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Craig Lukin
Virginia Institute of Marine Science

Maynard M. Nichols
Virginia Institute of Marine Science

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by

Craig Lukin and Maynard Nichols

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Gloucester Point, Virginia 23062

W.J. Hargis, Jr.
Director

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Introduction

Box cores have been widely used by marine geologists in research efforts requiring undisturbed vertical sections of subaqueous sediments. Coring devices initially developed by Reineck (1963) and Bouma and Marshall (1964) have been modified to enhance their application for a wide range of sediment types and research objectives.

Most box core devices now have a modified central stem which provides control of core penetration. This development has increased the versatility of the corer by making possible the recovery of a full core in bottom sediments ranging from gravelly sand to soft clay. Recently a box core liner system was developed at the University of Southern California (Karl, 1976) for the Bouma-type box core. This system allows one to retain and store a large number of undisturbed cores for further analyses without the expense of additional stainless-steel core boxes.

Present research on fluid mud in the Chesapeake Bay has required additional modifications and refinements to existing box core systems. Early core liner designs were found to be inadequate for retaining fluid mud samples. When filled with sediment they were too heavy, bulged at the sides and could not effectively preserve the delicate fluid structures within the upper surface of the core. No provisions were made in existing liner designs to seal the top of the core, or to prevent disturbance of the upper surface of a partially filled core resulting from handling. When the liner system developed by Karl (1976) was used in the Chesapeake Bay, it was found difficult to slab the cores for radiographic examination.

Acceptable results on fluid mud samples were found to be more a matter of luck than skill.

This report describes a new box core liner system which has been developed as a result of our research on fluid mud. The design presented here has been successfully used on three cruises. Radiographs of over 35 cores have shown minimal post-sampling disturbance of the fluid mud. Each liner can be fabricated in less than two hours with a material expense under $35. The cost of each unit can be substantially reduced if the large liner component is reused.

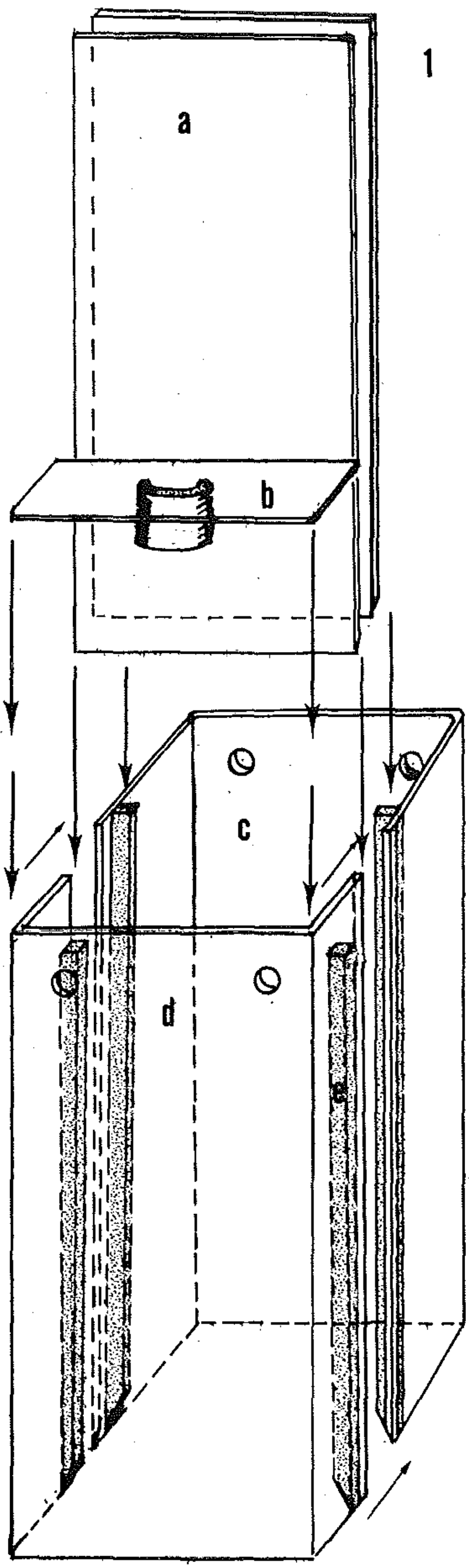
The box core liner system is designed to be used with removable base plate, bridle and guard components developed for the box core spade, by Karl (1976). We have found 22 guage stainless-steel to be the most durable material for these components. Karl suggests aluminum for the base plates and stainless-steel base plate is used, the bridle can be attached directly to the base plate, minimizing the number of separate components in the system. The spade guard, which is subject to a great deal of shear when the spade digs into the sediment to seal the bottom of the core, was frequently damaged when thinner guages of stainless-steel were used. Slot head bolts used by Karl to fasten the spade guard to the spade were replaced with hexagonal head bolts. This improvement resolved the problem of access and wear experienced with slot head bolts, and it decreased setup time for the box core.

