EVALUATION OF THE SEISMOGENIC LAYER DEPTH IN JAPAN USING THE JMA CATALOGUE

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Introduction

The strong motion simulation technique based on fault models is recognized as the useful method to estimate earthquake motions caused by a fault rupture of an inland earthquake.

Irikura and Miyake proposed the standard method to decide the fault model parameters. Among these parameters, the depth range of a fault plane is one of the most important items in modeling a buried rupture fault of an inland earthquake.

In this study, we investigated the regional characteristics of seismogenic layer to determine such parameter properly using the JMA catalogue.
Fig. 1 Estimation Method of Upper and Lower Cutoff Depths of Seismogenic Layer (K. Ito and S. Nakamura, 1998)  
(D10%: Upper Depth  D90%: Lower Depth)
Japan Island is divided into 15 Regions referring to seismo-techtonic structure.

JMA unified source data before Oct. 2001 is used for evaluation under the conditions of $D<30\text{km}$, $M>2.0$, and excepting volcano and subduction earthquakes data as possible.

Fig. 2 15 Regions Covering All of Japan
Fig.3 Example of Distribution of Focal Depth (North-Kyusyu)
Curves of East-Hokkaido, Kanto, Izu and Tokai regions have different tendency from other regions. They may include the data of volcano and subduction earthquakes.

Fig.4 Focal Depth and Cumulative Frequency of Event in 15 Regions
The upper and lower cutoff depth of seismogenic layer of 15 regions in Japan were estimated in the range of 6km-20km.
(a) Error of Focal Depth to Magnitude  (b) Error of Focal Depth to Number Stations

Fig. 6 Example of Error of Focal Depth Determination Related to Magnitude and Number of Stations

The error of the focal depth was about 0.5km-1.5km in large magnitude (M>4.0) and in large number of stations (N>30) by the JMA unified data.
Investigation by Data of Individual Inland Earthquake

Following 6 individual inland earthquakes including their aftershocks are selected to investigate the uniformity of the upper and lower cutoff depths of seismogenic layer in each region.

1) *Tottori-ken Seibu* Earthquake, 6 Oct. 2000 (M7.3)  *(Chugoku Region)*
2) *Akita Senhoku* Earthquake, 15 March 1914 (M7.1)  *(West-Tohoku Region)*
3) *Miyagi-ken Hokubu* Earthquake, 12 May 1900 (M7.0)  *(East-Tohoku Region)*
4) *Nagano-ken Seibu* Earthquake, 14 Sep. 1984 (M7.3)  *(Chubu Region)*
5) *Yamaguchi-ken Hokubu* Earthquake, 25 June 1997 (M6.1)  *(Chugoku Region)*
6) *Iwate-ken Nairiku Hokubu* Earthquake, 3 Sep. 1998 (M6.1)  *(East-Tohoku Region)*
Fig. 7 Focal Depth and Cumulative Frequency of Events of 6 Inland Earthquakes
Table 1 Depth Parameters of 6 Inland Earthquakes

<table>
<thead>
<tr>
<th>Inland Earthquake (Region)</th>
<th>Depth Parameter (km)</th>
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<tbody>
<tr>
<td></td>
<td>D10%</td>
<td>D50%</td>
<td>D90%</td>
<td></td>
</tr>
<tr>
<td>Tottori-ken Seibu (Chugoku Region)</td>
<td>11.5 (7.8)</td>
<td>13.1 (10.5)</td>
<td>15.2 (13.7)</td>
<td></td>
</tr>
<tr>
<td>Akita Senhoku (West-Tohoku Region)</td>
<td>11.1 (10.3)</td>
<td>12.9 (13.2)</td>
<td>13.7 (17.4)</td>
<td></td>
</tr>
<tr>
<td>Miyagi-ken Hokubu (East-Tohoku Region)</td>
<td>8.5 (9.6)</td>
<td>11.5 (12.2)</td>
<td>13.2 (14.6)</td>
<td></td>
</tr>
<tr>
<td>Nagano-ken Seibu (Chubu Region)</td>
<td>8.6 (6.4)</td>
<td>10.2 (8.0)</td>
<td>11.9 (11.7)</td>
<td></td>
</tr>
<tr>
<td>Yamaguchi-ken Hokubu (Chugoku Region)</td>
<td>10.0 (7.8)</td>
<td>13.4 (10.5)</td>
<td>15.8 (13.7)</td>
<td></td>
</tr>
<tr>
<td>Iwate-ken Nairiku Hokubu (East-Tohoku Region)</td>
<td>7.2 (9.6)</td>
<td>10.6 (12.2)</td>
<td>12.2 (14.6)</td>
<td></td>
</tr>
</tbody>
</table>

The upper and lower cutoff depths of the 6 individual inland earthquakes corresponded with that of each region.
Conclusion

• The upper and lower cutoff depth of seismogenic layer of 15 regions in Japan were estimated in the range of 6km-20km using the JMA unified data before Oct. 2001.

• The error of the focal depth was about 0.5km-1.5km in large magnitude (M>4.0) and in large number of stations (N>30) by the JMA unified data.

• The upper and lower cutoff depths of 6 individual inland earthquakes corresponded with that of each region. So they were considered almost uniform in each region.

• The focal depth by the JMA unified data before Oct. 2001 used in this study is estimated about 2km deeper than that by the revised JMA unified data after Oct. 2001. (Ueno, Hatakeyama, et.al., 2001)
Further Subject

- The JMA unified data from Oct. 1997 to Sep. 2001 was used in this study. But JMA improves the hypocenter determination procedures after Oct. 2001 and is reevaluating the data before Oct. 2001. So it is need to confirm the results of this study using the revised new data when the new data is published.