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【Material】 Database of reflection surveys in Japan and pattern of active faults in seismic reflection profile

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Abstract

After the 1995 Hyogoken-Nanbu earthquake, the Minister of Education, Culture, Sports, Science and Technology have funded subsidy for local governments to survey active faults. By the end of 2001, 90 faults have been surveyed by local governments. We collected 84 seismic reflection profiles obtained by these surveys and made a database. The database recorded names, locations, sense of faults, and geological conditions of the seismic reflection profiles. We divided faults' appearance of these profiles into eight types according to the pattern of reflection surfaces in the reflection profiles ; that is, faults are recognized as (1) step (13 profiles), (2) scarp (37 profiles), (3) discontinuity of reflection surfaces (4 profiles), (4) step and scarp (20 profiles), (5) step and discontinuity of reflection surfaces (1 profile), (6) step and reflector of fault plane (3 profiles), (7) scarp and reflector of fault plane (3 profiles), and (8) discontinuity of reflection surfaces and reflector of fault plane (3 profiles). Most of reflection profiles of (1), (2), (4), (6) and (8) types are obtained across reverse faults. So, these results mainly reflect characteristics of reverse faults.

1 Introduction

In Japan, about 2,000 active faults are known on the land (Research

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Group for Active Faults in Japan, 1991). We must grasp the past events and slip intervals of these active faults to prevent the damage from earthquakes caused by the active faults. Detailed surveys of the active faults, especially near large cities, are very important. After the 1995 Hyogoken-Nanbu earthquake, The Ministry of Education, Culture, Sports, Science and Technology (MEXT) selected 98 major active faults, which meet the conditions; 1) Magnitude of an earthquake generated by the fault can be greater than 7. 2) The damage by the earthquake may bring serious influence on the economy and the society. MEXT funded subsidy for local governments to survey active faults. By the end of 2001, surveys of 90 faults started and those of 46 faults have been completed by local governments. The results of those surveys are contributory for local governments to draw up regional earthquake disaster prevention plan. The full texts of survey reports are open to the public and appeared in the home page of the Headquarters for Earthquake Research Promotion (2001) (http://www.jishin.go.jp/main/index.html).

Seismic reflection survey is enforced in most of the surveys of active faults. Nakamura et al. (2002) collected 73 seismic reflection profiles from that home page and made a database. The database recorded names, locations, and sense of the faults, as well as geological conditions of the seismic reflection profiles. Nakamura et al. (2002) also classified faults' appearance in these profiles and inquired into relationship among faults' appearance, sense of faults and geological conditions. However, only a few figures of profiles were shown in Nakamura et al. (2002).

In the present study, we added 11 seismic reflection profiles, which were reported after Nakamura et al. (2002)'s work, to 73 profiles of Nakamura et al. (2002). The collection of profiles is useful for studying active faults, because we can easily compare seismic reflection profiles at various regions. The main purpose of this material is to present figures and the table of all 84 profiles. Based on the table and figures, we re-investigate a relationship among faults' appearance, type of faults and geological conditions.

2 Procedures of data acquisition and making a database

A flow chart in this study is shown in Fig. 1. Each process is the same as Nakamura et al. (2002) and explained in the followings.

By the end of 2001, 99 reports prepared by local governments appeared in the home page. We collected 127 seismic reflection profiles from these reports. We also collected 6 reflection profiles of the Kagiya fault zone and the

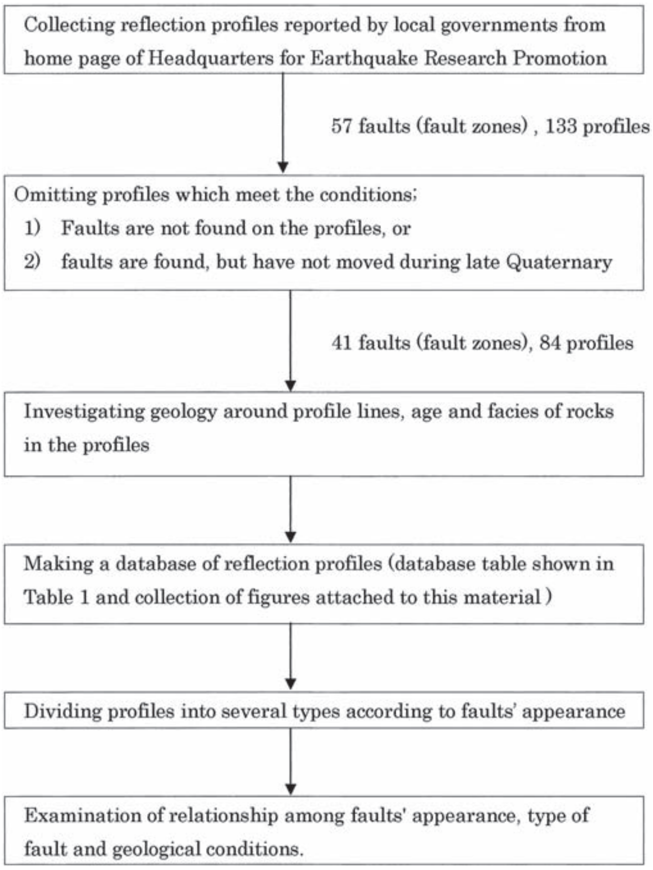


Fig. 1. A flow chart of this study.

Takahama flexure from paper reports made out by Aichi Prefecture (2000). Consequently, we collected 133 reflection profiles of 57 fault zones and made out a database of these profiles.

We removed some reflection profiles from database, in which active faults were not found. As a result, 84 profiles were used in this study (Fig. 1). Fig. 2 shows the locations of the faults (fault zones) where 84 reflection profiles were collected. These profiles were divided into eight types described in the next section. Around each profile we collected information on the geology and made a database. The database consists of a table and figures of reflection profiles.

Contents of the table are shown in Table 1 and all the figures of profiles are attached to this material. We changed the size of the figures collected, and added distances and two-way travel times. However, we did not add any informations to the profiles.

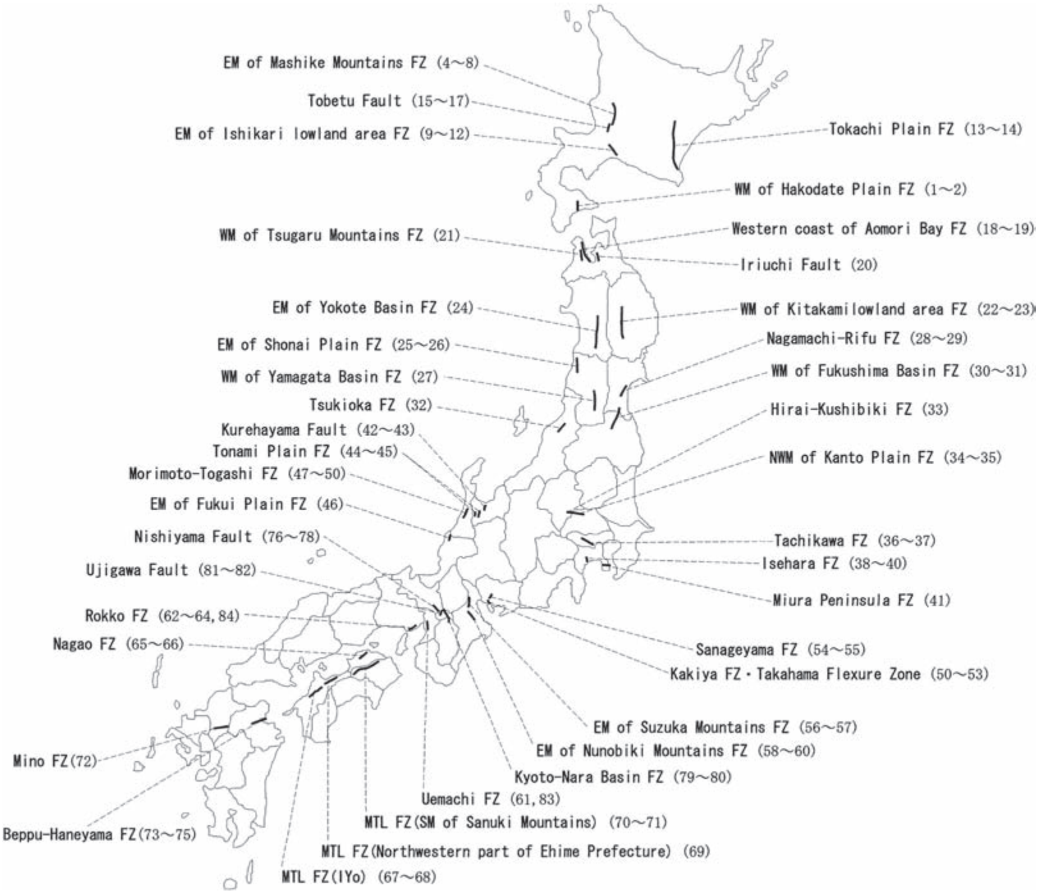


Fig. 2. Faults and fault zones where reflection profiles were collected. Numbers in the parentheses correspond to those in the database shown in Table 1 and attached figures. Abbreviations: EM—Eastern Margin; WM—Western Margin; NM—Northern Margin; NWM—North-Western Margin; SM—Southern Margin; FZ—Fault Zone.

3 Grouping of faults' appearance in the seismic reflection profiles

3.1 Types of faults' appearance

We define four types of profiles according to faults' appearance in the profiles; 1) step, 2) scarp, 3) discontinuity of reflection surfaces, 4) fault plane.

1) step (A-type)

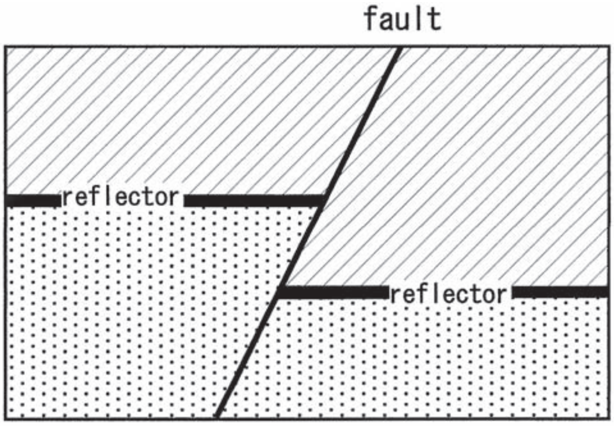
Reflection profiles of step type (A-type) reveal gaps of seismic reflectors generated by faulting. A schematic figure of the A-type profile is shown in Fig. 3-a. We show the Shiroishi profile line located at the western margin of the Fukushima basin fault zone obtained by Miyagi Prefecture (2000) in

Table 1. Contents of the database. At sense, R, S and N mean reverse, strike slip and normal fault, respectively. Slip rate is the classification of average slip rate. Names of profile lines are those shown in prefecture's report. Concerning to faults' appearance and geology, see the text.

