2001 Fall Meeting
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Cite abstracts as *Eos Trans. AGU, 82*(47), Fall Meet. Suppl., Abstract xxxxx-xx, 2001

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AN: **V22E-02**
TI: Multiparameter Measurements at Montserrat and their Interpretation: Honoring the Memory of Bruno Martinelli
AU: *** Voight, B**
EM: *voight@ems.psu.edu*
AF: *Pennsylvania State University, Department of Geosciences, 334 Deike Building, University Park, PA 16802 United States*
AU: *** Voight, B**
EM: *voight@ems.psu.edu*
AF: *Montserrat Volcano Observatory, St. John's, Montserrat*
AU: **Young, S**
AF: *Montserrat Volcano Observatory, St. John's, Montserrat*
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AU: **Thompson, G**
AF: *Montserrat Volcano Observatory, St. John's, Montserrat*
AU: **Williams, D**
AF: *Montserrat Volcano Observatory, St. John's, Montserrat*
AU: **Williams, P**
AF: *Montserrat Volcano Observatory, St. John's, Montserrat*
AB: Bruno claimed we cannot make worthwhile predictions about a volcano's activity without understanding the physical processes occurring inside it, and this requires the joint interpretation of measurements of many different phenomena. Current well-documented volcanism at Soufriere Hills Volcano exemplifies this philosophy. Extrusions are (and were) unsteady and accompanied by oscillating patterns of ground deformation, seismicity, and gas exhalation. Deformations on the short term were best expressed by tiltmetry, with inflations and deflations at periods from 3 to 30 hours indicating shallow pressure changes in magma. Earthquake swarms or tremor occurred about the conduit when a critical magma

pressure was exceeded. The oscillations of rapid extrusion of magma or explosions indicate instability in the magma flow, which we suggest results from viscosity changes induced by degassing and microlite crystallization. Increased viscosity of shallow degassed magma causes flow stagnation; conduit pressure then builds as detected by tilt and seismicity, and then is released as the plug yields and a slug of magma is extruded. The viscosity is dependent on volatile content of magma, and within an elastic magma-and-conduit system, oscillatory flow is produced for a critical range of input flow rates. Thus at Montserrat unstable flow was recognized only after July 1996 after a substantial increase in eruption rates. Slower, generally steady extrusion had occurred earlier between November 1995 and July 1996. The short-term oscillations were used to forecast times, near or just after the pressure peak, when dome collapse and associated nuees ardentes were most likely, or when vulcanian explosions were likely to occur. Likewise, longer-period patterns over 6-7 weeks were recognized, involving nearly steady extrusion after several weeks of strongly oscillating, high pressure flowage. These patterns, due to periodic rebuilding of magma chamber pressurization and high conduit input flow rates, were also useful in hazards mitigation; e.g., a forecast was made in August 1997 for the occurrence of dome collapse and explosive eruptions one month later, and a large event in late December 1997 was anticipated similarly. Lava flow to the surface from Feb 1998 to Nov1999, but the resumed flow has oscillated with cyclic seismicity indicating pressurization, and with gas flux (and extruded lava) lagging behind the pressure peak. The Montserrat data and analogues elsewhere suggest that oscillatory flow is a fundamental mode of behavior at silicic volcanoes, and recognition and understanding of it allows improved short- and medium-term forecasts of timing and eruption style.

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