

# The Development of Engineering and Ecological Geology at Moscow State University at the Turn of the 20th and 21st Centuries (on the Seventieth Anniversary of the Chair of Engineering and Ecological Geology)

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Received April 5, 2007

DOI: 10.3103/S0145875208010018

## FROM THE DEVELOPMENT HISTORY OF ENGINEERING AND ECOLOGICAL GEOLOGY AT MOSCOW UNIVERSITY

The Chair of engineering and ecological geology of the Geological Department of M.V. Lomonosov Moscow State University (MSU) is marking its 70th anniversary on February 1, 2008. For decades, it has been one of the strongest pedagogical and scientific staffs of Russian engineering and environmental geologists.

In 1938, Professor M.M. Filatov organized the Chair of soil science as the first independent structural unit that joined lecturers and researchers in the field of engineering geology at MSU. From 1938 to 1942, he was in charge of this Chair; then the first associate professor and later professor S.S. Morozov replaced him at this position (from 1942 to 1954). In 1954, after 16 years of independent development, the Chair of soil science was transformed into the Chair of soil science and engineering geology by amalgamating a group of engineering geologists who worked at the Chair of hydrogeology. In August 1986, the former was reorganized into the Chair of engineering geology and geological environment protection. From 1954 to 1988, Professor, Academician of the AN USSR E.M. Sergeev headed the Chair, and in 1989 Professor, Academician of the Russian Academy of Natural Sciences (RANS) and the International Academy of Sciences of Higher Schools (IAS HS) V.T. Trofimov took charge of it. In 1998, the Chair was reorganized into the Chair of engineering and ecological geology, headed by V.T. Trofimov.

Five stages can be distinguished in the developmental history of engineering geology at Moscow University. The *first stage* is the origin of engineering geology at Moscow University, which lasted from the end of the 19th century until 1938. It was closely associated with the name of Academician A.P. Pavlov and his studies in the field of applied geology; with the studies of the famous geologist Professor E.V. Milanovskii concerning the design of a number of the largest hydraulic engineering constructions on the Volga, the Angara, and

other rivers, and the course on engineering geology for university students he created; and also, with the name of Professor M.M. Filatov. It was he who established the first specialization in the field of engineering geology—*Road Soil Science*—at Moscow University. This was opened in 1930 at the Chair of soil science of the soil geographical division at the physico-mathematical department, and soon (in 1934) it was reorganized into the wider specialty of *Soil Science*.

The *second stage* (1938–1954) was the formation stage of the engineering geologist school at MSU. On one hand, this was marked by the opening of the Chair of soil science at the geological and soil department of MSU on February 1, 1938; and on the other hand, by the development of other studies in engineering geology carried out by related Chairs (of dynamic geology and hydrogeology) of this department. This resulted in a paradoxical situation where specialties providing geological support of construction turned out to be given by different chairs. Geological processes and engineering geological methods of investigation were taught without engineering geological study of soils and rocks (soil science), and specialists graduating from the soil science Chair did not have the necessary courses on engineering geodynamics. Also, scientific research study suffered from this situation because it could not be integrated. This was changed in 1954, when, according to the decision of the scientific council of the geological faculty, the USSR Ministry of Higher Education transformed the soil science Chair into the Chair of soil science and engineering geology, and the Chair of hydrogeology and engineering geology into the Chair of hydrogeology.

The *third stage* (1954–1986) was the stage of the final establishment of the engineering geologist school at MSU. It was performed under the guidance of E.M. Sergeev, Professor, Corresponding member (1966), and later Academician (1979) of the AN USSR. This stage was characterized by the final formation of all scientific aspects of engineering geology, soil sci-

ence, engineering geodynamics, and regional engineering geology in research areas. This was reflected in the next structural reorganization of the Chair at the beginning of the 70s. Three educational scientific laboratories were formed instead of the three structural units present at that time. These were: the Laboratory of soil science and technical melioration of soils (the previously organized laboratory of soil mechanics and the newly formed laboratory of hard rocks entered into this laboratory); the Laboratory of engineering geodynamics (which included the process-modeling laboratory and the problem laboratory of slope processes); and the Laboratory of regional engineering geology.

The Chair staff, both in quantitative and qualitative terms, was changing remarkably during that stage. At the beginning of the stage, it amounted to 35 employees, whereas the number of state budget employees reached 60 and 54 permanent workers in expeditionary divisions at the end.

The *fourth development stage* (1986–1996) of engineering geology was characterized by further evolution of scientific research studies in all aspects of engineering geology directed at estimating and predicting changes in engineering geological conditions under technological impact. In 1986, the Chair was renamed into the Chair of engineering geology and geological environment protection. Consequently, the research has gone in new directions concerning engineering geological substantiation of protection and the rational use of geological environments along with estimating the resistance of such environments to technological impacts.

The change in the Chair name also caused changes in the names of laboratories. Thus, the Laboratory of engineering geodynamics was renamed the Laboratory of engineering geodynamics and geological environment protection and the Laboratory of regional engineering geology was renamed the Laboratory of regional engineering geology and rational use of the geological environment. A portion of all the scientific problems under study in all laboratories became associated with the protection and rational use of the geological environment. In 1986, the first Chair graduates received a degree in the specialization of *Geological environment protection*.

By the end of the fourth stage, the number of staff members was 66, among whom there were 10 doctors and 22 candidates of sciences. The total number of Chair members was reduced by the end of the fourth stage. This was caused by a reduction in the number of expeditionary workers, first due to the curtailment and then the almost complete termination of economic contract studies [Trofimov, 1998].

The *fifth stage* (from 1996) in the Chair development was characterized by carrying out investigations, not only in the field of engineering geology, but also in a new aspect of geological sciences: ecological geology. Therefore the Chair structure and its name

changed. By order of the MSU rector on May 26, 1996, a new laboratory was organized under the name of Ecological geology, and the Laboratory of engineering geodynamics and geological environment protection was renamed the Laboratory of engineering geodynamics and substantiation of engineering protection of territories. Since March 26, 1998, the Chair has been called the Chair of engineering and ecological geology.