No	Local governments	Name of Fault	Sense	Slip rate	Name of Profile Line	Faults' appearance	Geology
1	Hokkaido	WM of Hakodate Plain FZ	R	B-L	Line A	A, B	I
2					Line B	A, B	I
3		EM of Mashike Mountains FZ	R	B-L	Rausu	A	I
4					Uryu	A	I
5					Shin-Totsukawa	B	I
6		EM of Mashike Mountains FZ	R	B-L	Rausu	B	I
7					Uryu	A	I
8					Shin-Totsukawa	A, B	I
9		EM of Ishikari lowland area FZ	R	B-L	Iwamizawa	B	I
10					Sorai (Line 1)	B	I
11					Sorai (Line 2)	A, B	I
12					Izumisato	A, B	I
13		Tokachi Plain FZ	R	B-L	Satsunai	B	I
14					Senju	B	I
15		Tobetsu Fault	R	B-L	Shin-Shinotsu	A, D	I
16					Kita-Hiroshima	B	I
17					Oasa	B	I
18	Aomori	WM of Tsugaru Mountains FZ	R	B-L	T-3	B	I
19					T-4	A, B	I
20		Iriuchi FZ	R	B-H	Hosogoshiasada	B	I
21		Western coast of Aomori Bay FZ	R	C	Line 2	B	I
22	Iwate	WM of Kitakami lowland area FZ	R	B-L	Ishidoriya	A, B	I
23					Yokomoriyama	B	I
24	Akita	EM of Yokote Basin FZ	R	B-H	Deep line	A, D	III
25	Yamagata	EM of Shonai Plain FZ	R	B-H to A	Sakata	A, B	I
26					Matsuyama	B, D	I
27		WM of Yamagata Basin FZ	R	B-H	Murakisawa B	B	I
28	Miyagi	Nagamachi-Rifu FZ	R	B-H	Line 1	A, B	I
29					Line 3	B	I
30		WM of Fukushima Basin FZ	R	A	Shiroishi	A	II
31	Fukusima	WM of Fukushima Basin FZ	R	B-H	Kori	A, D	I
32	Nigata	Tsukioka FZ	R	B-L	Sasagami	A	III
33	Gunma	Hirai-Kushibiki FZ	R	B-L	Sk－1	A	I
34	Saitama	NWM of Kanto Plain FZ	R	B-L	Line A	B	I
35					Line B	B	I
36	Tokyo	Tachikawa FZ	R	B-L	T97－1	B	I
37					T97－2	B	I
38	Kanagawa	Isehara Fault	R	B-L	S－1	A, B	I
39					S－2	A	I
40					S－3	B	I
41		Miura Peninsula FZ	S	B-L	Yokosuka	A, B	I

Table 1.

42	Toyama	Kurehayama Fault	R	B-L	Deep line	B, D	I
43					Shallow line	B, D	I
44		Tonami Plain FZ	R	B-L	Hohrinji	A	I
45					Takashozu	A	II
46	Fukui	EM of Fukui Plain FZ	S	B-L	P-wave Line	A, B	II
47	Ishikawa	Morimoto FZ	R	B-L	Hikita - Kamiyanai	A, B	I
48					Umeda	A, B	I
49		Morimoto-Togashi FZ	R	B-L	Kosaka	B	I
50					Shijuman	A	I
51	Aichi	Kakiya FZ・Takahama Flexure Zone	R	B-L	Line A	B	I
52					Line C	B	I
53					Line E	B	I
54		Sanageyama FZ	S	B-L	Shallow line	B	I
55					Extreme shallow line	A	III
56	Mie	EM of Suzuka Mountains FZ	R	B-L	Extreme shallow line	B	I
57					Deep line	A, B	IV
58		EM of Nunobiki Mountains FZ	R	B-L	Shiraki	B	I
59					Mukumoto	B	I
60					Katada	B	I
61	Osaka	Uemachi FZ	R	B-L	Izumi	B	III
62	Hyogo	Rokko FZ	R	B-L	Shukugawa	A, B	III
63					Kobayashi	A, B	III
64					Koyoen	B	III
65	Kagawa	Nagao FZ	R	B-L	Kanan	A	III
66					Nagao	C, D	III
67	Ehime	MTL TZ(Iyo)	S	B-L	Line B	C, D	IV
68					Line C	C, D	IV
69		MTL TZ(Northwestern part of Ehime Prefecture)	S	B-L	Matsuyama	C	IV
70	Tokushima	MTL TZ(SM of Sanuki Mountains)	S	A	Line 1	C	IV
71					Line 2	C	IV
72	Fukuoka	Mino Fault	N	B-L	Fukueki	C	IV
73	Oita	Beppu- Haneyama FZ	N	A	Oita River	A, C	IV
74					Funai Castle	B	I
75					Art Hall	B	I
76	Kyoto City	Nishiyama Fault	R	B-L	Matsuo	B	IV
77					Katagihara	B	IV
78					Haikata	B	IV
79		Kyoto-Nara Basin FZ	R	B-L	L1	A, B	IV
80					L2	A	IV
81		Ujigawa Fault	R	B-L	Yawata	B	I
82					Momoyama-Minami	B	I
83	Osaka City	Uemachi FZ	R	B-L	Line 2	A, B	III
84	Kobe City	Rokko FZ	R	B-L	Line 1	A, B	III



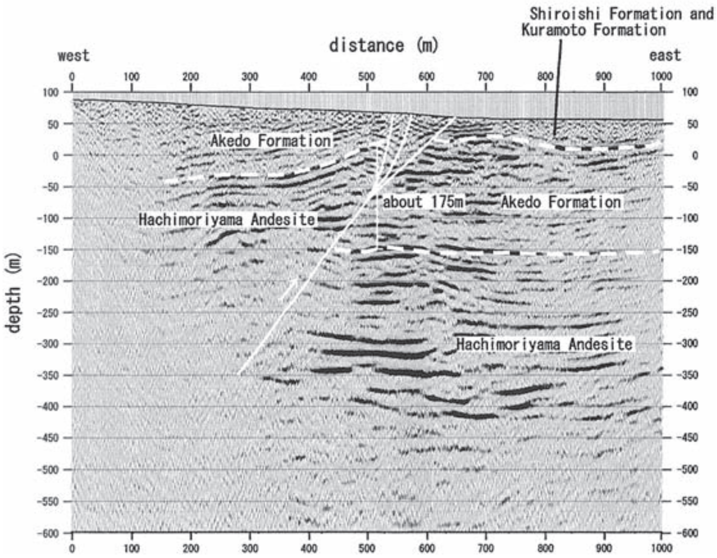


Fig. 3. Schematic figure of A-type profile (Fig. 3-a, upper part), and an example of A-type profile (Fig. 3-b, lower part). Depth 0 means above sea level of 0 m.

Fig. 3-b as a typical example of the A-type profile.

The profile line is located at Fukuoka-Kuramoto, Shiroishi City, and the length of the survey line is about 1000 m. Around the profile line, the NNE-strike fault scarplets are distributed on the alluvial fan (Shinya, 1984), and the profile line was set up crossing these fault scarplets. The reflection profile indicates that Miocene rocks (the Hachimoriyama Andesites, the Shiroishi Formation, and the Akedo Formation) are deformed by active faults. The dip of the active faults and the vertical displacement of the lower limit of the Akedo Formation across the faults are estimated to be about 55° and 175 m,

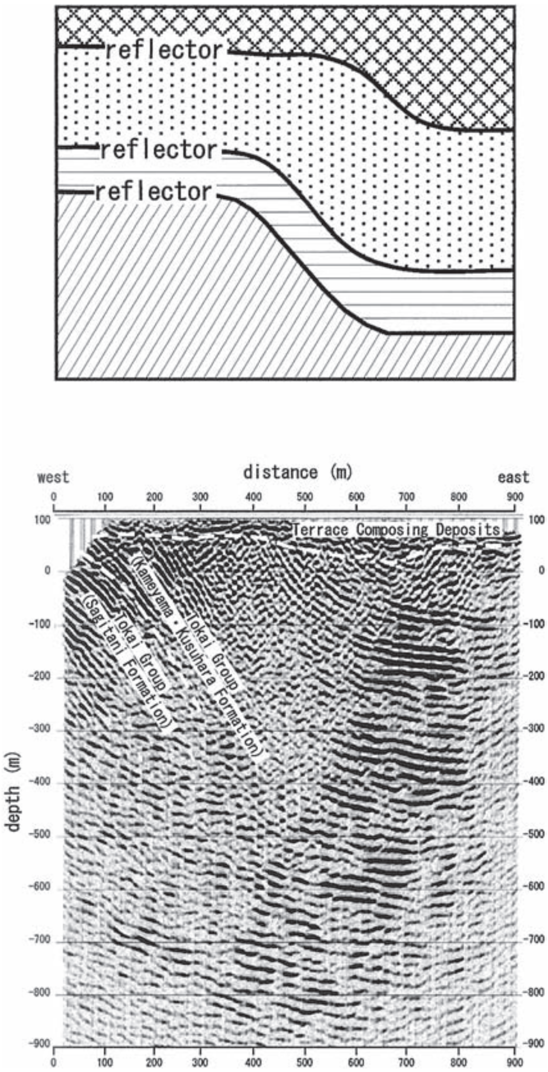


Fig. 4. Schematic figure of B-type profile (Fig. 4-a, upper part), and an example of B-type profile (Fig. 4-b, lower part).

respectively.

2) scarp (B-type)

In reflection profiles of scarp type (B-type), we can recognize smoothly deformed seismic reflectors going down toward footwall of a fault. A schematic figure of the B-type profile is shown in Fig. 4-a. A typical example of the B-type profile is the Mukumoto profile line at the eastern margin of the Nunobiki mountains fault zone profiled by Mie Prefecture in 1997 (Fig. 4-b).

On the left bank of Anno River, Geino Town, alluvial, L2, and M2 terraces are distributed, and M2 terrace is vertically deformed by active faults (Ota and Sangawa, 1984). The profile line was set up crossing to the fault scarplets on M2 terrace and the length of the survey line is about 1000 m. In this reflection profile, we can recognize that reflection surfaces in the thick deposit of the Tokai group, Plio-Pleistocene sediments go down toward the east (Mie Prefecture, 1998).

3) discontinuity of reflection surfaces (C-type)

Reflection surfaces do not continue across the faults in profiles of this type (C-Type). A schematic figure of a profile of the C-type is shown in Fig. 5-a. Reflection profiles of the C-type also show gaps of seismic reflectors caused by faulting, similar to reflection profiles of the A-type. A difference between the A-type and the C-type is that in the A-type we can correlate reflection surfaces across the fault, but in the C-type we cannot find corresponding reflection surfaces in the other side of the fault.

The Matsuyama profile line, profiled by Ehime Prefecture on the Kawakami fault, a part of the Median Tectonic Line, is an example of the C-type (Fig. 5-b). An alluvial terrace formed by the Shigenobu River is widely distributed in the Takai area, Matsuyama City, and the ENE- strike fault scarplets are developed on the alluvial terrace (Goto and Nakata, 1998). The profile line was set up crossing these fault scarplets and length of the survey line is about 650 m. In the reflection profile, the Izumi Group (Cretaceous) seemed to be contacted with the Plio- Pleistocene sediments across the faults (Ehime Prefecture, 1999).

4) reflector of fault plane (D-type)

Fault planes are represented as seismic reflectors in profiles of the D-type. A schematic figure of the D-type is shown in Fig. 6-a. We give in Fig. 6-b a profile of Kurehayama fault obtained by Toyama Prefecture (1997), as a typical example of the D-type profile. The profile line was set up about 6.6 km in length from Bunden, Fuchu Town, to Tochitani, Toyama City, and the structure was surveyed down to about 3000 m in depth. In the reflection profile, Neogene and Quaternary sediments incline toward the east in the hanging wall and toward the west in the footwall near the fault plane.

The D-type is likely to appear with other types of faults' appearance. In the case of the Kurehayama fault, both reflector of fault plane and scarp appear in the same seismic profile.

