

A CASE STUDY ON THE RESCUE AND REHABILITATION AFTER AN UNEXPECTED DISASTER

**— THE ERUPTION OF MT. USU OF
AUGUST 7 TO 13, 1977 —**

PWRI TECHNICAL MEMORANDUM No.1293

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**Public Works Research Institute
Ministry of Coustruction**

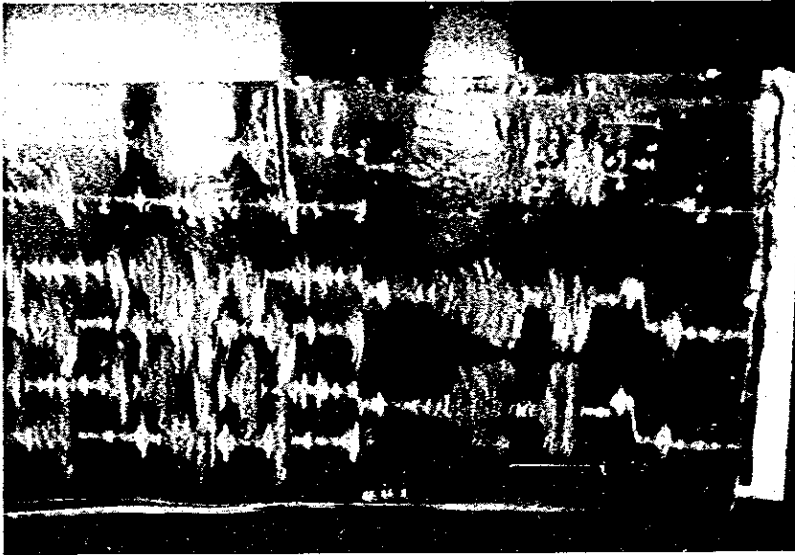


Photo-1 Earthquake Motion Record
Preceding the Eruption Observed
at Muroran Meteorological Ob-
servatory.

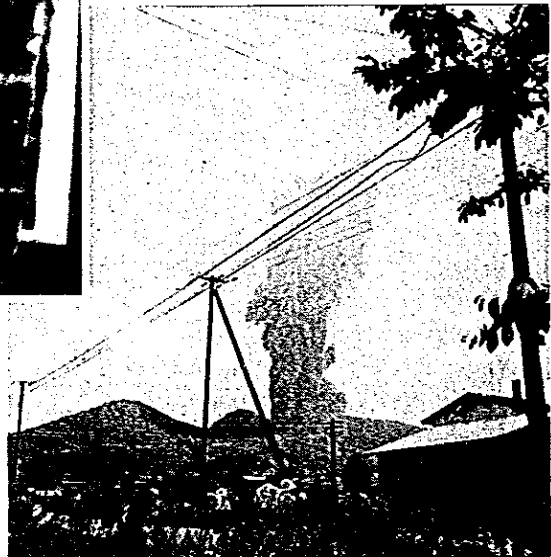


Photo-2 Scene of the Eruption on
August 7.

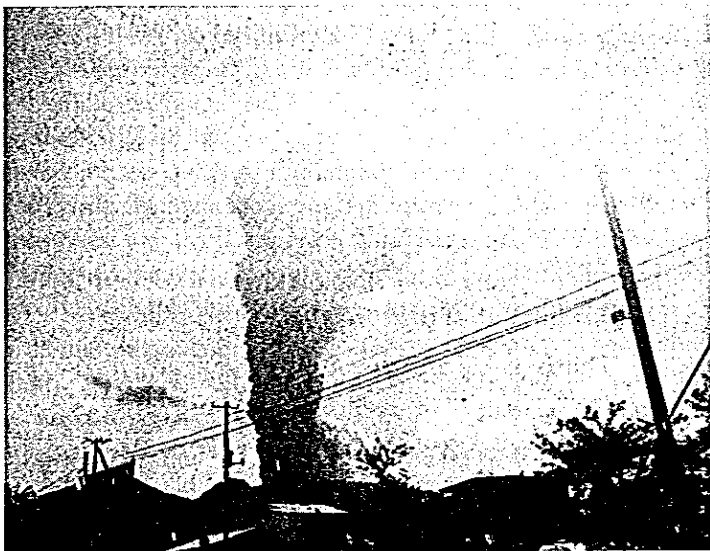


Photo-3 Scene of the Eruption on August 7.

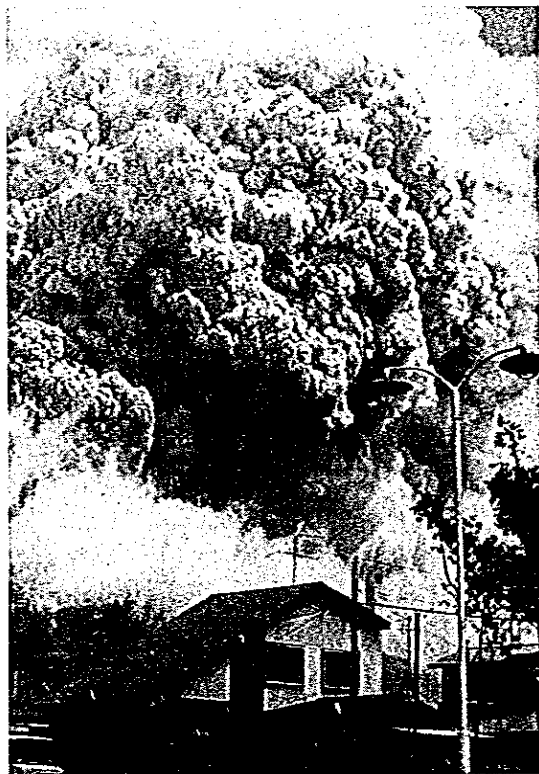


Photo-4 Scene of the Eruption on August 7.



Photo-5 Scene of the Eruption on August 7.

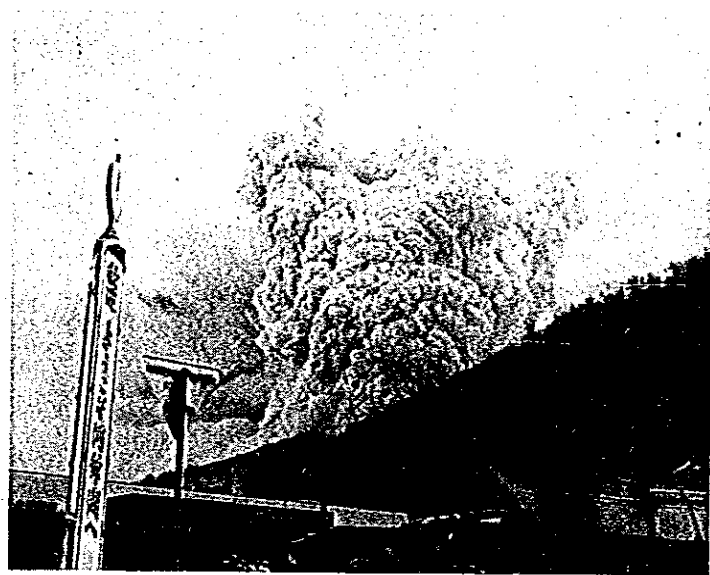


Photo-6 Scene of the Eruption on August 7.



Photo-8 Volcanic Ashes and Bomb.



Photo-7 Volcanic Ashes and Bomb.



Photo-9 Volcanic Ashes and Bomb.

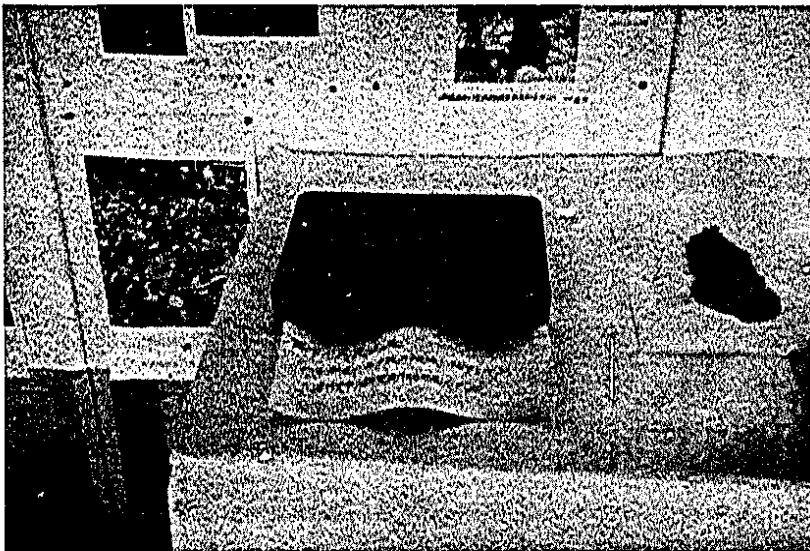


Photo-10 Volcanic Ashes and Bomb.



Photo-11 Ash Fall on the National Highway and the Removal Works.

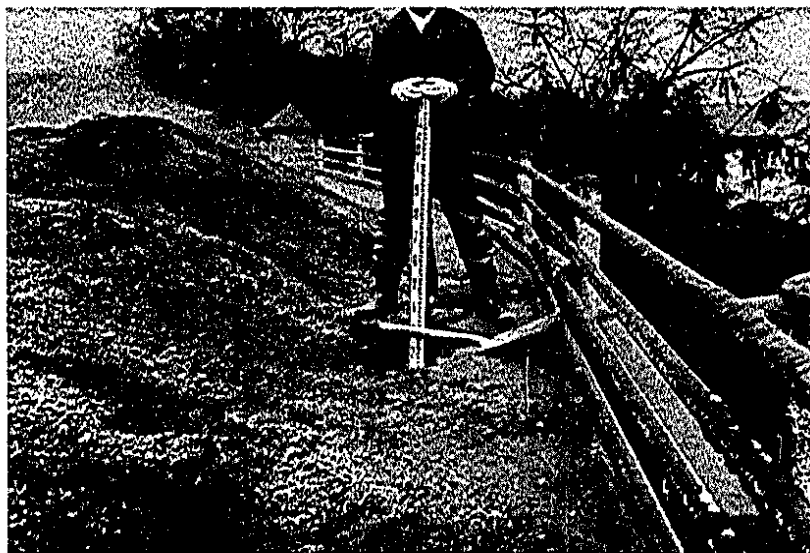


Photo-12 Ash Fall on the National Highway and the Removal Works.



Photo-13 Ash Fall on the National Highway and the Removal Works.

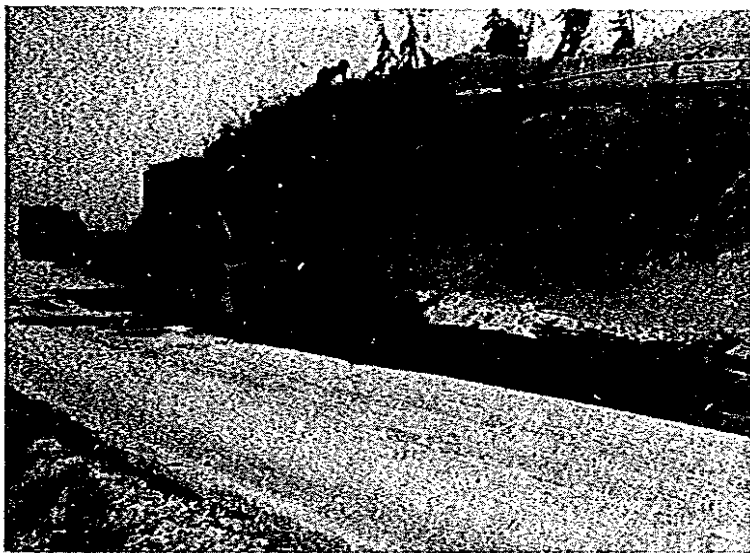


Photo-14 Ash Fall on the National Highway
and the Removal Works.



Photo-16 Volcanic Ashes Drifting
on Lake Toya.



Photo-15 Ash Fall on the National Highway
and the Removal Works.

