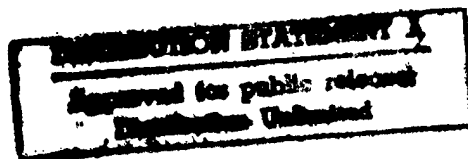


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METEOROLOGY

CLIMATE MODELING AT PACIFIC OCEAN INSTITUTE OF GEOGRAPHY

Moscow VOZDUSHNYY TRANSPORT in Russian 15 Feb 84 p 4

[Interview by S. Glukhov, special correspondent of this paper in Vladivostok, with Anatoliy Petrovich Oreshko]

[Text] The Pacific Ocean Institute of Geography at the Far East Research Center of the USSR Academy of Sciences, is concerned with more than problems of weather in the near future. Of course, the problem of prompt forecast of ice is very important to the Arctic cruises of our ships. And weather forecasts are needed for planning many problems of the national economy.

But, in addition, the scientists at this institute are developing mathematical models of climate and are making computers answer questions such as "What would happen if...." Such preliminary work is absolutely mandatory before affecting nature in some region or other. This is expressly what we were told about by Anatoliy Petrovich ORESHKO, candidate of physicomathematical sciences, head of laboratory of mathematical climate modeling.

Climate and weather forecasting is, without exaggeration, not only a rather pressing matter for mankind today, but one of the scientifically most difficult ones. Suffice it to mention that weather also means harvest, i.e., food and raw materials for industry, and the effectiveness of many sectors of the national economy, in particular, the safety and regularity of civil aviation flights.

In order to comprehend the mechanisms that form climate, which refers to the many-year weather conditions, it is not enough to merely take into consideration processes that take place in the atmosphere and world oceans. It is necessary to know about the behavior of extensive ice masses, as well as the extremely complex chemical and biological cycles occurring on earth's surfaces. All these processes interact in some way, which is not known to us as yet in many respects. And we are striving, first of all, to isolate from this extremely complicated set the chain of expressly climatic causes and effects.

And the route selected for this was mathematical modeling of climate. The Worldwide Meteorological Organization and International Council of Scientific Unions, in whose work Soviet scientists are very active also, have developed a program for the study of global atmospheric processes--PIGAP. The national program of the Soviet Union, which is closely linked with PIGAP, contains as one of the sections the results of research conducted in our laboratory. We have yet to build a model for climate forecasting in the Far East and to predict with certainty what fishermen and seamen, farmers and civil aviation workers, industrial and construction workers--all who are in the Far East--can expect at the turn of the next century.

Everybody knows from their school class in geography that the climate conditions of the Far East are determined by monsoons, which are stable seasonal winds, the direction of which changes drastically to its opposite twice a year. The abrupt change in all meteorological characteristics occurs in the Far East at the continent-sea boundary. The so-called Siberian anticyclone also has an appreciable influence on our region. Large and small cyclones and typhoons follow one another through the Maritime Kray, which originated in equatorial regions.

Hence it is understandable that, for purposes of planning the national economy, knowledge of only the trend in climate change, which depends largely on the condition of the atmosphere, could yield an enormous economic effect. For this reason, the features that we must predict include average and extreme air temperatures, intensity of precipitations, depth of snow, level of incident solar radiation and many others....

I should stress in particular that the parameter that is of greatest importance to us is the temperature on the surface of the ocean, since the accuracy of a forecast depends precisely on it in many respects. This is why hydrologists who are making telephotographs from aircraft are the traditional customers of Aeroflot.

Icebergs form an interface between the above-mentioned parts of the model, between the atmosphere and ocean. The ice is more or less permanent, but because it has not been studied sufficiently, it sometimes leads to extreme situations, such as happened last fall in the eastern sector of Arctica. In October, 22 transports were stuck in the ice of the Sea of Chukotsk. The wrong ice forecast was one of the causes.

The conclusion is unequivocal: very much in the model we are developing depends on how much we know about this permanent factor. Year-round and more comprehensive observation of icebergs is needed. And we cannot manage this without aircraft, serving as ice scouts.

Perhaps someone will be amazed at the figure that we shall cite, but it is indeed true: the ice sheets of Antarctica and Greenland alone contain about 80% of the world's stock of fresh water. Hence it is obvious that even the most insignificant deviation of the climatic temperature balance could have disastrous consequences for some low-lying coastal regions.

And this assumption is not from the realm of fantasy. Suffice it to recall that such fluctuations had occurred in the Far East during glaciation of earth in the Pleistocene. A graphic example is the so-called Behring land, the 1000-km wide "bridge" that connected Chukotka and Alaska at that time. The appearance and disappearance of many islands, of Behring land itself, as well as change in configurations of the eastern part of the Asian continent, were attributable to fluctuations of the world oceans.

Could such a thing happen in the future? Our climate model should theoretically be able to answer this difficult question too.

Scientists have computed a hypothesis on computers, such as melting of the ice armor of Antarctica. The answer was that the world oceans will rise by an average of 80 meters, with all the ensuing consequences.

They also imagined a variant such as melting of Arctic ice. Here are some of the possible consequences: drastic change in temperature at the equator; the traditional paths of cyclones will shift to the north; there will be a drought in many agricultural regions.

Even these two examples show convincingly how dangerous man's imprudent intervention into nature is, and this applies 100-fold on a global scale.

Intervention into the sensitive and rather delicate world of nature in such cases is recommended, first of all, on paper, on a model, in the form of a strictly validated, thoroughly computed scientific scenario: "What would change on earth if" For mankind has already repeatedly paid with bitter consequences for its haste and folly.

We know from history that, in the past, the climate changed repeatedly. There is every reason to expect that it will also change in the future. But in what direction?

In the 1940's, for example, air temperature in northern regions rose gradually to a maximum, after which the return to a cooler climate started. Evidently, that brief period of warming up was the most "acute" of all those that occurred in the last 500 years. At the present time, some cooling is occurring on earth, suffice it to recall the increasing incidence of extreme and, usually, unexpected winter whims.

But none of the scientists wants to offer an unequivocal answer to the question of whether it will become colder or warmer on our planet in the immediate future.

In other words, the problem of creating a global climate model has not been solved anywhere as yet to any significant degree. Obviously, the task put to us of creating a mathematical climate model for the Far East region requires much time and expense.

In our laboratory, considerable knowhow has been acquired in modeling various natural phenomena. The results already obtained are of theoretical and practical interest. The intensive development of productive forces in the east of our

country acutely requires reliable climate forecasts, since mistakes here could lead to useless expenditure of hundreds of millions of rubles.

Thus, within a few years, we should already produce the first statistical-probabilistic model of Far East climate in the future, the fundamental principle of which is to preserve a climate that is beneficial for human life.

10,657
CSO: 1865/89

EVALUATION OF PROBABILITIES OF LARGE DEVIATIONS OF CLIMATIC CHARACTERISTICS FROM PRESENT LEVELS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 19, No 12, Dec 83 (manuscript received 20 Oct 82) pp 1259-1266

DEMCHENKO, P. F., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] A stochastic "zero-dimensional" model for the evolution of mean hemispherical temperature has been employed in estimating the mean time of spontaneous transition to a regime of total glaciation of the earth. Proceeding along these lines, the author uses a model with two degrees of freedom for evolution of mean hemispherical temperature and the latitude of the boundary of the snow-ice cover. Using the A. D. Venttsel' asymptotic theory of quasi geopotential it was possible to ascertain the mean times when these variables reach some fixed level. The model presented here makes it possible not only to estimate the mean time of spontaneous thawing of the polar cap, but also the most probable mean hemispherical temperatures and equator - pole temperature differentials at the time of its disappearance. The estimates show that with the present-day values of climatic parameters the thawing of arctic ice is an improbable event. The fact that several million years ago the Arctic was free of ice indicates that the external conditions for formation of climate were then different (CO_2 atmospheric content might have been greater.) In actuality, with the earth's modern climate the mean times for spontaneous transition to a regime of total glaciation of the earth and spontaneous thawing of the snow-ice cover exceed the earth's geological age. Figures 2; references 18: 10 Russian, 8 Western.

[51-5303]

PRESENT-DAY STATUS OF INVESTIGATIONS OF ANTHROPOGENIC INFLUENCE ON ATMOSPHERIC OZONE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 19, No 12, Dec 83 (manuscript received 24 Sep 82) pp 1235-1251

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[Abstract] This is a review of the present day status of research on global spatial-temporal variability of the total content of atmospheric ozone. There is still a probable risk of weakening of the ozone layer as a result of the discharge of fluorocarbons, although in the future attention must also be given to other halogenated compounds which may reach the stratosphere. Should the discharge of fluorocarbons continue at the present rate, this should eventually lead to a decrease in the total ozone content by approximately 10%. For the time being there are no anthropogenically caused changes in the total ozone content (according to theoretical estimates, it should already have decreased by 1%, but such a change cannot be detected using existing methods). Numerical modeling indicates the existence of latitudinal and seasonal variations which must be taken into account in estimates of the consequences of a decrease in ozone content for man's health and the environment. Industrial statistics indicate a decrease in production of freons 11 and 12 during the years 1974-1979, but their production and the production of other chlorine compounds may increase in the future, constituting a threat for the ozone layer. The detection of long-term ozone content trends is complicated by the presence of a considerable natural variability (the search for trends requires the establishment of an integrated global system for ozone observations, including satellite observation methods). The most dangerous consequence of a decrease in ozone content would be skin cancer proliferation and a destructive effect on many types of natural vegetation, agricultural crops, land and marine organisms. There is a need for continuing and expanding programs for investigating all the main aspects of the problem, including numerical modeling, long-term global monitoring and laboratory measurements. A priority item is the monitoring of the ozone concentration at altitudes greater than 35 km where it is most responsive to anthropogenic effects. Tables 3; references 28: 11 Russian, 17 Western.
[51-5303]

MODELING SEASONAL EVOLUTION OF THERMAL REGIME OF OCEAN-ATMOSPHERE SYSTEM

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 20, No 1, Jan 84 (manuscript received 12 Nov 82, after revision 28 Mar 83)
pp 48-56

KAGAN, B. A., RYABCHENKO, V. A. and SAFRAY, A. S., Institute of Oceanology,
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[Abstract] The authors propose a thermodynamic model of the ocean-atmosphere system used in reproducing the seasonal evolution of the thermal regime of this system and clarifying the role of individual factors controlling its variability. In formulating the model the point of departure is traditional concepts concerning the nature of meridional circulation in the ocean. It is assumed that in the middle and low latitudes there is a slow upwelling of water regulated by receipt of cold deep waters from the high latitudes. Adhering to this scheme, two regions are defined: the region of the temperate and low latitudes (upwelling region) and region of formation of cold deep waters in the high latitudes and it is taken into account that in the upwelling region where ocean heating occurs the upper quasi-homogeneous layer and the deep layers are separated from one another by a sharply expressed thermocline, whereas in the region of formation of cold deep waters the thermocline is degenerate as a result of intensive ocean cooling. Two zonal regions are similarly defined in the atmosphere: the region of the temperate and low latitudes, extending over the upwelling region and the land adjacent to it, and the high latitudes region situated over the remaining part of the land, the region of formation of cold deep waters and the polar region of the ocean, covered with ice. The atmosphere and ocean can therefore be represented in the form of five interconnected boxes. This fundamental model is supplemented by a whole series of simplifying assumptions. It is shown that the climatic characteristics obtained using the model agree rather well with observational data. The results of numerical experiments intended for clarifying the role of individual factors controlling the seasonal variability of the characteristics of the climatic system and for checking the sensitivity of the solution to choice of different schemes for the parameterization of heat fluxes at the ocean surface and at the interface between the upper quasihomogeneous layer and the deep ocean layers are discussed. The authors emphasize that the proper reproduction of the seasonal evolution of the climatic system imposes rigorous requirements on the completeness and accuracy of description of different factors. Unless these requirements are met there is no hope of obtaining a realistic picture of climatic variability. Figures 1; tables 1; references 14: 7 Russian, 7 Western.

[57-5303]

TURBULENT PULSATIONS OF HORIZONTAL AND VERTICAL WIND VELOCITY COMPONENTS IN CLOUDS OF DIFFERENT GENERA

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
No 1, Jan 84 (manuscript received 4 Nov 82; after revision 3 Mar 83) pp 10-18

MAZIN, I. P., SILAYEVA, V. I. and STRUNIN, M. A., Central Aerological
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[Abstract] Turbulence measurements in clouds required development of special instrumentation for continuous registry of fluctuations of the longitudinal wind velocity component (pneumoanemometer) and fluctuations of the vertical wind velocity component (anemoclinometric sensor of angle of attack in combination with a system for measuring aircraft motion). The resolution in the frequency range from 0.06 to 1 Hz was not less than $0.1 \text{ m} \cdot \text{sec}^{-1}$ with a relative measurement error ~8% for the horizontal (longitudinal) and ~7% for the vertical fluctuation components. The measurements were made in 1978-1980 mostly over the European USSR and in the Far East during investigation of frontal cloud systems. The flights were made in an IL-18D aircraft, primarily in middle- and upper-level clouds. It was found that there is an intermittence of quiet ($\sigma_u, \sigma_w < 0.1 \text{ m} \cdot \text{sec}^{-1}$) and turbulent ($\sigma_u, \sigma_w > 0.1 \text{ m} \cdot \text{sec}^{-1}$) zones and the patterns of distribution of the lengths of these zones in clouds of different genera were determined. Data are given on the distribution of σ_u and σ_w and the rates of dissipation of turbulent energy σ are presented. The degree of anisotropy of wind fluctuations and the peculiarities of structure of different types of convective clouds are discussed, with particular attention to embedded Cu. In turbulent sectors the distribution of fluctuations of wind velocity components is close to normal. The degree of anisotropy of wind fluctuations was investigated and it was found that it can be great in individual sectors. On the average for all sectors for stratiform clouds wind fluctuations are isotropic, whereas for convective clouds they are anisotropic. Figures 4; tables 3; references 4: 3 Russian, 1 Western. [57-5303]

UDC 551.574

DENSITY, SPECIFIC HUMIDITY AND WATER VAPOR ELASTICITY ABOVE CONDENSATION LEVEL

Tbilisi SOOBASHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 112, No 2,
Nov 83 (manuscript received 1 Oct 82) pp 305-308

ARVELADZE, M. P., SULAKVELIDZE, G. K. and SULAKVELIDZE, Ya. G., Georgian
Republic Administration of Hydrometeorology and Environmental Monitoring;
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[Abstract] A study was made of the change in specific humidity, elasticity and density of water vapor above the condensation level on the following

assumptions: at all altitudes above the condensation level the water vapor in a cloud is in a saturated state; the ascent of air occurs in conformity to the moist adiabatic law; the condensed water droplets and ice particles do not fall from the air volume in which their condensation or sublimation occurred. Equations are derived for the elasticity of saturated water vapor at any altitude z , for water vapor density and for specific humidity above the condensation level. These equations make it possible to conclude that the parameters characterizing humidity in a convective cloud above the condensation level are dependent on temperature at the condensation level and the altitude above this level. With ascent above the condensation level a decrease in specific humidity occurs not only due to the condensation of water vapor, but also as a result of change in water vapor density with altitude. With these considerations taken into account, an expression is derived for the density of water vapor at the altitude z during adiabatic ascent and in the absence of condensation. It is then possible to compute the condensed water above the condensation level. This makes it possible to compute the quantity of water vapor condensed into droplets or sublimated in the form of ice particles during the moist adiabatic ascent of air. In the lower layers of the atmosphere a decrease in water vapor density up to 30% is caused by its expansion. Most condensation and sublimation of water vapor in a cloud occurs at temperatures to -10 , -12°C ; above the level of these temperatures the condensation and sublimation of water vapor introduce no substantial change in the adiabatic liquid water content of a cloud. References: 3 Russian.
[101-5303]

UDC 629.195-551.521

RADIATIVE HEAT EXCHANGE IN ATMOSPHERE DISTURBED BY VOLCANIC ERUPTION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 274, No 4, Feb 84
(manuscript received 12 May 83) pp 799-801

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MOSKALENKO, N. I., Limnology Institute, USSR Academy of Sciences, Leningrad

[Abstract] The authors examine the peculiarities of radiative heat exchange in an atmosphere disturbed by an evolving gas-dust cloud arising as a result of a volcanic eruption. The air mass disturbed by volcanic products has a high concentration of CO_2 , SO_2 , CH_4 and also a considerable turbidity caused by aerosol of volcanic origin. Under the influence of diffusion and air mass circulation the air mass is rapidly propagated and through gaps in the tropopause formed by powerful ascending flows enters the stratosphere and forms a stratospheric aerosol with time-evolving optical and structural characteristics. The most significant changes are caused by volcanic aerosol in the radiation regime of the stratosphere in the altitude range 20-30 km. The principal volcanic effect on radiative heat exchange is cooling of the earth's surface and troposphere. This cooling effect is intensified due to a decrease in the greenhouse effect of tropospheric water vapor and an increase in the glaciation zone and movement of the ice cover into the lower

latitudes. This climatic reaction is manifested to a greater degree on the continents than over the oceans. There is also an intensification of precipitation with an increase in atmospheric turbidity. Volcanism in the present era increases moisture exchange in the ocean-continent-atmosphere system, favoring ice accumulation and expansion of areas with an ice cover. In the stage preceding a volcanic eruption a great volume of gases is ejected into the stratosphere, increasing the concentration of stratospheric water vapor, CO₂ and sulfur gas. The possible presence of nitrogen oxides may exert a great climatic effect due to a change in planetary albedo and the greenhouse effect. Under certain circumstances volcanic aerosols can result in a warming effect which is intensified by feedbacks. Fluctuations of the frequency and intensity of volcanic activity could be one of the principal reasons for a temporary modulation of climate, advance and retreat of glaciers in the past. Figures 2; references 11: 9 Russian, 2 Western.

[90-5303]

OCEANOGRAPHY

UKRAINIANS EXPLORE OCEAN BOTTOM FROM AFRICA TO SOUTH AMERICA

Kiev PRAVDA UKRAINY in Russian 11 Mar 84 p 4

[Article by V. Petrenko: "Secrets of the Ocean Floor--Keeping Up With Events"]

[Text] Radiograms are received daily by the Sector of Marine Expeditions at the presidium of the Ukrainian Academy of Sciences, and metal flags--silhouettes of research ships--are moved on the large wall map.

"The flagship, Academician Vernadskiy, of our research fleet is already heading from the shores of Africa to South America," says N. G. Mikhaylov, candidate of engineering sciences, scientific secretary of the Sector of Marine Expeditions.

The oceans on an ordinary map are colored in different shades of dark and light blue. And here, on the maps of the ocean floor, everything appears different: mountain ranges have extended over thousands of kilometers.

One of them, the Mid Atlantic, is the one that Academician Vernadskiy is crossing. There, at a great depth, the ocean floor is cut by a deep longitudinal depression along the axis of the range, the so-called rift. The African and South American lithospheric plates are separating along this line at the rate of several centimeters per year.

Such sites are usually notable for powerful movements of segments of the earth's crust, underwater volcanic eruptions and earthquakes. For this reason, scientists are interested in comprehensive studies of the ranges and adjacent formations of the floor topography. During this trip, the Ukrainian geophysicists are studying the structure of rift zones and intensity of hot currents from the womb of our planet. Geologists, in turn, are striving to "catch" and raise to the surface samples of basic ore from the transverse fractures of Vernadskiy and Vim using deep-water scoops.

Ahead is one of the most interesting stages of the cruise. It will pass in the part of the Atlantic that is adjacent to the South American continent, in the region of the estuary of the Amazon River. This huge river carries into the ocean not only about 6000 cubic km of water per year, but 930 million tons of solid matter. It is these sediments that are deposited on the ocean floor that are attracting the attention of scientists.

