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D O C U M E N T S B R A N C H

T R A N S L A T I O N

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D O C U M E N T S B R A N C H

T R A N S L A T I O N

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Ref CD No 268.4

Report No 1

SEISMIC RESEARCH

Prepared by

Documents Branch
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[redacted]

Ref CD No 268,4, 2(a)

Document No 261[illegible]72, "Bulletin of the Academy of Science of the USSR," Vol X, No 1, 1946, contains articles on seismic research, illustrated with curves and diagrams. Summaries of the contents of each article are submitted below. Complete details are available in Documents Branch.

[redacted]

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"The Representation of Seismic Fields" by G A Gamburtsev (Summarized), pp 11-18.

1. The primary materials obtained by seismic prospecting are the seismograms, or records of the seismograph. The data recorded on the seismograms afford a number of basic elements both quantitative and qualitative. These seismic elements may be simple, determined by only one trace; or they may be complex, determined by many traces. Specifically, the seismic elements may be kinematic, fixing time of arrival and, hence, distance; or they may be dynamic, showing intensity from the wave form of the traces. The qualitative elements may be treated quite broadly; for example, the very existence of a certain type wave may be taken as a seismic element.

2. On superficial observation of the seismic data, the whole field or aggregate of the various seismic elements seems to represent, generally speaking, a multidimensionality. For instance, the field or collection of such a simple seismic element as the run time of a certain type wave is a function of two pairs of arguments or variables:

(1) The co-ordinates (x,y) of the point of reception.

(2) The co-ordinates (ξ,η) of the point of seismic excitation.

3. The dimension of a field for some seismic elements decreases because of specific qualities in these elements and under certain seismological conditions. To decrease the dimension in the general case, it is necessary to set up certain relations between the field arguments; that is, it is necessary to confine the range of observations to the plane and to arbitrary points or curves.

4. The most important relations which reduce the four-dimensional field of simple seismic elements to a two-dimensional field can be expressed by the following equations:

$$\xi = \text{constant}, \qquad \eta = \text{constant} \qquad (1)$$

$$\xi = x \quad , \quad \eta = y \qquad (2)$$

$$F_1(x,y) = 0 \quad , \quad F_2(\xi,\eta) = 0 \qquad (3)$$

The first relation simply states in mathematical language that the seismic survey or prospecting was conducted holding the shop point or center of tremor excitation on the surface and at one constant fixed point. Similarly, the second set of equations corresponds to an areal or superficial survey according to the reflection method; that is, the principal receiver lies near the shot point, which point is made to move around the surface, as indicated by the variable relationship in equations (2). The third relation, in equations (3), corresponds to a number of cases where receiver and shot point move over the surface tracing plane curves as different seismic observations are made: F_1 and F_2 define the movement. In particular, the third relation corresponds to the usual longitudinal profile; that is, the points of reception and the points of tremor excitation are made to lie on the same line. The third general relation also corresponds to a pair of nonlongitudinal profiles; that is, the points of reception

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and the points of excitation lie respectively on two different lines parallel to each other. So as to trace out a straight line or two straight lines, or two quite general and arbitrary curves, the type of movements of successive observations is defined by the functional forms F_1 and F_2.

5. Relations (1) and (2) are simple and undistinguished by any peculiarities. As for relation (3), the field can be represented by the coordinates (u,v), where u and v , respectively, are the distances from some initial point along the two curves, $F_1(x,y) = 0$ and $F_2(\xi,\eta) = 0$. For the longitudinal profile, $u = x$ and $v = \xi$.

6. The rectangular diagram (x,ξ) possesses an axis of symmetry ($\xi = x$); therefore, those seismic elements, such as the run time, which hold a mutual or symmetrical relation may be represented within the limits of a half plane, that is, above or below the axis of symmetry. The rectangular diagram (u,v) may also be used to represent conveniently the field for a pair of nonlongitudinal profiles in the case of mutual or symmetrical relations, since it does not matter on which of the two straight lines the source point or receiver are situated. It is important only that source point and receiver be situated on different straight lines for each separate observation. The diagram (u,v) has no axis of symmetry for a pair of nonlongitudinal profiles. The rectangular diagram (u,v) clearly represents where the regions of refractions exist and reveal Mintrop's waves. On such a diagram one may see the isochronous lines and the boundaries or limits of the regions where qualitative discontinuities exist.

