

A Report for

**THE HEN DOMEN
ARCHAEOLOGICAL PROJECT**

on a

Geophysical Survey

carried out

on the

**MOTTE AND BAILEY CASTLE AT
HEN DOMEN**

March/August 1991

Author P P Barker C.Eng MICE MIWEM AIFA

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building have been identified which have allowed conjectural reconstructions to be made. The ground plan used in the site plans in the report are from Phase X c1150 (see Figure 5 in the Summary Report 1960-1988).

The southern half of the bailey has not been excavated, leaving an archaeological resource which is likely to be comparable to the northern half.

2.5 Survey objectives

One objective of the survey was to assess the southern extent of the large building on the eastern side of the motte ditch (marked A on Figure 3). In addition the well documented deposits of features in the northern half of the site may be reflected in the southern half, so providing an aid to the interpretation of the geophysical surveys.

2.6 Survey methods

Surveys were carried out with magnetometry, resistivity and ground probing radar. All are discussed under Methodology below.

3 **METHODOLOGY**

3.1 Date of fieldwork

The surveys were carried out on two visits during 1991. The resistivity, magnetometer and part of the ground probing radar surveys were carried out on 3 March and further GPR on 12 August 1991. The weather was dry and sunny on both occasions.

3.2 Grid locations

The layout of survey grids and radar transects are shown in Figures 3, 7 and 8.

3.3 Description of techniques and equipment configurations

3.3.1 *Magnetometer*

Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTesla (nT) in an overall field strength of 48,000nT, can be accurately detected using an appropriate instrument.

The mapping of the anomaly in a systematic manner will allow an estimate of the type of material present beneath the surface. Strong magnetic anomalies will be generated by buried iron-based objects or by kilns or hearths. More subtle anomalies such as pits and ditches can be seen if they contain more humic material which is normally rich in magnetic iron oxides when compared with the subsoil.

To illustrate this point, the cutting and subsequent silting or backfilling of a ditch may result in a larger volume of weakly magnetic material being accumulated in the trench

compared to the undisturbed subsoil. A weak magnetic anomaly should therefore appear in plan along the line of the ditch.

The magnetic survey was carried out using an FM36 Fluxgate Gradiometer, manufactured by Geoscan Research. The instrument consists of two fluxgates mounted 0.5m vertically apart, and very accurately aligned to nullify the effects of the earth's magnetic field. Readings relate to the difference in localised magnetic anomalies compared with the general magnetic background.

3.3.2 *Resistance Meter*

This method relies on the relative inability of soils (and objects within the soil) to conduct an electrical current which is passed through them. As resistivity is linked to moisture content, and therefore porosity, hard dense features such as rock will give a relatively high resistivity response, while features such as a ditch which retains moisture give a relatively low response.

The resistance meter used was an RM15 manufactured by Geoscan Research incorporating a mobile Twin Probe Array. The Twin Probes are separated by 0.5m and the associated remote probes were positioned approximately 15m outside the grid. The instrument uses an automatic data logger which permits the data to be recorded as the survey progresses for later downloading to a computer for processing and presentation.

Though the values being logged are actually resistances in ohms they are directly proportional to resistivity (ohm-metres) as the same probe configuration was used through-out.

3.3.3 *Ground Probing Radar*

Two of the main advantages of radar are its ability to give information of depth as well as work through a variety of surfaces, even in cluttered urban environments and which normally prevent other geophysical techniques being used.

A short pulse of energy is emitted into the ground and echoes are returned from the interfaces between different materials in the ground. The amplitude of these returns depends on the change in velocity of the radar wave as it crosses these interfaces. A measure of these velocities is given by the dielectric constant of that material. The travel times are recorded for each return on the radargram and an approximate conversion made to depth by calculating or assuming an average dielectric constant (see below).

Drier materials such as sand, gravel and rocks, i.e. materials which are less conductive (or more resistant), will permit the survey of deeper sections than wetter materials such as clays which are more conductive (or less resistant). Penetration can be increased by using longer wavelengths (lower frequencies) but at the expense of resolution (see 3.4.2 below).

As the antennae emit a "cone" shaped pulse of energy an offset target showing a perpendicular face to the radar wave will be "seen" before the antenna passes over it. A

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pl g

p f

p

 g

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gn (g)

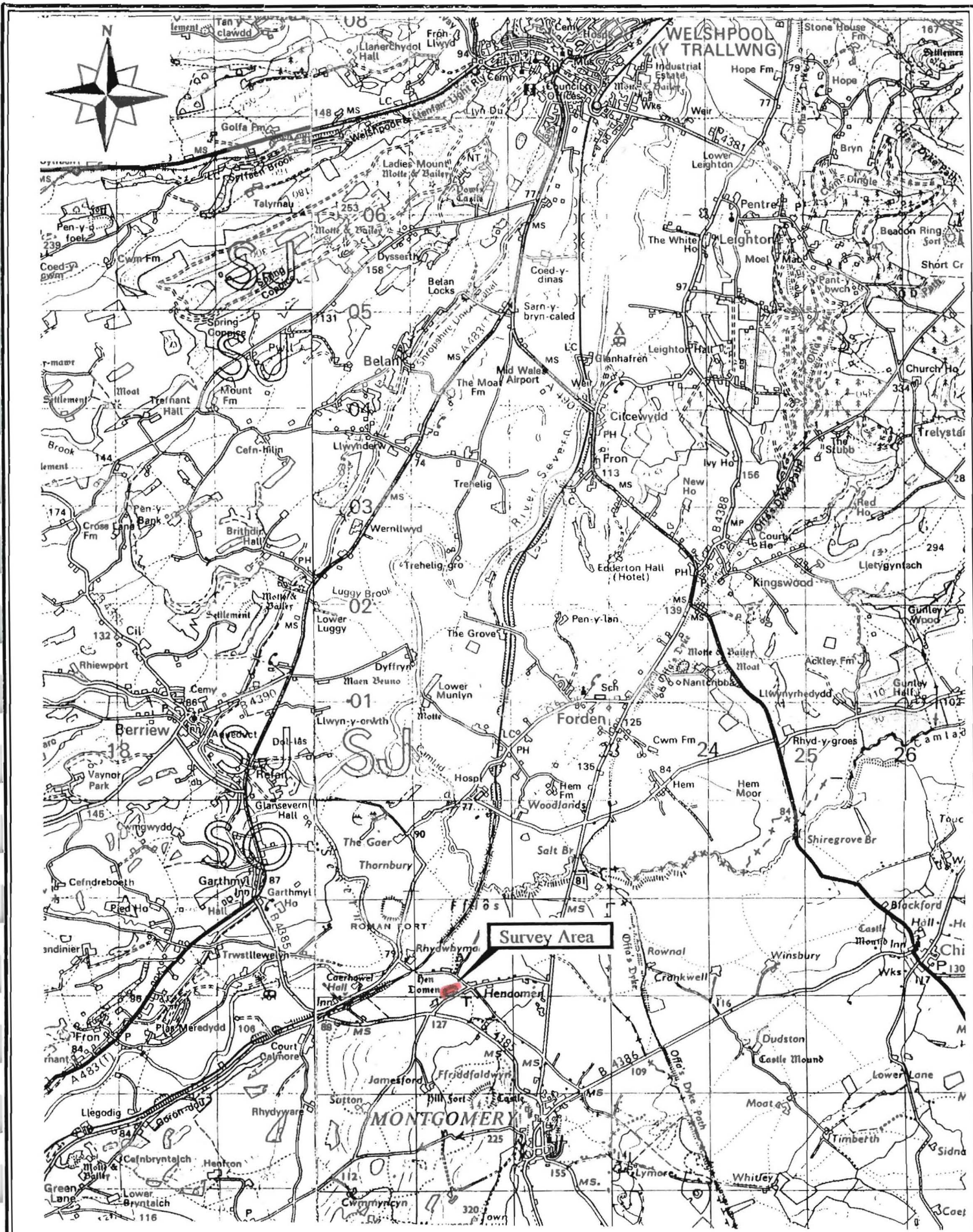


5 CONCLUSIONS AND RECOMMENDATIONS

The results of the survey indicate that many aspects of the bailey found in the northern half are repeated in the south. These include the scatter of iron work, the increased depths of deposits at the tail of the rampart and the substantial building in the centre of the bailey.

It is recommended that should any further geophysics be considered for the site consideration is given to using a range of antennae from high down to low frequency. If each is used to collect data from an orthogonal 1m grid then comparable time slice plots can be made allowing a detailed analysis of the results. This information together with more detailed magnetometer and resistivity would permit an in-depth, non-intrusive study of the un-excavated site to be made and compared with the evidence from the extensive excavations.

Such a project would prove a good subject for a master degree or doctorate and enable a strategy to be formulated for further studies of the castle.



Date March & Aug 1991

Scale 1:50,000

Figure 1

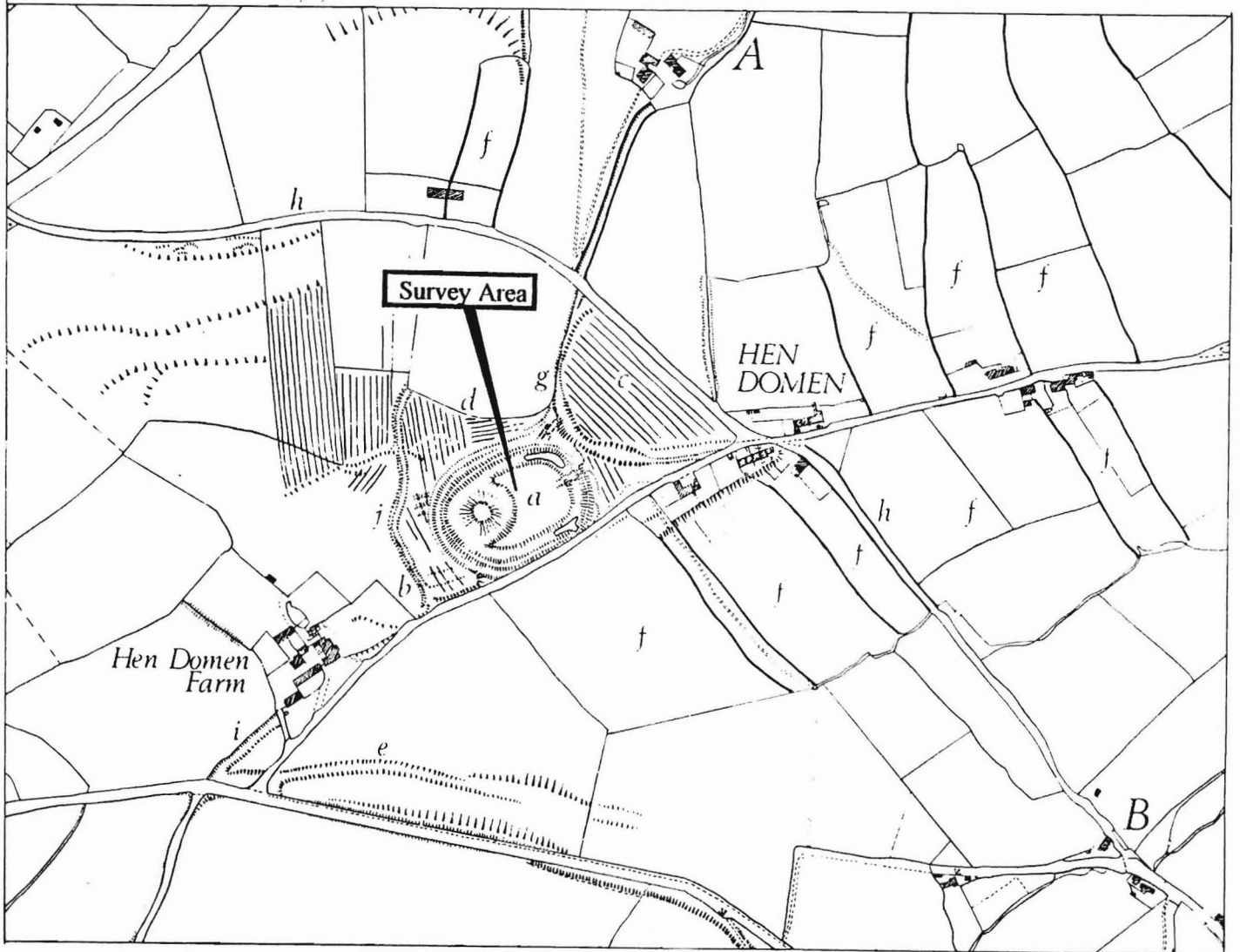
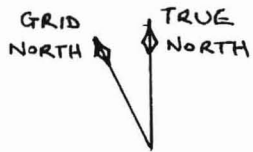
Client THE HEN DOMEN
ARCHAEOLOGICAL PROJECT

Subject Geophysical Survey
Hen Domen Powys
General Location Plan

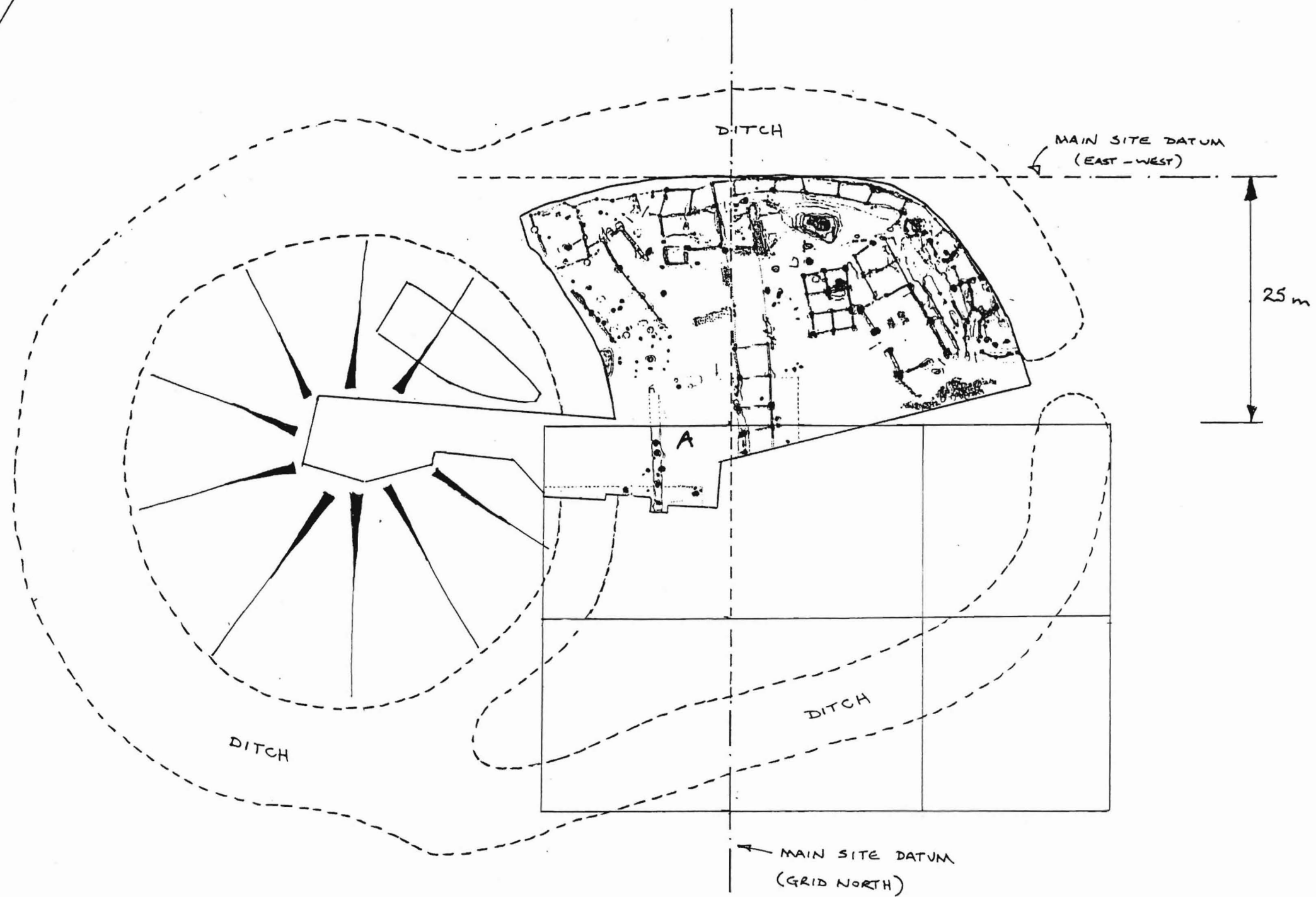
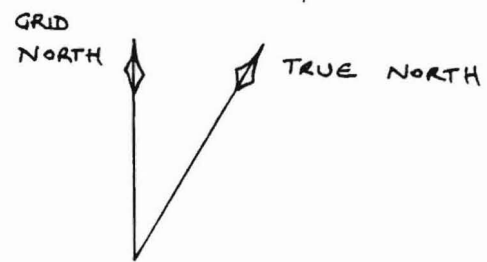
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Scale 1:5000	Subject Geophysical Survey Hen Domen, Powys	
Figure 2	Detailed location plan showing earthworks and field boundaries around the site	



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FIGURE: 3

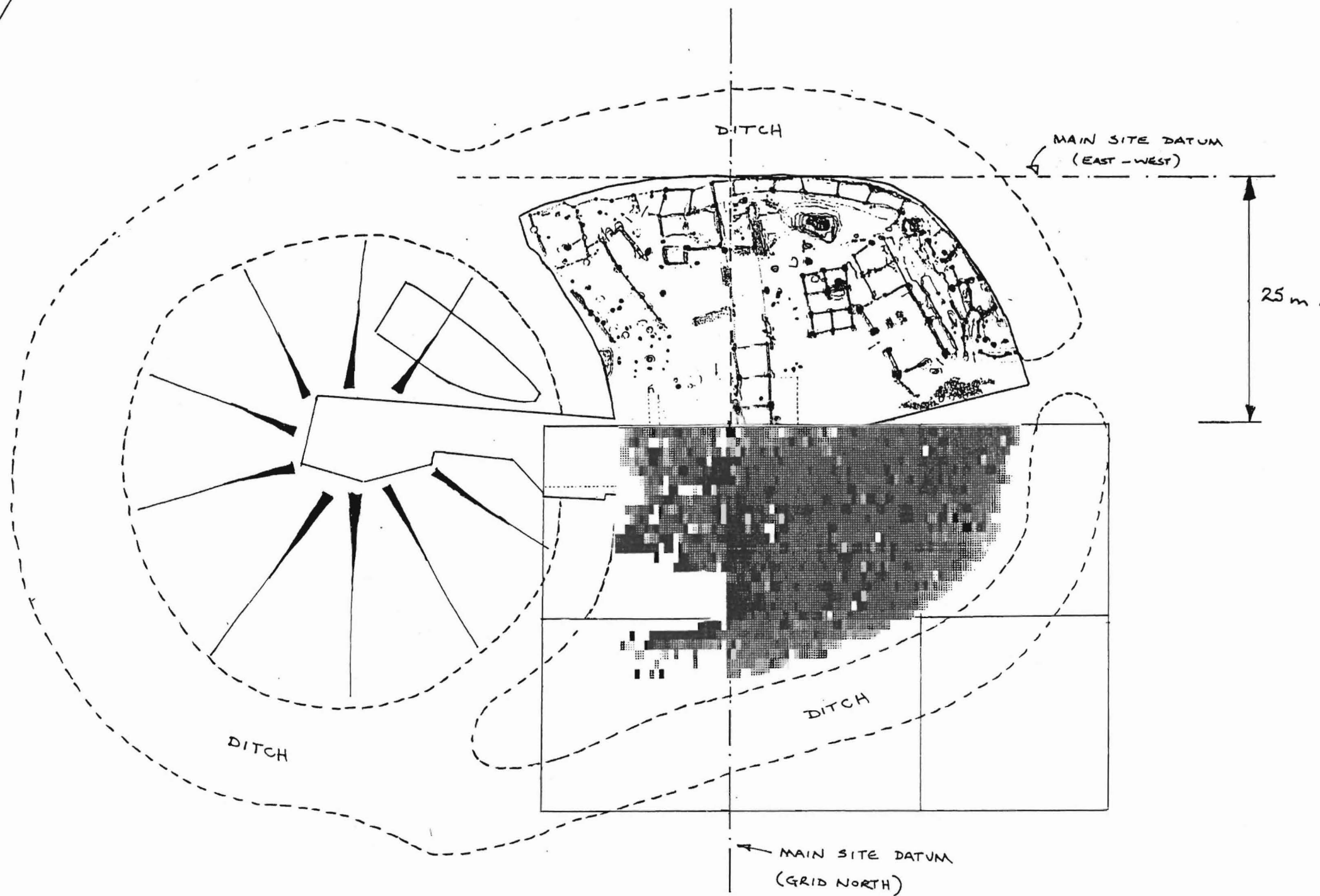
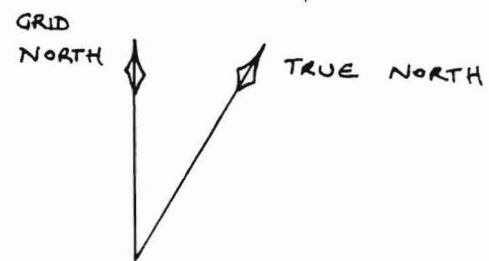
SCALE: 1:500

SUBJECT: Geophysical Survey - Hen Dómen, Powys
Site plan showing excavated areas and survey grid layout

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Plotting parameters
 Minimum -20nT (white)
 Maximum +15nT (black)

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FIGURE: 4

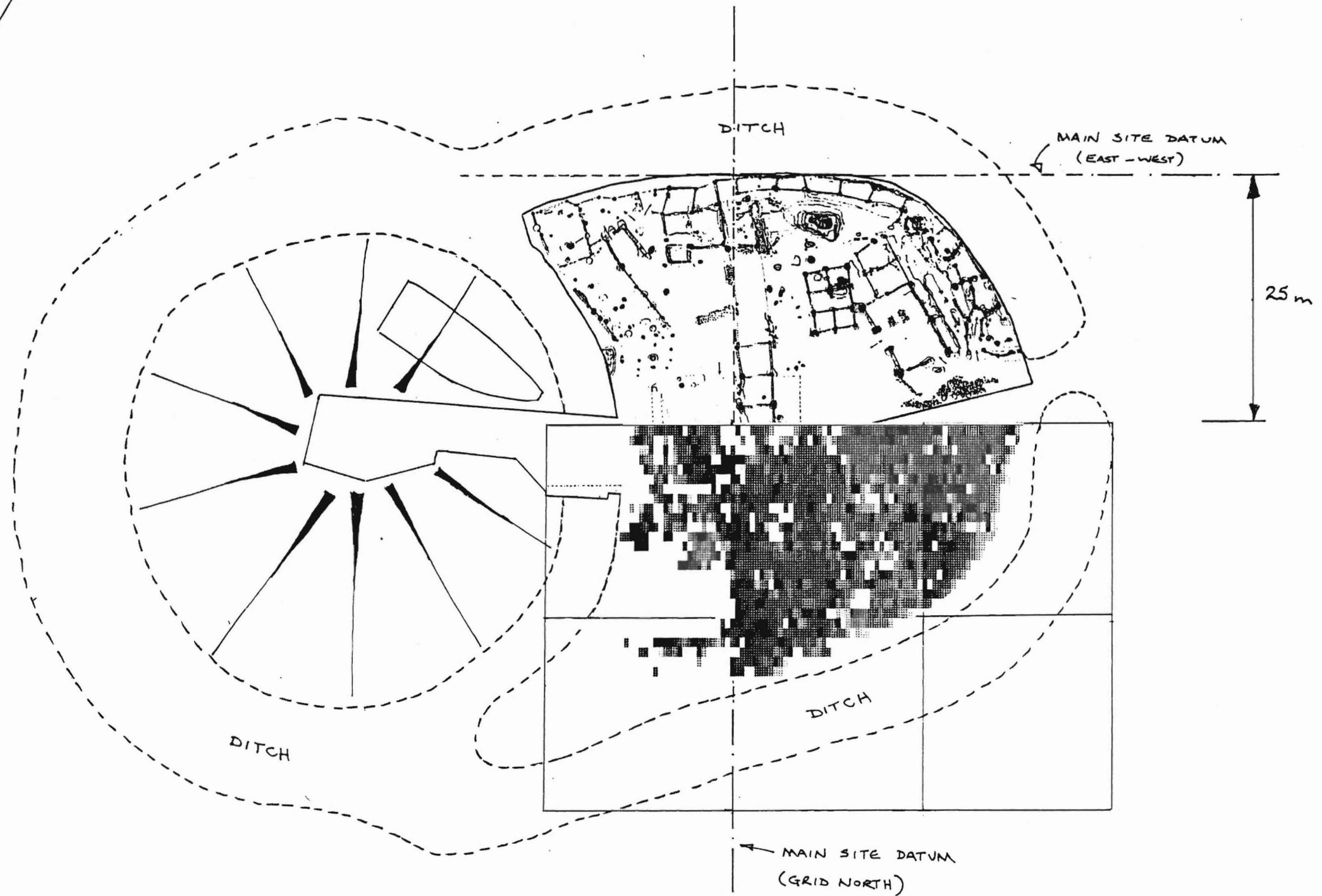
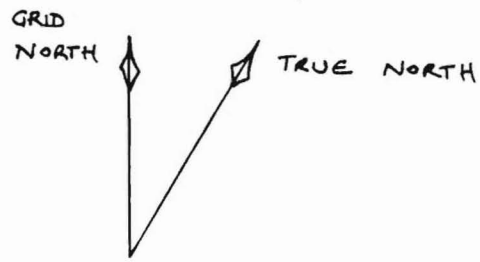
SCALE: 1:500

