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동해 울릉분지의 지구물리학적 연구
한국-러시아 공동연구

A Geophysical study on the Ulleung Basin, the East Sea (the Sea of Jpapn)
-Korea and Russia cooperative research-

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한국해양연구소

제 출 문

한국해양연구소장 귀하

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요 약 문

I. 제 목

동해 울릉분지의 지구물리학적 연구 (한국-러시아 공동연구)

II. 연구개발의 목적 및 중요성

동해는 북서 태평양지역에서 가장 활발히 조사가 이루어지고 있는 주변해의 하나로서 이의 생성기원에 대해서는 여러가지의 학설이 제시되고 있다. 최근에는 동해의 주요 구조인 일본분지와 야마토분지에서 얻은 심부 굴절파 탐사자료를 이용하여 동해의 전반적인 심부 지질구조를 밝힘과 아울러 이의 생성기원을 구명하려는 연구가 활발히 전개되고 있다. 현재까지 심부구조에 대한 지구물리학적 연구는 주로 일본과 러시아에 의해 주도되고 있으나 동해의 생성기원에 대한 결정적인 단서를 제공할 것으로 기대되는 울릉분지에 대한 심부구조는 조사자료의 부족으로 밝혀지지 않고 있다.

삼면이 바다로 둘러싸인 우리나라는 해양분야에 대한 선견과 투자가 절실하지만 가장 중요한 동해에 대한 체계적인 지구물리학적 조사가 주변국들에 비해 부족한 실정이다. 한반도에 가까이 위치하는 울릉분지의 심부구조를 독자적으로 밝히는 과제는 동해에 대한 체계적이고 심도있는 연구로써 뿐만 아니라 고환경 복원의 차원에서도 매우 의미가 크다고 할 수 있다.

이 연구에서는 동해 울릉분지에서 러시아와 공동으로 수행한 탐사를 통하여 동해 생성기원의 구명에 극히 중요한 심부 굴절/반사 탄성파자료의 획득, 처리, 그리고 해석기법을 독자적으로 확립함과 동시에 울릉분지의 심부지질구조를 밝히고자 한다.

Ⅲ. 연구개발의 내용 및 범위

울릉분지의 심부지각구조를 밝히기 위해 울릉분지의 중심축과 그 직교방향을 따라 각각 350km 및 250km 길이의 탄성파 측선을 설정하였다. 여기에 30지점에 해저면 지진계(OBS)를 설치하고 3660 in^3의 대형 에어건 파원을 이용하여 심부 탄성파 굴절 및 반사자료를 획득하였다. 해저면 지진계 측선의 전 구간뿐만 아니라 보조측선에서 (전체 2800 km) 12 - 14 Kjoule 의 스파커 파원을 이용한 단일채널 지층탐사를 수행하여 상부지질의 구조를 자세히 얻고자 하였다.

OBS에 기록된 심부탄성파 자료를 A/D한 후 FIR bandpass 필터를 적용하여 잡음을 억제하고 신호를 보강하였다. 탄성파 굴절자료는 거리에 대해 진폭보정을 한 후 도면으로 나타내어 해석을 용이하게 하였다. 해석시에는 먼저 굴절파의 도착시간, 경사, 기타 진폭분석 등을 통해 지각구조와 지각내 탄성파속도를 추정하였으며 파선추적기법을 이용하여 타당한 지각구조와 모호경계면의 깊이를 결정하였다.

기록된 탄성파 자료는 심부지각과 모호경계면의 정보를 담고 있으므로 적절한 처리와 해석을 통해 지금까지 밝혀지지 않고 있는 울릉분지의 전체적인 지각구조를 약 20 km 깊이까지 구명하였다.

Ⅳ. 연구개발결과 및 활용에 대한 건의

이 연구의 중요한 의의중 하나는 동해 울릉분지의 심부 지각구조를 밝혀낼 수 있는 중요한 자료를 얻기 위한 한국과 러시아의 공동조사가 성공적으로 수행되었다는 것이다. 공동조사시에는 울릉분지에서 지금까지 사용되지 않았던 해저면 지진계와 대용량의 에어건을 이용한 심부 탄성파자료를 얻을 수 있었다. 이 연구의 가장 중요한 결과는 처음으로 울릉분지의 심부지각구조와 모호 불연속면을 찾아

서 동해에 대한 우리의 연구능력을 획기적으로 증대시킨 것이다. 현재까지의 울릉분지의 연구에서 얻은 성과는 다음과 같다 :

1. 지각구조는 분명히 상부 및 하부 지각으로 구성되어 있음을 확인하였다. 전반적으로 하부지각은 8 - 10 ㎞ 두께로서 분포하며 정상적인 해양성지각에 비해 매우 두껍다고 할 수 있다.

2. 모호 불연속면은 해저면하 16 - 17 ㎞의 깊이에서 아주 평탄하게 나타나고 있지만 현재로서 한반도의 대륙사면부근에서는 확인되지 않는다.

3. 지금까지의 연구결과에 따르면 울릉분지의 지각구조는 전체적으로 야마토분지와 매우 유사하다.

차후의 연구는 울릉분지와 한반도경계부에 대한 정밀한 지각구조를 밝히는 데에 중점을 두어야 할 것이다. 이 지역은 판구조론에 의거하여 동해의 성인을 구명하기 위해 매우 중요한 지각변이지역으로 가정되고 있음에도 불구하고 이에 대한 심부지질이 연구되지 못하고 있다. 따라서 이 연구에서와 같이 차후에도 지속적인 한국과 러시아의 공동연구를 통하여 동해 전체의 지각구조를 밝혀내는 것은 학문적인 측면에서의 중요성 뿐만 아니라 동해를 중심으로 하는 해양개발의 근간을 세울 수 있다는 측면에서 매우 중요할 것으로 기대된다.

한국은 이제 동해의 지각구조를 구명하기 위한 탐사가 막 시작된 단계이므로 지금까지 이 분야에서 많은 연구를 수행한 일본, 러시아와 공동조사를 하는 형태가 상당기간 바람직할 것이다. 동해에 대한 심도있는 연구성과는 어느 의미에서 국력의 상징이라고 할 수 있으므로 그 중요성은 말할 필요가 없으며 특히 지금까지 체계적인 조사가 수행되지 않은 울릉분지에 대해서 우리가 독자적으로 연구할 수 있는 정책적인 배려가 필요하다.

SUMMARY

I. Title

A Geophysical study on the Ulleung Basin, the East Sea(the Sea of Japan)

-Korea and Russia cooperative research-

II. Significance and Objectives of the Study

The East Sea (the Sea of Japan) is one of the marginal seas in the northwest Pacific which have drawn intensive studies in terms of its formation. Recent studies in the East Sea are focused on investigating the deep crustal structure on the basis of refraction data from the major basins such as the Japan and Yamato Basins whereby the descriptions of the formation can be found. The geophysical works on the deep crust so far have been made by Russia and Japan, but the Ulleung Basin has little studied on a crustal scale despite that this basin is assumed to have many valuable clues to the entire formation frame of the East Sea.

The Korean Peninsula surrounded by the sea on all sides but north requires investment and insights on marine works and the East Sea are getting much more important than ever. But the geophysical works on the East Sea based on systematic and enduring program plans have been insuffucient compared with neighboring countries. The subject of investigating independently the Ulleung Basin adjacent to the Korean Peninsula in terms of the crustal structure may well have a great meaning not only in the reconstruction of paleogeography but also in scientific and profound researches for the East Sea.

This study aims at investigation of the crustal structure of the Ulleung Basin. The emphasis is given to acquisition, processing and interpretation of deep refraction/reflection data from an experiment conducted in the summer of 1991 by the joint research program of Korea and Russia. Our final goal is to present the crustal sturcture of the Ulleung Basin which will facilitate descriptions of the formation of the East Sea in a whole scale.

Ⅱ. Scope of the Study

The deep refraction/reflection experiment was conducted in the cross configuration consisting of long and perpendicular lines which were designed along the main sedimentary axis and transverse direction of the Ulleung Basin, respectively. A total of 30 OBSs (Ocean Bottom Seismometers) were deployed to cover the whole study area. 3660 in^3 air gun was used as a seismic soure which is expected to generate seismic waves sufficient for investigation of the deep structure

Single channel sparker profiling was also conducted using a 12 - 14 Kjoule sparker along the cross configuration and complementary lines as well to acquire the geologic structure to the acoustic basement that can serve in refining the upper structure of the Ulleung Basin. The line length of sparker profiling reached a total of 2800 km.

The processing steps of seismic data for displaying the OBS record sections are :

(1) Digitization of seismic data

(2) Bandpass filtering to enhance the adequate signal to noise ratio

(3) Corrections for the amplitude decay with source to receiver distance

(4) Display of record sections in reduction velocity and range units

The preliminary interpretation of the record sections was performed by use of arrival times and slopes of the first break in combination with the amplitude analysis. These measurements were used to construct the approximate geologic structure of the crust. The ray-tracing algorithm was incorporated in the determination of the appropriate crustal structure and the depth to the Moho discontinuity.

The recorded seismic signals contain the information on the deep crust and Moho, thus the structure of the Ulleung Basin was, for the first time, investigated to the depth of about 20 km.

Ⅳ. Results of the Study and Further Suggestions

One of the important features of this study is that Korea and Russia cooperative expedition was successfully conducted employing the Ocean Bottom Seismometers (OBSs) and 3660 and 1830 in^3 airguns to obtain invaluable seismic data from which the deep crustal structure of the Ulleung Basin can be revealed. The most important result is the crustal structure and Moho discontinuity was, for the first time, identified and traced in the Ulleung Basin. Several results drawn from the present study on the Ulleung Basin are as follows :

1. The deep structure is clearly consisting of the upper and lower crust.

The lower crust, in general as thick as 8 - 10 km, is much thicker than the normal oceanic crust.

2. The Moho discontinuity lies very flat at depths of 16 - 17 km underneath the seafloor. Yet the Moho cannot be traced near the continental slope of the Korean Peninsula.

3. The crustal structure of the Ulleung Basin is very similar to that of the Yamato Basin on the basis of the preliminary interpretation.

The future work will be concentrated on construction of the detailed crustal structure of the assumed transitional area between the Ulleung Basin and the Koren Peninsula. The deep structure of the East Sea near the Korean Peninsula has not been fully understood in spite of its importance to descriptions of the formation of the East Sea within the general framework of plate tectonics. The present expedition results necessitate the continuation of the Korea - Russia cooperative research based on a long term plan to investigate the detailed crustal structure of the East Sea.

Korea has just got started on the study of the deep crustal strucrue of the East Sea, therfore it would be desirable to make researches in cooperation with Russia and Japan that have accumulated results in this area.

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PART I

KORDI

KOREA OCEAN RESEARCH AND DEVELOPMENT INSTITUTE

INTRODUCTION

In the summer of 1991, a marine geophysical research cruise was carried out in the Ulleung Basin (the Tsushima Basin) in the southeast part of the East Sea (the Sea of Japan) under the joint research program of the Korea Ocean Research and Development Institute (KORDI) and the Institute of Marine Geology and Geophysics (IMGG), Fareast Branch of Russian Academy of Siences.

The Ulleung Basin is one of the major basins in the East Sea (Fig.1) whose deep structure is believed to be of great help to the understanding of the formation of the East Sea. Yet investigations of the Ulleung Basin have been conducted only occasionally mainly in terms of single channel shallow acoustic profiling, sediment sampling and several sonobuoy experiments. Though multi channel seismic works along with magnetic and gravity measurements for oil exploration have been made, most of them were extremely limited in vertical and areal dimensions to construct a crustal model.

The purpose of KORDI and IMGG cooperative expedition was to obtain seismic wavefields and magnetic measurements to investigate the Ulleung Basin on a crustal scale. To obtain seismic data, OBSs (Ocean Bottom Seismometers) were deployed at 30 stations along the major sedimentary axis of the Ulleung Basin (Profile I) and its transverse (Profile II) (Fig.2). The OBSs were expected to record seismic wavefields from the crust and Moho discontinuity and upper mantle in the case of oceanic environments with the use of 60 and 30 liter air guns as a seismic energy source. Single channel profiling was also conducted using the sparker source with 12 to 14 Kjoule

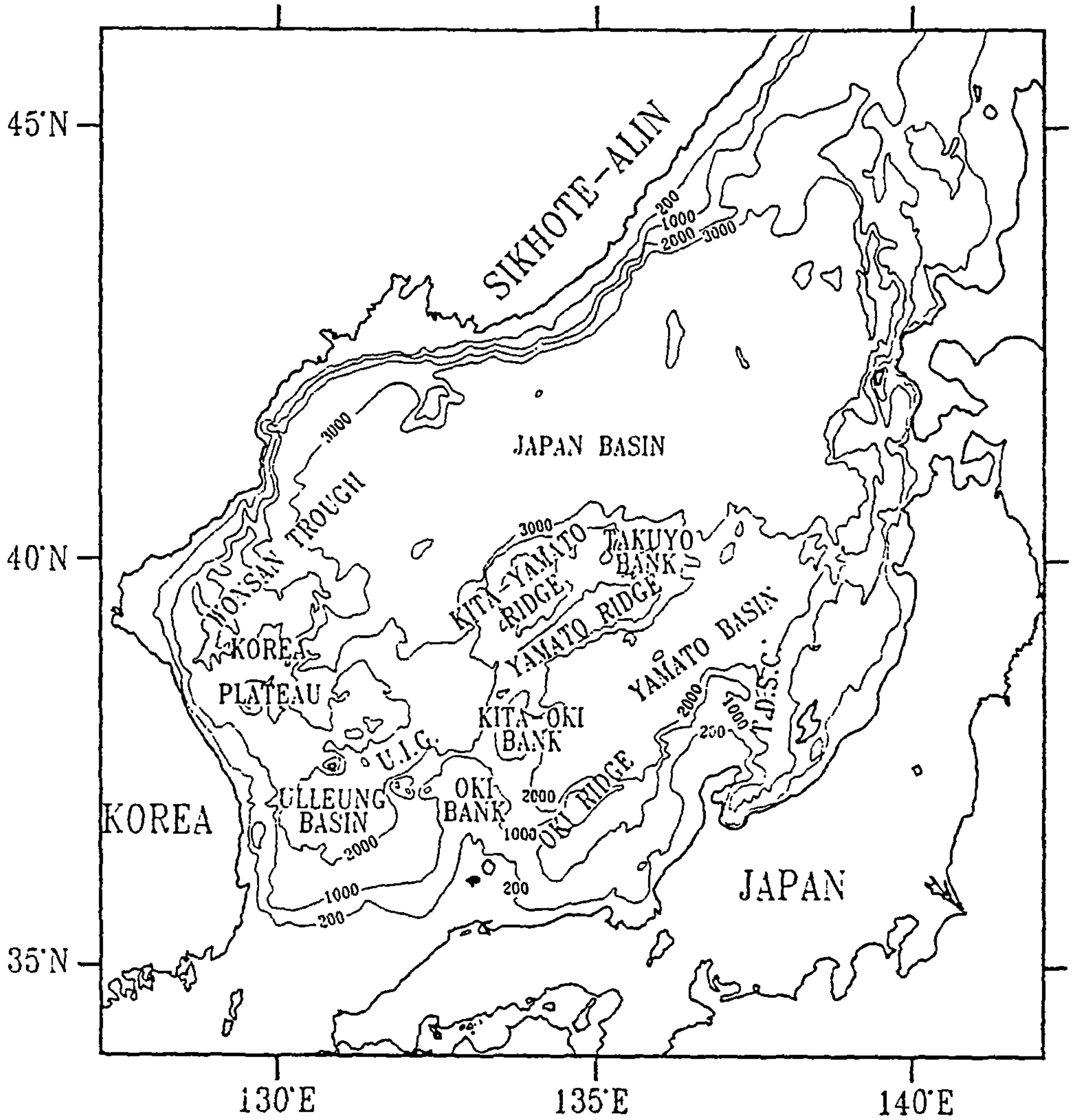


Fig 1. Major physiographic features of the East Sea

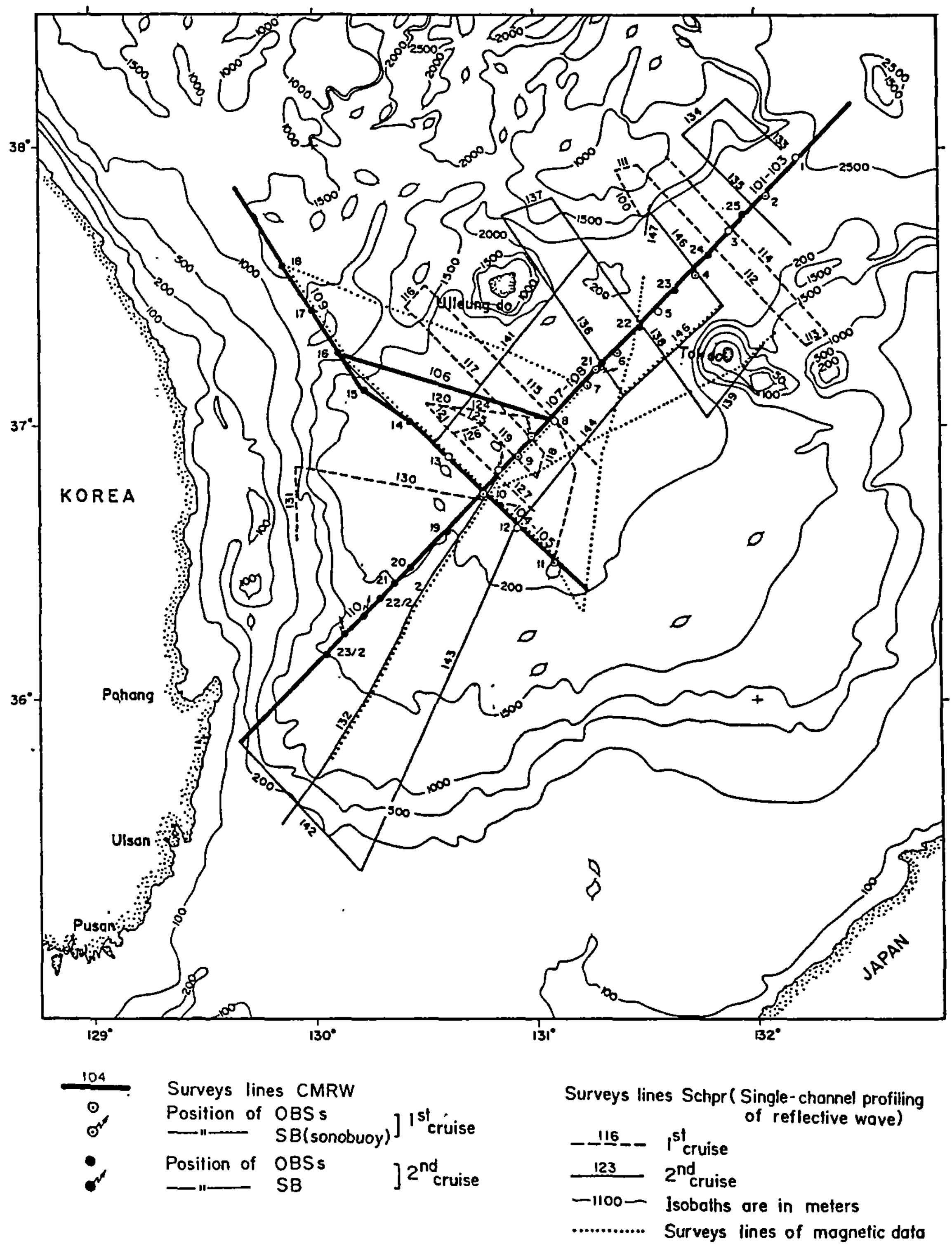


Fig 2. Configuration and setting of the experiment

capacity to constrain the upper geologic structure above the acoustic basement. Magnetic measurements were made in part along the whole cruise track to acquire supplementary geophysical data.

This report presents the work scope of the Korea-Russia joint cruise and descriptions of OBS record sections. Emphasis will be given to the preliminary interpretation in terms of the crustal velocity structure estimated from the OBS record sections. All of the data are at the preliminary stage of analysis, the geophysical results will be presented in more detail in the near future.

CRUSTAL STRUCTURE OF THE EAST SEA

The East Sea is one of famous marginal seas in the West Pacific. The characteristics of marginal seas are well described in Ludwig et al (1971) in terms of their crustal structure. The descriptions on the marginal seas and the East Sea (Ludwig et al. 1971; Kobayashi, 1985; Celaya et al. 1987) were collected in the following to have general understanding of their geophysical features rather than geological and/or tectonical view points.

Marginal basins, such as the Bering, Okhotsk, Japan, and South China seas, are located between the continent and the outer volcanic or orogenic island arc and are important regions of sedimentation. Menard (1967) considered small ocean basins, including those virtually enclosed by continent, to be regions of crustal transition from oceanic to continental crust. The essential characteristic of a normal oceanic crust is that it contains a layer (Layer 3) with a velocity near 6.7 km/sec and a thickness of about 5 km. A normal oceanic crust may be modified to such an extent that the resultant structure has characteristics intermediate between continental and oceanic crust. According to Andreyeva and Udintsev (1958) the crust under the East Sea has oceanic thickness but continental seismic velocities. Other measurements in the East Sea indicate oceanic thickness and oceanic seismic velocities. More recent refraction measurements in the Japan Basin indicate that the crust is typically oceanic in structure (Kovylin and Neprochnov, 1965; Murauchi, 1966; Vasilkovsky et al., 1971). The present consensus is that compared to the Japan Basin, the Yamato Basin has shallower sea floor, thinner sediments, shallower basement surface; the Yamato Basin has Layer 3 that is 3 to 4 km thicker than that in the Japan

Basin and a low-velocity mantle (Ludwig et al., 1975; Chung, 1990). The schematic structure section of the East Sea from the Japan to the Yamato Basin is shown in Fig. 3.

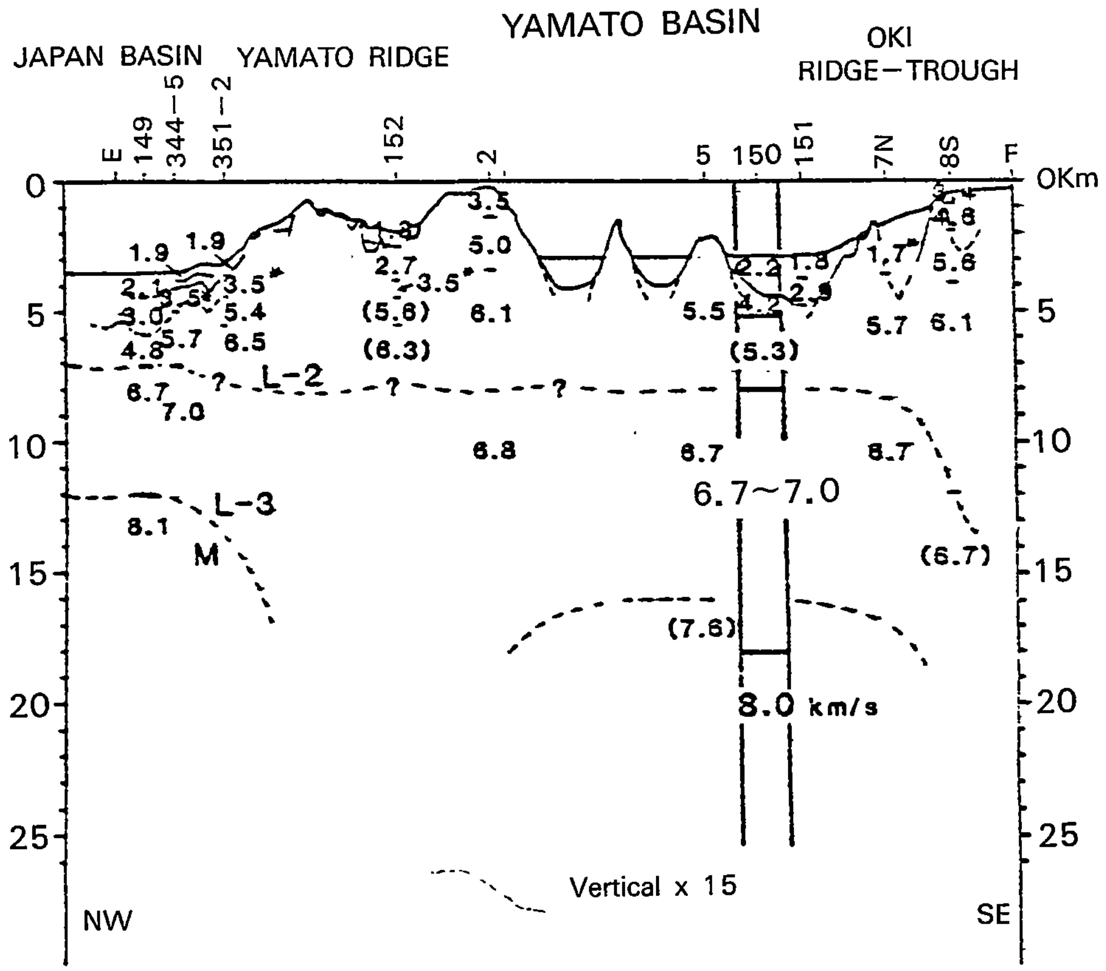


Fig 3. The schematic structure section of the East Sea from the Japan to the Yamato Basin(from Hirata et al., 1987)

WORK SCOPE and EQUIPMENTS

1. Motivation and Cruise Plan

The East Sea comprises five major morphotectonic units: the Japan, Yamato, and Ulleung Basins, the Yamato Ridge, and the Korea Plateau (Fig.1), where the Ulleung Basin adjacent to Ulleung-do island is also referred to as the Tsushima Basin after Tsushima island far in the south. The major basins in the East Sea have been main subjects in marine geology, geophysics, seismology, exploration gephysics, tectonics and other sciences in terms of the formation mechanism of the East Sea.

According to Chough and Barg (1987), the present consensus is that three deep basins in the East Sea were formed by back-arc spreading related to subduction processes (Isezaki and Uyeda, 1973; Uyeda and Miyashiro, 1974; Hilde et al., 1976; Uyeda and Kanamori, 1979) and more complex plate interactions (Tapponier et al., 1982; Kimura and Tamaki, 1986). The Japan and Yamato Basins have been well studied by innumerable workers including the above, yet the Ulleung Basin has little studied on a crustal scale in spite of the fact that this basin, contiguous to the continental zone of the Korean Peninsula, is expected to contain important meanings in general understanding of the whole crustal structure and formation of the East Sea.

At the beginning of 1991, KORDI (Korea Ocean Research and Development Institute) and IMGG (Institute of Marine Geology and Geophysics of the Russian Academy of Sciences Fareast Branch) agreed on cooperative marine geophysical works to investigate the deep crustal structure of the Ulleung Basin. They agreed on employing OBS's (Ocean Bottom Seismometers) and large capacity air guns. The OBS, which detects and records seismic wavefields at the relatively quiet ocean floor, is well suited for detecting signals from the deep structures below the sediments. To constrain the sedimentary structure of the Ulleung Basin, continuous seismic profiling with the use of a high energy sparker was also adopted.

The cruise was fulfilled using two research vessels "Morskoy Geofizik (866 tons)" and "Professor Gagarinsky (1150 tons)" from the Research Fleet Department of the Academy of Sciences of Russia Far East Branch during the period from August 6 to September 9, 1991. The geophysical survey line layout was planned to investigate the Ulleung Basin along the major axis (Profile I) and transverse (Profile II) directions with 180 and 110 nautical miles, respectively. Such configuration pattern was supposed to be adequate for evaluation of the crustal structure of the Ulleung Basin.

