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WORKING PAPER NO. 10

LOCH FLEET: BATHYMETRY AND SEDIMENT DISTRIBUTION

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PROGRESS REPORT FOR THE CEGB-SSEB LOCH FLEET PROJECT

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CEGB-SSEB LOCH FLEET PROJECT

PROGRESS REPORT, MARCH 1985

Bathymetric survey

A bathymetric survey of Loch Fleet was carried out during the last week of July 1984. x, y co-ordinates were determined using plane tables and polar alidades from two shore stations and the base-line distance was fixed trigonometrically using a standard theodolite. z was determined using a calibrated Elliot graphic echo-sounder (model G500S/2) mounted in an inflatable boat. x, y and z point fixes were co-ordinated by CB radio during continuous traversing and the position and frequency of points was decided subjectively according to the frequency of slope changes indicated by the echo-sounder. In all 353 points were located with a mean x, y precision of approximately 3 metres and a z precision of 12.5 cm.

The fixed points were subsequently digitised and contoured using the MAPICS digital mapping system. Figures 1 and 2 show the distribution of points and the contoured bathymetry respectively. Morphometric data were calculated using software supplied by Mapics Ltd., and Table 1 shows data for lake area and lake volume and other morphometric variables.

	1984	1910 (Murray and Pullar)
Area (ha)	17.06	18.13
Vol (m ³)	1.051 x 10 ⁶	1.16 x 10 ⁶
Z _{max} (m)	16.80	16.45
\bar{Z} (m)	6.15	6.64

Table 1 Comparison of bathymetric data for Loch Fleet. Surveyed July 1984 during low water level conditions. Water surface 55 cm below temporary bench mark chiselled into granite boulder.

The lake was originally surveyed by Murray and Pullar in 1910, and Figure 3 shows a copy of their results. Table 1 compares the morphometric data. Although the Murray and Pullar survey was carried out in considerably less detail the morphometric values are very similar.

Sediment sampling

Both surface sediment sampling and sediment coring were carried out during July 1984. Surface sediment samples were needed to assess the spatial distribution of diatoms in the accumulating zone of the lake, to provide samples for chemical analysis, and in order to make a map of sediment type. Sediment cores were required to evaluate recent sediment stratigraphy and to choose the most suitable core for detailed analysis. All sites were fixed by shore survey as described above.

1. Kajak coring. Short surface sediment cores were taken with the Kajak corer at 29 sites in zones where organic mud is accumulating. Each of the short cores was extruded in the boat and the 0-1 cm sample was retained for diatom analysis. The remaining sediment was discarded. The location of these sites is shown in Figure 4. Diatom analysis will be carried out on all these samples.
2. Ekman grab sampling. Ekman grab samples were taken at the same stations as the Kajak samples, in the zone of organic sediment accumulation, as well as throughout the rest of the lake basin where minerogenic sediments occurred. Only in areas of the lake bottom covered by boulders or solid rock was it impossible to take samples. The distribution of these sites is shown in Figure 5 and a map of sediment types based on these samples is shown in Figure 6. Since no grain-size analyses have been carried out divisions between categories are subjectively based on a x 20 stereoscopic examination of the samples and on loss on ignition values. A contour

map of these values is shown in Figure 7. Table 2 gives details of sediment type according to the Troels-Smith classification and lists loss on ignition values for individual samples. Subsamples of the Ekman grab material have been sent to Dr. Gordon Glover, NCB Rotherham, for chemical and mineralogical analysis.

Ekman No.	% LOI	Troels-Smith	Ekman No.	% LOI	Troels-Smith
1	29.32	Ld3 Dg1	47	16.96	As2 Ag1 Ld1
2	45.16	Ld4 Dg+	48	2.01	As3 Gal
3	51.09	Ld4 Dg+	49	23.76	Ld4 Dg+
4	44.17	Ld4 Dg+	50	1.21	As2 Ag1 Gal
5	45.06	Ld4 Dg+	51	29.18	Ld4 Ag+ Dg+
6	51.80	Ld4 Dg+	52	6.58	Gs2 Ld2 Dg+
7	52.58	Ld4 Dg+ Ag+	53	1.50	As2 Dg1 Gal
8	43.04	Ld4 Dg+	54	2.35	Gg2 As1 Ag1
9	2.05	As2 Ag1 Gal	55	1.04	Gg3 As1 Ld+
10	32.55	Ld3 Gs1	56	0	O*
11	5.07	Gg4	57	0	Stony/Moss
12	2.54	Gg3 Ld1	58	0	O*
			59	5.14	Gs3 Ld1 Dg+
20	48.04	Ld4 Dg+ Ga+	60	9.14	Ld2 Gal As1 Dg+
21	42.11	Ld4 Dg+ Ga+	61	24.88	Ld4 Ga+ Dg+
22	5.53	Ld3 Gal	62	1.70	Gg3 Ld1
23	44.33	Ld4 Dg+	63	1.37	Gg4 Ld4
24	1.67	Gs3 Ld1 Dg+	64	1.36	Gg4 Ld+
25	7.49	Ld4 Ga+	65	0	Stony/Moss
26	1.51	Gs3 Gg1 Ld+ Dg+	66	1.97	As3 Gal
27	41.74	Ld3 Gal Dg+	67	0	LFe4 iron oxide concretion
28	36.02	Ld4 Dg+	68	14.07	Ld4 Ga+ Dg+
29	50.49	Ld4 D1+	69	1.81	Gg4 Ld+
30	47.37	Ld4 Dg+	70	11.19	Ld4 Ga+ Dg+
31	47.01	Ld4 Dg+	71	28.57	Ld4 Ga+ Dg+
32	47.13	Ld4 Dg+	72	0	O*
33	44.44	Ld4 Dg+	73	1.73	Gg3 Ld1
34	46.12	Ld4 Dg+	74	1.78	Gg3 Gal Ld+
35	1.51	Ga2 As1 Ag1	75	2.69	Gs2 As2 Ld+
36	42.81	Ld4 Ga+ Dg+	76	5.59	As3 Ag1
37	8.19	Ag3 Ld1	77	1.35	Gs3 Ld1
38	0	O*	78	0	O*
39	22.54	Ld4 Dg+ Ag+	79	0	Stony/Moss
40	1.33	Gg3 Gs1 Ld+	80	0	O*
41	5.88	Gg3 Gs1 Ld+	81	0	O*
42	1.73	As3 Gal	82	0	Stony/Moss
43	1.32	As2 Ag1 Gal	83	0	O*
44	1.68	As3 Ag1 Gal	84	25.87	Ld3 Ag1
45	42.29	Ld4 Ga+	85	40.67	Ld3 Ag1 Dg+
46	48.96	Ld4 Dg+	86	3.15	Gs3 Ld1

* = No retrieval.

