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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

GEOPHYSICS, ASTRONOMY AND SPACE

No. 384

This serial publication contains abstracts of articles from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

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I. ASTRONOMY

News

2.6-METER TELESCOPE INSTALLED AT BYURAKAN OBSERVATORY

Moscow PRAVDA in Russian 6 Oct 76 p 6

[Article by Yu. Arakelyan and V. Molchanov, "Window Into the Universe"]

[Summary] On Mount Aragats there is a sturdily built tower with a silvery dome. There stands a powerful telescope which has been solemnly turned over to astronomers by its creators, representatives of the Leningrad Optical-Mechanical Combine, whose chief designer is B. K. Ionnisiani. The telescope [a photograph of which accompanies the text] has been handed over to the scientists of the Byurakan Astrophysical Observatory Academy of Sciences Armenian SSR. The chief engineer of the combine, Vladimir Skorodumov, explains: "With respect to the mirror size, this is the same as for the Crimean telescope, 2.6 meters in diameter. But the quality of the reflector is better. At a single point it is possible to collect considerably more light energy sent by a distant star. The telescope has three foci. Three different light collectors can be activated simultaneously. The telescope control system has been improved..." The search for celestial objects is being made with television cameras: the 200-ton dome is turned easily, quietly; it does not rest on rails, as usual, but on rubber wheels. The observatory director, Academician V. A. Ambartsumyan, states: "The facts accumulated by astrophysicists have gradually led to the conclusion that the universe is a rapidly and profoundly changing world. In our time we see the birth and development of stars and galaxies." We leaf through an album of "star associations," those discovered by V. A. Ambartsumyan and his students. These are groupings of relatively young celestial bodies. Their age is several tens of millions of years. Here are photographs of the central parts of galaxies. Another atlas shows mysterious Markaryan galaxies. B. Ye. Markaryan, Academician Armenian Academy of Sciences has discovered about a thousand galaxies with excess UV radiation. On the basis of the discoveries made during the last 30 years specialists at the Byurakan Observatory have been formulating the concept that the evolution of stars and galaxies is not from a gas-dust state, but instead from dense to rarefied matter. Young star groups are constantly forming as a result of decay of superdense protostars.
[37]

II. METEOROLOGY

News

NOTES ON METEOROLOGICAL LIDARS

Moscow IZVESTIYA in Russian 30 Sep 76 p 6

[Article by A. Blokhin, "Echo from the Stratosphere"]

[Summary] P. Bokhan, who heads the laser technology division at the Tomsk Institute of Atmospheric Optics of the Siberian Department USSR Academy of Sciences, states: "Virtually all the physical parameters of the atmosphere -- pressure, humidity, temperature, wind intensity, air flow turbulence, presence of gases and aerosols, can be determined using a lidar. And this is not at some single point, but in the entire thickness of the earth's atmosphere." The introduction of laser sounding instruments created at Tomsk into the meteorological observation system is truly creating a revolution in meteorology. One of the many purposes of a lidar is for the airport service. Its all-seeing ray is capable of determining the lower boundary of clouds with an accuracy to a meter; this is of enormous importance under complex meteorological conditions. Laser methods have no competitors in the service for monitoring the state of the environment. The basis of the laser system of observations in large cities is stationary points servicing a territory of tens of square kilometers and for remote and speedy analysis of local contaminations of the air basin it is possible to employ lasers which are mounted on special trucks. Portable lidars are simply installed in flying laboratories, aircraft or helicopters; this affords a possibility for monitoring the atmosphere over enormous expanses. Such a flying patrol can monitor main gas pipelines and detect even small leaks. Lidars can also be employed in monitoring the toxicity of exhaust gases of automobiles. The presently employed gas analyzers are ill-suited for this purpose. The director of the institute, V. Zuyev, Corresponding Member USSR Academy of Sciences, states: "Many express the fear that laser technology is too expensive. And the very first experimental lidars cost us about 50,000 rubles. However, when in mass production their cost will decrease greatly."
[33]

IMPORTANCE OF CLIMATOLOGICAL STUDIES EMPHASIZED

Moscow IZVESTIYA in Russian 21 Aug 76 p 5

[Article by A. Velichko: "What Will the Climate Be Like?"]

[Summary] A paleogeographic analysis of the recent epoch of natural development shows that our interglacial epoch is cooler than the preceding one. Study of the evolution of soils and vegetation indicates that its warm peak has already passed and that the last two or three thousand years have been characterized by a general trend in the direction of cooling. It is postulated that transition to the next cold epoch may occur in two or three millenia. Now it is very important to recognize that the natural variations of climate can be highly modified (extinguished or intensified) by influences on climate exerted by human activity. Climatologists must determine the overall effect of different anthropogenic factors responsible for both warming and cooling. This will make it possible, in predicting the natural conditions of the future, to rely on the reconstruction of the conditions which existed in the past. Such reconstructions, models in the form of a series of paleogeographic maps, are being compiled at the Geography Institute USSR Academy of Sciences. For example, should climatologists establish a tendency to a considerable warming, the probable model of changes in natural conditions can be a reconstruction of the last interglacial period. On the other hand, with a dominant influence of the atmospheric dust content factor and an obvious tendency to cooling there can be an accelerated transition to the colder phases of the interglacial cycle or onset of a glacial cycle and then a reconstruction of the conditions characteristic of a glaciation epoch would fit. There are real possibilities of the purposeful regulation of climate. By learning how to evaluate precisely the dependence of climate on different factors it will be possible to exert a rational influence on its natural change. Study of the state and changes of the environment requires the joint efforts of specialists from different countries. A joint conference of Soviet and American scientists will be held on this theme late this year within the framework of an intergovernmental agreement between the two countries on conservation of the environment. The time has come to join the efforts of climatologists, paleogeographers, glaciologists and other specialists for establishing in the USSR a unified research project for studying the dynamics of natural climatic changes, their prediction and regulation.
[195]

WEATHER EXPEDITION DEPARTS FOR NORTH ATLANTIC

Moscow PRAVDA in Russian 10 Oct 76 p 6

[Article by A. Khramtsov, "In Northern Latitudes"]

[Text] A group of workers from the Murmansk Administration of the Hydrometeorological Service has set out for the North Atlantic aboard the scientific research ship "Vsevolod Berezkin."

In the Barents, Norwegian and Greenland Seas the participants in the expedition will carry out a complex study of the factors which influence weather in the northern latitudes. The cruise of the "weather ship" will last until January. [4]

Abstracts of Scientific Articles

CO_2 EXCHANGE BETWEEN OCEAN AND ATMOSPHERE IN ANTARCTICA

Leningrad INFORMATSIONNY BYULLETEN' SOVETSKOY ANTARKTICHESKIY EKSPEDITSII in Russian No 93, 1976, pp 43-50

[Article by Yu. I. Lyakhin and I. M. Katunin, Leningrad Hydrometeorological Institute and Arctic and Antarctic Scientific Research Institute, "The Antarctic Ocean, Direction and Rate of Exchange Between the Ocean and Atmosphere"]

[Abstract] In this study an attempt was made, on the basis of hydrochemical and hydrometeorological observations carried out on the Eleventh Antarctic voyage of the "Professor Zubov," December 1972-January 1973, to estimate the rate of CO_2 exchange in this region of the world ocean. As shown on a map (Fig. 1), total alkalinity and pH of surface water were analyzed in a number of places in the Antarctic Ocean. These data, in combination with standard measurements of temperature and salinity, make it possible to compute the partial pressure of CO_2 at the ocean surface. The computed pCO_2 values in the surface water layer, and also the pCO_2 difference in the atmosphere and water and the measured wind speeds in the observation regions, are given in Table 1. In most cases pCO2 at the ocean surface is greater than in atmospheric air. The CO_2 flux is directed primarily from the ocean to the atmosphere. The results of the investigations confirm the earlier conclusions drawn by Wattenberg (WISS. ERGEBN. DER DEUTSCH. ATLANT. EXPED. AUF DEM DAMPFER "METEOR", Vol 8, 1933, pp 333-352) that there is a region of the Atlantic sector of the Antarctic Ocean to the north of 60°S in which the CO_2 content in the surface water layer is close to the CO_2 content in the atmosphere. The mean rate of release of CO_2 from the ocean to the atmosphere in the Atlantic and Indian Ocean sectors during summer is 28.5 mmol/m^2day.
[215]

CLIMATE OF CENTRAL ANTARCTICA IN PAST

Moscow ZEMLYA I VSELENNAYA in Russian No 5, 1976, pp 38-39

[Article by V. M. Kotlyakov, "Climate of Central Antarctica Over a 50,000-Year Period"]

[Abstract] Drilling of a deep borehole was started in 1970 at Vostok station in Antarctica. The plan called for penetrating the entire thickness of the ice cover, which here attains a thickness of about 3.5 km. The ice core is extracted and an oxygen isotope analysis is made. The results of analysis of 250 ice samples were used in constructing a paleotemperature isotopic profile. This profile covers a period of 46,500 years. Certain assumptions were made in computing the profile: constancy of ice dynamics such as thickness of the ice cover, mean annual rate of accumulation and rate of ice flow. It is believed that such assumptions are valid for Antarctica. It appears from the profile, however, that during the time of formation of the lower part of the ice cover the temperature was approximately 5°C colder than in the subsequent period. Definite events can be identified on the profile [which is reproduced in the article] which correlate with events in the northern hemisphere. The data indicate that the most favorable climatic conditions prevailed in Antarctica during the period 7500 to 4000 B.C. There were three "warm" periods separated by colder epochs. The character of profiles for Antarctica and Greenland in general is the same. However, the age of the bottom layers of the glacier is many hundreds of thousands of years and drilling work is continuing in order to obtain additional paleoclimatological information.
[42]

NUMERICAL MODELING OF ATMOSPHERE-OCEAN CIRCULATION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 3, 1976, pp 556-559

[Article by S. S. Zilitinkevich, Corresponding Member USSR Academy of Sciences A. S. Monin, V. G. Turikov and D. V. Chalikov, Institute of Oceanology, "Numerical Modeling of Joint Circulation of the Atmosphere and Ocean"]

[Abstract] During 1974-1975 specialists in the Leningrad Division of the Institute of Oceanology constructed a numerical model of joint circulation of the atmosphere and ocean. It consists of "blocks" for the atmosphere, upper layer of the ocean and climate of the ocean, and also subprograms for computing interaction among these "blocks" and for output of the results in the form of isoline maps, cross sections, zonal profiles, extremal values and integral characteristics of different hydrodynamic fields (the programs for the BESM-6 computer and the masses of parameters contain about 120,000 symbols on 2,000 punched cards). After preliminary numerical experiments it was possible to compute joint circulation of the atmosphere and ocean using a four-level grid with a horizontal grid interval of about 1,000 km (model with 7,960 degrees of freedom) and with initial data in a form close to the mean annual zonal distributions of air temperature and

temperature of the upper layer of the ocean, adiabatic vertical air temperature distribution, relative humidity 50%, constant atmospheric pressure at sea level 1013 mb, absence of wind and constant thickness of the upper homogeneous layer of the ocean 50 m. Numerical experiments with the model are discussed. The results indicate that the model in general is suitable for numerical experiments on climate and for assimilation of data from the first GARP global experiment of 1978-1979. The model could be improved by reducing the intervals in the spatial grid.
[43]

STUDY OF THE STRUCTURE OF HAILSTORMS

Budapest IDOJARAS in Hungarian Vol 80 No 4, Jul-Aug 76 pp 202-210

[Article by Endre Wirth, Head of the Department of Applied Cloud Physics, Central Institute of Atmospheric Physics, Budapest]

[Abstract] Studies were carried out to determine the size distribution of ice particles in hailstorms and to ascertain the behavior of hailstorms being observed by radar for the purpose of finding out what relationships, if any, exist between size distribution and reflectivity as determined by radar. The "standardized scattering cross section" is calculated from the size distribution. This gives the Mie scattering cross section. This information ultimately gives the "equivalent reflectivity." Test results are presented to illustrate the procedures involved and the usefulness of the approach. The advantages of combining various approaches for ascertaining the structure of hailstorms are outlined. Further studies are needed to permit utilization of radar information for hailstorm detection and forecasting.
[40]

III. OCEANOGRAPHY

News

TASS REPORTS NEW RESEARCH SHIP "PROFESSOR BOGOROV" ON FIRST CRUISE

Moscow PRAVDA in Russian 29 September 1976, p 3

[TASS Report: "On the First Cruise"]

[Text] The new scientific research vessel of the USSR Academy of Sciences "Professor Bogorov" left the port of Kaliningrad today on its first expeditionary cruise. The ship was named in honor of the famous Soviet oceanologist, V. G. Bogorov.

This ship of science was constructed in Finland and is the first of a new type of research vessel. It is intended in general for geological-geophysical and hydrophysical research. The ship's specialization will enable it to increase significantly the efficiency of scientific studies in the ocean. The vessel is outfitted with various laboratories. The ship has an automated navigation system based on satellite navigation which enables it to receive continuous information on the ship's position with an accuracy up to two hundred meters. The latest types of echo sounders can measure depths up to twelve thousand meters and make it possible to carry out continuous surveys of bottom relief along the research route. [4]

SOVIET AND AMERICAN SCIENTISTS MEET TO DISCUSS TSUNAMI PROBLEMS

Moscow PRAVDA in Russian 27 September 1976, p 1

[Article by G. Petrov, "Against Tsunamis"]

[Text] Novosibirsk, 26 September. In Akademgorodok of the Siberian Division USSR Academy of Sciences a meeting of Soviet and American experts is being held on the problems of tsunamis.

Gigantic waves, which form as a result of vibrations of the bottom of oceans and seas, produce great destruction or cause huge damage to the economy and residents of coastal areas. More often than usual Japan, the Hawaiian Islands, the western coast of America and the sea coast of the Far East in the Soviet Union suffer this disaster.