10,657
CSO: 1865/89

UDC 551.628.515:543.42

RESULTS OF LABORATORY INVESTIGATIONS OF STOKES EMISSION SPECTRA OF
PETROLEUM AND DIESEL FUEL FILMS ON WATER SURFACE

Moscow OKEANOLOGIYA in Russian Vol 23, No 6, Nov-Dec 83
(manuscript received 16 Apr 82) pp 1049-1052

ABRAMOV, O. I., YEREMIN, V. I., LOBOV, L. I., POLOVINKO, V. V. and
ROMANOV, D. A., All-Union Electrotechnical Institute imeni V. I. Lenin,
Moscow; Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers

[Abstract] In order to determine petroleum and petroleum products in the waters of the world ocean by noncontact laser sounding with the use of UV lasers it is necessary to know the spectral characteristics of Stokes emission of polluted waters. This is because the Stokes emission caused by combined scattering and photoluminescence of waters carries information on the quantity and chemical composition of pollutants. Accordingly, for determining the possibilities of the noncontact laser method specialists at the All-Union Electrotechnical Institute carried out investigations of the spectral composition of Stokes emission of thin films of different brands of petroleum and diesel fuel on the water surface. Working jointly, the All-Union Electrotechnical Institute and the Moscow Institute of Geodetic, Aerial Mapping and Cartographic Engineers developed a spectral instrument whose block diagram is shown as Fig. 1 (the principle of operation is discussed in detail). In this instrument the source of sounding radiation is a ruby laser (radiation wavelength $\lambda_0 = 0.3472 \mu\text{m}$; maximum pulse power 1 MW; pulse duration 25-30 nanosec; radiation power smoothly adjustable in range 0.1-1 MW; pulse repetition rate 1 Hz). The measurements of the spectra of Stokes emission of polluted waters were made for two brands of petroleum and four brands of diesel fuel. It was found that there is a nonlinear dependence of the brightness of Stokes emission of films of petroleum products on the density of the sounding radiation. The greatest contrast is in the region $0.37\text{-}0.38 \mu\text{m}$ and $0.41\text{-}0.43 \mu\text{m}$. The results of the investigations confirmed the good prospects of the laser noncontact spectrometric method for detection, quantitative and qualitative determination of petroleum pollution on the water surface. Figures 2; references: 2 Russian.
[49-5303]

BIOMORPHIC ULTRAMICROSCOPIC STRUCTURES IN PELAGIC FERROMANGANESE NODULES

Moscow OKEANOLOGIYA in Russian Vol 23, No 6, Nov-Dec 83

(manuscript received 15 Mar 83) pp 997-1000

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[Abstract] The formation of lacustrine ferromanganese nodules occurs with the participation of specific bacterial microflora, which has been described in detail in the literature, but the role of microorganisms in the genesis of pelagic ferromanganese nodules remains unclear. This article gives data obtained by the authors in an electron microscope investigation of the composition and microstructure of pelagic ferromanganese nodules. The data were collected on the 48th voyage of the "Vityaz'" in 1970 in the central part of the zone of occurrence of Mid-Pacific seamounts in the Pacific Ocean (iron content 10-12%, manganese content 18-22%). In addition to the usual microstructures there were those which can be classified as biomorphic. The most characteristic of these are coccoid, tubular and panicled. The coccoid formations are round or convexolenticular bodies with a diameter 1-1.5 μm and are usually found in an aggregate state (Fig. 1). The tubular forms have the form of small tubes with a length of 1-10 μm with an external diameter of about 0.2 μm ; the thickness of their walls is about 0.01 μm . These tubes are straight and curved. Panicled formations consist of elongated bundles of fibers with a length of 2-5 μm and a thickness up to 0.2 μm . The thickness of individual fibers does not exceed 0.001 μm . An attempt at their identification was made. New types of bacteria and bacterial spores occurring in the marine medium, oxidizing and precipitating manganese, were discovered. Figures 3; references 23: 17 Russian, 6 Western.
[49-5303]

UDC 551.24.01

POSSIBILITY OF APPLICATION OF PLASTIC DESTRUCTION THEORY TO ANALYSIS OF STRUCTURE AND SEISMICITY OF MID-OCEANIC RIDGES

Moscow OKEANOLOGIYA in Russian Vol 23, No 6, Nov-Dec 83

(manuscript received 1 Apr 82, after revision 2 Dec 82) pp 990-996

MALKIN, B. V. and IVANCHENKO, G. N., Moscow State University
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[Abstract] This is an investigation of the applicability of some results of the theory of plastic destruction of flat strips subjected to dilatation to an analysis of the mechanical behavior of the lithosphere under definite tectonophysical conditions. The study is based on the assumption of the possibility of localizing plastic deformation for the lithosphere using a

scheme of destruction of a flat strip at a scale in which the thickness of a lithospheric plate is used as the thickness of the strip. With the latter assumption the zone of localization of plastic deformation will be several hundred kilometers in length. This makes it possible to discriminate such structures on maps at scales of 1:10,000,000-1:20,000,000. This model is applied in an examination of the initial stages in the formation of mid-oceanic ridges. The characteristic angular relationships of the direction of displacement of plates subjected to plastic and brittle destruction are analyzed. On the basis of plastic destruction effects the authors propose an interpretation of the phenomenon of surface structures with an echelon arrangement, the appearance of trenches transverse to the ridges and a stressed state of the lithosphere in nonorthogonal mid-oceanic ridges. Also examined are some deviations from an ideal scheme of plastic destruction of a flat strip (absence of a plastic reaction in the lithospheric surface layer, nonconfirmation to the geometrical relationships assumed in the theoretical scheme), since not the entire thickness of the lithosphere has a plastic reaction and its upper part is destroyed brittly with the formation of fractures orthogonal to the imparted force. The model is compared with and tested against a number of regions in the world ocean. Figures 5; references 33: 28 Russian, 5 Western.

[49-5303]

UDC 551.463(261)

RENEWAL OF PRINCIPAL MEDITERRANEAN SEA WATER MASSES

Moscow OKEANOLOGIYA in Russian Vol 23, No 6, Nov-Dec 83
(manuscript received 19 Aug 82, after revision 24 Nov 82) pp 960-962

OVCHINNIKOV, I. M., Southern Division, Institute of Oceanology
imeni P. P. Shirshov, USSR Academy of Sciences, Gelendzhik

[Abstract] On the basis of investigations of the thermohaline structure and water balance of the sea, water exchange through the straits and approximate estimates of some dynamic factors the author has attempted to determine the time required for renewal of the principal water masses in the Mediterranean Basin. It is shown that by knowing the volumes of inflowing Black Sea and Atlantic waters it is easy to determine the time of total renewal of all its waters (95 years). The renewal of waters in the eastern part of the sea, which is greater in volume, requires far less time (about 80 years) than the renewal of waters in the western basin (about 126 years). The time required for total renewal of the surface water mass due to inflow of waters through the straits is about 8.5 years; the time for total renewal of intermediate waters is 25.5 years; for renewal of the deep waters it is 71 years. These computations are correct only on the assumption that these processes transpire exclusively due to the main factors without allowance for the interaction of water masses with one another. The cited figures must therefore be regarded as approximate. The data clearly show that the capacity of the Mediterranean Sea for self-purification is extremely limited. This sea is a sort of accumulator of pollutants which for a long time (40-70 years) are seemingly stored in the deep waters. Tables 1; references 10: 4 Russian, 6 Western.

[49-5303]

SELF-SIMILAR REGIMES OF NONSTATIONARY TURBULENT CONVECTION

Moscow OKEANOLOGIYA in Russian Vol 23, No 6, Nov-Dec 83
(manuscript received 19 Jul 82, after revision 14 Mar 83) pp 944-949

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[Abstract] A study was made of well-developed turbulent convection in order to clarify various self-similar regimes of nonstationary turbulent convection. In describing these regimes it is possible to use the approaches developed in turbulence theory and the theory of the atmospheric surface layer. The authors examine different regimes of penetrating turbulent convection in the absence of a mean shear current. Density stratification in a fluid is determined only by temperature changes, the influence of salinity being neglected. The following assumptions and simplifications are also made in formulation of the problem. The random fields of temperature and velocity fluctuations are considered, as in atmospheric surface layer theory, as statistically homogeneous in horizontal planes, but in contrast to surface layer theory are considered, as in atmospheric surface layer theory, as statistically homogeneous in horizontal planes, but in contrast to surface layer theory are considered to be statistically nonstationary. At the initial moment in time ($t = 0$) all the fluid is in a state of rest and has a temperature constant in depth. With times $t > 0$ the fluid is cooled from the surface, giving rise to a zone of convective turbulent mixing propagation from the surface into the depth of the fluid. In this formulation the problem is solved using the semiempirical theory of turbulence. Three regimes of penetrating convection are considered (these are similar to the three classical problems of thermal conductivity). These are: I -- regime of constant boundary temperature, II -- regime of constant boundary heat flow, III -- regime corresponding to instantaneous "impulse" cooling. Solution of a system of equations (1)-(3) with stipulated boundary conditions is obtained for the convective regimes I-III. On this basis the authors give the results of computations of the profiles of temperature and turbulent energy and the terms in the equation for the balance of turbulent energy responsible for the production and dissipation of turbulence. Figures 2; references 13: 12 Russian, 1 Western.

[49-5303]

TRAPPED TOPOGRAPHIC WAVES IN BALTIC SEA

Moscow OKEANOLOGIYA in Russian Vol 23, No 6, Nov-Dec 83
(manuscript received 15 Jun 82) pp 928-931

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[Abstract] The theory of waves trapped by the bottom was first proposed by P. Rhines (GEOPHYS. FLUID DYN., Vol 1, No 3, pp 273-302, 1970). The theory was first formulated for small slopes, but topographic waves trapped by the bottom also arise when there are considerable bottom slopes. Many theoretical and experimental studies have dealt with shelf waves in a stratified ocean, but the literature contains nothing indicating that such waves, trapped in a vertical direction (by the bottom) and in a horizontal direction (by the slope), can also exist in the open ocean where there is a considerable bottom slope and the sea is not homogeneous. These phenomena are examined here for the open part of the Baltic Sea. A characteristic feature of the topographic waves detected by current velocity measurements there is that they are trapped by topography, by the slope in a horizontal direction and the bottom. The content of this article is presentation of the evidence for trapped topographic waves and interpretation of their behavior. An in situ experiment in 1977 revealed waves with a 3-day period, whereas another in 1980 revealed well-expressed 6-8-day variation of current velocity. In the interpretation, in addition to the Rhines model, the J. M. Huthnance model (J. PHYS. OCEANOGR., Vol 8, No 1, pp 74-92, 1978) was also used, the latter being applicable for an arbitrary bottom topography and stratification. It is shown that the Huthnance model indicates the possibility of existence of waves trapped by topography in the open ocean. An advantage of the model is a separation of the vertical and horizontal modes of topographic waves in the case of arbitrary bottom topography; on the other hand, the model does not take a macroscale current into account, so that the model can only be a first approximation in the interpretation of in situ measurements. Figures 3; references 8: 2 Russian, 6 Western.

[49-5303]

GENERALIZED SPECTRA OF SLIGHTLY NONLINEAR ROSSBY WAVES

Moscow OKEANOLOGIYA in Russian Vol 23, No 6, Nov-Dec 83
(manuscript received 4 Jul 83) pp 923-927

REZNIK, G. M. and SOOMERE, T. E., Institute of Oceanology
imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] An important feature of the evolution of systems of slightly nonlinear Rossby waves is a quite intensive transfer of energy to the zonal component of movement, that is, to wave vectors having a predominantly meridional direction. This feature is not dependent on the initial form of the spectrum. The F spectrum of a thermodynamically equilibrium state is isotropic and coincides with the equilibrium spectrum of two-dimensional turbulence:

$$F = \frac{1}{a+b\chi^2}. \quad (1)$$

Spectrum (1) can be obtained directly from the kinetic equation for Rossby waves. However, as demonstrated in this article, it is possible to find equilibrium spectra in a class of spectra including generalized functions ("generalized spectra"), no longer being isotropic. Here it is shown that the spectrum of a stationary zonal flow, proportional to the Dirac δ -function, is a solution of the kinetic equation for Rossby waves. The stability of this spectrum is proven. An equation is derived describing the evolution of the spectrum of waves against the background of a zonal flow, as well as an equation for the entropy of such a system. Further, it is shown that a spectrum equal to the sum of the spectrum of a stationary zonal flow and an isotropic equilibrium spectrum is also thermodynamically in equilibrium and stable. It is concluded that the intensive transfer of energy to wave vectors predominantly of a meridional direction not only does not contradict the tendency of the system to thermodynamic equilibrium, but can be caused precisely by such a tendency to an equilibrium spectrum of the type arrived at in this investigation. References 9: 7 Russian, 2 Western.
[49-5303]

SEASONAL VARIABILITY OF SURFACE CURRENTS IN WORLD OCEAN

Moscow OKEANOLOGIYA in Russian Vol 23, No 6, Nov-Dec 83
(manuscript received 20 Aug 82, after revision 3 Feb 83) pp 917-922

BREKHOVSKIKH, A. L., DEMIN, Yu. L. and SHAKHANOVA, T. V., Institute of
Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] In OKEANOLOGIYA, Vol 20, No 4, pp 607-612, 1980 A. L. Brekhovskikh published the first results of diagnostic computations of surface climatic currents in the world ocean in summer in a grid with a 1° interval, a higher resolution than the 5° interval used by other authors, but it was characterized by a number of obvious shortcomings, for example, extrapolation of data was required. The author and his colleagues have now corrected this deficiency. Use was made of mean multiyear fields of atmospheric pressure for the four seasons of the year prepared at the USSR Hydrometeorological Center. These maps cover the entire earth and preclude the need for extrapolation. The mean multiyear temperature and salinity fields for the four seasons and data on ocean depths were taken from the same source as in the earlier study, but now were first smoothed with a Tukey filter. The computations were made using the Sarkisyan quasigeostrophic model. The numerical computation method was described in the earlier study. The maps compiled on the basis of the new data and with the new procedures accompany this article as large foldouts (only maps for the winter and summer). These maps are compared in detail with those published earlier. The new maps clearly illustrate the presence of the seasonal variation in climatic circulation of surface waters in the world ocean. For most currents it has only a quantitative character. Qualitative seasonal changes occur primarily in the northern part of the Indian Ocean where a strong influence of the monsoon is felt. Figures 2; references 15: 12 Russian, 3 Western.
[49-5303]

FRACTIONATION OF CHEMICAL ELEMENTS AT OCEAN-ATMOSPHERE INTERFACE

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE,
KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 1, Jan 84
(manuscript received 17 Mar 83) pp 6-9

BEZBORODOV, A. A., YEREMEYEVA, L. V. and LISHENKO, S. V., Marine Hydrophysical
Institute, Ukrainian Academy of Sciences, Sevastopol

[Abstract] A study was made of the macrocomponents of the salt composition in the surface microlayer (SML) and the relationships among them. The literature contains no information on this subject. The investigation also included the content of some trace elements and fractionation processes at

the ocean-atmosphere interface. The SML water samples were taken during expeditionary work in the Indian Ocean in 1979. The SML is enriched to different degrees with different components: to the greatest degree with Ca and SO_4 and trace elements, and to the least degree with Na. For research purposes SML samples were taken from a layer with a thickness not less than 200 mm, 4-5 times greater than its true thickness. It is shown that with transition from the ocean into the atmosphere the fractionation of ions already occurs within the SML. The observed fractionation cannot be caused by Gibbs adsorption or thermal diffusion. The more probable mechanism is the selective adsorption of ions on surface-active organic molecules accumulating at the ocean-atmosphere interface. This mechanism was tested in experiments with the ionic flotation of sea water in the presence of different surface-active substances. The postulated mechanism was fully confirmed. It was demonstrated that air bubbles, rising to the surface from the lower water layers, play an enormous role in the exchange of matter between the ocean and atmosphere. The fractionation of ions occurs at their surface. The bubbles transport matter to the sea-air interface and upon bursting of the bubbles at the ocean surface very tiny droplets are cast into the air and create a definite chemical composition of sea air. In the enrichment of the PML by individual elements an important role is evidently played by their rate of transport due to molecular diffusion within the limits of the boundary diffusion layer (BDL), having a thickness of about 40 μm . Tables 3; references 8: 4 Russian, 4 Western.
[65-5303]

UDC 551.464(267)

INFLUENCE OF WIND ON RATE OF GAS EXCHANGE THROUGH OCEAN-ATMOSPHERE INTERFACE

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 1, Jan 84
(manuscript received 13 Apr 83) pp 3-6

BATRAKOV, F. G., YEREMEYEV, V. N. and ZEMLYANOV, A. D., Marine Hydrophysical Institute, Ukrainian Academy of Sciences, Sevastopol

[Abstract] A timely problem in oceanology is the nature of the exchange of matter between the ocean and atmosphere. The expression $F = K_L \alpha \Delta P$ gives the flux of any gas through the ocean-atmosphere interface (K_L is the rate of gas exchange, α is gas solubility, ΔP is the difference in partial pressures of gas in the ocean and atmosphere). The problem can be reduced to obtaining the dependence of K_L on wind velocity v , which to a considerable degree determines the state of the near-water layer of the atmosphere and the upper mixed layer in the ocean. Until now it has been impossible to draw any unambiguous conclusion concerning the nature of the dependence of K_L on v . The authors have sought to solve this problem by using data on the vertical distribution of the inert radioactive gas Rn^{222} in ocean waters. The results can be used in an analysis of gas exchange in all cases when the physico-chemical and biochemical factors exert no significant influence on transfer processes in the surface microlayer of sea water. It is necessary to make

prolonged observations at a single point or in a small polygon with persistence of quasiuniform hydrometeorological characteristics during the measurements. Such investigations were made during 1980-1982 in some regions of the Indian and Atlantic Oceans. An original method, described in the text, was used in measuring the Rn^{222} concentration. Figure 1 in the text shows examples of the vertical distribution of Rn^{222} . Figure 2 illustrates the dependence of the rate of gas exchange on wind velocity. As a result of this work a dependence was established between the rate of gas exchange and wind speed varying in the range 3-12 m/sec. Figures 2; references 3: 2 Russian, 1 Western.
[65-5303]

UDC 911.2:551.46

BOOK REVIEWS: TIKHIY OKEAN. SER. 'GEOGRAFIYA MIROVOGO OKEANA' (PACIFIC OCEAN. SERIES 'GEOGRAPHY OF THE WORLD OCEAN'), RESPONSIBLE EDITORS V. G. KORT AND S. S. SAL'NIKOV, LENINGRAD, NAUKA, 1981, 388 PAGES, INDIYSKIY OKEAN. SER. 'GEOGRAFIYA MIROVOGO OKEANA' (INDIAN OCEAN. SERIES 'GEOGRAPHY OF THE WORLD OCEAN'), RESPONSIBLE EDITORS V. G. KORT AND S. S. SAL'NIKOV, LENINGRAD, NAUKA, 1982, 388 PAGES

Leningrad IZVESTIYA VSESOYUZNOGO GEOGRAFICHESKOGO OBSHCHESTVA in Russian Vol 116, No 1, Jan-Feb 84 (manuscript received 1 Aug 83) pp 84-85

LITOVKA, O. P.