Description of the Liner System

The core liner system consists of: (1) a two piece core liner sleeve constructed of 0.32 cm (1/8 inch) plexiglass; (2) cutting plates; (3) a surface retainer plate with a spacer of 1.91 cm (3/4 inch) galvanized conduit; and (4) top and bottom sealer plates.

1. Two Piece Plexiglass Liner Sleeve (Fig. 1c, d, e): Plexiglass is cut and bent with a heat element to the inside dimensions of the stainless-

BOX CORE LINER SYSTEM



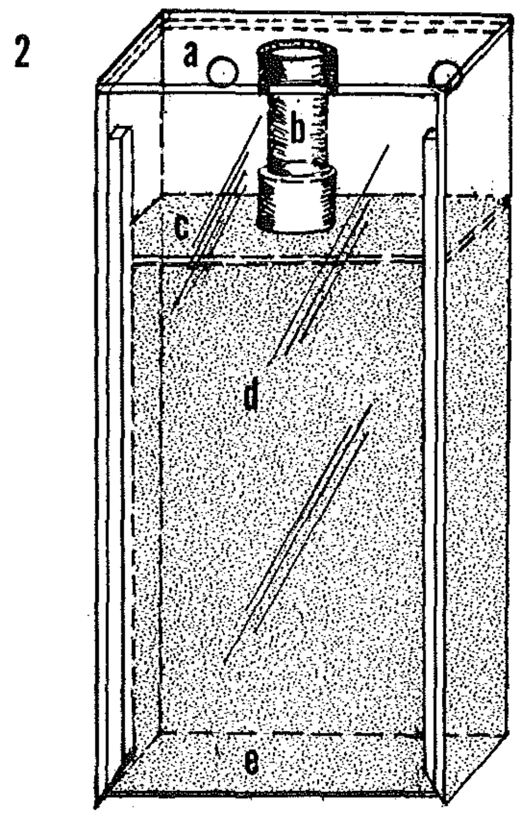


Figure **1. EXPLODED VIEW**: a) cutting plates; b) core top sealer plate; c) large liner; d) X-ray liner; e) cutting plate guides.

Figure **2. X-RAY LINER (WITH SAMPLE)**: a) top sealer plate; b) space retainer; c) surface retainer plate; d) cutting plate; e) bottom sealer plate.

steel core box. The X-ray liner should be 5.1 cm (2 inches) deep, this seems to be an optimum thickness for radiography even in sediments with shell material. The shallow X-ray liner is cut 0.32 cm (1/8 inch) shorter at the top so that when the top sealer plate is set in position, both components of the liner sleeve are the same length. Two sets of cutting plate guides are fabricated from 0.64 X 0.64 cm (1/4 X 1/4 inch) plexiglass strips bevelled at one end and glued to the inside edges of the liner sleeves. Holes are drilled into the liner sleeves which correspond to holes in the stainless-steel core box.

2. Cutting Plates (Fig. 1a): Two rectangular sheets of plexiglass are cut slightly narrower than the widest dimension of the liner so that the cutting sheets can slide into the core liner along the guides. The cutting edge is then bevelled to approximately 45°.

3. Surface Retainer Plate and Spacer (Fig. 2b, c): Plexiglass retainer plates fit into the top of both the X-ray liner and large liner components to deter post-sampling disturbance of the upper surface. The two outside corners of each surface retainer must be shaped to conform to the bent corners of the X-ray liner. Sufficient space should be provided between the retainer plate and X-ray liner cutting guides so that one of the cutting plates can be pushed between the retainer plate and cutting guides. A spacer made from galvanized conduit pipe or PCV pipe is sufficient to retain the space between the surface retainer plate and top sealer plate. Short sections of PCV pipe are glued to both the surface retainer and top sealer plates. They function as sockets to prevent the galvanized spacer from falling out of position.