7. The following are examples of seismic elements that may be useful in decreasing multidimensional fields by their own natures:

(1) The apparent velocity in an arbitrary direction of Mintrop's wave, connected with the seismic boundary diverging slightly from the plane.

(2) The value $t_0 = t_1 + t_2 - T_0$, where t_1 and t_2 are the run times of Mintrop's wave along the longitudinal profile and where T_0 is the run time of the same wave between the shot points; here the refracting boundary is supposed to diverge only slightly from the plane.

Multidimensionality decreases to 3 in the first case (1) and to 2 in the second (2).

8. The correlation method of refracted waves and the combined method of reflected and refracted waves may be of importance in seismic prospecting.

"Correlation Systems of Observations in Seismic Prospecting by the Method of Reflected and Refracted Waves" by G A Gamburtsev (Summarized), pp 19 - 29.

1. The various systems for observing reflected or refracted waves may all be resolved into methods of representing observational data on a two-dimensional plane, that is, a generalized plane of observation on which each single point corresponds to each single seismic determination, usually characterized by a pair of points on the real plane of observation.

2. In such a method of representation, a "continuous" chain of points

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(correlational course) on the generalized plane of observation will correspond to the two-dimensional correlation systems of observation, if the principle of mutual or symmetrical relations holds, and if the waves correlate.

3. The correlational course may be divided into two parts, in both of which the shot point maintains its constant position, only the tremor receiver changing position (course-of-position correlation).

Adjoining courses of the position correlation differ with the change in position of the shot point and possess points in common which are mutual points or point-of-transposition correlation, only if the full correlation course possesses continuity.

4. Two different correlation courses between two given points on the generalized plane of observation form a closed correlation course. The simplest closed correlation courses represented on the generalized plane of observation are rectangles, in the case of longitudinal profiles and a pair of nonlongitudinal profiles.

5. The considerations mentioned in the text may be applied to the following two-dimensional systems:

(1) Areal survey with fixed position for the shot point.

(2) Longitudinal profile.

(3) A pair of nonlongitudinal profiles.

(4) Etc.

6. When impossible to represent the whole system on the two-dimensional plane, correlation relation of separate two-dimensional observation systems must be studied. The problem to be solved here is the correlation relation of two pairs of points corresponding to two isolated seismic determinations.

This problem leads to consideration of the correlation system of observations by a pair of nonlingitudinal profiles.

7. The correlation relation of two reflections or two refractions may be simplified considerably when mixed forms of phase correlation can be applied to the combined profiles of refracted and reflected waves.

* * *

"Waves Caused by a Moving Source in a Solid Elastic Medium" by G A Gamburtsev (Summarized), pp 30 - 44.

1. Many authors have pointed out the analogy or similarity between: (1) Mintrop's seismic waves traveling between two layers and (2) the ballistic sound waves caused by a projectile exceeding the speed of sound. The analogy is more complete for ballistic waves in a solid medium, that is, a wave caused by a moving source in a solid elastic medium

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2. The theory of ballistic waves in a solid homogeneous and isotropic medium is based on Stokes' problem of an object moving in a medium.

The problem of waves caused by a moving source requires an additional study of the kinematical diagram. This study shows what type of solution of Stokes' problem must be chosen for each moment of time.

3. A good example of the above-mentioned analogy is the case of linear and steady motion of a point of instantaneous power.

The following article discusses and gives numerous examples of the above analogy.

* * *

"The Problem of Interpreting the Reflection Time Curves in Three Dimensions" by G V Gamburtsev (Summarized), pp 45 -62.

The seismic velocity, V, is assumed to be a known function, $V(x,y,z)$, of a point (x,y,z) in space. Also assumed is the surface time-distance function, $t(x,y)$, of reflected waves at a fixed point, $S(x_0,y_0)$, of the surface, P_0, where $z = 0$. That is, at this point the time, $t = t_s$, of the arrival of the reflected wave and the gradient, $_s$, = grad t_{P_0} (x_0,y_0), of the surface time function are assumed. The position of the point of explosion, O, is given as $O(o,o,o)$. It is required to find:

(1) The co-ordinates, x_R, y_R, z_R, of the reflecting element, R, and

(2) The azimuth, , of the slope direction and the angle of the slope.

