Underground Imaging Using Shear Waves

− Comparison of the under ground image by the two different size vibrators −

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ABSTRACT

We improved a shallow-layer underground image resolution using the pulse compression which used a giant-magnetostriction vibrator. This time, we compared two kinds of giant magnetostrictive vibrators. From the experimental results, we can confirm that conventional type giant magnetstriction vibrator shows a good image in the shallow area(30cm depth), but the new giant magnetostriction vibrator show a good image in the deep area(100cm depth).

1. INTRODUCTION

We have been studied the shallow underground imaging using a giant magnetostriction vibrator and pulse compression[1-4] method. From our previous study, we confirmed that the underground image is become poor when the imaging depth is become deeper. This is because frequency-dependent attenuation influences it. Therefore, to overcome this effect, more powerful vibrator is prepared. This time, we compared and examined two kinds of giant magnetostrictive vibrators.

2. EXPELIMENTAL SETUP

The experimental setup for underground imaging is shown in Fig. 1. The geophone is used as a velocity sensor. Twelve geophones are arranged in a straight line with 50cm intervals. Therefore, the length of the measurement line is 5.5m. McSEIS-SX (Oyo Corp. McSEIS-SX, MODEL-1125R) is used as a acquisition equipment. Giant magnetostriction vibrators are used as a sound source. To generate the shear waves[3], this vibrator is set on the aluminum base as shown in Fig. 2. A pasta pot (dia. 9 × length 27cm) and a plastic container (20 × 30 × 5.5cm) are used as the buried objects (shown in Fig. 3). A pasta pot was buried at 30cm depth, and a plastic container was buried at 100cm depth. The output waveform is down chirp (800-300 [Hz], duration times 200ms).

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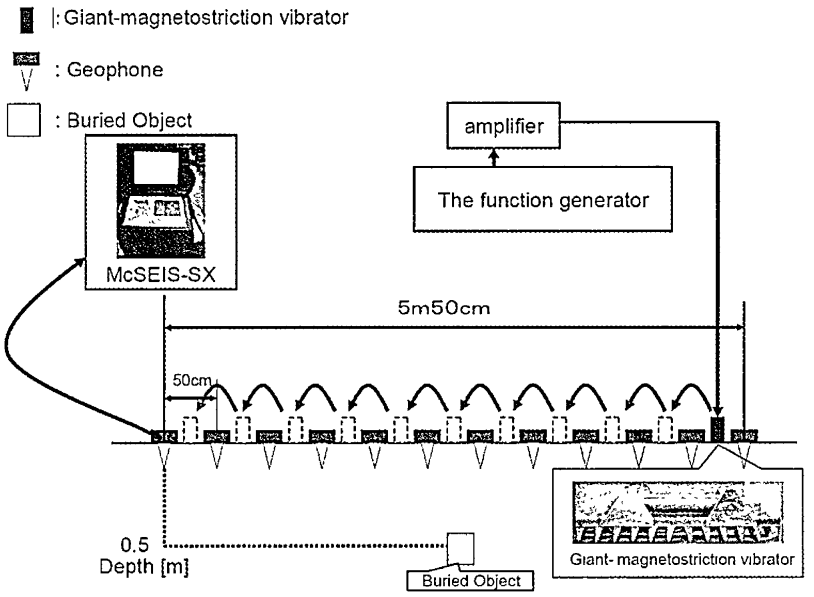

Fig.1 Experimenatl setup.