3.2 The result of grouping profiles

The result of grouping all 84 reflection profiles collected in this study is shown in Fig. 7. Some reflection profiles had features of two types. For instance, the Kurehayama fault revealed B-type and D-type characteristics, as mentioned above. In the profile of the T-4 profile line, at the western margin of the

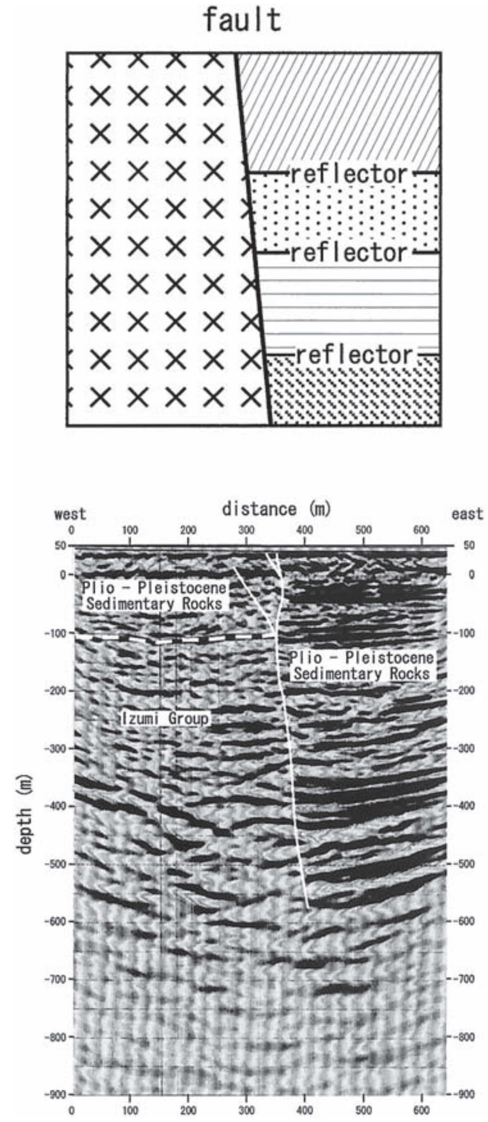


Fig. 5. Schematic figure of C-type profile (Fig. 5-a, upper part), and an example of C-type profile (Fig. 5-b, lower part).

Tsugaru Mountains fault zone, we can recognize both smoothly deformed seismic reflectors (B-type) and secondary gaps of reflectors (A-type) behind the fault scarp. Therefore the faulting mainly formed the scarp (B-type) concerning to the T-4 profile. Another example is the Shukugawa profile line, the Rokko fault zone. We can recognize smoothly deformed seismic reflectors near the surface (B-type), as well as gaps of seismic reflectors displaced by faulting (A-type) at deep zone (at a depth of about 1000 m). However, the most of profiles of the A + B type show B-type appearance in the main part

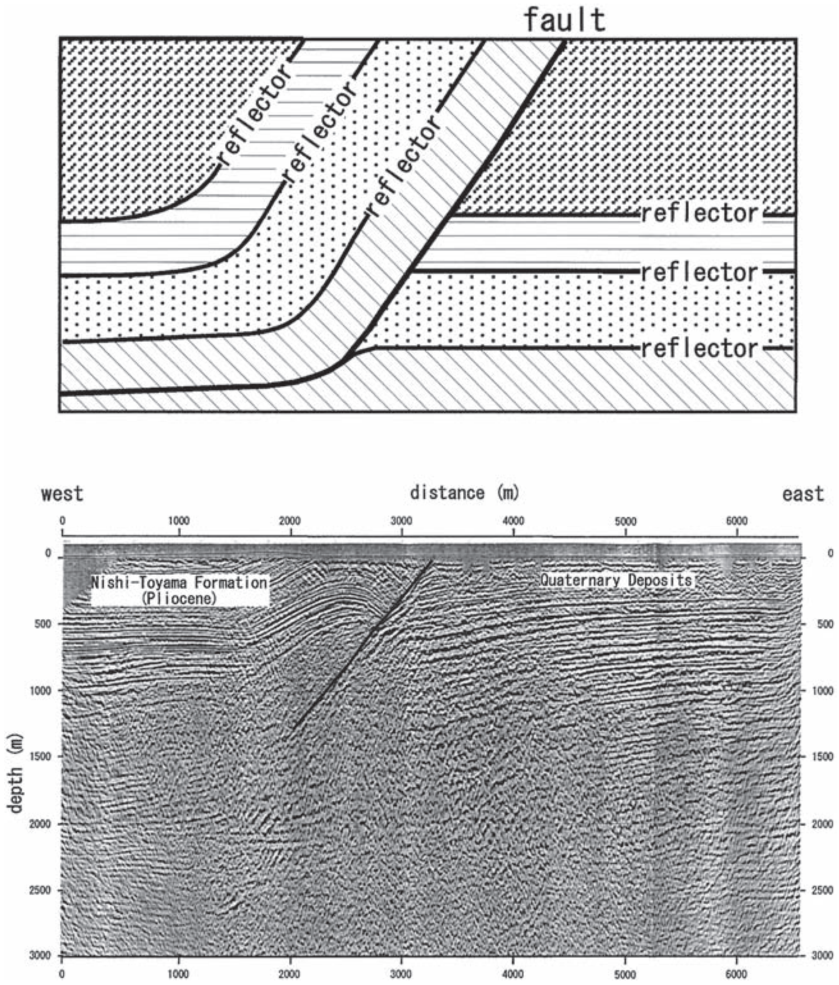


Fig. 6. Schematic figure of D-type profile (Fig. 6-a, upper part), and an example of D-type profile (Fig. 6-b, lower part).

of the faults as the T-4 profile.

Considering these cases, we divided collected reflection profiles into eight cases shown in Fig. 7. The number of profiles of each type is 13 (A-type), 37 (B-type), 4 (C-type), 20 (A + B type), 1 (A + C type), 3 (A + D type), 3 (B + D type), and 3 (C + D type), respectively.

4 Discussion

The most of reflection profiles are of the reverse faults (71 profiles), and the reflection profiles of the strike slip faults (9 profiles) and the normal faults (4 profiles) are quite few. Therefore the result of classification (Fig. 7)

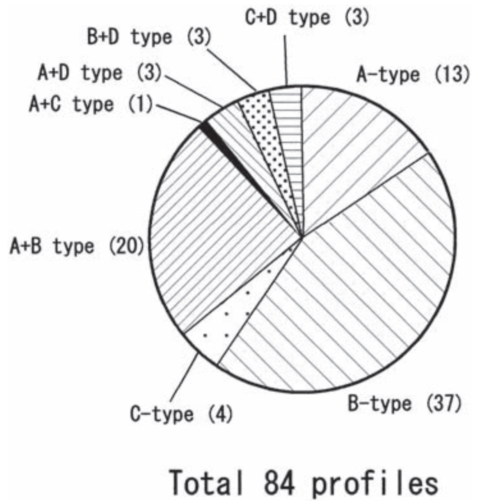


Fig. 7. Result of classification. Number of profiles with each faults' appearance is shown in a parenthesis.

and the following discussion may mainly reflect the characteristics of reverse faults.

Number of the A-type profiles is 13 (Fig. 7). A-type tends to appear in an area where depth of the basement rock is shallow (for example, the Kanan Line (profile number 65)) or in a volcanic rock area (for example, Shiroishi Line (profile number 30)). Furthermore, if the dip of a fault is gentle, the fault plane appears as reflection surfaces (for example, Kori Line (profile number 31)).

The B-type is the most popular type of faults' appearance (Fig. 7). The B-type tends to appear in a thick sedimentary rock (Miocene to Holocene strata) area and low vertical average slip rate (≤ 0.5 mm/yr) area (for example, Mukumoto Line (profile number 59)). Such a geological condition and low slip rate may account for that reverse faults generate ductile deformation of strata and form fault scarps.

Number of the A + B type profiles is 20 (Fig. 7). The most of profiles of the A + B type have slip sense, geological conditions, and vertical slip rate similar to the profiles of the B-type, because the most of profiles of the A + B type have smoothly deformed seismic reflectors and secondary gaps of reflectors as mentioned in 3.2. Reflection profiles of other types are too few to argue about the general trend of each type.

Relationship between faults' appearance and geological condition is shown in Fig. 8. We divided geological condition beneath profile lines into four patterns; pattern I (Quaternary + Tertiary sedimentary rocks), pattern II (Quaternary + Tertiary volcanic and sedimentary rocks), pattern III (Quaternary

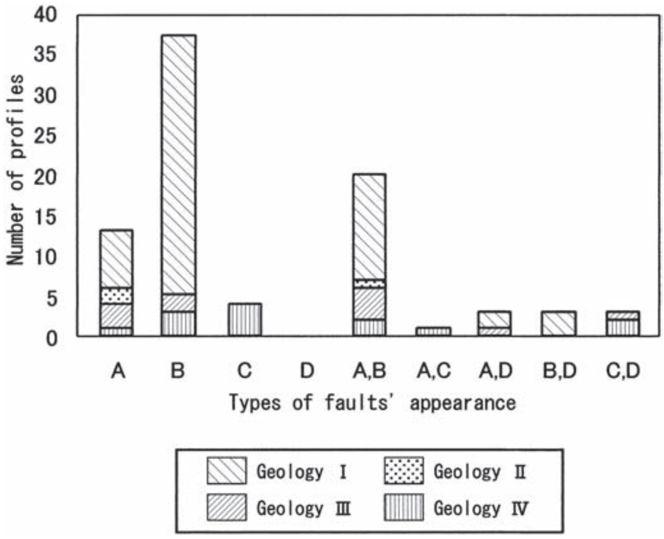


Fig. 8. Relationship between faults' appearance A ~ D and Geology I ~ IV. Geology I: Quaternary + Tertiary sedimentary rocks, Geology II: Quaternary + Tertiary volcanic and sedimentary rocks, Geology III: Quaternary + Tertiary sedimentary rocks + Granite), and Geology IV: Quaternary + Tertiary sedimentary rocks + Meso-Paleozoic basement rocks.

+ Tertiary sedimentary rocks + Granite), and pattern IV (Quaternary + Tertiary sedimentary rocks + Meso-Paleozoic basement rocks).

In the reflection profiles with the geological condition of pattern I, the B-type profiles are most frequently recognized. The number of B-type accounts for about 40 percent and the amount of B, A + B, and B + D type is about 70 percent of the all profiles with pattern I. This means that thick sedimentary layers (Miocene to Holocene strata) tend to form fault scarps.

Relationship between a faults' appearance and an average slip rate of the active faults is shown in Fig. 9. In this study, an average slip rate means a vertical average slip rate mainly obtained by trench and drilling surveys. Concerning to a faults' appearance of the B-type, a vertical average slip rate is mostly low-ranking of B class. The amount of B-L and C class is about 80 percent of all the profiles.

On the other hand, the amount of B-L and C class is about 90 percent of B-type and A + B type. Consequently, we think that, a low vertical average slip rate also contributes to form fault scarps. But we can't deny that a vertical average slip rate is underestimated on the surface because thick sedimentary layers dissipate deformation by faulting when earthquake happens.

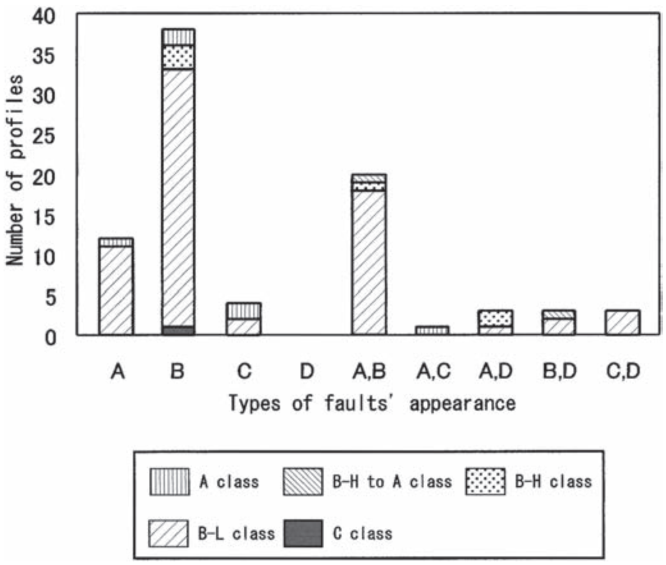


Fig. 9. Relationship between faults' appearance and average slip rate of active faults.

5 Summery

1) We collected 84 reflection profiles from local governments' reports and made a database and divided them according to the fault's appearance in the profle.
2) B-type (scarp) is the most popular type in all types of faults' appearance. Thick sedimentary rocks (Miocene to Holocene strata), and low vertical average slip rates (≤ 0.5 mm/yr) seem to be a cause of formation of scarps.
3) With the geological condition of pattern I (Quaternary + Tertiary sedimentary rocks), scarp is the greatest number of faults' appearance. Combination (I, B) accounts for about 40 percent of all type of faults' appearance.
4) Most of the profiles (71 profiles) were for reverse faults. Therefore 2) and 3) may reflect the characteristics of reverse faults.

