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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS

GEOPHYSICS, ASTRONOMY AND SPACE

No. 409

This serial publication contains abstracts of articles and news items 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

Abstracts of Scientific Articles

MOLECULAR HYDROGEN IN ATMOSPHERES OF JUPITER AND SATURN

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 3, No 9, 1977 pp 420-423

[Article by V. G. Teyfel', Astrophysical Institute Academy of Sciences Kazakh SSR, "Content of Molecular Hydrogen in the Atmospheres of Jupiter and Saturn"]

[Abstract] The interpretation of data on the equivalent width of the quadrupole line S(1) (4-0) of molecular hydrogen in the spectra of Jupiter and Saturn within the framework of a two-layer model of formation of lines with a Doppler profile leads to a H_2 content in the atmosphere above the clouds of 8.5±1.1 km-amagat for Jupiter and 20±7 km-amagat for Saturn. It is shown that by using data on the CH_4 content it is possible to find the relative concentration of methane which with respect to the number of molecules is found to be (relative to hydrogen) equal to $\sim 3.1 \cdot 10^{-3}$ for Jupiter and $3.2 \pm 1.2 \cdot 10^{-3}$ for Saturn. Neglecting other small hydrocarbon components (acetylene, ethane), it is also found that the H/C ratio for Jupiter is about 650 and for Saturn is 725±275. This indicates at least a 2 or 3^x relative excess of carbon in the atmosphere of both planets in comparison with the cosmic levels ($H/C \approx 2500$) and solar content ($H/C \approx 1900$).
[55]

REVIEW OF STUDIES OF SOLAR RADIOEMISSION AND PROTON FORECASTS

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR in Russian No 8, 1977 pp 23-33

[Article by N. P. Tsimakhovich, Radioastrophysical Observatory Academy of Sciences Latvian SSR, "Solar Radioemission and the Problem of Proton Forecasts"]

[Abstract] This review covers the following subjects: radio observations of the active sun and radio bursts, identification of proton flares, forecasting of proton flares, quasiperiodic fluctuations of solar radio emission, precomputation of change of radioemission fluctuations and observations of variability of solar radioemission at the radioastrophysical observatory

Academy of Sciences Latvian SSR. This observatory has an active program for the detection and investigation of quasiperiodic fluctuations (QPF) of solar radio waves in the decimeter range. Observations are made at frequencies of 780, 600 and 326 MHz. Special detectors with stable amplification have been developed for this purpose. The observations began in 1973 using a 10 m parabolic dish. Processing of the collected data indicated that in the flux of radio waves in this range there is a series of quasiperiodic variations (QPV) with periods from several to tens of minutes. The spectrum of QPV periods varies in the course of the day with the gradual appearance and subsequent attenuation of individual components. There is a highly variable relationship between QPV of different wavelengths, where identical periods are traced only in 1/3 of all the cases. The results indicate a nonuniformity of the parameters of solar plasma at the levels of generation of the above-mentioned frequencies corresponding to the lower solar corona. A theoretical investigation of the propagation of Alfvén waves in the solar atmosphere revealed that at the altitudes of the lower corona the phase velocity of magnetic field disturbances can be very great. Measurement of the phase shifts of plasma fluctuations at different levels of the solar atmosphere, that is, a more detailed analysis of changes in the spectra of QPV at spaced frequencies, can give considerable information for determining the type of waves propagating there. The high degree of variability of the QPV indicates a possibility of using them as a source of information on changes in the physical and geometric properties of centers of activity.
[63]

II. METEOROLOGY

Abstracts of Scientific Articles

INVESTIGATION OF PERIPHERAL REGION OF CUMULONIMBUS CLOUDS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 236, No 3, 1977 pp 568-570

[Article by V. M. Zakharov, A. I. German, A. P. Tikhonov and A. Ye. Tyabotov, Central Aerological Observatory, "Characteristics of Macrostructure of Peripheral Region of Cumulonimbus Clouds in Prethunderstorm and Thunderstorm States"]

[Abstract] The article discusses an effect discovered in the peripheral region of a thunderstorm cloud by means of the laser sounding method. It involves the presence of a precloud layer for which the scattering coefficient σ is an order of magnitude less than for the cloud itself. The degree of polarization P for a cloud on the average is 1.4 times less than for the precloud layer. This layer is separated from the cloud by another layer with a scattering coefficient close to σ for the cloudless atmosphere. The thickness of this layer is dependent on the thunderstorm state of the cloud. If thunderstorm processes are observed in a cloud, ℓ_2 [thickness of the layer between the precloud layer and the cloud] is several tens of meters. For ordinary clouds $\ell_2 = 0$. Accordingly, the discovered effect makes it possible, using laser sounding, to detect thunderstorm-dangerous clouds, that is, predict a thunderstorm.
[64]

COAGULATION GROWTH OF HAILSTONE NUCLEI

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 87, No 1, 1977 pp 73-76

[Article by G. A. Nadibaidze and N. A. Begalishvili, Transcaucasian Scientific Research Hydrometeorological Institute, "On the Kinetics of Coagulation Growth of Hailstone Nuclei"]

[Abstract] A study of the kinetics of coagulation growth of a mass of hailstone nuclei in a medium of supercooled droplets is of considerable interest for understanding the physics of hail formation. In this article a system of nonlinear integrodifferential equations is given for describing the coagulation growth of ice and liquid particles. In earlier articles [N. A. Begalishvili, et al., SOOBSHCHENIYA AN GSSR, 80, No 2, 1975; G. A. Nadibaidze, et al., TRUDY ZakNIGMI, No 63(69), 1975] it was shown that under certain conditions precise analytical solutions of these equations can be obtained. The solutions obtained in the earlier studies and an expression derived in this paper serve as tests for checking the correctness of the proposed numerical modeling of the coagulation growth of a system of droplets and nuclei of hailstones described by the earlier derived system of equations. The modeling scheme presented here has a high accuracy; the error in liquid-water content is not more than 5% and the error in concentration is not more than 2%. A figure shows the distributions of nuclei of hailstones by sizes in the case of their growth in large- and small-drop media. The comparison shows that with an increase of large droplets in the medium larger hail particles appear in the medium than in the case of growth of small droplets in the medium.
[66]

COMPUTING COEFFICIENT OF HEAT EXCHANGE BETWEEN SEA SURFACE AND ATMOSPHERE

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 87, No 1, 1977 pp 77-80

[Article by D. K. Mikautadze, Tbilisi State University, "Computation of the Coefficient of Heat Exchange Between the Surface of the Black Sea and the Atmosphere"]

[Abstract] On the basis of radiosonde data the author computed the total energy of the troposphere using equations derived earlier. This involved computations of the increment of total energy of the troposphere for the following directions of an air mass: Odessa-Sukhumi, Odessa-Stambul, Odessa-Tuapse, Konstantsa-Tuapse, Stambul-Sukhumi, etc. Computations of the heat exchange coefficient were made using the formula

$$K_1 = \Delta E/t, \qquad (1)$$

where ΔE is the difference in total air energy in cal/cm^2 between the points of air mass passage; t is the time of passage of an air mass between these same points in seconds. For the considered cases the author computed the mean value of the "atmosphere-sea" heat exchange coefficient by months. It was found that the mean heat exchange coefficient varied from +0.002 to ±0.007 cal^1/cm^{-2} sec^{-1}. The data show that in December and January, and also in summer, regardless of the temperature regime, the surface of the Black Sea imparts heat to the intruding air mass. In the

other, transitional months the heat exchange coefficient is dependent on the intruding air masses. An increase in the total energy of the air mass occurs for the most part due to evaporation from the sea surface and enrichment of the air with water vapor when there is a small temperature decrease. This phenomenon also determines the modifying nature of the influence of the Black Sea on the climate of Western Georgia and Krasnodarskiy Kray. It is shown that it is possible to compute the value and sign of the heat exchange coefficient between the sea and atmosphere per unit time from a unit surface. For this purpose ΔQ must be divided by the area S of the polygon for which it was computed and by the time t during which computations were made using the formula

$$K_2 = \Delta Q/St. \qquad (2)$$

According to computations, the value of the heat exchange coefficient K_2 varies in the range from -0.007 to +0.007 $cal^1/cm^{-2}\ sec^{-1}$. The values of the heat exchange coefficient, determined using formulas (1) and (2), agree well; the difference between them is insignificant. The cited data confirm the possibility of using formulas of the types (1) and (2) for computing turbulent heat fluxes over the sea when using averaged initial data. [66]