4. Top and Bottom Sealer Plates (Figs. 1b, 2a, e): A top plate is cut to the outside dimensions of the X-ray liner component. When positioned over the liner, the inside edge of the top plate should be flushed with the

exterior side of the X-ray liner cutting plate. A section of PCV pipe is glued to the top plate in the same position as that on the surface retainer. The bottom plate is cut to the outside dimensions of the X-ray liner and with the exception of the PCV "socket" is identical to the top plate. In some cases a tighter seal for the surface retainer plate would be advantageous. This could easily be achieved with an O-ring attached to the surface retainer plate of the X-ray liner.

Shipboard Procedure

Preparing the liner system for coring:

1. Attach the top sealer plate to the X-ray liner using nylon reinforced tape. It is best to attach only the exterior edge of the plate to the liner (creating a hinged joint) so the plate can be moved out of the way when the core is sliced. This is done prior to coring to facilitate sealing the X-ray liner after sample recovery.

2. Position the two liner components inside the stainless-steel core box. The X-ray liner is set on the removable side of the core box, and the holes in the liner are matched up to those in the steel box.

3. Duct tape is adhered around the entire bottom edge of the box core to prevent sediment from getting in between the liner and core box. Additional tape is required at the top of the box core to hold the liner in position.

4. Attach the removable stainless-steel base plate and guard plate to the box core spade with hexagonal head bolts. The corer is now ready to be lowered over the side.

Preparinq the Box Core for Subsampling and Radiographic Examination After Recovery

1. Remove the spade guard and attach Link Locks (Karl, 1976) to bridle and stainless-steel core box. Detach the core head from frame (Fig. 3 C, D, E).

2. Lift the top sealer plate and push the cutting plates through the sediment. One cutting plate is inserted between the two cutting guides, while the other is guided along the outer edge of the X-ray liner cutting guides. The bevelled edge of the X-ray cutting plate will force the plate against the guides insuring an accurate cut.

3. A galvanized or PCV pipe spacer is measured and cut to the exact length of the space remaining at the top of the core. The surface retainer plate is positioned at the sediment surface and then the spacer is positioned into the PCV socket on the retainer plate (Fig. 2).

4. The top sealer plate is repositioned over the X-ray liner and taped to the X-ray liner cutting plate. A plate cut to fit into the top of the large liner is positioned at the surface of the sediment in the large liner section.

5. The entire core is layed on its side, with the removable side of the core box facing upwards, and the steel box is opened. The plate over the surface of the large liner can be held in position with a piece of wood butted against a back stop (Fig. 4).

6. At this point the Link Locks can be removed and the base plate pulled away from the bottom of the core. In most cases the sediment at the base of the core is stiff enough to remain intact without the base plate. If the sediment is highly fluid, the procedure below should be carried out with the core in a vertical position. The bottom sealer plate is hand held in position and the X-ray liner lifted out of the core box.

While one person holds the core vertically, another wipes the outside of the liner clean and secures the bottom plate to the liner with duct tape.

7. After the X-ray liner is sealed and labeled, the remaining sample in the large liner section can be dissected and subsampled as required.

Summary

Sedimentologists at VIMS have used the core liner system described in this report with satisfactory results. This system reduces post-sampling disturbance of fluid mud samples, overcomes bulging at the sides and readily obtains a sealed vertical section of core for radiographic examination. This system is designed to be used with a standard Bouma core box and does not require the fabrication of a special liner housing.

