BULLETIN OF THE EARTHQUAKE
RESEARCH INSTITUTE
UNIVERSITY OF TOKYO
Vol. 66 (1991) pp. 497-516

Crustal Structure of a Seismic-Refraction Profile across the Median and Akaishi Tectonic Lines, Central Japan

Ritsuko S. MATSU'URA[1)]*, Toshikatsu YOSHII[1)], Takeo MORIYA[2)],
Hiroki MIYAMACHI[2)]**, Yoshimi SASAKI[3)],
Akira IKAMI[4)]***, and Mizuho ISHIDA[5)]

[1)] Earthquake Research Institute, the University of Tokyo, Tokyo, Japan.
[2)] Faculty of Science, Hokkaido University, Sapporo, Japan.
[3)] Faculty of Education, Gifu University, Gifu, Japan.
[4)] School of Science, Nagoya University, Nagoya, Japan.
[5)] National Research Institute for Earth Science and Disaster Prevention, Tsukuba, Japan.

(Received June 28, 1991)

Abstract

In 1985, the Research Group for Explosion Seismology conducted a seismic refraction experiment along a profile in the central Japan region from Haruno, Shizuoka Prefecture to Tsukude, Aichi Prefecture. The 53 km-long profile with six shot points and 76 temporary observation sites crosses two major tectonic lines: the Median and the Akaishi. The refraction analysis reveals the P-wave velocity structure down to 5 km depth below the sea level under the profile. The structure of the upper crust along the profile is divided into four parts: A) the part east of the Akaishi tectonic line, B) the central part between two tectonic lines, C) the low-velocity zone at the Median tectonic line, and D) the part west of the Median tectonic line, by these two tectonic lines. The structure change at the Akaishi tectonic line is sharp, while the low-velocity zone of 4 km width exists under the Median tectonic line. P-wave velocities of the uppermost layers in A, B, C, and D are 3.1 km/s, 4.4 km/s, 3.8 km/s, and 4.5 km/s, respectively. The P-wave velocity of 6.0 km/s appears at depths of 5.6 km, 0.5 km, 4.7 km, and 2.6 km below the sea level in A, B, C, and D, respectively. P-wave velocities in B are the highest at each depth. Those in D are the second highest, while those in A are the lowest. Although the profile is only 53 km long,

* Now at Institute of Statistical Mathematics, Tokyo, Japan.
** Now at Faculty of Science, Kagoshima University, Kagoshima, Japan.
*** Now at Earthquake Research Institute, the University of Tokyo, Tokyo, Japan.
(A. IKAMI passed away on October 1, 1991)

two velocity discontinuities are found in the deeper parts of this profile from reflected waves. One is at the depth of 14 km under the Akaishi tectonic line. It extends 5 km both to the east and west, and slopes down to the west at an angle of 22 degrees. This discontinuity corresponds to the upper boundary of the local high seismicity zone in the lower crust under the profile. The reflected waves at this discontinuity can be clearly recognized even in raw records, and a sharp velocity contrast of about 10% exists there. The other discontinuity lies about 10 km deeper beneath the former one, and slopes down to the west at an angle of about 10 degrees. This discontinuity can be recognized in a wider area under the profile. It corresponds to the upper surface of the Philippine Sea plate subducting toward the northwest in this area.

1. Introduction

As one of a series of research projects on the crustal structure of Japan by the Research Group for Explosion Seismology, the 1985 experiment was done on the profile in Tokai area (Fig. 1). This profile crosses the Median and Akaishi tectonic lines. The Median tectonic line is an active right-lateral Quaternary fault (*e.g.* OKADA, 1973), while the Akaishi tectonic line has not been active recently. How the crustal structure changes across these tectonic lines is a very interesting problem.

The profile is located close to the focal region of the expected Tokai earthquake. In this area, the Philippine Sea plate subducts under the Eurasian plate toward the northwest with a speed of 6 cm/y. The depth of its upper surface under the profile is between 25 km and 30 km (ISHIDA,

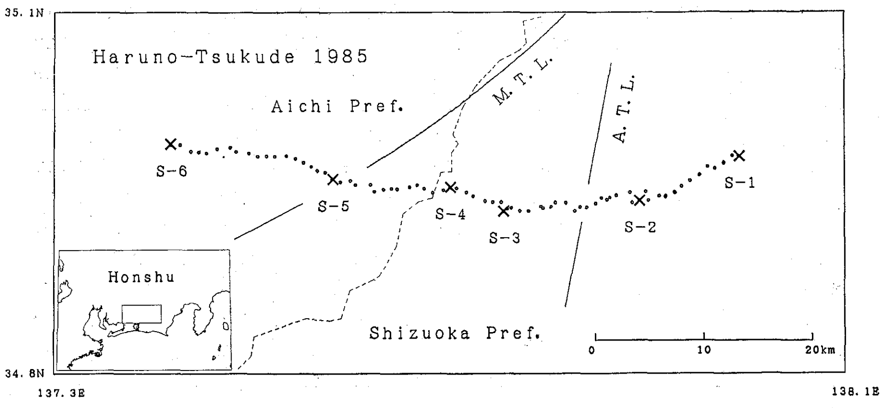


Fig. 1. Distribution of shot and observation sites. Crosses and solid circles indicate shot points and observation sites, respectively. Tectonic lines are shown by solid lines. M. T. L. and A. T. L. indicate the Median and the Akaishi tectonic lines, respectively. Broken lines show boundaries between prefectures.

1991). The part of the plate under the profile passed the Suruga trough only one and three-quarter million years ago. How the structure changes between the lower crust and the recently subducted plate is also interesting.

In the present paper, we analyze the travel time data of the profile and derive the structure of P-wave velocities in the upper crust, which also satisfies the waveform characteristics of observed records. We also utilize reflection data processing techniques to reveal the deeper structure.

2. Field Procedure

The total profile length was 53 km from Haruno, Shizuoka Prefecture, to Tsukude, Aichi Prefecture. There were six shot points in the profile (Fig. 1). Hereafter, shots are called S-1, S-2, S-3, S-4, S-5, and S-6 from east to west. The Median tectonic line crosses the profile just east of S-5, while the Akaishi tectonic line crosses it in the middle of S-2 and S-3. Dynamites of 300 to 500 kg were detonated in bore holes of 50 to 70 m depth (Table 1). In order to determine P-wave velocities near the surface, six observation stations were also set every 100 m from each shot point.

The seismic data were recorded at 76 sites on portable cassette-recording seismographs with 2.2 Hz vertical component seismometers (Mark Products L-22D, $h=0.7$). The radial component data were also recorded by the similar horizontal component seismometers at half of the stations. The seismic signal was recorded in FM or PCM mode. The spectral response of the total recording system was set to be flat between 0.5 and 30 Hz.

JJY (Japanese standard time signal broadcast on the radio) was used for the time calibration. It was recorded at least before and after an explosion was recorded to calibrate signals of an installed crystal clock. The accuracy of time was kept better than 0.01s.

All stations were located on 1 : 25,000 topographic maps to the ac-

Table 1. List of shot points.

