

The Federal State Institution
of Science

Zavaritsky Institute of Geology and Geochemistry

Russian Academy of Sciences
Ural Branch

Ekaterinburg 2013





A.N. Zavaritsky Institute of Geology and Geochemistry (www.igg.uran.ru), a leading academic institution in the field of Earth Sciences in the Urals, was established in 1939 as the Mining and Geology Institute, UB of the USSR Academy of Sciences. After the separation of the Geophysics and Mining Departments into independent institutions, the Mining and Geology Institute was transformed into the Institute of Geology, and in 1966 it was renamed the Institute of Geology and Geochemistry. In 1970 the Institute was named after academician A.N. Zavaritsky. At present, the Institute has about 150 employees, including 90 researchers, 2 academicians, 3 corresponding members of RAS, 15 doctors in geology and mineralogy, and 45 candidates of sciences. Thirty nine employees have an age not exceeding 35 years. The Institute has "Geoanalitik" Analytical Centre.

The Institute Structure

Research units

- Laboratory of Stratigraphy and Paleontology
- Laboratory of Regional Geology and Geotectonics
- Laboratory of Paleovolcanism and Regional Geodynamics
- Laboratory of Petrology and Magmatic Formations
- Laboratory of Lithology
- Laboratory of Geochemistry and Ore-Forming Processes
- Laboratory of Physical and Chemical Research
- Hydrogeology and Geoecology Group

Scientific support units

- Library
- Information Section
- Electronic Communication

Production subdivisions

- Polishing workshop
- Garage

Management



**Director
Academician
of RAS,**
Doctor of Geology
and Mineralogy
**Sergey L.
Votyakov**



**Deputy Director
for Science**
Cand. Sc.
in Geology
and Mineralogy
Elena V. Anikina



**Scientific
Secretary**
Cand. Sc.
in Geology
and Mineralogy
**Tatyana A.
Osipova**



**Deputy Director
for General
Issues**
**Evgeniy V.
Gorchakov**

Scientific Council

S.L. Votyakov, RAS Academician (Chairman); **T.A. Osipova**, Cand.Sc. (Scientific Secretary); **E.V. Anikina**, Cand.Sc. (Vice-Chairman); **A.I. Grabezhev**, Doc. Sc.; **K.K. Zoloyev**, RAS corr. member; **K.S. Ivanov**, Doc. Sc.; **U.K. Ivanov**, Cand.Sc.; **A.Y. Kisin**, Doc.Sc.; **V.A. Koroteev**, RAS Academician; **A.A. Krasnobaev**, Doc. Sc., Prof.; **A.V. Maslov**, RAS corr.member; **K.N. Malitch**, Cand.Sc.; **G.A. Mizens**, Doc.Sc.; **V.V. Murzin**, Doc. Sc.; **E.V. Pushkarev**, Cand.Sc.; **A.I. Rusin**, Doc.Sc.; **G.B. Fershtater**, Doc.Sc., Prof.; **V.V. Kholodnov**, Doc.Sc.; **I.S. Chashchukhin**, Cand. Sc.; **V.V. Chernykh**, Doc. Sc.; **B.I. Chuvashov**, RAS corr. member, Prof.; **Y.V. Shchapova**, Cand.Sc.

Basic research activities of the Institute

- Formation of the intracontinental mobile belts of the Earth: stratigraphy, tectonics, magmatism and metamorphism.
- Geochemistry and mineralogy of petrogenesis and ore genesis; models of mineral deposit formation of the Ural type mobile belts.
- Formation and evolution patterns of sedimentary basins in different geodynamic settings and associated mineral deposits.
- Environmental aspects of natural and technogenic processes interaction; scientific basis for reducing the effects of technogenesis; development of analytical tools to study the mineral substance.



Laboratory of Stratigraphy and Paleontology

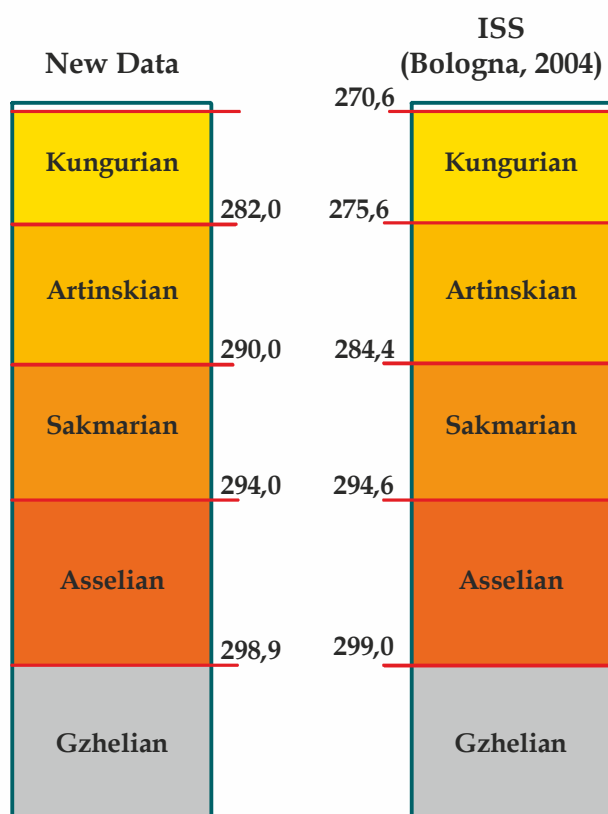
Main Research Areas

- Evolutionary paleontology, general regularities of the development of the organic world, systematic organization of superior taxons.
- Geology of bauxite and phosphate deposits in the Northern Urals.
- Devonian, Carboniferous, Permian, Jurassic, Cretaceous and Paleogene Stratigraphy, Biostratigraphy and Paleobiogeography.
- General classification issues, classification of mineral deposits.

Main Results

- Lower boundaries of the Lower Permian Stages of the International stratigraphy scale were substantiated. Reference sections that meet the generally requirements of the establishment of boundaries of the stratigraphic units of the International scale were suggested.
- A series of zonal biochronology scales were developed: Lower Permian Urals scale using conodonts, Carboniferous scale using foraminifera; Gzhelian stage using conodonts; on a regional Paleogene scale using dinocysts (accepted as a priority scale in the stratigraphic scheme of the Paleogene of West Siberia).
- Multistage formation of organogenic structures in the Urals and the Eastern part of the Russian platform was revealed. Their spatial-temporal association with the areas of tectonic activity was determined. The Silurian-Middle Devonian reef system was associated with the western edge of the Ural paleo continental sector, the Late Devonian-Early Carboniferous system of organogenous structures was associated with the Kama-Kinel trough system, whereas the Late Carboniferous-Early Permian system was confined to the slopes of the West Uralian foredeep.

Isotopic dating of the Stage boundaries of the Lower subsystem of the Permian system



Research and Education Activities

The laboratory staff give lectures at the Ural State Mining University in the following disciplines:

- Historical Geology;
- Regional Geology;
- Micropaleontology;
- General Stratigraphy, Basic Paleontology of the invertebrata;
- General Geology (workshops).

Laboratory staff:

13 employees, including one corresponding member of RAS, 2 doctors of science, 6 candidates of science, one graduate student



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Research Projects

In the recent five years the Laboratory staff conducted five research projects supported by Russian Fund for Basic Research (RFBR).

Honours

Medal of academician A.A. Borisyak «For Paleontology Development» (RAS corr. member B.I. Chuvashov).

Zonal scale of Gzhelian Stage of the Urals based on conodonts

Stage	Zone	Species-index
Asselian	isolatus	<i>S. wabaunsensis</i> <i>S. isolatus</i>
	<i>wabaunsensis</i>	
	<i>bellus</i>	<i>S. bellus</i>
	<i>simplex</i>	<i>S. simplex</i>
	<i>virgicus</i>	<i>S. virgicus</i>
	<i>vitali</i>	<i>S. vitali</i>
	<i>simulator</i>	<i>S. simulator</i>
	<i>firmus</i>	<i>S. zethus</i> <i>S. firmus</i>
Kasimovian		

Publications

Afanasieva M.S., Amon E.O. Devonian Radiolarians of Russia // Paleontological Journal. 2011. V. 45. № 11. P. 1313-1532.

Vasilyeva O.N., Musatov V.A. Paleogene biostratigraphy of the North Caspian region based on dinocysts and nannofossils from the Novouzensk borehole. Article 2. Biotic events and paleoecological settings // Stratigraphy and Geological Correlation. 2010. V. 18. № 2. P. 179-199.

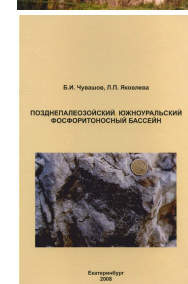
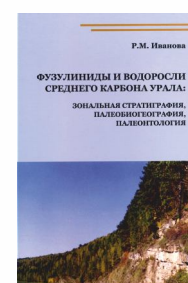
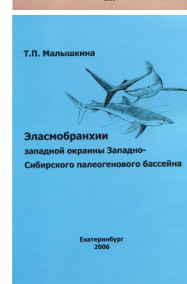
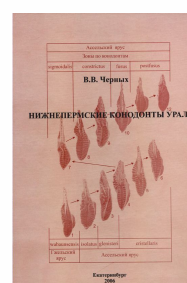
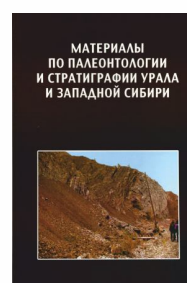
Ivanova R.M. Fusulinids and algae of the Middle Carboniferous of Urals: zonal stratigraphy, paleobiogeography, paleontology. Ekaterinburg: IGG UB RAS. 2008. 204 p. (in Russian).

