

“The Kumamoto, Japan, Earthquake Series of April 2016”

Kenji SATAKE, Earthquake Research Institute, the University of Tokyo

The April 2016 Kumamoto earthquakes caused devastating damage including 50 casualties. The epicentral region is located in the Beppu-Shimabara graben belt, running east-west direction through central Kyushu with north-south tension. Mt. Aso, an active volcano in the large caldera (diameter of ~ 20 km), is located in the graben, east of the earthquake source. The graben structure parallels the Median Tectonic Line, which continues to east in Shokoku as an active fault. It continues to the southwest toward Okinawa trough, a backarc basin of Ryukyu trench.

The earthquake series started with an M 6.5 event, called foreshock, on April 14, followed by M 6.4 event ~2.5 hours later. On April 16, ~ 28 hours after the first event, the largest event with M 7.3 occurred. This earthquake, called mainshock of the Kumamoto earthquake series, triggered earthquakes with M~6 in Aso (~ 50 km from the epicenter) and Oita (~ 80 km) regions. The aftershock activity as well as triggered seismicity in Aso and Beppu regions was very high, nearly 250 earthquakes with M > 3.5 occurred within 30 days of the foreshock.

Both foreshock and mainshock have predominantly strike-slip mechanism with north-south tensional axis. The focal mechanism solution and aftershock distributions indicate left-lateral strike slip faultings with slightly different strikes. The maximum peak acceleration from the foreshock and mainshock were 1580 gal and 1791 gal, respectively. The maximum horizontal displacements recorded on GNSS network during the foreshock and mainshock were 20 cm and 98 cm, respectively. The satellite (InSAR) data indicate the mainshock fault extended about 35 km from the epicenter.

The foreshock occurred on the ~ 6 km long northern segment of Hinagu fault, whereas the mainshock occurred on the ~ 28 km long eastern segment of Futagawa fault. Postseismic field surveys indicate that the surface rupture with maximum offset of 2 m appeared along these active faults. The Earthquake Research Committee evaluated possibilities of an M 6.8 earthquake on the northern segment of Hinagu fault and an M 7.0 earthquake on the eastern segment of Futagawa fault. Because the size and fault length of foreshock and mainshock were similar to the forecast, these events may be considered as two main shocks rather than foreshock-main shock series.