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SINTEF REPORT

TITLE

GPR measurements RV33 Minnesund

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ABSTRACT

This rapport is based on measurements made with the Ground Penetrating Radar close to Minnesund in Akershus. The investigations were conducted by Senior Research Scientist Dagfin Gryteselv and PhD Research Fellow Anne Lalagüe. The purpose of these measurements is to determine asphalt and base layers thickness, in preparation for rehabilitation works.

KEYWORDS	ENGLISH	NORWEGIAN
GROUP 1	Road Engineering	Vegteknikk
GROUP 2	Field survey	Feltundersøkelse
SELECTED BY AUTHOR	GPR	Georadar

TABLE OF CONTENTS

1 GPR MEASUREMENTS

1.1 Equipment

The equipment used is Geoscope from 3d-radar. Measuring width is 2,25m and the antenna is raised 30 cm above the ground. A limited number of channels is selected, to allow a reasonable high survey speed.

1.2 Weather conditions

Measurements are carried out during dry weather. No water on the pavement.

1.3 Recorded data

Starting and ending points match the GPS coordinates and kilometre markers. In case of divergence, the reference is the *kilometre markers*.

Start point: Hp02, km 0

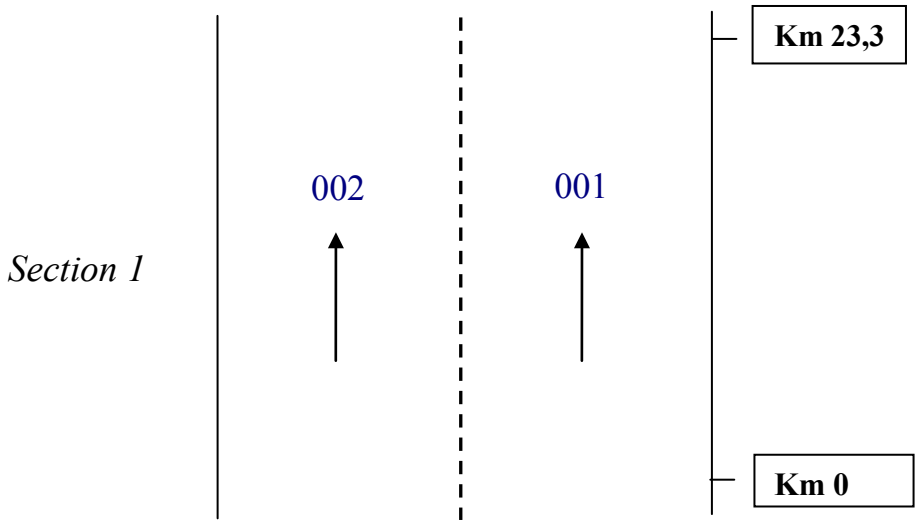
End point: Hp02, km 23,3

File name	Road	Section	Length (km)	Registered length (m)
001	RV33	Hp02 Km 0 → Km 23,3	23,3	*23,317*
002	RV33	Hp02 Km 23,3 → Km 0	23,3	*23,324*

Measured sections

1.4 Layout

The resulting profiles are displayed on the same sheet: file 002 (left lane) at the bottom, file 001 (right lane) at the top, from starting point Km 0 (see radargrams).



2 RESULTS

2.1 Files processing

GPR data are analyzed with Road Doctor. They are filtered, rescaled and set to zero level. The dielectric constant determines the speed with which the wave travels and is used for thicknesses calculations. It varies from material to material:

