AN IMPROVED FILTERING TECHNIQUE FOR CALCULATION OF CALCAREOUS NANNOFOSSIL ACCUMULATION RATES

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Introduction

Numerical abundances of microfossils in sediment are routinely calculated for most of the major microfossil groups. Because of their very small size and numerically astronomical populations, however, the absolute abundances of nannofossils per unit of sediment (# coccolith/g) have long been substituted for by simple adjectives for relative abundance, such as abundant, common, few/frequent and rare. Modern palaeoceanography utilises various proxies, and the numerical abundance of nannofossils can be an useful tool for palaeoceanographic analysis.

Over the last 10 years, various techniques have been proposed to calculate the numerical abundance of nannofossils, and these can be classified into four groups: 1) smear-slide method; 2) microbeads method; 3) settling method; and 4) filtering method. Baumann *et al.* (1999) presented an excellent review and evaluation of these techniques. The widely-used **smear-slide method** gives only semiquantitative data, and it requires some training to make a good slide. Okada (1992) proposed the use of **microbeads** for calculation of relative abundances of nannofossils, and Bollmann *et al.* (1999) invented an elaborated spraying technique with microbead spiking (SMS method) to calculate the numerical abundance. The SMS method seems to be a rapid and reliable technique, but may be a bit too cumbersome for some workers. Although it requires no special equipment, the **settling method** (Beaufort, 1991; Flores & Sierro, 1997; Geisen *et al.*, 1999) requires a working-space that must be undisturbed for 12 to 24 hours, and also carries a possibility of assemblage alteration (Baumann *et al.*, 1999; Bollmann *et al.*, 1999). The **filtering technique** proposed by Andruleit (1996) requires shorter preparation time and cause less assemblage alteration but uses a rotary splitter that is rather expensive and is not a tool ordinary laboratories are usually equipped with.

I have attempted to improve on Andruleit's (1996) filtering technique by using inexpensive and commonly available laboratory apparatus. As an additional advantage of the new technique, it uses less glassware (less washing) and requires a smaller working-space. In addition to the abundance study, the slide prepared by this new method can be used for the investigation of species assemblages with a light-microscope or an SEM.

Methodology

The new technique proposed here can be summarised as follows:

1. A small amount of sediment sample is dried in a drying oven at a temperature of about 50°C. For indurated samples, a mortar and pestle should be used to gently crush the sample before drying, but grinding is strongly prohibited.

2. A portion of sample weighing between 0.01 and 0.02g is weighed, with an accuracy of 0.0001g.

3. The weighed sample is placed in a graded 20ml test-tube and 10ml of buffered distilled water is added. Ordinal piston core samples or crushed rock samples do not require chemical additives but, if necessary, organic matter can be removed using 5-10% hydrogen peroxide or clay can be deflocculated using 0.5N sodium metaphosphate (or a detergent) (McIntyre *et al.*, 1967). In any case, make the volume of sample suspension up to 10ml. If you use any chemical additives, the sample should be left for several hours.

4. Agitate the sample suspension ultrasonically for 10 seconds and homogenise it by pressing the tube against the swivel-head of a tube-mixer (or touch-mixer) for several seconds. Immediately following homogenisation, a fraction of sample suspension is extracted with a micropipette (between 50 to 1000µl, depending upon the richness of nannofossils) and poured into a small beaker containing 150 to 200ml of buffered distilled water.

5. The contents of the beaker are mixed with a stirring rod and filtered through a plain white, 47mm diameter, 0.45µm pore-size, type HA Millipore filter. The filter is dried in a drying oven at a temperature of about 50°C. Drying will be completed within 10 to 30 minutes.

6. An approximately 1.2cm x 1.2cm portion of the dried filter is cut out and placed on a glass slide. The piece of filter is rendered transparent with a drop of immersion oil and covered with an 18mm x 18mm coverslip. The four corners of the coverslip are fixed to the slide using nail-polish.

7. The slide is examined under a polarising light-microscope at x640 to x1250 magnification, and the total number of nannofossils observed within a known view field is recorded.

The amount of sediment on the filter ranges between 0.005mg and 2.0mg. Depending upon the filtering device employed, the filtered area may vary, but it normally measures around 1000mm^2. By measuring the proportions of the observed area, the counted nannofossil number can be converted to numerical abundance per gram of sediment. Numerical abundances ranging between several thousands to tens of billions (n x 10^3/g to n x 10^{10}/g) can be measured by this technique.

The nannofossils soaked in the immersion oil tend to become etched or dissolved after several months of storage. The speed of corrosion varies between different brands, and Zeiss's own brand seems to be the least harmful (J. Young, pers. comm., 2000). But even the Zeiss oil causes significant dissolution after several months of storage. It is, therefore, advised that light-microscope

observation should be completed within one month of the slide-making. The filter itself can be stored safely for many years, and you can remake the microscope slide whenever necessary. According to my experience, there are no suitable optical (photo-curing) adhesives available to be used for permanent mounting of the Millipore filter; some are too viscous to penetrate the filter fabric, and others make the filter cloudy after UV treatment.

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