III. OCEANOGRAPHY

Abstracts of Scientific Articles

DISTRIBUTION OF HELIUM CONCENTRATION IN ARCTIC OCEAN

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 236, No 3, 1977 pp 565-567

[Article by Corresponding Member USSR Academy of Sciences Yu. P. Bulashevich and N. P. Kartashov, Geophysics Institute, Ural Scientific Center, "Distribution of the Helium Concentration in the Arctic Ocean"]

[Abstract] A study was made of the vertical distribution of helium in the waters of the Arctic Ocean at a point with the coordinates 85°N, 240°E on Alpha Rise and the density of the helium flux was determined. Water samples were taken with a fully metal vacuum sampler lowered to the stipulated depth from the surface of the pack ice with a thickness of about 3 m. A determination of the helium content in the samples was made at the Geophysics Institute using a mass spectrometer with a chromatographic attachment. The gas factor, that is, the total quantity of dissolved gas, was also determined. The error in measuring the helium concentration was in the range $\pm 0.02 \cdot 10^{-5}$ ml/liter. It was found that the helium concentration has a maximum at a depth of 50 m, a diffuse minimum at approximately 1,400 m and increases sharply near the bottom. The tabulated and corrected measurements make it possible to draw the preliminary conclusion that there is an approximate equality of the densities of the helium fluxes for the continental and oceanic crusts. In this respect the helium fluxes are similar to the heat flow.
[64]

SEMIMONTHLY INEQUALITY OF INTERNAL WAVES OF TIDAL PERIOD

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 236, No 3, 1977 pp 733-735

[Article by Yu. A. Ivanov and Ye. G. Morozov, Institute of Oceanology, "On the Semimonthly Inequality of Internal Waves of Tidal Origin"]

[Abstract] Numerous measurements of currents and temperatures carried out at buoy stations in the ocean show that on all the spectra of oscillations of hydrological characteristics there is a clearly expressed burst in the

neighborhood of a 12-hour period. These oscillations are the result of barotropic and baroclinic tidal waves. The tide-generating forces of the moon and sun excite a barotropic tide in the ocean. This paper presents the results of an investigation of the semimonthly inequalities of internal semidiurnal waves on the basis of measurements of water temperature in the Atlantic Hydrophysical Polygon. Variations of temperature, in contrast to fluctuations of current velocity, are virtually completely determined by internal gravitational waves. The analysis was based on all measurements of temperature at the 200-m horizon (102 measurements at 17 points). The principal shortcoming of the measurements is that the longest series of data obtainable were 25 days. During the registry period (about 25 days) there were 1-2 amplitude maxima and minima. The amplitude of the oscillations can vary by a factor of 5-6. However, such a clear semimonthly variability is not always observed. The spectra show a clearly expressed energy-carrying peak in the neighborhood of a 14-day period. An analysis of the measurement data makes it possible to conclude that the semimonthly inequalities are a characteristic property of the semidiurnal internal gravitational waves.
[64]

IV. TERRESTRIAL GEOPHYSICS

News

SUPERDEEP DRILLING IN AZERBAYDZHAN AND ON KOLA PENINSULA DESCRIBED

Moscow PRAVDA in Russian 21 Oct 77 p 6

[Article by V. Danilov: "To the Depths of the Planet"]

[Text] A superpowerful drill rig which is operating on the Kola Peninsula has driven a borehole to a depth of 8,000 m. This work has been done by the workers of the "Uralmash" Production Combine. And it has been reported from Azerbaydzhan that a second apparatus created at the combine is operating continuously.

The apparatus designed for the drilling of boreholes to a depth of 15 km can be called explorers of the earth's deep layers. The towers of each of these rigs, at their base occupying an area of hundreds of square meters, rise to the height of a skyscraper. The power of the principal generators is about 10,000 KW. Mud is fed by four pumping stations which are capable of driving entire rivers into motion. In an ample building similar to the structure of a large workshop there are individualized workshops, living quarters and a dining hall. As befitting a modern enterprise there is a high level of automation and mechanization of productive processes. Therefore, the number of personnel required for the deep explorer is small -- about 60 persons.

The "Uralmash" workers keep a close eye on the successes of geological workers at two points in the Soviet Union which are at a great distance from one another. The expeditions are receiving constant assistance from the enterprises and are supplied spare parts for mechanisms.

"Studies are continuing of the operation of these mechanisms under different conditions, both there where they must overcome the resistance of crystalline formations of special hardness and in a region of relatively soft sedimentary rocks," says V. Gramolin, section chief of the chief designer's office of "Uralmash." "Plans call for obtaining highly valuable material necessary for the planning of new apparatus whose construction is to meet the needs of geologists."
[59]

SUPERDEEP DRILLING IN AZERBAYDZHAN SSR CONTINUED

Moscow IZVESTIYA in Russian 19 Oct 77 p 4

[Article by Z. Kadymbekov: "Towards the Secrets of the Earth's Mantle"]

[Text] An unusual experiment began in the steppe near the rayon center Saatly on one steaming June day. The bit of a powerful and unique drill rig, the "Uralmash-15 000," easily penetrated into the ground and after overcoming the first meters headed into the deep layers of the earth. The planned objective, the final target of the drillers, was at a depth of 15 km.

IZVESTIYA reported to its readers about the start and the objectives of the Azerbaydzhan superdeep drilling expedition. We recall that this scientific-technical experiment will assist scientists in a better understanding of the structure of the earth's crust, will help in exposing the secrets of formation of deep deposits of minerals, and will help in clarifying the laws of their formation. At the same time specialists are testing unique Soviet-produced equipment created in Sverdlovsk at the "Uralmash" plant.

What figures are now on the scale registering the depth of penetration?

"Since the moment of the start," says the chief engineer of the expedition N. Efendiyev, "we have gone more than 2,700 m. The rate is normal. After lowering of the first technical column the core is extracted and each 250 m geophysical investigations are carried out."

The deeper the drilling tool is lowered into the deep layers by the drillers, the more diversified and complex becomes the search by the scientists. In particular, they are interested in rock samples from still unattained strata in the earth.

The drilling master on duty keeps an eye on the drill rig by means of a television screen. It is not mandatory that he be on the work platform. A glance at the instruments is sufficient.

The raising and lowering of the tool to the face are the most time-consuming operations in drilling but the level of automation and mechanization at the Saatly superdeep hole makes it possible to accomplish these operations without any special efforts. Now that the starting period has passed it is possible to observe the smoothness and effectiveness of interaction of different links in the complex organism of this tower, which has the height of a 20-story building. Manipulations by levers, pressing of a button, and the raising-lowering mechanism is activated. The "mechanical arms" carefully raise the giant pipe columns and unscrew the pipes. The routine samples of the dark gray core are sent for laboratory investigation.

In honor of the anniversary of the Great October Revolution the drillers have promised to drill 1,000 meters above and beyond the plan.
[58]

Abstracts of Scientific Articles

SOLUTION OF DYNAMIC PROBLEMS IN SEISMICS OF HORIZONTALLY STRATIFIED MEDIA

Kiev GEOFIZICHESKIY SBORNIK AN UkrSSR in Russian No 76, 1977 pp 3-11

[Article by Ye. K. Lossovskiy and L. I. Osinovskaya, Geophysical Institute Ukrainian Academy of Sciences, "Possibility of Solution of Dynamic Problems of Seismics of Horizontally Stratified Media Without Allowance for Multiple Reflections (Numerical Experiment) II]

[Abstract] This is the second part of the article; the first part was published in GEOFIZICHESKIY SBORNIK, No 69, 1975. It is shown here that for a plane-parallel multilayer medium with a random acoustic structure the following important assertion is correct:

$$\left(n < \frac{\sqrt{\frac{\pi}{2}}}{\sigma + |m|\sqrt{\frac{\pi}{2}}} \right) \supset \left(\left| \frac{A_{\text{mult sum}}}{A_{\text{single}}} \right| \leqslant 0.1 \right),$$

indicating the possibility of solution of a number of direct and inverse dynamic problems in the seismics of multilayered media without taking multiple reflections into account. This conclusion was drawn using a model of a layered medium stipulated statistically. The latter means that the results of this study go beyond the framework of a horizontally uniform medium and within the limits of a stipulated dispersion σ^2 of the elastic properties are also correct for layered media inhomogeneous in a horizontal direction.
[68]

SOLUTION OF PROBLEM OF SEPARATION OF TWO INTERFERING WAVES

Kiev GEOFIZICHESKIY SBORNIK UkrSSR in Russian No 76, 1977 pp 12-22

[Article by V. A. Dyadyura and O. I. Sokolovskiy, "Ukrgeofizrazvedka," "Solution of the Problem of the Separation of Two Interfering Waves"]

