3D seismic velocity structure in the lower crust beneath the San-in district

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Introduction

In the San-in district, a linear distribution of epicenters is seen along the Japan Sea coast. The linear distribution of epicenters is called the seismic belt along the Japan Sea coast. Large earthquakes also occurred in and around the seismic belt. What localizes the distribution of earthquakes in the San-in district far from the plate boundary? We thought that we could explain the reason by the model proposed by Iio et al. (2002, 2004). The model is as follows. A part of the lower crust has low viscosity. The low viscous part was called 'weak zone'. The stress and strain in the upper crust are concentrated right above the weak zone and earthquakes occur there. We estimated the seismic velocity structure in the lower crust beneath the San-in district in detail by carrying out seismic travel time tomography to verify whether the weak zone exists there.

Seismic travel time tomography

We carried out the tomography with FMTOMO (Rawlinson et al., 2006). FMTOMO implements wavefront tracking (de Kool et al., 2006), which can trace rays robustly. We set the study area shown in Figure 1. We used travel times picked by JMA for earthquakes that occurred in the study area (Figure 1), as well as with the travel times manually picked for earthquakes that occurred within the Philippine Sea Slab (PHS). Because seismic waves from these earthquakes to stations in the San-in district pass through the lower crust beneath the San-in district, we can expect that those data improve the resolution at the lower crust. Because those seismic waves also pass through the PHS, the velocity structure in and around the PHS plays an important role in this study. However, the dataset used in this study is not enough to estimate accurately the velocity structure. For this reason, we estimated in advance rough velocity structure in a wider area shown in Figure 2, and used the velocity structure as an initial velocity model.
In this study, we revealed that the lower crust beneath the seismic belt in the San-in district has low velocity anomalies. Since velocities of rocks decrease with temperature or fluid content, the lower crust beneath the San-in district might have low viscosity (weak zone). Therefore, the results of this study support the model proposed by Iio et al. (2002, 2004).

Acknowledgement: We used JMA's earthquake catalogs. We also used waveform data from permanent stations of NIED.

Keywords: tomography, San-in district, lower crust, intraplate earthquake

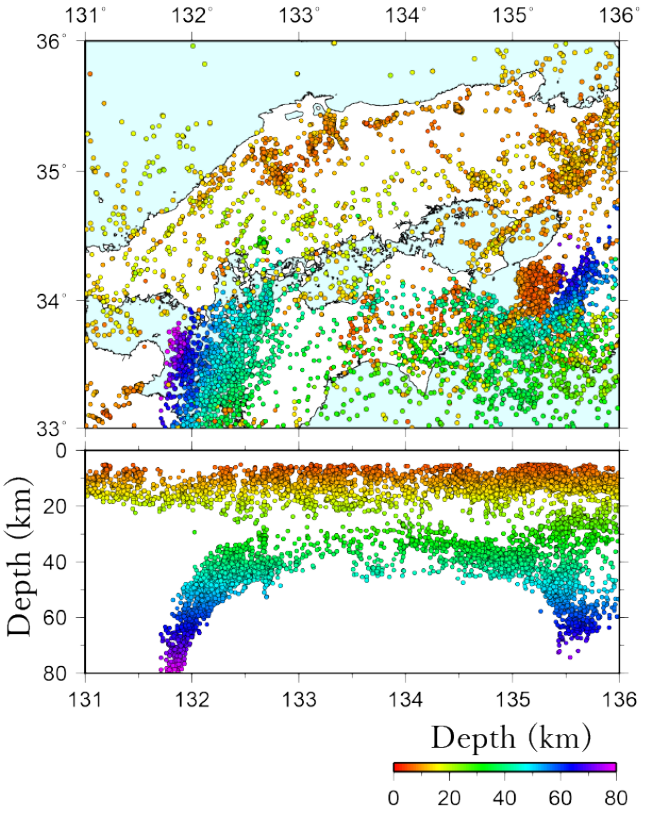

Figure 1 The distribution of earthquakes used in the tomography.

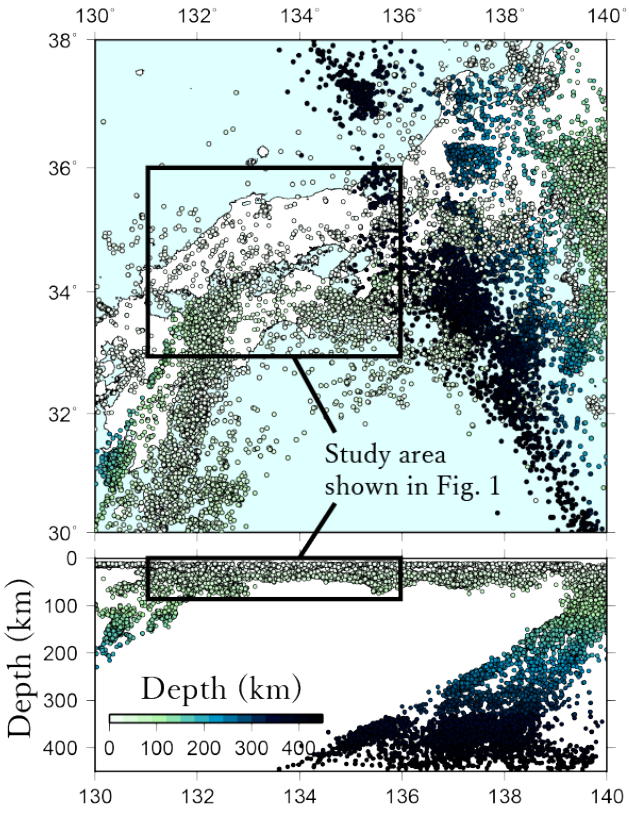

Figure 2 The distribution of earthquakes used for estimating rough velocity structure of an wide region which is used as an initial velocity model.