SUBJECT: Geophysical Survey - Hen Domen, Powys
 Site plan showing grey scale plot of magnetometer data

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Plotting parameters
 Minimum -10nT (white)
 Maximum +10nT (black)

DATE: March & August 1991

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FIGURE: 5

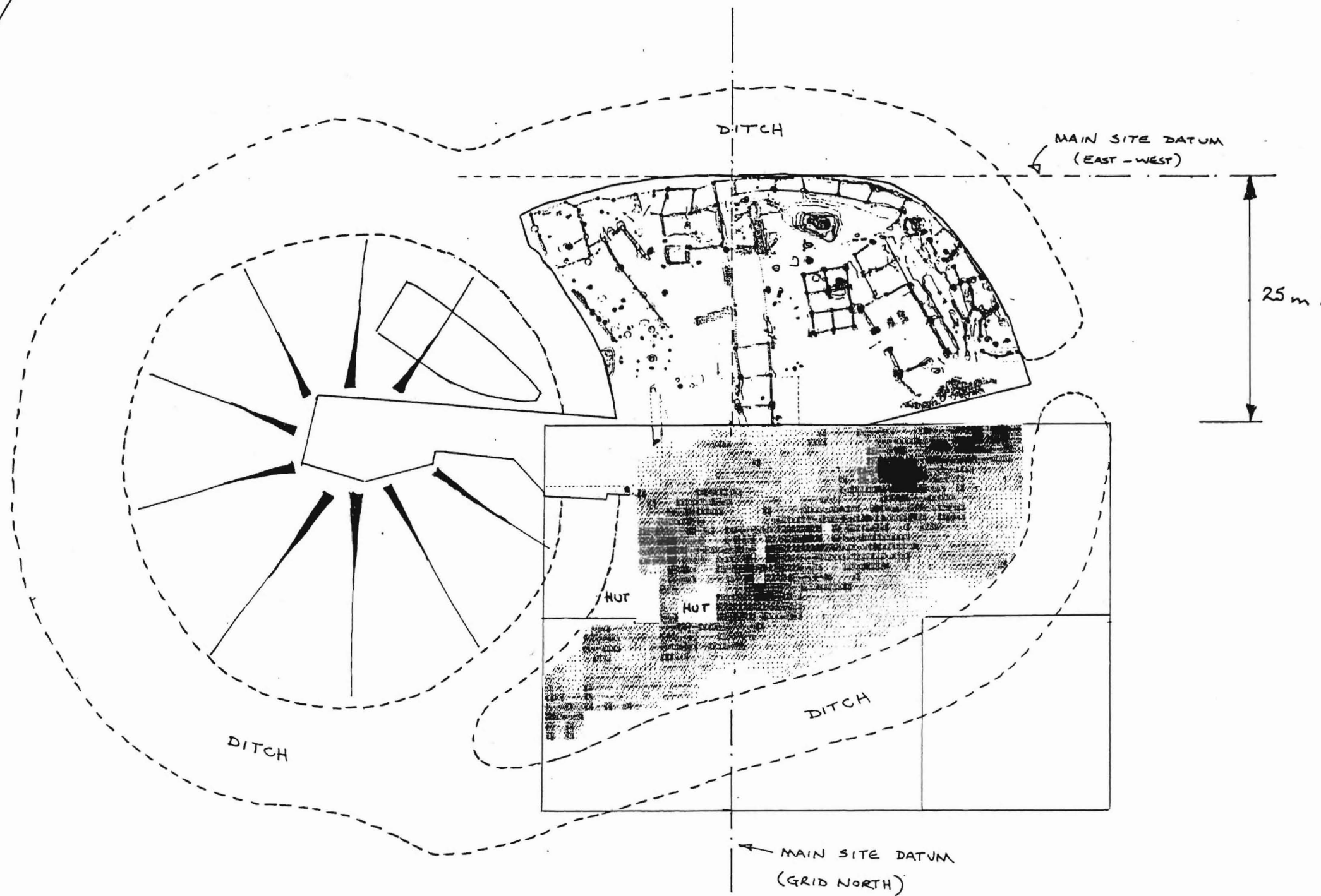
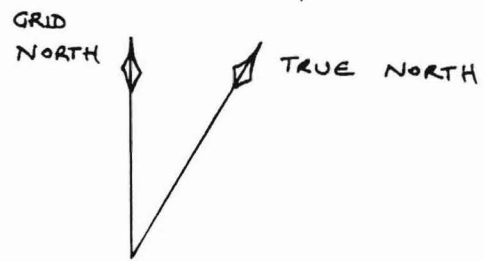
SCALE: 1:500

SUBJECT: Geophysical Survey - Hen Domen, Powys
 Site plan showing grey scale plot of processed magnetometer data

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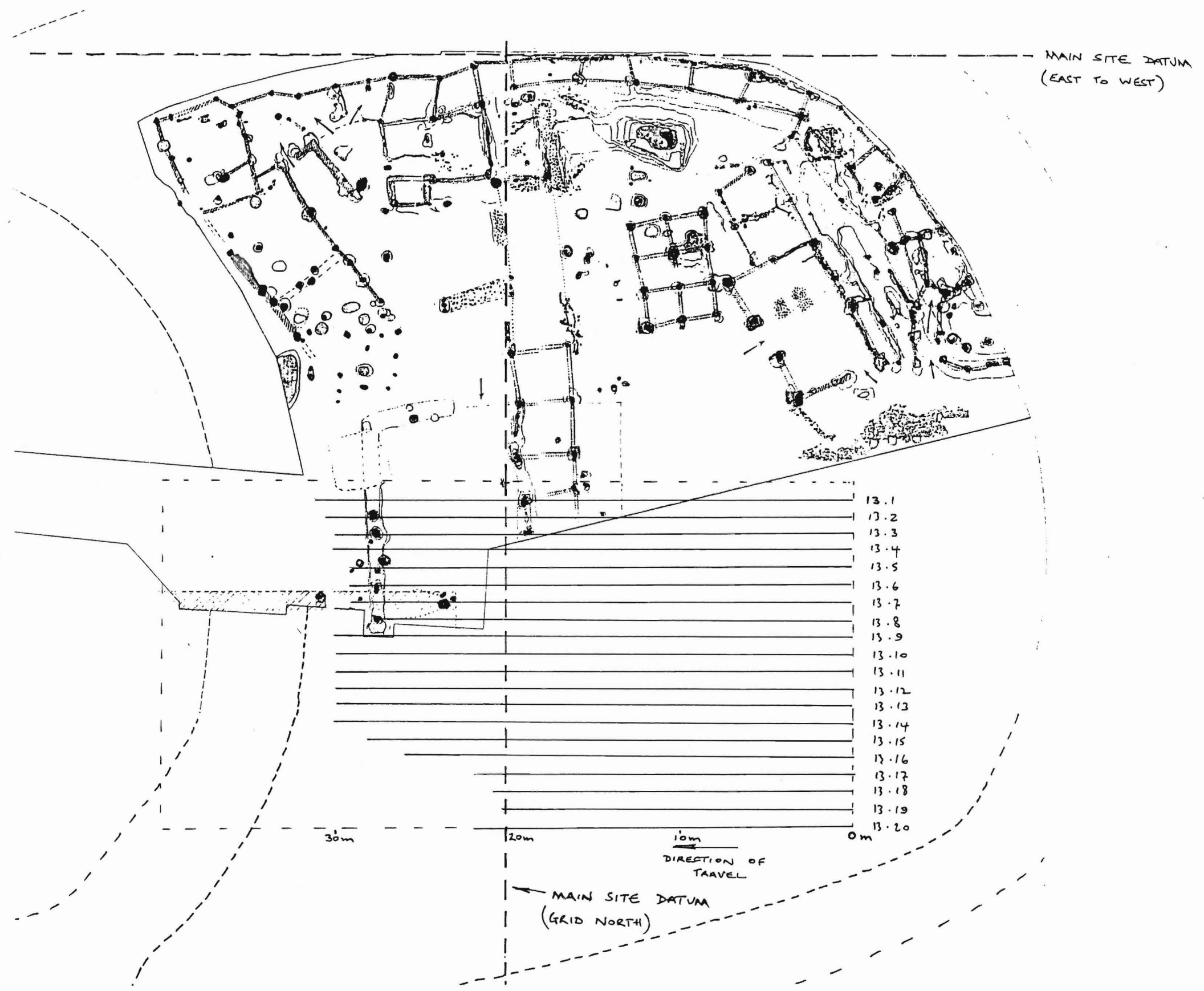
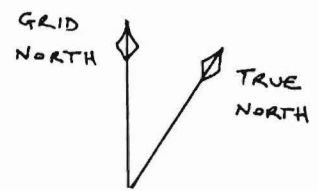
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Plotting parameters
 Minimum 70Ω (black)
 Maximum 125Ω (white)

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SCALE: 1:500	SUBJECT: Geophysical Survey - Hen Domen, Powys Site plan showing grey scale plot of resistivity data		



DATE: March 1991

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FIGURE: 7

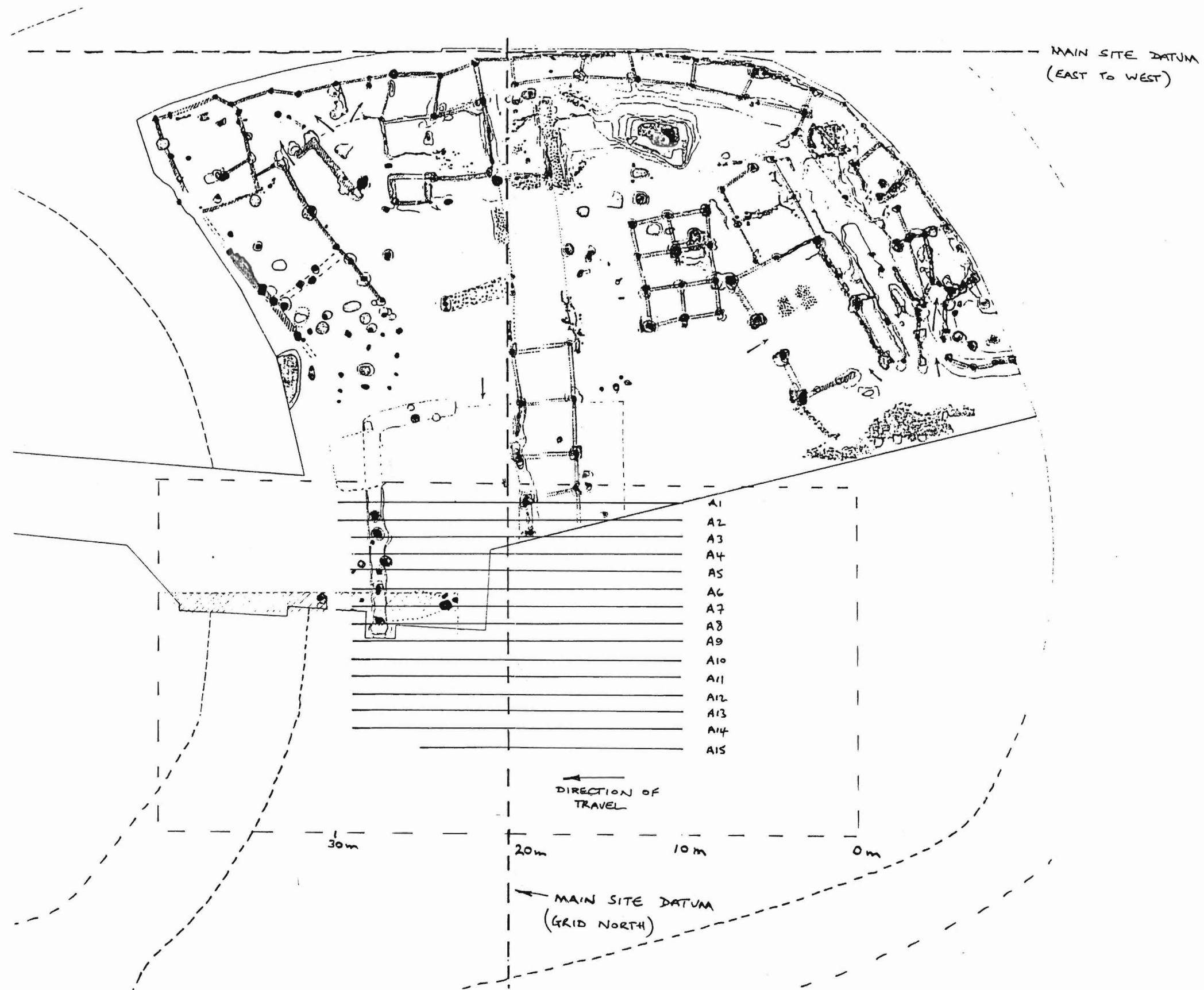
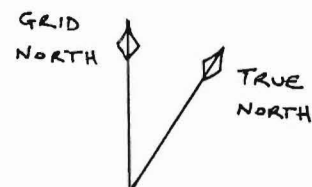
SCALE: 1:250

SUBJECT: Geophysical Survey - Hen Domen Powys
Site plan showing position of radar traverses carried out on 3rd March 1991

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DATE: August 1991

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FIGURE: 8

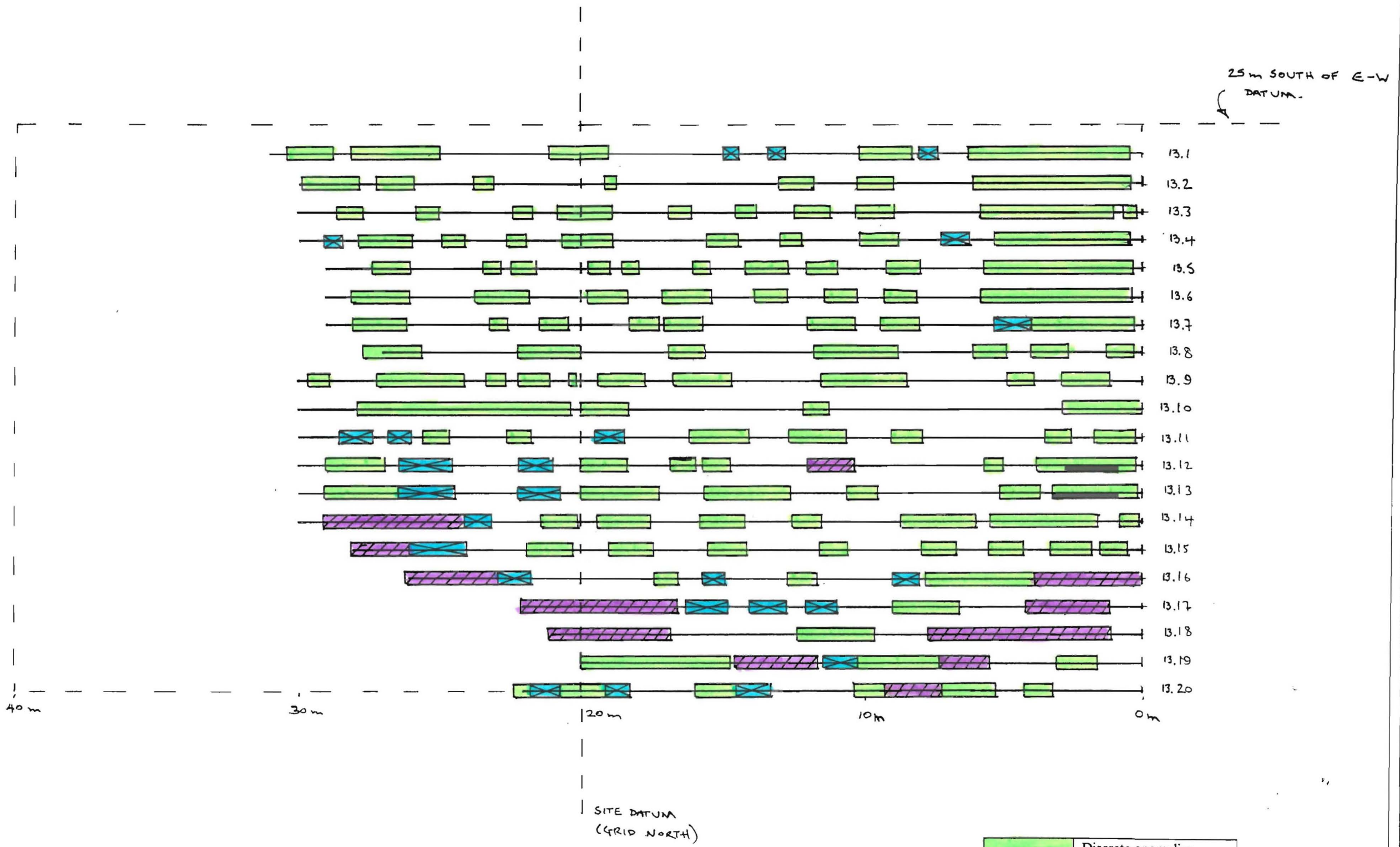
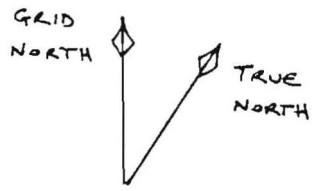
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SUBJECT: Geophysical Survey - Hen Domen Powys
Site plan showing position of radar traverses carried out on 12th August 1991

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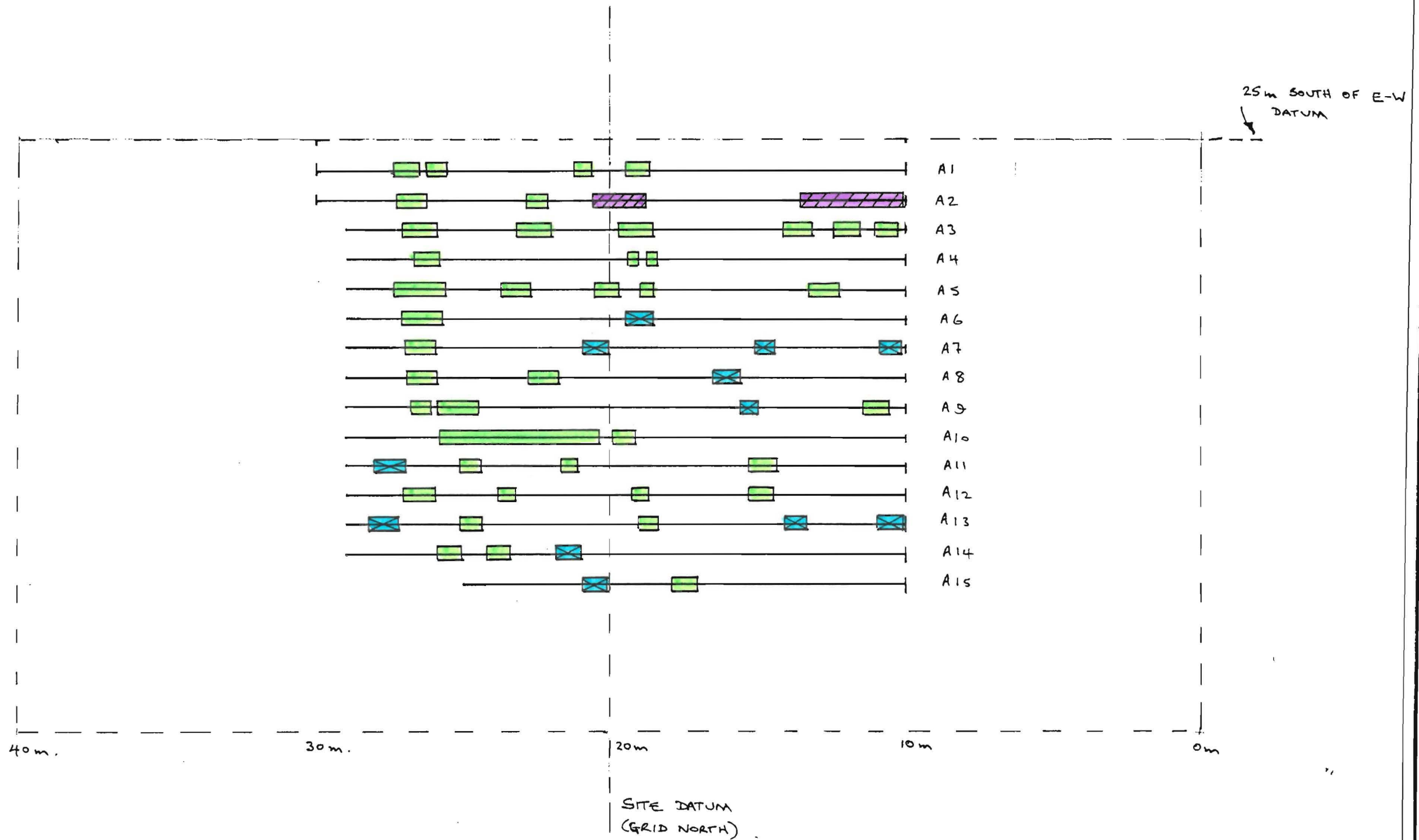
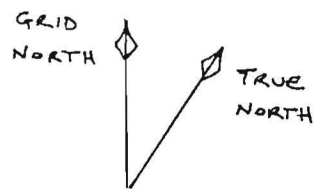
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	Discrete anomalies
	Point diffraction
	Planar reflection

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SCALE: 1:150	SUBJECT: Geophysical Survey - Hen Domen Powys Abstraction of anomalies for the radar survey carried out on 3 rd March 1991			