Table 2 % loss-on-ignition and Troels-Smith classification for Ekman grab samples.

References

- Battarbee, R.W., Appleby, P.G., Odell, K. and Flower, R.J. 1985
²¹⁰Pb dating of Scottish lake sediments, afforestation and
accelerated soil erosion. Earth Surface Processes and Landforms
10, 137-142.
- Murray, J. and Pullar, L. 1910 Bathymetrical Survey of the Scottish
Fresh-water Lochs Vol. 5, Edinburgh: Challenger Office.

LOCH FLEET

DISTRIBUTION OF SURVEYED POINTS

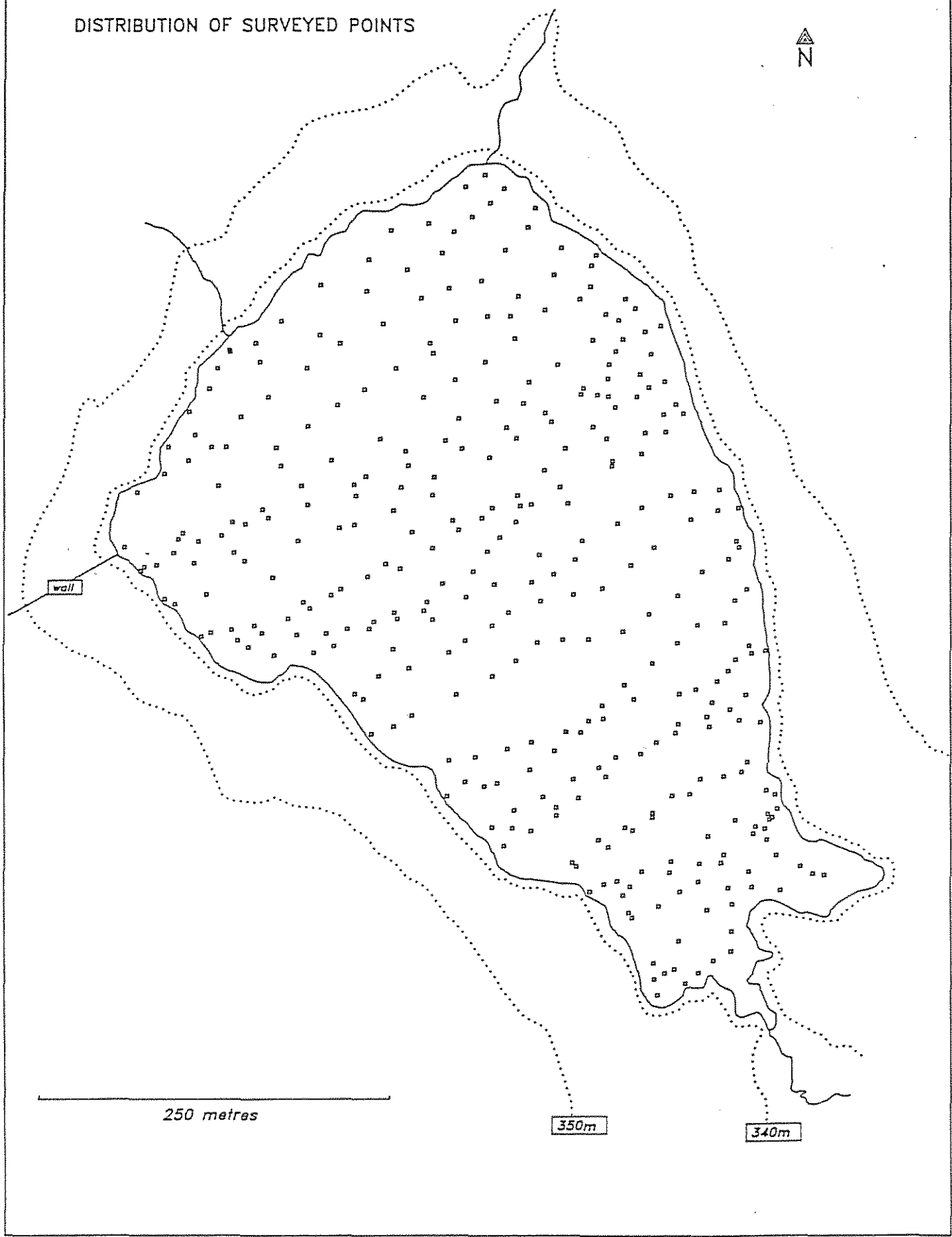


Fig. 1 Distribution of points used to derive bathymetry.

