Dissertations

Characteristics of backscattered ultrasonic signals from the floor of the southern Baltic

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The relationships between the physical and statistical parameters of an acoustic signal echo, and the properties and structure of sediments in the Polish sector of the Baltic Sea were studied and presented in the thesis. The measurements of sea-bottom reverberations of ultrasonic with-modulation pulse signals of frequencies 30, 50, 60, 120 and 210 kHz were made on board the r/v 'Oceania' during several cruises to the southern Baltic in 1991–1994.

These data were numerically processed in order to extract from the signal the distinctive parameters related to the type of bottom sediments.

The physical parameters include the pressure reflection coefficient at the water-sediment interface, the integral backscattering strength, the duration of reverberation, and the attenuation coefficient for selected sediment layers; the statistical parameters are the centre of gravity of the reflected pulse, the normalised moment of inertia of the echo and the skewness of the signal envelope.

For the purposes of interpretation the thesis develops and discusses the numerical model correlating the dependences between the space distribution of the scattered acoustic field and the statistical parameters of the corrugated interface surface; attenuation in the sub-bottom layer has been taken into account.

The principal achievements of the research are displayed on a number of figures and maps representing the relationships examined and established by the author. In the majority of cases, wherever existing geological data permitted this, the acoustic characteristics were compared to the corresponding

geological maps of the sea bottom based on the classical method of direct geological corer data sampling.

Having applied cluster analysis to the data sets of the averaged acoustic signal charecteristics, the author was able to classify them into four groups. The groups corresponded to the four cluster centres and were assigned to a given type of sediment. The sediment types most often occurring in the southern Baltic are:

- marine clayey silts on silty clays (70–80 m depth),
- marine silty clays, silty sands,
- marine fine sands on till,
- marine gravel sands and marine sandy gravels (20–30 m depth).

The good correlation between the acoustic signal characteristics and different sediment types determined for selected acoustic transects (across the Słupsk Furrow and the southern Middle Bank or in the Gulf of Gdańsk) show that the method applied by the author is useful in sea bottom characterisation.

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