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Stress field in the western part of Tottori Prefecture inferred from focal mechanisms inversion

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Stress tensor inversions using focal mechanisms data are important in understanding the stress fields in the seismogenic region. In this study, we performed a stress tensor inversion using the data from the Joint Group for the Dense Aftershock Observations of the 2000 Western Tottori Prefecture earthquake. Kawanishi et al., (2009) could not estimate the stress field in the region where the main shock slip was large since the stress fields in the region is not homogeneous. Thus, in this study we divided the region into smaller subregions where stress fields can be regarded to be homogenuous. Furthermore we tried to improve the standard stress inversion method using focal mechanisms (ex. Gephart and Forsyth (1984)) to accurately estimate stress fields using less data.

If the shear stress on the fault plane is relatively low, theoretical slip vectors can change significantly by small changes of a strike and/or dip of the fault plane, therefore in such a case, misfit angles on the fault plane can inherently include large error. Since we could not accurately estimate stress fields in such a case, we tried to improve the accuracy of stress field analysis by reducing a weight for misfit angles when the shear stress normalized by S1-S3 is small. Simulations using test data show that the improved method estimates stress tensor more accurately than standard methods.

In this study, we used high-quality 1536 earthquake focal mechanisms data. We divided the aftershock area into 9 subregions along the axis of the aftershock distribution and 3 subregions along depth. In addition, to estimate stress fields in large sip area estimated by Iwata and Sekiguchi (2002), we further divided the subregions based on the spatial distribution of the static stress changes generated by the main shock and estimated stress field in each region. We inferred that the strength of fault planes in the large slip area is strong because directions of the maximum principal stress axis obtained by the stress inversion do not coincide with those of the static stress changes. On the other hand, we inferred that the strength of fault planes at either end of the large slip area is weak since directions of the maximum principal stress coincide with those of the static stress changes. From these results, we inferred that stress relaxation occurred prior to the main shock in the area where strength of fault planes is weak, but that stress concentration occurred prior to the main shock in the area where strength of fault planes is strong. This may be the reason why the large slip by the main shock occurred in this area.