The general solution of this problem is by the time-field method, in accordance with the equation:

$$R(x,y,z) \equiv t(x,y,z) - t'(x,y,z) = 0.$$

Special solutions are proposed for definite forms of the expression $V = V(x,y,z)$, as shown below:

(1) If V = constant, the problem is easily solved by the aid of the formulas below and by graphic construction using the mirror-image method:

$$Vt_s \cos e = V^2 t_s |T_s| = L = (SO_1)_{xy}$$

$$Vt_s \sin e = H = (SO_1)_z$$

$$\tan \phi = (OO_1)_{xy} \div (SO_1)_z$$

$$\cos \theta' = V T_p$$

$$h : H = 1 : L \quad \text{(See original text.)}$$

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(2) If $V = V(u)$, where u is a rectilinear co-ordinate axis arbitrarily oriented, the problem is solved by the construction of and comparison between the longitudinal- and transversal-wave, front-wave diagrams, which represent plane sections of the time fields of the arrival of direct-t and reflected-t' waves at various points in space.

The reflecting element, R, lies on the ray arriving at point S where $t = t'$. The angle, A, and ϕ are determined by a certain set of relations (see text) and by graphic construction.

(3) If the overlying medium consists of a set of earth layers in which velocities V_i = constant where $i = 1,2,3, \ldots n$, separating boundaries of arbitrary form, then the approximate solution of the problem is by the image method (see text).

3. If the overlying medium consists of layers with boundaries of arbitrary form and if, in layer i, velocity $V_i = V_i(u_i)$ where $i = 1,2, \ldots n$, then the solution is obtained by combining the above methods.

* * *

"Interpreting Surface Time Curves of Reflected Waves" by I S Berson (Summarized), pp 63 - 70.

The present article considers the problem of interpreting surface time curves of reflected waves in the case of one spatially situated boundary of separation of arbitrary form. The velocity, V, in the overlying medium is assumed to be constant and known.

The presented method of interpreting surface time curves is to work out consecutively the separate elements of the time surface corresponding to different points of observation. It is shown that the elements sufficient for a univalent determination of the situation in the space of the element of the reflected boundary are:

(1) The element of the surface time curve, that is, the multitude or group of values, t, of the time of arrival of the reflected wave to the given point, A, and

(2) The element of the gradient, γ, of the function of the surface time curve.

From these are deduced the formulas for determining the co-ordinates of the refraction point and the formulas for determining the angle and direction of inclination of the boundary of separation at the point. These formulas make possible the determination of the whole reflecting boundary.

If the values t and τ are continuous functions of the co-ordinates of the points of observations, then the reflecting boundary represents a continuous surface with a continuously changing tangent plane (no discontinuities).

If the velocity, V, is an unknown constant, it is possible to determine it with the aid of one surface time curve within a certain interval.

* * *

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"Method for Solving the Specific Problem of Refracted Waves in Continuous Media with Boundaries of Discontinuities" by I S Berson (Summarized), pp 71 - 90.

In the present work, the author considers the method for solving the specific problem of determining the time curve of refracted waves in the case where the velocities of propagation of the elastic waves and the refracting boundaries are given. This method is based on the determination of the sequence of seismic rays.

The refracting boundaries are usually supposed to represent simple (as regards the horizontal axis) and continuous curves of an arbitrary form which may have, however, of singularities and the velocities are continuous and differentiable functions of the co-ordinates, having discontinuities of the first order on the boundaries, i.e.

Furthermore,

$$a_{i+1}(x,z)/Q_i > a_i(x,z)/Q_i$$

The problem consists of two parts:

(1) Determination of the refracted ray's trajectory.

(2) Determination of the ray's travel time.

The method for solving this problem is Fermat's principle. This principle states that the following integral is stationary:

$$t = \int_0^{x_0} F\left(x, z, \frac{dz}{dx}\right) dx = \int_0^{x_0} \frac{1}{a(x,z)} \cdot (1 + z'^2)^{\frac{1}{2}} dx.$$

This integral represents the travel time for a wave from the fixed source, O(o,o), to the variable point of observation, that is, the point $A(x_0, 0)$.

