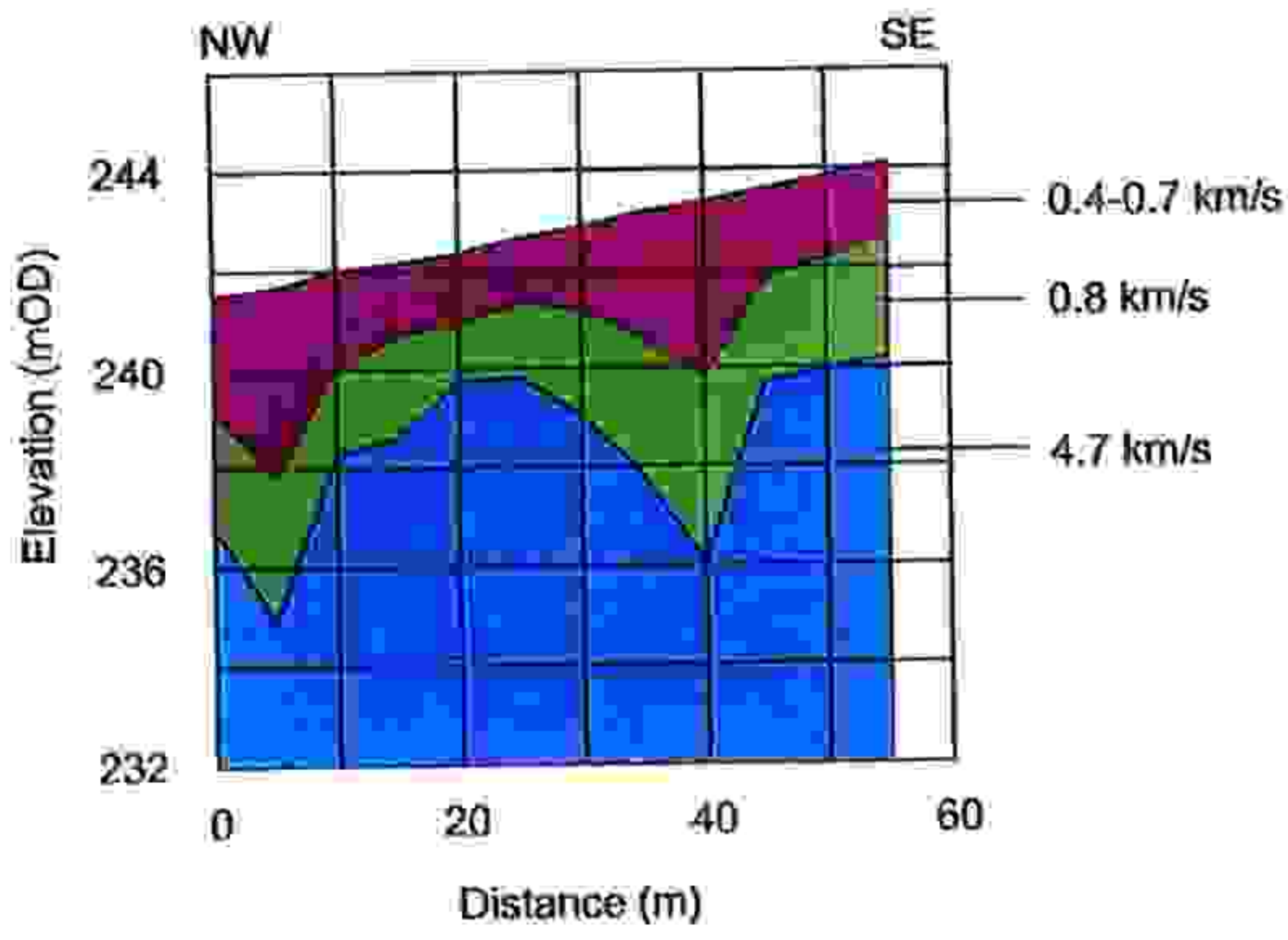


Appendix C

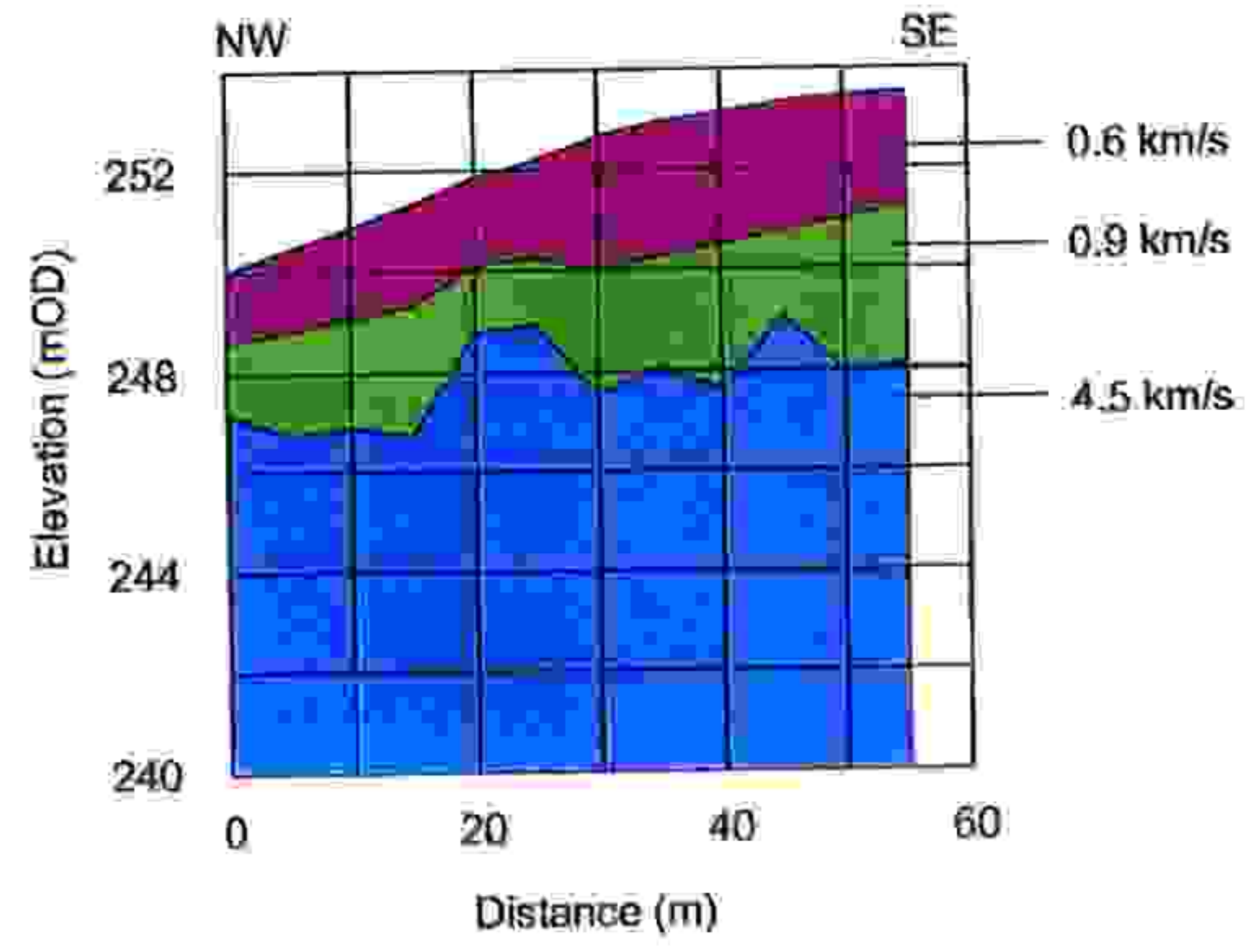
2 Figures

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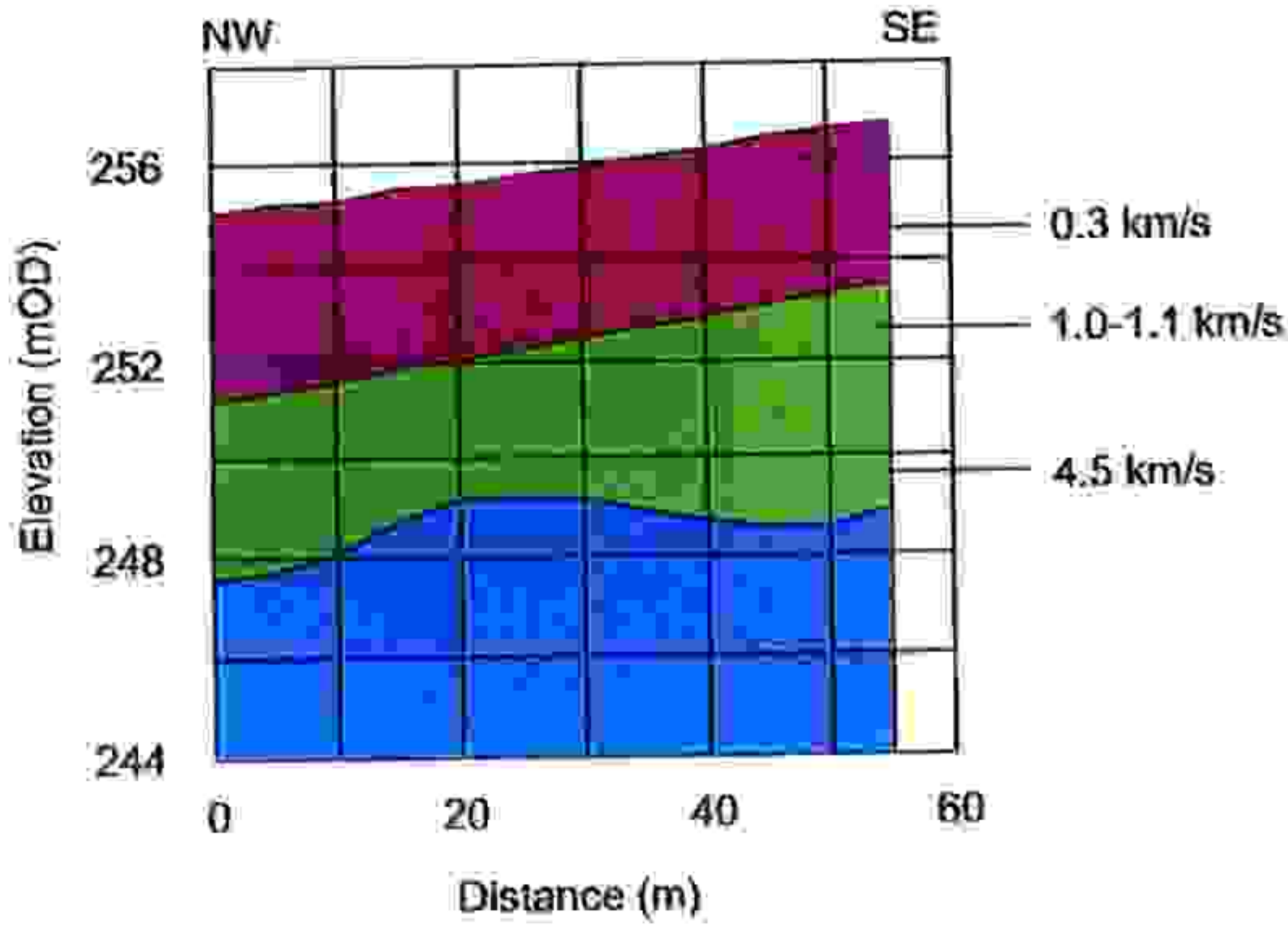
Seismic Refraction Profile 1



