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RESEARCH REPORT

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Further high resolution analyses of surface sediment cores taken from Lake Baikal

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Second Year Report to the Leverhulme Trust on Grant: F.134 AZ

September 1994

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RECENT ENVIRONMENTAL CHANGE IN LAKE BAIKAL: <u>F134.AZ</u>

Leverhulme 2nd Year Report September 1993 - September 1994

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Resume

Following up our work reported in the 1st year pilot study report (Mackay *et al.* 1993), a total of 31 surface sediment cores were collected from Lake Baikal in the summer of 1993, in accordance with the original project proposals. Of these only 22 are suitable for quality stratigraphic work at the ECRC. These cores were taken from selected sites along the length of the lake, but owing to problems with ship-time and equipment, the southern basin was not fully sampled at this time. Consequently, earlier this year in March, we undertook a further expedition to collect more cores from the southern basin. This involved working from the lake whilst frozen, and hence necessited new techniques; 1700 m 'Kevlar' rope was purchased and a new winch refurbished, the latter being funded by The Royal Society. A further 7 cores were collected, 6 of which are suitable for stratigraphic work. These cores will also be used to check core replicability. There now remains one area, approximately 5 km from the eastern shore of the southern basin, following a transect towards the middle of that basin, where we still need to collect several cores (ca. 3) and this will be done early next year in March 1995.

Results to date

The first year of this project was spent assessing the feasablity of collecting surface cores from Lake Baikal using a specially designed box-corer for this project (Flower *et al.* submitted to *Limnology & Oceanography*). A pilot core (BAIK 6) was collected in September 1992 which was analysed for diatoms, biogenic silica, carbonaceous particles, trace metals, organic carbon content and magnetic minerals. The core was then radiometrically dated using ^{210}Pb analyses. The results of these analyses were incorporated into a report for the Leverhulme Trust (Mackay *et al.* 1993) and form the basis of two publications (Flower *et al.* submitted to *Nature* and Mackay *et al.* submitted to *Proceedings 13th International Diatom Symposium*). Oral presentations regarding these results have also been presented: British

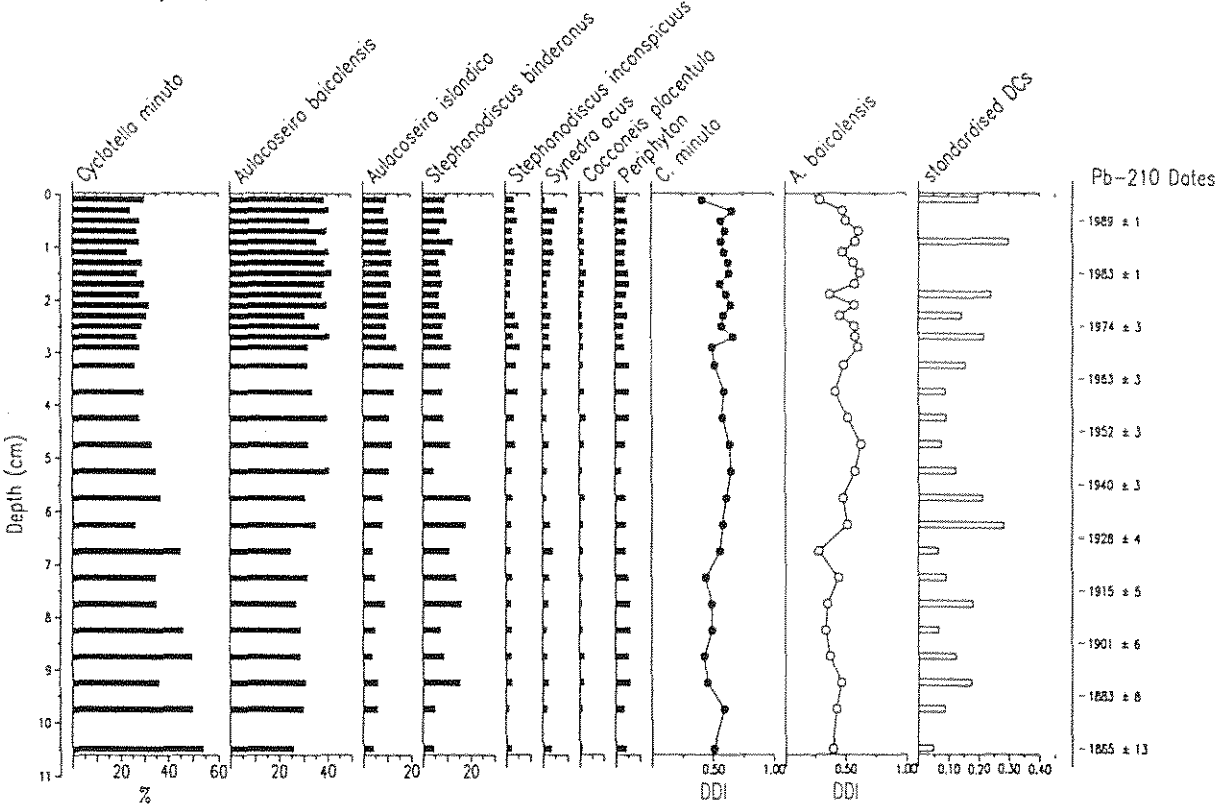
Diatom Meeting, Bristol 1993; Diatoms as Indicators of Global Climate Change, Workshop, Irkutsk, 1993; International Workshop: Baikal as a Natural Laboratory for Global Climate Change, Irkutsk, 1994; 13th International Diatom Symposium, Acquafredda de Maratea, Italy 1994.