LOCH FLEET BATHYMETRY

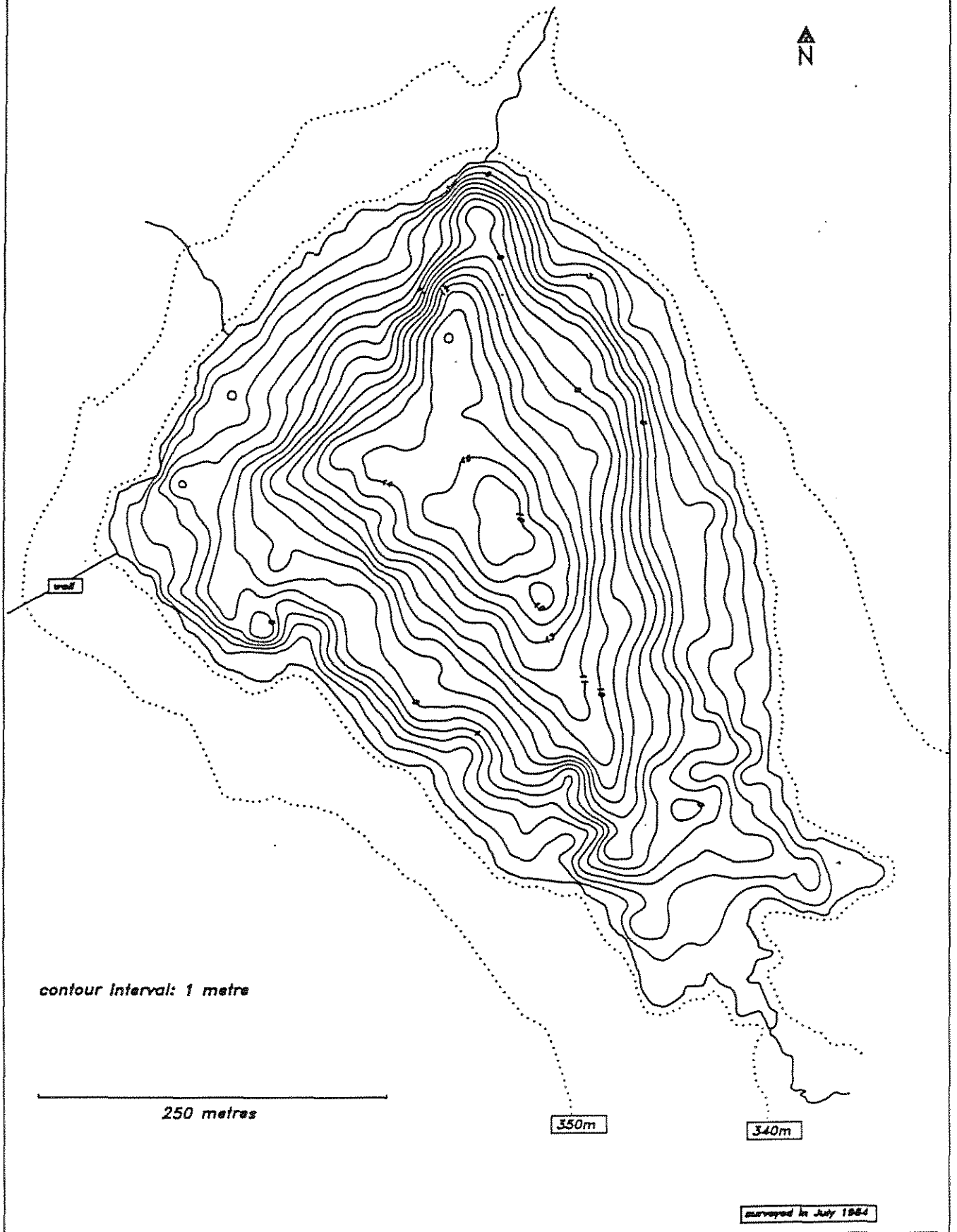
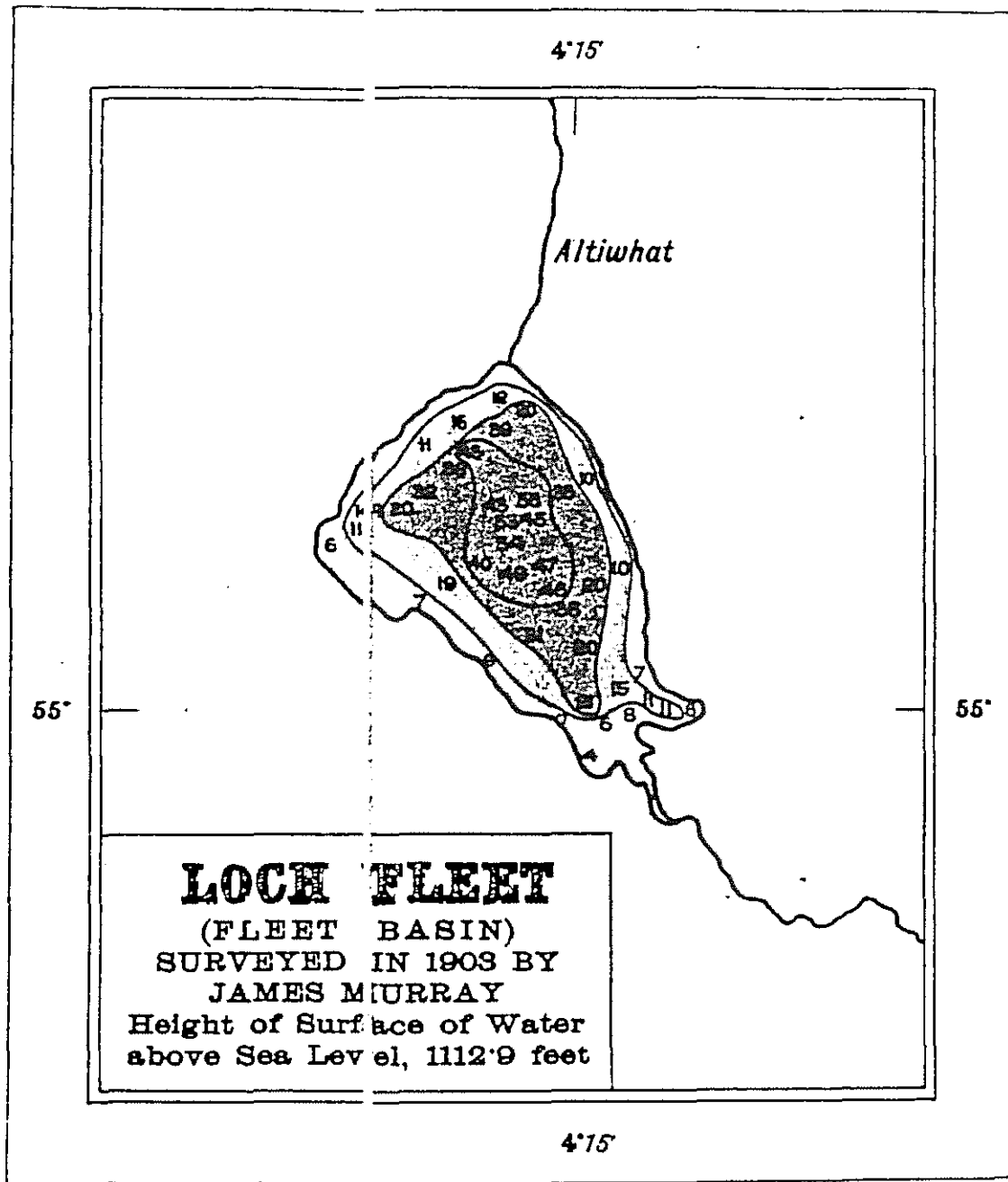


Fig. 2 Bathymetry.



J.G. Bartholomew.

Fig. 3 Bathymetry as surveyed by Murray and Pullar (1910).