2. LIST of EQUIPMENTS USED for the KOREA-RUSSIA COOPERATIVE EXPEDITION

A. SINGLE CHANNEL SEISMIC PROFILING SYSTEM

1). SPARKER

Energy	: 12 - 14 Kjoules
No. electrodes	: 7 - 9
Operating Electricity	: 220 Volts
Frequency of wavelet	: less than 50 Hz
Rapetition Rate	: 9 Seconds

2). HYDROPHONE

Total Length : 250 Meters

Length of Active Part : 150 Meters

No. Elements : 32

3). GRAPHIC RECORDER

Recording Papar : Wet type

Recording Length : 5 Seconds

4). DIGITAL RECORDING EQUIPMENT

A/D Convertor : 10 Bits

Sampling Rate : 2 KHz

Word Length : 1.5 bytes

Trace Length : 3 Seconds

Trace Memory : 9,000 Bytes

Magnetic Tape Drive

Tape : 2400ft reel type

Recording Density : 800 Bytes/inch

Recording Period : 9 Hrs.

B. DEEP REFRACTION SURVEY SYSTEM

1). OCEAN BOTTOM SEISMOMETER

Receiver (Vertical electrodynamic type)

Degree of Dampling : 0.55 - 0.70

Transmission Coefficient : 24 Vs/m

Recorder (Analog type)

Magnetic Tape : H4406-12

Revolving Rate	: 0.39 mm/sec
Maximium Duration	: 10 Days
No. Channels	: 4
Registration Unit	
Seismic Tracking	: 70 DB
Amp. Noise	: less than 0.25 mKV eff.
Mooring Type	: Tied to surface buoy

2). AIR GUN

Volume	: 60 Liters (3660 in^3)
Frequency of Wavelet	: 4 - 12 z
Maximum Repetition Rate	: 2 Min.

3). Compressor

Volume	: 15 Liter/Min. x 4
Pressure	: 200 Atm.

C. OTHERS

. NAVIGATION : Laran/Transit Satellite Nav. System

3. Experiments with OBSs

The OBSs were designed and manufactured in the Institute of Physics of the Earth of the Academy of Sciences of Russia. Each OBS consists of a seismic receiver and a registration unit cased into a steel cylindrical container. The vertical electrodynamic seismic receiver of NS-3 type is mounted in a joint pendant, providing vertical orientation of the axis, independently of the container position on the seabottom. The own frequency of the seismic receiver is 3.5-4.0 Hz, while the degree of damping and transmission coefficient are 0.55-0.70 and 24 Vs/m, respectively.

The registration unit consists of the band drawing mechanism with electronic plates of the station and the block of autonomous quartz clocks. The band drawing mechanism is constructed by a one-motor scheme, whose leading assembly is an electromotor with stable current of IDR-type. The magnetic tape type is H4406-12 which moves at a velocity of 0.39 mm/sec. The capacity of the magnetic cassette is about 350 m, providing continuous registration of seismic oscillation at a station for 10 days. Number of motor turns is kept strictly stable with the help of an automatic regulation scheme. An electronic engine is powered by 6 V battery with less than 1.5 mA current.

Registration is made through an eight channel block of magnetic heads. The following information is recorded on magnetic tape: seismic signal on two sensitivity levels with spread of 30 dB; enveloping of hydroacoustic channel; time code (on two tracks); accompanying signal (pilot signal); minute pulses. The frequency range of registered seismic signals is 2-25 Hz, and hydroacoustic signals 20-25 Hz. Total geodynamic range of seismic tracking is 70 dB. The level of dynamic overlapping between sensitive and coarse channels is 10 dB. The amplification noise, reduced to the exit, is less than 0.25 mkV eff., that allows to record useful signals with the shift of about 10E-9 km.

30 OBS's were deployed at the seabottom along the two profiles. Profile I starts at the northeast rim, running between two islands, Ulleung-do and Dok-do and terminates at the southwest rim of the Ulleung Basin. Profile II, perpendicular to Profile I, was planned such that the recorded

wavefields would provide crustal seismic anisotropy information if possible (Fig.2). The two profiles were composed of 10 seismic lines, each of them had 5 OBS's at an interval of 10 or 20 km. After the "Morskoy Geofizik" deployed 4 or 5 OBS's at predetermined locations along a straight seismic line, the "Professor Gagarinsky" traced the seismic line shooting an air gun to generate seismic waves. Two air guns with 60 and 30 liter capacity were used alternatively at 4 and 2 minutes repetition rate. As the ship speed of the "Professor Gagarinsky" was 5.5 to 6.5 knots, the repetition rates of 4 and 2 minutes correspond to 600-700 and 300-350 meters, respectively. The frequencies of seismic wave signature generated from both air guns were maximum at 18 and 30 hz, respectively.

4. Continuous Profiling

Simultaneously with airgun shooting, the conventional continuous profiling using the sparker was conducted along the whole seismic lines constituting main profiles I and II, and orthogonal lines aboard the "Professor Gagarinsky". This profiling work was expected to yield the sedimentary structure to the basement surface, which, in turn, served to constrain the analysis of OBS data (Fig.2).

The sparker with 12-14 kjoule capacity and the floating hydrostreamer of 50 m length were used as seismic source and receiver, respectively, both were designed and manufactured by IMGG. As the frequency band of the emitted seismic signals from the sparker is approximately 90-120 Hz, resolution of profiling is not expected to exceed 15 meters. The investigation depth below the sea bottom reached commonly more than 1.0-1.5

sec in two-way travel time in sedimentary stratum sequences, corresponding to 1.0-2.0 km in depth. Thus at least the middle part of the sedimentary column was fully investigated.

The profiling data was recorded on an analogue graphic recorder, at the same time on magnetic tapes through a digital equipment for further processing. The total line length fulfilled by profiling reached 1490 nautical miles.

RECORD SECTIONS and INTERPRETATION

1. Data Processing

The first step of the data processing aimed at producing preliminary record sections. After OBS was retrived, the seismic trace data recorded in the magnetic reel tape in analogue form were digitized. We then bandpass filtered the data using a FIR (finite impulse response) filter with 0 - 12.5 Hz band which appears to enhance the sigal to noise ratio. Before producing basic seismic record sections, the multiplication factor x/20 km was used to correct for amplutude decay due to the increasing source-to-receiver offset. The OBS data sections were linear moveout (LMO) corrected using the reduction velocity of 7.0 km/sec, which is assumed to be a typical velocity of the lower crust (Layer 3). Layer 3 with a velocity near 7 km/sec and a thickness of about 5 km is the main feature of of a normal oceanic crust. If the horizontal coherent phases are observable in a LMO corrected section, it will directly indicate the existance and characteristics of Layer 3.

2. Discriptions of record sections

Descriptions are given below of the characteristics of the record sections that are important in defining the principal features of the crustal structure of the Ulleung Basin. The "-" and "+" signs attached to range values in the sections denote the north and south directions, respectively (see Fig.2). The record sections on Profile I are described here representative of the northern, the middle and the southern part of the Ulleung Basin. On Profile II, two OBS stations (12, 13) were analyzed which show adequate signal to noise ratio. In the following, Layer 2 denotes the layer beneath the sediments with velocities less than 6.5 km/sec. Layer 3, the lower crust above the mantle, has velocities greater than 6.5 km/sec.

(a) Profile I - Northern Part

OBS-1. These data (Fig.4) extend more than 70 km south of OBS-1, which is situated on the north tip of Profile I. Within the range of 15 km, the data are highly contaminated by noise and important signal is missing. A first arrival begins to appear from a range of 15 km. This arrival represents crustal compressional wave energy but for a range of 30 - 35 km, the energy is damped away. The strong coherent phases occur out to a range of 35 - 45 km, but this feature is difficult to tell whether it suggests the possible existance of the Moho triplication or the effects of inhomogeneities in the crust. The apparent velocity of the first arrival to range of 55 km is less than 7 km/sec. From a 55 km range, the phases are characterized by the strong amplitude and a remarkable discontinuity in

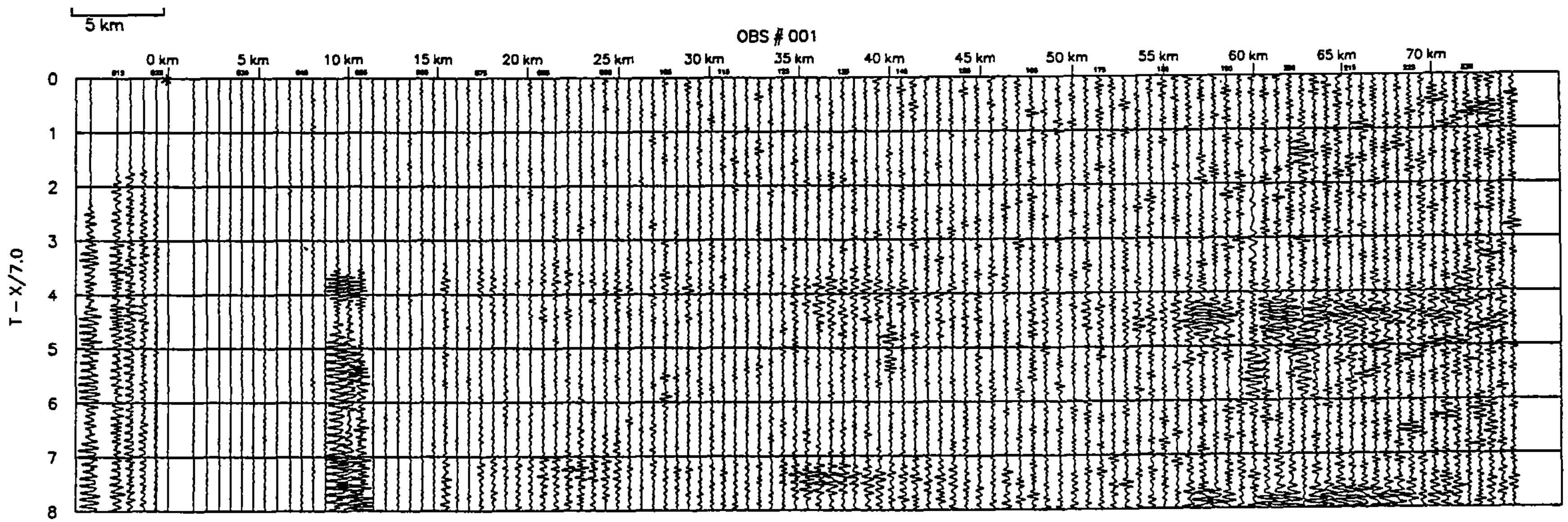


Fig 4. Record section of OBS-1

arrival time with the previous phases. This wave group has the possibility of representing the supercritical crust-mantle reflections (PmP) and the existance of a low velocity zone (LVZ) in the lower crust. However, the record section of OBS-1 should be analyzed in more detail.

OBS-4. This station also is located in the northern part of the Ulleung Basin. The record section (Fig.5) in the northeast direction shows distinct and clear first arrivals through the entire range, which make it easy to compute apparent velocities of the individual phases. The distinct phases in the ranges of 4 - 13 km with apparent velocities of 4.5 - 5.5 km/sec are interpreted as refractions from the upper crust. Taking into account the short range of these phases compared to other record sections which will be shown later, the depth of the upper crust is assumed to be less than 2 km. From a range around 13 km, a coherent phase stretches out to the 50 - 60 km range with a velocity slightly greater than 6 km/sec which is related to the top of the lower crust. The earlier arrival of this phase on the right hand side than on the left hand side indicates the lower crust comes up toward south of OBS-4. The most important feature of these data is that the strong coherent phase whose trajectory is hyperbolic is demonstrated from a range of 50 km out to more than 70 km. On the basis of kinematic and dynamic features of the phase, this wave group is assumed to be associated with reflection from the Moho. If the strong amplitude from the range of 50 km are assumed to be the typical feature of supercritical reflection from the Moho, this phase possibly indicates the existance of LVZ in the lower crust. No refraction from the mantle (Pn) is observable beyond the apparent reflection.

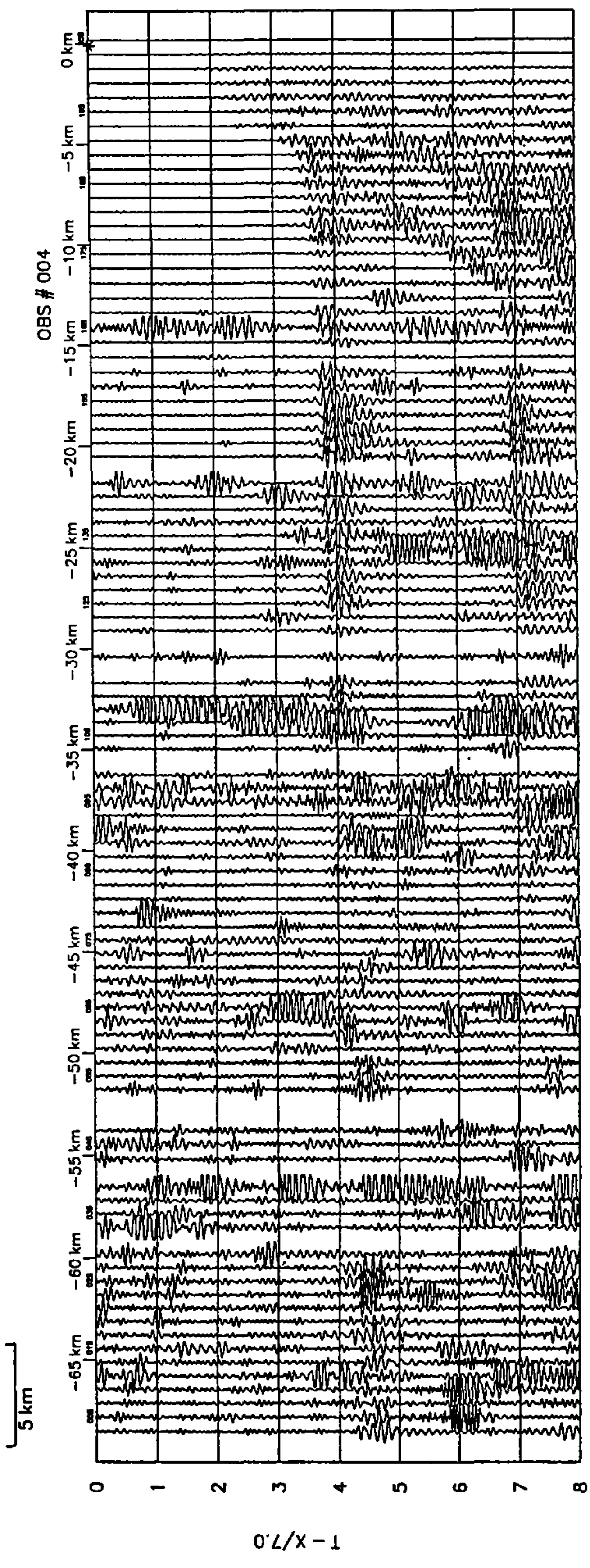


Fig 5. Record section of OBS-4

(b) Profile I - Middle Part

OBS-6. The record section of this station (Fig.6) displays two distinct phases, whose slopes are discriminated at 11 km range, related to Layer 2 and 3 with velocities less than and more than 6.5 km/sec, respectively. This implies that the upper crust here is thicker than in the northern part. However, the first arrivals are not traced from 40 km range on either side. The coherent phase appearing beyond 50 km range to the south is assumed to be PmP. The Moho discontinuity in this area lies at almost the same depth as in the northen part.

OBS-7. This station is located 40 km southwest of OBS-6. The general features similar to those of OBS-6 indicates there is no drastic changes in the crustal structure in the middle part (Fig.7).

(c) Profile I - Southern Part

OBS-21. As this station is located near the continental slope, the recorded data were anticipated showing wavefields related to the transitional zone from the continental to the oceanic environments or subduction evidences of the oceanic crust if any. The data are not immediately interpretable due to the high noise level in the far range (Fig.8). First arrival times cannot reasonably found beyond 40 km range though several phases are observable. To construct a detailed velocity structure of this area, more observations are needed which clearly show coherent phases related to the deep structure.

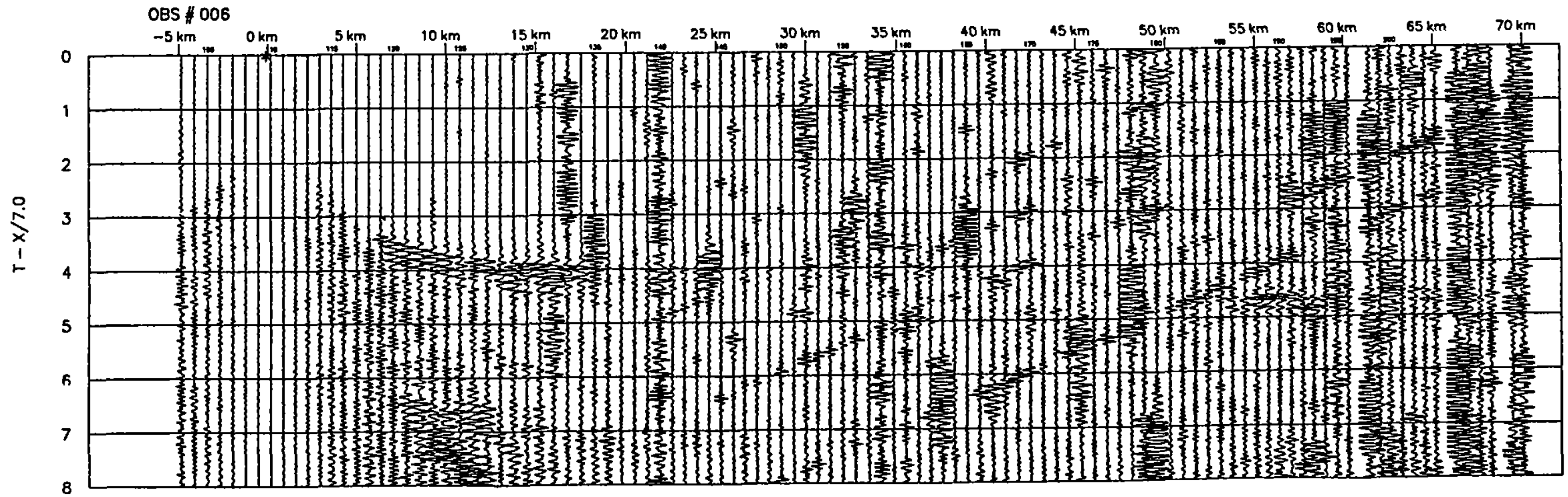


Fig 6. Record section of OBS-6

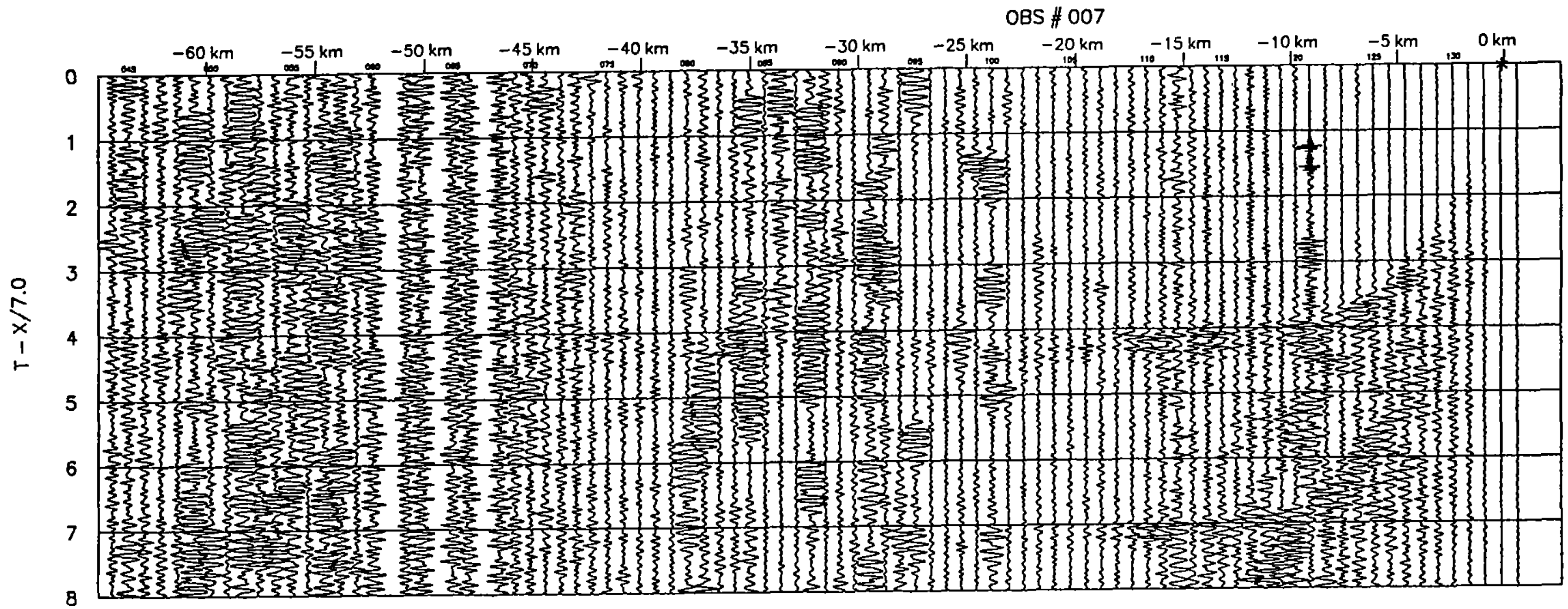


Fig 7. Record section of OBS-7

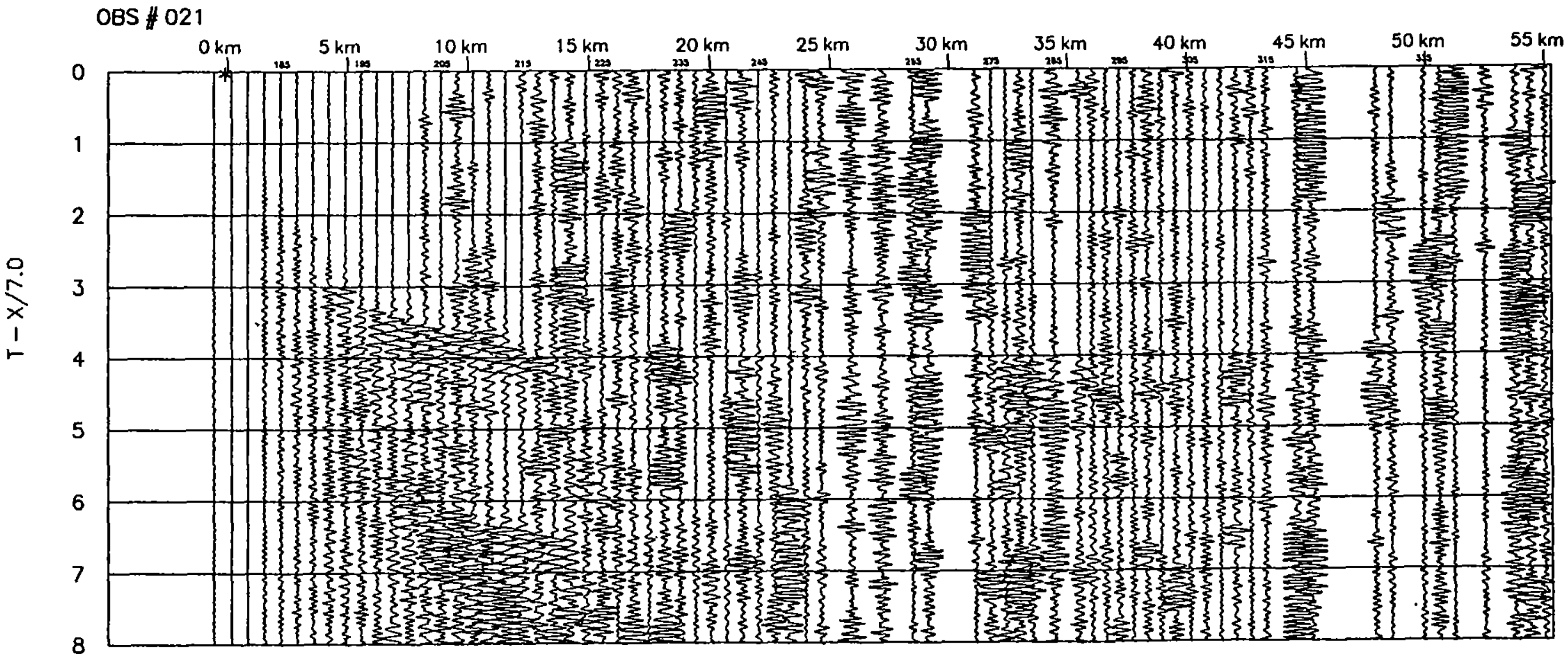


Fig 8. Record section of OBS-21

(d) Profile II

OBS-12. This record section (Fig.9) is obtained along Transverse Profile II in the northwest direction. The data display adequate signal to noise ratio and are quite attractive so that it clearly shows the crustal refraction and PmP as two discrete arrivals separated in time. The refraction phases identifiable within a range of 15 km have apparent velocities varying from 4.0 - 6.6 km/sec are assumed to be related to the upper crust. The upper crust appears to consist of three layers, since these phases can be distinguished with different apparent velocities. In the range from 15 km, the lower crustal refraction phase and PmP, which are observed clearly, extends to more than 65 km. This phase extending continuously suggests the lower crust is quite thick. The strong variation in PmP amplitude is not abservable.

OBS-13. This OBS station is located 40 km northwest of OBS-12. The record section was obtained in the reverse direction of the OBS-12 section, thus it can well serve in constructing the velocity structure of Profile II. Showing almost the same features as for OBS-12 this section manifests the horizontally homogeneous velocity structure along Profile II (Fig.10). Based on combination with the OBS-12 record section, Profile II has the flat crust and Moho discontinuity.

