AOB Seminar

講演者名：Prof. Chris Newhall
所　　属：Earth Observatory of Singapore,
　　　　　Nanyang Technological University
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　　　　　別館第 1 会議室
講演題目：Some scientific and social lessons from Pinatubo

Some scientific and social lessons from Pinatubo

Chris Newhall and many colleagues from PHIVOLCS and USGS

- For the first time, modern monitoring captured the pre-, syn-, and post-eruption signatures of a sulfur-rich, plinian, caldera-forming eruption.
- Apparently, the M 7.8 Luzon earthquake of July 16, 1990, 100 km NE of Pinatubo, started a chain of events that led to Pinatubo's large eruption in June 1991, perhaps by squeezing basaltic magma upward.
- Basalt intruded residual, viscous, crystal-rich dacite magma 8-12 km beneath the volcano. Mixing of the two began at least 30-45 days before magma was erupted, and lasted up until <1 week before eruption.
- Many of the early precursory earthquakes were 5 km northwest of Pinatubo, rather than directly beneath the volcano. They reflected pressurization of the residual magma body and strain release on tectonic faults, not dike intrusion.
- Pinatubo's geologic past, rather than unique precursors, was the main reason to suspect that a large eruption was pending. Seismic and gas precursors were typical of any eruption, until a sharp increase in shallow LP earthquakes in just the last 24 hours before the climactic eruption. These LP earthquakes didn't begin until after the mixture of basalt and dacite had already been erupted and erupting magma was now purely (gas-rich) dacite.
- Pinatubo's eruption was unusually powerful because the volcano had been dormant for ~500 years and had apparently trapped incoming carbon dioxide, water, sulfur dioxide, and other magmatic gases so effectively that these volatiles saturated the melt and then formed a discrete phase of volatile bubbles in dacite magma at >8 km depth. Discrete volatile bubbles at depth may be a necessary condition for sustained, plinian eruptions.
- Within years, more than half of the debris on Pinatubo's slopes was washed by lahars and sediment-laden streamflow into the surrounding lowlands, adding to Pinatubo's broad alluvial fans. Economic losses and human displacements from post-eruption hydrologic

hazards exceeded those of the eruption itself. Sediment yields in the first few years broke previous world records by 1-2 orders of magnitude.

- In August 2000, surface water of the new caldera lake was 30°C while that at 60-m depth was ≥ 70°C! Probably, CO_2 bubbles in the water column stabilized hot water at depth through the early history of the lake. But by 2001, CO_2 flux had diminished enough to allow overturn and mixing.
- Throughout the Pinatubo crisis, quick scientific advice and willingness of public officials to act on that advice has saved >> 10,000 lives and averted >$1 billion of property damage and other economic disruption. Different messages for different people helped – including personal advice, video of hazards, a hazard map, an event tree, scenarios, simple alert levels and bulls-eye evacuation zones. Uncertainties remained high throughout, but trust that had been developed between scientists, public officials, and citizens in preceding months and years allowed timely risk mitigation.

For more info, see:

Newhall and Punongbayan, eds., Fire and Mud, Eruptions and Lahars of Pinatubo Volcano, Philippines. Full-text online at http://pubs.usgs.gov/pinatubo. Also, many papers in volcano and climate journals.