Geological Investigation
for
the Broadlands Hydropower Project

Appendix

CHAPTER 2

SEISMIC REFRACTION PROSPECTING

2.1General

SEISMIC REFRACTION PROSPECTING - BROADLANDS HYDROPOWER PROJECT

1. INTRODUCTION

The work commenced on the 18/12/2002 and continued for nearly three months, finishing on the11/03/2003.The steep slopes along the trace made it very difficult for leveling and specially during rains, the crew could work only for few hours in the field.

The bore hole information were used to calibrate the instrument at the beginning of the project and later for checking the interpretations.

2. TOPOGRAPHY AND GEOLOGY

The tunnel trace crosses over a wide variety of morphological features such as flat, undulating, low angle slopes and steep slopes. In the flat terrain for about ¼ of the total length, the tunnel will be constructed by cut and cover method and run through the rock for the rest of the trace. The elevation at the starting point is 132.539 m.a.s.l and ends at 59.211 m.a.s.l.

Geologically the area is formed of a folded sequence of pre Cambrian metamorphic rocks. They are predominantly charnockitic and other gneisses with intermittent quartzite bands. Boreholes drilled in the area have shown that the rocks are weathered down to great depths at places. The seismic velocities vary laterally indicating a lateral variation in rate of weathering from place to place.

The main structural features of the area is seen in the topographic forms, lineations and drainage pattern, all of which are discernable on the available aerial photographs.

The region is partly covered by tea plantations and the rest by home gardens and secondary forest giving shelter to a multitude of animals from snakes to wild boar and a variety of birds.

3. FIELDWORK

3.1 The Team and Equipment

The entire team engaged in the field work comprised of

2 Geophysicists 1 Field Manager 1 Engineering Geologist

2 Surveyors (Geodetic Surveying) 7 Laborers

2 Drivers

During the fieldwork the team was divided in to two

a) Surveying and Leveling

b) Seismic Refraction Survey

The measuring Equipment consisted of the following

1 set PASI Digital Shallow Refraction Seismic Apparatus/12 Channels / Italian

12 No. of Geo-phones and cables

External Trigger and other required cables

2 No. of TOPCON Total Stations for surveying and leveling

2 Hired vehicles

4. METHODOLOGY

It is assumed that the reader is familiar with the theoretical and practical aspects of seismic refraction method. Those interested in becoming acquainted with these techniques or wishing to obtain more profound knowledge in this field- are referred to the extensive literature on the subject.

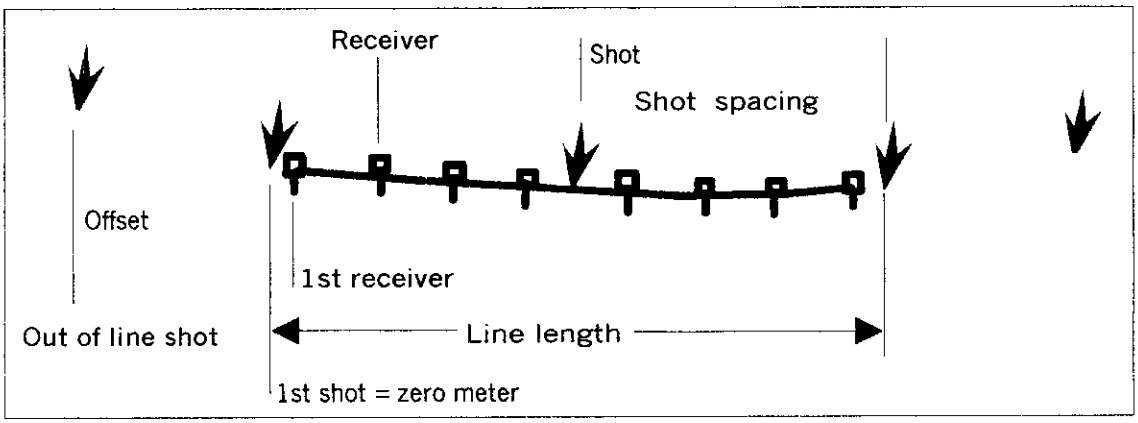
4.1 Seismic Refraction Method

Almost all the seismic survey lines along the tunnel trace had a common over-lap point at the beginning and at the end. This practice made it easy to double check the interpretation.

Field Geometry

All distances are computed from first End-of-line shot. This shot is always distance 0 and must exist. First Out-of-line shot must have a negative distance. Line length is computed from first End-of-line shot to the last End-of-Shot.

Usually, the first End-of-line shot distance to the first receiver is half receiver spacing.

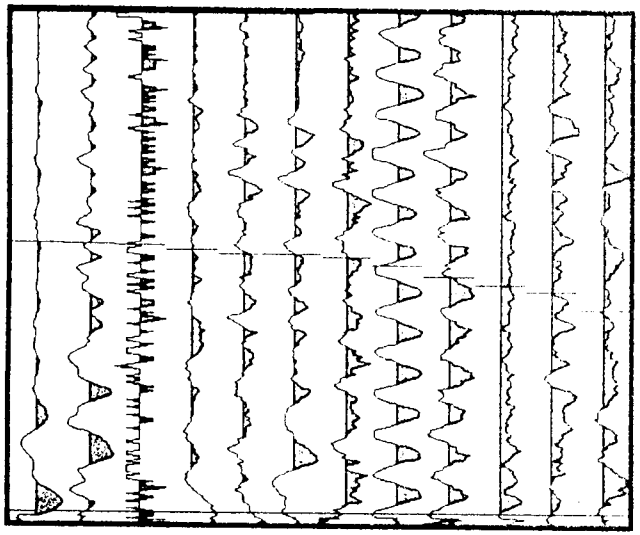


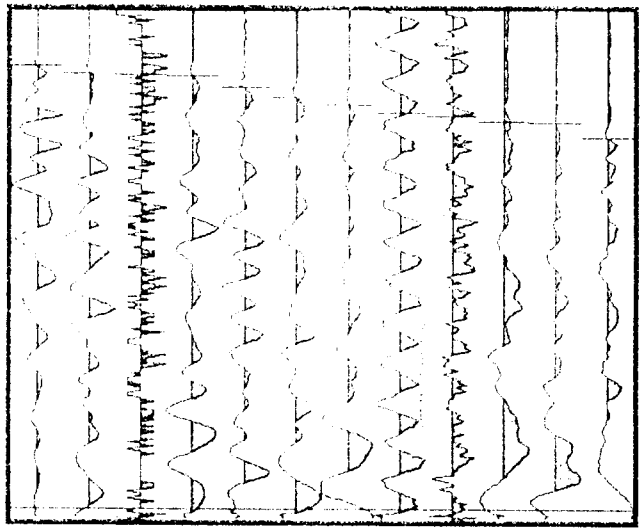
The seismic refraction method consists of measuring (at known points along the surface of the ground) the travel times of compress ional waves generated by an impulse energy source. The energy source is usually a small explosive charge and the energy is detected, amplified, and recorded by special equipment designed for this purpose. The instant of the explosion, or "zero-time" is recorded on the record of arriving pulses. The raw data, therefore , consists of travel times and distances and the time distance information is then manipulated to convert it into the format of velocity variations with depth. The process is schematically illustrated in figure below. All measurements are made at the surface of the ground and the subsurface structure is inferred from interpretation methods based on the laws of energy propagation.

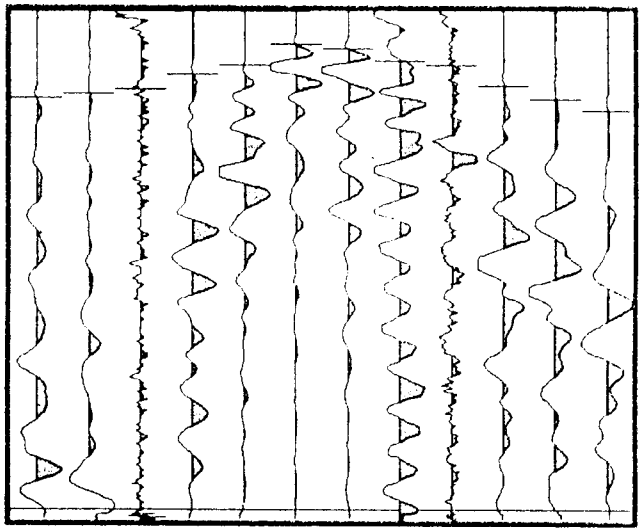
The propagation of seismic energy through subsurface layers is described by essentially the same rules that govern the propagation of light rays through transparent media. The refraction or angular deviation that a light ray or se4ismic pulse undergoes when passing from one material to another depends upon the ratio of the transmission velocities of the two materials. The fundamental law that describes the refraction of light rays is Snell's Law, and this, together with the phenomenon of "critical incidence", is the physical foundation of seismic surveys.

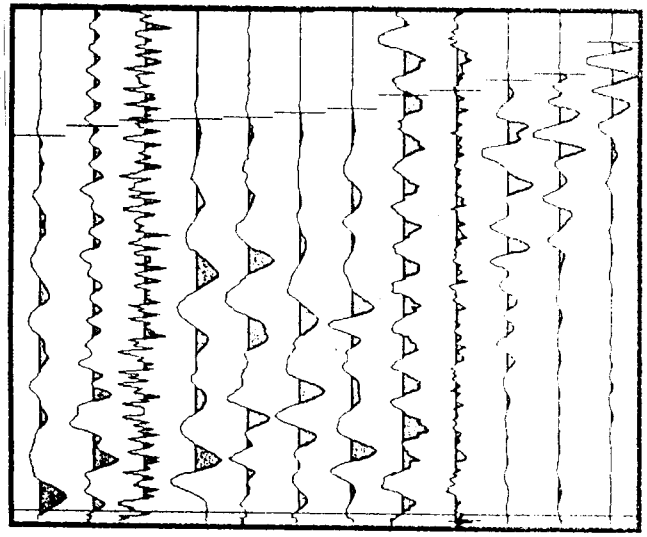
Data on both the geophone distances and shot distances are given in the annex, presenting all the seismograms of the survey together with the respective time-distance graphs.

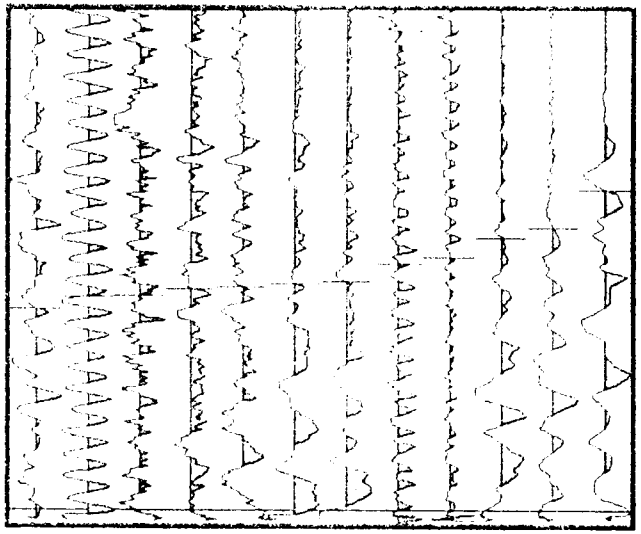
2.2 Original Oscillograph Records











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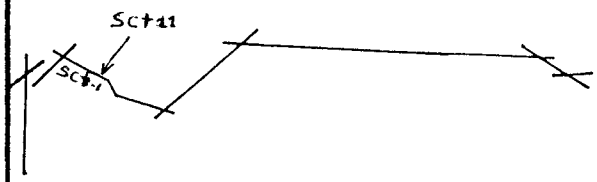
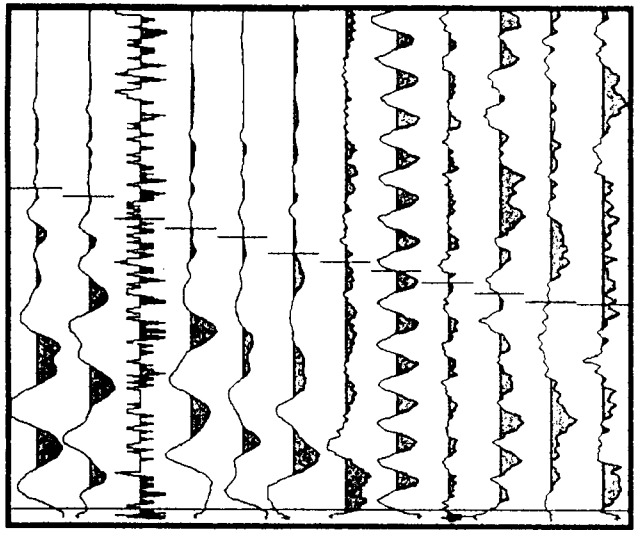
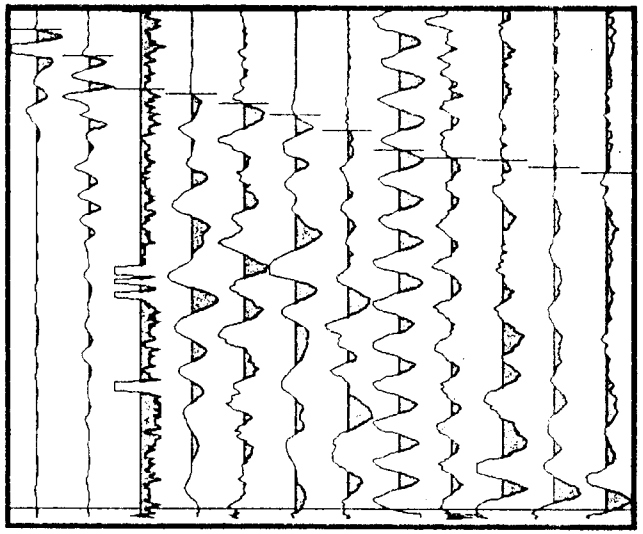
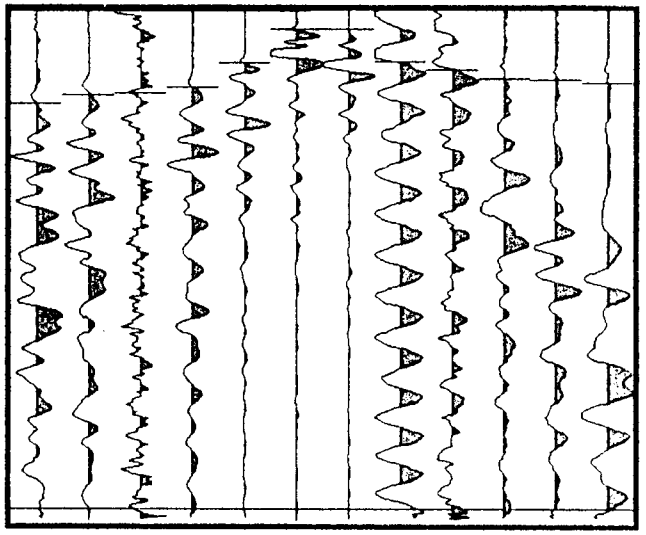
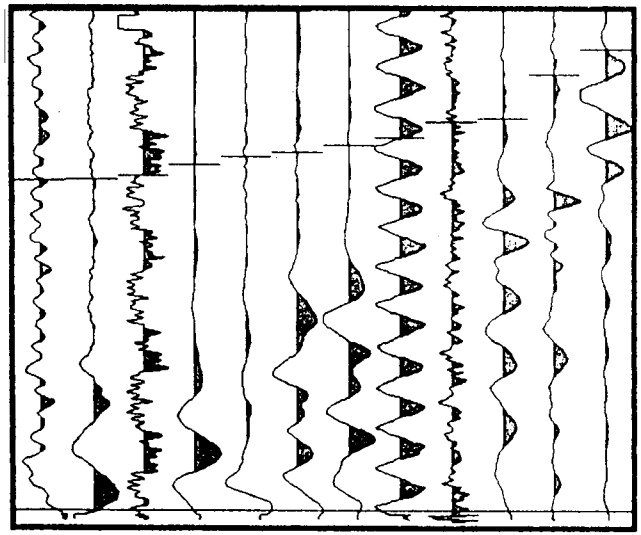
Geophone Spacing	:	5m

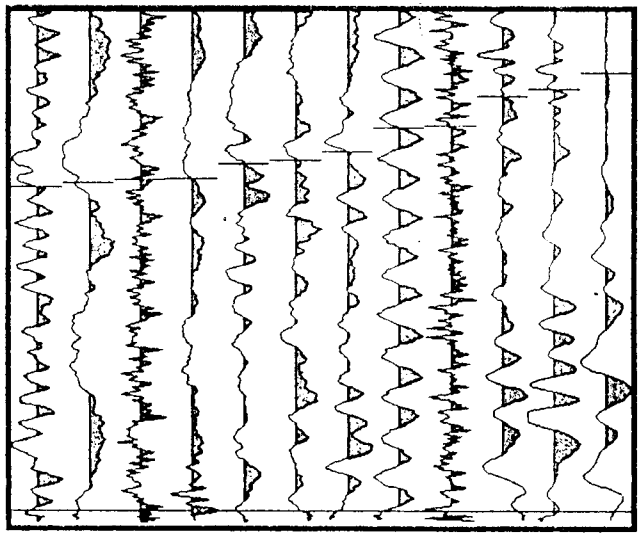












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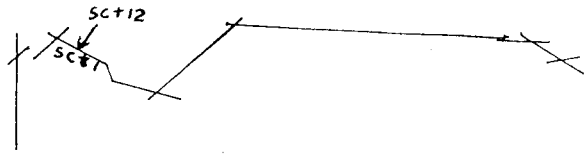

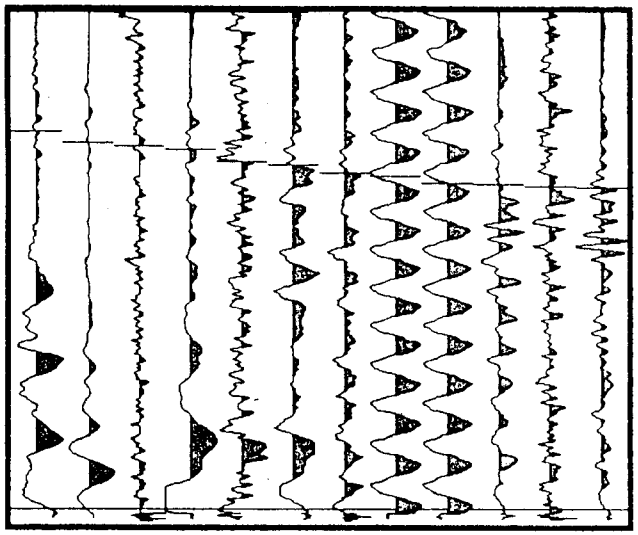

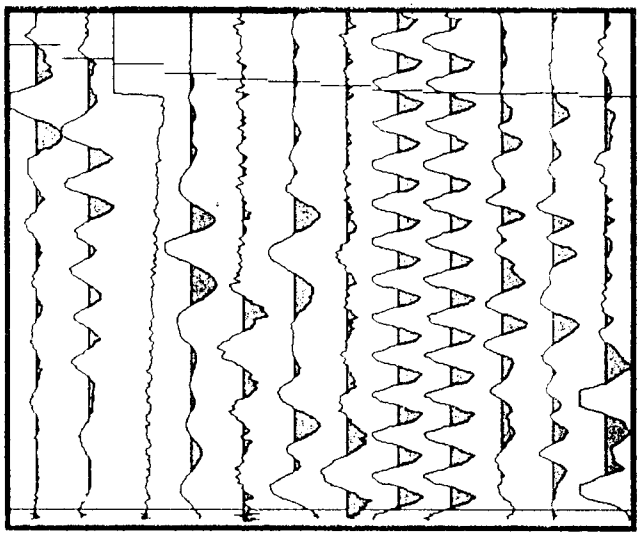

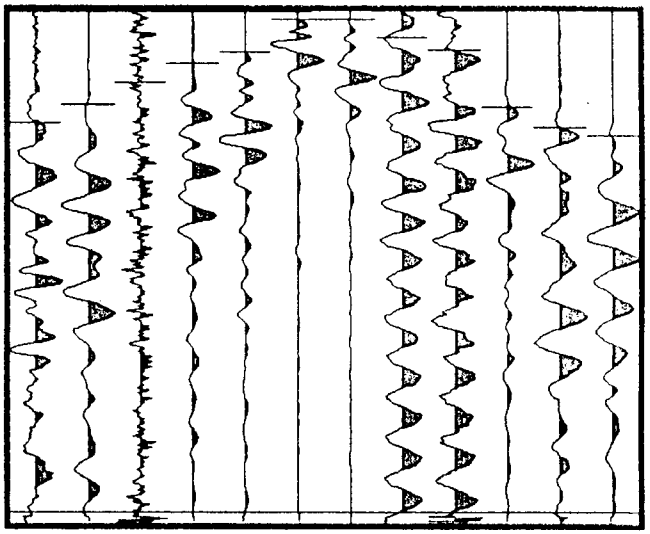

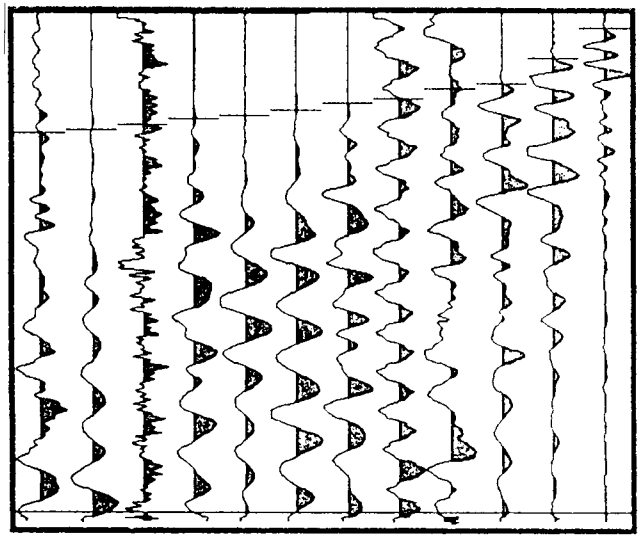

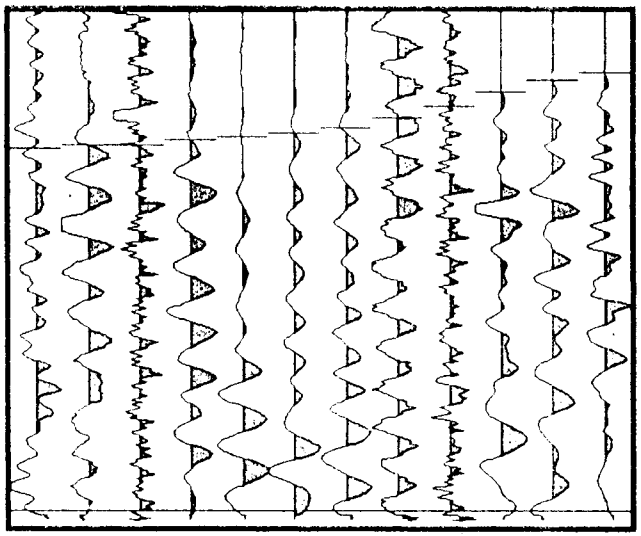

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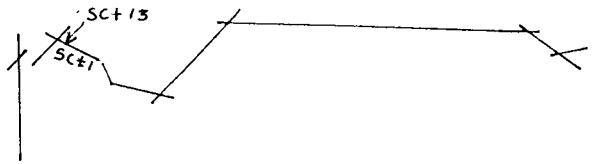

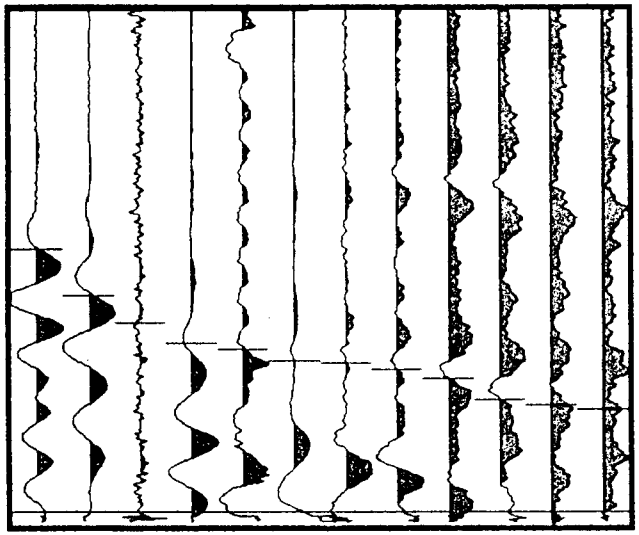

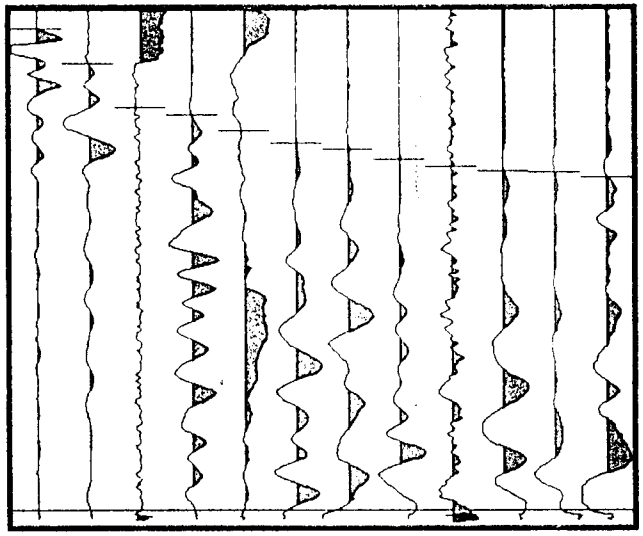

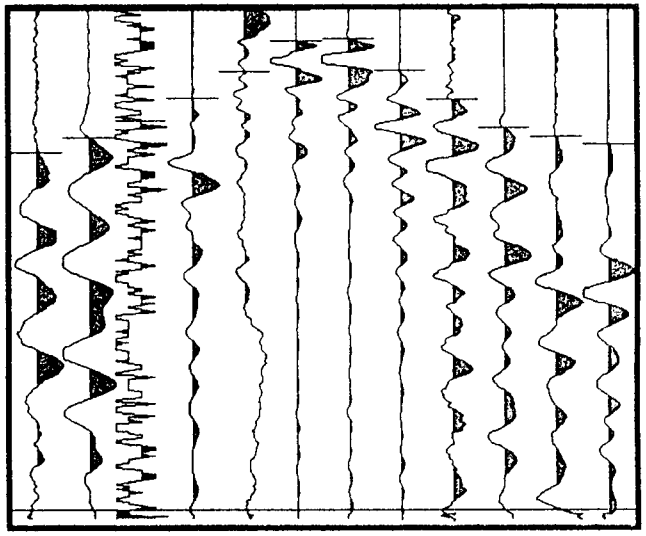

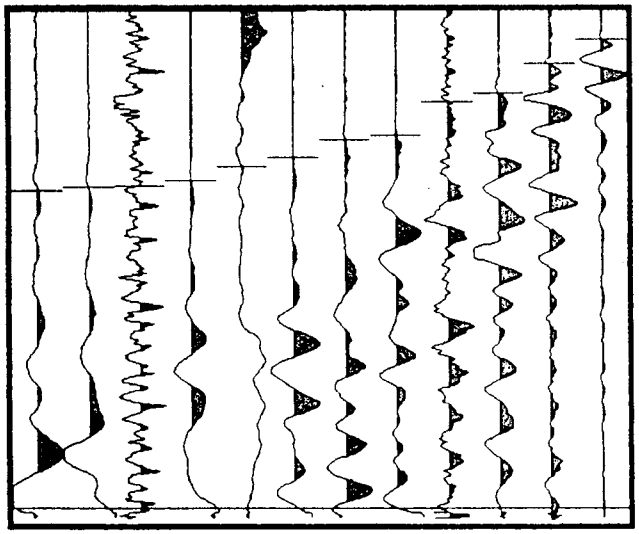

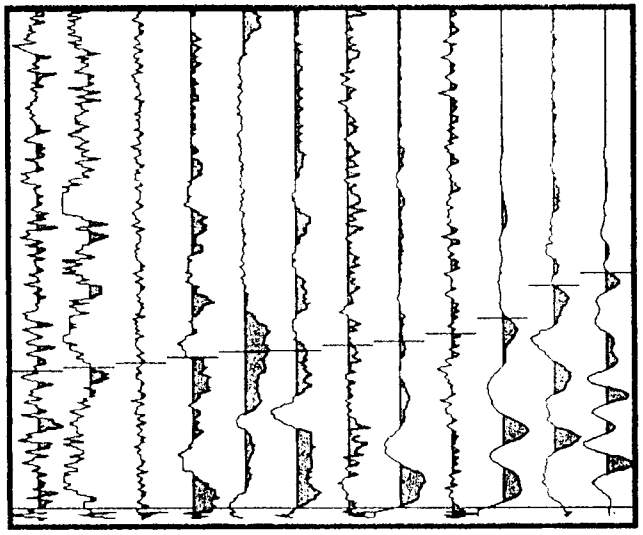

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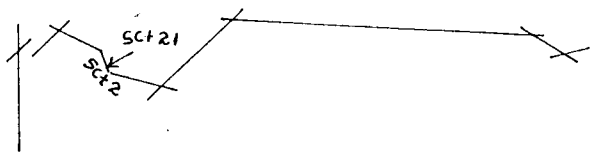

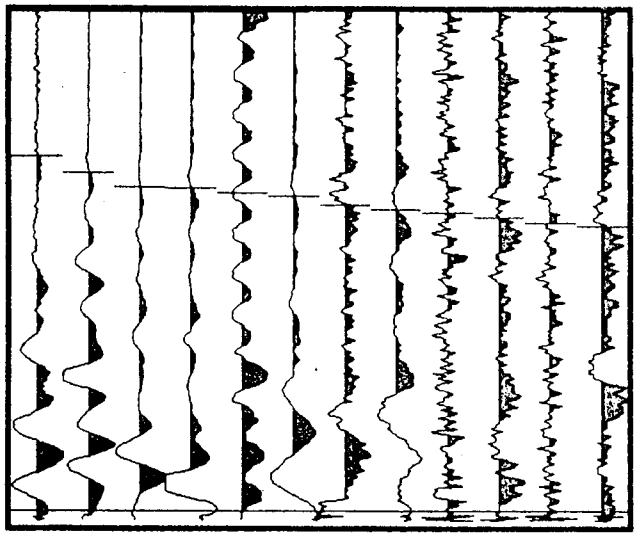

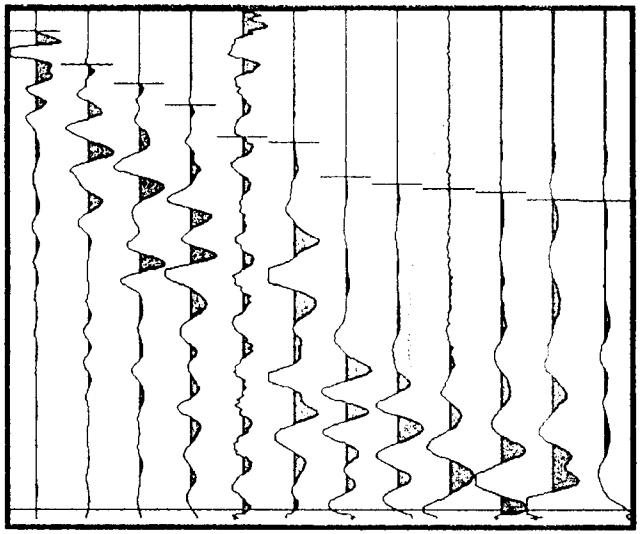

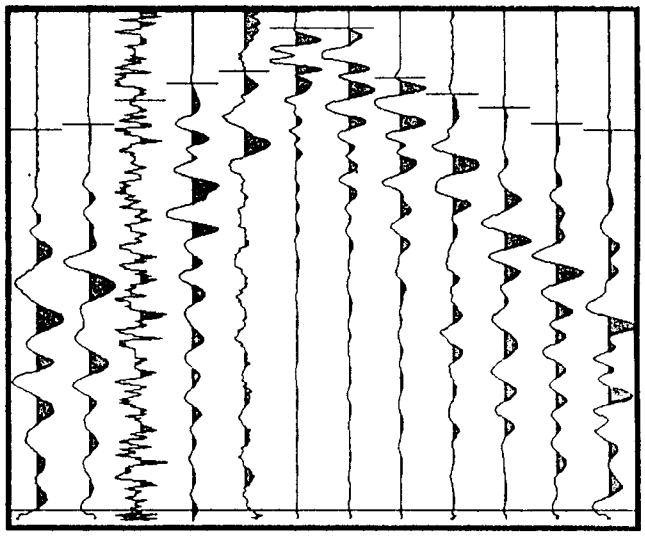

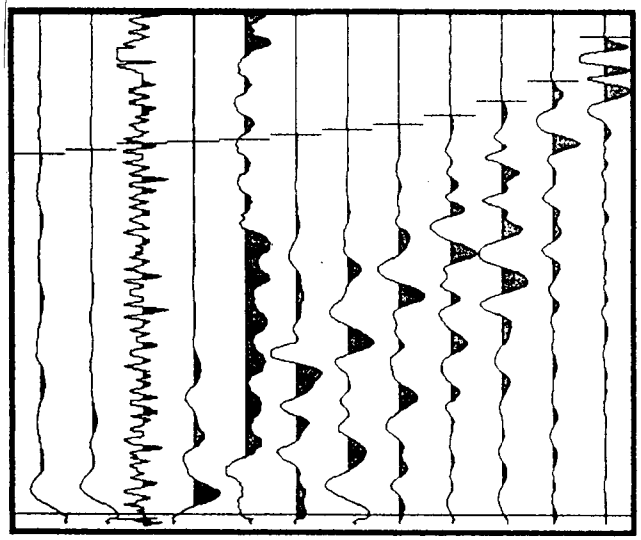

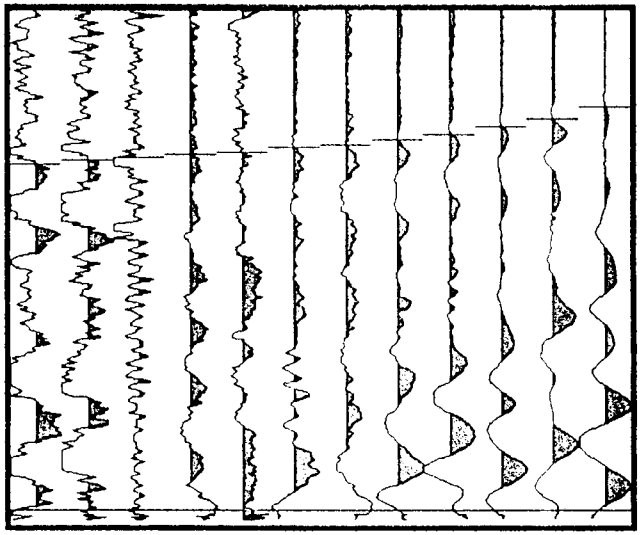

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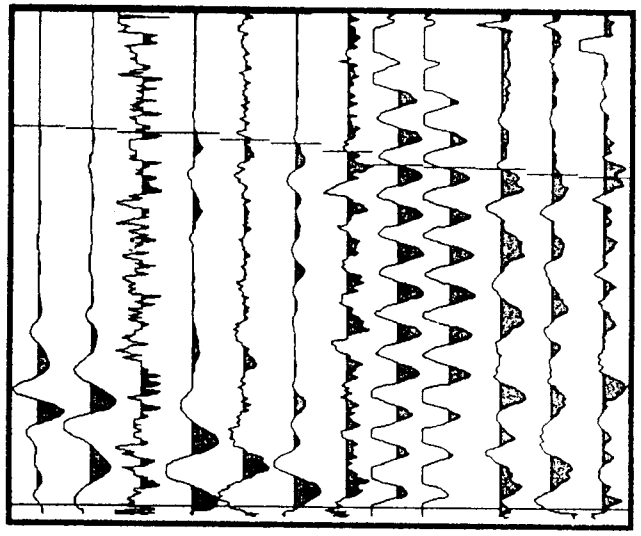

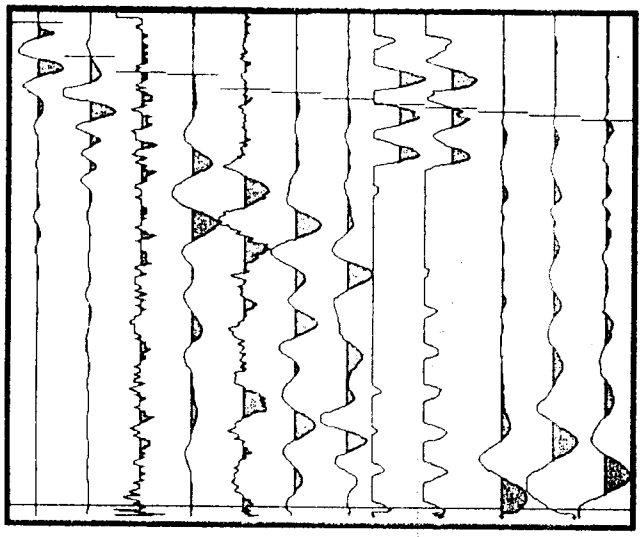

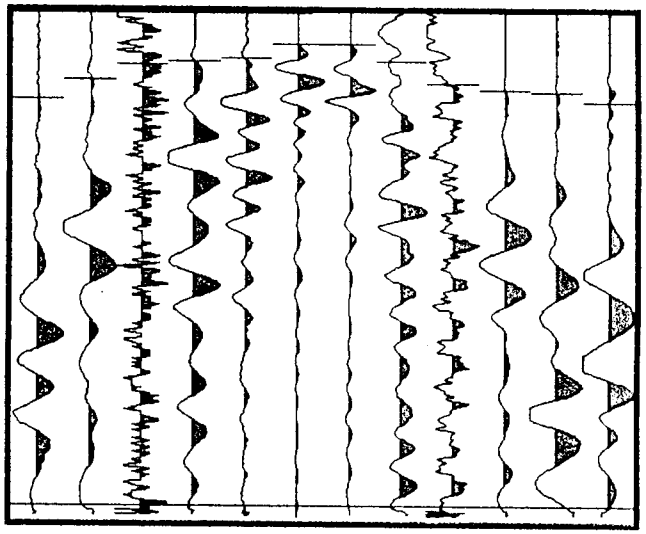

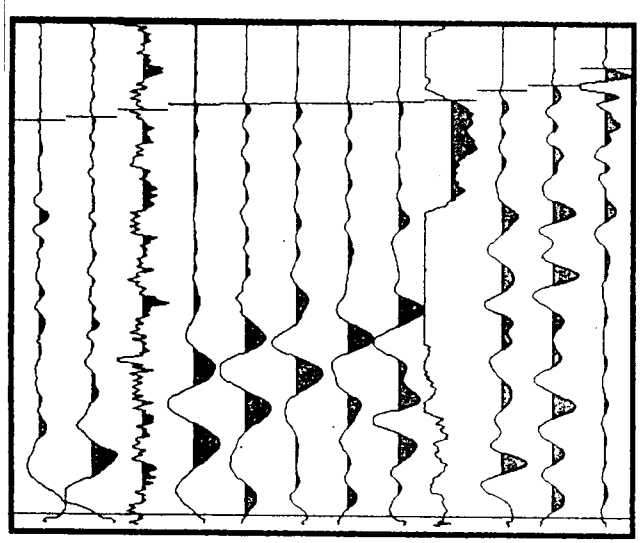

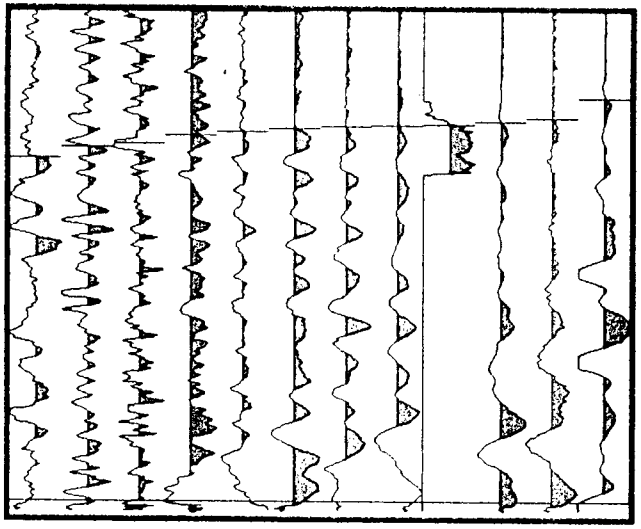

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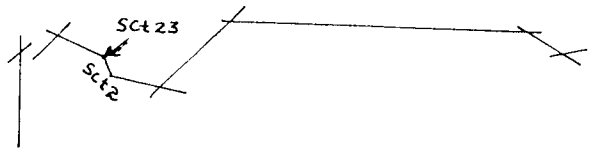

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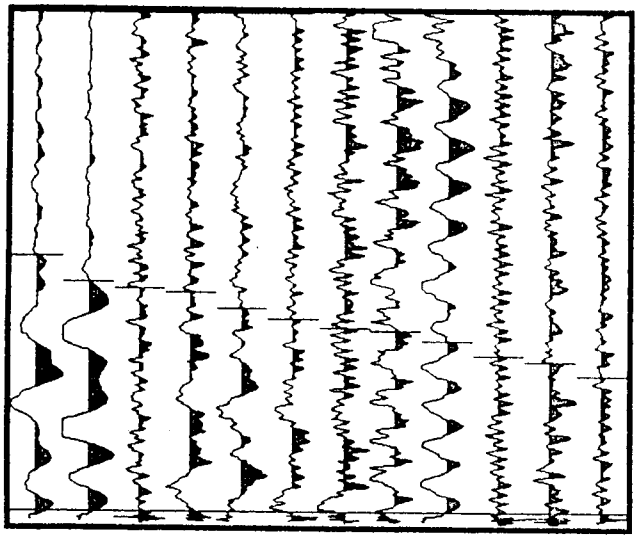

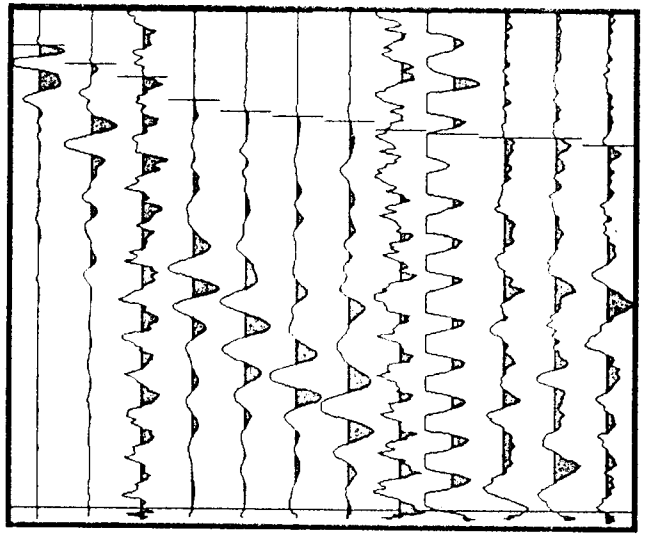

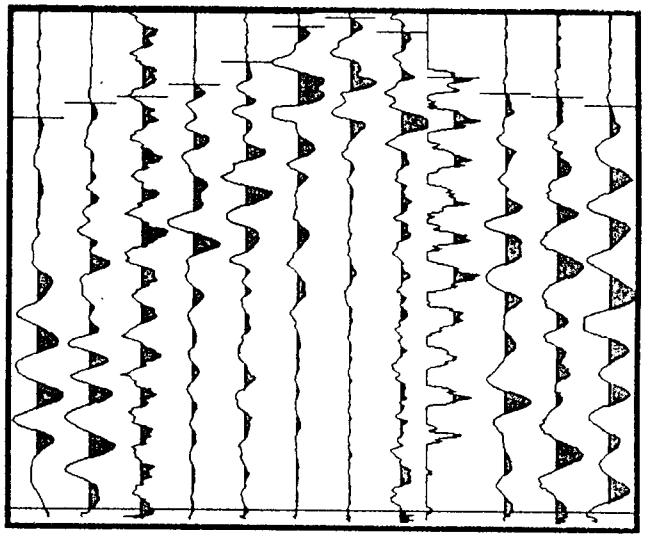

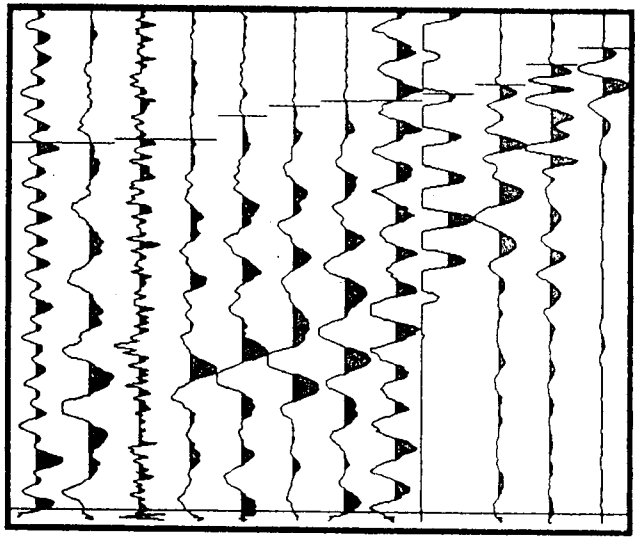

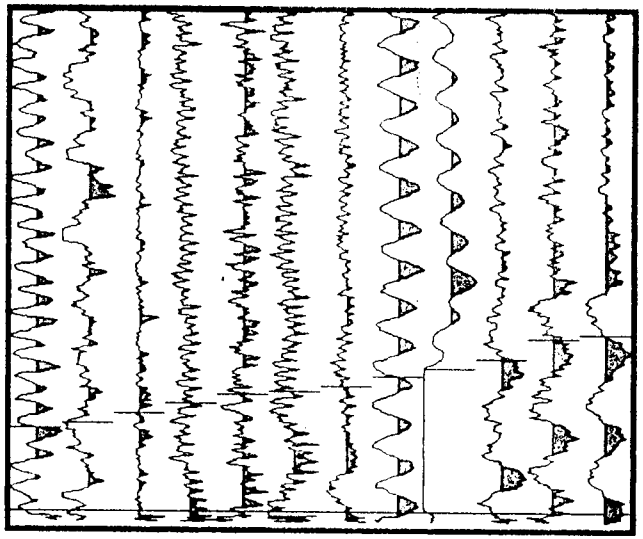

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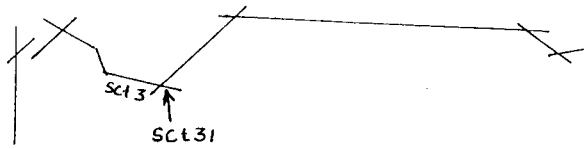

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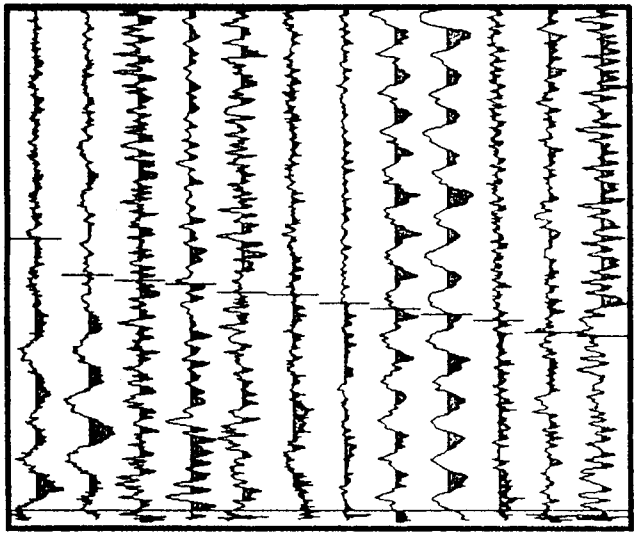

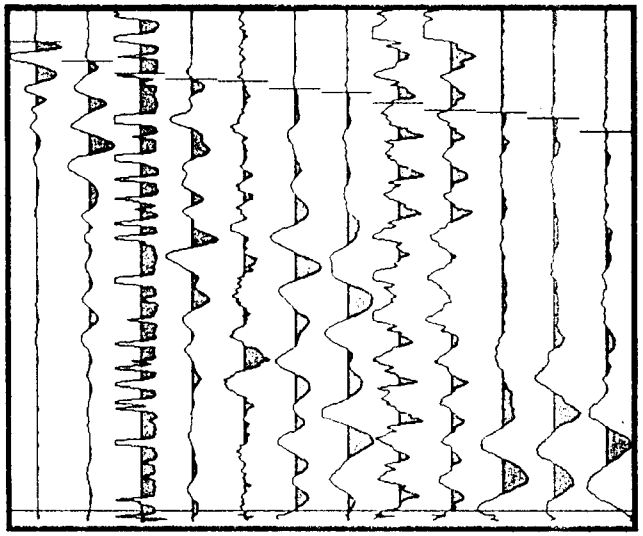

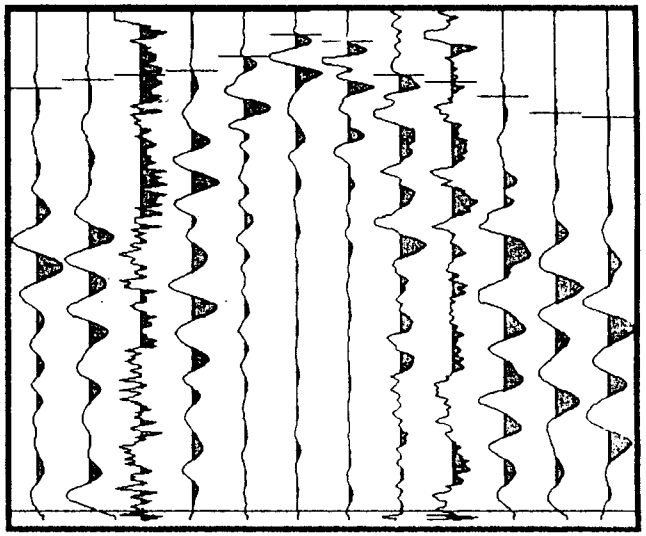

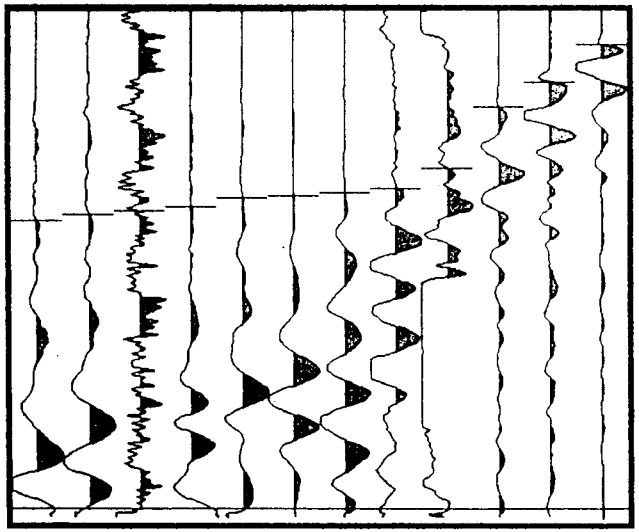

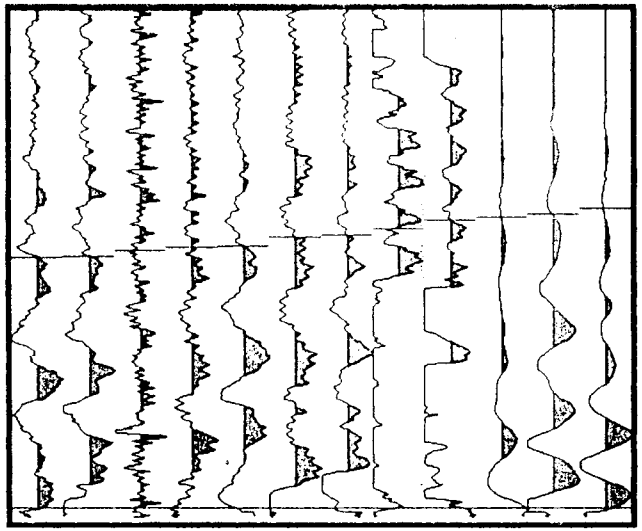

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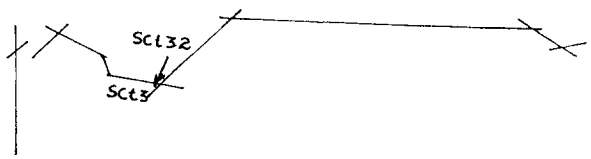
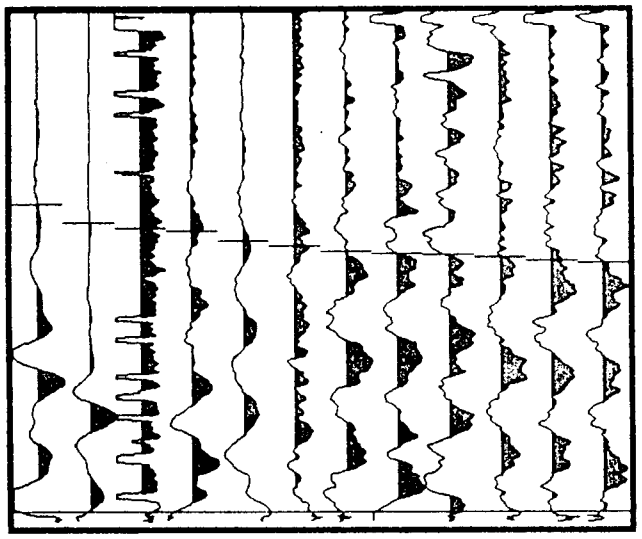
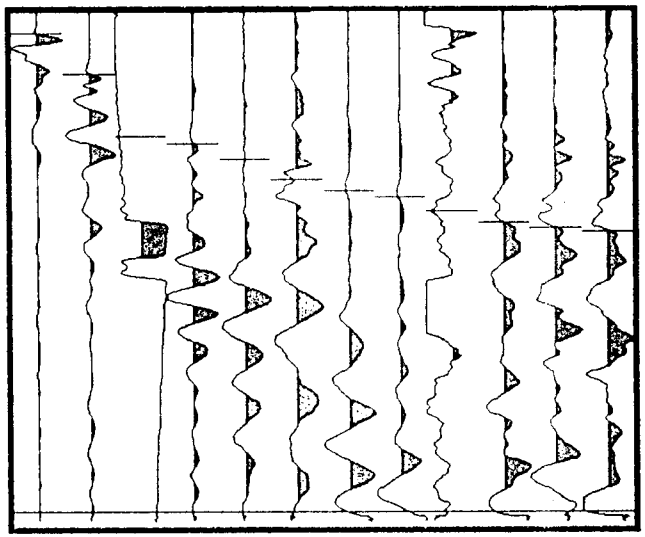
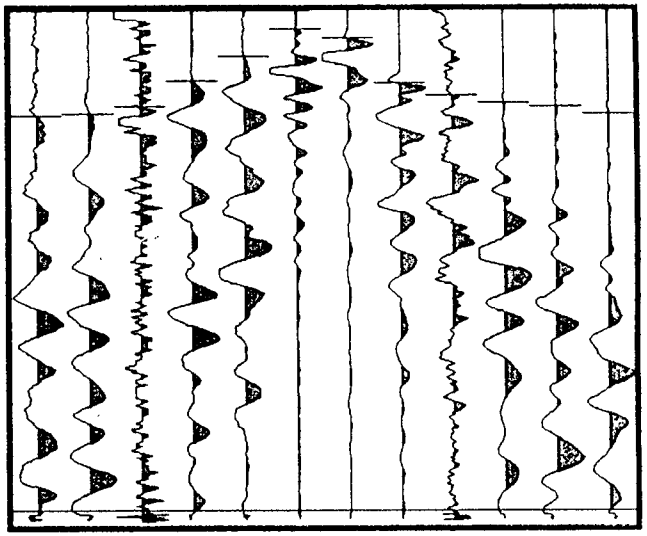
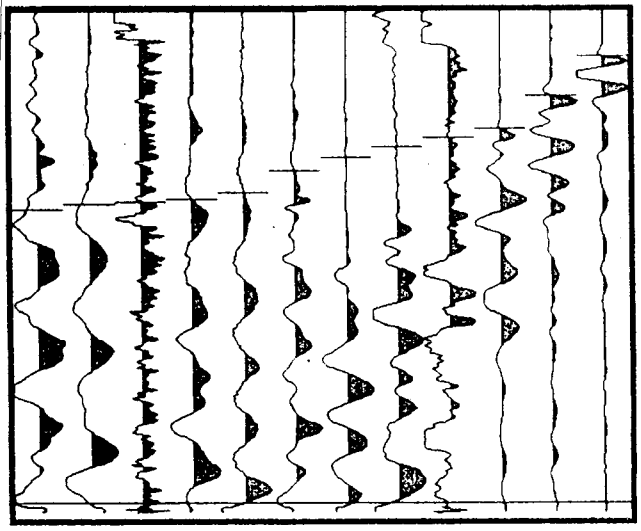
Geophone Spacing : 5m

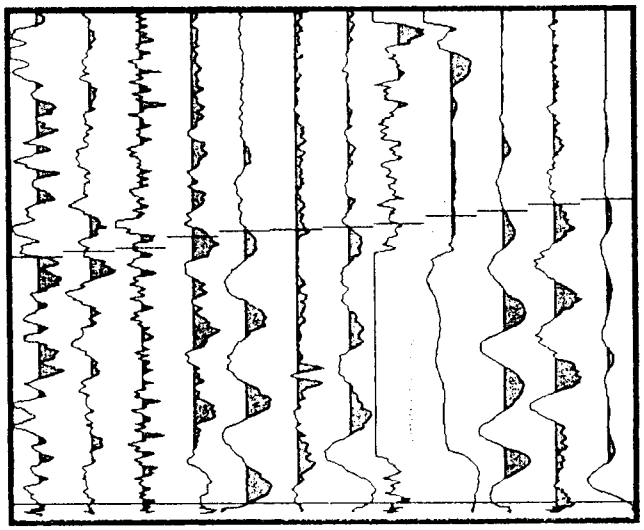




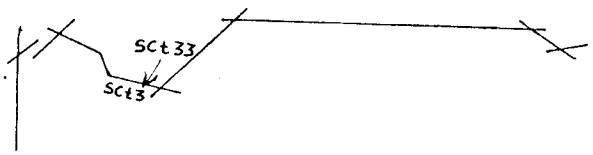


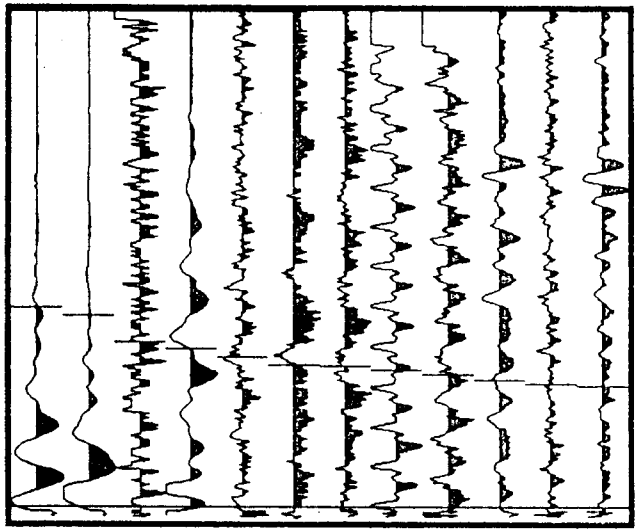


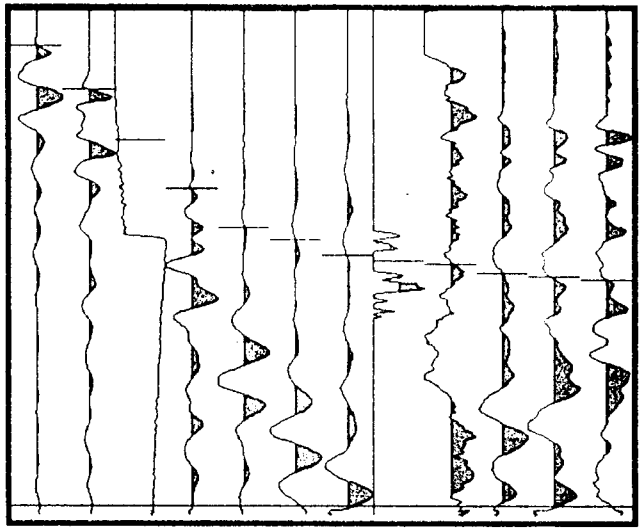


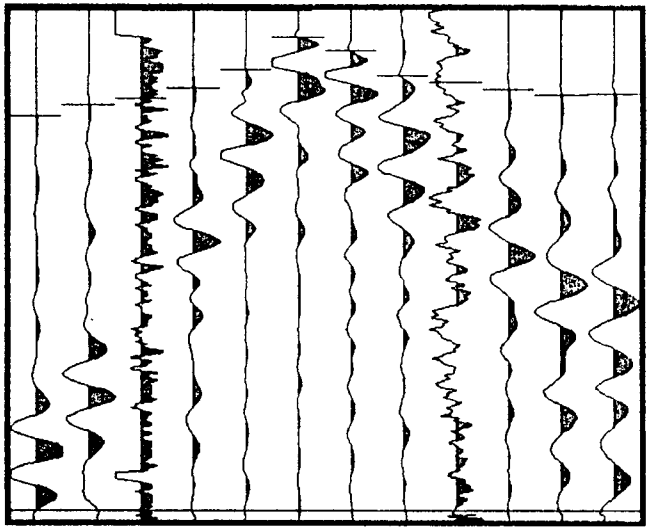


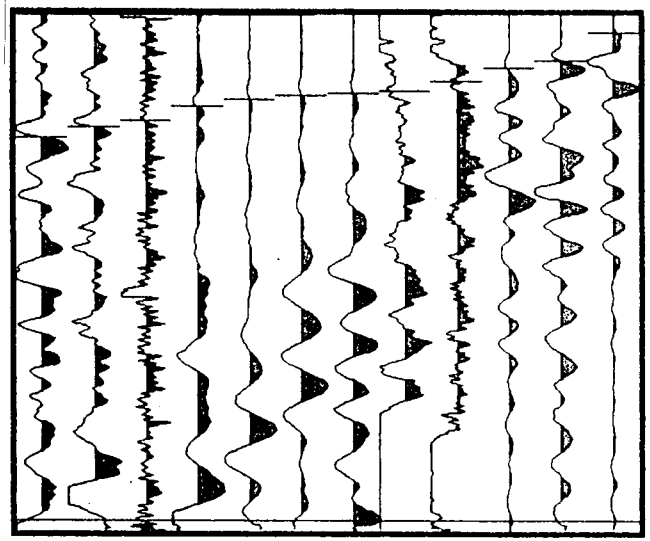
Spread No. : sct33
Number of Geophones : 12
Geophone Spacing : 5m

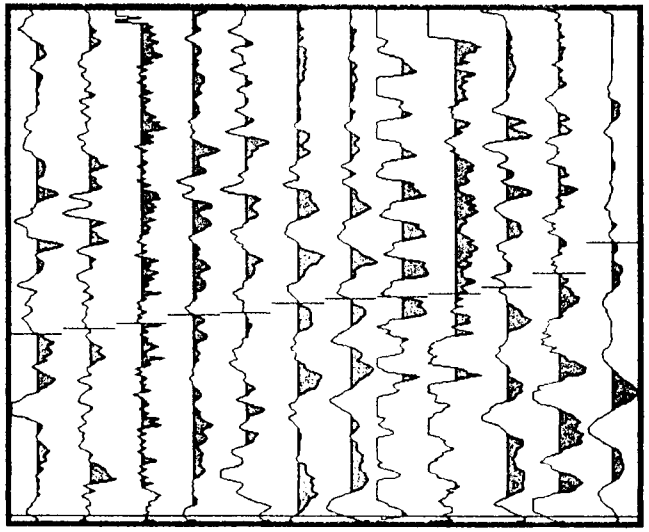




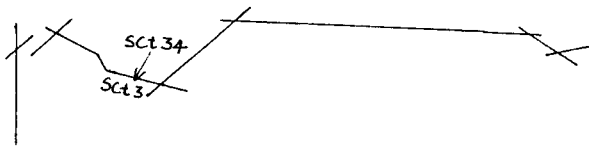


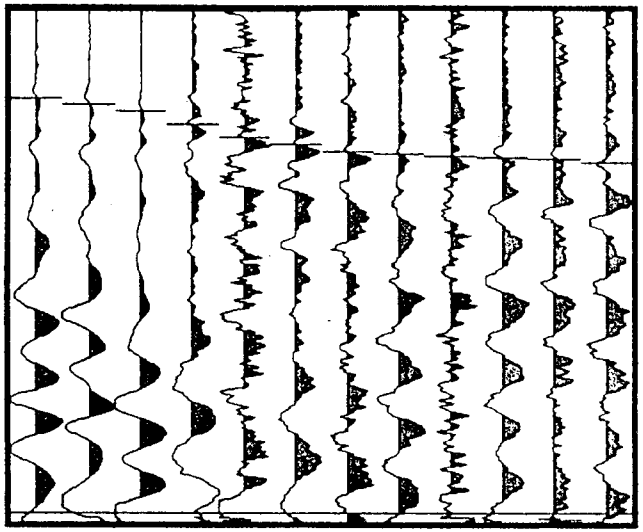


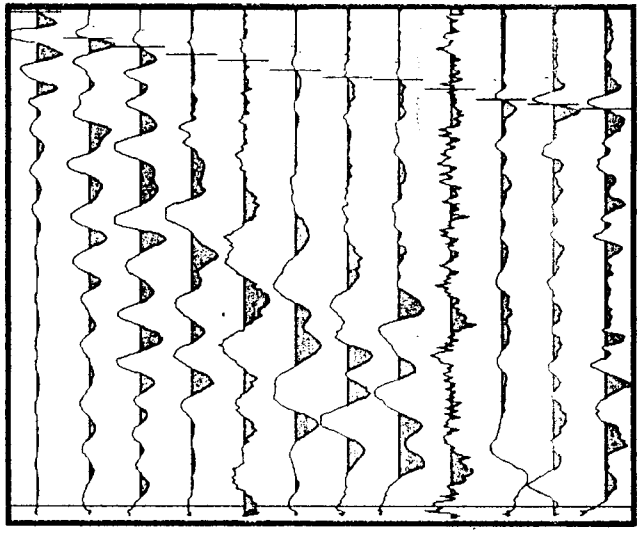


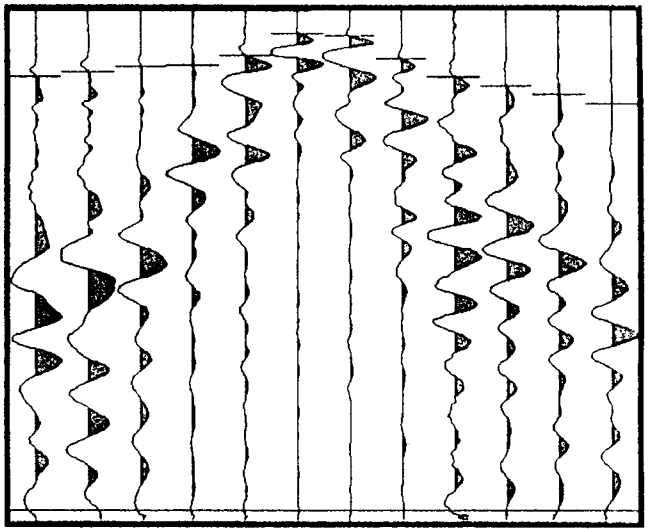


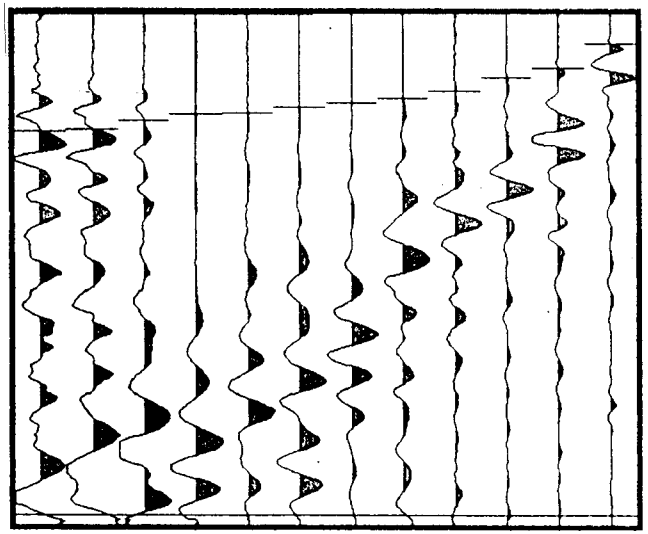
Spread No. : sct34
Number of Geophones : 12
Geophone Spacing : 5m

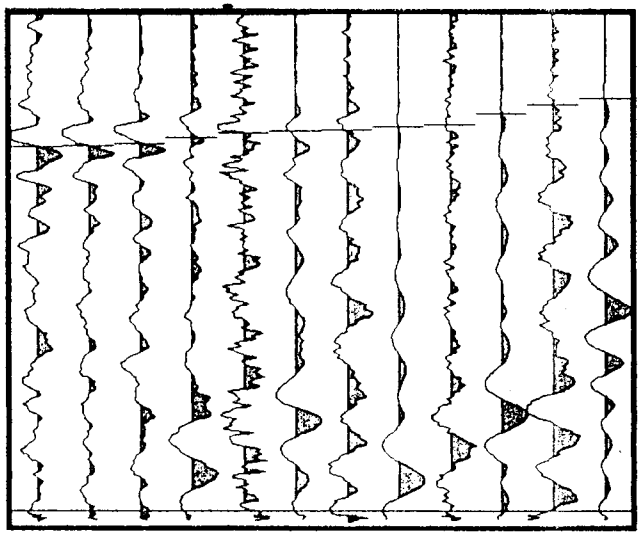




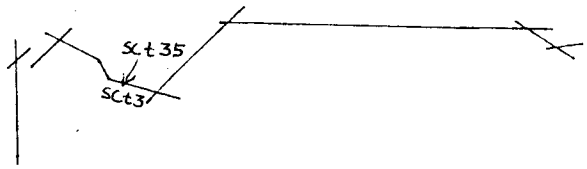


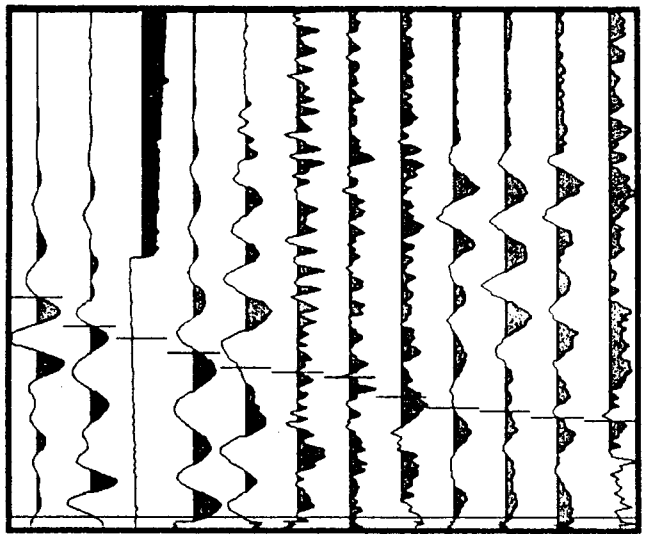


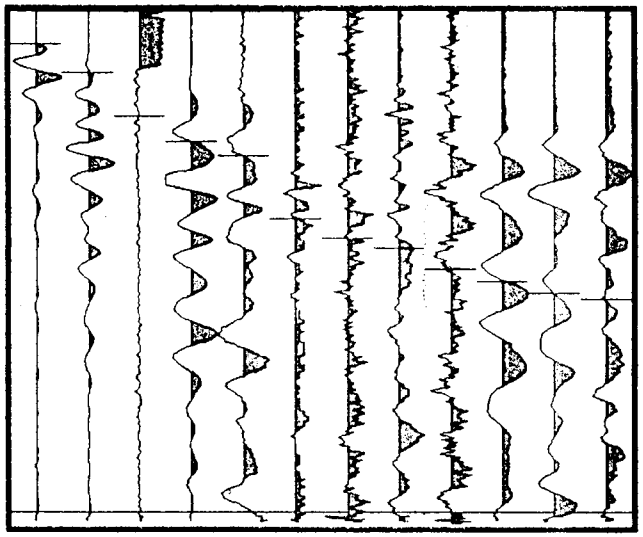


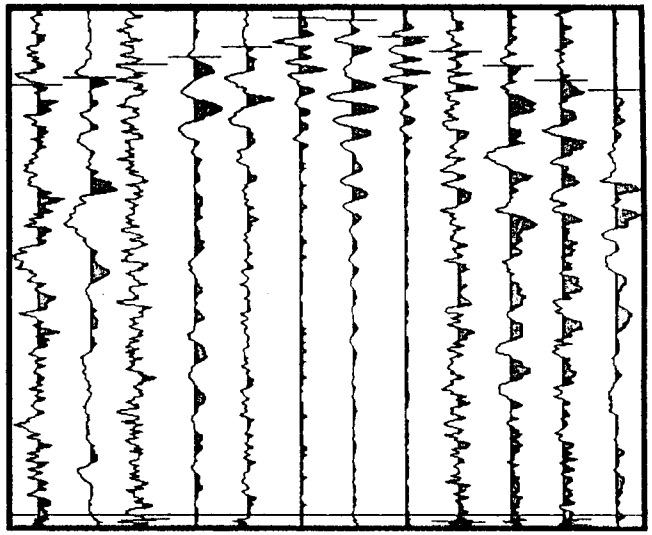


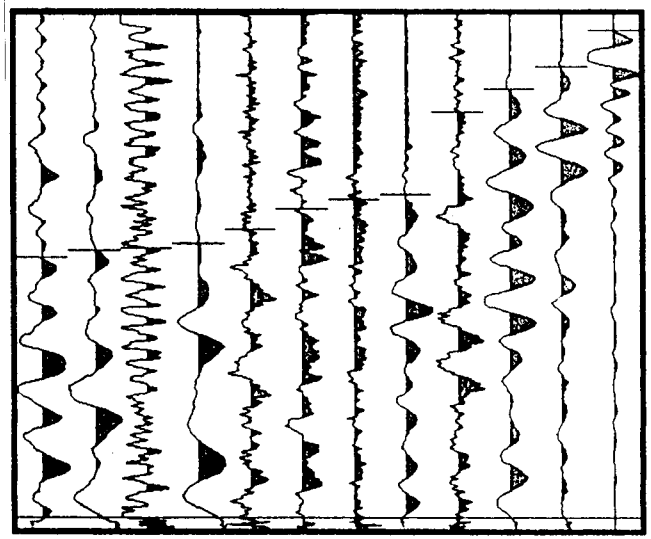
Spread No.	: sct35
Number of Geophones	: 12
Geophone Spacing	: 5m

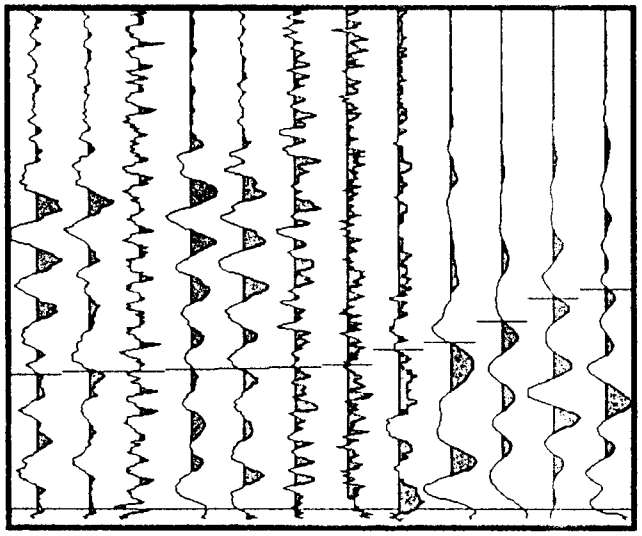




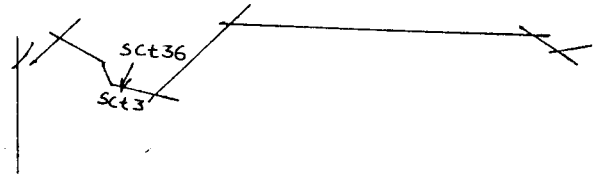


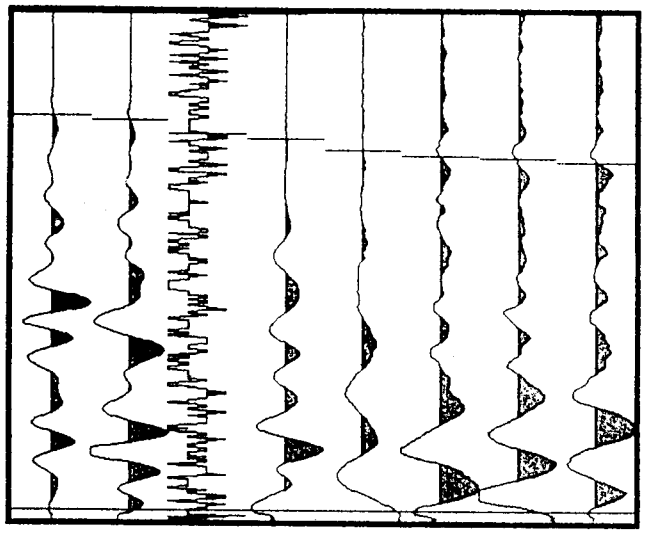


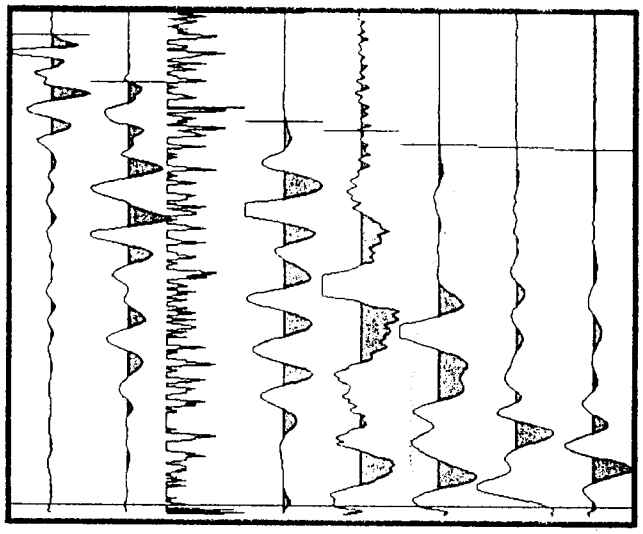


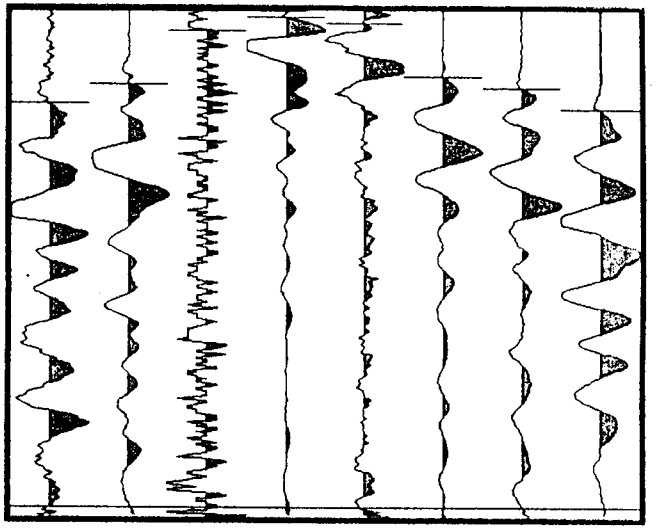


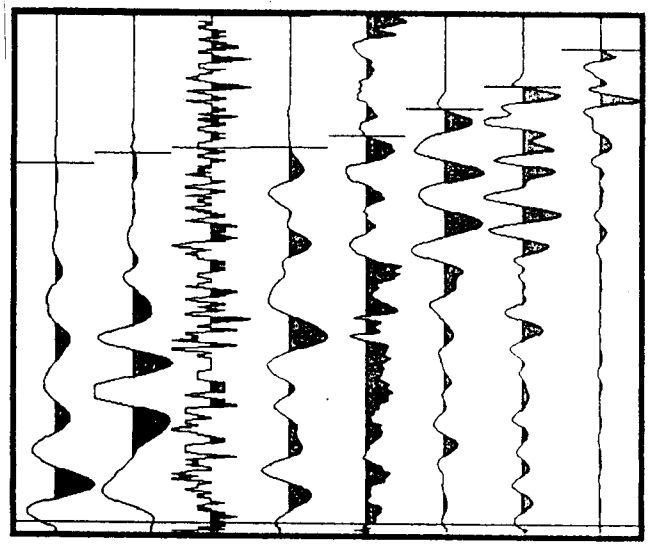
Spread No. : sct36
Number of Geophones : 12
Geophone Spacing : 5m