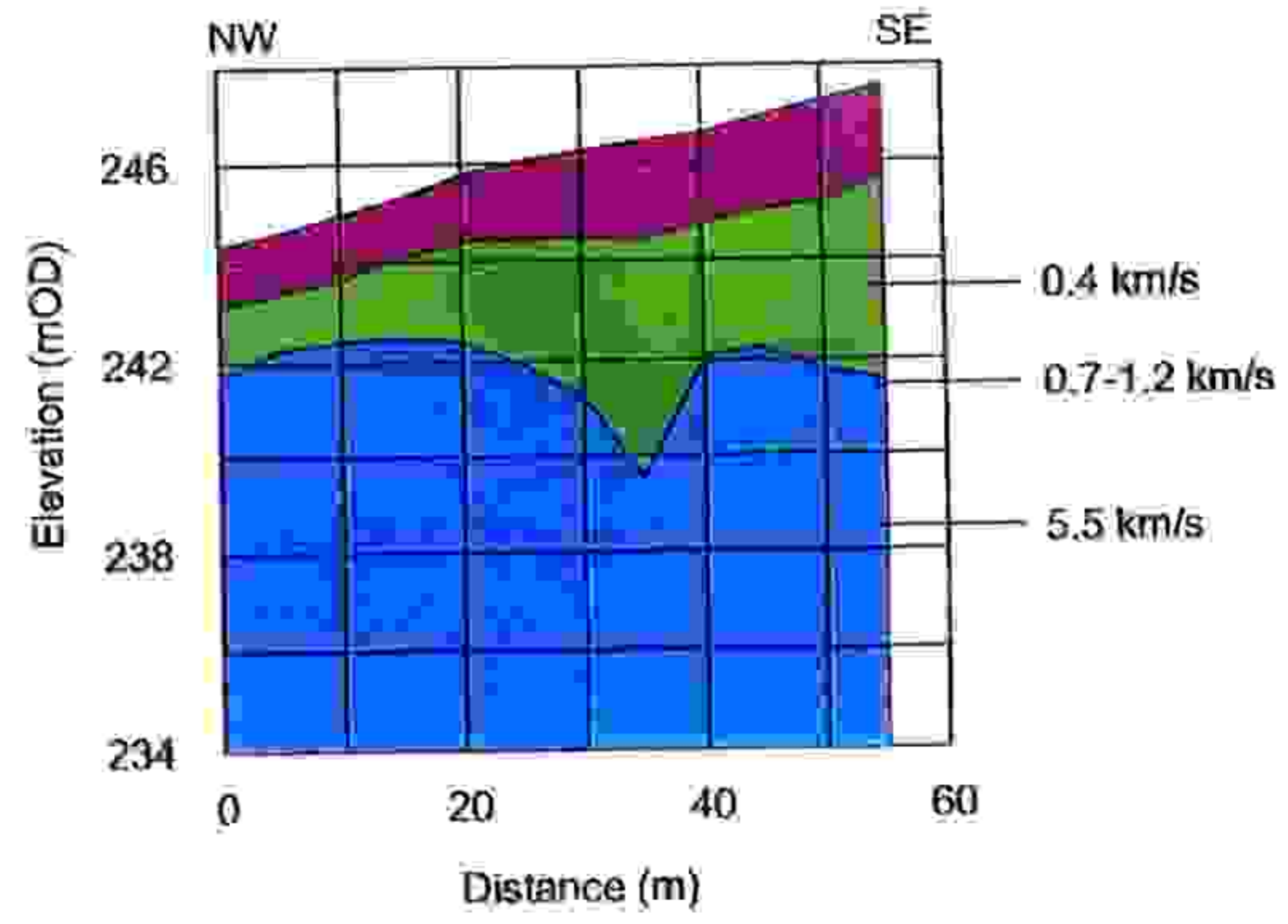
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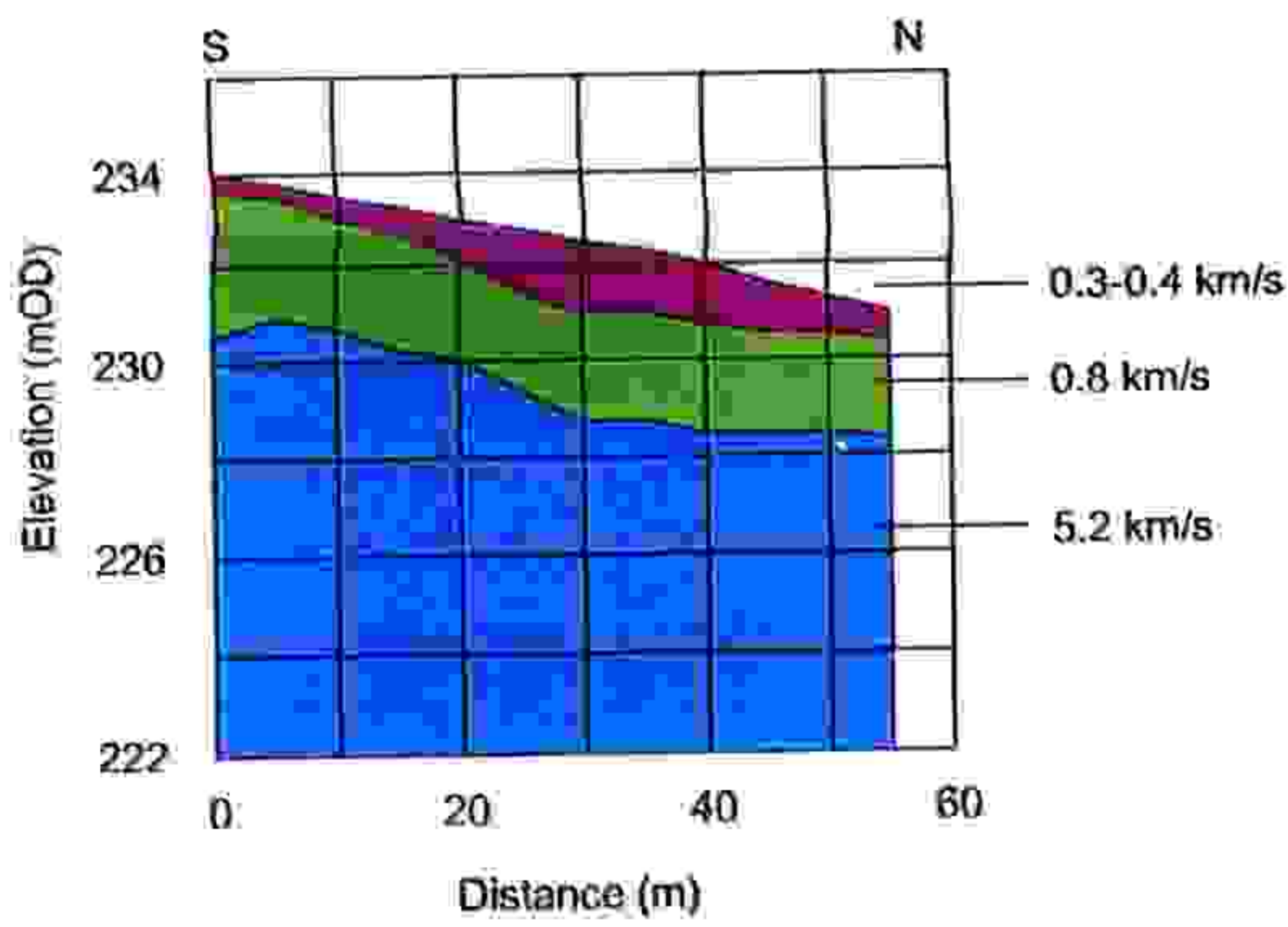
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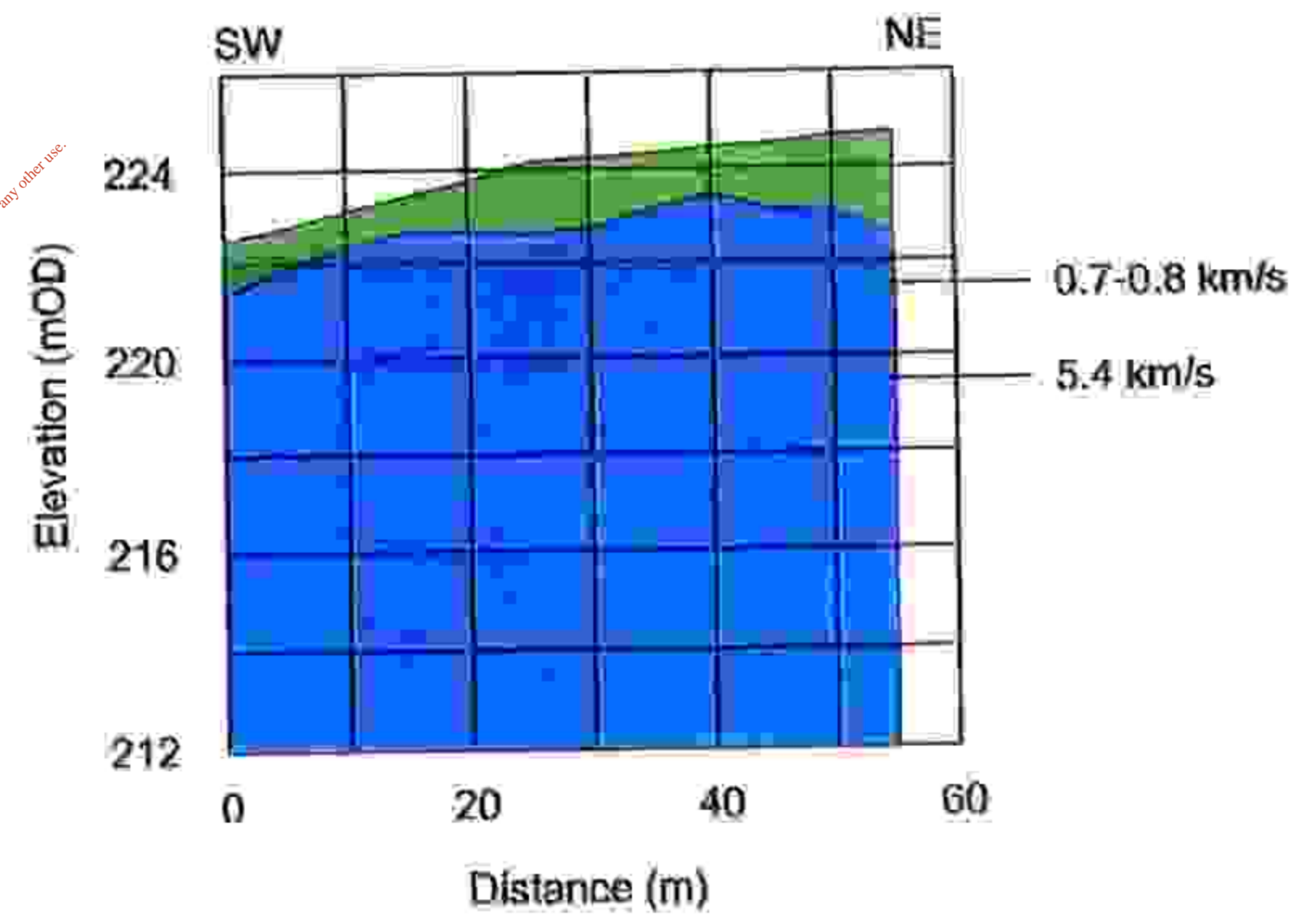
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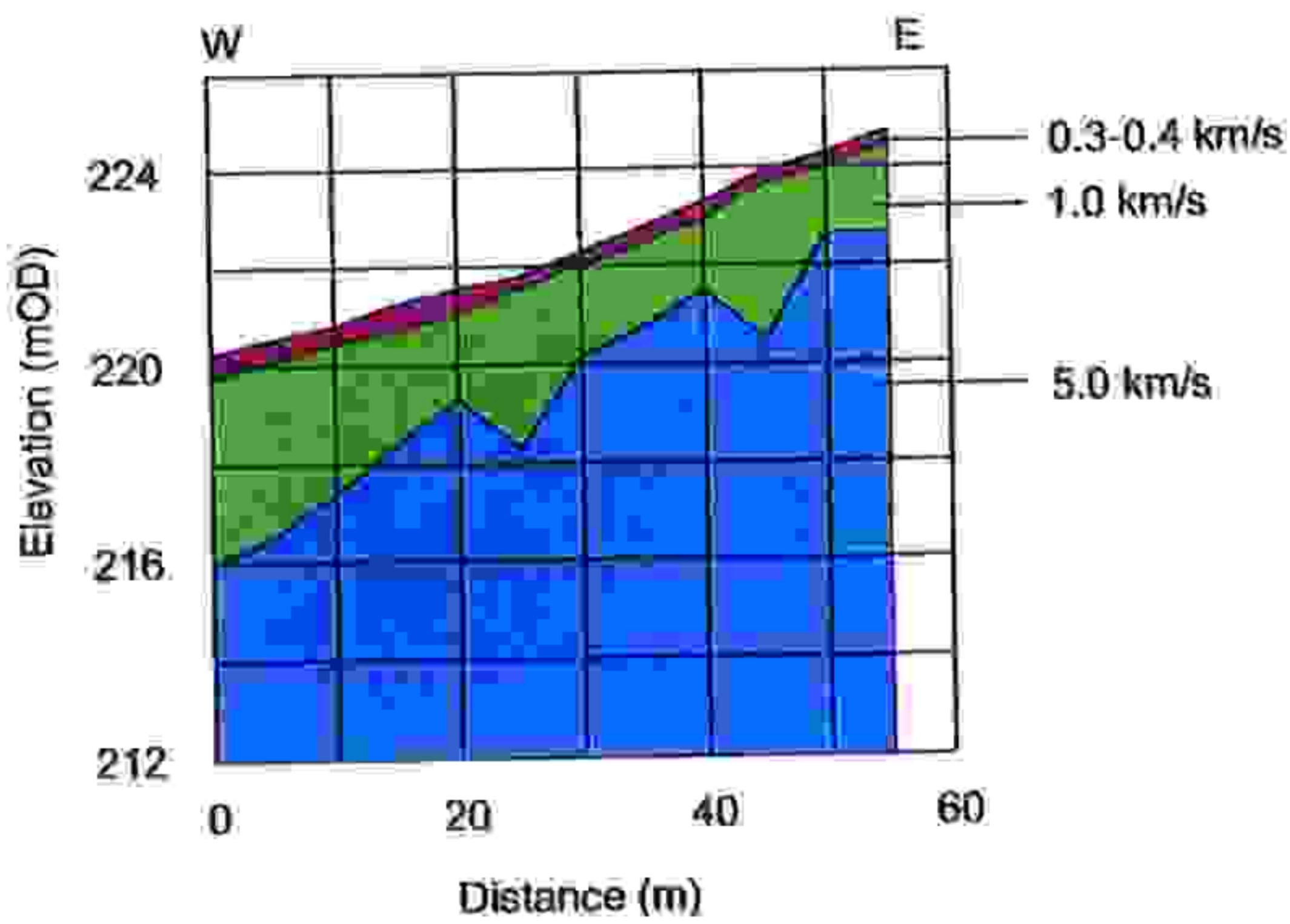
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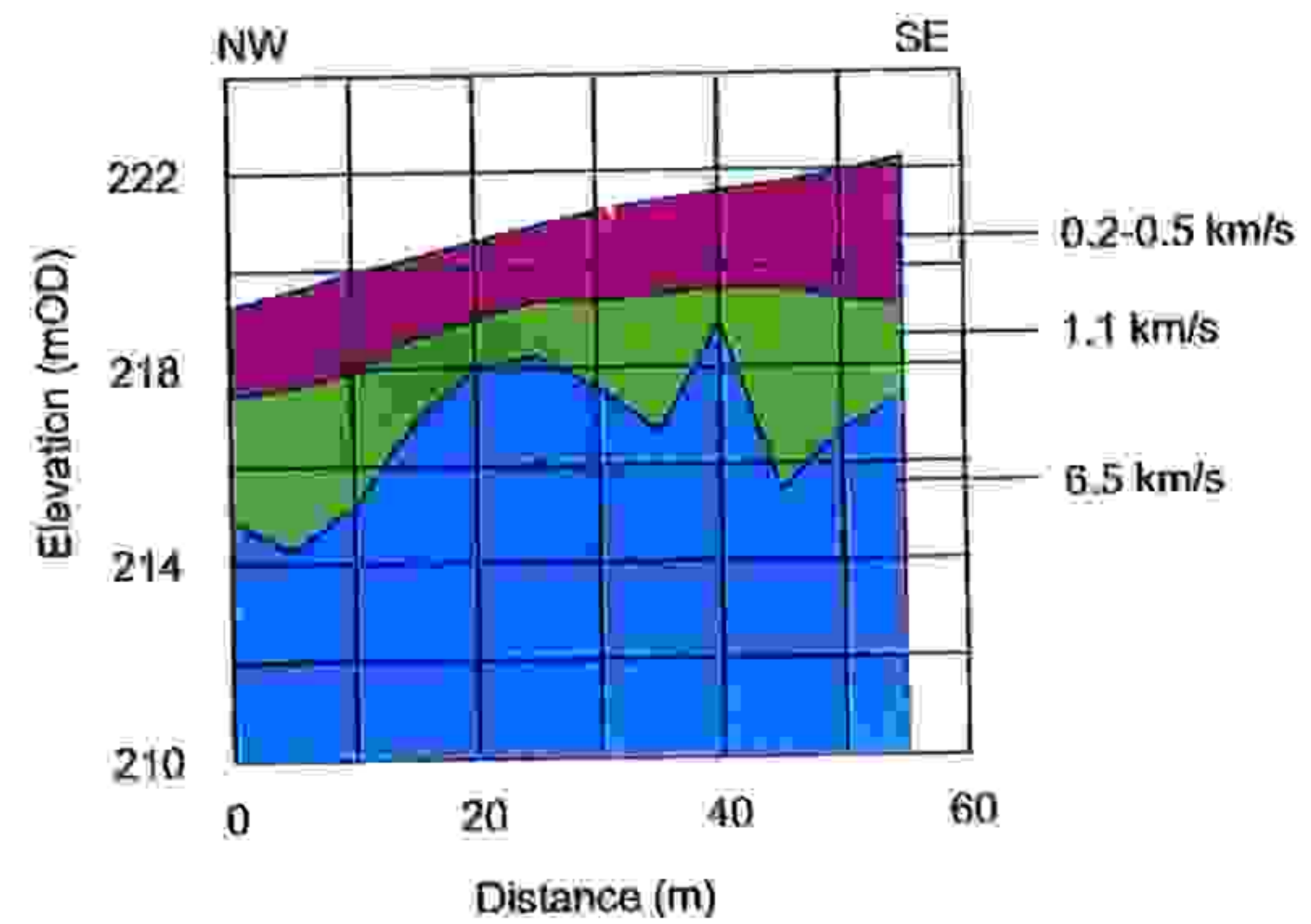
Seismic Refraction Profile 6



Seismic Refraction Profile 7



Seismic Refraction Profile 8



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CLIENT: Foundation and Exploration Services
PROJECT: Meenaboll Site Investigation Geophysical Survey
TITLE: Figure 1: Interpretation Seismic Refraction Profiles 1 - 8