By calculus of variations, the solution for this problem leads one to the determination of the refracted ray's trajectory, assuming a discontinuous function, F, under the integral. As a result, we get a system of equations which allow one to determine the refracted ray's trajectory for an arbitrary position of the source and tremor receiver. This system may have one or several solutions, or even none at all. Sometimes the solution proves to be incompatible with certain positions of the source and receiver, and sometimes the solution is incompatible with any arbitrary situation.

If the system of equations determining the trajectory of a seismic ray has a solution, the travel time is calculated by the above integral expressions, where $z = z(x)$ is the equation of the trajectory. If there is only one solution, the time curve corresponding to the given refracting boundary will consist of a single branch. If the system has several solutions, the time curve may consist of several branches differently situated. Therefore, it is possible that the number of branches of the time curve for a medium with many layers does not correspond to the number of refracting boundaries. This fact may cause errors in the interpretation of the observed time curves. It is possible, however, that at least some of the refracted waves, "following each other" and corresponding to the same boundary, possess only an insignificant intensity and will not be taken into account in the analysis of the seismogram. For the solution of the question, therefore, it is necessary to consider the dynamic problem of the intensity of re-

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fracted waves corresponding to a given structure of the medium. It may be expected that the analysis of the form and intensity of the seismogram will considerably improve the accuracy of the interpretation of observations.

* * *

"The Initial Points of the Time Curves of Mintrop's Waves" by I P Kosminskaya (Summarized), pp 91 - 100.

The Seismic Laboratory of the Institute of Theoretical Geophysics obtained seismic data in 1944 on the Apsheron Peninsula, using the correlation method of refr[illegible] waves. For the first time, they obtained material that made possible not only to distinguish the region of the appearance of Mintrop's waves which had been observed formerly, but also to fix the initial points of the time curves of the waves. The observed waves correspond to a boundary of separation greater than 3 kilometers in depth. Further, good reflections were obtained from this boundary. The experiments showed that Mintrop's waves, within the range of their appearance, are characterized by a relatively great intensity and by a less [illegible]trical form on the seismo[illegible]r record than the waves reflected from the same boundary.

The values of the co-ordinates of the initial point obtained by experiment were practi[illegible] the same as those obtained by calculations. The calculations were [illegible] under the supposition that the waves are propagated like Mintrop's waves.

The initial velocity, V_1, may be determined from the initial point of the time curve in the upper medium. The value of the velocity V_1 is thus determined with approximately the same degree of accuracy (about three percent) as by the method of reflection. The value of the velocity V_1 depends to only a small degree on the angle of inclination, ϕ, of the boundary of separation.

For $\phi < 20^\circ$, one uses the following equation deduced from the supposition of a horizont[illegible] boundary of separation:

$$V_1' = x_M V_R \cdot t_M - 1$$

The values of the velocity V_1, which are calculated with the aid of the co-ordinates of the initial points by the above equation and another (see original text), are compatible with the data from seismic coring and the reflection meth[illegible].

* * *

"The Time Curves of Refl[illegible]ted Waves in the Case of a Vertical Gradient of Velocity" by A M Loi[illegible]tsev (Summarized), pp 101 - 114.

In the present article, the author deduces the equations of the time curves of reflecte[illegible]ves for one linear inclined boundary of separation in the case [illegible] constant vertical [illegible]radient of velocity in the overlying medium. [illegible] this case, the time curves of the reflected

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waves represent smooth curves having a minimum. Furthermore, these curves are asymmetrical with respect to the vertical axis passing through the minimal point of the line curve.

Methods of approximation lead to effective values of velocity, depth, and angles of inclination differing from the real values. These differences are greater when the vertical gradient of velocity, the angle of inclination, [illegible] the depth of the boundary of separation.

The author shows that it is necessary to take into account the vertical gradient when construction the reflecting boundaries. The author gives a description of one of the possible approximate methods which may be used to determine the degree of accuracy, as opposed to methods using the supposition of a homogeneous overlying medium.

* *

Document No 239722, "Bibliography of Textbooks on the Weather and Climate of the USSR," East Asia Research Institute, Mar 1944, contains abstracts of several hundred volumes on the subject dated prior to 1941. These are not available in the Documents Branch at present. The section listing seismological works is brief, and the only item of interest is the following, listed as being available at the Manchurian Railway Co, Ltd:

<u>The Distribution of Epicenters in the USSR: Vol 2, Siberia,</u> by V V Popoff in "Reports of the Seismological Institute," 1939.