Joint work of Soviet and American specialists has been stipulated by an agreement on collaboration in the area of environmental protection which was concluded in 1972. Within the limits of this program a joint expedition was organized in the Pacific Ocean on the Soviet scientific research ship "Valeriy Uryvayev." Investigations were conducted on numerical simulation of the propagation of tsunamis and on the study of the excitation of these waves. Recording equipment was also developed. Scientists can now calculate on computers the parameters of tsunami waves for specific areas of the Pacific Ocean. The results which were obtained by the specialists of the Computation Center Siberian Division USSR Academy of Sciences were highly regarded by specialists.

In Novosibirsk Soviet and American specialists are exchanging information and are outlining plans for further operations whose practical purpose will be to create a joint system for the prevention of tsunamis in the Pacific Ocean. [5]

COLLECTION OF PAPERS ON NATURE OF THE OCEAN

Moscow KOMPLEKSNYYE ISSLEDOVANIYA PRIRODY OKEANA in Russian No 5, Izd-vo Moskovskogo Universiteta, 1975, 261+ pages

[Collection of articles, edited by G. A. Saf'yanov and G. B. Zevina]

[Abstract] The fifth issue of this collection of articles (the first issue appeared in 1970, the fourth in 1973) presents the results of the latest investigations of specialists in the Geology, Geography and Biology-Soils Faculties of Moscow State University. The collection papers describe the dynamics of water masses in the ocean and "mediterranean" seas, the geomorphology of the sea floor and coastal zone, sea sedimentation and paleogeography, and also the method for investigating sediments. The biology part of the collection gives various data on biology, systemics, morphology, propagation and productivity of sea animals and algae.

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WATER PURITY STUDY IN ARCTIC OCEAN

Moscow PRAVDA in Russian 18 Oct 76 p 1

[Article by A. Khramtsov: "Protecting the Ocean"]

[Text] Murmansk. The first complex expedition of the laboratory of hydrochemistry and water protection of the Arctic and Antarctic Institute has completed its work in the seas of the Arctic Ocean.

The data obtained will be used to compile scientifically based recommendations for preservation of the purity of the Arctic basin. [4]

SESSION OF OCEAN OPTICS SECTION OF OCEANOGRAPHIC COMMISSION

Moscow OKEANOLOGIYA in Russian Vol XVI No 4, 1976, pp 720-722

[Article by G. G. Neuymin, "Second Plenary Session of Ocean Optics Section of the USSR Academy of Sciences Oceanographic Commission"]

[Abstract] The second plenary session of the Oceanographic Commission Ocean Optics Section was held during the period 13-15 May 1975 at the Marine Hydrophysical Institute at Simferopol'. The session was devoted to methods and apparatus used in measuring light fields in the sea. Five sessions were held with the presentation of 26 reports; 58 representatives from 23 organizations participated. Board chairman K. S. Shifrin gave a report on "Problems and Principal Results of Investigations of Light Fields in the Sea"; G. G. Neuymin gave a paper entitled "Apparatus and Methods for Measuring the Natural Light Field in Seas and Oceans." Other papers included: A. P. Ivanov -- "Principal Properties of the Light Regime at Great Depths in Ocean Waters"; V. K. Solomonov -- "Measuring Underwater Illumination"; M. Ye. Li, et al. -- "Influence of the Photometer Angular Sensitivity Function on the Accuracy in Measuring Some Parameters of the Light Field"; T. M. Prokudina, et al. -- "Method for Computing the Light Field in a Deep Regime from the Primary Optical Properties of the Medium in its Models and in the Real Ocean..."; M. Ye. Li -- "Universal Wide-Range Photometer for Investigating the Light Field Underwater"; V. I. Yeremin, et al. -- "Apparatus and Methods for Measuring Natural Underwater Illumination"; V. V. Bacherikov, et al. -- "Monochromatic Radiation Detector with an Adjustable Frequency in the Visible Spectrum"; V. I. Yeremin, et al. -- "Shipboard Measurement of the Attenuation of Laser Signals in Sea Water"; V. I. Yeremin, et al. -- "Spectral Measurements Using a Submergible Flash Lamp"; V. V. Bacherikov, et al. -- "Use of Nonlinear Measurement Equipment and Methods in Carrying Out Hydrooptical Investigations"; V. P. Nikolayev, et al. -- "Experimental Investigation of the Statistical Structure of the Natural Underwater Light Field Using the 'Chernomor' Sealab"; O. I. Prokopov, et al. -- "Experimental Investigations of the Statistical Characteristics of Underwater Illumination in Transparent Waters"; M. S. Khulapov, et al. -- "Application of a Nonstatic Model for Clarifying the Mechanism of Appearance of Fluctuations of the Underwater Light Field"; G. A. Tolkachenko -- "Method for Investigating the Spatial-Temporal Variability of the Field of Underwater Illumination"; V. G. Yakubenko -- "Experimental and Model Investigation of Brightness Fluctuations of the Underwater Light Field"; A. I. Sud'bin, et al. -- "Errors in Measuring the Statistical Fluctuations of Underwater Illumination"; V. I. Degtyarev, et al. -- "Automatic Instrument for Measuring the Coefficient of Spectral Brightness of the Sea Surface"; M. Ye. Li -- "Color Index of Ocean Waters"; P. P. Sherstyankin -- "Method, Apparatus and Some Results of Investigation of the Underice Light Field on Baykal"; Yu. A. Gol'din, et al. -- "Experimental Investigation of the Nonstationary Light Field in the Sea"; D. M. Bravo-Zhivotovskiy, et al. -- "Apparatus for Measuring the Frequency Contrast Characteristics of the Water"; B. F. Kel'balikanov -- "Results of Comparative Field Tests of Instruments for Measuring the Attenuation Index for Directed Light." The next plenary session is to be devoted to the use of optical methods for studying oceans, seas and internal water bodies; that session is to be held in 1976.
[201]

Abstracts of Scientific Articles

DIFFRACTED WAVES IN CONTINUOUS SEISMIC PROFILING

Moscow OKEANOLOGIYA in Russian Vol XVI, No 4, 1976, pp 706-712

[Article by I. N. Yel'nikov, Southern Division Institute of Oceanology, "Travel-Time Curves of Diffracted Waves in Continuous Seismic Profiling in the Ocean"]

[Abstract] In this paper an attempt is made at a theoretical examination of the direct kinematic problem of continuous seismic profiling for the case of diffracted waves. The author derives the equation for the travel-time curve of a diffracted wave for the case of an n-layered medium with flat tilting discontinuities. The shape of the travel-time curve is a hyperbola, in the overwhelming majority of the cases with displacement of the curve minimum relative to the center of diffraction. The article describes a method for determining stratum and effective velocities on the basis of travel-time curves of diffracted waves. The stratum velocities are determined only in the case of a horizontally layered medium. It is proposed that the derived analytical expressions for the travel-time curves of diffracted waves be used in the interpretation of continuous seismic profiling data by carrying out preliminary theoretical computations of the travel-time curves and then comparing them with experimental data. The comparison method involves a great volume of electronic computer work. This method will be most effective if it is used in combination with other methods for interpreting t_0 travel-time curves.
[201]

HYDROOPTICAL RESEARCH UNDER "SHELF-CHERNOMOR" PROGRAM

Moscow OKEANOLOGIYA in Russian Vol XVI, No 4, 1976, pp 723-726

[Article by V. P. Nikolayev, V. G. Yakubenko, A. A. Zhil'tsov, V. K. Tutubalin, V. M. Pavlov and M. S. Khulapov, "Hydrooptical Research Under the 'Shelf-Chernomor' Program"]

[Abstract] Underwater investigations with use of the "Chernomor" sealab were carried out during the periods June-July 1973 and July-August 1974 along the shores of Bulgaria near Cape Maslen. The purpose of the joint USSR-Bulgarian expeditions (with GDR participation) was an experimental investigation of the statistical structure of the natural underwater light field caused by surface waves. The article cited above describes the method used and gives the preliminary research results. Figure 1 gives a diagram of the arrangement of instruments for registering the fluctuations of the underwater light field (FULF) simultaneously with the waves. The system is described in detail. During the two expeditions a total of 180 records were obtained, each consisting of a wave record and one to five FULF records. During the course of registry the light sensors were placed at horizons from 1 to 16 m, solar zenith angles varied from 12 to 70°, waves were classes 0-4. There were 78 determinations of the index of light attenuation by sea water and 11 determinations of the scattering index. It was found, for example, that with an increase in the registry horizon there is low-frequency filtering of FULF. However, near the horizon of sunlight focusing there should be an enrichment of the FULF spectrum with high-frequency components, which in turn should lead to a sign-variable change in the FULF correlation radius with depth, attaining its minimum values near the horizons of sunlight focusing. Another important result of the work was the testing and perfecting of an underwater method based on the clearly coordinated interaction between an aquanaut or diver servicing the light sensors and a surface operator.
[201]

BEDROCK IN SEA OF OKHOTSK

Moscow SOVETSKAYA GEOLOGIYA in Russian No 6, 1976, pp 12-31

[Article by A. A. Geodekyan, G. B. Udintsev, B. V. Baranov, A. F. Beresnev, Institute of Oceanology, O. A. Bogatikov, Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry, K. Burke, University of Texas, V. V. Gabov, Institute of Geochemistry and Analytical Chemistry, G. S. Gnibidenko, Sakhalin Multidiscipline Scientific Research Institute, Yu. I. Dmitriyev, Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry, L. P. Zonenshayn, N. A. Kurentsova, Institute of Oceanology, Yu. N. Raznitsin, Institute of Geology, G. B. Rudnik, Institute of Oceanology, N. M. Sushchevskaya, Institute of Geochemistry and Analytical Geochemistry, "Bedrock on the Floor of the Sea of Okhotsk"]

[Abstract] Data are presented on the petrography and petrochemistry of the bedrock on the floor of the central part of the Sea of Okhotsk, samples of which were obtained during dredging during the 53d voyage of the scientific research ship "Vityaz'" (1972) and the 13th voyage of the research vessel "Dmitriy Mendeleyev" (1974). A high percentage of the outcrops of the acoustic basement consist of magmatic rocks: quartzy diorites, granodiorites, gabbro-norites, plagioliparites, dacites, basalts, andesites. The

greenstones associated with them constitute remnants of a more ancient basement. The volcanic rocks for the most part belong to a typical limestone-alkali series. The intrusive rocks can be related to a plagiogranite-granodiorite formation. The absolute age of most of the magmatic rocks is 85-95 million years (Upper Cretaceous). In general, the studied bedrocks of the floor of the Sea of Okhotsk can be regarded as components of an island-arc complex and mark the position of a Late Cretaceous volcanic arc. In this light, the existence of a submerged ancient crystalline complex in the central part of the Sea of Okhotsk seems improbable.
[32]

SEDIMENTATION IN THE EQUATORIAL INDIAN OCEAN

Kiev GEOLOGICHESKIY ZHURNAL in Russian Vol 36, No 5, 1976, pp 19-27

[Article by G. A. Belyavskiy, V. D. Burlachenko, V. A. Yemel'yanov and N. N. Kachanov, Institute of Geological Sciences, Ukrainian Academy of Sciences, "New Data on Sedimentation in the Equatorial Zone of the Indian Ocean (Results of the Eleventh Voyage of the 'Akademik Vernadskiy')"]

[Abstract] On the basis of the results of field laboratory investigations of samples of bottom sediments taken in 1975 on the 11th voyage of the scientific research vessel "Akademik Vernadskiy" at 32 stations, the authors have characterized the principal characteristics of recent sedimentation in such regions of the Indian Ocean as the northern part of the Central Indian Ocean Basin, the region of the Arabian Sea - Indian Ocean mid-oceanic ridge, the southern part of the Somali Basin and the central part of the Bay of Bengal. Information is given on natural moisture content, volumetric weight, plastic strength, adhesiveness of bottom sediments, their mineralogical composition and the nature of vertical changes in the mentioned properties of the deposits. Accompanying the text is a map of the route of the eleventh voyage and a chart of geological cores of bottom sediments in the entire defined oceanic region.
[30]

WATER CIRCULATION IN THE ANTARCTIC OCEAN

Leningrad INFORMATSIONNYY BYULLETEN' SOVETSKOY ANTARKTICHESKOY EKSPEDITSII in Russian No 93, 1976, pp 35-39

[Article by G. I. Baranov, Arctic and Antarctic Scientific Research Institute, "Circulation of Waters in the Southern Ocean in the Global System of Ocean Currents"]

[Abstract] In contrast to earlier investigations, the author examines the circulation of waters in the Southern Ocean as an inseparable part of the global system of ocean currents. This has made it possible to detect new characteristics in the structure of the Antarctic Circumpolar Current (ACC) and estimate its volume discharge (pertinent data are given in Table 1). The author has constructed an integrated map of the topography of the zero surface of the world ocean and then maps of the dynamic topography for different standard horizons. The latter served as a basis for creating a model of the circulation of waters, Fig. 1. Figure 2 is a map of the distribution of abyssal red clay in the Antarctic Ocean. Conditions at the following horizons are described: surface, 250 m, 500 m, 1,000 m, 1,500 m, 2,000 m, 2,500 m, 3,000 m, 3,500 m. Conclusions are indicative of a unity in the structure of circulation of waters in the world ocean agreeing with conclusions drawn by H. G. Godell (Folio 17, Am. Geogr. Soc., 1973, pp 1-6) concerning the distribution of the areas of abyssal red clay in the Antarctic Ocean. In particular, the area of abyssal red clay in the Pacific Ocean sector coincides quite precisely with the position of the bottom part of the eastern subtropical center of action in the ocean. The configuration of the area is evidence of a general transport of sediments to the west.
[215]

SEISMIC SOUNDING OF CRUST IN BLACK SEA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 4, 1976, pp 924-927

[Article by Yu. P. Neprochnov, I. N. Yel'nikov, A. F. Neprochnova, A. A. Pokryshkin, Ye. G. Popovich, G. A. Semenov, B. N. Grin'ko and L. P. Sheina, Institute of Oceanology, "Detailed Seismic Sounding of the Earth's Crust in the Black Sea Basin"]

[Abstract] In the summer of 1973 specialists at the Institute of Oceanology carried out deep seismic sounding for the purpose of making a detailed study of the structure of the earth's crust in the abyssal basin of the Black Sea. The selected study area was the western part of the depression. The work was done aboard the research vessel "Akademik S. Vavilov" on two mutually perpendicular profiles with self-contained bottom seismographs as the registry points. Seismic waves were excited by a pneumatic sound source (chamber volume 28 liters). The source was towed by the vessel at a depth of about 15 m, which ensured the low-frequency spectrum (8-20 Hz) necessary for DSS. The principal objective of the work in 1973 was obtaining information on the fine structure of the layer with a velocity of 4.0-4.5 km/sec, detected in all regions of the basin. It is of great interest for interpreting the early stages in the geological history of the Black Sea. A velocity model was constructed, as reproduced in Fig. 3 in the text. It was found that at the bottom of the sedimentary

stratum with a velocity of 4 km/sec there are at least three layers, one of which is possibly a layer of reduced velocity. One of the possible variants of the geological interpretation of the model is given. If it is assumed that the boundary with a velocity of 4.0-4.5 km/sec can be identified with the top of the calcareous rocks of the Upper Cretaceous-Eocene, the layer of reduced velocity can be represented by the sandy-clayey deposits of the Lower Cretaceous.
[60]

IV. TERRESTRIAL GEOPHYSICS

News

AUTOMATED SEISMIC STATIONS BEGIN OPERATION NEAR GAZLI

Moscow IZVESTIYA in Russian 5 Oct 76 p 5

[TASS Report: "On the Track of Underground Storms"]

[Text] Several automated seismic stations have begun around-the-clock watch in the region of the village of Gazli where an earthquake occurred this spring. The stations are part of the large automated regional system (BARS) which eventually will cover all of Central Asia. [4]

REPORT ON SAATLY SUPERDEEP BOREHOLE PROJECT

Moscow PRAVDA in Russian 13 Oct 76 p 6

[Article by M. Kapustin and L. Tairov: "What is There Under the Earth's Crust?"]