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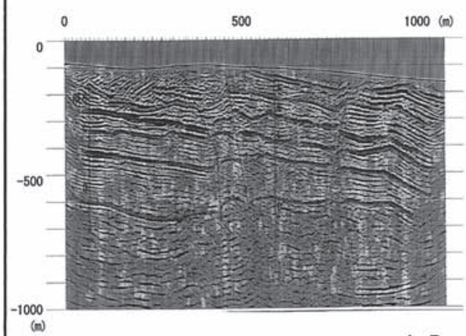
Attached figures

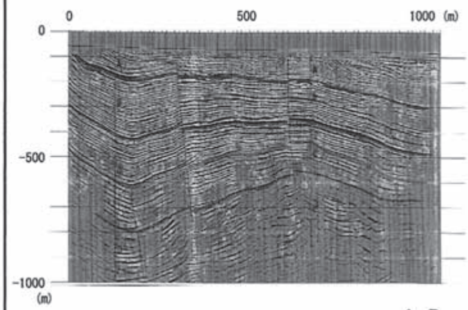
Figures of reflection profiles collected. Profile number, name of fault (or fault zone), name of profile and faults' appearance type shown in each figure correspond to those in the database shown in Table 1. Alphabets at the lower right of the each figure are type of faults' appearance. The vertical axis is the depth of reflection profile (depth 0 means above sea level of 0 m), and the horizontal axis is the distance of profile, respectively.

1 WM of Hakodate Plain FZ (Line A)



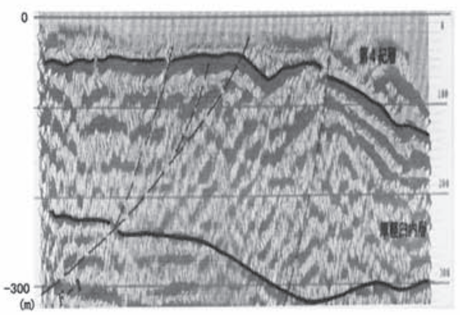
A, B

2 WM of Hakodate Plain FZ (Line B)



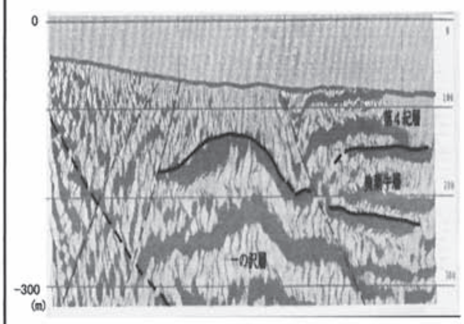
A, B

3 EM of Mashike Mountains FZ (Rausu)



A

4 EM of Mashike Mountains FZ (Uryu)

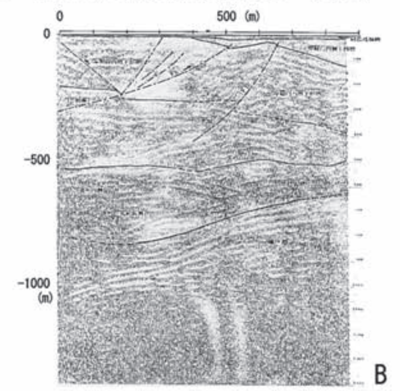


A

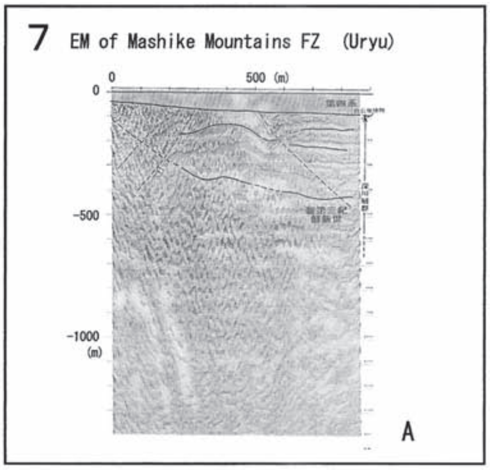
5 EM of Mashike Mountains FZ (Shin-Totsukawa)

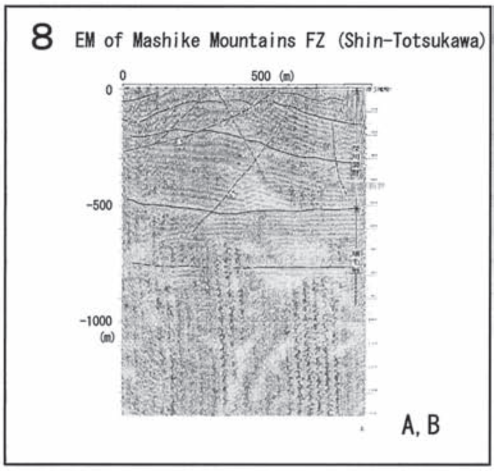
B

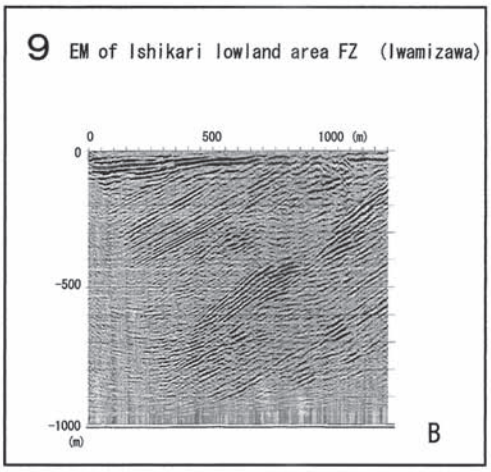
6 EM of Mashike Mountains FZ (Rausu)

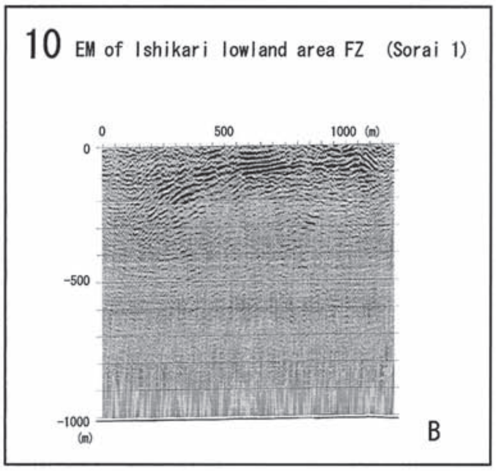


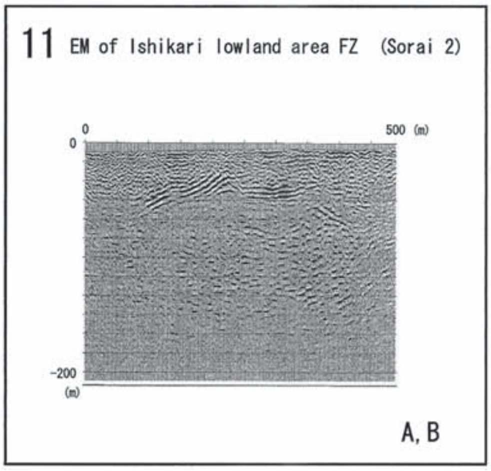
B

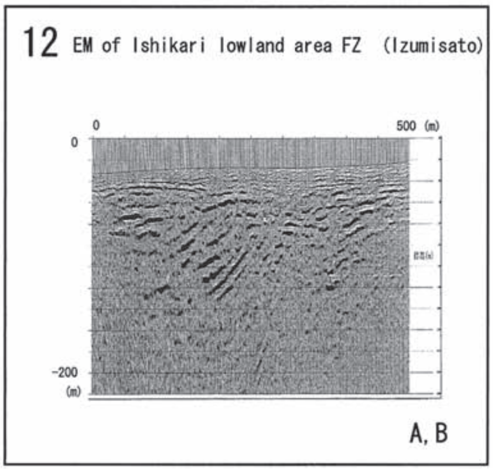

7 EM of Mashike Mountains FZ (Uryu)
0
500 (m)
0
-500
-1000
(m)
A


8 EM of Mashike Mountains FZ (Shin-Totsukawa)
0
500 (m)
0
-500
-1000
(m)
A, B

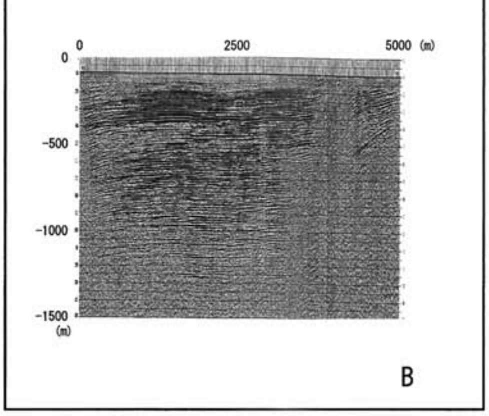

9 EM of Ishikari lowland area FZ (Iwamizawa)
0
500
1000 (m)
0
-500
-1000
(m)
B


10 EM of Ishikari lowland area FZ (Sorai 1)
0
500
1000 (m)
0
-500
-1000
(m)
B

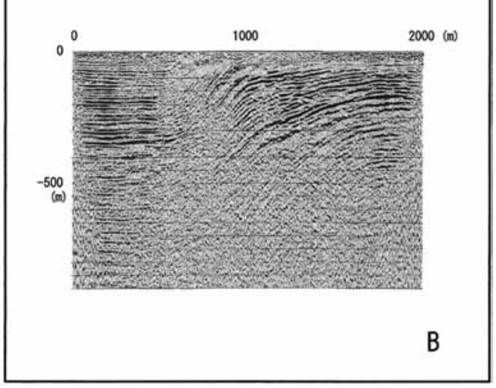

11 EM of Ishikari lowland area FZ (Sorai 2)
0
500 (m)
0
-200
(m)
A, B


12 EM of Ishikari lowland area FZ (Izumisato)
0
500 (m)
0
-200
(m)
A, B

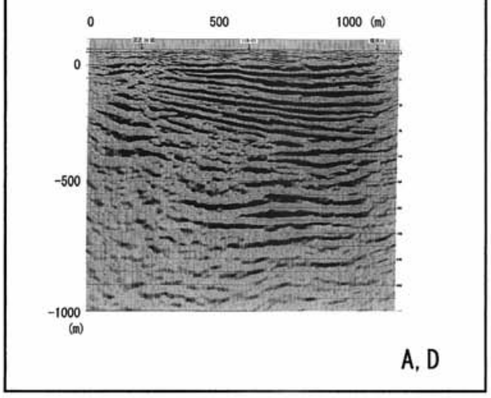
13 Tokachi Plain FZ (Satsunai)



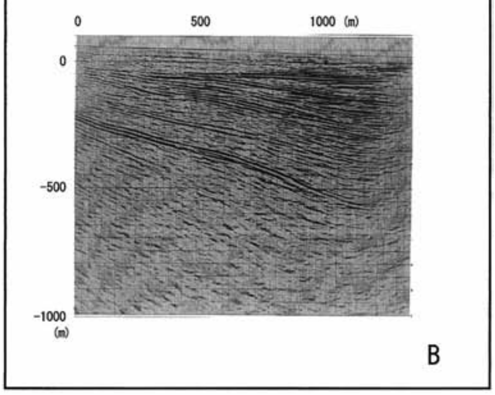
14 Tokachi Plain FZ (Senju)



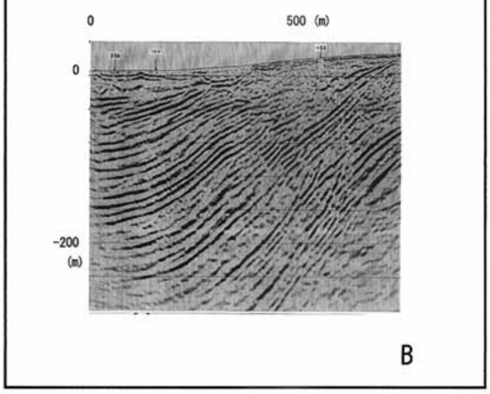
15 Tobetsu Fault (Shin-Shinotsu)