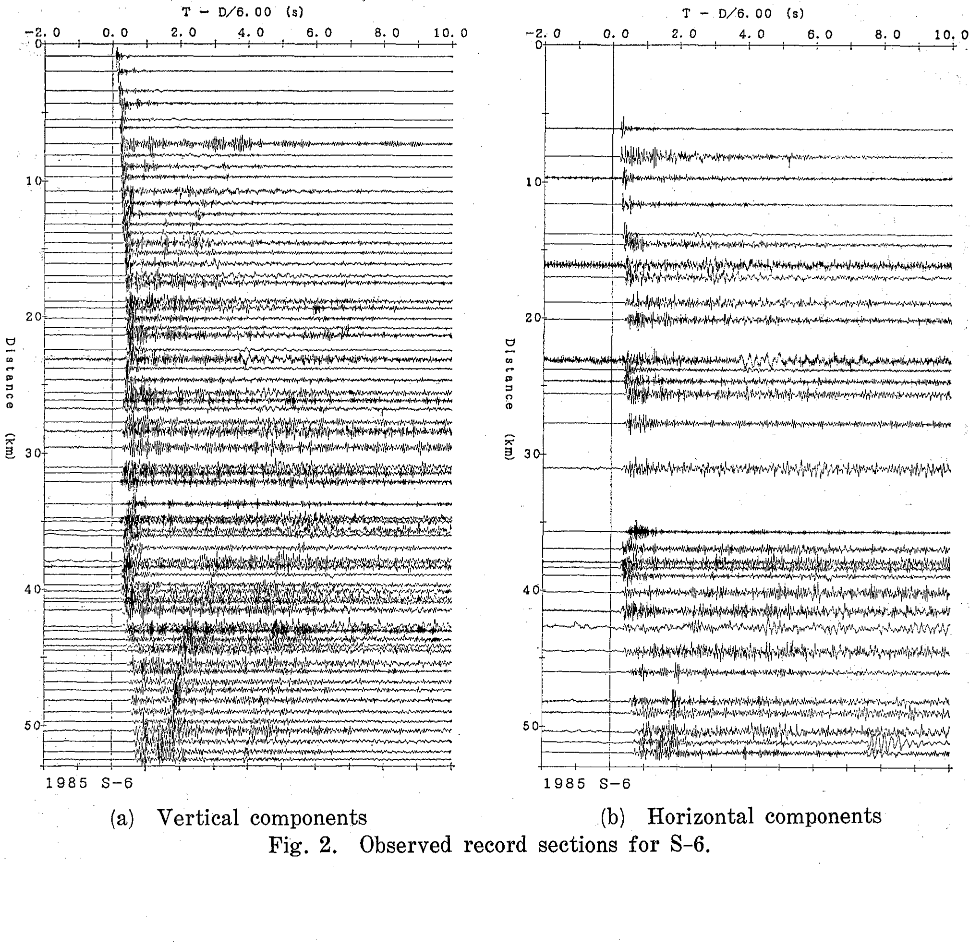
Shot	Date	Time	Latitude	Longitude	Height	Charge
S-1	1985 Nov. 29	01:12:00.06	34°58′49.4″N	137°59′38.6″E	409 m	500 kg
S-2	Nov. 28	01:01:59.69	34°56′37.3″N	137°53′35.9″E	131 m	300 kg
S-3	Nov. 28	01:12:00.70	34°56′05.8″N	137°45′21.5″E	300 m	300 kg
S-4	Nov. 29	01:02:00.69	34°57′18.0″N	137°42′05.3″E	295 m	400 kg
S-5	Nov. 28	01:21:59.89	34°57′42.4″N	137°34′57.9″E	223 m	400 kg
S-6	Nov. 29	01:22:00.00	34°59′27.3″N	137°25′05.3″E	596 m	500 kg

curacy of 20 m (Fig. 1). The average station spacing is about 700 m. Altitudes of the stations vary from 75 m to 600 m. Detailed data such as locations of the stations, travel times, *etc.* were published in a separate paper (RESEARCH GROUP FOR EXPLOSION SEISMOLOGY, 1989).

3. Data Analysis

Travel times were read manually from the reproduced records. Impulsive first arrivals were visible on most of the records. Each first arrival was classified into three ranks: A, B, and C, which correspond to accuracies of 0.01s, 0.03s, and 0.05s, respectively. When the very onset was difficult to read within the accuracy of rank C, it was removed from all figures and further analysis. Arrival times of later phases were read only when they could be identified within the accuracy of rank C.

In order to utilize the information in waveforms, each record was



(a) Vertical components (b) Horizontal components

Fig. 2. Observed record sections for S-6.

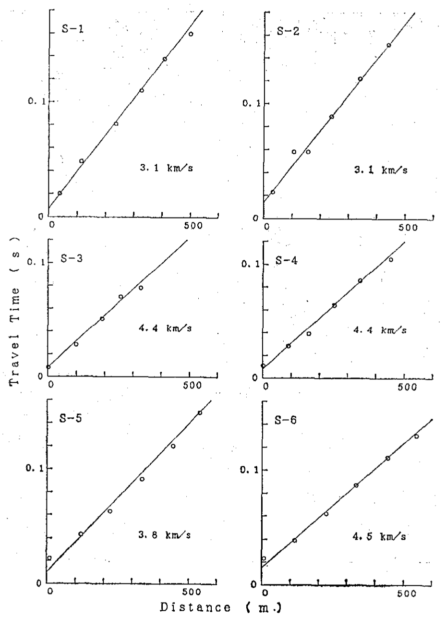


Fig. 3. Travel time curves near each shot. Solid lines and numerals in each figure indicate the least square solutions.

digitized through a 12-bit A/D converter with 100 Hz sampling. In Fig. 2, examples of the record sections reproduced from these digital data are shown. Waveform data in digital form are easily passed through various filters which are useful to identify later phases. They even make it possible to use reflection data analysis, which will be described later. What are notable from the raw record sections are: 1) S waves can be seen even on vertical components, and 2) clear later phases can be seen in the record sections of the vertical component.

We obtained the P-wave velocity structure by forward modeling to achieve the best fit between observed and calculated travel times by asymptotic ray theory (ČERVENÝ *et al.*, 1977). In order to extract the information contained in waveforms, we searched for the best model among models in which P-wave velocities have gradients in vertical and lateral directions, and they are continuous except at the boundary between the uppermost layer and the next one. With these restrictions, we could use the SEIS83 computational program (ČERVENÝ and PŠENČÍK, 1983) for the calculation of travel times and the synthesized seismograms. We chose the single force type source for synthesization in order to obtain S waves, which are seen clearly in our observations and do not appear for explosive sources theoretically.

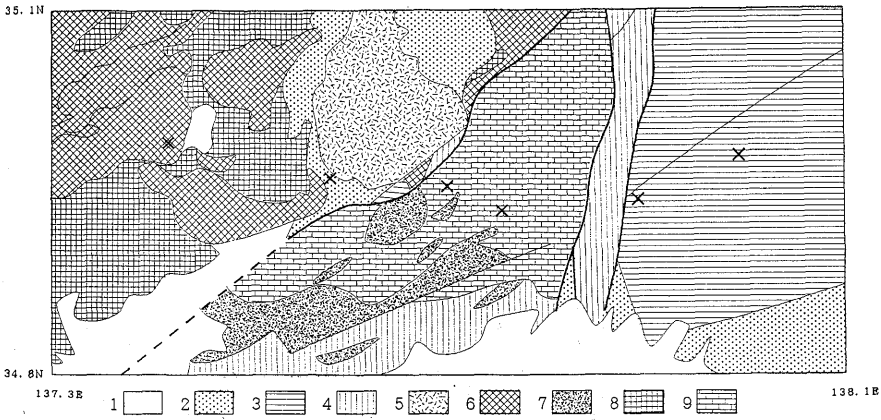
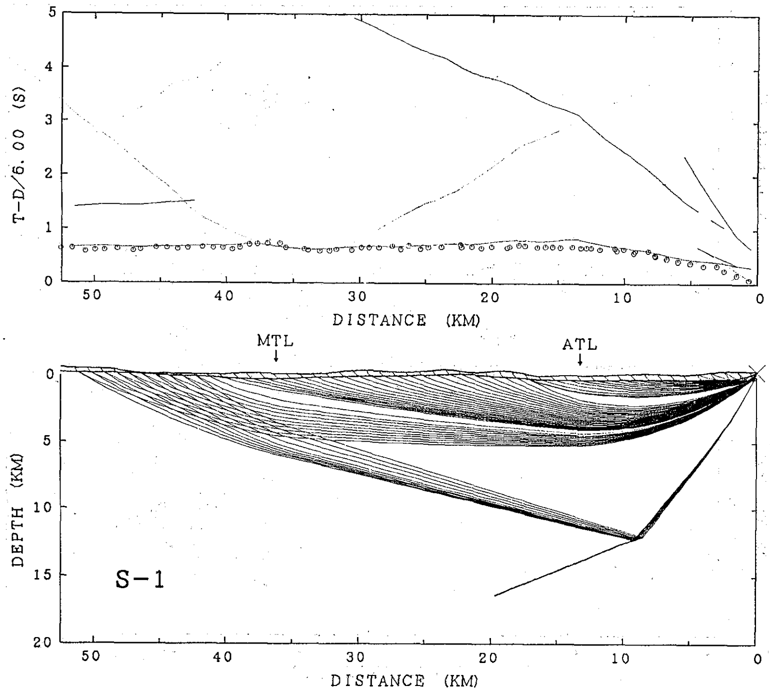