Malyshkina T.P. Elasmobranchii of the west area of the West Siberian Paleogene basin. Ekaterinburg: IGG UB RAS. 2006. 123 p. (in Russian).

Chernykh V.V. Conodonts of Gzhelian Stage of the Urals. Ekaterinburg: IGG UB RAS. 2012. 158 p. (in Russian).

Davydov V., Krainer K. and Chernykh V. Fusulinid biostratigraphy of the Lower Permian Zweikofel Formation (Rattendorf Group; Carnic Alps, Austria) and Lower Permian Tethyan chronostratigraphy // Geological Journal. 2013. V. 48. № 1. P. 57-100.

Chuvashov B.I. Reef systems of the Uralian mobile belt and evolution of the reef-forming biotes // Reef formations and reefs during evolution of biosphere. M.: Palaeontological Institute RAS. 2011. P. 71-115. (in Russian).





Laboratory of Regional Geology and Geotectonics

named after RAS corresponding member S.N. Ivanov

Main Research Areas

- The study of regional geology, tectonics and history of the development of mobile belts and adjacent platforms, with the Ural fold belt and its platform framing as an example.
- The study of rare metal pegmatites and Be-mineralization of the Urals.
- The study of Alpine ultramafic rocks of the Ural-Mongolian fold belt and associated chromite mineralization.
- The study of inorganic geochemistry of oil in the Northern Eurasia.
- The study of the crystalline basement of the West Siberian Plate and the problem of its oil-and-gas bearing capacity.
- Biostratigraphy of the Middle Paleozoic Urals and adjacent regions, based on the study of brachiopods and conodonts.

Main Results

- Tectonic zoning was clarified and a new geodynamic model of the Urals - one of the world standards of fold belts - was proposed.
- Based on a series of experiments on mass transfer of organic compounds into synthesized hydrocarbons and mineral thermal water it has been experimentally shown that the presence of biomarkers in natural oils is not an indisputable proof of the organic origin of oil, and it may well be acquired by hydrocarbons during their migration through sedimentary rock containing organic matter (in collaboration with scientists from the Institute of Organic Synthesis, Ural Branch of the Russian Academy of Sciences and OOO "KogalymNIPIneft").
- The study of the age, composition and mineragenic type of magmatic, sedimentary and metamorphic complexes in the western part of the West Siberian basement was performed. Based on the comprehensive geological and geophysical studies and mapping of large segments of the territory, a new scheme of structural formation zones of the basement was developed and a new geological map of the western part of the pre-Jurassic basement of the West Siberian Plate was created.
- Based on the author's geological and petrological, and also mineralogical and petrochemical methods of chromite prospecting within the Rai-Iz massif the main types of chromite ores and their ore-controlling structures were identified. Compositions of chromite, chromite-rich ores, and ultramafic rocks within known and newly discovered ore occurrences were studied, and the data on the oxy-thermal barometric conditions of chromite formation were evaluated.

Honours

Medal «V.I. Smirnov. 100 years» (K.S. Ivanov).

Research and Education Activities

Laboratory employees teach Gemmology, Mineralogy, Micropaleontology and General Geology at the Ural State Mining University.

Research Projects

Over the recent five years five research projects were supported by RFBR (including 2 projects of the targeted fundamental research).

Laboratory staff:

24 employees, including 2 doctors of sciences,
12 candidates, 7 graduate students



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Publications

In 2006-2012 more than 200 scientific papers were published, including:

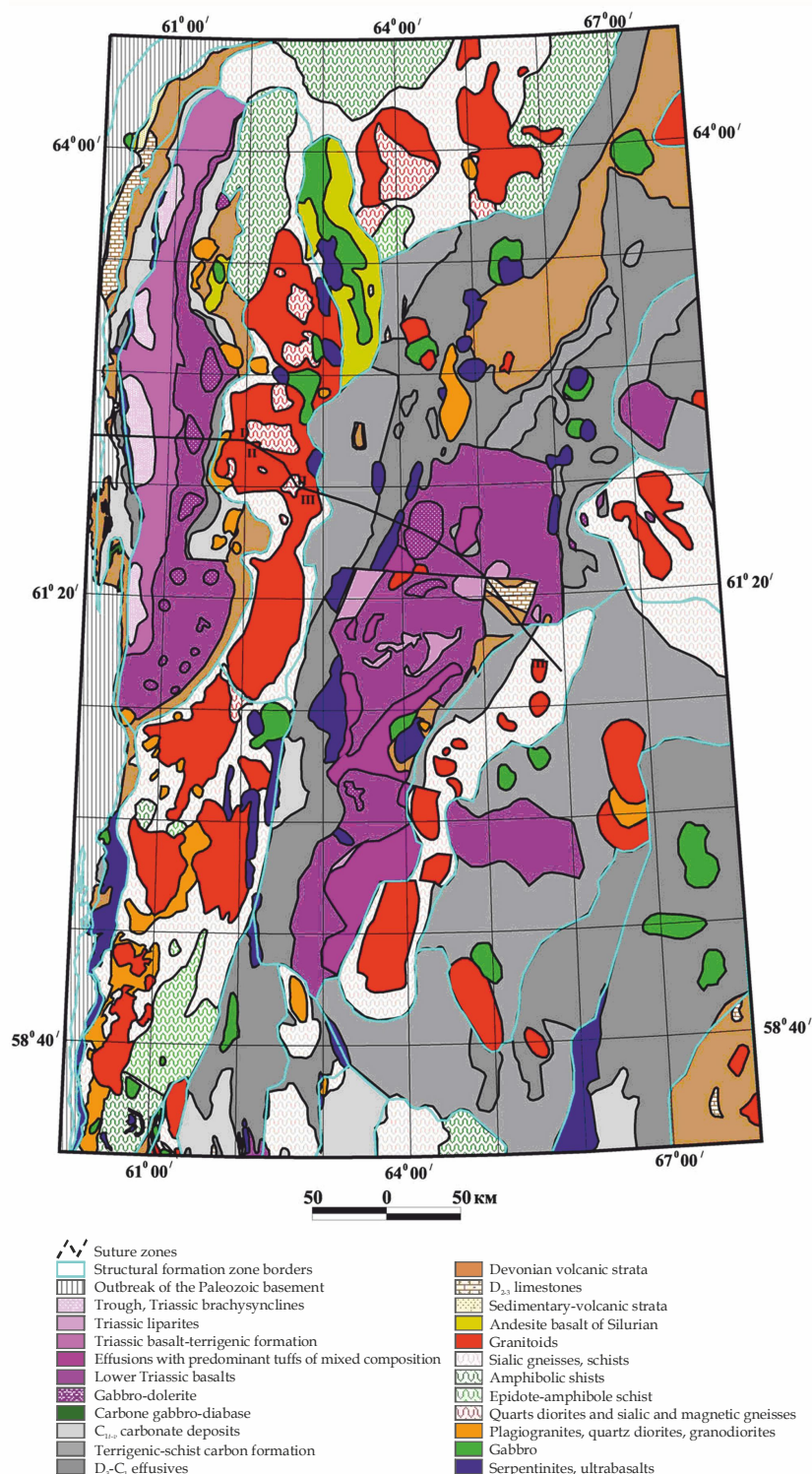
Ivanov K.S., Koroteev V.A., Pecherkin M.F., Fyodorov Yu.N., Yerokhin Yu.V. History of geological development and the structure of the West-Siberian oil and gas-bearing megabasin eastern part basement // *Russian Geology and Geophysics*. 2009. V. 50. № 4. P. 365-379.

Ivanov K.S., Krasnobaev A.A., Smirnov V.N. Zircon geochronology of Klyuchevskoi gabbro-ultramafic massif and the problem of the age of the Mohorovicic paleoboundary in the Central Urals // *Doklady Earth Sciences*. 2012. V. 442. Part 2. P. 173-177.

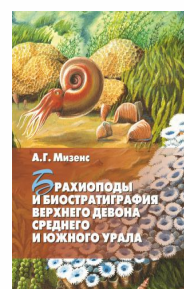
Smirnov V.N., Ivanov K.S. The First Zircon U-Pb Dating (SHRIMP II) for the Silurian Ophiolites in the Urals // *Doklady Earth Sciences*. 2012. V. 430. Part 1. P. 15-18.

Smirnov V.N., Fadeicheva I.F., Ivanov K.S. Geochemistry of Volcanic Rocks in the Tagil Zone of the Urals as an Indicator of Geodynamic Environments of Their Formation // *Doklady Earth Sciences*. 2008. V. 423. Part 1. P. 1278-1281.

Mizens A.G. Brachiopods and biostratigraphy of the Upper Devonian of the Middle and Southern Urals. Ekaterinburg: UB RAS. 2012. 324 p. (in Russian).



