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AN IMPROVED CORER FOR SOFT SEDIMENTS

For certain scientific purposes it is essential to have precise and undisturbed cores of soft sediments as much as one meter long. Although a number of coring devices have been built for this purpose, most have often been found to be unacceptable for various scientific or operational reasons. Of those in general use, the box corer is most satisfactory and best known. It consists of a supporting framework that is set on the bottom, a heavily-weighted rectangular core box, and a blade that slices under the box from the side to hold the sediment in the box when the frame is retrieved. The box corer retrieves short (usually 20 to 30 cm long) cores that are undisturbed and of high quality which have served as a standard for a decade or so. Unfortunately, because of its inherent weight, the box corer is difficult to use on the small ships (under 20 m long) that are most likely to be available for coastal work. The two versions of the box corer weigh about 300 and 600 kilograms and, except when the sea is flat calm, tend to be unmanageable and dangerous.

The Coastal Water Research Project required a lighter, more conveniently handled, coring device that would take equally good (undisturbed) cores of soft bottom materials extending downward to the underlying clay base. The principal need for such cores was to permit vertical sectioning of the bottom muds so that chemical changes in the sea bottom over the last few decades could be measured.

The corer that finally emerged after much thought, as well as considerable trial and error, is shown in Figure 1. Its weights and dimensions are given in the accompanying box; its principal features are described herewith.

In sampling very soft sediments whose surface is easily blown away or otherwise disturbed it is necessary to minimize the currents or the shock wave that precedes some corers. The box corer solves this problem by having a large weight slowly press the box downward into the sediments. We have chosen instead to use a very thin walled cylinder (steel and liner together are only 2 mm thick) that is completely open at the top and falls rapidly for the last meter. This causes the core tube to cut cleanly thru the water and the bottom without disturbing the interface. A very thin-walled core catcher is held open by the water as it falls, but closes to seal the end when the core tube is withdrawn from the bottom.

Three features make this tool particularly effective: First, it uses a triggering mechanism much like that employed on previous generations of deep sea core tools. When an advance weight contacts the bottom a lever is released that allows the weighted core barrel to fall the final

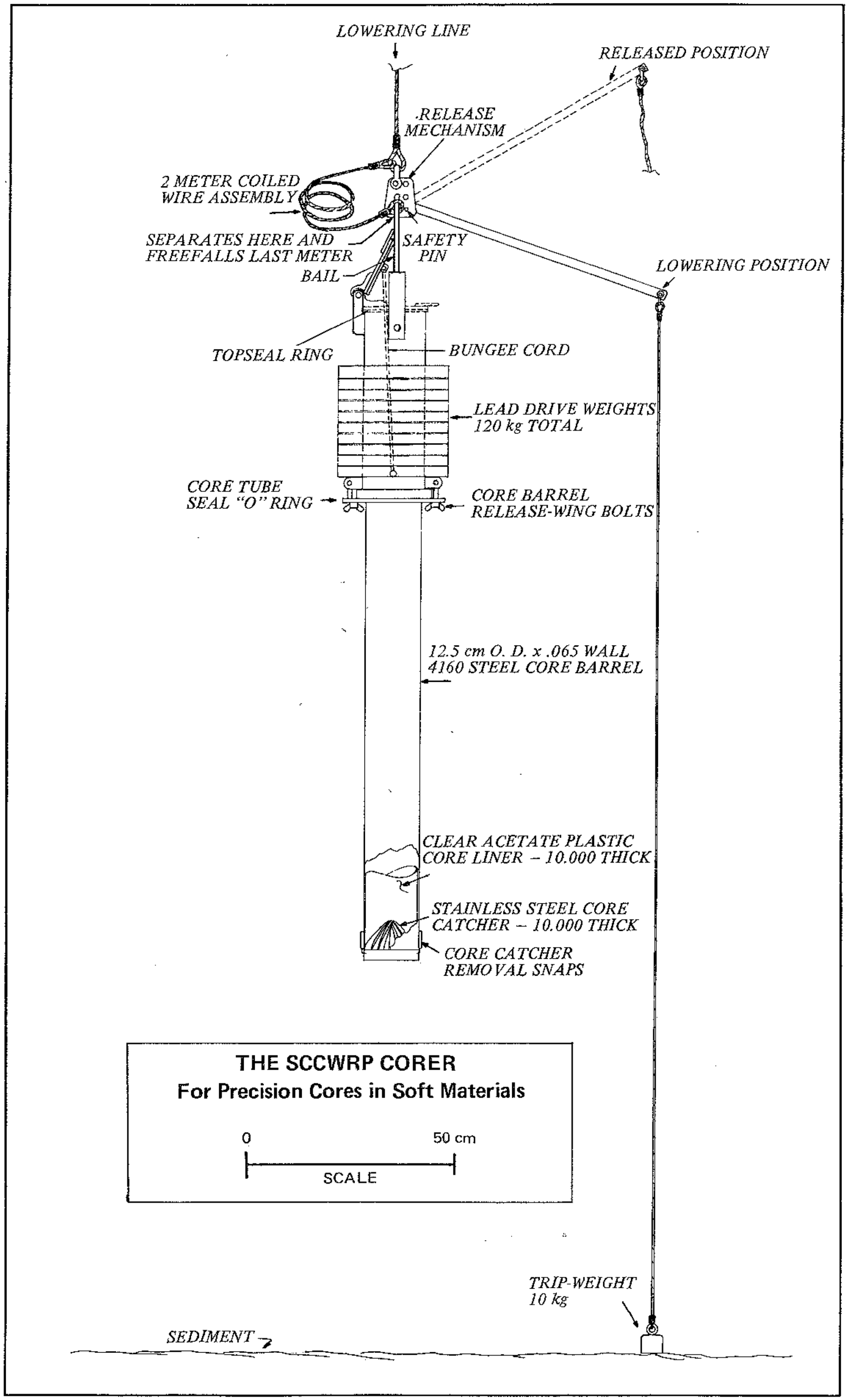
LOWERING LINE
RELEASED POSITION
.RELEASE MECHANISM
2 METER COILED WIRE ASSEMBLY
SEPARATES HERE AND FREEFALLS LAST METER
SAFETY PIN
BAIL
LOWERING POSITION
TOPSEAL RING
BUNGEE CORD
LEAD DRIVE WEIGHTS 120 kg TOTAL
CORE TUBE SEAL "O" RING
CORE BARREL RELEASE-WING BOLTS
12.5 cm O. D. x .065 WALL 4160 STEEL CORE BARREL
CLEAR ACETATE PLASTIC CORE LINER – 10.000 THICK
STAINLESS STEEL CORE CATCHER – 10.000 THICK
CORE CATCHER REMOVAL SNAPS
THE SCCWRP CORER
For Precision Cores in Soft Materials
0
50 cm
SCALE
TRIP-WEIGHT 10 kg
SEDIMENT