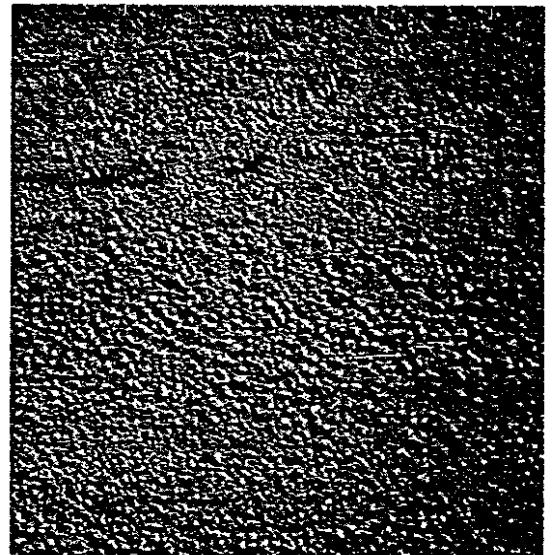


Photo-17 Volcanic Ashes Drifting
on Lake Toya.



Photo-18 Damages of Telecommunication Facilities.

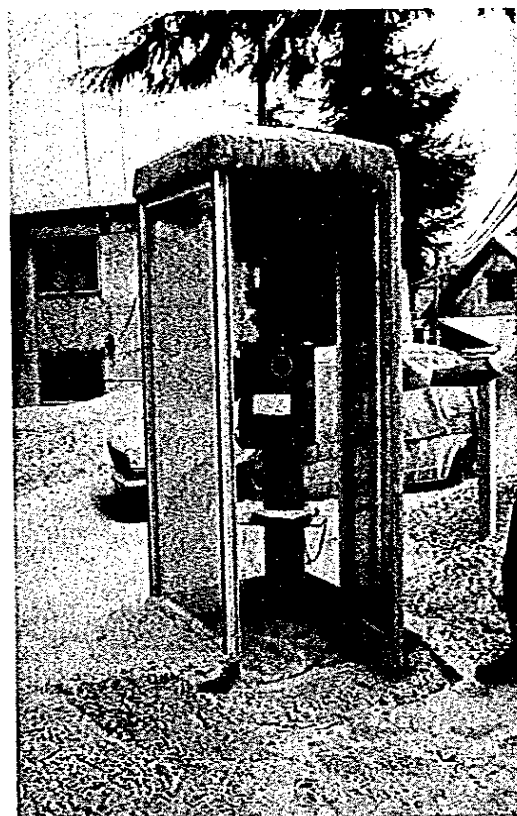


Photo-20 Damages of Telecommunication Facilities.

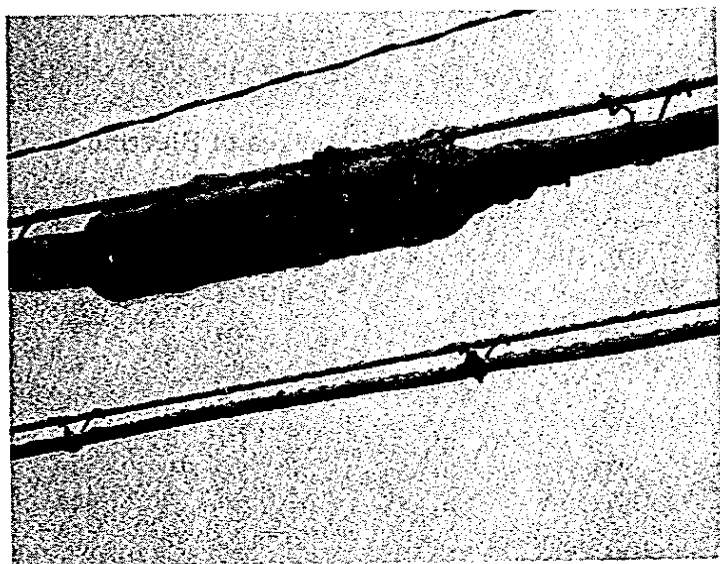


Photo-19 Damages of Telecommunication Facilities.



Photo-21 Damages of Telecommunication Facilities.

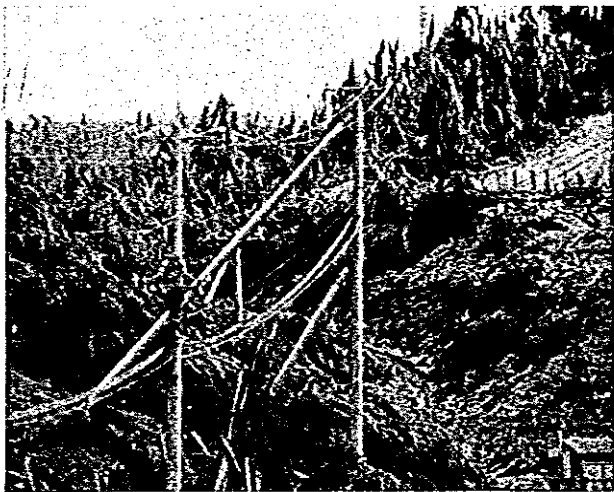


Photo-22 Damages of Electric Facilities

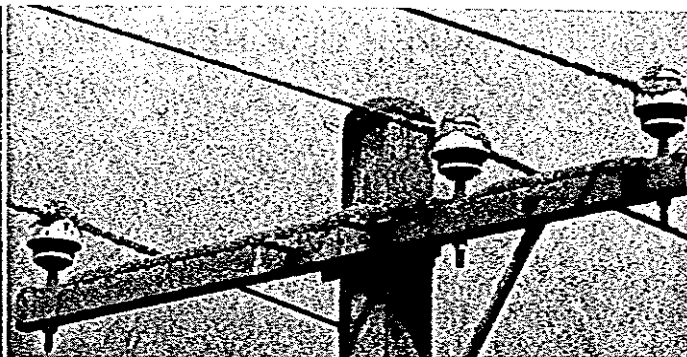


Photo-25 Damages of Electric Facilities



Photo-23 Damages of Electric Facilities



Photo-26 Damages of Electric Facilities.

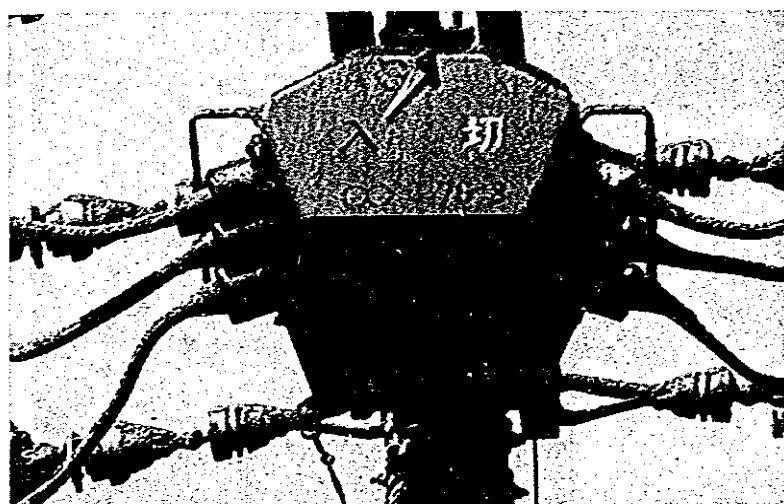


Photo-24 Damages of Electric Facilities



Photo-27 Damages of Sankei Hospital in Sobetsu Town.

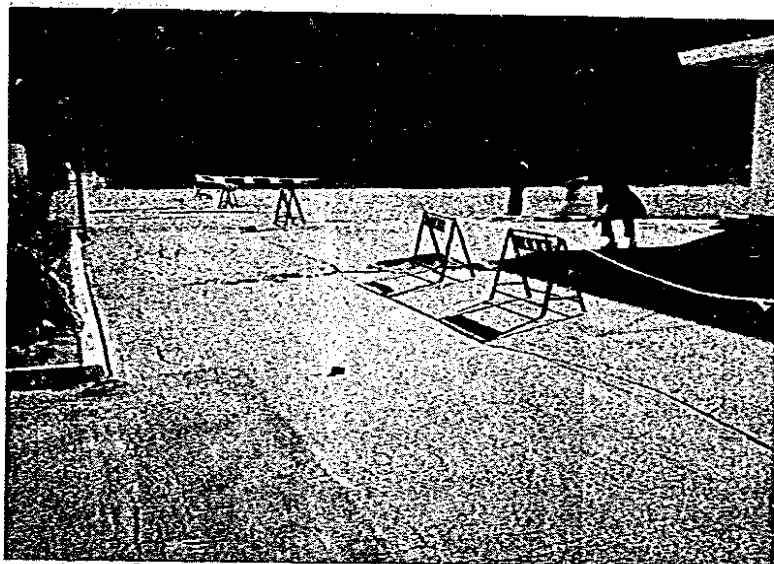


Photo-28 Damages of Sankei Hospital in Sobetsu Town.



Photo-30 Damages of Sankei Hospital in Sobetsu Town.

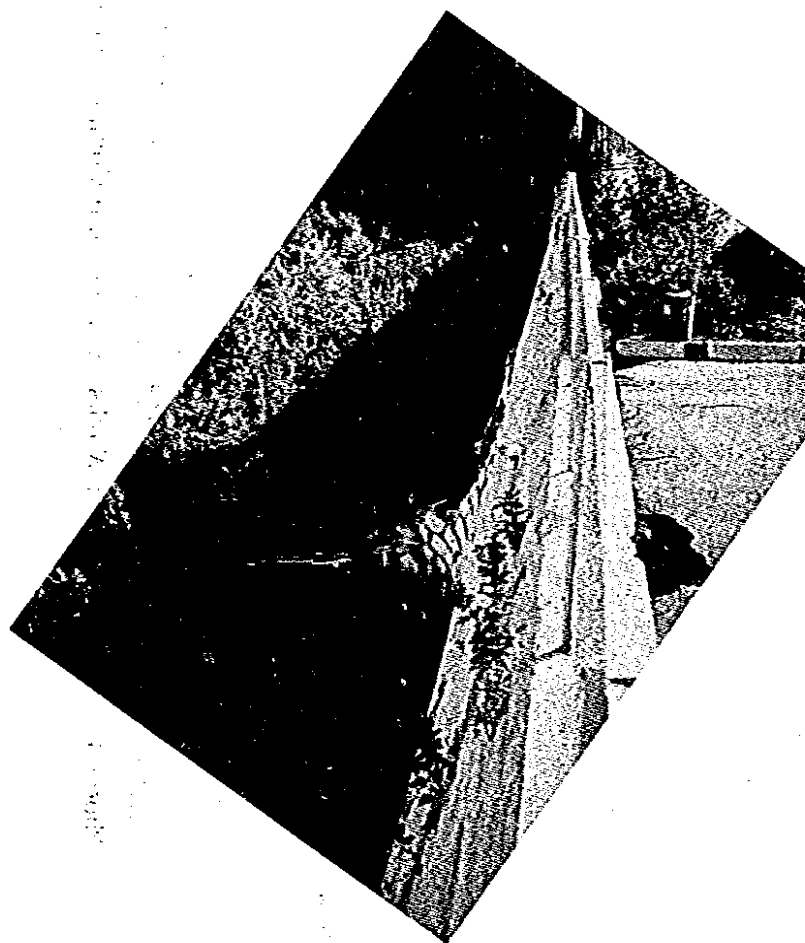


Photo-29 Damages of Sankei Hospital in Sobetsu Town.

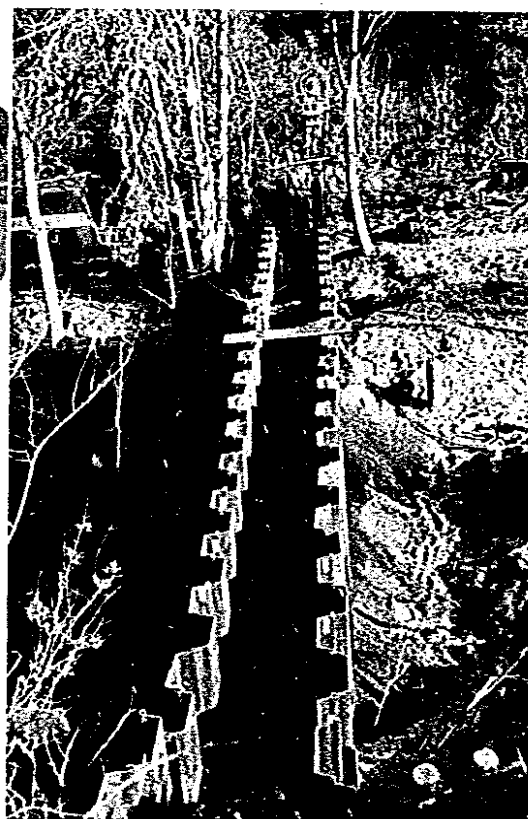


Photo-31 Reconstruction Works near Konomi Complex in Abuta Town as of September 22.