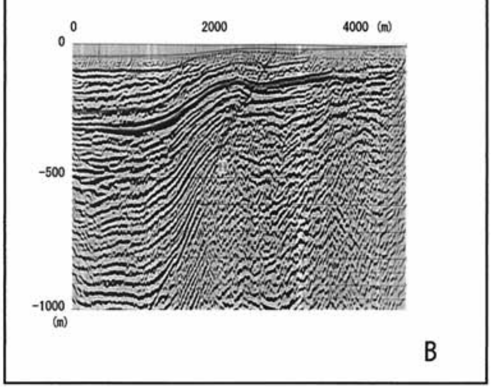
16 Tobetsu Fault (Kita-Hiroshima)

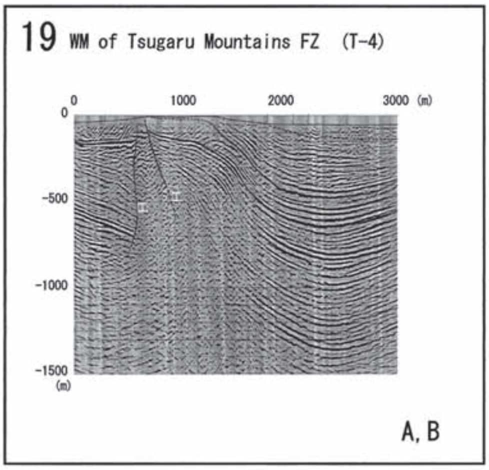


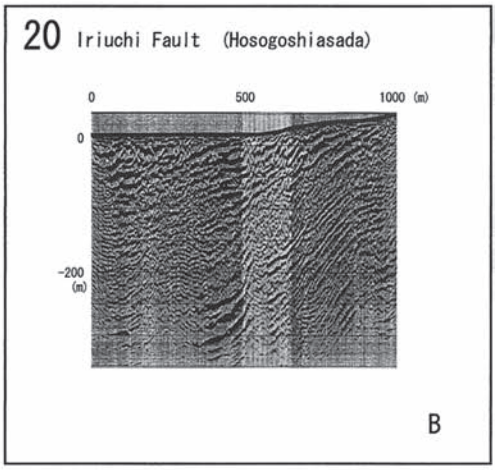
17 Tobetsu Fault (Oasa)

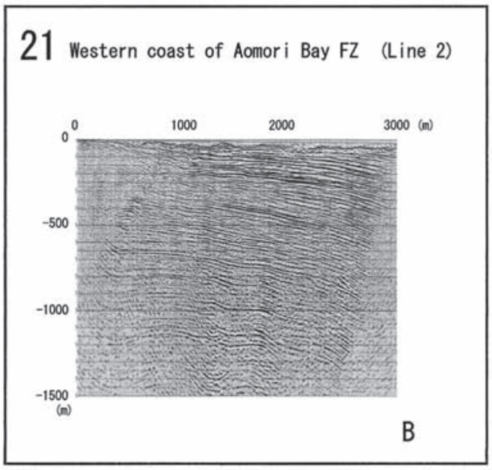


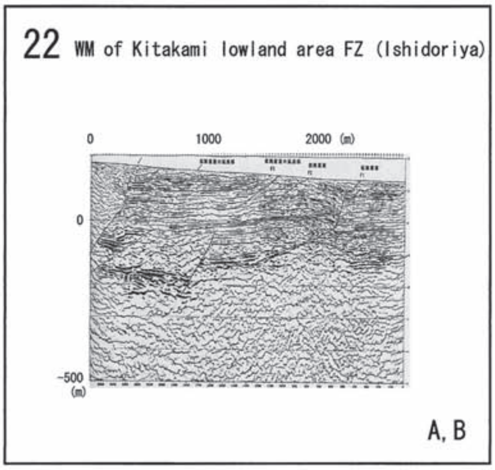
18 WM of Tsugaru Mountains FZ (T-3)

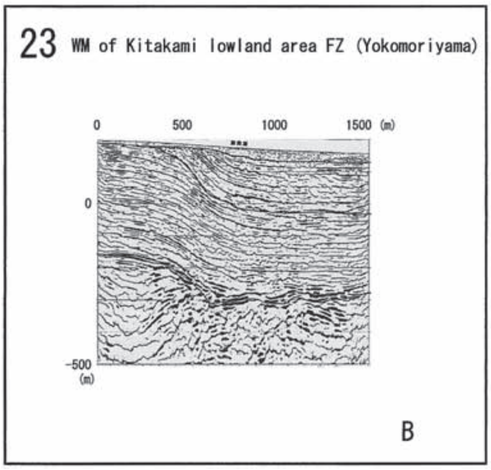


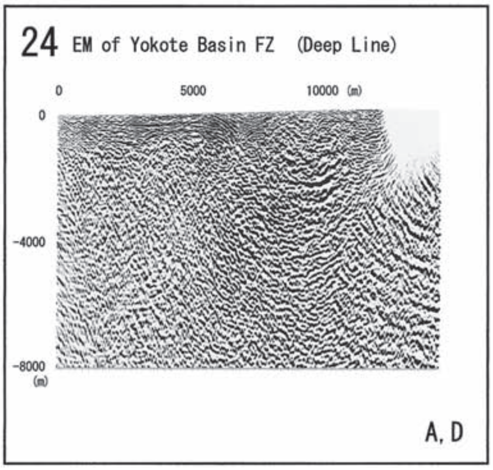

19 WM of Tsugaru Mountains FZ (T-4)
0 1000 2000 3000 (m)
0
-500
-1000
-1500 (m)
A, B


20 Iriuchi Fault (Hosogoshiasada)
0 500 1000 (m)
0
-200 (m)
B

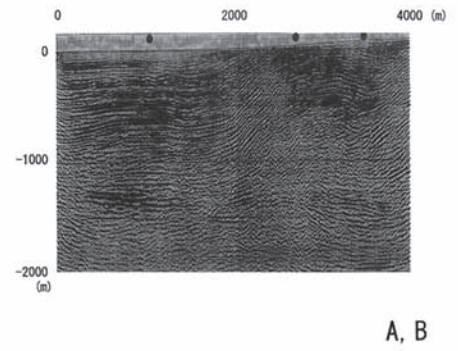

21 Western coast of Aomori Bay FZ (Line 2)
0 1000 2000 3000 (m)
0
-500
-1000
-1500 (m)
B


22 WM of Kitakami lowland area FZ (Ishidoriya)
0 1000 2000 (m)
0
-500 (m)
A, B

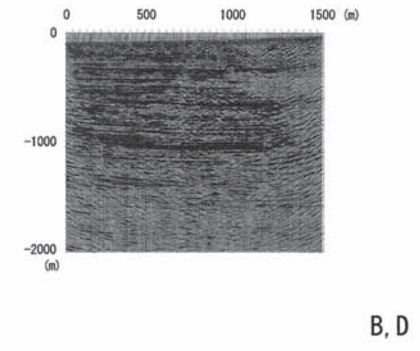

23 WM of Kitakami lowland area FZ (Yokomoriyama)
0 500 1000 1500 (m)
0
-500 (m)
B


24 EM of Yokote Basin FZ (Deep Line)
0 5000 10000 (m)
0
-4000
-8000 (m)
A, D

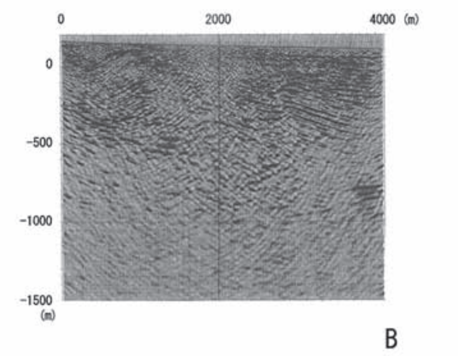
25 EM of Shonai Plain FZ (Sakata)



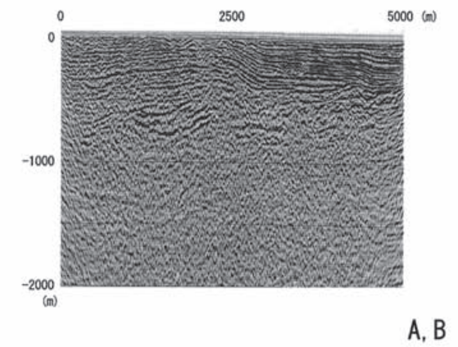
26 EM of Shonai Plain FZ (Matsuyama)



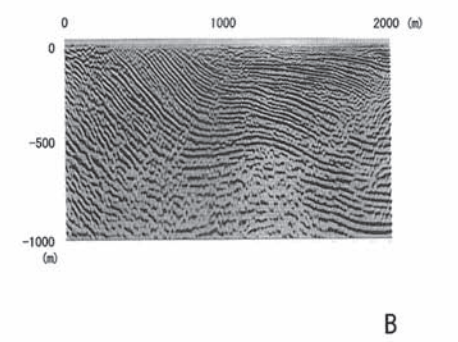
27 WM of Yamagata Basin FZ (Murakisawa B)



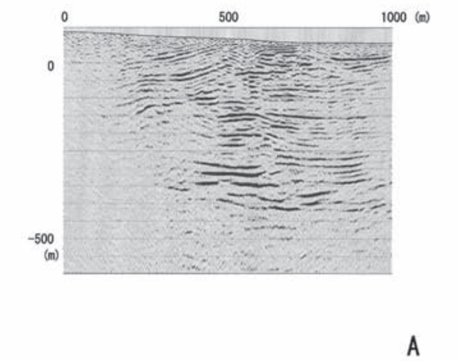
28 Nagamachi-Rifu FZ (Line 1)



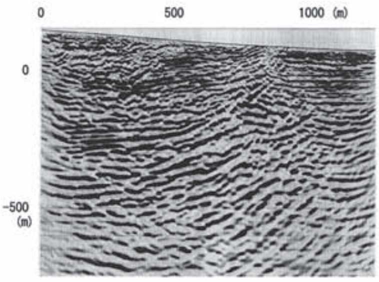
29 Nagamachi-Rifu FZ (Line 3)