	Discrete anomalies
	Point diffraction
	Planar reflection

DATE: August 1991

CLIENT: THE HEN DOMEN ARCHAEOLOGICAL PROJECT

FIGURE: 10

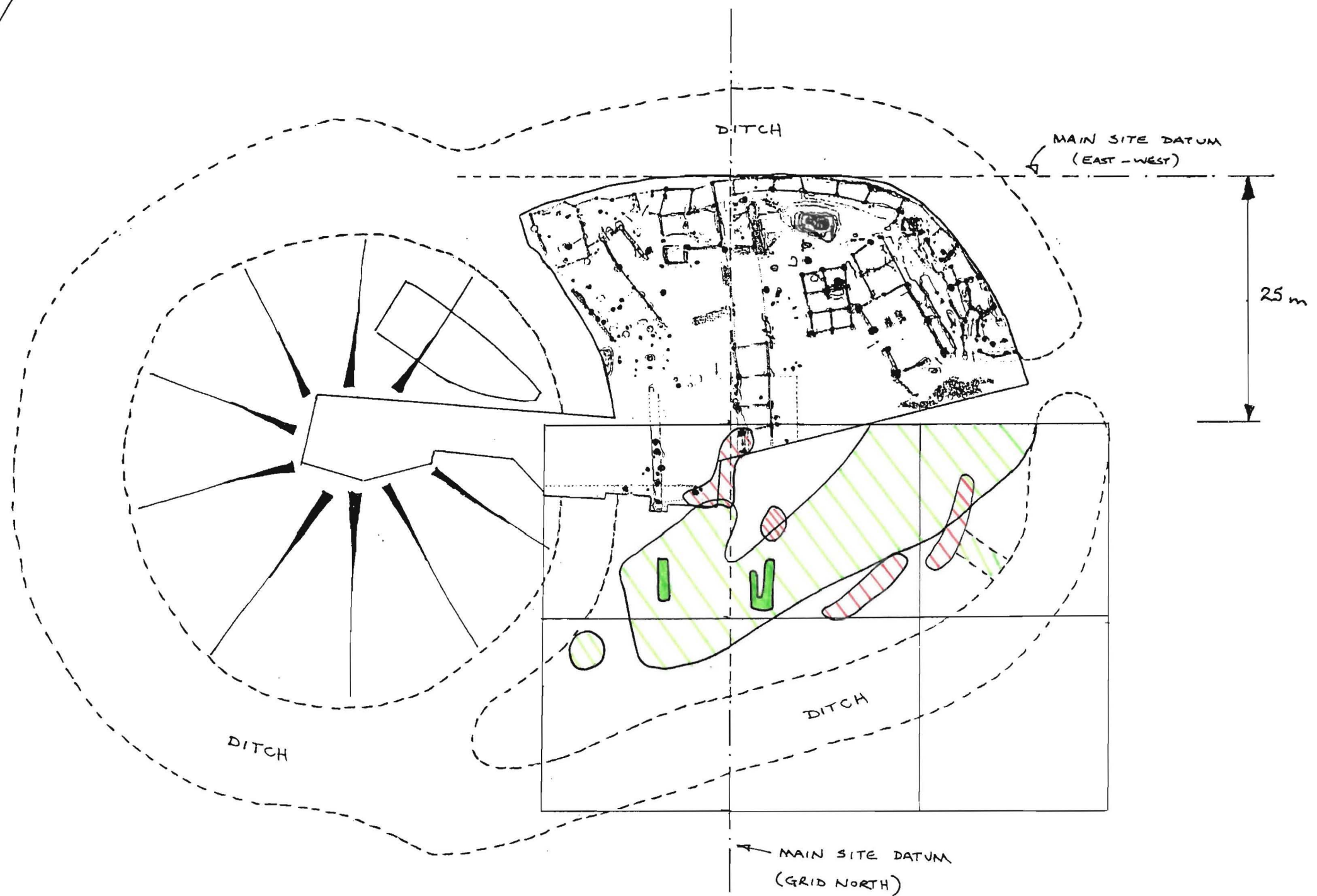
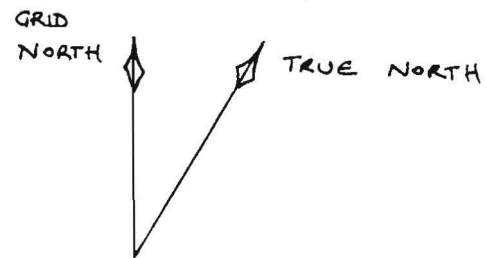
SCALE: 1:150

SUBJECT: Geophysical Survey - Hen Domen Powys
Abstraction of anomalies for the radar survey carried out on 12th August 1991

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	Stronger magnetic anomalies
	Area of deposits
	Discrete low resistance anomaly ?timber slot

DATE: March & August 1991

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FIGURE: 11

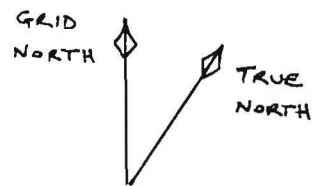
SCALE: 1:500

SUBJECT: Geophysical Survey - Hen Domen, Powys
Abstraction of magnetic and resistance anomalies

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FIGURE: 12

SCALE: 1:250

SUBJECT: Geophysical Survey - Hen Domen, Powys
Abstraction of radar anomalies

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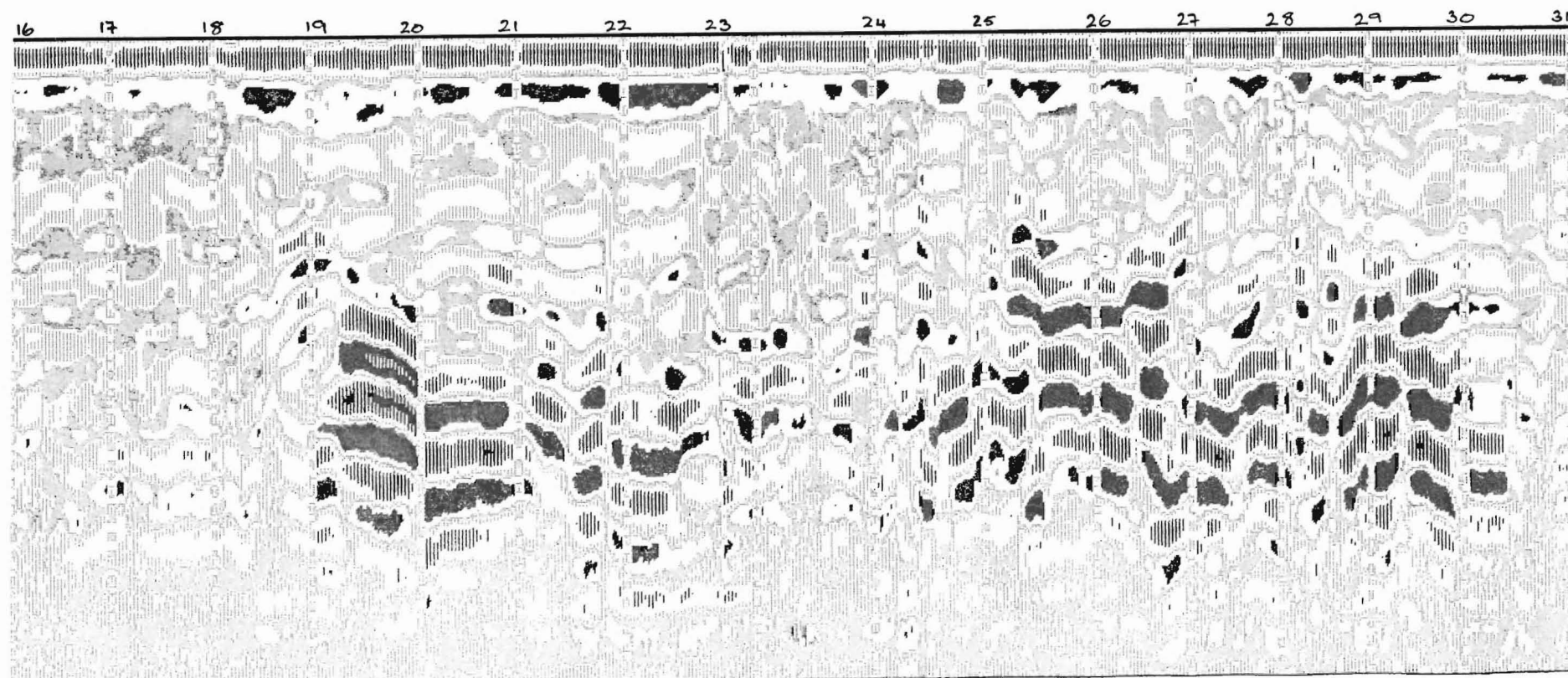
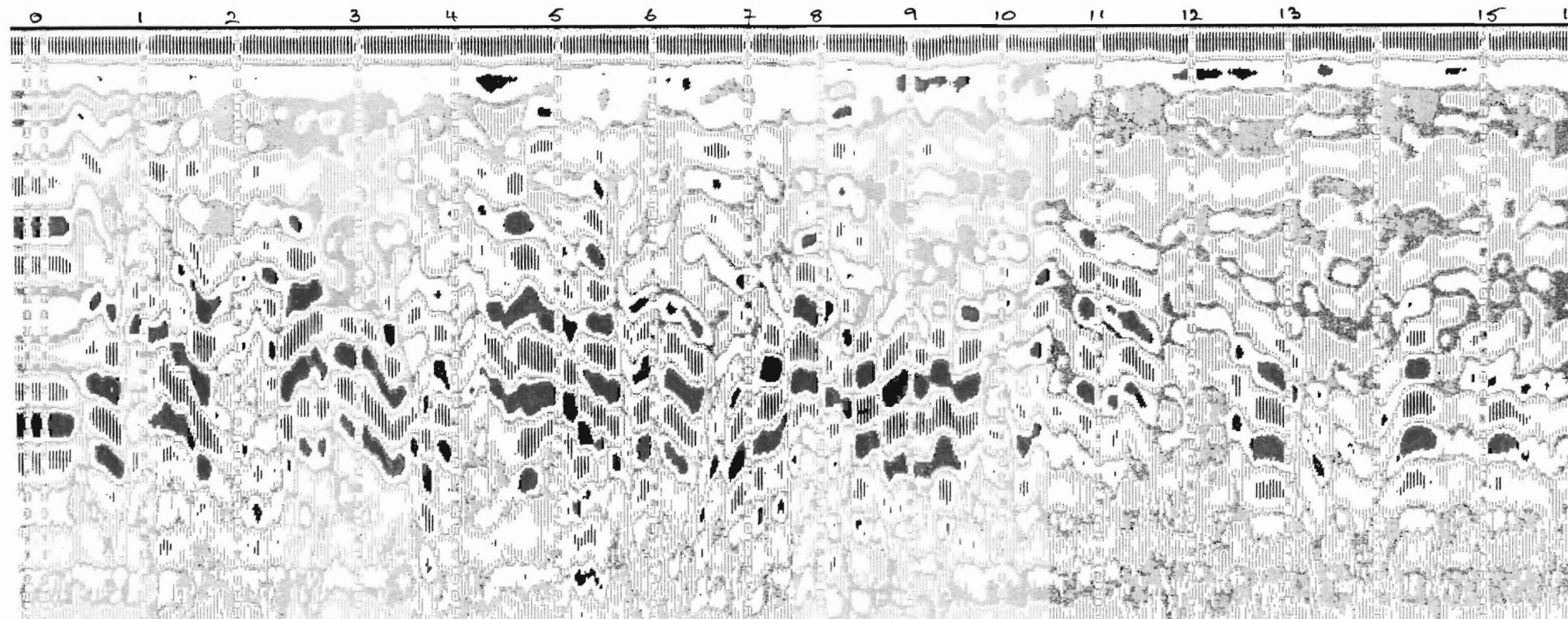
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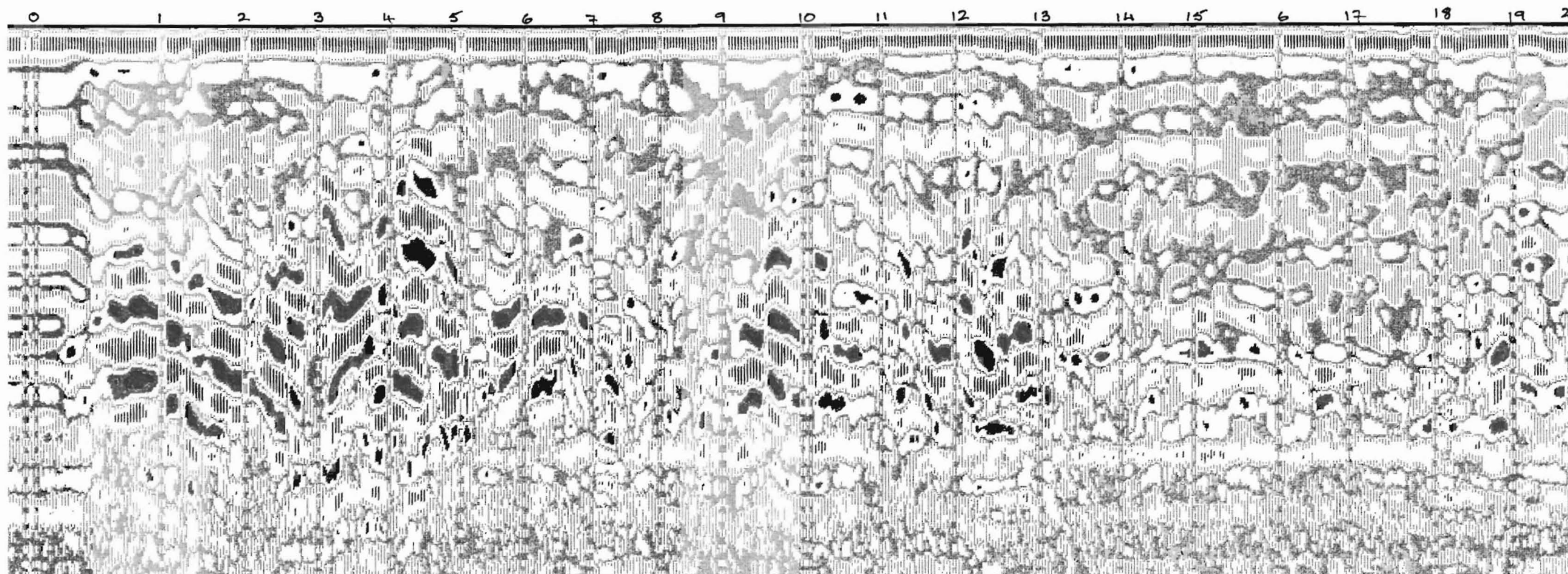
3 March 1991

RADARGRAM OF TRAVERSE 13.1

Antenna 300MHz
Range 50nsec
Marker interval 1m

Max. depth of scan = 2.1m based on a
velocity of 0.1m/nsec





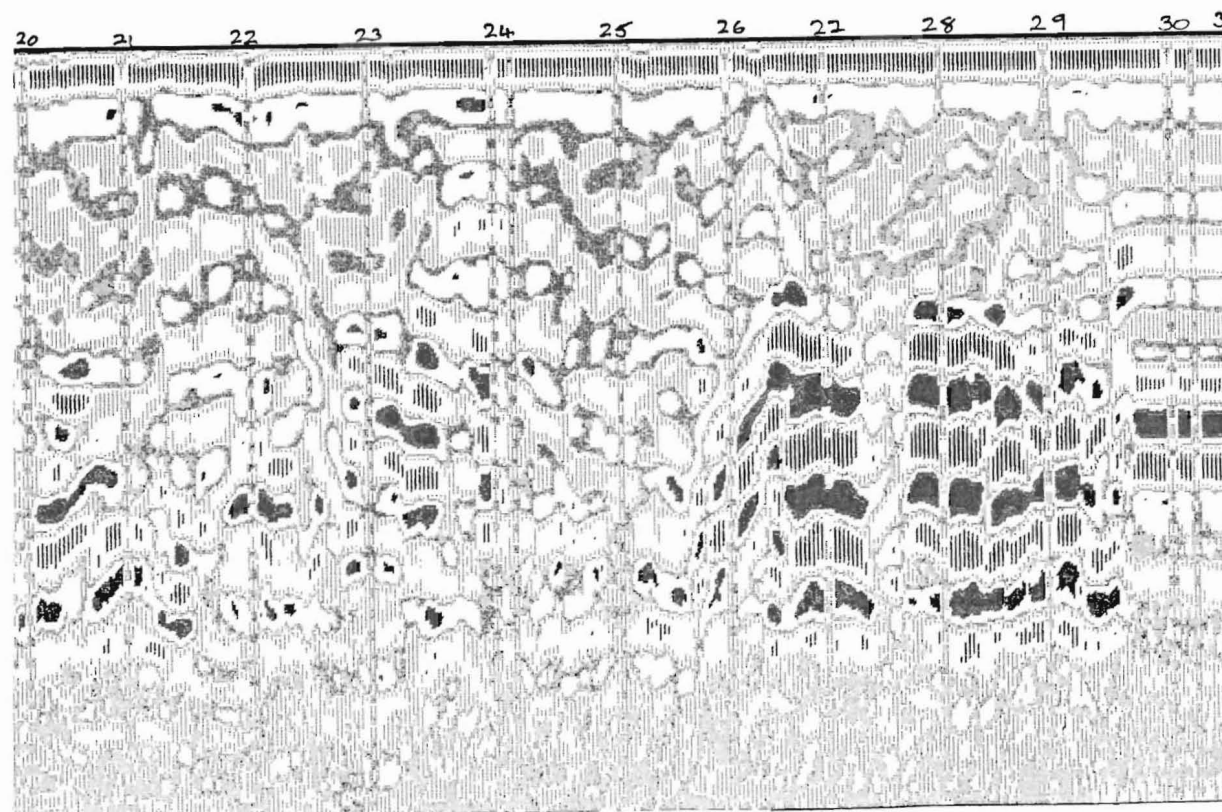
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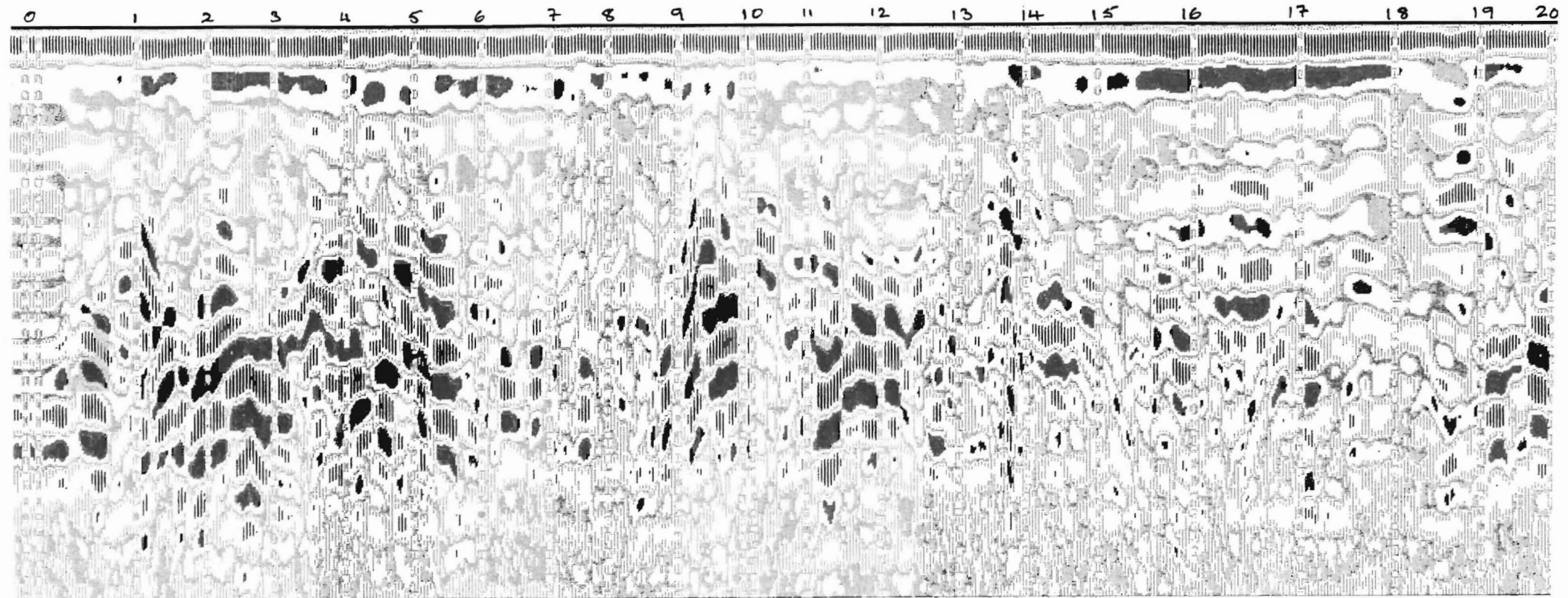
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RADARGRAM OF TRAVERSE 13.2

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 Marker interval 1m

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 velocity of 0.1m/nsec





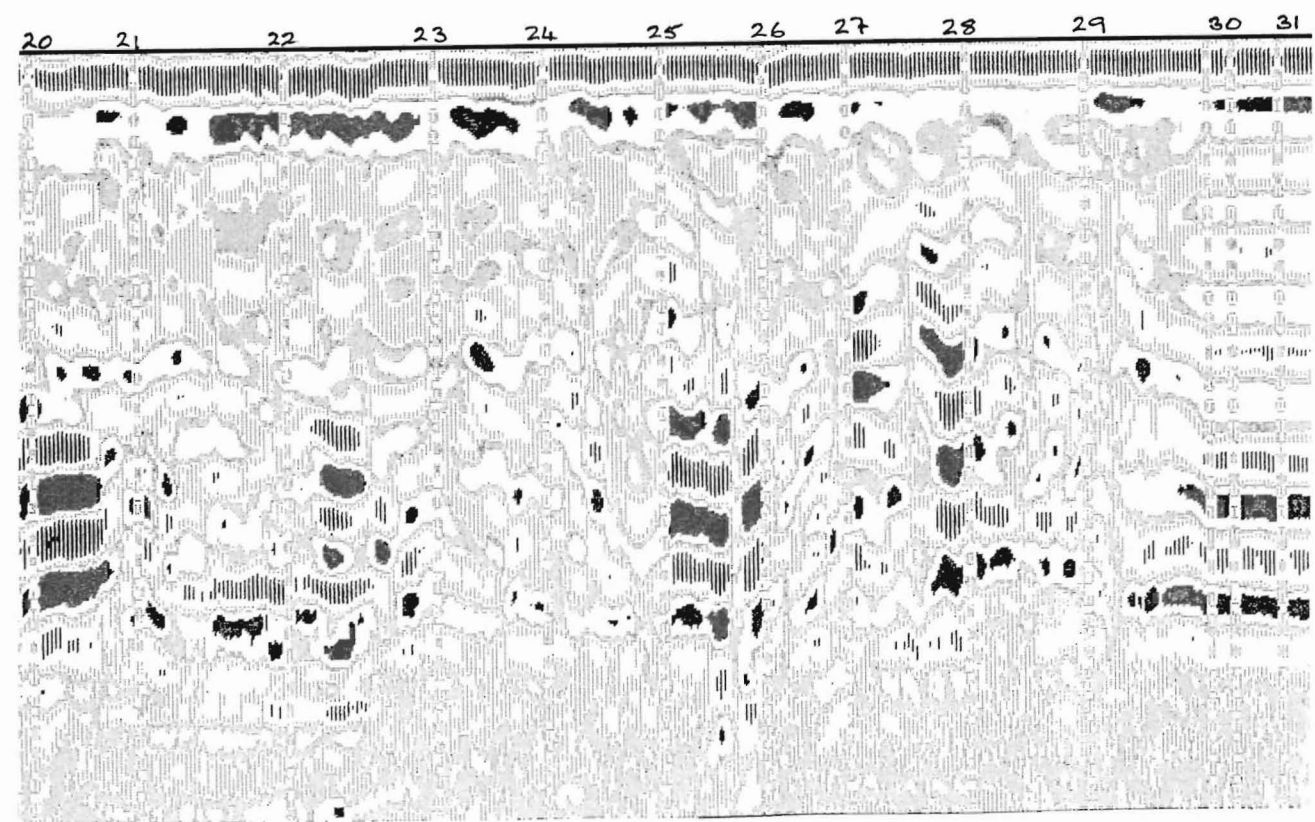
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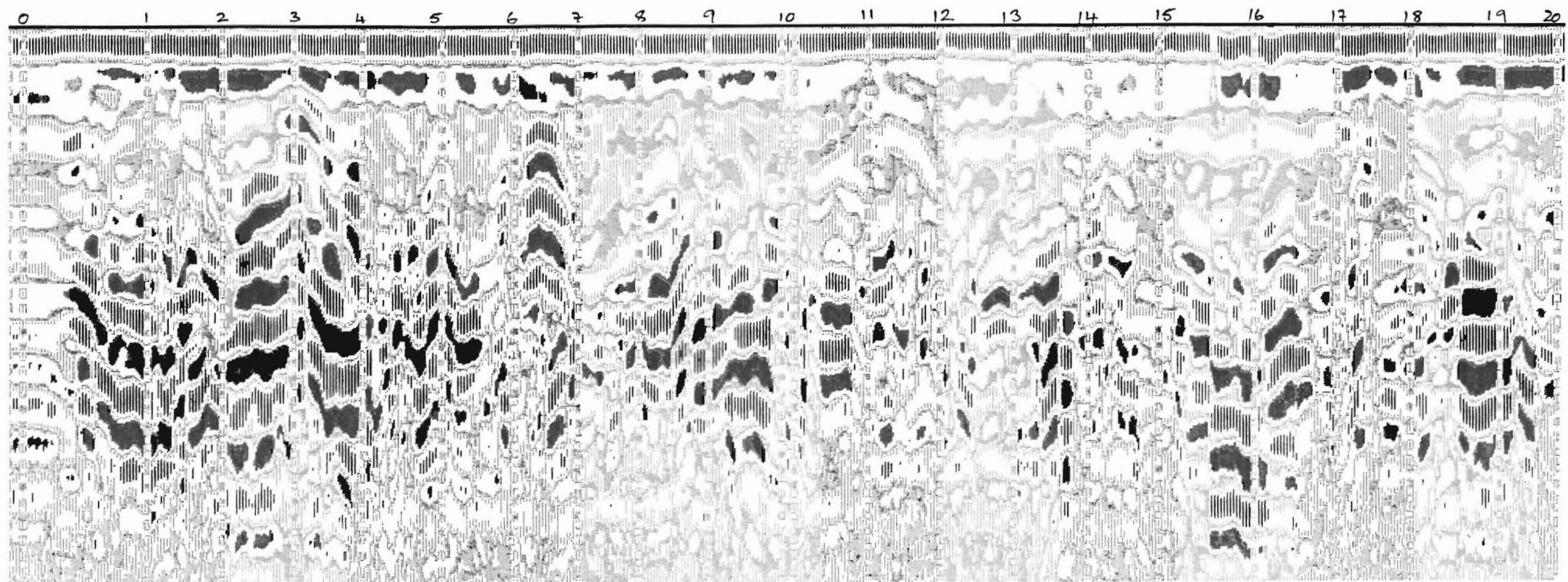
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 Range 50nsec
 Marker interval 1m