LOCH FLEET

LOCATION OF KAJAK CORE SAMPLES
CORED JULY 1984

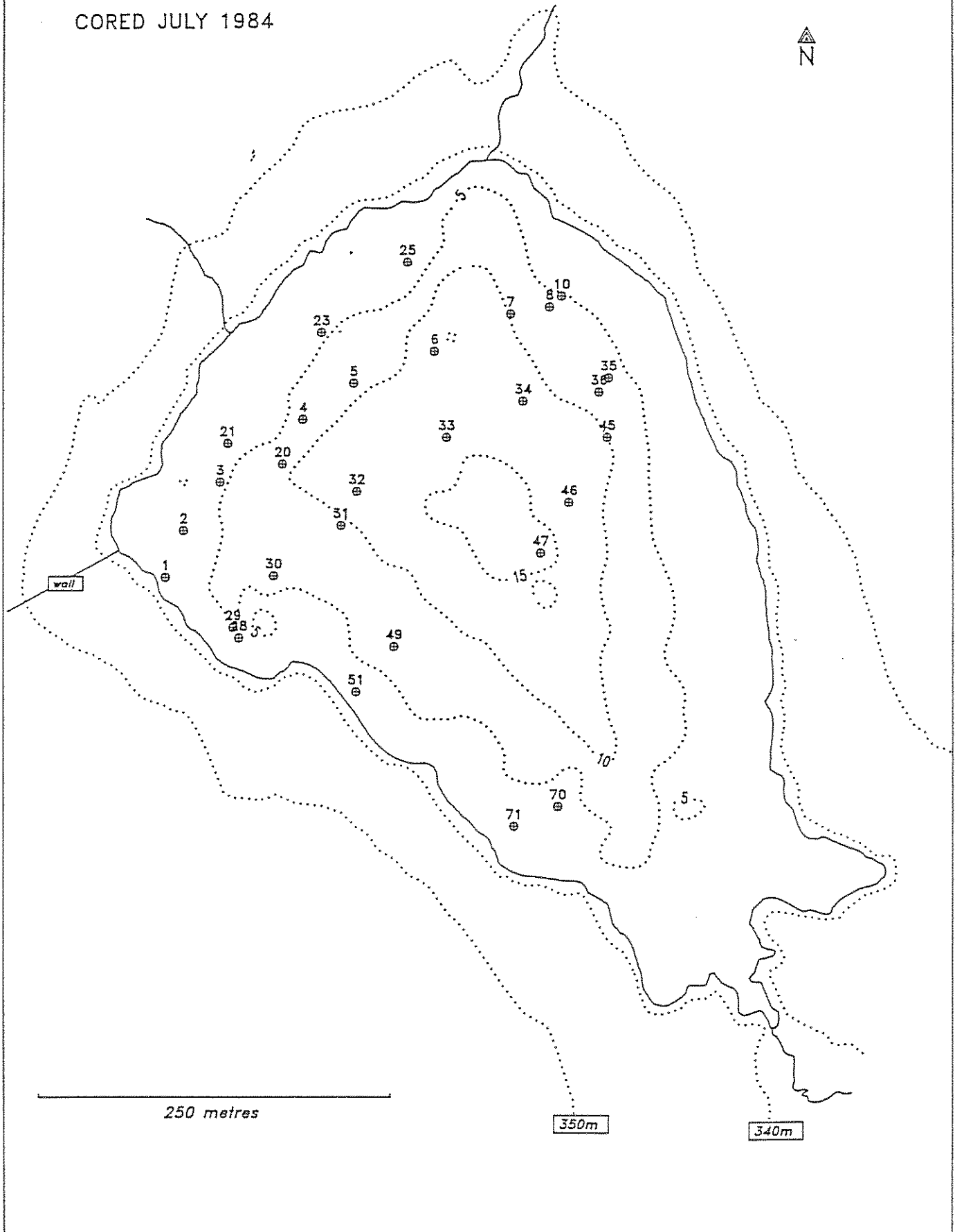


Fig. 4 Location of Kayak core samples.

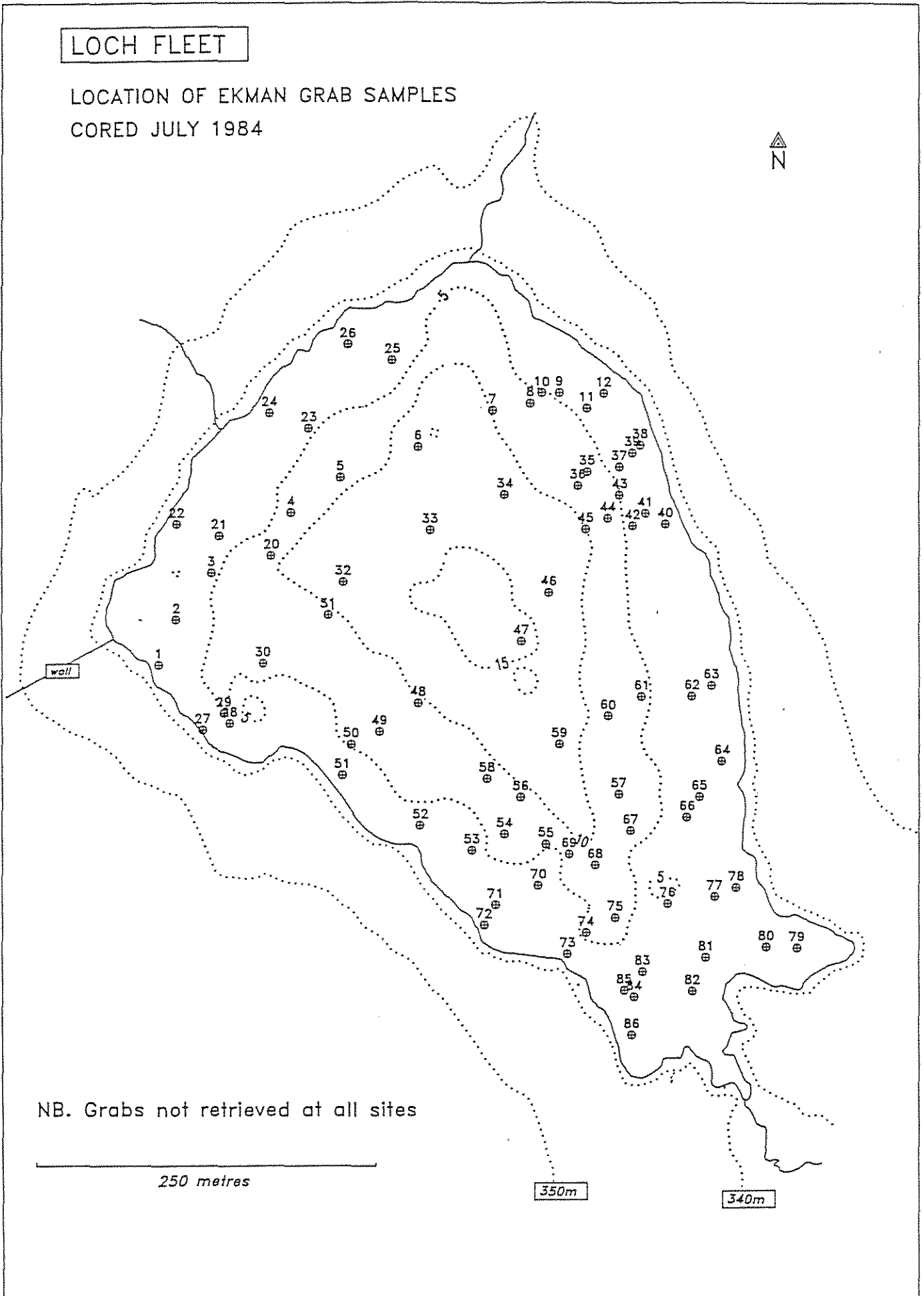


Fig. 5 Location of Ekman Grab samples.

