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A modified tape-peel technique for preparing permanent qualitative microfossil slides

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Abstract

A method is described for the preparation of permanent microfossil mounts directly transferred from the surface of frozen lake sediment cores. Particulate material is transferred from the freeze dried vertical surfaces of frozen cores and on to microscope slides using transparent adhesive tape and contact cement. The contact cement and organic matter are then removed by combustion and chemical means and the isolated siliceous microfossils fixed in a permanent mounting resin. The technique produces slides with undisturbed sediment stratigraphy and excellent optical quality and permits the study of core microstratigraphy using high resolution phase or interference contrast microscopy.

Introduction

Annually laminated sediments have drawn considerable interest in the last decade because of their potential as a precise geochronological record of sedimentation in lakes (Ludlam, 1969, 1984; Meriläinen, 1970; Renberg, 1976, 1978; Saarnisto, 1980; Simola, 1979, 1981). Examining these structures in detail can be difficult because the laminations are, in most cases, too fine to allow mechanical sub-sampling. Even in cases where the laminations are thin enough to permit mechanical separation with probes or scalpel blades, such procedures cannot reveal subtle differences in the seasonal succession of the microfossil flora.

Several methods have been developed for the study of the fine structure of laminated sediments. The earliest of these (Tippett, 1964; Merkt, 1971) involved impregnating the core with either hartz or wax and sectioning with a microtome. Poor optical quality of the sections and the difficult, time-consuming procedure limited the usefulness of both techniques. The tape-peel technique introduced by Simola in 1977 improved both the optical quality of the slides, and the speed and ease with which slides are made. In this procedure, a thin layer of sediment from the dried surface of a frozen core is caught on a strip of adhesive tape, which is then cut and mounted directly under a cover glass for microscopic viewing. This technique produced best results in sediments with very high diatom and clastic contents, because the presence of organic matter obscured many of the microfossils. In addition, the uneven optical quality of the adhesive tape itself prohibits exami-

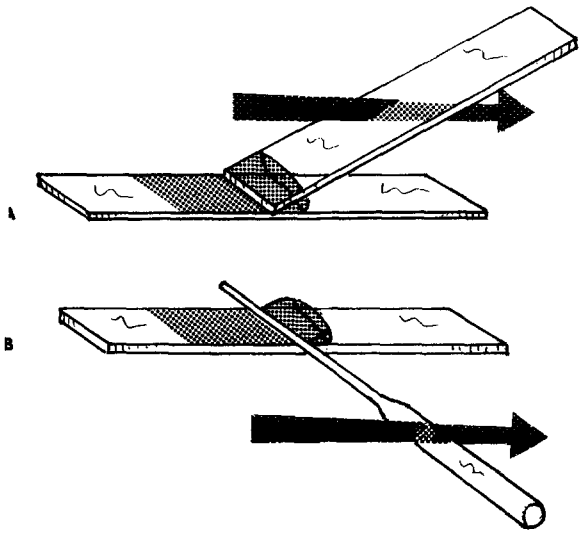

Fig. 1. Procedure for applying thin adhesive layers to a microscope slide using: (a) the edge of another microscope slide or (b) the tip of a Pasteur pipette.

nation of the slides under oil immersion or with phase contrast optics, and makes exact taxonomic identification of microfossils impossible without confirmation by mechanical subsampling techniques.

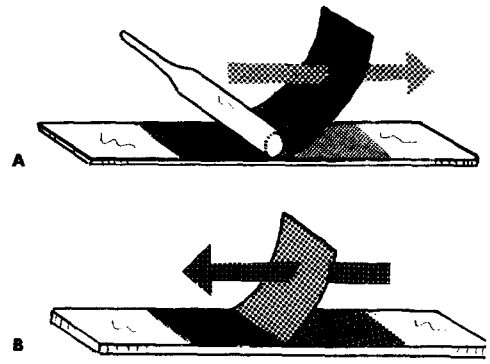

Fig. 2. Procedure for transferring a sediment layer from an adhesive tape strip to a microscope slide: (a) the particle coated strip is applied firmly and evenly to the rubber adhesive coated microscope slide, and (b) the adhesive tape is slowly peeled back, leaving a thin coating of particles on the slide.