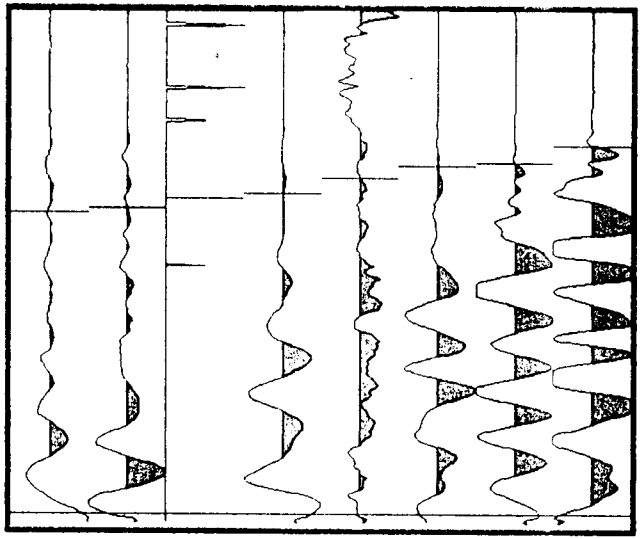




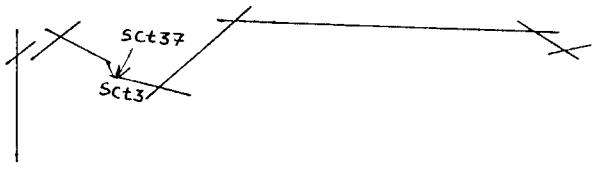


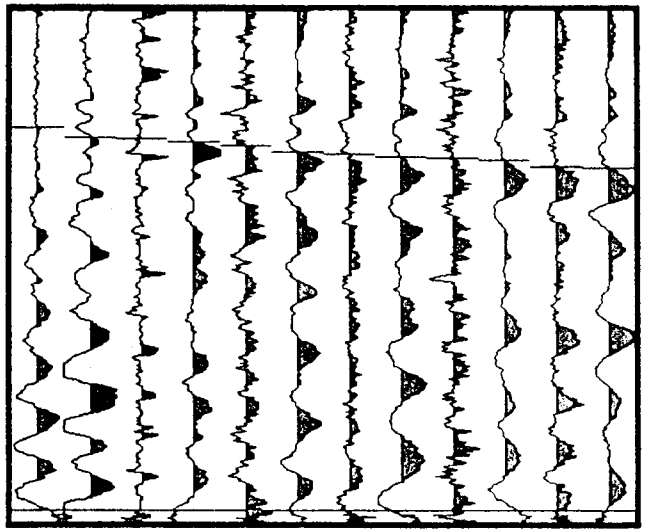


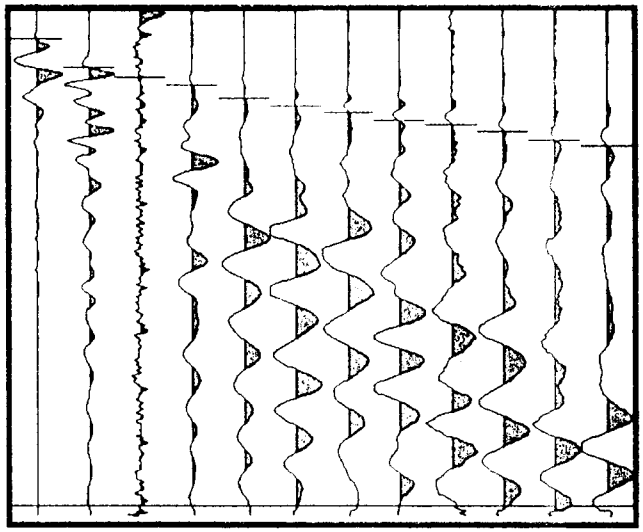


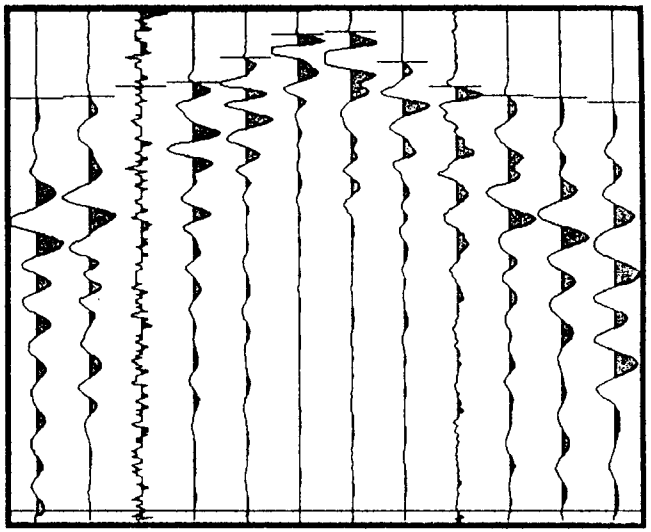


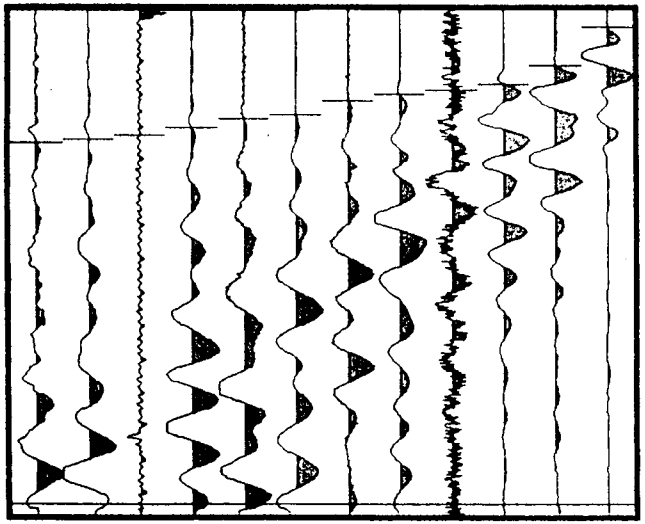
Spread No. : sct37
Number of Geophones : 12
Geophone Spacing : 5m

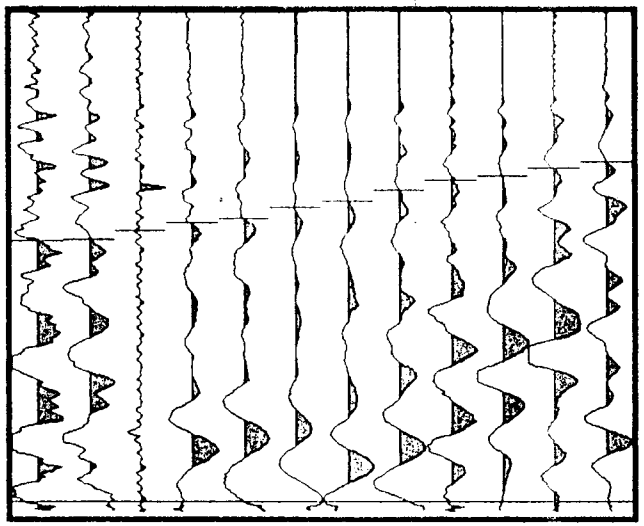




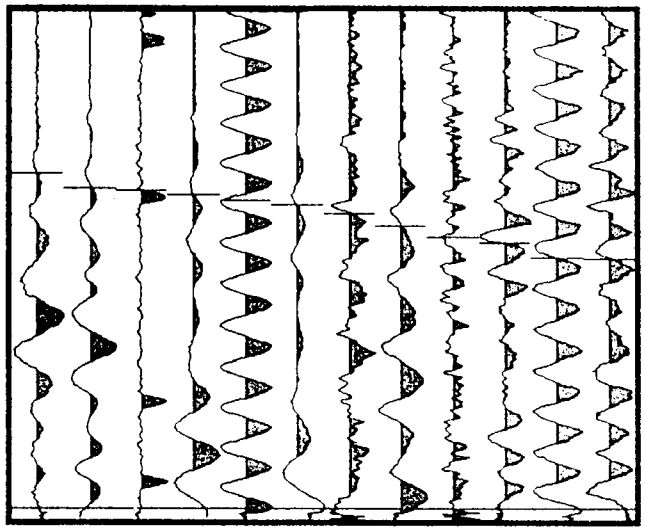


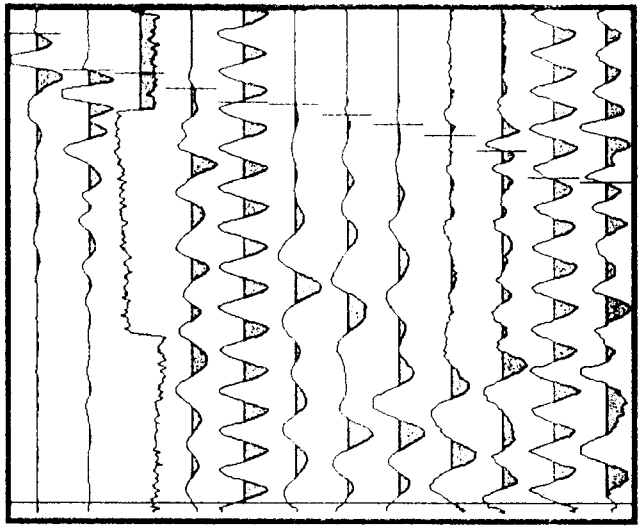


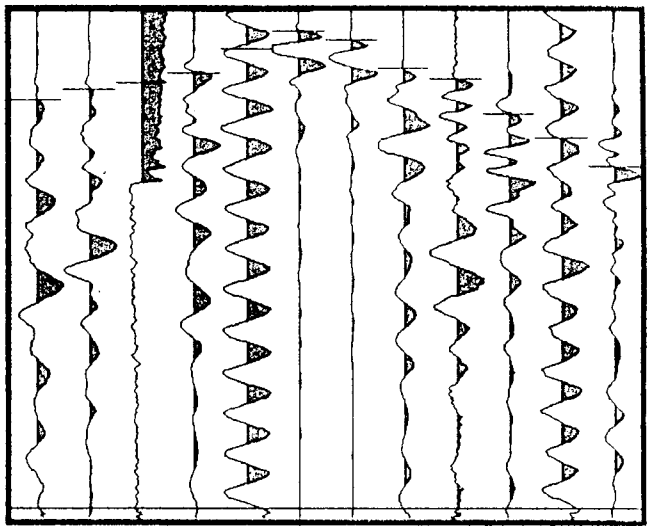


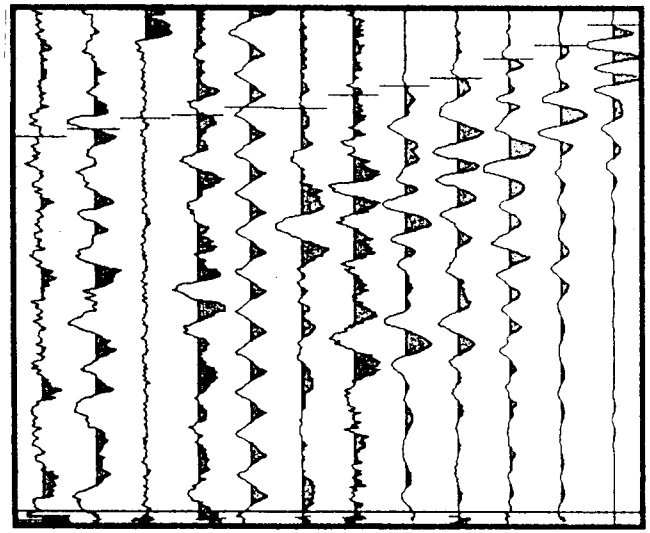


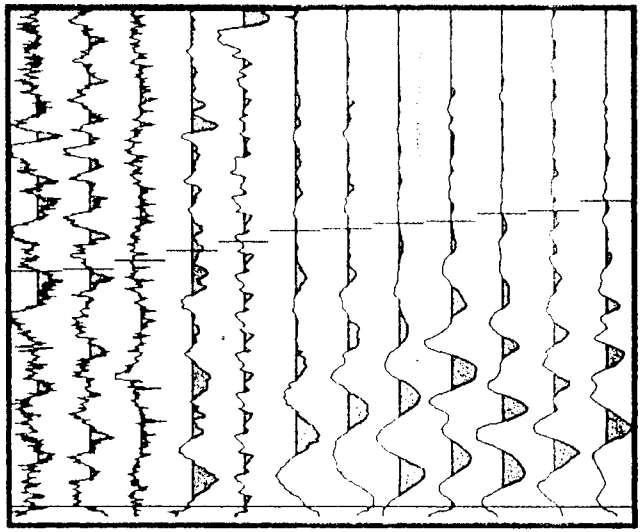
Spread No. : sdt11
Number of Geophones : 12
Geophone Spacing : 5m



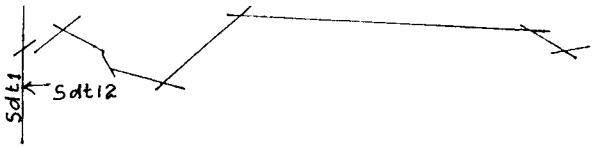


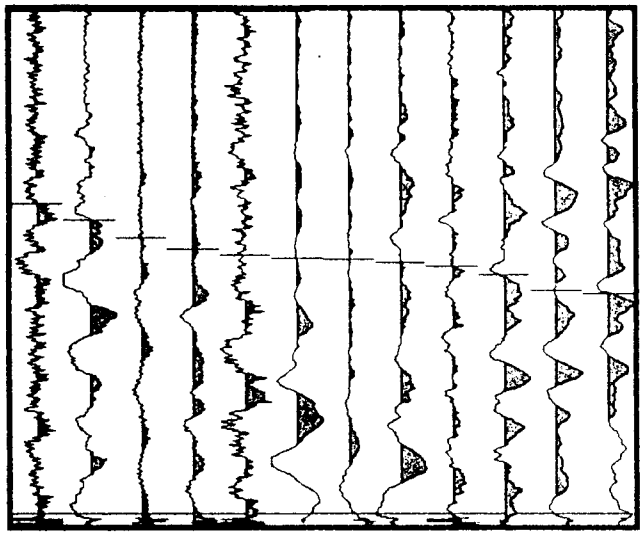


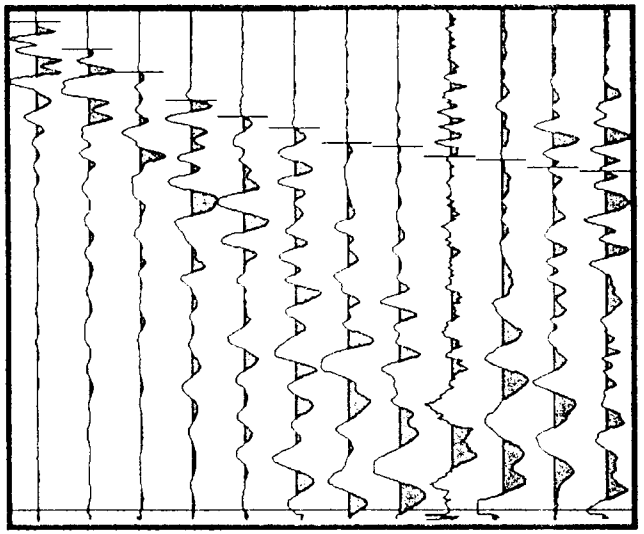


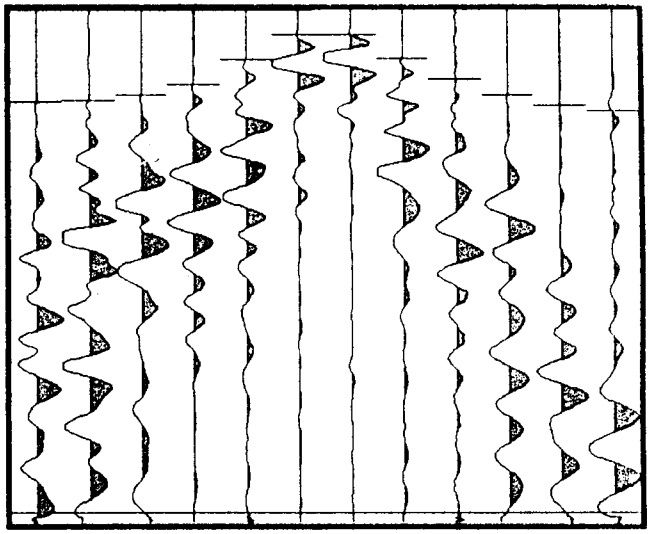


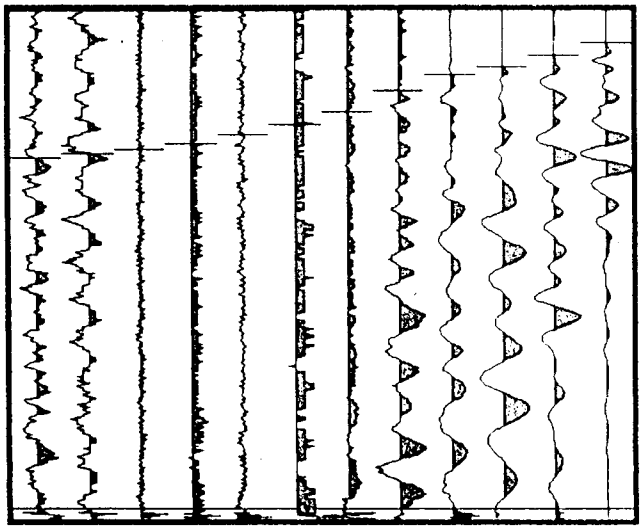
Spread No. : sdt12
Number of Geophones : 12
Geophone Spacing : 5m

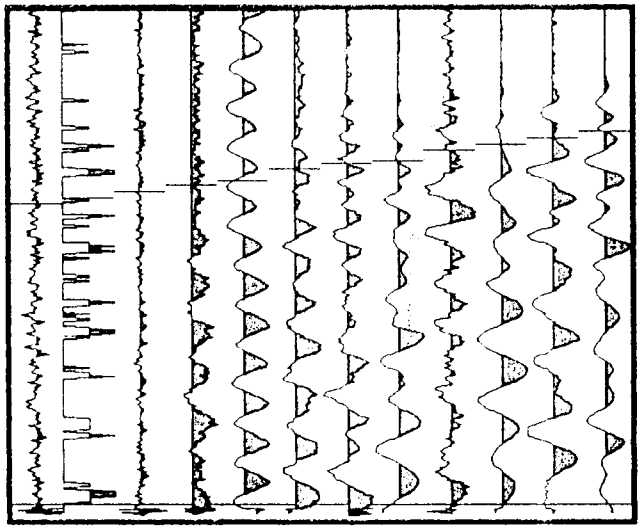




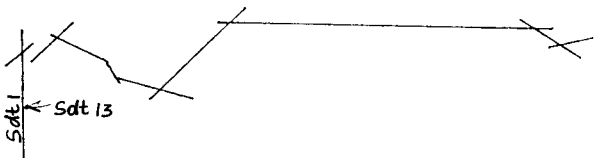


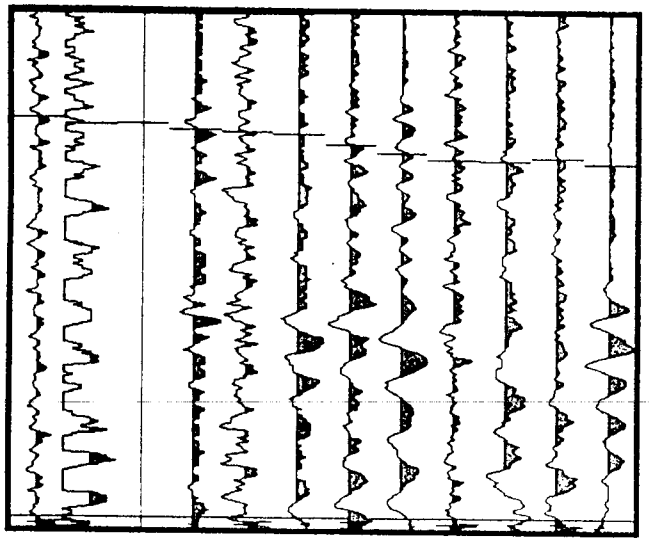


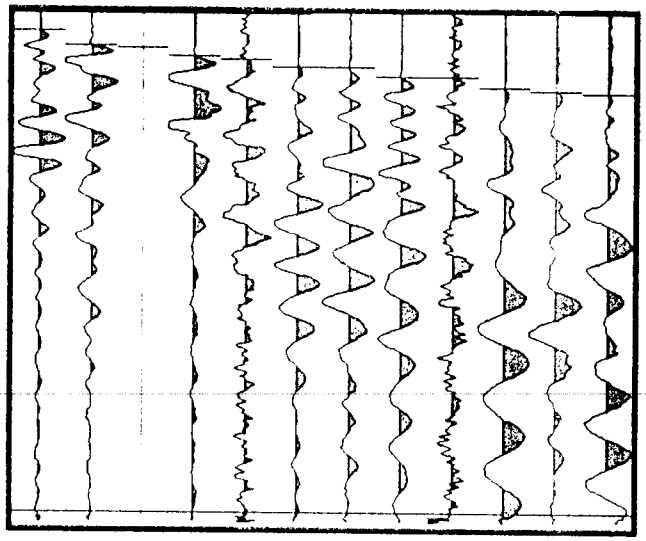


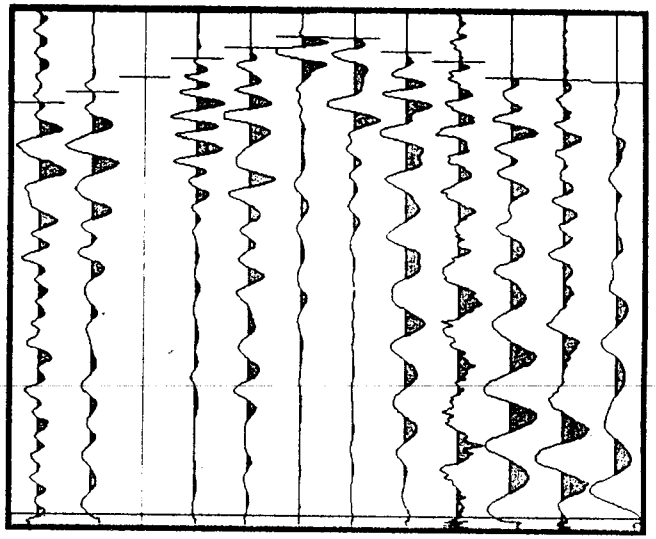


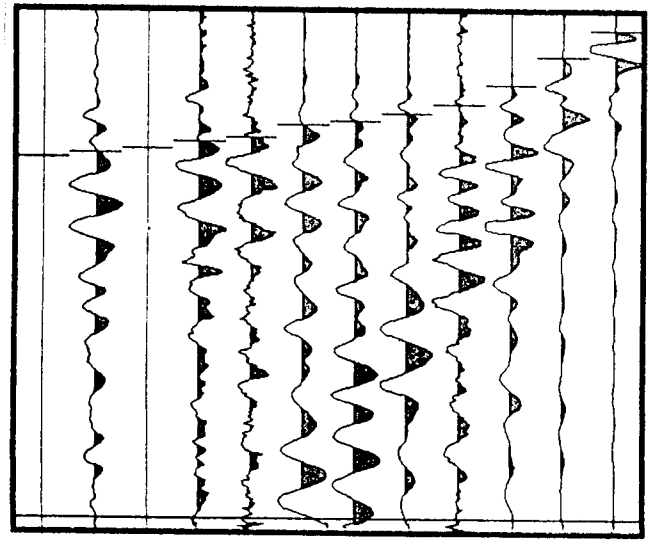
Spread No. : sdt13
Number of Geophones : 12
Geophone Spacing : 5m

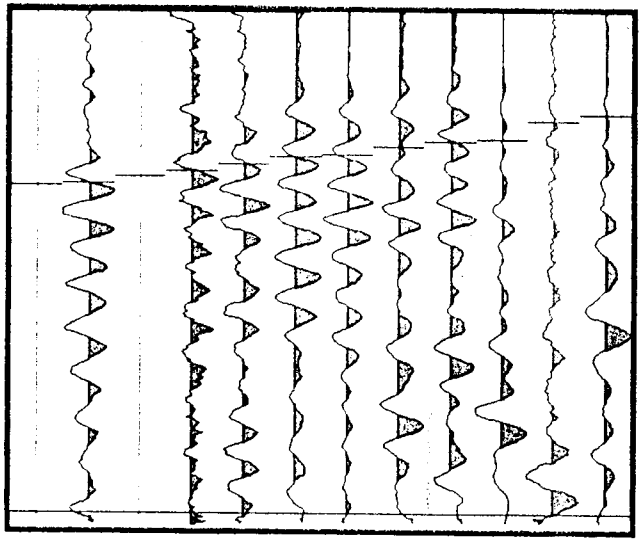




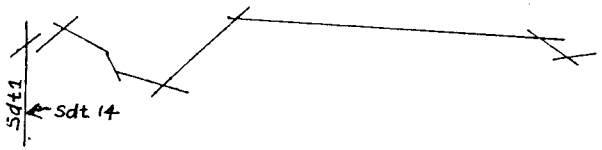


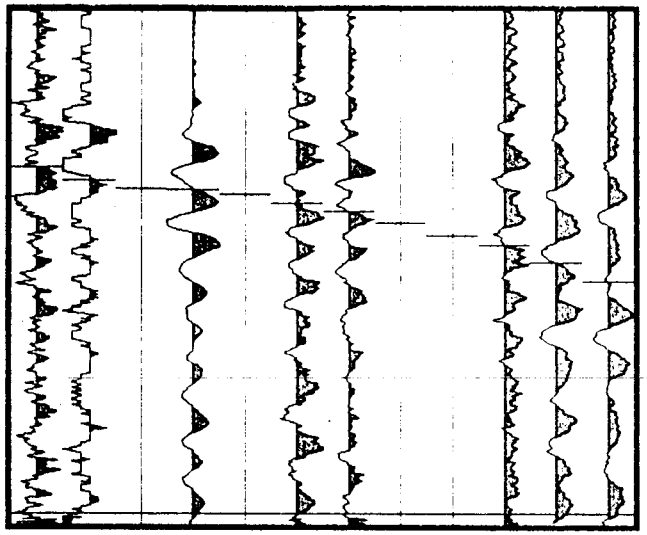


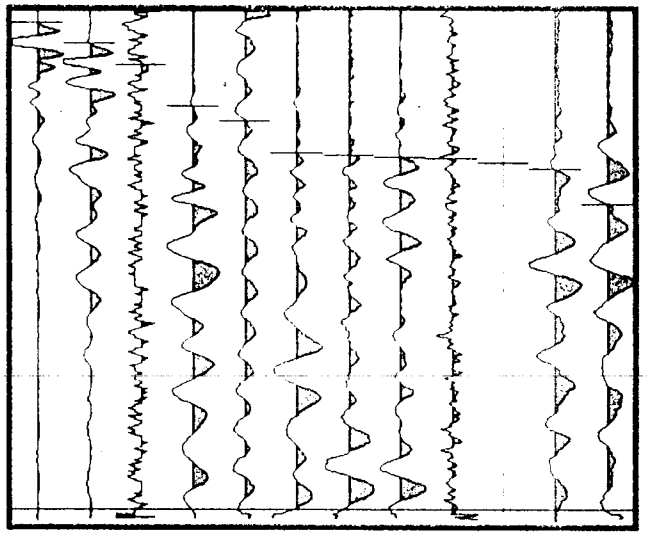


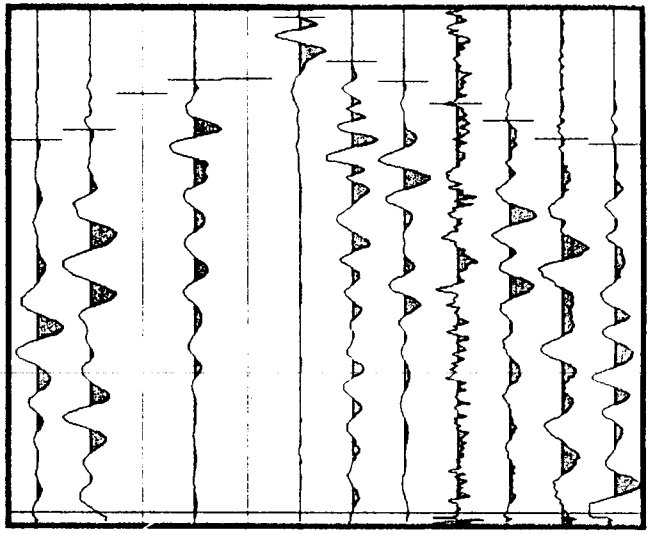


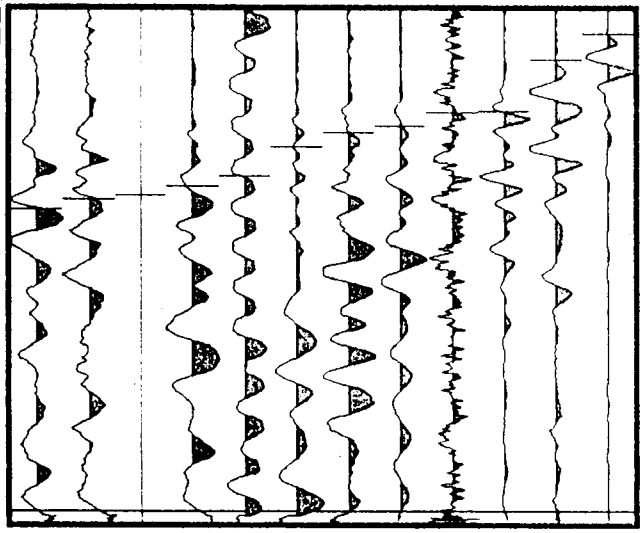
Spread No. : sdt14
Number of Geophones : 12
Geophone Spacing : 5m

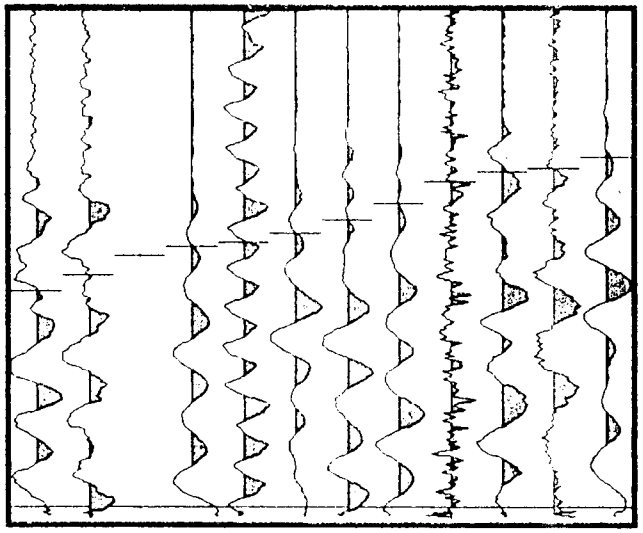




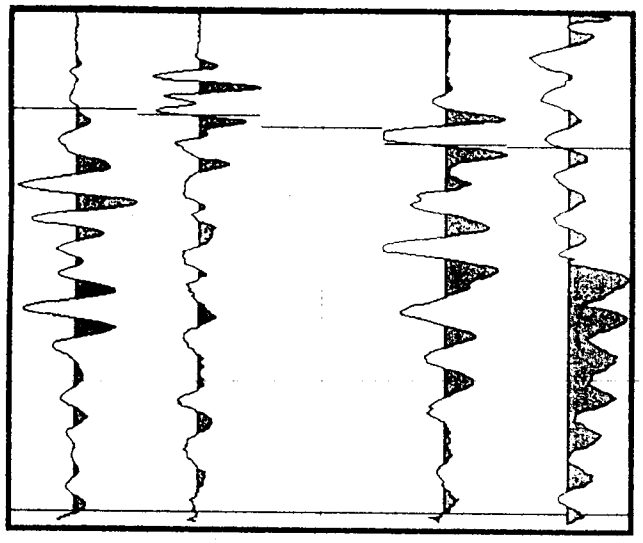


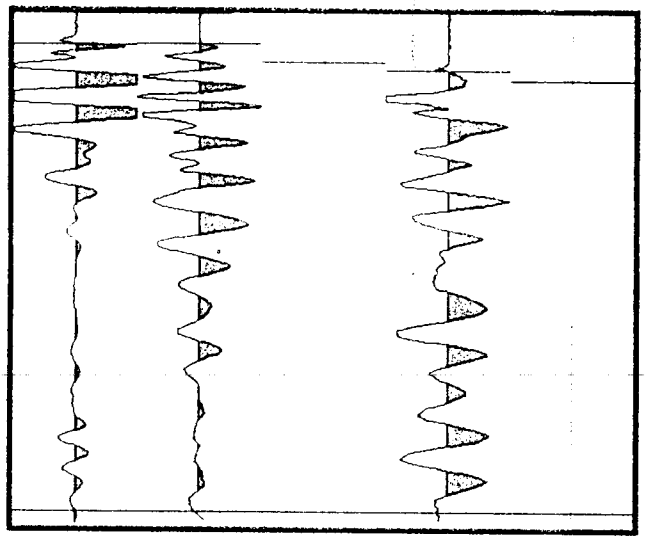


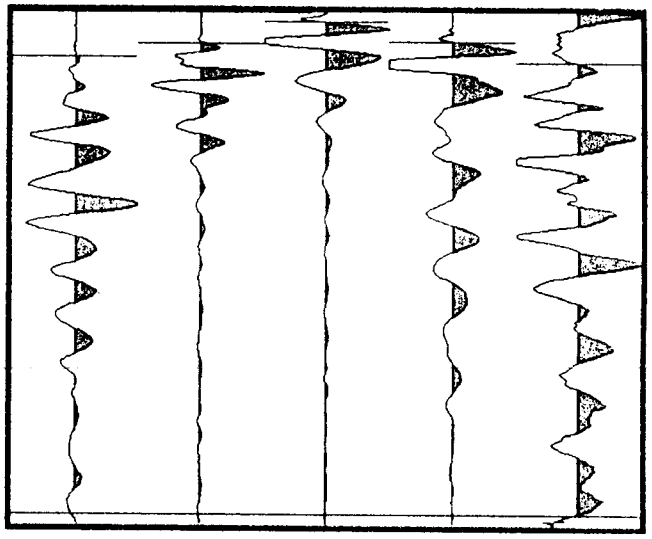


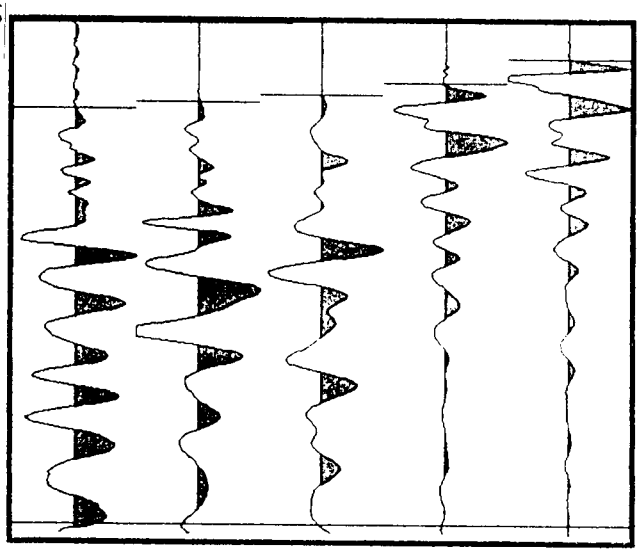


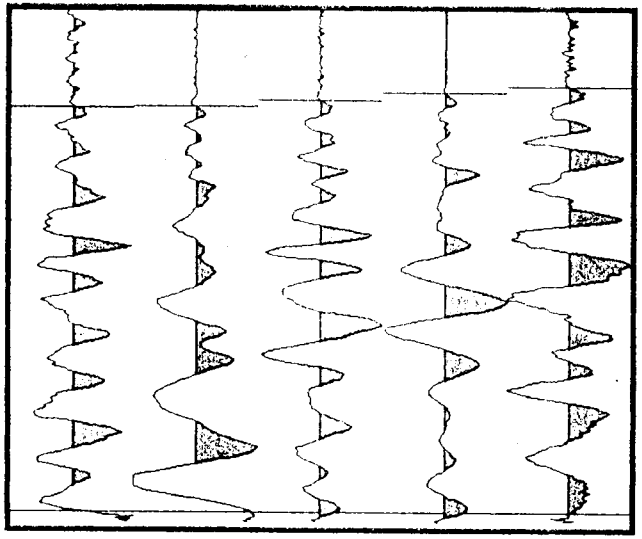
Spread No. : sdt15
Number of Geophones : 12
Geophone Spacing : 5m



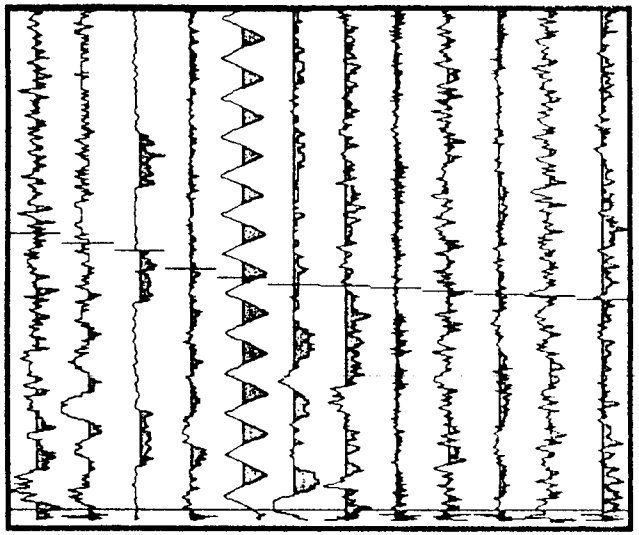


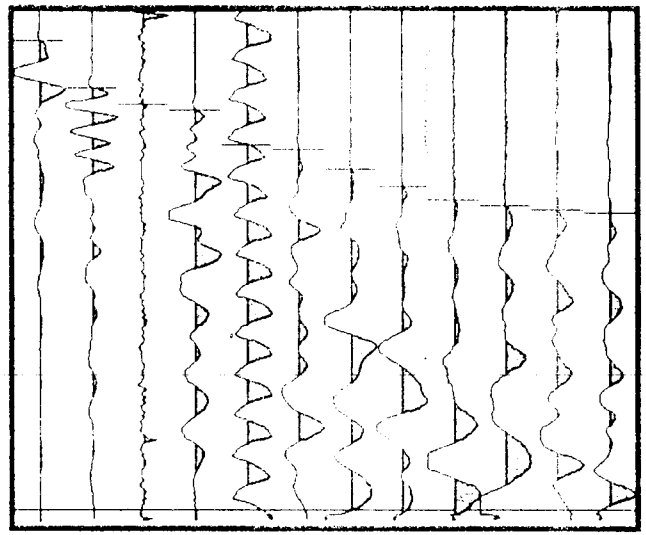


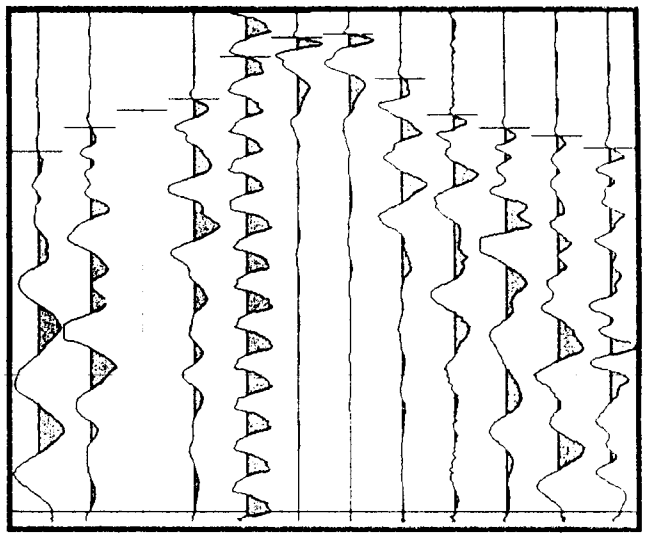


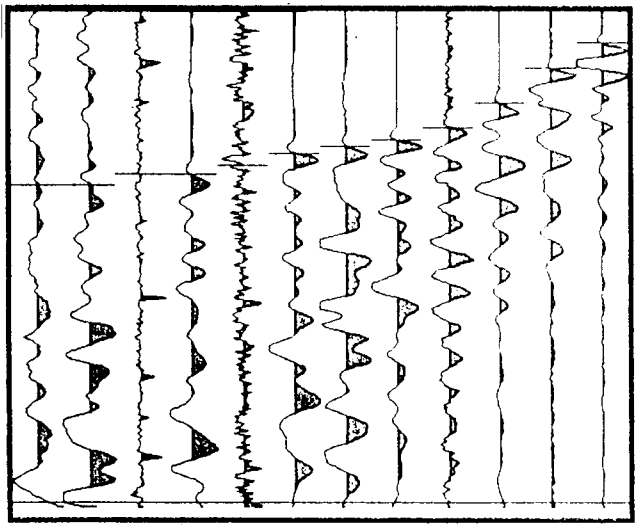


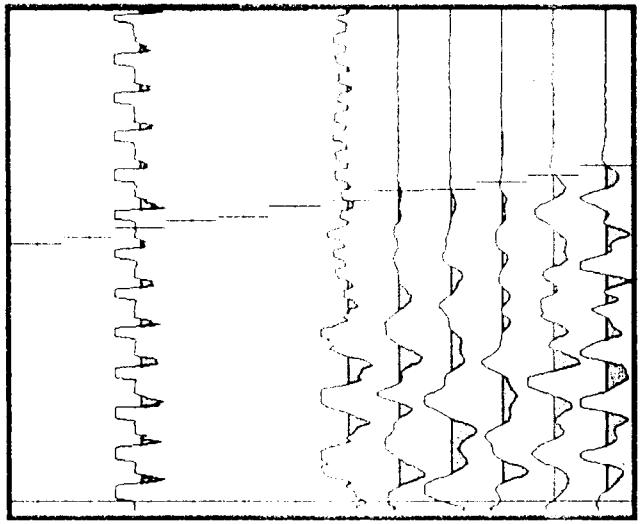
Spread No. : sdt16
Number of Geophones : 05
Geophone Spacing : 5m



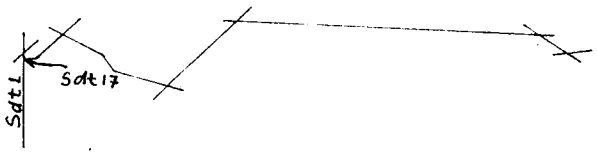


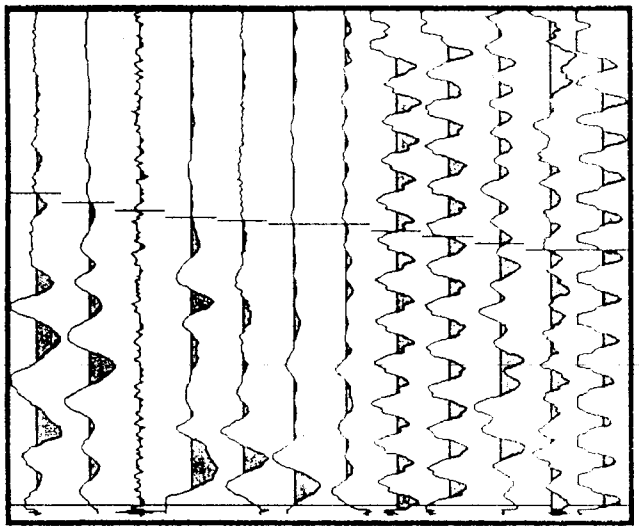


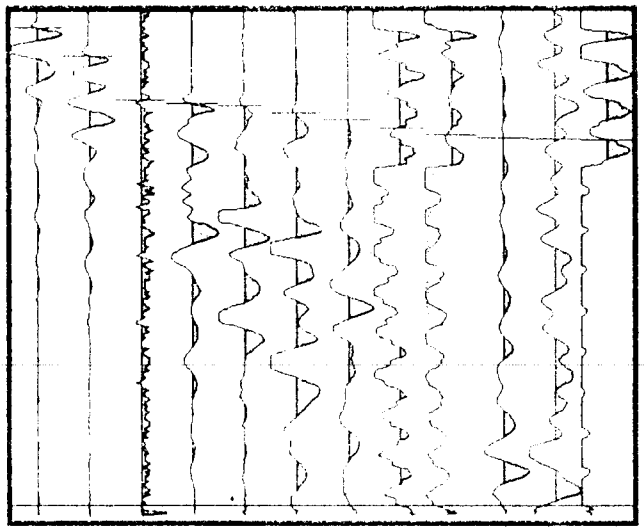


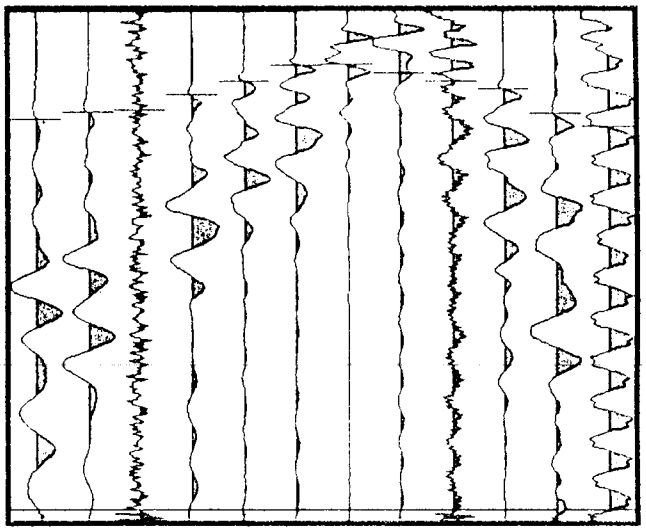


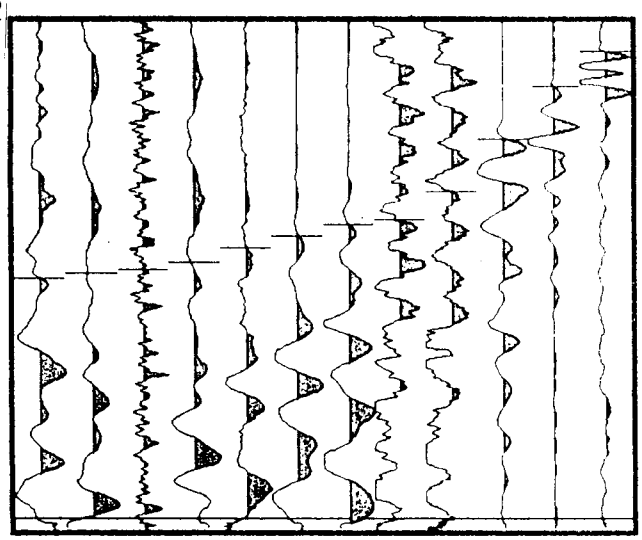
Spread No. : sdt17
Number of Geophones : 12
Geophone Spacing : 5m

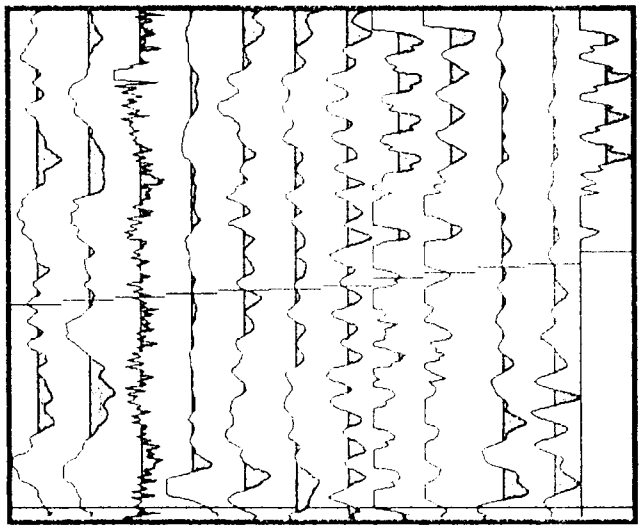




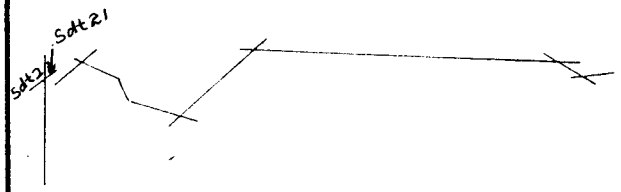


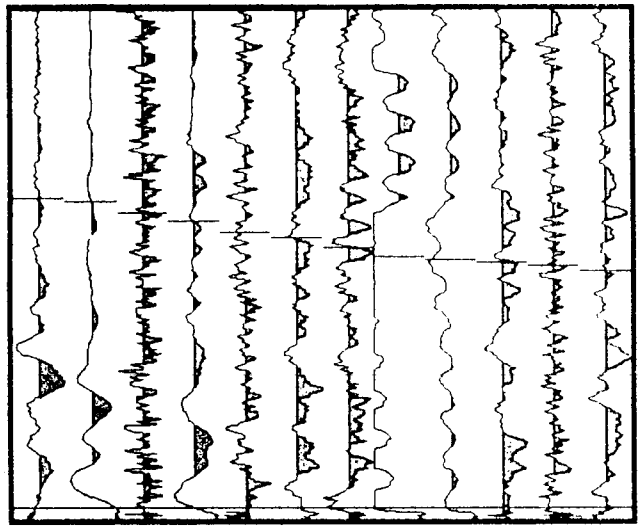


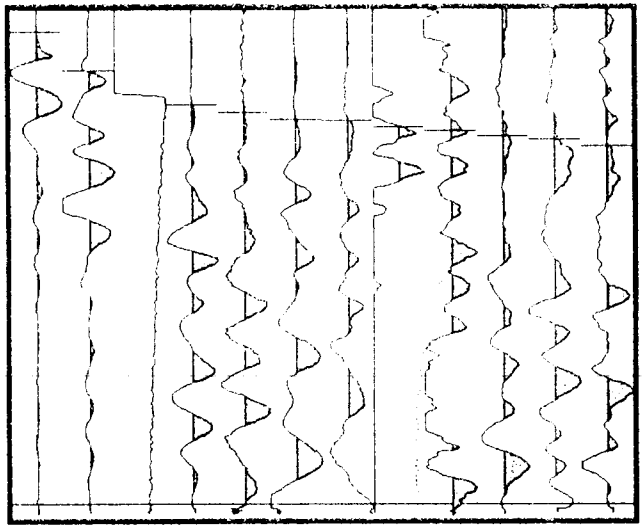


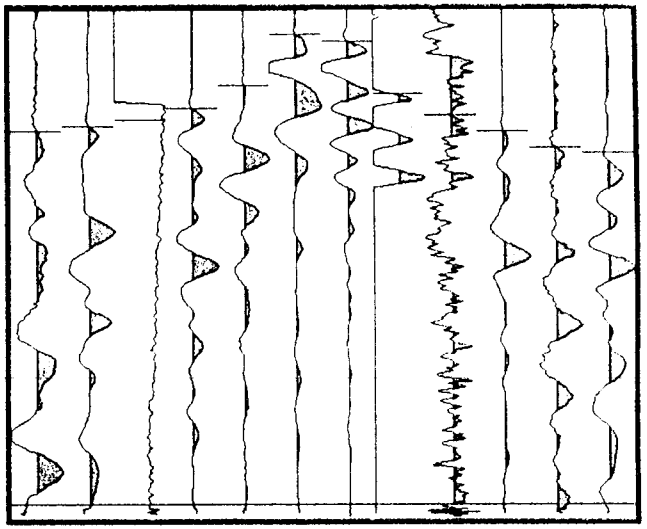


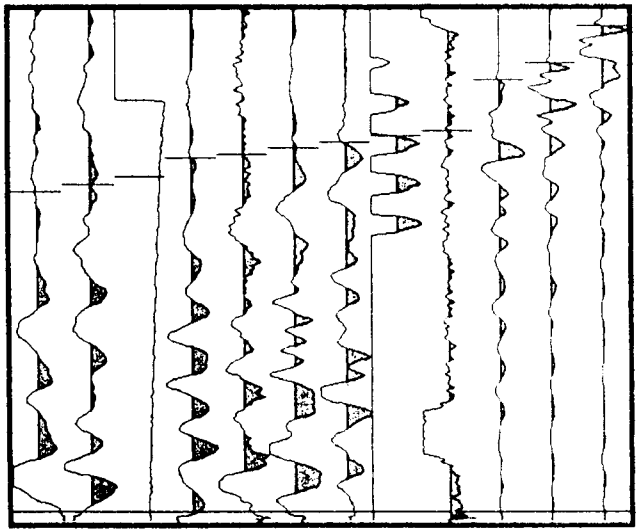
Spread No. : sdt21
Number of Geophones : 12
Geophone Spacing : 5m

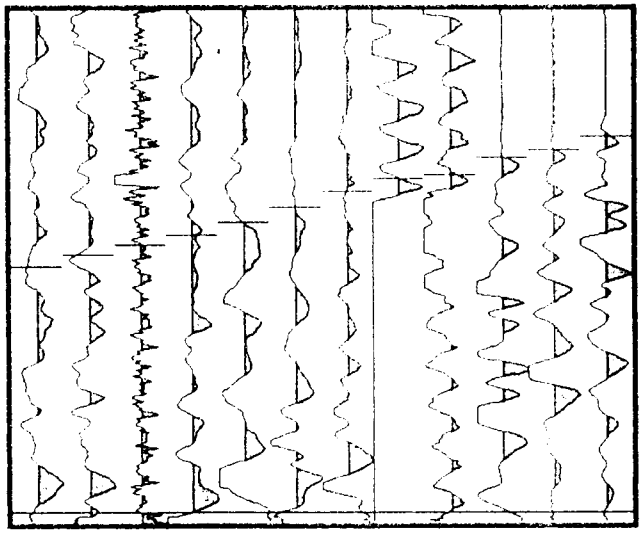




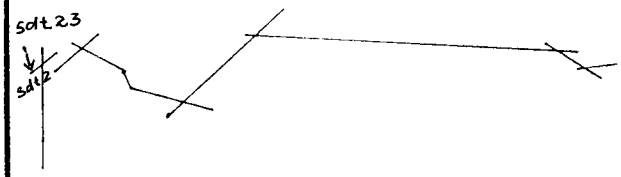


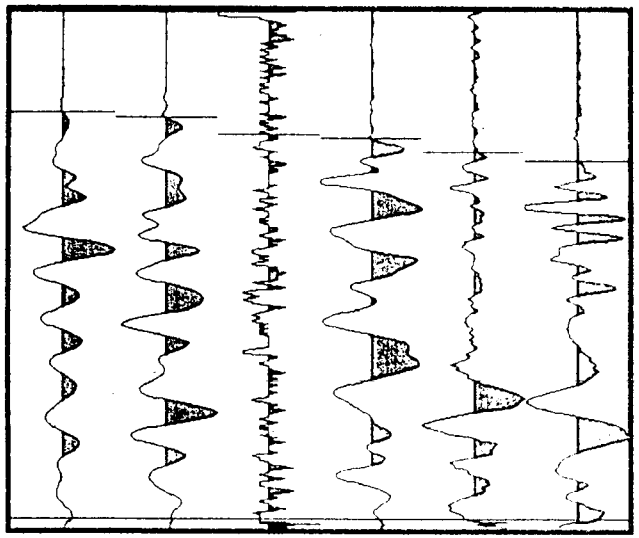


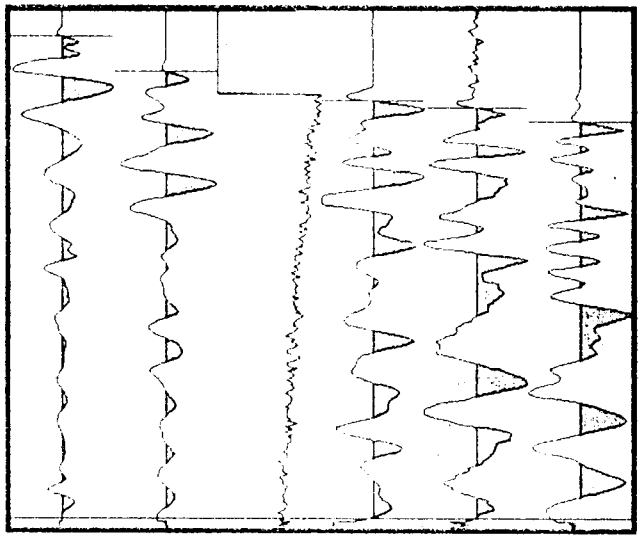


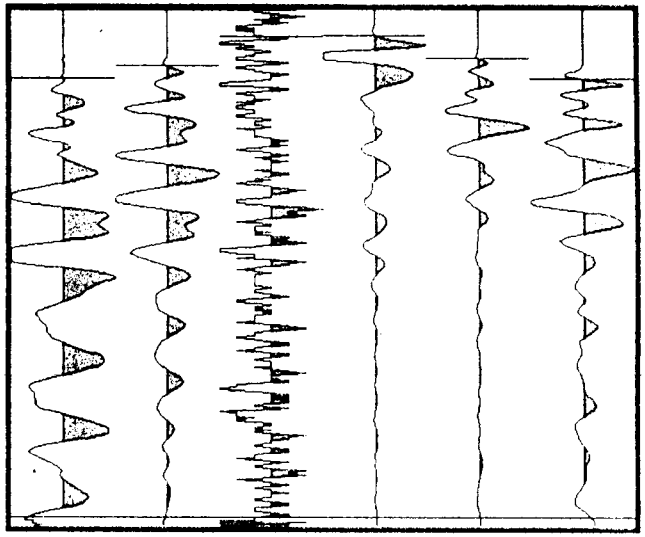


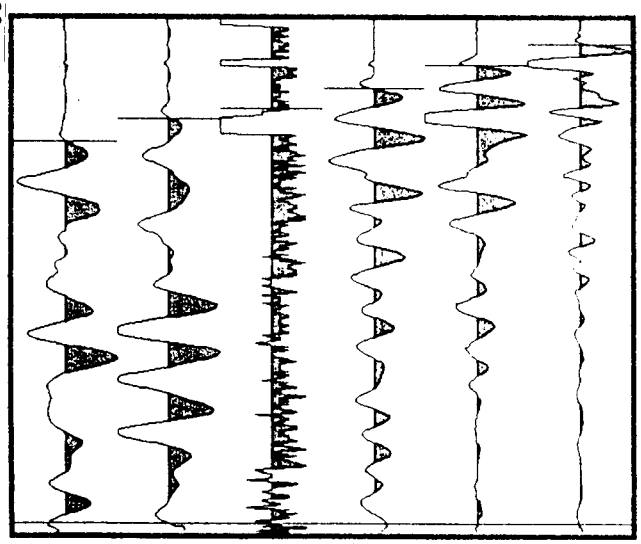
Spread No. : sdt23
Number of Geophones : 12
Geophone Spacing : 5m

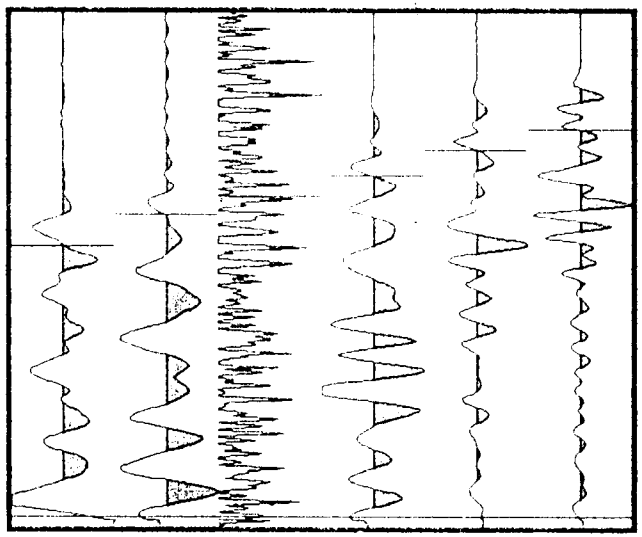




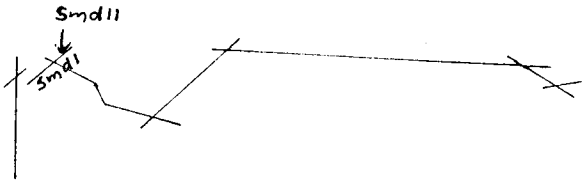


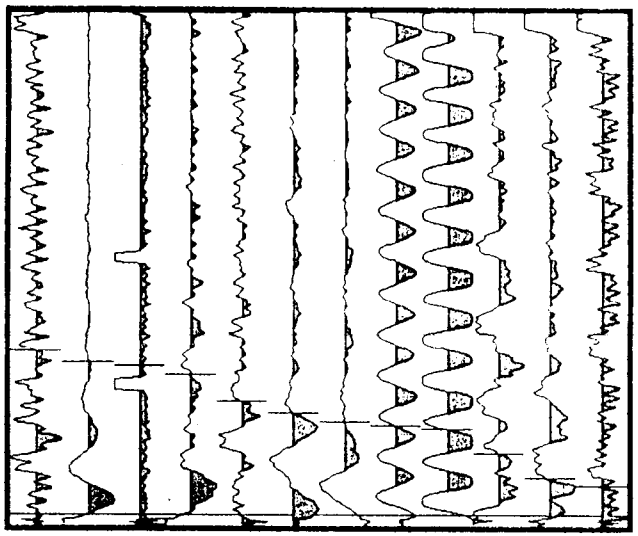


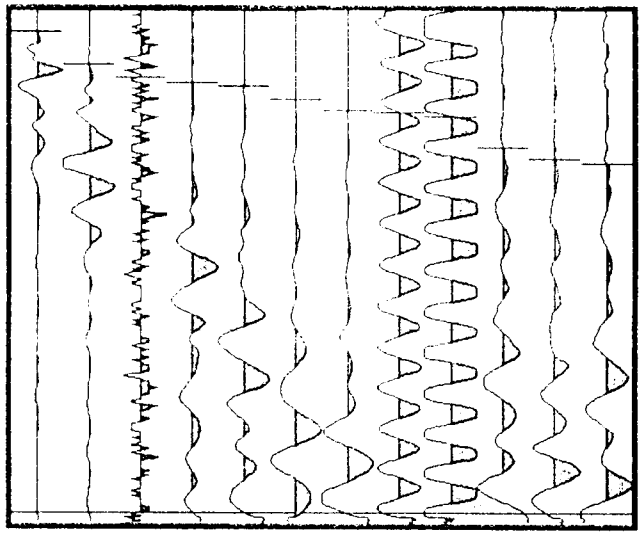


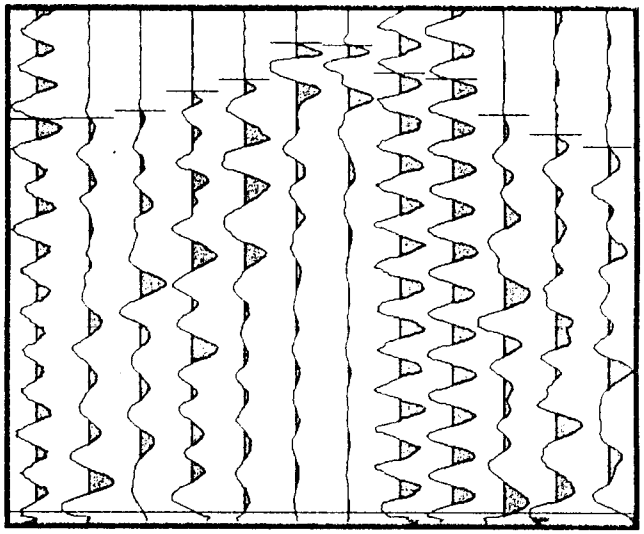


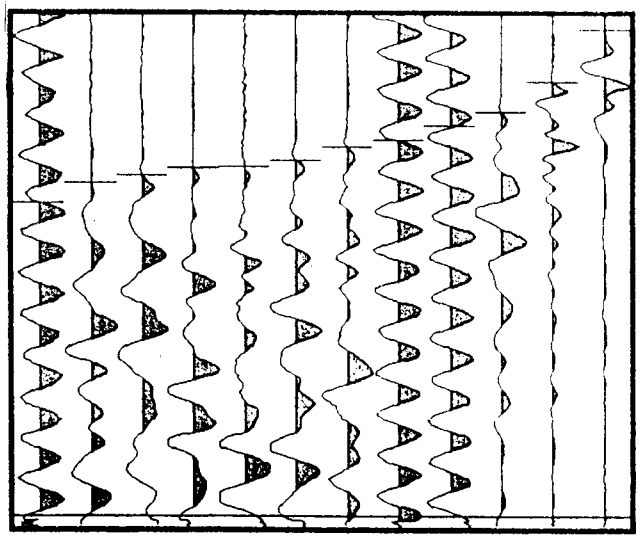
Spread No. : smd11
Number of Geophones : 06
Geophone Spacing : 5m

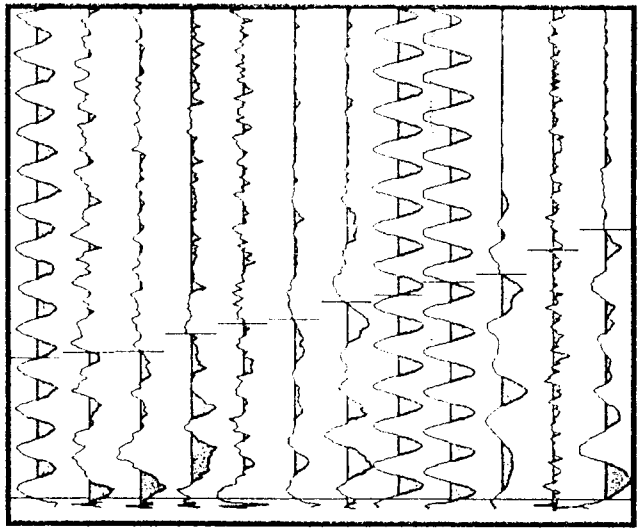




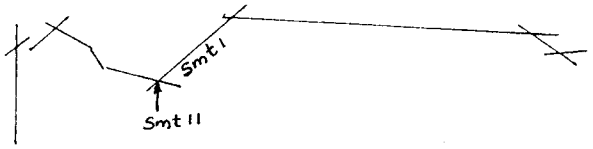


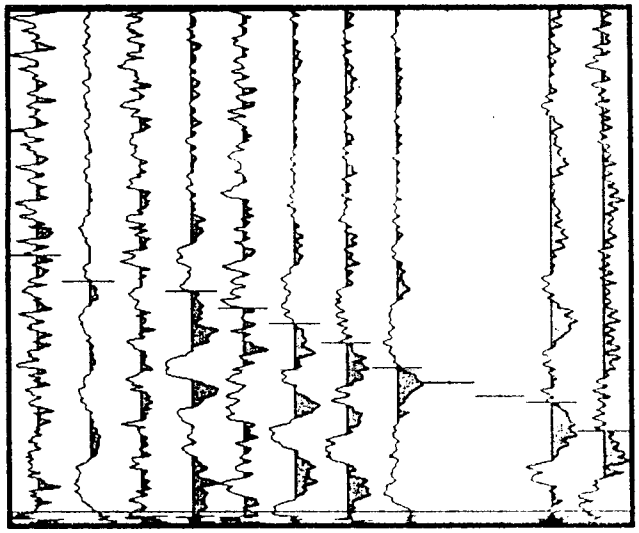


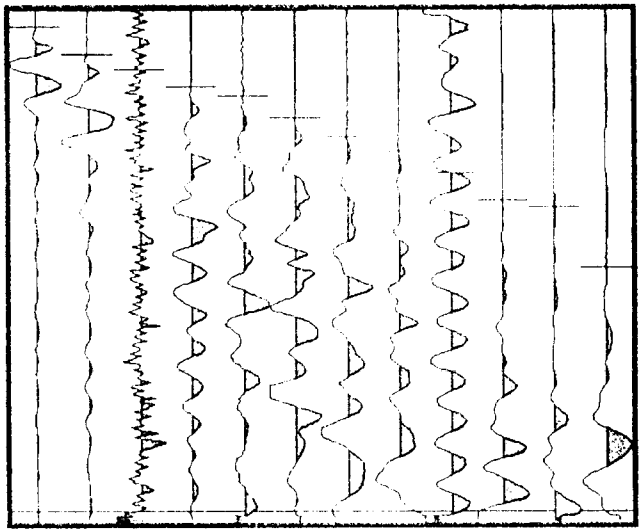


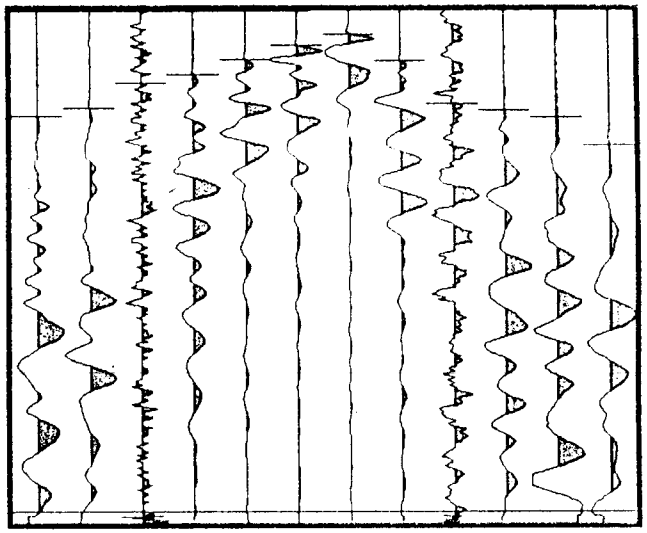


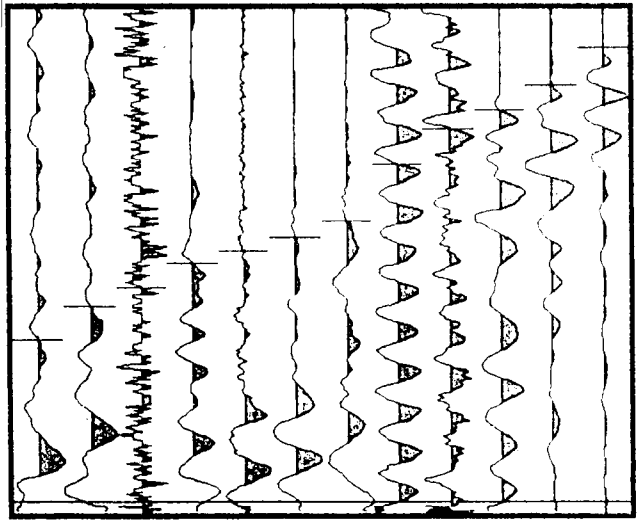
Spread No. : smt11
Number of Geophones : 12
Geophone Spacing : 5m

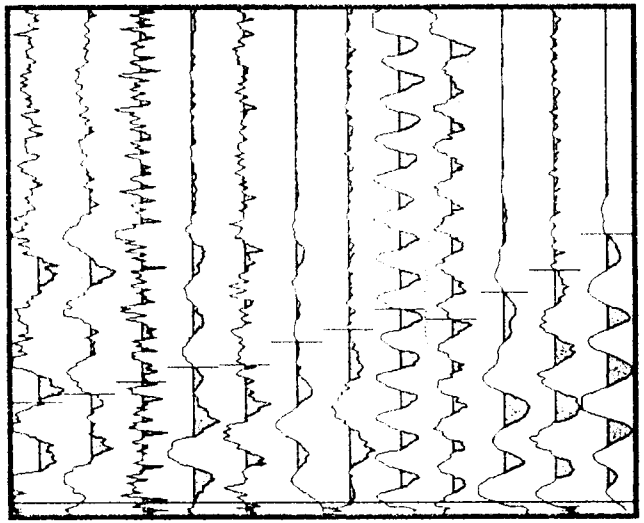




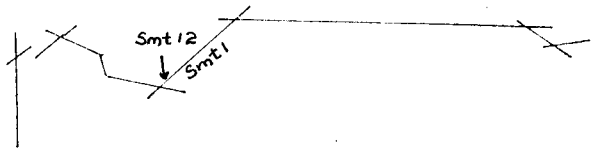


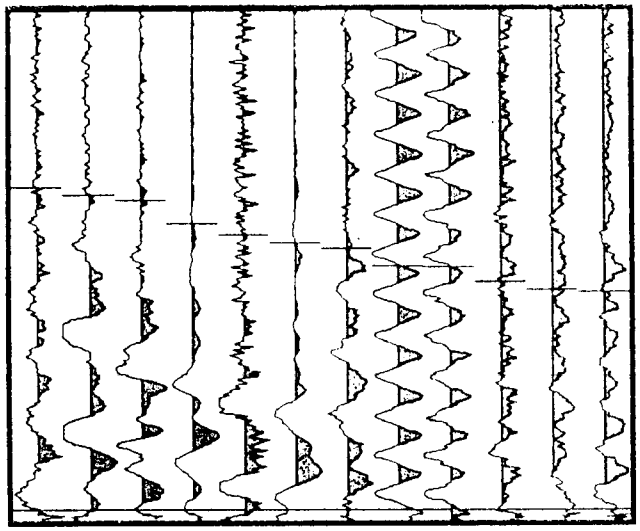


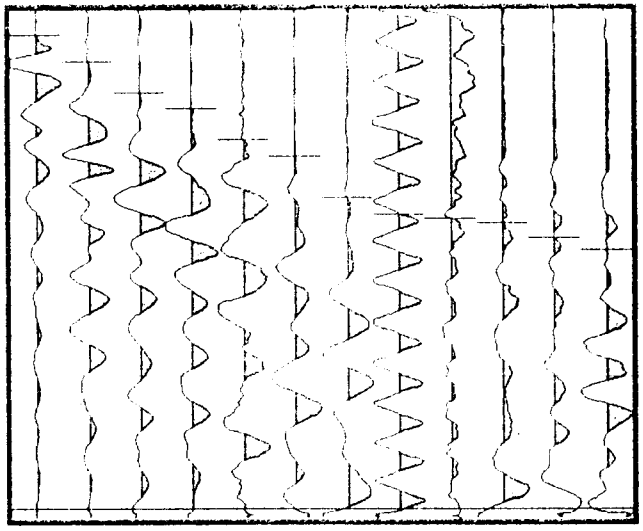


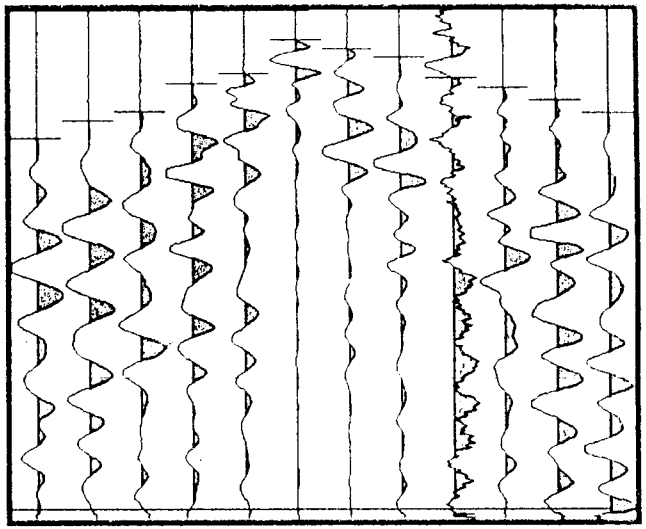


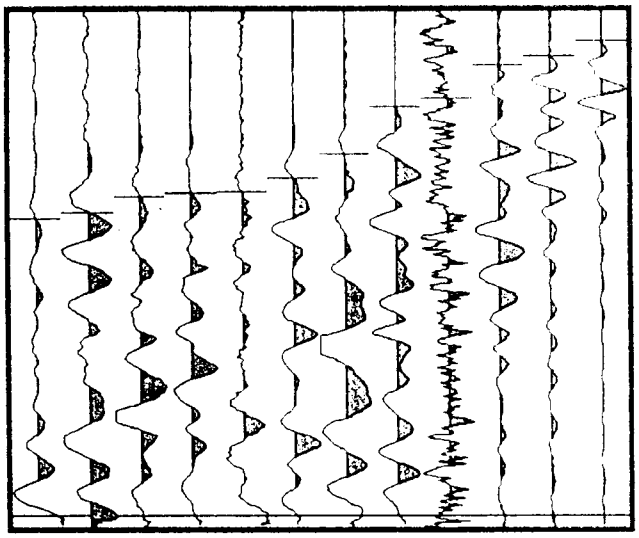
Spread No. : smt12
Number of Geophones : 12
Geophone Spacing : 5m