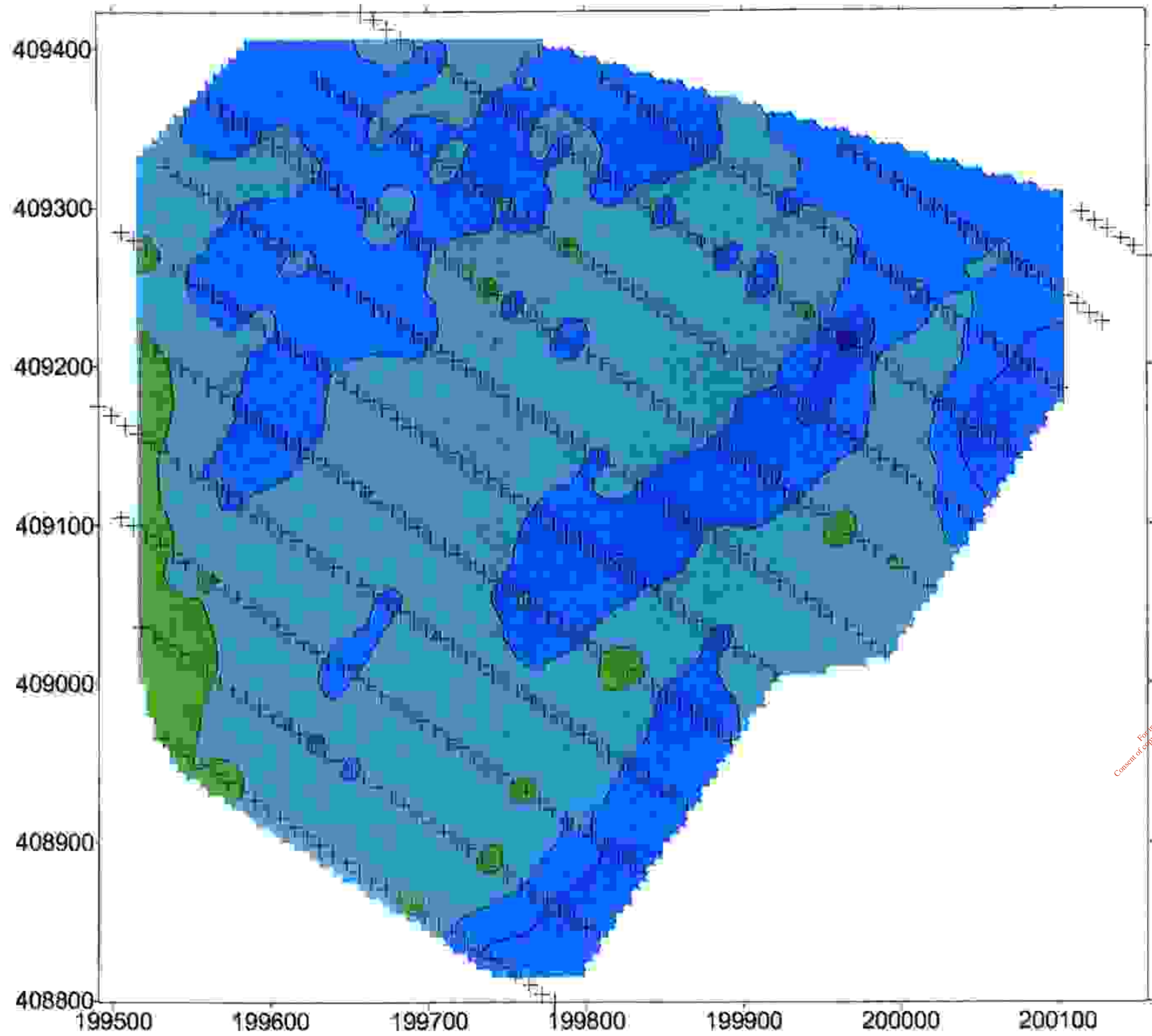
LEGEND: Interpretation of Seismic Refraction Profiles

 Peat
 Glacial Till (mainly soft to firm compaction)
 Strong Bedrock
 0.3 km/s Seismic velocity

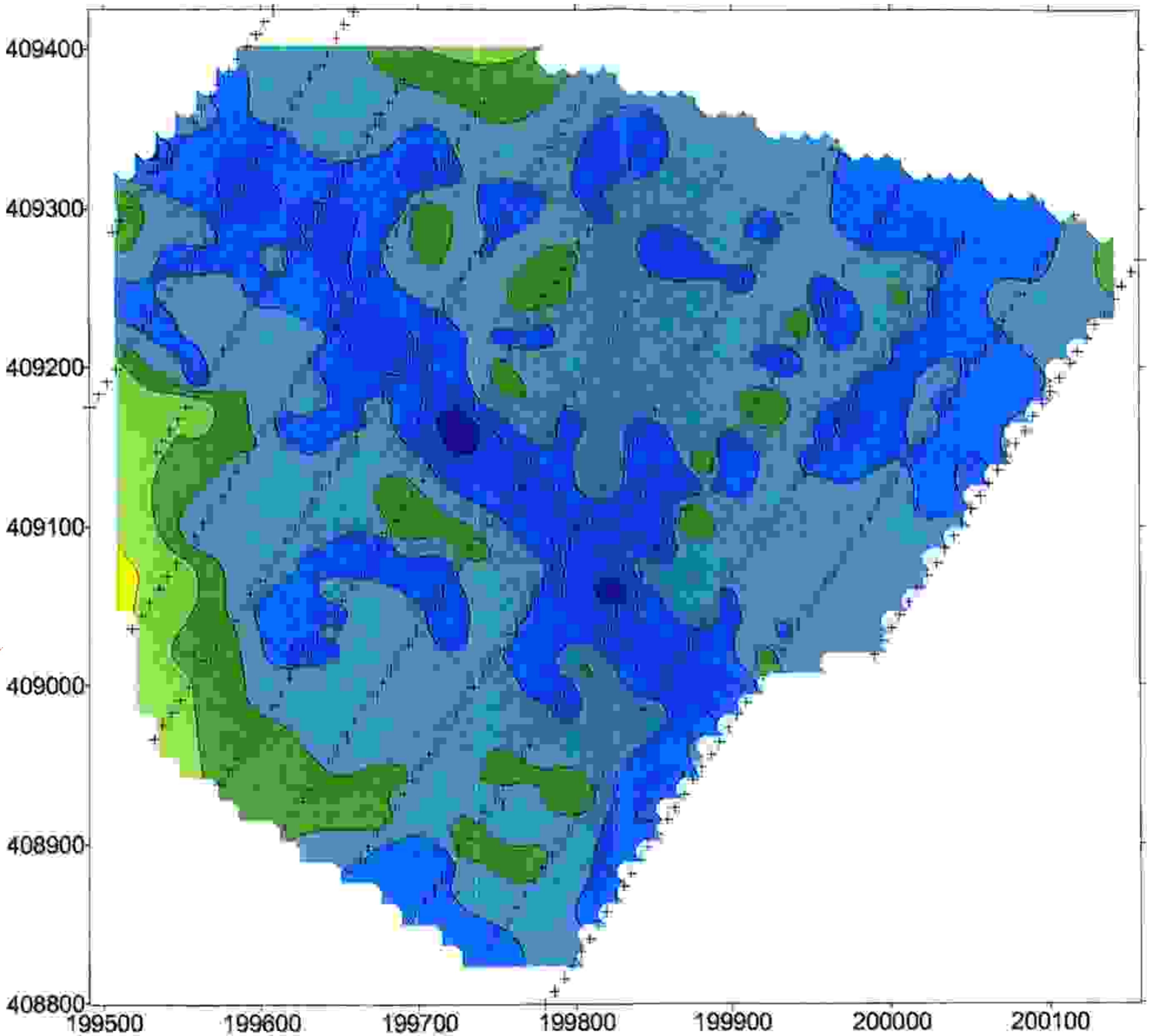
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Project: 1503
Drawn: HK/BW
Date: 3/3/03
MEL File: 1503_Fig1.dwg
Based on:

Figure 2: Visualisation of the VLF-EM Data

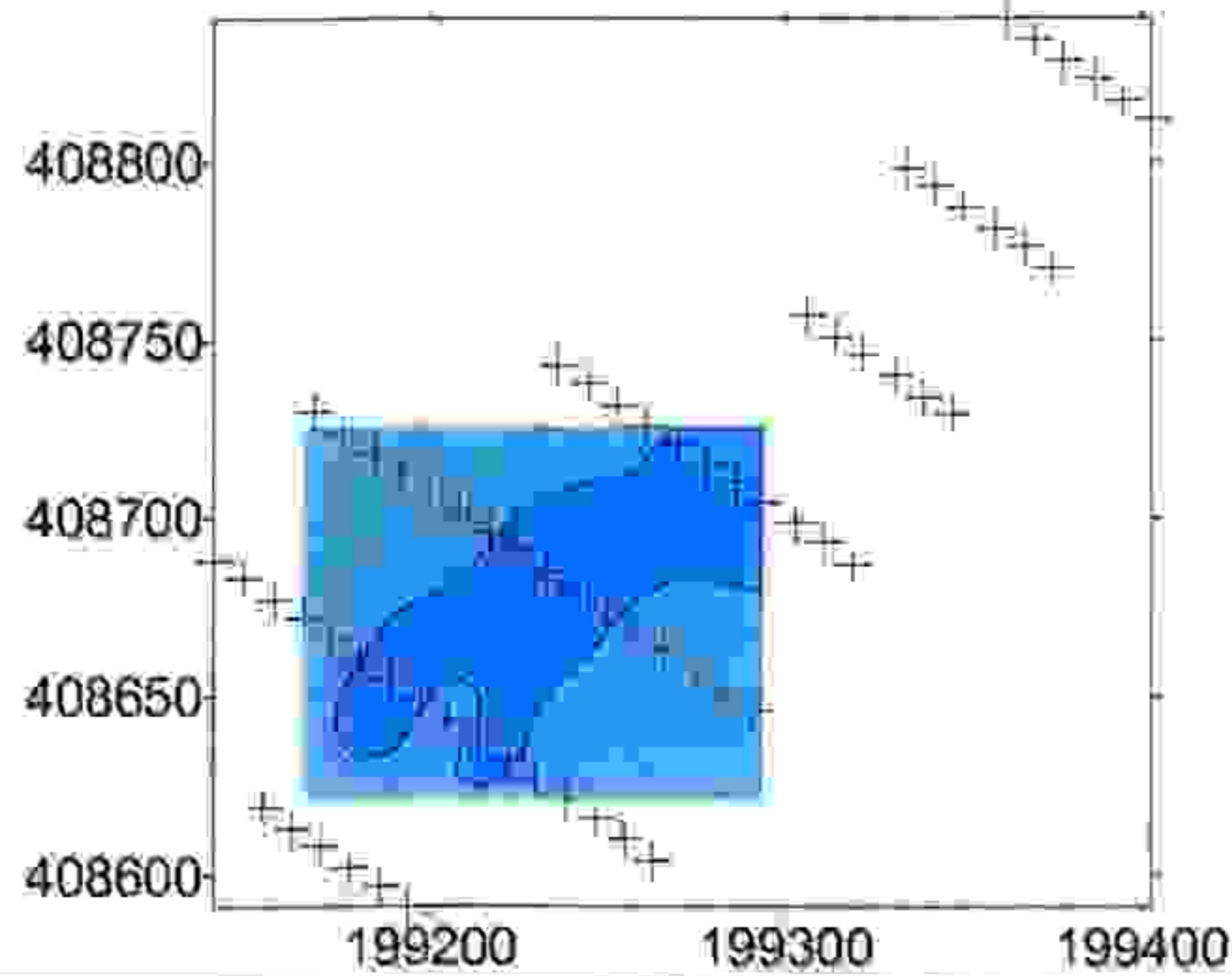
Area A JXZ Data



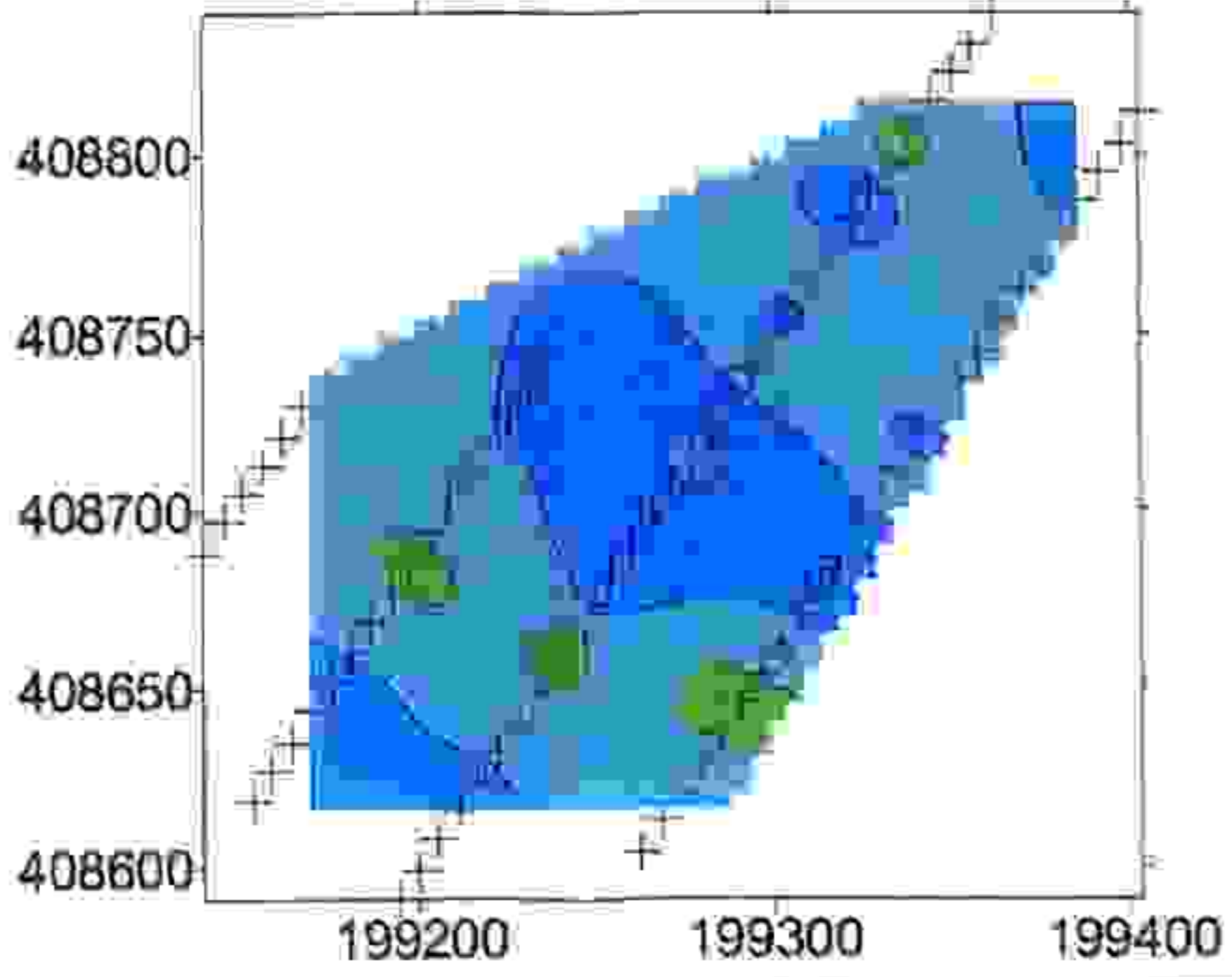
Area A GBR Data



Area B JXZ Data



Area B GBR Data



Foundation and Exploration Services
Meenaboll Site Investigation
Co. Donegal
Geophysical Survey – Phase 2

Report Status: Draft

MEL Project Number: 1503

MEL File Ref: 1503-085.doc

Thursday 23rd October 2003

Confidential Report To:

Foundation and Exploration Services
6 Kilbelin Lawns
Newbridge
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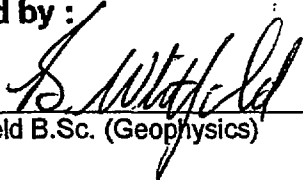
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 **Minerex**
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Hydrogeological, Environmental,
Geophysical Services

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EXECUTIVE SUMMARY

1. Minerex Environmental Ltd. (MEL) carried out the Phase 2 of a geophysical survey in August 2003 for the site investigation for a proposed landfill development at Meenaboll, Co Donegal.
2. The geophysical survey consisted of 2D-Resistivity and seismic refraction profiles over the area of the proposed landfill cells.
3. VLF-EM measurements were carried out towards the NW of the site to trace the continuation of a previously interpreted dolerite dyke.
4. The survey gave a detailed picture of the peat and glacial till thickness across the survey area.
5. The bedrock resistivities and seismic velocities are high, indicating a strong compact bedrock with little weathering or fracturing.
6. Smaller resistivities within the bedrock indicate localised areas of possible increased weathering and fracturing and changes in bedrock type as in the case of the dolerite dyke.
7. The VLF-EM survey shows that the dolerite dyke/fault zone continues to the NW. It follows and crosses small streams that flow towards the SW and the Finn-Catchment.