This paper presents an improvement to the tape-peel technique in which the organic matter, including the adhesive tape, can be removed, leaving the minerogenic and biogenic microfossils in their original orientations on the slide. This technique produces permanent mounts of high optical quality and allows the use of phase con-

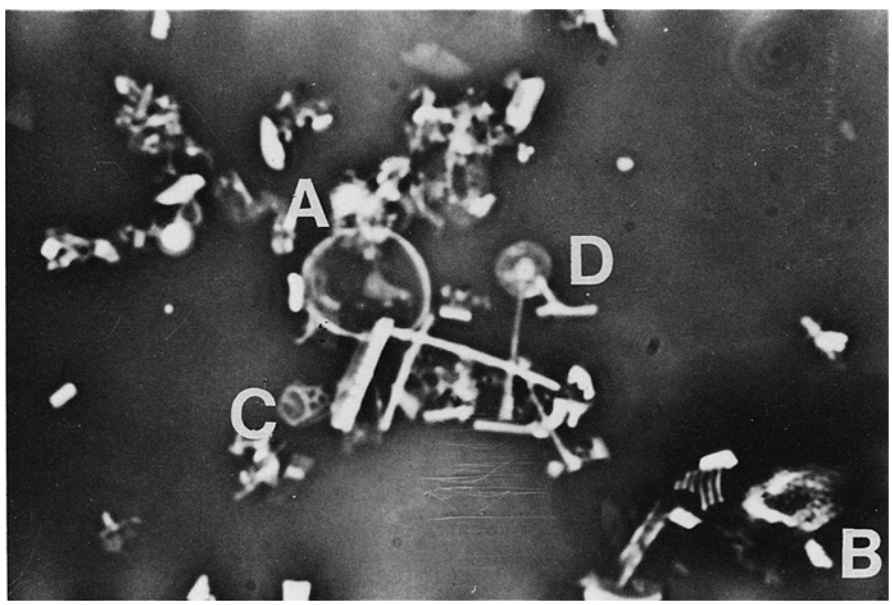

Fig. 3. Photomicrograph of mallomonadacean scales from Lake 223 (ELA) sediments. Sample preparation was by the modified tape-peel procedure. A) *Mallomonas caudata* scale, B) *Mallomonas pseudocoronata* scale, C) *Mallomonas hindonii* scale, and D) unidentified scale.

Table 1. Comparison of diatom counts (percentages) from the same Lake 223 (ELA) short sediment core using Simola's original technique and the modified procedure. The 1 cm interval counts were averaged mathematically from discrete 1 mm interval counts.

Diatom species	Relative percentage of assemblage (%)					
	Modified tape peel			Un-modified tape peel		
	2–4 cm	3–4 cm	4–5 cm	2–3 cm	3–4 cm	4–5 cm
Asterionella ralfsii	3.7	<1	<1	2.0	<1	<1
Synedra acus	5.9	16.1	18.4	36.2	31.4	38.2
Rhizosolenia eriensis	23.2	14.8	5.7	<1	<1	<1
Cyclotella stelligera	21.1	28.3	38.9	9.0	10.0	15.2
Fragilaria construens	10.6	11.8	9.3	11.8	10.3	12.4
Other species	35.5	28.5	27.2	40.5	47.3	33.2