Geological engineering issues still prevailed in the scientific plan of the Chair (see below). But also principally new issues appeared: ecological geology and engineering geology, i.e., theoretical methodological foundations and relations, development of the theoretical fundamentals of the doctrine on the ecological functions of the lithosphere, etc.

During these stages, the Moscow university school of engineering geologists, i.e., a school at the international level, formed at MSU and continues its successful study at the present time. Its formation is associated with the names of M.M. Filatov, who organized the Chair of soil science in 1938; I.V. Popov, S.S. Morozov, E.M. Sergeev, and G.S. Zolotarev. This school produced the doctors of sciences V.M. Bezruk, Yu.K. Vasil'chuk, A.N. Vakhtangov, E.A. Voznesenskii, S.D. Voronkevich, G.A. Golodkovskaya, B.M. Gumenskii, I.P. Zelinskii, R.S. Ziangirov, E.V. Kalinin, K.A. Kozhobaev, E.N. Kolomenskii, I.G. Korobanova, V.A. Korablev, V.S. Krupoderov, V.M. Kutepov, N.A. Maksimovich, V.A. Mymrin, Nguen Than (Vietnam), V.I. Osipov, Yu.B. Osipov, V.N. Sokolov, V.E. Sokolovich, B.I. Sergeev, V.T. Trofimov, Sh.E. Usupaev, V.S. Fedorenko, L.V. Shaumyan, N.L. Sheshenya, more than 254 candidates of sciences, and also more than 1300 Specialists and 51 Masters of geology.

The results of the 60-year study experience of engineering geologists of Moscow University are concentrated in publications of different years [Gerasimova, 2001; Filatov, 1940]. The principal achievements can be formulated as follows:

(1) the Chair as one of the leading scientific methodological centers, the first in the USSR and then Russia, played an important role in the development of higher engineering geological education in this country; its professors have contributed much to the elaboration of standard curricula, which underlie the specialty preparation program for students pursuing a degree in hydrogeology and engineering geology. Textbooks and teaching materials developed by lecturers of the Chair were applied at geological institutes of higher education both in our country and abroad for many years;

(2) a great contribution was made to the formation of engineering geology as a science of the geological cycle and to development of its theoretical fundamentals. The main direction of the Chair's scientific study consisted of a systematic development of all the scientific aspects of engineering geology (soil science, engineering geodynamics, and regional engineering geol-

ogy), and also of a number of applied aspects of engineering geology (engineering geology of cities and city agglomerations, engineering geology of hydraulic power plants, engineering geology of mineral deposits, etc.), and of the methodology for engineering geological exploration;

(3) the engineering geologists of MSU played an important role in the organization and operation of the USSR AN Research Council on engineering geology and soil science (from 1966 to 1980) and the USSR AN Research Council on engineering geology and hydrogeology, and in the activities of the national group of engineering geologists of the USSR and Russian National Committee of Geologists; they provided close interaction between Russian engineering geologists and the International Association of Engineering Geologists (IAEG);

(4) Chair members played a leading role in the initiation of the AN USSR Journal *Engineering Geology*, whose first issue was published in 1979; this journal was later renamed and reoriented by its Editor-in-Chief Academician V.I. Osipov, the Chair graduate, as the *Geocology Journal*;

(5) the Chair organized many scientific conferences, including forums, in cooperation with the IAEG and the International Geological Congress.

The scientific and educational activity of the Chair members in the field of engineering geology was highly appreciated in our country and abroad. The eight-volume monograph *Engineering geology of the USSR* received the Lenin Award in 1982. E.M. Sergeev and I.V. Popov (posthumously) were among the laureates of this award. Previously in 1952, I.V. Popov and G.S. Zolotarev received the Stalin Award as the co-authors of the two-volume monograph *Manual on Engineering Geological Exploration for Hydraulic Construction*.

A cycle of monographic studies and original maps on engineering geology providing effective national economical development of Western Siberia was awarded with a USSR State Award in 1977. Among its laureates were four members of the Chair: E.M. Sergeev, A.S. Gerasimova, S.B. Ershova, and V.T. Trofimov. In 1988, a similar award was given to the textbook *Soil science* (5th edition, 1983). As well, Sergeev, G.A. Golodkovskaya, Ziangirov, Osipov, and Trofimov were its laureates. The participation of Trofimov in the creation of the five-volume monograph *Geocryology of the USSR* was appreciated by giving him the rank of a laureate of the Russian Federation State Award in 1993 [Gerasimova, 2001; XX vek—lichnosti..., 2004].

The results of long-term studies of the Chair staff for engineering the geological mapping of Western Siberia were distinguished by the Lomonosov Award of MSU (1st rank) in 1975, and three major participants: Sergeev, Gerasimova, and Trofimov, were honored with the rank of laureates of this award. In 1998, E.A. Voznesen-

skaa became the laureate of the Shuvalov Award of MSU (2nd rank), which is given to young scientists, for his monograph *Soil Behavior under Dynamic Impact* (published in 1997).

The scientific activity of the school was highly appreciated by the geological community, when Sergeev was elected Academician of the AN USSR, Osipov, an Academician of the RAS, V.T. Trofimov, an academician of the RANS and IAS HS, Yu.K. Vasil'chuk an academician of the RANS, and Voznesenskii, Voronkevich, and Korolev, as corresponding members of the RANS.

The scientific activities of professor S.D. Voronkevich and assistant professor E.A. Voznesenskii received international acknowledgment: they were elected as members of the New York Academy of Sciences in 1996. Sergeev was an honorary doctor of the Bratislava (1972) and Warsaw (1974) Universities, and was awarded Hans Cloos Medal (IAEG).

The scientific and teaching activity of the Chair's professors was widely recognized. S.S. Morozov (1967), Popov (1969), Zolotarev, Golodkovskaya (1992), and Trofimov (1998) were each conferred the rank of "Honored Scientific Worker of the Russian Federation." In 1997, the Scientific Council of Moscow University awarded the rank of "Honored Professor of MSU" to Golodkovskaya, and the year before that, to Zolotarev. In 1998, this rank was conferred on Trofimov, and in 2002, he won the Lomonosov Prize of MSU for his teaching activities.