Figure 1.

THE SCCWRP CORER		
Length overall		1.8 m
Maximum core length		1.0 meters
Core diameter		10 cm
Thickness of steel shell	1.5 mm	
Thickness of core liner	.5 mm	
Total thickness	2.0 mm	
Weight of tool (excepting weights)		10 kg
10 lead weights, 12 kg each		120 kg
Fall distance after triggering		1 m

meter. This causes the thin-edged barrel to cut into the mud while moving at about 4 m/sec with an equivalent weight of about 900 kilograms (if it takes a core 30 cm long).

Second, it is essential that the tube holding the core be tightly sealed, both on withdrawal from the bottom and on lifting clear of the water. Otherwise the core catcher will collapse and release the core or the soft core material will leak out around the catcher. We have provided a rubber seal, coated with silicone, both at the top lid and at the disconnection joint just below the weights, that prevents leakage of air or water.

Third, the top lid must be held completely open to prevent the core tube from sending a shock wave ahead and disturbing the uppermost surface of the sediments. This is accomplished by having the bail of the corer hold the top lid open. After the core tube has bottomed, the weight of the lever arm moves the bail out of the way, allowing an internal bungee cord to snap the lid shut and hold it there.

The actual taking of the core is instantaneous and automatic. As soon as the winch operator is aware that bottom has been reached he can begin retrieving wire. Once back at the surface, the core tool is swung aboard and set vertically on a rubber pad while the upper part of the barrel (including the weights) is detached and swung free. Then the excess water in the upper part of the core barrel is siphoned out, the core catcher unlatched, and the steel core tube lifted off revealing the core standing on the core catcher in its thin plastic core holder.

The core holder is then maintained in a vertical position, secured with tape to prevent flexing, marked with station location and orientation, and the top of the core flooded with liquid nitrogen which immediately freezes the upper surface. The core is then put in a box with dry ice where it freezes solidly. In this latter fashion it is returned to the laboratory.

