SACC
Sediment
Free corer
SACC
Sédiment
Carottier libre

Spring-arm core closer (SACC)

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ABSTRACT

A spring-arm core closer (SACC) is described which does not disturb the sediment and is highly reliable. SACC is designed to replace core catchers, ball seals and other types of core retainers which disturb the sediments. SACC can be used on cores with a stationary, rigid outer frame. Additionally, SACC can accommodate various diameter core tubes. When attached to a disturbance free corer, SACC permits the retrieval of large diameter cores suitable for diagenetic, nutrient exchange and sediment-water interface studies.

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RÉSUMÉ

Un nouveau type d'obturateur à ressort pour carottier (SAAC)

Cette note présente un nouveau type d'obturateur à ressort pour carottier, de fonctionnement sûr et ne perturbant pas la carotte prélevée. Le SAAC est destiné à remplacer les obturateurs traditionnels, clapets sphériques et autres types de fermeture de carottier qui perturbent les sédiments. Le SAAC peut être fixé sur un cadre rigide. De plus cet appareil peut s'adapter à des tubes de diamètres variés. Fixé à un carottier libre, il permet de prélever des carottes de large diamètre convenant pour des études de diagenèse, d'échange de sels nutritifs et d'interface eau-sédiment.

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INTRODUCTION

The purpose of this paper is to describe a spring-arm core closer (SACC) which attaches to a hydraulic corer and reliably obtains undisturbed cores. For sediment studies on nutrient regeneration, diagenetic processes and sediment-water exchange rates the investigator needs undisturbed cores (Rowe *et al.*, 1975; Hartwig, 1976; Suess, 1976; Berner, 1977). Craib (1965) designed a hydraulic corer to obtain single, small diameter (5.7 cm), short (20-30 cm) undisturbed cores for this purpose. Pamatmat *et al.* (1973) modified the Craib corer to obtain four cores at one time.

The principal of these hydraulic corers is a slow penetration of the core tube into the sediment. This permits cores to be obtained which are undisturbed both at the surface and along the entire length of the core. This is in contrast to gravity type (core tubes or box cores) or vibracorers which can disturb both the surface and subsurface sediments due to bow wave, impact, and vibrational effects.

Both the Craib and Pamatmat hydraulic corers use ball seals to close the core tubes. In operation there are two problems with ball seals. One is that the ball must be substantially larger in diameter than the core tube or it will enter the core tube and compact a layer of bottom sediment. This not only disturbs the bottom sediment layers but forces the bottom layers of interstitial water upward. Secondly, there are short-comings on ball seal reliability. The core closer described in this paper does not suffer from these problems and can be attached to either the Craib or Pamatmat hydraulic corer or to any other corer with a stationary, rigid outer frame.

PRINCIPLES OF OPERATION

The operational procedure for the core closer is described in the Addendum. In this section the basic principles of operation of the core closer and adjustments made to the core closer are discussed.

Spring forces from a single coiled spring operate the core closer (Fig. 1). Vertical spring tension is adjusted by compressing the coiled spring (K) between the lever arm and bushing (N and O). Lever arm rotational

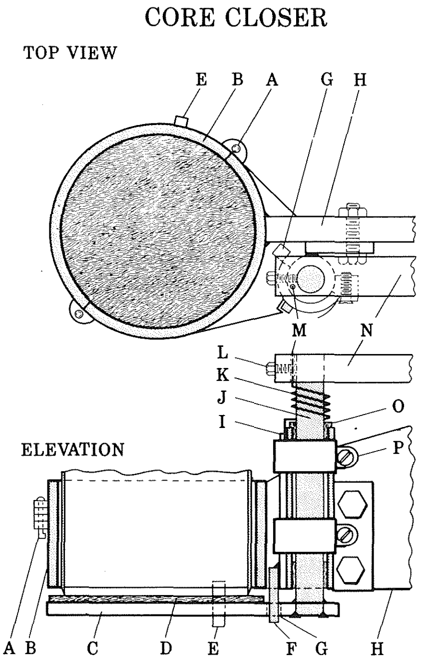

Figure 1
Spring-arm core closer showing: A) hinge with removable pin; B) core guide; C) base plate; D) open-cell neoprene; E) stop; F) tit; G) stop hole; H) support arm; I) adjustable guide; J) base plate support; K) coiled spring; L) lever arm bolt; M) hole in lever arm for coiled spring; N) lever arm; O) bushing; and P) clamp.

