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ELECTROSTATIC PROBE FOR CLEANING CLAYS FOR SCANNING ELECTRON MICROSCOPY FABRIC STUDIES

Key Words—Electrostatic Probe, Fabric, Fracture surface, Preparation technique, Scanning electron microscopy.

During the SEM investigations of clay fabrics it is essential that loose debris be removed from the fractured surfaces of the samples. No matter what methods are used in the preparation of the samples, cleaning of the fractured surfaces is the final step before coating. Reasonable certainty should exist that the technique used for cleaning does not disturb the fabric. This report describes a method of cleaning fractured surfaces with little disturbance of the fabric.

Fractured surfaces are usually cleaned by multiple application and removal of Sellotape, as described by Barden and Sides (1971) and Tovey and Yan (1973). Not only is this a time-consuming technique, but the repeated application and removal of the Sellotape often results in the preferred removal of flat-lying particles. In addition, the procedure may cause severe disturbance of delicate structures characteristic of some highly sensitive clays, e.g., the Drammen clay. Hulbert and Bennett (1975) described a technique for electrostatic cleaning of the fracture surfaces. They developed the electrostatic charge by briskly rubbing a cellulose acetate butyrate tube with a piece of polyester cloth, the charge was then used to remove the surface dust. The following procedure is a further development of that technique.

Instead of the cellulose acetate butyrate tubing, a brass rod covered with a polytetrafluoroethylene (PTFE) sleeve was used (Figure 1A), and instead of polyester cloth, a regulated high-voltage, direct-current power supply (EHT) was used. The power source, a Brandenburg Model 800, was capable of producing 20–30 kV. For safety reasons, the current capability of the supply was limited to <1 A.

Figure 1B shows the layout for cleaning the samples. The SEM stubs were placed on an aluminum- or copper-grounded specimen stand containing holes, the diameter of which provided a snug fit for the stubs. The clearance between the sample surfaces and the probe was between 0.5 and 2.0 cm. During the cleaning procedure the EHT supply was gradually increased to the maximum output. This gave satisfactory results and avoided damage to the generator. The maximum voltage was maintained for as long as 2 min, after which the EHT supply was turned off and the probe wiped clean. Each row of stubs was treated in a similar manner before the polarity of the system was reversed. The entire procedure was then repeated, because the cleaning time required for a sample was found to be greatly shortened by this reversal of polarity.

Typical results are shown in Figure 2. Figure 2a is a stereographic SEM pair showing a surface that has not been subjected to cleaning, whereas Figure 2b shows a surface that has been cleaned as described above.

Note that the specimen stand must be grounded and that the equipment should stand well clear of any other grounded objects. The actual probe should not be approached while it is in operation, as high voltages of this magnitude can be fatal.

This technique provided a fast, efficient, and consistent method for cleaning delicate fabric structures of clays for SEM studies. Little specialized equipment was necessary, however, a degree of caution was needed during the operation.

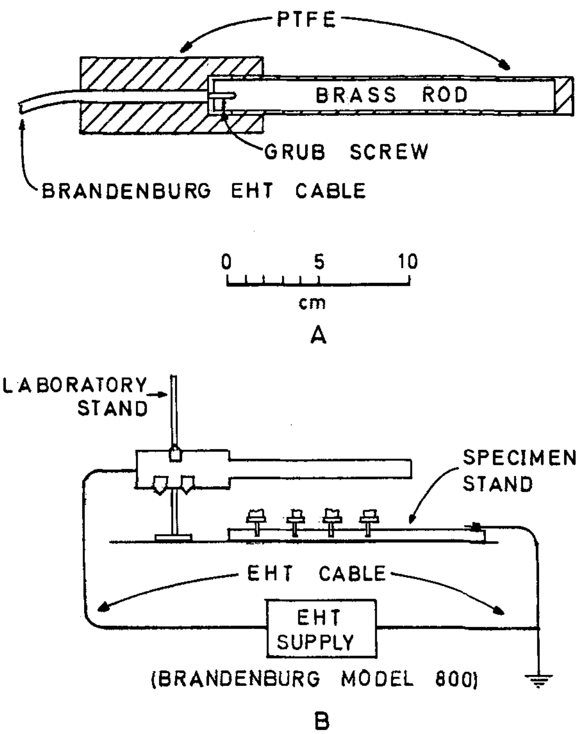

Figure 1. (A) Electrostatic probe (to scale). (B) Diagrammatic layout of the apparatus. Clearance between the stubs and the probe is 0.5–2.0 cm.