The developmental history of *ecological geology* at the Moscow University covers a very short period. Only after 1990 the Chair members started to study in this principally new aspect of geological science, which investigates the ecological functions of the lithosphere, patterns in their formation and spatiotemporal changes under the effects of natural and technogenic conditions due to the activities of the biota, and first of all, of humans. Within three years, the first series of fundamental studies was published, and in 1997, the monograph "Theory and Methodology of Ecological Geology."

The results of the study of the Chair members in the field of ecological geology can be briefly described as follows:

(1) the theoretical and methodological principles of ecological geology as a new aspect of modern geology were elaborated;

(2) a curriculum of the new specialty "Ecological geology" was elaborated, and a number of classical Universities in Russia follow it in their training of Bachelors, Specialists, and Masters; the geological faculty of MSU first accepted students pursuing this specialty in 1994; in 2000, the RF Ministry of Education approved the State Educational Standard (SES) of specialty 013300, *Ecological geology*;

(3) in 1996, the first special structure in the world was organized that is professionally engaged in a new aspect of geology; this was the Laboratory of Ecologi-



cal Geology, and in 1998 its Chair was organized, in whose name the words *ecological geology* were present;

(4) the syllabi of subjects concerning ecological geology provided by the State Educational Standard (SES) for the specialty "Ecological geology" were prepared and teaching manuals on many of them were published, including the first textbook on *Ecological Geology*" (2002, authors Trofimov and D.G. Ziling) in the world;

(5) the Chair organized and actively participated in three international scientific conferences *Ecological geology and the Rational Use of Subsoil* (1997, 2000, and 2003), and also the first (2000) through eighth (2007) Interuniversity conferences of young scientists *The School of Ecological Geology and Rational Use of Subsoil*.

The scientific and educational activity of the staff in the field of ecological geology has already received wide acknowledgment, both in our country and abroad. V.T. Trofimov, D.G. Ziling, and M.B. Kurinov were awarded the 1st rank prize of the Moscow Society of Nature Explorers for their monograph *Theory and Methodology of Ecological Geology* (1997). This was also expressed in that the development of SES standard curricula and syllabi was performed within the framework of the educational methodic council headed by professors of the geology faculty of MSU.

#### CURRENT STRUCTURE AND STAFF OF THE CHAIR OF ENGINEERING AND ECOLOGICAL GEOLOGY

The present Chair structure was developed in 1996. It consists of teaching and support staff and four scientific laboratories: (1) soil science and technical melioration of soils; (2) engineering geodynamics and substantiation of engineering protection of territories; (3) regional engineering geology and rational use of the geological environment; and (4) ecological geology. This structure has remained unchanged for the last ten years. In contrast, the Chair staff has considerably changed. During this period, associate professor B.A. Snezhkin, part-time professor Ziangirov (2006), and researchers A.V. Anikeev (2001), D.A. Spiridonov (2001), and I.K. Fomenko (2004) left the Chair; since the beginning of the 2000–2001 academic year, Osipov no longer works as a professor. Leading research workers Gerasimova, Ziling, Kolomenskii, Z.A. Krivosheva, and associate professor E.N. Ogorodnikova retired. The oldest professor of the Chair, G.S. Zolotarev, passed away in June 2006 (1914–2006). E.N. Voznesenskii was elected a professor of the Chair (2000), T.I. Averkina, M.B. Kurinov, S.K. Nikolaeva, V.N. Shirokov, E.N. Samarin, and I.Yu. Grigor'eva were elected associate professors, and A.V. Bershov, an assistant. The scientific and engineering staff of the Chair has

been largely renewed recently, because former post-graduates came to study here.

The teaching staff included 14 lecturers, 11 support workers, and 33 researchers by 2008. At that time the deputy heads of the Chair were: general deputy Professor Voznesenskii (from 2002), scientific study deputy senior researcher V.G. Shlykov (to the middle of 1999), associate professor I.Yu. Grigor'eva (from 1999), and senior researcher T.V. Andreeva (2006–2007) during her business trip abroad; Voznesenskii (till May 2002) and S.K. Nikolaeva (from 2002) were scientific secretaries of the Chair.

The teaching staff includes 5 professors (Trofimov, Voznesenskii, G.A. Golodkovskaya, E.V. Kalinin, and V.A. Korolev), 6 associate professors (Averkina, I.Yu. Grigor'eva, Kurinov, Nikolaeva, Samarin, and Shirokov), and an assistant (Bershov). Moreover, in 2007 senior research workers T.V. Andreeva and Yu.V. Frolova occupied the posts of associate professors. The teaching support staff of the Chair that organized and helped in the teaching process consisted of 11 workers: leading engineer M.V. Flamina, 1st category engineers N.P. Bol'shakova, O.I. Golubtsova, T.Yu. Merkulova, V.V. Vshiltseva, and I.Yu. Silina, 2nd category engineers M.V. Kopteva–Dvornikova, 1st category technical workers L.P. Tereshkova and E.A. Makarova, 2nd category technical worker M.M. Vorob'eva, and technical worker A.A. Zhuravleva.

During the last decade, considerable changes also took place in the scientific staff of the Chair. V.N. Sokolov became the Head of the Laboratory of soil science and technical melioration, Ziling was the alternate Head of the Laboratory of ecological geology (until 2004), and Yu.K. Vasil'chuk became the Head of the Laboratory of regional engineering geology. During this period, T.V. Andreeva, S.D. Balykova, T.A. Baraboshkina, A.V. Ershova, N.A. Larionova, L.L. Panas'yan, Yu.V. Frolova, M.A. Khar'kina, D.I. Yurkovets, V.V. Funikova et al. were elected senior researchers of the Chair. Also the staff of engineers and technical workers changed.

The body of the laboratory of soil science and technical melioration of soils consists currently of 16 employees: Trofimov, scientific supervisor; Sokolov, Head of the Laboratory; senior researchers V.M. Ladygin, N.A. Larionova, L.L. Panas'yan, V.V. Funikova, D.I. Yurkovets<sup>1</sup>, and V.V. Krupskaya<sup>1</sup>; research worker M.S. Chernov; leading engineers O.V. Razgulina, V.D. Kharitonov, and L.A. Levitskaya<sup>1</sup>, 1st category engineer F.A. Provorov<sup>1</sup>, specialists in precise and special devices G.M. Churakov, E.N. Dobrolyubov<sup>1</sup>, and K.V. Bernard<sup>1</sup>.