Loch Fleet Surface Sediment

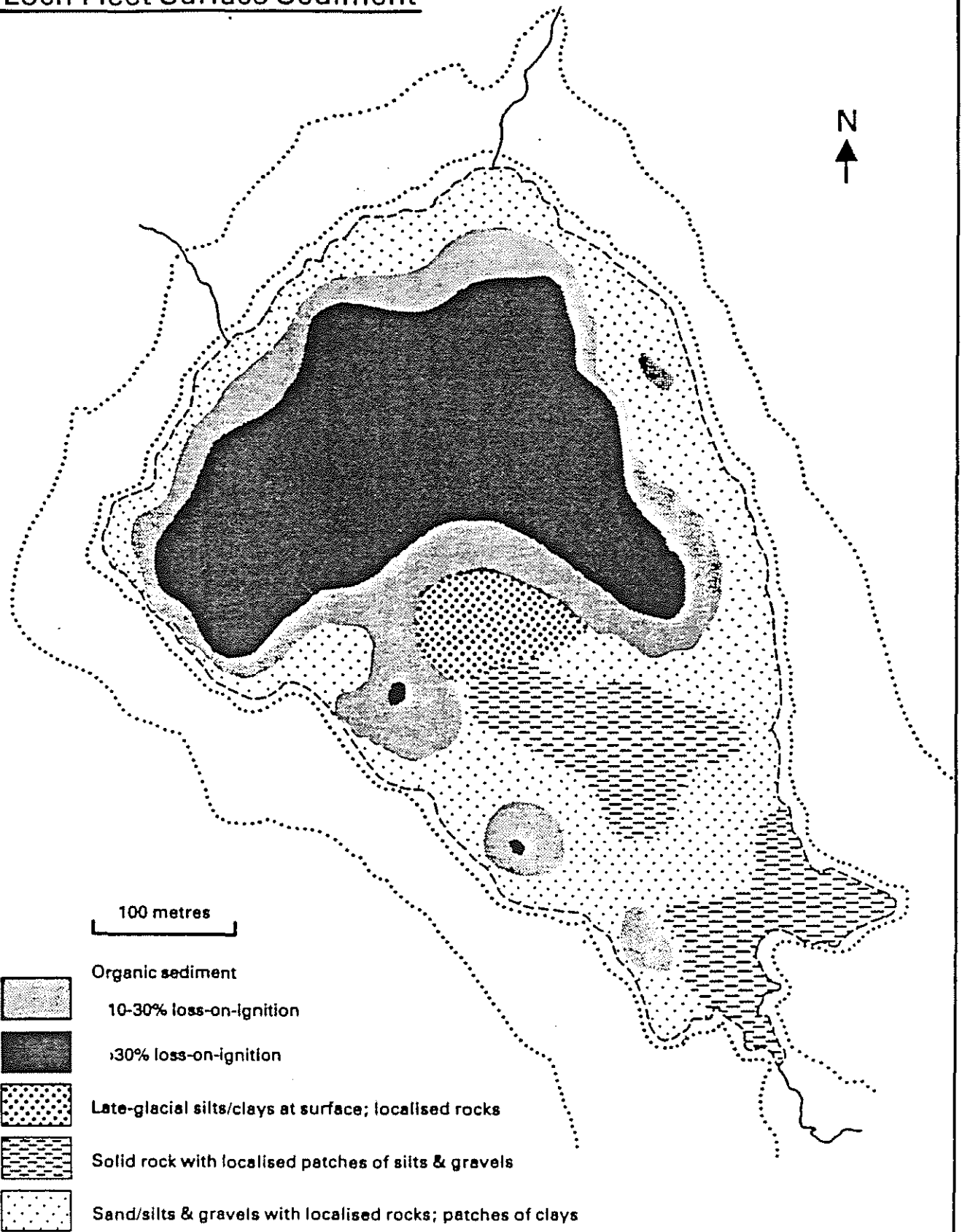


Fig. 6 Distribution of main surface sediment types.

