Dynamics of volcanic explosion: outcomes of our project in priority areas and future researches

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The project 'Dynamics of Volcanic Explosion' has been supported for the fiscal years of 2002 to 2006 as one of the Scientific Researches in Priority Areas, Grants in Aid for Scientific Research by MEXT. The central purpose of this project is to improve comprehensive understanding of elementary processes and generation mechanisms of volcanic explosions and to contribute to mitigation of volcanic hazards through the application of the researches. The project has involved about a hundred researchers working on various fields of volcanology, fluid dynamics and social sciences for crises.

As a result of extensive studies in this project, substantial development has been achieved in some research areas. For instance, a new devise called 'Mobile Observatory for Volcanic Explosion (MOVE)' that is operated with a remote control has been developed for sampling of volcanic products near dangerous craters, on-site observation of the explosion condition including air pressures and temperatures, and installation of some instruments including seismometers and GMT sensors. A scaling law that describes the intensity of explosion for wide intensity ranges has been discovered and confirmed by some field experiments and compilation of various data. Shallow gas migration below the crater bottom has been detected and interpreted to be a common precursory process of volcanic explosions based on seismic and ground deformation studies for some active volcanoes. The processes of the degassing and fragmentation of magma have been better understood through some theoretical analyses and various experimental studies. Computer simulation for stationary and non-stationary magma flow has revealed a simple criterion that may control the choice between explosive and effusive eruptions. Computer simulation of volcanic clouds and pyroclastic flows has been made in a more rigorous way and justified the empirical relation describing entrainment of the ambient air.

There are still lots of problems that have not yet been clarified enough and wait future works. In this context it is important to note that only poor information is available for the underground processes that may lead to volcanic explosions. This problem can be covered effectively by making systematic studies of related research areas with strong mutual interactions. In particular computer simulation is expected to play an important role in connecting field observations, experimental data and theoretical analyses and in integrating various research outcomes toward a more comprehensive understanding. For the first step our project proposes a system of computer simulation with the data base that involves basic principles usable to the simulation as well as the data of material properties and field observations.