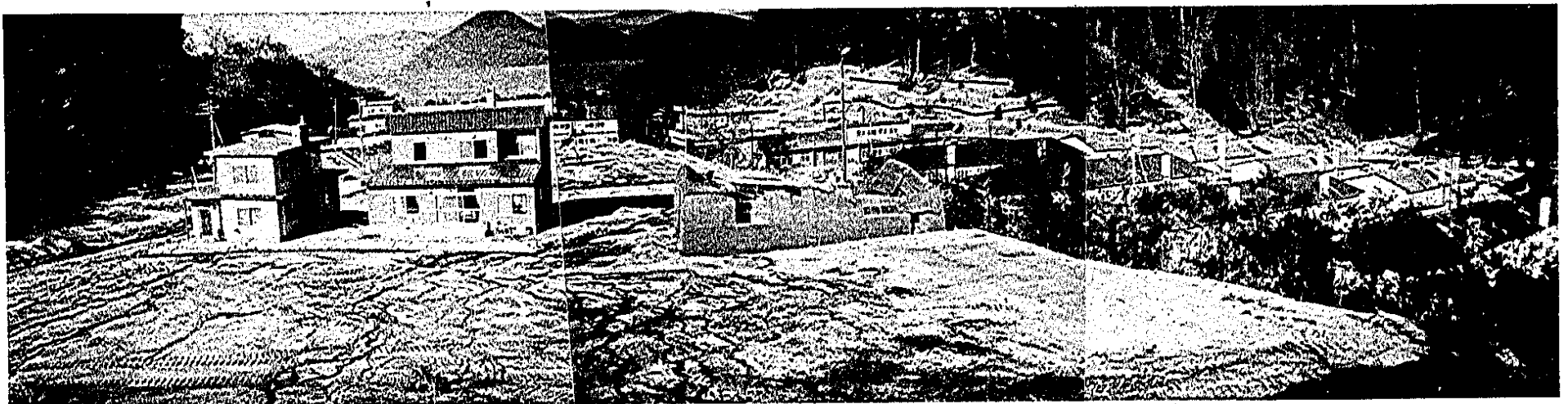


Photo-32 Reconstruction Works near Konomi Complex in Abuta Town as of September 22.

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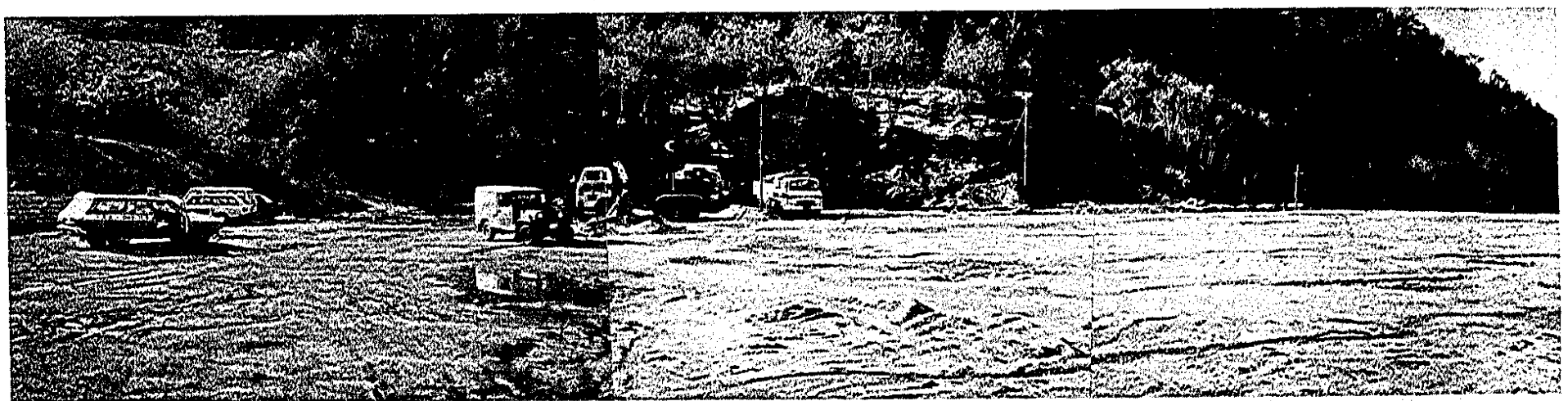


Photo-33 Reconstruction Works near Konomi Complex in Abuta Town as of September 22.

CONTENTS

Introduction	1
1. Outline of the Eruption of Mt. Usu of 1977	3
2. Damage	9
3. Rescue and Rehabilitation after the Eruption	16
4. Application of Law Systems for Relief	37
5. Conclusion	40
6. Acknowledgements	43
7. References	44
Appendix	45

Introduction

Measures to suppress damages caused by natural disasters could be categorized into the following three :

Predictions

To predict the occurrence of disaster induced phenomena and to suppress sources of the disasters.

Pre-disaster Countermeasure

To augment the disaster resistivity of structures and facilities preceding a disaster in order to reduce probabilities of failure and to allocate them adequately.

Post-disaster Countermeasures

To minimize the expansion of disasters if inevitably emerged.

The predictions has not applied so far to the unexpected disasters such as earthquakes and eruptions for practical use. To rely only upon the pre-disaster countermeasure might be partly sufficient, because these disasters should be brought suddenly beyond precautions and there exist possibilities of occurrence of the greater disasters exceeding the anticipated level from engineering aspects. Therefore in preparing organizational systems for disasters a reasonable combination of pre- and post-disaster countermeasures should be indispensably discussed.

However few researches on the post-disaster countermeasures for natural disasters have been carried out and the methodology for them has not been established. An interdisciplinary study should be encouraged among such fields as sociological and natural sciences and engineering technology.

The authors made a field study from 19 to 22 of September, 1977 on the rescue and rehabilitation after the eruption of Mt. Usu emerged from 7 through 13 of August. The rescue and rehabilitation conducted by the relevant administrations and public corporations were put most emphasis in this study. The personal

interview was adopted.

January, 1978

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1. Outline of the Eruption of Mt. Usu of 1977

1.1 Dimensions of the Eruption

Dimensions of the eruption of Mt. Usu of 1977 was as follows:

- 1) Name : Mt. Usu
- 2) Eruption period : August 7 - 13, 1977
- 3) Location of the mouth of the volcano. (Refer to Fig. 1-1):
E 140°50' N 42°32'
Border of Date City, Sobetsu Town and Abuta Town in Hokkaido
Prefecture.
- 4) Altitude : 725 m

1.2 The Symptom and Emergence of the Eruption

There had not been observed any symptoms of ground surface around Mt. Usu before the eruption. Since 3:00 AM of August 6 eruptive earthquakes were observed. The occurrence of earthquakes reached 2,950 times till 9:00 AM of August 7, in which 240 were sensible. Fig. 1-2 shows the numbers of earthquakes in 32 hours before the first eruption.

Mt. Usu first erupted at 9:12 AM, August 7. The bursting was estimated to reach around 12,000 m high. Iburi and Hidaka districts suffered a shower of volcanic ashes and bomb. Big eruption occurred again at 1:30 PM of the next day. In the following eruption as of 23:00 of the same day, fire-column could be observed. One of the biggest eruption took place at around 11:00 AM, August 9. The consecutive eruptions ceased on August 13. The maximum magnitude of the earthquake occurred was estimated at 4.3 in Richter scale.

1.3 Volcanic Ash Fall and Climate

The distribution of the ash fall relied upon the velocity and direction of winds. As for the first eruption (9:12 AM, August 7) W - NW wind was blowing at 5 - 10 m/sec, and the southeast vicinity of Mt. Usu suffered the ash composed of Desite (SiO_2 68-71%). At night of the same day 10 - 25 m/sec wind from W - WNW carried the ashes to 180 km far from Mt. Usu.

Much of ashes moistened by rainfalls, which caused a great damage to agricultural products, covered the northwest part of the foot of Mt. Usu. Fig. 1-3 and 4 indicate the distribution of the ash fall.

During one month following the eruption it rained three times in this district. Muroran Meteorological Observatory issued a rain and flood alarm on August 8, and warning on August 16 and 25.

1.4 Debris Flow

Only a little debris flow which brought no remarkable damage was observed after the eruption.

1.5 Historical Records on the Eruptions of Mt. Usu

Refer Appendix which describes historical records on the eruptions of Mt. Usu.

