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NOTE

A Glove Box for the Subsampling of Suboxic and Cold Core Sediment

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아산화 및 저온의 코아 퇴적물 중 부시료 채취를 위한 글러브박스

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To solve two problems, temperature shock to the man and difficulty in exchanging the air in the glove box into N2 gas, during the subsampling of suboxic and cold core sediments, a portable glove box with a refrigerating machine and a gas exchanging bag was constructed for subsampling of sediment cores on board. The refrigerator of the glove box can cool down 200 litter air at 30°C to 2°C±2°C within 5 minutes. The air in the box is easily exchangable with N2 gas easily and efficiently using the glove bag. This box was successfully operated during the second KORDI's deep sea research cruise of 1989 in the North equatorial Pacific. Pore water data obtained from the cruise show no evidence for artifacts caused by warming up or oxidation of sediments during subsampling.

아산화 및 저온의 코아 퇴적물 중 부시료 채취시 실험자에게 미치는 온도 충격과 글러브박스내의 공기를 질소가스로 교체할 때의 난점을 개선하기 위하여, 이동이 가능하고 냉장고와 기체교환풍선을 가진 글러브박스를 제작·실험했다. 본 글러브박스는 30℃의 실온에서 200리터의 기체를 5분 이내에 2℃±2℃로 냉각시킬 수 있다. 또한 기체교환풍선을 이용해 글러브박스내의 기체를 질소가스로 쉽게 교체할 수 있다. 이 글러브박스는 태평양의 클라리온-클리퍼톤 균열대 지역에서 수행된 KODOS-89 탐사에서 성공적으로 작동되었으며, 얻어진 공극수 자료로부터 퇴적물 시료의 가열 또는 산화의 흔적을 찾을 수 없었다.

I. INTRODUCTION

The vertical distributions of sediment and pore water chemistry have been used to elucidate the diagenetic processes of geochemically important elements, such as nutrients and trace metals (Sawlan and Murray, 1983; Klinkhammer *et al.*, 1982; Froelich *et al.*, 1988). To obtain reliable data, sediments should be sampled and subsampled with a minimum physical and chemical disturbances, and pore waters should be extracted from the sediments maintaining its in-situ condition.

It was reported that temperature changes in sediment during sampling can significantly alter the pore water chemistry (Fanning and Pilson, 1971). Silica concentration reportedly increases up to ca. 25% with increasing of 10°C in temperature (Fanning and Pilson, 1971). Oxidation of pore waters also produce some artifacts in pore water data. Reduction of phosphate and silica concentrations by 50% and 15% respectively are reported as results of oxydation (Bray *et al.*, 1973; Loder *et al.*, 1978). As deep sea sediment is usually suboxic and cold, subsampling of the sediment should be done in the subox-

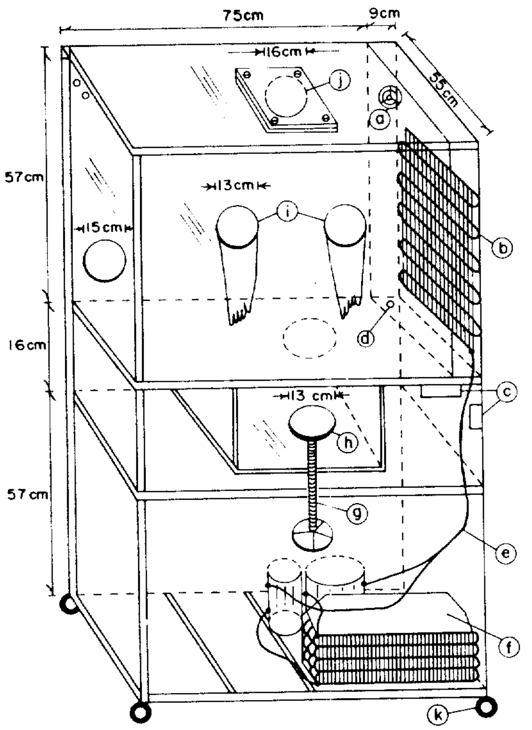

Fig. 1. Schematic diagrams of the glove box: (a) Cooling fan, (b) Cooling coil, (c) Temperature controller, (d) Drain hose, (e) Cooler connecting coil, (f) Compressor, (g) Extruding screw, (h) Extruding head, (i) Glove, (j) Door, (K) 4-wheel.