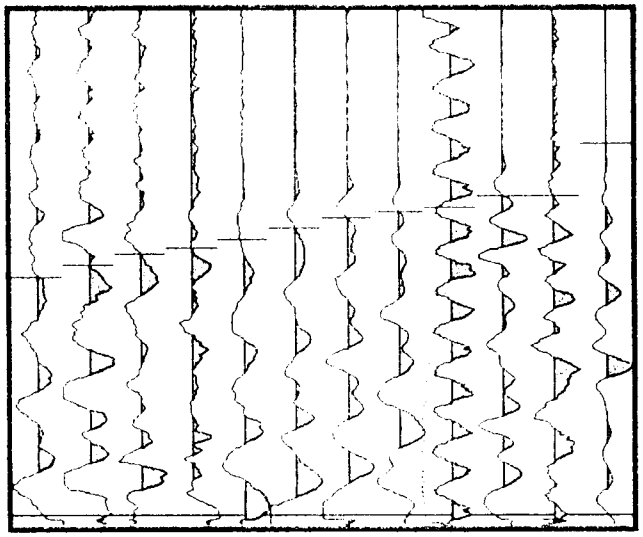




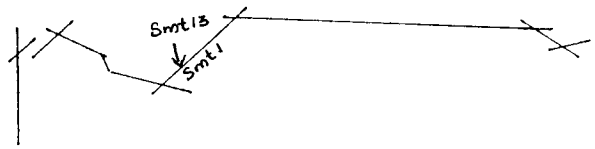


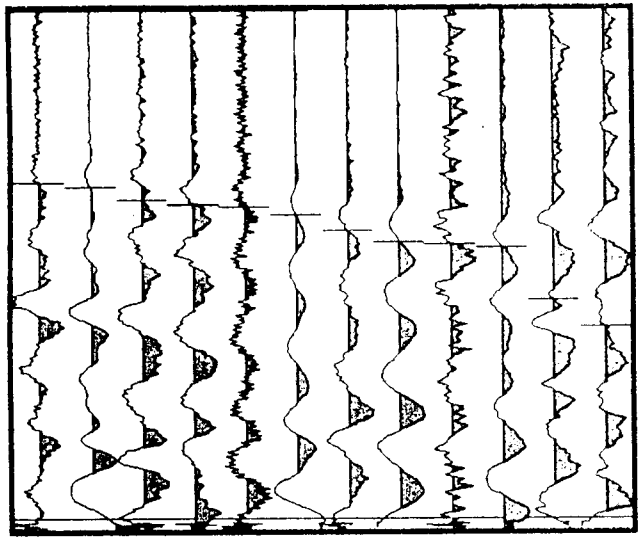


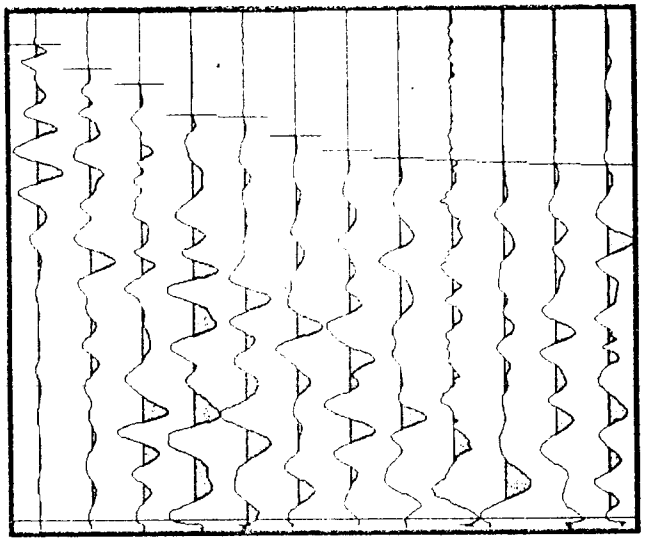


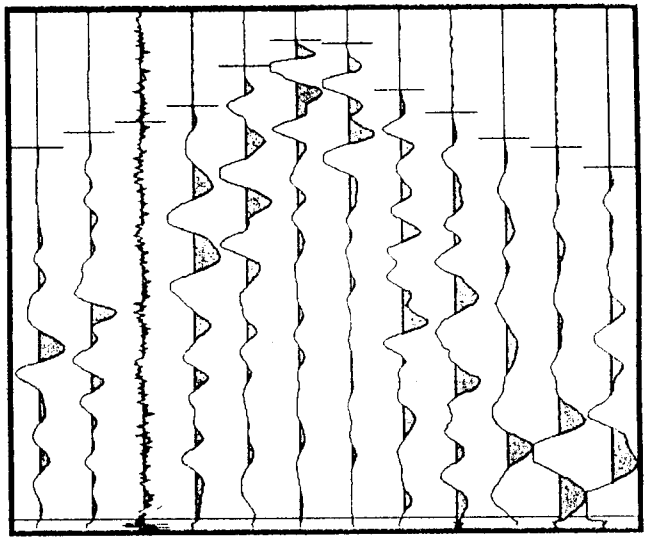


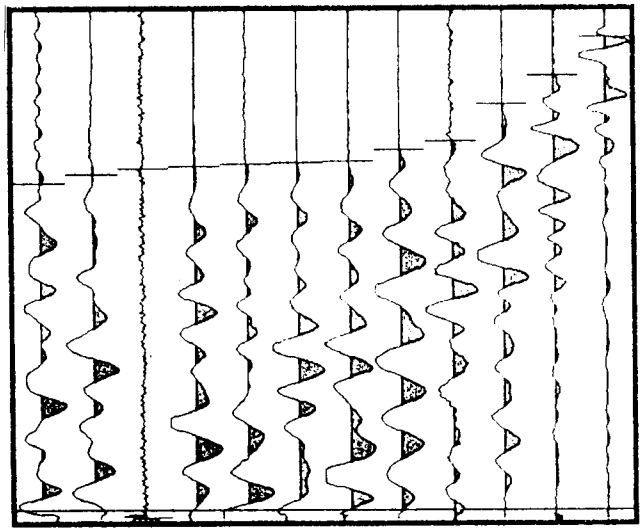
Spread No. : smt13
Number of Geophones : 12
Geophone Spacing : 5m

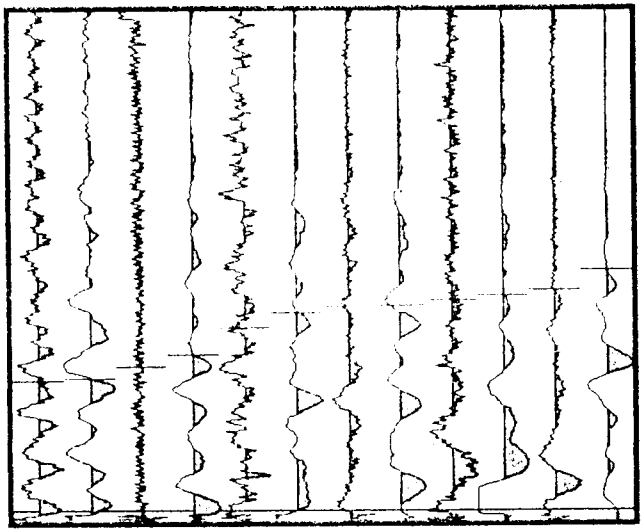




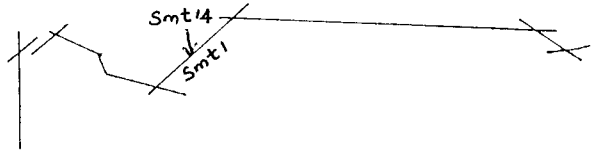


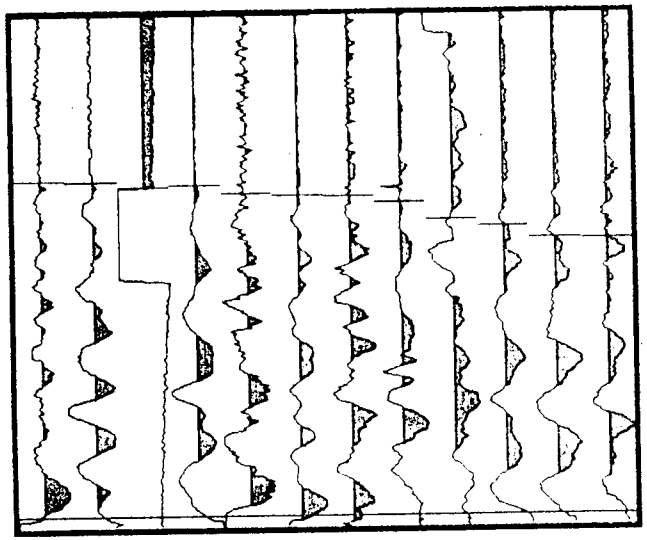


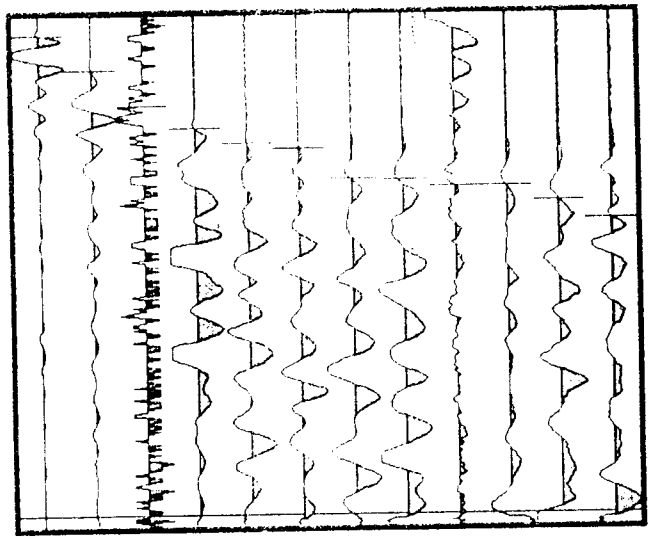


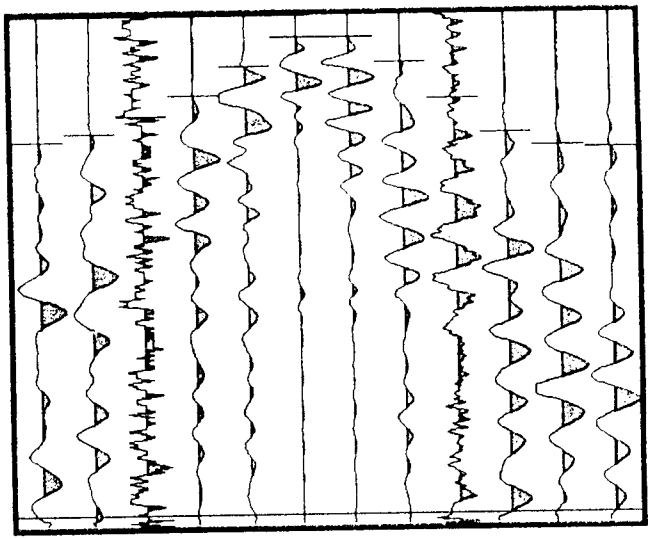


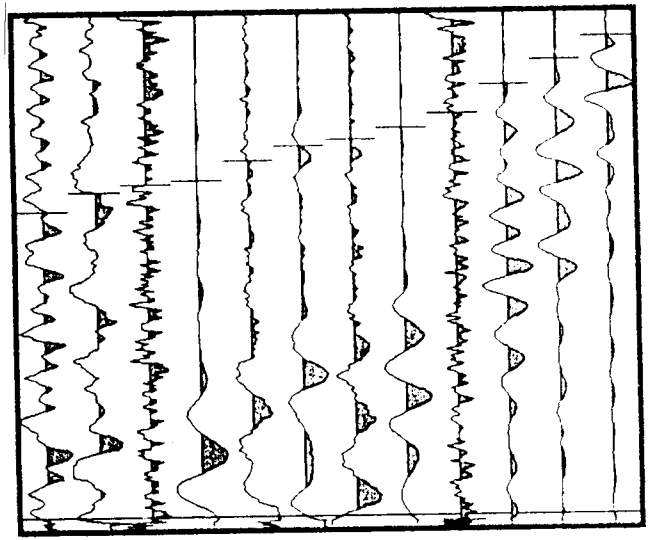
Spread No. : smt14
Number of Geophones : 12
Geophone Spacing : 5m

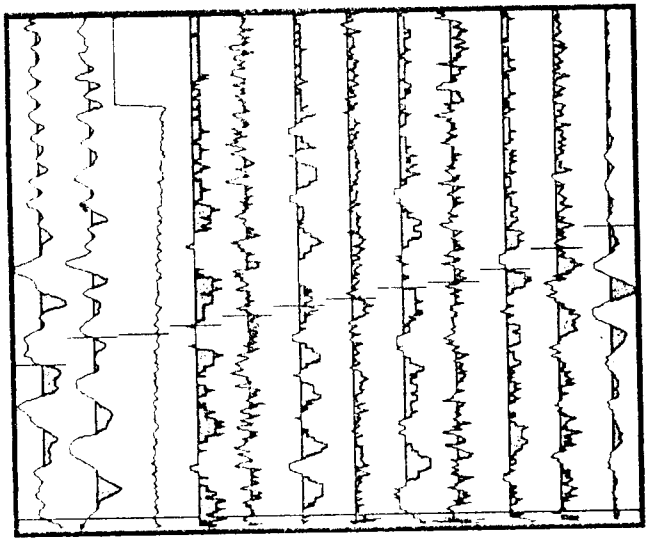




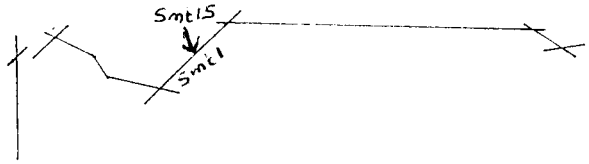


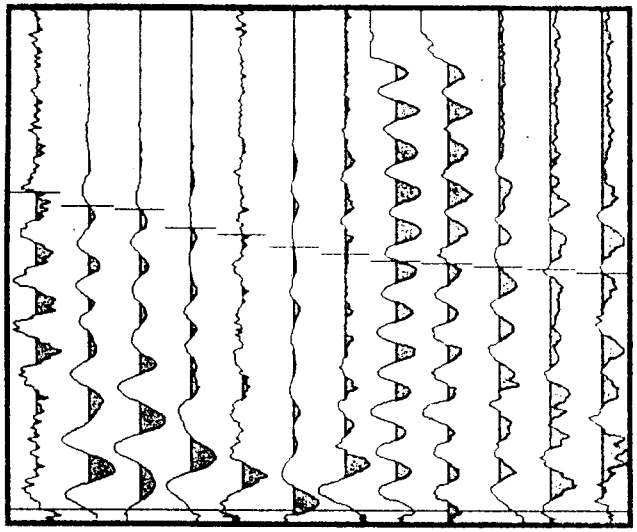


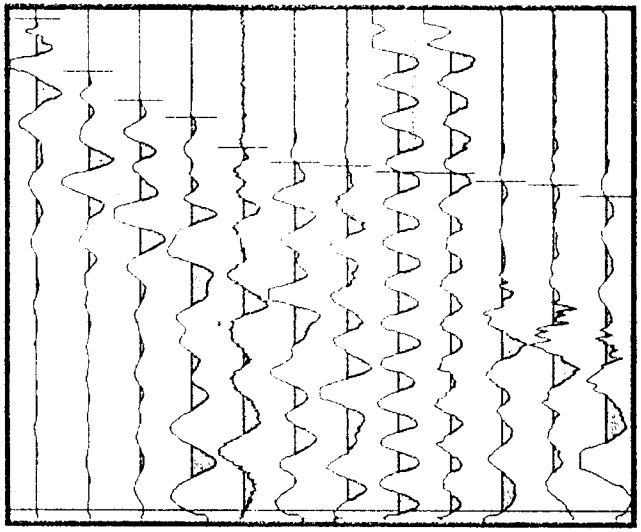


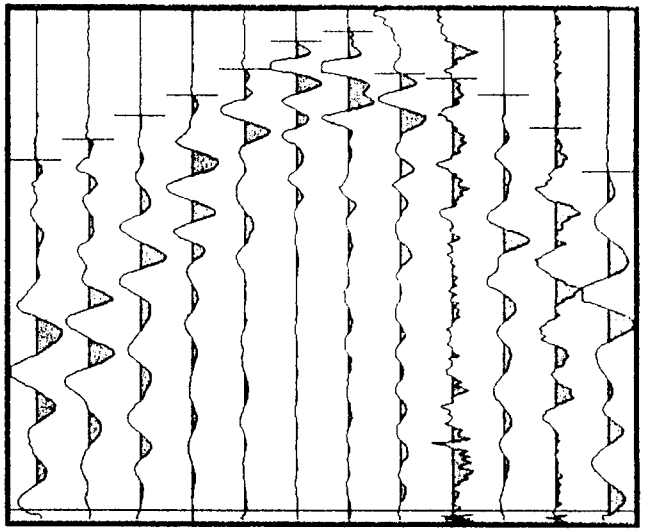


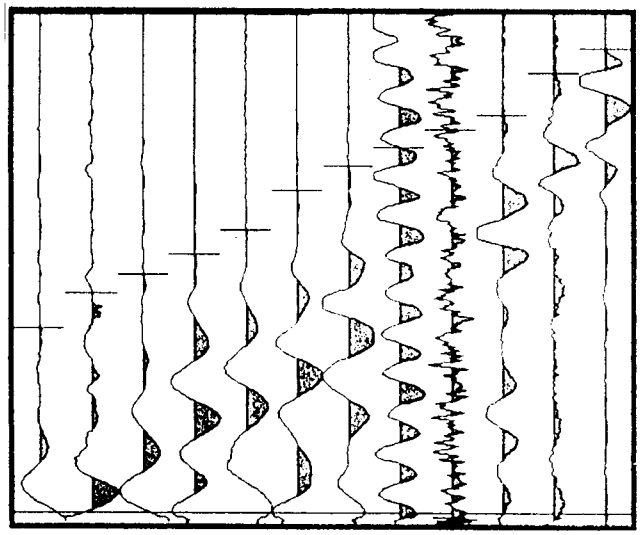
Spread No.	: smt15
Number of Geophones	: 12
Geophone Spacing	: 5m

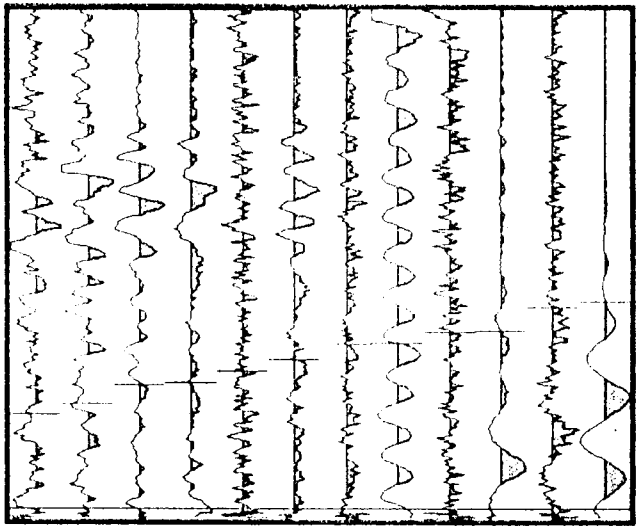




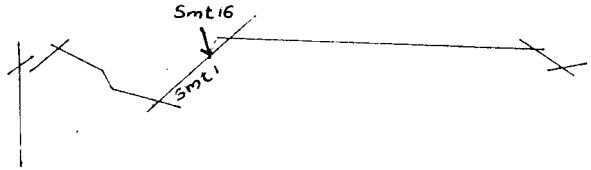


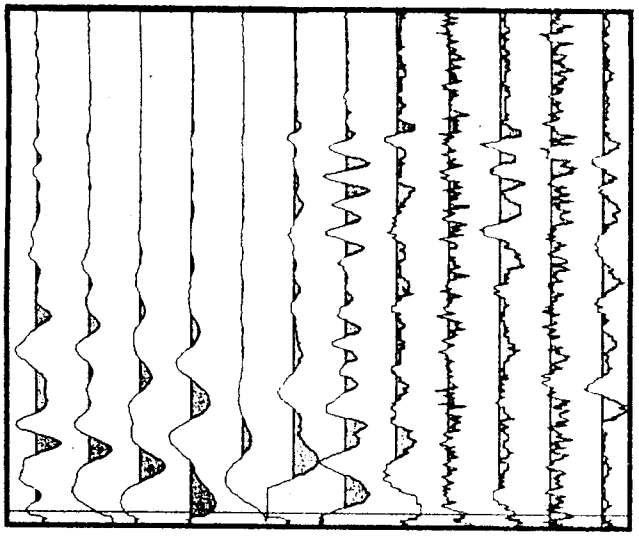


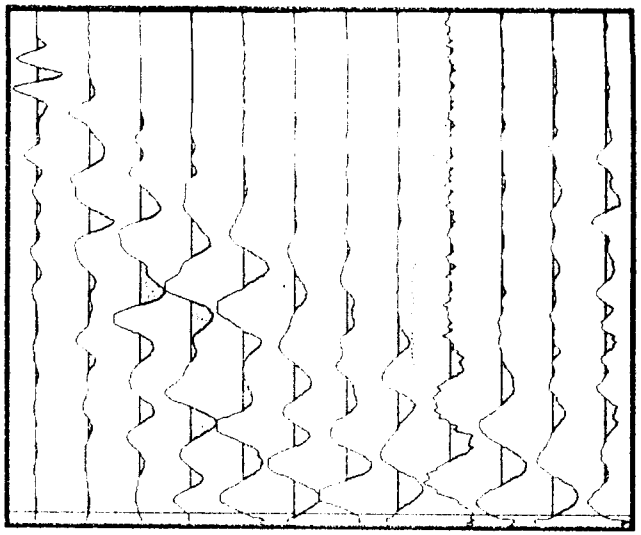


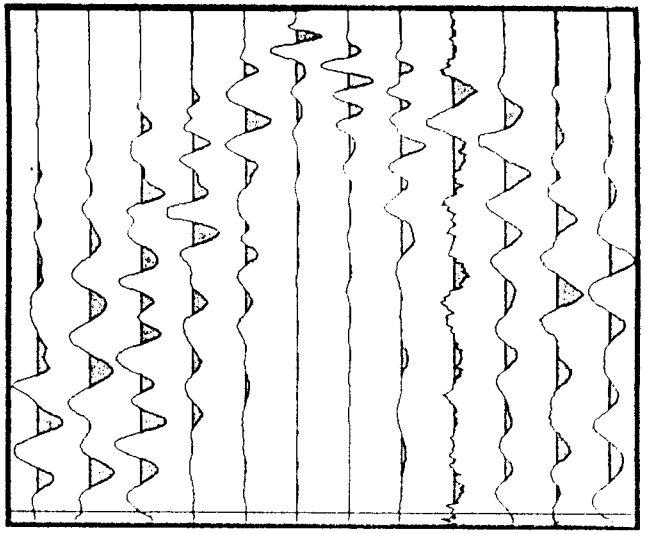


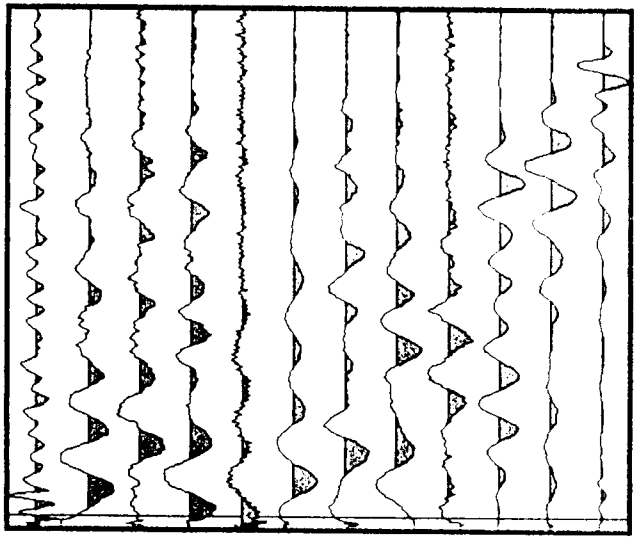
Spread No. : smt16
Number of Geophones : 12
Geophone Spacing : 5m

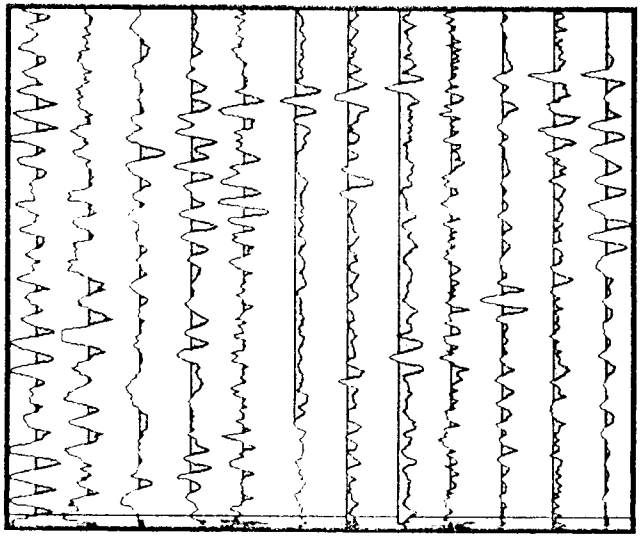




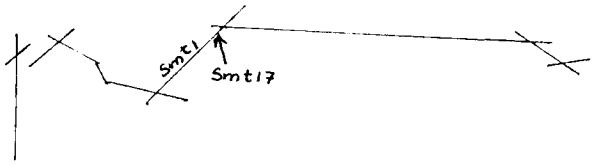








Spread No. : smt17
Number of Geophones : 12
Geophone Spacing : 5m



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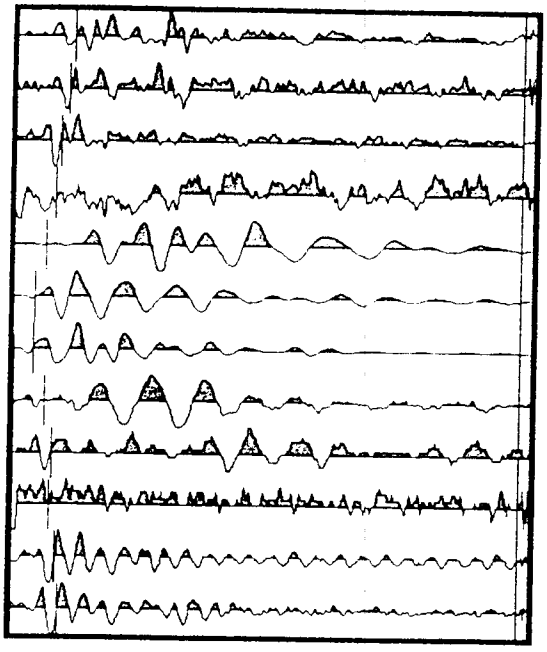

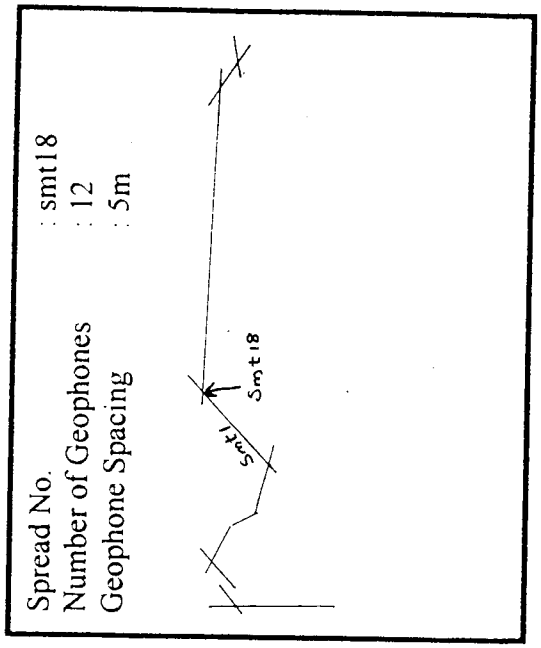

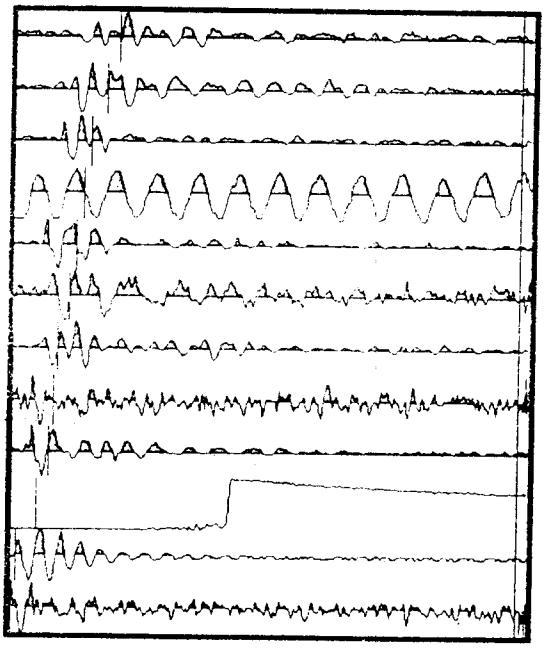

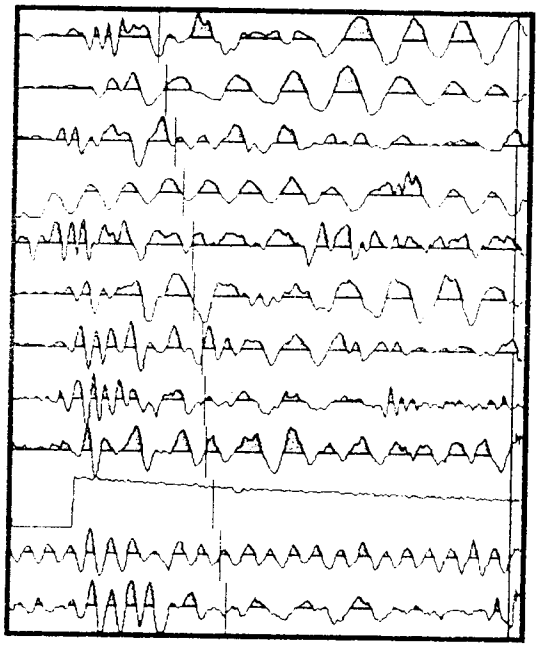

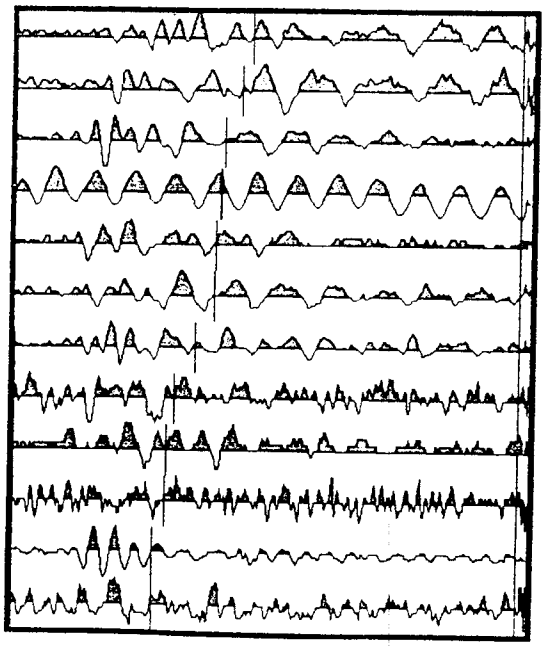

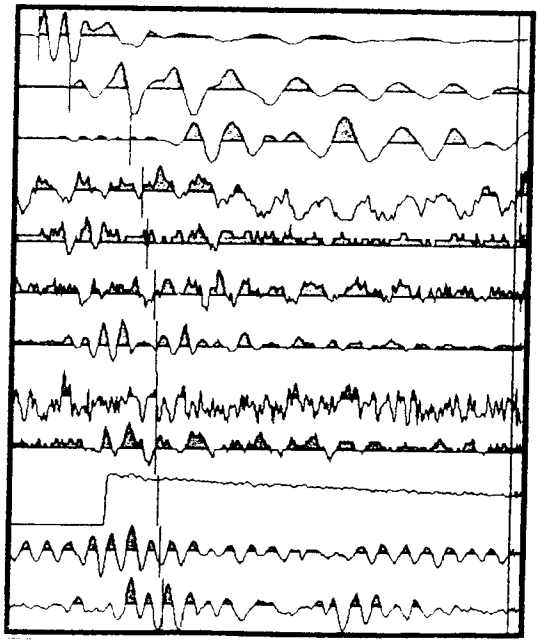

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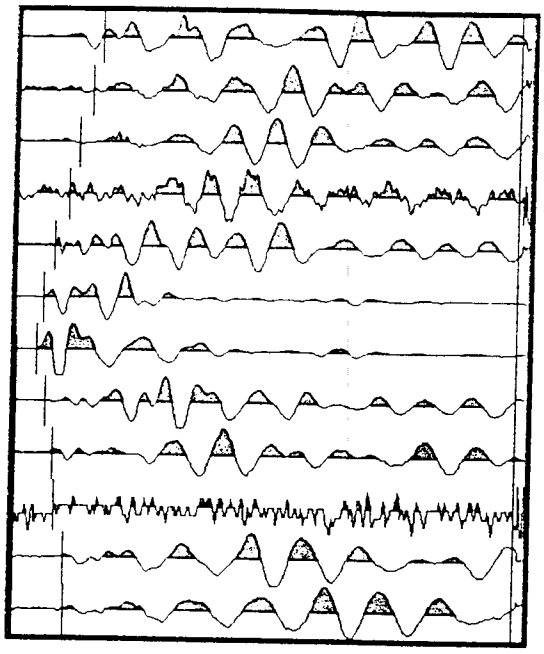

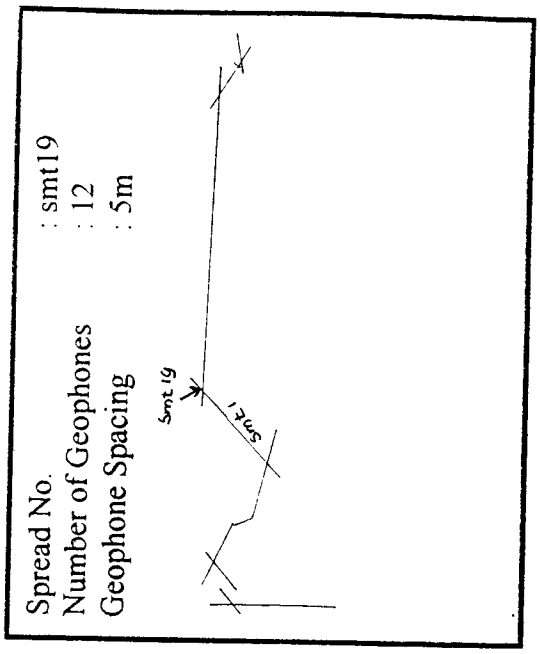

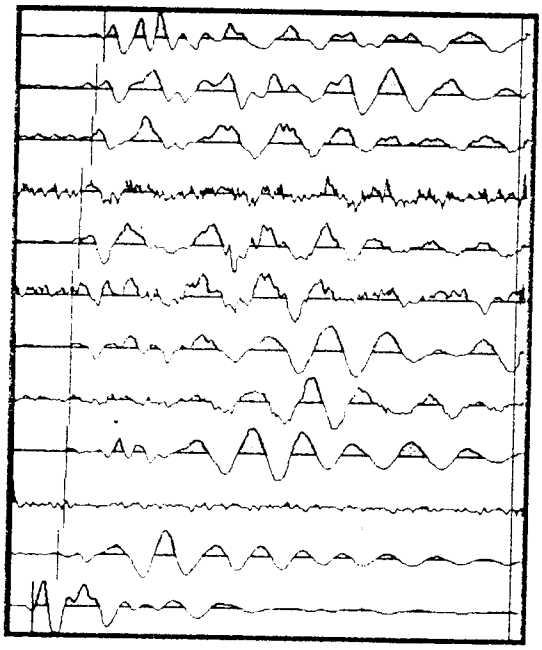

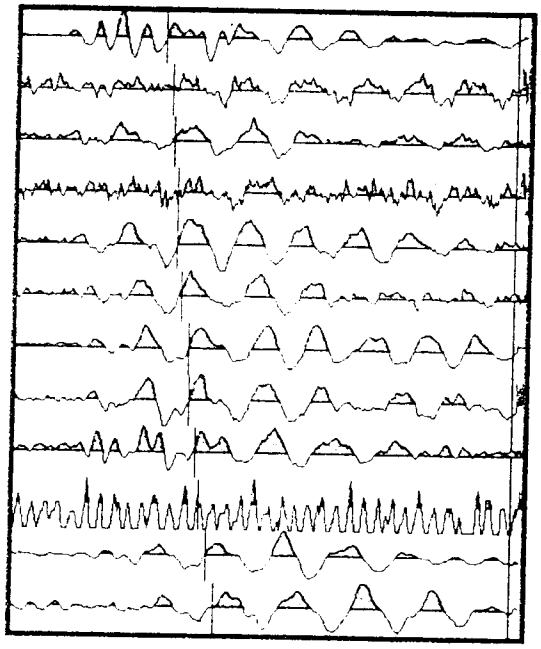

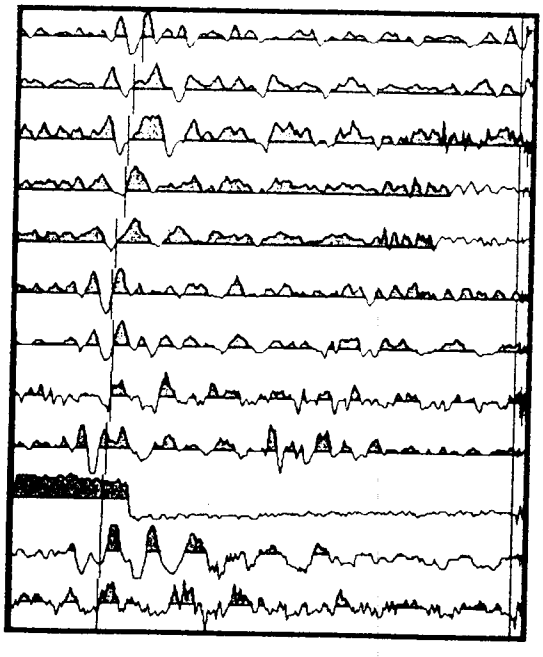

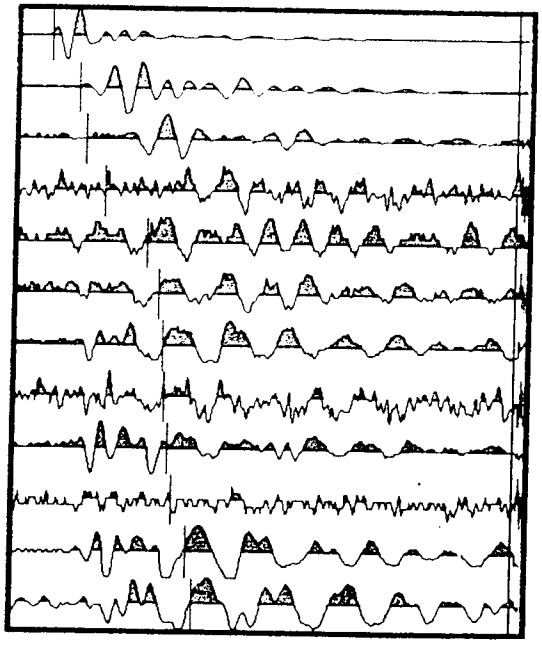

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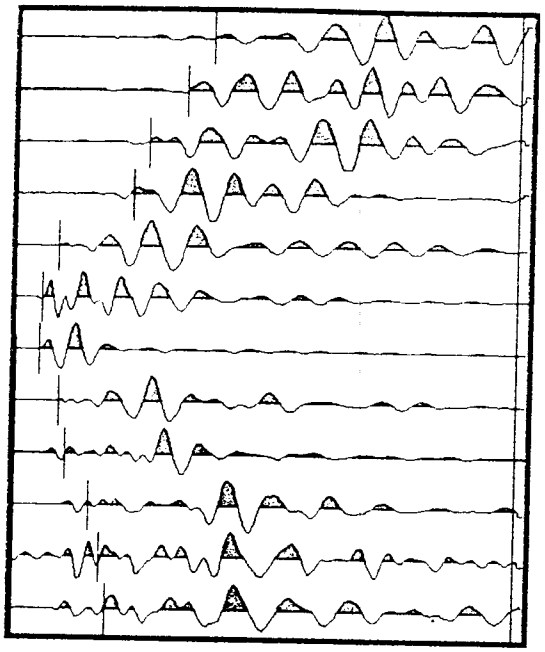
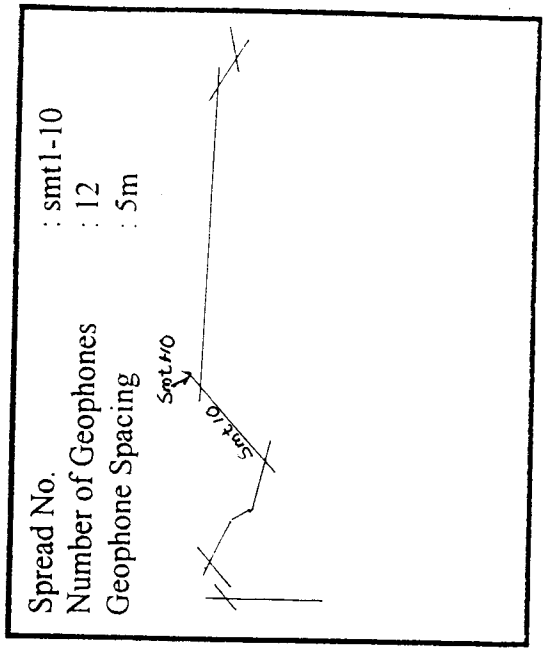
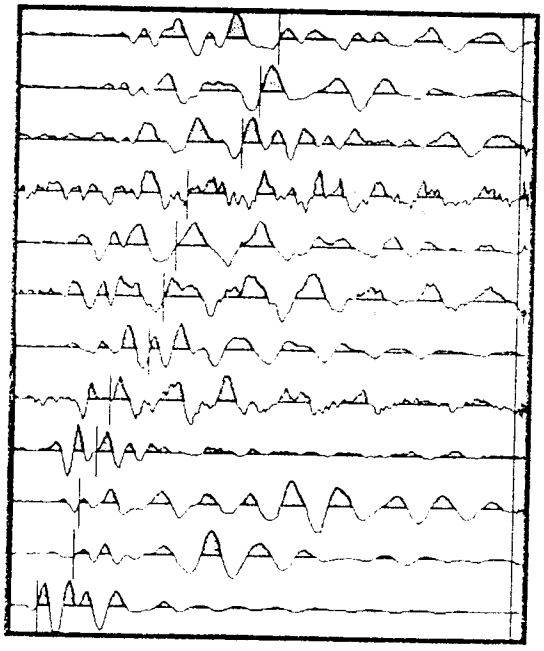
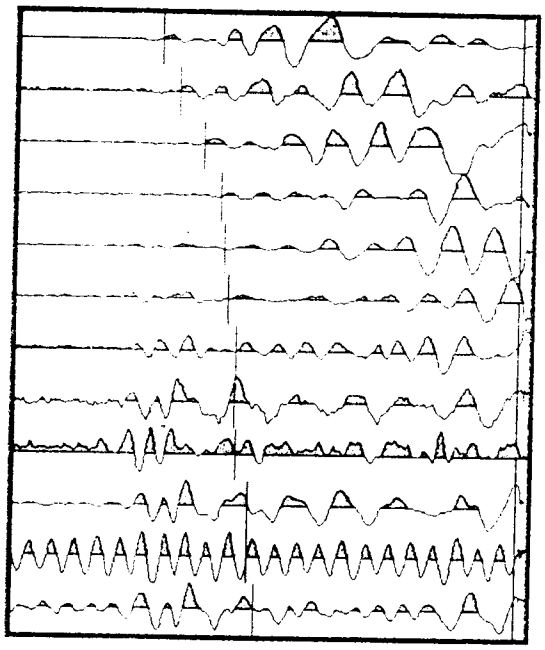
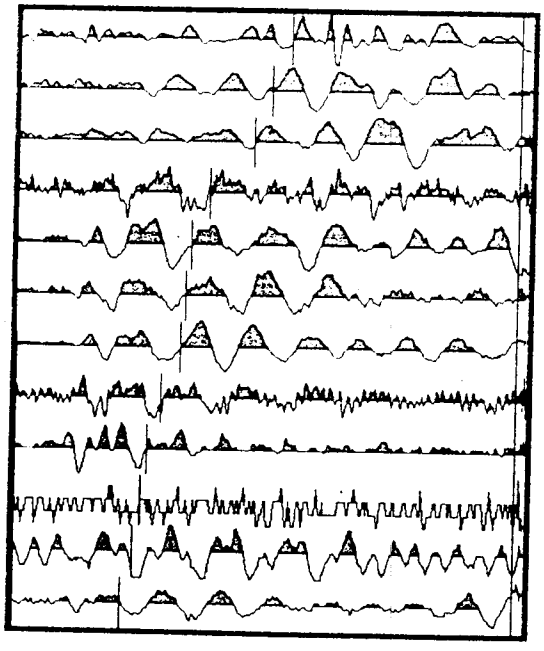
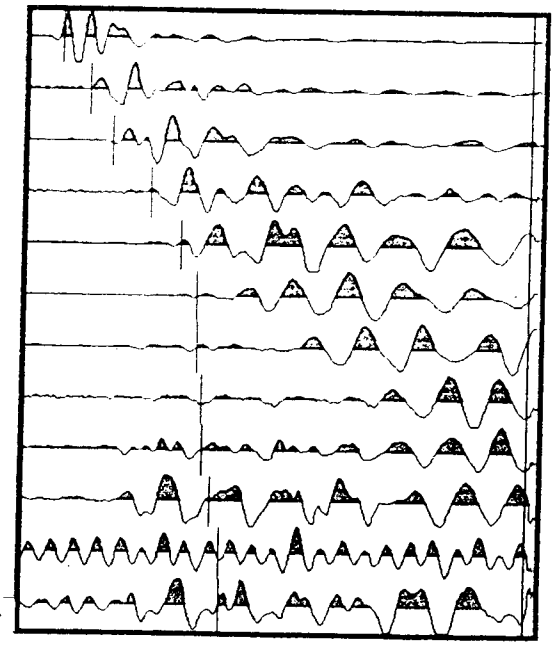


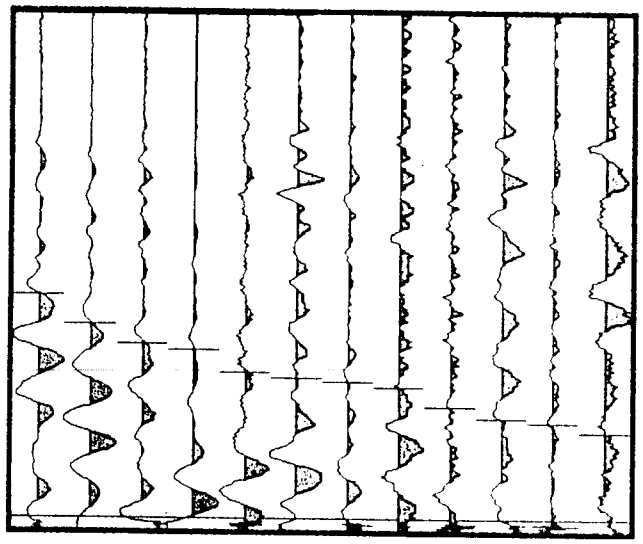


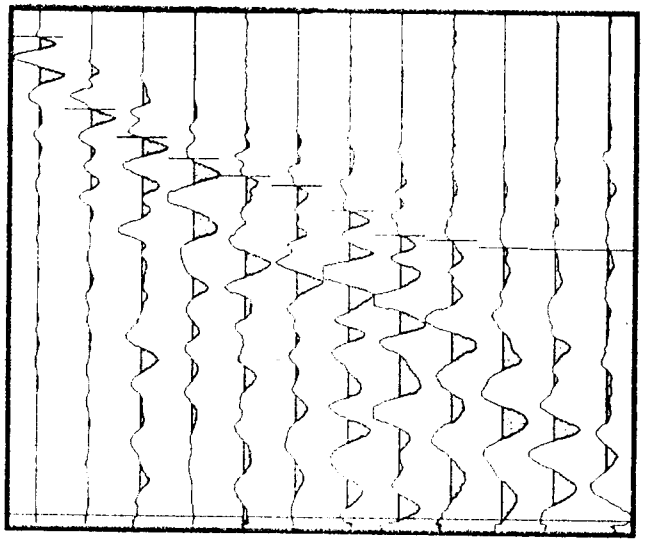


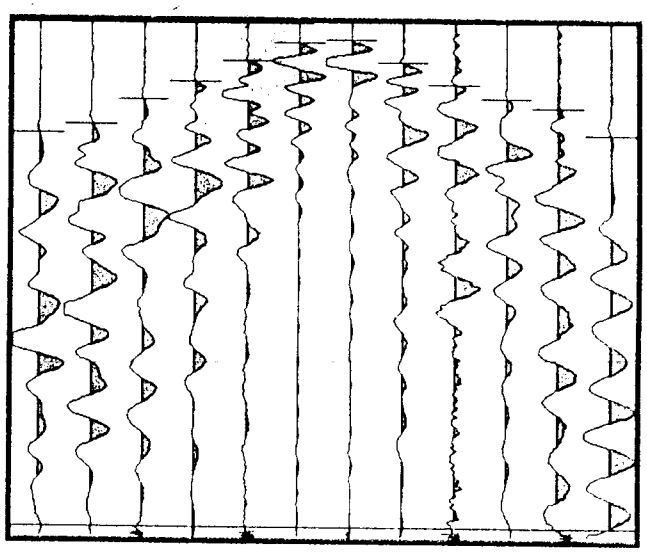


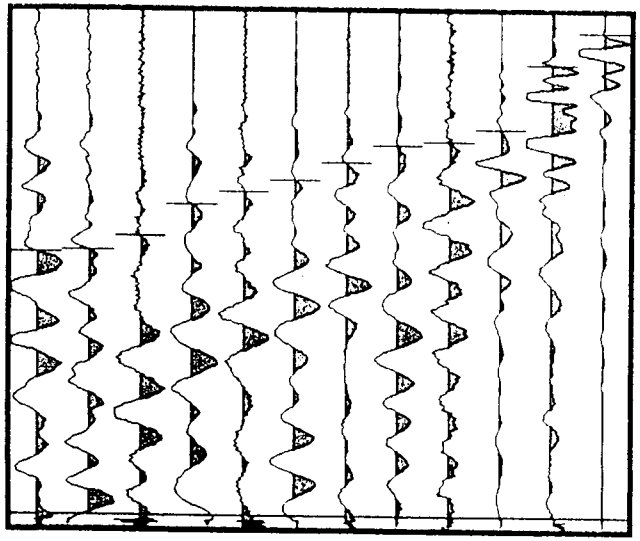


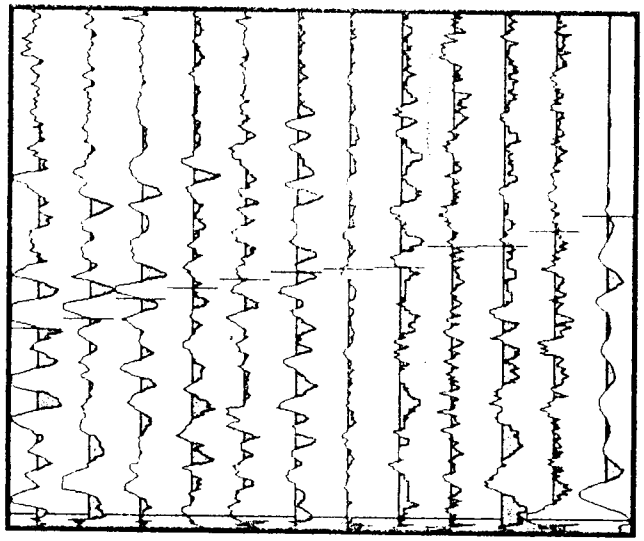




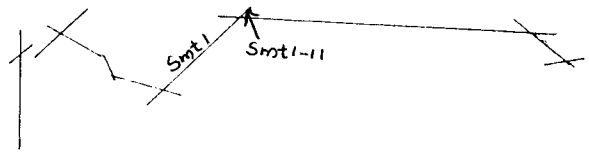


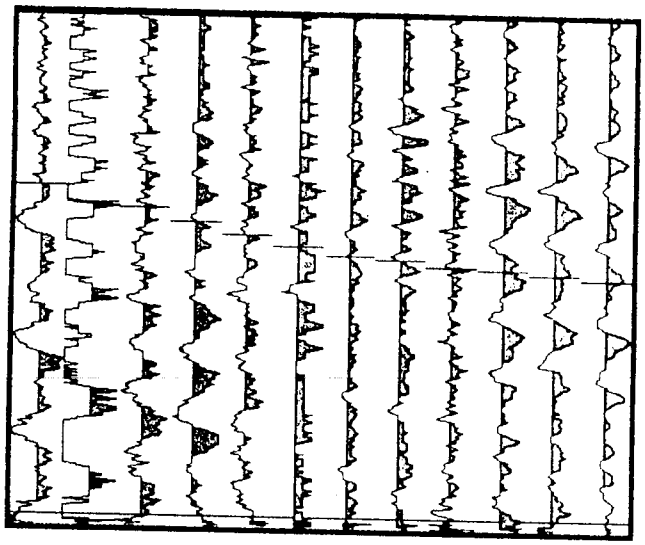


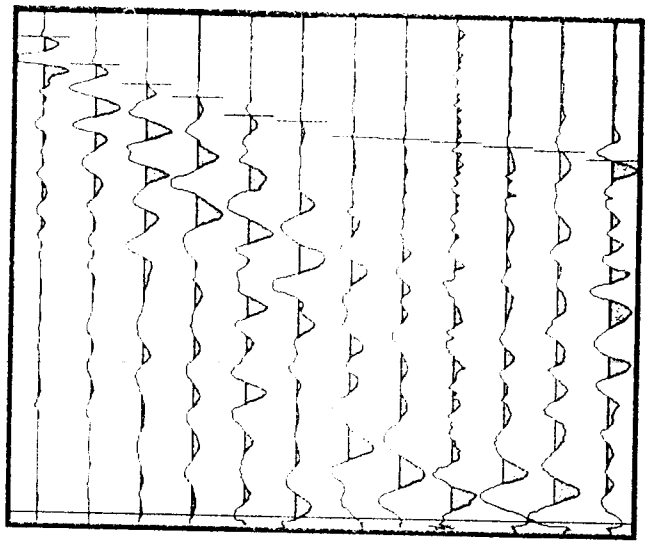


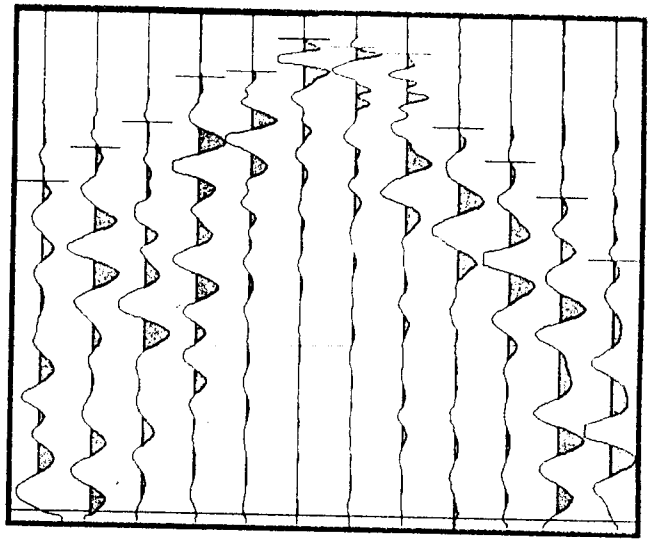


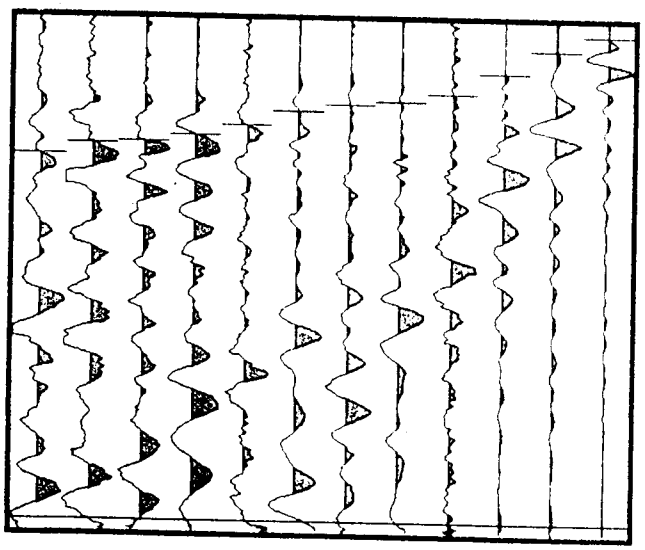
Spread No. : smt1-11
Number of Geophones : 12
Geophone Spacing : 5m

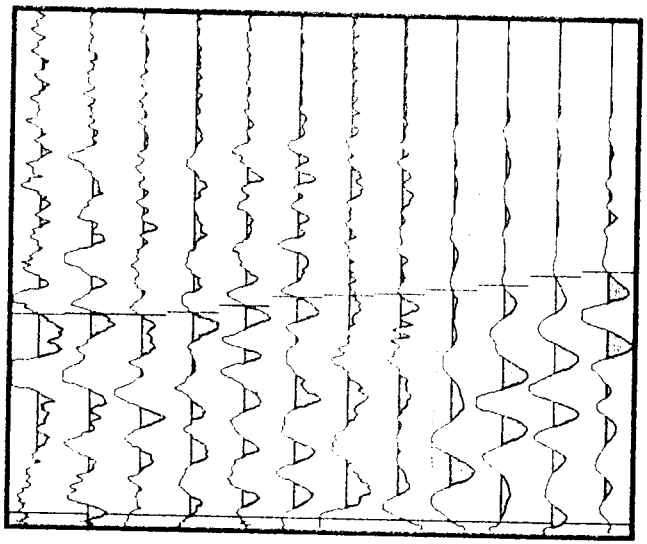




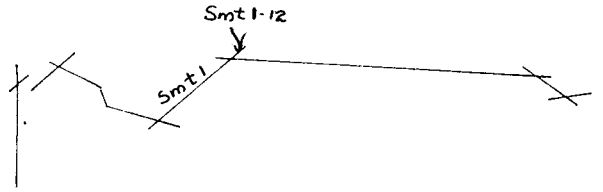


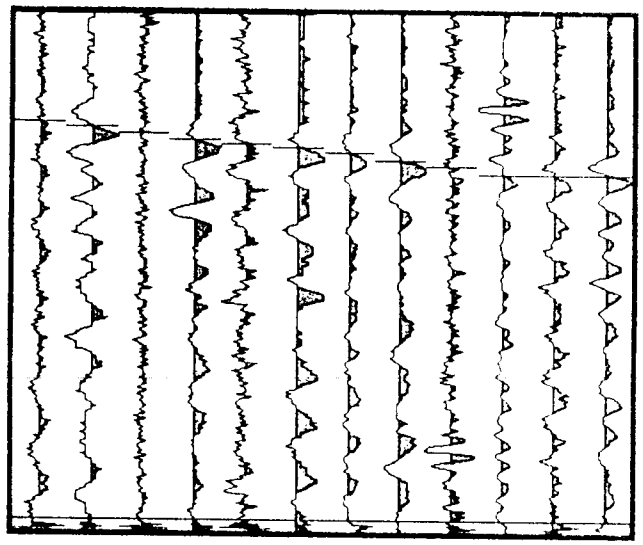


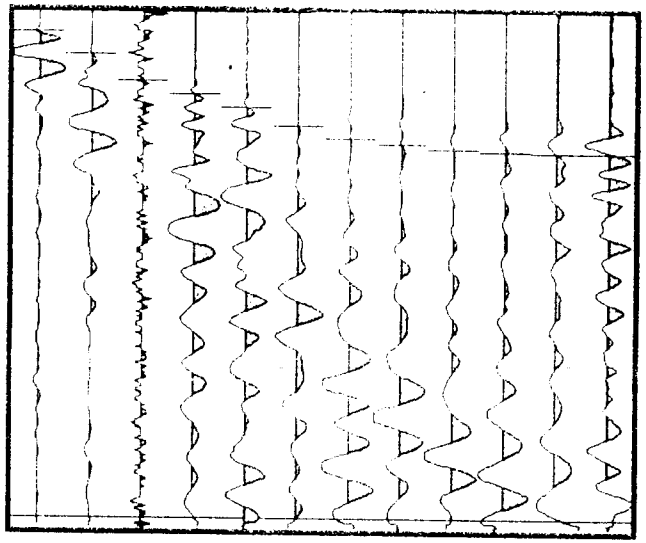


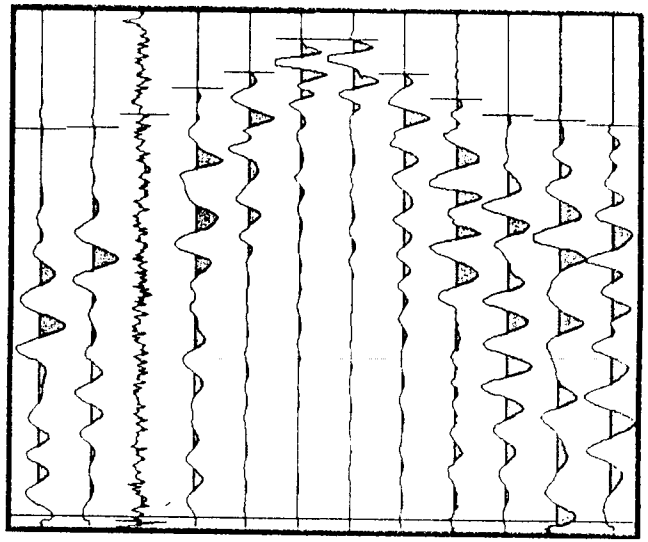


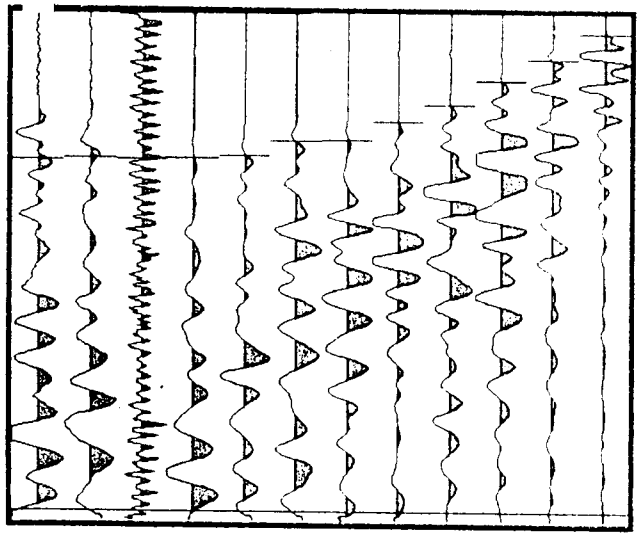
Spread No. : smt1-12
Number of Geophones : 12
Geophone Spacing : 5m

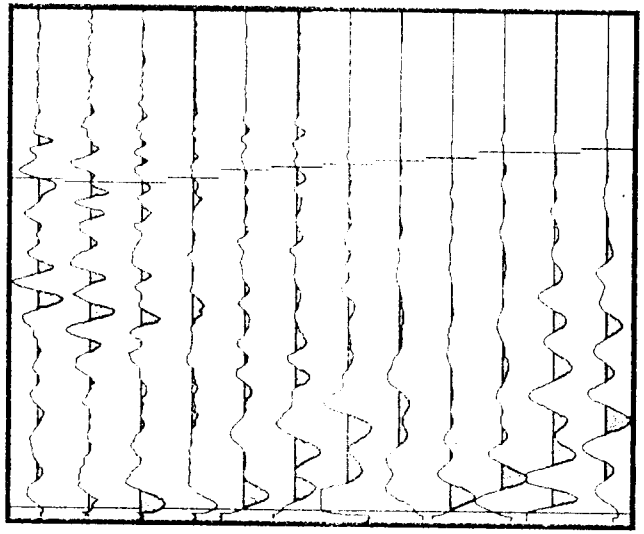




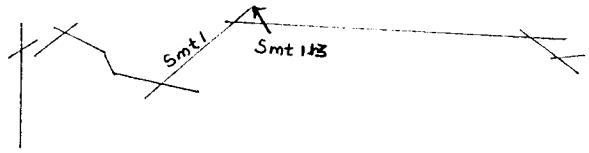


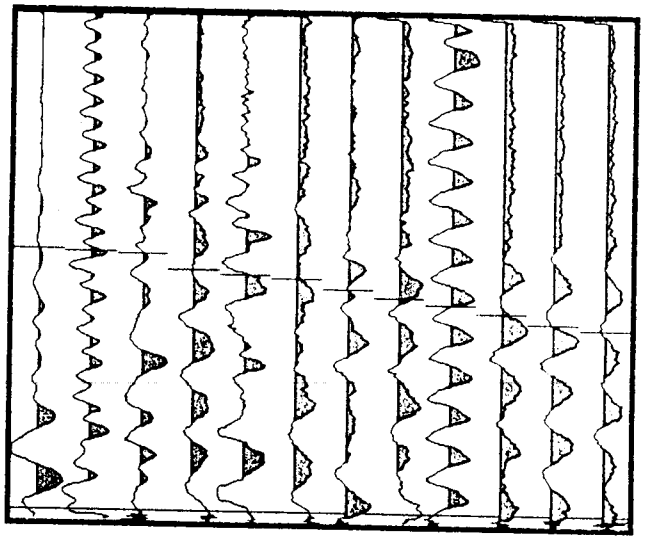


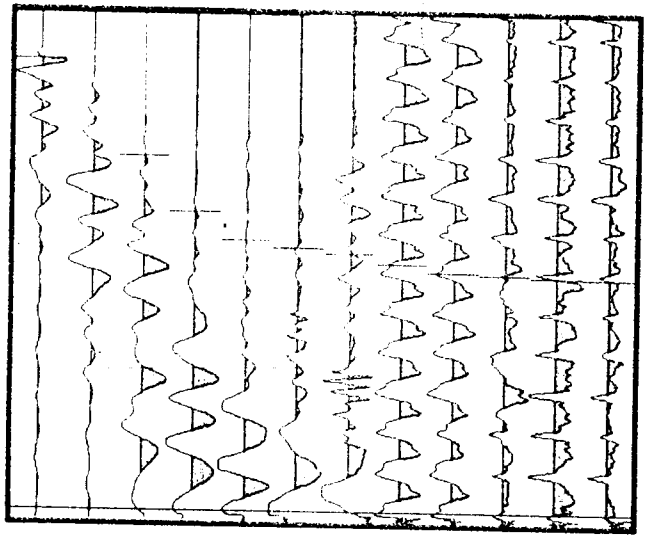


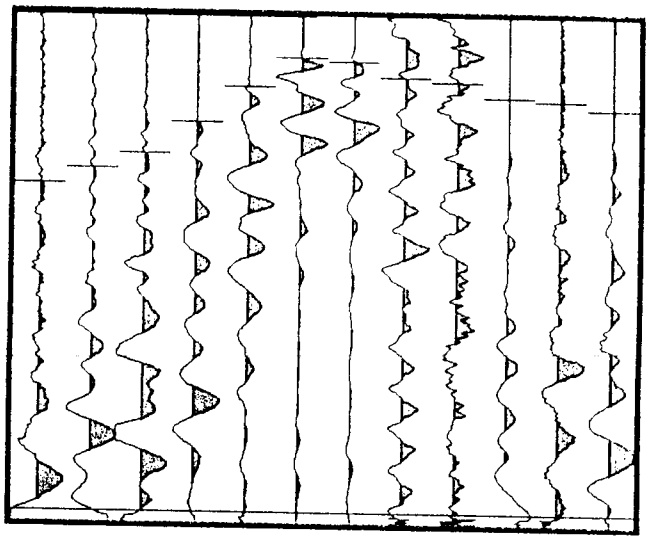


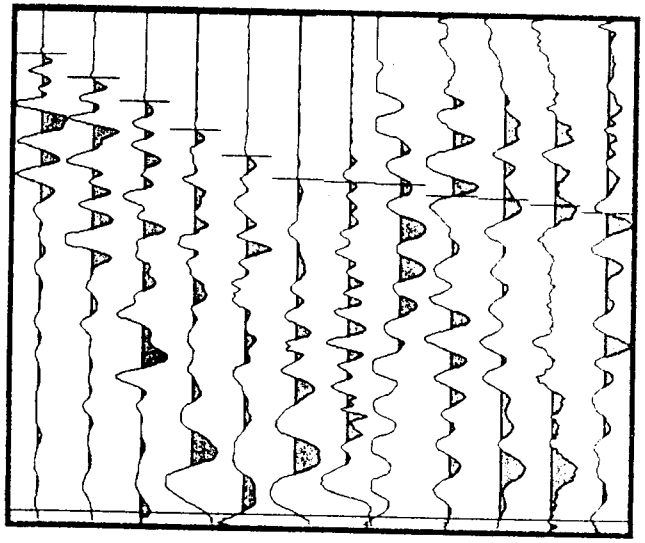
Spread No. : smt1-13
Number of Geophones : 12
Geophone Spacing : 5m

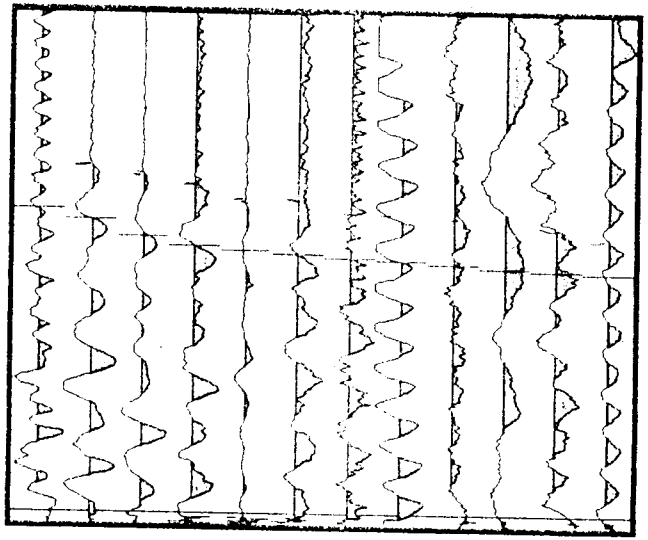




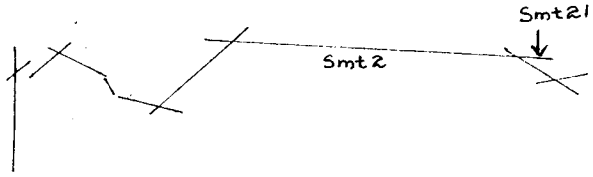


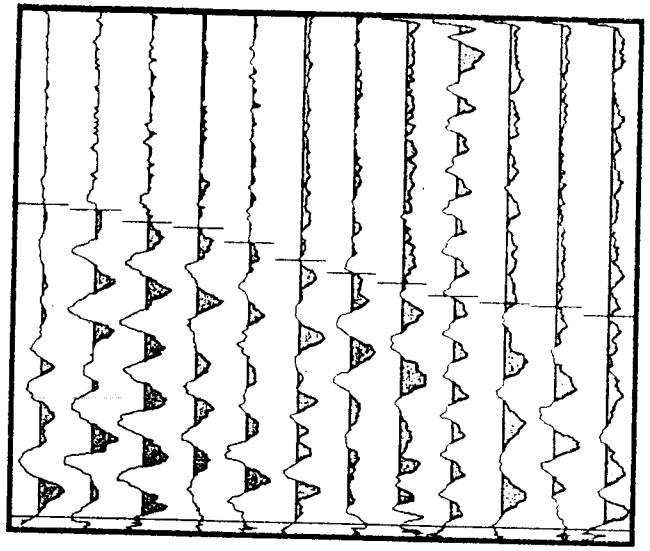


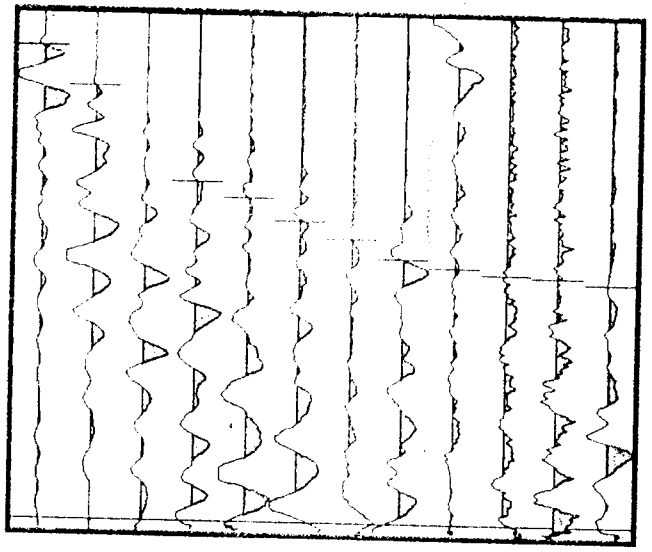


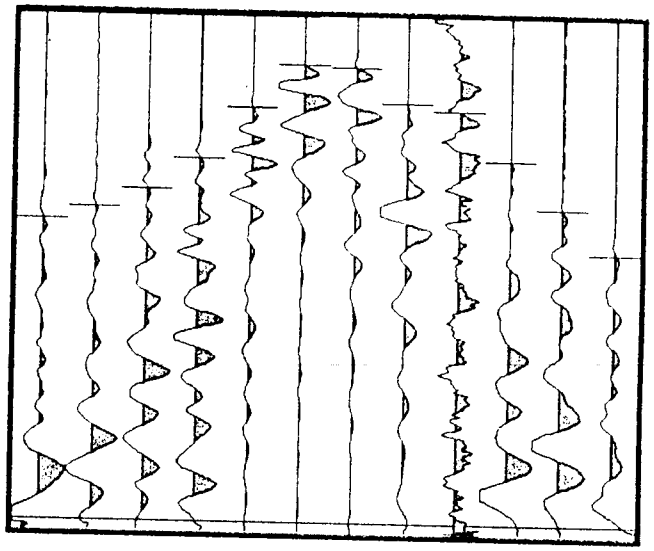


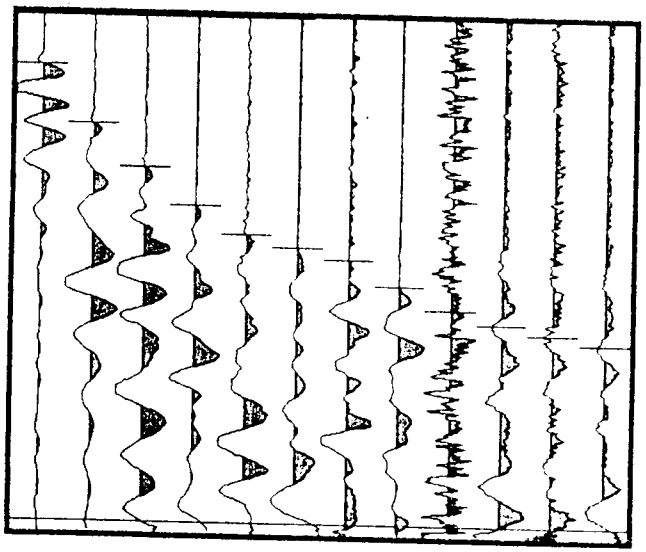
Spread No. : smt21
Number of Geophones : 12
Geophone Spacing : 10m

