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Origin OF Gold Ores in Black-Shale Hosted Deposits OF the Bodaybo Region, Russia

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1 Introduction

The Bodaybo Au-bearing region (the Baikal orogenic belt) is one of the largest one in Russia. It hosts the well-known giant Sukhoi Log deposit (over 2 000 t Au) as well as several smaller deposits (Verninskoye, Golets Vysochayshiy, etc.). All Au deposits of the Bodaybo region are hosted by Upper Proterozoic black shales.

There are two main genetic models of Sukhoi Log deposit formation that are also applicable to other Au-deposits of the Bodaybo region: 1) metamorphic-hydrothermal model (Buryak, 1982) suggests sedimentary rocks as a source of metals and regional and dynamic metamorphism as a trigger for ore formation; 2) magmatic-hydrothermal model suggests relation between Au mineralization and a hypothetic deep seated granite intrusion (Distler et al., 2004). The latter model assumes that fluids and metals, at least partly, were of magmatic origin.

This research is aimed to describe rather small Au-deposits of the Bodaybo region: Kopylovskoe, Kavkaz and Krasnyi and to compare them with the data available for larger and better studied deposits of the same region.

2 Host Rocks

Kopylovskoye and Kavkaz deposits are hosted by the Dogaldyn Formation and the Krasnyi deposit is hosted by the Vacha Formation. The aforementioned formations overlie the Khomalkho Formation which hosts the Sukhoi Log deposit.

Host rocks of the three studied deposits are similar in composition. Main minerals are quartz, feldspars, and mica (illite, muscovite, and paragonite). Metacrystals of ferrous carbonates are wide-spread. Florencite is a typical authigenic mineral for Dogaldyn Formation. Average C_{org}

content in the black shale is about 2% in the Dogaldyn Formation and up to 7% in the Vacha Formation. Carbonaceous matter is present as graphitoid (kerogen) with very low hydrocarbon contents. The host rocks underwent greenschist metamorphism (muscovite facie). Petrography and REE geochemistry (the absence of Ce and Eu-anomaly) suggest metamorphic origin of mica (fig. 1) (Palenova et al., 2013).

3 Ore Mineralogy

Au-mineralization occurs in three types: 1) sulphide veinlet-disseminated type with veinlets concordant to host rock schistosity; 2) carbonate-quartz veins cross-cutting the schistosity; and 3) stockwork zones.

Pyrite is the main ore mineral. It occurs as three morphological types: 1) syn-sedimentary and diagenetic pyrite (Py1) forms framboids, nodules, fine-grained aggregates; 2) catagenetic and/or metamorphic pyrite (Py2) forms metacrystals and medium-grained aggregates with relics of Py1 and inclusions of native gold and Ni, Co, As minerals; 3) euhedral cubic coarse-grained pyrite without gold inclusions, widely distributed in host rocks of the studied region. EMPA and LA-ICP-MS study showed Py1 is enriched in trace elements (Au, Ag, Te, Sb, Pb, Cu, Zn, Mo and Co). In Py2 trace element contents are generally lower but more variable.

Pyrrhotite, chalcopyrite, galena, pentlandite, gersdorffite, millerite, cobaltite, and native gold of high fineness (700 to 940‰) are also common ore minerals.

4 Pb-Pb Isotope Geochemistry

Pb isotopes data were analyzed in pyrite from Kavkaz and Kopylovskoye deposits by MC-ICP-MS. $^{206}\text{Pb}/^{204}\text{Pb}$, $^{207}\text{Pb}/^{204}\text{Pb}$ и $^{208}\text{Pb}/^{204}\text{Pb}$ ratios are 18.272 to 18.291, 15.627 to 15.632 and 38.337 to 38.500, respectively, for Kavkaz