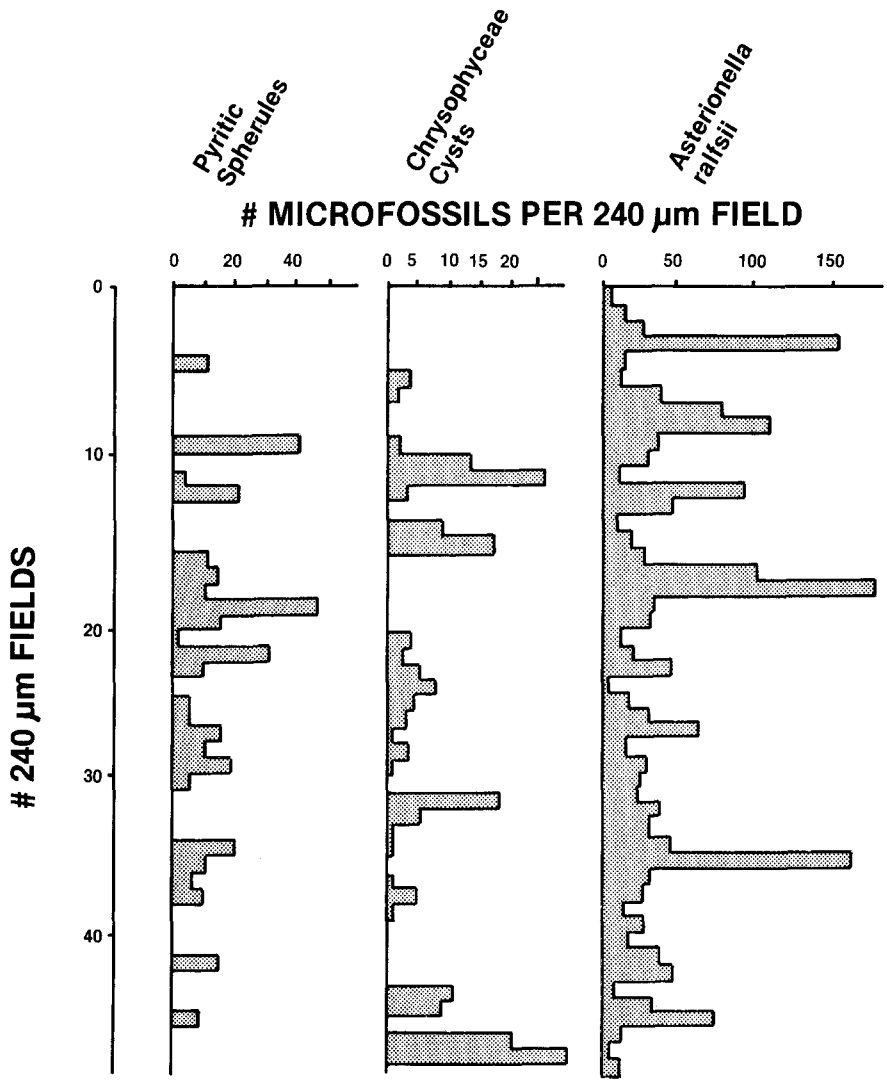

Fig. 4. Close-interval counts of three microfossil remains from a Pollen Lake (Haliburton County) sediment core using the modified tape-peel procedure. The sampling interval was 240 µm or approximately the diameter of a single field at 400 × magnification.

