ABSTRACT

A series of investigations that study the iron cycle in Banyoles lake, as well as its incidence on the development of phototrophic sulfur bacteria, is presented. First, three basins located at the North area of Banyoles Lake (C-III, C-IV and C-VI) are compared. The differences found among them, are mainly in the differential behavior of the stratification (C-III and C-VI are meromictic with different degrees of stability, whereas C-VI is holomictic), and explain the dynamics of phototrophic sulfur bacteria at each basin. A more detailed focus is made on the iron cycle in C-IV during a extended period of time. Afterwards, the dynamics of phototrophic bacteria populations growing in this basin is described on the basis of their apparent relationship to iron.

Soluble iron (Fe^{2+}) can be found in the monimolimnion of C-IV during the whole spring and early summer, reaching maximal concentrations up to 70 µM. It accumulates by two ways. One is the release of Fe^{2+} from the sediment. The other is the inflow from the bottom springs, particulary S_4, which carries Fe^{2+} up at a measured rate of 1350 mmol $Fe^{2+} \cdot h^{-1}$, contributing roughly 40 % of the total accumulated Fe^{2+}. However, the release of soluble iron from sediment is temporal (spring and early summer), while iron enters C-IV from the bottom springs all year long. Once sulfide production in sediment begins to be significant, iron is removed from the solution in the form of FeS, decreasing its concentration drastically. This compound has been found as amorphous FeS (mackinawite), with calculated values for -logpK_s ranging from 2 to 4. In summary, C-IV shows an alternation of both the iron and sulfur cycles, which chemically interact resulting in the precipitation of Fe^{2+} in the form of FeS. Both the accumulation of Fe^{2+} and its removal have been monitored during 1988 and 1989, and a kinetic model mathematically describing the behavior of iron has been developed.

The growth of phototrophic bacteria communities in the studied basins was strongly limited by the quantity of available light at the depth where they were found. Both Chlorobiaceae and Chromatiaceae show similar adaptations to light limiting conditions, increasing their carotenoid /bacteriochlorophyll ratio. On the other hand, the depth of the oxic/anoxic boundary was different at each basin depending on the stratification dynamics. This fact has a strong affect on both the quantity and time of appearance of phototrophic bacteria, but does not on influence the relative composition of such communities. The following species have been isolated from Banyoles Lake: Chromatium minus, Chlorobium limicola and Chlorobium phaeobacteroides .C. limicola *could only be isolated from C-VI,*

while the other two species are commonly found in each of the tree studied basins.

Two remarkable aspects dealing both with the iron cycle and sulfur phototrophic bacteria in C-IV are:

1. A dense population of Chlorobium phaeobacteroides *growing in a ferrous environment, in which sulfide was almost indetectable*

2. The similar pattern of distribution of Fe^{2+} and Chlorobium phaeobacteroides, *showing peaks that coincide in space and time.*

These observations suggest an ecological and physiological relationship between iron and those microorganisms, that can be interpreted as a mechanism of adaptation to conditions of extremely low sulfide concentrations. Under laboratory conditions, Fe^{2+} is passively adsorbed by Chlorobium phaeobacteroides, *in quantities up to 1 μg of Fe^{2+}/μg Bchlor e. Pure cultures of* C. phaeobacteroides *and* C. limicola, *incubated with "Pfennig" medium containing 44 $mg \cdot L^{-1}$ of FeS (the equivalent to 0.5 mM od Fe^{2+} and 0.5 mM of S^{2-}), oxidized this compound photosynthetically to elemental sulfur and ferrous iron. Chromatiaceae did not show this ability. The results of these experiments support the hypothesis of an adaptation of Chlorobiaceae to adverse environmental conditions, providing a better understanding of the above mentioned obsevations.*