IN-SITU DETERMINATION OF THE VARIABILITY OF SEAFLOOR ACOUSTIC PROPERTIES: AN EXAMPLE FROM THE ONR GEOCLUTTER AREA

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In support of the US ONR-sponsored Geoclutter program, we have developed, built, and deployed a relatively inexpensive, robust, small-ship-deployable device (ISSAP - In situ Sound Speed and Attenuation Probe) for rapidly measuring sound speed and attenuation in near-surface sediments. We have demonstrated its ability to make reliable and precise measurements (+/- 1-2 m/s for sound speed, < +/- 1 dB/m for attenuation). We have found that in the Geoclutter area the sound speed varies on the order of 200–300 m/s over spatial scales of 10’s of kms and the attenuation (at 65 kHz) varies on the order of 60 dB/m. On scales of less than one kilometer, the sound speed can vary by more than 100 m/s and attenuation by approximately 25 dB/m. On the sub-meter scale, much of the seafloor is relatively homogeneous but some areas show sound speed variation of approximately 50 m/s and attenuation variation on the order of 25 dB/m. These variations are probably related to the presence of large clasts or shells in the measured path.

1 Introduction

With growing pressure to operate in shallow waters, navies around the world are being faced with the challenges of understanding the complex acoustic environment of near-coastal regions. With this in mind, the U.S. Office of Naval Research has undertaken a series of research programs aimed at gaining a better knowledge of both the ocean and seafloor environments in shallow water settings. Amongst these is the Geoclutter program, whose long-term goal is to understand the causes and implications of geologic clutter (reverberation) in a geologically well-characterized shallow-water environment. The field area selected for the Geoclutter program is the mid-outer continental shelf off New Jersey, USA (Fig. 1). The New Jersey margin was chosen for the Geoclutter study because the bathymetry and portions of the shallow subsurface of this area had already been mapped in detail as part of an earlier ONR program aimed at understanding the

origin of subsurface stratigraphy on continental margins (STRATAFORM; [1,2]). In addition to multibeam bathymetry, ‘calibrated’ backscatter data (at 95 kHz from the multibeam sonar) was also collected as part of the STRATAFORM program.

Figure 1. Location map for Geoclutter field area on the continental shelf off New Jersey, USA. Survey area extends from approximately 50 m to about 150 m water depth and covers an area of approximately 1300 sq. km.

The overall scientific objectives of the Geoclutter program are: 1) to understand, characterize, and predict lateral and vertical, naturally-occurring heterogeneities that may produce discrete acoustic returns at low grazing angles (i.e., "geologic clutter") and then; 2) to conduct precise acoustic reverberation experiments at this site to understand, characterize, and potentially mitigate the geologic clutter. In order to meet these objectives and to properly implement acoustic models for the Geoclutter area, we need to know, or predict, the key acoustic and physical properties throughout the volume of interest (i.e., grain size, density, sound speed, attenuation). The properties of the near-surface seafloor sediments are particularly important. A possible approach to this problem is to use the 95-kHz multibeam backscatter data collected in the region, which may provide information on seafloor sediment properties. The relationship between backscatter and sediment properties remains ambiguous however, and cannot yet be used as a direct and quantitative predictor of seafloor properties. Understanding the relationship between the multibeam backscatter and the properties of the seafloor is a sub-theme of our Geoclutter research program.

We thus fall back on more traditional means of sampling and laboratory measurements to obtain the needed seafloor property data. Given the coarse-grained, sandy nature of the sediment in the region we were concerned that laboratory