Schematic geological map of the pre-Jurassic basement of the western part of Khanty-Manty region (compiled by K.S. Ivanov, Y.N. Fedorov, V.V. Kormiltsev, 2007)





Laboratory of Lithology

Main Research Areas

- Sedimentology, postsedimentation processes.
- Petrography and mineralogy of clastic, clay and carbonate rocks.
- Paleogeography and paleotectonics.
- Geochemistry (including isotope geochemistry) and minerageny of sedimentary sequences (magnesite, siderite, fluorite, etc.).

Main Results

- The regularities of the formation of the most complete Upper Precambrian sedimentary sequences of Northern Eurasia, defined by the long-term destructional and constructional evolution of the upper continental crust were determined (in collaboration with Institute of Precambrian Geology and Geochronology RAS, Institute of Geology USC RAS and Institute of Geology and Mineralogy SB RAS).
- A model of the stepwise formation of stratiform deposits (magnesite -> fluorite -> ankerite-siderite -> barite-polymetallic) in Riphean sedimentary sequences during stages of rifting as a result of evaporite brines migration through the permeable carbonate horizons was developed.
- The epigenetic nature of the Rb-Sr- and O-, and the Rb-Sr- and C-isotope systems was determined for magnesites and siderites, respectively, of the South-Urals province. Given the isotopic and geochemical criteria, the difference of the early diagenetic, catagenetic (syn-mineral) and superimposed (post-mineral) metasomatic dolomitization was substantiated (together with Institute of Precambrian Geology and Geochronology RAS).
- In proluvial complexes of the molasse basin, D₃ north of the Kazakhstan continent, C₃ intermountain basin of the East Urals and P₂-T₁ Pre-Urals depression, the formation of soil horizons, confined to the floodplain facies and facies of shallow lakes were identified. The levels of paleo soil enable to record breaks in the process of mountain formation.
- A sequence-stratigraphic model of the Upper Vendian deposits of the Middle Urals was constructed. The most fossil-bearing sections (SE White Sea region) and the most thick Upper Vendian sections (Middle Urals) were correlated (together with Institute of Petroleum Geology and Geophysics SB RAS).
- The study of material composition of the south-west base of the West Siberian plate allowed to specify the location of the collision suture between 'Uralides' and 'Kazakhstanides'. Valeryanovskaya area was proven to be part of the Kazakhstan continent in the Early Carbon; hence the collision suture goes not along the Urkashsk fault, as suggested by the most well-known model, but more to the west, probably along the Tobolsk fault.

Research and Education Activities

The laboratory staff teach General Geology, Geology of Sedimentary Basins and Lithology at the Ural State Mining University.

Research Projects

In the recent five years, 8 scientific projects of the Laboratory were supported by RFBR grants.

Laboratory staff:

8 employees, including one RAS corr. member,
1 doctor of science, 2 candidates of science,
1 graduate student



Head of Laboratory:

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Publications

Over the last five years, the Laboratory staff published two monographs and more than 60 articles in peer-reviewed journals including:

Petroff A.P., Sim M.S., Maslov A., Krupenin M., Rothman D.H., Bosak T. Biophysical basis for the geometry of conical stromatolites // *Proceedings of the National Academy of Sciences of the United States of America*. 2010. V. 107. № 22. P. 9956–9961.

Petrov G.A., Ronkin Yu.L., Maslov A.V., Lepikhina O.P. Vendian and Silurian Ophiolite Formation Stages on the Eastern Slope of the Middle Urals // *Doklady Earth Science*. 2010. V. 432. Part 1. P. 570–576.

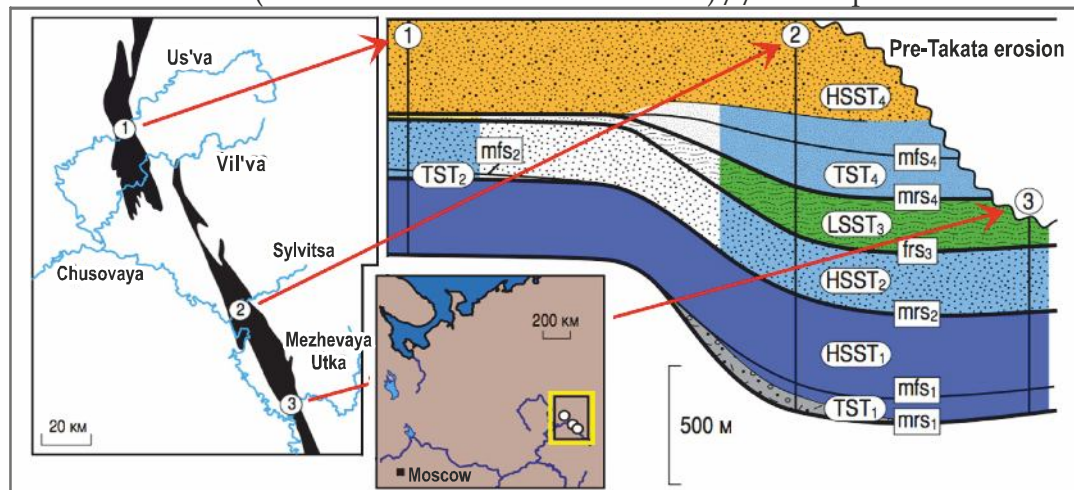
Krupenin M.T., Kuznetsov A.B., Krylov D.P., Maslov A.V. Stable Isotopes of Carbon and Oxygen as Indicators of Magnesite Metasomatism in the Lower Riphean Deposits of the Southern Urals // *Doklady Earth Sciences*. 2011. V. 439. Part 2. P. 1122–1126.

Mizens G.A. Trace elements and characteristics of the sources of clastic material in the Devonian and Carboniferous sedimentary formations of the eastern zones of the Southern Urals // *Geochemistry International*. 2009. V. 47. № 12. P. 1180–1197.

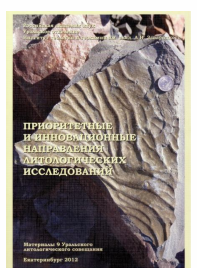
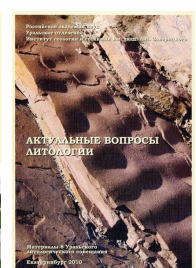
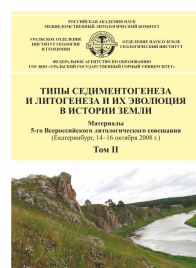
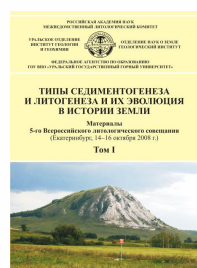
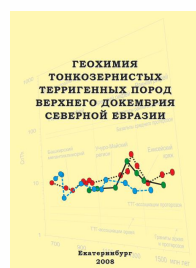
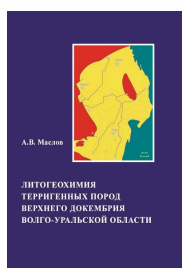
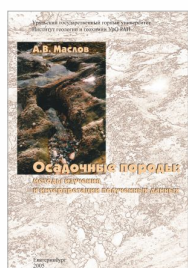
Yalysheva A.I. Typomorphic features of clastic quartz from Precambrian sediments of Southern and Middle Urals // *Lithosphere*. 2010. № 1. P. 64–83. (in Russian).

Maslov A.V., Ronkin Y.L., Nozhkin A.D., Letnikova E.F., Dmitrieva N.V., Podkovyrov V.N. Clarks of concentrations of trace elements in the Riphean fine-grained terrigenous rocks of the Uchur-Maya region and the Yenisei Range // *Russian Journal of Pacific Geology*. 2010. V. 4. № 5. P. 379–397.

Kokshina L.V. Clay minerals in paleozoic graywackes' cement: Magnitogorsk megazone (the South Ural) and Borovsk zone (the south-west of western Siberia) // *Lithosphere*. 2010. № 2. P. 33–42 (in Russian).



Sequence-stratigraphic framework of Upper Vendian deposits of the western slope of the Central Urals





Laboratory of Petrology and Magmatic Formations named after D.S. Shteinberg

Main Research Areas

- The study of magmatism evolution of epioceanic orogens, with the Urals as an example and the global standard.
- The formational analysis of igneous rocks, the study of the P-T conditions of their forming.
- The fluid regime (the role of halogens and sulfur) and potential mineralization.
- The petrogenesis of mafic-ultramafic and granitoid associations of the Urals, their isotopic-geochemical and age evolution.
- The study of relations between magmatism and mineralization.
- The analysis of specific feature of the deep-seated 'above-subduction' magmatism (anatexis).

