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ANNUAL REPORT ON STRONG-MOTION EARTHQUAKE RECORDS IN JAPANESE PORTS (1998)

港湾地域強震観測年報（1998）

佐藤幸博
一井康二
星野裕子
佐藤陽子
井合進
長尾毅

運輸省港湾技術研究所

技術政策総合研究所 図書室 蔵

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Contents

Abbreviations used above:

AR : Analog Records of Reproduced Accelerograms

IR : Integrated Velocities and Displacements

RS : Response Spectra

FS : Fourier Spectra

LO : Loci of Accelerations, Velocities and Displacements

港湾地域強震観測年報（1998）

佐藤　幸博*
一井　康二*
星野　裕子**
佐藤　陽子**
井合　進***
長尾　毅****

要　旨

1962年より実施されている港湾地域強震観測網においては，1998年12月31日現在，5503個の強震記録が蓄積されるに至っている。このうち、1998年中には 112個の強震記録が得られている。強震計の台数としては，1998年12月31日現在，94台の強震計が60港に設置されており，設置状況としては，65台が地盤上に，22台が地中に，7台が構造物上となっている。本強震観測網では、機械式アナログ記録方式の SMAC-B2型強震計、電気式アナログ記録方式の ERS-B,-C,-D型強震計および電気式デジタル記録方式のERS-F,-G型強震計の６種類の強震計が使用されている。ただし，アナログ型のSMAC-B2型強震計およびERS-B,C,D型強震計については、最新型の ERS-G型強震計に数年の内に更新される予定となっている。

本報告は、1998年に港湾地域強震観測網で得られた記録について報告するものである。本観測網で得られた記録は、地震毎に分類され，地震諸元，観測地点，記録番号，最大加速度等とともに，本報告に掲載されている強震観測表(Strong-Motion Earthquake Observation Results)にまとめられている。強震観測表の地震諸元は，気象庁発行の「地震・火山月報（防災編）」および「全国震源データ」に基づいている。また，強震記録の記録番号は，各観測地点から記録が送られてきた順番に付けられており，記録の分類として，頭文字「S」で始まる記録は SMAC-B2型強震計で得られた記録，「M」はERS-B,-C,-D型強震計で得られた記録，「F」はERS-F,-G型強震計で得られた記録をそれぞれ示している。強震観測表にまとめられている記録の中で，最大加速度が 20Galを越える記録については，観測結果として再生した加速度記録波形を示している。また，最大加速度が 50Galを越える比較的大きな記録については，さらに，補正加速度記録波形，速度波形，変位波形，応答スペクトル，フーリエスペクトル，水平面内の加速度・速度・変位の軌跡も併せて示している。

1998年における港湾地域強震観測は，以下に示す諸機関の協力の下に実施された。

運輸省港湾局	運輸省港湾建設局	北海道開発局港湾部	沖縄開発庁沖縄総合事務局
東京都港湾局	静岡県港湾課	宮崎県港湾課	大阪市港湾局

また，本年報の作成には，各観測地点での強震観測担当者の努力に負うところが非常に大きい。担当者各位に敬意と謝意を表すとともに，各観測地点で実際に強震計の点検ならびに記録の取扱いに携わった方々の氏名を次頁以降に掲載する。

キーワード：　地震，　港湾強震観測，　数値化加速度記録，　応答スペクトル

*　　構造部　地盤震動研究室
**　　科学技術庁重点研究支援協力員
***　　構造部　地震防災研究室長
****　　構造部　地盤震動研究室長
〒239-0826　横須賀市長瀬３－１－１　運輸省港湾技術研究所
Phone:0468-44-5028　Fax:0468-44-0839　E-mail: Satoh_yuk@cc.phri.go.jp

強震観測担当者（1998年1月～12月）

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ANNUAL REPORT ON STRONG-MOTION EARTHQUAKE RECORDS IN JAPANESE PORTS (1998)

Yukihiro SATO*
Koji ICHII*
Yuko HOSHINO**
Yoko SATO**
Susumu IAI***
Takeshi NAGAO****

Synopsis

Since 1962, strong-motion earthquakes and earthquake responses of structures have been observed in the major ports in Japan. By the end of December 1998, 5503 accelerograms had been accumulated and analyzed at the Geotechnical Earthquake Engineering Laboratory of the Port and Harbour Research Institute.

The strong-motion earthquake observation network in port areas in Japan consists of 94 strong-motion accelerographs installed at 60 ports as of December 1998. 65 accelerographs out of 94 are installed at ground surface, 22 accelerographs are in ground by using bore-hole and the rest 7 are on structures such as quay walls. In the network, two types of accelerographs have been used; one is the SMAC-B2 accelerograph and the other is the ERS accelerograph. The SMAC-B2 accelerograph is of a mechanical type and the ERS accelerograph is of an electrical type equipped with either analogue or digital recorder.

This report presents results of observation and preliminary analysis of records obtained in 1998, which are listed in the tables of Strong-Motion Earthquake Observation Results with their maximum accelerations, being classified in accordance with earthquakes. For the records of ground motions with maximum accelerations exceeding 20 Gals (=cm/sec^2), computer plots of reproduced acceleration are presented. For the records of ground motions with maximum acceleration exceeding 50 Gals, computer plots of corrected acceleration, integrated velocity and displacement, response spectra, Fourier spectra, and loci of accelerations, velocities and displacements in horizontal plane are presented.

Key Words: Earthquake, Port, Strong-Motion Earthquake Observation, Digitized Acceleration Record, Response Spectra

* Member of Geotechnical Earthquake Engineering Laboratory, Structures Division
** STA Core Research Project Assistance Fellow
*** Chief of Earthquake Disaster Prevention Laboratory, Structures Division
**** Chief of Geotechnical Earthquake Engineering Laboratory, Structures Division
3-1-1 Nagase Yokosuka 239-0826, Japan
Phone:+81-468-44-5028 Fax:+81-468-44-0839 E-mail:Satoh_yuk@cc.phri.go.jp

1. Introduction

The observation of the strong-motion earthquake in major ports in Japan was started in 1962 by the Geotechnical Earthquake Engineering Laboratory of the Port and Harbour Research Institute. The observation network was expanded year by year and 94 accelerographs had been installed in 60 ports as of December 1998. 5503 accelerograms had been obtained in the network by the end of 1998. The number of accelerograms obtained in 1998 were 112. Two types of accelerographs have been used in the network, namely the SMAC-B2 accelerograph and the ERS accelerograph. As of December 1998, 2661 accelerograms out of 5503 had been obtained by the SMAC-B2 accelerograph and 2842 accelerograms by the ERS accelerograph.

The records had been published as annual reports after preliminary processing and analyses which will be explained later. The records from 1963 to 1975 had been published in the preceding annual reports which had similar format to the present one[1)-11)]. Because digitized data of vertical components of the records from 1963 to 1975 were not included in those reports, the data were reported separately[12)]. After the annual report for the records of 1976 and 1977, a new data processing procedure was introduced, and accelerations with instrument correction, integrated velocities and displacements, Fourier spectra and response spectra had been reported in the annual reports[13)-30)]. When disastrous earthquakes occurred, special reports had been published for the earthquake records besides annual reports[31)-42)].

In 1968, there occurred an earthquake of JMA Magnitude 7.9 in south-east off Hokkaido island. This earthquake was named the 1968 Tokachi-Oki Earthquake, and large number of aftershocks followed. Many damage took place to buildings, roads, port facilities and many other types of structures, and many accelerograms were obtained in the network. In particular, an accelerogram with the maximum acceleration of 259 Gals (=cm/sec^2) was recorded at Hachinohe Port in northern part of Honshu island. Because of the large magnitude of the earthquake and the damage to structures, the records were of great interest and importance, and a special report was published for the records[31)]. In 1978, Japan was hit by two great earthquakes which were the 1978 Izu-Oshima-Kinkai Earthquake of JMA Magnitude 7.0 in south-central off Honshu island and the 1978 Miyagi-Ken-Oki Earthquake of JMA Magnitude 7.4 in north-east off Honshu island. Records of these earthquakes were compiled into two special reports[32),33)]. In 1982, port structures were damaged by the 1982 Urakawa-Oki Earthquake of JMA Magnitude 7.1 in south-east off Hokkaido island, and records of the earthquake were also compiled into a special report[34)]. In 1983, serious damage was brought about in the Japan Sea side of north-west off Honshu island by the 1983 Nipponkai-Chubu Earthquake of JMA Magnitude 7.7, and records of the earthquake were compiled into a special report[35)]. In 1984, an earthquake of JMA Magnitude 7.1 occurred off east coast of Kyushu island in Hyuga-nada, and brought slight damage to port facilities. Records of the earthquake were compiled into a special report[36)]. In 1987, an earthquake of JMA Magnitude 6.7 hit the metropolitan area. The earthquake caused some damages to structures and reclaimed lands area also liquefied slightly by this earthquake. Records of the earthquake are compiled into a special report[37)]. In 1993, two great earthquakes occurred in Hokkaido island, which were the 1993 Kushiro-Oki Earthquake of JMA Magnitude 7.8 in east off Hokkaido on January 15 and the 1993 Hokkaido-Nansei-Oki Earthquake of JMA Magnitude 7.8 in south-west off Hokkaido on July 12. Serious damage was brought about in Hokkaido and many accelerograms were recorded in the network. The records obtained by these two big earthquakes were compiled into special reports[38),39)]. In 1994, two great earthquakes occurred, which were the 1994 Hokkaido-Toho-Oki Earthquake of JMA Magnitude 8.1 in east off Hokkaido island on October 4 and the 1994 Sanriku-Haruka-Oki Earthquake of JMA Magnitude 7.5 in east off Honshu island on December 28. Many accelerograms were recorded in the network. These records are also compiled into special reports[40),41)].

In 1995, one of the most disastrous earthquake in the world hits Hanshin area of Japan. The earthquake named as 1995 Hyogo-Ken Nambu Earthquake of JMA Magnitude 7.2. Most of structures in Kobe port were severely damaged by this earthquake. The records obtained during this earthquake and aftershocks are compiled into a special report[42)].

This report presents the strong-motion earthquake records observed in 1998. The records obtained in the network in 1998 are listed in tables of Strong-Motion Earthquake Observation Results with their maximum accelerations, being classified by earthquakes. For the acceleration records obtained in ground or on ground with maximum accelerations exceeding 20 Gals, computer plots of reproduced accelerograms are prepared. For the records obtained in

ground or on ground with maximum acceleration exceeding 50 Gals, computer plots of reproduced accelerograms, integrated velocities and displacements, response spectra, Fourier spectra and loci of accelerations, velocities and displacements in horizontal plane are prepared. Digitized data table of accelerograms and calculated data table of response spectra had been listed in the proceeded annual reports in old days, but those data are not included in this report because those printed digital data tables are not often used any more.

Following organizations cooperated with the Port and Harbour Research Institute in the strong-motion earthquake observation in port area;

(a) The Bureau for Ports and Harbours of the Ministry of Transport
(b) The Regional Bureaus for Port Construction of the Ministry of Transport
(c) The Port and Harbour Division, Hokkaido Development Bureau of the Hokkaido Development Agency
(d) The Okinawa General Office of the Okinawa Development Agency
(e) The Harbour Bureau of Tokyo Metropolitan Government
(f) The Harbour Bureau of Osaka Municipal Government
(g) The Harbour Section of Shizuoka Prefectural Government
(h) The Harbour Section of Miyazaki Prefectural Government

2. Network and Instruments

(1) Network

The network of the Port and Harbour Research Institute covered the whole coast line of Japan with 94 strong-motion accelerographs in 60 ports at the end of 1998. The locations of ports where accelerographs were installed as of December 1998 are shown in **Figure 1**. The numbers attached to the ports in **Figure 1** correspond to the numbers of ports in **Table 1**.

The stations in the network are listed in **Table 1** with the type of accelerograph and the installation condition, being classified by ports. The detailed information of the stations is described in the reports on the site characteristics[43)-48)]. At the end of 1998, the accelerographs at 7 stations out of 94 stations were the SMAC-B2 accelerographs and the rest 87 were the ERS accelerographs.

(2) Servicing

Installation and servicing of the accelerographs have been made by the port construction offices of the previously described organizations under the guidance of the Geotechnical Earthquake Engineering Laboratory. It is directed that accelerographs should be checked at least once a month and after an earthquake larger than the JMA seismic intensity scale II shown in **Table 2**. JMA seismic intensity scale has slightly changed at February 1996 and new scale are summarized in **Table 2**. Immediately after the earthquake, the accelerograms are sent to the Laboratory by mail without any treatment or reading to avoid possible damage to the records.

(3) Station

There are three kinds of stations in the network. The first is to record accelerations at ground surface, the second is in ground by using bore-hole and the third is to record earthquake response of structures. The station which records earthquake response of structures is always accompanied with another station which records ground acceleration in its vicinity.

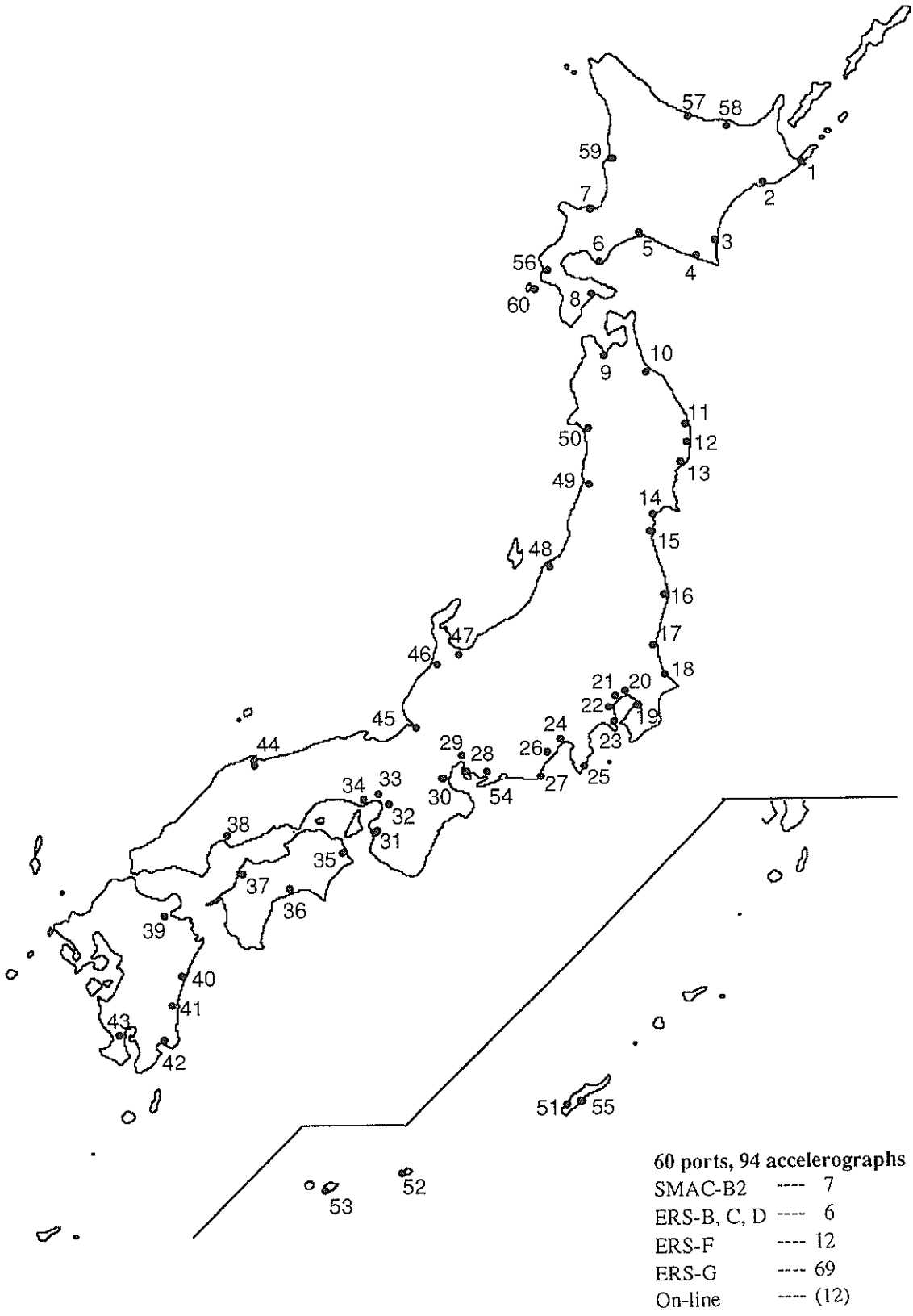


Figure 1 Location of ports where accelerogarphs are installed as of December 1998

Table 1 List of Strong-Motion Earthquake Station of the Port and Harbour Research Institute

(December 1998)

No.of port*	Name of port		Name of station	Type of accelerograph	Installation condition	Ref. No.**
1	Hanasaki	1	Hanasaki-F	ERS-F	on ground	935
2	Kushiro	2	Kushiro-G	ERS-G	on ground	34, 935
		3	Kushiro-GB	ERS-G	in ground	935
3	Tokachi	4	Tokachi-G	ERS-G	on ground	298, 935
4	Urakawa	5	Urakawa-G	ERS-G	on ground	935
5	Tomakomai	6	Tomakomai-G	ERS-G	on ground	107, 935
6	Muroran	7	Muroran-G	ERS-G	on ground	34, 107, 935
7	Otaru	8	Otaru-G	ERS-G	on ground	107, 935
8	Hakodate	9	Hakodate-G	ERS-G	on ground	298, 935
		10	Hakodate-FB	ERS-F	in ground	935
		11	Hakodate-F	ERS-F	on ground	935
		12	Hakodate-FR	ERS-F	on structure	935
9	Aomori	13	Aomori-G	ERS-G	on ground	107, 156, 298, 935
10	Hachinohe	14	Hachinohe-G	ERS-G	on ground	34, 107, 935
		15	Hachinohe-GB	ERS-G	in ground	935
11	Miyako	16	Miyako-G	ERS-G	on ground	34, 107, 935
12	Kamaishi	17	Kamaishi-M	ERS-C	on ground	351, 935
		18	Kamaishi-MB	ERS-D	in ground	351, 935
13	Ofunato	19	Ofunato-bochi-G	ERS-G	on ground	34, 107, 935
		20	Ofunato-bo-S	SMAC-B2	on structure	34, 107, 935
		21	Ofunato-mound-M	ERS-C	on structure	935
14	Sendai	22	Sendai-M	ERS-C	on ground	351, 935
		23	Sendai-MB	ERS-D	in ground	351, 935
15	Soma	24	Soma-S	SMAC-B2	on ground	935
16	Onahama	25	Onahama-ji-G	ERS-G	on ground	34, 351, 935
		26	Onahama-ji-GB	ERS-G	in ground	935
17	Hitachinaka	27	Hitachinaka-F	ERS-F	on ground	935
18	Kashima	28	Kashima-zokan-S	SMAC-B2	on ground	34, 156, 298, 935
19	Chiba	29	Chiba-G	ERS-G	on ground	107, 935
		30	Chiba-GB	ERS-G	in ground	935
20	Tokyo	31	Shinagawa-G	ERS-G	on ground	935
		32	Shinagawa-GB	ERS-G	in ground	935
21	Kawasaki	33	Kawasaki-FB	ERS-F	in ground	935
		34	Kawasaki-F	ERS-F	on ground	935
		35	Kawasaki-FR	ERS-F	on structure	935
22	Yokohama	36	Yamashita-FB	ERS-F	in ground	935
		37	Yamashita-F	ERS-F	on ground	935
		38	Yamashita-FR	ERS-F	on structure	935
23	Yokosuka	39	Koken-G	ERS-G	on ground	935
		40	Koken-S	SMAC-B2	on ground	34, 935
24	Tagonoura	41	Tagonoura-S	SMAC-B2	on ground	107, 935
25	Shimoda	42	Shimoda-F	ERS-F	on ground	935
26	Shimizu	43	Shimizu-G	ERS-G	on ground	935
		44	Shimizu-GB	ERS-G	in ground	935
27	Omaezaki	45	Omaezaki-M	ERS-C	on ground	351, 935
28	Kinuura	46	Kinuura-ji-S	SMAC-B2	on ground	107, 298, 935
29	Nagoya	47	Nagoya-sorami-G	ERS-G	on ground	935
		48	Nagoya-sorami-GB	ERS-G	in ground	935
		49	Nagoya-inae-G	ERS-G	on structure	34, 935

(to be continued)

(**Table 1** Continued)

No.of port*	Name of port		Name of station	Type of accelerograph	Installation condition	Ref. No.**
30	Yokkaichi	50	Yokkaichi-G	ERS-G	on ground	34, 935
		51	Yokkaichi-GB	ERS-G	in ground	935
31	Wakayama	52	Wakayama-G	ERS-G	on ground	34, 298, 935
32	Osaka	53	Osaka-ji-G	ERS-G	on ground	34, 935
		54	Osaka-minami-G	ERS-G	on ground	34, 935
33	Amagasaki	55	Amagasaki-G	ERS-G	on ground	156, 935
34	Kobe	56	Kobe-ji-S	SMAC-B2	on ground	34, 935
		57	Kobe-ji-GB80	ERS-G	in ground	935
		58	Kobe-ji-GB40	ERS-G	in ground	935
		59	Kobe-ji-G	ERS-G	on ground	935
		60	Kobe-maya-G	ERS-G	on ground	298, 935
		61	Rokko-GB80	ERS-G	in ground	935
		62	Rokko-GB40	ERS-G	in ground	935
		63	Rokko-G	ERS-G	on ground	935
35	Komatsujima	64	Komatsujima-G	ERS-G	on ground	107, 935
36	Kochi	65	Kochi-G	ERS-G	on ground	34, 298, 935
37	Matsuyama	66	Matsuyama-G	ERS-G	on ground	156, 935
38	Hiroshima	67	Hiroshima-G	ERS-G	on ground	34, 935
39	Oita	68	Oita-G	ERS-G	on ground	156, 935
40	Hososhima	69	Hososhima-G	ERS-G	on ground	34, 298, 935
41	Miyazaki	70	Miyazaki-G	ERS-G	on ground	298, 935
		71	Miyazaki-GB	ERS-G	in ground	935
42	Shibushi	72	Shibushi-G	ERS-G	on ground	935
43	Kagoshima	73	Kagoshima-G	ERS-G	on ground	34, 298, 935
44	Sakaiminato	74	Sakaiminato-G	ERS-G	on ground	34, 298, 935
45	Tsuruga	75	Tsuruga-G	ERS-G	on ground	34, 935
46	Kanazawa	76	Kanazawa-G	ERS-G	on ground	107, 935
47	Fushiki-Toyama	77	Toyama-G	ERS-G	on ground	34, 935
		78	Toyama-GB	ERS-G	in ground	935
48	Niigata	79	Niigata-G	ERS-G	on ground	34, 298, 935
49	Sakata	80	Sakata-G	ERS-G	on ground	34, 935
50	Akita	81	Akita-G	ERS-G	on ground	34, 351, 935
		82	Akita-GB	ERS-G	in ground	935
51	Naha	83	Naha-G	ERS-G	on ground	298, 935
		84	Naha-GB	ERS-G	in ground	935
52	Hirara	85	Hirara-G	ERS-G	on ground	298, 935
53	Ishigaki	86	Ishigaki-G	ERS-G	on ground	298, 935
54	Mikawa	87	Mikawa-G	ERS-G	on ground	935
		88	Mikawa-GB	ERS-G	in ground	935
55	Nakagusuku	89	Nakagusuku-G	ERS-G	on ground	935
56	Setana	90	Setana-G	ERS-G	on ground	935
57	Monbetsu	91	Monbetsu-G	ERS-G	on ground	935
58	Abashiri	92	Abashiri-G	ERS-G	on ground	935
59	Rumoi	93	Rumoi-G	ERS-G	on ground	935
60	Okushiri	94	Okushiri-G	ERS-G	on ground	935

*The numbers correspond to those in Figure 1.

**The numbers correspond to those of the Technical Note of the Port and Harbour Research Institute, in which site characteristics of the stations are given.
These references include the site where initially SMAC-B2 accelerograph and it was already replaced with ERS type.

Table 2 JMA Seismic Intensity Scale

0 : NO FEELING
Imperceptible to people.

I : SLIGHT
Felt by only some people in the building.

II : WEAK
Felt by most people in the building. Some people awake. Hanging objects such as lamps swing slightly.

III : RATHER STRONG
Felt by most people in the building. Dishes in a cupboard rattle occasionally. Electric wires swing slightly.

IV : STRONG
Many people are frightened. Most sleeping people awake. Hanging objects swing considerably and dishes in a cupboard rattle. Unstable ornaments fall occasionally. Electric wires swing considerably.

V(Lower) : VERY STRONG (Lower)
Some people find it difficult to move. Hanging objects swing violently. Most unstable ornaments fall. People notice electric-light poles swing. Occasionally less earthquake-resistant houses suffer damage to walls and pillars.

V(Upper) : VERY STRONG (Upper)
Many people are considerably frightened and find it difficult to move. Most dishes in a cupboard and most books on a bookshelf fall. In many cases, unreinforced concrete-block walls collapse and tombstones overturn. Many automobiles stop because it becomes difficult to drive. Occasionally, less earthquake-resistant houses suffer heavy damage to walls and pillars and lean.

VI(Lower) : DISASTROUS (Lower)
Difficult to keep standing, A lot of heavy and unfixed furniture moves and falls. In some buildings, wall tiles and windowpanes are damaged and fall. Occasionally, less earthquake-resistant houses collapse.

VI(Upper) : DISASTROUS (Upper)
Impossible to keep standing and to move without crawling. Most heavy and unfixed furniture moves and falls. In many buildings, wall taile and windowpanes are damaged and fall. Most unreinforced concrete-block walls collapse. Many, less earthquake-resistant houses collapse.

VII : VERY DISASTROUS
Thrown by the shaking and impossible to move at will. Most furniture moves to a large extent and some jumps up. In most buildings, wall tailes and windowpanes are damaged and fall. Occasionally, even highly earthquake-resistant buildings are severely damaged and lean.

In the stations which record the ground acceleration, one of the horizontal components of the accelerograph is directed to the due north except a few accelerographs. Some of the accelerographs are installed in parallel with the structures because most of port facilities such as quay walls or piers have two-dimensional-structure and it is desirable to record the components of the ground acceleration parallel and perpendicular to the principal axes of the structure. In the stations which record structural response and the accompanying stations which record the ground acceleration in its vicinity, accelerographs are installed parallel to the structure in which earthquake response is needed.

Two horizontal components of the accelerograph are usually corresponding to North-South (NS) and East-West (EW) direction, respectively. However, if the direction of the component of the accelerograph is different from the geometric direction, the deviation angle in degree is used to represent components direction. For example, N10E component means that the direction deviates 10 degrees eastward from the due north.

Each station in the network has its own abbreviated name listed in **Table 1**. The name consists of the location, the type of the accelerograph and the installation condition. For instance, the stations in Kushiro port in Hokkaido island are named Kushiro-G and Kushiro-GB, respectively. 'Kushiro' means the location of the station. In some sites where the accelerograph installed at the port construction office, the suffix 'ji' is attached as 'Kobe-ji'. The suffix 'G' represents type of acceleration and means that the ERS-G type accelerograph is installed at Kushiro port. If the SMAC-B2 accelerograph is installed, this suffix becomes 'S', if the ERS-B, -C and -D type accelerograph, 'M', and if the ERS-F type accelerograph, 'F'. The suffix 'B' after 'G' in Kushiro-GB represents installation condition and means that the accelerograph is installed in ground using bore-hole. If there is no suffix representing installation condition such as Kushiro-G, that means the accelerograph is being installed at ground surface. If the suffix representing installation condition becomes 'R', that means the accelerograph is being installed on the structure. In the Kobe-ji site and Rokko site, two accelerograph are installed at different depth of in ground. The suffix of number like '40' after 'B' represents the depth of in ground accelerograph.

(4) Accelerograph

(a) SMAC-B2 accelerograph

The SMAC-B2 accelerograph was developed by the Committee for the Standard Strong Motion Accelerograph. It is a three component mechanical type accelerograph which scratches records on a rolled waxed paper. The specifications of the SMAC-B2 accelerograph are shown in **Table 3**. Inside view and theoretical frequency characteristics are also shown in **Figure 2** and **Figure 3**, respectively.

The SMAC-B2 accelerograph has been one of the standard accelerographs in the network of the Port and Harbour Research Institute. At the earlier stage of the strong-motion observation, the SMAC-B2 accelerograph was one of the standard models and suitable for the observation condition in port areas. After the SMAC-B2 accelerograph, several types of accelerograph were developed by the Committee. In the network, however, the SMAC-B2 accelerograph has only been used as a mechanical type accelerograph because it was inconvenient to use many types of accelerographs from the view point of instrument correction procedure and maintenance. As of December 1998, total number of SMAC-B2 accelerograph being used is 7.

5 Gals (=cm/sec^2) is adopted as a triggering level of the accelerograph in places where ground noise is small, and 8 Gals in places where ground noise is relatively large because of heavy motor trucks for construction work or cargo transportation. A few number of the accelerographs located beside roads carrying very heavy traffic are triggered at 11 Gals.

At present, an action program is going on to replace the SMAC-B2 accelerographs with digital type accelerographs.

Table 3 Specifications of the SMAC-B2 accelerograph

Component	2 horizontal and 1 vertical
Natural period	0.14 sec.
Sensitivity	12.5 Gal/mm
Damping	Critical
Damping mechanism	Air piston
Maximum recording acceleration	500 Gal
Recording speed	10 mm/sec.
Recording medium	Waxed paper
Driving mechanism for recorder	Hand-wound spring motor
Recording duration	3 min.
Recording capacity	5 earthquakes/roll
Starter	Electric contact made by vertical motion
Period of starter pendulum	0.3 sec.
Starter threshold	5 Gal
Auxiliary starter	Mechanical, works at 100 gal
Time marking	1 sec.
Power supply	4 dry cells
Size	54×54×37 in cm
Net weight	100 kg

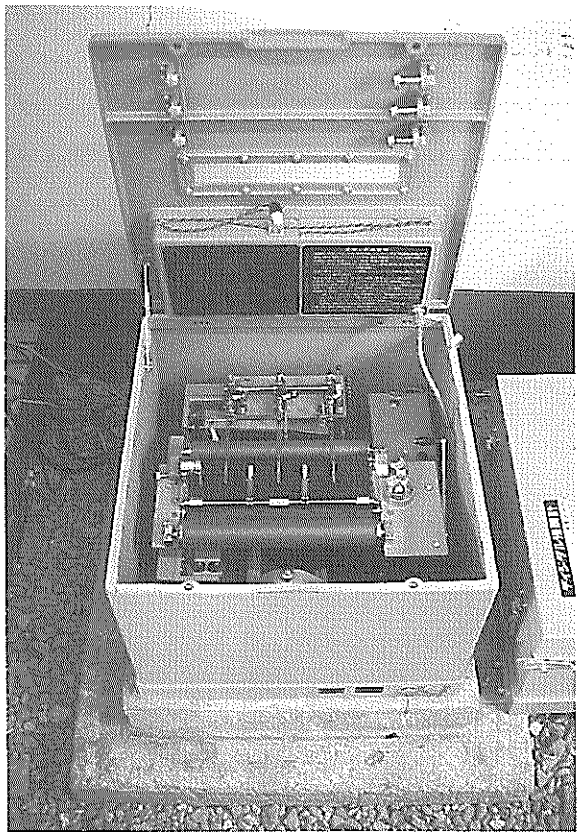
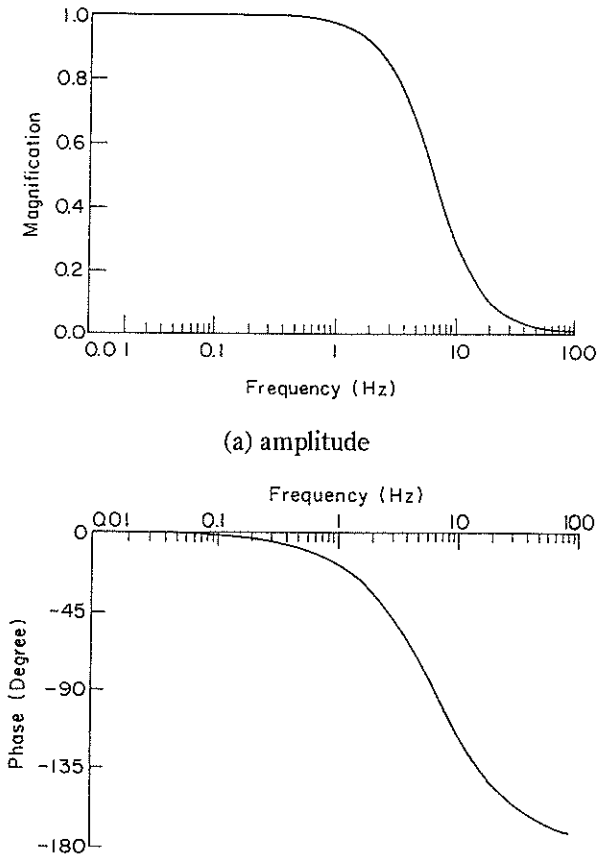


Figure 2 Inside view of the SMAC-B2 accelerograph



(a) amplitude

(b) phase

Figure 3 Frequency characteristics of the SMAC-B2 accelerograph

(b) ERS accelerograph

The SMAC-B2 accelerograph has been very widely used in the network. However, there exist some places where the SMAC-B2 accelerograph can not be installed, such as on structures or in ground. For that reason, the ERS accelerograph was developed by the Geotechnical Earthquake Engineering Laboratory to observe earthquake motions in a specific condition. Transducers and a recorder of the ERS accelerograph are separately installed for the observation.

Table 4 Specifications of the ERS-B accelerograph

Transducer	
Type	Moving coil type
Component	2 horizontal
Natural period	0.5 sec.
Damping factor	17
Damping mechanism	Electro-magnetic
Capacity	250 Gal
Coil impedance	320 ohm
Sensitivity	about 2mv/Gal(circuit open)
Water tightness	over 200 kg/cm^2
Recorder	
Type	Electro magnetic oscillograph
Natural frequency of galvanometer	100 Hz
Sensitivity	166 mm/mA
Recording paper	92 mm(width)×30 m(length) (visible without processing)
Paper speed	2 cm/sec.
Time mark	0.1 sec.
Power supply ... Rechargeable battery, Charged automatically when it is necessary.	

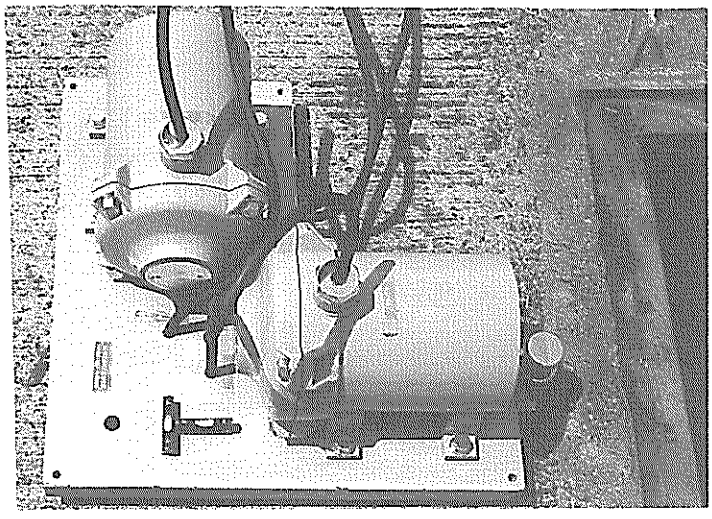


Figure 4 Transducers of the ERS-A and –B accelerograph

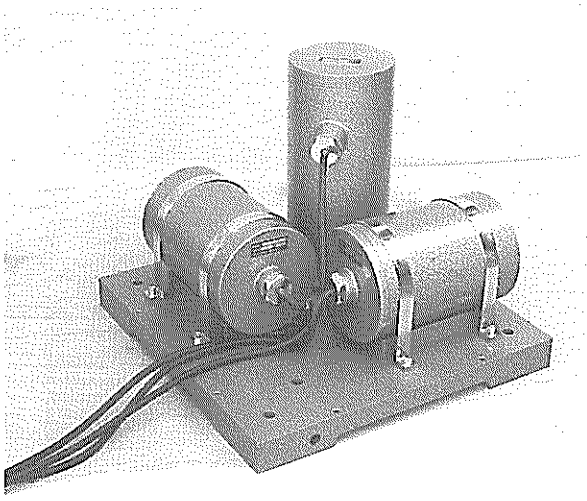


Figure 5 Transducers of the ERS-C accelerograph

Table 5 Specifications of the ERS-C(D) accelerograph

Transducer	
Type	Moving coil type
Component	2 horizontal and 1 vertical
Natural frequency	3 Hz(5 Hz)
Damping factor	17(10)
Damping mechanism	Electro-magnetic
Capacity	500 Gal
Water tightness	over 20 kg/cm^2
Recorder	
Type	Electro magnetic oscillograph
Natural frequency of galvanometer	270 Hz
Recording paper	198 mm(width) × 30m(length) (visible without processing)
Paper speed	4 cm/sec.
Time mark	0.1 sec.
Sensitivity (overall)	2 Gal/mm, or 10 Gal/mm
Power supply ... Rechargeable battery, Charged automatically when it is necessary.	

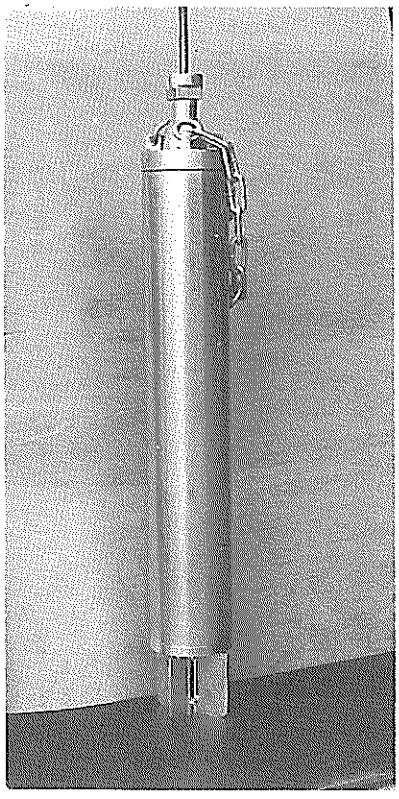
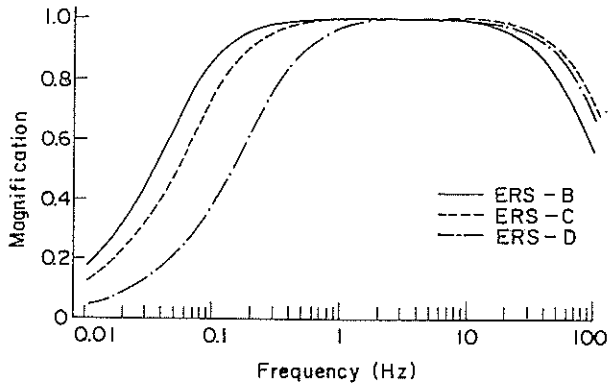
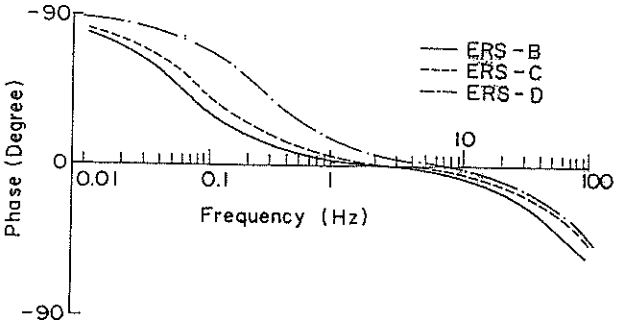


Figure 6 Transducers of the ERS-D accelerograph



(a) amplitude



(b) phase

Figure 7 Frequency characteristics of the ERS-B,-C and -D accelerograph

First, the accelerograph with magnetic tape data recorders was developed. This accelerograph was called the ERS-A accelerograph. After some period of operation, the magnetic tape data recorders were replaced by an oscillograph. The model with an oscillograph was named as the ERS-B accelerograph. The ERS-A and -B accelerograph records only two horizontal components of acceleration. The specifications of the ERS-B accelerograph are shown in **Table 4** and the transducer of the ERS-A and -B are shown in **Figure 4**. The last ERS-B accelerographs are removed at the end of December, 1998.

After that, the ERS-C accelerograph was developed and installed. While the ERS-B accelerograph records accelerations in two horizontal components, the ERS-C accelerograph records acceleration of vertical component as well as two horizontal ones. The transducer of the ERS-C accelerograph is shown in **Figure 5**. The ERS-C accelerographs are working at 4 stations at present as shown in **Table 1.**

The ERS-D accelerograph was also developed for recording acceleration in ground. Accelerographs of this type had been installed at 2 stations in the network as shown in **Table 1.** The transducers of the ERS-D accelerograph are installed in bore-hole and they have the same specifications as those of the ERS-C accelerograph. The specifications of the ERS-C and -D accelerographs are shown in **Table 5.** The transducers of the ERS-D accelerograph are shown in **Figure 6.**

In the ERS-B, -C and -D accelerographs, the transducers are almost directly connected with galvanometers in the oscillograph. There exist only resistor circuits to adjust sensitivity and impedance matching between them. No electronic amplifier is used to attain maximum reliability of the instrument. The overall sensitivity is more than 10 mm per Gals (=cm/sec^2) and it is easily adjusted by changing resistors of the circuit. Therefore, the ERS-B, -C and -D accelerograph have advantage to start the observation in its maximum sensitivity and to readjust

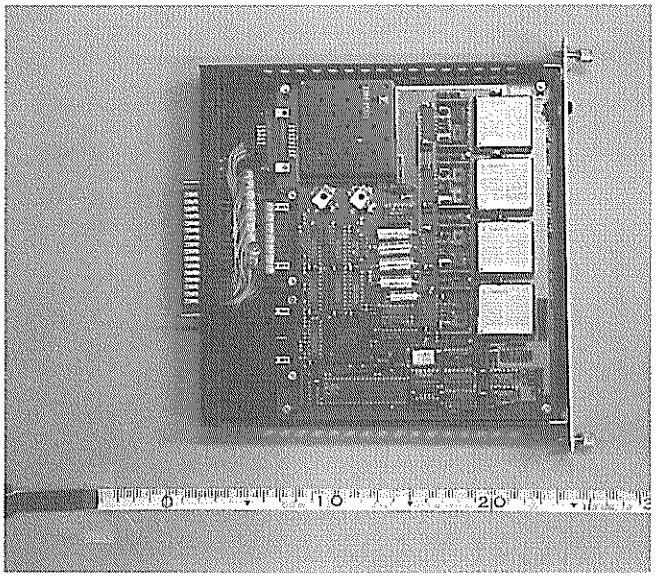


Figure 8 Inside view of the memory of the ERS-F accelerograph

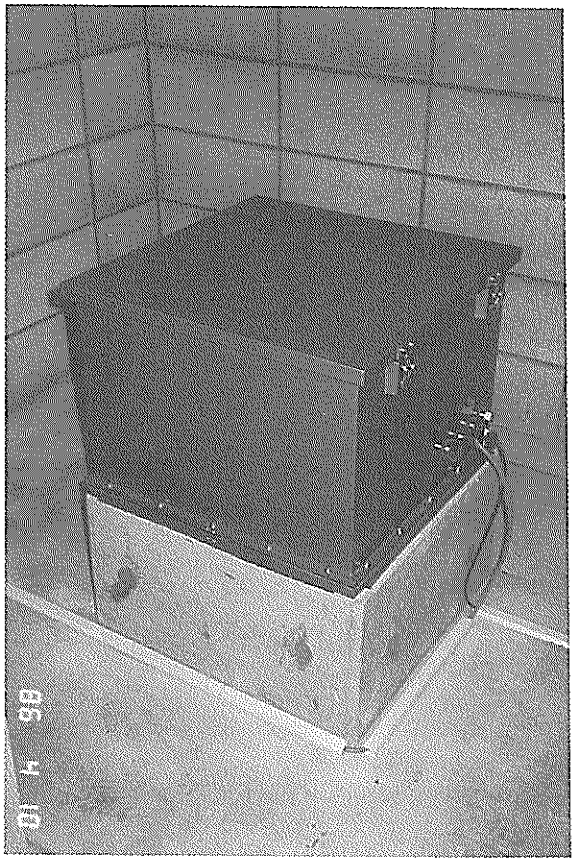


Figure 9 Standard type of the ERS-F accelerograph

the sensitivity into the appropriate one for the strong-motion after obtaining some records. The frequency characteristics of these accelerographs are shown in **Figure 7.** The triggering levels of these ERS accelerographs are similar to those of the SMAC-B2 accelerographs. If the ERS-B, -C and -D accelerographs are installed at the station, the suffix which represents type of accelerograph becomes 'M' in the name of the station. For instance, the name of the station at Omaezaki port becomes Omaezaki-M because the ERS-C accelerograph is installed.

(c) ERS-F accelerograph

The ERS-F accelerograph is a digital type strong-motion accelerograph equipped with non-volatile, solid state magnetic bubble memories. The main unit of the recording system, shown in **Figure 8**, consists of four non-volatile, solid-state magnetic bubble memories of the total memory size of 1 Mbytes and the controlling parts, of which dimensions are 240 × 240 × 35 mm, weighing about 1 kg. Double units can be installed in a recording system, but single unit is installed for

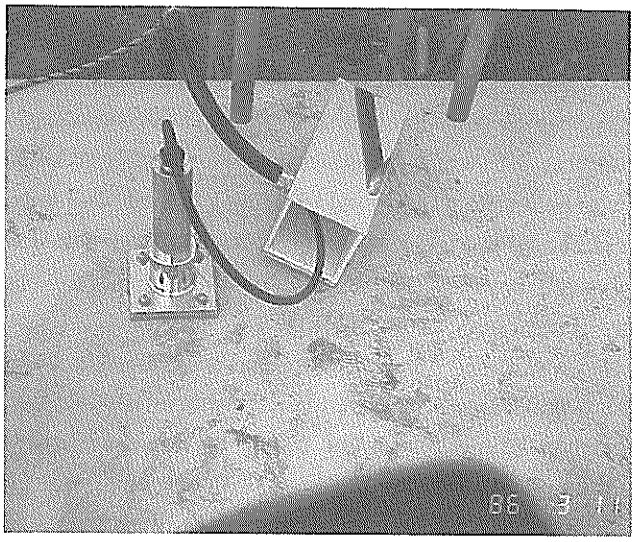


Figure 11 Transducers of the ERS-F and -G accelerograph attached to structures

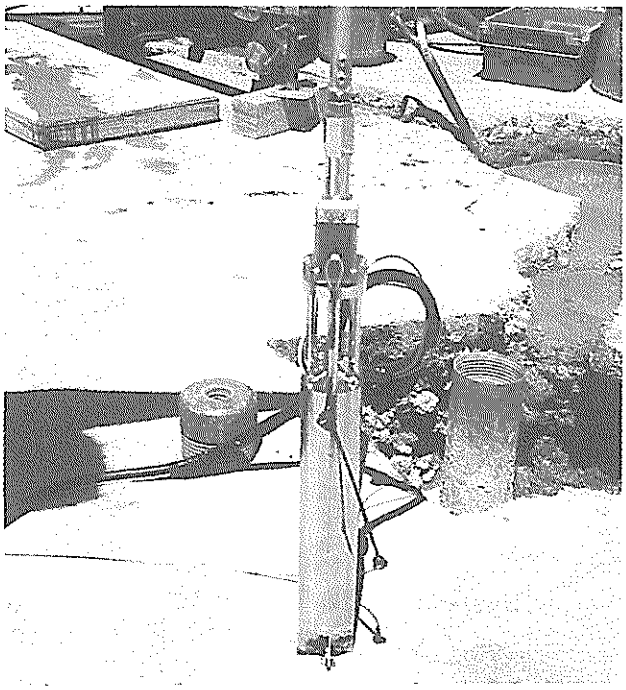


Figure 10 Transducers of the ERS-F and -G accelerograph installed ground

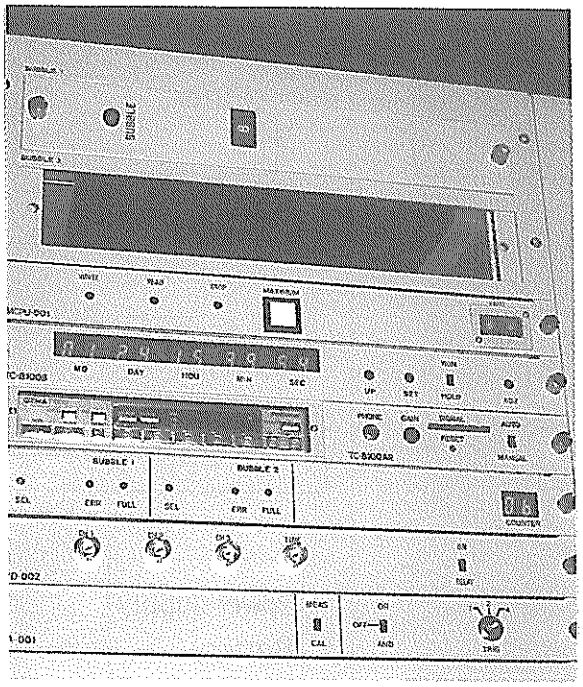


Figure 12 Front view of the recording system of the ERS-F accelerograph

the recording system at Hakodate Port and Hitachinaka Port. Time signal is recorded by using one channel in this system and the recording time of three components of acceleration and one time signal is about 40 minutes in double bubble memories.

There are several types of the ERS-F accelerographs. The standard type shown in **Figure 9** is a self-contained box type which contains transducers and a recorder with magnetic bubble memories all in one. The other is a sepa rated type in which transducers and a recorder are separated with each other. **Figure 10** shows the transducers which is to be installed in ground by using bore-hole and to observe earthquake motions at base or in ground. The transducers shown in **Figure 11** is to be attached to structures. The front view of the recording system of the ERS-F accelerograph including the magnetic bubble memories is shown in **Figure 12.** Total number of the ERS-F accelerograph is 12 at present as shown in **Table 1.**

The ERS-F accelerograph has a system shown by a block-diagram in **Figure 13,** and satisfies the specification shown in **Table 6.** The frequency characteristics of the transducers are shown in **Figure 14.** Recording duration of an earthquake motions is one minute at minimum, and the duration can be extended up to 10 minute at a step of one minute by monitoring the level of the acceleration. The recording duration is extended if the level of the monitored acceleration after each 40 seconds from the trigger or extension is higher than the trigger level of the acceleration. The main unit of the recording system can record ten earthquake motions by 60 seconds of three components at the maximum. If earthquakes occur successively and the earthquake motion data should over flow the recording system, records of the greater maximum accelerations are retained. As exception to this, however, records of 180 seconds are stored in the first-come first-serve basis.

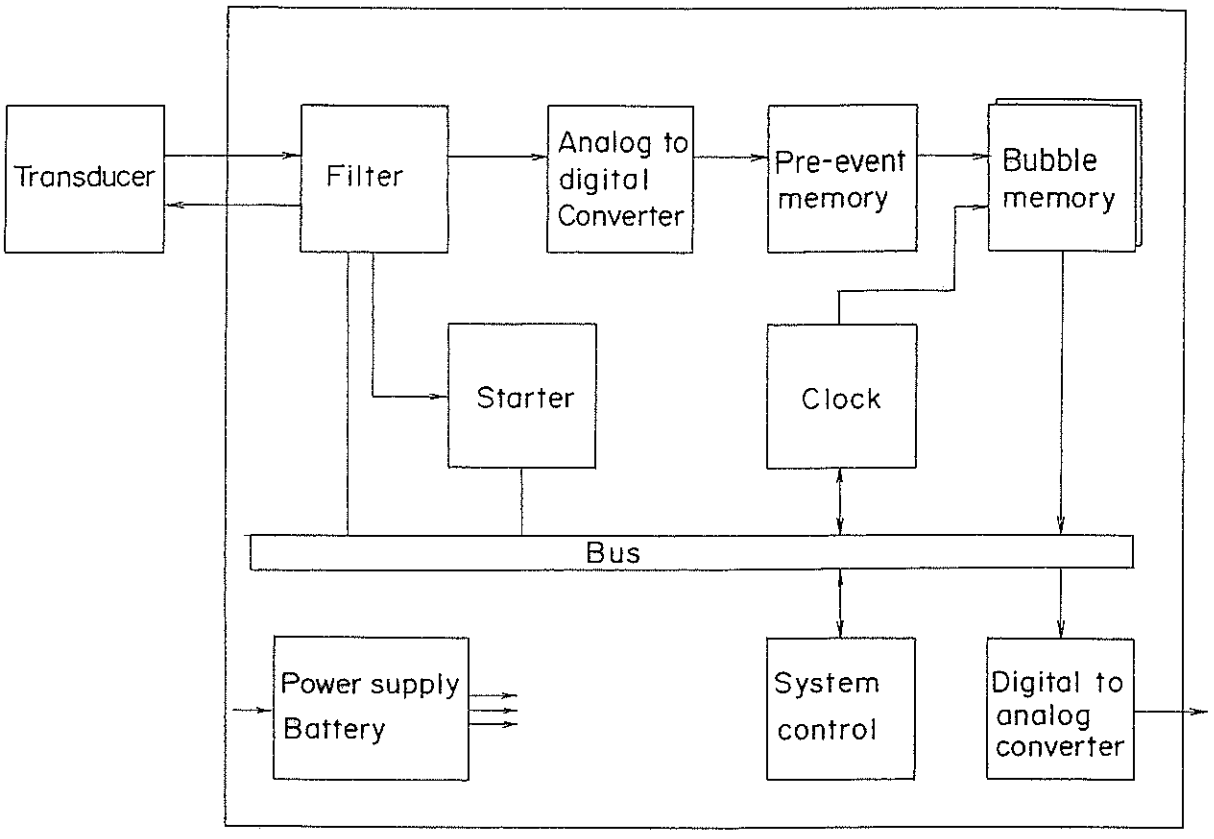


Figure 13 Block-diagram of the ERS-F accelerograph

(d) ERS-G accelerograph

The ERS-G accelerograph is an improved version over the ERS-F accelerograph. Transducers of the accelerographs are almost the same to those of the ERS-F accelerograph. In the ERS-G accelerograph, IC-CARD memory as shown in **Figure 15** is used for the recording system and some improvements are done for the controlling system. The memory size of the IC-CARD is 2 Mbytes. The recording time of three components of acceleration is about 52 minutes in one card. The triggering level of acceleration can be set at several steps. The capacity of accelerograph is 2G, and the level of maximum acceleration (sensitivity) can be set at appropriate value from 0.008G to 2G. Total number of the ERS-G accelerograph is 69 at the end of December 1998.

The specification of the ERS-G accelerograph is shown in **Table 6** with the specifications of the ERS-F accelerograph and frequency characteristics of the

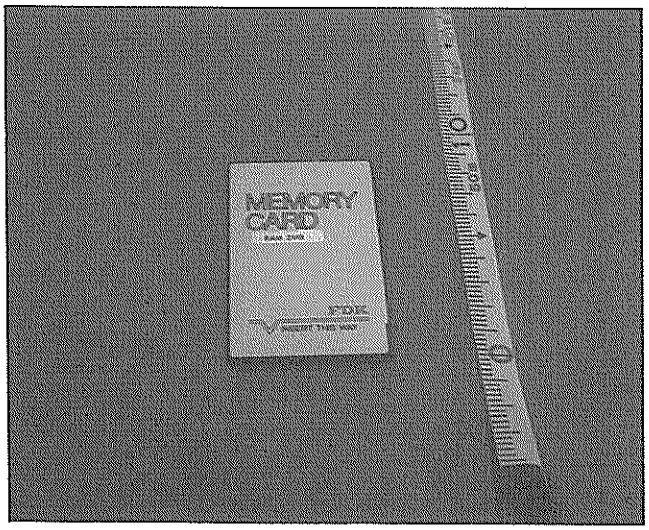
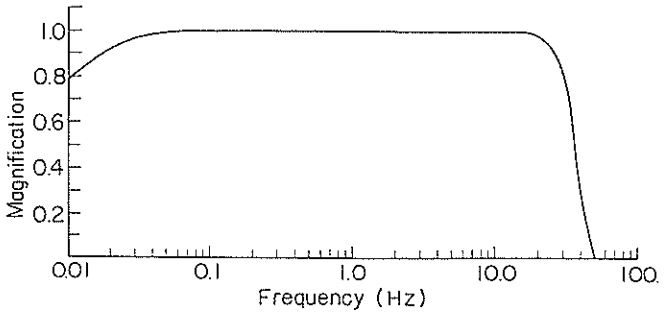
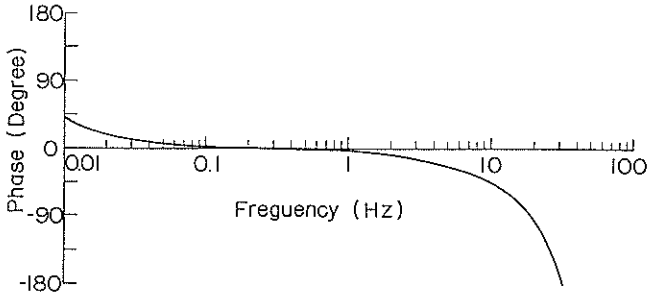


Figure 15 Memory (IC-CARD) of the ERS-G accelerograph



(a) amplitude



(b) phase

Figure 14 Frequency characteristics of the ERS-F and -G accelerograph

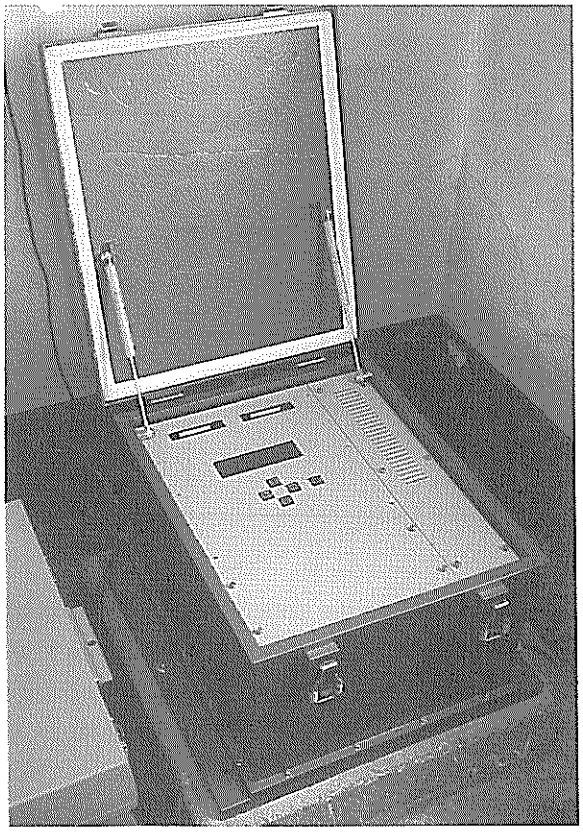


Figure 16 Inside view of the ERS-G accelerograph

Table 6 Specifications of the ERS-F and –G accelerograph

Overall Capabilities	Maximum acceleration capacity	(-F) 2G (-G) 0.008G～2G, variable
	Frequency characteristics	0.01Hz～35Hz
	Dynamic range	86 dB over
Transducer	Accelerometer	
	Component	2 horizontal, 1 vertical
	Maximum capacity	(-F) 2G (-G) 0.008G～2G, variable
	Sensitivity	10^{-5}
	Type	Force-balance servo or Velocity-balance servo
Filter	High pass	0.007 Hz -6 dB/octave
	Low pass	35 Hz –18 dB/octave
A/D conversion	Resolution	16 bits
	Conversion rate	100 Hz
Pre-Event Memory	10 seconds.	
Clock	Accuracy of internal clock 1/100 seconds corrected ever an hour by NHK time signal	
Starter	Trigger levels : 0.5, 1, 2% of maximum acceleration	
Recorder	No. of channel	(-F) 4～10 channel (1 time signal) (-G) 3～12 channel
	Memory size	(-F) Bubble Memory : 1 Mbytes × 2 (-G) IC-CARD Memory: 2 Mbytes
	Record length	1 ～ 10 minutes/record
	Maximum Recording Length	(-F) 40 minutes/4ch. (-G) 52 minutes/3ch.
	Record of greatest maximum acceleration secured	
Related Information's	Observation station, Number of records, Start time of each data, Maximum accelerations of each component	
Calibration	Overall calibration are possible	
Backup Power Supply	2 hour after power storage	
Container	Aluminum box, Water-Proof, Size (-F) : 54(L), 54(W), 38(H)cm (-G) : 54(L), 54(W), 33(H)cm	

transducers which are the same as the transducers of ERS-F accelerograph are shown in **Figure 14.** Standard type of the ERS-G accelerograph is shown in **Figure 16** in which transducers and recording system with IC-CARD are contained all in one. The type of the transducer of the ERS-F and -G accelerograph installed at ground surface is usually force-balance type. However, the velocity-balance type is recently adopted for the transducers installed in ground because of the safety against lightning.

After recording earthquakes, the main unit (memory) of the recording system is pulled out from the recording system of the ERS-F and -G accelerograph and replaced by another memory ready for recording the coming earthquakes. The pulled out unit, bubble memory with a static eliminator on the connector to the unit of the ERS-F accelerograph and IC-CARD of the ERS-G accelerograph, is packed in a case and sent to the Laboratory. The unit is set on the reproducer which is connected to a computer and digital time histories of earthquake motions are reproduced in

the Laboratory. Absolute time at the trigger of the record is also obtained from the record of the internal clock of the accelerograph. As shown in **Table 6**, these recording system have digital delay memory for 10 seconds. If the recording started before the first motion of the earthquake, some of the portion of the record preceding the first motion is omitted.

Some of the ERS-G accelerographs are connected to the telephone line (NTT-ISDN digital data transfer line) and on-line data transfer system between sites and Geotechnical Earthquake Engineering Laboratory at Yokosuka is available. This on-line monitoring system have been installed at 12 strong-motion observation station as of December, 1998 and an action program to extend the system is now going on. Most of the strong-motion observation station with ERS-G accelererograph will be in on-line system until the end of 2000, and it will be no necessary to send IC-CARD any more. Furthermore, monitoring the status of accelerographs is possible using this on-line network system and maintenance of accelerograph will be speedy and easy.

(5) Foundation and House

As most of the harbour structures have shallow foundations and do not rest on bed rock, spread foundations for the accelerographs are being used. All the SMAC-B2 accelerographs in the network are installed on simple spread foundations which are made of reinforced concrete shown in **Figure 17.** The hollow space under the foundation is allocated to make the bulk density of the foundation equal to that of the soil, so that the disturbance to the records due to the foundation can be minimized. The foundations are also used for the ERS-F and -G accelerographs which were installed after the SMAC-B2 accelerograph for replacement.

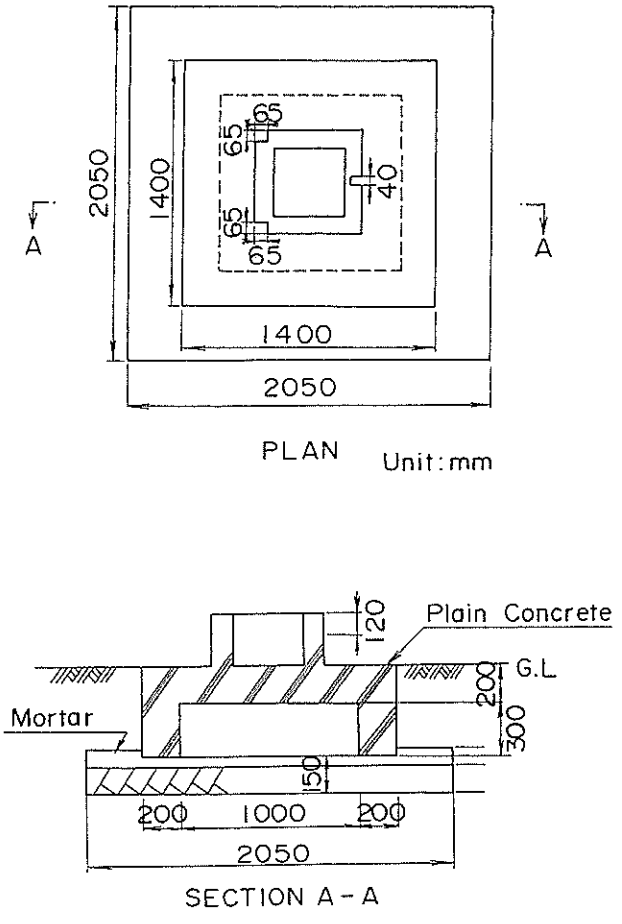


Figure 17 Foundation for the SMAC-B2 accelerograph

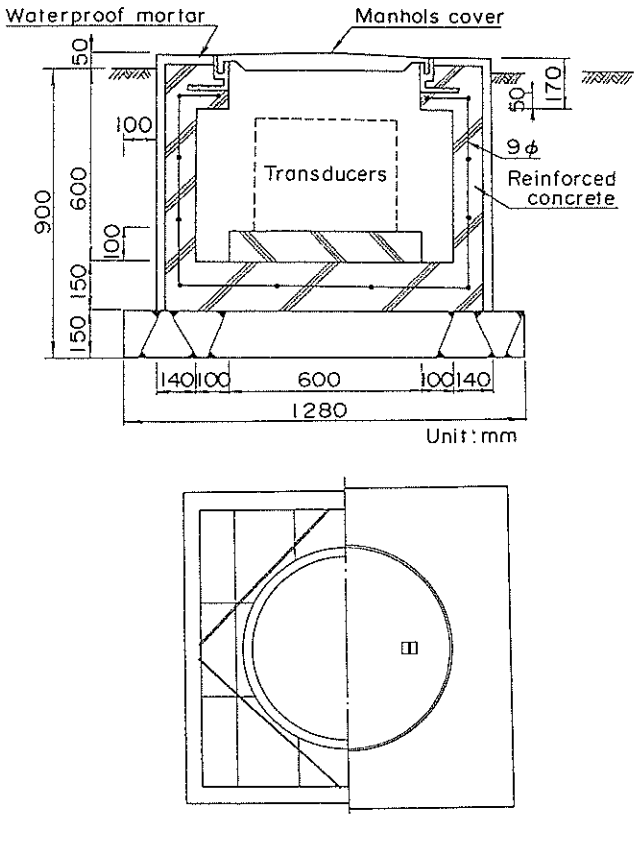


Figure 18 Foundation for the ERS-C accelerograph

The standard foundation for the ERS-B and -C accelerograph has not been established. Shape and size of a foundation for transducers of the ERS-C accelerograph are illustrated in **Figure 18.**

Usually, no pile is used to support the accelerograph and its foundation, but in the stations on very soft soil or very loose sand, concrete piles or wooden piles are used. For example, the foundation at the Niigata-G station is supported by piles. All the foundations are isolated from houses covering the accelerographs.

Most of the accelerographs are covered with houses which were built for the accelerographs. Some of the accelerographs are installed in houses which were built for other purposes. The houses built for covering accelerographs are made of reinforced concrete or concrete blocks, and some are prefabricated houses. The house of the Onahama-ji-G,GB station is shown in **Figure 19** as an example.

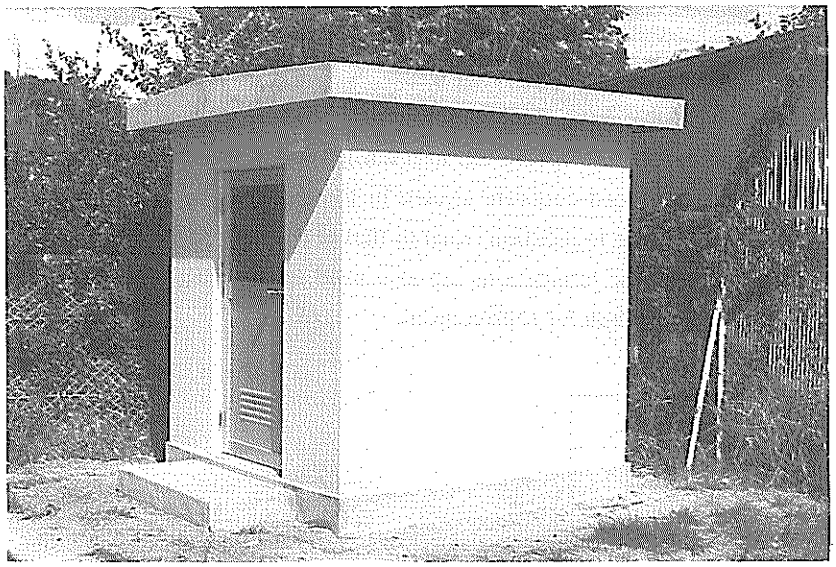


Figure 19 House of the Station (Onahama-ji-G, GB Station)

3. Preliminary Processing

All the accelerograms collected at the Geotechnical Earthquake Engineering Laboratory of the Port and Harbour Research Institute are listed in the tables on Strong-Motion Earthquake Observation Results, which are classified by earthquakes and listed in the later part of this report. They undergo the following preliminary processing.

At first, each accelerogram is given a record number according to the order of its arrival at the Laboratory. The record number for the accelerogram by the SMAC-B2 accelerograph begins with the capital letter 'S', that by the ERS-B, -C and -D accelerograph, with the capital letter 'M' and that by the ERS-F and ERS-G, with the capital letter 'F'.

Then, an earthquake which corresponds to each accelerogram is confirmed or determined. There is no time information in the accelerograms obtained by the SMAC-B2 accelerograph and the ERS-B, -C and -D accelerograph because those accelerographs are not equipped with an internal clock. Therefore, most of the accelerograms are sent to the Laboratory with the earthquake information from the stations. However, there are a few of the accelerograms without such information because the accelerograms were found in the regular servicing and it was difficult to find the corresponding earthquake at the station. For such accelerograms without time information, the earthquake is determined by considering both the possible period of the recording and the earthquake occurred in that area at that period.

The determination or the confirmation of the corresponding earthquake is based on Monthly Report on Earth-

quakes and Volcanoes in Japan by the Japan Meteorological Agency (JMA)[49] and Japan seismological data FD published by JMA[50]. Some of the accelerograms, however, remain without matching earthquakes. In this case, those earthquakes are treated as earthquake unknown. The accelerogram whose earthquake is unknown is not listed in the tables if both of its maximum horizontal accelerations are smaller than 20 Gals. It will be noted that the reliability of the earthquake determination based on such procedure for accelerograms with small acceleration is limited in the case that accelerograms do not have accurate time information.

Accelerograms by the SMAC-B2 accelerograph are recorded on a rolled waxed paper which has dark red background. The recording by scratching the waxed paper with a stylus leaves the semi-translucent trace on the waxed paper. Because the waxed paper is not stable against scratching and is not appropriate to be used for the digitization, the photographic contact print of the original accelerogram had been made on a special photographic sheet. This sheet is made of mylar film and stable against temperature change, humidity, and mechanical distortion. Because the photographing company which was used in the network changed their system and it is impossible to get the special photographic sheet any more, a normal photographic paper have been used since May, 1997. Therefore, the accuracy of reproducing the observed records have been slightly reduced in the S-2668 record and following records obtained by SMAC-B2 accelerograph. The sizes of the sheet are 55 cm in length and 30 cm in width. If the significant portion of the record is longer than 30 to 45 cm, the copy will be made on two sheets or more and the portion of about 10 cm at the end of each sheet is overlapped with each other for confirming data continuity in the successive sheets. After this processing, the record becomes black traces and semi-translucent background in the copy sheet and they are in good contrast for the digitization. The record by the ERS-B, -C and -D accelerograph is only chemically stabilized by sensitization before being used for digitization.

From the photographic copy or the stabilized original record, the maximum acceleration of each component is read by using a magnifying glass. In this reading, the base-line setting is not so accurate as that made in digitizing the accelerogram and these maximum accelerations are not so accurate and different from those processed through digitization, standard data processing and preliminary analyses which will be explained later. The maximum accelerations, which are listed in the tables of Strong-Motion Earthquake Observation Results and are not processed through preliminary analyses, are those determined by this preliminary processing. For the records by the ERS-F and -G accelerograph, acceleration data are directly read by a computer and the time information is included in the record. Therefore, the maximum acceleration and the time of triggering are obtained accurately, and the corresponding earthquakes of records are easily determined.

In the tables of Strong-Motion Earthquake Observation Results, the time in the earthquake data refers to the Japan Standard Time which is earlier than GMT by 9 hours, the magnitude is the JMA Magnitude which is determined by the JMA and the seismic intensity of the shock is estimated by the JMA according to the scale shown in **Table 2.**

4. Digitization

(1) Digitizer

Two types of digitizers are used in the Laboratory. One is for digitization of records by the SMAC-B2 accelerograph and the other is for digitization of records by the ERS-B, -C and -D accelerograph.

The digitizer for the accelerograms obtained by the SMAC-B2 accelerograph is a semi-automatic instrument. The view and the specifications of the digitizer are shown in **Figure 20** and **Table 7**, respectively. The digitizer works in the following way.

On the digitizer table, there is a magnifying glass which can be moved along the transverse (vertical) axis by

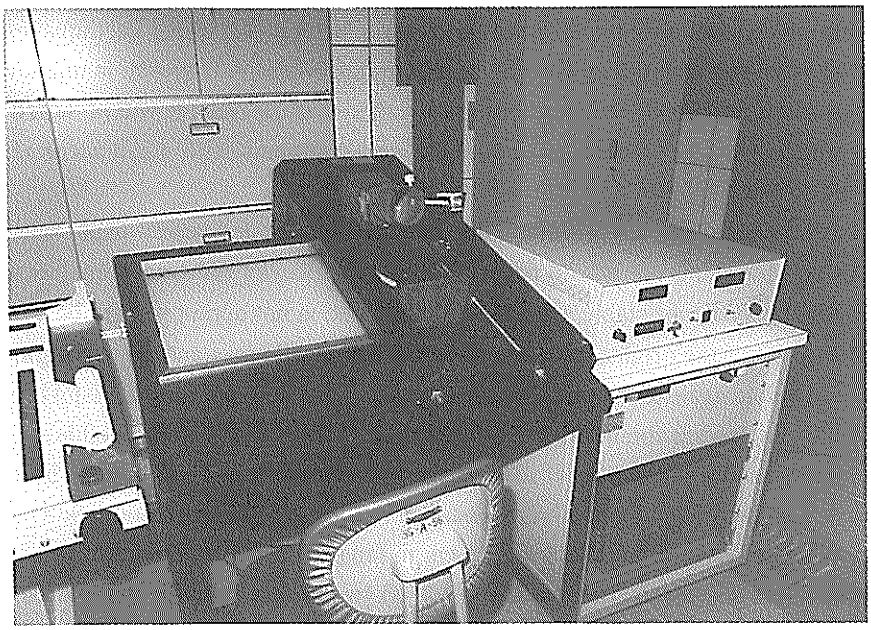


Figure 20 Digitizer for records by the SMAC-B2 accelerograph

Table 7 Specifications of digitizer for records by SMAC-B2 accelerograph

Digitizer Table	
Size of table	750 mm(X)× 660 mm(Y)
Effective area	430 mm(X)× 300 mm(Y)
Magnifying glass	5x, with a cross hair and illumination
Translation of magnifying glass	
Y-axis (vertical)	manual by rotating a wheel
X-axis (horizontal)	automatic, at intervals of 0.1 mm
Analog to Digital Converter and Control	
Resolution(overall)	1000 counts per a millimeter
Indication	
Y-axis (vertical)	sign and 4 digits
X-axis (horizontal)	4 digits

rotating a small wheel near the glass. A magnescale is connected to the wheel, and the electric digital output corresponding to the position of the magnifying glass is produced from the magnescale. The magnifying glass has a cross-hair and a lamp to illuminate the accelerogram within its range. The operator places the cross-hair on the trace of an acceleration record and pushes a button, then the digital output from the magnescale is displayed on the panel and is stored in the memories of the computer. After this step, the magnifying glass is automatically shifted along the longitudinal (horizontal) axis by 0.1 mm.

The records obtained by the ERS-B, -C and -D accelerographs are processed with an on-line oscillogram digitizer connected to a computer which is shown in **Figure 21.** A record is placed on the digitizer table and an operator traces earthquake wave forms with a cursor of the digitizer. The travels of the cursor along horizontal and vertical axis are digitally counted and the coordinates of the cursor are transferred into memories of the computer at a step of 0.1 mm along the horizontal axis.

After the necessary portions of the record are digitized, digitized values in the memories are processed by

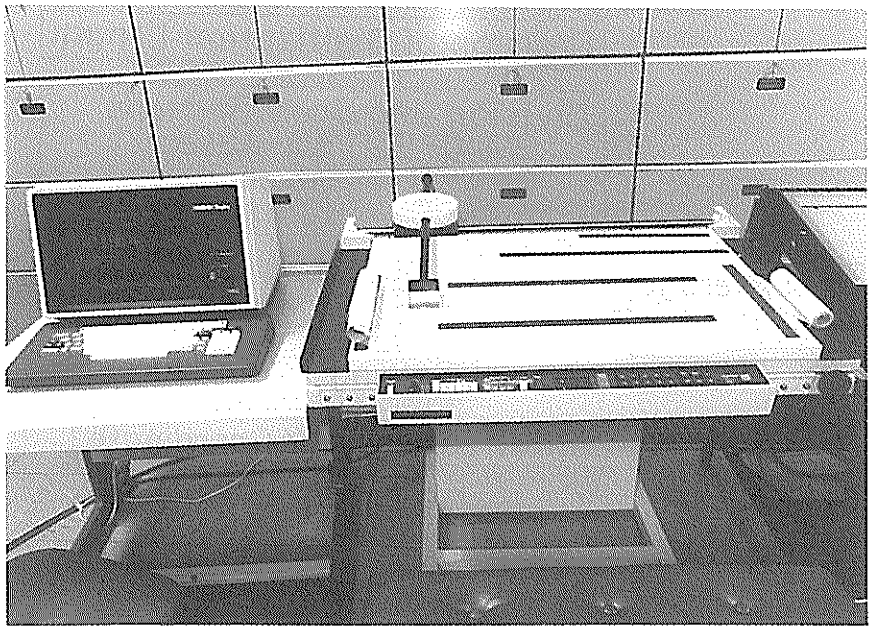


Figure 21 Digitizer for records by the ERS-B, -C and -D accelerograph

computer programs. According to the directions given to the computer through the keyboard, printed list, magnetic tape and analog reproduction etc. are obtained as outputs of the digitized records in the memories.

(2) Digitization

The digitization procedure, which is shown in **Figure 22** and described here, has been applied for records obtained since 1976.

(a) SMAC-B2 accelerograph

The records by the SMAC-B2 accelerograph consist of acceleration records, fixed traces, timing marks, arc traces and free vibration traces for calibration of the characteristic periods and damping factors of the accelerograph. Among them, traces to be digitized are the recorded accelerations, the fixed traces and the arc traces. Digitized fixed traces and digitized arc traces are used for the standard data processing described later.

The fixed traces are recorded by the pens fixed to the accelerograph frame. The arc traces are recorded manually with the recording pens supported by pivots while the paper drive mechanism is stopped. The arc traces show offset of the pens from the normal position where the pens are parallel to the direction of paper driving. The timing marks are pulses at intervals of one second. The timing marks are used only to obtain the average recording speed because fluctuation of the timing marks are estimated as small as the digital unit of the digitizer (0.1 mm) according to the results of the tests of the SMAC-B2 accelerographs[51]. The average error in the time marking is expected to be less than 1 % and the fluctuation is less than 0.5 % according to the results of the tests of the SMAC-B2 accelerographs. In order to obtain the average paper speed, intervals of 30 pulses is measured by the digitizer for a record by the ERS-B, -C and -D accelerographs.

A record is digitized from the starting point of recording. Portion of the record to be digitized is determined so as to include discernible acceleration on the paper. This determination is done by observation of a record to be digitized. The portion of the record to be digitized is divided into some sections because of the limitation of the digitizer table. Length of each section is about 30 to 45 cm which is almost equivalent to 30 to 45 seconds. Digitization unit in the amplitude is 0.008 mm which is equivalent to 0.1 Gal. Contact prints are made for each

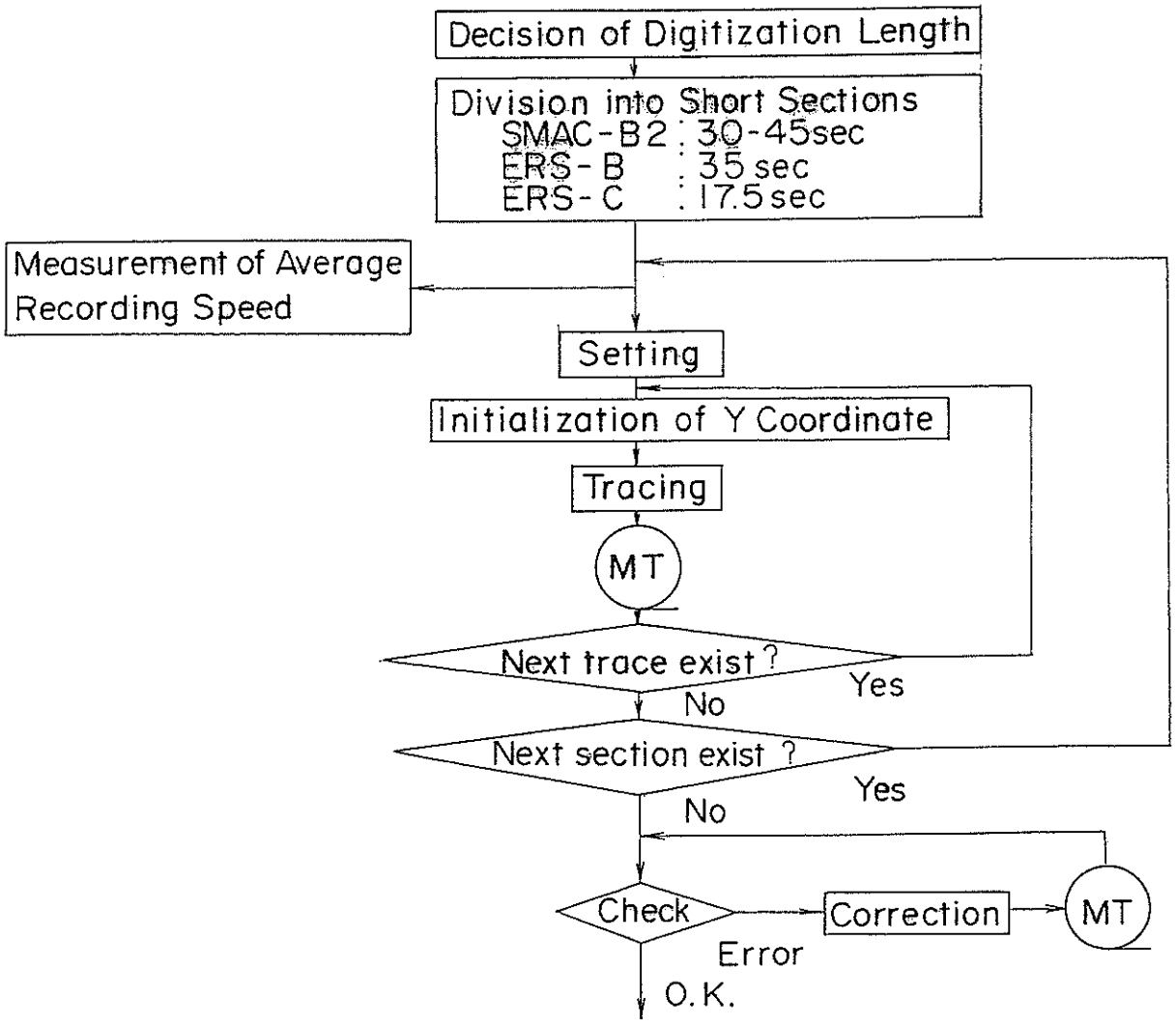


Figure 22 Digitization procedure

section as described previously. Digitization procedure is summarized as follows;

- Setting of the copy

A photographic copy of a record to be digitized is fixed on the table of the digitizer with tape. The table is rotated by an adjusting screw so that the fixed trace on the copy is parallel to horizontal axis of the digitizer. Two points on the fixed trace located on both ends of section are used for this adjustment and vertical coordinate value of the two points are made to coincide with each other.

- Initialization of transverse coordinate

The origin of vertical coordinate of each sheet is tentatively set in the digitization procedure because Sectional Base-Line Location described later is to be applied in the standard data processing. Transverse coordinate of a first point to be digitized is usually set to zero.

- Tracing

The traces are digitized by an operator in the way described in the preceding section. Three components of ac-

celerations, two fixed traces, and three arc traces are digitized at the intervals of 0.1 mm along horizontal axis. The intervals are almost equivalent to 0.001 second. Because accelerations are recorded in a cylindrical coordinate system, the digitized amplitude values do not correspond to equal time intervals.

- Recording of Digitized Data

Digitized data in the memory of the computer are recorded in the magnetic disk with such data as record number, component, station, date and time of the earthquake, time intervals, etc.

(b) ERS-B, -C and -D accelerograph

The records by the ERS-B, -C and -D accelerograph consist of recorded accelerations, fixed traces and timing marks. The fixed traces are recorded by light beams reflected from fixed mirrors attached to the oscillograph frame. They are parallel lines at intervals of 2 mm drawn in the whole breadth of the recording paper. The recorded accelerations and one of the fixed traces located in the center of the oscillogram are digitized. The record to be digitized is divided into some sections because of the limitation of the digitizer table. Length of each section is about 70 cm, which corresponds to about 35 seconds on a record by the ERS-B accelerograph and about 17.5 seconds on a record by the ERS-C and -D accelerograph.

Procedure of setting of a record by the ERS-B, -C and -D accelerograph and the initialization of transverse (vertical) coordinate is similar to that for a record by the SMAC-B2 accelerograph. The record is digitized by an operator in the way described in the preceding section. The accelerations are digitized at intervals of 0.1 mm, which corresponds to 0.005 second on a record by the ERS-B accelerograph and about 0.0025 second on a record by the ERS-C and D accelerograph. The fixed trace is digitized at intervals of about 5 cm, which corresponds to 2.5 seconds on a record by the ERS-B accelerograph and 1.25 seconds on a record by the ERS-C and -D accelerograph. Then the digitized data of the fixed trace are obtained by linear interpolation at intervals of 0.1 mm. The digital unit in the amplitude is 0.1 mm, which corresponds to about 0.1 Gal (=cm/sec^2) on a record by the ERS-B accelerograph and about 0.2 Gal or about 1.0 Gal on a record by the ERS-C and -D accelerograph. In the case of the ERS-C and -D accelerographs, sensitivities of the galvanometers are calibrated for each recording with a calibration signal before resetting paper drive.

Timing marks of the records by the ERS-C and -D accelerograph, which are pulses at intervals of 0.1 second generated by a crystal timer, are used only to measure the average recording speed because fluctuation of the timing marks is expected as small as that of the digital unit of the digitizer (0.1 mm) according to the results of the tests of the ERS-C and -D accelerographs[51]. In the case of a record by the ERS-B accelerograph, timing marks are not used because accuracy of the timer depends on that of the frequency of the power supply which consists of batteries and a DC-AC inverter.

5. Standard Data Processing

The procedure for the standard data processing, which is shown in **Figure 23** and described here, has been applied for records obtained since 1976, although the correction for start up of recording paper drive of the SMAC-B2 accelerograph was slightly modified for the improvement of the accelerograph[51]. The acceleration processed through the standard data processing will be called '**Original Acceleration**' hereafter.

Standard data processing for a record by the SMAC-B2 accelerograph is performed under following procedures;

(1) Fixed Trace Subtraction
(2) Sectional Base-line Location

(3) Linearization of Coordinate
(4) Correction for Start up of Recording Paper Drive
(6) Equal Spacing

Standard data processing for a record by the ERS-B, -C and -D accelerograph is performed under following procedures;

(1) Fixed Trace Subtraction
(2) Sectional Base-line Location
(5) Smoothing
(6) Equal Spacing

Standard data processing for the records by the ERS-F and -G accelerograph are described in item (7). Each correction procedure is described briefly as follows.

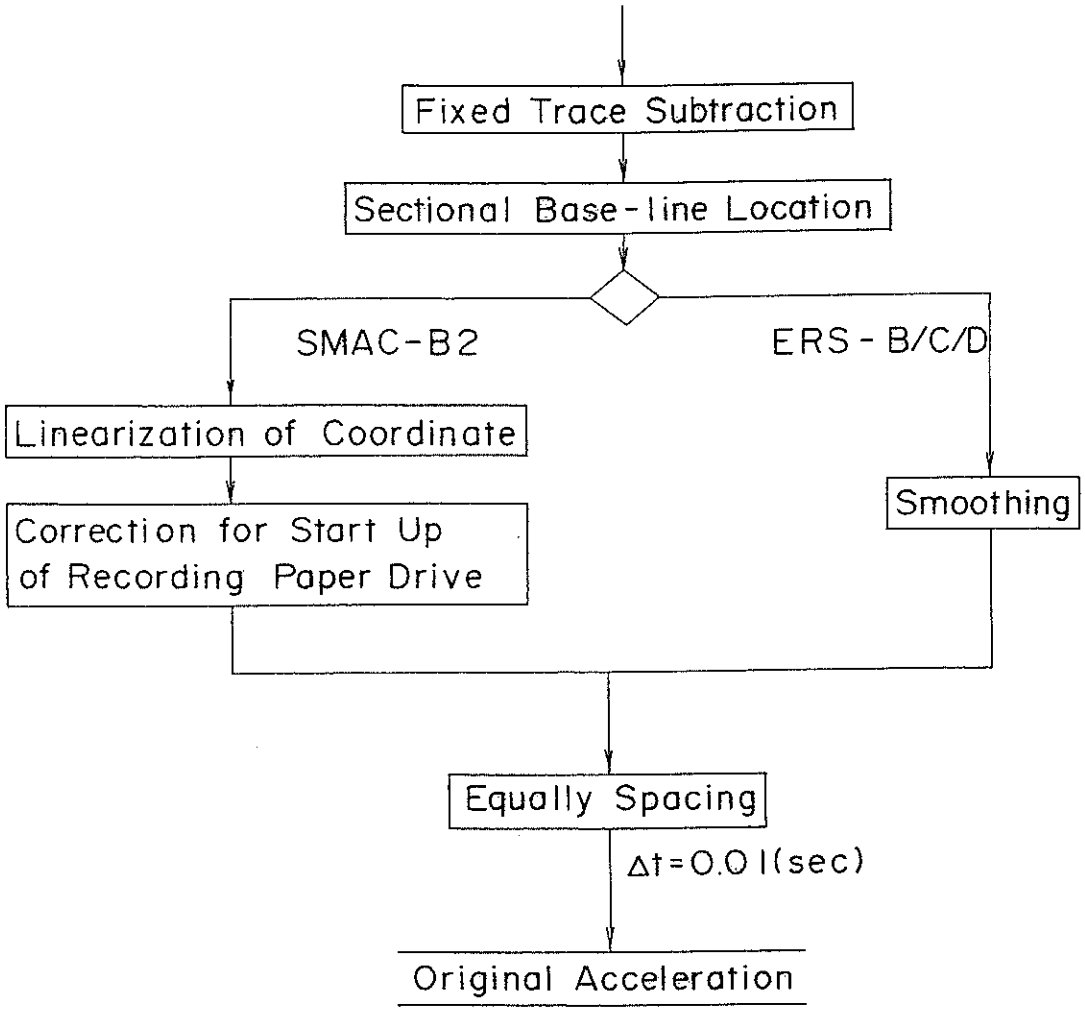


Figure 23 Procedure of standard data processing

(1) Fixed Trace Subtraction

This correction is applied in order to eliminate the following errors.

i) errors caused by the transverse motion of recording paper in the drive mechanism of the accelerograph
ii) systematic errors caused by an imperfect transverse moving mechanism of the digitizer cross-hair system
iii) errors of sectional rotation of the record on the digitizer table at the setting

The systematic errors of the digitizer cross-hair system were found to be negligible according to the tests with a straight line made of a stretched steel wire and a stretched gut.

Digitized fixed traces are smoothed by a weighted running average scheme before subtracted from the accelerogram. The weight function is defined as follows;

$$\omega(t) = \begin{cases} \sqrt{\alpha/\pi}\ exp\left(-\alpha\ t^2\right) & if\ |t| \le t_0 \\ 0 & otherwise \end{cases} \qquad \text{(1)}$$

where $\alpha = (\pi/2)^2$ and $t_0 = \sqrt{\alpha/5} = 0.7\ (s)$

At both ends of a section for digitization, α and t_0 in Eq.(1) are redefined by $\alpha = 5/S^2$ and $t_0 = S$, where S(s) is the distance from the end of a section. This weighted running average corresponds to low pass filter of the cut off frequency of about 0.5 Hz. The smoothed fixed traces are subtracted from the accelerogram. In the case of a record by the SMAC-B2 accelerographs, subtraction is made as follows;

- An upper trace is corrected by an upper fixed trace,
- A lower trace is corrected by a lower fixed trace and
- A center trace is corrected by an average of an upper and a lower fixed traces.

In the case of records by the ERS-B, -C and D accelerograph, one fixed trace is subtracted from all the components of an accelerogram.

(2) Sectional Base-line Location

As described previously, base-line is arbitrarily inserted for each section by the initialization of transverse coordinate. Sectional translation brings mainly low frequency errors into the accelerogram and produces an natural response of a low cut filter for integration around a point of junction of digitized sections. Base-line is located so as to make an ideal average of acceleration over almost infinite length zero. On the sectional base-line location, the authors assume that low frequency components up to about 1/T, where T is the minimum length of sections, are almost none if calculation of spectrum is done over the infinite length for the accelerogram which have been corrected by the fixed trace subtraction and which have an ideal true base-line for each section. Based on the detailed study of the base-line location in the frequency space, the base-line is located sectionally so as to make a weighted average of each sectional acceleration zero. The weight function is defined by

$$u(t) = \Delta t \sqrt{\beta/\pi}\ exp\left(-\beta t^2\right) \qquad \text{(2)}$$

where Δt is time interval, $\beta = 20/T^2$ and $T(s)$ is length of each section

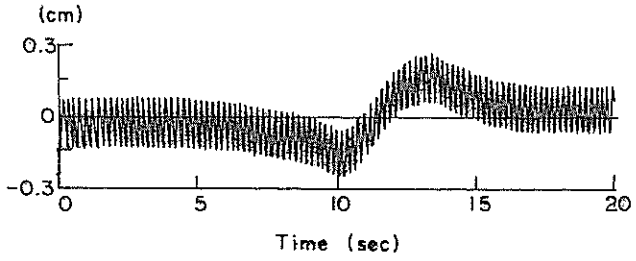


Figure 24 Integrated displacement from the acceleration record with sectionally located base-lines by a least square fit scheme

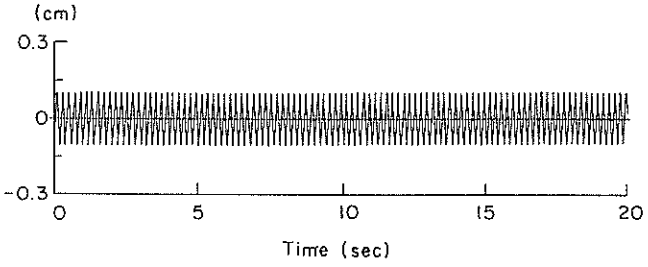


Figure 25 Integrated displacement from the acceleration record with sectionally located base-lines by proposed method

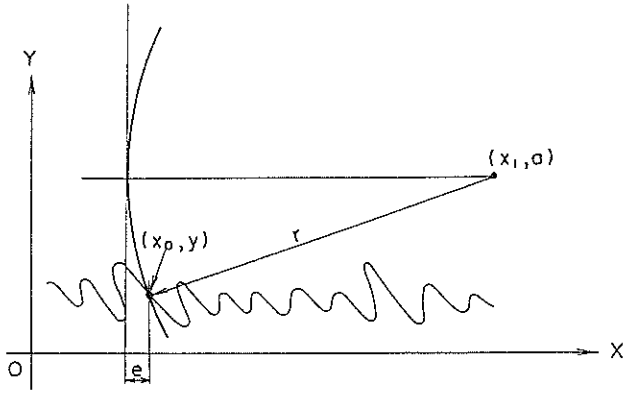


Figure 26 Linearization of coordinate

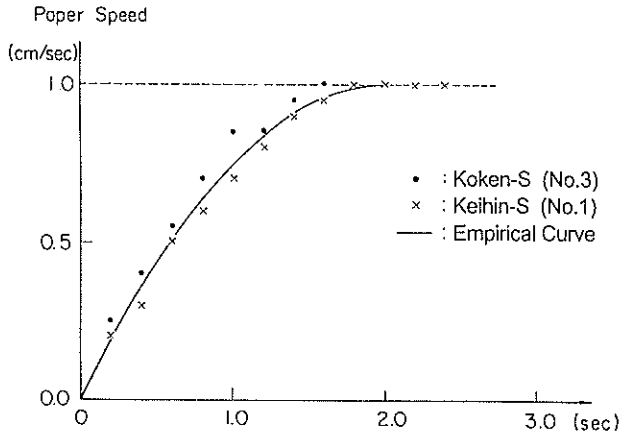


Figure 27 Variable recording speed on start up of recording paper drive

The expected error of the location is almost proportional to the quantities of low frequency components up to about 1/T(Hz). Because the authors do not have enough space to describe the detailed study, the authors introduce an example calculation to illustrate the difference between the proposed base-line location and the base-line location of least square fit scheme for each section. A sine wave generated by a computer of 100 Gal, 5 Hz and 5000 data with time intervals of 0.01 second is divided into two sections; one section is the first 2510 data and the other is the last 2490 data, which are looked upon as a sectionally digitized accelerogram. Sectional base-lines are located by the two method. Displacements are calculated from the two accelerations by the fixed filter method described later and a portion of the results including the junction of two sections are shown in **Figure 24** and **Figure 25**, respectively. The time of 10.1 seconds is the junction in these figures. These figures indicate that the proposed base-line location is much better in this case because true displacement is a sine wave.

(3) Linearization of Coordinate

This correction is applied to a record by the SMAC-B2 accelerograph to obtain a corrected longitudinal (X) coordinate of each datum. Transverse (Y) coordinate of the pivot of the recording pen is calculated from the digitized arc trace as shown in **Figure 26.** Let **r(mm)** denotes the radius of the arc which is the length of the arm of the recording pen, **y(mm)** denotes Y coordinate of a point whose X coordinate is to be corrected, **a(mm)** denotes Y coordinate of the

center of the arc which is the pivot of the pen and e denotes error of X coordinate of the point to be corrected, then we have the following equation.

$$e = r - \sqrt{r^2 - (y-a)^2} \qquad (3)$$

Although the arc trace is digitized with arbitrarily determined base-line, the linearization of coordinate is uniformly performed because (y-a) in the equation remains constant for any base-line. **a(mm)** in the equation will be set to zero if arc traces are accidentally not drawn or length of the arc trace is short which means the case the maximum difference of **X** coordinates of the arc trace is less than 0.5 mm.

(4) Correction for start up of recording paper drive

The variation of recording paper speed of the SMAC-B2 accelerograph is represented by the following equation which is based on the tests conducted at the Laboratory shown in **Figure 27.**

$$v = \begin{cases} \left[1 - 1/b^2 (t - t_0)^2\right] v_a & \text{if } 0 \le t \le t_0 \\ v_a & \text{if } t_0 < t \end{cases} \qquad (4)$$

where v : paper speed at time t (cm/s)
v_a : paper speed after reaching constant speed (cm/s)
t : time after triggering (s)
t_0 : constant (s)
b : constant (s)

If t_0 and **b** are given, the correction for the start up of recording paper drive is simple problem. For the correction of the digitized records in the preceding annual report, t_0=**2.0(s)** and b =**2.0(s)** were used. After the annual report had been published, it was found that more appropriate correction would be possible with a slight modification of t_0 value. For the correction of the most of the digitized records in this report, t_0 =**1.9(s)** is used.

(5) Smoothing

Smoothing is applied to a record by the ERS-B, -C and -D accelerograph. A record by the ERS-B, -C and -D accelerograph is digitized at intervals of 0.1 mm which correspond to about 0.005 second on a record by the ERS-B accelerograph and corresponds to about 0.0025 second on a record by the ERS-C and -D accelerograph. Frequency components higher than about 50 Hz are eliminated because there are almost no significant components of seismic acceleration over 50 Hz for the most of the record obtained by the ERS-B, -C and -D accelerograph so far.

The weight function is defined by

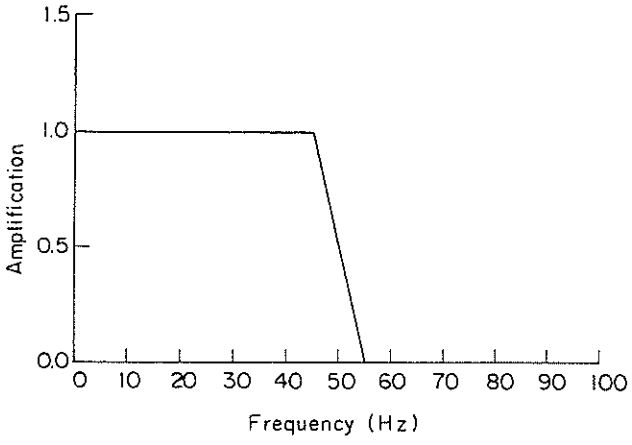


Figure 28 Filter for the smoothing

$$g(t)=\begin{cases} f_0+f_1 & if\ t=0 \\ \dfrac{2}{f_1-f_0}\dfrac{\cos(2\pi f_0 t)-\cos(2\pi f_1 t)}{(2\pi t)^2} & if\ 0<|t|\le 1.0 \\ 0 & otherwise \end{cases} \quad \text{..... (5)}$$

where $f_0=45\,(Hz)$ and $f_1=55\,(Hz)$

The filter corresponding to this weighted running average , which is shown in **Figure 28**, is approximately expressed as follows. Errors of the approximation are less than 0.3 %.

$$G(f)=\begin{cases} 1 & if\ |f|\le f_0 \\ \dfrac{f_1-|f|}{f_1-f_0} & if\ f_0\le|f|\le f_1 \\ 0 & if\ f_1<|f| \end{cases} \quad \text{..... (6)}$$

where $f_0=45(Hz)$ and $f_1=55(Hz)$

(6) Equal Spacing

Data are equally spaced at intervals of 0.01 second by means of linear interpolation. A record by the SMAC-B2 accelerograph is digitized at intervals of 0.1 mm and is processed through the linearization of coordinate. The data processed through the linearization of coordinate are unequally spaced data, whose interval of data are longer than 0.01 second on portions of accelerogram where absolute value of acceleration decreases and intervals of data are shorter than 0.01 second elsewhere.

A record by the ERS-B, -C and -D accelerograph is digitized at intervals of 0.1 mm, which corresponds to about 0.005 second on a record by the ERS-B accelerograph and about 0.0025 second on a record by the ERS-C and -D accelerograph. There is no possibility of aliasing by the equal spacing at the interval of 0.01 seconds because their high frequency components over 50 Hz are eliminated by the smoothing. High density of sampling at digitization enables us to separate high frequency components which are possibly contaminated by digitization errors and assures us much accuracy of the interpolation.

(7) Processing for the Records by the ERS-F and -G Accelerograph

Standard data processing and preliminary analyses described later for the records by the ERS-F and -G accelerograph are almost the same as those by ERS-B, -C and -D accelerograph. The differences are as follows;

- Overall base-line correction is applied for the data at the standard data processing.
- No smoothing is applied for the data at the standard data processing.
- As an instrument correction at the preliminary analyses, correction for the phase is applied but no correction is applied for the amplitude at the preliminary analyses.
- Low pass filter with cut-off frequency of 25 Hz and roll-off frequency of 40 Hz are applied by using a digital filter of cosine shape in frequency domain at the preliminary analyses.
- As the high pass filtering at the preliminary analyses, parameter E for the Variable Filter in Eq.(19), which is to be described later, is determined by the following equation;

$$E=(p\cdot 0.001)\cdot 0.02236 \qquad (7)$$

in which p *(=1000 Gal/2 [16])* is the sensitivity of the ERS-F and -G accelerograph.

The factors in Eq.(7) was obtained by the study on the noise level obtained by the power spectra of the noise under the conditions with connectors of signal conditioner in short circuit.