[Text] The Muganskaya steppe, framed on the west by mountain outliers which fade in the haze, extends out broadly and smoothly. Here, on the outskirts of Saatly village, rises the 68-m steel drill rig which is gigantic even on the scale of the Azerbaydzhan oilfields.

We stand under the blinding sun in front of the openwork steel rectangle which is dissimilar to any ordinary pyramidal tower. On the metal "hood" which covers it at the top is the inscription: "Uralmash-15,000." The purpose of this structure is to reach a depth of 15 km. For this purpose it was created at the Ural Machine Building Plant imeni Sergo Ordzhonikidze.

The chief of the Saatly Geological Prospecting Expedition "Azneft'" Oktay Ibragimov has more than once reached great depths. In his time his drill rig No 100 reached the record depth of 6,700 m. Today he familiarizes

us with the superdeep borehole. We see the enormous hall of the power-mechanical complex with pumps, rated for a pressure of 400 atmospheres, the crane complex with a load-lifting capacity of 400 tons: on its "shoulders" rests the weight of the multikilometer "string" of light alloy pipes. There is the automatic apparatus which ensures the most time-consuming and heavy work -- hoisting-lowering operations. In nature there are no "everlasting" bits; even the most perfect must be changed periodically, and this means that from time to time it is necessary to raise the column of hundreds of pipes to the surface and then again lower them. Monotonous, time-cosuming work. But now it will be done with automatic equipment.

Here, at Saatly, a warehouse has been created for samples of the core and a laboratory for their study. After all, the information obtained in the first superdeep borehole is of interest to scientists and practical workers in different fields of specialization. An additional comment: not far from the unusual drill rig a hotel has been constructed for specialists and also a pad for the landing of helicopters...

At a depth of 6,500 km from the place where the Saatly drill rig now stands there is some still only imaginary sphere, to attain which is now harder than attaining the moon or Mars. This is the center of the earth, travel to which has been accomplished only by the heroes of the novel by Jules Verne. And although man has succeeded in solving many very difficult problems like penetration into space, his steps into the depths of the earth, as before, remain modest.

Long ago it became clear: it is impossible to drive a shaft to a great depth. The first obstacle is a continuous temperature increase: on the average one degree is added each 33 meters. As a result, at the bottom of any shaft even 1 1/2 km deep it is impossible for humans to work.

But to drill a borehole to superdeep levels is a task of enormous technical complexity. After all, a drill is an apparatus for grinding rocks, which in essence is held on a long column of pipes. What strength this probe should have, being directed by man into the deep layers of the earth!

Geologists distinguish several layers of the earth's crust, whose thickness attains 50 km. The uppermost layers consist of sedimentary rocks: clays, limestones, sandstones. They contain deposits of minerals. The next layer of the crust is granite; it was formed from ancient sedimentary rocks which had been subjected to the action of high pressure and temperatures. Still deeper is basalt; it is heavier than granite and contains more iron, magnesium, calcium. This latter "shell," covering the entire earth, is the mantle, which for the time being has still not been reached by man. Scientists postulate that the outer part of the mantle, which sometimes is called the "Mohorovicic discontinuity," can consist of heavy rock, a mixture of peridotite and basalt. But for the time being this is only a hypothesis, a prediction...

Why is the superdeep hole being drilled at Saatly? This question is answered by the chief of the geology division of "Azneft'," Sh. Kocharli. The fact is that already in the 1930's the scientists noted some geophysical anomaly observed locally. Thus, the earth's crust in this geographic zone is considerably thinner -- about 15 km. It has even been postulated that here there is no granite layer. Guesses were confirmed to a considerable degree by the drilling of a satellite borehole in 1970, which reached a depth of 6,240 m. This depth was reached by a team led by the master workmen Mamed Mamedov and Tugut Ismaylov. Now work at far greater depths is to begin.

The first kilometers will be drilled by the jet-turbine drilling method. Then the reliable turbodrill comes into play.

The first experimental meters of the superdeep hole have been drilled. A long way has to be drilled into the deep layers of the earth before specialists will be able to draw definite conclusions about what is there, beneath the earth's crust.

The well-known British scientist and writer of science fiction Arthur Clark, in his book entitled "Characteristics of the Future," includes an interesting table. It lists the principal stages in development of future technology. He assigns the appearance of probes for investigating the deep layers of the earth to the year 2010. According to his calculations, this will occur ten years after man begins to populate the entire planet, create artificial reasoning and learn to slow time down.

The borehole in Saatly and the similar "superdeep" hole which has been drilled on the Kola Peninsula will probably bring this day closer.
[47]

NOTES ON KOLA SUPERDEEP DRILLING OPERATION

Moscow NEDELYA in Russian No 38 (20-26 Sep) 76 p 3

[Article by V. Belov: "Surge Into the Depths of the Planet"]

[Excerpts] The chief of the Kola Geological Prospecting Expedition D. Guberman took a common-looking roundish lump from the shelf, laid it on his palm and extended it to me.

"This piece of rock was raised from a depth of 7,240 m. We tried to get it for many years."

Today we have far more information about space than about that which is situated beneath our feet. We can only postulate with a small degree of probability what may be the composition and aggregate state of matter

lying below the "basalt" layer and the so-called Mohorovicic discontinuity. That is why scientists and specialists throughout the entire world have their attention riveted on the Kola superdeep borehole. The drill rig which was employed during the first stage in the drilling has been replaced by a new giant rig specially constructed by the Uralmashzavod, outfitted with an automatic system for the raising and lowering of pipes. The purpose of the drilling is a study of the structure of the lower levels of the earth's crust and to raise to the surface the unknown substance making it up.

At the Eighth World Petroleum Congress in Moscow in 1971 Soviet scientists presented a communication on their project for drilling superdeep boreholes. This report was entitled "Problems in Drilling a Borehole to a Depth of 15,000 m." Its authors were N. S. Timofeyev, L. A. Shreyner, L. Ye. Simonyants, B. V. Baydyuk, R. M. Eygeles, M. I. Virozhbitov. They presented this report when the drilling of the superdeep borehole had just begun on the Kola Peninsula.

I chanced to arrive at the Kola superdeep hole when the last meters were being drilled prior to the end of the first stage in the drilling project. The drill rig is situated near the village of Zapolyarnyy, on the shores of a lake with the name Vil'gisskoddeoayvin"yarvy, which translated from the Finnish means "Lake Under Wolf Mountain."

The Kola drillers required five years in order to reach a depth of 7,263 meters. These were years of stressed work. It is well known that the lion's share of all the work time of drillers is expended on so-called raising and lowering work. The hole is drilled 10 meters and then the entire multikilometer column of pipes must be raised upward in order to add to it, to replace the worn-out bit. Then it is lowered again. And this is done day to day, from year to year.

The drillers of the Kola expedition could for 7,000 m maintain the angle of deviation of the shaft of this borehole in the limits 6.5° from the vertical. In the opinion of specialists, this is an outstanding technical achievement, especially since the geological conditions for drilling are unfavorable. The Kola borehole with a depth of 7,263 meters is the only one in the world which is drilled in crystalline rocks (in this case the very ancient Baltic shield).

In the drilling area there is much noise and the clanging of the drilling tool, the winch is swinging out and the motors are humming. With the drill rig it is like with any other. I and the director of the expedition are observing the course of the drilling without leaving the office: a videomonitoring set is turned on. The dial is turned and on the screen one sees the preparations-repair shop where the drill pipes are being carefully checked by means of electronic defectoscopy.

There are many problems -- technical and scientific. Special pipes are being developed from heat-resistant alloys, ways are being developed for protecting the pipes against wear, means are being sought to deliver to the surface the greatest possible amount of core, methods are being devised for drilling without raising the column for replacing the worn-out bit, and much else. Research institutes, geological enterprises, and plants are successfully working on the implementation of the grandiose project. What the drillers have done merits great credit. These are experienced and talented people who have undergone serious competitions in order to participate on this expedition and who have demonstrated their skills.
[59]

FEATURE ARTICLE ON KOLA SUPERDEEP BOREHOLE

Moscow NAUKA I ZHIZN' in Russian No 3 1976, pp 34-40

[Article by A. Asan-Nuri, Director of the All-Union Scientific Research Institute of Drilling Technology and M. Vorozhbitov, Chief of the Problems Laboratory on Drilling to the Mantle, "On the Way to the Mantle"]

[Abstract] Work has been completed on the drilling of the SG-3 borehole, the Kola superdeep hole. It was begun in May 1970 and by early 1975 had penetrated into the deep layers to a depth of 7,263 meters. Although other holes have been drilled deeper, nevertheless this well is a record holder because no other has been drilled so deep into the crystalline rocks of the Precambrian. For the first time in world practice a considerable part of the borehole has been drilled without casings. The article gives exceptional detail concerning different aspects of this project. The second stage is to be carried out during 1976-1980. The borehole should reach the 10.5 km level during this stage. In this stage many solutions will be sought and found for the third stage of drilling -- from 10,500 to 15,000 m. But already the temperature at the face is 130° Celsius, which was expected at a depth of 15 km. And the pressure at the face is 800 atm! At 15 km the temperature is expected to be 300° Celsius and the pressure will be 1,600-1,800 atm. Under these conditions the drilling process will be slowed and the borehole walls may possibly lose their strength. A new drilling method will be used which does not require raising the column of drill pipes. Even now, acoustic logging has been carried out. Earlier it had been assumed that at great depths the velocity of seismic waves would increase due to increasing rock density. In fact, at a depth of seven kilometers the seismic waves move more slowly than in the layers near the surface. Also unconfirmed was the hypothesis in vogue concerning the temperature gradient. It had been postulated that in ancient crystalline formations the temperature of the deep layers would increase by 1° with each 100 meters. And so it was to a depth of 2,000 m. According to calculations, at a depth of seven kilometers the temperature should be about 60-70° Celsius, but it was 120°.
[113]

OPHIOLITE SAMPLES OBTAINED FROM MARIANA TRENCH

Moscow IZVESTIYA in Russian 10 Oct 76 p 4

[Article by S. Korepanov, "Journey Into the Abyss"]

[Summary] In May of this year the scientific research ship of the USSR Academy of Sciences "Dmitriy Mendeleyev" departed from Vladivostok and headed for the Philippine Sea. The participants had the task of taking samples of ophiolites from the bottom of the deepest depressions in the world ocean -- the Mariana and Java trenches. These depressions were selected because they are natural faults in the ocean crust whose bottoms should extend into the earth's upper mantle. For the time being no superdeep hole has yet reached such a depth. Collection of samples from different depths in these trenches would give a picture of the ancient past of our planet. The southeastern part of the Philippine Sea is an ideal place for research. First, because this sea is most distant from the continent and it has enormous submarine ridges which rise 10 km, protecting the trench from the transport of terrigenous sediments into it by submarine currents. These are the best conditions for obtaining bedrock, part of the earth's upper mantle. The voyage of the "Dmitriy Mendeleyev" has now been completed. Tens of containers with precious dredged material have been dispatched to laboratories in different countries of the world. A. Peyve, who headed the expedition and who is the director of the Geology Institute USSR Academy of Sciences, states: "Jointly with Soviet scientists, on shipboard there were specialists on ophiolites from the United States, France, Japan, Yugoslavia and Czechoslovakia, representatives of a total of 11 countries. The successes of the expedition can be attributed to the fact that this was a purely geological expedition. The investigations of the deepest depressions in the world ocean were carried out in accordance with the international project for study of ophiolites, the direction of which has been assigned by UNESCO to the scientists of the Soviet Union."
[55]

Abstracts of Scientific Articles

SEISMIC ANISOTROPY OF CRUST AND MANTLE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 8, 1976, pp 53-61

[Article by M. V. Nevskiy and Ye. M. Chesnokov, Institute of Physics of the Earth, "Deep Seismic Sounding Observation Systems for Studying Seismic Anisotropy of the Earth's Crust and Upper Mantle"]