LOCH FLEET

DISTRIBUTION OF ORGANIC MATTER

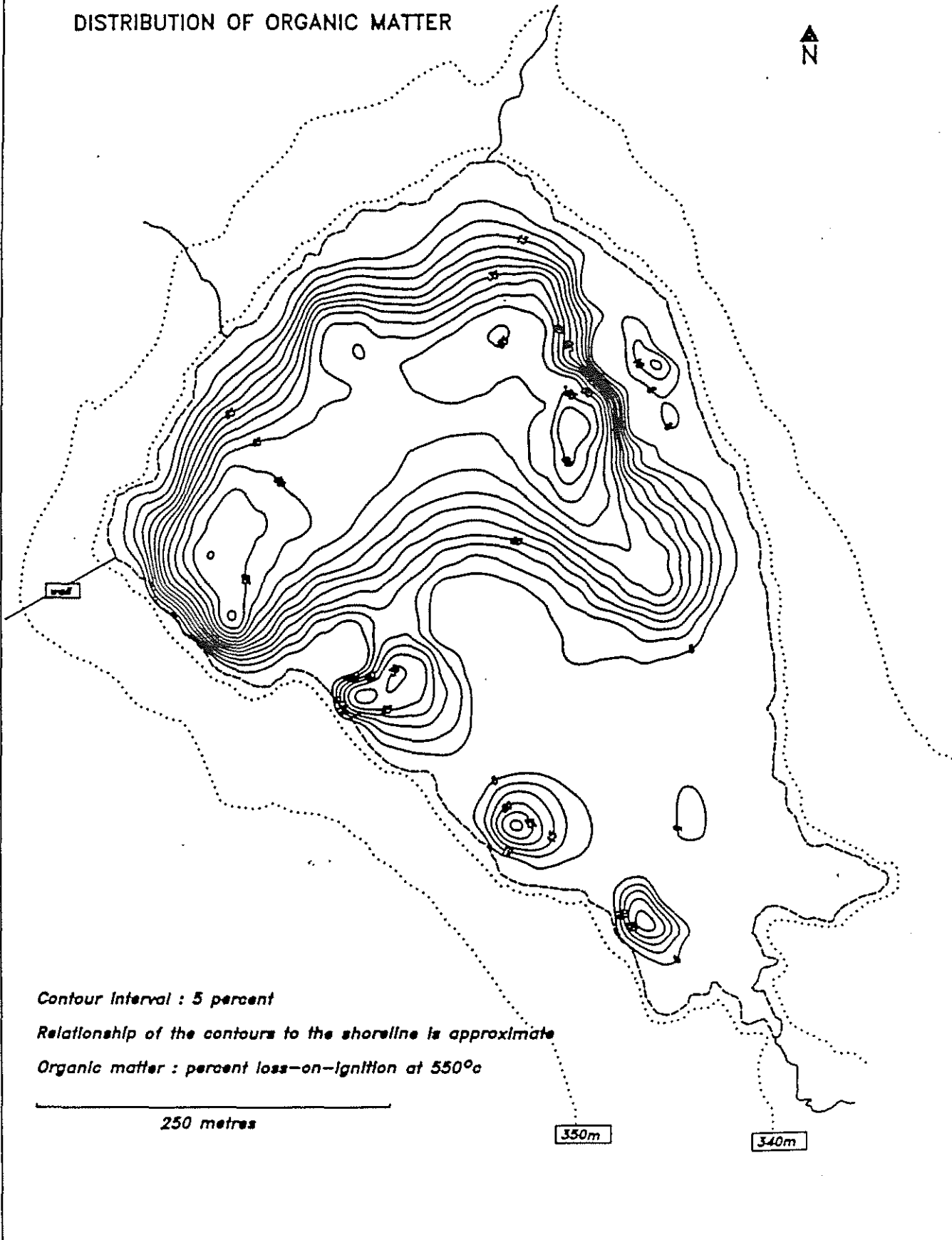


Fig. 7 Distribution of organic matter, as determined by loss-on-ignition.

LOCH FLEET

LOCATION OF MINICORES AND LIVINGSTONE CORES
CORED JULY 1984

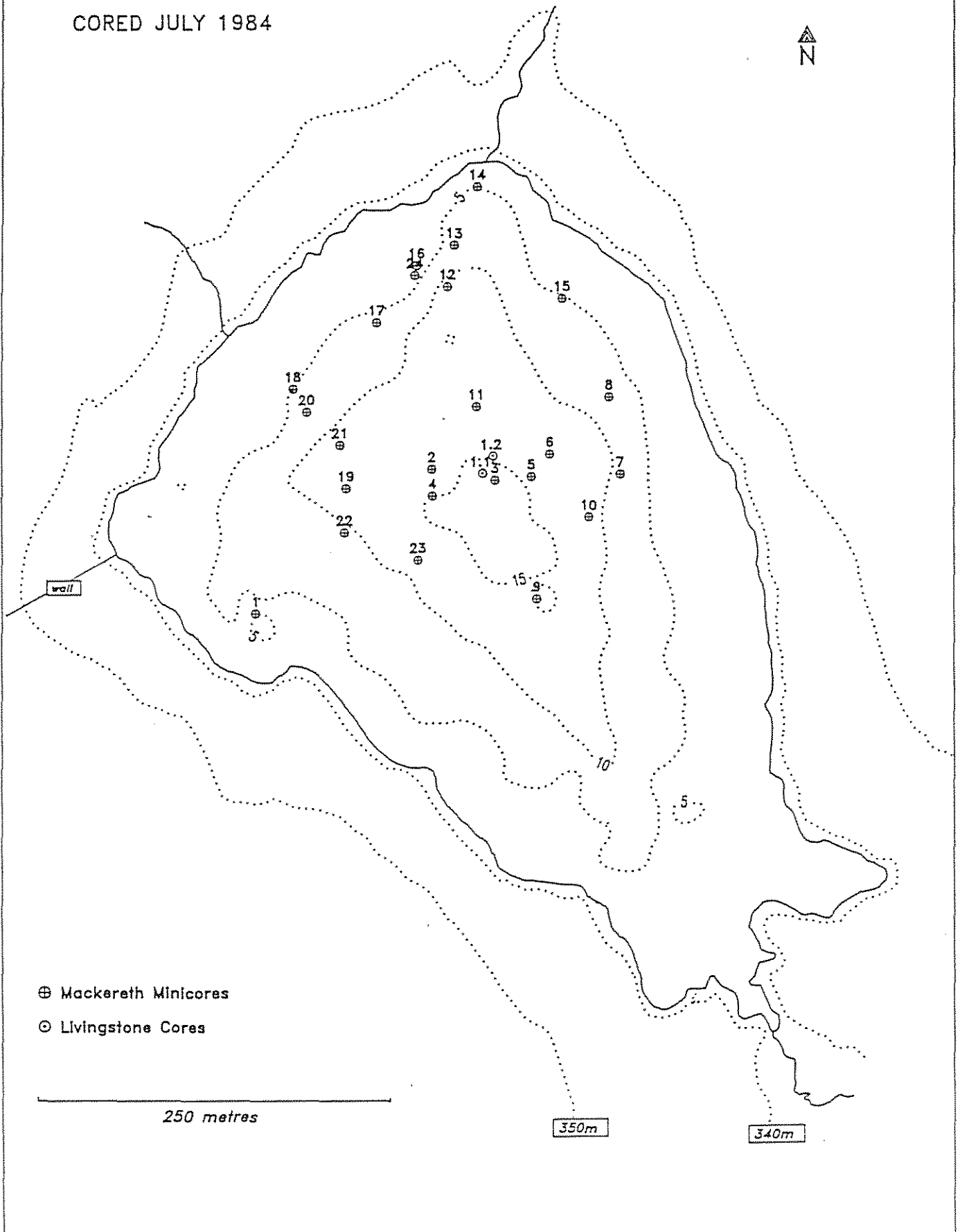


Fig. 8 Location of Mackereth minicores and Livingstone cores.