In summary, the crustal structure under the Ulleung Basin is clearly consisting of Layer 2 and Layer 3, which indicates that the crust is of oceanic cháracteristics. The seismic velocity of Layer 3 appears slightly less than 7 km/sec. The main difference of the northern part from the other

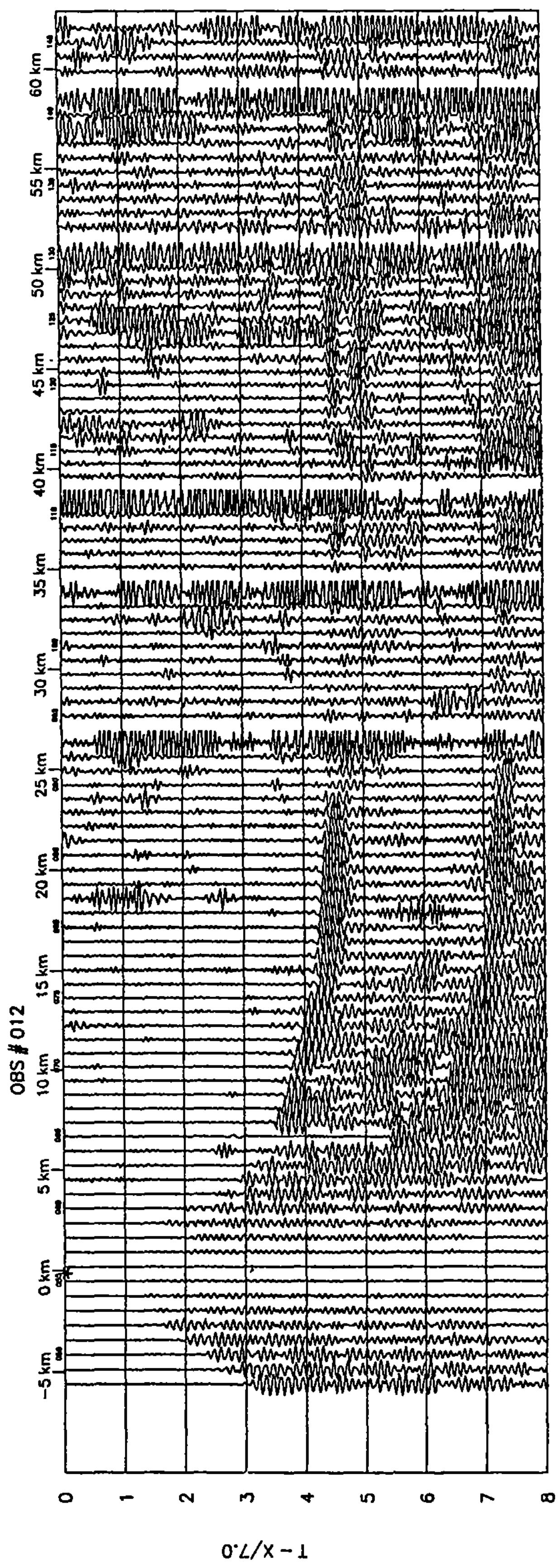


Fig 9. Record section of OBS-12

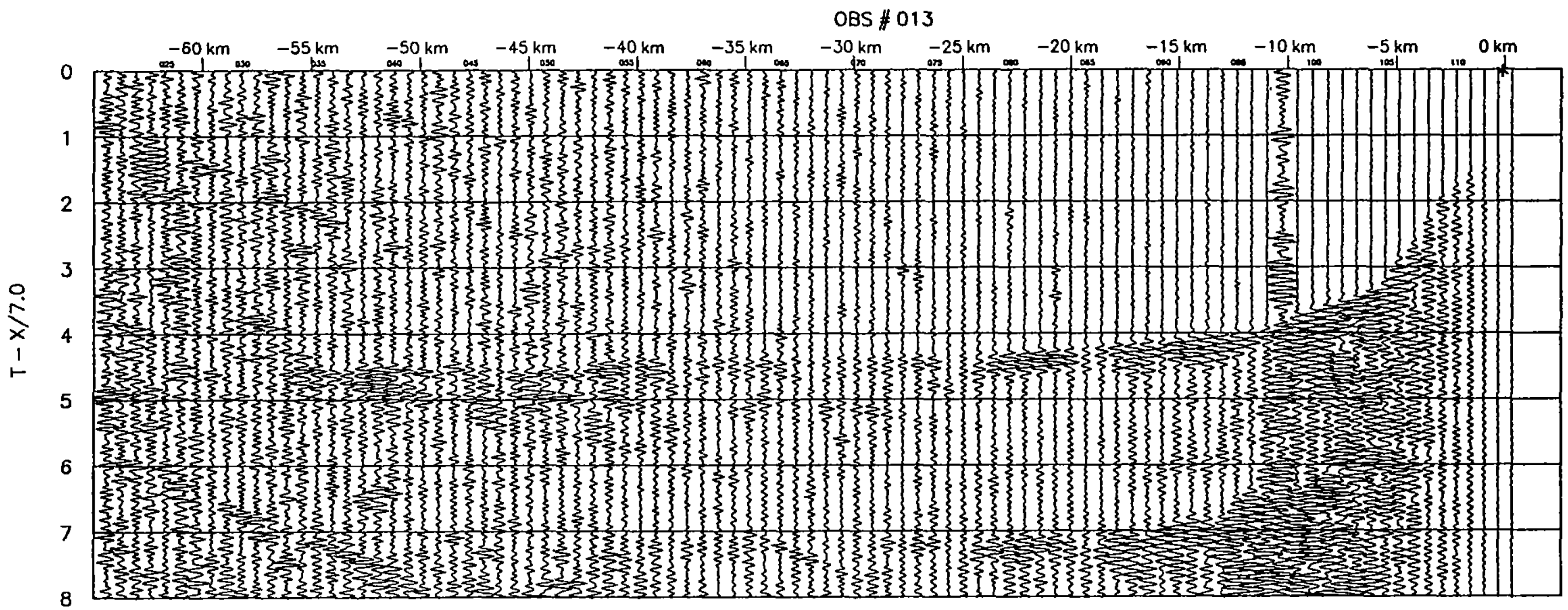


Fig 10. Record section of OBS-13

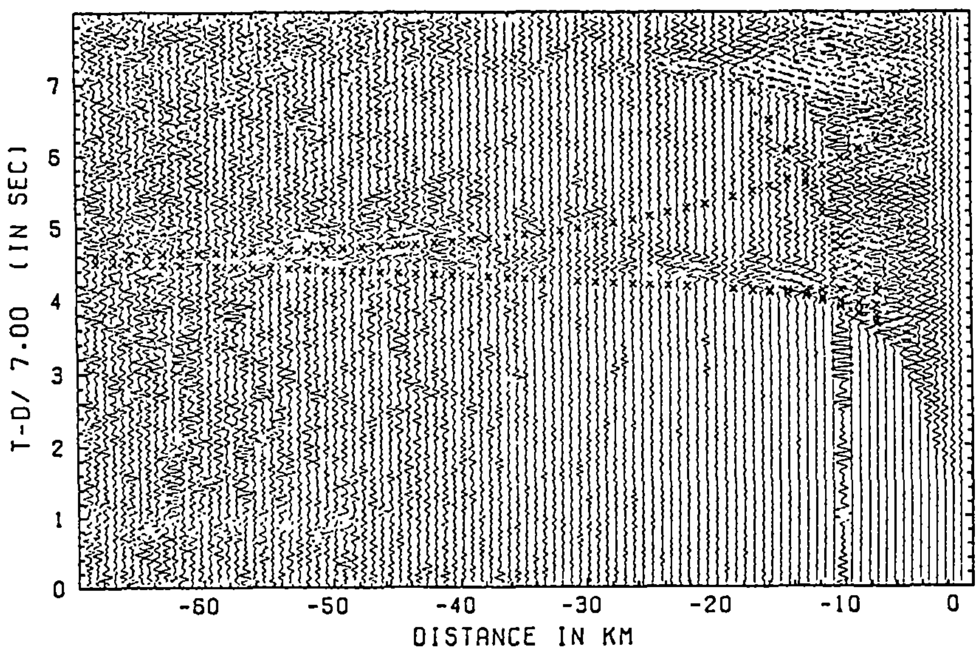
parts is that the northern part has thinner upper crust and thicker lower crust. The Moho discontinuity lies very flat at the depth of about 16 - 17 km from sea level. The velocity distribution of the crust under the Ulleung Basin is in good accordance with that of a normal oceanic crust. But the crustal thickness is much greater than a normal oceanic crust. In the northern part, an evidence of LVZ (low velocity zone) is perceived from supercritical reflections from the Moho (PmP), but this has to be studied more carefully.

3. Interpretation

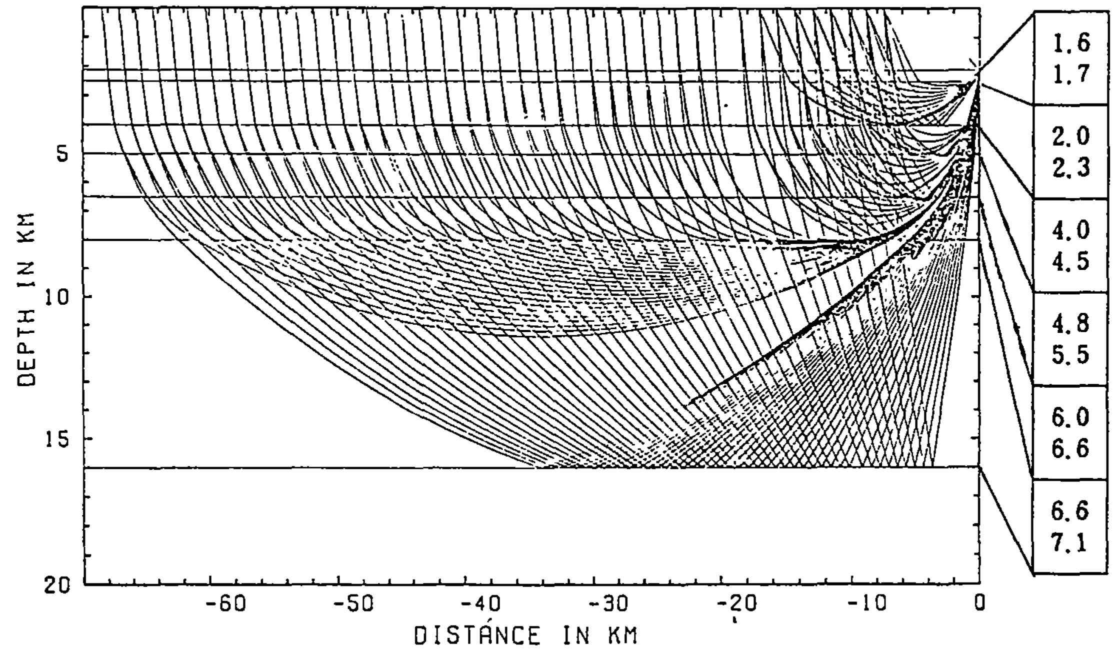
The preliminary interpretation was conducted in two stages. First, an initial velocity structure was constructed on the basis of apparent velocities determined form the slopes of refracted phase. Second, the velocity structure was refined using ray tracing (Cerveny et al., 1983). At this point, we have constructed the laterally homogeneous velocity structures at OBS-13, which represents the middle part of the Ulleung basin (Fig.11). The final interpretation results on the basis of a combination of sparker profiling data and two-dimensional (2-D) ray tracing will be given in the near future.

The record sections from the Ulleung Basin in the above suggest that the crustal structure of the northern part is different from that of the central and southern parts. The main difference lies in the thickness of the upper crust. In the northern part, the crust with velocities from 6.5 to 6.8 km/sec is extraordinarily thick as much as approximately 10 km, which is overlain by the thin upper crust whose velocities are less than 6.5 km/sec. The total crustal thickness including the sedimentary layers is estimated as 14 - 15 km. Anomalously high amplitude phase with strong coherency is observed from 40 km range out to more than 70 km, however, this phase has yet to be analyzed in more detail to explain the crustal structure.

The central part, occupying the main area of the Ulleung Basin, is chracterized by a thicker sediment layer than the northern part. The interface between the lower and upper crusts gently deepens toward southwest but the Moho seems to be very flat. The wavefields show several distinct phases with different velocities in the upper crust. The



(a)



(b)

Fig 11. (a) Record section of OBS-13 with calculated travel times which are in the constructed velocity-depth section denoted by *,
(b) Ray diagram

velocities in the upper crust are calculated as 3.2 - 3.6, 4.3 - 4.5, and 5 km/sec, respectively. The Moho discontinuity lies at the same depth as in the northern part.

The southwestern part approaches the continental slope of Korea. The record section of OBS-21 in this area shows some interesting features which appear to be related to the transitional crust but at present definitive descriptions could not be made due to poor data quality. From the present data, the upper crust with 5.7 - 6.0 km/sec velocities are observed to rise abruptly to less than 3 km depth beneath the seafloor. The lower crust and Moho are very difficult to trace, however this area is possibly linked with the transitional crust or interaction between continental and (sub)oceanic crusts. Future work will be concentrated on this area with more observations and detailed analysis.

The data sections of OBS-12 and 13 on the transverse Profile II show adequate signal to noise ratio where the crustal refraction and crust-mantle reflection are observable as two distinct arrivals. The velocity distribution is in accordance with the typical oceanic crust. The velocity structure constructed on the basis of a record section of OBS-13 displays that the lower crust with velocities higher than 6.5 km/sec has thickness of 8 km. The thickness of the upper crust and the sediment layer is about 4 km and 2 km, respectively. Accordingly, the depth to the Moho from the seafloor amounts to 16 km.

The velocity structures underneath Profile I and II are shown in Fig.12 and 13. These figures were prepared by IMGG in cooperation with KORDI. The structures were the results of preliminary interpretation of the record sections based mainly on first arrival times and has to be refined using a ray tracing technique. In Fig.13, the legend is: (1) Reflectors located

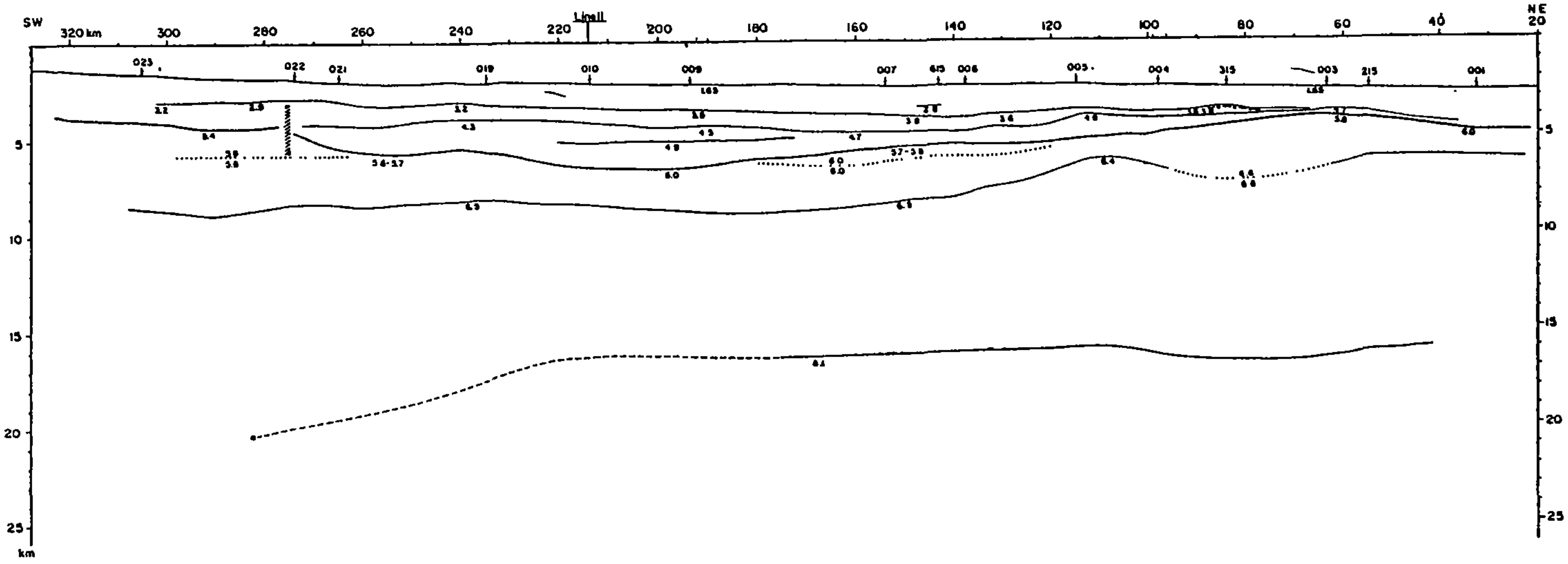


Fig 12. Velocity-depth structure for Profile I based on preliminary interpretation

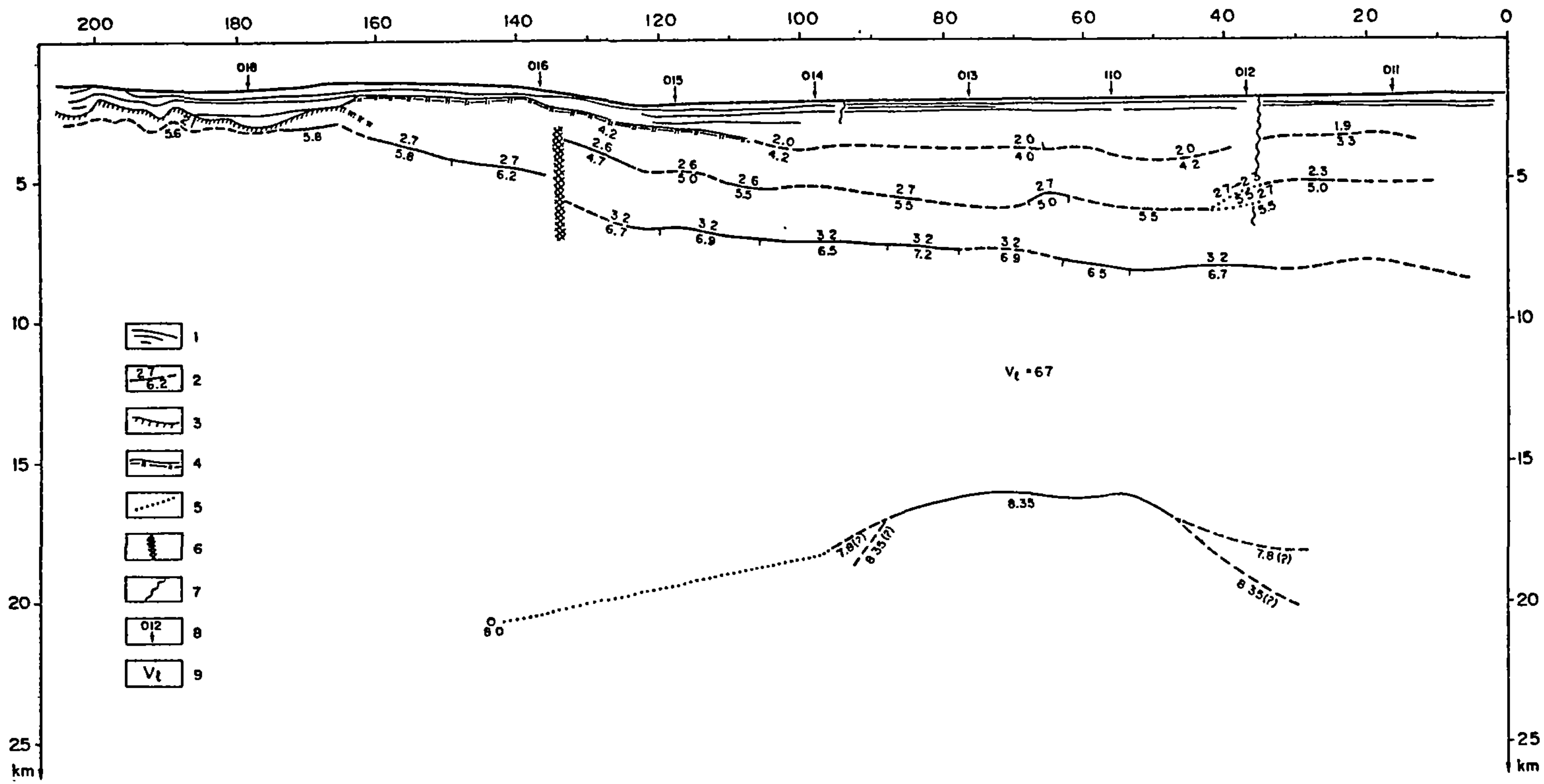


Fig 13. Velocity-depth structure for Profile II based on preliminary interpretation

from single channel seismic profiling, (2) Boundaries given from refraction data, (3) Paleozoic basement, (4) Volcanic basement, possibly neogene, (5) Boundaries in guess, (6) Thrust and fault zone, (7) Change of sediment cross section, (8) Location of OBS station, (9) Average velocity, respectively.

CONCLUSION

The present expedition made under the cooperative research program of Korea and Russia has revealed, for the first time, the deep crustal structure of the Ulleung Basin in the Esat Sea using ocean bottom seismometers, airguns and sparker profiling technique. The following conclusions can be drawn from the results of this experiment :

1. The Ulleung Basin is, as a whole, covered with a sedimentary sequence with less than 2 km/sec velocity whose thickness is assumed about 2 km. In some areas, mainly in the middle part, the acoustic basement with 5 km/sec is observable at the depth of more than 4 km beneath the seafloor. This suggests that the sedimentary sequence extends to a considerable depth of more than 4 km and the sediments are consolidated in the lower sequence.

2. In the northern part, the upper crust rises gently to the north. The crustal structure deduced from record sections here is different from that of the central and southern parts. The lower crust with velocities from 6.5 to 6.8 km/sec is extraordinarily thick as much as approximately 10 km. The total crustal thickness including the sedimentary layers is estimated as 14 - 15 km.

3. The central part, occupying the main area of the Ulleung Basin, is chracterized by a thicker sediment layer than the northern part. The interface between the lower and upper crusts gently deepens toward southwest but the Moho seems to be very flat. The upper crust appears to have several distinct layers with different velocities. The Moho discontinuity lies at the same depth as in the northern part.

4. In the southern part, the upper crust with 5.7 - 6.0 km/sec velocities are observed to rise abruptly appear to less than 3 km depth beneath the seafloor. The lower crust and Moho are very difficult to trace, however this area is possibly linked with the transitional crust or interaction between continental and (sub)oceanic crust.

5. The crustal structure under Profile II has a well defined crust-mantle boundary. The thickness of the upper crust and the sediment layer is about 4 km and 2 km, respectively and the depth to the Moho from the seafloor amounts to 16 km.

6. The general distribution of velocities in the Ulleung Basin shows good accordance with the normal oceanic crust. But the crust is much thicker than the normal oceanic crust. The crustal structure of the Ulleung Basin is very similar to that of the Yamato Basin (Chung, 1990) on the basis of the preliminary interpretation.

One of important features of this study is that the Korea and Russia cooperative expedition was successfully conducted employing the Ocean Bottom Seismometers (OBSs) and air guns of 3660 and 1830 in^3 to obtain invaluable seismic data from which the deep crustal structure of the Ulleung Basin can be revealed. The most important result is the crustal structure and Moho discontinuity were, for the first time, identified and traced in the Ulleung Basin. The future work will be concentrated on construction of the detailed crustal structure of the Ulleung Basin and present descriptions of the formation of the East Sea within the general framework of plate tectonics.

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PART II

IMGG

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INSTITUTE OF MARINE GEOLOGY & GEOPHYSICS

KOREA MINISTRY OF SCIENCE & TECHNOLOGY

KOREA OCEAN RESEARCH AND DEVELOPMENT INSTITUTE

PRESIDENT KORDI	DIRECTOR IMGG
B. K. PARK	K. F. SERGEEV
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1991, DECEMBER, 20	1991, DECEMBER, 20

R/V PROFESSOR GAGARINSKIY, CRUISE 10

R/V MORSKOY GEOPHISIC, CRUISE 39

PRELIMINARY REPORT

OF MUTUAL RUSSIA-KOREA EXPEDITION

(AUG. 8-SEPT. 11 1991)

YUZHNO-SAKHALINSK, 1991

ESSAY OF RESEARCH CRUISE

Marine seismic researches in the South-West part of the East sea (Ulleung Basin) were based on coorperative works according to the Soviet-Korea Memorandum and Statement of Intentions, which were discussed and then signed in Yuzhno-Sakhlinsk (USSR) and Seoul (Korean Republic), correspondingly. The planned works are within the frames of the International Project "Transecti" (PACTRAN) and envicages the regional studies of deep structure of the Earth's Crust of one of the most interesting regions of the East Sea, where such investigations in the past were conducted only occasionaly with single stations of sonobuoys. Besides, these observations are also the important part the five-year investigations programs KORDI and IMGG of the USSR Academy of Sciences Far Department in the field of studies of the back-arc (maginal) basins of the west Pacific according to the Project "Lithos" and "The continent-ocean boundary".

This report is based , mainly, on the results obtained with two research vessels: "Morskoy Geofisik" (1100 tons) and "Professor Gagarinsky" (1150 tons) of the Research Fleet Department of the Academy of Science of the USSR Far East Department.

The area under investigations (polygon) is situated within Ulleung Basin and adjacent to it (from the North-East to Ulleung-do and Tok-do(Piankur Is.)) part of the Japan depression (Figs.1,2). The north-east part of the polygon was studied more detaily with seismic reflection profiling, because the Ulleung Basin was studied by the Japanese geophysicists with regional net of seismic reflection profiles on scientific vessel of Hakurei-Maru in April-May, 1977 (Fig.2).