[Abstract] The article examines an iteration method for determining the useful wave on the basis of the totality of the sections of the wave field, representing the sum of two waves with differing arrival fronts. The iteration procedure is carried out on the basis of the principles of the subtraction method. The authors demonstrate the convergence of the computation process. It is shown that the iteration process can be represented in the form of multichannel filtering. The article gives an analysis of the errors arising as a result of superposing on the wave field of interference and the errors in a priori information on the time of wave arrival. A numerical method is described for analyzing the properties of multichannel filtering systems.
[68]

SYNTHESIS OF INTERFERENCE SYSTEMS FOR SEPARATING SIGNALS IN SEISMIC RECORDS

Kiev GEOFIZICHESKIY SBORNIK AN UkrSSR in Russian No 76, 1977 pp 23-35

[Article by A. N. Gerasimenko, Ivano-Frankovskiy Institute of Petroleum and Gas, "The Problem of Spectral Synthesis of Interference Systems for Separating Signals in Seismic Records"]

[Abstract] The author formulates the problem of synthesis of the frequency characteristics of some system used in the joint separation of interfering signals in a seismic record. In the example of a second-order system the article gives a detailed analysis of its principle of operation. For systems of an arbitrary order it was possible to obtain the sought-for frequency characteristics in the form of amplitude and phase relationships. The method for solving the problem of the joint separation of signals involves an inversion of the matrix of the Fourier transform of a mathematical model of the seismic record. The mathematical model is a system of linear-operator equations. The seismic waves are assumed to be plane and their apparent velocities fall in the range $V^*_{min} < V^* < V^*_{max}$.
[68]

SPECTRAL-SPATIAL ANALYSIS OF GEOMAGNETIC FIELD

Kiev GEOFIZICHESKIY SBORNIK AN UkrSSR in Russian No 76, 1977 pp 36-45

[Article by A. A. Petrova, Leningrad Division, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, "Method for Spectral-Spatial Analysis of the Geomagnetic Field"]

[Abstract] This paper is devoted to an investigation of the geomagnetic field by the spectral-spatial analysis method. A spectral-spatial representation quite fully reflects the morphology and principal characteristics

of the field, change in the spectrum along the profile. This makes it possible to evaluate the limits of uniform sectors of the field and define the boundaries of structures of different orders, as well as the general characteristics of regions different in geological structure. The spectral-spatial analysis makes it possible to determine the optimum parameters of filtering of the geomagnetic field and carry out checking of the change in field structure in different transformations. Comparison of the results of spectral-spatial analysis with the results of other geophysical methods, especially with data from deep seismic sounding, makes it possible to refine our ideas concerning the deep structure of the earth's crust.
[68]

APPROXIMATION OF CONTOUR OF GRAVITATING MASSES

Kiev GEOFIZICHESKIY SBORNIK AN UkrSSR in Russian No 77, 1977 pp 50-57

[Article by P. I. Balk and T. V. Balk, Irkutsk University, "On the Construction of the Initial Approximation of the Contour of Gravitating Masses Using Their Harmonic Moments"]

[Abstract] On the basis of the harmonic moments of gravitating masses it was possible to solve the inverse problem of gravimetry in three model classes of field sources which are of interest for practical work. Also considered is classes of individual three-parameter bodies of revolution convenient for the approximation of spheroids, round cylinders and isosymmetric bodies. An analytical solution was obtained for the inverse problem for a structure consisting of two spheres arbitrarily arranged in space. The inverse problem is solved for a system of two horizontal cylinders of finite strike. The used first harmonic moments with a satisfactory degree of accuracy were determined by the approximation method. The proposed algorithms can be used finding the initial approximation of anomaly-forming masses.
[67]

SYSTEM FOR INVERSE FILTERING IN SEISMIC PROSPECTING

Kiev GEOFIZICHESKIY SBORNIK AN UkrSSR in Russian No 77, 1977 pp 67-71

[Article by A. S. Ganzenko, A. N. Gerasimenko and M. G. Lizanets, Geophysical Institute Ukrainian Academy of Sciences and Ivano-Frankovskiy Institute of Petroleum and Gas, "Generalization of the Inverse Filtering Method for Spatial-Temporal Systems in the Reflected Waves Method of Seismic Prospecting"]

[Abstract] The fundamental principles of inverse filtering in seismic prospecting were formulated for a class of time functions. At the same time, an analysis of some transforms of seismic records, based on their summing,

used in seismic prospecting, indicates the possibility of the existence of inverse filters of space-time functions. The authors formulate the problem of inverse space-time and strictly spatial filtering of seismic signals. Applicable to a model of a seismic record, determined in the form of a set of plane two-dimensional seismic waves, the article gives relationships determining the problem of inverse space-time filtering as a problem in the solution of the corresponding convolutional integral equations.
[67]

METHOD FOR ESTIMATING FOCAL DEPTHS OF NEAR EARTHQUAKES

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 8, 1977 pp 125-129

[Article by M. I. Kruglyakov, Institute of the Earth's Crust, Novosibirsk, "Possibility of Estimates of the Focal Depths of Near Earthquakes in the Baykal Area Using Waves of the pP, sP Types"]

[Abstract] In order to estimate focal depths on the basis of formulas which are easily derived from geometrical considerations the author shows that it is possible to compute the theoretical differences of the travel times pP-P, sP-P as a function of focal depth. The assumption is made that the head waves registered in the first arrivals at distances of about 250-300 km are propagated along the Mohorovicic discontinuity. The tabulated data show that the differences in travel times are rather slightly dependent on the velocity parameters and thickness of the earth's crust. With an accuracy in reading the difference sP-P = ±1.0 sec the error in determining focal depth from an individual observation is $\Delta h = \pm 3$ km; with an error pP-P = ±1.0 sec $\Delta h = \pm 5$ km. The possible errors can be decreased when the depth estimates are made on the basis of observations of different waves at a number of stations.
[54]

CHARACTERISTIC CURVES FOR ARTIFICIAL FIELD METHOD

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 8, 1977 pp 109-117

[Article by B. I. Rabinovich, Siberian Scientific Research Institute of Geology, Geophysics and Mineral Raw Materials, "Two-Layer Sounding Curves Obtained by the Artificial Field Method Using Horizontal Magnetic Field Components in the Near Zone"]

[Abstract] The development of the method of sounding with artificial formation of a field in the near zone at present involves a study of the vertical component of the magnetic field. This greatly limits the possibilities

of the prospecting method in inhomogeneous media. However, a number of organizations have now developed sensors for registering the horizontal components of the magnetic field and their derivatives. Specialists at the Siberian Scientific Research Institute of Geology, Geophysics and Mineral Raw Materials and the Institute of Geology and Geophysics have computed sounding curves for a two-layer horizontal cross section with galvanic and induction types of field excitation. The cases of a homogeneous half-space and a two-layer medium with an insulating and conducting base are considered. The author analyzes the horizontal magnetic components and their derivatives, together with a description of the specific resistivity curves. Methods for determining the cross section parameters from these curves are described.
[54]

HYDROGEODYNAMIC PRECURSORS OF SOUTH KURILE EARTHQUAKES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 236, No 1, 1977 pp 50-53

[Article by Academician M. A. Sadovskiy, F. I. Monakhov and A. N. Semenov, Sakhalin Multidiscipline Scientific Research Institute and Far Eastern Scientific Center, "Hydrogeodynamic Precursors of South Kurile Earthquakes"]

[Abstract] For a more complete study of the hydrogeodynamic effects associated with earthquakes the authors carried out systematic observations of the ground water regime. In particular, such observations have been carried out since November 1976 on Kunashir Island in the Kuriles. There is a system of hydrogeological boreholes on the island. Three of these, located at distances of 2.5-3 km from the Pacific Ocean coast, were selected for carrying out observations of water level variations. Borehole depths were 550, 410 and 510 m. Analysis of the water level graphs and seismic activity graphs revealed that all the registered level variations, having the character of a slow dropoff with subsequent stabilization and a sharp rise, correlate well with earthquakes of a definite class. It was established that the levels begin to react to the preparation of earthquakes whose energy class K is above some minimum value K_{min} for a given epicentral distance. The hydrogeodynamic precursors (drop in water level in the boreholes) can be discovered during the preparation of close earthquakes of an energy class not less than 9.5. When the measurements are made daily or continuously, several days before earthquakes there was a decrease in water level in all the boreholes. On the eve of earthquakes the drop in level stopped. Earthquakes occurred either at the time of the lowest levels or at the beginning of a rise. A sharp rise in level after earthquakes was always observed except in those cases when one earthquake was followed by another, as a result of which there was a superposing of the rise and fall of levels from two earthquakes close in time. This change in water levels is a hydrogeodynamic reflection of physicomechanical processes occurring at earthquake foci both during the period of preparation for a tremor and after it. These data are useful in predicting earthquakes and in formulating a physical model of an earthquake focus.
[65]

