

SEISMICITY OF THE SOUTH OF THE KURIL ISLANDS

By S. A. Fedotov*

Thorough seismic investigations show that earthquakes of over 9 degrees are unlikely to occur on the territory of the Southern Kuril Islands.

In 1957-1959 the Institute of the Earth's Physics of the USSR Academy of Sciences was conducting, under the IGY programme, complex geophysical and geological investigations on the territory of the Kuril Islands, Kamchatka, Okhotsk Sea and Kuril deep-water trough the aim of which was to study the area of transition from the continent to the ocean (I).

This work planned a thorough investigation of seismicity, its relations with tectonics and volcanism, construction of vertical velocity sections of the Earth's crust and the mantle's upper strata, the study of the spectral and energy characteristics of earthquakes of the region, insertion of more accurate data into the map of seismic zoning on the Kuril Islands. To carry out the seismic investigations, a network of high-sensitive seismic stations has been organized in 1957 and they continue the observations in 1960 too. Their location is given in Fig. 1.

The temporary seismic stations of the Southern Kuril network have equipment that is now usually used by the Soviet scientists conducting seismic observations.

To record the three components of the ground oscillations electro-dynamical vibrographs VEGIK and galvanometers GB-IY are used. The period of own oscillations of the VEGIK pendulum is easily regulated within 0.5-1.5 sec. The frequency of own oscillations of the suspension system of the GB-IY galvanometer is about 14 cycles. The description of these devices is given in paper (2). The registering channels of these stations have equal frequency characteristic (Fig. 2) which was selected after an experimental registration with different frequency characteristics. Cuts of the characteristics for low and high frequencies are necessary to neutralize storm micro seisms and wind disturbances the level of which is rather high on the Kuril Islands. Each station has four recording channels. Three channels of the station record components of the ground oscillations during weak earthquakes with maximum magnification 10.000. The fourth channel is assigned to record felt earthquakes. It has maximum magnification 500 which at a selected frequency characteristics ensures, within the limits of the seismogram, records of earthquakes with intensity up to 5 degrees.

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The registration speed is 240 mm/min as the result of which the errors in time readings on the seismogrammes do not exceed ± 0.15 sec.

Among the supplementary equipment mention should be made of a device for automatic increase of the brightness of light rays during an earthquake, a device for an automatic reception of precise time signals and circuits switching in at the moment of an earthquake to record it by an oscillograph at a speed of 600 mm/min and more for a subsequent analysis of the spectrum.

The above equipment records a great number of weak near earthquakes, the efficient time service helping it to reduce errors in determining the epicentres and their depths, the equipment obtains data on seismicity of the area under investigation-within short periods of time.

Thorough seismic observations have confirmed those conceptions which have been formed up on the seismicity of the Southern Kuril Islands on the basis of the data of the permanent seismic stations (4), (5), (6) used as a cornerstone for seismic zoning in 1957 (3).

The Earth's crust within the limits of the Southern Kuril Islands possesses low seismic activity. No strong earthquakes occur there (4), (5), (6) and as evidence expeditionary observations not many weak earthquakes occur.

During January-October 1958 the Earth's crust in the zone of the Iturup Island saw less than 40 weak earthquakes which were distinctly recorded by all the temporary stations on the Iturup Island that make for 10 percent of the total number of weak near earthquakes having been recorded by these stations during the same span of time, Fig. 3. Thus, a compact group of weak earthquakes has been distinguished that are being recorded at the Reydovoe station with S-P = 0.1 - 0.9 sec. These earthquakes may be of volcanic origin.

The greater part of weak and strong earthquakes in the Southern Kuril zone in 1957-59 occurred under the Earth's crust between the islands and the deep-water through. An illustration of this is a map of near earthquakes for March 1959 which is a typical monthly map of epicentres from data of the temporary stations in the Southern Kuril zone obtained in 1957-59. In the same area there occurred a strong tsunami earthquake dated as far as November 6, 1958 (7).

Data on the strong Southern Kuril Islands for the last 50 years (4), (5), (6) and expeditionary observations of weak earthquakes permit to arrive at the following conclusions.

Strong surface earthquakes on the Southern Kuril Islands are unlikely. Dangerous for constructions in these regions are strong earthquakes the minimum hypocentral distances to which exceed 100 km. and, as a rule, vary from 120 to 200 km.

At the above hypocentral distances the earthquakes intensity does

not exceed, on the average, 9 degrees, even during disastrous earthquakes with magnitude $M \geq 8$, that is confirmed by the consequences of the Kamchatka Earthquake on November 4, 1952 (8) and of the Iturup Earthquake on November 6, 1958 (7), Fig. 5.

Thus, earthquakes with intensity exceeding 9 degrees are unlikely to occur on the territory of the Southern Kuril Islands.

The Kuril Islands are marked on the Map of Seismic Zoning of the USSR as a 9-degree zone (3). The expeditionary observations of recent years have confirmed the estimate.

The investigation of seismicity on the Southern Kuril Islands by the temporary stations is continued in the following directions:

a) the study of the spectral characteristics of the earthquakes occurring in the Southern Kuril zone;

b) the study of the dependence of the number of the earthquakes on their energy, especially, that of foreshocks and aftershocks of the earthquake on November 6, 1958 with M (magnitude) ≥ 8 ;

c) the study of the relation of the seismicity and the Earth's crust structure and the upper layers of the mantle on the given area of the island arc.

