Types of Primary Sources of Placer Gold of the East Siberian Platform (Lena-Viluy Interfluve)

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Abstract. Wide scattering halo of shotty and thin fine-gold with unidentified commercial placers and primary sources is typical for the eastern Siberian platform, particularly for the central part of Viluy syneclise. Forecast and exploration of primary sources of placer gold is a very urgent goal for the areas, covered by thick cover of sedimentary deposits, and identification of their formation belonging affects selection of the general direction of exploration and evaluation of gold deposits. Indicators, typical for gold-quartz-lowsulfide, gold-silver and gold-platinoid formations of primary sources are identified for the first time according to generalization of available materials on mineralogic-geochemical features of placer gold from the Lena-Viluy interfluves (Estern Siberian platform).

1. Introduction

The aim of this study is to solve a fundamental problem – to forecast primary sources of gold and identification of their formation belonging, based on generalization of materials on mineral-geochemical characters of placer gold and nature of its distribution in platform areas, overlain by thick layers of sedimentary deposits. Actuality of this project is related to identification of primary gold deposits in the eastern part of the Siberian platform (Lena-Viluy interfluve), where range of placer gold scattering is widely distributed, with unidentified primary sources. Detailed study of mineralogical-geochemical features of placer gold, which can preserve “genetic memory” of its primary sources, greatly helps to determine relation of gold-bearing placers with primary sources. Large set of the known mineralogical and geochemical methods of studying features of placer gold is used to solve these problems. Obtained data will allow to identify formation type of primary sources, and hereby, increase the accuracy of the forecast and purposefulness of prospecting primary sources of gold in certain areas. Vilyui region is among the first gold districts discovered on the territory of Yakutia. Findings of large amounts of placer gold in fluvial deposits of the Vilyui r. have aroused considerable interest in this territory as a potentially gold-bearing province.

The study area (Figure 1) is at the centre of the Siberian platform (southern flank of the Vilyui syncline). It is mainly made of Mesozoic and partly of Middle Paleozoic rocks, which are, for the most part, overlain by Quaternary deposits. Magmatic rocks are widespread only on the western margin of the Vilyui syneclise. They are represented by Permo-Triassic traps and, in the area of the Markha-Vilyui interfluve, by basaltic sheets of Middle Paleozoic age.

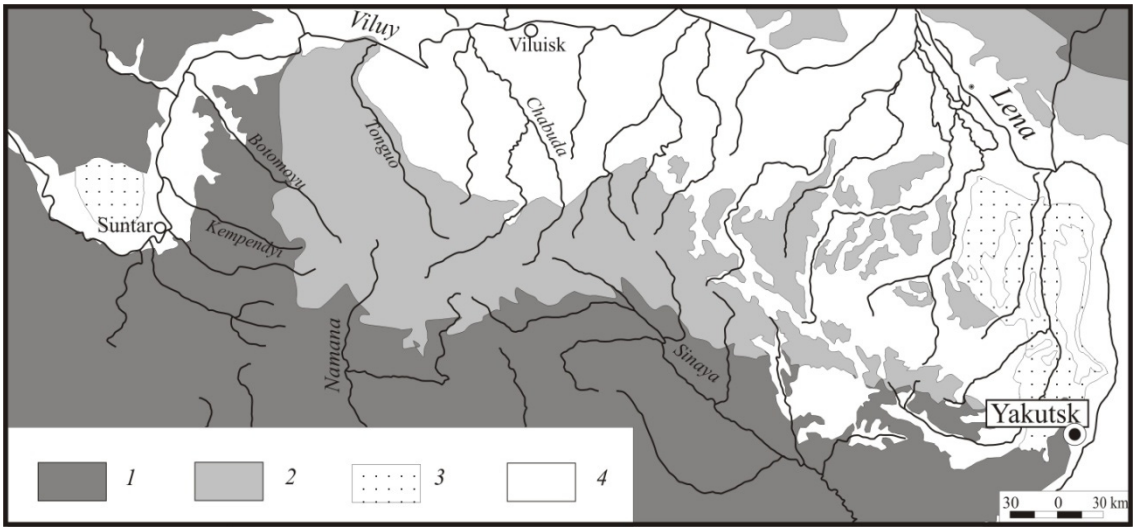


Figure 1. Schematic map of the Lena-Vilyui interfluve

1-Jurassic sediments, J; 2-Cretaceous sediments, K; 3 -Neogenesediments, N; 4- Quaternary, Q

The paper presents the results of studying mineralogical-geochemical characteristics (morphology, fineness, trace elements, microinclusions, internal structure, etc.) of placer gold from fluvial deposits of different streams in the Lena-Vilyui interfluve area (eastern Siberian platform). The previous studies of gold mineralization in the region are briefly discussed using published and unpublished data.