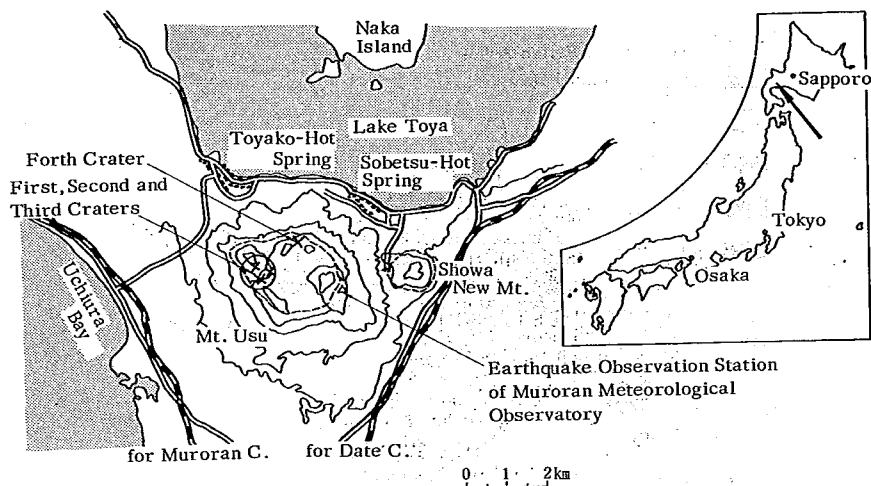


Fig. 1-1 Locations of Mt. Usu and Craters

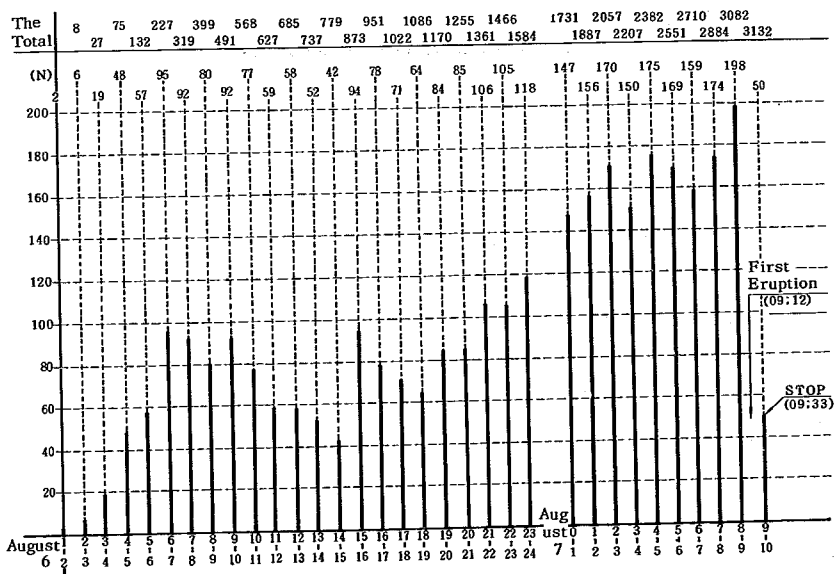


Fig. 1-2 Numbers of Earthquakes 32 Hours before the Eruption

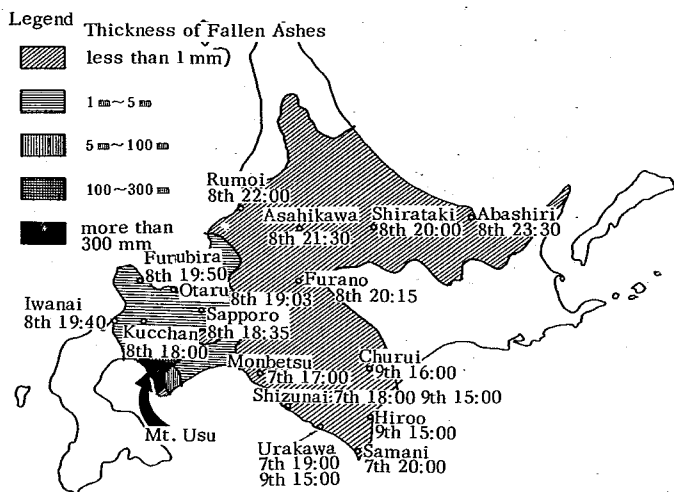


Fig. 1-3 Distribution of Fallen Ashes

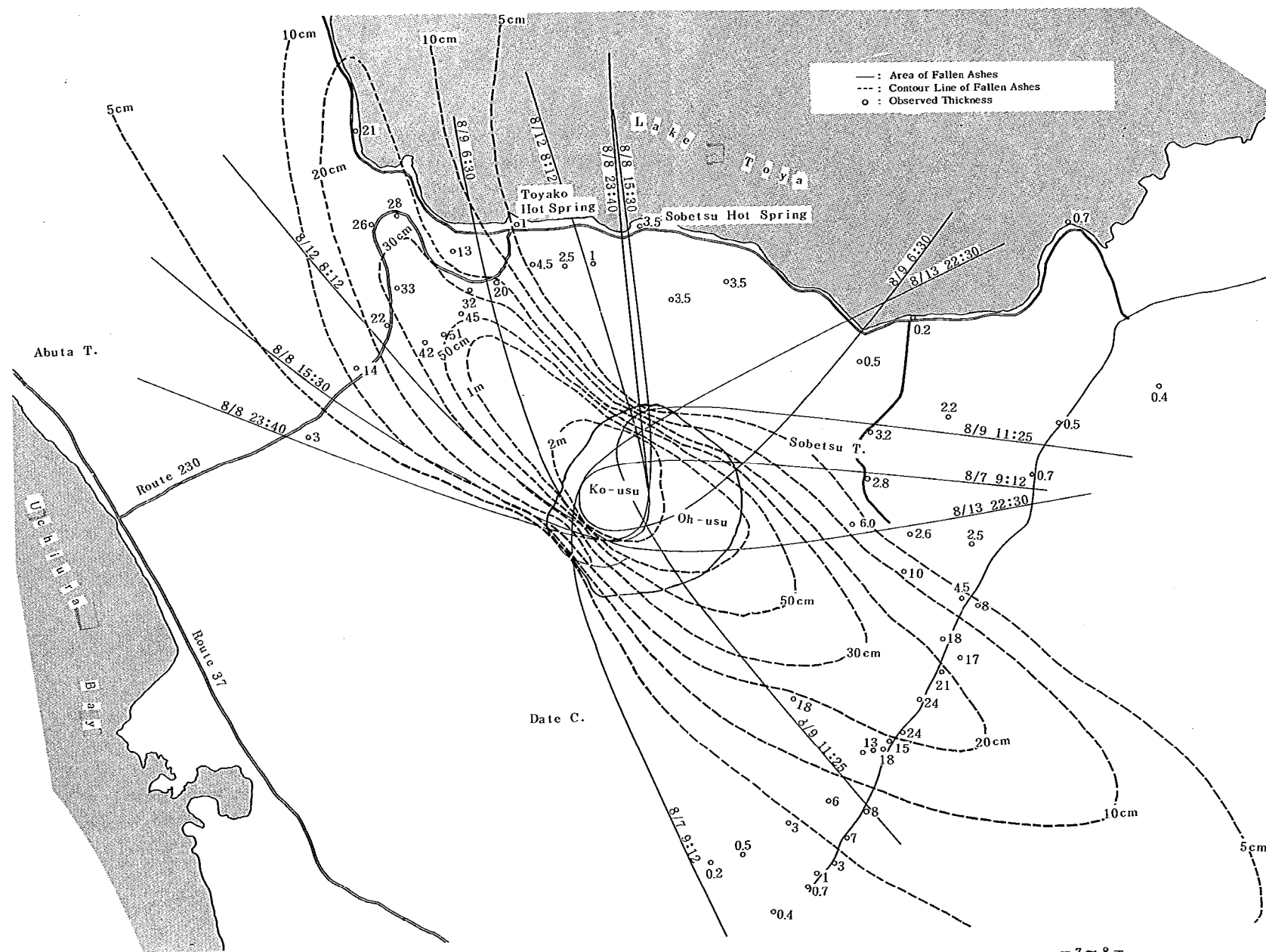


Fig. 1-4 Distribution of Fallen Ashes and Wind Direction

2. Damage

2.1 General Scopes

Total loss by the eruption of Mt. Usu is, according to the survey of the Disaster-prevention and Fire Defense Section, Hokkaido Prefectural Office, about 31.7 billion yen, in which 82.8% of the damage is that of agriculture. It does not include the income reduction of the tourism industry on Lake Toya in Toya National Park coming up to 990 million yen. Damage to the industrial facilities were 3.5% of the total. Damage to the lifeline systems such as civil engineering structures, and telecommunication and electric facilities were not severe.

Most of the losses concentrate on Date C., Abuta T., Sobetsu T. and Toya V. surrounding Mt. Usu.

2.2 Damage of Dwelling

Damage of dwelling houses were mainly caused by the fall of volcanic ashes and bomb, and rarely by inundation. The breakdown of the damages are as follows:

	Classification	Number	Loss (thousand yen)
Dwellings	Totally damaged	8 (26 families)	64,081
	Half damaged	4 (4 families)	4,180
	Partially damaged	370 (534 families)	322,918
	Total		391,179
Non-dwelled buildings		33	20,980
Grand total			412,159

2.3 Damage of Agriculture, Fishery and Forestry

Damage of agriculture involve those of products and farm land caused by the fallen ashes.

Damage of the cultivated scallop and trout were the most part in fishery.

Forestry in this district also suffered from the ash fall causing damage to forests and nursery trees.

According to the survey of the Hatching Office of Lake Toya the transparency

of water extremely dropped after the eruption but has recovered satisfactorily.
Influences to fishes are still under investigation.

	Classification	Number	Loss (thousand yen)
Agriculture	Agricultural product	16,426 ha	7,590,021
	Fruits	3.6 ha	6,600
	Agricultural facilities	173	195,676
	Livestock	118	2,546
	Farm land	4,019 ha	2,226,305
	Relevant facilities	38	1,833,695
	Total		11,854,843
Fishery	Cultivated scallop	6,486 t	} 1,496,505
	Cultivated trout	46,253	
	Total		1,496,505
Forestry	Private forest		6,947,650
	National forest		5,950,000
	Total		12,897,650
Grand total			26,248,998

2.4 Damage of Educational and Sanitary Facilities

Water supplies in Abuta T. and Toyoura T. were cut off after the eruption, because the water quality of the rivers and lake got worse. A filtration plant in Abuta T. was abandoned since the debris flow was anticipated nearby to destroy it. A hospital in Sobetsu T. quitted the practice having cracks on the walls and columns of the building. (Ref. Photo. 27 - 30)

	Classification	Number	Loss (thousand yen)
Educational facilities	Elementary and junior highschool	29	30,057
	Senior highschool	3	1,214
	Gymnasium	9	46,659
	Miscellaneous	1	59,692
	Total		137,622

	Classification	Number	Loss (thousand yen)
Sanitary facilities	Water supply	5	1,058,121
	Medical facilities	2	657,409
	Total		1,715,530
Grand total			1,853,152

2.5 Damage of Industrial Facilities

This area is involved in a national park and is famous for the tourist's resort. There are many tourism facilities on Lake Toya. These facilities suffered great damage. The following amount of losses does not include the income reduction.

	Classification	Number	Loss (thousand yen)
Industrial facilities	Industry and mining	18	162,430
	Construction	28	65,680
	Commerce	105	304,960
	Service	109	323,130
	Tourist	4	238,070
Total			1,094,270

2.6 Damages of Civilengineering Facilities

This category includes the removal of fallen ashes from roads and river facilities.

	Classification	Number	Loss (thousand yen)
Civilengineering facilities	Roads	41	401,524
	Lakes	1	102,000
	Rivers	8	167,260
	Total		670,784

2.7 Damage of Telecommunication Facilities

Damage of telecommunication facilities were mainly caused by the adhesion of ashes to cables and the leaning of trees near them.

2.8 Damage of Electric Facilities

In the area of 3 km far from the volcano electricity cables were cut by the volcanic bomb fall. As for the area of 15 km electric leakage emerged because of the decrease of insulation caused by the wet ashes. The leaning of trees caused the disconnection of the cable.

The biggest electric power failure took place from the evening of August 9 through the afternoon of August 10 at 3,650 houses.

	Classification	Number	Loss (thousand yen)
Electric facilities	Failed lines	7	79,000
	Supports	23	
	Disconnection of cable	25	
	Miscellaneous		
Total			79,000

2.9 Other Damage

Japanese National Railways (JNR) stopped Iburi-line from August 7, 10:00 AM because of the thick ash fall (18 - 22 cm). It was partly reopened on August 15 and fully on September 3.

	Classification	Number	Loss (thousand yen)
Ashes fall to residential land	Removal of ashes	137,038 m ³	554,565
Nursery school		1	12,000
Park		9	18,400
Police	Police box	1	17
	Patrol car	3	250
	Total		267
JNR	Railways		215,000
	Civilengineering facilities		60,000
	Architecture		250,000
	Electric facilities		55,000
	Coaches		20,000

Miscellaneous	16,000
Total	616,000
Grand total	1,201,232

Table 2-1. Items of Damages in Mt. Usu Eruption (Unit : thousand yen)

Item	Number	Loss
(Local Government)		
Dwellings	382 houses, 564 families	391,179
Non-dwelled Buildings	33	20,980
Agriculture	40,567 ha, 211 facilities, 118 livestock	11,854,843
Civilengineering Structures	47	510,784
Forestry	3,830 ha, 2,635 thousand trees	6,947,650
Fishery	—	1,496,505
Sanitary Facilities	5	1,715,530
Nursery School	1	12,000
Parks	9	18,400
Removal of Ashes from Residential Land	137,038 m ³	554,565
Industrial Facilities	264	1,094,270
Educational Facilities	32 schools	137,622
Police	4	267
Total		24,754,595
(National Government, Public Corporation)		
HDB	3 national highways	160,000
Forestry		5,950,000
Telecommunication Facilities	1,185	130,000
JNR		616,000
Electric Facilities		79,000
Total		6,935,000
Grand Total		31,689,595

Table 2-2 Damage of Each Municipality (unit : thousand yen)

(Local Government)

Items Municipality	Dwelling	Non-dwelled Building	Agriculture	Civil- engineering Structure	Forestry	Fishery	Sanitary Facility	Nurse	Park	Removal of Ashes from Residential Land	Industrial Facility	Educational Facility	Police	Total
Muroran C.												570		74,666
Noboribetsu C.			58,376	11,820	3,900									
Date C.			5,424,955	49,921	2,514,831	716,829			5,300		178,220	666		8,890,722
Toyoura T.			211,456	5,623	315,309	219,340	85,457				33,510			870,695
Abuta T.	391,179	20,980	1,238,489	392,701	2,662,856	559,341	945,461	12,000	3,200	541,577	468,820	125,693	267	7,362,544
Toya V.			2,245,940	21,319	749,077	995	59,044			12,988	2,720	7,810		3,099,893
Sobetsu T.			1,089,905	28,918	653,165		625,568		9,900		411,000	413		2,818,869
Shiraoi T.			3,545											3,545
Otaki V.			4,579											4,579
Total (Iburi)	391,179	20,980	10,277,245	510,302	6,899,138	1,496,505	1,715,530	12,000	18,400	554,565	1,094,270	135,132	267	23,125,513
Niseko T.			164,712											164,712
Makkari V.			537,014	482	28,277									565,773
Rusutsu V.			809,968		20,235							2,490		832,693
Kimobetsu T.			53,115											53,115
Kyogoku T.			12,789											12,789
Total (Shiribeshi)			1,577,598	482	48,512							2,490		1,629,082
Grand Total	391,179	20,980	11,854,843	510,784	6,947,650	1,496,505	1,715,530	12,000	18,400	554,565	1,094,270	137,622	267	24,754,595

3. Rescue and Rehabilitation after the Eruption

3.1 Organizations and their Functions

Disaster Countermeasures Basic Law fundamentally prescribes the procedures of disaster prevention. Central, Prefectural and Municipal Disaster Prevention Council are responsible for preparing the matters relating to disaster prevention, emergency measures and rehabilitation in our country. Additionally each prefectural authority and municipality has the regulation prescribing to temporarily establish the special organization for its own for rescue and rehabilitation.

