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Depth dependence of ambient noise at low frequency range in the eastern sea of Korea

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1. Introduction

An ambient noise level in the ocean is important parameter to enhance passive sonar detection performance. It is also significant parameter to design undersea surveillance system in harbor. For this reason, many researchers have measured and analyzed ambient noise in the ocean during a few decades. From these studies, it is well known that the primary sources of ambient noise in the deep ocean are distant shipping and ocean surface wind and they in the coastal ocean are the breaking waves and marine life as well as the shipping and wind. However, an ambiguity in acoustic interpretation of the observed ambient noise in the ocean still exists. In this study, we investigated depth dependence of ambient noise levels at low frequency range in the eastern sea of Korea.

2. Experimental Measurement

The measurement of ambient noise was made at a site in the eastern sea of Korea, its water depth was about 2,200 m. The ambient noises at the site were measured using self-recording hydrophones which were lowered at water depths of 50, 150, and 250 m. The self-recording hydrophone (SRH) was consisted of hydrophone sensor (Reson, TC-4032) and data recording hardware. The sampling rate and maximum recording duration of the hydrophone were 65,536 Hz and 24 hours, respectively. The measurement of ambient noise at the experimental site was carried out in March 2012. The water temperature was also observed by using XBT probe. It was used to simulate propagation of ambient noise and to measure the sound channel axis at the experimental site. The sound channel axis was formed near water depth of 250 m. During the measurement of the ambient noise, the sea state number was 2 and the ship number was 0 in less than 10 nmile. Other noise sources including the main and auxiliary engines of the research vessel were also shut down to minimize the noises radiating by the vessel.

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3. Results and Discussion

Figure 2 shows mean noise levels of ambient noises measured at the experimental site. As shown in **Fig.2**, the mean noise levels in the frequency range from 20 Hz and 20 kHz almost appeared similar at water depth of 50 and 150 m. However, they did not appeared similar over the frequency range from 20 and 400 Hz at water depth of 250 m. These differences of mean noise levels can be caused by shipping noise in the coast of eastern sea of Korea.

Figure 3 shows numerical simulation results for propagation losses of shipping noises generated in the coastal sea. RAM model for this simulation was used. Representative frequencies of shipping noises at low and high frequency ranges were selected by 100 Hz and 1 kHz, respectively. The acoustic source depth was assumed by 5 m. As shown in **Fig. 3**, the acoustic wave at the frequency of 100 Hz is propagated at water depths of 160 ~ 600 m. However, the sound at the frequency of 1 kHz was widely propagated without the depth dependence. This means that the acoustic waves at low frequency range can significantly propagate to be trapped near the sound channel axis, when they propagate along the continental slop from the coastal sea to the open sea. At low frequency range, therefore, mean noise levels of ambient noises at water depth of 250 m in **Fig. 2** could be appeared higher than those at other water depths. These numerical simulation results differ from those in deep sea. Generally, low frequency acoustic waves in deep sea are broadly trapped inside sound channel and the ambient noise levels at sound channel axis are lower than those at stratification depths.

4. Conclusion

In this study, we investigated depth dependence of ambient noise levels at low frequency range in the eastern sea of Korea. The ambient noise levels at low frequency range near the sound channel axis were higher than those at stratification depths. This seemed to be related to traps of low frequency acoustic waves due to the continental slop in the eastern sea of Korea.

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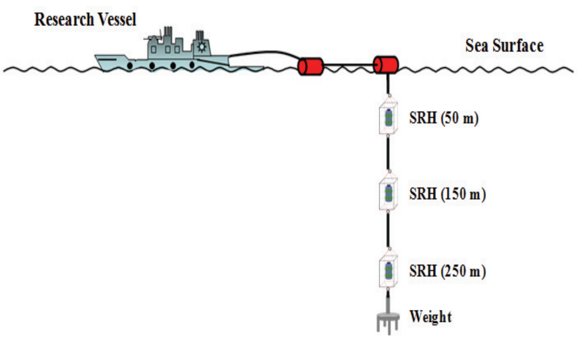

Fig. 1 Schematic diagram of experimental setup.

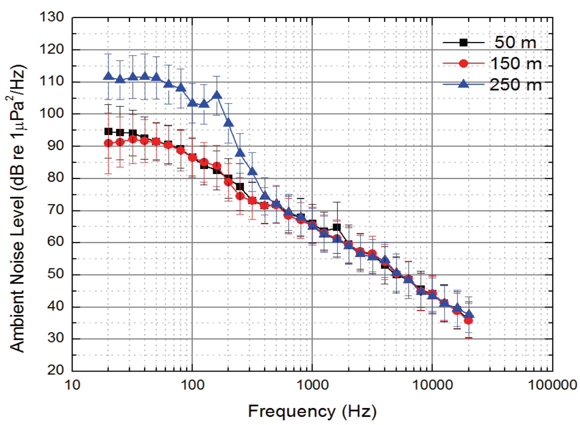

Fig. 2 Mean noise levels of ambient noises observed at the experimental site.

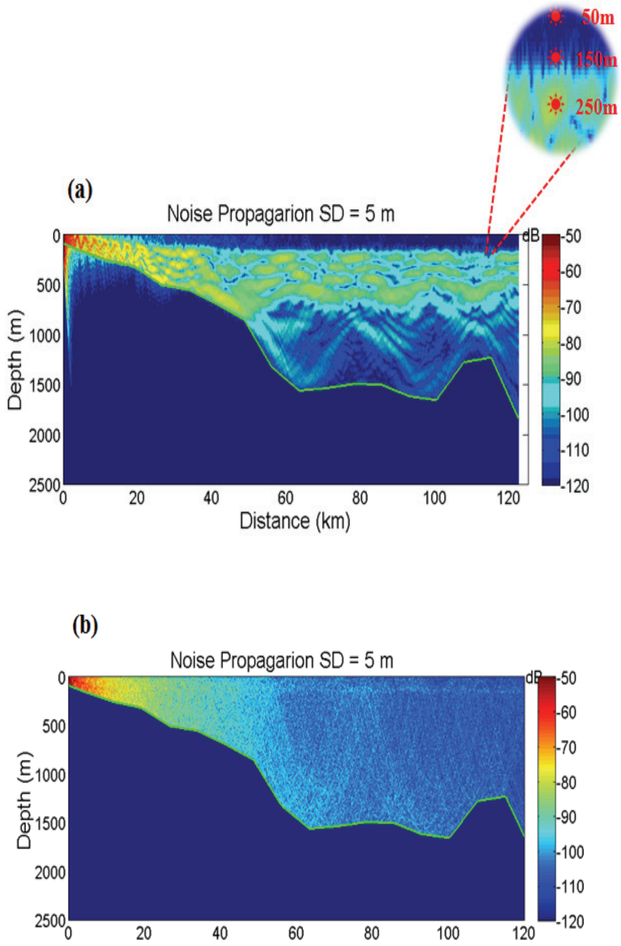

Fig. 3 Propagation losses of shipping noises at the frequencies of 100 Hz and 1 kHz in the coastal sea.