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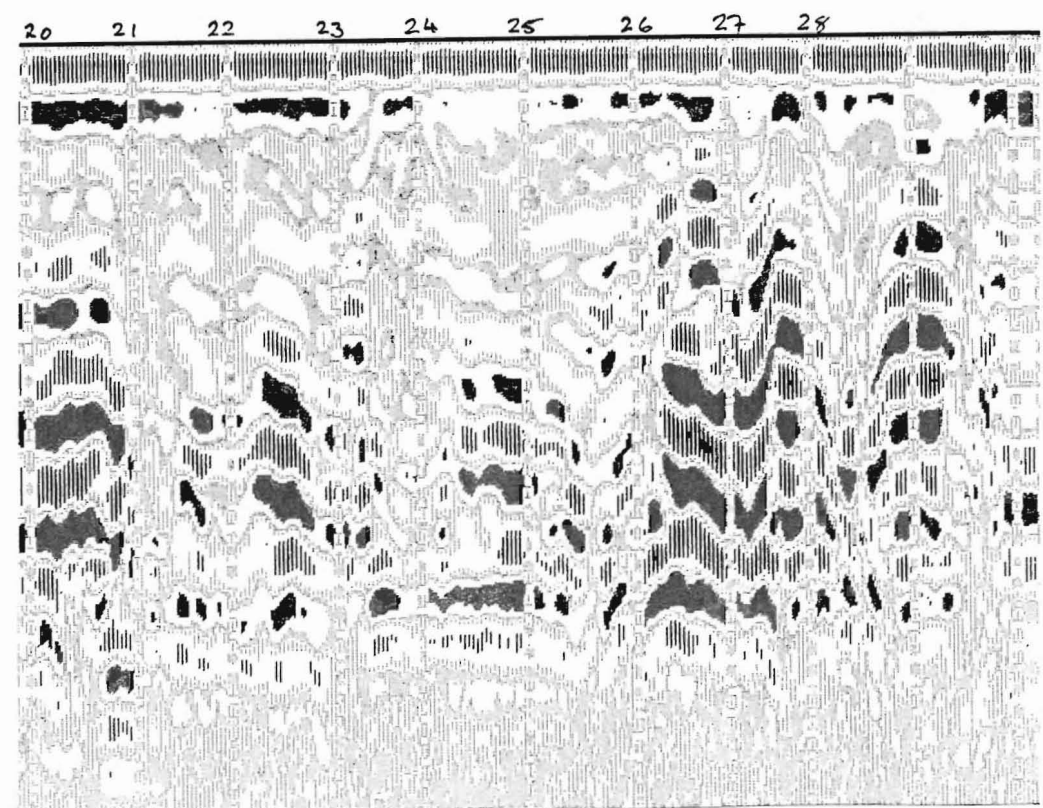
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RADARGRAM OF TRAVERSE 13.4

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Range 50nsec
Marker interval 1m

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velocity of 0.1m/nsec



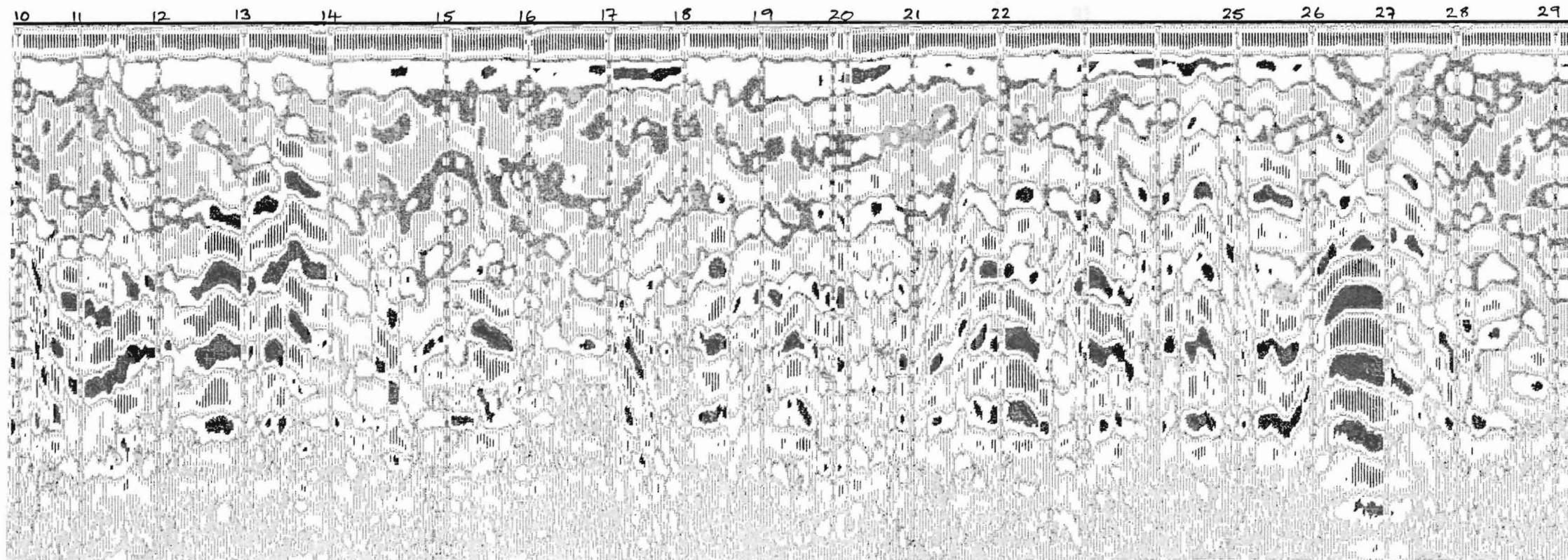
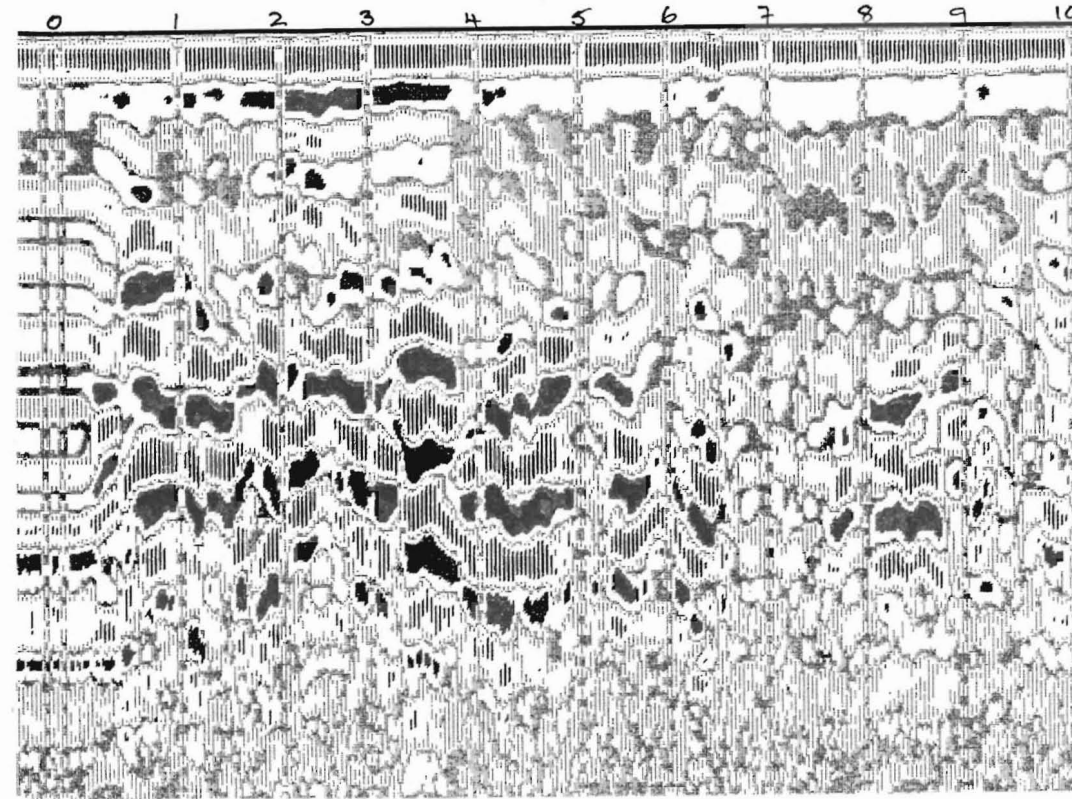
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RADARGRAM OF TRAVERSE 13.5

Antenna 300MHz
Range 50nsec
Marker interval 1m

Max. depth of scan = 2.1m based on a
velocity of 0.1m/nsec



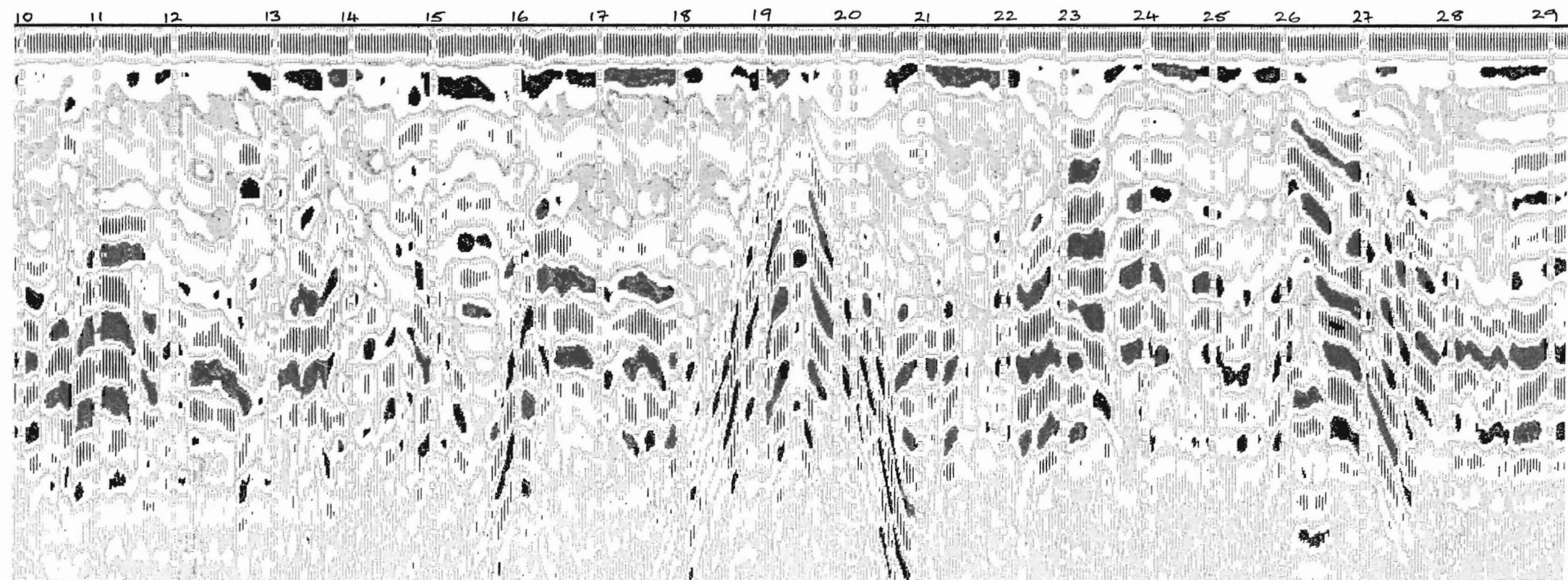
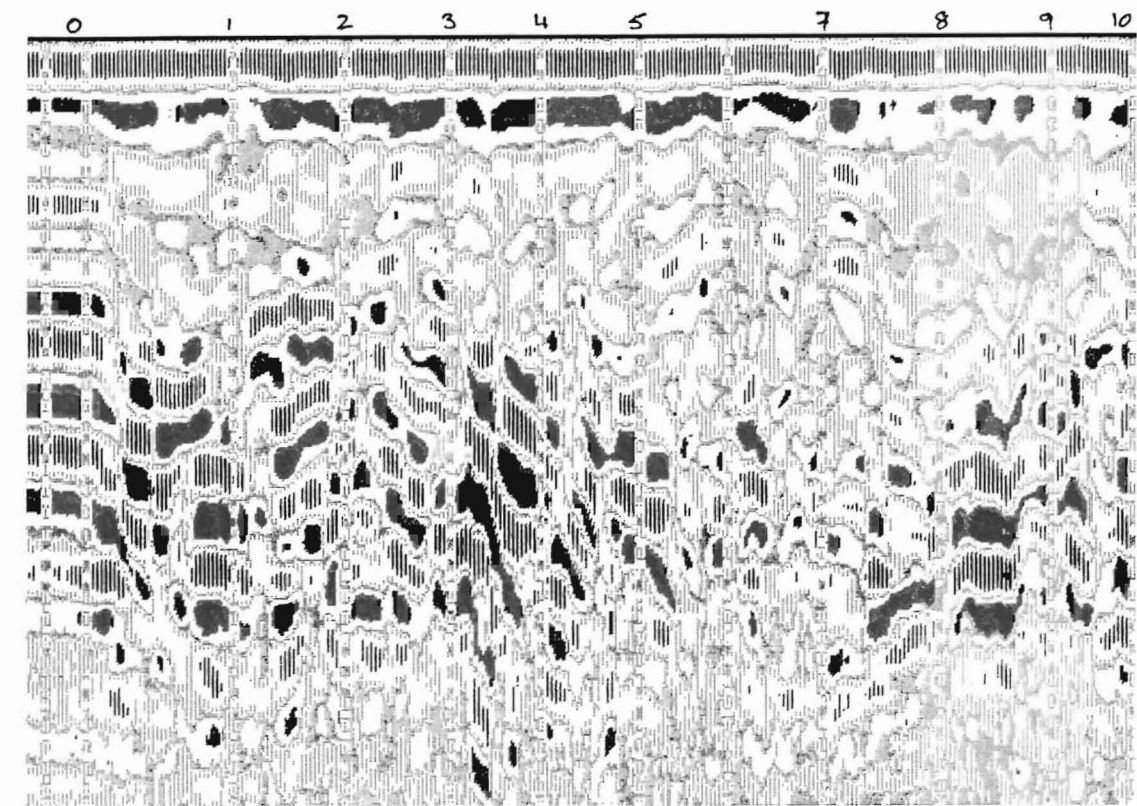
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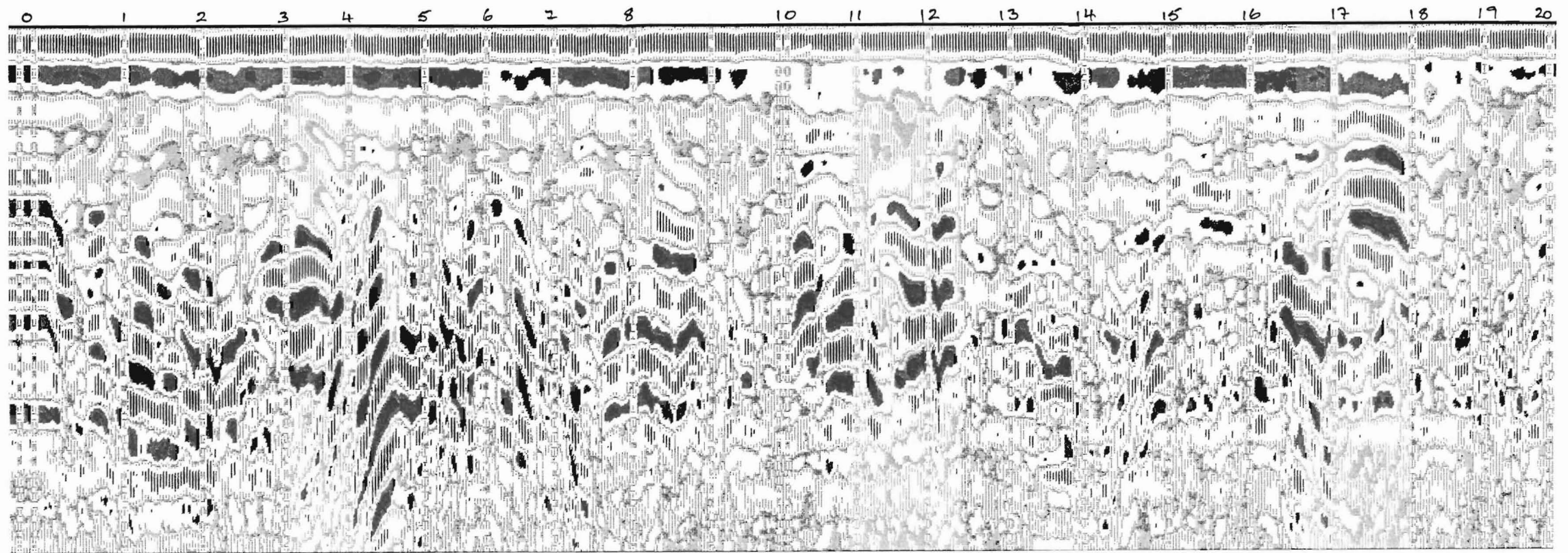
3 March 1991

RADARGRAM OF TRAVERSE 13.6

Antenna 300MHz
Range 50nsec
Marker interval 1m

Max. depth of scan = 2.1m based on a
velocity of 0.1m/nsec





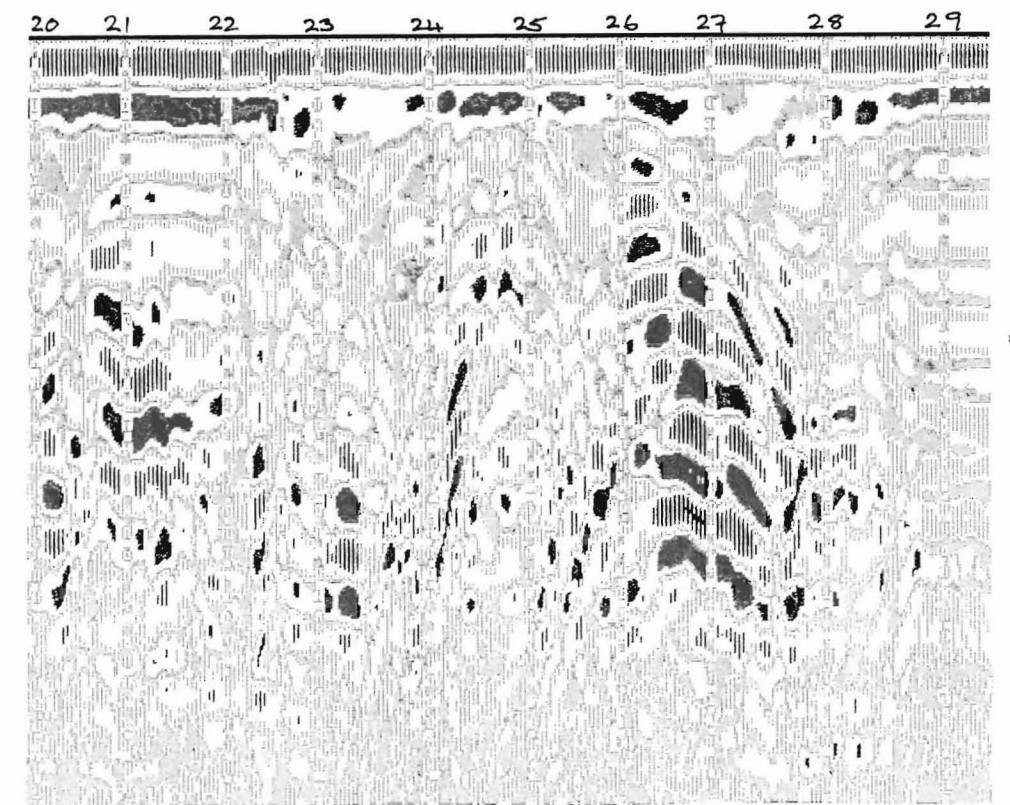
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RADARGRAM OF TRAVERSE 13.7

Antenna 300MHz
 Range 50nsec
 Marker interval 1m

Max. depth of scan = 2.1m based on a
 velocity of 0.1m/nsec



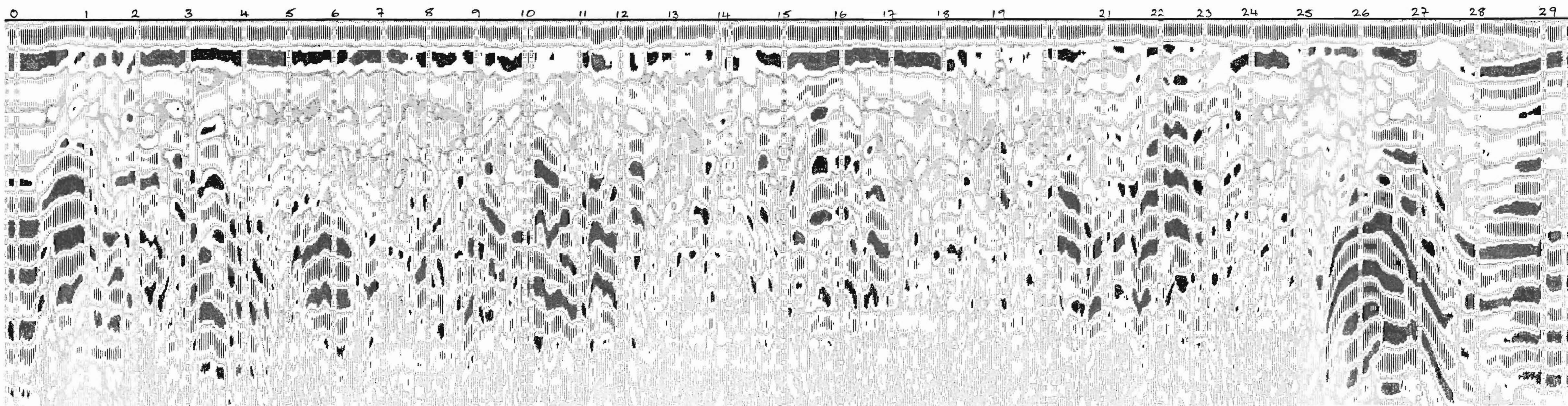
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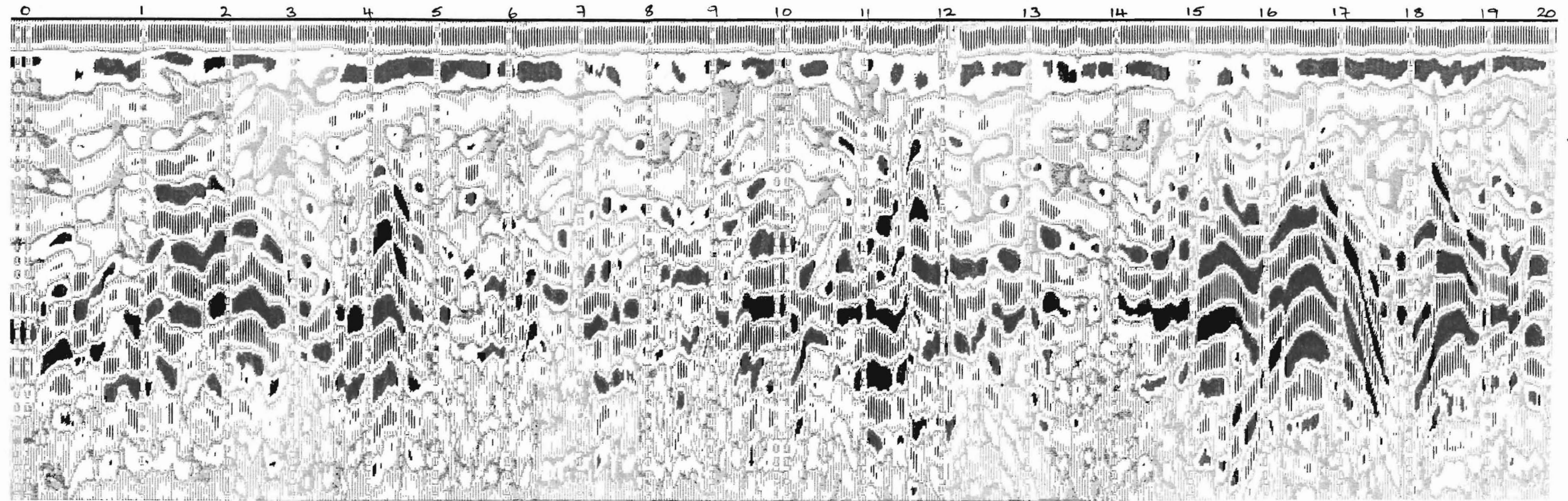
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RADARGRAM OF TRAVERSE 13.8