After the eruption each of the authority and municipality promptly set up the Rescue and Rehabilitation Center as shown in Table 3-1.

Fig. 3-1 and 2 show the structures of the Center of Prefectural Government Office and Abuta Town Office respectively. These were completely the same as the usual structures of organization just renaming each division. The business procedures also were almost the same as the usual. There were no newly established organizations nor the reorganizations. Establishing the Center only contributed to make the administrations concentrate upon the rescue and rehabilitation. In other aspect Japanese administrations have been well organized in advance to cope with disasters.

As an example of the temporary organization especially established of a semi-public enterprise Fig. 3-3 shows the structure of the Center established by Hokkaido Electric Company. Again the structure was same as the usual. However in this case each member who belonged to the Center concentrated on the disaster issues and was separated from the routine work. Consequently the enterprise could not afford to share these members too long. In contrast to the administrations whose Centers continued for more than one month, the enterprise continued its Center from August 9 through 11.

The possibility of debris flow was one of the significant problems, because the fallen ashes absorbing rainfall were considered to slide down easily. Several organizations had the responsibility to cope with the debris flow. The Prefectural Government Office gathered up the project team consisting of the relevant organizations and three specialists of University of Hokkaido (Fig. 3-4). The specialists

had the initiative in the project team to decide on which kind of sabo works should be applied.

Fig. 3-5 illustrates the organizations and their responsibilities to cope with disasters in Japan. The head of a municipality has a heaviest responsibility for the rescue. For example he is the only person to be able to notice his order of evacuation to residents from an indicated dangerous area to an indicated refuge place as prescribed in Disaster Countermeasures Basic Law.

There existed opposing opinions about the date to quit the evacuation. About one month after the eruption the heads of the municipalities surrounding Mt. Usu wished to rescind the order, because the residents and the industries there (of them were of tourism) evacuated in the area strongly claimed that would suffer more deficit if the order went on. On the other hand Prefectural Government Office and Police Head Office of Hokkaido considered the order should be continued by reasons that volcanological experts still warned the possibility of reeruption. Finally the heads of the municipalities made a critical decision to rescind based on their authority.

There are 14 intermediate Branch Offices of Prefectural Government throughout Hokkaido, which are different than other prefectures of Japan. They are entrusted several authorities by the Governor. In this case Iburi Branch Office in Muroran C. 25 km southeast of Mt. Usu was in charge of coping with the disaster. It functioned as an information center among various administrations, police and self defense forces. It was fortunate for the Office to be located utterly out of the damaged area and still not so far from it. Moreover other governmental and prefectural branch offices were located in Muroran and it was easy to exchange the information.

3.2 Evacuation and Rescue

First order of evacuation to residents and visitors was issued at Sobetsu and Abuta T. on August 7, 9:30 AM immediately after the first eruption as of 9:12. The area to be evacuated expanded to Date C. and Toya V. The maximum evacuated people accommodated in schools, public halls, etc. reached 4,491 as shown in Table 3-2.

Evacuation was cooperatively conducted by the self defense forces, police and fire departments. Evacuees were carried by privately owned automobiles, buses and vehicles of self defence forces.

Abuta T. constructed 60 temporary houses for the people, who had abandoned their dwellings (i.e. Konomi complex) because of the possibility of debris flow, by mid September.

3.3 Conservation of Traffics and Traffic Control

Iburi line of JNR and national highway route 230 are the principal transportation in this area. Iburi line of railroad was out of services due to the ash fall until September 3. Therefore the national highway and other local highways were the only way to transport. Muroran Construction Division of Hokkaido Development Bureau (HDB) supervising national highways and Muroran Construction Office of Prefectural Government responsible for the prefectural highways both made a great effort in cooperation with the adjacent offices, self defense forces and general contractors to conserve the traffic by removing the fallen ashes.

For example Abuta Branch Office of Muroran Construction Division, HDB were responsible for national highways route 36, 37 and 230. At the first eruption WNW wind brought the ashes to the area along route 36. The ashes on the road was a few but deteriorated the perspective on route 36. The Branch Office stopped the traffic of route 36 from Noboribetsu C. to Shiraoi T. from 13:31 through 18:00 of August 7. Only a little traffic confusion emerged for this control owing to an adequate previous notice.

As to the fifth and seventh eruptions (13:30 and 15:55 of August 8) ashes covered along route 230 conveyed by SE wind. The 30 cm or more thick ashes made the traffic stop. Route 230 was supposed to be used as a refuge route and Rescue and Rehabilitation Center at Abuta T. was going to have the residents in the dangerous area evacuated in the early morning of August 9. Abuta Branch Office made an endeavor to remove the fallen ashes on the route from 19:00 of August 8 and completed at 22:35 midnight. Unfortunately the eruption of August 9, 0:15 brought 25 - 30 cm thick ashes again on the route. The removal squad with graders and other equipment started the operation at 4:20 and completed by 7:20. It made

possible for the residents to refuge. Sprinkler trucks washed out the ashes on the highway to keep the perspective.

Table 3-3 shows the number of equipment used for the ash removal at Abuta Branch Office.

A big scale trench will be constructed along route 230 in order to prevent the possible debris flow beyond the highway.

In Japan there are two kinds of traffic control. One is executed by the police to regulate the traffic condition such as traffic congestion, traffic accidents and traffic pollution. The other is by the road administrator to keep clear ways from the physical obstacles such as land slides, subsidence, inundation, etc.. Immediately after the eruption the road administrators (e.g. Muroran Construction Division of HDB, Muroran Construction Office of Prefectural Government) stopped the traffic due to the fallen ashes.

After they had been removed however, the police did not rescind the strict traffic control to maintain public peaces. Exceptionally the residents of the kept out area were permitted to enter with a certification for traffic privilege.

3.4 Communication

The procedure of communication was the same as usual during the time of rescue and rehabilitation. The information flowed as follows:

Lower organization — Intermediate organization — Head organization
The instruction flowed reversally:

Head organization — Intermediate organization — Lower organization
To cite an example of HDB, head, intermediate and lower organizations respectively correspond to the Head Office, Muroran Construction Division and Abuta Branch Office.

Medium of the communication mostly relied on telephones of Japan Telegraph and Telephone Public Corporation (JTTPC). HDB, Hokkaido Electric Company, Police and JNR had their own microwave telecommunication network.

Disaster Prevention and Fire, and Sabo Sections of Prefectural Government

Office had received the information on the symptom of the eruption. They dispatched the personnels to Sobetsu T. preceding to the eruption. They collected the information, analysed it and sent it to Prefectural Government Office if required. These direct measures of communication seemed to be very effective in case of emergency.

Area of Hokkaido is such the biggest as 78,500 km² other than prefectures in Japan. It is not efficient that a governor has whole authorities of the Prefectural Government. Therefore some of them are entrusted to 14 Branch Offices. In this disaster Iburi Branch Office at Muroran C. functioned as an intermediate organization. It was convenient for mutual communication that most of the relevant organizations concentrated here in such a way done as Muroran Construction Division, Muroran Construction Office, Muroran Health Center, Muroran Policestation and self defense forces in this case. Personnels of these organizations were dispatched to of the Branch Office during the emergency. They exchanged the information there and sent it to their organization respectively. The police installed an exclusive line of the police microwave network. The self defense forces had an exclusive wireless. As stated above the Branch Office presented an opportunity to the other organizations for the mutual direct communication during the emergency.

It was necessary for the administrations to disseminate the information on the eruption and compulsive evacuation to the residents. For this purpose it was effective that the dissemination system such as circulation in the community was well developed and had been exercised in the usual life. The dissemination cars of police and fire departments were also used to notice the evacuation.

In order to cope with the relief and rehabilitation of the residents life, Prefectural Government set up a temporary office at Abuta T. on September 2. It dealt with the following affairs.

- (1) Consultation on the loan for the tourism and commercial industries.
- (2) Planning the countermeasures to increase opportunities of employment and instructing them to workers.

(3) Other affairs required.

The office consisted of the following personnel:

Prefectural Government Office	Several personnels of General Affairs, Industry and Tourism, Labor, Health and Public Welfare Divisions
Iburi Branch Office	One relevant personnel

Setting the temporary office indicates how the Prefectural Government put emphasis on the relief and rehabilitation of the residents and industries in the damaged area.

The information on the traffic was conveyed as usual through Road Information Center and Traffic Control Center. They are affiliated associations of road administrators and police respectively and acquired the information from the mother organizations.

During the emergency, as far as the authors know, there was only one case of confusion and delay of communication. Police did not transmit the information about traffic control conducted by itself adequately although it usually had. Information was exceptionally transmitted as;

Local policestation —→ Police Head Office —→ Prefectural Government Office
—→ Local road administrators

Commonly it is directly transmitted to local road administrators from the local policestation. There was a case that it took two days of transmission.

Telephone is indispensable during an emergency. In this disaster the demand for the telephone call drastically increased. It included business call and private to confirm whether the family and relatives were safe. The estimated peak telephone call was about five times of the capacity of Date Telegraph and Telephone Station (JTTPC). It became very difficult to call from outside of the area.

They continued day by day to increase 261 circuits in total for long distance calls by August 19. Therefore the confusion of telecommunication was limited only first 3 days and 5 days after the first eruption almost all calls became possible. JTTPC installed 70 charge free telephones at the refuge places which were used by 1.2 million messages in 53 days.

JTTPC also installed two temporary wireless stations whose capacity was 24 circuits for each through Mori station 50 km far from Date C. as shown in Fig. 3-8. The telephones using these circuits were installed in the Rescue and Rehabilitation Centers of municipalities. The area code of these were not of this district but of Mori station.

JTTPC had installed emergency telephones whose circuit was independent from the commercial lines in municipal offices. These were utilized several times during the emergency.

As stated above there were some confusion in telephone system but it was recovered rapidly owing to the adequate operation.