Main Results

- A summary monographic description of intrusive magmatism of the best studied part of the Ural mobile belt (Middle and South Urals) is fulfilled. The main informative features of ultramafic-mafic, gabbro, granite and granitic complexes were formulated, allowing to understand the nature and the laws of the belt evolution and its endogenous activity in the Paleozoic period (see Fig.).
- The U-Pb age of zircons from granites and apogranite metasomatites of Berezovsky gold field is determined. The age of granites is 302 ± 3 and 305 ± 7 Ma. The age of beresites related to the main stage of hydrothermal gold mineralization is 294 ± 2 Ma. The obtained age data exactly determine the position of the main economic type of gold mineralization in the geological history of the Middle Urals and its relation to the processes of early collision.
- Effusive and intrusive ankaramites were found in the Early - Middle Devonian volcanic island arc suites of the Middle and South Urals. Ankaramitic melts were concluded to be parental for platinum-bearing dunite-clinopyroxenite-gabbro complexes of the Ural-Alaskan type.
- The data characterizing the age boundaries of formation of massifs and various in depth Ti-Fe-V-fields of the Kusinsky-Kopansky complex of the Southern Urals were obtained. The lower age boundary of 1380–1385 Ma is dated by U-Pb age of zircon from anorthosites the Medvedevsky deposit, while the data of U-Pb dating of zircon from the late granite porphyry dikes define the time (1353 ± 16 Ma) of completion of the formation of this complex.
- The most productive for quartz-vein-type gold mineralization in mantle-crust massifs of tonalite-granodiorite-granite composition, such as the Shartashsky, Akhunovsky and others, were found to have their own distinct fluid characteristics. Apatites show low chlorine contents and high sulfur concentrations. Elevated contents of sulfur, reaching 1.0 wt.% SO_3 were found in apatites of granite porphyry dikes and beresites of the Berezovsky gold deposit. These data provide direct evidence for the magmatic source of sulfur participation in the formation of gold mineralization of the Berezovsky deposit.

Research Projects

In the recent five years, 7 research projects of the laboratory of Petrology and Magmatic Formations have been supported by RFBR grants.

Laboratory staff:

19 employees, including 2 doctors of science,
11 candidates of science, 2 post-graduate



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Publications

Fershtater G.B., Krasnobaev A.A., Bea F., Montero P., Borodina N.S. Intrusive magmatism of the early stages Uralian epiocceanic orogen development: U-Pb geochronology (LA-ICP-MS, NORDSIM, SHRIMP-II), geochemistry, evolution // *Geochemistry International*. 2009. V. 47. № 2. P. 143-162.

Fershtater G.B., Kholodnov V.V., Kremenetsky A.A., Krasnobaev A.A., Borodina N.S., Zin'kova E.A., and Pribavkin S.V. Au-bearing gabbro-tonalite-granodiorite-granite plutons of the Urals: Age, geochemistry, and magmatic and ore evolution // *Geology of Ore Deposits*. 2010. V. 52. № 1. P. 58-76.

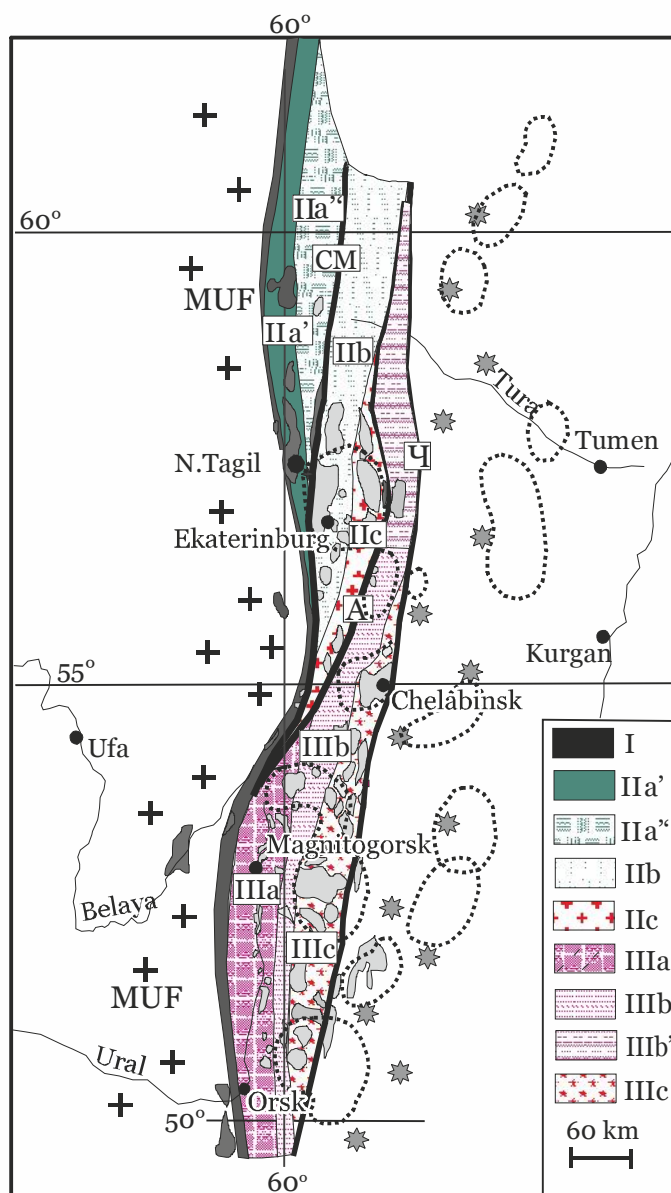
Fershtater G.B. Paleozoic intrusive magmatism of the Ural as a key to understanding its nature // *Lithosphere*. 2012. № 1. P. 3-13 (in Russian).

Kholodnov V.V., Shagalov E.S. The upper and lower age boundaries of the middle riphean (Ti-Fe-V) intrusions of the Kusinsko-Kopanskii complex in the South Urals: U-Pb dating of zircons from the Medvedevskoe deposit // *Doklady Earth Science*. 2012. V. 446. Part 2. P. 1171-1175.

Fershtater G.B. The Main Features of the Uralian Paleozoic Magmatism and the Epiocceanic Nature of the Orogen // *Mineralogy and Petrology*. 2013. V. 107. № 1. P. 39-52.

Garuti G., Pushkarev E.V., Thalhammer O.A.R., Zaccarini F. Chromitites of the Urals (Part 1): Overview of chromite mineral chemistry and geotectonic setting. // *Ophioliti*. 2012. V. 37. № 1. P. 27-53.

Pribavkin S., Avdonina I., Zamyatin D. Mineralogy, conditions of crystallization and melt generation of epidote-bearing porphyries from the Middle Urals, Russian federation // *Mineralogy and Petrology*. 2013. V. 107. № 1. P. 125-147.



The scheme of tectono-magmatic zoning of the Middle and South Urals. I – the common Ural suture megablock including the Main Ural fault zone (MUF); II, III – island-continental megablocks: North-West (II) with the Ordovician-Silurian island Tagil Megazone including the Ural Platinum-bearing Belt (IIa') and volcanic zone (IIa''), Devonian-Early Carboniferous active continental margin (IIb) and continental area (IIc), and the South East (III) with Devonian island arc volcanic zone (the Magnitogorsk Megazone, IIIa), Devonian-Early Carboniferous active continental margin (IIIb) and predominantly Paleozoic continental zone (IIIc). The sign IIIb' shows the northern part of the active continental margin, whose belonging to the southeastern megablock requires further study. To the west of the territory shown there is Paleozoic continental megablock, a passive Paleozoic margin; to the east – Trans-Urals, a transition zone to the Kazakhstan continent. Dotted ovals mark gravimetric minimums supposedly fixing buried granite-gneiss domes.





Laboratory of Paleovolcanism and Regional Geodynamics named after G.F. Chervyakovsky

Main Research Areas

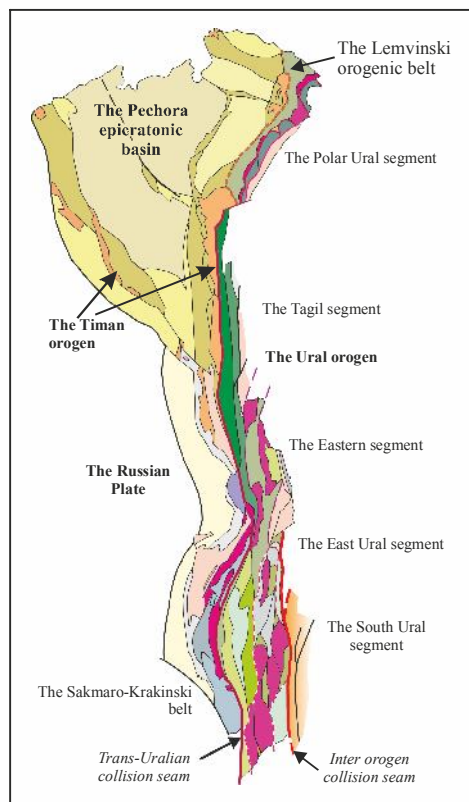
- Petrological, mineralogical, isotopic and geochronological studies of mantle mafic-ultramafic and crustal metamorphic complexes of the Urals as indicators of geodynamic evolution of the mobile belts lithosphere.
- Geodynamics and volcanism in the formation of the Earth's crust during accretion-collision processes of orogenic system formation.

