

Toward monitoring and modeling for eruption prediction

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An article entitled as 'Seismic monitoring and modeling of an active volcano for prediction' published in 2000 by Aki and Ferrazzini clearly stated what he thought important in scientific approach for eruption prediction. In this article, he mentioned some difference in style between modeling for hazard prediction and that for ordinary sciences. Due to this difference, scientific modeling for eruption prediction is not easy, but he emphasized importance of modeling for scientific eruption prediction. I would like to overview how Professor Aki had been concerned with volcanology and how he reached the 'starting point' for quantitative prediction of eruptions.

Professor Aki, who has been often introduced as a great seismologist, contributed a lot to volcanology. His research paper in 1957, 'Local concentration of magma as a stationary irreversible process' indicates that he had interested in magmatic process since his early research life. In late 1970s and 1980s, his relationship to volcanology became deeper, through his work for the theory of fluid driven crack models for volcanic tremor and three dimensional velocity inversions. His purpose was probably to reveal subsurface magmatic process, not to apply seismological methods to volcanic process.

Professor Aki's intensive research on volcano started after the experiment of a lava lake in Kilauea Iki in 1976. Aki, Fehler and Das (1977) proposed a fluid driven crack model for volcanic tremor excitation, which was improved and has been developed by Chouet (for example, Chouet (1996)). Aki and Koyanagi (1981) estimated magma flow rate in the uppermost mantle by applying the crack model improved by Chouet to the deep volcanic tremor beneath Hawaii, and proposed a reduced displacement as an indicator of magmatic flow. In the case of Long Valley Caldera's seismic crisis in 1980, he applied this indicator to infer the reason of the absence of volcanic tremor. The crack model for volcanic tremor has been still developed by many scientists (for example, Kumagai and Nakano). I feel Professor Aki's living hope to reveal magmatic process beneath Hawaii from his papers and lectures. His research targeting on Hawaii continued until early 1990s.

After his moving to Piton de la Fournaise in 1996, he confirmed the need of a close interplay between monitoring and modeling for quantitative prediction of volcanic eruption, through the seismic research of the volcanic island and his experience of the 1998 eruption. In 2000 and 2001, he presented two papers insisting the importance of quantitative modeling generally for hazard prediction. I think that scientists are usually good at modeling for a restricted dataset, but that we need some change in mind to create a model for temporally evolving dataset like volcanic monitoring. Professor Aki stated in his papers and lectures after 2000 that he is at the starting point toward the goal for quantitative prediction of volcanic eruption. We are also at the same starting point.