6. Preliminary Analyses

The Standard procedures of the preliminary analyses described here have been applied for records obtained since 1976[51),52)]. The standard procedures of preliminary analyses consist of filtering for instrument correction, filtering for correction of low or high frequency components, integration, calculation of response spectra and Fourier spectra. The flow of the preliminary analyses is shown in **Figure 29.**

(1) Methods of Correction and Integration

Instrument correction, filtering, integration are applied in frequency domain. FFT is applied for the accelerogram which is extended with a section of zero outside the digitized portion in order to avoid link effect. The length of section of zero **L (s)** is determined so as to meet the following condition.

$$L>max\left[2/3T,10.0\right] \qquad (8)$$

where T *(s)* is the minimum length of sections made by the division of an accelerogram for the digitization. This condition is based on the examination of impulse responses of the high pass filters for integration to be described later. Length of the section of zero L is decided so as to make calculation time of FFT short as much as possible in the given memory size of the computer.

(2) Filters for Instrument Correction and Supplementary Filter

(a) Filters for a record by the SMAC-B2 accelerograph

The filter for instrument correction $A_s(f)$ is defined by the inverse of the frequency characteristics of the transducer of the SMAC-B2 accelerograph as follows.

$$A_s(f)=1-\left(\frac{f}{f_s}\right)^2+2h_s\left(\frac{f}{f_s}\right)i \qquad (9)$$

where $f_s=1/0.14=7.1(Hz)$ and $h_s=1.0$

The supplementary filter $B_s(f)$ is defind by

$$B_s(f)=\begin{cases}\left[1+\left(|A_s(f)|-1\right)exp\left\{-\dfrac{\left(|f|-f_o\right)^2}{20}\right\}\right]\dfrac{1}{|A_s(f)|} & otherwise\\ 1 & if\ |f|\le f_o\end{cases} \qquad (10)$$

where $f_o=10(Hz)$

The supplementary filter is designed to suppress high frequency digitization noise and at the same time preserve high frequency components of an accelerogram in order to lessen an abnormal response of the filter to discontinuities at both ends of digitized portion of the accelerogram. The filter for instrument correction $A_S(f)$ and the supplementary filter $B_S(f)$ are shown in **Figure 30** and **Figure 31**, respectively. Combined filter by $A_S(f)$ and $B_S(f)$, which is shown in **Figure 32**, is applied for overall instrument correction for records by the SMAC-B2 accelerograph.

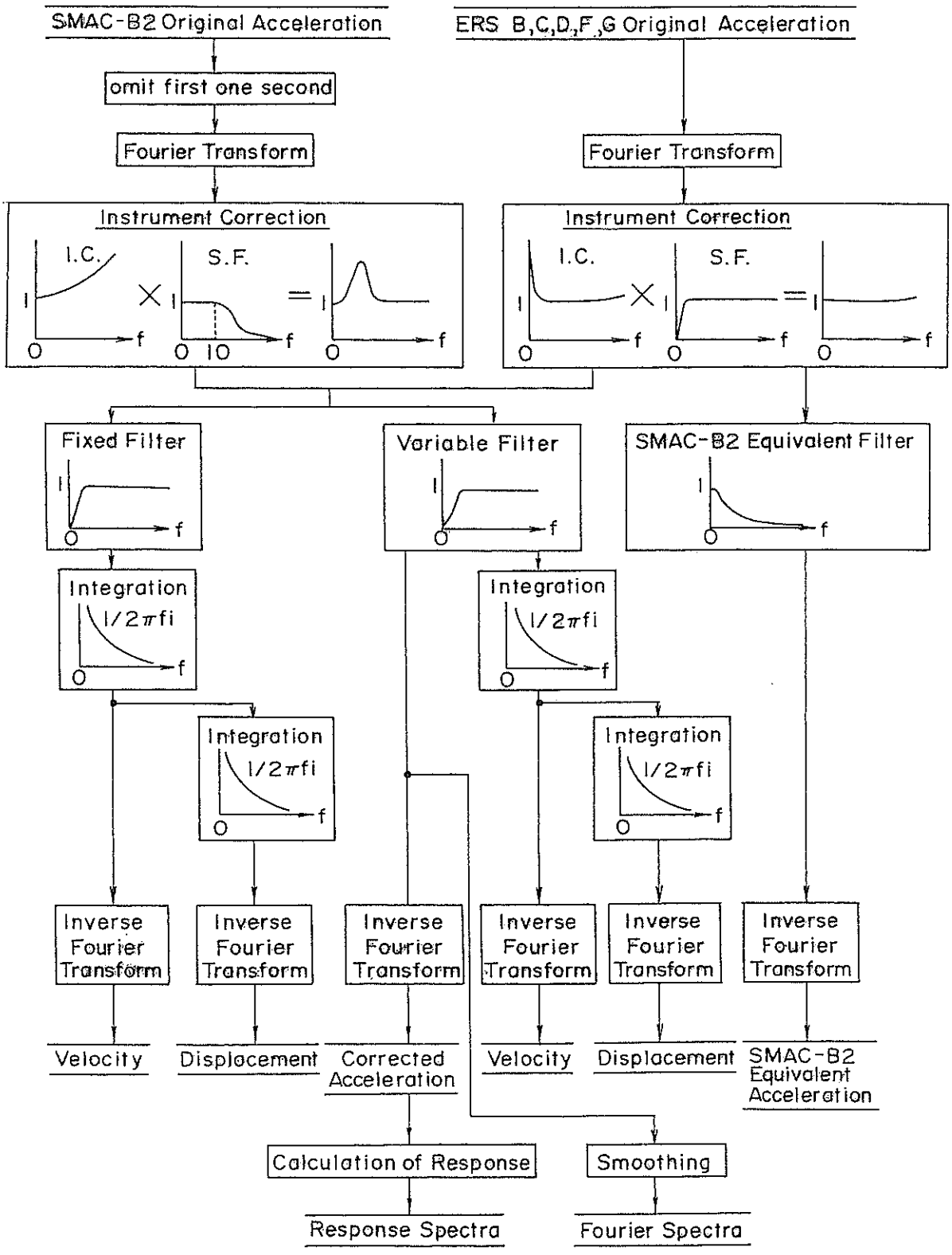


Figure 29 Procedure of preliminary analyses

(b) Filters for a record by the ERS-B, -C and -D accelerograph

The filter for the instrument correction $A_E(f)$ is defined by following equations;

$$A_E(f) = A_P(f) \cdot A_G(f) \quad \text{..... (11)}$$

$$A_P(f) = 1 + \frac{i}{2h_P}\left(\frac{f}{f_P} - \frac{f_P}{f}\right) \quad \text{..... (12)}$$

$$A_G(f) = 1 - \left(\frac{f}{f_G}\right)^2 + 2h_G\left(\frac{f}{f_G}\right)i \quad \text{..... (13)}$$

where for a record by the ERS – B accelerograph

$f_P = 2.0(Hz), h_P = 17, f_G = 100(Hz)$ and $h_G = 0.7$

for a record by **The** ERS – C accelerograph

$f_P = 3.0(Hz), h_P = 17, f_G = 250(Hz)$ and $h_G = 0.7$

for a record by **The** ERS – D accelerograph

$f_P = 5.0(Hz), h_P = 10, f_G = 100(Hz)$ and $h_G = 0.7$

In the above equations, $1/A_P(f)$ means frequency characteristics of the pick up of the accelerograph and $1/A_G(f)$ means those of the galvanometer. Filters for instrument correction $A_E(f)$ are shown in **Figure 33** for 3 types of accelerograph.

The supplementary filter $B_E(f)$ is defined by

$$B_E(f) = \begin{cases} 1/|A_P(f)| & if\ |f| \le f_P \\ 1 & otherwise \end{cases} \quad \text{..... (14)}$$

where $A_P(f)$: Filter for the instrument correction of the pick up

f_P : Characteristic frequency of the pick up of each accelerograph

The supplementary filter is designed to suppress low frequency digitization errors. The supplementary filters $B_E(f)$ are shown in **Figure 34.** For overall instrument correction of records obtained by ERS-B, -C and -D accelerograph, combined filters by $A_E(f)$ and $B_E(f)$, which is shown in **Figure 35**, are applied.

(c) Filters for a record by the ERS-F and -G accelerograph

As mentioned earlier, correction for the frequency characteristics of phase, shown in **Figure 14 (b)**, is only applied for the data as a instrument correction and no correction is applied for the amplitude. As for the amplitude, however, components in high frequency range is cut off by the following equations because there is no significant information found in high frequency range so far.

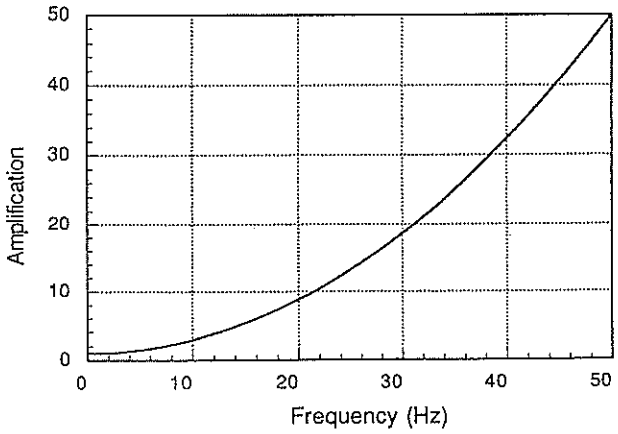


Figure 30 The filter for instrument correction for records by the SMAC-B2 accelerograph

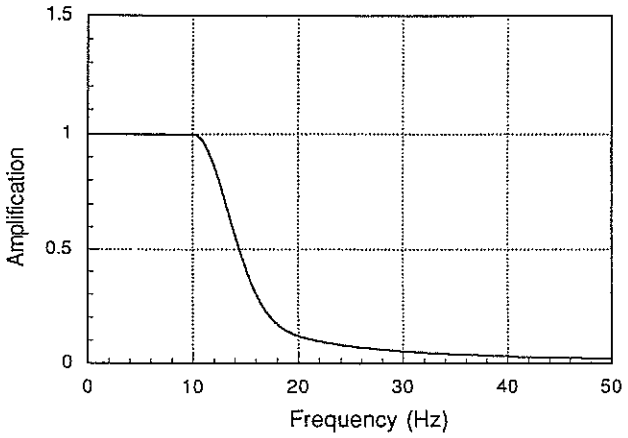


Figure 31 The supplementary filter for records by the SMAC-B2 accelerograph

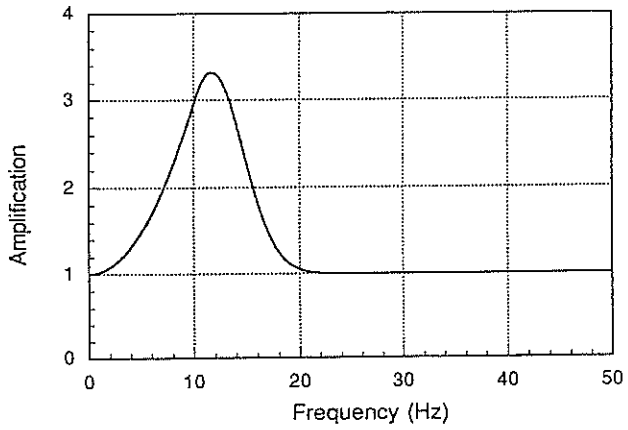


Figure 32 The combined filter for records by the SMAC-B2 accelerograph

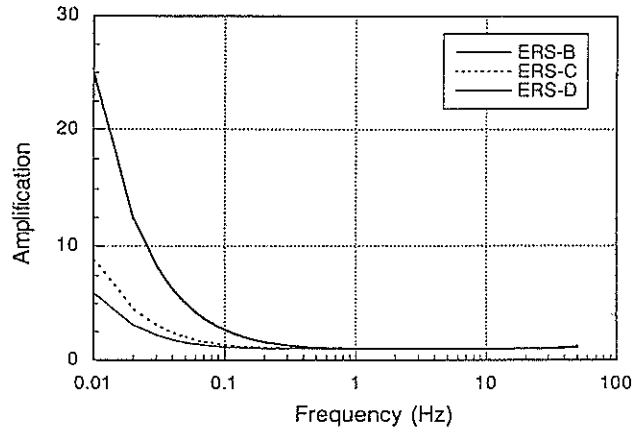


Figure 33 The filter for instrument correction for records by the ERS-B, -C and -D accelerograph

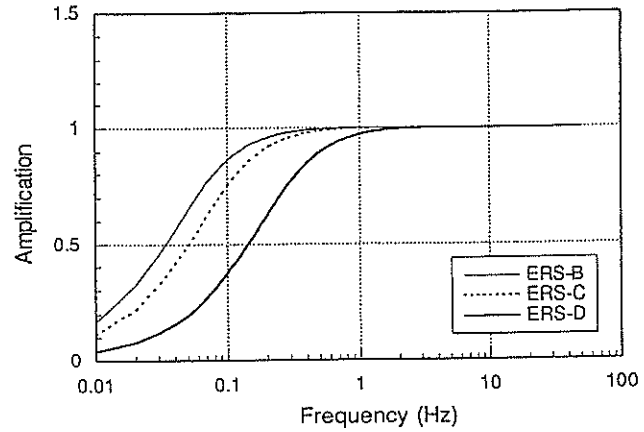


Figure 34 The supplementary filter for records by the ERS-B, -C and -D accelerograph

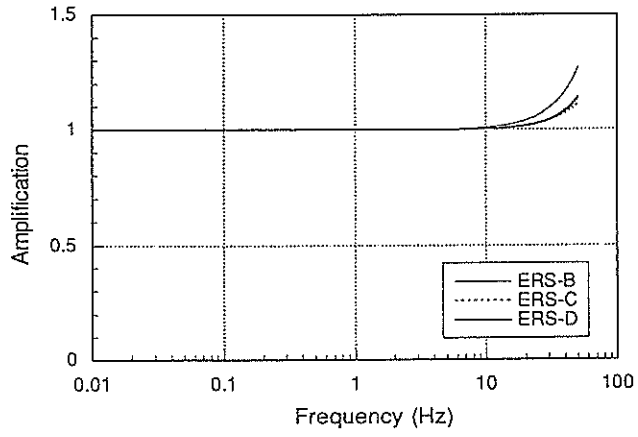


Figure 35 The combined filter for records by the ERS-B, -C and -D accelerograph

$$A_f(f)=\begin{cases}1 & if\ |f|\le f_1\\ \frac{1}{2}\left[\cos\left(p\frac{f-f_1}{f_2-f_1}\right)+1\right] & if\ f_1<|f|\le f_2\\ 0 & if\ |f|>f_2\end{cases} \qquad \text{(15)}$$

where $f_1 = 25(Hz)$ and $f_2 = 40(Hz)$

(3) SMAC-B2 Equivalent Filter

Frequency characteristics of SMAC-B2 accelerograph are different from those of ERS type accelerograph. In order to make it easy to compare the accelerograms by these different types of accelerographs, a filter defined in the following equation is applied for records by the ERS type accelerograph.

$$S(f)=\frac{1}{1-\left(\frac{f}{f_s}\right)^2+2h_s\left(\frac{f}{f_s}\right)i} \qquad \text{(16)}$$

where $f_s = 1/0.14 = 7.1(Hz)$ and $h_s = 1.0$

This filter is shown in **Figure 36** and has the same frequency characteristics as that of the SMAC-B2 accelerograph. The filter is applied for the acceleration records by the ERS type accelerograph processed through the filter for instrument correction and the supplementary filter. Acceleration processed through this filter will be called '**SMAC-B2 Equivalent Acceleration**' in this report. This acceleration can be compared with the '**Original Acceleration**' by the SMAC-B2 accelerograph. Although acceleration processed by this filter can not represent accurate acceleration and its maximum acceleration will be smaller than that of a record through instrument correction especially in high frequency range, all the accelerograms by this procedure can be directly compared with each other.

(4) High Pass Filters for Integration

Processed through the preliminary correction procedure, a digitized accelerogram is expected to have only such errors as random digitization errors and errors of sectional base-line location. Errors of sectional base-line location affect mainly to frequency components lower than about $1/T$, where T is the length of a section of an accelerogram divided for digitization.

As a result of the examination of random digitization errors, frequency characteristics of Signal-to-Noise (SN) ratio calculated for each frequency are found to be similar to those of digitized acceleration. In other words, ratio of digitized acceleration to digitization errors calculated for each frequency is large if the corresponding frequency components of the digitized acceleration is large. For the frequency components higher than about $1/T$, the result of the examination of digitization errors may remain valid. The result implies that SN ratio of a frequency component varies with the frequency characteristics of accelerogram to be digitized.

The cut-off frequency of a high pass filter for integration of a digitized accelerogram should be varied in accordance with frequency characteristics of an accelerogram from such a point of view that SN ratio should be kept higher than some constant level for every frequency component and at the same time the physically real signals should be preserved as much as possible. On the other hand, cut-off frequency of the filter should be kept constant for any accelerograms from such a point of view that the preserved real seismic signals should be filtered out by the same filter

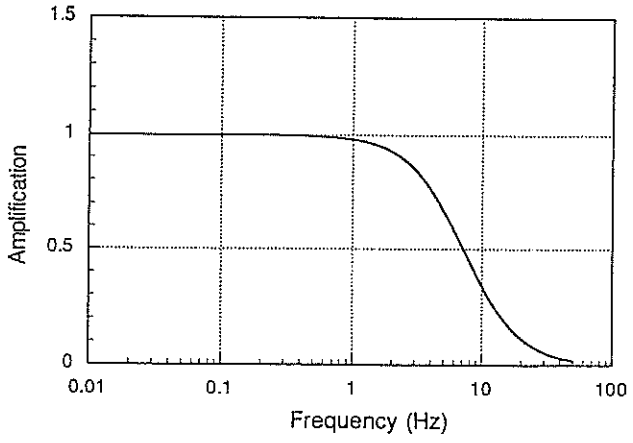


Figure 36 The SMAC-B2 equivalent filter

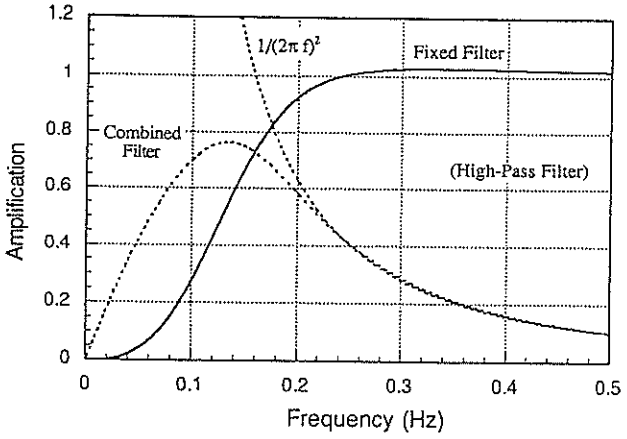


Figure 37 The fixed filter and the combined filter for double integral

for the purpose of comparison between two or more velocities or displacements even if integrated errors are more or less included in them.

In order to satisfy a wide range of applications of the strong-motion records from the various view points, the authors proposed two methods of correction of an accelerogram to obtain integrated velocities and displacements. One is a method with a fixed filter and the other is a method with a variable filter.

(a) Fixed filter

This filter is defined by the following equation.

$$H_1(f) = \frac{1}{1-\left(\frac{f_0}{f}\right)^2 - 2h\left(\frac{f_0}{f}\right)i} \cdot \frac{1}{\sqrt{1+\left(\frac{f_1}{f}\right)^2}} \qquad (17)$$

where $f_0 = 1/6(Hz), h = 0.552$ and $f_1 = 0.1(Hz)$

This filter is designed to make it easy to compare the integrated displacement with records obtained by the one magnification strong-motion seismometer (T=6 seconds and h=0.552) deployed by the Japan Meteorological Agency (JMA). Cut-off frequency (3 dB down) of this filter is 0.154 Hz. This filter is shown in **Figure 37.**

(b) Variable filter

This filter is defined by the following equation;

$$H_2(f) = \left[1 - exp\left\{-\left(\frac{f}{f_c}\right)^2\right\}\right]^2 \qquad (18)$$

The parameter f_C in the equation varies so as to make σ equal to E, where σ is defined by

$$\sigma^2 = \frac{1}{M}\int_{-\infty}^{\infty} |x(f)|^2 \cdot \left[1 - exp\left\{-(fT)^2\right\}\right]^4 \cdot [1 - H_2(f)]^2 \, df \qquad (19)$$

Where M is the length of whole-digitized portion,

T is the minimum length of a section of accelerogram,

$X(f)$ is Fourier Transform of the original acceleration and

E is the value listed below;

For a record by the SMAC-B2 accelerograph

$$E = 0.5 \text{ (Gal)}$$

For a record by the ERS-B, -C and -D accelerograph

$$E = 0.05p \text{ (Gal)}$$

Where p (Gal/mm) is the sensitivity of the ERS-B, -C and -D accelerograph

For a record by the ERS-F and -G accelerograph

$$E = (p \cdot 0.001) \cdot 0.02236 \text{ (Gal)}$$

where p (1000 Gal/2^{16}) is the sensitivity of the ERS-F and -G accelerograph

Cut-off frequency (3 dB down) of this filter is $1.36f_C$. This filter is shown in **Figure 38** and **Figure 39**.

Decision procedure of f_C is illustrated in **Figure 40**. f_C is fundamentally determined so as to filter out some constant amount of low frequency components of an accelerogram higher than about $1/T$. The greater low frequency components of an accelerogram are, the lower f_C should be. Because the greater low frequency components of an accelerogram are, the higher SN ratio of these components are. Low frequency components lower than about **1/T** are eliminated for the decision procedure of f_C because they are possible to be contaminated by the errors at sectional base-line location and the relation between the SN ratio and the quantity of a frequency component of an accelerogram is afraid no longer remaining valid.

This decision procedure of f_C is, however, a compromise between such a view point as to keep SN ratio over some constant level for every frequency component and keep f_C to be a constant. The reason why such a compromised method is proposed is that the compromise makes decision procedure of f_C more stable against possible fluctuation of the relation between quantity of a frequency component of an accelerogram and the SN ratio. The relation may, to some extent, depend on frequency characteristics of an accelerogram to be digitized, digitized length of an accelerogram, non-stationarity of an accelerogram, etc. and the relation itself is valid only in a stochastic sense.

The reason why a fixed low pass supplementary filter is proposed instead of a variable one for a record by the SMAC-B2 accelerograph is that the possible fluctuation of the relation is expected to be greater for high frequency components. Slope of both of the high pass filters proposed here are designed to be mild in order to lessen an artificial predominant frequency component around the cut-off frequency.

(5) Outputs of Preliminary Analyses

(a) Acceleration, Velocity and Displacement

A portion of first one second of the original acceleration of the SMAC-B2 accelerograph is omitted for the instrument correction and the integration because even a slight difference of start up of recording paper drive between SMAC-B2 accelerographs and even a small difference of selection of starting point of digitization may sensitively affect accuracy of the portion of first short section processed through the correction of start up of the recording paper drive. In the case of the original acceleration of the ERS type accelerograph, no data is omitted. These accelerations are processed by the methods of correction and integration described previously. The calculated results are shown in figures and tables as results of preliminary analyses shown in the later part of this report.

In this report, '**Corrected Acceleration**' denotes acceleration with instrument correction processed through the

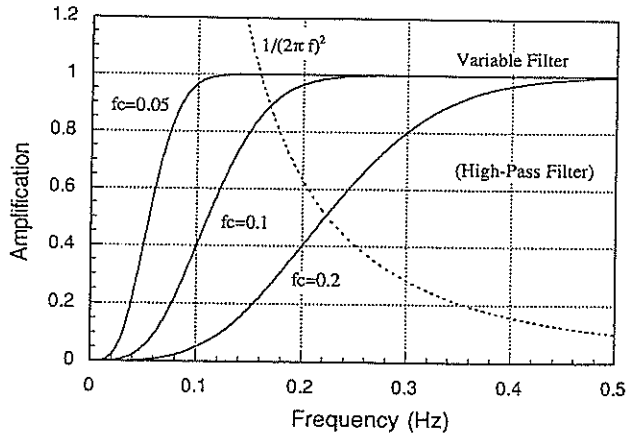


Figure 38 The variable filter and double integral

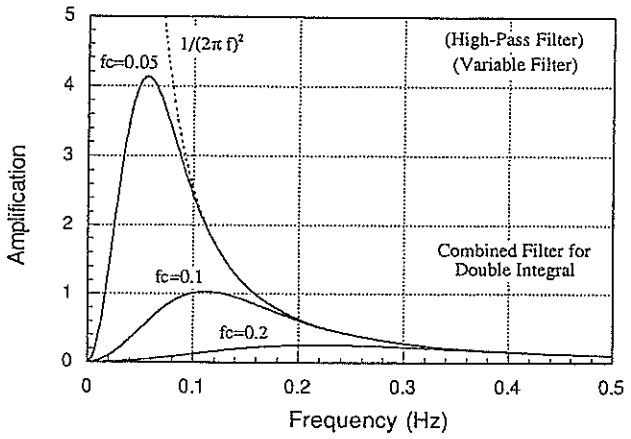
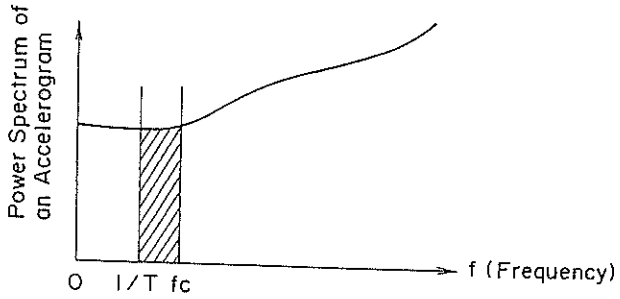


Figure 39 The combined filter of the variable filter for double integral



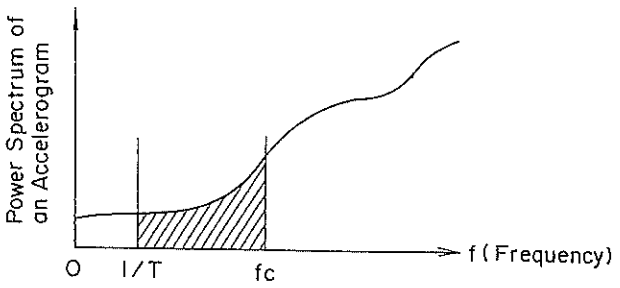


Figure 40 Simplified illustration of decision procedure of fc

variable filter and '**SMAC-B2 Equivalent Acceleration**' denotes acceleration obtained by the SMAC-B2 equivalent filter as shown in **Figure 29.** Integrated velocities and displacements are calculated with both the fixed filter and the variable filter. The parameter f_C for cut-off frequency of the variable filter is shown in the tables on the results of preliminary analyses.

The corrected acceleration of the different types of accelerographs can not necessarily be compared with each other because the difference of the supplementary filters produces difference mainly on the high frequency components over 10 Hz of the filtered accelerations. Instead of comparison of the corrected accelerations, SMAC-B2 equivalent acceleration can be freely compared with the original acceleration of the SMAC-B2 accelerograph except for the low frequency components lower than about 0.1 Hz.

(b) Response Spectra

Response spectra are calculated from the corrected acceleration, which is an acceleration with instrument correction processed through the variable filter as described previously. The response spectra in the previous annual reports before 1968 were calculated from the digitized records by a digital computer using Runge-Kuta-Gill method to integrate numerically the equation of motion of the oscillator. The response spectra in the present report are calculated with a step by step calculation of the exact solution to the governing differential equation[53]. No significant difference was seen in the results calculated by the both methods, according to the trial calculations.

The time interval of each step of the calculation is 0.01 second for the oscillators of natural periods longer than

0.2 second. For the oscillators of shorter periods, the small time intervals are selected to that one cycle of the undamped free oscillation of the oscillator is covered at least by 20 steps of the numerical calculation to maintain the necessary accuracy. In these calculation, the digitized records at smaller time intervals are made by means of the interpolation in the computer.

To calculate response spectra, entire length of the record is not necessary and the last part of the record after the maximum response have appeared is in effect meaningless in the calculation. Besides, the shorter record is more preferable from view point of the calculation time. On some long records, their beginning parts of small acceleration are not used in the calculation so far as it is thought that the neglected parts do not affect the results of the calculation. In this report, the whole record length is adopted as length of calculating response spectra for the records less than 60 seconds. For the records of which time duration is more than 60 seconds, the length of 60 seconds which includes portions of main strong-motion is adopted as length of calculation. Acceleration ratio, absolute acceleration response, relative velocity response and relative displacement response are presented in this report as results of response spectra of 0%, 1% and 5% damping.

As response spectra of the period longer than about $1/f_c$ are influenced by the high pass filter ($1.36/f_c$ is the period of 3 dB down of the filter); i.e., calculated response spectra is true if real seismic signals do not exist in the period longer than about $1/f_c$ and calculated response spectra are smaller than the true value if real seismic signals do exist. In the case of the corrected acceleration by the SMAC-B2 accelerograph, response spectra of the period shorter than about 0.1 sec is also influenced by the low pass filter. Users of the response spectra should be careful about these characteristics of the response spectra calculated for the corrected acceleration and difference between the response spectra for the corrected acceleration and those for the uncorrected acceleration which had been calculated so far.

(c) Fourier Spectrum

The Fourier spectra are calculated by the FFT from the corrected acceleration. The time length for calculation is identical with the time length for calculating response spectra. The spectra in this report, however, are multiplied by the length of the record for calculation and then smoothed with the Parzen window of 1 Hz band width.

(d) Loci

The loci of accelerations, velocities and displacements in horizontal plane are included in this report. The records used for plotting loci are corrected accelerations, integrated velocities and displacements processed through the variable filter.

7. Summary of Observation

Strong-motion earthquakes and earthquake responses of structures have been observed in the major ports in Japan since 1962. 5503 accelerograms have been obtained by the end of 1998 in the network of the Port and Harbour Research Institute. As of December 1998, 94 strong-motion accelerographs have been installed in 60 ports in Japan. 65 accelerographs out of 94 are installed at ground surface, 22 accelerographs are in ground by using bore-hole and the rest 6 are on structures such as quay walls.

This report presents all the records obtained in 1998. The records obtained in 1998 are listed in the tables of Strong-Motion Earthquake Observation Results with their maximum accelerations, being classified in accordance with earthquakes. For the records of ground motions with maximum accelerations exceeding 20 Gals (=cm/sec^2), computer plots of reproduced acceleration are presented. For the records of ground motions with maximum accelerations exceeding 50 Gals, computer plots of reproduced accelerograms, integrated velocities and displacements, response spectra, Fourier spectra and loci of accelerations, velocities and displacements in horizontal plane are presented.

In **Table 8**, a statistical summary (total number of records) of the strong-motion observation in the network is given at the end of 1998. In **Table 9**, record numbers of accelerograms of which digitized records and spectra have been published by the end of 1998 are shown. The number in the parentheses behind each record number shows the number of the Technical Note of the Port and Harbour Research Institute in which the record is presented.

(Received on June 30, 1999)

Table 8 Statistical Summary of Records

(December 1998)

Name of Station	Total Number of Records	Number of Records (20≦Max. Accel.<50Gals)	Number of Records (Max. Accel.≧50Gals)
ABASHIRI-G	0	0	0
AKITA-GB	4	1	0
AKITA-G	4	0	1
AKITA-S*	33	7	2
AMAGASAKI-G	25	9	2
AMAGASAKI-S*	9	2	0
AOMORI-G	7	3	1
AOMORI-S*	48	17	6
CHIBA-G	0	0	0
CHIBA-S*	99	19	4
HACHINOHE-GB	0	0	0
HACHINOHE-G	0	0	0
HACHINOHE-JI-S*	24	11	8
HACHINOHE-S*	111	16	5
HAKODATE-FB	17	3	1
HAKODATE-F	17	3	2
HAKODATE-FR	18	5	2
HAKODATE-G	0	0	0
HAKODATE-M*	50	17	6
HANASAKI-F	59	14	3
HANASAKI-M*	36	21	7
HIRARA-G	6	2	1
HIRARA-S*	5	1	0
HIROSHIMA-G	10	3	0
HIROSHIMA-S*	9	5	4
HIROSHIMA-JI-S*	5	0	0
HITACHINAKA-F	252	113	33
HOSOSHIMA-G	1	1	0
HOSOSHIMA-F*	12	1	0
HOSOSHIMA-S*	54	19	7
ISHIGAKI-G	7	1	0
ISHIGAKI-S*	5	1	0
INAE-S*	23	7	0
INAE-SANBASHI-M*	20	10	1
INAE-YAITA-M*	30	13	3
KAGOSHIMA-G	5	2	1
KAGOSHIMA-S*	26	4	0
KAMAISHI-M	46	20	1
KAMAISHI-MB	46	4	1
KANAZAWA-G	1	1	0
KANAZAWA-S*	9	3	1
KASHIMA-S*	32	9	3
KASHIMA-JI-S*	30	6	3
KASHIMA-ZOKAN-S	137	34	12
KAWASAKI-FB	52	5	3
KAWASAKI-F	52	10	4
KAWASAKI-FR	52	17	5
KAWASAKI-CHI-M*	187	22	2

(to be continued)

(**Table 8** Continued)

(December 1998)

Name of Station	Total Number of Records	Number of Records (20≦Max. Accel.＜50Gals)	Number of Records (Max. Accel.≧50Gals)
KAWASAKI-KO-M*	107	28	6
KEIHIN-JI-S*	133	19	2
KINUURA-JI-S	25	5	1
KINUURA-S*	8	4	2
KOBE-DAI6-S*	13	3	0
KOBE-DAI8-G*	1	0	1
KOBE-DAI8-S*	18	2	1
KOBE-JI-GB80	0	0	0
KOBE-JI-GB40	0	0	0
KOBE-JI-G	0	0	0
KOBE-JI-S	18	6	1
KOBE-MAYA-DAI1-M*	16	7	2
KOBE-MAYA-DAI2-M*	21	7	1
KOBE-MAYA-G	0	0	0
KOBE-MAYA-M*	22	4	1
KOCHI-G	3	1	0
KOCHI-S*	21	3	1
KOCHI-JI-S*	13	3	0
KOKEN-G	3	2	1
KOKEN-M*	60	5	0
KOKEN-S	34	6	2
KOMATSUJIMA-G	3	2	2
KOMATSUJIMA-S*	17	2	0
KUSHIRO-GB	24	3	2
KUSHIRO-G	24	10	4
KUSHIRO-S*	49	16	6
KUSHIRO-JI-S*	14	7	3
MATSUYAMA-G	12	6	0
MATSUYAMA-S*	25	4	2
MIKAWA-GB	4	0	0
MIKAWA-G	4	0	1
MINAMATA-M*	3	0	0
MIYAKO-G	31	14	7
MIYAKO-S*	49	28	12
MIYAZAKI-GB	9	2	1
MIYAZAKI-G	9	3	3
MIYAZAKI-M*	50	10	4
MONBETSU-G	0	0	0
MURORAN-G	42	11	5
MURORAN-S*	69	14	6
NAGOYA-INAE-G	2	1	1
NAGOYA-SORAMI-GB	2	2	0
NAGOYA-SORAMI-G	2	0	2
NAGOYA-ZOKAN-S*	26	5	2
NAHA-GB	15	0	0
NAHA-G	15	2	0
NAHA-S*	1	0	0
NAHA-ZOKAN-S*	2	1	0

(to be continued)

(**Table 8** Continued)

(December 1998)

Name of Station	Total Number of Records	Number of Records (20≦Max. Accel.＜50Gals)	Number of Records (Max. Accel.≧50Gals)
NAKAGUSUKU-G	2	0	0
NIIGATA-G	26	4	1
NIIGATA-S*	12	1	0
NIIGATA-JI-S*	5	1	0
OFUNATO-S*	21	3	2
OFUNATO-BOCHI-S	73	16	5
OFUNATO-BO-S	119	41	24
OFUNATO-MOUND-M	83	27	8
OITA-G	4	2	1
OITA-S*	13	7	4
OKITSU-S*	28	4	0
OKUSHIRI-G	0	0	0
OMAEZAKI-M	40	3	0
ONAHAMA-JI-GB	10	2	0
ONAHAMA-JI-G	10	6	4
ONAHAMA-JI-S*	37	25	8
ONAHAMA-S*	67	13	4
OSAKA-CHUO-S*	8	1	0
OSAKA-JI-G	4	2	1
OSAKA-JI-S*	12	1	1
OSAKA-MINAMI-G	4	2	0
OSAKA-MINAMI-S*	0	0	0
OTARU-G	8	2	1
OTARU-S*	13	0	0
ROKKO-GB80	0	0	0
ROKKO-GB40	0	0	0
ROKKO-G	0	0	0
RUMOI-G	0	0	0
SAKAIMINATO-G	6	3	0
SAKAIMINATO-S*	0	0	0
SAKAIMINATO-JI-S*	13	6	3
SAKATA-G	0	0	0
SAKATA-S*	61	6	0
SENDAI-M	98	22	5
SENDAI-MB	98	4	0
SETANA-G	0	0	0
SHIBUSHI-G	6	1	0
SHIBUSHI-S*	15	0	0
SHIMIZU-GB	1	0	0
SHIMIZU-G	1	0	0
SHIMIZU-KOJYO-S*	25	7	4
SHIMIZU-MIHO-S*	26	4	2
SHIMI.-SEKITAN-M*	23	11	5
SHIMI.-SEKITAN-S*	10	5	2
SHINAGAWA-GB	2	0	0
SHINAGAWA-G	3	1	2
SHINAGAWA-M*	1	1	1
SHINAGAWA-MB*	91	2	0

(to be continued)

(**Table 8** Continued)

(December 1998)

Name of Station	Total Number of Records	Number of Records (20≦Max. Accel.<50Gals)	Number of Records (Max. Accel.≧50Gals)
SHINAGAWA-S*	128	31	8
SHIOGAMA-KOJYO-S*	96	20	6
SHIOGAMA-S*	19	1	0
SHIMODA-F	13	1	0
SOMA-S	67	19	7
TAGONOURA-S	61	9	1
TOKACHI-G	5	4	0
TOKACHI-M*	111	61	23
TOMAKOMAI-G	5	1	0
TOMAKOMAI-S*	35	10	7
TOYAMA-GB	1	0	0
TOYAMA-G	1	0	0
TOYAMA-S*	8	3	2
TSURUGA-G	3	1	1
TSURUGA-S*	33	3	1
URAKAWA-G	1	1	0
URAKAWA-S*	160	20	7
WAKA.-GANPEKI-S*	7	2	0
WAKAYAMA-G	51	20	17
WAKAYAMA-S*	41	19	3
WAKAYAMA-JI-S*	12	5	4
WAKA.-SUMIKEN-S*	0	0	0
YAMASHITA-FB	91	2	0
YAMASHITA-F	91	18	5
YAMASHITA-FR	91	37	15
YAMASHI.-DAI7-M*	81	6	1
YAMASHI.-DAI6-S*	102	31	11
YAMASHITA-HEN-M*	199	19	6
YAMASHITA-HEN-S*	119	24	8
YOKKAICHI-GB	1	1	0
YOKKAICHI-G	1	0	1
YOKKA.-CHITOSE-S*	16	6	3
YOKKA.-DAI2-M*	20	4	2
YOKKA.-SEKITAN-M	55	12	5
YOKKAICHI-JI-S*	5	2	0
TOTAL	5503	1339	452
ERS	2842	704	229
SMAC	2661	635	223

* Strong-motion observation of the stations had already been stopped.

Table 9 Summary of Analyzed Record Numbers

(December 1998)

Name of Station	Record Numbers which had been digitized and analyzed (Ref. No.**)				
AKITA-GB	F-708(892)	F-904(892)	F-1226(936)		
AKITA-G	F-709(892)	F-905(892)	F-1227(936)		
AKITA-S*	S-655(160)	S-1567(458)	S-1585(458)	S-1586(458)	
AMAGASAKI-G	F-765(907)	F-803(907)	F-804(907)	F-805(907)	F-808(907)
	F-809(907)	F-810(907)	F-811(907)	F-812(907)	F-813(907)
	F-817(907)	F-818(907)	F-819(907)	F-820(907)	F-821(907)
	F-849(907)	F-850(907)	F-932(907)	F-933(907)	F-934(907)
AOMORI-G	F-680(853)	F-692(892)	F-713(892)		
AOMORI-S*	S-235(80)	S-264(80)	S-670(160)	S-1573(458)	S-1592(458)
	S-2488(777)	S-2523(778)	S-2530(778)		
CHIBA-S	S-1378(374)	S-1545(487)	S-1884(547)	S-2107(619)	
HACHINOHE-S*	S-252(80)	S-669(160)	S-857(202)	S-1202(319)	S-1453(426)
	S-1575(458)				
HACHINOHE-JI-S*	S-1968(618)	S-1984(618)	S-2261(676)	S-2486(777)	S-2582(853)
	S-2597(892)	S-2598(892)	S-2606(892)		
HAKODATE-FB	F-508(777)	F-541(778)	F-542(776)	F-544(778)	F-667(853)
	F-687(892)	F-888(892)			
HAKODATE-F	F-545(778)	F-546(776)	F-548(778)	F-603(778)	F-668(853)
	F-689(892)	F-891(892)			
HAKODATE-FR	F-509(777)	F-549(778)	F-550(776)	F-552(778)	F-604(778)
HAKODATE-M	M-357(374)	M-523(442)	M-630(458)	M-639(458)	M-1444(777)
	M-1472(778)	M-1473(776)	M-1476(778)	M-1520(853)	
HANASAKI-F	F-478(776)	F-510(777)	F-681(853)	F-773(853)	F-777(853)
	F-1188(936)	F-1201(936)	F-1299(936)		
HANASAKI-M*	M-106(287)	M-262(338)	M-496(426)	M-887(547)	M-1014(588)
	M-1017(588)	M-1296(676)			
HIRARA-G	F-1224(936)	F-1225(936)			
HIROSHIMA-G	F-790(907)	F-1181(936)			
HIROSHIMA-S*	S-364(98)	S-1306(338)	S-1623(487)		
HITACHINAKA-F	F-12(588)	F-15(588)	F-19(588)	F-34(618)	F-36(618)
	F-43(618)	F-46(618)	F-107(649)	F-174(649)	F-358(705)
	F-384(705)	F-423(727)	F-456(727)	F-483(776)	F-525(777)
	F-756(909)	F-885(909)	F-1063(909)	F-1230(936)	F-1231(936)
	F-1233(936)	F-1234(936)	F-1237(936)	F-1279(936)	
HOSOSHIMA-S*	S-213(98)	S-453(100)	S-544(116)	S-545(116)	S-1231(338)
	S-1625(487)	S-1729(503)	S-2022(618)		
INAE-YAITA-M*	M-1553(907)				
KAGOSHIMA-G	F-1123(936)	F-1184(936)			
KAMAISHI-M	M-1494(776)	M-1447(777)	M-1523(853)	M-1537(892)	

(to be continued)

(**Table 9** Continued)

(December 1998)

Name of Station	Record Numbers which had been digitized and analyzed (Ref. No.**)				
KAMAISHI-MB	M-1075(618)	M-1448(777)	M-1524(853)		
KANAZAWA-G	F-800(907)				
KANAZAWA-S*	S-2506(776)				
KASHIMA-S*	S-196(64)	S-612(136)	S-647(136)		
KASHIMA-JI-S*	S-770(181)	S-813(202)	S-845(202)	S-882(202)	
KASHIMA-ZOKAN-S	S-1206(319)	S-1506(446)	S-1678(519)	S-1867(547)	S-1910(588)
	S-1957(588)	S-2110(619)	S-2196(676)	S-2206(676)	S-2492(777)
	S-2639(909)	S-2667(909)			
KAWASAKI-FB	F-461(776)				
KAWASAKI-F	F-98(619)	F-123(649)	F-462(776)	F-516(776)	F-739(892)
	F-985(892)	F-991(907)			
KAWASAKI-FR	F-463(776)	F-517(776)			
KAWASAKI-CHI-M*	M-186(317)	M-220(319)	M-406(374)	F-619(487)	
KEIHIN-JI-S*	S-1188(319)	S-1390(374)	S-2112(619)		
KINUURA-JI-S	S-2621(907)	S-2672(936)			
KINUURA-S*	S-480(100)	S-585(136)			
KOBE-DAI8-G	F-764(907)				
KOBE-JI-S	S-2615(907)	S-2623(907)			
KOBE-MAYA-M*	M-704(487)				
KOCHI-G	F-791(907)				
KOCHI-S*	S-211(98)				
KOCHI-JI-S*	S-1730(503)				
KOKEN-S	S-1046(338)	S-2106(619)	S-2417(776)		
KOKEN-M*	M-170(317)				
KOMATSUJIMA-G	F-794(907)	F-652(840)			
KUSHIRO-GB	F-506(777)	F-527(777)	F-670(853)	F-672(853)	F-674(853)
	F-695(853)	F-697(892)	F-1185(936)		
KUSHIRO-G	F-507(777)	F-528(777)	F-671(853)	F-673(853)	F-675(853)
	F-696(853)	F-698(892)	F-1186(936)	F-1213(936)	F-1215(936)
	F-1217(936)				
KUSHIRO-S*	S-98(62)	S-369(98)	S-634(136)	S-674(160)	S-733(181)
	S-741(181)				
KUSHIRO-JI-S*	S-1976(618)	S-2171(649)	S-2390(727)		
MATSUYAMA-G	F-792(907)	F-1187(936)			
MATSUYAMA-S*	S-1303(338)	S-1731(503)	S-1624(487)		
MIKAWA-G	F-1119(936)				
MIYAKO-G	F-582(776)	F-584(776)	F-514(777)	F-587(778)	F-726(892)
	F-730(892)	F-734(892)	F-727(840)		

(to be continued)

(**Table 9** Continued)

(December 1998)

Name of Station	Record Numbers which had been digitized and analyzed (Ref. No.**)				
MIYAKO-S*	S-236(80)	S-271(80)	S-312(80)	S-273(98)	S-420(98)
	S-537(116)	S-1204(319)	S-1104(338)	S-1317(338)	S-1972(618)
	S-2255(676)				
MIYAZAKI-GB	F-1067(909)				
MIYAZAKI-G	F-1052(909)	F-1068(909)	F-1124(936)		
MIYAZAKI-M*	M-228(338)	M-795(503)	M-877(547)	M-1107(618)	
MURORAN-G	F-505(777)	F-554(778)	F-560(778)	F-568(778)	F-679(853)
	F-700(892)	F-701(892)	F-1266(936)	F-1267(936)	
MURORAN-S*	S-234(80)	S-241(80)	S-399(80)	S-1425(426)	S-1474(442)
	S-1571(458)	S-1599(458)	S-1979(618)		
NAGOYA-INAE-S*	S-2616(907)				
NAGOYA-INAE-G	F-1122(936)				
NAGOYA-SORAMI-GB	F-1120(936)				
NAGOYA-SORAMI-G	F-1121(936)				
NAGOYA-ZOKAN-S*	S-578(136)	S-1966(588)			
NIIGATA-G	F-705(892)	F-827(909)			
NIIGATA-S*	S-107(62)				
NIIGATA-JI-S*	S-1203(319)				
OFUNATO-S*	S-140(64)	S-282(98)	S-361(98)		
OFUNATO-BO-S	S-2547(778)				
OFUNATO-BOCHI-S	S-554(116)	S-786(181)	S-1022(287)	S-1210(319)	S-1120(338)
OFUNATO-MOUND-M	M-1493(778)	M-1450(777)	M-1579(936)		
OITA-G	F-869(907)	F-1115(909)			
OITA-S*	S-924(236)	S-1629(487)	S-1734(503)	S-2021(618)	
OKITSU-S*	S-1071(317)				
OMAEZAKI-M	M-1571(936)				
ONAHAMA-S*	S-111(62)	S-1043(287)	S-1191(319)	S-1330(338)	
ONAHAMA-JI-S*	S-1330(338)	S-1505(446)	S-1602(487)	S-1633(487)	S-1946(588)
ONAHAMA-JI-GB	F-1179(936)				
ONAHAMA-JI-G	F-1113 (936)	F-1178(936)	F-1180(936)	F-1211(936)	
OSAKA-JI-G	F-854(907)	F-855(907)	F-856(907)	F-1041(907)	
OSAKA-JI-S*	S-2618(907)				
OSAKA-MINAMI-G	F-851(907)	F-852(907)	F-853(907)	F-1040(907)	
OTARU-G	F-536(777)	F-538(778)	F-539(778)	F-540(780)	F-676(853)
	F-694(892)				
SAKAIMINATO-G	F-793(907)	F-1183(936)	F-1208(936)		
SAKAIMINATO-JI-S*	S-2248(676)	S-2251(676)	S-2383(727)		
SAKATA-S*	S-1568(458)	S-2604(892)			

(to be continued)

(**Table 9** Continued)

(December 1998)

Name of Station	Record Numbers which had been digitized and analyzed (Ref. No.**)				
SENDAI-M	M-572(446)	M-1127(618)	M-1498(776)	M-1445(777)	M-1536(892)
SENDAI-MB	M-1446(777)	M-1547(892)			
SHIMIZU-KOJYO-S*	S-74(62)	S-1063(317)	S-1064(317)		
SHIMIZU-MIHO-S*	S-1066(317)	S-1069(317)			
SHINAGAWA-G	F-1046(909)				
SHINAGAWA-S*	S-340(98)	S-441(98)	S-1394(374)	S-1787(519)	S-1885(547)
	S-2111(619)	S-2130(649)	S-2395(727)	S-2419(778)	
SHIOGAMA-KOJYO-S*	S-782(181)	S-1118(338)	S-1201(319)	S-2006(618)	S-2029(618)
	S-2551(776)	S-2602(892)	S-2612(892)		
SHIOGAMA-S*	S-138(64)				
SOMA-S	S-1872(547)	S-2001(618)	S-2031(618)	S-2051(618)	S-2096(618)
	S-2220(676)	S-2487(777)	S-2584(853)	S-2610(892)	S-2656(909)
	S-2681(936)	S-2675(936)	S-2682(936)		
TAGONOURA-S	S-1055(317)	S-2653(909)			
TOKACHI-M*	M-125(287)	M-145(287)	M-247(338)	M-260(338)	M-340(338)
	M-341(374)	M-439(426)	M-521(442)	M-522(442)	M-540(446)
	M-636(487)	M-703(487)	M-911(547)	M-972(547)	M-1078(618)
	M-1200(649)	M-1242(649)	M-1383(727)	M-1416(776)	M-1459(776)
	M-1443(777)	M-1519(853)	M-1534(892)	M-1511(840)	M-1564(909)
TOKACHI-G	F-1094(936)	F-1182(936)	F-1221(936)		
TOMAKOMAI-S*	S-877(202)	S-1418(426)	S-1472(442)	S-1977(618)	S-2491(777)
	S-2528(778)	S-2531(778)	S-2581(853)	S-2600(892)	
TOYAMA-GB	F-787(907)				
TOYAMA-G	F-788(907)				
TOYAMA-S*	S-1892(547)	S-2502(776)			
TSURUGA-G	F-789(907)	F-1117(936)			
TSURUGA-S*	S-1549(487)				
URAKAWA-S	S-1978(618)	S-2186(676)	S-2401(727)	S-2458(776)	S-2490(777)
	S-2580(853)	S-2599(892)	S-2608(892)	S-2668(936)	S-2669(936)
WAKAYAMA-G	F-497(776)	F-503(776)	F-660(840)	F-715(840)	F718(840)
	F-795(907)	F-937(907)	F-943(909)	F-944(909)	F-948(909)
	F-950(909)	F-1029(909)	F-1030(909)	F-1071(909)	F-1125(936)
WAKAYAMA-S*	S-945(236)	S-1028(287)	S-1031(287)		
WAKAYAMA-JI-S*	S-265(98)	S-266(98)	S-788(181)		
YAMASHITA-FB	F-753(853)				
YAMASHITA-F	F-95(619)	F-168(649)	F-325(676)	F-878(909)	F-1139(936)
	F-1142(936)	F-1246(936)			
YAMASHITA-HEN-S*	S-412(98)	S-658(160)	S-1058(317)	S-1189(319)	S-1362(374)
	S-1386(374)	S-1614(487)	S-2113(619)	S-2155(649)	

(to be continued)

(**Table 9** Continued)

(December 1998)

Name of Station	Record Numbers which had been digitized and analyzed (Ref. No.**)				
YAMASHITA-HEN-M*	M-217(319)	M-403(374)	M-1022(588)	M-1056(588)	M-1183(619)
	M-1195(649)	M-1226(649)			
YOKKA.-CHITOSE-S	S-577(136)	S-2619(907)	S-2671(936)		
YOKKA.-SEKITAN-M	M-1555(907)	M-1582(936)			

* Strong-motion observation of the stations had already been stopped.

** The numbers correspond to those of the Technical Note of the Port and Harbour Research Institute, in which results of preliminary analysis are presented.

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Strong-Motion Earthquake Observation Results

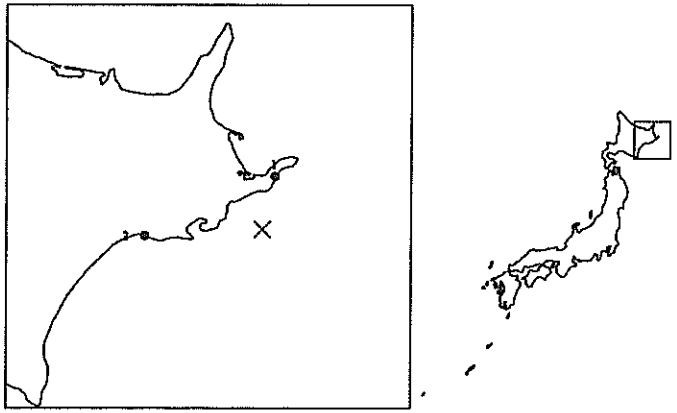
(1998)

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

03:19 JAN. 3 ,1998
OFF NEMURO PENINSULA
EPICENTER : 42 56.3'N 145 24.8'E
DEPTH : 50.2KM MAGNITUDE : 4.8

JMA INTENSITIES

Ⅲ : KUSHIRO,NEMURO
Ⅰ : TOMAKOMAI,ABASHIRI, OBIHIRO,HIROO



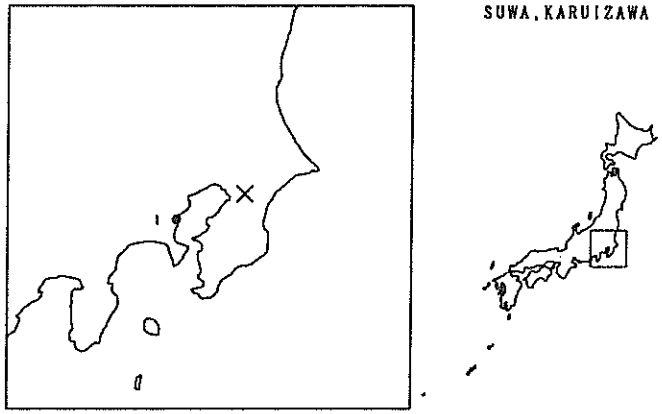
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST (KM)
1	HANASAKI-F	ON GROUND	F-1300	36	20	12	40
2	KUSHIRO-G	ON GROUND	F-1219	14	25	7	86
2	KUSHIRO-GB	IN GROUND	F-1218	7	11	4	86

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

02:17 JAN. 14,1998
CENTRAL CHIBA PREF
EPICENTER : 35 35.1'N 140 14.4'E
DEPTH : 75.2KM MAGNITUDE : 4.9

JMA INTENSITIES

Ⅱ : MITO,KUMAGAYA,NIKKO, KOFU
Ⅰ : SHIZUOKA,MAEBASHI, KAWAGUCHIKO,SHIRAKAWA, SUWA,KARUIZAWA



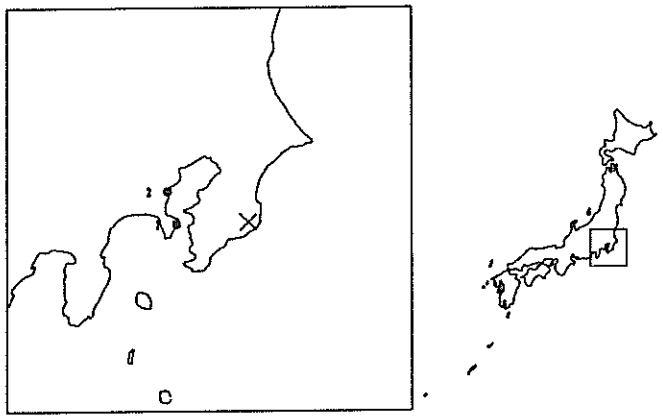
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	YAMASHITA-FR	ON STRUC.	F-1256	35	22	3	54
1	YAMASHITA-F	ON GROUND	F-1255	11	14	6	54
1	YAMASHITA-FB	IN GROUND	F-1254	4	3	2	54

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

10:57 JAN. 16,1998
KUJUKURI COAST BOSO PEN
EPICENTER : 35 12.3'N 140 18.4'E
DEPTH : 57.2KM MAGNITUDE : 4.6

JMA INTENSITIES

Ⅲ : CHIBA,YOKOHAMA
Ⅱ : TOKYO
Ⅰ : CHOSHI,MITO,SHIZUOKA,
KAWAGUCHIKO,KOFU



	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	KOKEN-G	ON GROUND	F-1209	19	15	4	53
2	YAMASHITA-FR	ON STRUC.	F-1259	22	13	8	63
2	YAMASHITA-F	ON GROUND	F-1258	10	8	9	63
2	YAMASHITA-FB	IN GROUND	F-1257	3	4	2	63

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

05:11 JAN. 22,1998
NORTHERN IBARAKI PREF
EPICENTER : 36 30.8'N 140 35.4'E
DEPTH : 58.2KM MAGNITUDE : 3.8

JMA INTENSITIES

Ⅱ : MITO

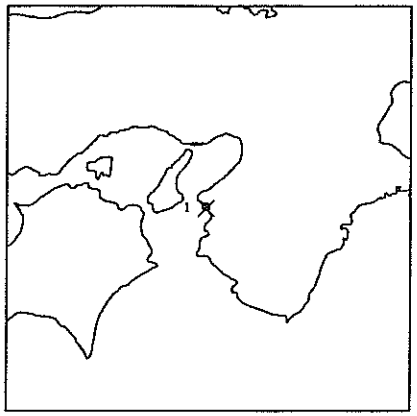
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1280	12	18	14	14

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

06:32 JAN. 24,1998
NW WAKAYAMA PREF
EPICENTER : 34 12.2'N 135 9.1 'E
DEPTH : 11.1KM MAGNITUDE : 3.7

JMA INTENSITIES

Ⅱ : WAKAYAMA
Ⅰ : OSAKA,TOKUSHIMA



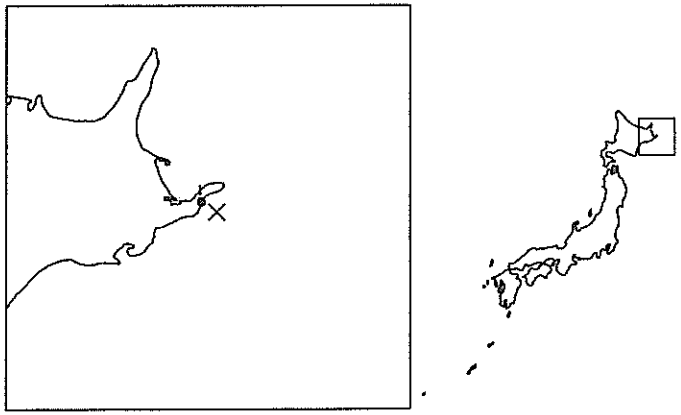
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	WAKAYAMA-G	ON GROUND	F-1353	42	48	79	1

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

19:48 FEB. 5 ,1998
OFF NEMURO PENINSULA
EPICENTER : 43 11.9'N 145 43.1'E
DEPTH : 45.3KM MAGNITUDE : 4.9

JMA INTENSITIES

Ⅱ : KUSHIRO,NEMURO
Ⅰ : URAKAWA,OBIHIRO,HIROO



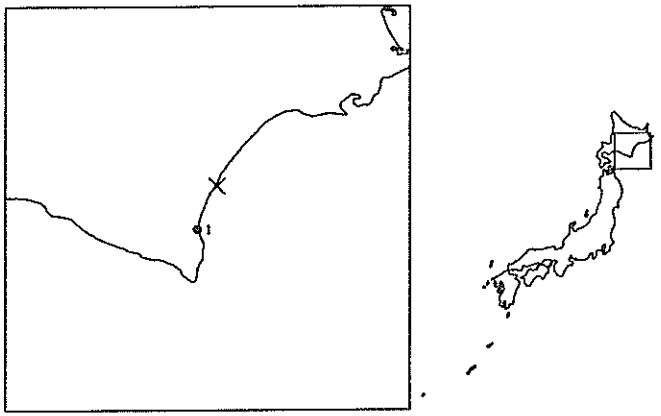
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HANASAKI-F	ON GROUND	F-1302	11	14	8	13

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

23:55 FEB. 16,1998
TOKACHI REGION
EPICENTER : 42 33.8'N 143 32.6'E
DEPTH : 59.2KM MAGNITUDE : 4.2

JMA INTENSITIES

Ⅱ : HIROO
Ⅰ : URAKAWA,OBIHIRO,KUSHIRO



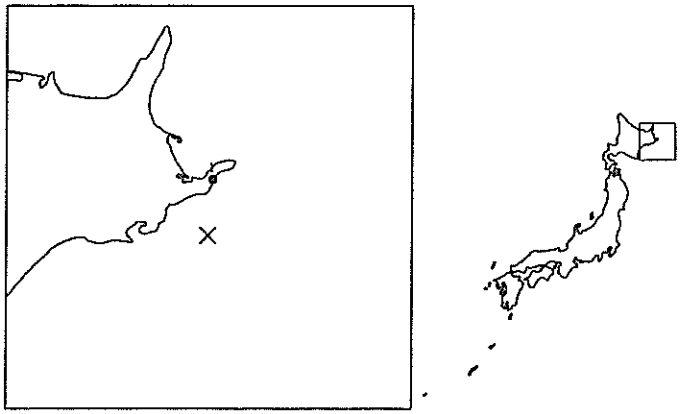
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	TOKACHI-G	ON GROUND	F-1265	28	34	11	35

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

00:01 MAR. 5 ,1998
OFF NEMURO PENINSULA
EPICENTER : 42 54.6'N 145 28.7'E
DEPTH : 49.2KM MAGNITUDE : 4.2

JMA INTENSITIES

I : NEMURO



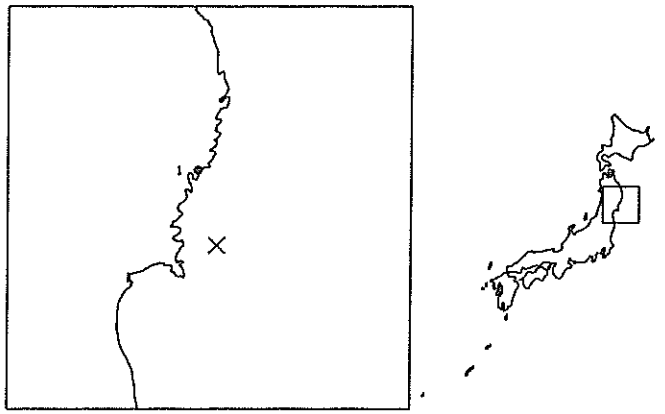
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HANASAKI-F	ON GROUND	F-1303	6	22	6	42

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

09:02 MAR. 8 ,1998
KINKAZAN REGION
EPICENTER : 38 30.3'N 141 50.7'E
DEPTH : 54.2KM MAGNITUDE : 4.4

JMA INTENSITIES

II : OFUNATO
I : MIYAKO,MORIOKA,
ISHINOMAKI,SENDAI



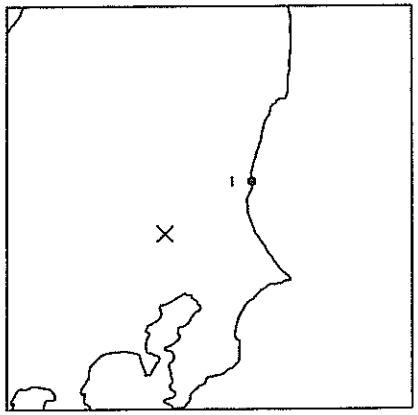
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	OFUNATO-MOUND-M	ON STRUC.	M-1597	4	4	5	57

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

13:46 MAR. 8 ,1998
SW IBARAKI PREF
EPICENTER : 36 5.0 'N 139 51.5'E
DEPTH : 51.2KM MAGNITUDE : 4.4

JMA INTENSITIES

Ⅲ : NIKKO,UTSUNOMIYA,
KUMAGAYA
Ⅱ : MITO,YOKOHAMA
Ⅰ : FUKUSHIMA,SHIRAKAWA,
CHIBA,TATEYAMA,TOKYO,
KOFU



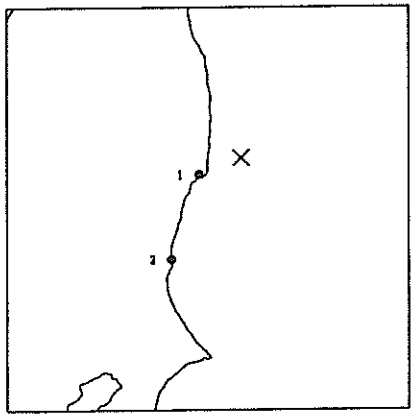
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1281	14	12	5	75

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

08:03 MAR. 17,1998
E OFF FUKUSHIMA PREF
EPICENTER : 37 1.7 'N 141 15.6'E
DEPTH : 51.3KM MAGNITUDE : 4.5

JMA INTENSITIES

Ⅱ : SHIRAKAWA
Ⅰ : SENDAI,FUKUSHIMA,MITO



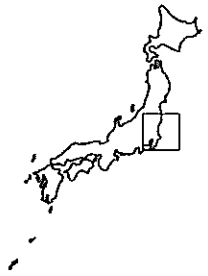
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	ONAHAMA-J1-G	ON GROUND	F-1229	55	44	28	32
1	ONAHAMA-J1-GB	IN GROUND	F-1228	13	10	7	32
2	HITACHINAKA-F	ON GROUND	F-1282	10	6	5	91

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

18:37 MAR. 23,1998
E OFF IBARAKI PREF
EPICENTER : 36 22.2'N 141 10.5'E
DEPTH : 44.3KM MAGNITUDE : 5.3

JMA INTENSITIES

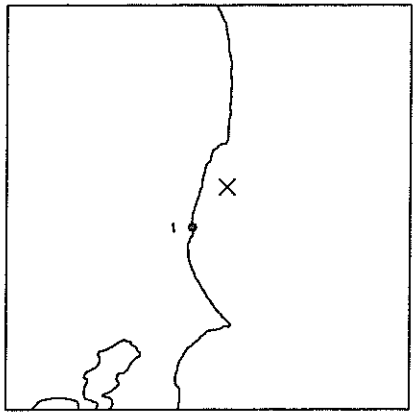
Ⅲ : MITO
Ⅱ : NIKKO,CHOSHI,CHIBA,
SHIRAKAWA,TOKYO,
YOKOHAMA
Ⅰ : UTSUNOMIYA,KUMAGAYA,
TATEYAMA,FUKUSHIMA,
MAEBASHI,SUWA



	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	KASHIMA-ZOKAN-S	ON GROUND	S-2684	22	21	6	65
2	HITACHINAKA-F	ON GROUND	F-1283	55	49	24	49

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

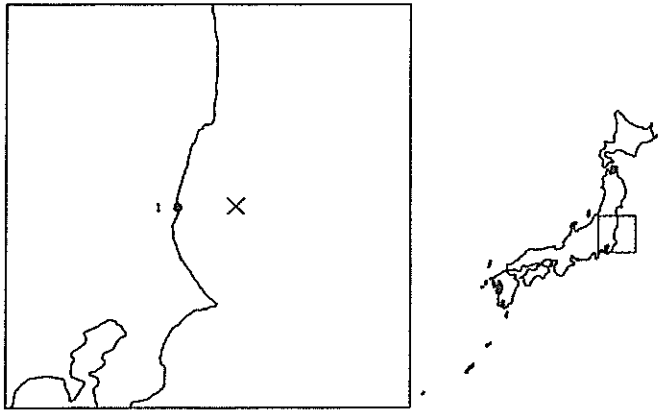
23:50 MAR. 28,1998
E OFF IBARAKI PREF
EPICENTER : 36 38.0'N 140 55.9'E
DEPTH : 50.2KM MAGNITUDE : 4.0



	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1284	12	12	8	39

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

00:36 MAR. 30,1998
E OFF IBARAKI PREF
EPICENTER : 36 21.8'N 141 5.5 'E
DEPTH : 43.2KM MAGNITUDE : 3.9



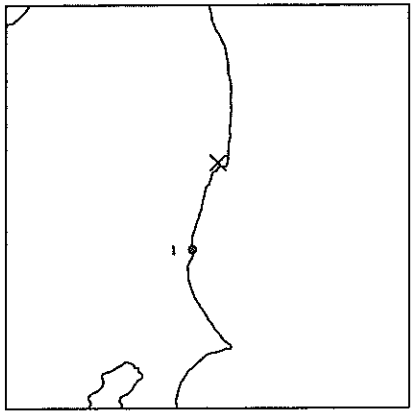
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1285	17	15	9	42

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

02:44 APR. 9 ,1998
EASTERN FUKUSHIMA PREF
EPICENTER : 36 57.1'N 140 53.4'E
DEPTH : 93.2KM MAGNITUDE : 4.6

JMA INTENSITIES

Ⅱ : FUKUSHIMA,SHIRAKAWA, NIKKO,MITO
Ⅰ : UTSUNOMIYA,ISHINOMAKI, SENDAI,KUMAGAYA,TOKYO, YOKOHAMA



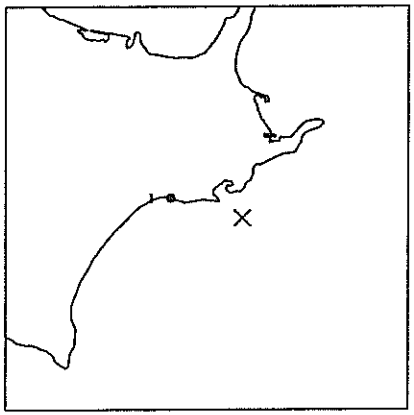
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1286	14	15	11	67

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

14:29 APR. 9 ,1998
OFF NEMURO PENINSULA
EPICENTER : 42 48.1'N 144 58.5'E
DEPTH : 47.2KM MAGNITUDE : 4.8

JMA INTENSITIES

Ⅲ : KUSHIRO
Ⅱ : URAKAWA,HIROO
Ⅰ : TOMAKOMAI,OBIHIRO, NEMURO



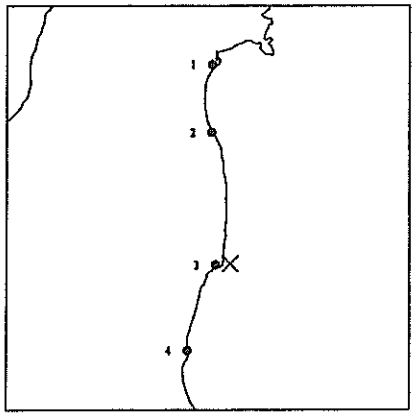
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	KUSHIRO-G	ON GROUND	F-1269	17	35	6	54
1	KUSHIRO-GB	IN GROUND	F-1268	6	11	3	54

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

17:45 APR. 9 ,1998
E OFF FUKUSHIMA PREF
EPICENTER : 36 56.4'N 141 1.9 'E
DEPTH : 93.2KM MAGNITUDE : 5.4

JMA INTENSITIES

Ⅳ : MITO
Ⅲ : FUKUSHIMA,SHIRAKAWA,
NIKKO
Ⅱ : UTSUNOMIYA,ISHINOMAKI,
SENDAI,CHOSHI,CHIBA,
OFUNATO,MORIOKA,
YAMAGATA,TOKYO,YOKOHAMA



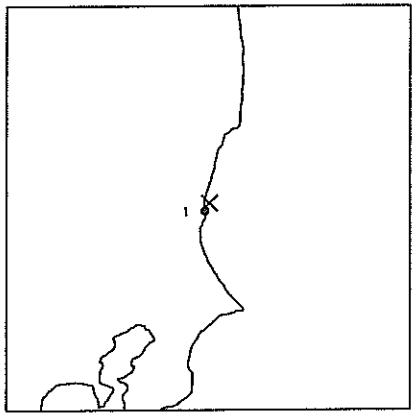
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	SENDAI-MB	IN GROUND	M-1599	6	6	4	149
1	SENDAI-M	ON GROUND	M-1598	24	22	9	149
2	SOMA-S	ON GROUND	S-2685	26	31	8	98
3	ONAHAMA-JI-G	ON GROUND	F-1264	116	118	68	11
3	ONAHAMA-JI-GB	IN GROUND	F-1263	17	34	28	11
4	HITACHINAKA-F	ON GROUND	F-1287	76	72	47	71

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

19:07 APR. 11,1998
NORTHERN IBARAKI PREF
EPICENTER : 36 26.2'N 140 39.7'E
DEPTH : 54.2KM MAGNITUDE : 4.3

JMA INTENSITIES

Ⅲ : MITO
Ⅱ : SHIRAKAWA,NIKKO
Ⅰ : FUKUSHIMA,UTSUNOMIYA,
KUMAGAYA,TOKYO



	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1288	99	111	35	6

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

20:32 APR. 22,1998
SHIGA GIFU BORDER REGION
EPICENTER : 35 9.9 'N 136 34.2'E
DEPTH : 10.1KM MAGNITUDE : 5.4

JMA INTENSITIES

Ⅲ : NAGOYA,HIKONE,FUKUI, TSURUGA,SUWA,YOKKAICHI, TSU,TOYOOKA
Ⅱ : FUKUI,IIDA,GIFU,OSAKA, NARA
Ⅰ : TOYAMA,TATEYAMA,WAJIMA, KANAZAWA,SHIZUOKA, WAKAYAMA

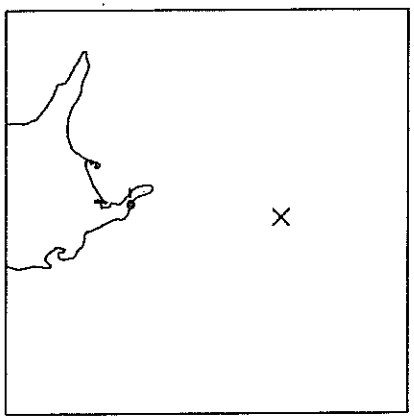
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	NAGOYA-INAE-G	ON STRUC.	F-1272	28	30	20	28
1	NAGOYA-SORAMI-G	ON GROUND	F-1271	78	59	31	28
1	NAGOYA-SORAMI-GB	IN GROUND	F-1270	19	24	8	28
2	YOKKAICHI-G	ON GROUND	F-1275	42	54	23	24
2	YOKKAICHI-GB	IN GROUND	F-1274	21	18	2	24

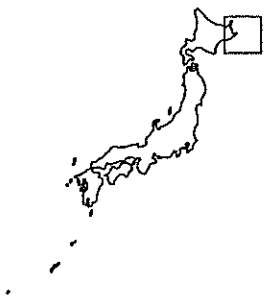
STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

13:35 APR. 25,1998
E OFF HOKKAIDO
EPICENTER : 43 2.7 'N 146 57.3'E
DEPTH : 55.0KM MAGNITUDE : 4.7

JMA INTENSITIES

Ⅰ : NEMURO





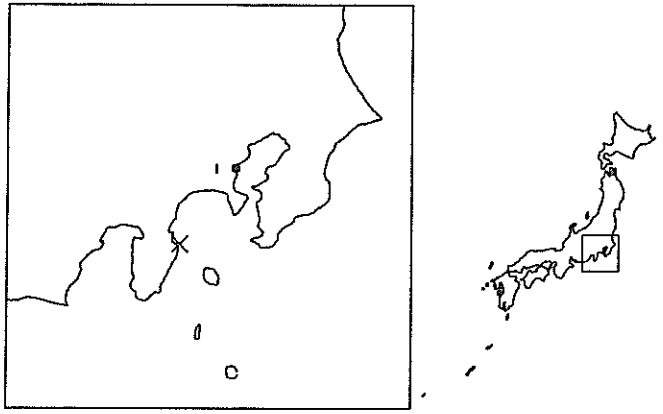
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HANASAKI-F	ON GROUND	F-1304	3	8	2	113

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

07:37 APR. 26,1998
E OFF IZU PENINSULA
EPICENTER : 34 57.6'N 139 10.4'E
DEPTH : 4.1KM MAGNITUDE : 4.7

JMA INTENSITIES

Ⅲ : YOKOHAMA
Ⅱ : MISHIMA,TATEYAMA
Ⅰ : SHIZUOKA,TOKYO,KOFU,
NIKKO



	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	YAMASHITA-FR	ON STRUC.	F-1291	27	18	3	70
1	YAMASHITA-F	ON GROUND	F-1290	10	11	6	70
1	YAMASHITA-FB	IN GROUND	F-1289	3	3	1	70

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

07:06 APR. 27,1998
SW IBARAKI PREF
EPICENTER : 36 5.1 'N 139 53.1'E
DEPTH : 50.2KM MAGNITUDE : 4.0

JMA INTENSITIES

Ⅰ : KUMAGAYA,NIKKO,
UTSUNOMIYA,TOKYO,
YOKOHAMA

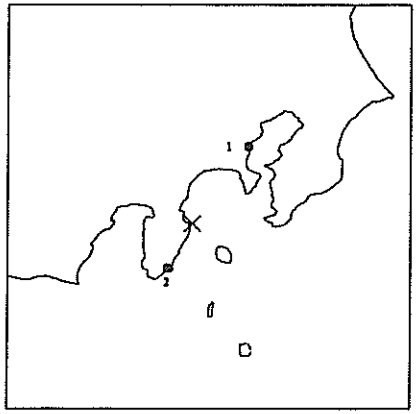
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1307	12	16	5	73

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

11:09 MAY 3 ,1998
E OFF IZU PENINSULA
EPICENTER : 34 57.3'N 139 10.6'E
DEPTH : 2.1KM MAGNITUDE : 5.7

JMA INTENSITIES

Ⅲ : MISHIMA,TATEYAMA,
YOKOHAMA
Ⅱ : TOKYO,SHIZUOKA,IIDA
Ⅰ : MISHIMA,KUMAGAYA,CHIBA,
KAWAGUCHIKO,KOFU,SUWA,
KARUIZAWA,MITO



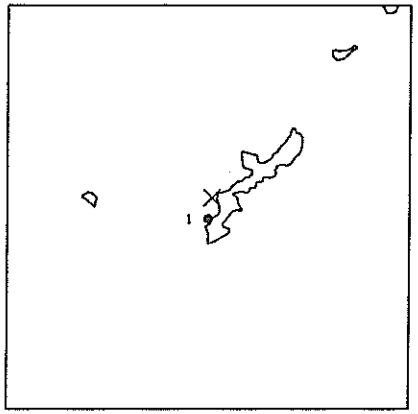
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	YAMASHITA-FR	ON STRUC.	F-1294	27	19	4	70
1	YAMASHITA-F	ON GROUND	F-1293	18	11	9	70
1	YAMASHITA-FB	IN GROUND	F-1292	5	3	2	70
2	SHIMODA-F	ON GROUND	F-1341	5	9	4	38

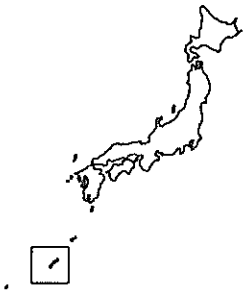
STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

11:53 MAY 5 ,1998
NEAR OKINAWAJIMA ISLAND
EPICENTER : 26 23.3'N 127 41.7'E
DEPTH : 14.0KM MAGNITUDE : 4.2

JMA INTENSITIES

Ⅱ : NAHA





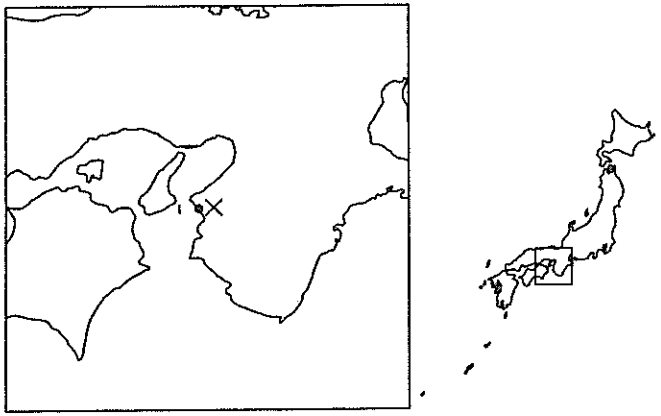
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	NAHA-G	ON GROUND	F-1277	29	20	10	15
1	NAHA-GB	IN GROUND	F-1276	19	7	5	15

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

20:19 MAY 6 ,1998
NW WAKAYAMA PREF
EPICENTER : 34 13.2'N 135 15.9'E
DEPTH : 10.1KM MAGNITUDE : 3.7

JMA INTENSITIES

Ⅲ : WAKAYAMA
Ⅰ : OSAKA



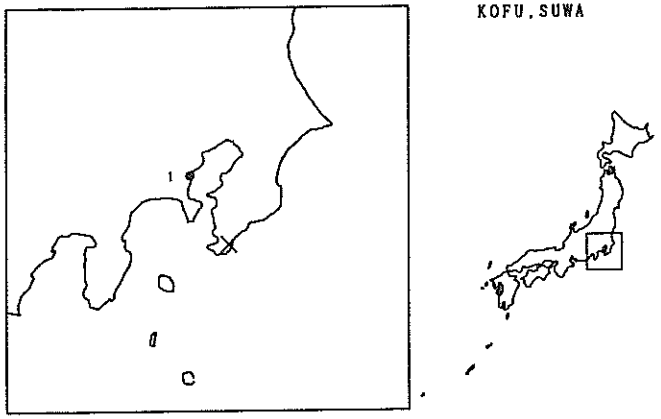
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	WAKAYAMA-G	ON GROUND	F-1354	27	12	14	10

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

03:45 MAY 16,1998
SOUTHERN BOSO PENINSULA
EPICENTER : 34 58.1'N 139 56.6'E
DEPTH : 73.1KM MAGNITUDE : 4.8

JMA INTENSITIES

Ⅲ : TATEYAMA,TOKYO
Ⅱ : CHIBA,YOKOHAMA
Ⅰ : NIIJIMA,NIKKO,
UTSUNOMIYA,KAWAGUCHIKO,
KOFU,SUWA



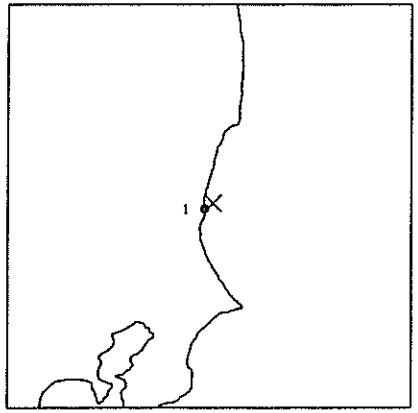
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	YAMASHITA-FR	ON STRUC.	F-1297	57	28	5	58
1	YAMASHITA-F	ON GROUND	F-1296	25	24	7	58
1	YAMASHITA-FB	IN GROUND	F-1295	8	7	2	58

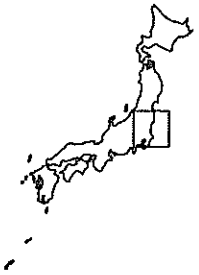
STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

16:06 MAY 17,1998
NORTHERN IBARAKI PREF
EPICENTER : 36 25.1'N 140 41.7'E
DEPTH : 54.2KM MAGNITUDE : 3.8

JMA INTENSITIES

Ⅱ : MITO





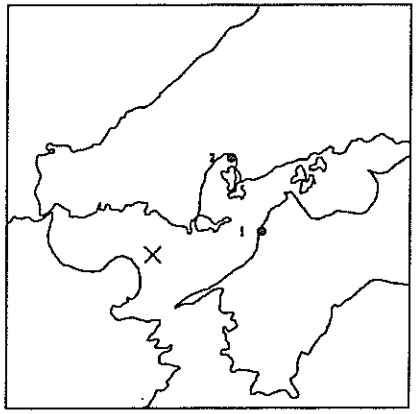
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1308	24	27	10	7

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

04:49 MAY 23,1998
IYONADA SETONAIKAI
EPICENTER : 33 41.7'N 131 50.8'E
DEPTH : 84.1KM MAGNITUDE : 5.3

JMA INTENSITIES

Ⅳ : OITA
Ⅲ : HAGI,OKAYAMA,HIROSHIMA, KURE,MATSUYAMA,UWAJIMA, YAMAGUCHI
Ⅱ : MATSUE,FUKUYAMA, TAKAMATSU,KOCHI, WAKAYAMA,TOKUSHIMA,SAGA, KUMAMOTO



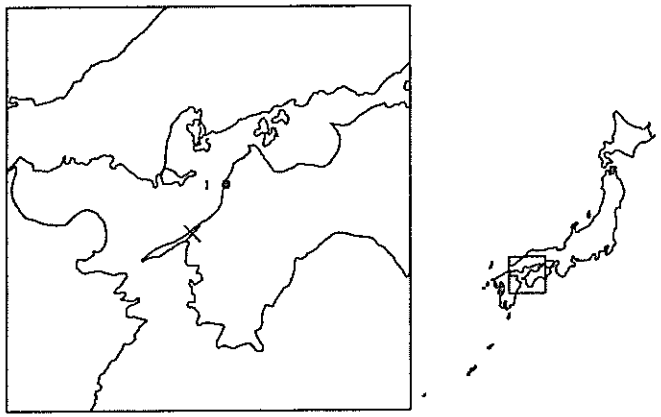
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	MATSUYAMA-G	ON GROUND	F-1298	29	27	9	82
2	HIROSHIMA-G	ON GROUND	F-1278	36	28	12	92

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

08:09 MAY 28,1998
SW EHIME PREF
EPICENTER : 33 31.5'N 132 26.5'E
DEPTH : 49.1KM MAGNITUDE : 4.0

JMA INTENSITIES

II : YAMAGUCHI
I : MATSUYAMA,OKAYAMA,
HIROSHIMA



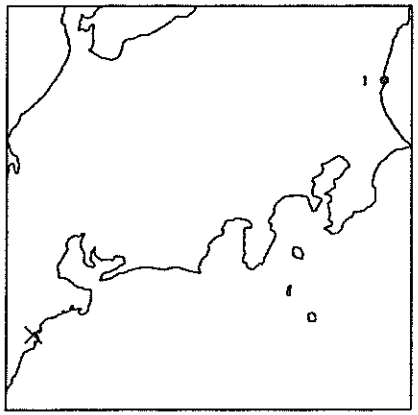
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	MATSUYAMA-G	ON GROUND	F-1306	12	7	4	44

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

16:35 JUNE 1 ,1998
SOUTHERN MIE PREF
EPICENTER : 34 2.6 'N 136 13.2'E
DEPTH : 410.2KM MAGNITUDE : 6.0

JMA INTENSITIES

II : TOKYO
I : NIKKO,UTSUNOMIYA,
OFUNATO,MITO,CHIBA,
YOKOHAMA,TATEYAMA



	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1309	4	5	2	476

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

16:55 JUNE 5 ,1998
E OFF IBARAKI PREF
EPICENTER : 36 34.9'N 141 4.3 'E
DEPTH : 46.3KM MAGNITUDE : 3.9

JMA INTENSITIES

I : MITO

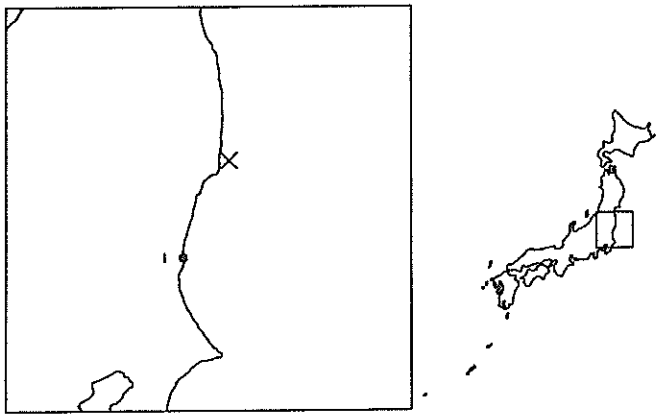
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1310	20	23	7	46

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

16:47 JUNE 8 ,1998
E OFF FUKUSHIMA PREF
EPICENTER : 37 0.7 'N 141 3.5 'E
DEPTH : 67.2KM MAGNITUDE : 4.2

JMA INTENSITIES

Ⅱ : SHIRAKAWA
Ⅰ : FUKUSHIMA,MITO,NIKKO



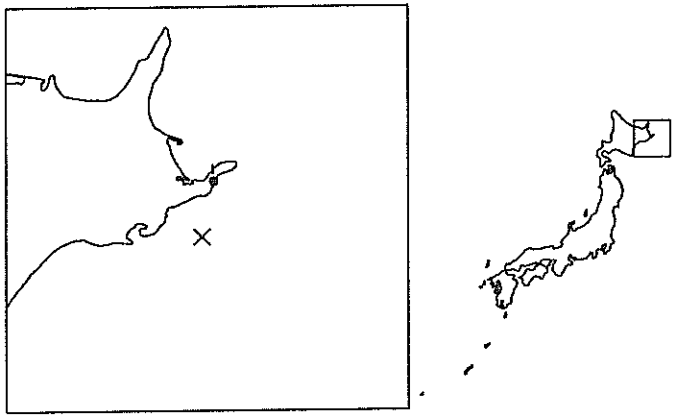
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1311	8	9	5	79

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

19:58 JUNE 14,1998
OFF NEMURO PENINSULA
EPICENTER : 42 55.0'N 145 25.0'E
DEPTH : 49.2KM MAGNITUDE : 4.2

JMA INTENSITIES

Ⅰ : KUSHIRO,NEMURO



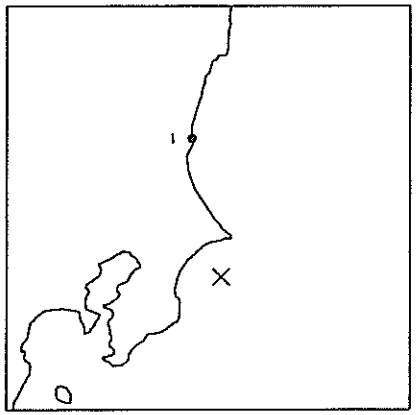
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HANASAKI-F	ON GROUND	F-1362	10	8	4	42

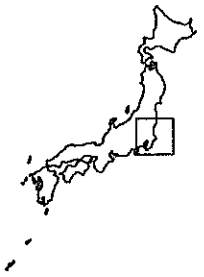
STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

22:17 JUNE 14,1998
E OFF BOSO PENINSULA
EPICENTER : 35 26.6'N 140 46.1'E
DEPTH : 50.2KM MAGNITUDE : 5.6

JMA INTENSITIES

Ⅲ : CHIBA,TATEYAMA,YOKOHAMA
Ⅱ : TOKYO,SUWA
Ⅰ : KUMAGAYA,NIKKO,
UTSUNOMIYA,KARUIZAWA,
SHIRAKAWA,KOFU





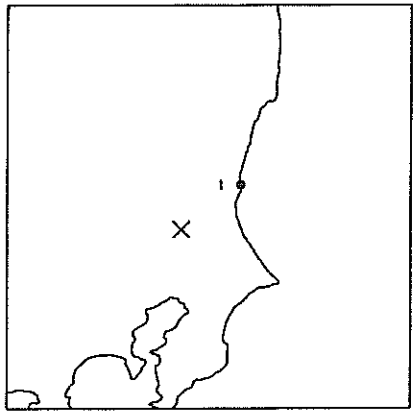
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1312	4	6	4	105

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

23:52 JUNE 24,1998
SW IBARAKI PREF
EPICENTER : 36 7.3 'N 140 6.3 'E
DEPTH : 73.2KM MAGNITUDE : 4.6

JMA INTENSITIES

Ⅲ : KUMAGAYA,NIKKO,
UTSUNOMIYA
Ⅱ : MITO,SHIRAKAWA,TOKYO,
YOKOHAMA
Ⅰ : MAEBASHI,FUKUSHIMA,
CHIBA,TATEYAMA,
KARUIZAWA

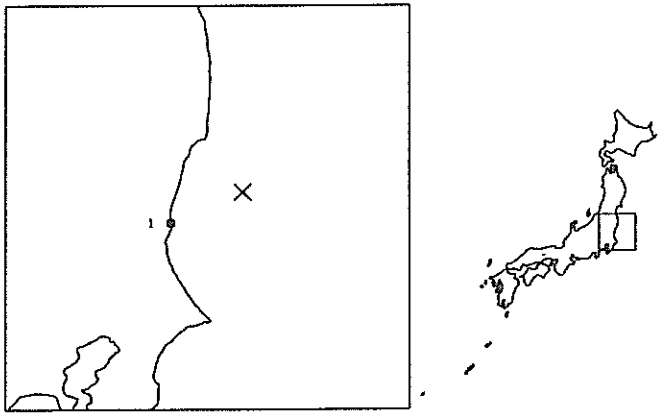


	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1313	11	12	10	54

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

03:03 JULY 1 ,1998
E OFF IBARAKI PREF
EPICENTER : 36 33.1'N 141 13.4'E
DEPTH : 42.3KM MAGNITUDE : 4.0

JMA INTENSITIES
I : MITO

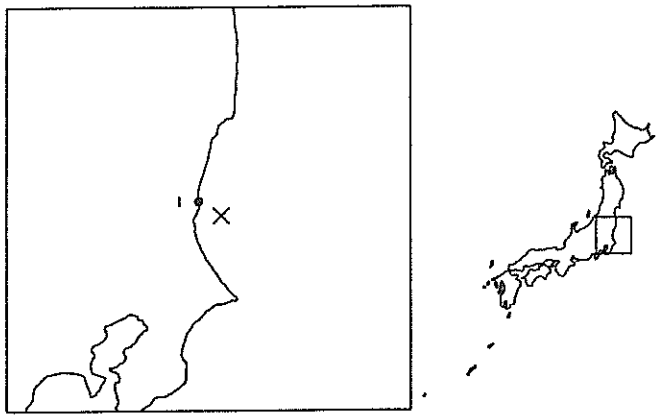


	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1314	8	7	5	57

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

23:10 JULY 5 ,1998
E OFF IBARAKI PREF
EPICENTER : 36 16.6'N 140 47.7'E
DEPTH : 48.2KM MAGNITUDE : 3.7

JMA INTENSITIES
I : MITO,CHIBA



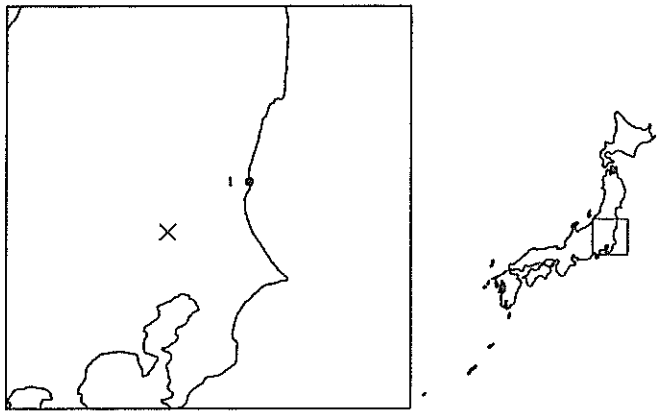
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1315	13	13	6	20

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

07:09 JULY 15,1998
SW IBARAKI PREF
EPICENTER : 36 5.4 'N 139 54.0'E
DEPTH : 51.2KM MAGNITUDE : 4.4

JMA INTENSITIES

II : MITO,NIKKO,UTSUNOMIYA,
KUMAGAYA,TOKYO
I : CHIBA,YOKOHAMA



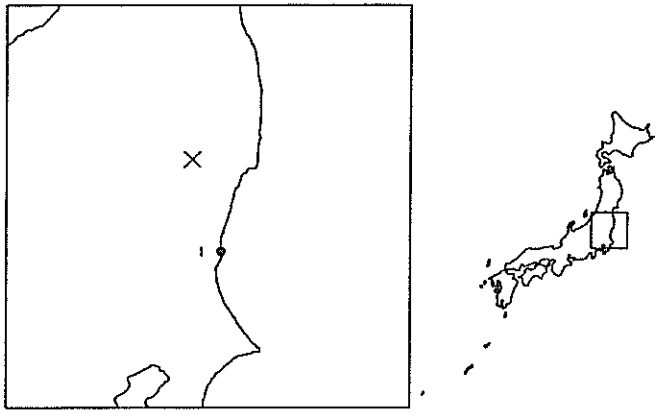
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1319	8	9	5	72

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

12:14 JULY 21,1998
MID FUKUSHIMA PREF
EPICENTER : 37 1.3 'N 140 26.3'E
DEPTH : 87.1KM MAGNITUDE : 4.0

JMA INTENSITIES

I : FUKUSHIMA,SHIRAKAWA,
MITO



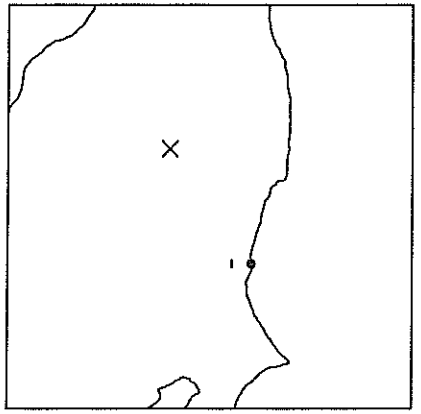
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1320	12	13	4	72

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

20:09 AUG. 3 ,1998
WESTERN FUKUSHIMA PREF
EPICENTER : 37 11.9'N 139 59.9'E
DEPTH : 10.1KM MAGNITUDE : 4.9

JMA INTENSITIES

Ⅲ : SHIRAKAWA
Ⅱ : MITO,NIIGATA
Ⅰ : FUKUSHIMA,NIKKO,
ISHINOMAKI,SENDAI,
SAKATA,YAMAGATA



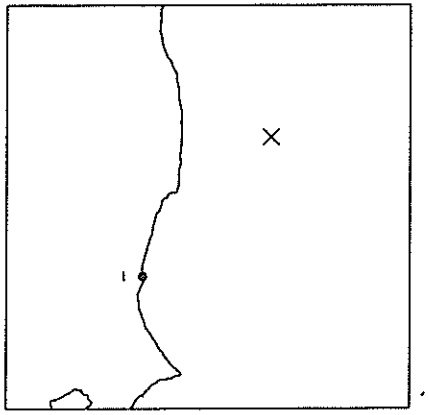
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1321	7	9	4	105

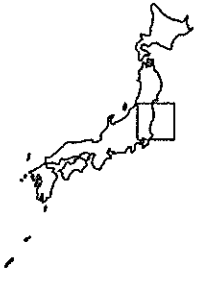
STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

23:05 AUG. 16,1998
E OFF FUKUSHIMA PREF
EPICENTER : 37 14.2'N 141 46.7'E
DEPTH : 44.4KM MAGNITUDE : 5.2

JMA INTENSITIES

Ⅱ : FUKUSHIMA,SHIRAKAWA,
MITO
Ⅰ : ISHINOMAKI,NIKKO,
UTSUNOMIYA,KUMAGAYA,
CHOSHI,CHIBA,MORIOKA,
YAMAGATA,TOKYO,YOKOHAMA





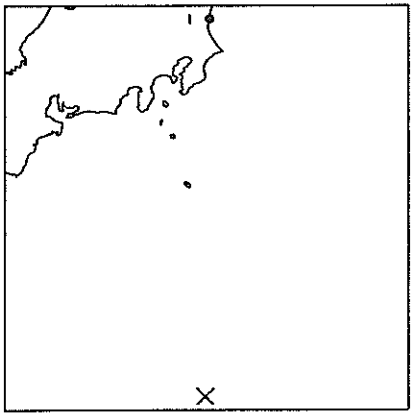
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1322	7	7	4	140

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

15:40 AUG. 20,1998
W OFF OGASAWARA
EPICENTER : 28 54.2'N 139 53.2'E
DEPTH : 457.0KM MAGNITUDE : 7.1

JMA INTENSITIES

Ⅲ : TATEYAMA
Ⅱ : CHIBA,TOKYO,FUKUSHIMA,
SHIRAKAWA,NIKKO,
UTSUNOMIYA,YOKOHAMA
Ⅰ : KUMAGAYA,CHOSHI,TOKYO,
ISHINOMAKI,SENDAI,
MISHIMA,OFUNATO,MORIOKA,
SAKATA,KOFU,SUWA



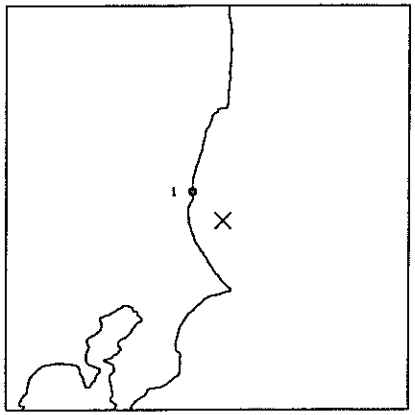
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1323	5	5	2	834

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

22:46 AUG. 26,1998
E OFF IBARAKI PREF
EPICENTER : 36 10.5'N 140 51.1'E
DEPTH : 43.2KM MAGNITUDE : 3.6

JMA INTENSITIES

Ⅰ : MITO



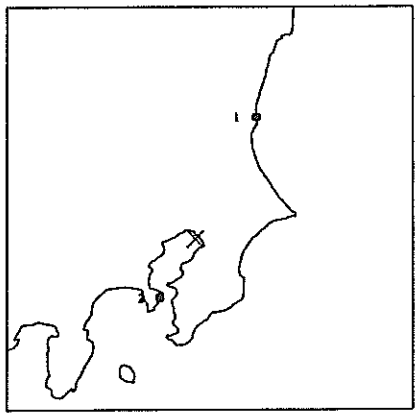
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1324	8	4	2	31

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

08:46 AUG. 29,1998
CENTRAL CHIBA PREF
EPICENTER : 35 36.2'N 140 2.7 'E
DEPTH : 67.2KM MAGNITUDE : 5.1

JMA INTENSITIES

Ⅳ : TOKYO,YOKOHAMA
Ⅲ : KUMAGAYA,CHIBA,TATEYAMA,
KOFU
Ⅱ : NIIJIMA,MITO,NIKKO,
KAWAGUCHIKO,SUWA,
KARUIZAWA
Ⅰ : CHOSHI



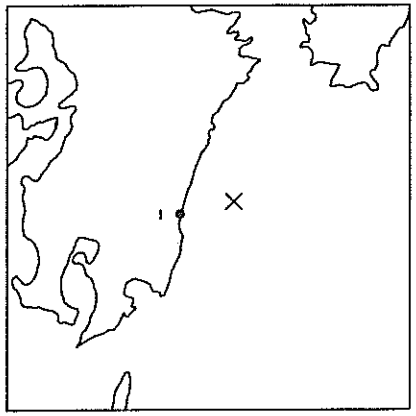
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1325	9	7	4	101
2	KOKEN-G	ON GROUND	F-1318	31	33	14	51

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

08:02 SEP. 4 ,1998
HYUGANADA REGION
EPICENTER : 31 59.3'N 131 52.4'E
DEPTH : 32.2KM MAGNITUDE : 4.5

JMA INTENSITIES

Ⅲ : MIYAZAKI
Ⅱ : NOBEOKA,MIYAKONOJO, HITOYOSHI
Ⅰ : KUMAMOTO,OITA,KAGOSHIMA, NOBEOKA



	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	MIYAZAKI-G	ON GROUND	F-1375	33	23	9	40
1	MIYAZAKI-GB	IN GROUND	F-1374	15	11	4	40

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

05:49 SEP. 7 ,1998
OFF NEMURO PENINSULA
EPICENTER : 43 7.8 'N 145 40.0'E
DEPTH : 48.2KM MAGNITUDE : 4.2

JMA INTENSITIES

Ⅱ : NEMURO
Ⅰ : KUSHIRO

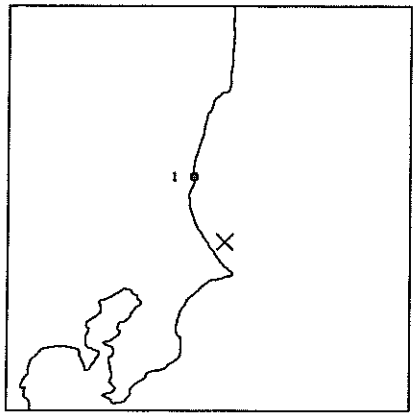
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HANASAKI-F	ON GROUND	F-1363	21	26	13	17

