



MeMoVolc

Measuring and Modelling of Volcano eruption dynamics

Research Networking Programme of the European Science Foundation (ESF)

www.memovolc.fr

Sinabung Volcano, 2014

What is MeMoVolc?

- ❑ Research Networking Programme of the ESF (European Science Foundation):
 - Co-ordinated programmes that aim at facilitating exchange of scientific ideas, personnel and knowhow between nationally funded researchers or research groups, in order to enhance synergy across national boundaries at the European level and beyond)
 - Self-coordinated structures
 - Participation in activities subject to open call to all ESF member states
- ❑ Focus on volcano eruption dynamics. Has broadened to include precursory phenomena and risk aspects
- ❑ Supported financially by 8 countries
- ❑ Budget of 423 k€ over 5 years for networking activities

Network objectives

❑ **Research component (workshops, travel grants, publications)**

- Tackle fundamental problems of volcano eruption dynamics synergistically at the interfaces between traditional disciplines.
- Forge collaborations, and build international and trans-disciplinary working groups, through scientific meetings and mobility between laboratories and observatories.

❑ **Training component (summer schools)**

- Communicate trans-disciplinary concepts and approaches to young volcano scientists

Contributing member organisations

FRANCE: Centre National de la Recherche Scientifique (CNRS)
Université Blaise Pascal, Clermont-Ferrand
Institut de Physique du Globe de Paris (IPGP)
Université d'Orléans

GERMANY: Deutsche Forschungsgemeinschaft (DFG)

ICELAND: Rannís Icelandic Centre for Research

ITALY: Istituto Nazionale di Geofisico e Vulcanologia (INGV)
University of Florence

NORWAY: Research Council of Norway

PORTUGAL: University of the Azores

SWEDEN: Swedish Research Council

SWITZERLAND: Swiss National Science Foundation

ESF Network activities

- ❑ Scientific meetings
- ❑ Scientific travel grants for short visits between laboratories and volcano observatories for the purposes of networking on specific projects.
- ❑ Summer schools

Note – network funds are for networking (travel and subsistence only), not 'research'

Scientific meetings and resulting working groups

MeMoVolc launch meeting

Clermont-Ferrand, 17-18 January 2012. Organized by T. Druitt (Clermont-Ferrand, France)

Unrest at Santorini Caldera (2011-2012)

Santorini, 27-28 March 2012. Organized by T. Druitt (Clermont-Ferrand, France), L. Francalanci (U. Florence, Italy) and G. Vougioukalakis (IGME, Greece)

Tracking and understanding volcanic emissions through cross-disciplinary integration: A textural working group

Clermont-Ferrand, 6 and 7 November, 2012. Organized by L. Gurioli (Clermont-Ferrand, France)

Workshop on magma emplacement and volcano-tectonics

University of Oslo, 4-6 February 2013. Organized by O. Galland (U. Oslo), S. Burchardt (U. Uppsala) and V. Troll (U. Uppsala)

European Volcano Observatories Workshop – EVOW

University of the Azores, 14-16 October 2013. Organiser José Pacheco (CVARG, Portugal)

Workshop on Satellite-Data-Driven Detection, Tracking and Modeling of Volcanic Hot Spots

Clermont-Ferrand, 28-30 May 2013. Organisers A. Harris (Clermont-Ferrand, France), P. Labazuy (Clermont-Ferrand, France) and T. De Groeve (European Commission Joint Research Centre)

Workshop on imaging volcanic plumes

Stromboli, 24-29 June 2013. Organisers Mike Burton (INGV Pisa, Italy), Ulrich Platt (University of Heidelberg, Germany), Fred Prata (NILU, Norway)

Dynamics of volcanic explosive eruptions

Geneva, 29-31 January 2014. Organisers: C. Bonadonna (Geneva, Switzerland), R. Cioni (INGV, Pisa), A. Costa (INGV, Bologna) and T. Druitt (Clermont-Ferrand, France)

