



Signal Detection of Microwave Frequency due to Rock Fracture in Volcanic Activities

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Microwave emission due to rock fracture was found in the experiments in our laboratory. Rock fractures are expected to be association with volcanic activities on the following occasions: (1) Volcano quake, (2) Eruption from a crater, (3) Collapse of a crater cliff. In order to observe the microwave in volcanic activities, we developed a measuring system and installed it on the volcano of Oyama at Miyake-island about 100 km south of Tokyo. This paper presents the constitution of the measuring system, observation site, and obtained data with analytical explanation. The microwave signals at three frequency bands of 300 MHz-, 2 GHz- and 18 GHz are received by the assigned antennas and receivers. The antennas are placed to point the rock cliff of the volcano crater. At the higher two frequencies, heterodyne schemes are adopted for amplification. The microwave signals are digitized and multiplexed using personal computers at the top of the mountain, then transmitted to the foothill. The data are transferred to Tokyo via communication circuits. The observation has been carried out from November 2007 with several interruptions. First, we confirmed the obtained data, then, checked the correlation with several factors such as lightening and ground quakes. The contamination of microwaves due to lightening was not observed in the concerned data. Interferences with artificial radio waves are recognized at particular frequencies, but can be are filtered out by post processing. The correlation between the microwaves and ground quakes is significant. Accordingly, we can conclude that the microwaves are emitted from the above-mentioned rock fractures all of which cause ground quakes. In the future, microwaves could be used to detect an earthquake as well as a volcanic activity because rock is expected to fail around the epicenter. But for the verification purpose of the methodological availability, a volcanic activity may be more convenient than an earthquake because of the known location and hopefully time. The sensors for microwave detection may be applied to early warning systems for natural hazards such as an earthquake or a volcanic eruption. That is because the microwave due to rock fracture can penetrate the ionosphere to reach a satellite in orbit and strong enough to be received by the satellite. But the relation between a rock fracture and quakes has not been clarified at all, and is left to the future research.