[Abstract] This is a review of two regional volumes of the 6-volume series GEOGRAPHY OF THE WORLD OCEAN (GEOGRAFIYA MIROVOGO OKEANA). They contain thorough descriptions of the physical geography and economic geography of the Pacific and Indian Oceans. These are the first such geographical descriptions in the Soviet or foreign literature and represent a substantial scientific advance in study of the oceans. There has never been such an effort at regionalization of ocean areas; since there has been little or no precedent for undertakings of this type the reviewer is reluctant to make critical comments. A remarkable success has been achieved, original solutions have been found and a solid theoretical base has been applied. This applies, in particular, to: the optimum structure of the integrated physical geography and economic geography description of the oceansphere, introduction of principles of physical geography regionalization and economic geography differentiation of the ocean and writeup of a description on the basis of the formulated principles. Each of the volumes is divided into three sections: "Physiographic and Biological Description of Ocean," "Economic Geography Description of Ocean" and "Economic Provinces of Ocean." The following are examined in detail: relief, geological structure, geophysical fields at the ocean floor, characteristics of shores and islands, climate, hydrology, principal features of water chemistry. In addition to a political map, there are the following regionalization maps: physical geography, biogeography and fish resources. Prepared on the basis of very recent data, the volumes have a large number of illustrations. Two additional regional volumes are forthcoming.
[66-5303]

FLUCTUATIONS OF VELOCITY DISTRIBUTION UNDER INFLUENCE OF SUSPENDED PARTICLES ON TURBULENCE IN BOTTOM CURRENT

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 19, No 11, Nov 83
(manuscript received 19 Sep 82, after revision 20 Feb 83) pp 1188-1197

SAMOLYUBOV, V. I., GALKIN, S. V. and ZELENOV, A. A., Moscow State University

[Abstract] Data from a series of in situ investigations of a two-nucleus suspension flow in the course of the diurnal cycle are used in analyzing transformation of the vertical structure of the velocity field and the spectra of its low-frequency fluctuations responsible for such transformations. The investigations were made in a deep natural water body of the canyon type with a depth as great as 300 m, a length of about 60 km and a maximum width of 5 km. A density stratification was ensured by an increased concentration of suspended particles with a grain size 2-70 μm . The in situ measurements were made with a gradient apparatus with a height of 4.5 km to which was attached (at intervals of 0.5 m) sensors for measuring the modulus of current velocity and its fluctuations, photonephelometers and semiconductor thermistors. This apparatus was joined by a cable to a ship, this making it possible to obtain continuous nephelometric profiles and temperature curves of the entire thickness of the bottom current. Water samples were taken from the flow using a special gradient bathometric system. The studies revealed a "bursting" of the nuclei of the internal density currents in the thickness of the stratified flow caused by variations in the positions and thicknesses of the boundary layers at the suspension frequencies f_s . Fluctuations at the characteristic frequencies $f_s = (\omega_0/S) \partial S / \partial z$ were detected as a result of a combination of hydrological measurements and precise methods for analysis of the granulometric composition of the suspended particles (here ω_0 is the mean weighted hydraulic granularity, S is the concentration of suspended matter, z is distance from the bottom). Also examined is the temporal change in integral and local Reynolds numbers and evaluations of the buoyancy scale. The decisive influence of f_s fluctuations on structure of a suspension current as the principal source of turbulent formations of an external scale is demonstrated. This turbulence is among the fundamental processes determining energy and mass exchange and structure in bottom currents. Figures 4; references: 6 Russian.
[41-5303]

SOME CHARACTERISTICS OF RADIATION FIELD IN MEDIUM WITH FLUCTUATING OPTICAL PARAMETERS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 19, No 11, Nov 83 (manuscript received 27 May 82) pp 1172-1179

KATSEV, I. L., Physics Institute, Belorussian Academy of Sciences

[Abstract] Natural scattering formations, such as clouds, fog and sea water, are media whose optical parameters have spatial and temporal fluctuations. The presence of fluctuations whose spatial scale is much less than the size of individual scatterers and commensurable with the length of the free path of a photon in the medium results in a change in the mean values of the light field in the medium and the appearance of a fluctuating component. These are matters which the author has examined in earlier studies (IZV. AN SSSR: FAO, Vol 17, No 7, pp 725-731, 1981; Vol 18, No 8, pp 884-885, 1982; Vol 17, No 5, pp 478-486, 1981). Proceeding on the basis of this earlier work, the author now determines the influence of fluctuations of optical parameters of the medium on the characteristics of the mean radiation field. The small-angle approximation is used in solving the problem of radiation propagation in a medium with fluctuating extinction and scattering indices. The following characteristics of the mean light field are determined: integral flux, dispersion of the angular distribution of radiation intensity, and most importantly, the optical transfer function. Formulas are derived for the spatial spectrum and the dispersion of illumination fluctuations in the medium. Figures 2; references: 7 Russian.
[41-5303]

SHELF WAVES IN PRESENCE OF CURRENTS AND STABILITY OF BOUNDARY CURRENTS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 19, No 12, Dec 83 (manuscript received 28 Jun 82) pp 1288-1294

YEFIMOV, V. V. and FAYN, I. V., Marine Hydrophysical Institute, Ukrainian Academy of Sciences; Sakhalin Multidiscipline Scientific Research Institute, Far Eastern Scientific Center, USSR Academy of Sciences

[Abstract] Long trapped waves play an important role in the dynamics of boundary regions of the ocean. Among these trapped waves there are continental shelf waves or topographic Rossby waves on the shelf propagating along the shore due to the joint effects of the earth's rotation and change in ocean depth. In the presence of currents continental shelf waves will be "drifted" with some mean velocity of the main current. In the case of a current with a horizontal velocity shear they have the following features: there is only a finite number of modes of continental shelf waves (possibly

a total absence of modes); shelf waves cannot exist for large wave numbers; the equations describing continental shelf waves allow the existence of solutions increasing and attenuating with time. Equations and effects of such a type appear in the theory of barotropic stability of zonal currents and the Rayleigh stability tests are directly applicable to the case of propagation of shelf waves in a shear flow, provided that the vorticity gradient in the Rayleigh equation is replaced by the gradient of current potential vorticity. The current will be stable if the potential vorticity gradient does not change sign in the considered region. With these considerations taken into account, the authors examine the problem of propagation of shelf waves in the presence of a barotropic shear current and horizontal friction in a semi-infinite rotating ocean with a cylindrical shelf and a linear shore. In the case of currents directed in a direction opposite the propagation of shelf waves it was found that there are unstable (growing) waves. The period of such waves is determined by the current velocity along the shore and the wave length is determined by the relationship between bottom slope and flow velocity. Examples of the propagation of shelf waves in the Strait of Florida and in the Kuroshio Current are examined. It is shown that horizontal friction can result in a loss of stability of the boundary current relative to barotropic shelf oscillations for flows bounded to the left by a coast in the northern hemisphere. Growing waves have rather considerable periods determined by the horizontal gradient of flow and short lengths. Figures 5; references 11: 8 Russian, 3 Western.
[51-5303]

UDC 551.465.41

ASYMPTOTIC FORM OF SOLUTION OF PROBLEM OF SEASONAL EVOLUTION OF THERMAL REGIME IN OCEAN

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 19, No 12, Dec 83 (manuscript received 6 Jul 82) pp 1328-1331

MASLOVA, N. B. and RYABCHENKO, V. A., Institute of Oceanology, USSR Academy of Sciences

[Abstract] The thermal regime of the deep layers of the ocean is stabilized over the course of many hundreds of years and accordingly reproduction of evolution of the temperature field, even when using simple models, requires great expenditures of computer time. The authors use the box model proposed by B. A. Kagan, et al. (IZV. AN SSSR: FAO, Vol 18, No 4, pp 373-382, 1982) for validating the possibility of application of asymptotic analysis in developing an efficient means for calculating the long-period temporal evolution of the thermal regime of the ocean. It is shown that the time scale for stabilization of the temperature field is several orders of magnitude greater than the time required for stabilization of the thickness of the upper quasihomogeneous layer (UQL) and heat flows at the boundary between the UQL and deep layer (DL) of the ocean. The presence of a small parameter in the system makes it possible to describe slow changes in the

temperature field by an asymptotic series whose coefficients take into account the cumulative effect of short-period (seasonal) variations. Asymptotic formulas are derived which were used in computing the seasonal evolution of temperature and thickness of the UQL (the initial data were taken from the Kagan article cited above). The results are given in a table, which as a comparison also gives the results of numerical solution of the derived system of equations by the Runge-Kutta method with these same initial data. It is shown that the temperature and thickness values at different moments in the annual cycle, computed by the two methods, virtually coincide. Computations of a periodic solution by the Runge-Kutta method require about 9 minutes computer time; using the asymptotic formulas the time for solving the problem is reduced to 9 sec. A possible application of the formulas is in solution of problems in paleoclimatology. Tables 1; references: 1 Russian. [51-5303]

UDC 551.465.11:551.465.41

FORMING OF UPPER HOMOGENEOUS LAYER IN MEDITERRANEAN BASIN

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 19, No 12, Dec 83 (manuscript received 28 Jun 82, after revision 17 Sep 82) pp 1312-1317

IVANOV, Yu. A., PLAKHIN, Ye. A. and BYSHEV, V. I., Institute of Oceanology, USSR Academy of Sciences

[Abstract] The formation of the upper homogeneous layer is examined for different basins of the Mediterranean Sea, taking its specific hydrophysical regime into account. In the Mediterranean, with some initial vertical distribution of temperature and salinity in the surface layer, and also with a definite intensity and duration of surface cooling in winter, favorable conditions can arise for density mixing to maximum depths. In two earlier studies (OKEANOLOGIYA, Vol XI, No 4, pp 623-628, 1971; Vol XII, No 3, pp 407-415, 1972) Ye. A. Plakhin by indirect hydrological methods computed some parameters making it possible to estimate the depths of penetrating convection. A map (Fig. 1) was compiled to show the maximum depths of penetrating convection. In the northern part of the western basin convective mixing in the cold season can extend to the bottom; in some regions of the eastern basin (Levant Sea) convection can extend to a depth of 200-350 m. This article gives the results of a numerical experiment with a model of non-stationary thermohaline structure of the upper layer for these two regions. Using the numerical model it was possible to obtain a good correspondence between the numerical results and diagnostic computations made on the basis of the mean field of temperature and salinity and data from specific expeditions. In the future the results can be used in predicting the depths of penetration of convection and determination of the upper boundary of the jump layer when there are adequately complete data on the seasonal variation of temperature and salinity at the surface. Figures 4; references: 6 Russian. [51-5303]

CROSS-SPECTRAL ANALYSIS OF ATMOSPHERIC PRESSURE MICROFLUCTUATIONS AND LOW-FREQUENCY SEA LEVEL CHANGES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 20, No 1, Jan 84 (manuscript received 20 Sep 82) pp 57-64

BYCHKOV, V. S., Water Problems Institute, USSR Academy of Sciences

[Abstract] The experiments described here involved synchronous registry of atmospheric pressure with a response of 0.23 mb per mm of record and level changes of the sea with a response of 4 mm of level excess per 1 mm of record. The synchronous records of the processes were of the analog type, continuous, with a vertical scale making possible the simultaneous registry of fluctuations with periods from 5 minutes to 24 hours. On the curve of diurnal or semidiurnal fluctuations there was registry of high-frequency (relative to diurnal) fluctuations with periods from 5 minutes to 2 hours. The total duration of these synchronous records was 4 months (2 months for Cuba, 2 months for the Southern Caspian). The fluctuations of atmospheric pressure were registered at a height of 1-2 m above sea level; sea level changes were registered in the coastal zone at a depth of about 5 m, 100 m from the shore. It was found that high linear coherence coefficients and minimum phase shifts between these processes are observed in the high-frequency part of the spectrum of fluctuations ($\tau \sim 10$ minutes). The nonlinear transfer of energy between these processes was investigated and an explanation is given for the observed effects. The principal conclusion drawn from the study is that the difference in the velocity of propagation of long waves in the ocean (300 m/sec) and atmosphere (170 m/sec) is related to the presence of a nonresonance energy flux from one medium to the other. Figures 6; references: 10 Russian.
[57-5303]

UDC 551.513.1

SUPERCRITICAL REGIMES IN ROSSBY WAVE PROPAGATION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 20, No 1, Jan 84 (manuscript received 15 Dec 82) pp 3-9

MIRABEL', A. P., Institute of Oceanology, USSR Academy of Sciences

[Abstract] This is a critical review of the barotropic instability of Rossby wave motion (E. N. Lorenz, J. ATMOS, SCI., Vol 29, No 2, pp 258-269, 1972). The author feels that the results of investigations of instability in Rossby wave motion are applicable to a description of zonal jet flows in the atmosphere and ocean. On the basis of the qualitative similarity of the physical patterns of secondary motion accompanying Rossby wave instability and jetlike motions in the atmosphere and in the open ocean it is possible

to relate the generation and intensification of jets to the effect of instability of a planetary wave. Against this background, using a three-mode approximation, the author analyzes the nonlinear stability of a barotropic Rossby wave propagating amidst a constant current. This is followed by formulation of a nonlinear dynamic system in amplitude-phase variables which allows a closed solution in the form of elliptical functions. Then an unstable case is analyzed which corresponds to a predominance of nonlinearity over dispersion (β -effect) and approximation formulas for the solution are obtained for this case. The periods 2Ω of system oscillations are determined. There is an increase in the period with a decrease in the initial energy of the perturbations with an almost constant modulation intensity and a decrease in 2Ω with a decrease in the amplitude of the fundamental wave and the dispersion parameter. The article ends with a qualitative analysis of stationary states of the system. Figures 4; references 8: 2 Russian, 6 Western.
[57-5303]

UDC 551.506.3:551.5

QUASIBIENNIAL CYCLE OF THERMODYNAMIC ATMOSPHERE-OCEAN INTERACTION IN NORTH ATLANTIC

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 274, No 4, Feb 84
(manuscript received 20 Jun 83) pp 922-925

NELEPO, B. A., academician, Ukrainian Academy of Sciences, YEFIMOV, V. V. and SIZOV, A. A., Marine Hydrophysical Institute, Ukrainian Academy of Sciences, Sevastopol

[Abstract] This investigation of the quasibiennial cycle of atmosphere-ocean interaction was made using archives of hydrometeorological data for 1957-1977 collected at the All-Union Scientific Research Institute of Hydrometeorological Information-World Data Center. Winter and summer situations were examined. Data relating to one of the phases of the quasibiennial cycle (westerly or easterly) were selected for analysis of the entire archives. The mean temperature of the upper 200-m layer of the ocean was computed. Surface pressure, cloud cover and surface temperature were used in the analysis. The entire North Atlantic from the equator to 60-65°N was broken down into 5° latitude zones. It was found that there is a very significant difference in the thermodynamic characteristics of the boundary layers of the atmosphere and ocean in the westerly and easterly phases of the cycle. For example, in the westerly phase in both winter and summer the maximum heat reserve in the upper 200-m layer is concentrated near the southern and northern boundaries of the studied region. The latitude zones where in the westerly phase T_{200} is 1-2°C greater than in the easterly phase coincide with regions of the maximum transport of waters by the Northern Trades and North Atlantic Currents. The westerly phase is characterized by an increase in the heat content of the upper layer of waters transported by the northerly and

southerly branches of the subtropical circulation. At the center of the subtropical circulation in both winter and summer $\bar{T}_{200}$ in the westerly phase on the average is 0.2°C lower than in the easterly phase. To the south of the North Trades Current and to the north of the North Atlantic Current the water in the layer 0-200 m in the westerly phase is colder than in the easterly phase by $0.5-1.5^{\circ}\text{C}$. On the other hand, the mean heat reserve in the upper layer of the ocean remains constant during different phases; the mapped temperature differences (Fig. 1) must be attributed to heat redistribution among the latitude zones, the large-scale redistribution of thermal anomalies being attributable directly to the biennial fluctuation of heat transfer by the subtropical circulation. These fluctuations are accompanied by and are interrelated to a corresponding redistribution of macroscale anomalies of surface pressure, cloud cover and surface temperature. The physical mechanisms of the quasibiennial cycle clearly warrant closer investigation. Figures 2; tables 1; references: 8 Russian.
[90-5303]

TERRESTRIAL GEOPHYSICS

DRILL RIG BEGUN FOR SUPERDEEP BOREHOLE IN SOUTHERN UKRAINE

Moscow PRAVDA in Russian 11 Jan 84 p 6

[Article by S. Chudakov, DNEPROVSKAYA PRAVDA correspondent, Dnepropetrovsk Oblast]

[Text] Work has begun on construction of the drill rig for the Krivoy Rog superdeep borehole, whose drilling is provided for by the program of the USSR State Committee on Science and Technology in connection with investigation of the earth's crust and upper mantle.

This is one of the 11 similar boreholes which are to be drilled at different points in our country.

In combination with geophysical investigations, the Krivoy Rog borehole will make it possible, in addition to fundamental scientific problems, to solve a number of practical problems in the formation and distribution of commercial-grade ores in the deep horizons of the Krivoy Rog iron ore basin.

Nikolay Yefimovich Baklanov, chief of the Southern Ukrainian Expedition of the Krymgeologiya (Crimean Geology) Association, states: "Here, in Chovoivanovka village, and to be more precise, directly under our feet, where we are now standing, is a tectonic fault of the greatest interest to scientists. In selecting precisely this site on the so-called Ukrainian crystalline shield, scientists made no mistake. Their prediction was also confirmed by the core which we obtained from a depth of a thousand meters."

The Krymgeologiya Association has accumulated considerable experience in drilling deep boreholes: drilling to a depth of 5,000 m is by no means unusual. However, there is much to be solved here for the first time.

Jointly with scientists, during drilling plans call for the replacement of bits without raising of the tool. Geophysicists are testing special apparatus developed by the Kiev Experimental Design Bureau of Geophysical Instrument Making. Acoustic methods for investigating the earth's deep layers will also be tested here.

5303

CSO: 1865/83

MAGNETOHYDRODYNAMIC GENERATOR HELPS PREDICT EARTHQUAKES

Frunze SOVETSKAYA KIRGIZIYA in Russian 3 Mar 84 p 4

[Unsigned article]

[Text] Kirgiz seismologists have received a powerful new tool for the prediction of strong earthquakes. In cooperation with specialists of the Institute of High Temperatures, USSR Academy of Sciences, they have begun investigations of the earth's deep layers using a magnetohydrodynamic (MHD) generator.

This apparatus, situated in the foothills of the Kirgiz Range, on the right bank of the Alamedin River, sends very strong (up to 2,000 A) electric current pulses into the depths of the earth for a distance of 40 or more kilometers. Passing through different rocks, the discharge makes it possible to obtain data on their resistivity and to detect dangerous sectors among them. The possibility of this is related to the fact that the deformation of rocks prior to an earthquake changes to a lesser degree than their resistivity. Accordingly, the use of MHD apparatus is now considered to be one of the most effective methods for predicting strong underground "storms."

F. N. Yudakhin, deputy director of the Institute of Seismology, Kirgiz SSR, states: "Over the territory of Kirgiziya, 95% of which falls in the zone of earthquakes with 8-9 scale units, a whole variety of seismic, geomagnetic, electrometric and seismogeochemical observations are made. These include the changes in the seismic regime, magnetic fields, variations in the chemical and gas composition of ground water; these can be used in judging tectonic thrusts. Magnetotelluric soundings of the earth's crust and upper mantle to a depth of 150-200 km and measurements of shows of mercury vapor at the sites of deep faults where so-called mercury 'breathing' of the earth is registered are being made for this purpose.

A map of seismic regionalization of the republic has been constructed on the basis of the multisided investigations. It defines zones of possible occurrence of strong earthquakes and also less seismically active regions favorable for further exploitation.

