OTS: 60-31,103

JPRS: 3087

16 March 1960

THE WORK OF THE SCIENTIFIC-TECHNICAL GEOPHYSICAL CONFERENCE

(USSR)

[Translation]

Distributed by:

OFFICE OF TECHNICAL SERVICES
U. S. DEPARTMENT OF COMMERCE
WASHINGTON 25, D. C.
Price: $0.50

U. S. JOINT PUBLICATIONS RESEARCH SERVICE
205 EAST 42ND STREET, SUITE 300
NEW YORK 17, N. Y.

F O R E W O R D

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JPRS: 3087
CSO: 3426-D

ON THE RESULTS OF THE WORK OF THE SCIENTIFIC-TECHNICAL GEOPHYSICAL CONFERENCE

(USSR)

Razvedka I Okhrana Nedr
[Prospecting and Conservation of Mineral Resources]
Pages 54-59
Russian, per

A. S. Shirokov
Ministry of Geology and Conservation of Mineral Resources USSR.

A scientific-technical geophysical conference, organized by the Ministry of Geology and Conservation of Mineral Resources of the USSR, the State Scientific-Technical Committee of the Council of Ministers of the USSR and the Scientific-Technical Mining Society was held in Moscow on 6-8 October 1959.

749 delegates from 154 industrial, scientific-research, and experimental-design establishments and other organizations of the Ministry of Geology and Conservation of Mineral Resources of the USSR, the USSR State Planning Commission, Academies of Science of the USSR and Union republics, Soviet Economic Councils (Sovnarkhozes) and from scientific-research and training institutes participated in the work of the conference.

In an introductory speech, B. N. Yerofeyev, Deputy Minister of Geology and Conservation of Mineral Resources of the USSR, noted that geophysical research methods, the volume of which will be increased over 2 times during the Seven-Year Plan, play a major role in the prospecting of mineral deposits. The conference must be devoted to the cause of further raising the level of geophysical work and its geological efficiency and encouraging wide circles of geophysicists and geologists to fulfill the historical directives issued at the XXI Congress and at the June Plenum of the Central Committee of the Communist Party of the Soviet Union.

The conference examined problems concerning the status, trends, methods and perspectives in the development of scientific-research, experimental design, instrument building and applied geophysical work carried out by various establishments and organizations in the Soviet Union.

More than 300 delegates participated in the discussion of the 165 reports and communications presented at the conference, which closed by adopting a sweeping resolution.

V. V. Fedynskiy, a member of the Board of the Ministry of Geology and Conservation of Mineral Resources of the USSR and chief of the Geophysical Department, read an important basic paper entitled "The Basic Tasks and Prospective Development of Geophysical Operations Concerned With the Prospecting and Survey of Mineral Resources During the 1959-1965 Period". The speaker pointed out that the volume of operations performed by all known geophysical methods has been significantly increased during the current seven-year period and their distribution among the various regions and minerals resources has been improved. The ratio of geophysical survey methods in the general complex of geological prospecting operations will be increased from 15.4% in 1958 to 25% in 1959. A significant amount of geophysical work will be conducted in the eastern regions of the Soviet Union. The paper stressed the role played by scientific-research institutes in developing and improving the procedures and techniques of individual geophysical survey methods and their combined application in all stages of geological survey work.

The paper read by A. S. Shirokov and V. V. Zhuravlev Geophysics Department of the Ministry of Geology and Conservation of Mineral Resources USSR), entitled "Status of Technical Equipment and Prospective Development of Geophysical Instrument Construction", gave a detailed description of the present status and basic methods for intensifying scientific-research and experimental design work in the field of geophysical instrument construction.

The paper read by A. N. Tikhonov (Council on Methods of Prospecting Geophysics), and Ye. V. Karus (Institute of Earth Physics of the USSR Academy of Sciences) entitled "Status and Research Trends in the Development of New and the Improvement of Present Methods of Prospecting Geophysics at the USSR Academy of Sciences and at Academies of Sciences of Union Republics", and the paper of M. K. Polshkov (All-Union Scientific Research Institute of Geophysics) entitled "Status and Development Trends of Scientific-Research Work in Applied Geophysics in the USSR", were mainly concerned with a description of a wide range of problems concerning theoretical developments and the creation of new and advanced geophysical survey methods (including aerial geophysical methods), the design of more efficient geophysical instruments and equipment used in all methods of geophysical prospecting, and the mechanization and automation of geophysical operations.