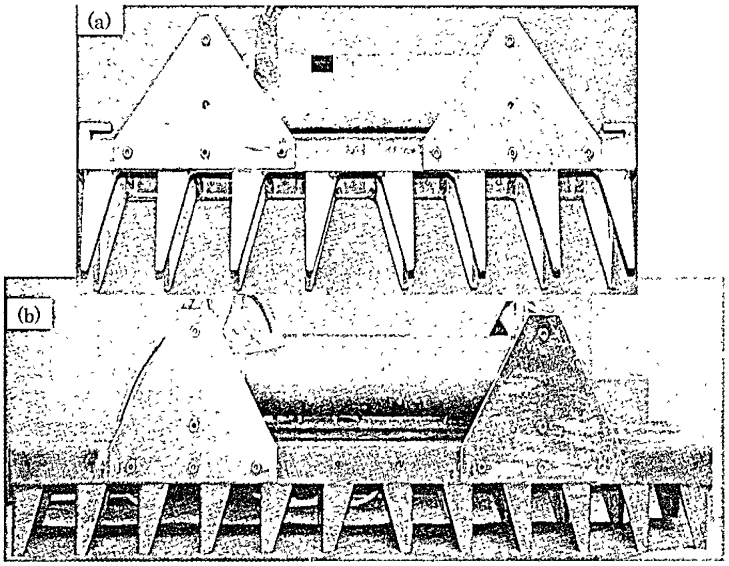

Fig.2 Photograph of sound source.
(a) Traditional giant magnetostriction vibrator and Aluminum base,
(b) New giant magnetostriction Vibrator and Aluminum base.

3. TWO DIFFERENT SIZE GIANT MAGNETOSTRICTION VIBRATOR

To simplify, a conventional type giant magnetstriction vibrator (Moritex Corp., AA140J013-MS1, dia.:49mm length:188mm, 1.6kg) is called a normal vibrator, and new one is called big vibrator (Moritex Corp., AA-150LHAS, dia : 78mm, length : 290mm, 5.2kg). Two amplifier which was fitted to the

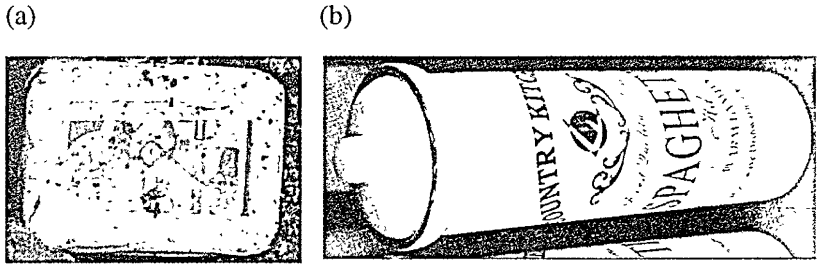

Fig.3 Buried objects.
(a) Hollow plastic container (20 × 30 × 5.5cm),
(b) Hollow pasta pot (dia.9cm × 29cm).

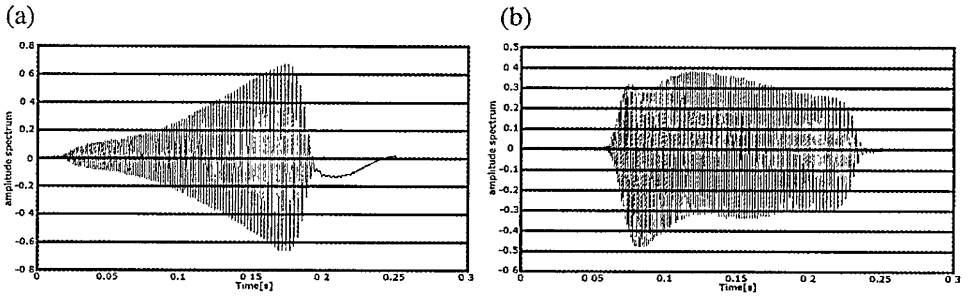

Fig.4 Waveform of vibration velocity. (a)big vibrator, (b)normal vibrator.

characteristic of each vibrators are used this experiment. Down chirp wave (800-300Hz, 200ms duration time) is used as a transmitted wave. To compare the frequency properties of the vibrators, the waveform of vibration velocities are measured by the laser Doppler vibrometer. Figure 4 shows examples of the measurement result. From these figures, normal vibrator shows almost flat velocity from high frequency. On the other hand, big one shows non flat characteristic. The velocity amplitude is smaller at the high frequency, and it is bigger at the low frequency than the normal one. To consider about the frequency-dependent attenuation, big vibrator has a possibility of the good image in a deep region.

4. EXPERIMENTAL RESULT

For comparing the performance evaluation of the two vibrators, underground imaging experiment was carried out.