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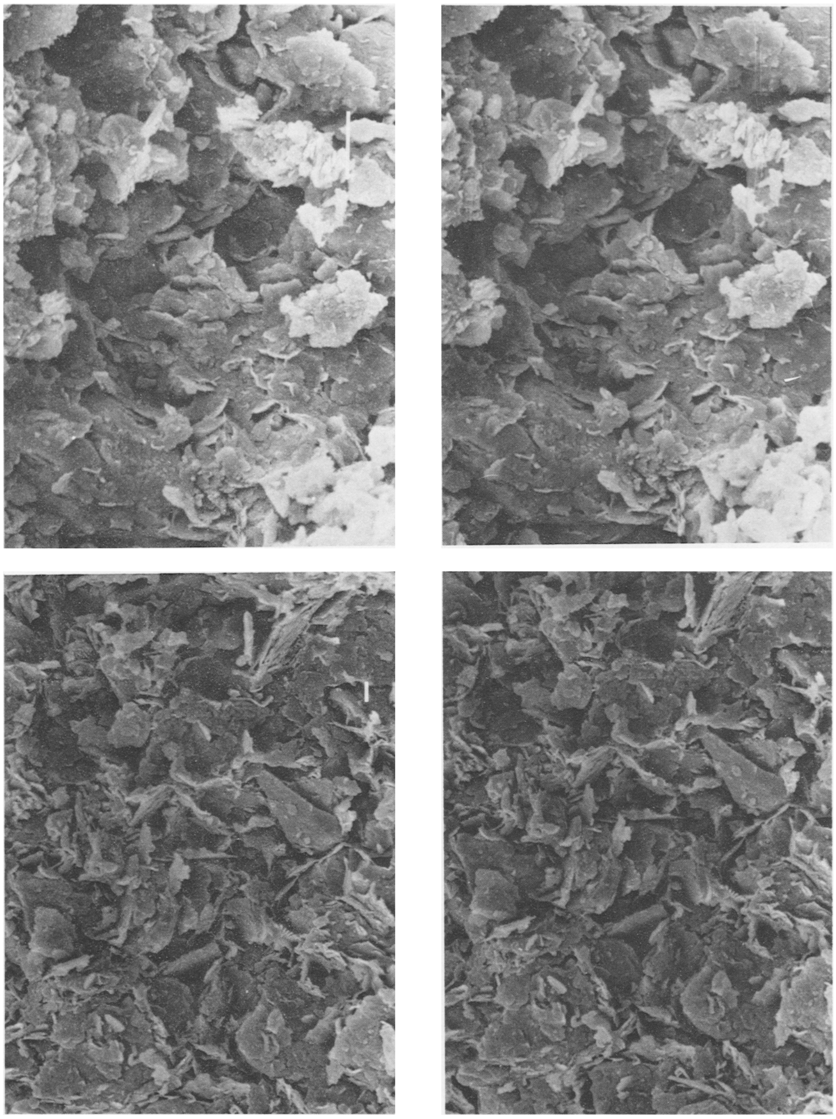

Figure 2. Scanning electron micrographs of: (upper stereo pair) uncleaned sample; matrix from Irish Sea Boulder Clay, Lligwy, North Wales; section fractured in the vertical plane (scale bar = 10 μm); and (lower stereo pair) cleaned sample; matrix of a mud taken from an Irish Sea core; section fractured in the vertical plane (scale bar = 5 μm).

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School of Ocean Science C. R. BATES
University College of North Wales A. S. G. JONES
Marine Science Laboratories
Gwynedd LL59 5EY, Wales
United Kingdom

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