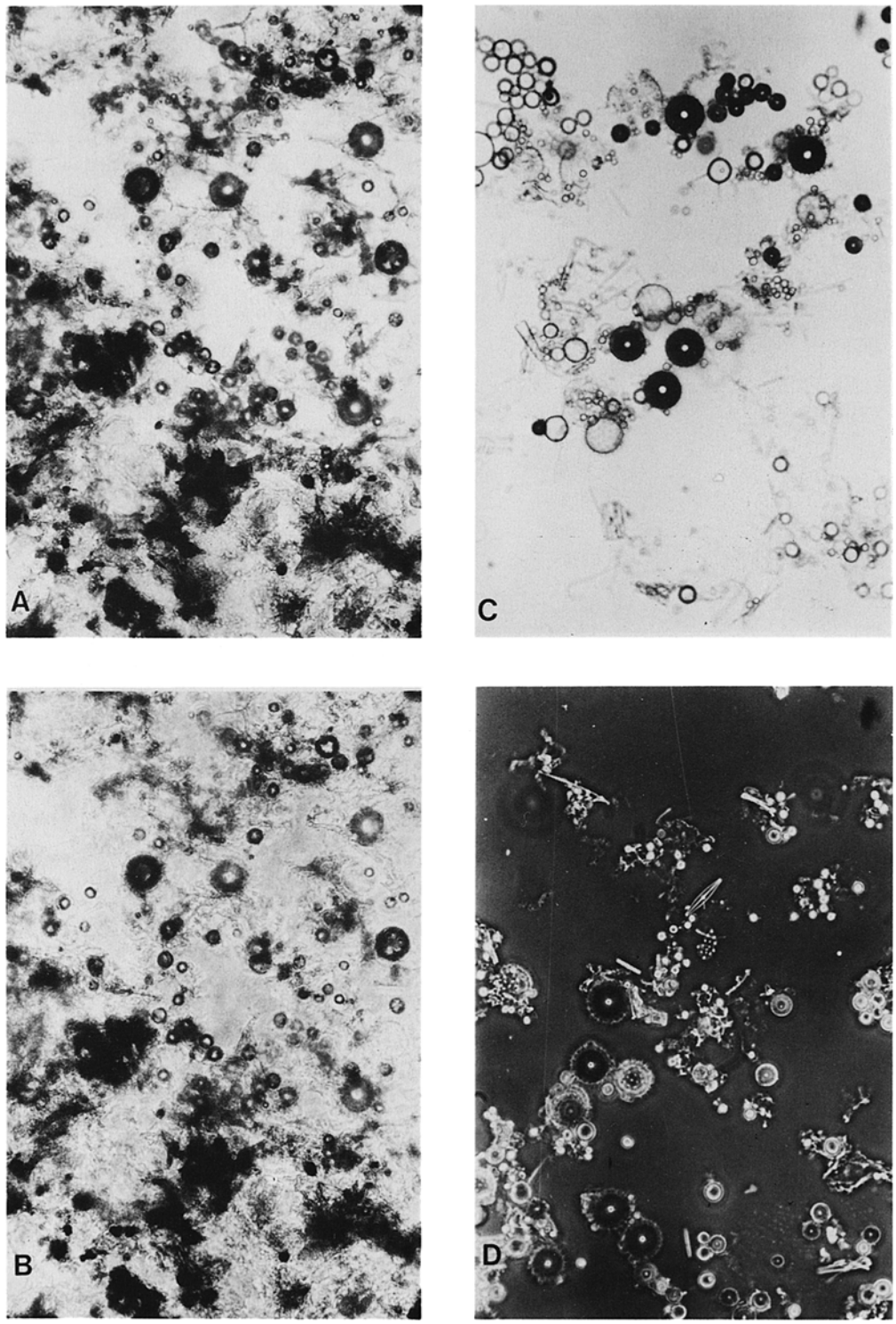

Plate 1. Photomicrographs of four fields from the same sediment tape peel; fields A and B prepared using the unmodified tape-peel procedure, and fields C and D using the modified procedure. Fields B and D photographed using phase contrast microscopy, fields A and C using Köhler illumination.

trast and oil immersion microscopy. It is rapid, is simple, and requires no special equipment.

Description of the procedure

Sediment cores may be taken with a freeze-corer (Huttunen and Meriläinen, 1978) or with a standard coring device, extruded and frozen according to Saarnisto (1980). The former method is preferred because it produces fewer distortions due to expansion and contraction of sediments, and in most instances, it preserves very delicate sediment structures better than standard coring procedures (Saarnisto, 1980).

As in Simola's technique, the vertical surfaces of the frozen sediment core are flattened and smoothed with a carpenter's plane and then carefully cleaned with distilled water to remove loose or cross-contaminated particles. The core is then exposed to a vigorous air flow at -5 °C causing the planed surface to freeze-dry. When a thin layer of sediment has dried, usually after two to six hours depending on the freezer temperature and core characteristics, the surface is sampled while still frozen by pressing Magic Brand® adhesive tape onto the core surface and peeling off a thin layer of sediment. To prevent condensation, the particle-coated tapes are allowed to dry for several hours. In Simola's (1977) procedure, the tape would be cut and mounted for microscopic viewing at this stage without any further treatment.