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

08:40 SEP. 8 ,1998
NEAR CHOSHI CITY
EPICENTER : 35 55.9'N 140 49.6'E
DEPTH : 36.2KM MAGNITUDE : 4.2

JMA INTENSITIES

I : MITO,CHOSHI



	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1326	5	6	2	53

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

16:24 SEP. 15,1998
SOUTHERN MIYAGI PREF
EPICENTER : 38 16.6'N 140 45.9'E
DEPTH : 13.1KM MAGNITUDE : 5.0

JMA INTENSITIES

Ⅳ : SENDAI
Ⅲ : YAMAGATA
Ⅱ : ISHINOMAKI,SHINJO, OFUNATO,FUKUSHIMA, SHIRAKAWA,MIYAKO, MORIOKA,MITO
I : SAKATA

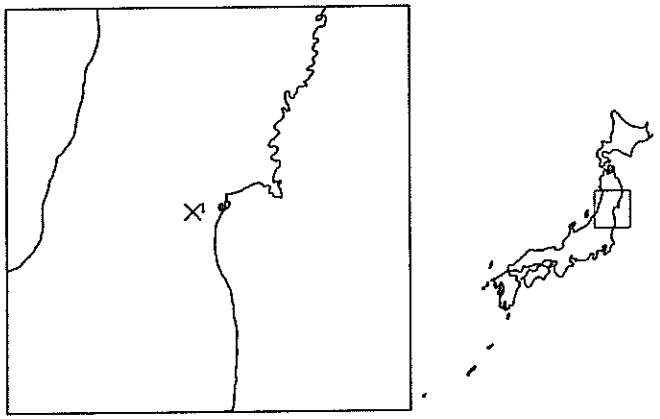
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	SENDAI-MB	IN GROUND	M-1603	14	23	20	21
1	SENDAI-M	ON GROUND	M-1602	46	67	29	21
2	HITACHINAKA-F	ON GROUND	F-1327	5	5	2	210

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

16:31 SEP. 15,1998
SOUTHERN MIYAGI PREF
EPICENTER : 38 16.3'N 140 45.5'E
DEPTH : 12.1KM MAGNITUDE : 3.6

JMA INTENSITIES

Ⅱ : SENDAI



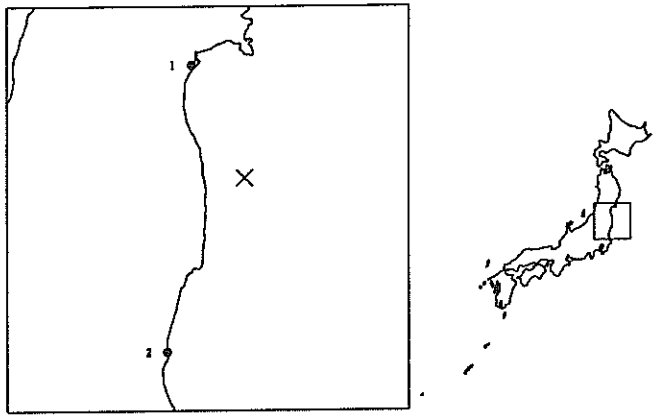
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	SENDAI-MB	IN GROUND	M-1605	1	2	1	22
1	SENDAI-M	ON GROUND	M-1604	8	10	5	22

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

06:59 SEP. 25,1998
E OFF FUKUSHIMA PREF
EPICENTER : 37 30.0'N 141 23.0'E
DEPTH : 82.2KM MAGNITUDE : 4.6

JMA INTENSITIES

Ⅱ : ISHINOMAKI,SENDAI,
YAMAGATA,MITO,OFUNATO
Ⅰ : MORIOKA,FUKUSHIMA,
SHIRAKAWA,NIKKO,TOKYO



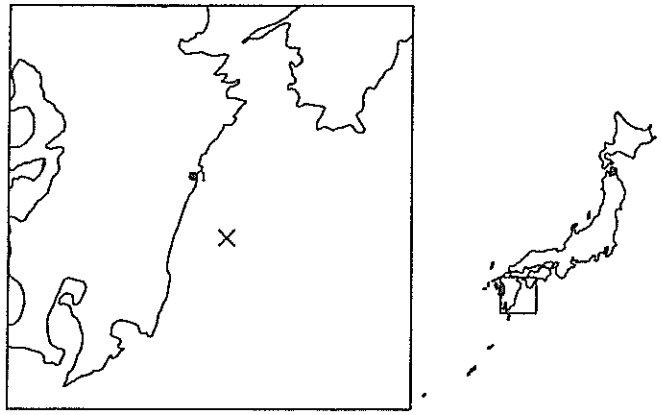
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	SENDAI-MB	IN GROUND	M-1607	13	12	7	92
1	SENDAI-M	ON GROUND	M-1606	4	5	3	92
2	HITACHINAKA-F	ON GROUND	P-1329	10	8	6	141

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

02:50 SEP. 28,1998
HYUGANADA REGION
EPICENTER : 32 1.5 'N 131 55.7'E
DEPTH : 37.3KM MAGNITUDE : 4.4

JMA INTENSITIES

Ⅱ : MIYAZAKI
Ⅰ : NOBEOKA,MIYAKONOJO,
HITOYOSHI

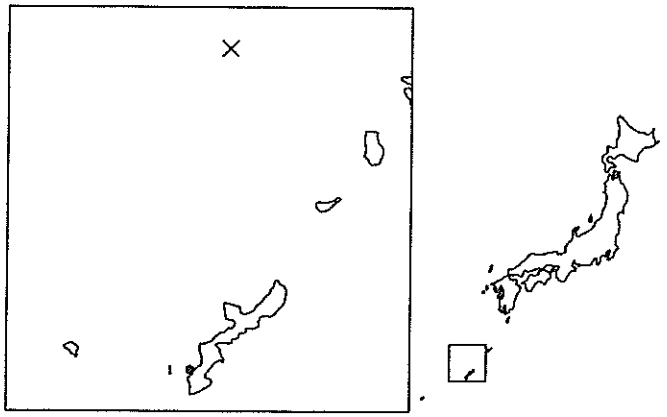


	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HOSOSHIMA-G	IN GROUND	F-1336	35	47	5	52

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

20:15 OCT. 3 ,1998
NW OFF AMAMI-OSHIMA IS
EPICENTER : 28 24.4'N 127 50.7'E
DEPTH : 220.0KM MAGNITUDE : 5.8

JMA INTENSITIES
Ⅲ : NAZE
Ⅱ : NAGO,NAHA

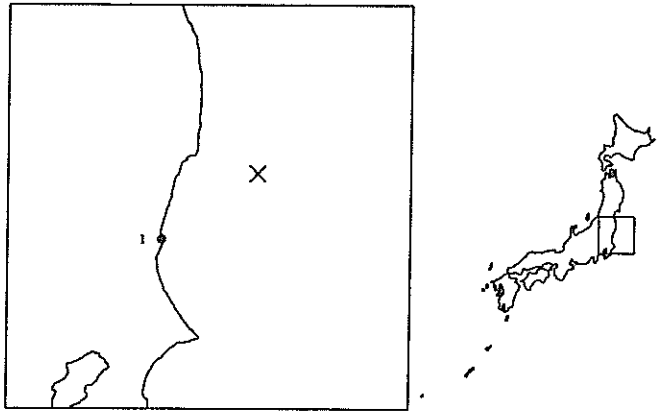


	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	NAHA-G	ON GROUND	F-1317	7	10	3	240
1	NAHA-GB	IN GROUND	F-1316	3	4	2	240

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

02:00 OCT. 4 ,1998
E OFF IBARAKI PREF
EPICENTER : 36 46.1'N 141 28.0'E
DEPTH : 46.5KM MAGNITUDE : 4.5

JMA INTENSITIES
Ⅱ : SHIRAKAWA,MITO
Ⅰ : FUKUSHIMA



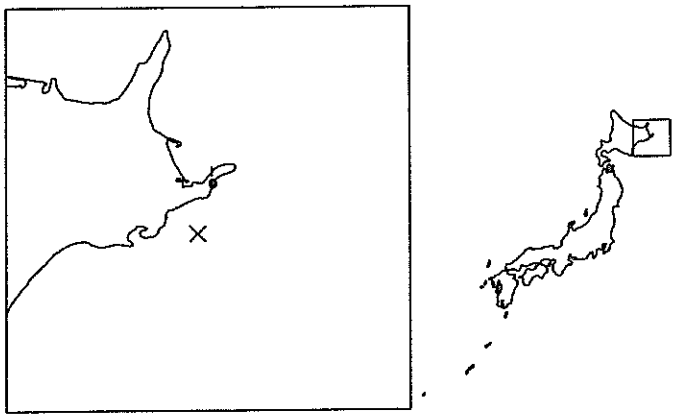
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1330	9	12	3	86

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

12:36 OCT. 13,1998
OFF NEMURO PENINSULA
EPICENTER : 42 57.5'N 145 23.4'E
DEPTH : 51.2KM MAGNITUDE : 3.8

JMA INTENSITIES

I : NEMURO



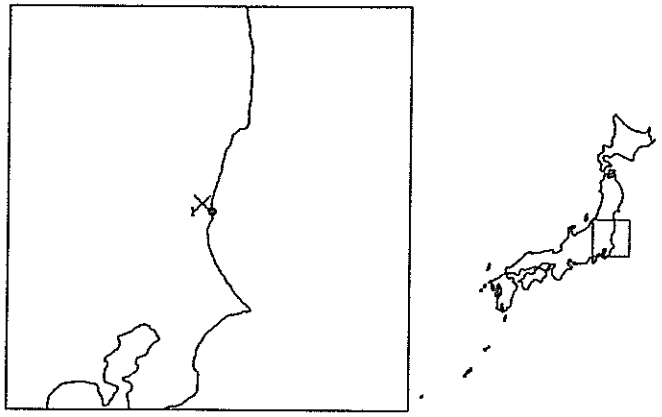
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
I	HANASAKI-F	ON GROUND	F-1364	8	18	4	39

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

06:43 NOV. 5 ,1998
NORTHERN IBARAKI PREF
EPICENTER : 36 26.7'N 140 32.4'E
DEPTH : 61.2KM MAGNITUDE : 4.2

JMA INTENSITIES

II : MITO
I : NIKKO,UTSUNOMIYA,CHOSHI,
TOKYO



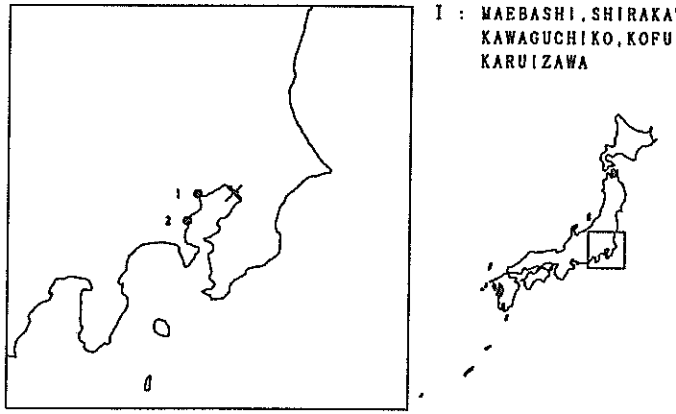
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1331	22	26	11	9

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

21:40 NOV. 8 ,1998
CENTRAL CHIBA PREF
EPICENTER : 35 36.6'N 140 3.2 'E
DEPTH : 78.2KM MAGNITUDE : 4.6

JMA INTENSITIES

IV : YOKOHAMA
III : TOKYO
II : MITO,NIKKO,KUMAGAYA,
CHIBA
I : MAEBASHI,SHIRAKAWA,
KAWAGUCHIKO,KOFU,
KARUIZAWA



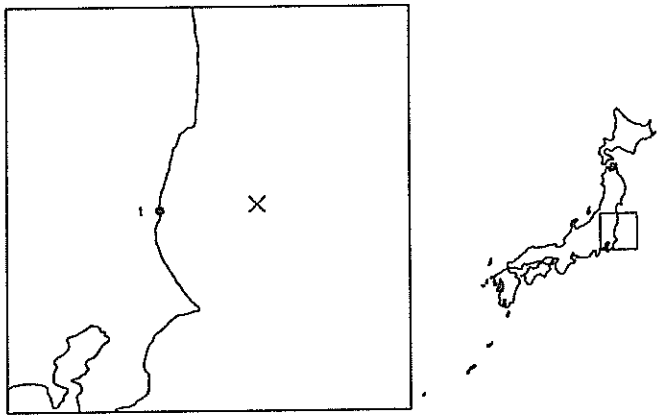
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	SHINAGAWA-G	ON GROUND	F-1369	85	48	16	26
1	SHINAGAWA-GB	IN GROUND	F-1368	14		5	26
2	YAMASHITA-FR	ON STRUC.	F-1358	88	100	12	39
2	YAMASHITA-F	ON GROUND	F-1357	35	58	13	39
2	YAMASHITA-FB	IN GROUND	F-1356	8	13	4	39

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

17:25 NOV. 16,1998
E OFF IBARAKI PREF
EPICENTER : 36 22.4'N 141 25.0'E
DEPTH : 46.4KM MAGNITUDE : 4.2

JMA INTENSITIES

I : MITO



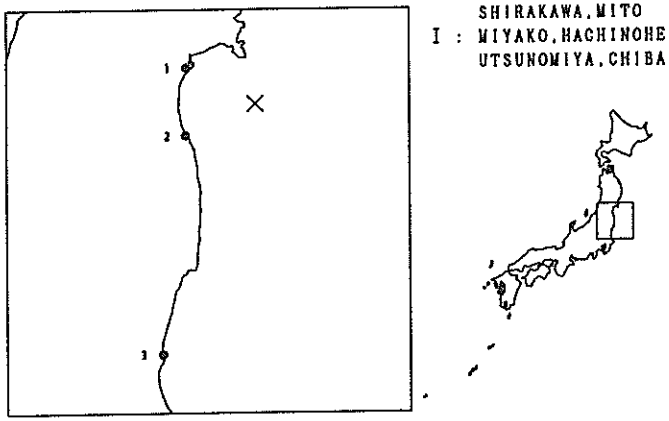
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1332	7	8	3	71

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

04:48 NOV. 24,1998
SE OFF MIYAGI PREF
EPICENTER : 38 0.1 'N 141 35.3'E
DEPTH : 82.1KM MAGNITUDE : 5.1

JMA INTENSITIES

Ⅲ : ISHINOMAKI,OFUNATO, SENDAI,YAMAGATA, FUKUSHIMA
Ⅱ : MORIOKA,SAKATA,SHINJO, SHIRAKAWA,MITO
I : MIYAKO,HACHINOHE,NIKKO, UTSUNOMIYA,CHIBA



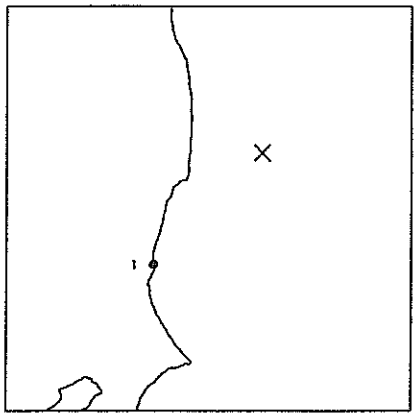
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	SENDAI-M	ON GROUND	M-1609	95	85	31	58
1	SENDAI-MB	IN GROUND	M-1608	18	23	13	58
2	SOMA-S	ON GROUND	S-2686	13	21	5	58
3	HITACHINAKA-F	ON GROUND	F-1333	12	12	8	199

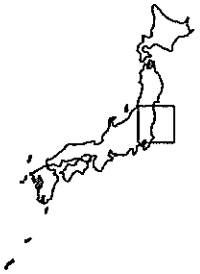
STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

02:36 NOV. 25,1998
E OFF FUKUSHIMA PREF
EPICENTER : 37 3.9 'N 141 36.6'E
DEPTH : 42.4KM MAGNITUDE : 4.6

JMA INTENSITIES

Ⅲ : SHIRAKAWA,FUKUI
Ⅱ : MITO
Ⅰ : FUKUSHIMA,MITO,NIKKO,
UTSUNOMIYA





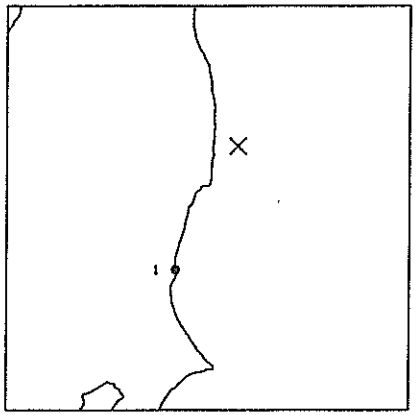
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1334	10	9	4	116

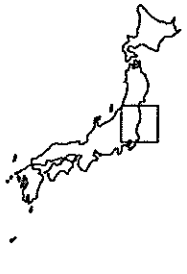
STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

21:52 NOV. 29,1998
E OFF FUKUSHIMA PREF
EPICENTER : 37 10.3'N 141 12.9'E
DEPTH : 81.2KM MAGNITUDE : 4.2

JMA INTENSITIES

Ⅰ : SHIRAKAWA,MITO,NIKKO





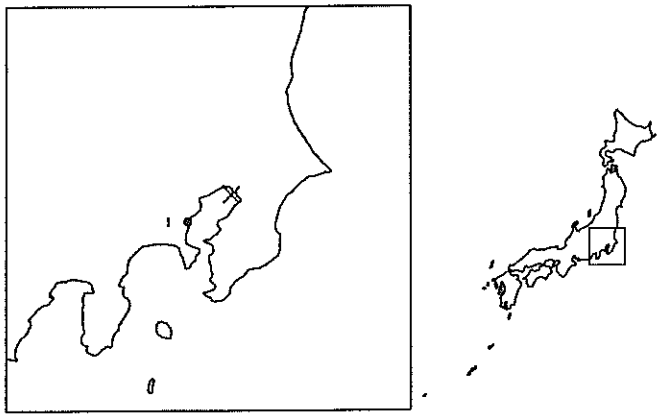
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1335	8	7	4	102

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

05:15 DEC. 3 ,1998
CENTRAL CHIBA PREF
EPICENTER : 35 36.3'N 140 2.4 'E
DEPTH : 66.2KM MAGNITUDE : 4.2

JMA INTENSITIES

II : TOKYO,YOKOHAMA
I : MITO,CHIBA,NIKKO



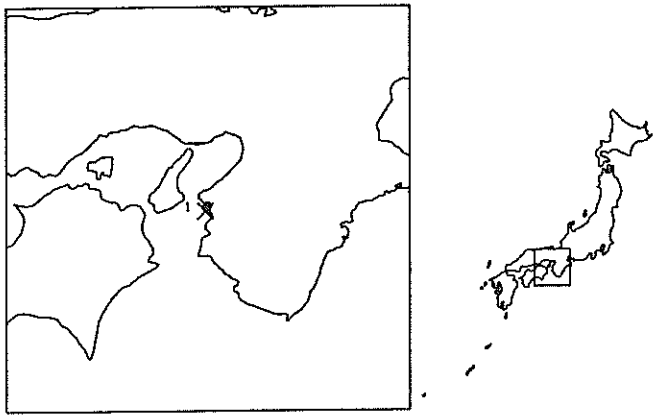
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	YAMASHITA-FR	ON STRUC.	F-1361	9	14	6	38
1	YAMASHITA-F	ON GROUND	F-1360	5	10	7	38
1	YAMASHITA-FB	IN GROUND	F-1359	2	3	3	38

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

01:58 DEC. 6 ,1998
NW WAKAYAMA PREF
EPICENTER : 34 10.8'N 135 8.0 'E
DEPTH : 9.1KM MAGNITUDE : 3.4

JMA INTENSITIES

II : WAKAYAMA



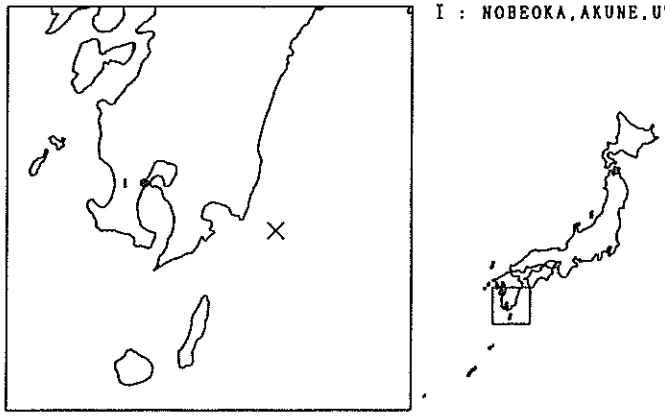
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	WAKAYAMA-G	ON GROUND	F-1355	72	33	31	4

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

09:18 DEC. 16,1998
SE OFF OSUMI PEN
EPICENTER : 31 16.6'N 131 36.2'E
DEPTH : 32.3KM MAGNITUDE : 5.5

JMA INTENSITIES

Ⅳ : MIYAZAKI
Ⅲ : MIYAKONOJO,KAGOSHIMA
Ⅱ : MAKURAZAKI,KUMAMOTO,
HITOYOSHI,OITA
Ⅰ : NOBEOKA,AKUNE,UWAJIMA



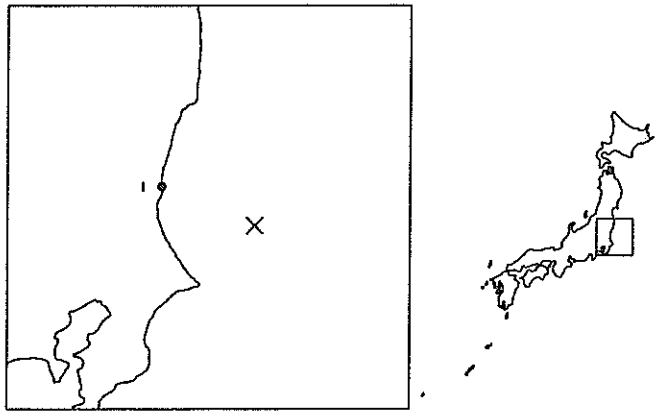
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	KAGOSHIMA-G	ON GROUND	F-1337	14	18	7	103

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

21:49 DEC. 17,1998
FAR E OFF IBARAKI PREF
EPICENTER : 36 4.5 'N 141 22.5'E
DEPTH : 41.4KM MAGNITUDE : 4.9

JMA INTENSITIES

Ⅱ : MITO,CHOSHI
Ⅰ : CHIBA,FUKUSHIMA,
SHIRAKAWA,NIKKO,TOKYO,
YOKOHAMA



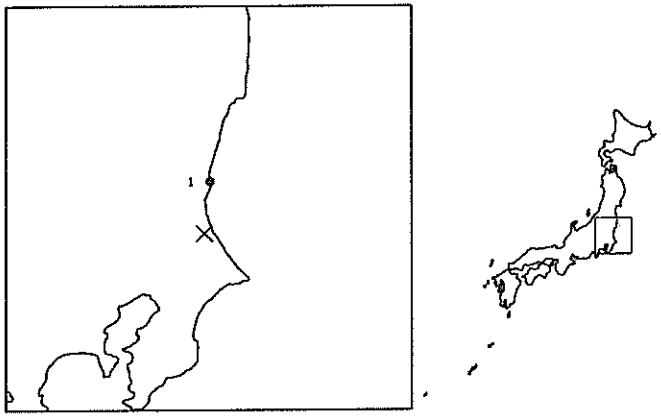
	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1342	11	18	4	76

STRONG-MOTION EARTHQUAKE OBSERVATION RESULTS

19:23 DEC. 22,1998
SOUTHERN IBARAKI PREF
EPICENTER : 36 2.4 'N 140 32.2'E
DEPTH : 61.2KM MAGNITUDE : 4.1

JMA INTENSITIES

Ⅱ : MITO
Ⅰ : NIKKO,SHIRAKAWA,
YOKOHAMA



	STATION	CONDITION	RECORD NUMBER	MAX.ACC.(GAL) (NS)	(EW)	(UD)	DIST. (KM)
1	HITACHINAKA-F	ON GROUND	F-1343	8	7	3	39

Results of Preliminary Analyses (1998)

RECORD NUMBER : F-1300

STATION : HANASAKI-F

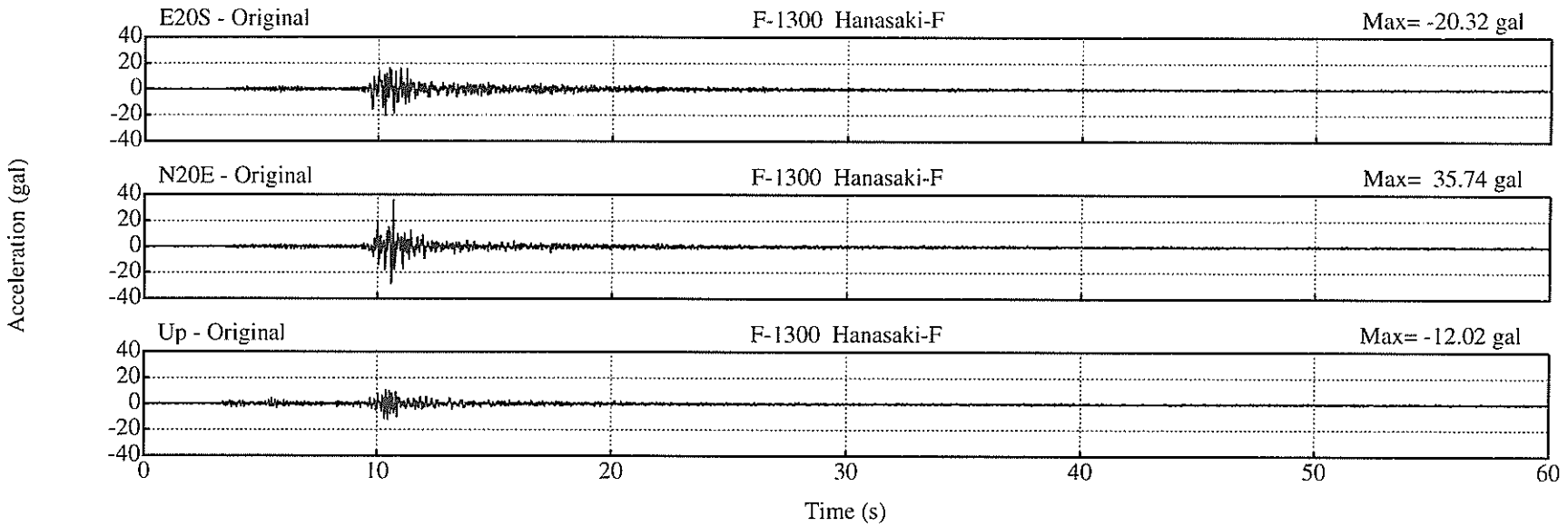
EARTHQUAKE DATA

DATE AND TIME	3:19 JAN. 3,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	OFF NEMURO PENINSULA
LATITUDE	42°56.3′ N
LONGITUDE	145°24.8′ E
DEPTH	50.2KM
JMA MAGNITUDE	4.8

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	35.7	20.3	12.0	39.7

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1219

STATION : KUSHIRO-G

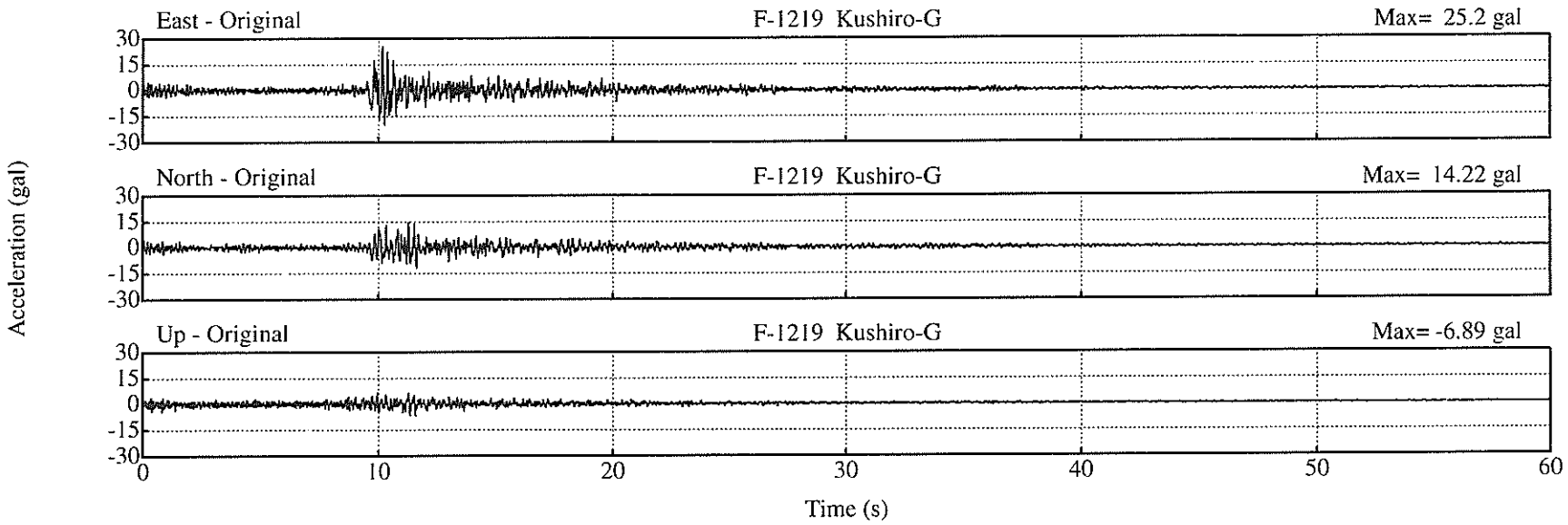
EARTHQUAKE DATA

DATE AND TIME	3:19 JAN. 3,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	OFF NEMURO PENINSULA
LATITUDE	42°56.3′ N
LONGITUDE	145°24.8′ E
DEPTH	50.2KM
JMA MAGNITUDE	4.8

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	14.2	25.2	6.9	25.7

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1353

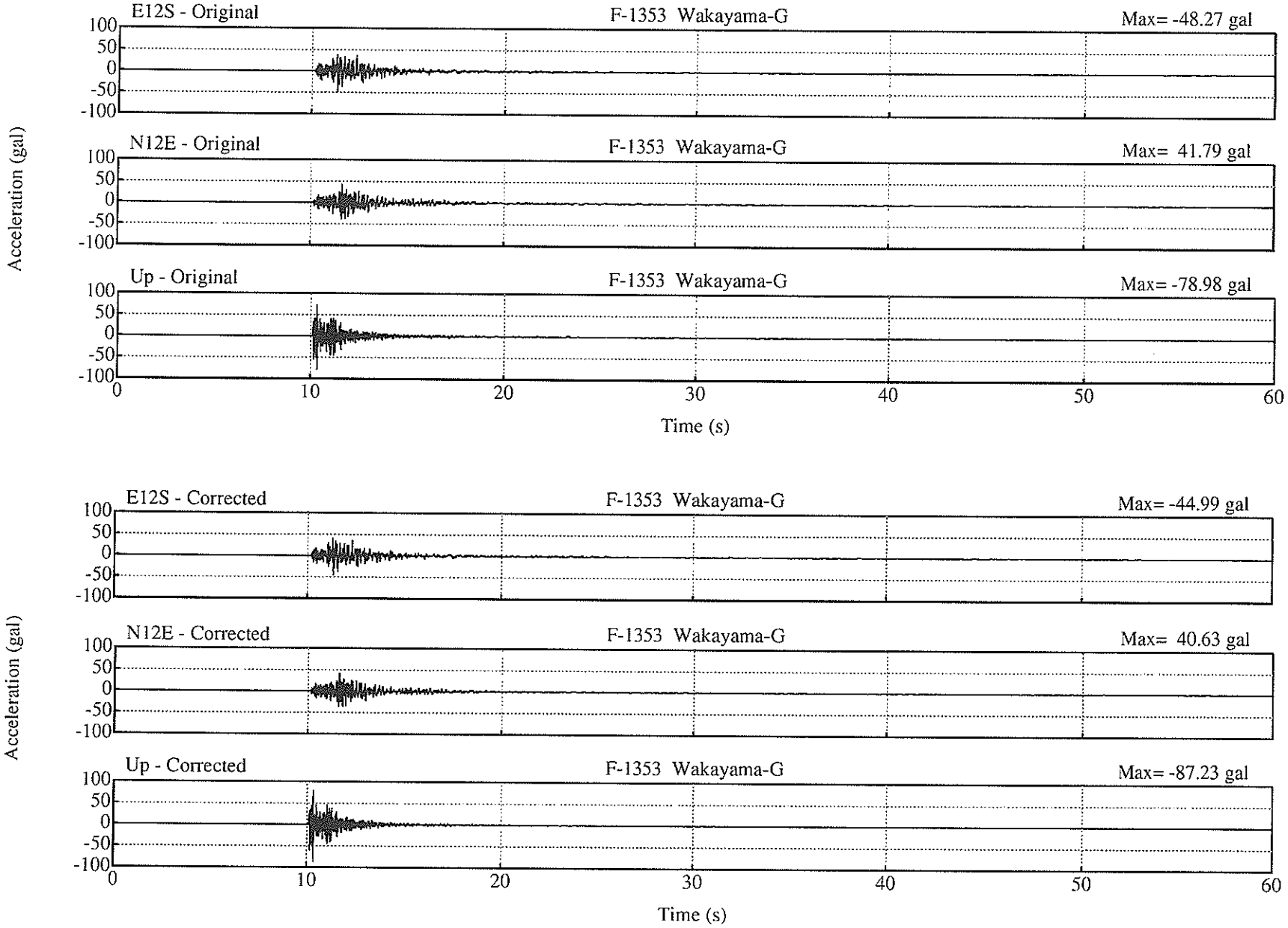
STATION : WAKAYAMA-G

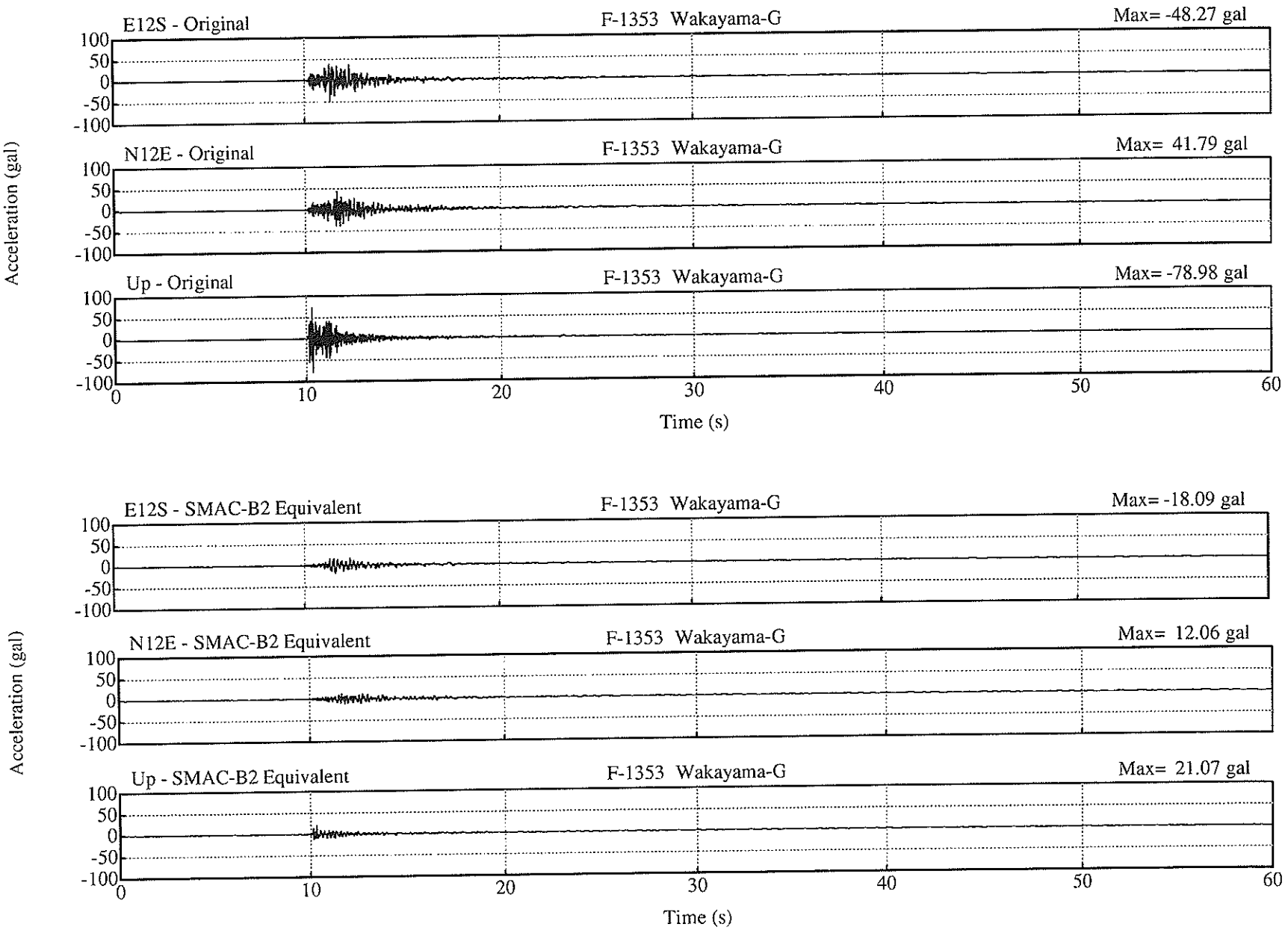
EARTHQUAKE DATA

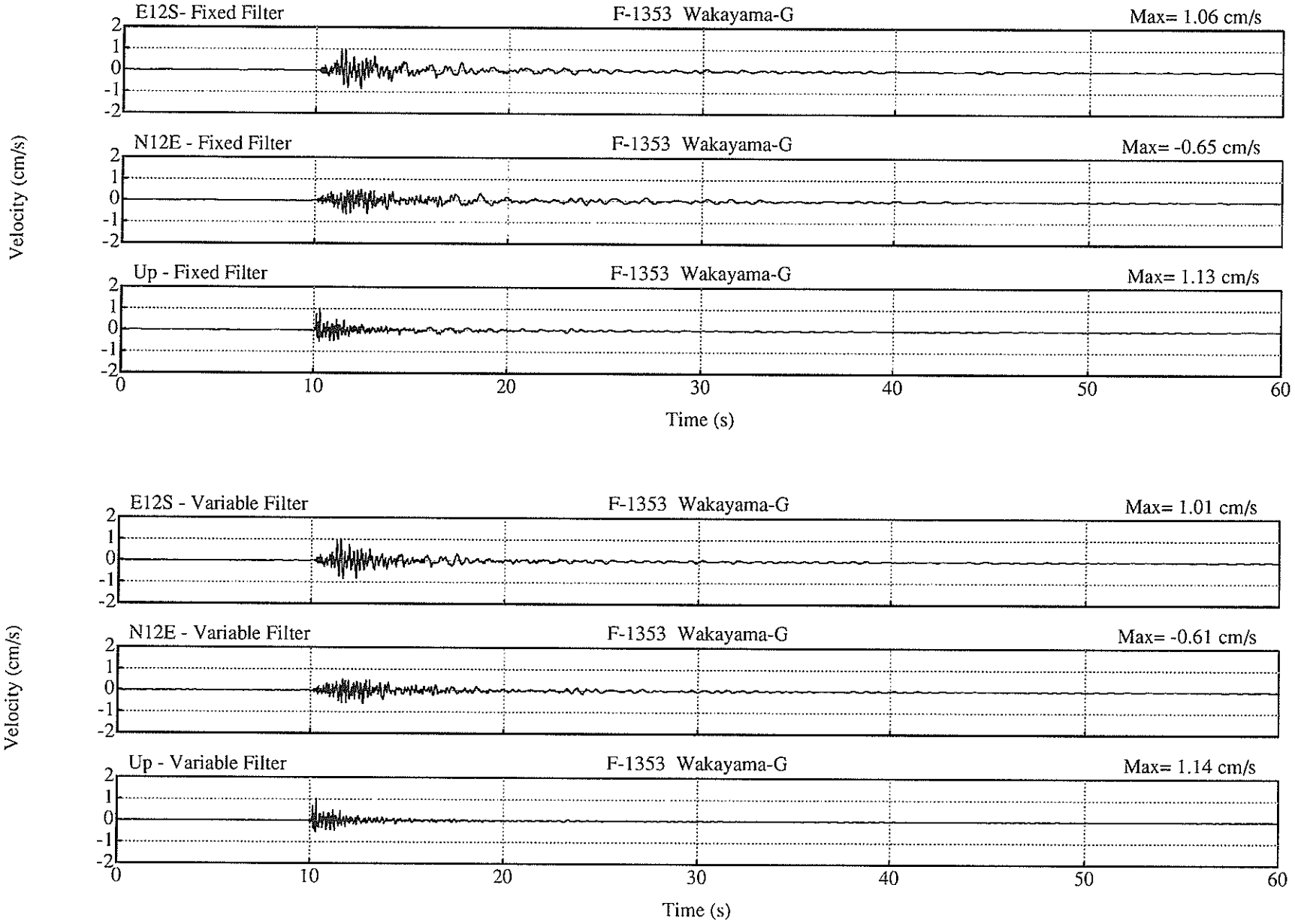
DATE AND TIME	6:32 JAN.24,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	NW WAKAYAMA PREF
LATITUDE	34°12.2′ N
LONGITUDE	135° 9.1′ E
DEPTH	11.1KM
JMA MAGNITUDE	3.7

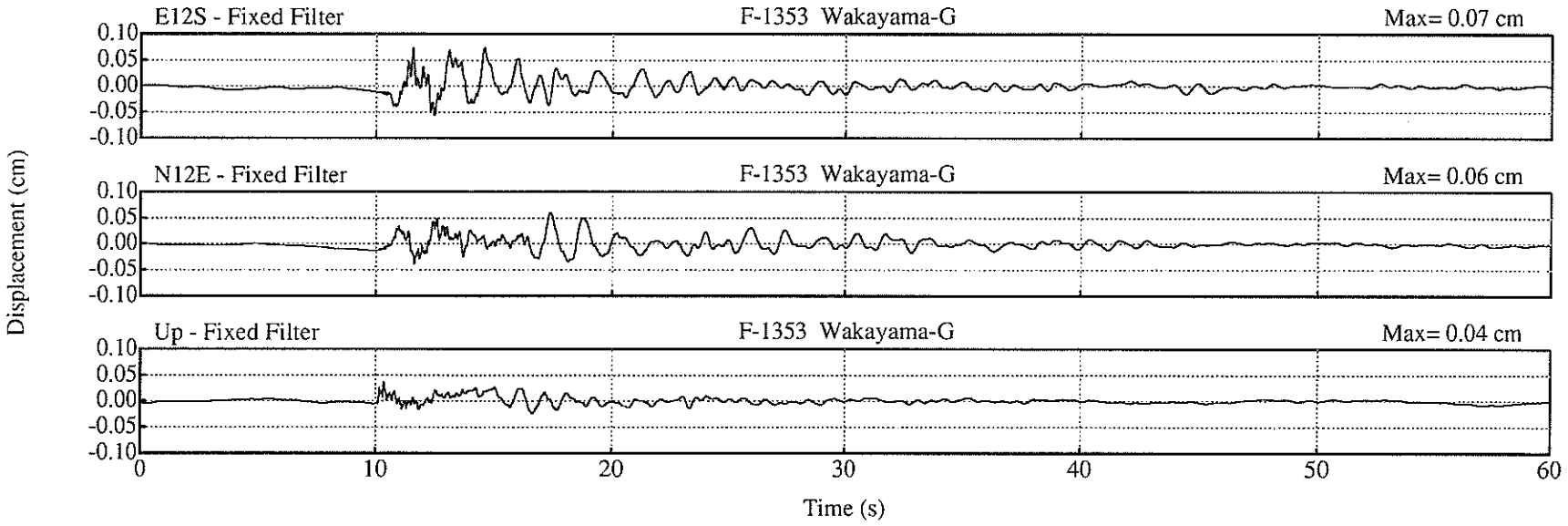
	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
PARAMETER OF THE VARIABLE FILTER				
FC (HZ)	0.909	0.817	1.550	
MAXIMUM ACCELERATION (GAL)				
SMAC-B2 EQUIVALENT	12.1	18.1	21.1	18.1
ORIGINAL	41.8	48.3	79.0	48.4
CORRECTED	40.6	45.0	87.2	45.4
MAXIMUM VELOCITY (CM/SEC)				
FIXED FILTER	0.65	1.06	1.13	1.09
VARIABLE FILTER	0.61	1.01	1.14	1.04
MAXIMUM DISPLACEMENT (CM)				
FIXED FILTER	0.06	0.07	0.04	0.08
VARIABLE FILTER	0.03	0.05	0.02	0.05

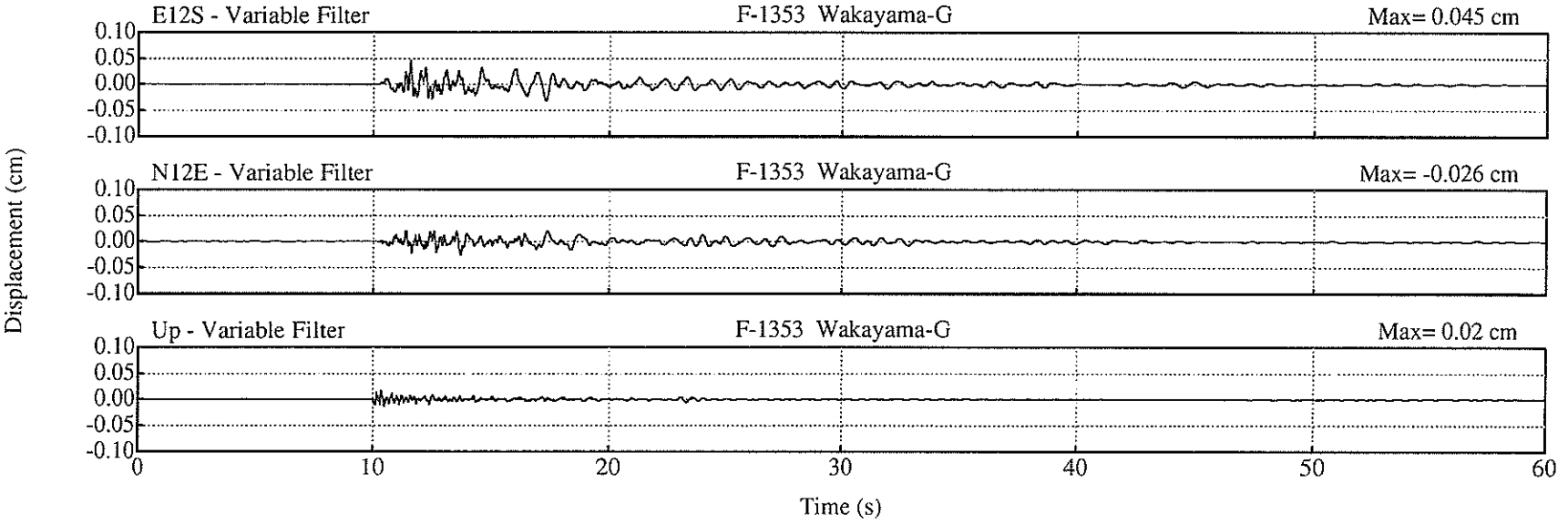
* RESULTANT OF HORIZONTAL COMPONENTS

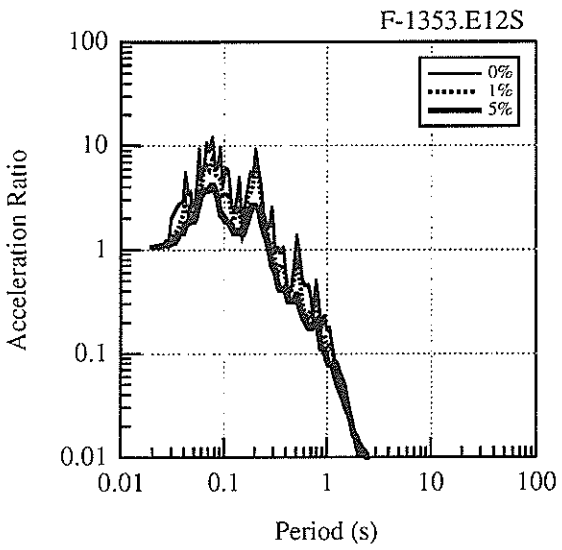

E12S - Original
F-1353 Wakayama-G
Max= -48.27 gal
N12E - Original
F-1353 Wakayama-G
Max= 41.79 gal
Up - Original
F-1353 Wakayama-G
Max= -78.98 gal
Acceleration (gal)
Time (s)
E12S - Corrected
F-1353 Wakayama-G
Max= -44.99 gal
N12E - Corrected
F-1353 Wakayama-G
Max= 40.63 gal
Up - Corrected
F-1353 Wakayama-G
Max= -87.23 gal
Acceleration (gal)
Time (s)

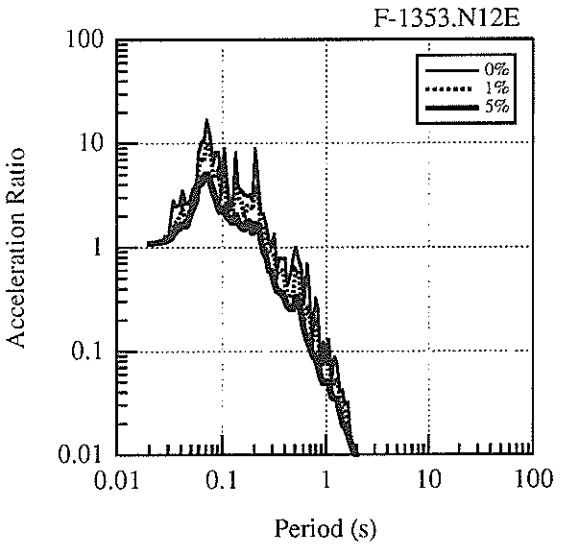

E12S - Original
F-1353 Wakayama-G
Max= -48.27 gal
N12E - Original
F-1353 Wakayama-G
Max= 41.79 gal
Up - Original
F-1353 Wakayama-G
Max= -78.98 gal
Acceleration (gal)
100
50
0
-50
-100
0
10
20
30
40
50
60
Time (s)
E12S - SMAC-B2 Equivalent
F-1353 Wakayama-G
Max= -18.09 gal
N12E - SMAC-B2 Equivalent
F-1353 Wakayama-G
Max= 12.06 gal
Up - SMAC-B2 Equivalent
F-1353 Wakayama-G
Max= 21.07 gal
Acceleration (gal)
Time (s)

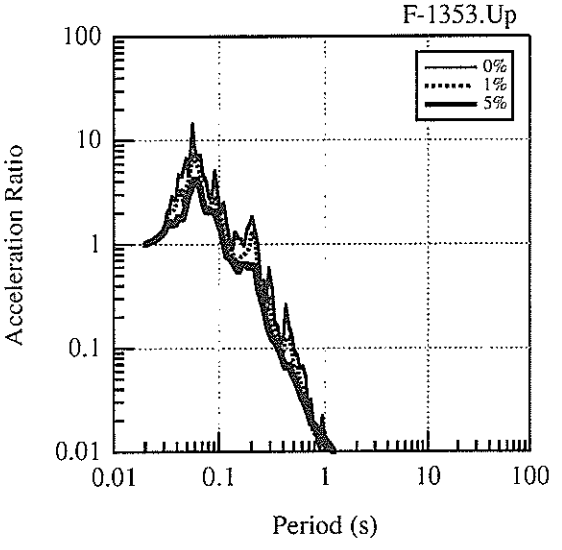

E12S- Fixed Filter
F-1353 Wakayama-G
Max= 1.06 cm/s
N12E - Fixed Filter
F-1353 Wakayama-G
Max= -0.65 cm/s
Up - Fixed Filter
F-1353 Wakayama-G
Max= 1.13 cm/s
Velocity (cm/s)
Time (s)
E12S - Variable Filter
F-1353 Wakayama-G
Max= 1.01 cm/s
N12E - Variable Filter
F-1353 Wakayama-G
Max= -0.61 cm/s
Up - Variable Filter
F-1353 Wakayama-G
Max= 1.14 cm/s
Velocity (cm/s)
Time (s)

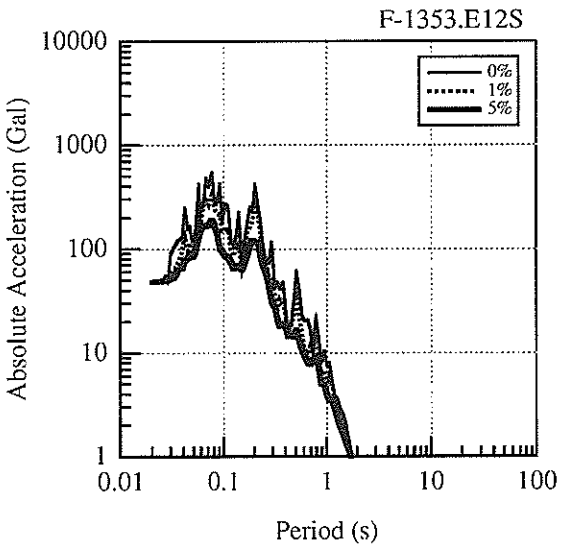

E12S - Fixed Filter
F-1353 Wakayama-G
Max= 0.07 cm
N12E - Fixed Filter
F-1353 Wakayama-G
Max= 0.06 cm
Up - Fixed Filter
F-1353 Wakayama-G
Max= 0.04 cm
Displacement (cm)
0.10
0.05
0.00
-0.05
-0.10
0
10
20
30
40
50
60
Time (s)

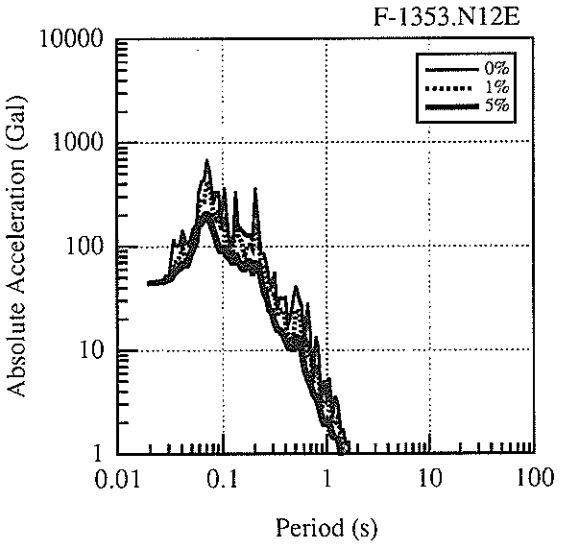

E12S - Variable Filter
F-1353 Wakayama-G
Max= 0.045 cm
N12E - Variable Filter
F-1353 Wakayama-G
Max= -0.026 cm
Up - Variable Filter
F-1353 Wakayama-G
Max= 0.02 cm
Displacement (cm)
0.10
0.05
0.00
-0.05
-0.10
0
10
20
30
40
50
60
Time (s)

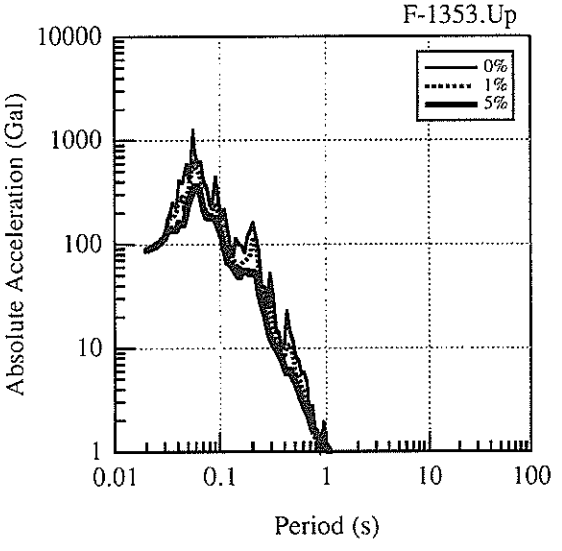

F-1353.E12S
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

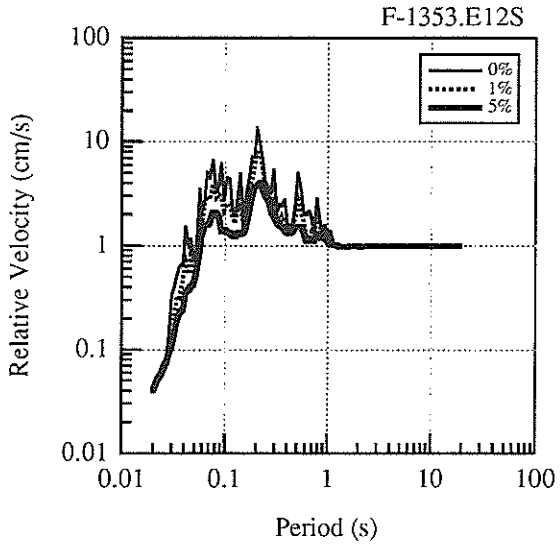

F-1353.N12E
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

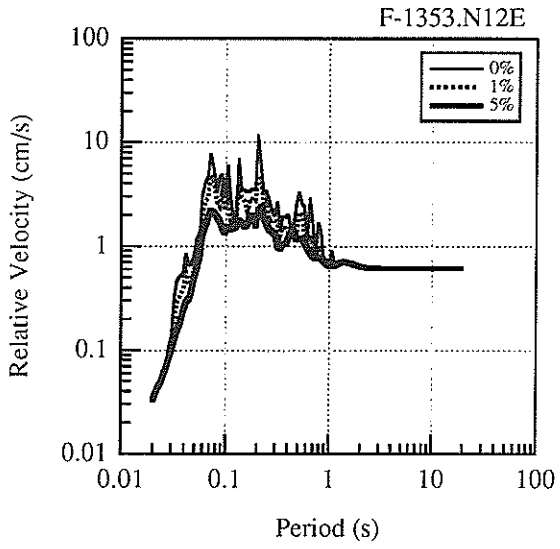

F-1353.Up
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

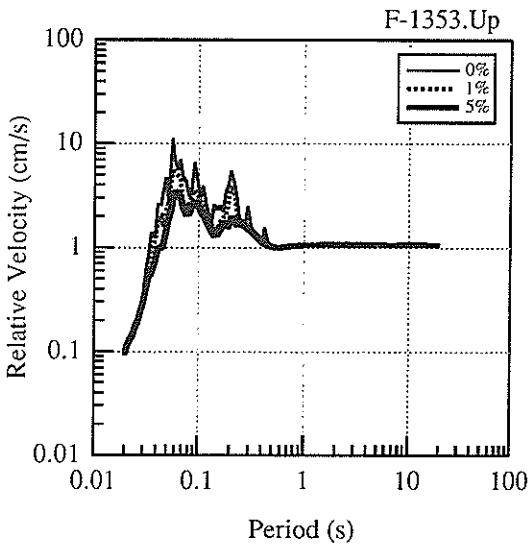

F-1353.E12S
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

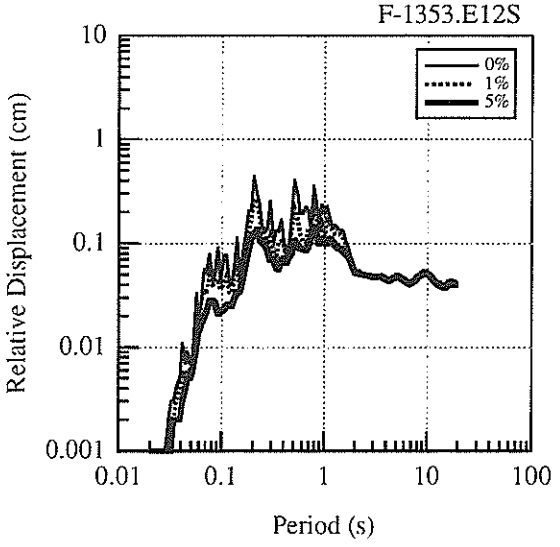

F-1353.N12E
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

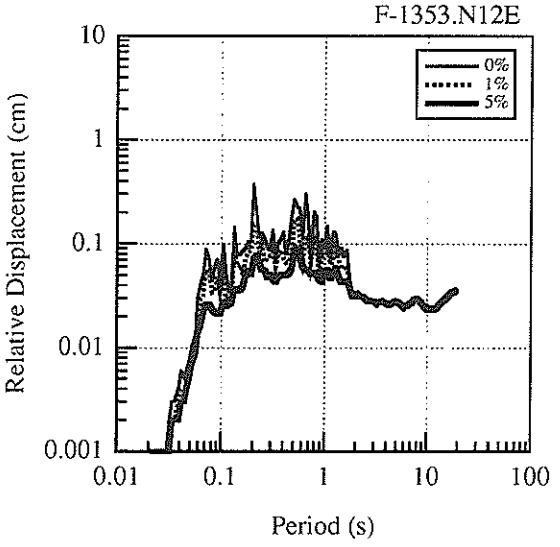

F-1353.Up
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

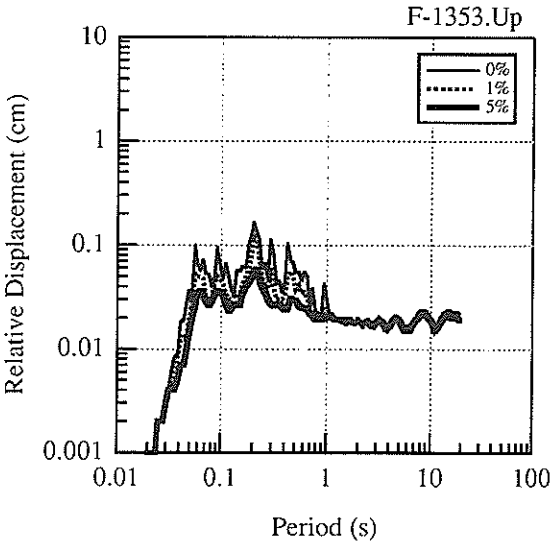

F-1353.E12S
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

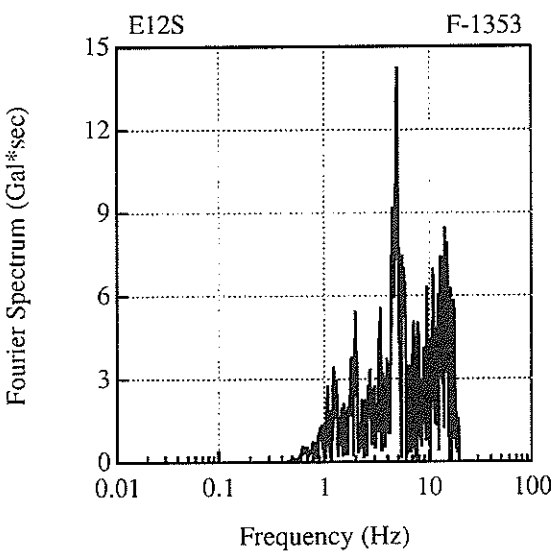

F-1353.N12E
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

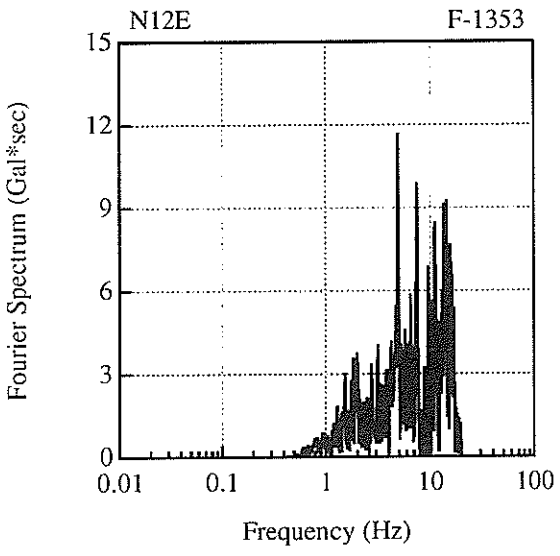

F-1353.Up
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

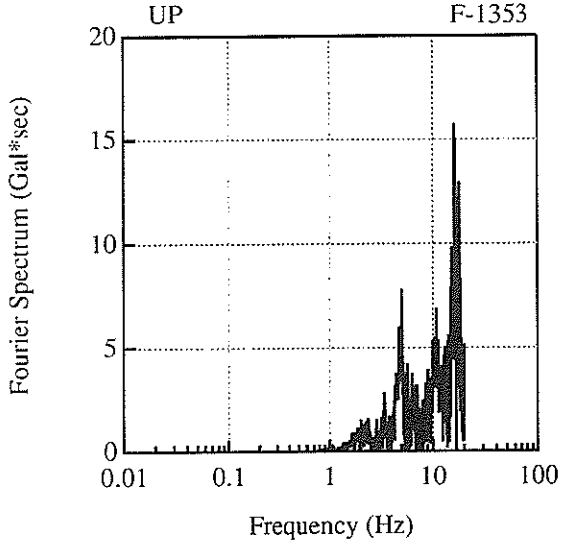

F-1353.E12S
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

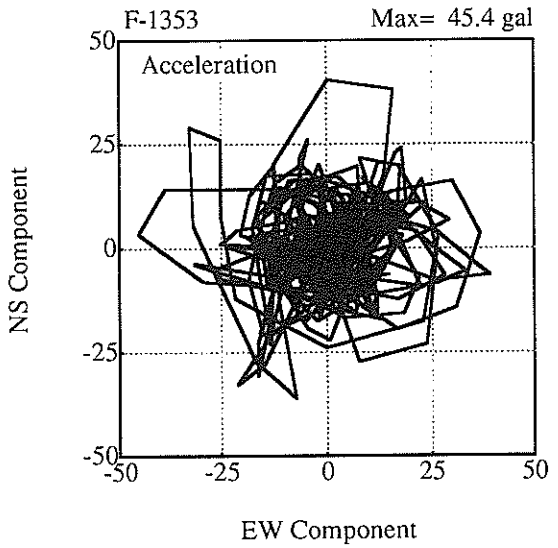

F-1353.N12E
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

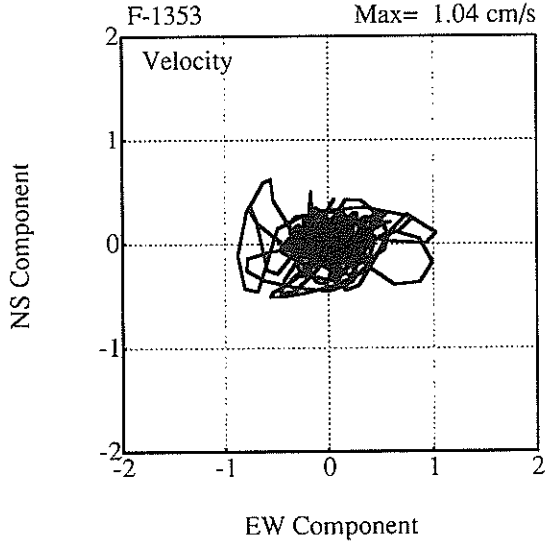

F-1353.Up
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

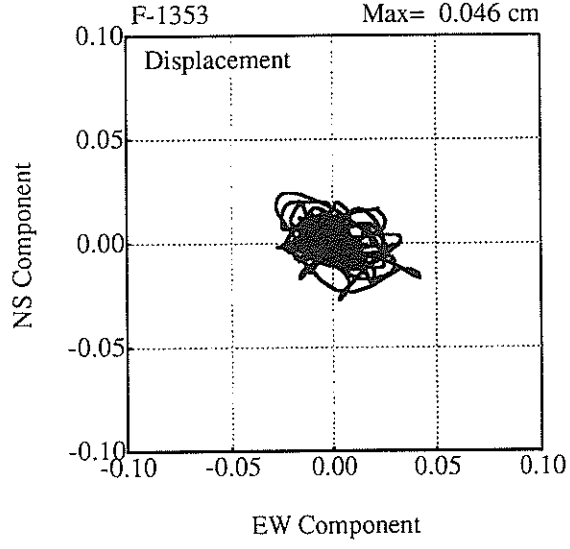

E12S
F-1353
Fourier Spectrum (Gal*sec)
15
12
9
6
3
0
0.01
0.1
1
10
100
Frequency (Hz)


N12E
F-1353
Fourier Spectrum (Gal*sec)
15
12
9
6
3
0
0.01
0.1
1
10
100
Frequency (Hz)


UP
F-1353
Fourier Spectrum (Gal*sec)
20
15
10
5
0
0.01
0.1
1
10
100
Frequency (Hz)


F-1353
Max= 45.4 gal
Acceleration
NS Component
50
25
0
-25
-50
-50
-25
0
25
50
EW Component


F-1353
Max= 1.04 cm/s
Velocity
NS Component
2
1
0
-1
-2
-2
-1
0
1
2
EW Component


F-1353
Max= 0.046 cm
Displacement
NS Component
0.10
0.05
0.00
-0.05
-0.10
-0.10
-0.05
0.00
0.05
0.10
EW Component

RECORD NUMBER : F-1273

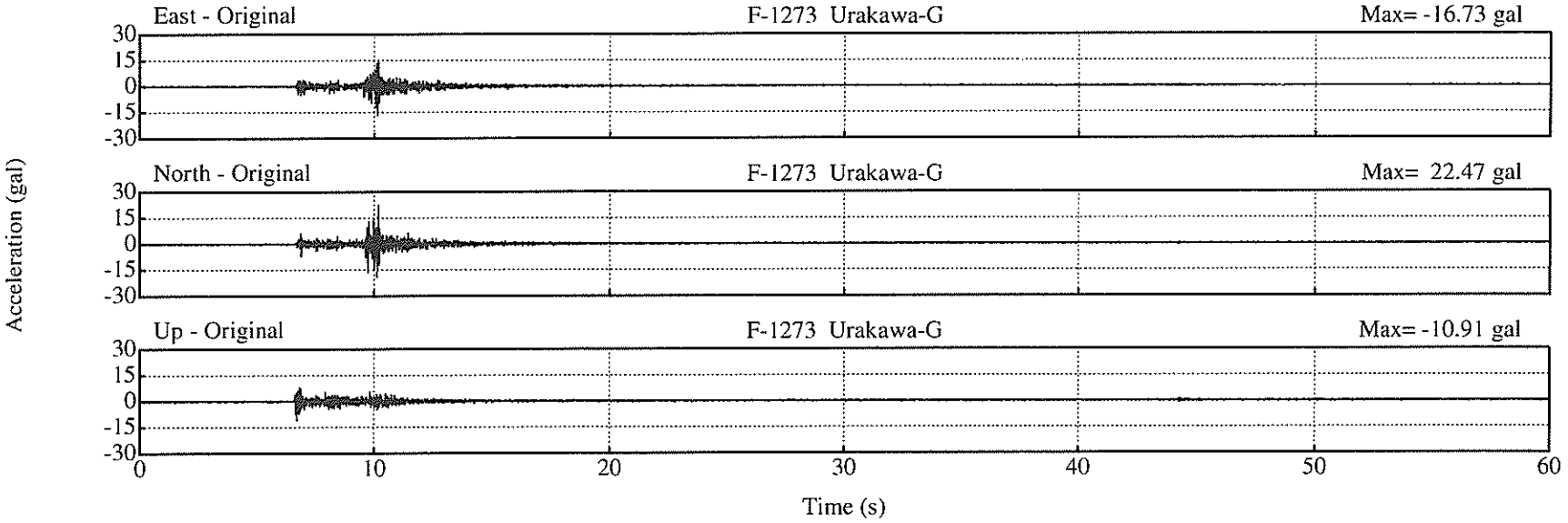
STATION : URAKAWA-G

EARTHQUAKE DATA

DATE AND TIME	23:16 JAN.31,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	NOT AVAILABLE
LATITUDE	NOT AVAILABLE
LONGITUDE	NOT AVAILABLE
DEPTH	NOT AVAILABLE
JMA MAGNITUDE	NOT AVAILABLE (EARTHQUAKE UNKNOWN)

	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	22.5	16.7	10.9	24.1

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1265

STATION : TOKACHI-G

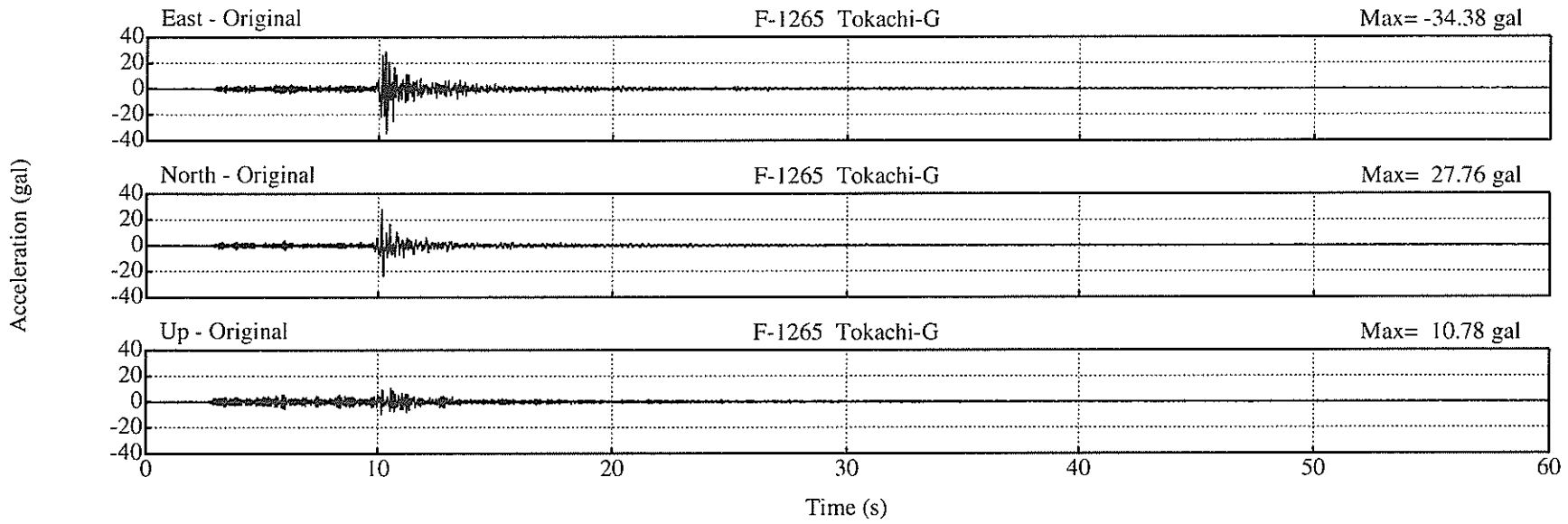
EARTHQUAKE DATA

DATE AND TIME	23:55 FEB.16,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	TOKACHI REGION
LATITUDE	42°33.8′ N
LONGITUDE	143°32.6′ E
DEPTH	59.2KM
JMA MAGNITUDE	4.2

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	27.8	34.4	10.8	37.8

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1303

STATION : HANASAKI-F

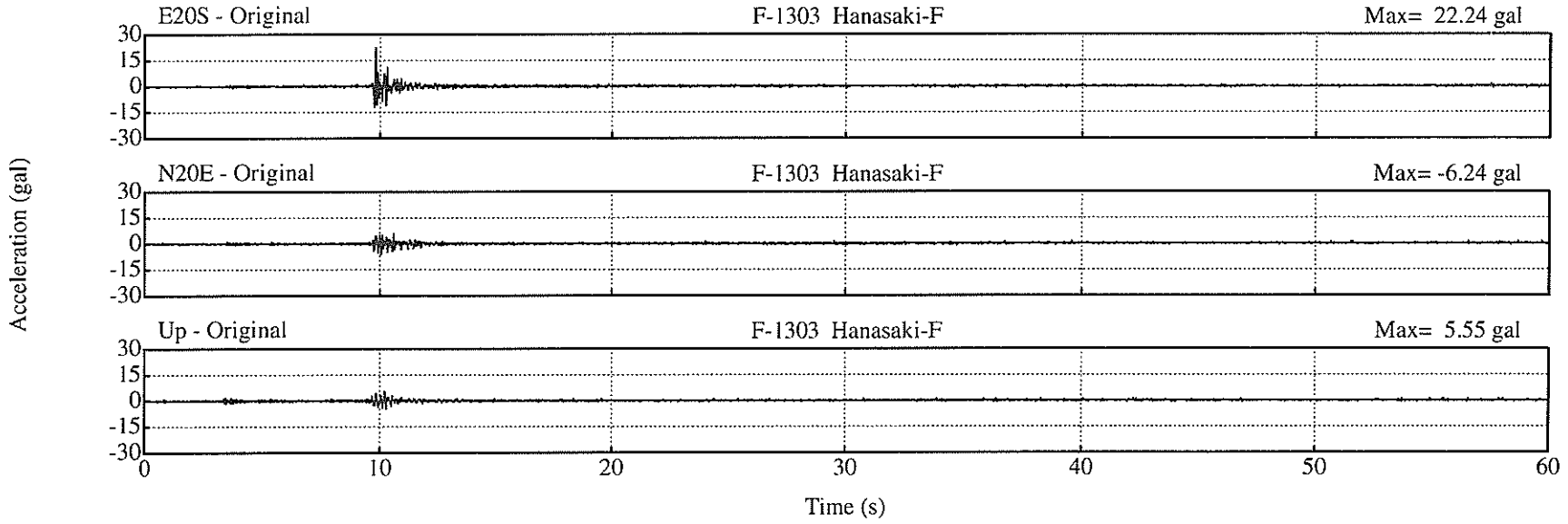
EARTHQUAKE DATA

DATE AND TIME	0: 1 MAR. 5,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	OFF NEMURO PENINSULA
LATITUDE	42°54.6′ N
LONGITUDE	145°28.7′ E
DEPTH	49.2KM
JMA MAGNITUDE	4.2

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	6.2	22.2	5.5	22.7

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1229

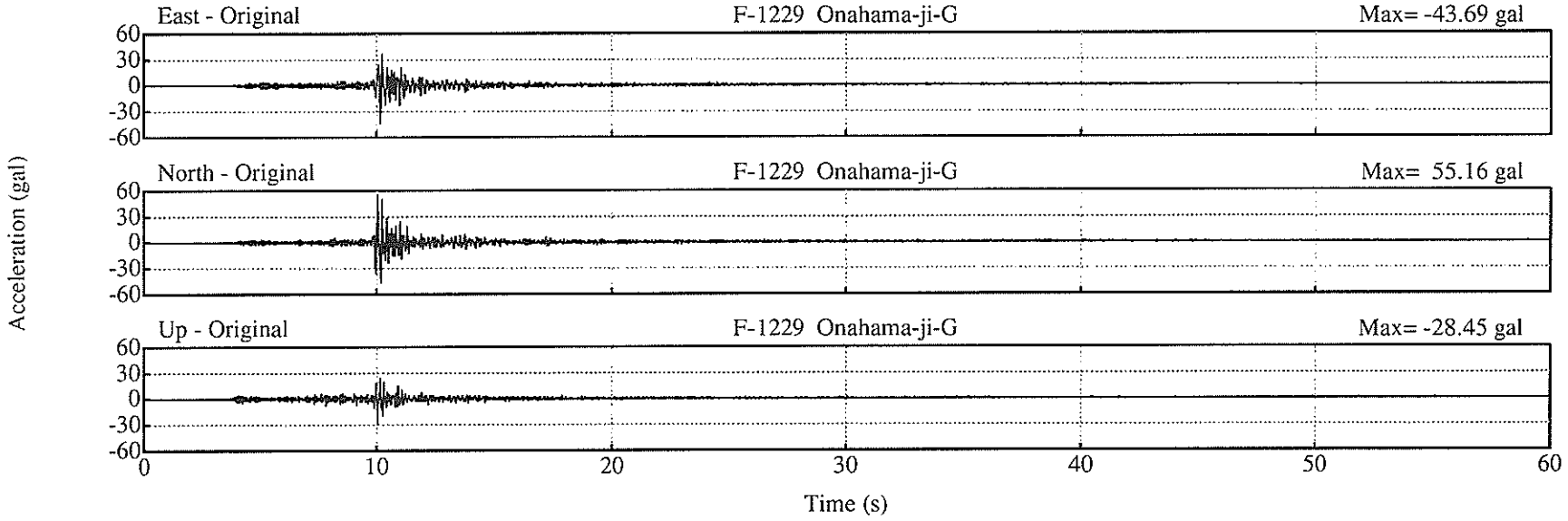
STATION : ONAHAMA-JI-G

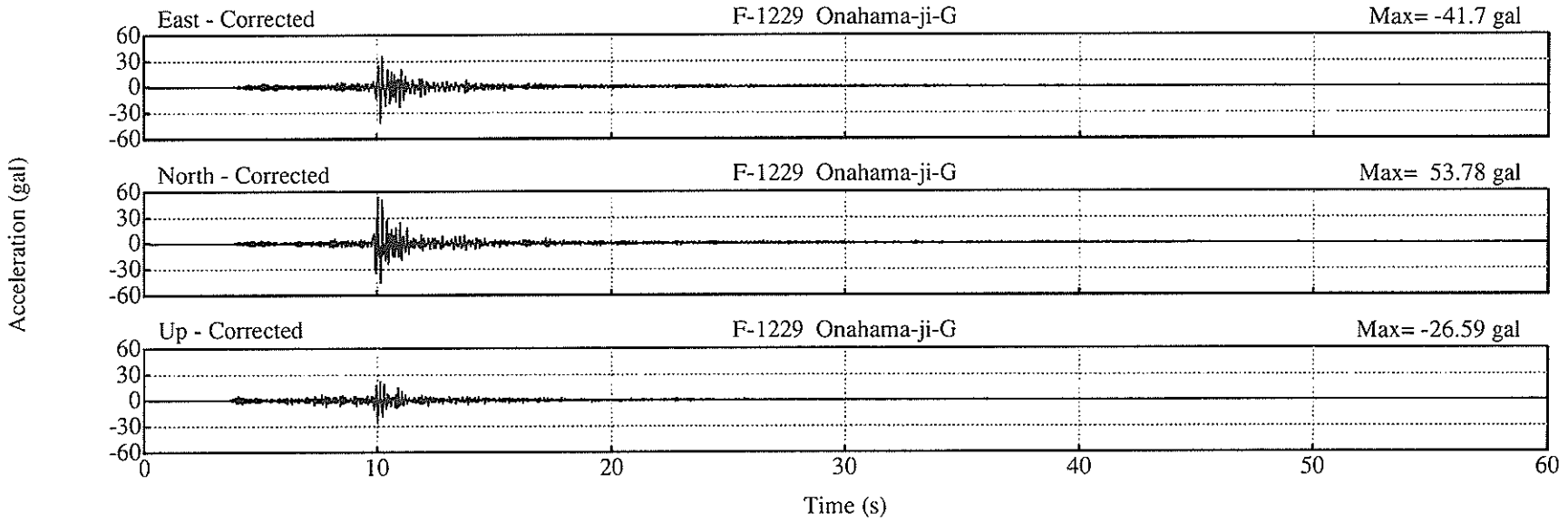
EARTHQUAKE DATA

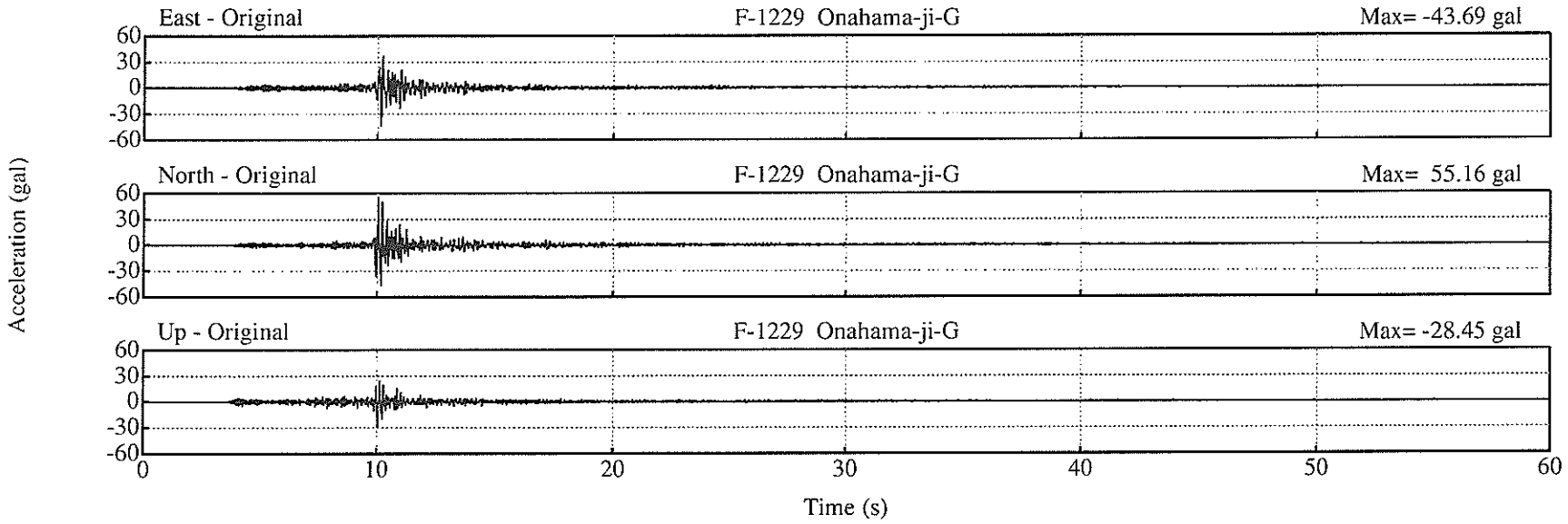
DATE AND TIME	8: 3 MAR.17,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	E OFF FUKUSHIMA PREF
LATITUDE	37° 1.7′ N
LONGITUDE	141°15.6′ E
DEPTH	51.3KM
JMA MAGNITUDE	4.5

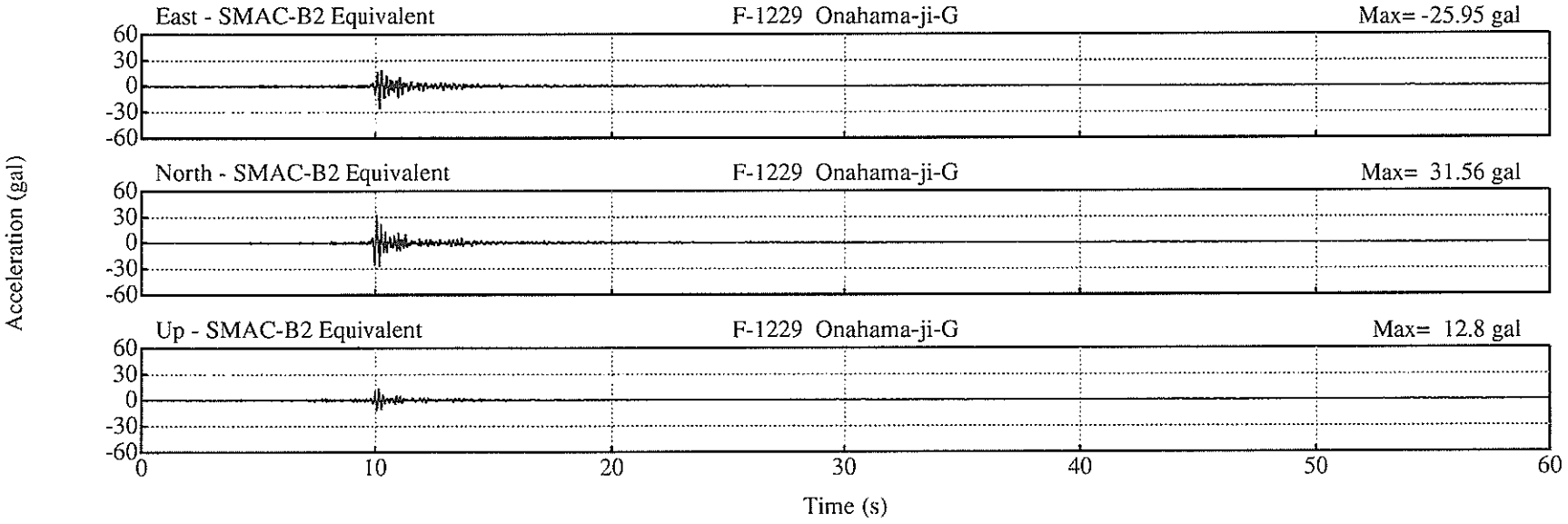
	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
PARAMETER OF THE VARIABLE FILTER				
FC (HZ)	2.026	2.447	3.039	
MAXIMUM ACCELERATION (GAL)				
SMAC-B2 EQUIVALENT	31.6	26.0	12.8	37.1
ORIGINAL	55.2	43.7	28.4	61.5
CORRECTED	53.8	41.7	26.6	60.9
MAXIMUM VELOCITY (CM/SEC)				
FIXED FILTER	1.61	1.28	0.58	1.82
VARIABLE FILTER	1.42	1.14	0.57	1.73
MAXIMUM DISPLACEMENT (CM)				
FIXED FILTER	0.07	0.06	0.02	0.07
VARIABLE FILTER	0.05	0.03	0.02	0.05

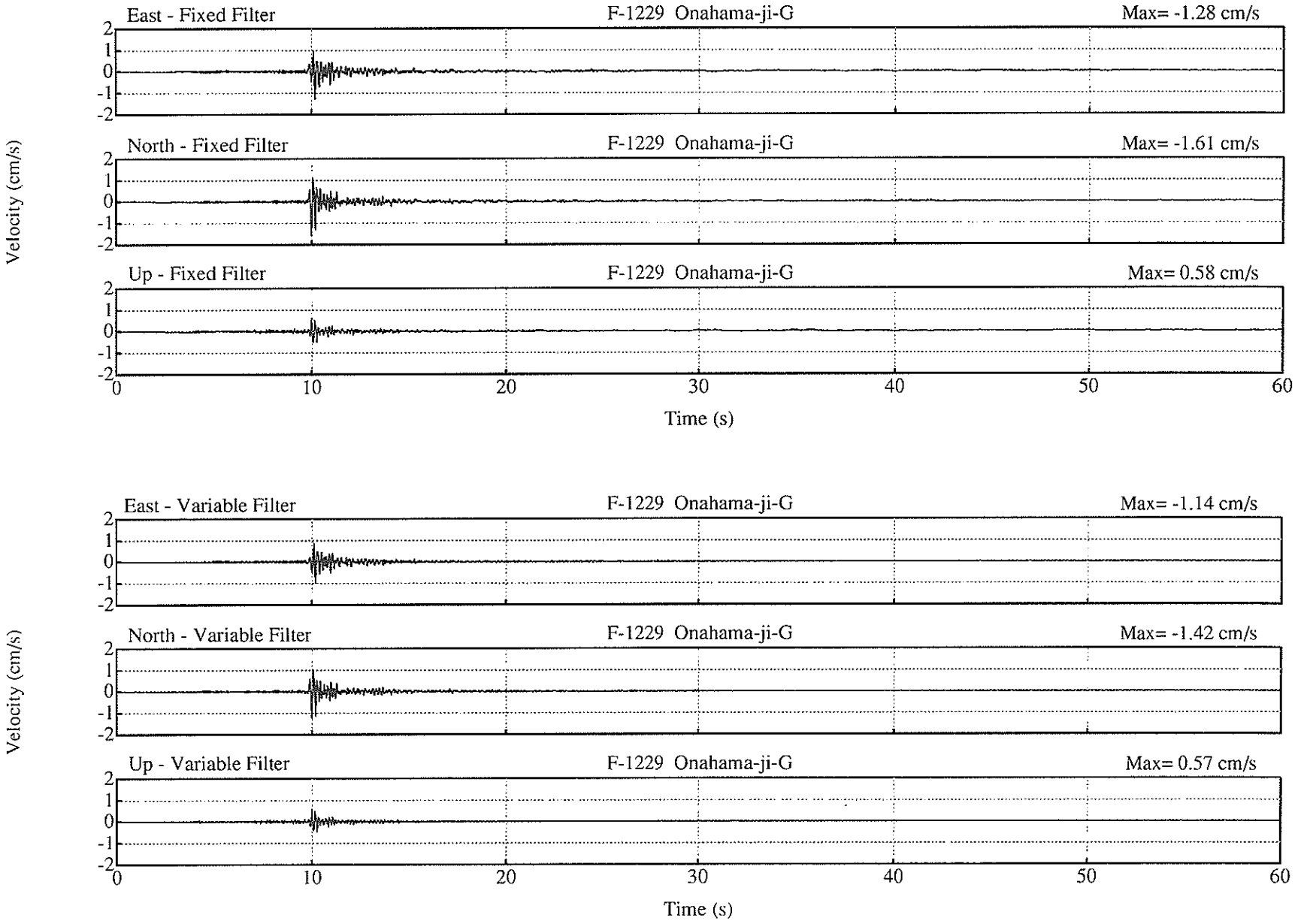
* RESULTANT OF HORIZONTAL COMPONENTS

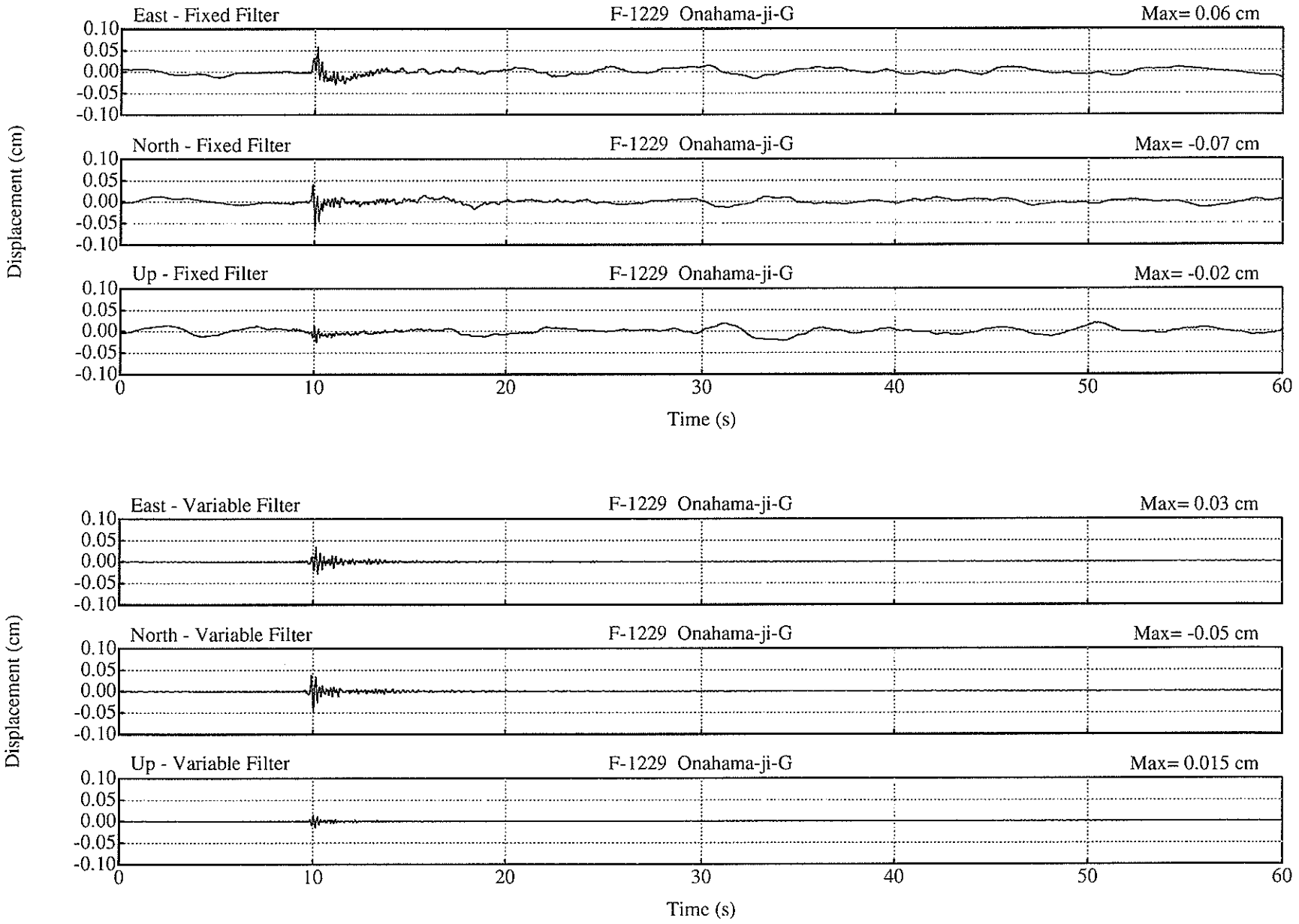

East - Original
F-1229 Onahama-ji-G
Max= -43.69 gal
North - Original
F-1229 Onahama-ji-G
Max= 55.16 gal
Up - Original
F-1229 Onahama-ji-G
Max= -28.45 gal
Acceleration (gal)
60
30
0
-30
-60
0
10
20
30
40
50
60
Time (s)

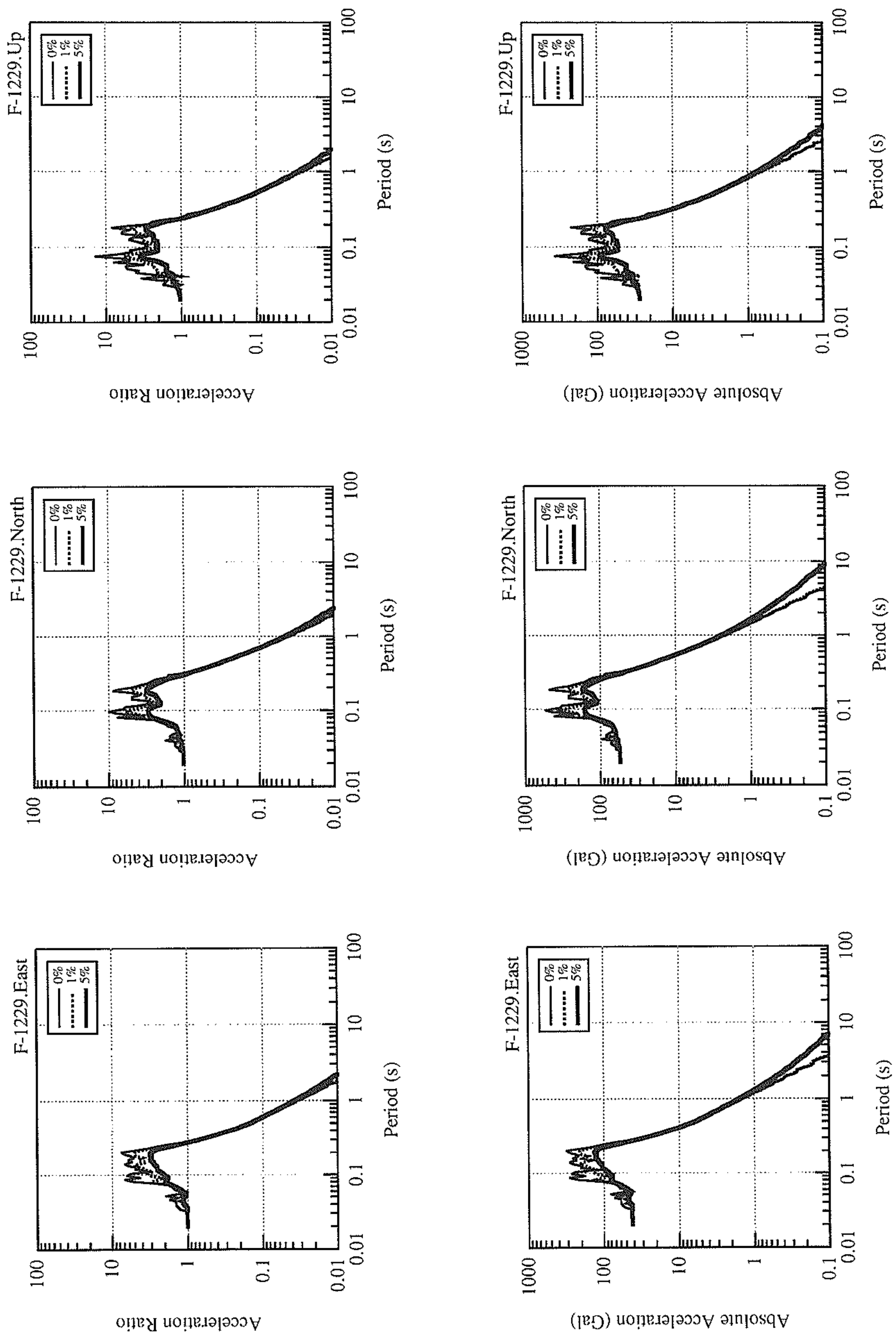

East - Corrected
F-1229 Onahama-ji-G
Max= -41.7 gal
North - Corrected
F-1229 Onahama-ji-G
Max= 53.78 gal
Up - Corrected
F-1229 Onahama-ji-G
Max= -26.59 gal
Acceleration (gal)
60
30
0
-30
-60
0
10
20
30
40
50
60
Time (s)


East - Original
F-1229 Onahama-ji-G
Max= -43.69 gal
North - Original
F-1229 Onahama-ji-G
Max= 55.16 gal
Up - Original
F-1229 Onahama-ji-G
Max= -28.45 gal
Acceleration (gal)
60
30
0
-30
-60
0
10
20
30
40
50
60
Time (s)

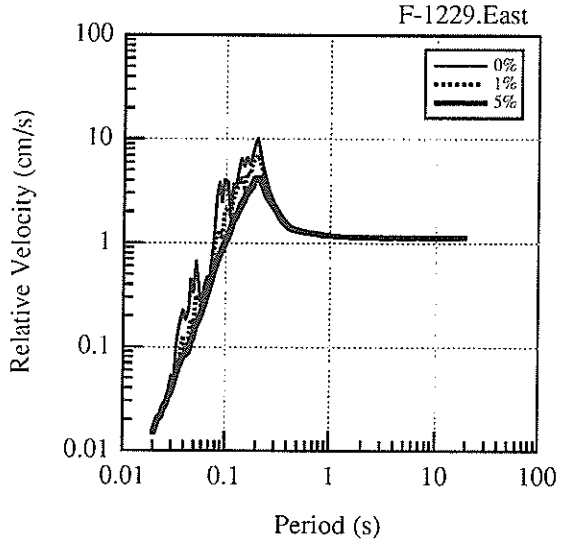

East - SMAC-B2 Equivalent
F-1229 Onahama-ji-G
Max= -25.95 gal
North - SMAC-B2 Equivalent
F-1229 Onahama-ji-G
Max= 31.56 gal
Up - SMAC-B2 Equivalent
F-1229 Onahama-ji-G
Max= 12.8 gal
Acceleration (gal)
60
30
0
-30
-60
0
10
20
30
40
50
60
Time (s)

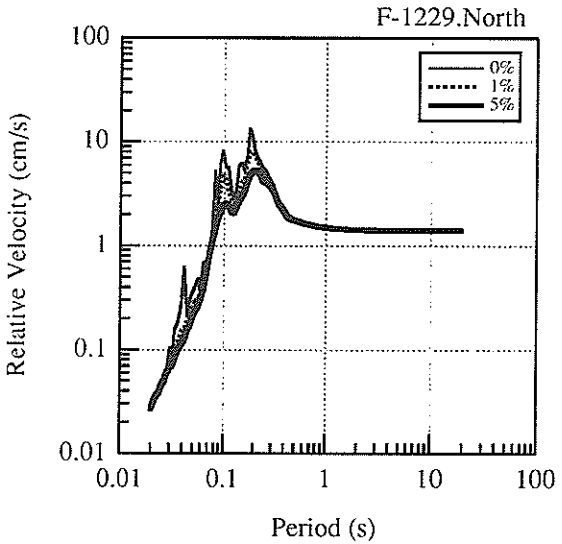

East - Fixed Filter
F-1229 Onahama-ji-G
Max= -1.28 cm/s
North - Fixed Filter
F-1229 Onahama-ji-G
Max= -1.61 cm/s
Up - Fixed Filter
F-1229 Onahama-ji-G
Max= 0.58 cm/s
Velocity (cm/s)
Time (s)
East - Variable Filter
F-1229 Onahama-ji-G
Max= -1.14 cm/s
North - Variable Filter
F-1229 Onahama-ji-G
Max= -1.42 cm/s
Up - Variable Filter
F-1229 Onahama-ji-G
Max= 0.57 cm/s
Velocity (cm/s)
Time (s)