From magma ascent to ash generation: Investigating volcanic conduit processes by integration of experiments, numerical modelling and observations

To take place in Pisa, 25-27 October 2014. Organisers: M. Polacci and M. de' Michieli Vitturi (INGV, Pisa, Italy)

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Working group on pyroclast characterization and correlation with geophysical signals

(Organiser L. Gurioli)

Questions

- ☐ Sampling strategies
- ☐ What to measure (field, geochemical, eruption statistics)
- ☐ Improved standardization, measurement precision, measurement protocols
- ☐ Multidisciplinary sampling and measurement routines and standards

Working group established, with four sub-groups

- ☐ Textures
- ☐ Geochemical
- ☐ Deposits
- ☐ Geophysical

Presented at AGU

Meeting report in preparation for publication

Scientific travel grants

21 inter-laboratory travel grants to young (and some older) scientists :

- Influence of the fragmentation process on explosive eruptions: comparison between laboratory and numerical modelling results. Mattia de' Michieli Vitturi (INGV, Pisa, Italy) in collaboration with Bettina Scheu (University of Munich, Germany) Access the report for this project
- Modelling analog experiments on conduit two-phase flow. Laura Pioli (University of Geneva, Switzerland) in collaboration with Giovanni Macedonio (Vesuvius Observatory, Naples, Italy) Access the report for this project
- Monitoring Mount Etna using Doppler radar. Estelle Bonny and Franck Donnadieu (Clermont-Ferrand, France) in collaboration with Mauro Coltelli (Mount Etna Volcano Observatory, Catania, Italy) Access the report for this project
- Testing crustal volatile remobilisation. Sylvia Berg and Valetin Troll (Uppsala University, Sweden) in collaboration with Margherita Polacci (INGV, Pisa, Italy) Access the report for this project
- Modelling of volcanic plumes. Matteo Cerminara (INGV-Pisa, Italy), and Sébastien Valade (Clermont-Ferrand, France) Access the report for this project
- Characterization and modelling of hydrothermal fumaroles. Sampling and analytical methodologies. Fátima Viveiros (CVARG, Portugal) in collaboration with Giovanni Chiodini (Osservatorio Vesuviano, Italy) Access the report for this project
- Coupling the decompression dynamics and disequilibrium crystallization: comparison between laboratory and numerical modelling results. Caroline Martel (ISTO, Orléans, France) in collaboration with Mattia de' Michieli Vitturi (INGV-Pisa, Italy) Access the report for this project
- Buoyancy of Azorean magmas: consequences on ascent, intrusion and formation of magma storage areas beneath main volcanic systems. Vittorio Zanon (CVARG, Portugal) in collaboration with Nicole Métrich (IPGP, France) Access the report for this project Access publications for this project
- Analogue modelling of the dynamic emplacement of cone sheets in volcanoes. Steffi Burchardt (Uppsala, Sweden) in collaboration with Olivier Galland (Oslo, Norway). Access the report for this project
- A multi-scale hazard assessment for tephra fallout at Hekla volcano. Sébastien Biass (University of Geneva, Switzerland) in collaboration with Armann Hoskuldsson (University of Iceland). Access the report for this project
- Thermal structure of pyroclastic density currents at the Azores. Massimiliano Porreca (CVARG, Portugal) in collaboration with Leonardo Sagnotti (University of Rome, Italy). Access the report for this project
- Quantitative assessment of lava flow hazard at Pico Island, Portuguese Azores. Annalisa Cappello (INGV Catania, Italy) in collaboration with Maria Queiroz (CVARG, Portugal). Access the report for this project
- Modelling of explosive behaviour at Kameni Volcano, Santorini. Tim Druitt (Clermont-Ferrand, France) in collaboration with Augusto Neri (INGV Pisa, Italy).
- Shallow conduit processes – magma degassing and microlite formation in Hekla, Iceland. Jonas Gudnason (University of Iceland, Iceland) in collaboration with Olgeir Sigmarsson (Clermont-Ferrand, France). Access the report for this project
- On the origin of mafic, K-rich magmas at Vulcano Island (Aegean Archipelago). Giovanni Lanzo (INGV Palermo, Italy) in collaboration with Bruno Scaillet (University of Orléans, France). Access the report for this project
- Magma dynamics feeding large volcanic eruptions: The case of Campi Flegrei (Italy). Silvio Mollo (Rome, Italy) in collaboration with Olivier Bachmann (ETH Zurich, Switzerland). Access the report for this project
- From observations to experiments: Describing and characterising convective instabilities of volcanic plumes. Simona Scollo (INGV Catania, Italy) in collaboration with Costanza Bonadonna (University of Geneva, Switzerland). Access the report for this project
- Timescales of magmatic processes at Stromboli and the interaction between shallow- and deep-seated processes. Olgeir Sigmarsson (University of Iceland, Iceland) in collaboration with Lorella Francalanci (University of Florence, Italy).
- Study of the fragmentation mechanisms of recent Plinian eruptions in Martinique, and consequences for their eruptive regimes. Ulrich Kueppers (University of Munich, Germany) in collaboration with Edouard Kaminski (IPGP Paris France). Access the report for this project
- Study of the fragmentation mechanisms of recent Plinian eruptions in Martinique, and consequences for their eruptive regimes. Guillaume Carrazzo (IPGP Paris France) in collaboration with Ulrich Kueppers (University of Munich, Germany).
- Selection and characterisation of sampling sites for S. Miguel Island fumaroles. Development of laboratory facilities to improve preparedness in emergency situations. Stefano Caliro (INGV Naples, Italy) in collaboration with Gabriela Quiroz (CVARG Portugal). Access the report for this project