In the modified procedure, five thin layers of rubber cement are applied to a pre-cleaned microscope slide in rapid succession, using a Pasteur pipette or the edge of another slide (Fig. 1). The rubber cement coating is set by fogging with steam and then dried for two or three minutes. The sediment-covered tape strips are then cut into convenient lengths (3 to 5 cm) and firmly, but carefully, pressed onto the cement-coated microscope slides with a finger or the end of a Pasteur pipette (Fig. 2). Immediately before applying the tape-peel, the slide is re-fogged to prevent the tape from adhering to the rubber cement. The tape strip is then peeled off the slide. This leaves a layer of sediment particles on the rubber cement coating. With practice, a very thin, even coating of particles can be transferred to the slide.

The organic matter (including the rubber cement) is then combusted by placing the slide directly into a preheated muffle furnace at 550 °C for 20 to 30 minutes. After slowly cooling, to prevent fracturing the slide, the remaining particles (mainly diatoms or other siliceous remains) are fixed into place by allowing a five percent solution of Hyrax® (in toluene) to flow across the slide by capillary action. When the fixative has dried thorougly, the slides are dipped into concentrated HCl for 10 to 15 minutes, dried, and then rinsed in distilled water to remove acid-soluble minerals and ash. The slides may be heated again at 550 °C for a few minutes to remove any fixative

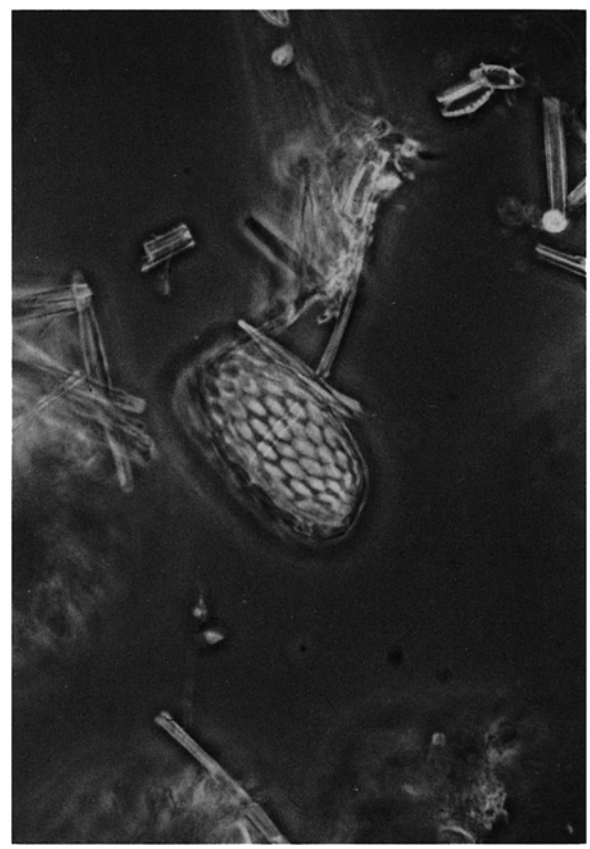

Fig. 5. Photomicrograph of undamaged subfossil of a testate amoeba from Lake 223 (ELA) sediments. Sample preparation was by the modified tape peel procedure.

clouded by the acid treatment and, when cool, mounted with cover glasses using Hyrax®.