The scientific stuff consisted of 3 scientific workers on "Morskoy Geofisik" and 4 on "Professor Gagarinsky". six of them are the workers of

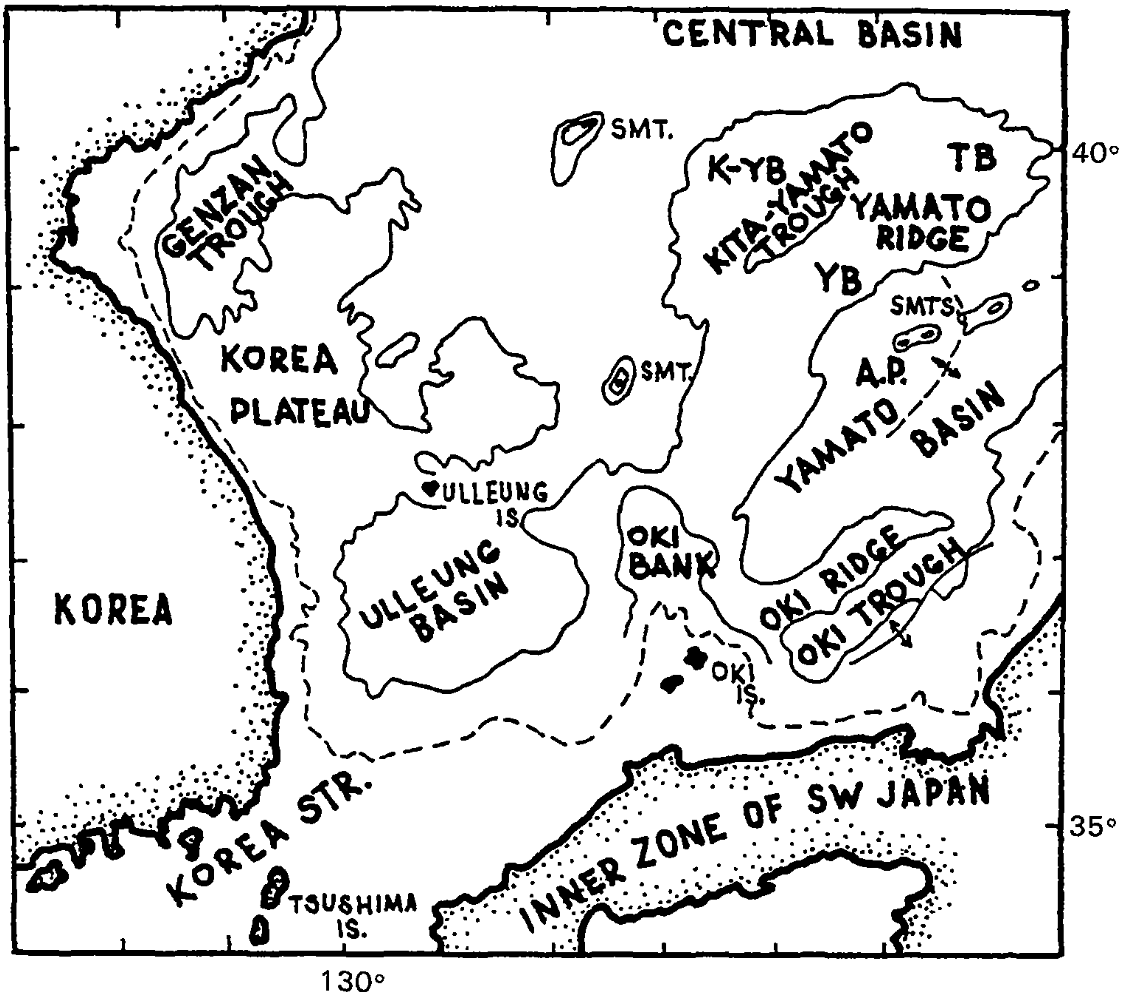


Fig 1. Review map south-west of the East(Japan) Sea of Korea. (Ludwig et al., 1975)

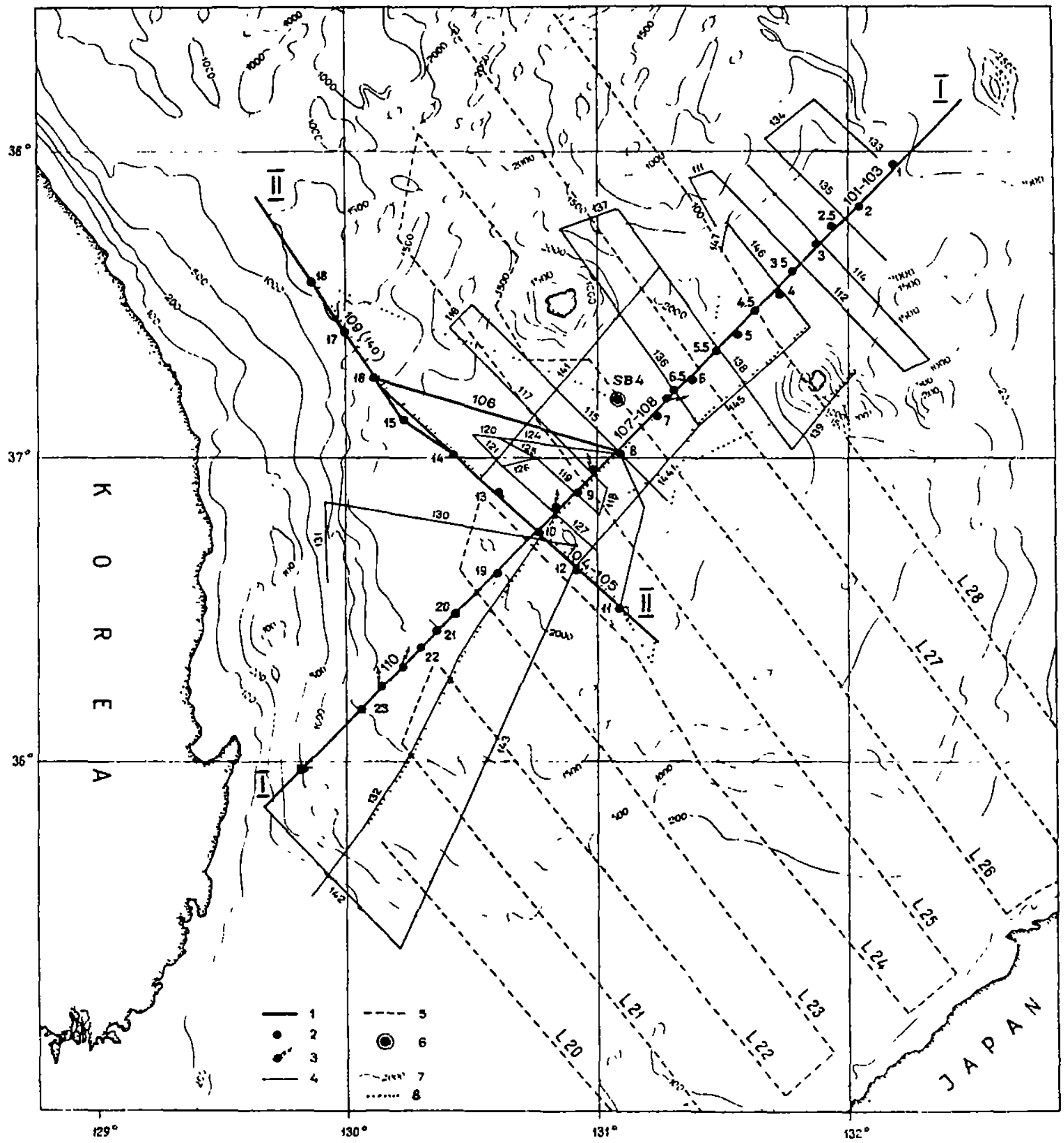


Fig 2. Map of investigate area of Russia-Korean mutual expedition on R/V Morskoy Geophysik and R/V Prof. Gagarinsky(07 aug.-16 sept. 1991).

1-Surveys lines CMPW, 2-Position of OBSs, 3-Position of SB, 4-Surveys lines SchPr(single-channel profiling of reflective wave), 5-Surveys lines SchPr(Honza, 1978), 6-Sono-buoy(Honza et al., 1978), 7-Isobaths are in meters, 8-Surveys lines of magnetic data.

the Institute of Marine Geology and Geophysics and one from the Insititute of Physics of the Earth of the USSR Academy of Sciences. Besides, in each of two periods of the cruise two scientific workers took part.

The technical stuff was represented with 12 workers of the IMGG and 3 from the Institute of Physics of the Earth of the USSR Academy of sciences (Moscow) (Table 1.).

The scientific vessels "Moskoy Geofizik" and "Professor Gagarinsky" left Vladivostok port on August 6 and 7, respectively, and conducted investigations in the north-east and central parts of the polygon up until August 22, 1991 (16 days) and then visited the Pusan port (Korean Republic) on August 24 at 8 o'clock of Korean time. On August 26 both vessels left the Pusan port and continued the works of the second period up to Setember 9, 1991 (14 days), mainly, in the central and south-eastern parts of the polygon. The second visit to Pusan port (Korean republic) was on the period from 9 to 11 of Setember, 1991 (Table 2.).

Common single-channel seismic profiling with analogue and partly digital recording was fulfilled with help of the IMGG equipment, using sparker of 12KJ capacity, with ship's speed not more than 6.5 knots. Main researches with refracted waves were conducted with the help of ocean bottom seismometer (OBS) having the sound sources of 30 KJ and 60 KJ capacity. The scheme of the profiles is given in Fig.2., and characteristics and coordinates of the observation stations are shown in Tables 2,3,4.

The vessel position was determined using the technique of the firm Japan Radio Co Ltd, providing recording of satellite information system Tranzit NNSS USA, recorders JLE-3850, JNA-761 LORAN-C, printer NKG-32 and plotter NWU-52, and, besides, we used the satellite system of "Tsikada" and

Table 1. Scientific staff

Anosov Gennadiy	m	1938	chief exped. Korsakov
Khabibullin Murat	m	1954	scientist
Yezhenkin Igor	m	1959	----
Urov Yuriy	m	1939	----
Shishov Oleg	m	1944	----
Shevlyukov Yevgeniy	m	1966	----
Malakhova Yelena	m	1951	----
Kryutchenko Viktor	m	1943	----
Bikkenina Saniya	f	1938	senior scien.
Han-Joon kim	m	1958	, Pusan
Yong Joo	m	1960	, Pusan
Zhigulyov Vladimir	m	1952	chief cruise, Korsakov
Lyapishev Eduard	m	1966	assistant of engineering, Korsakov
Monakov Dmitriy	m	1961	----
Paliy Nikolay	m	1942	----
Chekhonin Mikhail	m	1963	----
Nicolaicheva Tatiana	f	1951	----
Misileyych Helena	f	1952	----
Buckanov Victor	m	1941	, Moscow
Varda Henry	m	1940	----
Bashkirev Valeriy	m	1946	----
Beresnev Olleg	m	1955	----
Nam-Do Jang	m	1965	, Pusan
Chan-Hong Park	m	1957	, Pusan

Table 2. Coordinates OBS(Prelimenary)

No	Name	Profile	Latitude.N	Longitude.E
1	OBS-1	101	37 57.36	132 10.03
2	OBS-2	101	37 49.62	132 01.92
3	OBS-3	101	37 43.54	131 54.93
4	OBS-4	101	37 32.46	131 43.12
5	OBS-5	101	37 24.40	131 33.65
6	OBS-6	103	37 15.34	131 22.37
7	OBS-7	103	37 09.11	131 14.78
8	OBS-8	103	37 02.89	131 07.05
9	OBS-9	103	36 55.08	130 57.89
10	OBS-10	103	36 45.85	130 46.28
11	OBS-11	105	36 30.80	131 04.91
12	OBS-12	105	36 38.31	130 55.25
13	OBS-10A	105	36 45.23	130 45.71
14	OBS-13	105	36 52.81	130 36.13
15	OBS-14	105	37 00.16	130 26.17
16	OBS-6.5	108	37 12.45	131 19.62
17	OBS-5.5	108	37 20.10	131 29.20
18	OBS-4.5	108	37 29.21	131 38.74
19	OBS-3.5	108	37 36.67	131 47.36
20	OBS-2.5	108	37 44.97	131 55.80
21	OBS-14A	109	37 01.30	130 26.11
22	OBS-15	109	37 06.60	130 14.13
23	OBS-16	109	37 16.08	130 07.47
24	OBS-17	109	37 25.31	129 59.62
25	OBS-18	109	37 35.07	129 51.68
26	OBS-19	110	36 37.84	130 35.85
27	OBS-20	110	36 30.02	130 26.60
28	OBS-21	110	36 27.60	130 21.99
29	OBS-22	110	36 22.68	130 18.25
30	OBS-23	110	36 11.19	130 03.40

Table 3. Coordinates Sonobuoys(Prelimenary)

No :	Name	:Profile :	Latitude.N	: Longitude.E
1	Sb-1	103	37 12.28	131 17.64
2	Sb-2	107	36 34.10	130 59.96 flow-
			36 35.31	130 55.76 offset
3	Sb-3	107	36 49.75	130 50.54 ""
			36 50.83	130 48.47 ""
4	Sb-4	107	36 57.07	131 00.18 ""
			36 57.43	130 59.22 ""
5	Sb-5	110	36 17.85	130 12.17
			36 17.90	130 13.01 ""
6	Sb-6	110	36 13.88	130 07.33
			36 14.01	130 08.26 ""

"Parus". In a whole, error in determination of the vessel coordinates was less than 150-180 m. The total length of the route of "Morskoy Geofizik" was about 2800 miles, and that of "Professor Gagarinsky" - 4750 miles.

INTRODUCTION

The East Sea(Sea of Japan), finally formed in the middle Tertiary, is one of the most studied marginal seas of the North-West Pacific.

The mechanism of formation of the East Sea is connected with the collapse of continental crust or its oceanization (Belousov and Rudich, 1961; Minato and Hinahashi, 1970 et al.). There exists a point of view, that this sea was originally the oceanic basin (Vasilkovsky et al., 1971). Having reviewed all the available data up to 1973 Harley et al. (Harley et al., 1973) proposed hypothesis, according to which the sea appeared as a result of drift of Japan apart from Asia, and Yamato Rise and Yamato Basin are the by-shore section of the continental crust. Some time later proposition about belonging of the Yamato Rise to the one island-arc system of Japan was confirmed also with the Deep-Sea Drilling Project data (Ludwig et al., 1975). After appearing of the plate tectonics hypothesis the previous views were re-viewed and formation of the East Sea now is related to collision and underthrust of the hypothetical ridge of Kula, belonging to the Pacific plate (Uyeda and Miyasiro, 1974).

According to the proposed hypothesis the time of the East Sea formation was estimated from the Upper Cretaceous to Oligocene with final stage of formation in Early Miocene.

At the background of well studied north, north-west and east parts of the sea the west and south-west its part, adjacent to the continental zone of Korean Peninsula are weakly studied (Chough and Barg, 1987; Chough et al., 1990; Lee et al.,1991 et al.). This area connects the Korean plateau (border land) and Ulleung Basin. The later therefore was selected as the object for.studing of the Earth's Crust structure, details of its type, thickness and age of sedimentary layer, filling up the basin and the adjacent sea areas

The Ulleung Basin is situated in the south-west part of the East Sea. In the north the region of the Oki bank is joined with the south-west closing of Central Basin. The south-east limit coinsides with the west slope of Honshu Isl., and the west and north-west with the slope of the Korean Plateau and continental slope of the Korean peninsula. The basin has comparatively small dimensions (60.5 km^2) and maximal depth up to 2.5 km. The basin bottom is rather smooth, gently sloping to the south direction.

The layer with velocity more than 3.5 km/s, represented with volcanogeneous complex, is identical to the green tuff formation and belongs to the acoustic basement, and crust-mantle discontinuity is at the average depth of 16 km (Ludwig et al., 1975). The maximum depth of accoustic basement at the deepest reflections reaches 2.2 s. The total thickness of sediments in the Ulleung Basin is hardly more than 3500m. The crust type is not known yet, although in the central basin and in the north area of the Ulleung Basin the crust belongs to the oceanic type (Katao, 1988).

Within sedimentary cover according to the data of discontinuous seismic profiling (or MOV OGT) there are distinguished three seismic complexes, being characterized with there specific peculiarities. The upper seismic complex is represented with turbidites, mainly; is rather stratified with longitudinal high-frequency reflections, is not formed. This formation is connected with relatively abyssal plain to the south of Ulleung Isl. The velocities within the complex are 1.56-2.2 km/s, and the thickness varies from 0.29 to 2.78 km.

The middle seismic complex is stratified with short reflecting areas, weakly deformed with increasing of the latter towards the continental slope. The velocities within this complex are 2.07-2.93 km/s. The thickness varies from 0.33 to 1.36 km, increasing notably in the south-west direction.

The lower layer with weak reflections is transparent. The interface reaches 3.0 km, and velocities from 2.02 to 4.0 km/s. The lower margin is not distinct, water-worn.

The conducted drilling within the north part of the East Sea according to the ODP, Legs 127 and 128 confirmed principally three-fold division of sedimentary cover. The matter composition from bore-hole to bore-hole weakly varies and only towards under-sea rises and up-swellings the increase of volcanogeneous material is not noticed (Shipboard Scientific, 1990).

At the west board of basin continental slope the sedimentary layer thickness increases sharply. The stratigraphic investigation data allow to data the sedimentary cover with late Oligocene and Miocene-Quaternery (Chough et al., 1990).

Limited data about the basin structure, its position within the structure of the East Sea mega-basin, the crust type, thickness and age of sedimentary cover need more detailed and aimed investigations, the beginning of which was done by the international expedition of this year.

II. STRUCTURE AND TECHNIQUE OF RESEARCHES

The main geophysical method of researches, the preliminary results of which are given below, in the last expedition were the methods of continuous seismic profiling with reflected waves in a variance of central ray of reversed scheme of tracing of the wave first arrivals.

Both research programs formed one expedition, connecting cruises of two research vessels "Morskoy Geofizik" and :Professor Gagarinsky", belonging to the Far East department of the Academy of Science of the USSR. "Morskoy Geofizik" provided simultaneously performance of five buoy stations (on the refraction profiles) with interval between 20 and 10 km, and "Professor Gagarinsky" provided the impulse generation with interval 2 min for 30 liters and 4 min for 60 liters airguns. With the velocity of emitting vessel of 5.5 - 6.5 knots, with what all the geophysical observations were conducted, these time intervals corresponded to 300-350 m, or 600-700 m parts of the profiles.

Simultaneously with the work of the elastic oscillation source with the aim of refracted wave method the research vessel "Professor Gagarinsky" conducted the works with standard (routine) method of continuous profiling waves.

II.1 CONTINUOUS SEISMIC PROFILING

The method of studies of the structure of sedimentary volcanogeneous layer with routine method of single-channel seismic profiling in the variance of central ray is known rather well beginning with the pioneer work of M.Ewing (D.Kennet, 1987) in the 50th of this century. During next years this method development will be continued with the design of highly effective equipments, compact and economic emitters. The recording and emitting (sparker with capacity about 12 -14 KJ) technique, used in present investigations, was designed and manufactured by IMG&G ED of the Academy of Sciences of the USSR, including floating hydrostreamer 50 meter length (64 piezo-phones PDS-7, switched on parallely), analogue recorder, providing registration of seismic echo-signal at electrochemical paper within the frequency band from 60 to 250 Hz, and sensitivity not less than 10 mkw at the entry. The dynamic range of trans-tract of amplifying was equal to 60 db. The total amplifying range, including stepped regulation with step of 6 db is 140 db. The analogue recorder is provided with of automatic regulation of sparker block, allowing to preserve the stable range of recording of reflected signal, equal to 3.0 s for any possible depths of sea or ocean.

Resolution of the method is (at a frequency of reflected signal of 100Hz) not worse than 15 meters. The used capacity of sparker (12-14 KJ) provided the frequency range of emitted signal within the band 90-120 Hz, and the depth of investigations under favourable seismological conditions below the sea bottom reached commonly not less than 1.0-1.5 s of two way travel time or 1.0-2.0 km of thickness of the sedimentary volcanogenic stratum sequence. The most detaily and confidently the middle part of the sedimentary cover was studied.

The method of simultaneous mutual work of large-volume airguns, which generate strong signals for providing observation with refracted waves together with investigations with method of continuous seismic profiling with reflected waves is used in studies, conducted by IMGG, from 1982. Such complexity gives opportunity of highly effective control over conditions of generation of refracted waves at sea bottom (in upper parts of sedimentary layer) and conditions of their registration with bottom stations. This method has great advantage above simple echo-sounding of the sea bottom relief along the line of bottom station disposition, because it allows to put corrections not only for geometry of sea bottom surface (that is commonly and rather widely used in the world practice of the method of refracted waves), but also takes into consideration all heterogeneities in the structure of sedimentary-volcanogeneous layer.

Besides the analogue recording the complex of the equipment under consideration includes digital block of registration and storage of received information on magnetic tape. This block consists of 10-bite (discharge) analogue digital transducer, which is drived with microprocessor device on the basis of personal computer, and magnetic registrator, which allows to pack information in digital form with density of 800 bite/inch. For the parameters of registration, used during the expedition, one disk of magnetic tape recorder (750 m of magnetic tape) provided 8-9 hours of continuous registration of the data of seismic profiling with reflected waves.

The method of reflected profiling was used also for polygon investigations of long the profile series, with the step of 20-30 miles orthogonally to trend of geological structures which envelope the regions under studies from the North-West and South-East.

The total volume, fulfilled with the above method, is equal to 1490 nautical miles. The main part of profiles is restricted to the area, adjacent to the structure of Ulleung-do island (Ullingo).

II.2 SEISMIC PROFILING WITH REFRACTED WAVES

Seismic observations with refracted waves were fulfilled at two orthogonal profiles I and II (Fig.2.), each being 180 and 110 nautical miles long and having 24 and 8 bottom and radio-buoy stations, respectively. The profile I was done along the basin axis zone under consideration and transacts in the region DS-7 and DS-5 the line of Ulleung-do and Liankur Island. Transversal to the former profile II was done at the north-west rim of the Ulleung Basin, the basement of which, from the numerous geological data, is not younger than Pre-Cambrian, and has, most possibly, the earth's crust type, rather near to the continental one.

It was supposed that such profile pattern would allow to evaluate the earth's crust type of the Ulleung Basin and the velocity meanings of elastic waves at the basement of sedimentary cover of this province.

The method of observation using refracted waves, realized in this expedition, is the two-time profiling along the discontinuity of sedimentary cover basement in a variance of reversed scheme with correlative tracing of waves of first arrivals. With the frequencies of main registered waves of about 10-16 Hz and apparent velocities of 2.0 km/s to 7.0 km/s·the wave length are equal to 150-200 and 400-700 m. Taking into account, that the distance between neighbour traces reached 300-700 m, the chosen measuring intervals did not provide, strictly saying, demands to the correlative method of tracing (not more than half a period); but, using only the first arrivals of the registered waves in a complex with group correlation (according to recording form) rather often lucky to fulfill the phase correlation too.

Registration of oscillations, caused with arrival of refracted waves to the pickups of the bottom (or radio-buoy) stations, was fulfilled with the help of equipment complex, including emission, receiving and recording system. The whole emission system was installed on R.V "Professor Gagarinsky", and receiving-recording ones - on "Morskoy Geofizik", which allowed to increase the effectivity of conducted works by about 70%.

Emission of seismic signals was fulfilled with the help of air-guns with volume of 30dm^3 and 60dm^3 with working pressure of compressed air of 15000 Pa. The frequency spectrum maximum was 18 and 30 Hz.

The receiving of seismic signals was fulfilled with the help of radio-buoy and bottom seismic stations.

In the radio-buoy stations the hydrophones, manufactured on the basis of piezo-electric pickups PDS-7, were used receiving system. After amplication and modulation the seismic information was transmitted by radio-channel to the one board registering system, where was fixed on magnetic tape in analogue form . With the aim of increasing of dynamic range of recording, registration of seismic information was fulfilled simultaneously along some channels with vatious coefficients of amplification.

In present expedition the bottom stations were used, designed and manufactured in the Institute of Physics of the Earth of the Academy of

Science of USSR. Station construction consists of seismic receiver and registrator, cased into steel cylindrical container. The vertical electro-dynamic seismic receiver of NS-3 type is mounted in joint pendant, providing vertical orientation of the axies, independently on the container position at sea bottom. The seismic receiver has the following parameters: own frequency 3.5-4.0 Hz, degree of damping 0.55-0.70, transmission coefficient 24 Vs/m.

The registratior consists of the band drawing mechanism with electronic plates of the station and the block of autonomous quartz clocks.

The band drawing mechanism is constructed by one-motor scheme, the leading assembly of which is an electromotor with stable current of IDR - type. The magnetic tape type is H4406-12. The working velocity of tape moving is 0.39 mm/s. Capacity of magnetic cassette is about 350 m, providing continuous work of the station during 10 days day and night. Number of motor turns is kept strictly stable with the help of scheme of automatic regulation, providing comparison of motor rotation frequency of quartz generation. Scheme of electronic engine is feeded from battery of 6V and uses not more than 1.5 mA.

Scheme of registration has eight-channel block of magnetic heads. The following information is recorded on magnetic tape: seismic signal on two levels of sensitivity with spread of 30 db; enveloping of hydro-acoustic channel; time code (on two tracks); accompaniment signal (pilot signal); minute pulses.

The frequency range of the registered seismic signals is 2-25 Hz , hydro-acoustical signals -20-25 Hz. Total geodynamic range of seismic track is 70 db. The level of dynamical overlapping between sensitive and coarse channels is 10 db. Own noise of amplificaton, reducted to the exit, is not more than 0.25 mkV eff., that allows to record the useful signals with the shift of about 10^{-9} km.

The apparature possibilities of the station allow with the help of filter of high frequencies to distinguish select the signals of hydro-acoustic channel, enveloping of which, after being detected, is recorded on magnetic tape. The times of arrival of hydroacoustic waves is used in the process of further interpretation for determination of the distance between oscillation source and the reception station (station disposition).

The block of autonomous quartz clocks of the station includes driver generator with themo-stated quartz resonator with 100 kHz or 10 kHz, devider of frequency and a coder, transforming parallele code of current time into corded on magnetic tape. The present code contains information about numbers of minuate, hours and date of the month. Stability of clock run is about 10^{-8}, exactness of its run is about 10^{-7}.

Run away of bottom clocks during autonomous work of the station was determined with the help of absolute time of on board synchrono-
meter 47-37.

Installation and salvaging of radio-buoy stations were provided with the help of buoy-rep. The scheme of station installation at the bottom is shown in Fig.3.

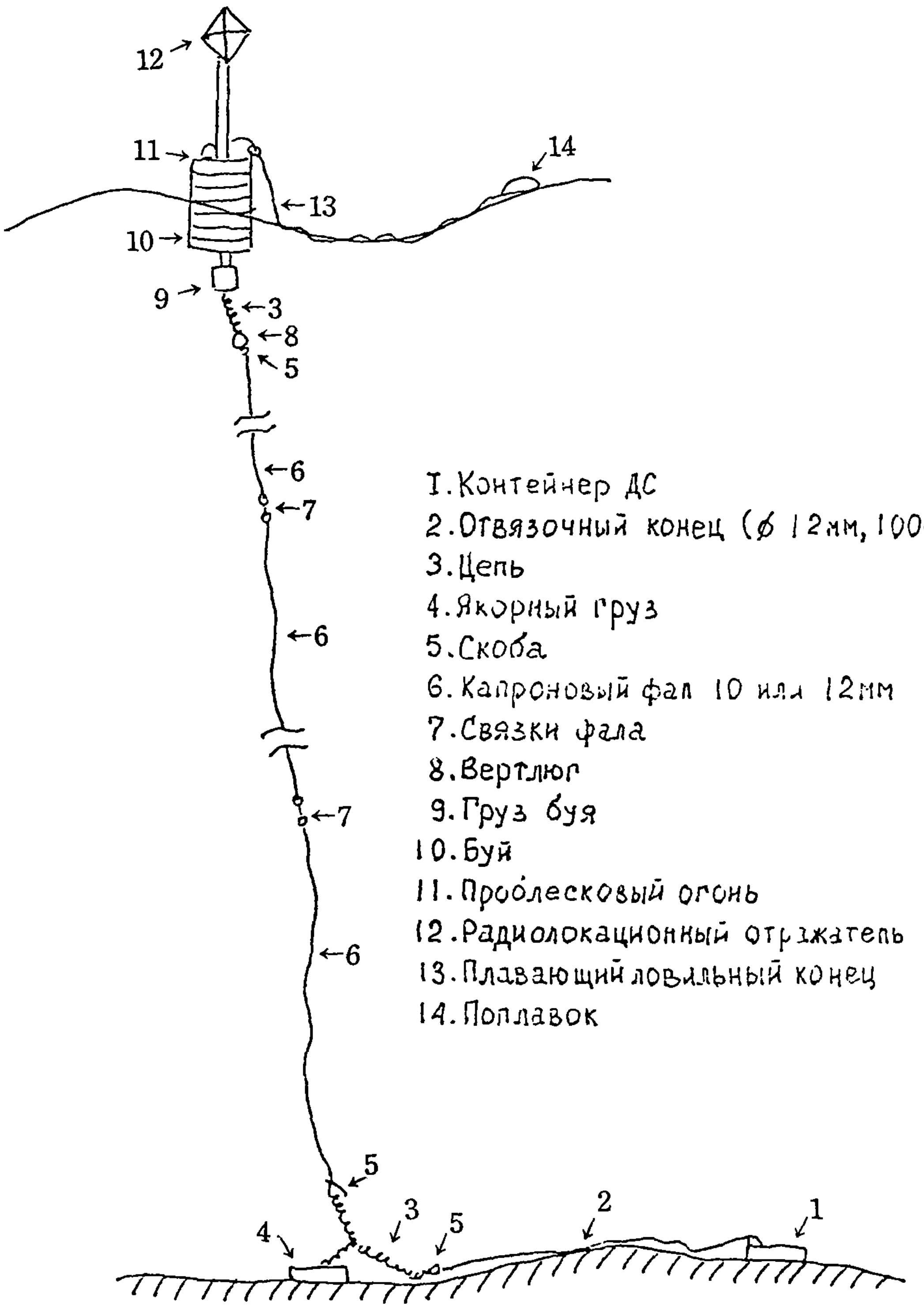


СхеМа ОСНаСТКН АПСС

Fig 3. Schematic drawing of ocean bottom seismic(OBS) station layout.