* *

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Document No 273902, "East Asia Meteorological Data: Siberia," Central Meteorological Observatory, Jan 1942, approx 600 pp.

This document is in the process of complete translation and will be available shortly as a Documents Branch publication. It contains data from 150 meteorological observatories, and, although no mention is made in the document of seismographic observations, it is believed that many of these observatories contain seismographic instruments. All these observatories are located on keyed maps in the subject document. Name of the 150 observatories follows:

Tobolsk	Co-ordinates			
Berezovo	63°	56' N	66°	24' E
Yurginskoye	56	43	67	29
Kondinskoye	62	22	65	45
Kulgan	55	27	65	19
Obdorsk	66	31	66	35
Padun	56	30	66	37

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Samarovo	60°	58' N	69°	04' E
Satyzhinskoye	59	51	64	50
Surgut	61	15	73	24
Staro-Sidorovo	56	26	65	10
Tara	56	54	74	17
Tyumen	57	10	65	32
Tobolsk	58	12	68	14
Tobolsk Agricultural School	58	18	68	16
Turinskoye	58	03	63	40
Zavodoukovskoe	56	32	66	33

Tomsk		Co-ordinates		
Andovinsky Prilsk	52	24	85	09
Barnaul	53	20	83	47
Belgachskoye Lesnye	51	00	80	18
Biisk	52	32	85	16
Bolshe-Mikolsky Prilsk	55	08	87	80
Borovya Ozero	51	45	80	20
Bulinskoye Ozero	53	08	78	27
Itkulskiy Zavod	52	41	84	37
Kaynsk	55	27	78	20
Kaynsk School	55	27	78	18
Kaynsk Railroad Station	55	21	78	21
Kamen	53	43	81	31
Karagatskiy Forpost [sic]	55	12	80	17
Kolchuginskoye Mines	54	40	86	12
Kolyvan	55	18	82	45
Kuchuk	52	45	82	02
Kuznetsk	53	46	87	12
Loktevskoye	51	13	81	22

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Mariinsk	56°	13' N	87°	45' E
Narym	58	55	81	35
Neodzhidanyy [illegible]isk	53	17	89	04
Pravaya Ob'	55	01	82	53
Proroko-Ilim[illegible] Priisk	52	19	89	12
Salair	54	15	85	47
Spasskaya Rezi[illegible]tsiya	52	48	87	50
Taiga	56	04	85	37
Tatarskaya	55	13	75	57
Chulym	55	06	80	58
Tyumentsevs[illegible]	53	16	83	33
Tisul	55	37	88	17
Tomsk	56	30	84	58
Tomsk Agricul[illegible]ral School	56	41	85	00
Taurak	51	35	85	05
Vyshye-Subras[illegible] Priisk	52	21	88	36
Zmeinogorsk	51	08	82	20
Zyryanovskiy [illegible]ik	49	43	84	16
Altayskaya	49	10	85	34
Tamyshevskiy [illegible]lok	51	53	77	22
Kokpetky	48	45	82	22
Karkaralinsk	49	25	75	29
Ust-Kamenogor[illegible] Ferma	49	45	82	41
Uzon-Bulak	50	12	79	38
Semipalatinsk	50	24	80	13
Zaysan	47	28	84	51
<u>Akmolinsk</u>		<u>Co-ordinates</u>		
Akmolinsk	51	12	71	23
Omsk	54	58	73	23

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Yeniseysk	Co-ordinates			
Abakanskiy Zavod	52°	39' N	90°	07' E
Achinsk	56	19	90	29
Yeniseysk	58	27	92	11
Yermakovskoye	53	20	92	30
Kamenka	58	37	95	40
Kansk	56	12	95	39
Kazachinskoye	57	45	93	12
Kezhma	58	58	101	04
Konkordievskiy Priisk	60	40	91	56
Krasnoyarsk	56	01	92	52
Minusinsk	53	43	91	41
Novo-Mariinskiy Priisk	65	05	93	25
Maximovo	59	30	91	02
Tolstyy-Nos	70	05	83	40
Turkhansk	65	55	87	38
Troitskoye	57	13	94	58