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List of Tables, Figures and Maps in Appendices:

Appendix	Title	Pages	Type	MEL Document Reference
A	Table 1: Location of Geophysical Profiles	1 x A4	B&W	1503_2_Tab1.xls
A	Table 2: Summary of Seismic Refraction Interpretation	N/A	N/A	Included in text
A	Table 3: Summary of Interpretation of 2D-Resistivity	N/A	N/A	Included in text
B	Map 1: Location Map	1 x A3	Colour	1503_2_Map1.dwg
B	Map 2: Interpretation of VLF-EM Phase 2 Survey	1 x A3	Colour	1503_2_Map2.dwg
C	Figure 1: Interpretation Seismic Refraction Profiles 9 – 16	1 x A3	Colour	1503_2_Fig1.dwg
C	Figure 2: Interpretation Seismic Refraction Profiles 17 - 24	1 x A3	Colour	1503_2_Fig2.dwg
C	Figure 3: Interpretation 2D-Resistivity Profile 1	1 x A4	Colour	1503_2_Fig3.dwg
C	Figure 4: Interpretation 2D-Resistivity Profile 2	1 x A4	Colour	1503_2_Fig4.dwg
C	Figure 5: Interpretation 2D-Resistivity Profile 3	1 x A4	Colour	1503_2_Fig5.dwg
C	Figure 6: Interpretation 2D-Resistivity Profile 4	1 x A4	Colour	1503_2_Fig6.dwg

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1. INTRODUCTION

1.1 Background

Minerex Environmental Ltd. (MEL) carried out a geophysical survey in August 2003 on behalf of Foundation & Exploration Services for the Phase 2 of the geophysical site investigation of a proposed landfill at Meenaboll, Co. Donegal. The geophysical survey consisted of seismic refraction, 2D-Resistivity and VLF-EM measurements. The seismic and 2D-Resistivity survey was carried out over the area of the proposed landfill cells. The previous survey was a geophysical reconnaissance survey over a wider area to determine if the site was generally suitable for the proposed development and to assist in locating the most suitable area for the proposed landfill cells (MEL, 2003). A VLF-EM survey was carried out to the NW of the site to trace a feature previously interpreted as a dolerite dyke.

1.2 Objectives

The main objectives of the geophysical survey were as follows:

- To establish the depth of glacial till and peat deposits in the area of the proposed landfill cells
- To identify any major fracture zones, fault lines or other features in the bedrock
- To trace the interpreted dolerite dyke further to the NW of the site

1.3 Site Description

The area for proposed landfill cells has a size of approx. 5.6 ha. The elevations over this area range from 220 to 250 m.OD.

1.4 Geology

The geology has been described in the previous report (MEL, 2003).

1.5 Report

This report includes the results and interpretation of the geophysical survey. Maps, figures and tables are included in the appendices to illustrate the survey and the results. More detailed descriptions of geophysical methods and measurements can be found in Milsom (1989) and Reynolds (1997).

The client supplied a digital base map of the site with elevation contours and spot heights. The maps and elevations were used in this report. Borehole logs and information about the peat and rock depth in the trial pits was used for the interpretation of the geophysical survey.

The interpretative nature and the non-intrusive survey methods must be taken into account when considering the results of this survey and Minerex Environmental Limited, while using appropriate practise to execute, interpret and present the data give no guarantees in relation to the existing subsurface.

2. GEOPHYSICAL SURVEY

2.1 Methodology

The following methods, survey parameters and quantities were carried out for the Phase 2 survey and can be seen on the survey location map (Map 1).

1. Four 315m long continuous 2D-Resistivity Profiles (R1 to R4) with 64 electrodes and a 5 m electrode spacing were carried out. This method determines 2D-cross sections of subsurface resistivity and was carried out to determine the general overburden thickness and features within the bedrock.
2. A VLF-EM survey at a 10 m station spacing along four SW to NE trending 200 m long lines was carried out with an ABEM Wadi instrument (84 readings). The survey lines are indicated on Map 1. The survey used the VLF transmitter in Oxford (GBX 19.6 kHz). The previously used station GBR was not turned on during the survey period. A repeat line carried out over a previous anomaly showed that the same results were obtained with both transmitters. The VLF-Survey was heavily disturbed by the influence of a metal fence running along the river.
3. Sixteen Seismic Refraction Profiles with 12 geophones at a 3 m spacing and a length of 33 m each were carried out at the locations indicated on Map 1. A 12 gauge seismograph gun was used as an energy source. At the endshots and the midshot the peat thickness was determined with a push probe and the thickness was incorporated into the seismic models.

2.2 Site Work

The site work was carried out between the 25th and 28th of August 2003. The weather was generally favourable and good quality and repeatable data was gathered.

3. RESULTS AND INTERPRETATION

The interpretation of geophysical data was carried out utilising the known response of geophysical measurements, typical physical parameters for subsurface features that may underlay the site and the experience of the authors.

The survey results tie in with results from the previous survey and from the direct site investigation. The results obtained for the area under the proposed landfill cells are much more detailed than those obtained with the reconnaissance survey.

3.1 Seismic Refraction

The seismic refraction data has been interpreted as layered earth models (Fig. 1 and 2). The following Table 2 summarises the interpreted layers.

Table 2: Summary of Seismic Refraction Interpretation

Seismic Velocity (km/s)	Thickness (m)	Interpretation	Compaction/Strength
0.2 – 0.4	0 – 3.5 m	Peat	Soft
0.7 – 1.1	0.5 – 4 m	Glacial Till	Soft – firm
3.8 – 6.0	N/a	Rock	Strong competent

The high seismic velocities for the rock indicate little weathering or fracturing below the rock level shown in the cross sections. If strongly weathered or fractured rock exists it would be included as a thin layer at the bottom of the glacial till.

3.2 2D-Resistivity

The 2D-Resistivity models obtained by inversion software are shown in Figures 3 to 6 on the upper sections where the resistivities are colour coded. Where the seismic refraction profiles were measured on the 2D-Resistivity profiles the top of bedrock layer boundary as interpreted from the seismic survey is drawn as a thick black line over the resistivity section. The interpretation obtained from both methods is drawn onto the lower cross section on the figures. The layers interpreted from the 2D-Resistivity are summarised in Table 3:

Table 3: Summary of Interpretation of 2D-Resistivity

Resistivity (Ohmm)	Thickness	Interpretation
General Range	(m)	

< 400	0 – 6 m	Overburden (Peat and Glacial Till)
< 800	N/A	Psammitic Schist (locally smaller resistivity)
> 800	N/A	Psammitic Schist

Most of the survey area is underlain by overburden over psammitic bedrock with a high resistivity. This indicates, as interpreted in the previous geophysical report, that the schist is compact without major fracturing and with very small water content.

At some areas the resistivity within the bedrock has a locally smaller resistivity. This indicates either changes in bedrock type or a relatively higher degree of fracturing and weathering.

Two such areas occur on Profile 3 (270m) and Profile 4 (250 m) and they coincide with the previously interpreted dolerite dyke.

At the start of Profile 1 (0-60m) and Profile 3 (0 – 80m) smaller bedrock resistivities are indicated at shallow depths below the top of the rock. This could be due to deeper weathering or a change in the bedrock type. This area occurs at the edge or outside the proposed landfill cells.

On Profile 4 at 150 m a smaller resistivity occurs at a depth of 40 – 50 m. The cause could be a change in the bedrock type or a deeper dolerite intrusion.

3.3 VLF-EM

Map 2 shows the results of the VLF-EM survey. An anomaly similar in size and amplitude to the anomalies measured over the dolerite dyke found in the previous survey was measured on profile EM204 at 140 m (Map 2).

Strong anomalies caused by a metal fence running along the small stream were found on profiles EM201 to EM203. Because of the size of these anomalies no anomalies from the dyke/fault zone could be found.

No anomalies were found near the start or end of profiles EM201 to EM204. It is therefore interpreted that the dolerite dyke/fault zone discovered on the site continues straight to the NW. This is in line with all geological observations of dolerite dykes in the area.

The interpreted path of the dyke to the NW follows the small stream coming from the site and crosses a second small stream, which flows in the valley towards a the SW.

4. CONCLUSIONS

- The thickness of peat and glacial till and the bedrock depth were measured with a good spatial resolution over the area of the proposed landfill cells.
- The rock underlying the proposed landfill cells is strong competent psammitic schist.
- In some areas within the bedrock the resistivity has localised smaller values. This could be due to dolerite intrusions, changes in bedrock type and a relatively higher degree of weathering and fracturing.
- The dolerite dyke/fault zone continues to the NW of the site and follows and crosses small streams that flow towards the SW and therefore towards the Finn Catchment.

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5. REFERENCES

1. **GSI, 1997.** Geology of North Donegal. Bedrock Geology 1:100,000 Map Series. Geological Survey of Ireland.
2. **Milsom, 1989.** Field Geophysics. John Wiley and Sons.
3. **Minerex, 2003.** Meenaboll Site Investigation, Co. Donegal, Geophysical Survey, 2003.
4. **Reynolds, 1997.** An Introduction to Applied and Environmental Geophysics. John Wiley and Sons.

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Appendix A

Table 1

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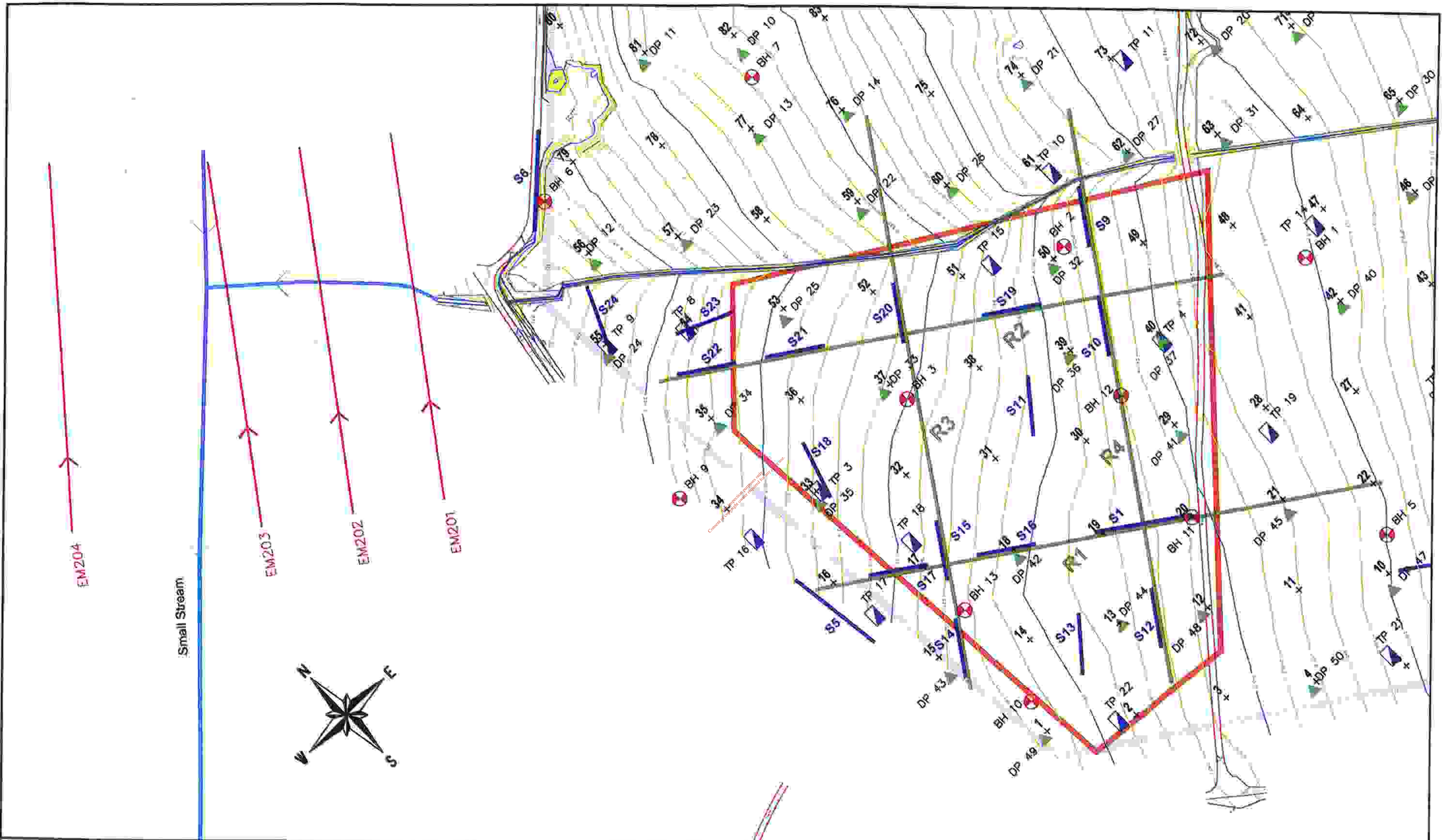
Table 1: Location of Geophysical Profiles

2D-Resistivity Profile Name	Start Easting	Start Northing	End East	End North	Length (m)	Profile Direction	Seismic Refraction Profile Name	Start at 2D-Resistivity Profile Meter	End at 2D-Resistivity Profile Meter
R1	199495	409110	199757	408934	315	NW to SE	S1 (Phase 1)	155	210
							S16	90	123
							S17	30	63
R2	199513	409250	199774	409075	315	NW to SE	S22	10	43
							S21	60	93
							S19	180	213
R3	199518	409011	199693	409273	315	SW to NE	S14	5	38
							S15	60	93
							S20	190	223
R4	199599	408936	199775	409198	315	SW to NE	S12	20	53
							S10	180	213
							S9	240	273
Seismic Refraction Profile Name	Start Easting	Start Northing	End East	End Northing	Length (m)	Profile Direction			
S11	199638	409085	199659	409111	33	SW to NE			
S13	199567	408974	199589	408999	33	SW to NE			
S18	199536	409139	199546	409171	33	SW to NE			
S23	199537	409262	199567	409248	33	NW to SE			
S24	199507	409285	199520	409315	33	SW to NE			
VLF-EM Profiles	Start Easting	Start Northing	End East	End Northing	Length (m)	Profile Direction			
201	199384	409287	199502	409449	200	SW to NE			
202	199343	409317	199461	409479	200	SW to NE			
203	199303	409346	199421	409508	200	SW to NE			
204	199228	409417	199359	409568	200	SW to NE			

