1P6-5

Influence of source depth and position for upward sound propagation on continental slope
大陸傾斜を上向きに伝搬する音波に対する音源深度と位置の影響

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1. Introduction

When the sound wave propagates from the continental shelf to the basin, the sound wave passed through the shelf-break is increased the depth of propagation along the continental slope. And, it is changed to the propagation centering on sound channel (SC) axis when arriving at the basin[1].

Conversely, when the sound wave is propagated from the basin side toward the continental shelf, the sound wave is not reached to the continental shelf. Even if the source depth becomes deep and the sound wave reaches the shelf-break, the penetration to the bottom at the shelf-break and in the shallow water becomes large[2].

Then, the reason is examined. In the above-mentioned propagation, the propagation is influenced by the topography of the continental slope. Therefore, the shape of the bottom is simplified, and the reason is considered. And, the influence of the range position and the depth of the sound source on the sound propagating is examined in the condition that the bottom monotonously becomes shallow. The sound speed profile is used by the MUNK profile in this examination.

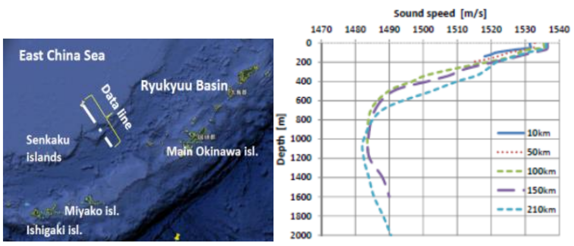

Fig. 1 Data line and Sound speed structures

2. Bi-directional sound propagation in area of continental shelf and basin

Fig. 1 is shown the data line and the sound speed structure of East China Sea. And GDEM data is used for this. The minimum sound speed in the basin is about 1000 m of depth. The frequency used is 100 Hz, and the properties of bottom is the silt. AS for the sound propagation code, FOR3D[3] is used.

2-1 Sound propagation from continental shelf toward basin

The sound propagation from continental shelf to basin is shown Fig. 2. The sound radiated from the continental shelf is formed the shallow water duct. The sound that passed the shelf-break is increased the depth along the continental slope. In the basin, it is changed to the propagation centering around the SC axis.

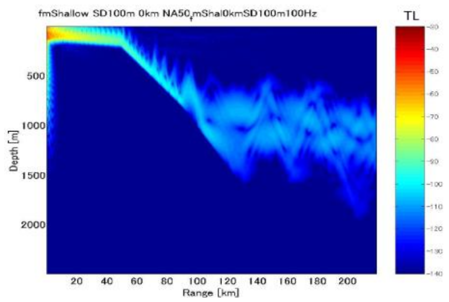

Fig. 2 Sound fields for frequency of 100 Hz SD;100 m

2-2 Sound propagation from basin toward continental shelf

The sound propagating of source depth (SD) 100m is shown in Fig. 3. The calculation reversed the data of Fig. 2. The sound wave rises up a continental slope repeating the reflection and refraction. However, at 130km from the sound source, the transmission loss is increased, and the penetration to the bottom is increased. The cutoff of propagation by the slope is generated. Though it is not shown here, the sound wave with SD 1000 m is reached at the depth of continental shelf. However, the propagation in the shallow water is different from the propagation of shallow water duct.

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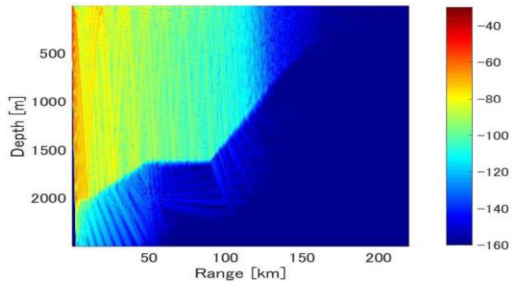

Fig. 3 Sound fields for frequency of 100 Hz
SD;100 m

3. Influence on sound propagation of source position and source depth in MUNK profile

The slope rises monotonously by 4500 m at 100 km. The slope angle is about 2.3° .

3.1 Source depth at 50 km from starting position of continental slope

The cutoff position is risen to shallow depth by deepened SD. The sound field of SD 1000 m and transmission loss (TL) curve to receiving depth (RD) are shown in Fig. 4. SD 1000m is the depth of a minimum sound speed in MUNK profile. Sound source is 50 km from the starting position of continental slope. RD is 50 m to 200 m. The sound field is formed to the near surface, The cutoff here is the trap depth[4] in surface duct propagation, and the range is about 147km. Though it is not shown here, the cutoff position is descended when SD exceeds 1000 m.

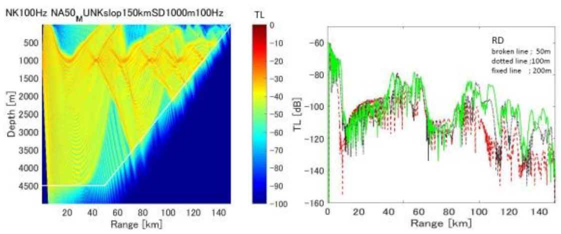

Fig. 4 Sound field and TL curve from 50 km pnt.
freq; 100 Hz left) sound field right) TL curve

3.2 Relation between sound source position and start of continental slope

The comparison of the sound field and TL by the source position is shown in Fig. 5. The sound source position is a) 0 km and b) 25 km from the starting point of continental slope, respectively. The position in which TL become more than -150dB changes from 75 km to 70 km. Though it isn't shown here, the position of the cutoff moves to shallower depth when the sound source position goes away from the start of the continental slope.

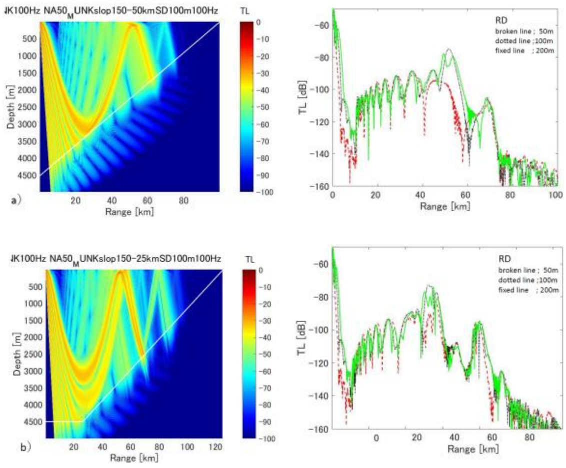

Fig. 5 Comparison of source position
a) 0 km at starting of slope
b) 25km from starting of slope

5. Summary

In the propagation from continental shelf, the sound wave increases the depth according to the slope in the continental slope, and is changed to propagation centering around SC axis.

Conversely, in the propagation from the basin side, the cutoff for the propagation is generated by the source depth. In the area of the upward inclined bottom, the angle of the propagation is subtracted by the inclination of the bottom. Therefore, the penetration to the bottom is changed by changing the reflected angle to the bottom in every time. Moreover, becoming SD around SC axis, the sound wave is propagated up to the depth of the shallow water duct. However, even if the shallow water duct is formed, the penetration to the bottom is large.

The reason is the incident angle to the horizontal bottom becoming large. And, when the incident angle reaches the critical angle, a lateral wave is generated. The re-radiation from a lateral wave is considered to influence propagation.

References

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