T. N. Simonenko and T. N. Spizharskiy (All-Union Geological Scientific-Research Institute) read a paper entitled "The Use of Geophysical Data in Drawing a Tectonic Map of the USSR on a Scale of 1:2,500,000", showing the advantages of a geological map based on the use of geophysical data.

The report made by B. V. Kotlyarevskiy (Geophysics Department) and L. A. Ryabinkin (MINKHIGP [Moscow Inst-Res Chem/Geophy Equip Constr] entitled "Status and Development Trends of Seismographic Geophysical Exploration", noted that over 60% of the funds allocated to geophysics in the current Seven-Year Plan will be spent on seismographic geophysical exploration work. Therefore, it is necessary in the first place to improve the methods and techniques used in seismographic geophysical exploration and to introduce a complex mechanization and automation of production into geophysical methods.

A large number of reports and communications were presented and discussed in the seven sections which worked simultaneously during the conference.

In the Section of Structural Geophysics, 19 reports and communications were presented and discussed, which were concerned with regional geophysical surveys of the folded substructure and of the sedimentary cover in various regions of the USSR, with a study of the depth structure of the earth's crust and with the use of geophysical methods of exploration in oil and gas prospecting.

As was noted in the papers read by V. I. Kulikov, M. V. Chervinskaya, L. I. Ivanov and others, a correct orientation of survey and prospecting work for oil, gas and other types of mineral resources can be achieved in a number of regions with the aid of structural and geological diagrams, obtained in regional geophysical surveys.

The section noted that new modifications of regional geophysical survey methods have been developed in recent years, such as the TT electric geophysical exploration method and the KMPV seismorgraphic geophysical exploration method. As was noted in the reports of Yu. N. Godin and I. P. Kosminskaya, surveys of the earth's crust with the aid of deep seismic probings are extensively practiced, thus allowing to trace the course of plutonic fractures and to study separate levels.

The problem concerning the use of combined geophysical methods including seismographic and gravimetric prospecting and radiometric methods, for direct prospecting of oil and gas deposits in Bashkiria, Azerbaydzhan and Turkmenia, was examined in papers read by F. A. Alekseyev and I. G. Medovskiy.

At the same time, the section noted the inadequate development of regional surveys. There is still a lack of a sufficiently complete study of geological structure based on geophysical data, especially in regard to regions of Siberia and the Far East. The accuracy of the cartographic drawing of substructure contours sometimes does not comply with the necessary requirements. The section recommended that work on deep seismic probing be continued in order to study the deep (plutonic) structure of the earth's crust in dry land areas and in regions of different geological structure, and also in seas and oceans.

Regional geophysical surveys should be widely used in the systematic study of the deep geological structure of the country's territory, in estimating the mineral potential of individual regions and in establishing a scientific basis for subsequent survey and prospecting operations, in conducting deep geological mapping together with geological surveying and drilling operations, and in drawing geological maps on a 1:200,000 scale. A recommendation was made to significantly increase the volume of scientific-research work aimed at improving combined regional geophysical surveys and the methods used for conducting such surveys under geological conditions, as well as work on the development of direct prospecting methods for locating oil and gas deposits, using seismographic and gravimetric prospecting techniques, and also radiometric methods.

A total of 23 reports and communications on various questions concerned with the prospecting of mineral deposits were presented in the Section of Mineral Geophysics. These questions included the general status and development of geophysical operations during complex prospecting of mineral deposits; and results of the application of geophysical methods in mapping belt (closed) ore regions; and a number of specific projects concerned with the development of equipment, methods, etc.

The great achievements of geophysicists in developing combined geological and geophysical prospecting methods for locating mineral deposits in Kazakhstan and Uzbekistan, the positive results of the application of geophysics in geological mapping work conducted in the Transbaykal region and in the prospecting of rich iron ore in the Kursk magnetic anomaly and in Western Siberia, in studying the diamond fields of Yakutiya and copper deposits in the Urals, etc. were pointed out in the reports presented by A. D. Miller, A. P. Solovov and others.

Of great interest were reports, describing the development of new mineral geophysical methods, such as radiography (A. D. Petrovskiy), the "radiokip" method (A. D. Frolov), and the methods of induced polarization and underground gravimetry; as well as a report by A. G. Tarkhov, concerning certain additions to the theory of information in exploratory geophysics.