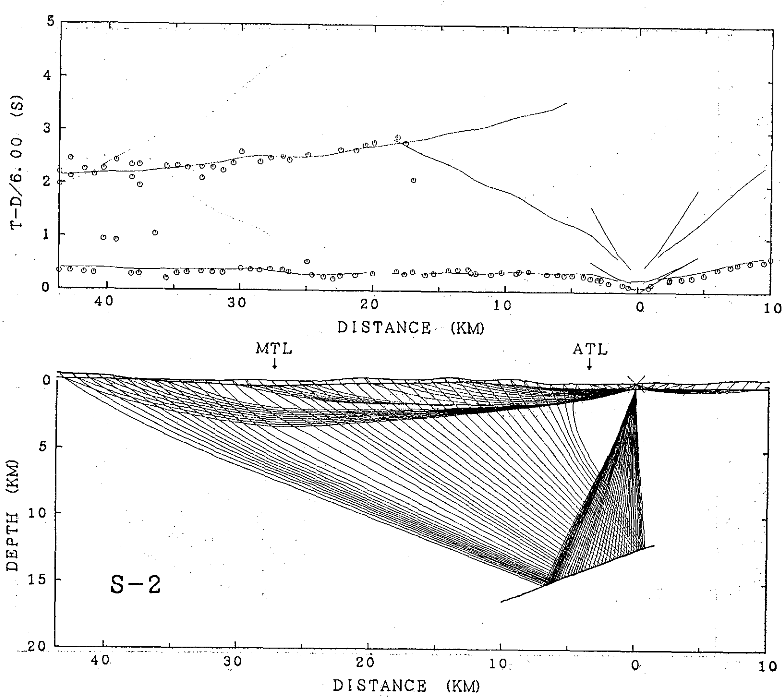
Fig. 4. Geological map of the area after the 1:200,000 Geological Map of Toyohashi. Crosses indicate six shot points.
1: Quaternary, 2: Neogene, 3: Late Mesozoic to Paleogene, 4: Permian to Early Mesozoic, 5: Neogene igneous rocks, 6: Cretaceous plutonic rocks, 7: Permian igneous rocks, 8: Ryoke metamorphic rocks, 9: Sanbagawa metamorphic rocks.

The P-wave velocities of the uppermost parts were determined from observed travel times near each shot point (Fig. 3). The velocity near each shot point is obtained by the least square method. For S-1 and S-2, it is 3.1 km/s. For S-3 and S-4, it is 4.4 km/s. For S-5 and S-6, it is 3.8 km/s and 4.5 km/s, respectively. Based on the surface geology of this area (GEOLOGICAL SURVEY, 1972; Fig. 4), lateral boundaries of P-wave velocities in the uppermost layer along the profile were assumed in the starting model as follows. The boundary of the 3.1 km/s-area and the 4.4 km/s-area is the Akaishi tectonic line. The 3.8 km/s-layer is assumed to appear only in the narrow zone between S-5 and the Median tectonic line. The area west of this zone has a layer of 4.5 km/s.

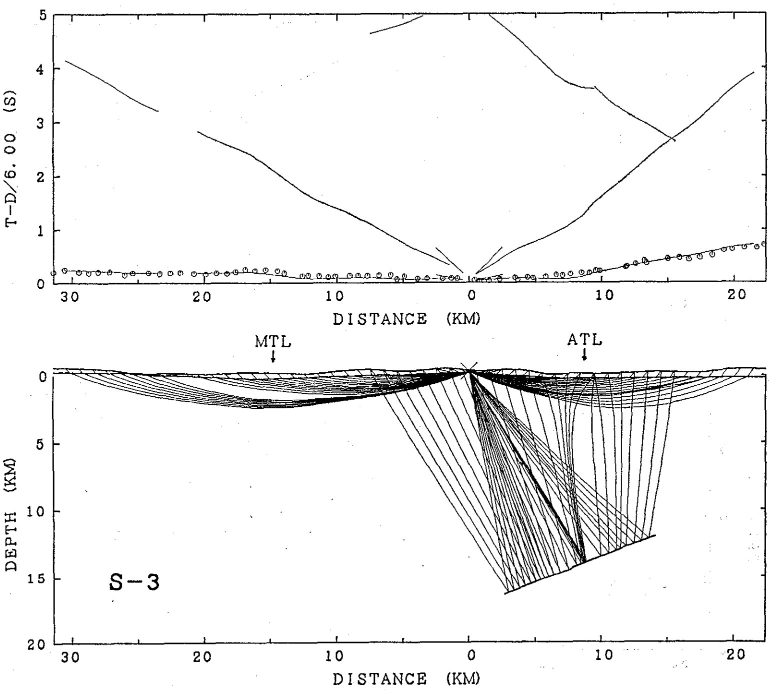
Reduced travel times of first and later arrivals with a reduction velocity of 6.0 km/s are shown in Fig. 5. Record sections of vertical components for all shots are shown in Fig. 6. What is clear from the travel time data is the following (RESEARCH GROUP FOR EXPLOSION SEISMOLOGY, 1989): 1) At stations ten kilometers or less from S-1, first arrivals from shot S-1 show such a low apparent velocity, 4.7 km/s. Data at stations farther than 10 km from S-1 show an apparent velocity of about 6 km/s with the largest intercept time (0.8 s) among six shots (Fig. 5(a)). First arrivals of shot S-2 in the direction of S-1 also show a low apparent velocity (Fig. 5(b)). The velocity between S-1 and S-2 must be lower than in other parts. 2) Travel times observed at sites between the two tectonic lines show the very small intercept times (0.1 s) for shots S-3 and S-4 (Fig. 5(c), (d)). The velocity of 6 km/s appears at



