ELASTIC CHARACTERISTICS OF THE BOTTOM AT THE ACOUSTIC POLYGON IN PETER THE GREAT BAY (SEA OF JAPAN)

A.N. Samchenko, I.O. Yaroshchuk

The paper considers various remote and direct methods and approaches to obtaining the elastic properties of loose bottom sediments of the sea bottom. Some of the considered options for obtaining the elastic properties of the bottom were applied on an acoustic test site. The acoustic test site is located in the Peter the Great Bay of the Sea of Japan. The results of calculating the elastic properties of sediments by direct and indirect methods are shown. The direct method was proposed by Hamilton and Bachman. The velocities of the longitudinal, transverse waves and density are calculated based on empirical dependencies with the granulometric composition of samples of bottom sediments. Indirect methods for restoring the elastic properties of the bottom are based on data from high-frequency acoustic studies. The calculation of porosity, density, longitudinal and transverse velocities in bottom sediments was carried out using empirical communication models with a normal reflection coefficient from the bottom. The obtained results of calculating the elastic properties of the bottom by various methods are also compared. The obtained data on the elastic properties of bottom sediments served as the basis for the geoacoustic model of the bottom of the acoustic test site and the Peter the Great Bay as a whole.

Keywords. bottom elastic characteristics, high-frequency acoustics, granulometric composition, geoacoustic model, Peter the Great Bay

References

1. Ageeva N.S. Propagation of sound in a shallow sea. Ocean acoustics. M.: Nauka, 1982. P. 107-118.

2. Dolgikh G.I., Chupin V.A. Experimental assessment of the transformation of hydroacoustic radiation into a seismoacoustic wave. Acoust. journal. 2005 No. 5. P. 628-632.

3. Lysanov Yu.P. On the geoacoustic model of the upper layer of sediments in shallow seas. Okeanologiya, 1980. Vol. 25. No. 3. P. 714-716.

4. Biot M.A. Theory of propagation of elastic waves in a fluid-saturated porous solid. I. Low frequency range. J. Acoust. Soc. Am. 1956. Vol. 28. P. 168–178.

5. Stoll R. D. Sediment Acoustics. New York: Springer, 1989. 153 p.

6. Williams K.L. An effective density fluid model for acoustic propagation in sediments derived from Biot theory. J. Acoust. Soc. Am. 2001. Vol. 110 (5). P. 2276–2281.

7. Hamilton E.L., Bachman R. T. Sound velocity and related properties of marine sediments. J. Acoust. Soc. Am. 1982. Vol. 72 (6). P. 1891-1904.

8. Lisyutin V.A. Lastovenko O.R. Evaluation of the effect of internal and viscous friction on the dispersion and attenuation of sound in unconsolidated marine sediments, Acoust. Journal. 2020. Vol. 66, No. 4. P. 420–436. DOI: 10.31857/S0320791920040061

9. Schock S.G. A Method for estimating the physical and acoustic properties of the sea bed using chirp sonar data. IEEE J. of Ocean. Eng. 2004. Vol. 29 (4). P. 1200–1217.

10. Schock S.G. Remote estimates of physical and acoustic sediment properties in the South China Sea using chirp sonar data and the Biot model. IEEE J. of Ocean. Eng. 2004. Vol. 29 (4). P. 1218–1230.

11. Dolgikh G.I., Dolgikh S.G., Pivovarov A.A., Samchenko A.N., Chupin V.A., Shvyryov A.N., Yaroshchuk I.O. The Feasibility of Laser Strainmeters for Sea Floor Diagnostics. Doklady Earth Sciences. 2013, Vol. 452, No. 1, pp. 971-975. DOI: 10.1134/S1028334X13090158

12. Pivovarov A.A., Samchenko A.N., Shvyrev A.N., Yaroshchuk I.O. The use of a hydrophysical research complex in a full-scale experiment on the shelf of the Sea of Japan. Underwater research and robotics. 2020. No. 2 (32). pp. 56-61.

13. Korotchenko R.A., Samchenko A.N., Yaroshchuk I.O. The spatiotemporal analysis of the bottom geomorphology in Peter the Great Bay of the Sea of Japan // Oceanology. 54 (4), pp. 497-504. DOI: 10.1134/S0001437014030047.

14. Samchenko A.N. Geoacoustic modeling on the shelf using geoinformation systems. Bulletin of the FEFU School of Engineering. 2017. No. 4. C. 131-138. DOI: doi.org/10.5281/zenodo.1119189.

15. Svininnikov A.I., Yaroshchuk I.O. Geoacoustic model of the shelf of the Sea of Japan. Bulletin of the Far Eastern Branch of the Russian Academy of Sciences, 2006. No. 3. P. 85-93.

16. Hamilton E.L. Vp/Vs and poisson's ratios in marine sediments and rocks. J. Acoust. Soc. Am. 1979. Vol. 66. P 1093-1101.

17. Hamilton E.L. Geoacoustic modeling of the sea floor. J. Acoust. Soc. Am. 1980. Vol. 68. P. 1313-1340.

About the authors

SAMCHENKO Alexander Nikolaevich, Ph.D., senior researcher
Pacific Oceanological Institute, Far Eastern Branch of the Russian Academy of Sciences
Address: 43, Baltiyskaya st., Vladivostok, 690041, Russia
Scientific fields: shelf geology and geophysics
Phone: +7(423) 231-26-17.
E-mail: samchenko@poi.dvo.ru
ORCID: 0000-0002-5184-0718

YAROSHCHUK Igor Olegovich, Doctor of sciences, physics and mathematics, Senior researcher, Head of the Laboratory
Pacific Oceanological Institute, Far Eastern Branch of the Russian Academy of Sciences
Address: 43, Baltiyskaya st., Vladivostok, 690041, Russia
Scientific fields: statistical hydroacoustics, statistical modeling, seismoacoustics, oceanology
Phone: +7(423) 231-26-17. **Fax:** +7(423) 231-26-17
E-mail: yaroshchuk@poi.dvo.ru
ORCID: 0000-0002-3212-9752