**ASSESSMENT OF CHANGES IN TOTAL PHOSPHORUS IN WEST LAKE, B.C:
A PALEOLIMNOLOGICAL ASSESSMENT (March 2003)**

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BACKGROUND

A sediment core was retrieved from West Lake with a modified K-B corer (internal diameter ~7.62 cm) on February 10, 2003 by Bruce Carmichael and colleagues. A 20.5-cm core was retrieved from a depth of approximately 16.3 meters. Samples were sectioned into 0.5 cm intervals and shipped to Queen's University on 10 February, 2003, where they were stored in our coldroom at 4 °C. All the samples were weighed to determine the total wet weight of sediment prior to subsampling for ^{210}Pb analyses. Twenty intervals were subsampled for diatoms every one cm from 0.0 to 19.0 cm. Sixteen intervals, spaced at 1-cm intervals for the top 11 cm, then 2 cm to the bottom of the core, were prepared for ^{210}Pb analysis (see below) and then counted on the gamma counter facilities at PEARL, Queen's University.

METHODS

210-Pb Dating and Percent Organic Matter

The wet weight of the sediment was determined for all the subsections of the core that were shipped to Queen's. Nineteen samples were dried in the freeze drier at PEARL (24 hr. cycle). Dry weight of the sediment and percent water was determined. Dry sediment was then precisely weighed into a plastic tube for gamma spectroscopy. These samples were then sealed with epoxy and allowed to sit for three weeks in order for ^{214}Bi to equalize for determination of supported ^{210}Pb used in estimating core chronology. Activities of ^{210}Pb, ^{137}Cs and supported ^{210}Pb (via ^{214}Bi) were determined for each sample. These spectra were then used to estimate the chronology of the core.

The activities (in disintegrations per minute/gram) of ^{210}Pb, ^{137}Cs and ^{214}Bi were determined using the procedures outlined in Schelske et al. (1994). These values were converted into picoCuries/gram for use in the Binford program (see below). Unsupported ^{210}Pb was calculated by subtracting supported ^{210}Pb (as determined by the average ^{214}Bi counts from all samples within each of the cores) from the total ^{210}Pb activity at each level. The sediment chronology and sedimentation rates were calculated using the constant rate of supply (CRS) model (Appleby and Oldfield, 1978) from the estimates of ^{210}Pb activities and estimates of cumulative dry mass (Binford, 1990). See Appendix B for a summary of ^{210}Pb calculations (B-1), and the dating output file from the CRS model (B-2).

Percent organic matter was determined for all sixteen of the samples that were ^{210}Pb dated (Appendix A) using standard loss-on-ignition methods (Dean, 1974). A known quantity of dried sediment (recorded to four decimal places) was heated to 550°C for 2 hours. The difference between the dry weight of the sediment and the weight of sediment remaining after ignition was used to estimate the percent of organic matter in each sediment sample.

Diatom Preparation and Enumeration

Slides for diatom analysis were prepared using standard techniques (Cumming et al. 1995). Briefly, a small amount of wet sediment was suspended in a 50:50 (molar) mixture of sulfuric and nitric acid in a 20-ml glass vial for 24 hr. prior to being submersed at 70°C in a hot water bath for 5 hr. The remaining sediment material was settled for a period of 24 hr, at which time the acid above the sample was removed. The sample was rinsed with distilled water and allowed to settle once again for 24 hrs. The procedure was repeated approximately 10 times until the sample was acid free (litmus test). The samples were settled onto coverslips in a series of four 100% dilutions, which when dry, were mounted onto glass slides using a high-resolution mounting media called Naphrax®. For each sample, at least 400 diatom valves were enumerated with a Leica DMRB microscope equipped with DIC optics at 1000X magnification (Numerical Aperture of objective = 1.3). These analyses were based on the references of Krammer and Lange-Bertalot (1986, 1988, 1991a,b), Patrick and Reimer (1966, 1975) and Cumming et al. (1995).

Diatom-based Reconstructions of Total Phosphorus

Inferences of total phosphorus from the diatom assemblages in the core are based on a phosphorus model developed from 111 freshwater lakes from the 219 lakes sampled by Wilson et al. (1996). This model is based on estimates of the optima of taxa from weighted-averaging regression on non-transformed relative percentage data. The coefficient of determination (r^2) of this model is 0.66, and the jackknifed r^2 is 0.47. This model is superior to the earlier models developed by Reavie et al. (1995) for several reasons including its better predictive ability and the larger number of samples which provide more analogs for downcore reconstructions.

The total phosphorus inferences (Fig. 1E) were critically assessed to determine: 1) if they tracked the main direction of variation in the diatom species assemblages (Fig. 1D); and 2) to assess if the assemblages encountered in the core are well represented in the modern-day samples (Fig. 1F). If the diatom-based phosphorus reconstructions match the main direction of variation in the diatom assemblages in the core, then we can be fairly confident that the diatoms are tracking changes that are related to phosphorus. If the correlation between the main direction of variation and the diatom-inferred phosphorus values is weak or nonexistent, then other environmental variables (e.g. water depth, conductivity, turbulence, etc.), or interactions between environmental variables, are likely responsible for the observed changes in diatom assemblages.

Determination of the Main Direction of Variation

The main direction of variation in the diatom assemblages in the core was determined from the first axis scores from a principal components analysis (PCA) ordination using non-transformed species abundance data (Fig. 1D). A PCA was chosen to represent the main direction of variation of the diatom assemblages in these cores based on the small gradient length (< 1.5 standard deviation units) obtained in an initial detrended correspondence analysis (DCA) ordination.