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Range 50nsec
Marker interval 1m

Max. depth of scan = 2.1m based on a
velocity of 0.1m/nsec





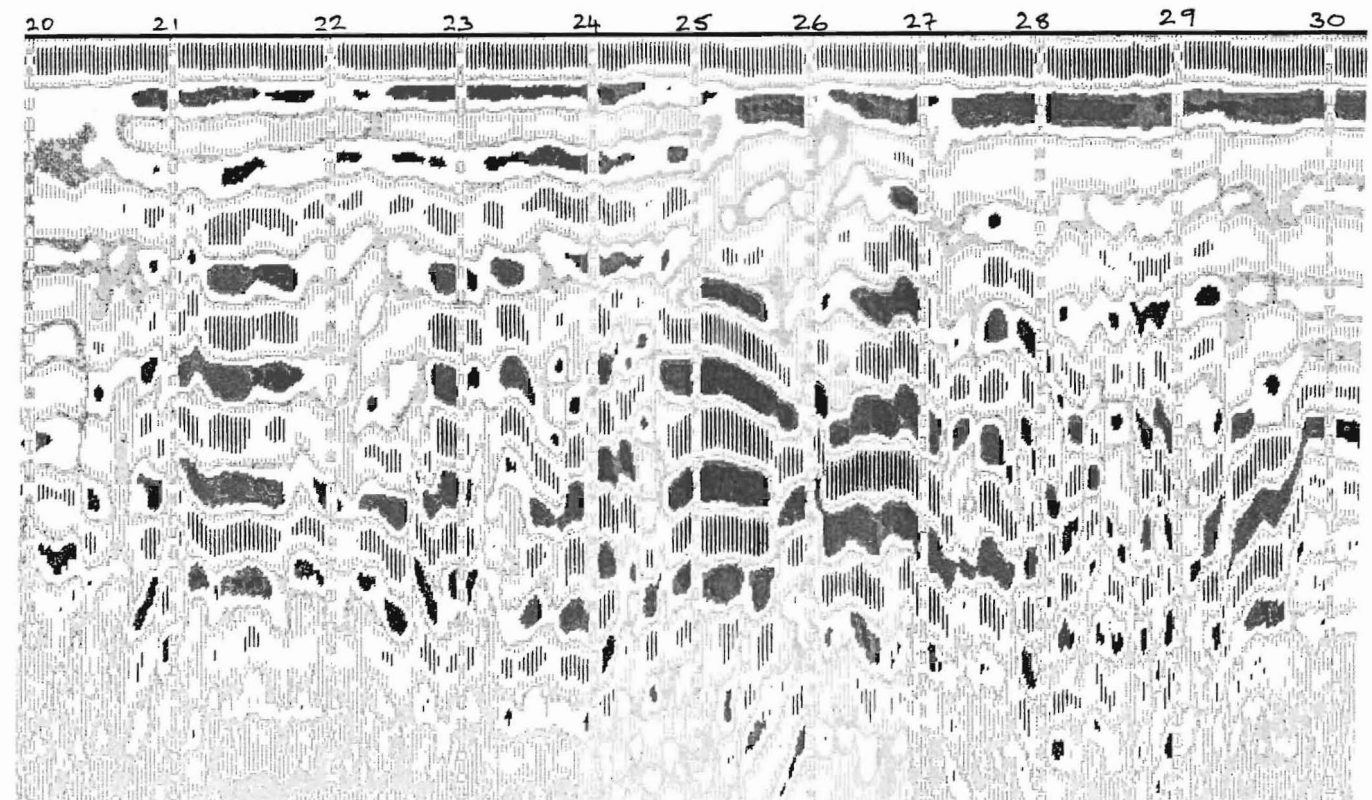
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RADARGRAM OF TRAVERSE 13.9

Antenna 300MHz
 Range 50nsec
 Marker interval 1m

Max. depth of scan = 2.1m based on a
 velocity of 0.1m/nsec



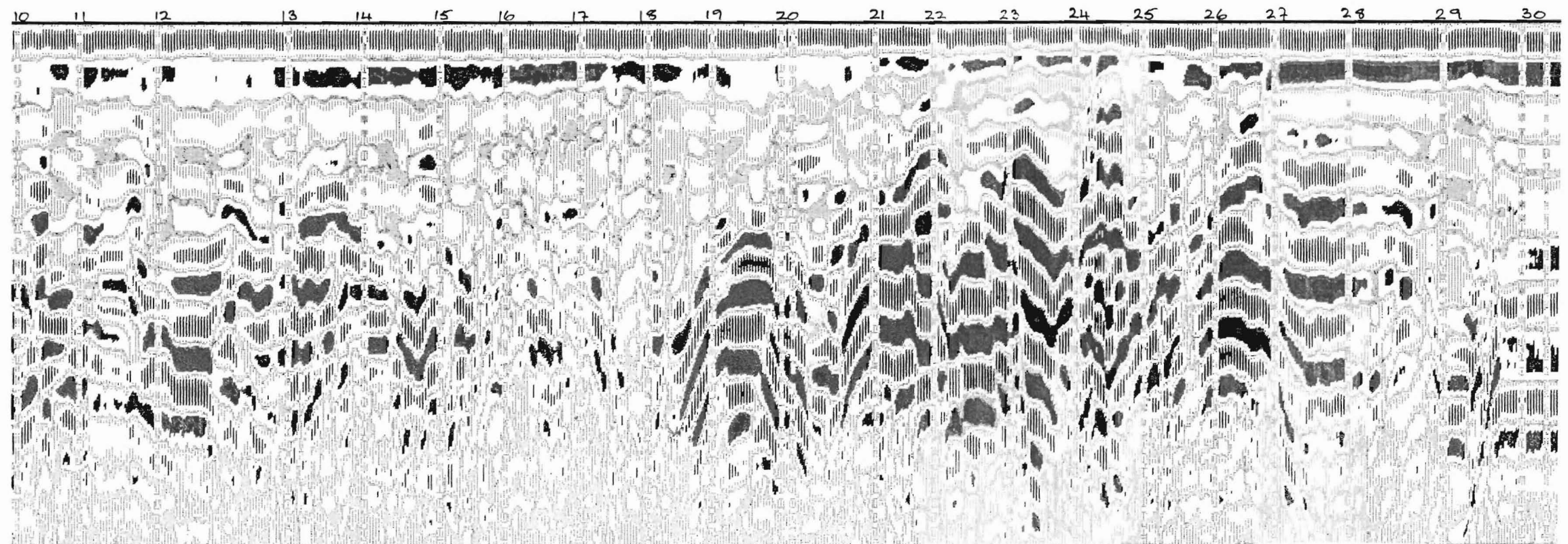
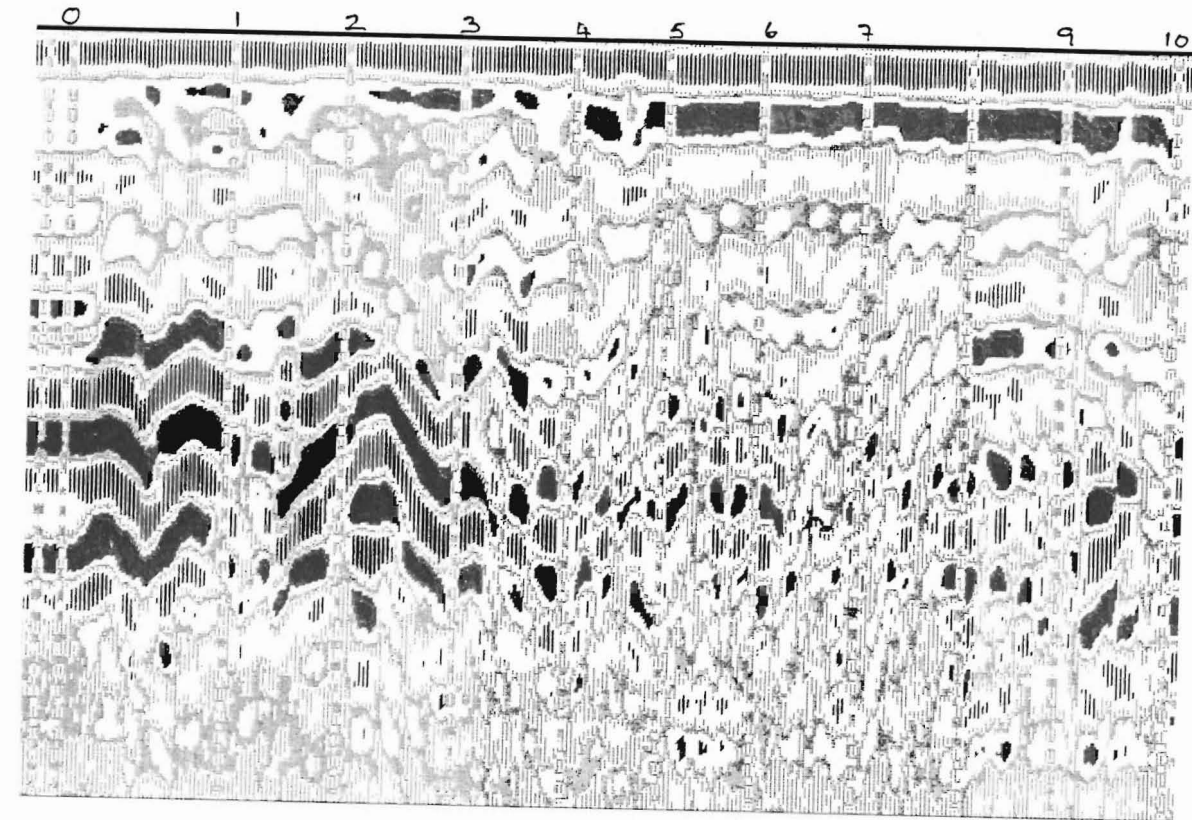
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RADARGRAM OF TRAVERSE 13.10

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Range 50nsec
Marker interval 1m

Max. depth of scan = 2.1m based on a
velocity of 0.1m/nsec



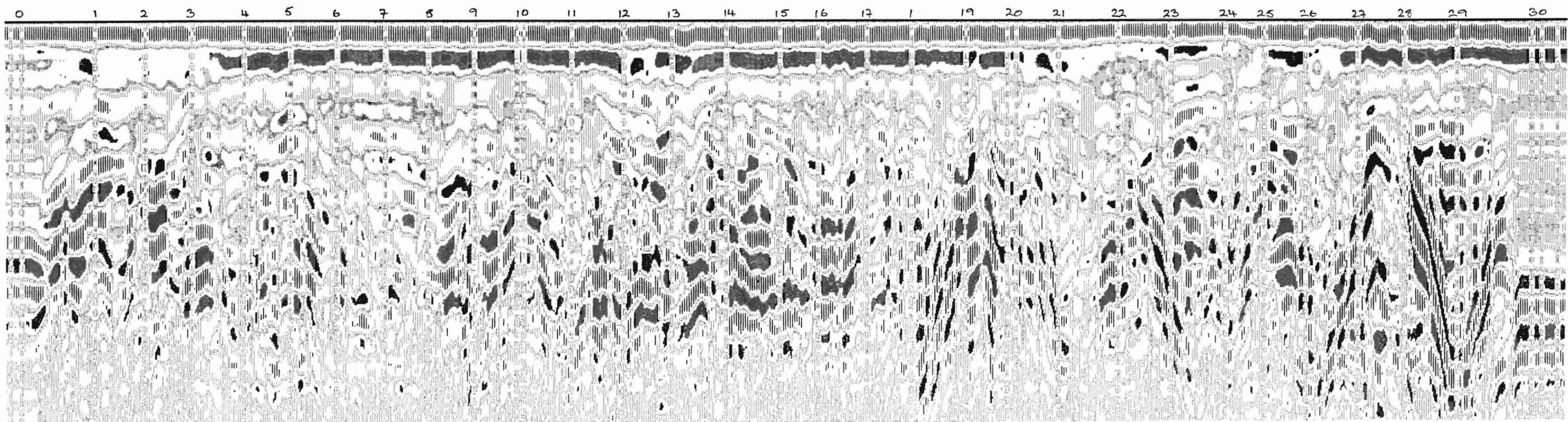
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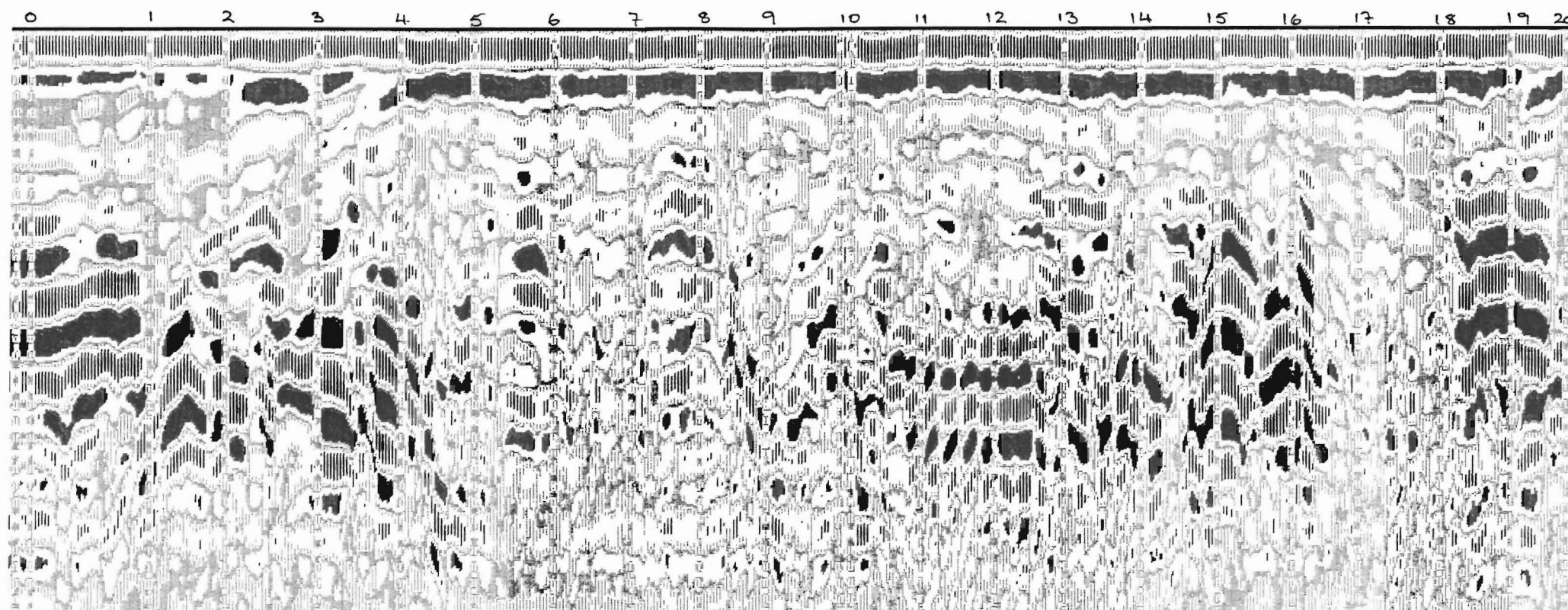
3 March 1991

RADARGRAM OF TRAVERSE 13.11

Antenna 300MHz
Range 50nsec
Marker interval 1m

Max. depth of scan = 2.1m based on a
velocity of 0.1m/nsec





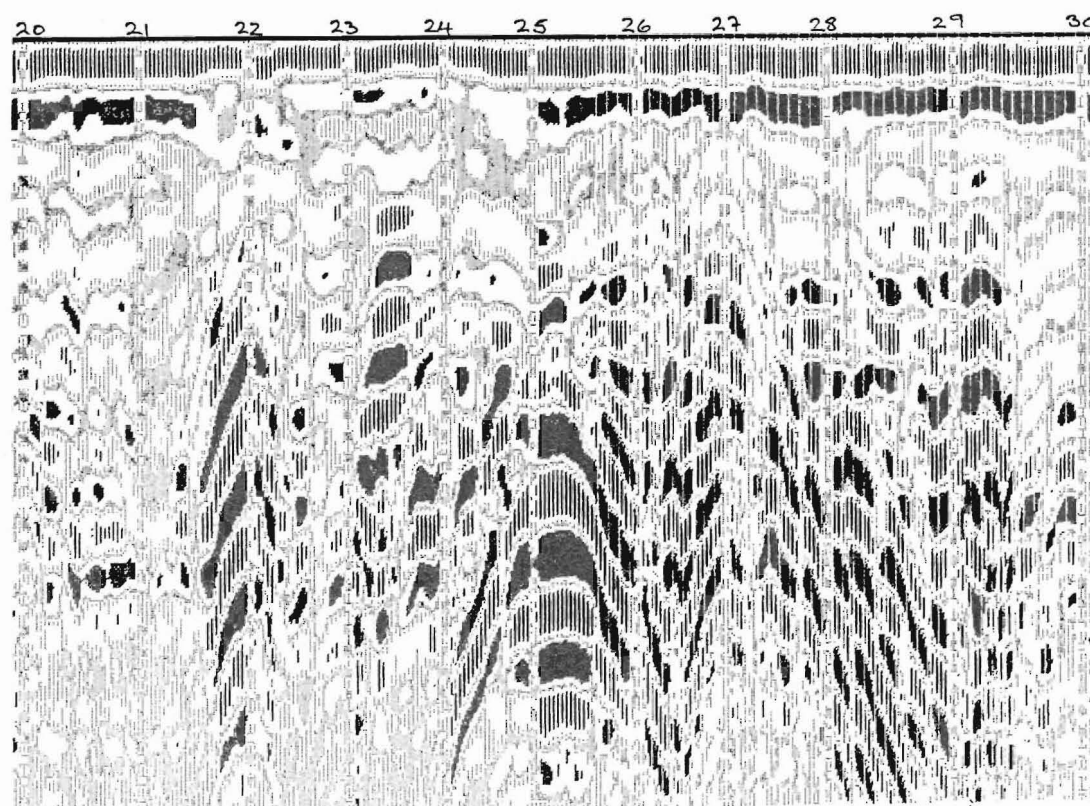
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3 March 1991

RADARGRAM OF TRAVERSE 13.12

Antenna 300MHz
 Range 50nsec
 Marker interval 1m

Max. depth of scan = 2.1m based on a
 velocity of 0.1m/nsec



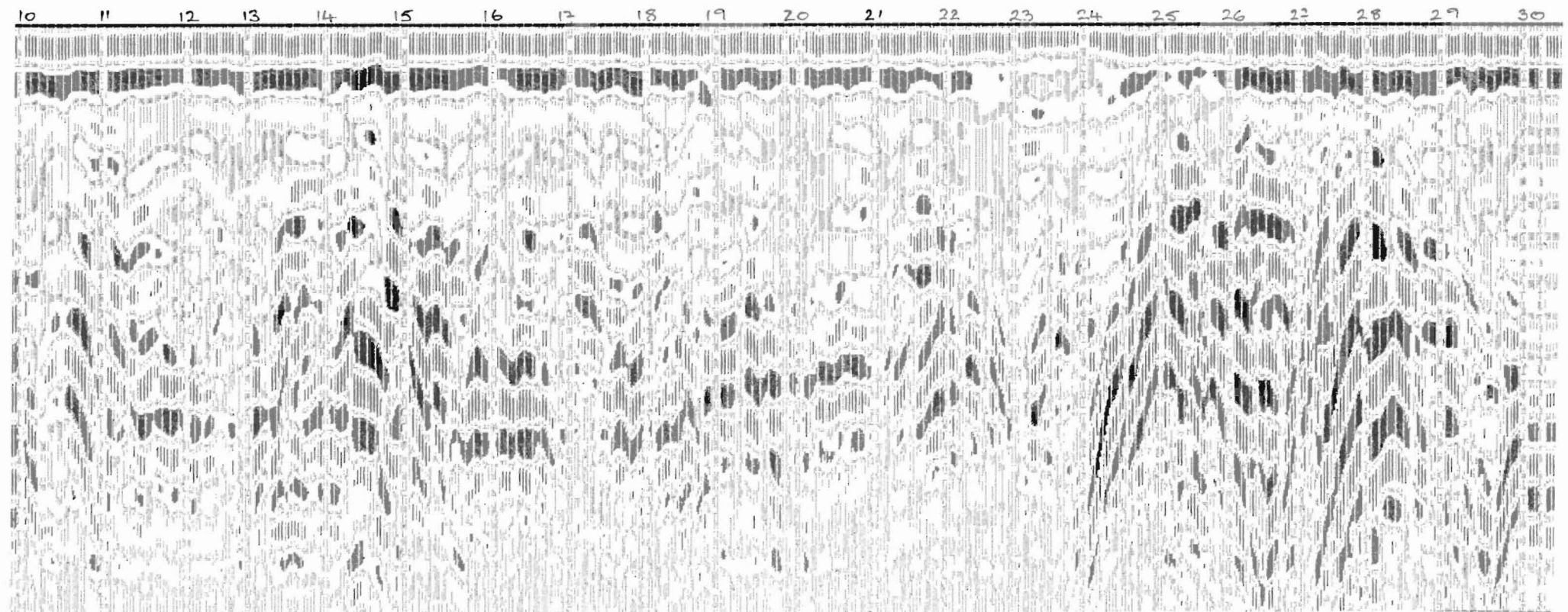
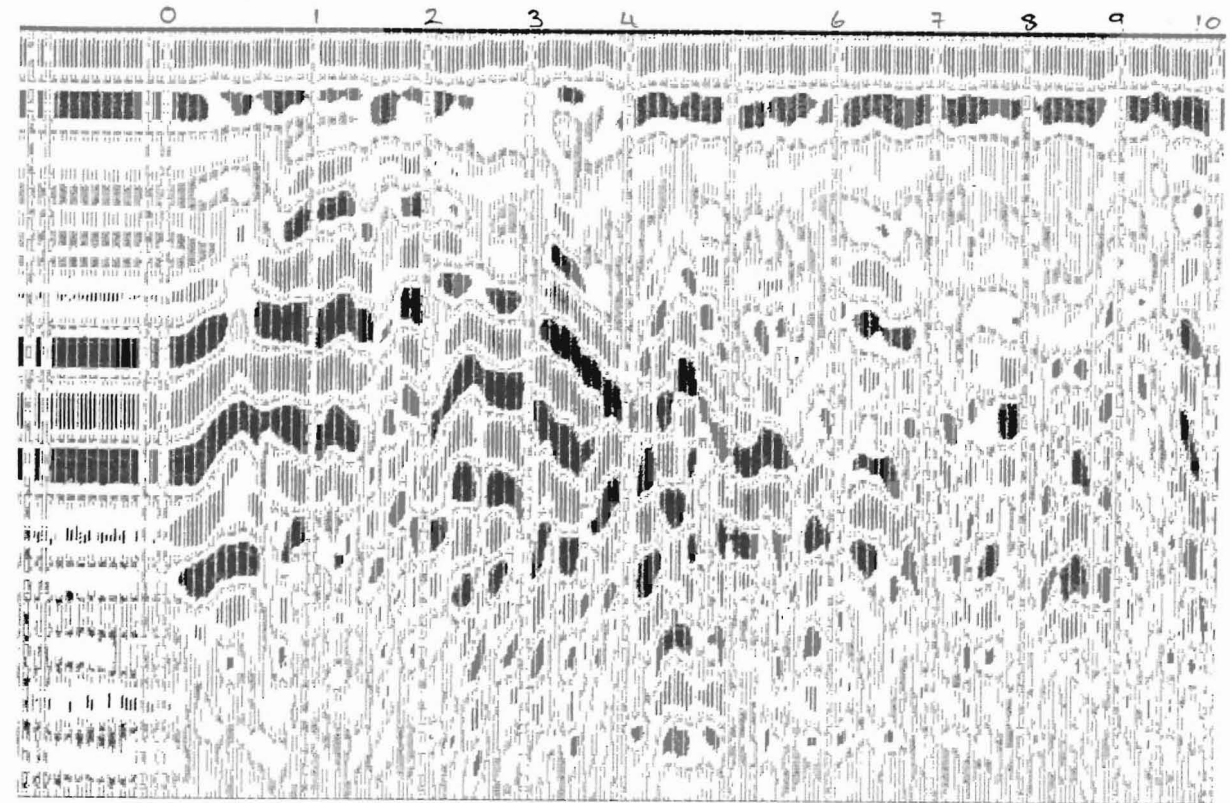
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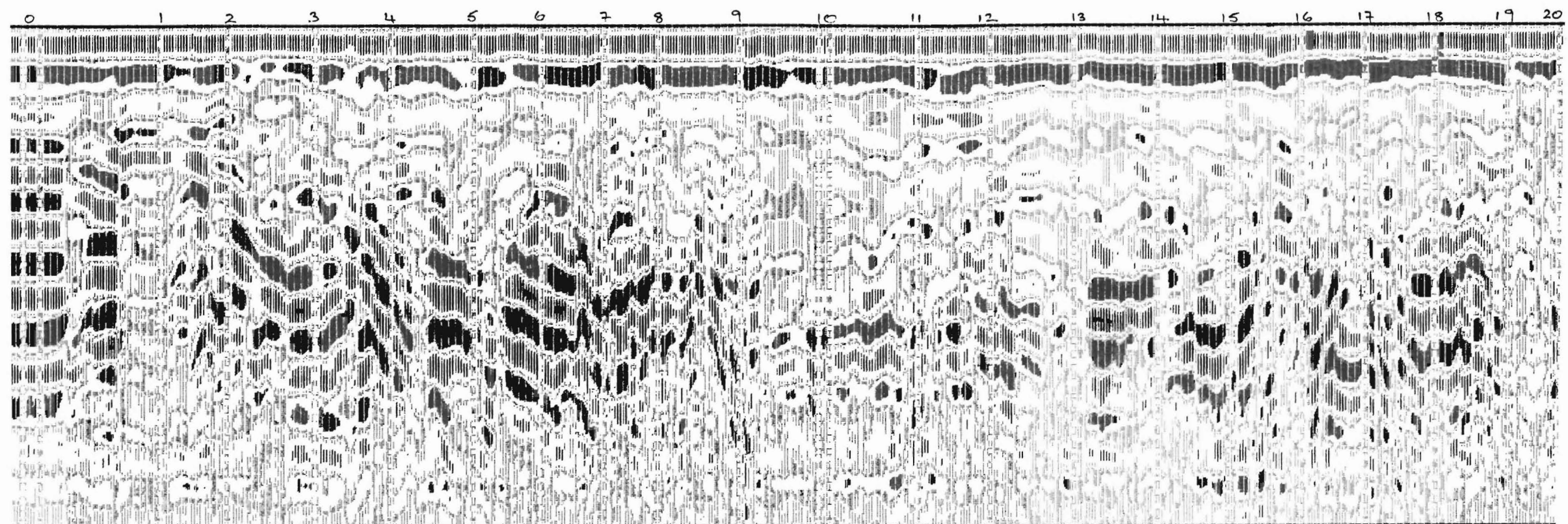
3 March 1991

