

Seismic activity related to the 2002 magma intrusion at Hachijo Island

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A seismic swarm occurred at the east foot of Mt. Hachijo-Fuji, one of the volcanos of Hachijo Island on August 13, 2002. Ground deformation and seismic migration have been observed by stations in Hachijo Island. Several studies have been made on magma intrusion but few attempts have been made at the seismicity. To better understand the seismic activity and magma intrusion, we determined velocity structures and detailed hypocenter distribution in 2002. First, velocity structures were inverted. We adopted the tomoDD code (Zhang and Thurber, 2003) to 29,338 arrival times of 438 events from November 2002 to December 2009, obtained by 13 stations in and around Hachijo Island. Second, hypocenter distribution in 2002 was calculated using the new velocity model applied to 39,154 arrival times of 916 events together with 87,626 wave correlation data from August 13 to 15, 2002. The velocity models show that a high velocity zone exists widely beneath Hachijo-Fuji at a depth of 15 km and ascends up to 5 km in the volcanic vent of Hachijo-Fuji. Two low velocity zones exist around the high velocity vent at depths of 6-15 km. The earthquakes distribute in the velocity boundary between high and low zones at depths of 10-13 km. They migrate upward in a narrow plane, striking southwest-northeast, dipping northwest at 45 degrees. The first beginning minor earthquakes occurred at the bottom of the distribution aligned southwest to northeast and stayed there for two hours. For another two hours they moved upward making concentrated seismicity. Next, they moved up to 10 km and changed the direction to the north. Then the activity finally migrated to the north offshore after several days. Magma intrusions and related fluid and gas release at depths of about 12 km are the universal cause of volcanic earthquake swarm generation. The hypocenter migration harmonizes with ground deformation recorded by the tilt-meter in Hachijo Island. Thus high-resolution 3-D seismic data indicate magma or fluid migration pathways upward along faults systems from 13 to 10 km depth toward the north offshore.

Keywords: Hachijo Island, seismic activity, seismic migration, magma intrusion, ground deformation