[Abstract] The paper gives an analysis of deep seismic sounding observation systems used for studying the azimuthal seismic anisotropy of the upper mantle. The authors propose a method for computing an optimum (with respect to the volume of observations) system of radial longitudinal profiles making it possible to determine the parameters of anisotropy in the horizontal plane with stipulated evaluations of the experimental errors in measuring velocities. There is basis for assuming that the anisotropy of velocities of seismic waves is a common property of the upper mantle. For clarifying the scales of manifestation and possible nature of anisotropy it is necessary to formulate and systematically carry out special observations in different regions. When using the proposed observation system it is possible to separate the effects of anisotropy and a randomly situated horizontal nonuniformity of the medium. The method for processing the experimental data used as the basis for the method for computing the system is based for the time being only on one but extremely characteristic indicator of the anisotropy of elastic properties: periodicity of the azimuthal dependence of the velocities of longitudinal seismic waves. In the further improvement of the method for detecting seismic anisotropy it is also important to use its other distinguishing characteristics. There is basis for assuming that the method can be used directly in the practice of seismic investigations of the anisotropy of the elastic properties of the earth's crust and upper mantle under both continental and oceanic conditions.
[186]

MAGNETIC VARIATIONS OF MAGNETOSPHERIC AND IONOSPHERIC CURRENTS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 8, 1976, pp 68-72

[Article by D. S. Fayermark, Central Economic-Mathematics Institute, "Surface Magnetic Variations of Magnetospheric and Ionospheric Currents"]

[Abstract] The paper cited above gives an analysis of surface magnetic variations of electric currents in the earth's magnetosphere and ionosphere. For a dipole approximation of the main geomagnetic field it was possible to derive explicit formulas giving a spherical expansion of the potential of magnetic variations arising from magnetospheric and ionospheric currents. The derived formulas were used for computing specific current systems (S_q variations under conditions of nonequinoctial conductivity). A. I. Richmond ("The Computation of Magnetic Effects," J. ATMOS. TERR. PHYS., 36, 245, 1974) published formulas close to the final formulas presented in this paper.
[186]

DEEP STRUCTURE OF BAYKAL RIFT

Moscow SOVETSKAYA GEOLOGIYA in Russian No 6, 1976, pp 43-56

[Article by Yu. A. Zorin, V. A. Rogozhina, S. V. Lysak, M. R. Novoselova, V. I. Naydich, A. M. Popov, V. A. Golubev and V. V. Mordvinova, "Complex Geophysical Investigations of the Deep Structure of the Baykal Rift"]

[Abstract] Analysis of seismological data has shown that the region of the anomalous mantle beneath the Baykal rift extends to a depth of 400 km or more. Interpretation of the gravitational field in combination with data from other geophysical methods made it possible to compile a new map of the depths of the Mohorovicic discontinuity and to detect inhomogeneities in the upper part of the region of the anomalous mantle which are spatially related to the fields of Cenozoic basalts. As a result of analysis of data from magnetotelluric sounding, magnetometry and geothermy it was concluded that there is a nonstationary nature of the regional geothermal field in the rift zone indicating a recent appearance of the anomalous mantle region. The parameters of the geothermal anomaly in the Lake Baykal region make it possible to assume that it is associated with a fault zone along which heat from the mantle moves convectively. In summarizing the results of the complex investigations, the authors conclude that there is a limit on the Baykal rift zone in strike and that there is a complex combination of discontinuities between the crust and the plastic layers in the riftogenesis process.
[32]

SEA SEISMIC PROSPECTING FOR STUDY OF SEISMICALLY ACTIVE ZONES

Kiev GEOFIZICHESKIY SBORNIK in Russian No 68, 1975, pp 40-44

[Article by N. K. Kivshik and B. S. Krivchenkov, Krymmorgeologiya Geological Prospecting Combine, "Use of Sea Seismic Prospecting for Studying Seismically Dangerous Zones]

[Abstract] The article cited above gives the preliminary results of sea seismic prospecting work by the central ray method carried out in 1972-1973 in a sector of the Black Sea between Yalta and Alushta. Pneumatic sound sources with a chamber capacity of 3-7 liters were used. Comparison of the structural -tectonic map constructed on the basis of the collected data with isobaths of the sea floor indicates, in general, that to the 200-m isobath there is a coincidence of bottom morphology and the reflecting horizon. For the zone of the continental slope, within the limits of the discriminated downwarps, in the bottom relief of the sea there are terracelike uplifts with an amplitude up to 50 m, evidence of inversion neotectonic processes of formation of the morphology of the sea floor. A distinguishing characteristic of the geological structure of the sector is a block structure, determined by a system of tectonic dislocations having different orientations and ages. A high percentage of the discriminated dislocations found in the region of the continental slope indicates a continuing process of its formation. The results of the study confirm the effectiveness of the method used for solving the problems raised in the program for studying seismically dangerous zones. [2]

GRAVIMETRY AND SEISMIC SOUNDING IN REGIONAL TECTONICS STUDY

Kiev GEOFIZICHESKIY SBORNIK in Russian No 68, 1975, pp 49-54

[Article by M. V. Avdulov, Moscow University, No 68, 1975, pp 49-54]

[Abstract] Objectively deep seismic sounding (DSS) is a more precise method than gravimetry in the study of regional tectonics because it makes it possible to obtain the most complete and valuable information about the cross section. However, in folded regions the possibilities of the seismic method are lessened and the accuracy of the gravimetric method is increased; this makes it desirable to use a combination of deep seismic sounding and gravimetry in these regions. In the joint interpretation of deep seismic sounding data and when there are sharp discrepancies when using the two methods, preference should be given to DSS data in cases when there is a system of counter and overtaking travel-time curves relating to the same discontinuity. As an illustration, the paper examines the results of study of crustal structure on the Crimean Peninsula. A quantitative interpretation of the gravity field of the Crimean Peninsula makes it possible to conclude that

beneath Mountainous Crimea the thickness of the earth's crust varies in the range 36-40 km. Seismic data indicate the presence of reflecting surfaces at depths of about 50 km under the Mountainous Crimea. However, the reflecting surfaces at depths of about 50 km must not be regarded as the crust-mantle discontinuity, but as an intermediate boundary in the upper mantle. This point of view makes possible a good correlation of the results of quantitative interpretation of seismic and gravimetric data.
[2]

GEOPHYSICAL FIELDS, SEISMICITY, DEEP STRUCTURE AND RECENT DYNAMICS

Kiev GEOFIZICHESKIY SBORNIK in Russian, No 68, 1975, pp 64-74

[Article by A. I. Bilinskiy, A. P. Bondarenko, T. Z. Verbitskiy, B. I. Volosetskiy, V. G. Kuznetsova, M. I. Mel'nichuk, R. S. Pronishin, I. Sh. Rakhimova, Ya. S. Sapuzhak and V. I. Somov, L'vov Affiliate of Mathematical Physics Mathematics Institute Ukrainian Academy of Sciences, "Study of the Correlation of Geophysical Fields with Seismicity, Deep Structure and Recent Dynamics of the Earth's Crust in the Carpathian Polygon"]

[Abstract] The Carpathian Geodynamic Polygon, established in 1966, is situated in the SW part of the Soviet Carpathians (a map accompanies the text) on the boundary with Czechoslovakia, Hungary and Rumania in a region of maximum differentiation of the most recent crustal movements. The objective of investigations in the polygon is study of the correlation between geophysical fields and seismicity, deep structure and recent dynamics of the earth's crust. The studies provide for the clarification of temporal changes in physical fields and recent deformations of the earth's crust, being a reflection of the tectonic processes transpiring in the earth's deep layers. The following are discussed in considerable detail: principal characteristics of deep structure, seismicity, gravity field variations, geomagnetic field variations, variations of the electromagnetic field, conductivity, elastic properties, recent crustal movements. The integrated analysis of all these data is considered. The results indicate that the sensitivity of the seismic characteristics of the medium to its stressed state is dependent on the Poisson coefficient of the matrix, change in the compressibility coefficient of slitlike voids under pressure, external pressure, porosity, relationship between the compressibility coefficient of fractures and the volume compressibility of their filler. With a decrease in the Poisson coefficient of the matrix, porosity, length and number of slitlike voids and with an increase in the ratio between the compressibility coefficient of the fractures and the volume compressibility of their filler, and also the effective pressure on the rock skeleton, the sensitivity of the characteristics of elasticity to change in the stressed state is decreased.
[2]

CONTRIBUTION TO THEORY OF SURFACE AND INTERNAL WAVES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 229, No 4, 1976, pp 820-823

[Article by A. I. Leonov, Institute of Mechanical Problems, "Two-Dimensional Korteweg-De Vries Equations in the Nonlinear Theory of Surface and Internal Waves"]

[Abstract] The Korteweg-De Vries equation belongs to a class of precise nonlinear equations in partial derivatives. Attempts have been made to generalize these equations for an inhomogeneous case. In this paper the author delineates an asymptotic procedure for deriving the two-dimensional Korteweg-De Vries equation for internal gravitational waves with surface waves taken into account. The problem is solved with the following formulation: it is assumed that there is a stably stratified ideal fluid which fills an unbounded layer with the thickness H in an unperturbed state. Using the H value and also the density ρ, taken at the surface of the fluid, and also gravity g, it is possible to make all the parameters dimensionless. In solving the problem it is possible to examine three-dimensional nonstationary wave movements on a quiet shallow sea.
[167]

ALGORITHMS FOR INTERPRETING MAGNETIC-GRAVITATIONAL ANOMALIES

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 8, 1976, pp 62-67

[Article by T. B. Kalinina, All-Union Scientific Research Institute of Prospecting Geophysics, "Statistical Algorithms for the Interpretation of Magnetic and Gravitational Anomalies"]

[Abstract] This is a brief review of statistical algorithms and investigations of the effectiveness of interpretation of potential fields. The following sections are included: 1. Optimum Algorithms for Evaluations of Parameters of "Standard" Geological Objects; 2. Theoretical Investigation of the Effectiveness of Optimum Interpretation Methods; 3. Evaluations of Moments of Complex Distributions of Sources of Potential Fields; 4. Combination of Methods in the Interpretation of Magnetic and Gravity Fields; 5. Effectiveness and Comparison of Nonoptimum Interpretation Methods. The review therefore is essentially a state-of-the-art summarization in this field.
[186]

METHODS FOR GEOMAGNETIC RESEARCH IN VOLCANIC-SEISMIC REGIONS

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR, SERIYA GEOLOGICHESKAYA in Russian No 3, 1976, pp 62-68

[Article by T. A. Akishev, V. I. Pochtarev, I. M. Pudovkin and A. S. Sokolov, Leningrad Division of the Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "Some Problems in the Methods for Making Geomagnetic Investigations in Volcanic and Seismically Active Regions"]

[Abstract] Geomagnetic investigations carried out by the authors on Kamchatka and in southern and southeastern Kazakhstan lead to the conclusion that the amplitude of the secular variation field is a value changing with time and directly dependent on the activity of the course of deep processes. On the basis of field work by different methods it is concluded that the most promising is a modification of the magnetic method by means of which it is possible to study the long-wave spectrum of variations of the geomagnetic field genetically related to processes within the earth. Therefore, field investigations of the anomalousness of secular variation are the first and an essential step in this direction, making it possible to carry out seismic regionalization on the basis of the degree of magnetic activity. Specific recommendations are made on how to carry out such investigations.
[220]

PROPAGATION OF SURFACE WAVES IN BLACK SEA REGION

Kiev GEOFIZICHESKIY SBORNIK in Russian No 68, 1975, pp 34-39

[Article by S. A. Kapitanova, Seismology Division, Geophysics Institute Ukrainian Academy of Sciences, "Propagation of Surface Seismic Waves in the Black Sea Region and Peculiarities of Structure of the Earth's Crust"]

[Abstract] For studying a great number of earthquakes with epicenters around the shores of the Black Sea the author constructed experimental curves of the dispersion of group velocities of Rayleigh and Love surface waves. The study is based on data for earthquakes of 1960-1970 registered by general and long-period seismographs at the "Simferopol'" seismic station. The article gives data on a comparison of experimental data and theoretical dispersion curves of structural models of a layered earth's crust. The parameters of the investigated earthquakes are given in a table. It was possible to obtain the averaged structure of the crust on five profiles in the Black Sea which also extended a short distance onto the land. The constructed theoretical curves illustrate the possibility of modeling the properties of the real medium on the trajectory of mixed wave paths (land and sea). The proposed interpretation of extensive observational data on surface seismic waves in the Black Sea region is an attempt at estimating the layered-block structure of the local earth's crust in the first approximation. (Thicknesses of sediments, the "granite" and "basalt" layers are given.)
[2]

DYNAMIC CHARACTERISTICS OF SURFACE SEISMIC WAVES

Kiev GEOFIZICHESKIY SBORNIK in Russian No 68, 1975, pp 82-89

[Article by B. N. Volosetskiy, L'vov Affiliate of Mathematical Physics Mathematics Institute Ukrainian Academy of Sciences, "First Results of Study of the Dynamic Characteristics of Surface Seismic Waves in the Carpathians"]

[Abstract] The dynamic characteristics of surface seismic waves in the Carpathians were investigated using the records of distant earthquakes. It is shown here that the dynamic characteristics of surface waves during their propagation through the Carpathians experience changes caused by the peculiarities of structure of the medium. The interpretation of the results made it possible to correlate the observed characteristics of the dynamic parameters with inhomogeneities in the structure of the Carpathians. For example, the observed increase in the amplitudes of the transmitted waves at Uzhgorod station in comparison with L'vov station made it possible to conclude that in this region there is a lesser rigidity of the medium, and this means lesser velocities of body waves and density. Thus, the maxima on the curves of the coefficients of transmission for the profiles L'vov-Uzhgorod and Kosov-Rakhov indicate a downwarping of the Mohorovicic discontinuity under the Carpathian Mountains. Therefore, a study of the peculiarities of the dynamic characteristics of surface waves during their transmission in media with an inhomogeneous structure makes it possible to obtain information on these inhomogeneities.
[2]

INVESTIGATIONS IN THE CRIMEAN GEODYNAMIC POLYGON

Kiev GEOFIZICHESKIY SBORNIK in Russian No 68, 1975, pp 8-15

[Article by N. S. Blagovolin, Geography Institute USSR Academy of Sciences, "Some Results and the Most Important Tasks in Complex Investigations in the Crimean Geodynamic Polygon"]