Appendix B

2 Maps

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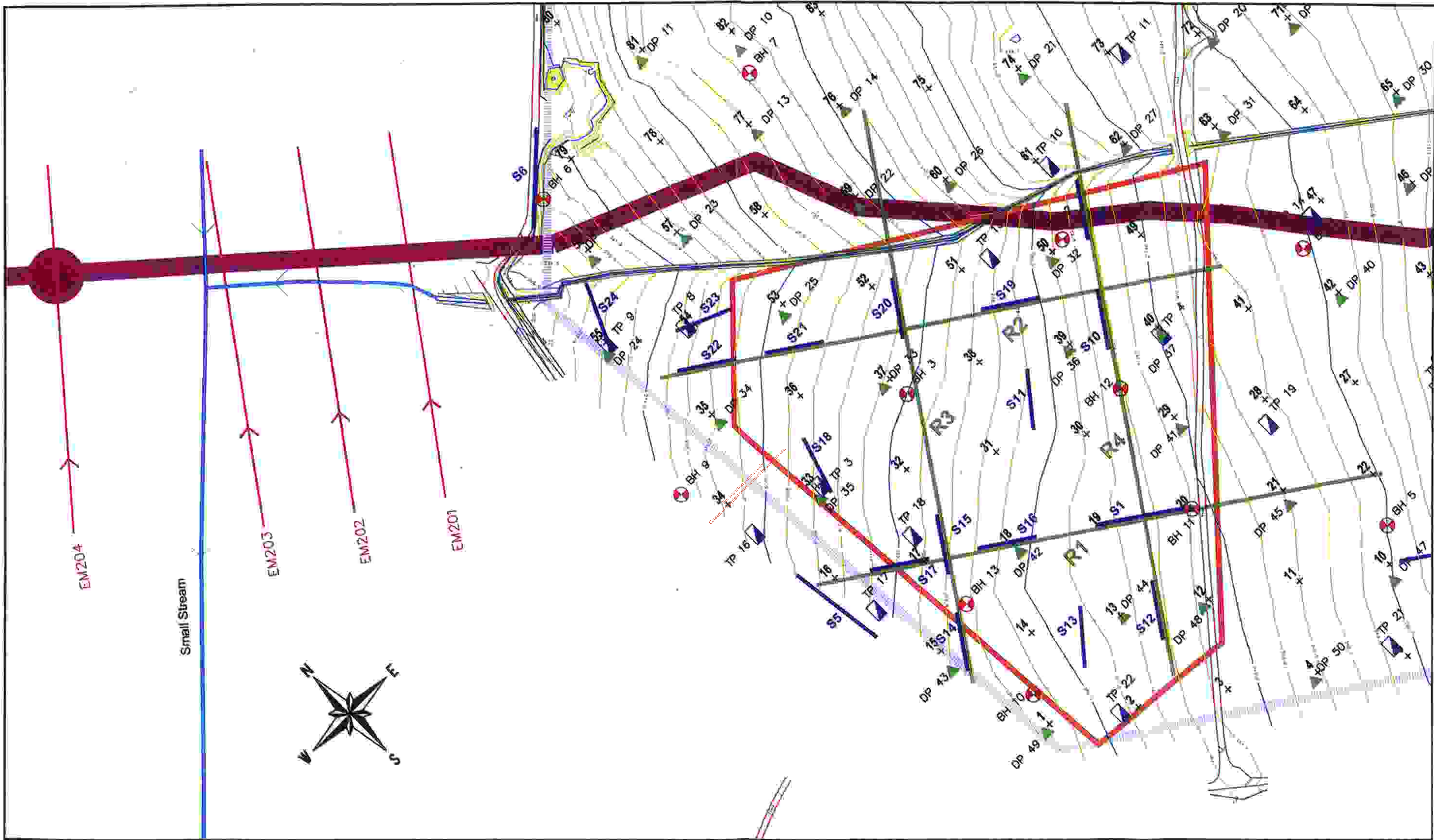
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CLIENT	Foundation and Exploration Services
PROJECT	Meenaboll Site Investigation Geophysical Survey - Phase 2
TITLE	Map 1: Location Map

LEGEND	
	2D-Resistivity Profile
	Seismic Profile
	VLF-EM Line
	Outline Proposed Landfill Cells
	Small Stream

	BH 1	Borehole
	TP 1	Trial Pit
	DP 1	Dynamic Probe

Scale:	1:2000
Project:	1503
Drawn:	HK
Date:	15/9/03
MEL File:	1503_2_Map1.dwg
Based on:	6613-2d



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CLIENT Foundation and Exploration Services

PROJECT Meenaboll Site Investigation Geophysical Survey - Phase 2

TITLE Map 2: Interpretation of VLF-EM Phase 2 Survey

LEGEND

-  VLF-EM Line
-  Small Stream
-  Dolerite Dyke/Fault Zone
-  VLF-EM Anomaly

Scale: 1:2000

Project: 1503

Drawn: HK

Date: 15/9/03

MEL File: 1503_2_Map2.dwg

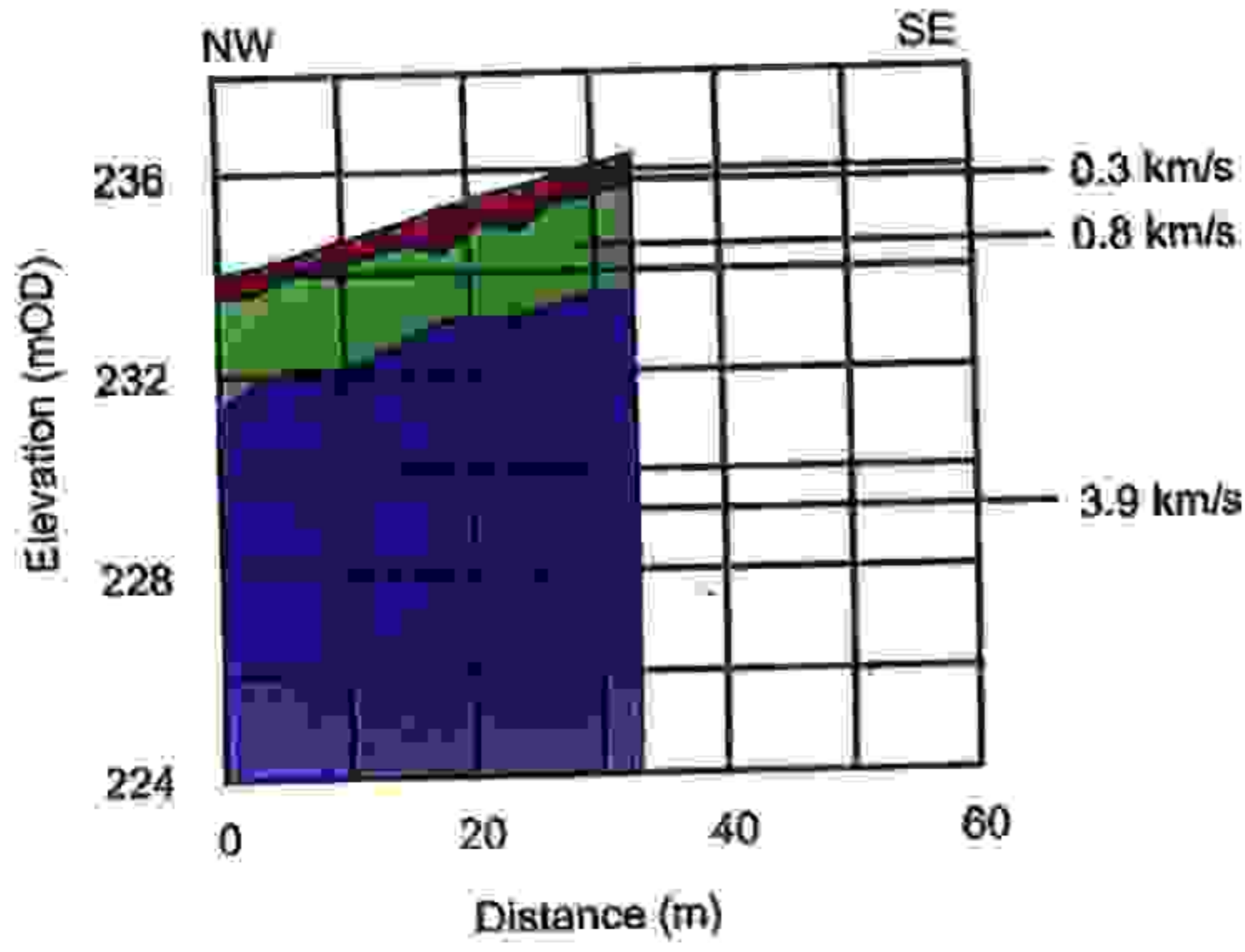
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Appendix C

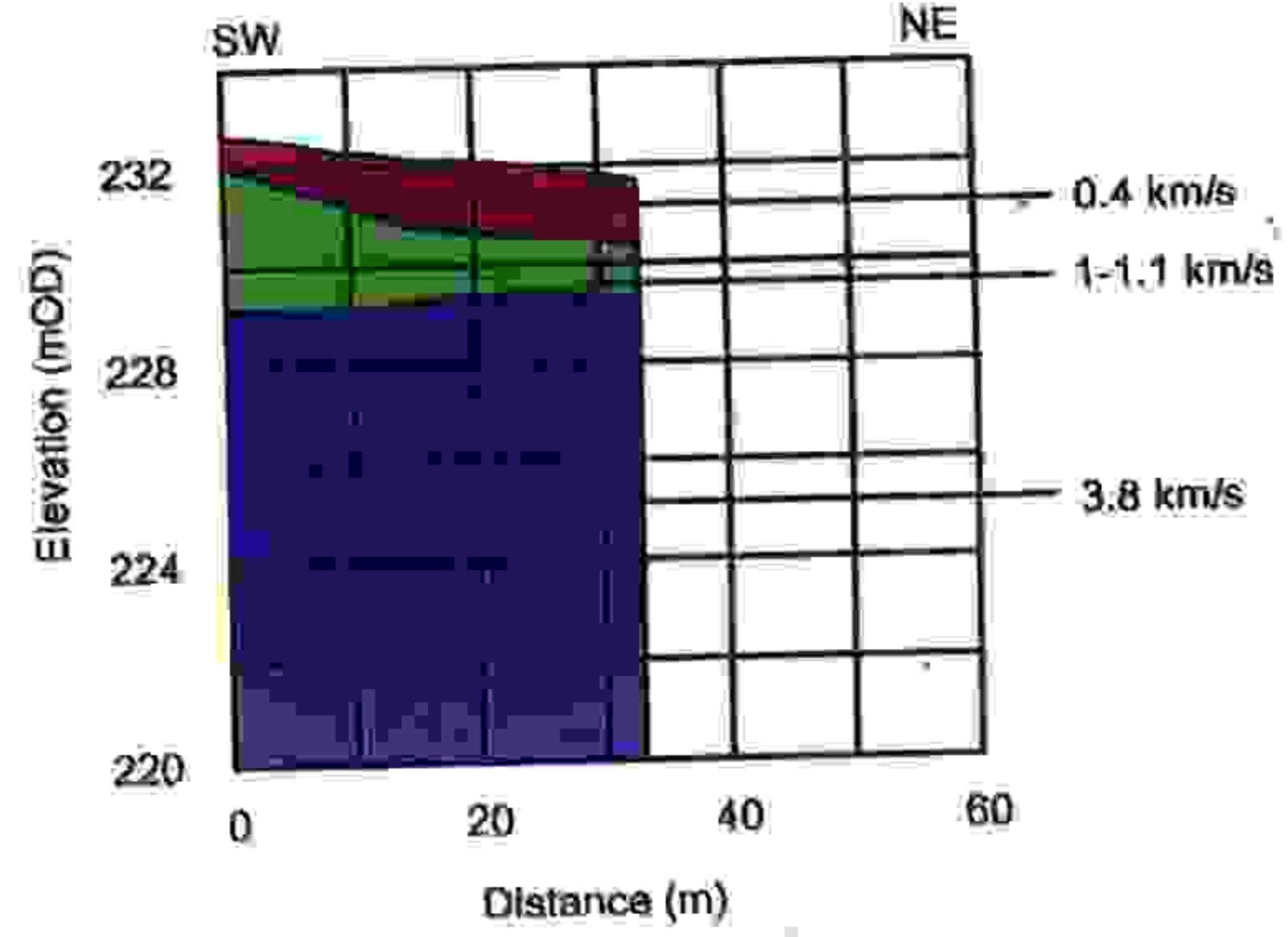
6 Figures

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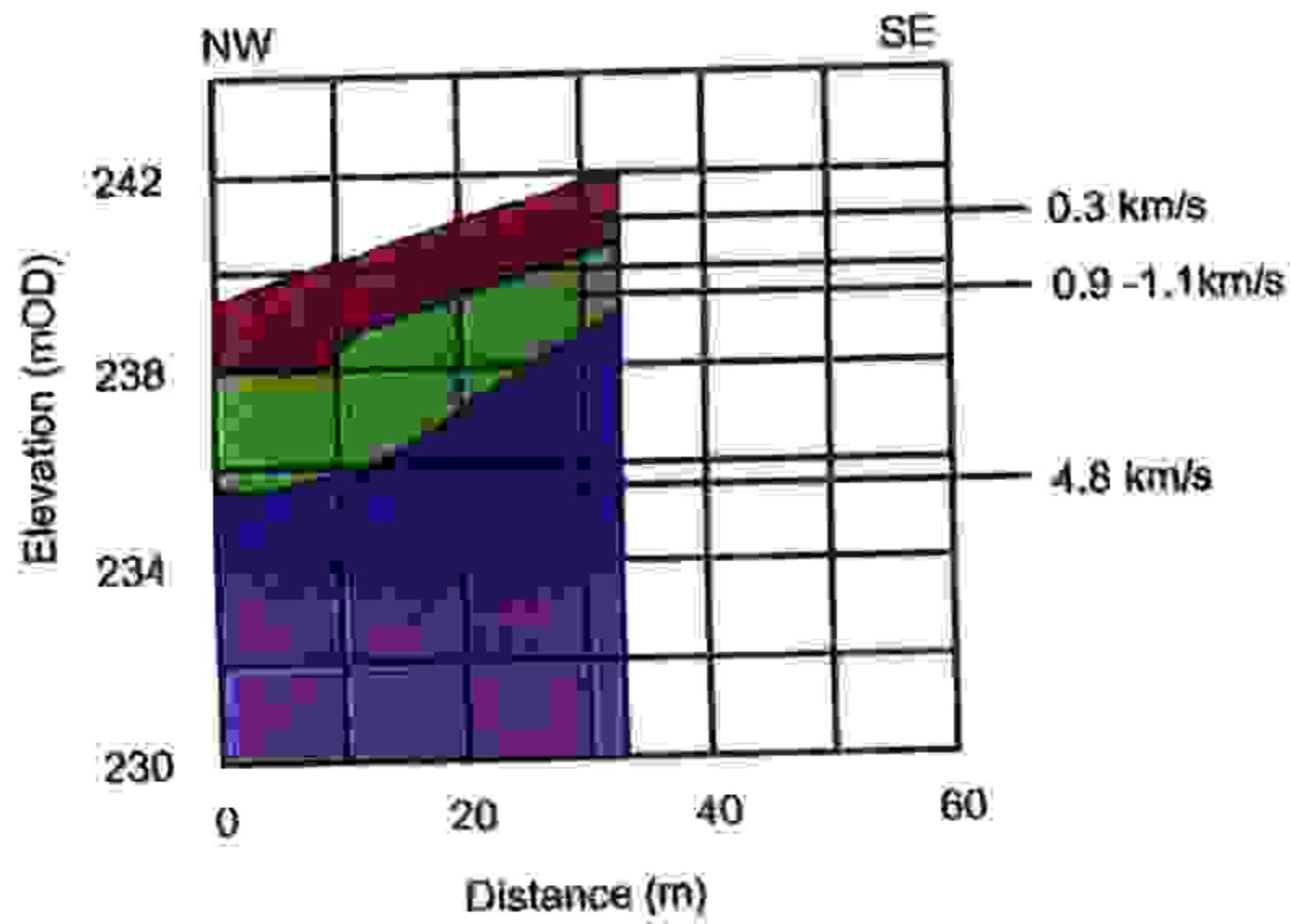
Seismic Refraction Profile 17



