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An improved Kajak-type gravity core sampler for soft bottom sediments

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ABSTRACT

A new, modified model of the Kajak tube core sampler is presented. The new sampler is intended for use on soft sediments, and hence of light weight (12 kg). The improved sampler offers the following advantages. (1) increased robustness, (2) simplified attachment of the coring tube to the holder and valve assembly, permitting quick exchange of sampling tubes, (3) unimpeded flow of water through the tube during slow descent, (4) a reliable, automatic mechanism closing the top of the core tube after impact, and (5) an easily dismantled supporting frame, which also protects the sampler from damage against the side of the boat in rough weather. The operation of the sampler has been observed *in situ* and during ordinary shipboard collection of core samples, with satisfactory results.

1. Description and operation

We have substantially modified the Kajak-type gravity corer [5]. The new sampler is light in weight (12 kg in air) and may be conveniently operated from even a small craft (Fig. 1). The frame, the tube holding unit and the main parts of the valve system are made of brass. The tube holding unit consists of two metal rings, fitted together by a pair of excenter torsional clasps and a matching interior Neoprene O-ring. All screws and nuts are of acid resistant steel. In order to avoid damage if the device strikes the side of the boat, the legs of the frame are made of polycarbonate, which stretches and gives slightly without becoming deformed. The frame construction is easily dismantled by unscrewing a nut at each corner of the frame and releasing the four screws which attach the legs to the tube holding unit. This makes the instrument handy and more portable.

In its current version, the sampler is equipped with a transparent cylindrical Plexiglas (acrylic glass) coring tube. The tube is 500 mm long with an inside diameter of 80 mm and a wall thickness of 5 mm. The cutting lower end of the tube has a 30 mm high, sharp outside tapering. The upper end of the tube is bevelled to obtain a good fit to the tube

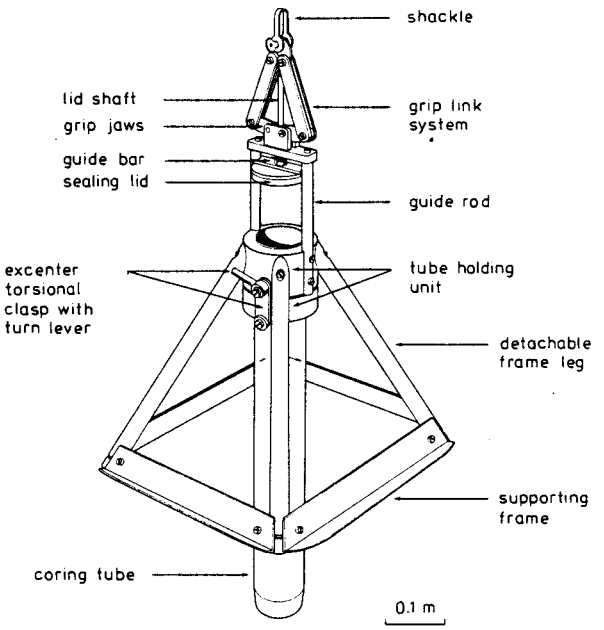

Figure 1. Schematic diagram of the core sampler in cocked position.

holder and the valve assembly. By coating the screw of the lid with e.g. Teflon, it is possible to obtain sediment and supernatant water samples unexposed to any metal.
On cocking, the coring tube is inserted into the tube holding unit and fixed by turning the levers of the excenter clasps, thereby squeezing the O-ring inwards against the coring tube. The lid rises and is retained by the two jaws which grip the lid shaft. These jaws are tautened by the attachment line via the link system.
During descent the valve is kept open. When the tube has penetrated the sediment bed and the sampler rests on the bottom, the hoist line slackens and the arms of the grip link system drop down, thereby automatically releasing the grip of the jaws on the lid shaft. The lid moves down, guided by the two rods and closes the upper end of the coring tube. When the hoist line tautens again, the sealing becomes self-tightening by virtue of the grip jaws now firmly pressing down the top of the lid shaft. This closing mechanism is adapted from Kajak et al. [5] and Brinkhurst et al. [2]. Underneath the lid of the new sampler is a sealing disc of Evazote (foamed cross-linked ethylene vinyl acetate), which obviates the need of grease for tightening. If the sediment core obtained is too short or too watery, it is easily lost when passing the water surface. This can be prevented by submerging the lower end of the core in a water-filled bucket before the sampler is lifted out of the water.
An additional accessory for the sampler which we have found practical is an expansion-tightening piston stopper for sealing the coring tube after retrieval (Fig. 2). It consists of

