976), the main source of gold from placers in the Sutam district are quartz–pyrite–pyrrhotite and quartz–carbonate–polysulfide veins in granulites, and the source of placers in the Dambuka region is gold-enriched Early Precambrian rocks of the Kamrai Formation (Alektorova and Shmuraeva, 1997).

The areas controlled by the Suntar, Kempendyai, Tyukyan, Chybyda, and Khapchagai blocks of the Baikal–Vilyui Paleoproterozoic belt of the crystalline basement of the Siberian Platform should be classified as potentially promising for buried gold placers in the Vilyui Syncline. Gold ore objects in the metamorphic rocks of these blocks may also exist. The thickness (370–500 m) of Jurassic deposits overlying the high of the Suntar block will make it possible to prospect for ore gold.

CONCLUSIONS

The placer gold content of the Vilyui Syncline is controlled by the regional structure of the crystalline basement of the Siberian Platform—the Baikal–Vilyui Paleoproterozoic belt. The belt is overlain by the sedimentary cover of the Vilyui Syncline, 0.4–10 km thick (Early Precambrian metamorphic rocks have been exposed at a depth of 368 m by the Suntar borehole under Lower Jurassic deposits). The boundaries and tectonics of the Baikal–Vilyui belt have been substantiated by an analysis of the structure of the gravitational field. The belt includes a system of basement blocks with a common northeastern strike, which form horsts (of the Suntar type) and grabens (of the Kempendyai type). The Baikal–Vilyui belt was formed during intraplate rifting in the Paleoproterozoic: under extension–compression conditions, granulite blocks were brought up from lower levels of the crust.

The gold-bearing placers of the Vilyui Syncline are mainly confined to the Suntar, Tyukyan and Chybyda granulite blocks, the metamorphic and igneous rocks of which were the primary gold source in the sedimentary cover. The suture zone of the Baikal–Vilyui belt was very permeable to deep fluids, responsible for both gold migration and formation of quartz veins bearing ore gold in the sedimentary cover. The types of possible primary sources of gold (gold–platinoid, low-sulfidation gold–quartz, and gold–silver) reflect the features of the evolution of Early Precambrian gold during sedimentation in the Vilyui Syncline. The areas controlled by the Suntar, Kempendyai, Tyukyan, Chybyda, and Khapchagai blocks of Early Precambrian rocks, which may contain gold objects, should be considered promising for buried gold placers in the Vilyui Syncline.

ACKNOWLEDGMENTS

The authors are grateful to Dr. Geol.–Minerol. Sci. Z.S. Nikiforova for discussion (Yakutsk) of the problem of the gold potential in the Vilyui Syncline during our joint work at DPMGI SB RAS.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

OPEN ACCESS

This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>.

