AN OCEAN BOTTOM HYDROPHONE INSTRUMENT
FOR SEISMIC REFRACTION EXPERIMENTS
IN THE DEEP OCEAN

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( Accepted 20 October, 1978)

Abstract. Tests of a new Ocean Bottom Hydrophone (OBH) instrument have recently been completed at Woods Hole Oceanographic Institution. This instrument is designed to float ~3 m above the seafloor at depths of up to 6100 m for periods of up to 10 days and continuously records the output of a single hydrophone on a four-channel 0.064 cm/s (1/40 in./s) analog magnetic tape recorder. This instrument has an acoustic transponder and release system and is designed primarily for multiple deployments as a fixed ocean bottom receiver for seismic refraction work.

1. Introduction

Design and construction of the Woods Hole Oceanographic Institution ocean bottom hydrophone (OBH) instrument began in early 1976. Five successful test deployments were made in the fall of that year. In late 1977, two seismic refraction experiments, involving sixteen instrument deployments and recoveries in a twelve day period, were carried out on the Mid-Atlantic Ridge at 23°N. Excellent data were recorded by all instruments. In the spring of 1978, four instruments were laid south of Bermuda for 10 days to monitor aftershocks of the magnitude 6.2 earthquake of 0442z 24th March. At least 10 shocks were clearly recorded by three instruments (see Table I). This paper describes the OBH instrument and reports briefly on the test results.

The OBH was designed primarily for use in explosion seismic refraction experiments. We needed the capability to make two to four deployments lasting 2–3 days of each of 8–10 instruments during a typical one-month cruise. An acoustic, rather than a time release system was thus necessary to provide rapid instrument location and recovery. A simple and accessible electronics and recording system was necessary to permit speedy testing and refurbishing of the instrument between deployments. To carry out, successfully, complex experiments involving so many instruments, we needed the flexibility of operation provided by continuous (rather than pre-programmed interval) recording. This latter consideration, together with a desire for reasonable frequency response up to ~100 Hz (to provide adequate timing resolution of water wave arrivals)

Contribution No. 4174 of the Woods Hole Oceanographic Institution.

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resulted in the decision to use analog recording at a tape speed of $1/40 \text{ in./s}$ (0.064 cm/s). Our desire to maintain the highest possible instrument recovery rate with the minimum of development resulted in the use of a well proven commercially available acoustic release system. No existing design of ocean bottom hydrophone instrument (Carmichael et al., 1977; Langford and Whitmarsh, 1977) satisfied our requirements. The decision to build a hydrophone instrument rather than a seismometer was based on many factors, the two most important of which were (a) our lack of understanding of how seismometers couple to the ground motion of different types of seafloor and (b) the improved recovery reliability produced by having no non-expendable part of the package in contact with, or within 3 m of the seafloor.

The cost of components for the OBH recording package is approximately $5,000. The total cost of an instrument including labor, overheads and an AMF release/transponder is between $20,000 and $25,000.

### 2. Exterior Mechanical Design

The instrument consists of two cylindrical pressure cases, containing the recording electronics and the acoustic release, clamped to a 5-cm-square-section fiberglass pipe (Figure 1). Four 42.5-cm-diameter glass spheres, each providing ~25 kg of buoyancy, are secured to the pipe on fiberglass plates. Table II gives the buoyancy and weight of the components of the instrument. The net positive buoyancy after anchor release is 36.3 kg, sufficient to ensure recovery after failure of one glass sphere or flooding of the OBH case. The anchor consists of an 82-kg concrete block and a danforth anchor which are attached to the acoustic release by ~3 m of 0.95-cm dacron rope.

The acoustic transponder and release is an unmodified AMF Model 325. Two strobe lights and a radio beacon activated by pressure switches facilitate location of the instrument once it has surfaced. The pressure compensated hydrophone

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**TABLE I**

<table>
<thead>
<tr>
<th>Date</th>
<th>Area of operation</th>
<th>Number of launchings</th>
<th>Number lost</th>
<th>Number of instruments failures</th>
<th>Approx. time down</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct. 1976</td>
<td>Banda Sea, Indonesia</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>6-12 hours</td>
<td>Tests on individual units</td>
</tr>
<tr>
<td>Nov. 1977</td>
<td>Kane Fracture Zone, Central Atlantic</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>6 days</td>
<td>Two refraction experiments, each 2-3 days long, each using 8 units</td>
</tr>
<tr>
<td>June 1978</td>
<td>350 km south of Bermuda</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>10 days</td>
<td>Passive micro-seismic study</td>
</tr>
</tbody>
</table>