30 WM of Fukushima Basin FZ (Shiroishi)

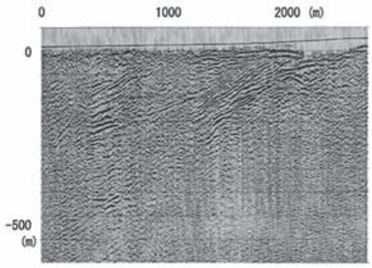


31 WM of Fukushima Basin FZ (Kori)



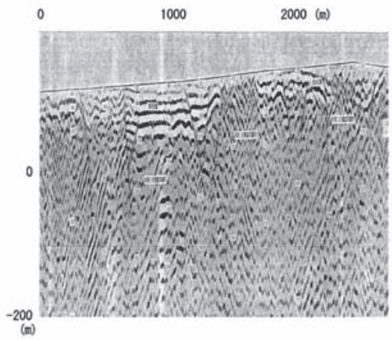
A, D

32 Tsukioka FZ (Sasagami)



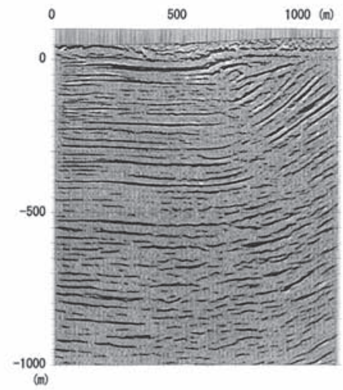
A

33 Hirai-Kushibiki FZ (Sk-1)



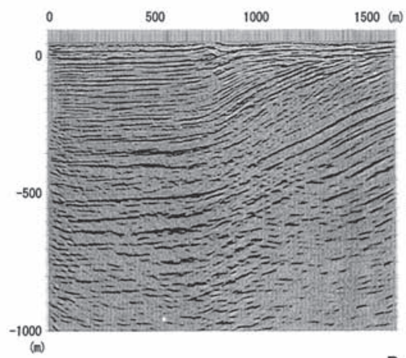
A

34 NWM of Kanto Plain FZ (Line A)



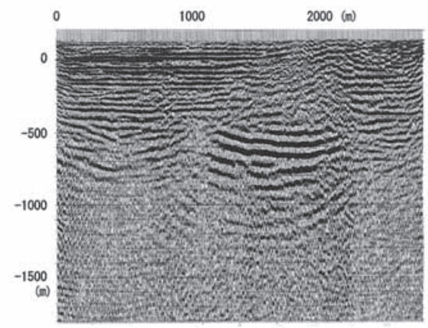
B

35 NWM of Kanto Plain FZ (Line B)

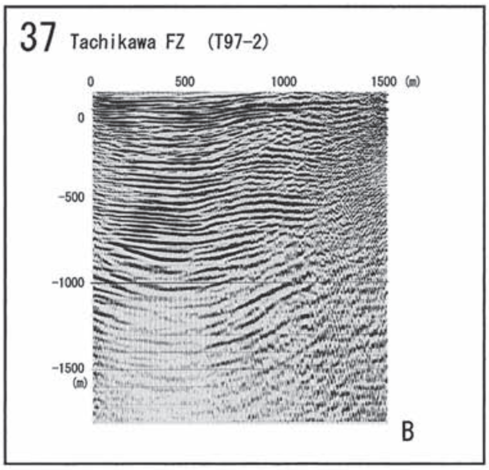


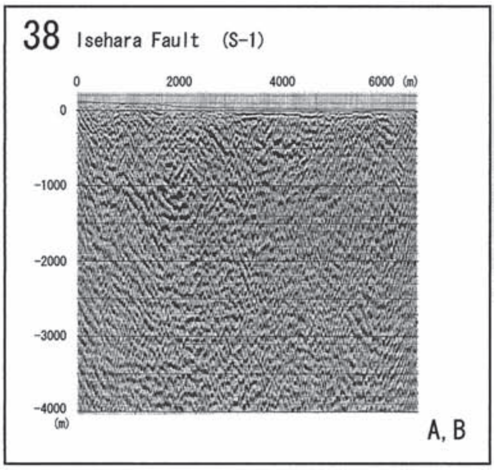
B

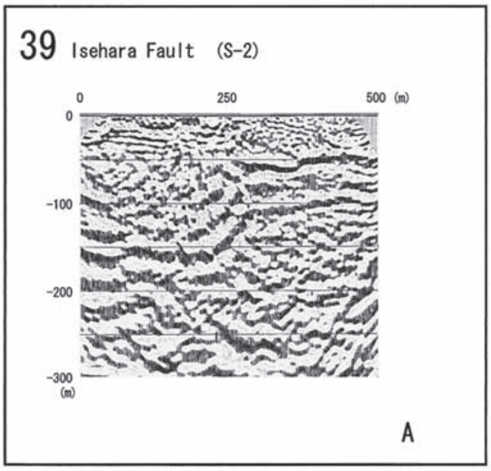
36 Tachikawa FZ (T97-1)

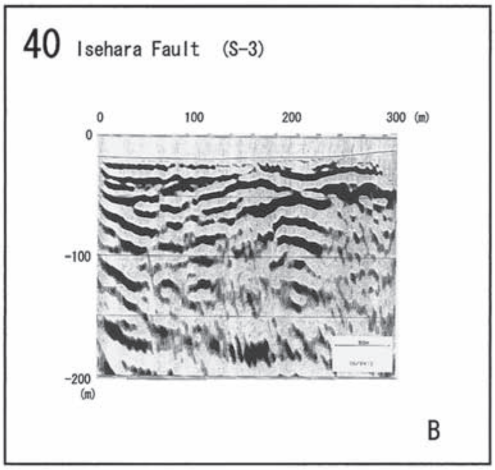


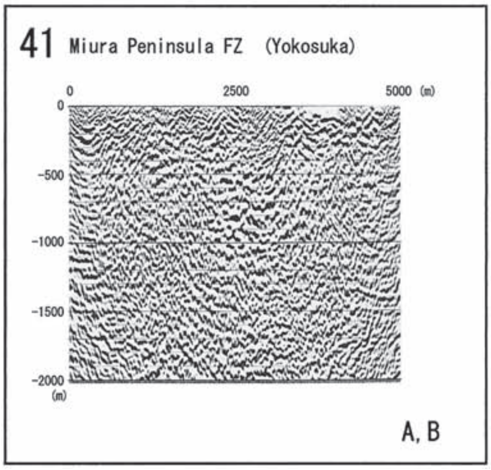
B

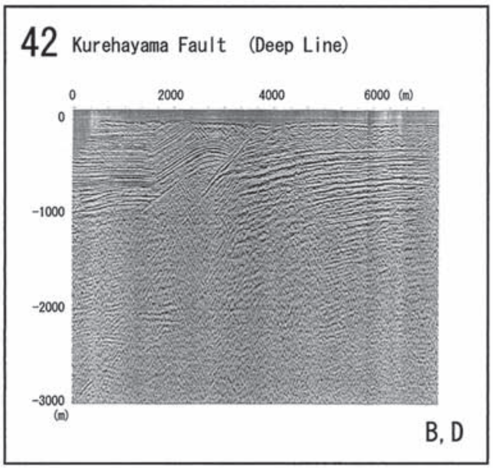

37 Tachikawa FZ (T97-2)
0 500 1000 1500 (m)
0
-500
-1000
-1500 (m)
B


38 Isehara Fault (S-1)
0 2000 4000 6000 (m)
0
-1000
-2000
-3000
-4000 (m)
A, B

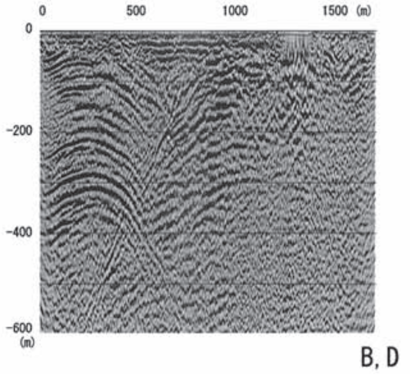

39 Isehara Fault (S-2)
0 250 500 (m)
0
-100
-200
-300 (m)
A


40 Isehara Fault (S-3)
0 100 200 300 (m)
0
-100
-200 (m)
B

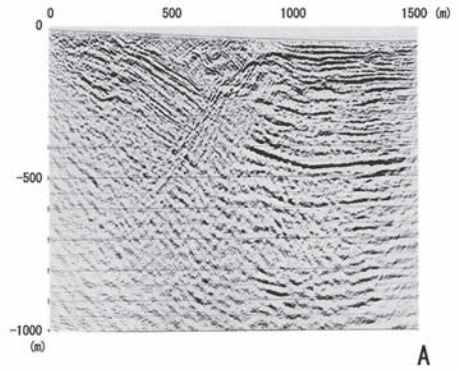

41 Miura Peninsula FZ (Yokosuka)
0 2500 5000 (m)
0
-500
-1000
-1500
-2000 (m)
A, B


42 Kurehayama Fault (Deep Line)
0 2000 4000 6000 (m)
0
-1000
-2000
-3000 (m)
B, D

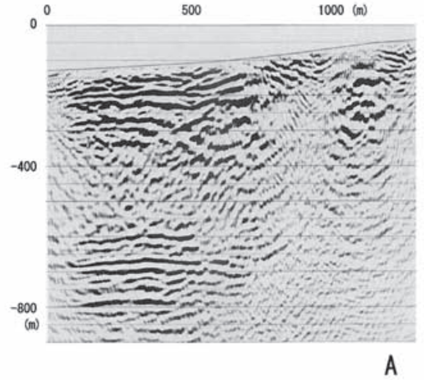
43 Kurehayama Fault (Shallow line)



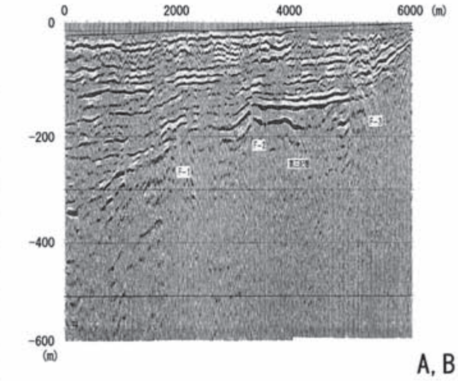
44 Tonami Plain FZ (Hohrinji)



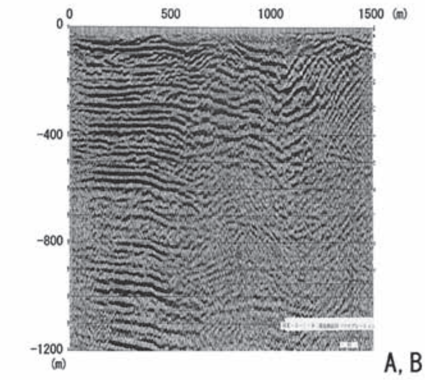
45 Tonami Plain FZ (Takashozu)



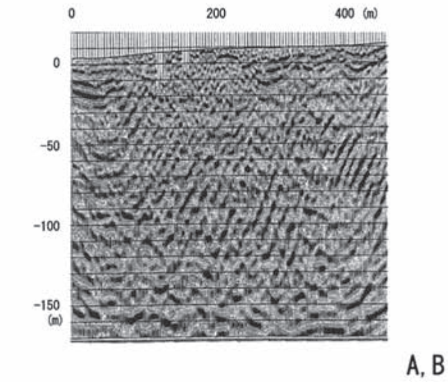
46 EM of Fukui Plain FZ (P-wave Line)



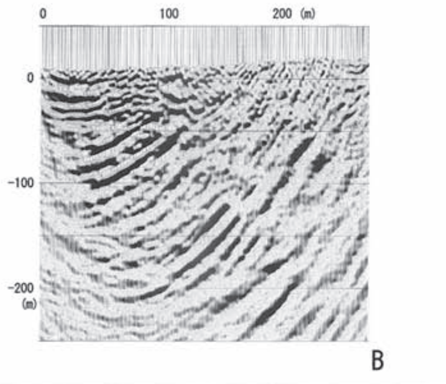
47 Morimoto FZ (Hikita-Kamiyanai)



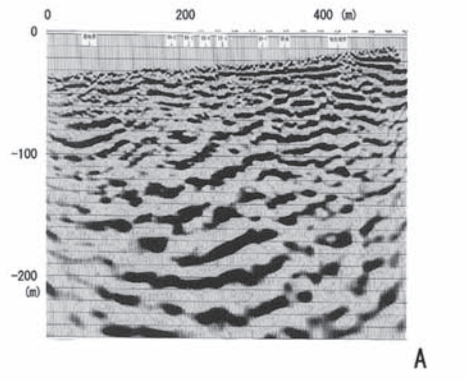
48 Morimoto FZ (Umeda)



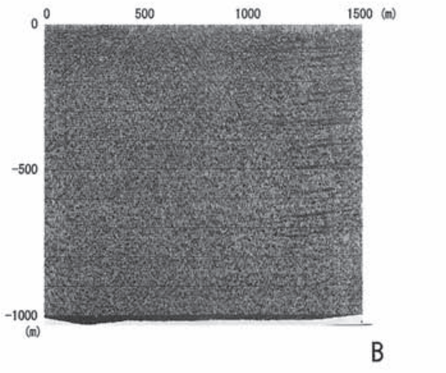
49 Morimoto-Togashi FZ (Kosaka)