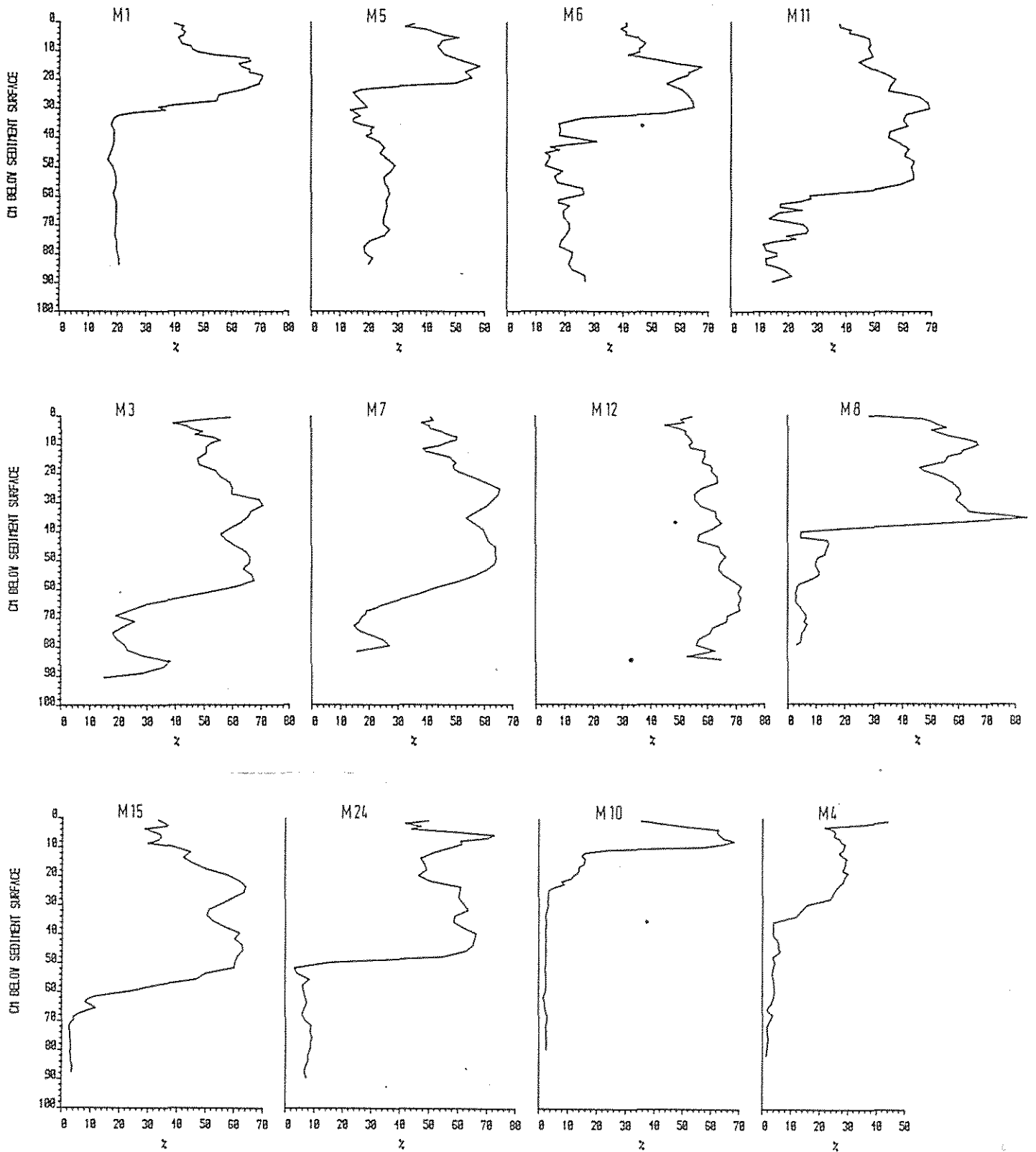


Fig. 9a % LOI Mackereth minicores.

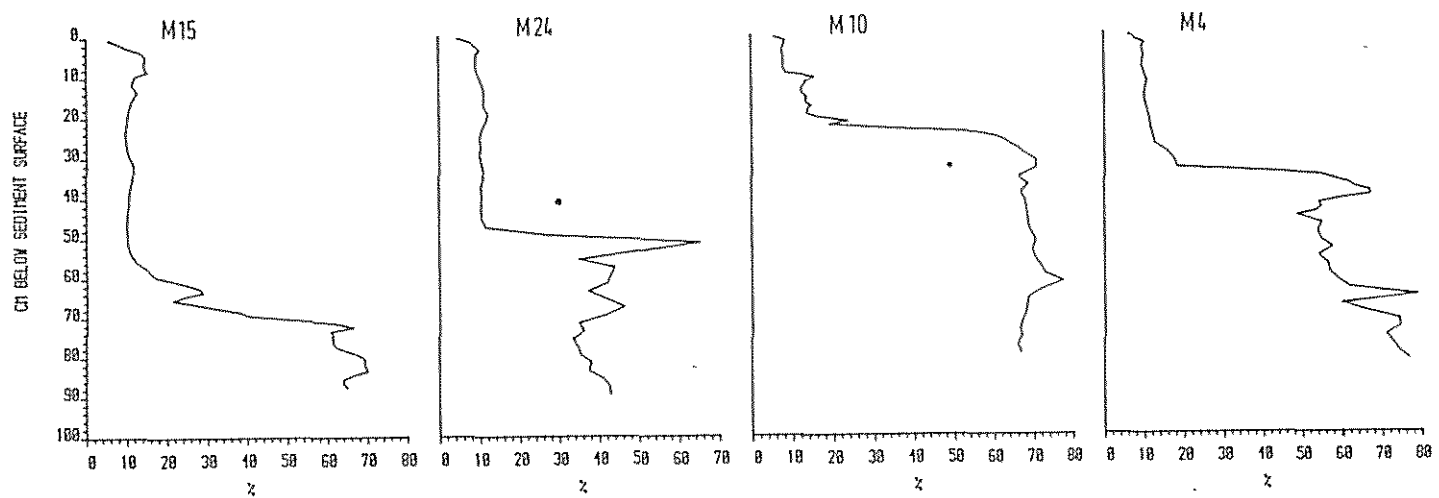
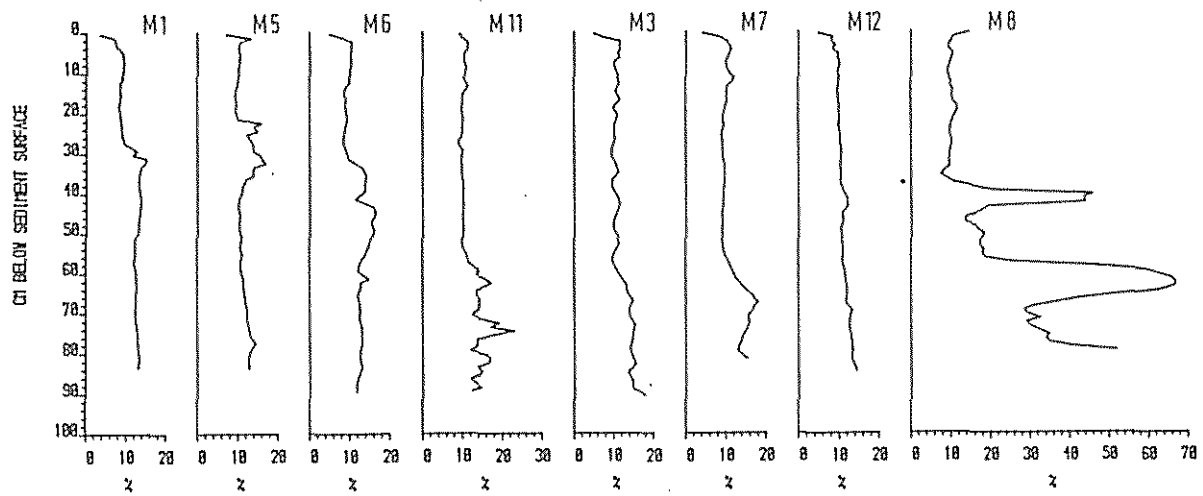


Fig. 9b % Dry weight Mackereth minicores.

