Geological Education in the U.S.S.R.

by D.P. Lobanov and E.D. Yershov

This article outlines the overall organization and course structure of geological education in the Soviet Union. There are now nearly 200 000 geologists and technicians with first or higher degrees from technical schools, higher technical institutes and universities. To illustrate the latter two, the authors review the syllabuses for geological studies at Moscow State University and the Moscow Geological Prospecting Institute. (Certain explanatory sections have been added by the Editor based on information from the U.S.S.R. National Committee of Geologists).

Historical Background

Geological education in the U.S.S.R. began in the 18th century with the opening of mining schools in the Urals. These schools taught Russian grammar, mineralogy, geognosy, mining and mine surveying. In the middle of the nineteenth century, a special mining school was founded in Ekaterinburg (now Sverdlovsk) to train specialists for mineral production. In 1755, Moscow University and in 1773, the Mining College in Petersburg (Leningrad) were established for the teaching of geological and mining subjects. Lectures on geological subjects were delivered in the Medical Faculty and later (1804) in the Faculty of Physics and Mathematics (Vorobjov et al., 1980).

The study of geology and mining was based on the fundamental work of the great scientist M. Lomonossov and on the practical techniques of many talented Russian miners and engineers. By the early 20th century, there were in many Russian cities a variety of institutions offering geological courses, many with their own individual teaching systems. After the October 1917 Revolution, all citizens of the U.S.S.R. were given the right to higher education, and since then the volume and quality of geological education has greatly increased. Each of the fifteen Soviet republics now trains its own geologists.

Structure of Soviet Geological Education

Geological education in the U.S.S.R. is carried out at universities, higher technical institutes and special technical schools. There are direct (full-time) studies, evening studies and tuition by correspondence.

There are now more than 90 000 geological technicians in the U.S.S.R. In general, these are graduates of three to four year

Figure 1: Using the electron microscope.

courses at "special schools" (secondary technical institutions), of which there are over 40 in the U.S.S.R., graduating together some 5000 students each year. Some may later advance to "colleges" (universities and higher technical institutes), where the average course lasts five years. College graduates are called Geologists or Engineers in Geology, and they now number approximately 100 000. There are today more than 50 colleges, which graduate a total of some 6000 students each year. Soviet universities teach a range of subjects, including the natural sciences, whereas the higher technical institutes generally concentrate on one discipline. One example of the latter is the Moscow Institute ("I. Goubkine") for Oil and Gas Industry, one of nine such institutes where engineers specializing in the geology of and exploration and drilling for oil and gas are trained.

Candidates are roughly equivalent to Ph.D. graduates, having published several papers in a coherent field of study. The category of Doctor is higher than that of Candidate, and scientists with this title must have produced a number of significant works (e.g. monographs) in one field or, perhaps, pioneered a new one. An approximate equivalent here might

Figure 2: Moscow State University.

Figure 3: Practical field training in geophysics.

be the D.Sc. of British universities. There are some 7000 Candidates and Doctors now in the U.S.S.R., and about 300 new ones are added each year.

Most graduates from the special schools enter industry, while many from universities go on to research positions (Fig. 1). As a rule one to two years before graduation, all students know the place of their future job. After their final exams, they are given official assignments to work in accordance with their specialization. The best graduates, of course, have a wider choice of positions.

The Central Committee of the Communist Party and the Council of Ministers, govern the work of the universities and higher institutes through instructions and recommendations from the Ministry of Higher Education, which confirms and renews teaching programs every five or six years. Some leading colleges may, however, have their own syllabuses, which are monitored by the Ministries of Higher Education and Geology.

Every Soviet geologist is expected to be familiar with both theory and practice, to enrich his knowledge, to widen his social-political outlook and to supervise workers and technicians. Education at all Soviet colleges and universities is free of charge. Advanced students get a State allowance, and there are also scholarships from the Ministries of Higher Education and Geology, the Academy of Sciences and the Central Committee of the Young Communist League.