Yakutsk	Co-ordinates			
Blagoveshchenskiy Priisk	58	10	114	17
Tenyuka-Olekma	57	50	122	04
Yakutsk	62	01	129	43
Kazach'ye (Ust-Yansk)	70	55	136	27
Markhinskiy Ulus	63	17	117	40
Markhinskoye	62	10	129	43
Nizhne-Kolymsk	63	82	160	59
Olekminsk	60	22	120	26
Ust'Maya	60	25	134	29
Rodchevo	66	18	152	40
Russkoye Ust'ye	71	01	149	26

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Suntar	62°	30' N	149°	26' E
Sredne-Kolymsk	67	10	157	10
Tikhono-Zadonskiy Priisk	58	30	113	19
Verkhoyansk	67	33	132	24
Vilyuysk	63	45	121	35
Irkutsk		Co-Ordinates		
Beznosovo	53	59	104	15
Biryusa	55	59	97	53
Bratskiy Ostrog	56	04	101	50
Dushkachan	55	51	107	38
Bol'shoye Goloustnaye	52	01	105	27
Ilimsk	56	51	103	49
Irkutsk	52	16	104	19
Zherdovskaya Agricultural School	52	41	104	27
Kharbatovskoye	53	45	106	02
Kirensk	57	49	108	07
Listvinichnoye	51	51	104	51
Mondy	51	39	100	58
Nishne-Udinsk	54	55	99	03
Nikolayevskiy Zavod	55	55	101	28
Olkhon	53	03	106	54
Osoloy	56	30	106	14
Usolye	52	44	103	42
Ust-Kutskiy Zavod	56	45	105	39
Peschnaya Bukhta	52	15	105	44
Tayshet	55	47	97	43
Tulun	54	33	100	22
Tunka	51	45	102	36
Zalari	53	33	102	30
Verkhnyaya Uda	53	52	101	52

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Transbaikal	Co-ordinates			
Akatuy	51°	03' N	117°	46' E
Aksha	50	15	113	30
Barguzin	53	37	109	38
Bol'shoy Ushkaniy	53	55	108	27
Borzya	50	26	116	31
Dagarskiy Lighthouse	55	42	109	53
Dogye	51	30	118	14
Dono	50	53	117	35
Goryachinsk	53	00	108	18
Yamarovka	50	37	110	15
Kabansk	53	03	106	39
Kharauz	56	16	106	17
Khilok	51	25	110	35
Mangut	49	41	112	42
Mogzon	51	44	112	01
Myeovsk	51	43	105	52
Nerchinsk	51	58	116	35
Nerchinskiy Zavod	51	19	119	37
Onur	52	20	106	49
Olovyannaya	50	56	115	36
Tankhoy (Pereyemnaya)	51	33	105	10
Petrovskiy Zavod	51	14	118	51
Stretensk	52	14	117	42
Chita	52	02	113	30
Turinskiy Lighthouse	52	56	108	12
Troitskosavsk	50	22	106	27
Verkhnyaya Mishikha	51	30	105	58
Verkhne-Udinsk	51	50	107	36

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Maritime	Co-ordinates			
Ayan	56°	28' N	138°	17' E
Gishiga	62	02	160	40
Grodekovo	44	22	131	20
Khabarovsk	48	28	135	07
Markovo-na-Anadyre	64	45	170	50
Nikolayevskiy Lighthouse	48	58	140	22
Nikolskoye (Bering Island)	55	12	165	59
Nikolsk Ussuriyskiy	43	47	131	57
Nikolayevsk-na-Amure	53	08	140	45
Nomo Marienskiy Post	64	45	177	33
Okhotsk	59	21	143	17
Pavlinovka	43	39	131	52
Petropavlovsk Lighthouse	52	53	158	47
Posyet	42	39	130	48
Povorotny Lighthouse	42	40	133	03
Preobrazhenskoye	54	49	167	28
Rukovskoye	50	47	142	55
Skryplev Lighthouse	43	02	131	57
Vyazemskaya	47	37	134	46
Vladimirskiy Post	64	25	186	29
Vladivostok Observatory	43	07	131	54
Vladivostok Port	43	07	131	54
Vladivostok Station	43	07	131	55
Amur	**Co-ordinates**			
Blagoveshchensk	50	15	127	38
Dzhalinda	53	28	123	55
Yekaterino-Nikolsk	47	45	130	58
Sofiskiy Priisk	52	27	134	07
Chernyayevo	52	47	126	00

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Sakhalin	Co-ordinates			
Alexandrovskiy Post	50°	50' N	142°	07' E
Galkino Vrazhskoye	47	20	142	44
Korsakovskiy Post (Lo-ho)	46	39	142	48
Kririon Lighthouse (T'ai-po)	45	54	142	05
Onor	50	14	142	35

In addition, document No 273908 contains lists of observatories for atmospheric pressure, atmospheric temperature, and rainfall and days of maximum rainfall.

