D-08

Magma supply system at Merapi volcano, inferred from the location of VT earthquakes and their focal mechanisms

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Merapi (2968 m), located in central Java, is one of the most active and dangerous volcanoes in Indonesia. The volcano has repeated episodes of dome growth and collapse, producing pyroclastic flows during historical time. Volcano-tectonic (VT) earthquakes have been classified into deep (VTA) and shallow one (VTB). Since August 2000, number of VT events (M=1.0-1.6) had increased, and pyroclastic flows have successively occurred from the middle of January, 2001 (Fig. 1). From ground-tilt observation, Subandoriyo et al (1998) estimated that pressure sources are located at three ranges of depth, 0.4-0.7km, 1.7km and 3.8km. From chemistry of volcanic gases, Hirabayashi et al (1998) estimated degassing depth of Merapi magma to be 1-1.7km. The location and focal mechanism of VT earthquakes during the period from August 2000 to January 2001 were examined, and the results were discussed in relation to magma supply system of Merapi volcano (Fig. 2).

The focal zone vertically extends to about 4 km deep beneath the summit. VTA events are located at the depth 2.2 – 4.1 km and the VTB ones at the depth shallower than 1.3 km. An aseismic zone is observed around 1.3 – 2.2 km deep between the hypocenter zones of the two types of VT earthquakes, interpreted as shallow magma storage (Ratdomopurbo, 1995). A small seismic gap is also found within VTB zone, dividing those events into the deep and the shallow one.

Focal mechanism of VT events was estimated by using both amplitude and polarity of P-wave first motions at 4 seismic stations, assuming double couple mechanism and homogenous medium.

Determined focal mechanisms for VTA events are of normal-fault types. VTA events might originate by increase in horizontal tension when magma rose up from deeper portion. Orientation of their T-axes is nearly horizontal in NEE-SWW direction which might be affected by the E-W regional tectonic stress.

As for the VTB, normal fault types are dominant at the deeper VTB zone, while at the shallower part, both reverse fault and normal fault types are originated. The pressure increases at shallow magma storage may cause generation of deep VTB events of normal fault types. As VTB events frequently originated, corresponding to increase of multiphase (MP) events which are related to growth of lava dome, shallow VTB events of reverse fault type might be generated by horizontal compression related to pressure decrease in magma conduit due to extrusion of lava and gases, and occasionally by pressure increase at the shallow part due to accumulation of magma or volcanic gases.

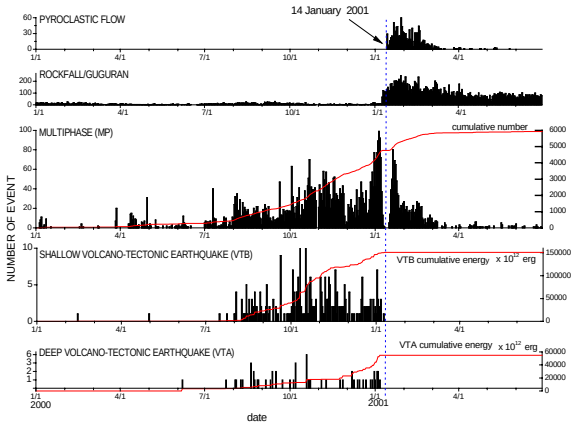

Fig. 1 Daily number of pyroclastic flows, rockfalls, MP events, VTB and VTA

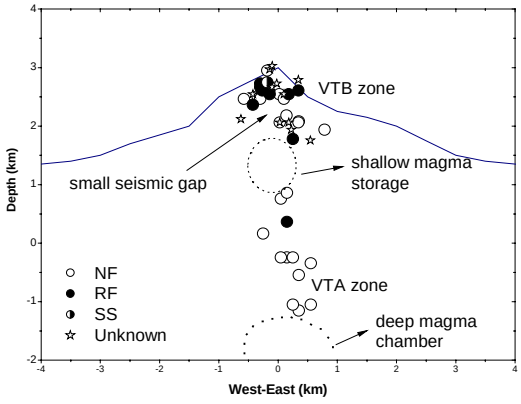

Fig. 2 Image on magma supply system at Merapi volcano, and location and focal mechanism of volcano-tectonic earthquakes