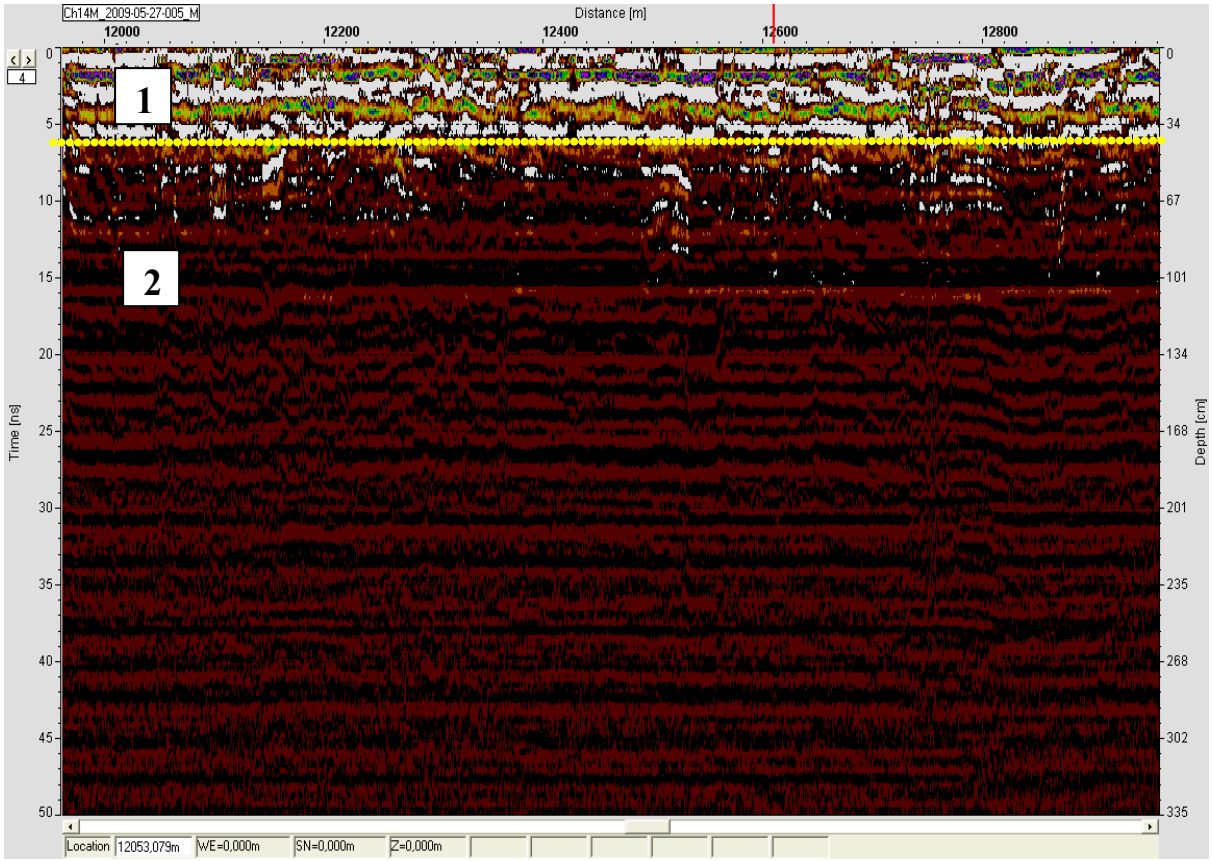
Material	Dielectric values
Air	1
Water (fresh)	81
Bedrock (granite)	5-7
Asphalt/ bituminous pavements	4-8
Crushed base	6-8
Road structure in average (dry)	5

Dielectric values normally used in the GPR data interpretation in Scandinavia

In this project the selected average value for interpretation is **ε = 5.**

2.2 Longitudinal profile

Two material groups ("media") presenting different electrical properties are identified:

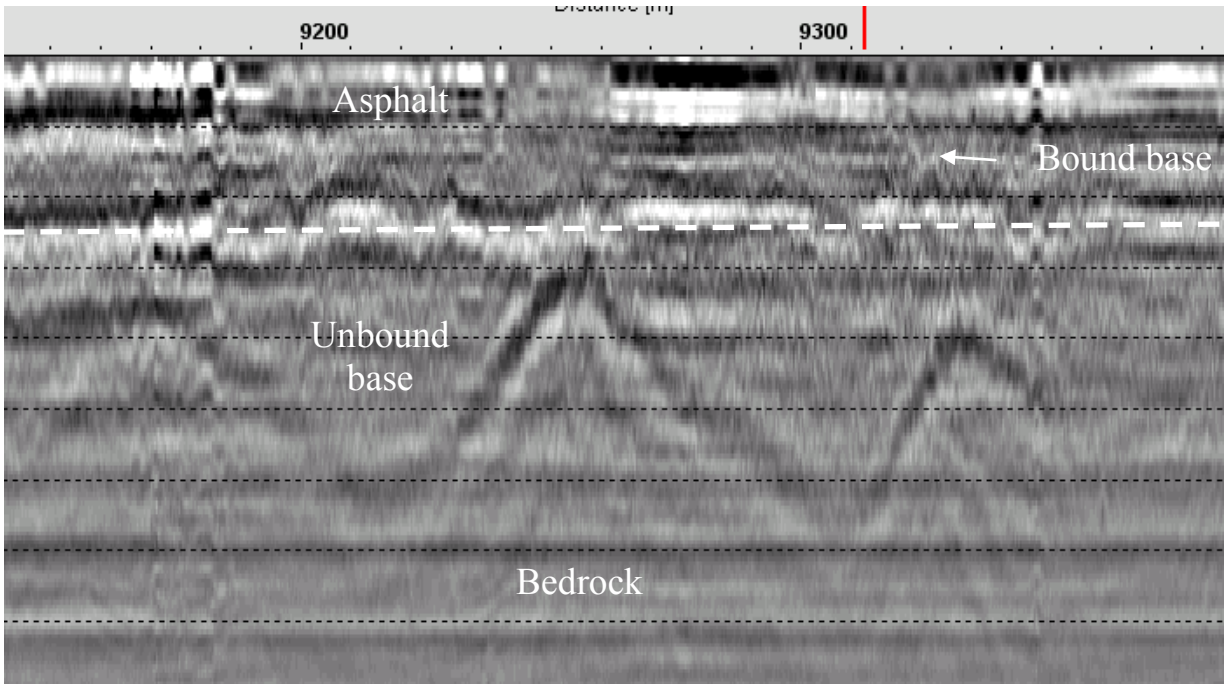


- Within medium 1, another interface can be located (see orange line on radargrams). It shows that two materials with low contrast in electrical properties form Medium 1. These are probably:
    - Asphalt and other type of asphalt (old)
    - Asphalt and bound base

- According to the surrounding area, Medium 2 appears to be bedrock (*fjell*).

- At some parts, an interface is located within Medium 2 (see radargrams). The colour and contrast observation indicates that the top layer has a higher dielectric value and water content. This can correspond to a gravel/sandy layer on top of rock.

Interpretation:



Note:

GPR profiles and data collected from historic drill cores ("Oppgravingsregisteret") present the same tendency: a layer thickness increase or decrease is corroborated by results from drill cores. However these data must be considered with care, since they were collected many years ago and rehabilitation/maintenance works have probably been done from that time. For example, the first 5 km are about 20 cm thinner than before: milling has probably been carried out.

3 CONCLUSION

GPR measurements give satisfactory results and it is possible to delineate three types of materials:

1- Asphalt/Bound base
2- Gravel/sand/crushed stones
3- Bedrock

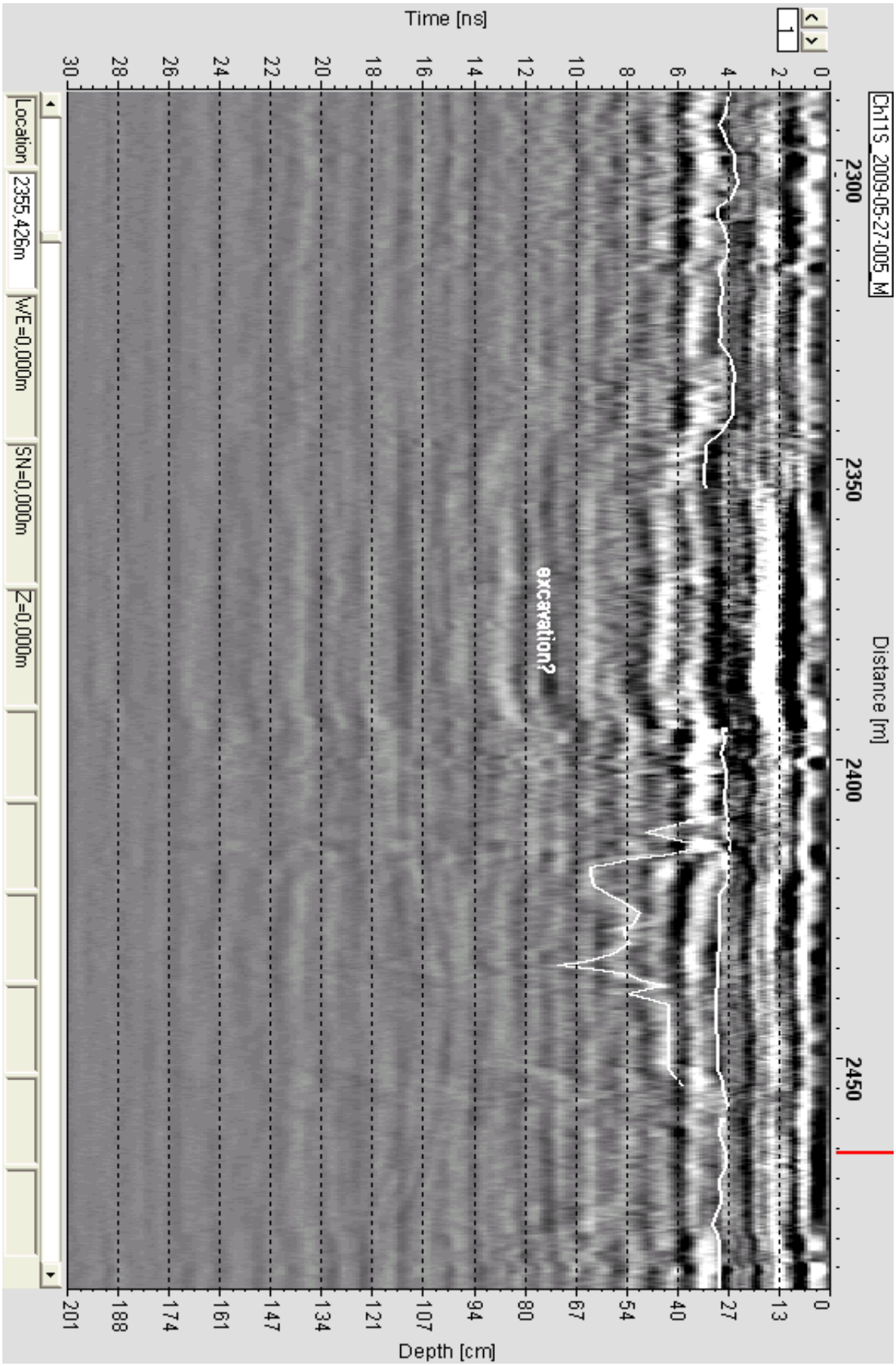
The nature of these materials can not be determined with absolute certainty, but arise from data collected from historic drill cores and environment observation.

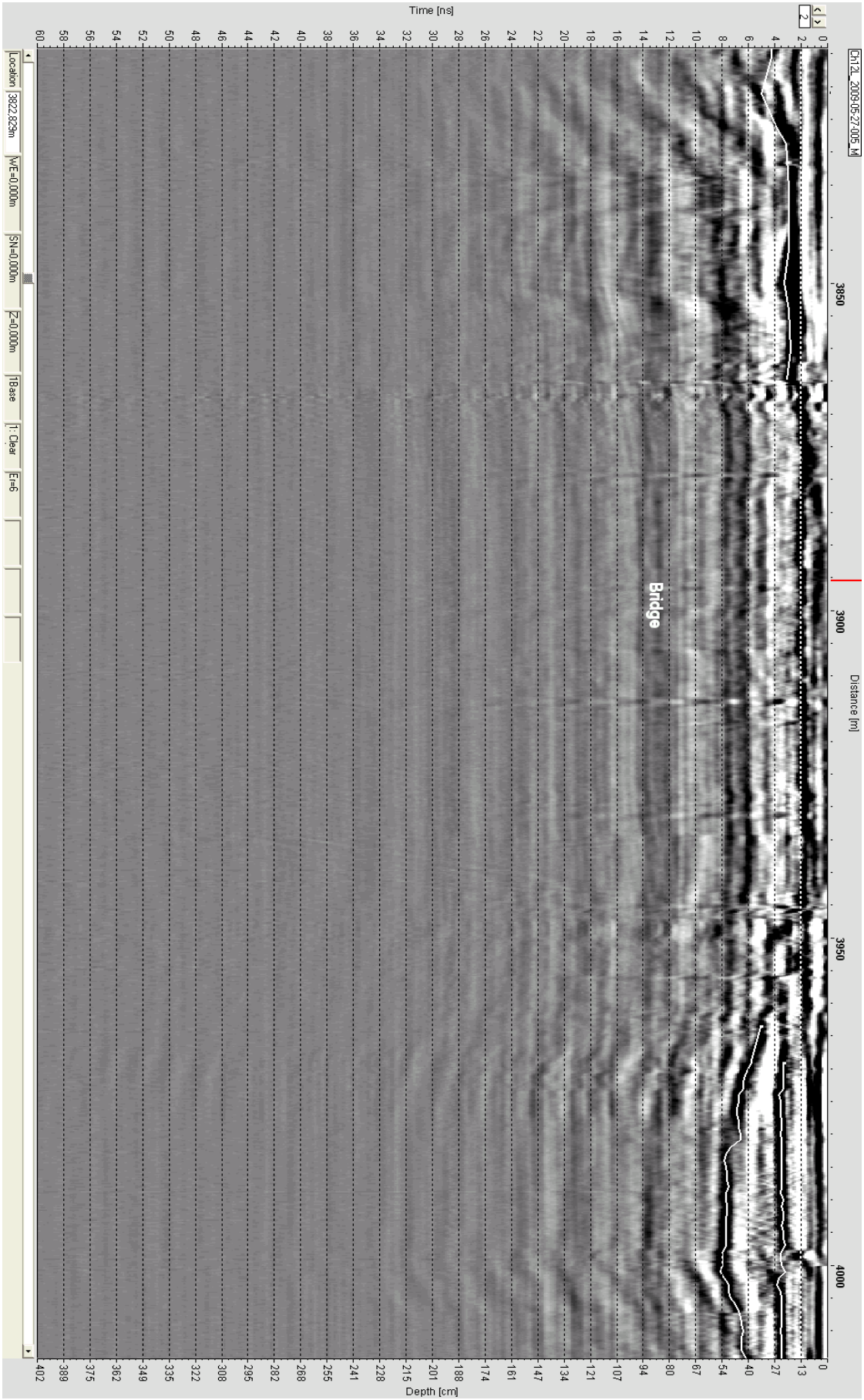
The average asphalt and bases thicknesses are listed in the table below:

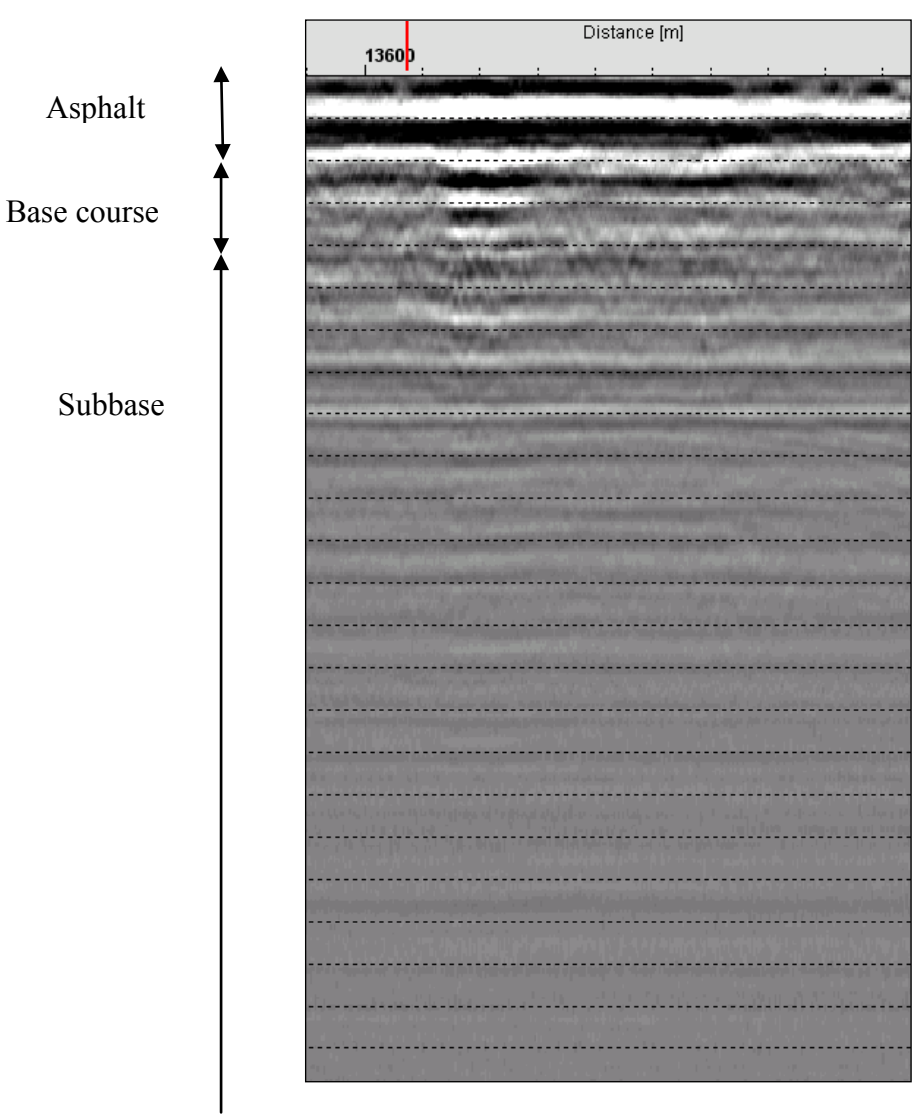
Distance (m)		**Average thickness (cm)**		
From	*To*	*Asphalt*	*Bound base*	*Unbound base*
0	1485	18	-	20
1485	4956	13	13	0 - 50
4956	5295	20	-	0 - 90
5295	12486	13	13	0 - 110
12486	14356	20	-	0 - 50
14356	16048	13	13	0 - 50
16048	17358	20	< 5	0 - 110
17358	19700	13	13	0 - 50
19700	20175	20	< 5	0 - 30
20175	21176	13	13	0 – 40
21176	21376	20	< 5	0 – 40
21376	23300	13	13	0 - 40