Table 3-1 Date of the Establishment of Rescue and Rehabilitation Center in each Administration

Organization	Established Date of Rescue and Rehabilitation Center
Prefectural Government	August 10
Iburi Branch Office	August 10
Date City	August 7
Sobetsu Town	August 7
Abuta Town	August 7
Toyoura Town	August 8
Toya Village	August 8
Makkari Village	August 8
Kucchan Town	August 8
Shikotan Town	August 8
Kimobetsu Town	August 8
Niki Town	August 9
Rusutsu Village	August 9

Table 3-2 Number of Evacuees and the Refuge Places

Municipality	District	Issued Date of the Instruction to Evacuate	Rescinded Date of the Instruction to Evacuate	Refuge Places	Number of Evacuees											
					Aug. 7	8	9	10	11	12	13	14	15	16		
Sobetsu T.	Takinomachi Onsen Showashinzan	8/7 10:53	8/7 16:10	Nakabara Elementary School	381	373	363	298	280	211	189	75	43	43		
		8/7 11:03	8/7 16:10	Kubonai Junior Highschool	380	-	-	-	-	-	-	31	-	-		
	Sankai Hospital Chounichien Onsen	8/7 9:12	Partially Rescinded	Minami-Kubonai Welfare Hall	20	31	41	53	53	53	39	53	53	53		
		8/8 17:00		Kubonai Elementary School	250	-	-	-	-	-	-	-	-	-		
		8/7 9:30		Minami-Kubonai Youth Hall	-	48	234	182	106	94	87	62	62	64		
		8/8 17:00		Snow Removal Center	-	10	-	-	-	-	-	-	-	-		
8/9 9:50	Public Hall	-	-	-	17	31	31	-	29	28						
Total					1,031	462	638	533	456	389	346	221	187	188		
Abuta T.	Irie, Izumi	8/7 9:30	Partially Rescinded 8/7 15:15	TBS Bowling Alley	330	2,403	290	240	240	230	232	232	262			
				Irie Nursery School	-	-	300	160	218	180	149	149	180			
	Kouseien	8/7 9:30	8/7 16:00	Irie Gymnasium	-	125	633	320	326	326	320	320	318			
				Irie Public Hall	110	-	-	26	36	35	95	95	111			
	Kourakuen	8/7 9:30	Partially Rescinded 8/23 8:30	Ryosho Temple	-	106	124	40	33	33	33	33	33			
				Tokujo Temple	-	-	-	-	60	-	-	-	-			
	Onsen	8/9 10:10	Abuta Commercial Highschool	-	-	350	170	140	150	142	142	172				
			Hozo Temple	-	-	30	30	30	30	30	30	34				
			Toyo Community Center	-	-	170	20	45	33	26	36	36				
			Kawamata Resident	-	-	75	-	-	-	-	-	-				
			Drive Inn	-	-	26	26	26	-	-	6					
			Total				440	2,634	1,998	798	1,027	1,152	1,010	1,047	1,047	1,152
			Date C.	Kaminagawa Usu Nishi-Kannai Kaminagawa	8/7 10:10	8/8 17:30	Nagawa Welfare Home	20	110	110	55	44	42	42	0	0
8/7 11:00	Usu Elementary School	2,600			-		-	-	-	-	-	-	-			
8/7 11:00	Date Junior Highschool	270			-		-	-	-	-	-	-	-			
8/14 0:50	Nagawa Junior Highschool	130			-		-	-	-	-	-	-	-			
Total					3,020	110	110	55	44	42	42	0	0	0		
Toya V.	Misawa Asahlura	8/17 21:45 8/17 21:45	8/19 17:00 8/19 17:00	Toya Community Center. Inns 44 Private Residents												
Total																
Grand Total					4,491	3,206	2,746	1,386	1,527	1,583	1,448	1,268	1,234	1,240		

(Table 3-2 continued)

Refuge Places	Number of Evacuees																	
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Sept. 1	2	
Nakabora Elementary School	-	45	43	59	59	59	40	33	33	35	35	35	35	35	35	34	33	
Kubonai Junior Highschool	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Minami-Kubonai Welfare Hall	-	53	53	53	42	53	53	21	41	20	20	20	20	20	9	8	9	
Kubonai Elementary School	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Minami-Kubonai Youth Hall	63	62	60	62	78	76	76	78	79	79	79	82	82	61	57	56	59	
Snow Removal Center	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Public Hall	-	26	26	25	21	25	22	-	-	-	-	-	-	-	20	20	20	
Total	63	186	182	199	190	213	191	132	153	134	134	137	137	116	121	48	121	
TBS Bowling Alley	261	273	305	312	327	342	363	364	364	362	363	380	387	387	310	310	388	
Irie Nursery School	187	182	192	197	207	212	221	223	228	260	235	-	155	155	146	146	149	
Irie Gymnasium	318	332	334	336	330	330	325	327	327	327	327	327	414	414	356	356	347	
Irie Public Hall	112	126	148	151	151	153	165	165	165	165	161	161	173	173	175	175	188	
Ryosho Temple	33	33	33	33	38	33	33	38	38	38	38	38	57	57	57	57	57	
Tokujo Temple	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Abuta Commercial Highschool	176	162	167	168	174	181	185	185	184	184	184	127	70	70	84	84	83	
Hozo Temple	34	34	34	34	30	34	37	30	30	30	30	30	30	30	37	37	37	
Toya Community Center	44	44	44	44	40	44	44	40	40	40	40	40	50	50	50	50	50	
Kawamata Resident	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Drive Inn	6	6	6	6	-	6	6	-	-	-	-	-	-	-	-	-	-	
Total	1,171	1,192	1,263	1,281	1,267	1,335	1,379	1,372	1,376	1,406	1,378	1,103	1,336	1,336	1,215	1,215	1,299	
Nagawa Welfare Home	0	37	38	0	0	0	0	0	0	0	-	-	-	8	8	9	9	
Usu Elementary School	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Date Junior Highschool	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nagawa Junior Highschool	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total	0	37	38	0	0	0	0	0	0	0	0	-	-	8	8	9	9	
Toya Community Center	33	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	
Inns	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
44 Private Residents	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total	59	0	0	0	0	0	0	0	0	0	0	-	-	0	0	0	0	
Grand Total	1,293	1,415	1,483	1,480	1,457	1,548	1,570	1,504	1,529	1,540	1,512	1,219	1,473	1,452	1,344	1,272	1,429	

(Table 3-2 continued)

Refuge Places	Number of Evacuees																
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Nakabora Elementary School	32	32	33	33	32	32	33	33	33	33	33	33	33	33	33	33	33
Kubonai Junior Highschool	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Minami-Kubonai Welfare Hall	9	9	3	8	-	-	-	-	-	-	-	-	-	-	-	-	-
Kubonai Elementary School	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Minami-Kubonai Youth Hall	56	56	47	45	47	47	47	44	-	-	-	-	-	-	-	-	-
Snow Removal Center	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Public Hall	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Total	117	117	103	106	99	99	100	97	53	53	53	53	53	53	53	53	53
TBS Bowling Alley	387	387	378	378	367	368	346	327	327	298	269	240	229	227	227	207	143
Irie Nursery School	145	144	160	159	157	-	-	-	-	-	-	-	-	-	-	-	-
Irie Gymnasium	336	301	301	300	293	257	200	103	103	103	88	80	84	79	59	60	60
Irie Public Hall	185	165	166	167	159	-	-	-	-	-	-	-	-	-	-	-	-
Ryosho Temple	57	57	57	57	57	-	-	-	-	-	-	-	-	-	-	-	-
Tokujo Temple	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Abuta Commercial Highschool	82	78	78	78	71	-	-	-	-	-	-	-	-	-	-	-	-
Hozo Temple	30	30	30	30	31	-	-	-	-	-	-	-	-	-	-	-	-
Toya Community Center	60	60	60	60	60	-	-	-	-	-	-	-	-	-	-	-	-
Kawamata Resident	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Drive Inn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	1,282	1,222	1,230	1,219	1,195	625	546	430	430	401	357	320	313	306	286	267	203
Nagawa Welfare Home	8	8	7	9	8	8	8	8	7	8	5	3	0	0	0	0	0
Usu Elementary School	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Date Junior Highschool	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nagawa Junior Highschool	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	8	8	7	9	8	8	8	8	7	8	5	3	0	0	0	0	0
Toya Community Center	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inns	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44 Private Residents	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0	0	0	0	-	-	-	0	0	0	0
Grand Total	1,407	1,347	1,340	1,325	1,302	732	654	535	490	462	415	376	366	359	339	320	256

Table 3-3 Number of Equipment Used for Ash Removal in H.D.B.

Works	Owner	Equipment	Number of Equipment Used																														
			Aug. 8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total						
Ash Transport	General Contractor	Dump Truck (4t)		1		2	4																								7		
		" (6t)					5																								5		
		" (11t)		10	18	13	29																								70		
	H. D. B.	" (3.5t)	1	2	2	2	1	2		1	2	2	2	1	1	1	1	1	1		1			2	1					28			
	Total		1	13	20	17	39	2		1	2	2	2	1	1	1	1	1	1	1		1			2	1					110		
Collection and Loading of Ashes	General Contractor	Tructer Shovel (1.0m ³)	2	2	2	3	3																								12		
		" (2.1m)	3	4	4	5	8				1	1	1	1	1	1	1	1													32		
		Bulldozer (3t)				1	1																									2	
		" (11t)	1																													1	
		" (21t)					1																									1	
		Motor Grader (3.7m)			1	1	2																									4	
	H. D. B.	Tructer Shovel (1.4m)																			1					1						2	
		Motor Grader (3.7m)			1	1	1	1		1		1		1																		6	
	Total		6	6	8	11	16	1		1	1	2	1	1	1	1	1	1	1		1				1				1			60	
Ash Removal	General Contractor	Motor Grader (3.7m)	2	2			2																									6	
	H. D. B.	Motor Grader (3.7m)	1	1																												2	
		Snow Removal Truck (7t)	1	1																												2	
		Road Cleaner	1			1		1		1		1	1	1	1	1		1	1	1	1	1			1	1						16	
	Total		5	4		1	2	1		1	1	1	1	1	1		1	1	1	1	1			1	1							26	
Dust Removal	General Contractor	Sprinkler (6,300l)		1	1	1	1											1	1	1	1	1	1	1	1							13	
	H. D. B.	" (")	2	1	1	1	1											1	1	1	1	1			1	1						13	
	Total		2	2	2	2	2											2	2	2	2	2	2	1	1	2	2						26
Sprinkling	General Contractor	Sprinkler (6,300l)						1	1	1	1	1	1	1	1																		8
	H. D. B.	" (")						1	1	1	1	1	2	2	2																		11
	Total							2	2	2	2	2	3	3	3																		19
Others	H. D. B.	Wagon	1	1	2	1	1	2		1	2	2	1	1	2	2	2	2	2	2	2	2	2	1	1	1	2					34	
	Total		1	1	2	1	1	2		1	2	2	1	1	2	2	2	2	2	2	2	2	1	1	1	2						34	
Grand Total			15	26	32	32	60	8	2	6	8	9	8	7	8	4	7	7	6	6	6	3	2	6	7							275	

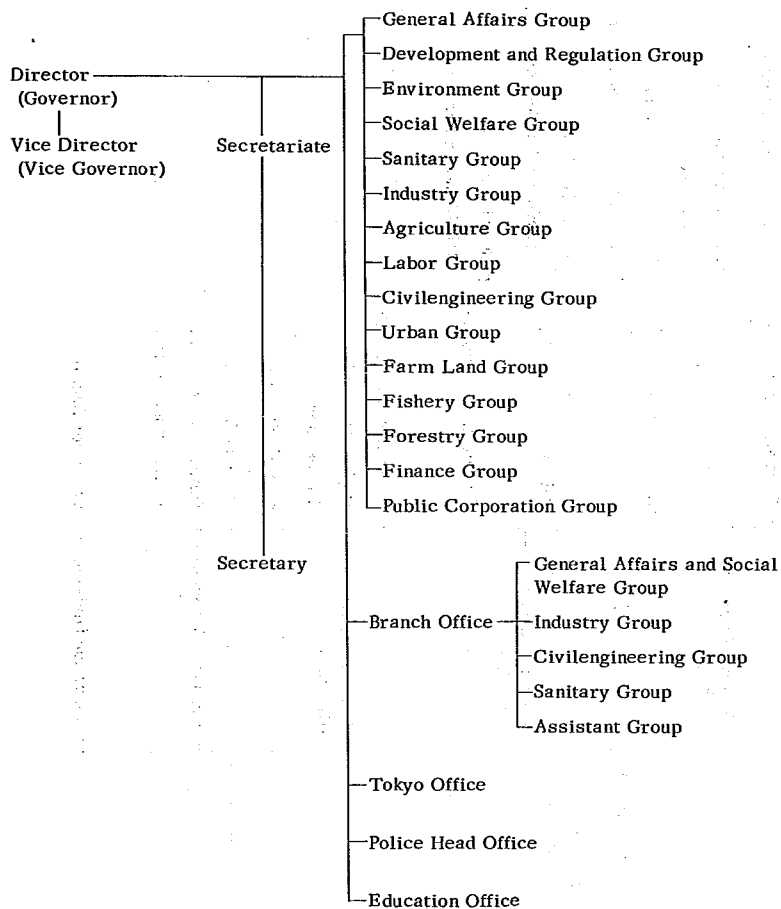


Fig. 3-1 Structure of Rescue and Rehabilitation Center of Hokkaido Prefectural Government

(Primary Organization)