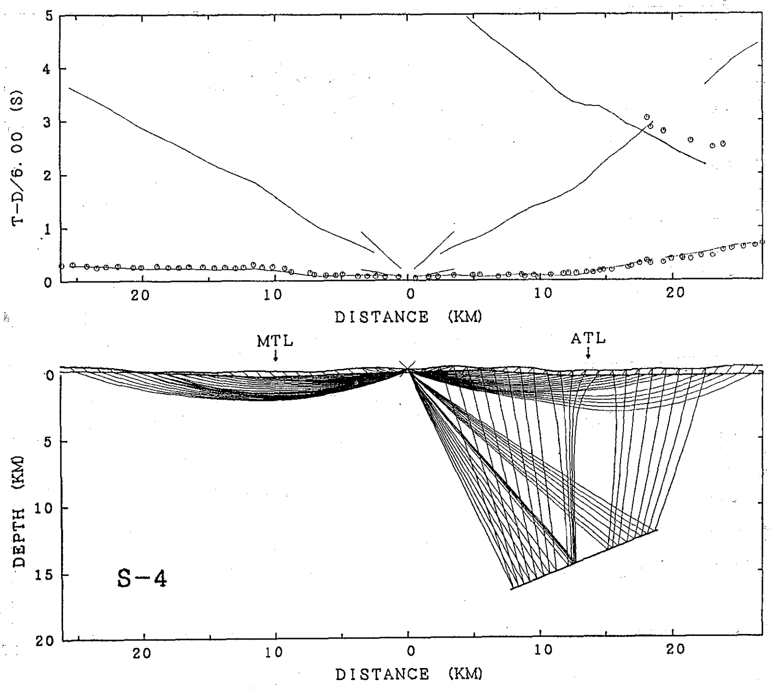
(a) for shot S-1



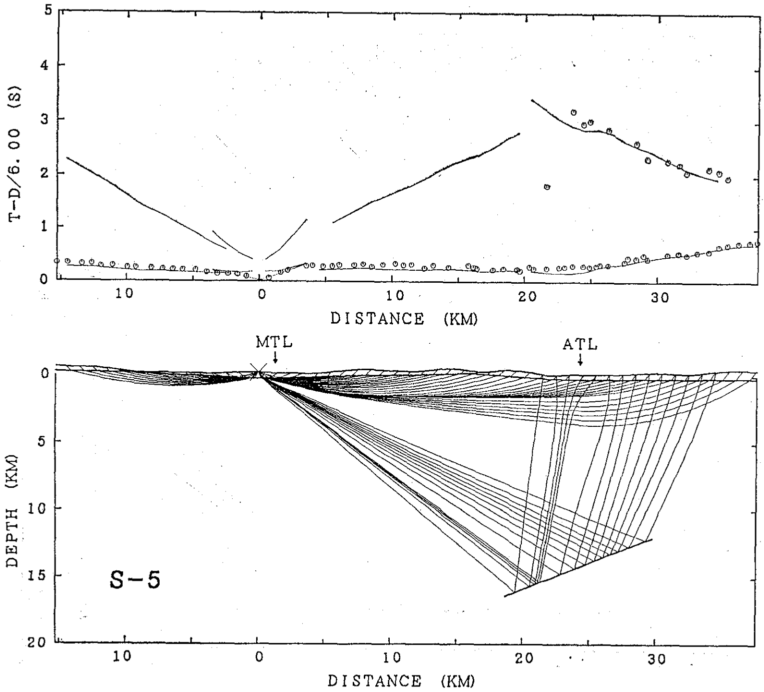
(b) for shot S-2



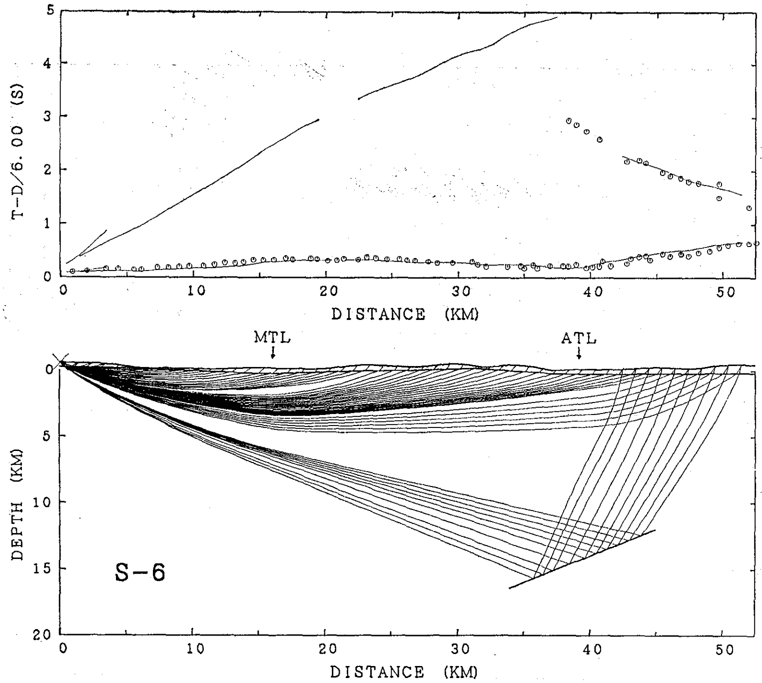
(c) for shot S-3



(d) for shot S-4

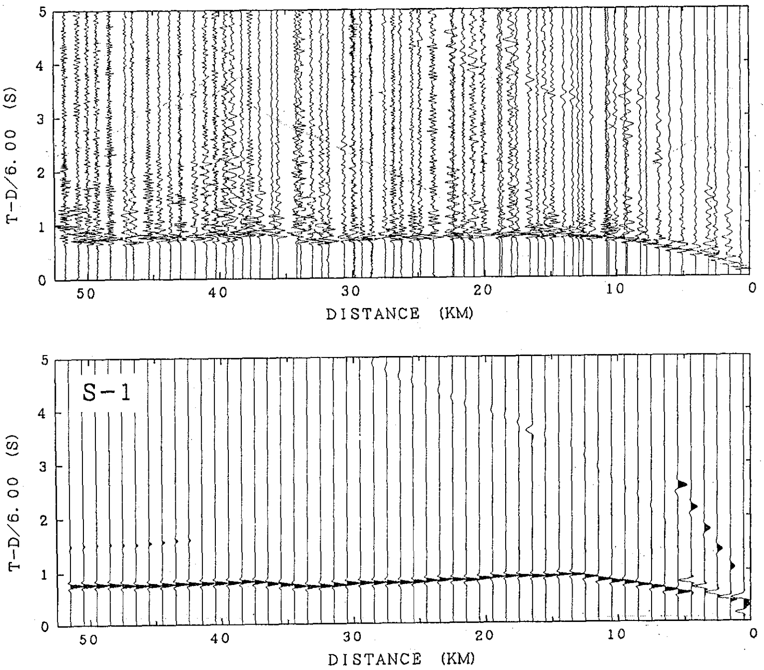


(e) for shot S-5

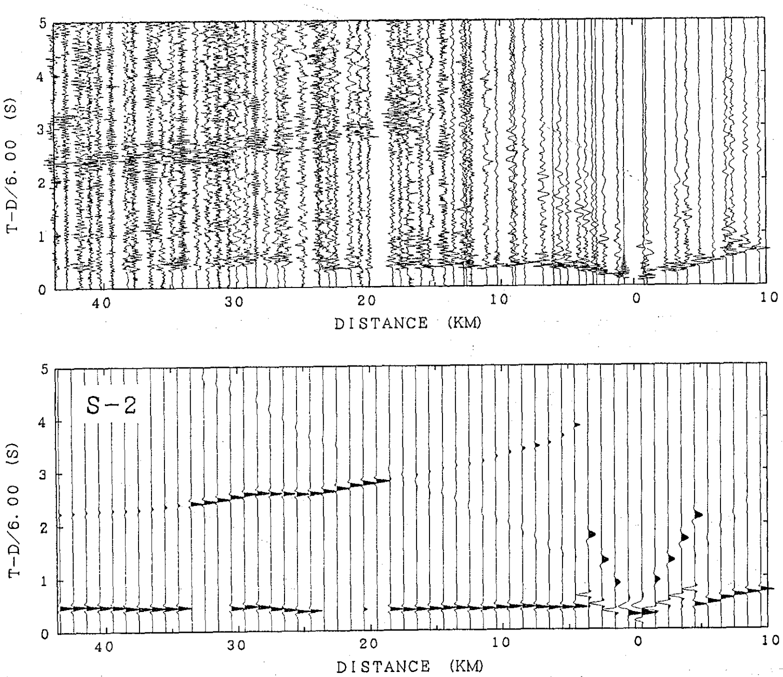


(f) for shot S-6

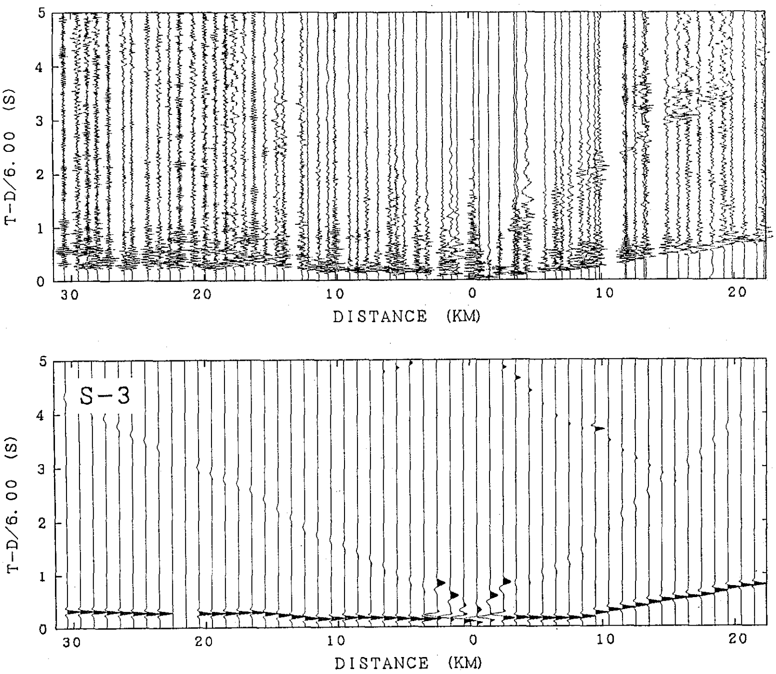
Fig. 5. Reduced travel times and the corresponding ray paths. Circles indicate observed data. Solid lines show calculated travel times for the obtained model.



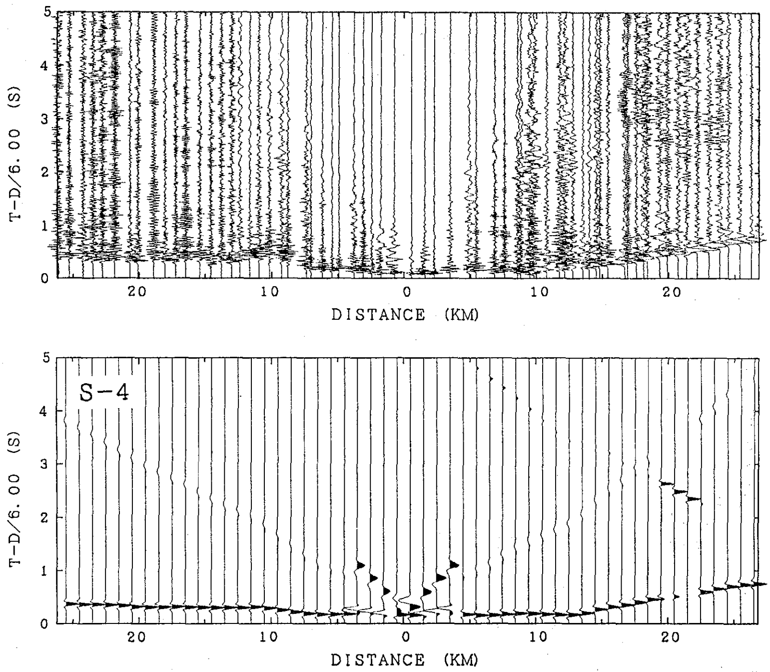
(a) for shot S-1



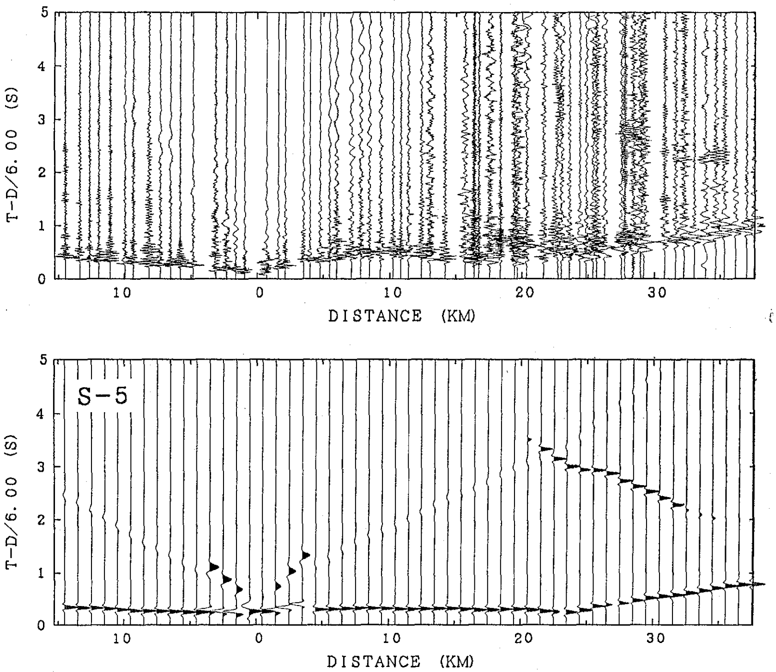
(b) for shot S-2



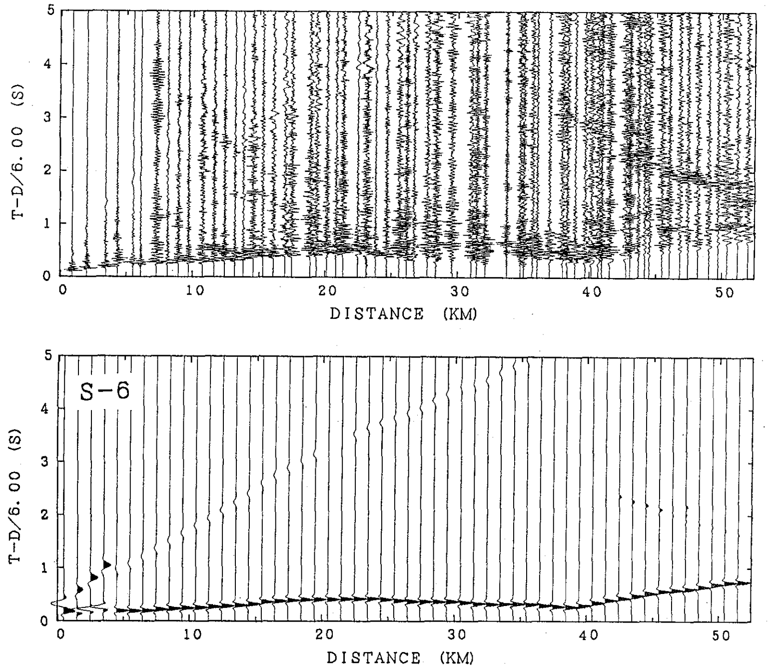
(c) for shot S-3



(d) for shot S-4



(e) for shot S-5



(f) for shot S-6

Fig. 6. Synthesized seismograms and observed record sections. Time axis is reduced by a velocity of 6.0 km/s. The amplitude scale of each record is adjusted so that the maximum amplitude of each trace becomes a unit length on the figure.

a very shallow depth (about 500 m) in this area. 3) Travel times of shots S-1, S-2, S-3, and S-4 observed at sites around the Median tectonic line involve delay of about 0.05s compared those at the stations surrounding these sites (Fig. 5(a)-(d)). The velocities under the Median tectonic line therefore appear to be slightly smaller than those in the surrounding area. 4) The clear later phase is seen in large amplitudes on traces of shot S-2 obtained at stations fifteen kilometers away or farther west from S-2 (Fig. 6(b)). The apparent velocity of this phase is slightly larger than the first arrivals'. The corresponding phase is also seen on traces observed at the eastern sites of the profile for shots S-4, S-5, and S-6 (Fig. 6(d)-(f)). Its apparent velocity is larger than that for S-2.

