Fluid distribution and its upwelling pathway beneath the source region of Matsushiro seimsmic swarm

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The Matsushiro seismic swarm, a series of more than 700,000 earthquakes occurred over a 2 years (1965-1967) in the vicinity of Minakami-yama quaternary volcano, was associated with a strike-slip faulting sequence and accompanied by a large amount of fluid outflow. In this study we have determined two-dimensional (2-D) resistivity structure, three-dimensional (3-D) seismic velocity structure and S-wave polarization anisotropy beneath the source region of the seismic swarm area.

In order to determine a 2-D resistivity structure, magnetotelluric (MT) stations were deployed in the study area. The MT data were collected using five component wide-band MT instruments (Phoenix MTU-5 system). A simultaneous remote reference measurement was carried out at the Nishiwaga site (400 km northeast of the study area). The observed apparent resistivity and phase data were inverted simultaneously using the 2-D inversion code of Ogawa and Uchida [1996].

We also applied a tomographic method [Zhao et al., 1994] to P and S arrival times from 14,348 regional earthquakes to determine a 3-D P and S wave velocity structure in and around the source region.

To investigate S-wave polarization anisotropy at 9 stations located in the source region, a S-wave splitting analysis of Silver and Chan [1991] was applied to waveform data from shallow earthquakes.
The obtained 2-D resistivity, 3-D seismic velocity structure and S-wave polarization anisotropy show as follows: (1) A prominent electrical conductor exists beneath the water outflow area and it is imaged in the depth of 2-10 km. (2) A seismic low P and S wave velocity anomaly is imaged in the lower crust and uppermost mantle below the electrical conductor. These anomalies may reflect melt and aqueous fluids upwelling from the upper mantle. (3) The orientations of faster polarized S wave are changed dramatically in the water outflow area and are parallel to the two conjugate faults associated with the seismic swarm. (4) These results indicate that the fluid outflow was originated in volcanic fluids from the upper mantle and its upwelling through the intersection part of conjugate faults was contributed to the occurrence of seismic swarm and anomalous fluid outflow.

Keywords: resistivity, seismic velocity, seismic anisotropy, seismic swarm, fluid outflow