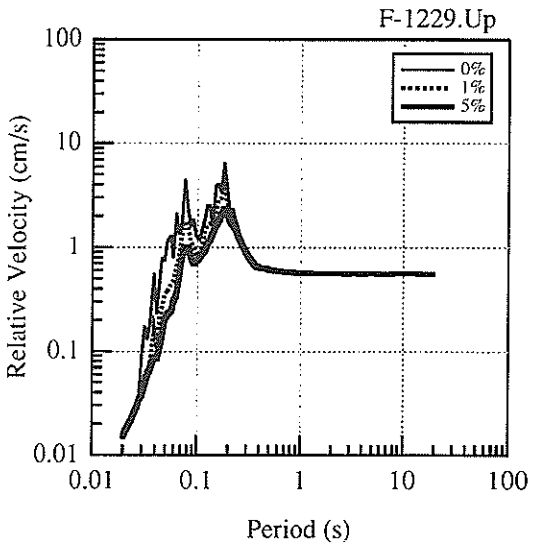

East - Fixed Filter
F-1229 Onahama-ji-G
Max= 0.06 cm
North - Fixed Filter
F-1229 Onahama-ji-G
Max= -0.07 cm
Up - Fixed Filter
F-1229 Onahama-ji-G
Max= -0.02 cm
East - Variable Filter
F-1229 Onahama-ji-G
Max= 0.03 cm
North - Variable Filter
F-1229 Onahama-ji-G
Max= -0.05 cm
Up - Variable Filter
F-1229 Onahama-ji-G
Max= 0.015 cm
0.10
0.05
0.00
-0.05
-0.10
0
10
20
30
40
50
60
Displacement (cm)
Time (s)

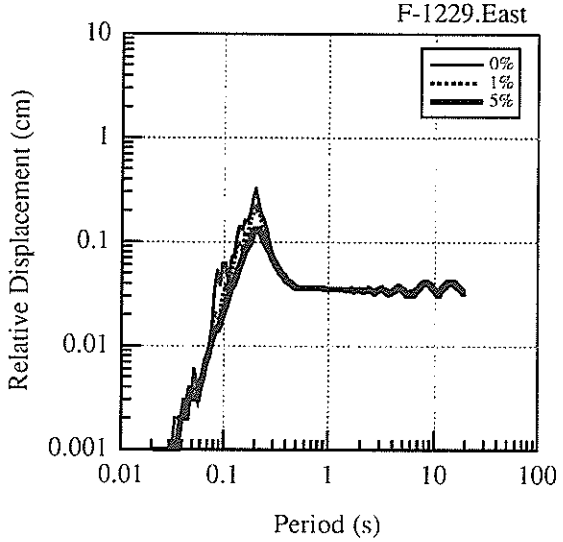


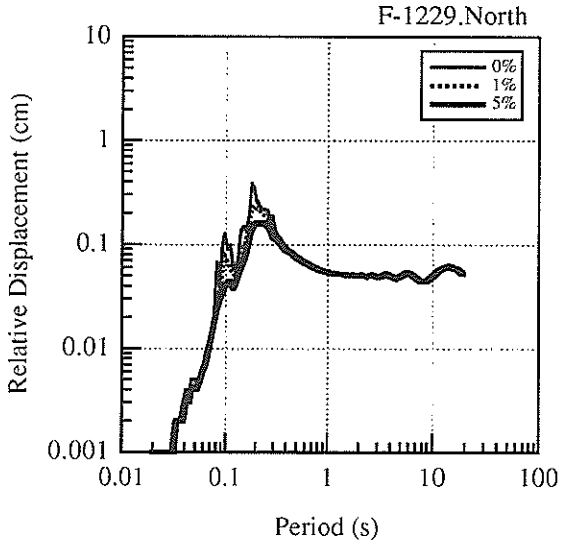
F-1229.East
F-1229.North
F-1229.Up
Acceleration Ratio
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%

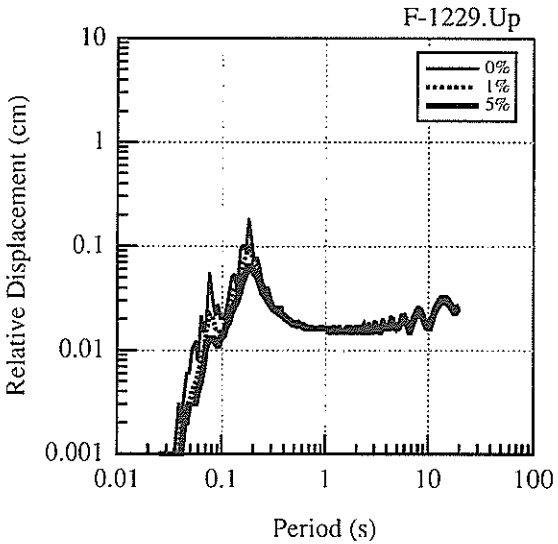

F-1229.East
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

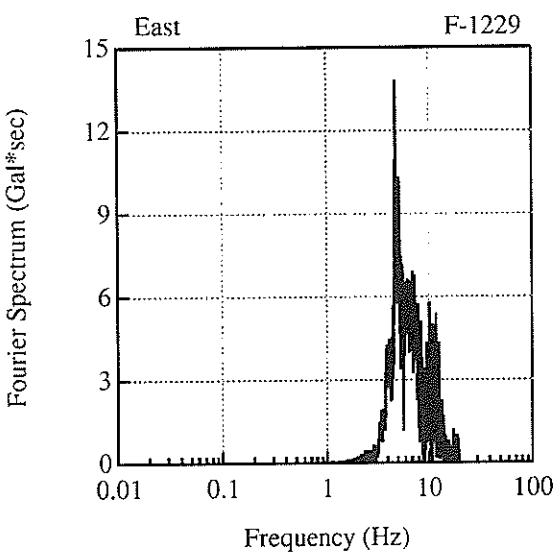

F-1229.North
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

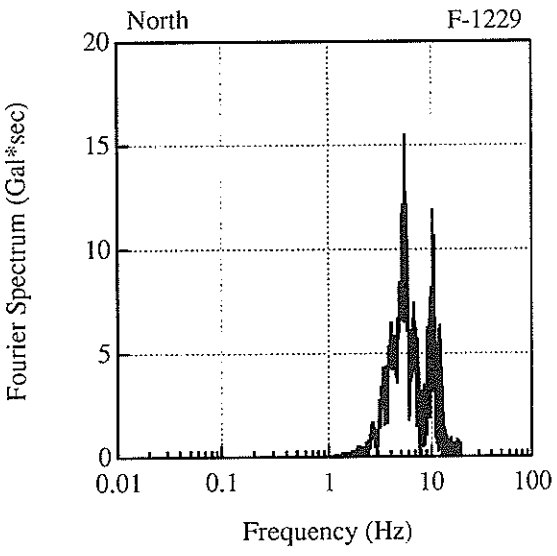

F-1229.Up
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

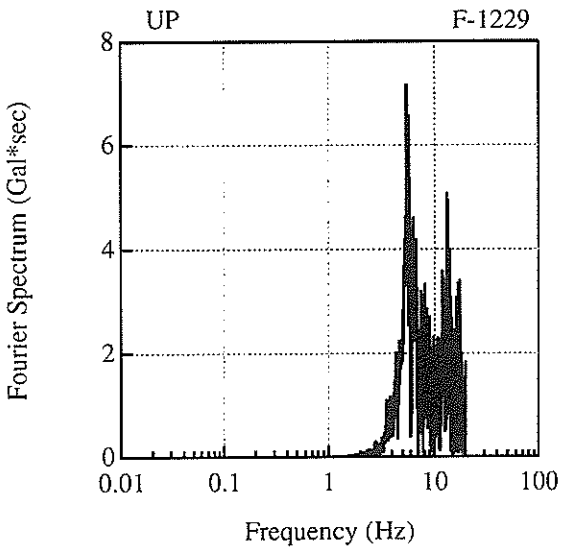

F-1229.East
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

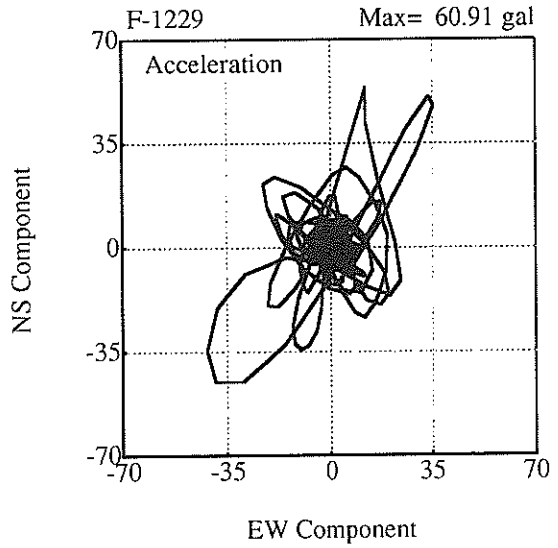

F-1229.North
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

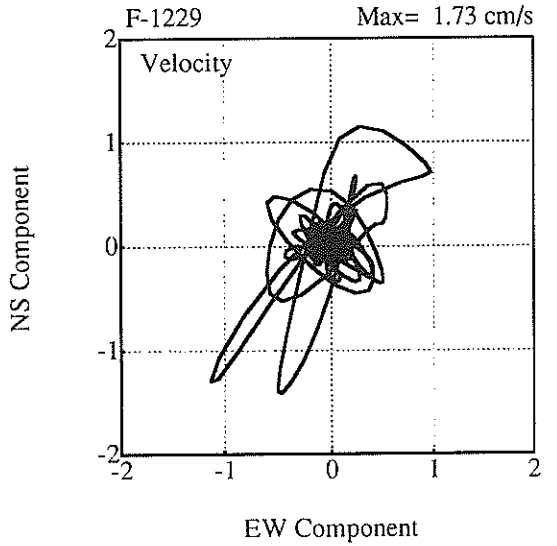

F-1229.Up
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

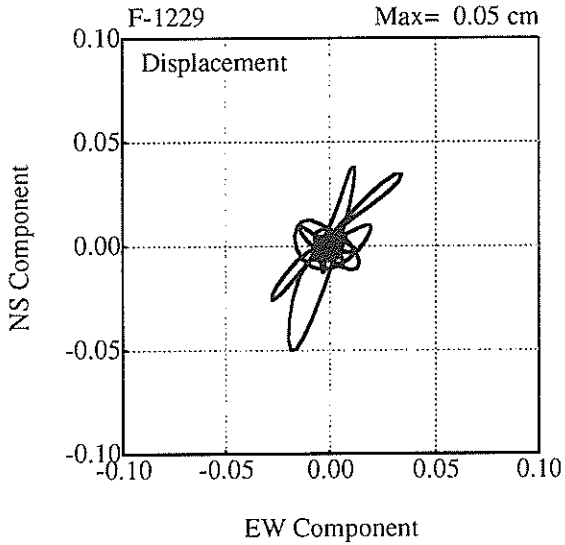

East
F-1229
Fourier Spectrum (Gal*sec)
15
12
9
6
3
0
0.01
0.1
1
10
100
Frequency (Hz)


North
F-1229
Fourier Spectrum (Gal*sec)
20
15
10
5
0
0.01
0.1
1
10
100
Frequency (Hz)


UP
F-1229
Fourier Spectrum (Gal*sec)
8
6
4
2
0
0.01
0.1
1
10
100
Frequency (Hz)


F-1229
Max= 60.91 gal
Acceleration
NS Component
70
35
0
-35
-70
-70
-35
0
35
70
EW Component


F-1229
Max= 1.73 cm/s
Velocity
NS Component
2
1
0
-1
-2
-2
-1
0
1
2
EW Component


F-1229
Max= 0.05 cm
Displacement
NS Component
0.10
0.05
0.00
-0.05
-0.10
-0.10
-0.05
0.00
0.05
0.10
EW Component

RECORD NUMBER : F-1283

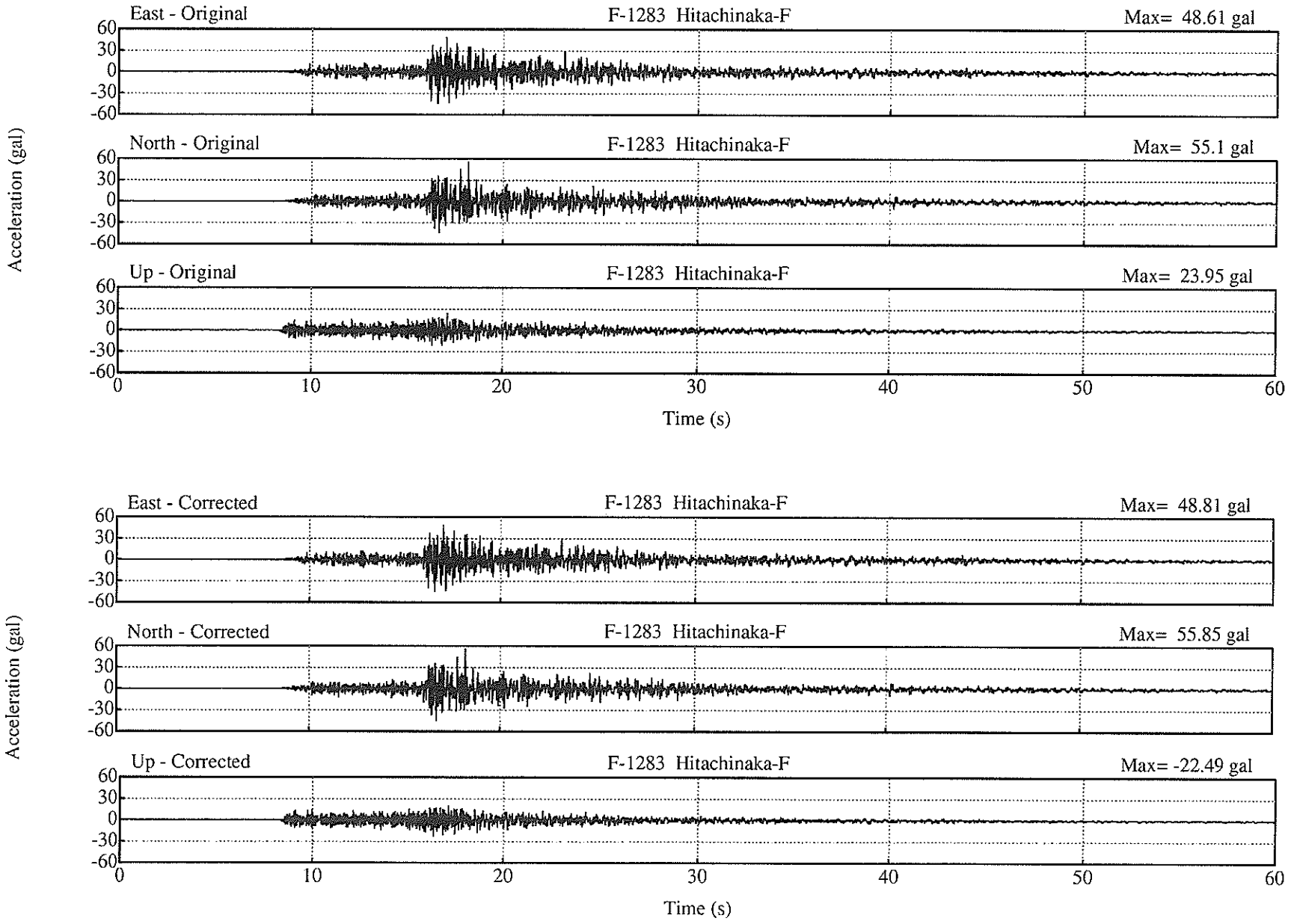
STATION : HITACHINAKA-F

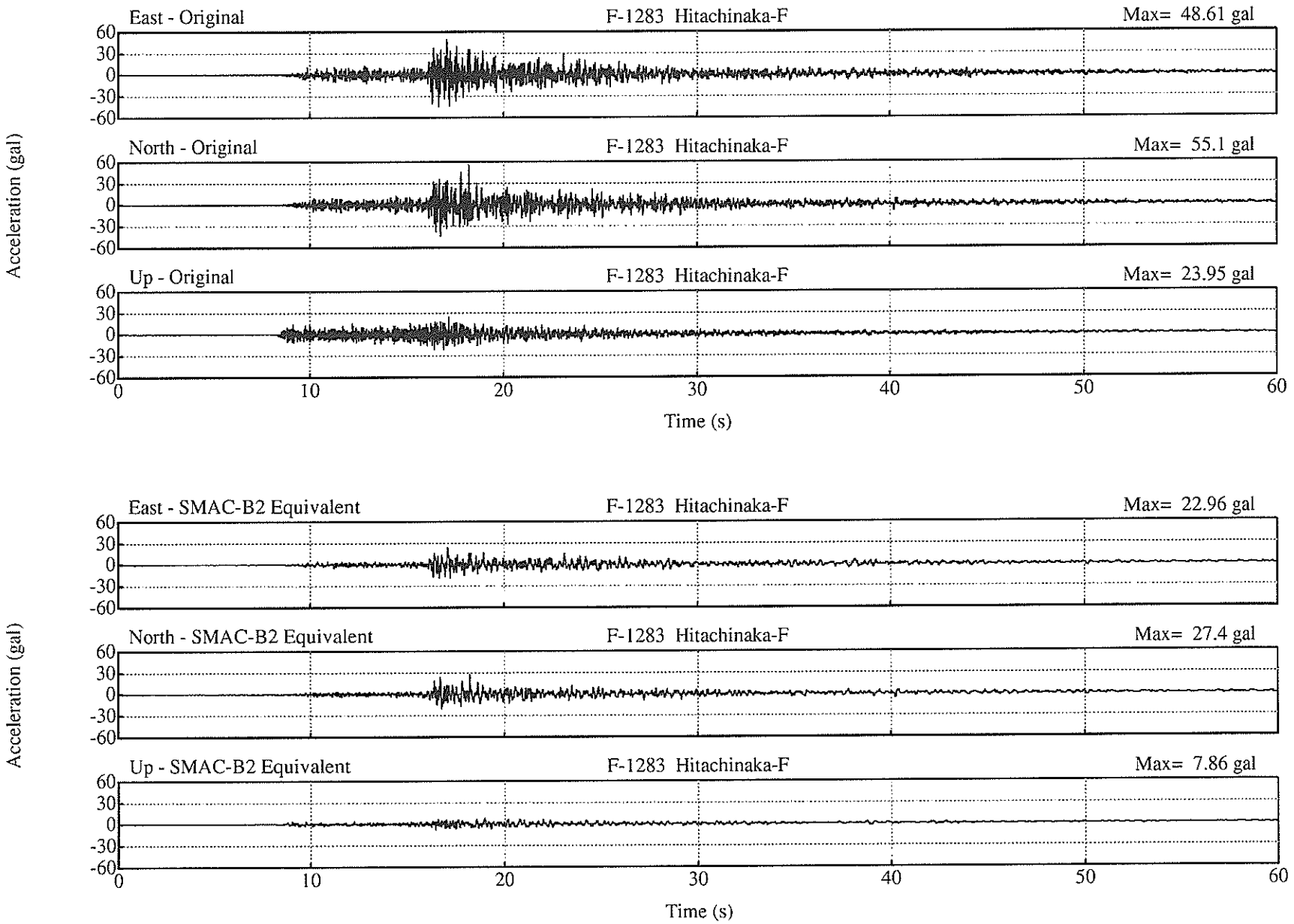
EARTHQUAKE DATA

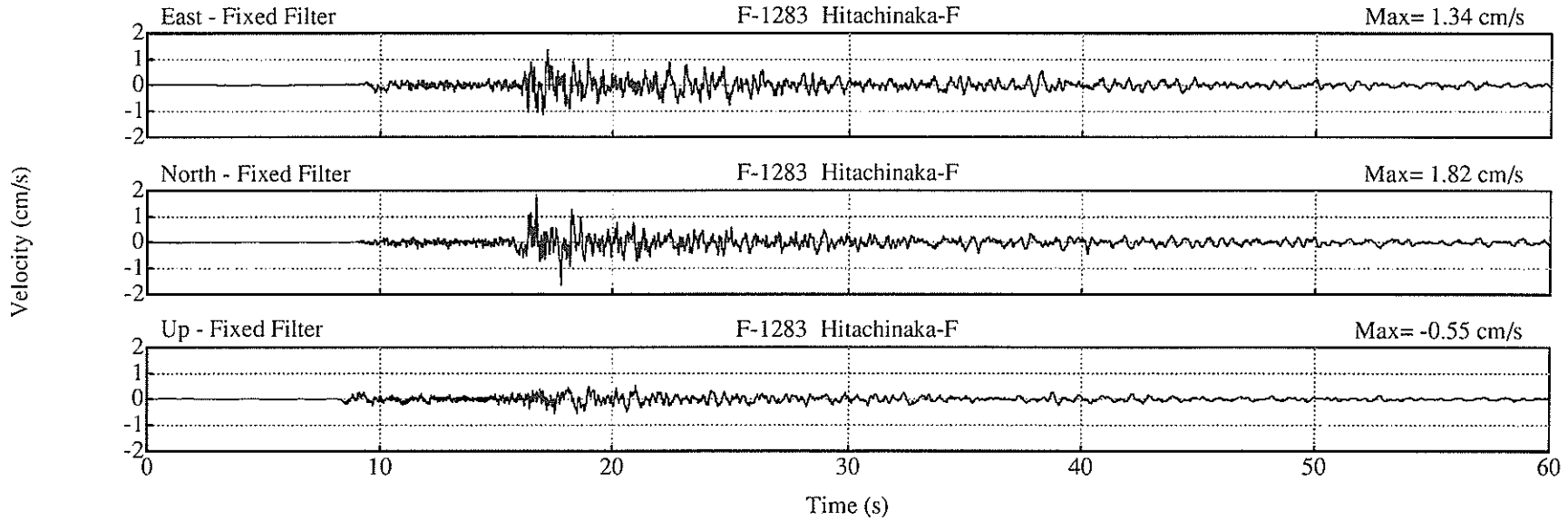
DATE AND TIME	18:37 MAR.23,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	E OFF IBARAKI PREF
LATITUDE	36°22.2′ N
LONGITUDE	141°10.5′ E
DEPTH	44.3KM
JMA MAGNITUDE	5.3

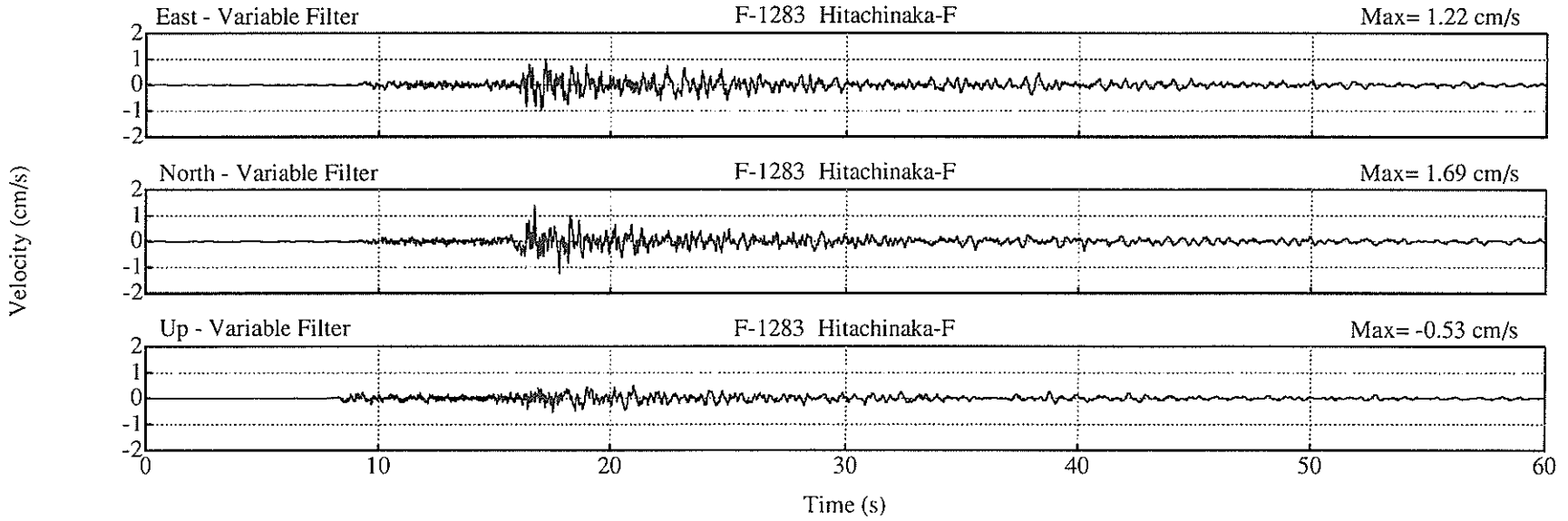
	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
PARAMETER OF THE VARIABLE FILTER				
FC (HZ)	0.457	0.512	0.585	
MAXIMUM ACCELERATION (GAL)				
SMAC-B2 EQUIVALENT	27.4	23.0	7.9	27.4
ORIGINAL	55.1	48.6	23.9	57.7
CORRECTED	55.9	48.8	22.5	59.0
MAXIMUM VELOCITY (CM/SEC)				
FIXED FILTER	1.82	1.34	0.55	1.88
VARIABLE FILTER	1.69	1.22	0.53	1.75
MAXIMUM DISPLACEMENT (CM)				
FIXED FILTER	0.15	0.14	0.08	0.16
VARIABLE FILTER	0.12	0.12	0.05	0.14

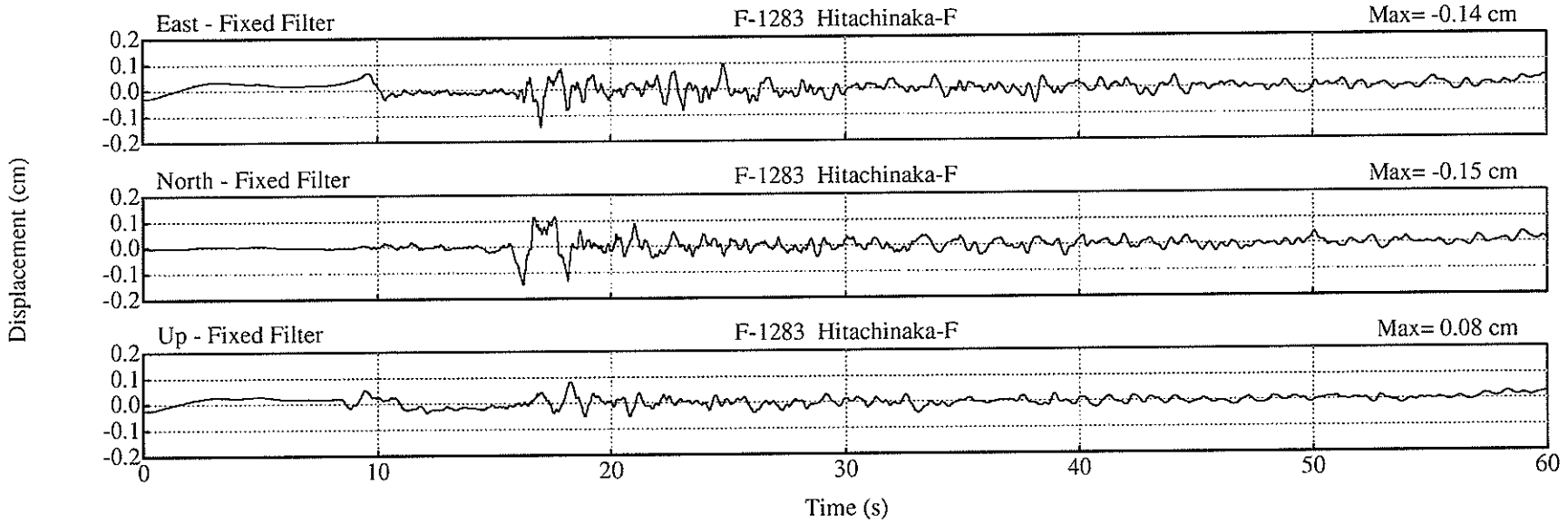
* RESULTANT OF HORIZONTAL COMPONENTS

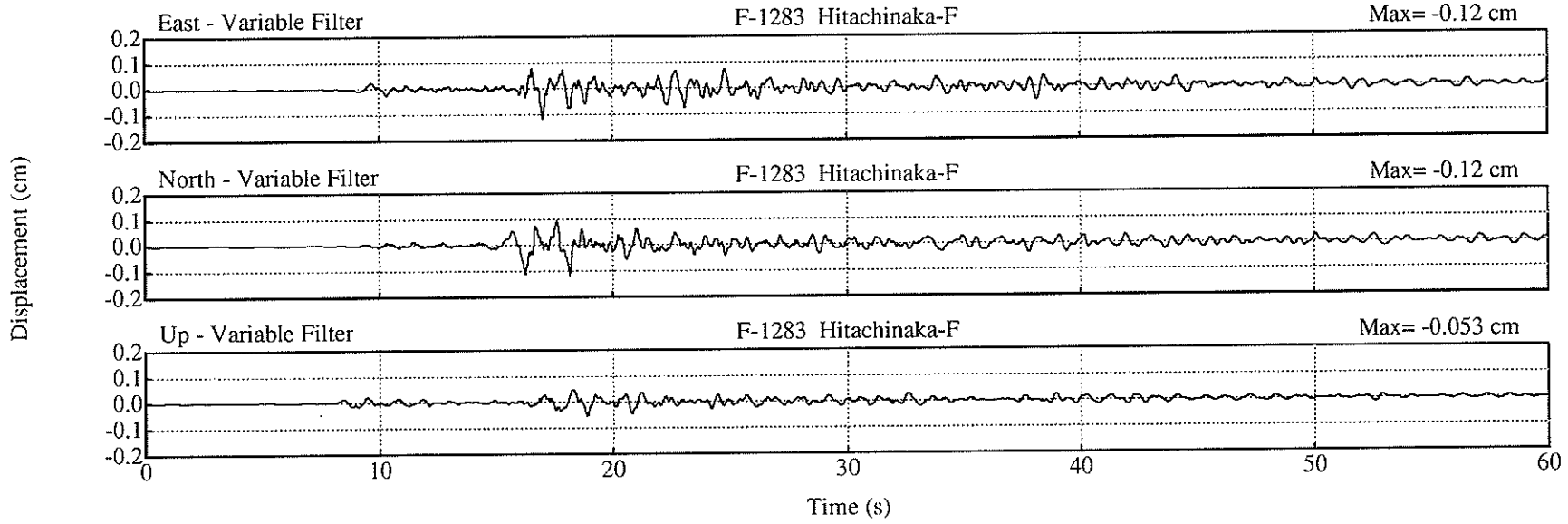

East - Original
F-1283 Hitachinaka-F
Max= 48.61 gal
North - Original
F-1283 Hitachinaka-F
Max= 55.1 gal
Up - Original
F-1283 Hitachinaka-F
Max= 23.95 gal
Acceleration (gal)
60
30
0
-30
-60
0
10
20
30
40
50
60
Time (s)
East - Corrected
F-1283 Hitachinaka-F
Max= 48.81 gal
North - Corrected
F-1283 Hitachinaka-F
Max= 55.85 gal
Up - Corrected
F-1283 Hitachinaka-F
Max= -22.49 gal
Acceleration (gal)
Time (s)

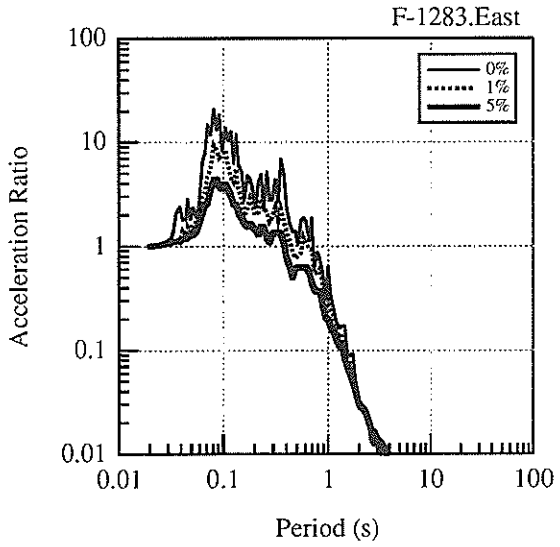

East - Original
F-1283 Hitachinaka-F
Max= 48.61 gal
North - Original
F-1283 Hitachinaka-F
Max= 55.1 gal
Up - Original
F-1283 Hitachinaka-F
Max= 23.95 gal
Acceleration (gal)
60
30
0
-30
-60
0
10
20
30
40
50
60
Time (s)
East - SMAC-B2 Equivalent
F-1283 Hitachinaka-F
Max= 22.96 gal
North - SMAC-B2 Equivalent
F-1283 Hitachinaka-F
Max= 27.4 gal
Up - SMAC-B2 Equivalent
F-1283 Hitachinaka-F
Max= 7.86 gal
Acceleration (gal)
Time (s)

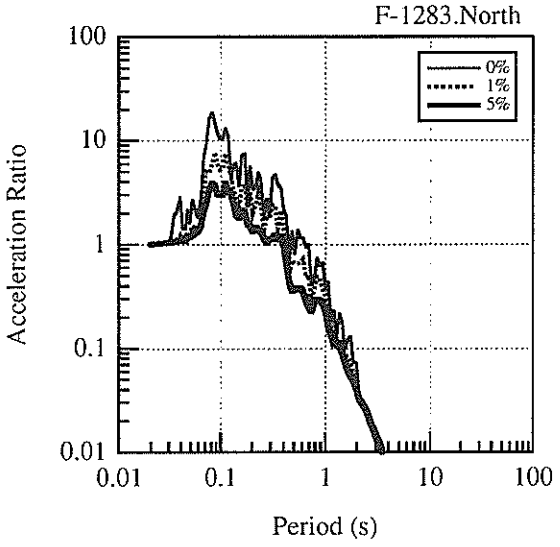

East - Fixed Filter
F-1283 Hitachinaka-F
Max= 1.34 cm/s
North - Fixed Filter
F-1283 Hitachinaka-F
Max= 1.82 cm/s
Up - Fixed Filter
F-1283 Hitachinaka-F
Max= -0.55 cm/s
Velocity (cm/s)
Time (s)

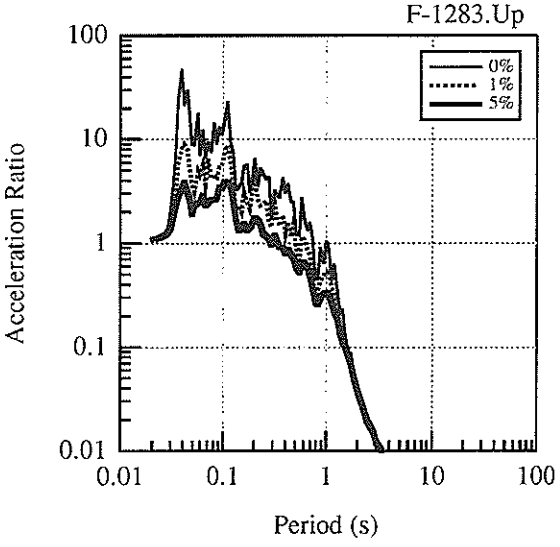

East - Variable Filter
F-1283 Hitachinaka-F
Max= 1.22 cm/s
North - Variable Filter
F-1283 Hitachinaka-F
Max= 1.69 cm/s
Up - Variable Filter
F-1283 Hitachinaka-F
Max= -0.53 cm/s
Velocity (cm/s)
Time (s)

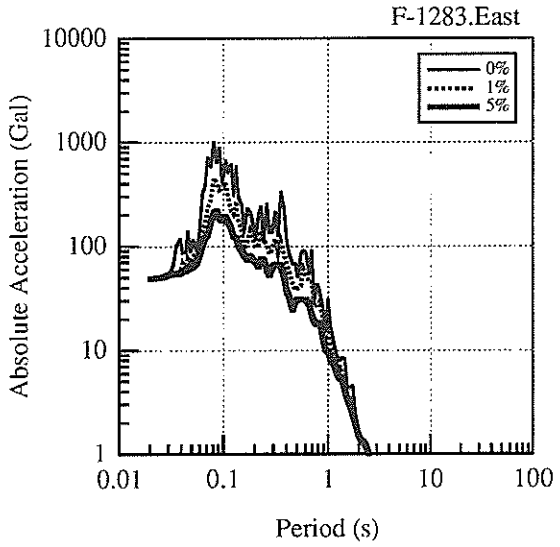

East - Fixed Filter
F-1283 Hitachinaka-F
Max= -0.14 cm
North - Fixed Filter
F-1283 Hitachinaka-F
Max= -0.15 cm
Up - Fixed Filter
F-1283 Hitachinaka-F
Max= 0.08 cm
Displacement (cm)
0.2
0.1
0.0
-0.1
-0.2
0
10
20
30
40
50
60
Time (s)

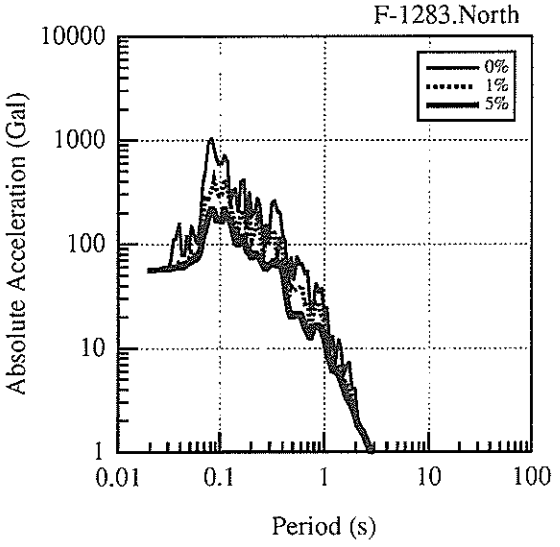

East - Variable Filter
F-1283 Hitachinaka-F
Max= -0.12 cm
North - Variable Filter
F-1283 Hitachinaka-F
Max= -0.12 cm
Up - Variable Filter
F-1283 Hitachinaka-F
Max= -0.053 cm
Displacement (cm)
0.2
0.1
0.0
-0.1
-0.2
0
10
20
30
40
50
60
Time (s)

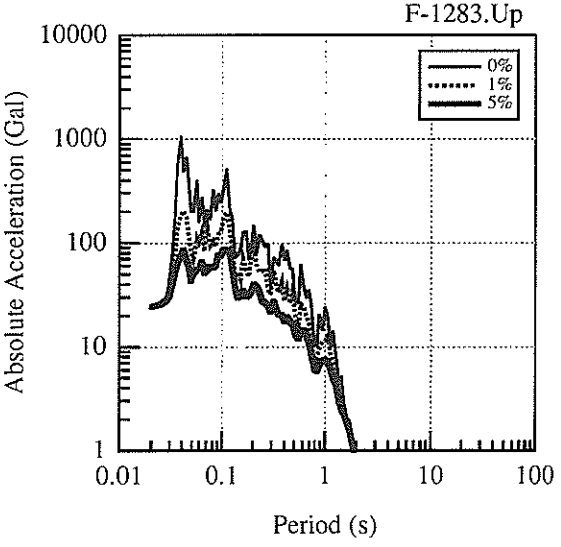

F-1283.East
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

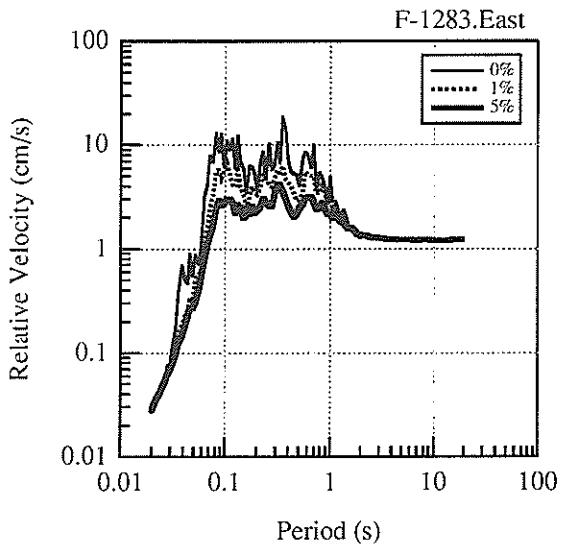

F-1283.North
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

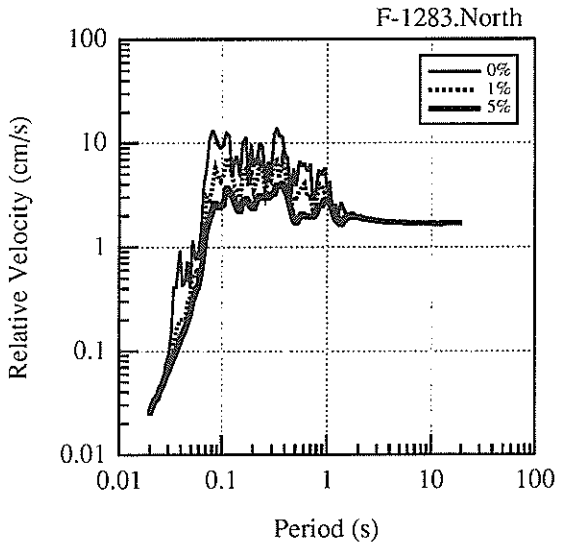

F-1283.Up
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

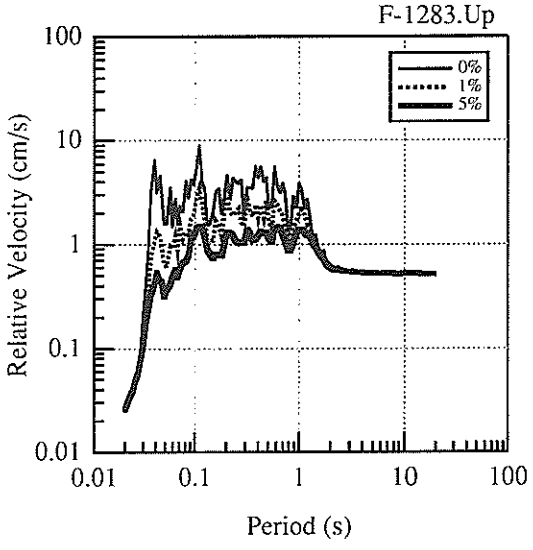

F-1283.East
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

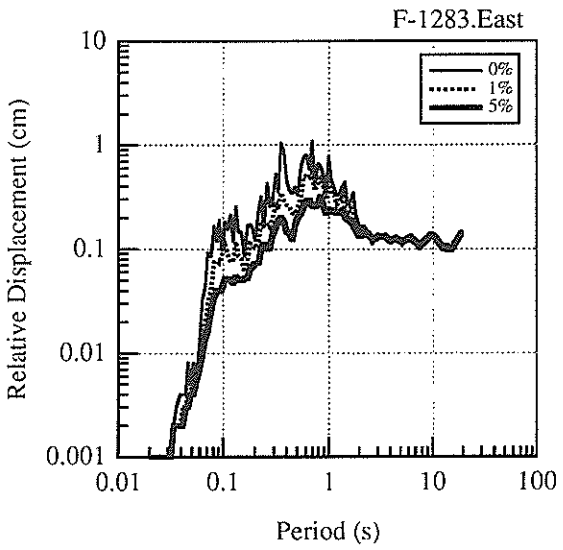

F-1283.North
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

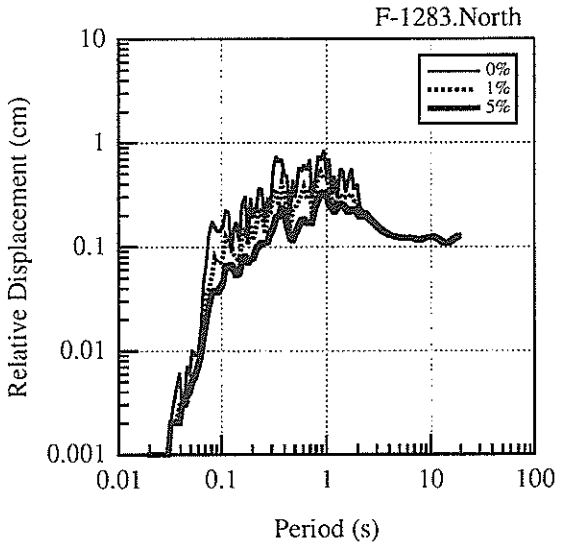

F-1283.Up
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

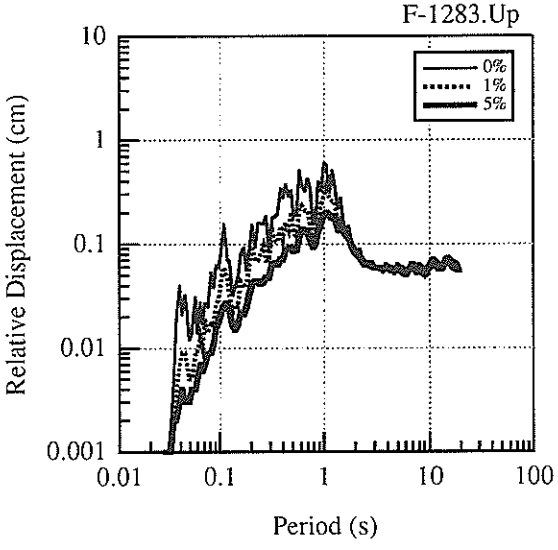

F-1283.East
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

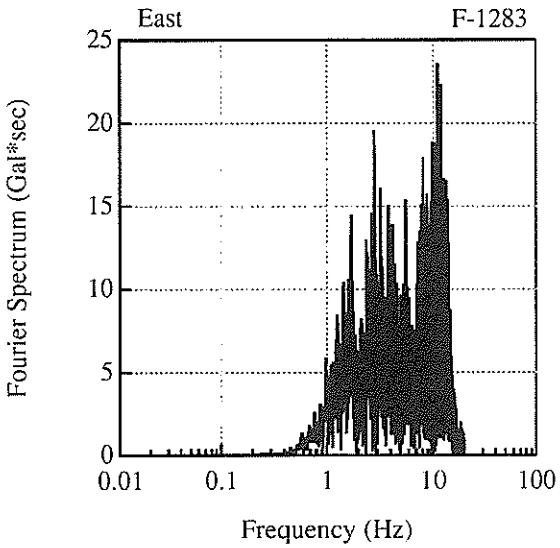

F-1283.North
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

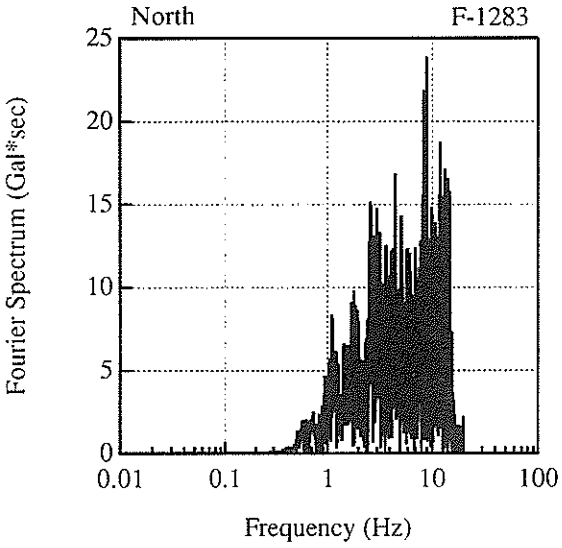

F-1283.Up
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

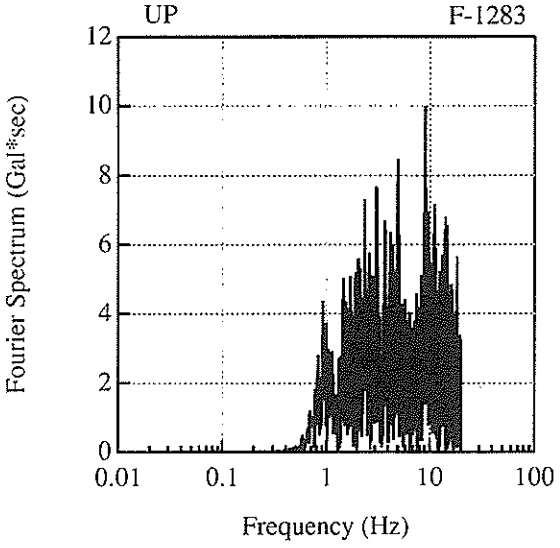

F-1283.East
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

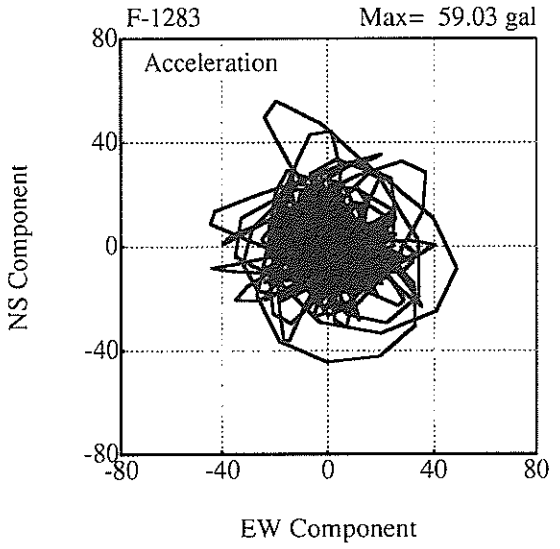

F-1283.North
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

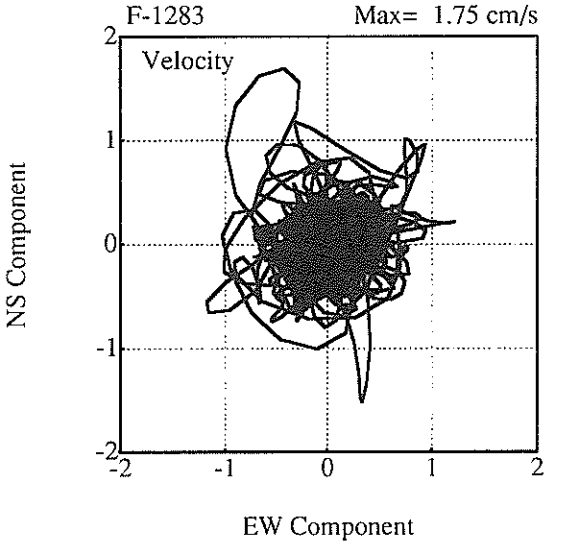

F-1283.Up
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

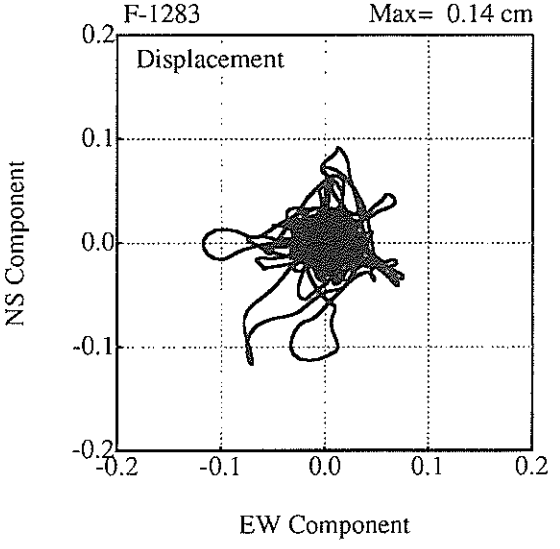

East
F-1283
Fourier Spectrum (Gal*sec)
25
20
15
10
5
0
0.01
0.1
1
10
100
Frequency (Hz)


North
F-1283
Fourier Spectrum (Gal*sec)
25
20
15
10
5
0
0.01
0.1
1
10
100
Frequency (Hz)


UP
F-1283
Fourier Spectrum (Gal*sec)
12
10
8
6
4
2
0
0.01
0.1
1
10
100
Frequency (Hz)


F-1283
Max= 59.03 gal
Acceleration
NS Component
80
40
0
-40
-80
-80
-40
0
40
80
EW Component


F-1283
Max= 1.75 cm/s
Velocity
NS Component
2
1
0
-1
-2
-2
-1
0
1
2
EW Component


F-1283
Max= 0.14 cm
Displacement
NS Component
0.2
0.1
0.0
-0.1
-0.2
-0.2
-0.1
0.0
0.1
0.2
EW Component

RECORD NUMBER : S-2684

STATION : KASHIMA-ZOKAN-S

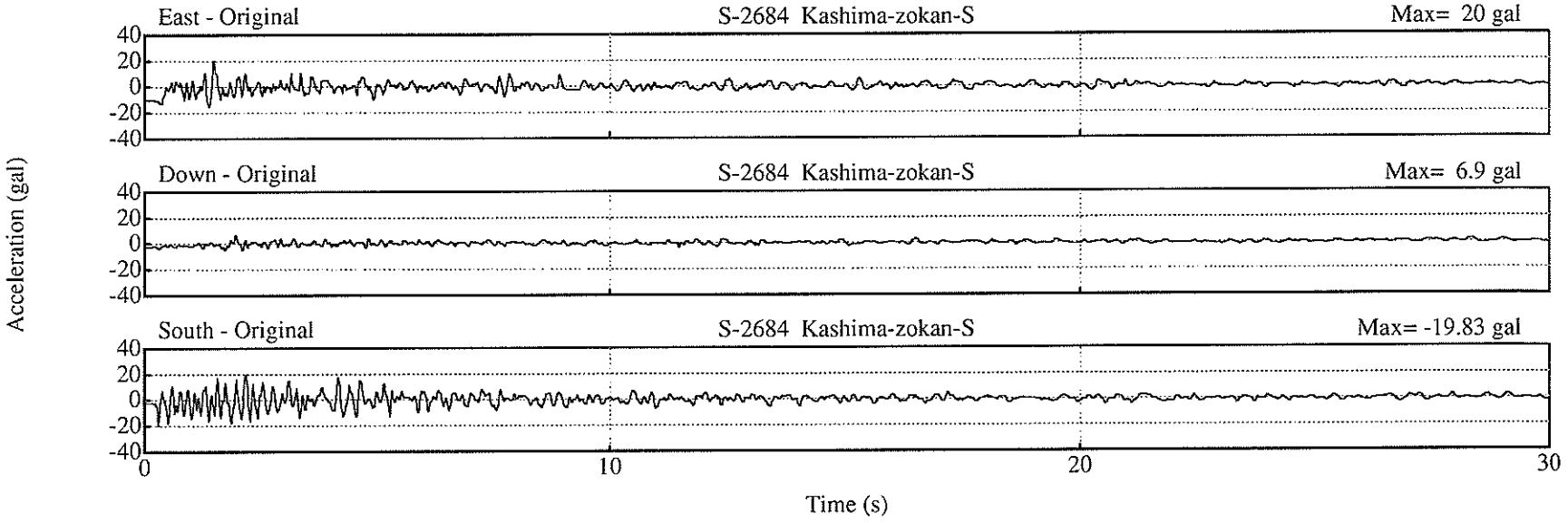
EARTHQUAKE DATA

DATE AND TIME	18:37 MAR.23,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	E OFF IBARAKI PREF
LATITUDE	36°22.2′ N
LONGITUDE	141°10.5′ E
DEPTH	44.3KM
JMA MAGNITUDE	5.3

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	19.8	20.0	6.9	23.0

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1269

STATION : KUSHIRO-G

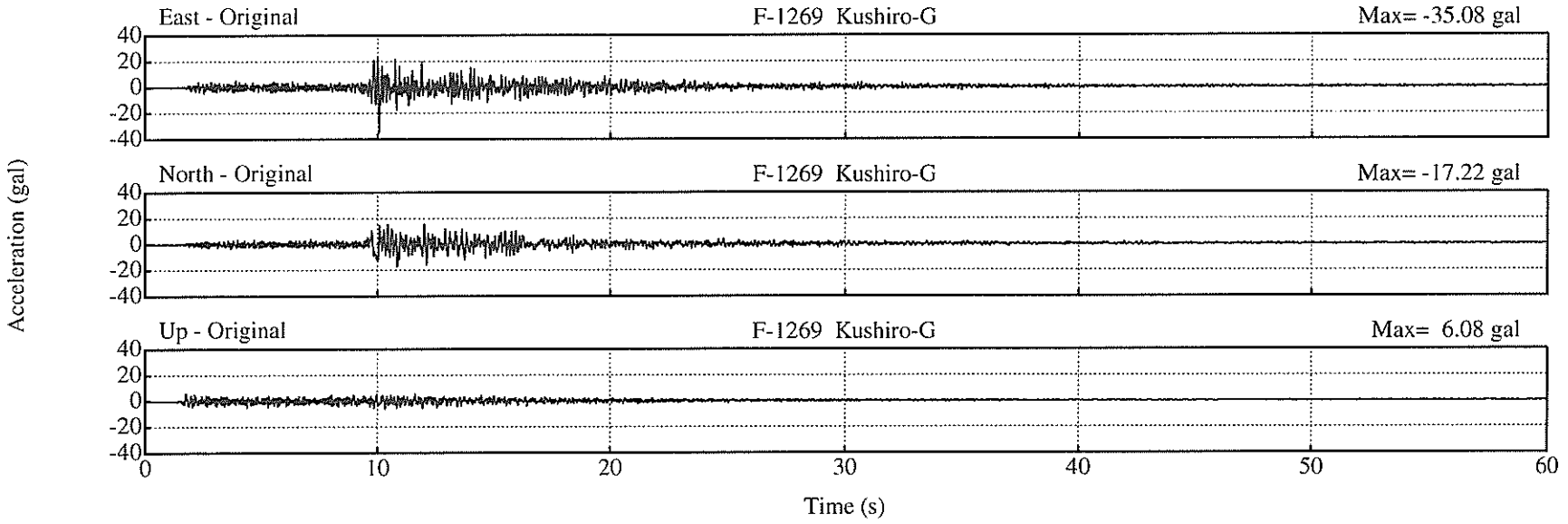
EARTHQUAKE DATA

DATE AND TIME	14:29 APR 9,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	OFF NEMURO PENINSULA
LATITUDE	42°48.1′ N
LONGITUDE	144°58.5′ E
DEPTH	47.2KM
JMA MAGNITUDE	4.8

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	17.2	35.1	6.1	35.4

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : S-2685

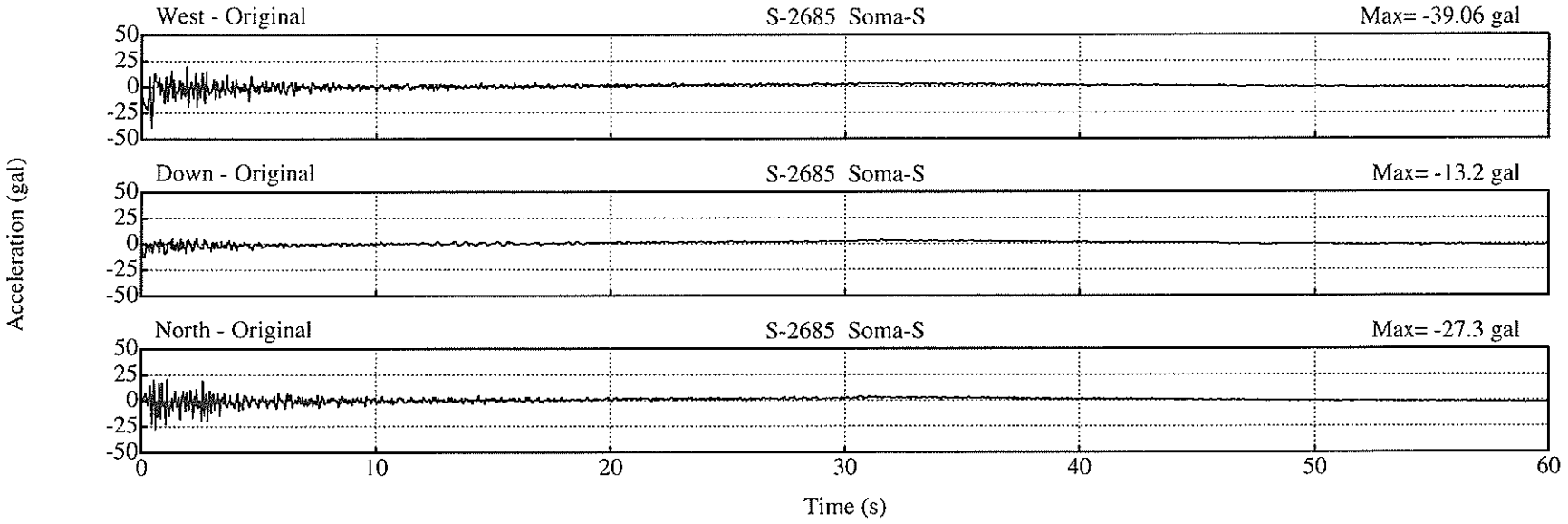
STATION : SOMA-S

EARTHQUAKE DATA

DATE AND TIME	17:45 APR 9,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	E OFF FUKUSHIMA PREF
LATITUDE	36°56.4′ N
LONGITUDE	141° 1.9′ E
DEPTH	93.2KM
JMA MAGNITUDE	5.4

	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	27.3	39.1	13.2	40.3

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : M-1598

STATION : SENDAI-M

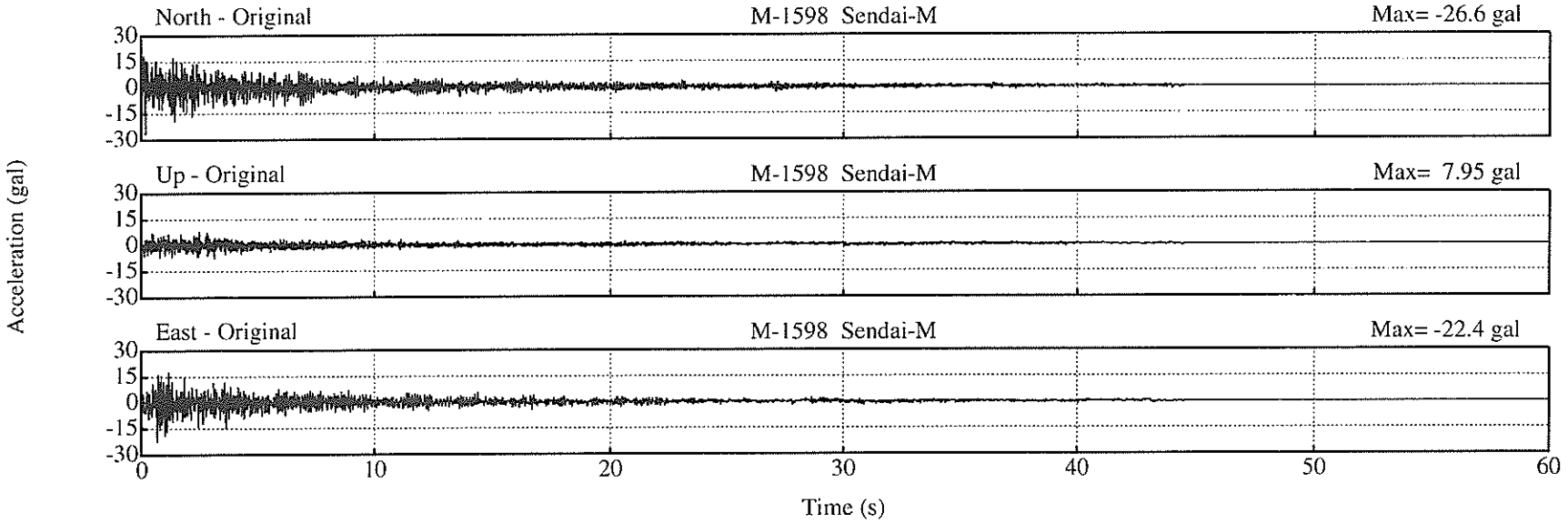
EARTHQUAKE DATA

DATE AND TIME	17:45 APR 9,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	E OFF FUKUSHIMA PREF
LATITUDE	36° 56.4' N
LONGITUDE	141° 1.9' E
DEPTH	93.2KM
JMA MAGNITUDE	5.4

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	26.6	22.4	7.9	27.2

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1263

STATION : ONAHAMA-JI-GB

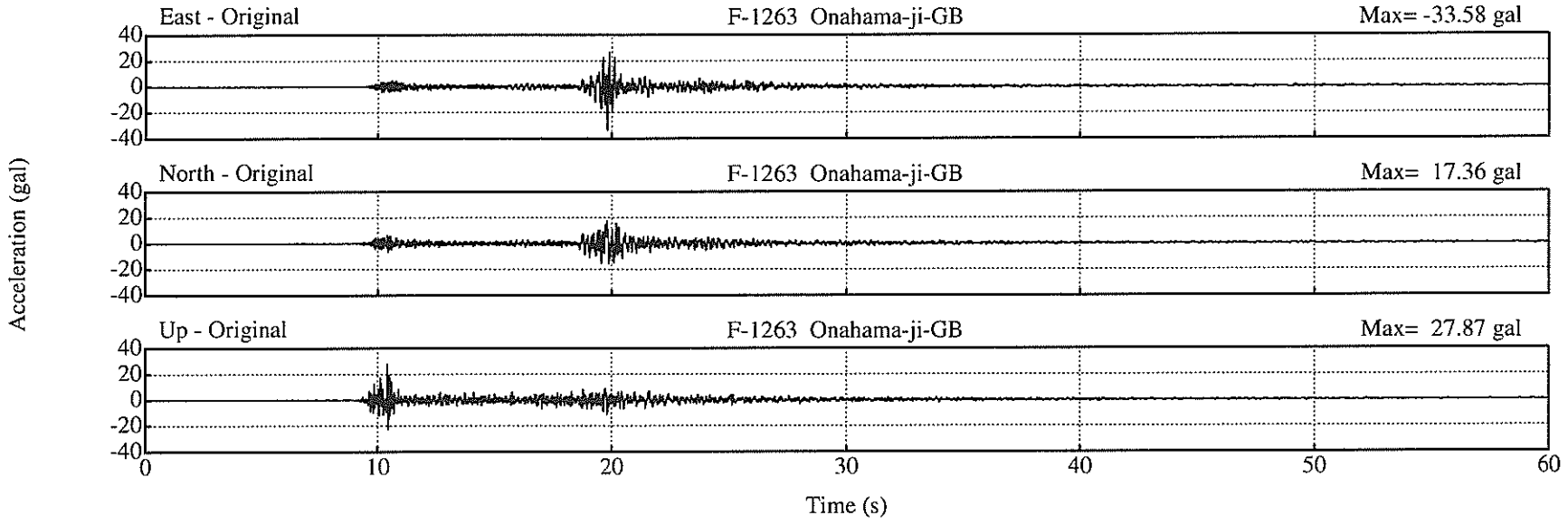
EARTHQUAKE DATA

DATE AND TIME	17:45 APR 9,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	E OFF FUKUSHIMA PREF
LATITUDE	36° 56.4' N
LONGITUDE	141° 1.9' E
DEPTH	93.2KM
JMA MAGNITUDE	5.4

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	17.4	33.6	27.9	35.5

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1264

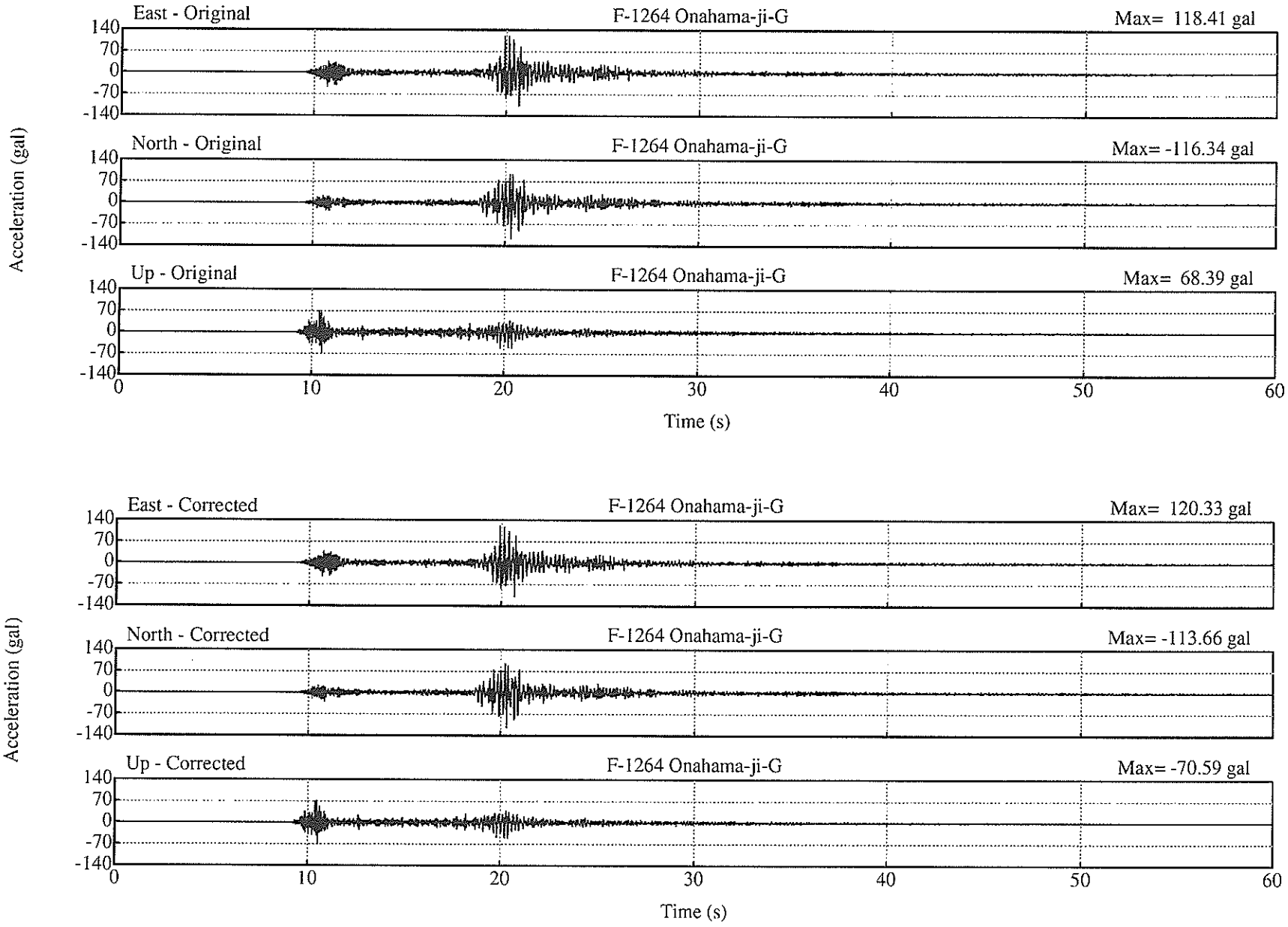
STATION : ONAHAMA-JI-G

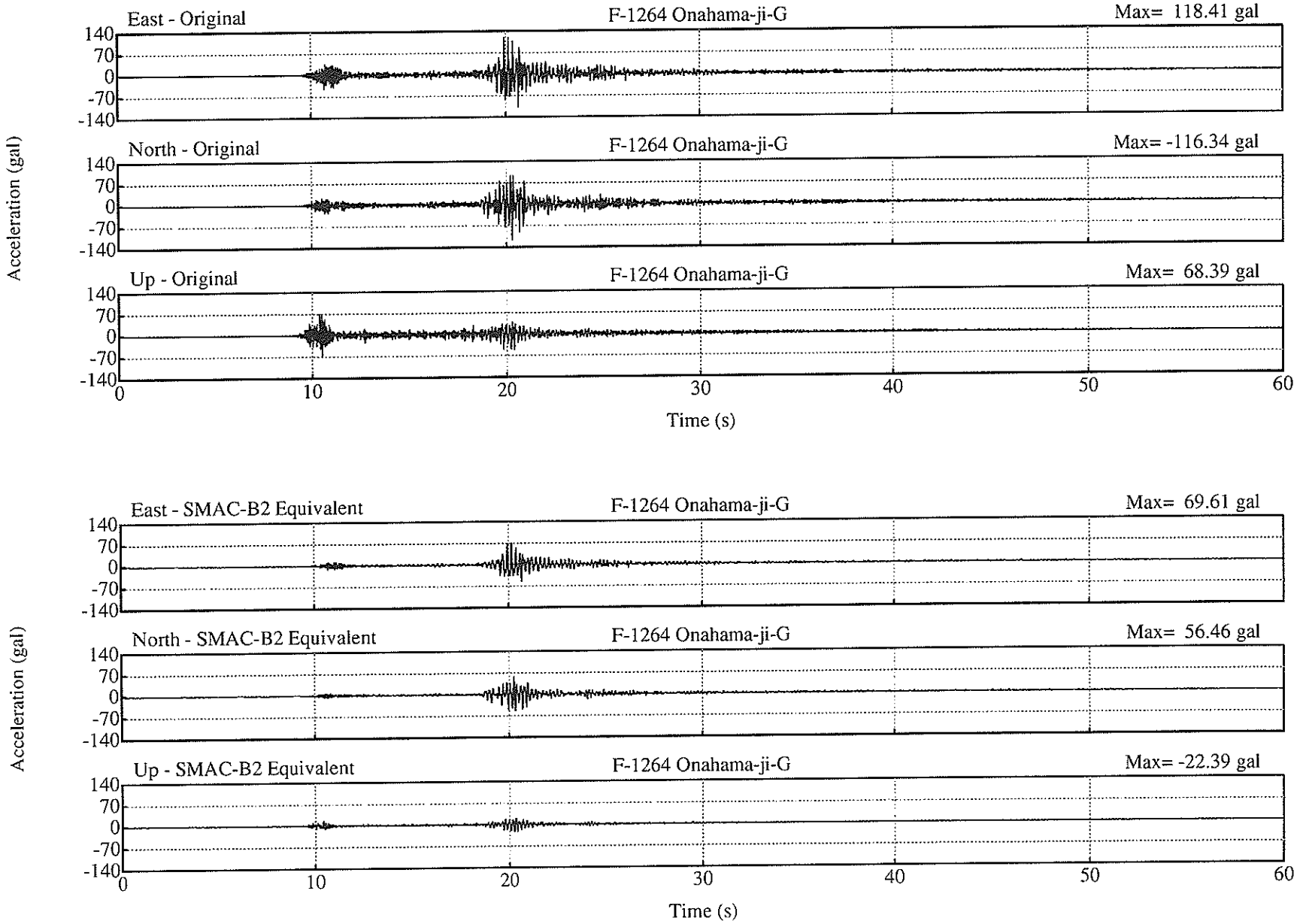
EARTHQUAKE DATA

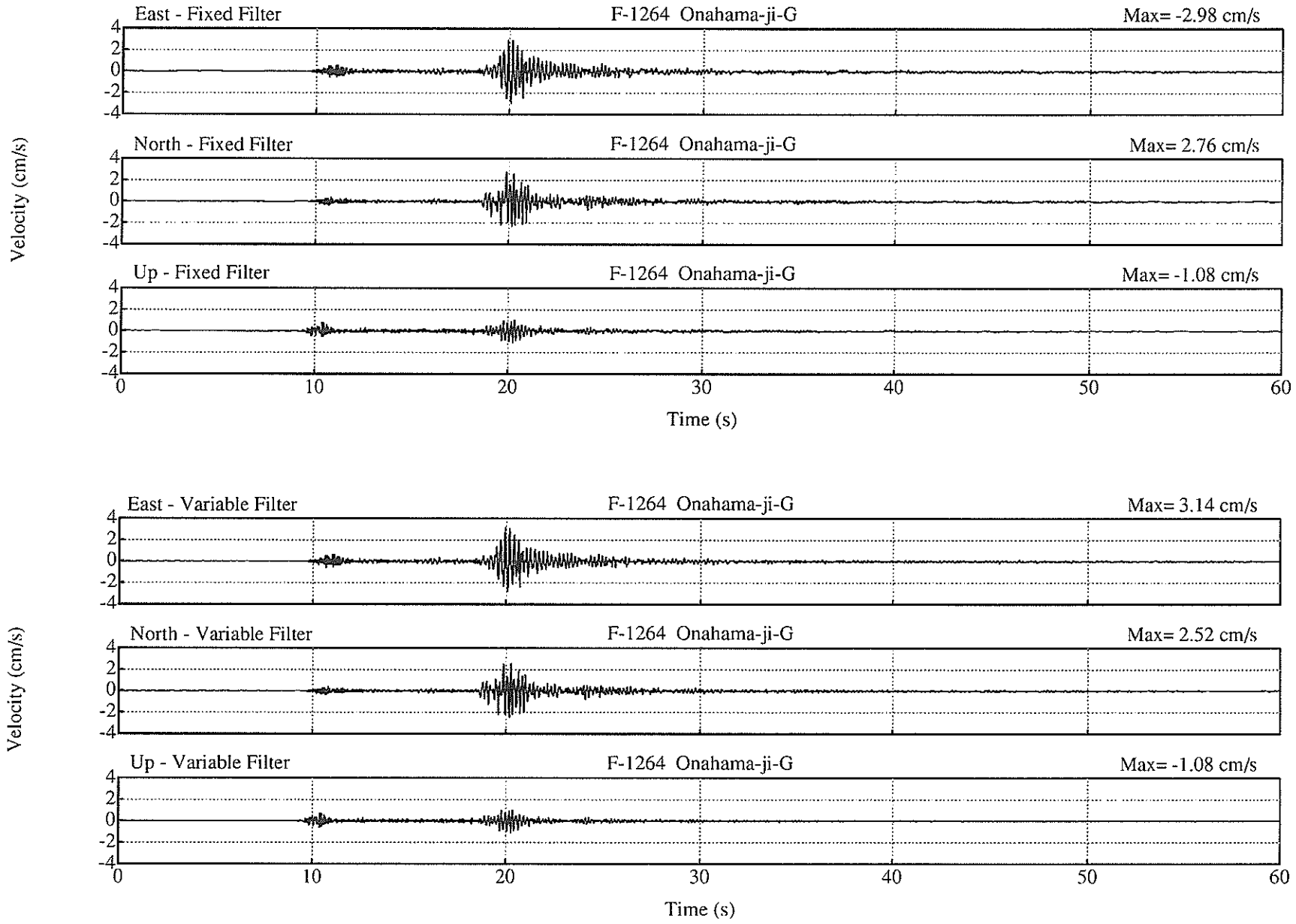
DATE AND TIME	17:45 APR 9,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	E OFF FUKUSHIMA PREF
LATITUDE	36° 56.4′ N
LONGITUDE	141° 1.9′ E
DEPTH	93.2KM
JMA MAGNITUDE	5.4

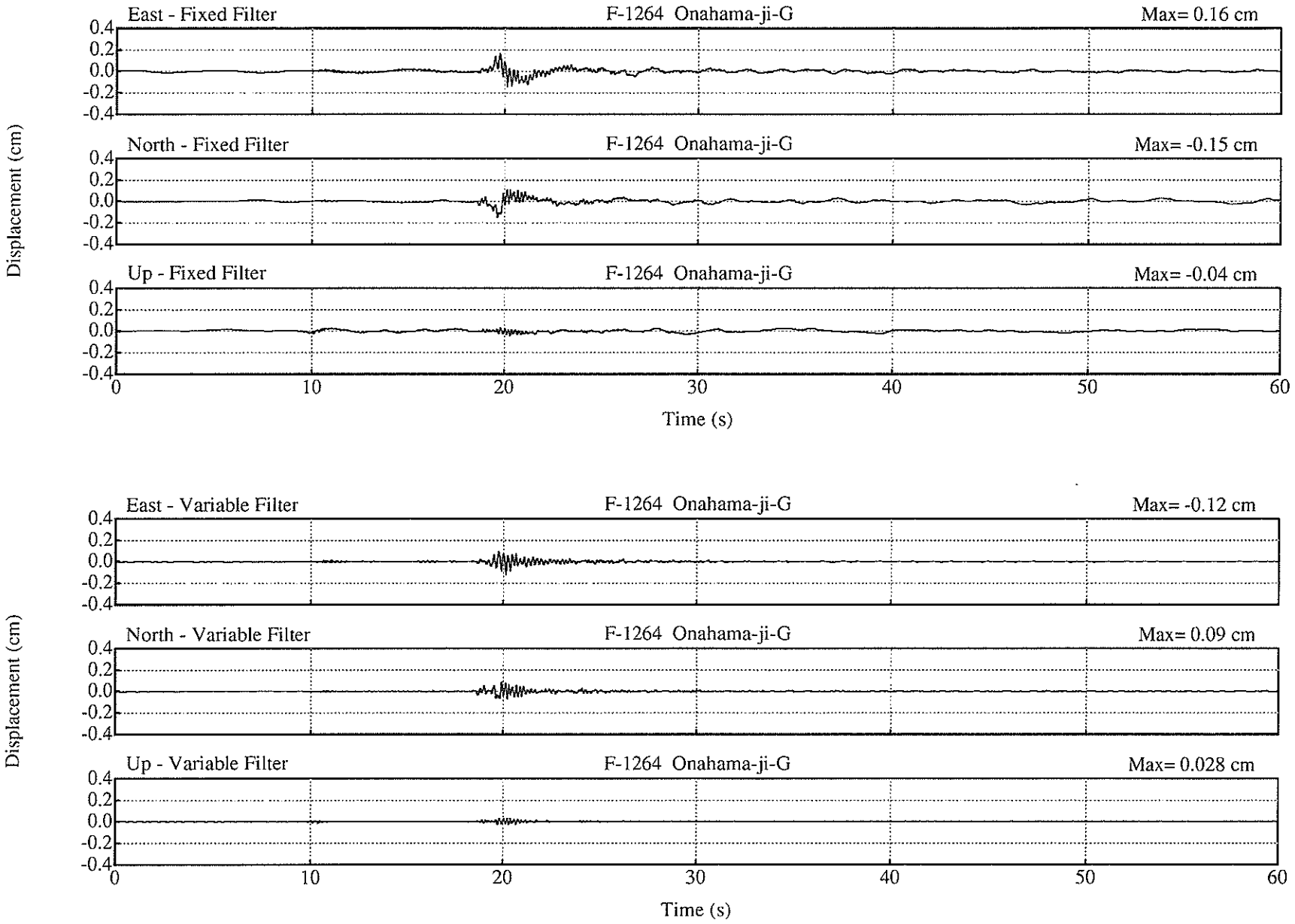
	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
PARAMETER OF THE VARIABLE FILTER				
FC (HZ)	0.951	0.951	1.916	
MAXIMUM ACCELERATION (GAL)				
SMAC-B2 EQUIVALENT	56.5	69.6	22.4	82.1
ORIGINAL	116.3	118.4	68.4	140.1
CORRECTED	113.7	120.3	70.6	137.1
MAXIMUM VELOCITY (CM/SEC)				
FIXED FILTER	2.76	2.98	1.08	3.72
VARIABLE FILTER	2.52	3.14	1.08	3.92
MAXIMUM DISPLACEMENT (CM)				
FIXED FILTER	0.15	0.16	0.04	0.20
VARIABLE FILTER	0.09	0.12	0.03	0.14

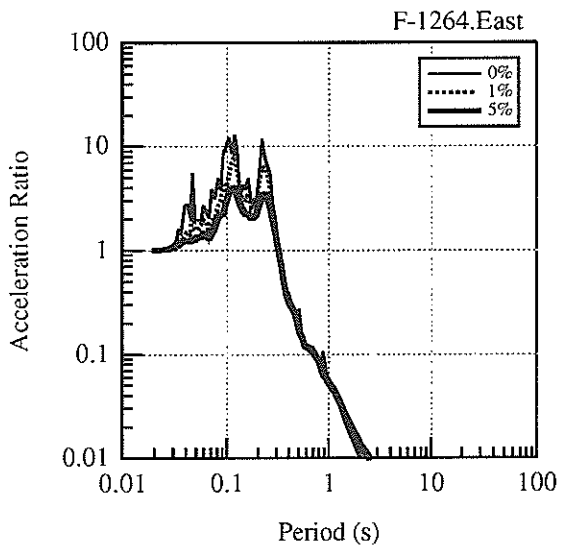
* RESULTANT OF HORIZONTAL COMPONENTS

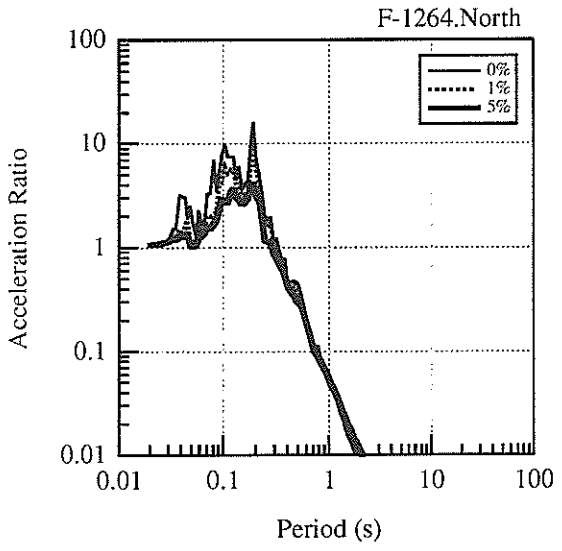

East - Original
F-1264 Onahama-ji-G
Max= 118.41 gal
North - Original
F-1264 Onahama-ji-G
Max= -116.34 gal
Up - Original
F-1264 Onahama-ji-G
Max= 68.39 gal
Acceleration (gal)
140
70
0
-70
-140
0
10
20
30
40
50
60
Time (s)
East - Corrected
F-1264 Onahama-ji-G
Max= 120.33 gal
North - Corrected
F-1264 Onahama-ji-G
Max= -113.66 gal
Up - Corrected
F-1264 Onahama-ji-G
Max= -70.59 gal
Acceleration (gal)
Time (s)

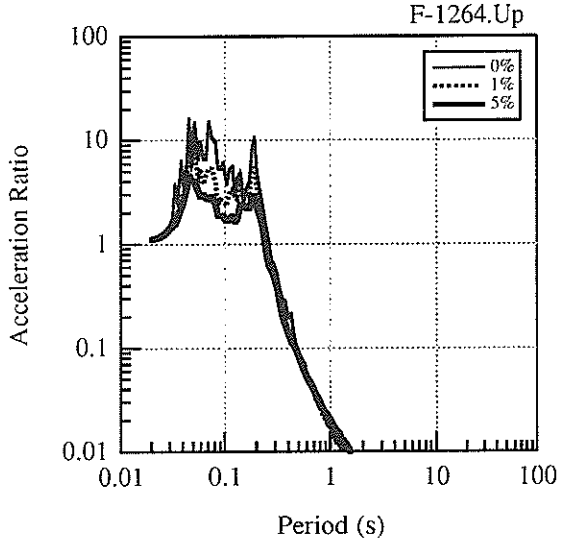

East - Original
F-1264 Onahama-ji-G
Max= 118.41 gal
North - Original
F-1264 Onahama-ji-G
Max= -116.34 gal
Up - Original
F-1264 Onahama-ji-G
Max= 68.39 gal
Acceleration (gal)
140
70
0
-70
-140
0
10
20
30
40
50
60
Time (s)
East - SMAC-B2 Equivalent
F-1264 Onahama-ji-G
Max= 69.61 gal
North - SMAC-B2 Equivalent
F-1264 Onahama-ji-G
Max= 56.46 gal
Up - SMAC-B2 Equivalent
F-1264 Onahama-ji-G
Max= -22.39 gal
Acceleration (gal)
Time (s)

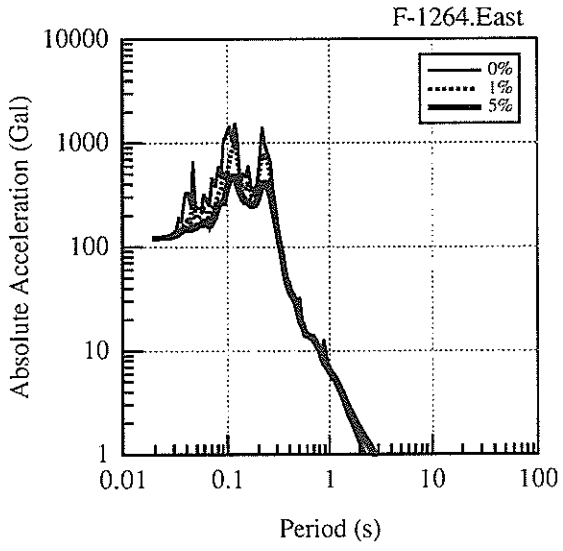

East - Fixed Filter
F-1264 Onahama-ji-G
Max= -2.98 cm/s
North - Fixed Filter
F-1264 Onahama-ji-G
Max= 2.76 cm/s
Up - Fixed Filter
F-1264 Onahama-ji-G
Max= -1.08 cm/s
Velocity (cm/s)
Time (s)
East - Variable Filter
F-1264 Onahama-ji-G
Max= 3.14 cm/s
North - Variable Filter
F-1264 Onahama-ji-G
Max= 2.52 cm/s
Up - Variable Filter
F-1264 Onahama-ji-G
Max= -1.08 cm/s
Velocity (cm/s)
Time (s)

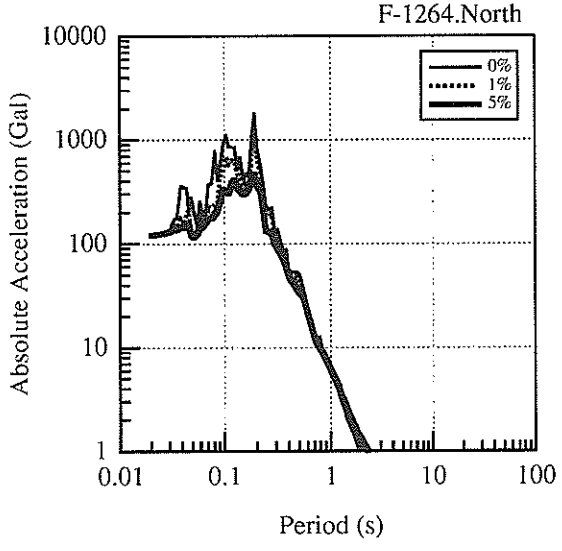

East - Fixed Filter
F-1264 Onahama-ji-G
Max= 0.16 cm
North - Fixed Filter
F-1264 Onahama-ji-G
Max= -0.15 cm
Up - Fixed Filter
F-1264 Onahama-ji-G
Max= -0.04 cm
Displacement (cm)
0.4
0.2
0.0
-0.2
-0.4
0
10
20
30
40
50
60
Time (s)
East - Variable Filter
F-1264 Onahama-ji-G
Max= -0.12 cm
North - Variable Filter
F-1264 Onahama-ji-G
Max= 0.09 cm
Up - Variable Filter
F-1264 Onahama-ji-G
Max= 0.028 cm
Displacement (cm)
Time (s)

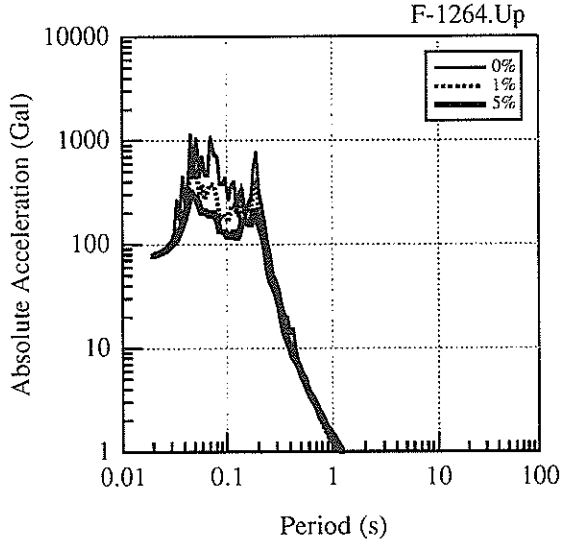

F-1264.East
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

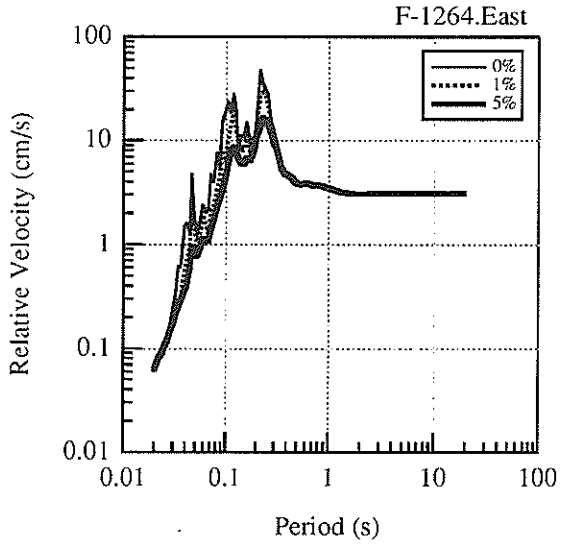

F-1264.North
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

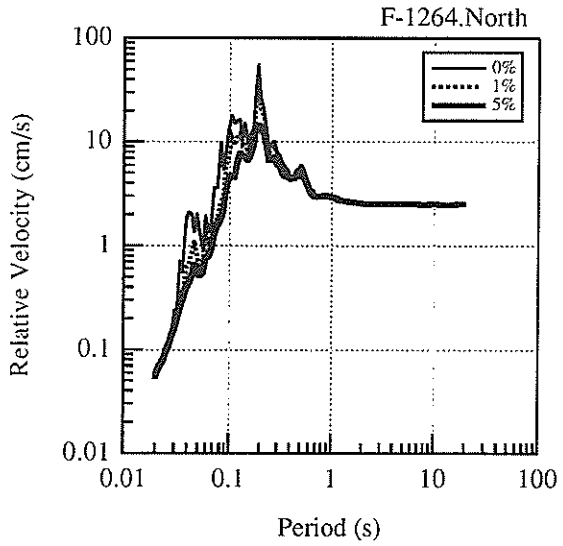

F-1264.Up
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

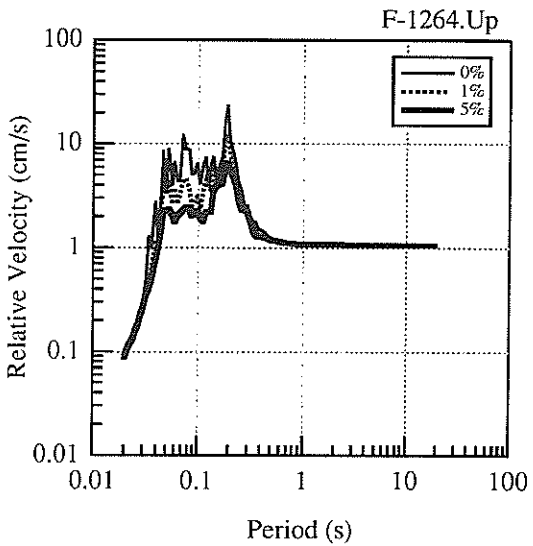

F-1264.East
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

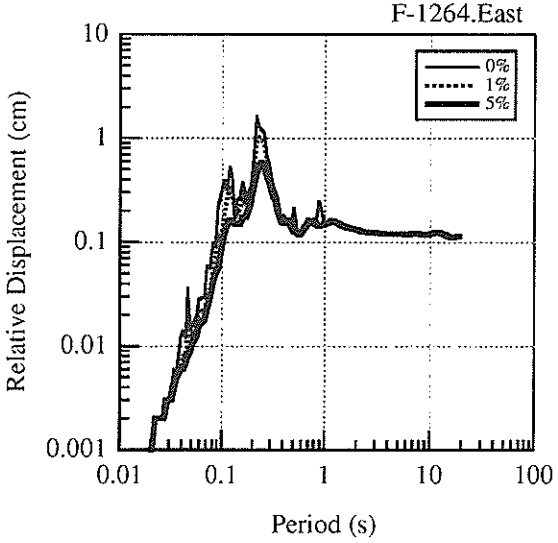

F-1264.North
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

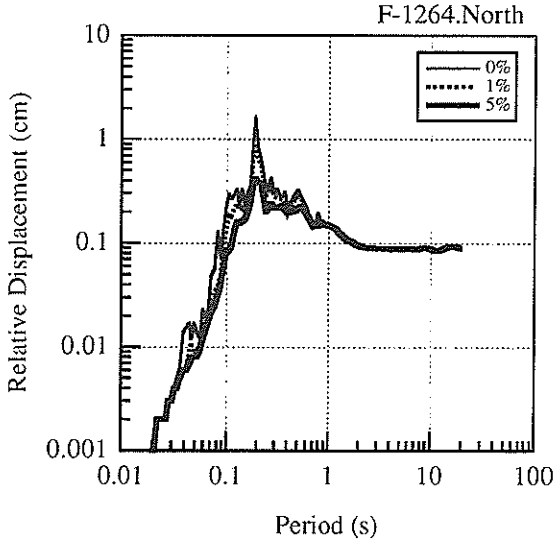

F-1264.Up
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

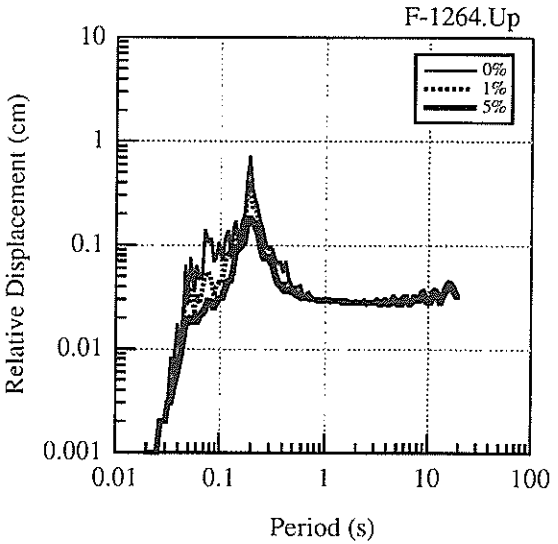

F-1264.East
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

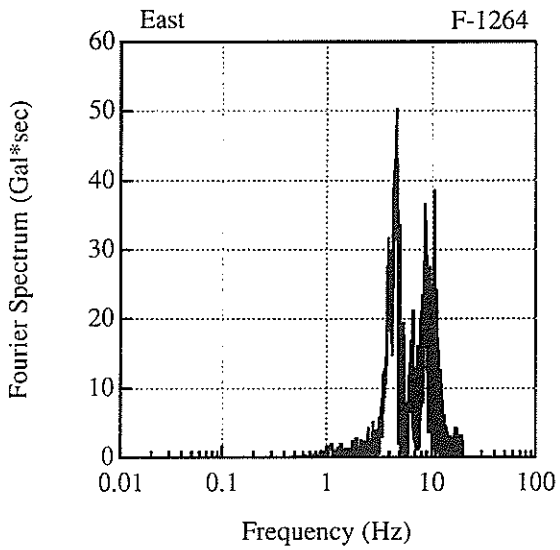

F-1264.North
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

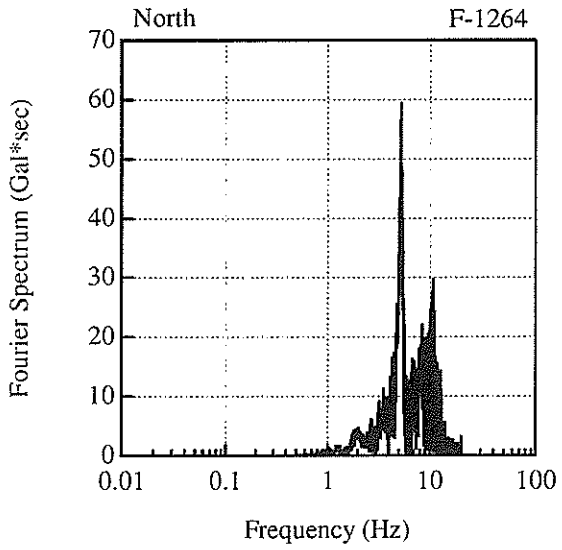

F-1264.Up
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

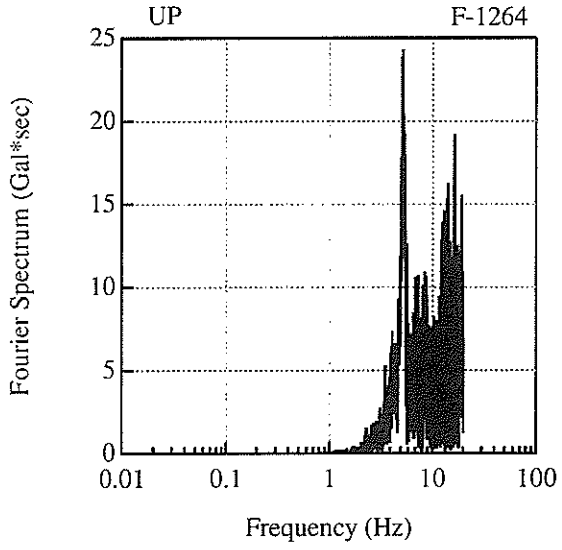

F-1264.East
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

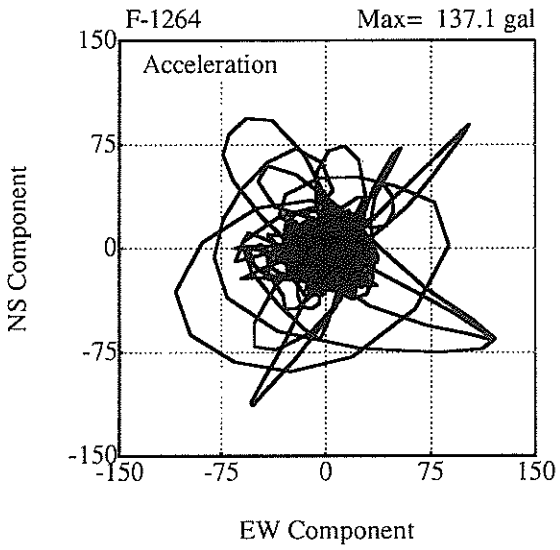

F-1264.North
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

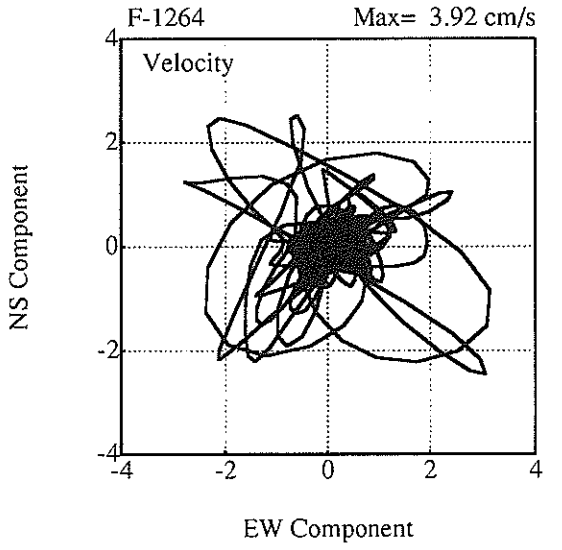

F-1264.Up
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

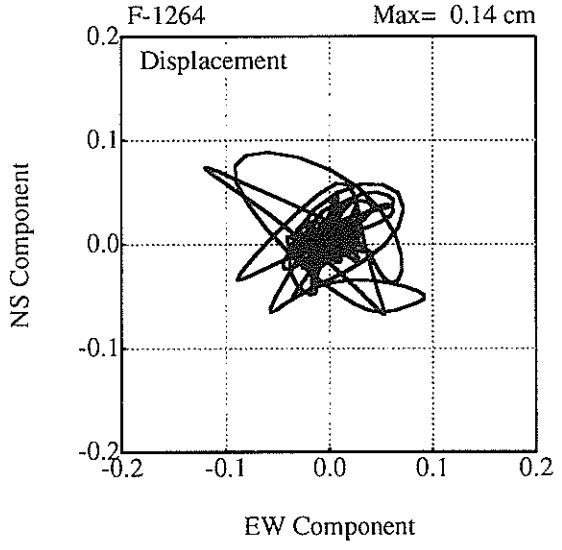

East
F-1264
Fourier Spectrum (Gal*sec)
60
50
40
30
20
10
0
0.01
0.1
1
10
100
Frequency (Hz)


North
F-1264
Fourier Spectrum (Gal*sec)
70
60
50
40
30
20
10
0
0.01
0.1
1
10
100
Frequency (Hz)


UP
F-1264
Fourier Spectrum (Gal*sec)
25
20
15
10
5
0
0.01
0.1
1
10
100
Frequency (Hz)


F-1264
Max= 137.1 gal
Acceleration
NS Component
150
75
0
-75
-150
-150
-75
0
75
150
EW Component