Main Results

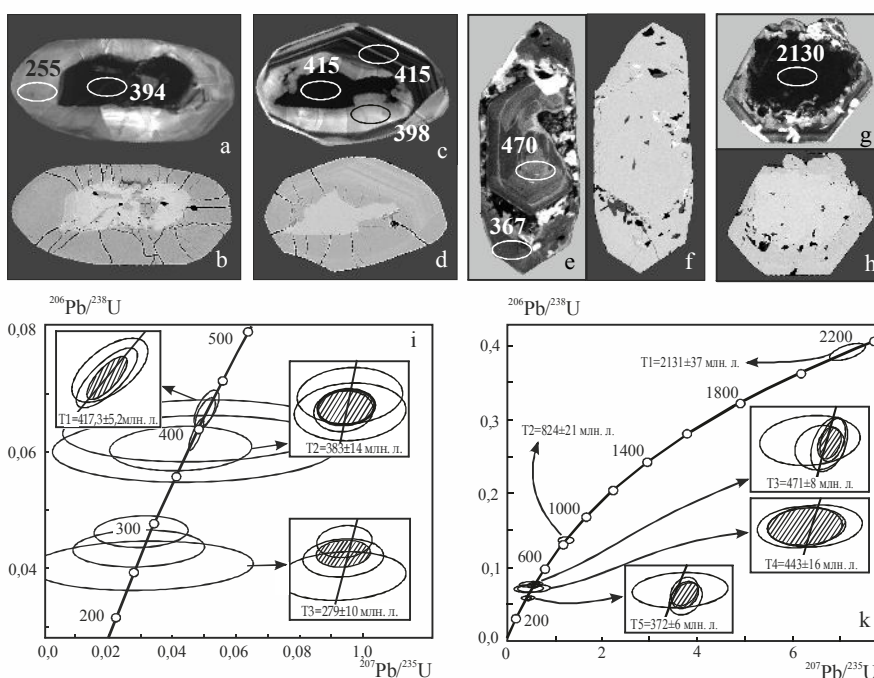
- The features of volcanism of the Ural orogen were identified; its comparability and linked ophiolitic associations with modern and ancient ocean formations were shown.
- Orogenic systems of different ages, including the newly identified Timan orogen were found to be integrated in the Timan-Ural lithosphere segment as a result of movements of lithospheric plates.
- The main age frames of orogen forming cycles and metamorphic processes were determined.
- The main features of plate-tectonic metallogeny as a new research area in theoretical metallogeny were outlined. The possibility of expanding mineral resources at the expense of non-traditional and new sources was shown.

Honors

Award of the Government of the Russian Federation in the field of Science and Technology (V.A. Koroteev, Academician, V.M. Necheukhin, Doctor of sciences).



The scheme of tectonic and geodynamic elements of Timan-Ural segment of Eurasia



Polygenic-polychronic «zirconology» of the Urals: amphibole miaskites of Ilmenogorsky massif (a-d, i), garnet-pyroxene rocks of Maskyutovsky complex (e-h, k). Zircon CL-images (a, c, e, g) and BSE-images (b, d, f, h); isotope U-Pb-data (SHRIMP, i, k).

Laboratory staff:

16 employees, including 1 RAS Academician,
3 doctors of science, 3 candidates of science
and 2 graduate students



Head of Laboratory:

Elena N. Volchek

Cand. Sc. in Geology and
Mineralogy

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Research Projects

Over the past five years, the laboratory members were the leaders and implementors of RFBR grants and projects carried out under the programs of the Presidium of RAS, inter-regional and interdepartmental programs of basic research, integration programs of basic research of UB RAS, and initiative programs of basic research of UB RAS.

Research and Education Activities

V.A. Koroteev is the head of Mineralogy, Petrology and Geochemistry department at the Ural State Mining University. A.I. Rusin, professor of IPY USMU, gives a course of lectures on «Petrography of igneous, metamorphic and metasomatic rocks».

Publications

Koroteev V.A., Ogorodnikov V.N., Sazonov V.N., Polenov Ju.A. Minerageny of the suture zone of the Urals. Ekaterinburg: UB RAS, 2010. 413 p. (in Russian).

Necheuckin V.M., Dushin V.A., Olovyanishnikov V.G. Paleogeodynamic assoziacion and tectonic-geodynamic elements of the Ural-Timan-Paleoaziatic segment of the Eouroaziatic. Ekaterinburg: UB RAS; Ural State University of Mining. 2009. 158 p. (in Russian).

Paleogeodynamic map of the Ural-Timan-Paleoasiatic segment of the Euroasia. Scale 1 : 2 500 000. Compiled by **Necheuckin V.M., Dushin V.A., Olovyanishnikov V.G.** Ekaterinburg: UB RAS; Ural State University of Mining. 2009. (in Russian).

Krasnobaev A.A., Rusin A.I., Rusin I.A., Busharina S.V. Zircons, zircon geochronology, and petrogenetic problems of the lherzolite massifs of the South Urals // Geochemistry International. 2011. V. 49. № 5. P. 482-497.

Malyshev A.I. Gas Diffusion in the Evolution of Magmatic Systems // Doklady Earth Sciences. 2008. V. 422. № 1. P. 1113-1115.

Rusin A.I., Valizer P.M., Krasnobaev A.A., Baneva N.N., Medvedeva E.V., Dubinina E.V. Origin of the garnet-anortite-clinopyroxene-amphibole rocks from the Ilmenogorskii Complex (Southern Urals) // Lithosphere. 2012. № 1. P. 91-109 (in Russian).

Volchek E.N., Necheukhin V.M. The petrochemical peculiarities of volcanic rocks of Sukholozhskaya zone (Middle Ural eastern segment) and their significance for geodynamic reconstruction // Lithosphere, 2012, № 3. P. 146-150 (in Russian).





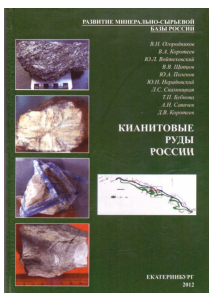
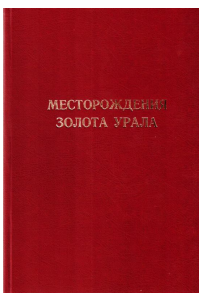
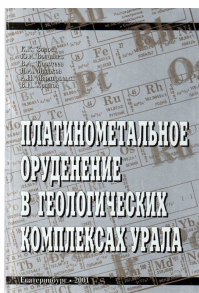
Laboratory of Geochemistry and Ore-Forming Processes

Main Research Areas

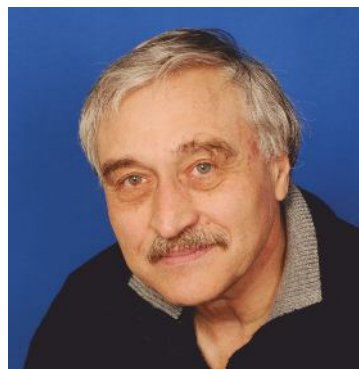
- Geodynamic situation and structural control of mineralization, the main age range of mineralization.
- Radiogenic (Hf-Nd-Sr-Os) and stable (C-O-H-S-Cu) isotopic systematics of rocks, ores and minerals. The sources of the ore substance and ore-bearing fluids in deposits formation, the role of carbonaceous substance in the ore formation.
- Geochemistry and mineralogy of platinum-group elements and gold.
- Os-isotope evolution of the upper mantle.
- Mineral composition of ores, mineral typomorphism, and entry forms of mineral components in ores; mineralogical and technological mapping of ore-metasomatic formations; comprehensive use of mineral resources.
- Determination of physical and chemical parameters of the ore-forming fluids, thermodynamic parameters and the redox state of the mineralization environment.

Main Results

- The study of mineralogical and geochemical and isotopic-geochemical characteristics of different in age zircons of the Norilsk-1 economic sulphide-bearing ultramafic-mafic intrusion has proved their polygenetic and polychronous nature, reflecting the multistage formation of rock associations. According to the Hf-Nd isotopic systematics, three contrasting Hf-Nd clusters characterizing rocks of different composition and ore content have been identified. Isotopic signatures imply a mixture of juvenile material, SCLM and old crust (Fig. 1).
- New data on the geological and structural situation, near-ore metasomatism, mineral composition and ore-forming conditions of the main types of gold deposits in the Urals, including non-traditional ones (Svetlinskoye, Gagarskoye, Vorontsovskoye) have been obtained.
- An indicative role of oxygen fugacity in reconstructing the conditions of ultramafic rocks formation from magmatic depletion stage to metamorphic processes in the continental crust has been shown. The role of chromite formation in the history of their development has been defined.
- The platinum-group minerals of chromitites of dunite-harzburgite complexes have been found to be associated with isotopically contrasting sources of the ore material. The obtained data give evidence in favor of a multistage evolution of the depleted mantle material.
- New data on the mineral composition, geochemistry, formation conditions, age and material sources (based on the study of Rb-Sr, Sm-Nd, U-Pb and Lu-Hf isotope systems) for Nb-Zr-REE deposits associated with carbonatites have been obtained.
- In the Urals all ore types of copper-porphyry deposits have been identified. The ores of many of them have high concentrations of rhenium, including those of industrial level. Prognostic criteria of new porphyry deposits have been developed (Fig. 2).



Laboratory staff:
26 employees, including
one corresponding member of RAS, 4 doctors
of science, 13 candidates of science,
and 5 graduate students



Head of Laboratory:
Valery V. Murzin
Doctor of Geology and
Mineralogy
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e-mail: murzin@igg.uran.ru

Honors

The Award of the Government of the Russian Federation in the field of Science and Technology (K.K. Zoloev, RAS corr. member, V.N. Ogorodnikov, Doctor Sc., Prof.), Excellent Prospector (O.B. Azovskova), «Golden Diploma-2007», III International Forum on Science, Technology and Education (N.A. Grigoryev).

Publications

Grabazhev A.I. Rhenium in porphyry copper deposits of the Urals // *Geology of Ore Deposits*. 2013. V. 55. № 1. P. 13-26.

Ogorodnikov V.N., Koroteev V.A., Voytekhevsky Yu.L. Kianite ores of Russia. Ekaterinburg: UB RAS, 2012. 334 p. (in Russian).