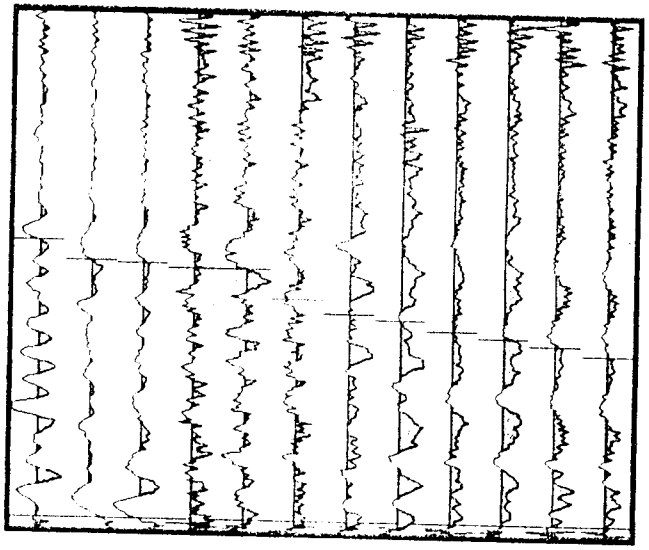




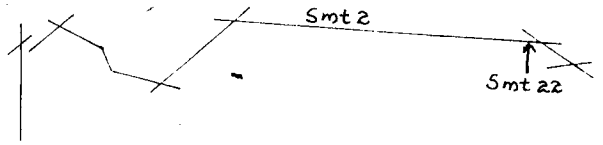


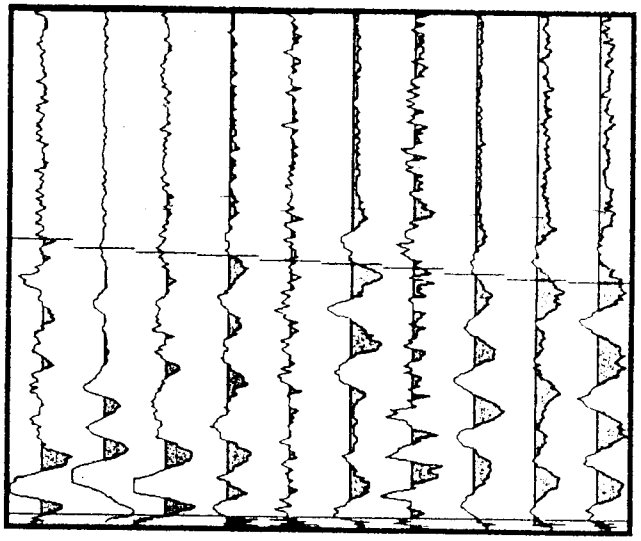


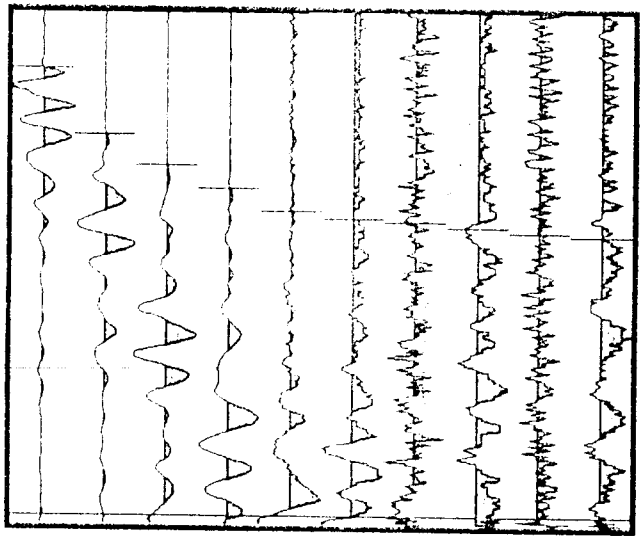


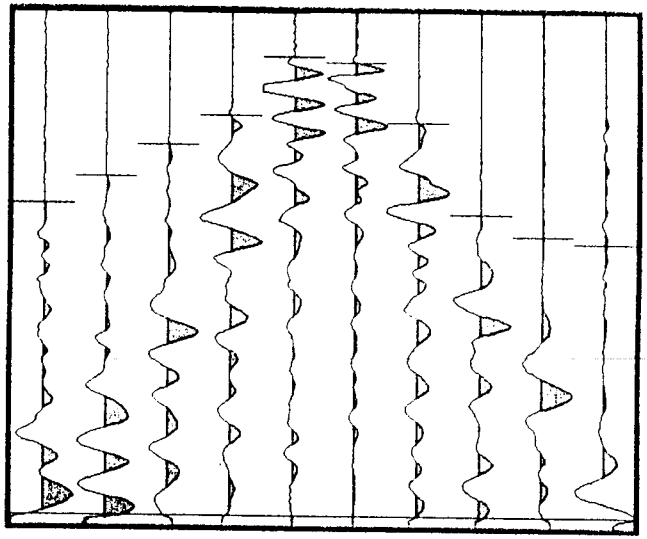


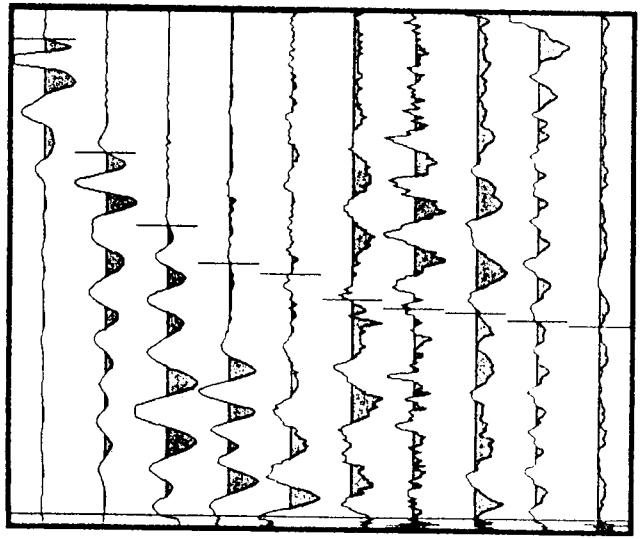
Spread No. : smt22
Number of Geophones : 12
Geophone Spacing : 10m

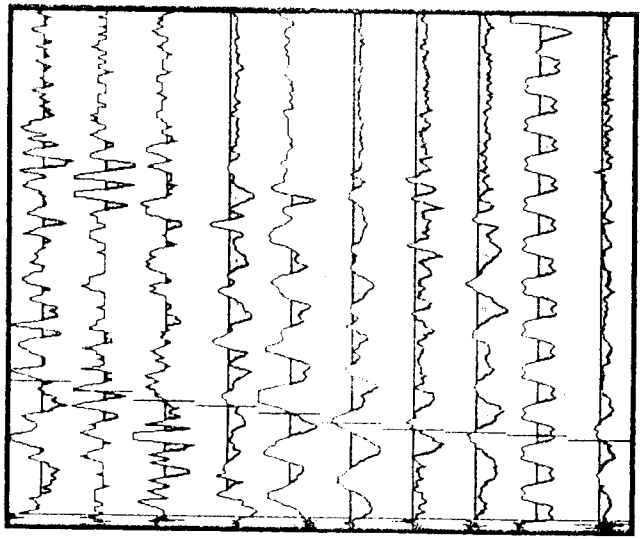




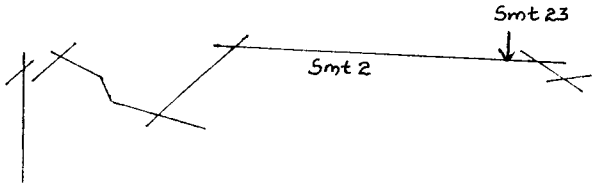








Spread No. : smt23
Number of Geophones : 12
Geophone Spacing : 10m



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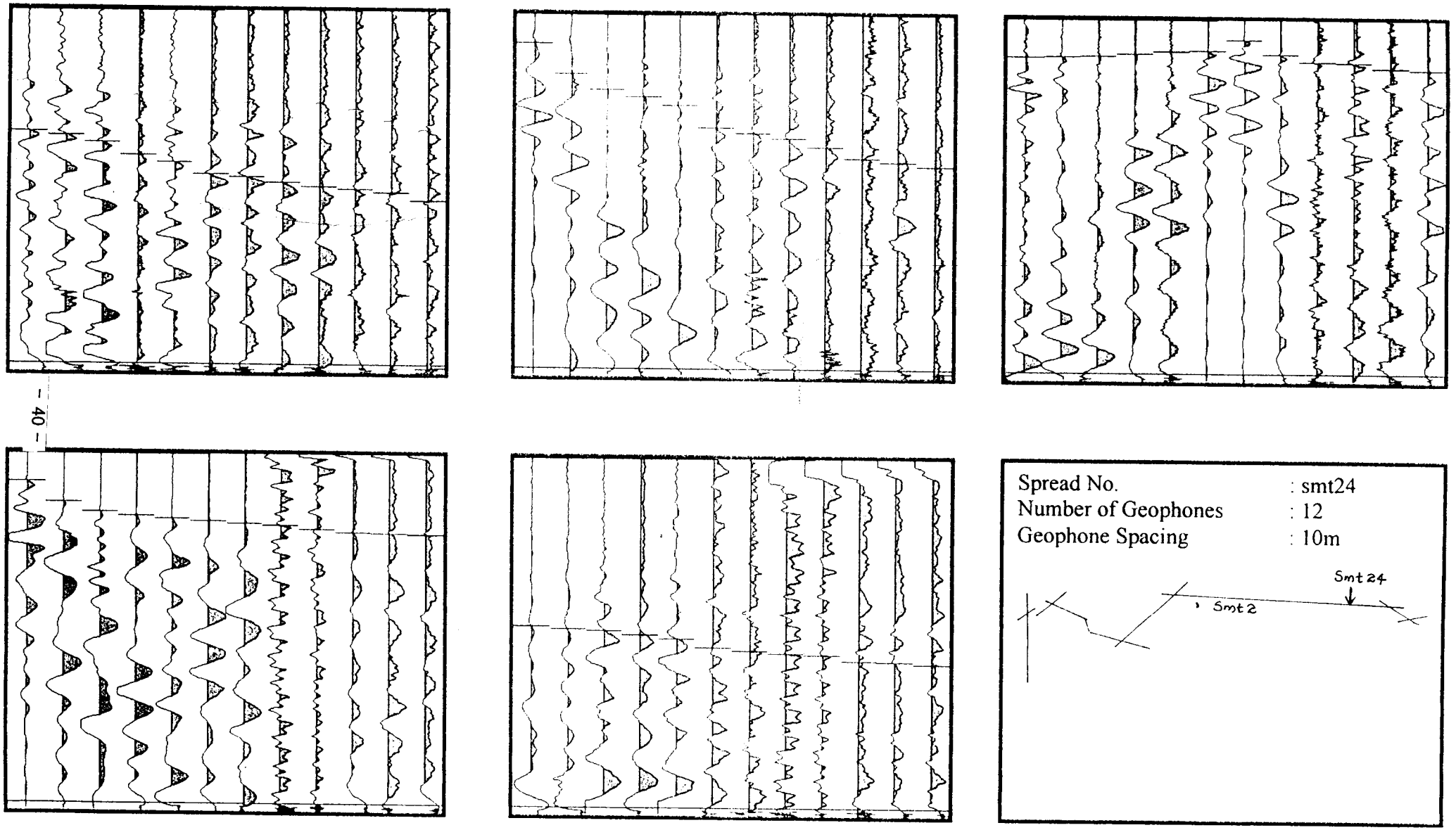
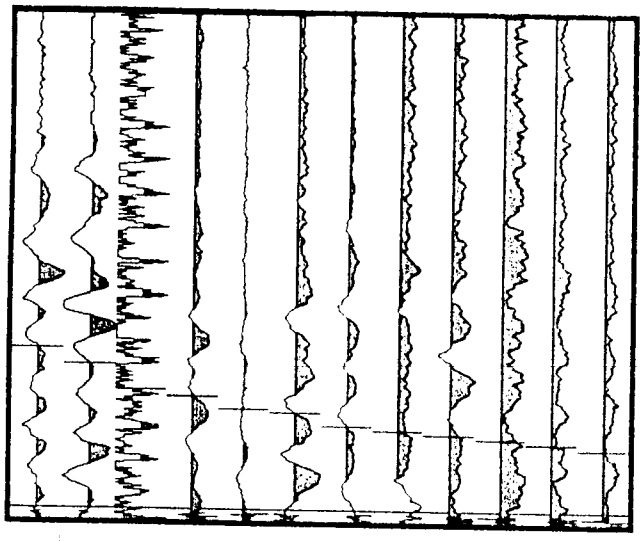
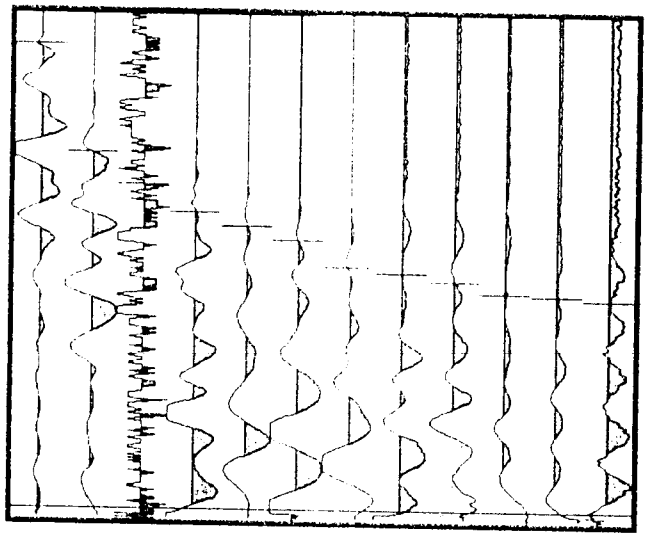
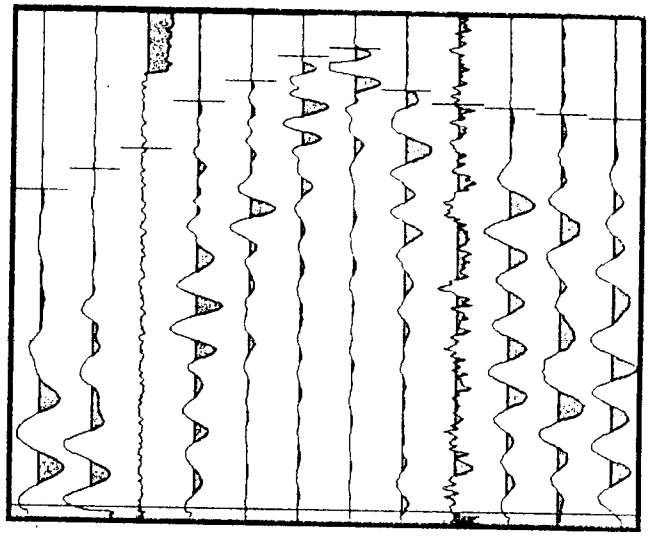
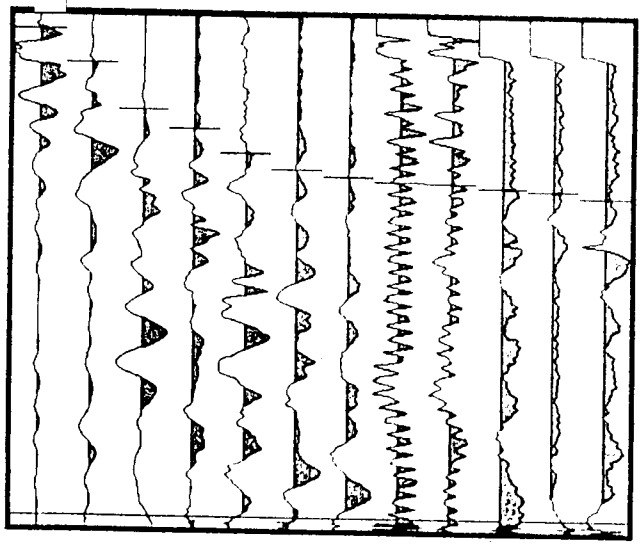
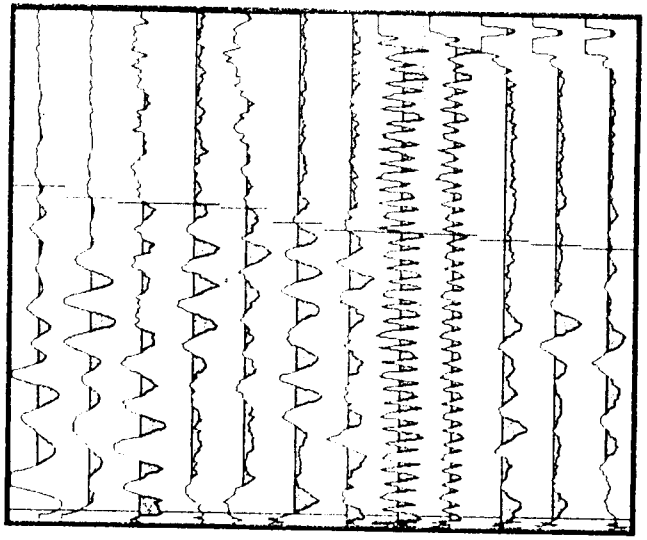




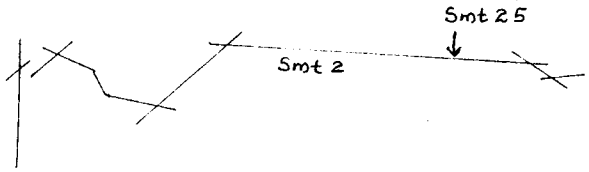


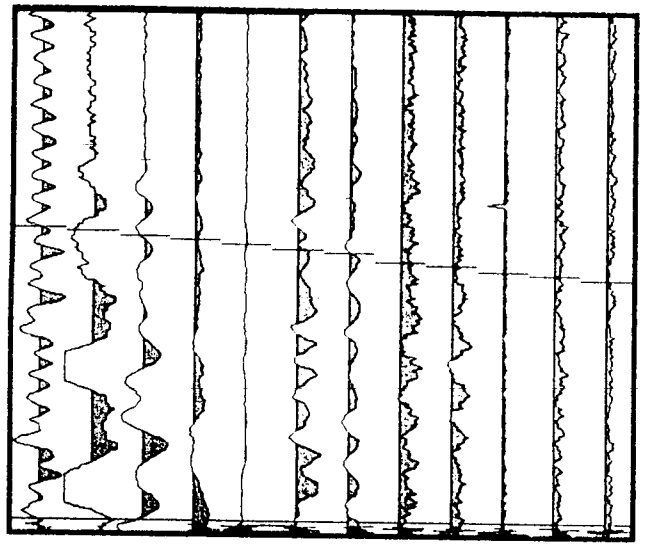


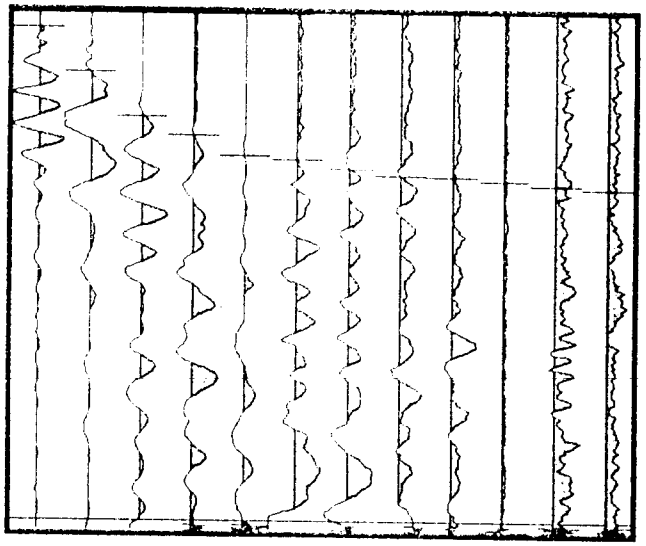


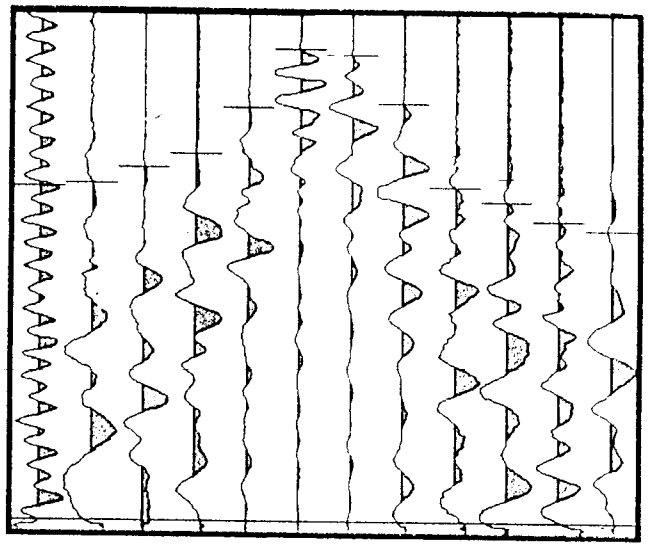


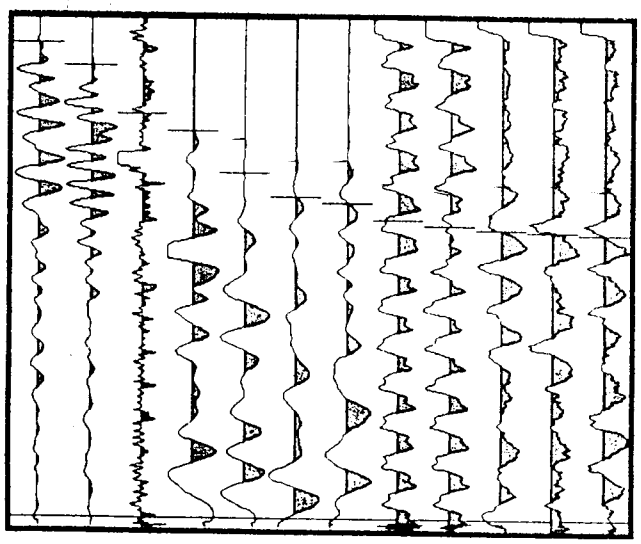
Spread No.	: smt25
Number of Geophones	: 12
Geophone Spacing	: 10m

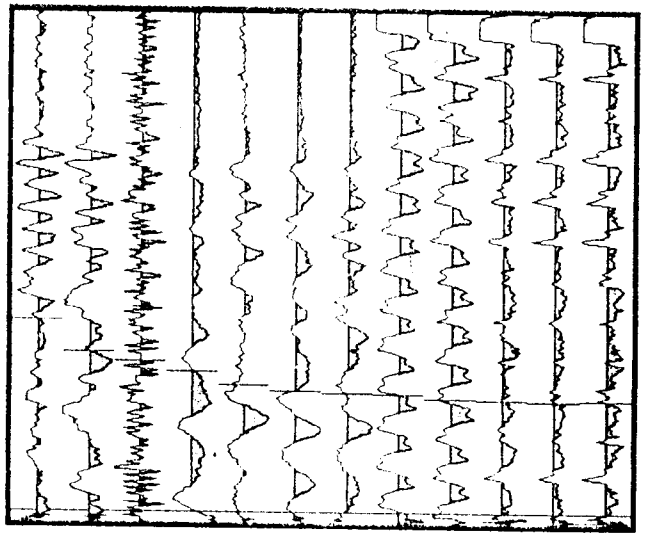




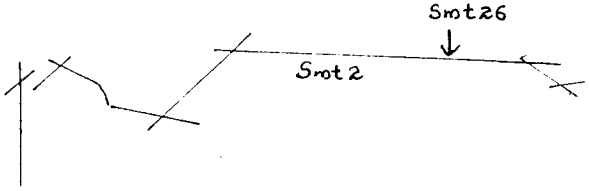


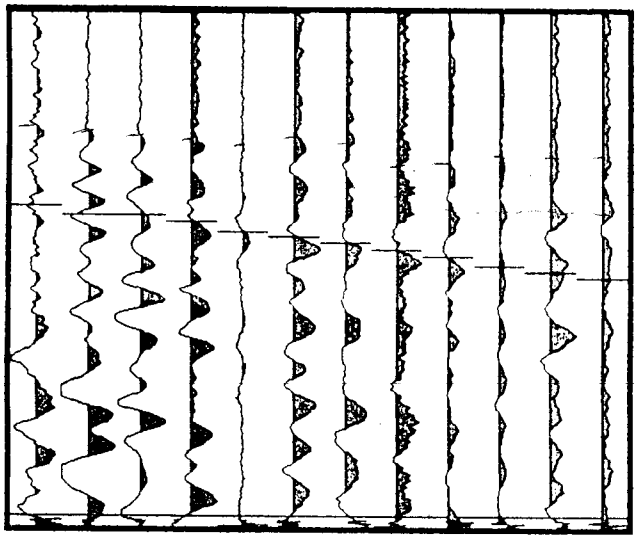


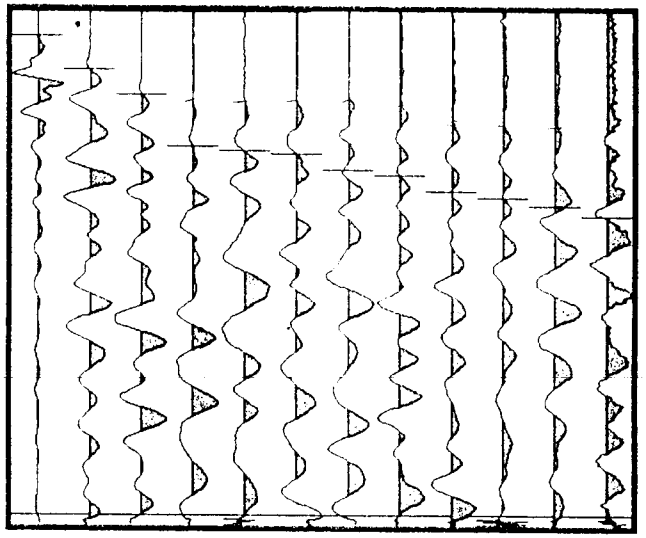


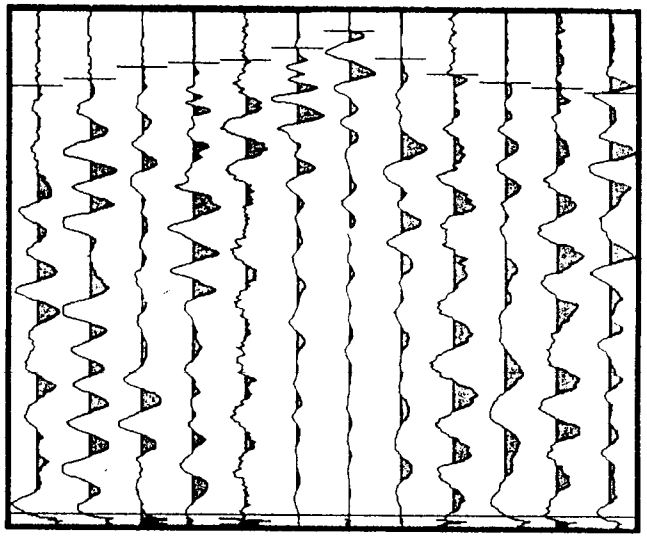


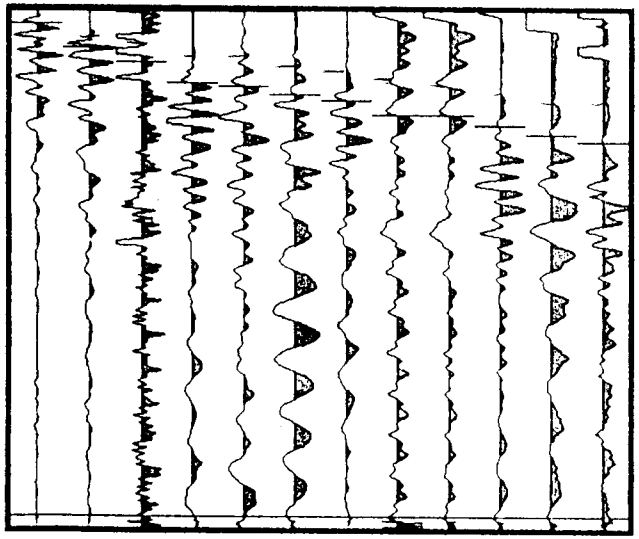
Spread No.	: smt26
Number of Geophones	: 12
Geophone Spacing	: 10m

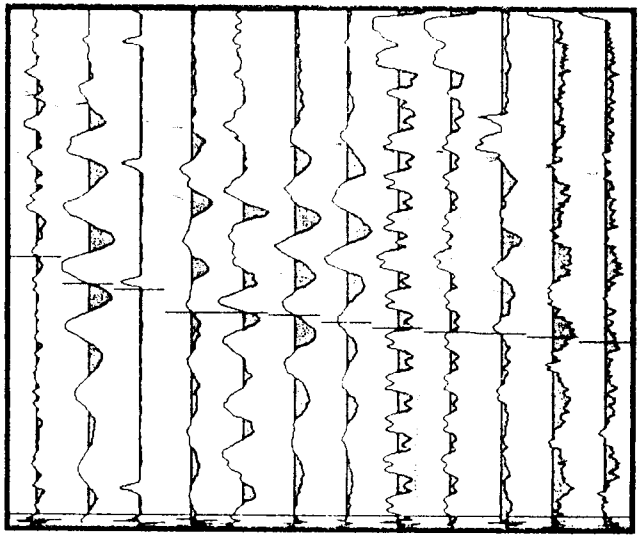




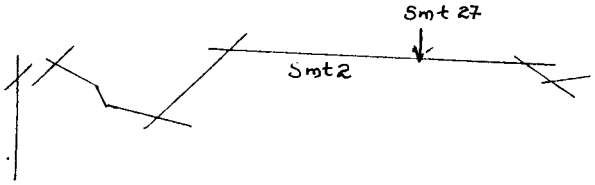


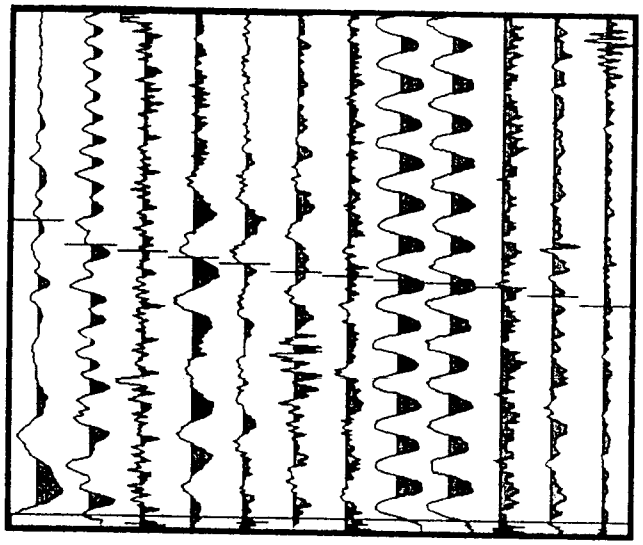


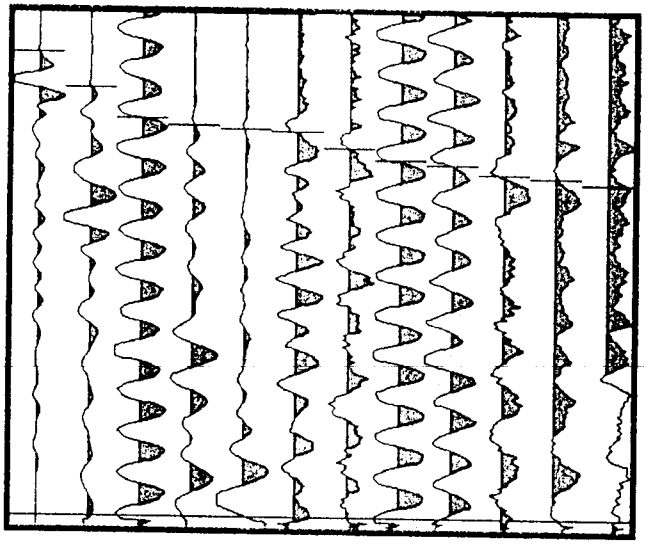


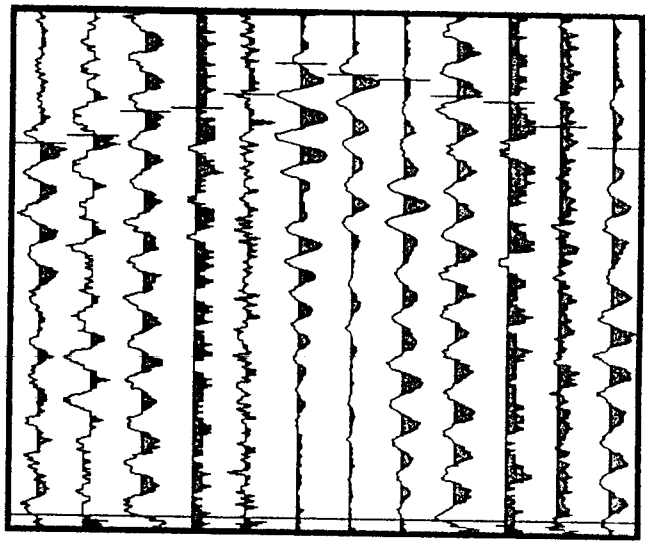


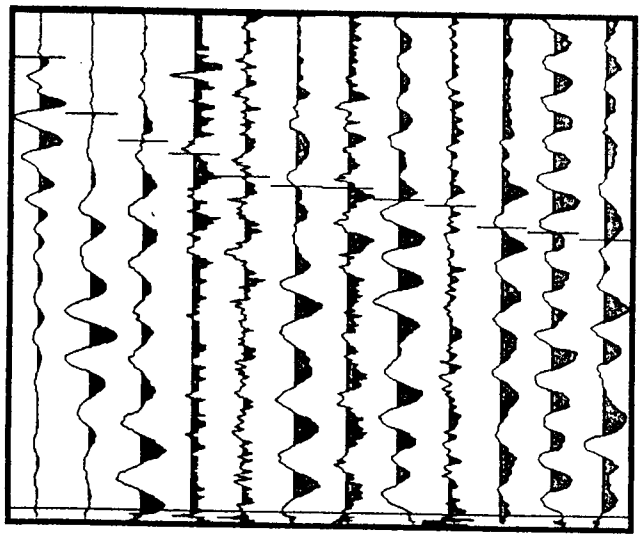
Spread No. : smt27
Number of Geophones : 12
Geophone Spacing : 10m

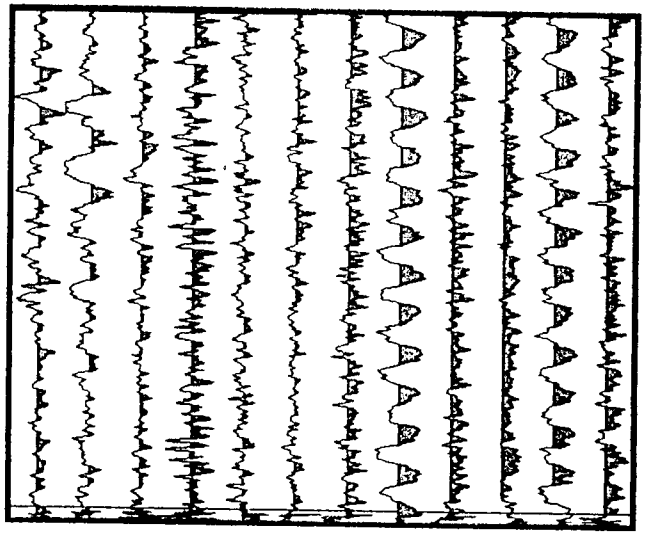




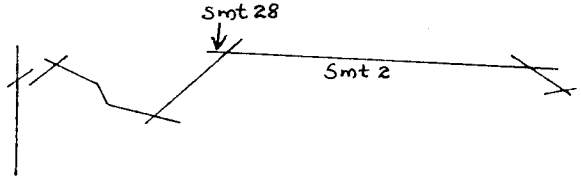


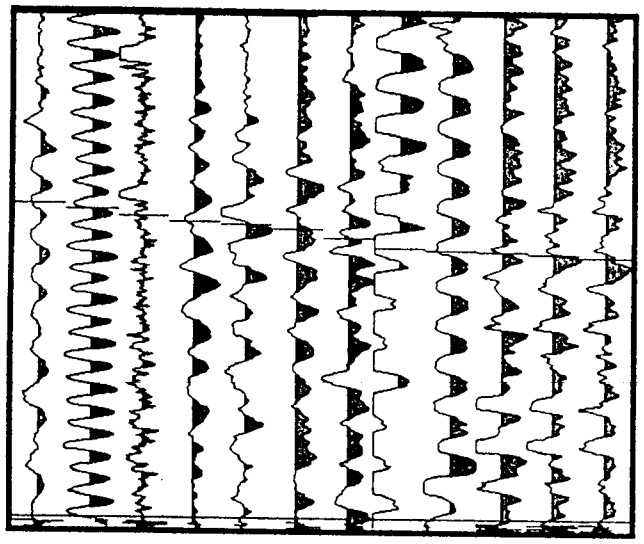


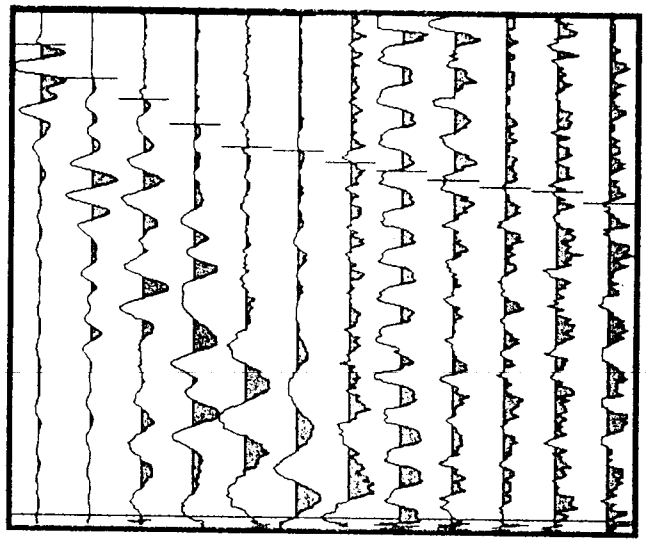


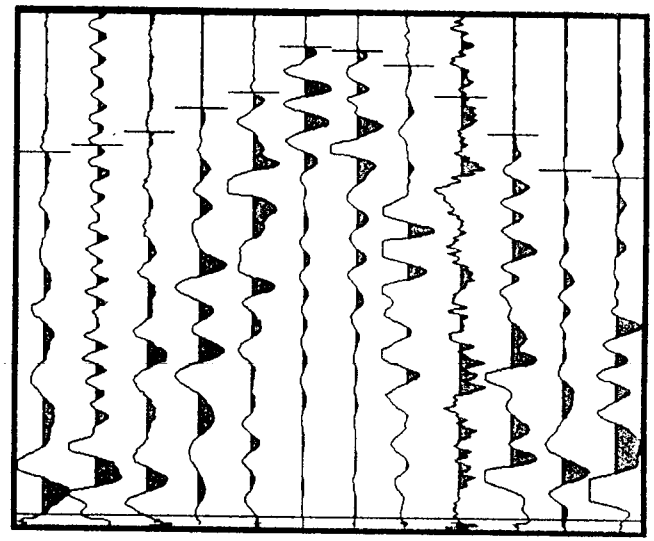


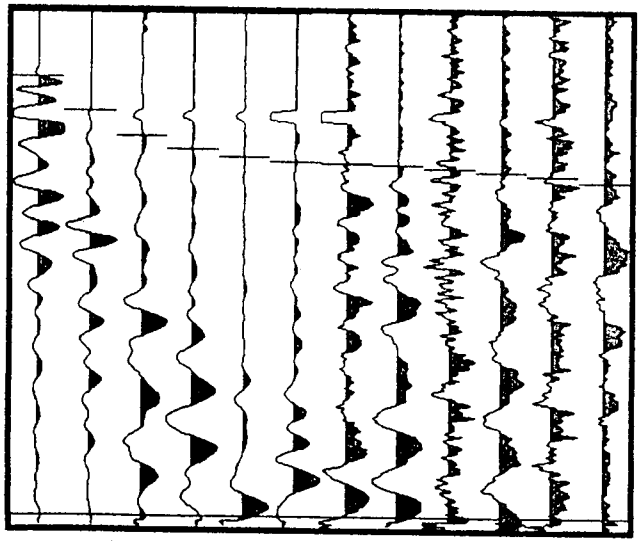
Spread No. : smt28
Number of Geophones : 12
Geophone Spacing : 10m

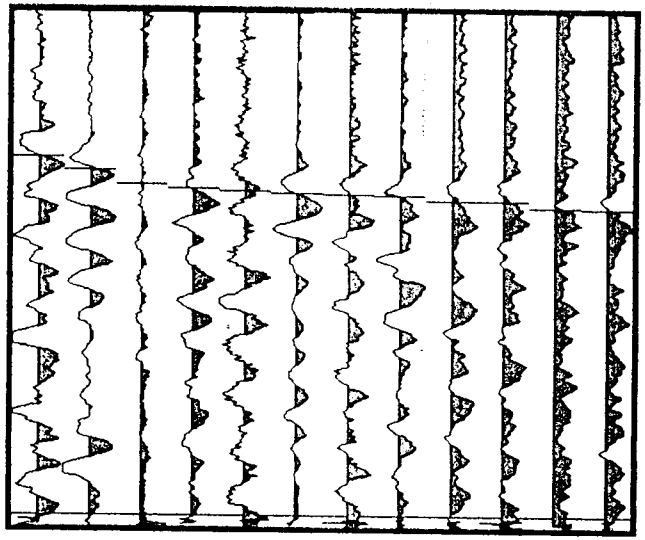




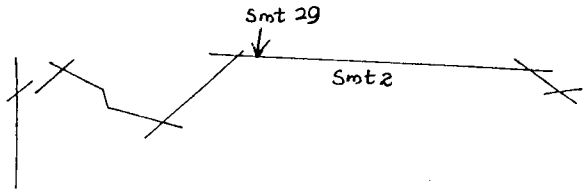


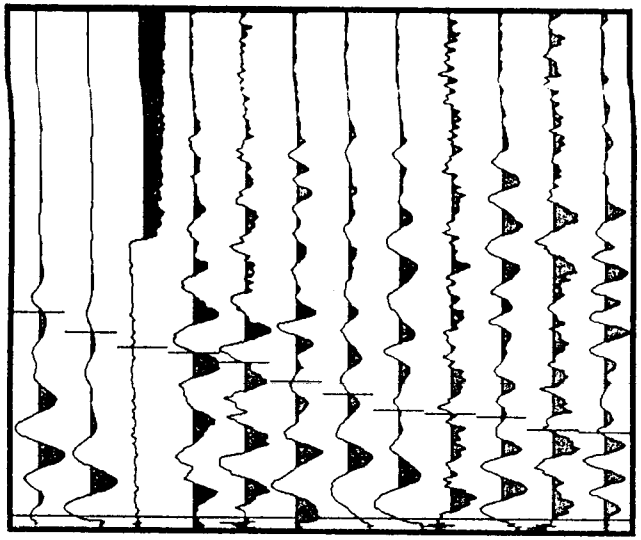


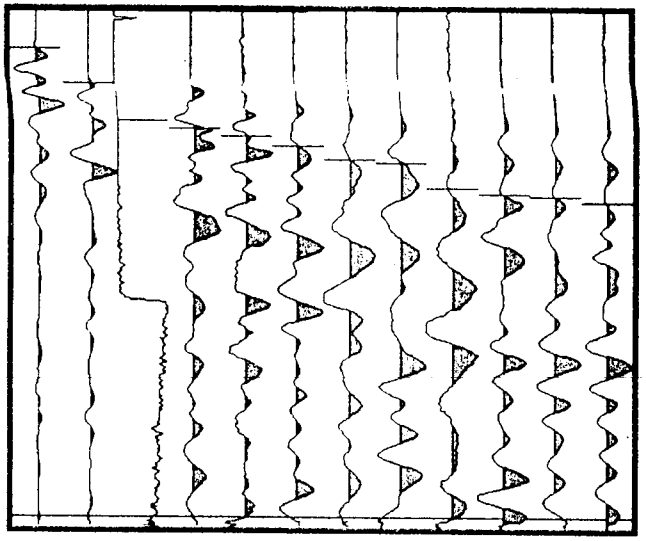


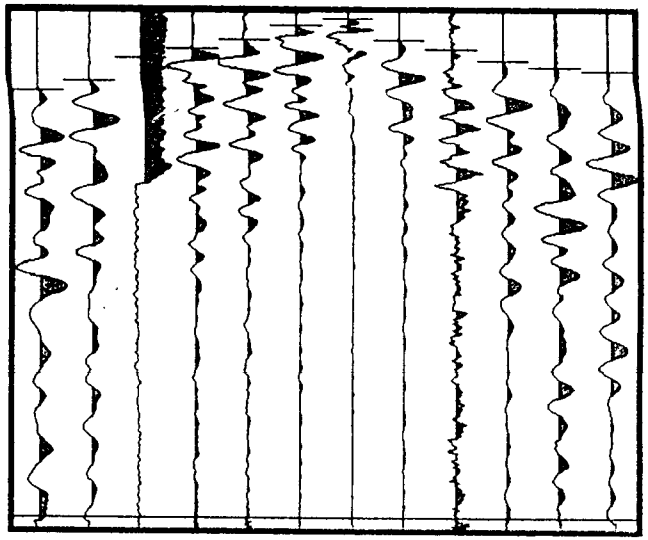


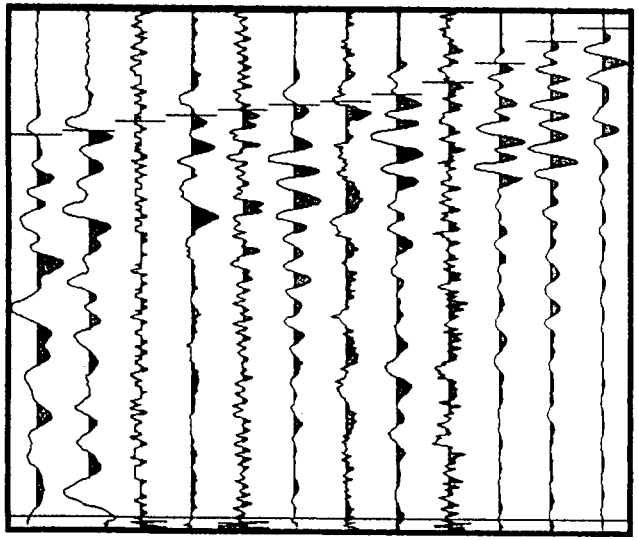
Spread No. : smt29
Number of Geophones : 12
Geophone Spacing : 10m

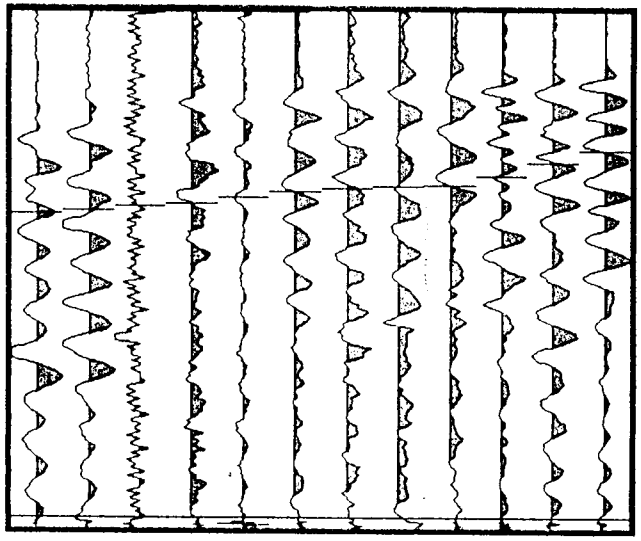




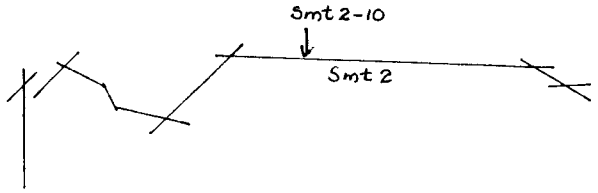








Spread No. : smt2-10
Number of Geophones : 12
Geophone Spacing : 5m



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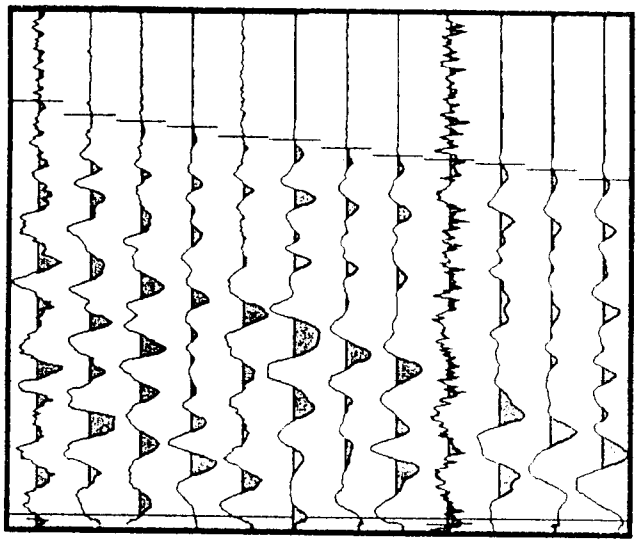
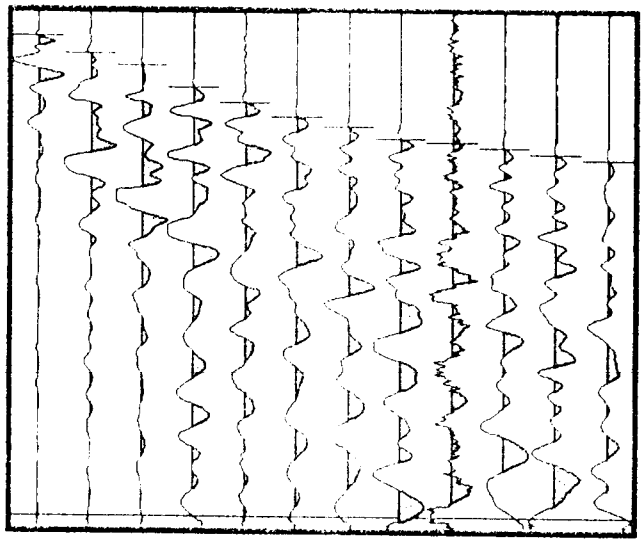
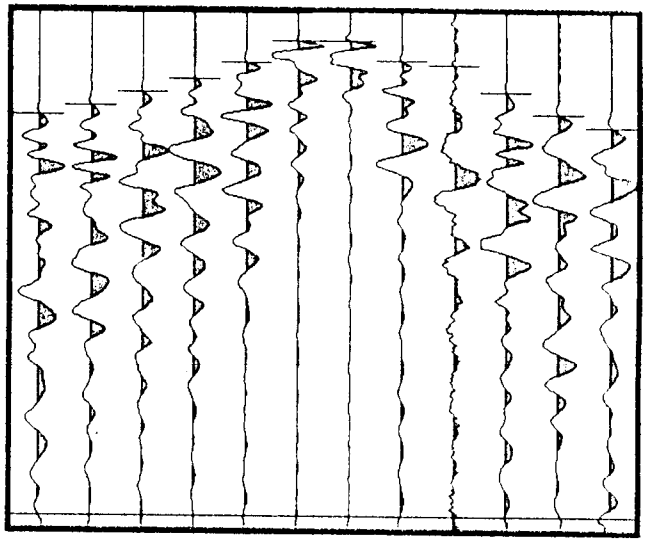
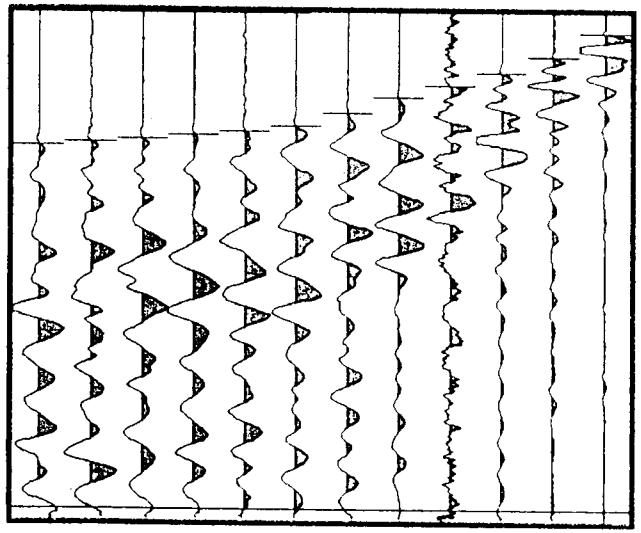
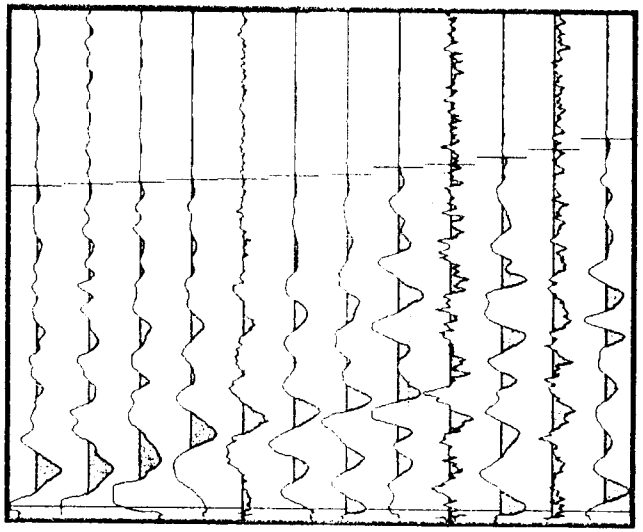


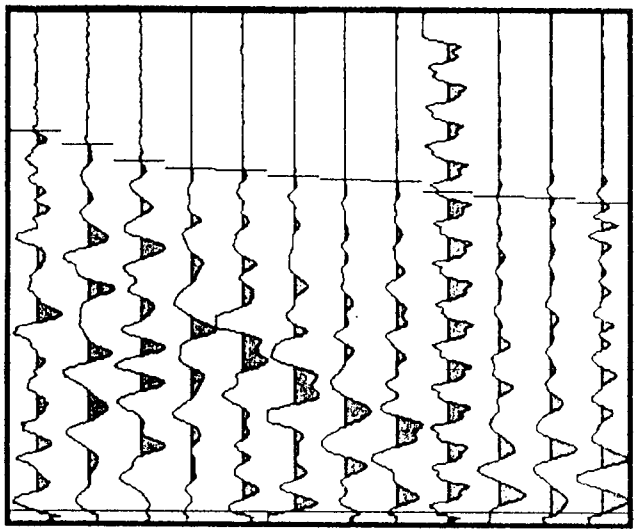


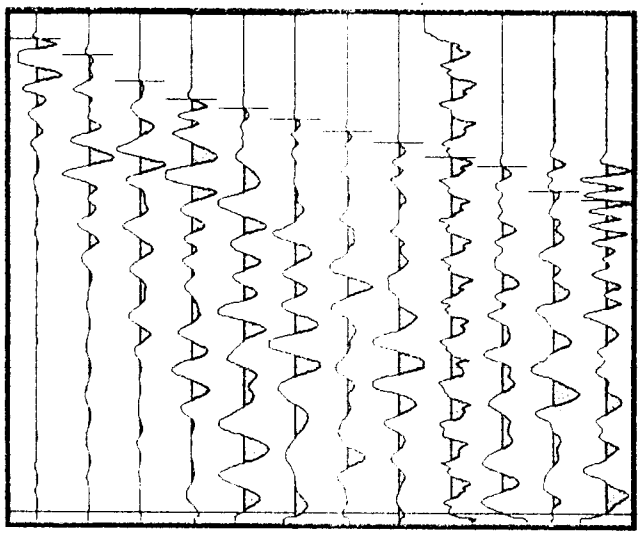


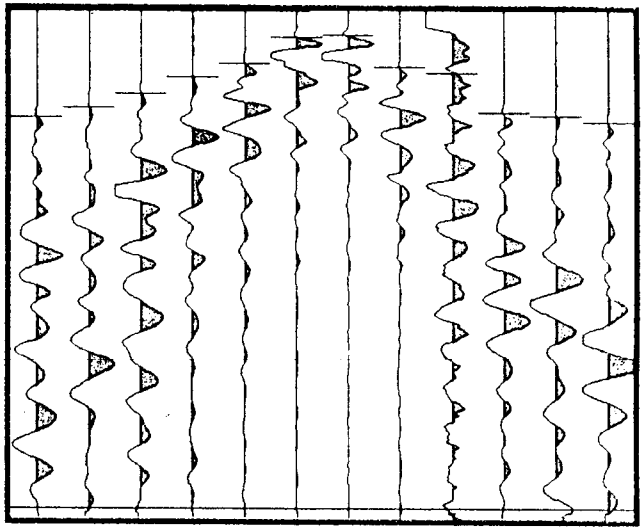


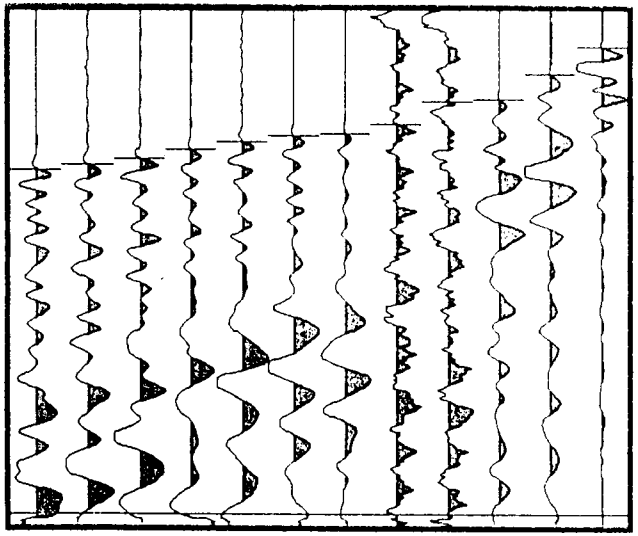


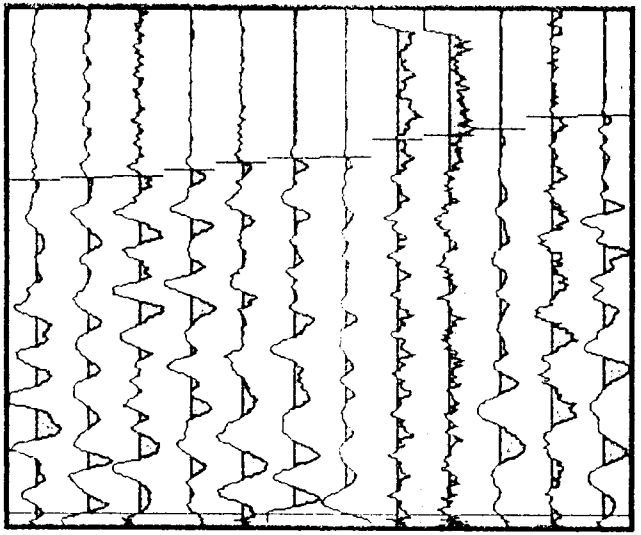
Spread No. : smt32
Number of Geophones : 12
Geophone Spacing : 5m



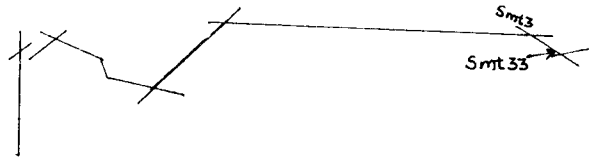


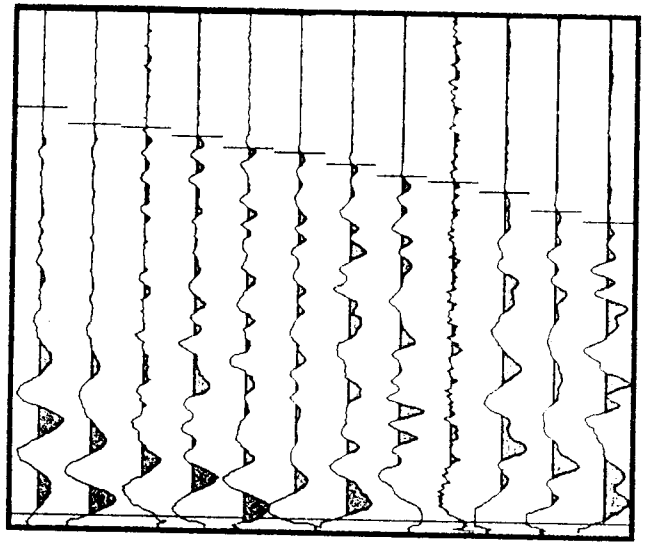


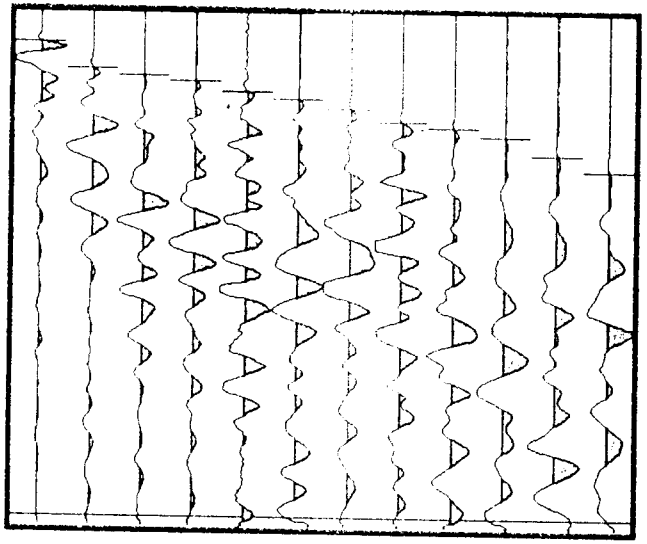


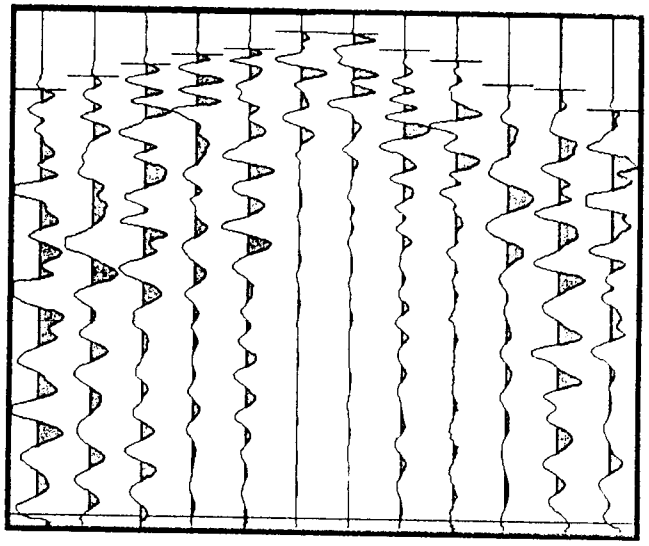


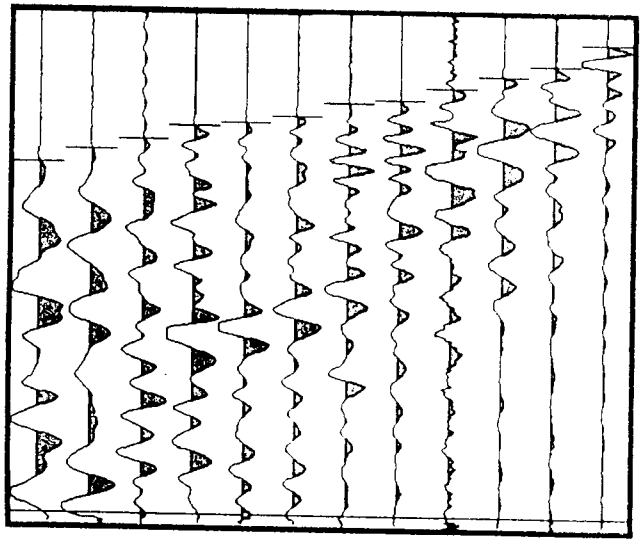
Spread No. : smt33
Number of Geophones : 12
Geophone Spacing : 5m

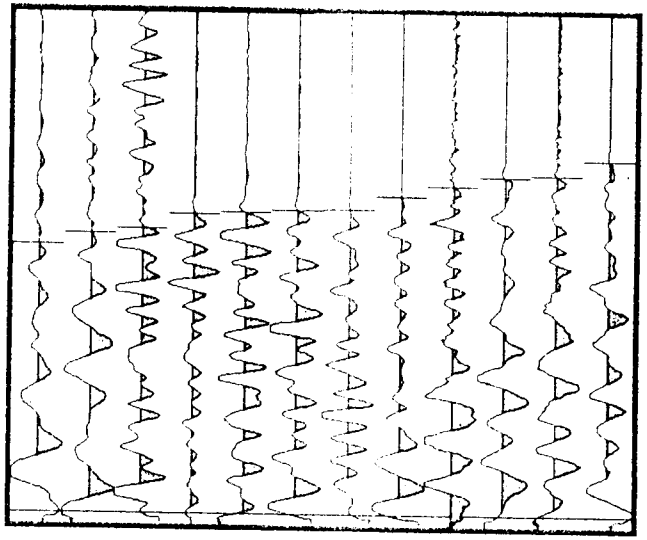




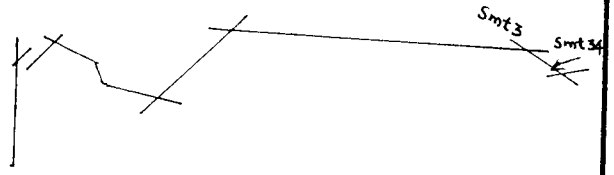


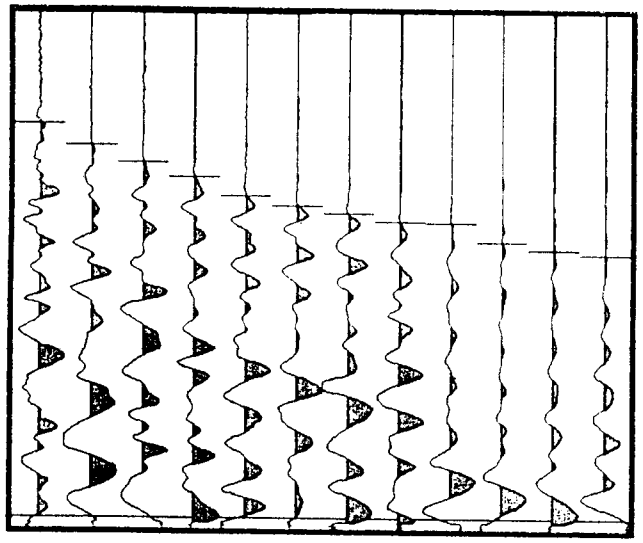


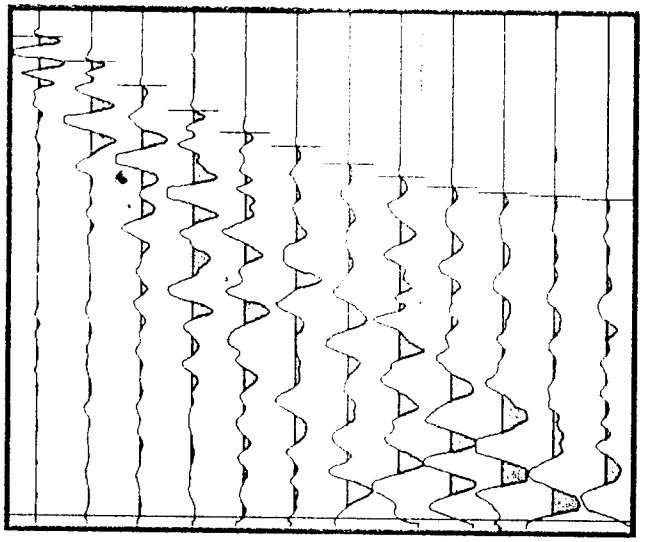


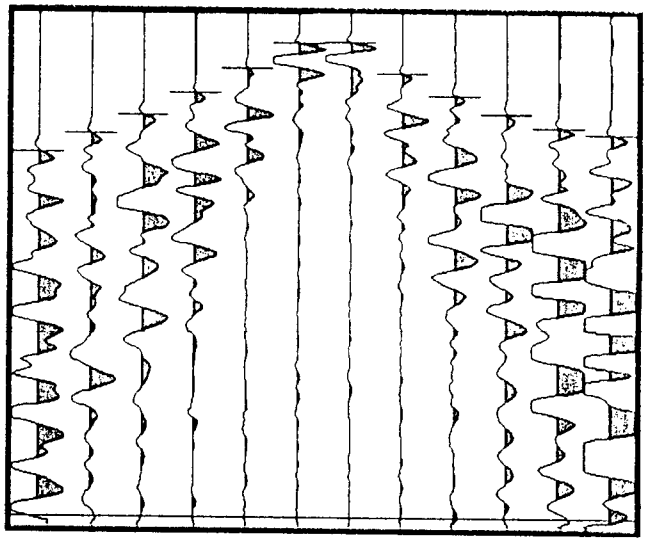


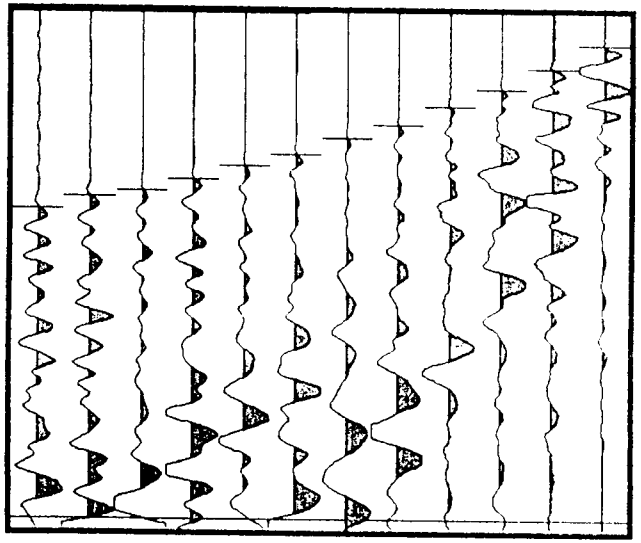
Spread No. : smt34
Number of Geophones : 12
Geophone Spacing : 5m

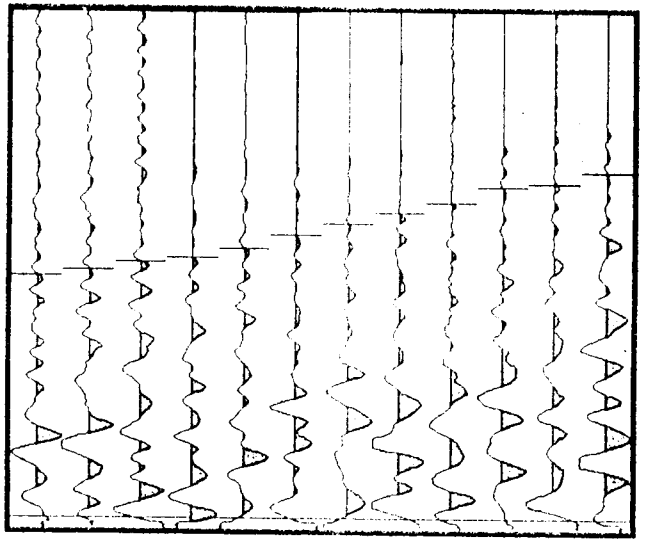




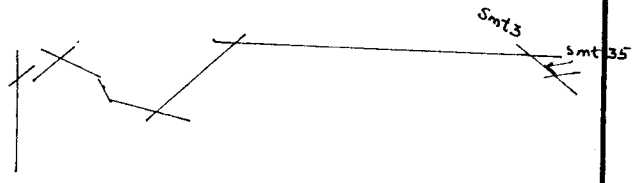


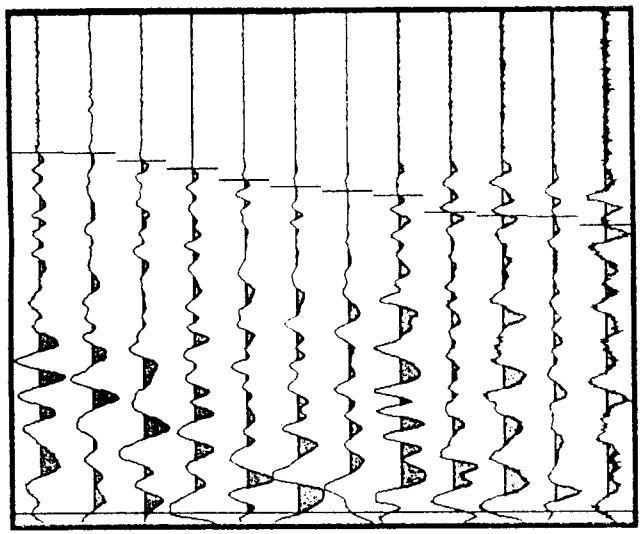


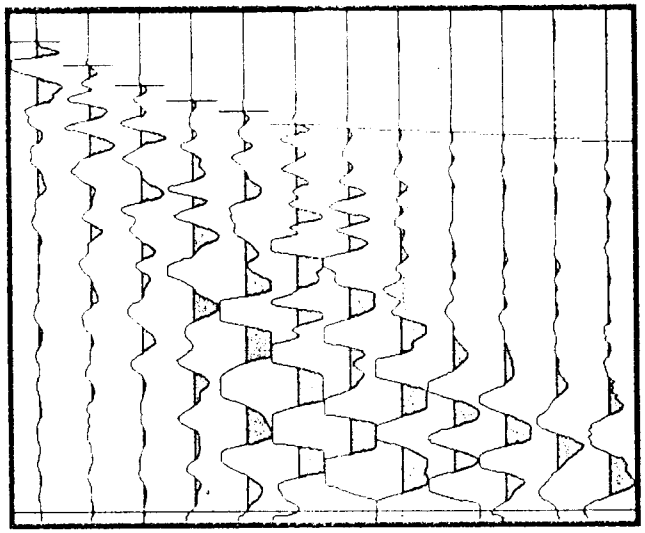


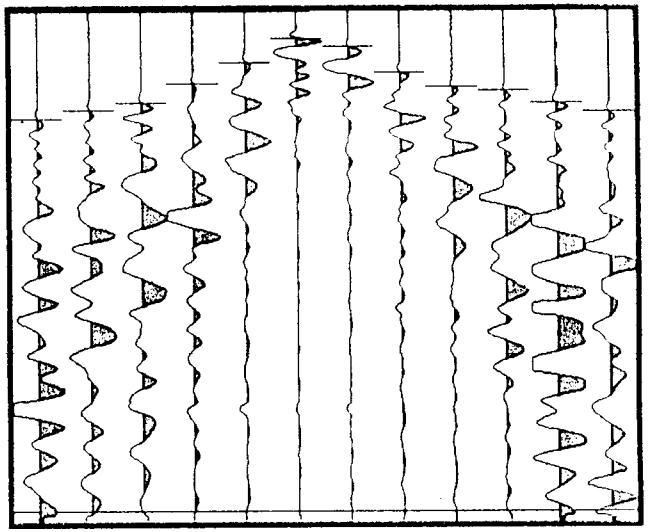


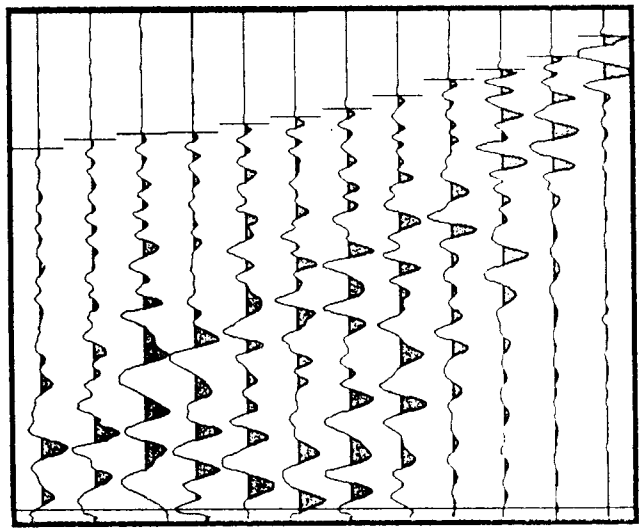
Spread No. : smt35
Number of Geophones : 12
Geophone Spacing : 5m

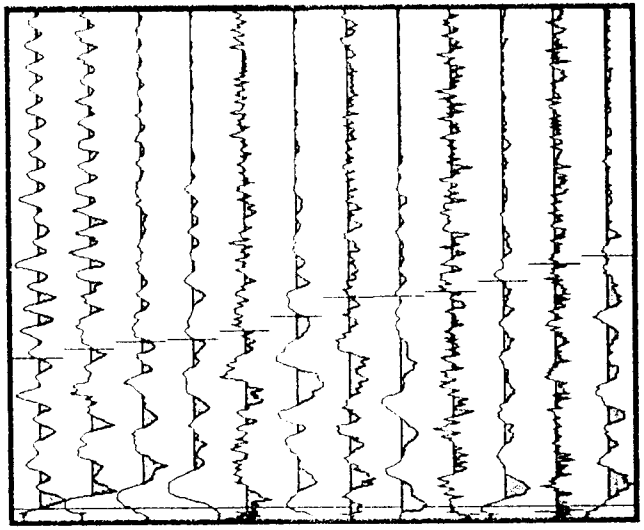




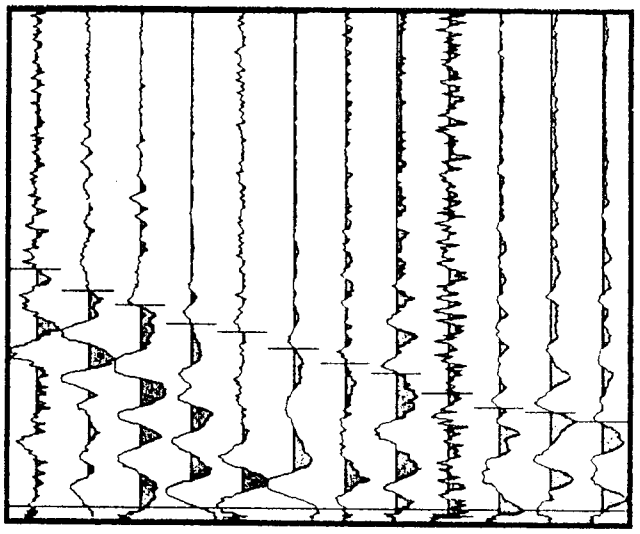


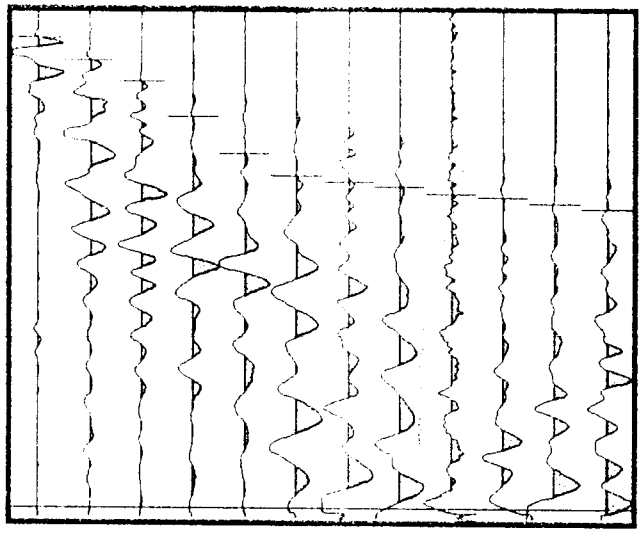


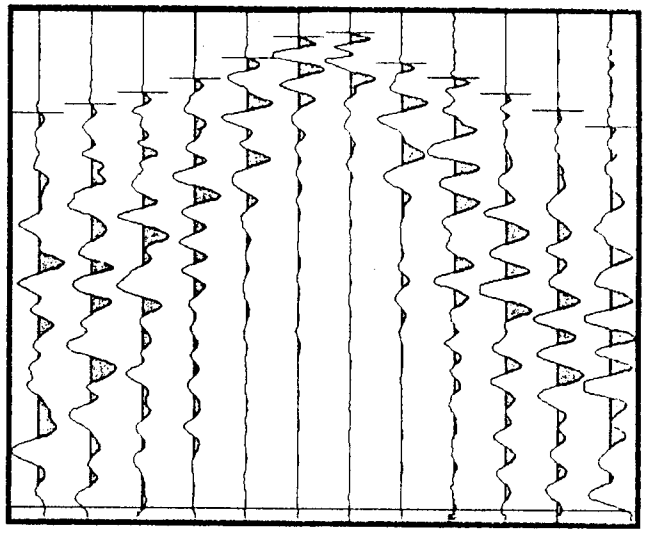


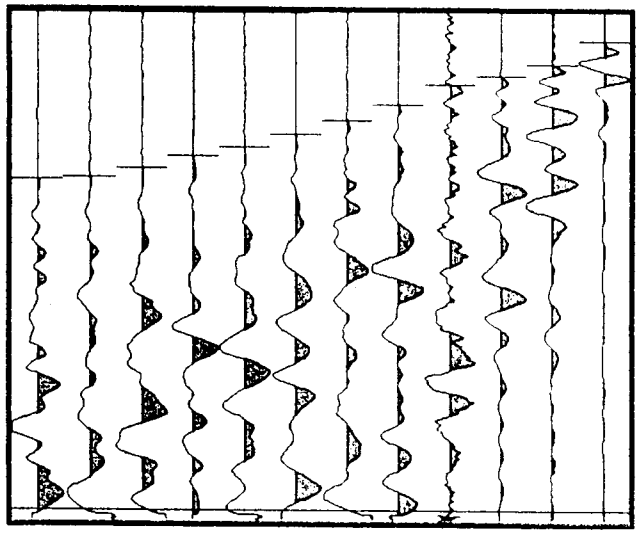


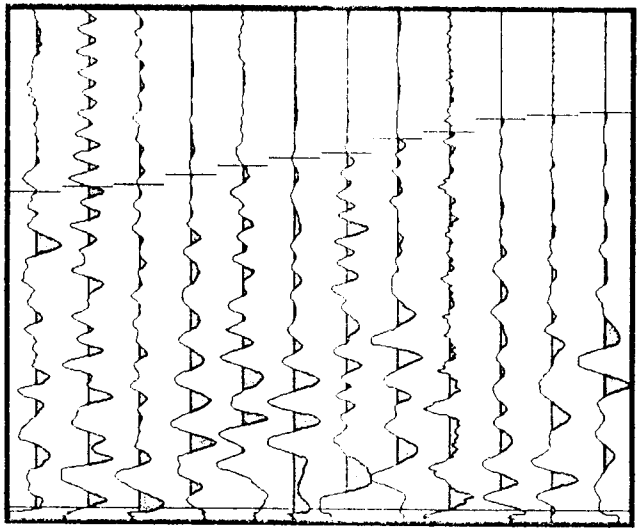
Spread No. : smt36
Number of Geophones : 12
Geophone Spacing : 5m



