Training of Specialists and Masters on Geology in the Field of Placers, Technogenic Deposits and Research the Microstructures of Substance in Perm University

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Abstract

Placers and man-made (technogenic) deposits are an important resource for mining in the world. The geological department of the University of Perm has being training of specialists, bachelors, masters and PhDs in placer and technogenic deposit geology since 1961. A scientific school has been formed to study the structure and composition of alluvium deposit and placers. Specialized concentrating complexes and techniques have been developed that allow for prospecting and exploration for placers of gold, platinum, diamonds, zirconium-titanium minerals. Much attention is paid to the study of the geology of technogenic-mineral formations.

The consolidation of knowledge and practical work skills occurs during the period of specialized training practice in the search and exploration of minerals. The practice takes place on alluvial deposits and man-made objects of the Western Urals, the Krasnoyarsk Territory, Khakassia and Tuva. While studying, students write scientific articles and take part at scientific conferences. The materials of educational and industrial practices are the basis for the implementation of term, graduate and thesis bachelors and specialists, master's theses. Over the past 10 years, more than 150 graduates have been trained for industrial, scientific, and research organizations.

Keywords: Training, specialists and masters on geology, field of placers, technogenic deposits, Nano-sculpture the surface of gold.

Introduction

Placers and man-made (technogenic) deposits are an important resource for mining in the world. Placers are among the deposits mastered by mankind since ancient times. These attract attracted attention primarily due to the ease of their development, simplicity and low cost of extracting useful minerals from them. Placers and now continue to play an important role as sources of many types of mineral raw materials - gold, platinum, diamonds, cassiterite, zirconium-titanium minerals, amber and other minerals. Technogenic placers remain in the form of dumps and landfills after the development of natural alluvial deposits and are also an important source of mineral raw materials in the world.

Therefore, the training of qualified specialists in the field of geology of placers, technogenic deposits and microstructure research of substances is an important task. The Geology Department of the Perm University has being training of specialists, bachelors, masters and PhDs in placer and technogenic deposit geology since 1961. A scientific school has been formed to study the structure and composition of alluvium deposits and placers. The main topics are fine grains of minerals of useful. Perm University twice (2005, 2015) held international meetings at which reports on placer geology were discussed.

In the study of placers, we use standard and innovative approaches. Specialized concentrating complexes and techniques have been developed for prospecting and exploration of gold, platinum, diamonds and zirconium-titanium minerals placers. Much attention is paid to the study of technogenic-mineral complexes. During the course the students firstly obtain basic

geological knowledge. Then they study the special courses Geology of placers", "Alluvial lithogenesis", "Panning method", "Geology of technogenic deposits", "Fine valuable minerals", "Mineral processing (geological approach)". Published textbooks, manuals and monographs are used in the educational process (Lunev and Naumova, 2005, 2011; Osovetsky, 2009, 2012, 2013; Osovetsky and Naumova, 2014; Naumov, 2011). Special courses are given by professors of Perm University, as well as visiting professors from other universities, scientific and industrial organizations. Academician N.A. Shilo, Doctor of Geology, Professor N.G. Patyk-Kara, Doctor of Geology, Professor A.V. Korobitsyn, Doctor of Geology, Professor Yu.V. Shumilov, Doctor of Geology, Professor A.G. Barannikov, Doctor of Geology, Professor A.V.Lalomov at various times have deen working at the Department of Mineral Exploration and Prospecting at the Perm University. Canadian placer geologists W. LeBarge and Alejandra Duk-Rodkin lectured to undergraduate and graduate students.

Field studies

Specialists in the geology of placers in the world use standard concentrating complexes and technologies for prospecting and exploration of gold, platinum, diamond and zirconium-titanium placers. The peculiarity of our approach is that the Perm University has developed a unique enrichment plant "Small Valuable Minerals". This is a combination of processing equipment: screen (sieve), screw separator and screw gateway. This installation is compact and easy to use. It showed good results in the enrichment of placers deposits.

The consolidation of knowledge and practical work skills occurs during the period of specialized training practice on the prospecting and exploration of minerals. The practice takes place on alluvial deposits and man-made objects of the Western Urals, at enterprises and deposits of the Krasnoyarsk Territory, Khakassia and Tuva with participation of the students of Oxford University (UK) and China Petroleum University (China, Qingdao).

Specialized geological practice of the students is carried out in accordance with the curriculum approved by the Educational-Methodical Council of the Geological Department of Perm State National Research University. The practice is organized in order to consolidate the theoretical knowledge of students on the courses: "Petrography", "Mineralogy", "Structural Geology". The form of practice is geological excursion. The main tasks of the practice are developing the skills of field geological research, collecting sampels of rocks, ores and fossilized remains of ancient flora and fauna, materials for students research, replenishing educational geological collections.

