The directions of fault strikes and the GPS velocity field

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In-situ stress measurements at sites close to the Nojima fault in Hyogo prefecture, Japan, ruptured during the 1995 Hyogo-ken Nanbu earthquake ($M_{JMA} = 7.3$), have revealed that shear stress is scarcely acting parallel to the fault plane and that the stress difference is very small near the fault core axis. This means that the fault damage zone is under the post-failure state. The P- and S-wave velocities have been calculated for the damage zone through the fracture density estimated from the measured stress magnitudes. It has been found that these calculated velocities are consistent with those of the fault zone up to the depth of about 15 km for other faults. Therefore, we may conclude that the stress state observed near the Nojima fault is not peculiar to the shallow part of the Nojima fault but universal to faults. A fault zone model has been proposed on the basis of these observational and analytical results. The model predicts that the shear strength of a fault is smaller than 1/10 of the lithostatic pressure in magnitude at the depth. This means that the fault plane is approximated to be one of the principal planes of stress. Here, we consider a displacement field where the displacements lie uniformly along the X direction. If one of the principal axes of stress is in the direction X, the principal planes should be parallel or perpendicular to the displacement direction. Assuming that the displacement is parallel to the GPS velocity, that is the rate of a coordinate shift of the GPS station, the directions of the GPS velocity are compared with those of the fault strike for the recent earthquakes, which have been determined by the seismological methods. It is found that the strike lies parallel or perpendicular to the displacement direction with a difference smaller than about 10 degrees. This result supports that faults are weak. Further, it is suggested that the stress field in the crust is produced by the displacements, which are considered to be parallel to the GPS velocities.