A crustal deformation model for central Kyushu with a graben area represented by dislocation

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The 2016 Kumamoto earthquakes, including an Mw 7 earthquake on April 15 (UTC) and previous two Mw 6 earthquakes, have struck central Kyushu region, Japan. These earthquakes have been considered to occur at right-lateral strike-slip faults. First, we confirm this result by GNSS data analyses at a sampling rate of 30 seconds using a kinematic PPP method.

On the other hand, the epicenters of the 2016 Kumamoto earthquakes were located within a graben area (N-S extension), named as the Beppu-Shimabara graben. Truly the aftershocks and induced earthquakes were composed of right-lateral strike-slip earthquakes and normal-fault earthquakes. We should consider both components when discussing the sources of the crustal deformation in this area.

In this study, we estimate stationary deformation rates at GEONET stations in central Kyushu using three-direction (both horizontal and vertical) GNSS data of the F3 solution during 2000-2010. We observed stationary subsidence at several millimeters per year in the graben area.

On the basis of the observation, we set block boundaries with tracing surface faults. We assume elastic dislocations on the boundaries other than rigid motion of the blocks. We interpret the rifting zone in the graben area as a reverse of collision zone, where the collision zone can be represented by a vertical dislocation with a tensile component (Shimazaki and Zhao, 2000). In addition, we model elastic deformation due to subduction of the Philippine sea plate and magma accumulation beneath several volcanos (Mt. Aso, Kuju, Unzen).

We invert the deformation rates of the above components from the Green's function and the estimated stationary deformation rates, using a least-square method with singular value decomposition (the same method as SSS32-01 in this meeting). At present, we obtained stable solutions for all the components, for instance, back-slip rates over 1 cm/yr at the source faults of the 2016 Kumamoto earthquake and compression of the magma reservoirs about 10^6 m^3/yr beneath the volcanos.

Keywords: Kumamoto earthquake, Crustal deformation, Graben area