QUANTITATIVE INTERPRETATION OF GRAVITY ANOMALIES

Kiev GEOFIZICHESKIY SBORNIK AN UkrSSR in Russian No 76, 1977 pp 70-78

[Article by A. S. Grishin, S. V. Golobokov, I. V. Dankevich and V. A. Rzhanitsyn, Geophysics Institute Ukrainian Academy of Sciences and Geology Administration Belorussian SSR, "Method and Results of a Quantitative Interpretation of Gravity Anomalies for Structural-Tectonic Constructions in the Pripyatskiy Downwarp"]

[Abstract] Computations on the basis of gravimetric data show that for the deep structure of the Pripyatskiy downwarp, as for the Dneprovsko-Donetskaya depression, an inverse negative form may be characteristic. The results of modeling "fix" a rise of the Mohorovicic discontinuity to 40 km and a simultaneous plunging of the Conrad discontinuity to 23 km approximately in the axial part of the downwarp. The mean depth of the M discontinuity is 42 km; for the C discontinuity it is 20 km. In the geodensity section of the earth's crust in the granite layer one can arbitrarily define an "intermediate" layer with a density of 2.80-2.85 g/cm^3, which is seemingly transitional from the granite to the basalt layer. As the upper boundary of the intermediate layer it is possible to use a seismic discontinuity registered within the basement when using the refracted waves method. The boundaries of the Pripyatskiy downwarp are two major faults which undoubtedly are in the mantle, along which sharp displacements of all the principal deep discontinuities in the earth's crust were "modeled." From the displacement of the model surfaces of the "transitional" and basalt layers it is possible to note a series of presumably "crustal" faults, for the most part coinciding with the faults bounding second-order structures along the surface of the crystalline basement. The investigations reported in this study made it possible to solve the following basic problems: 1. On the basis of testing of a correlation scheme, demonstrate the fundamental possibility of using it in structural-tectonic constructions under the conditions prevailing in the Pripyatskiy downwarp. 2. The possibilities of geodensity modeling were tested using an automated system for the interpretation of gravity anomalies.
[68]

DIRECT MEASUREMENT OF HEAT FLOW IN BOREHOLES

Kiev GEOFIZICHESKIY SBORNIK AN UkrSSR in Russian No 76, 1977 pp 79-81

[Article by R. I. Kutas, M. I. Bevzyuk, O. A. Gerashchenko and T. G. Grishchenko, Geophysical Institute Ukrainian Academy of Sciences and Institute of Technical Thermophysics Ukrainian Academy of Sciences, "Direct Measurement of Heat Flows from the Earth's Deep Layers in Boreholes"]

[Abstract] Special heat flow thermoelectric sensors have been developed at the Institute of Technical Thermophysics Ukrainian Academy of Sciences. On the basis of these sensors and joint work with the Geophysics Institute it was possible to develop a device for measuring heat flows in boreholes. The device, with a thickness of 6 mm and a diameter of 45 mm, is illustrated in a figure and is briefly described. The borehole device is lowered on a three-strand cable to the bottom of the borehole; a stationary regime sets in within 2.5-3.5 hours. The instrument was tested in three regions with different geological conditions and known but different heat flows: Carpathian downwarp, Ukrainian shield, Dneprovsko-Donetskaya depression. The resulting data show that in most boreholes the flows measured by these devices and computed using the geothermal gradient agree rather well. The flows measured with these devices agree better with the results of computations at great depths, where the heat field is more uniform. In the surface layer the convergence of the results deteriorates, possibly attributable to the great influence exerted on the temperature distribution by surface nonstationary processes, the dynamics of ground water and nonuniformity of the cross section. Due to the transfer of heat by moving waters there is a decrease in the geothermal gradient and accordingly a decrease in the conductive heat flow, which is computed from the gradient of temperature and thermal conductivity of the rocks. Under such conditions thermometric sensors give more stable results.
[68]

INTERACTION OF ELECTROMAGNETIC WAVES AND PLASMA OSCILLATIONS IN MAGNETOSPHERE

Kiev GEOFIZICHESKIY SBORNIK AN UkrSSR in Russian No 77, 1977 pp 77-81

[Article by V. N. Makarenko and A. K. Yukhimuk, Geophysical Institute Ukrainian Academy of Sciences, "Interaction Between Strong Electromagnetic Waves Propagating Along Lines of Force of the Geomagnetic Field and Plasma Oscillations"]

[Abstract] The authors examine the generation of oscillations in plasma with an anisotropic velocity distribution in the presence of an external electromagnetic wave propagating along the lines of force of the earth's magnetic field. It is shown that if the plasma becomes unstable under the influence of such factors as the external electromagnetic wave, anisotropy of temperatures and the cone of losses, instabilities develop in the system. These instabilities are a singular hybrid of anisotropic instabilities in the field of an electromagnetic wave. The results can be used in the interpretation of geophysical phenomena in the earth's magnetosphere.
[67]

POSITIVE BAYLIKE DISTURBANCES IN AURORAL ZONE

Kiev GEOFIZICHESKIY SBORNIK AN UkrSSR in Russian No 77, 1977 pp 82-84

[Article by V. M. Litinskiy and F. I. Sedova, L'vov Affiliate of Mathematical Physics, Mathematics Institute Ukrainian SSR, "Positive Baylike Disturbances in the Auroral Zone"]

[Abstract] A study was made of the disturbance vectors of positive bays in the auroral zone. The authors selected all positive bays registered at Kiruna Observatory during 1964 and 1971 (130 disturbances). Maps were compiled of the distribution of disturbance vectors on the basis of data from northern hemisphere observatories. It is clear that at Kiruna and observatories adjacent to it the northerly component of variations is positive. However, the direction of the disturbance vectors for the cited examples has considerable differences. Most of the considered disturbances were caused by return currents. Disturbances with a clearly expressed easterly electrojet are rather rare. At latitudes 60-67° in the eastern sector it is common to observe disturbances caused by return currents from the westerly electrojet, which can considerably complicate the discrimination of an independent easterly current. It appears that the current system of a geomagnetic bay in most cases has one westerly electrojet and only comparatively rarely does an easterly electrojet arise (observed in the near-midday and afternoon hours).
[67]

RELATIONSHIP BETWEEN SEISMIC PROCESSES AND TECTONICS IN CRIMEA

Kiev GEOFIZICHESKIY SBORNIK AN UkrSSR in Russian No 77, 1977 pp 13-23

[Article by B. G. Pustovitenko and V. N. Trostnikov, Seismology Division Geophysical Institute Ukrainian SSR, "The Problem of the Relationship Between Seismic Processes and Tectonics in the Crimea"]

[Abstract] A joint analysis of seismicity and tectonics in the Crimea indicated that in sectors with a marked change in the gradients of the latest tectonic movements ancient deep faults of longitudinal and transverse direction can be activated and release the accumulating stresses in the earth's crust in the form of earthquakes. Collected data on the mechanisms of earthquakes make it possible to reconstruct the directions of the stress axes in deep regions of the earth's crust. In three analyzed cases at the foci of earthquakes there were active dilatational forces with a nearly horizontal direction and compressive forces close to vertical. Observed trends in migration of earthquake foci along the region reflect the current activity of deep faults in the coastal part of the Black Sea. This activity evidently can be caused by a system of stresses, common for the region, associated with processes of formation of the earth's crust in the zone of the continental slope and expansion of the Black Sea depression.
[67]

REVIEW OF SOME WORK IN CARPATHIAN GEODYNAMIC POLYGON

Kiev GEOFIZICHESKIY SBORNIK AN UkrSSR in Russian No 76, 1977 pp 64-69

[Article by V. I. Somov, G. T. Sobakar', M. M. Kurbanov, M. I. Mel'nichuk and V. G. Kuznetsova, L'vov Affiliate of Mathematical Physics Institute of Mathematics Ukrainian Academy of Sciences and Geophysical Institute Ukrainian Academy of Sciences, "Status of Investigations of Secular Variations of the Gravity Field in the Carpathian Geodynamic Polygon"]

[Abstract] The territory of the Carpathian Geodynamic Polygon (a map accompanies the text) has been studied by a complex of geological-geophysical and geodetic methods. This has made it possible to obtain some idea concerning the deep structure and physical properties of matter in the earth's crust. For the investigated region it was possible to compile detailed maps of the gravity and magnetic fields, a map of recent vertical and horizontal movements of the earth's crust, a map of seismic activity and frequency of recurrence of tremors and maximum possible earthquakes. The polygon intersects International Deep Seismic Sounding Profile III, along which deep magnetotelluric and magnetovariation investigations are carried out; a network of fundamental control points was created for complex instrumental observations. There are three seismic stations. The principal objective of work in the polygon is a study of the relationship between geophysical fields and seismicity, deep structure and recent dynamics of the earth's crust. This article, in particular, describes gravimetric measurements and evaluates them. The pattern of change in secular variation of the gravity field and its close correlation with solar activity is discussed.
[68]