Professor E.V. Kalinin is the scientific supervisor and the alternate head of the Laboratory of engineering geodynamics. This Laboratory consists of senior researcher O.S. Barykina, research worker N.B. Arta-

<sup>1</sup>By-workers.

monova, leading engineer I.P. Gvozdeva, 1st category engineers N.V. Yurkovets (Kuznetsova) and E.S. Kushnareva<sup>1</sup>.

The laboratory of regional engineering geology has 7 employees: Yu.K. Vasil'chuk, Head of the Laboratory, senior researchers N.S. Krasilova, S.D. Balykova, A.V. Ershova, research worker N.A. Budantseva, 1st category engineer E.O. Golovina<sup>1</sup>, and 2nd category engineer G.I. Maslova. Professor Trofimov is the scientific supervisor of the Laboratory.

The laboratory of ecological geology consists of 5 employees: senior researchers M.A. Khar'kina and T.A. Baraboshkina<sup>1</sup>, leading researcher A.D. Zhigalin<sup>1</sup>, research worker L.A. Tsukanova, and leading engineer N.D. Khachinskaya. Professor V.T. Trofimov is the scientific supervisor of the Laboratory.

The Chair staff closely collaborates with the faculty scientific research laboratory investigating the influence of geological factors on the physicochemical solidification of soils. The largest part of this laboratory consists of graduates or former employees of the Chair. This laboratory has been headed by professor Voznesenskii since 2006, who was appointed deputy dean of the Geological Faculty in 2007. At present, the staff of this laboratory consists of 10 members. It includes senior researchers S.D. Voronkevich<sup>1</sup>, L.V. Goncharova, T.T. Abramova, T.G. Makeeva, V.I. Baranova, and V.I. Divisilova, leading engineers V.M. Fedorov, K.E. Valieva, and E.A. Fedyayeva, and engineer P.A. Yavlyaev.

All in all, during this period the Chair staff ranged between 66 and 58 specialists, among them 7 doctors and 25 candidates of sciences, 6 laureates of the USSR State Prize (Gerasimova, Golodkovskaya, Ziangirov, Zolotarev, Osipov, and Trofimov), a laureate of the State Prize of Russia (Trofimov), and 2 laureates of the 1st rank Lomonosov Prize (Gerasimova and Trofimov).

#### TEACHING AND METHODOLOGICAL TEACHING ACTIVITY OF THE CHAIR IN TRAINING PROFESSIONALS IN THE FIELD OF ENGINEERING AND ECOLOGICAL GEOLOGY

The main objective of the Chair was and still is the preparation of high-skilled specialists in the framework of two specialties: *Hydrogeology and Engineering Geology* and *Ecological Geology*, and also candidates of sciences through post-graduate study and from young employees. The joint annual loading of the Chair lecturers increased and changed within a range from 11 300 to 11 700 h. The total number of lecture courses delivered by the Chair staff reached 53, 5 of which are accompanied by extensive laboratory courses. The Chair lecturers not only teach students pursuing the above specialties, but also deliver lectures on subjects of *Engineering geology*, *Ecological geology*, and *Geology* to the students of other specialties of the geo-

logical faculty, and the *Soil science* course to students of the Chair of cryolithology and glaciology and the Chair of physical geography of the Geographical faculty.

During the decade in question, the Chair participated in the multilevel preparation of students in the specialization "Geology," a new specialization in the natural science block in the list of higher education specializations given by classical universities of Russia. In accordance with this approach, the first four years of education within the framework of each professional orientation (corresponding to common specialties) are absolutely similar in their content and volume. Students, having completed the four-year syllabus, receive a Bachelor's degree in geology and may continue their education to get a Master's degree (admission is competitive, 5–6th year of education) or a Specialist (5th year). Altogether in the years from 1998 to 2007, the Chair prepared 178 people in higher education: 119 Specialists, 51 Masters (3 of these were from China), and 8 Bachelors (6 from China).

The preparation of students in the context of the specialty *Hydrogeology and engineering geology* was realized through the specialties *Engineering geology*, *Soil science and artificial lithogenesis*, and *Protection of the geological environment*. The first of these was successfully acquired by 69 people; the second, by 2, and the third, by 25 persons; these each received a Specialist's degree. The program *Engineering geology* was finished by 25 Masters, and 8 people got a Master's degree in *Soil science and artificial lithogenesis*.

Note that since the 2000–2001 academic year, education is occurring according to a new curriculum in compliance with the State Educational Standard for specialty 011400: *Hydrogeology and engineering geology*. This caused the need to develop a series of new courses and revise previous ones. The curricula of all specialties were renovated with regard to the requirements of the SES in force. All these methodical considerations were included in collected volumes regularly published by the geological faculty of MSU. In 2000 the *Curricula and Syllabi* and *Educational and Practical Training* were published, and in 2002 *Graduate Studies and State Examination*. In 2004, a revised and corrected edition of *Curricula and Syllabi* and *Specializations and Master's Programs* were published, which included curricula and programs of the courses of "the right side" along with abstracts of subjects of specializations and Master's programs on engineering geology delivered by the Chair.

The preparation of students in the Bachelor's program in the *Ecological geology* specialty was started by the geological faculty in 1994 and in the Master's program, in 1998. However, specialty 013300, *Ecological geology*, as an experimental specialty was organized at MSU by the order of the RF Ministry of Education only in October 1999. In 2000, the State Educational Standard of specialty *Ecological geology* 013300 was approved for the first time. It was elaborated mainly by members of the Geological Faculty and adjusted with



standards of other geological specialties in humanitarian and natural science disciplines, differing in a larger number of hours for biological and chemical courses. In respect to common professional subjects, the SES of the specialty *Ecological geology* comprised 17 courses compulsory for all geological specialties (including *Ecological geology*) and 13 new courses absent in the curricula of other specialties. Among them are: "Fundamentals of geoecology," "Landscape science," "Soil science," "Meteorology and hydrology," "Ecological geodynamics," "Ecological hydrogeology and hydrochemistry," "Ecological geochemistry," "Ecological expertise," "Industrial Ecology," "Human ecology (medical aspects)," "Legal foundations of the use of subsoil and protection of subsurface resources," "Economics of nature management," and "Principles of ecological geological exploration."