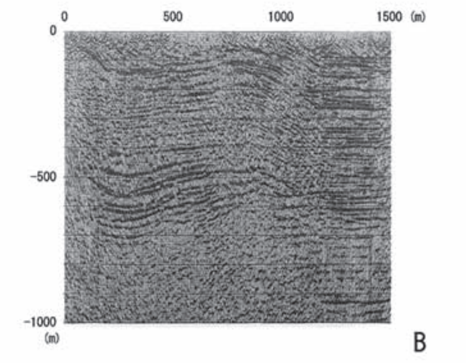
50 Morimoto-Togashi FZ (Shijuman)



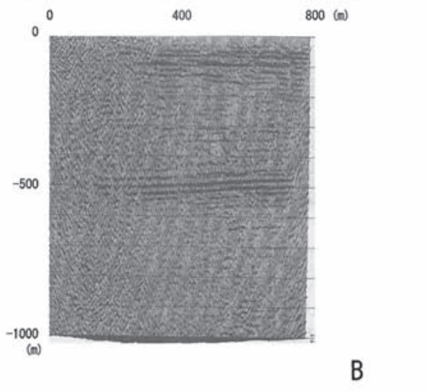
51 Kakiya FZ・Takahama Flexure Zone (Line A)



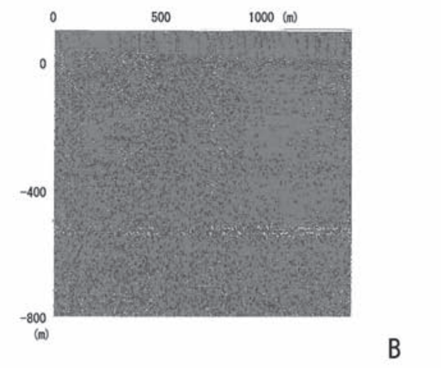
52 Kakiya FZ・Takahama Flexure Zone (Line C)

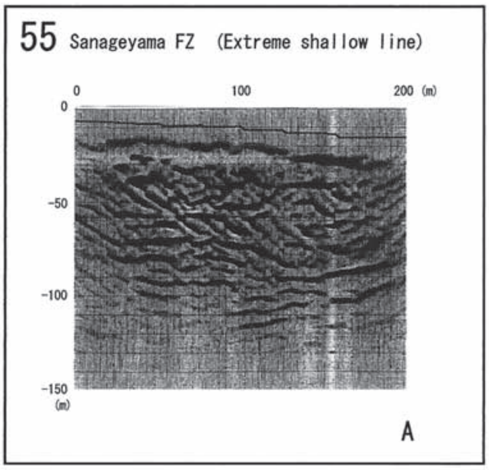


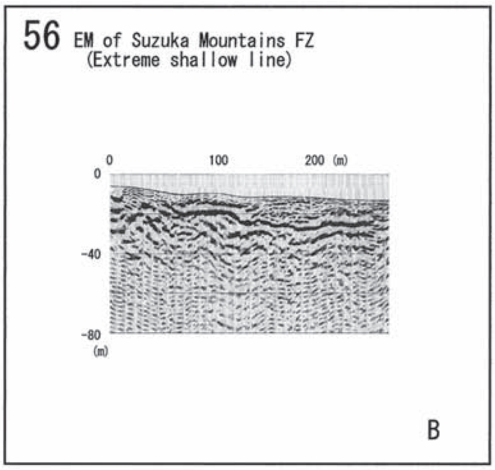
53 Kakiya FZ・Takahama Flexure Zone (Line E)

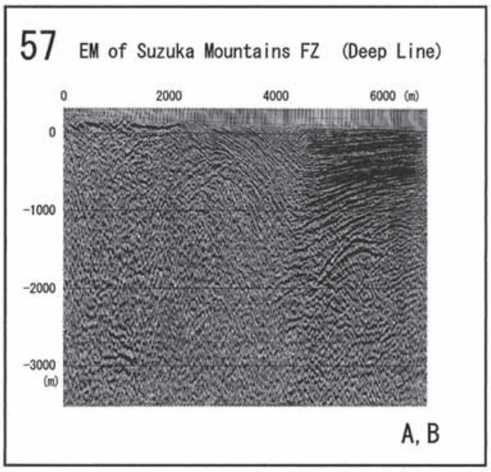


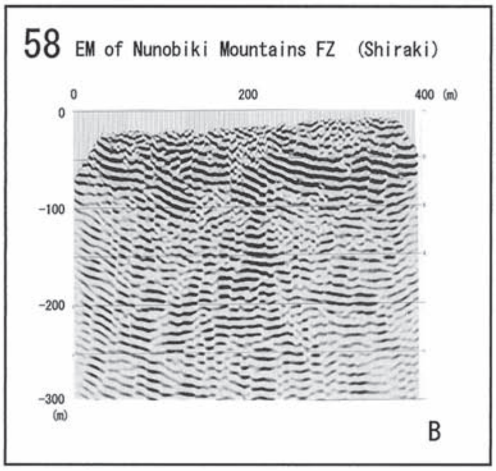
54 Sanageyama FZ (Shallow line)