The following information on seismographic installations made by the Japanese in territories now available to USSR has been extracted from "The Seismological Bulletin of the Central Meteorological Observatory of Japan," documents 303531, 288686, 303511 and 303512:

Sakhalin

Ochiai	Geographical lat N	47°	20'
	Long E	142	47
	Geocentric Lat	47	08
	Equipment	Portable seismometer	
	Date reported	1938	
Ōtomari	Geographical Lat N	46	39
	Long E	142	46
	Geocentric Lat	46	27
	Equipment	Wiechert's horizontal seismograph Wiechert's vertical seismograph Omori's seismograph Omori's tromometer Seismograph of low magnification	
	Date reported	1940	

Korea

Heijō	Geographical Lat N	39	02
	Long E	125	45
	Geocentric Lat	38	51
	Equipment	Portable seismograph of low magnification	
	Date reported	1940	

Manchuria

Dairen	Geographic Lat N	38	54
	Long E	121	38
	Geocentric Lat	38	43
	Equipment	Wiechert's horizontal seismograph Wiechert's vertical seismograph Omori's tromometer Omori's seismograph Portable seismometer	

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	Date reported	1938
Hsin-king (Ch'ang-ch'ung)	Geographic Lat N	43° 55'
	Long E	125 18
	Geocentric Lat	43 43
	Equipment	Portable seismometer
	Date reported	1937
Mukden (Feng-t'ien)	Geographic Lat N	41 47
	Long E	123 24
	Geocentric Lat	41 35
	Equipment	Wiechert's horizontal seismograph Wiechert's vertical seismograph
	Date reported	1937
Ying-k'ou	Geographic Lat N	40 40
	Long E	122 14
	Geocentric Lat	40 28
	Equipment	Portable seismometer
	Date reported	1937

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"The Seismological Bulletin of the Central Meteorological Observatory of Japan," 1938, [illegible] 288741, lists installation of Galitizin's horizontal and vertical seismographs in the Tokyo Central Observatory. No other stations reported having this equipment. Installation of other equipment mentioned in reference is not recorded.

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Ref CD 268.4 3(a-e)

The following documents, which are available at the Army Map Service have appeared in lists entitled "Heringen Collection Accession Reports," Ten lists have appeared since 20 Jun 1946 and are numbered one to ten.

Report No 4 --Doc [illegible]-17. "Bulletin of the Academy of Sciences of the USSR: Geographic and Geophysical Series," 1940.

Report No 5 --Doc [illegible]-735. "Transactions of the Seismological Institute," No 3 (1930), No 31 (1933), No 79 (1938).

Report No 6 --Doc [illegible]. "Transactions of the Central Geological and Prospecting Institute," 54 vol dated 1935-1940.

Report No 9 --Doc [illegible]-917. "Report on Prospecting Geologic Works near the Villages Transapole, Poynovichi, Dubinets, Zharavinka and Station Lupolovo in Vogiler Raion, White Russia --1938-39," A V Vashkevich.

Report No 10 --Doc [illegible]-5314. "Principles of Seismology," B Gutenberg, 1935, Russian translation from German.

Report No 10 --Doc [illegible]-5335. "Equipment for Geologic Prospecting," (reference book) Central Geologic Administration, 1938, Russian.

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There is considerable additional material accessioned in reports No 4 and 5 of this series between documents No A-619 and A-938 on the subjects of geology, prospecting, etc. which could be examined for the desired information. All of these documents are Russian periodicals.

Ref CD 268.4 HK

Japanese research in seismology, as reported in the bulletins of the Seismological Research Institute, Tokyo Imperial University, is available at the Documents Branch for 1930, 1932, 1934-36 and 1938-43. The research reported on in these bulletins is chiefly concerned with preventative measures against earthquakes, although seismic prospecting is also represented.

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