CRUSTAL STRUCTURE IN CRIMEA

Kiev GEOFIZICHESKIY SBORNIK AN UkrSSR in Russian No 77, 1977 pp 24-30

[Article by N. V. Sologub, Geophysical Institute Ukrainian Academy of Sciences, "Structure of the Earth's Crust in the Mountainous Crimea According to Deep Seismic Sounding Data"]

[Abstract] During 1974-1975 specialists at the Geophysical Institute Ukrainian Academy of Sciences used the deep seismic sounding method along the Sevastopol'-Kerch' profile for clarifying the deep structure of the earth's crust and upper mantle in the Crimean mountainous structure and a study of deep faults, on the basis of which it would be possible to determine blocks in the earth's crust and seismically dangerous zones in this region. This work revealed an extremely complex wave pattern, on the basis of whose peculiarities the profile can be divided into two sectors -- western and eastern; along the profile along the Mohorovicic discontinuity it is possible to distinguish three blocks: down-dropped (50.0-54.0 km -- western

and eastern, and uplifted (44.0-45.0 km) -- central, bounded by deep faults. On the basis of an analysis of the behavior of the seismic horizons and thickness of the strata between them it was possible to detect deep faults which bound individual blocks in the earth's crust along the considered profile. Four main deep faults and several secondary faults were detected. It is shown (a full-page cross section along the profile accompanies the text) that on the basis of the behavior of the Mohorovicic discontinuity and seismic discontinuities in the consolidated crust the territory of the mountainous Crimea can be divided into two independent blocks.
[67]

MULTICHANNEL SUBTRACTION FILTERS

Kiev GEOFIZICHESKIY SBORNIK AN UkrSSR in Russian No 77, 1977 pp 58-66

[Article by V. A. Dyadyura and O. I. Sokolovskiy, "Ukrgeofizrazvedka,"
"Multichannel Subtraction Filters"]

[Abstract] In earlier studies Ye. A. Kozlov (IZV. AN SSSR, FIZIKA ZEMLI, 7, pp 32-42, 1974; PRIKLADNAYA GEOFIZIKA, 74, "Nedra," Moscow, pp 3-12, 1974) formulated a new approach to solution of the problem of subtraction of wave packets of very great importance in the problem of increasing the directivity of interference systems. In examining the problems involved in numerical application of the proposed method, Ye. A. Kozlov notes the unwieldiness of the computation process and therefore in final form gives algorithms only for separation of two waves. Kozlov's studies do not cover the dependence of stability of the solution on the parameters of the initial model and the spectral composition of the separated functions. In this new article the authors examine an easily applied numerical model for solution of the problem formulated by Ye. A. Kozlov and determine the necessary and adequate condition for its solution. The authors consider the possibility of discriminating a signal from the observed wave field, represented by the superposing of N regular waves, by the multichannel filtering method; then new classes of multichannel filtering systems -- multichannel subtraction filters -- are introduced.
[67]

V. UPPER ATMOSPHERE AND SPACE RESEARCH

News

H. CURIEN COMMENTS ON SOVIET-FRENCH SPACE COOPERATION

Moscow PRAVDA in Russian 25 Oct 77 p 4

[TASS Report: "Deepening Cooperation"]

[Text] "Soviet-French cooperation in the exploitation of space and its use for peaceful purposes evokes the great satisfaction of the French public. For the past eleven years relations between the scientists and specialists of both countries have developed continually, and at the present time there is no area of knowledge where there are no paths to joint study," declared Hubert Curien, President of the National Space Research Center [Centre National d'Etudes spatiales].

"During 1977," noted H. Curien, "twelve joint projects were realized."
[5]

TASS ANNOUNCES LAUNCHING OF "KOSMOS-959"

Moscow PRAVDA in Russian 22 Oct 77 p 3

[TASS Report: "'Kosmos-959'"]

[Abstract] The artificial earth satellite "Kosmos-959" was launched in the Soviet Union on 21 October 1977. The satellite was inserted into an orbit with the following parameters:
-- initial period, 94.8 minutes;
-- apogee, 891 kilometers;
-- perigee, 153 kilometers;
-- orbital inclination, 66 degrees.
[5]

TASS ANNOUNCES LAUNCHING OF "KOSMOS-960"

Moscow PRAVDA in Russian 26 Oct 77 p 3

[TASS Report: "'Kosmos-960'"]

[Abstract] The artificial earth satellite "Kosmos-960" was launched in the Soviet Union on 25 October 1977. The satellite was inserted into an orbit with the following parameters:
-- initial period, 95.1 minutes;
-- apogee, 549 kilometers;
-- perigee, 505 kilometers;
-- orbital inclination, 74 degrees.

TASS ANNOUNCES LAUNCHING OF "KOSMOS-961"

Moscow PRAVDA in Russian 27 Oct 77 p 3

[TASS Report: "'Kosmos-961'"]

[Abstract] The artificial earth satellite "Kosmos-961" was launched in the Soviet Union on 26 October 1977. The satellite was inserted into an orbit with the following parameters:
-- initial period, 88.5 minutes;
-- apogee, 302 kilometers;
-- perigee, 125 kilometers;
-- orbital inclination, 66 degrees.

LAUNCHING OF GEOPHYSICAL ROCKET "VERTIKAL'-6"

Moscow PRAVDA in Russian 26 Oct 77 p 6

[TASS Report: "Vertikal'-6'"]

[Text] In accordance with the program of cooperation among socialist countries in the field of space research and exploitation of space for peaceful purposes, on 25 October 1977 at 1515 hours Moscow time the "Vertikal'-6" geophysical rocket was launched from the middle latitudes of the European USSR to an altitude of 1500 kilometers.

The "Vertikal'-6" geophysical rocket is intended for the continuation of complex research on the earth's atmosphere and ionosphere and also the interaction of short-wave solar radiation with the earth's atmosphere.

Scientific apparatus made in the People's Republic of Bulgaria, the Hungarian People's Republic, the Soviet Union and the Czechoslovakian Socialist Republic was mounted in the stabilized instrument package which separated from the rocket at an altitude of 173 kilometers.

During the flight of the "Vertikal'-6" geophysical rocket ground measurements of various ionospheric parameters were conducted.

Specialists of Bulgaria, Hungary, Czechoslovakia and the USSR participated in the assembly and testing of the scientific apparatus placed on the "Vertikal'-6" rocket, as well as in its launching.

Simultaneously, near the launching site of the "Vertikal'-6" geophysical rocket a set of meteorological rockets were launched for the purpose of complex measurement of various atmospheric parameters and the development of methods and systems for rocket sounding of the atmosphere. Scientific apparatus developed by specialists of Bulgaria, Hungary, Rumania, Poland and the USSR was mounted on these rockets.

The scientific organizations of the countries participating in the joint experiment have begun to process the information received. [5]

TASS ANNOUNCES LAUNCHING OF "KOSMOS-962"

Moscow PRAVDA in Russian 30 Oct 77 p 3

[TASS Report: "'Kosmos-962'"]

[Abstract] The artificial earth satellite "Kosmos-962" was launched in the Soviet Union on 28 October 1977. The satellite was inserted into an orbit with the following parameters:
-- initial period, 104.9 minutes;
-- apogee, 1,022 kilometers;
-- perigee, 983 kilometers;
-- orbital inclination, 83 degrees.

REVIEW OF RESEARCH CONDUCTED ON "SALYUT-5"

Moscow PRAVDA in Russian 19 Oct 77 p 3

[Article by V. Avduyevskiy, K. Kondrat'yev and V. Bol'shakov: "'Salyut-5': Results of Studies in Orbit"]

[Text] The orbital scientific station "Salyut-5" was put into orbit more than a year ago, on 22 June 1976, in accordance with the program of investigation of space.

"Soviet science," says the General Secretary of the Central Committee CPSU Comrade L. I. Brezhnev, "considers the creation of orbital stations with replaceable crews to be man's main path into space." The launching of the 'Salyut-5' station was a new and significant step along this route. The purpose of the launching was the carrying out of a broad complex of investigations and experiments in the interests of science and the national economy and the further testing of the design of the station, its on-board systems and apparatus in manned and automatic regimes.