SEDIMENTARY COVER STRUCTURE

At the time section of the continuous seismic profiling there are distinguished three seismic-acoustic complexes, registered within the sedimentary cover, and surface of acoustic basement, which in wave pattern distinguishes each from other by characteristic pecularities of the reflected signal record. These complexes are conditionally divided into strongly stratified, weakly stratified and acoustically transparent. Fig.4. shows the fragment of time cross section, in which they are, respectively, with letters A,B,C and the surface of acoustic basement with letter 'D'.

The strongly stratified complex is characterized with high energy and sure correlations of the reflected signal phases. At time cross-section it is well distinguised as interval of recording, represented with entire alternation of sub-horizontally occuring reflecting horizons.

The weakly stratified complex is distinguished with some less energy of the reflecting signal, high amplitude dispersion, increased frequency spectra and availability of the diffraction wave background. At the time cross-section it is characterized with recording with high seismic background and episodically traced weakly correlated reflecting horizons.

The acoustically transparent complex at the cross section of continuous seismic profiling is distinguished with time interval of recording, within which the correlated reflections are practically absent. Such wave pattern is commonly registered in the cases, when sedimentary layers weakly differ one from another according to seismoacoustic parameters.

The surface of the acoustic basement at time cross-section, as a rule, is distinguished with continuous background of highly dispersive

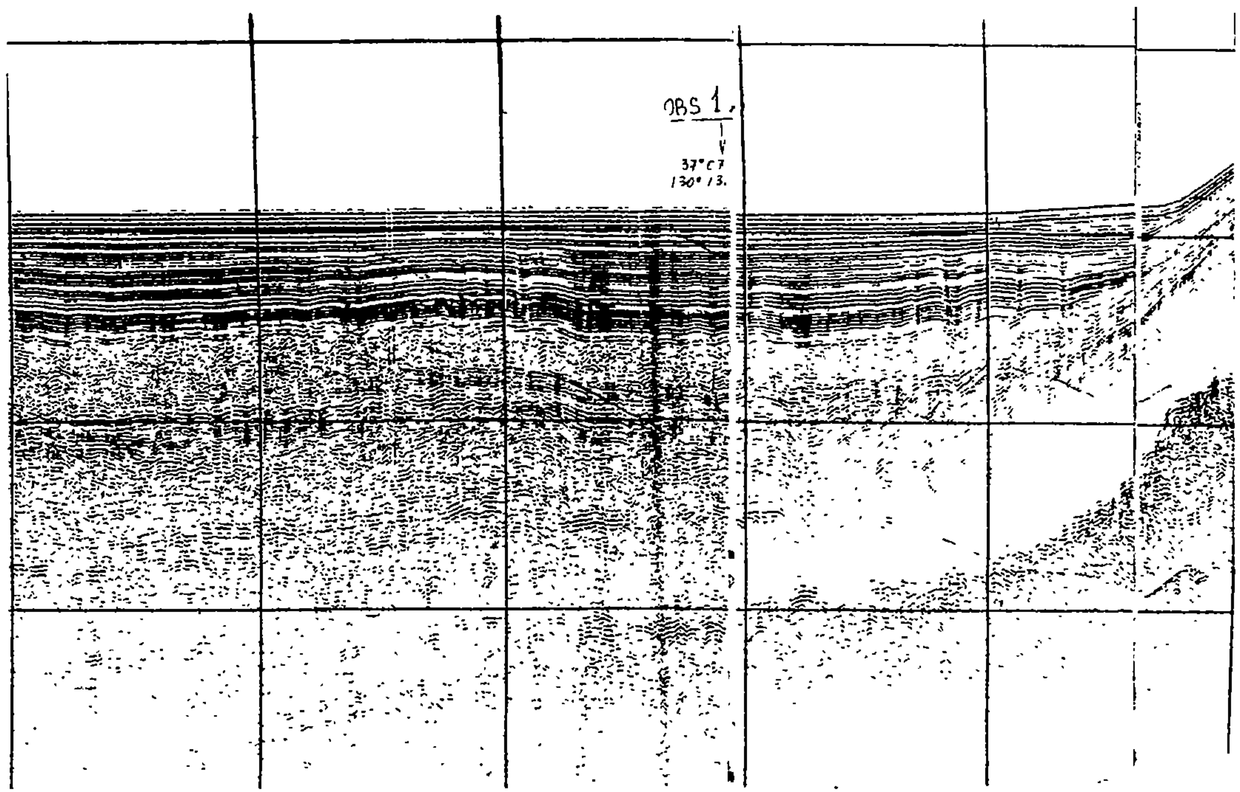


Fig 4. An illustration of a seismoacoustic unit : A-well stratified ; B-weakly stratified ; C-acoustically transparent ; D-acoustic basement.

diffraction waves, below which no reflections are recorded.

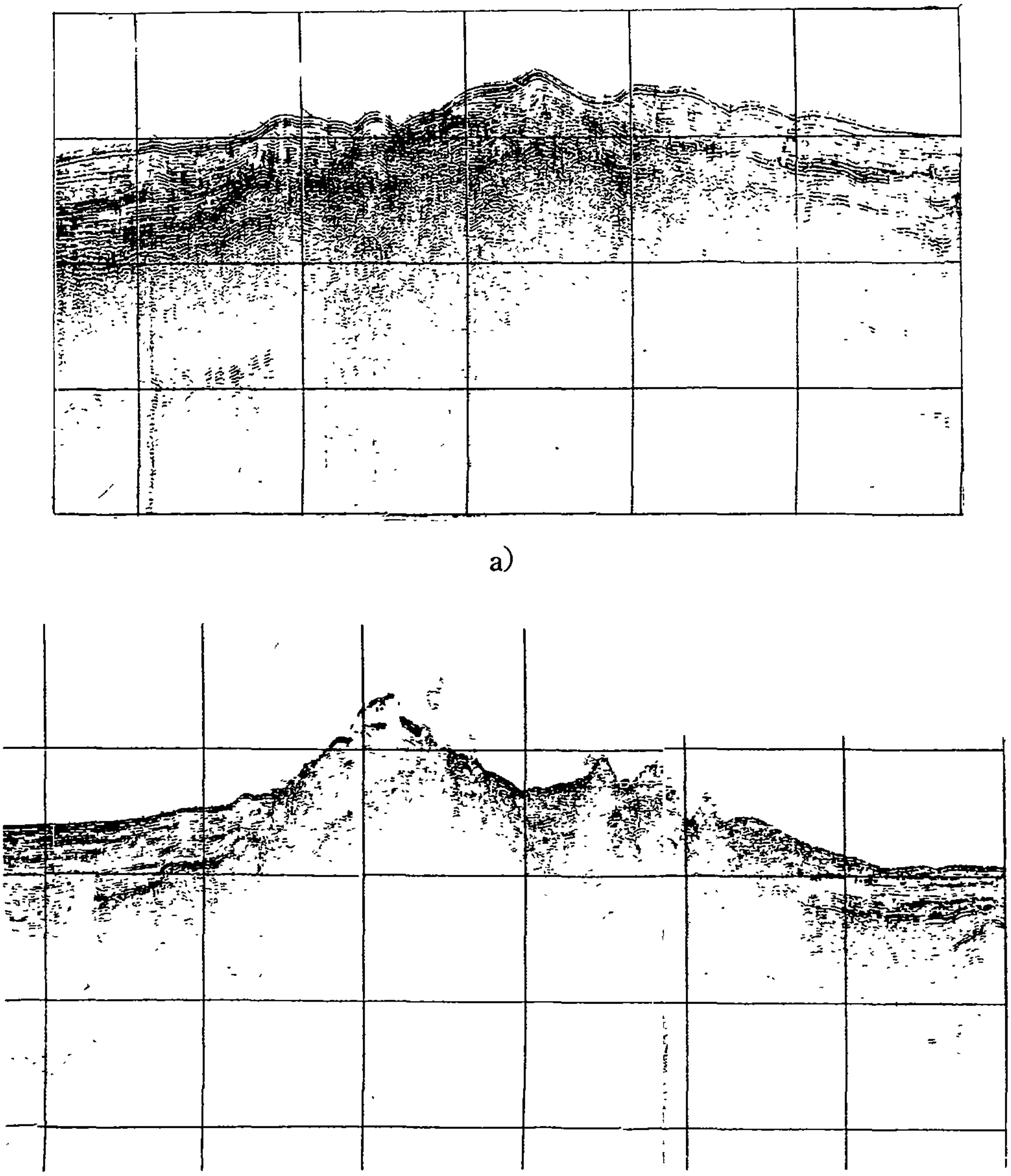
Nevertheless of such rather complex wave pattern, some regularities of distribution of the above complexes can be seen.

Strongly stratified complex occurs only in abyssal part of the Central depression (to the South of Ulleung-do and Liankur Is.), where its deposits compose the upper part of sedimentary cover sequence. The complex reflecting discontinuities have sub-horizontal laying, discordant, as a rule, with the surface of underlying layers (Fig.5.).

The maximal thickness of the complex was noted in the central of depression, where it reaches 0.3 s of double travel time of seismic ray. While reaching the Korean continental slope, its thickness gradually decreases to zero. But sedimentary layers do not wedge out at the foot of this slope, but are adjacent to the surface of underlying layer at various angles (Fig.6.). Along all the region under consideration there is no deformation of the layers of stongly stratified complex, excluding the south-west margin of Tsushima depression, where their weak deformation is noticed near foot of the continental slope (Fig.7.).

The feature of structure and structural occuring of this complex testifies to the fact, that this complex is composed of , possibly, turbidites deposits.

The weakly stratified complex is distributed everywhere within the polygon under consideration. It composes the Tsushima depression, and the upper part of the sequence on the continental slope parts in the north-east part of the depression (to the North of Ulleung-do and Liankur Isl.) (Fig.8.). The sedimentary formations of this complex are weakly which are traced up to 70-90 km. According to kinematic (decreasing from 8.0 to 6.8 km/s with distance) and dynamic features this wave group can be associated



a)

b)

Fig 5. Acoustic basement uplifts in the abyssal part of the basin between the Ulleung-do and Liankur islands (a)-profile 145, b)-profile 136).

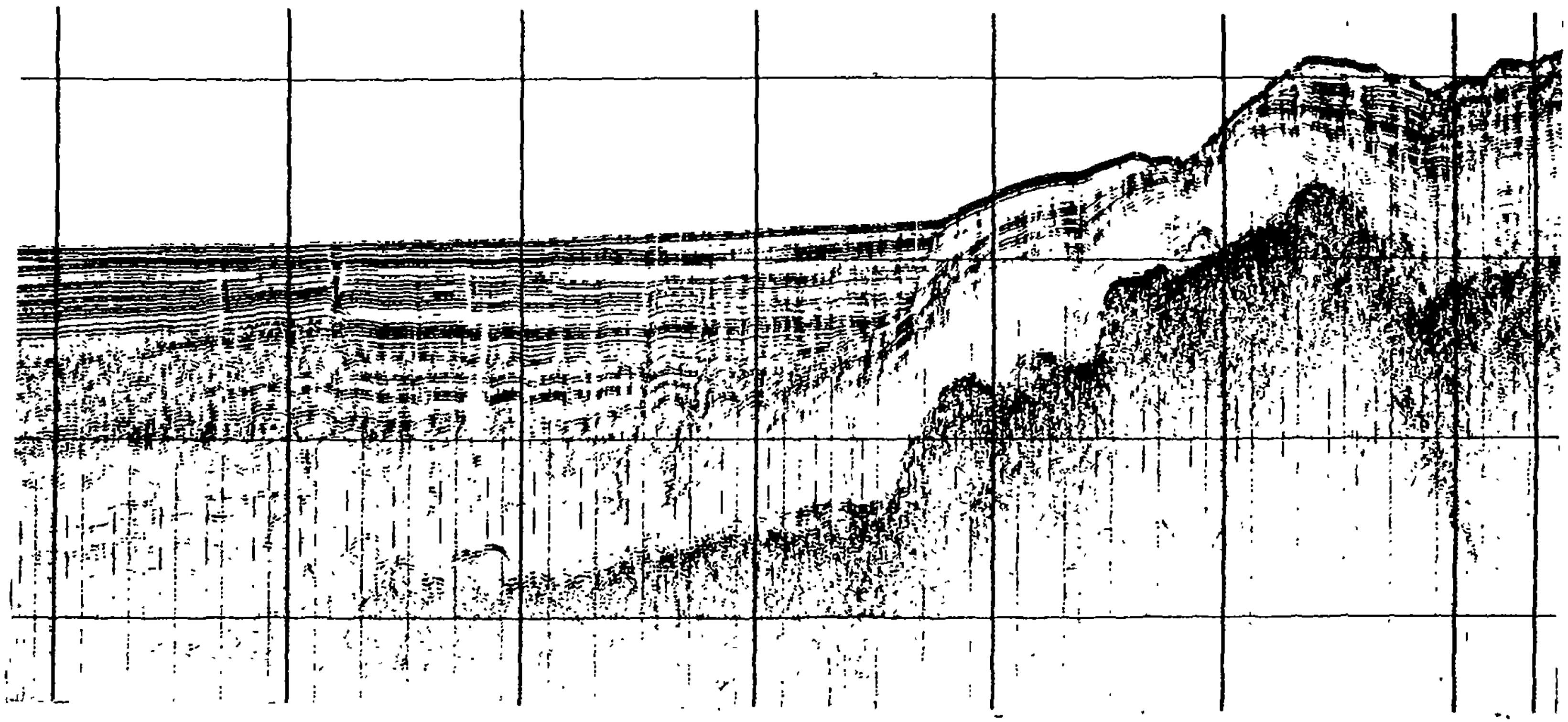


Fig 6. Interaction of well stratified unit layers and underlying sediments at the foot of the continental slope.

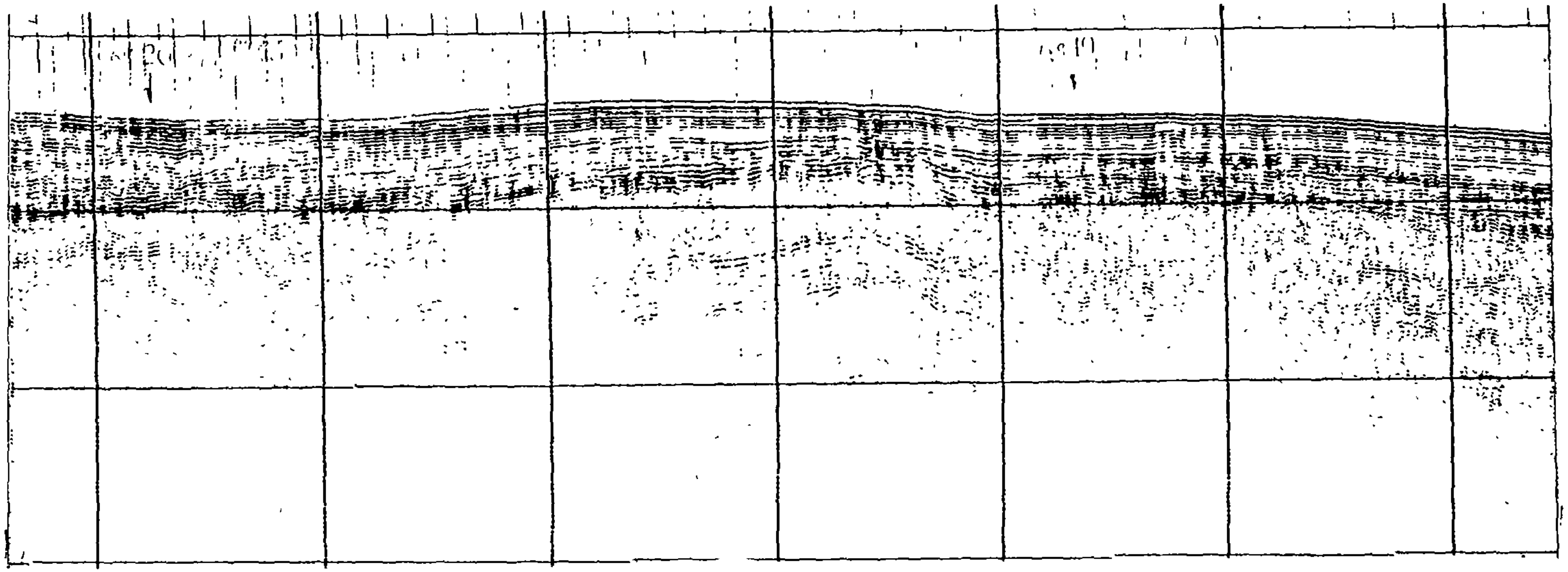


Fig 7. An illustration of weak deformation of the upper well stratified unit on the south-western edge of the Tsushima basin(profile 110).

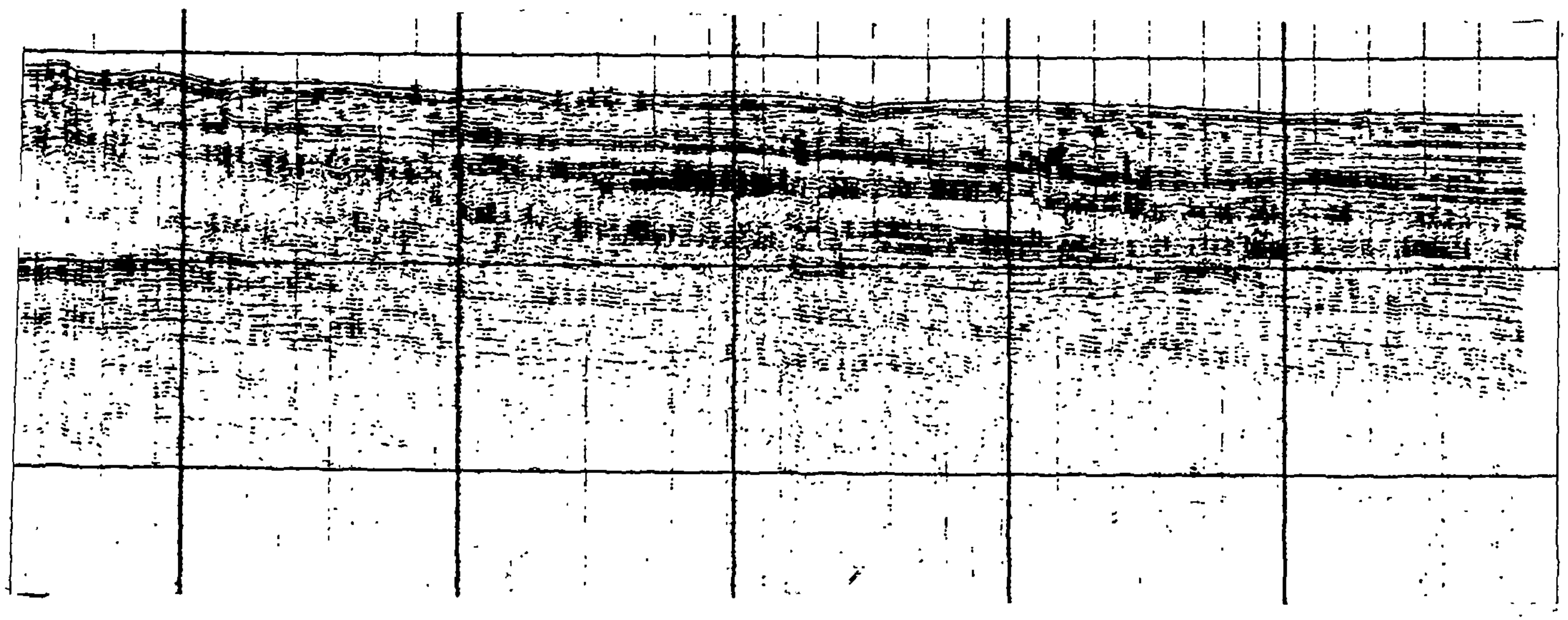


Fig 8. An example of the weakly stratified unit surface occurence(to the north-east off the Ulleung-do and Liankur islands).

with that, reflected from the lower Earth's crust discontinuity - possibly, M - discontinuity. This associaton is not exact, because the refracted wave from M-discontinuity were not recorded and it is based on comparison with Japanese information for Yamato Basin.

The central profile part (120-240 km, OBS 5-10) is characterized with increasing of interval of tracing of the waves connected with sedimentary layer. Here they are recorded up to distance of 15020 km to the station. Distinctly, nearly on all the station records, the waves with apparent velocities of 3.3-3.5, 4.0-4.6 and 5.0-5.6 km/s are recorded. The apparence of wave with V=6.0-6.4 km/s here is delayed, respectively, to 15-20 km in difference of the north part (10-13 km) and area of its tracing decreases up to 15 km in comparison with the north part (20-25 km). Recording of waves with V=6.6-6.7 km/s in the first arrivals begins with the distance of about 35 km on the preceeding part too.

The observed increase of velocity from 6.7 to 7.1-7.3 km/s at a distance more than 45 km from the station gives opportunity to suppose existance within the Crust lower parts of high-velocity layer. The noted in the north part general weakening of recording at a distance of 35-40 km is preserved here too, but distinguishing an intensive group of reflected waves, which are characteristic of the north part, is difficult here because of increased noise background. On records of st.6 at a distance of more than 60 km there is traced a group of waves with apparent velocities about 8.1 km/s. The nature of this group of waves at this phase of interpretation is yet unknown.

EARTH'S CRUST MODEL

The constructed on the base of distinguished waves preliminary models of the Earth's Crust with approximate methods were detalized with the solving of direct kinematic task (Cerveny, 1985). The method of synthetic seismograms was not used at that stage of work. Fig.9. shows one example of observed seismogram along Line I. The models constructed for the north and central parts in one-dimension version are shown in Figs.10,11. to construct the uppermost part of sedimentary cover we used data of Ludwig et al.,(1975) and Honza, (1978).

As it is seen from the given models, there is a difference in the structure of the Crust of the north and central parts of the profiles. These difference is characteristic of the Upper Crust thickness. The north part is characterized with sedimentary layer thickness of about 2.5 km up to the boundary with velocity 6.0 km/s (Fig.10.). Thickness of the layer with V=6.0 km/s is about 1.3 km. The lower Crust with velocities 6.5 and 6.8 km/s has 10 km thickness. The total thickness of igneous crust is 14 km. Sedimentary layer is characterized with the highest gradient of velocity (0.05 1/s). The central profile part, beginning from the traverse of Ulleung-do island, is characterized with the increased comparing with the north part thickness of sedimentary layer (Fig.11.). The total thickness of the latter up to discontinuity with V=6.0 km/s is 5 km. The total increase of thickness occurs at the expense of increase of thickness of the layer with velocities 3.4 and 4.5 km/s and appearence of additional layer with velocity of 5.5 km/s. The velocity gradients here are little lower, than in the north part and is 0.2 1/s. The thickness of the layers with velocity 6 km/s and Lower Crust with velocity 6.5-6.6 km/s are

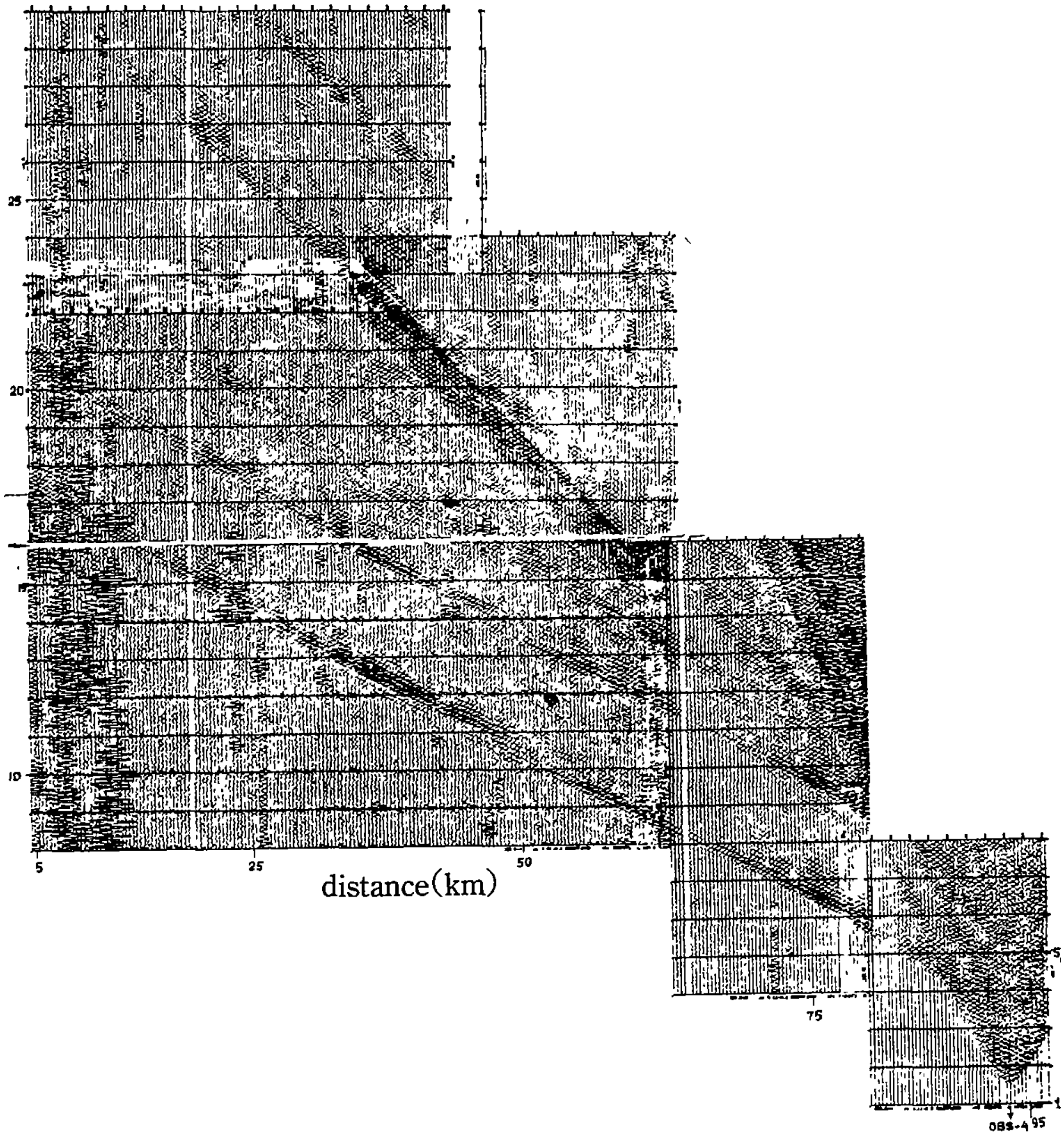


Fig 9. Observed seismogram along Line I. OBS-4.