Figure 5 show examples of the imaging results when the depth of the buried object is 100cm. In this case buried object is hollow plastic container (20 × 30 × 5.5cm).

From these figures, the result of big vibrator (Fig. 5 (a)) is more excellent than the result of normal vibrator (Fig. 5 (b)).

Figure 6 show examples of the imaging results when the depth of the buried object is 30cm. In this case, buried object is hollow pasta pot (dia. 9 × length 27cm).

From these figures, the result of normal vibrator (Fig. 6 (b)) is more excellent than the result of big vibrator (Fig. 6 (a)).

5. CONCLUSION

This time, we compared the imaging result of two different size giant magnetostriction vibrators. As the experimental results, normal

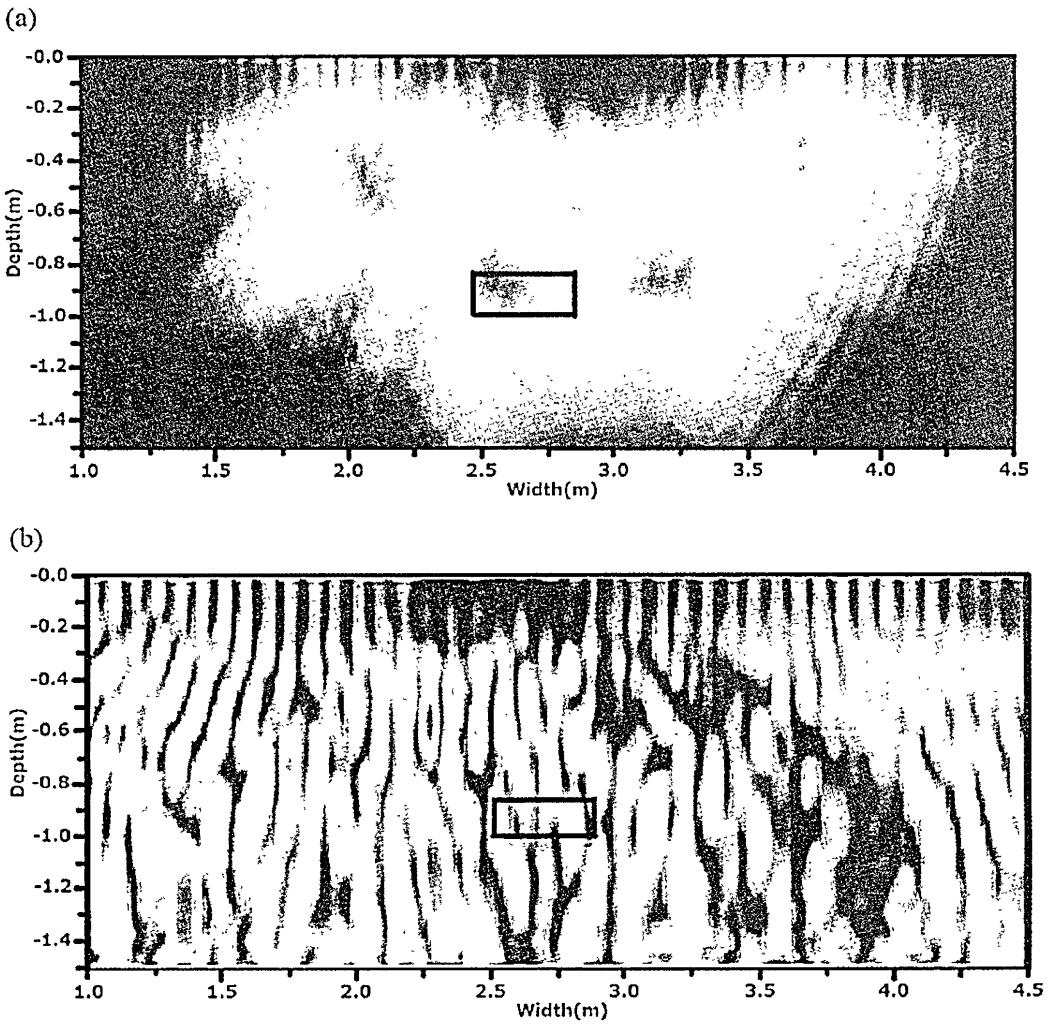

Fig.5 An example of underground image (Buried depth is 100cm).
An buried object is a hollow plastic container (20 × 30 × 5.5cm).
(a) An underground image by a big vibrator
STC (Sensitivity time control) : 1.0
STCT (STC available time) : 45ms, Sound Speed : 110 [m/s],