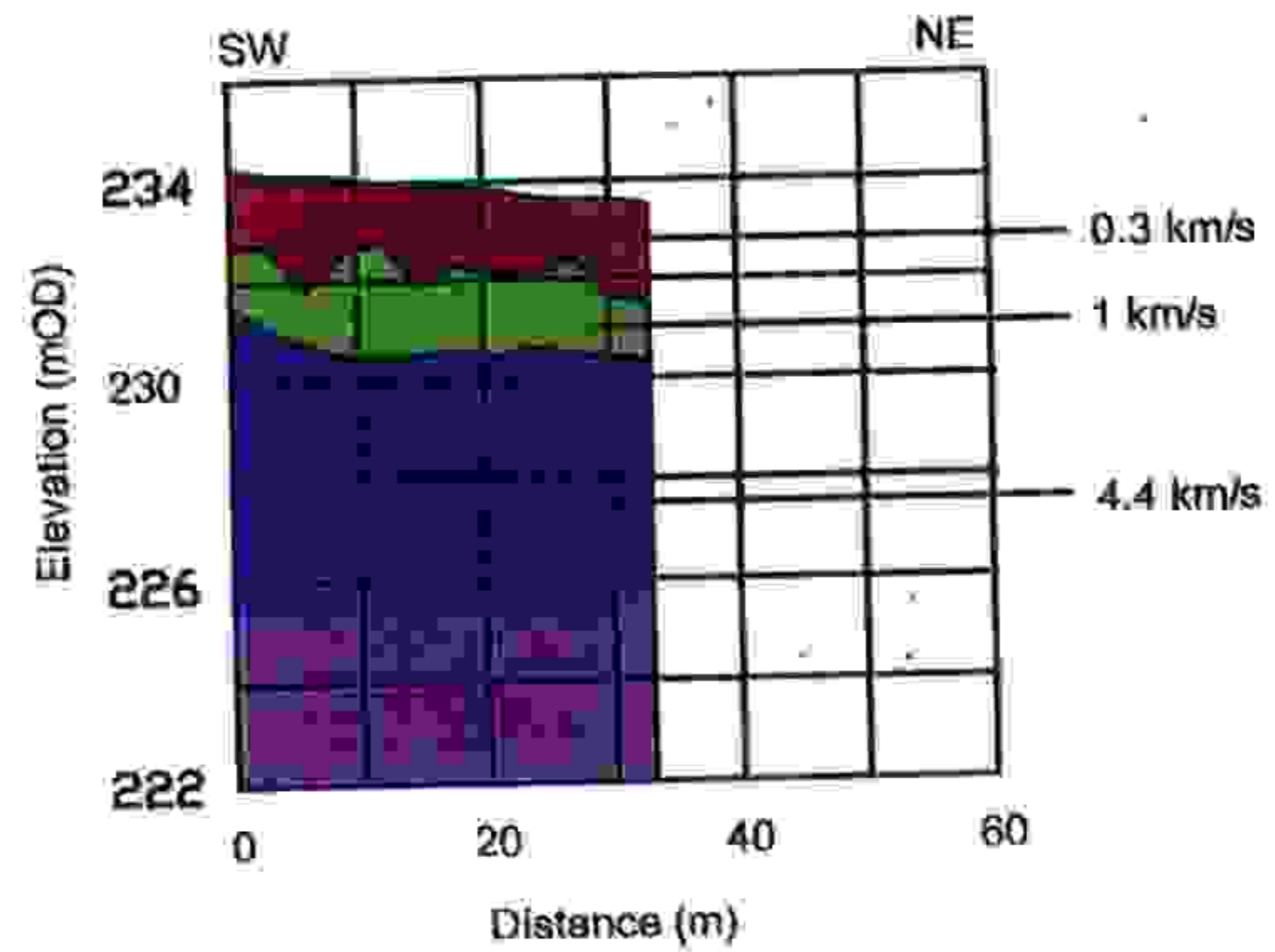
Seismic Refraction Profile 18



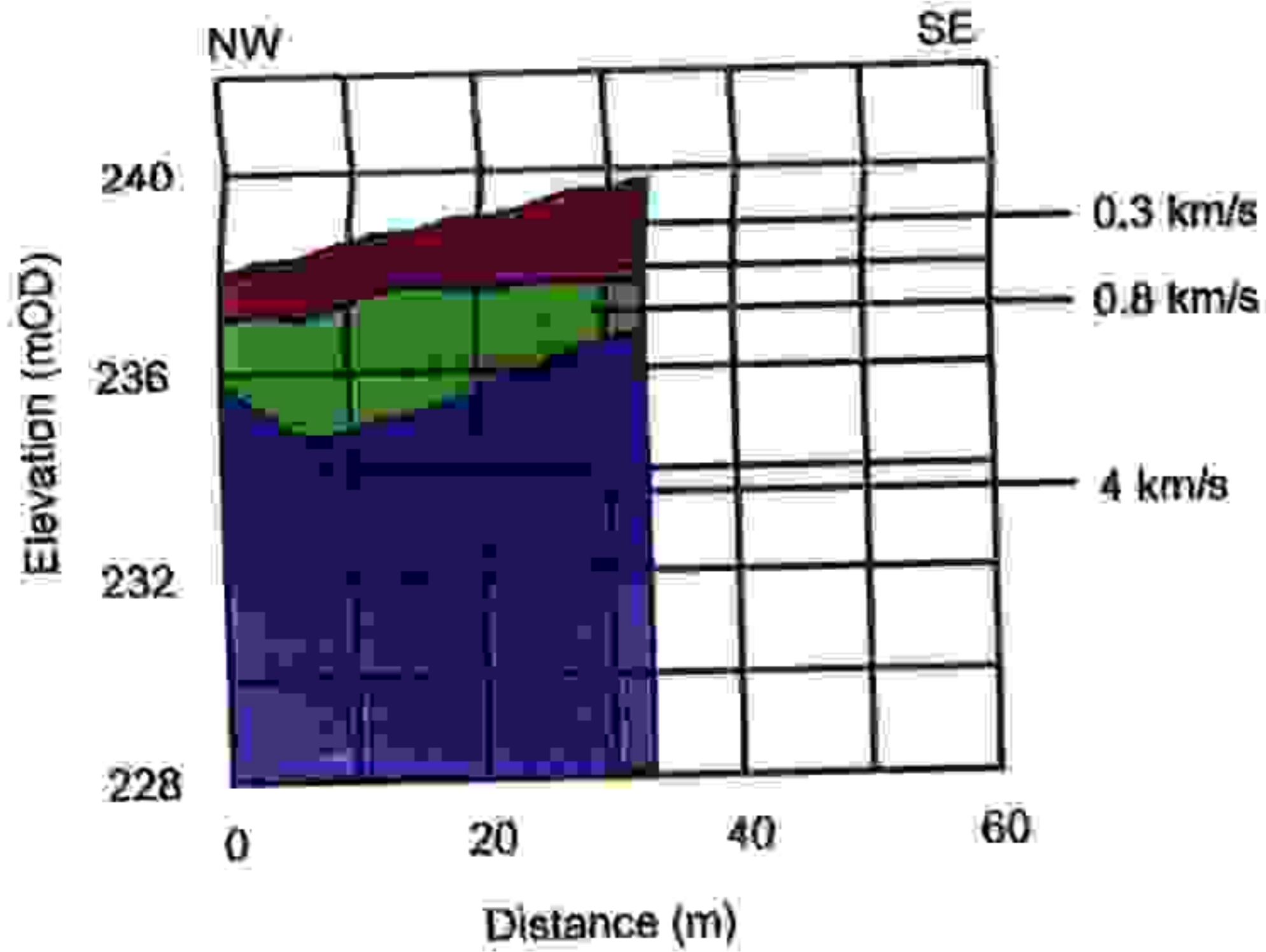
Seismic Refraction Profile 19



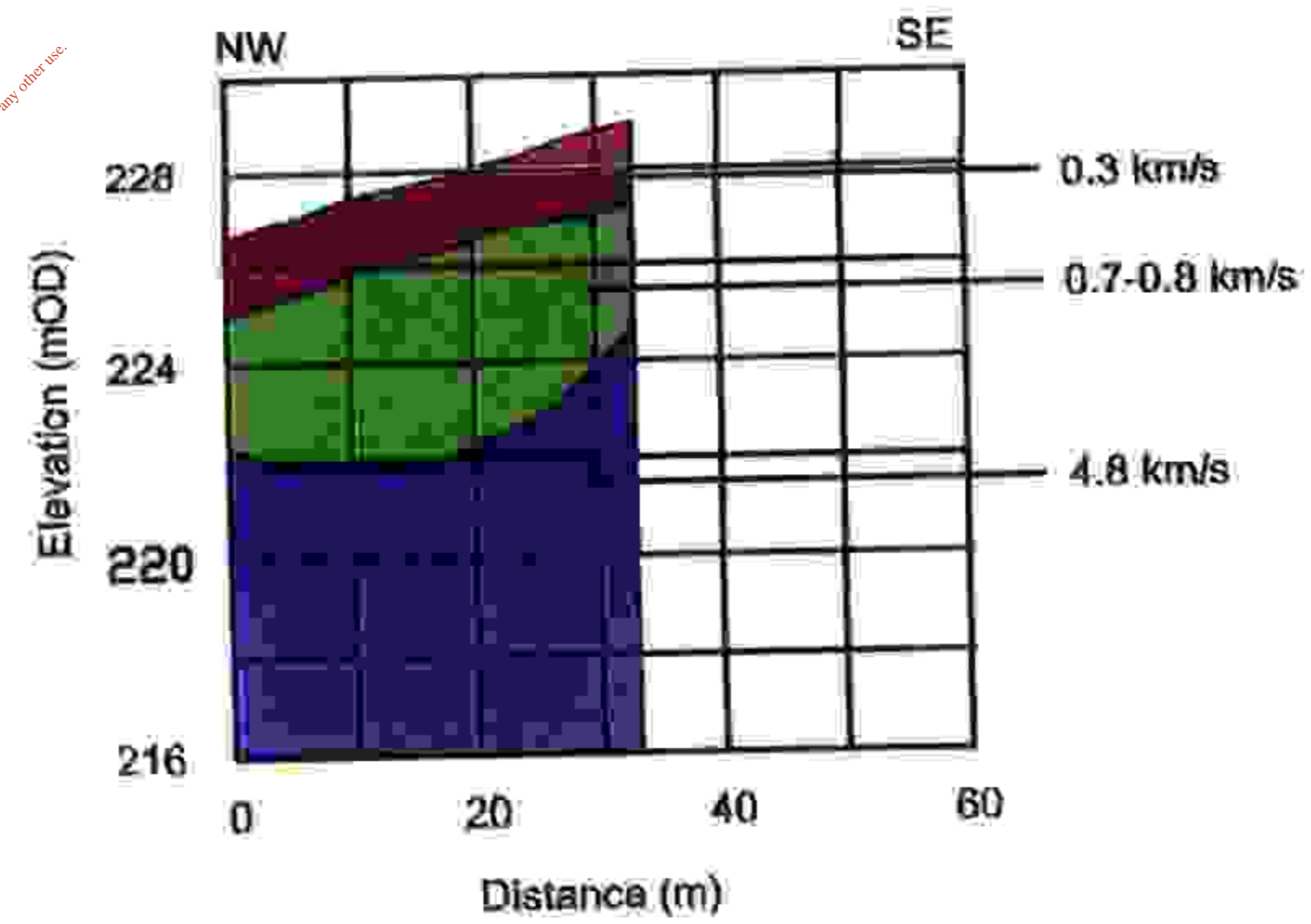
Seismic Refraction Profile 20



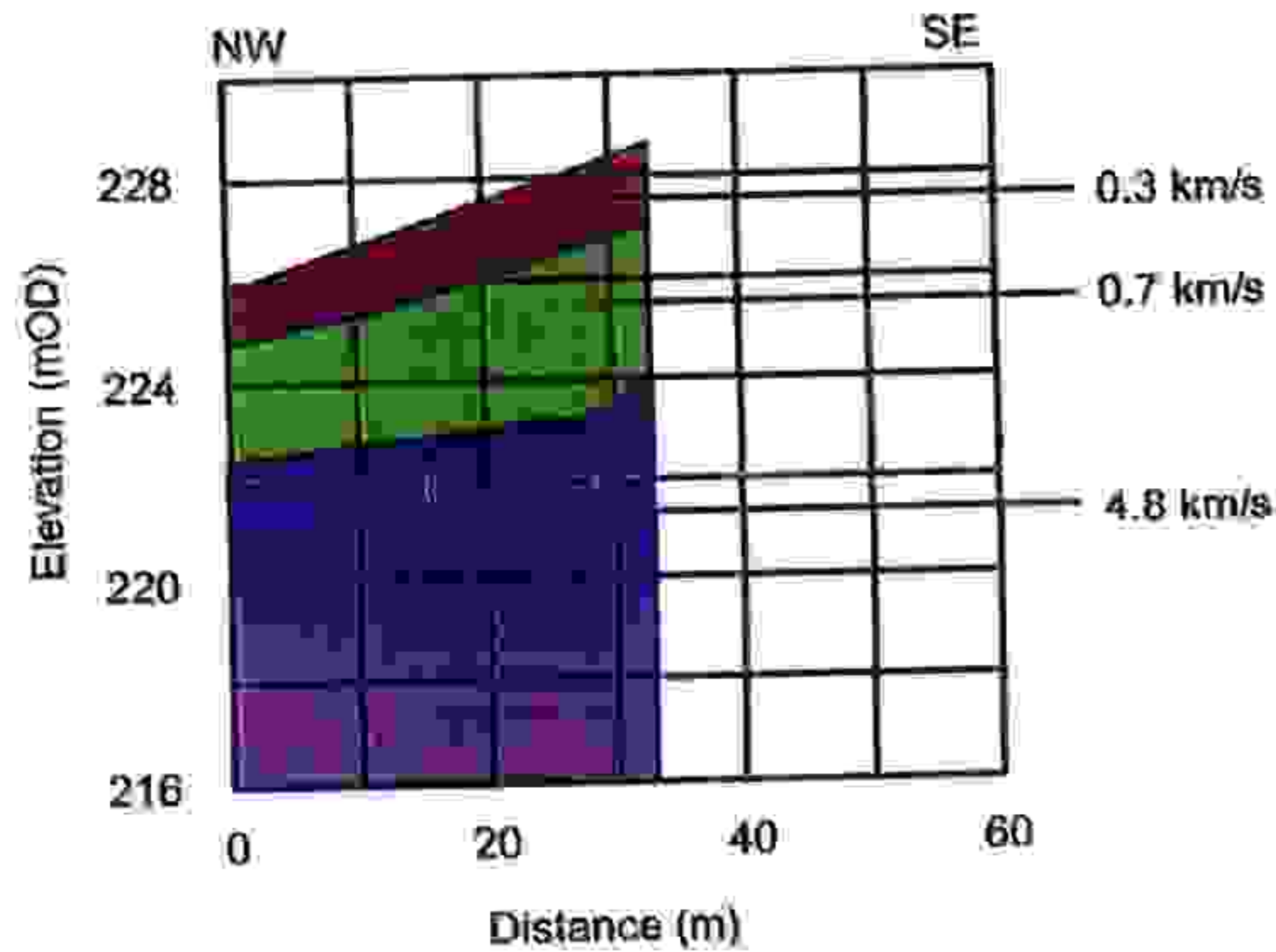
Seismic Refraction Profile 21



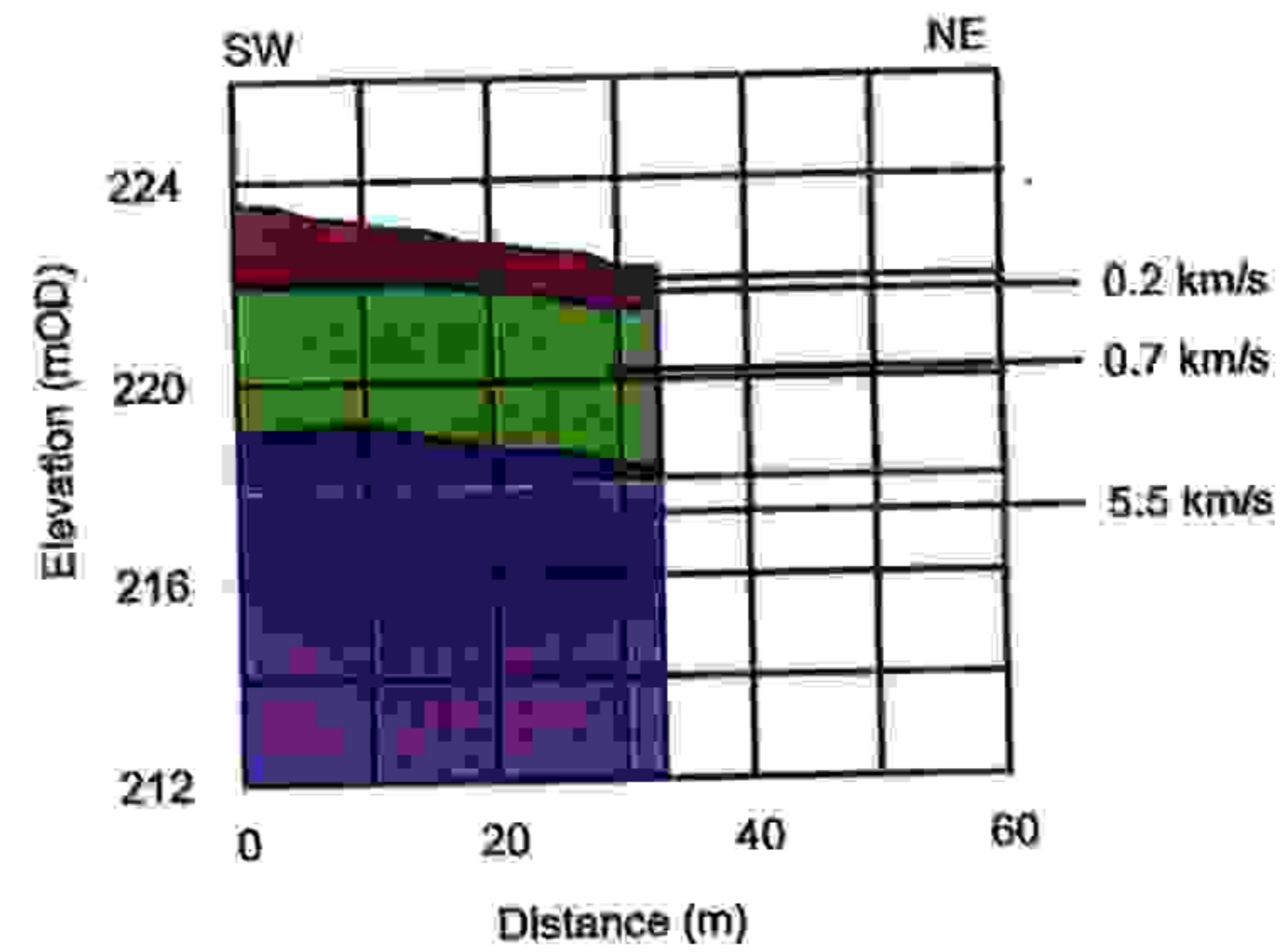
Seismic Refraction Profile 22



Seismic Refraction Profile 23



Seismic Refraction Profile 24

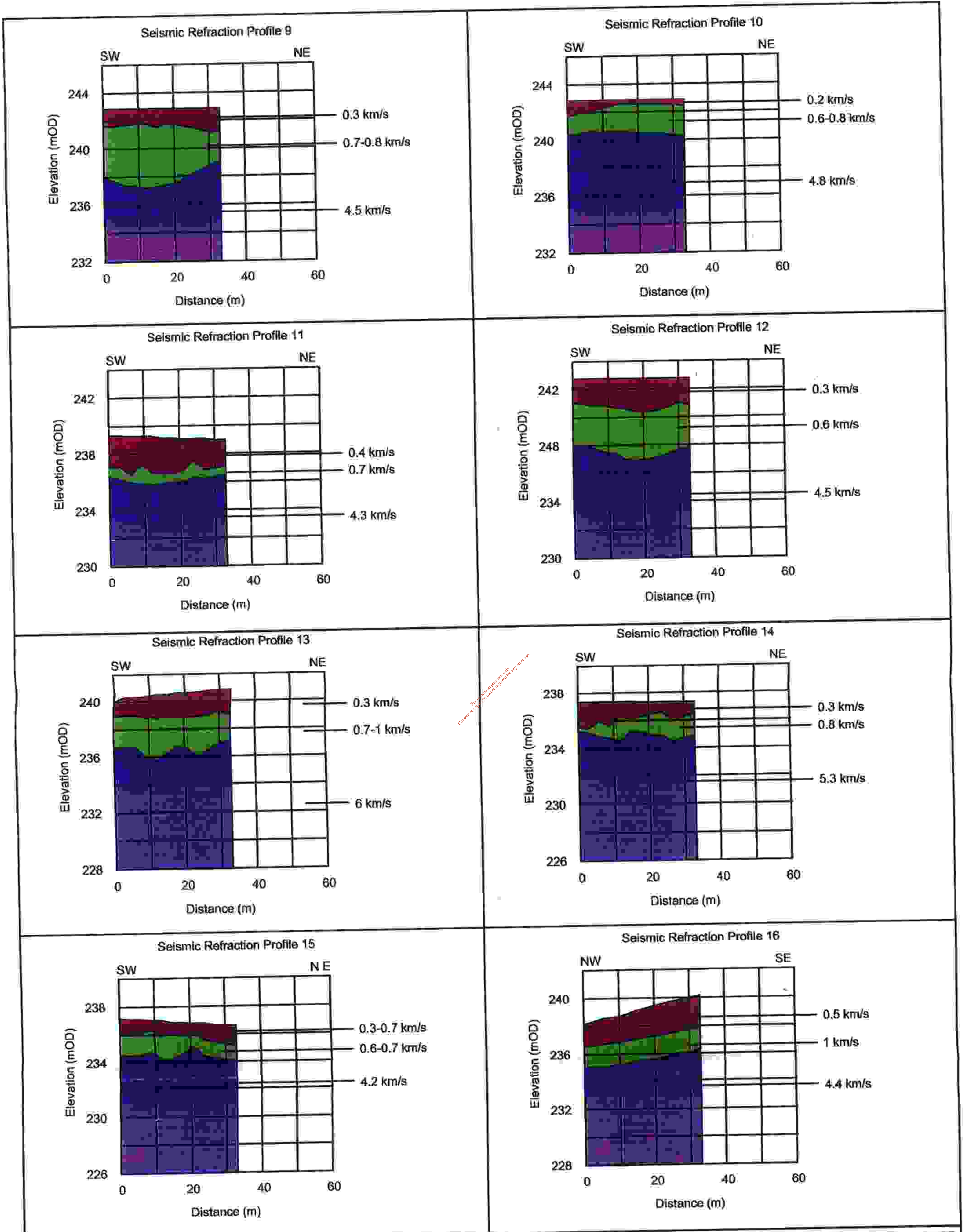


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CLIENT: Foundation and Exploration Services
PROJECT: Maenaboll Site Investigation Geophysical Survey - Phase 2
TITLE: Figure 2: Interpretation Seismic Refraction Profiles 17-24

LEGEND: Interpretation of Seismic Refraction Profiles
■ Peat
■ Glacial Till (mainly soft to firm compaction)
■ Strong Bedrock
 0.3 km/s: Seismic-velocity

Scale: h1/1000,v1/250
Project: 1503
Drawn: SC
Date: 15/8/03
MEL File: 1503_2_Fig2.dwg
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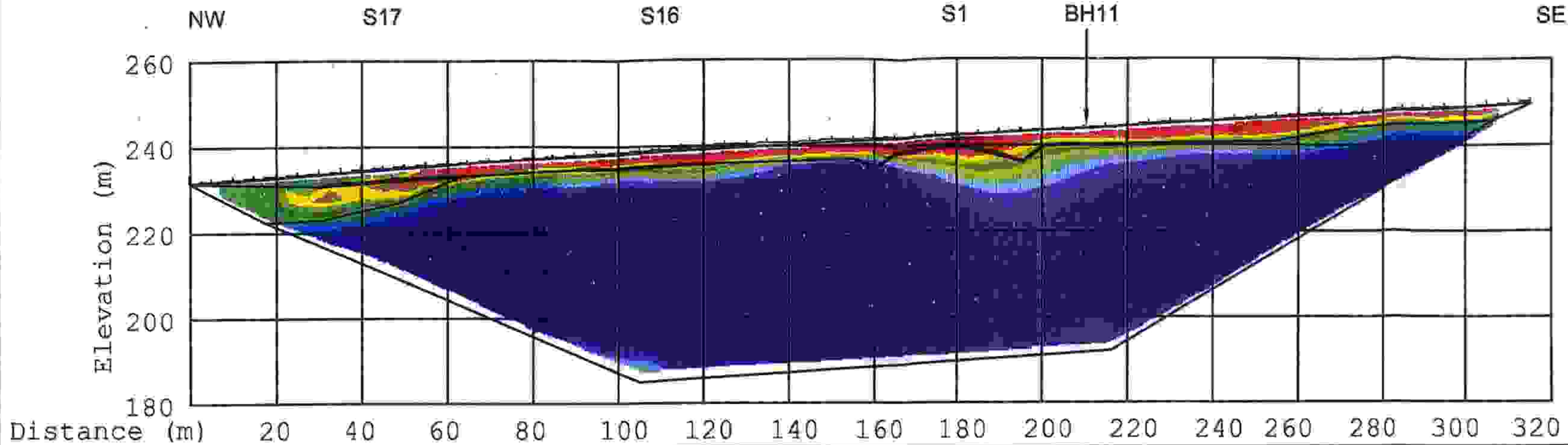