Chashchukhin I.S., Votyakov S. L., Shchapova Yu.V. Crystallochemistry of spinel and oxygen thermobarometry of the ultramafites in folded regions. Ekaterinburg: Institute of Geology and Geochemistry UB RAS. 2007. 310 p. (in Russian).

Sazonov V.N., Koroteev V.A. Uhe main goldproductive and associated metasomatic formation of the Urals. Ekaterinburg: Institute of Geology and Geochemistry UB RAS, 2009. 161 p. (in Russian).

Grigoriev N.A. Chemical elements distribution in the upper continental crust. Ekaterinburg: UB RAS, 2009. 382 p. (in Russian).

Soroka E.I. High-aluminiferous rocks at the Maldynyrd ridge of the Prepolar Urals. Ekaterinburg: UB RAS. 2009. 84 p. (in Russian).

Nedosekova I.L., Belousova E.A., Sharygin V.V., Belyatsky B.V., Baynova T.B. Origin and evolution of the Ilmeny-Vishnevogorsky carbonatites (Urals, Russia): insights from trace-elements compositions, and Rb-Sr, Sm-Nd, U-Pb, Lu-Hf isotope data // *Mineralogy and Petrology*. 2013. V. 107. № 1. P. 101-123.

Malitch K.N., Belousova E.A., Griffin W.L., Badanina I.Yu. Hafnium-neodymium constraints on source heterogeneity of the economic ultramafic-mafic Noril'sk-1 intrusion (Russia) // *Lithos*. 2013. V. 164-167. P. 36-46.

Research Projects

Over the last 5 years, 6 projects of the Laboratory of Geochemistry and Ore-Forming Processes were supported by RFBR.

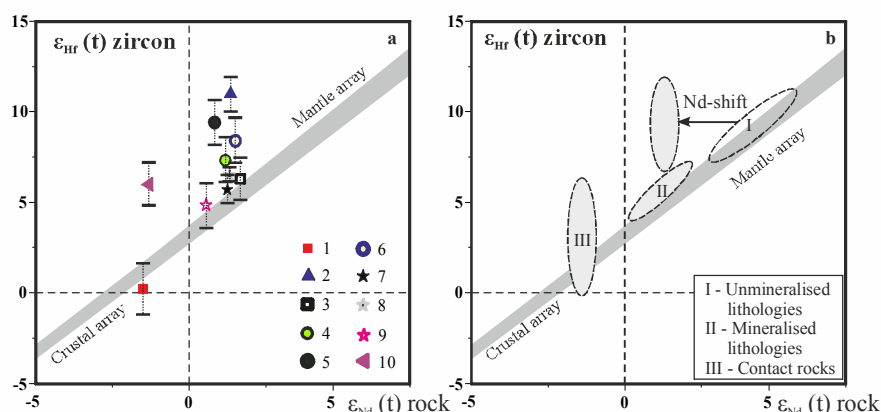


Fig. 1. Plot of zircon $\epsilon_{Hf}(t)$ versus whole-rock $\epsilon_{Nd}(t)$ for the Noril'sk-1 intrusion. 1-10 – samples: 1, 10 – contact rocks, 2-6 – unmineralized rocks, 7-9 – mineralized rocks. Mantle and crustal arrays (shown in gray) according to Vervoort et al. (1999)

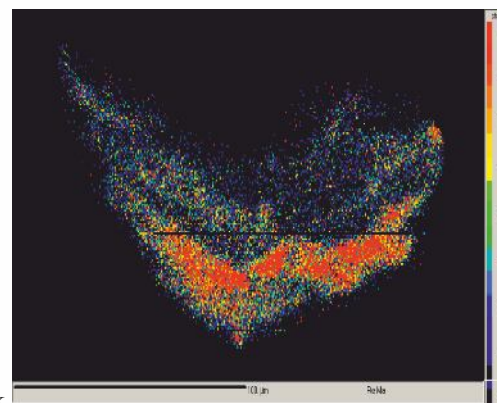


Fig. 2. Re distribution in molybdenite grain from a quartz vein of the East Artemovskiy copper-porphyry array. Red – $>0.6\%$; blue – $0.2-0.4\%$; black – $<0.1\%$



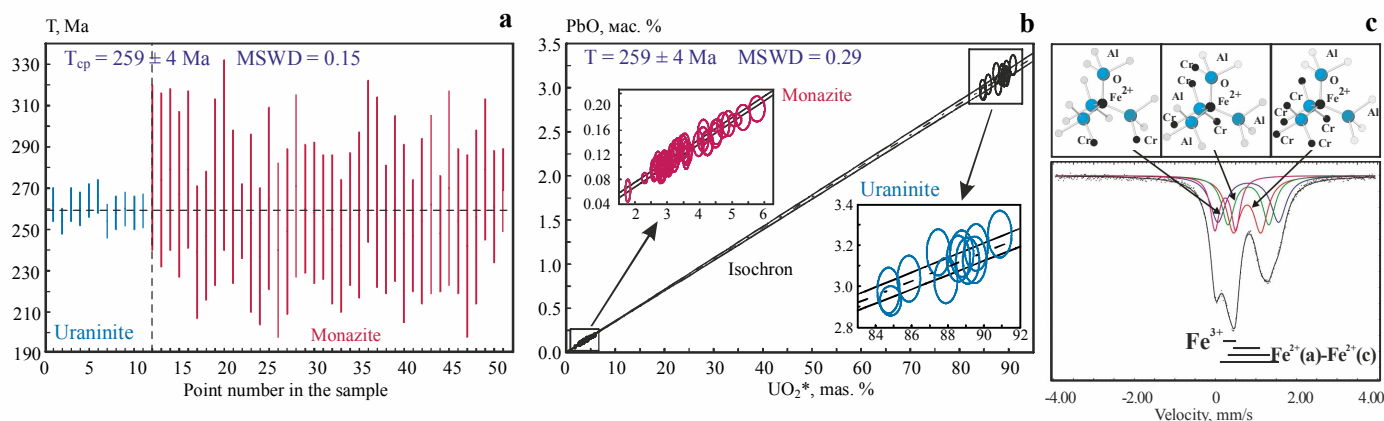
Laboratory of Physical and Chemical Research

Main Research Areas

- Development and improvement of isotope-geochemical, spectroscopic and other methods of analyzing the microstructure and defects in minerals and rocks.
- The study of phenomena, stimulated by radiation and thermobaric and chemical effects on minerals; the study of atomic and electronic structure of mineral defects, their mechanisms of formation and decay.
- Comprehensive study of crystal chemistry and physics of natural and synthetic, organic and industrial minerals, their composition, structure and properties as the basis for geochronological constructions and restoration of the minerals crystallization conditions and evolution in a certain geological (bioecological) situation.

Main Results

- The algorithm for microprobe chemical dating of U-Th-minerals has been improved (patent № 2457468). The characteristics of crystal chemistry and physics of these minerals from a number of geological targets of the Urals and Siberia have been studied, and their chemical dating has been performed (Fig. a, b). Their atomic and electronic structure has been simulated, and micromodels for their radiation disordering have been proposed.
- Fossilization regularities of fossil remains of mammals of the Quaternary period in the Urals have been determined. Criteria for the evaluation of their relative ages and conditions of burial (together with the Institute of Plants and Animals Ecology, UBRAS) have been proposed.
- On the basis of Mössbauer spectroscopy, the crystal chemistry of iron in the spinels from ultramafic rocks of the Urals, Siberia and the Far East (Fig. c) has been studied. The evolution of the oxidation state of ultramafic rocks in different formation and transformation stages has been revealed.
- Physical and chemical properties of physiological and pathogenic dental tissues of humans living in the Urals have been analyzed. Some approaches to address the pathogenesis and treatment of dental diseases (with USMA) have been proposed.



Variations in the values of Th-U-Pb age and their weighted average for point definitions in uraninite and monazite from granitoids of Western Siberia basement (a), and bimineral U-Pb-isochron (b) and structural models of three types of Fe^{2+} ions with different second coordination area in chrome spinel (c)

Laboratory staff:

29 employees, including 1 academician of RAS,
7 candidates of science and three graduate students



Head of Laboratory:

Yuliya V. Shchapova

Cand.Sc. in Physics and
Mathematics

tel.: (343) 371-60-03

e-mail: shchapova@igg.uran.ru

Publications

In 2006-2012 more than 150 scientific papers, including 5 monographs, were published and two patents were received.

Smirnov N.G., Votyakov S.L., Sadykova N.O., Kiseleva D.V., Shchapova Yu.V. Physical and chemical characteristics of mammal fossil bone remnants and the problem of their relative age estimation. Part 1. Thermal analysis and trace element mass-spectrometry. Part II. IR- and radiospectroscopy, microscopy. Monographs. Ekaterinburg. 2009. 118 p. 82 p. (in Russian).

Votyakov S.L., Kiseleva D.V., Shchapova Yu.V., Smirnov N.G., Sadykova N.O. Thermal properties of fossilized mammal bone remnants of the Urals // Journal of Thermal Analysis and Calorimetry. 2010. V. 101. P. 63-73.

Shchapova Yu.V., Votyakov S.L., Kuznetsov M.V., Ivanovskii A.L. Effect of Radiation Defects on the Electronic Structure of Zircon by X-Ray Photoelectron Spectroscopy Data // Journal of Structural Chemistry. 2010. V. 51. № 4. P. 657-662.

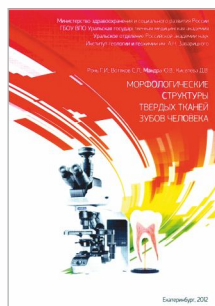
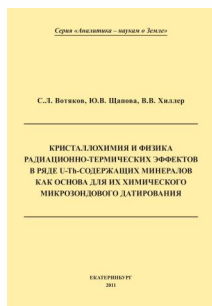
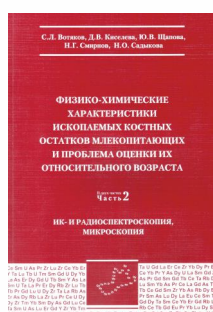
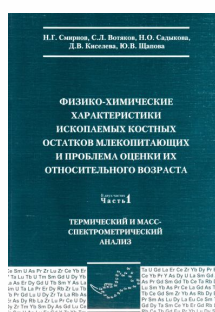
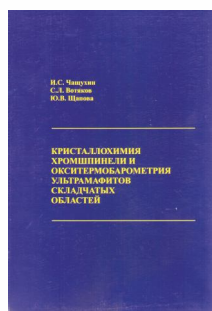
Votyakov S.L., Adamovich NN. Laser ablation and water standards usage in ICP-MS-analysis of minerals // Lithosphere. 2011. № 4. P. 56-69. (in Russian).

Votyakov S.L., Shchapova Yu.V., Khiller V.V. Crystal chemistry and physics of radiation and thermal effects in some of U-Th- bearing minerals as a basis for the chemical microprobe dating. Monograph. Ekaterinburg. UB RAS Press. 2011. 336 p. (in Russian).

Ron' G.I., Votyakov S.L., Mandra Yu.V., Kiseleva D.V. Morphological structures of human teeth solid tissues. Monograph. Ekaterinburg. USMA. 2012. 148 p. (in Russian).

Votyakov S.L., Hiller V.V., Shchapova Yu.V. Composition and chemical microprobe dating of U-Th-bearing minerals. Part I. Monazites from the Urals and Siberia // Geology of Ore Deposits. 2012. V. 54. № 8. P. 625-637.

Votyakov S.L., Shchapova Yu.V., et al. Monazite spectroscopy and physics: the usage state and prospects for Urals geochronology problems // Lithosphere. 2012. № 4. P. 158-172. (in Russian).



Research and Education Activities

Two Candidate's Thesis were completed. Together with the Ural State University (USU), the Scientific Educational Centre "Mineral Physics" was organized, and the concept of the "Environmental Management" faculty in the USU was developed. Since 2009, the Russian Youth School-Conference «Minerals: Structure, Properties, Methods of Research» is held annually.

Research Projects

Over the past five years, three projects were supported by RFBR; Government Contract № 02.740.11.0727 was carried out in 2009-2012 within the frame of Federal program «Scientific and scientific-pedagogical personnel of innovative Russia» together with the Ministry of Science and Education.



«Geoanalitik» Analytical Centre of the Ural Branch of RAS

Head: Sergey L. Votyakov, Academician of RAS, Director of the Institute

tel./fax: +7 (343) 371-19-97, www.geoanalyst.igg.uran.ru, e-mail: director@igg.uran.ru

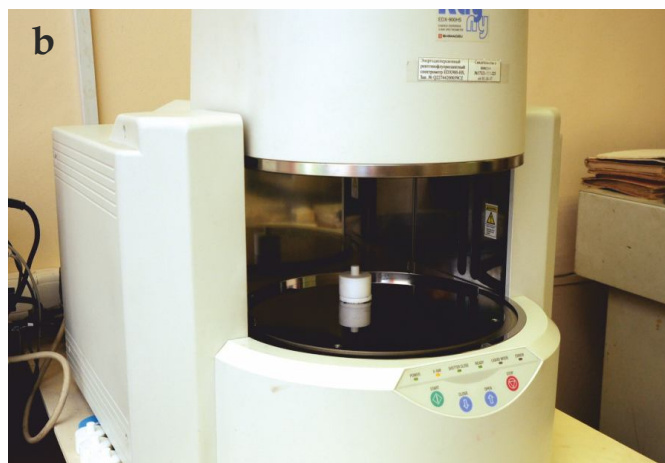
Deputy Head: Yuliya V. Shchapova, Cand. Sc. in Physics and Mathematics, Associate Professor,

tel./fax: +7 (343) 371-60-03, e-mail: shchapova@igg.uran.ru

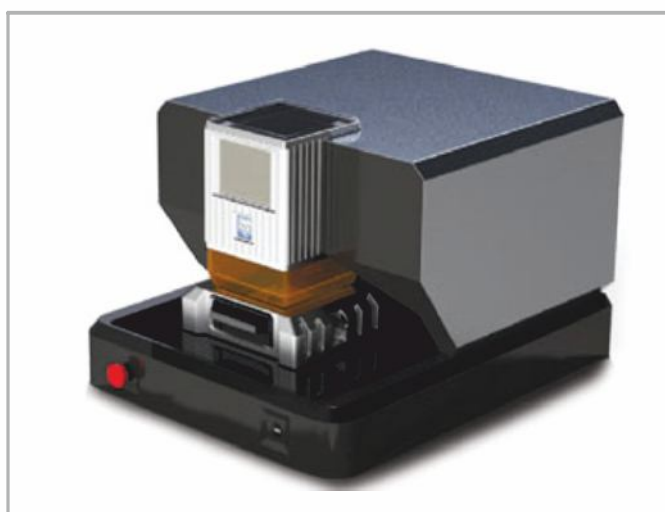
- It is a multi-disciplinary center, providing current techniques in the field of quadrupole mass spectrometry with inductively coupled plasma, X-ray fluorescence and spectral analysis, X-ray diffraction and thermal analysis, isotope geochemistry and geochronology, electron-probe microanalysis and electron microscopy, physics and spectroscopy of minerals.
- The Centre was organized in 2006 and equipped with a number of unique devices; it was accredited by the Federal Agency for Technical Regulation and Metrology (certificate № ROSS RU.0001.516761). It is part of the Nano Materials Testing Center (№ ROSS RU.0001.22HH02), staffed by highly qualified personnel - analysts.
- The Centre provides quantitative information on the chemical (microelement and isotopic) and phase composition, the crystal and electronic structure parameters, the type, concentration and localization of structural defects, the optical properties of minerals, rocks, ores, technological and biogenic objects, natural and drinking water.
- Shimadzu demonstration laboratory is in operation, its devices are adapted to the tasks in the field of earth sciences. Educational and methodical work is conducted, training courses and seminars, and the annual joint Urals-Siberian meeting on equipment and assessment methods are organized.
- The Centre cooperates with the regional departments of the Ministry of Natural Resources, ecological, environmental and other organizations to perform the analyses, and arrange training and learning courses, seminars and exhibitions.



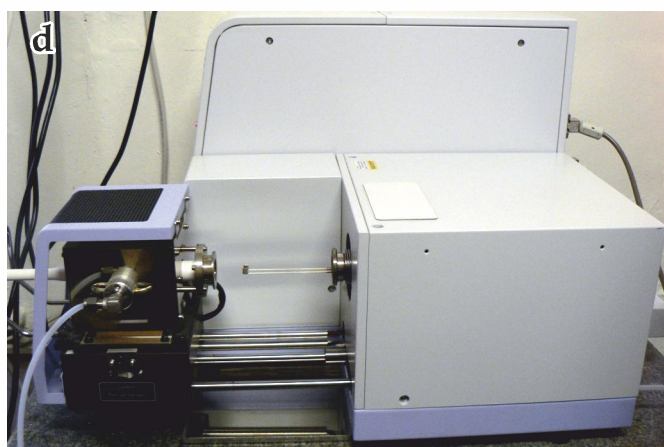
Cameca SX 100 Electron probe microanalyzer with five wave spectrometers, Bruker energy dispersion attachment (a) and JSM-6390LV scanning electron microscope with INCA Energy 450 X-Max 80 attachment (b) to determine elements up to U (including light Be, B, C, N, O) containing 0.01-100 wt.% and locality to 1 mm, for elemental mapping of grains, to produce BSE-images for chemical dating of U-Th-bearing minerals, to investigate micro objects with magnification up to 300,000 in high-vacuum and low-vacuum mode and assess their 3D-images.



Wave XRF-1800 spectrometer (a) and EDX-900HS energy dispersive spectrometer (b) for X-ray fluorescence analysis of minerals, rocks and ores, with the definition of rock-forming and trace elements containing 0.01-100 wt.% and up to 1 mm scale. ELAN-9000 Quadrupole mass spectrometer with inductively coupled plasma (c) and ContraAA 700 atomic absorption spectrometer with a source of continuous spectrum with a flame and electrothermal atomic ionization (d) for the determination of trace content (ppm) of elements in solutions and minerals. Decomposition of minerals, rocks and ores weighing from 10 to 20 mg in specialized clean rooms of 7 and 8 ISO class, using ultra-pure reagents, specialized ware, PLP-01 microwave ovens, Speedway MWS-3+ systems for microwave decomposition, and INC-05 autoclave module.



LSX-500 and NWR213 attachments for laser ablation of samples using YAG: Nd-laser (radiation: 266 nm and 213 nm, crater diameter: 4 to 250 microns).



XRD-7000 Diffractometer with polycapillary optics and NTK-1200N high-temperature attachment (a) to study the structure of minerals in the range 25-1500°C, determine their phase composition, and assess their degree of perfection. Mole laser Raman microprobe (b), IR Affinity IK-Fourier spectrometer with a microscope (c), UVmini-1240 optical spectrometer, KlaviR pulse cathode luminescence analyzer, ESR70-03 DX/2 radio spectrometer to obtain spectroscopic characteristics of minerals and rocks; assess the type, structure and concentration of defects, interposition cation distribution, radiation damage of the structure, etc. Diamond TG-DTA derivatograph (d) to determine thermal characteristics (degassing, discharge of OH groups and water) of rocks, minerals, ores weighing between 10 and 20 mg in the temperature range of 25 to 1500°C.



Neptune Plus multi-collector mass spectrometers with inductively coupled plasma (a) and thermionic Triton Plus (b) to determine the abundance of radioactive and stable isotopes, Rb-Sr-age and Sm-Nd-age of rocks and minerals.

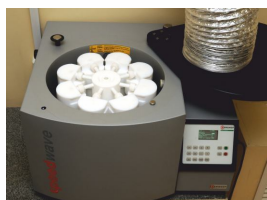
Sample Preparation Methods For Mass Spectrometry

Laser ablation of the samples

Sample surface preparation for laser ablation
(polishing, resurfacing)



Sample



MVS-3 Microwave opening system

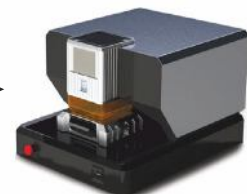


GEFEST Microwave oven

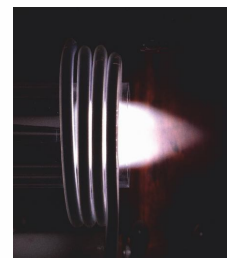


MKP-05 Autoclave for sample preparation

Chemical preparation of the samples
(decomposition, dissolution)



NWR213 Device

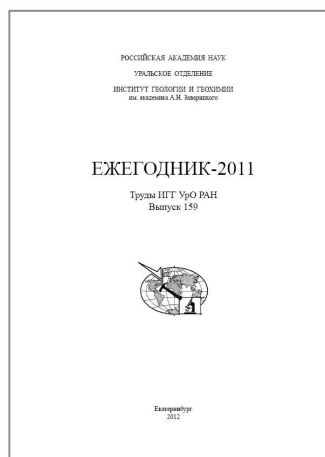
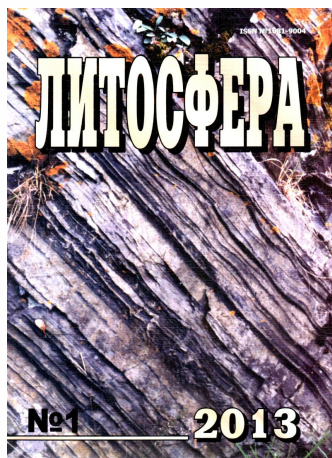


Mass-spectrometry burner



Isotope module of high 6 ISO class of cleanness with the equipment for sample preparation and analysis.

Publishing Activity



Since 2001, the Institute is publishing the Lithosphere journal (www.lithosphere.ru, registration certificate PI № 77-7039 in the Ministry of Press and Information of the Russian Federation; Editor-in-chief: **V.A. Koroteev**, RAS Academician, tel. 371-58-16, e-mail: koroteev@igg.uran.ru; Managing Editor – **Elena N. Volchek**, Cand. Sc. tel. 371-67-47, e-mail: volchek@igg.uran.ru). The journal is listed by Higher Attestation Commission (HAC), and published bimonthly (6 issues annually). Five years impact factor is 0.516.

Collection of articles «Proceedings of the Institute of Geology and Geochemistry» is published since 1940, with its recent 159th issue published in 2012.

Full-text versions of the Lithosphere journal and Proceedings of the Institute of Geology and Geochemistry are available in the E-Library and on the Institute website.

Postgraduate and Doctoral Education

The Institute has full-time and part-time Postgraduate Program (License of the Federal Service for Supervision in Education and Science of 19.03.2013, reg. № 0601) in the following specialties: 25.00.01 – General and Regional Geology, 25.00.02 – Stratigraphy and Paleontology, 25.00.03 – Geotectonics and Geodynamics, 25.00.04 – Petrology and Volcanology, 25.00.05 – Mineralogy and Crystallography, 25.00.06 – Lithology, 25.00.09 – Geochemistry, Geochemical Methods of Prospecting Mineral Deposits, 25.00.11 – Geology, Prospecting and Exploration of Solid Mineral Deposits, Minerageny. Currently 15 graduate students are trained at the Institute.

The Institute also has Doctoral Program (Decree of the Presidium of the Ural Branch of the Russian Academy of Sciences of 12.08.1997 № 6-2) in the following specialties: 25.00.01 – General and Regional Geology, 25.00.02 – Stratigraphy and Paleontology, 25.00.04 – Petrology and Volcanology, 25.00.05 – Mineralogy and Crystallography, 25.00.06 – Lithology, 25.00.09 – Geochemistry, Geochemical Methods of Prospecting Mineral Deposits, 25.00.11 – Geology, Prospecting and Exploration of Solid Mineral Deposits. Currently four doctorate fellows are being trained. Head, Postgraduate and Doctoral Education: **Tatyana Osipova**, Scientific Secretary of the Institute (tel. 371-70-29, e-mail: osipova@igg.uran.ru).

Coordination of Research

Employees of the Institute are part of several Russian interdepartmental scientific boards and committees, coordinating the activities of the academic, industrial and educational organizations in various fields of geology. Chairman of the Volcanology and Paleovolcanology Commission at the Interdepartmental Petrography Committee, Department of Earth Sciences, RAS: **V.A. Koroteev**, Academician; Co-chairman of the Commission on Mineral Crystal Chemistry affiliated with the Russian Mineralogical Society: **S.L. Votyakov**, Academician; Chairman of the Ural Interdepartmental Stratigraphy Commission: **B.I. Chuvashov**, RAS corr. member (tel: +7 (343) 371-05-88, e-mail: chuvashov@igg.uran.ru); Chairman of the Ural Section of the Scientific Council on Lithology and Sedimentary Minerals, Department of Earth Sciences (DES) RAS: **A.V. Maslov**, RAS corr. member (tel: +7 (343) 371-42-46, e-mail: maslov@igg.uran.ru); Chairman of the Ural Section of the Scientific Council on Tectonics and Geodynamics, DES RAS: **K.S. Ivanov**, Doc. Sc. (tel: +7 (343) 371-62-82, e-mail: ivanovks@igg.uran.ru); Chairman of the Ural Regional Petrography Council, Interdepartmental Petrography Committee, DES RAS: **E.V. Pushkarev**, Cand. Sc. (tel: +7 (343) 371-17-85, e-mail: pushkarev@igg.uran.ru); Chairman of the Ural Branch of the Russian Mineralogical Society: **Y.V. Erokhin**, Cand. Sc. (e-mail: erokhin@igg.uran.ru).

International Cooperation



Employees of the Institute participate in the following international programs:

- The behavior of stable (O, C) and radiogenic (Sr) isotopes in the shells of Devonian, Carboniferous and Permian brachiopods of the United States, the Russian Platform and the Urals (together with the Geochemistry Laboratory, A & M University, Texas, USA).
- Isotope dating of the stage limits of the lower Permian system of the Western Ural (with the International Institute for the Study of the Permian System, Idaho, USA).
- The origin of zircons from ultramafic-mafic intrusions of the Noril'sk province (Russia) and other ultramafic massifs using Lu-Hf isotope systematics; the study of material sources of platinum-group element deposits using Re-Os isotope systematics (in cooperation with the Australian Research Center for Geochemical Evolution and Metallogeny of Continents, Department of Earth and Planetary Sciences, Macquarie University, Sydney, Australia).
- The study of geochemistry of the third seismic layer of the ocean (under the guidance of the Joint International Ocean Drilling Program).

Council of Young Scientists

The institute has 39 employees that are less than 35 years old. Young employees are winners of prestigious scientific awards and prizes: O.E. Pogromskaya was awarded the Medal of the Russian Academy of Sciences for young scientists in the field of Earth Sciences (2003), the Governor of the Sverdlovsk Region Award for young scientists was given to S.V. Pribavkin (2006), D.V. Kiseleva (2009), V.S. Ponomarev (2011). The award of L.D. Shevyakov for young scientists was obtained by Y.V. Erokhin (2002) and O.E. Pogromskaya (2003); the grant of the Governor of Sverdlovsk Region was given to Y.V. Klyukin (2010). Chairman of the Council of Young Scientists: **Alexander V. Alexeev**, Cand. Sc., tel.: (343) 371-60-03, e-mail: alexeev@igg.uran.ru.

Conferences

The Institute regularly convenes the following Russian Conferences: «Readings in memory of academician A.N. Zavaritsky» and «Readings in memory of RAS corresponding member S.N. Ivanov», «Ural Lithology Meeting», «Ural Mineralogy School», the youth School-Conference «Minerals: Structure, Properties and Methods».

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Brochure

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