A set of syllabus projects for the specialty (differing from the syllabi in Bachelors' preparation of the specialization *Geology*) was presented to the Ministry of Education and approved in 2000. The syllabi of special disciplines were revised based on the teaching experience at MSU and SPbSU (St. Petersburg State Univ.) and reapproved by the Ministry of Education in 2002. Among the authors of syllabi and curricula are many lecturers of the Chair of engineering and ecological geology. These methodical elaborations were published in the form of an abstract in the mentioned SES and collected issues of the geological faculty of MSU.

In the last decade, 23 people with a Specialist's degree in ecogeology graduated from the Chair. Fifteen students successfully received a Master's degree.

Furthermore, the Chair staff elaborated a syllabus of a refresher course *Engineering and ecological geology of oil and gas basins*, and also the syllabus and curriculum of the innovative Master's project *Ecological geology of territories disturbed technogenically (TDT)* in the context of the program *Formation of the system of innovative education at Lomonosov MSU*. In the framework of this project, the Chair staff has developed syllabi for new disciplines: *Ecological geology of TDT*, *Patterns in the formation of ecological functions of the lithosphere*, *Estimation of changes in the ecological geological conditions under technogenic impact*, *Risk-analysis of technocratically developed territories*, *Ecological geological mapping of TDT*, *Ecological geodynamics of TDT*, *Problems in predicting changes in the geological environment in the TDT limits*, *Geological factors of ecological risk*, *Ecological geological conditions of Russia*, *Physicochemical methods of investigating the components of ecological geological systems and ecological interpretation of results*, *Geochemical factors of ecological risk and microelements*, and *Contamination of TDT soils and their purification*.

During the period from 1996 to 2006, 40 persons entered the post-graduate degree course of the Chair. It was completed by 15 people, and 13 of them successfully defended candidate dissertations. Moreover, can-

didate dissertations were defended by 2 members of the Chair and one attached to the post-graduate degree course.

During this period, a number of textbooks and teaching manuals were published: textbooks by Trofimov and Ziling *Ecological geology* (2002), Kalinin *Engineering geological calculations and simulation* (2006), *Soil science* (6th edition, Trofimov, Korolev, Voznesenskii, Golodkovskaya, Vasil'chuk, Zianguirov, ed. by V.T. Trofimov, 2005); teaching manuals of *Field methods of hydrogeological, engineering geological, geocryological, and ecological geological explorations* (2001), Trofimov et al. *Ecological geological maps* (2002, 2007), Samarin, Bershov, and Fomenko *Lecture Course on the Statistical Processing of Engineering Geological Information* (2004), E.N. Ogorodnikova and Nikolaeva *Technogenic soils* (2004), Voronkevich *Principles of Technical Melioration of Soils* (2005), Trofimov and Ziling *Formation of Ecological Functions of the Lithosphere* (2005), Trofimov et al., *Transformation of the Ecological Functions of the Lithosphere in the Epoch of Technogenesis* (2006), *Laboratory Studies on Soil Science* (edited by Trofimov and Korolev, 2008), Korolev *Monitoring of Geological, Lithotechnical, and Ecological Geological Systems* (2007), Trofimov and Krasilova, *Engineering Geological Maps* (2007), etc.

## RESULTS OF SCIENTIFIC STUDIES IN 1998–2007

From 1998 to 2000, the scientific research study of the Chair was carried out in two aspects, the *Theory of formation of engineering geological conditions of the Earth and their evolution in the epoch of technogenesis* and *Development of theoretical principles of the doctrine on ecological functions of the lithosphere*. In the context of the first aspect, 12 themes were developed, and 2 themes of the second were developed as well [Trofimov, 1998]. Eight themes were reported; there were publications, including monographic ones.

The study on classifying the Earth's engineering geological structural features resulted in the publishing of the monograph *Engineering Geological Structures of the Earth* (authors Trofimov, Averkina, Spiridonov, 2001). The monograph *Engineering Geology and Ecological Geology—Theoretical Methodological Principles and Interrelation* (1999) finished the development of the eponymous theme by Trofimov and Ziling. The books "Genesis of Loess Soil Subsidence" (Trofimov, 1999) and "Loess Cover on the Earth and Its Properties" (2001) are the results of the development made by Trofimov, Andreeva, Balykova, and Ershova of the theme *Loess Cover on the Earth and Its Engineering Geological Peculiarities*. The monograph "Ecological functions of the lithosphere" (Trofimov, Ziling, Baraboshkina, Bogoslovskii, Zhigalin, Khar'kina, et al., 2000) was written in the course of elaborating the theme *Developing the Theoretical Foundations of the Doctrine of Ecological Functions of the Lithosphere*.

The generalization of the theme *Artificial soils as a technogenic product* permitted the teaching manual *Technogenic Soils* (Ogorodnikova and Nikolaeva, 2004) to be written and later published.

On other themes, articles were written and reports made at conferences of different levels. Among them are: *Theoretical and Methodical Principles of Modeling and Predicting the Properties of Binder Soils Based on Their Mineral Structural and Thermodynamic Indices. Development of Fundamental Principles of Modeling and Predicting Behavior of Clay Soils in the Technogenic Zone for Optimization of Exploration and Solution of Ecological Problems* (Korolev, Sokolov, Shlykov, et al.); *Patterns in the Formation of Engineering Geological Properties of Volcanic Rocks in Different Tectonic Structures of the Earth* (Golodkovskaya, Ladygin, Frolova, et al.); *Investigation of Time Effects of Deformation and Destruction of Soils under Variable Loads*, finished by publishing a monograph *Dynamic Instability of Soils* (Voznesenskii, 1999); *Development of Methods for Probability Simulation of Engineering Geological Processes Based on Cell Automates* (Kolosnenskii, Kharitonov, et al.); *Patterns and the Mechanism of Slope and Accompanying Processes. Development of Standard Engineering Geological Models and Geomechanical Schemes as a Basis for Predicting and Substantiating Engineering Protection* (Zolotarev, Kalinin, Anikeev, et al.); *Role of the Deformation Mode (DM) of Rocks in the Formation of Geological Processes. Exploration of DM of Rock Masses by Mathematical and Experimental Methods* (Kalinin, Panas'yan, and Shirokov); *Development History of Engineering Geology* (Zolotarev and Gerasimova); *Theoretical issues in the Evolution Problem of Engineering Geological Conditions of the Earth during the Technogenic Epoch* (Trofimov, Kurinov, Spiridonov, et al.); *Study of Historical Geological Patterns in Formation of Engineering Geological Peculiarities of Rock Masses with Thick Ice Wedges* (Yu.K. Vasil'chuk).