5303

CSO: 1865/83

UDC 550.344.094+550.347.24

USING APPARENT PERIODS OF SEISMIC OSCILLATIONS IN DETERMINING LENGTHS OF
FAULTS AT BAYKAL AREA EARTHQUAKE FOCI

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 1, Jan-Feb 84
(manuscript received 5 Oct 81) pp 90-97

SOLOMONENKO, A. V. and SOLOMONENKO, N. V., Institute of Earth's Crust,
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[Abstract] Regional studies of the apparent periods of seismic oscillations in seismically active regions reveal that transverse waves have periods greater than the corresponding longitudinal waves. However, in many cases the opposite is observed. Accordingly, the author has used experimental data in explaining this phenomenon and at the same time has attempted to use it in determining the lengths of fractures at earthquake foci. Data from the seismic stations in the Baykal area for 1968-1979 were used in the study. The dependence of $T_s - T_p$ on epicentral distance Δ for earthquakes of energy classes 7-13 which occurred in the Baykal seismic zone was analyzed. All the earthquakes used in the study had foci within the crust. Histograms of the $T_s - T_p$ values taken into account. In approximately 40% of the cases the longitudinal oscillations have apparent periods of the maximum displacements which are greater than for the corresponding transverse oscillations. The transverse oscillations are "drawn out" with an increase in distance from the source more strongly than the longitudinal oscillations. This fact can be attributed only to the peculiarities of radiation of oscillations by the source. In the same 40% of the cases the angle between the direction of propagation of a fracture at the earthquake focus and the direction to a seismic station is less than a right angle. A formula is derived showing that the period of an S-wave can be greater than the period of the corresponding P-wave only in a case when $\cos \theta < 0$, that is, $\theta > 90^\circ$. This formula can serve as a basis for determining the lengths of fractures at earthquake foci. Such computations were made for energy classes 7-12 occurring in the northeastern part of the Baykal rift zone. It has been noted that the lengths of fractures at earthquake foci in this part of the Baykal seismic zone are approximately 5 times less than for the world in general. An explanation for this phenomenon is presented. Figures 7; tables 1; references 13: 11 Russian, 2 Western.

[80-5303]

DYNAMICS OF DISPERSION REGIME OF VOLCANIC ERUPTIONS 2. DISCHARGE
INSTABILITY CONDITION AND NATURE OF CATASTROPHIC EXPLOSIVE ERUPTIONS

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 1, Jan-Feb 84
(manuscript received 12 Feb 83) pp 23-35

SLEZIN, Yu. B., Volcanology Institute, Far Eastern Scientific Center, USSR
Academy of Sciences

[Abstract] The author has defined a rather general theory which explains the principal characteristics of explosive eruptions. The theory is based on a number of fundamental principles. An eruption is a mechanical process of transport of deep matter to the earth's surface from some volume (the focus) through a relatively narrow conduit. During an eruption the focus can be regarded as an isolated volume; the process of its feeding from the deeper zones has a quite low intensity and a greater inertia in comparison with the discharge process during an eruption. The transported matter is a viscous fluid containing dissolved volatile components released in the gas phase with a pressure decrease. The regime of outflow of matter can be considered stationary in individual stages of the eruption. With these and other simplifying assumptions it was possible to obtain proof of the possibility of the appearance of catastrophic jumplike changes in the eruption regime as a result of a slow continuous change in individual parameters of the process. It was possible to determine specific parameters, the nature of their changes and their critical values at which a catastrophe can occur. There are three principal controlling parameters--focal depth, conduit conductivity parameter and focal pressure in excess of hydrostatic pressure, which in the course of an eruption can change from a small positive value to a rather significant negative value. These results were used in formulating a specific scheme of development of catastrophic explosive eruptions. A catastrophic explosive eruption in the light of this theory is not an explosion in the ordinary sense of the word, but instead of a sharp jump in the intensity of outflow arising as a result of continuous development of the process. The discovered correlation between catastrophic explosive eruptions and the geometry of the "focus-conduit" system gives a theoretical basis for developing geophysical methods for predicting the potential danger of specific volcanoes. Figures 4; tables 1; references 20: 17 Russian, 3 Western.

[80-5303]

DESCRIPTIVE STATISTICAL MODEL OF EARTHQUAKE FOCAL RADIATION AND ITS APPLICATION IN EVALUATING SHORT-PERIOD STRONG MOVEMENT

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 1, Jan-Feb 84
(manuscript received 6 Sep 82) pp 3-22

GUSEV, A. A., Volcanology Institute, Far Eastern Scientific Center, USSR Academy of Sciences

[Abstract] The description of short-period focal radiation is important for comprehending the focal process and developing methods for predicting strong movements. Deterministic focal models have been ineffective for a wide-band description of focal radiation; statistical models give a sound basis for such a description. However, serious difficulties arise when obtaining numerical evaluations. Data from teleseismic wide-band observations cannot be used due to virtually complete absorption of short-period S-waves and there are virtually no wide-band observations in the near zone. In order to reconstruct the spectrum on the basis of wide-band observations it is necessary to combine different wave field concepts (surface waves, ray description, scattered waves). In this article quite simple methods are used in obtaining preliminary evaluations of the spectrum in a wide frequency band. The author uses data from the literature in deriving a law for the scaling of the focal spectra of earthquakes in a wide frequency band. The principal features of this law are an absence of similarity and the presence of two characteristic frequencies (~ 0.2 and $3-10$ Hz). The mean power flux of short-period radiation from the surface of the focus is weakly dependent on magnitude. The flux is relatively low for the foci of major earthquakes. Formulas are derived for determining the "static" and wave fields of accelerations near an incoherent focus from the focal spectrum and magnitude-distance-acceleration or intensity computational expressions are obtained on their basis. These expressions agree well with the empirical data. Figures 6; references 58: 23 Russian, 35 Western.

[80-5303]

SPECIAL SEISMIC CHARACTERISTICS AND KINETIC FOCAL PARAMETERS OF IRANIAN EARTHQUAKES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 12, Dec 83
(manuscript received 21 Dec 81) pp 68-75

ANNARAZOVA, T. A., Institute of Physics of Earth imeni O. Yu. Shmidt, USSR Academy of Sciences

[Abstract] A study was made of Iranian earthquakes with a magnitude $M \geq 6$ during the years 1968-1981. The 25 earthquakes registered during this

period are tabulated; 16 of these with clear records of longitudinal or transverse waves were selected for further study. The majority of the records were of two types: 1) the body wave train consists of three extrema or impulses; 2) a five-impulse body wave train. Analysis revealed that these seismograms have nothing which distinguished them from the records of earthquakes in other seismically active regions. The number of impulses on the seismogram is not dependent on the position of the earthquake epicenter; it is governed by the position of the fault plane relative to the ray arriving at the recording station, that is, is determined by the angle of emergence of the seismic ray at the focus. The development of the seismic process at the foci of these earthquakes corresponds to a model of discontinuous fracturing. In the first stage of focal development a destruction plane of finite extent appears. This is followed by a process of concentration of stresses on its contour and subsequent focal development in the form of a circle whose radius increases at a finite rate. A study of the kinematic parameters revealed that the fracturing time and duration of the focal process development increase with an increase in magnitude. The duration of the interruption in the destruction process is evidently not dependent on magnitude. The rates of fracturing in the area of the ring remain finite and vary in the range 0.9-3.4 km/sec. The dependence of the focal radii (in km) on magnitude can be expressed as $\rho = 96(M-6)+19.5$, this being applicable for evaluating the extent of foci of Iranian earthquakes with $M \geq 6.5$. The position of fracturing planes can be determined unambiguously using the known focal mechanisms and the angles of emergence of seismic rays from the foci. The depth of penetration of the foci was determined. Figures 5; tables 3; references 6: 5 Russian, 1 Western. [56-5303]

UDC 550.831

UNIQUENESS OF INVERSE PROBLEM IN GRAVIMETRY FOR HOMOGENEOUS POLYHEDRONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 12, Dec 83 (manuscript received 25 Oct 82) pp 60-67

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[Abstract] This is essentially a further development of a study by M. A. Brodskiy, et al., "Uniqueness of Solution of Two-Dimensional Inverse Problems in Gravimetry and Magnetometry for Polyhedrons," DOKL. AN SSSR, Vol 264, No 2, pp 318-322, 1982, where necessary and adequate conditions were obtained for determining polyhedrons on the basis of their external potential. These theorems and the counterexamples set forth in the earlier study have made possible completion of investigations of this inverse problem. This required the use and development of new methods in this field. The author here presents a proof of the uniqueness theorem for polyhedrons using methodology more complex and unwieldy than for plane polyhedrons, but adhering to the logic in the first investigation. The basis for the proof is the equality of internal potentials under the condition of equality of external

potentials of the bodies. The analytical approach of the direct three-dimensional potential problem, investigated in a number of other studies (Isakov, V. M., DIFFERENTIAL'NYE URAVNE NIYA, Vol VIII, No 1, pp 30-40, 1972; Strakhov, V. I., et al., TEORIYA I PRAKTIKA INTERPRETATSII GRAVITATSIONNYKH I MAGNITNYKH POLEY V SSSR, Kiev, Nauk, dumka, 1982, 324 pages; Zhdanov, M. S., IZV. AN SSSR: FIZIKA ZEMLI, No 9, pp 32-46, 1974), is used here in solving the inverse problem. References: 5 Russian.
[56-5303]

UDC 550.831

SOLUTION OF DIRECT PROBLEM IN GRAVIMETRY ON SPHERICAL EARTH

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 12, Dec 83
(manuscript received 20 Sep 82) pp 34-49

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[Abstract] In making computations which are used in constructing density models of the crust and upper mantle on the basis of the observed gravity field it is usually assumed that the earth's surface is flat. In order to facilitate allowance for the earth's sphericity in such work the authors propose two algorithms for solving the direct ~~gravimetric~~ ^{gravimetric} problem for geopotential and its derivative in a radial direction on a spherical earth for a three-dimensional body, inhomogeneous in depth, bounded by spherical coordinate surfaces. This is essentially a generalization of the study by V. Vyskocil and M. Burda in STUDIA GEOPHYSICA ET GEODAETICA, No 3, pp 213-218, 1976, for an earth of nonuniform radius. One of the algorithms is characterized by exceptional accuracy (a comparison is made of the gravitational effects of bodies which may be considered analogues of one another for spherical and flat earths). These algorithms are intended for constructing density models of large structures on the earth or other planets on the basis of their gravitational fields. Examples are given of the errors arising in the case of nonallowance for the earth's sphericity. In the better of the proposed algorithms all the computations are made independently and there is no sharp accumulation of errors as in the simpler variant. Figures 6; tables 4; references 23: 16 Russian, 7 Western.
[56-5303]

SEISMICITY AS STOCHASTIC PROCESS WITH PHYSICAL PARAMETERS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 12, Dec 83
(manuscript received 24 Jul 81) pp 16-28

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[Abstract] Although the seismic process is such a highly important physical process, the seismic regime, the totality of seismic events, has been traditionally described by quantitative parameters not having a physical content. In order to rectify this situation the author outlines a model of the seismic process as a series of states of an inhomogeneous medium characterized by an instantaneous distribution of the probabilities of sizes of fractures. There is a discussion of the conditions exerting an influence on the parameters of the curve of frequency of recurrence of earthquakes γ and their variation in time and space. The model proposed here as the point of departure contains a representation of some volume of an inhomogeneous and locally stressed medium (such as a crustal block) in the form of an autonomous ensemble of elements differing in strength which is given the sense of permeability (or "transparency") for the propagating fracture. The fracture is interpreted as a disruption of medium structure in a segment the probability of whose length is dependent on the composition of the ensemble. This leads to a decreasing distribution of fractures with a parameter similar to and (after corresponding correlation conversion) numerically close to the parameter γ of curves of the frequency of recurrence of earthquakes. Further taking into account that the strength structure of the medium is corrected by the local fields of stresses arising and disappearing together with fractures, it is possible to formalize this circumstance through a change in the composition of the strength ensemble occurring under the influence of fluctuations. Then the rock mass fragmentation process in the model corresponds to the evolution of a statistically characterized state of a system (medium) whose macroscopic parameters are expressed in seismicity terms. As with other processes involving the appearance and disappearance of "particles," this is a self-organizing process. Its temporal structure is essentially dependent on the values of the "microscopic" parameters. The medium spontaneously becomes "more transparent" and then "more turbid." Conditions arise for the freeing of elastic energy, then its accumulation. The process has a tendency to stationarity in the sense of a constancy of the γ parameter, although there may be fluctuations associated with a change in external conditions. The nature of changes in the level of stresses is another matter. In addition to slowly changing planetary or endogenous factors this level is probably determined by rapidly arising local fields of "live" fractures or zones of plastic flow. Since the earth's crust is evidently an open system, with an influx of energy from the outside, in the future this should lead to the use of nonequilibrium thermodynamics, determining the conditions for the development of spatial-temporal structures of a self-organizing (in this case seismic) process. Figures 3; references 47: 42 Russian, 5 Western. [56-5303]

DEEP GEOPHYSICAL INVESTIGATIONS IN ZONES OF PRESENT-DAY ACTIVE VOLCANISM

Novosibirsk TIKHOOKEANSKAYA GEOLOGIYA in Russian No 6, Nov-Dec 83
(manuscript received 16 May 83) pp 118-120

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[Abstract] This is a review of a book by S. T. Balesta entitled ZEMNAYA KORA I MAGMATICHESKIYE OCHAGI OBLASTEY SOVREMENNOGO VULKANIZMA (Earth's Crust and Magma Hearths in Regions of Present-Day Volcanism) (Moscow, Nauka, 1981). It deals with the structure of the crust and magma hearths in regions of present-day volcanism in the example of Kamchatka; physical properties, structure of the crust and top of the mantle and magma hearths of other regions of present-day magmatism (Japan, Hawaiian Islands, Iceland) are analyzed; the results of ultrasonic seismic modeling, the peculiarities of the method for seismic probing of Kamchatkan volcanoes and the nature of field data and the method for their processing are examined; finally, the deep structure and magma hearths of Kamchatka are considered in detail. The book gives extensive data on the physical properties of magma and zones of partial melting of rocks according to data in the literature and the author's own observations. The materials indicate that the attenuation of seismic wave energy increases sharply at a temperature of about 1200°C and the velocities of seismic wave propagation decrease considerably; with an increase in temperature up to 1000°C resistivity decreases by several orders of magnitude, and by several orders of magnitude more in melts; there is a direct dependence between viscosity and resistivity; resistivity is also strongly dependent on the presence of free water and ore components in rocks; the density of magmas, due to the mutually compensating influence of temperature and pressure with depth, differs sharply from the density of the country rock. These findings and much else enabled the author to draw sound conclusions concerning the effectiveness of different geophysical methods for studying the deep structure of volcanic regions and magma hearths. A method for studying deep structure in such regions is outlined: in the first stage longitudinal deep seismic profiles are run; this is followed by nonlongitudinal observation systems with different shot point-volcano and volcano-reception point distances; electromagnetic investigations with natural and artificial sources; study of geothermal regime of deep layers. Much of this review is devoted to a critique of various statements and conclusions which are supposedly erroneous. In addition, it is said that the monograph is poorly illustrated. Nevertheless, the book is deemed to be an important contribution to the literature.

[67-5303]

LOCAL GRAVITY ANOMALIES AND CRUSTAL DENSITY INHOMOGENEITIES IN SOUTHERN KURILE ISLANDS

Novosibirsk TIKHOOKEANSKAYA GEOLOGIYA in Russian No 6, Nov-Dec 83
(manuscript received 5 Jan 83) pp 105-108

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[Abstract] The article describes surface seismic work carried out by Sakhalin geophysicists during recent years in the Southern Kurile Islands and experimental and methodological gravimetric observations made along three profiles intersecting Kunashir Island and one profile run along the southern part of the island. In addition, observations were made on a regional profile. These and other observations revealed a marked differentiation of gravity anomalies, this serving as a basis for defining density inhomogeneities in the crust. Figure 1 in the text shows maps of residual anomalies for Kunashir and Shikotan Islands. Due to the detailed gravimetric observations discussed in the article it was possible for the first time to map and quantitatively compute a series of well-expressed inhomogeneities in the density of rocks in the upper part of the earth's crust in the Southern Kurile Islands. There was found to be a correlation between the nature of the gravity field and the history of geological development of the lesser and greater island arcs. This substantially increases the significance of detailed gravimetric observations when carrying out geological work in active regions of the transition zone from the Asiatic continent to the Pacific Ocean. Figures 2; references: 5 Russian.
[67-5303]

UDC 550.83:551.24(571.54/55+571.6)

GEOPHYSICAL AND TECTONIC CHARACTERISTICS OF MONGOLIAN-OKHOTSK SEISMIC ZONE

Novosibirsk TIKHOOKEANSKAYA GEOLOGIYA in Russian No 6, Nov-Dec 83
(manuscript received 9 Nov 82) pp 52-56

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[Abstract] The authors have ascertained the structure of the epicentral field of earthquakes in the Mongolian-Okhotsk seismic zone and have sought to determine its correlations with deep structure of the crust and mantle. The territory involved is western Mongolia, the Baykal region, Transbaykalia and the USSR Far East. Maps of epicenters and density of the logarithm of earthquake density were constructed for the investigated territory. Figure 1 is a map of regionalization of this epicentral field. The different seismic systems included in the zone are discussed in detail. It is shown that the

Mongolian-Okhotsk seismic zone is spatially linked to a very large arched structure and is a reflection of its development at the present time. The most important factor governing the tectonic life of this structure is a gigantic lens of the anomalous mantle with a high temperature and viscosity. Despite the unified global source of development of the entire Mongolian-Okhotsk seismic zone, the nature and position of the structural elements making it up (seismic systems and aseismic windows) are governed by the inhomogeneous structure of the upper crustal horizons. The aseismic windows coincide with relatively weakly modified masses of Early Precambrian rocks and appear stable with respect to mechanical movements. The zone continuing the Baykal rift to the east does not seem to be a typical rift zone. Figures 2; tables 1; references: 11 Russian. [67-5303]

UDC 550.834:551.241(265.53)

SEISMIC MODEL OF EARTH'S CRUST IN SOUTHERN SEA OF OKHOTSK REGION AND SOME RESULTS OF ITS GEOLOGICAL INTERPRETATION

Novosibirsk TIKHOOKEANSKAYA GEOLOGIYA in Russian No 6, Nov-Dec 83
(manuscript received 27 May 83) pp 3-12

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[Abstract] This is a description of the principal features of crustal structure in the southern Sea of Okhotsk along a very representative geotraverse (reproduced as Fig. 1). Since 1957 there has been a great number of deep seismic soundings along five profiles, considerably supplemented by work by the reflected waves method, as well as detailed seismic investigations by the correlation method of refracted waves, reflected waves method in the common deep point modification and continuous seismic profiling, this making it necessary to integrate all these data. Emphasis here is on the data for profiles 1-M and 1-O, where in the upper lithosphere a new seismic boundary with a boundary velocity of 7.0-7.1 km/sec has been discovered. Figure 2 shows the seismic section along the geotraverse (profiles 1-M and 1-O). The results indicate that the earth's crust exhibits extremely significant changes in the direction from Eurasia to the Pacific Ocean with respect to both thickness and internal structure. On the basis of these parameters it is possible to define several crustal geoblocks: mountainous structure of Sakhalin and its shelf region, Kurile abyssal basin and uplift of Kurile island arc. The crust in the Sakhalin part of the geotraverse, like the crust of the continental regions of the Far East, belongs to the continental type, but it differs from the Primor'ye crust in having "reduced" velocities in the "granite-metamorphic" layer and increased values in the "basalt" layer with a simultaneous decrease in its thickness. Among the many findings of interest, it was discovered that the entire northwestern slope of the Kurile Basin is a major fault zone penetrating down to the depth of the

"basalt" layer. Judging from the stratification of individual crustal blocks in the southern part of the Sea of Okhotsk, the latter is a single megablock of a crust of the continental type. The surface with "mantle" (8.0 km/sec) velocities of seismic waves registered at depths of about 11 km in the Kurile Basin region cannot be identified with the Mohorovicic discontinuity and instead is an intracrustal structural formation evidently arising due to intensive metamorphism of rocks in the lower part of the earth's crust under the influence of high temperatures. Figures 2; tables 1; references 39: 32 Russian, 7 Western.
[67-5303]

UDC 550.834.3

DEPENDENCE OF VELOCITY ON DEPTH DETERMINED FROM TRAVEL-TIME CURVES OF REFRACTED WAVES IN RANDOMLY INHOMOGENEOUS MEDIA

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 10, Oct 83 (manuscript received 10 Jan 83) pp 95-100