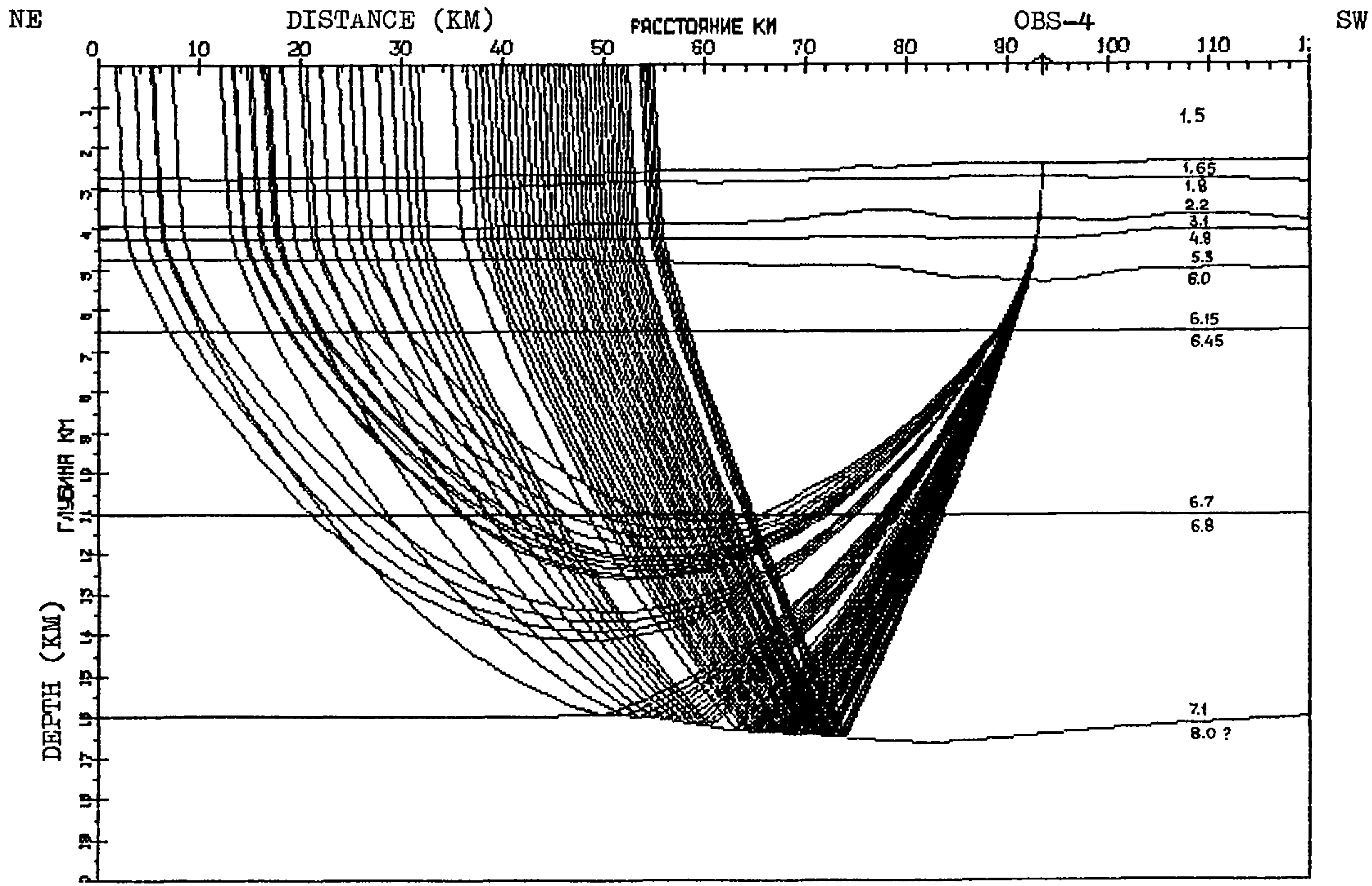


Fig 10. Example of two-dimensional ray tracing based on model of Fig(B1).

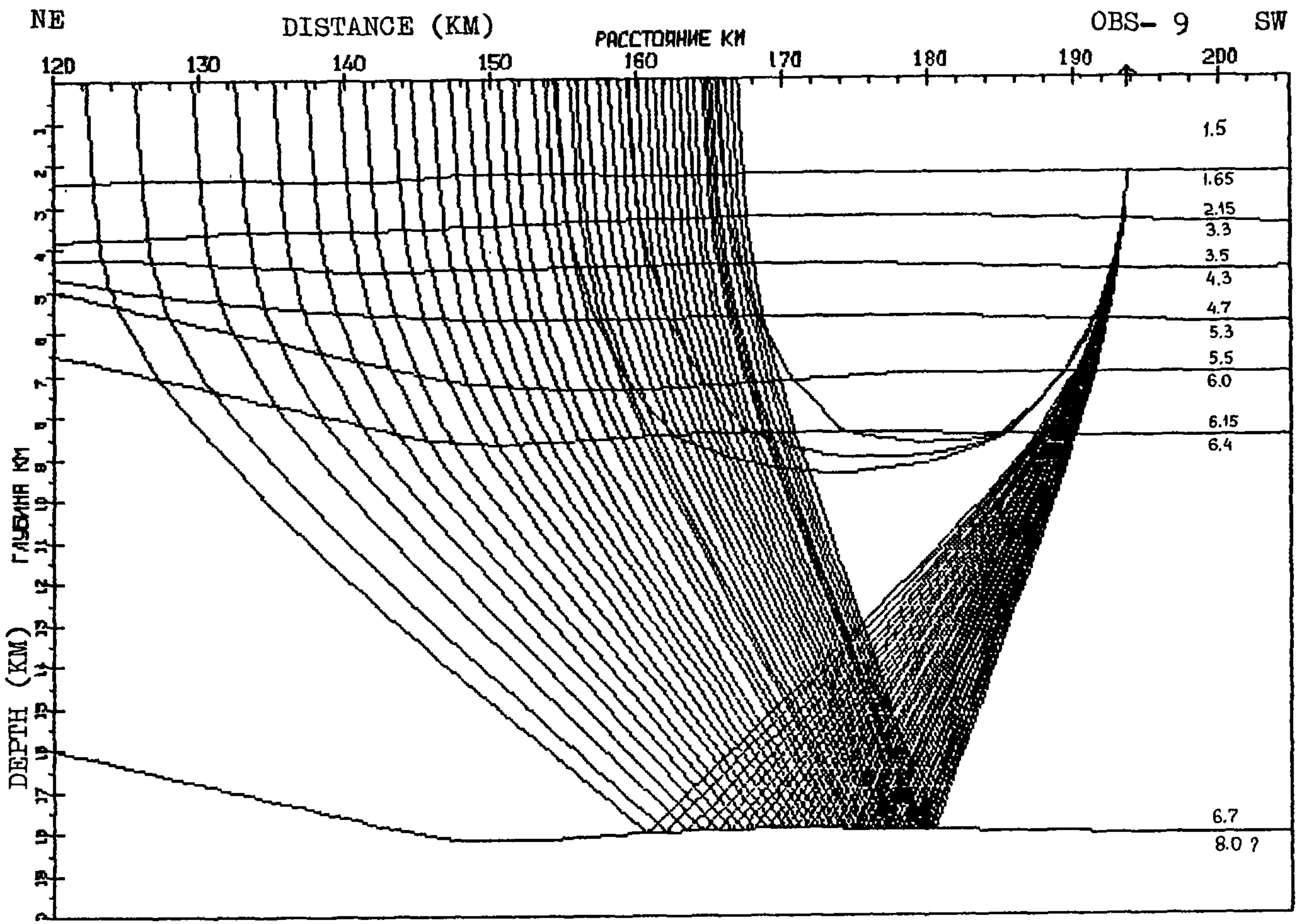


Fig 11. Example of two-dimensional ray tracing based on model of Fig(B2).

approximately equal with the north part. Respectively, the total thickness of the igneous crust here is about 16 km (Fig.12.).

Therefore, according to character of lyering, velocity structure and total thickness, the Earth's Crust along the Profile I in the depressing Ulleung is similar to the Yamato depression crust (Honslu) and the northen part of the Japan depression (Bikkenina, Zhiltsov, Soloviev, 1991) and differs, as it follows from the above, from typically oceanic crust.

The question about origin of the depression may be discussed after final interpretation of all the received material.

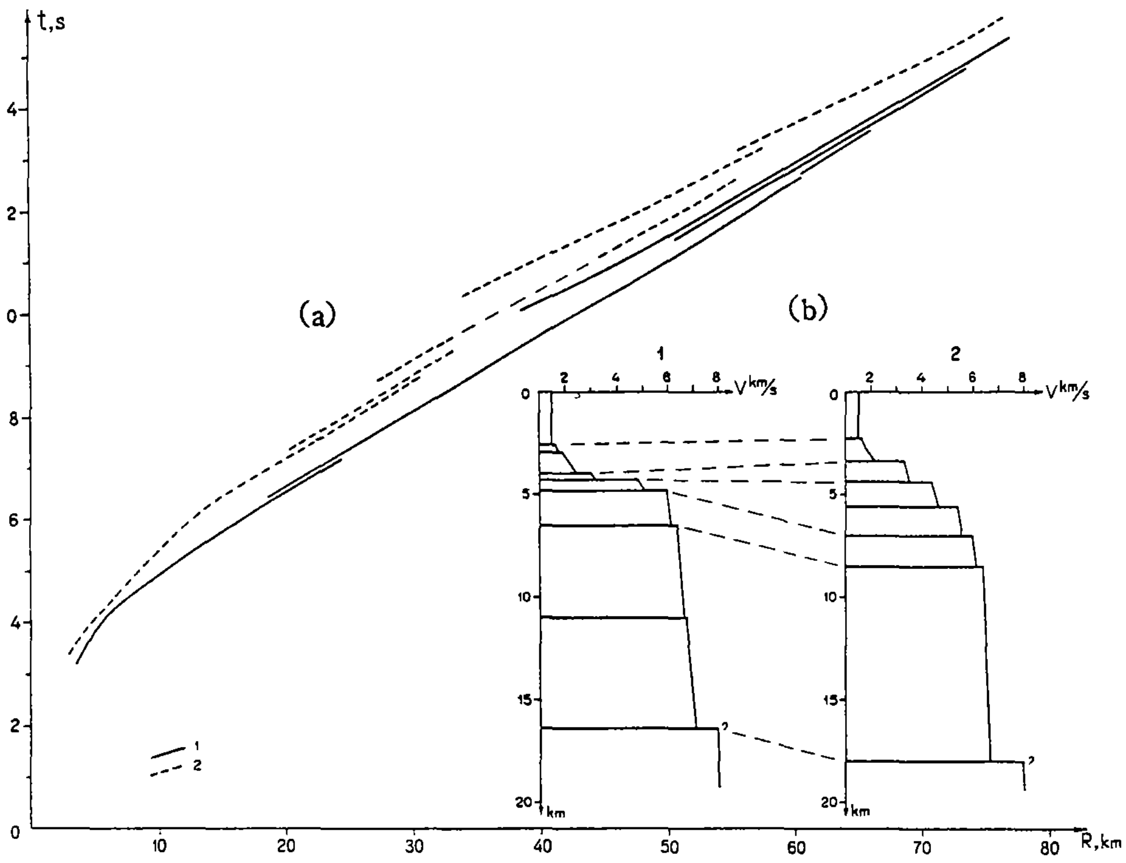


Fig 12. Curve travel time (a) and average P-wave velocity structure of the crust (b) beneath the Tsushima Basin(line I, north-eastern (1) and central (2) parts).

GEOMAGNETIC INVESTIGATIONS

The method of conduction and interpretation of geomagnetic survey at the water area under consideration is characterized with several peculiarities:

- high gradients of geomagnetic field variation determines the necessity to install some buoy magneto-variation stations or organizations of special net work of hydromagnetic survey and using of gradientmeters for adequate taking into account variations of the fields of outer and induced sources, which role in the anomalous field can be equal up to 50 and more nTl (Marderfield,B., 1989);

-discordance of the model of International Geomagnetic Reference Field to the main geomagnetic field (Turmanov, Yu, 1991) determines the necessity to conduct additional investigations in the field of creation of local field relativeness of the studies in water area with the aim of reduction of various scale and various time surveys to the unique scale and unique epoch;

-complexity in conducting of hydromagnetic survey with another geophysical investigations on board of one vessel causes the necessity of utilization of special noise protection pick-ups.

All the above tasks at present are decided in Laboratory of Magnetometry of IMGG FED of Academy of Sciences of USSR. The result of these investigations can be used during fulfillment of cooperation investigations in future interpretation of magnetic data of East sea.

CONCLUSION

The preliminary consideration of experimental data, received during the cruise of 1991 allows to note the following points:

1. According to seismic data the disintegration line between Ulleung Basin and Central depression of the East sea is a line, connecting Ulleung-do and Linkur island.

2. The thickness of sedimentary deposits, characterizes with velocity values from 2.0-6.0 km/s, increases towards south-south-west at the expense of increase of thickness of the layer with the velocities 3.0-5.0 km/s.

3. The presence of stepped time arrivals plot, correspond to the discontinuity within the sedimentary cover, may testify to possible presence within the sequence of alternating rocks with high and decreased velocities.

4. The lower part of sequence of the Ulleung Basin Earth's Crust is well correlated with sequence of the Earth's Crust of Yamato Basin and the North part of the East (Japan) Sea.

5. Mutual interpretation of reflected and refracted data allows to suppose the tracing of the lower part of sedimentary cover sequence to within the Korean peninsula shelf. If it is so, then the young nonlithificated sediments of shelf area are underlyed with the strata the velocity in which are not less than 5.0 km/s.

6. During the further stages of investigation of Ulleung Basin with seismic methods the studies must be planned including land-sea profiles, being across the profile I. Also it is necessary to fulfill special observation with powerful sources.

PRELIMINARY DESCRIBES OF CROSS-SECTIONS OF THE EARTH'S CRUST OF ULLEUNG BASIN

The analysis of the recorded seismic wave fields has been realized nd two cross-sections of the earth's crusr are constructed along the profiles 1 and 2 which were setted along and across the Ulleung basin of the Eastern Sea.

The cross-sections were constructed by the traditional methods as the time field method, and etc. The cross-sections being given from this procedure was looked as the initial seismic models of the earth's crust on this region of Eastern Sea which will be subjected mathematical modeling in the future.

Nevertheless the results of the construction of the reffered cross-sections responce many of main features of depth's structure from our Viewpoint of the earth's crust.

Profile 1

The boundary with the boundaries velocity V=5.7 - 6.0 km/s was studied most confidently and less confidently for the MohoroVichlcha's (boundary M) boundary with the boundaries velocity about 8.0 to 8.35 km/s.

The cross-section as whole may be schematically divided by the three blocks:

the northern block which is the conjuction of the Ulleung and southern path of the central Japan basins (0 - 120 km).

the central one, which is Ulleung basin itself (120-260 km).

the southern one which is transition zone (260-320 km) to continental slope of Korean Peninsula.

In the northern block the interface with boundary wave velocity V=5.8 - 6.0 km/s is situated at the depth of 4 km and is overlied by the layers with the velocity of V=1.6 - 2.4 km/s at top and V=4.7 km/s on the bottom of overlying thickness.

The interface between the layers with V=6.0 km/s and V=6.6 km/s isn't sharp and may be represented by jump of the first derivation of velocity function.

The Moho boundary is found at the depth of 16-18 km and is constructed with using of the opposing travel time curves of reflected waves.

In the central block the interface with V=5.7 -6.0 km/s dip up to the depth of 6.0 km/s. From the top of the cross-section it may be resolved with different degrees of confidence the following boundaries with boundary wave velocities 3.2-3.6 km/s, 4.3-4.5 km/s, 4.9 km/s.

The Mpho interface is situated here at the depth below 16 km.

In the southern part the interface with V=5.7 - 6.0 km/s is abruptly lifted up to 4 km and to the end of the profile this boundary is traced with the velocity V=5.5 km/s. Upper from it we can distinguish only the interface V=2.9-3.2 km/s.

The depth of Moho is about 20 km on range of 280-290 km of the profile, i.e. We can see it abruptly subside under the continent. We suppose that there is a faulting zone at the point of 277 km of profile 1 as it is showed by the bottom topography and the configuration of seismic boundaries with velocities 4.3, 5.4 and 5.7-6.0 km/s.

To close of this presentation it may be noted the following. For the detail charácteristics of the crust it need to make the more detail system of observations for evidences of the detail characteristics of upper part of the crust on the range of 100-160 km of profile one.

Profile 2

Well, to provide the geological interpretation of prepared models of profile 2 need to pay the attention to follows things.

There are two main blocks of the earth's crust which are separated one from another by junction contact as the fault on the point 133 km of profile of Line 2 and are marked by thrust's zone.

The first block (0-130 km) define the Ulleung Basin itself. The earth's crust have a sequences of layers, in which the velocities are typically for the ocean's crust, but unlike conventional models the thickness of layers are increased.

The acoustic basement in this block (v = 4.0 km/s) have rather the volcanic nature (that is beyond in the western, arised parth of that block). However, on the eastern part this cross - section (0 - 40 km) the boundary with (v = 3.3 km/s is traced in the wave field instead the boundary with v - 4.0 km/s that is more closely to normal sedimentary rocks. Thus, it may be assumed that the volcanic rocks of acoustic basement is overlied by the normal or typical cross - section of sediments, then their total thickness in the Ulleung Basin up to the boundary with v - 5.0 - 5.5 km/s is not less then 3 - 4 km.

The other block of referred cross - section (133 - 200 km) characterize the continental crust here. The sedimentary rocks underlie the geological basement (v - 5.6 - 6.2 km/s), which is also the acoustic basement at the same time.

To provide that the cross-section of this Line 2 is more detailed in their parametries (especially, for sedimentary cover). We must work in the fure with more detail observations. With that in this case, in region of the above blocks's contact (100 - 160 km) the OBS stations would be needed to distribute with step of the long of not more than 5 km, and of 10 km on the part of Line 2.

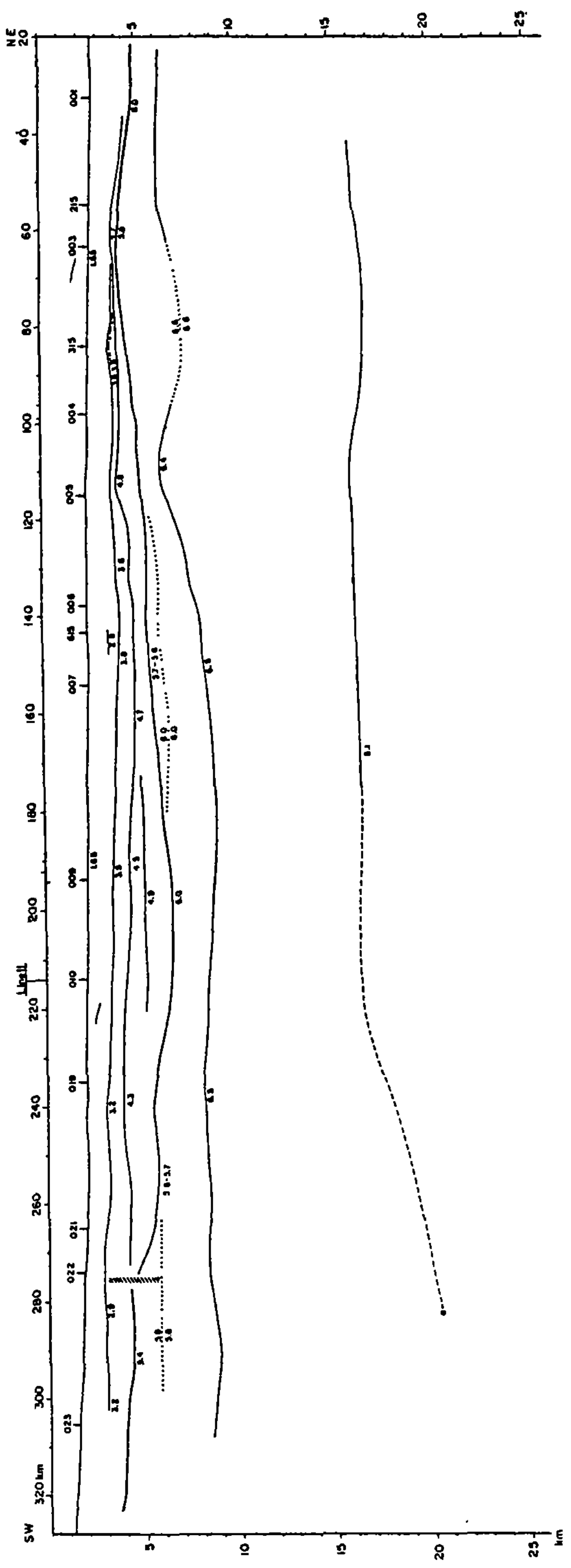
PROFILE INTERPRETATION

The earth crust seismic sections of the Ulleung-do Basin presented here are the first two-demensional seismic models, but they are preliminary.

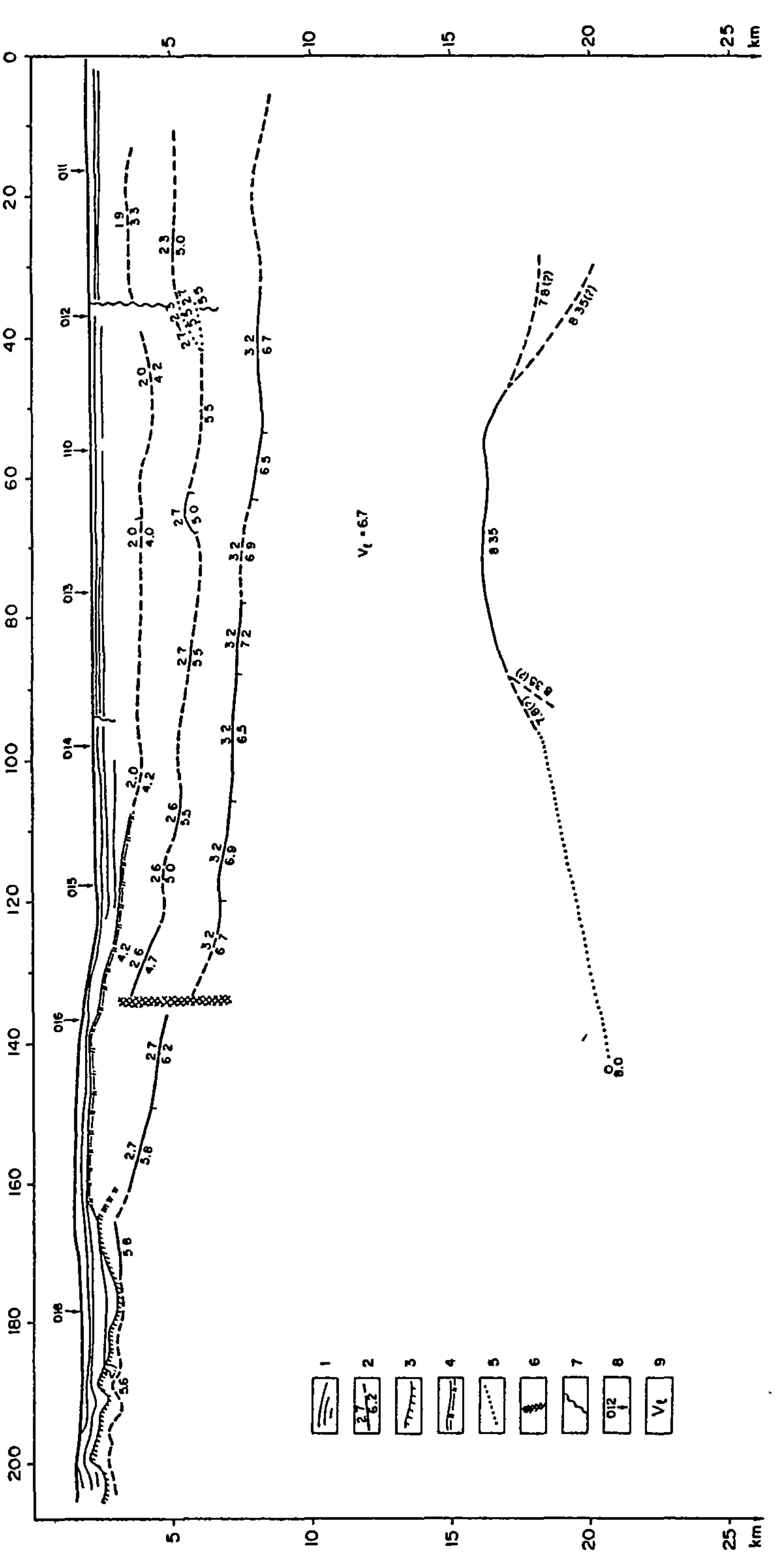
It,s quite possible that after being tested by mathematic modelling the depths of boundaries locations and values of velocities within layers may change. Neverthless, we think the main features of the earth's crust in this region will not change considerably.

Besides, it should be said that correlation of acoustic basement of Ulleung-do Basin in case if was defined by single-channel profiling data using electric source was determinated with interface which is characterized the boundaries's velocity of not more than 4.0 km/s, as on the western slope of the basin this basement evidently coincides with ancient geological basement which have the boundaries velocity more than 5.5 - 5.8 km/s.

The earth's crust thickness is estimated within the range of 16 - 18 km (taking account the water layer), M - boundary has evidently increased (up to 8.35 km/s) velocities and is accompanied by a thin low velocity layer on the below part of the crust. The lowest thickness of the earth's crust is marked along 40 - 80 km range of the profile 2.


NE
SW
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320 km
5
10
15
20
25
km

Profile 1.



0
20
40
60
80
100
120
140
160
180
200
5
10
15
20
25
km
011
012
110
013
014
015
016
018
V_t = 6.7
8.35
7.8(?)
8.35(?)
8.0
1
2
3
4
5
6
7
8
9

Profile 2.

APPENDIX

Legend of referred pictures

1. reflectors got from single channel seismic profiling;
2. boundaries being given by the refraction method; on top number is average velocity, on bottom - boundaries velocity;
3. Paleozoic basement;
4. volcanic basement, may be Neogene;
5. range of interpolation of boundaries location;
6. thrust and fault zone;
7. zone of qualitative changes of sediment cross - section;
8. positions of OBS stations;
9. layer's velocity, velocities within the layers.

Table 4. Coordinates of seismic survey lines.