RADARGRAM OF TRAVERSE 13.13

Antenna 300MHz
Range 50nsec
Marker interval 1m

Max. depth of scan = 2.1m based on a
velocity of 0.1m/nsec





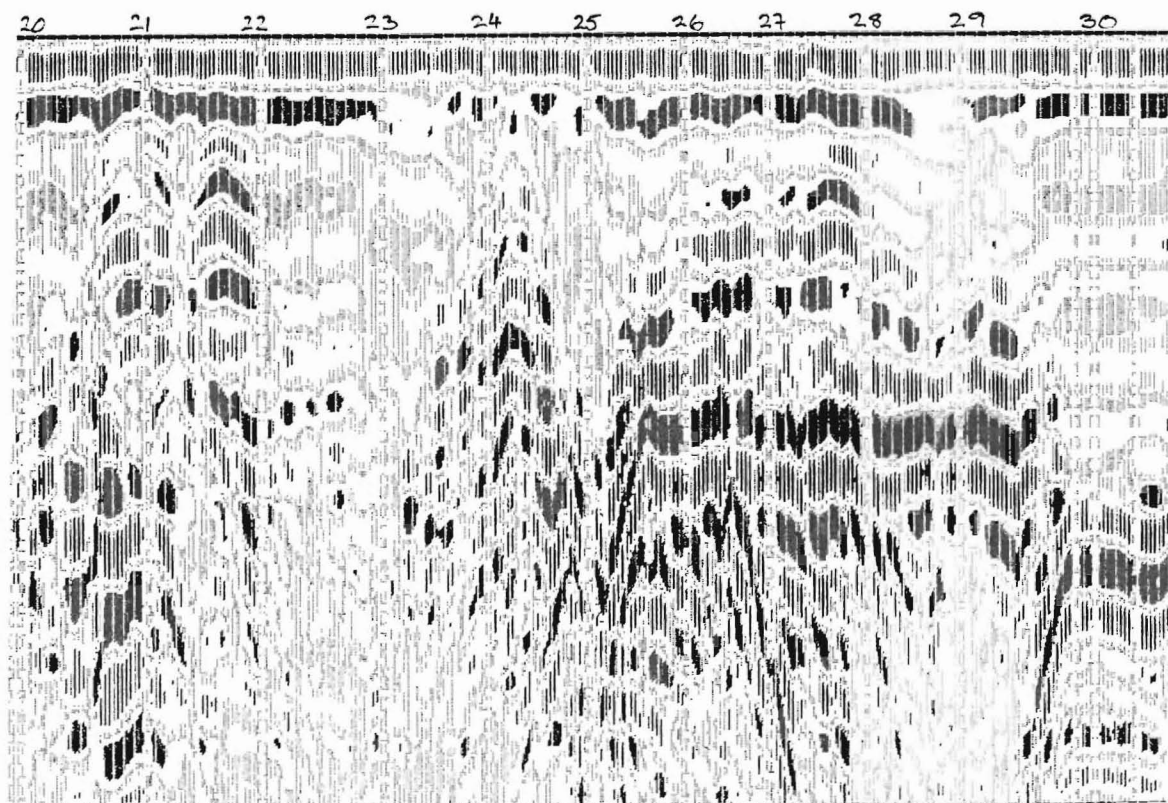
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3 March 1991

RADARGRAM OF TRAVERSE 13.14

Antenna 300MHz
Range 50nsec
Marker interval 1m

Max. depth of scan = 2.1m based on a
velocity of 0.1m/nsec



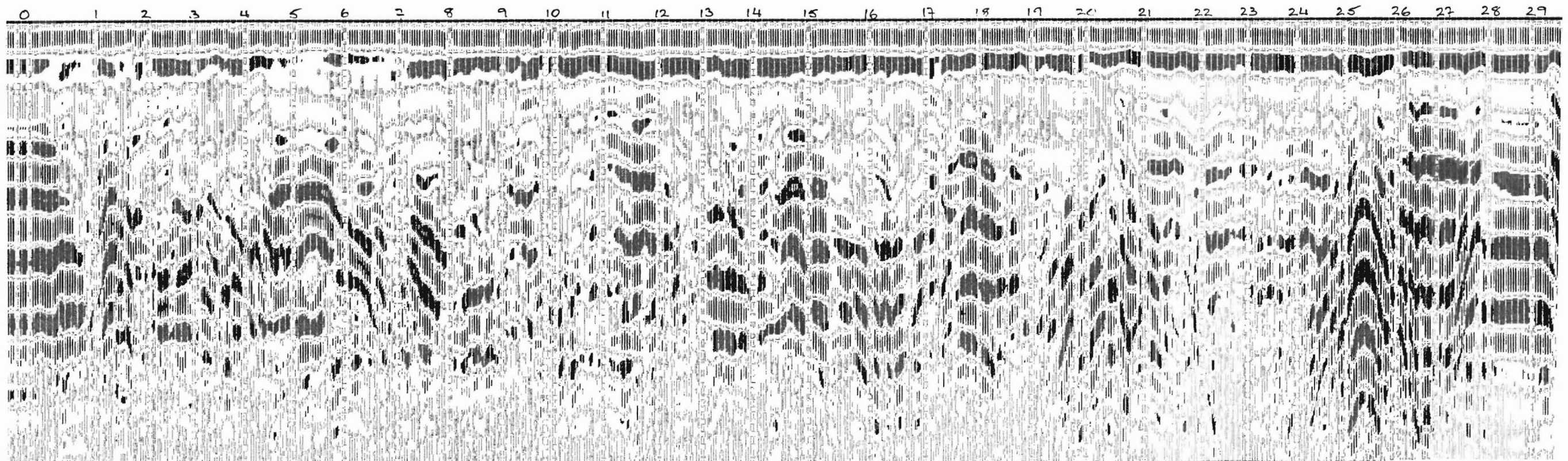
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RADARGRAM OF TRAVERSE 13.15

Antenna 300MHz
Range 50nsec
Marker interval 1m

Max. depth of scan = 2.1m based on a
velocity of 0.1m/nsec



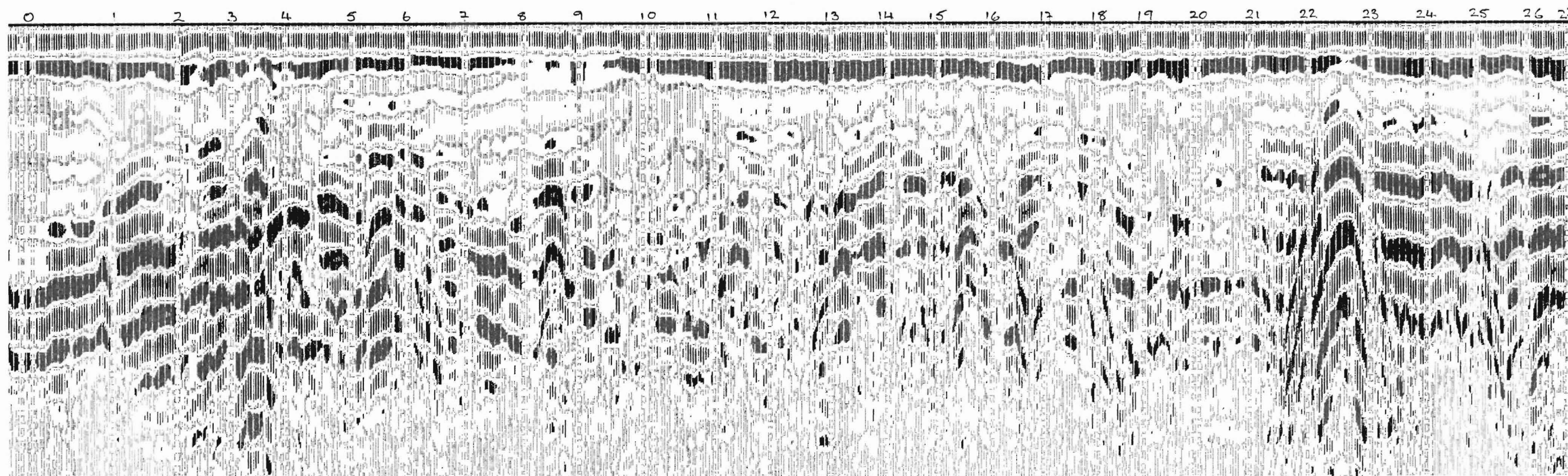
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RADARGRAM OF TRAVERSE 13.16

Antenna 300MHz
Range 50nsec
Marker interval 1m

Max. depth of scan = 2.1m based on a
velocity of 0.1m/nsec



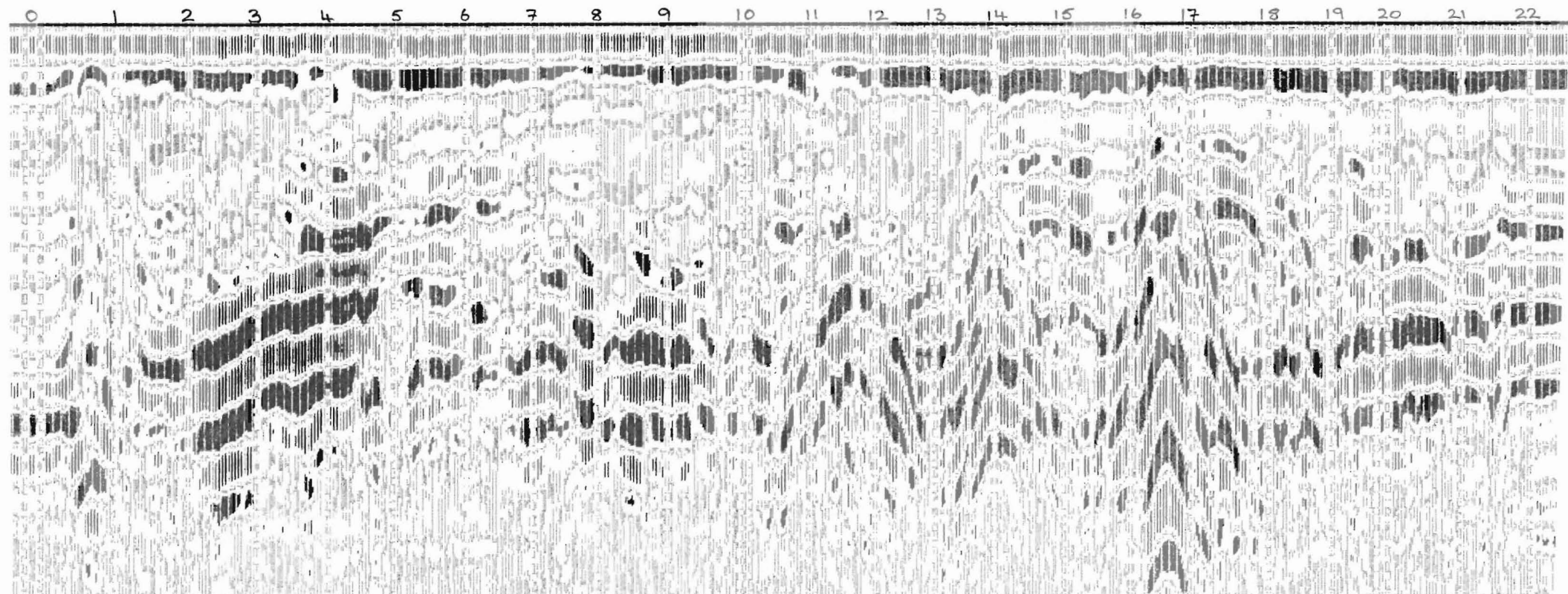
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RADARGRAM OF TRAVERSE 13.17

Antenna 300MHz
Range 50nsec
Marker interval 1m

Max. depth of scan = 2.1m based on a
velocity of 0.1m/nsec



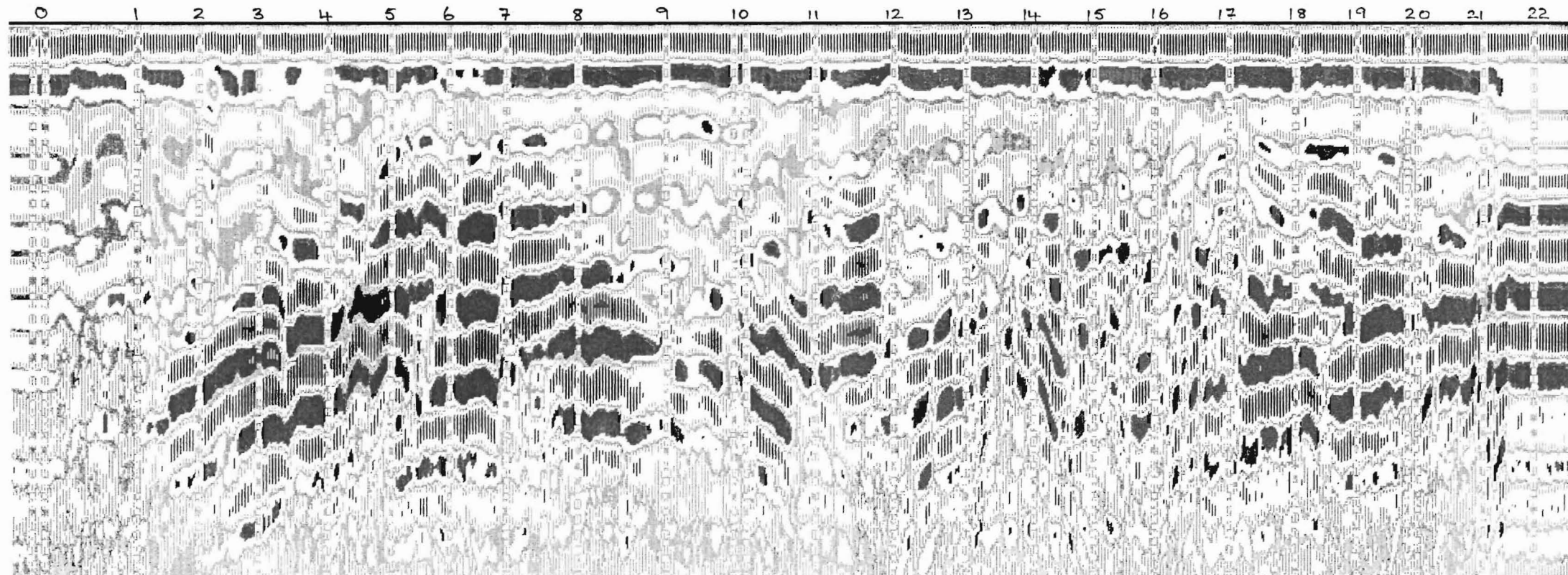
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3 March 1991

RADARGRAM OF TRAVERSE 13.18

Antenna 300MHz
Range 50nsec
Marker interval 1m

Max. depth of scan = 2.1m based on a
velocity of 0.1m/nsec



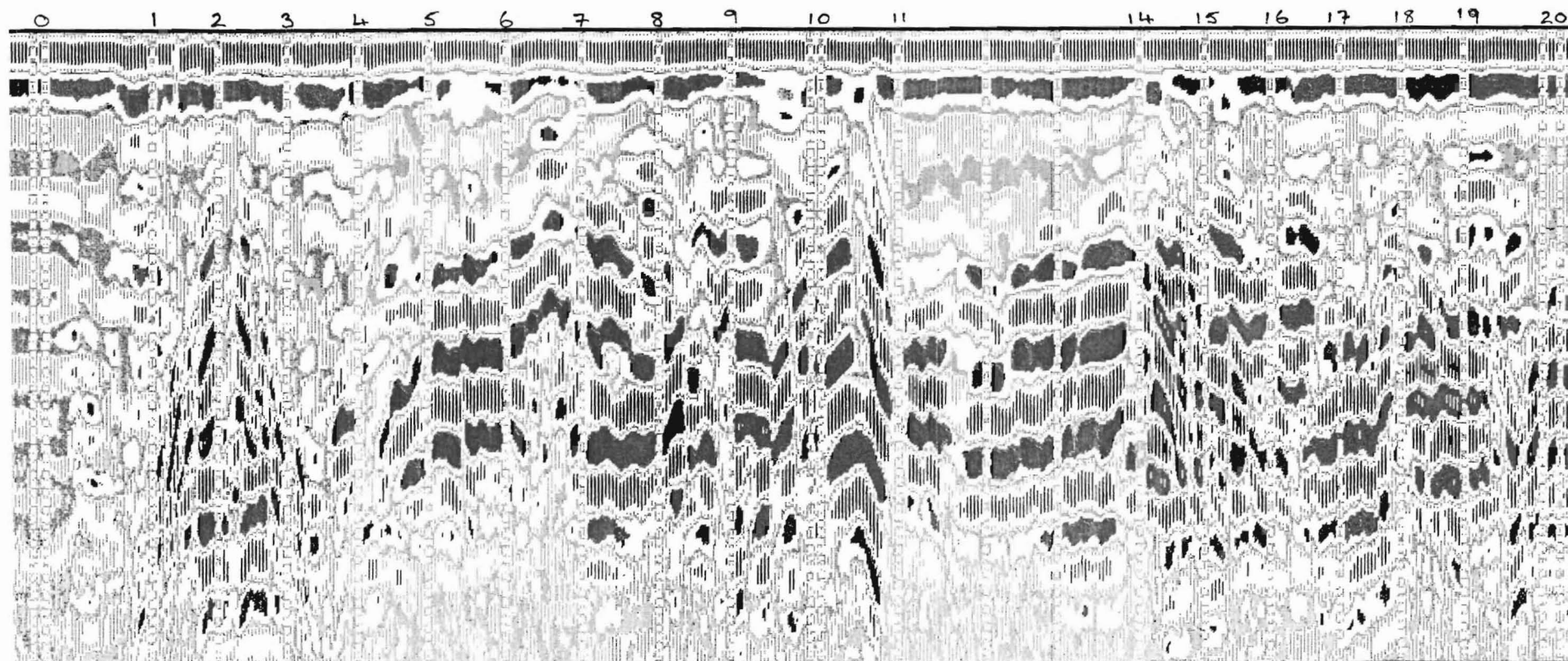
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3 March 1991

RADARGRAM OF TRAVERSE 13.19

Antenna 300MHz
Range 50nsec
Marker interval 1m

Max. depth of scan = 2.1m based on a
velocity of 0.1m/nsec



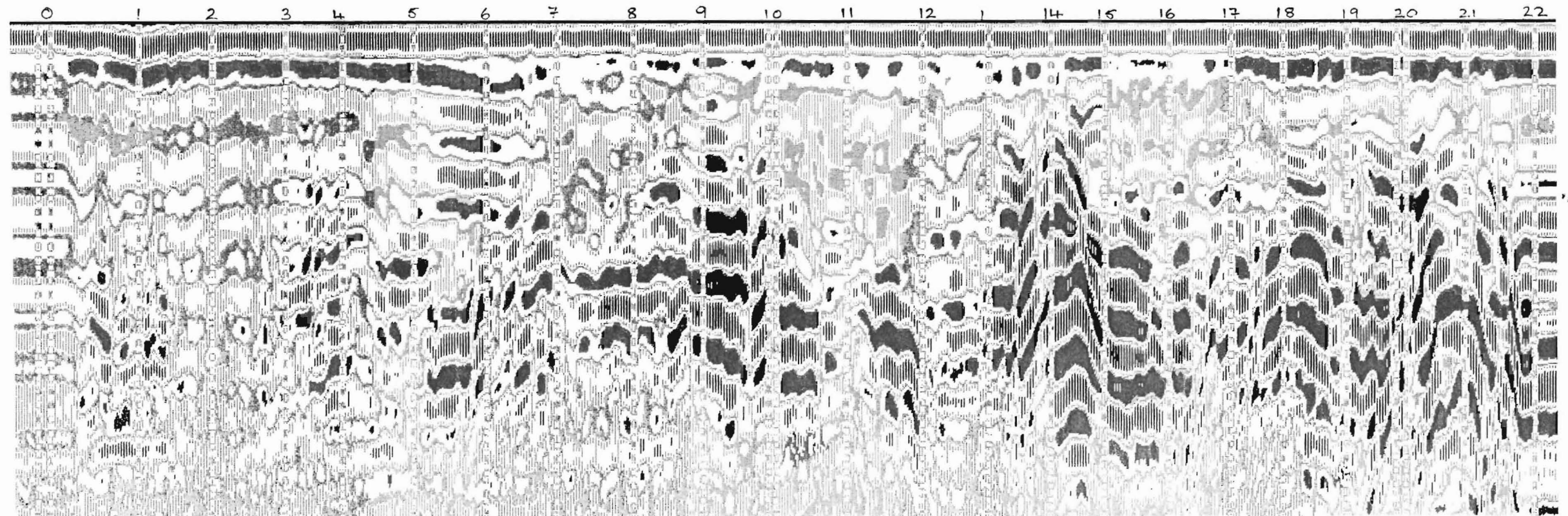
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3 March 1991