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[Abstract] The influence of local velocity inhomogeneities on the travel-times of refracted waves and the dependence of velocity on depth determined from them was investigated. This paper is a continuation of the author's earlier work along these lines (IZV. AN SSSR: FIZIKA ZEMLI, No 3, pp 34-43, 1983; No 10, pp 46-54, 1983). A clarification of the principal laws of wave propagation in media containing local velocity inhomogeneities is sought using a stochastic model of the medium in which the velocity values are separated into deterministic and random components: $v(x,z) = V(z) + \delta V(x,z)$. The deterministic component $V(z)$ characterizes the regional properties of the medium and changes linearly $V(z) = V_0(1 + \beta z)$. The random component $\delta V(x,z)$ describes velocity inhomogeneities which are characterized by the contrast of velocity fluctuations $\mu(z) = [(\delta V)^2]^{1/2}/V(z)$ and the correlation coefficient of the inhomogeneities $N(r)$. Proceeding on this basis, an attempt was made to establish an analytical dependence between the statistical characteristics of the model (V , μ , a) and the apparent velocity $v^*(x)$, determined from the mean travel-time curve, and also the use of $v^*(x)$ to determine the dependence of velocity on depth $v(z)$. An analysis was also made of the relationship between $v(z)$ and $V(z)$. Three different models were examined. It was found that the dependence of apparent velocity on distance $v^*(x)$, determined from the mean travel-time curve, differs from the similar dependence for the deterministic travel-time curve: near the source the apparent velocities are exaggerated by a value a little less than the contrast of the velocity inhomogeneities, whereas at greater distances the apparent velocities are understated. The dependence of velocity on depth $v(z)$, determined from $v^*(x)$, differs from the deterministic velocity component. The dependence of velocity on depth is not linear: with an increase in depth the gradient of velocity increase decreases. In the initial part the gradient

and velocity values are exaggerated in comparison with the deterministic velocity component, but beginning with some depths become less than for the deterministic velocity component. Figures 4; references: 9 Russian. [76-5303]

UDC 550.831+550.838

ECONOMICAL DIFFERENCE METHODS FOR SOLVING DIRECT PROBLEMS IN GRAVIMETRIC AND MAGNETIC PROSPECTING

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 10, Oct 83 (manuscript received 14 Sep 82) pp 68-76

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[Abstract] A method is proposed for the solution of direct problems in gravimetry and magnetometry based on solution of Dirichlet difference problems for the Poisson equation in the selected region. An effective computation scheme is developed for solution of direct problems for bodies of an arbitrary configuration and variable density. The algorithm, given here in detail, was tested in solution of a number of model problems. Although the algorithm is written up for a plane (two-dimensional) problem, it could easily be adapted to a three-dimensional case, although the solution of the latter requires a far larger computer memory. The merits of the algorithm include the following: a) possibility of finding both external and internal fields; b) possibility of solution of direct problems with arbitrary laws of density distribution in regions of arbitrary configuration. Accordingly, it is suggested that the proposed algorithm will have a broad field of applicability, particularly in the interpretation of data from surface and borehole (mine) observations in ore geophysics. Figures 6; tables 1; references 17: 14 Russian, 3 Western. [76-5303]

UDC 550.831.(267.2)

DENSITY INHOMOGENEITIES IN UPPER MANTLE OF EASTERN INDIAN OCEAN

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 10, Oct 83 (manuscript received 12 Apr 82) pp 55-67

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[Abstract] Little has been published concerning the structure of the upper mantle beneath the Indian Ocean. Sufficient data are now available for preparing a description. Crustal thickness is known quite well and on the

19th cruise of the "Akademik Vernadskiy" new information was collected on the gravity field, which here is used together with data published by R. S. Detrick, et al. in JGR, Vol 84, B12, pp 3637-3653, 1979, where information along four profiles is given. During the "Akademik Vernadskiy" expedition free-air anomalies were measured along four different profiles intersecting the Bay of Bengal, East Indian Ocean Ridge and the Sunda island arc, the total length of these profiles being 6,600 km. The reference point for model Δg curves had a value -560 mgal. Since information was desired on the anomalous masses beneath the M discontinuity, the residual anomalies (Δg_{res}) were analyzed. They were obtained by subtracting the gravitational effect of the oceanic crust, tied in to the zero level (-560 mgal), from the observed field (Δg_{obs}). Figure 1 is a map of the investigated region, with the 8 profiles plotted; Fig. 2 is a gravitational model of the Bay of Bengal lithosphere; Figures 3 and 4 are corresponding models for the East Indian Ocean Ridge and the Sunda island arc; Fig. 5 illustrates the influence of variations of the density of crustal layers on the nature of the gravitational effect from the initial model. This study for the first time has revealed a heterogeneous structure of the upper mantle in the eastern part of the Indian Ocean with both normal and anomalous density values. Figures 5; references 34: 14 Russian, 20 Western.
[76-5303]

UDC 550.344.094.45

RAY TRAJECTORIES IN STOCHASTIC MEDIA WITH LINEAR DEPENDENCE OF DETERMINISTIC VELOCITY COMPONENT ON DEPTH

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 10, Oct 83
(manuscript received 24 Nov 82) pp 46-54

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[Abstract] The authors investigated the influence of random inhomogeneities of a medium along the ray trajectory, a problem of fundamental importance because real geological media are essentially inhomogeneous. In solving direct and inverse problems in seismics the medium is usually approximated by quite simple models which fail to take into account the influence of local inhomogeneities of the medium on wave propagation. In order to clarify the patterns of wave propagation in inhomogeneous media the authors here propose a two-dimensional model of a stochastic medium in which the velocity of wave propagation is divided into deterministic and random components: $v(x,z) = V(z) + \delta V(x,z)$. The deterministic component $V(z)$ varies only with depth in the direction z and describes the regional properties of the medium. The random component $\delta V(x,z)$ is governed by the presence of local inhomogeneities which are characterized by the correlation coefficient $N(r)$ and the contrast of velocity fluctuations. With this formulation of the problem, the Markov diffusion approximation is applied in obtaining the law of ray refraction in a stochastic medium with a linear dependence of the

deterministic velocity component on depth. The refraction law has an integral dependence on the parameters of the medium and differs from the classical Snellius law. The most probable trajectory, computed from the integral refraction law, differs from the unperturbed trajectory. The observed difference in trajectories is dependent on the parameters of the medium and increases with distance. Figures 2; tables 1; references 10: 7 Russian, 3 Western.
[76-5303]

UDC 550.834

SPHERICAL WAVE REFRACTION WITH SHORT DISTANCES OF SOURCE FROM INTERFACE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 10, Oct 83
(manuscript received 3 Apr 81) pp 32-45

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[Abstract] If a source of seismic waves is situated a short distance from an interface there will be a considerable contribution to the field of the refracted wave from inhomogeneous waves excited by the source. This results in formation of a system of low-frequency nonuniformly refracted and "outflowing" waves, constituting the subject of this article. Investigation of the system of nonuniformly refracted and "outflowing" waves for a case when the source is in a high-velocity medium revealed that the polarization of nonuniformly refracted waves and the homogeneous components of the "outflowing" waves is close to linear. With increasing distance between the source and interface the amplitudes of these waves decrease rapidly. The authors give an in-depth analysis of the phenomenon for two cases: 1) plane interface of two fluid half-spaces, 2) plane interface of two elastic half-spaces. The article constitutes the first systematic analysis of the dynamic and kinematic characteristics of these types of waves. Comprehension of this phenomenon will prove useful in seismological and borehole investigations, particularly in seismic prospecting and especially when waveguides are present in the section. Figures 9; references 8: 5 Russian, 3 Western.
[76-5303]

DISCREPANCIES IN KINEMATIC PARAMETERS OF EARTHQUAKES ACCORDING TO OBSERVATIONS BY REGIONAL AND WORLD NETWORKS OF STATIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 10, Oct 83
(manuscript received 17 Jun 82) pp 22-31

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[Abstract] The discrepancies between hypocenters determined on the basis of observational data from the regional and world networks of stations are analyzed for the Central Asia region. It is shown that only regional stations, outfitted with high-response instrumentation, are capable of properly registering the initial point of the destruction process at an earthquake focus. However, teleseismic data can be used with necessary corrections for depth and t_0 . This can be done by several methods, one of which is proposed in this article; these methods, however, are complex and time-consuming. There is a full discussion of the errors in determining earthquake parameters when using data registered at distant stations resulting from the loss of the first arrivals when registering P waves. Thus, the hypocenters according to data from the world network are 17 km deeper and the focal times are 1.9 sec greater than according to data registered at regional stations. It is clear that in order to determine hypocenters in the world network of stations with a regional accuracy it is necessary that data be used from a reference network of stations equipped with high-response instruments capable of registering oscillations from earthquakes with $M \sim 4.5$, since earthquakes even with $M \geq 7$ begin precisely from this energy level. If this is not taken into account there will be inevitable errors in using data from the world network of stations in drawing boundaries within the earth, in seismic regionalization and in predicting seismic events. Figures 4; tables 1; references 23: 15 Russian, 8 Western.
[76-5303]

EXCITATION OF SPHEROIDAL OSCILLATIONS IN VISCOELASTIC EARTH

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 10,
Oct 83 (manuscript received 28 Jun 82) pp 3-16

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[Abstract] Earlier articles in this series (S. Ts. Akopyan, et al., DOKLADY AN SSSR, Vol 235, No 4, 1977; IZV. AN SSSR: FIZIKA ZEMLI, No 2, 1978) examined torsional oscillations in a viscoelastic earth excited by a point source. It was demonstrated that aperiodic motions arise together

with attenuating oscillations. In another article (IZV. AN SSSR: FIZIKA ZEMLI, No 8, 1978) the same authors investigated aperiodic signals for the very simple case of torsional oscillations of a homogeneous model of the earth. Continuing this work, S. Ts. Akopyan gives a formulation and solution of the problem of excitation of spheroidal oscillations in a viscoelastic earth by a point source. The excitation of the spheroidal oscillations is examined in one-, two- (liquid core - mantle) and three-layer (solid core - liquid core - mantle) viscoelastic models of the earth having a constant density and Lamé step functions. A very detailed examination is made of the appearance of aperiodic signals accompanying the excitation of radial oscillations in a viscoelastic homogeneous earth with different rheology. Three types of volumetric and shear inelasticity were examined: standard linear body--creep function of an exponential type, rheology with creep power functions and a Lomnits body, described by a logarithmic creep function. It is shown that in the case of weak absorption $Q \gg 1$ the amplitudes of the aperiodic signals are small ($\sim Q^{-1}$). Figures 2; references 12: 9 Russian, 3 Western. [76-5303]

UDC 528.5.088

POSSIBLE INTERPRETATION OF DISCREPANCY IN RESULTS OF ABSOLUTE GRAVITY DETERMINATION AT SEVRES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 274, No 2, Jan 84
(manuscript received 12 Apr 83) pp 300-304

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[Abstract] At Sèvres, as at any other observatory, pedestals, columns and walls create a nonuniformity of the gravity field in the room where measurements of absolute gravity are made. The neglecting of this gravitational field nonuniformity can result in errors which multiply exceed the accuracy in measuring absolute gravity which is usually cited. There are two ways in which this nonuniformity is reflected. First, due to the vertical gravity gradient $\partial g / \partial z$ there is a change in the length of the path traversed by the test body during free falling. Second, due to the vertical gravity gradient errors arise in the reduction of the measured absolute gravity value to some point in space. These factors are taken into account here in examining the results of absolute gravity determinations at the International Bureau of Weights and Measures at Sèvres, where Italian, Russian and Chinese instruments were used on the same pedestal (American and French instruments were on a different pedestal). The free falling method was used. Allowance for the above-mentioned factors gave an improvement in the convergence of results. Although the findings are preliminary, the purpose of the article was to stress the necessity for making allowance for the indicated nonuniformity when making fundamental gravitational experiments. Figures 2; tables 1; references: 1 Russian. [55-5303]

NATURE OF 640-KM SEISMIC BOUNDARY

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 274, No 2, Jan 84
(manuscript received 24 Mar 83) pp 296-299

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[Abstract] The boundary separating the upper and lower mantle can be attributed either to a phase transition or a change in the chemical composition of matter. The author here contends that the first of these hypotheses is consistent with the latest seismic investigations. The results of studies of the phase transitions in olivine and in the pyroxene-garnet components of mantle matter at high pressures and a temperature of 1000°C have shown that in the olivine component at a depth of 500 km there is a transition to the spinel phase, which at 720 km decays into perovskite and rock salt structures. The phase transitions in the pyroxene-garnet component are completed with transition to a perovskite structure at 600 km. Against this background, new seismic investigations can be interpreted to support the thesis of a phase transition origin of the 640-km discontinuity. This research included work in southern Norway and the western United States, but most importantly, a Russian analysis of observations of exchange, longitudinal and surface waves. The latter study, with an error of only a few kilometers, fixes the transition boundary at 640 km. Many significant conclusions can be drawn with acceptance of the phase transition hypothesis. For example, it makes possible an explanation of the decrease in seismic energy released at depths of 650-700 km in comparison with the interval 550-650 km. The fine structure of the transition can be explained on the assumption of thermal convection in the upper mantle with heating from the lower layer. The joint interpretation of seismic and gravitational data strongly suggests that the sources of some major geopotential anomalies consist of two anomalous masses, one situated in the neighborhood of the mentioned boundary, whereas the other (of the opposite sign) is situated deeper in the lower mantle. The materials presented in this article fully support the hypothesis that the boundary separating the upper and lower mantle is associated with the phase transition in the olivine component of mantle matter and the phase equilibrium curve of this transition has a negative slope of about $-30 \text{ bar}/^\circ\text{C}$. Figures 3; references 15: 8 Russian, 7 Western. [55-5303]

NEW DATA ON UPPER MANTLE LATERAL INHOMOGENEITIES IN WESTERN EURASIA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 273, No 5, Dec 83
(manuscript received 16 May 83) pp 1087-1090

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[Abstract] A study was made of all data published up to 1982 concerning the velocity of longitudinal waves along the surface of the upper mantle in Western Eurasia. The data related to 63,000 km of profiles, 53,000 km being first-order profiles. This made it possible to construct a map of V_b^M (boundary velocity of longitudinal waves at the Mohorovicic discontinuity). In compiling this map data for second- and third-order profiles were taken into account for regions not covered by first-order profiles. The V_b^M data reveal important macroinhomogeneities of the upper mantle. For the main low-frequency inhomogeneity it was possible to discriminate two generalized regions: western, relatively monolithic, with reduced velocities of the upper mantle, and eastern, with relatively high V_b^M values. The first includes the central and western parts of the East European Platform, Paleozoic and Alpine regions of Europe outside Russian and the Mediterranean Sea to the west of the meridian 30°E . Here the total range of V_b^M values varies from 7.6 to 8.4 km/sec, the mean value on profiles with a total extent of 31,000 km being 8.07 km/sec. The eastern region is located to the east of the meridian of Gor'kiy and the line Gor'kiy - Khar'kov - Odessa. This region takes in the eastern part of the East European Platform, the greater part of the Central Eurasian young Platform, the eastern part of the Alpine folded region, the paleozooids of the Urals and Kazakhstan, the Tien Shan and Pamir Ranges. The mean V_b^M value here is 8.24 km/sec, considerably greater than the mean continental value. V_b^M ranges from 7.6 to 8.6 km/sec. The distribution of V_b^M values plotted separately for the eastern and western regions reveal distinct differences. The mean and modal values of both sets of V_b^M values differ by approximately 0.2 km/sec; the ranges of changes and features of lateral variability are essentially different. Details concerning these differences are given. Figures 2; references 15: 14 Russian, 1 Western. [35-5303]

SHOT WAVES IN FROZEN GROUND

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNIЧЕСКОY FIZIKI in Russian
No 6, Nov-Dec 83 (manuscript received 26 Oct 82) pp 52-57

LYAKHOV, G. M. and FRASH, G. B., Moscow

[Abstract] Experiments to study shot waves were carried out in sandy and clayey loam ground in its natural bedding under conditions of seasonal freezing to depths of 0.45-0.5 m. Stress measurements were made using piezoceramic transducers with a frequency of oscillations 40,000 Hz with the registry of signals on electronic oscillographs and membrane transducers with a frequency 4000 Hz and registry with loop oscillographs. The sensors and explosive charge were placed at the same depth in shot holes drilled in frozen ground. The holes were refilled and tamped and the experiments were conducted after the ground was frozen. The charges weighed 0.1 kg. The depth of placement of the sensors in sandy ground was 0.4 m at -0.2°C ; in clayey loam it was 0.2 m at -0.4°C or 0.35 m at -9.2°C and 0.45 m at a temperature close to zero. Comparison with earlier investigations revealed that the dynamic properties of frozen ground are essentially dependent on the granulometric composition, content of components in an initial unfrozen state and on temperature. In frozen water-saturated ground the velocity of wave propagation is greater and the duration of the wave is less than in frozen nonsaturated ground. With an increase in temperature there is an increase in the velocity of propagation of longitudinal waves and therefore the nature of change in the velocity of shot waves of finite amplitude and longitudinal waves is identical when the ground is frozen. The experiments confirm that the main laws of wave attenuation have a common character in frozen and unfrozen ground. Frozen ground, like unfrozen ground, must be regarded as a multicomponent solid medium with plastic properties and second viscosity. The difference from unfrozen ground is in the quantitative manifestation of these properties and the dependence of the determining physicomachanical characteristics on temperature. Figures 5; tables 4; references: 7 Russian. [44-5303]

UDC 553.981/.82.2.044

NEW VARIANT OF EVALUATION OF PREDICTED PETROLEUM AND GAS RESERVES ON GENETIC BASIS

Tashkent UZBEKSKIY GEOLOGICHESKIY ZHURNAL in Russian No 5, Sep-Oct 83 pp 24-28

AKRAMKHODZHAYEV, A. M., KIRSHIN, A. V. and NUGMANOV, A. Kh.