[Abstract] It can be said that there has been adequate study of the deep structure of the earth's crust, ancient and young structures, relief, recent and current movements for the entire Crimean Peninsula; there has been satisfactory study of recent vertical movements of the earth's crust in Lowland Crimea. There is therefore basis for regarding the entire Crimean Peninsula as a polygon for testing of the method for studying the correlation between different elements of structure of the earth's crust and its movements of different types. In the central part of Mountainous Crimea, characterized by a clearly expressed block structure, it is necessary to continue study of recent horizontal movements using the 1962 triangulation network. It is necessary to continue regular leveling of the highly

accurate line of 1962-1964 in the Crimean Polygon -- annually or at intervals of two or three years. It is of particular interest to compare the results of leveling with the nature of seismic activity in the Crimea and the intensity of recent exogenous processes (using data from repeated ground stereophotogrammetric surveys). It is extremely desirable to repeat leveling along certain lines, thereby making it possible to refine and make more detailed the map of recent vertical movements in Lowland Crimea. The performance of these studies and continuation of seismological, geophysical, geomorphological and stereophotogrammetric investigations will make the Crimean Polygon one of the most complex and highly productive geodynamic polygons of the USSR.
[2]

POLARIZATION METHOD OF SEISMIC INVESTIGATIONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 3, 1976, pp 553-555

[Article by Ye. I. Gal'perin, Institute of Physics of the Earth, "Polarization Method of Seismic Investigations"]

[Abstract] Investigations have shown that the seismic waves observed in real media both at the surface and at internal points in the medium in the overwhelming majority of cases are polarized nonlinearly. The polarization of direct longitudinal and transverse waves can be used for a quantitative study of the sources of excitation and their directivity. Work has led to the creation of a polarization method of seismic investigations based on a combination of the selection of waves at a point using the criterion of polarization of oscillations and the selection of waves in a volume using the criterion of direction of propagation. In technical respects the method is based on the combination of three-component observations at a point and three-dimensional observations in space. In contrast to traditional methods, the polarization-position correlation of waves, used for analysis of the wave field, provides for the discrimination and tracing for each wave not the spatially fixed (such as vertical), but the variable components of oscillations ensuring the discrimination of a wave in the best way. The paper discusses the geological effectiveness of the polarization method. Wave selection at a point using the polarization criterion in addition to traditional methods for selecting waves along observation lines on the basis of the apparent velocity criterion increases the possibility of analyzing complex wave fields when ordinary methods are inadequate.
[43]

FIGURE OF THE GEOID AND MANTLE MELTS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 3, 1976, pp 674-677

[Article by I. G. Klushin and I. I. Abramovich, All-Union Scientific Research Geological Institute, "Figure of the Geoid and Composition of Mantle Melts"]

[Abstract] This paper gives data on some peculiarities of the chemical composition of igneous rocks which serve as a basis for correlations with deep processes responsible for the appearance of global anomalies of gravitational potential. The initial data for the analysis were geophysical and petrochemical data relating to the areas of recent and Quaternary volcanism within the limits of the Pacific Ocean ring. Use of gravitational potential anomalies and not gravity anomalies (in the Bouguer, Faye and isostatic reductions) is attributable to the fact that potential anomalies more effectively reflect the influence of deep masses. The authors made use of more than 3,000 total chemical analyses in ascertaining the composition of the products of recent and Quaternary volcanism. Table 1 in the text gives the distribution of volcanic areas by groups with different gravitational potential values and excesses of the geoid over the spheroid. Figure 1 shows the relationship between the chemical parameters of basalts and the characteristics of gravitational potential. The article examines the correlation between h (the excess of the geoid over the spheroid) and the chemical composition of the volcanic rocks. This correlation is especially clear in the products of mantle magmas: in basalts and andesites. In zones with high h values it is more common to encounter rocks which are relatively enriched with iron, that is, formations characterized by increased density. The Fe concentration increases nonlinearly with an increase in h. One-dimensional dispersion analysis indicated a high reliability of the dependence: confidence coefficient $P \geqslant 0.975$. The change in Na_2O concentration exhibits a tendency to a decrease with transition to zones with high h values.
[43]

ELECTROKINETIC PHENOMENA AND MAGNETIC ANOMALY IN UZBEKISTAN

Tashkent UZBEKSKIY GEOLOGICHESKIY ZHURNAL in Russian No 4, 1976, pp 12-16

[Article by Kh. A. Rakhmatulin and R. I. Sultanbekov, Seismology Institute, Uzbek Academy of Sciences]

[Abstract] Geomagnetic profiles with a total length of 300 km, with a distance between stations of 4-5 km, were run in 1968 in the Tashkent Geodynamic Polygon. T measurements of the geomagnetic field were made between May 1968 and February 1971. These revealed an anomaly in the region of the Poltoratskoye uplift. The nature of the anomalies (maximum 23γ) is attributable to the variable pressure regime in the underground gas storage stratum. This collector stratum, in the Chanakskaya suite of the Senomanian stage of the Upper Cretaceous, is at a depth of 520 m in the arch. Natural gas is pumped into the stratum at 95 atm. The stratum pressure here

of the collector itself is 60 atm. The excess pressure on rocks of this arch is accompanied by a piezomagnetic effect. However, it is clear that the magnetization of rocks in the arch is inadequate for creating the registered anomaly. An investigation was made to determine the additional source exciting the magnetic field. This source was found to be the interaction between the filtering fluid and the collector stratum, that is, the interaction between the fluid and solid phases, accompanied by the appearance of an electromagnetic field. These phenomena are called electrokinetic. It is concluded that in those regions of the earth's crust where there is interaction between the fluid and solid phases a definite contribution to the strength of the local geomagnetic field is always made by electrokinetic phenomena.
[41]

CALIBRATION CURVE FOR DETERMINING EARTHQUAKE MAGNITUDE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 7, 1976, pp 77-80

[Article by I. V. Gorbunova and N. V. Shatornaya, Institute of Physics of the Earth, "Calibration Curve for Determining Earthquake Magnitude from PKIKP Waves"]

[Abstract] The seismic stations of the Soviet Union and Western Europe register only body waves of the PKP type from most of the earthquakes with a magnitude $M \geqslant 6$ in the southern hemisphere using highly sensitive apparatus. These waves are clearly discriminated on the records of short-period apparatus. In this paper the authors propose a calibration curve for determining magnitudes from waves of this type registered at distances of 115-160°. The first attempts at constructing a calibration curve were made using observations for "Obninsk" station (see I. V. Gorbunova, et al., KOMPLEKSNYYE GEOFIZICHESKIYE NABLYUDENIYA V OBNINSKE, Obninsk, 1974). The paper cited above is essentially a continuation of that study. The authors have refined the values of the calibration function in dependence on epicentral distance. The calibration curve has been refined only for PKIKP waves. [PKIKP is a longitudinal wave passing through the entire earth: crust, mantle, outer core, transition zone from the outer to the inner core, inner core.] The data cited here indicate a real possibility of using this calibation curve in seismological practice.
[129]

NONUNIFORMITY OF EARTH'S ROTATION STUDIED

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 4, 1976, pp 811-814

[Article by Sh. A. Guberman, Institute of Applied Mathematics, "D-Waves and Nonuniformity of the Earth's Rotation"]

[Abstract] In an earlier study (DAN, Vol 224, No 3, 1975) the author presented a hypothesis on the spatial-temporal distribution of the epicenters of earthquakes. 1. Along the earth's meridians there is propagation of waves which initiate earthquakes with a magnitude $M \geqslant M_0$ (D waves); their velocity v_D is 0.15° per year (16.6 km/year); 2. The distribution of D-waves is symmetric relative to the equator. This hypothesis is confirmed in many regions of the earth. The propagation of D-waves along the meridians and their symmetry relative to the equator suggests that there is a relationship between D-waves and nonuniformity of the earth's rotation. In this paper the following hypothesis is explored. When the velocity of the earth's rotation attains a local minimum D-waves are generated at both poles. Table 1 in the text gives data on nonuniformity of the earth's rotation from 1815 through 1967. The hypothesis can be checked exclusively using only earthquakes occurring in the polar regions. A study was made using 23 Arctic earthquakes with $M \geqslant 6.0$. Fifteen of these correspond to minima given in Table 1. The total duration of the minima in the change in velocity of the earth's rotation is 57 years, that is, 0.373 of the investigated interval (153 years). These data make it possible to adopt the hypothesis with a probability of 0.975. A different approach gave a similarly high probability of correctness of the hypothesis.
[60]

MOTION OF INHOMOGENEOUS GRAVITATING MEDIUM

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 4, 1976, pp 815-818

[Article by Zh. S. Yerzhanov, Academician Kazakh Academy of Sciences, and I. A. Garagash, Institute of Mathematics and Mechanics Academy of Sciences Kazakh SSR, "Description of Movement of an Inhomogeneous Gravitating Medium"]

[Abstract] In this paper, using as a point of departure the possible movements occurring for continuous media for the case of small perturbations, the authors derive linearized equations of motion of an inhomogeneous gravitating half-space with initial stresses. On the basis of an analysis of the known experimental data on the influence of pressure and temperature on the elastic constants of rocks it is shown that it is possible to simplify the derived expressions for the earth's crust and obtain a representation of the general solution of the equations of motion. The equations of motion for an inhomogeneous gravitating medium (16) derived in this study and the representation of their general solution in the form (17) can be used in computing theoretical dispersion curves for the phase velocities of surface waves used for a quantitative evaluation of the parameters of the crust and mantle.
[60]

STRING GRAVIMETER DESCRIBED

Moscow REFERATIVNYY ZHURNAL, 52. GEODEZIYA I AEROFOTOS"YEMKA, OTDEL'NYY VYPUSK in Russian No 7, 1976, 7.52.95P

[Patent awarded to A. M. Lozinskaya, I. L. Yashayayev and Z. I. Fomina, All-Union Scientific Research Institute of Geophysical Prospecting Methods; Moscow, Author's Certificate USSR, No 4455004, published 3 July 1975, "String Gravimeter"]

[Text] In known string gravimeters with an electromechanical feedback the dependence between the frequency of oscillations of the string and the acceleration acting upon it are nonlinear (see RZh, 1972, 2.52.89P). For the purpose of attaining a linear dependence on the assumption of use of this variant of gravimeter design there is a flat constant-capacitance capacitor. One of the capacitor plates is connected to a load and the other to the housing. The input of the frequency discriminator is connected to the output of a string oscillator, whereas the output of the frequency discriminator is connected to the capacitor.
[62]

VERTICAL GRAVITATIONAL GRADIENT METER

Moscow REFERATIVNYY ZHURNAL, 52. GEODEZIYA I AEROFOTOS"YEMKA, OTDEL'NYY VYPUSK in Russian No 7, 1976 7.52.94P

[Patent awarded to M. A. Telepin; Moscow, Author's Certificate USSR, No 475584 (No 929574), published 19 September 1975, "Vertical Gravitational Gradient Meter"]

[Text] An instrument is proposed for measuring the vertical gradient of gravity on a moving base. The upper and lower weights of the sensing system are automatically held in a zero reading position by means of a feedback excluding the lateral swinging of the weights. Attached to the moving sensing system are conducting or polarizing plates, to one side of which there are pairs of fixed plates -- electrodes connected through potentiometric regulators with sensors for registering the rotation of the base about the mutually perpendicular axes.
[62]

GRAVIMETRIC TIE-IN OF AES OBSERVATION STATION

Moscow REFERATIVNYY ZHURNAL, 52. GEODEZIYA I AEROFOTOS"YEMKA, OTDEL'NYY VYPUSK in Russian No 7, 1976 7.52.89

[Article by B. Prokopiyev and B. Nikolov; Sofia, GEOD., KARTOGRAF., ZEMEUSTR., 15, No 4, pp 5-8, "Gravimetric Tie-in of 'Plana' Artificial Earth Satellite Observation Station"]

[Text] Connection of the Dragalevtsy control point with Samokov station was accomplished in two variants: through Kovachevtsy and through the "Plana" artificial earth satellite observation station. The connection was made by runs with GAK-7T and GR/K2 gravimeters. The processing of the measurement results was by use of the Yu. D. Bulanzhe formulas. The adjusted Δg values along both runs coincided with an accuracy to 0.001 mgal. Thus, the "Plana" artificial earth satellite observation station can be included in the highly accurate gravimetric network of Bulgaria.
[62]

TRANSFER OF MILLIGAL UNIT TO A GRAVITY NETWORK

Warsaw GEODEZJA I KARTOGRAFIA in Polish Vol 25 No 2 1976 pp 83-90

[Article by Marcin Barlik, "The Transfer of Milligal Unit to a Gravity Network Using Quartz Gravimeters"]

[Abstract] The author has attempted to determine the accuracy of the milligal unit of a gravimetric network observed using quartz gravimeters of the types: GAK 7T, Sharpe CG-2, Worden. These gravimeters were used in Poland for running filling gravimetric networks to serve as a basis for plotting further details and in geophysical prospecting. Field workers measured gravity differences and adjusted two portions of third-order gravimetric networks several hundreds of square kilometers in area. The gravimeters used were thoroughly tested at the Gravimetric Laboratory of the Warsaw Polytechnic Institute. The author gives a detailed discussion of the changes in the equations for the quartz gravimeters. It was concluded that the calibration of the GAK 7T gravimeters should be accomplished every two months and the Sharpe and Worden gravimeters should be calibrated each four months. The gravimeter equation coefficients were ascertained for each type of gravimeter.
[103]

CHARACTERISTICS OF WAVES FROM SHEAR DISPLACEMENT ALONG FRACTURE

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ZEMLI in Russian No 7, 1976, pp 20-26

[Article by S. D. Vinogradov, Institute of Physics of the Earth, "Investigation of the Characteristics of Longitudinal and Transverse Waves from a Shear Displacement Along a Ready Fracture"]

[Abstract] In the paper cited above the author has investigated a model in two-dimensional form of a shear displacement along a ready fracture within the material. A plastic plate 3 mm thick was used. The so-called stick-slip phenomenon is investigated. Longitudinal and transverse waves were registered. The article describes the shape of the pulses and the directional diagram for the longitudinal and transverse waves was obtained. Investigation of the characteristics of elastic waves in this model, including the ratio of the amplitudes of the transverse and longitudinal waves and their comparison with theoretical values, indicated that the studied source is shear in its character and its radiation coincides most closely with the radiation of an elementary dislocation. This makes possible a further study of the seismic characteristics of the source. [129]

V. UPPER ATMOSPHERE AND SPACE RESEARCH

News

TASS ANNOUNCES LAUNCHING OF "METEOR" WEATHER SATELLITE

Moscow PRAVDA in Russian 18 Oct 76 p 2

[TASS Report: "'Meteor' is in Orbit"]

[Text] On 16 October 1976 a "Meteor" weather satellite was launched in the Soviet Union. The basic mission of the satellite is to provide meteorological information necessary for use in the operational weather service.