motion is adjusted by loosening the lever arm bolt (L) and rotating the lever arm. Base plate rotational distance is adjusted by loosening the clamps (P) holding the adjustable guide and attached tit (I and F) and turning them in the desired direction. These adjustments should be made prior to the first deployment and once made require little further attention.

The photograph (Fig. 2) shows the SACC at an oblique angle with the stop (E) resting on a pencil. The nylon string going from the lever arm (N) to the removable pin (A) is to prevent losing the pin when it is out of the hinge. Note also the two clamps (P) secured around the adjustable guide (I) and the coiled spring (K) coming through the hole in the lever arm (M).

During deployment the core tube is kept in a partially lowered position by a 2.5 cm circular spacer placed between a core arm and the lift plate (Fig. 3). In this position the core tube is lowered sufficiently to act as a rotational stop for the SACC base plate (*see* Addendum; Procedure, step d.). The circular spacer rolls off the core arm when the corer reaches the sediment and the winch cable tension is relaxed. With the spacer disengaged the core arms and attached core tubes are lifted an extra 2.5 cm during retrieval.

The sequence of SACC action during deployment, core tube removal and corer retrieval is as follows. During core penetration into the sediment the base plate presses against the side of the core tube preventing closure of SACC. As the core tube is being removed from the sediment the cored material is held in place by a seal at the top of the core tube (Fig. 3). Since the spacer was disengaged during core penetration into the sediment, the core barrel can be lifted an extra 2.5 cm providing sufficient clearance between the bottom of the core and the sediment surface for the base plate to rotate beneath the core tube. The spring causes the base plate to rotate clockwise until it strikes the stop welded onto the core guide (E and B, Fig. 1). This movement aligns the base plate with the core tube. The upward tension of the coiled spring presses the 0.65 cm layer of open-celled neoprene (D, Fig. 1) cemented to the base plate up against the core tube effecting a seal. In this position the core tubes complete their removal from the sediment until the core arms meet the lift plate (Fig. 3) and the entire corer is lifted from the sediment surface and hauled up to the ship.

After recovery of the corer, each core tube is capped and removed as discussed in the Addendum. A new set of core tubes are put into place, the SACC's for each core tube are actuated and the corer is again ready to be deployed.

FIELD TEST

SACC, attached to a Pamatmat multiple corer using 7.5 cm diameter core tubes, was tested in the Chesapeake Bay in gravel-silt, sand, sandy-silt and silty sediments. After initial adjustments of the spring tension and base plate rotational distance, 24 cores (6 deployments of the corer) were taken.

Operationally, SACC performed as expected in all but one instance (23 of 24 cores) where the failure was due to the core tube slipping down during withdrawal from the sediment preventing the base plate from rotating beneath the core tube. Depth of core tube penetration into sediments was dependent upon the sediment pro-