[Abstract] The volumetric-genetic method for evaluating potential resources of petroleum and gas is now used independently or in combination with geological analogue methods. The method is based on research by the author

(A. M. Akramkhodzhaev, ORGANICHESKOYE VESHCHESTVO--OSNOVNOY ISTOCHNIK NEFTI I GAZA, Tashkent, 1973; NEFT' I GAZ--PRODUKTY PREOBRAZOVANIYA ORGANICHESKOGO VESHCHESTVA, Moscow, 1981; UZB. GEOL. ZH., TR. IGIG SO AN SSSR, No 512, pp 120-132, 1981). The different variants of the method are based on a number of concepts concerning changes in the content and composition of bitumoids in the katagenesis zone, determined on the basis of chemical-bituminological data. In those variants the computations do not take into account a very high percentage of hydrocarbon products of earlier stages of transformation of organic matter diagenesis and early katagenesis; as a result, the potential reserves of petroleum and gas can be underestimated by 30%. The proposed hydrocarbon balance takes into account not only hydrocarbon products newly formed in katagenesis, as before, but also fluid and gaseous products of earlier stages in the transformation of organic matter, sorbed in its micro- and small pores and desorbing at the onset of mesokatagenesis. The new modification makes possible an estimate of the potential reserves of petroleum and gas separately and the possible limits of their variation in the basin as a whole, both for individual lithological-stratigraphic complexes and for their totality, and also with combination with elements of a geological analogue for individual petroleum and gas geological or geotectonic zones. The different prerequisites for application of the method are discussed. As of 1 January 1980 the method has been used in Western Kazakhstan in estimating the predicted reserves of hydrocarbons and planning prospecting work. Figures 2; references: 8 Russian. [38-5303]

UDC 551.24(575.11+575.1)

SITES OF POSSIBLE OCCURRENCE OF STRONG EARTHQUAKES ACCORDING TO GEOLOGICAL-GEOMORPHOLOGICAL DATA IN EXAMPLE OF EASTERN UZBEKISTAN

Tashkent UZBEKSKIY GEOLOGICHESKIY ZHURNAL in Russian No 5, Sep-Oct 83
(manuscript received 13 May 83) pp 19-23

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[Abstract] The discrimination of lineaments and morphostructural nodes, as well as morphostructural regionalization of Eastern Uzbekistan at a scale of 1:500,000 and determination of the site of possible occurrence of earthquakes with $M \geq 5$, were accomplished by the method proposed by Ye. Ya. Rantsman (MESTA ZEMLETRYASENIY I MORFOSTRUKTURA GORNYKH STRAN, Moscow, pp 40-155, 1979). This map is reproduced in this article. It is demonstrated that earthquakes of different intensity can occur at nodes with different geological-geomorphological parameters. The greatest potential danger is characteristic of nodes where first-order lineaments intersect; a lesser intensity will be characteristic of nodes where a first- and a second-order lineament intersect, etc. Different categories (orders) of nodes (intersections) were defined. Each category of node corresponds to a definite class of earthquake. At many

of the mapped nodes there have already been seismic events. The morpho-structural regionalization was based not only on special research, but also the results of interpretation of topographic maps and aerial photographs. Use of the regionalization map makes it possible to determine the inter-sections where on the basis of geological-geomorphological seismicity criteria the occurrence of strong earthquakes can be expected. Compilation of such maps can serve as a basis for detailed seismic regionalization and the planning of hydroengineering, industrial and other structures, including atomic power stations. All this is important for predicting earthquakes and the patterns of distribution of mineral deposits. Figures 1; tables 1; references: 29 Russian.
[38-5303]

UDC 550.831:551.24

OPTIMUM DENSITY STRUCTURE OF UPPER MANTLE ALONG JAPAN - SHATSKIY RISE -
EMPEROR SEA MOUNTS GEOTRAVERSE

Novosibirsk TIKHOOKEANSKAYA GEOLOGIYA in Russian No 5, Sep-Oct 83
(manuscript received 24 Mar 83) pp 27-38

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[Abstract] The authors feel that sufficient materials have now been accumulated to justify a thorough study of the structure of the crust and upper mantle of the Pacific Ocean floor along deep sections (geotraverses) along which all geological information available for a distance ± 100 km from the axis of the geotraverse is plotted. The authors chose a deep section of the Pacific Ocean floor along the profile Japan - Shatskiy Rise - Emperor Sea Mounts for constructing its optimum density model. There has been a relatively good study along this geotraverse by seismic methods, gravimetric information is available, and the west edge of the geotraverse joins the eastern part of the Sikhote-Alin' - Sea of Japan - Honshu - Pacific Ocean geotraverse, this making it possible to use part of the information from this profile in constructing in a priori density model. The joint examination of these two geotraverses as a whole (Sikhote Alin' - Emperor Sea Mounts) in the future will make it possible to represent the overall structure of the upper mantle along a deep section intersecting all the main structures of the northwestern sector of the Pacific Ocean. Figure 1 is a 2-page diagram of a crustal density section along the geotraverse; Fig. 2 is an a priori density model of the upper mantle; Fig. 3 is an optimum density model of the upper mantle along the geotraverse. The basic problems were solved by solution of the inverse gravimetric problem. Use of this method made it possible to define sharp lateral and vertical upper mantle inhomogeneities. Everywhere along the geotraverse there is an asthenospheric layer with a thickness from 60 to 120 km. There is evidence of isostatic compensation of the principal upper mantle inhomogeneities to depths of 250 km

the mantle is essentially laterally homogeneous. Figures 3; tables 1; references 34: 17 Russian, 17 Western.
[34-5303]

UDC 550.83

ALLOWANCE FOR GEOMAGNETIC FIELD VARIATIONS AND TIE-IN OF OBSERVATIONS IN
HIGHLY PRECISE AEROMAGNETIC SURVEYS

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 10, Oct 83
(manuscript received 14 Jan 83) pp 107-114

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[Abstract] Geomagnetic field variations caused by nonstationary external sources constitute the principal interference in a magnetic survey and survey accuracy is therefore for the most part determined by the reliability in evaluating variations and the methods for taking them into account. Corrections for variation are determined by direct or indirect methods, but direct methods are inapplicable in arctic regions. However, δT_a makes a considerable contribution to total survey error in virtually all regions of the USSR. Whereas earlier it was assumed that δT_a is determined for the most part by the intensity of variations or the shore effect, in highly precise surveys it is necessary to take into account δT_a due to inhomogeneity of geological structure of a survey sector; such an effect can exceed the survey error by an order of magnitude. An indirect method should be used for taking variations into account in highly precise surveys. The article examines some variants of these methods which the author developed for highly precise surveys in the high latitudes (but applicable in any regions). The use of any indirect method requires an observation network which is optimum for a particular region. This article describes a new method, applicable under any conditions and the most reliable yet devised for evaluating variations along working and intersecting ("cutting") flight lines. Many of the earlier devised methods are in fact special cases of this more general method. This is essentially an iteration method for the tie-in of both types of flight lines, using a zero approximation (employing variations determined on the basis of data for the magnetovariation station closest to the sector). This iteration method is applicable regardless of the number of intersecting flight lines, embodies known special cases and can be recommended for magnetometric or other types of investigations carried out during movement. Figures 2.
[36-5303]

DETERMINING PARAMETERS OF RADIATING FOCUS FROM AMPLITUDE SPECTRA OF BODY WAVES

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 10, Oct 83
(manuscript received 14 Jan 83) pp 102-106

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[Abstract] In an earlier study (FIZ.-TEKHN, PROBL. POLEZN. ISKOP., No 5, 1978) V. I. Shcheglov outlined a specific physicommechanical model of an earthquake focus and solved the direction radiation problem for a displacement source in the form of a rupture plane of the length L and width W . It was possible to compute algorithms for displacements in longitudinal and transverse waves and also their absolute amplitude spectra for any initial data. Proceeding on this basis, the authors give a clarification of the laws of change of the characteristics of radiation amplitude spectra as a function of changing focal parameters. L. Brune (J. GEOPHYS. RES., Vol 75, 1970) was the first to propose a solution of this problem and this enjoyed favor for some time before its shortcomings became obvious. It is for this reason that a study was made of the relationship between the parameters of an earthquake focus and the spectral characteristics of radiation in body waves. It was found that the parameter $p = W/L$ (W is the width and L is the length of the rupture plane) is an index of strength of the medium and the isometric character of the rupture plane and exerts a decisive influence on the dynamics of focal radiation. In addition, a study was made of the correlation between the change in rupturing velocities along the length and width of the rupture plane and the behavior of the spectral characteristic $v_{0.5}$. When $p = \text{const}$ with an increase in the ratio $\tan \varphi = c_1/c_W$ (discussed in the text) the radiation spectrum becomes more high-frequency (displacement earthquakes should be more high-frequency than earthquakes with a thrust mechanism). Finally, the authors demonstrate the possibility of determining the rupturing velocities c_1 and c_W ; these can be used as a new informative parameter of the seismic process. Figures 6; references 12: 4 Russian, 8 Western.
[36-5303]

UDC 550.385

POSSIBLE SOURCES OF IRREGULAR GEOMAGNETIC VARIATIONS

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 5, No 6, Nov-Dec 83
(manuscript received 15 Jun 82) pp 76-79

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[Abstract] A hypothesis has been formulated which explains the mechanism of generation of a substorm current system. It is postulated that the plasma,

moving from the tail of the magnetosphere, reaches closed lines of force. Beginning movement along them, the particles create diamagnetic currents which will be directed (looking at the end of the tube from the earth) in a clockwise direction. Therefore, the tube of force is a sort of magnet which will be parallel to the earth's magnet. The interaction of these magnets is manifested in a mutual repulsion and the tube of force with the moving particles will withdraw somewhat. As a result, the base of the bundle of lines of force is displaced northward, which is indicated by poleward motion of auroras at the time of the explosive phase of the substorm. This mechanism of repulsion of trapped plasma by the primary field apparently is of great importance in nature. This can explain the ejection of solar magnetic lines of force and the formation of a sectoral structure of the interplanetary magnetic field. The northward moving tube of force generates an auroral electrojet in the earth's conducting layers, which in spreading out forms the current system of the substorm. This jet will not be directed to the west, but to the east. It was found that substorms in earth currents correspond in their form to records of magnetic fields, provided that distortions of the currents by conductivity inhomogeneities in the earth's crust and the skin effect are neglected. It is postulated that it is not the magnetic field of the ionospheric current system which causes earth currents, but instead currents in the earth create the observed field. (In the case of in-phase disturbances, however, there is a clearly expressed induced nature of earth currents in comparison with the primary field.) The nonuniformity of distribution of centers of current systems of substorms on the Eurasian continent is explained as follows. Taking into account the difference in the conductivity of the ocean and continent, the distribution of currents will change little with movement of the outflowing jet along the shore of the Arctic Ocean between Scandinavia and Novaya Zemlya. The westward-flowing currents will flow around the continent from the west until the total resistance of the oceans and continent is comparable. A result of this will be the observed increase in the frequency of appearance of centers of current systems near the Urals. The mean amplitudes of substorms at observatories situated in the auroral zone at the ocean shore are considerably greater than at observatories located at this same latitude in the depths of the continent. Figures 3; references: 15 Russian. [37-5303]

UDC 550.388.2

IONOSPHERIC EFFECT OF PARTIAL SOLAR ECLIPSE OF 31 July 1981

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 5, No 6, Nov-Dec 83
(manuscript received 5 Apr 82) pp 71-76

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[Abstract] The following observations were made at the space physics observatory of the Geophysical Institute, Ukrainian Academy of Sciences,

at Kiev during the period of the partial solar eclipse of 31 July 1981: vertical and slant sounding of the ionosphere, registry of scintillations of radio signals of artificial earth satellites and variation of the geomagnetic field. These data were supplemented by solar observations at the Astronomical Observatory of Kiev State University. Vertical sounding of the ionosphere before, during and some time after the eclipse was at 1- and 5-minute intervals. Scintillations of radio signals from artificial satellites were registered at frequencies of 150 MHz (3-channel spaced reception), 40 MHz and 180 MHz (single-channel reception). Slant sounding was along the path Moscow-Kiev in the frequency range from 3.5 to 27.5 MHz. A very strong magnetic storm was registered at the Kiev Magnetic Observatory before the eclipse; this storm lasted 150 hours. This strong magnetic storm was preceded by considerable helioactivity. The solar flares and magnetic storm caused an ionospheric storm with very great $\Delta f_0 F_2$ deviations. During the eclipse the usual effect was not registered due to strong helio-geomagnetic activity. E-region anomalies were observed: a local ionization cloud was formed with a very narrow range of electron concentration, decreasing from the low-frequency end. The F1 layer was formed an hour earlier. The effective recombination coefficient obtained during the period of the eclipse agrees with data from rocket experiments. Figures 3; tables 1; references: 3 Russian. [37-5303]

UDC 550.388.2

INFLUENCE OF ELECTRIC FIELDS ON POTENTIAL WAVES IN EARTH'S MAGNETOSPHERE

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 5, No 6, Nov-Dec 83
(manuscript received 15 Feb 83) pp 68-71

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[Abstract] Electric fields E_0 , parallel and perpendicular to the geomagnetic field H_0 , have been observed in the earth's magnetosphere by means of satellite probe measurements. These fields are associated with the development of anomalous resistance and double electric layers. This article is devoted to an investigation of the influence of such fields on the development of potential disturbances in the earth's magnetosphere. A linearized system of equations is used for describing the potential waves. Solution of this system gives a dispersion equation for potential disturbances. After rewriting this equation, it was possible to investigate the behavior of ionosonic waves ($kS_1 \ll \omega \ll kS_e$). Expressions are derived which indicate that with $E_0 = 0$ the spectrum of oscillations coincides with the usual spectrum of ionosonic oscillations which can exist in nonisothermal plasma ($T_e \gg T_i$). In the presence of a non-zero electric field there will be a drift of electrons v_d and the term $\gamma_k \sim (kE_0)$ will appear in the expression for the decrement. The presence of $E_0 \neq 0$ leads to a decrease in the decrement of attenuation of oscillations and with $v_d + \alpha(kE_0) > v_b$, when $\gamma_k > 0$, to their increase. Since $\gamma_k \sim (kE_0)$, the electric field will lead to a strengthening

or weakening of increase in the waves in dependence on the direction of the wave vector k relative to the electric field E_0 . High-frequency Langmuir oscillations are analyzed. This analysis revealed that the longitudinal and transverse electric fields observed in the magnetosphere from satellites exert an important influence on the development and propagation of potential disturbances. The examination presented here confirms that the strengthening (attenuation) of waves is dependent on the direction of the wave vector k relative to the external electric field. References: 7 Western.
[37-5303]

UDC 550.834

USE OF BRIEFLY DELAYED INDUSTRIAL SHOTS FOR DEEP SEISMIC SOUNDING PURPOSES

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 5, No 6, Nov-Dec 83
(manuscript received 23 Feb 82) pp 62-68

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[Abstract] In order to decrease the seismic effect of a shot on buildings and structures and ensure a uniform degree of pulverization of rocks and ores when setting off industrial shots it is common to use briefly delayed shooting. A large shot is not set off simultaneously, but a short intervals of 0.01-0.05 sec in groups or series of shot hole charges. This procedure makes it possible to set a safe level of seismic oscillations. A statistical processing of the parameters of a large number of these shots, registered in the Southern Urals and on the Kola Peninsula, has led to a series of significant conclusions. It was found that briefly delayed shots for the excitation of wave fields, both in the immediate neighborhood of the charge and at distances 40-400 km, differ substantially from special seismic charges and this is important to take into account when using them in seismic investigations. The energy in the low-frequency regions of the spectrum of oscillations of such a shot increases slowly with an increase in the total weight of the charge and drops off quickly with an increase in the number of delay stages. A ratio of the high- and low-frequency parts of the oscillations makes it possible to evaluate the fraction of seismic energy radiated by the shot in the frequency range registered in deep seismic sounding. The described briefly delayed shots can be used as a source of elastic energy in deep seismic soundings if the total delay is less than 0.5 sec. Figures 6; tables 1; references: 11 Russian.

[37-5303]

UNIQUENESS IN PLANE INVERSE PROBLEMS IN GRAVIMETRY AND MAGNETOMETRY

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 273, No 5, Dec 83
(manuscript received 16 Feb 83) pp 1097-1101

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[Abstract] In a general formulation solutions of inverse problems in gravimetry and magnetometry are not unique. The problem of discriminating classes of distribution of field sources within whose framework the inverse problem has a unique solution is of great theoretical and practical importance. Due to the great analytical difficulty of the problem, it is customary to study a plane (two-dimensional) problem in which it is possible to apply the theory of functions of a complex variable. In an earlier study (DAN, Vol 264, No 2, p 318, 1982) the authors used the methods of the theory of functions of a complex variable in investigating the uniqueness in inverse problems of gravimetry and magnetometry in classes of finite homogeneous simply connected polygons and it was found that there is no uniqueness in these classes. In this new investigation the authors have succeeded in discriminating an adequately broad class of finite simply connected regions in which there is uniqueness in solution of plane inverse problems in gravimetry and magnetometry with an arbitrary (unknown a priori) density (magnetization). Also given is a generalization relating to the case of a stipulated polynomial density (magnetization). Both these matters are discussed in detail. References 10: 9 Russian, 1 Western.
[35-5303]

UDC 622:550.372

EMISSION EFFECTS OF 'MEMORY' IN ROCKS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 273, No 5, Dec 83
(manuscript received 21 Feb 83) pp 1094-1097

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[Abstract] Acoustic and electric phenomena arising during the deformation and destruction of rocks can be regarded as earthquake precursors. Development of the destruction process in rocks results in an increase in the activity and level of acoustic emission (AE) and electromagnetic radiation (EMR). This article gives the results of investigations of acoustic and electromagnetic emission effects accompanying the cyclic loading of rock samples. The investigated objects were marble and silvinit-carnallite salts. A hydraulic press was employed in the linear loading of samples to a pressure

10 MPa at which they were held for 10 minutes, after which the load was removed. Then the samples were subjected to secondary loading to a pressure of 16 MPa. Conductivity σ , AE and EMR were registered during the process of loading and unloading of the samples. It was found that in the course of the first loading cycle AE and EMR exist only in the dynamics of loading and with cessation of the latter disappear. In the case of salt the increase in loading can result in a monotonic increase in AE and EMR, whereas for marble AE and EMR are manifested in the form of individual bursts whose level exceeds the background level by a factor of 2-10. In a loading regime the times of appearance of EMR and AE impulses coincide, but the activity of the latter is greater. With the second loading (after total unloading) up to the maximum load in the first cycle the AE level is approximately an order of magnitude less than in the preceding cycle, whereas the EMR level is commensurable with the EM background. Therefore, for rocks there is a nonreproducibility of AE during the second loading of the samples up to the maximum load of the preceding cycle, known for construction materials and called the Keiser effect. Investigations of σ for samples of marble and salt indicated that in the course of the first loading cycle it increases linearly, by a factor of 2-2.5 for marble and a factor of 4-5 for salt. The second loading of samples is accompanied by an insignificant increase in σ and only upon attaining the maximum loading does the increase in σ increase sharply (by a factor of 6-8 for marble and a factor of 10-15 for salt). By analogy with the Keiser effect the collected experimental data can be interpreted as the phenomenon of nonreproducibility of EMR and conductivity of rocks with repeated loading up to the maximum load of the preceding loading. The observed differences in the dependences of σ and EMR during repeated loading of marble and salt are evidently related to the peculiarities of deformation of these rocks. The described phenomena should play an important role in recognizing the fundamental relationship between the dynamics of deformation of rocks and their electric properties and also in establishing the physical nature and methods for using the "memory" of rocks in investigation of their stressed state, in earthquake prediction and in studying dynamic processes in a rock mass. Figures 2; references 7: 6 Russian, 1 Western.