The reports showed the significant expansion of the potential application mineral geophysics.

At the same time, the section noted the very low degree of efficiency of geophysical operations during prospecting for non-ferrous and rare metal deposits especially "blind" deposits and ore bodies located at great depths. The use of geophysical methods in indirect prospecting of mineral deposits, in tracing ore-indicating symptoms, and in studying the structure of mineral deposit regions is not given the proper amount of consideration. In general, the development and improvement of combined regional geophysical surveys during prospecting of useful mineral deposits are still lagging behind industrial requirements. The section suggest that mining enterprises should concentrate their efforts on the conduct of regional complex geophysical operations prior to prospecting work. In locating and studying mineral deposit regions, and in order to study their structure and factors which will facilitate mineral prospecting work, it was considered expedient to carry out large-scale complex geophysical surveys on a 1:50,000 and 1:10,000 scale in conjunction with geochemical methods and prospecting-surveying operations, together with drilling and mining operations.

Work involving a generalization of available geophysical materials, aimed at clarifying their geological interpretation and selecting a rational combination of surveying methods, as well as a detailed study of the physical properties of rocks and minerals, will be of great help in raising the efficiency of mineral geophysics. The section suggests that scientific-research organizations engage in more intensive work aimed at developing and introducing new geophysical methods and improving presently used methods of prospecting and exploring mineral deposits, and that they should also develop rational complex methods applicable to the conditions prevailing in individual mineral regions. Particular attention must be given to a further elaboration of the theory of presently used and newly developed mineral geophysical methods.

The Section of Seismic Exploration heard 26 reports and communications concerned with the theory and general problems in the field of seismographic geophysical exploration, the development of new seismographic exploration equipment, methodical problems, and the results of seismic exploration in oil and gas bearing regions.

Of exceptionally great interest were the reports presented by I. S. Berzon, concerning the study of the dynamic characteristics of seismic waves in real media, by N. N. Puzyrev on the registration of transverse waves, and by A. M. Yepinat'yeva on multiple reflected waves. Among the reports, having an important practical significance, one might mention in the first place the papers read by A. O. Slutskovskiy, A. N. Fedorenko and others concerning the design of new models of seismic stations, the paper read S. Ya. Rappoport and others on marine seismic

exploration, the paper by A. K. Shmelev on river seismographic exploration, the paper by V. D. Zav'yalov on a method of spatial seismographic probing, the paper by L. D. Raykher on the development of a plane front method, the paper by Ne. V. Karus and others on the study of physical and mechanical properties of rocks by a pulse superasonic core-sampling method, etc.

The section noted that seismographic exploration is the most accurate geophysical method used at the present time. In a number of regions in the Caspian lowland area and other regions, seismographic exploration is the basic method used in preliminary deep drilling operations performed in promising oil and gas bearing structures. Mining enterprises have scored substantial achievements in developing seismographic exploration methods. The plane front method and the spatial seismographic probing method have been developed and are being sucessfully used by the Ukrainian Geophysical Trust, and a river seismographic exploration method has been developed by the Tyumen Oil Exploration Trust.

Within the past few years, the following methods have been developed and used in production correlation method of refracted waves; the deep seismographic probing method; the controlled guided reception method; modifications of frecuency seismographic exploration methods (VChS- High-Frequency Seismographic Exploration, and NChS- Low-Frequency Seismographic Exploration) and marine seismographic exploration. The following new seismographic equipment has been designed and is now used: a seismographic set with magnetic recording (SSM - 57, PPMZ-2), a portable seismographic set (SS-24P), marine seismographic sets (MSS-58) piezoseismographic spits (orscythes?) and various types of seismographic receivers.

Considerable progress has been made at scientific-research institutes in developing methods for interpreting seismic data. However, seismographic exploration is not capable of solving geological problems in all regions. The geological efficiency of seismographic exploration methods is particularly low in the prospecting of sloping platform-type structures, in studying complex structures and in prospecting for mineral deposits. As a rule, anticline sections of tectonically disrupted upheavals are not exposed by seismographic exploration; in many regions the exposure depth of the pit is not sufficiently great. The cost of seismographic exploratory operations is extremely high in a number of regions, especially in Siberia and in the Far East.

