Gold mining area of the Yenisei Ridge in the East Siberia is one of the largest in Russia in terms of production and reserves of gold. Large gold deposits, including the world-class ones, are localized here among the Precambrian metamorphic rocks. They belong to two different age types. The first vein gold-quartz type includes a number of deposits with average gold reserves (Eldorado, Ayakhta, Vasilevskoye and others), the largest of them is the Sovetskoye deposit. Ores are represented by low-sulfide quartz veins, vein zones and stockworks with pyrite, arsenopyrite and coarse gold. The second Au-As (± Sb) type is represented by voluminous deposits of disseminated ores of pyrite-arsenopyrite composition with a fine-grained gold in black shales. It includes such unique deposits as Olympiada and Blagodatnoye, as well as a number of large and medium-scale deposits such as Veduga, Poputninskoye, Titi mukhta, Bogolyubovskoye, Panimbinskoye, and many others. A specific feature of this type deposits is the spatial coincidence of gold and antimony mineralization of different ages. The latter occurs at all deposits of this type and has commercial importance at the Olympiada and Uderey deposits. The most important and yet unsolved genetic problems of these deposits is determination of their age and relation to magmatism. The recent literature data (Sazonov et al, 2007; Vernikovsky et al, 2006, 2008; Nozhkin et al, 2008, 2011; Vrublevsky et al, 2011, etc.) and our results on the dating of rocks and gold mineralization (U-Pb, Ar-Ar and Re-Os methods) provide a new approach in solving these problems.

The age of gold-quartz mineralization of the Sovetskoye deposit established by the newly formed sericite from the quartz-sericite-arsenopyrite (gold-arsenopyrite mineral assemblage) veinlet with native gold intersecting the early metamorphic quartz vein is 820.3 ± 8.2 Ma. The younger recovered high-grade coarse gold in pyrite-muscovite veins intersecting altered shales with arsenopyrite also occur at this deposit. The Ar-Ar age of muscovite from these veins is 775.8 ± 8.1 Ma. The similar age of the early quartz-sericite-arsenopyrite veins with native gold was also established at the Veduga gold deposit (805 ± 6.3 Ma).

Based on the available published isotopic-geochronological data and the authors' dating (U-Pb, Ar-Ar, and Re-Os methods) of rocks and ore mineral assemblages from the Olimpiada deposit, we propose the following chronology of Neoproterozoic metamorphic, magmatic, and ore-forming processes:

1) granitoids of the Teya complex: 976 ± 4.7 Ma (U-Pb); 2) granites of the Tyradinsky intrusion with which rare metal Mo-W mineralization is associated: 894.1 ± 4.7 Ma (U-Pb);
3) regional metamorphism and formation of associated pyrite-pyrrhotite mineral association: > 800-775 Ma (Likhanov et al, 2011, 2013);
4) intrusion of granitoids of the Ayakhta complex, contact metamorphism and associated pyrite-pyrrhotite mineralization: 760-750 Ma (Vernikovsky et al 2006, 2008);
5) mineral assemblages of gold mineralization: gold-arsenopyrite, gold-poly sulfide and berthierite antimonite, the time span of which is in the interval of 750-650 Ma;

The time of formation of gold-arsenopyrite mineralization of the main stage (parageneses with acicular and elongated-prismatic arsenopyrite) have been established using Re-Os dating of the acicular arsenopyrite by isochron is 689 ± 28 Ma (Fig. 1) and close age (Ar-Ar) have the newly formed associating muscovite, which is compatible with the age of alkaline mafic rocks of the
Zahrebetinskiy complex. The Ar-Ar age of antimony berthierite-antimonite mineralization is 672.7 ± 4.1 Ma that correlates with the age of the Chapinskiy alkaline picrite-lamproite, Zahrebetinskiy gabbro-nepheline syenite, Chivindinskiy trachybasaltic, Srednetatarskiy jilolite-foyaite and Penchenginsky fenite-carbonatite complexes.

So, the formation of the main productive mineral associations of gold mineralization of the Olympiada ore field (gold-arsenopyrite, gold-polysulfide, berthierite-antimonite) as well as the Veduga and Uderey deposits covers the time span of 714 - 640 Ma that corresponds to the occurrence of mafic alkaline, alkaline, and alkaline granitic magmatism within the Yenisei Ridge structures.

According to time of formation, gold-sulfide mineralization and manifestations of rift magmatism within the Yenisei Ridge correspond to the stage of large-scale development of mafic and alkaline magmatism of the Franklin large igneous province and associated Cu-Ni-Pt (Kingshashkoe, Verhne-Kingshashkoe, Yoko-Dovyren etc.), TR-REE-carbonatite (giant Tomtor deposit in the Anabar shield and a number of manifestations in the Aldan shield) and Au-As mineralizations in the Siberian and North American cratons (Vladykin et al., 2014).

References