F-1264
Max= 3.92 cm/s
Velocity
NS Component
4
2
0
-2
-4
-4
-2
0
2
4
EW Component


F-1264
Max= 0.14 cm
Displacement
NS Component
0.2
0.1
0.0
-0.1
-0.2
-0.2
-0.1
0.0
0.1
0.2
EW Component

RECORD NUMBER : F-1287

STATION : HITACHINAKA-F

EARTHQUAKE DATA

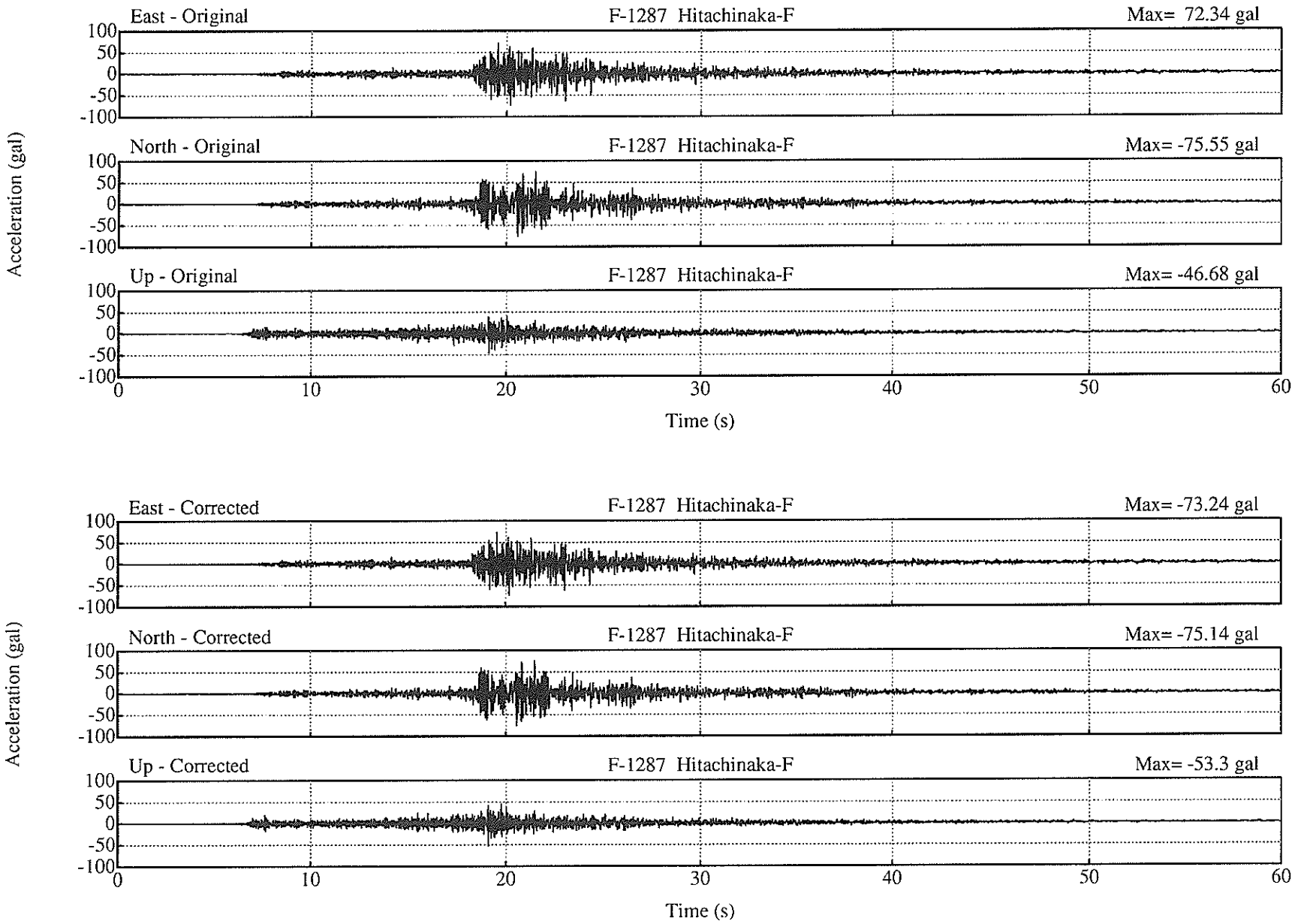
****

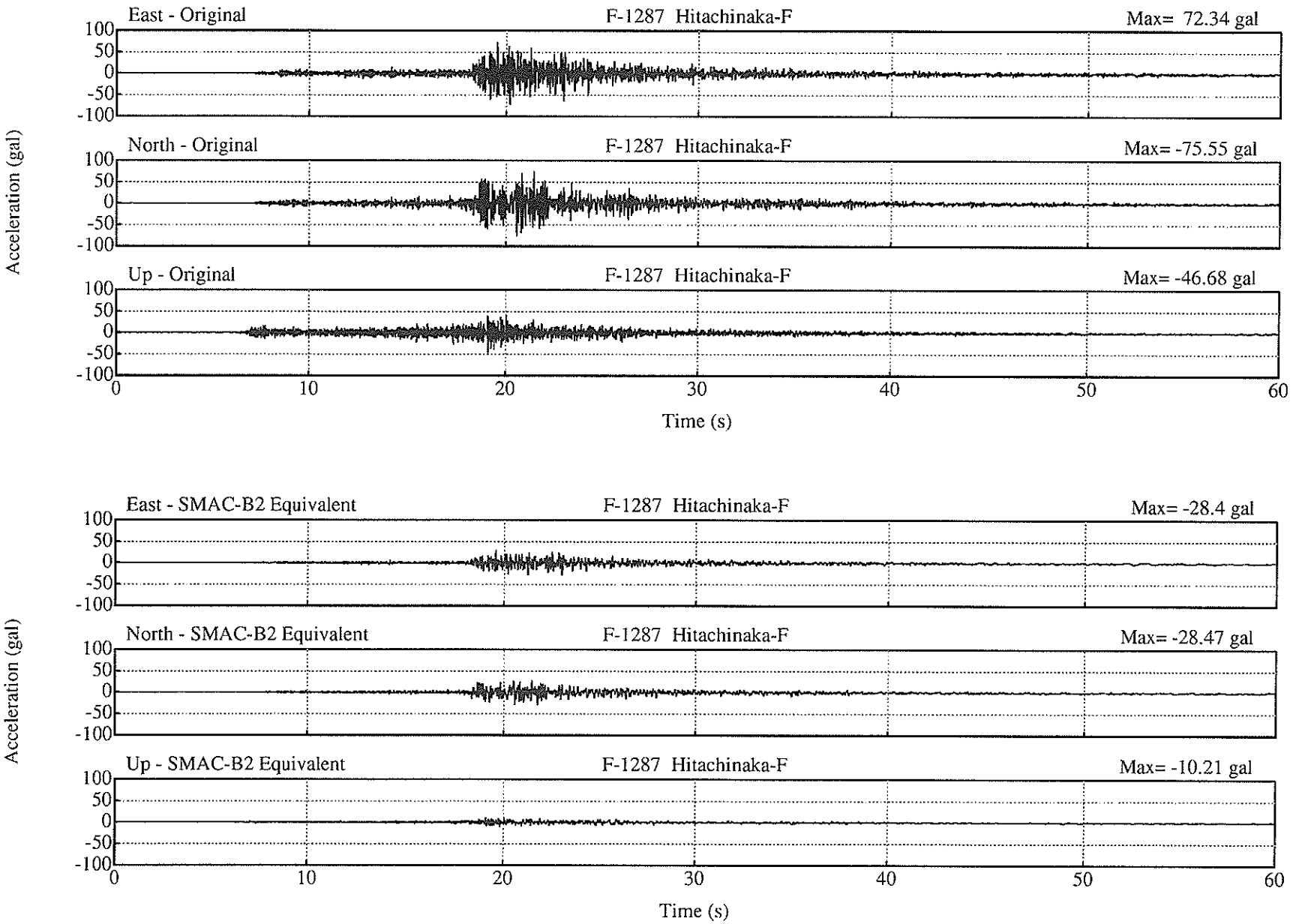
DATE AND TIME	17:45 APR 9,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	E OFF FUKUSHIMA PREF
LATITUDE	36° 56.4' N
LONGITUDE	141° 1.9' E
DEPTH	93.2KM
JMA MAGNITUDE	5.4

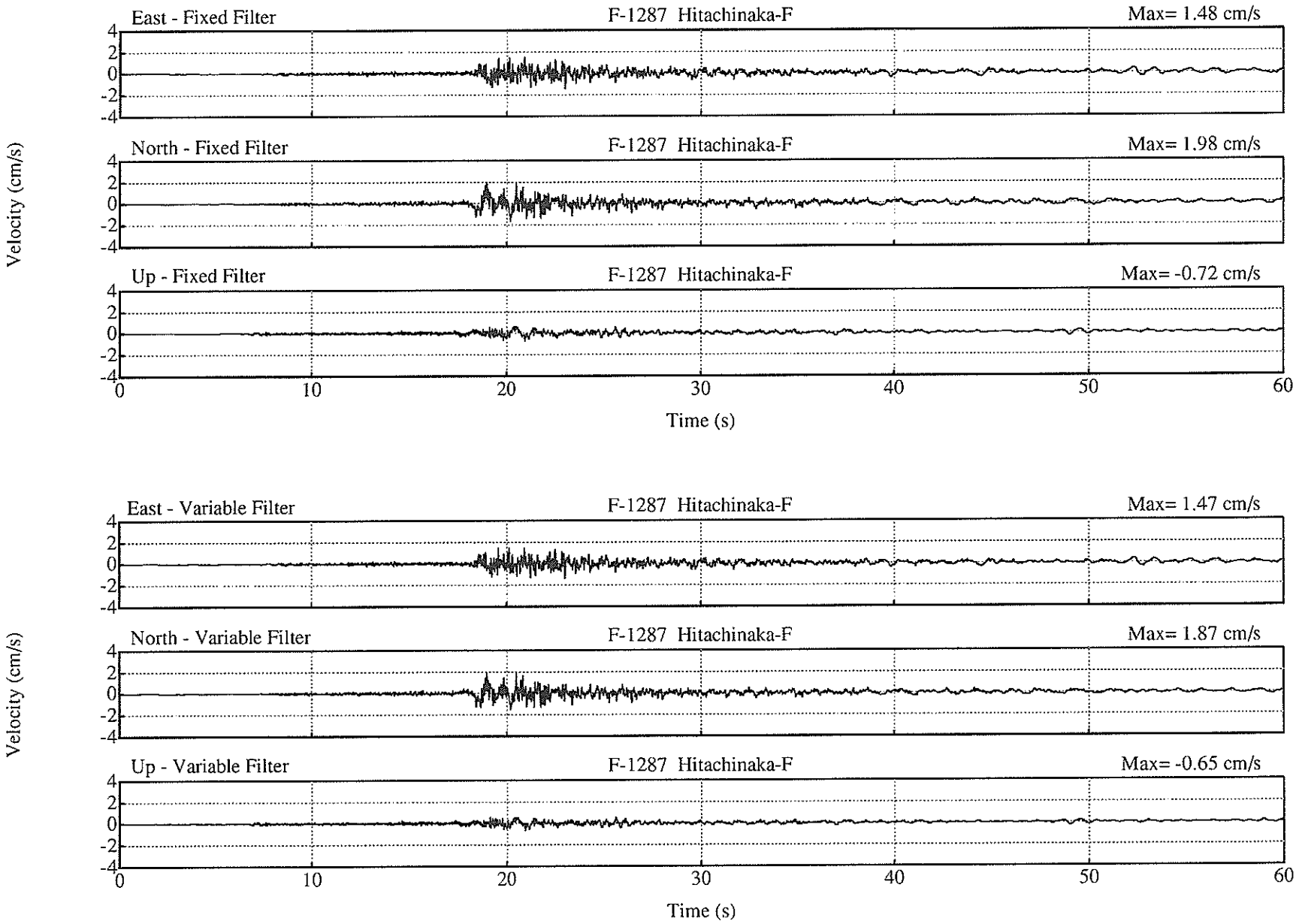
****

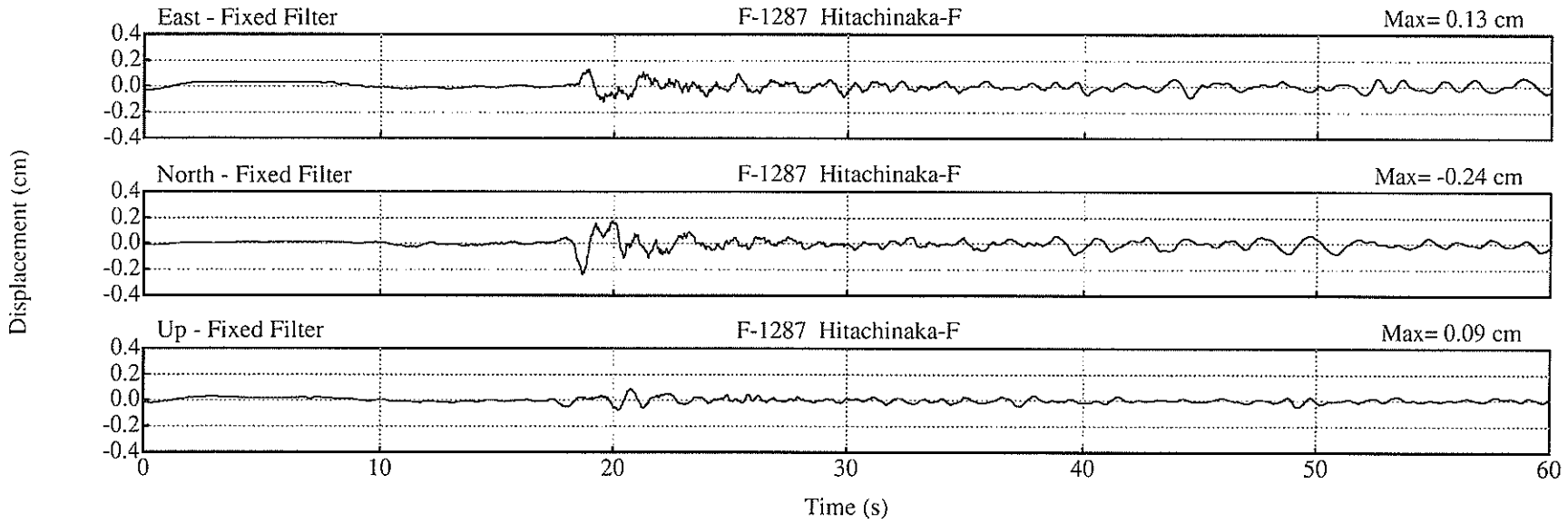
	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
PARAMETER OF THE VARIABLE FILTER				
FC (HZ)	0.359	0.390	0.524	
MAXIMUM ACCELERATION (GAL)				
SMAC-B2 EQUIVALENT	28.5	28.4	10.2	30.6
ORIGINAL	75.5	72.3	46.7	79.5
CORRECTED	75.1	73.2	53.3	78.4
MAXIMUM VELOCITY (CM/SEC)				
FIXED FILTER	1.98	1.48	0.72	2.15
VARIABLE FILTER	1.87	1.47	0.65	1.90
MAXIMUM DISPLACEMENT (CM)				
FIXED FILTER	0.24	0.13	0.09	0.26
VARIABLE FILTER	0.20	0.11	0.07	0.21

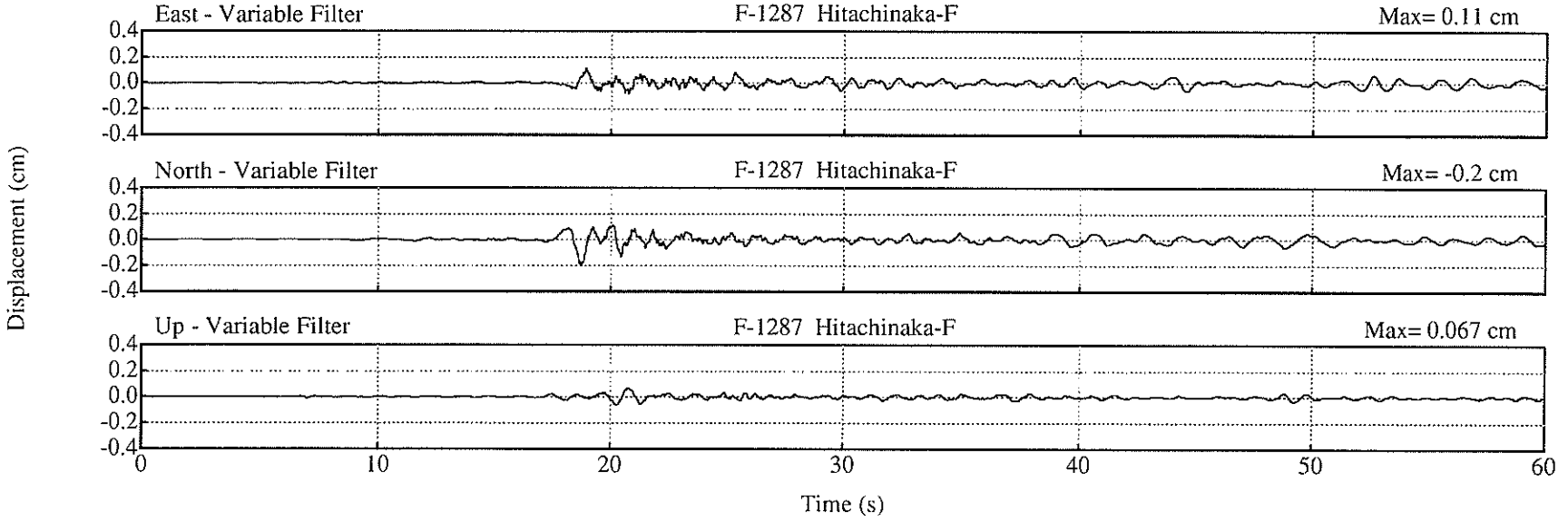
* RESULTANT OF HORIZONTAL COMPONENTS

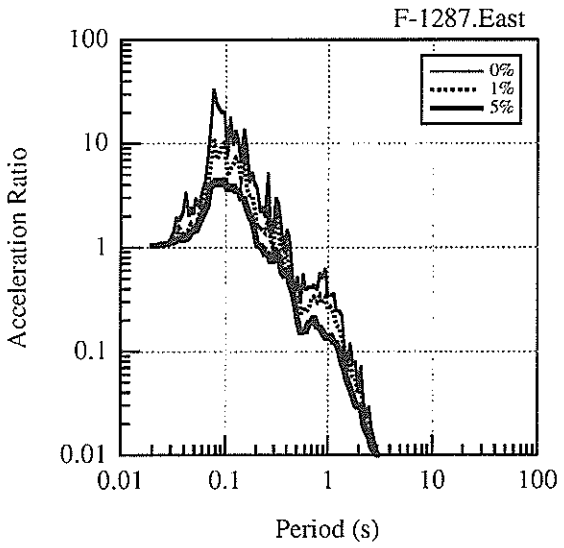

East - Original
F-1287 Hitachinaka-F
Max= 72.34 gal
North - Original
F-1287 Hitachinaka-F
Max= -75.55 gal
Up - Original
F-1287 Hitachinaka-F
Max= -46.68 gal
Acceleration (gal)
100
50
0
-50
-100
0
10
20
30
40
50
60
Time (s)
East - Corrected
F-1287 Hitachinaka-F
Max= -73.24 gal
North - Corrected
F-1287 Hitachinaka-F
Max= -75.14 gal
Up - Corrected
F-1287 Hitachinaka-F
Max= -53.3 gal
Acceleration (gal)
Time (s)

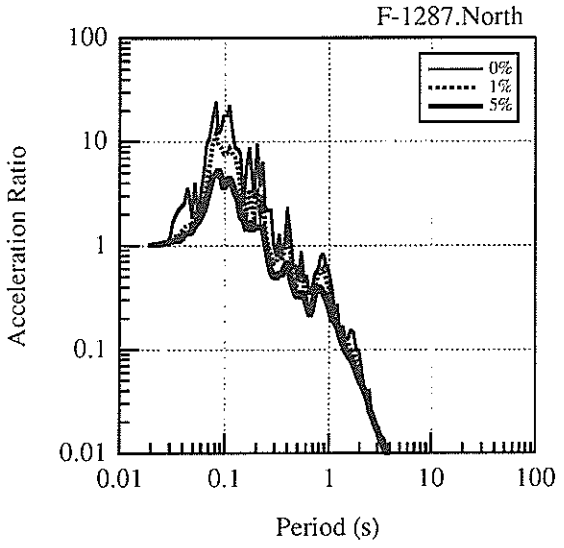

East - Original
F-1287 Hitachinaka-F
Max= 72.34 gal
North - Original
F-1287 Hitachinaka-F
Max= -75.55 gal
Up - Original
F-1287 Hitachinaka-F
Max= -46.68 gal
Acceleration (gal)
100
50
0
-50
-100
0
10
20
30
40
50
60
Time (s)
East - SMAC-B2 Equivalent
F-1287 Hitachinaka-F
Max= -28.4 gal
North - SMAC-B2 Equivalent
F-1287 Hitachinaka-F
Max= -28.47 gal
Up - SMAC-B2 Equivalent
F-1287 Hitachinaka-F
Max= -10.21 gal
Acceleration (gal)
Time (s)

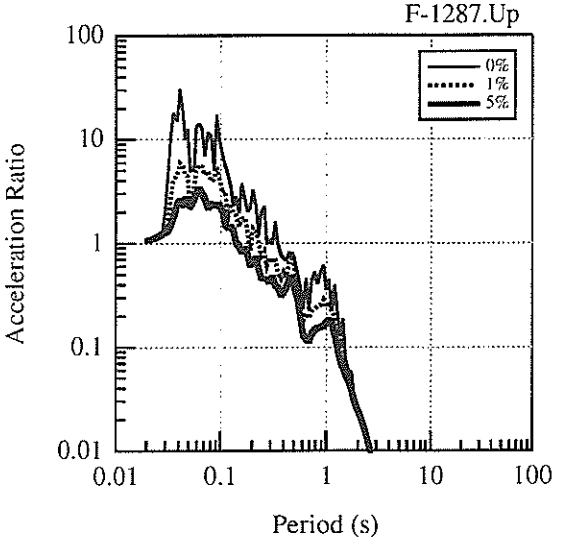

East - Fixed Filter
F-1287 Hitachinaka-F
Max= 1.48 cm/s
North - Fixed Filter
F-1287 Hitachinaka-F
Max= 1.98 cm/s
Up - Fixed Filter
F-1287 Hitachinaka-F
Max= -0.72 cm/s
Velocity (cm/s)
Time (s)
East - Variable Filter
F-1287 Hitachinaka-F
Max= 1.47 cm/s
North - Variable Filter
F-1287 Hitachinaka-F
Max= 1.87 cm/s
Up - Variable Filter
F-1287 Hitachinaka-F
Max= -0.65 cm/s
Velocity (cm/s)
Time (s)

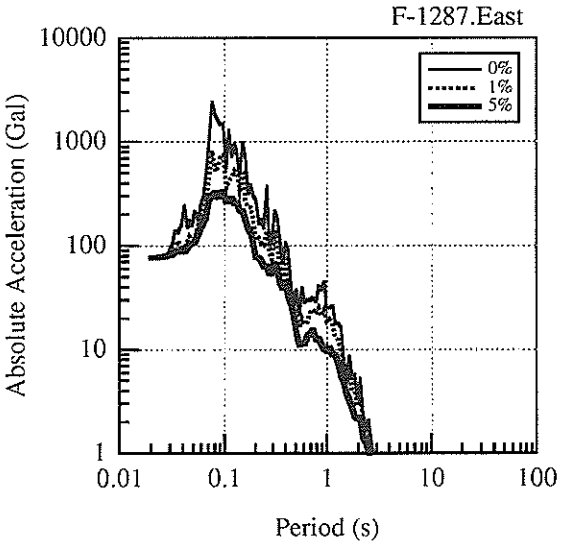

East - Fixed Filter
F-1287 Hitachinaka-F
Max= 0.13 cm
North - Fixed Filter
F-1287 Hitachinaka-F
Max= -0.24 cm
Up - Fixed Filter
F-1287 Hitachinaka-F
Max= 0.09 cm
Displacement (cm)
0.4
0.2
0.0
-0.2
-0.4
0
10
20
30
40
50
60
Time (s)

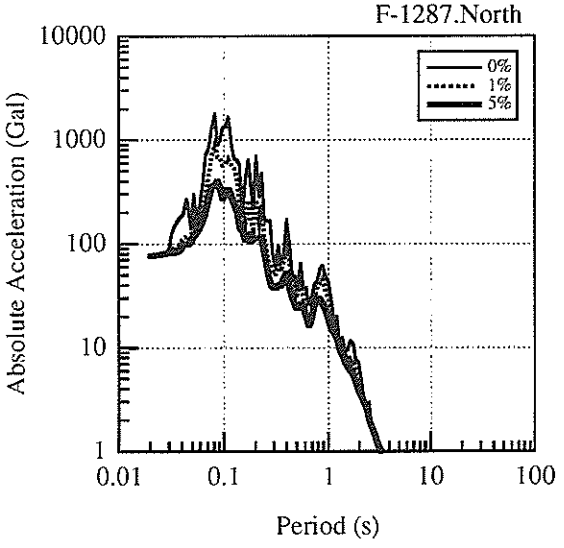

East - Variable Filter
F-1287 Hitachinaka-F
Max= 0.11 cm
North - Variable Filter
F-1287 Hitachinaka-F
Max= -0.2 cm
Up - Variable Filter
F-1287 Hitachinaka-F
Max= 0.067 cm
Displacement (cm)
0.4
0.2
0.0
-0.2
-0.4
0
10
20
30
40
50
60
Time (s)

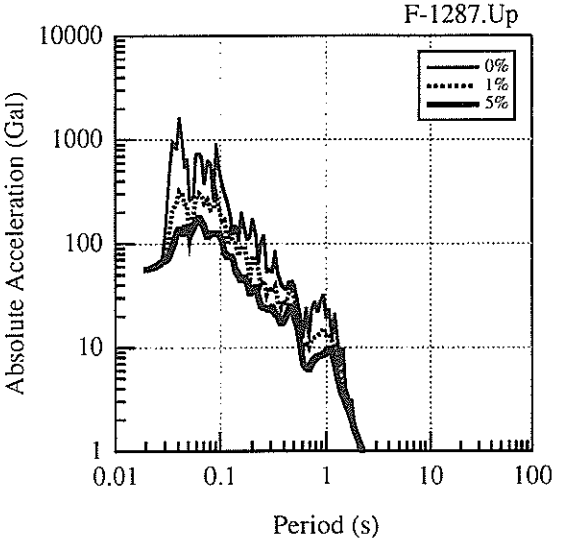

F-1287.East
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

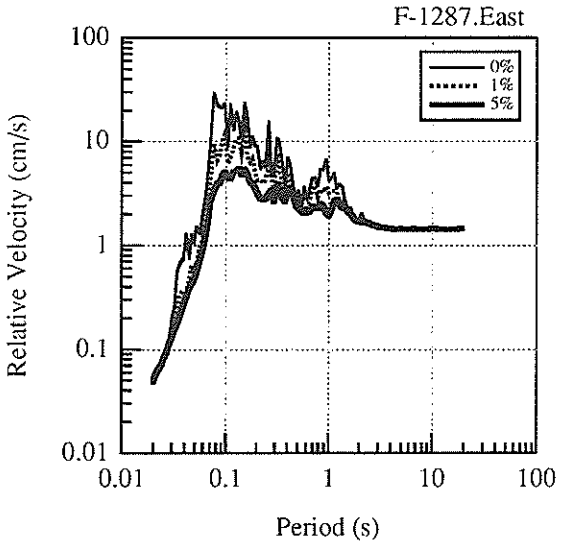

F-1287.North
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

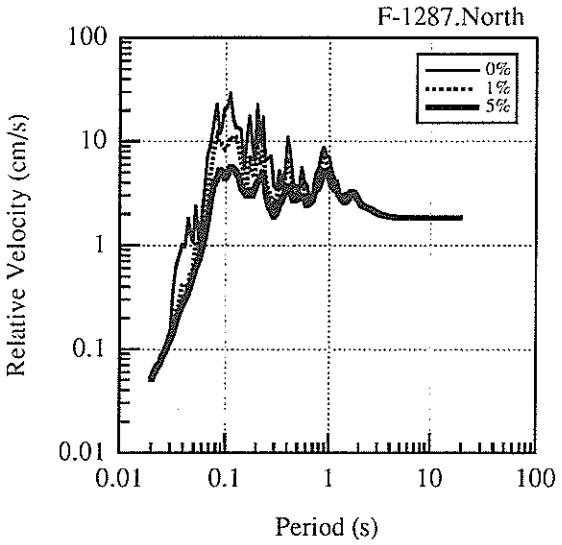

F-1287.Up
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

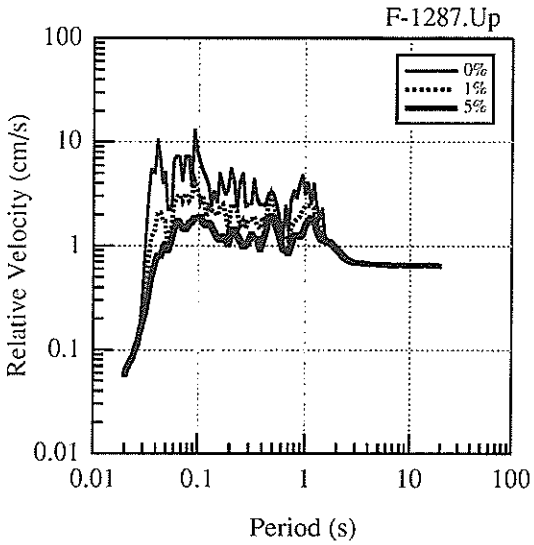

F-1287.East
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

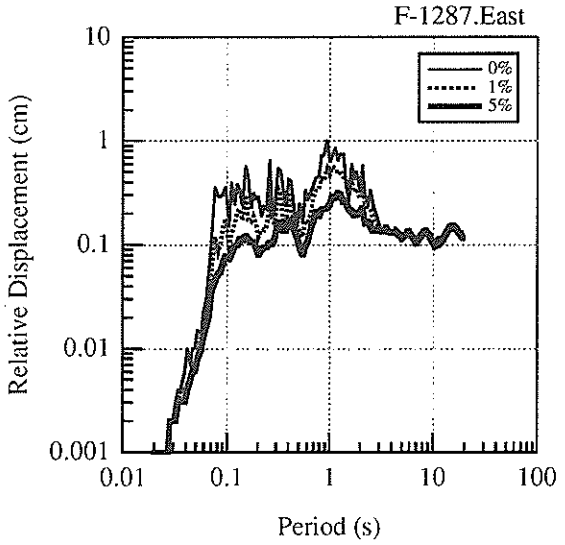

F-1287.North
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

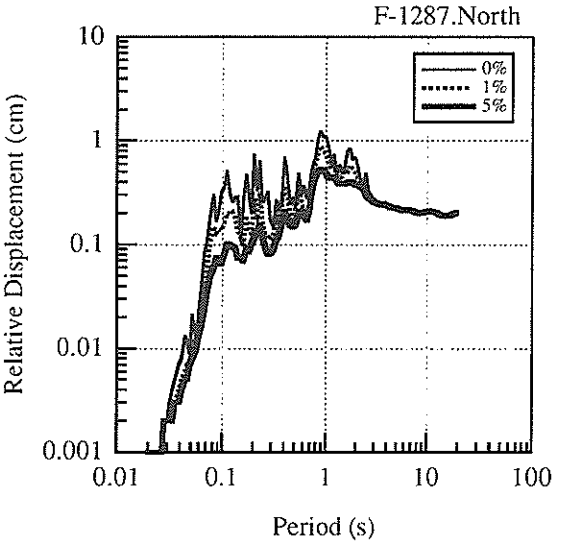

F-1287.Up
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

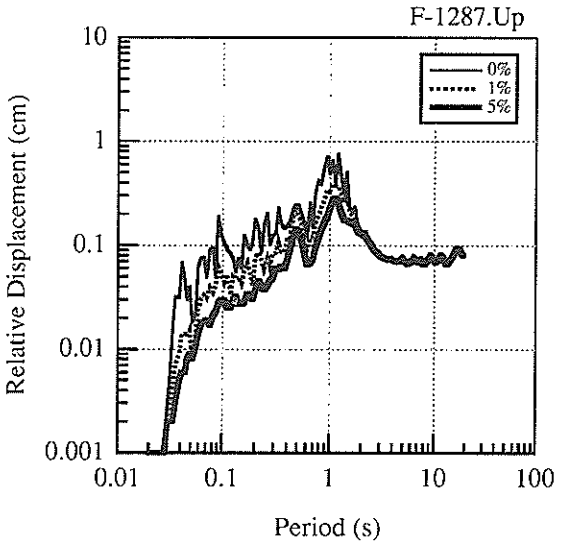

F-1287.East
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

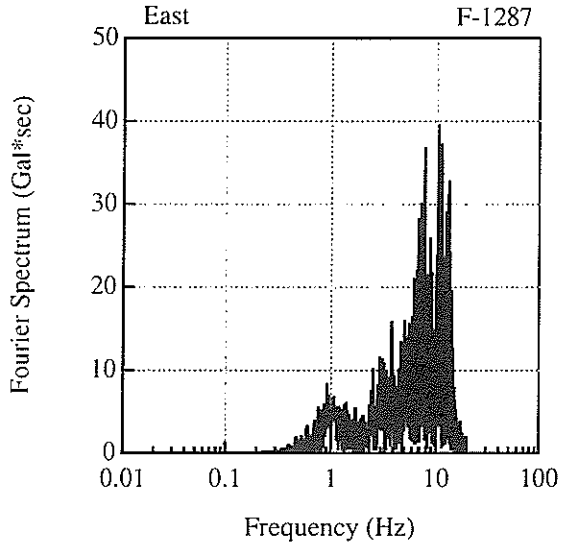

F-1287.North
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

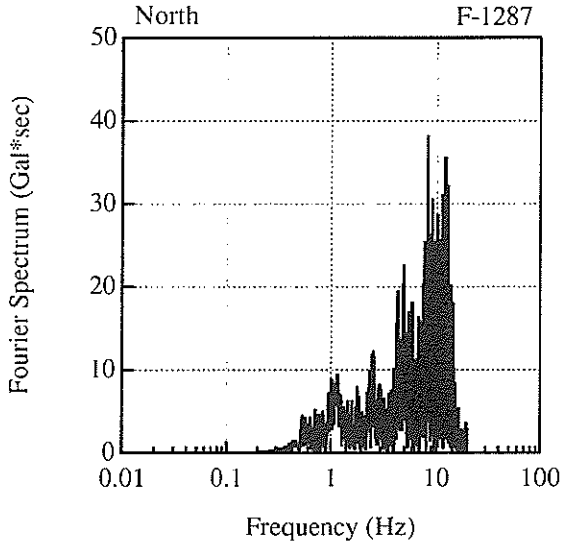

F-1287.Up
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

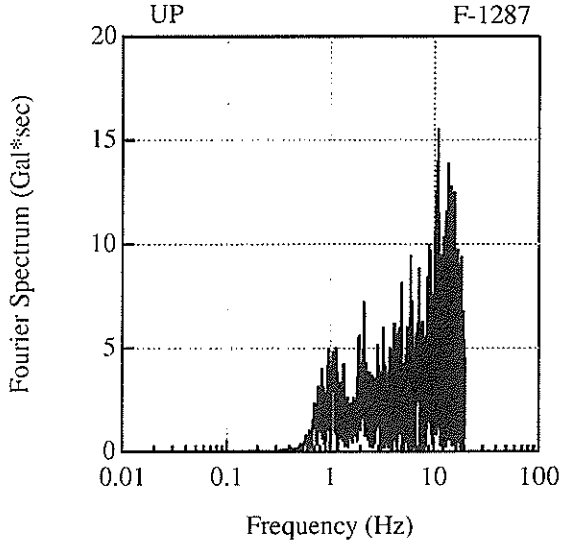

F-1287.East
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

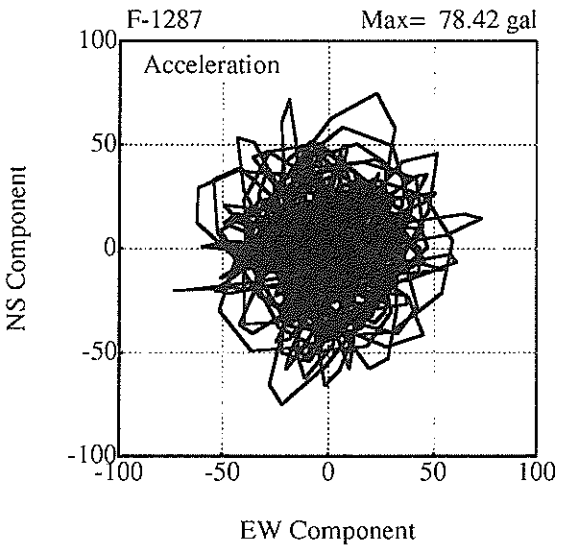

F-1287.North
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

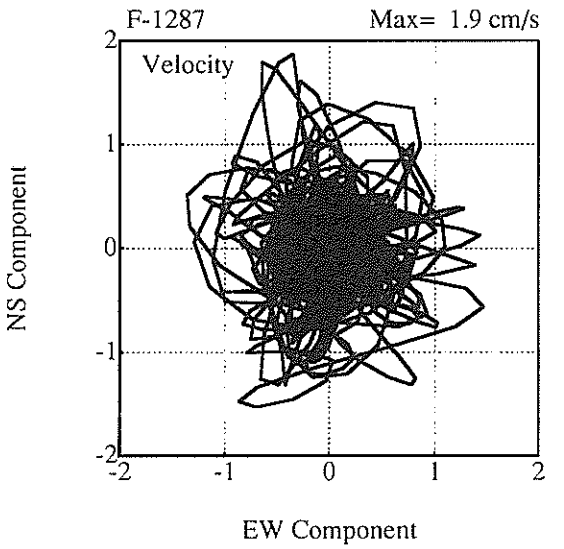

F-1287.Up
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

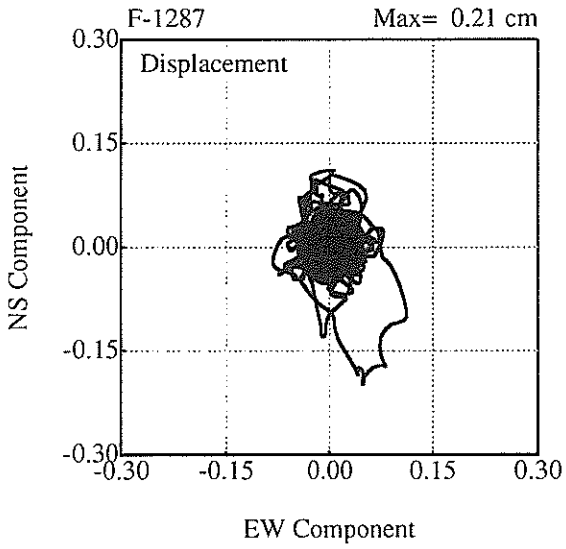

East
F-1287
Fourier Spectrum (Gal*sec)
Frequency (Hz)
0.01
0.1
1
10
100
0
10
20
30
40
50


North
F-1287
Fourier Spectrum (Gal*sec)
Frequency (Hz)
0.01
0.1
1
10
100
0
10
20
30
40
50


UP
F-1287
Fourier Spectrum (Gal*sec)
Frequency (Hz)
0.01
0.1
1
10
100
0
5
10
15
20


F-1287
Max= 78.42 gal
Acceleration
NS Component
EW Component
-100
-50
0
50
100


F-1287
Max= 1.9 cm/s
Velocity
NS Component
EW Component
-2
-1
0
1
2


F-1287
Max= 0.21 cm
Displacement
NS Component
EW Component
-0.30
-0.15
0.00
0.15
0.30

RECORD NUMBER : F-1288

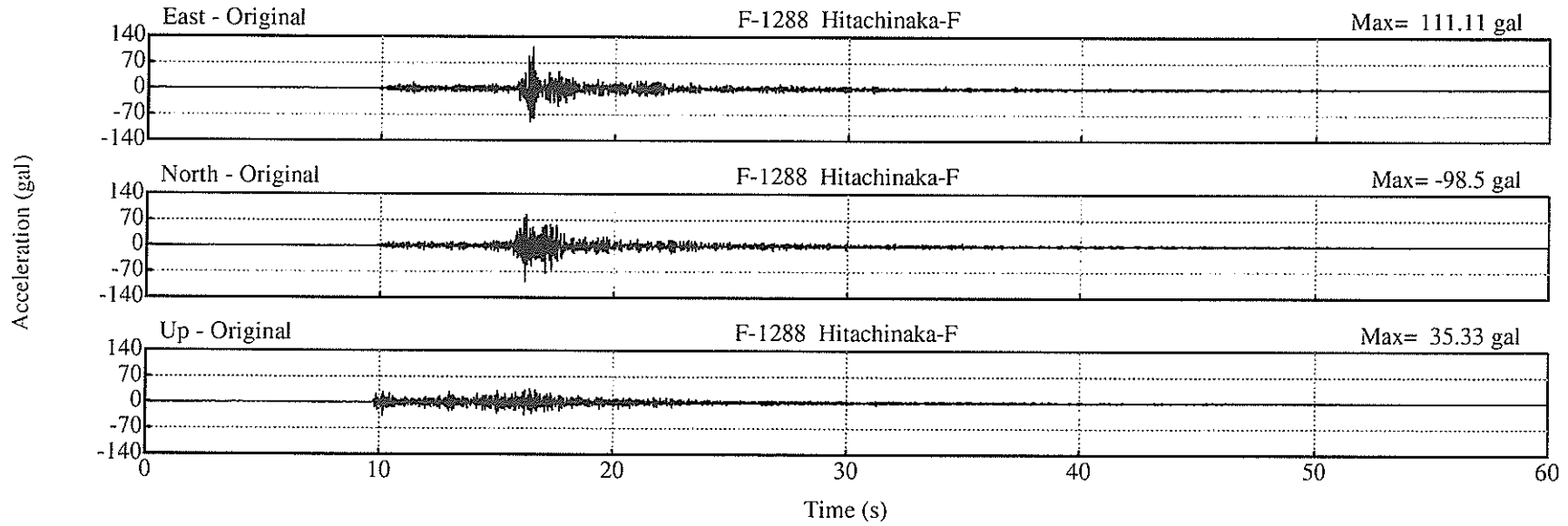
STATION : HITACHINAKA-F

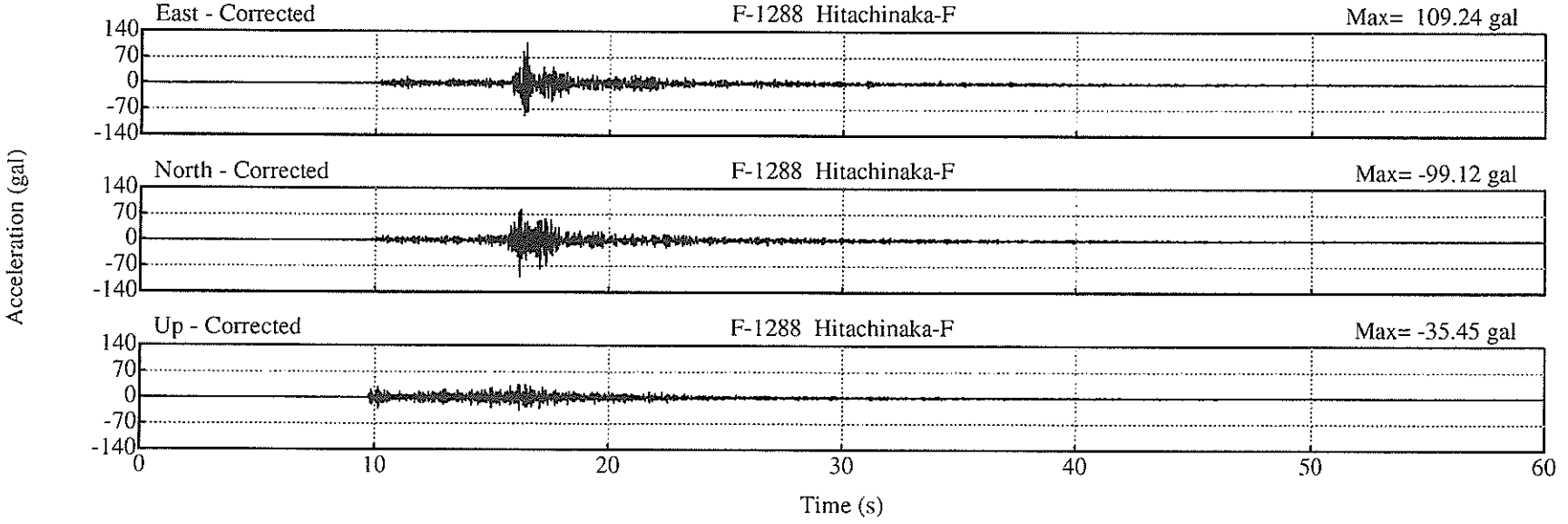
EARTHQUAKE DATA

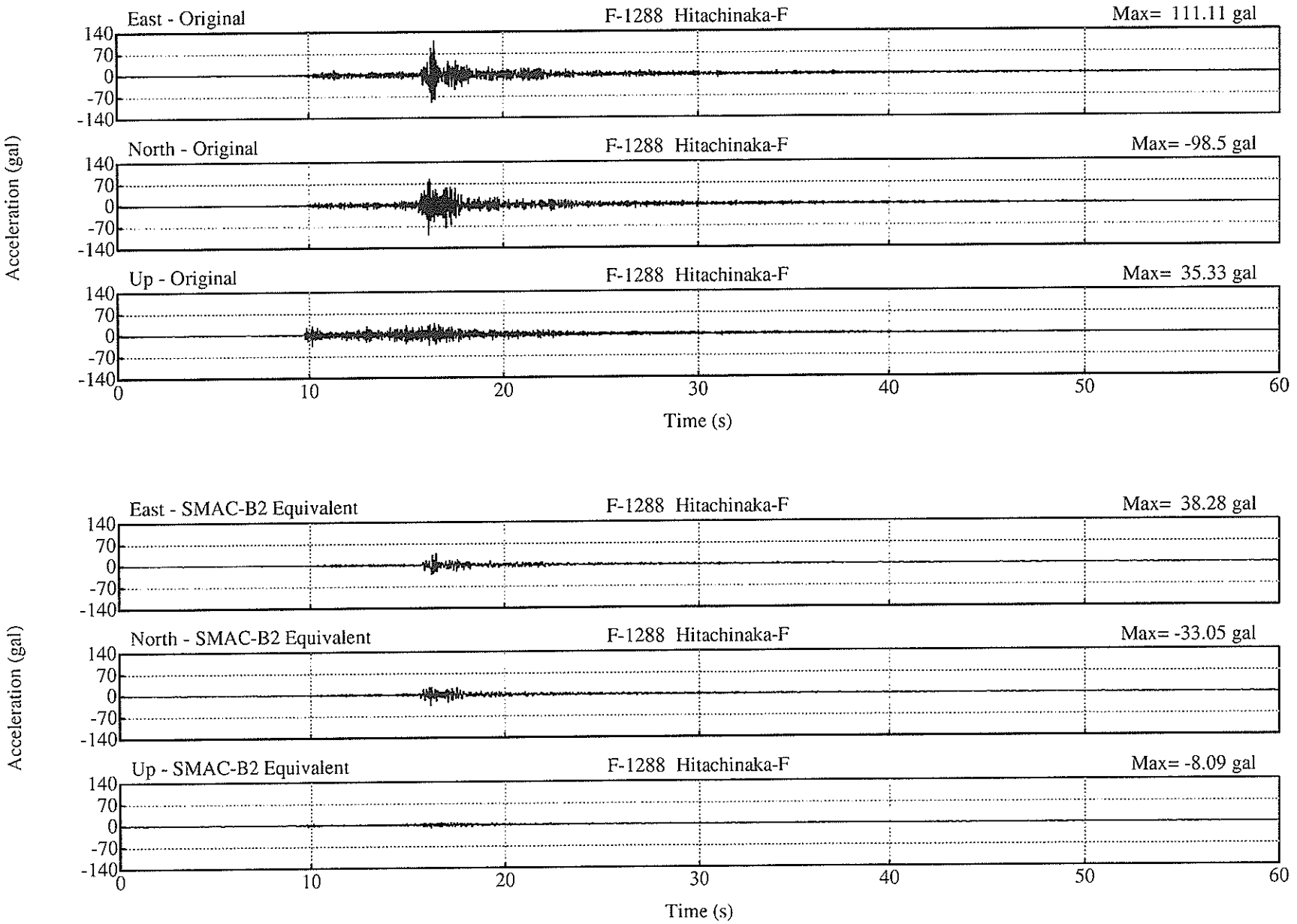
DATE AND TIME	19: 7 APR 11,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	NORTHERN IBARAKI PREF
LATITUDE	36°26.2′ N
LONGITUDE	140°39.7′ E
DEPTH	54.2KM
JMA MAGNITUDE	4.3

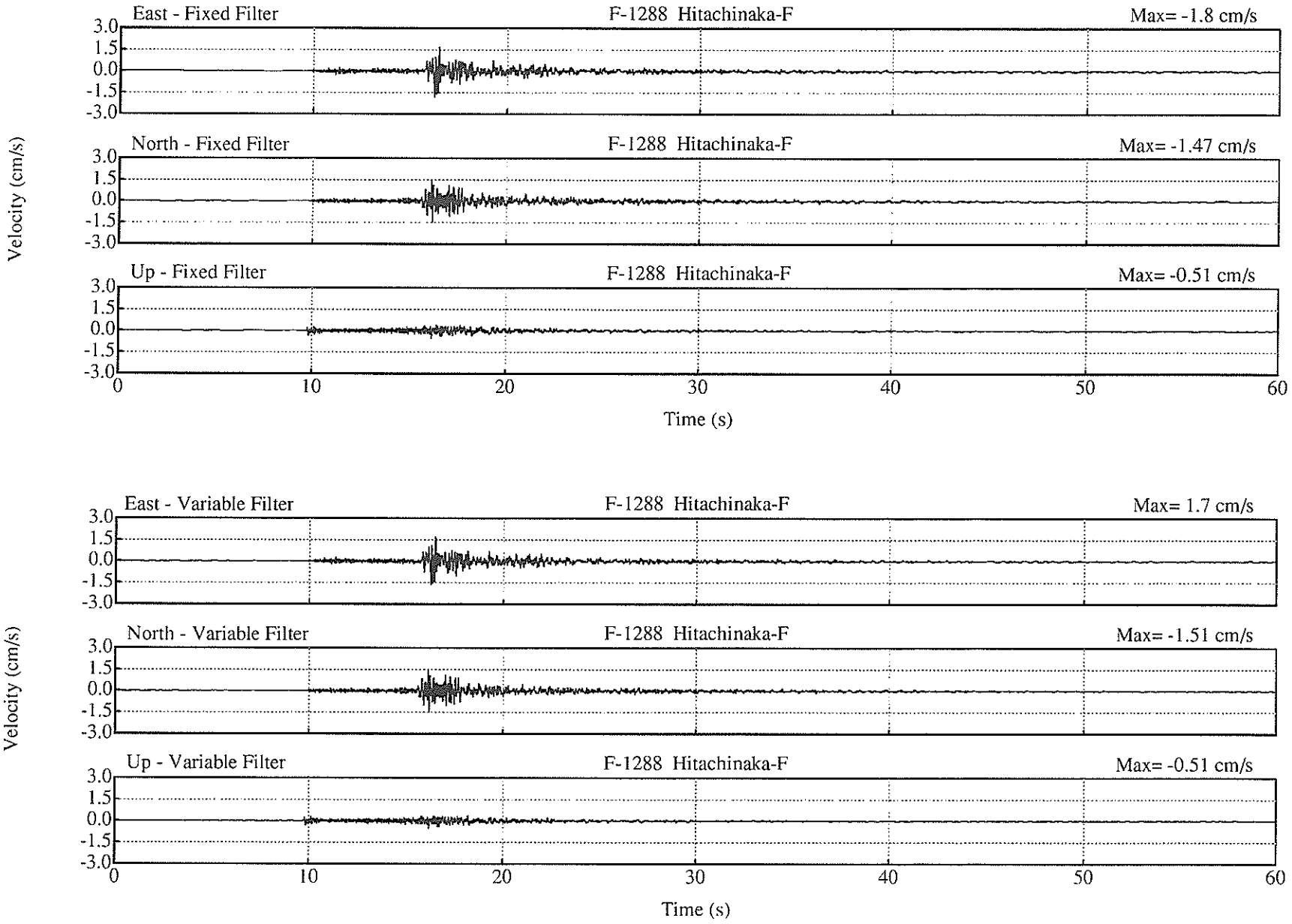
	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
PARAMETER OF THE VARIABLE FILTER				
FC (HZ)	0.982	0.750	1.037	
MAXIMUM ACCELERATION (GAL)				
SMAC-B2 EQUIVALENT	33.1	38.3	8.1	42.8
ORIGINAL	98.5	111.1	35.3	119.9
CORRECTED	99.1	109.2	35.4	116.0
MAXIMUM VELOCITY (CM/SEC)				
FIXED FILTER	1.47	1.80	0.51	1.96
VARIABLE FILTER	1.51	1.70	0.51	1.91
MAXIMUM DISPLACEMENT (CM)				
FIXED FILTER	0.04	0.09	0.04	0.09
VARIABLE FILTER	0.03	0.07	0.02	0.07

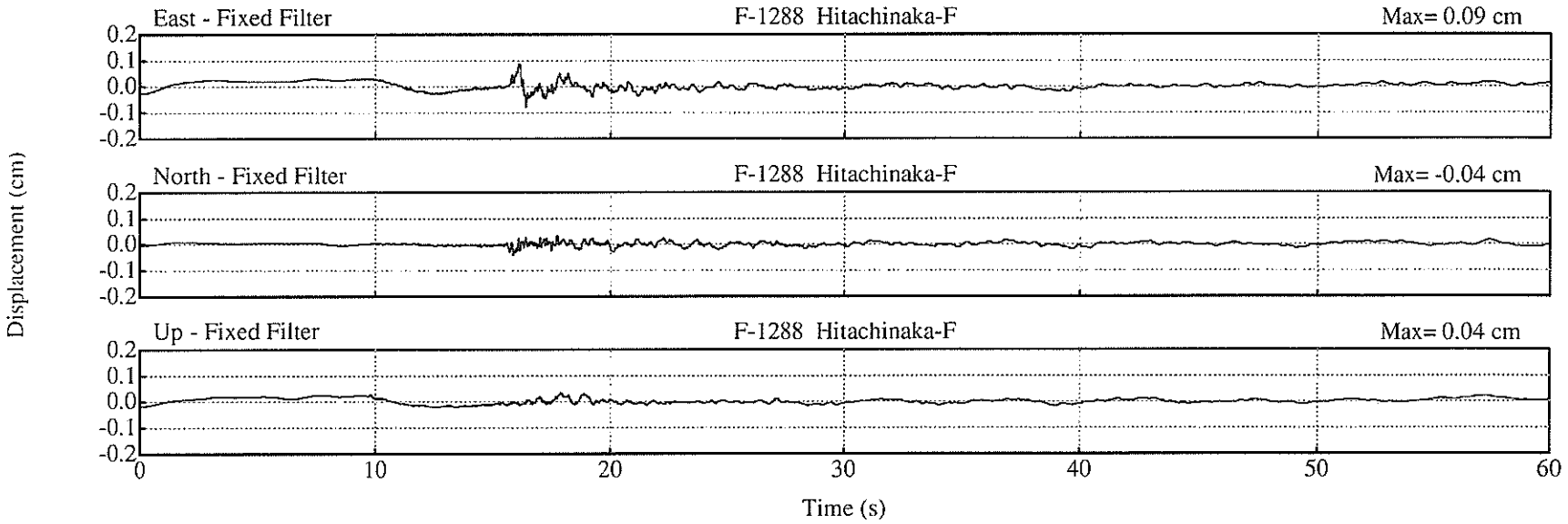
* RESULTANT OF HORIZONTAL COMPONENTS

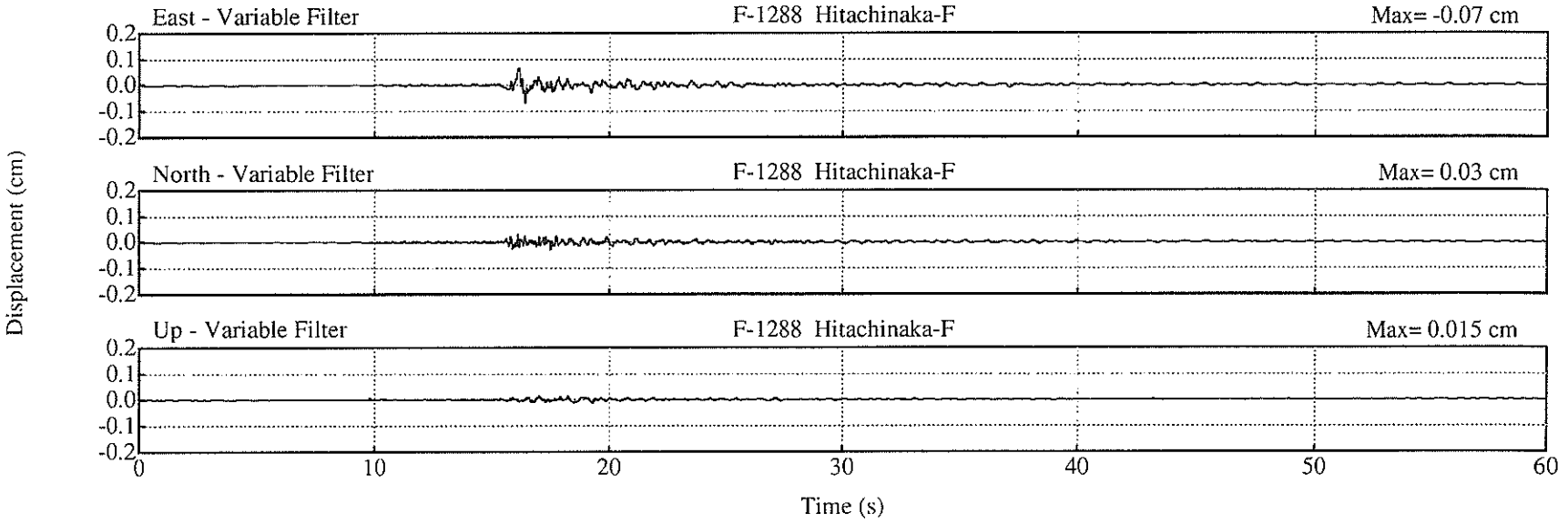

East - Original
F-1288 Hitachinaka-F
Max= 111.11 gal
North - Original
F-1288 Hitachinaka-F
Max= -98.5 gal
Up - Original
F-1288 Hitachinaka-F
Max= 35.33 gal
Acceleration (gal)
140
70
0
-70
-140
0
10
20
30
40
50
60
Time (s)

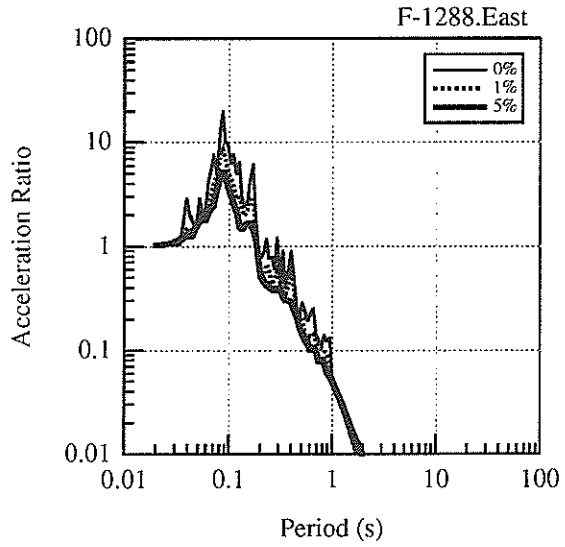

East - Corrected
F-1288 Hitachinaka-F
Max= 109.24 gal
North - Corrected
F-1288 Hitachinaka-F
Max= -99.12 gal
Up - Corrected
F-1288 Hitachinaka-F
Max= -35.45 gal
Acceleration (gal)
140
70
0
-70
-140
0
10
20
30
40
50
60
Time (s)

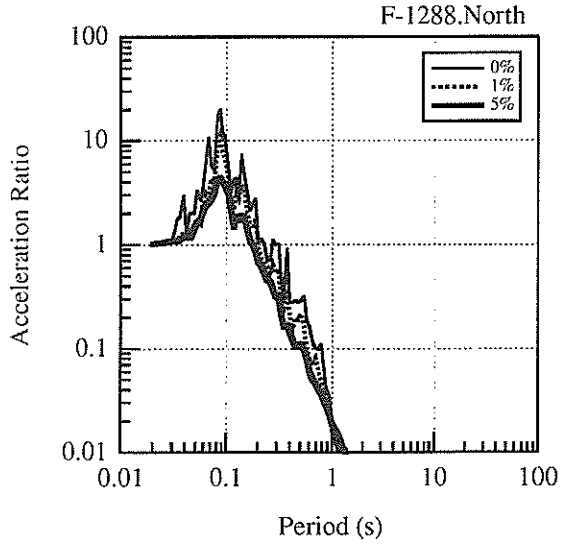

East - Original
F-1288 Hitachinaka-F
Max= 111.11 gal
North - Original
F-1288 Hitachinaka-F
Max= -98.5 gal
Up - Original
F-1288 Hitachinaka-F
Max= 35.33 gal
Acceleration (gal)
140
70
0
-70
-140
0
10
20
30
40
50
60
Time (s)
East - SMAC-B2 Equivalent
F-1288 Hitachinaka-F
Max= 38.28 gal
North - SMAC-B2 Equivalent
F-1288 Hitachinaka-F
Max= -33.05 gal
Up - SMAC-B2 Equivalent
F-1288 Hitachinaka-F
Max= -8.09 gal
Acceleration (gal)
Time (s)

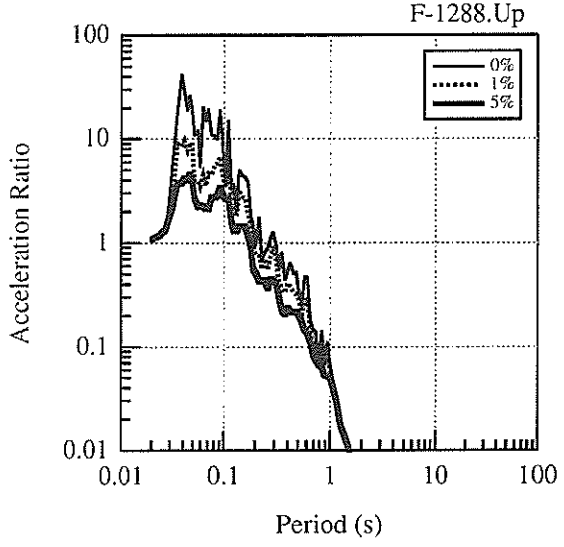

East - Fixed Filter
F-1288 Hitachinaka-F
Max= -1.8 cm/s
North - Fixed Filter
F-1288 Hitachinaka-F
Max= -1.47 cm/s
Up - Fixed Filter
F-1288 Hitachinaka-F
Max= -0.51 cm/s
Velocity (cm/s)
3.0
1.5
0.0
-1.5
-3.0
0
10
20
30
40
50
60
Time (s)
East - Variable Filter
F-1288 Hitachinaka-F
Max= 1.7 cm/s
North - Variable Filter
F-1288 Hitachinaka-F
Max= -1.51 cm/s
Up - Variable Filter
F-1288 Hitachinaka-F
Max= -0.51 cm/s
Velocity (cm/s)
Time (s)

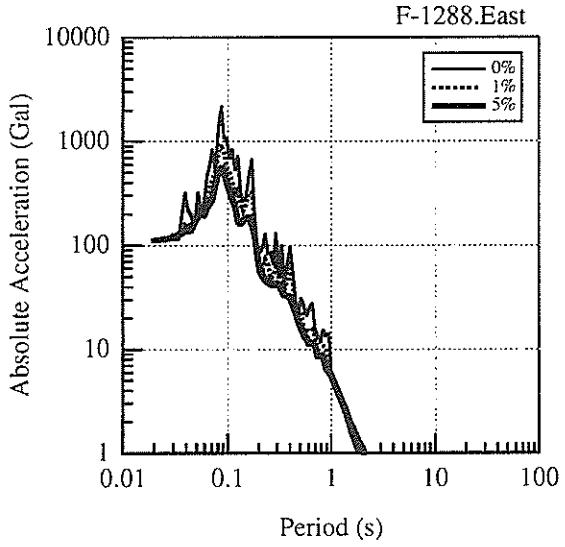

East - Fixed Filter
F-1288 Hitachinaka-F
Max= 0.09 cm
North - Fixed Filter
F-1288 Hitachinaka-F
Max= -0.04 cm
Up - Fixed Filter
F-1288 Hitachinaka-F
Max= 0.04 cm
Displacement (cm)
0.2
0.1
0.0
-0.1
-0.2
0
10
20
30
40
50
60
Time (s)

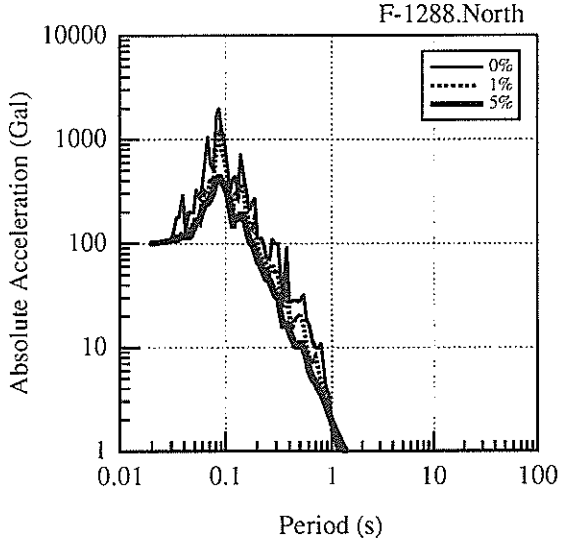

East - Variable Filter
F-1288 Hitachinaka-F
Max= -0.07 cm
North - Variable Filter
F-1288 Hitachinaka-F
Max= 0.03 cm
Up - Variable Filter
F-1288 Hitachinaka-F
Max= 0.015 cm
Displacement (cm)
0.2
0.1
0.0
-0.1
-0.2
0
10
20
30
40
50
60
Time (s)

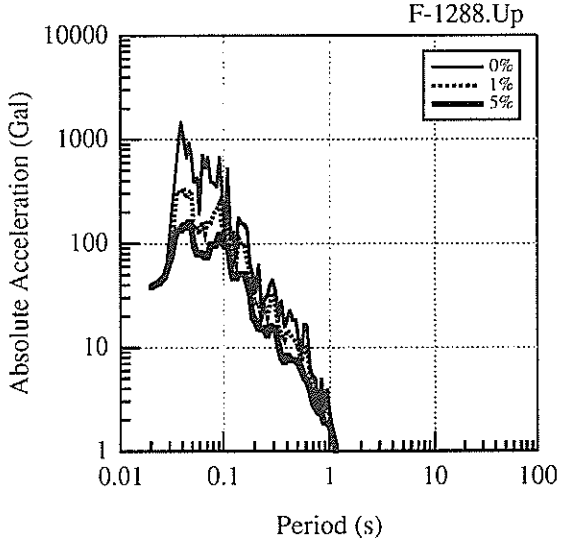

F-1288.East
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

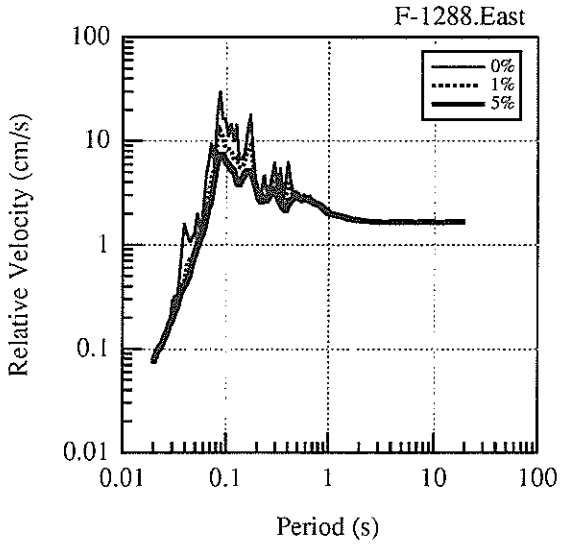

F-1288.North
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

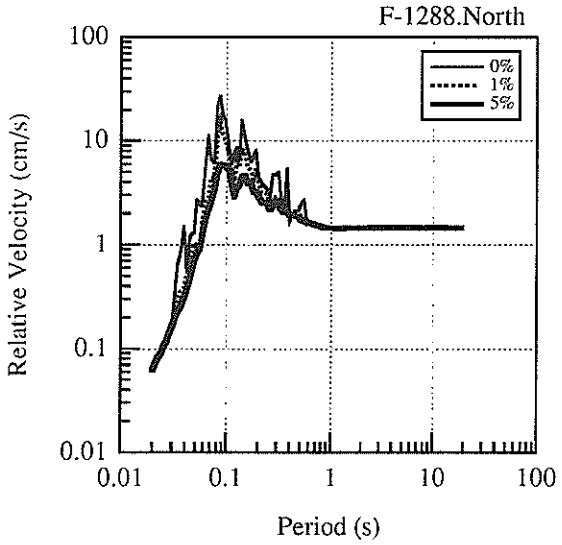

F-1288.Up
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

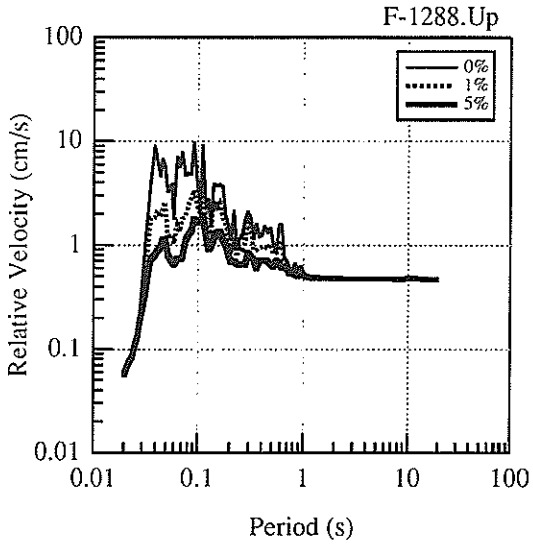

F-1288.East
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

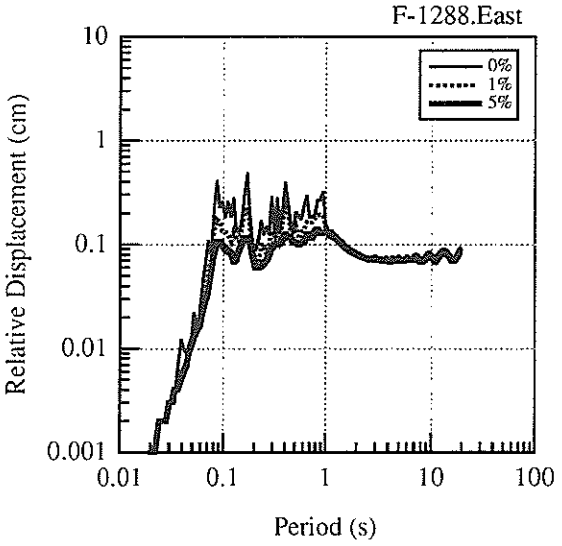

F-1288.North
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

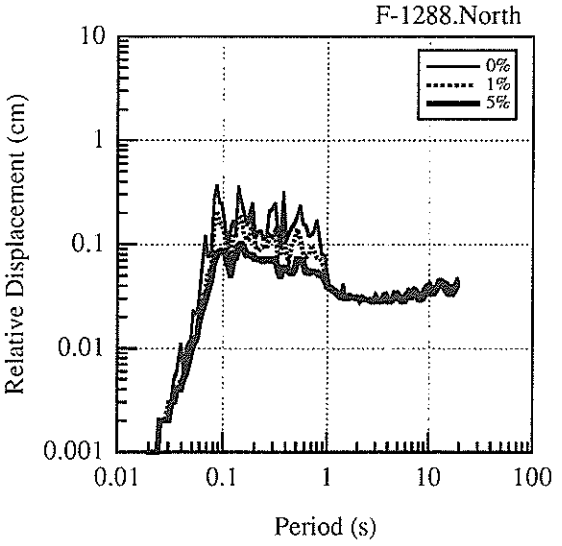

F-1288.Up
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

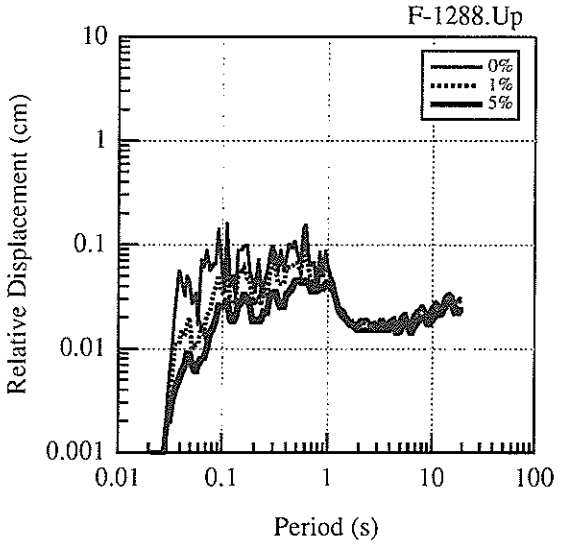

F-1288.East
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

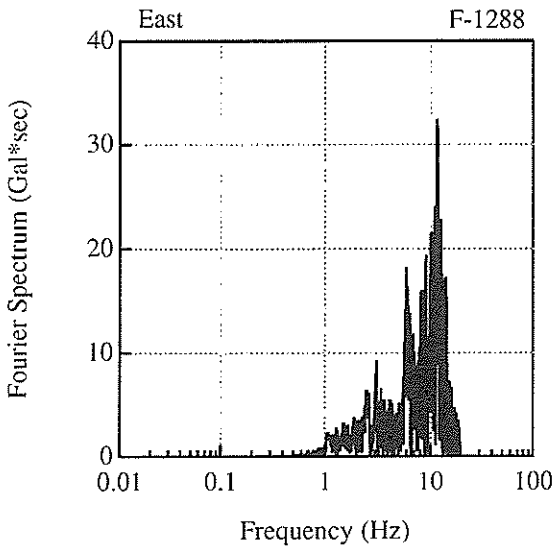

F-1288.North
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

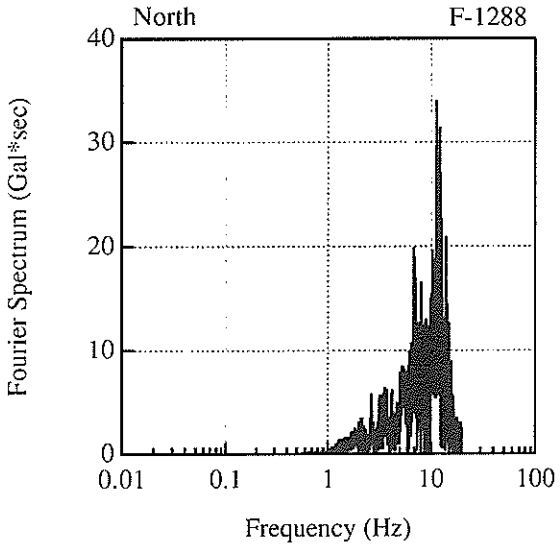

F-1288.Up
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

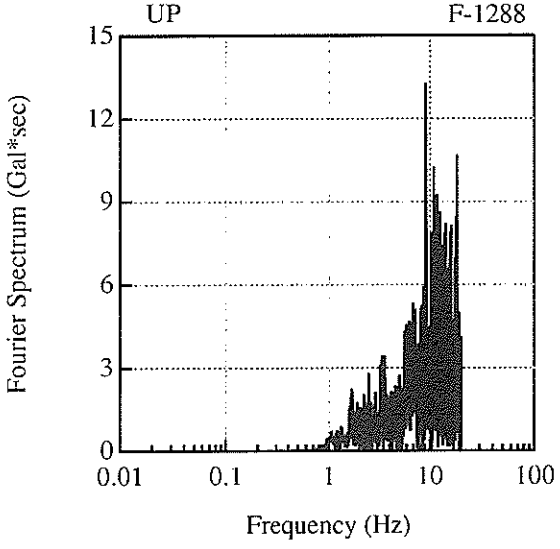

F-1288.East
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

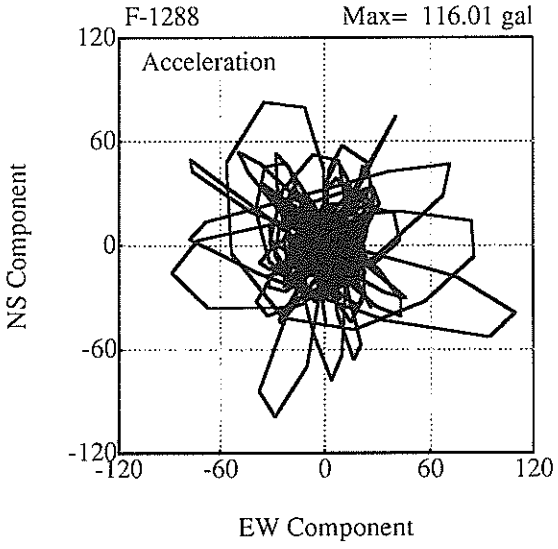

F-1288.North
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

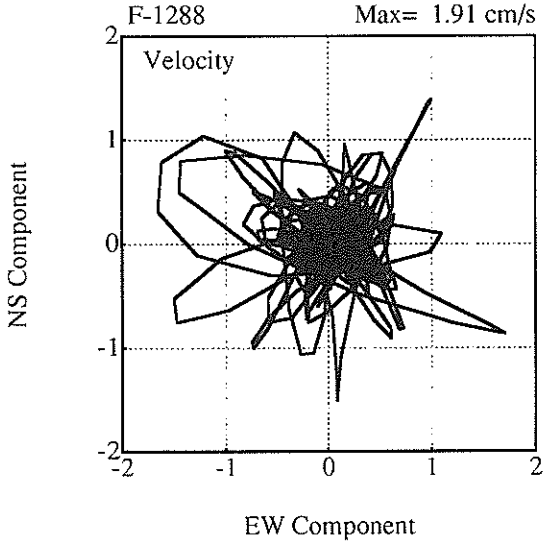

F-1288.Up
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

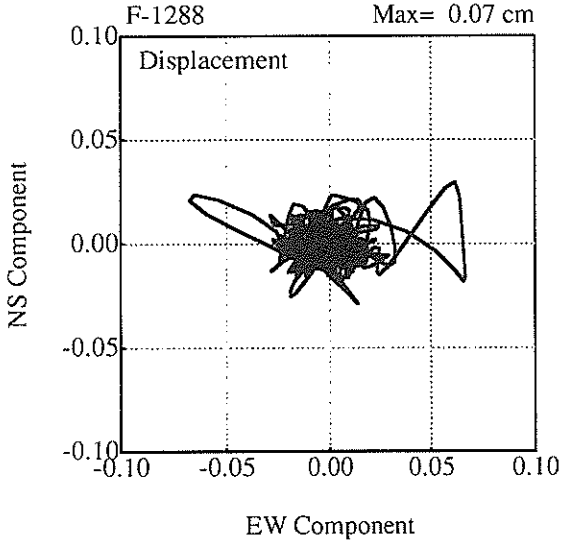

East
F-1288
Fourier Spectrum (Gal*sec)
40
30
20
10
0
0.01
0.1
1
10
100
Frequency (Hz)


North
F-1288
Fourier Spectrum (Gal*sec)
40
30
20
10
0
0.01
0.1
1
10
100
Frequency (Hz)


UP
F-1288
Fourier Spectrum (Gal*sec)
15
12
9
6
3
0
0.01
0.1
1
10
100
Frequency (Hz)


F-1288
Max= 116.01 gal
Acceleration
NS Component
120
60
0
-60
-120
-120
-60
0
60
120
EW Component


F-1288
Max= 1.91 cm/s
Velocity
NS Component
2
1
0
-1
-2
-2
-1
0
1
2
EW Component


F-1288
Max= 0.07 cm
Displacement
NS Component
0.10
0.05
0.00
-0.05
-0.10
-0.10
-0.05
0.00
0.05
0.10
EW Component

RECORD NUMBER : F-1270

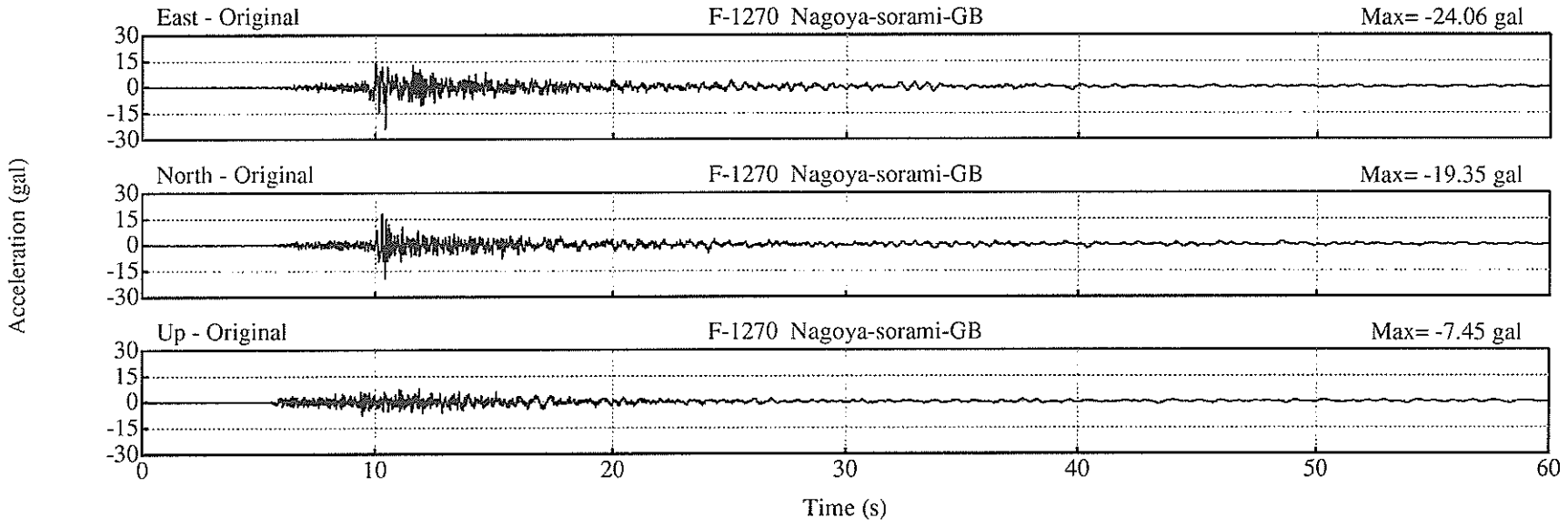
STATION : NAGOYA-SORAMI-GB

EARTHQUAKE DATA

DATE AND TIME	20:32 APR 22,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	SHIGA GIFU BORDER REGION
LATITUDE	35° 9.9′ N
LONGITUDE	136°34.2′ E
DEPTH	10.1KM
JMA MAGNITUDE	5.4

	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	19.3	24.1	7.5	24.4

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1271

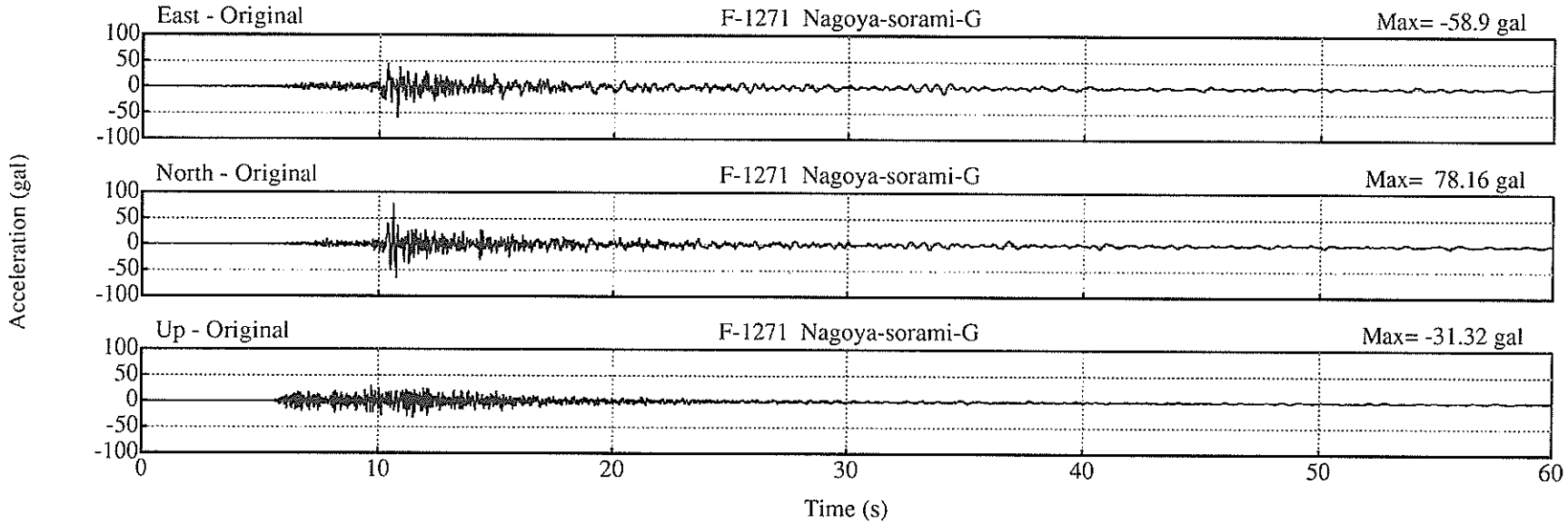
STATION : NAGOYA-SORAMI-G

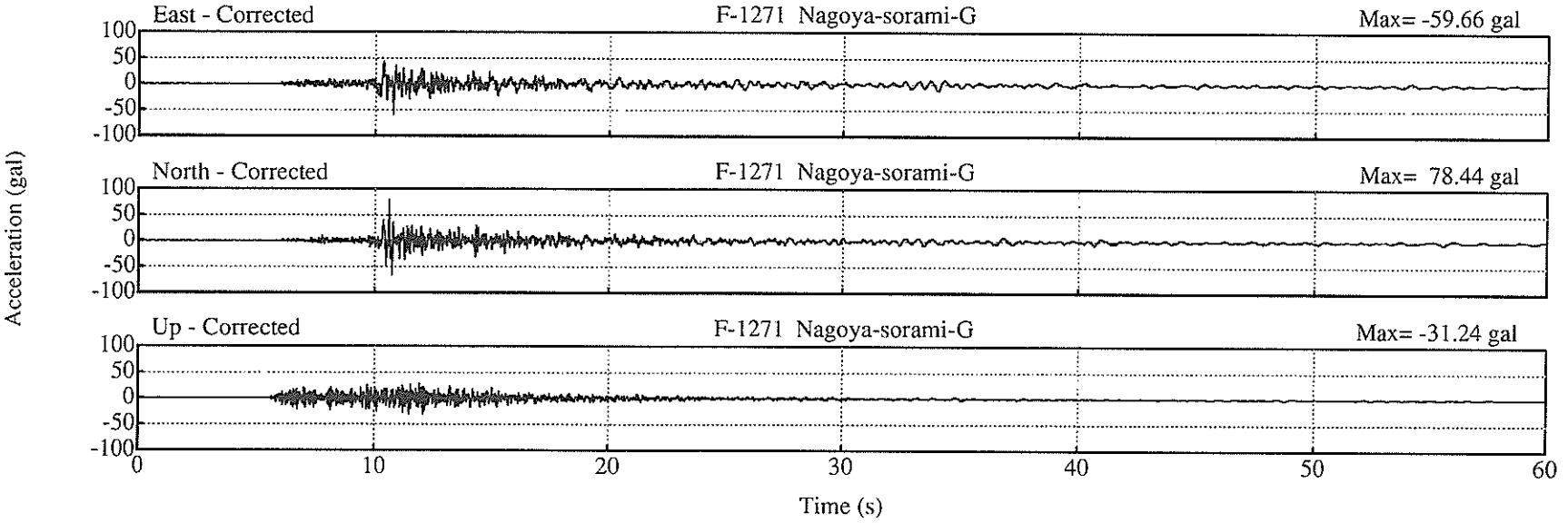
EARTHQUAKE DATA

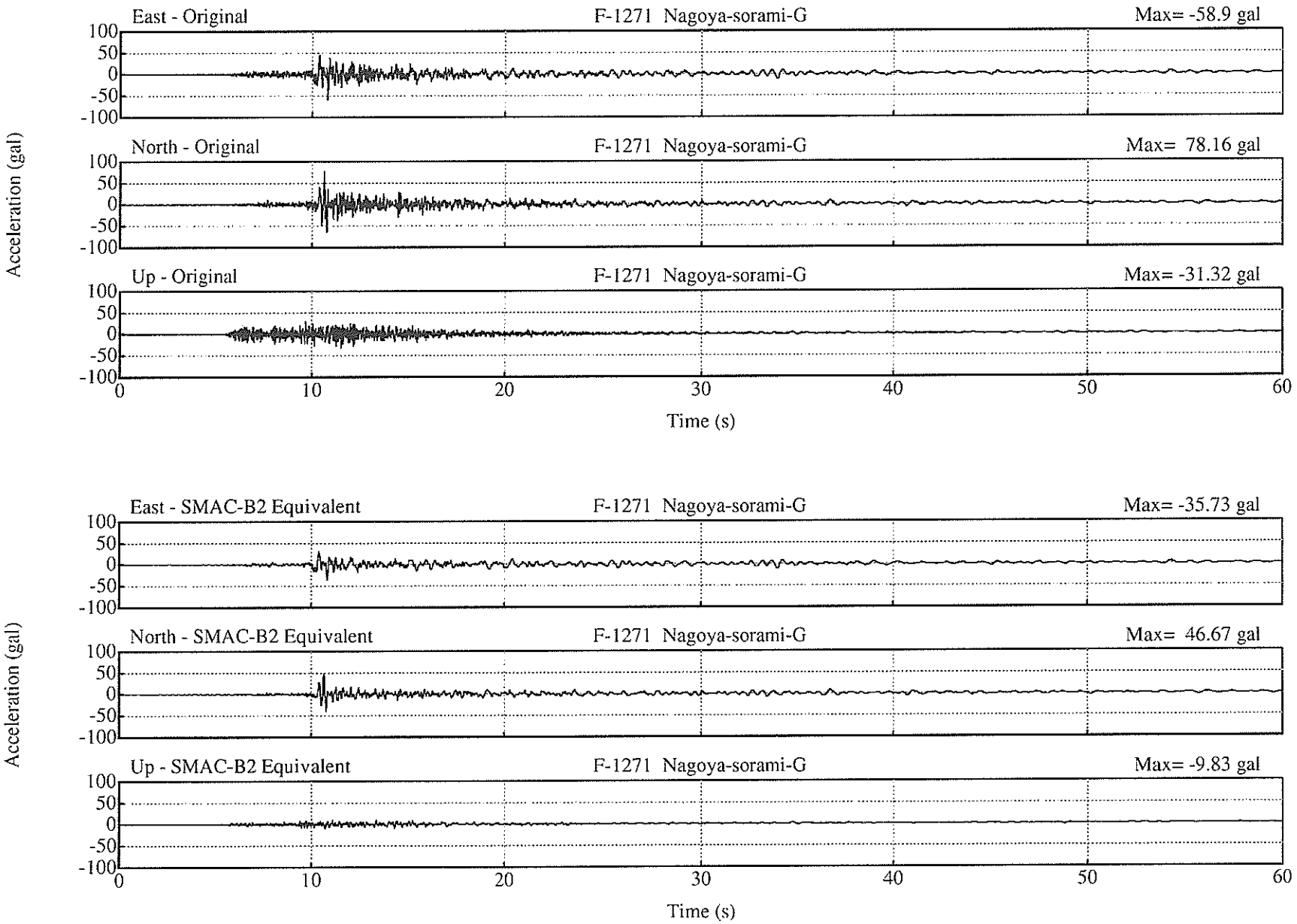
DATE AND TIME	20:32 APR 22,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	SHIGA GIFU BORDER REGION
LATITUDE	35° 9.9′ N
LONGITUDE	136°34.2′ E
DEPTH	10.1KM
JMA MAGNITUDE	5.4

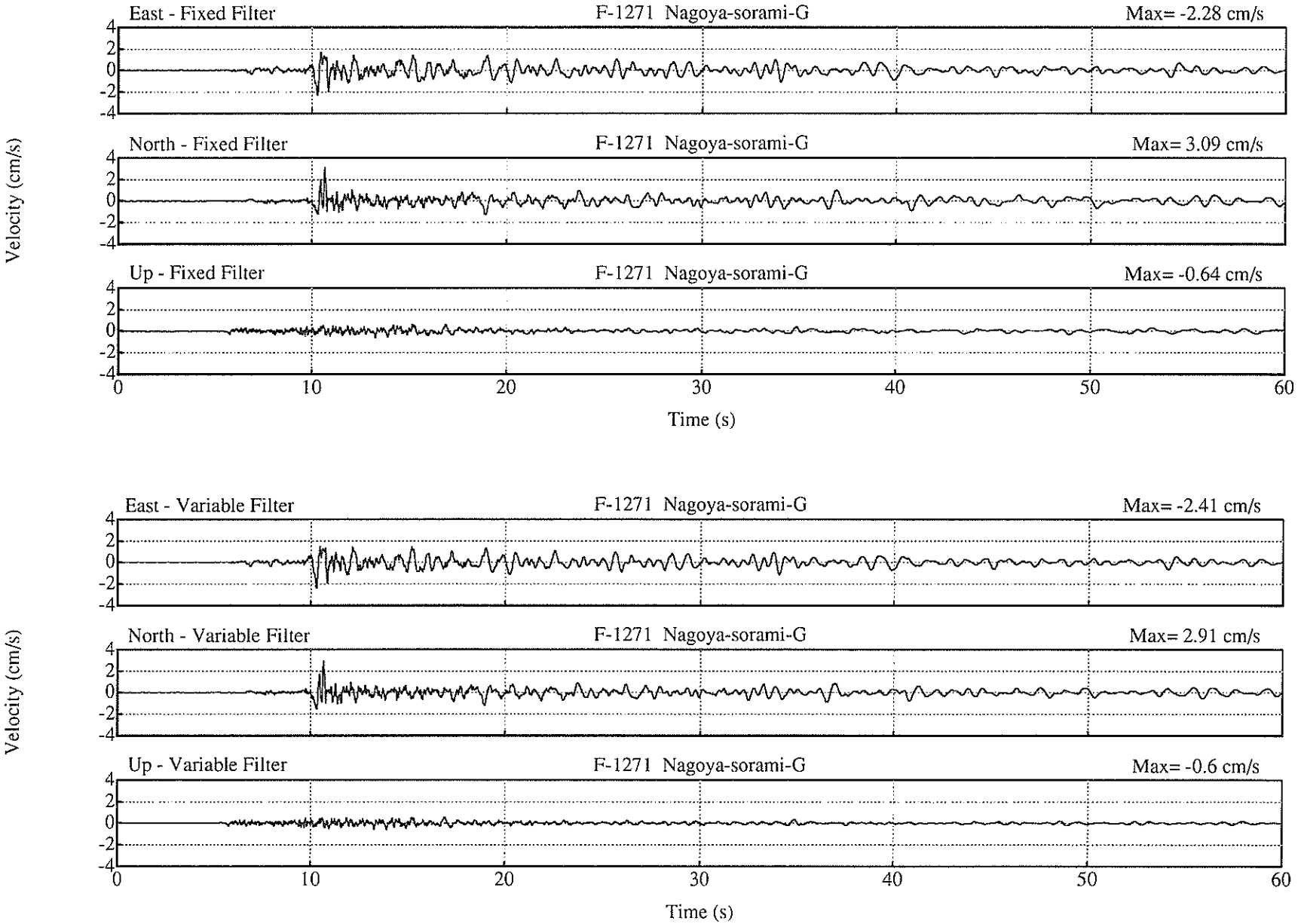
	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
PARAMETER OF THE VARIABLE FILTER				
FC (HZ)	0.359	0.390	0.579	
MAXIMUM ACCELERATION (GAL)				
SMAC-B2 EQUIVALENT	46.7	35.7	9.8	46.8
ORIGINAL	78.2	58.9	31.3	78.2
CORRECTED	78.4	59.7	31.2	78.5
MAXIMUM VELOCITY (CM/SEC)				
FIXED FILTER	3.09	2.28	0.64	3.29
VARIABLE FILTER	2.91	2.41	0.60	3.12
MAXIMUM DISPLACEMENT (CM)				
FIXED FILTER	0.28	0.30	0.11	0.39
VARIABLE FILTER	0.22	0.24	0.05	0.33

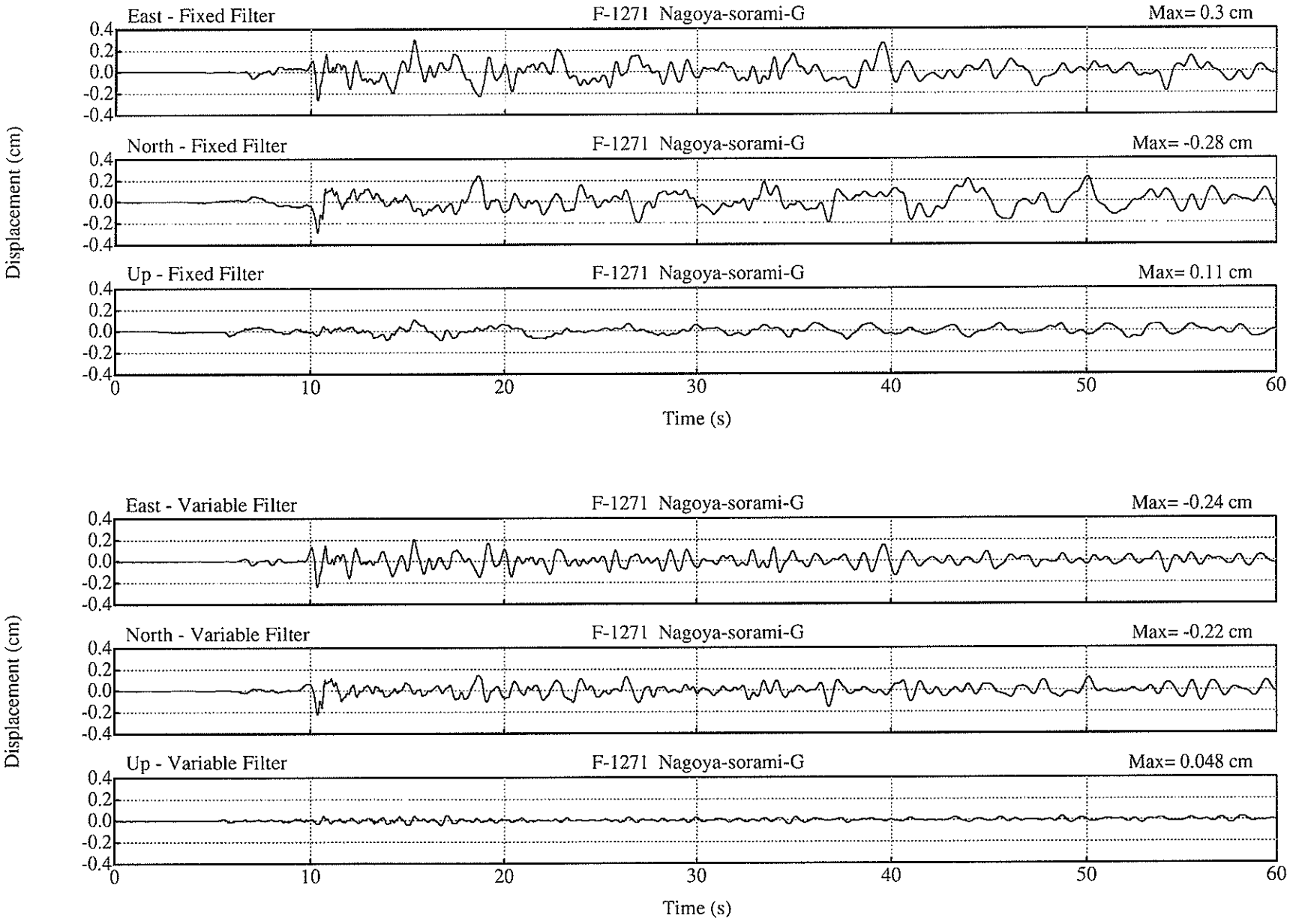
* RESULTANT OF HORIZONTAL COMPONENTS

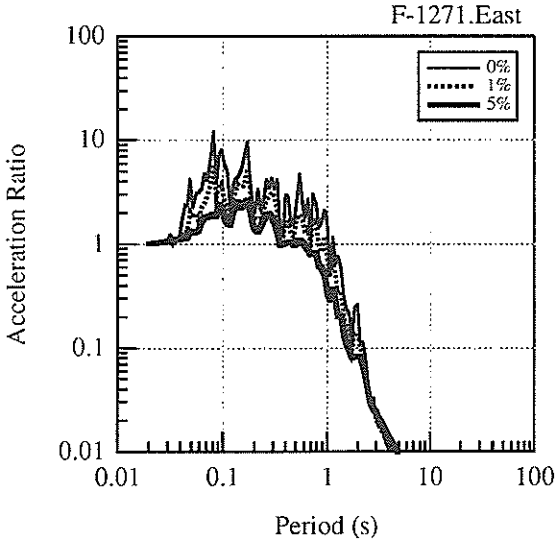

East - Original
F-1271 Nagoya-sorami-G
Max= -58.9 gal
North - Original
F-1271 Nagoya-sorami-G
Max= 78.16 gal
Up - Original
F-1271 Nagoya-sorami-G
Max= -31.32 gal
Acceleration (gal)
100
50
0
-50
-100
0
10
20
30
40
50
60
Time (s)

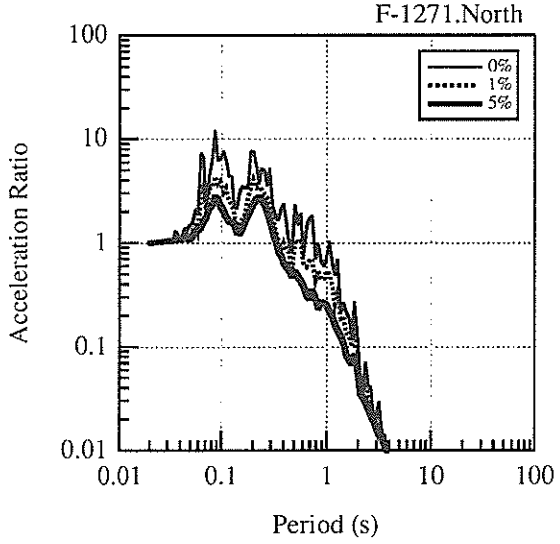

East - Corrected
F-1271 Nagoya-sorami-G
Max= -59.66 gal
North - Corrected
F-1271 Nagoya-sorami-G
Max= 78.44 gal
Up - Corrected
F-1271 Nagoya-sorami-G
Max= -31.24 gal
Acceleration (gal)
100
50
0
-50
-100
0
10
20
30
40
50
60
Time (s)