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CLIENT	Foundation and Exploration Services
PROJECT	Meenaboll Site Investigation Geophysical Survey - Phase 2
TITLE	Figure 1: Interpretation Seismic Refraction Profiles 9 - 16

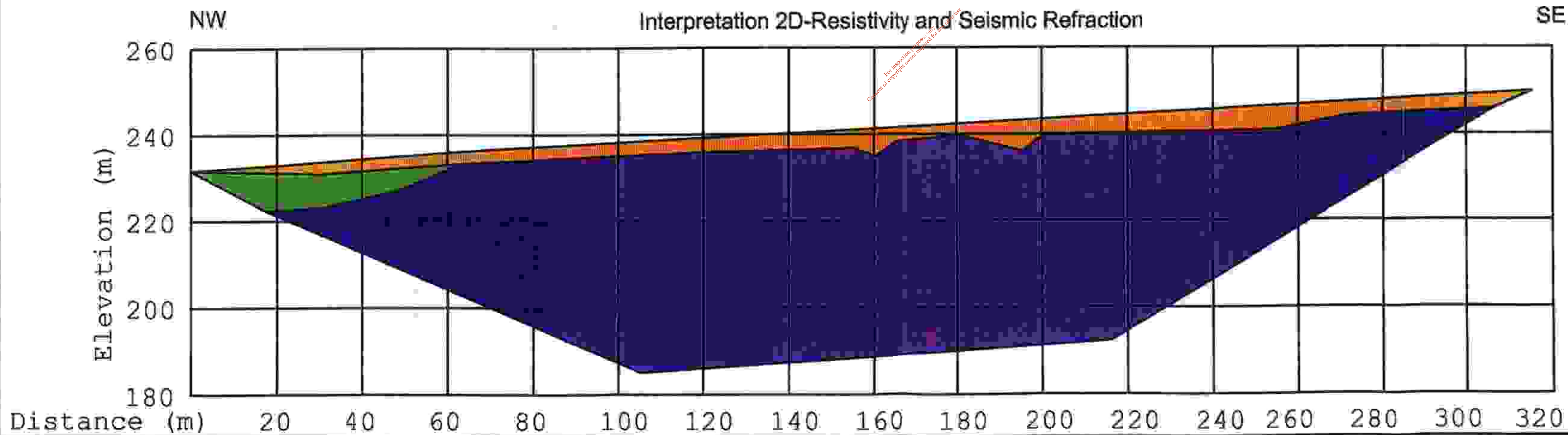
LEGEND	Interpretation of Seismic Refraction Profiles
	Peat
	Glacial Till (mainly soft to firm compaction)
	Strong Bedrock
0.3 km/s	Seismic velocity

Scale:	h1/1000.v1/250
Project:	1503
Drawn:	SC
Date:	15/9/03
MEL File:	1503_2_Fig1.dwg
Based on:	

2D-Resistivity Profile 1



Interpretation 2D-Resistivity and Seismic Refraction



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PROJECT Meenaboll Site Investigation Geophysical Survey - Phase 2

TITLE Figure 3: Interpretation 2D-Resistivity Profile 1



— Top of Rock Layer from Seismic Refraction

Key to Interpretation (see Report for Details)

- Overburden
- Psammitic Schist
- Psammitic Schist (locally smaller resistivity)