Analog Analysis of Diatom Assemblages

The reliability of the total phosphorus inferences in the core assumes that the diatom assemblage encountered downcore are well represented in our modern diatom assemblages. To determine if appropriate analogs existed for the core samples, we determined which samples in our present-day dataset of 111 lakes most resembled each of the downcore samples. This determination was based on a squared chord dissimilarity coefficient between all species found in each of the core samples. The best match between downcore and modern samples was compared with the distribution of best match between modern samples. Any downcore samples that were more dissimilar than 80% of the modern distribution were deemed to be a 'poor analog'. Similarly, any downcore samples that were more dissimilar than 95% of the modern distribution were deemed to have 'no analog' in our present-day dataset. If the downcore assemblages have good representation in modern samples, more confidence can be placed in the reconstruction. If modern analogs do not exist or are poor, then caution must be placed in reconstructions from these downcore samples.

RESULTS AND DISCUSSION

^{210}Pb Profile, Sedimentation Rates and Organic Matter

The ^{210}Pb activity of the West Lake core was low and did not show an expected exponential decay with core depth (Fig. 1A), suggesting either variations in sediment deposition or mixing of the core. The ^{137}Cs profile suggests that cesium has been mobile within the sediments (Fig. 2). Thus, although there is not a distinct peak in the ^{137}Cs profile, the rise at around 13.5 cm does indicate that the sediment deposited before this point are older than 1963. A distinct peak in ^{137}Cs is a marker for 1963, since 1963 corresponds to the peak in atmospheric testing of nuclear weapons, and consequently fallout of isotopes such as ^{137}Cs. The ^{210}Pb model suggests that 1963 occurs between 9.5-11 cm. Given the rather complex ^{210}Pb profile and the mismatch with ^{137}Cs there is uncertainty in the estimated chronology of approximately 10 years.

Results from the CRS model suggest that sedimentation rates started to increase in the early 1950s, with more pronounced increases since the 1980s (Fig. 1B). However, because sedimentation rates can vary across a lake basin caution must be placed on interpreting sedimentation rates from one core in the basin. Analysis of organic matter (OM) from the core indicates relatively low organic sediments (14-16% OM) that have been relatively constant since the 1800s (Fig. 1C). There have been very small increases starting in 1960s (Fig. 1C), but the scale only spans a 2% OM change, and thus the increase is relatively small.

Diatom Assemblage Changes and Analyses

One hundred and twenty-one diatom taxa were documented in the core from West Lake. The majority of these taxa were rare (< 1-3% maximum abundance, Appendix C). The dominant taxa throughout the last 200 years were the mesotrophic to eutrophic planktonic taxa *Stephanodiscus parvus*, *Stephanodiscus minutulus* and *Aulacoseira subarctica*.

Cluster analysis indicated that the total sum of squares was extremely low, suggesting that there has been little change in the assemblage over the last 200 years, so zones based on such a low sum of squares are not presented (Fig. 3). The flora has been dominated by mesotrophic to eutrophic planktonic taxa *Stephanodiscus parvus*, *Stephanodiscus minutulus* and *Aulacoseira subarctica*. Subdominant taxa that also appear throughout the core include *Fragilaria pinnata*, *Fragilaria crotonensis*, *Asterionella formosa* and *Tabellaria* species.

Diatom-inferred total phosphorus (TP) estimates indicate small fluctuations in TP between 18 μgL^{-1} to 24 μgL^{-1} (Fig. 1E). The correlation between the main direction of variation in taxa (i.e. PCA axis 1 scores) (Fig. 1D) and the log TP inferences is relatively high ($r = 0.77$) suggesting that the minor fluctuations seen in the percent composition of the diatom flora are consistent with changes in inferred TP. Analog analysis suggests that all samples had good analogs in the calibration set of modern diatom assemblages (Fig. 1F) providing evidence that the TP inferences are reliable.

Summary

In summary, the TP levels of West Lake have varied little over the past 200 years (20-24 μgL^{-1}, with one low point around 1820 of 18 μgL^{-1}). The diatom flora has remained relatively stable throughout this time being dominated by mesotrophic to eutrophic planktonic taxa *Stephanodiscus parvus*, *Stephanodiscus minutulus* and *Aulacoseira subarctica*. There have been increases in sedimentation rates starting in the 1950s, increasing at a greater rate since the 1980s and small increases in organic matter since approximately 1960.

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FIGURE CAPTIONS

Figure 1. Summary diagram for West Lake showing: A) total ^{210}Pb activity; B) the sediment accumulation rate; C) the change in the percent of organic matter in the core; D) the main direction of variation in the diatom assemblage data; E) diatom-based estimated of late-summer total phosphorus; and F) analog analysis showing the dissimilarity between present-day and downcore samples (any sample that has a squared chord distance > 0.8 was determined to be a poor analog, whereas any sample with a squared chord distance greater than 1.1 was determined to have no analog in the modern dataset).

Figure 2. ^{210}Pb profile and ^{137}Cs profile for West Lake.

Figure 3. Stratigraphy of the most abundant diatom taxa found in the sediment core from West Lake, B.C. (see Appendix C-1 for a complete list of taxa and the relative percentage data). The diatom taxa are arranged in order of increasing late-summer total phosphorus (TP) optima.