The satellite was inserted into an orbit with the following parameters:
-- apogee, 904 kilometers;
-- perigee, 871 kilometers;
-- orbital inclination, 81.3 degrees;
-- initial period of revolution, 102.5 minutes.

The satellite carries meteorological apparatus enabling it to obtain pictures of clouds and snow cover on the illuminated and shadow sides of the earth and also to obtain data on the thermal energy reflected and radiated by the earth and the atmosphere.

In addition to the meteorological apparatus, the "Meteor" satellite has: a system to maintain constant orientation of the satellite toward the earth, a power supply system with autonomous orientation of the solar batteries toward the sun, a radio system for precise measurement of orbital elements, and a radiotelemetry system for transmitting data on the operation of the instruments and scientific equipment to earth.

The apparatus installed on the satellite is functioning normally. The coordination-computation center is processing the incoming information. Meteorological information goes to the USSR Hydrometeorological Center for processing and utilization. [4]

TASS ANNOUNCES LAUNCHING OF "SOYUZ-23" MANNED SPACECRAFT

Moscow PRAVDA in Russian 15 Oct 76 p 1

[TASS Report: "A New Launch Into Space"]

[Text] At 2040 hours Moscow time on 14 October 1976 the "Soyuz-23" spacecraft was launched in the Soviet Union. The ship is manned by a crew consisting of ship commander Lieutenant Colonel Vyacheslav Dmitriyevich Zudov and flight engineer Lieutenant Colonel-Engineer Valeriy Il'ich Rozhdestvenskiy.

The aim of the launch of the "Soyuz-23" ship is to continue scientific and technical studies and experiments with the "Salyut-5" orbital scientific station which were begun on 7 July 1976 during the joint flight of the "Soyuz-21" transport ship and the "Salyut-5" station.

The on-board systems of the "Soyuz-23" craft are operating normally. The crew members are feeling well.

Cosmonaut comrades V. D. Zudov and V. I. Rozhdestvenskiy have begun to carry out the flight program. [4]

TASS ANNOUNCES "SOYUZ-23" COMPLETES TEN REVOLUTIONS

Moscow PRAVDA in Russian 16 Oct 76 p 1

[TASS Report: "Flight Continues"]

[Text] Flight Control Center, 15 September. By 1200 hours Moscow time the "Soyuz-23" spaceship had completed ten revolutions around the earth.

After correction of the trajectory, performed at 0155 hours, the orbital parameters are:

-- apogee, 275 kilometers;
-- perigee, 243 kilometers;
-- period of revolution, 89.5 minutes;
-- orbital inclination, 51.6 degrees.

According to reports from the crew and data from telemetric information, cosmonauts V. D. Zudov and V. I. Rozhdestvenskiy are feeling well. The flight systems of the ship are functioning normally. [5]

TASS REPORTS FAILURE OF "SOYUZ-23" DOCKING MANEUVER

Moscow PRAVDA in Russian 17 Oct 76 p 1

[TASS Report: "'Soyuz-23': Before the Return to Earth"]

[Text] Flight Control Center, 16 October. The second workday in the flight of cosmonauts Vyacheslav Zudov and Valeriy Rozhdestvenskiy aboard the "Soyuz-23" spacecraft ended today at 0300 hours Moscow time.

Cosmonauts Zudov and Rozhdestvenskiy carried out the operations planned according to the program for the second day of the flight. At 2158 hours on 15 October the "Soyuz-23" craft was put in an automatic approach mode for rendezvous with the "Salyut-5" station. Due to an operational malfunction in the approach control system the docking with the "Salyut-5" station was cancelled.

The crew members are concluding the flight and preparing for return to earth.

The "Salyut-5" orbital station is continuing its flight in an automatic regime. [4]

TASS ANNOUNCES LAUNCHING OF "KOSMOS-859"

Moscow PRAVDA in Russian 12 Oct 76 p 3

[TASS Report: "'Kosmos-859'"]

[Abstract] The artificial earth satellite "Kosmos-859" was launched in the Soviet Union on 10 October 1976. The satellite was inserted into an orbit with the following parameters:

-- initial period, 89.6 minutes;
-- apogee, 360 kilometers;
-- perigee, 180 kilometers;
-- orbital inclination, 65 degrees.

TASS REPORTS LANDING AND RECOVERY OF "SOYUZ-23" CREW

Moscow PRAVDA IN Russian 18 October 76 p 1

[TASS Report: "The Crew of the 'Soyuz-23' Spacecraft Has Returned to Earth"]

[Text] On 16 October 1976, after conclusion of operations aboard the "Soyuz-23" spacecraft, cosmonaut comrades Vyacheslav Dmitriyevich Zudov and Valeriy Il'ich Rozhdestvenskiy returned to earth. At 2046 hours Moscow time the descent craft of the "Soyuz-23" spaceship landed 195 kilometers southwest of the city of Tselinograd.

The crew prepared the "Soyuz-23" craft for descent to earth and at 2002 hours Moscow time the braking engine was fired. Upon conclusion of the engine's operation separation of the ship's compartments took place. The descent craft entered a descent trajectory and at an altitude of seven kilometers the parachute system was activated. The descent craft landed on the surface of Lake Tengiz.

The search and rescue complex, including airplanes, helicopters and floating craft accomplished the evacuation of the cosmonauts and the descent craft under complex nighttime and heavy snowfall conditions.

Comrades Zudov and Rozhdestvenskiy are in good health.

In all stages of the flight and after the landing the crew acted confidently and performed their duties efficiently. [4]

TASS ANNOUNCES LAUNCH OF "VERTIKAL'-4" GEOPHYSICAL ROCKET

Moscow PRAVDA in Russian 15 Oct 76 p 3

[TASS Report: "Launch of 'Vertikal'-4'"]

[Text] In accordance with the program of cooperation of socialist countries in the field of study and use of space for peaceful purposes, at 1350 hours Moscow time on 14 October 1976 the "Vertikal'-4" geophysical rocket was launched from the territory of the European USSR in the middle latitudes to an altitude of 1,512 kilometers.

The "Vertikal'-4" geophysical rocket is intended to continue complex studies of the earth's atmosphere and ionosphere as well as the interaction of solar short-wave radiation with the earth's atmosphere.

In the instrument package, which separated from the rocket at an altitude of 173 kilometers, there was installed scientific apparatus manufactured in the People's Republic of Bulgaria, the German Democratic Republic, the Soviet Union, and the Czechoslovak Socialist Republic.

During the flight of the "Vertikal'-4" geophysical rocket ground measurements of various parameters of the ionosphere were simultaneously performed.

Specialists from Bulgaria, the GDR, USSR, and Czechoslovakia participated in the assembly and testing of the scientific apparatus installed on the "Vertikal'-4" rocket and also took part in the launch.

Scientific organizations of the countries participating in the joint experiment have begun processing the information obtained. [4]

ACADEMICIAN PETROV INTERVIEWED ON "VERTIKAL'-4" EXPERIMENT

Moscow PRAVDA in Russian 17 Oct 76 p 3

[Interview with Academician B. N. Petrov: "'Portrait' of the Atmosphere"]

[Text] On 14 October specialists scuccessfully carried out an interesting space experiment under the "Interkosmos" program. Participating in its preparation were scientists of Bulgaria, German Democratic Republic, USSR and Czechoslovakia. Using the powerful "Vertikal'-4" geophysical rocket, it was possible to make complex investigations of the earth's upper atmosphere and ionosphere to an altitude of about 1,500 km. A PRAVDA correspondent asked the chairman of the Council on International Cooperation in Exploration and Use of Space USSR Academy of Sciences, Academician B. N. Petrov, to comment on this event.

Q: Please tell us about the importance of this space experiment for science.

A: In the upper layers of the atmosphere interesting physical processes transpire which have not yet been adequately studied. In order to analyze fully all these complex phenomena it is necessary, together with satellite measurements, to carry out investigations using vertically launched rockets.

Such experiments make it possible to obtain the vertical cross section of the atmosphere to an altitude of 1,500 km, in a short time period (up to 15 minutes) measuring the principal physical parameters of the neutral upper atmosphere and ionospheric plasma.

Q: Would you tell in greater detail about the scientific goals of this experiment?

A: The launching of the "Vertikal'-4" is a continuation and development of planned long-term investigations of the upper atmosphere and ionosphere initiated by the scientists of the socialist countries using the geophysical rockets "Vertikal-1, 2, 3" and the satellites "Interkosmos-2, 8, 10, 12 and 14."

The gas composition in the upper atmosphere and ionosphere changes with altitude: the heaviest (molecular) particles are situated at the bottom (to altitudes of approximately 200 km), whereas above one finds atomic oxygen.

The highest layer of the atmosphere contains the lightest of the gases -- neutral hydrogen and hydrogen ions (protons).

None of the preceding rockets of the "Vertikal'" series emerged beyond the limits of the "oxygen part" of the ionosphere. The "Vertikal'-4" passed through the transition zone between the oxygen and hydrogen parts of the ionosphere situated, depending on the time of day and season of the year, at altitudes of 600-1,000 km and reached the hydrogen region of the ionosphere, sometimes known as the "protonosphere."

The scientific instrumentation on the "Vertikal'-4" was carried in the instrument compartment. It is separated from the rocket, which makes it possible to ensure a high purity and quality of the scientific experiments and its stabilization and orientation on the sun in flight and also to exclude the influence on instrument readings from a number of effects from rotation of the container.

The specialists of Bulgaria, GDR, USSR and Czechoslovakia developed and fabricated for the "Vertikal'-4" more than ten complex and diverse scientific instruments. Some parameters of ionospheric plasma were measured using different methods and instruments. This substantially increases the reliability of the measurements and makes it possible to check the research results.

During the flight of the rocket, near the launching site the specialists carried out measurements of ionospheric characteristics by radio methods to altitudes of about 300 km. In particular, this was done with participation of specialists from Rostov University, using unique multifrequency apparatus which they developed for studying the absorption of radio waves.

In general, the ionospheric investigations aboard the "Vertikal'-4" are the most complete of all those carried out up to the present time.

Q: Could you not summarize some results of the ten years of joint work of scientists of the socialist countries in space exploration?

A: Under the "Interkosmos" program there were launchings of 16 satellites, four geophysical rockets and several tens of meteorological rockets. The apparatus carried on these objects was developed and fabricated by the scientific and industrial organizations of the fraternal countries. The materials from the joint experiments will make a substantial contribution to the exploration of space.

Late in September at Kaluga there was an international symposium with the participation of scientists from Bulgaria, Hungary, GDR, Poland, Rumania, Soviet Union and Czechoslovakia at which specialists summarized the results of joint investigations during the last decade. In particular, the participants in the symposium examined new results obtained using rockets and satellites in the "Interkosmos" series. Plans call for joint work providing

for carrying out investigations of circumterrestrial space, the moon and planets of the solar system using more complex space vehicles.

Now in the socialist countries specialists are developing scientific instrumentation for new space experiments on automatic universal orbital stations, geophysical and meteorological rockets. The joint experiments under the "Interkosmos" program serve as a clear example of the effectiveness of combining the efforts of scientists of the socialist countries in the exploration and use of space.
[53]

SHATALOV COMMENTS ON FIRST STAGE OF "SOYUZ-23" FLIGHT

Moscow PRAVDA in Russian 16 Oct 76 p 3

[Article by Yu. Apenchenko: "Night Watch"]

[Text] The beginning of the first work day in space orbit is determined by the launching time. The "Soyuz-23" began its flight at about 2100 hours, so that the first work watch of the crew fell at nighttime. And while the cosmonauts worked, all those who ensured their flight were also awake.

We will now discuss the first "Rodonov" watch with the director of the training of Soviet cosmonauts V. A. Shatalov.

"On a flight of any duration the first day is something special," says Vladimir Aleksandrovich. "It solves a great deal, creates a mood, an atmosphere in which implementation of the program begins."

"Just how would you categorize the crew's mood during the first hours of the 'Soyuz-23' flight?"

"Calmness. The cosmonauts maintained an even, good mood during the prelaunching hours and carefully made preparations for the launching time. When in orbit the commander and the ship's engineer immediately proceeded to work and in the initial stage there is always plenty of it. It is necessary to check the condition of different ship systems and the engine."

To be sure, all these operations and their sequence were patiently practiced on a trainer. But in real flight there are inevitably deviations from the averaged theoretical model which is created under terrestrial conditions. In principle everything occurs the same, but nevertheless this is not the case. Each ship has its own character and it is manifested in flight already on the first revolutions around the planet.

"This I know well from my own experience," notes V. A. Shatalov. "On three occasions I have been launched into space. And although all three times I flew in ships of the 'Soyuz' type, there was absolutely no identity among them. The differences were manifested in some peculiarities of control, the sensitivity with which the ship responds to the actions of the pilot. You pay sharp attention even to such seemingly unimportant details, for example, as the color and clarity of the image on the screens of the optical devices so responsive to one button or another. In short, instead of some 'mean' theoretical 'flight' on the ground it is necessary to act in a real way, which cannot be simulated, and in such a way that the adjustment of the crew to the ship will be rapid and without complications."