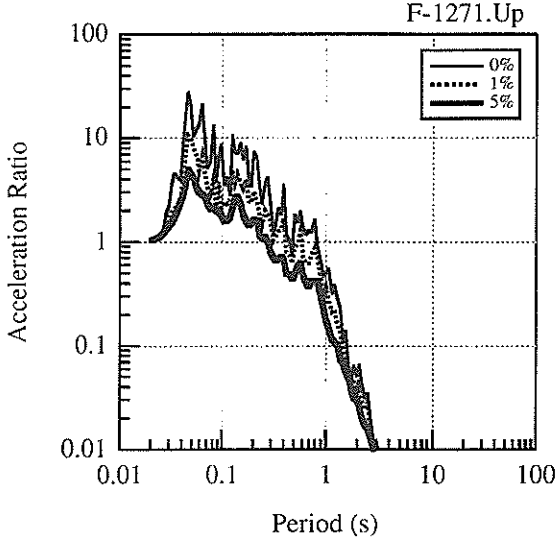

East - Original
F-1271 Nagoya-sorami-G
Max= -58.9 gal
North - Original
F-1271 Nagoya-sorami-G
Max= 78.16 gal
Up - Original
F-1271 Nagoya-sorami-G
Max= -31.32 gal
Acceleration (gal)
Time (s)
East - SMAC-B2 Equivalent
F-1271 Nagoya-sorami-G
Max= -35.73 gal
North - SMAC-B2 Equivalent
F-1271 Nagoya-sorami-G
Max= 46.67 gal
Up - SMAC-B2 Equivalent
F-1271 Nagoya-sorami-G
Max= -9.83 gal
Acceleration (gal)
Time (s)

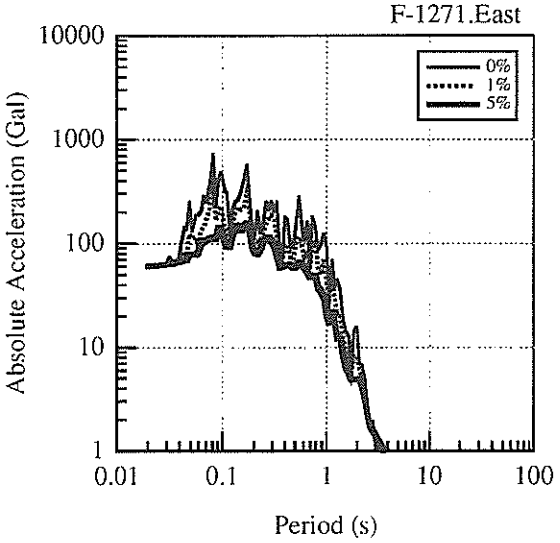

East - Fixed Filter
F-1271 Nagoya-sorami-G
Max= -2.28 cm/s
North - Fixed Filter
F-1271 Nagoya-sorami-G
Max= 3.09 cm/s
Up - Fixed Filter
F-1271 Nagoya-sorami-G
Max= -0.64 cm/s
Velocity (cm/s)
Time (s)
East - Variable Filter
F-1271 Nagoya-sorami-G
Max= -2.41 cm/s
North - Variable Filter
F-1271 Nagoya-sorami-G
Max= 2.91 cm/s
Up - Variable Filter
F-1271 Nagoya-sorami-G
Max= -0.6 cm/s
Velocity (cm/s)
Time (s)

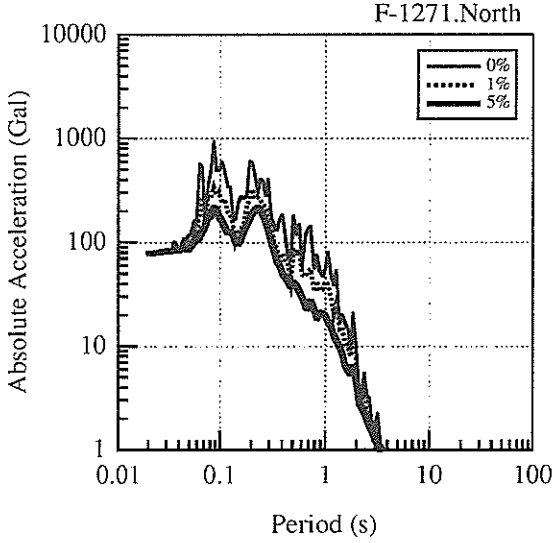

East - Fixed Filter
F-1271 Nagoya-sorami-G
Max= 0.3 cm
North - Fixed Filter
F-1271 Nagoya-sorami-G
Max= -0.28 cm
Up - Fixed Filter
F-1271 Nagoya-sorami-G
Max= 0.11 cm
Displacement (cm)
0.4
0.2
0.0
-0.2
-0.4
0
10
20
30
40
50
60
Time (s)
East - Variable Filter
F-1271 Nagoya-sorami-G
Max= -0.24 cm
North - Variable Filter
F-1271 Nagoya-sorami-G
Max= -0.22 cm
Up - Variable Filter
F-1271 Nagoya-sorami-G
Max= 0.048 cm
Displacement (cm)
Time (s)

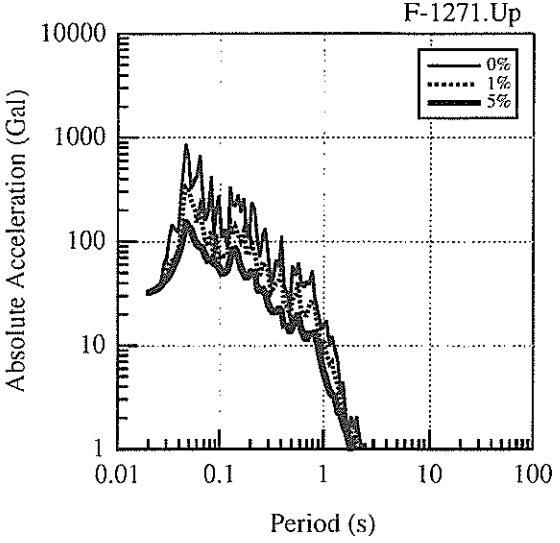

F-1271.East
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

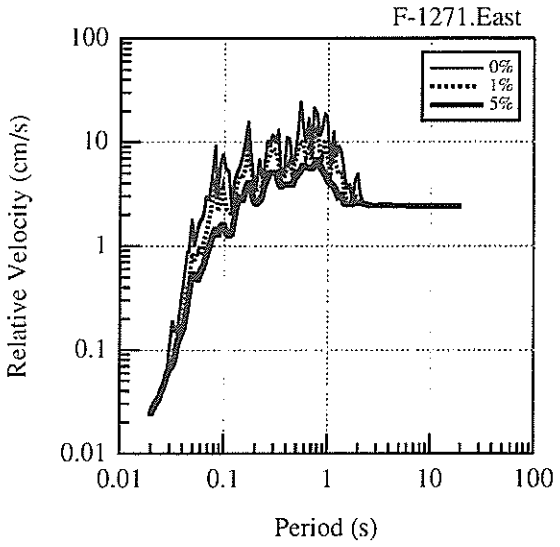

F-1271.North
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

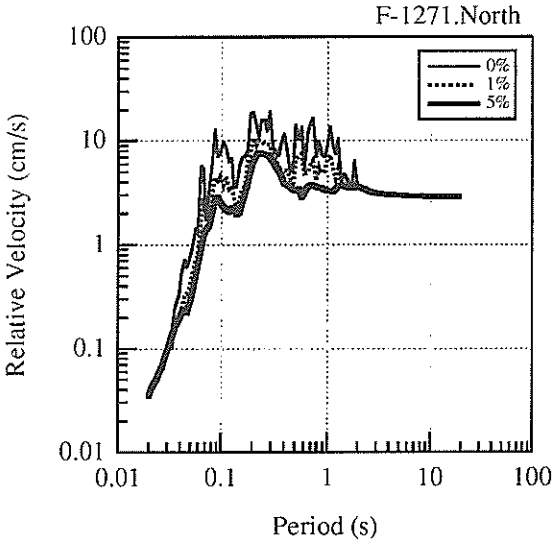

F-1271.Up
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

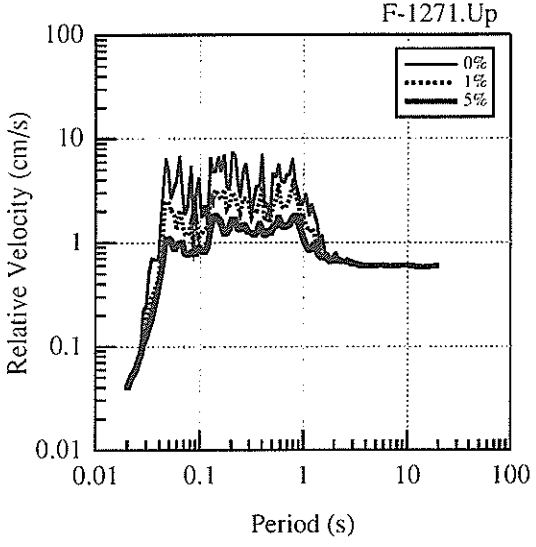

F-1271.East
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

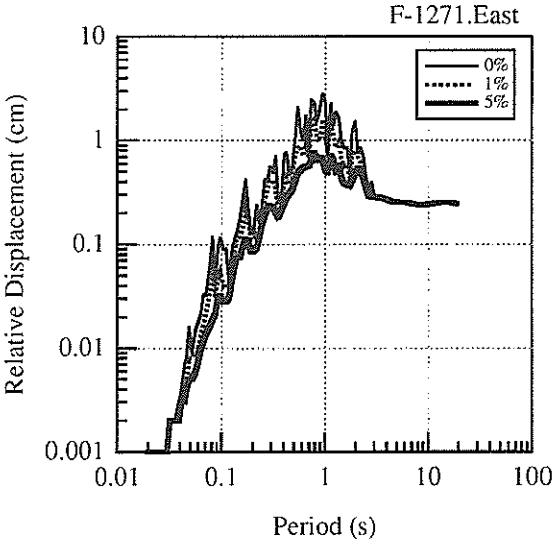

F-1271.North
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

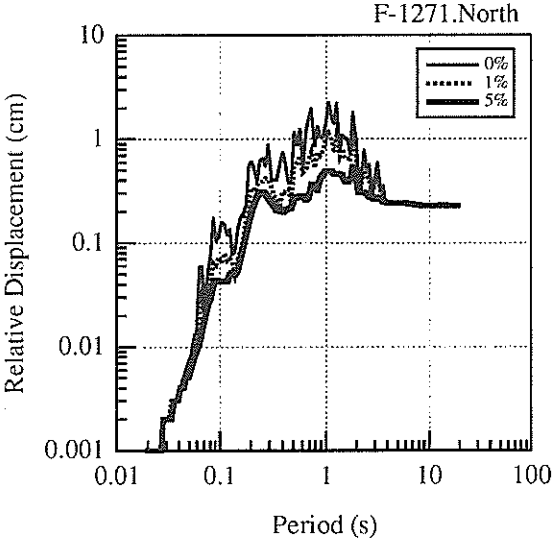

F-1271.Up
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

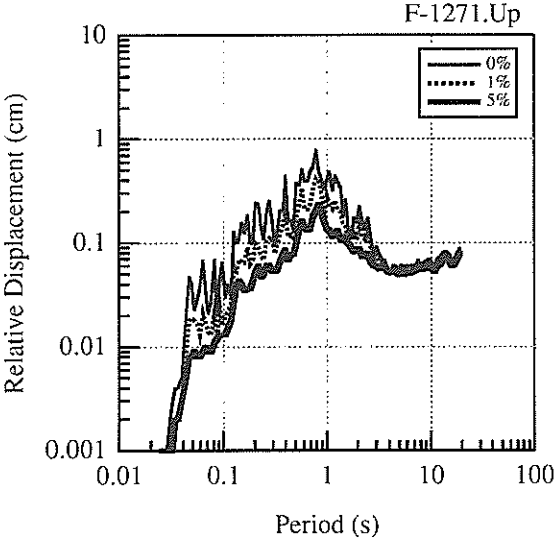

F-1271.East
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

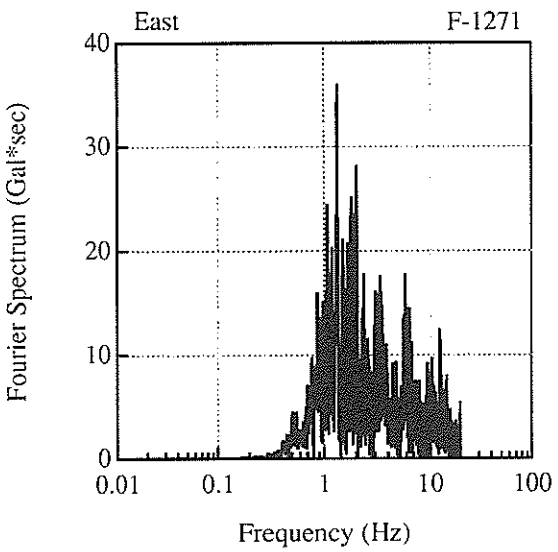

F-1271.North
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

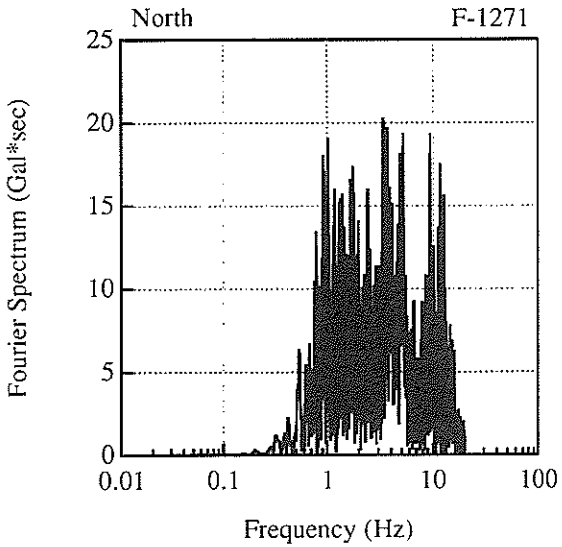

F-1271.Up
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

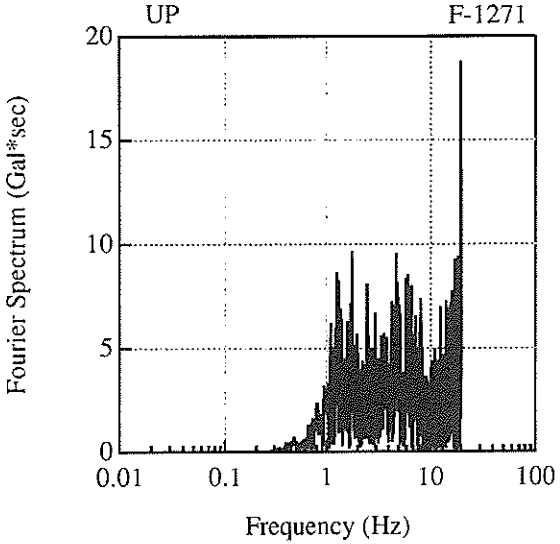

F-1271.East
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

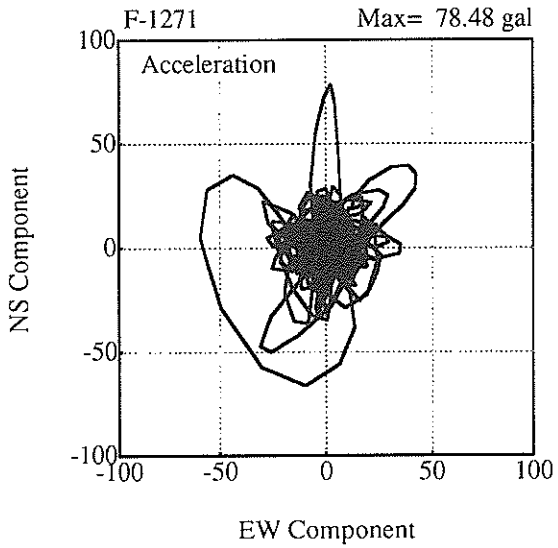

F-1271.North
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

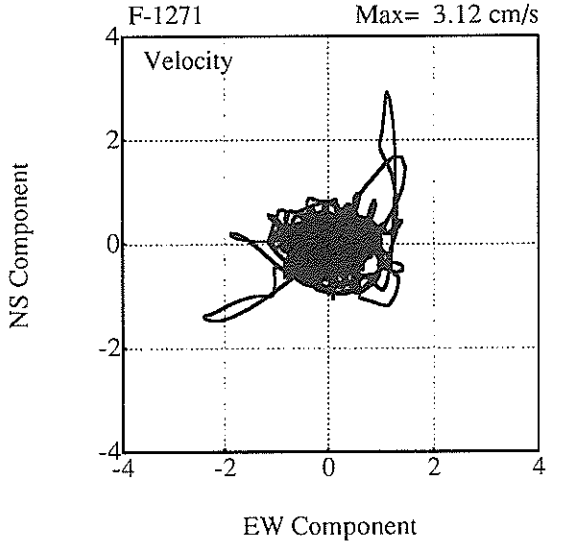

F-1271.Up
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

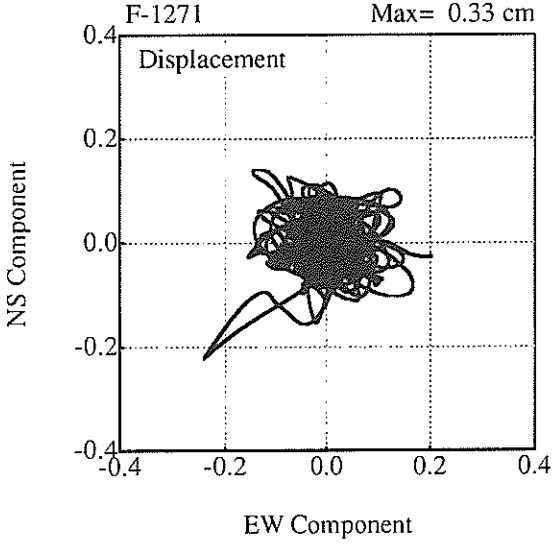

East
F-1271
Fourier Spectrum (Gal*sec)
40
30
20
10
0
0.01
0.1
1
10
100
Frequency (Hz)


North
F-1271
Fourier Spectrum (Gal*sec)
25
20
15
10
5
0
0.01
0.1
1
10
100
Frequency (Hz)


UP
F-1271
Fourier Spectrum (Gal*sec)
20
15
10
5
0
0.01
0.1
1
10
100
Frequency (Hz)


F-1271
Max= 78.48 gal
Acceleration
NS Component
100
50
0
-50
-100
-100
-50
0
50
100
EW Component


F-1271
Max= 3.12 cm/s
Velocity
NS Component
4
2
0
-2
-4
-4
-2
0
2
4
EW Component


F-1271
Max= 0.33 cm
Displacement
NS Component
0.4
0.2
0.0
-0.2
-0.4
-0.4
-0.2
0.0
0.2
0.4
EW Component

RECORD NUMBER : F-1272

STATION : NAGOYA-INAE-G

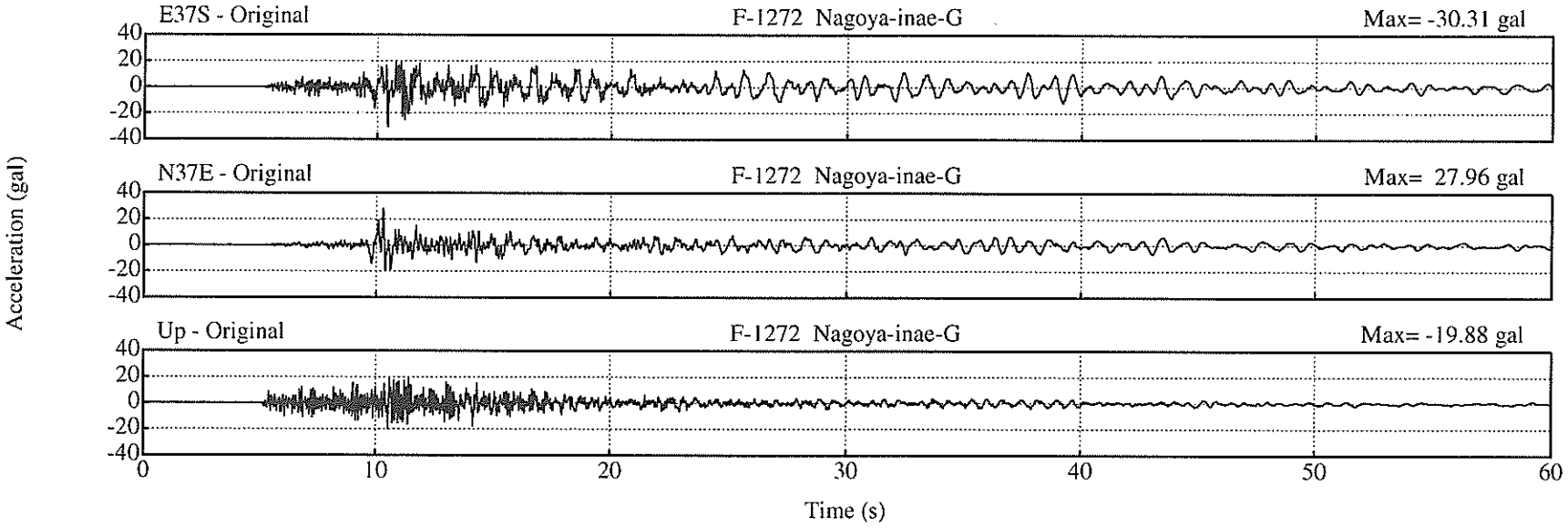
EARTHQUAKE DATA

DATE AND TIME	20:32 APR 22,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	SHIGA GIFU BORDER REGION
LATITUDE	35° 9.9′ N
LONGITUDE	136°34.2′ E
DEPTH	10.1KM
JMA MAGNITUDE	5.4

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	28.0	30.3	19.9	30.8

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1274

STATION : YOKKAICHI-GB

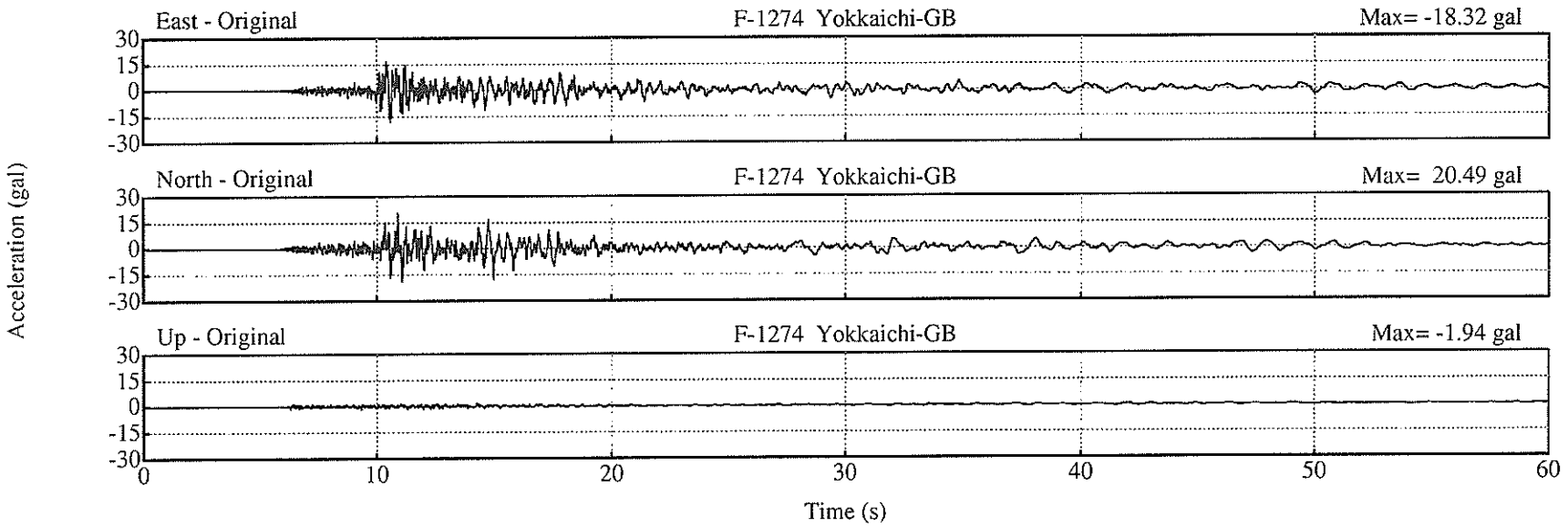
EARTHQUAKE DATA

DATE AND TIME	20:32 APR 22,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	SHIGA GIFU BORDER REGION
LATITUDE	35° 9.9′ N
LONGITUDE	136°34.2′ E
DEPTH	10.1KM
JMA MAGNITUDE	5.4

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	20.5	18.3	1.9	24.8

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1275

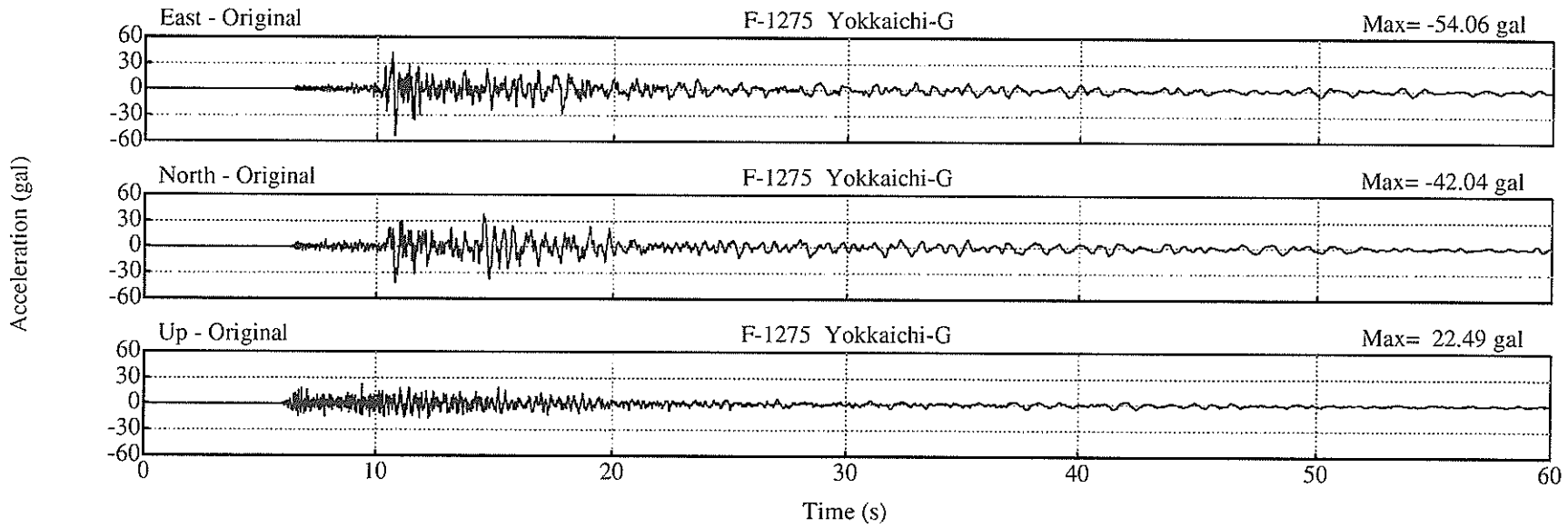
STATION : YOKKAICHI-G

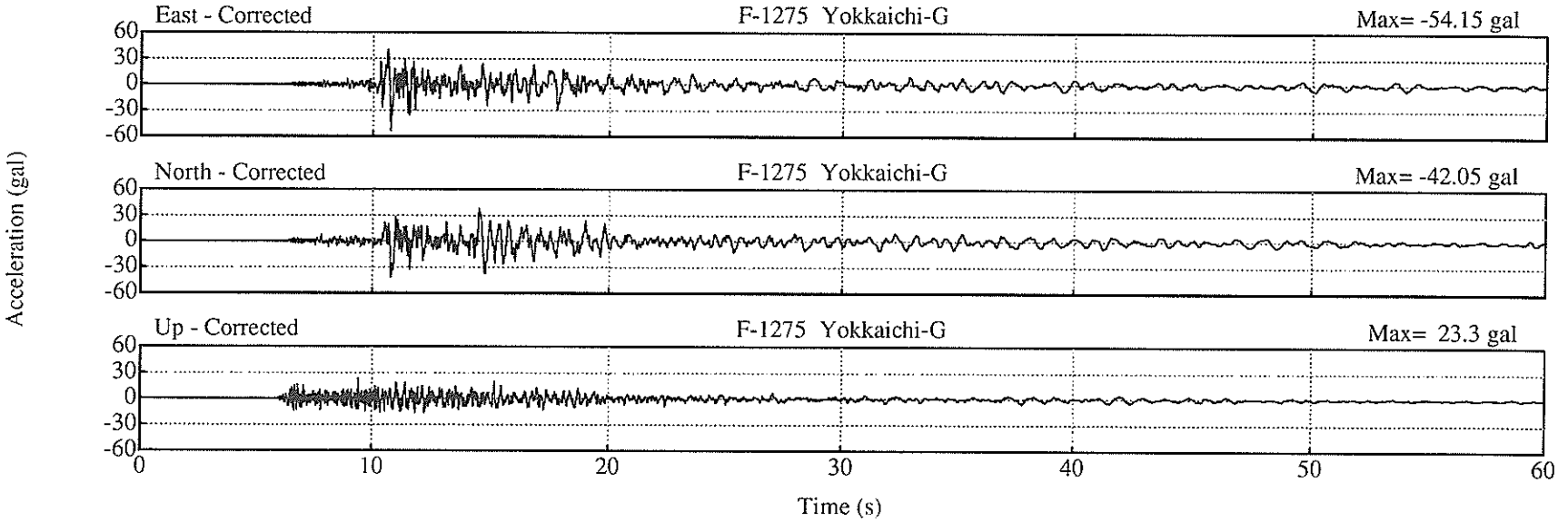
EARTHQUAKE DATA

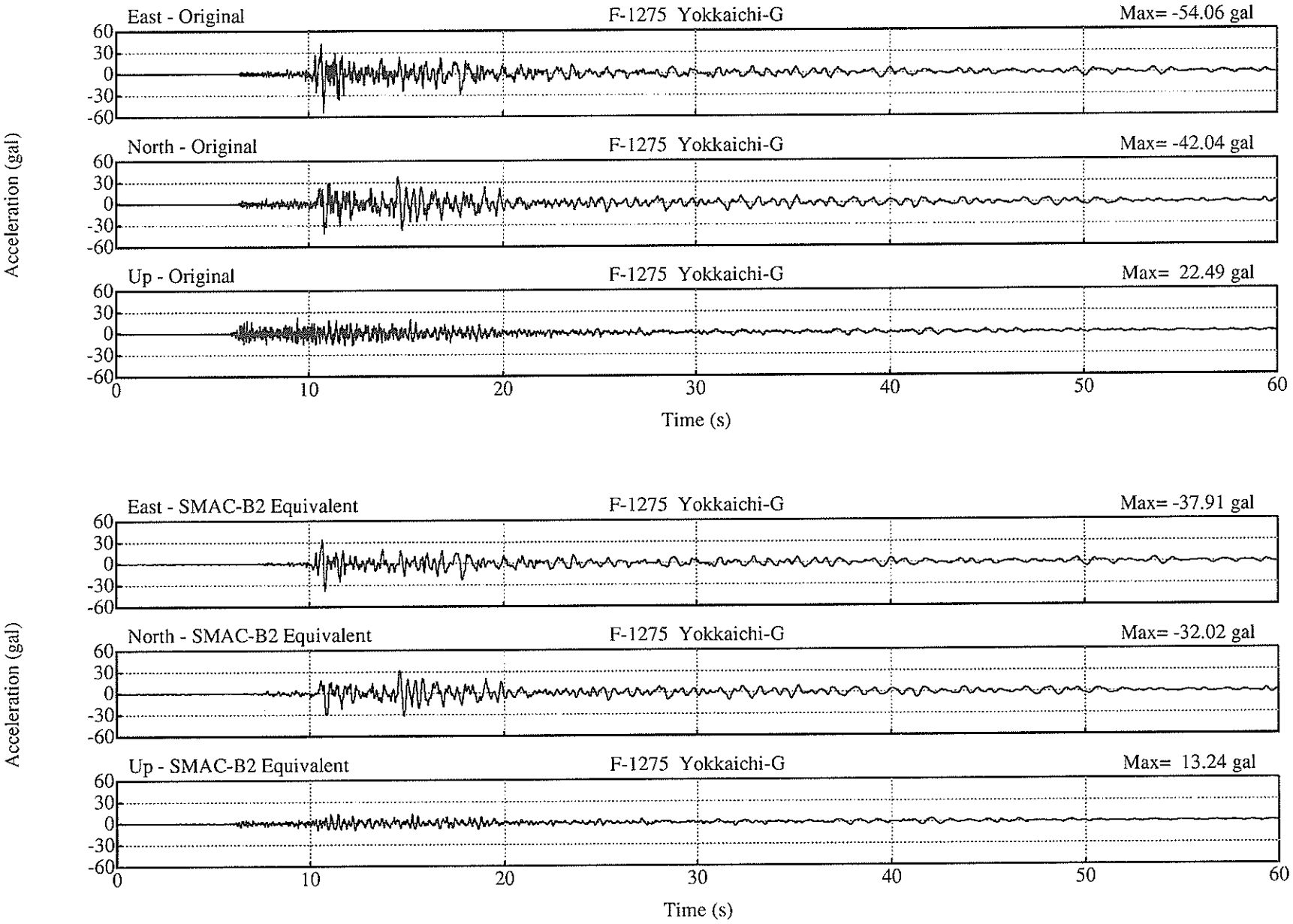
DATE AND TIME	20:32 APR 22,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	SHIGA GIFU BORDER REGION
LATITUDE	35° 9.9' N
LONGITUDE	136°34.2' E
DEPTH	10.1KM
JMA MAGNITUDE	5.4

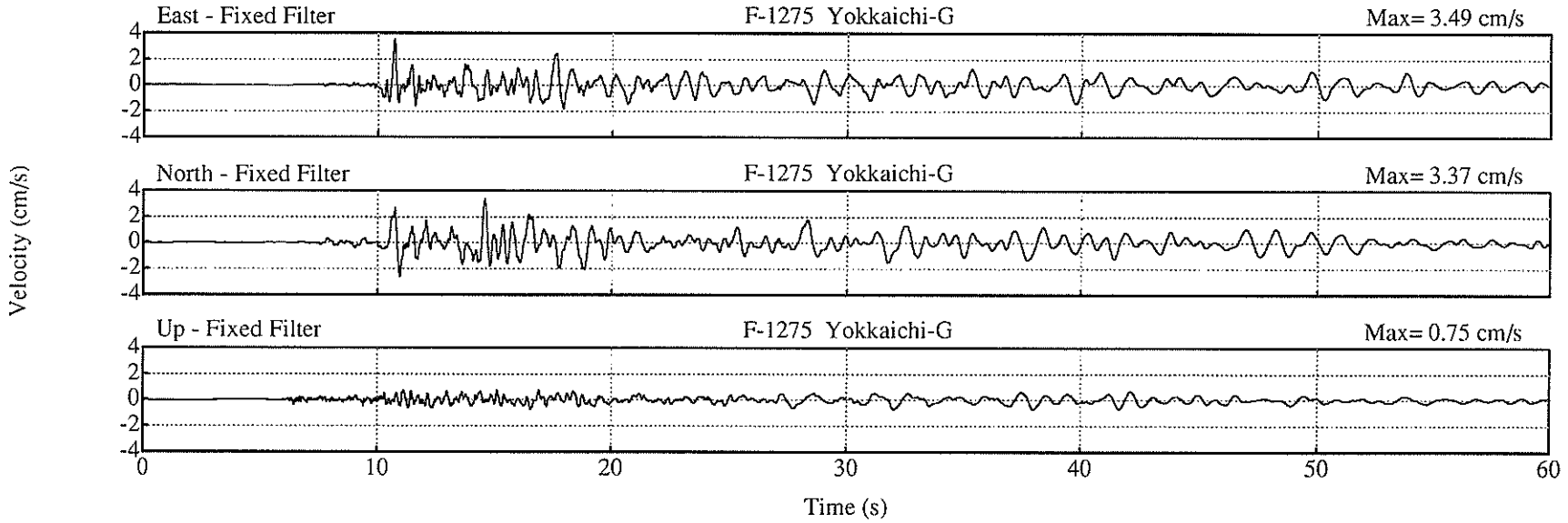
	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
PARAMETER OF THE VARIABLE FILTER				
FC (HZ)	0.304	0.323	0.427	
MAXIMUM ACCELERATION (GAL)				
SMAC-B2 EQUIVALENT	32.0	37.9	13.2	45.8
ORIGINAL	42.0	54.1	22.5	62.2
CORRECTED	42.1	54.2	23.3	62.1
MAXIMUM VELOCITY (CM/SEC)				
FIXED FILTER	3.37	3.49	0.75	4.26
VARIABLE FILTER	3.41	3.36	0.71	4.28
MAXIMUM DISPLACEMENT (CM)				
FIXED FILTER	0.50	0.40	0.16	0.53
VARIABLE FILTER	0.37	0.31	0.12	0.39

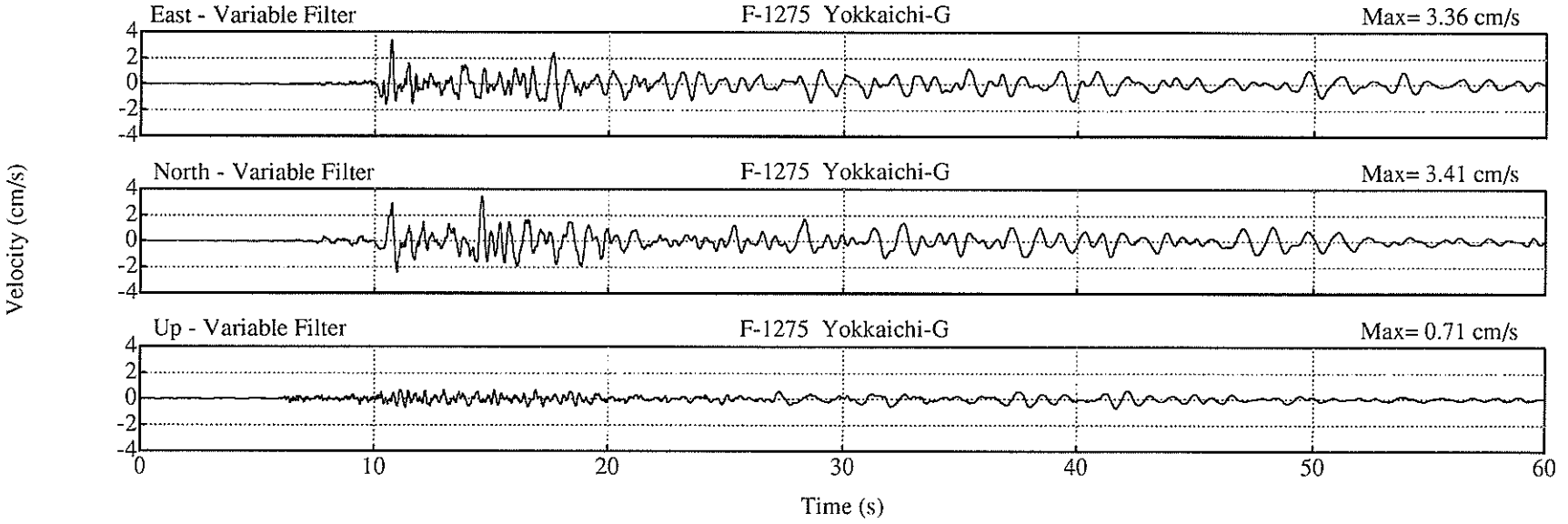
* RESULTANT OF HORIZONTAL COMPONENTS

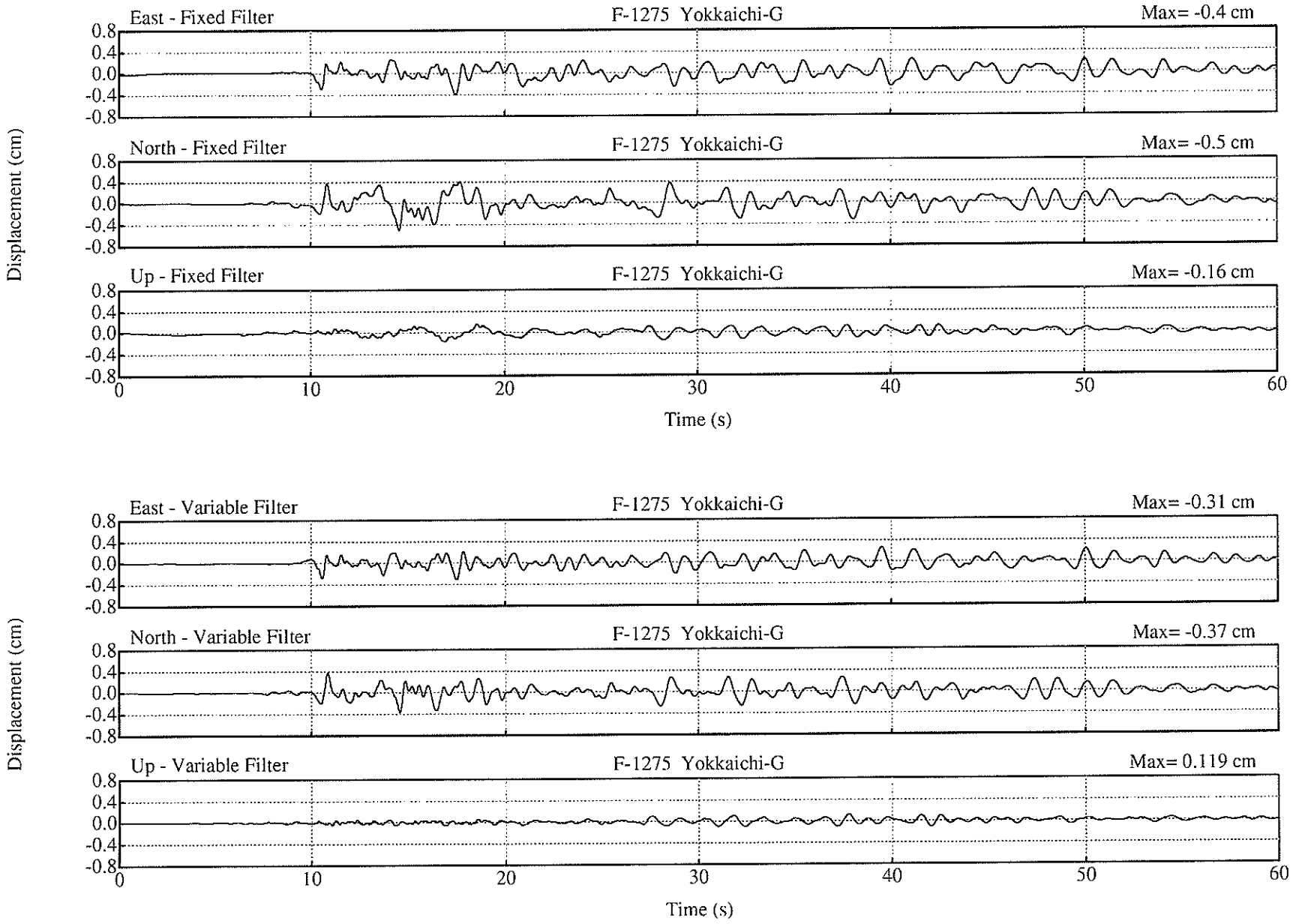

East - Original
F-1275 Yokkaichi-G
Max= -54.06 gal
North - Original
F-1275 Yokkaichi-G
Max= -42.04 gal
Up - Original
F-1275 Yokkaichi-G
Max= 22.49 gal
Acceleration (gal)
60
30
0
-30
-60
0
10
20
30
40
50
60
Time (s)

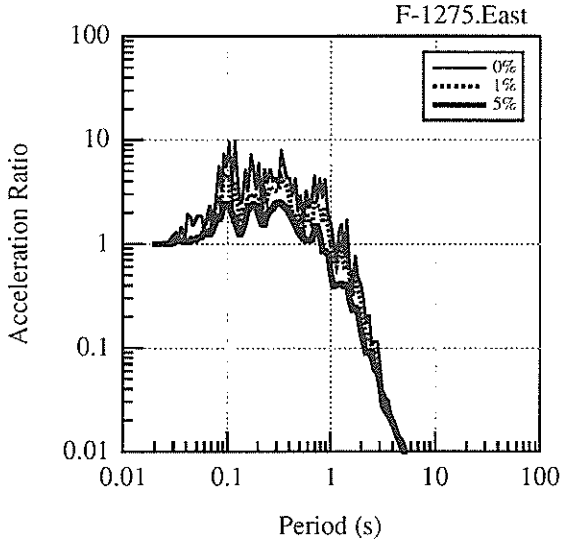

East - Corrected
F-1275 Yokkaichi-G
Max= -54.15 gal
North - Corrected
F-1275 Yokkaichi-G
Max= -42.05 gal
Up - Corrected
F-1275 Yokkaichi-G
Max= 23.3 gal
Acceleration (gal)
60
30
0
-30
-60
0
10
20
30
40
50
60
Time (s)

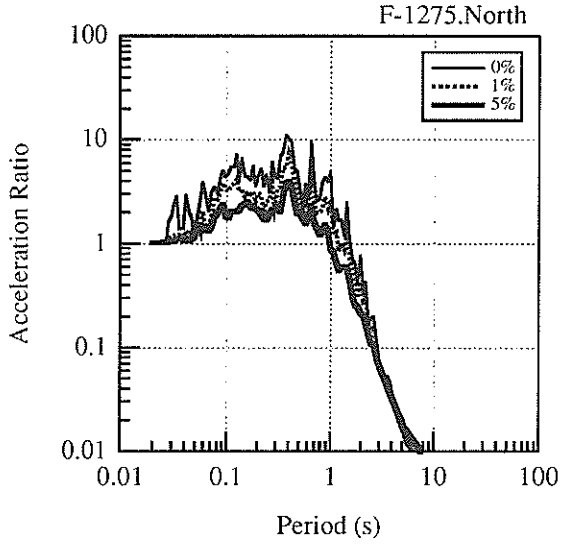

East - Original
F-1275 Yokkaichi-G
Max= -54.06 gal
North - Original
F-1275 Yokkaichi-G
Max= -42.04 gal
Up - Original
F-1275 Yokkaichi-G
Max= 22.49 gal
Acceleration (gal)
60
30
0
-30
-60
0
10
20
30
40
50
60
Time (s)
East - SMAC-B2 Equivalent
F-1275 Yokkaichi-G
Max= -37.91 gal
North - SMAC-B2 Equivalent
F-1275 Yokkaichi-G
Max= -32.02 gal
Up - SMAC-B2 Equivalent
F-1275 Yokkaichi-G
Max= 13.24 gal
Acceleration (gal)
Time (s)

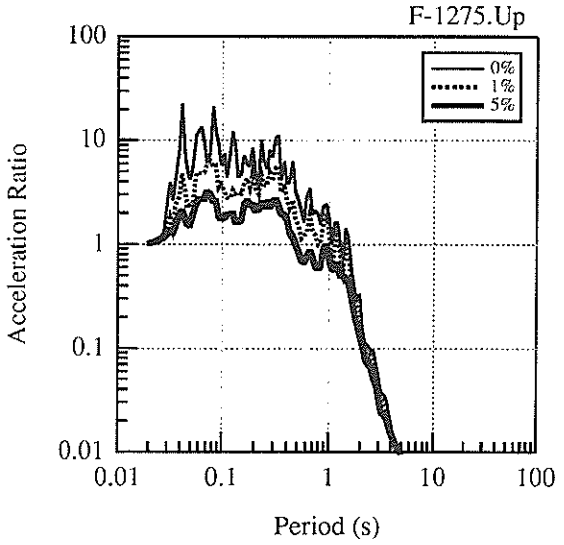

East - Fixed Filter
F-1275 Yokkaichi-G
Max= 3.49 cm/s
North - Fixed Filter
F-1275 Yokkaichi-G
Max= 3.37 cm/s
Up - Fixed Filter
F-1275 Yokkaichi-G
Max= 0.75 cm/s
Velocity (cm/s)
Time (s)

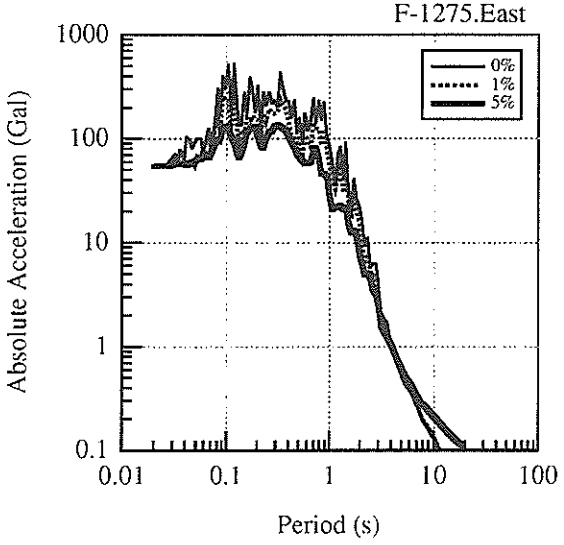

East - Variable Filter
F-1275 Yokkaichi-G
Max= 3.36 cm/s
North - Variable Filter
F-1275 Yokkaichi-G
Max= 3.41 cm/s
Up - Variable Filter
F-1275 Yokkaichi-G
Max= 0.71 cm/s
Velocity (cm/s)
Time (s)

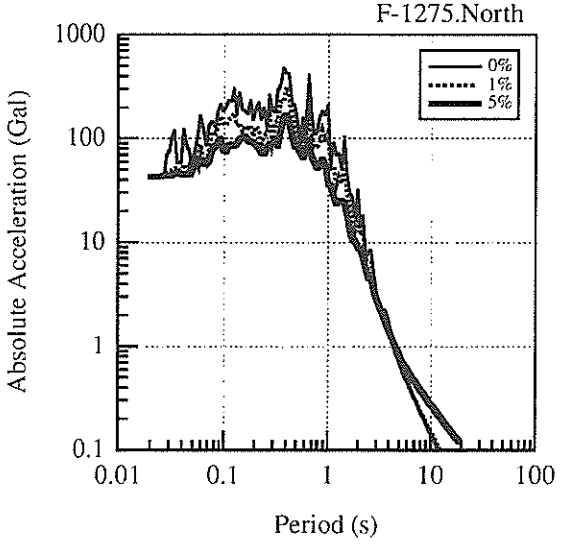

East - Fixed Filter
F-1275 Yokkaichi-G
Max= -0.4 cm
North - Fixed Filter
F-1275 Yokkaichi-G
Max= -0.5 cm
Up - Fixed Filter
F-1275 Yokkaichi-G
Max= -0.16 cm
East - Variable Filter
F-1275 Yokkaichi-G
Max= -0.31 cm
North - Variable Filter
F-1275 Yokkaichi-G
Max= -0.37 cm
Up - Variable Filter
F-1275 Yokkaichi-G
Max= 0.119 cm
Displacement (cm)
0.8
0.4
0.0
-0.4
-0.8
0
10
20
30
40
50
60
Time (s)

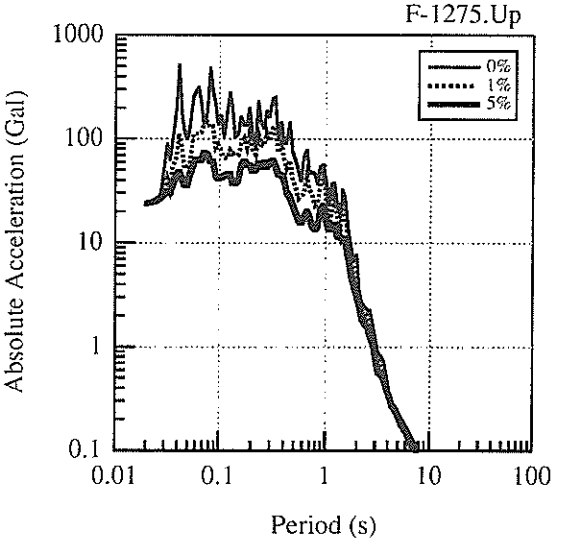

F-1275.East
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

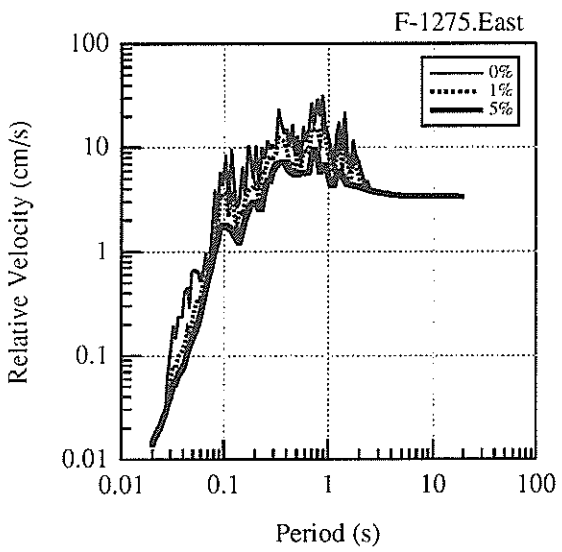

F-1275.North
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

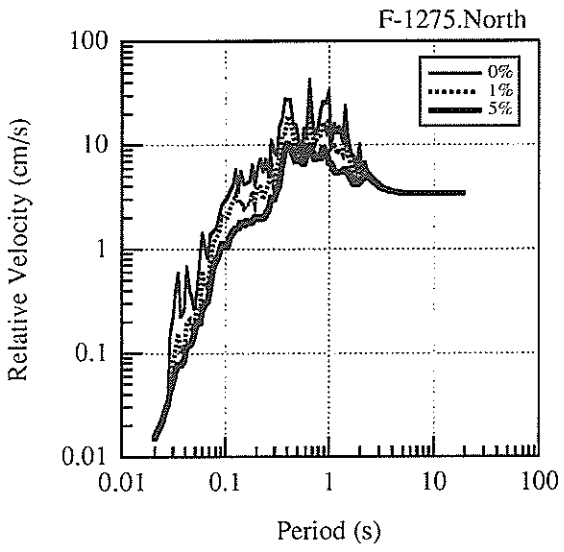

F-1275.Up
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

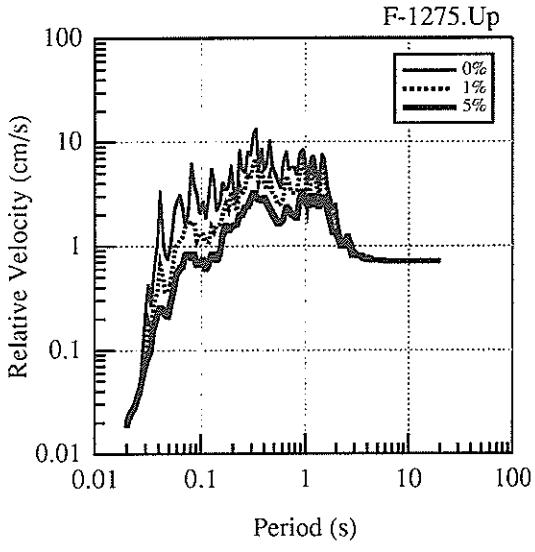

F-1275.East
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
1000
100
10
1
0.1
0.01
0.1
1
10
100

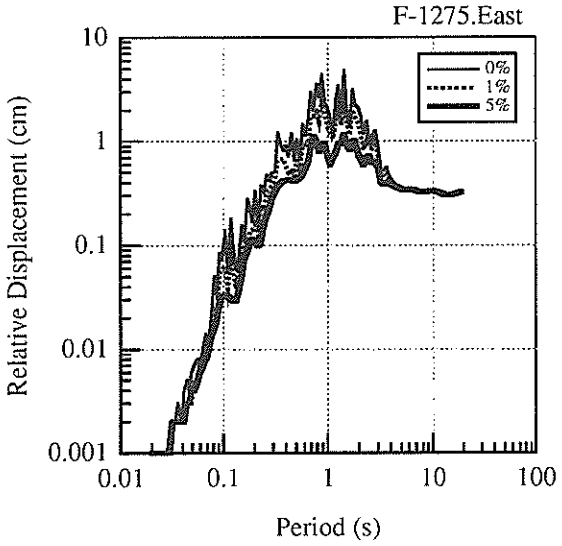

F-1275.North
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
1000
100
10
1
0.1
0.01
0.1
1
10
100

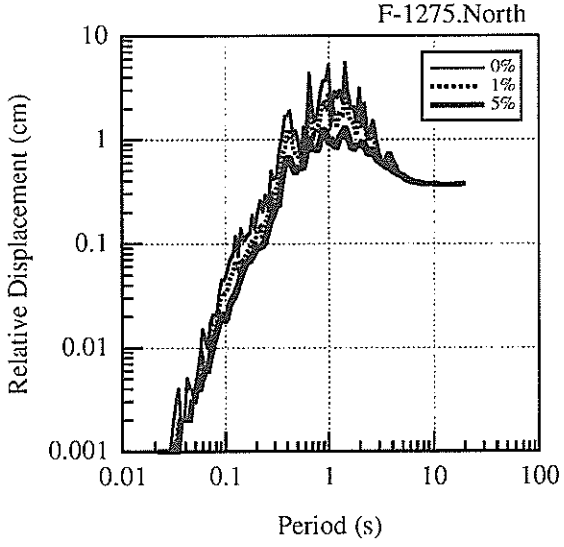

F-1275.Up
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
1000
100
10
1
0.1
0.01
0.1
1
10
100

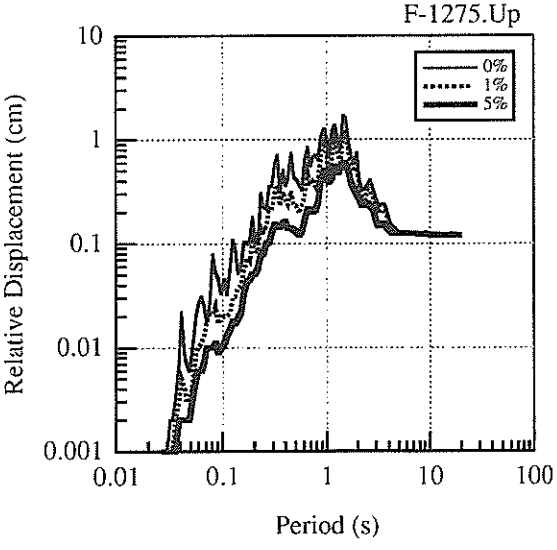

F-1275.East
Relative Velocity (cm/s)
Period (s)
0%
1%
5%

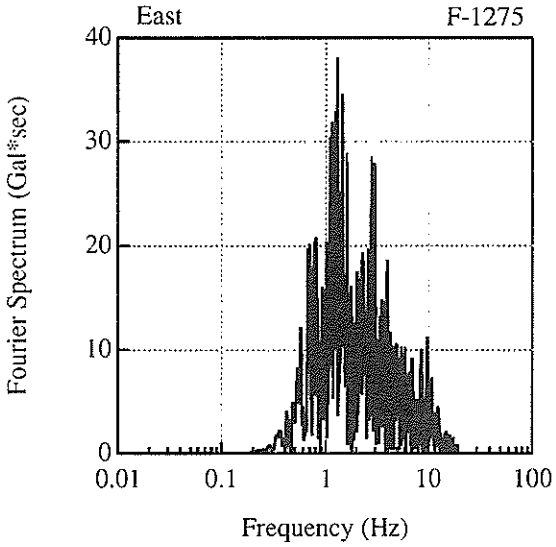

F-1275.North
Relative Velocity (cm/s)
Period (s)
0%
1%
5%

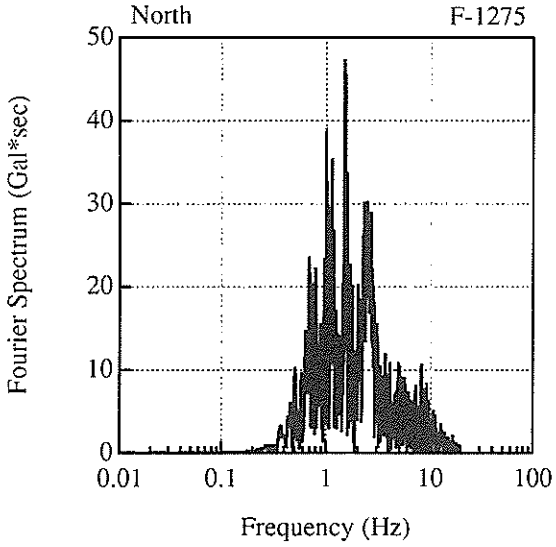

F-1275.Up
Relative Velocity (cm/s)
Period (s)
0%
1%
5%

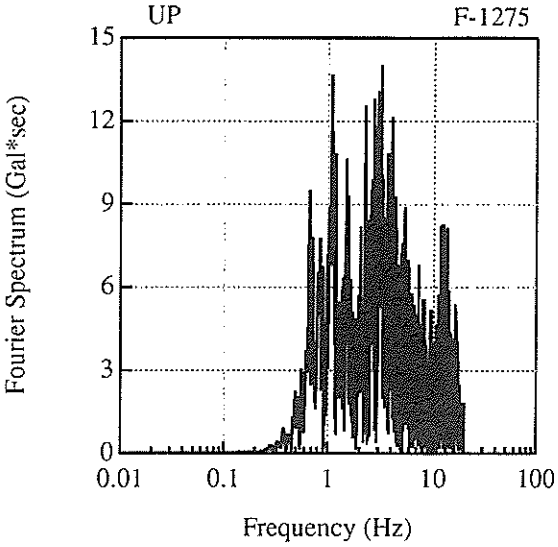

F-1275.East
Relative Displacement (cm)
Period (s)
0%
1%
5%

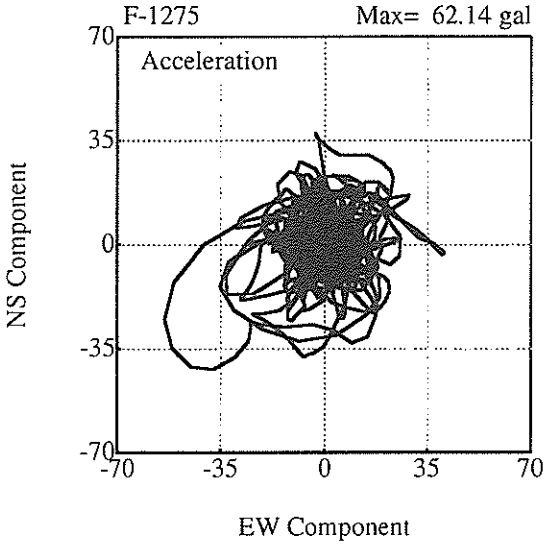

F-1275.North
Relative Displacement (cm)
Period (s)
0%
1%
5%

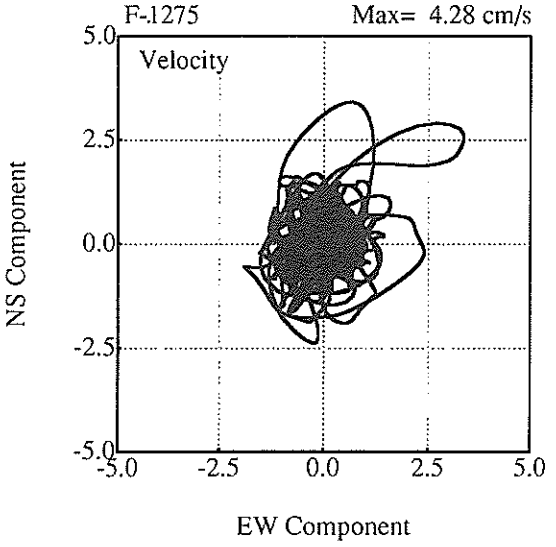

F-1275.Up
Relative Displacement (cm)
Period (s)
0%
1%
5%

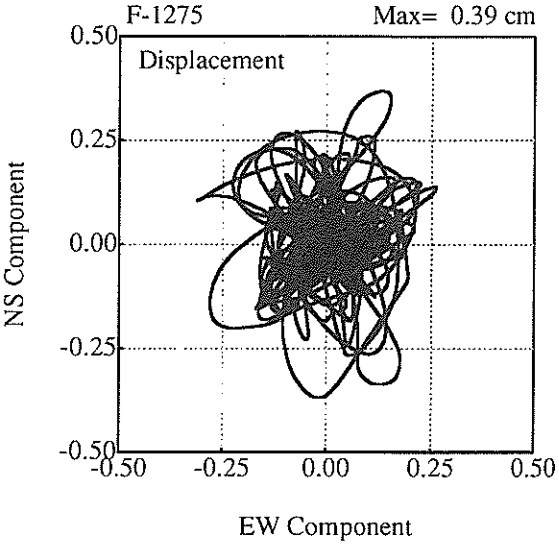

East
F-1275
Fourier Spectrum (Gal*sec)
40
30
20
10
0
0.01
0.1
1
10
100
Frequency (Hz)


North
F-1275
Fourier Spectrum (Gal*sec)
50
40
30
20
10
0
0.01
0.1
1
10
100
Frequency (Hz)


UP
F-1275
Fourier Spectrum (Gal*sec)
15
12
9
6
3
0
0.01
0.1
1
10
100
Frequency (Hz)


F-1275
Max= 62.14 gal
Acceleration
NS Component
70
35
0
-35
-70
-70
-35
0
35
70
EW Component


F-1275
Max= 4.28 cm/s
Velocity
NS Component
5.0
2.5
0.0
-2.5
-5.0
-5.0
-2.5
0.0
2.5
5.0
EW Component


F-1275
Max= 0.39 cm
Displacement
NS Component
0.50
0.25
0.00
-0.25
-0.50
-0.50
-0.25
0.00
0.25
0.50
EW Component

RECORD NUMBER : F-1277

STATION : NAHA-G

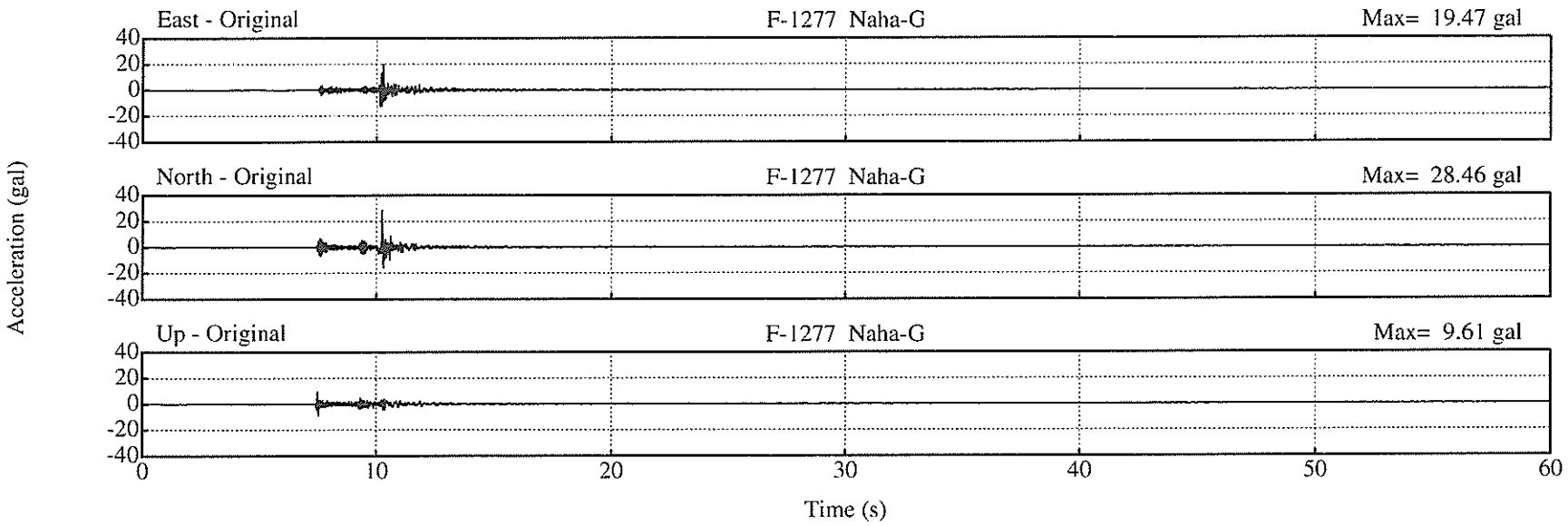
EARTHQUAKE DATA

DATE AND TIME	11:53 MAY 5,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	NEAR OKINAWAJIMA ISLAND
LATITUDE	26°23.3′ N
LONGITUDE	127°41.7′ E
DEPTH	14.0KM
JMA MAGNITUDE	4.2

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	28.5	19.5	9.6	28.5

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1354

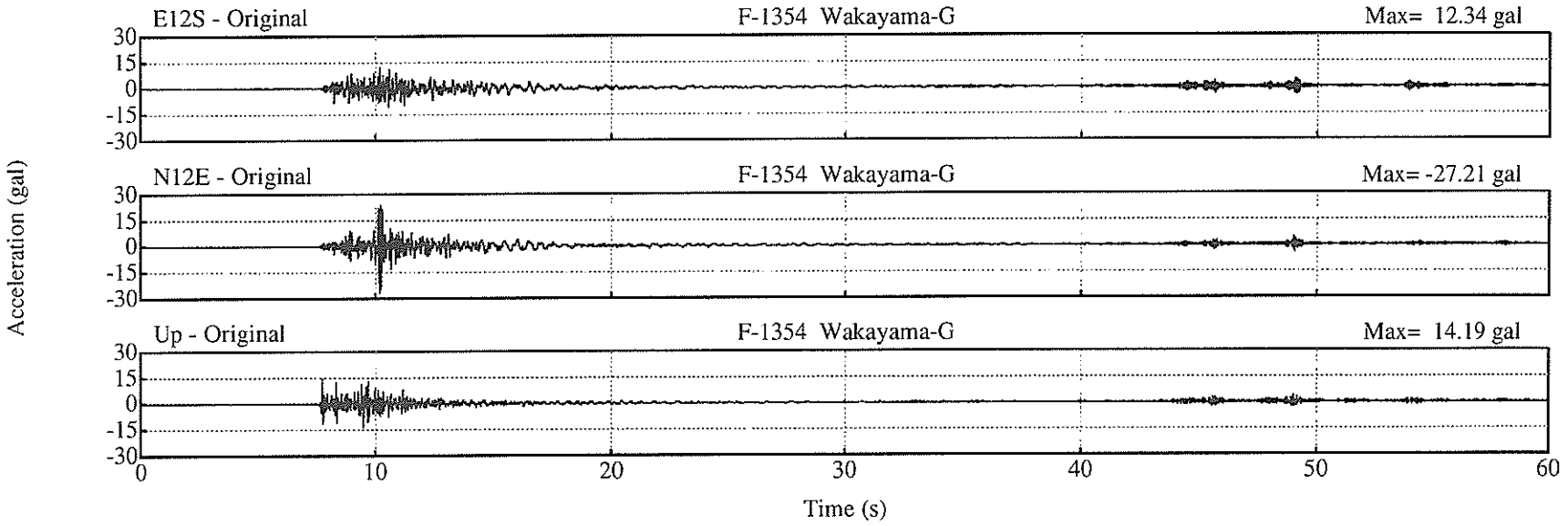
STATION : WAKAYAMA-G

EARTHQUAKE DATA

DATE AND TIME	20:19 MAY 6,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	NW WAKAYAMA PREF
LATITUDE	34°13.2′ N
LONGITUDE	135°15.9′ E
DEPTH	10.1KM
JMA MAGNITUDE	3.7

	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	27.2	12.3	14.2	27.6

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1296

STATION : YAMASHITA-F

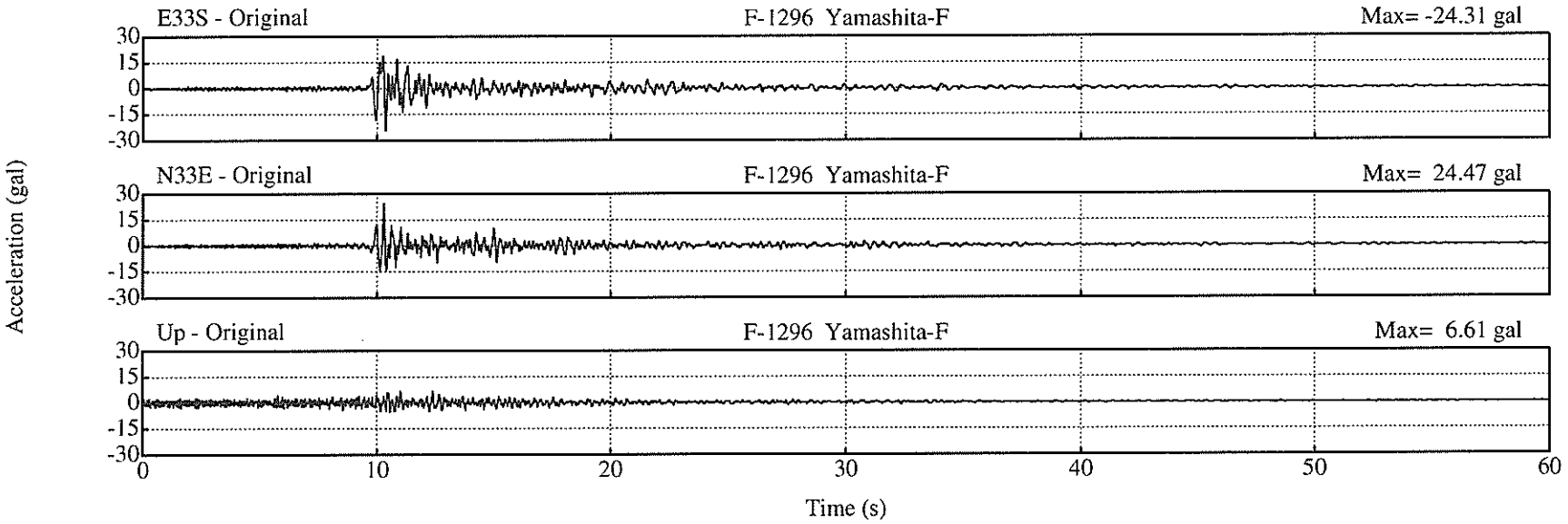
EARTHQUAKE DATA

DATE AND TIME	3:45 MAY 16,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	SOUTHERN BOSO PENINSULA
LATITUDE	34°58.1′ N
LONGITUDE	139°56.6′ E
DEPTH	73.1KM
JMA MAGNITUDE	4.8

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	24.5	24.3	6.6	27.2

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1308

STATION : HITACHINAKA-F

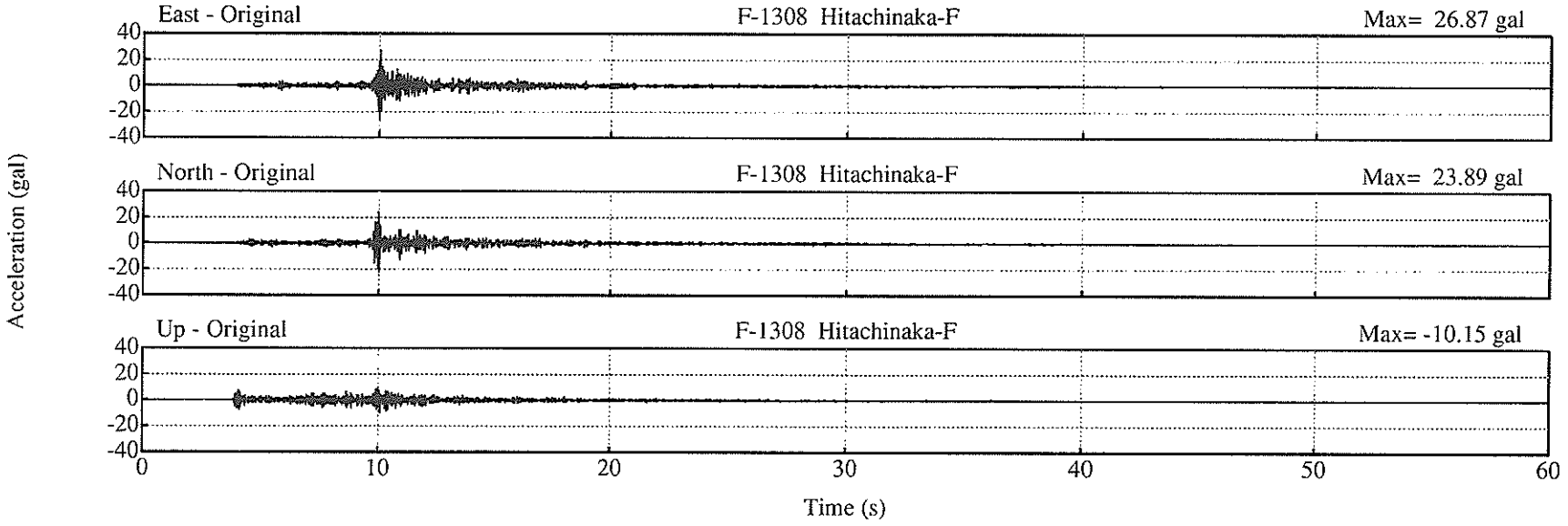
EARTHQUAKE DATA

DATE AND TIME	16: 6 MAY 17,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	NORTHERN IBARAKI PREF
LATITUDE	36°25.1' N
LONGITUDE	140°41.7' E
DEPTH	54.2KM
JMA MAGNITUDE	3.8

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	23.9	26.9	10.1	35.0

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1278

STATION : HIROSHIMA-G

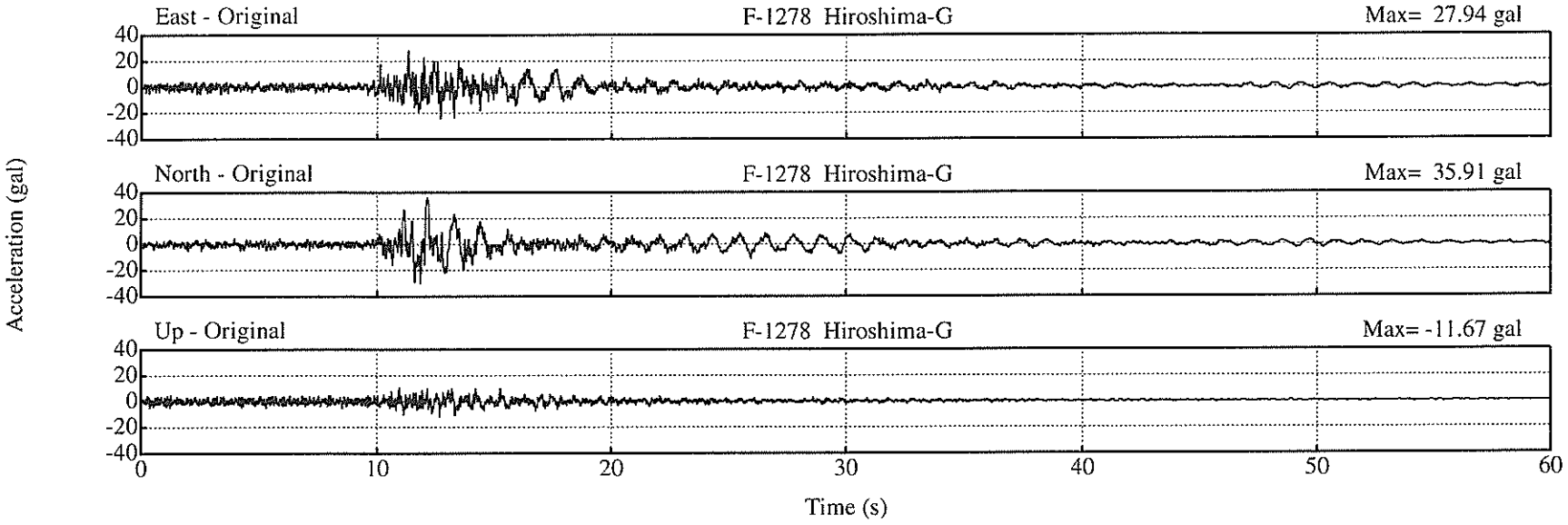
EARTHQUAKE DATA

DATE AND TIME	4:49 MAY 23,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	IYONADA SETONAIKAI
LATITUDE	33°41.7′ N
LONGITUDE	131°50.8′ E
DEPTH	84.1KM
JMA MAGNITUDE	5.3

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	35.9	27.9	11.7	37.6

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1298

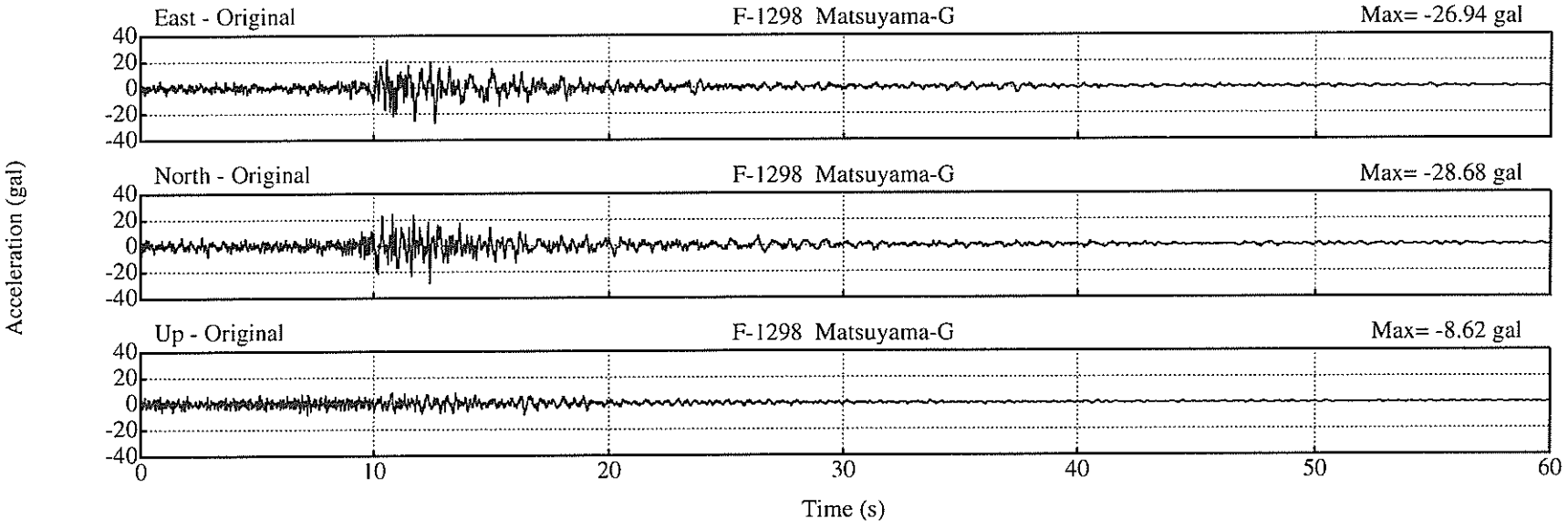
STATION : MATSUYAMA-G

EARTHQUAKE DATA

DATE AND TIME	4:49 MAY 23,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	IYONADA SETONAIKAI
LATITUDE	33°41.7′ N
LONGITUDE	131°50.8′ E
DEPTH	84.1KM
JMA MAGNITUDE	5.3

	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	28.7	26.9	8.6	33.6

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1310

STATION : HITACHINAKA-F

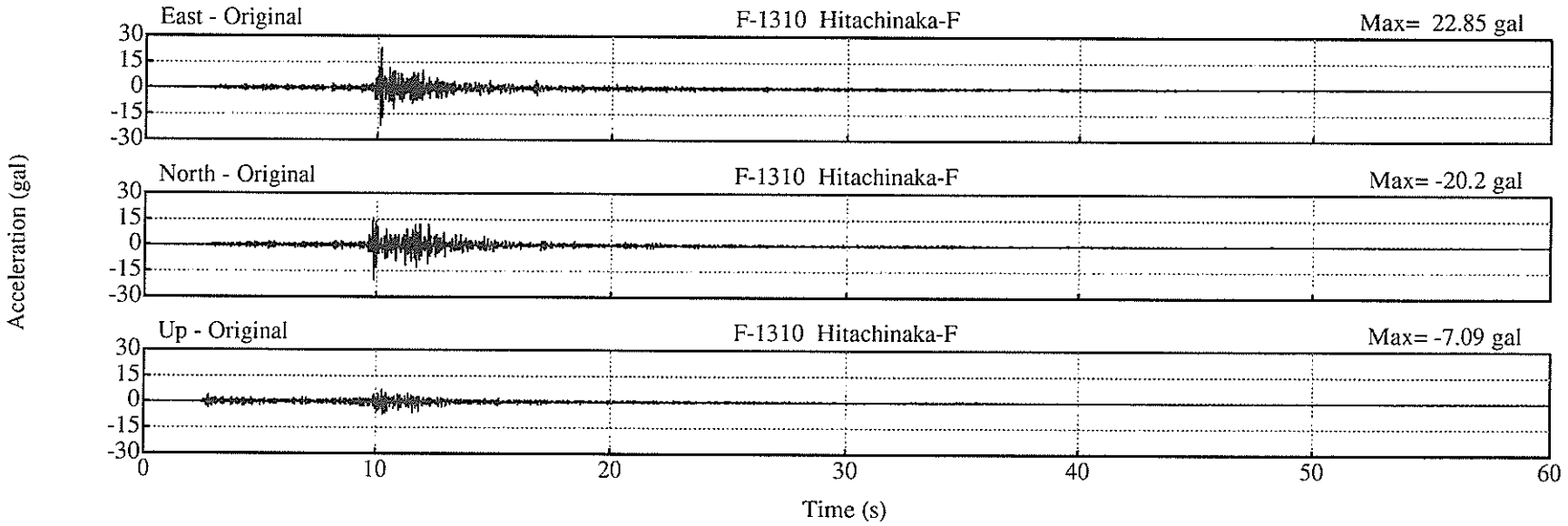
EARTHQUAKE DATA

DATE AND TIME	16:55 JUNE 5,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	E OFF IBARAKI PREF
LATITUDE	36°34.9′ N
LONGITUDE	141° 4.3′ E
DEPTH	46.3KM
JMA MAGNITUDE	3.9

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	20.2	22.9	7.1	22.9

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1318

STATION : KOKEN-G

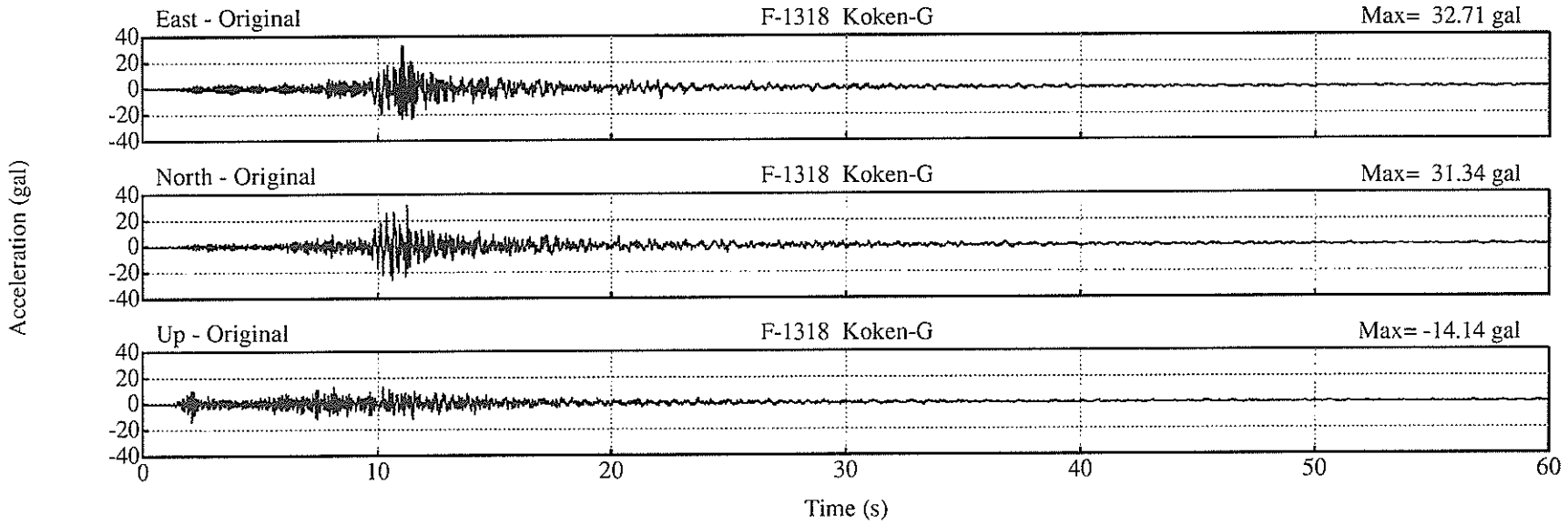
EARTHQUAKE DATA

DATE AND TIME	8:46 AUG.29,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	CENTRAL CHIBA PREF
LATITUDE	35° 36.2' N
LONGITUDE	140° 2.7' E
DEPTH	67.2KM
JMA MAGNITUDE	5.1

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	31.3	32.7	14.1	34.1

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1375

STATION : MIYAZAKI-G

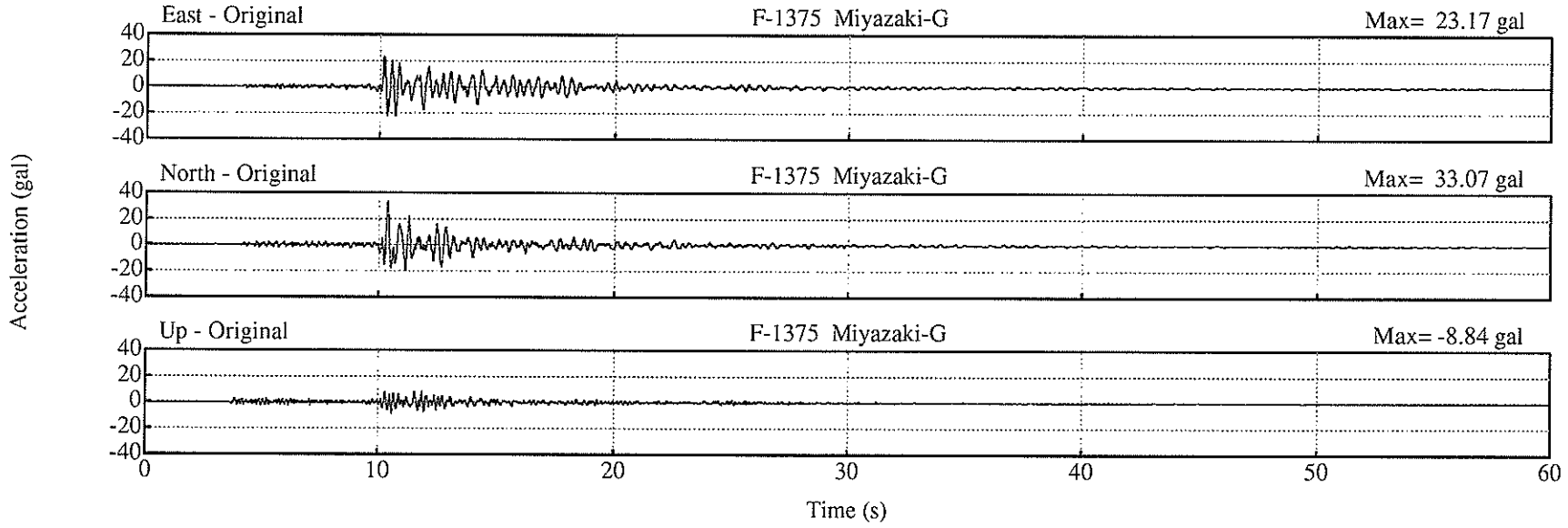
EARTHQUAKE DATA

DATE AND TIME	8: 2 SEP. 4,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	HYUGANADA REGION
LATITUDE	31°59.3′ N
LONGITUDE	131°52.4′ E
DEPTH	32.2KM
JMA MAGNITUDE	4.5

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	33.1	23.2	8.8	35.9

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1363

STATION : HANASAKI-F

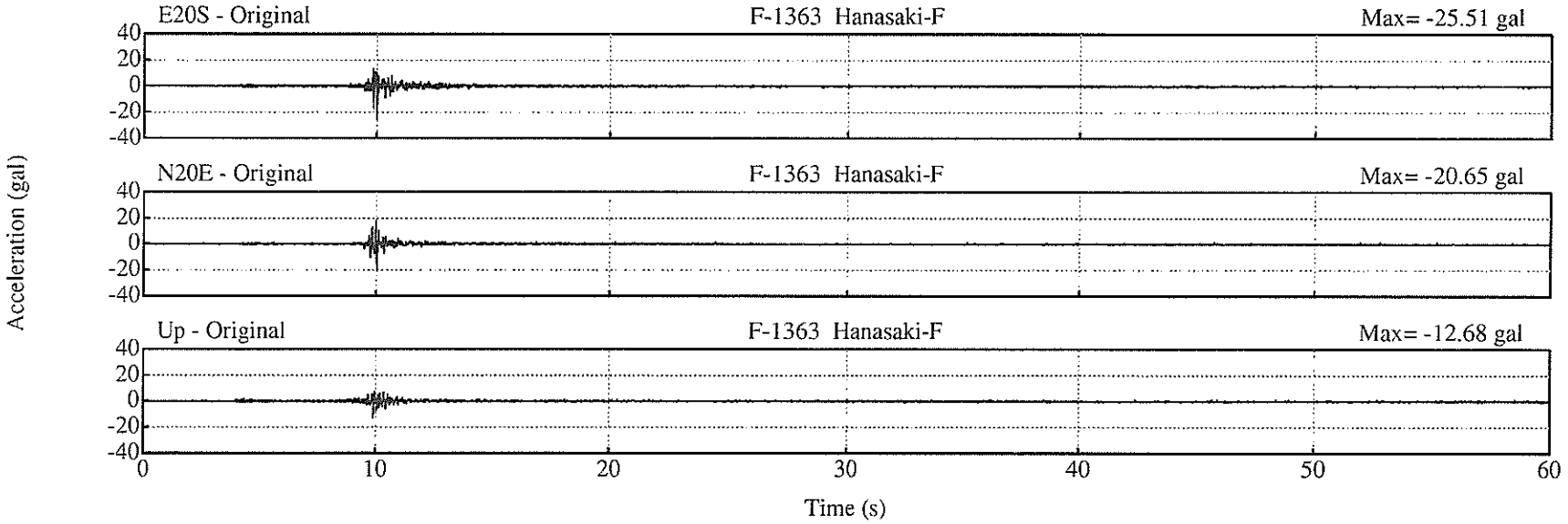
EARTHQUAKE DATA

DATE AND TIME	5:49 SEP. 7,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	OFF NEMURO PENINSULA
LATITUDE	43° 7.8′ N
LONGITUDE	145°40.0′ E
DEPTH	48.2KM
JMA MAGNITUDE	4.2

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	20.7	25.5	12.7	30.8

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : M-1602

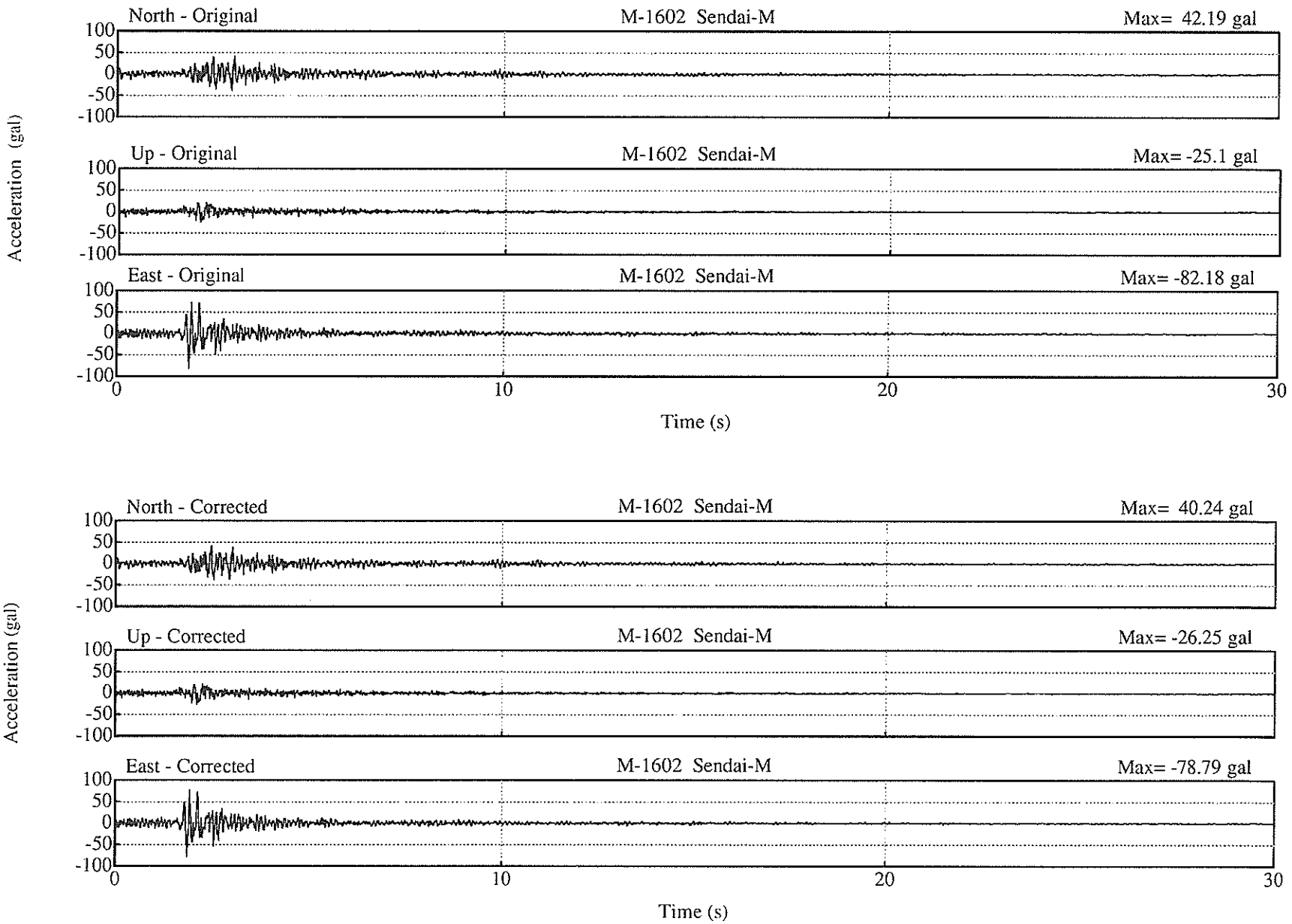
STATION : SENDAI-M

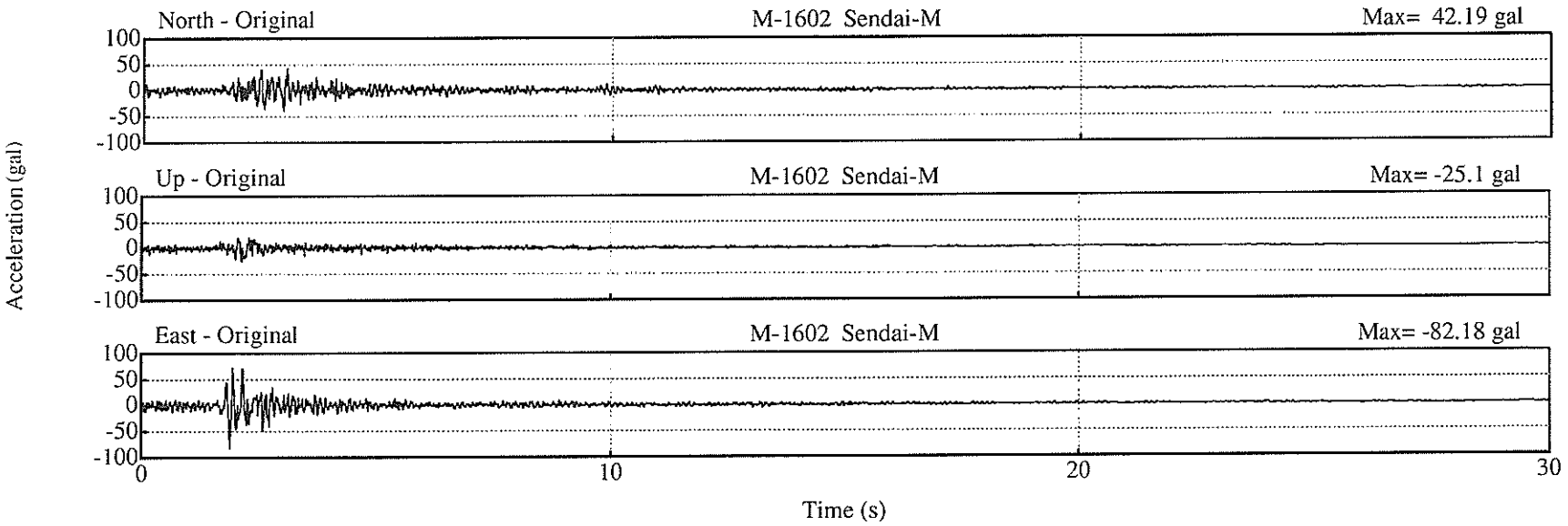
EARTHQUAKE DATA

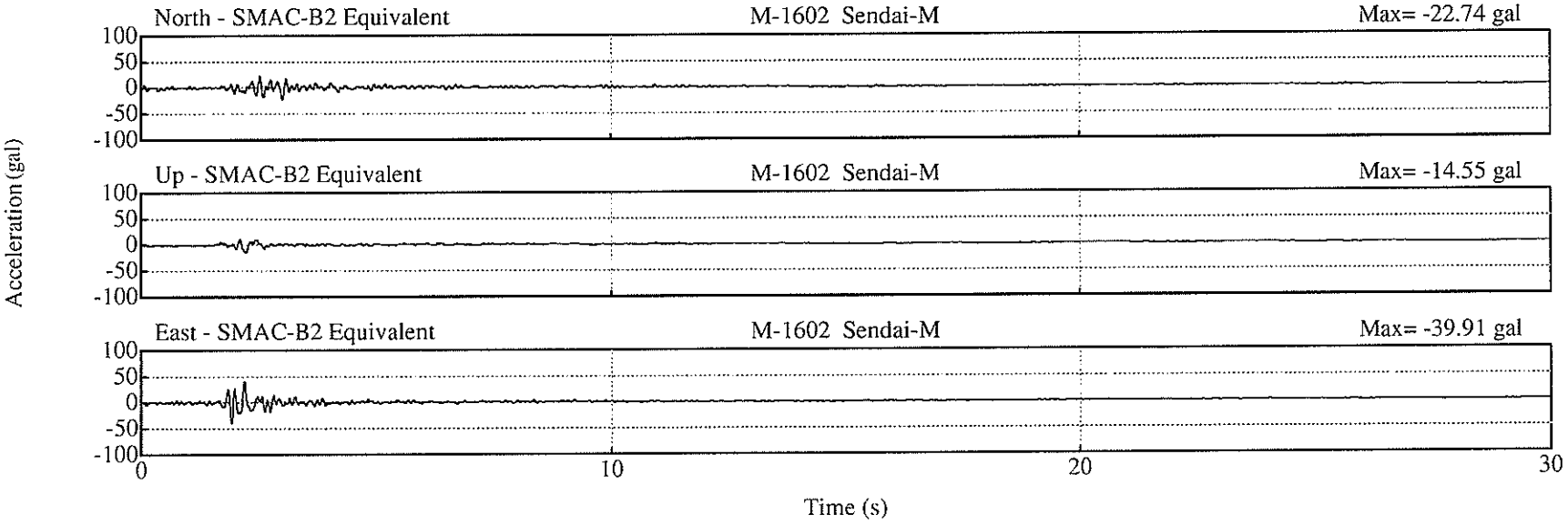
DATE AND TIME	16:24 SEP.15,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	SOUTHERN MIYAGI PREF
LATITUDE	38°16.6' N
LONGITUDE	140°45.9' E
DEPTH	13.1KM
JMA MAGNITUDE	5.0