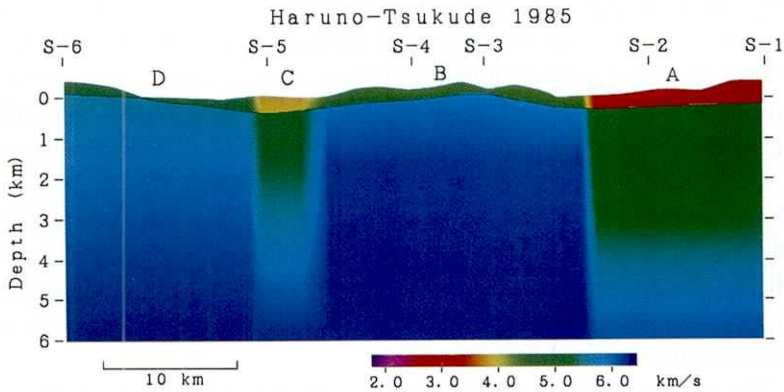
By means of the above features of travel time data, we formulated the initial model for the P-wave velocity structure. The uppermost part is divided into four parts as described previously. The P-wave velocities in these parts were fixed through the course of searching for the best model, while the lateral boundaries between the different velocities were moved as the occasion demanded. The deeper parts are divided into three parts by the two tectonic lines in the starting model. The thickness of the uppermost layer as well as the velocity and its vertical gradient under that layer in each part are set to represent the features of 1) and 2) adequately. In the course of improving the model, we have to introduce the low-velocity zone of 4 km width at the Median tectonic line not only in the uppermost layer. Without this zone, the model cannot represent the features of 3).

The S-wave velocity structure could not be obtained in detail, since few S-phase travel time data satisfied the accuracy of rank C. We compared S-phase arrivals in the synthesized seismograms for several candidates for Poisson's ratio with observed seismograms.

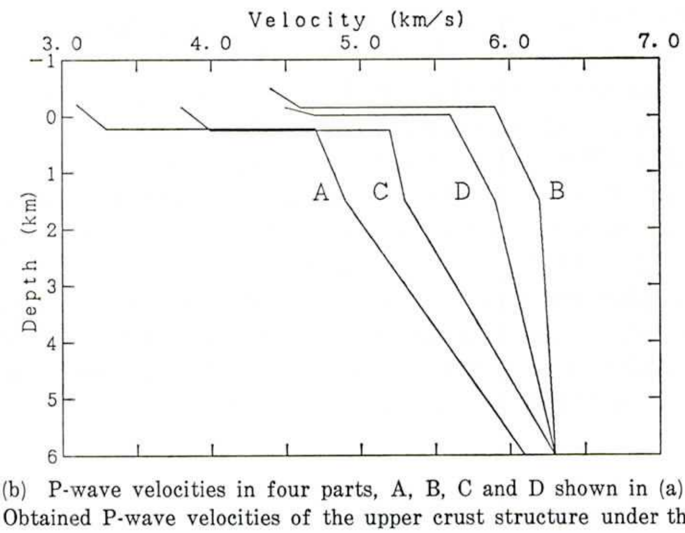
The profile length is only 53 km. However, information on the lower crust and deeper structure could be obtained from later arrivals and wave forms. We processed all of the waveform data as reflection data (*e.g.* YOSHII, 1990). Although 76 stations and six sources are sparsely set and source time is not long, seismograms show good S/N without stacking. The refracted parts are removed by the first break mute for (Δ km/6 km/s+1s), where Δ is the epicentral distance. Each trace is expected to display reflectors under the middle point between its source and the geophone. The gain recovery is done as in the processing of ordinary reflection data. The normal move out correction is done with the velocity of $(5.7+0.05\times$two-way travel time) km/s.

4. Results and Discussion

Figure 7 shows the final model obtained. The theoretical travel times and corresponding ray paths for this model are shown in Fig. 5. The synthesized seismograms from this model are compared with observed ones in Fig. 6. The upper part of the crust along the profile is divided by the two tectonic lines into four parts: the part east of the Akaishi tectonic line (indicated as A), the central part between the two tectonic lines (B), the low-velocity zone under the Median tectonic line (C), and the part west of the Median tectonic line (D). P-wave velocities in A are the lowest among those in four parts of the same depth. Those in B are the highest. The Akaishi tectonic line divides A from B.



(a) P-wave velocities are shown by colors.



(b) P-wave velocities in four parts, A, B, C and D shown in (a).

Fig. 7. Obtained P-wave velocities of the upper crust structure under the profile.

Among the infinite ways of improving the model, we avoid introducing a velocity discontinuity except at the bottom of the uppermost layer in each part. The discontinuity of the vertical velocity gradient is only introduced at the depth of 1.5 km. We aimed to obtain a final model with a small number of parameters. Since we did not smooth the discontinuity of the velocity gradient by introducing layers and parameters, the synthesized seismograms still show rather small amplitudes at first arrivals of certain traces. However, it is wiser to use different methods such as the Gaussian beam method to obtain a closer fit to the observed waveforms than to struggle with an SEIS83-type program. Our final model gives enough agreement on waveforms within the limitations of SEIS83.

Poisson's ratio of 0.25 is chosen in the final model of Fig. 7. There are not any clear differences of the ratio among the four parts of the profile. Direct S waves observed at a few stations near each shot arrived later than expected by the ratio of 0.25. It is plausible that Poisson's ratio in the uppermost layer is far greater than 0.25. It is also plausible that it takes scores of msec for the generation of S waves after P waves are generated by an explosive source. Our S-wave data could not tell which is the chief reason.

The Median tectonic line is one of the active major strike-slip faults in Japan, while the Akaishi tectonic line is old and not active recently. Although the part of the Median tectonic line that the profile crosses is *Certainty III*, it is only 20 km southwest from the active part of *Certainty I* near Misakubo (RESEARCH GROUP FOR ACTIVE FAULTS, 1980). A sharp change in the P-wave velocity structure is observed at the old Akaishi tectonic line. The velocity beneath the Median tectonic line is lower than those on both sides and forms a low-velocity zone of about four-kilometer width. The vertical extent of this zone is at least 5 km. A similar low-velocity zone is also reported beneath a part of the San Andreas fault in California (*e.g.* TREHU and WHEELER, 1987). The existence of such a low-velocity zone beneath a fault may be evidence of recent activity. Conversely, such a sharp boundary line of the structure as the Akaishi tectonic line is a fossil of an ancient fault.

The gravity anomaly of the area around the profile is shown in Fig. 8 (SHICHI *et al.*, 1988). The assumed density is 2.67 g/cc. The Bouguer anomaly is low in the part east of the Akaishi tectonic line (A) and the low-velocity zone under the Median tectonic line (C), where a P-wave velocity of 6.0 km/s appears at depths of 5.6 km and 4.7 km, respectively. The anomaly is high in the central part (B) and the part west of the Median tectonic line (D), where the 6.0 km/s layer appears at depths of 0.5 km and 2.6 km, respectively. In A and C, the density

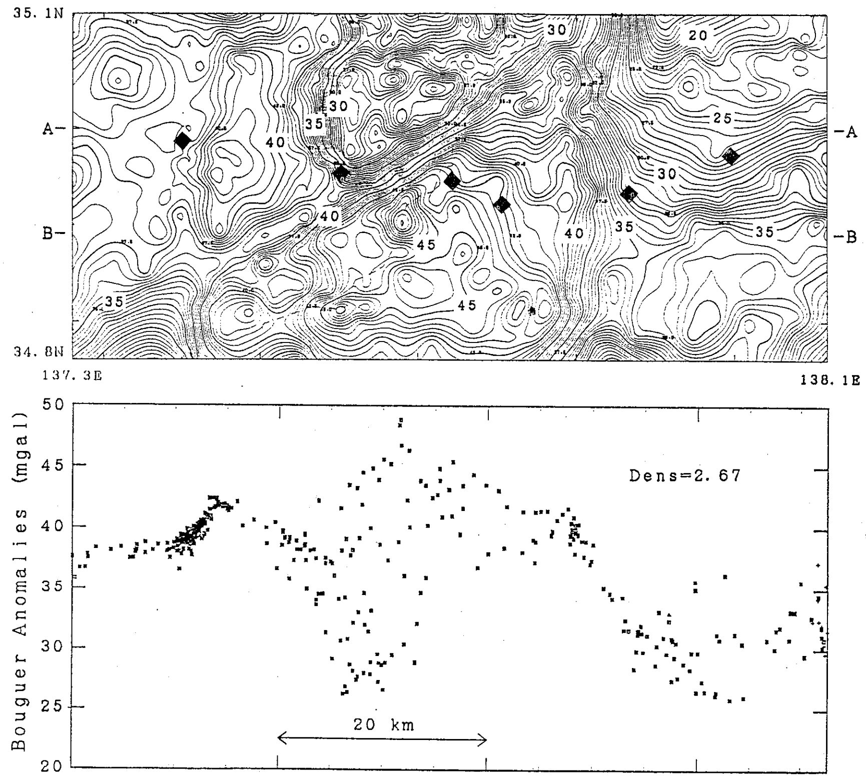


Fig. 8. Bouguer anomaly in the area around the profile based on the data of SHICHI *et al.* (1988).

Top figure shows the contour map of the anomaly of the area shown in Fig. 1. Closed rhombi indicate six shot points.

Bottom figure shows the east-west cross section of the Bouguer anomaly in the area between A and B shown in the top figure.

as well as Lame's constant is small. Rocks in these areas may be more porous and less rigid than those in B and D. Surface rocks in both B and D were metamorphosed (Fig. 4). The metamorphism made rocks in these parts denser and more rigid.

The clear later phases of feature 4) correspond to the reflected waves at the sharp velocity discontinuity of about 10% lying under the Akaishi tectonic line around the depth of 14 km. The discontinuity slopes down about 22 degrees to the west and extends at most 5 km to the east and west. The discontinuity and ray paths of reflected waves are shown in Fig. 5. Such clear reflected phases in raw records are seldom observed in the crust by explosion experiments in Japan.

The reflection from this discontinuity is also clear at about 5–6s of two-way travel time in the seismic section (Fig. 9). We can follow this

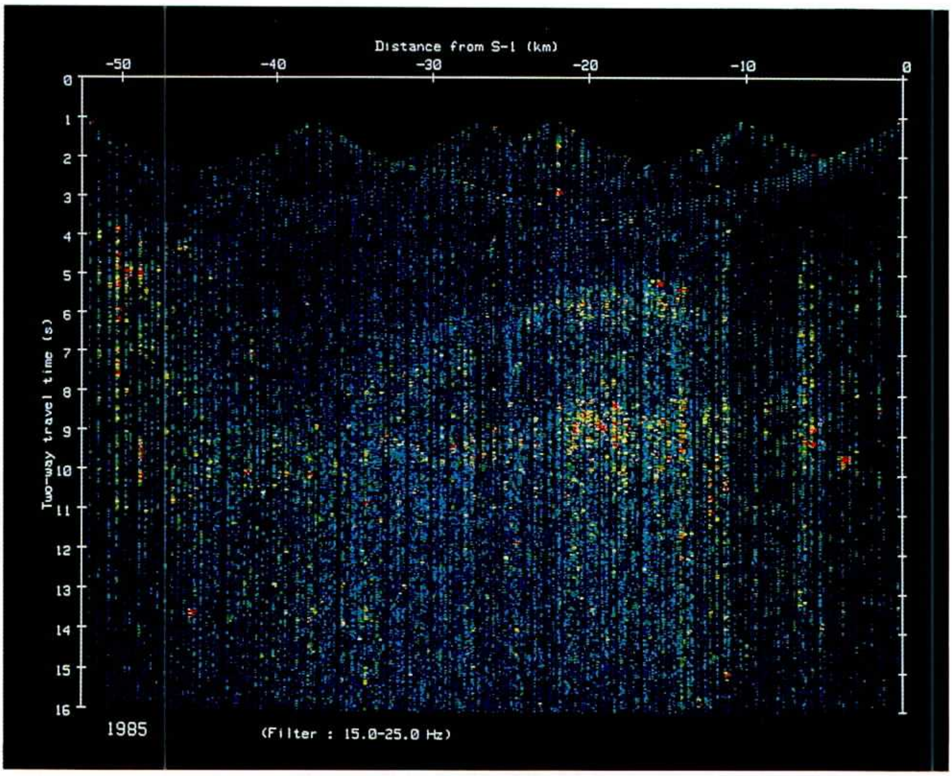


Fig. 9. The seismic section obtained by the reflection data analysis described in the text. A band-pass filter from 15 Hz to 25 Hz is used. Vertical axis shows the two-way travel time. Blue and red colors indicate small and large amplitudes, respectively.

phase for about 20 km in the horizontal direction. However, it swerves and becomes weak at both ends. The sharp velocity discontinuity only extends 10 km as the result of the travel time analysis. The swerved parts at both ends represent the diffraction at edges of the discontinuity. This discontinuity is very sharp, but it is small and local.

The hypocenter distribution of natural earthquakes along the profile is shown in Fig. 10. The location of this sharp discontinuity coincides with the upper boundary of the high seismicity region under the Akaishi tectonic line which is also inclined to the west. Earthquakes in the Philippine Sea plate lie beneath this region. The seismicity in the plate beneath this region is lower than that on both sides. The composition of the lower crust is different beneath the Akaishi tectonic line.

In Fig. 9, another discontinuity is seen at 8–9s of two-way travel time. When the P-wave velocity is assumed to be 7 km/s under the former discontinuity, this discontinuity lies about 10 km beneath the first

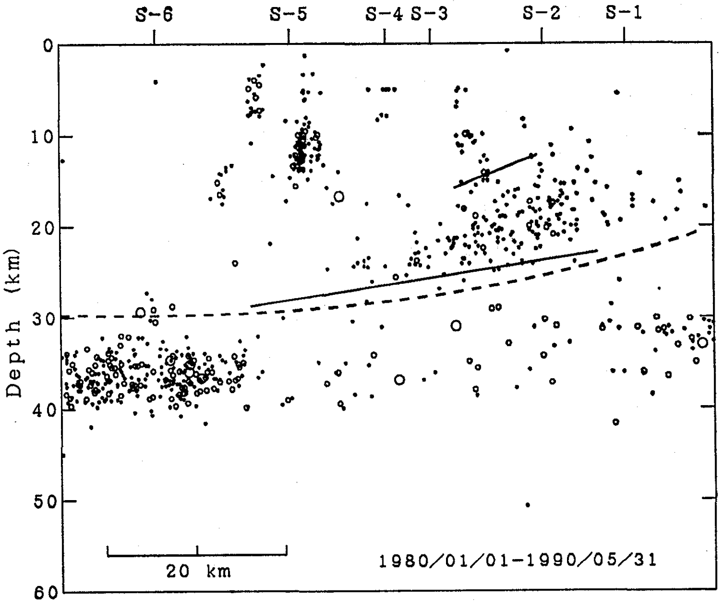


Fig. 10. The hypocenter distribution of micro and larger earthquakes in the area around the profile based on data of the National Research Institute for Earth Science and Disaster Prevention. The east-west cross section of the area between A and B in Fig. 8 is shown. The solid lines indicate two sharp discontinuities of P-wave velocities revealed by this study. The seismicity at depths from 30 to 40 km represents activity in the Philippine Sea plate. The upper boundary of the Philippine Sea plate according to ISHIDA (1991) is shown by the broken line.

one. This reflector is clear from the Median tectonic line to the part east of the Akaishi tectonic line. The reflection is not clear in the part west of the Median tectonic line, where the seismicity in the Philippine Sea plate is higher than in other areas (Fig. 10). This reflector does not swerve. It slightly slopes down to the west at about 10 degrees.

This discontinuity corresponds to the upper surface of the subducting Philippine Sea plate (Fig. 10, ISHIDA, 1991). Although the profile is short and the experiment was carried out by the refraction method, we can obtain the reflection at the boundary of the Philippine Sea plate and the Eurasian plate. However, the velocity contrast between the island-arc crust and the sea plate is not as large as it appears in the raw records.

5. Conclusions

From data obtained in an experiment along the profile crossing the Median and the Akaishi tectonic lines, we determined the crustal structure of P-wave velocities under the profile. The structure beneath the active Median tectonic line forms a low-velocity zone, while the old Akaishi tectonic line forms a sharp lateral boundary of the structure.

The upper crustal structure under the profile is divided into four parts: (A) the part east of the Akaishi tectonic line, (B) the central part between the two tectonic lines, (C) the low-velocity zone of 4 km width under the Median tectonic line, and (D) the part west of the Median tectonic line. The velocity at each depth is highest in B, the second highest in D, and lowest in A. The P-wave velocity of 6 km/s appears at depths of 5.6 km, 0.5 km, 4.7 km, and 2.6 km in A, B, C and D, respectively. The Bouguer anomaly is high in B and D. However, Poisson's ratio of 0.25 can represent S-wave arrivals in all parts.

From the clear reflected waves, a sharp discontinuity 10 km long, which corresponds to the upper boundary of the high seismicity region in the lower crust, was found at the depth of 14 km under the Akaishi tectonic line. The reflection data analysis enabled us to recognize another deeper velocity discontinuity, which extends beneath most of the profile. It corresponds to the upper surface of the Philippine Sea plate subducting under the Eurasian plate. The depth of this discontinuity agrees well with the depth of the Philippine Sea plate model recently obtained (ISHIDA, 1991).

Acknowledgments

We are grateful to members of the Research Group for Explosion Seismology for their cooperation. R. SHICHI and his colleague kindly approved use of their gravity data along the profile. The experiment was done with support from the Special Projects Fund of the Earthquake Research Institute, the University of Tokyo as part of the Fifth Earthquake Prediction Project in Japan. Satoru KURIYAMA (at Institute of Disaster Prevention, Kyoto University then) partly contributed to this work in the first stage.

References

ČERVENÝ, V., I. A. MOLOTKOV, and I. PŠENČÍK, 1977, Ray method in seismology, Univ. Karlova, Praha, 214pp.

ČERVENÝ, V. and I. PŠENČÍK, 1983, Program Package SEIS83, Univ. Karlova, Praha.

GEOLOGICAL SURVEY, 1972, Toyohashi, 1:200,000 Geological Map.

ISHIDA, M., 1991, Geometry and relative motion of the Philippine Sea plate and Pacific plate beneath the Kanto-Tokai district, Japan, *J. Geophy. Res.* (in press).

OKADA, A., 1973, The faulting of the Median tectonic line in the Quaternary, in the Median tectonic line, Ed. by R. Sugiyama, Tokai Univ. Press, pp. 49-86 (in Japanese).

RESEARCH GROUP FOR ACTIVE FAULTS, 1980, Active faults in Japan, sheet maps and inventories, Univ. Tokyo Press, Tokyo, p. 24 and pp. 192-193 (in Japanese with English summary).

RESEARCH GROUP FOR EXPLOSION SEISMOLOGY, 1989, Explosion seismic observations in Shizuoka and Aichi Prefectures, central Japan (Haruno-Tsukude profile), *Bull. Earthq. Res. Inst., Univ. Tokyo*, **64**, 533-551 (in Japanese with English abstract).

SHICHI, R., A. YAMAMOTO, and M. SAWAI, 1988, Bouguer anomalies around Mt. Ontake and Shidara area, Aichi Pref., in 70th Meet. Geod. Soc. Symp. Recent Crustal Movements (IV) Abstracts, Geod. Soc. Japan and Nation. Commit. Geodesy Sci. Council Japan, pp. 118-119 (in Japanese).

TREHU, A. M., and W. H. WHEELER IV, 1987, Possible evidence for subducted sedimentary materials beneath central California, *Geology*, **15**, 254-258.

YOSHII, T., 1990, Reflection analysis of the waveform data obtained in seismic-refraction experiments, *Abstr. Fall Meet., Seism. Soc. Japan*, No. 2, 91 (in Japanese).

中部日本の中央構造線および赤石構造線を横切る屈折法測線の地殻構造

地震研究所 松浦律子* 吉井敏尅

北海道大学理学部 森谷武男 宮町宏樹**

岐阜大学教育学部 佐々木嘉三

名古屋大学理学部 伊神煇***

防災科学技術研究所 石田瑞穂

1985年11月，地震予知計画の一環として人工地震による地殻構造調査が，静岡県春野町と愛知県作手村を結ぶ全長約 53 km の測線で行われた．この測線の位置は予想されている東海地震の震源域のすぐ西側であり，さらに，中央構造線と赤石構造線を横切っている．爆破点は測線上に 6 箇所，臨時観測点は 76 箇所である．

主として初動の走時をもとに，波線追跡法によって地下数 km までの地殻の比較的浅い部分の構造が推定された．中央構造線と赤石構造線は構造の著しい境界となっており，上部地殻の地震波速度は両構造線の間で最も大きく，赤石構造線の東側でかなり小さい．中央構造線は，それ自体が低速度となっている．上部地殻のほか，深さ約 15 km 付近にある著しい反射面の位置も，波線追跡法により求められた．この反射面は測線全体で認められるわけではなく，測線の東端に近い 10 km 程度の範囲に限られている．

今回の実験はもともと屈折法探査として企画されたものであるが，記録がかなりの数にのぼるので，簡単な反射法的な手法を用いて処理してみた．往復走時で 8～10 s 付近に，西に向かってわずかに深くなる明瞭な反射面が測線のほぼ全体にわたって現れた．深さにすると 20～30 km となるこの反射面は，微小地震の分布などから推定されている東海地域の下に沈み込むフィリピン海プレートの上面とよく一致する．

* 現在，統計数理研究所

** 現在，鹿児島大学理学部

*** 現在，地震研究所（1991 年 10 月 1 日逝去）