Scale: 1:1500

Project: 1503

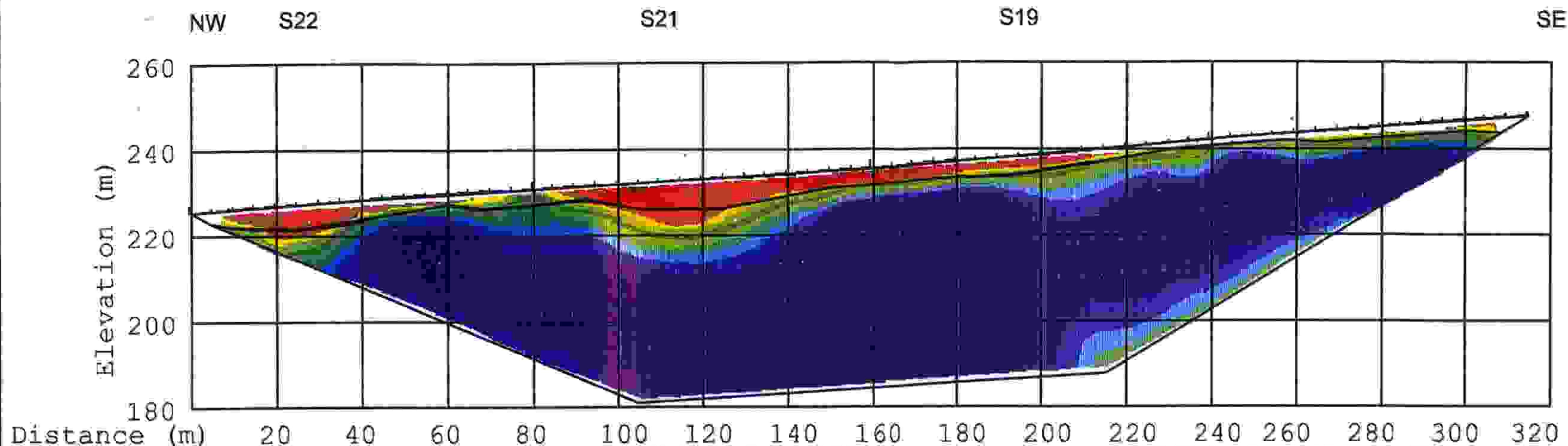
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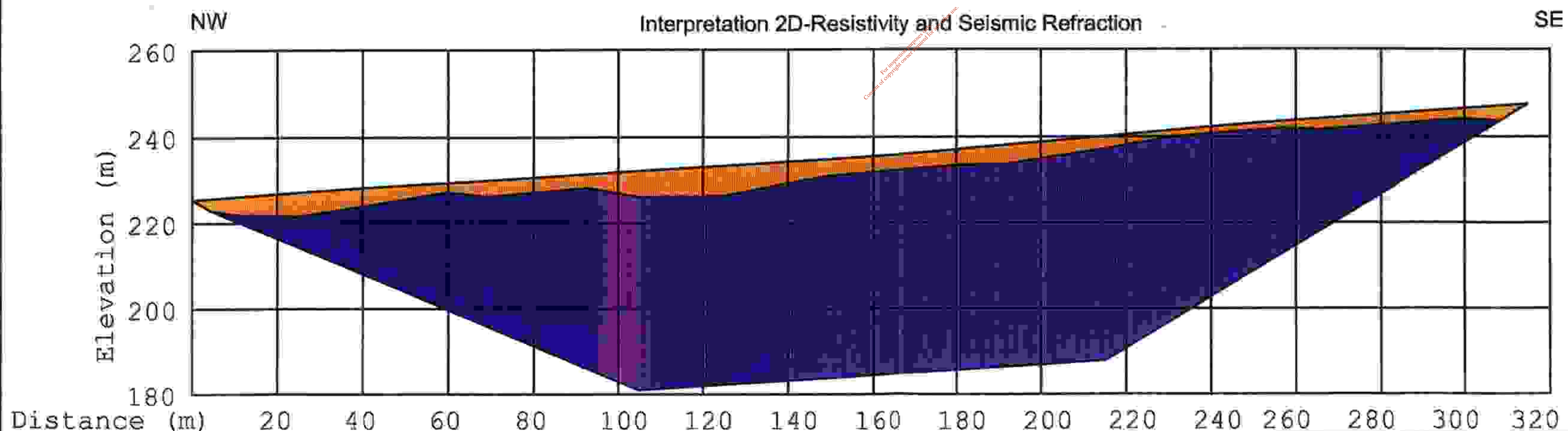
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Based on:

2D-Resistivity Profile 2



Interpretation 2D-Resistivity and Seismic Refraction



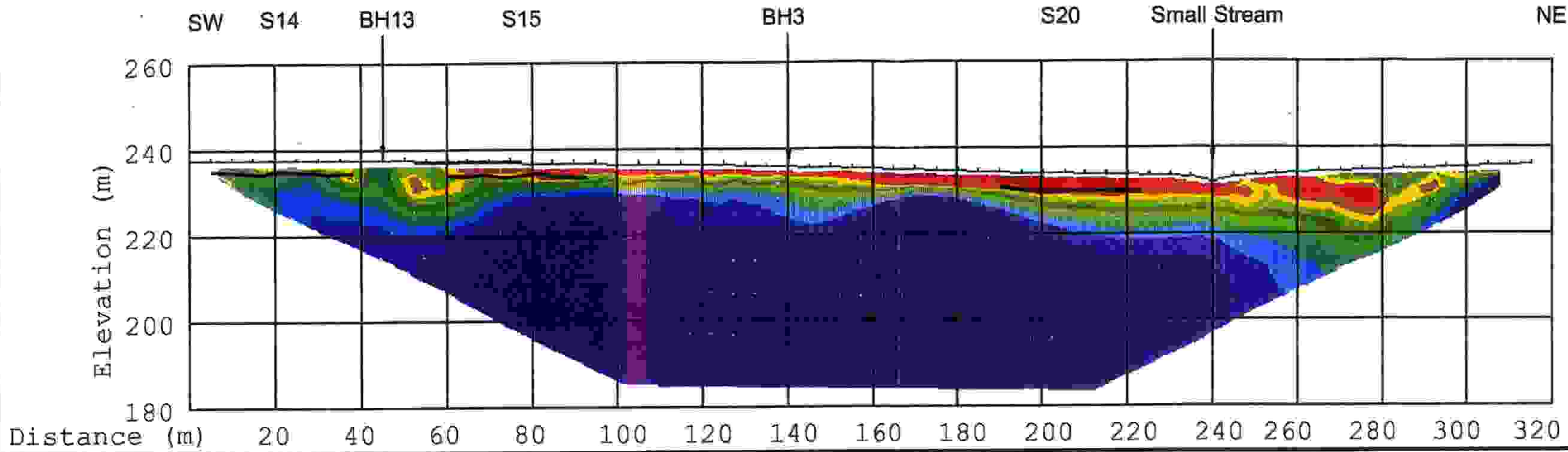
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CLIENT Foundation and Exploration Services
PROJECT Meenaboll Site Investigation Geophysical Survey - Phase 2
TITLE Figure 4: Interpretation 2D-Resistivity Profile 2

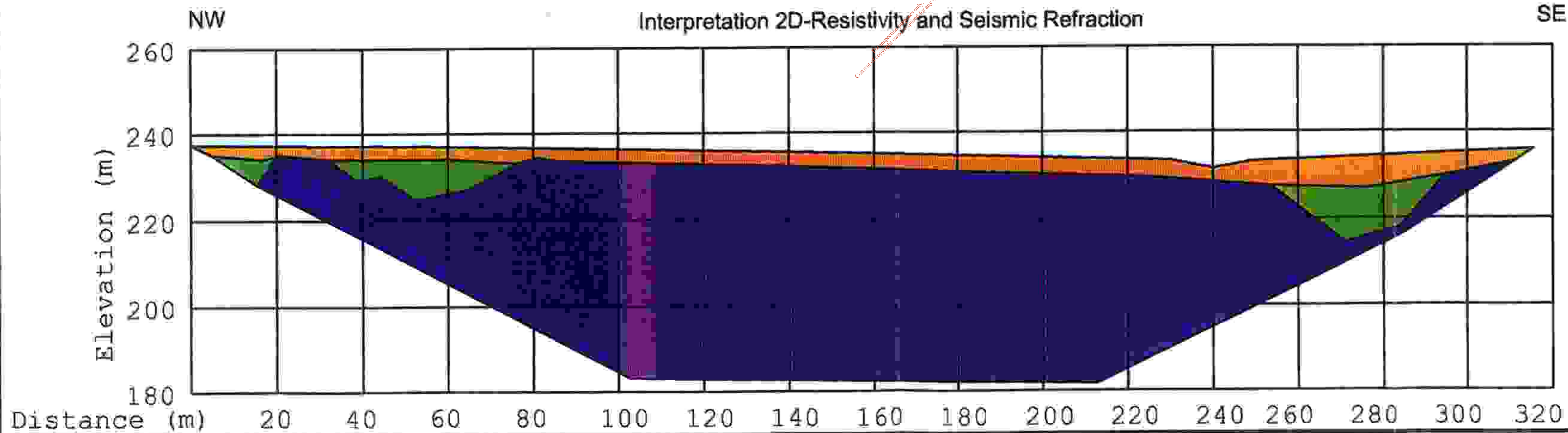
LEGEND
Model Resistivities (Ohm-m)
100 159 252 400 635 1008 1600 2540
— Top of Rock Layer from Seismic Refraction.
Key to Interpretation (see Report for Details)
Overburden Psammitic Schist
Psammitic Schist (locally smaller resistivity)

Scale: 1:1500
Project: 1503
Drawn: HK
Date: 15/9/03
MEL File: 1503_2_Fig4.dwg
Based on:

2D-Resistivity Profile 3



Interpretation 2D-Resistivity and Seismic Refraction



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CLIENT	Foundation and Exploration Services
PROJECT	Meenaboll Site Investigation Geophysical Survey - Phase 2
TITLE	Figure 5: Interpretation 2D-Resistivity Profile 3

LEGEND

Model Resistivities (Ohm-m)

100 159 252 400 636 1008 1600 2540

— Top of Rock Layer from Seismic Refraction

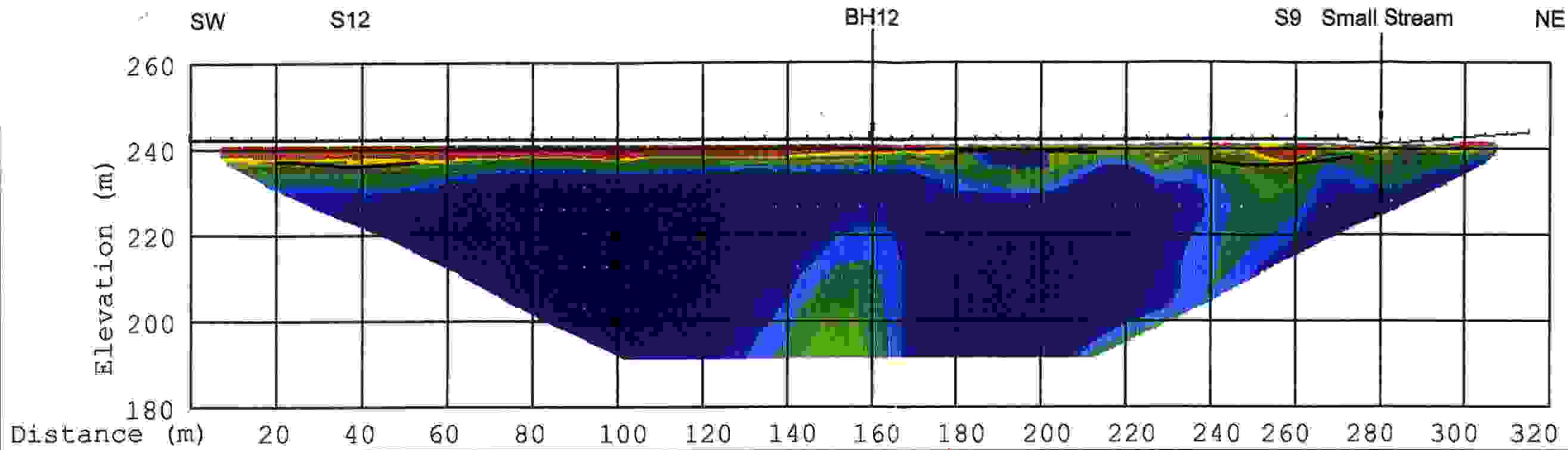
Key to Interpretation (see Report for Details)

Overburden Psammitic Schist

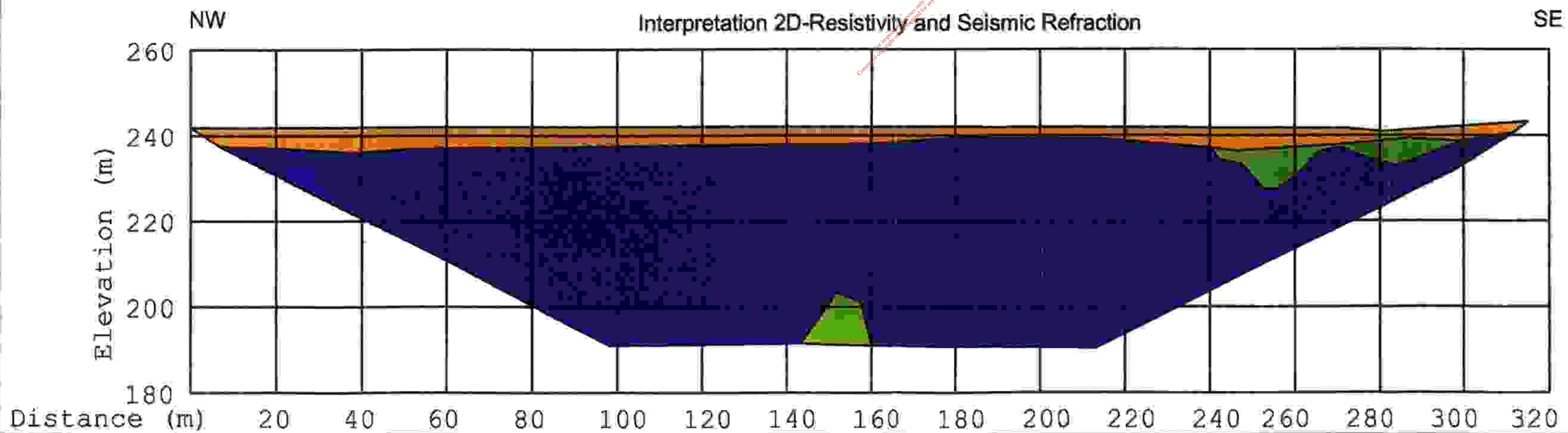
Psammitic Schist (locally smaller resistivity)

Scale:	1:1500
Project:	1503
Drawn:	HK
Date:	15/9/03
MEL File:	1503_2_Fig5.dwg
Based on:	

2D-Resistivity Profile 4



Interpretation 2D-Resistivity and Seismic Refraction

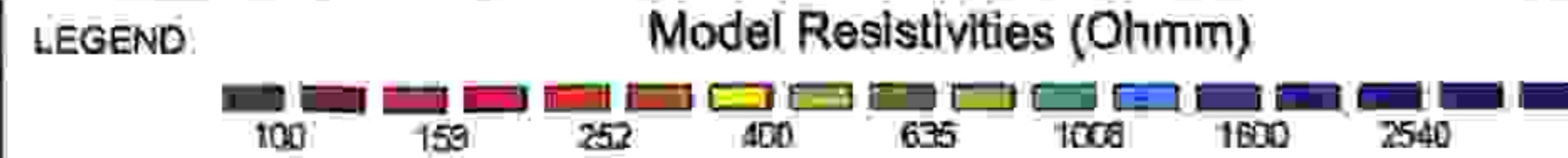


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CLIENT Foundation and Exploration Services

PROJECT Meenaboll Site Investigation Geophysical Survey - Phase 2

TITLE Figure 6: Interpretation 2D-Resistivity Profile 4



— Top of Rock Layer from Seismic Refraction

Key to Interpretation (see Report for Details)

Overburden Psammitic Schist
 Psammitic Schist (locally smaller resistivity)

Scale: 1:1500

Project: 1503

Drawn: HK

Date: 15/9/03

MEL File: 1503_2_Fig6.dwg

Based on: