3P6-1

Sound propagation from continental shelf to arc
大陸棚から海弧までの音波伝搬

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1. Introduction

When the sound wave is propagated from continental shelf to the basin via shelf-break, the sound wave is increased the depth according to the inclination of continental slope without the spreading on the shelf-break. Then, the sound wave become the propagation of up-ward refraction after exceeding the depth of sound channel (SC). And, the sound propagation on the basin area is formed near SC propagation[1,2].

Inversely, when the sound wave is propagated from the basin toward continental shelf, the propagation configuration is changed by the source depth (SD). In shallow depth of SD, Transmission loss (TL) is increased during the continental slope. And, when SD is became the depth of ±600 m of SC axis, the sound is gone up to shelf break, and is entered in continental shelf. When SD increases further, TL's rapidly increased range is away from the shelf-break[3,4].

Then, sound propagation to the sea arc via basin of sound radiated from continental shelf side is examined.

2. Acoustical conditions from continental shelf to the sea arc

The sound speed profile used for the examination is MUNK Profile. The sound speed is decreased with increasing depth from the surface. The depth of minimum sound speed is 1000m, and the sound speed is 1500m/s, after that, the sound speed is increased with the depth. The bottom profile is shown in Fig. 1. The continental slope is the range of 50 km-210 km from sound source (SS), and the depth of basin is 2000 m. The depth of sea arc is 300 m, and the width is 6 km. The depth is increased after the sea arc, and the depth become 2030 m at 310 km from SS.

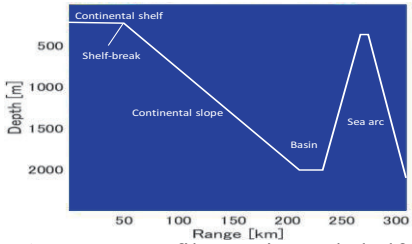

Fig. 1 Bottom profile continental shelf to sea arc

The calculation code is used FOR3D[5], wide angle PE model.

3. Sound propagation from continental shelf to sea arc

3.1 Sound propagation from continental shelf

Sound field (SF) at source depth (SD) 100m is shown in Fig. 2. When the sound wave propagated on continental shelf was passed through shelf-break, the propagation depth is increased along continental slope. The sound wave reached at the basin bottom is propagated by the bottom reflection and refraction. The propagated sound is reflected by the slope of the sea arc, and goes up on the slope. However, TL is increased about 260km from SS.

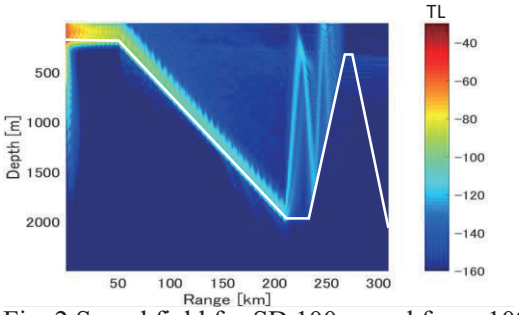

Fig. 2 Sound field for SD 100 m and freq.; 100 Hz

TL curves is shown in Fig. 3. SD is 100 m, and the receiving depth (RD) is 200m (broken line),

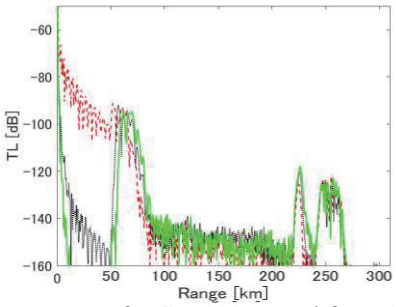

Fig. 3 TL curve for SD 100 m and freq. 100 Hz
RD; 200 m (broken line), 300 m (dotted line),
450 m (solid line)

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250m (dotted line), and 300m(solid line). TL passed shelf-break is rapidly increased, and becomes over -145dB. Then, TL from 220km to 260km is decreased by the reflection on the slope of the sea arc. Moreover, TL is increased before the top of the sea arc. And, TL is large beyond this range. The same trend of TL is shown by the changed SD on continental shelf. And, the sound propagation exceeding the sea arc cannot be seen even in the twice slope of the sea arc.

