CHAROPHYTES IN THE SEDIMENTS OF MALHAM TARN

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A number of recent studies have focussed upon identification of charophyte oospores in an attempt to identify their colonisation and development within lakes, some of which span many thousands of years. Since charophytes are confined to clear waters, their presence also provides information on lake clarity and in some cases, trophic status. In this study we analysed a long piston core taken from the centre of Malham Tarn for charophyte remains and report on the findings in this short article.

RESEARCH SUMMARY

Charophytes, particularly *Chara virgata* (syn. *Chara globularis*) cover large areas of the Tarn floor and are capable of depositing calcium carbonate as the result of photosynthesis :

$$2HCO_3^- + Ca^{2+} = H_2O + CaCO_3 + CO_2$$

Bicarbonate enters the Tarn as a result of a chemical reaction of the limestone bedrock in the catchment with rainwater charged with soil-respired carbon dioxide. This reaction releases calcium ions from the limestone as shown on the left-hand side of the equation. Within the Tarn, charophytes, along with other aquatic macrophytes, remove carbon dioxide from the water as a result of photosynthesis resulting in the formation of water and calcium carbonate. The *Chara* surface attracts the calcium carbonate and the stems become heavily encrusted (the common name for these plants is stonewort). After death their remains accumulate in the lake sediment forming marl.

Charophytes reproduce by means of oospores. These are small egg-like bodies encased by a helical cell that becomes heavily calcified (Fig. 1). The form of these spores is so distinctive that they have been identified in ancient lake sediments millions of years old. In our study, we sieved samples of lake sediment from the core at regular intervals down to a depth of 6.5 m. We then looked for evidence of *Chara* stems and oospores. We also undertook measurements on the fossils so that their dimensions could be compared with modern *C. virgata* growing in the Tarn today.

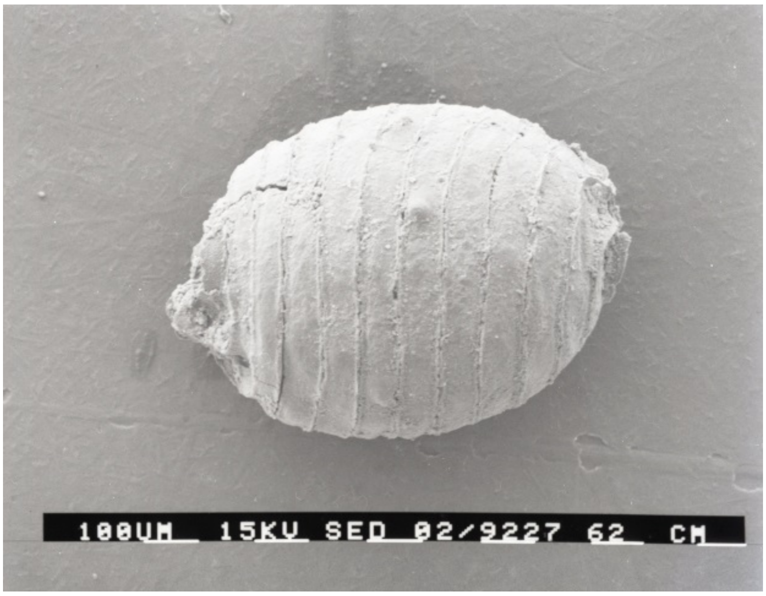

FIGURE 1. Scanning electron micrograph of a calcified charophyte oospore.

Measurements of charophyte stem diameters showed considerable variation within the fossil assemblage but an analysis of variance demonstrated that the greatest difference occurred between the modern *Chara* which had significantly wider stems. Within the oospore population however, no such differences were obtained. These findings suggest that on the basis of the oospores, only one species of *Chara* has dominated the Tarn though most of the

Postglacial period but that the plants were smaller in former times. However, it is also possible that another smaller species of *Chara* was present in past times and further work is needed to clarify the situation.

We also found that preservation of *Chara* was poor in the upper 20 cm of the core corresponding to a period after the Tarn was dammed in the 1790s to raise the water level. This event led to erosion of the raised bog of Tarn Moss that borders the western side of the Tarn, changing the nature of the sediment. It is possible that calcification has been inhibited as a result of this change owing to chemical changes, including nutrient enrichment of the Tarn sediments. More recently, a small increase in water temperature, and increases in atmospheric nitrogen deposition may have influenced *Chara* growth in the Tarn leading to the development of larger plants.

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