REFERENCES

- Alektorova, E.A. and Shmuraeva, L.Ya., Problems of bedrock Precambrian gold potential of the Dambukin block of the Aldan–Stanovoi Shield, in *Dokembrii Severnoi Evrazii: Tezisy dokladov* (Precambrian of Northern Eurasia. Proc. Conf.), St. Petersburg: IGGD RAN, 1997, p. 3.
- Cherskii, N.V., *Bogatstva nedr Yakutii* (Mineral Resources of Yakutia), Yakutsk, 1971.
- Dodin, D.A., Chernyshov, N.M., Polferov, D.V., and Tar-novetskii, L.L., *Platinometal'nye malosul'fidnye mestorozhdeniya v ritmichno rassloennyykh kompleksakh* (PGM Low-Sulfide Deposits in Rhythmically Layered Complexes), Moscow: Geoinformmark, 1994.
- Egorkin, A.V., Zyuganov, S.K., Pavlenkova, N.A., and Chernyshev, N.M., Results of lithosphere structure at the profiles of Siberia, *Geol. Geofiz.*, 1988, no. 5, pp. 120–128.
- Egorov, A.S., *Glubinnoe stroenie i geodinamika litosfery Severnoi Evrazii (po rezul'tatam geologo-geofizicheskogo modelirovaniya vdol' geotraversov Rossii)* (Deep Structure and Geodynamics of Lithosphere of Northern Eurasia: Evidence from Geological–Geophysical Modeling along Russian Geotraverses), St. Petersburg: VSEGEI, 2004.
- Gaiduk, V.V., *Vilyuiskaya Srednepaleozoiskaya Riftovaya Sistema* (Vilyui Middle Paleozoic Rift System), Yakutsk: YaF SO AN SSSR, 1988.
- Glebovitsky, V.A., Kotov, A.B., Sal'nikova, E.B., Larin, A.M., and Velikoslavinsky, S.D., Granulite complexes of the Dz-hugdzhur–Stanovoi fold region and the Peristanovoi Belt: age, formation conditions, and geodynamic settings of metamorphism, *Geotectonics*, 2009, vol. 43, no. 4, pp. 253–263.
- Isakov, V.M., Starosel'tsev, K.V., Shelukhina, O.I., and Makhnach, E.N., Lithotectonic complexes of the southern Siberian Platform basement, *Regional. Geol.*, 2012, vol. 11, no. 3, pp. 12–18.
- Istomin, I.N. and Mishnin, V.M., Problem of searching for PGM deposits in Yakutia, *Vestn. Goskomgeol.*, 2003, no. 2, pp. 13–27.
- Karta anomal'nogo magnitnogo polya (ΔT_a) Rossii i prilegayushchikh akvatorii. Masshtab 1 : 10000000* (Map of the Anomalous Magnetic Field (ΔT_a) of Russia and Adjacent Basins. Scale 1 : 10000000), Litvinova, T.P., and Shmuraeva, N.P., St. Petersburg: VSEGEI, 1995.
- Kiselev, A.I., Egorov, K.I., and Maslovskaya, M.I., Geodynamics of the evolution of kimberlite and basic magmatism in the Vilyui paleorifta, *Otechestvennaya Geol.*, 2002, no. 4, pp. 40–45.
- Kogen, V.S., Gold mineralization of the Sutam cluster (Stanovoi Range), in *Geneticheskie tipy i zakonomernosti razmeshcheniya mestorozhdenii zolota Dal'nego Vostoka* (Genetic Types and Distribution of Far East Gold Deposits), Novosibirsk: Nauka, 1976, pp. 107–111.
- Kushev, V.G., Greenstone deeps (trough complexes) of East Siberian in the system of Archean cratons and Proterozoic mobile belts, in *Dokembriiskie trogovye komplekсы Baikalo-Amurskogo regiona i ikh metallogeniya* (Precambrian Trough Complexes of the Baikal–Amur Region and their Metallogeny), Novosibirsk: IGI SO AN SSSR, 1985, pp. 28–34.
- Levashov, K.K., Middle Paleozoic rift system of eastern Siberian Platform, *Sov. Geol.*, 1975, no. 10, pp. 49–58.
- Masaitis, V.L., Mikhailov, M.V., and Selivanovskaya, T.V., *Vulkanizm i tektonika Patomsko-Vilyuiskogo srednepaleozoiskogo avlakogena* (Volcanism and Tectonics of the Middle Paleozoic Patom–Vilyui Aulacogen), Moscow: Nedra, 1975.
- Mikhailov, V.A., Vilyui metalliferous province and some aspects of its development, *Rossyi, Istochniki, Ikh Genezis I Perspektivy* (Placers, Sources, their Genesis, and Prospects), Yakutsk, Izd-vo YaNTs SO RAN, 2000, pp. 173–179.
- Mineragenicheskaya karta Rossiiskoi federatsii. Masshtab 1 : 5000000* (Metallogenic Map of the Russian Federation. Scale 1 : 5000000), St. Petersburg: VSEGEI, 2008.
- Mishnin, V.M., Badarkhanov, V.I., and Boloznev, V.I., *Yakutskii Megakraton: Netraditsionnye Aspekty Tektoniki i Mineragenii* (Yakutian Megacraton: Non-Traditional Aspects of Tectonics and Metallogeny), Yakutsk: YaF SO AN SSSR, 1987.
- Mokshantsev, K.B., Gornshtein, D.K., and Gusev, G.S., *Tektonicheskoe stroenie Yakutskoi ASSR* (Tectonic Structure of the Yakutian ASSR), Moscow: Nauka, 1964.
- Nikiforova, Z.S., Gerasimov, B.B., Glushkova, E.G., and Kazhenkina, A.G., Gold resource potential of the eastern Siberian Platform: placers and their feeding sources, *Geol. Ore Deposits*, 2013, vol. 55, no. 4, pp. 265–277.
- Nikiforova, Z.S., Geological–structural control and criteria for prediction of types of bedrock sources of placer gold potential of the eastern Siberian Platform, *Izv. Vyssh. Uchebn. Zaved., Geol. Razved.*, 2018, no. 5, pp. 17–24.
- Nikiforova, Z.S., Gerasimov, B.B., Glushkova, E.G., and Kazhenkina, A.G., Indicative features of placer gold for the prediction of the formation types of gold deposits (east of the Siberian Platform), *Russ. Geol. Geophys.*, 2018, vol. 59, no. 10, pp. 1318–1329.
- Okrugin, A.V., Significance of typomorphic Cr-spinels for prediction of bedrock sources of placer platinum of the eastern Siberian Platform, *Otechestvennaya Geol.*, 2005, no. 5, pp. 3–10.
- Polyanskii, O.P., Prokop'ev, A.V., Babichev, A.V., Korobeinikov, S.N., and Reverdatto, V.V., The rift origin of the Vilyui Basin (East Siberia), from reconstructions of sedimentation and mechanical mathematical modeling, *Russ. Geol. Geophys.*, 2013, vol. 54, no. 2, pp. 121–137.