During this period, the researchers and lecturers of the Chair actively carried out, along with state budget themes, scientific studies and projects supported by grants received on a competitive basis from various foundations (RFBR, FSP "Integration," RF Ministry of Science and Education, program "Universities of Russia," INTAS, Institute for Sustainable Communities, etc.). Thus, RFBR grants supported the following themes: "Time effects of deformation and destruction of soils" (supervisor Voznesenskii), "Classification of engineering geological structures of the Earth and their characteristic" (Trofimov), "Logical and actual diversity of engineering geological structures of the Earth" (Trofimov), "Fundamentals of modeling the properties of argillaceous rocks of subaqueous origin" (Sokolov), "Investigation of the mineral composition effect on the formation of corrosion properties of argillaceous rocks" (L.A. Tsukanova), "Study of formation mechanism of syngenetic subsidence of eolian loess rocks" (Andreeva).

The themes of the performed studies supported by the program "Fundamental Studies of Higher Schools. Universities of Russia" grants were also very diverse. They were as follows: "Composition, structure, properties, and patterns of clay mineral transformation under different conditions of diagenesis and epigenesis" (Voznesenskii); "Ecological functions of the lithosphere" (Trofimov); "Functional analysis of ecological geological systems: methodology, methods, exploration experience" (Golodkovskaya); "Development of unconventional principles and methods of prevention and elimination of technogenic impact (damage, destruction, and pollution) on mountain range rocks" (Voronkevich); "Ecological geological maps: their content, themes, and assignment" (Ziling); "Simulation of dynamics and evolution of engineering geological conditions during the technogenic epoch" (Spiridonov). E.A. Voznesenskii performed the studies "Extended energy approach in the dynamics of soils" supported by the INTAS grant and "Low-cost reduction of the environment pollution at exploiting oil and gas fields" supported by the Institute for Sustainable Communities grant.

Contract studies were developing as well. From 1996 to 1998, they were carried out along with the Ministry of Natural Resources of Russia on the theme "Theoretical fundamentals of ecological geology" and on the theme "Content and methods for next generation ecological geological mapping," in 1999. In 1998, the studies on the theme "Estimation of landslide slope stability within the limits of Zagorsk SAPP constructions during the initial period of exploitation" were finished. In 1999, studies were performed within the framework of the new contract "Estimation of the influence of engineering geological characteristics of soil masses on the landslide slope stability within the limits of Zagorsk SAPP constructions under conditions of the reconstructed drainage barrier."

In 2000, the Chair accepted a new state budget theme for five years (2000–2005) for implementation. Three themes were worked out at the Laboratory of soil science and technical melioration: "Petrogenetic patterns in the formation of rock properties (by the example of effusive and carbonate rocks)" (scientific supervisor Golodkovskaya); "Simulation and prediction of the deformation and destruction of soils under variable loads" (Voznesenskii); and "Study of patterns in the formation of properties of clay soils as components of engineering geological and ecological geological systems" (Korolev). The developments made in the context of the latter were generalized by Korolev in his monograph *Purification of Polluted Soils* (2001).

Studies were carried out at the Laboratory of geodynamics and substantiation of engineering protection of territories on the theme "Patterns in the formation, simulation, and prediction of downwarping and subsidence of the Earth's crust in karst areas" (scientific supervisor Kalinin). Based on the obtained data and also on materials of previous developments, they wrote and pub-



lished the book *Simulation of Stress Fields in Engineering Geological Masses* (authors: Kalinin, Panas'yan, Shirokov, Artamonova, and Fomenko, 2003).

Investigations were performed at the Laboratory of regional engineering geology and rational use of the geological environment under guidance of Trofimov on three themes: "Theory and methodology of current regional engineering geology," "Patterns in formation and spatial distribution of collapsible loess rocks of Northeastern Eurasia," and "Engineering geological maps." The results of these studies were presented in monographs *Theoretical Fundamentals of Regional Engineering Geology* (Trofimov and Averkina, 2007), *Key Engineering Geological Sections of Loess Rocks of Northeastern Eurasia* (Trofimov, Andreeva, Balykova, Ershova, and Ya.E. Shaevich, 2008), and the teaching manual *Engineering Geological Maps* (Trofimov and Krasilova, 2007),

Two themes were elaborated under the guidance of Yu.K. Vasil'chuk: "Historical geological patterns in formation of engineering geological peculiarities of rock masses with syngenetic ice wedges during the Late Pleistocene and Holocene" and "Historical geological patterns in formation of engineering geological peculiarities of rock masses of convex-hilly peat bogs during the Holocene." The result of studies on the former was Vasil'chuk's monograph *Ice Wedges: Heterocyclicity, Heterochrony, Heterogeneity* (2006).

At the Laboratory of ecological geology, studies were carried out in the framework of two themes: "Development of theoretical fundamentals of the doctrine on ecological functions of the lithosphere" and "Analysis of the current state and development of fundamentals of ecological geological mapping." In the context of the former, after the monograph *Ecological Functions of the Lithosphere* (2000), the teaching manual *Transformation of Ecological Functions of the Lithosphere during the Technogenic Epoch* was published in 2006 (Trofimov, Ziling, Baraboshkina, Zhigalin, and Khar'kina). The results of the development of the latter theme and also a contract study with the Russian Research Institute of Hydrogeology and Engineering Geology (VSEGINGEO) can be found in the brochure *Logic and Content of a Map of the Current State of the Upper Horizon of the Earth's Crust as a Factual Base for Ecological Geological Mapping* (Trofimov, Ziling, Baraboshkina, Bogoslovskii, Zhigalin, Krasilova, and Khar'kina, 2004) and two editions of the teaching manual "Ecological Geological Maps" (Trofimov, Ziling, Baraboshkina, Khar'kina, and Zhigalin, 2002, 2007).