Summer schools

Volcanic ash: from magma to aviation impact

25-29 June 2012, Nicolosi, Sicily

Organisers: A. Neri (INGV, Italy), M. Coltelli (INGV, Italy), and T.H. Druitt (Clermont-Ferrand, France)

Lecturers: T. Druitt, U. Kueppers, M. Polacci, M. Gudmundsson, M. Gouhier, A. Neri, C. Bonadonna, M. Coltelli

Magmatic volatiles: from generation to atmospheric loading

1-5 July 2014, Stóru-Tjarnir (close to Krafla Volcano), Iceland.

Organisers: O. Sigmarsson (Laboratoire Magmas et Volcans, Clermont-Ferrand, France and Nordic Volcanological Centre, University of Iceland), T. Thordarsson (Institute of Earth Sciences, University of Iceland) and R. Pedersen (Nordic Volcanological Centre, University of Iceland)

Lecturers: T. Thordarsson, B. Scaillet, M. Edmonds, D. Laporte, O. Sigmarsson, M. Burton, A. Aiuppa, S. Carn; A. Robock



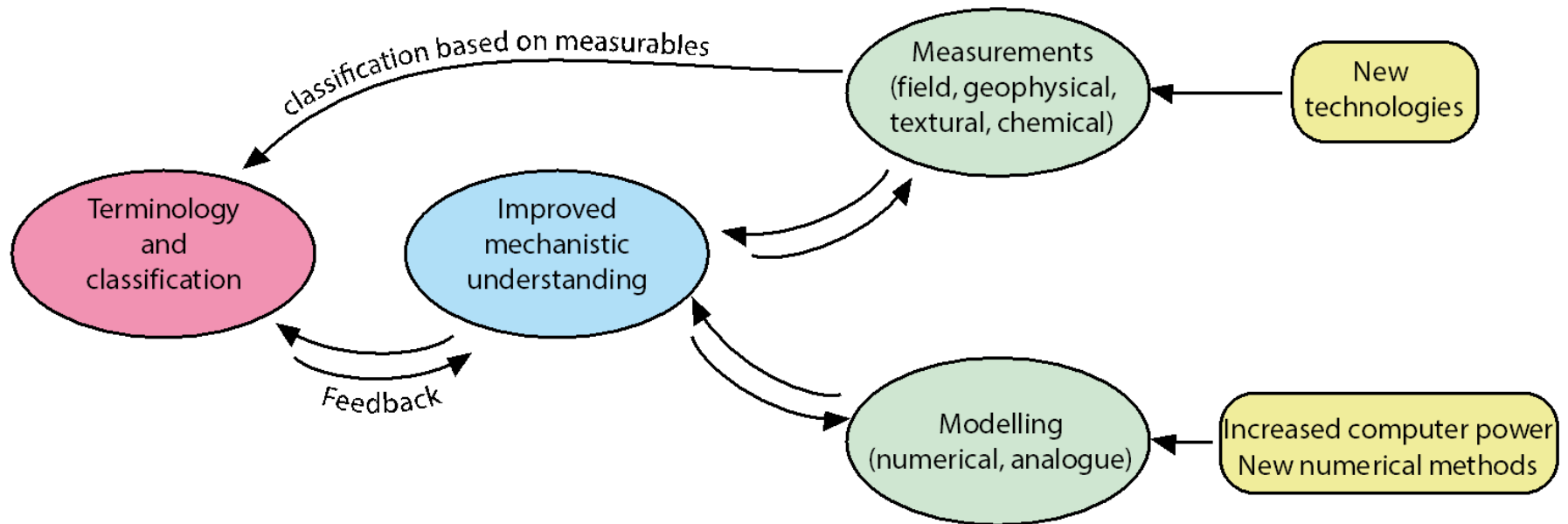


Dynamics of volcanic explosive eruptions

Geneva, 29-31 January 2014

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Meeting context



Advances in measurement and modelling capabilities