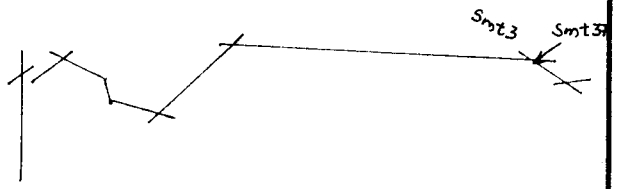


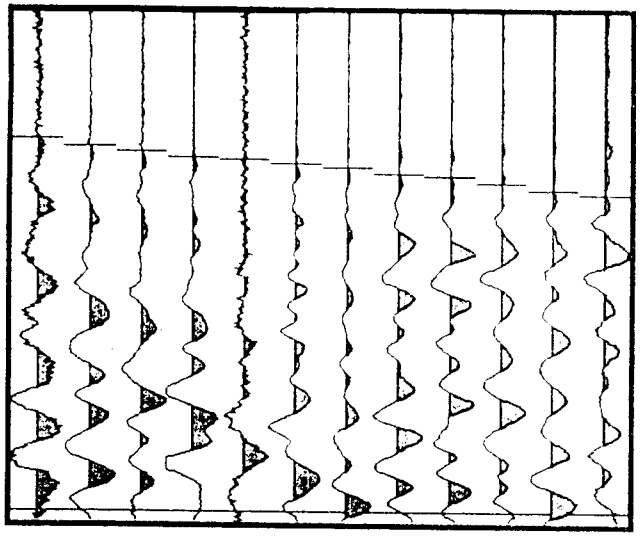


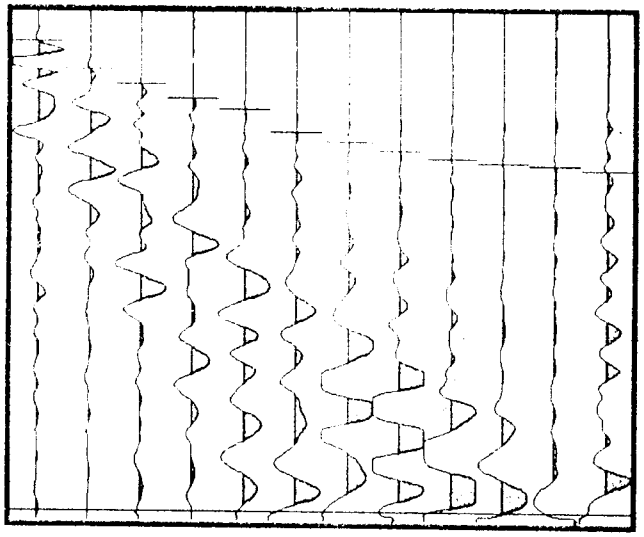


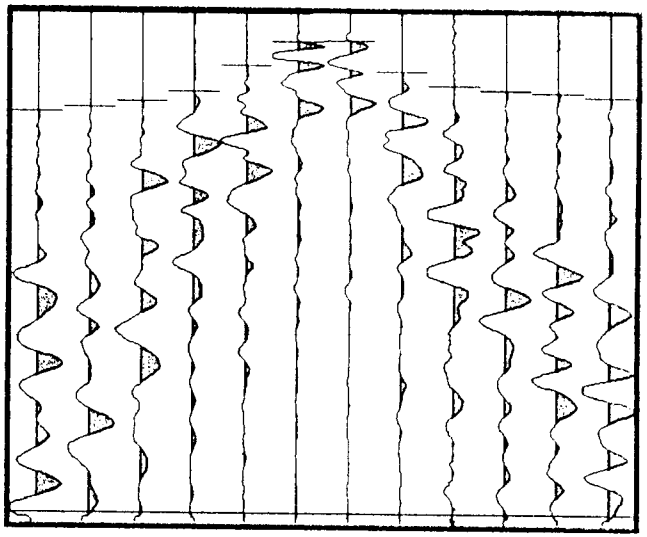


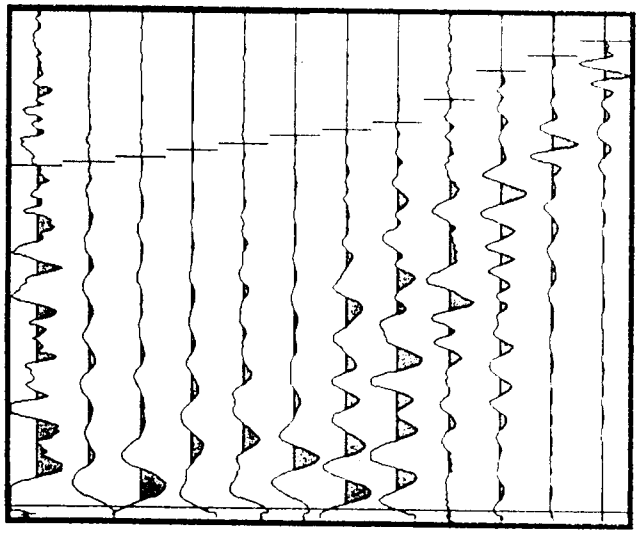
Spread No. : smt37
Number of Geophones : 12
Geophone Spacing : 5m

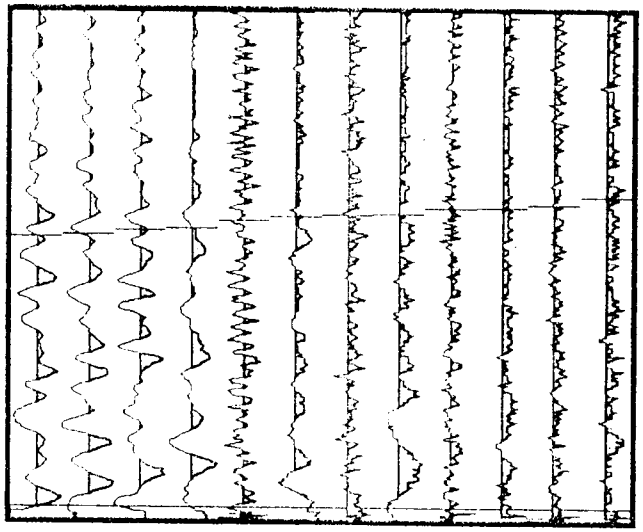




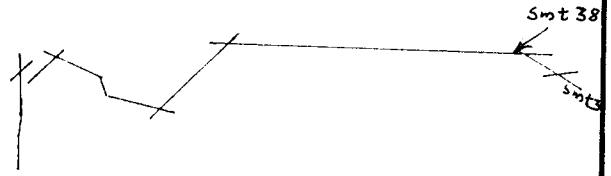


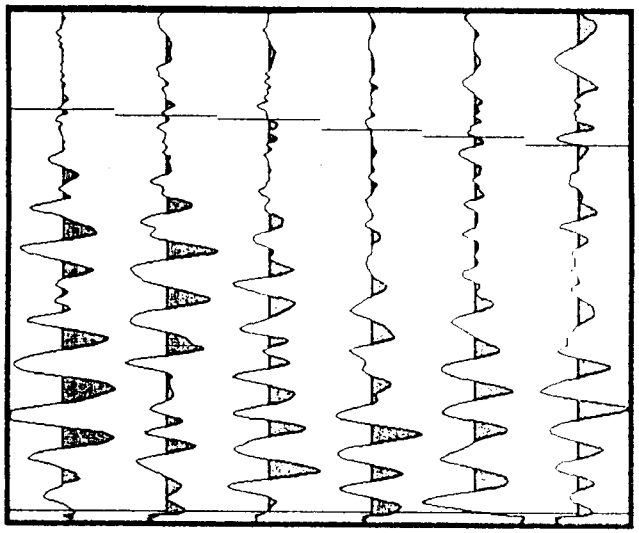


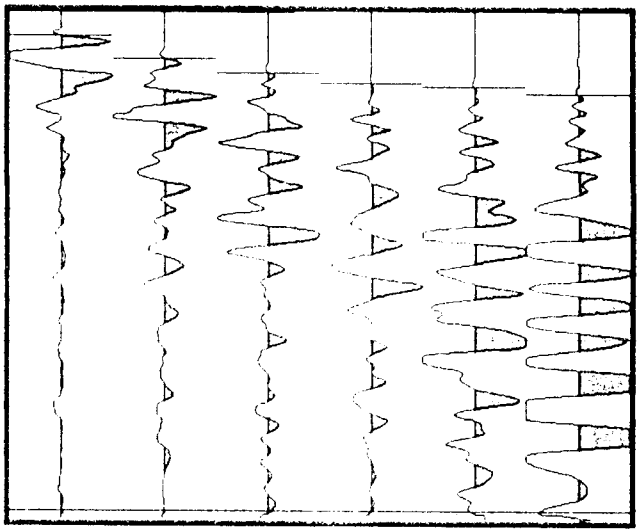


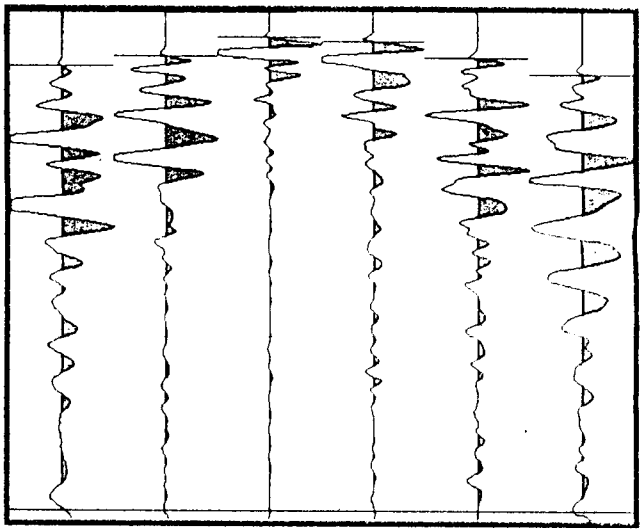


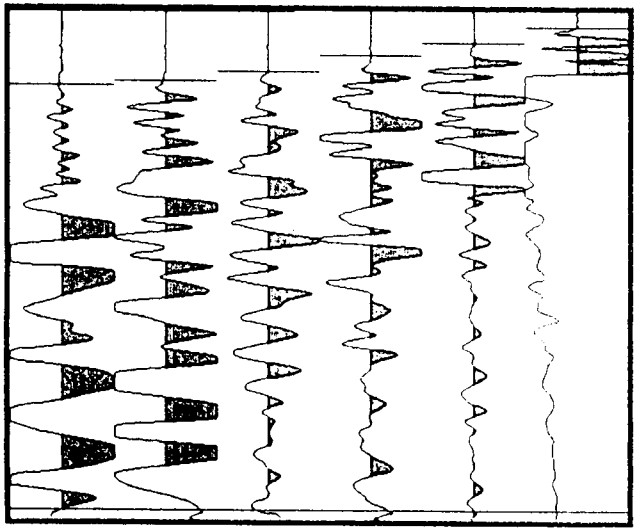
Spread No. : smt38
Number of Geophones : 12
Geophone Spacing : 5m

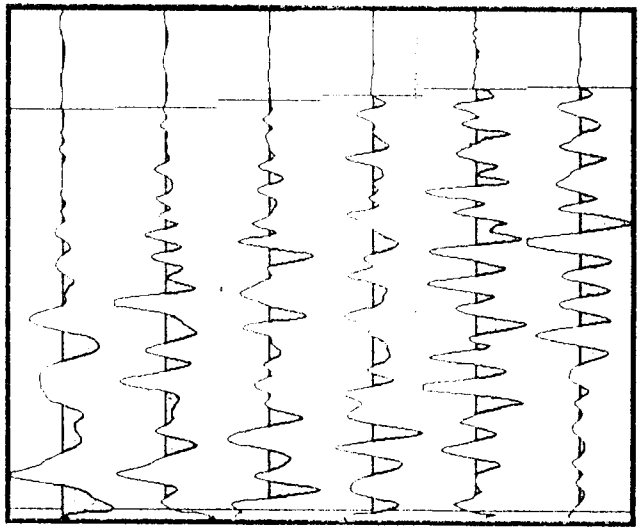




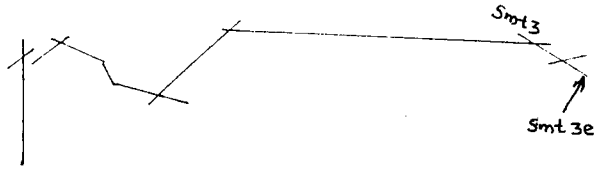


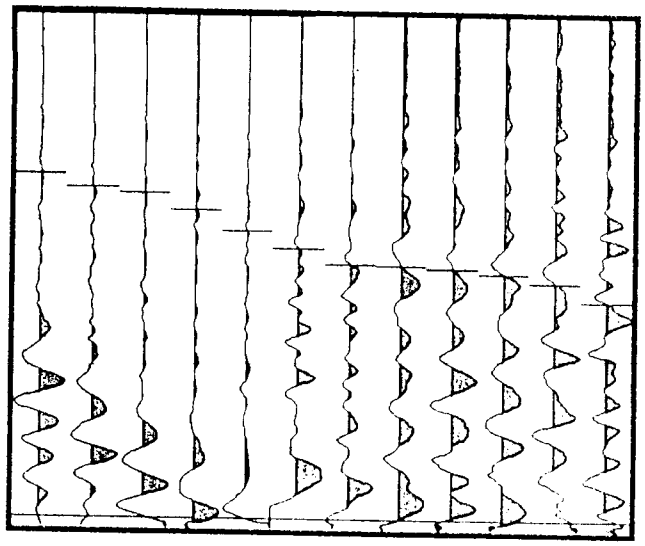


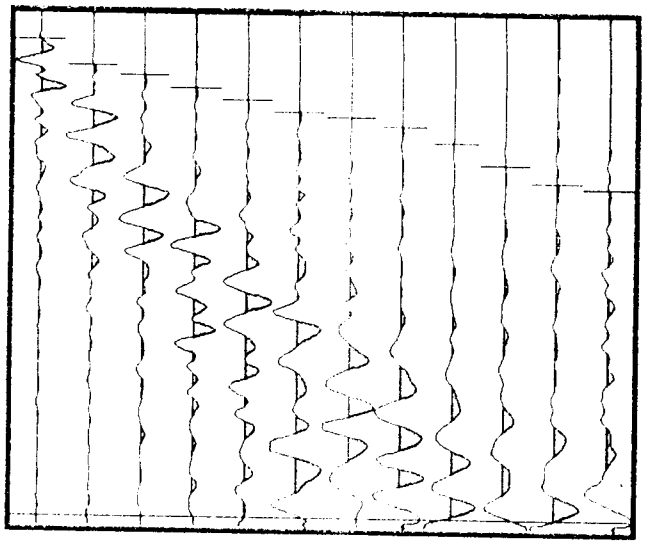


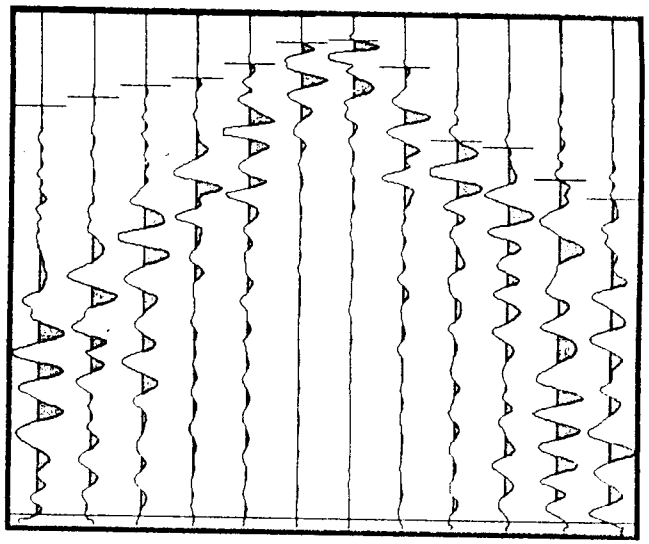


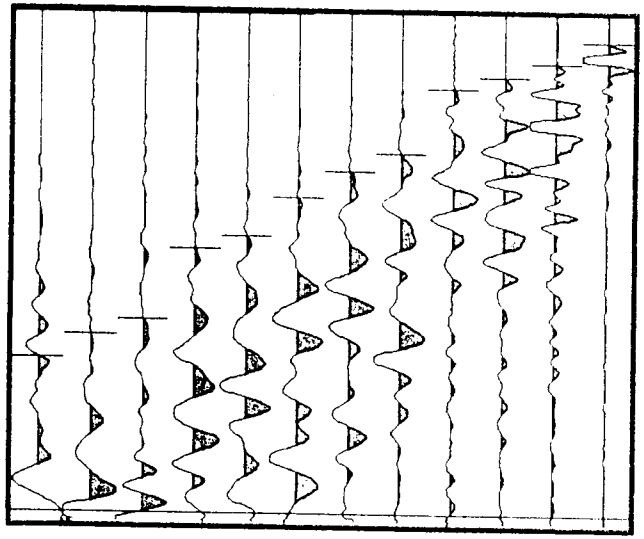
Spread No. : smt3e
Number of Geophones : 06
Geophone Spacing : 5m

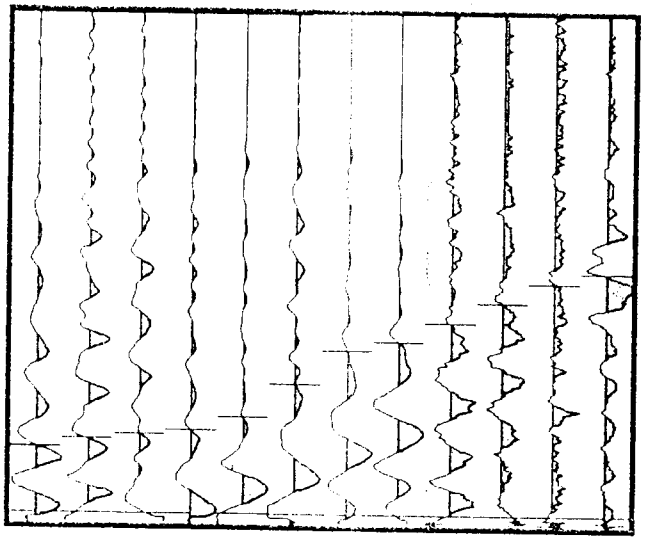




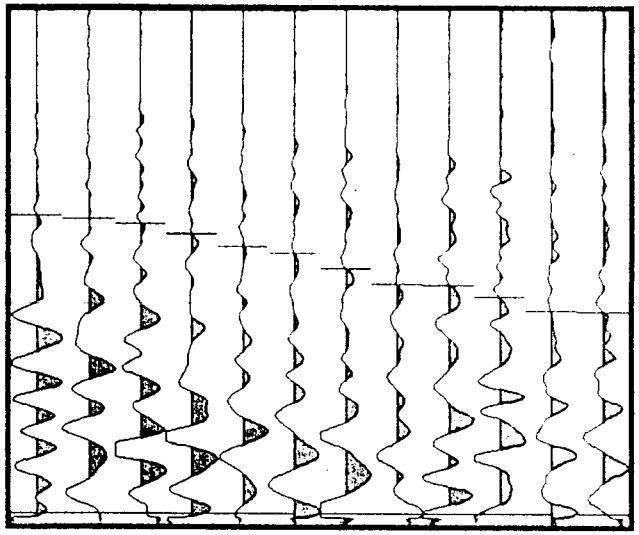


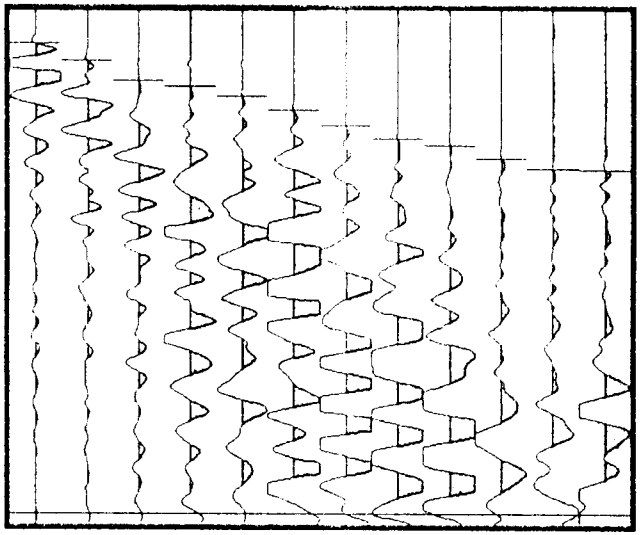


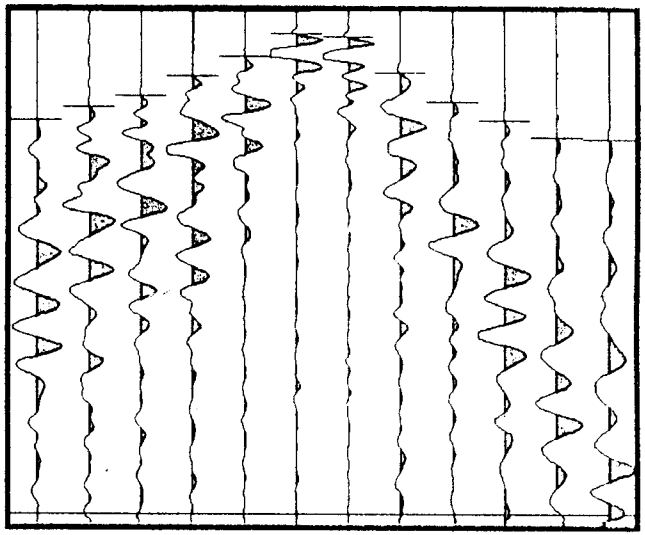


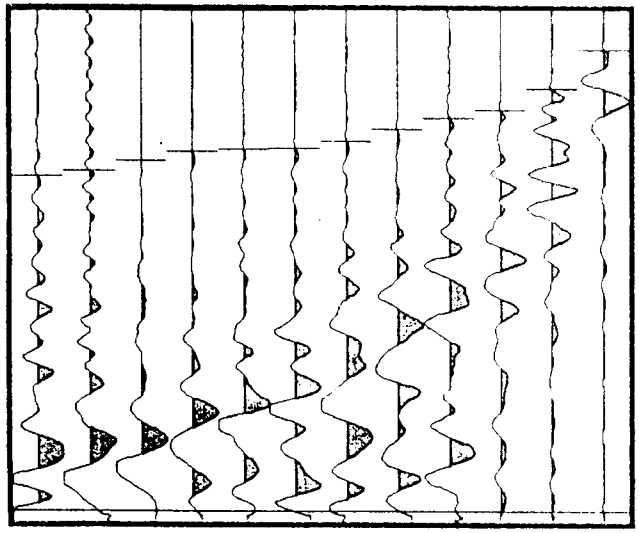


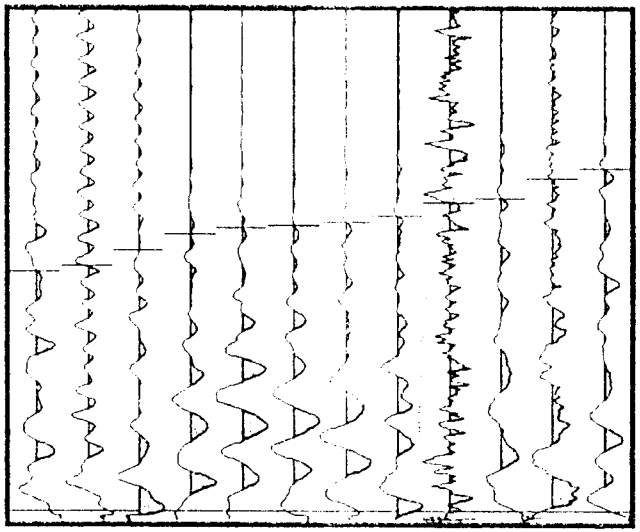
Spread No. : smt41
Number of Geophones : 12
Geophone Spacing : 5m



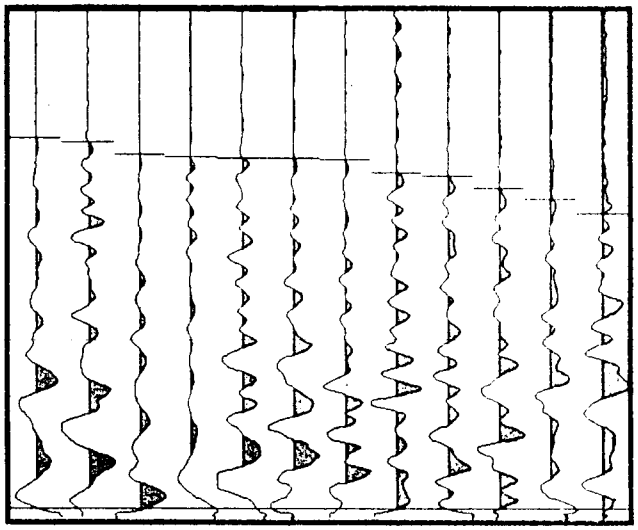


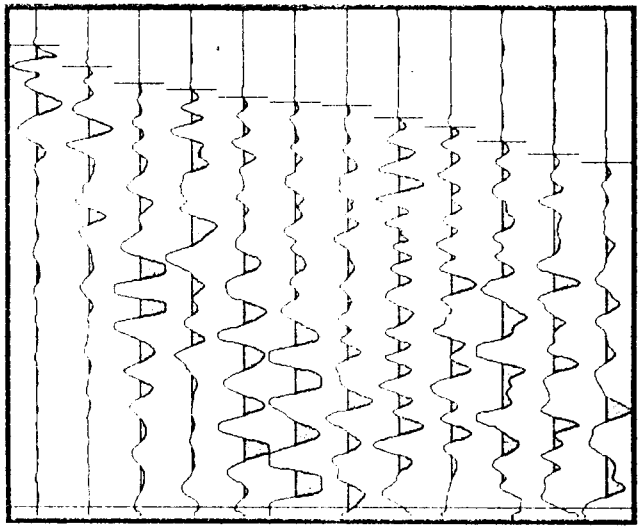


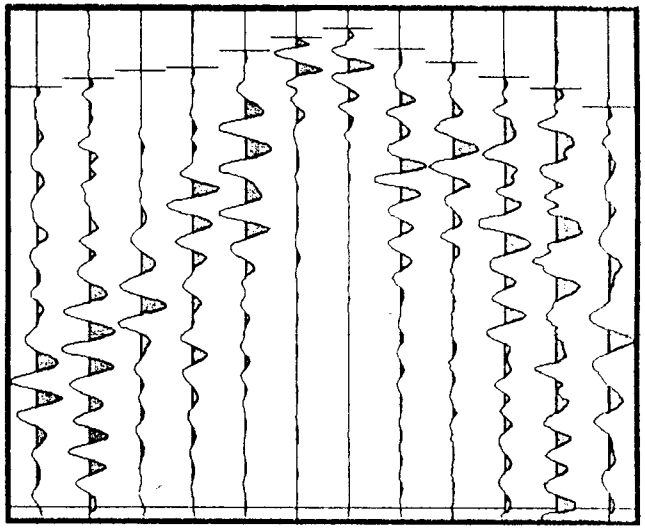


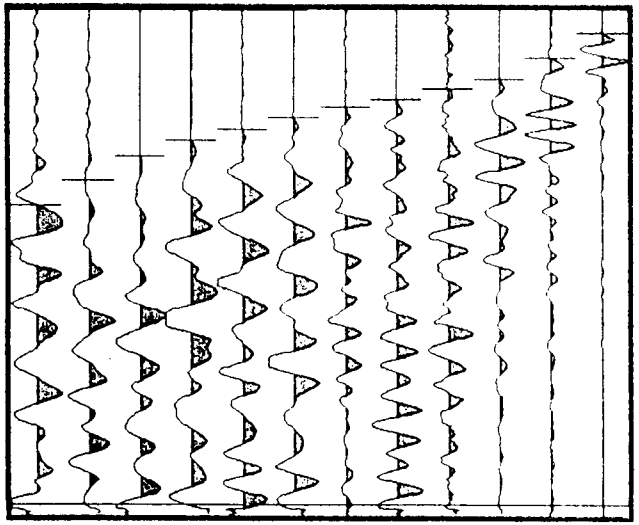


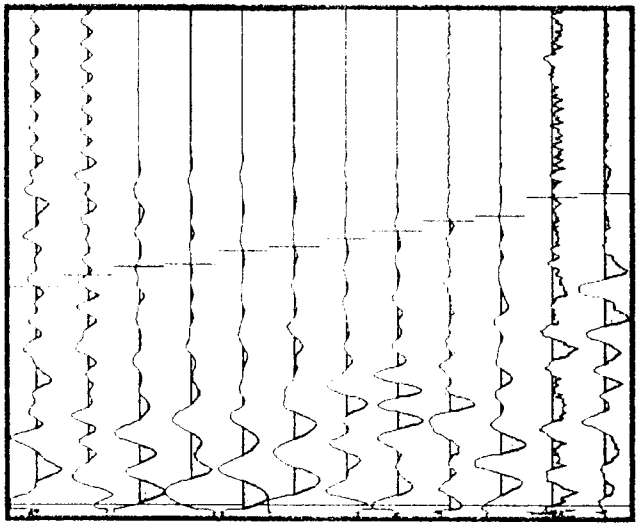
Spread No.	: smt42
Number of Geophones	: 12
Geophone Spacing	: 5m



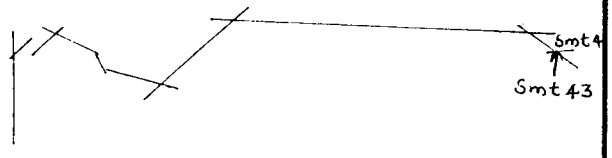


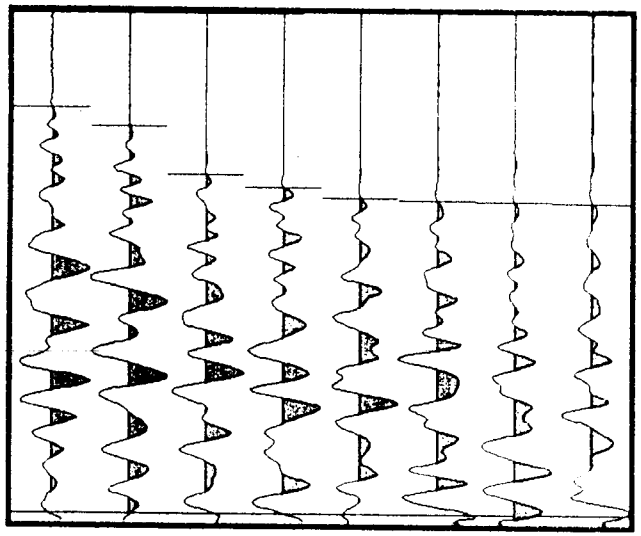


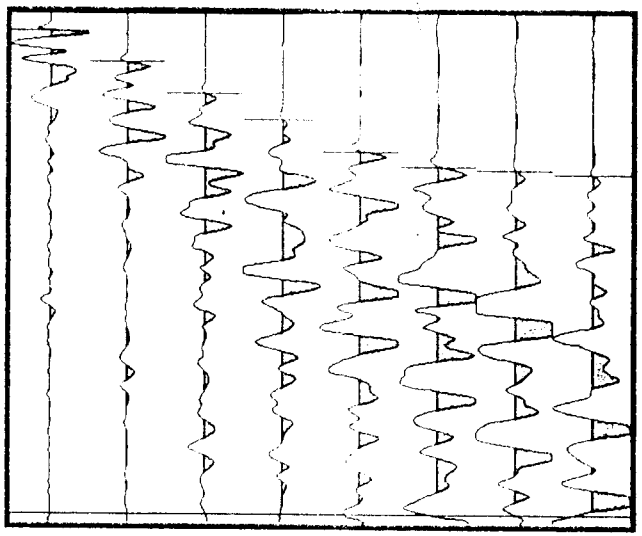


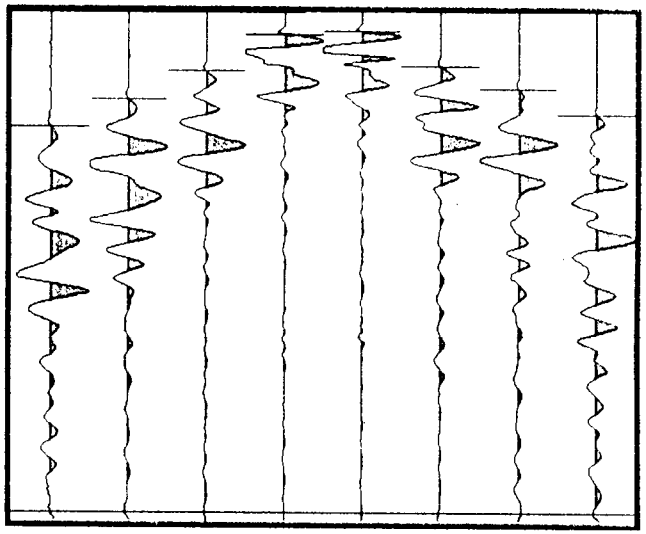


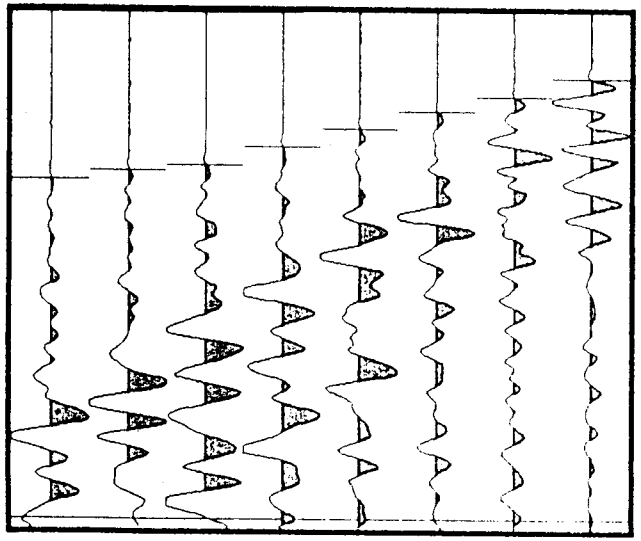
Spread No. : smt43
Number of Geophones : 12
Geophone Spacing : 5m

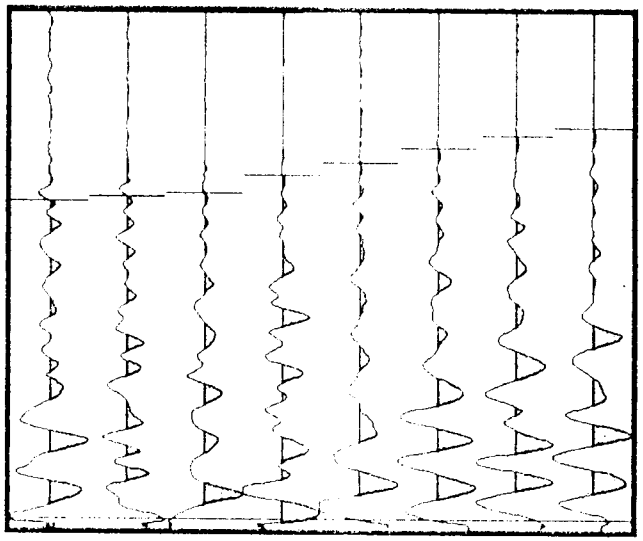




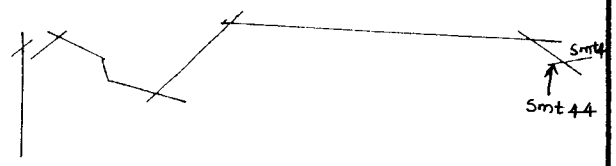


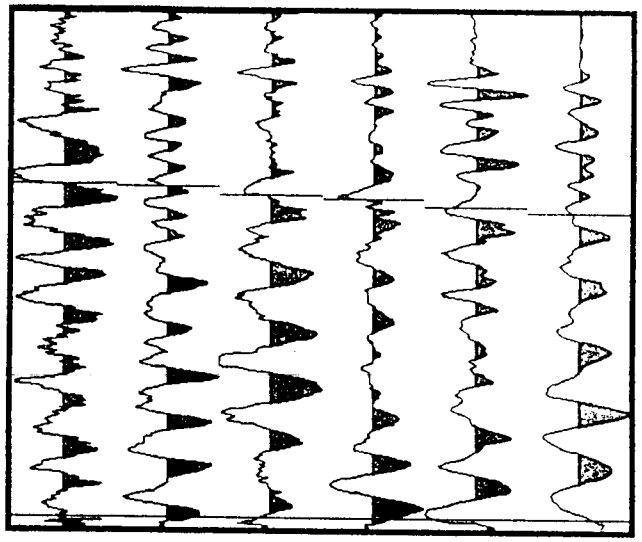


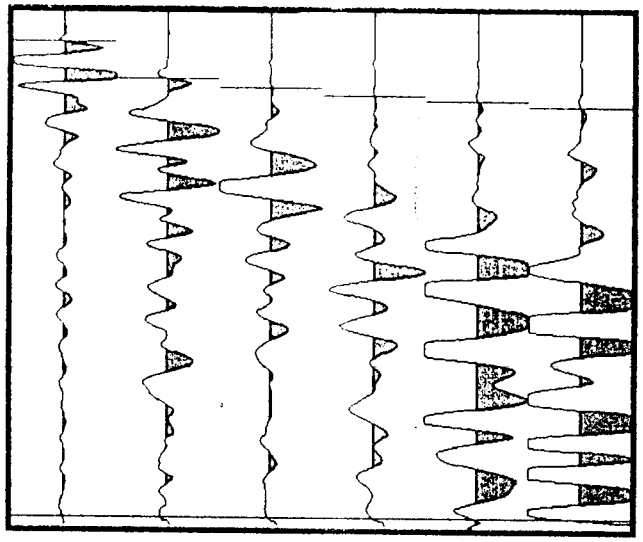


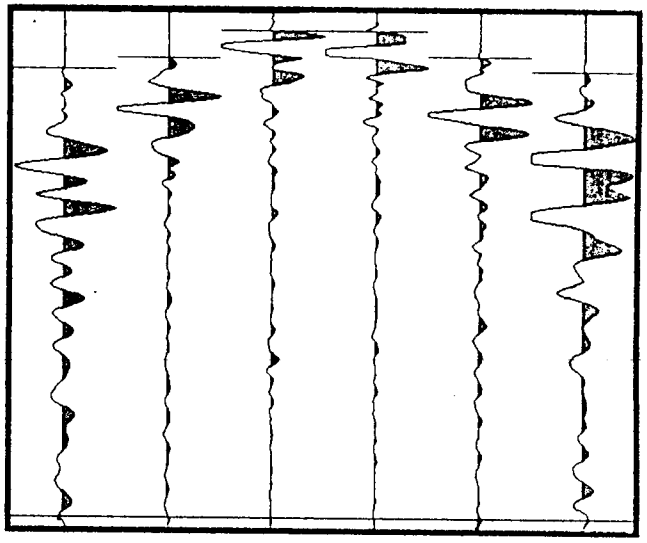


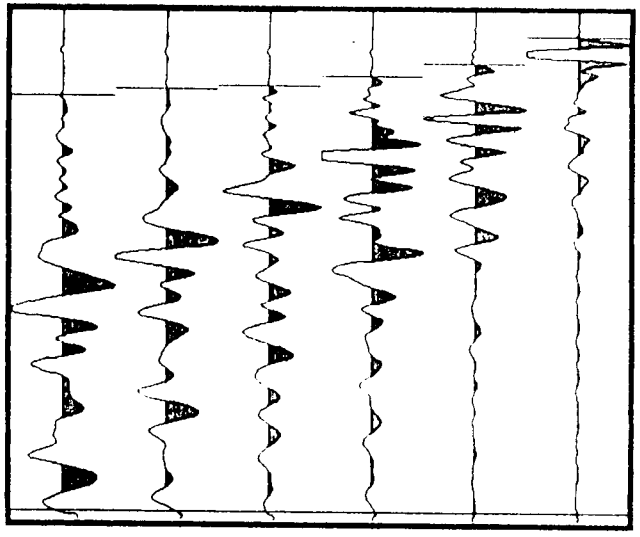
Spread No. : smt44
Number of Geophones : 08
Geophone Spacing : 5m

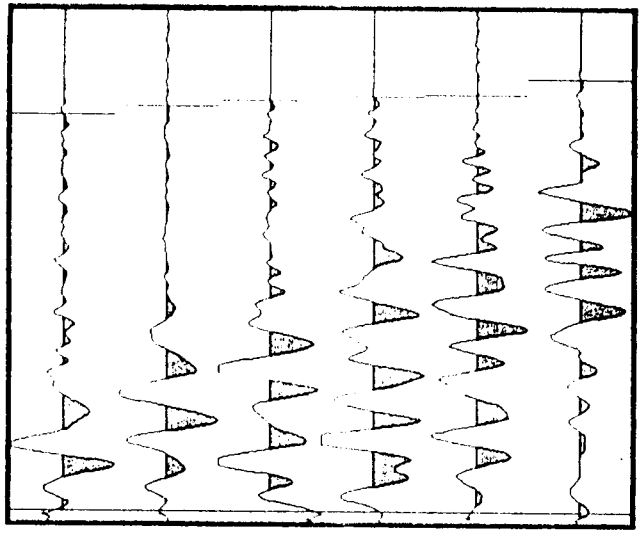




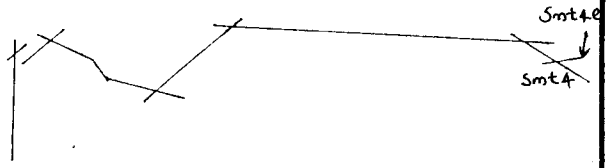








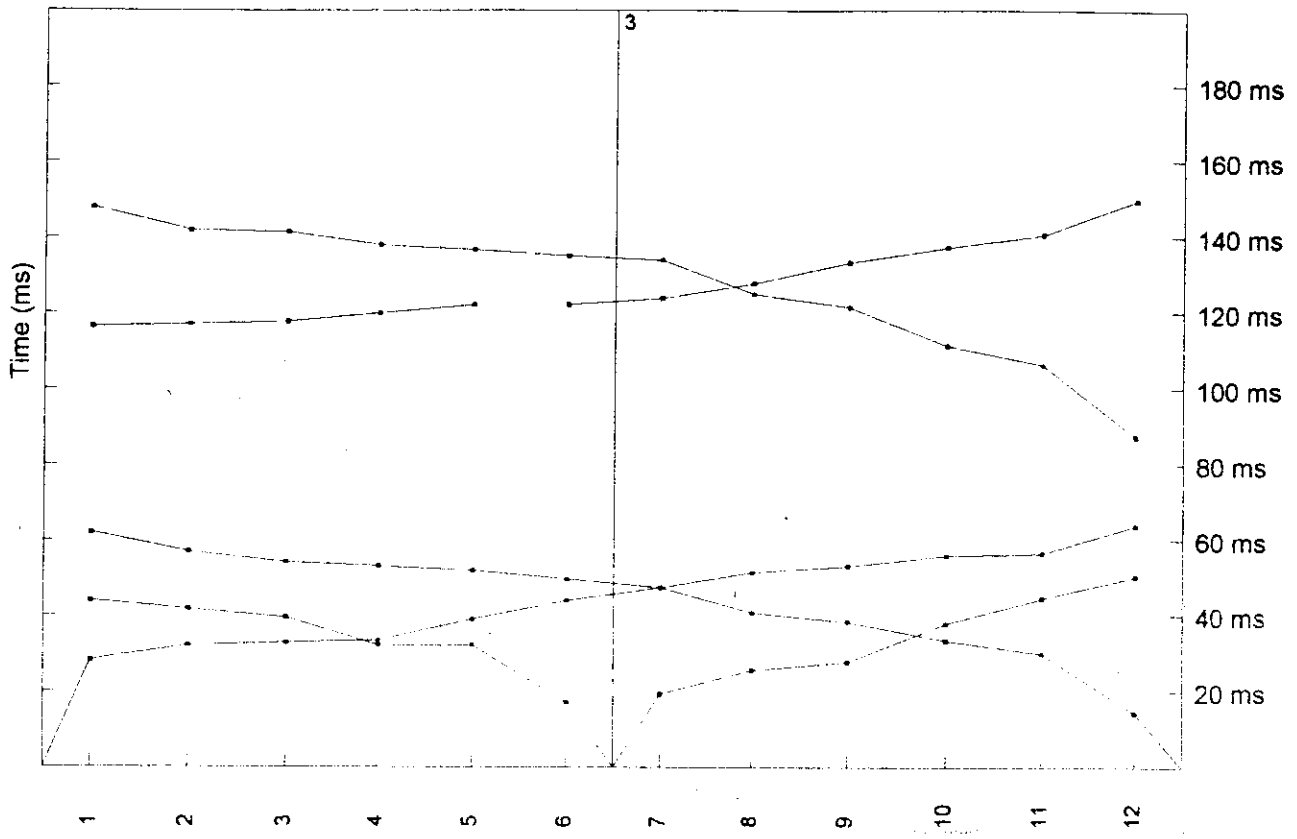
Spread No.	: smt4e
Number of Geophones	: 06
Geophone Spacing	: 5m



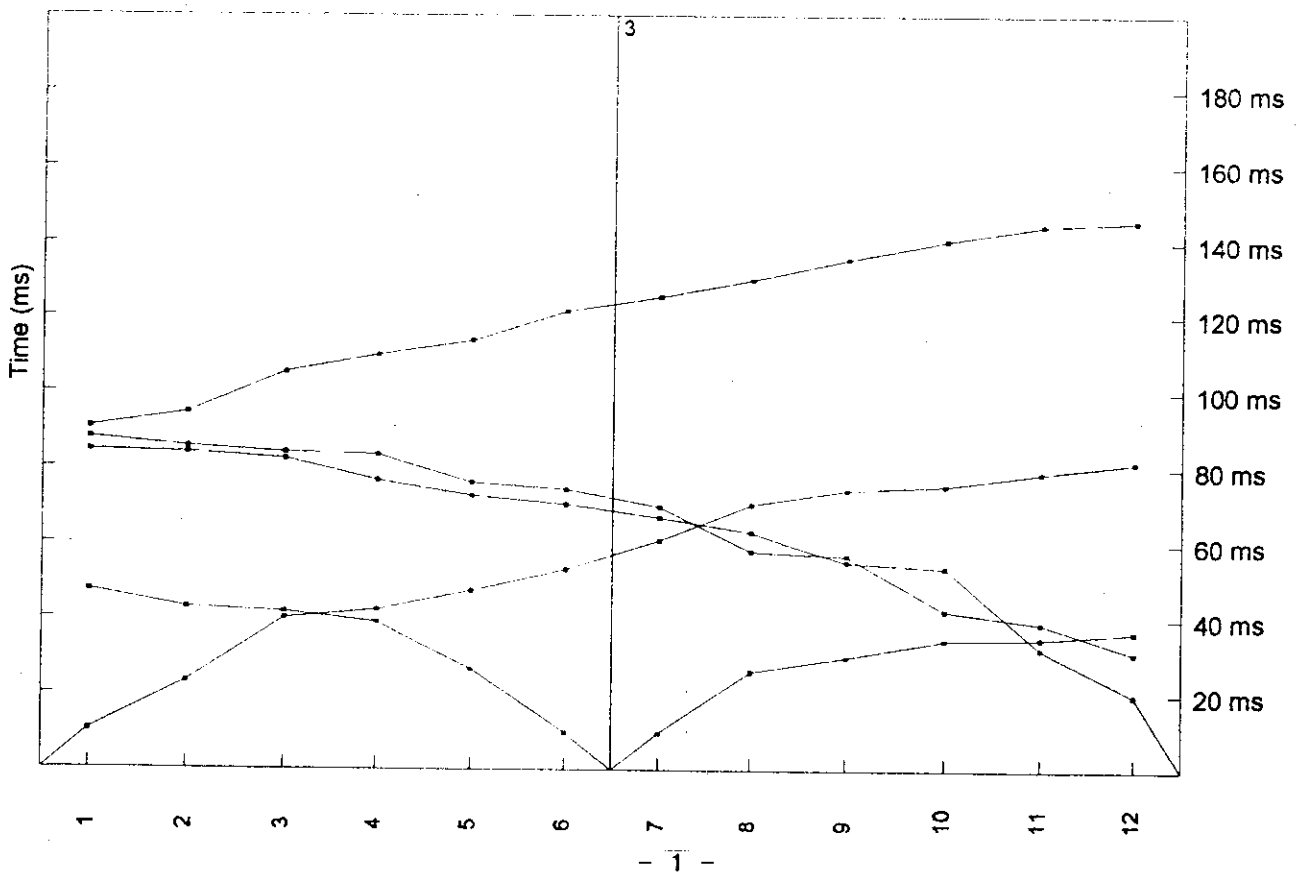
2.3 Time Distance Curve

UNIVERSITY OF PERADENIYA
DEPARTMENT OF GEOLOGY
PERADENIYA - SRI LANKA

Section SCT11

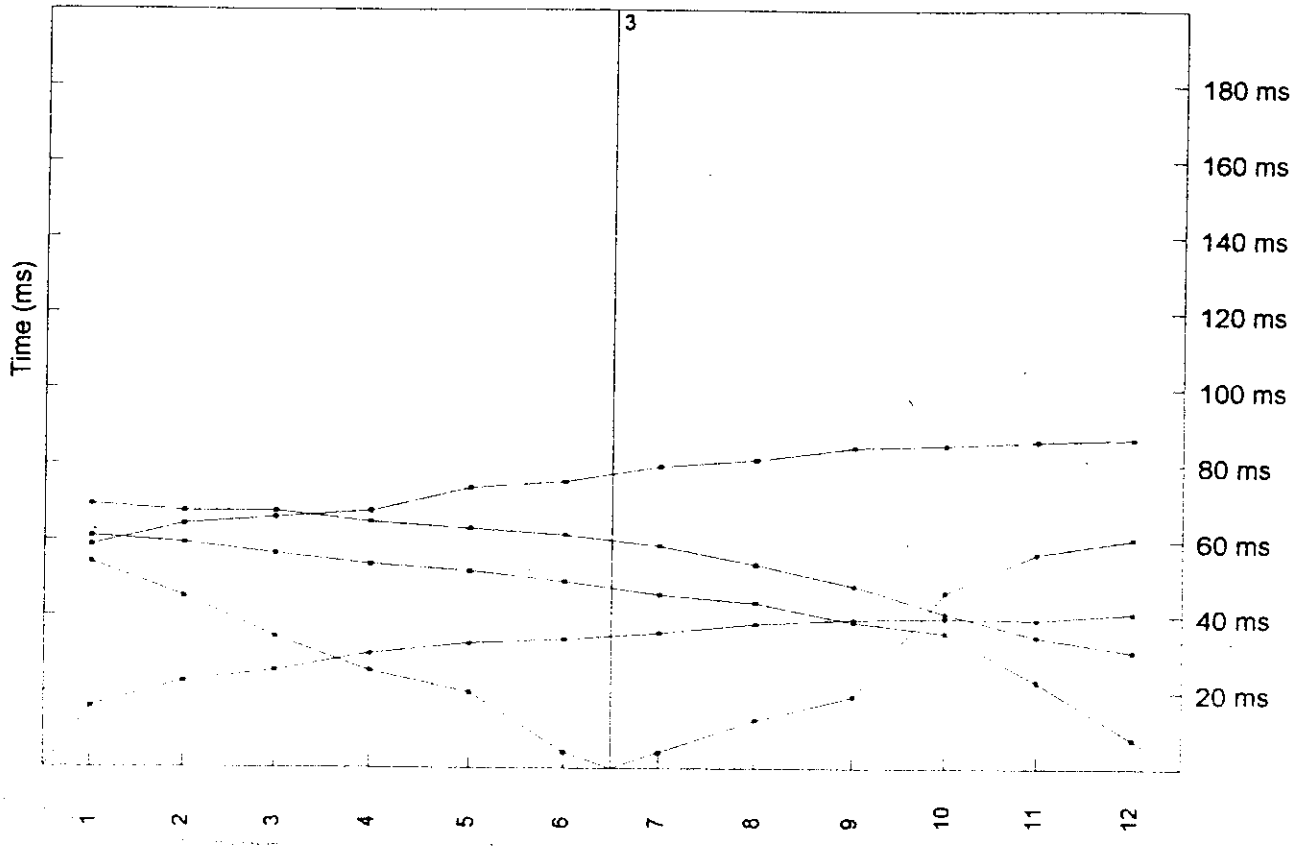


Section SCT12



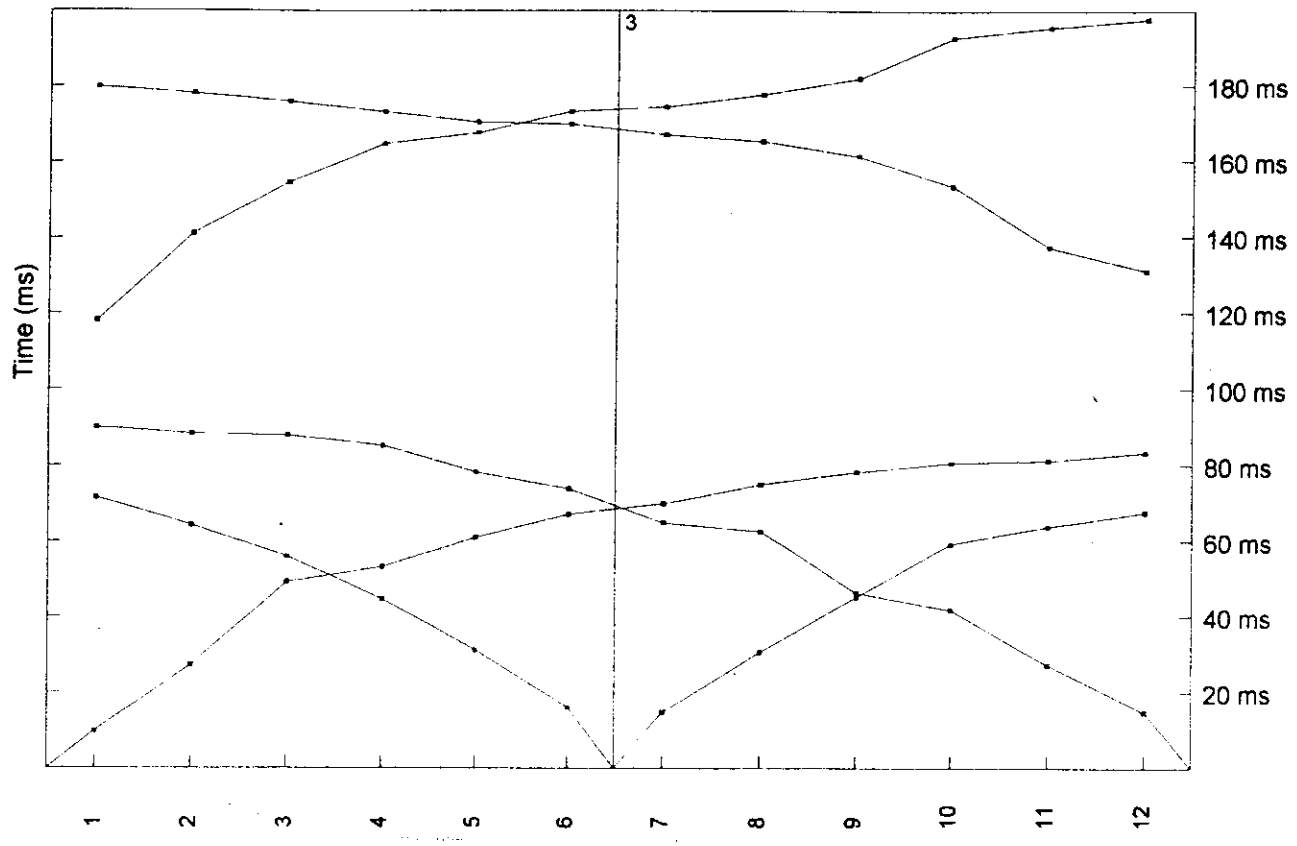
Section SCT13

UNIVERSITY OF PERADENIYA
DEPARTMENT OF GEOLOGY
PERADENIYA - SRI LANKA



UNIVERSITY OF PERADENIYA
DEPARTMENT OF GEOLOGY
PERADENIYA - SRI LANKA

Section SCT21



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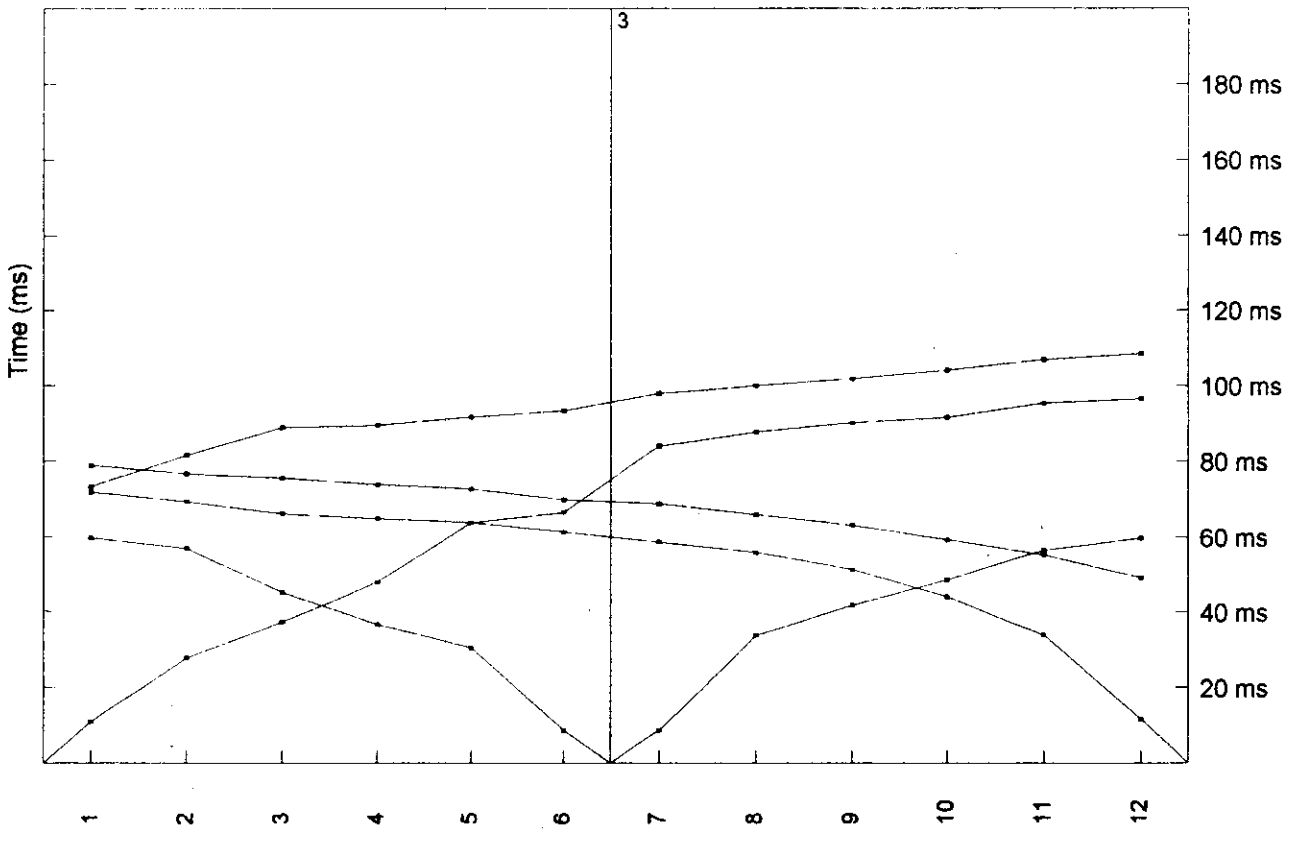
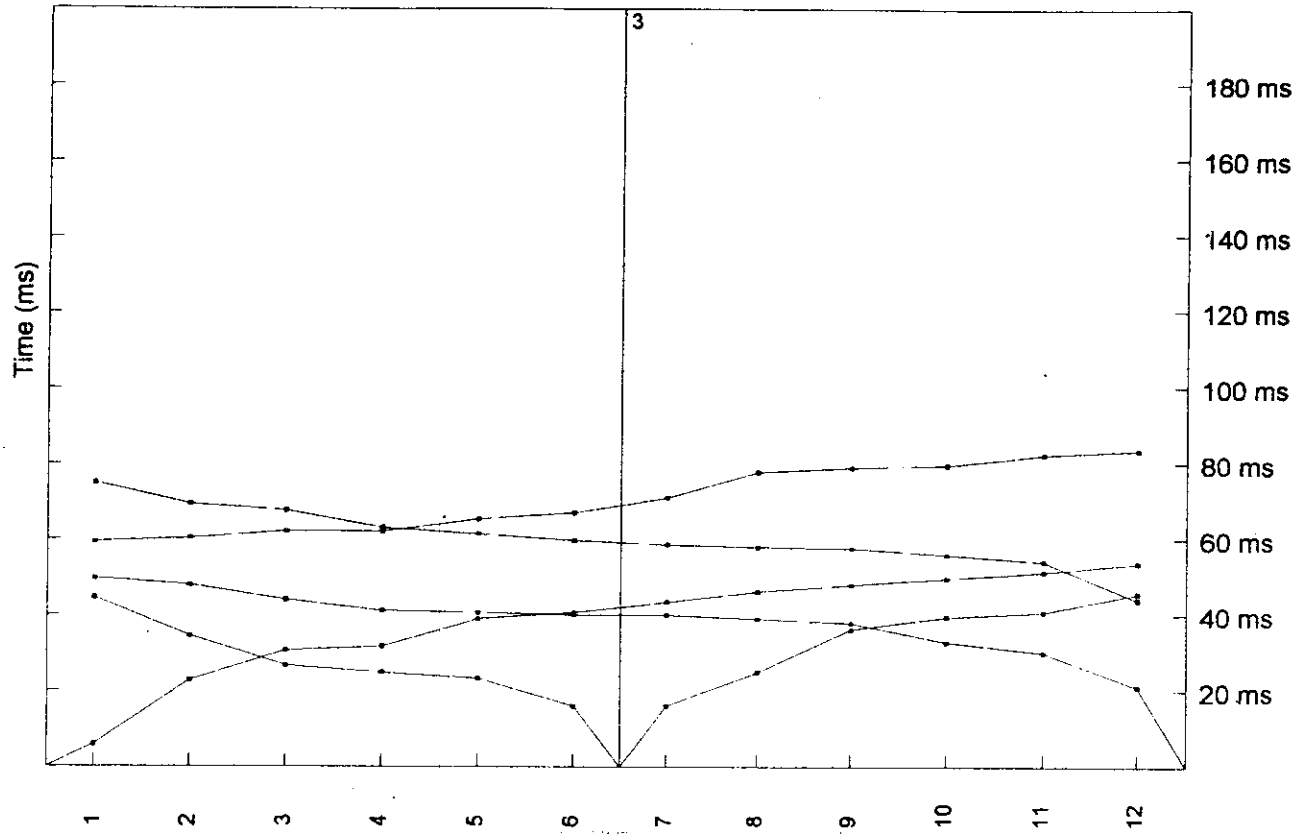
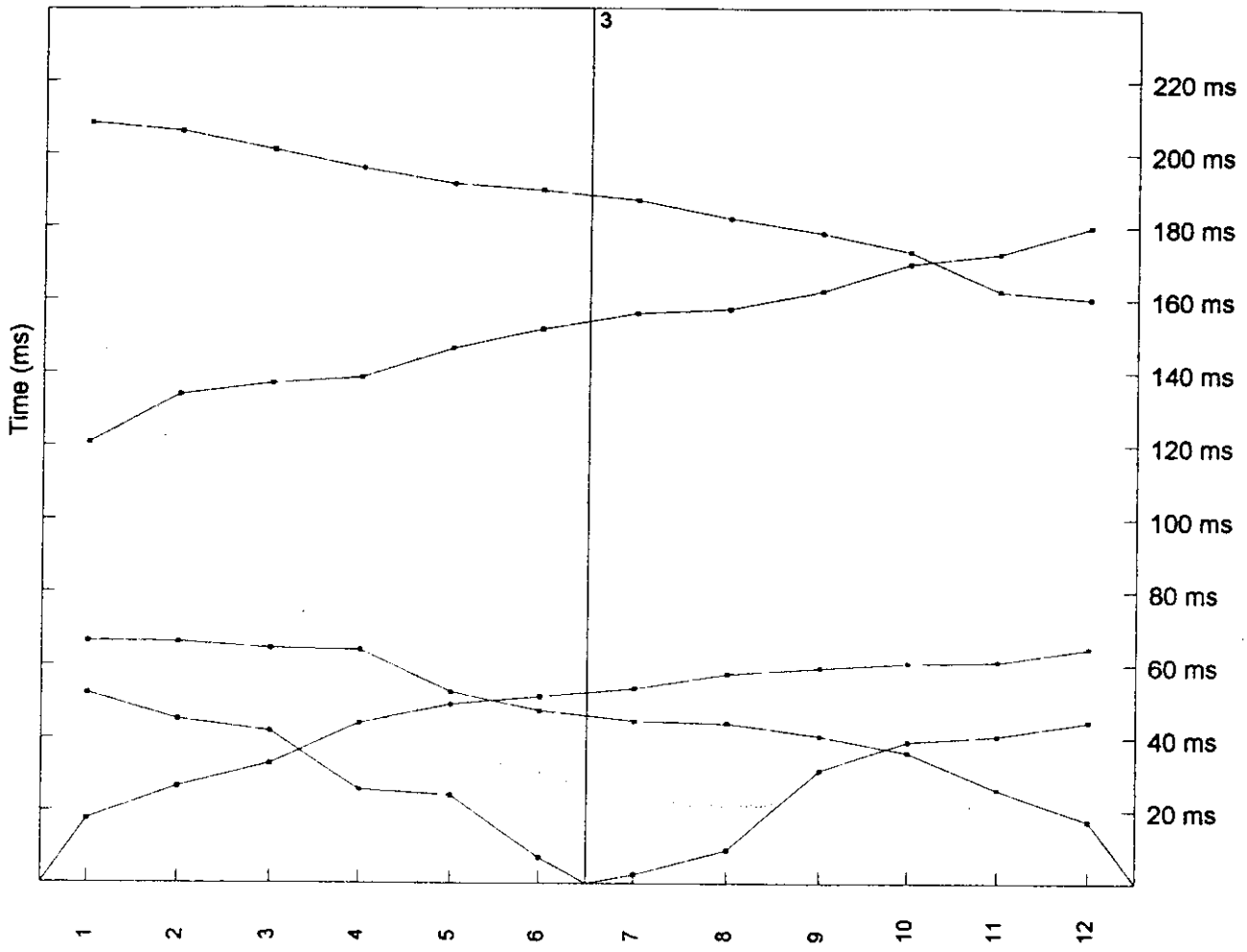