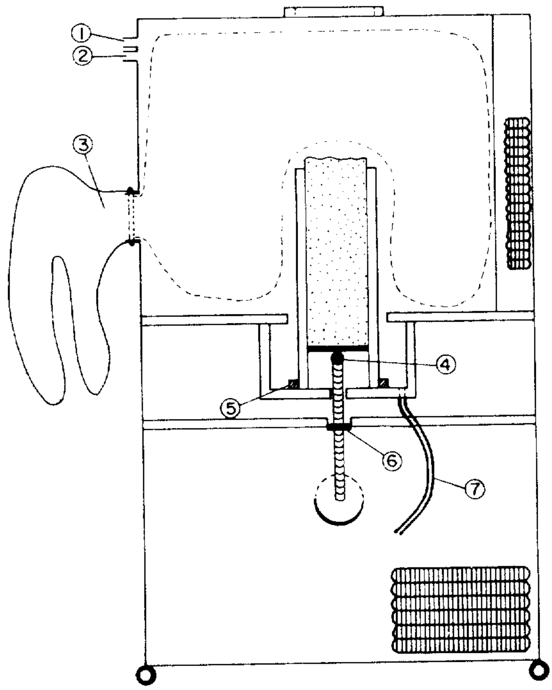

Fig. 2. Schematic cross diagrams of glove box: (1) N2 gas inlet, (2) Air outlet, (3) Gas exchanging bag (solid line; during N2 gas purging, dashed line; during evacuating), (4) Ball, (5) Clamp, (6) Screw, (7) Drain hose.

ic and cold condition.

Some glove boxes were designed and used to study the suboxic and cold sediment (Rideout and Pagett, 1984; Edenborn *et al.*, 1986; Froelich *et al.*, 1988). They are mostly operated in a large cold van in order to control the internal temperature of the box. It is expensive and needs large space to set up the cooling van system aboard for the subsampling of sediments and pore waters. Working in the cold van imposes temperature shock to man especially in the warm equatorial area. If one is exposed to the 20 °C atmosphere after working in the cold van, he will probably catch a cold, have a headache or dizziness. Another difficulty is hardening of hands in the cold van. This is fatal for the skillful hand work in the glove box. Exchanging the air in the glove box with N2 gas was usually achieved by evacuating the box with vacuum pump and purging N2 gas into it repeatedly. To obtain large volume difference between the air and the N2 gas in a box for the gas exchanging, great vacuum and large over pressure for the box is needed. But this is practically impossible because of the flexible gloves attached to the box. Another way is doing many times of evacuating and purging process. But this method needs too much time.

We made and tested a simple and portable glove box which allows the vertical subsampling of a sediment core while maintaining a cold and suboxic condition efficiently and easily using a refrigerator and a glove bag.

II. METHOD

1. Design of Glove Box

Schematic diagrams of our glove box are

shown in Fig. 1 and 2. This glove box is composed of two parts, *i.e.* an acrylic sampling box and a steel supporting frame. The box was made of 10 mm thickness clear acrylic plates to minimize the metal contamination. all parts of the box were glued together using cholorform except the upper part which is attached to main body with screws.

The colling system is composed of compressor (f), cooling coil (b), automatic temperature controller (c) and cooler connecting coil (e) (Fig. 1). The cooling system can cool down the 500 litter of 30℃ air to 2℃±2℃ within 5 minutes. An air circulating fan (a) is attached onto the inner wall of the box to homogenize the air in the box.

A large and flexible vinyl bag (3) is mounted on the front side of the box to exchange the air in the box into N2 gas (Fig. 2). Its shape was designed to expel the air in the box fully when it was evacuated as shown in Fig. 2.

The sediment extruder is composed of a long-bar screw (g), a frictionless ball (4) and an acrylic disk (h) with 12 cm diameter. A pair of rubber gloves (i) are tightly attached to both side panels of the box with stainless strip screws and soft rubber strips. To introduce the core into the box, a 16-cm diameter circular door (j) is made on the upper panel of the box.

To make the glove box portable, 4-wheel and its locking system (k) are attached to the bottom frame. The overall weight of this glove box system is approximately 80 kg and the volume of the box is 200 litter.

2. Application to sediment subsampling

A cooperative cruise between Korea Ocean Research and Development Institute and U. S. Geological survey was carried out a cooperative curise in the western margin of the Calrion-Clipperton fracture zone (9-12° N, 152-154° E) in the North equatorial Pacific in October, 1989. Several sediment cores were retrieved using a box corer.

On retrieving a box corer from the sea bed, overlaying water in the box corer is siphoned off, and 13 cm diameter acryl core liner was inserted slowly into the sediment in the box corer. This liner was quickly dug out, capped at the bottom, and transported to a previously cooled glove box keeping up right.

The internal temperature of the box was maintained at 2℃ ± 2℃. The air in the box was exchanged into N2 gas by suctioning out the air in the box with vacuum pump and blowing N2 gas into the box. During suctioning, the vinyl bag is sucked into the box. So, most of air in the box is easily removed with only little vacuum. During blowing, the vinyl bag is inflated out from the box. So the N2 gas volume in the box is greatly increased with only little over pressure. This procedure was repeatedly carried out for four times. A little over pressure is maintained inside the box during the entire subsampling procedure.