In accordance with the program, after two weeks of autonomous flight, the cosmonauts B. V. Volynov and V. M. Zholobov on 7 July were delivered to the orbital station, which had demonstrated excellent technical characteristics, aboard the transport ship "Soyuz-21." In the course of a 48-day flight on the station the crew carried out an extensive program of scientific and technical investigations and experiments. On 24 August the cosmonauts returned to the earth. After this, for more than five months the station carried out flight in an automatic regime.

The "Soyuz-24" spaceship was launched on 7 February 1977 for continuing investigations aboard the station. This ship was manned by the cosmonauts V. V. Gorbatko and Yu. N. Glazkov. Over a period of 16 days they also carried out the intended program and on 25 February returned to the earth. They dedicated their flight to the 60th anniversary of the Great October Revolution.

The further flight of the station was in an automatic regime. The automatic returnable module with research and experimental data was separated from it on 26 February and descended to earth in the stipulated region of the territory of the USSR. On 8 August the flight program was fully carried out. The station was imparted a braking impulse, after which it entered the dense layers of the atmosphere and ceased its existence.

For more than a year the station was in a controllable flight regime, primarily with orientation on the earth. The high orientation accuracy considerably increased the effectiveness of investigations of the earth and circumterrestrial space in the interests of science and the national economy, which was one of the principal tasks of the "Salyut-5." In the investigation

of the sun and individual celestial bodies there was assurance of a highly accurate orientation of the station on the investigated celestial body.

During the course of the entire flight the on-board systems of the station functioned normally. A high quality of the atmosphere was ensured in the compartments: temperature was in the range 20-23 degrees Celsius, pressure was 780-850 mm. The flight was tracked and corrected at the ground analog complex.

During the time of station flight in automatic and manned regimes it was possible to make more than 300 astrophysical, geophysical, technological and biomedical and other investigations and experiments.

The astrophysical investigations were made using an IR telescope-spectrometer receiving electromagnetic radiation in the range from 2 to 15 microns. For the first time it was possible to obtain an IR exoatmospheric spectrum of the sun and circumsolar space. A preliminary analysis indicated that in the range 4-8 microns there are changes in the intensity of solar radiation which were not discovered by means of surface spectrometry and for which the molecular absorption of light is possibly responsible. By means of the IR telescope it was possible to obtain valuable emission spectra of circumterrestrial space.

An IR spectrometric study was made of the lunar surface and IR galactic sources.

By means of the IR telescope it was possible, also for the first time in such a broad range of emissions, to carry out an IR spectroscopic study of the earth's atmosphere on the basis of its transmission (transparency). Transmission spectra for the earth's atmosphere were obtained in the range 2-15 microns for altitudes up to 50-70 km. On the basis of these spectra it was possible to determine the vertical distribution of carbon dioxide, carbon monoxide, ozone and other components, which will make it possible to judge how the atmosphere is influenced by man's industrial activity.

A matter of great importance is the study of the earth's natural resources by means of a photographic survey from space. The "Salyut-5" carried photographic and spectrographic complexes of apparatus for carrying out surveys in different ranges of the spectrum of electromagnetic radiations on different types of film. The reliable operation of the "Salyut-5" stabilization control system made it possible to carry out a space survey with different angles of inclination of the optical axis of the photosurvey camera, held steady during the period of the survey with a high accuracy.

In the interests of different branches of the national economy it was possible to carry out photographing of a considerable part of the territory of the Soviet Union: Southern Urals, Aral Sea, Altay mountain system, Dzhugarskiy Alatau, spurs of the Pamirs and Tien Shan, and also the surfaces of

the Indian, Pacific and Atlantic Oceans with a total area of 65 million square kilometers. As a result of a hydrological study of space photographs it was possible to refine the shape of the shoreline of Lake Zaysan, changing after the creation of the Bukhtarminskaya hydroelectric power station, and the reservoir; lakes in the region of low rounded hills in Kazakhstan not reflected on maps were discovered; reservoirs (Charvakskoye and Toktogul'skoye) in the region of the Western Tien Shan were mapped. It was possible to refine the boundaries of the Aral Sea in comparison with the maps of 1970. A forecast of the dynamics of its dessication was prepared; this will make it easier to seek ways for preserving this water body.

Hydrographic maps for regions of Central Asia and the high-mountain regions of the Tien Shan and Pamirs were compiled. It was established that some salt lakes have disappeared (for example, Lake Kokshekol' has now become completely covered by solonchaks). Tributaries of rivers which had not been plotted earlier on maps have been discovered. Space photographs of inaccessible regions of the Fergana-Talasskiy fault in the foothills of the Tien Shan for the first time have made it possible to trace its boundaries clearly for more than 700 kilometers. As a result, geologists could clarify the dynamics of the marginal zones of the fault, which will make it possible to evaluate this region differently from the point of view of seismicity and to obtain new data on minerals.

In surveys from great altitudes it has been possible to scan the floor of the oceans at small depths. This will make it possible to refine the forms of underwater relief and discover zones of underwater volcanic activity.

Several hundred spectrograms have been obtained for different types of natural formations and landscapes in different regions of the earth -- forested and agricultural regions, steppe and arid sectors, water surfaces and clouds. They have served as a basis for experimental catalogues of the spectral characteristics of natural features. This will help in developing methods for checking on the state of forests, water resources, agricultural crops, and solve problems relating to melioration and predicting crop yields.

A new element in spectral investigations of the environment was the measurement of the degree of polarization of light, specifically solar radiation reflected by the cloud cover, water surfaces and other natural formations of our planet. Such measurements are necessary for developing methods for evaluating the degree of contamination of a water surface by petroleum and petroleum products, evaluation of the moisture content of the surface layer of the ground and determining the structure and state of the cloud cover.

The data obtained on the "Salyut-5" by means of a spectrographic study of the twilight and daytime horizons of the earth were used for determining the vertical optical structure of the upper troposphere and stratosphere. For example, on microphotograms and vertical profiles of brightness which were obtained it was easy to see the earlier known aerosol layer (Junge layer) which was situated at altitudes 19-20 km. In addition, many spectrograms

contain information on the presence of global aerosol layers at altitudes 35 and 50 km.

A characteristic of the technological program on the "Salyut-5" station was a combination of physical investigations developing the theoretical principles of space production and experiments of direct practical importance. The complex of corresponding apparatus consisted of the "Kristall," "Potok," "Diffuziya," "Sfera" and "Reaktsiya" instruments.

The "Kristall" instrument is an air thermostat with three crystallizers in which aluminum-potassium sulfate was formed from a supersaturated aqueous solution. Such experiments were carried out in space for the first time.

A study of the crystals growing under weightlessness conditions and delivered to the earth indicated that they differed from those grown on the earth in their external appearance and internal structure. As established by crystallographic investigations, in space samples of crystals there is an increased number of gas-liquid inclusions and an alternation of zones containing such inclusions with zones free of inclusions.

Useful information on the behavior of the gas bubbles in the fluid was also obtained when carrying out experiments with the "Potok" instrument.

An experiment with the "Diffuziya" instrument was devoted to a study of diffusion. On the basis of its results it was demonstrated that under weightlessness conditions natural convection was considerably lessened.

The "Sfera" instrument is an ohmic heater within which a bar of Wood's alloy is melted. It was found in an analysis of the material delivered from aboard the station that the form of the sample is ellipsoidal and its surface relief is complex. A change in the phase composition of the alloy was discovered. The mechanism of this change awaits explanation.

The "Reaktsiya" instrument was used for studying the processes of soldering and melting of metals. The tested technology of soldering of metallic parts can find extensive use in space technology.

In the course of biological experiments a study was made of the influence of weightlessness on a number of the principal parameters of the vital functioning of organisms: embryonal development, growth and division of cells, inheritance, radiosensitivity and behavior. It can be noted that the absence of gravity led to a change in the behavior and mechanisms of spatial orientation of fish and also formation of higher fungi. However, there were no significant changes in the processes of embryonal development of fish and especially the vestibular apparatus.

On the "Salyut-5" station a series of experiments was carried out for the testing of promising on-board systems. The development of cosmonautics insistently requires an increase in the duration of space flights, in the

course of which the need can arise for a full or partial replacement of the atmosphere aboard the ship. A partial replacement of the atmosphere aboard the "Salyut-5" station was carried out without impairing the comfortable conditions in its rooms for the first time in the practice of manned flights.

The station was used in carrying out extensive ergonomic investigations, during the course of which a study was made of the activity of cosmonauts during manual control of the station, visual observation of the earth's surface, conducting communications, movement with a load and other operations. Using specially formulated methods the cosmonauts evaluated the layout of the compartments, the system for the display of information, harness and means for movement within the station, and illumination. The evaluations were high.