Course Structure

The average five year course at Soviet universities runs for some 4500-5000 hours. Students have up to 36 classes (normally 45 minutes) each week (excluding physical education) in the first to third years, and up to 30 hours a week in the fourth and fifth years. Independent research, library work and assignments total 2700 to 3000 hours.

Classes in engineering subjects make up over 1200 hours, and in geological topics more than 2000 hours, or for the more specialized courses, 3000 hours. Geological courses include historical and regional geology, Quaternary deposits, lithology, palaeontology, geomorphology, structural geology, geotectonics, mapping, mineralogy, petrography, crystallography, geochemistry, ore deposits, prospecting (geological, geophysical and geochemical) hydrogeology, geological engineering and environmental geology.

Socio-political subjects make up 12% of the total course work and include topics such as the history of the Soviet Communist Party (120 hrs in the first year), Marxist-Leninist philosophy (90 hrs in the second and third years) and political

Figure 4: Studying crystal structure at MSU.

economy (140 hrs in the fourth year). Students may also attend elective courses on Marxist-Leninist ethics and aesthetics, and scientific atheism.

Foreign language studies (English, German, French or Spanish) include 800 hours of compulsory classes, 330-340 of optional classes and 250 hours of independent work. There are 530 hours devoted to physical education, for it is considered very important that geologists should be familiar with matters of health and hygiene.

Much attention is also paid to physics, mathematics, chemistry and engineering. For example, students learn probability theory, mathematical statistics, and the principles of mathematical logic and cybernetics applied to geological problems.

Moscow State University

The Geological Faculty of the Moscow State University, "M. Lomonosov", is a leader in Soviet geological education (Fig. 2). The MSU Geological Faculty trains specialists in five areas: geological surveying, prospecting for oil and gas, geophysical prospecting, geochemical prospecting, and hydrogeology and geological engineering.

Students of geological surveying have three main choices of specialization: mapping and the search for useful minerals, geology and mineral exploration, and palaeontology. The first group concentrates on the study of the structure and development of the crust, modern geological processes and geomorphology. The second group focuses on the distribution of minerals in the crust, exploration methods, and the composition and structure of deposits. Palaeontology specialists also take lectures on biological subjects.

Students who select oil and gas prospecting are trained in the detection and evaluation of oil, gas and coal deposits, including the application of geochemistry to this field. The geophysical option includes gravity, magnetic, seismic, and electrical methods of prospecting, and geophysical engineering (Fig. 3). Those graduating from this stream are employed in scientific research institutes, or in mineral prospecting. They may also do research in such applied fields as engineering construction, hydrogeology and marine geophysics.

In the geochemical stream, students specialize in petrography, mineralogy, crystallography or geochemistry. Petrographers study the geology, structure, metallogeny and physical properties of magmatic and metamorphic rocks, and they also do experimental research in technical petrography. Mineralogy students concentrate on the conditions of formation of minerals, their physical and chemical properties, and the composition of ore deposits. These students also do

laboratory research on synthetic minerals. Crystallography specialists study the structure and the chemical composition of crystals and minerals (Fig. 4), with the focus on the properties that make them useful in industry. The geochemists study the geochemical processes in the crust, methods of separation and analysis of ores and minerals, the determination of their absolute age, and geochemical prospecting. They also do laboratory, experimental and industrial research.

Hydrogeology and geological engineering students specialize also in geocryology and soils. Hydrogeologists are trained in the search for potable, medicinal and industrial groundwaters, and after graduation they may be involved in hydro-technical work (e.g. dams and reservoirs), land drainage and reclamation, water supply, or the control of mine waters. Specialists in geological engineering and soils study rocks as the base for construction, and geotechnical work. Those concentrating on geocryology must learn methods of researching frozen grounds, and the process and structures of permafrost and seasonally frozen grounds.

In training geologists for all specialties, practical training is of great importance. MSU students, for example, acquire practical training in the field parties of the Ministry of Geology and the Academy of Sciences.

