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Spatial variation of the stress field and 3-D seismic velocity structure in the seismic belt of San-in district

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Spatial variations of the stress field and heterogeneous structures of the crust are important to clarify the earthquake occurrence mechanism. We used data from 50 temporary stations and 27 permanent stations in and around the seismic belt in the San-in district to look into a relation between the stress field, 3D seismic velocity structure seismicity and pore fluid pressures.

The stress field is estimated by a standard method of stress inversion using focal mechanisms. The estimated RMS of misfit angle is less than 10 degrees for each analysis area. This means that the estimated stress field can reproduce observed variations of slip directions. The azimuths of the maximum horizontal stress in the central part of the seismic belt are oriented in N120‘E-N130‘E, while in the other regions, they are oriented in almost N100‘E-N110‘E. This spatial change in the stress field in and around the seismic belt is consistent with the result by Kawanishi et al., (2009).

We also determined a 3D seismic velocity structure in the San-in district by using the program FMTOMO(Rawlinson et al., 2006) Grid intervals are 0.05‘ along the latitudinal and longitudinal directions, and 3 km in the vertical direction. As a result, we found that there are low velocity zones around the eastern Shimane Prefecture and the aftershock region of the 2000 Western Tottori. It seems that these low velocity zones extend to 13 km depth. We can see a relation between low velocity and the seismicity in this region. The low velocity zones are located boundary between low and high velocity zone. It seems that the seismicity in the eastern Shimane may be controlled by an upper crustal heterogeneity or fluid.

In order to clarify whether crustal fluid caused earthquake in the San-in district, we looked into the distribution of pore fluid pressure by using the results from the stress inversion and tomographic analyses. We assume that stress field is homogeneous within each region of the stress inversion and the friction coefficient on each fault is constant (0.6), as indicated by Byerlee’s law (Byerlee, 1978), then we can conclude that observed variation of focal mechanism is caused by variations in pore fluid pressures acting on faults. The result showed that there are results which have various fault strength. This is consistent with that crustal fluids in a low velocity zone in the San-in district is related to the seismicity in this region.

Keywords: focal mechanism, stress field, tomography