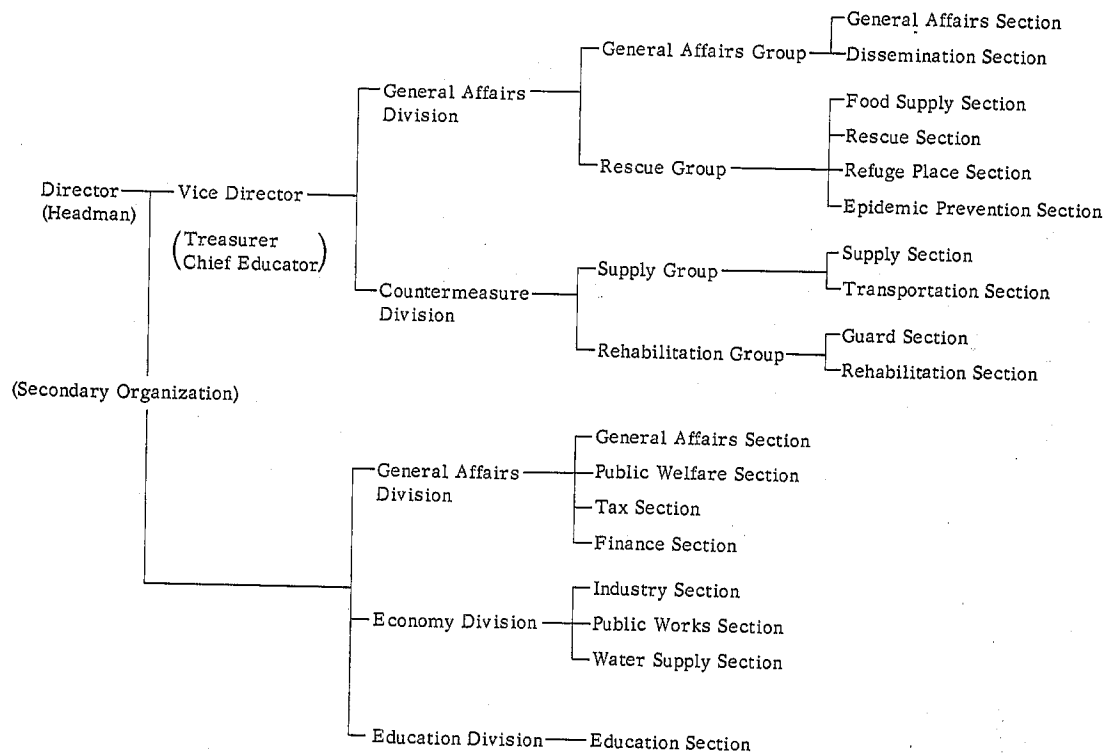


Fig. 3-2 Structure of Rescue and Rehabilitation Center of Abuta Town

(Brance Office)