We have shown that the most recent sediments (BAIK 6) do contain a record of anthropogenic contamination, in the form of certain trace metals eg lead and zinc, and, more unambiguously, spheroidal carbonaceous particles (Mackay *et al.* 1993). However, the diatom assemblages in BAIK 6 show no statistically significant response in relation to increasing atmospheric contamination (Figure 1): rates of change of diatom species were analysed using the program RATEPOL (Birks & Line unpublished) and the statistical significance of any changes (i.e. dissimilarity coefficients (DC's) estimated using unrestricted Monte Carlo permutation tests ($p \leq 0.05$; 0.40923). However, a trend of increasing *Cyclotella minuta* dominance towards the base of the core (ca. 1850 AD) is apparent. Preservation studies carried out during routine counting of valves (DDI's) indicate that any variation between the taxa is not a function of increased dissolution down the core.

The following cores have now also been analysed for diatoms and biogenic silica: southern basin - BAIK 8, BIAK 19, BAIK 38; middle basin - BAIK 21, BAIK 22, BAIK 25; northern basin - BAIK 29, BAIK 30. Figures 2 & 3 shows diatom analyses of just two of these cores. We have just received the results of radiometric analyses of BAIK 22, and are now waiting for cores BAIK 19, 25, 29 and 38 to be analysed. The results of radiometric dating of at least two of these cores (BAIK 19; BAIK 29) will be available by December 1994.

In many of these cores the increasing dominance of *C. minuta* over *Aulacoseira baicalensis*

Figure 1 Composite Diatom Diagram for BAIK 6
DDI = diatom dissolution indices
DC's = dissimilarity coefficients



before ca. 1850 is very marked (Figures 2 & 3). These changes in dominance occur before the proliferation of industries in the catchment of Lake Baikal, and so the change in species composition could not have been caused by increased levels of pollution. However, because these changes occur through out the whole length of the lake, they may represent a response to a change in climate, such as the Little Ice Age. Firmer conclusions cannot be made at this stage until the radiometric analyses of other cores is complete. It remains to be seen whether the increase in *Synedra acus* at the top of BAIK 38 is a response to anthropogenic contamination or cultural eutrophication.

Future Work

The emphasis of our work in the last year of the program is counting diatoms in the cores collected. We are waiting for more radiometric core dating results, and it is hoped that future papers on the stratigraphy of recent Baikal sediments may soon be published when these dates become available. Many of these cores will also be subjected to further trace metal, magnetic mineral and carbonaceous particle analyses, covering both temporal and spatial aspects of the cores. We also have a Russian scientist visiting the ECRC, funded by the Royal Society, early next year to help with some of the counting and especially taxonomic problems encountered during the project. Plans are in hand for a field visit to Lake Baikal in March 1995, to finish the core collection program. Also, since the longer record of diatom assemblage changesin these cores are particlarly interesting from a climate change point of view, we are requesting funding for ^{14}C dates for one core, from N.E.R.C..