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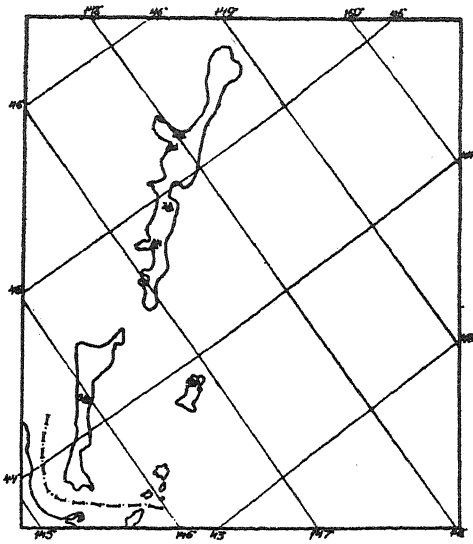


Fig. 1 The Southern-Kuril network of temporary stations.
 1 - the permanent seismic station "Kurilsk",
 2-6 - temporary stations,
 2 - the temporary station "Reydoevce".

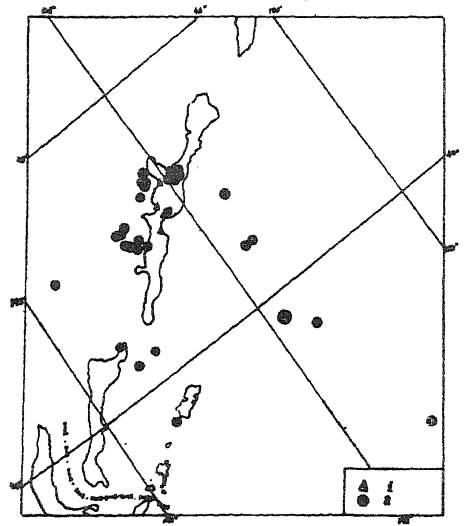


Fig. 3 The map of weak earthquakes in the Earth's crust of the Iturup zone for January-October 1958.
 1 - temporary seismic stations that operated on the Iturup in 1958,
 2 - earthquake epicentres in the Earth's crust.

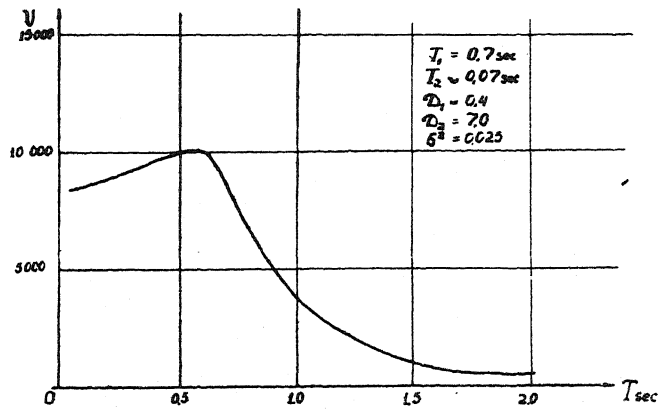


Fig. 2. Optimum frequency characteristics to record near earthquakes on the Kuril Islands.

V - magnification, T - period of ground oscillations,
 T₁ and T₂ - periods of own oscillations of the vibrograph pendulum
 and of the galvanometer frame,
 D₁ and D₂ - dampings of the vibrograph and galvanometer,
 σ² - linking coefficient of the galvanometric registration.

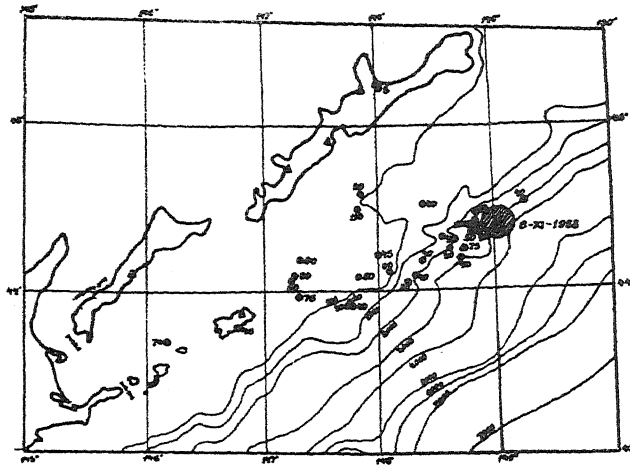


Fig. 4. The map of the epicentres of weak earthquakes of the Southern Kuril zone for March 1959. Next to the epicentres are indications of the earthquake depths in km. The epicentre of the disastrous earthquake on November 6, 1958 is hatched. The isobates of the ocean are plotted.

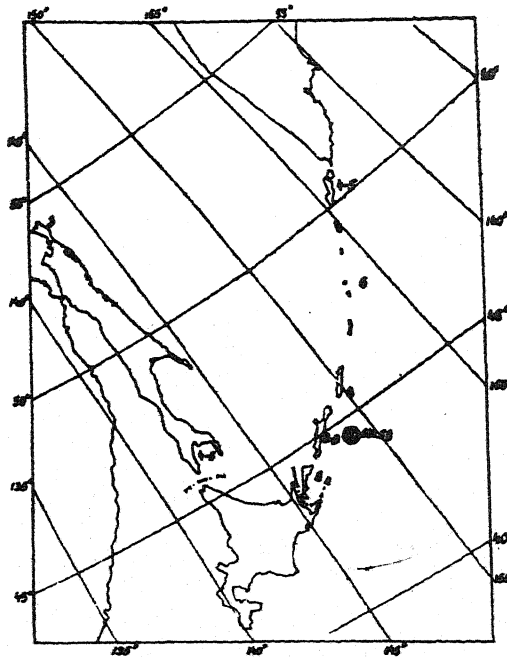


Fig. 5. The earthquake magnitude in degrees on November 6, 1958, the Kuril Islands.