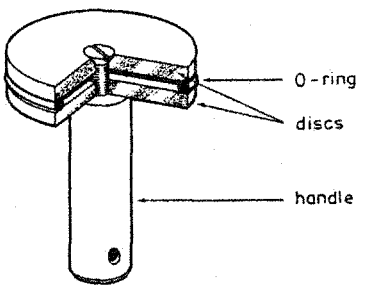

Figure 2. Diagram showing the expansion-tightening piston stopper for sealing of the coring tube, in cross section.

two discs of PVC (polyvinyl chloride) with an outer O-ring of Neoprene between. The stopper is fixed by turning the handle which screws the discs together thus causing the O-ring to be squeezed outwards against the coring tube. This type of stopper is excellent for transport as well as for incubation of collected sediment cores. It should be noted that the upper stopper must have a perforation to allow the surplus supernatant water to escape.

For reliable results, very careful, slow entry and penetration of the sediment is recommended (cf. Fig. 7 in Blomqvist [1] and conclusions by Evans [3, p. 89] and Evans and Lasenby [4, p. 168]). Special care should be taken to ensure that drift and wave-induced motion of the boat during sampling does not disturb the upper sediment layers, or cause a distorted and slanted coring, or repeated penetration [6, 7]. Strong water currents can also adversely affect the sampling procedure.

2. Concluding remarks

Compared to most earlier core tube sampling devices, our sampler offers the following advantages: (1) a generally robust design, with few working parts, (2) a simple and handy attachment of the coring tube to the holder and the valve assembly, permitting quick exchange of tubes, (3) unimpeded water flow through the tube during slow descent, (4) a reliable, automatic, self-tightening top closing mechanism, (5) a supporting frame which reduces the tilting tendency of the device when entering the sediment and which also protects the coring tube from striking against the side of the boat, and (6) an easily dismantled frame construction. When properly operated it is useful for sampling soft bottom sediment. *In situ* SCUBA diver observations confirm that the sampler functions as intended, and that the supporting frame prevents tilting after impact (Fig. 3). The new instrument has functioned well during two years of routine sampling in the Baltic Sea, at depths of up to 50 m.

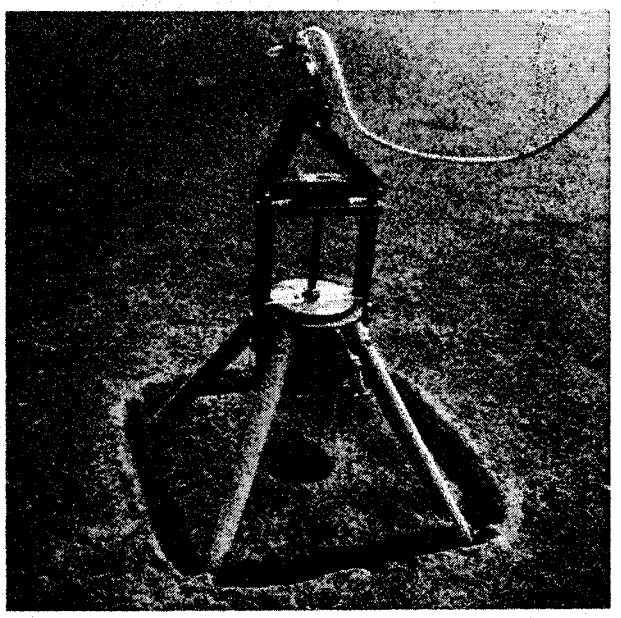

Figure 3. Underwater photograph of the core sampler, resting on a soft bottom sediment at a water depth of about 10 m in the Baltic Sea. This photograph was taken about 20 seconds after impact. Note the core shortening, a phenomenon inherent in the tube coring process, and starting at a certain depth of penetration in the sediment column ([1] and references therein).

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