The section outlined the following principal work trends: the development and introduction of operational methods utilizing reproduceable recordings and devices for the automatic processing of data; the development of a theory for grouping receivers and oscillation sources; the development of methods allowing the utilization of new types of waves (transverse, exchange and diffracted waves) for obtaining additional data on a geological profile, and the use of dynamic characteristic of seismic waves during interpretation. Particular attention was given to providing industrial enterprises with modern seismic instruments, equipment and all auxiliary materials and means of transport.

The Section of Electric Geophysical Exploration heard 22 reports and communications dealing with the development of methods and equipment based on the procedures and results of application of electric geophysical exploration in solving geological problems. A large number of interesting reports and communications were presented by scientific-research institutes (A. N. Tikhonov, N. M. Shuval-Sergeyev, L. Ya. Mizyuk, L. L. Van'yan, V. A. Komarov, N. P. Silin, S. M. Sheyman and others).

The section noted a considerable increase, in the past few years in the volume of electric geophysical exploration work for solving problems of structural geology, and in prospecting and surveying mineral deposits during hydrogeological and geological engineering surveys, and during geological mapping operations; the range of geological problems solved with the aid of this method has also expanded. Procedures and equipment used in a number of new electric geophysical exploration methods have been developed and introduced, or are in a final development stage, as a result of work done at scientific-research institutes, industrial organizations, design bureaus, and geophysical instrucment building plants. Such new methods include dipole electric probing, marine electric exploration, electric frequency probing methods, magnetotelluric profiling, aerialelectric exploration methods, and also methods utilizing telluric currents, and the establishment of an induced potential field, and radiowave translucence and "radiokip" methods. Standard electric exploration sets ERS-23, ERS-16.5 and EPL-57, and electric compensators ESK, KSRM and EAK have been designed and are now in use.

The section noted that at the present time, there is a definite possibility for making greater use of electric exploration methods in solving problems of structural geology by using methods which are less costly than seismographic exploration, such as telluric current, magnetotelluric profiling, and field formation.

The use of aerial electric exploration methods together with inductive ground methods in mineral geophysics will result in a more rapid study of mineral regions and in a more definite determination of mineral and non-mineral anomalies.

The section recommends an increase in the volume of electric exploration work in prospecting-surveying and exploration operations, and also suggests an intensification of scientific-research and design work aimed at developing and adopting new electric exploration methods and equipment, and improving presently used methods and instruments. Such work should involve primarily the completion of the development of the theory, methods and equipment used in electromagnetic frequency probing and of the procedures and instruments used in the field formation method, in order to solve structural geological problems connected with mineral deposits. The conference recommends that work on the theory of interpreting data obtained in electric exploration surveys be considerably accelerated and that computer devices be used.

The Section of Gravimetric Exploration heard 21 reports devoted to various problems concerning methods and techniques used in gravimetric operations, and to prospects of their further development. Great interest was expressed in the report presented by L. V. Petrov describing the tasks confronting gravimetric exploration in the current Seven-Year Plan, and in the report of K. Ye. Veselov, S. A. Poddubnyy, B. A. Andreyev and others, describing the development status of new equipment and of methods used in interpreting gravimetric exploration data.

The section noted that considerable progress has been made in the field of gravimetric exploration in recent years. The volume of gravimetric exploration operations has increased, technical equipment has been improved, the range of applied methods has been expanded, and the geological efficiency of these methods has been raised. At the present time, gravimetric exploration, combined with magnetic exploration, supporting seismic routes and drilling data is one of the principal methods used in studying the deep geological structure of the earth's crust and in geological mapping. In many regions, gravimetric exploration is also used in prospecting for oil, gas and mineral deposits. Substantial methodical achievements have been made in marine and underground gravimetric exploration, in the study of rock densities, and in developing topographic and geodetic measures allowing the conduct of gravitational surveys. Great progress has been made in the interpretation of gravimetric exploration data, in methods used for classifying gravitational anomalies, aligning anomalies, etc.

The section noted that the effectiveness of gravimetric exploration remains inadequate in many cases and does not stand up to industrial requirements. The resolving power of gravimetric exploration in prospecting for mineral deposits and enclosing rocks was found to be inadequate in a number of cases.