Moscow Geological Prospecting Institute

A good example of a higher technical institute for geological training is MGPI – the Moscow Geological Prospecting Institute, "S. Ordjonikidze". This is the only college in the U.S.S.R. specializing in rare, non-ferrous and radioactive metal deposits. Candidates and Doctors of Science comprise 78% of its staff (Lobanov, 1979).

There are seven directions of study at MGPI of which three are on similar topics to those at MSU described above. In contrast to the university students, those at MGPI receive wide practical training as engineers in prospecting methods, mining technology, and the economics and management of geological exploration. Upon graduation, they receive the degrees of "Geological (Geophysical, Hydrogeological) Engineer" or "Mining Economist."

Geological surveying at MGPI has four directions: geological surveying and prospecting for (1) all types of solid rocks, (2) rare and radioactive elements, (3) semi-precious stones, and (4) the applied mineralogy of diamonds and semi-precious, precious and industrial "stones."

MGPI students in geophysical prospecting specialize in methods for rare and radioactive elements, structural geophysics, mining geophysics, or the geophysics of drill holes. All students have lectures on exploration geophysics, petrophysics, nuclear geophysics, the recording and interpretation of geophysical data, and on gravity, magnetic, electrical, and radiometric surveys.

The third area in common with MSU is hydrogeology, but MGPI students concentrate more on prospecting for and evaluation of underground waters, and on geotechnical aspects. Under the title of technology and techniques of prospecting, MGPI trains mining engineers in the technology of drilling and rock openings. Practical training takes place on modern drill-rigs in the MGPI laboratories, which approximate industrial drill equipment and conditions of production drilling. Students learn to construct mathematic models of drill processes and to use computers for the analysis and optimization of drilling.

MGPI students may select mine economics and management. In addition to geological and technical subjects, they study the theory and practice of geological and economic valuation of deposits. They also have lectures on management, psychology and sociology. After graduation they are employed on geological expeditions, and in mines, offices of economics and so forth. There are also specialties at MGPI in the

technology and complete mechanization of underground mining and the exploitation and mechanization of placers.

MGPI students gain practical training (for which they earn a salary) in the field expeditions and institutes of the Ministry of Geology. They may, for example, learn at first hand problems of super-deep drilling on the Kola Peninsula (see Kozlovsky, 1982 – Ed.), they may work on data from the Soviet automatic space stations on Venus, or they may gain practical experience in big mines and quarries.

Good contacts between MGPI and the Academy of Sciences allow students to master the newest methods of remote sensing, laser and telemetric systems, neutron activation analysis, the use magneto-hydrodynamic generators in prospecting, and much more.

Other Aspects

Soviet colleges require that their students engage in independent research. During their courses, students devote 250 hours to their own work, in addition to presenting papers at annual college conferences. Many take part in student competitions organized each year by the Academy of Sciences and the Ministry of Geology. The best works may be published and awarded cash prizes, medals or certificates.

Finally it should be mentioned that many geological institutions have clubs for school children to introduce them to the profession. They may receive in this way theoretical and practical training in some of the most interesting geological regions of our country. There are also geological excursions, which take place during school holidays (see cover photograph). These youngsters are a good source for future geologists, and they learn also to love nature and to protect it for future generations.

References (in Russian except as noted)

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Prof. **D.P. Lobanov** has been the Chancellor of MGPI since 1964. He is a specialist in the geotechnology of rare and radioactive elements, and has authored works on the construction of mining equipment, and prospecting methods for deposits with complicated structure. His scientific research is reflected in more than 200 publications and 60 patents.

Prof. **E.D. Yershov** is the Dean of the Geological Faculty at MSU. His main research is on the field of geocryology, and he has been an active participant in developing the main principles of cryolithogenesis, and the thermodynamics, physics, chemistry and mechanics of frozen rocks. He is a member of the National Councils for Geological Engineering and Geocryology of the Academy of Sciences.

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