2. Previous studies

Gold placers have been already known in the study area for more than 150 years. P. Klark was the first to report on the gold placers in the river basin of Vilyui as early as 1861. But still the genesis of gold placers and their primary sources remain unknown. Opinions differ as to the types of bedrocks responsible for the formation of the extensive dispersion halo of gold in the Lena-Vilyui interfluve area. Some authors such as Zverev [1] and Obruchev [2] put forward a hypothesis assuming that the main primary sources for platinum and gold in the Vilyui placers were the rocks of trap magmatism. They came to this conclusion after finding gold occurrences in the endocontact zone of trap bodies with carbonate rocks (Khapchan Mt. on the Ygyatta r. and Krestovaya Mt. on the Akhtaranda r.). They also documented high gold concentrations in conglomerates occurring nearby the traps. Rzhonsnitsky [3] explained the formation of gold placers in the Lena-Vilyui interfluve area by the erosion of ore bodies in the Vitim-Patom highlands and transportation of the eroded material in the Jurassic, as well as by gold supply from the trap fields. Masaitis et al [4] believed that one of the sources of modern placers was gold ore deposits (with up to 1 g/t Au) genetically associated with basic magmatism. The data obtained by Istomin and Mishnin [5] substantiate the existence of an Early Proterozoic mobile belt with widely manifested basic magmatism in the study area. According to them, gold mineralization of Precambrian age was related to this belt.

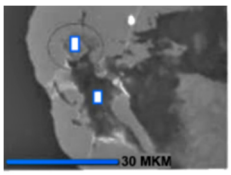
3. Methods and samples

To define the fineness, trace elements and mineral inclusions of gold particles, they were fixed in epoxy. Gold flakes and platelets were placed vertically to avoid their loss on polishing. This enabled to have an optimum section of a gold particle for further studies, in which a high-fineness external coat developed in exogenic conditions and the unaltered central part could be well seen. This method permits establishing the primary endogenic nature of gold. Quantitative relations between gold and trace elements (Ag, Cu, Hg) were determined. Studies were conducted on a Cameca “Camebax-

Micro" microanalyser. Three to five measurements were made in the central and marginal parts of gold particles. It is only the results of measuring the relics of primary gold that were taken into consideration. The content of trace elements in the placer gold (samples with a weight of 5 mg) was determined by the atomic-emission spectrum analysis with the use of a spectrograph. To study the microinclusions in gold, the energetic spectrometer "Oxford" INCA-sight and the scanning microprobe JEOL JSM-6480 LV were used. To provide a prompt search of microinclusions and to differentiate between gold of different fineness, the grains were studied in back-scattered electrons with the use of a navigator Point ID. The analyses were all made at the laboratory of physico-chemical methods of analysis, IGABM, SB RAS.

4. Results and Discussions

Detailed mineralogical study of placer gold from channel fill and Quaternary deposits of numerous water courses of the Lena-Viluy interfluve (East Siberian platform) was carried out. More than 300 objects were analysed in all, herewith, morphologic features of gold, particle-size distribution, fineness, composition of trace elements, internal structure and presence of microinclusions were studied. Obtained results suggest the following conclusions.



Processing option : All elements analysed

Spectrum	Inclusion	Au	Ag	Total
1	Native silver	4.94	88.81	93.75

All results in weight, %

Figure 2. Microinclusion of native silver in placer gold

Determined indicator signs of placer gold, specifically high fineness (950-999 ‰), increased Cu content (up to 1.47%), micromineral inclusions of pyrite, arsenopyrite, quartz and carbonates, existence of recrystallization structures, lines of plastic deformation are typical for primary sources of low-sulfide gold-quartz formation (Figure 3).