Section SCT23

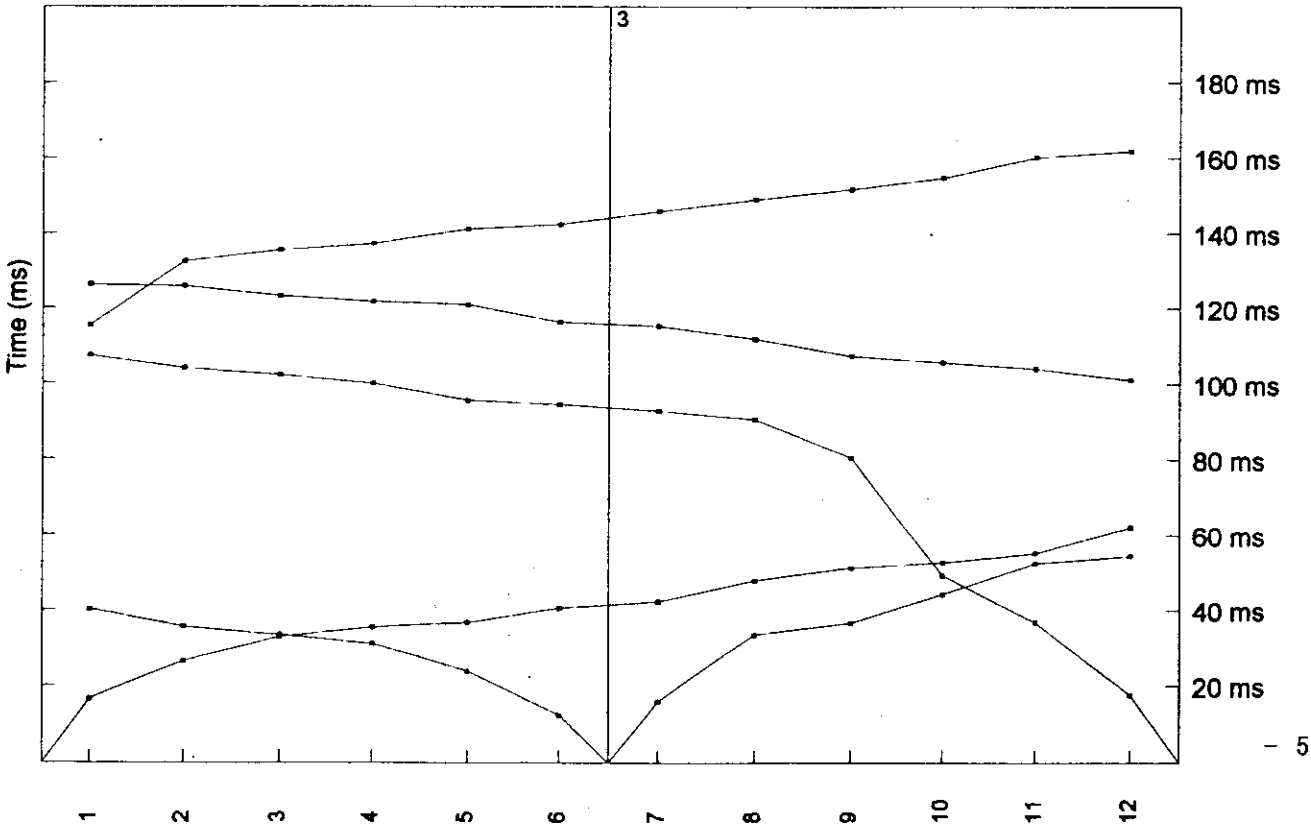
UNIVERSITY OF PERADENIYA
DEPARTMENT OF GEOLOGY
PERADENIYA - SRI LANKA



Section SCT31

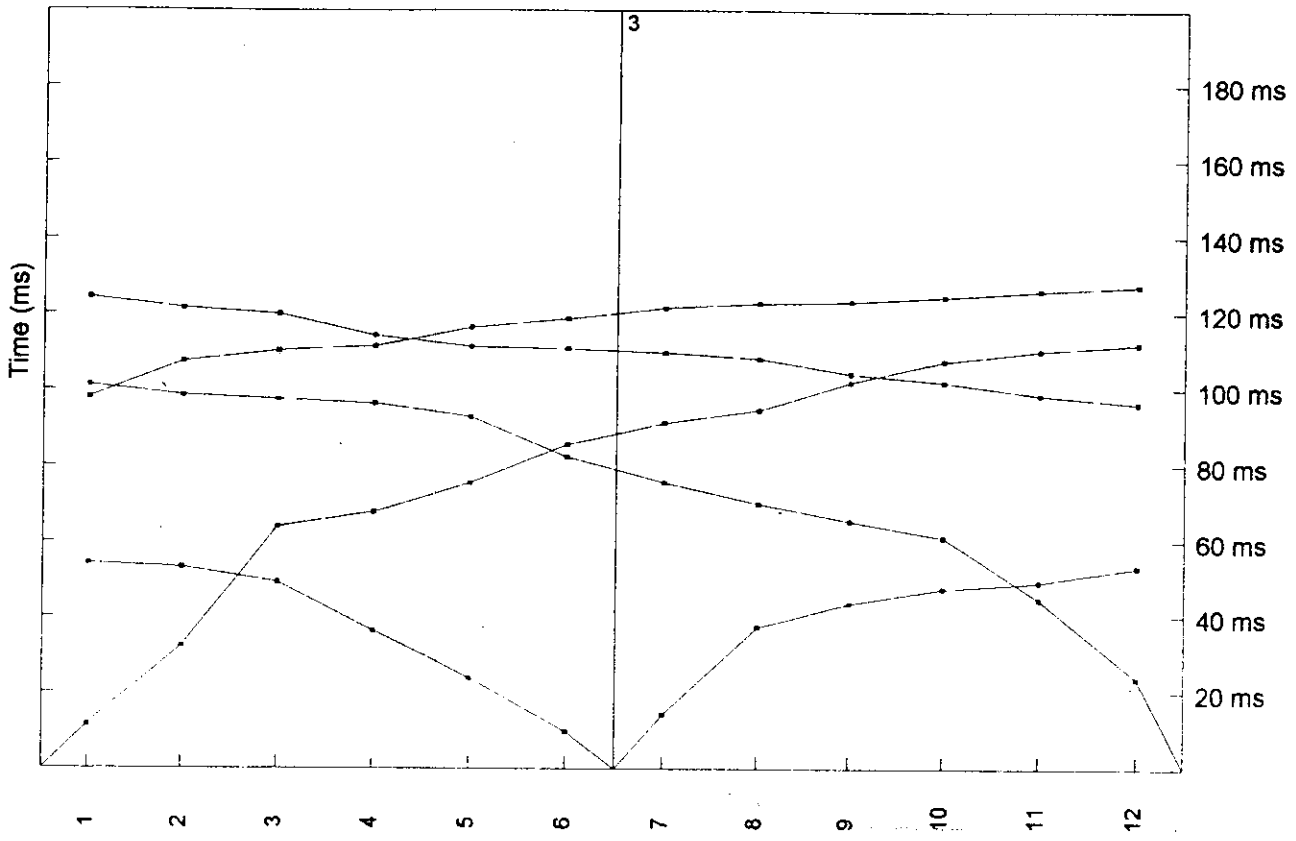


Section SCT32



UNIVERSITY OF PERADENIYA
DEPARTMENT OF GEOLOGY
PERADENIYA - SRI LANKA

Section SCT33



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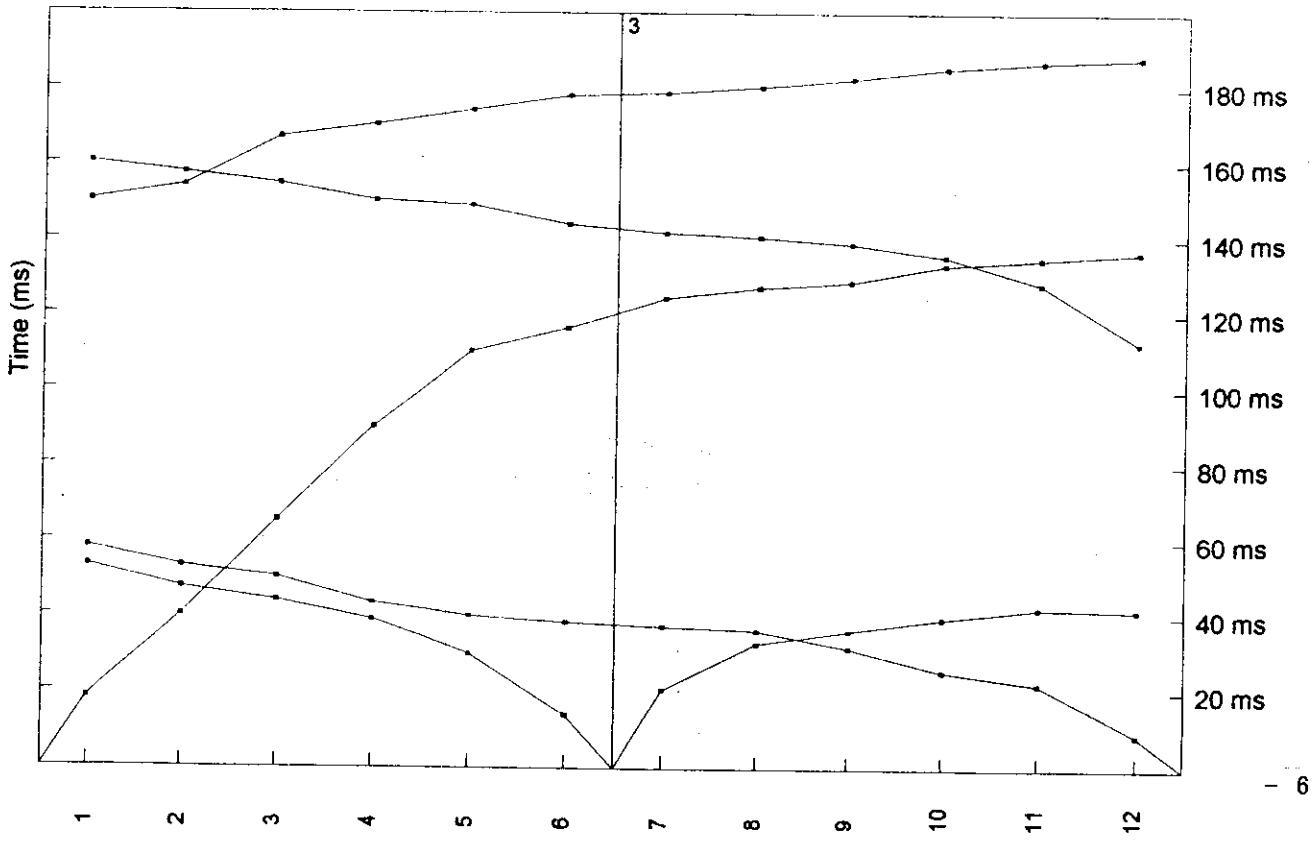
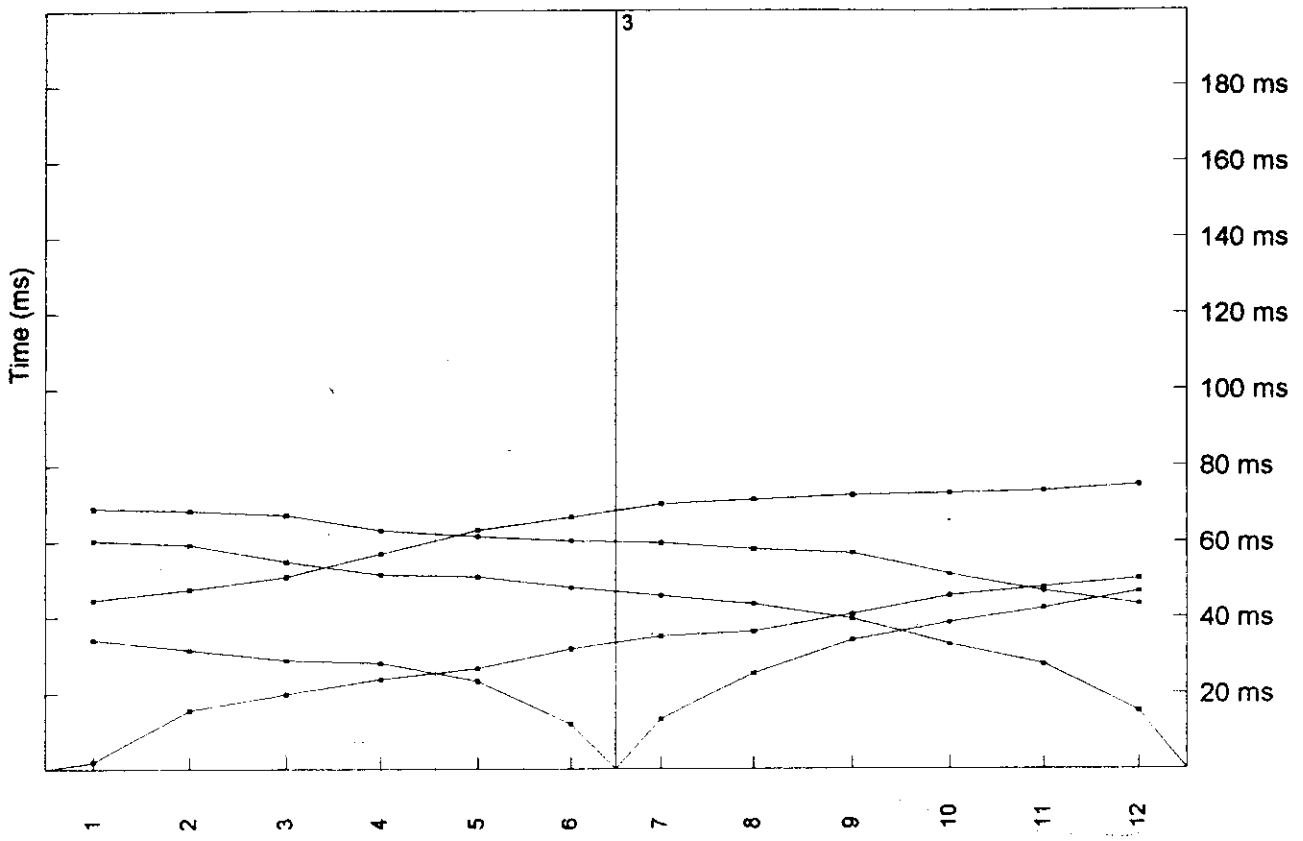
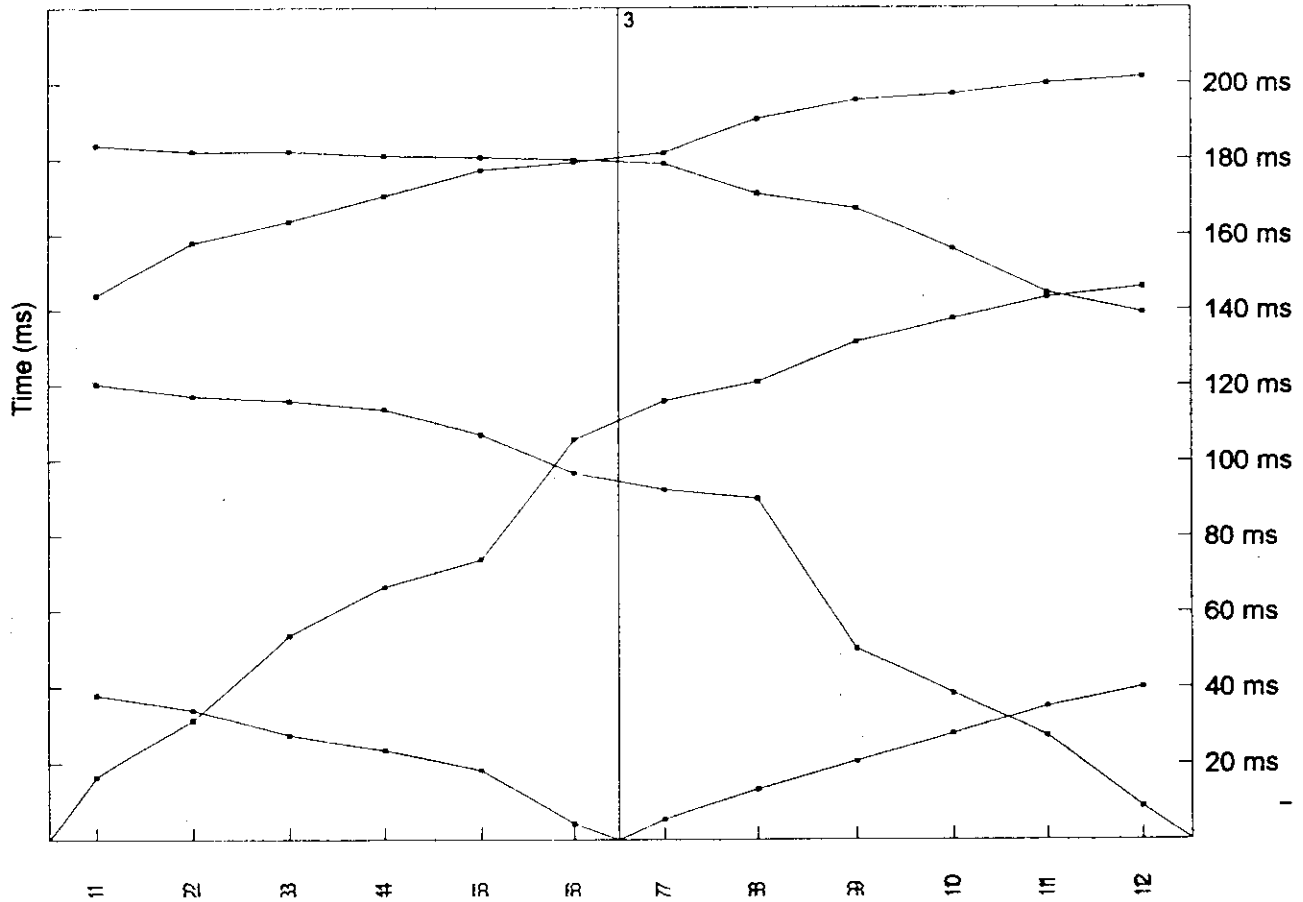


UNIVERSITY OF PERADENIYA
DEPARTMENT OF GEOLOGY
PERADENIYA - SRI LANKA

Section SCT35

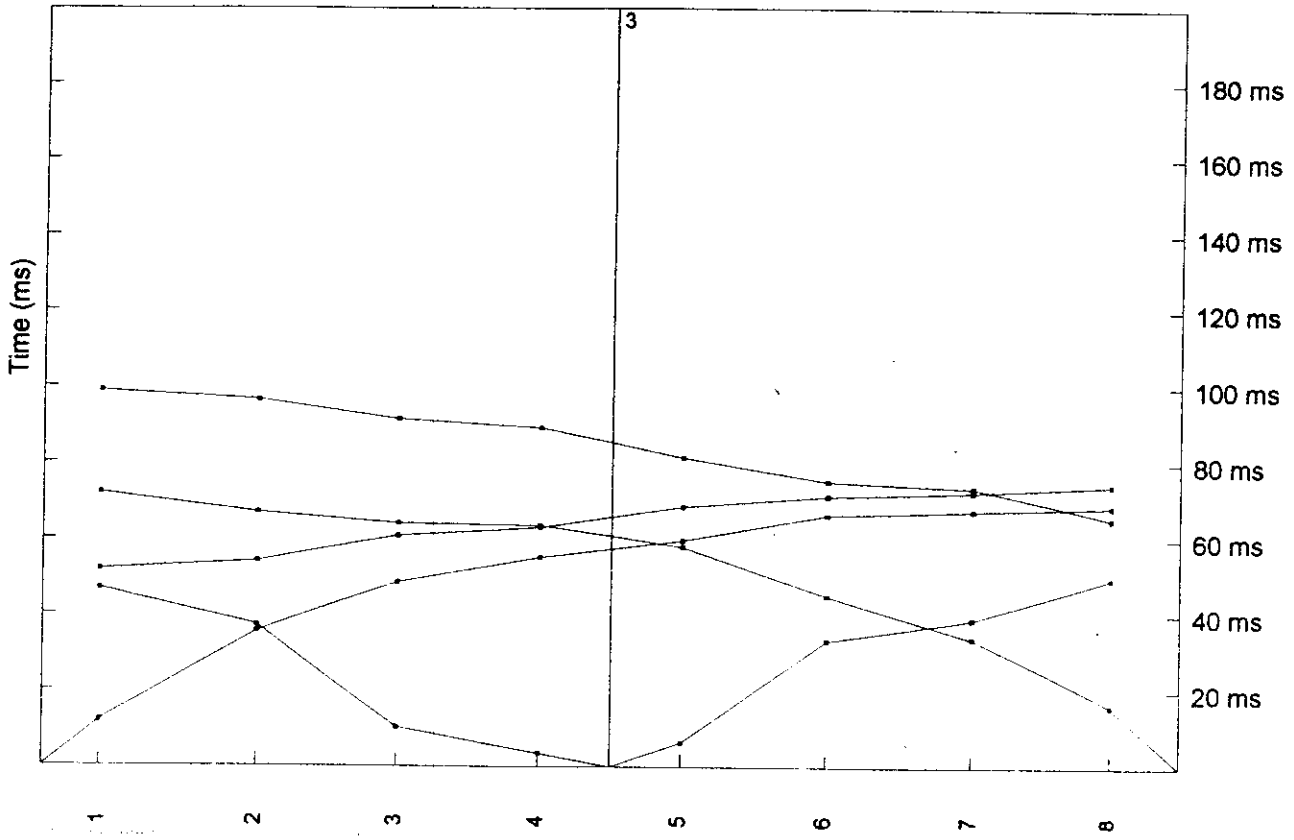


Section SCT36



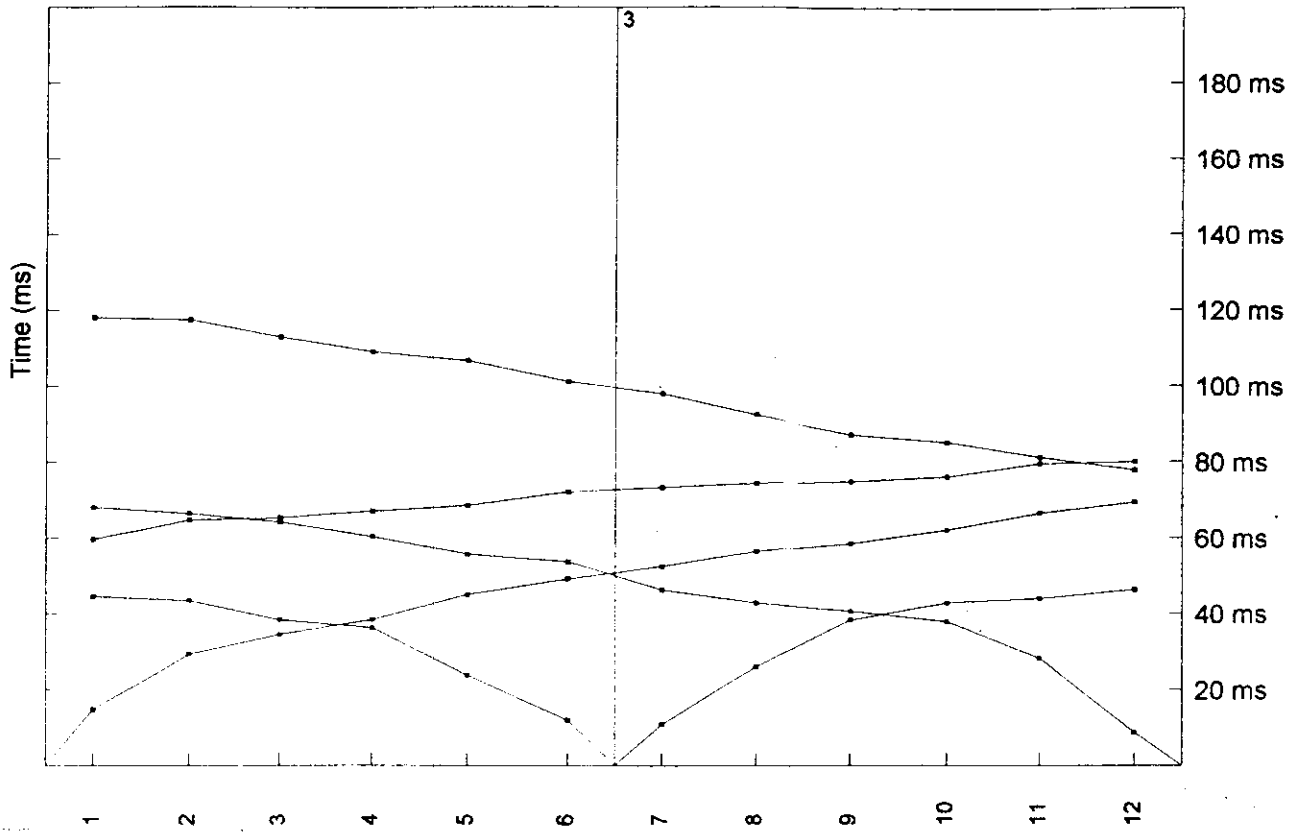
Section SCT37

UNIVERSITY OF PERADENIYA
DEPARTMENT OF GEOLOGY
PERADENIYA - SRI LANKA

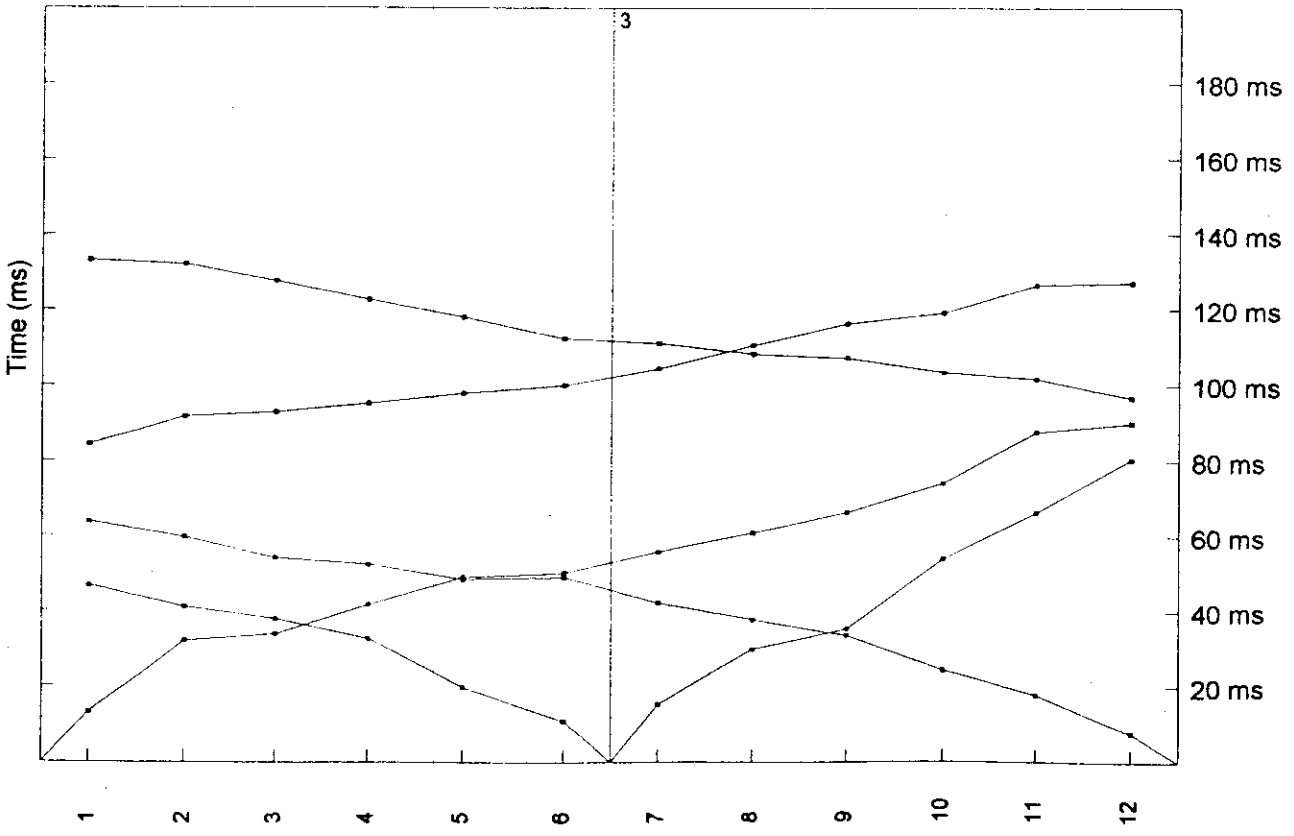


Section SDT11

UNIVERSITY OF PERADENIYA
DEPARTMENT OF GEOLOGY
PERADENIYA - SRI LANKA

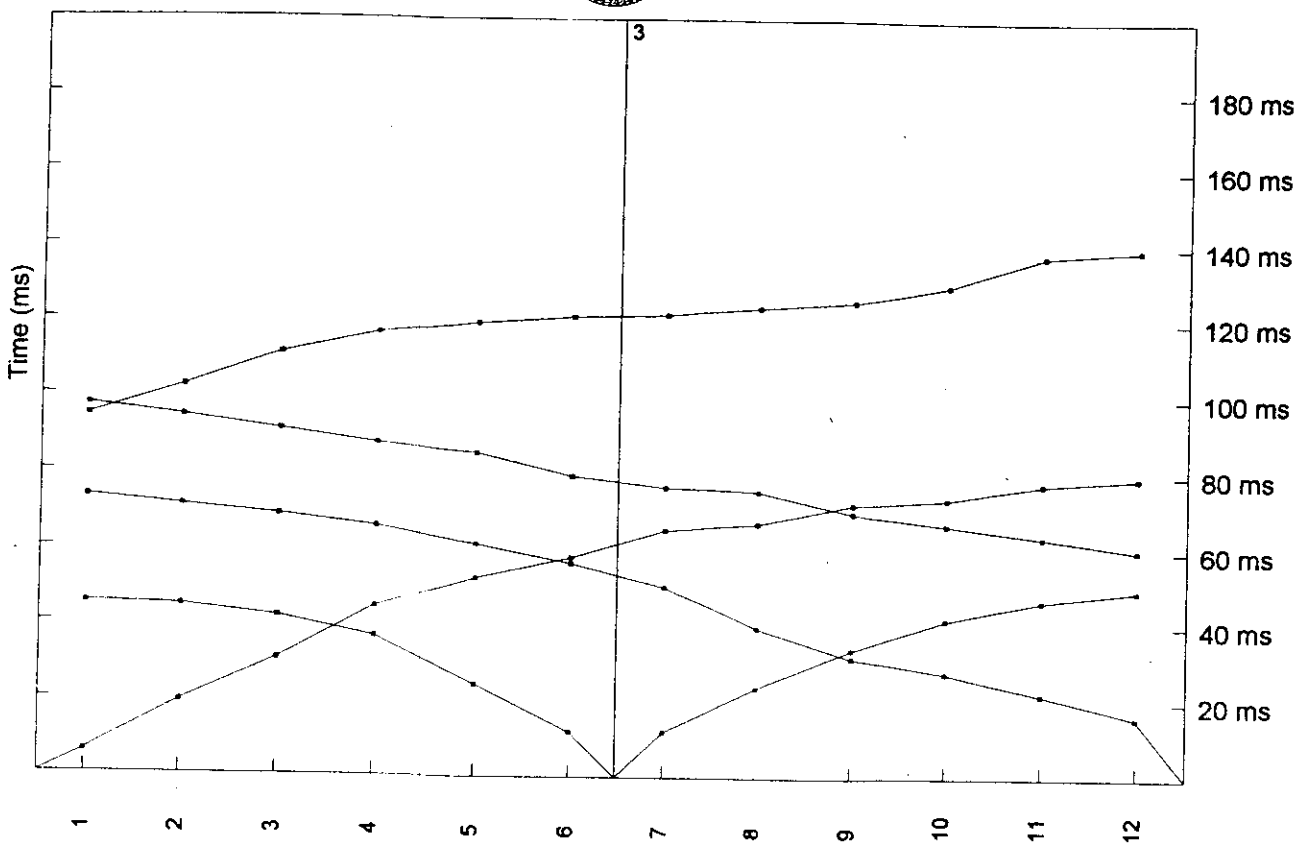


Section SDT12



Section SDT13

UNIVERSITY OF PERADENIYA
DEPARTMENT OF GEOLOGY
PERADENIYA - SRI LANKA



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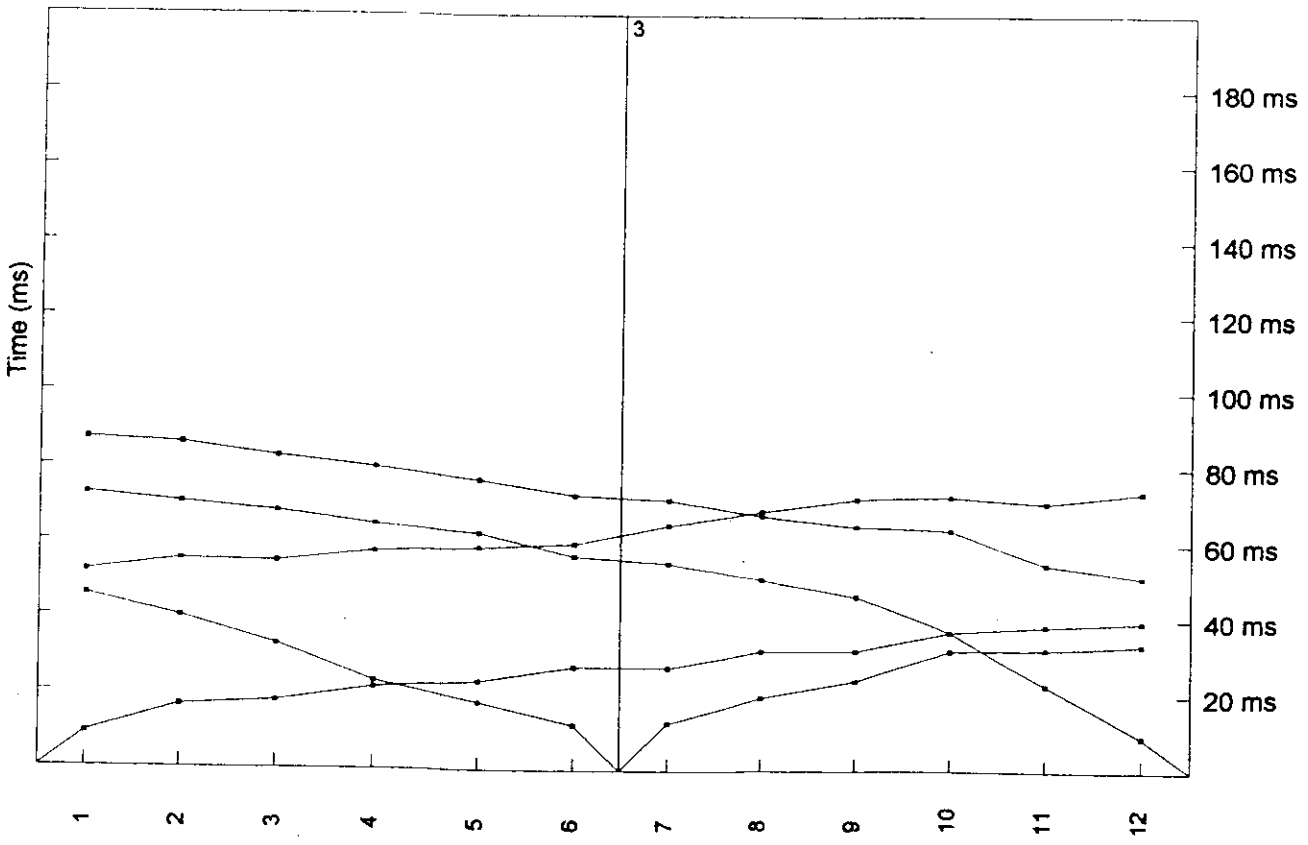

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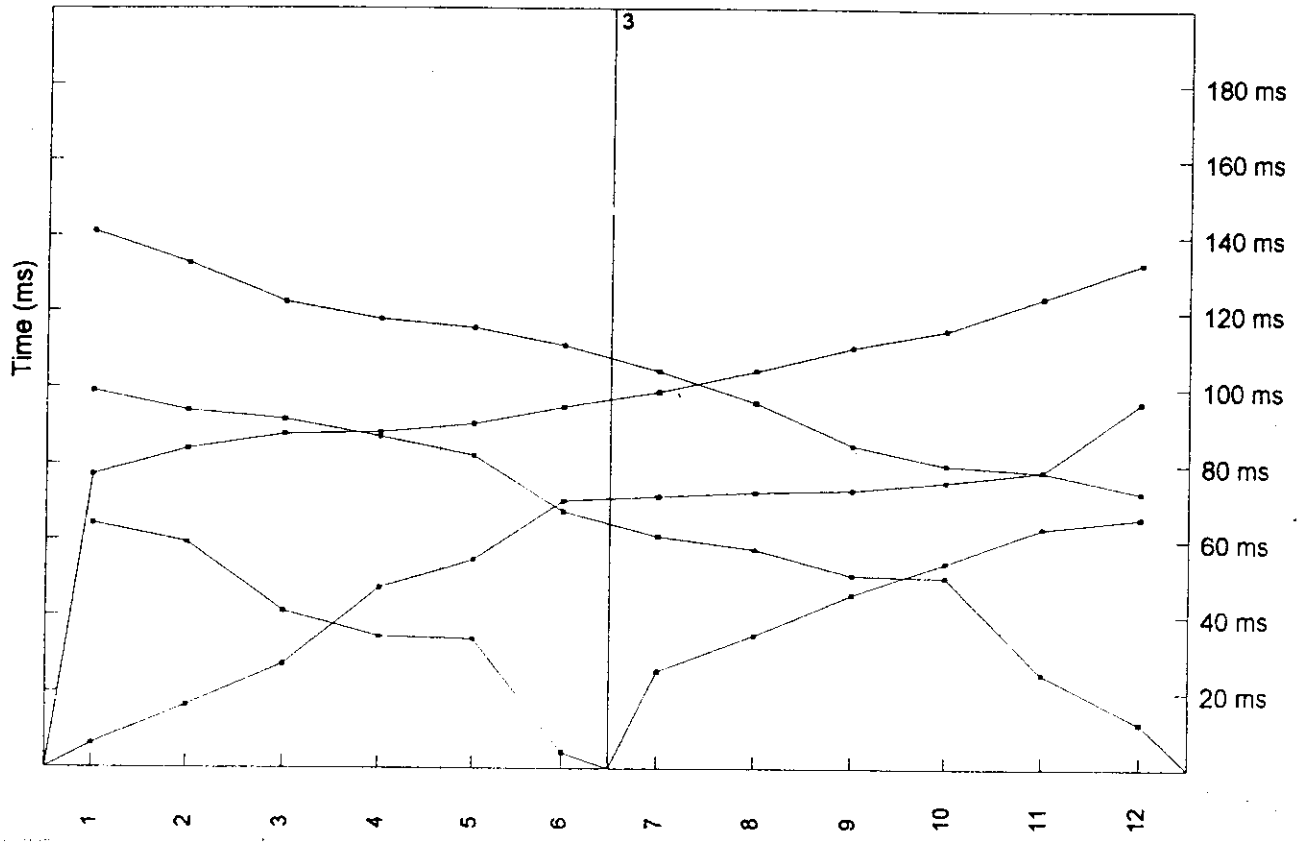

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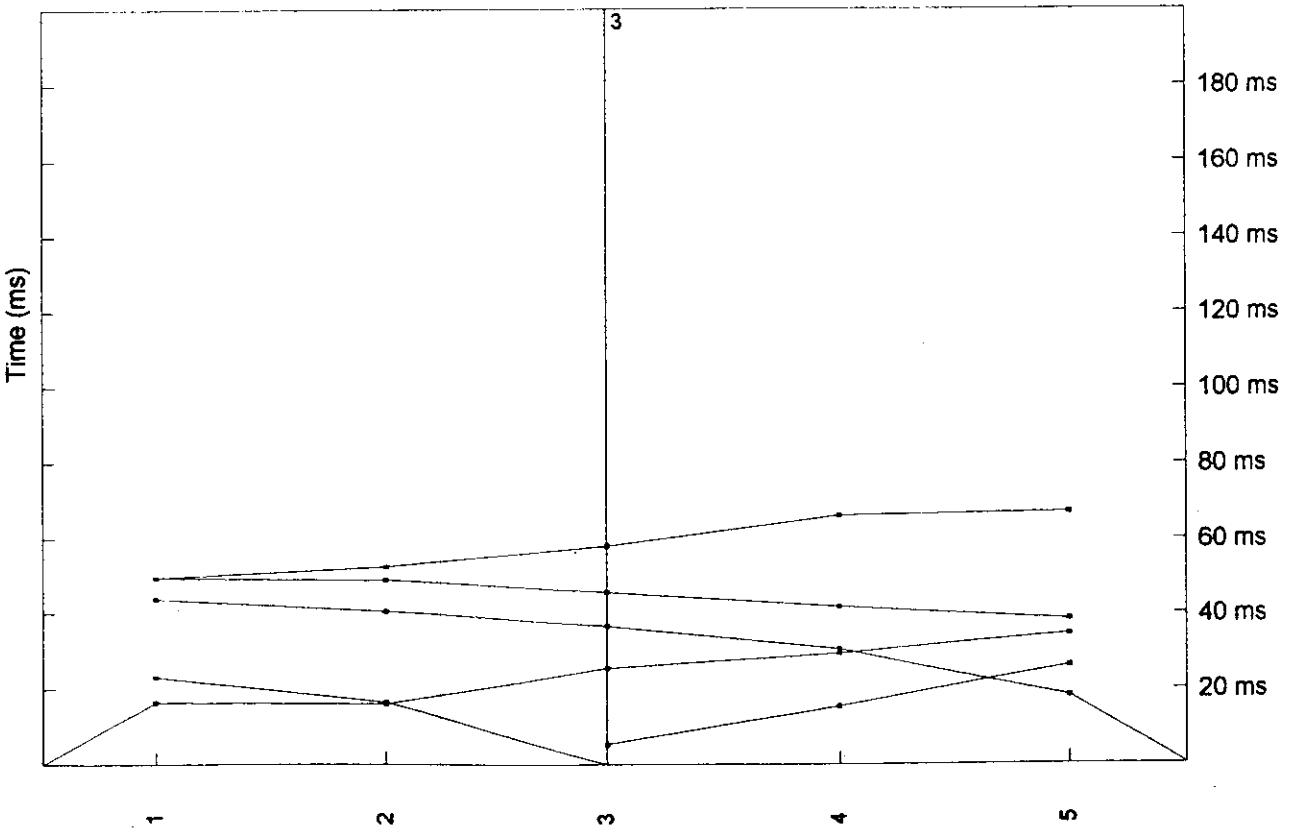
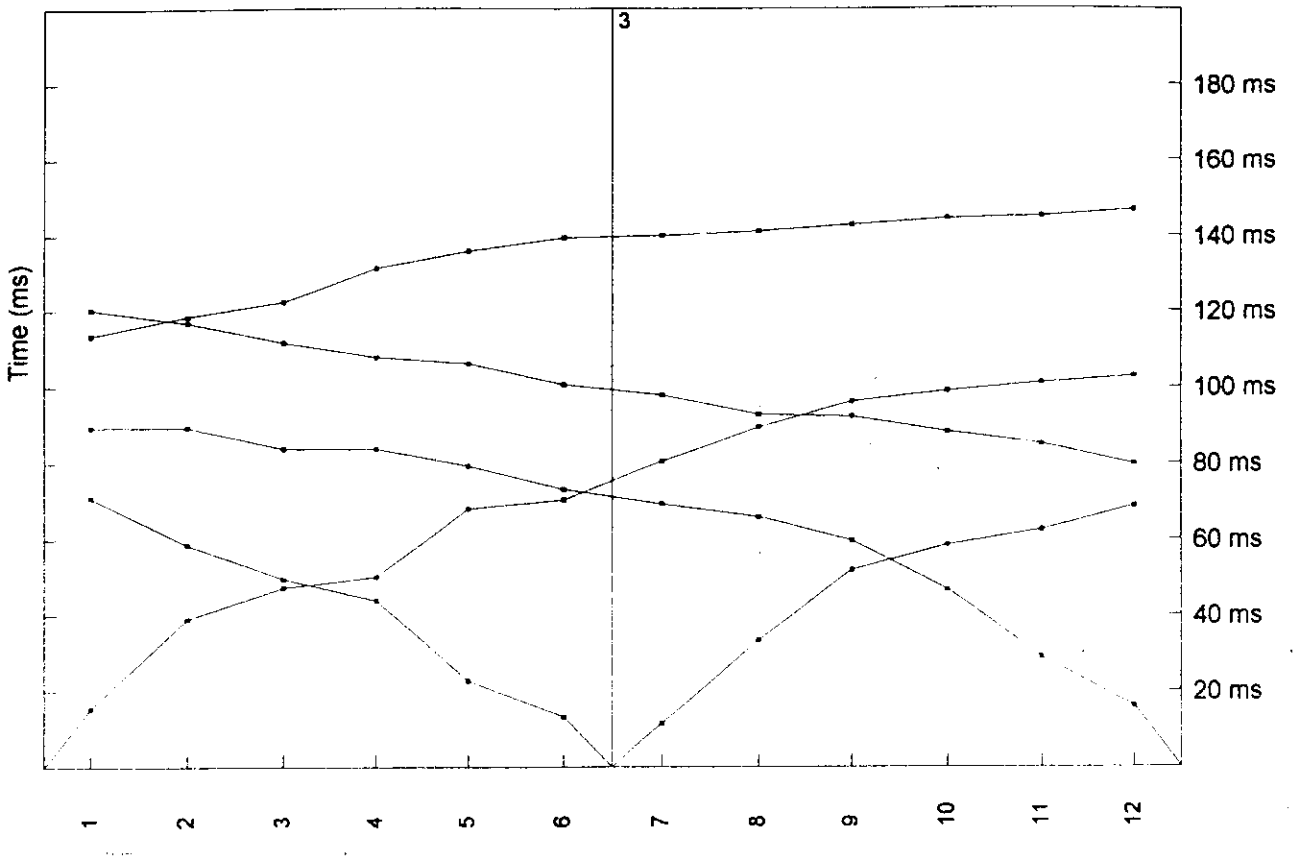
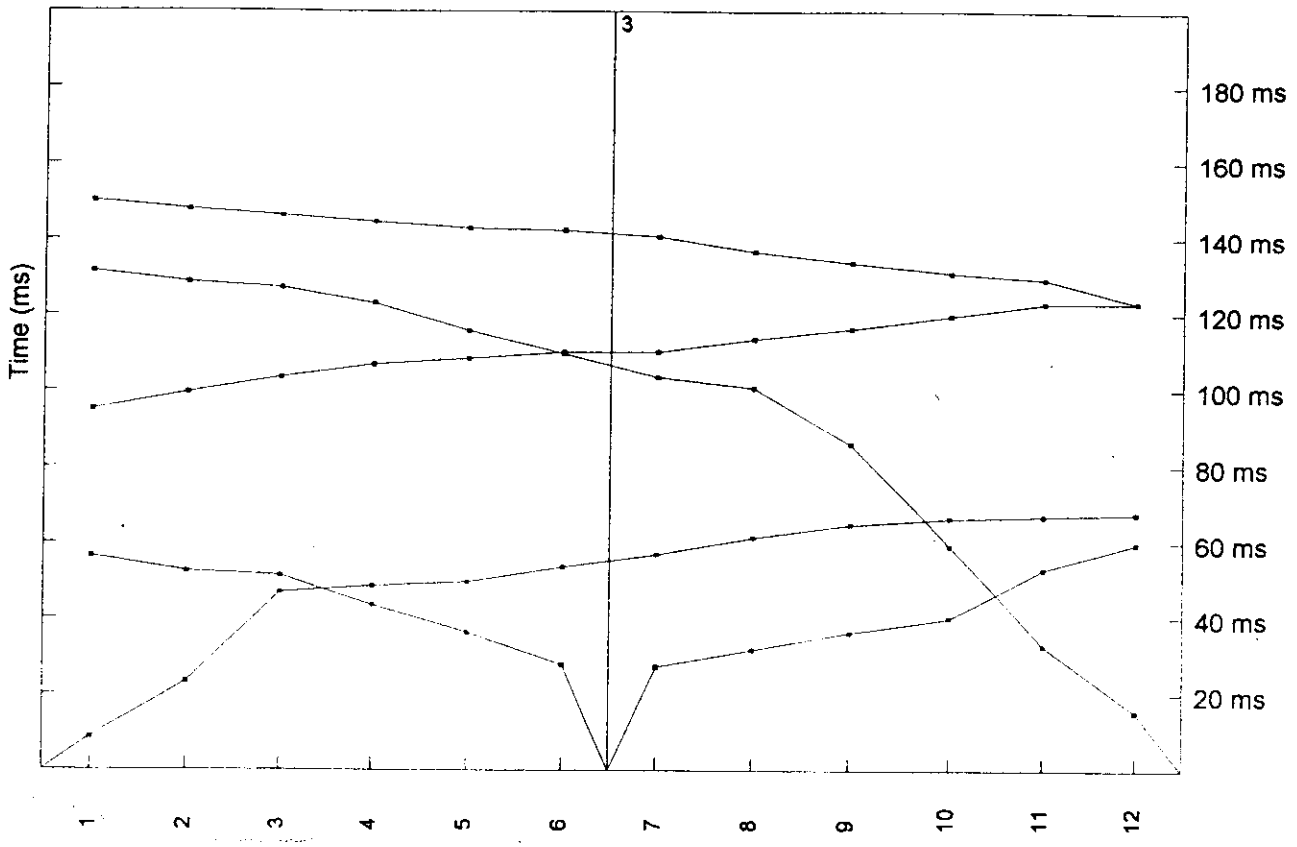


Section SDT17

UNIVERSITY OF PERADENIYA
DEPARTMENT OF GEOLOGY
PERADENIYA - SRI LANKA



Section SDT21



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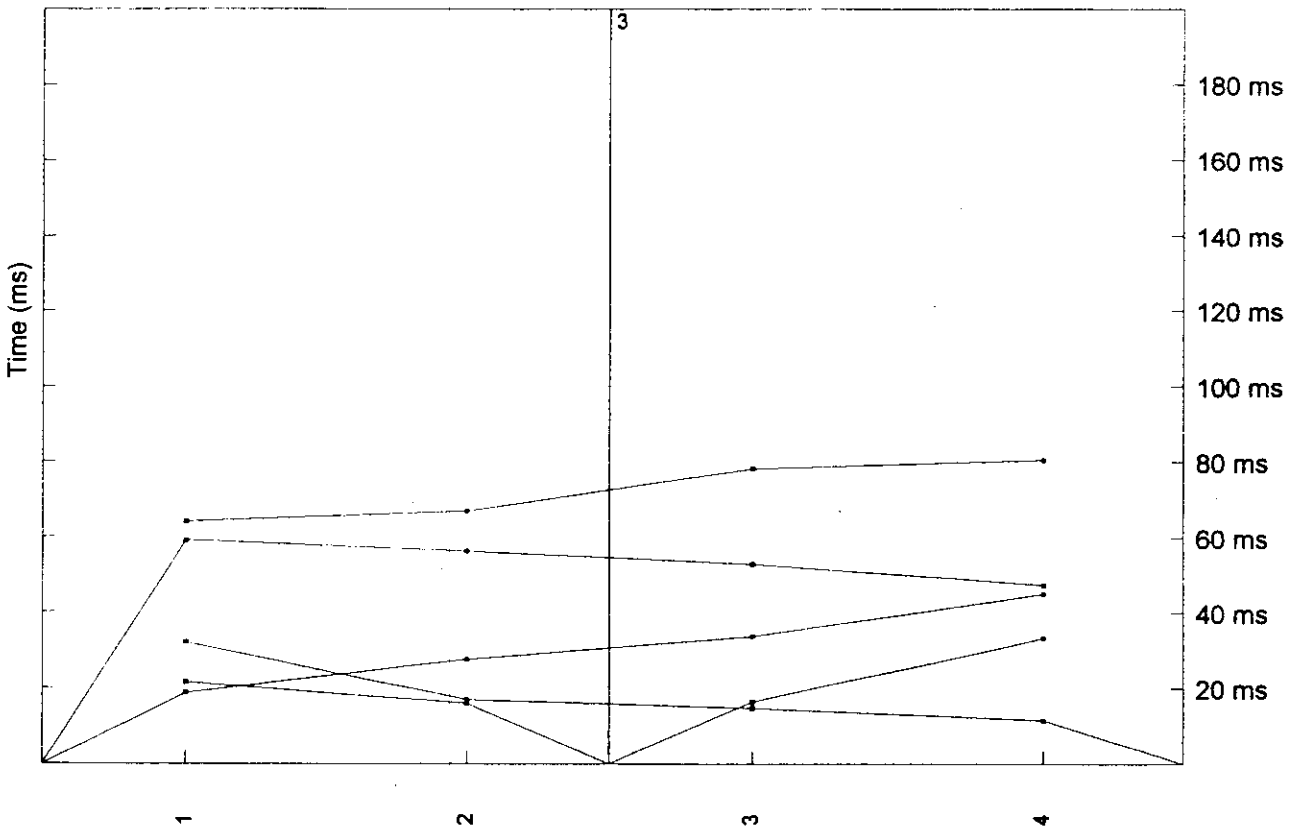
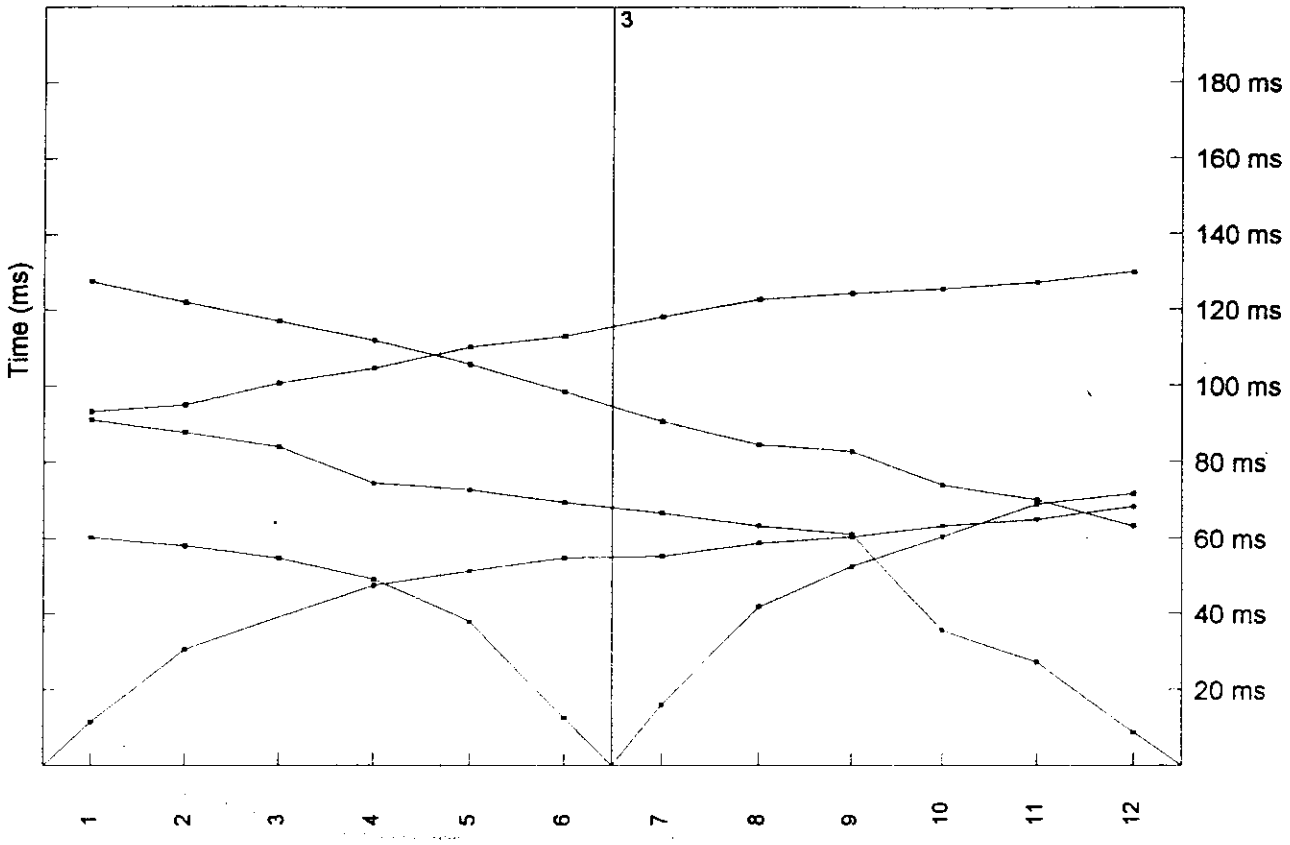


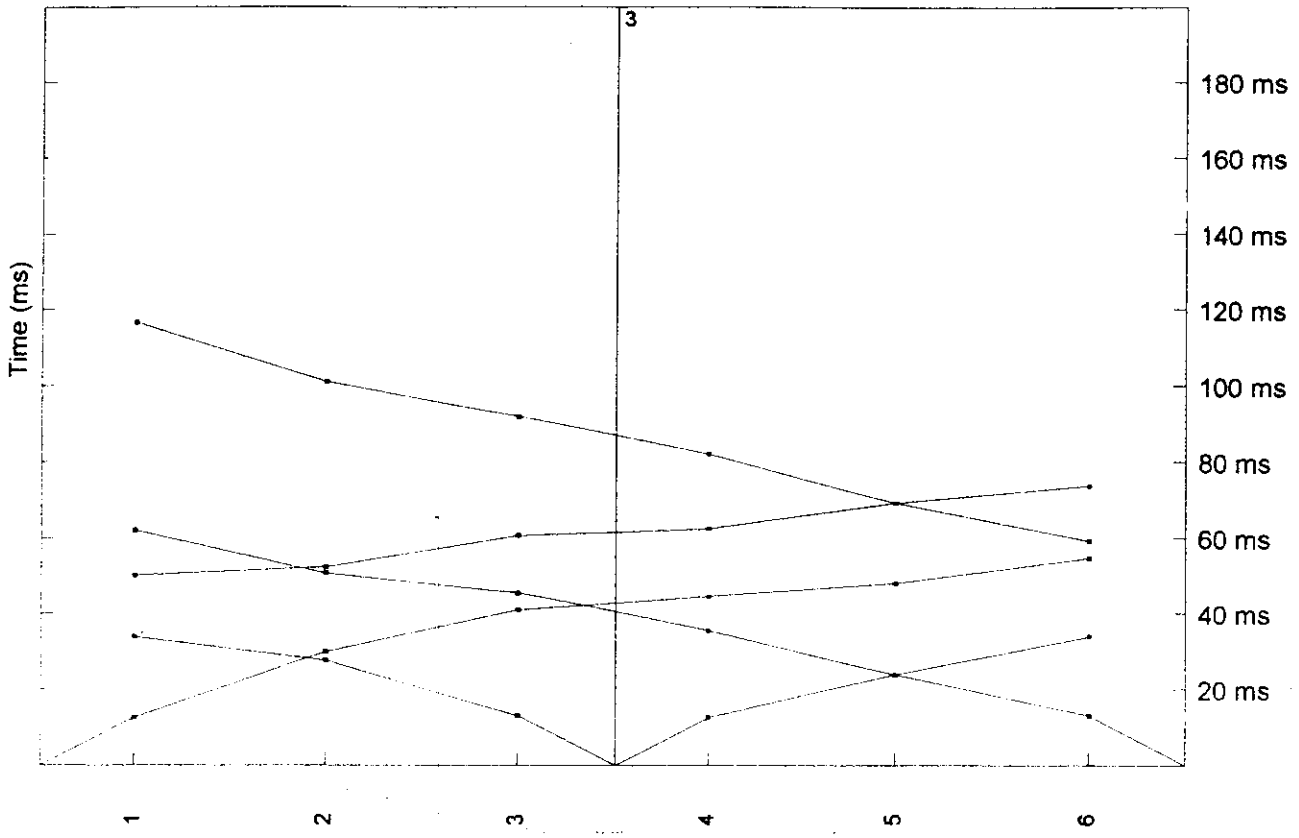
Section SDT23

UNIVERSITY OF PERADENIYA
DEPARTMENT OF GEOLOGY
PERADENIYA - SRI LANKA

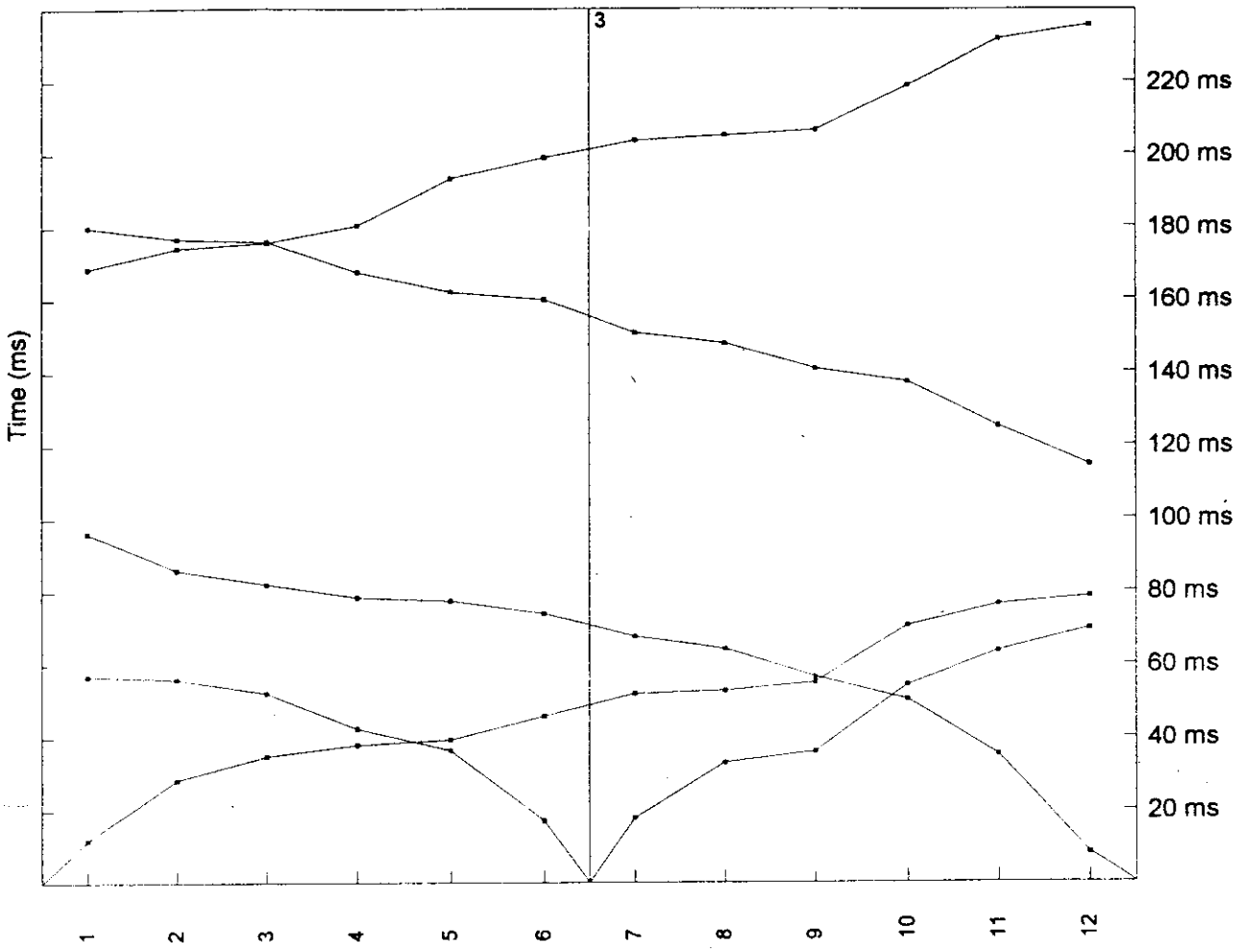


Section SMD11

UNIVERSITY OF PERADENIYA
DEPARTMENT OF GEOLOGY
PERADENIYA - SRI LANKA



Section SMT11



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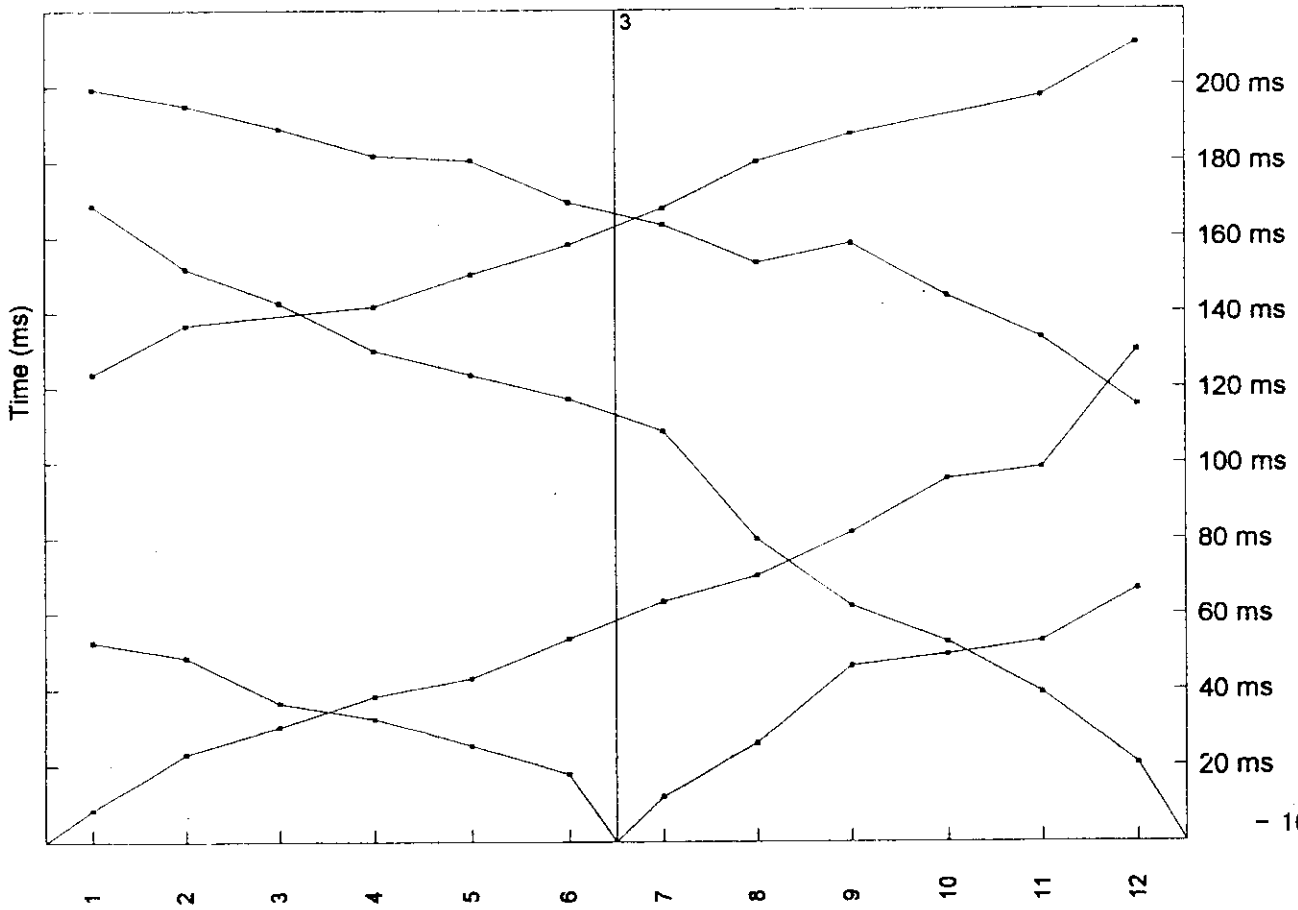
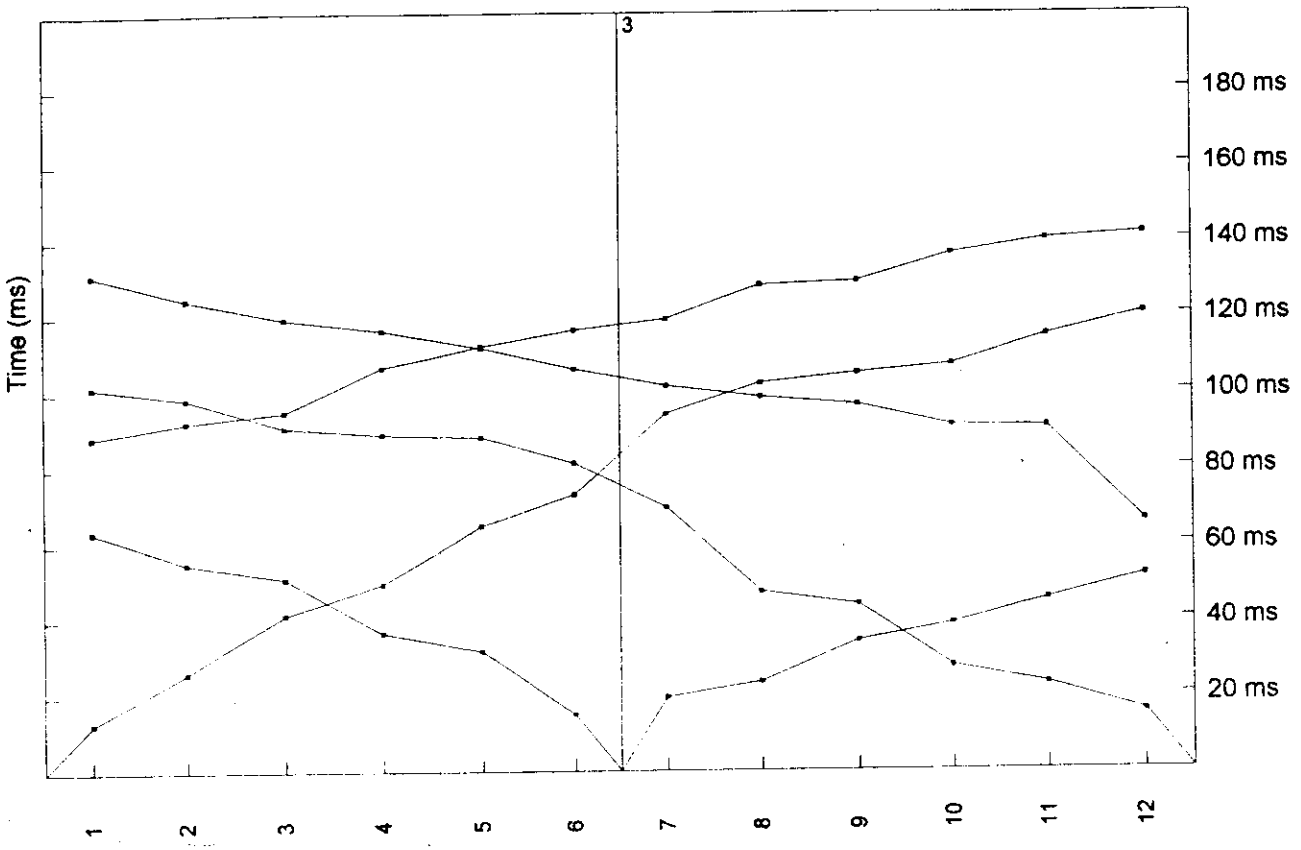
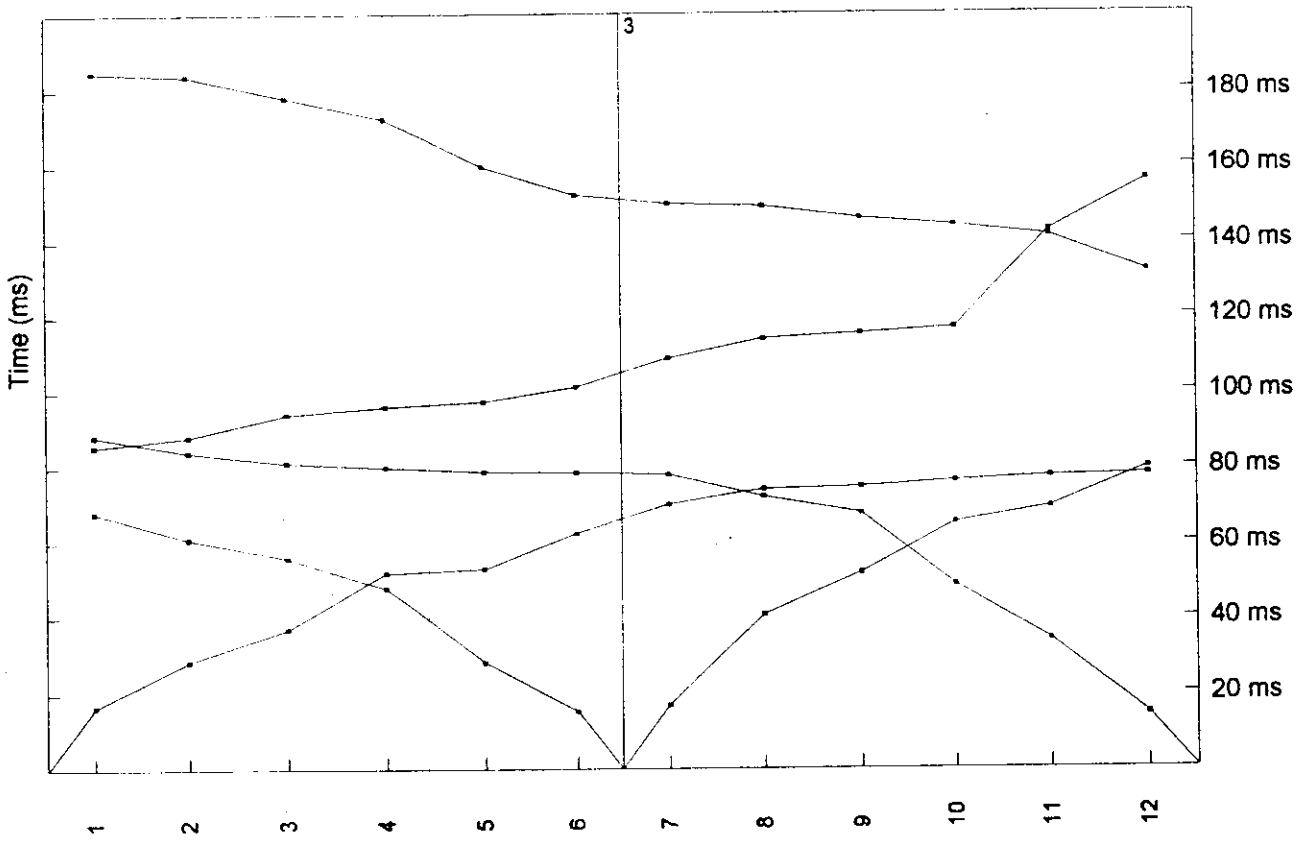


Section SMT13



Section SMT14



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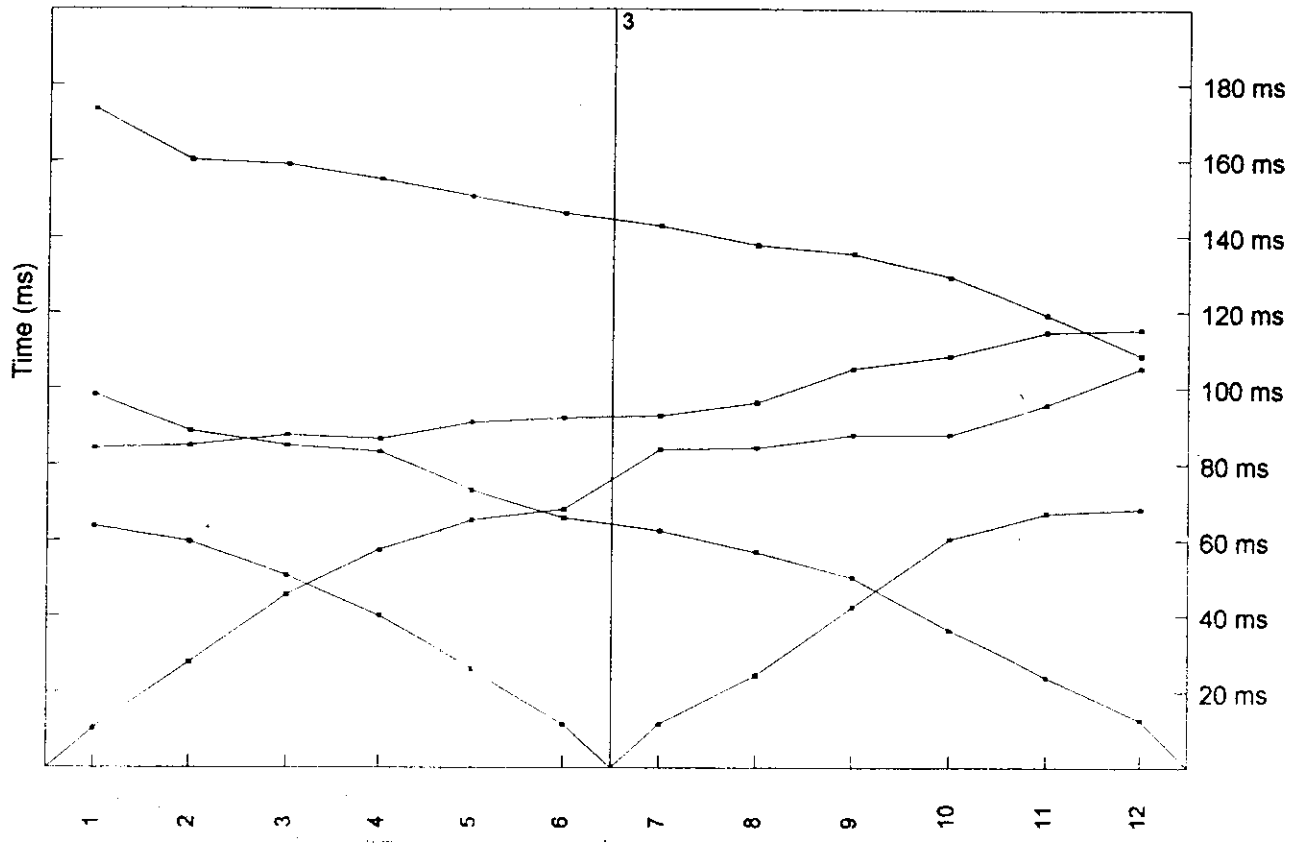

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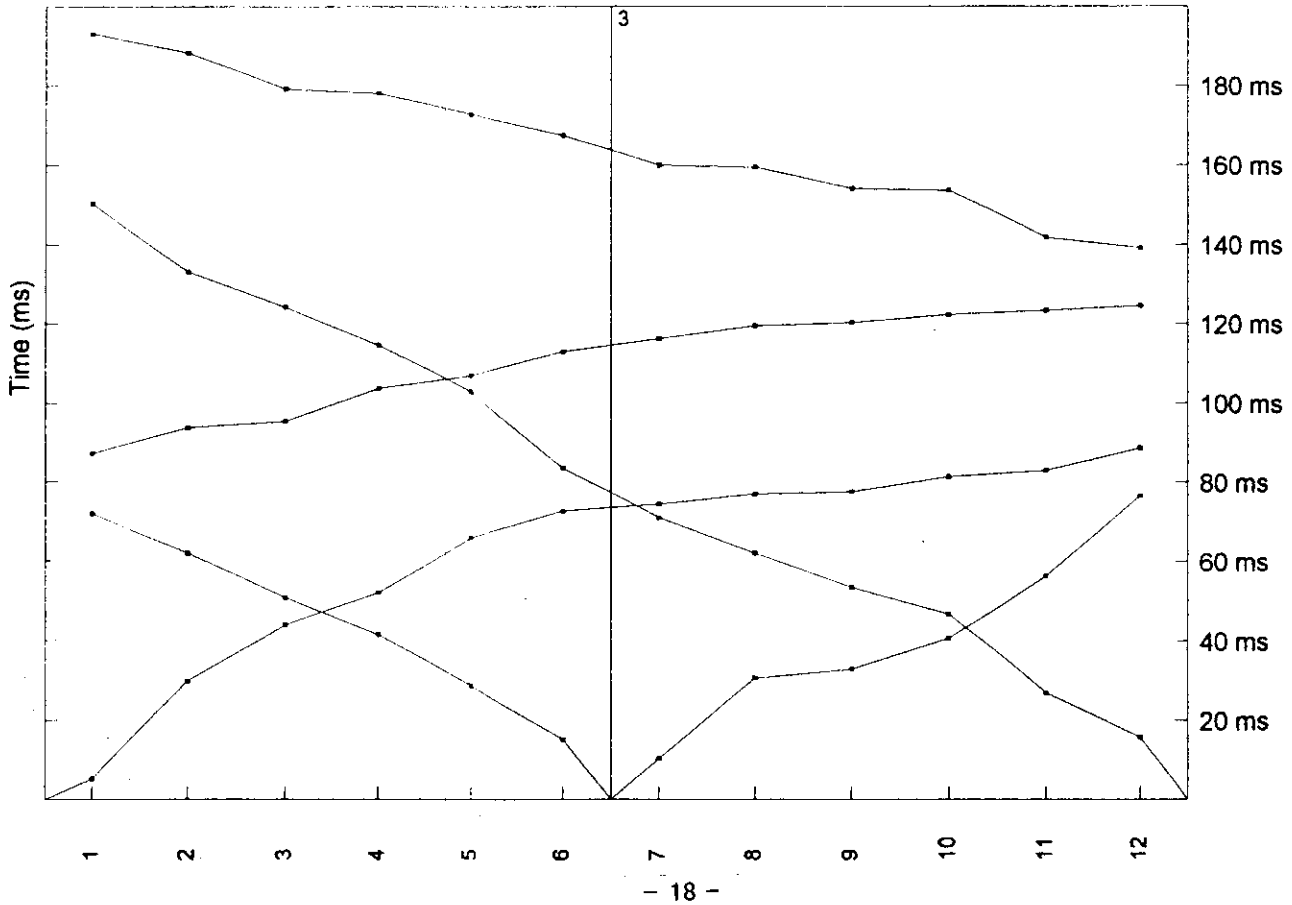

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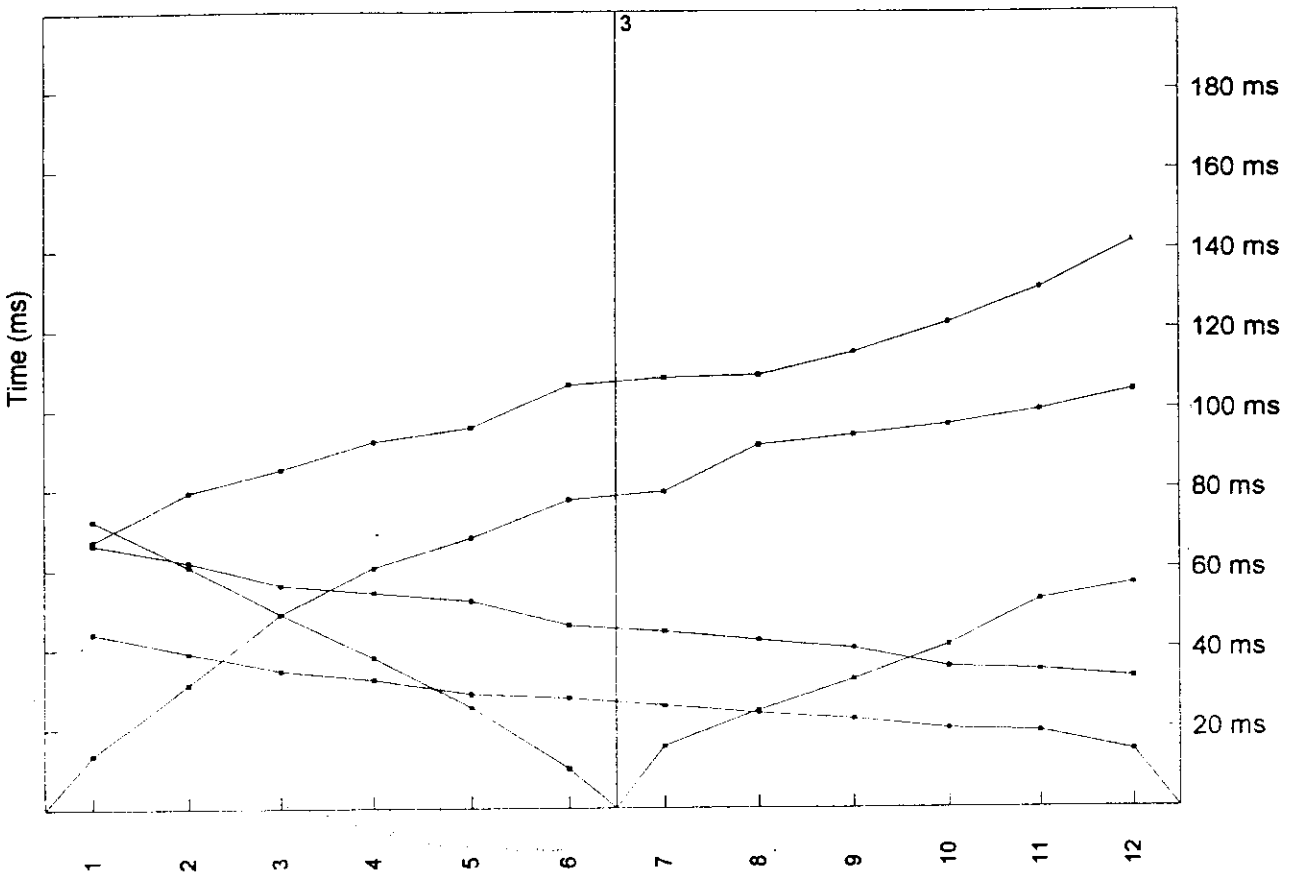