FIG. 1

West Lake

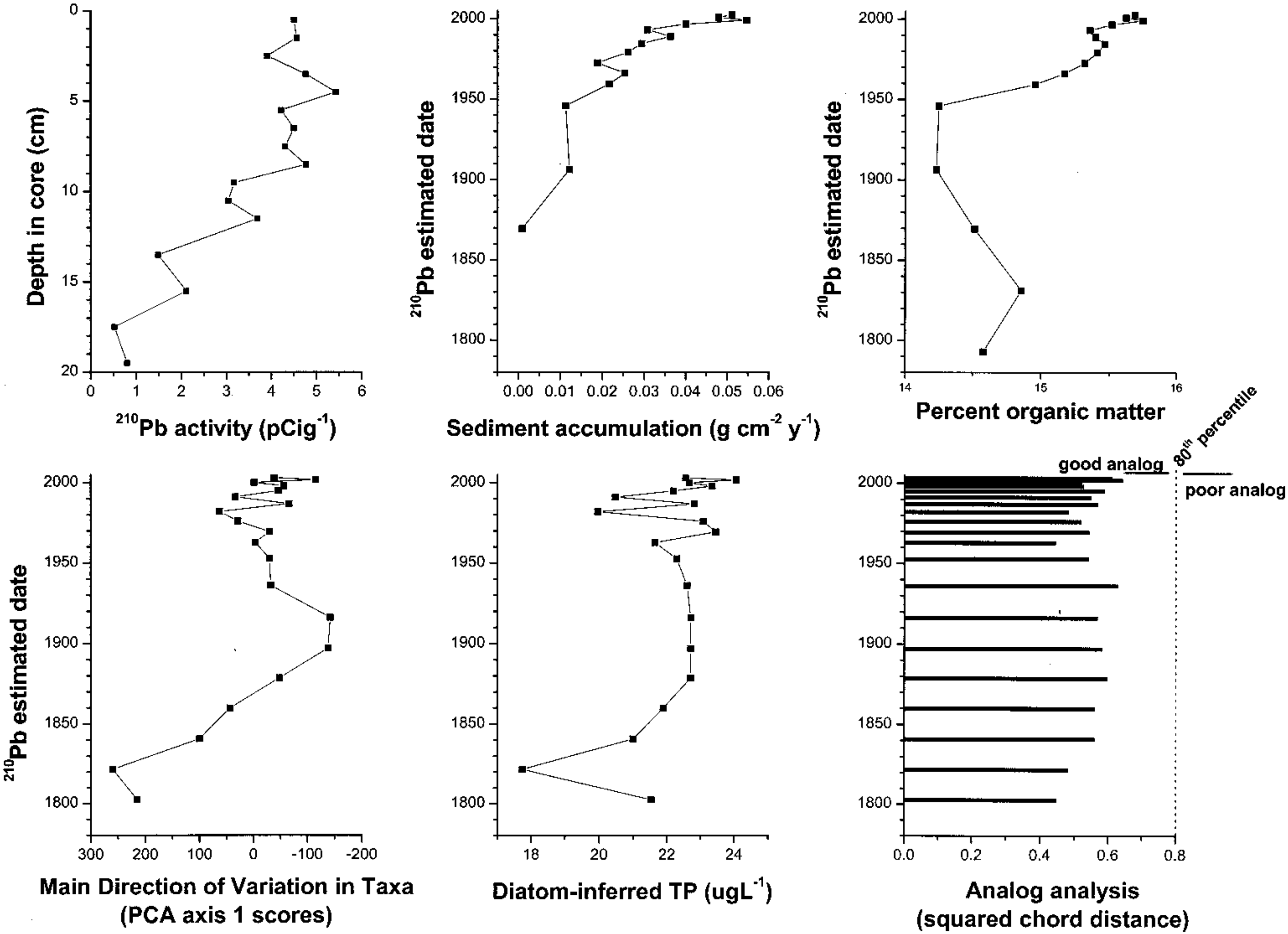
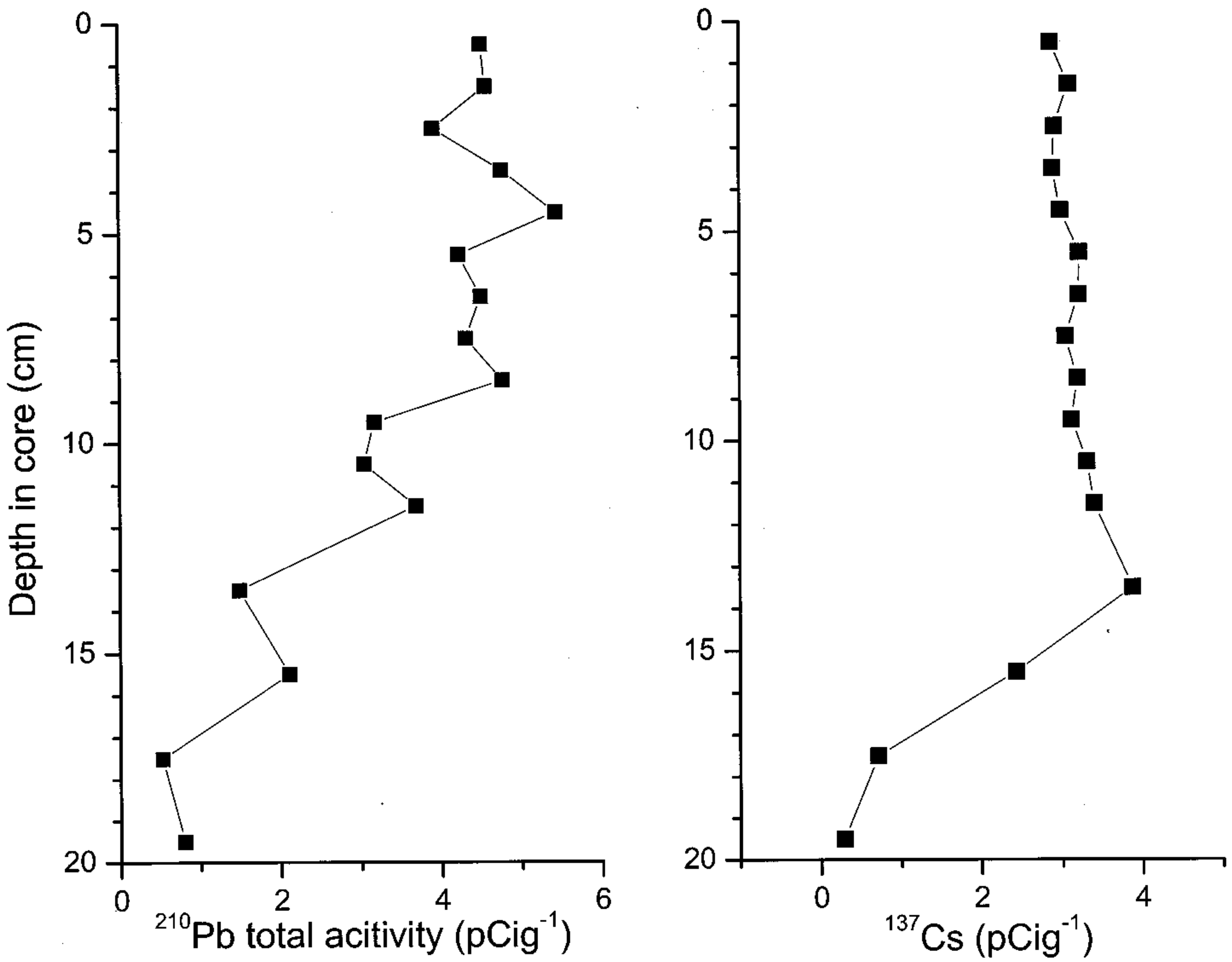