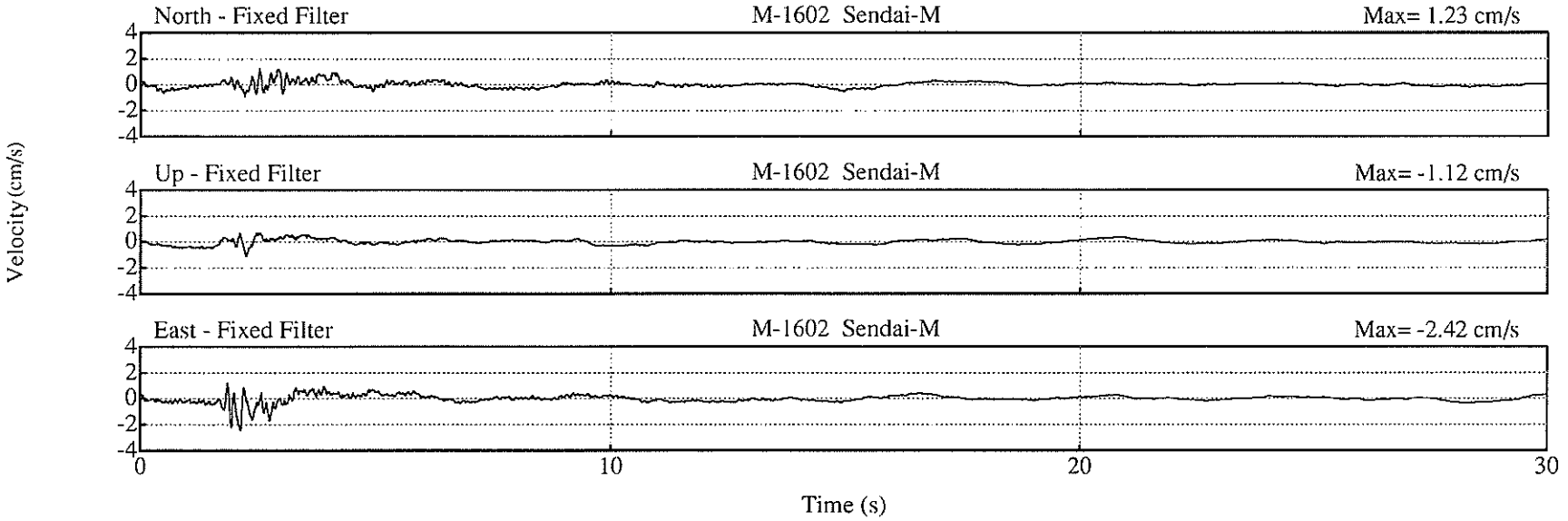
	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
PARAMETER OF THE VARIABLE FILTER				
FC (HZ)	0.196	0.144	0.217	
MAXIMUM ACCELERATION (GAL)				
SMAC-B2 EQUIVALENT	22.7	39.9	14.5	40.5
ORIGINAL	42.2	82.2	25.1	82.7
CORRECTED	40.2	78.8	26.2	79.3
MAXIMUM VELOCITY (CM/SEC)				
FIXED FILTER	1.23	2.42	1.12	2.43
VARIABLE FILTER	1.04	1.91	1.22	1.92
MAXIMUM DISPLACEMENT (CM)				
FIXED FILTER	0.49	0.85	0.44	0.87
VARIABLE FILTER	0.17	0.61	0.15	0.62

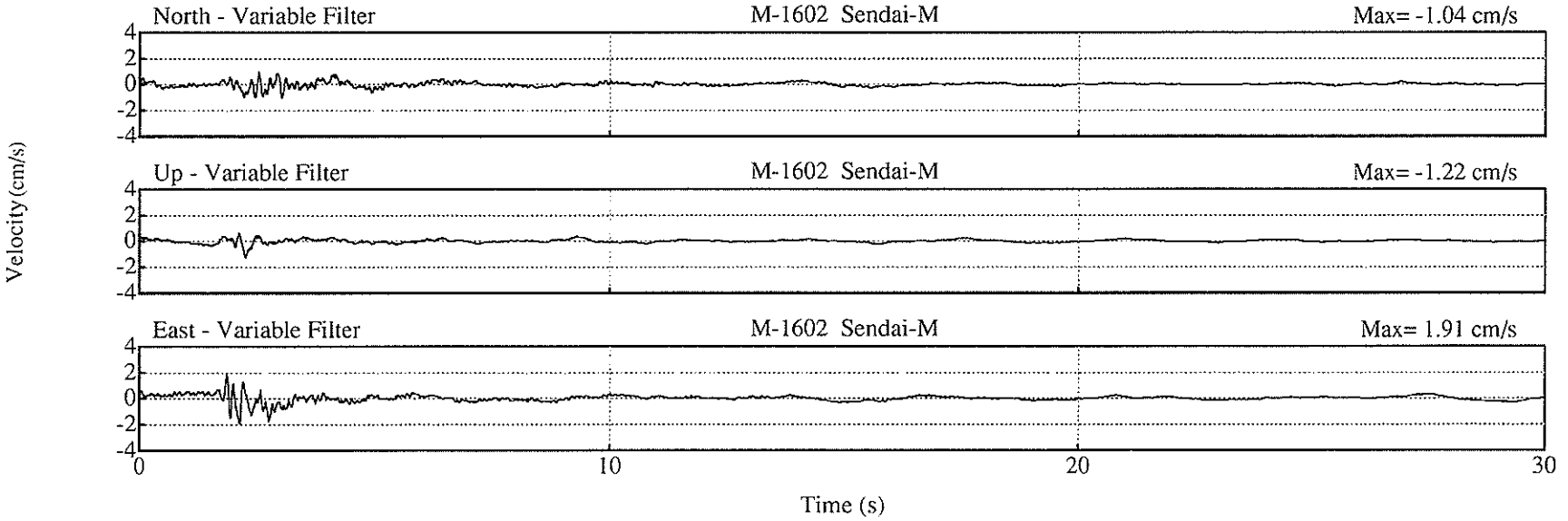
* RESULTANT OF HORIZONTAL COMPONENTS

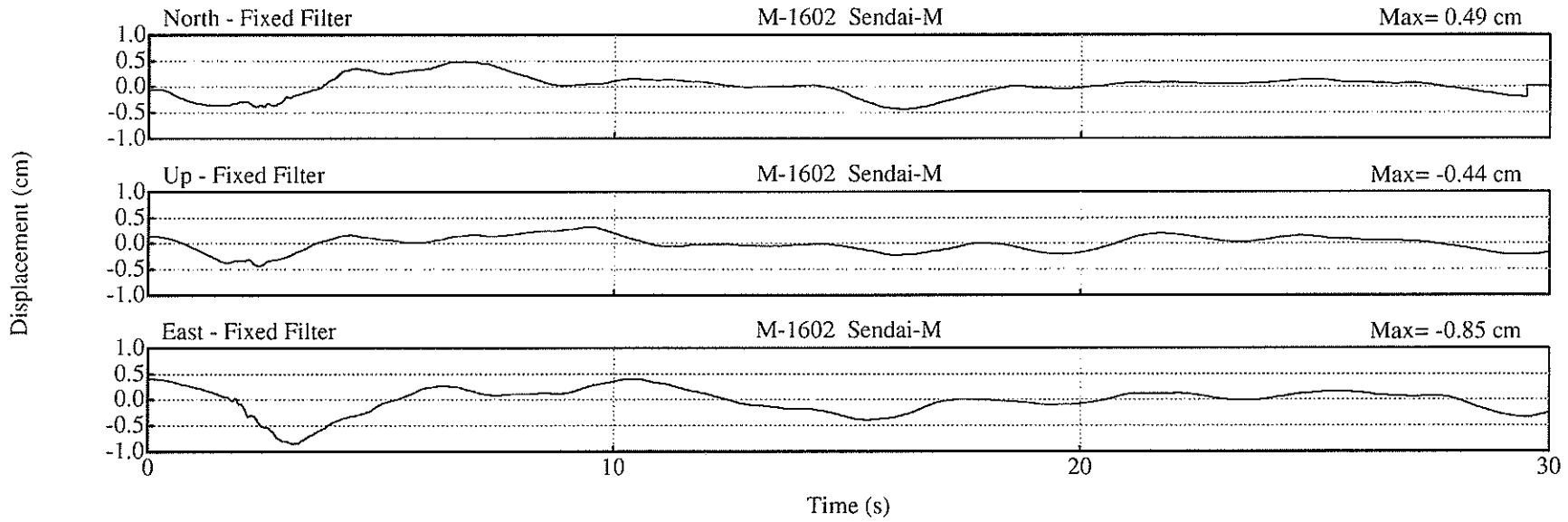

North - Original
M-1602 Sendai-M
Max= 42.19 gal
Up - Original
M-1602 Sendai-M
Max= -25.1 gal
East - Original
M-1602 Sendai-M
Max= -82.18 gal
Acceleration (gal)
100
50
0
-50
-100
0
10
20
30
Time (s)
North - Corrected
M-1602 Sendai-M
Max= 40.24 gal
Up - Corrected
M-1602 Sendai-M
Max= -26.25 gal
East - Corrected
M-1602 Sendai-M
Max= -78.79 gal
Acceleration (gal)
Time (s)

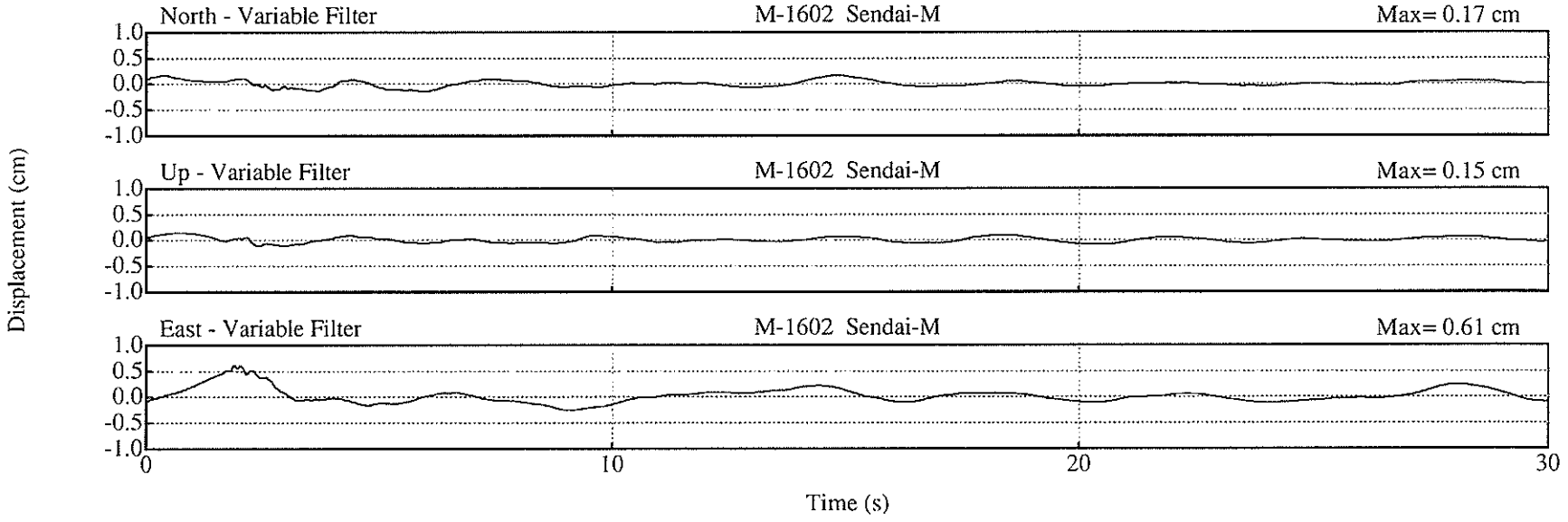

North - Original
M-1602 Sendai-M
Max= 42.19 gal
Up - Original
M-1602 Sendai-M
Max= -25.1 gal
East - Original
M-1602 Sendai-M
Max= -82.18 gal
Acceleration (gal)
100
50
0
-50
-100
0
10
20
30
Time (s)

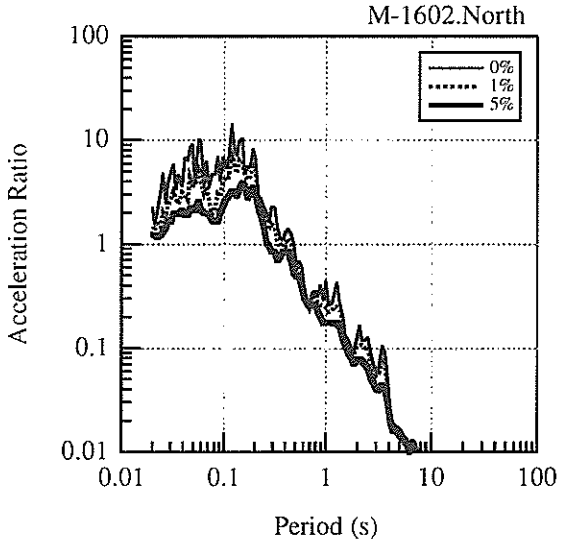

North - SMAC-B2 Equivalent
M-1602 Sendai-M
Max= -22.74 gal
Up - SMAC-B2 Equivalent
M-1602 Sendai-M
Max= -14.55 gal
East - SMAC-B2 Equivalent
M-1602 Sendai-M
Max= -39.91 gal
Acceleration (gal)
100
50
0
-50
-100
0
10
20
30
Time (s)

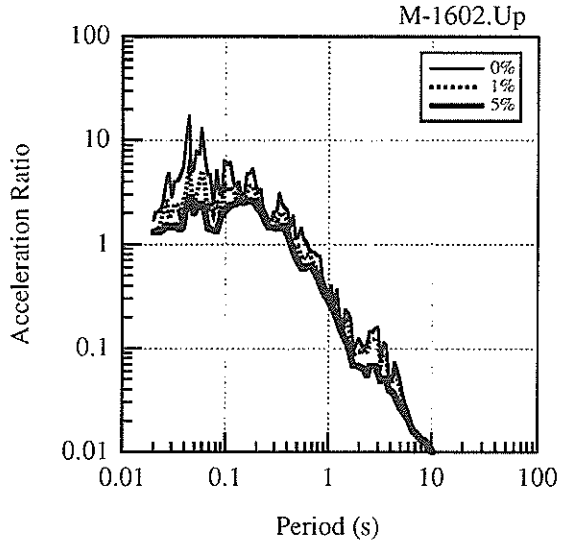

North - Fixed Filter
M-1602 Sendai-M
Max= 1.23 cm/s
Up - Fixed Filter
M-1602 Sendai-M
Max= -1.12 cm/s
East - Fixed Filter
M-1602 Sendai-M
Max= -2.42 cm/s
Velocity (cm/s)
4
2
0
-2
-4
0
10
20
30
Time (s)

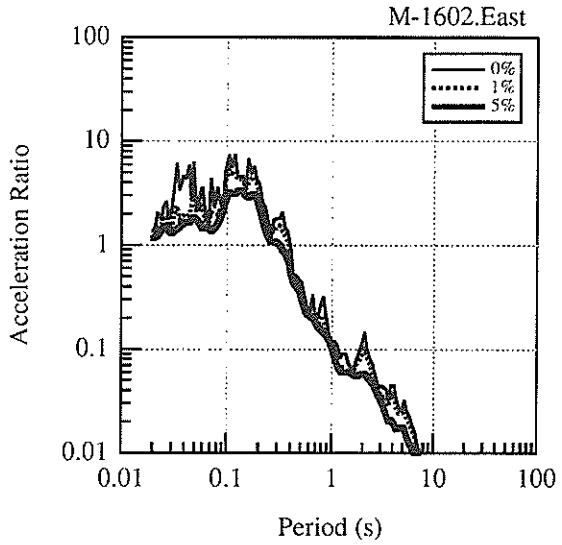

North - Variable Filter
M-1602 Sendai-M
Max= -1.04 cm/s
Up - Variable Filter
M-1602 Sendai-M
Max= -1.22 cm/s
East - Variable Filter
M-1602 Sendai-M
Max= 1.91 cm/s
Velocity (cm/s)
4
2
0
-2
-4
0
10
20
30
Time (s)

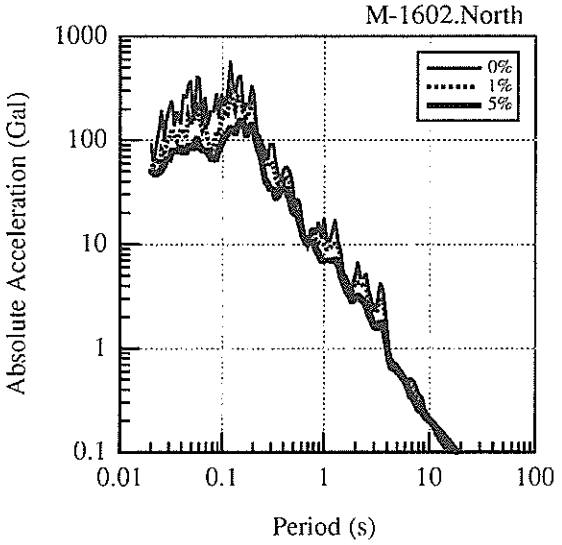

North - Fixed Filter
M-1602 Sendai-M
Max= 0.49 cm
Up - Fixed Filter
M-1602 Sendai-M
Max= -0.44 cm
East - Fixed Filter
M-1602 Sendai-M
Max= -0.85 cm
Displacement (cm)
1.0
0.5
0.0
-0.5
-1.0
0
10
20
30
Time (s)

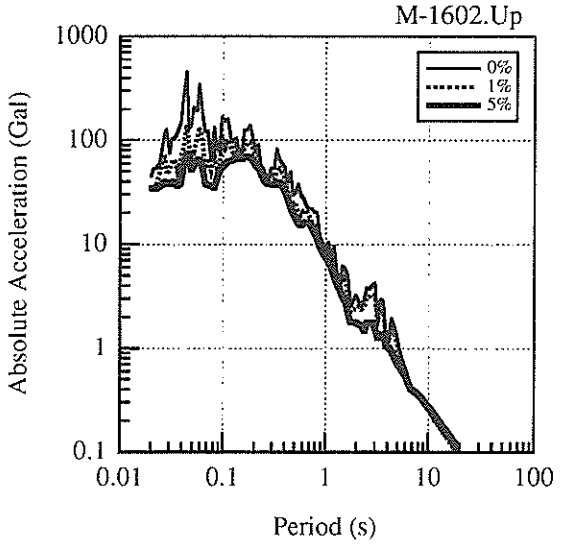

North - Variable Filter
M-1602 Sendai-M
Max= 0.17 cm
Up - Variable Filter
M-1602 Sendai-M
Max= 0.15 cm
East - Variable Filter
M-1602 Sendai-M
Max= 0.61 cm
Displacement (cm)
1.0
0.5
0.0
-0.5
-1.0
0
10
20
30
Time (s)

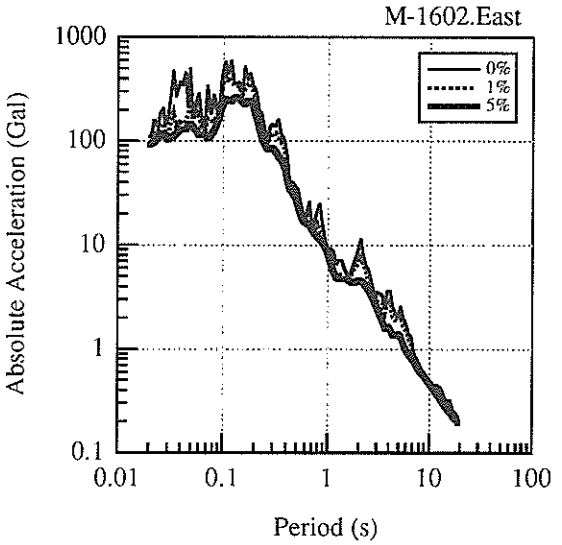

M-1602.North
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

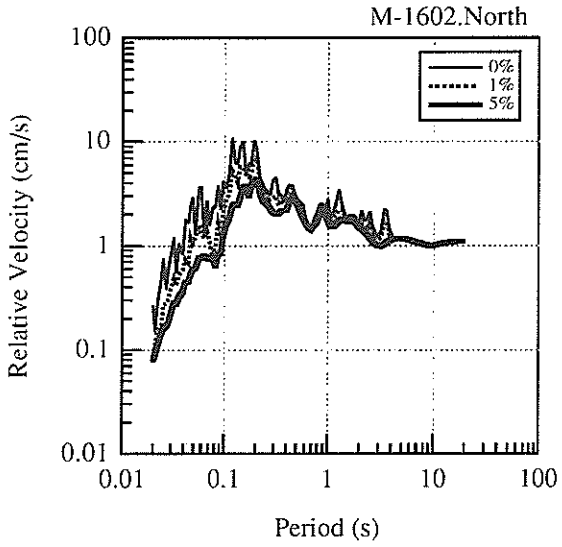

M-1602.Up
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

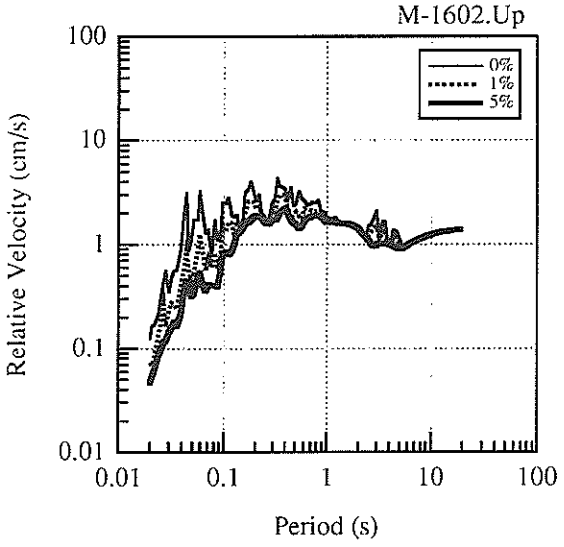

M-1602.East
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

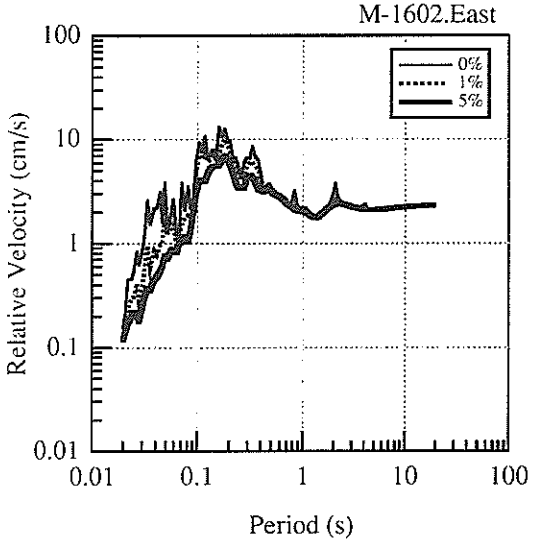

M-1602.North
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
1000
100
10
1
0.1
0.01
0.1
1
10
100

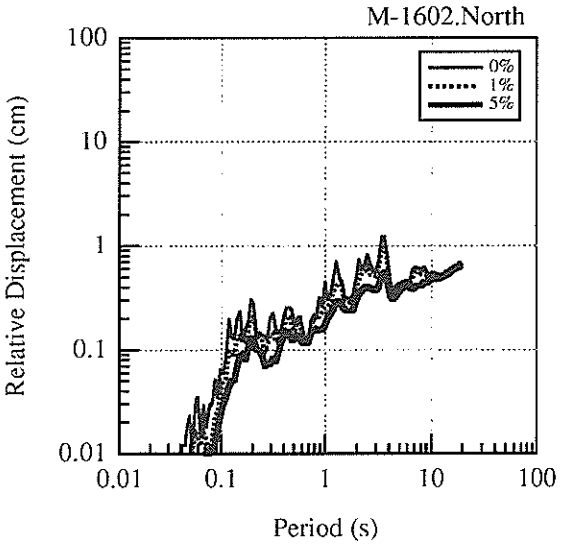

M-1602.Up
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
1000
100
10
1
0.1
0.01
0.1
1
10
100

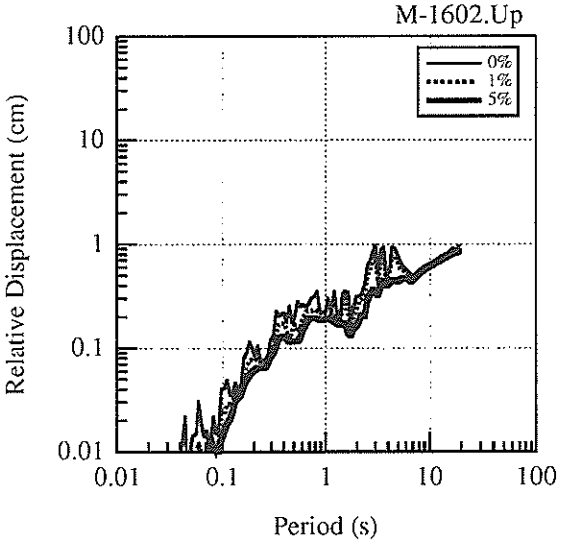

M-1602.East
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
1000
100
10
1
0.1
0.01
0.1
1
10
100

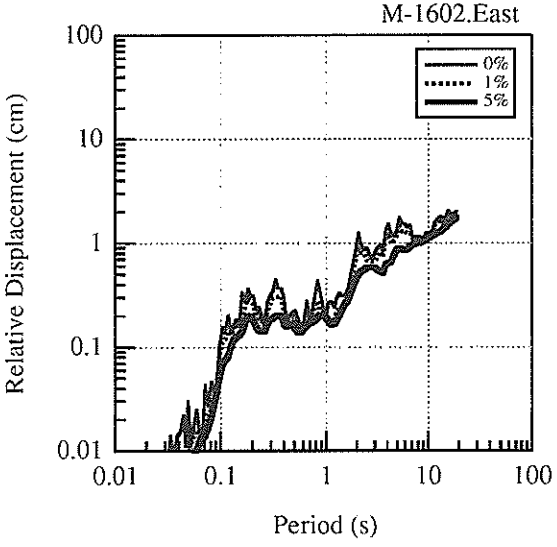

M-1602.North
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

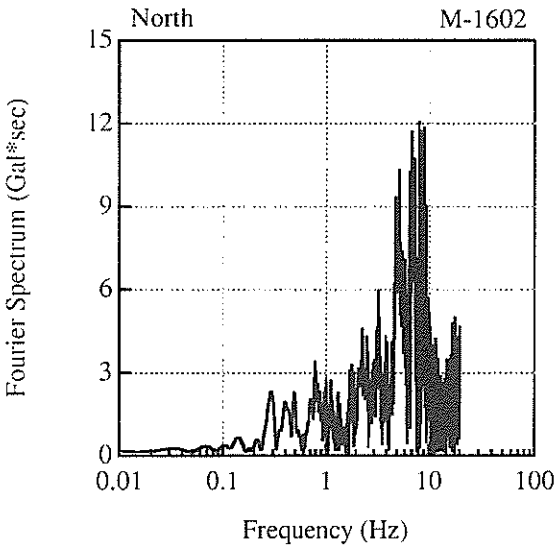

M-1602.Up
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

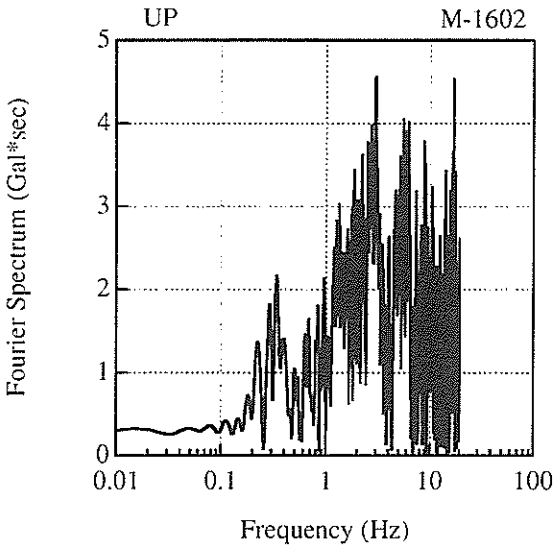

M-1602.East
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

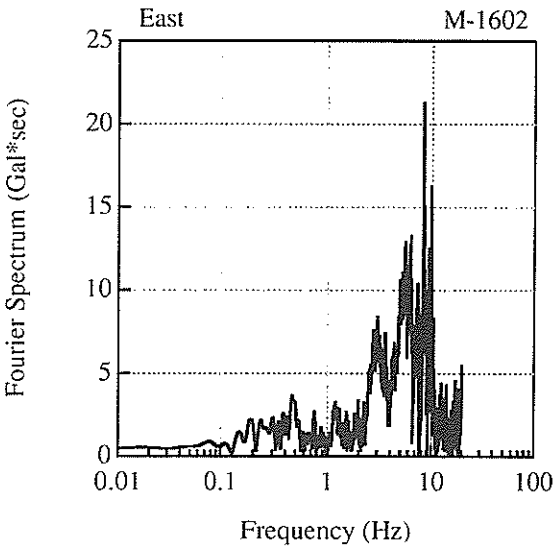

M-1602.North
Relative Displacement (cm)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

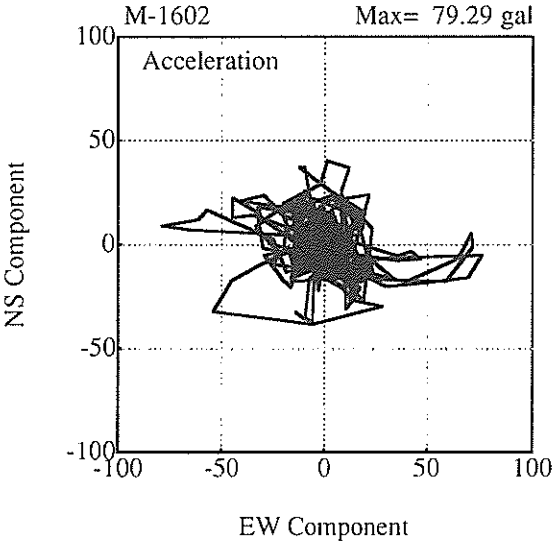

M-1602.Up
Relative Displacement (cm)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

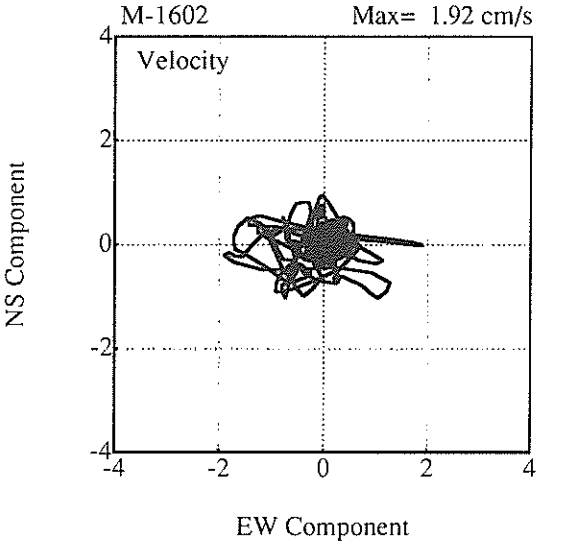

M-1602.East
Relative Displacement (cm)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

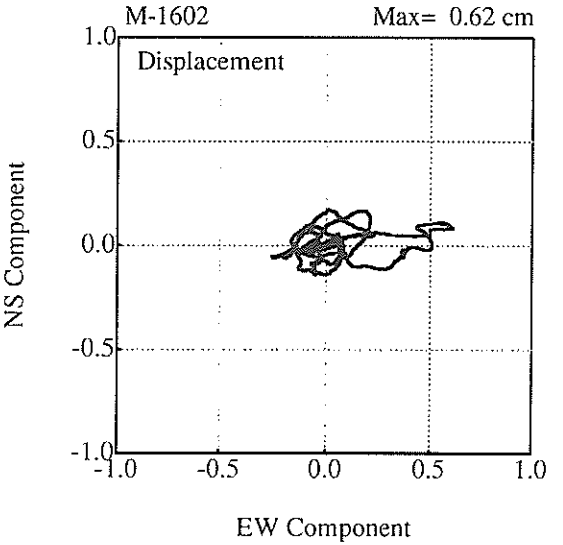

North
M-1602
Fourier Spectrum (Gal*sec)
Frequency (Hz)
0
3
6
9
12
15
0.01
0.1
1
10
100


UP
M-1602
Fourier Spectrum (Gal*sec)
Frequency (Hz)
0
1
2
3
4
5
0.01
0.1
1
10
100


East
M-1602
Fourier Spectrum (Gal*sec)
Frequency (Hz)
0
5
10
15
20
25
0.01
0.1
1
10
100


M-1602
Max= 79.29 gal
Acceleration
NS Component
EW Component
-100
-50
0
50
100


M-1602
Max= 1.92 cm/s
Velocity
NS Component
EW Component
-4
-2
0
2
4


M-1602
Max= 0.62 cm
Displacement
NS Component
EW Component
-1.0
-0.5
0.0
0.5
1.0

RECORD NUMBER : M-1603

STATION : SENDAI-MB

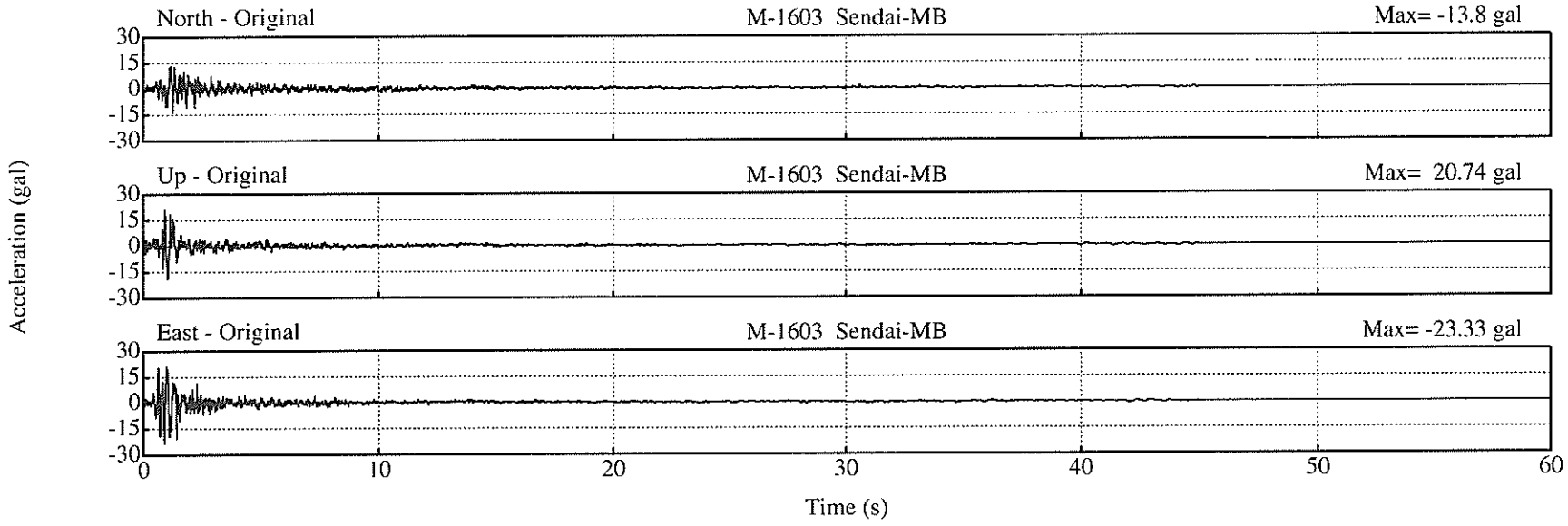
EARTHQUAKE DATA

DATE AND TIME	16:24 SEP.15,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	SOUTHERN MIYAGI PREF
LATITUDE	38°16.6′ N
LONGITUDE	140°45.9′ E
DEPTH	13.1KM
JMA MAGNITUDE	5.0

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	13.8	23.3	20.7	23.4

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1336

STATION : HOSOSHIMA-G

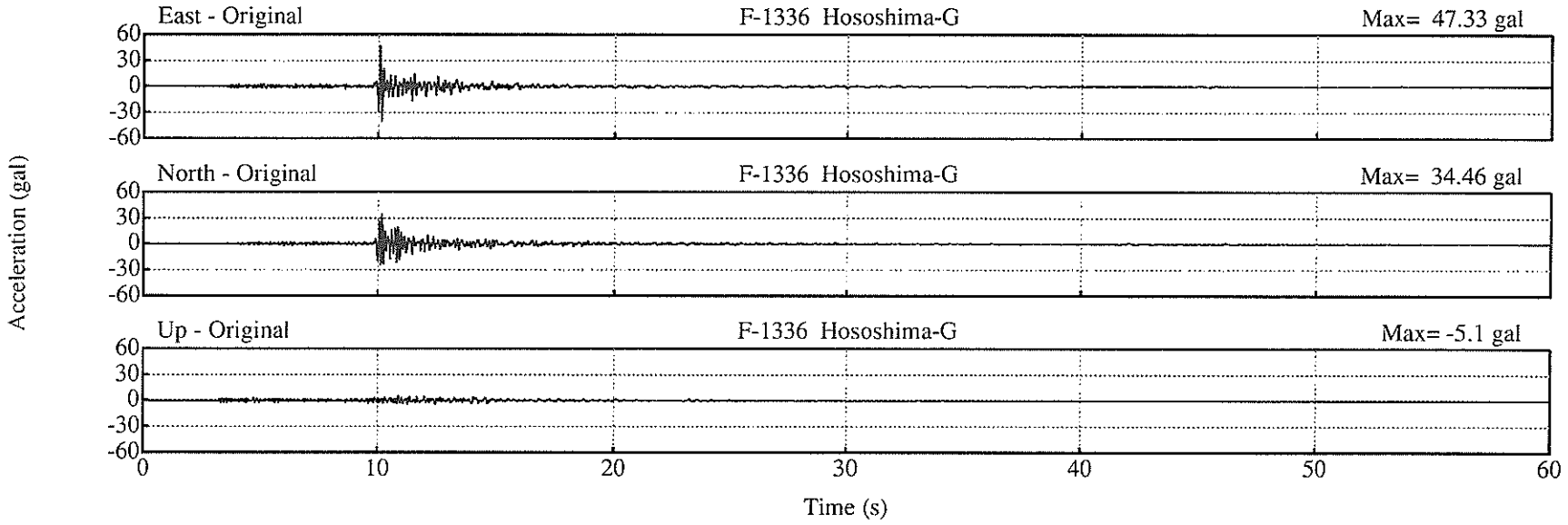
EARTHQUAKE DATA

DATE AND TIME	2:50 SEP.28,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	HYUGANADA REGION
LATITUDE	32° 1.5′ N
LONGITUDE	131°55.7′ E
DEPTH	37.3KM
JMA MAGNITUDE	4.4

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	34.5	47.3	5.1	51.8

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1331

STATION : HITACHINAKA-F

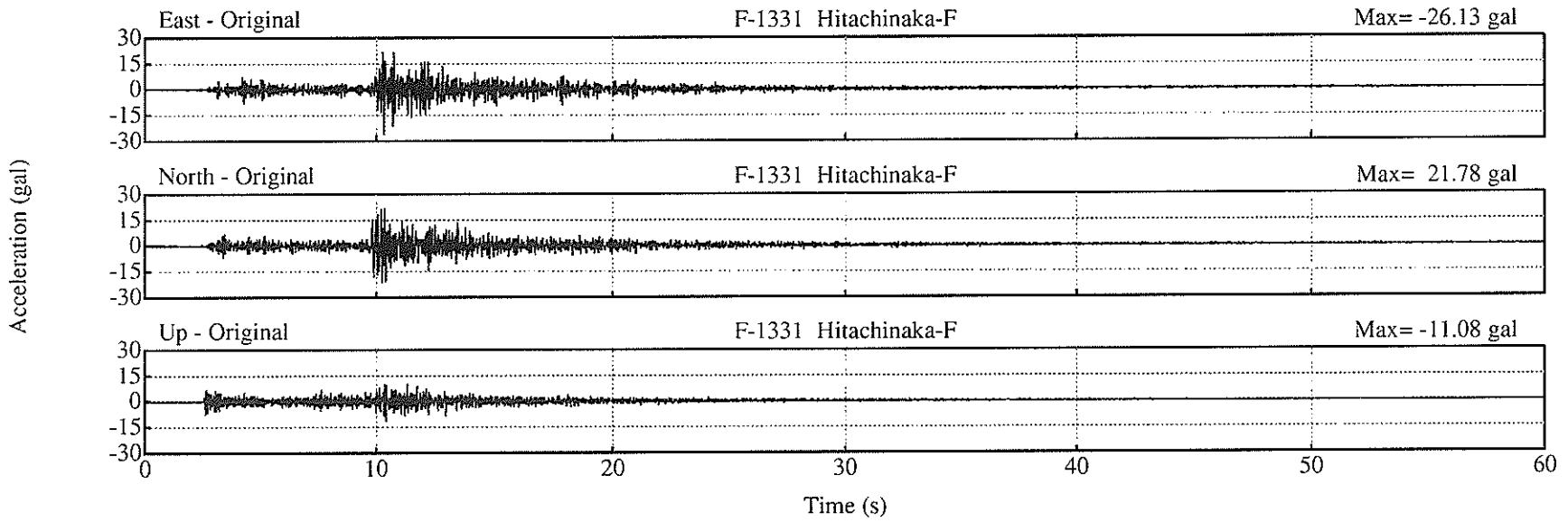
EARTHQUAKE DATA

DATE AND TIME	6:43 NOV. 5,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	NORTHERN IBARAKI PREF
LATITUDE	36°26.7′ N
LONGITUDE	140°32.4′ E
DEPTH	61.2KM
JMA MAGNITUDE	4.2

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	21.8	26.1	11.1	28.0

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : F-1357

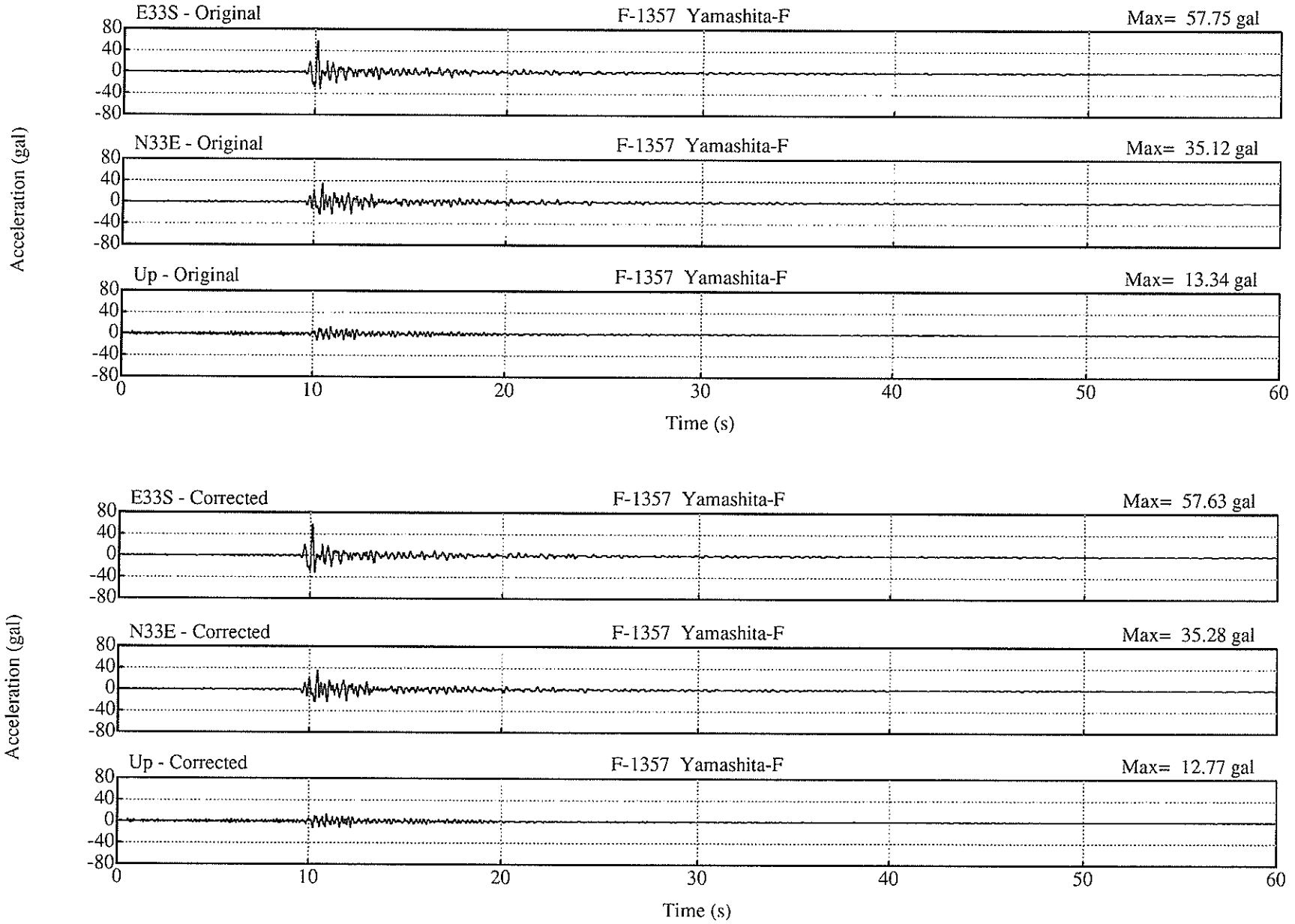
STATION : YAMASHITA-F

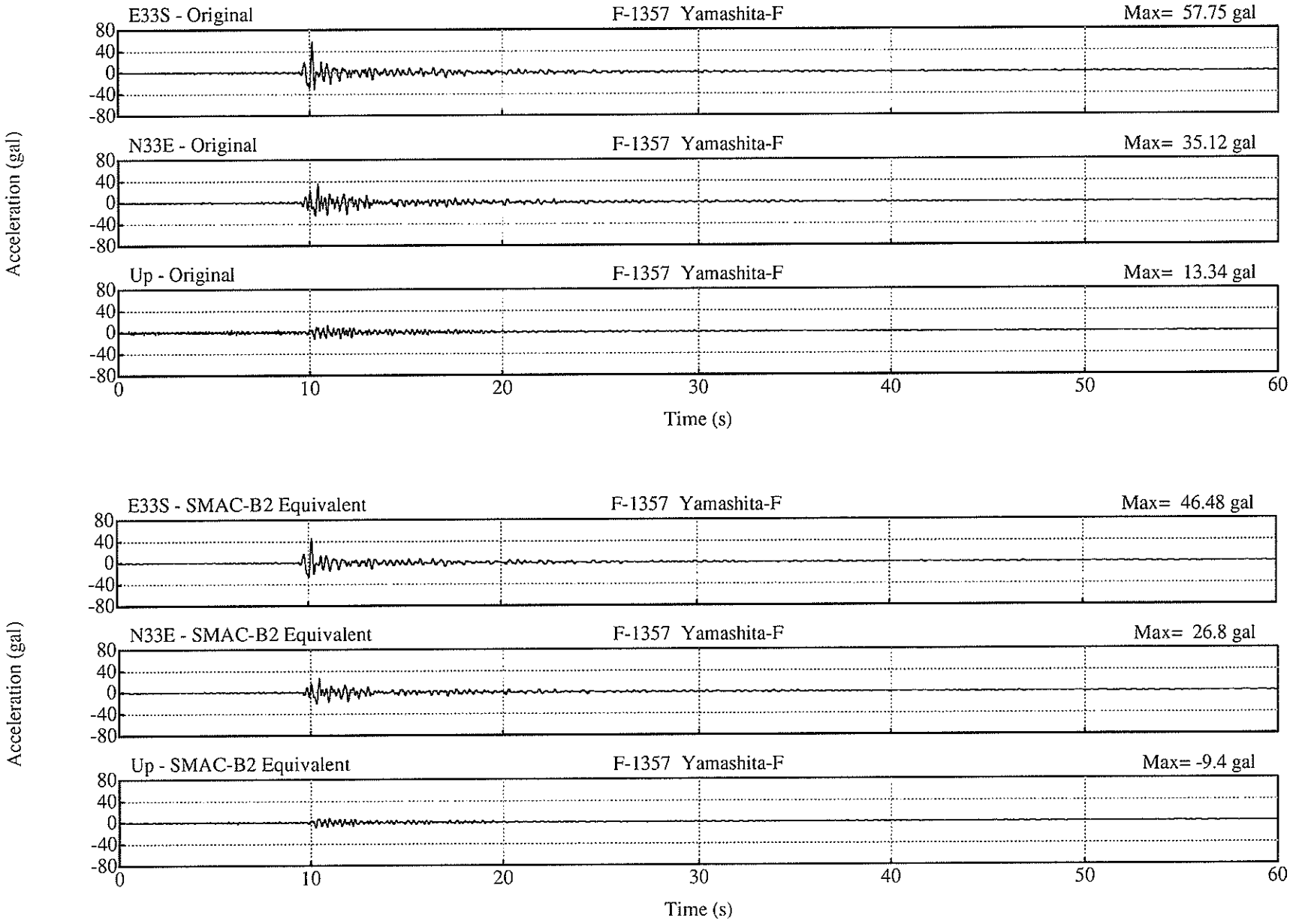
EARTHQUAKE DATA

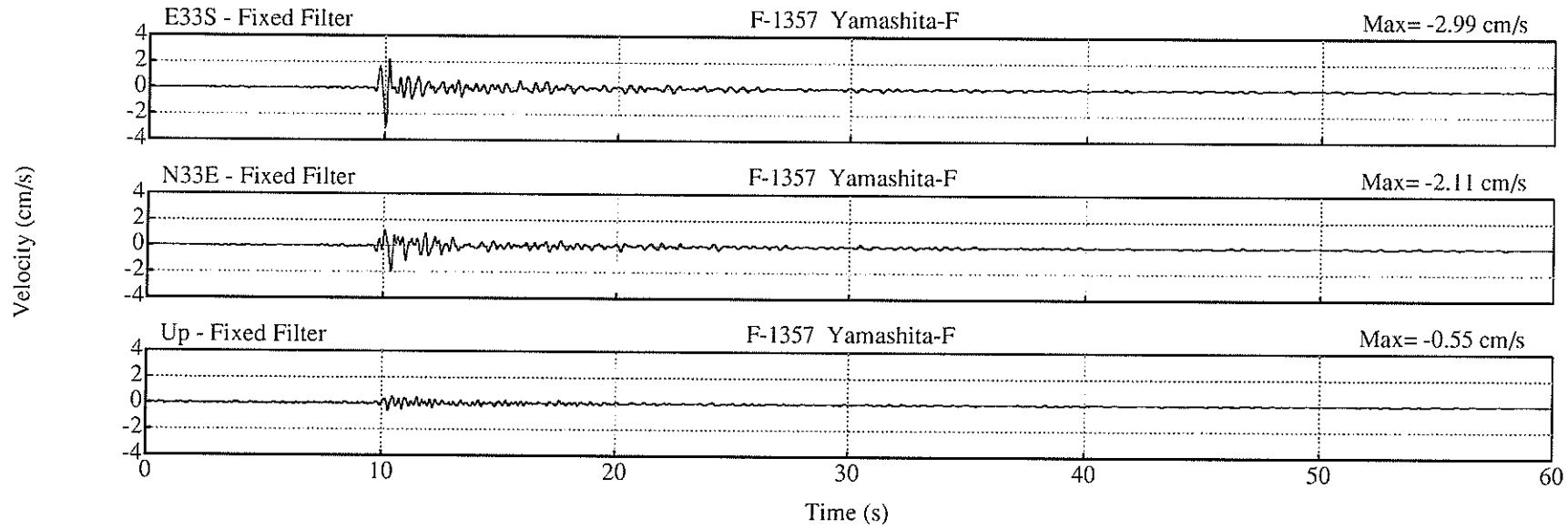
DATE AND TIME	21:40 NOV. 8,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	CENTRAL CHIBA PREF
LATITUDE	35° 36.6' N
LONGITUDE	140° 3.2' E
DEPTH	78.2KM
JMA MAGNITUDE	4.6

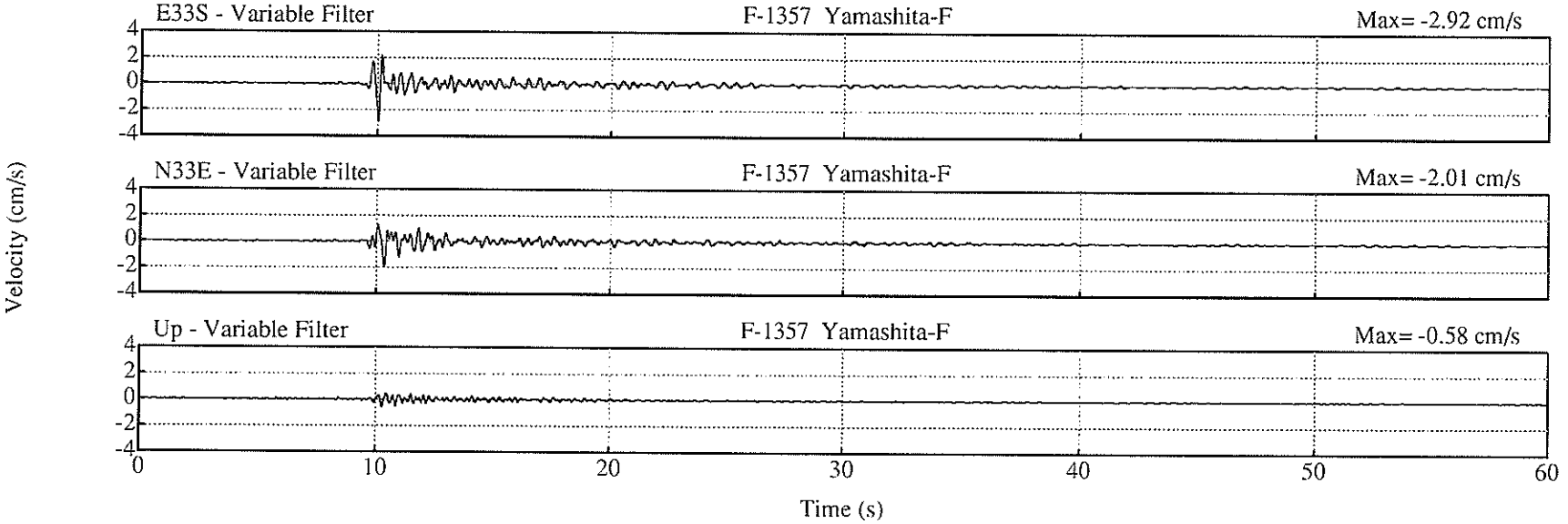
	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
PARAMETER OF THE VARIABLE FILTER				
FC (HZ)	0.744	0.738	1.153	
MAXIMUM ACCELERATION (GAL)				
SMAC-B2 EQUIVALENT	26.8	46.5	9.4	47.2
ORIGINAL	35.1	57.7	13.3	58.6
CORRECTED	35.3	57.6	12.8	58.5
MAXIMUM VELOCITY (CM/SEC)				
FIXED FILTER	2.11	2.99	0.55	3.23
VARIABLE FILTER	2.01	2.92	0.58	3.15
MAXIMUM DISPLACEMENT (CM)				
FIXED FILTER	0.13	0.20	0.07	0.22
VARIABLE FILTER	0.12	0.18	0.03	0.20

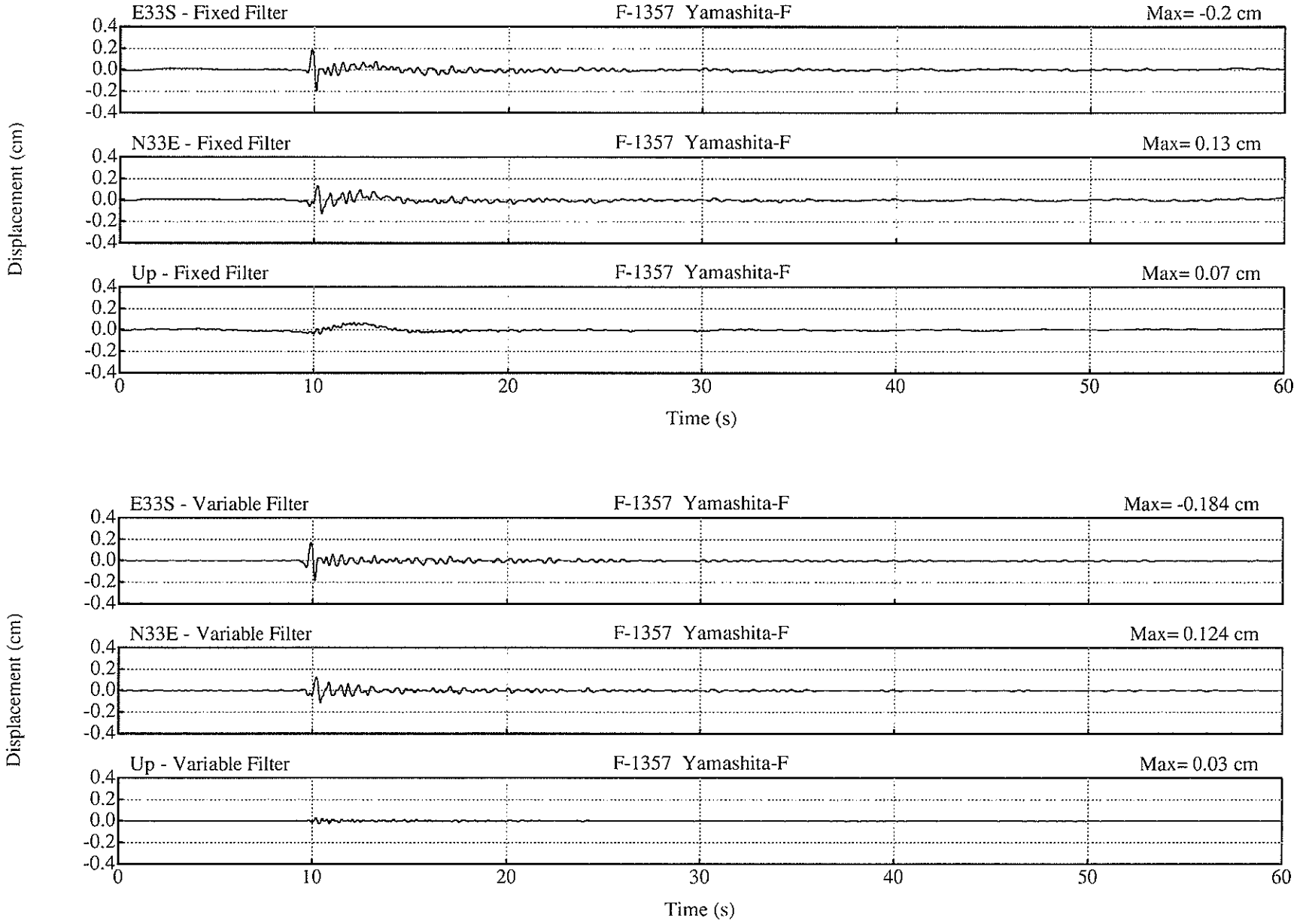
* RESULTANT OF HORIZONTAL COMPONENTS

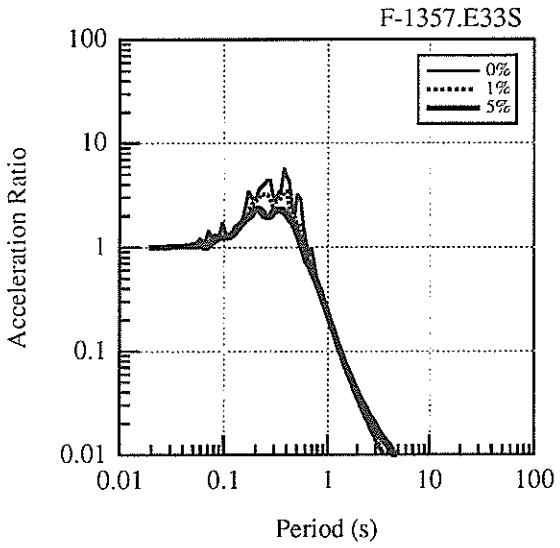

E33S - Original
F-1357 Yamashita-F
Max= 57.75 gal
N33E - Original
F-1357 Yamashita-F
Max= 35.12 gal
Up - Original
F-1357 Yamashita-F
Max= 13.34 gal
Acceleration (gal)
80
40
0
-40
-80
0
10
20
30
40
50
60
Time (s)
E33S - Corrected
F-1357 Yamashita-F
Max= 57.63 gal
N33E - Corrected
F-1357 Yamashita-F
Max= 35.28 gal
Up - Corrected
F-1357 Yamashita-F
Max= 12.77 gal
Acceleration (gal)
Time (s)

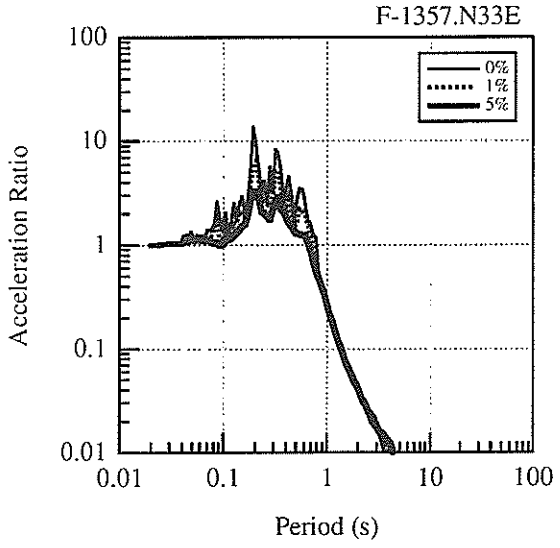

E33S - Original
F-1357 Yamashita-F
Max= 57.75 gal
N33E - Original
F-1357 Yamashita-F
Max= 35.12 gal
Up - Original
F-1357 Yamashita-F
Max= 13.34 gal
Acceleration (gal)
80
40
0
-40
-80
0
10
20
30
40
50
60
Time (s)
E33S - SMAC-B2 Equivalent
F-1357 Yamashita-F
Max= 46.48 gal
N33E - SMAC-B2 Equivalent
F-1357 Yamashita-F
Max= 26.8 gal
Up - SMAC-B2 Equivalent
F-1357 Yamashita-F
Max= -9.4 gal
Acceleration (gal)
Time (s)

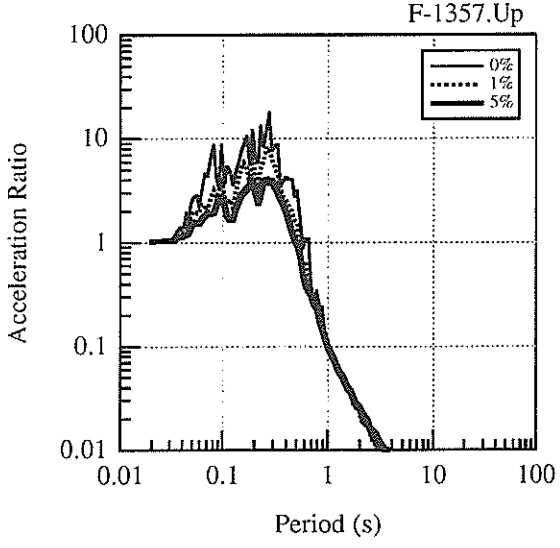

E33S - Fixed Filter
F-1357 Yamashita-F
Max= -2.99 cm/s
N33E - Fixed Filter
F-1357 Yamashita-F
Max= -2.11 cm/s
Up - Fixed Filter
F-1357 Yamashita-F
Max= -0.55 cm/s
Velocity (cm/s)
Time (s)

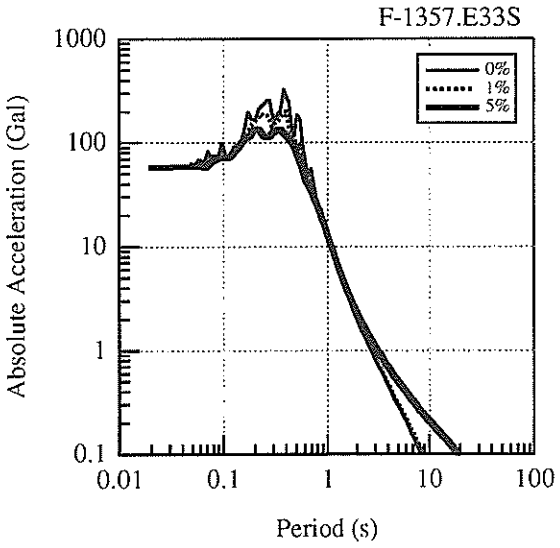

E33S - Variable Filter
F-1357 Yamashita-F
Max= -2.92 cm/s
N33E - Variable Filter
F-1357 Yamashita-F
Max= -2.01 cm/s
Up - Variable Filter
F-1357 Yamashita-F
Max= -0.58 cm/s
Velocity (cm/s)
Time (s)

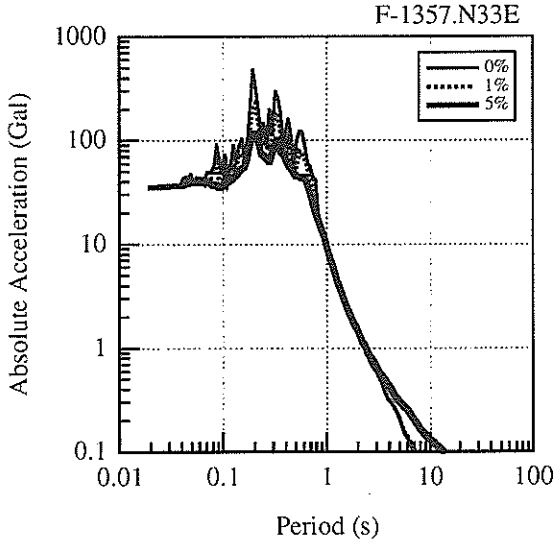

E33S - Fixed Filter
F-1357 Yamashita-F
Max= -0.2 cm
N33E - Fixed Filter
F-1357 Yamashita-F
Max= 0.13 cm
Up - Fixed Filter
F-1357 Yamashita-F
Max= 0.07 cm
Displacement (cm)
Time (s)
E33S - Variable Filter
F-1357 Yamashita-F
Max= -0.184 cm
N33E - Variable Filter
F-1357 Yamashita-F
Max= 0.124 cm
Up - Variable Filter
F-1357 Yamashita-F
Max= 0.03 cm
Displacement (cm)
Time (s)

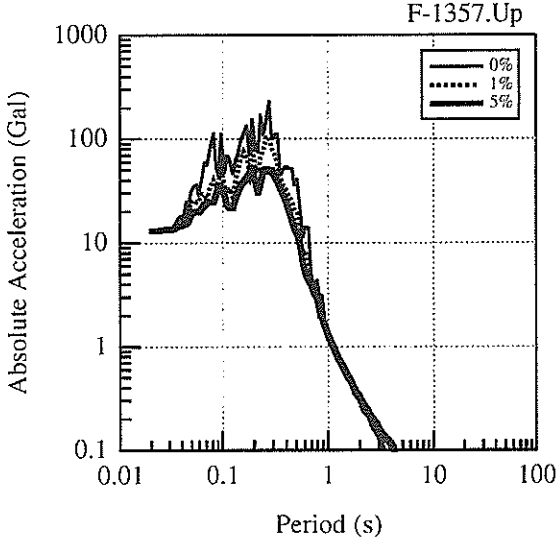

F-1357.E33S
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

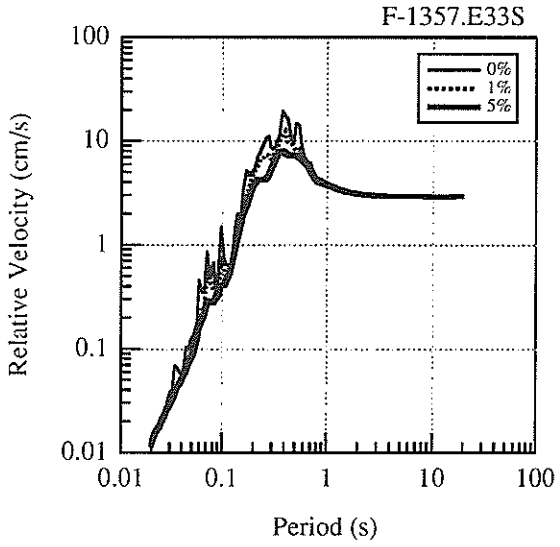

F-1357.N33E
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

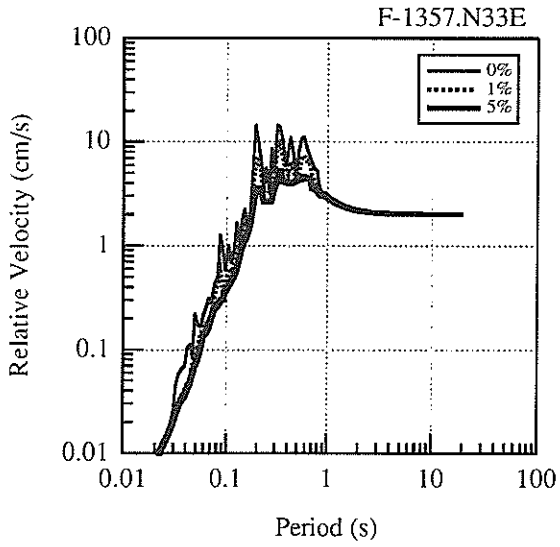

F-1357.Up
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

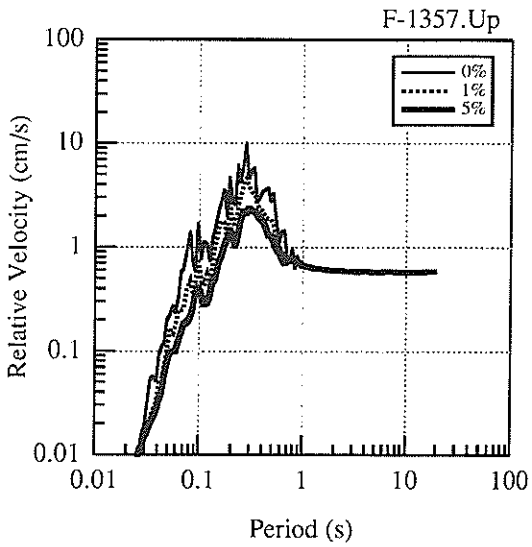

F-1357.E33S
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
1000
100
10
1
0.1
0.01
0.1
1
10
100

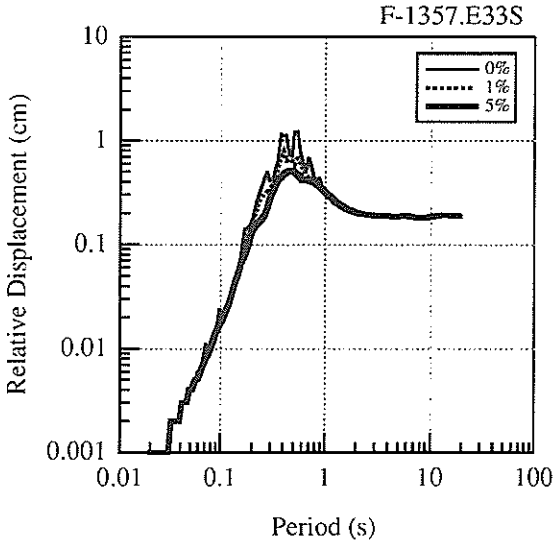

F-1357.N33E
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
1000
100
10
1
0.1
0.01
0.1
1
10
100

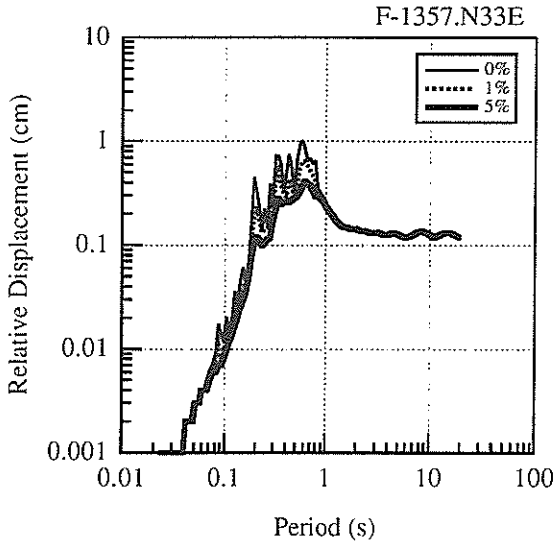

F-1357.Up
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
1000
100
10
1
0.1
0.01
0.1
1
10
100

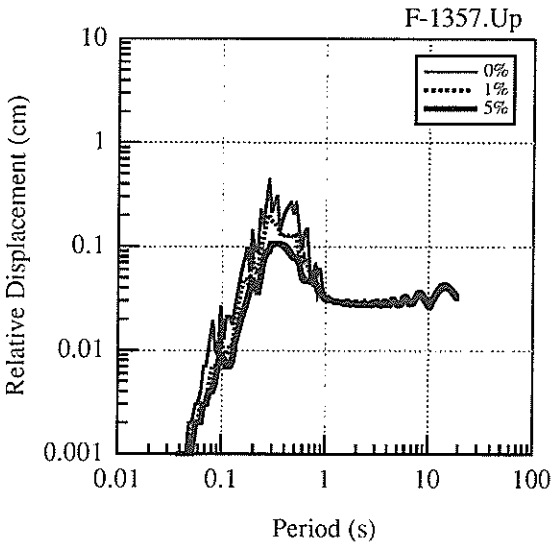

F-1357.E33S
0%
1%
5%
Relative Velocity (cm/s)
Period (s)
100
10
1
0.1
0.01
0.01
0.1
1
10
100

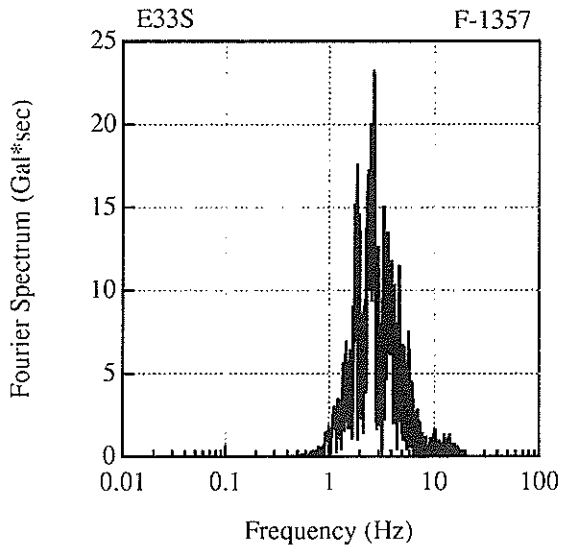

F-1357.N33E
0%
1%
5%
Relative Velocity (cm/s)
Period (s)
100
10
1
0.1
0.01
0.01
0.1
1
10
100

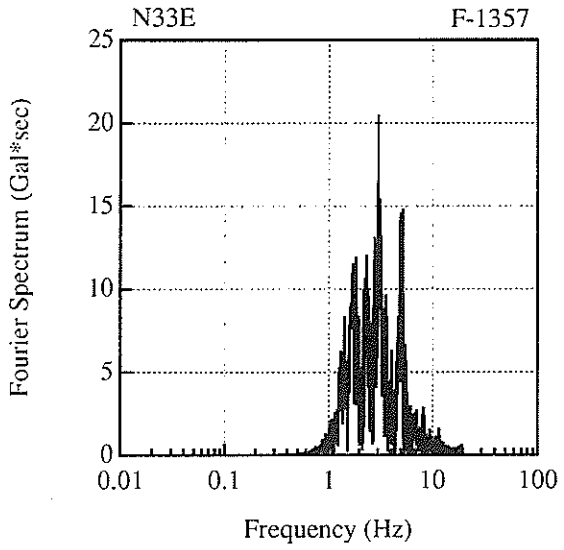

F-1357.Up
0%
1%
5%
Relative Velocity (cm/s)
Period (s)
100
10
1
0.1
0.01
0.01
0.1
1
10
100

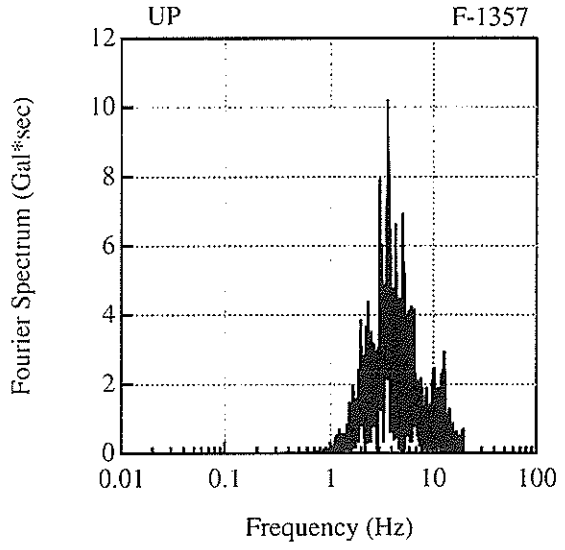

F-1357.E33S
0%
1%
5%
Relative Displacement (cm)
Period (s)
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

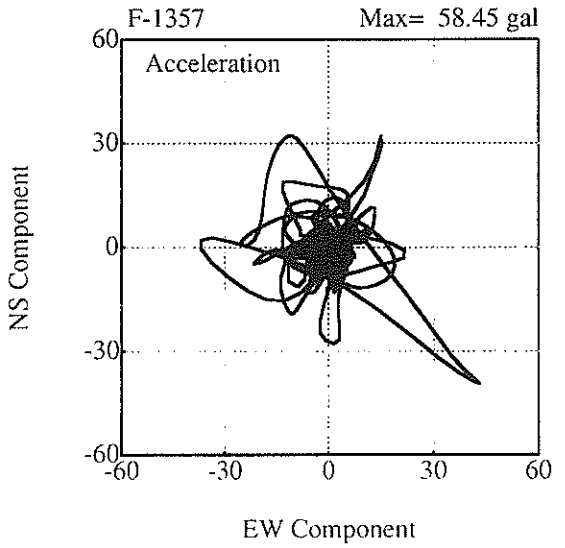

F-1357.N33E
0%
1%
5%
Relative Displacement (cm)
Period (s)
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

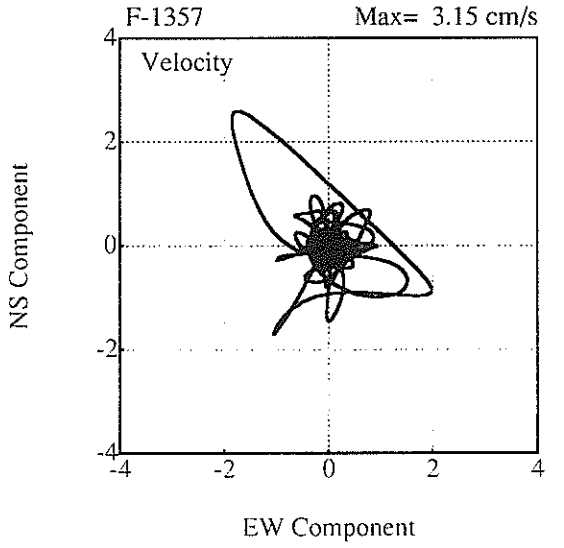

F-1357.Up
0%
1%
5%
Relative Displacement (cm)
Period (s)
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

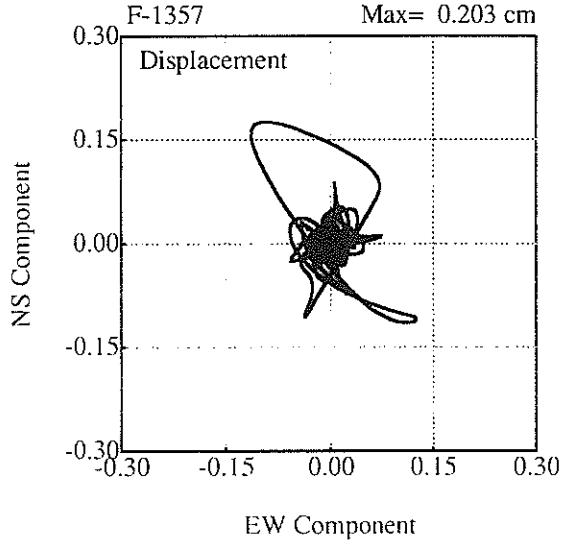

E33S
F-1357
Fourier Spectrum (Gal*sec)
25
20
15
10
5
0
0.01
0.1
1
10
100
Frequency (Hz)


N33E
F-1357
Fourier Spectrum (Gal*sec)
25
20
15
10
5
0
0.01
0.1
1
10
100
Frequency (Hz)


UP
F-1357
Fourier Spectrum (Gal*sec)
12
10
8
6
4
2
0
0.01
0.1
1
10
100
Frequency (Hz)


F-1357
Max= 58.45 gal
Acceleration
NS Component
60
30
0
-30
-60
-60
-30
0
30
60
EW Component


F-1357
Max= 3.15 cm/s
Velocity
NS Component
4
2
0
-2
-4
-4
-2
0
2
4
EW Component


F-1357
Max= 0.203 cm
Displacement
NS Component
0.30
0.15
0.00
-0.15
-0.30
-0.30
-0.15
0.00
0.15
0.30
EW Component

RECORD NUMBER : F-1369

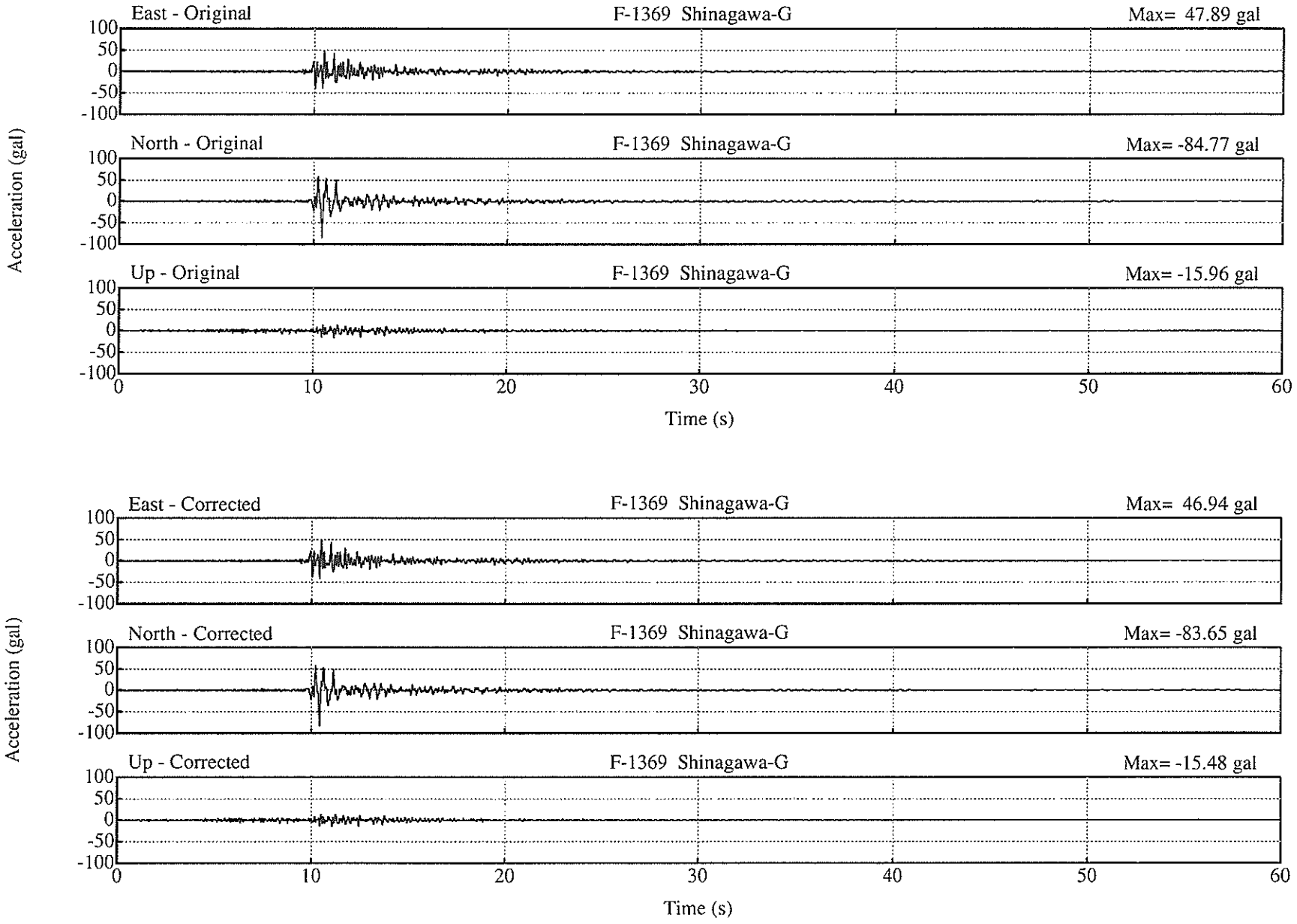
STATION : SHINAGAWA-G

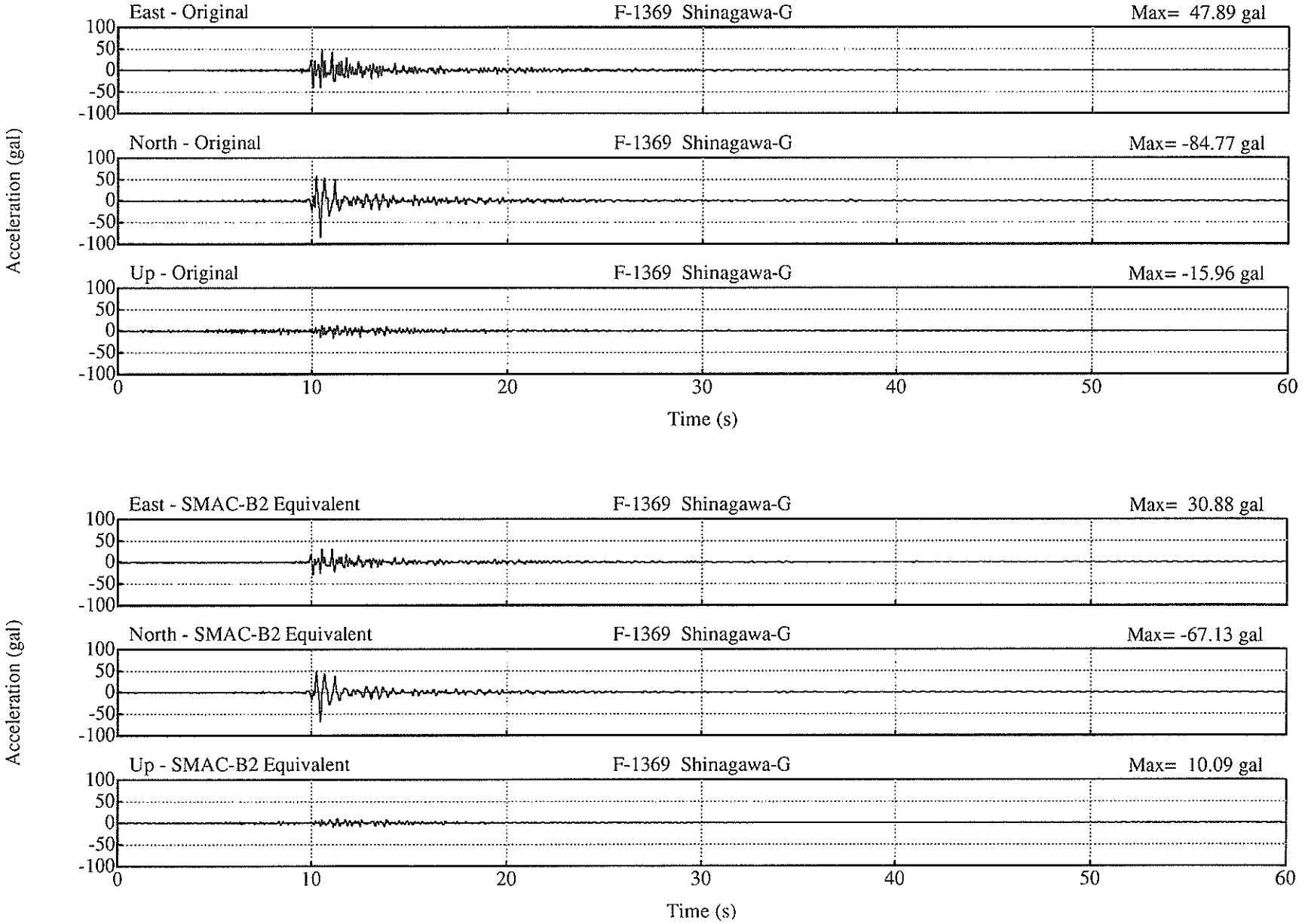
EARTHQUAKE DATA

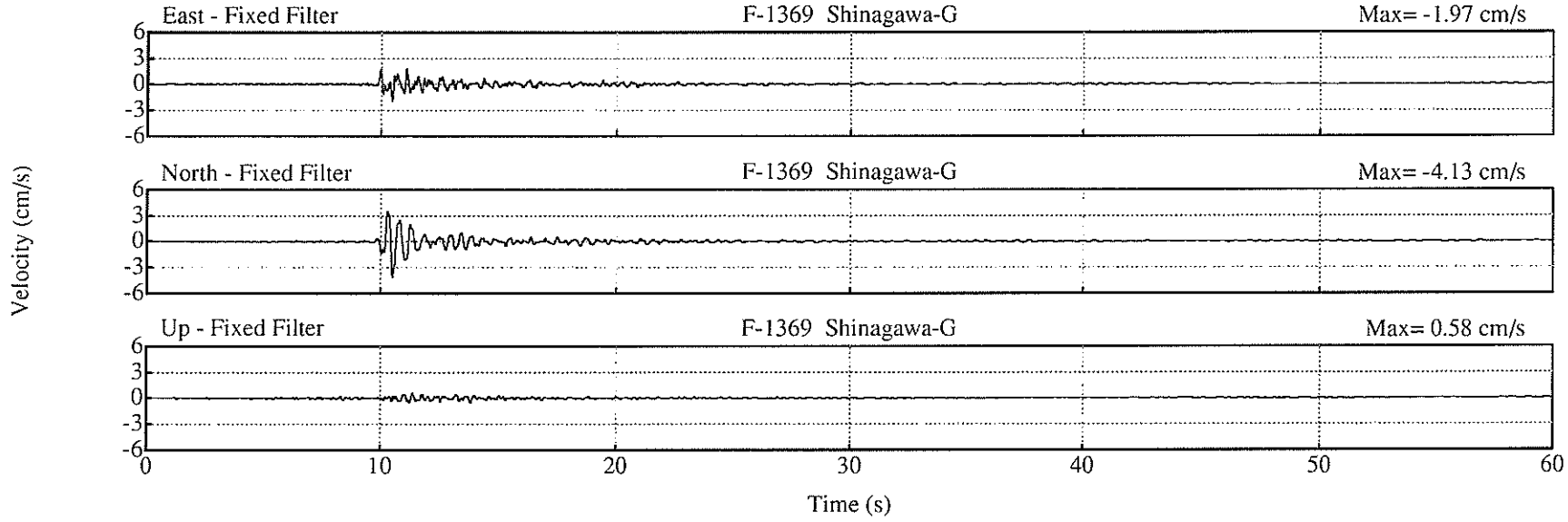
DATE AND TIME	21:40 NOV. 8,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	CENTRAL CHIBA PREF
LATITUDE	35° 36.6′ N
LONGITUDE	140° 3.2′ E
DEPTH	78.2KM
JMA MAGNITUDE	4.6

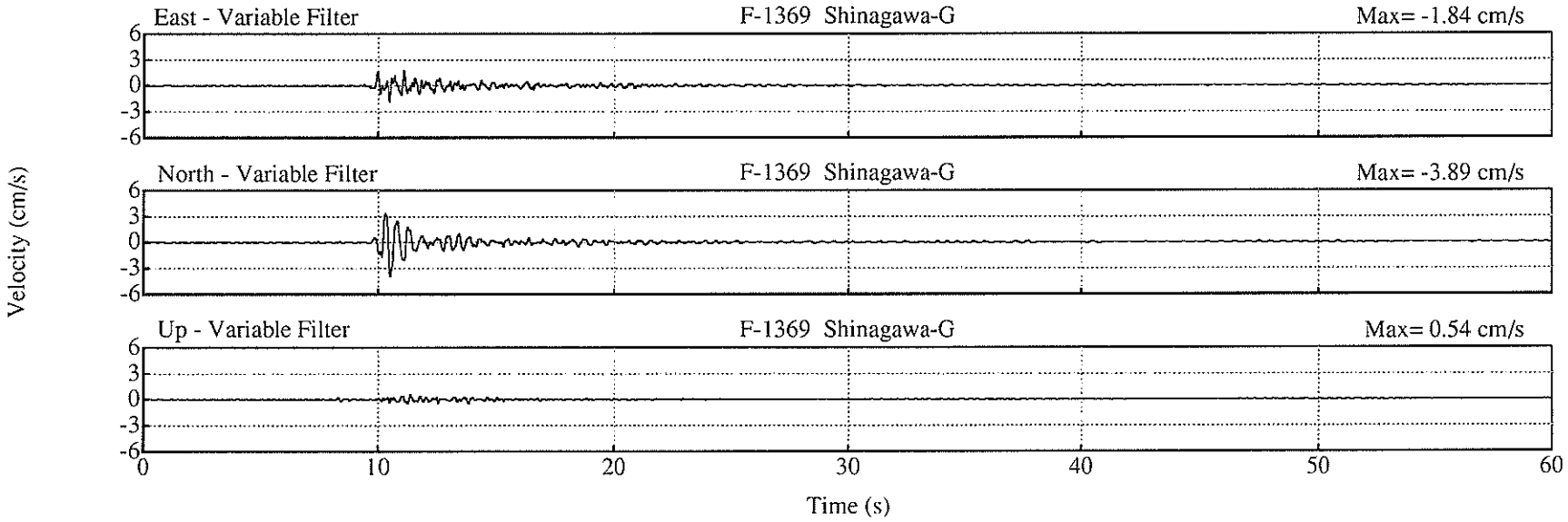
	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
PARAMETER OF THE VARIABLE FILTER				
FC (HZ)	0.915	0.878	1.489	
MAXIMUM ACCELERATION (GAL)				
SMAC-B2 EQUIVALENT	67.1	30.9	10.1	71.4
ORIGINAL	84.8	47.9	16.0	93.6
CORRECTED	83.6	46.9	15.5	92.6
MAXIMUM VELOCITY (CM/SEC)				
FIXED FILTER	4.13	1.97	0.58	4.32
VARIABLE FILTER	3.89	1.84	0.54	4.05
MAXIMUM DISPLACEMENT (CM)				
FIXED FILTER	0.34	0.15	0.04	0.34
VARIABLE FILTER	0.32	0.11	0.03	0.32

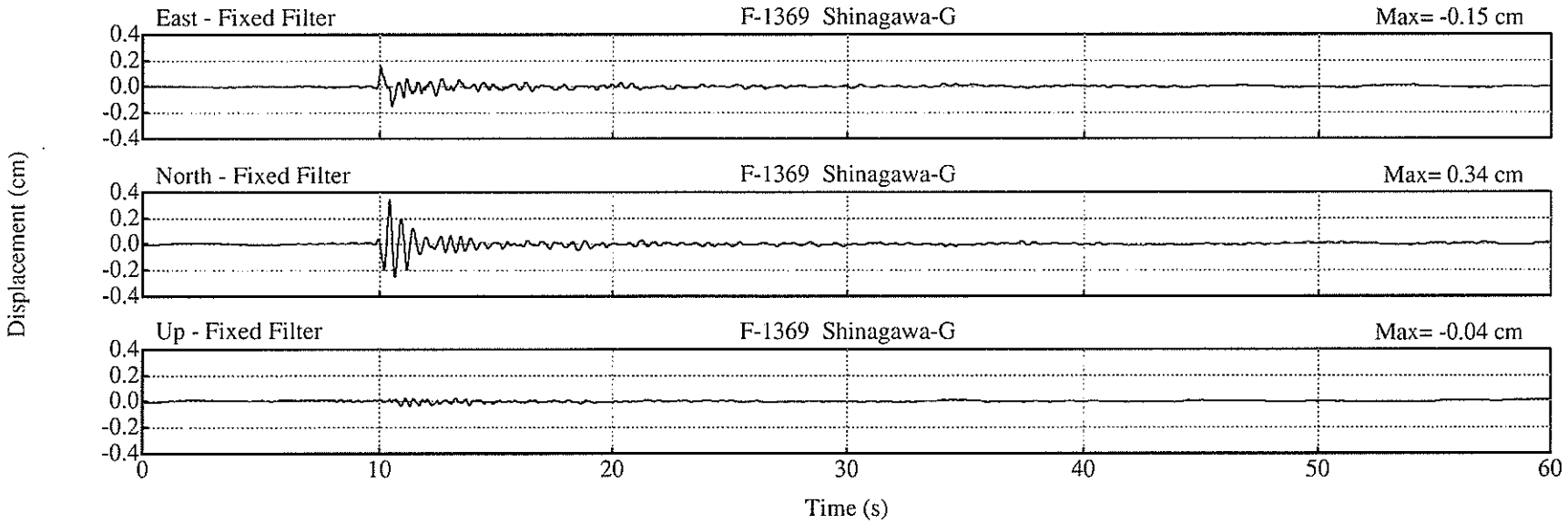
* RESULTANT OF HORIZONTAL COMPONENTS

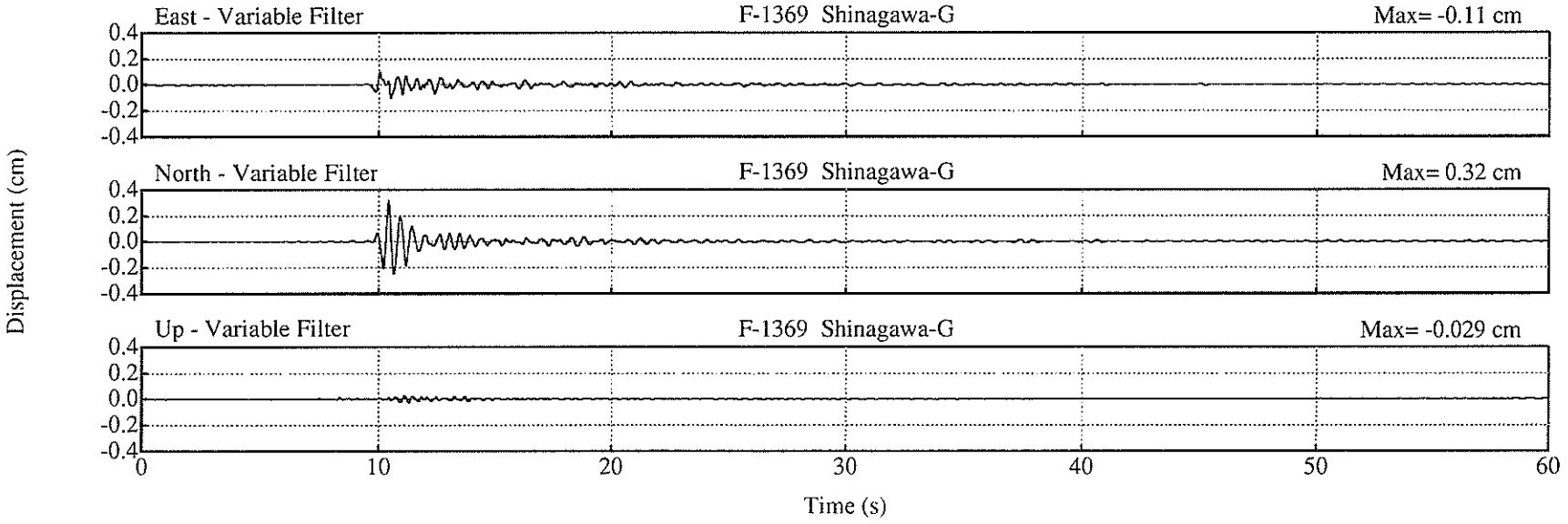

East - Original
F-1369 Shinagawa-G
Max= 47.89 gal
North - Original
F-1369 Shinagawa-G
Max= -84.77 gal
Up - Original
F-1369 Shinagawa-G
Max= -15.96 gal
Acceleration (gal)
100
50
0
-50
-100
0
10
20
30
40
50
60
Time (s)
East - Corrected
F-1369 Shinagawa-G
Max= 46.94 gal
North - Corrected
F-1369 Shinagawa-G
Max= -83.65 gal
Up - Corrected
F-1369 Shinagawa-G
Max= -15.48 gal
Acceleration (gal)
Time (s)

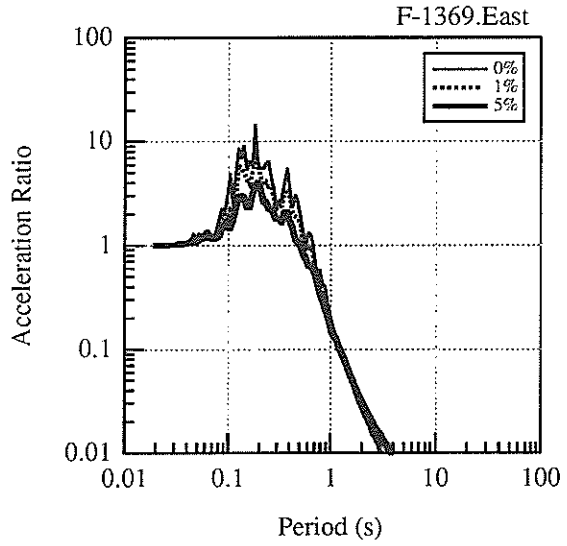

East - Original
F-1369 Shinagawa-G
Max= 47.89 gal
North - Original
F-1369 Shinagawa-G
Max= -84.77 gal
Up - Original
F-1369 Shinagawa-G
Max= -15.96 gal
Acceleration (gal)
100
50
0
-50
-100
0
10
20
30
40
50
60
Time (s)
East - SMAC-B2 Equivalent
F-1369 Shinagawa-G
Max= 30.88 gal
North - SMAC-B2 Equivalent
F-1369 Shinagawa-G
Max= -67.13 gal
Up - SMAC-B2 Equivalent
F-1369 Shinagawa-G
Max= 10.09 gal
Acceleration (gal)
Time (s)

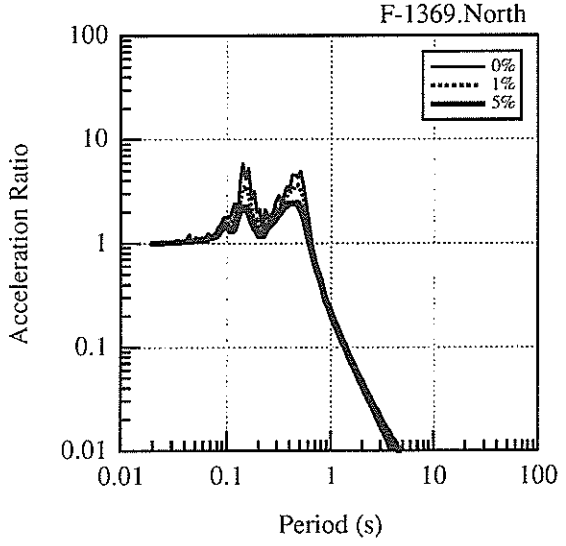

East - Fixed Filter
F-1369 Shinagawa-G
Max= -1.97 cm/s
North - Fixed Filter
F-1369 Shinagawa-G
Max= -4.13 cm/s
Up - Fixed Filter
F-1369 Shinagawa-G
Max= 0.58 cm/s
Velocity (cm/s)
6
3
0
-3
-6
0
10
20
30
40
50
60
Time (s)

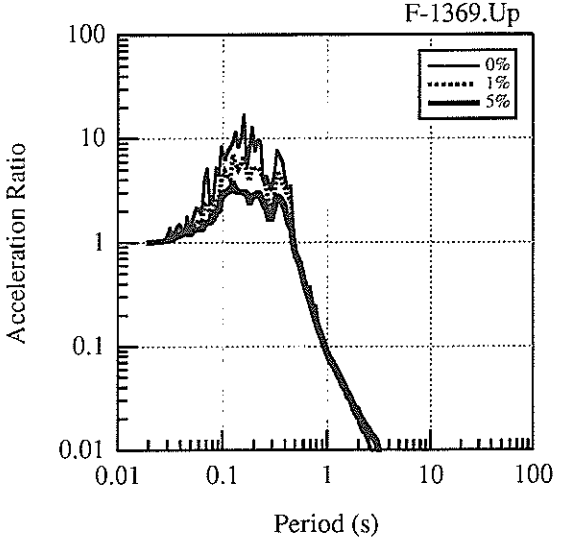

East - Variable Filter
F-1369 Shinagawa-G
Max= -1.84 cm/s
North - Variable Filter
F-1369 Shinagawa-G
Max= -3.89 cm/s
Up - Variable Filter
F-1369 Shinagawa-G
Max= 0.54 cm/s
Velocity (cm/s)
6
3
0
-3
-6
0
10
20
30
40
50
60
Time (s)