The successful flight of the "Salyut-5" station -- a major achievement in Soviet cosmonautics -- can be credited to Soviet scientists, designers and workers -- all who participated in its creation and the implementation of the experiment. The results of the flight will be used in solving scientific and national economic problems, as well as in the designing of promising space vehicles.
[62]

COMMENTS ON THE DEVELOPMENT OF GEOPHYSICAL ROCKETS

Moscow PRAVDA in Russian 26 Oct 77 p 6

[Article by V. Gubarev: "'Vertikal'-6': Through the Atmosphere"]

[Text] Long, long ago, at the time when there were still no satellites, Sergey Pavlovich Korolev, his friends and colleagues, spent many months in the steppes, sending geophysical rockets into the sky. The rockets did not have sufficient power to put the scientific instrumentation into circumterrestrial orbit and they glanced into space for only a few minutes. Later these minutes developed into days, months and years of work in space by orbital stations.

Scientists sometimes call geophysical rockets "the explorers of the atmosphere." Indeed they, penetrating to altitudes which cannot be reached by either aircraft or balloons, carried science into space, into which man strode on 4 October 1957.

And only a month later Layka was put into space. This was a qualitatively new step in the exploration of space. And it was prepared in rockets which carried four-legged stratonauts -- dogs -- into the upper layers of the atmosphere.

During the years which followed the space vehicles seemingly "squeezed" geophysical rockets from our field of view. And although they were regularly launched in the Arctic and in Antarctica, in the southern part of India and in the Atlantic Ocean, from aboard the research vessels of the USSR Academy of Sciences and from meteorological polygons, in their popularity they yielded to their fellows in space. Rockets were transformed into an ordinary tool for studying the atmosphere, a powerful tool in the hands of modern science.

The "Interkosmos" program began a new stage in the biography of geophysical rockets. The first of these, the "Vertikal'," was launched on 28 November 1970. The apparatus for the instrument compartments of the rockets is being created by many scientific teams in member countries of the socialist economic bloc and with respect to its parameters and complexity of fabrication is in no way inferior to "cosmic" apparatus.

"Science today is characterized by the multisided nature of research," says V. S. Vereshchetin, Deputy Chairman of the "Interkosmos" Council of the USSR Academy of Sciences. "This can be seen clearly in the joint space program carried out by specialists of the socialist countries. It includes investigations of circumterrestrial space, the sun, moon and planets. The apparatus is mounted on the "Interkosmos" satellites, automatic interplanetary vehicles, spaceships and orbital stations. Also in extensive use are the "Vertikal'" geophysical rockets, MR-12 meteorological rockets, and M-100 and MMR-06 meteorological rockets. Investigations on space vehicles and rockets supplement, or rather, enrich one another. A new model of the "Vertikal'" rocket was tested in 1976. It makes it possible to carry out more thorough investigations of the earth's and solar atmospheres.

The "Vertikal'-6" puts an instrument package up to an altitude of about 170 km and then travels another 1,300 km before returning to the earth. It describes a giant loop in circumterrestrial space: more than 2,700 km. The scientists of the Soviet Union, Czechoslovakia, Hungary and Bulgaria have created for the "Vertikal'-6" a complex of instruments each of which corresponds to the most recent requirements of modern science.

The "Vertikal'-6" carried an instrument for studying the atmospheric concentration of electrons and ions. It was created by specialists of Bulgaria and the USSR. The mass-spectrometer apparatus was developed in our country and Czechoslovakia. In addition, an astrophysical probe is continuing investigations of solar radiation which were carried out during preceding rocket launchings.

Specialists of the member countries of the socialist economic bloc participated in preparations for the launching of the "Vertikal'-6" and met from space the instrument package which landed not far from the launch pad.

The satellite flies speedily around the earth. And the instruments carried aboard it can be compared with observers, passengers of an express train who view the landscapes from a train window. Something very interesting has

just flashed by, but the flight of the satellite is too rapid and there is no way for it to slow down. The "Vertikal'" instruments are narrow specialists and they bring information on the depths of the planetary atmosphere. Study from above -- from a satellite, and from within -- from a rocket, is enabling scientists to visualize better what is occurring in the thickness of the air ocean surrounding our planet.
[75]

PETROV INTERVIEWED AT 28TH INTERNATIONAL ASTRONAUTICS CONGRESS

Moscow KOMSOMOL'SKAYA PRAVDA in Russian 12 Oct 77 p 4

[Article by V. Andriyanov and V. Zubkov: "At Home in Space"]

[Excerpts] Q: Boris Nikolayevich, what would you first say about the Congress?

A: To be sure, I would mention "Interkosmos-17." It was launched literally before the congress itself. Scientists of several socialist countries participated in its launching. The Czechoslovakian specialists returned exactly on time for the opening of the congress.

We are now entering into a new phase of cooperation. What is characteristic of this phase? Satellites of a new generation are being launched: "Interkosmos-15, 17." These are automatic standardized orbital stations [AUOS -- avtomaticheskiye unifitsirovannyye orbital'nyye stantsii]. They make it possible to carry out more complex, long-term multisided experiments. This was a first. Second: the last "Vertikal'" geophysical rockets were also of a new generation. Rising to an altitude of 1,500 km and above, they probe the atmosphere and give its "cross section." They bring data on the characteristics of the atmosphere at different altitudes at virtually one and the same time. Investigations by means of rockets and satellites supplement one another. This is important for a study of the composition and density of the earth's atmosphere and ionosphere, they are different at different altitudes, for evaluating the influence of solar activity on the state of the ionosphere.

Q: Are you discussing solar-terrestrial relationships?

A: Yes, this is one of the current major problems in the investigation of space. The "Prognoz" satellites are used for the same purpose. At the time of their flight it was possible to register a very interesting phenomenon -- compression of the magnetosphere and ionosphere by the solar wind.

The new stage in cooperation is also characterized by a multisided nature of the investigations and the launching of biological satellites. Biological satellites are real laboratories in orbit. Academician O. G. Gazenko

told about their operation in detail. I will mention only that artificial gravity was created for the first time on the biosatellite. For the first time data were obtained on the difference in flight of experimental animals under weightlessness conditions and under conditions of artificial gravitation.

An important part of the program for the next few years is the participation of citizens of the socialist countries in manned flights. Now at the Cosmonaut Training Center imeni Yu. A. Gagarin there is training of cosmonaut candidates from Czechoslovakia, Poland, GDR. Cosmonaut candidates from the other socialist countries which are participating in the "Interkosmos" program are undergoing selection and training at home.

Q: Boris Nikolayevich, let's glance forward. What, in your opinion, will the second decade of the "Interkosmos" program be like?

A: In this program an ever-greater place will be occupied by applied investigations of direct national economic importance. In the next decade the family of cosmonauts will be replenished. As I said, it will become international.

Space technology is now taking the first steps, is involved in the first experiments. It can be hoped that in the course of the next decade it will find its practical application. And finally, and this is especially important to emphasize: space technology will ever more actively hand over its achievements to terrestrial branches of the national economy. The instruments, alloys and constructions developed for space will also serve with honor on earth. In short, space will more and more furnish its achievements to earth.

Problems of fundamental science will always remain in the field of space investigations. They also include such cardinal problems as the formation of matter.

If astronomy is taken in general, a new direction has been noted in its development -- exoatmospheric astronomy. Why? Because the entire short-wave spectrum of electromagnetic radiation is absorbed by the atmosphere it cannot be studied by means of surface instrumentation. But space investigations will make it possible to study the entire spectrum of emissions. It appears that precisely the short-wave radiation spectrum contains enormous information on the structure of stars and the matter from which they consist and those processes which transpire in them. We will learn more and more concerning the structure of the sun, on the processes on the sun exerting a direct influence on the earth. Exoatmospheric astronomy is one of the "hottest" points in the development of modern science. Within the field of exoatmospheric astronomy gamma astronomy is particularly interesting. The experiments carried out on the French satellite "Sneg-3," launched by a Soviet carrier rocket in accordance with the program of cooperation with France, are specifically in the field of gamma astronomy.

Q: Boris Nikolayevich, in work under the "Interkosmos" program you first had an international group of scientists and researchers and now cosmonauts are being included...