The practice areas are the geologically well-studied placers of the Eastern Sayan, the eastern slope of the Kuznetsk Alatau, the Minusinsk Intermountain Trough, and the Tuva Basin. Students independently conduct field testing of gold placers on the "Small Valuable Minerals" installation. The objects of excursions are mineral deposits of more than 10 geological and industrial types, Paleozoic and Mesozoic stratotypical cuts, standards of ore-bearing igneous complexes, geological sights and natural monuments of world and federal rank. All objects of practice are well naked.

The organizational forms of practice are bus and walking tours. The organization of life are accommodation in tent camps andmeals in the field. The time and the main places of practice coincide with the time and places of practice for geological students from leading universities in Siberia: Tomsk Polytechnic University, Novosibirsk, Siberian and Tomsk State Universities. Students and teachers have the opportunity to meet, establish business contacts and make friends with colleagues. Duration of practice is 13 days. Excellent climate, good nudity, diversity of geological structures are very useful for educational geological practice of geological students.

During the internship, students visit unique deposits at the Kuznetsk Alatau (Kommunarovskoe gold ore, Sorskoye copper-molybdenum, and Teysk skarn-magnetite); in the Minusinsk depression (bentonite, coal); in the Western Sayan (Kibik-Kordonskoe marble, Abaza iron ore); in the Tuva intermountain trough (chrysotile asbestos Ak-Dovurak, coal). At

some deposits (gold Tardan, gold placers of the Bai-Syut River, Saraly) and in the river valleys (Yenisei, Abakan, Kea-Khem, Bia-Khem, their tributaries), students conduct field testing, assess the gold-bearing nature and man-made formations. They get practical skills in using pans (prospector's tray) and spiral concentrators. Students use the enrichment plant «Small Valuable Minerals » for enriching samples and trapping fine gold.

Laboratory research

At the laboratory stage, students process samples and carry out particle size, mineralogical and petrographic analyzes.

Samples taken in the field arestudied according to the following scheme:

1) drying; 2) magnetic and electromagnetic separation; 3) isolation of the heavy fraction (minerals with specific gravity over 2.9 g/cm^3); 4) research under a binocular microscope of minerals and gold. They detect gold sizes, determine the coefficients of flatness, sphericity, roundness and describe gold morphology.

Modern scientific equipments are used for research such as a compact powder diffractometer D2 Phazer (Bruker) for X-ray diffraction analysis, a JSM-6390LV microscope (Jeol) and EDS energy dispersive spectrometer (Oxfordinstruments) for electron microscopy and microprobe analysis; a JSM-7500F microscope (Jeol) for high-resolution electron microscopy; an X-ray fluorescence spectrometer S8 Tiger (Bruker) for an X-ray fluorescence analysis, an thermal analyzer of the synchronous thermal analysis STA 409 Luxx with detectors for thermogravimetric

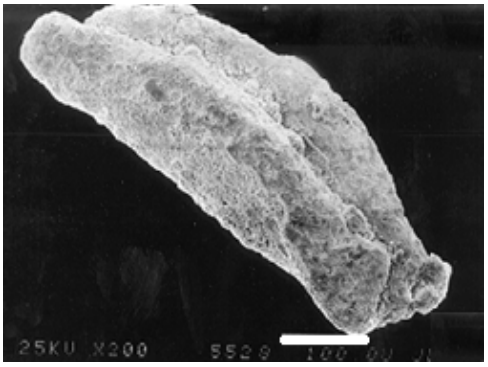

Figure 1 *Gold from man-made dumps (Kytylym placer, Sverdlovsk region), general view of grains. Scale line is 100 mkm*

Figure 2 *New formations on the surface of gold. Increase (number of times) - 12000*

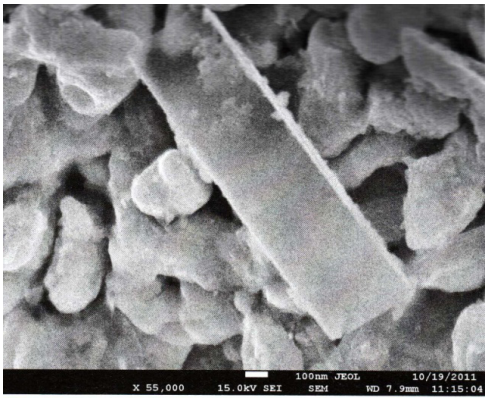

Figure 3 *New formations on the surface of gold (nanofilm). Scale line is 100 nm*