[35-5303]

UDC 550.343.6

HYDROGEOLOGICAL AND HYDROMETEOROLOGICAL PRECURSORS OF ASHKHABAD CATASTROPHIC EARTHQUAKE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 273, No 5, Dec 83
(manuscript received 5 May 83) pp 1091-1094

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[Abstract] The author made a retrospective analysis of variations of hydrogeological and hydrometeorological elements during the period of the Ashkhabad earthquake of 5 October 1948 ($M = 7.3$). This revealed a number of anomalies

which can be regarded as precursors of this earthquake. The study was based on data from the meteorological stations of Southern Turkmenia, including Ashkhabad, and a hydrogeological station (data from 20 boreholes and wells) in the epicentral zone of the earthquake on the Ashkhabad alluvial fan. Variations in ground water level and ground water temperature were studied at depths from 2 to 25 m. Details are given concerning the following fields of investigation: ground water table, ground water temperature, soil temperature, air temperature, precipitation, air humidity, discharge of springs. The analysis revealed that the Ashkhabad earthquake of 1948 occurred against a background of considerable deviations of a number of hydrometeorological and hydrogeological characteristics from the mean values of these parameters in the Ashkhabad region. At present it is difficult to judge whether meteorological factors exerted an influence on the development of the strong earthquake or whether their anomalous regime was a result of heating of the medium over the focus of the future earthquake. Particularly meriting attention are the considerable changes in temperature, ground water level and some hydrometeorological elements in the short period of time providing the strong earthquake. Even the relatively rough measurements of ground water parameters used in the analysis indicate a considerable variation during the period of earthquake preparation and the possibility of their use for detecting the precursors of strong seismic processes. A study of the interrelated factors (solar activity, atmospheric circulation, hydrometeorological elements, earth's crust, crustal gases and fluids) might have made it possible to predict the Ashkhabad earthquake. Figures 2; references: 3 Russian. [35-5303]

UDC 550.838:518.5

METHOD FOR EVALUATING PARAMETERS OF MAGNETIZED OBJECT OF GREAT HORIZONTAL EXTENT

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 1, Jan-Feb 84
(manuscript received 18 Mar 83) pp 85-94

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[Abstract] A class of model bodies, represented by a rectangular parallelepiped, is widely used in the interpretation of magnetic anomalies. It is convenient in approximating geological objects of a great horizontal extent: large blocks in the earth's crust, intrusive masses, etc. Most studies along these lines have dealt with a two-dimensional case and there has been no adequate investigation of stability of the solutions. Since in interpretation work there is a great need for three-dimensional models, the author has developed methods for evaluating the parameters of a three-dimensional magnetized parallelepiped, this work being a continuation and modification of his earlier work in which a prism was examined (GEOFIZ. SB., No 60, pp 43-52, 1974; No 66, pp 62-72, 1975). A computational experiment was carried out on an electronic computer, a search being made for the most stable relationships between the parameters of the model and the characteristics of

its field. Emphasis here is on problems in evaluating the parameters of localized objects approximated by a parallelepiped. The conditions for the appearance of the equivalence when evaluating the depth of magnetized masses are analyzed. Considerable attention is given to the case of oblique magnetization, such as evaluating of the lower edge and angle of magnetization and determining the position of lateral faces. The practical application of the method is illustrated in examples of interpretation of observed anomalies. The method can also be employed in selecting initial approximations for optimizing models on an electronic computer. Figures 7; tables 3; references: 12 Russian.
[84-5303]

UDC 550.834.5

POSSIBILITIES OF STUDYING INELASTIC PROPERTIES AND CHARACTERISTICS OF MEDIUM INHOMOGENEITY USING SPECTRA OF SCATTERED WAVES

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 1, Jan-Feb 84
(manuscript received 10 Jan 83) pp 61-70

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[Abstract] A knowledge of the spectrum on an elementary seismic signal (ES) is needed in studying the spectral characteristics of geological media, in obtaining optimum reproduction, compression and detection filters. In determining the spectrum from seismic data the length of the record must greatly exceed the length of the ES. However, the requirement of stationarity is not satisfied and the possibility of using this spectral information is limited. It is shown here that this problem can be overcome if information on other paths is used, provided it is statistically independent. In this article the inelastic properties of geological media are studied by the use of sets of waves scattered by deep inhomogeneities of the medium. Averaging the N paths, from which statistically dependent information is subtracted, makes it possible to increase the accuracy in determining the power spectra to a prestipulated accuracy. The article gives algorithms for finding this power spectrum for an elementary seismic signal scattered by a small-scale inhomogeneity and an inhomogeneity of a stipulated size. These algorithms are the basis for determining all the principal spectral characteristics of the medium. The form of the dependence of the effective attenuation of seismic waves as a function of frequency is theoretically validated and experimentally confirmed. It was found that at frequencies lower than 20-25 Hz diffraction scattering is greater than other forms of frequency-dependent losses of seismic energy. This mechanism is one of the most important in forming of the amplitude spectrum of a signal propagating in a medium and unless its influence is taken into account it is impossible to determine the inelasticity characteristics of the medium. After setting forth an algorithm for determining the scattering function for a small-scale inhomogeneity, the

authors cite examples of determination of the coefficient of effective attenuation, decrement of effective absorption and scattering function of waves of a small-scale inhomogeneity. Figures 5; references: 7 Russian. [84-5303]

UDC 550.348.098

GEOACOUSTIC METHOD FOR CONTINUOUS MONITORING OF STRESSED-STRAINED STATE OF EARTH'S CRUST

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 1, Jan-Feb 84
(manuscript received 17 Jan 83) pp 55-61

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[Abstract] Specialists at the Institute of Applied Problems in Mechanics and Mathematics have developed a geoacoustic measuring system (a block diagram accompanies the text). Ceramic piezoelectric transducers with characteristic frequencies 10-25 KHz are used as sources and detectors of longitudinal waves. The source is excited by an alternating voltage of 150-300 V with a frequency of 1-10 KHz. The electric signals from the detectors are amplified and filtered for discriminating the frequency harmonics. The phase shift of the received signal of the fundamental frequency and the amplitude of oscillations of the fundamental and multiple frequencies are determined. The measured wave parameters are registered with a rate of paper movement of 2 cm/hour on punched tape, facilitating computer input. Measuring system stability is monitored. There is continuous registry of the supply voltage, atmospheric pressure, humidity and temperature, all necessary in interpreting the observational data. The method of continuous geoelectric monitoring of the stressed-strained state of the rock mass was field tested in the Carpathian Geodynamic Polygon in 1978-1980. Very diversified temporal variations of measured wave parameters were registered. A joint spectral and correlation analysis was made of the results of these geoacoustic observations and corresponding time series of theoretical values of the tide-generating force. It was found that there is a substantial influence of tidal deformations of the earth on the registered parameters of elastic waves. Different geoacoustic parameters are not identically sensitive to changes in the tide-generating force. Individual time-limited anomalies of different duration were detected. It can be postulated on the basis of the collected data that short anomalies are caused by the "discharge" of stresses in the investigated rock complex, whereas more prolonged anomalies are caused by deformations of the crust accompanying preparation for tectonic earthquakes. Proposals are made for checking and improving the method. Figures 5; references 24: 21 Russian, 3 Western. [84-5303]

PHYSICAL NATURE OF GEOMAGNETIC MICROBAYS

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 1, Jan-Feb 84
(manuscript received 9 Jun 80) pp 54-55

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[Abstract] In earlier studies (GEOMAGNETIZM I AERONOMIYA, No 6, pp 1128-1129, 1973; No 1, pp 176-177, 1975) the authors describe a special type of variations which were given the name microbays. This name was assigned because in their properties they resembled baylike disturbances, although in most cases their amplitudes and periods were considerably less. Since that time V. I. Afanas'yev has published similar materials (TRUDY IZMIR AN SSSR, No 12, pp 20-45, 1957; GEOMAGNITNYYE AKTIVNOSTI I SOLNECHNYYE KORPUSKULYARNYYE POTOKI, Moscow, IZMIR AN SSSR, pp 5-27, 1966). Afanas'yev described what he called weak identical disturbances (WID) of the geomagnetic field based on data for stations separated 120° in longitude and 15° in latitude; a total of 646 cases registered during 1949-1957 were analyzed. However, instead of examining individual peaks of these disturbances he investigated intervals of disturbances which at longitudinally spaced observatories had a great similarity of amplitudes and phases. A thorough comparison of the microbays and WID revealed that they are the very same type of variations. If only isolated WID peaks are considered, they correspond to microbays. An example is given. WID (microbays) coincide with sudden commencements of storms, indicating that they have common sources: shock waves of the solar wind. In any study of geomagnetic bays (substorms) it is necessary to take into account the presence of WID which have a similar external appearance but which constitute an independent type of variations. Figures 1; references: 4 Russian.
[84-5303]

STRUCTURE AND DIRECTION OF EVOLUTION OF EUROPEAN TECTONOSPHERE ACCORDING TO GEOLOGICAL AND GEOPHYSICAL DATA

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 1, Jan-Feb 84
(manuscript received 27 Dec 82) pp 39-48

BUR'YANOV, V. B., GORDIYENKO, V. V., ZAVGORODNYAYA, O. V., KULIK, S. N. and LOGVINOV, I. M., Geophysical Institute, Ukrainian Academy of Sciences, Kiev

[Abstract] The method of construction of regional geophysical models was used in a study of evolution of the tectonosphere in Europe. The authors compiled a map of heat flow in Europe and diagrams showing the distribution of conducting objects in the earth's crust and upper mantle and the

gravitational effect of the European mantle. The use of these data, information from deep seismic sounding and the patterns of distribution of the velocities of seismic waves in the European mantle made it possible to construct the mentioned geophysical models in accordance with the polymorphous-advection hypothesis of deep processes. It is shown that the last period in the geological history of Europe is characterized by activation of its southern and western parts, expressed in the formation of deep depressions, different types of fault-magmatic activation and epiplatform orogenesis. These processes are accompanied by anomalies of the heat flow, gravity and other fields of a mantle nature. The most recent mantle activation affected virtually the entire epi-Hercynian platform and considerable regions of the epi-Caledonian and epi-Baykal platforms and possibly individual portions of the epi-Proterozoic platform. As a result of these processes there has been a substantial reduction in crustal thickness in the southern and western parts of Europe. At the present time in western and southern Europe a process is transpiring which in the not distant geological past ended in an oceanization process. Accordingly, a considerable part of the territory of Western and Southern Europe can be considered a transition zone between the Eurasian continent and the Atlantic Ocean in its initial stage of development. Figures 7; references 17: 14 Russian, 3 Western. [84-5303]

UDC 550(831:834).05.072:552.321

SEISMOGRAVITATIONAL MODELING OF DEEP GEOLOGICAL STRUCTURE OF KIROVOGRAD PROTOPLATFORM COMPLEX

Kiev GEOFIZICHESKIY ZHURNAL in Russian Vol 6, No 1, Jan-Feb 84
(manuscript received 15 Sep 82) pp 32-39

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[Abstract] The investigated territory belongs for the most part to the Kirovograd protoplatform complex of the Ukrainian shield. Deep seismic sounding profiles XXIV and XXV intersect the Kirovograd complex in meridional and latitudinal directions (Fig. 1 in the text is a map of the area, geological features and profiles discussed). Figure 2 (which is on an unnumbered folded page) shows a deep seismo-gravi-geological model of the Ukrainian shield along profile XXV; Fig. 3 is a corresponding crustal model along profile XXIV. These two models reveal both the vertical and lateral differentiation of the velocity section. There are no contradictions with earlier studies, but some new structural features were discovered. The choice of the density model using a stable solution of the linear problem in gravimetry and the modeling of the observed gravity field on the basis of the idea of an "absolute" tie-in of the computed anomalies confirmed the legitimacy of interpretation of the seismic data on the basis of the concept of deep magmatic diapirism. A feature of the density model is that the maximum deficit of mass is associated with the central part of the gravitationally active layer, which does not exceed 20 km in thickness. An interpretation based on the deep

magmatic diapirism concept makes it possible to overcome the contradiction between the structure of the gravity field and the structure of the velocity section. This first use of the described method makes clear that the Kirovograd protoplatform complex in fact consists of two deep magmatic diapirs. In essence they are major stratiform intrusions with several different differentiation schemes and therefore different primary chemical compositions. Figures 3; references; 16 Russian.
[84-5303]

UDC 525.622(474.2)

EVALUATING TIDAL VERTICAL DEFORMATION OF EARTH'S SURFACE AT TALLIN

Tallin IZVESTIYA AKADEMII NAUK ESTONSKOY SSR: GEOLOGIYA in Russian No 1, Jan-Mar 84 (manuscript received 26 Nov 82) pp 14-18

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[Abstract] The vertical component of tidal deformation can be determined indirectly by measuring the tidal change of gravity caused by the direct influence of the tide-generating force, by the vertical displacement of the surface relative to the center of the earth under the influence of lunar and solar attraction and by the redistribution of the earth's mass during its deformation. By discriminating from the total tidal change in gravity that part which is caused by a displacement of the earth's surface and knowing how this change is related to radial (vertical) deformation it is possible to solve the inverse problem: determination of vertical displacement on the basis of the tidal change in strength of the gravitational field. Knowing the actual tidal change of gravity and the gravimetric factor it is possible to estimate the tidal vertical displacement of the earth's surface. Station observations of tidal changes of gravity during the period 1965-1977 (19 months) at the Tallin Gravimetric Station revealed that the gravimetric factor is 1.162. The maximum vertical tidal displacement at Tallin is 35 cm. The minimum amplitude of these oscillations is about 6 cm. On the average the earth's surface under the influence of tide-generating forces of the moon and sun varies in the range 20 cm. The great amplitude of tidal deformations at Tallin is attributable to the substantial role of diurnal waves in the total tide. This same figure of 20 cm is applicable for the entire area around the Gulf of Finland. Figures 1; references 8: 6 Russian, 2 Western.
[103-5303]

MODELING ANISOTROPIC PROPERTIES OF MEDIA WITH ORIENTED FRACTURES

Tbilisi SOOBASHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 112, No 2, Nov 83 (manuscript received 12 Nov 82) pp 297-299

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[Abstract] The process of fracture formation at the focus of an impending earthquake occurs along a definite orientation governed by tectonic shears. A medium with parallel fractures is anisotropic. Many methods have been used in the theoretical computation of the elastic properties of such media. Since different assumptions are made in developing these methods it was decided to check their effectiveness by laboratory experiments using models with controllable parameters. In the experiments use was made of two-dimensional models with a system of parallel slitlike gaping notches simulating fractures. The models were fabricated from steel plate 0.2 mm thick and Plexiglas plates with a thickness of 1.5 mm. The velocities of propagation of longitudinal and transverse waves were investigated. The diameters of the circular models were 140 and 208 mm and the number of grooves was 1,060 and 303 respectively. An ultrasonic instrument was used; the sources and detectors of P waves were Rochelle salt transducers. Transverse waves were excited and registered by shear oscillation detectors designed using polarized piezoceramic. The experimental results are compared with computations made by different methods. The curves corresponding to different theories quantitatively differ greatly from one another but there is a satisfactory correspondence of the shape of both the theoretical and experimental curves, revealing a uniformity of the dependence of wave propagation velocity on angle of approach to the oriented system of fractures. An attempt is made to resolve various discrepancies. It is noted that the construction of three-dimensional models of media with an oriented system of fractures involves serious technical difficulties. However, such experiments make it possible to simulate the phenomenon of the splitting of shear waves and the influence of fluid diffusion in the pore space on the dependence of the velocities of longitudinal and transverse waves on the angle of their approach to an oriented system of fractures. Figures 2; references 6:
4 Russian, 2 Western.

[101-5303]

MAGNITUDE CLASSIFICATION OF EARTHQUAKES OF KAMCHATKA, KURILES AND NORTHEASTERN JAPAN DURING 1911-1961

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 5, Sep-Oct 83
(manuscript received 7 Sep 82) pp 96-102

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[Abstract] An attempt was made to compile the most complete list of Kurile-Kamchatka earthquakes in the Southern Kuriles up to 1958 and in the Northern Kuriles and Kamchatka up to 1961 on the basis of data published in all bulletins and catalogues. Emphasis was on obtaining a catalogue adequately uniform with respect to energy classification. In determining approximate magnitude use was made of a method based on existence of a dependence between magnitude M and the number of stations N , data for which are given in the international bulletins. The resulting catalogue (KATALOG KURILO-KAMCHATSKIKH ZEMLETRYASENIY 1911-1961 gg. Ch. I and II. MATERIALY MTsD-B, Moscow, 1981, rotaprint) is more complete than any other list or catalogue for this region. Information is given on 3,137 Kurile-Kamchatka earthquakes during this period. Magnitudes could be determined for 3,006 of these events. Magnitudes for 1,281 were determined for the first time using the dependence $M(N)$. This means that the catalogue includes 1,401 events not listed in earlier catalogues. The precise epicentral coordinates are unknown for 194 earthquakes. The ISS, BCIS and JMA bulletins were fully exploited. Among the significant materials presented in this article are a graph of the distribution of Kurile-Kamchatka earthquakes by years and graphs of the frequency of recurrence of Kurile-Kamchatka events for seven different periods. Figures 4; tables 4; references 16: 13 Russian, 3 Western.
[75-5303]

EXPERIENCE IN COMPUTING SEISMIC WAVE FIELD IN MODEL OF KURILE ISLAND ARC

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 5, Sep-Oct 83
(manuscript received 29 Nov 82) pp 91-96

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[Abstract] Existing algorithms for computing the phases and amplitudes of seismic waves make it possible to compute the wave field in virtually any complexly structured inhomogeneous models of media. Here the authors use an algorithm and program for computing the amplitudes and phases of seismic waves in a model of the structure of an island arc-abyssal trench from a

source situated at different depths in a focal zone. In this model the mantle is broken down into blocks; the velocity in each block differs from the Jeffreys-Bullen velocity section by a constant value. The authors compute the nonclosures of the arrival time of P-waves with a Jeffreys-Bullen travel-time curve for a source at a depth of 450 km in the direction of propagation across the arc. These nonclosures were compared with those obtained in the course of the Kurile seismic experiment; the real nonclosures considerably exceed the computed nonclosures, indicating a great velocity deficit in the continental block of the mantle. Surface travel-time curves and amplitude curves were computed for three positions of the source—40, 70 and 130 km along the focal zone. It was found that the azimuthal differences of the amplitude curves can attain considerable values. The findings in this article are compared with data published by V. D. Anakhin, et al. (IZV. AN SSSR: FIZIKA ZEMLI, No 1, pp 13-20, 1969) on the decrease in amplitudes of longitudinal waves of Kurile earthquakes in the range of epicentral distances 100-1,000 km. The experimental and theoretical curves of decrease in the amplitude of longitudinal waves were compared. There was a good coincidence of the theoretical and experimental curves, indicating a very high quality of the upper mantle oceanic block, which is evidently $Q \sim 6,000$. Figures 5; references 18: 10 Russian, 8 Western.