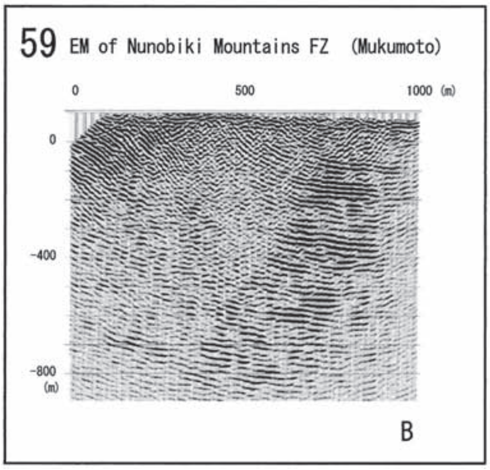


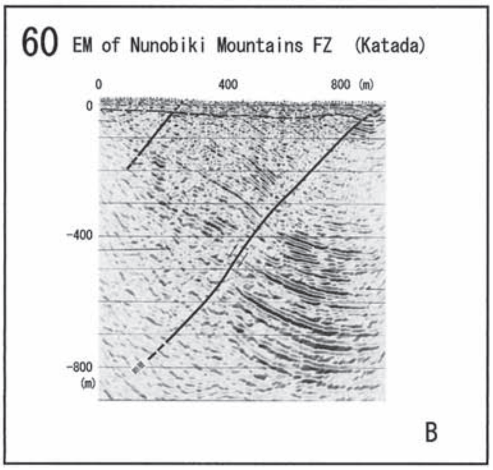

55 Sanageyama FZ (Extreme shallow line)
0 100 200 (m)
0
-50
-100
-150 (m)
A

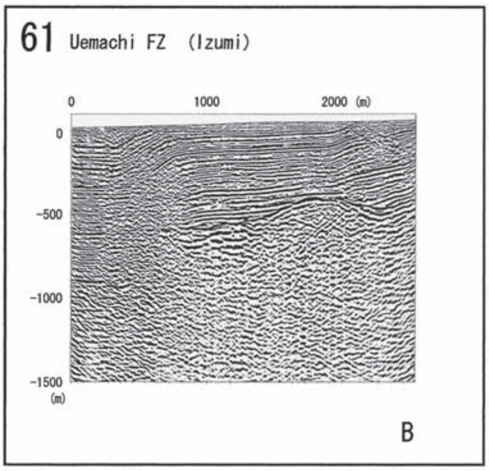

56 EM of Suzuka Mountains FZ (Extreme shallow line)
0 100 200 (m)
0
-40
-80 (m)
B

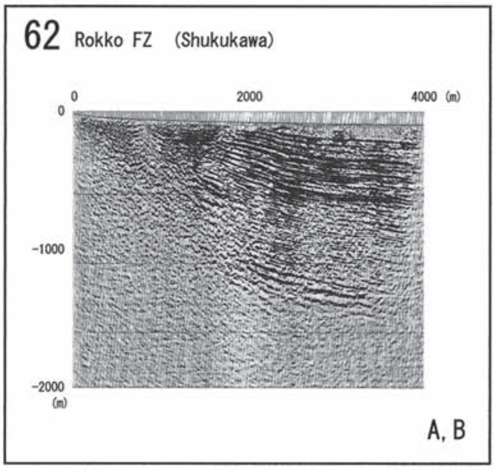

57 EM of Suzuka Mountains FZ (Deep Line)
0 2000 4000 6000 (m)
0
-1000
-2000
-3000 (m)
A, B

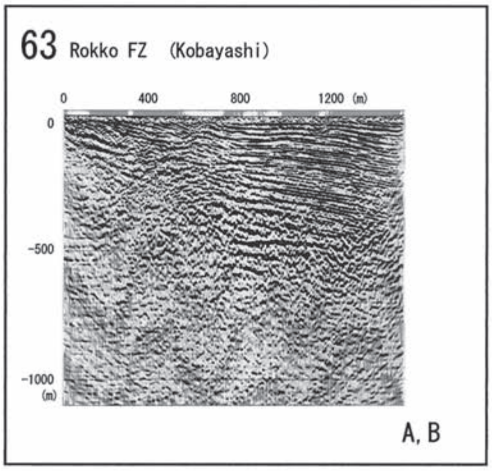

58 EM of Nunobiki Mountains FZ (Shiraki)
0 200 400 (m)
0
-100
-200
-300 (m)
B

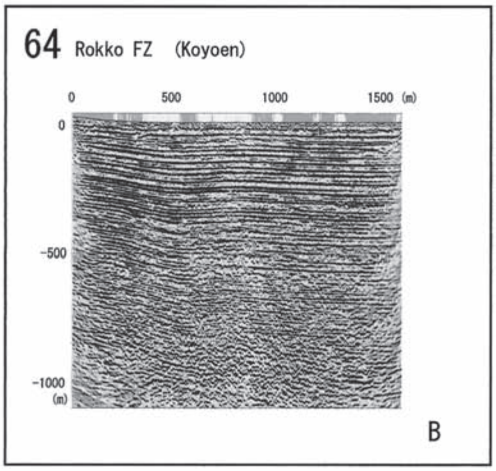

59 EM of Nunobiki Mountains FZ (Mukumoto)
0 500 1000 (m)
0
-400
-800 (m)
B

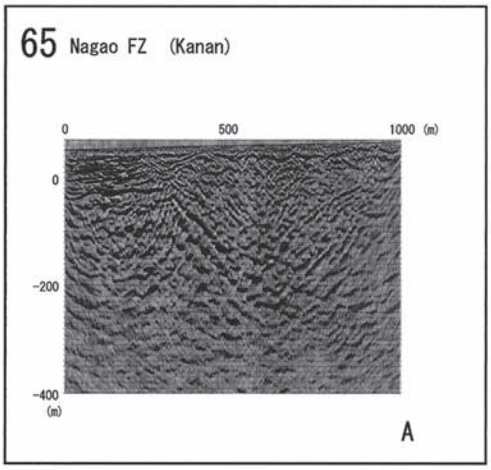

60 EM of Nunobiki Mountains FZ (Katada)
0 400 800 (m)
0
-400
-800 (m)
B

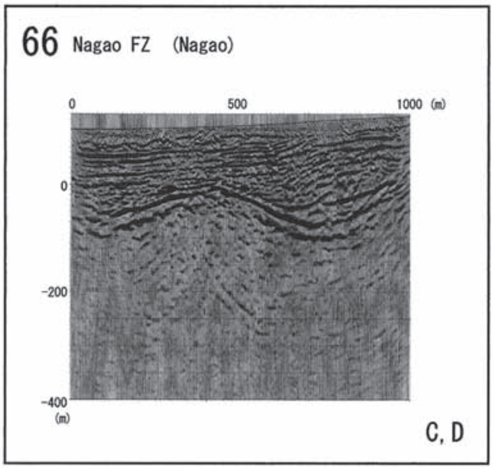

61 Uemachi FZ (Izumi)
0
1000
2000 (m)
0
-500
-1000
-1500 (m)
B


62 Rokko FZ (Shukukawa)
0
2000
4000 (m)
0
-1000
-2000 (m)
A, B

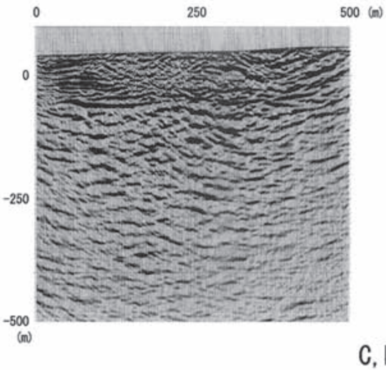

63 Rokko FZ (Kobayashi)
0
400
800
1200 (m)
0
-500
-1000 (m)
A, B


64 Rokko FZ (Koyoen)
0
500
1000
1500 (m)
0
-500
-1000 (m)
B


65 Nagao FZ (Kanan)
0
500
1000 (m)
0
-200
-400 (m)
A

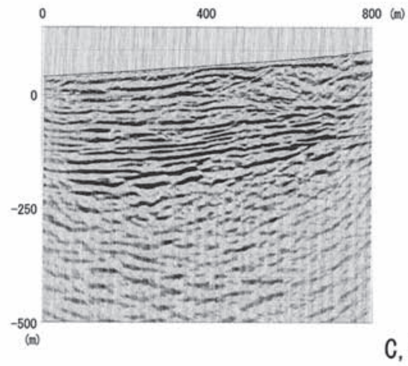

66 Nagao FZ (Nagao)
0
500
1000 (m)
0
-200
-400 (m)
C, D

67 MTL TZ(Iyo) (Line B)



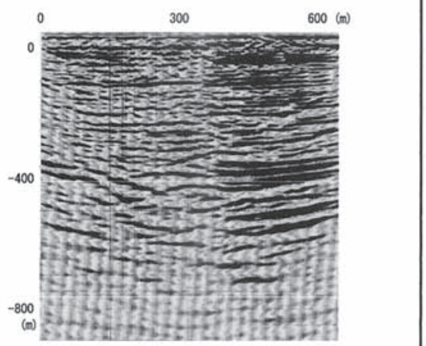
C, D

68 MTL TZ(Iyo) (Line C)



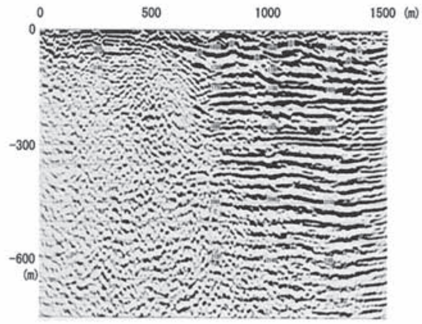
C, D

69 MTL TZ(NW part of Ehime Pref.) (Matsuyama)



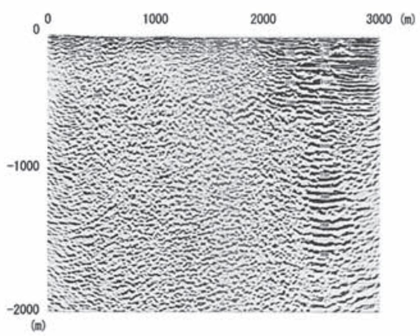
C

70 MTL TZ(SM of Sanuki Mountains) (Line 1)



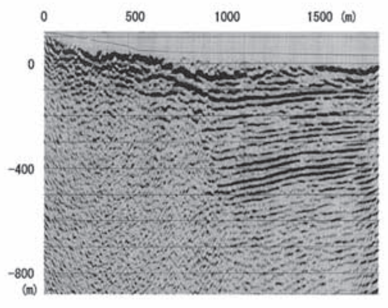
C

71 MTL TZ(SM of Sanuki Mountains) (Line 2)



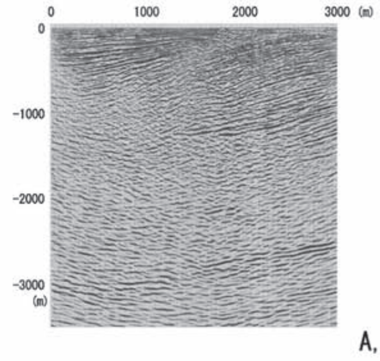
C

72 Mino Fault (Fukueki)

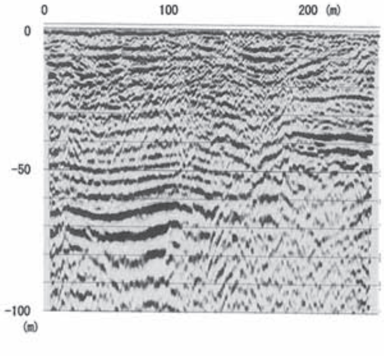


C

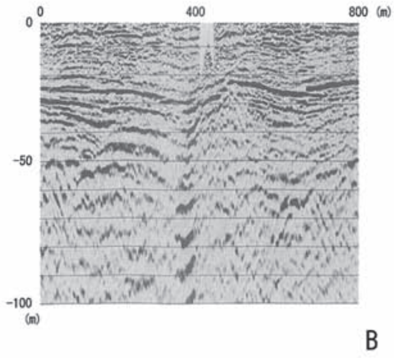
73 Beppu- Haneyama FZ (Oita River)



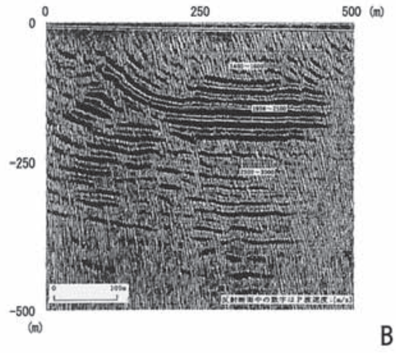
74 Beppu- Haneyama FZ (Funai Castle)



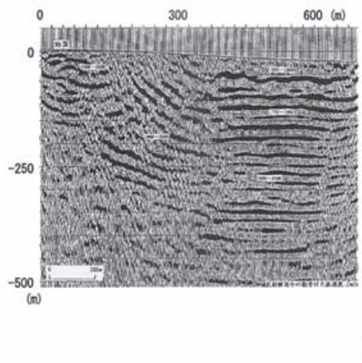
75 Beppu- Haneyama FZ (Art Hall)



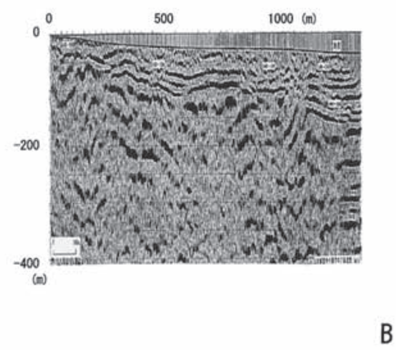
76 Nishiyama Fault (Matsuo)

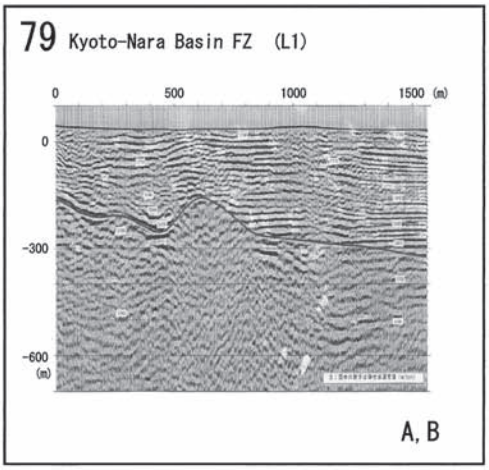


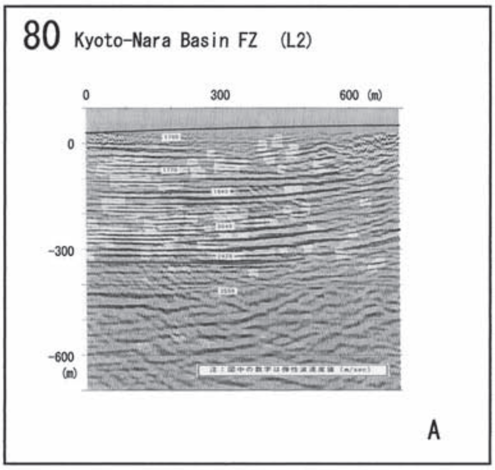
77 Nishiyama Fault (Katagihara)

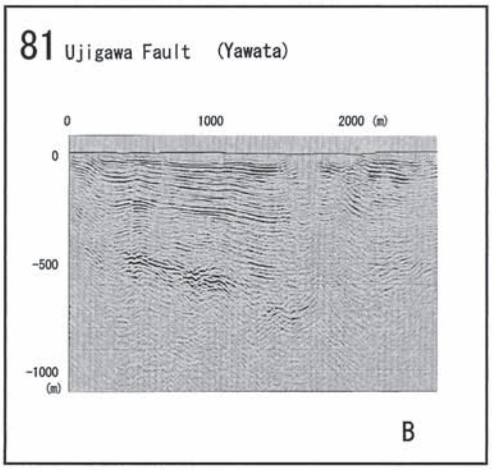


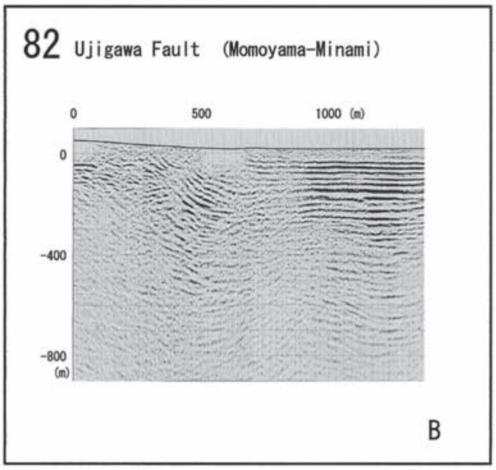
78 Nishiyama Fault (Haigata)

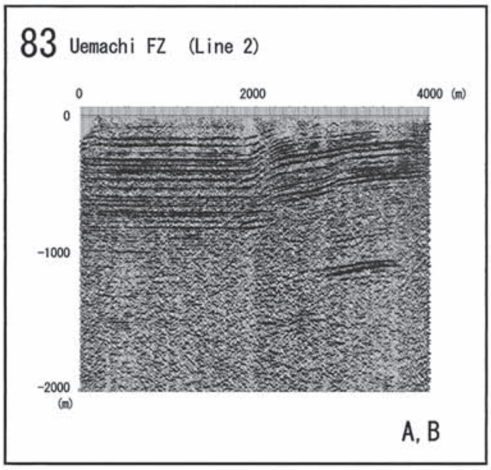


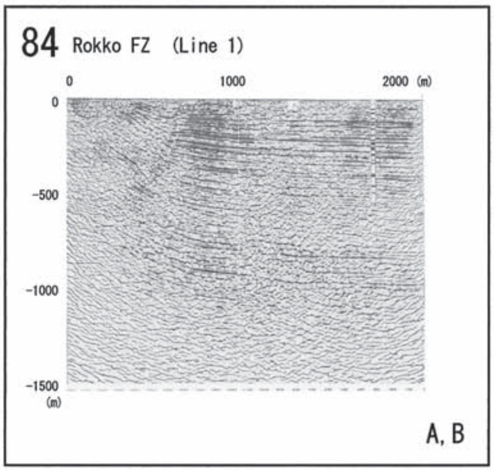

79 Kyoto-Nara Basin FZ (L1)
0
500
1000
1500 (m)
0
-300
-600
(m)
A, B


80 Kyoto-Nara Basin FZ (L2)
0
300
600 (m)
0
-300
-600
(m)
A


81 Ujigawa Fault (Yawata)
0
1000
2000 (m)
0
-500
-1000
(m)
B


82 Ujigawa Fault (Momoyama-Minami)
0
500
1000 (m)
0
-400
-800
(m)
B


83 Uemachi FZ (Line 2)
0
2000
4000 (m)
0
-1000
-2000
(m)
A, B


84 Rokko FZ (Line 1)
0
1000
2000 (m)
0
-500
-1000
-1500
(m)
A, B