FIG. 2


Depth in core (cm)
0
5
10
15
20
0
2
4
6
210Pb total acitivity (pCig-1)
0
5
10
15
20
0
2
4
137Cs (pCig-1)

West Lake, British Columbia

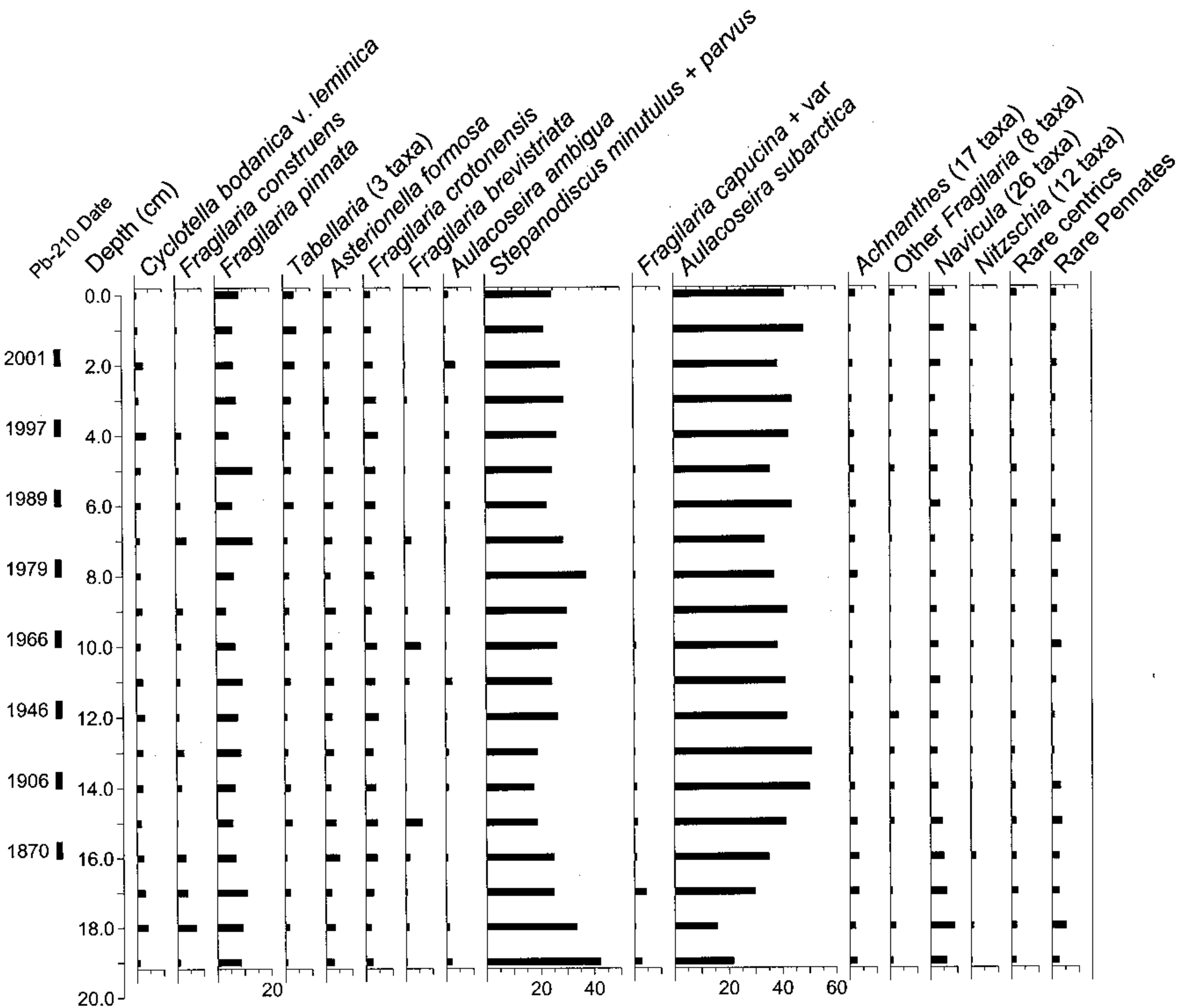


FIG. 3

Appendix A

Summary File West Lake

Pb210 and LOI summary

* = extrapoloted dates

INTTOP (cm)	INTBOT (cm)	137Cs (pCig-1)	Pb210Act (pCi/g)	estimated AD date	SEDRATE (g/cm2/yr)	LOI(550C) %organic
0.5	1	2.8566	4.5025	2002.7	0.0511	15.69038
1.5	2	3.0792	4.5591	2001.0	0.0478	15.62423
2.5	3	2.9058	3.9042	1999.3	0.0546	15.74821
3.5	4	2.8816	4.7598	1996.8	0.0399	15.51882
4.5	5	2.9786	5.4277	1993.2	0.0307	15.3572
5.5	6	3.2075	4.2178	1989.1	0.0362	15.39738
6.5	7	3.2022	4.4967	1984.7	0.0293	15.46534
7.5	8	3.0381	4.3077	1979.4	0.0261	15.41164
8.5	9	3.1840	4.7657	1972.7	0.0188	15.31802
9.5	10	3.1142	3.1674	1966.2	0.0253	15.17074
10.5	11	3.3032	3.0391	1959.4	0.0216	14.95644
11.5	12	3.3883	3.6822	1946.0	0.0113	14.24915
13.5	14	3.8710	1.4858	1906.2	0.0122	14.2312
15.5	15	2.4283	2.1087	1869.5	0.0009	14.51376
17.5	17	0.7091	0.5219	1831.2		14.85668
19.5	20	0.2857	0.8019	1793.0		14.57814

Diatom analyses

Depth (cm TOP	Depth (cm BOTTOM	estimated AD date	log TP	TP	PCA Axis 1	ANALOG min. sq.chord
0	0.5	2003.167	1.353	22.542	-38	0.6096
1	1.5	2001.85	1.381	24.044	-115	0.6421
2	2.5	2000.157	1.355	22.646	-1	0.5211
3	3.5	1998.04	1.368	23.335	-56	0.5274
4	4.5	1995.012	1.346	22.182	-46	0.5890
5	5.5	1991.159	1.311	20.464	34	0.5496
6	6.5	1986.889	1.358	22.803	-66	0.5684
7	7.5	1982.065	1.300	19.953	63	0.4835
8	8.5	1976.052	1.363	23.067	29	0.5197
9	9.5	1969.44	1.370	23.442	-30	0.5433
10	10.5	1962.804	1.335	21.627	-3	0.4450
11	11.5	1952.695	1.348	22.284	-30	0.5432
12	12.5	1936.045	1.354	22.594	-32	0.6286
13	13.5	1916.159	1.356	22.699	-142	0.5688