- ❑ Ground- and satellite-based remote sensing techniques
 - plume heights, exit speeds, magma masses and fluxes, gas masses and fluxes, gas/magma ratios, eruption energy (seismic, acoustic, thermal)
- ❑ Techniques for improved deposit mass integration
 - eruption mass; total particle size distribution
- ❑ Techniques for fallout deposit 'inversion'
 - plume heights, magma fluxes
- ❑ Techniques for precise and rapid pyroclast characterization
 - volatile contents, textural parameters

Advances in mechanistic understanding

Magma chamber

- ❑ Volume available, volatile content, chamber pressure
- ❑ Degassed remanent magma; deep replenishment magma

Conduit ascent

- ❑ Gas-magma coupling; two-phase flow regimes
- ❑ Vesiculation/coalescence history
- ❑ Permeability development
- ❑ Degassing and microlite growth
- ❑ Development of large viscosity and pressure gradients
- ❑ Fragmentation mechanism and efficiency

Jet and plume dynamics

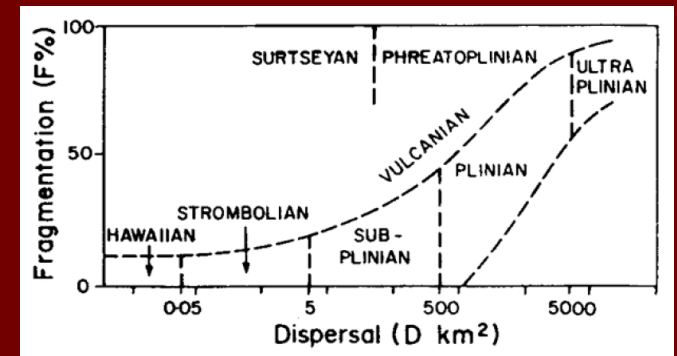
- ❑ Crater shape
- ❑ Plume stability behaviour

Are our classification systems adequate?

