

Seasonal variations in population abundance of freshwater magnetococci and spatial arrangement of magnetosomes in cells

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Motivation

The abundance and morphotype distribution of magnetotactic bacteria in Lake Balaton were studied from spring to autumn in 2004, by observing magnetically purified drops with an optical microscope. In order to study the physical and chemical properties of magnetosomes and their locations within cells, whole mounts and stained thin sections were examined using TEM coupled with energy filtered imaging.

Seasonal variations in population abundance

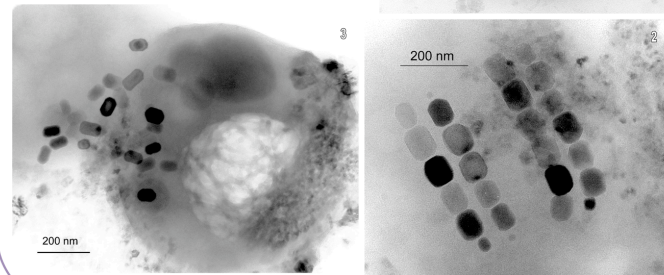
Fresh and earlier collected samples were examined using an optical microscope. In stored samples collected in winter magnetococci appeared in March, at the same time when they appeared in their natural medium. Fast-swimming magnetococci dominated until October, when smaller spirilla became abundant. Interestingly, spirilla also appeared in earlier collected, stored samples in which cocci morphotypes were in the majority earlier. In general, the fresh and stored samples contained the same morphotypes at a given time.

DATE OF SAMPLING	Febr.11	April.01	June 04	Aug 05	Sept.19	Oct.22	Nov.17
MORPHOTYPE	Small coccos	Small coccos, Spirillum	Small coccos	Small coccos	Small coccos	Small coccos, Spirillum	Spirillum
DATE OF OBSERVATION	Febr.11	March 23	April 01	April 07	April 21	May 03	May 13
QUANTITY	no cells	no cells	no cells	no cells	no cells	no cells	no cells
DATE OF OBSERVATION	June 04	June 30	Aug 05	Aug 25	Sept 13	Sept 19	Oct 06
QUANTITY	no cells	no cells	no cells	no cells	no cells	no cells	no cells
DATE OF OBSERVATION	Oct 22	Oct 26	Nov 16	Nov 17	Nov 24	Nov 30	Dec 07
QUANTITY	no cells	no cells	no cells	no cells	no cells	no cells	no cells

■ - first appearance
 The number of the symbols mean the quantity of bacteria:
 □ - several cells, □□ - less than 100 cells, □□□ - band of bacteria, □□□□ - several micrometer thick band of bacteria

Studies of whole cells

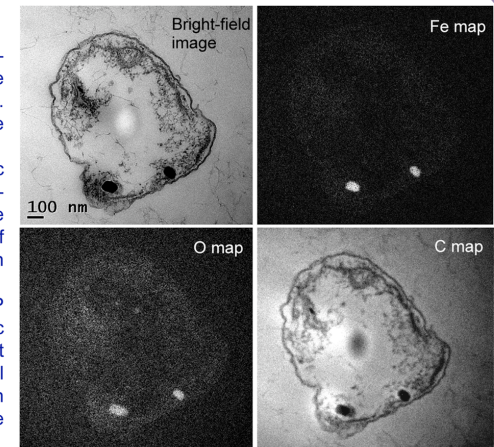
Based on the spatial arrangements of magnetosomes, three types of cocci occurred, including cells that contained magnetite in (1) two single chains, (2) two double chains and (3) partial chains or clusters. The sizes and shapes of the crystals were also different in these three types of cells.



Cell compositions

We used electron energy-loss maps to study the distribution of Fe, O and C. The cells did not contain Fe outside the magnetosomes. Typically, the magnetotactic cocci contained P- and Ca-rich electron dense material, both in the form of granules and dispersed in the cell.

Owing to their high P contents, the magnetotactic cocci may play an important role in the geochemical cycling of nutrients within the sediments of Lake Balaton.



Ultrathin sections

In order to observe the positions of magnetosomes inside cells we studied ultrathin, stained sections. Magnetite crystals appeared to be anchored to the inner cell membrane and were enveloped by stained material, apparently representing the magnetosome membrane. The crystals were in the same orientation with their long axes approximately perpendicular to the cell wall.