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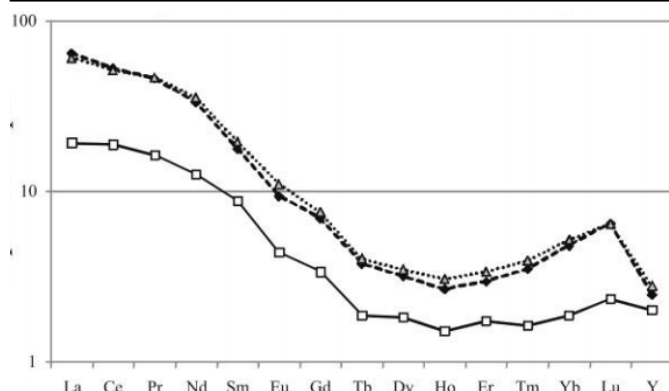


Fig. 1. Chondrite normalized REE pattern of black shale of Kopylovskoye (black rhombs), Kavkaz (grey triangles), and Krasny (white squares).

and 18.155 to 18.202, 15.602 to 15.627 and 38.226 to 38.237, respectively, for Kopylovskoye. Obtained Pb-Pb data suggest common geochemical type of the source of Pb for these deposits, which by the Doe Zartman model can be identified as "crustal". Such Pb-Pb signatures are similar to those obtained for the Sukhoi Log, Golets Vysochayshiy and Verninskoye deposits (Chernyshev et al., 2009 and unpubl. data).

5 Discussion

The studied deposits are similar to the Sukhoi Log deposit in structure, grade of host rock metamorphism, carboniferous matter presence, and ore assemblages.

Detailed isotope studies ($\delta^{18}\text{O}$, $\delta^{34}\text{S}$, $\delta^{13}\text{C}$, Pb-Pb, $^{87}\text{Sr}/^{86}\text{Sr}$) of the Sukhoi Log deposit (Chang et al., 2008; Ikonnikova et al., 2009) identified the primary role of terrigenous-carboniferous rocks in the formation of Au-bearing mineralization. Moreover, trace element distribution in different generations of pyrites from Sukhoi Log convincingly demonstrated the possibility of the base and precious metals extraction from the organic matter and the diagenetic pyrite (Large et al., 2007).

Comparison of the obtained data for three deposits

studied with that for large deposits (Sukhoi Log, Verninskoye, Golets Vysochayshiy) proves the absence of stratigraphic control of Au mineralization, regional scale of ore-forming processes and low probability of any relation to a hypothetical deep-seated pluton.

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References

- Buryak, V.A. 1982. Metamorphism and Ore Formation. Nedra, Moscow. 256 pp. (in Russian).
- Chang Z., Large R.R., Maslennikov V., 2008. Sulfur isotopes in sediment-hosted orogenic gold deposits: Evidence for an early timing and a seawater sulfur source // *Geology*, 38: 971–974.
- Chernyshev I.V., Chugaev, A.V. Safonov Yu.G., Saroyan M.R., Yudovskaya M.A., Eremina A.V., 2009. Lead isotopic composition from data of high-precision MC-ICP-MS and sources of matter in the large-scale Sukhoi Log noble metal deposit, Russia. *Geology of Ore Deposits*. V. 51 (6). P. 496–504
- Distler V.V., Yudovskaya M.A., Mitrofanov G.L., Prokof'ev V.Y., Lishnevskiy E.N., 2004. Geology, composition and genesis of the Sukhoi Log noble metals deposit, Russia. *Ore Geology Reviews*, 24: p. 7–44.
- Ikonnikova T. A., Dubinina E. O., Saroyan M. R., Chugaev A. V., 2009. Oxygen isotopic composition of quartz veins and host rocks at the Sukhoi Log Deposit, Russia. *Geology of Ore Deposits*, 51(6): 505–512.
- Large R.R., Maslennikov V.V., Robert F., Danyushevsky L.V., Chang Z., 2007. Multistage sedimentary and metamorphic origin of pyrite and gold in the giant Sukhoi Log Deposit, Lena gold province, Russia. *Economic Geology*, 102: 1233–1267.
- Palenova E.E., Belogub E.V., Novoselov K.A., Zabolotina M.V., 2013. Mineralogic and geochemic characteristic of the black shales from gold ore objects, Artemovsk ore area (Bodaybo region). *Proceedings of the Siberian Branch of the Earth Sciences Section of the Russian Academy of Natural Sciences. Geology, prospecting and exploration of ore deposits*, 43 (2): 29–36. (in Russian)