(b) An underground image by a normal vibrator
STC (Sensitivity time control) : 1.2
STCT (STC available time) : 45ms, Sound Speed : 110 [m/s].

vibrator shows a good image in the shallow area, because it can be transmitted the high frequency component than the big one. On the other hand, big vibrator shows a good image in the deep area, because it can be transmitted the low frequency component than the normal one. In the future, another imaging method is going to be studied by using this data.

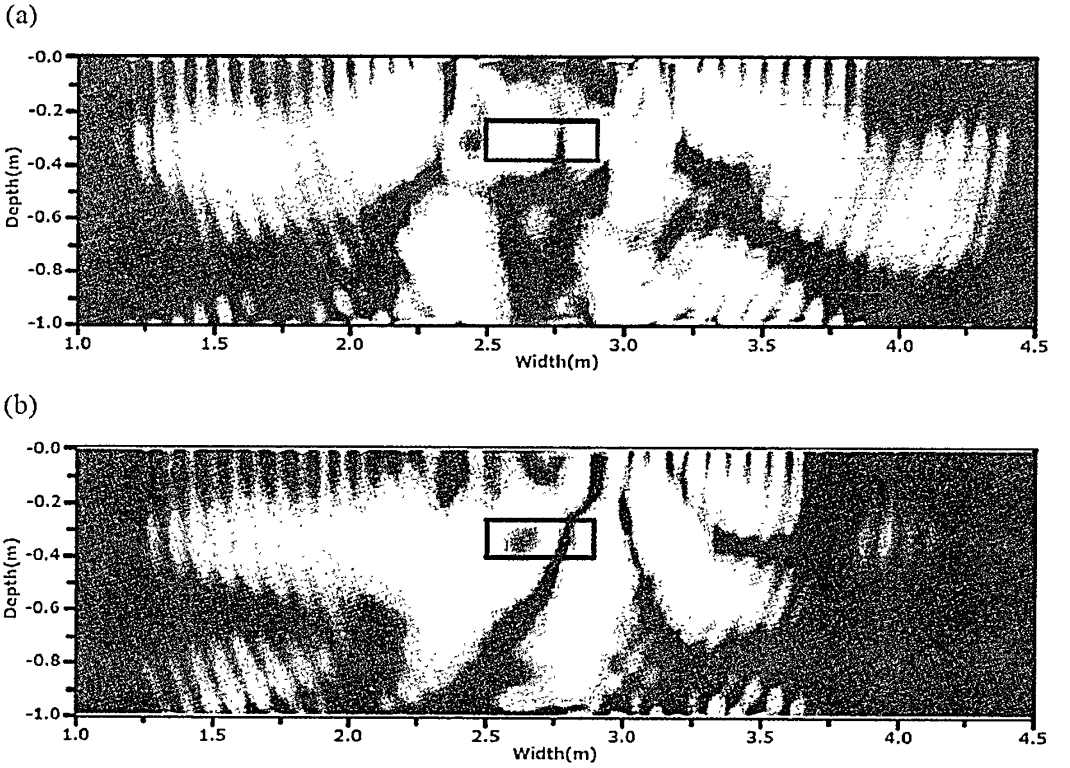

Fig.6 An example of underground image (Buried depth is 30cm).
An buried object is a hollow pasta pot (dia. 9 × length 29cm).
(a) An underground image by a big vibrator
STC (Sensitivity time control) : 0.5
STCT (STC available time) : 34ms, Sound Speed : 95 [m/s],
(b) An underground image by a normal vibrator
STC (Sensitivity time control) : 0.4
STCT (STC available time) : 34ms, Sound Speed : 95 [m/s].

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