DATA	GMT	LAT..N	LON..E	DEPTH	PK	PR
910809	21.40	3809.45	13226.72	2680	.0	101
910809	21.45	3809.12	13226.31	0	.5	101
910809	21.50	3808.78	13225.87	2680	.9	101
910809	21.55	3808.45	13225.45	0	1.4	101
910809	22.00	3808.15	13225.05	2680	1.9	101
910809	22.05	3807.86	13224.68	0	2.3	101
910809	22.10	3807.59	13224.28	2690	2.7	101
910809	22.15	3807.24	13223.73	0	3.1	101
910809	22.20	3806.97	13223.57	2690	3.5	101
910809	22.25	3806.67	13223.18	0	3.9	101
910809	22.30	3806.36	13222.80	2690	4.4	101
910809	22.35	3806.04	13222.44	0	4.8	101
910809	22.40	3805.75	13222.05	2690	5.2	101
910809	22.45	3805.45	13221.69	0	5.6	101
910809	22.50	3805.15	13221.31	2680	6.1	101
910809	23.00	3804.55	13220.58	2680	7.2	101
910809	23.05	3804.25	13220.18	0	7.7	101
910809	23.10	3803.93	13219:80	2680	8.1	101
910809	23.15	3803.61	13219.41	0	8.5	101
910809	23.20	3803.29	13219.00	2680	9.0	101
910809	23.25	3802.96	13218.60	0	9.5	101
910809	23.30	3802.62	13218.22	2680	9.9	101
910809	23.50	3801.35	13216.53	2680	11.0	101
910810	.30	3803.01	13218.67	0	11.4	101
910810	.35	3802.70	13218.26	0	12.9	101
910810	.40	3802.38	13217.84	2680	13.4	101
910810	.45	3802.04	13217.42	0	13.8	101
910810	.50	3801.71	13217.04	2680	14.3	101
910810	.55	3801.38	13216.63	0	14.8	101
910810	1.00	3801.04	13216.24	2680	15.2	101
910810	1.05	3800.70	13215.85	0	15.7	101
910810	1.10	3800.38	13215.39	2675	16.2	101
910810	1.15	3800.05	13215.00	0	16.6	101
910810	1.20	3759.72	13214.56	2660	17.0	101
910810	1.25	3759.39	13214.12	0	17.5	101
910810	1.30	3759.09	13213.67	2640	18.0	101
910810	1.35	3758.81	13213.22	0	18.5	101
910810	1.40	3758.52	13212.78	2650	19.0	101
910810	1.45	3758.23	13212.34	0	19.5	101
910810	1.50	3757.94	13211.91	2660	19.9	101
910810	1.55	3757.65	13211.46	0	20.4	101
910810	2.00	3757.36	13211.03	2640	20.8	101
910810	2.05	3757.07	13210.61	0	21.2	101
910810	2.10	3756.75	13210.21	2640	21.7	101
910810	2.15	3756.43	13209.82	0	22.1	101
910810	2.20	3756.11	13209.45	2640	22.6	101
910810	2.25	3755.80	13209.04	0	23.0	101
910810	2.30	3755.50	13208.64	2640	23.5	101
910810	2.35	3755.20	13208.24	0	23.9	101
910810	2.40	3754.90	13207.84	2640	24.3	101
910810	2.45	3754.60	13207.28	0	24.9	101
910810	2.50	3754.30	13206.88	2640	25.3	101
910810	2.55	3754.00	13206.48	0	25.8	101
910810	3.00	3753.70	13206.00	2620	26.2	101
910810	3.05	3753.38	13205.63	0	26.7	101
910810	3.10	3753.05	13205.26	2620	27.1	101
910810	3.15	3752.71	13204.87	0	27.8	101
910810	3.20	3752.36	13204.48	2600	29.2	101
910810	3.25	3752.01	13204.11	0	29.7	101

910810	3.30	3751.67	13203.75	2600	30.1	101
910810	3.35	3751.34	13203.38	0	30.6	101
910810	3.40	3751.01	13203.01	2600	31.0	101
910810	3.45	3750.68	13202.65	0	31.4	101
910810	3.50	3750.34	13202.28	2580	31.9	101
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910810	4.00	3749.66	13201.50	2580	32.8	101
910810	4.05	3749.32	13201.10	0	33.3	101
910810	4.10	3748.98	13200.69	2560	34.1	101
910810	4.15	3748.65	13200.28	0	34.6	101
910810	4.20	3748.31	13159.90	2560	35.0	101
910810	4.25	3747.99	13159.49	0	35.5	101
910810	4.30	3747.65	13159.11	2530	36.2	101
910810	4.35	3747.31	13158.76	0	36.6	101
910810	4.40	3746.97	13158.41	2520	37.3	101
910810	4.45	3746.63	13158.06	0	37.8	101
910810	4.50	3746.28	13157.71	2490	38.2	101
910810	4.55	3745.96	13157.35	0	38.6	101
910810	5.00	3745.62	13157.02	2520	39.1	101
910810	5.05	3745.27	13156.68	0	39.5	101
910810	5.10	3744.93	13156.34	2520	40.3	101
910810	5.15	3744.60	13155.98	0	40.7	101
910810	5.20	3744.25	13155.63	2490	41.2	101
910810	5.25	3743.90	13155.28	0	41.6	101
910810	5.30	3743.54	13154.93	2480	42.1	101
910810	5.35	3743.20	13154.56	0	42.5	101
910810	5.40	3742.85	13154.23	2480	43.0	101
910810	5.45	3742.48	13153.89	0	43.4	101
910810	5.50	3742.15	13153.52	2480	43.9	101
910810	5.55	3741.82	13153.18	0	44.5	101
910810	6.00	3741.47	13152.86	2490	44.9	101
910810	6.05	3741.15	13152.51	0	45.3	101
910810	6.10	3740.80	13152.15	2460	45.8	101
910810	6.15	3740.44	13151.82	0	46.2	101
910810	6.20	3740.06	13151.47	2440	46.7	101
910810	6.25	3739.68	13151.13	0	47.2	101
910810	6.30	3739.31	13150.75	2440	47.6	101
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910810	6.50	3737.72	13149.26	2405	49.6	101
910810	6.55	3737.37	13148.86	0	50.3	101
910810	7.00	3736.98	13148.45	2400	50.8	101
910810	7.05	3736.61	13148.04	0	51.3	101
910810	7.10	3736.23	13147.66	2400	51.7	101
910810	7.15	3735.89	13147.27	0	52.2	101
910810	7.20	3735.54	13146.88	2390	52.7	101
910810	7.25	3735.19	13146.48	0	53.1	101
910810	7.30	3734.85	13146.06	2390	53.6	101
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910810	7.45	3733.83	13144.78	0	55.1	101
910810	7.50	3733.48	13144.39	2360	55.6	101
910810	7.55	3733.14	13143.97	0	56.4	101
910810	8.00	3732.81	13143.53	2360	56.9	101
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910810	8.10	3732.11	13142.72	2360	57.8	101
910810	8.15	3731.77	13142.32	0	58.5	101
910810	8.20	3731.28	13142.12	0	59.0	101
910810	8.25	3731.10	13141.54	0	59.4	101
910810	8.30	3730.76	13141.16	2360	59.9	101
910810	8.35	3730.43	13140.78	0	60.3	101
910810	8.40	3730.08	13140.43	2360	61.0	101
910810	8.45	3729.74	13140.08	0	61.4	101

910810	8.50	3729.40	13139.71	2320	61.9	101
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910810	9.15	3727.81	13137.95	0	64.0	101
910810	9.20	3727.52	13137.57	2320	64.4	101
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910810	9.35	3726.62	13136.45	0	65.7	101
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910810	9.45	3726.01	13135.67	0	66.8	101
910810	9.50	3725.69	13135.26	2310	67.3	101
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910810	10.20	3723.76	13132.86	2320	70.4	101
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910810	10.30	3723.11	13132.10	2320	71.3	101
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910810	10.45	3722.17	13130.95	0	72.7	101
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910810	10.55	3721.58	13130.16	0	73.5	101
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910810	11.10	3720.67	13128.94	2320	74.9	101
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910810	11.25	3719.72	13127.66	0	76.3	101
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910810	11.45	3718.39	13125.86	0	78.6	101
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910810	12.55	3714.12	13119.32	0	85.6	101
910810	13.00	3713.81	13118.89	2240	86.0	101
910810	13.05	3713.49	13118.49	0	86.5	101
910811	4.25	3736.90	13150.34	0	.0	102
910811	4.30	3737.37	13150.77	2410	.6	102
910811	4.35	3737.83	13151.17	0	1.2	102
910811	4.40	3738.20	13151.53	2400	2.1	102
910811	4.45	3738.53	13151.83	0	2.5	102
910811	4.50	3738.92	13152.15	2430	3.0	102
910811	4.55	3739.33	13152.45	0	3.7	102
910811	5.00	3739.70	13152.77	2440	4.2	102
910811	5.05	3740.06	13153.11	0	4.6	102
910811	5.10	3740.42	13153.41	2460	5.1	102
910811	5.15	3740.79	13153.70	0	5.5	102

910811	5.20	3741.18	13154.01	2450	6.1	102
910811	5.25	3741.55	13154.30	0	6.6	102
910811	5.30	3741.92	13154.60	2450	7.0	102
910811	5.35	3742.30	13154.91	0	7.4	102
910811	5.40	3742.68	13155.22	2460	7.9	102
910811	5.45	3743.07	13155.53	0	8.4	102
910811	5.50	3743.44	13155.84	2480	8.8	102
910811	5.55	3743.81	13156.15	0	9.2	102
910811	6.00	3744.18	13156.47	0	9.8	102
910811	6.05	3744.55	13156.79	0	10.4	102
910811	6.10	3744.92	13157.13	2480	10.9	102
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910811	6.20	3745.61	13157.84	2470	11.8	102
910811	6.25	3745.97	13158.20	0	12.2	102
910811	6.30	3746.30	13158.59	2480	12.9	102
910811	6.35	3746.62	13158.97	0	13.3	102
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910811	7.10	3748.89	13201.59	2550	16.7	102
910811	7.15	3749.24	13201.94	0	17.2	102
910811	7.20	3749.61	13202.28	2520	17.6	102
910811	7.25	3749.96	13202.63	0	18.1	102
910811	7.30	3750.32	13202.96	2540	18.5	102
910811	7.35	3750.67	13203.31	0	19.0	102
910811	7.40	3751.03	13203.67	2580	19.4	102
910811	7.45	3751.39	13204.01	0	19.9	102
910811	7.50	3751.75	13204.36	2580	20.3	102
910811	7.55	3752.10	13204.70	0	21.7	102
910811	8.00	3752.46	13205.04	2580	22.1	102
910811	8.05	3752.84	13205.38	0	22.6	102
910811	8.10	3753.22	13205.73	2600	23.1	102
910811	8.15	3753.58	13206.10	0	23.5	102
910811	8.20	3753.95	13206.46	0	24.0	102
910811	8.25	3754.31	13206.82	0	24.4	102
910811	8.30	3754.69	13207.16	2620	24.9	102
910811	8.35	3755.08	13207.50	0	25.4	102
910811	8.40	3755.45	13207.85	2640	26.3	102
910811	8.45	3755.82	13208.22	0	26.7	102
910811	8.50	3756.18	13208.58	2640	27.2	102
910811	8.55	3756.56	13208.93	0	27.7	102
910811	9.00	3756.93	13209.30	2640	28.1	102
910811	9.05	3757.29	13209.67	0	28.6	102
910811	9.10	3757.67	13210.04	2650	29.4	102
910811	9.15	3758.04	13210.41	0	29.8	102
910811	9.20	3758.41	13210.78	2660	30.4	102
910811	9.25	3758.78	13211.15	0	30.9	102
910811	9.30	3759.17	13211.51	2660	31.3	102
910811	9.35	3759.55	13211.85	0	31.8	102
910811	9.40	3759.94	13212.22	0	32.3	102
910811	9.45	3800.33	13212.59	0	32.8	102
910811	9.50	3800.73	13212.95	2680	33.3	102
910811	9.55	3801.13	13213.31	0	33.8	102
910811	10.00	3801.51	13213.68	2680	34.2	102
910811	10.05	3801.89	13214.04	0	34.7	102
910811	10.10	3802.27	13214.40	2680	35.2	102
910811	10.15	3802.64	13214.77	0	35.7	102
910811	10.20	3802.98	13215.16	2680	36.1	102
910811	10.25	3803.36	13215.53	0	36.6	102
910811	10.30	3803.72	13215.90	2690	37.4	102
910811	10.35	3804.09	13216.27	0	37.9	102
910811	10.40	3804.44	13216.64	2690	38.3	102
910811	10.45	3804.87	13216.93	0	38.8	102

910811	10.50	3805.24	13217.30	2690	39.3	102
910811	10.55	3805.62	13217.67	0	39.8	102
910811	11.00	3805.99	13218.05	2700	40.2	102
910811	11.05	3806.38	13218.40	0	40.7	102
910811	11.10	3806.78	13218.77	2700	41.5	102
910811	11.15	3807.15	13219.15	0	41.9	102
910811	11.20	3807.56	13219.48	2720	42.4	102
910811	11.25	3807.94	13219.85	0	42.9	102
910811	11.30	3808.34	13220.21	2720	43.4	102
910811	11.35	3808.71	13220.61	0	43.9	102
910811	11.40	3809.08	13221.01	2720	44.4	102
910811	11.45	3809.45	13221.38	0	44.8	102
910814	3.35	3757.02	13210.37	0	.0	103
910814	3.40	3756.70	13209.97	2640	.5	103
910814	3.45	3756.36	13209.56	0	.9	103
910814	3.50	3756.02	13209.15	2640	1.4	103
910814	3.55	3755.70	13208.71	0	1.9	103
910814	4.00	3755.34	13208.29	2640	2.4	103
910814	4.05	3755.00	13207.86	0	2.8	103
910814	4.10	3754.65	13207.44	2610	3.3	103
910814	4.15	3754.29	13207.01	0	3.8	103
910814	4.20	3753.93	13206.58	2610	4.3	103
910814	4.25	3753.53	13206.20	0	4.8	103
910814	4.30	3753.18	13205.78	2600	5.3	103
910814	4.35	3752.81	13205.37	0	5.8	103
910814	4.40	3752.44	13204.98	2590	6.3	103
910814	4.45	3752.08	13204.58	0	6.7	103
910814	4.50	3751.73	13204.19	2590	7.2	103
910814	4.55	3751.38	13203.78	0	7.7	103
910814	5.00	3751.07	13203.36	2590	8.1	103
910814	5.05	3750.69	13202.96	0	8.6	103
910814	5.10	3750.35	13202.54	2560	9.1	103
910814	5.15	3750.00	13202.14	0	9.6	103
910814	5.20	3749.64	13201.76	2560	10.1	103
910814	5.25	3749.25	13201.43	0	10.5	103
910814	5.30	3748.92	13201.01	2560	11.0	103
910814	5.35	3748.55	13200.60	0	11.5	103
910814	5.40	3748.19	13200.20	2540	12.0	103
910814	5.45	3747.97	13159.91	0	12.3	103
910814	6.25	3744.71	13156.80	0	16.4	103
910814	6.30	3744.36	13156.37	2500	16.9	103
910814	6.35	3744.00	13155.93	0	17.4	103
910814	6.40	3743.66	13155.46	2490	17.9	103
910814	6.45	3743.32	13154.98	0	18.4	103
910814	6.50	3743.00	13154.50	2480	18.9	103
910814	6.55	3742.66	13154.02	0	19.4	103
910814	7.00	3742.32	13153.58	2480	19.9	103
910814	7.05	3741.98	13153.13	0	20.4	103
910814	7.10	3741.62	13152.68	2500	20.9	103
910814	7.15	3741.27	13152.21	0	21.4	103
910814	7.20	3740.93	13151.76	2460	21.9	103
910814	7.25	3740.57	13151.30	0	22.4	103
910814	7.30	3740.21	13150.85	2440	22.9	103
910814	7.35	3739.84	13150.42	0	23.4	103
910814	7.40	3739.45	13150.01	2460	23.9	103
910814	7.45	3739.08	13149.57	0	24.4	103
910814	7.50	3738.69	13149.19	2420	24.9	103
910814	7.55	3738.34	13148.77	0	25.4	103
910814	8.00	3737.98	13148.34	2410	25.9	103
910814	8.05	3737.63	13147.91	0	26.4	103
910814	8.10	3737.26	13147.50	2400	26.9	103
910814	8.15	3736.90	13147.07	0	27.4	103
910814	8.20	3736.50	13146.66	2390	27.9	103
910814	8.25	3736.13	13146.22	0	28.4	103
910814	8.30	3735.76	13145.81	2390	28.9	103
910814	8.35	3735.39	13145.37	0	29.4	103
910814	8.40	3735.01	13144.96	2390	29.9	103

910814	8.45	3734.64	13144.52	0	30.4	103
910814	8.50	3734.29	13144.09	2390	30.9	103
910814	8.55	3733.92	13143.67	0	31.4	103
910814	9.00	3733.56	13143.22	2380	31.9	103
910814	9.05	3733.18	13142.78	0	32.4	103
910814	9.10	3732.81	13142.35	2380	32.9	103
910814	9.15	3732.43	13141.91	0	33.4	103
910814	9.20	3732.05	13141.51	2380	33.9	103
910814	9.25	3731.67	13141.09	0	34.4	103
910814	9.30	3731.30	13140.70	2360	34.9	103
910814	9.35	3730.92	13140.30	0	35.4	103
910814	9.40	3730.53	13139.90	2360	35.9	103
910814	9.45	3730.16	13139.48	0	36.4	103
910814	9.50	3729.77	13139.10	2360	36.9	103
910814	9.55	3729.40	13138.67	0	37.4	103
910814	10.00	3729.02	13138.25	2360	37.9	103
910814	10.05	3728.65	13137.87	0	38.4	103
910814	10.10	3728.27	13137.47	2330	38.9	103
910814	10.15	3727.90	13137.06	0	39.4	103
910814	10.20	3727.54	13136.65	2320	39.9	103
910814	10.25	3727.18	13136.25	0	40.3	103
910814	10.30	3726.81	13135.86	2320	40.8	103
910814	10.35	3726.48	13135.46	0	41.3	103
910814	10.40	3726.17	13134.98	2320	41.8	103
910814	10.45	3725.84	13134.57	0	42.2	103
910814	10.50	3725.51	13134.13	2320	42.7	103
910814	10.55	3725.19	13133.68	0	43.2	103
910814	11.00	3724.84	13133.24	2320	43.7	103
910814	11.05	3724.49	13132.80	0	44.2	103
910814	11.10	3724.13	13132.37	2320	44.7	103
910814	11.15	3723.79	13131.90	0	45.2	103
910814	11.20	3723.42	13131.52	2320	45.7	103
910814	11.25	3723.11	13131.08	0	46.1	103
910814	11.30	3722.77	13130.68	2320	46.6	103
910814	11.35	3722.45	13130.22	0	47.1	103
910814	11.40	3722.10	13129.80	2320	47.6	103
910814	11.45	3721.76	13129.41	0	48.0	103
910814	11.50	3721.44	13129.04	2300	48.5	103
910814	11.55	3721.06	13128.74	0	48.9	103
910814	12.00	3720.73	13128.28	2300	49.4	103
910814	12.05	3720.38	13127.89	0	49.9	103
910814	12.10	3720.02	13127.51	2280	50.3	103
910814	12.15	3719.63	13127.15	0	50.8	103
910814	12.20	3719.31	13126.72	2260	51.3	103
910814	12.25	3718.97	13126.33	0	51.8	103
910814	12.30	3718.56	13125.99	2260	52.3	103
910814	12.35	3718.19	13125.58	0	52.7	103
910814	12.40	3717.84	13125.17	2260	53.2	103
910814	12.45	3717.46	13124.83	0	53.7	103
910814	12.50	3717.14	13124.38	2270	54.2	103
910814	12.55	3716.79	13123.93	0	54.7	103
910814	13.00	3716.40	13123.60	2280	55.1	103
910814	13.05	3716.08	13123.15	0	55.6	103
910814	13.10	3715.72	13122.76	2250	56.1	103
910814	13.15	3715.36	13122.37	0	56.6	103
910814	13.20	3715.04	13121.94	2280	57.0	103
910814	13.25	3714.66	13121.60	0	57.5	103
910814	13.30	3714.34	13121.18	2280	58.0	103
910814	13.35	3714.03	13120.77	0	58.4	103
910814	13.40	3713.72	13120.36	2280	58.9	103
910814	13.45	3713.38	13119.89	0	59.4	103
910814	13.50	3713.05	13119.50	2260	59.8	103
910814	13.55	3712.72	13119.12	0	60.3	103
910814	14.00	3712.38	13118.67	2240	60.8	103

910814	14.05	3712.01	13118.24	0	61.3	103
910814	14.10	3711.63	13117.82	2240	61.8	103
910814	14.15	3711.26	13117.39	0	62.3	103
910814	14.20	3710.92	13116.93	2220	62.8	103
910814	14.25	3710.52	13116.52	0	63.3	103
910814	14.30	3710.16	13116.11	2210	63.8	103
910814	14.35	3709.82	13115.66	0	64.3	103
910814	14.40	3709.51	13115.19	2200	64.8	103
910814	14.45	3709.11	13114.78	0	65.3	103
910814	14.50	3708.80	13114.27	2200	65.8	103
910814	14.55	3708.44	13113.84	0	66.3	103
910814	15.00	3708.09	13113.40	2200	66.8	103
910814	15.05	3707.75	13112.95	0	67.3	103
910814	15.10	3707.41	13112.50	2200	67.8	103
910814	15.15	3707.08	13112.09	0	68.3	103
910814	15.20	3706.79	13111.62	2200	68.7	103
910814	15.25	3706.43	13111.29	0	69.2	103
910814	15.30	3706.08	13110.89	2200	69.7	103
910814	15.35	3705.73	13110.55	0	70.1	103
910814	15.40	3705.48	13110.03	2190	70.6	103
910814	15.45	3705.11	13109.76	0	71.0	103
910814	15.50	3704.77	13109.35	2190	71.5	103
910814	15.55	3704.39	13109.05	0	71.9	103
910814	16.00	3704.05	13108.63	2180	72.4	103
910814	16.05	3703.65	13108.33	0	72.9	103
910814	16.10	3703.33	13107.95	2180	73.3	103
910814	16.15	3703.00	13107.53	0	73.8	103
910814	16.20	3702.62	13107.19	2170	74.3	103
910814	16.25	3702.31	13106.79	0	74.7	103
910814	16.30	3701.94	13106.43	2170	75.2	103
910814	16.35	3701.65	13105.97	0	75.6	103
910814	16.40	3701.30	13105.58	2170	76.1	103
910814	16.45	3700.96	13105.22	0	76.6	103
910814	16.50	3700.60	13104.87	2160	77.0	103
910814	16.55	3700.29	13104.44	0	77.5	103
910814	17.00	3659.95	13104.03	2160	77.9	103
910814	17.05	3659.64	13103.55	0	78.4	103
910814	17.10	3659.31	13103.12	2160	78.9	103
910814	17.15	3658.96	13102.73	0	79.4	103
910814	17.20	3658.62	13102.32	2160	79.9	103
910814	17.25	3658.28	13101.89	0	80.3	103
910814	17.30	3657.95	13101.48	2160	80.8	103
910814	17.35	3657.63	13101.03	0	81.3	103
910814	17.40	3657.34	13100.53	2160	81.8	103
910814	17.45	3656.99	13100.16	0	82.2	103
910814	17.50	3656.65	13059.76	2160	82.7	103
910814	17.55	3656.31	13059.37	0	83.2	103
910814	18.00	3656.03	13058.84	2160	83.7	103
910814	18.05	3655.69	13058.44	0	84.1	103
910814	18.10	3655.34	13058.03	2160	84.6	103
910814	18.15	3655.02	13057.60	0	85.1	103
910814	18.20	3654.71	13057.19	2160	85.5	103
910814	18.25	3654.41	13056.75	0	86.0	103
910814	18.30	3654.12	13056.30	2160	86.5	103
910814	18.35	3653.83	13055.92	0	86.9	103
910814	18.40	3653.49	13055.57	2160	87.3	103
910814	18.45	3653.18	13055.18	0	87.8	103
910814	18.50	3652.88	13054.84	2160	88.2	103
910814	18.55	3652.53	13054.49	0	88.6	103
910814	19.00	3652.19	13054.15	2160	89.1	103
910814	19.05	3651.94	13053.80	0	89.5	103
910814	19.10	3651.60	13053.46	2150	89.9	103
910814	19.15	3651.33	13053.14	0	90.7	103

910814	19.20	3650.99	13052.79	2160	92.0	103
910814	19.25	3650.70	13052.39	0	92.5	103
910814	19.30	3650.42	13052.00	2160	92.9	103
910814	19.35	3650.11	13051.68	0	93.3	103
910814	19.40	3649.82	13051.32	2160	93.7	103
910814	19.45	3649.54	13050.92	0	94.1	103
910814	19.50	3649.26	13050.53	2130	94.6	103
910814	19.55	3648.96	13050.18	0	95.0	103
910814	20.00	3648.66	13049.85	2120	95.4	103
910814	20.05	3648.35	13049.54	0	95.8	103
910814	20.10	3648.03	13049.22	2120	96.2	103
910814	20.15	3647.72	13048.86	0	96.6	103
910814	20.20	3647.41	13048.53	2120	97.0	103
910814	20.25	3647.11	13048.14	0	97.4	103
910814	20.30	3646.81	13047.78	2120	97.9	103
910814	20.35	3646.50	13047.42	0	98.3	103
910814	20.40	3646.20	13047.02	2120	98.7	103
910814	20.45	3645.92	13046.61	0	99.2	103
910818	18.35	3700.36	13104.83	0	.0	107
910818	18.40	3700.03	13104.40	2260	.5	107
910818	18.45	3659.68	13103.99	0	1.0	107
910818	18.50	3659.36	13103.57	2260	1.4	107
910818	18.55	3659.01	13103.17	0	1.9	107
910818	19.00	3658.67	13102.75	2260	2.4	107
910818	19.05	3658.31	13102.33	0	2.9	107
910818	19.10	3657.97	13101.92	2260	3.3	107
910818	19.15	3657.61	13101.50	0	3.8	107
910818	19.20	3657.28	13101.07	2260	4.3	107
910818	19.25	3656.95	13100.65	0	4.8	107
910818	19.30	3656.60	13100.23	2260	5.3	107
910818	19.35	3656.24	13059.82	0	5.8	107
910818	19.40	3655.88	13059.39	2260	6.3	107
910818	19.45	3655.53	13058.97	0	6.7	107
910818	19.50	3655.18	13058.54	2260	7.2	107
910818	19.55	3654.83	13058.10	0	7.7	107
910818	20.00	3654.48	13057.65	2250	8.2	107
910818	20.05	3654.13	13057.21	0	8.7	107
910818	20.10	3653.80	13056.75	2250	9.2	107
910818	20.15	3653.46	13056.31	0	9.7	107
910818	20.20	3653.12	13055.87	2240	10.2	107
910818	20.25	3652.77	13055.43	0	10.7	107
910818	20.30	3652.43	13054.99	2240	11.2	107
910818	20.35	3652.10	13054.54	0	11.7	107
910818	20.40	3651.77	13054.12	2240	12.1	107
910818	20.45	3651.43	13053.70	0	12.6	107
910818	20.50	3651.10	13053.28	2240	13.1	107
910818	20.55	3650.76	13052.86	0	13.6	107
910818	21.00	3650.42	13052.44	2240	14.1	107
910818	21.05	3650.09	13052.02	0	14.5	107
910818	21.10	3649.76	13051.58	2240	15.0	107
910818	21.15	3649.43	13051.16	0	15.5	107
910818	21.20	3649.10	13050.73	2240	16.0	107
910818	21.25	3648.77	13050.31	0	16.4	107
910818	21.30	3648.43	13049.88	2240	16.9	107
910818	21.35	3648.10	13049.44	0	17.4	107
910818	21.40	3647.76	13049.01	2240	17.9	107
910818	21.45	3647.44	13048.57	0	18.4	107
910818	21.50	3647.11	13048.13	2240	18.8	107
910818	21.55	3646.78	13047.69	0	19.3	107
910818	22.00	3646.44	13047.25	2220	19.8	107
910818	22.05	3646.11	13046.81	0	20.3	107
910818	22.10	3645.79	13046.37	2220	20.8	107
910818	22.15	3645.48	13045.94	0	21.2	107
910818	22.25	3644.85	13045.06	0	22.2	107
910818	22.30	3644.52	13044.60	2200	22.7	107

