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The Study of Fine and Nanoscale Gold in the Ores of Primary Deposits and Gold-Bearing Placers of Kazakhstan

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Abstract : The article discusses the problem of developing a methodology for studying thin and nanoscale gold in ores and placers of primary deposits, which will allow us to develop schemes for revealing dispersed gold inclusions and thus improve its recovery rate to increase the gold reserves of the Republic of Kazakhstan. The type of studied gold, is characterized by a number of features. In connection with this, the conditions of its concentration and distribution in ore bodies and formations, as well as the possibility of reliably determining it by "traditional" methods, differ significantly from that of fine gold (less than 0.25 microns) and even more so from that of larger grains. The mineral composition of rocks (metasomatites) and gold ore and the mineralization associated with them was studied in detail on the Kalba ore field in Kazakhstan. Mineralized zones were identified and samples were taken from them for analytical studies. The research revealed paragenetic relationships of newly formed mineral formations at the nanoscale, which makes it possible to clarify the conditions for formation of deposits with a particular type of mineralization. This will provide significant assistance in developing a scheme for study. Typomorphic features of gold were revealed, and mechanisms of formation and aggregation of gold nanoparticles were proposed. The presence of a large number of particles isolated at the laboratory stage from concentrates of gravitational enrichment can serve as an indicator of the presence of even smaller particles in the object. Even the most advanced devices based on gravitational methods for gold concentration provide extraction of metal at a level of around 50%, while pulverized metal is extracted much worse, and gold of less than 1 micron size is extracted at only a few percent. Therefore, when particles of gold smaller than 10 microns are detected, their actual numbers may be significantly higher than expected. In particular, at the studied sites, enrichment of slurry and samples with volumes up to 1 m^3 was carried out using a screw lock or separator to produce a final concentrate weighing up to several kilograms. Free gold particles were extracted from the concentrates in the laboratory using a number of processes (magnetic and electromagnetic separation, washing with bromoform in a cup to obtain an ultracontentrate, etc.) and examined under electron microscopes to investigate the nature of their surface and chemical composition. The main result of the study was the detection of gold nanoparticles located on the surface of loose metal grains. The most characteristic forms of gold secretions are individual nanoparticles and aggregates of different configurations. Sometimes, aggregates form solid dense films, deposits, and crusts, all of which are confined to the negative forms of the nano- and microrelief on the surfaces of golden. The results will provide significant knowledge about the prevalence and conditions for the distribution of fine and nanoscale gold in Kazakhstan deposits, as well as the development of methods for studying it, which will minimize losses of this type of gold during extraction.

Keywords : electron microscopy, micromineralogy, placers, thin and nanoscale gold
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