A: Yes, large scientific organizations have grown up in the socialist countries during the years of joint work. The style for joint work has been developed. And finally, the conditions under which all our work transpires is exceptionally businesslike, sincere and comradely. And this applies not only to our relationships with the scientists of the socialist countries. The "Interkosmos" council directs bilateral cooperation between the Soviet Union and the United States, France, India and Sweden.
[72]

COMMENTS ON USSR-INDIA SPACE COOPERATION

Moscow PRAVDA in Russian 20 Oct 77 p 5

[Article by O. Kitsenko: "USSR-India: Cooperation in Space Research"]

[Summary] The Indian press notes that one of the characteristics of cooperation between the USSR and India is the difference between the "assistance" of certain countries and the true assistance given to India by the Soviet Union, which in striving to assist it is attempting to make it fully independent. In May 1972 the Indian Space Research Organization and the USSR Academy of Sciences concluded an agreement on cooperation in the creation and launching of the first Indian satellite using a Soviet carrier rocket. That same year the USSR sent India samples of lunar ground returned by "Luna-16" and "Luna-20." An Indian satellite was launched by a Soviet carrier rocket in 1975. In 1978-1979 plans call for the launching of a 40-kg satellite by an Indian carrier rocket. Two and one-half years have elapsed since launching of the Indian satellite. The prolonged successful functioning of the satellite in orbit, exceeding expectations, indicates that with Soviet assistance India is capable of creating spaceships and controlling them. Indian scientists are planning a broadening of their space program, especially in ways which will be of assistance in the national economy. It has been officially announced that by 1988 India will launch a communications satellite. In the future satellites will be used for carrying out geological, geodetic, navigational and other investigations of economic importance. An important step in this direction will be the launching of a second Indian satellite, to be accomplished in cooperation with the USSR. On 12 October of this year the Minister of Communications declared that work on its creation is advancing successfully in accordance with plan. At Bangalore, where the satellite is being created, there was recently a regular meeting of Soviet and Indian scientists. It was decided that the new satellite will be put into orbit by a Soviet rocket from the territory of the USSR next year. This will be a more complex and improved vehicle. It will be considerably

heavier than the first. It will carry more equipment, including television cameras and microwave radio measuring apparatus. The new satellite will be used in solving more complex problems. It will carry out meteorological, hydrological and oceanological investigations. The results will make it possible to predict better the behavior of the principal rivers of India and the onset of monsoonal rains. This will be of great importance for improving the planning of the corresponding economic measures. Professor Rao has stated that the only way in which the developing countries can participate in the exploitation of space is cooperation with the developed countries. Indian-USSR cooperation can be regarded as a model in this respect. [61]

LAUNCHING OF "MOLNIYA-3" COMMUNICATIONS SATELLITE

Moscow PRAVDA in Russian 29 Oct 77 p 1

[TASS Report: " Molniya-3 in Flight"]

[Text] In accordance with the program for further development of communication systems using artificial earth satellites, on 28 October 1977 a "Molniya-3" communications satellite was launched from the Soviet Union into a high elliptical orbit. It has an on-board repeater apparatus that provides for operation of the system in the centimeter wavelength range.

The "Molniya-3" communications satellite is intended for operation in the system of long-range telephone and telegraph radio communication in the Soviet Union, for transmission of USSR Central Television programs to points in the "Orbita" network, and for international cooperation.

The satellite was inserted into an orbit with the following parameters:
-- apogee, 40,764 kilometers in the northern hemisphere;
-- perigee, 478 kilometers in the southern hemisphere;
-- period of revolution, 12 hours 15 minutes;
-- orbital inclination, 62.8 degrees.

In addition to apparatus for transmitting television programs and for providing long-range multichannel radio communication, the satellite carries on-board a command and measurement complex as well as systems for orientation, orbital correction and power supply for the satellite.

Communication sessions using the "Molniya-3" satellite will be conducted in accordance with the projected program. [5]

Abstracts of Scientific Articles

PROBLEM OF ATMOSPHERIC TRANSFER FUNCTION DISCUSSED

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 236, No 1, 1977 pp 47-49

[Article by N. G. Boldyrev and Corresponding Member USSR Academy of Sciences, Leningrad Electrical Engineering Institute and Leningrad State University]

[Abstract] In computing the brightness of the daytime and nighttime horizons observed from space it is impossible to neglect the atmospheric refraction phenomenon. In this case it is necessary to take into account the dependence of the atmospheric refractive index n on altitude H above the underlying surface, preferably in analytical form in the form of a formula making it possible to compute n for any H value. On the other hand, in a model of the atmosphere consisting of plane-parallel layers the light rays in the first approximation can be considered straight lines. In the interests of convenience in use of an electronic computers it is desirable to use the concept of volume density of the strength of light scattered by the atmosphere (N. G. Boldyrev, TEORETICHESKAYA FOTOMETRIYA, 1938; TR. GOS. OPTICH. IN-TA, Vol 13, 3, 1939). The formulated problem is solved by the application of this concept.
[65]

VI. MISCELLANEOUS

News

ATOMIC ICEBREAKER "SIBIR'" TESTED

Moscow PRAVDA in Russian 23 Oct 77 p 1

[Article by V. Gerasimov: "The Maiden Voyage of the 'Sibir'"]

[Text] The atomic icebreaker "Sibir'" yesterday left the construction berth of the Baltic Shipbuilding Plant imeni S. Ordzhonikidze on a shakedown voyage. On the multiday cruise the creators of the icebreaker and its crew are checking in working regimes the interaction among the numerous shipboard systems, their reliability and the navigational qualities of the new ship.

The Baltic workers made full use of the experience acquired in the course of construction of the flagship of the Soviet icebreaker fleet and reduced by six months the time required for construction of the new atomic-powered ship.

With respect to their main characteristics both vessels are identical. But nonetheless there is a difference between them which cannot be seen at first glance. The designers and shipbuilders introduced a series of newly designed units into the apparatus aboard the icebreaker and its makeup. The servicing of complex systems has become still easier and the conditions for living and working of the seamen have been made more convenient.

"I thank the designers and shipbuilders for such a ship," notes the Captain of the ship V. K. Kochetkov. I had the opportunity to sail on the famed 'Yermak.' Specialists are today saying with more and more assurance that throughout the entire year there can be navigation between the western and eastern ports of our country. And not only along the traditional Northern Sea Route, but by the shortest high-latitude routes."

The "Sibir'" icebreaker is in essence a whole floating city. It has more than 1,200 different rooms. There are ample and semicircular rooms and long passageways. There are excellently outfitted cabins for the crew members, a motion picture theater, library, sports halls and saunas.

The "Sibir'," like the "Arktika," was built by the entire country. About three hundred enterprises supplied the Baltic workers with equipment for the icebreaker. The shipbuilders worked on a forced schedule and inspired others by their example.

Very rightly among the outstanding workers at the plant we can mention the brigade leaders Heroes of Socialist Labor V. A. Smirnov, V. S. Kir'yanov, P. K. Dorokhin, winners of the Order of Work Honor P. S. Bondarev, V. P. Orlov, A. S. Stepanov.

The reduction of the shipbuilding period by four months in comparison with the "Arktika" enabled the Baltic workers to launch the "Sibir'" on the eve of the 25th Congress CPSU. And the atomic reactor was started up late in September.

"The initial tests revealed a high quality of installation of vitally important units and systems of the atomic plant, automated systems, and electric equipment," says the enterprise director V. N. Shershnev. "They will again be carefully checked in state tests..."

On the eve of the October holiday the "Sibir'" is returning to Leningrad. Then the Baltic workers will turn it over to representatives of its port of registry -- Murmansk. The new atomic hero will go out on its icy routes during this navigation season.
[57]

INITIAL RESULTS OF TWENTY-SECOND ANTARCTIC EXPEDITION

Riga SOVETSKAYA LATVIYA in Russian 11 Oct 77 p 2

[TASS Report: "Under the Ice of the Antarctic"]

[Text] A gigantic "wound" cutting the thickness of the earth's crust in Antarctica has been plotted on maps of the south polar continent by Soviet geologists. During the time of investigation of the shelf zone of the Weddell Sea and the mountain systems adjacent to it scientists discovered a so-called rift zone -- a deep fault along which, it is postulated, there is movement of the rock cover of the planet. Using geophysical methods it was possible to trace the strike of the fault for 500 kilometers along the ocean floor and for 300 kilometers into the depth of the continent.

This discovery, important for solution of problems in the geological history of Antarctica, was described to a TASS correspondent at the Scientific Research Institute of Arctic Geology. Here specialists have completed the first stage in the processing of scientific materials and collections sent to Leningrad by the participants of the seasonal detachment of the 22d Soviet Antarctic Expedition.

The director of the complex detachment, Candidate of Geological and Mineralogical Sciences V. Mosolov, stated that during two expeditionary months scientists and specialists have investigated more than 700,000 square kilometers. They made a seismic study of thick sediments on the shelf of the Weddell Sea, made an aerial photographic study of its shores and carried out radar sounding of the glacial dome of the adjacent part of Antarctica. Collections of rocks, minerals and fossilized remains of organisms were assembled. New outcrops of the ancient basement of Antarctica were found.

The collected data are introducing a number of significant corrections and refinements in our ideas concerning the past of the "white continent," its mineral wealth.

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