- Rosen, O.M., The Siberian Craton: tectonic zonation and stages of evolution, *Geotectonics*, 2003, vol. 37, no. 3, pp. 175–192.
- Rosen, O.M., Manakov, A.V., and Zinchuk, N.N., *Sibirskii kraton: formirovanie, almazonosnost'* (Siberian Craton: Formation and Diamond Potential), Moscow: Nauchnyi mir, 2006.
- Smelov, A.P., Gabyshev, V.D., Kovach, V.P., and Kotov, A.B., General structure of the basement of the eastern part of the craton, *Tektonika, geodinamika i metallogeniya territorii Respubliki Sakha (Yakutiya)* (Tectonics, Geodynamics, and Metallogeny of the Republic of Sakha (Yakutia)), Moscow: Maik Nauka/Interperiodika, 2001, pp. 108–112.
- Stogny, G.A. and Stogny, V.V., *Geofizicheskie Polya Vostochnoi Chasti Severo-Aziatskogo Kratona* (Geophysical Fields of the Eastern North-Asian Craton), Yakutsk: Sakhapoligrafizdat, 2005.
- Stogny, G.A. and Stogny, V.V., Typification of magnetic heterogeneities in the crystalline basement of the northeastern Siberian Platform, *Otechestvennaya Geol.*, 2006, no. 5, pp. 102–104.
- Stogny, G.A. and Stogny, V.V., Structure of crystalline basement of the Baikal–Patom fold belt and role of regional deep-seated faults in the formation of the Sukhoi Log gold deposit (East Siberia), *Geofizika*, 2016, no. 3, pp. 73–77.
- Tektonika, geodinamika i metallogeniya territorii Respubliki Sakha (Yakutiya)* (Tectonics, Geodynamics, and Metallogeny of the Republic of Sakha (Yakutia)), Parfenov, L.M. and Kuzmin, M.I., Moscow: MAIK. Nauka/Interperiodika, 2001.
- Timofeev, V.I., Placer gold potential of the Vilyui River basin, *Okhr. i Razved. Nedr*, 1965, no. 6, pp. 1–5.
- Timofeev, V.I., Nesterov, N.V., and Shchpunt, B.R., *Gold potential of Western Yakutia, Mater. po geologii i poleznym iskopaemym Yakutskoi ASSR (Proc. Geol. Mineral Resour. Yakutian ASSSR)* Vypusk XVII. Yakutsk, 1970.
- Trushkov, Yu.N., Izbekov, E.D., Tomskaya, A.I., and Timofeev, V.I., *Zolotonosnost' Vilyuiskoi sineklizy i ee obramleniya* (Gold Potential of the Vilyui Syncline and its Framing), Novosibirsk: Nauka, 1975.