RADARGRAM OF TRAVERSE 13.20

Antenna 300MHz
Range 50nsec
Marker interval 1m

Max. depth of scan = 2.1m based on a
velocity of 0.1m/nsec



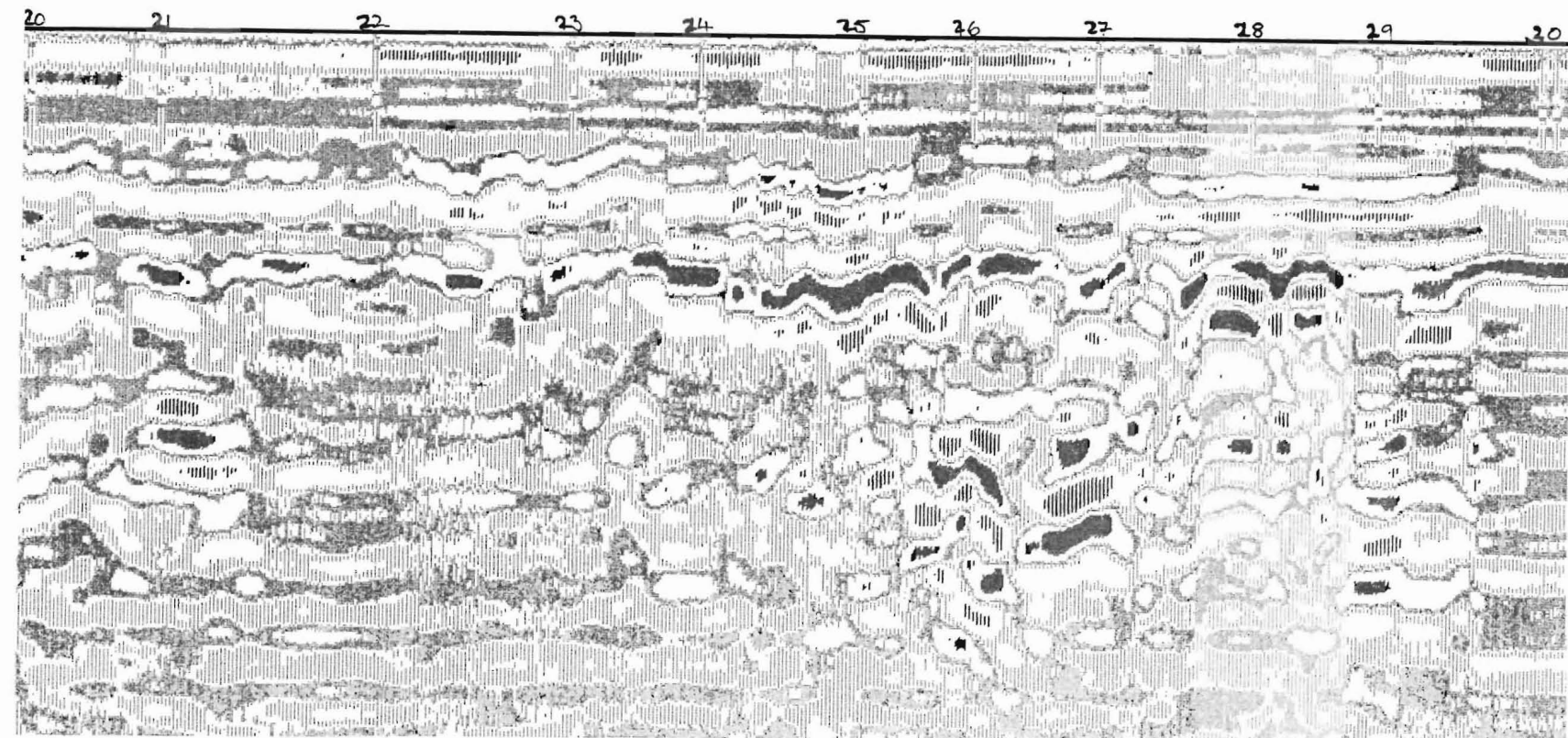
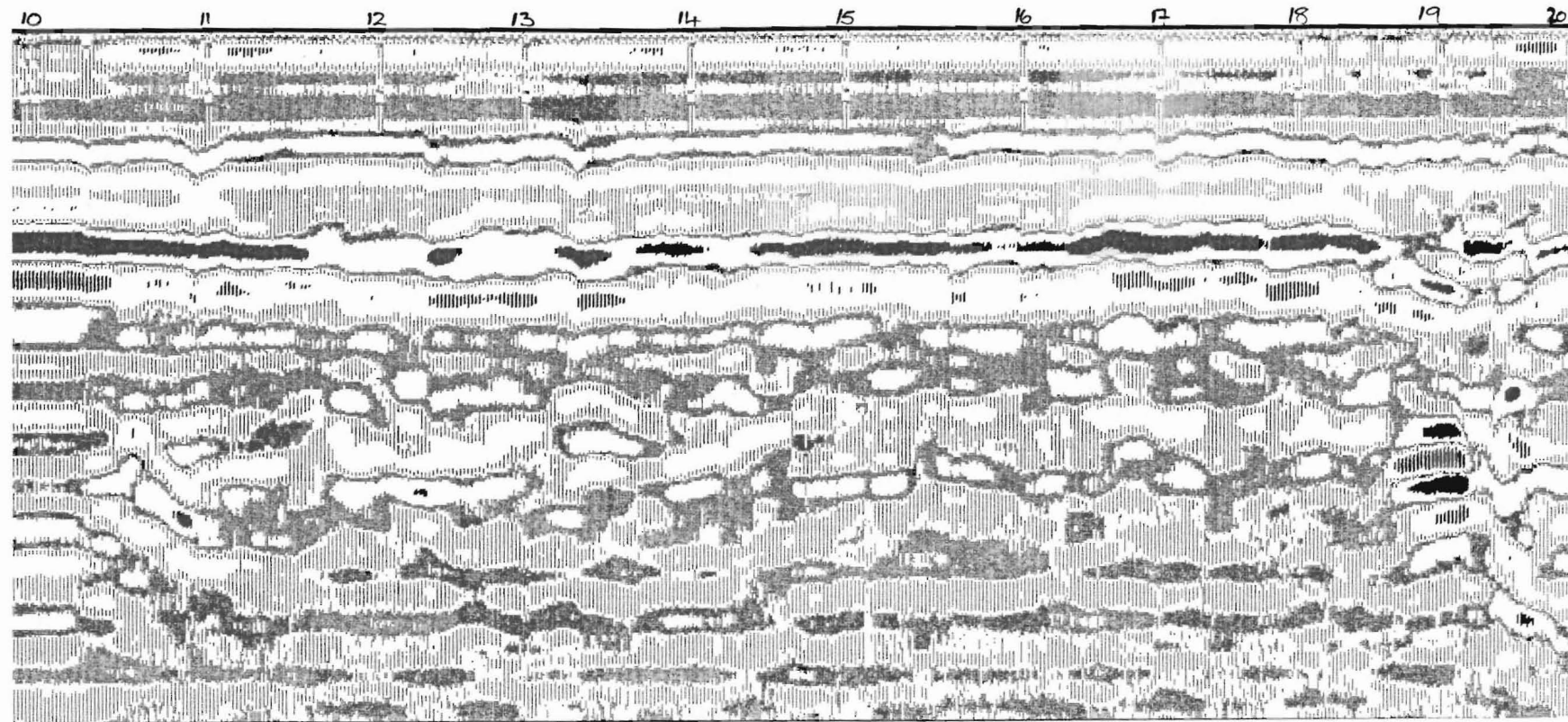
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12 August 1991

RADARGRAM OF TRAVERSE A1

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



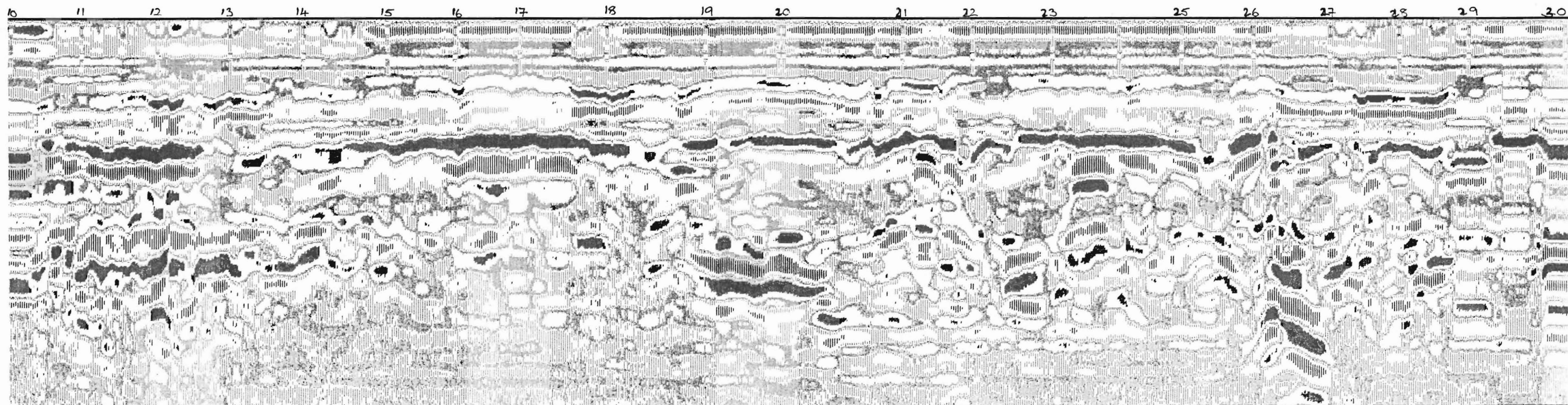
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RADARGRAM OF TRAVERSE A2

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



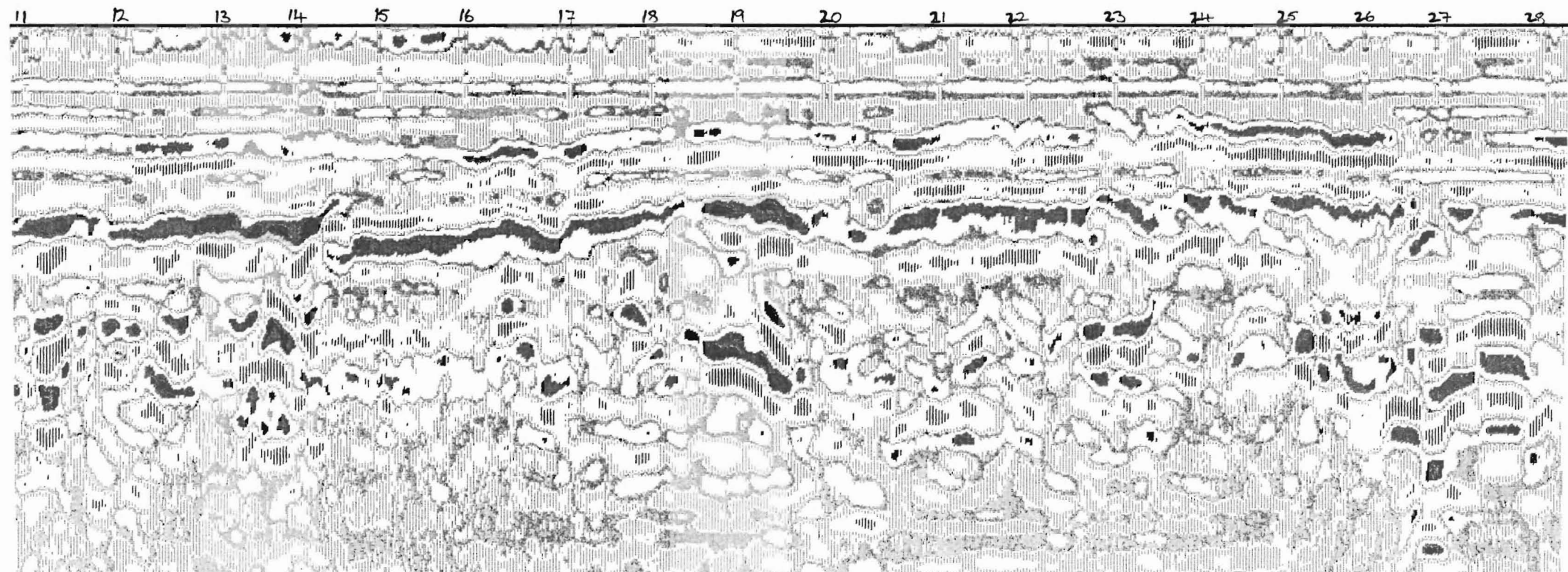
THE HEN DOMEN ARCHAEOLOGICAL PROJECT

12 August 1991

RADARGRAM OF TRAVERSE A3

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



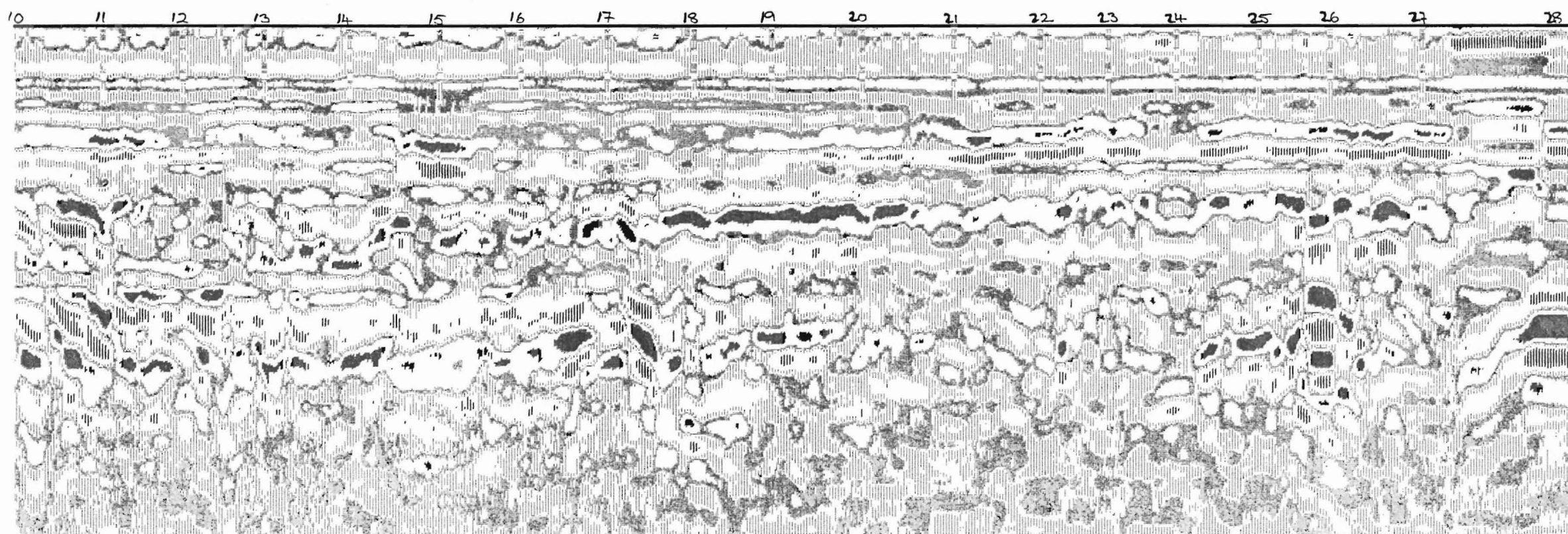
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RADARGRAM OF TRAVERSE A4

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



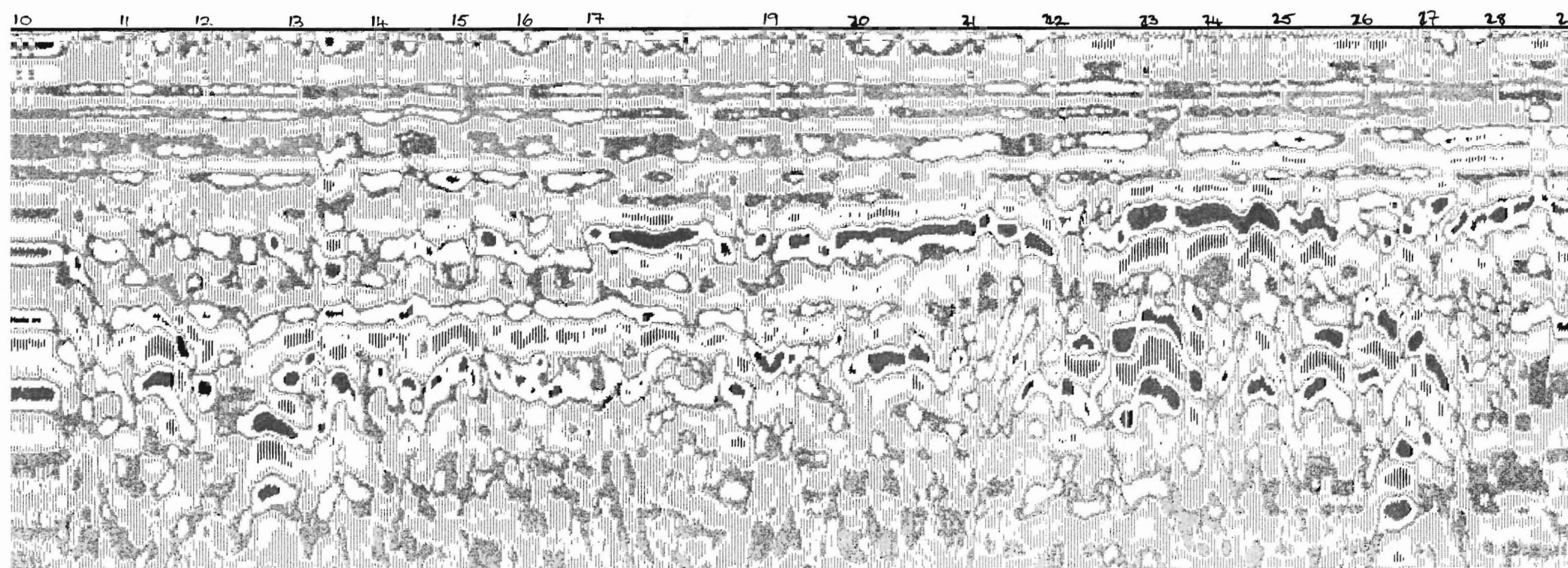
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12 August 1991

RADARGRAM OF TRAVERSE A5

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



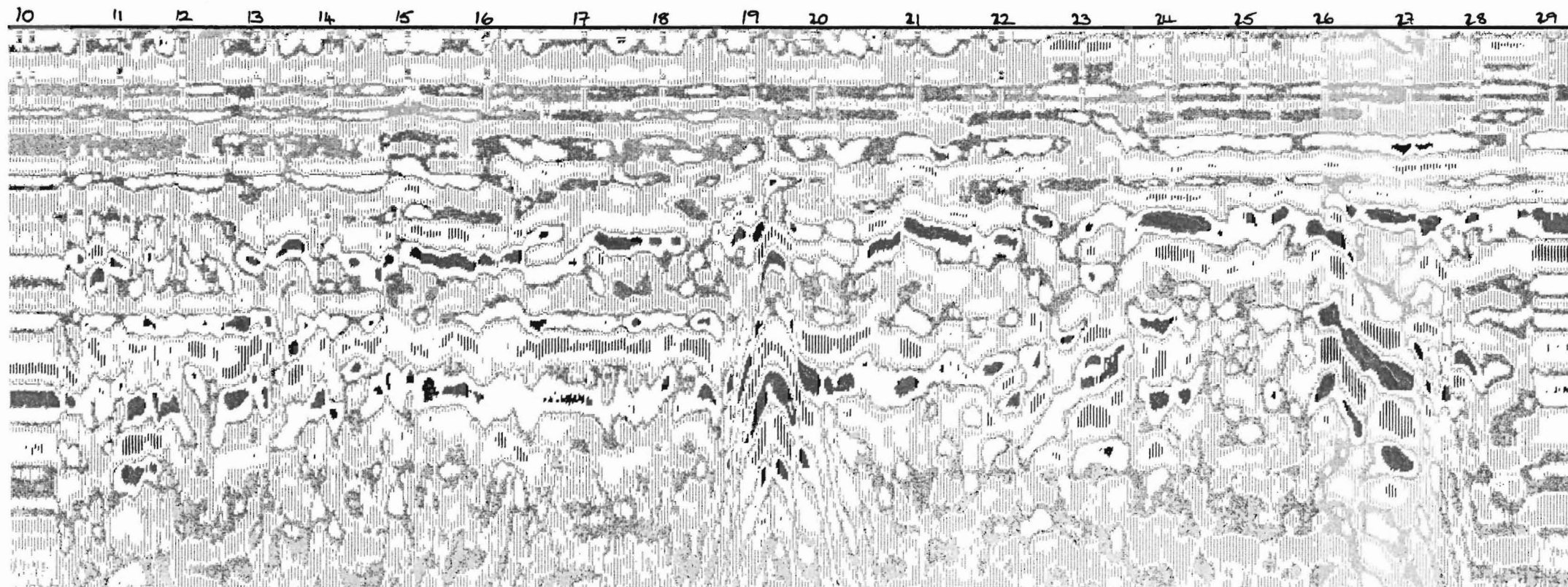
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RADARGRAM OF TRAVERSE A6

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



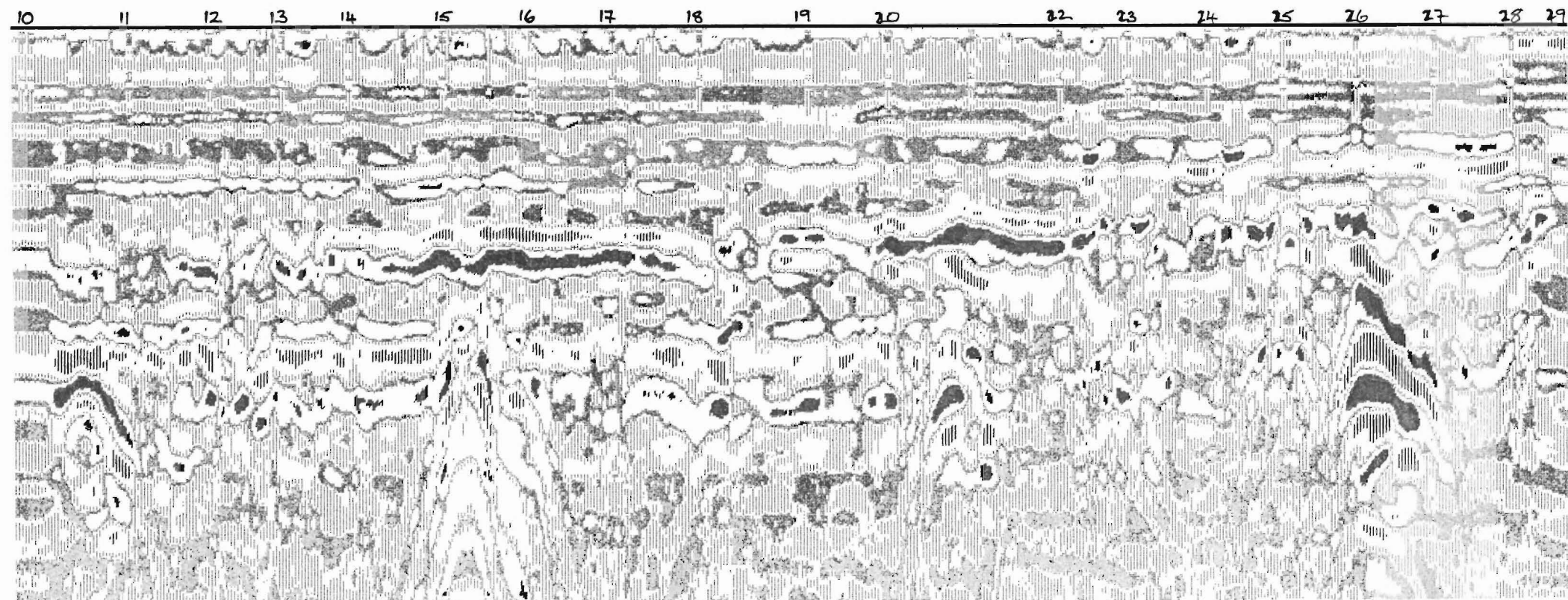
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RADARGRAM OF TRAVERSE A7