14	14.5	1897.034	1.356	22.699	-138	0.5816
15	15.5	1878.67	1.356	22.699	-48	0.5973
16	16.5	1859.925	1.340	21.878	44	0.5615
17	17.5	1840.8	1.322	20.989	100	0.5603
18	18.5	1821.675	1.249	17.742	260	0.4821
19	19.5	1802.55	1.333	21.528	215	0.4474

APPENDIX B-1

West Lake - Pb210

CALCULATIONS FOR INPUT INTO BINFORD PROGRAM

1 dps= 1Becquerrel

INTTOP (cm)	INTBOT (cm)	Pb-210 (dps/g) activity	Std dev Pb-210 (dps/g)	214Bi (dps/g)	137Cs (dps/g)	137Cs (pCig-1)	Pb210 activity (pCig-1)	Std dev Pb-210 (pCig-1)	214Bi (pCig-1)	Rho (g cm-3)
0.5	1	0.166594	0.008207	0.017399	0.105696	2.8566	4.5025	0.2218	0.4703	0.0998
1.5	2	0.168686	0.008466	0.030705	0.113932	3.0792	4.5591	0.2288	0.8299	0.0656
2.5	3	0.144457	0.007551	0.031932	0.107514	2.9058	3.9042	0.2041	0.8630	0.1159
3.5	4	0.176113	0.008444	0.013356	0.106619	2.8816	4.7598	0.2282	0.3610	0.1165
4.5	5	0.200826	0.009353	0.020651	0.110209	2.9786	5.4277	0.2528	0.5581	0.1301
5.5	6	0.15606	0.008892	0.023092	0.118676	3.2075	4.2178	0.2403	0.6241	0.1470
6.5	7	0.166378	0.008298	0.018259	0.118482	3.2022	4.4967	0.2243	0.4935	0.1385
7.5	8	0.159384	0.008708	0.019955	0.11241	3.0381	4.3077	0.2354	0.5393	0.1528
8.5	9	0.176331	0.008614	0.040715	0.117807	3.1840	4.7657	0.2328	1.1004	0.1463
9.5	10	0.117194	0.007282	0.033276	0.115226	3.1142	3.1674	0.1968	0.8994	0.1294
10.5	11	0.112445	0.007028	0.01856	0.122219	3.3032	3.0391	0.1899	0.5016	0.1899
11.5	12	0.136243	0.007557	0.024491	0.125367	3.3883	3.6822	0.2043	0.6619	0.2184
13.5	14	0.054974	0.004121	0.021859	0.143225	3.8710	1.4858	0.1114	0.5908	0.2341
15.5	15	0.07802	0.005503	0.05545	0.089848	2.4283	2.1087	0.1487	1.4987	0.1186
17.5	17	0.01931	0.002558	0.011548	0.026238	0.7091	0.5219	0.0691	0.3121	0.1961
19.5	20	0.02967	0.003257	0.024888	0.010572	0.2857	0.8019	0.0880	0.6727	0.2155