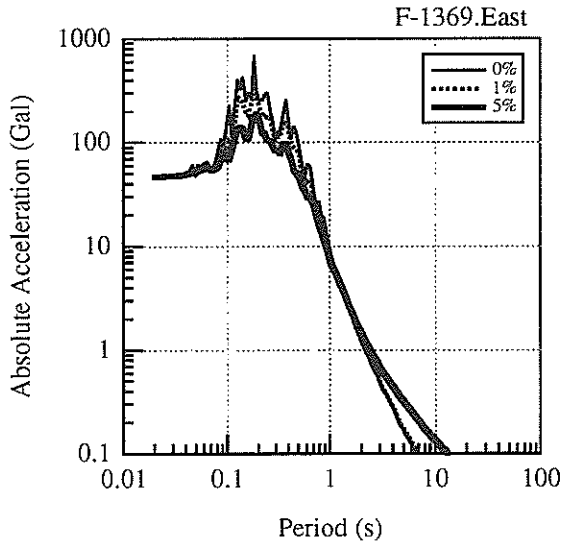

East - Fixed Filter
F-1369 Shinagawa-G
Max= -0.15 cm
North - Fixed Filter
F-1369 Shinagawa-G
Max= 0.34 cm
Up - Fixed Filter
F-1369 Shinagawa-G
Max= -0.04 cm
Displacement (cm)
0.4
0.2
0.0
-0.2
-0.4
0
10
20
30
40
50
60
Time (s)

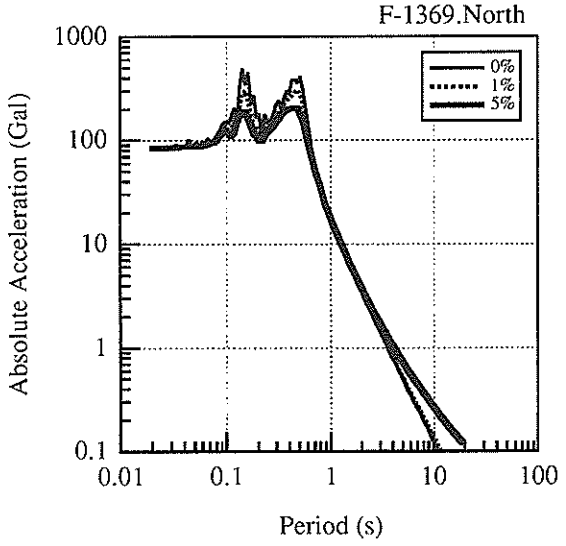

East - Variable Filter
F-1369 Shinagawa-G
Max= -0.11 cm
North - Variable Filter
F-1369 Shinagawa-G
Max= 0.32 cm
Up - Variable Filter
F-1369 Shinagawa-G
Max= -0.029 cm
Displacement (cm)
0.4
0.2
0.0
-0.2
-0.4
0
10
20
30
40
50
60
Time (s)

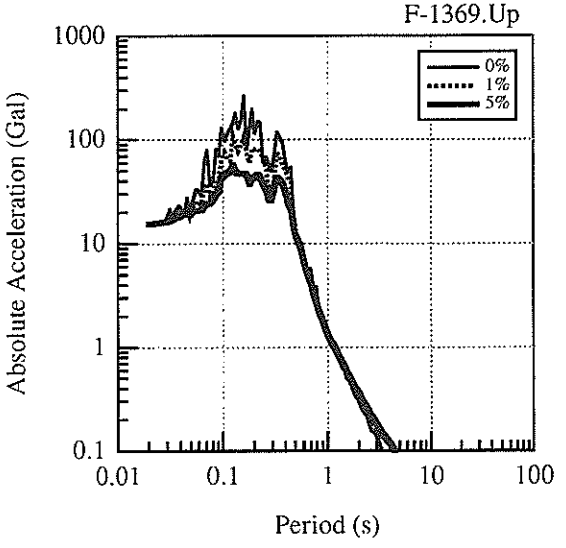

F-1369.East
Acceleration Ratio
Period (s)
0%
1%
5%

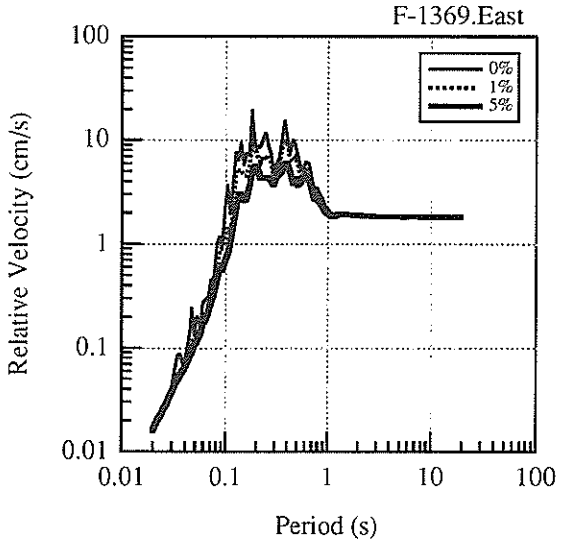

F-1369.North
Acceleration Ratio
Period (s)
0%
1%
5%

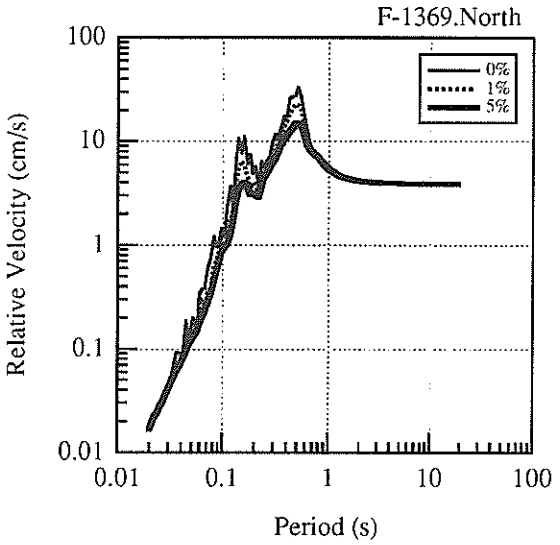

F-1369.Up
Acceleration Ratio
Period (s)
0%
1%
5%

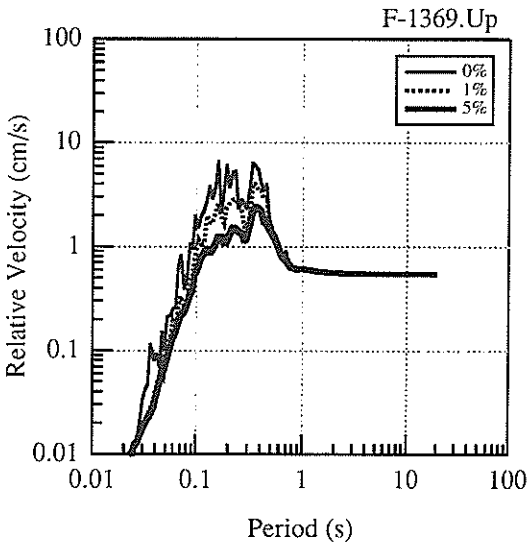

F-1369.East
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%

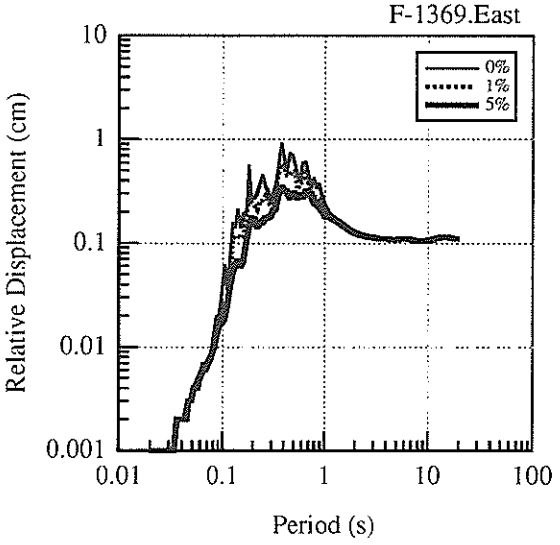

F-1369.North
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%

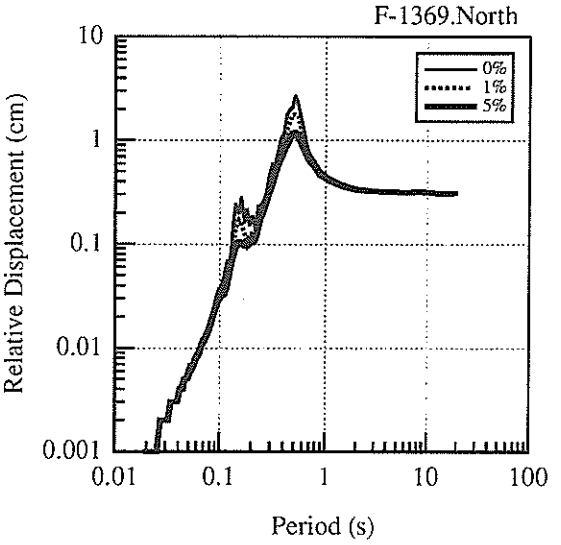

F-1369.Up
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%

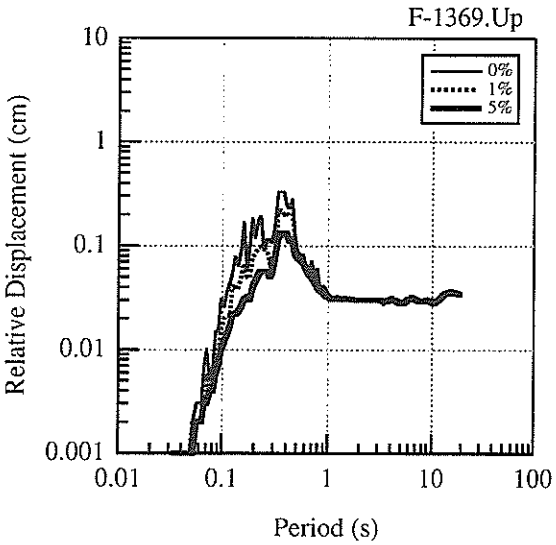

F-1369.East
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

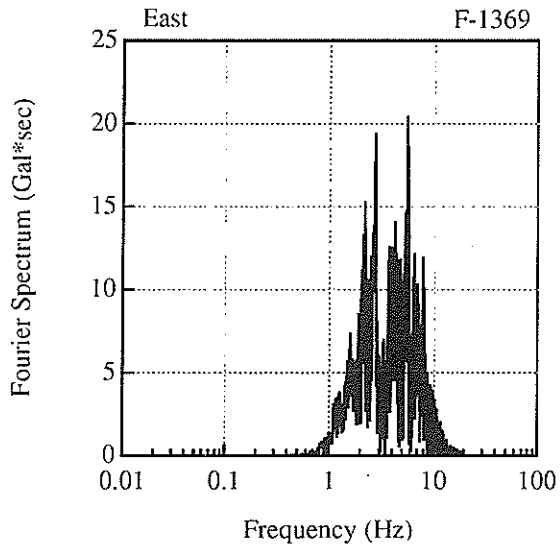

F-1369.North
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

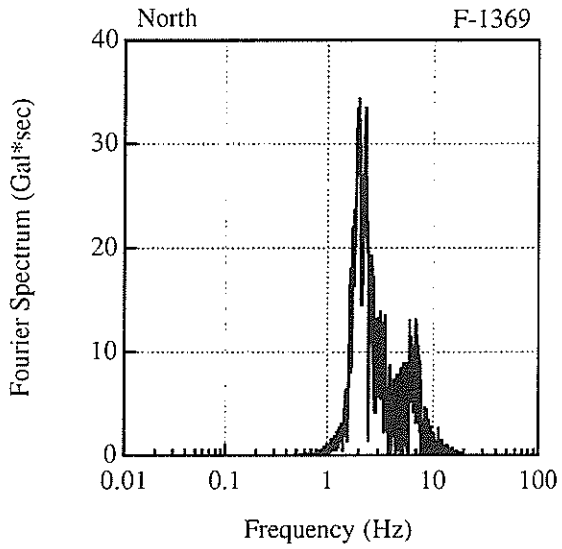

F-1369.Up
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

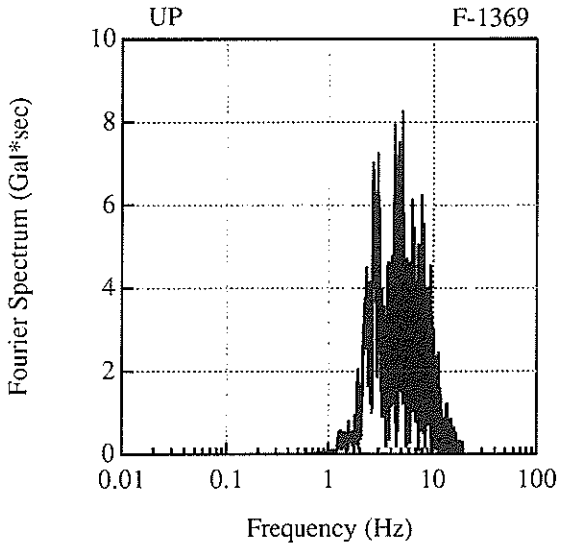

F-1369.East
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

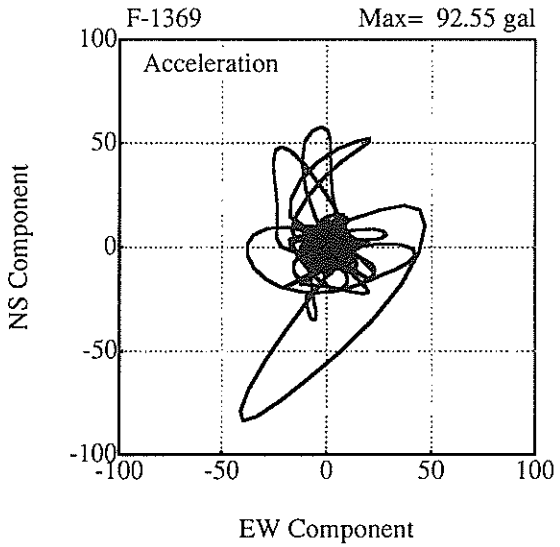

F-1369.North
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

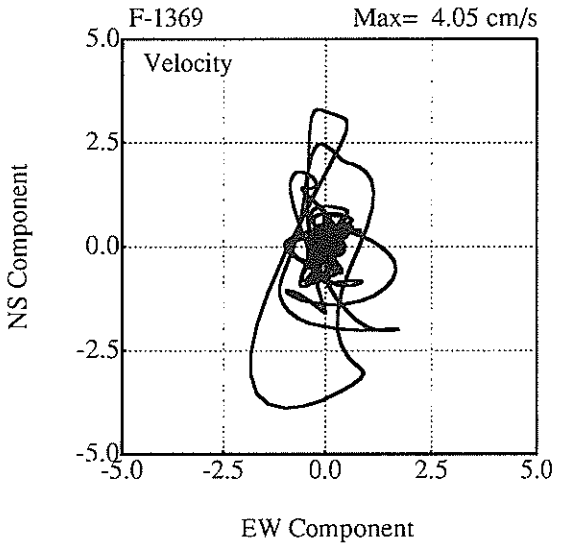

F-1369.Up
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

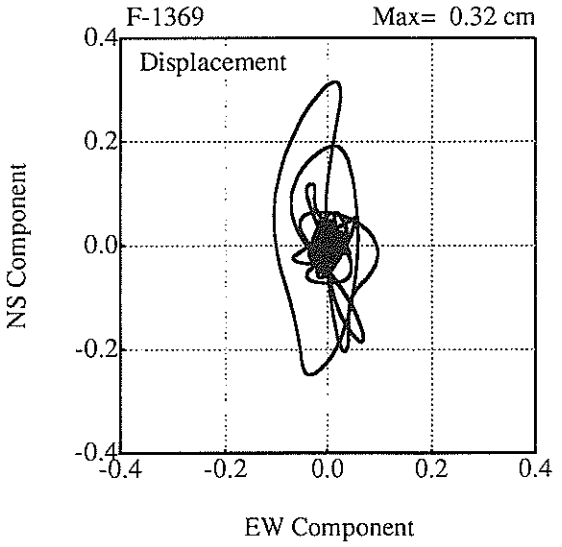

East
F-1369
Fourier Spectrum (Gal*sec)
25
20
15
10
5
0
0.01
0.1
1
10
100
Frequency (Hz)


North
F-1369
Fourier Spectrum (Gal*sec)
40
30
20
10
0
0.01
0.1
1
10
100
Frequency (Hz)


UP
F-1369
Fourier Spectrum (Gal*sec)
10
8
6
4
2
0
0.01
0.1
1
10
100
Frequency (Hz)


F-1369
Max= 92.55 gal
Acceleration
NS Component
100
50
0
-50
-100
-100
-50
0
50
100
EW Component


F-1369
Max= 4.05 cm/s
Velocity
NS Component
5.0
2.5
0.0
-2.5
-5.0
-5.0
-2.5
0.0
2.5
5.0
EW Component


F-1369
Max= 0.32 cm
Displacement
NS Component
0.4
0.2
0.0
-0.2
-0.4
-0.4
-0.2
0.0
0.2
0.4
EW Component

RECORD NUMBER : S-2686

STATION : SOMA-S

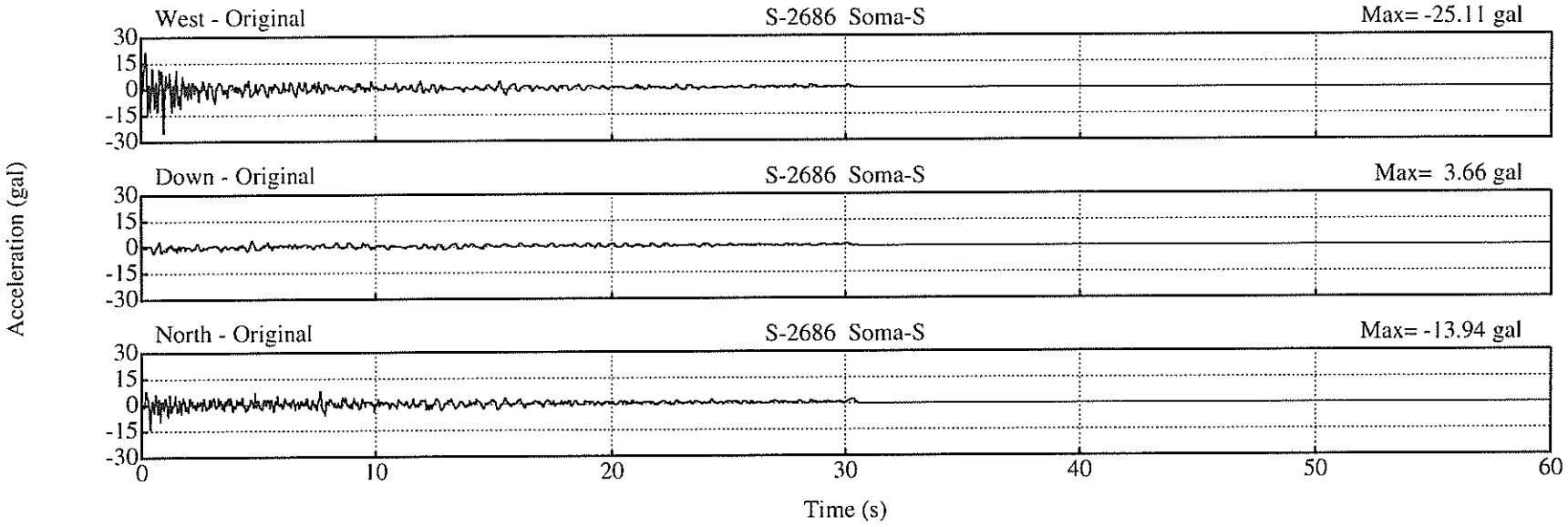
EARTHQUAKE DATA

DATE AND TIME	4:48 NOV.24,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	SE OFF MIYAGI PREF
LATITUDE	38° 0.1′ N
LONGITUDE	141°35.3′ E
DEPTH	82.1KM
JMA MAGNITUDE	5.1

PEAK VALUES OF COMPONENTS

	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	13.9	25.1	3.7	25.2

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : M-1608

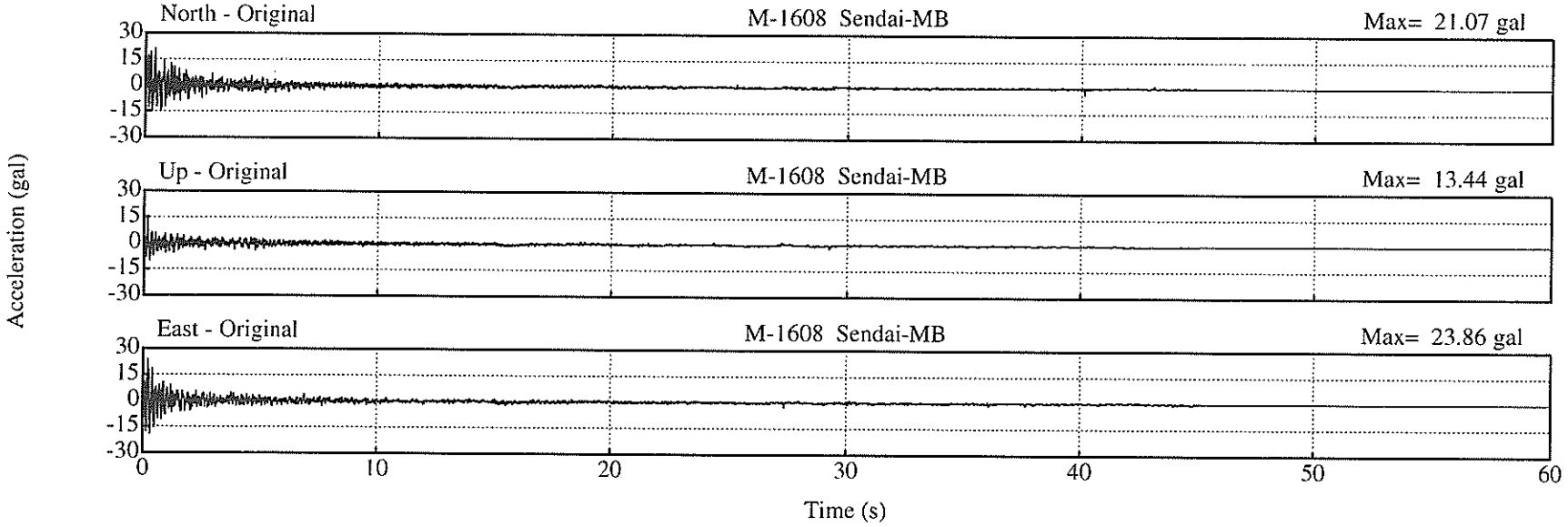
STATION : SENDAI-MB

EARTHQUAKE DATA

DATE AND TIME	4:48 NOV.24,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	SE OFF MIYAGI PREF
LATITUDE	38° 0.1′ N
LONGITUDE	141°35.3′ E
DEPTH	82.1KM
JMA MAGNITUDE	5.1

	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
ORIGINAL ACCELERATION (GAL)	21.1	23.9	13.4	28.5

* RESULTANT OF HORIZONTAL COMPONENTS



RECORD NUMBER : M-1609

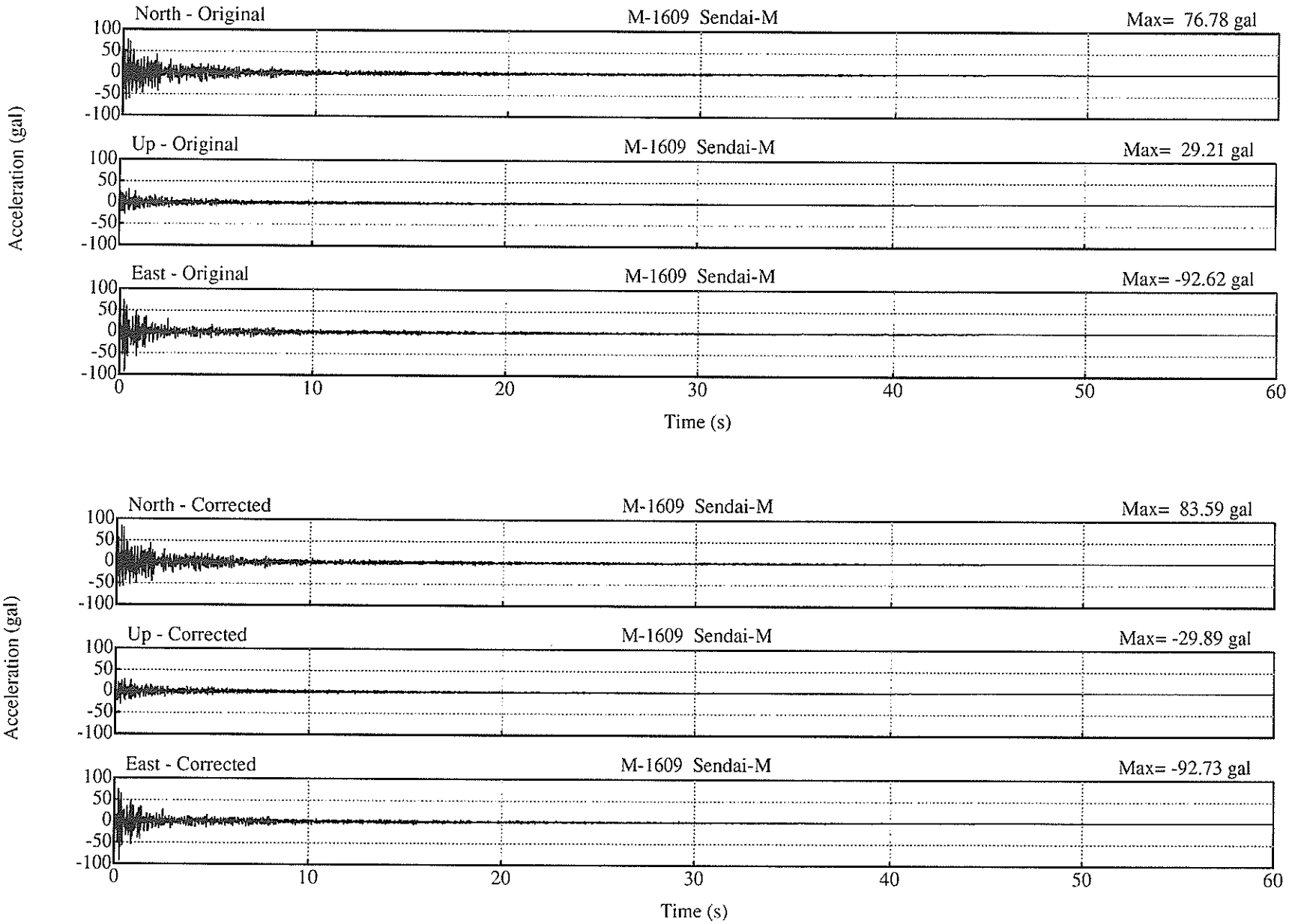
STATION : SENDAI-M

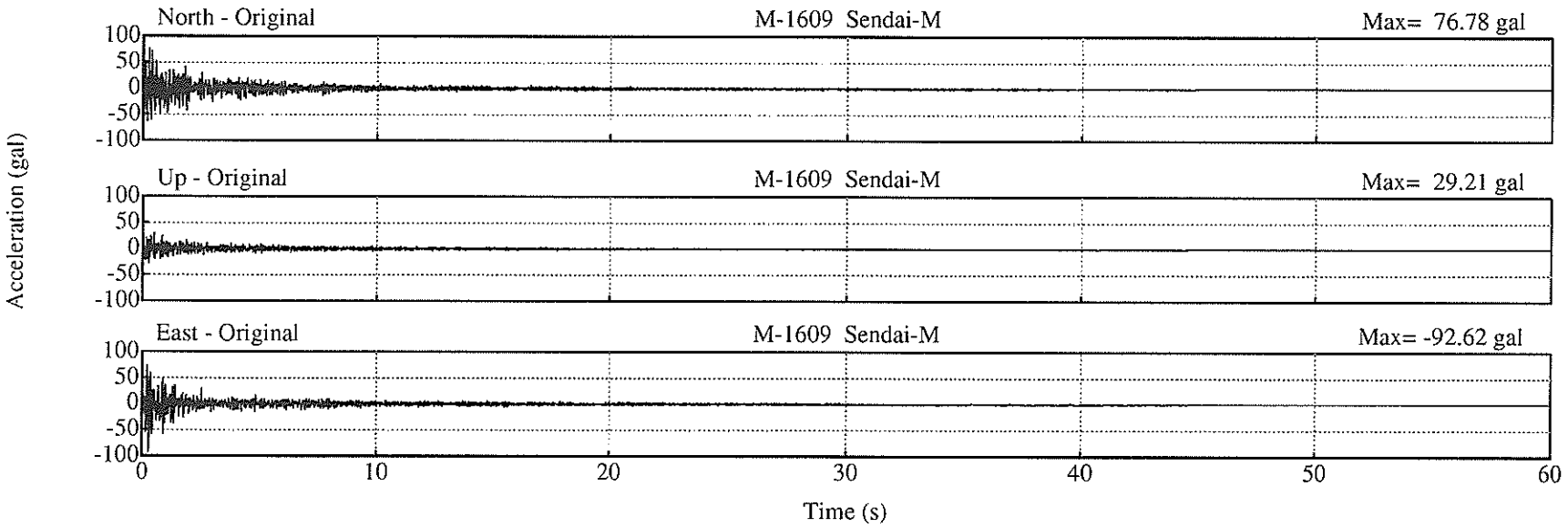
EARTHQUAKE DATA

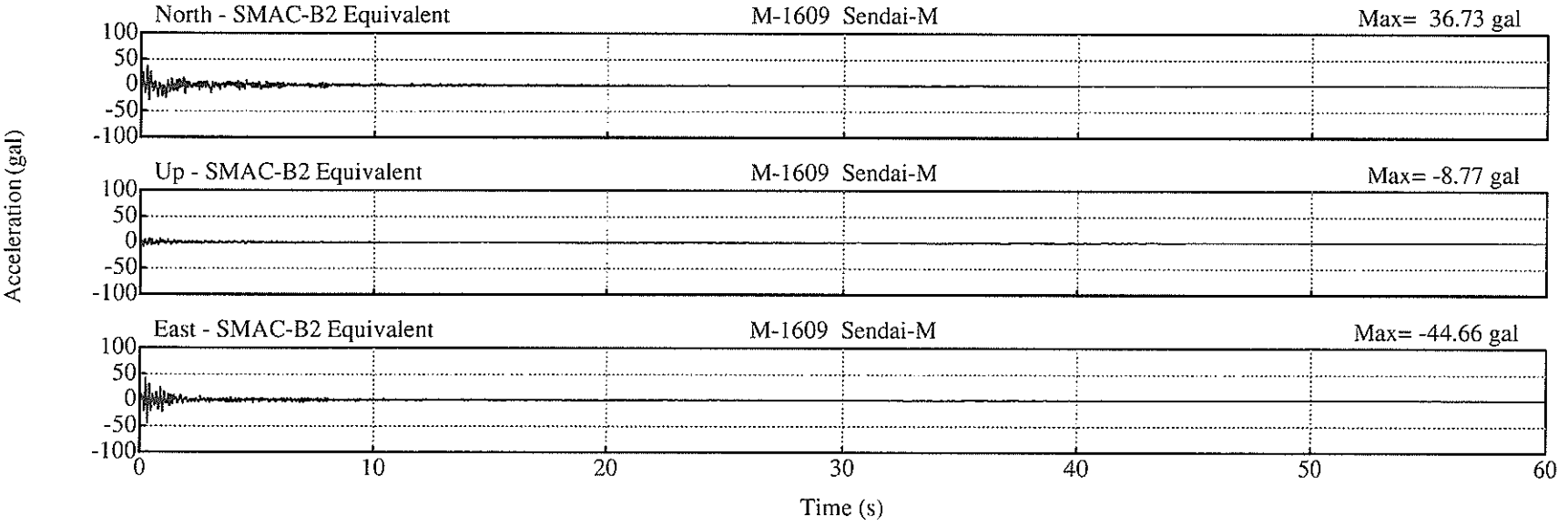
DATE AND TIME	4:48 NOV.24,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	SE OFF MIYAGI PREF
LATITUDE	38° 0.1′ N
LONGITUDE	141°35.3′ E
DEPTH	82.1KM
JMA MAGNITUDE	5.1

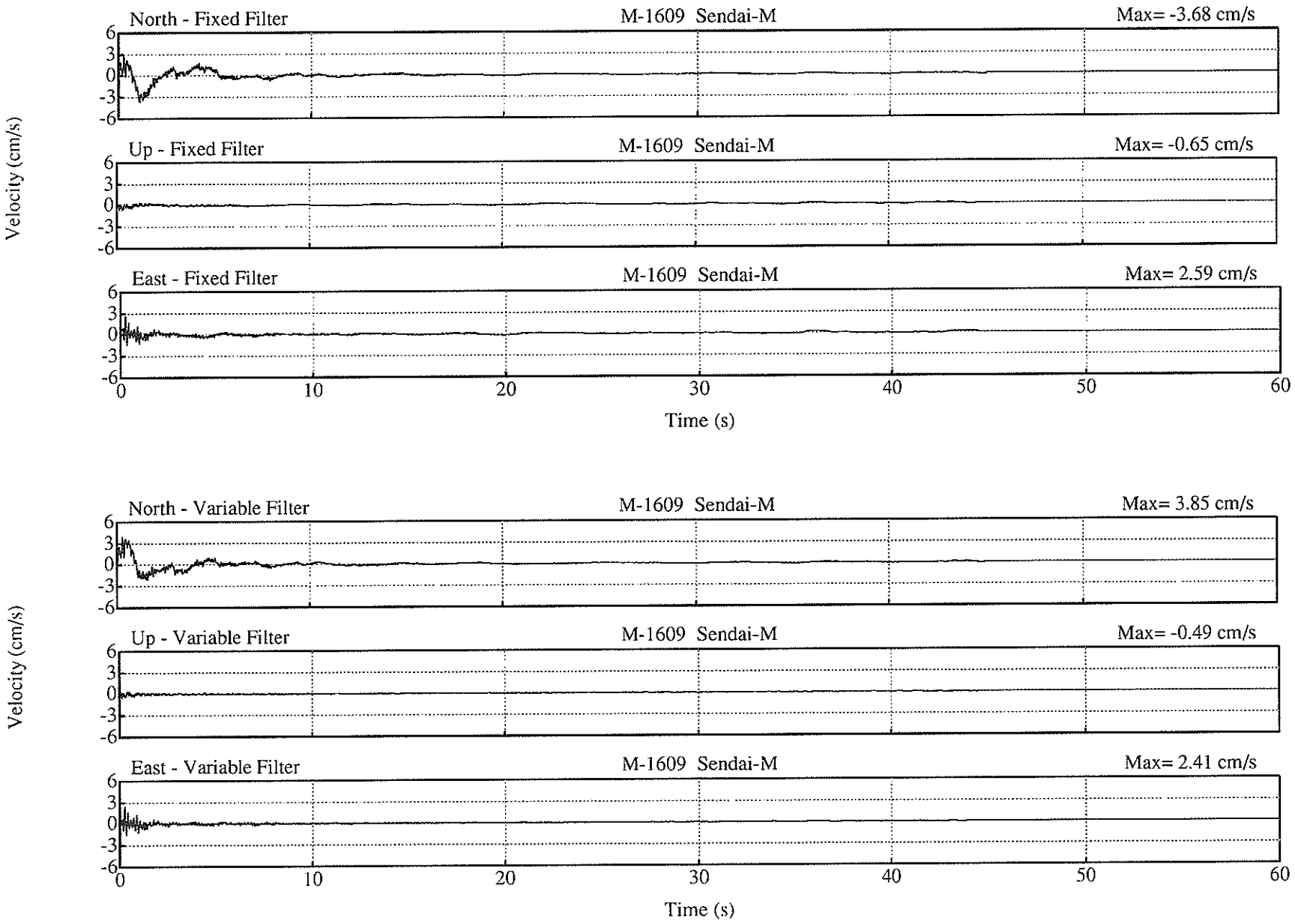
	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
PARAMETER OF THE VARIABLE FILTER				
FC (HZ)	0.120	0.391	0.721	
MAXIMUM ACCELERATION (GAL)				
SMAC-B2 EQUIVALENT	36.7	44.7	8.8	46.6
ORIGINAL	76.8	92.6	29.2	94.9
CORRECTED	83.6	92.7	29.9	92.9
MAXIMUM VELOCITY (CM/SEC)				
FIXED FILTER	3.68	2.59	0.65	3.71
VARIABLE FILTER	3.85	2.41	0.49	4.26
MAXIMUM DISPLACEMENT (CM)				
FIXED FILTER	1.31	0.21	0.14	1.32
VARIABLE FILTER	1.77	0.10	0.02	1.77

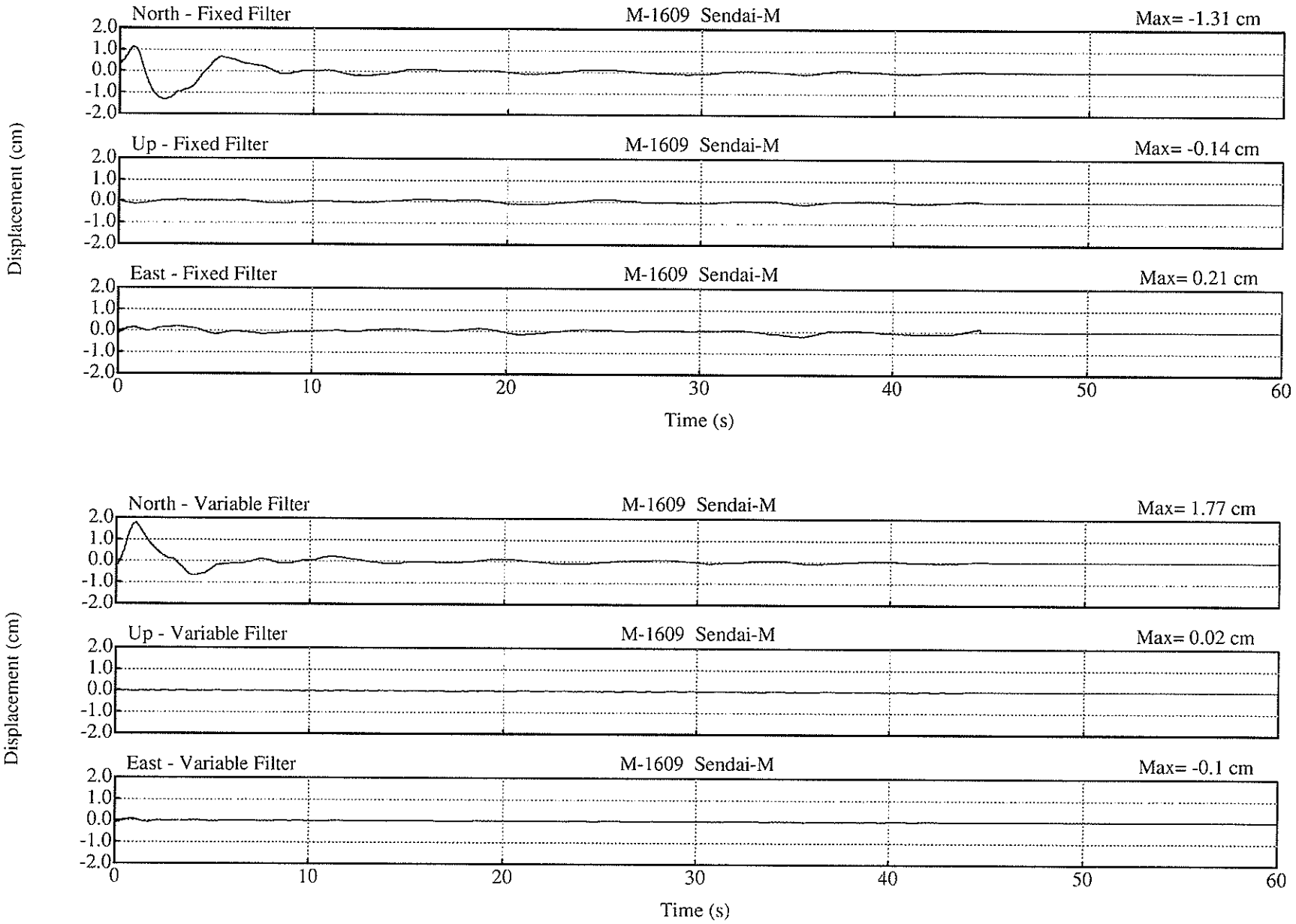
* RESULTANT OF HORIZONTAL COMPONENTS

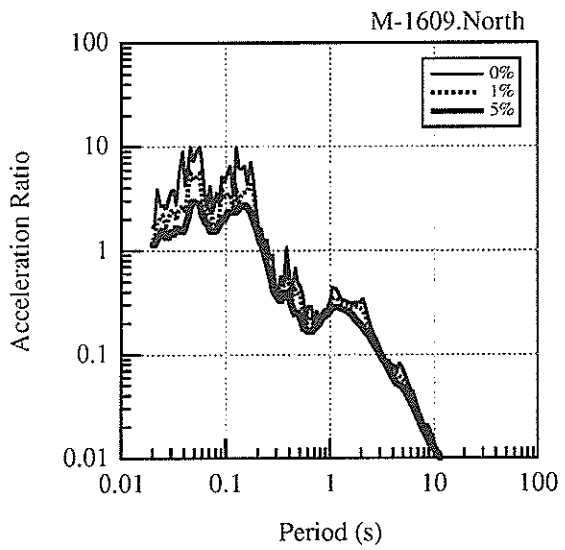

North - Original
M-1609 Sendai-M
Max= 76.78 gal
Up - Original
M-1609 Sendai-M
Max= 29.21 gal
East - Original
M-1609 Sendai-M
Max= -92.62 gal
Acceleration (gal)
100
50
0
-50
-100
0
10
20
30
40
50
60
Time (s)
North - Corrected
M-1609 Sendai-M
Max= 83.59 gal
Up - Corrected
M-1609 Sendai-M
Max= -29.89 gal
East - Corrected
M-1609 Sendai-M
Max= -92.73 gal
Acceleration (gal)
Time (s)

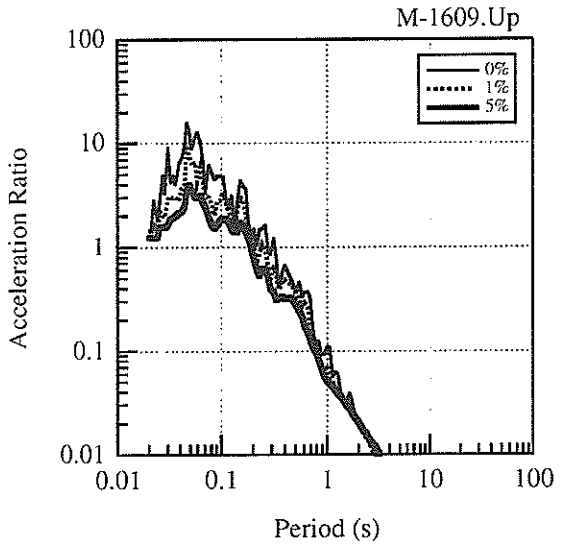

North - Original
M-1609 Sendai-M
Max= 76.78 gal
Up - Original
M-1609 Sendai-M
Max= 29.21 gal
East - Original
M-1609 Sendai-M
Max= -92.62 gal
Acceleration (gal)
100
50
0
-50
-100
0
10
20
30
40
50
60
Time (s)

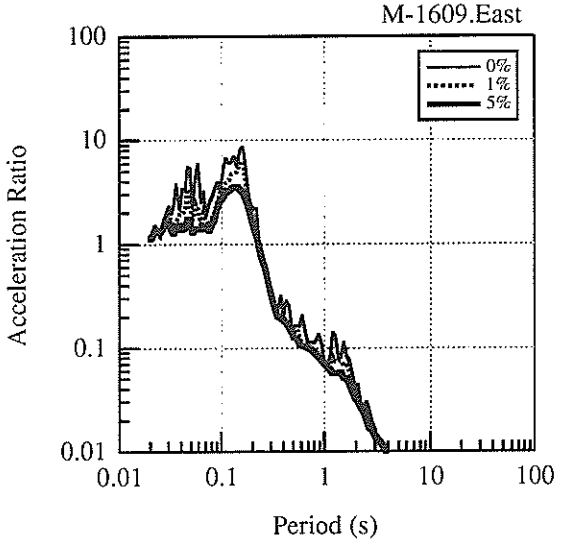

North - SMAC-B2 Equivalent
M-1609 Sendai-M
Max= 36.73 gal
Up - SMAC-B2 Equivalent
M-1609 Sendai-M
Max= -8.77 gal
East - SMAC-B2 Equivalent
M-1609 Sendai-M
Max= -44.66 gal
Acceleration (gal)
100
50
0
-50
-100
0
10
20
30
40
50
60
Time (s)

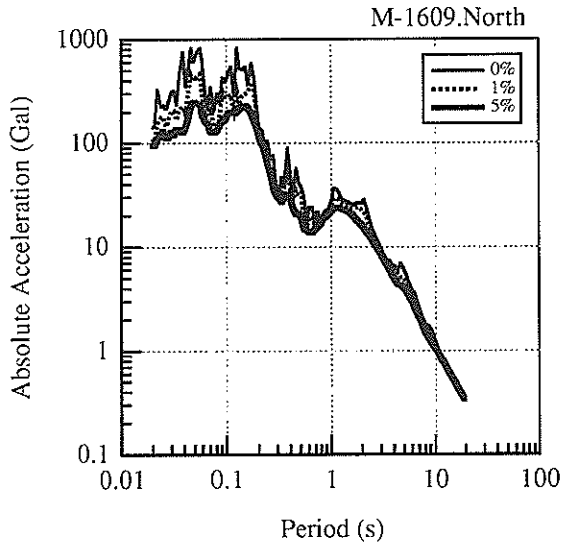

North - Fixed Filter
M-1609 Sendai-M
Max= -3.68 cm/s
Up - Fixed Filter
M-1609 Sendai-M
Max= -0.65 cm/s
East - Fixed Filter
M-1609 Sendai-M
Max= 2.59 cm/s
Velocity (cm/s)
Time (s)
North - Variable Filter
M-1609 Sendai-M
Max= 3.85 cm/s
Up - Variable Filter
M-1609 Sendai-M
Max= -0.49 cm/s
East - Variable Filter
M-1609 Sendai-M
Max= 2.41 cm/s
Velocity (cm/s)
Time (s)

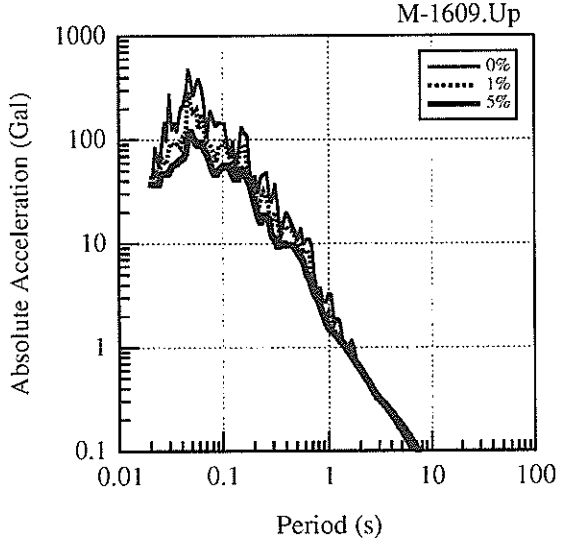

North - Fixed Filter
M-1609 Sendai-M
Max= -1.31 cm
Up - Fixed Filter
M-1609 Sendai-M
Max= -0.14 cm
East - Fixed Filter
M-1609 Sendai-M
Max= 0.21 cm
Displacement (cm)
Time (s)
North - Variable Filter
M-1609 Sendai-M
Max= 1.77 cm
Up - Variable Filter
M-1609 Sendai-M
Max= 0.02 cm
East - Variable Filter
M-1609 Sendai-M
Max= -0.1 cm
Displacement (cm)
Time (s)

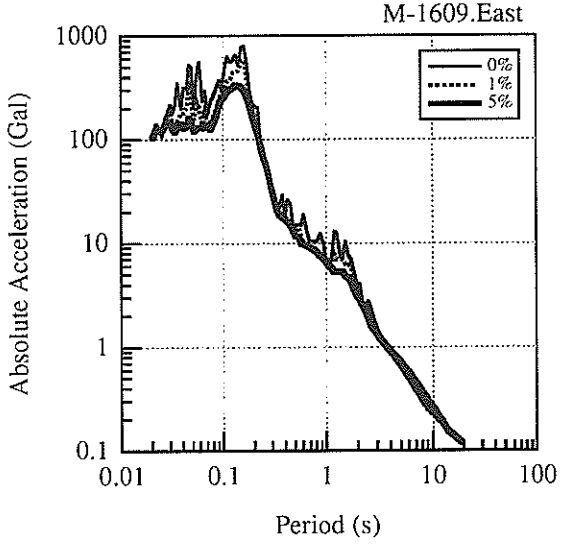

M-1609.North
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

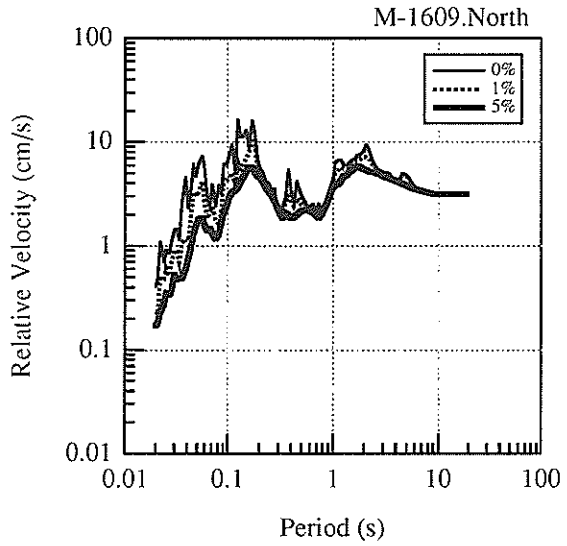

M-1609.Up
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

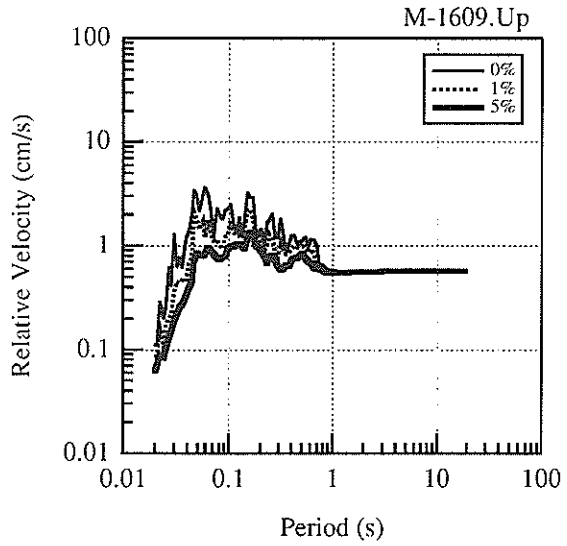

M-1609.East
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

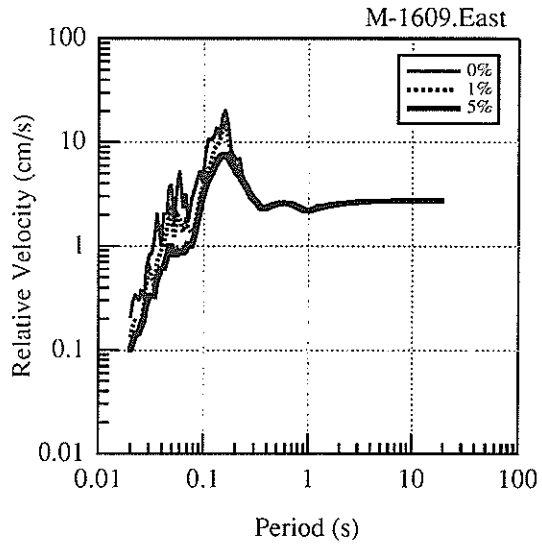

M-1609.North
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
1000
100
10
1
0.1
0.01
0.1
1
10
100

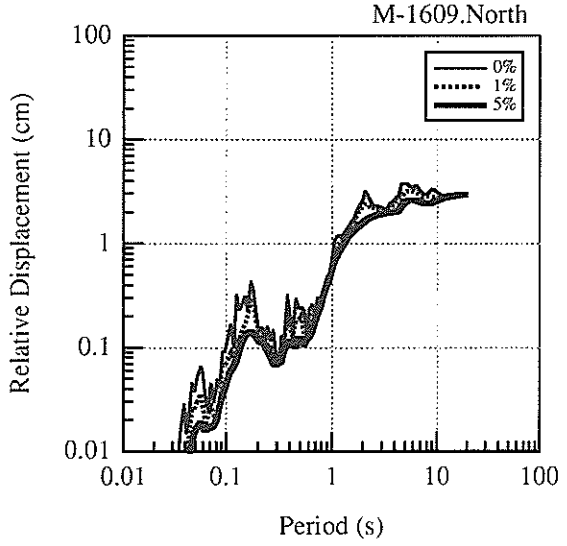

M-1609.Up
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
1000
100
10
1
0.1
0.01
0.1
1
10
100

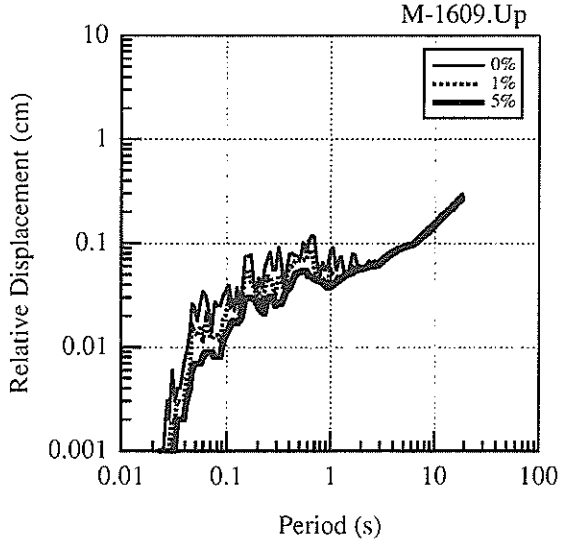

M-1609.East
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
1000
100
10
1
0.1
0.01
0.1
1
10
100

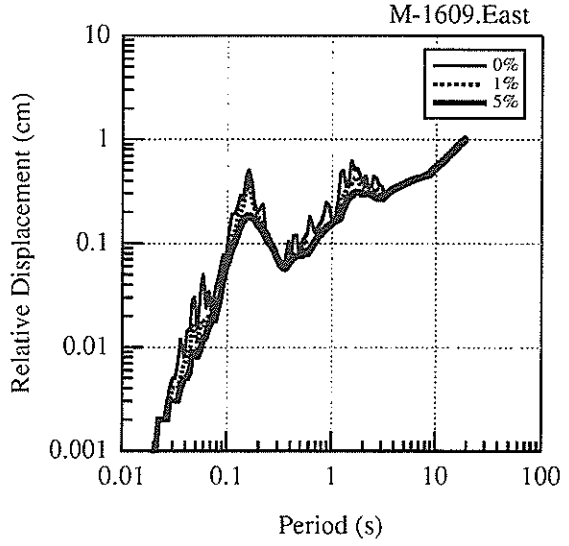

M-1609.North
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

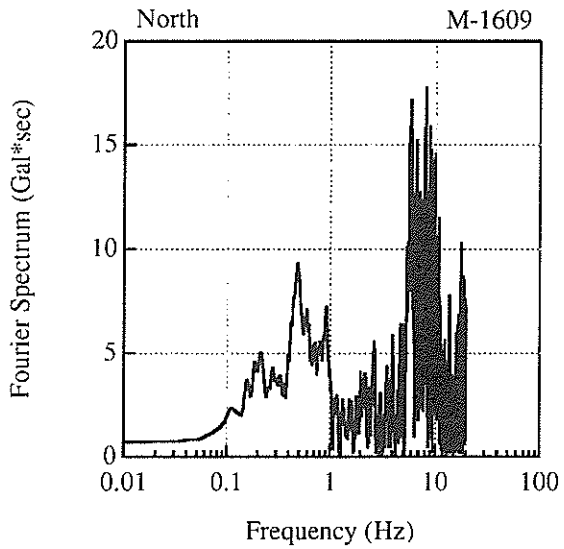

M-1609.Up
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

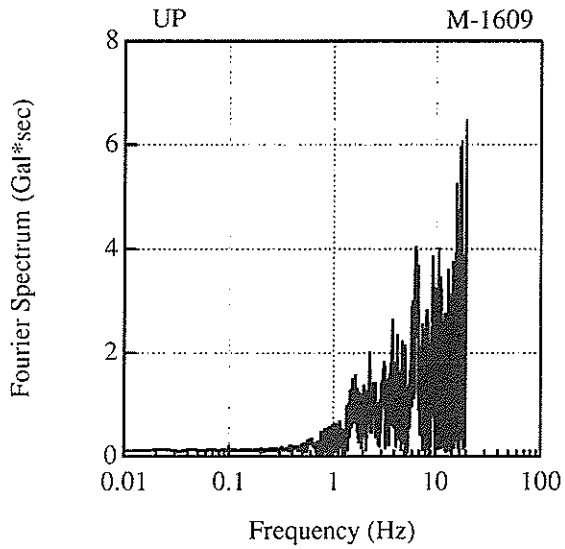

M-1609.East
Relative Velocity (cm/s)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

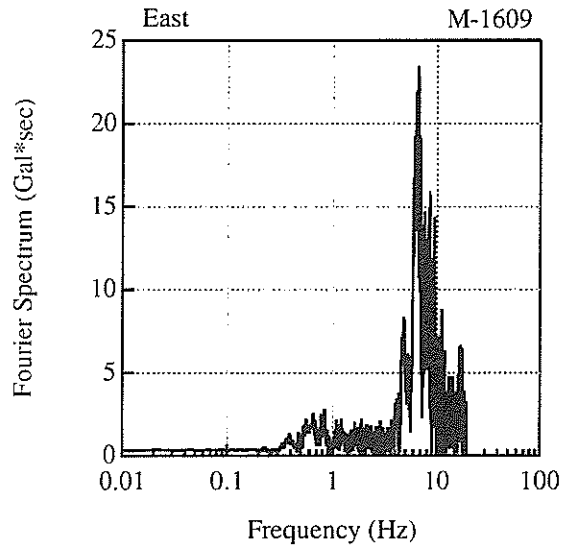

M-1609.North
Relative Displacement (cm)
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

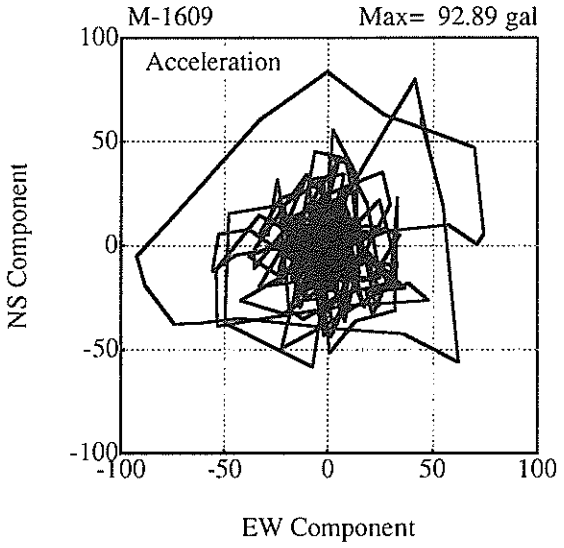

M-1609.Up
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

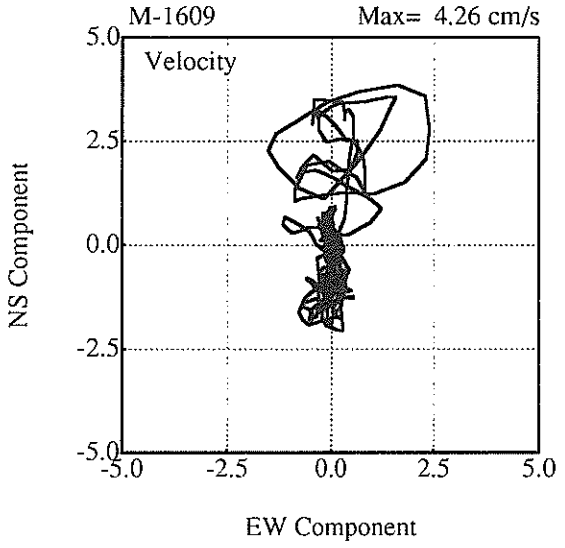

M-1609.East
Relative Displacement (cm)
Period (s)
0%
1%
5%
10
1
0.1
0.01
0.001
0.01
0.1
1
10
100

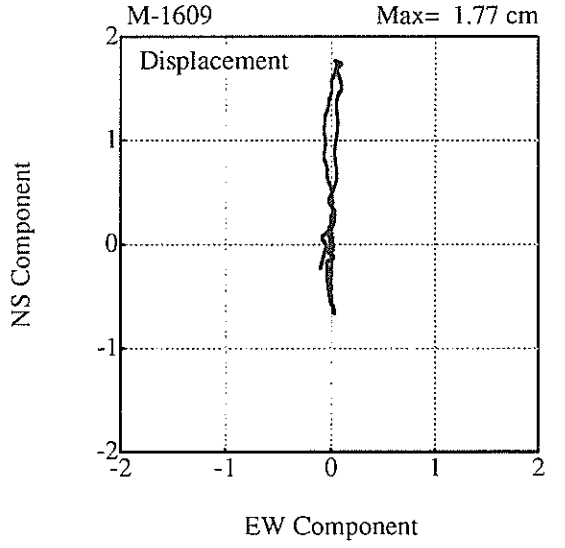

North
M-1609
Fourier Spectrum (Gal*sec)
Frequency (Hz)
0.01
0.1
1
10
100
0
5
10
15
20


UP
M-1609
Fourier Spectrum (Gal*sec)
Frequency (Hz)
0.01
0.1
1
10
100
0
2
4
6
8


East
M-1609
Fourier Spectrum (Gal*sec)
Frequency (Hz)
0.01
0.1
1
10
100
0
5
10
15
20
25


M-1609
Max= 92.89 gal
Acceleration
NS Component
EW Component
-100
-50
0
50
100


M-1609
Max= 4.26 cm/s
Velocity
NS Component
EW Component
-5.0
-2.5
0.0
2.5
5.0


M-1609
Max= 1.77 cm
Displacement
NS Component
EW Component
-2
-1
0
1
2

RECORD NUMBER : F-1355

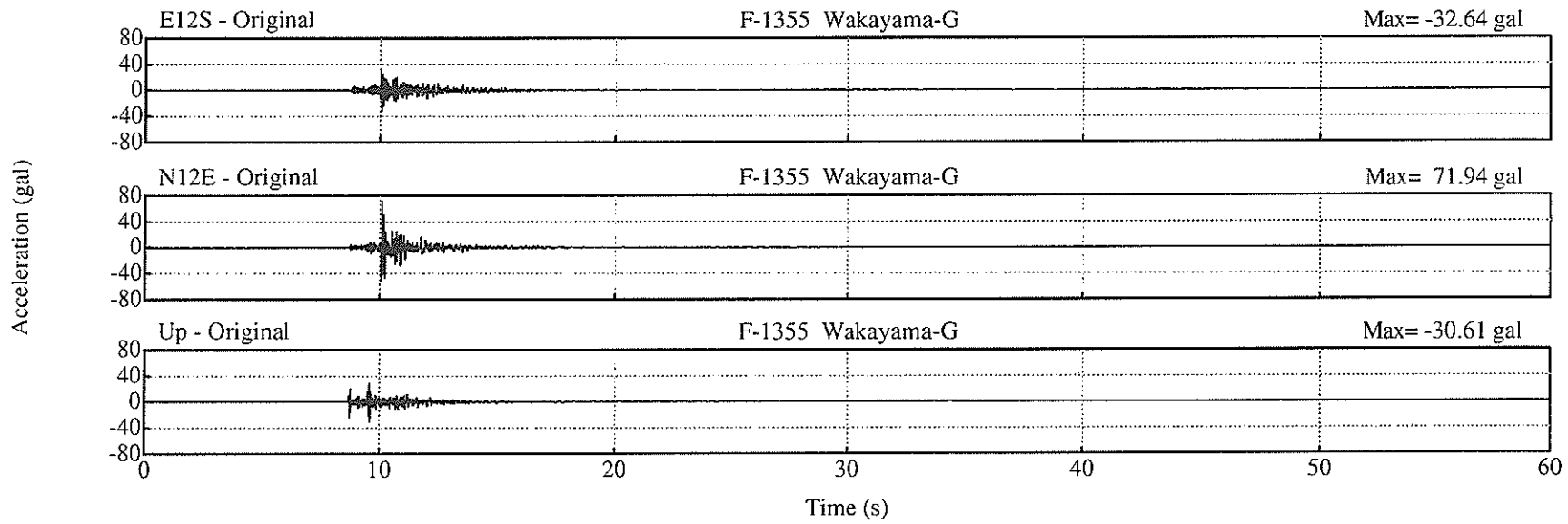
STATION : WAKAYAMA-G

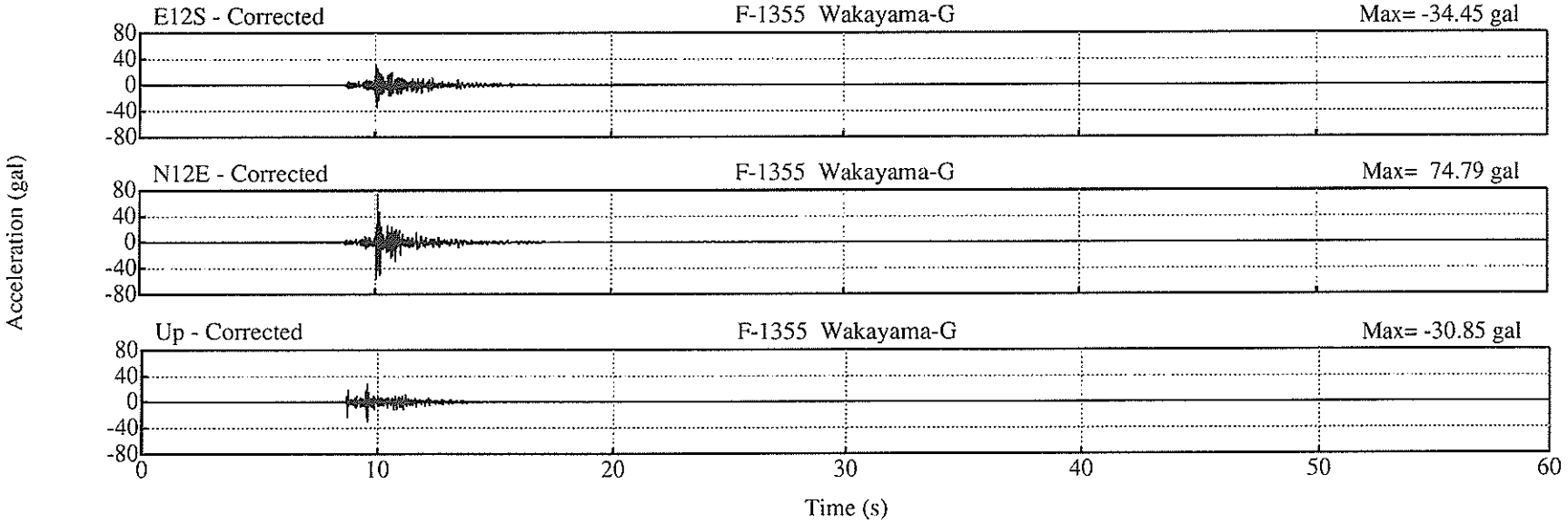
EARTHQUAKE DATA

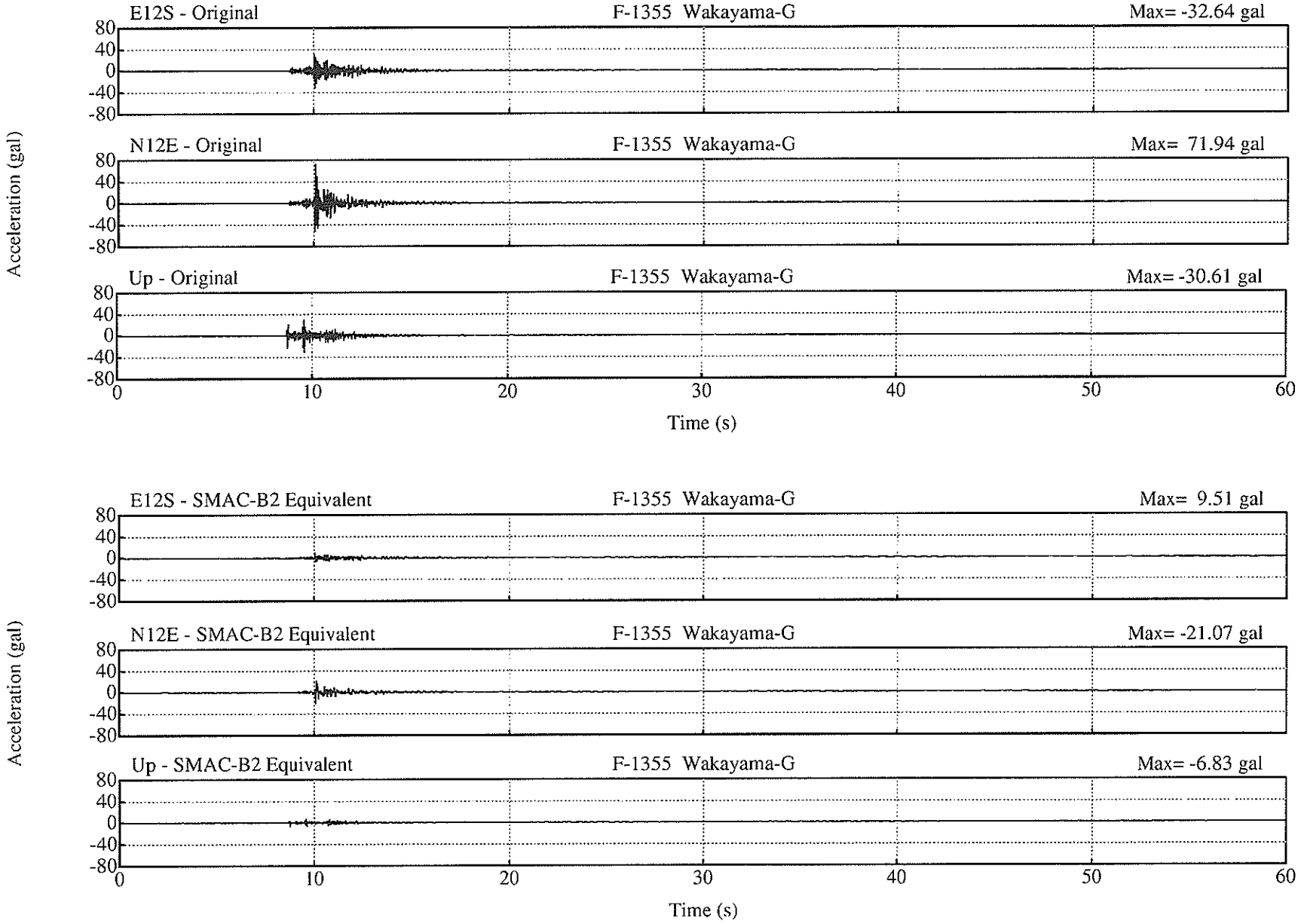
DATE AND TIME	1:58 DEC. 6,1998
LOCATION OF HYPOCENTER	
EPICENTRAL REGION	NW WAKAYAMA PREF
LATITUDE	34° 10.8′ N
LONGITUDE	135° 8.0′ E
DEPTH	9.1KM
JMA MAGNITUDE	3.4

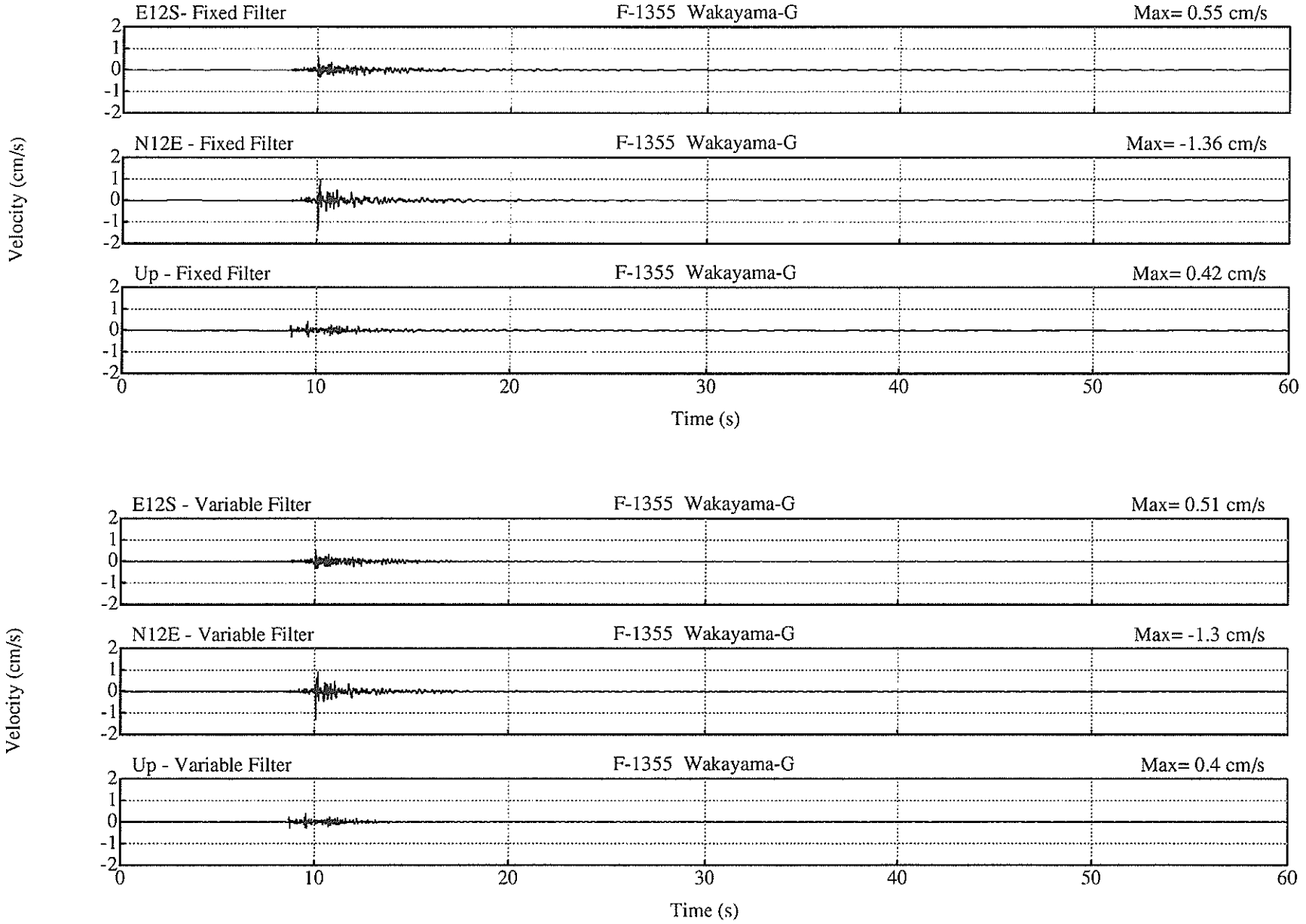
	PEAK VALUES OF COMPONENTS			
	N S	E W	U D	HORIZONTAL*
PARAMETER OF THE VARIABLE FILTER				
FC (HZ)	1.910	2.593	3.332	
MAXIMUM ACCELERATION (GAL)				
SMAC-B2 EQUIVALENT	21.1	9.5	6.8	21.6
ORIGINAL	71.9	32.6	30.6	75.4
CORRECTED	74.8	34.4	30.9	78.9
MAXIMUM VELOCITY (CM/SEC)				
FIXED FILTER	1.36	0.55	0.42	1.38
VARIABLE FILTER	1.30	0.51	0.40	1.32
MAXIMUM DISPLACEMENT (CM)				
FIXED FILTER	0.04	0.02	0.02	0.04
VARIABLE FILTER	0.03	0.01	0.01	0.03

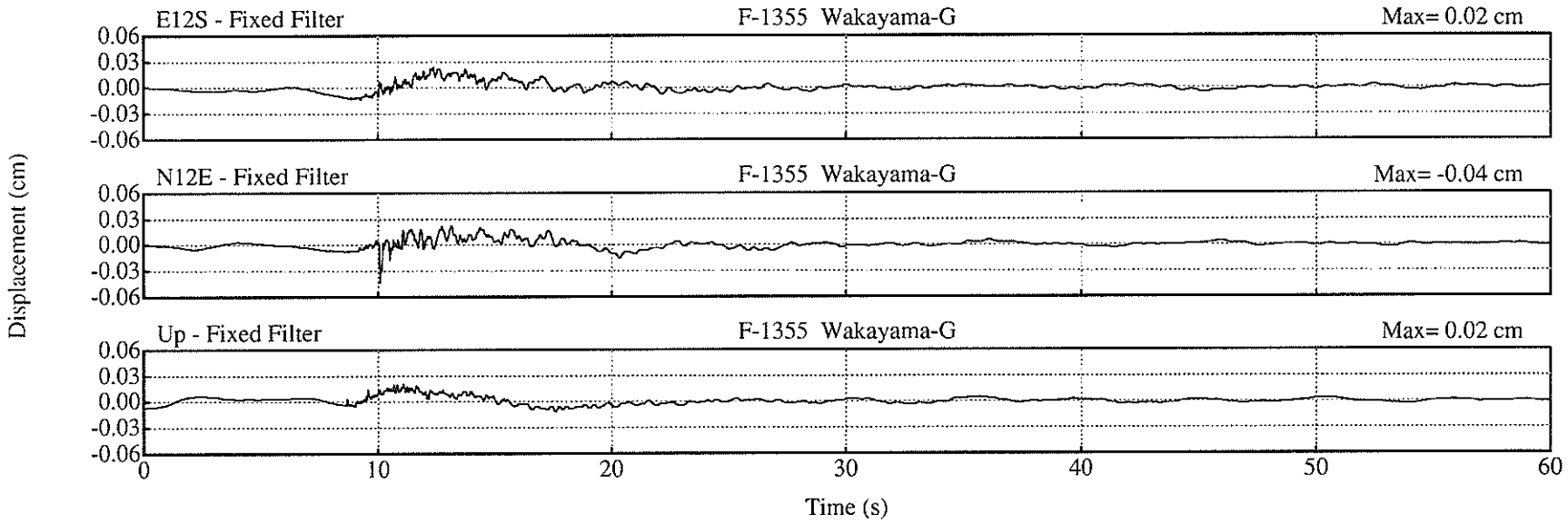
* RESULTANT OF HORIZONTAL COMPONENTS

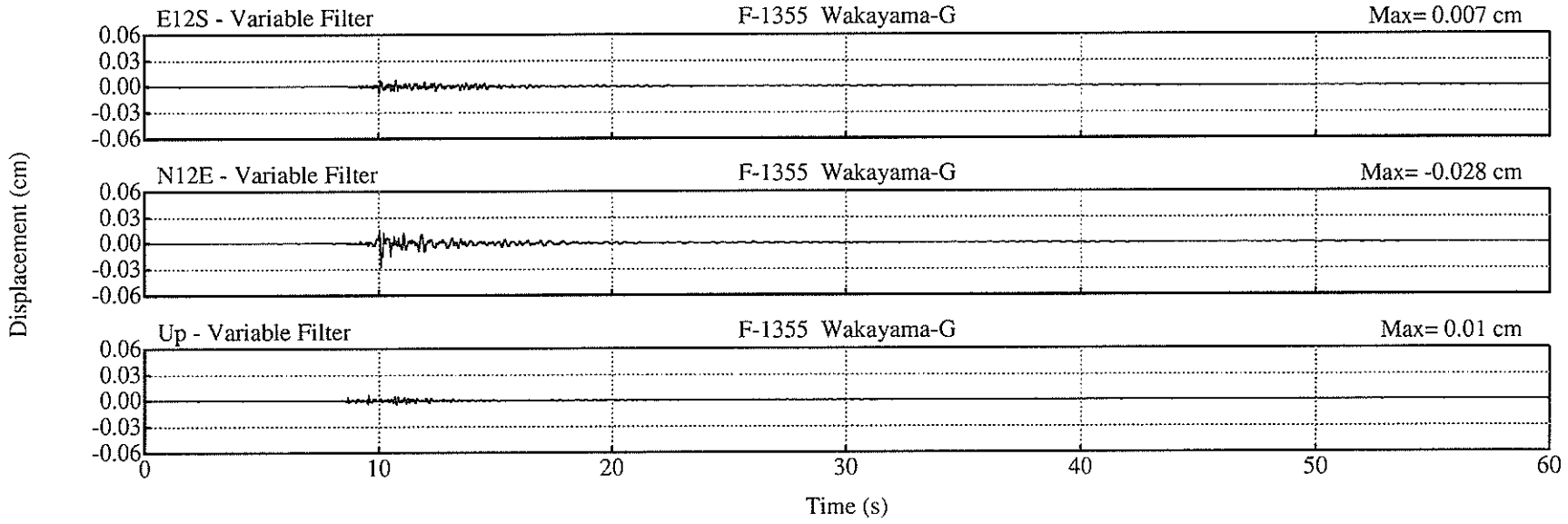

E12S - Original
F-1355 Wakayama-G
Max= -32.64 gal
N12E - Original
F-1355 Wakayama-G
Max= 71.94 gal
Up - Original
F-1355 Wakayama-G
Max= -30.61 gal
Acceleration (gal)
80
40
0
-40
-80
0
10
20
30
40
50
60
Time (s)

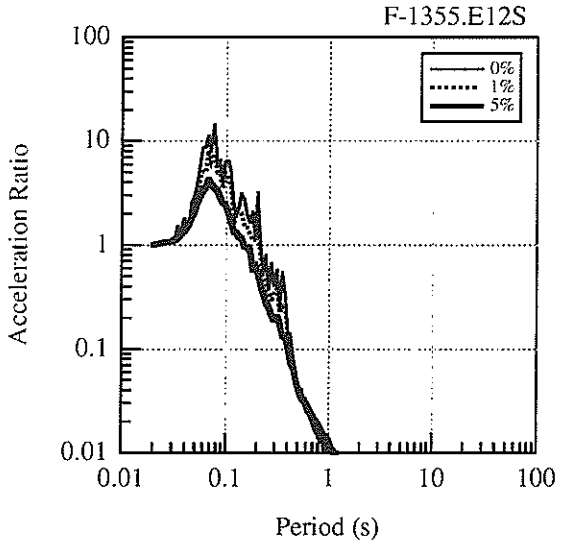

E12S - Corrected
F-1355 Wakayama-G
Max= -34.45 gal
N12E - Corrected
F-1355 Wakayama-G
Max= 74.79 gal
Up - Corrected
F-1355 Wakayama-G
Max= -30.85 gal
Acceleration (gal)
80
40
0
-40
-80
0
10
20
30
40
50
60
Time (s)

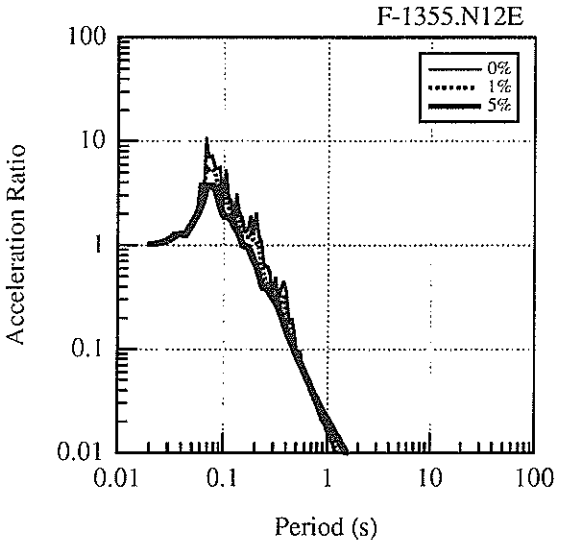

E12S - Original
F-1355 Wakayama-G
Max= -32.64 gal
N12E - Original
F-1355 Wakayama-G
Max= 71.94 gal
Up - Original
F-1355 Wakayama-G
Max= -30.61 gal
Acceleration (gal)
80
40
0
-40
-80
0
10
20
30
40
50
60
Time (s)
E12S - SMAC-B2 Equivalent
F-1355 Wakayama-G
Max= 9.51 gal
N12E - SMAC-B2 Equivalent
F-1355 Wakayama-G
Max= -21.07 gal
Up - SMAC-B2 Equivalent
F-1355 Wakayama-G
Max= -6.83 gal
Acceleration (gal)
Time (s)

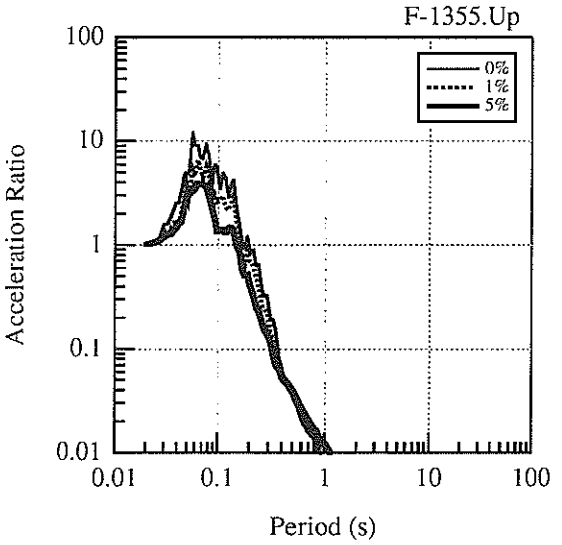

E12S- Fixed Filter
F-1355 Wakayama-G
Max= 0.55 cm/s
N12E - Fixed Filter
F-1355 Wakayama-G
Max= -1.36 cm/s
Up - Fixed Filter
F-1355 Wakayama-G
Max= 0.42 cm/s
Velocity (cm/s)
Time (s)
E12S - Variable Filter
F-1355 Wakayama-G
Max= 0.51 cm/s
N12E - Variable Filter
F-1355 Wakayama-G
Max= -1.3 cm/s
Up - Variable Filter
F-1355 Wakayama-G
Max= 0.4 cm/s
Velocity (cm/s)
Time (s)

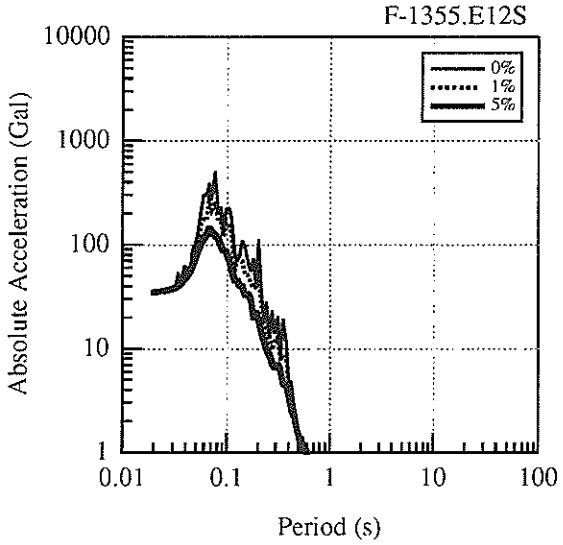

E12S - Fixed Filter
F-1355 Wakayama-G
Max= 0.02 cm
N12E - Fixed Filter
F-1355 Wakayama-G
Max= -0.04 cm
Up - Fixed Filter
F-1355 Wakayama-G
Max= 0.02 cm
Displacement (cm)
0.06
0.03
0.00
-0.03
-0.06
0
10
20
30
40
50
60
Time (s)

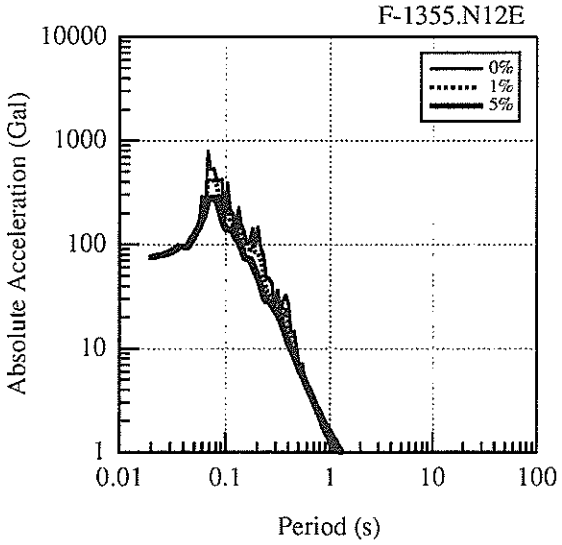

E12S - Variable Filter
F-1355 Wakayama-G
Max= 0.007 cm
N12E - Variable Filter
F-1355 Wakayama-G
Max= -0.028 cm
Up - Variable Filter
F-1355 Wakayama-G
Max= 0.01 cm
Displacement (cm)
0.06
0.03
0.00
-0.03
-0.06
0
10
20
30
40
50
60
Time (s)

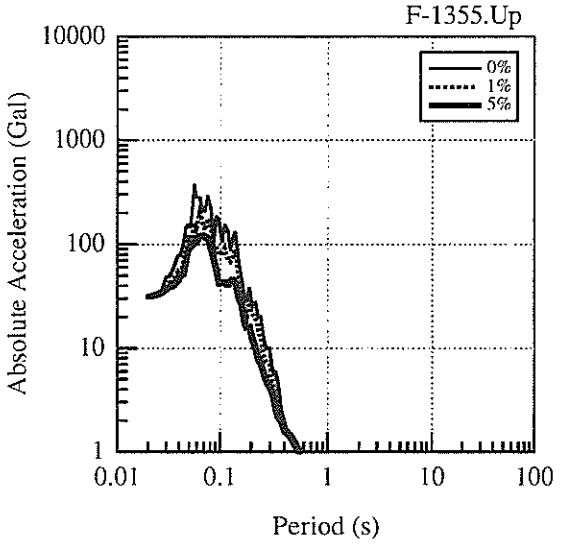

F-1355.E12S
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

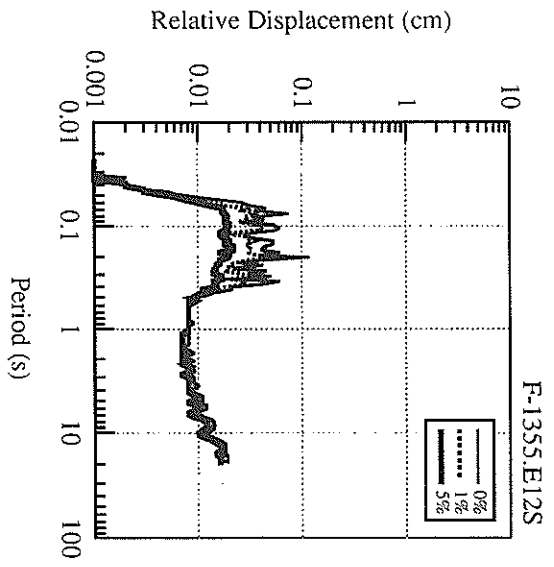

F-1355.N12E
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

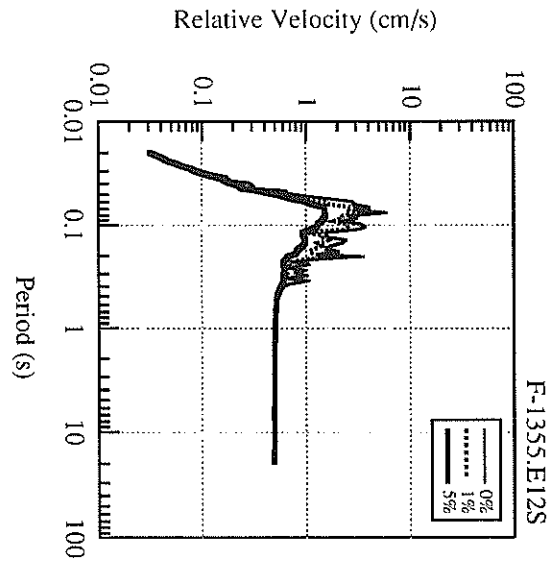

F-1355.Up
Acceleration Ratio
Period (s)
0%
1%
5%
100
10
1
0.1
0.01
0.01
0.1
1
10
100

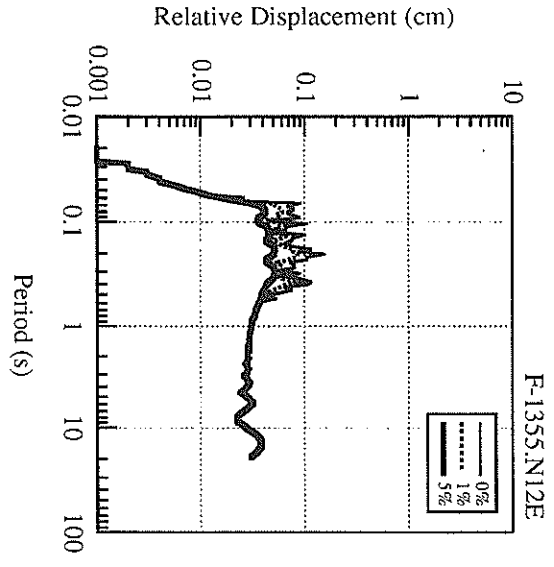

F-1355.E12S
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

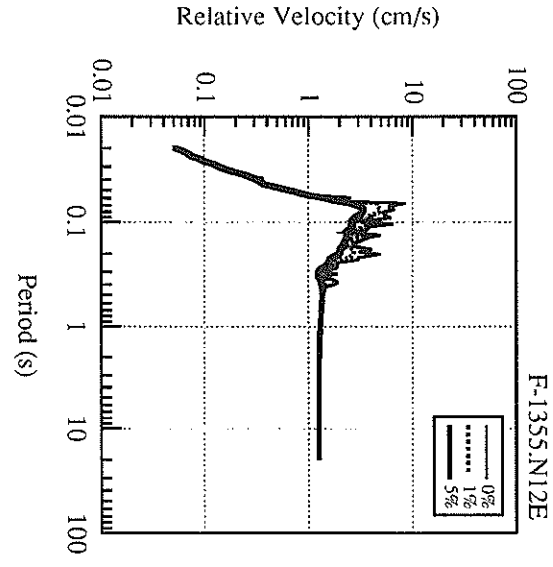

F-1355.N12E
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

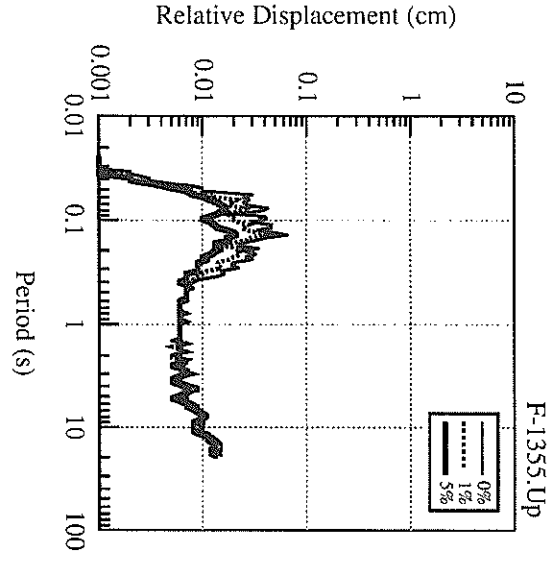

F-1355.Up
Absolute Acceleration (Gal)
Period (s)
0%
1%
5%
10000
1000
100
10
1
0.01
0.1
1
10
100

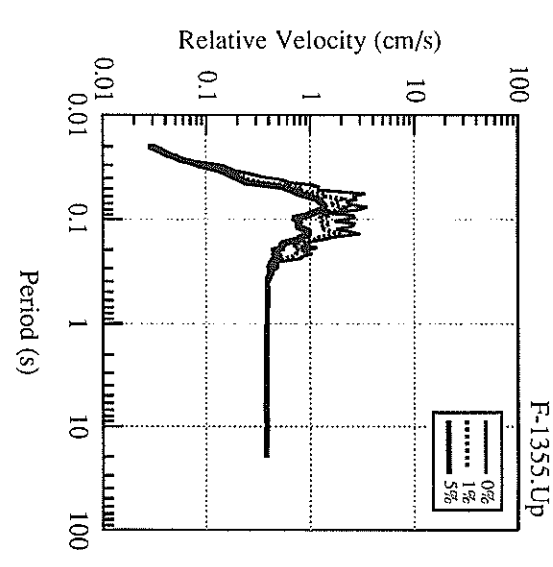

Relative Displacement (cm)
F-1355.E12S
0%
1%
5%
Period (s)
0.001
0.01
0.1
1
10
100

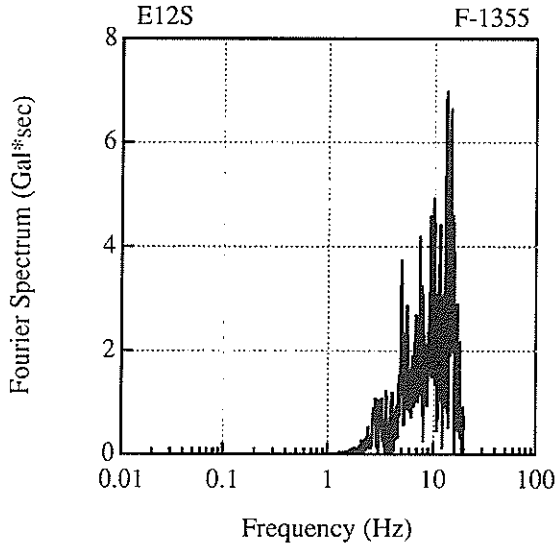

Relative Velocity (cm/s)
F-1355.E12S
0%
1%
5%
Period (s)
0.01
0.1
1
10
100

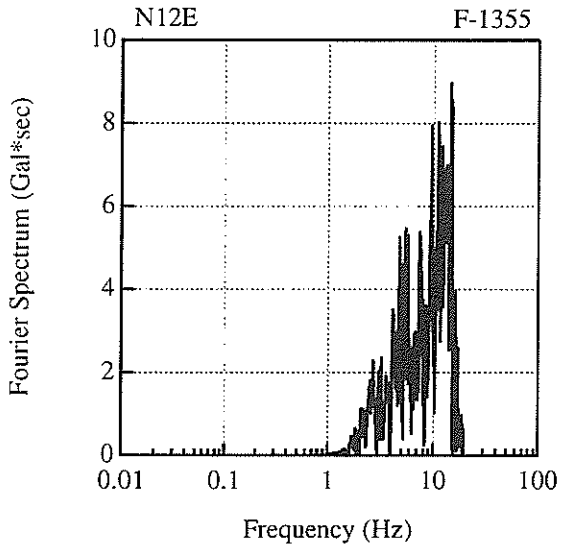

Relative Displacement (cm)
F-1355.N12E
0%
1%
5%
Period (s)
0.001
0.01
0.1
1
10
100

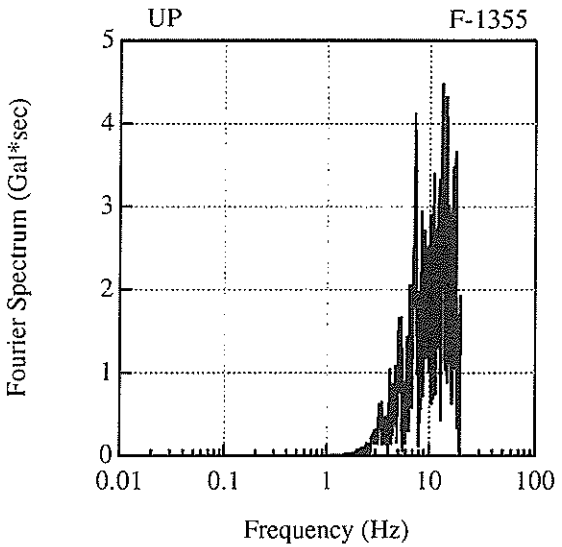

Relative Velocity (cm/s)
F-1355.N12E
0%
1%
5%
Period (s)
0.01
0.1
1
10
100

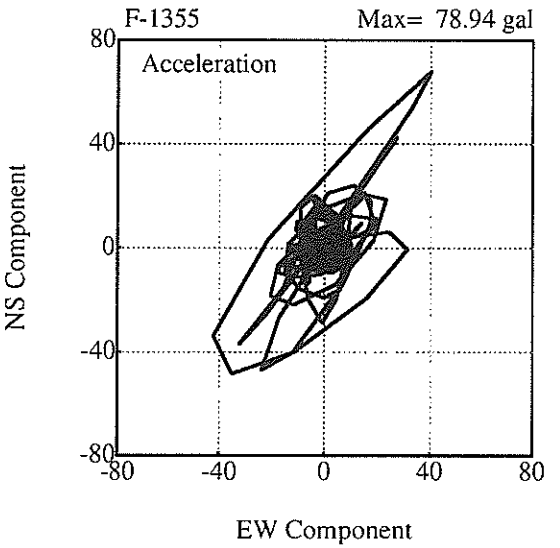

Relative Displacement (cm)
F-1355.Up
0%
1%
5%
Period (s)
0.001
0.01
0.1
1
10
100

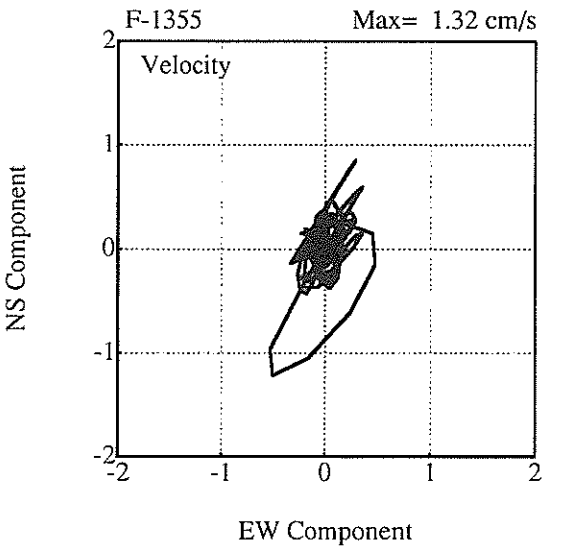

Relative Velocity (cm/s)
F-1355.Up
0%
1%
5%
Period (s)
0.01
0.1
1
10
100

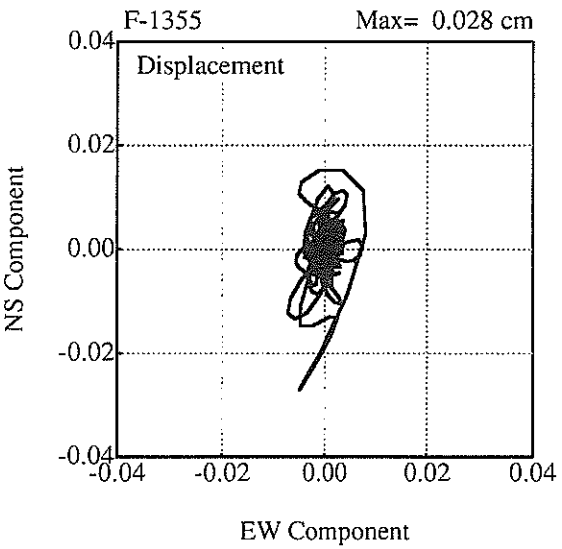

E12S
F-1355
Fourier Spectrum (Gal*sec)
Frequency (Hz)
0
2
4
6
8
0.01
0.1
1
10
100


N12E
F-1355
Fourier Spectrum (Gal*sec)
Frequency (Hz)
0
2
4
6
8
10
0.01
0.1
1
10
100


UP
F-1355
Fourier Spectrum (Gal*sec)
Frequency (Hz)
0
1
2
3
4
5
0.01
0.1
1
10
100


F-1355
Max= 78.94 gal
Acceleration
NS Component
EW Component
-80
-40
0
40
80


F-1355
Max= 1.32 cm/s
Velocity
NS Component
EW Component
-2
-1
0
1
2


F-1355
Max= 0.028 cm
Displacement
NS Component
EW Component
-0.04
-0.02
0.00
0.02
0.04

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編集兼発行人　運輸省港湾技術研究所

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