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



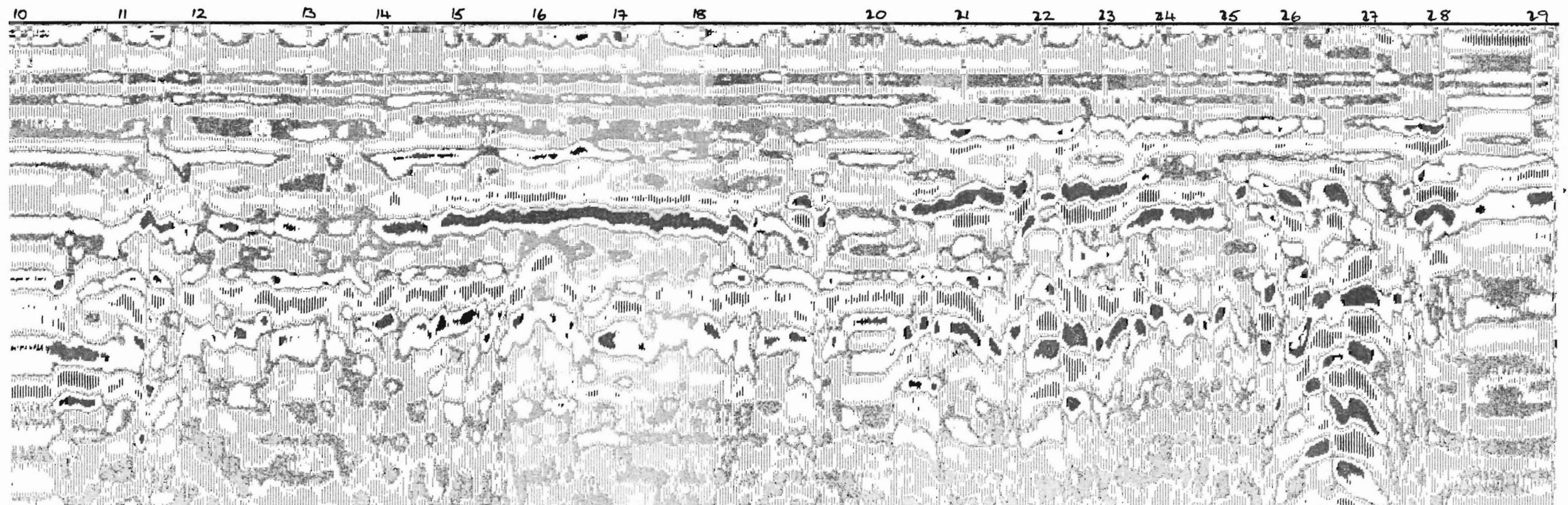
THE HEN DOMEN ARCHAEOLOGICAL PROJECT

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RADARGRAM OF TRAVERSE A8

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



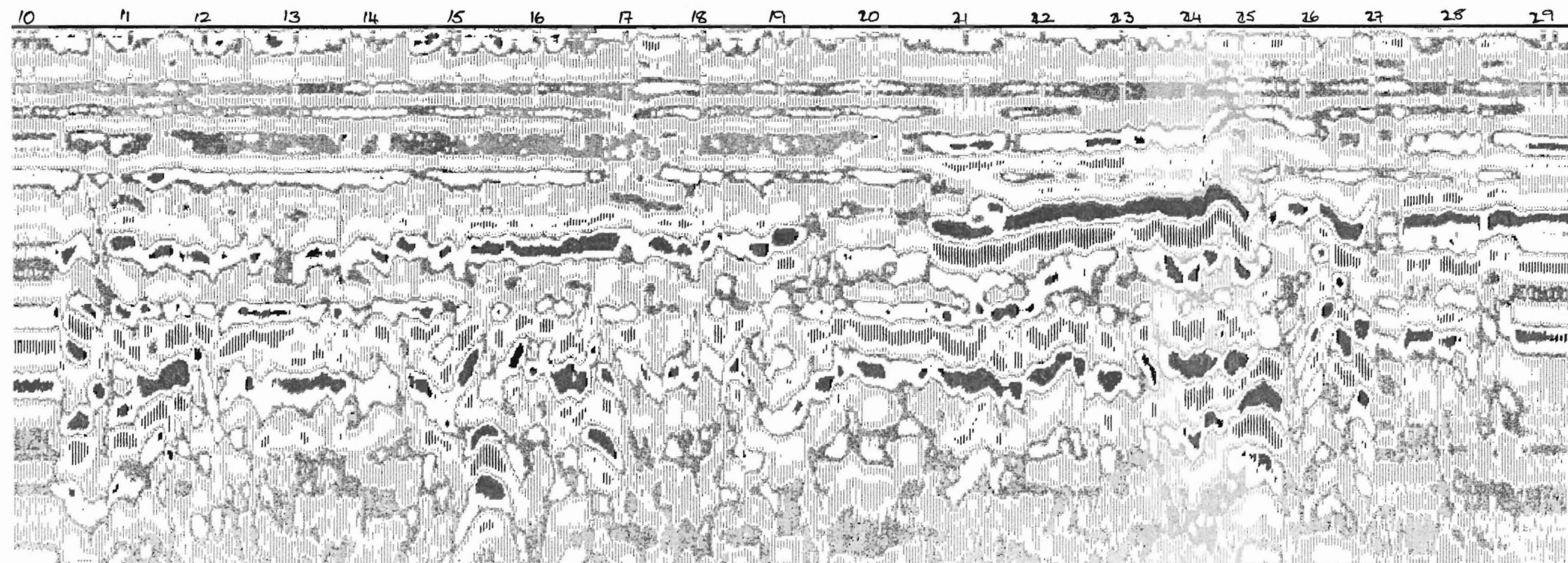
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RADARGRAM OF TRAVERSE A9

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



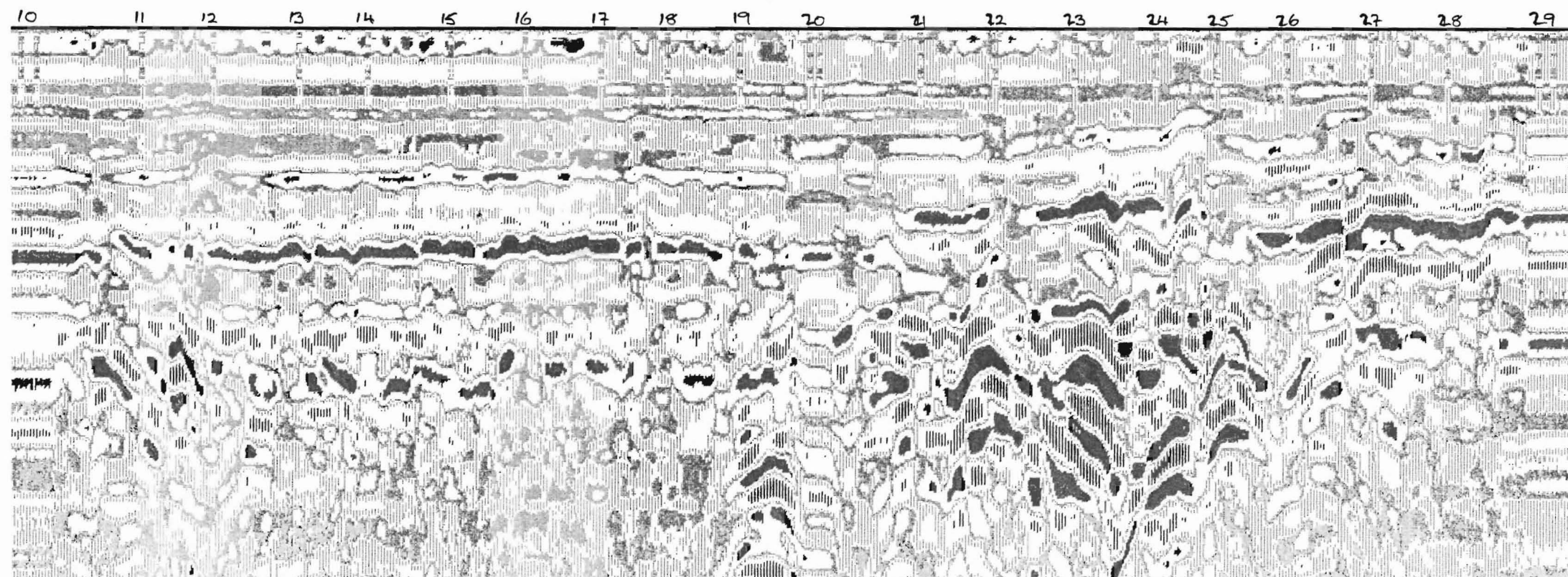
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RADARGRAM OF TRAVERSE A10

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



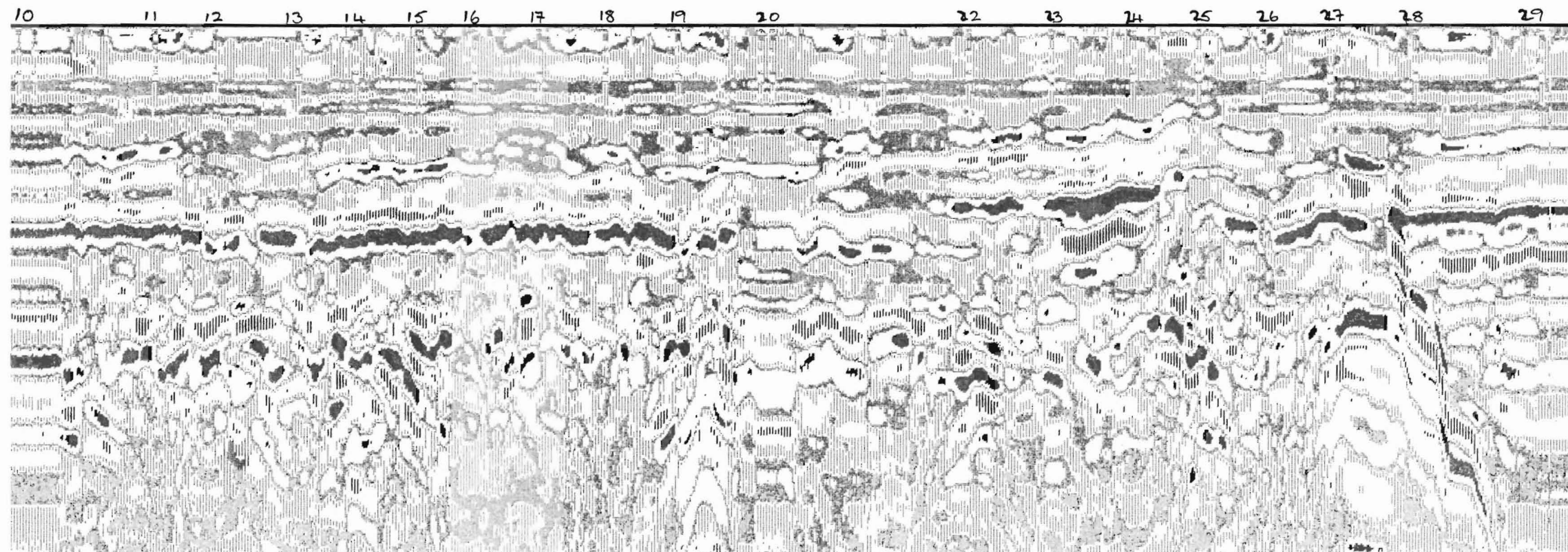
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RADARGRAM OF TRAVERSE A11

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



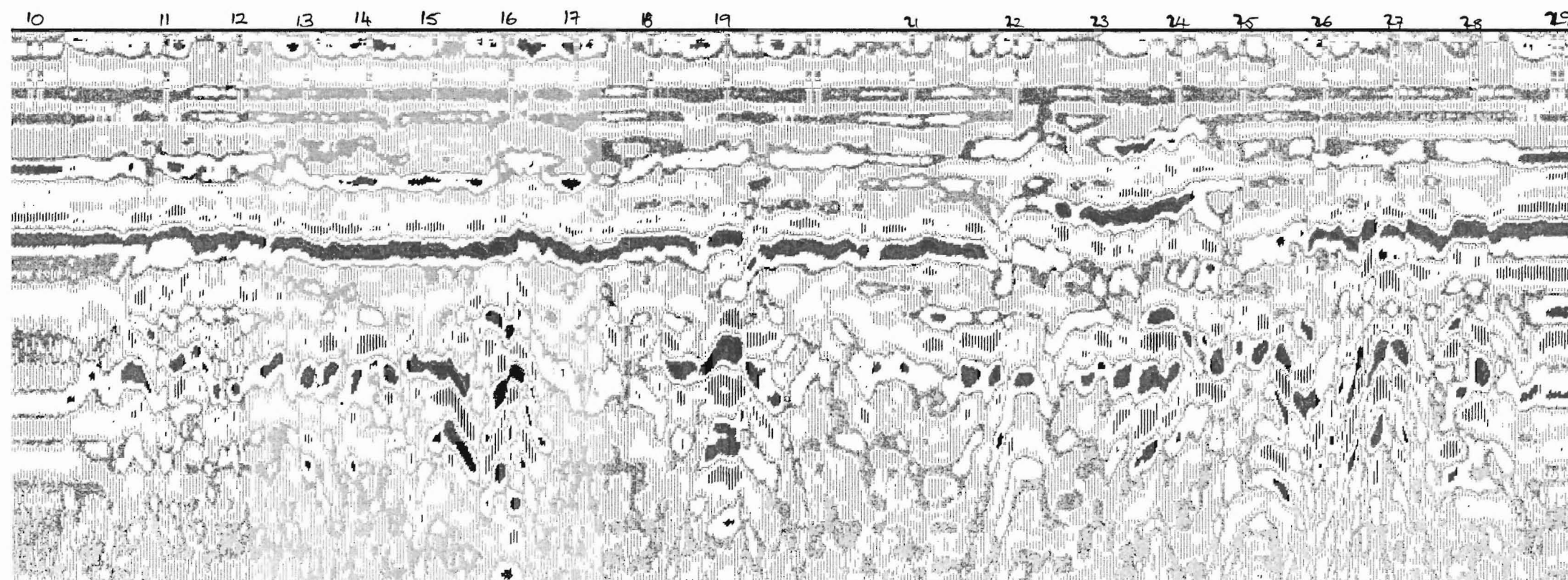
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RADARGRAM OF TRAVERSE A12

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



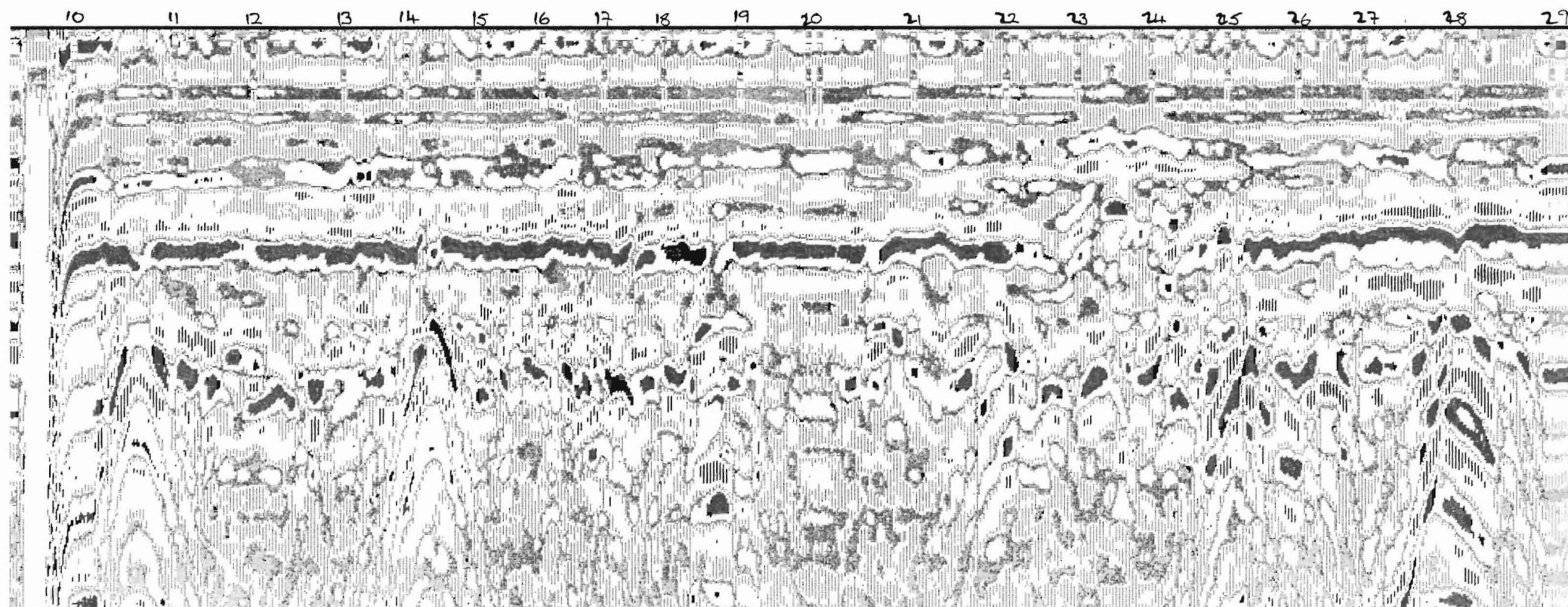
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RADARGRAM OF TRAVERSE A13

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



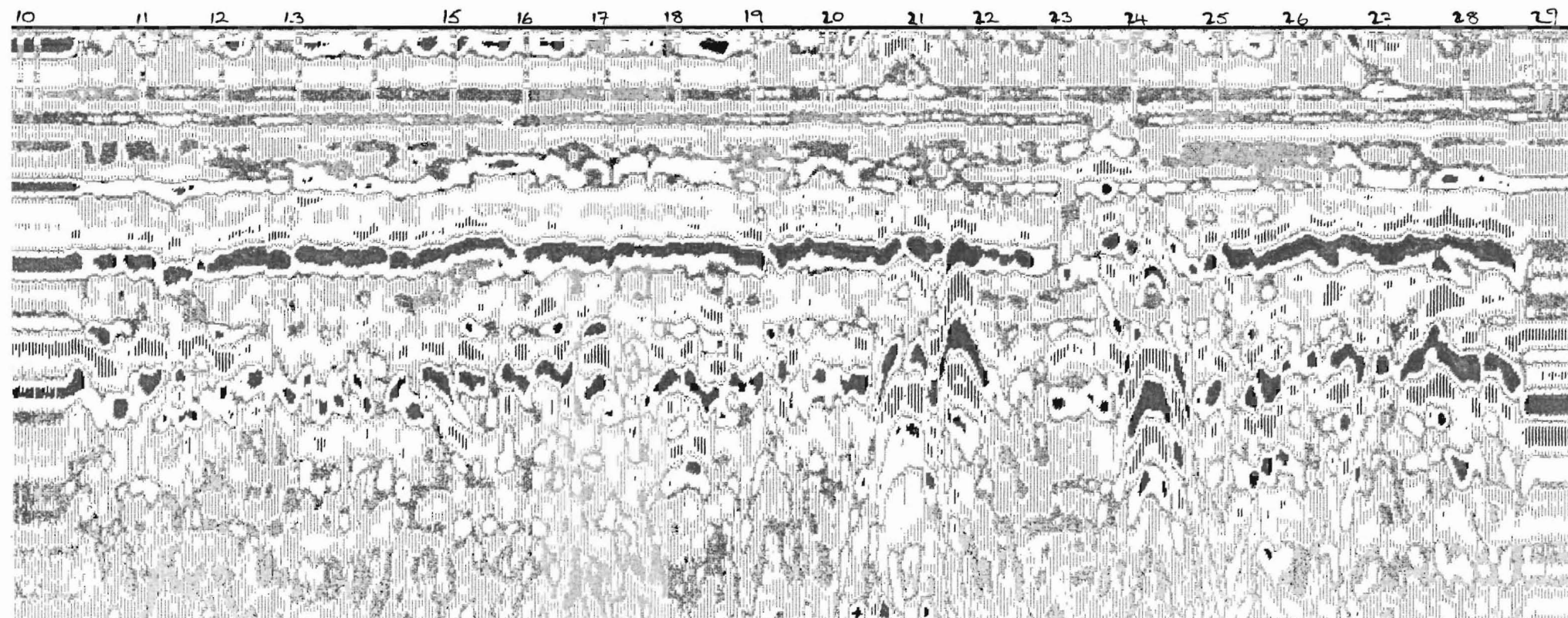
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RADARGRAM OF TRAVERSE A14

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



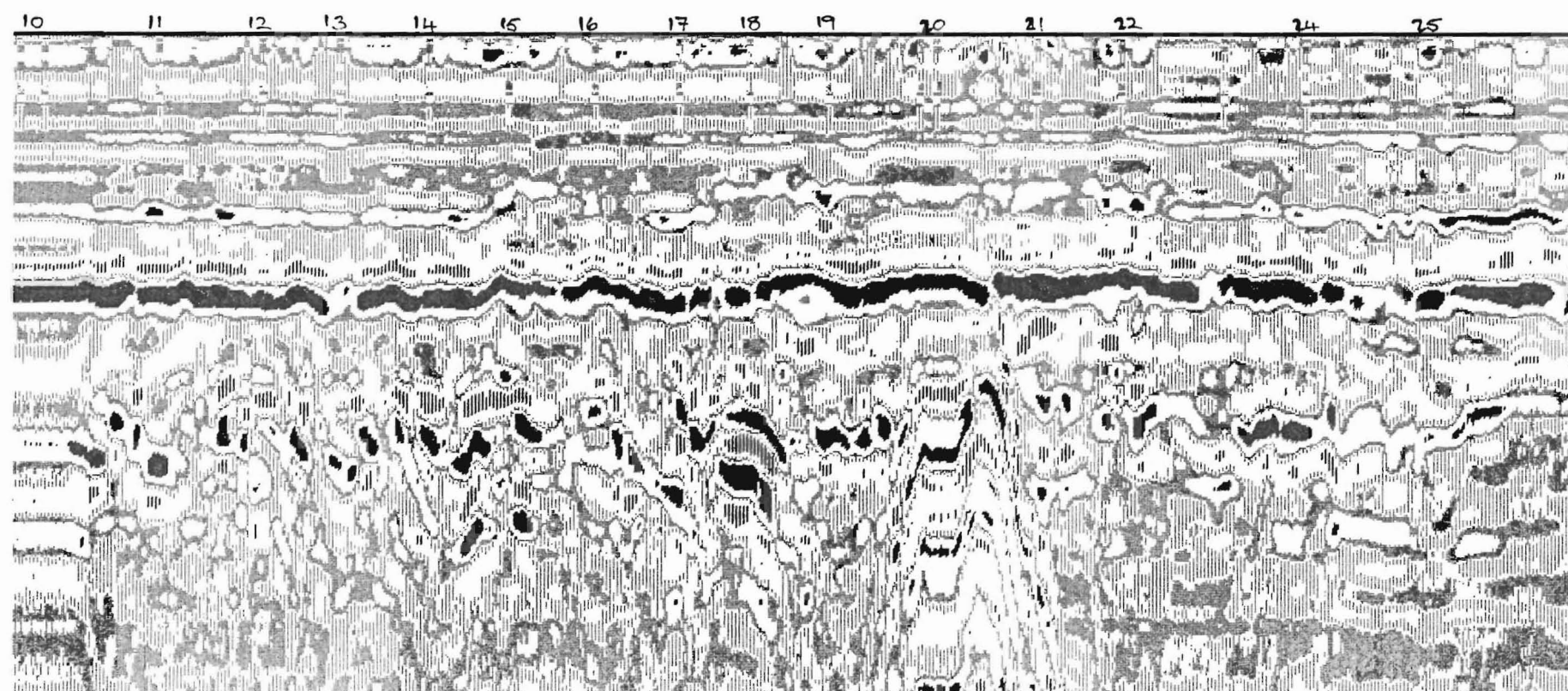
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RADARGRAM OF TRAVERSE A15

Antenna 300MHz
Range 40nsec
Marker interval 1m

Max. depth of scan = 1.7m based on a
velocity of 0.1m/nsec



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