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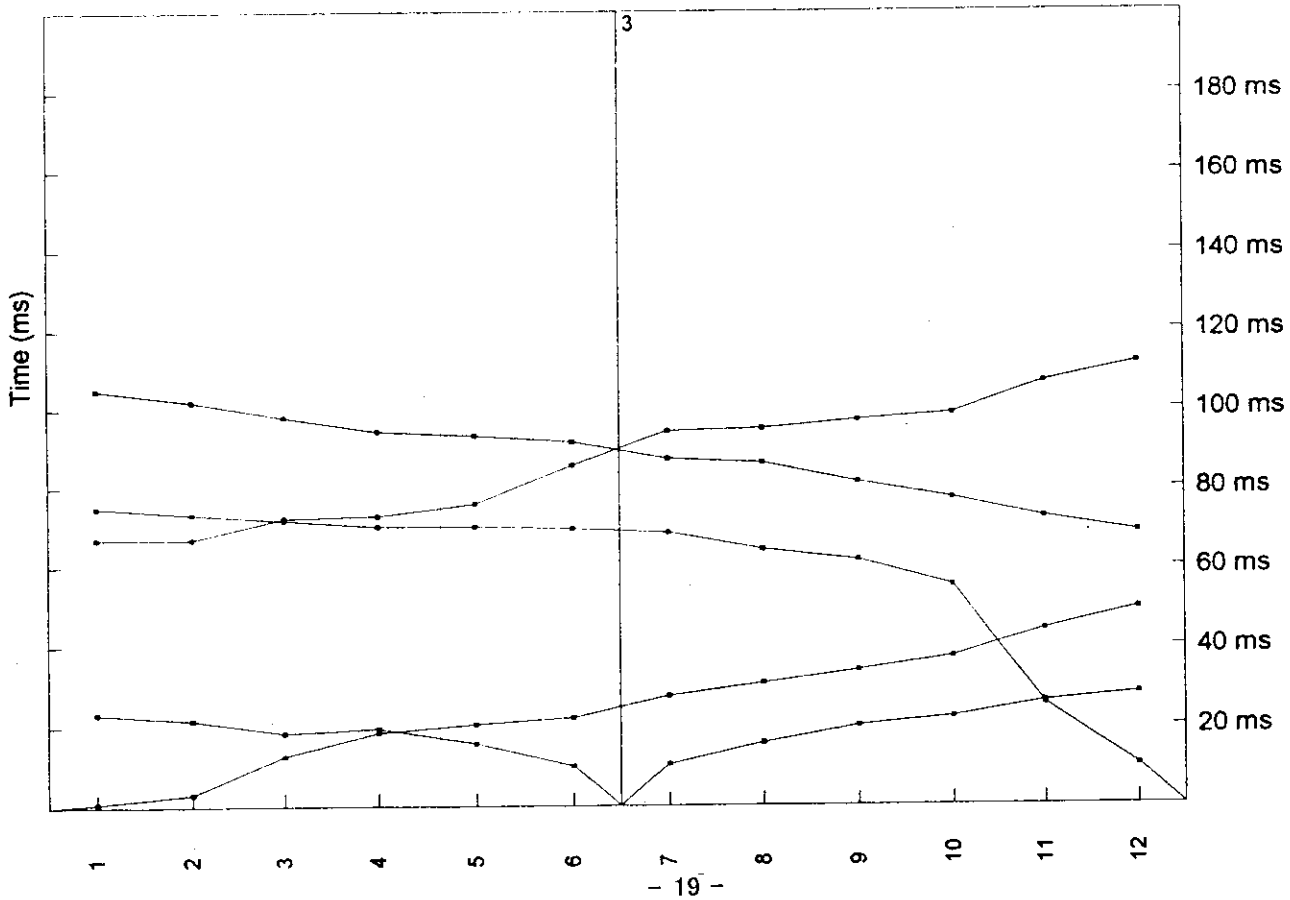

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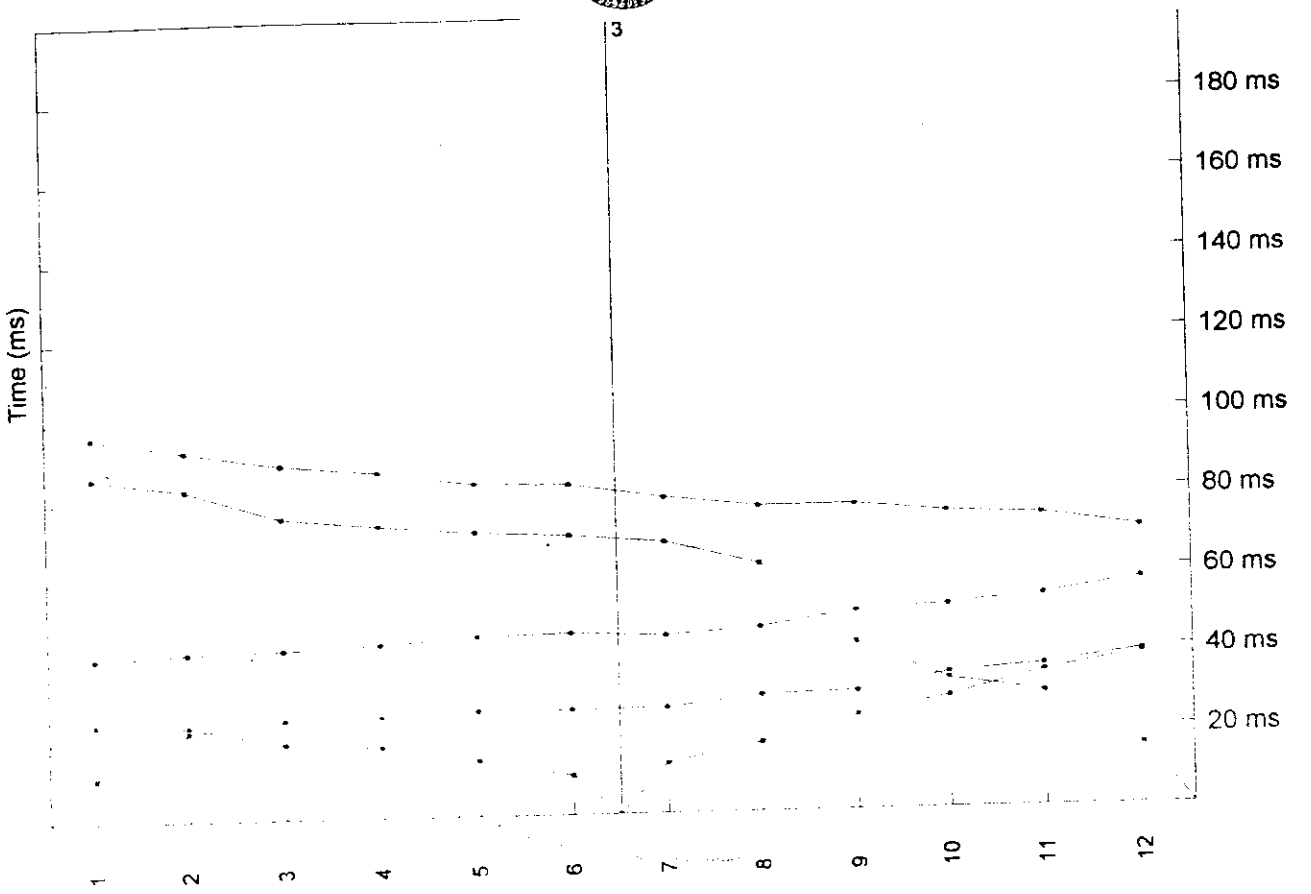

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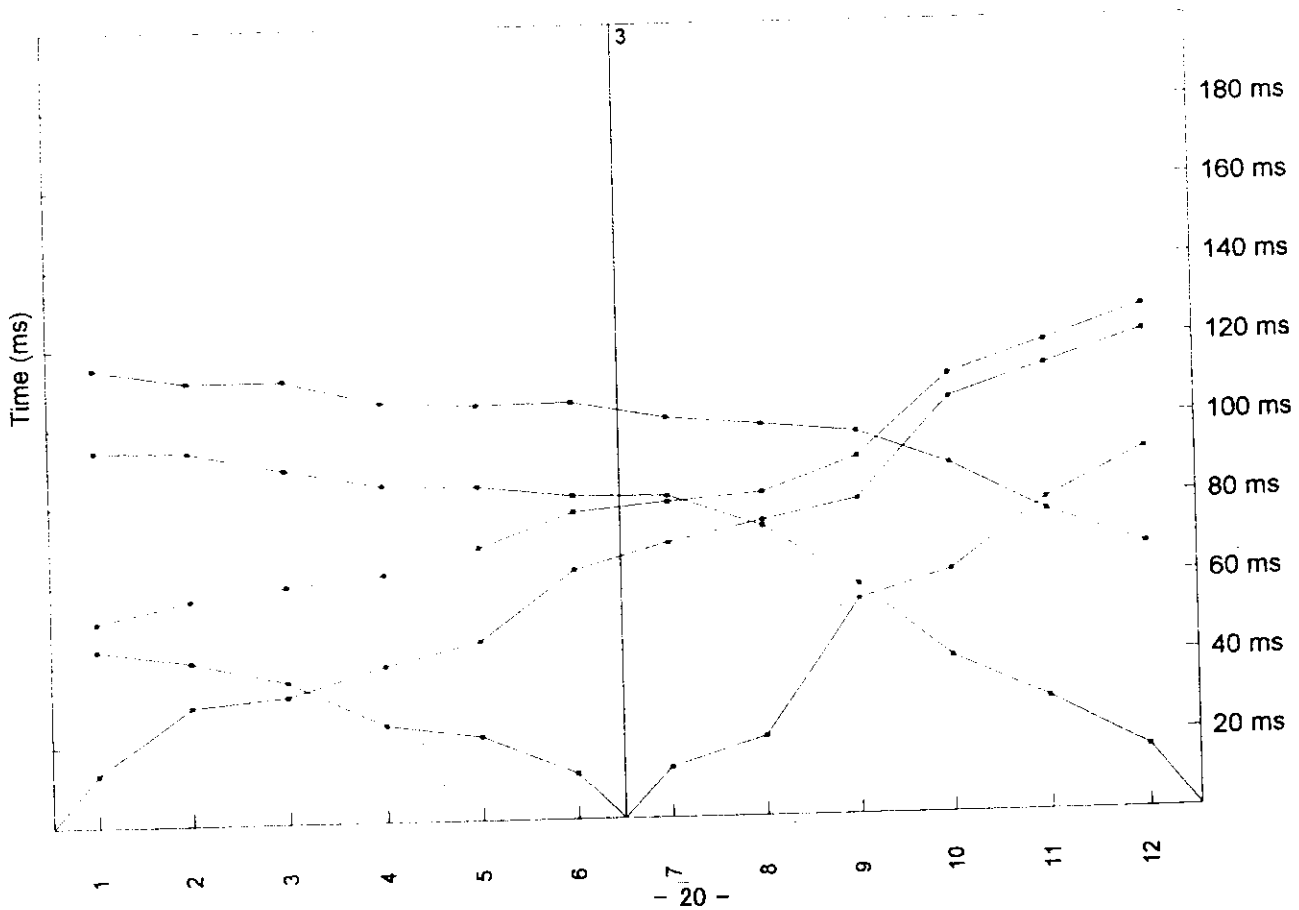

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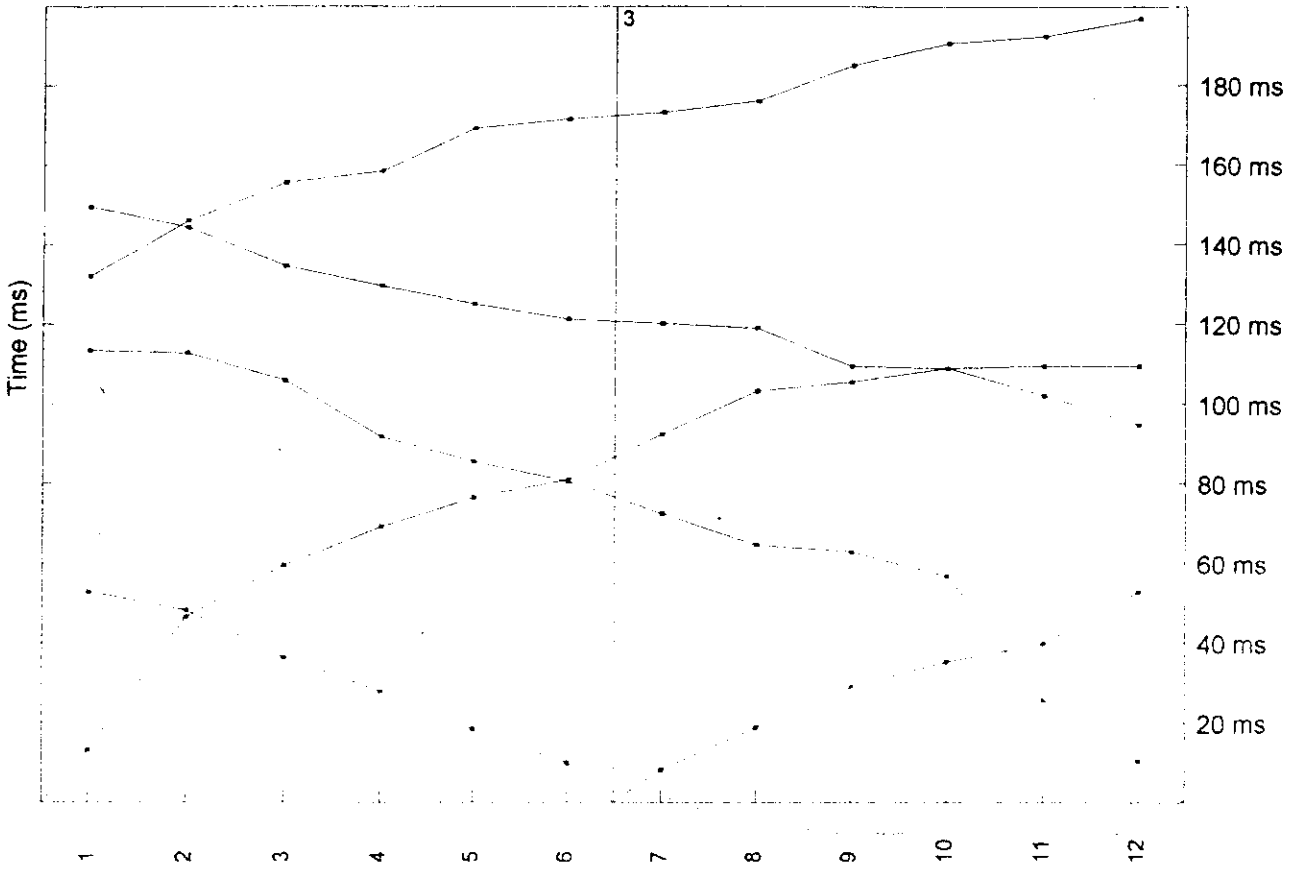

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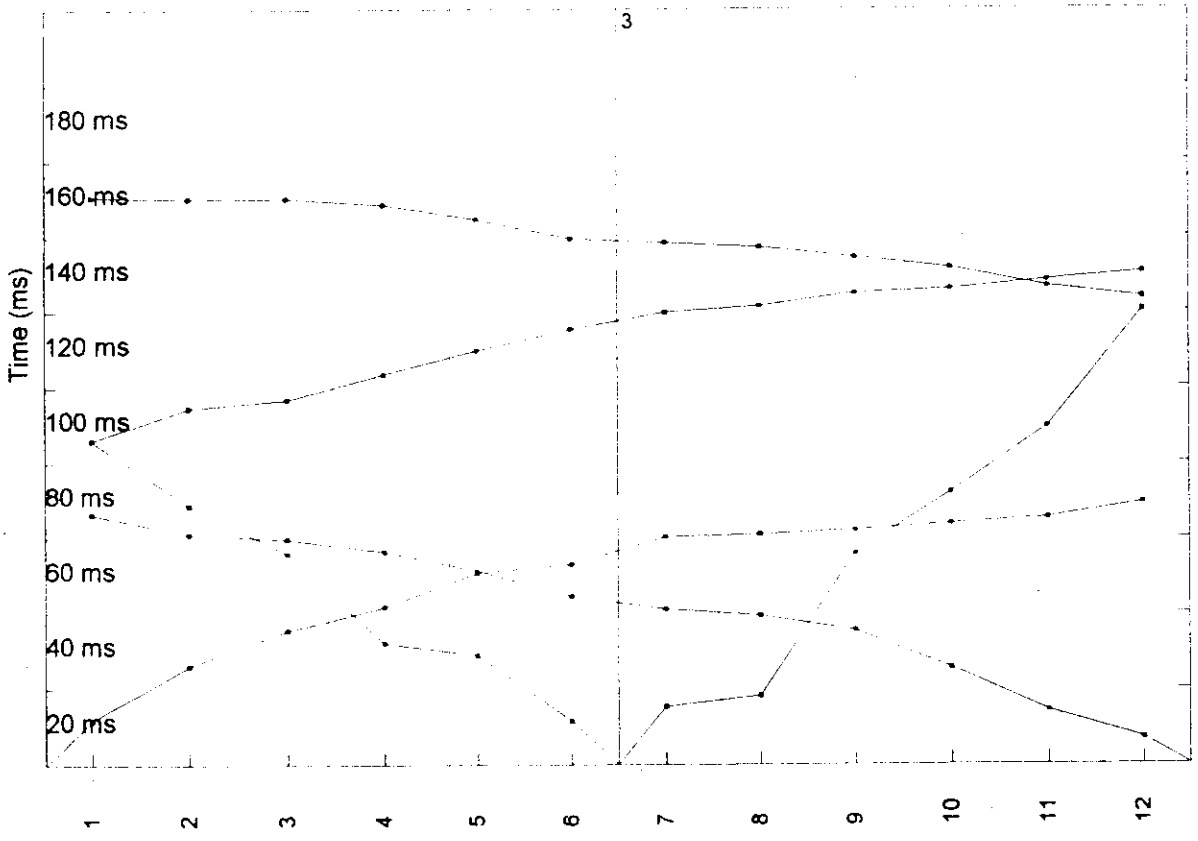

Section SMT1-13

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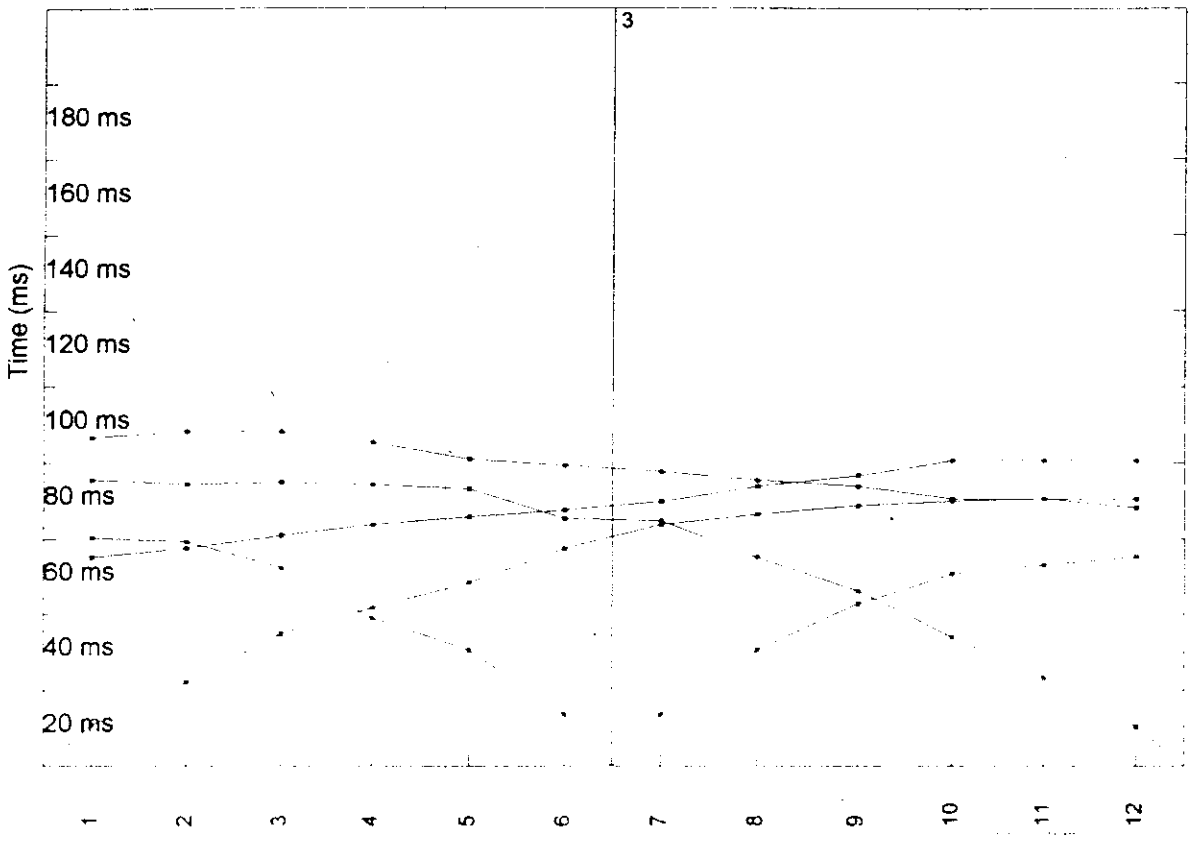

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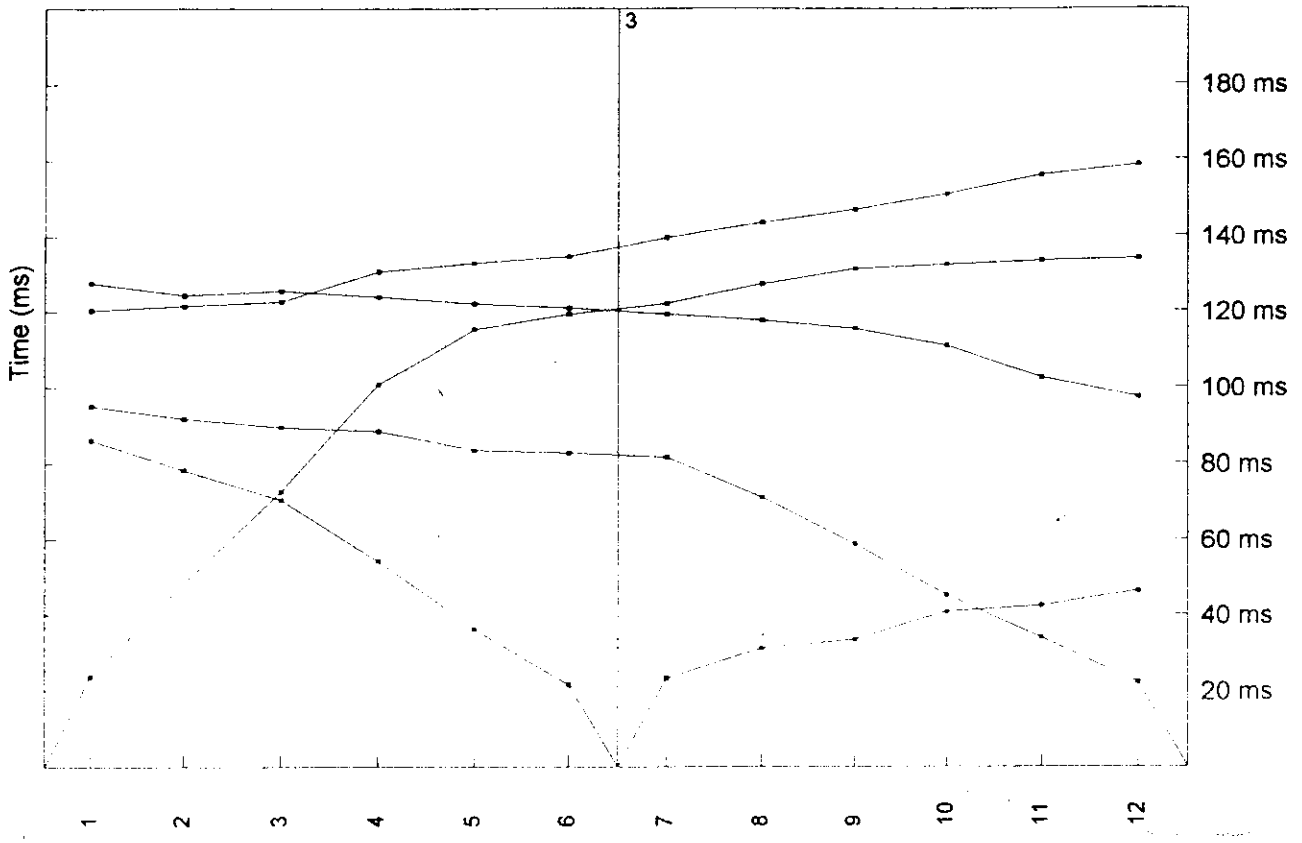

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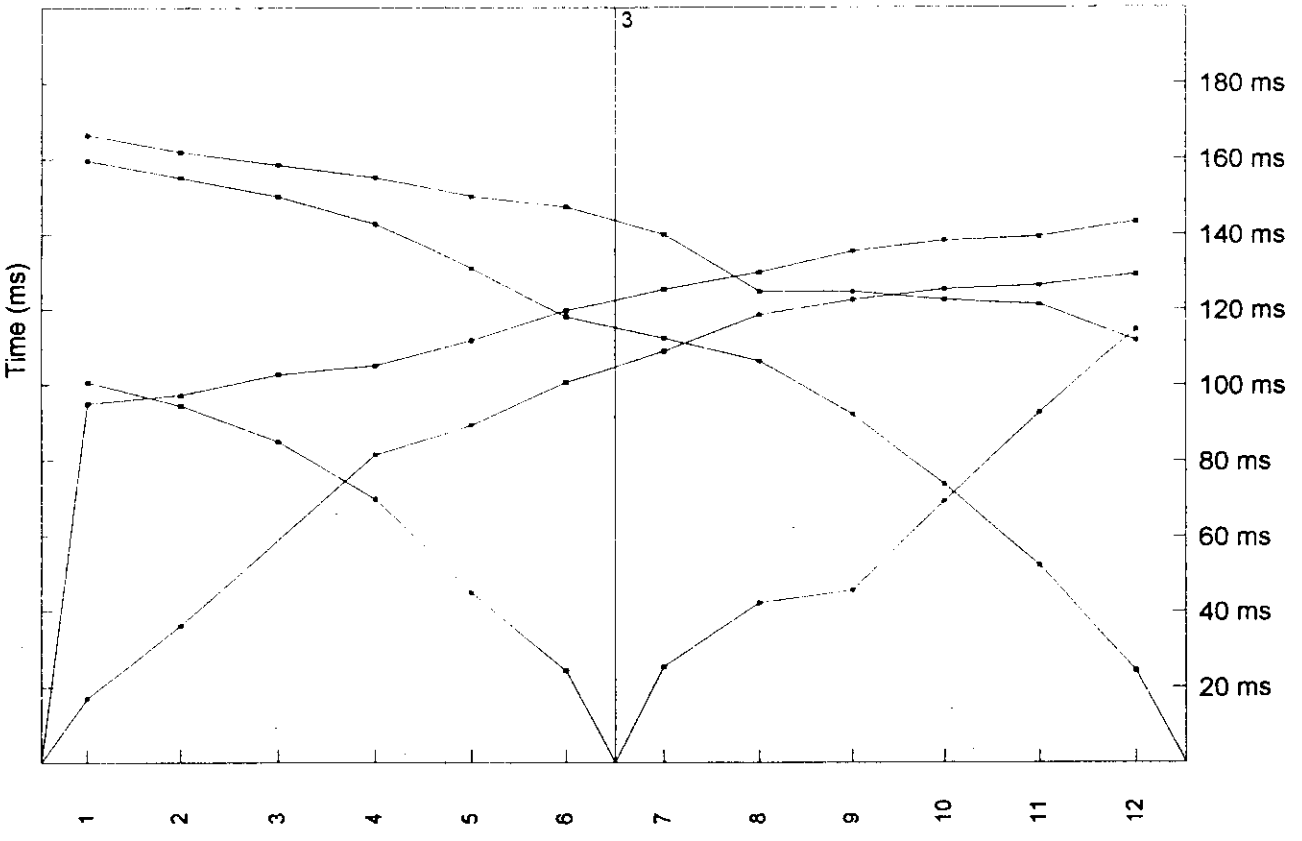

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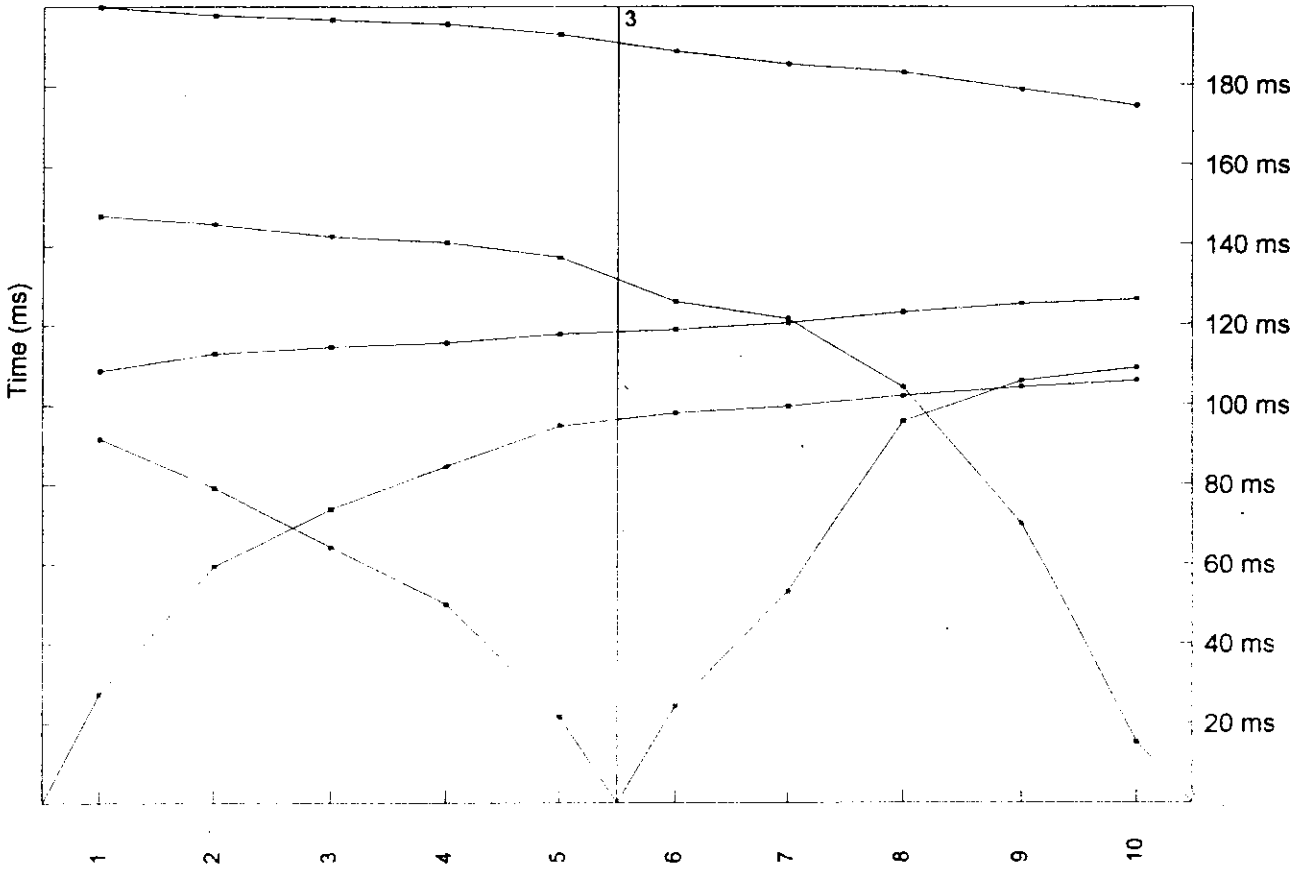

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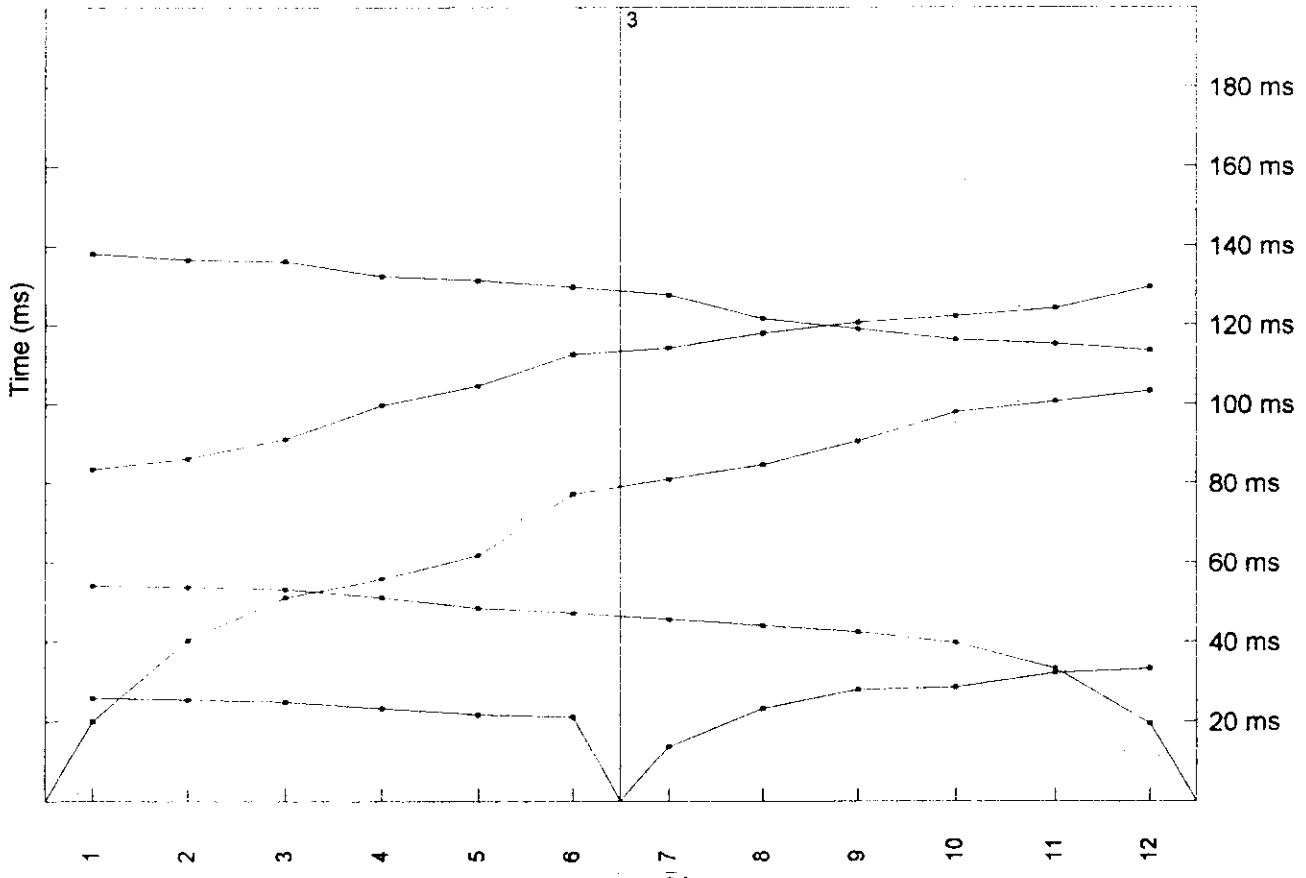

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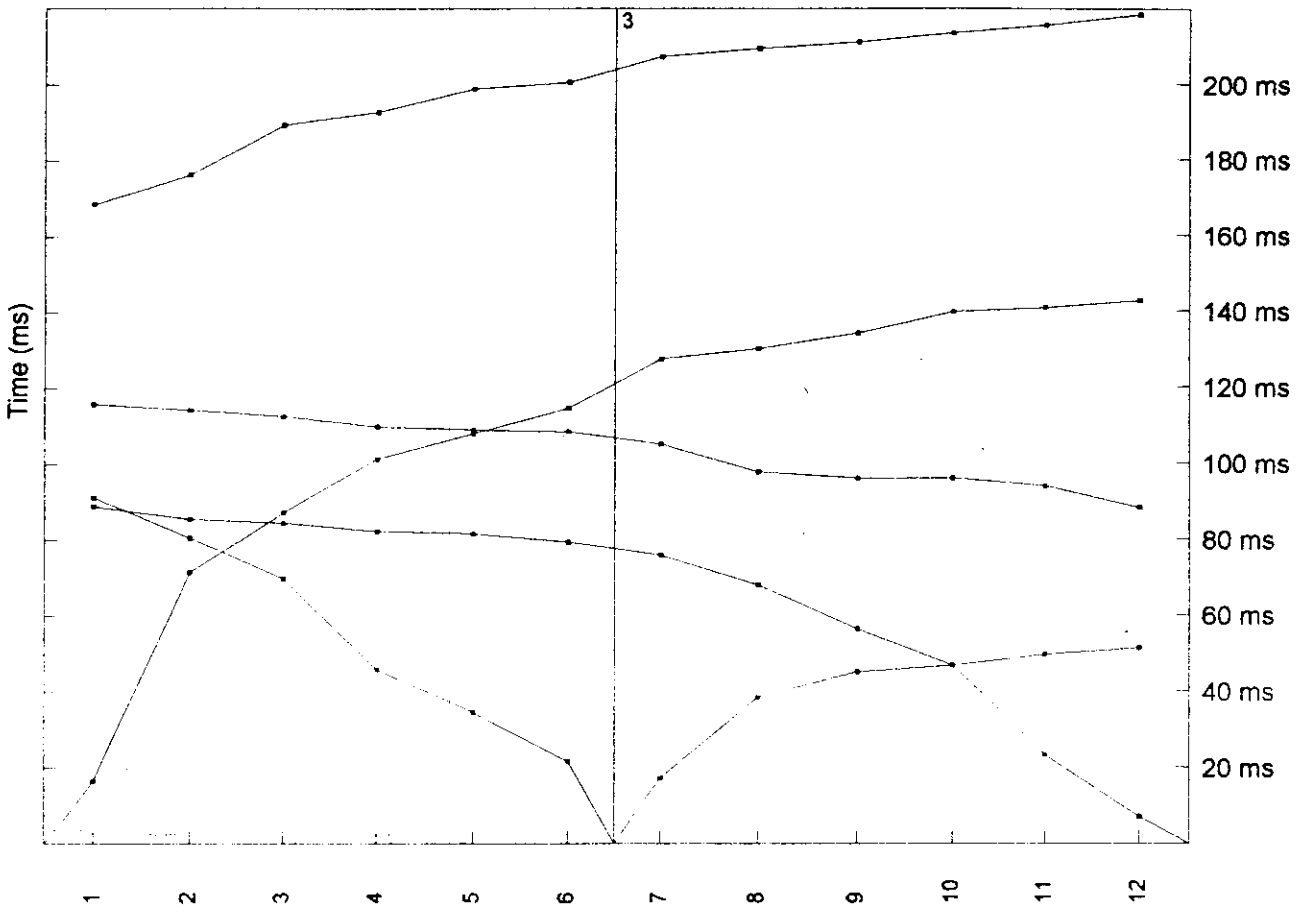

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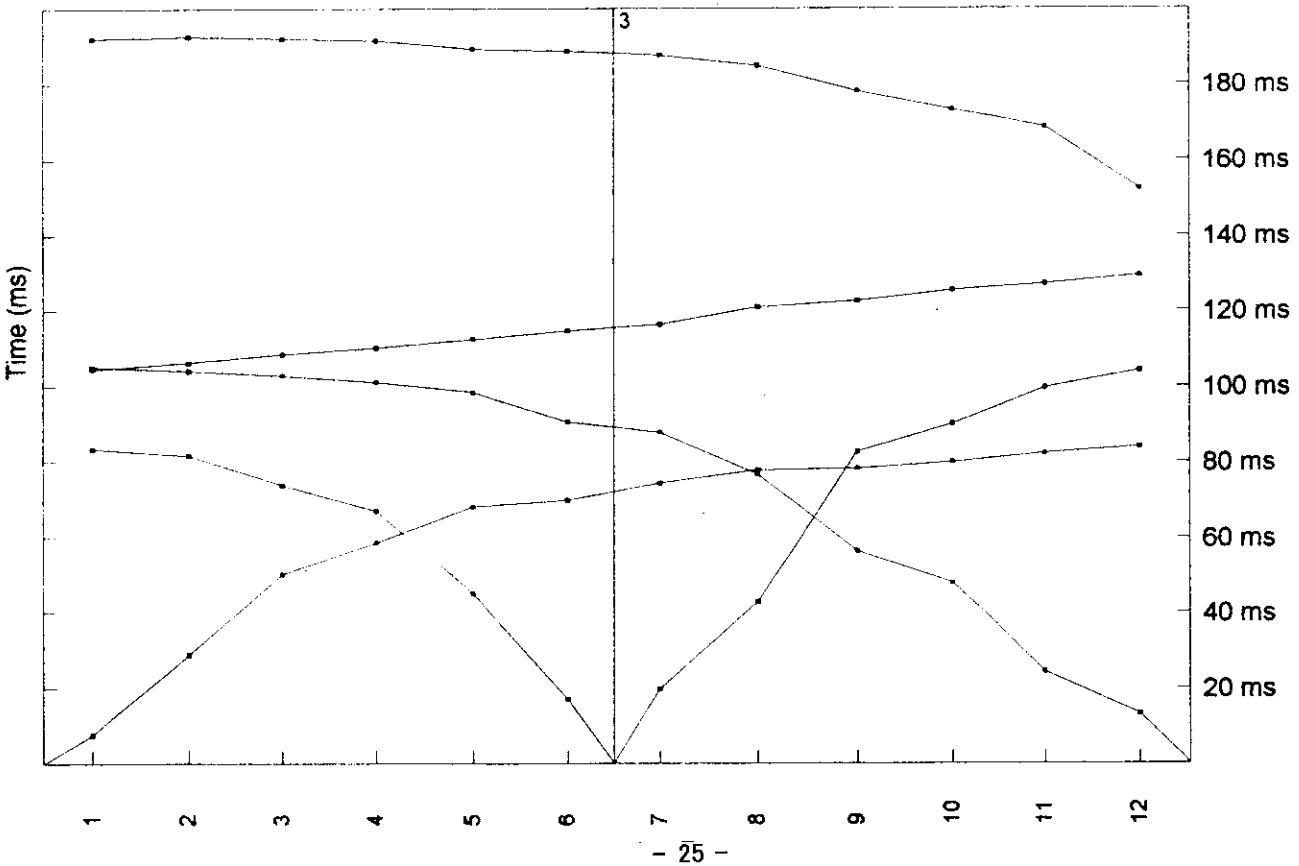

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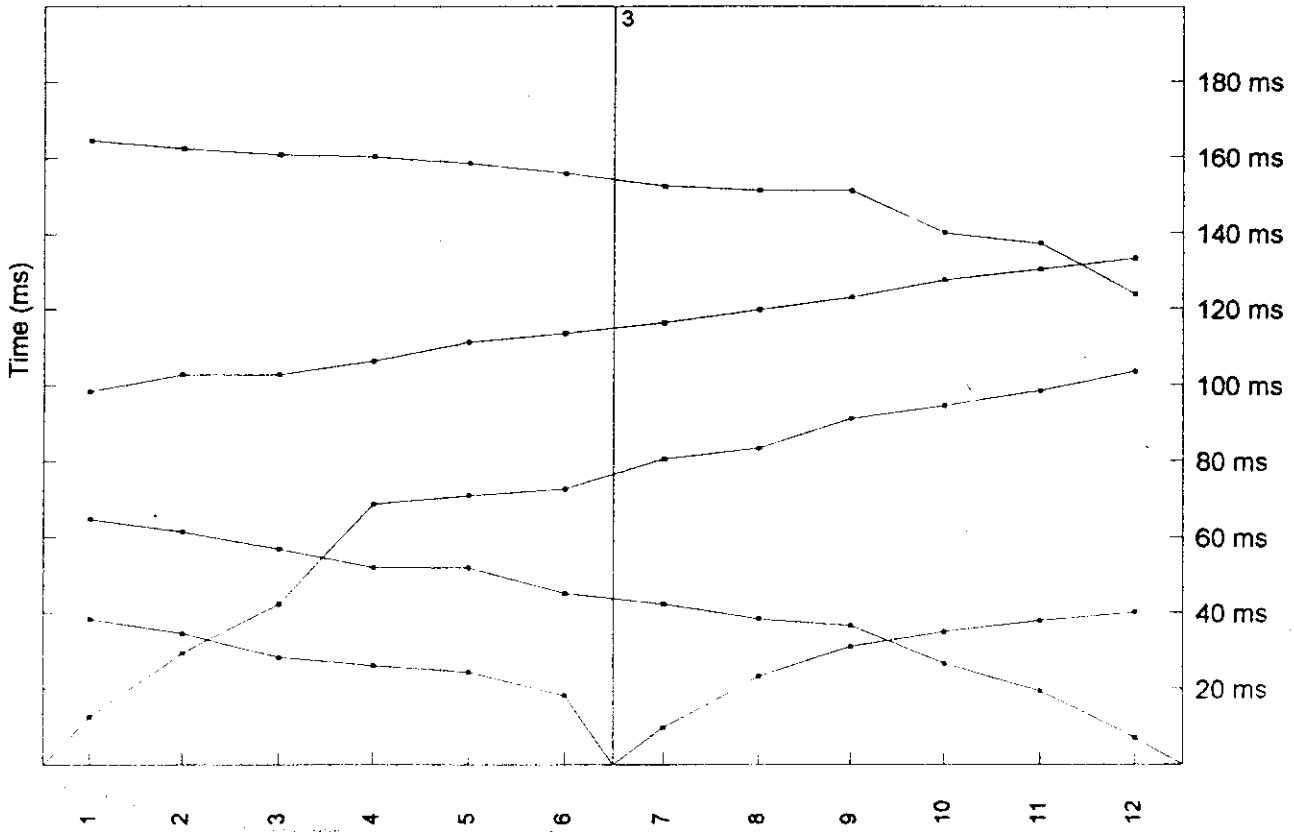

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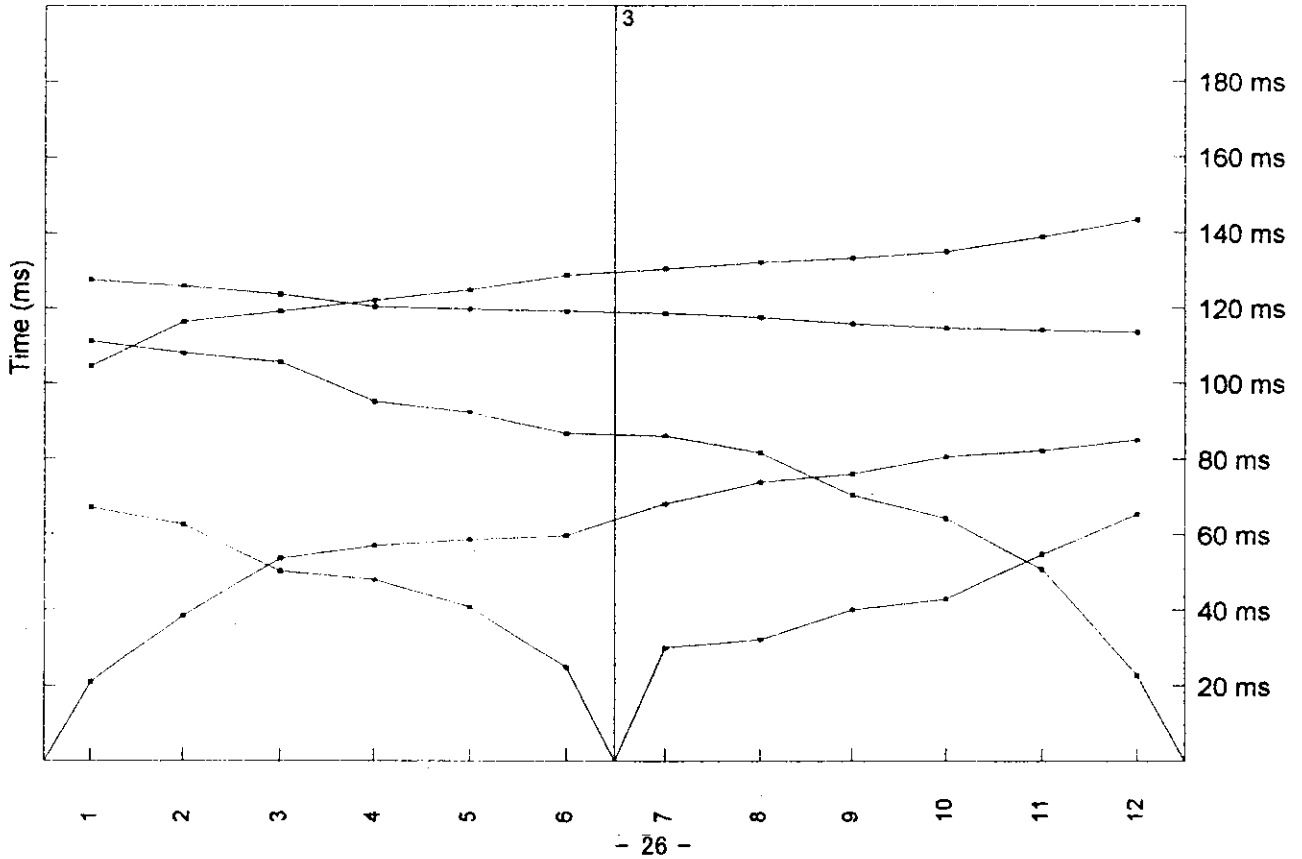

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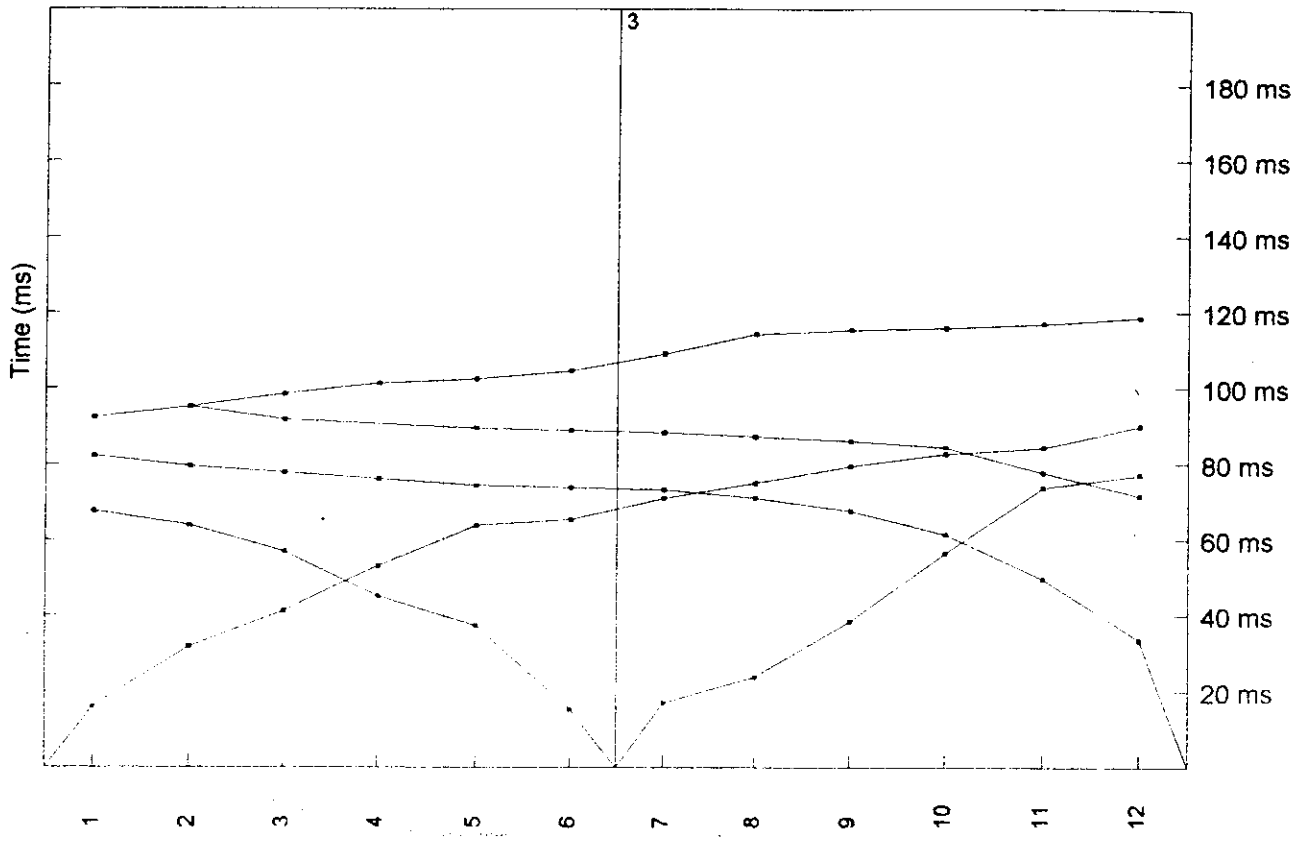

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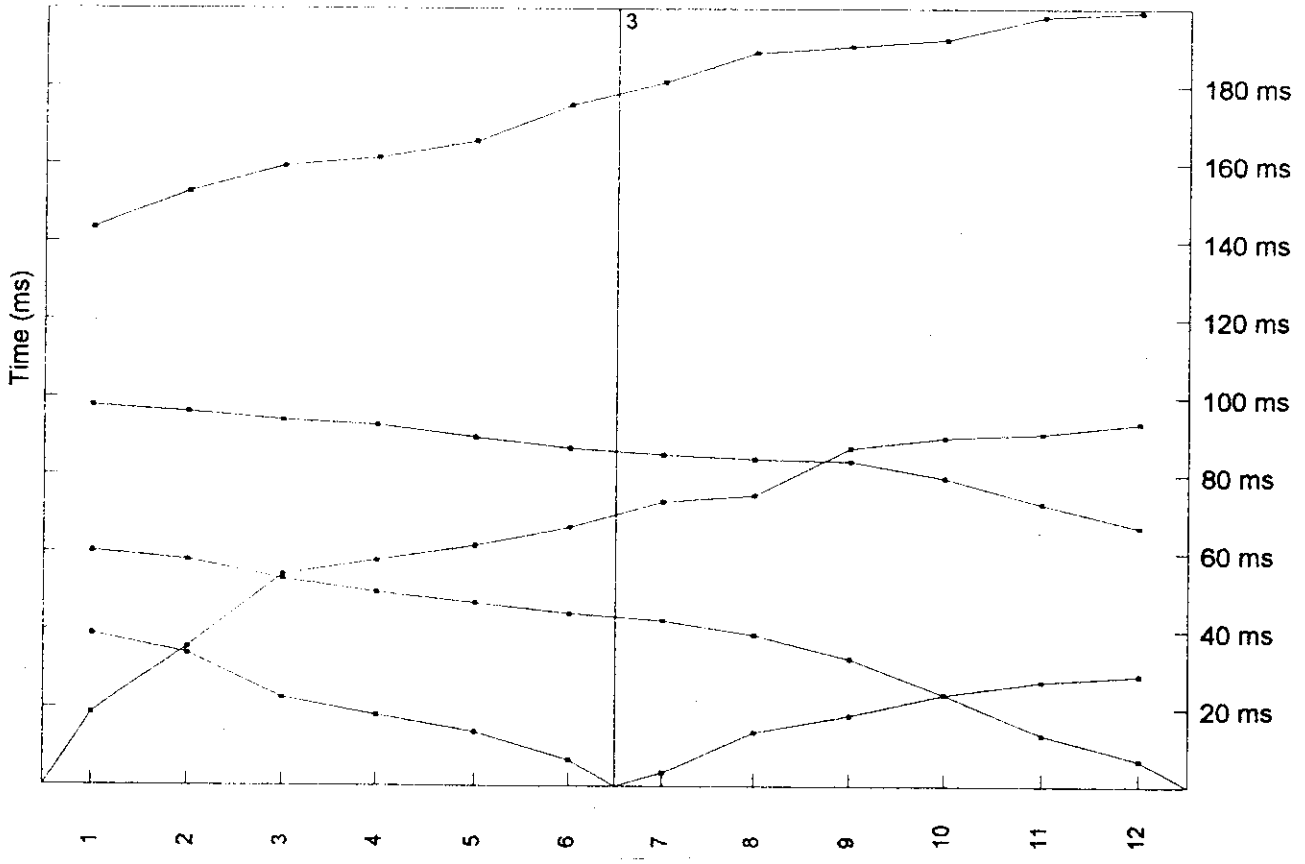

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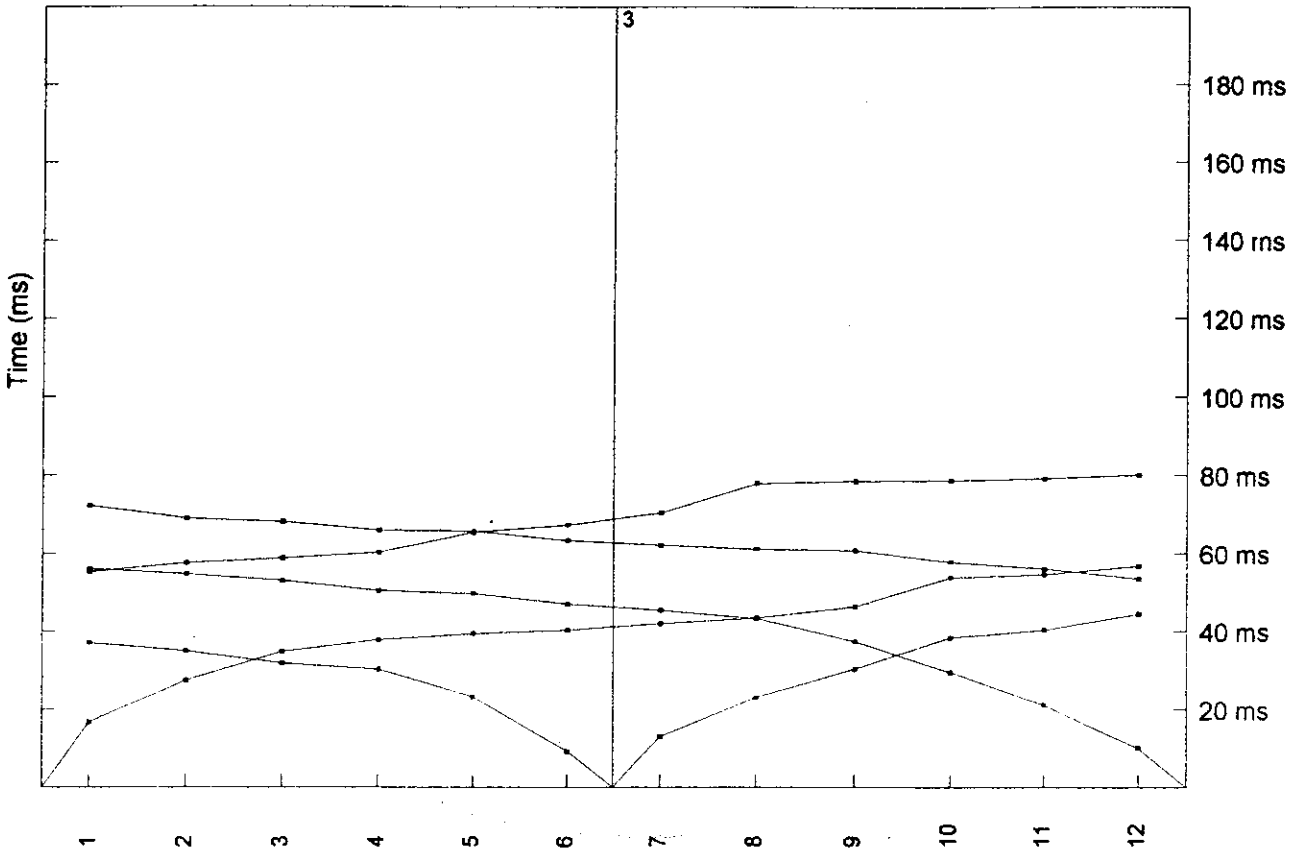

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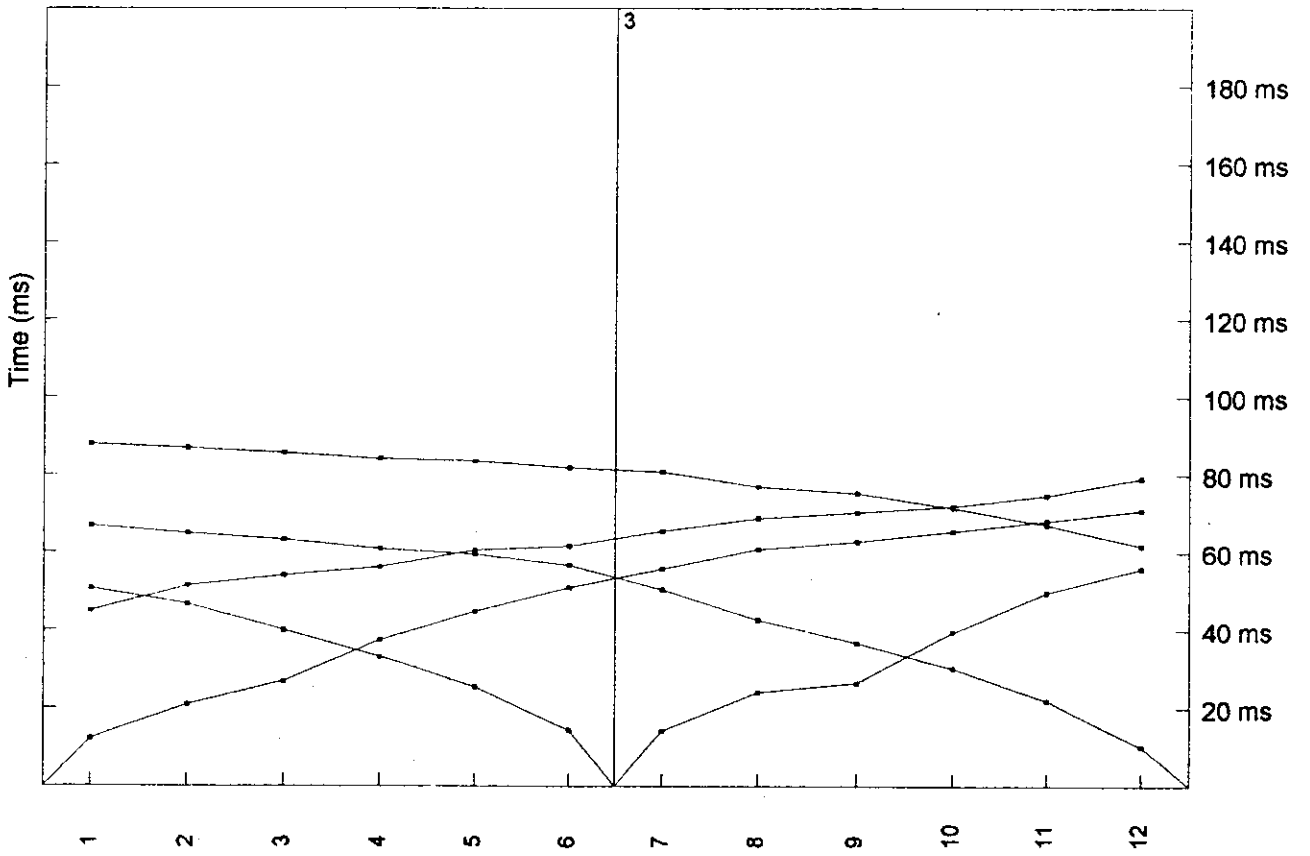

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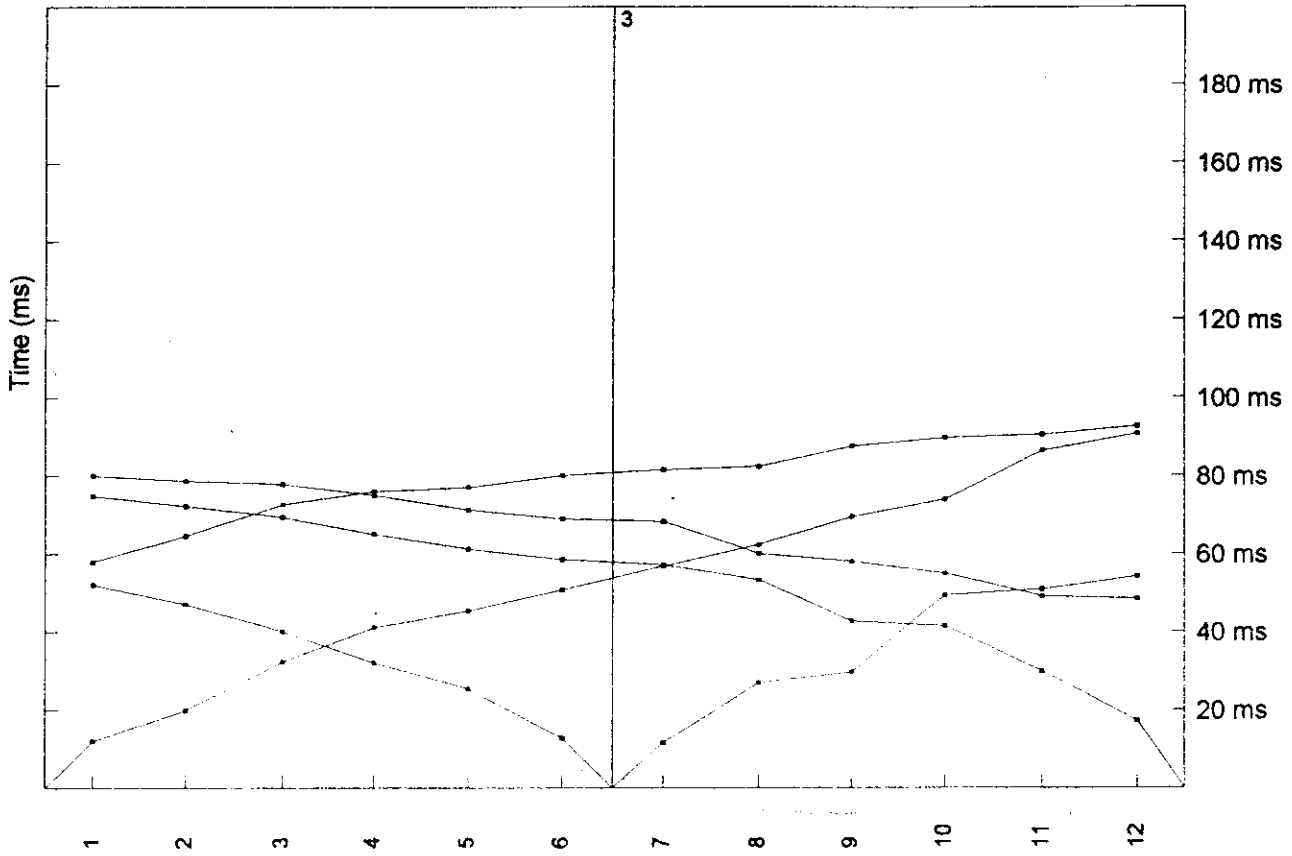
PERADENIYA - SRI LANKA

Section SMT33



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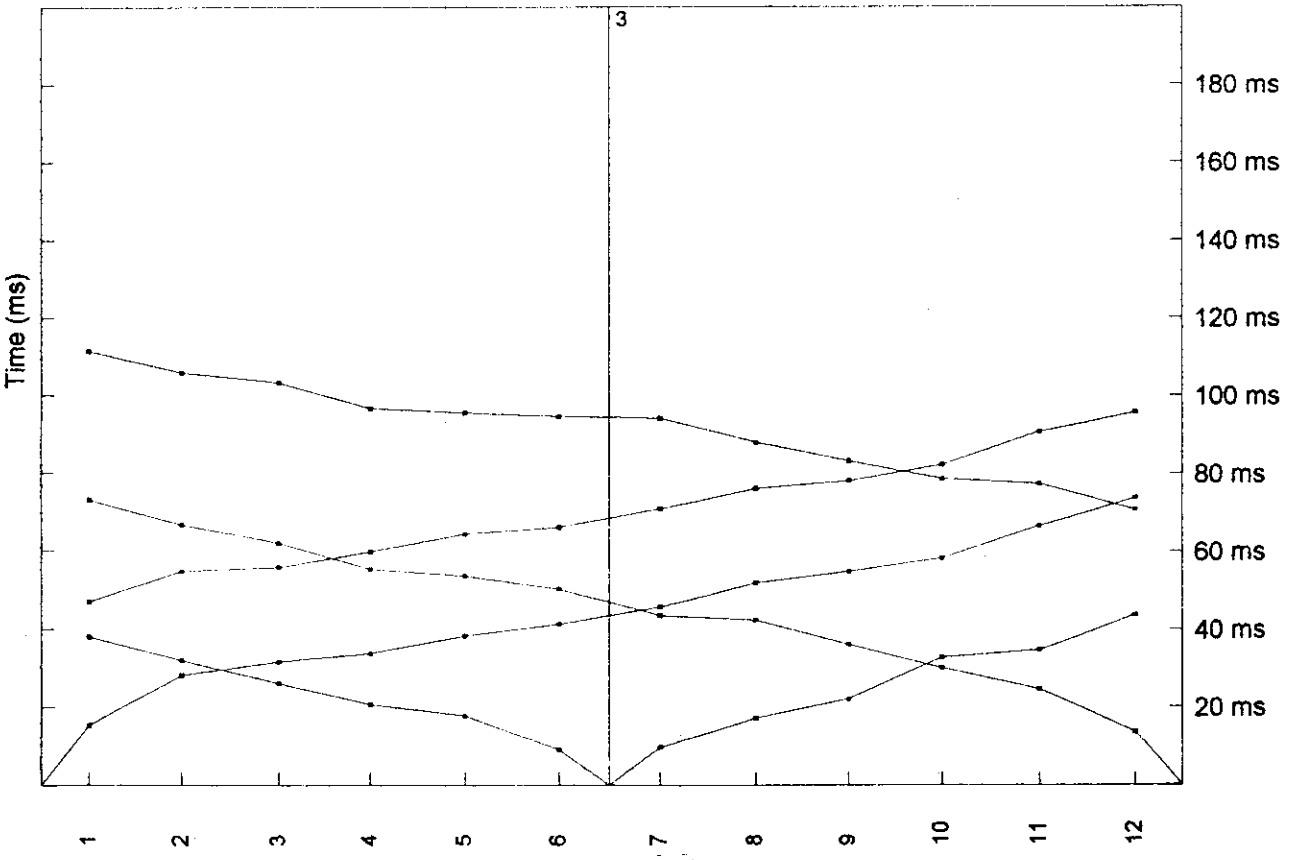

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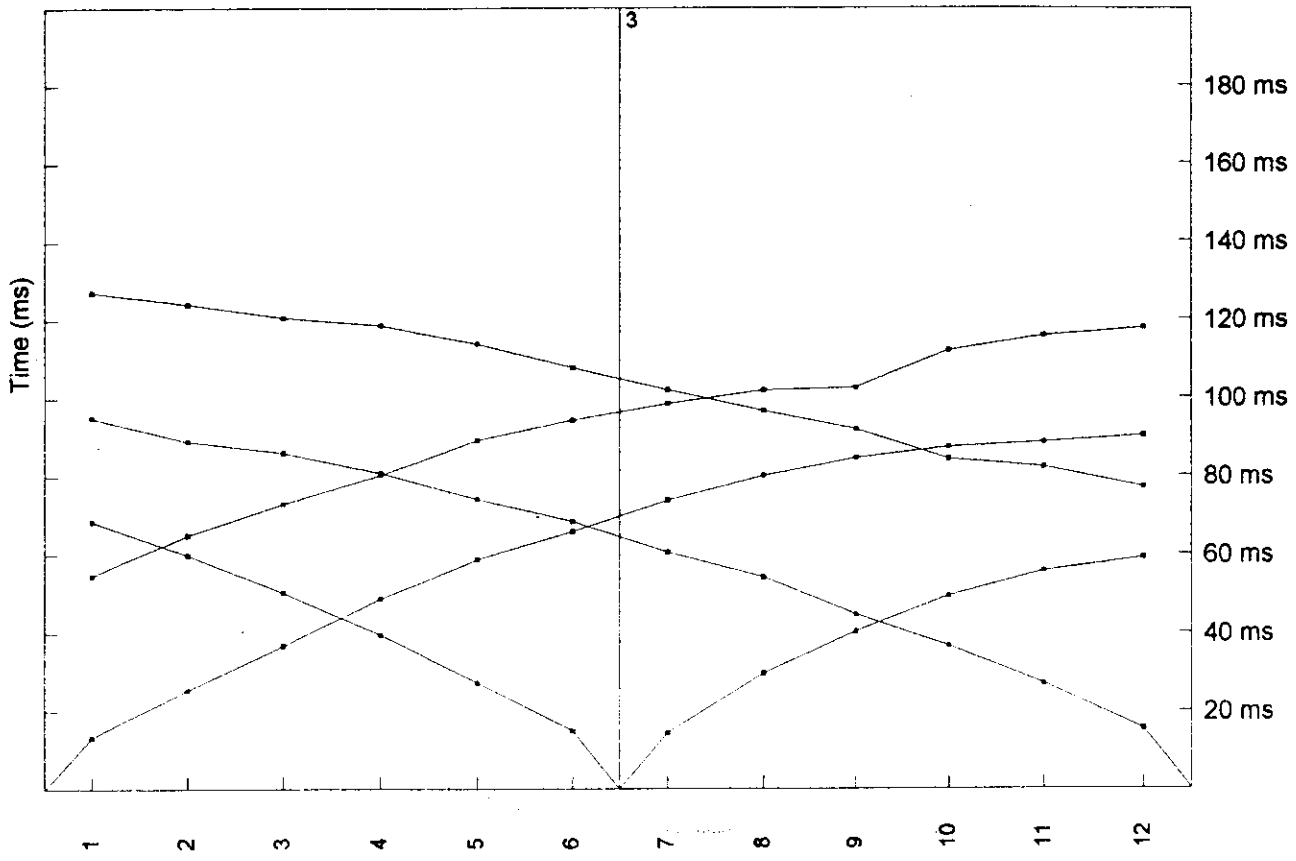

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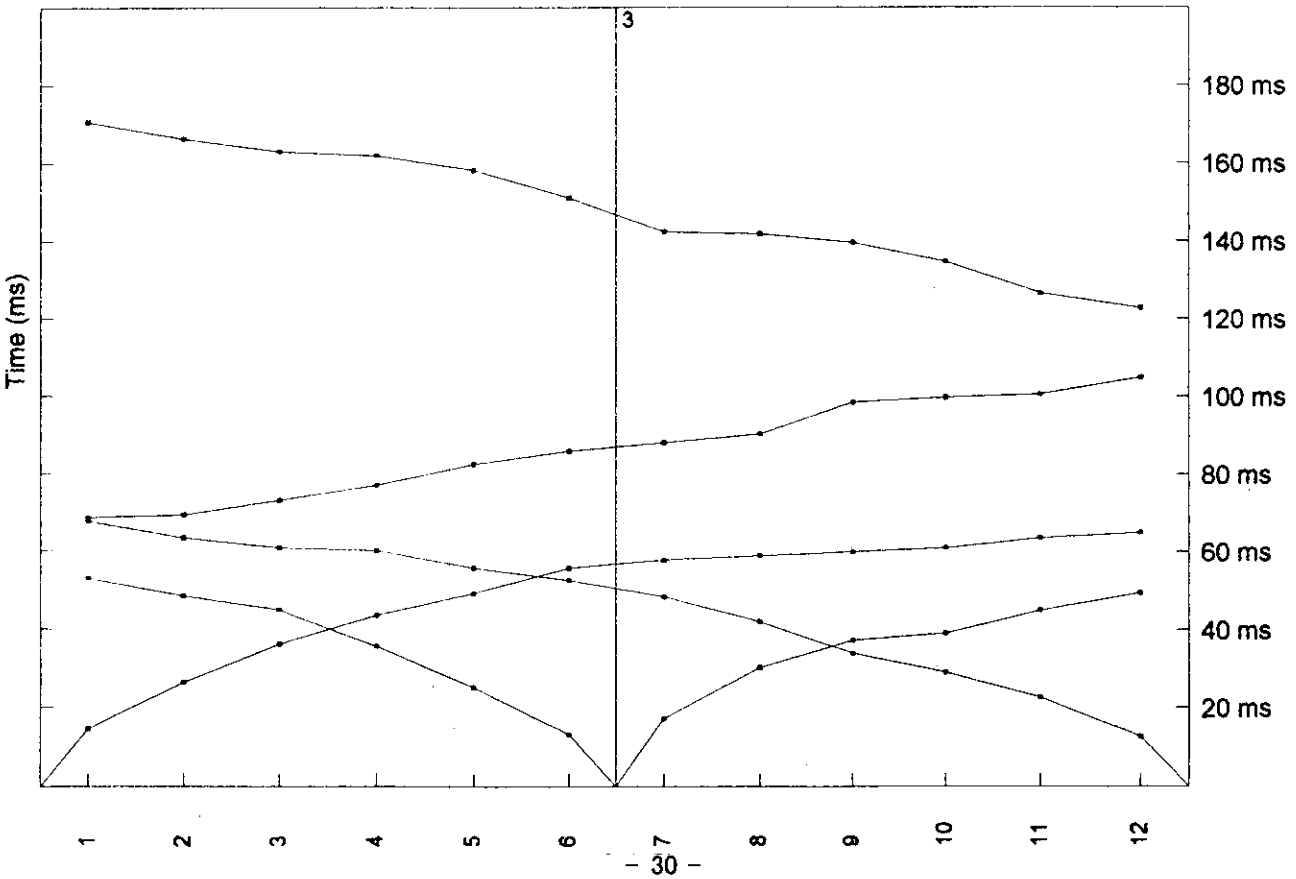