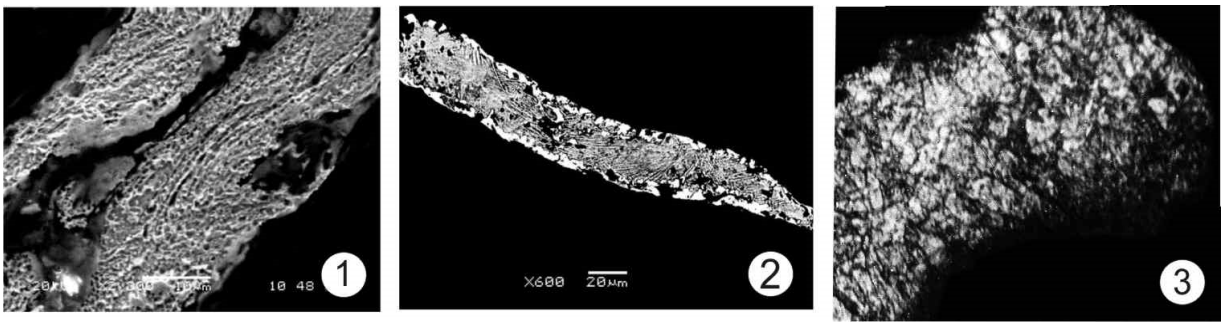
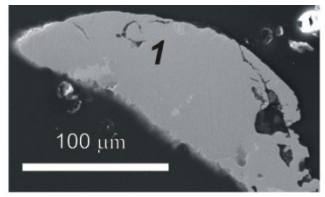


Figure 3. Internal structure of placer gold
1 – 2 – lines of plastic deformation (1 – x2300; 2 – x600); 3- recrystallization structures (x2000)

Discovery in placer gold (Kempendaу dislocation zone) of such indicator signs as high Ag content up to 47.7%, increased Hg content up to 1.46%, presence of wide range of trace elements Pb, Zn, As, Sb, Te, and microinclusions – strontium barite, native silver (Figure 2), adularia, calcite, cerebriform, porous internal structure and two-phase gold indicate generation of shallow low-temperature primary sources of gold-silver formation, paragenetically related to acid volcanism of andesite-dacite composition. We note that anomalously elevated concentrations of gold, chalcedony-like quartz, barite, and hematite are observed in fluvial alluvium of these rivers. The revealed indicators of placer gold correspond with well-known deposits of gold-silver formation. Complex of indicator signs,

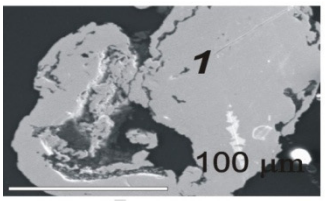
identified in placer gold – increased Cu content (up to 2.22%), permanent existence of trace elements Pt, Pd and Ni, as well as inclusions of exotic mineral phase of platinum group (Figure 4) gives basis to forecasting of the presence of primary sources of gold-platinoid formation within the Suntar arched uplift.



Processing option : All elements analysed

Spectrum	Inclusion	O	Al	Si	Ti	Cr	Pt	Au	Total
1	Exotic phase Pt	25.85	2.92	5.82	3.15	11.59	10.03	17.72	77.08

All results in compound, %



Processing option : All elements analysed

Spectrum	Inclusion	O	Al	Si	Ti	Cr	Fe	Pt	Au	Total
1	Exotic phase Pt	18.07	2.57	2.81	9.42	1.24	1.75	6.89	21.23	63.98

All results in compound, %

Figure 4. Microinclusions of exotic mineral phase of platinum group in placer gold

5. Conclusions

Based on the mineralogical and geochemical features of alluvial gold from eastern part of the Siberian platform are identified the indicator signs which meeting certain formational types of primary sources. The complex of identified mineralogical-geochemical features of placer gold from different watercourses of the Lena-Viluy interfluve (East Siberian platform) allows forecasting primary sources - gold-quartz-low sulfide, gold-silver and gold-platinoid formations for the first time.

Acknowledgement(s)

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