The section outlined the following basic problems: the conduct of regional surveys combined with other geophysical methods and drilling; two-milligallic (?) and milligallic (?) surveys for geological mapping purposes; the application of surveys with gravimeters, variometers and gradient meters for the prospecting and exploration of ore deposits, in particular for deposits located at great depths; the accelerated development and serial manufacture of high precision gravimeters of the GAK-6m type and of gravimeter-altimeters of the GVP-1 type. It was deemed necessary to improve radiogeodetic instruments (both air and ground modifications), and also to design improved computing devices for the processing and interpretation of gravimetric exploration data.

The Section of Magnetic Exploration heard 24 reports and communications, describing problems concerned with the theory and practice of interpretation of magnetic exploration data, with geological results of aerialmagnetic surveys, and with methods of compiling magnetic charts and instrument building. Of great interest were theoretical papers, describing the theory of the geophysical work performed by I. G. Klushin and S. V. Shalayev, in which problems concerning methods of interpreting magnetic anomalies were examined, as well as the paper read by F. N. Yefimov concerning the development of methods for conducting a fractional - mineralogical analysis of rocks.

In a summary report, presented by V. Ye. Nikitskiy, V. I. Fedyuk and T. M. Simonenko, and also in other reports, it was noted that considerable progress was achieved in recent years in the field of magnetic exploration during regional surveys, geological mapping and prospecting for mineral resources, and also in the study of magnetic properties of rocks. In addition, the range of problems which are being solved with the aid of magnetic exploration, used at the present time in a combination with other geophysical methods, has been significantly expanded.

In recent years, aeromagnetic surveys have found a particularly wide field of application during studies of the deep (plutonic) geological structure of large areas and in geological mapping operations. The geological effectiveness of aeromagnetic surveys was clearly demonstrated on hand of work done in the West-Siberian lowland, in Uzbekistan, in the Kurile and Kamchatka island region and in the Antarctic region.

In using a number of new modifications of ground magnetic exploration, favorable results were obtained with the following methods: the micromagnetic survey method (used on kimberlite pipes of Yakutiya), measurements of gradients of magnetic field components (krivoy Rog), use of variations in magnetic field elements for the classification of magnetic anomalies (Eastern Sayan region).

The following new instruments and equipment used in magnetic exploration will soon be manufactured: a high-precision aeromagnetometer A M-13, the ASG-45 set, the magnetovariational set SMV-2, the M-14 and M-16 ground quartz magnetometers and the portable magnetometer M-17. The design of instruments for the automatic processing of magnetic survey data is in progress. Methods involving the mathematical interpretation of magnetic field anomalies have been further developed.

The section noted the presence of serious shortcomings in the field of magnetic exploration, in spite of a certain amount of progress achieved in this area. Aeromagnetic and ground operations have so far not been supplied with adequate technical equipment and facilities. Methods for conducting large-scale surveys, etc. have not been developed to a sufficient extent.

The section recommended the continued development and industrial application of new methodical procedures for conducting ground and air surveys, which would provide the necessary high accuracy standards required in such operations. The section also recommended that work on the creation of an All-Union supporting magnetic network be conducted within the next 2-3 years. The design of equipment should include the design of optical and mechanical instruments provided with compensation pickups of the second harmonic type, including the development of guidance systems and of methods for excluding interference signals and allowing the continuous registration of signals.

The section also passed a resolution calling for an intensification of theoretical and experimental work aimed at developing and introducing radiogeodetic means for tying in the course of an aeromagnetic survey, and the development of new methods for the processing and quantitative interpretation of magnetic anomalies, involving the use of computing devices. In addition, development work on problems concerned with the theory and practice of magnetic exploration, as applied to the study of ore field structures and the exploration of ore deposits, should be substantially expanded, and the volume of large-scale aeromagnetic surveys (1:50,000 and 1:25,000) should be sharply increased.

The Section of Geophysical Bore Hole Surveys heard 23 reports and communications dealing with methods and techniques used in core-sampling (logging) operations, with development prospects of scientific-research and experimental design work, and with the design and output of new improved instruments and equipment.

The section noted that in recent years, as a result of the improvement of presently available and the development of new types of improved instruments and equipment, the productivity and geological efficiency of logging operations have been considerably increased, and that the costs of such operations have been significantly reduced.

The combined study methods used at the present time in oil and gas wells make it possible to isolate samplers and to estimate their oil and gas content in most regions. In a number of regions, the collecting properties of layers are determined in order to calculate available oil and gas reserves.