[75-5303]

UDC 550.344

ALGORITHM FOR DETERMINING COORDINATES OF HYPOCENTERS OF NEAR EARTHQUAKES AND SEISMIC WAVE PROPAGATION VELOCITY IN LAYER

Moscow VULKANOLOGIYA I SEISMOLOGIYA in Russian No 5, Sep-Oct 83
(manuscript received 20 Apr 82) pp 81-90

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[Abstract] The algorithm presented in this article makes possible a determination of the coordinates of earthquake hypocenters and a more precise determination of the velocity parameters of the medium. The first part of the article gives a method for determining the coordinates of earthquake hypocenters when the velocity section of the medium is known. A series of simplifying assumptions is made: the earth is flat, the observation system is situated in the plane XY and the velocity of propagation of seismic waves in the medium is a function only of depth. After solving the pertinent system of linear equations, the conditions imposed on the observation system are examined. The problem of more precise determination of the velocity section is formulated and the conditions for existence and uniqueness of solution of this problem are defined. The program (in ALGOL and FORTRAN IV) is described. The following matters are dealt with: determination of travel time of seismic waves, increase in accuracy of determination of focal depths and epicenter coordinates, choice of coordinate system and allowance for earth's sphericity, determination of magnitude, angles of emergence and azimuths and

accuracy in determining hypocenter coordinates. A model example of application of the algorithm is given. Tables 3; references 13: 11 Russian, 2 Western.
[75-5303]

UDC 550.341.5

RESULTS OF LONG-RANGE SEISMIC PREDICTION FOR KURILE-KAMCHATKA ARC FOR 1976-1980 AND PREDICTION FOR 1981-1985

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 5, Sep-Oct 83
(manuscript received 16 Dec 82) pp 74-80

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[Abstract] A long-range seismic prediction for the Pacific Ocean focal zone along the shores of Kamchatka and the Kurile Islands was made for 1976-1980 and for 1981-1985. In both cases seismicity was predicted for depths of 0-80 km in a strip extending 50-150 km from the axis of the volcanic zone. The prediction area was broken down into 15 sectors, as shown on an accompanying map. In each of these sectors the seismicity level was governed by a corresponding stage in the seismic cycle and can be evaluated on the basis of curves of the change in seismic activity and seismic energy release in the course of the cycle. A table gives distances reckoned along the focal zone; anticipated stage of seismic cycle; predicted mean seismic activity values A_{10} and the range of their standard deviations; lower limits of earthquake magnitudes anticipated with a probability of 0.8, 0.5 and 0.15; maximum possible magnitudes for the most dangerous sectors; A_{10} values and magnitudes of strongest earthquakes observed during 1976-1980 in each of the 15 sectors; evaluation of prediction. The data presented here show that the prediction for 1976-1980 for the most part was justified. Table 3 gives a long-range prediction for 1981-1985, once again broken down into 15 sectors with an indication of the cycle in which they are at the present time and a qualitative evaluation of the maximum possible danger. Figures 1; tables 3; references: 8 Russian.
[75-5303]

EARTHQUAKE SWARM IN NEIGHBORHOOD OF KARYMSKIY VOLCANO IN JANUARY-FEBRUARY 1978

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 5, Sep-Oct 83
(manuscript received 21 Dec 82) pp 64-73

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[Abstract] Karymskiy is one of the most active volcanoes on Kamchatka. It is characterized by three systems of well-expressed faults. A seismic station in its vicinity has been in operation since 1970 and a spatially stable epicentral zone of volcanic-tectonic earthquakes (VTE) has been pinpointed 6-10 km to the south of the cone. The zone then extends southward along a regional system of faults. This article describes a strong swarm of VTE which occurred there during January-February 1978. This series of events lasted for 32 days (25 January-25 February). The hypocentral coordinates were determined for 61 of these earthquakes; the focal depth for the most part was 0-10 km. The epicentral region coincides with the precise zone of swarms in 1964 and 1970-1973, indicating the presence of a spatially stable seismically active block of the earth's crust to the south of the volcano. The focal mechanism was determined for the six strongest earthquakes of the swarm. All six foci were characterized by a predominance of the horizontal component of movement over the vertical component (the focal movements had a predominantly shear character); a vertical component was also present in each case. Table 3 gives a detailed catalogue of the focal mechanisms of these 6 events; Table 4 gives the focal parameters for the 26 earthquakes in the swarm. The epicentral zone is in a region where there are no clearly expressed linear faults. These and other data confirm the assumption made earlier that the VTE of the Karymskiy structure are caused by intrusive processes. Figures 4; tables 4; references: 9 Russian.
[75-5303]

PREDICTING LATERAL ERUPTION OF KLYUCHEVSKAYA VOLCANO IN MARCH 1983

Moscow VULKANOLOGIYA I SEYSMOLOGIYA in Russian No 5, Sep-Oct 83
(manuscript received 6 Apr 83) pp 3-8

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[Abstract] According to a long-range forecast, the next eruption of Kluchevskaya Volcano with a probability of $2/3$ was expected in the period 1985-1989; the probability of an eruption up to March 1983 was 0.02. Prior to 7 March 1983 there were no groups of strong tectonic earthquakes in the neighborhood of the volcano which would have warned of any moderate or large eruptions. The probability of a lateral eruption in March 1983 was

insignificant. Figure 1 shows the characteristic states (five phases) of the volcano during February-March 1983. A swarm of small earthquakes did occur during the period 28 February-2 March. The temporal development of the storm and a sharp dropoff and cessation of eruption in the central crater indicated that a fissure had formed in the body of the volcano and the possibility of a lateral eruption. Experience suggested that magma would emerge at the surface where earthquake epicenters lie at the minimum elevation along the volcano slope. The lateral crater in fact formed at the center of the epicentral region. On 3 March it was postulated on the basis of these facts that the eruption would occur in the time interval 4-9 March. It began on 8 March. The weakness of the precursors made this prediction difficult. Field observations of the state of the central crater were of considerable assistance in this short-range prediction. On 6 March a notice was published in the local newspaper on the possibility of a lateral eruption and that it would present no threat to the local population. Figures 2; references: 8 Russian.
[75-5303]

INFLUENCE OF TROPOSPHERIC AEROSOL ON INTEGRAL ALBEDO OF CLOUDY ATMOSPHERE -
UNDERLYING SURFACE SYSTEM

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 19, No 11, Nov 83 (manuscript received 14 Oct 82, after revision 10 Jan 83)
pp 1161-1166

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USSR Academy of Sciences

[Abstract] This article generalizes the results given by the authors in their earlier paper entitled "Influence of Tropospheric Aerosol on Integral Albedo of the Atmosphere - Underlying Surface System" (IZV. AN SSSR: FAO, Vol 18, No 11, pp 1205-1212, 1982). Here it is shown that integral albedo is formed for the most part due to the albedo of clouds and the underlying surface, but aerosol outside the cloud can exert an influence. The authors examine the four-layer system shown in the figure.

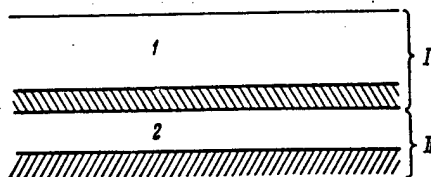


Fig. Four-layer system: 1 and 2--
aerosol layers; cloud and underlying
layers are shaded.

The system is broken down into two subsystems, I and II. Stipulated parameters for the individual layers and stipulated albedo of the underlying surface are used in computing the spectral albedo of the cloud layer of subsystems I and II and transmission. Knowing these parameters, it is possible to determine the albedo for the system (a formula for A_{sys} is derived). The approximate method outlined in this article reduces the problem of determining the albedo of the four-layer system to three independent problems, A_0 , A_I , A_{II} , each of which is solved quite simply and precisely in the δ -Eddington two-flux approximation on the assumption of homogeneity of the individual layers. Table 3 gives the results of computations for A_0 , A_I , A_{II} and A_{sys} . (In the layers outside clouds allowance is made for aerosol scattering and

absorption; in the cloud allowance is made for absorption and scattering on droplets). This table indicates the considerable effect of aerosol outside the cloud. In the case of small absorption aerosol scattering in the layers outside the clouds increases the albedo of the system as a whole. With strong industrial turbidity the albedos A_I and A_{sys} decrease considerably as a result of aerosol absorption. The formula derived for A_{sys} is evaluated and compared with the results obtained by other methods. Using the data in Table 3, the formula for A_{sys} and the results obtained in the earlier investigation it is easy to evaluate the aerosol effect in formation of the integral albedo of the system. Figures 1; tables 4; references 16: 10 Russian, 6 Western.
[41-5303]

UDC 551.511.32:551.558.21

INFLUENCE OF VELOCITY SHEAR ON CHARACTER OF FLOW OF INCOMPRESSIBLE STRATIFIED FLUID AROUND OBSTACLE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 19, No 11, Nov 83 (manuscript received 10 Mar 83) pp 1139-1150

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[Abstract] This is essentially a continuation of an earlier investigation by the author ("Spatial Problem of Flow of an Incompressible Fluid Around an Obstacle (Numerical Modeling)," IZV. AN SSSR: FAO, Vol 19, No 4, pp 357-365, 1983). In this further study the author examines a number of examples of flow of a fluid around an obstacle in the case of identical boundary conditions but with different velocity profiles of the oncoming flow. In the formulation of this problem it is assumed that flow velocity does not change sign and the conditions in the incident flow are stipulated. Analysis of the various variants reveals that an increase in horizontal velocity shear and the introduction of vertical shear intensify wave formation with some decrease in the amplitudes of the perturbations. The same occurs with disruption of the symmetry of flow. The examples indicate that the presence of a wind shear, both vertical and horizontal, improves conditions for the formation of leeward trapped waves. The results also show a possibility of the existence of several stationary regimes with one and the same form of the obstacle and the very same structure of the oncoming flow. The vertical plane passing through the crest indicates the direction where the waves have the greatest amplitude. A jump or zone of static instability can arise in this direction in currents with a vertical velocity shear. However, the introduction of a horizontal velocity shear eliminates the jump and exerts a smoothing effect on the waves, decreasing their amplitude. In all the considered examples the least perturbed vertical section is the plane situated at a distance of $1/4$ of the width of the obstacle from the axial plane. It is suggested that such a direction is favorable for the flights of aircraft in the case of an isolated mountain or peak rising above a range. Figures 5; references 11: 7 Russian, 4 Western.
[41-5303]

give a kinematic interpretation of the results with respect to the direction of meridional movement of the eddy in the initial stage. Finally, a comparison of the model with observations indicates a definite influence of the quasi-two-dimensional dynamics of vorticity on the nature of movement of macroscale solitary eddies. Figures 2; references 18: 14 Russian, 4 Western. [51-5303]

UDC 551.510.42:551.591.2

CONDENSATIONAL VARIABILITY OF SCATTERING PHASE FUNCTION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 19, No 12, Dec 83 (manuscript received 23 Mar 82) pp 1321-1324

ISAKOV, A. A., SVIRIDENKOV, M. A. and SIDOROV, V. N., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] Matrices of scattering of light by atmospheric aerosol were measured in the summer of 1979 during the joint Soviet-American aerosol experiment near Abastumani, Georgian SSR, using a polarization nephelometer. The nephelometer intake device included a heater which make it possible to vary temperature and relative humidity in the working volume of the nephelometer. This also made it possible to study the dependence of components of the scattering matrix on relative humidity and obtain data on the characteristics of light scattering by the dry base of aerosol. It was found that the dependence of the coefficient of directed light scattering D_{11} for a scattering angle $\varphi = 45^\circ$ on relative humidity can be expressed by the Hänel empirical expression

$$D_{11}(45^\circ) = D_{11}^0(45^\circ)(1 - r)^{-2\epsilon}, \quad D_{11}^0 \equiv D_{11}(r = 0) = D_{11}^{\text{dry}}$$

and can be applied in virtually the entire humidity range. Proceeding on this basis, the authors analyze the entire scattering phase function in the range of angles $15^\circ \leq \varphi \leq 165^\circ$. A total of 49 records of the $D(\varphi, r)$ dependence obtained in the course of 24 days at different times of day were analyzed. It is shown that the scattering phase function can be predicted if the phase function of the dry base of aerosol is known. It is further demonstrated that a single-parameter statistical model describes the condensational transformation of aerosol. The response of aerosol to changes in relative humidity is similar under the background conditions of Abastumani and Zvenigorod, indicating a similarity of the mean chemical composition of dry aerosol matter in different geographical regions. Figures 2; tables 2; references 5: 4 Russian, 1 Western. [51-5303]

LIMITING RANGES IN ATMOSPHERIC RADIOACOUSTIC SOUNDING

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 19, No 12, Dec 83 (manuscript received 22 Jul 82) pp 1267-1271

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[Abstract] It has become clear that in the case of adequately great radio-acoustic sounding ranges there is some factor which in the absence of wind drift of the acoustic beam begins to become operative. In this paper it is demonstrated that atmospheric turbulence is such a factor. Specifically, the authors examine qualitatively what occurs to a reflected signal in the presence of turbulence. Formulas are derived which make it possible to evaluate the maximum sounding range $R_{\max}$ in a turbulent medium, this leading to a formula for the maximum sounding range in a windless medium. The principal parameters of RASS (radioacoustic sounding systems) are given in a table for the purpose of comparing the maximum ranges possible with different RASS. There was a satisfactory agreement between $R_{\max}$ computed by the above-mentioned formula and experimental data. It is shown that in the absence of a wind the effective range of an RASS is essentially limited by the influence of atmospheric turbulence and even the use of systems compensating for wind drift (such as a mobile receiving antenna or the use of several receiving antennas) cannot bring about a significant increase in the effective range of RASS apparatus. Figures 1; tables 1; references 15: 9 Russian; 6 Western.
[51-5303]

MOVEMENT MECHANISM OF SOLITARY SYNOPTIC EDDIES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 19, No 12, Dec 83 (manuscript received 4 May 82) pp 1252-1258

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[Abstract] Despite the publication of numerous models, the question of the reasons for movement of a real thermohydrodynamic eddy remains open. The author examines a simple model which does not take into account the effects of generation and dissipation of energy, thermal and topographic inhomogeneities of a current and the underlying surface. In pure form this makes it possible to study the two-dimensional hydrodynamic mechanism controlling movement of a solitary eddy. Using this simple model the author examines some qualitative aspects and tendencies in the interaction of regular and singular vorticity of a two-dimensional conservative current on a plane and on a sphere. Making use of the dynamic invariants of the system and the demonstrated theorem on the maximum of kinetic moment, it was possible to

PECULIARITIES IN DETERMINING SMALL CONTENTS OF ATMOSPHERIC MOISTURE BY
SURFACE RADIO THERMAL SOUNDING METHODS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 19, No 12, Dec 83 (manuscript received 10 May 82) pp 1318-1321

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[Abstract] The radiometric method for determining total moisture content Q in a vertical column of the atmosphere has now been well developed. The method is effective in obtaining data on Q in the middle-latitude and tropical latitudes, but it is very difficult to use under anomalous conditions of low surface humidities and temperatures, that is, with t_0 below -30°C and a partial pressure of water vapor $e_0 \leq 0.3$ mbar. This is because there is a considerable decrease in absorption in the centimeter range and a small yield of information. A solution of this problem is remote sounding in the shorter-wave range of radio waves. Since at low temperatures humidity becomes extremely low, absorption in these lines is considerably reduced and the corresponding spectral lines become similar to the line $\lambda = 1.35$ km under normal conditions in the middle latitudes. This is the physical basis for possible use of strong H_2O submillimeter absorption lines in radio thermal sounding of the total moisture content under extremal atmospheric conditions. The author here investigates total vertical absorption of radio waves in atmospheric water vapor in the neighborhood of five lines in the centimeter, millimeter and long-wave parts of the submillimeter range. The investigation was limited to an altitude 10 km. The results make it possible to ascertain with what surface values e_0 and t_0 it is feasible to use specific wave ranges. The analysis of absorption in the cloudless atmosphere in the resonance regions of water vapor made it possible to formulate the conditions for optimum determination of moisture content in extremal situations. Regression relationships were obtained between the radio characteristics of the atmosphere in the neighborhood of the considered spectral lines and the total mass of water vapor in a column of the atmosphere and evaluations of the accuracy in determining total moisture content were obtained. Figures 1; tables 2; references 11: 9 Russian, 2 Western.

[51-5303]

DRIFT MOVEMENT OF AEROSOL PARTICLES IN FIELD OF ATMOSPHERIC GRAVITY WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 20, No 1, Jan 84 (manuscript received 16 Nov 82, after revision 9 Feb 83)
pp 33-39

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[Abstract] Since internal gravity waves exert an appreciable influence on the energetics and dynamics of the upper layers of the atmosphere the author has sought to clarify how they influence the motion of fine particles in the atmosphere. This can be of importance in analyzing the reactions of particles of natural atmospheric aerosol to wave perturbations of the IGW type. An understanding of this phenomenon is also important in understanding the behavior of artificial clouds of tiny metallized bodies whose motion is tracked by radar. The mechanism of drift motion of such particles was analyzed and it was found that there is an interrelationship between the size of particles in mean equilibrium and the wave parameters. The findings are applicable, in particular, to an analysis of noctilucent clouds. It was found that there is a simple interrelationship between the elements of the wave pattern observed in clouds and the size of the particles making them up. The size of the particles held in equilibrium at an altitude of 85 km in the presence of internal gravity waves is about 0.1-0.2 μm . In the case of noctilucent clouds it appears that the drift mechanism adequately explains the holding of particles in a suspended state and there need not be any ascending fluxes, whose existence at mesospheric altitudes is questionable. Tables 1; references 16: 14 Russian, 2 Western.
[57-5303]

ASYMPTOTIC FORMULAS FOR DISTRIBUTION MOMENTS IN SOLUTION OF RADIATION
TRANSFER EQUATION IN STOCHASTIC MEDIUM

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 20, No 1, Jan 84 (manuscript received 17 Jul 82, after revision 4 Oct 82)
pp 19-27

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[Abstract] Asymptotic formulas are derived for the moments of the random intensity of radiation passing through a layer of matter whose density is a random homogeneous field. Some of the formulas were given in an earlier article by the author (IZV. AN SSSR: FAO, Vol 18, No 12, pp 1289-1295, 1982), of which this article is essentially a continuation. However, in the initial article there was no validation of the asymptotic form for the

"quasi-Gaussian" distribution of probabilities for optical thickness of the layer. Such a validation is presented in section II of this article and this makes clear the physical sense of the structure of the corresponding asymptotic formula. Moreover, the precise asymptotic form in the earlier study was obtained only for a special Markov model of a random density field with an exponential correlation function. Now this result has been generalized for similar fields whose correlation functions are convex. Also presented here is a simplified model of the density field with independent values in stipulated layers of the thickness 2ρ , where ρ is the correlation scale. It is demonstrated that this model can give rather precise evaluations of the asymptotic form corresponding to more real fields and is convenient for evaluating the correlation function of random intensity. Section IV gives a heuristic analysis of the conditions under which these asymptotic formulas can be used in a three-dimensional case. A three-dimensional case makes it possible to assign a clear physical sense to intensification of the transmission of radiation due to stochastic density inhomogeneity. Tables 2; references: 7 Russian. [57-5303]

UDC 550.38

MAGNETIC EFFECT OF QUIET RING CURRENT

Tbilisi SOOBASHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian, Vol 112, No 2, Nov 83 (manuscript received 14 Oct 82) pp 301-304

FEL'DSHEYN, Ya. I. and PROCHKHIDZE, Ts. D., Geophysical Institute, Georgian Academy of Sciences; Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation

[Abstract] In an earlier article (GEOMAGNETIZM I AERONOMIYA, 19, No 2, pp 380-382, 1979) the authors discussed the magnetic effects of a quiet ring current at the geomagnetic equator near the solar activity minimum. This matter was also investigated by A. S. Kovtyukh, et al. in GEOMAGNETIZM I AERONOMIYA, 21, No 4, pp 755-757, 1981. Whereas the authors for magnetically quiet days in 1974 obtained $DR_{cn} = -18 \pm 4$ nT, Kovtyukh, et al. obtained $DR_{cn} = -8.1 \pm 2.2$ nT for 0800 UT on 24 January 1974. The authors now attempt to resolve this discrepancy, being confident that the difference is not attributable to the use of the initial stage of a geomagnetic storm in the separation of the D_{st} field into DCF and DR fields. Using the customary method the authors have reworked the data for 2 different time intervals. It was found that the magnetic effect of the quiet ring current for the two sets of data coincides within the limits of several nT, at the earth's surface averaging -16.7 nT, and there is no increase in the intensity of the ring current directly before the development of geomagnetic disturbances. The value $DR_{cn} = -16.7$ nT is the sum of the fields of two sources, the ring current field and the field of currents induced in the earth. The relationship of the fields of the external and internal sources is dependent on the duration of the interval elapsing after the injection of particles within

the radiation belt. The close DR_{cn} field values obtained by two methods indicate that $DR^q + DCF^q \sim 0$. During very quiet periods the boundary of the magnetosphere can withdraw to 12-13 R_E . In this case $DCF^q \sim 11-14$ nT and therefore $DR^q \sim 12$ nT. References 9: 3 Russian, 6 Western.
[101-5303]

UDC 551.5]1.14

COMPUTING SHORT-WAVE RADIATION FIELD WITHIN CLOUDLESS VERTICALLY INHOMOGENEOUS ATMOSPHERE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
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pp 28-32

GAVRILOVA, L. A., Leningrad State University

[Abstract] This article is a continuation of the author's previous work (IZV. AN SSSR: FAO (Vol 15, No 1, pp 110-114, 1979; Vol 17, No 4, pp 373-383, 1981; Vol 17, No 9, pp 940-945, 1981). These investigations were devoted to application of a precise method for solving the transfer equation, based on use of Ambursumyan functions, to solution of a number of problems in atmospheric optics. On the basis of precise computations an investigation was made of how legitimate it is to use a simplified model of a homogeneous atmosphere (scattering phase function and single scattering albedo do not change with altitude). Some approximate formulas were derived for computations of the radiant influx in the entire layer of the atmosphere, the radiation fluxes passing through interfaces and the intensity of night airglow observed from the earth's surface. It is against the background of this earlier work that the author now undertakes computation of the spectral fluxes and mean intensity within the atmosphere. Four levels in the range of altitudes characteristic for aircraft measurements of spectral fluxes were selected in order to use the results of computations for solving the model inverse problem of finding the volumetric coefficient of true light absorption on the basis of the known flux values. The computations were made for models of vertically inhomogeneous, homogeneous and two-layer atmospheres. The results indicated that in computing the fluxes within the atmosphere it is necessary to take atmospheric inhomogeneity into account, at least in the form of a two-layer model. Figures 4; tables 2; references 5: 4 Russian, 1 Western.
[57-5303]

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