3.2 Sound propagation from the outside of shelf-break

SF of 10km outside of shelf-break in SS is shown in Fig. 4. SD is 10m. Weak propagation exceeding the sea arc can be seen (denoted arrow).

Then, TL curves are shown in Fig.5. Fig. a (upper figure) is RD at shallow depth (50-150 m), and Fig. b (lower figure) is that of middle depth (200-300 m). There is a decrease of TL about 220 km in shallow RD. And, at middle RD, it occurs about 220 km, 260 km, and 290 km. It is arrowed,

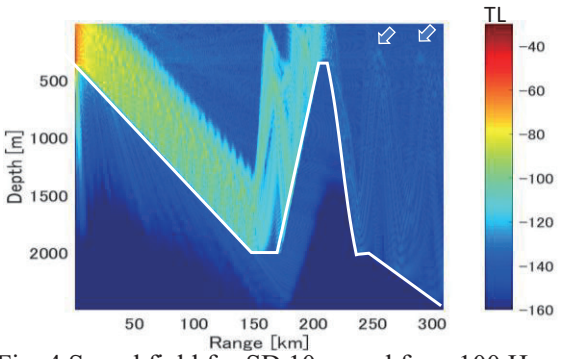


Fig. 4 Sound field for SD 10 m and freq. 100 Hz

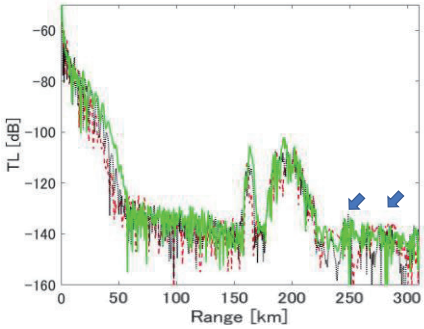
respectively. These are corresponded to the arrowed points of the sound field (refer Fig. 4). However, TL on the top of the sea arc is high. Therefore, the level is small though the sound wave exceeds the sea arc.

5. Summary

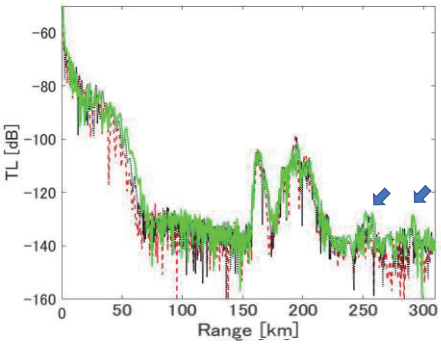
In FOR3D, the sound wave is radiated in the Gauss distribution from SS. In shallow water, especially, shallow water duct, the sound propagation with small grazing angle remains, and that of large grazing angle is attenuated. Because the propagation of a large angles is attenuated by the reflection of the surface and the bottom. Then, the sound having a small grazing angle is propagated in the basin, and it goes up on the slope of the sea arc. But TL is rapidly increased by the propagation on the slope at these angles.

And then, when SS is passed the shelf-break, the angular component is increased. As a result, the propagation over sea arc is generated. However, the sound propagation in these angles increases penetration to the bottom on the top of the sea arc. And, the attenuation on the top of the sea arc is became large. This is the same as the phenomenon of propagation to the continental shelf from the basin[4]. Therefore, the propagation level is became small beyond the sea arc.

In SS on the basin, the sound wave is exceeded the sea arc. However, because TL is increased by the sound propagation exceeding the sea arc, the propagation level is being small.



a) Shallow RD
RD; 50 m (broken line), 100 m (dotted line), 150 m (solid line)



b) Middle RD
RD; 200 m (broken line), 250 m (dotted line), 300 m (solid line)

Fig. 5 TL curves for SD 10 m and freq. 100 Hz

References

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