From 2001 to 2005, the number of grants that supported the studies performed by the Chair staff increased to 14. Let us name some of these studies: "Time effects of the deformation and destruction of soils" (supervisor Voznesenskii), "Patterns in the formation of engineering geological properties of volcanogenic soils in the lithification process" (Frolova),

"Organization and performance of complex expeditionary studies in the Kamchatka and Karelia regions in order to study the formation and the nature of magmatic rock properties" (Ladygin), and "Development of a new strategy of radiocarbon dating the Late Pleistocene and Holocene sediments and underground ice by accelerator mass-spectrometry and the refinement of chronology of main paleogeographic events in the North of Russia" (Vasil'chuk). Furthermore, 4 grants were received by young scientists (N.A. Budantseva, E.B. Kudryashova, V.V. Funikova, and Yu.N. Chizhova).

The number of studies under economic agreements increased to 24. The composition of tailings for a number of concentration plants at Aihalsk, Komsomol'sk, and Nyurbinsk diamond deposits and their effect on the consolidation of tailings were investigated (supervisor Korolev). The studies on the theme "Logic and content of the map of the current state of the geological environment as a factual base for ecological geological mapping" by the contract with VSEGINGEO were carried out by members of the Laboratory of ecological geology; 14 contracts on the study of engineering geological and ecological geological conditions of concrete objects in different parts of the country (European part, West Siberia, Kuznetsk Basin, Sakhalin, etc.) and foreign countries (Moldavia) were performed under guidance of E.A. Voznesenskii.

The growth in the number of studies under economic agreements was promoted the certification of the Chair Laboratory of soil science and technical melioration of soils for technical competence in testing soils of natural sedimentation, as well as soils and technogenic soils (including strengthened), and also in analyzing the composition and properties of underground and surface waters, which occurred in March 2005. The correspondence to main requirements of the GOST RISO MEK 17025 for testing laboratories was confirmed by the attestation certificate No. 300.089. This extended opportunities to the Chair for attracting off-budget studies under customers' contracts, and also it provided the laboratory with modern automatic devices for determination of physic and mechanical properties of soils.

In 2006, the Chair accepted a new five-year state-budget scientific target for investigations: "Investigation of diversity of engineering geological and ecological geological conditions of Russia as a requisite for substantiation of rational use of subsoil." Its main item was creation of a monograph *Engineering Geology of Russia* (scientific supervisor Trofimov). It consisted of three volumes: *Soils of Russia*, *Engineering Geodynamics of Russia*, and *Engineering Geological Structures of Russia*. All lecturers and researchers of all the scientific laboratories of the Chair take part in its creation.

Development of the above scientific problem is facilitated by investigations in the context of the project "Diversity of soils in Russia and innovations in managing their state and properties" (scientific supervisor Trofimov, executive in charge Voznesenskii). The enti-



tlement for this project was won in a competition held by the departmental target program "Development of the scientific potential of higher schools (2006–2008)."

The theme "Ecological geological conditions of Russia" is currently worked out at the Laboratory of ecological geology in the framework of this problem. The creation of the eponymous monograph is supposed in the issue, which must include a series of original ecological geological maps as an essential component.

Two more principally new themes are being elaborated at the Laboratory of soil science and technical melioration of soils owing to purchase of new expensive scientific equipment: "Micro- and nanostructure of natural and artificial soils: the role of different phases in its formation" (executive in charge Sokolov) and "Investigation of the nature and patterns of stress wave attenuations in soils" (Voznesenskii).

This state budget theme of the Chair was backed by development of related themes in the framework of RFBR grants and studies under economic agreements. Thus, in 2006 the studies supported by RFBR grants were performed on the themes "Time effects in deformation and destruction of soils" (supervisor Voznesenskii, executives Funikova, Samarin, Bershov, Kushnareva, P.A. Yavlyayev, F.A. Provorov, D.V. Lagonskaya, and M.L. Chernysheva), "Paleosoils and pedosystems of the Permian, Triassic, and Pleistocene: comparative morphostructural analysis, reconstruction of paleopedogenesis and paleolandscape conditions" (Sokolov), "Paleogeographic and paleoclimatic reconstructions of Russian Arctic Zone based on correlation of isotopic diagrams dated by radiocarbon of the late Pleistocene and Holocene ice wedges with isotopic curves of Greenland" (supervisor Vasil'chuk, executives N.A. Budantseva, Yu.N. Chizhova, and A.A. Zhuravleva).

In recent years, the number of studies under the economic agreement increased, especially at the Laboratory of soil science. In 2006, the studies on the following themes were carried out: "Development of new methods for estimation of dynamic stability of roadbed soils" (Voznesenskii, Funikova, Samarin, Bershov, Kushnareva, F.A. Provorov, and D.V. Lagonskaya); "Estimation of behavior of soils at the building site for the expected dislocation of a MFFF-R plant under dynamic loads" (Voznesenskii); "Expertise of a report on exploration of open pits of commonly occurring mineral resources in GP-4, GP-5, and GP-9 regions of Medvezhye field" (Voznesenskii, Kalinin, Shirokov, Samarin, and Bershov); "Exploration, certification, projection of development and recultivation of open pits of commonly occurring mineral resources based on novel technological solutions in the regions of Nerutinsk, West Yagenetsk, West Jubilee, Mariettinsk, South Padinsk areas" (Voznesenskii, Kalinin, Shirokov, Samarin, and Bershov); "Laboratory investigations of composition and properties of argillaceous, hard rock, and semi-rock soils of the Plesetsk bauxite deposit" (Voznesenskii, Ladygin, Panas'yan, Frolova, Shlykov,

V.D. Kharitonov, and Bershov); "Monitoring of the ecological situation within experimental ground region" (Voznesenskii, Samarin, and Bershov).