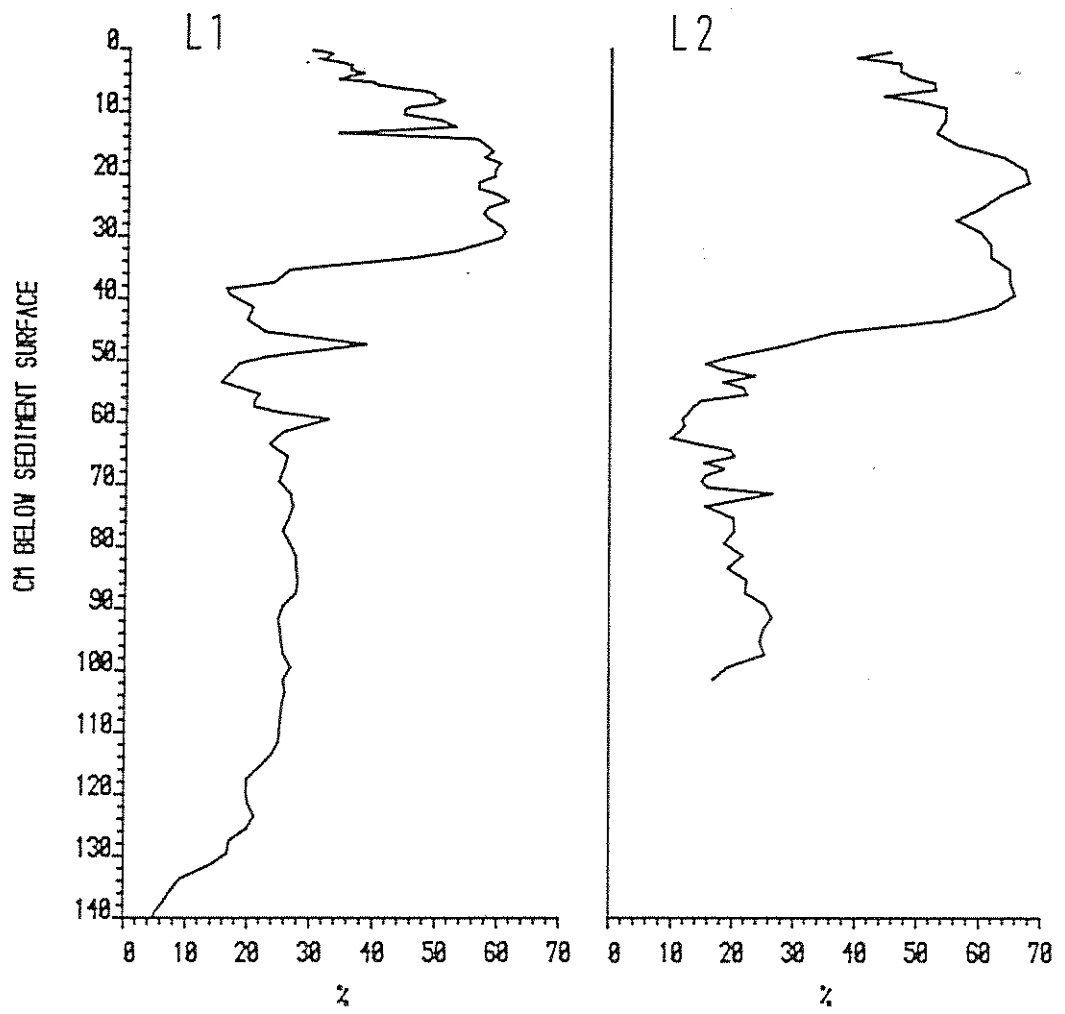


Fig. 10a % LOI Livingstone cores.

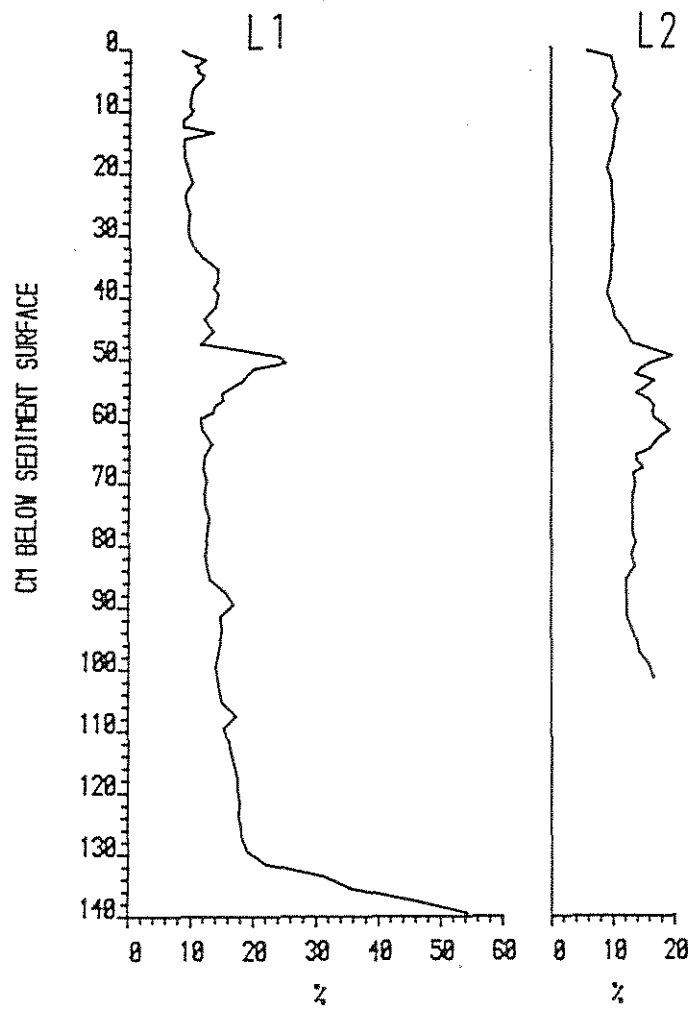


Fig. 10b % Dry weight Livingstone cores.

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