Figure 2
BAIK 29 Northern Basin

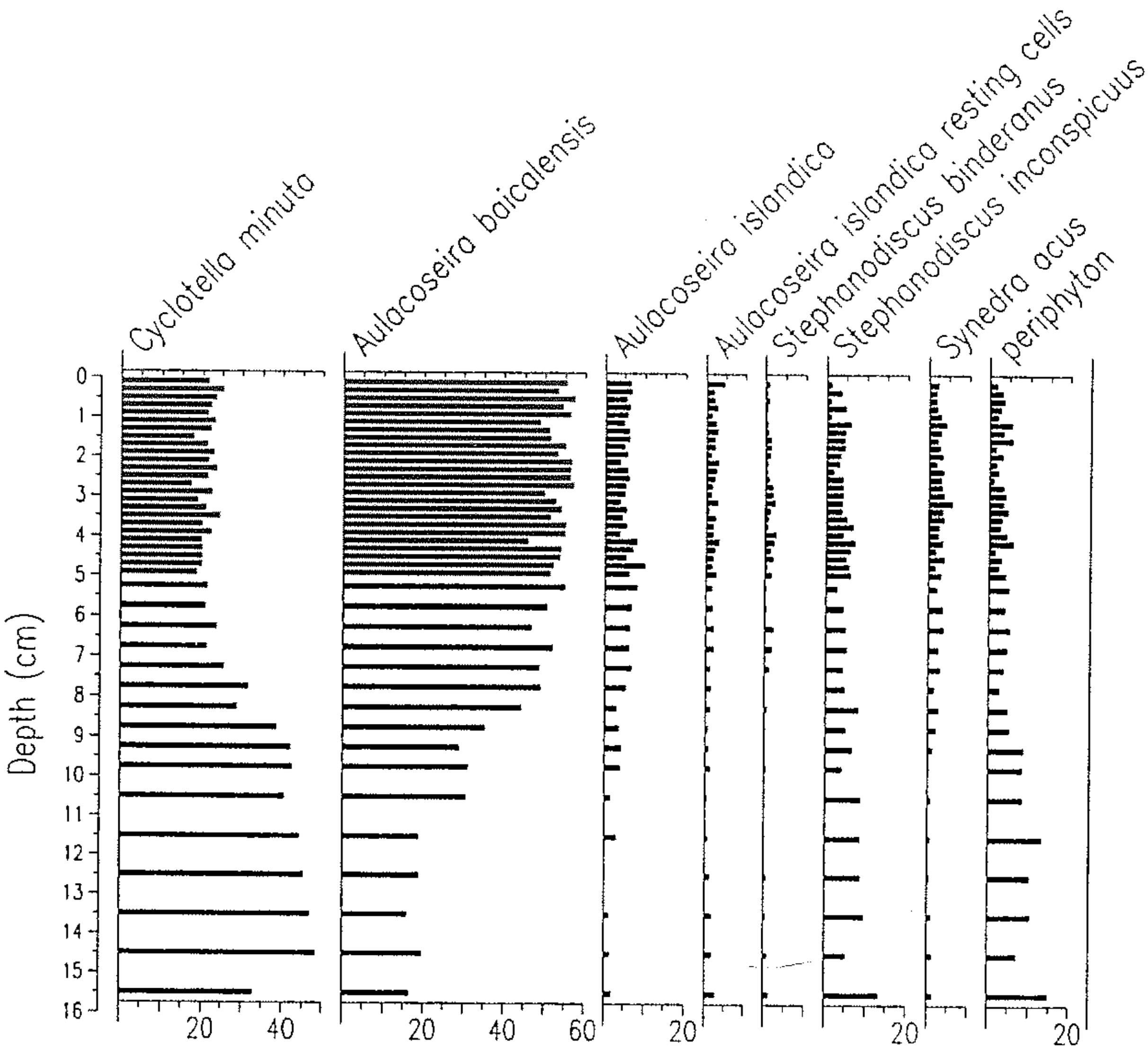
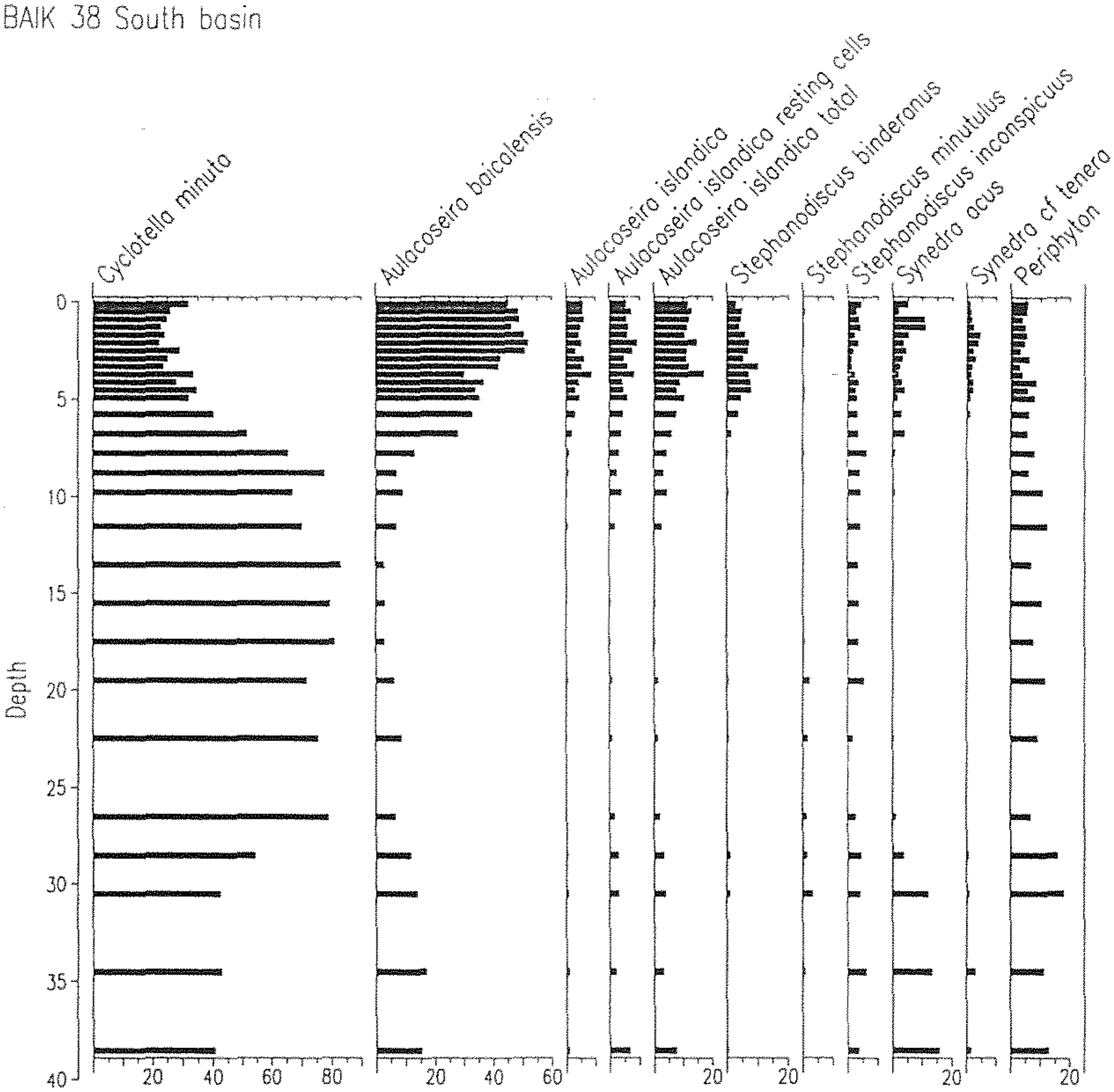


Figure 3
BAIK 38 South basin



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