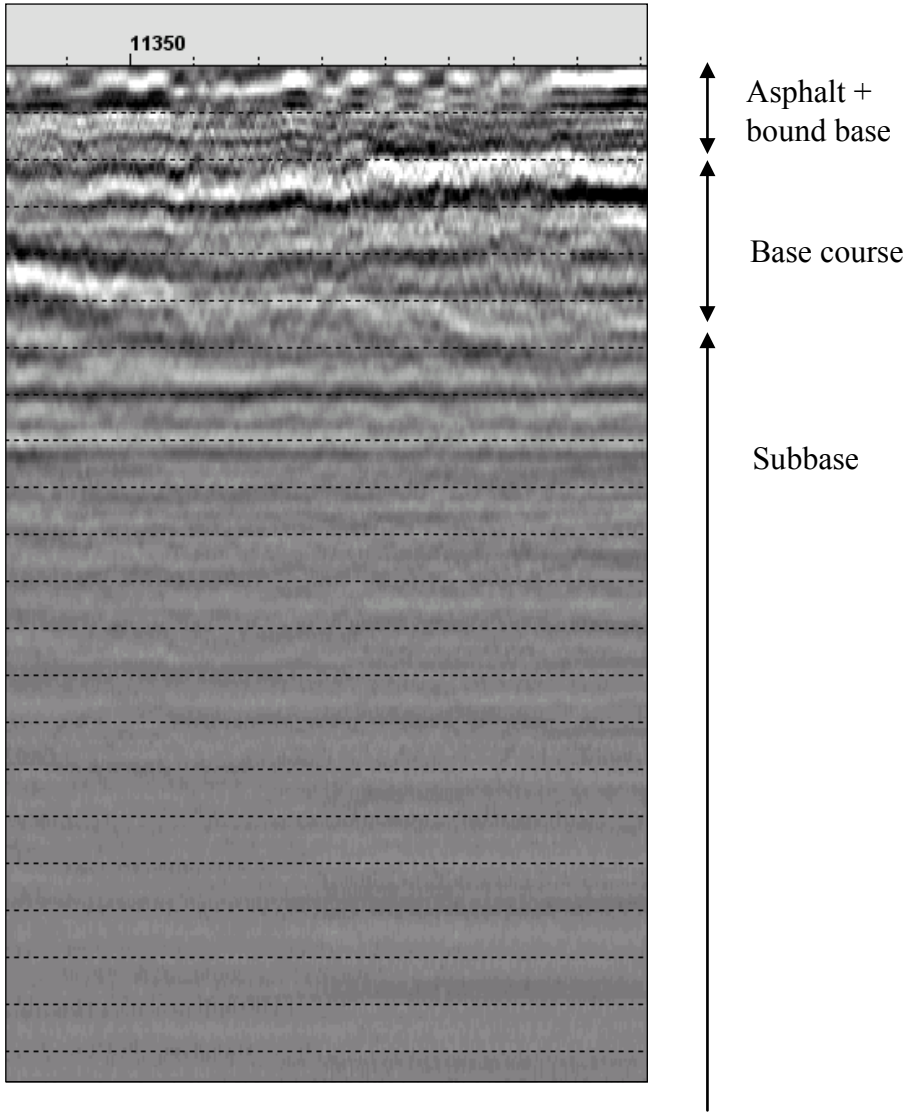
APPENDIX -

Some features are here highlighted:

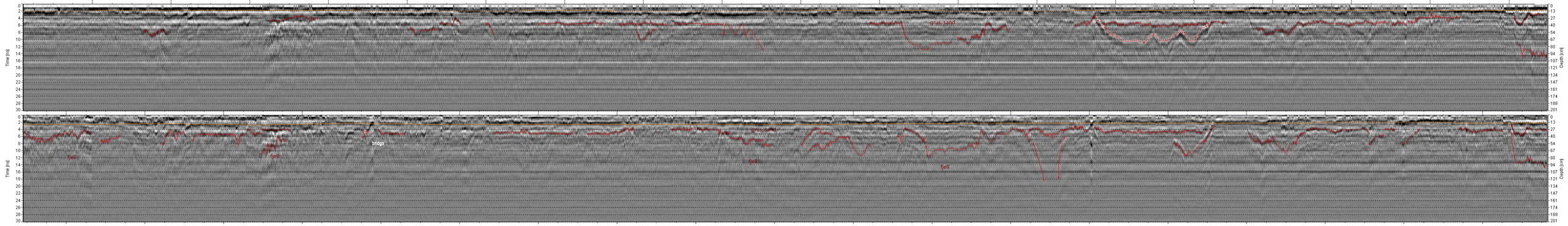


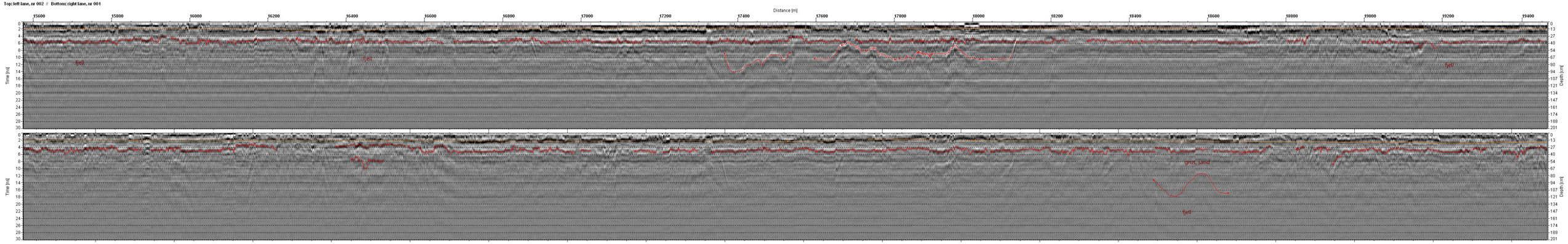

Ch12L_2009-05-27-005_M
Time [ns]
Distance [m]
Depth [cm]
Bridge
Location
3822.823m
WE=0.000m
SN=0.000m
Z=0.000m
Base
1: Clear
Er=6