Closing this section, I'd like to note that in the last decade publications of the Chair members were supported by RFBR publishing grants: Voznesenskii *Dynamic Instability of Soils* (Publishing House Editorial URSS, 1999); Korolev *Purification of Polluted Soils* (Publishing House MAIK "Nauka/Interperiodika," 2001); Grigor'eva *Microstructure of Loess Rocks* (Publishing House MAIK "Nauka/Interperiodika," 2001); Trofimov *Subsidence Formation Theory of Loess Rocks* (Publishing House GEOS, 2003); Trofimov and Averkina *Theoretical Fundamentals of Regional Engineering Geology* (Publishing House GEOS, 2007). The publishing grant of the federal target program "State support for the integration of higher education and fundamental science in 1997–2000" was given to a monograph by Vasil'chuk and Kotlyakov *Principles of Isotopic Geocryology and Glaciology* (Publishing House of Moscow University, 2000), and a grant of the federal target program "Integration of science and higher education of Russia in 2002–2006" was received for a monograph by Vasil'chuk *Ice Wedges: Heterocyclicity, Heterochrony, Heterogeneity* (Publishing House of Moscow University, 2006).

#### SCIENTIFIC ORGANIZATIONAL ACTIVITY OF THE CHAIR MEMBERS

Since 1998, the Chair has organized and held 9 international scientific conferences on various problems, including the most topical ones, of engineering and ecological geology at the geological faculty of Lomonosov MSU. Let us give the titles of these conferences. They are: "Genesis and models for formation of soil properties" (May 1998); "Theoretical problems of engineering geology" (May 25–26, 1999); "20th Century: figures and schools in engineering geology" (May 2000); "Novel types of engineering geological and ecological geological maps" (May 2001); "Petrogenetic, historical geological, and spatial problems in engineering geology" (May 28–29, 2002); "Diversity of soils: morphology, causes, and consequences" (May 27–28, 2003); "Engineering geology of masses of loess rocks" (May 25–26, 2004); "Problems in engineering geodynamics and ecological geodynamics" (February 2–3, 2006); "Monitoring of geological, lithotechnical, and ecological geological systems" (May 24–25, 2007).

The Chair staff actively participated in the organization of Sergeev's Readings. In the context of these readings, the memorial portion of the program was held at the geological faculty. Here the Chair members and guests made reports on the importance of E.M. Sergeev's studies and their further development and shared their memoirs about him. Six such sessions were held.

The tradition of MSU school of engineering geologists participating in the study of scientific organiza-

tional have also been continued in the field of ecological geology. The Chair staff took active part in the organization of the first (1997), second (2001) and third (2003) International conferences "Ecological Geology and Rational Use of the Subsoil" along with the first (2000) through the eighth (2007) inter-university conferences of young scientists "The School of Ecological Geology and Rational Use of the Subsoil." Chair members made general reports and lectures and leading reports on many themes.

## CONCLUSIONS

In the last decade, the system of higher education and economics in the country, and engineering geology, and ecological geology at the Moscow University have been developing in a positive direction despite all the difficulties in the current state of science, thus determining in many respects their development in the country as a whole. The school of engineering geologists of Moscow University has remained as the leading school in Russia that successfully solves many problems of engineering geology and higher professional engineering geological education.

During the same period, the Chair staff elaborated the theoretical and methodological principles of ecological geology as a new aspect of geological science. Together with the members of other chairs of the geological faculty, they established an essential foundation for higher ecological geological education in our country.

## REFERENCES

- XX vek—lichnosti i shkoly v inzhenernoi geologii SSSR i Rossii* (20th Century: Personalities and Schools in Geological Engineering in the USSR and Russia), Trofimov, V.T and Korolev, V.A., Eds., Moscow: Mosk. Gos. Univ., 2004.
- Filatov, M.M., Chair of Soil Science at the Moscow State University, *Scientific Proc. Mosk. Univ. Geologiya, Pedologiya, Soil Science*, 1940, issue 56, pp. 85–92.
- Gerasimova, A.S., *XX vek. Inzhener-geologi—laureaty Gosudarstvennykh premii* (Geological Engineers—Prize-Winners of State Premiums), Trofimov, V.T., Ed., Moscow: Mosk. Gos. Univ., 2001.
- Inzhenernaya geologiya v Moskovskom universitete* (Geological Engineering at the Moscow University, Gerasimova, A.S., Krivosheeva, Z.A., and Trofimov, V.T.), Moscow: Mosk. Gos. Univ., 1998.
- Korolev, V.A., Gerasimova, A.S., and Krivosheeva, Z.A., *Inzhener-geologi Moskovskogo universiteta: Biografiko-bibliograficheskii spravochnik* (Geological Engineers of the Moscow University: Biographic–Bibliographic Hand-Book), Trofimov, V.T., Ed., Moscow: Mosk. Gos. Univ., 1998.
- Morozov, S.S. and Sergeev, E.M., Evolution of the Chair of Soil Science and Engineering Geology of the Moscow University during 25 Years of Its Existence (1938–1963), *Voprosy Inzhenernoi Geologii i Gruntovedeniya*, 1963, issue 1, pp. 8–27.
- Sergeev, E.M., Activities of the Chair of Soil Science and Engineering Geology of the Moscow University during the Last Decade (1963–1972) and Some General Issues of Developing the Engineering Geology, *Voprosy Inzhenernoi Geologii i Gruntovedeniya*, 1973, issue 3, pp. 6–29.
- Sergeev, E.M., Evolution of Engineering Geology at the Moscow University, *Vestn. Mosk. Univ. Geologiya*, 1988, no. 1, pp. 44–54.
- Trofimov, V.T., Engineering Geology at the Moscow University in 1988–1998 (to the Sixtieths Anniversary of the Chair of Engineering Geology and Geological Medium Protection, *Vestn. Mosk. Univ. Geologiya*, 1998, no. 1, pp. 9–16.
- Trofimov, V.T., Fiftieth Anniversary of the Chair of Engineering Geology, *Vestn. Mosk. Univ. Geologiya*, 1988, no. 10, pp. 125–132.
- Trofimov, V.T., Gerasimova, A.S., and Krivosheeva, Z.A., School of Engineering Geologists at the Lomonosov Moscow State University, *Geoecologiya*, 1998, no. 1, pp. 3–15.