Sediment subsampling was done efficiently and rapidly from the core in the glove box by two pepole. The sediments was vertically extruded from the core liner using the long-bar screw (g), sliced with an acrylic spatular, and transferred to the polyethylene bag. Before subsampling, some subsampling apparatuses are precleaned by soaking them in 3N HCl solution followed by washing in distilled water. The core sediment was subsampled at predesigned depth intervals. Each sediment section was packed in the polyethylene bag and squeezed into two 50 m*l* polyallomer centrifuge tubes from the bag. After completing those procedures, the glove box was opened. It usually takes less than 2 hours to finish subsampling a sediment core after retrieving the box corer from the sea bed.

All the samples were centrifuged at 3,000 RPM for 15 minutes, and then supernatent pore water in the centrifuge tube was filtered through the precleaned 0.45 μm Millipore membrane filter paper to the 15 m*l* polyethylene bottle. Filtered pore water was quickly frozen until an-

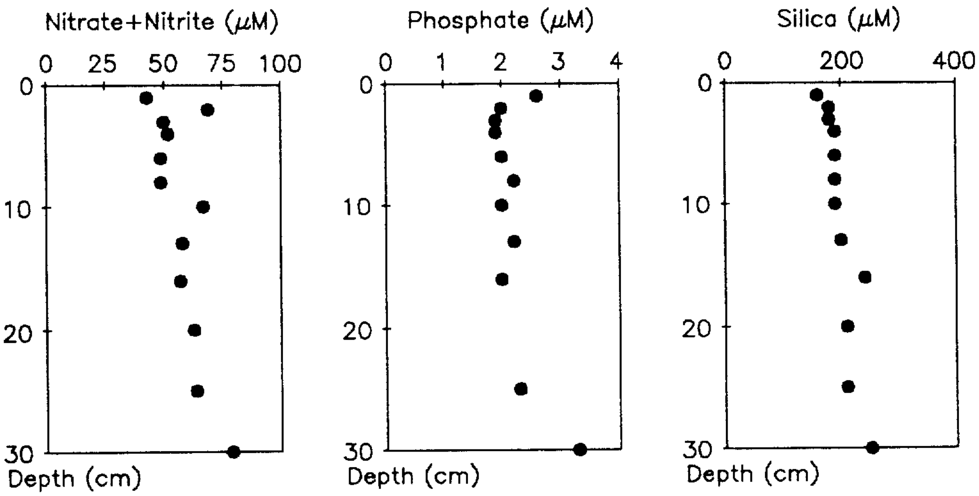

Fig. 3. Vertical distributions of Nitrate + Nitrite, Phosphate, Silica in Pore water. Samples are collected in the KODOS-89 area, North equatorial pacific.

Table 1. Comparison of nitrate, phosphate and silica concentration in the pore water of MANOP site S (Jahnk *et al.*, 1982) and this study area (nitrate + nitrite, phosphate and silica).

	MANOP site S	This study area
Nitrate	50 μM	50-60 μM
Phosphate	2 μM	2 μM
Silica	200 μM	200 μM

alysis.

3. Chemical Analysis of Pore water

Nitratet + nitrite, phosphate, and silica analyses were run on a Technicon Auto-Analyser system, using azo day method, phosphomolybdic method and silicomolybdic method respectively (Parsons *et al.*, 1984). Precisions of the analysis are within 1%.

III. RESULTS AND DISCUSSION

The vertical distributions of nutrient concentrations are presented in Fig.3. Nitrate + nitrite concentration was about 50-60 μM. Phosphate and silica concentration was nearly 2 μM and 200 μM, respectively.

Nitrite concentration is about ten times lower than the nitrate value in deep sea sediment (Jahnk *et al.*, 1982). It is reported that nitrate concentration is 50 μM in MANOP site S (Silicious ooze area) and 40 μM in MANOP site C (Carbonate ooze area) (Jahnk *et al.*, 1982). Our study area is known as the silicious ooze area. So we can say that our nitrate + nitrite concentrations are nearly similar to the reported values of MANOP site S (Table 1). We found that the adrupt increasing of nitrate + nitrite concentration in the depthe profile is associated with buried managanese nodule, not with analytical error.

Phosphate and silica concentration were reported to be about 2 μM and 200 μM, respectively (Jahnk *et al.*, 1982). There is no difference in phosphate and silica between the data obtained during the two different study (Table 1).

If the analysed samples had been oxidized during subsampling, there would be a large decrease in phosphate concentrations (Bray *et al.*, 1973; Loder *et al.*, 1978). If the samples had been warmed up, there would be a large increase in silica concentrations (Fanning and Pilson, 1978; Loder *et al.*, 1978). From the above results, we think that the sediment samples were not warmed up or oxigenated during subsampling in the glove box.

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