As is well known, the "Soyuz-23" is continuing scientific and technical experiments jointly with the "Salyut-5" orbital station, which is now operating in an automatic regime. Accordingly, there is a need for properly tying in the orbits of the ship and station. The "Soyuz-23" must carry out appropriate maneuvers for this purpose. But here much is dependent on the accuracy with which the ship is put into orbit and on the execution of the maneuver by the crew. Even the first revolution around the planet revealed that the flight path of the "Soyuz-23" was plotted with an enviable accuracy. Now it was up to the crew. How did V. Zudov and V. Rozhdestvenskiy make the maneuver? Everything was done by them so well that specialists feel that there will be no need to fire the engines a second time. In addition, the reproachless actions of the crew made it possible to create an additional time reserve for rest, which is especially important after such a long first day.

"The ship shows its 'character' and man shows his. And I must say that the characters of the commander and ship's engineer of the 'Soyuz-23' please us all," continues Vladimir Aleksandrovich. "Already for more than ten years I have known Zudov and Rozhdestvenskiy and I can say: the cosmonauts regard them with great respect and appreciate their modesty, combined with deep knowledge, enormous love of work, deep interest in the results of work and dedication. They carefully prepared for their 'journey to the stars' and met it extremely well prepared."

When we had finished the conversation the "Rodonov" call letters were again heard at the control center. Work in orbit continued.
[58]

DISCUSSION OF "SOYUZ-22" PHOTO EXPERIMENTS

Moscow IZVESTIYA in Russian 17 Sep 76 p 2

[Article by B. Konovalov: "Space 'Rainbow'"]

[Summary] In order for the dry and hot climate of Baykonur not to exert an influence on the quality of the photographs taken from space, the magazines are kept almost to the very launching in refrigerators. Each of these magazines weighs more than 13 kg: they not only hold a great supply of film, but also mechanisms for moving it. At the Space Research Institute the last tests of the camera were made in a high, light-filled hall which on the inside was clad with a silvery metal. The camera has six "pupils" [objectives] in a rectangular case which is divided by partitions. Each "pupil" corresponds to one of the magazines. Due to special light filters with a very narrow transmission band the film in each magazine registers a black-and-white picture as seen in its spectral range -- from the blue to the IR. As a result, the six-eyed apparatus can collect far more information than man's eye. The synchronism of the survey is maintained so precisely that all the images obtained in the six channels can be combined on the screen into a single picture. The multiprojector specially constructed for this purpose in the GDR makes it possible, from the six frames, to select any combination of four. With different combinations it is possible by use of artificial color to discriminate any necessary natural feature. On the basis of the color it is possible to distinguish a forest consisting of different species of trees and differentiate maturing grain from that which is already mature. The technical director of the project on the German side is Professor Karl Muller stated: "In the second half of 1975 at the Karl Zeiss Jena Enterprise there were approximately 500 of the most varied professionals engaged in this work...making use of the experience accumulated by the Space Research Institute USSR Academy of Sciences in surveys made aboard a flying laboratory. We were aided by many organizations, such as the Electronics Institute GDR Academy of Sciences." The deputy director of the USSR Space Research Institute, Doctor of Technical Sciences Yu. Khodarev, declared: "In essence we worked as a single team. And often, taking our leave on Friday night at Jena, we said to one another, 'well, we'll see you in Monday in Moscow'." At the plant one could view the camera, a short cylinder clad in green-colored vacuum insulation. It is part of the photo compartment. On one of the sides of this cylinder there is a large cover which fits over a window. On 15 September this window was opened for instrument checking. On 16 September Bykovskiy oriented the ship in such a way that it flew in orbit "tail first" and the window looked at the earth. The "Raduga" experiment was initiated on the 15th revolution.
[232]

REPORT ON "LUNA-24" SOIL SAMPLES

Moscow PRAVDA in Russian 10 Sep 76 p 3

[Article by Professor B. Vladimirov, "Borehole for Selenius"]

[Summary] The working cycle for the drill rig used during the "Luna-24" ground-sampling project can be divided into three principal stages: drilling and taking of the core, loading it into a container and making

the rocket ready for return. Provision is made for two drilling regimes: rotational -- through poorly consolidated ground and impact-rotational -- through solid rock. There is automatic switching from one drilling regime to the other. The control of the ground-sampling apparatus is assigned to an automatic system. Its commands result in logical operations for evaluating the drilling regime when it encounters ground of different strength and viscosity. It also ensures measurement of the work parameters of the apparatus and their transmission into the telemetric system. Although the control of operation of the ground-sampling apparatus is automated, at any time the operator, who is on the earth, can intervene. Long ground tests on the earth preceded sending of the drill rig to the moon. Complex apparatus was employed in simulating all stages in the operation: launching, flight to the moon, landing, operation on the moon, return of the sample, etc. All these stages were investigated by modeling on stands, many of which are truly unique. About 400 drillings were made, about 200 of them under conditions close to the moon. The model of lunar ground used was fragmented basalt from surface outcrops in Uzbekistan and Armenia. This material was in part pulverized and colored so as to check on whether there was assurance of an undisturbed state of the cores taken. The tests were made under conditions of simulated lunar night and day, cold and high temperatures. On 18 August 1976 the drill rig began its lunar work. At about 800 mm from the initial position the drill encountered relatively dense ground. In the first stage such indices of its strength as energy capacity and resistance to drilling were insignificant. At a depth of more than 1,200 mm the strength of the ground increased appreciably. The load on the drive of the drill rig increased and the drilling method was automatically changed, indicating that the drill had encountered monolithic ground. Then came a stable rotational regime which continued to the 1,600 mm level. Between depths of 1,600 and 2,200 mm the rotational regime alternated with a rotational-impact regime. Then the drill passed through dense layers of ground with individual inclusions of monolithic fragments and was automatically switched off at the 2,600 mm level.
[9]

"LUNA-24" REPORT ON LUNAR SOIL

Moscow PRAVDA in Russian 5 Sep 76 p 3

[Article by Yu. Zolotov, "Portrait of the Lunar Soil"]

[Summary] On 23 August a capsule with lunar ground was delivered to the Institute of Geochemistry and Analytical Chemistry. The capsule with the lunar ground, extracted from the descent module, was purified from possible contaminants and placed in a special chamber. The air was evacuated from the chamber and it was filled with helium. Then the capsule was opened, the drum with the wound-up flexible ground carrier was extracted and rewound on a flat "snail." In the course of rewinding measurements were made to de-

termine magnetic susceptability, making it possible to obtain the first ideas concerning the degree of filling of the ground carrier. A far more graphic picture was obtained a little later by the x-raying of the complex. It was found that the drill worked beautifully and that the ground carrier tube was filled. The x-ray photos made it possible to determine where the ground carrier should be cut. First inspection of the ground revealed that it was a fine powder with individual larger particles. Depending on the illumination, it appears to be brownish or dark gray. But deeper down the sample is far richer. The ground is inhomogeneous with layers which differ with respect to both color and size of particles. There are rather large pieces with a diameter of 5-6 mm and possibly larger and also very tiny and shiny particles, evidently of a vitreous nature. These vitreous particles probably appeared during the falling of meteorites on the lunar surface. This lunar ground cannot be wasted. It is too precious for science. Therefore it is necessary to have analytical methods which make it possible to operate with tens of milligrams of matter or even less. Analytical chemistry has created such methods. Moreover, specialists are using methods which do not require expenditure of the sample at all. The sample after the analysis is in the same form as before the investigation and it can be used for other studies. Ten or twenty milligrams of powder are pressed into a tiny tablet and exposed in an electron beam. This excites x-radiation in the matter and on the basis of its nature and intensity it is possible to ascertain what chemical elements are present and in what quantity. Ten or twelve elements are detected in this way, such as silicon, aluminum, magnesium, calcium, iron and titanium. The electron beam may be only a micron in diameter (x-ray microanalysis). However, in the first stage a defocused beam is used (diameter several millimeters). Then spark mass spectrometry is employed. It gives data on the content of trace elements. The method makes it possible to determine no less than 60 elements. Other investigations include: measurement of the optical characteristics of the ground, extensive mineralogical and petrological studies. Samples of this lunar material will be sent to colleagues in other countries for investigation there.
[210]

TASS ANNOUNCES LAUNCHING OF "KOSMOS-860"

Moscow PRAVDA in Russian 19 Oct 76 p 2

[TASS Report: "'Kosmos-860'"]

[Abstract] The artificial earth satellite "Kosmos-860" was launched in the Soviet Union on 17 October 1976. The satellite was inserted into an orbit with the following parameters:

[Abstract] The artificial earth satellite "Kosmos-860" was launched in the Soviet Union on 17 October 1976. The satellite was inserted into an orbit with the following parameters:

-- initial period, 89.6 minutes;
-- apogee, 278 kilometers;
-- perigee, 260 kilometers;
-- orbital inclination, 65 degrees.

TASS ANNOUNCES PLANS TO CONDUCT ROCKET LAUNCHES TO BARENTS SEA

Moscow PRAVDA in Russian 19 Oct 76 p 4

["TASS Report"]

[Text] During the period from 22 October through 5 November of this year the Soviet Union will conduct rocket launches into a region of the Barents Sea bounded by a circle with a radius of forty nautical miles with its center at the coordinates 73 degrees 00 minutes North Latitude and 35 degrees 00 minutes East Longitude.

TASS has been authorized to announce that for purposes of safety the government of the Soviet Union requests the governments of other countries using the sea and air lanes in the Barents Sea to instruct appropriate agencies so that ships and airplanes will not enter this region and the air space above it from 0500 to 2100 hours local time. [4]

REPORT FROM "SOYUZ-23" LANDING SITE

Moscow IZVESTIYA in Russian 19 Oct 76 p 2

[Article by A. Ivakhnov, "On the Soil of Turgayskaya Oblast"]

[Text] The sky over Arkalyk was very low and very dark. And the stars at a minimum were twice as bright as here over Moscow, for example. But suddenly both the sky and earth and everything around it were covered by a mist which was white as milk. For a short instant the outlines of the helicopters dissolved in this mist, became blurred, although they were not far from us, standing out in the varicolored aureoles of the airport lights.

We walked along the airfield and suddenly I saw: in the newly clearing sky (and the fog came and went in waves) one of the little stars suddenly began to increase in size, being colored a yellow-red, a blue glow arose behind it, and it became clear that it was moving rather rapidly from

southwest to northeast and the glow became ever-brighter. And now a rather long trail extended behind the star, as if a gigantic papakha with a bright red head was flying through the sky. The people in the airport building streamed out in the dozens in order to look at this beauty; these included USSR Flier-Cosmonaut A. Nikolayev, with whom we had arrived for a meeting with this "little star."

When the little star was hidden from the eyes, we went to an improvised command point and heard a communication over the loudspeakers: "The descent module is suspended on the parachute..."

And suddenly... The "Radony" transmit: "It's a sensation as if we landed on the water." At the command point there was a map and the directors of the search team calculated that according to the transmitted coordinates the descent module had landed at a distance of 130 km from Arkalyk -- in the enormous Lake Tengiz, which translated into the Russian language means "ocean." This information was confirmed from an aircraft which had been specially dispatched into the landing zone: "We are observing them visually in the water. A blue light is flaring up. The descent module is situated approximately two kilometers from the northern shore of the lake."

Now we were a little excited because the local inhabitants declared unanimously that the lake shore of Tengiz is a so-called "sor" (in the Kazakh language). In other words, it is a quagmire and the descent module can sink in it.

And now a communication: "The ship has listed greatly, the hatch is in the water. Zudov and Rozhdestvenskiy feel satisfactory, there is no need to be concerned."

Rafts with rescuers clad in special costumes were lowered into the water. But suddenly here, on the shores of Tengiz, the same fog arrived and a snowstorm developed. Visibility deteriorated to 500, then 300, 200 meters. At the command point there was already alarm for the cosmonauts and also for the rescuers, who had not reported back. Especially since the air temperature at nighttime dropped to -20°. Finally the rescuers reported by radio: they had encountered ice as thick as their palms, the ice had hummocked, with the ice masses riding up over one another, and it was difficult to get to the descent module...

A helicopter-refueler was sent to the landing site from Arkalyk, and taking advantage of the opportunity, the newspapermen flew along. The minutes went by endlessly. And suddenly one of the crew members cried out to us: "Look!"

Down below the lights of the descent module wavered amidst the waves. It was reported to us that N. Chernyavskiy, commander of one of the helicopters, had already reached it. He had attached the cable hooks through the "eyes" on the descent module and then had patiently waited until

another helicopter arrived to rescue them all. When he climbed aboard the helicopter he was completely covered with frost and looked like a snowman.

The helicopter carefully towed the descent module to the shore. And there we understood what a quagmire is, what the Kazakh word "sor" means. Beneath the snow there was liquid mud and the footprints of the people were immediately filled with a turbid saline slush. But now no one noticed this any longer.

And now Zudov and Rozhdestvenskiy were at the foot of their space "home." We, to be sure, were waiting to see what today's heroes would say. Someone surprisingly says aloud: "In Kazakhstan there are such large steppes and you have to go and land like on purpose in a lake."

"There's no other way that it could have been," responds the ship commander, "after all, my ship's engineer is the one seaman among all the cosmonauts..."

Zudov and Rozhdestvenskiy are by tradition photographed alongside the descent module. Then they are shrouded in fur covers and blankets and seated in the helicopter.

Our helicopter was delayed. When we arrived at the airport the aircraft with the cosmonauts had already departed for the cosmodrome. Our friends from the local newspaper TURGAYSKAYA NOV' stated that there was a brief meeting. In the name of all of Turgayskaya Oblast the First Secretary of the Party Obkom S. Kusainov congratulated the cosmonauts on their return to their native earth. V. Zudov and V. Rozhdestvenskiy in turn congratulated the workers of the oblast on the unprecedented harvest of this year -- 115 million poods of grain.

The "Soyuz-23" crew was handed the traditional bread and salt, diplomas and ribbons as honorary residents of the city of Arkalyk.