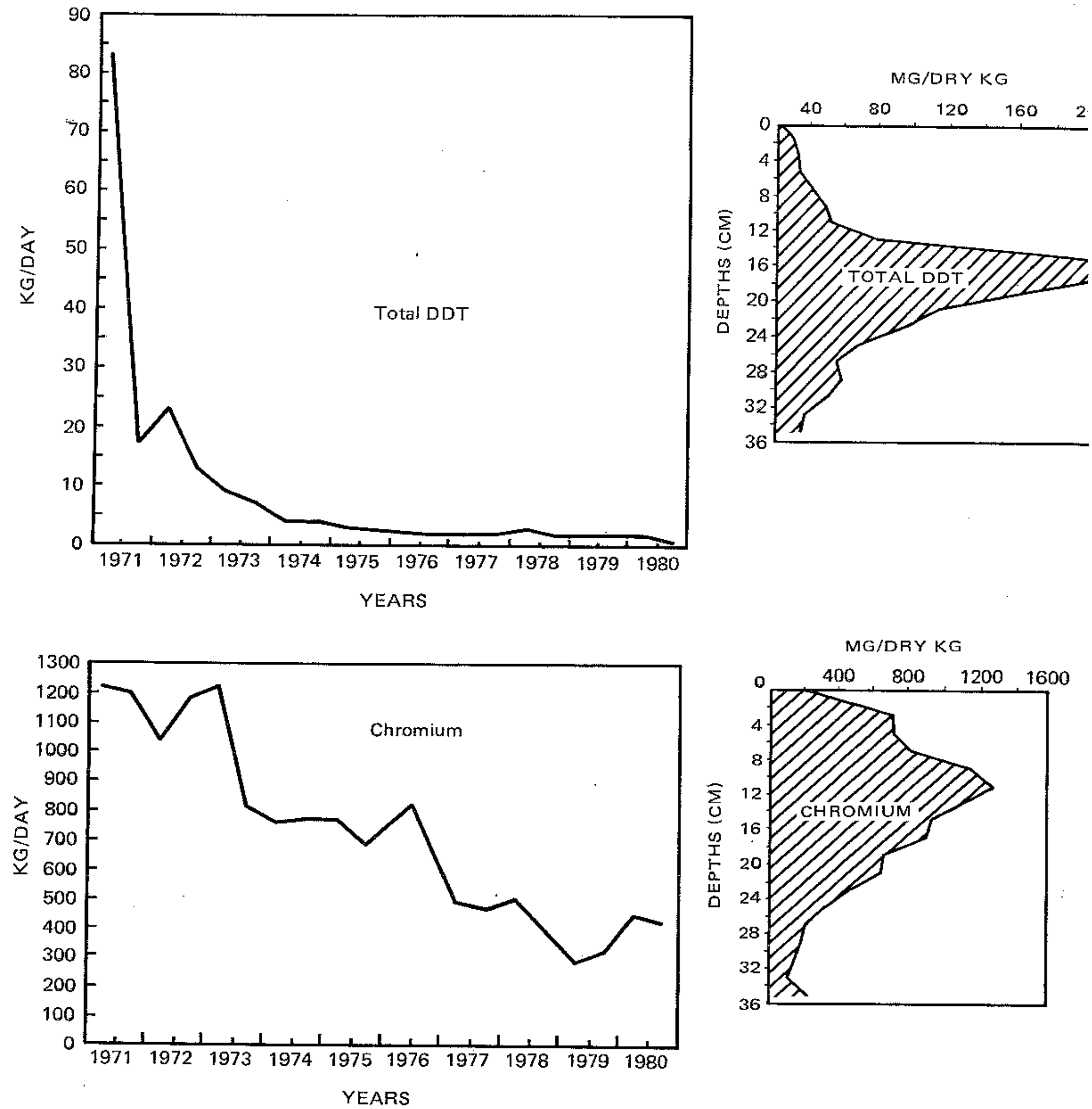

Figure 2. Comparison of discharges of DDT and chromium from Los Angeles County Outfall with the record in the sediments at their station 6C as determined by analyses of a core taken with the SCCWRP corer. The maximum amount of DDT and chromium at depths of about 10 cm probably were deposited in 1971. (Stull 1981).

To date some 40 cores have been taken in water depths of 30 to 500 meters with about 95% success. The longest single core taken to date is 84 cm in soft sediment off Palos Verdes at a depth of 500 m. At the same location a box corer would retrieve a core 30 to 40 cm long. Three cores taken off Orange County in depths of 339 meters were 51, 64 and 80 cm long.

The authors are of the opinion that it is very much easier to transport this core tool to and from the ship being used, and to operate this tool at sea, than it is to use the competing box corer. It is, of course, much lighter and less expensive. With either of these two devices the cores obtained are, qualitatively, the same. None of the other corers of which we know are satisfactory.

An example of data obtained with the SCCWRP corer is given in Figure 2 (Stull 1981). For a 36 cm deep core (which bottomed in clay) three chemical characteristics (organic nitrogen, total DDT and chromium) were measured at 2 cm depth intervals.

These show that as a result of treatment improvements and source control all three declined significantly both in the effluent and in the sediments during the last decade. The DDT peak is probably centered about 1970; one can readily see that the amount in the sediments decreased markedly with the cessation of discharge in 1971. Chromium has a broader peak, but it is now only 30% of the peak values reached in the early 1970s. Organic nitrogen, which reflects the organic solids discharged, is down in surficial sediments to 72% of the peak value. It will doubtless continue to decrease as improved plant facilities come on line.

At the same time as the above work, a comparison of the SCCWRP corer cores was made with those of the box corer at Los Angeles Sanitation District's station 6C in 1981 (6C is at a depth of 60 m 1.2 km west of the outfall). Cores from both devices were sliced horizontally at 2 cm intervals and the muds compared for copper content. The results were equivalent and LACSD adopted the SCCWRP device for future surveys (Garrison 1981).

REFERENCES

Stull, Jan. 1981. Quarterly Report of the County Sanitation Districts of Los Angeles County, July thru September 1981. R. P. Mille, ed.; pp. 122-124.

Garrison, W. E., *et al.* Ocean Monitoring and Research Ann. Rept. 1980-81, Los Angeles County Sanitation District. pp. 62-65.