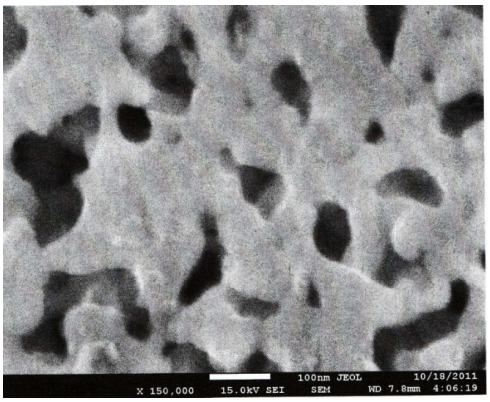

Figure 4 *New formations on the surface of gold (nanopores). Scale line is 100 nm*

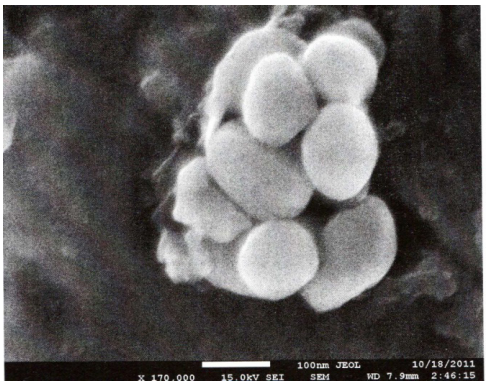

Figure 5 *New formations on the surface of gold (inclusions of micro- and nanoparticles of halite). Scale line is 100 nm*

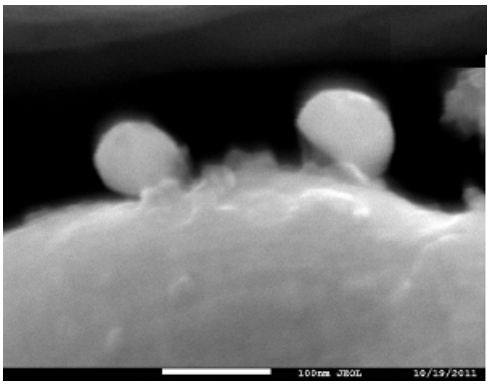

Figure 6 *New formations on the surface of gold (single particles of colloidal gold). Scale line is 100 nm*

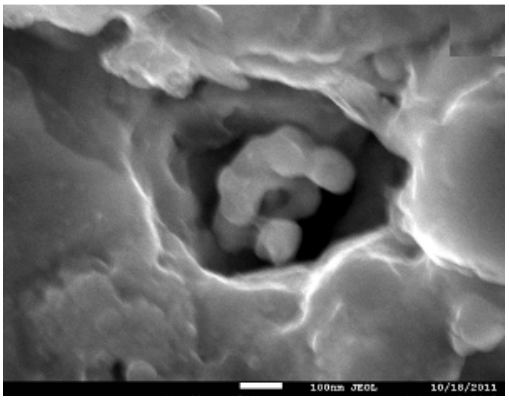

Figure 7 *New formations on the surface of gold (gold nanoparticles in the fossa). Scale line is 100 nm*

analysis, an atomic absorption spectrometer MGA-915 (Lumex) for atomic absorption analysis. Granulometric analysis of terrigenous rocks, petrographic and mineralogical studies, including those on Nikon Eklipsis 100 Pol microscopes (Nikon) are used too. Some results of these studies are shown in Fig. 1-7. The practical experience gained while working with gold on modern equipment is used by students in their professional activities. Special training and obtaining certificates of users on software systems, such as Micromine and others are applied for specialized research and synthesis of materials.

When working at one of the deposits of the Yenisei Ridge, students mined and transferred more than 70 grams of gold to the enterprise. During training students have been participating at scientific conferences of different levels: «Minerageny of ancient and modern oceans» (Miass), «Geology of the Western Urals», «Geology in the Developing World», «Readings in Memory of N.P. Chirvinsky» (Perm), Lomonosov readings (Moscow) and others with publishing the results of research. Usually students have from 1 to 4 publications.

Conclusions

The Department of Prospecting and Exploration of Minerals of Perm State University obtained the state accreditation

of the educational master program on the geological profile «Geology of gold deposits and fine valuable minerals». This program is unique. Masters of such profile are trained only at Perm University and nowhere else. Master's training is planned for both Russian foreign specialists.

While studying, students write scientific articles and take part at scientific conferences. The materials of educational and industrial practices are the basis for the implementation of term, graduate and thesis bachelors and specialists, master's theses. Over the past 10 years, more than 150 graduates have been trained for industrial, scientific, and research organizations. Improving the quality of geological education in the future can be achieved by increasing the volume of field practices, as well as the development of existing courses and the addition of new special courses on detailed studies of the substance.

Geological education at Perm University prepares specialists who are able to solve different scientific and production problems of scientific and technical research at the modern level.

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