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Source Process of the 2001 Hyogo-ken Hokubu Earthquake and Correlation between the Associated Swarm Activity and the deltaCFF

Takeshi Kimura[1], Yasumaro Kakehi[2]

[1] Earth and Planetary Sci., Kobe Univ, [2] Earth and Planetary Sci., Kobe Univ.

1.Introduction

An earthquake swarm activity started in December 2000 in northern part of Hyogo prefecture, and the largest event with Mw 5.2 occurred on January 12, 2001. After this event, the activity was activated and spread spatially. One remarkable feature of this activity is that we can see an activity region extending EW direction (corresponding to the largest event fault plane) and another activity region consisting of three lines extending NW-SE direction. In this study, we estimate source process of the largest event, and examine the correlation between the swarm activity and the changes in Coulomb failure function (deltaCFF) produced by the largest event and the successive events larger than Mw 4.0.

2.Problems of Kimura and Kakehi (2002)

In Kimura and Kakehi (SSJ Fall Meeting 2002, P123) we first estimated the source process of the largest event from waveform inversion using theoretical Green's functions and calculated deltaCFF by the largest event using obtained slip distribution. Furthermore, we calculated deltaCFF by Mw 4.0 or larger events which occurred after the largest event using the F-net data and the JMA's integrated hypocenter data. And we obtained the spatio-temporal change of deltaCFF by adding these deltaCFF every time a successive event occurs, and compared it with the spatio-temporal evolution of the swarm activity. A problem of this previous study is that the seismic moment of the largest event estimated by the waveform inversion (1.7x10**17Nm) is about twice larger than that of F-net (0.7x10**17Nm). So, the amount of slip and deltaCFF of the largest event may have been overestimated.

3.Reexamination of velocity structure and the result of waveform inversion

We consider the main cause of this slip overestimation is that the amplification of the seismic waves by the surface soil layers was not taken into account when calculating Green's functions. Therefore, by using the observed waveform of the small earthquake whose source processes are rather simple, we calibrate the velocity structure. First, using the velocity structure of Kimura and Kakehi (2002), we perform moment tensor inversion, and the optimal hypocenter, strike, dip, and rake are obtained by grid search. Next, by comparing the theoretical waveform calculated from the obtained optimal point source with the observed, we calibrate velocity structure. The waveform inversion of the largest event is again performed using the reexamined velocity structure. Consequently, the seismic moment is estimated as 1.0x10**17Nm, which is close to the value of F-net.

4.Correlation between swarm activity and deltaCFF

Next, we compare the deltaCFF estimated by the slip distribution of largest event and the swarm activity extending NW-SE direction. Since the largest event moment is smaller than that of Kimura and Kakehi (2002), the absolute value of the deltaCFF is reduced. For this reason, the influence of the successive smaller events on deltaCFF becomes relatively stronger. Moreover, since the slip distribution of the largest event is different from the previous one, the distribution pattern of deltaCFF by the largest event has also changed. Consequently, better correlation is seen between the deltaCFF and the swarm activity. Two of three lines of the swarm activity extending NW-SE direction correspond to the positive region of the deltaCFF by the largest event well. On the other hand, the other linear activity on the east seems to have extended NS direction according to the extension of the positive region of the deltaCFF generated by Mw4.0 or larger events in the same direction. This result indicates the deltaCFF the swarm activity itself produced had a great influence on the evolution of the swarm activity.

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