BINFORD FILE INPUTS FOR CALCULATIONS OF DATES AND SEDIMENTATION RATES

West
C1
16.00
0.2994

INTTOP (cm)	INTBOT (cm)	Pb210 Total (pCig-1)	Pb210 Unsup. (pCig-1)	Rho (g cm-3)	OM proportion	CUMTOP (g cm-2)	CUMBOT (g cm-2)	std Pb210 (pCig-1)
0.5000	1.0000	4.5025	3.8165	0.0998	0.16	0.0860	0.1359	0.2218
1.5000	2.0000	4.5591	3.8730	0.0656	0.16	0.1890	0.2218	0.2288
2.5000	3.0000	3.9042	3.2182	0.1159	0.16	0.2782	0.3361	0.2041
3.5000	4.0000	4.7598	4.0738	0.1165	0.16	0.3961	0.4544	0.2282
4.5000	5.0000	5.4277	4.7417	0.1301	0.15	0.5218	0.5869	0.2528
5.5000	6.0000	4.2178	3.5318	0.1470	0.15	0.6515	0.7250	0.2403
6.5000	7.0000	4.4967	3.8107	0.1385	0.15	0.7946	0.8638	0.2243
7.5000	8.0000	4.3077	3.6216	0.1528	0.15	0.9410	1.0174	0.2354
8.5000	9.0000	4.7657	4.0797	0.1463	0.15	1.0956	1.1688	0.2328
9.5000	10.0000	3.1674	2.4814	0.1294	0.15	1.2598	1.3245	0.1968
10.5000	11.0000	3.0391	2.3530	0.1899	0.15	1.4127	1.5076	0.1899
11.5000	12.0000	3.6822	2.9962	0.2184	0.14	1.6162	1.7254	0.2043
13.5000	14.0000	1.4858	0.7998	0.2341	0.14	2.0781	2.1951	0.1114
15.5000	15.0000	2.1087	1.4226	0.1186	0.15	2.5854	2.6447	0.1487
17.5000	17.0000	0.5219	0.0000	0.1961	0.15	2.9682	3.0663	0.0691
19.5000	20.0000	0.8019	0.0000	0.2155	0.15	3.3765	3.4843	0.0880

r

YOU ARE ANALYZING CORE C1 FROM LAKE West

THE DATA ARE:

INTTOP	INTBOT	PB210ACT	UNSUPACT	RHO	PERCORG	CUMMASST	CUMMASSB	SDACT
0.5	1.0	4.50250	3.81650	0.09980	0.160	0.0860	0.1359	0.2218
1.5	2.0	4.55910	3.87300	0.06560	0.160	0.1890	0.2218	0.2288
2.5	3.0	3.90420	3.21820	0.11590	0.160	0.2782	0.3361	0.2041
3.5	4.0	4.75980	4.07380	0.11650	0.160	0.3961	0.4544	0.2282
4.5	5.0	5.42770	4.74170	0.13010	0.150	0.5218	0.5869	0.2528
5.5	6.0	4.21780	3.53180	0.14700	0.150	0.6515	0.7250	0.2403
6.5	7.0	4.49670	3.81070	0.13850	0.150	0.7946	0.8638	0.2243
7.5	8.0	4.30770	3.62160	0.15280	0.150	0.9410	1.0174	0.2354
8.5	9.0	4.76570	4.07970	0.14630	0.150	1.0956	1.1688	0.2328
9.5	10.0	3.16740	2.48140	0.12940	0.150	1.2598	1.3245	0.1968
10.5	11.0	3.03910	2.35300	0.18990	0.150	1.4127	1.5076	0.1899
11.5	12.0	3.68220	2.99620	0.21840	0.140	1.6162	1.7254	0.2043
13.5	14.0	1.48580	0.79980	0.23410	0.140	2.0781	2.1951	0.1114
15.5	15.0	2.10870	1.42260	0.11860	0.150	2.5854	2.6447	0.1487
17.5	17.0	0.52190	0.00000	0.19610	0.150	2.9682	3.0663	0.0691
19.5	20.0	0.80190	0.00000	0.21550	0.150	3.3765	3.4843	0.0880

STANDARD DEVIATION OF SUPPORTED PB-210 = 0.2994

Pb-210 dates for Lake West core C1

INTTOP	INTBOT	MIDINT	TTOP	SDTTOP	TBOT	SDTBOT	SEDRATE	SDSEDRT	SUMTOP
0.5	1.0	0.7	0.00	0.95	0.98	0.96	0.0511	0.0127	6.3616
1.5	2.0	1.7	1.80	0.98	2.49	0.99	0.0478	0.0123	6.0145
2.5	3.0	2.7	3.34	1.00	4.41	1.01	0.0546	0.0141	5.7326
3.5	4.0	3.7	5.65	1.03	7.11	1.05	0.0399	0.0110	5.3353
4.5	5.0	4.7	8.87	1.08	10.99	1.11	0.0307	0.0093	4.8266
5.5	6.0	5.7	13.07	1.16	15.10	1.19	0.0362	0.0114	4.2349
6.5	7.0	6.7	17.29	1.24	19.65	1.29	0.0293	0.0099	3.7136
7.5	8.0	7.7	22.27	1.37	25.20	1.43	0.0261	0.0097	3.1794
8.5	9.0	8.7	28.55	1.55	32.44	1.67	0.0188	0.0080	2.6153
9.5	10.0	9.7	35.68	1.81	38.24	1.90	0.0253	0.0112	2.0945
10.5	11.0	10.7	41.56	2.08	45.97	2.24	0.0216	0.0108	1.7437
11.5	12.0	11.7	52.30	2.67	62.06	3.29	0.0113	0.0077	1.2482
13.5	14.0	13.7	92.13	7.40	101.77	8.91	0.0122	0.0142	0.3611
15.5	15.0	15.2	290.82	******	138.54	24.08	0.0009	0.0067	0.0007

