142. **Diatoms in a 197.2 meters Core Sample from Lake Biwa-ko**

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As part of the joint study on the paleolimnology of Lake Biwa-ko and the Japanese Pleistocene, a core, 197.2 m long was taken at a point 65.2 m deep in the central region of the lake in 1971. The core, intercalating at least twenty-five thin layers of volcanic ashes, is composed chiefly of gyttja and fine clay. It is well known that some excellent studies on the core have been reported already and are still being performed in various ways, for example paleomagnetically.

We made a preliminary quantitative study on diatoms in 79 samples of each 5 cm in length, which were taken at intervals of ca. 2.5 m down the core. The results are shown in Fig. 1. More than two hundred taxa of diatoms were found in the core samples, among which the following were major species.

- *Melosira solida* Eulenstein
- *M*. cf. *juergensi* C. A. Agardh
- *Stephanodiscus carconensis* Grunow and var. *pusilla* Grun.

According to Negoro (1960), *Melosira solida* and *Stephanodiscus carconensis* are the most noticeable planktons in Lake Biwa-ko, the former being dominant in April, November and December and the latter in January through March. While *Melosira* cf. *juergensi* and *Stephanodiscus* cf. *astraea* have not inhabited the lake in recent ages, so that they can be found as fossil species. Other diatoms, mostly Pennales, were scarce in quantity, but the number of species was very large. To make a comparison we surveyed diatoms in the present bottom sediments from Lake Biwa-ko which were dredged at four points in the deep region of the lake in 1972. The results showed that *M. solida*, *S. carconensis* and var. *pusilla* occurred at rate of 10.2, 5.2, and $7.2 \times 10^3$ cells/mg of dried mud on the mean for each of the four samples, respectively.

The abundance of the above four species and two other varieties changed in each sample. Above all, the variation of *M. solida* was remarkable, and based on it the five diatom zones (named A to E

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down the core) were classified. B and D diatom zones were also divided into two subzones respectively based on the variation of *Stephanodiscus* genus.

The assemblage in A diatom zone, being dominated by *M. solida* and *S. carconensis*, showed roughly the same feature as that of Lake Biwa-ko in recent times, while those in the remaining four diatom zones were fairly different from that. Above all, the assemblages in D2 and E diatom zones, being dominated by *S. cf. astraea* of which diameter is larger than *S. carconensis*, looked like rather one in the

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**Fig. 1.** Diatoms diagram on the 197.2 meters core sample from Lake Biwa-ko.

Dotted and broken lines in *M. solida* diagram; the fine cell wall form and the curved form respectively, dotted line in *M. italica* & *M. granulata* diagram; *M. granulata.*
Kobiwako group distributing in the Kosei district than one of recent times.

There were four propagation periods of *M. solida*, such as 3.3–10.7 m, 59.6–74.5 m in core depth at A diatom zone and C and E diatom zones. In those periods *M. solida* occurred with two to ten times as much abundance as in the present bottom sediments. Skvortzow (1936) classified *M. solida* as a warm climate species. Consequently, it can be concluded that Lake Biwa-ko was under a warm to temperate climate, at least in those periods.

It is a very noticeable fact that some horizons were found in the core at which the variation of diatom abundance and species was correlated with the event of oscillating geomagnetic field studied by Kawai, *et al.* (1972). The correlations are shown in Table I and Fig. 1. Among the correlations one at the Biwa event II was the most conspicuous.

<table>
<thead>
<tr>
<th>Geomagnetic events</th>
<th>Variation of diatoms</th>
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<tr>
<td>B (Blake event)</td>
<td>Extinct horizon of <em>M. cf. juergensi</em></td>
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<tr>
<td>C (Biwa event I)</td>
<td>Decrease horizon of <em>M. cf. juergensi</em></td>
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<td>C-D (Weak magnetism)</td>
<td>B1 diatom subzone</td>
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<tr>
<td>D (Biwa event II)</td>
<td>Decrease horizon of <em>M. solida</em> &amp; <em>M. cf. juergensi</em></td>
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It can be considered that an oscillating geomagnetic field had some influence on the diatoms existence, though it might be indirectly.

Diatoms in the upper 3.3–30 m part of the core. We have just finished a quantitative study on diatoms in 98 samples of each 5 cm in length, which were taken at intervals of ca. 25 cm from the upper 3.3–30 m part of the core. This part is included in the above mentioned A diatom zone, so that it is no exception that the major species in quantity are *M. solida*, *S. carconensis* and var. *pusilla*. However, it was recognized that both species varied in quantity and in quality at some horizons. Especially *M. solida* varied remarkably at four points, while *S. carconensis* at three points. The abundance diagram of each species is shown in Fig. 2, in which the arrow marks, such as Ms1 and Sc1, show the variation points.

In samples of 30 m–Ms4 (=Sc3) point the abundance of *S. carconensis* was roughly the same as in the present bottom sediments of Lake Biwa-ko. But valves of this species silicify more strongly than that of recent times. *M. solida* was roughly in the same abundance in the samples of 30–27 m in core depth and in the present bottom
sediments, but in the samples of 26.7 m–Ms4 point the species scarcely occurred. It can be considered that in the period of 30 m–Ms4 point the lake was under the same or a little cooler climate as the present day.

In the samples of Ms4–Ms2 point, *M. solida* occurred with about two times (in period of Ms4–Ms3 point) and three times (in period of Ms3–Ms2 point) as much abundance as in the present bottom sediments. It was the most conspicuous feature that nearly all *M. solida* showed a fine cell wall form, which differs from the normal one in following viewpoints. The form shows a slightly large valves and a thin mantle, of which pore and pore row arrangement are regular, like *M. islandica* subspec. *helvetica*. Since being found as a
chain colony composed of both forms, it is true that the fine cell wall form shows one state of polymorphous *M. solida*. Such deformation of *M. solida* can be assumed to be an adaptation to a fall of water temperature. *S. carconensis* showed no quantitative variation at Sc3 point, but the silicification of valves became weak. From these facts it can be considered that the climatic condition of the lake had alternated cool in the Ms4–Ms3 period and warm in the Ms3–Ms2 period.

At about the last stage in the period of Ms3–Ms2 point, that is, at Sc2 point, the abundance of *S. carconensis* proliferated abruptly and this condition continued to Sc1 point. The abundance in the period of Sc2–Sc1 point was about three times as much as in the present bottom sediments. On the other hand in the period of Ms2–Ms1 point, the fine cell wall form of *M. solida* decreased rapidly, contrary to that, the normal form increased. From these facts it can be considered that the water temperature of the lake rose slightly and this rising would have lead to a stronger circulation of the lake water, so that the trophogenic layer was enough nutrients to propagate *S. carconensis*.

In the period of Ms1–3.3 m the normal form of *M. solida* occurred with about four times as much abundance as in the present bottom sediments and the fine cell wall form became very scarce. While *S. carconensis* decreased at Sc1 point. Consequently, it can be concluded that the climate of Lake Biwa-ko was warm in the period of Sc1–3.3 m. And we can refer the period after Sc1 point to the post-glacial time.

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References