Asphalt
Base course
Subbase
Distance [m]
13600


11350
Asphalt +
bound base
Base course
Subbase

Top: left lane, nr 002 // Bottom: right lane, nr 001




Top: left lane, nr 002 // Bottom: right lane, nr 001
Distance [m]
15600
15800
16000
16200
16400
16600
16800
17000
17200
17400
17600
17800
18000
18200
18400
18600
18800
19000
19200
19400
Time [ns]
Depth [cm]
fjell
fjell
fjell
grus, sand
fjell
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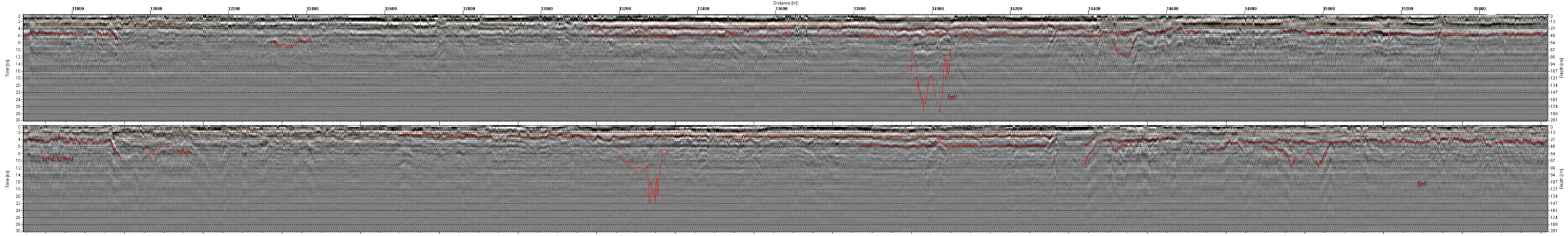
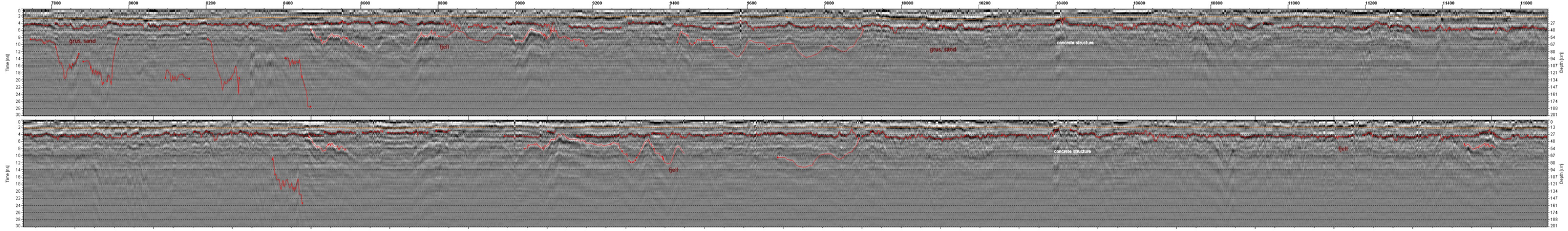
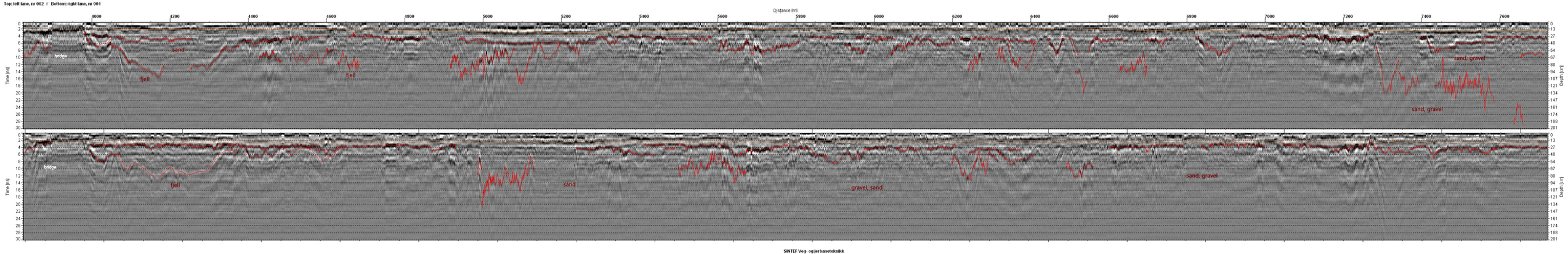
Top: left lane, nr 002 // Bottom: right lane, nr 001



SINTEF Veg- og jernbaneteknikk

Top: left lane, nr 002 // Bottom: right lane, nr 001




Top: left lane, nr 002 // Bottom: right lane, nr 001
Distance [m]
4000
4200
4400
4600
4800
5000
5200
5400
5600
5800
6000
6200
6400
6600
6800
7000
7200
7400
7600
Time [ns]
Depth [cm]
bridge
sand
fjell
fjell
sand, gravel
sand, gravel
bridge
fjell
sand
gravel, sand
sand, gravel
SINTEF Veg- og jernbaneteknikk

Top: left lane, nr 002 // Bottom: right lane, nr 001