910818	22.35	3644.26	13044.29	0	23.0	107
910828	17.15	3653.72	13055.59	0	.0	108
910828	17.20	3653.99	13055.96	2180	.4	108
910828	17.25	3654.24	13056.35	0	.8	108
910828	17.30	3654.55	13056.67	2180	1.2	108
910828	17.35	3654.77	13057.12	0	1.6	108
910828	17.40	3655.05	13057.49	2180	2.0	108
910828	17.45	3655.31	13057.93	0	2.5	108
910828	17.50	3655.64	13058.28	2180	2.9	108
910828	17.55	3655.94	13058.65	0	3.3	108
910828	18.00	3656.28	13059.05	2185	3.8	108
910828	18.05	3656.56	13059.46	0	4.2	108
910828	18.10	3656.91	13059.80	2190	4.7	108
910828	18.15	3657.22	13100.22	0	5.1	108
910828	18.20	3657.52	13100.62	2190	5.6	108
910828	18.25	3657.85	13101.00	0	6.0	108
910828	18.30	3658.20	13101.34	2190	6.5	108
910828	18.35	3658.48	13101.82	0	6.9	108
910828	18.40	3658.81	13102.20	2190	7.4	108
910828	18.45	3659.12	13102.65	0	7.9	108
910828	18.50	3659.50	13102.95	2190	8.3	108
910828	18.55	3659.80	13103.39	0	8.8	108
910828	19.00	3700.18	13103.71	2190	9.2	108
910828	19.05	3700.49	13104.14	0	9.7	108
910828	19.10	3700.84	13104.53	2190	10.2	108
910828	19.20	3701.49	13105.34	2190	11.1	108
910828	19.25	3701.83	13105.74	0	11.5	108
910828	19.30	3702.20	13106.08	2200	12.0	108
910828	19.35	3702.53	13106.50	0	12.5	108
910828	19.40	3702.89	13106.85	2200	12.9	108
910828	19.45	3703.22	13107.28	0	13.4	108
910828	19.50	3703.55	13107.72	2205	13.9	108
910828	19.55	3703.90	13108.14	0	14.3	108
910828	20.00	3704.24	13108.54	2210	14.8	108
910828	20.05	3704.58	13108.94	0	16.2	108
910828	20.10	3704.92	13109.34	2210	16.9	108
910828	20.15	3705.27	13109.73	0	17.4	108
910828	20.20	3705.64	13110.09	2215	17.9	108
910828	20.25	3705.99	13110.50	0	18.3	108
910828	20.30	3706.31	13110.92	2220	18.8	108
910828	20.35	3706.68	13111.30	0	19.3	108
910828	20.40	3707.04	13111.70	2220	19.8	108
910828	20.45	3707.39	13112.12	0	20.2	108
910828	20.50	3707.75	13112.52	2230	20.7	108
910828	20.55	3708.10	13112.90	0	21.2	108
910828	21.00	3708.46	13113.31	2235	21.7	108
910828	21.05	3708.81	13113.72	0	22.2	108
910828	21.10	3709.18	13114.15	2245	22.7	108
910828	21.15	3709.51	13114.58	0	23.1	108
910828	21.20	3709.84	13115.01	2240	23.6	108
910828	21.25	3710.17	13115.42	0	24.1	108
910828	21.30	3710.48	13115.86	2240	24.5	108
910828	21.35	3710.78	13116.28	0	25.0	108
910828	21.40	3711.07	13116.73	2250	25.5	108
910828	21.45	3711.38	13117.15	0	25.9	108
910828	21.50	3711.70	13117.59	2260	26.4	108
910828	21.55	3712.03	13118.01	0	26.9	108
910828	22.00	3712.35	13118.44	2270	27.3	108
910828	22.05	3712.68	13118.85	0	27.8	108
910828	22.10	3713.03	13119.27	2290	28.3	108
910828	22.15	3713.35	13119.69	0	28.7	108
910828	22.20	3713.68	13120.13	2310	29.2	108
910828	22.25	3714.01	13120.55	0	29.7	108
910828	22.30	3714.34	13120.98	2320	30.2	108

910828	22.35	3714.67	13121.41	0	30.6	108
910828	22.40	3715.00	13121.88	2300	31.1	108
910828	22.45	3715.34	13122.31	0	31.6	108
910828	22.50	3715.68	13122.77	2280	32.1	108
910828	22.55	3716.01	13123.22	0	32.6	108
910828	23.00	3716.35	13123.65	2290	33.1	108
910829	1.00	3715.64	13122.08	2300	34.5	108
910829	1.05	3715.95	13122.46	0	35.0	108
910829	1.10	3716.29	13122.88	2305	35.5	108
910829	1.15	3716.61	13123.31	31	.0	108
910829	1.20	3716.92	13123.74	2325	.0	108
910829	1.25	3717.26	13124.16	0	.5	108
910829	1.30	3717.58	13124.60	2340	1.0	108
910829	1.35	3717.91	13125.04	0	1.4	108
910829	1.40	3718.24	13125.50	2340	1.9	108
910829	1.45	3718.57	13125.91	0	2.4	108
910829	1.50	3718.94	13126.32	2340	2.9	108
910829	1.55	3719.30	13126.72	0	3.4	108
910829	2.00	3719.66	13127.14	2340	3.9	108
910829	2.05	3720.02	13127.55	0	4.3	108
910829	2.10	3720.39	13127.96	2340	4.8	108
910829	5.30	3726.95	13136.74	2360	14.4	108
910829	5.35	3727.34	13137.06	0	14.9	108
910829	5.40	3727.75	13137.36	2370	15.4	108
910829	5.45	3728.15	13137.67	0	15.8	108
910829	5.50	3728.56	13138.01	2370	16.3	108
910829	5.55	3728.97	13138.30	0	16.8	108
910829	6.00	3729.38	13138.61	2390	17.3	108
910829	6.30	3730.32	13139.45	2380	18.4	108
910829	6.35	3730.69	13139.79	0	18.9	108
910829	6.40	3731.06	13140.19	2390	19.4	108
910829	6.45	3731.43	13140.45	0	19.8	108
910829	6.50	3731.79	13140.97	2400	20.3	108
910829	6.55	3732.13	13141.38	0	20.8	108
910829	7.00	3732.38	13141.80	2410	21.3	108
910829	7.05	3732.72	13142.21	0	21.7	108
910829	7.10	3733.06	13142.60	2410	22.2	108
910829	7.15	3733.39	13142.99	0	22.6	108
910829	7.20	3733.72	13143.38	2410	23.1	108
910829	7.25	3734.05	13143.77	0	23.5	108
910829	7.30	3734.36	13144.16	2415	24.0	108
910829	7.35	3734.67	13144.57	0	24.4	108
910829	7.40	3734.97	13144.99	2420	24.9	108
910829	7.45	3735.28	13145.38	0	25.3	108
910829	7.50	3735.57	13145.79	2420	25.7	108
910829	7.55	3735.88	13146.15	0	26.1	108
910829	8.00	3736.19	13146.55	2430	26.6	108
910829	8.05	3736.50	13146.94	0	27.0	108
910829	8.10	3736.82	13147.31	2430	27.5	108
910829	8.15	3737.11	13147.69	0	27.9	108
910829	8.20	3737.41	13148.05	2440	28.3	108
910829	8.50	3739.23	13150.14	0	30.8	108
910829	8.55	3739.54	13150.46	0	31.2	108
910829	9.00	3739.84	13150.79	2470	31.6	108
910829	9.05	3740.16	13151.12	0	32.0	108
910829	9.10	3740.47	13151.45	2480	32.4	108
910829	9.15	3740.79	13151.79	0	32.8	108
910829	9.20	3741.11	13152.12	0	33.2	108
910829	9.25	3741.45	13152.44	0	33.6	108
910829	9.30	3741.80	13152.76	2560	34.1	108
910829	9.35	3742.16	13153.08	0	34.5	108
910829	9.40	3742.51	13153.39	2520	34.9	108
910829	9.45	3742.85	13153.70	0	35.4	108
910829	9.50	3743.21	13154.05	2520	35.8	108
910829	9.55	3743.53	13154.39	0	36.2	108

910829	10.00	3743.85	13154.73	2520	36.6	108
910829	10.05	3744.18	13155.07	0	38.2	108
910829	10.10	3744.53	13155.41	2560	39.2	108
910829	10.15	3744.89	13155.74	0	39.6	108
910829	10.20	3745.24	13156.06	2560	40.0	108
910829	10.25	3745.58	13156.38	0	40.5	108
910829	10.30	3745.93	13156.70	2580	40.9	108
910829	10.35	3746.26	13157.03	0	41.3	108
910829	10.40	3746.60	13157.38	2560	41.8	108
910829	10.45	3746.94	13157.75	0	42.2	108
910829	10.50	3747.27	13158.11	2560	42.6	108
910829	10.55	3747.63	13158.44	0	43.1	108
910829	11.00	3747.95	13158.81	2600	43.5	108
910829	11.05	3748.29	13159.17	0	44.0	108
910829	11.10	3748.63	13159.52	2620	44.4	108
910829	11.15	3748.97	13159.86	0	44.8	108
910829	11.20	3749.31	13200.20	2640	45.3	108
910829	11.30	3749.99	13200.90	2640	46.3	108
910829	11.35	3750.31	13201.27	0	47.2	108
910829	11.40	3750.62	13201.62	2640	47.6	108
910829	11.45	3750.96	13201.97	0	48.1	108
910829	11.50	3751.30	13202.31	2640	48.5	108
910829	11.55	3751.64	13202.65	0	49.3	108
910829	12.00	3751.99	13203.00	2640	50.4	108
910903	14.30	3658.08	13100.69	2180	.0	110
910903	14.35	3657.79	13100.20	0	.5	110
910903	14.40	3657.41	13059.81	2180	1.0	110
910903	14.45	3657.07	13059.40	0	1.5	110
910903	14.50	3656.76	13058.94	2180	1.9	110
910903	14.55	3656.43	13058.52	0	2.4	110
910903	15.00	3656.09	13058.08	2180	2.9	110
910903	15.05	3655.79	13057.54	0	3.4	110
910903	15.10	3655.46	13057.09	2180	3.9	110
910903	15.15	3655.10	13056.70	0	4.4	110
910903	15.20	3654.73	13056.32	2170	4.9	110
910903	15.25	3654.39	13055.88	0	5.4	110
910903	15.30	3654.00	13055.53	2170	5.8	110
910903	15.35	3653.67	13055.12	0	6.3	110
910903	15.40	3653.30	13054.76	2170	6.8	110
910903	15.45	3652.97	13054.30	0	7.3	110
910903	15.50	3652.64	13053.96	2160	7.7	110
910903	15.55	3652.34	13053.50	0	8.2	110
910903	16.00	3652.01	13053.12	2160	8.6	110
910903	16.05	3651.68	13052.75	0	9.1	110
910903	16.10	3651.34	13052.38	2160	9.5	110
910903	16.15	3651.00	13052.01	0	10.0	110
910903	16.20	3650.63	13051.69	2160	10.4	110
910903	16.25	3650.30	13051.32	0	10.9	110
910903	18.00	3650.32	13051.30	0	10.9	110
910903	18.05	3649.96	13050.99	0	11.3	110
910903	18.10	3649.64	13050.64	2160	11.7	110
910903	18.15	3649.29	13050.33	0	12.2	110
910903	18.20	3648.93	13050.01	2160	12.6	110
910903	18.25	3648.62	13049.65	0	13.0	110
910903	18.30	3648.28	13049.27	2160	13.5	110
910903	18.35	3647.94	13048.90	0	13.9	110
910903	18.40	3647.63	13048.50	2160	14.4	110
910903	18.45	3647.29	13048.17	0	14.8	110
910903	18.50	3646.98	13047.78	2140	15.3	110
910903	18.55	3646.66	13047.36	0	15.7	110
910903	19.00	3646.34	13046.98	2140	16.2	110
910903	19.05	3646.02	13046.61	0	16.6	110
910903	19.10	3645.70	13046.23	2130	17.1	110
910903	19.15	3645.38	13045.86	0	17.5	110
910903	19.20	3645.07	13045.44	2130	17.9	110

910903	19.25	3644.73	13045.08	0	18.4	110
910903	19.30	3644.43	13044.69	2130	18.8	110
910903	19.35	3644.15	13044.22	0	19.3	110
910903	19.40	3643.83	13043.83	2120	19.7	110
910903	19.45	3643.53	13043.45	0	20.2	110
910903	19.50	3643.17	13043.12	2120	20.6	110
910903	19.55	3642.87	13042.70	0	21.1	110
910903	20.00	3642.53	13042.36	2100	21.5	110
910903	20.05	3642.22	13041.96	0	22.0	110
910903	20.10	3641.89	13041.59	2100	22.4	110
910903	20.15	3641.55	13041.21	0	22.9	110
910903	20.20	3641.23	13040.83	2080	23.3	110
910903	20.40	3639.96	13039.34	2060	25.0	110
910903	20.45	3639.64	13038.94	0	25.5	110
910903	20.50	3639.34	13038.55	2050	25.9	110
910903	20.55	3639.02	13038.19	0	26.4	110
910903	21.00	3638.73	13037.76	2050	26.8	110
910903	21.05	3638.41	13037.37	0	27.3	110
910903	21.10	3638.11	13036.99	2050	27.7	110
910903	21.15	3637.80	13036.61	0	28.1	110
910903	21.20	3637.48	13036.25	2040	28.6	110
910903	21.25	3637.16	13035.90	0	29.0	110
910903	21.30	3636.84	13035.55	2040	29.4	110
910903	21.35	3636.52	13035.17	0	29.9	110
910903	21.40	3636.18	13034.82	2020	30.3	110
910903	21.45	3635.86	13034.48	0	30.7	110
910903	21.50	3635.53	13034.12	2010	31.2	110
910903	21.55	3635.20	13033.77	0	31.6	110
910903	22.00	3634.88	13033.37	2010	32.0	110
910903	22.05	3634.55	13033.00	0	32.5	110
910903	22.10	3634.24	13032.60	2010	32.9	110
910903	22.15	3633.92	13032.21	0	33.4	110
910903	22.20	3633.59	13031.82	2000	33.8	110
910903	22.25	3633.26	13031.43	0	34.3	110
910903	22.30	3632.97	13031.00	2000	34.7	110
910903	22.35	3632.67	13030.58	0	35.2	110
910903	22.40	3632.36	13030.18	2040	35.6	110
910903	22.45	3632.05	13029.79	0	36.1	110
910903	22.50	3631.73	13029.40	2040	36.5	110
910903	22.55	3631.41	13029.01	0	37.0	110
910903	23.00	3631.10	13028.63	2040	37.4	110
910903	23.05	3630.78	13028.24	0	37.9	110
910903	23.10	3630.46	13027.88	2050	38.3	110
910903	23.15	3630.16	13027.48	0	38.7	110
910903	23.20	3629.85	13027.12	2040	39.2	110
910903	23.25	3629.54	13026.72	0	39.6	110
910903	23.30	3629.23	13026.36	2040	40.0	110
910903	23.35	3628.91	13025.98	0	40.5	110
910903	23.40	3628.59	13025.58	2020	40.9	110
910903	23.45	3628.27	13025.23	0	41.4	110
910903	23.50	3627.94	13024.82	2020	41.8	110
910903	23.55	3627.60	13024.44	0	42.3	110
910904	.00	3627.26	13024.06	2040	42.7	110
910904	.05	3626.93	13023.65	0	43.2	110
910904	.10	3626.60	13023.23	2020	43.7	110
910904	.15	3626.27	13022.83	0	44.1	110
910904	.20	3625.94	13022.43	2000	44.6	110
910904	.25	3625.65	13021.96	0	45.1	110
910904	.30	3625.35	13021.52	2000	45.5	110
910904	.35	3625.05	13021.10	0	46.0	110
910904	.40	3624.71	13020.72	2000	46.5	110
910904	.45	3624.38	13020.35	0	46.9	110
910904	.50	3624.04	13019.96	1880	47.4	110
910904	.55	3623.70	13019.6C	0	47.8	110

910904	1.00	3623.37	13019.23	1940	48.2	110
910904	1.05	3623.04	13018.85	0	48.7	110
910904	1.10	3622.68	13018.51	1890	49.2	110
910904	1.15	3622.34	13018.15	0	49.6	110
910904	1.20	3622.00	13017.78	1840	50.0	110
910904	1.25	3621.67	13017.43	0	50.9	110
910904	1.30	3621.32	13017.06	1840	51.7	110
910904	1.35	3620.98	13016.70	0	52.7	110
910904	1.40	3620.64	13016.34	1820	54.0	110
910904	1.50	3619.97	13015.63	1800	56.1	110
910904	1.55	3619.62	13015.28	0	56.5	110
910904	2.00	3619.30	13014.92	1800	56.9	110
910904	2.05	3618.98	13014.56	0	57.4	110
910904	2.10	3618.66	13014.20	1800	57.8	110
910904	2.15	3618.34	13013.83	0	58.2	110
910904	2.20	3618.04	13013.46	1780	58.6	110
910904	2.25	3617.71	13013.11	0	59.1	110
910904	2.30	3617.41	13012.71	1780	59.5	110
910904	2.35	3617.10	13012.31	0	60.0	110
910904	2.40	3616.79	13011.93	1760	60.4	110
910904	2.45	3616.48	13011.54	0	60.8	110
910904	2.50	3616.17	13011.15	1750	61.3	110
910904	2.55	3615.88	13010.76	0	61.7	110
910904	3.00	3615.58	13010.39	1720	62.1	110
910904	3.05	3615.27	13010.02	0	62.6	110
910904	3.10	3614.97	13009.63	1700	63.0	110
910904	3.15	3614.67	13009.23	0	63.4	110
910904	3.20	3614.35	13008.86	1680	63.9	110
910904	3.25	3614.05	13008.43	0	64.3	110
910904	3.30	3613.79	13007.97	1650	64.8	110
910904	3.35	3613.51	13007.56	0	65.2	110
910904	3.40	3613.23	13007.19	1640	65.6	110
910904	3.45	3612.96	13006.87	0	66.0	110
910904	3.50	3612.73	13006.63	1620	66.3	110
910904	3.55	3612.52	13006.35	0	66.6	110
910904	4.00	3612.26	13006.05	1600	67.0	110
910904	4.05	3612.00	13005.72	0	67.4	110
910904	4.10	3611.75	13005.36	1600	67.7	110
910904	4.15	3611.48	13005.03	0	68.1	110
910904	4.20	3611.22	13004.65	1600	68.5	110
910904	4.25	3610.96	13004.30	0	68.9	110
910904	4.30	3610.70	13003.91	1560	69.3	110
910904	4.35	3610.41	13003.55	0	69.7	110
910904	4.40	3610.13	13003.15	1560	70.2	110
910904	4.45	3609.85	13002.75	0	70.6	110
910904	4.50	3609.58	13002.34	1540	71.0	110
910904	4.55	3609.33	13001.91	0	71.4	110
910904	5.00	3609.03	13001.51	1520	71.9	110
910904	5.05	3608.75	13001.10	0	72.3	110
910904	5.10	3608.43	13000.74	1500	72.7	110
910904	5.15	3608.11	13000.33	0	73.2	110
910904	5.20	3607.79	12959.94	1460	73.7	110
910904	5.25	3607.46	12959.56	0	74.1	110
910904	5.30	3607.11	12959.21	1440	74.6	110
910904	5.35	3606.77	12958.82	0	75.0	110
910904	5.40	3606.44	12958.47	1440	75.5	110
910904	5.45	3606.12	12958.11	0	75.9	110
910904	5.50	3605.77	12957.79	1400	76.3	110
910904	5.55	3605.46	12957.45	0	76.7	110
910904	6.00	3605.15	12957.06	1400	77.2	110
910904	6.05	3604.84	12956.71	0	77.6	110
910904	6.10	3604.53	12956.37	1360	78.0	110
910904	6.15	3604.25	12956.00	0	78.4	110
910904	6.20	3603.97	12955.66	1320	78.8	110

910904	6.25	3603.68	12955.32	0	79.2	110
910904	6.30	3603.42	12954.97	1300	79.6	110
910904	6.40	3602.91	12954.29	0	80.0	110
910904	6.50	3602.39	12953.61	1280	82.1	110
910904	7.00	3601.87	12952.94	1200	83.4	110
910904	7.05	3601.61	12952.62	0	83.8	110
910904	7.10	3601.35	12952.28	1200	84.2	110
910904	7.15	3601.09	12951.96	1180	84.5	110
910904	10.30	3601.76	12952.89	1235	85.5	110
910904	10.35	3601.51	12952.59	0	85.9	110
910904	10.40	3601.28	12952.23	1215	86.3	110
910904	10.45	3601.04	12951.91	0	86.6	110
910904	10.50	3600.80	12951.53	1190	87.0	110
910904	10.55	3600.49	12951.16	0	87.4	110
910904	11.00	3600.14	12950.78	1160	87.9	110
910904	11.05	3559.79	12950.39	0	88.4	110
910904	11.10	3559.44	12950.01	1115	88.8	110
910904	11.15	3559.14	12949.62	0	89.3	110
910904	11.20	3558.83	12949.20	1040	89.7	110
910904	11.25	3558.47	12948.81	0	90.2	110
910904	11.30	3558.14	12948.43	990	90.7	110
910904	11.35	3557.82	12948.01	0	91.1	110
910904	11.40	3557.51	12947.57	970	91.6	110
910904	11.45	3557.17	12947.16	0	92.1	110
910904	11.50	3556.79	12946.76	860	92.6	110
910904	11.55	3556.46	12946.33	0	93.1	110
910904	12.00	3556.09	12945.94	800	93.6	110
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910904	12.15	3555.05	12944.70	0	95.0	110
910904	12.20	3554.71	12944.29	640	95.5	110
910904	12.25	3554.37	12943.87	0	96.0	110
910904	12.30	3554.03	12943.42	535	96.5	110
910904	12.35	3553.69	12943.01	0	96.9	110
910904	12.40	3553.36	12942.54	420	97.4	110
910904	12.45	3553.02	12942.11	0	97.9	110
910904	12.50	3552.67	12941.69	270	98.4	110
910904	12.55	3552.34	12941.23	0	98.9	110
910904	13.00	3552.02	12940.79	175	99.4	110
910904	13.05	3551.64	12940.46	0	99.9	110
910904	13.10	3551.24	12940.04	160	100.4	110
910815	1.25	3624.73	13112.74	2000	.0	104
910815	1.30	3625.04	13112.29	2000	.5	104
910815	1.35	3625.36	13111.83	0	1.0	104
910815	1.40	3625.70	13111.38	2000	1.5	104
910815	1.45	3626.03	13110.93	0	2.0	104
910815	1.50	3626.36	13110.49	2000	2.4	104
910815	1.55	3626.71	13110.06	0	2.9	104
910815	2.00	3627.06	13109.62	2000	3.4	104
910815	2.05	3627.40	13109.20	0	3.9	104
910815	2.10	3627.76	13108.77	2010	4.4	104
910815	2.15	3628.11	13108.36	0	4.9	104
910815	2.20	3628.45	13107.93	2020	5.4	104
910815	2.25	3628.81	13107.52	0	5.9	104
910815	2.30	3629.17	13107.09	2040	6.4	104
910815	2.35	3629.51	13106.67	0	6.8	104
910815	2.40	3629.87	13106.25	2040	7.3	104
910815	2.45	3630.22	13105.83	0	7.8	104
910815	2.50	3630.58	13105.41	2040	8.3	104
910815	2.55	3630.95	13104.98	0	8.8	104
910815	3.00	3631.31	13104.54	2040	9.3	104
910815	3.05	3631.68	13104.11	0	9.8	104

910815	3.10	3632.03	13103.67	2040	10.3	104
910815	3.15	3632.38	13103.22	0	10.8	104
910815	3.20	3632.73	13102.74	2050	11.4	104
910815	3.25	3633.07	13102.29	0	11.9	104
910815	3.30	3633.41	13101.85	2050	12.3	104
910815	3.35	3633.74	13101.39	0	12.8	104
910815	3.40	3634.09	13100.94	2050	13.3	104
910815	3.45	3634.44	13100.49	0	13.9	104
910815	3.50	3634.80	13100.04	2070	14.4	104
910815	3.55	3635.15	13059.60	0	14.9	104
910815	4.00	3635.49	13059.16	2080	15.4	104
910815	4.05	3635.84	13058.72	0	15.8	104
910815	4.10	3636.18	13058.27	2080	16.3	104
910815	4.15	3636.52	13057.83	0	16.8	104
910815	4.20	3636.87	13057.39	2080	17.3	104
910815	4.25	3637.21	13056.96	0	17.8	104
910815	4.30	3637.57	13056.50	2080	18.3	104
910815	4.35	3637.92	13056.06	0	18.8	104
910815	4.40	3638.26	13055.64	2085	19.3	104
910815	4.45	3638.61	13055.21	0	19.8	104
910815	4.50	3638.95	13054.78	2100	20.3	104
910815	4.55	3639.31	13054.35	0	20.8	104
910815	5.00	3639.65	13053.93	2100	21.3	104
910815	5.05	3639.99	13053.51	0	21.7	104
910815	5.10	3640.32	13053.10	2100	22.2	104
910815	5.15	3640.67	13052.68	0	22.7	104
910815	5.20	3641.01	13052.27	2110	23.2	104
910815	5.25	3641.33	13051.85	0	23.6	104
910815	5.30	3641.65	13051.44	2110	24.1	104
910815	5.35	3641.97	13051.01	0	24.6	104
910815	5.40	3642.29	13050.58	2120	25.0	104
910815	5.45	3642.62	13050.15	0	25.5	104
910815	5.50	3642.95	13049.70	2120	26.0	104
910815	5.55	3643.28	13049.26	0	26.5	104
910815	6.00	3643.53	13048.74	2120	27.0	104
910815	6.05	3643.95	13048.41	0	27.5	104
910815	6.10	3644.30	13048.01	2120	27.9	104
910815	6.15	3644.65	13047.60	0	28.4	104
910815	6.20	3644.96	13047.17	2120	28.9	104
910815	6.25	3645.30	13046.76	0	29.3	104
910815	6.30	3645.65	13046.35	2120	29.8	104
910815	6.35	3645.96	13045.92	0	30.3	104
910815	6.40	3646.29	13045.49	2120	30.8	104
910815	6.45	3646.61	13045.05	0	31.3	104
910815	6.50	3646.93	13044.60	2120	31.7	104
910815	6.55	3647.26	13044.15	0	32.2	104
910815	7.00	3647.59	13043.70	2120	32.7	104
910815	7.05	3647.92	13043.24	0	33.2	104
910815	7.10	3648.25	13042.77	2120	33.7	104
910815	7.15	3648.60	13042.30	0	34.2	104
910815	7.20	3648.92	13041.84	2120	34.7	104
910815	7.25	3649.26	13041.38	0	35.2	104
910815	7.30	3649.60	13040.91	2120	35.7	104
910815	7.35	3649.93	13040.44	0	36.2	104
910815	7.40	3650.29	13039.96	2130	36.8	104
910815	7.45	3650.60	13039.57	0	37.2	104
910815	7.50	3650.96	13039.05	2140	37.8	104
910815	8.05	3652.07	13037.57	0	39.4	104
910815	8.10	3652.44	13037.09	2150	39.9	104
910815	8.15	3652.81	13036.61	0	40.4	104
910815	8.20	3653.14	13036.15	2150	40.9	104
910815	8.25	3653.48	13035.66	0	41.5	104
910815	8.30	3653.83	13035.18	2160	42.0	104
910815	8.35	3654.17	13034.69	0	42.5	104
910815	8.40	3654.50	13034.18	2160	43.0	104

PART Ⅲ

COLLECTING REFERENCES

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