Execution terminated : 0

C:\PB210>

APPENDIX C

West Lake
Analyst: KR Laird (April, 2003)

Taxa	Interval (cm) 0-0.5	1-1.5	2-2.5	3-3.5	4-4.5	5-5.5	6-6.5	7-7.5	8-8.5	9-9.5	10-10.5	11-11.5	12-12.5	13-13.5	14-14.5	15-15.5	16-16.5	17-17.5	18-18.5	19-19.5
Achnanthes calcar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
Achnanthes clevei	0.24	0.00	0.25	0.00	0.00	0.48	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.97	0.24	0.49
Achnanthes conspicua	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.25	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Achnanthes delicatula	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Achnanthes joursacense	0.00	0.24	0.00	0.00	0.49	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.23	0.48	0.00	0.24	0.71	0.49
Achnanthes lanceolata	0.00	0.00	0.00	0.00	0.25	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.47	0.00
Achnanthes lanceolata v. dubius	0.00	0.00	0.00	0.00	0.00	0.48	0.48	0.00	0.00	0.00	0.24	0.24	0.00	0.00	0.92	0.00	0.47	0.00	0.00	0.00
Achnanthes lanceolata spp. freq.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00
Achnanthes laterostrata	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Achnanthes levanderi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00
Achnanthes minutissima	0.95	0.00	0.00	0.49	0.74	0.00	0.96	0.46	0.49	0.24	0.73	0.72	0.00	0.25	0.00	0.48	1.42	2.19	0.24	1.23
Achnanthes oestrupii	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00
Achnanthes peragalli	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Achnanthes pinnata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.71	0.00	0.00	0.00
Achnanthes suchlandtii	0.00	0.24	0.25	0.24	0.00	0.00	0.48	0.00	0.00	0.24	0.00	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Achnanthes ziegleri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Achnanthes spp.	0.24	0.24	0.25	0.24	0.25	0.72	0.48	1.16	0.99	0.48	0.00	0.24	0.50	0.25	0.46	0.48	0.24	0.00	0.47	0.25
Amphora fogediana	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
Amphora pediculus	0.24	0.00	0.49	0.00	0.00	0.24	0.48	0.23	0.49	0.00	0.73	0.00	0.00	0.25	1.61	0.00	0.47	0.49	0.95	0.49
Amphora spp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Asterionella formosa	3.10	2.90	2.22	1.71	2.22	3.34	3.36	2.78	2.22	4.12	2.68	3.35	2.73	3.19	2.07	3.84	5.19	2.19	3.55	2.96
Aulacoseira ambigua	1.43	0.48	3.94	1.46	1.72	1.91	1.92	0.46	0.25	1.69	0.24	2.39	0.50	0.98	0.92	0.00	0.71	0.00	1.18	1.98
Aulacoseira canadensis	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aulacoseira crassipunctata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00
Aulacoseira subarctica	40.95	48.07	38.42	43.66	42.38	35.56	43.65	33.41	36.95	41.89	38.29	41.15	41.69	50.86	50.00	41.25	34.91	29.93	15.84	21.73
Aulacoseira spp.	0.95	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brachysira spp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00
Caloneis spp.	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cocconeis neodiminuta	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00
Cocconeis placentula	0.71	0.24	0.00	0.49	0.25	0.00	0.48	0.70	0.00	0.00	0.00	0.24	0.00	0.00	0.23	0.24	0.00	0.00	0.24	0.00
Cocconeis placentula v. euglypta	0.00	0.24	0.25	0.24	0.49	0.00	0.24	0.00	0.00	0.24	0.24	0.24	0.00	0.25	0.00	0.48	0.00	0.49	0.24	0.25
Cocconeis placentula v. lineata	0.00	0.24	0.00	0.00	0.00	0.24	0.24	0.70	0.99	0.97	0.73	0.00	0.99	0.00	0.46	1.20	0.71	0.24	0.24	0.99
Cocconeis spp.	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.23	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cyclotella bodanica v. lemanica	0.48	0.97	2.96	1.22	3.94	1.91	1.92	1.39	1.72	2.18	1.46	2.39	2.98	2.21	2.30	1.68	2.36	2.92	4.02	0.99
Cyclotella stelligera	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.48	0.24	0.73	0.71	0.74
Cymbella cesatii	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00
Cymbella microcephala	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.49
Cymbella minuta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.23	0.00	0.47	0.49	0.47	0.00
Cymbella muelleri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cymbella naviculiformis	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cymbella proxima	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00
Cymbella spp.	0.00	0.00	0.25	0.24	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Diatoma tenue	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00
Diploneis spp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Epithemia adnata	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Epithemia turgida	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Epithemia spp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eunotia hemicyclus	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00
Eunotia spp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Fragilaria brevistriata (+v. inflata)	0.00	0.00	0.49	0.98	0.00	0.24	0.00	2.55	0.00	0.97	5.85	1.44	0.00	0.25	0.46	6.24	1.42	0.49	1.18	0.49
Fragilaria capucina	0.00	0.48	0.00	0.00	0.25	0.72	0.48	0.46	0.00	0.00	0.00	0.48	0.50	0.25	0.92	1.20	0.94	2.92	0.24	1.73
Fragilaria capucina v. gracilis	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.00	0.00	0.00	0.00	0.00	0.00	1.46	0.00	0.99
Fragilaria capucina v. mesolepta	0.00	0.00	0.25	0.24	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fragilaria construens	0.48	0.72	0.25	0.00	2.22	1.19	1.68	3.94	0.00	2.42	1.71	1.44	0.99	2.70	1.84	0.24	3.30	3.89	7.09	0.99
Fragilaria crotonensis	2.38	2.66	3.45	4.39	5.17	4.06	4.08	2.55	3.45	2.42	4.39	3.59	4.96	2.95	3.92	4.56	4.25	2.92	1.89	2.47
Fragilaria exigua	0.00	0.00	0.00	0.00	0.00	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fragilaria leptostriata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00
Fragilaria nanana	0.24	0.24	0.25	0.00	0.49	0.24	0.48	0.00	0.25	0.24	0.24	0.24	0.50	0.49	0.23	0.00	0.24	0.00	0.00	0.00