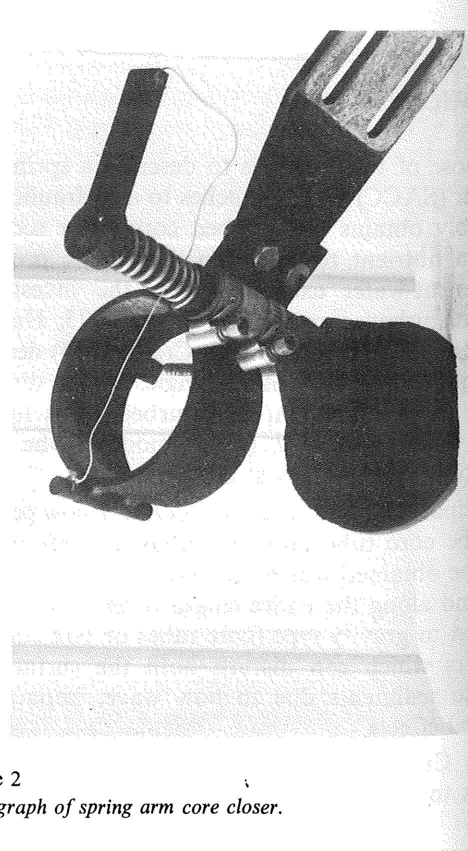

Figure 2
Photograph of spring arm core closer.

perties. In gravel-silt (loosely packed) and sandy (hard packed) sediments core lengths of 15 cm and 4 cm respectively were obtained. In sandy-silt and silty sediments cores of 25-30 cm were obtained. In all types of sediments sampled SACC operated correctly and retained the sediments during retrieval. Diver observations in sandy and silty sediments confirmed the fact that SACC performed as expected and caused no visible compaction or distortion of the bottom sediment layers.

When attached to a disturbance free corer, such as the Craib or Pamatmat corer, SACC permits the retrieval of large diameter undisturbed cores suitable for diagenetic studies, nutrient exchange studies and sediment-water interface studies. SACC can replace core catchers on other corers which have a stationary, rigid outer frame and provide reliable closing without the disadvantage of disturbing the sediment. SACC should be compatible to deep sea corers with minimal modifications to the bushings, neoprene base plate seal and spring. Also, by attaching sleeves to the inside of the core guide SACC could be used with various core tube diameters.

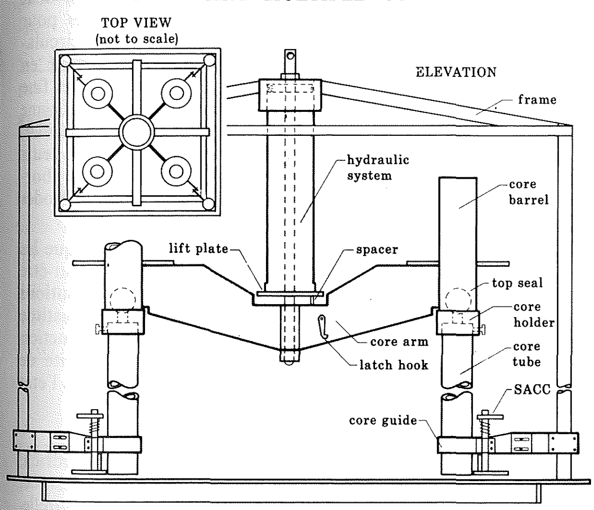

Figure 3
Pamatmat multiple corer.

Acknowledgements

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ADDENDUM

Procedure to operate SACC

Beginning from a closed position (*Fig.* 1)*: a) push down on lever arm* (*N*) *until base plate* (*C*) *clears tit* (*F*)*; b) rotate base plate counterclockwise until tit enters the stop hole* (*G*)*. If a core has been taken, slide a core cap or other closure over the bottom of the core as the base plate is rotated from beneath the core tube; c) in this position the base plate is secured in an open position and core tubes can be removed or put in place. When removing a core the top seal* (see *Fig.* 3) *should be first broken before the core guide* (*B*) *is opened by removing one of the retaining pins from its hinge* (*A*)*; d) when a core tube has been inserted, actuate SACC by depressing the lever arm until the tit clears the stop hole* (*G*)*. The base plate will then rotate and be held by spring tension* (*K*) *against the outside of the core tube; e) in this position the corer is ready to be used. Take core and retrieve corer onto vessel; f) repeat steps* (*a*) *and* (*b*) *to remove and install another core tube. Repeat steps* (*c*) *through* (*e*) *to take another core.*