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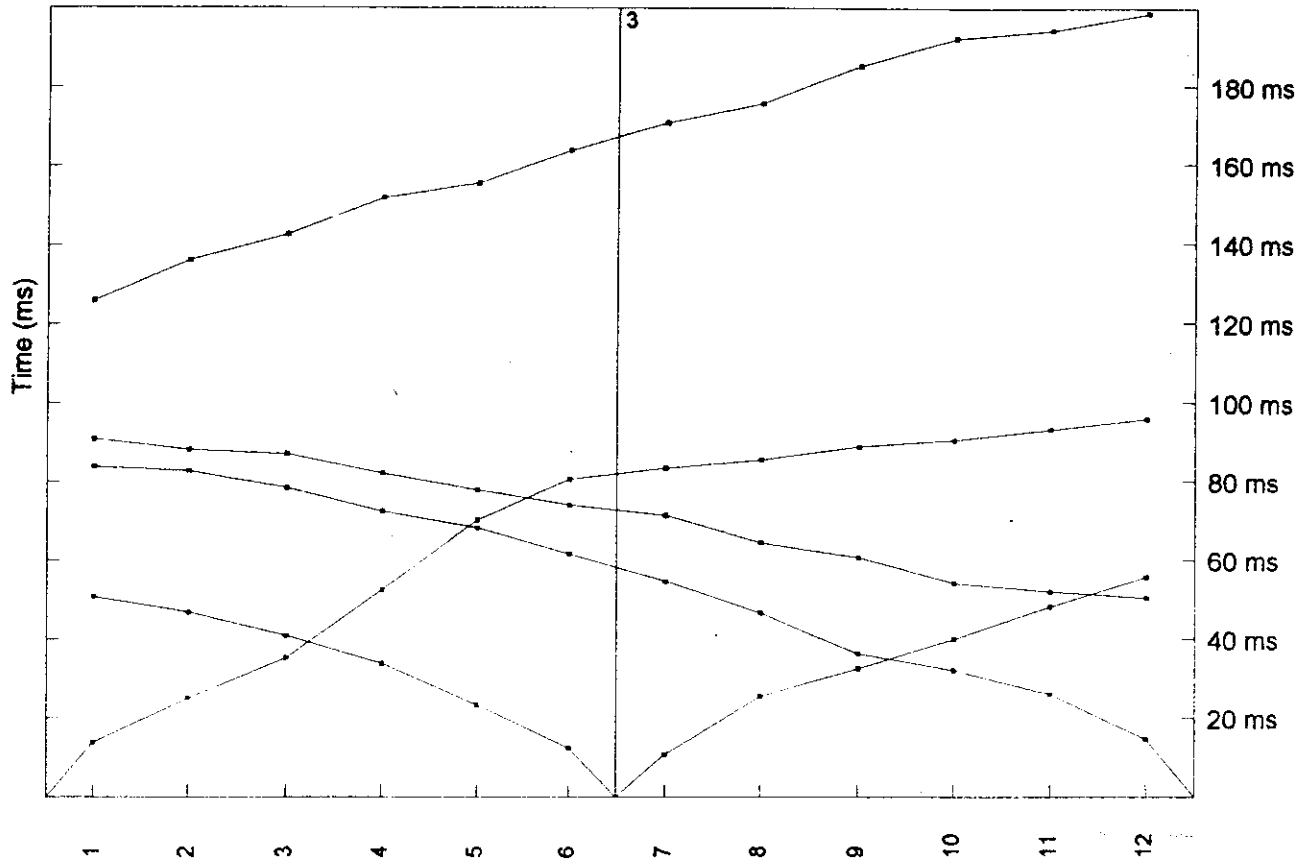
PERADENIYA - SRI LANKA

Section SMT37



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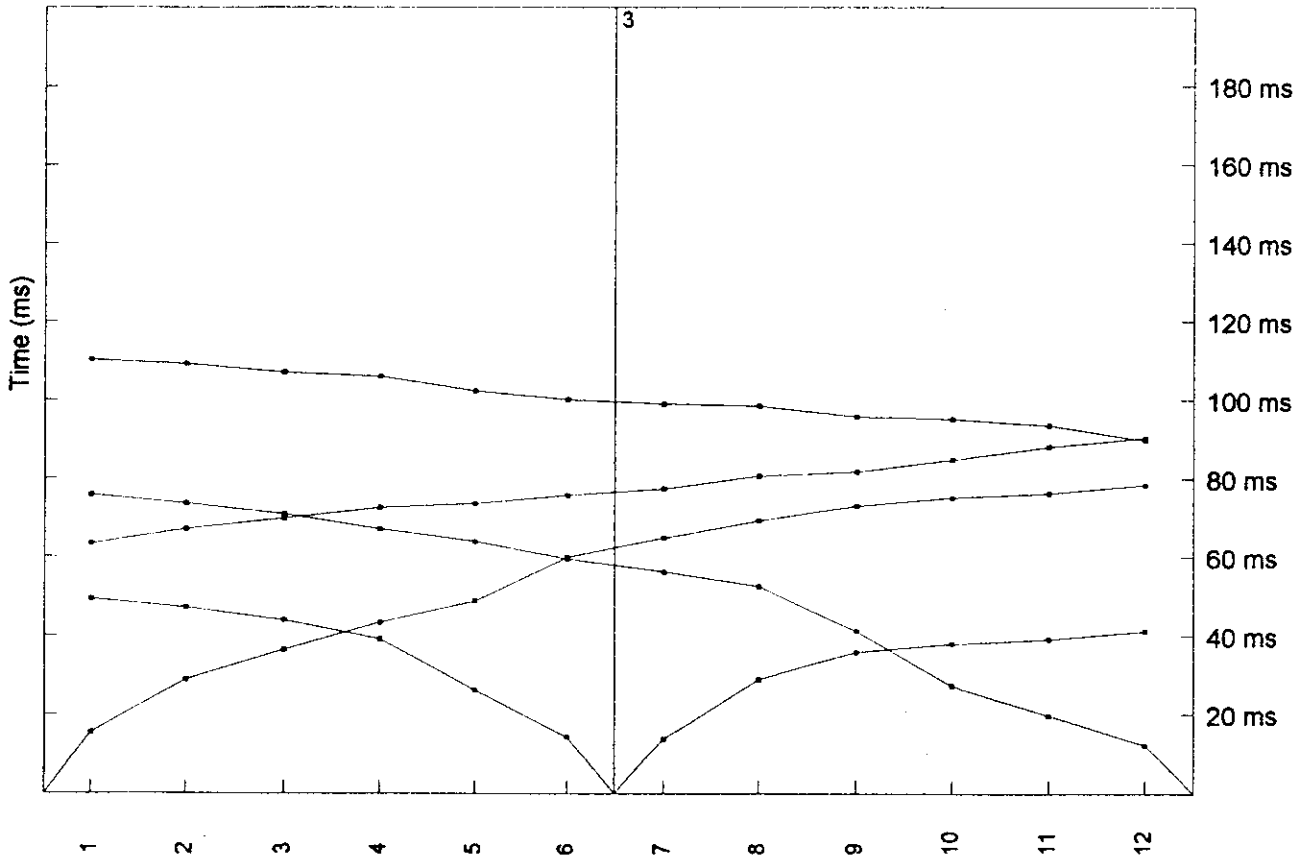
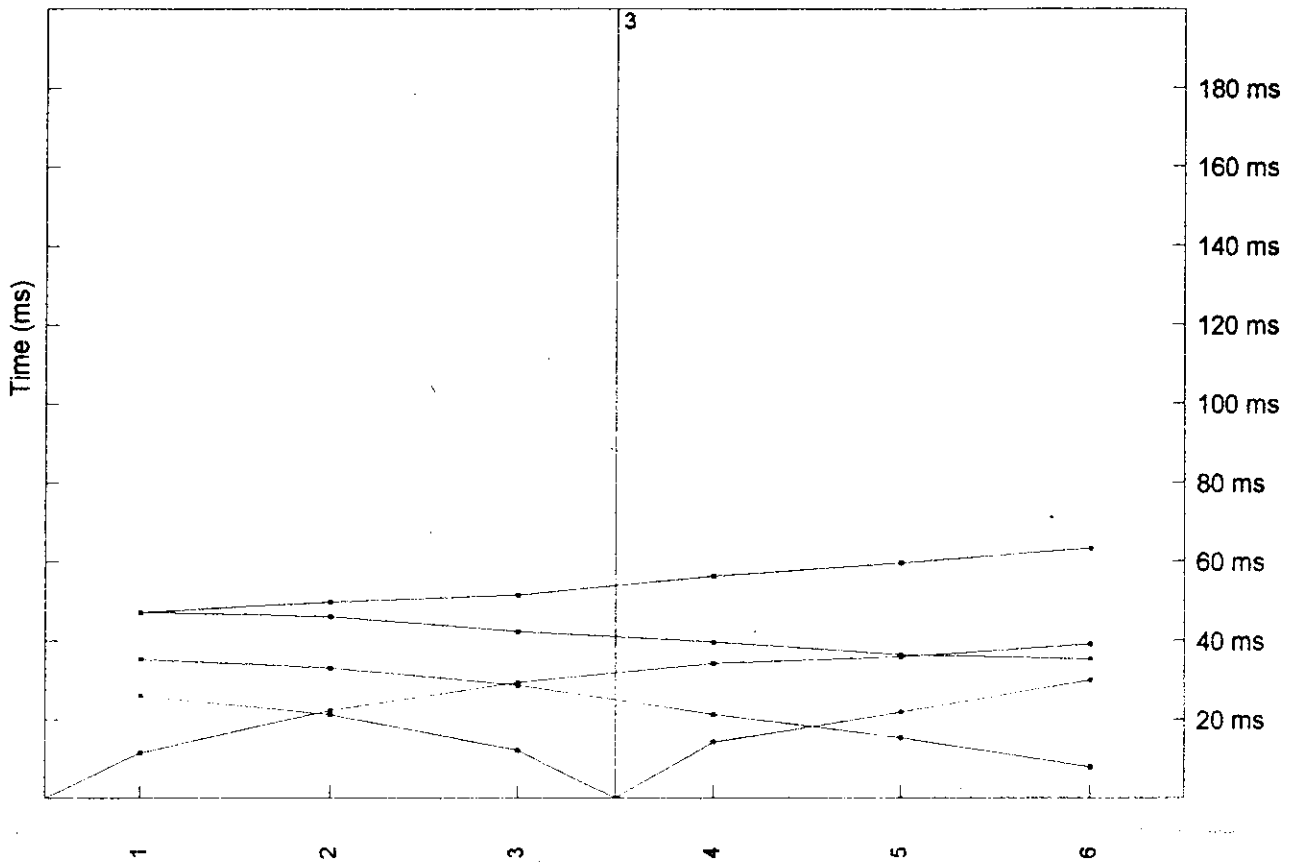


UNIVERSITY OF PERADENIYA
DEPARTMENT OF GEOLOGY
PERADENIYA - SRI LANKA



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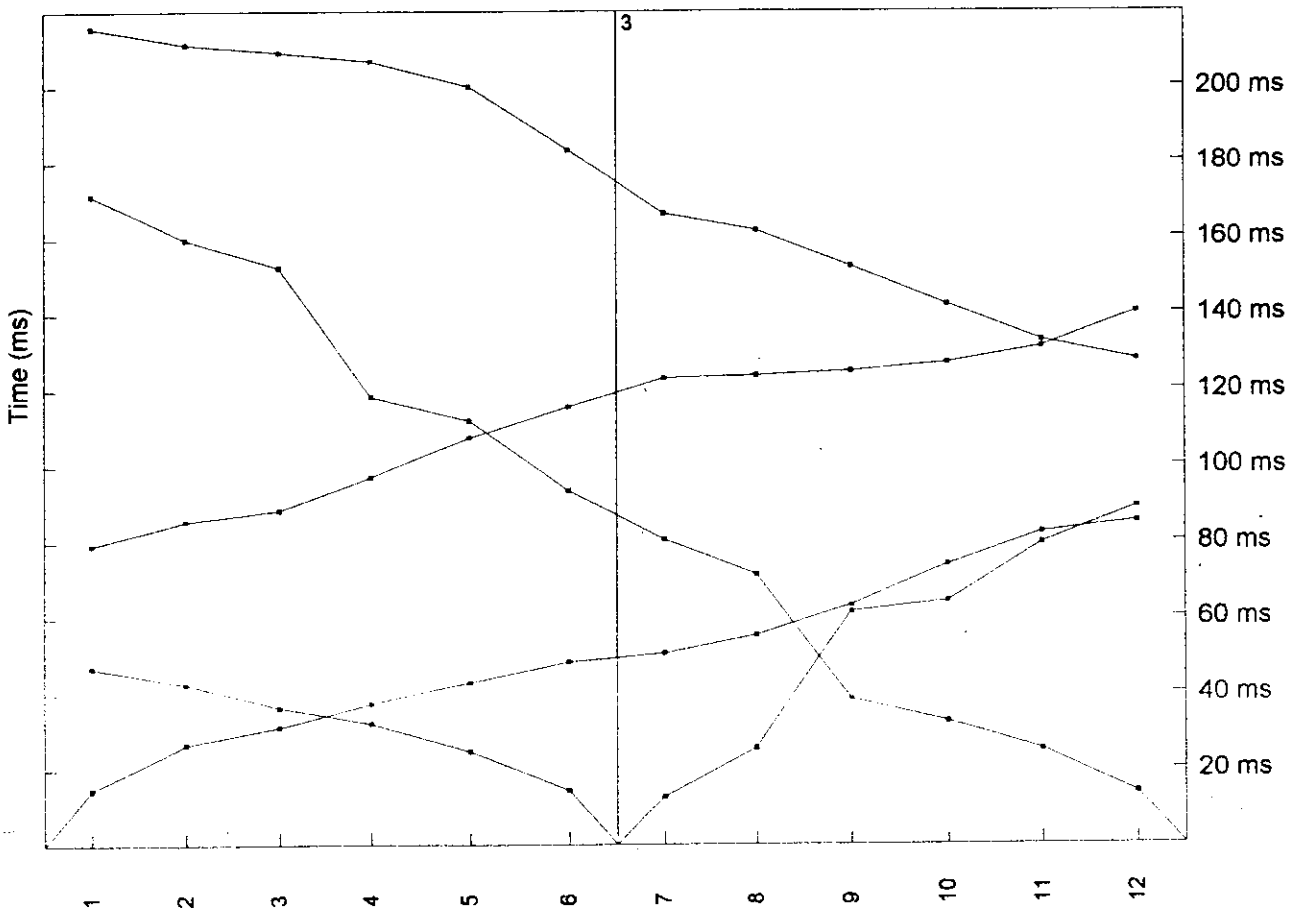

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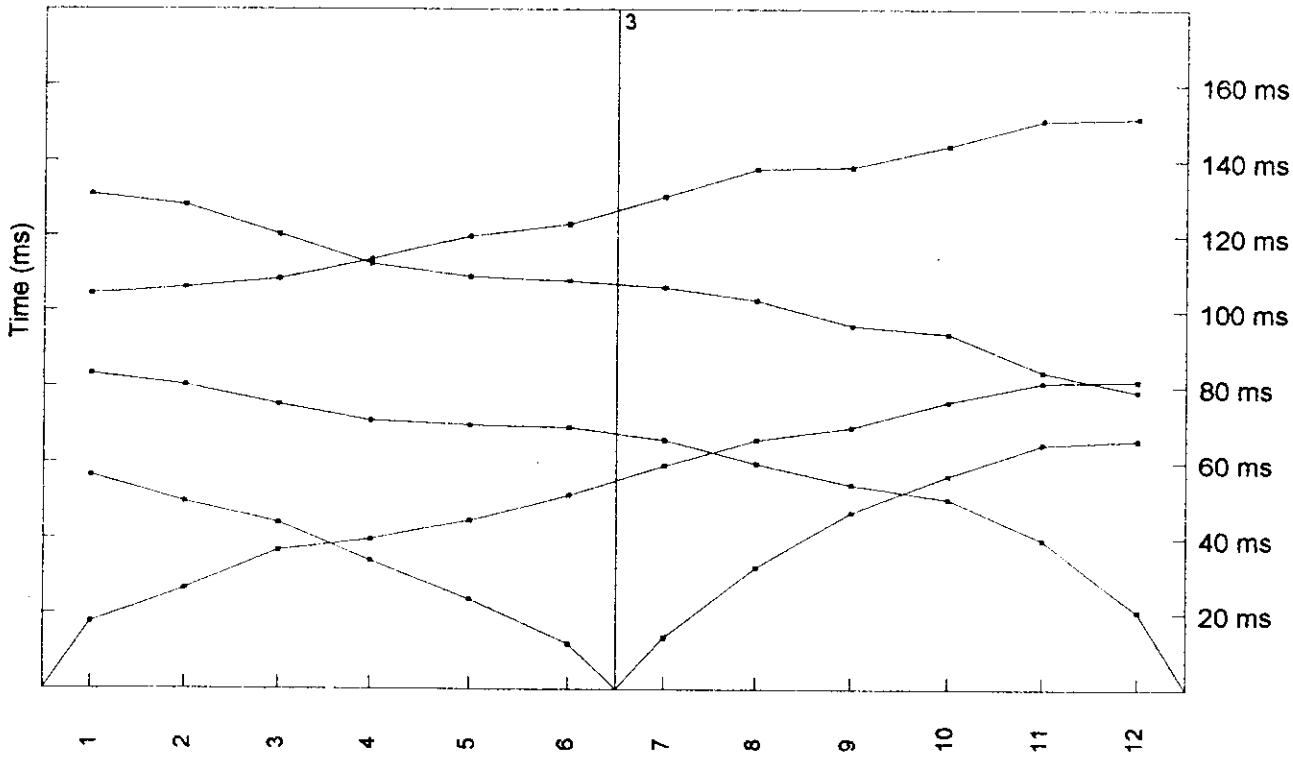

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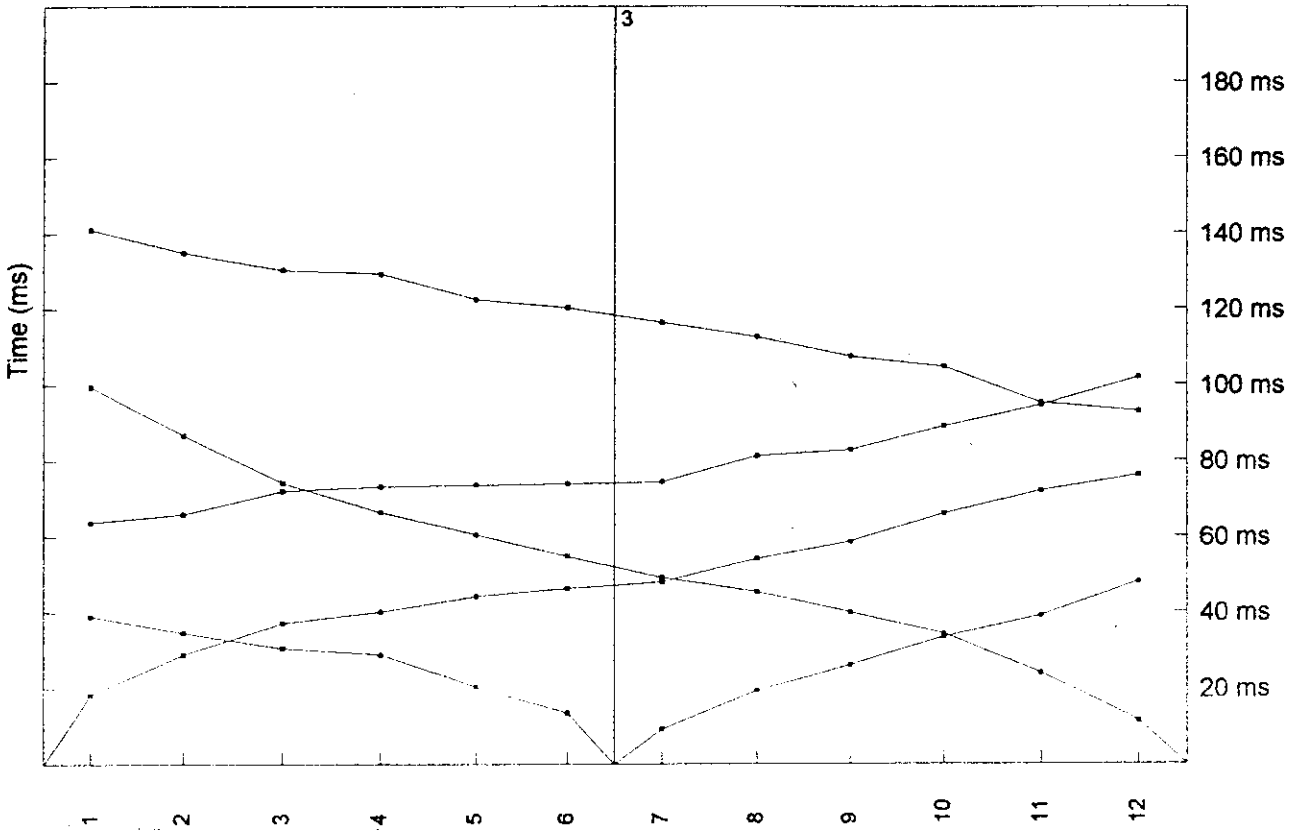

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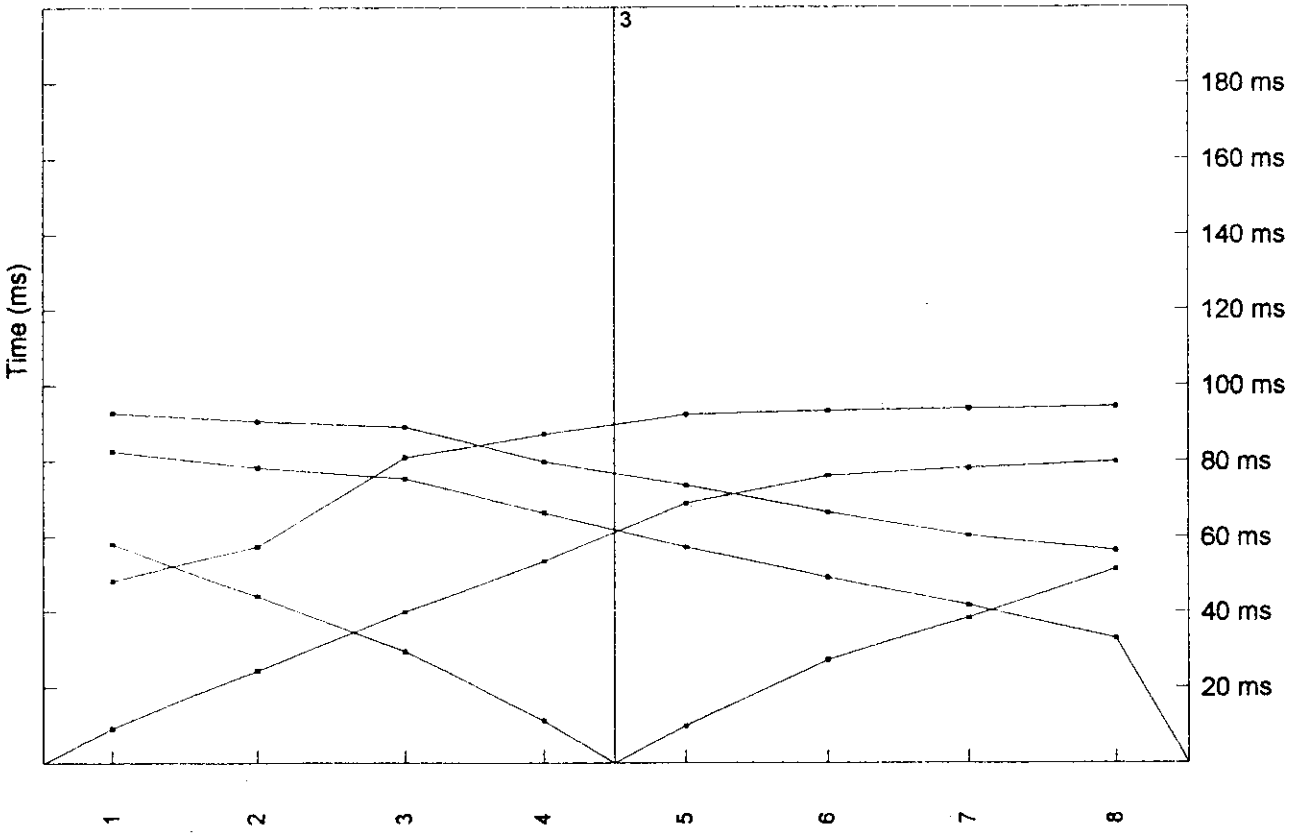

Section SMT4E

UNIVERSITY OF PERADENIYA
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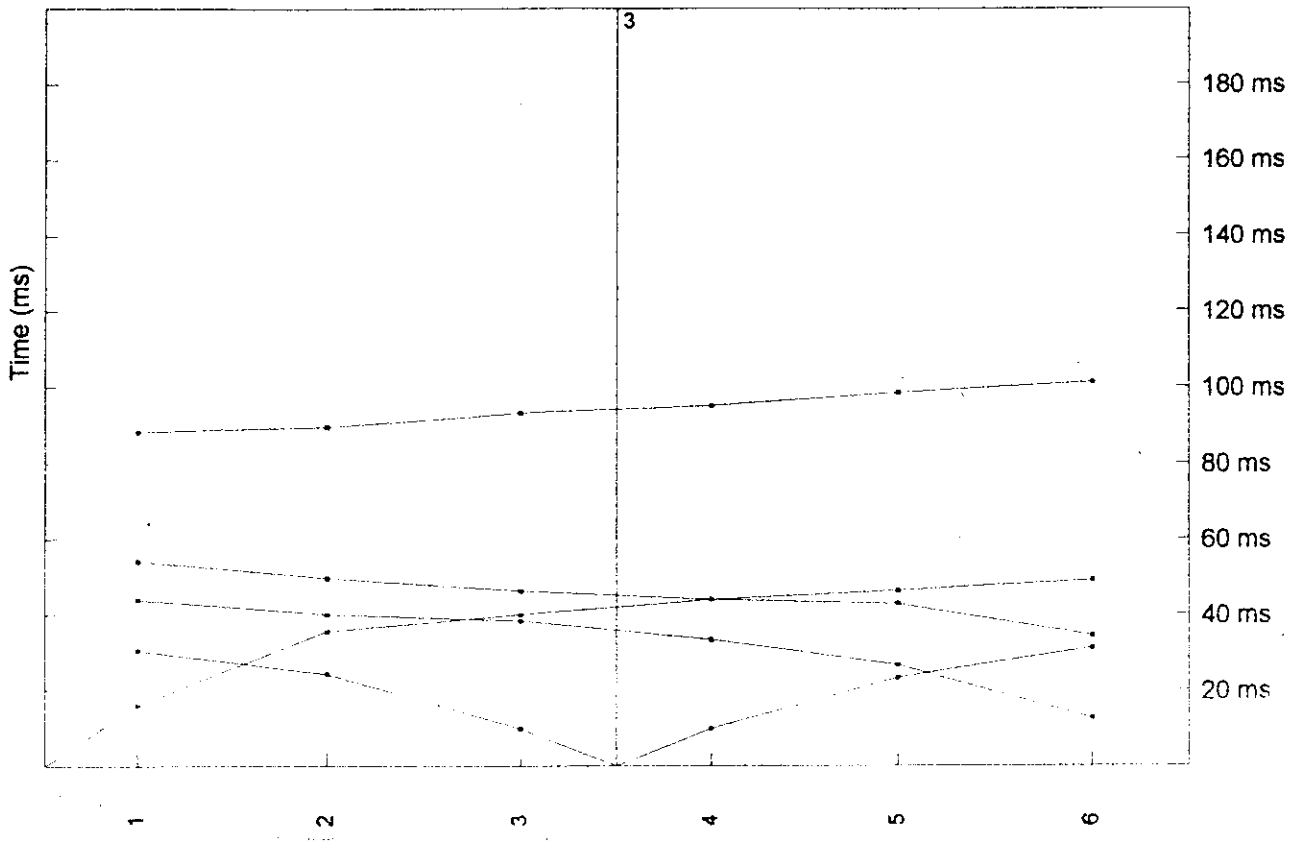
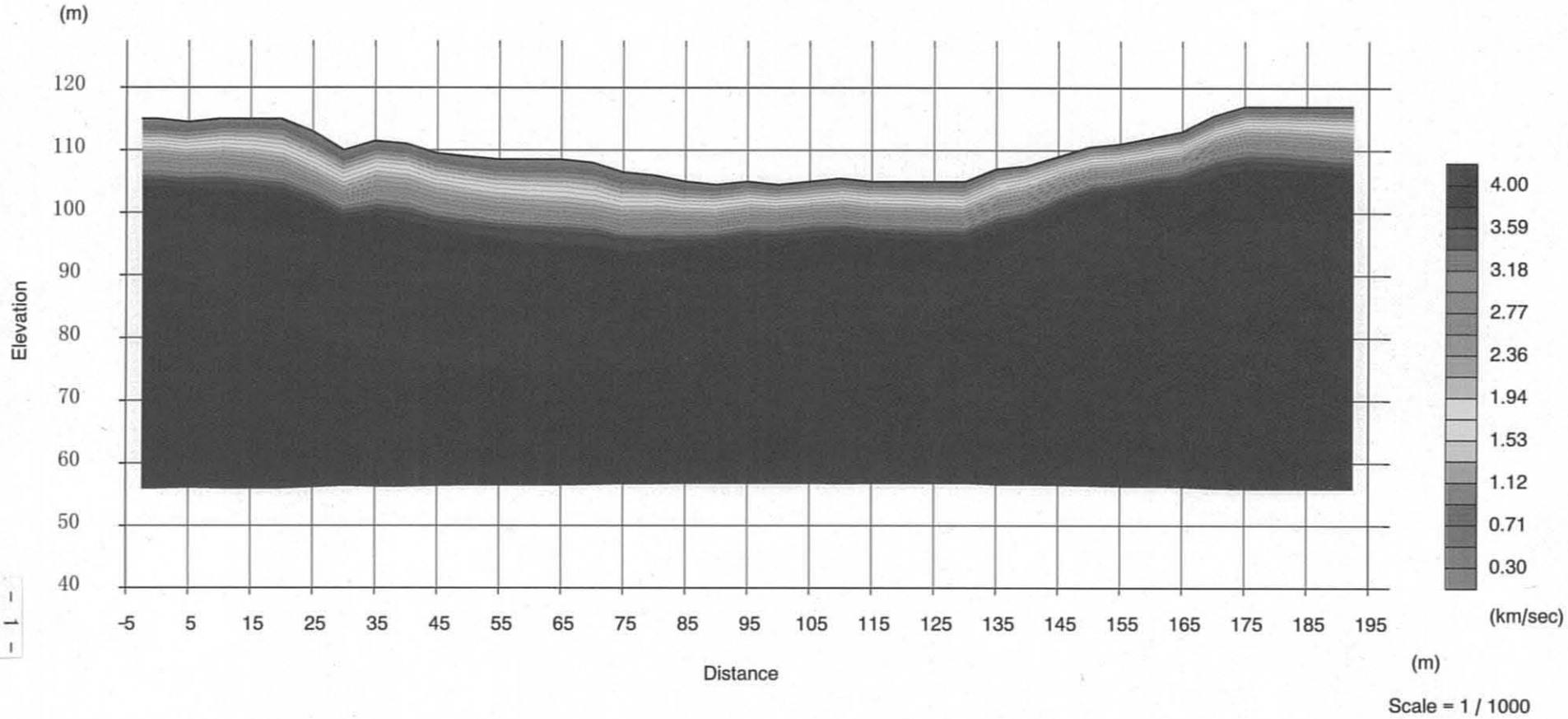
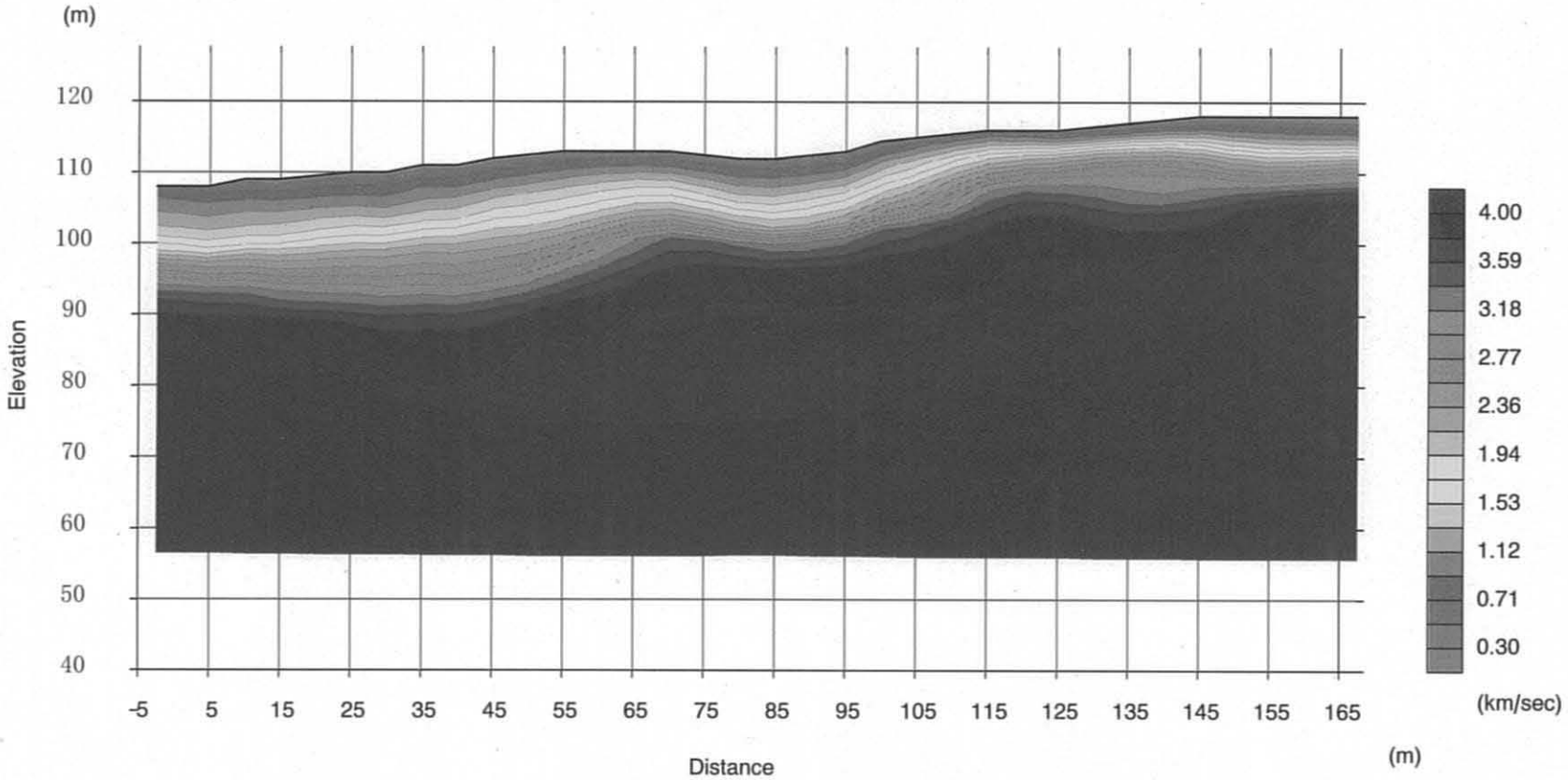


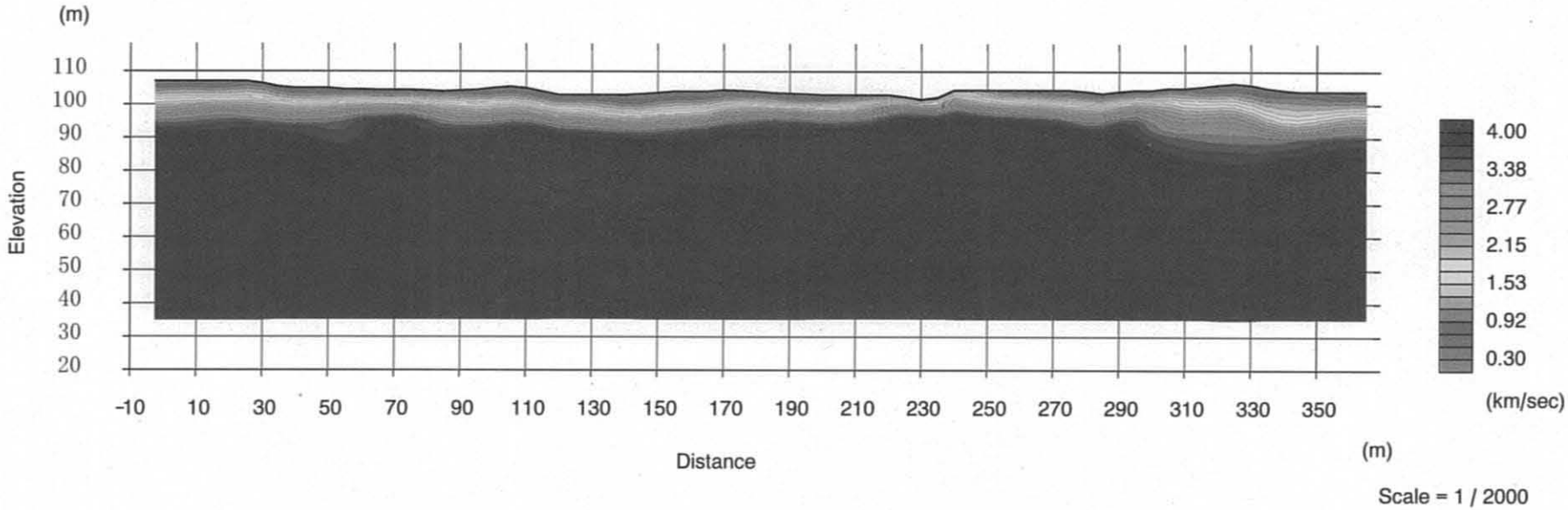
2.4 Seismic Wave Velocity Layer Profile



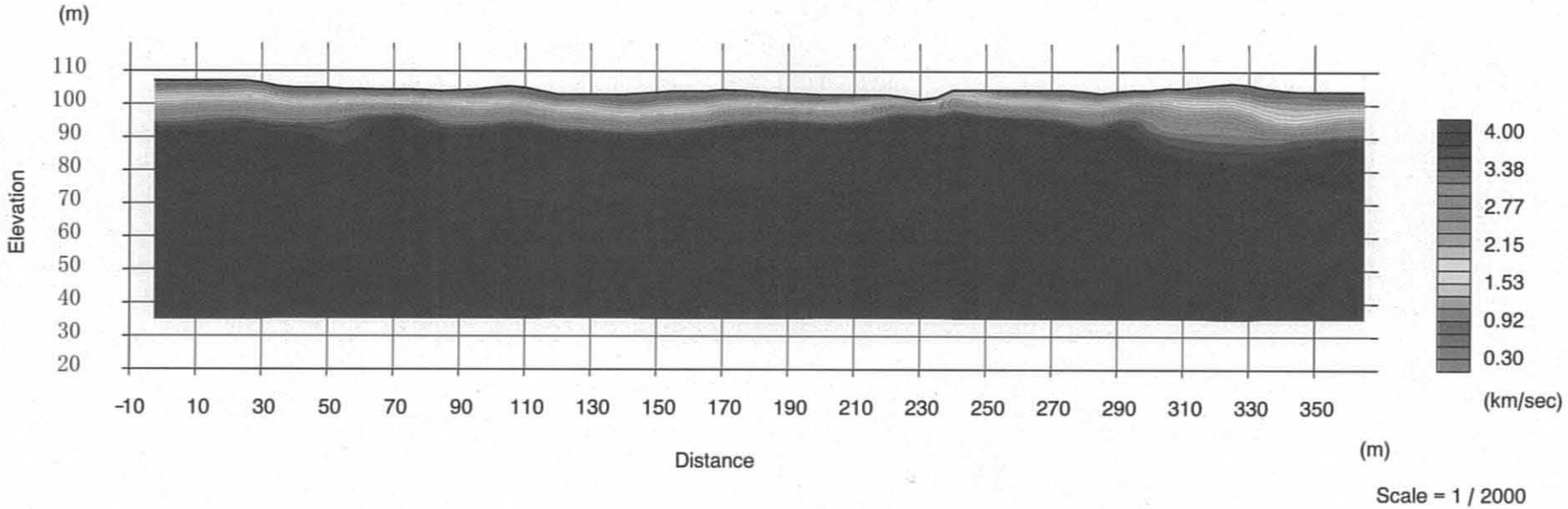
Seismic Wave Velocity Layer Profile Sct 1



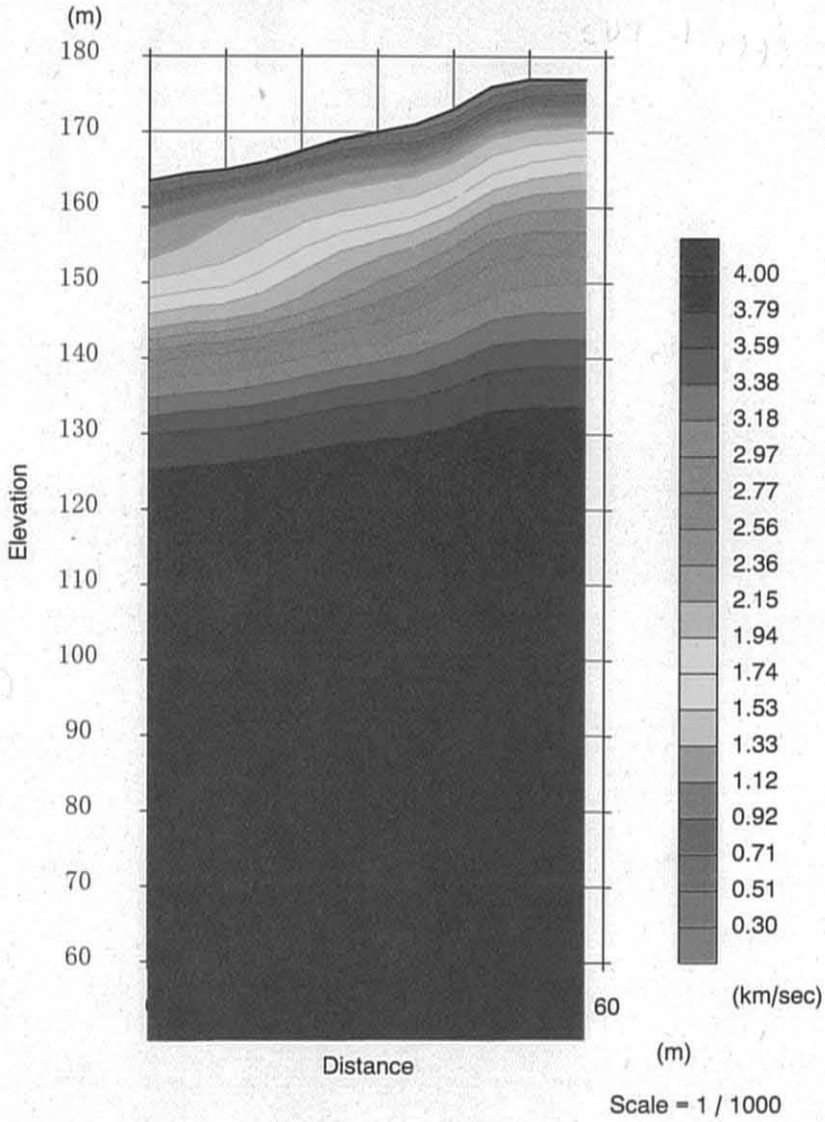
Seismic Wave Velocity Layer Profile Sct 2



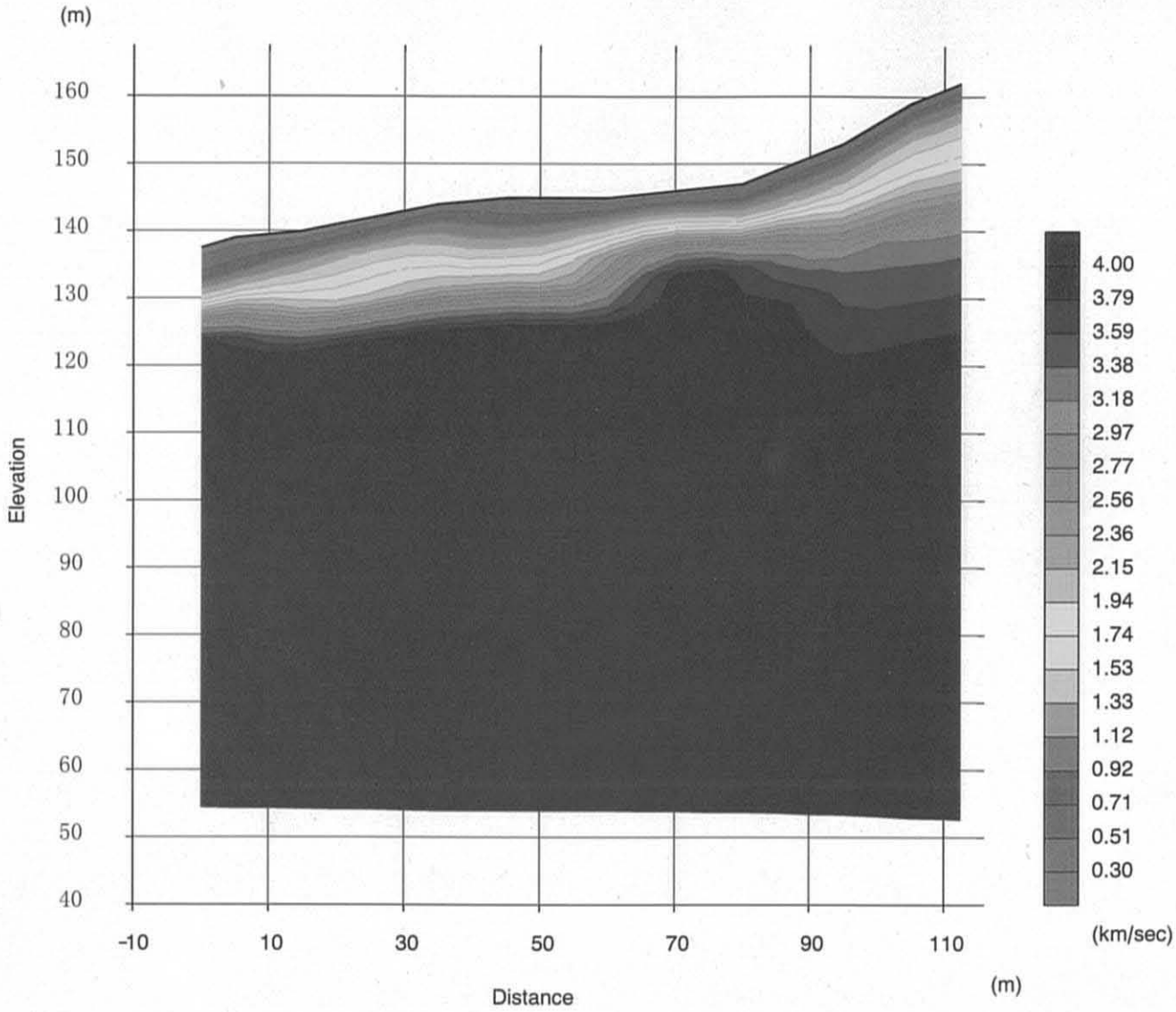
Seismic Wave Velocity Layer Profile Sct 3



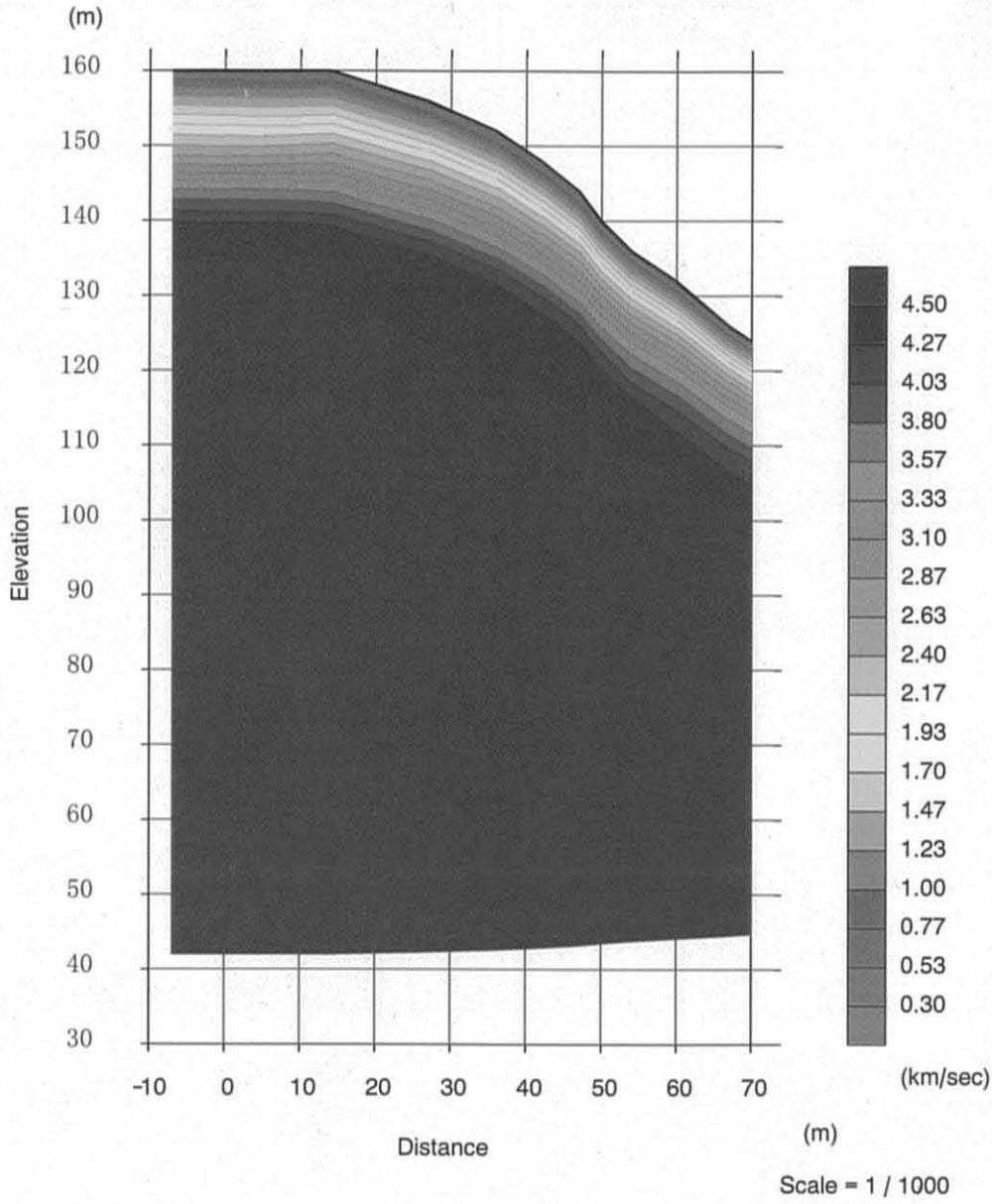
Seismic Wave Velocity Layer Profile Sdt 1(1)



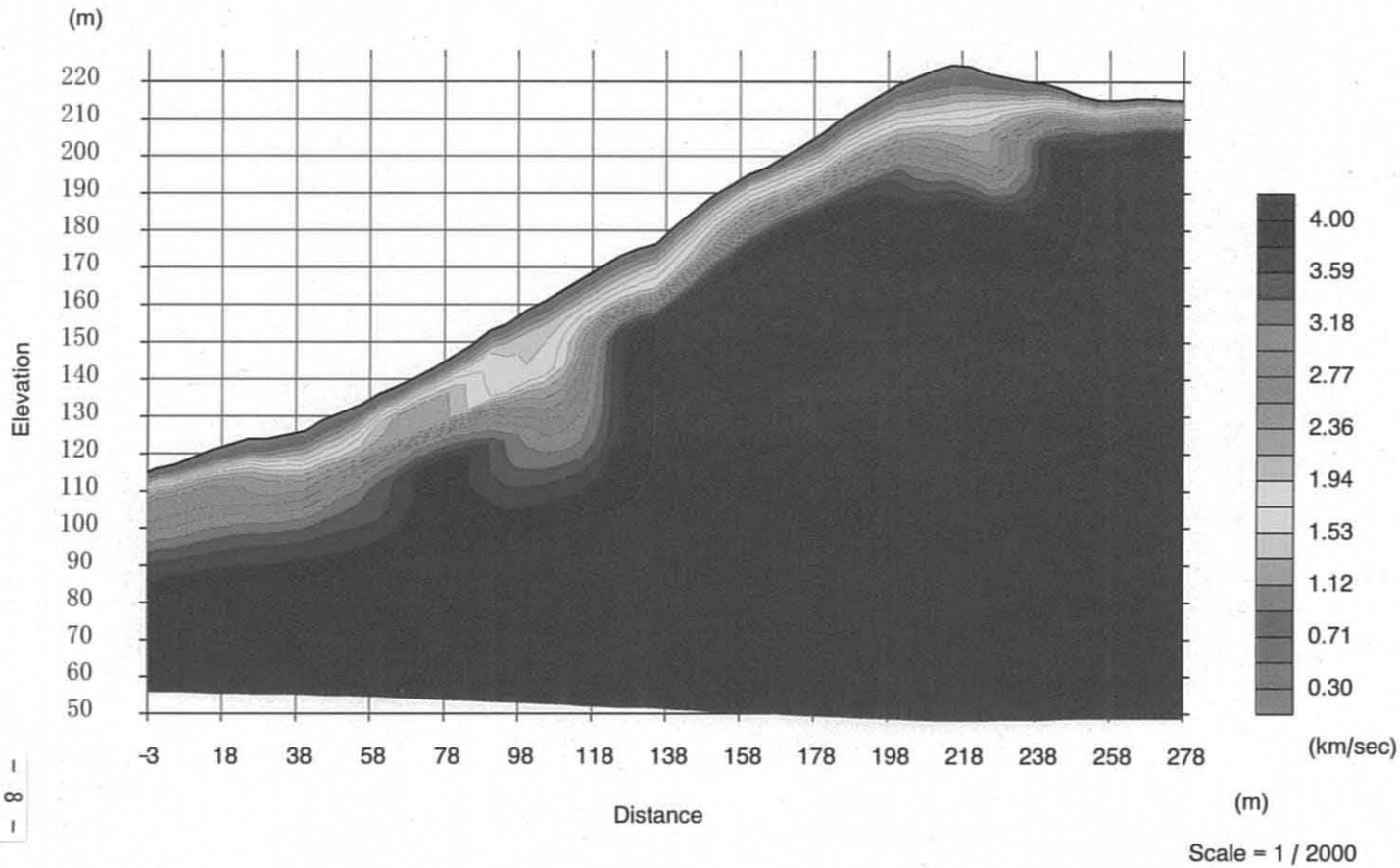
Seismic Wave Velocity Layer Profile Sdt 1(2)



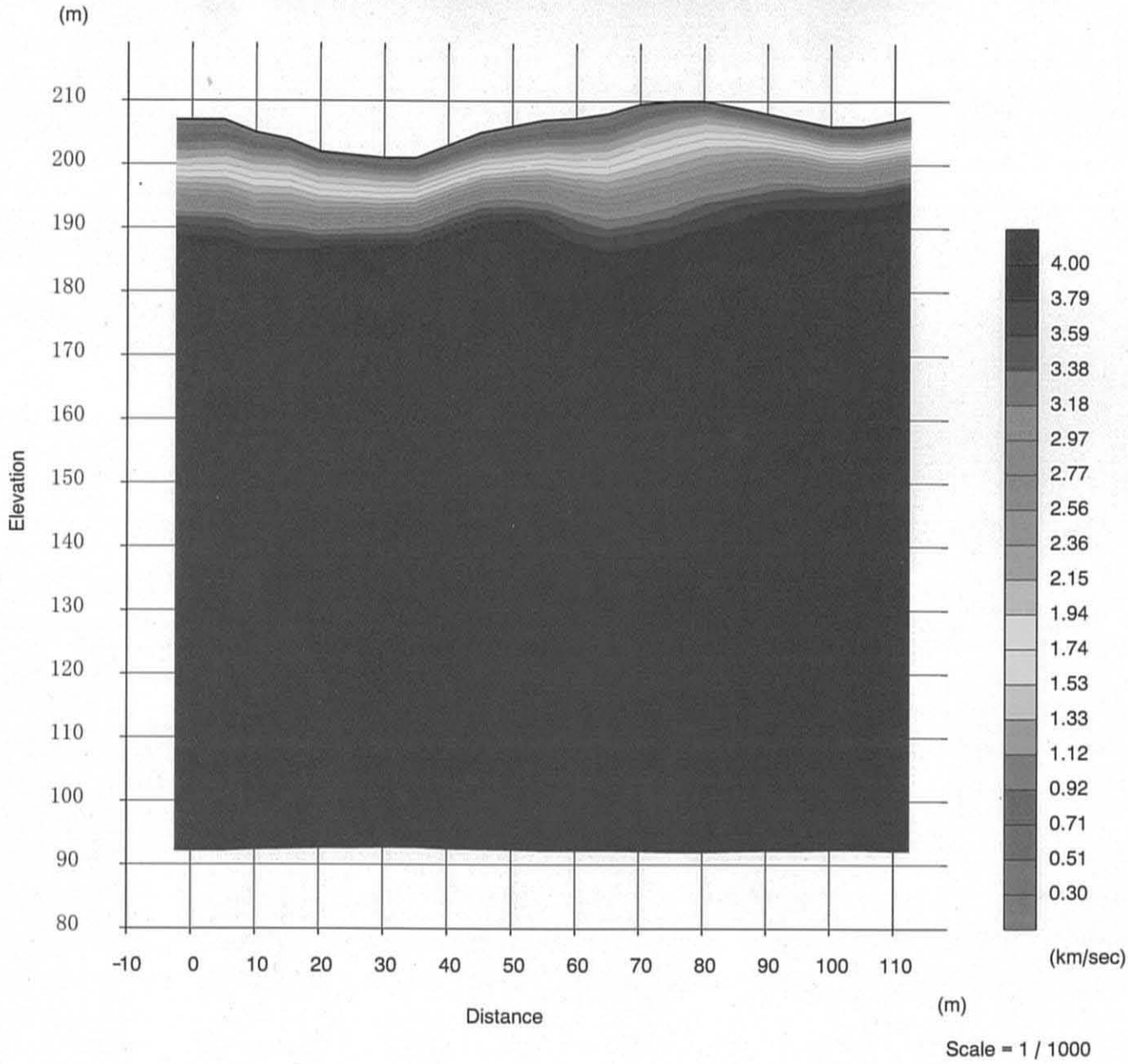
Seismic Wave Velocity Layer Profile Sdt 2



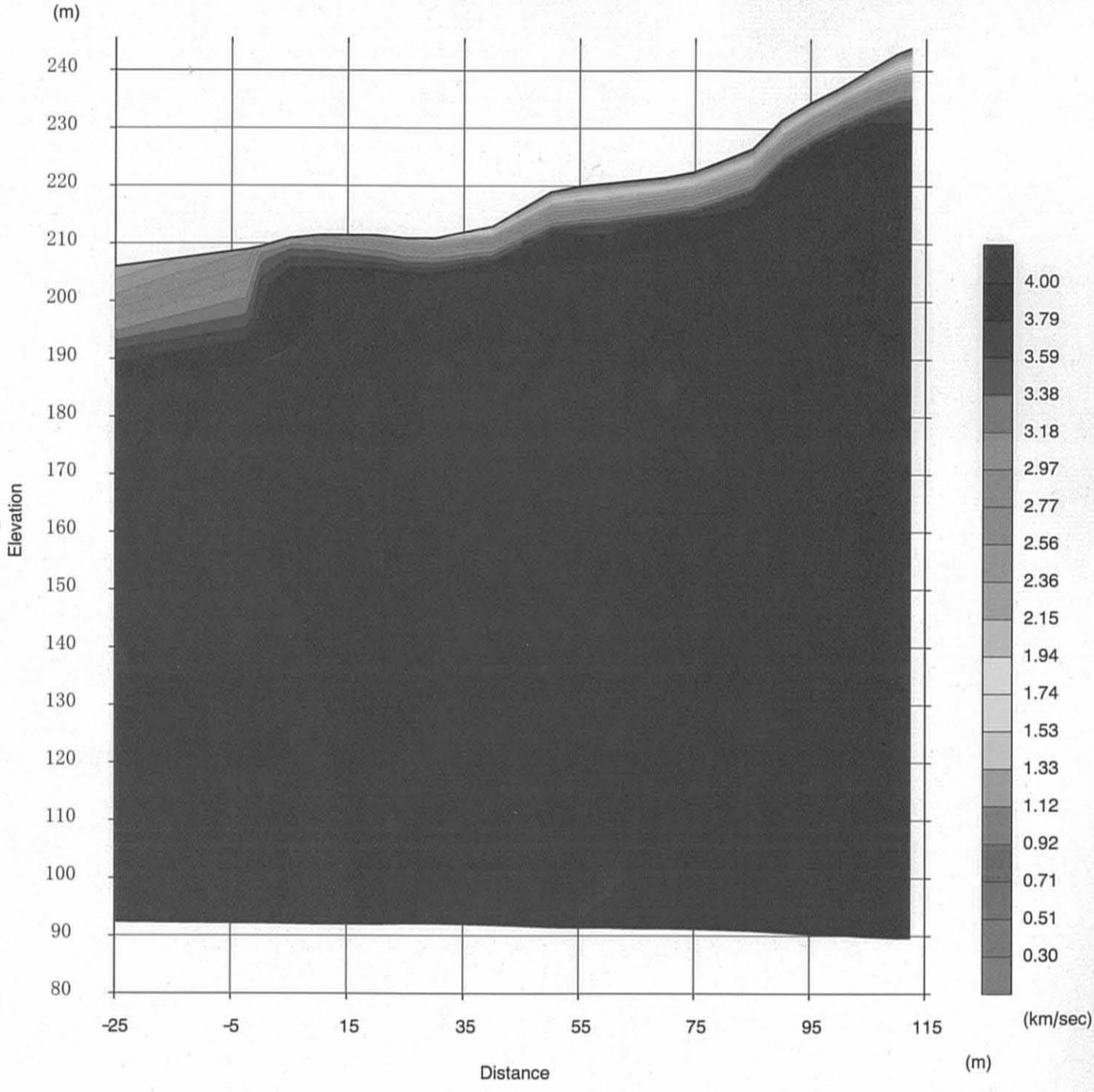
Seismic Wave Velocity Layer Profile Smd



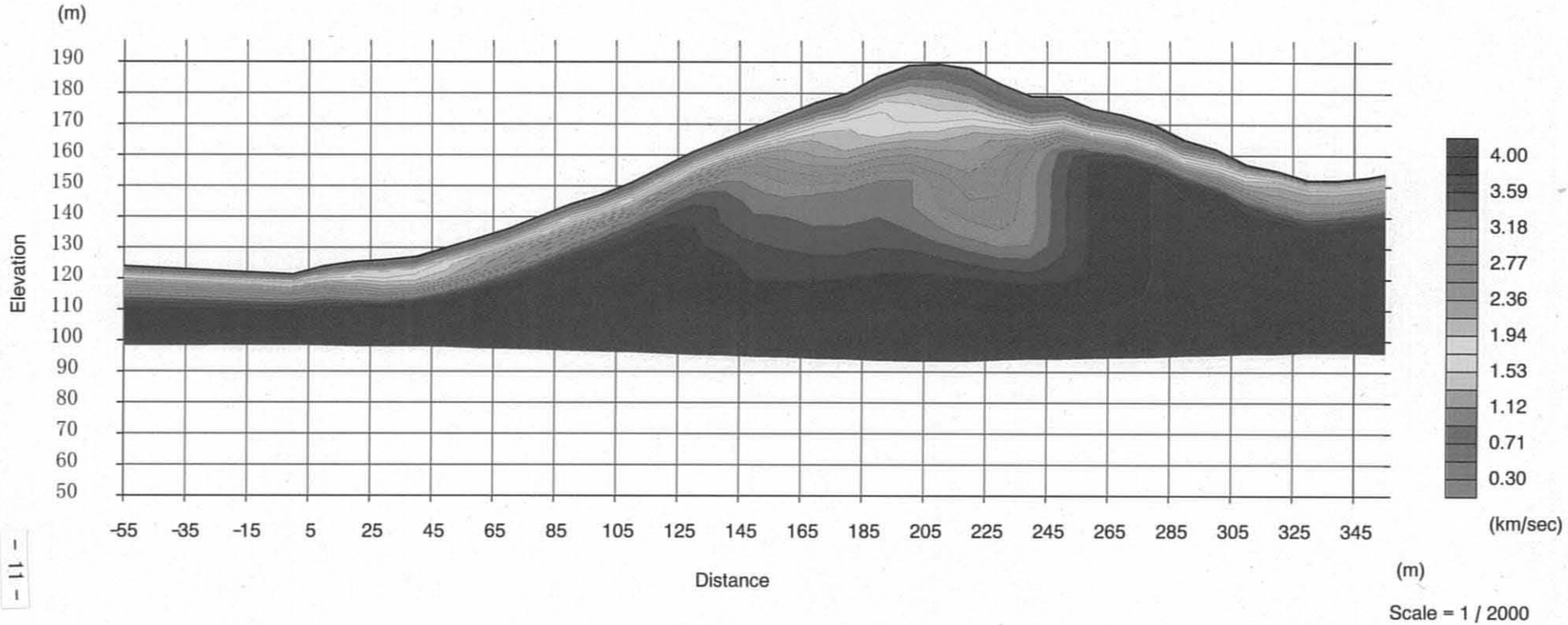
Seismic Wave Velocity Layer Profile Smt 1(1)



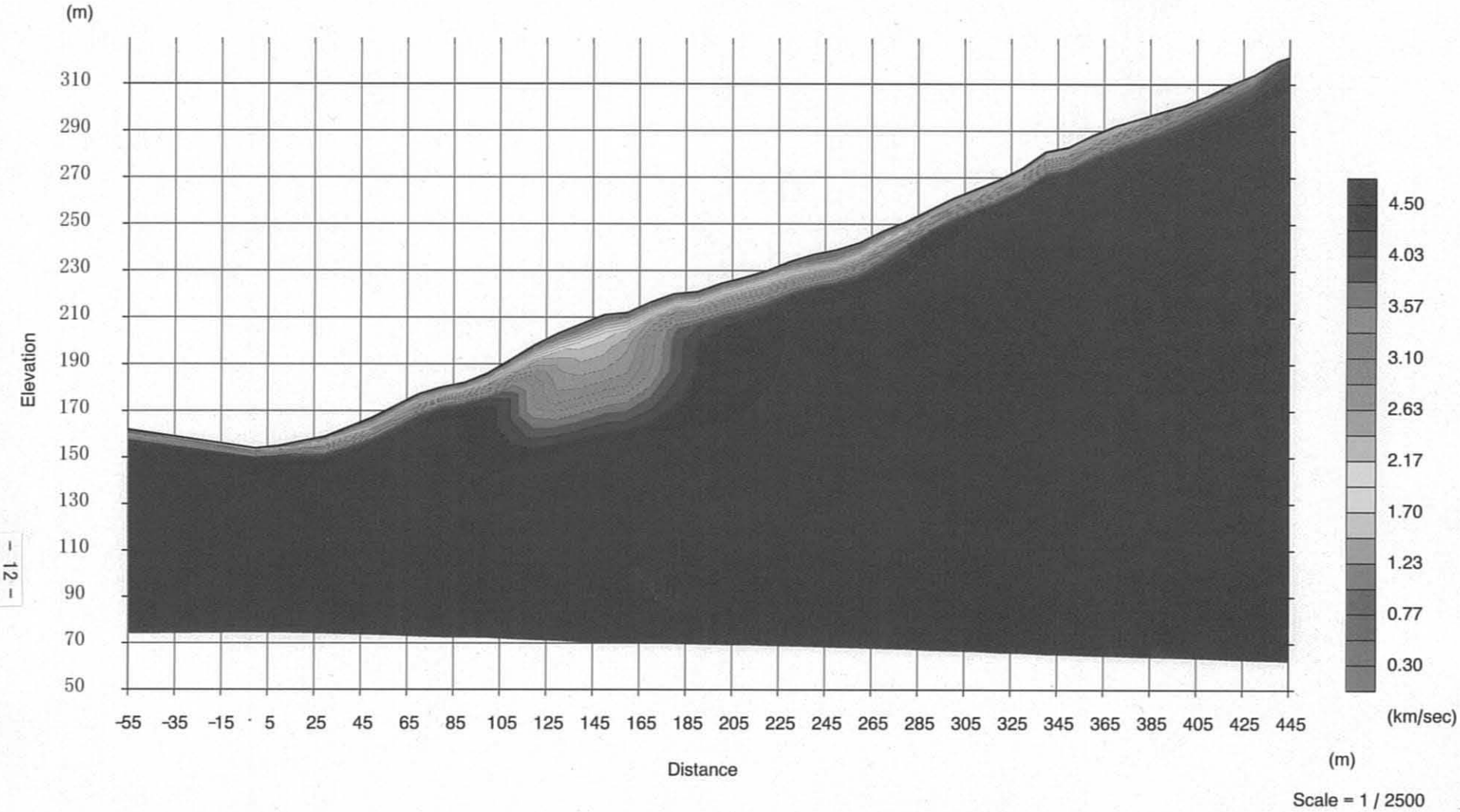
Seismic Wave Velocity Layer Profile Smt 1(2)



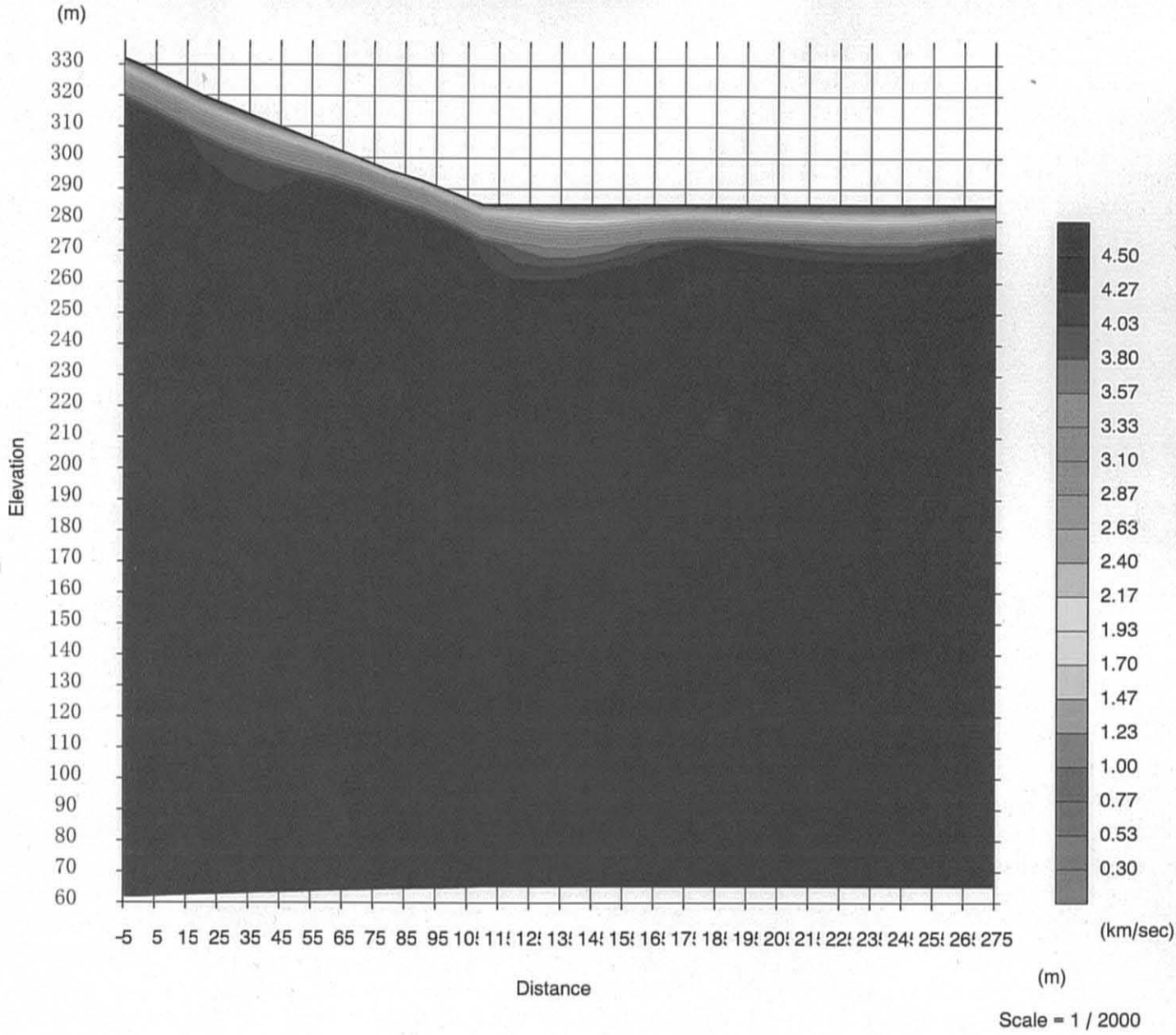
Seismic Wave Velocity Layer Profile Smt 1(3)



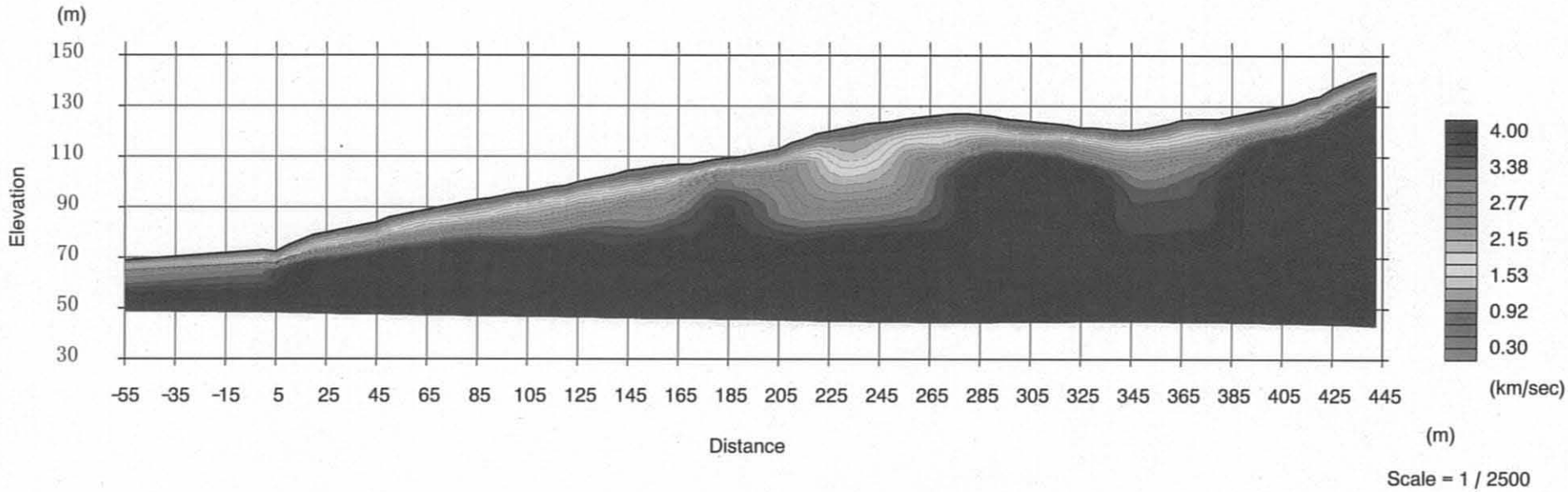
Seismic Wave Velocity Layer Profile Smt 2(1)



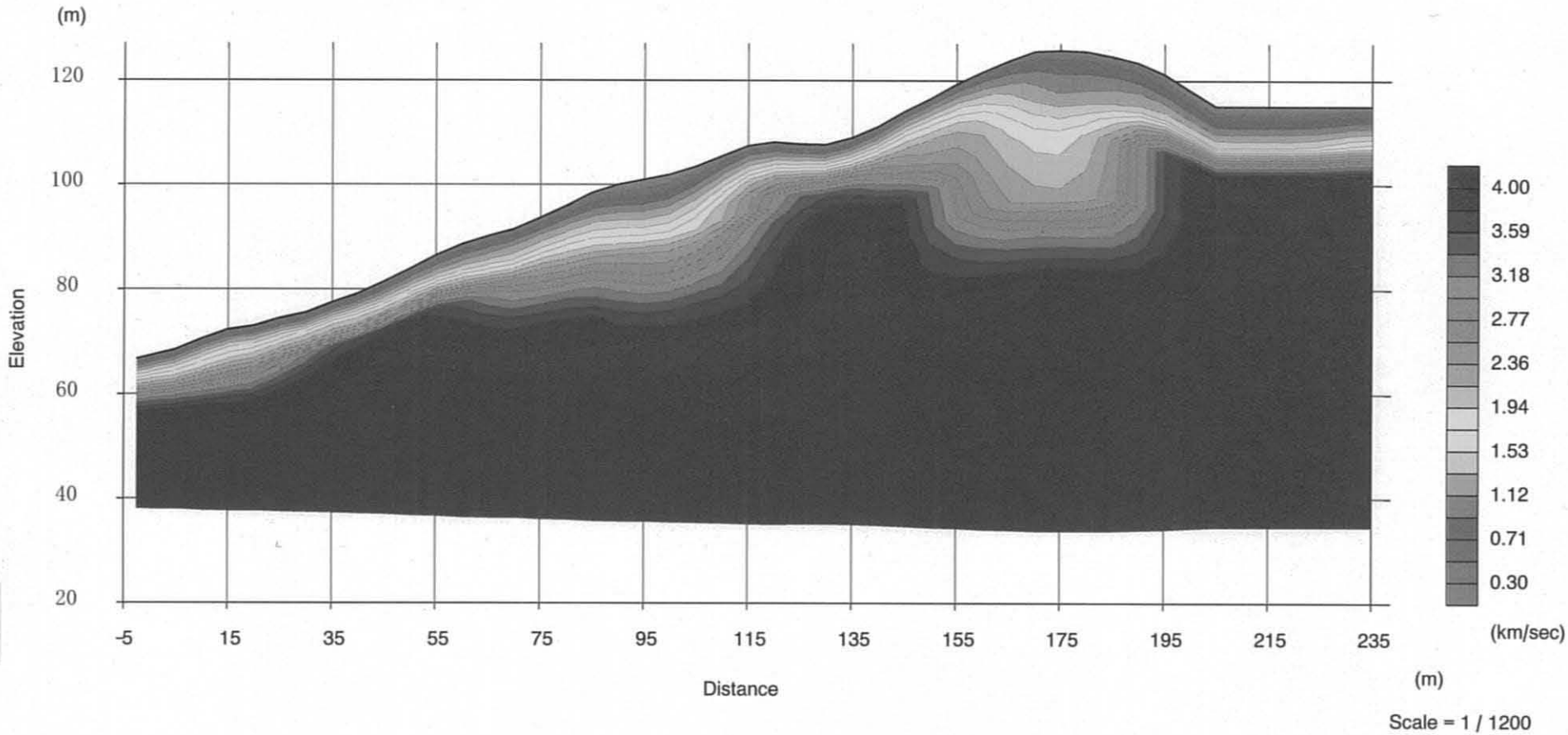
Seismic Wave Velocity Layer Profile Smt 2(2)



Seismic Wave Velocity Layer Profile Smt 2(3)



Seismic Wave Velocity Layer Profile Smt 3



Seismic Wave Velocity Layer Profile Smt 4

2.5 Photographs of Equipment and Field Work

Equipment of seismic refraction prospecting

Field work (Recording)