In coal deposits, bore hole pits are correlated by means of core-sampling operations, which also permit to establish the presence of coal layers and to determine their thickness and structure. As a result of the extensive use of the potentialities presented by core-sampling techniques, coreless and partly coreless mine pit drilling methods are being introduced in a number of coal-bearing areas.

Geophysical studies are being conducted on a wider scale in mineral bore holes, where layers are broken down according to geological differences and ore bodies (iron ores, sulfides, and others) are separated.

In this section, reports and communications were presented by V. N. Dakhnov, I. I. Fel'dman, K. N. Yakubson and others, which described the development of new methods for studying bore holes, such as selective gamma-gamma core sampling, allowing the quantitative determination of heavy elements present in ores (lead, tungsten, molybdenum, mercury); activation analysis for estimating the content of copper, aluminum and manganese; photoneutron core sampling, used in prospecting and reviewing rare element deposits; investigations of oil, gas and ore drillings based on data of induced polarization potentials.

A number of reports such as those presented by S. M. Aksel'rod, V. N. Ponomarev and others, described the results of work performed on the design of new equipment, such as for example, the design of bore hole neutron generators, magnetic and induction core sampling equipment, a new type of bore hole cement meter, which makes it possible to check the distribution of cement behind the column following cementing without the use of a radioactive source, a lateral drilling core-lifter, and a number of other geophysical instruments.

At the same time, the section noted a number of serious shortcomings in core sampling operations. The efficiency of geophysical studies performed in bore holes is still not always sufficiently high, and a number of problems still remain unsolved up to the present time. There are no reliable methods for isolating collectors in carbonate layers and fissured rocks, methods of determining the collecting properties of oil and gas layers are not being introduced to a sufficient extent into operational practice, and basic theoretical and experimental work is lagging behind.

Reliable methods for obtaining qualitative coal characteristics derived from results of geophysical studies are not available, and this fact prevents the development of highly productive and economic coreless drilling methods.

Core sampling operations are performed to a much smaller extent in ore deposits than in oil and coal deposits. Methods used in determining the presence of minerals and their percentage composition are being developed at a slow rate.

The development of new promising core sampling methods, such as lateral, acoustic, ultrasonic and other types of core sampling, is also proceeding at a slow rate. So far, no combined core sampling sets and drilling instruments, capable of simultaneously measuring several (4-5) parameters during a single drilling pass, have been designed.

The volume of scientific-research and design work aimed at developing new geophysical research methods and designing new equipment is completely inadequate.

The section recommended to expand scientific-research work in the field of geophysical studies of drillings, in order to increase the effectiveness of separating and estimating oil and gas collectors in carbonate deposits, and of fissured collectors, and to determine the quality of coals and the location of mineral zones, establishing at the same time the mineral percentage content in these zones. The design of combined core-sampling sets, of induction, lateral, acoustic, and selective gamma-gamma core sampling equipment, of instruments operating at high temperatures and pressures, of drilling core lifters of various diameters, etc. should be accelerated. It is also necessary to speed up the application of advanced operational methods and the introduction of automation and complex mechanization in basic and auxiliary operations.

The conference adopted a resolution, containing the following recommendations:

1. To introduce geophysical exploration methods in all types of combined geological-exploratory operations and in all of their stages, in order to achieve a higher degree of geological and economic efficiency. To make a more extensive use of aerogeophysical survey methods, and to put into effect a complex mechanization and automation of labor-consuming geophysical operations, such as seismographic exploration and core-sampling of drillings.

2. To intensify work concerned with the general application of results obtained in geological-geophysical surveys, with the study of physical properties of rocks and ores, and to draw up methodical handbooks and instructions describing each geophysical method. To sharply curtail the development schedule of experimental models of new equipment, and to reinforce design offices engaged in the construction of geophysical equipment.

The conference noted the need of improving the quality of manufactured equipment, of spare parts, drilling machinery, field equipment and special materials. Larger numbers of electronic and radio engineering specialists should be recruited by geophysical enterprises. Educational institutions should increase the number of graduating engineers and technicians in accordance with the plan calling for an expansion of geophysical operations during the next seven-year period. The conference performed a large amount of useful work, by outlining in its directives the basic development trends of all geophysical methods, and by exposing the presence of serious shortcomings in the organization, conduct and technical equipment of geophysical operations.

Participants at the conference made a number of critical observations, which will undoubtedly be taken into consideration in order to ensure the necessary development rate of geophysical survey methods in the very near future.

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