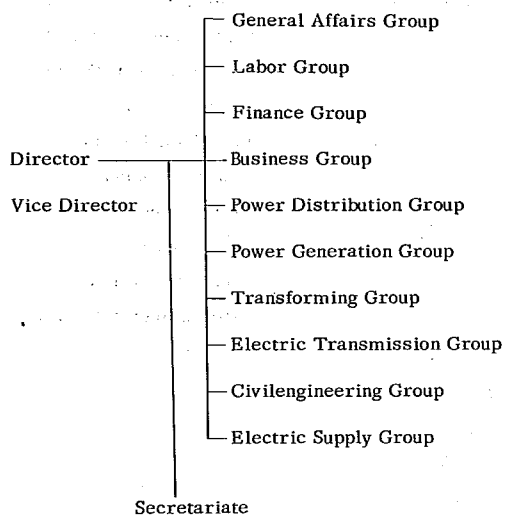


Fig. 3-3. Organization of Hokkaido Electric Company in Emergency

Hokkaido Prefectural Government

General Affairs Division

Development and Regulation Division

Civilengineering Division

Urban Division

Farm Land Division

Fishery Division

Forestry Division

Underground Resource Survey

Iburi Branch Office

Muroran Regional Construction Office

Hokkaido Police Head Office

Sapporo Regional Office, JMA

Hakodate Forestry Bureau

Hokkaido Development Bureau

Experts for Sabo Works

Fig. 3-4 Composition of the Project Team for Debris Flow Prevention

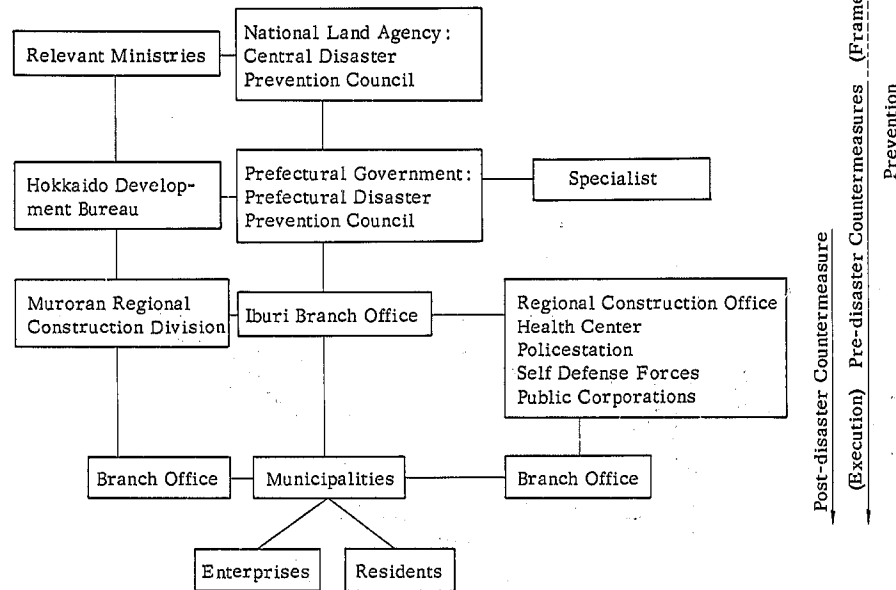


Fig. 3-5 Organization and Responsibility of Disaster Prevention in Japan

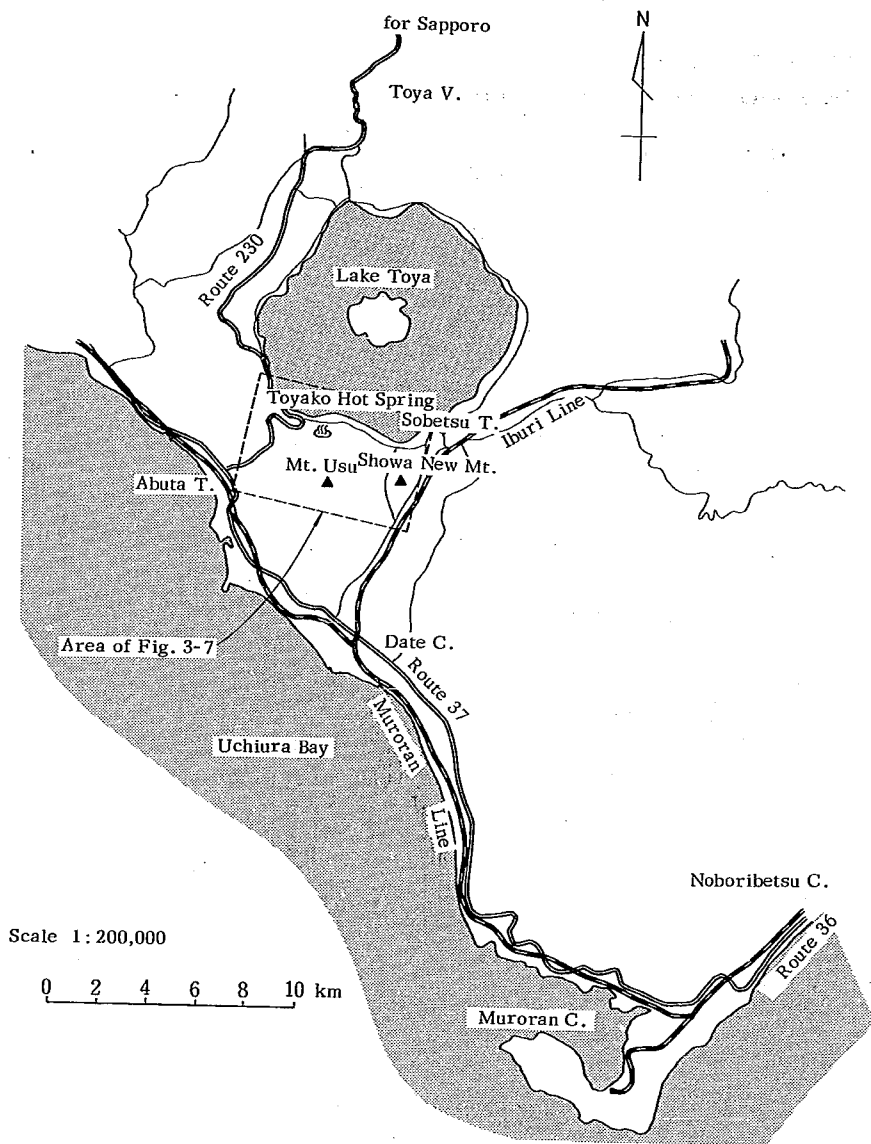


Fig. 3-6 Transportation Network of the Adjacent Area of Mt. Usu

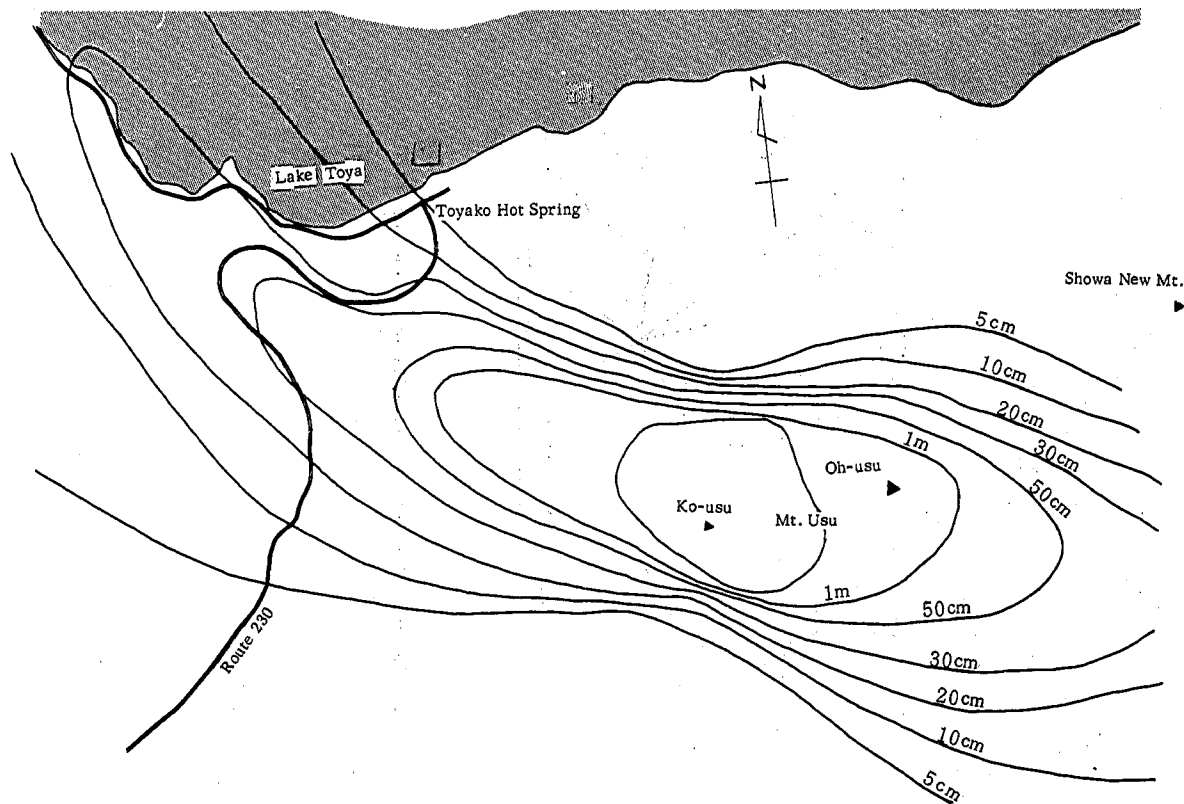


Fig. 3-7 Distribution of Fallen Ashes by the Mt. Usu Eruption

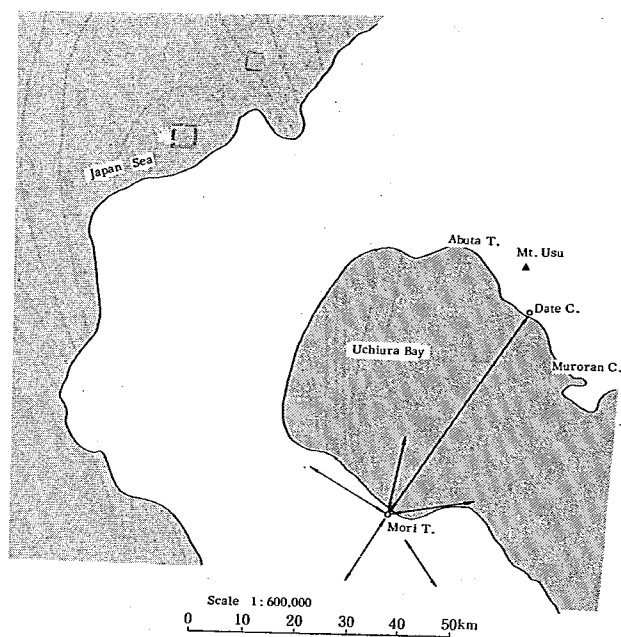


Fig. 3-8 Temporary Wireless Station Installed by JTTPC

4. Application of Law Systems for Relief

4.1 Reconstruction by the Relevant Administrations

The relevant administrations conducted the relief of the damaged area by employing several law systems as follows:

(1) Disaster Relief Law

By order of the municipalities Disaster Relief Law was applied respectively:

Abuta T., Sobetsu T.	18:00 of August 8, 1977
Date C.	9:00 of August 15, 1977
and Toya V.	10:00 of August 15, 1977

Based upon the Law supplying foods, lending blankets without charge, establishing the refuge places and construction of temporary houses were performed.

(2) Natural Disaster Financing Law

Cabinet decided to adopt the Law on October 4 in order to finance agriculturists and fishermen.

(3) Designation of Violent Disaster

Designation of Violent Disaster is under consideration for the time being by the Cabinet. If designated, Central Government should subsidize the specific public works, and certain share of expenses of local governments is mitigated.

(4) Subsidy

Central Government decided to advance the date to provide the annual subsidy to local governments which was supposed in September. Date C., Abuta T., Sobetsu T., Toyoura T. and Toya V. were qualified. Central Government also was considering the special subsidy.

(5) Moratoria

Prefectural Government, Bank of Japan and Regional Finance Bureau led creditors to permit the grace of debt.

Prefectural Government exempted the tuition of senior highschool students and aided the school expenses.

(6) Loans

Prefectural and Municipal Governments helped the medium and small traders and manufactures to get the loan from the People's Finance Corporation, Minor Enterprises Finance Corporation and Prefecture's Management Stabilization Fund.

(7) Exemption of Charges

Hokkaido Electric Company exempted the charge where power failure took place.

JTPC exempted the charge of the people who had evacuated following the instruction.

4.2 Works of Disaster Rehabilitation for Public Utilities

Expenses of works for disaster rehabilitation were shown below:

Organization	Works	Expense (thousand yen)
Hokkaido Development Agency	Road	54,144
		(including the urgency of 15,993)
Prefectural Government	Road	211,524
	River	162,172
	Sabo (land slide)	2,937,000

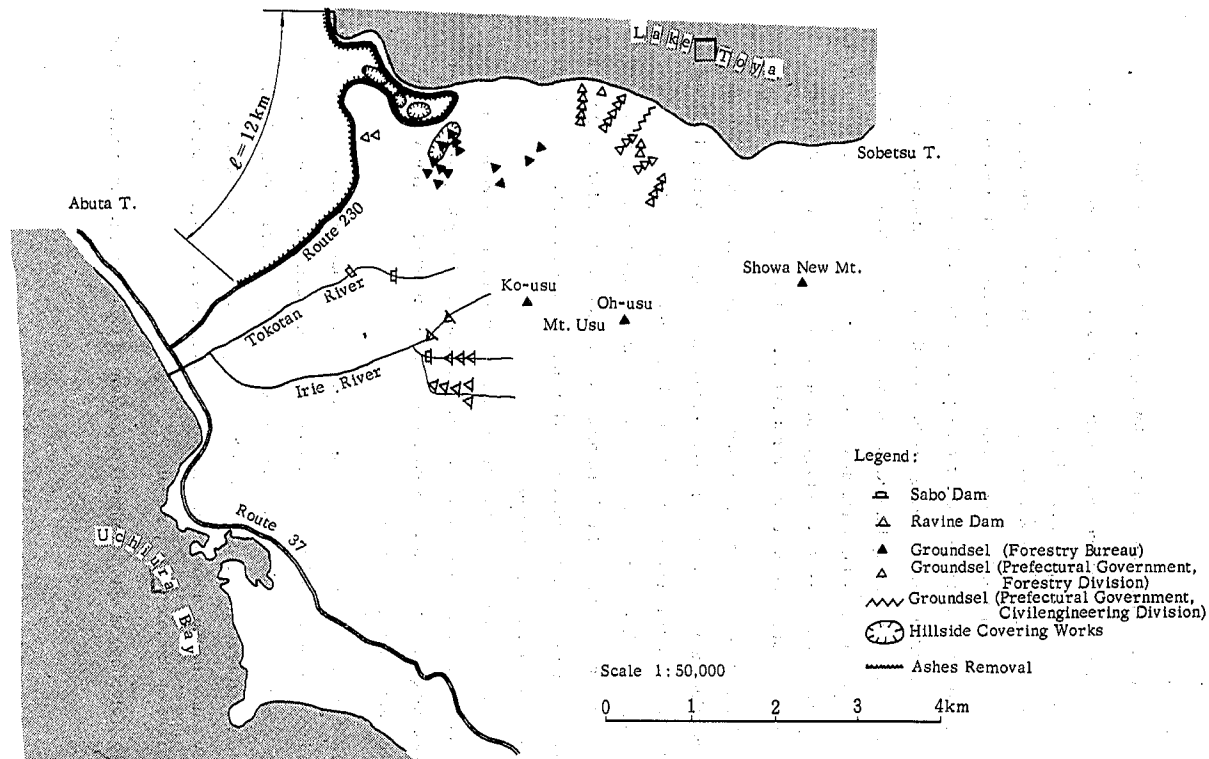


Fig. 4-1 Distribution of Sites of Works for Disaster Rehabilitation

5. Conclusion

From the researches stated above following conclusions can be made.

(1) Japan has experienced many disasters, mostly floods, and exercised the administrative functions through these incidents. Therefore the administrations are well organized with competent personnels to cope with disaster rehabilitation as proved in previous disasters. In case of Mt. Usu eruption each administration functioned effectively and contributed greatly to the rescue and rehabilitation. Lucky enough as for this disaster was that the area of the damaged area was mostly limited to Date C., Abuta T., Sobetsu T. and Toya V. (total area: 558 km²) and Muroran C., the biggest city in the district was out of it. Muroran was close enough to get the necessary information and dispatch personnels, and at the same time it got rid of the disaster itself.

(2) Even at usual direct communication is more efficient and accurate for exchanging the information than using an indirect media as mails and telephones. It is still more true in case of disaster, when everyone is upset.

In this case personnels from Regional Construction Office, health center, police department and self defense forces gathered up at Iburu Branch Office and exchanged the information directly. They also gathered and sent back the information to their organizations.

In Sobetsu municipal office personnels of relevant organizations and volcanological experts got together. They announced the synthesized opinion concerning the volcano at press conference every 10:00 AM. This was one outcome of the group discussion.

(3) The information about the eruption and the procedure and time of evacuation was efficiently and accurately conveyed to the residents. One reason for this was that the residents were well united. Their ancestors strugglingly settled and reclaimed this land in 19th century. The residents were considerably united by the blood and the cooperative spirit was strong. It contributed to transfer the information rapidly.

(4) Telephone is also an important medium of exchanging the information after

a disaster.

Immediately after the eruption a great number of telephone call rushed to Date station and stopped the function for three days. However Date station tried to increase the capacity and restored it in five days after the eruption.

On the other hand, suppose a big disaster happened in a bigger city as metropolitan, not only the relevant administrations would concentratively use telephones to perform their duties but also citizens would call their family and relatives.

Each capacity of the station is far less than required in the situation as aboves. Investing in the capacity to meet the extraordinary demand is not also practical. It is recommended to prepare the emergency circuit which can exclusively be used by the specific organizations relevant to rescue and rehabilitation. This kind of circuit independent from JTTPC is installed so far in Ministry of Construction, HDB, Police, JNR and electric companies. They are very effective in the emergency so that they should be encouraged to develop the performance.

Expanding the emergency telephone stated in chapter 3.4 is also to be emphasized.

(5) Personnel persueing the rescue and rehabilitation are always anxious for their families' safety. Assuring the safety and informing it to the personnel could improve their morale.

Abuta Branch Office, HDB had predetermined the way and place to refuge preceding to the peak of rescue, and informed it to the personnel and their family. They had no anxiety for the families' safety.

(6) The field study stated herewith was conducted about 40 days after the eruption. The time was convenient because the personnels whom we interviewed had just finished the busiest jobs as making the report of the damage and applying for budgets for the disaster rehabilitation. Moreover it was not so late for them to forget the details of the administrative or organizational procedure. Every interview was performed successfully owing to the cooperation of the personnel.

The evidence of the damage was deteriorated due to the 40 days. But it was not the big problem because our main purpose was not to survey the damage itself but the organizational response after the disaster.

(7) Interviews can mostly produce some qualitative information. However it is more convenient to get the quantitative data in order to process them and to use them for persuading others. Developing a methodology for collecting and analyzing the quantitative data should be encouraged in the future.

6. Acknowledgements

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Construction Division

Civil Engineering Research Institute

Muroran Construction Division

Japan Meteorological Agency

Sapporo Regional Office

Muroran Meteorological Observatory

Hokkaido Prefectural Office

General Affairs Division

Environment Division

Health Division

Civil Engineering Division

Urban Division

Hatching Office

Iburi Branch Office

Muroran Regional Construction Office

Date City Office

Abuta Town Office

Sobetsu Town Office

Toya Village Office

Date Policestation

Hokkaido Electric Company

Japan Telegraph and Telephone Public Corporation

7. References

Most of the data used in this report are acquired from the documents issued by each organization originally written in Japanese.

Other referred materials are as follows:

- 1) Executive Office of the President Office of Emergency Preparedness:
Report of the Congress, Disaster Preparedness, Jan. 1972
- 2) R. Wallace : Goals, Strategy and Tasks of the Earthquake Hazard Reduction Program, Geological Survey Circular 701, 1974
- 3) J. Haas, R. Ayre : The Western Sicily Earthquake of 1968, National Academy of Sciences, 1969
- 4) R. Dynes, J. Haas, E. Quarantelli : Some Preliminary Observations on Organizational Responses in the Emergency Period after the Niigata, Japan, Earthquake of June 16, 1964, Disaster Research Center, The Ohio State University, 1964
- 5) Committee on the Alaska Earthquake of the National Research Council :
The Great Alaska Earthquake of 1964, 1970

Appendix

Historical Records on the Eruptions of Mt. Usu.

Date	Outline	Remarks
Oct, 1611		There are objections
July 14, 1663	Five persons dead Several houses burned	
July 14, 1668		Doubtful
Dec., 1769		
1802		Doubtful
Jan. 19, 1822	Hot cloud 50 dead, 53 wounded 1437 horses dead	
March, 15, 1853	Small hot cloud	
1854 - 1855		Doubtful
1858 - 1859		Doubtful
1903		
July 25, 1910	Meiji New Mt. emerged	
1943 - 1945	Syowa New Mt. emerged	