Fragilaria cf. neoproducta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.48	0.00	0.00	1.44	0.00	0.00	0.00	0.00
Fragilaria pinnata	8.57	6.28	6.40	7.56	4.68	13.60	6.00	13.46	6.40	3.39	6.83	9.33	7.69	8.85	6.68	5.76	6.84	10.95	9.22	8.64
Fragilaria robusta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.49
Fragilaria tenera	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	1.15	0.00	0.00	0.49	1.89	0.49
Fragilaria ulna	0.96	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fragilaria spp.	0.95	0.00	0.74	0.98	0.00	0.48	0.00	0.00	0.00	0.24	0.00	0.00	0.25	0.49	0.00	0.00	0.00	0.24	0.00	0.00
Gomphonema angustum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00
Gomphonema parvulum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.00	0.00	0.00	0.00
Gomphonema spp.	0.48	0.48	0.25	0.24	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00
Gyrosigma spp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Meridion circulare	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00
Navicula capitata v. hungarica	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.25
Navicula cryptocephala	0.00	0.00	0.25	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00
Navicula cryptotenella	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00
Navicula cryptotenella fo. 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Navicula diluviana	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00
Navicula evan.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00
Navicula harderii	0.48	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Navicula laevissima	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Navicula mediocris	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Navicula cf. menisculus	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Navicula minima	1.43	2.42	0.25	0.73	0.25	0.00	0.96	0.00	0.49	0.97	0.24	0.24	0.50	0.49	0.69	0.72	2.59	1.46	0.71	0.99
Navicula cf. modica	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00
Navicula porifera	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96	0.71	0.00	0.00	0.00
Navicula pseudoscutiformis	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
Navicula pseudoventralis	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Navicula radiosa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Navicula schoenfeldii	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.49	0.00	0.00	0.00	0.00	0.00	0.00
Navicula scutelloides	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.00	0.00	0.00	0.00	0.00
Navicula cf. soodensis	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.18	0.00
Navicula submuralis	0.00	0.24	0.49	0.49	0.49	0.24	0.96	0.00	0.25	0.73	0.49	0.96	0.00	0.49	0.00	0.24	0.00	1.46	0.95	1.23
Navicula utermoehlii	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49
Navicula aff.utermoehlii	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00
Navicula cf. veneta	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.47	0.00	0.00	0.00
Navicula vitiosa	0.00	0.00	0.00	0.24	0.00	0.24	0.48	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Navicula vitabunda	0.00	0.24	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00
Navicula spp.	2.86	1.45	2.22	0.49	1.97	1.67	0.48	1.16	1.23	0.48	1.46	2.39	1.74	0.74	1.15	1.68	1.18	1.95	4.49	2.72
Nitzschia acicularis	0.00	0.24	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.24	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitzschia amphibia	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitzschia bacillum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitzschia dissipata v. media	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.46	0.00	0.00	0.49	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00
Nitzschia cf. fonticola	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitzschia frustulum	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.00	0.00
Nitzschia inconspicua	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Nitzschia liebetruthii	0.00	0.00	0.49	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.25	0.46	0.00	0.71	0.24	0.00	0.00
Nitzschia linearis v. subtilis	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitzschia palea	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitzschia paleacea	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nitzschia spp.	0.00	1.21	0.00	0.00	0.49	0.24	0.00	0.00	0.00	0.48	0.24	0.24	0.25	0.00	0.00	0.00	0.24	0.00	0.47	0.25
Pinnularia spp.	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rhoicosphenia abbreviata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.24	0.00
Simonsenia delognei	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00
Stephanodiscus alpinus	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00
Stephanodiscus medius	0.95	0.24	0.00	0.00	0.99	0.72	0.72	0.23	0.74	0.00	0.49	0.00	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stephanodiscus minutulus	3.10	5.07	6.13	6.10	6.65	9.55	6.24	7.66	7.88	9.93	6.59	6.94	9.18	4.42	4.84	6.71	13.44	12.65	13.24	17.53
Stephanodiscus niagarae	0.24	0.00	0.49	1.22	0.25	1.19	1.44	0.00	0.49	1.45	0.49	0.24	0.74	0.98	1.15	1.20	1.42	1.46	1.18	0.99
Stephanodiscus parvus	21.43	16.43	19.46	22.93	19.46	15.04	16.31	20.88	29.31	19.85	19.76	17.46	17.37	14.50	12.67	11.99	11.56	12.17	20.09	24.69
Surirella spp.	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00
Tabellaria flocculosa 3p	1.67	3.14	2.22	1.71	1.72	1.43	2.40	0.46	0.49	0.48	0.73	1.20	0.74	1.23	2.07	2.40	0.47	1.95	1.42	0.74
Tabellaria quadriseptata	2.14	1.93	1.97	0.98	0.74	1.19	1.20	0.70	1.23	1.45	0.98	0.96	0.25	0.00	0.00	0.24	0.00	0.00	0.00	0.00
Tabellaria spp.	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Central area unknown	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.24	0.47	0.00	0.47	0.00
Pennate unknown	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.00