Classification systems based on :

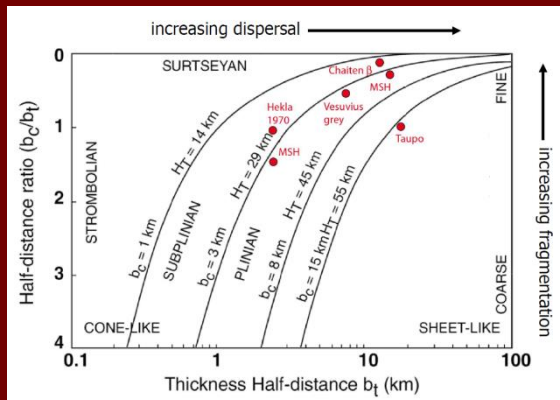
- Intensity (magma flux – plume height)
- Particle size distribution
- Magnitude (magma mass)

VEI	Ejecta volume	Classification	Description	Plume	Frequency
0	< 10,000 m ³	Hawaiian	non-explosive	< 100 m	constant
1	> 10,000 m ³	Hawaiian/Strombolian	gentle	100-1000 m	daily
2	> 1,000,000 m ³	Strombolian/Vulcanian	explosive	1-5 km	weekly
3	> 10,000,000 m ³	Vulcanian/Peléan	severe	3-15 km	yearly
4	> 0.1 km ³	Peléan/Plinian	cataclysmic	10-25 km	≥ 10 yrs
5	> 1 km ³	Plinian	paroxysmal	> 25 km	≥ 50 yrs
6	> 10 km ³	Plinian/Ultra-Plinian	colossal	> 25 km	≥ 100 yrs
7	> 100 km ³	Plinian/Ultra-Plinian	super-colossal	> 25 km	≥ 1000 yrs
8	> 1,000 km ³	Ultra-Plinian	mega-colossal	> 25 km	≥ 10,000 yrs

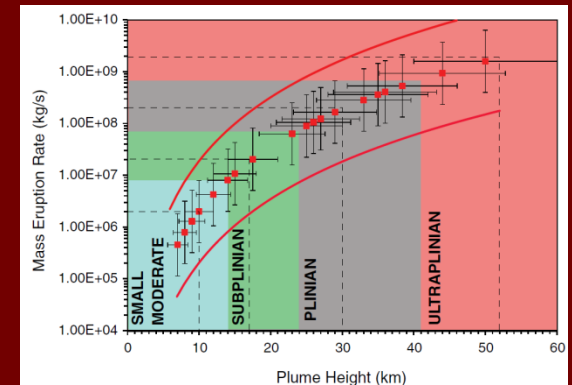


Newhall & Self 1982 ; Houghton et al 2013

Walker 1980



Pyle 1989



Bonadonna & Costa 2013

Are our classification systems adequate?

ISSUES:

- ❑ Plumes of small to moderate intensity: intensity overlap of hawaiian, strombolian, violent strombolian, vulcanian, subplinian
- ❑ How to take into account unsteadiness, and the timescale of that unsteadiness? How to measure it?
- ❑ Continuous ash-emission magmatic eruptions
- ❑ Simultaneous emission of tephra/lava or tephra/PDC
- ❑ Should new measurables (e.g., seismic, acoustic, thermal) be taken into account? How?

The meeting questions

1. Crucial parameters that drive and characterize explosive volcanism of different types, in particular the small-moderate explosions
2. New advances in our mechanistic understanding of these parameters and which still require investigations?
3. Shortcomings of the way explosive eruptions are typically described and characterized
4. What are the most distinctive parameters/processes that can be used to characterize/classify eruptions? And how can we measure them? (e.g. how can we characterize unsteadiness?)
5. Modern applications and use of eruption classification (advantages and disadvantages)
6. Suggestions for an alternative multidisciplinary classification scheme

The meeting deliverables

Consensual document with a review of recent advances in our understanding of eruption mechanisms and a classification of main eruptive parameters that drive explosive volcanism.

Short communication to BV?