Results and discussion

With most sediments this technique produces slides of excellent optical quality, which permits the study of even small microfossil remains such as mallomonadacean scales (Fig. 3). Occasionally, in some sediments with a large amount of clay or other clastic particles, the microfossils may be obscured, which makes it necessary to produce slides with an especially thin coating of particles. This can be achieved by reducing the thickness of the particle layer caught on the tape strips. Resistant ligands or accumulations of ash after combustions may also be a problem in some sediments. Reducing the thickness of the particle layer or increasing the combustion and acidifying times will usually improve the optical quality of the slides in these instances. However, too little material may result in an underestimating of very large diatoms (greater than 300 μm) such as some *Surirella* or *Pinnularia* species which may be thicker than the layer of dehydrated sediment and remain firmly anchored in the frozen core. This is not usually a serious problem because these diatoms rarely account for more than a small percentage of the total assemblage.

Comparison of diatom counts from tape-peels from the same short sediment core using Simola's 1977 technique and the modified procedure are shown in Table 1. The differences between the two sets of counts can be explained chiefly by the presence of organic matter in the unmodified procedure which makes observation and identification of small diatoms difficult. Also, because the unmodified procedure may not be used with oil immersion or phase contrast due to the uneven optical qualities of the tape, lightly silicified diatom species, such as *Rhizosolenia eriensis*, are not generally visible with this technique (Table 1). The difference in the optical qualities of the two techniques is demonstrated in Plate 1 which shows adjacent fields from the same tape (with similar particle densities) prepared using the two procedures.

The advantages of the tape-peel technique over traditional mechanical sub-sampling and chemical digestion techniques (e.g. Battarbee, 1973) lie not only in the increase in stratigraphic resolution (Fig. 4), but also in the superior preservation of very fragile remains such as *Rhizosolenia* or *Fragilaria* which usually appear in higher relative frequencies in comparison counts (Davidson, 1984). This is also confirmed by the frequent discovery of whole and intact remains of mallomonadaceans and testate amoebae (Fig. 5).

References

Battarbee, R. W., 1973. A new method for the estimation of absolute microfossil numbers, with reference especially to diatoms. Limnol. Oceanogr. 18: 647–653.

Davidson, G. A., 1984. Paleolimnological reconstruction of the acidification history of an experimentally acidified lake. M.Sc. thesis, Univ. Manitoba, Winnipeg, MB. xii + 186 p.

Huttunen, P. and J. Meriläinen, 1978. New freezing device providing large unmixed sediment samples from lakes. Ann. Bot. Fennici. 15: 128–130.

Ludlam, S. D., 1969. Fayetteville Green Lake, New York, III. The laminated sediments. Limnol. Oceanogr. 14: 848–857.

1984. Fayetteville Green Lake, New York, IV. Varve chronology and sediment focusing. Chem. Geo. 44: 85–100.

Merilaïnen, J., 1970. On the limnology of the meromictic Lake Valkiajarvi in the Finnish Lake District. Ann. Bot. Fennici. 7: 29–51.

Merkt, J., 1971. Zuverlassige Auszahlungen von Jahresschichten in Seesedimenten mit Hilfe von Gross-Dunnschlifffen. Arch. Hydrobiol. 69: 145–154.

Renberg, I., 1976. Paleolimnological investigations in Lake Prästsjöh. Early Norrland 9: 113–160.

1978. Palaeolimnology and varve counts of the annually laminated sediment of Lake Rudetjärn, northern Sweden. Early Norrland 11: 63–92.

Saarnisto, M., 1980. Studies of annually laminated lake sediments. *In* B. Berglund (ed.) Paleohydrological changes in the temperature zone in the last 15000 years. IGCP 158B. Lake and Mire Environments. Project guide, Vol. II. Specific Methods.

Simola, H., 1977. Diatom succession in the formation of annually laminated sediment in Lovojarvi, a small eutrophicated lake. Ann. Bot. Fennici. 14: 143–148.

1979. Micro-stratigraphy of sediment laminations deposited in a chemically stratifying eutrophic lake during the years 1913–1976. Holarct. Ecol. 2: 160–168.

1981. Sedimentation in a eutrophic stratified lake in southern Finland. Ann. Bot. Fennici. 18: 23–26.

Tippett, R., 1964. An investigation into the nature of the layering of deep water sediments in two eastern Ontario lakes. Can. J. Bot. 42: 1693–1704.