Effectively of synthetic wave forms for the evaluation in the crustal structure analysis

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1. Introduction

In the crustal structure studies using OBS and control sources in the oceanic region, most of analyses are carried out by the tomographic inversion using first refracted arrival times. Recent advances in instruments, rapid increase of density of instruments and shootings, and improvement of air-gun shooting technologies enable us to interpret real full wave form obtained by OBSs by using synthetic wave forms. In this talk, we present the application of the FDM waveform synthetics for a part of our new method of analysis on the crustal structure studies (Kasahara et al, this meeting, 2007).

2. Waveform calculation

Synthetic waveforms are calculated by the E3D software of FDM (Finite Difference Method) developed by Larsen (2000). We construct five gridded structural models of P and S wave velocity, Qp and Qs, and densities. A regular grid size of ˜30m in space and 1-2ms in time are used for the staggered grid. Although actual 8,000 in3 air-gun waveforms have much higher dominant frequencies (e.g., 7˜8 Hz), we use a 4 Hz zeror-phase Riceker wavelet in the current simulation due to the limitation of computer resources. A P source placed at the ocean bottom and the receivers at 500m spacing with 30m below the sea level were assumed for the air-gun shot simulation. It is evaluated the reciprocity and it is almost obtained. For the case of 120km (H) x 45 km (Z) 2D model, the total number of grids are 6M points and number of input data is 230MByte. Total time step is, for example, 20,000. For an interpretation of phases in synthetics, we use travel times calculated by graph method (Kubota et al., this meeting, 2007).

Simulated refracted phases in the crust (Pg) and Moho (PmP) tends to appear by large amplitudes to fit to observation. By the comparison of observed field records and synthetics, the phases generated by nearly constant velocity (or extremely low velocity gradient) layer, head waves, and Pn and reflected and diffracted phases from some interface in the crust are nearly consistent (Tsuruga et al, this meeting, 2007). We can conclude that it is necessary to use not only travel times, but also to compare the observed records and synthetics. Furthermore, the use of much higher frequency modeling and 3D modeling are urgently required.

3. Summary

In most of previous and current methods for analyzing seismic records for the crustal structure, travel times are frequently used. To enhance the quality of seismic data interpretation, it is necessary to use the waveform synthetic method. The waveform synthetics using the FDM are getting more popular in our crustal structure study because of increase of density of instruments, shootings and air-gun size, use of tuned air-gun sources, and improvement of acquisition system.