Some time later we arrived at the cosmodrome and heard the voice of V. Rozhdestvenskiy: "We have arrived safely and have warmed up. We feel wonderful. Tell the residents of Arkalyk that their bread is very tasty..." [67]

Abstracts of Scientific Articles

ION COMPOSITION OF NIGHTTIME F2 REGION DURING MAGNETIC STORM

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 3, 1976, pp 563-566

[Article by Yu. A. Romanovskiy and V. Yu. Gaydukov, Institute of Applied Geophysics, "Influence of Internal Gravitational Waves on Disturbance of the Ion Composition of the Nighttime F2 Region During the Period of a Magnetic Storm"]

[Abstract] This paper gives experimental data characterizing some peculiarities of disturbances of the ion composition in the nighttime F2 region during the period of a magnetic storm which can be attributed to the propagation of internal gravitational waves (IGW). For confirming the interpretation of the experimental data the authors made computations of disturbances of ion composition in the nighttime F2 region caused by the propagation of IGW. The data were obtained during mass spectrometer measurements on the "Kosmos-274" satellite during the period of the strong magnetic storm of 23-25 March 1969. The magnetic disturbance transpired during the period 0600-1300 UT and was accompanied by appreciable changes in the magnetic field at a global scale. The event was clearly characterized by a considerable ionization disturbance. This disturbance can be identified with a large-scale moving ionospheric disturbance whose appearance is ordinarily associated with the propagation of IGW in the thermosphere. The total duration of the disturbance was four or five hours (close to the duration of the magnetic storm). A graph illustrates the results of computations of disturbances of the concentrations of O^+ and O_2^+ ions during the propagation of IGW.
[43]

TRAJECTORIES OF VEHICLE WITH LIMITED-THRUST ENGINE

Moscow REFERATIVNYY ZHURNAL, 62. ISSLEDOVANIYE KOSMICHESKOGO PROSTRANSTVA, OTDEL'NYY VYPUSK in Russian No 7, 1976, 7.62.289

[Abstract of article by M. S. Konstantinov; Moscow, F. A. TSANDER I SOVREM. KOSMONAVTIKA, "Nauka," 1976, pp 148-154, "Analysis of Trajectories and Parameters of Vehicle with Limited-Thrust Engine by 'Transporting Trajectories' Method"]

[Text] This paper is devoted to the development of the 'transporting trajectories' method. The development essentially involves broadening of the class of 'transporting trajectories' as active flight trajectories with a specially selected control law. The control law makes it possible to carry out an analytical investigation of the vehicle trajectory. The great number of controlling constants makes possible a good approximation of the transporting trajectory to the optimum trajectory, which predetermines the success of linearization of the equations of motion accomplished in the transporting trajectories method. Bibliography of six items.
[29]

MANNED FLIGHT OF VEHICLE WITH LIMITED-THRUST ENGINE

Moscow REFERATIVNYY ZHURNAL, 62. ISSLEDOVANIYE KOSMICHESKOGO PROSTRANSTVA, OTDEL'NYY VYPUSK in Russian No 7, 1976, 7.62.290

[Abstract of article by Yu. A. Zakharov and M. S. Konstantinov; Moscow, F. A. TSANDER I SOVREM. KOSMONAVTIKA, "Nauka," 1976, pp 166-173, "Optimization of a System for Closed Manned Flight of a Vehicle with a Limited Thrust Engine"]

[Text] This paper deals with the problem of optimum designing of a space vehicle with a limited-thrust engine. For the purpose of creating artificial gravity aboard the spacecraft the latter is imparted a characteristic rotation about its center of mass. The authors propose a new formulation of the main problem of mechanics of space flight with a low thrust -- the problem of finding the conditions for delivery of the maximum pay load, making it possible to take into account the rotation of the vehicle and to accomplish its separation into "weight" and dynamic parts. A method is given for solving the problem of optimum planning and designing of spacecraft with low thrust making a closed interplanetary flight. An earth-Mars-Earth flight is examined as an example. Bibliography of nine items.
[29]

EVALUATING EFFECTIVENESS OF SOLAR SAIL

Moscow REFERATIVNYY ZHURNAL, 62. ISSLEDOVANIYE KOSMICHESKOGO PROSTRANSTVA, OTDEL'NYY VYPUSK in Russian No 7, 1976, 7.62.292

[Abstract of article by I. A. Merkulov and I. A. Khoromskiy; Moscow, F. A. TSANDER I SOVREM. KOSMONAVTIKA, "Nauka," 1976, pp 100-105, "Influence of Screen Parameters on Efficiency of a Solar Sail"]

[Text] A study was made of the influence of solar screens of different types on the relative weight evaluation of a solar sail and an ion engine supplied current by a solar cell. It was possible to establish the region of these parameters where the solar sail has an advantage over an ion engine. The graphs included in the study make it possible, on the basis of the known values of the solar sail parameters and the solar cell, to determine the duration of functioning of the engines in which the advantage in weight respects shifts from the ion engine to the solar sail. Bibliography of eight items.
[29]

OPTIMUM CONTROL OF ROTATION OF SPACECRAFT

Moscow REFERATIVNYY ZHURNAL, 62. ISSLEDOVANIYE KOSMICHESKOGO PROSTRANSTVA, OTDEL'NYY VYPUSK in Russian No 7, 1976, 7.62.294

[Abstract of article by K. G. Grigor'yev, A. M. Nikulin and Yu. B. Popov; Moscow, F. A. TSANDER I SOVREM. KOSMONAVTIKA, "Nauka," 1976, pp 162-165, "'Moving Regimes' of the Second Kind in Problems of Optimum Control of Rotation of a Spacecraft"]

[Text] Many of the optimum regimes obtained in the problems of orienting a spacecraft, from the point of view of the L. S. Pontryagin principle, are singular "cyclic moving regimes (moving regimes of the second kind)" and in the process of solution of the problem can be easily omitted. The presence in the solutions of these variational problems of sectors of "moving" or "slippage" is their fundamental peculiarity. Therefore, the investigation of this sort of problem is of definite interest. This paper examines moving regimes of the second kind arising during stabilization of a spacecraft of the Skylab type. Bibliography of five items.
[29]

PERTURBATIONS OF SECOND ZONAL HARMONIC OF GRAVITY FIELD

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, GEODEZIYA I AEROFOTOS"YEMKA in Russian No 3, 1976, pp 43-47

[Article by A. M. Portnov, Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers, "Problems in the Computer Output of Second-Order Perturbations of the Second Zonal Harmonic of the Gravity Field"]

[Abstract] Increases in the accuracy of satellite observations and the appearance of precise rangefinders, such as lasers, makes necessary a more precise allowance for the factors exerting an influence on the position of artificial earth satellites in solving problems in space geodesy. Second-order perturbations of the harmonics of the earth's gravity field are among these factors. Determination of these perturbations involves much analytical calculation which can be done only on an electronic computer. This paper is a contribution to the formulation of a system of programs making it possible to derive unwieldy analytical expressions and obtain their numerical values. The basic principles for constructing analytical expressions for this purpose on an electronic computer were given by V. I. Lapshina in BYULLETEN' ITA, Vol XIII, No 2(145), 1972; that was the point of departure for this author's work. Specifically, the material presented here makes it possible to solve the problem of second-order perturbations of the second zonal harmonic of the earth's gravity field.
[45]

LASER SOUNDING IN THE CENTRAL ARCTIC

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 4, 1976, pp 819-821

[Article by G. F. Tulinov, Yu. P. Dudoladov, M. V. Obraztsov, M. L. Shanen and Zh. Mezhi, Institute of Applied Geophysics and Aeronomy Service, France, "Laser Sounding of the Upper Atmosphere in the Central Arctic"]

[Abstract] In January 1975 on Kheys Island (80°37'N) specialists for the first time carried out an experiment with laser sounding of the upper atmosphere in the polar region. The purpose of this work, carried out under the program of Soviet-French cooperation in the field of space meteorology and aeronomy, was measurement of the concentration and vertical distribution of natural sodium in the Arctic mesosphere during the polar night. The atmosphere was probed using an organic laser operating on a solution of rhodamine in methanol. The laser had the following characteristics: pulse radiation energy 0.5 J; pulse duration 3μsec; radiation wavelength 5890 A; width of an emission line 0.15 A; pulse repetition rate 1-0.25 Hz. A preliminary analysis of the information, registered in analog form, indicates the presence of temporal variations in the profile of sodium distribution in the atmosphere. It is possible that these variations were caused by wave or dynamic processes transpiring in the polar region upper atmosphere. Computations of the absolute concentrations of atmospheric sodium were made by normalization of the experimental data to the signal reflected from an altitude of 30-35 km, where the atmosphere is considered purely molecular. The profile of the vertical distribution of the concentration of natural sodium in the polar region upper atmosphere obtained on 5 January at 0.25 Hz with an altitude interval of 1.2 km is shown in Fig. 2. Comparison of this profile with the results of a sounding carried out in the middle

latitudes shows that the nature of the vertical distribution and the absolute concentration of natural sodium in the polar latitudes are approximately similar to the distribution and content of sodium in the middle latitudes.
[60]

DISTRIBUTION OF ION CONCENTRATION IN IONOSPHERE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 5, 1976, pp 1062-1065

[Article by I. B. Balev, A. A. Gol'din, Ye. G. Grinval'd, V. A. Pavlenko, A. I. Savin, M. K. Serov and V. L. Tal'roze, Corresponding Member USSR Academy of Sciences, "Global Investigation of the Distribution of Concentration of Ions in the Ionosphere"]

[Abstract] A global investigation of the distribution of the concentration of ions in the ionosphere was carried out using the "Kosmos-469" satellite. Processing of the data received during nine days of flight gave a series of $26 \cdot 10^3$ instantaneous values for ion concentration along the satellite orbit at an altitude of 270 km (somewhat below the altitude of the maximum of concentration in the F layer). The results made it possible to plot on a map of the earth the distribution of the concentration of ions on the basis of measurements on the descending and ascending branches of the satellite orbit; this corresponds to the daytime and nighttime (LT) in the subsatellite region of the earth. The map of the daytime distribution agrees with known experimental data and theoretical concepts. It is characterized by an almost symmetric (relative to the equator) approximately uniform field of concentration in the range from $3 \cdot 10^4$ to 10^6 cm^{-3}. The regions of increased concentration in the neighborhood of the equator confirm the existence of equatorial anomalies. The map of the distribution of concentrations for nighttime (LT) shows that the ion concentration falls in a considerably broader range -- from $5 \cdot 10^{-1}$ to $7 \cdot 10^5$ cm^{-3}, whereas the distribution relative to the earth's surface has a sharply nonuniform character. Together with zones of equal concentration, extending along the equator (equatorial anomaly), in the latitude range ±50° over definite sectors of the earth's surface one can see local zones of considerably reduced (by 1-2 orders of magnitude) concentrations of ions relative to the level of concentrations in adjacent regions of the ionosphere. The existence of "geographically constant" local zones of substantially reduced concentration of ions means the presence of earlier unknown local sources of ionization and recombination, not changing their terrestrial coordinates, or stable currents in the ionosphere.
[61]

BISTATIC RADAR OBSERVATIONS OF VENUSIAN SURFACE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 5, 1976, pp 1059-1061

[Article by A. G. Pavel'yev, M. A. Kolosov, O. I. Yakovlev, A. I. Kucheryavenkov, S. S. Matyugov, V. I. Kayevitsev and I. E. Kalashnikov, "Experience in Bistatic Radar Observations of the Venusian Surface Using the 'Venera-10' Satellite"]

[Abstract] The "Venera-9" and "Venera-10" satellites made it possible to carry out a new investigation of the planetary surface by the bistatic radar method. The transmitter and receiver were spatially separated: the transmitter was on the satellite and the receiver was on the earth. Due to the lesser distance to the planet (than from the earth) it was possible to investigate finer characteristics of the planetary surface. In bistatic radar observations it is possible to observe surface sectors which are near the limbs of the visible disk of the planet. The observations were made in October-December 1975. The radio waves were in the 32-cm range in two regimes. In the first, with turning of the satellite's parabolic antenna by a fixed angle in the direction to the surface of the planet, in the second, at the time of setting of the vehicle behind the planet or at the time of its emergence from the radio shadow when the maximum of the directional diagram is oriented on the earth. The paper discusses specific cases of investigation of different regions of the planet -- a region with a width of 80 km and a length of 800 km and a region of the same width but with a length of 1,200 km. The distance between these regions was approximately 400 km. Figure 2 in the text shows the elevations and mean square slopes of surface irregularities in the first region, whereas Fig. 3 shows corresponding data for the second region. The findings are discussed. [61]

VI. MISCELLANEOUS

Abstracts of Scientific Articles

ICE CORE DATA FROM ANTARCTICA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 3, 1976, pp 656-659

[Article by N. I. Barkov, F. G. Gordiyenko, Ye. S. Korotkevich and V. M. Kotlyakov, "Isotopic Investigations of an Ice Core from Vostok Station (Antarctica) to a Depth of 950 m"]

[Abstract] The article gives the results of investigations of ice samples obtained in the form of a core with a diameter of 12 cm in a borehole drilled in 1972-1973 at Vostok station in Antarctica to a depth of 950 m. The measurements were made in 1972 and 1975 at Moscow University and in the Glaciology Division of the Geography Institute USSR Academy of Sciences. Mass spectrometers were used in determining O^{18} variations in samples which were delivered in frozen form to the laboratory and subjected to thawing at room temperature directly before the analysis. It was found that the isotopic profile [which is reproduced in the text] is formed virtually exclusively under the influence of the climatic factor and thus gives evidence of climatic coolings or warmings in pure form, uncomplicated by the influence of ice cover depth. The isotopic profile was constructed using data from 252 ice samples. The profile covers a period of 46,500 years. The climatic optimum of the Holocene in Central Antarctica occurred in the period 7,500-4,000 B.C. This agrees well with data for Greenland. This means that the principal temperature changes in the polar regions of the two hemispheres transpired synchronously during the last 50,000 years. [43]

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