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Acknowledgements

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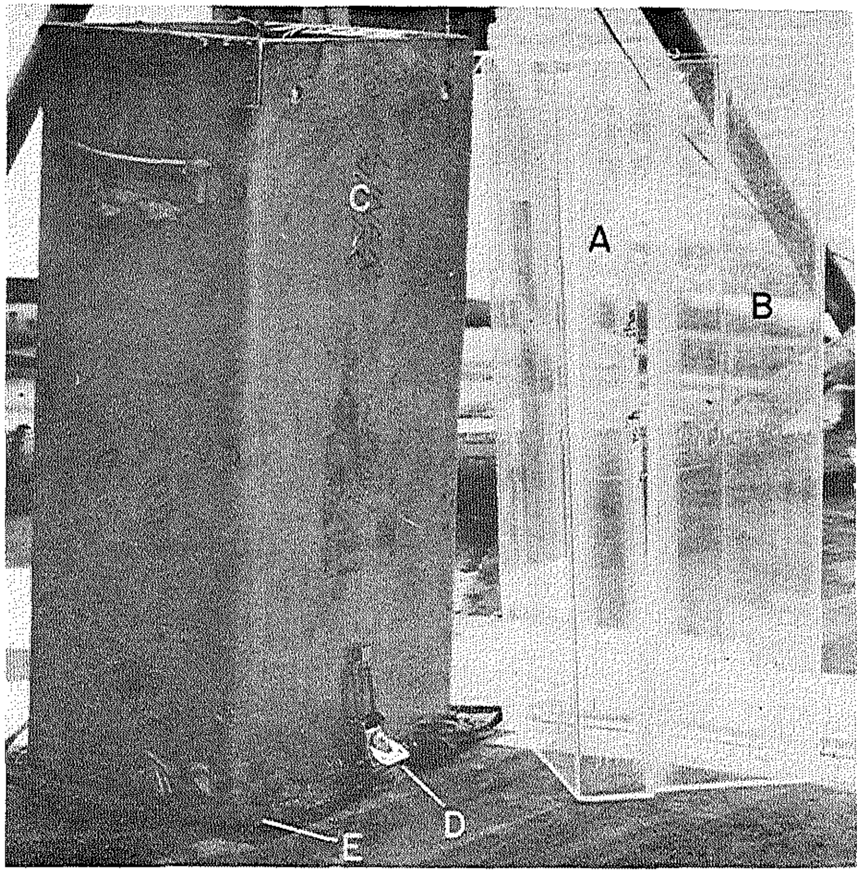

Figure 3. Photograph of stainless-steel core box after recovery of core (left), with view of plastic liner components (right). Prior to coring, plastic liners were taped inside of the steel core box at the left. A. X-ray liner section; B. large liner section; C. stainless-steel core box; D. Link Locks; E. removable base plate.

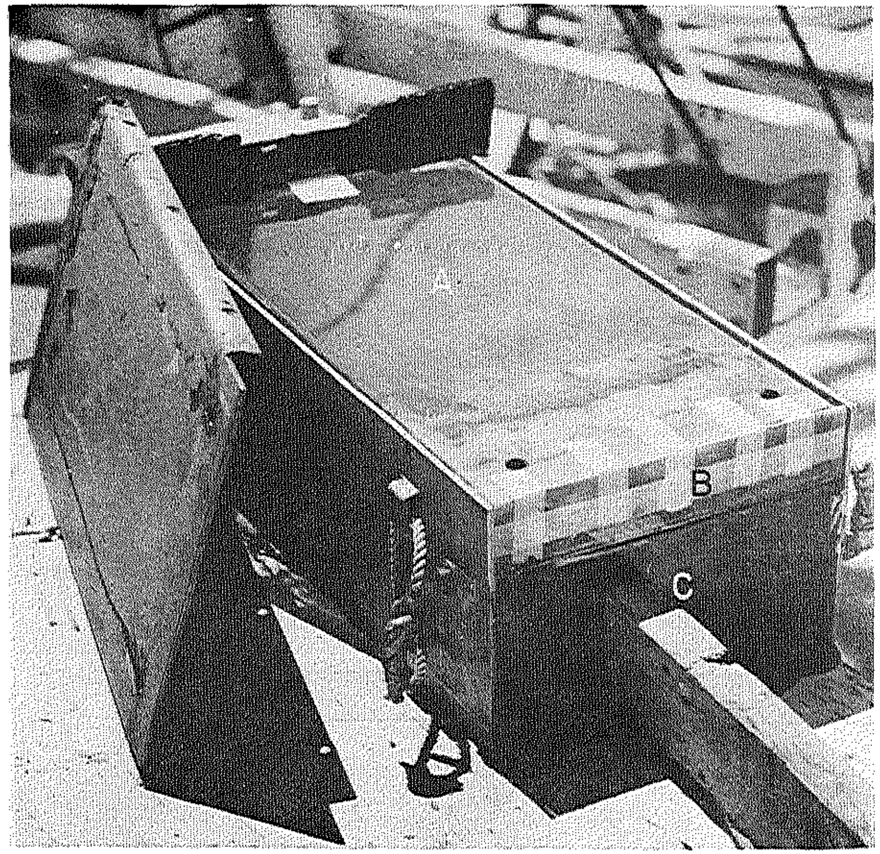

Figure 4. Photograph of stainless-steel core box positioned horizontally with face plate removed. A. X-ray liner section; B. top sealer plate; C. surface retainer (for large liner section).