1. INTRODUCTION

Diatoms (Bacillariophyceae) are microscopic algae which colonize all types of waterbodies. Diatoms have an external skeleton (a frustule, composed of two valves), made of hydrated silica and which ensures their preservation when sinking through the water column and in the sediments. Diatoms are one of the most sensitive biological indicators of continental and marine environments. The close relationships exhibited between contemporary diatom communities and environmental parameters enables the numerical estimation of palaeoenvironmental conditions from the sedimentary records by using transfer functions. During the last decade, diatoms have thus emerged as a powerful tool for environmental monitoring and palaeoenvironmental reconstruction.

Over the continents, one of the most spectacular application concerns the assessment of lake acidification trends in North America and Europe, associated with increased atmospheric acid loading (Charles et al., 1989; Charles and Smol, 1990; Birks et al., 1990). Palaeoecological studies offered the only means of obtaining direct evidence of past changes from lakes that lack historical data over the last century. Such historical perspectives allow a better predict how lakes will respond in the future.

Recent concern about climate changes has also stimulated interest in the diatom records of closed lakes which may fluctuate in water level and water chemistry in response to seasonal, interannual or longer-term climatic fluctuations, especially in arid and semi-arid regions. In this paper, the complex relationships which link lake level (or area) and lake salinity with climatic parameters are summarized. On the basis of some case studies, methods applied for reconstructing water depth and water chemistry by using diatoms are presented. The limits of such approaches for palaeoclimatic research are discussed. We show
that, in favourable cases, diatom-inferred palaeohydrological variables can be integrated in models of palaeolake systems and may help, indirectly, to estimate palaeoclimatic parameters.

In the oceanic domain where chemical conditions are relatively stable compared with that of continental waterbodies, diatom assemblages appear to be closely correlated with Sea Surface Temperature (SST) (Pichon et al., 1987). Although SST estimates have been firstly derived from transfer functions based on Foraminifera (CLIMAP Members, 1976), diatom-inferred SST are of utmost interest in high latitudes where Foraminifera are rare. Reconstruction of SST changes in the Southern Ocean (Labracherie et al., 1989; Pichon et al., 1992) allows interhemispheric comparison and correlations with Antarctic ice cores. Continental diatoms contained in marine sediments can also be used for palaeoclimatic reconstruction. These diatoms may be either windblown from the continents, or river transported. They may inform on changes in atmospheric circulation and/or river discharge. This topic is discussed here with the example of freshwater diatom influx in intertropical Atlantic during the Late Quaternary period.

2. LAKE SYSTEMS AT STEADY STATE. RELATIONSHIPS BETWEEN WATER DEPTH, WATER CHEMISTRY AND CLIMATIC CONDITIONS

Fluctuations in the extent and depth of closed lakes have been long recognized as a sensitive indicator of change in Precipitation/Evaporation (Street and Grove, 1976; Street-Perrott and Roberts, 1983). Fluctuations in the water balance may also result in changes in the concentration of dissolved salts. However, the lake water balance is the end product of interactions between climate, vegetation, runoff and groundwater storage (Fig. 1). Lake water-level and concentration thus depend largely on the water cycle in the catchment. This complexity may be responsible for apparent discrepancies between pollen evidence and lake level records. This was for instance discussed to explain high lake levels in the northern Mediterranean region during the Last Glacial Maximum (Prentice et al., 1992), or for Lake Sumxi (western Tibet) where the maximum in lake volume deduced from diatoms lags ~3000 yr behind the major wet pulse at 10,000 yr BP inferred from the pollen record (Van Campo and Gasse, 1993).

Any lake can be regarded as a system of transfer, recycling and storage of water, dissolved and solid material, and energy (thermic, photic and cinetic) (Fig. 2). At steady state, a lake basin is characterized by its morphometry and hydrological parameters which are site specific, and is in equilibrium with climatic