UNIVERSITÀ DEGLI STUDI
DI PERUGIA

DOTTORATO DI RICERCA
SCIENZA E TECNOLOGIA PER LA FISICA E LA GEOLOGIA

Short Course on Magmas, Eruptions and Risks

Fourth Edition

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Contact and information:

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Lecturer/researcher:

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Program

- 2 days of lectures in the morning (9-13 a.m.) and exercises in the afternoon (2:30- 5:30 p.m.) + 1 day in the field (Roman Magmatic Province).

Qualifications

A certificate of "successful participation at the short course on Magmas, Eruption and Hazard" can be obtained. This certificate is equivalent to 3 credit points in the graduate program at the University of Perugia. To get the certificate you need to submit a short report, max two pages (and the report has to be accepted).

Introduction

This course is aimed at providing an up to date and modern knowledge about magmatic-volcanic processes.

1. The first part will deal with magma physical and physico-chemical properties. This aspect is of particular importance especially for volcanic hazard assessment. Experimental studies allow simulating processes that are responsible for both effusive and explosive eruptions. High-temperature and high-pressure facilities give the advantage to deal with data representing the magma in the Earth interior and possibly to elucidate and assess future volcanic scenarios. Only when studying physical (i.e. density, viscosity), chemical (i.e. chemical elements distributions, volatile solubility) and structural properties (i.e. bond distance, oxidation state) we can build up general models to predict magma behaviour in dependence of intensive variables such as composition, temperature, and pressure. Participant will have the opportunity to visit the PVRG-lab and use HT experimental apparatus to measure magma viscosity.

2. The second part will focus on three main subjects:
1) A detailed description of seamounts activity with particular emphasis on the Mediterranean Seamounts and related risks. Additionally, submarine eruptions will be discussed using Marsili seamount as an example.
2) The physical and chemical mechanism of magma mixing with emphasis on the use of new conceptual models of Chaos Theory and Fractal Geometry and their integration with experimental petrology. The role of magma mixing in triggering volcanic eruption will be explored in detail.
3) The third part will focus on the dynamics of volcanic eruptions, from vent dynamics to emplacement as pyroclastic deposits. State of the art eruption classifications will be covered together with the quantification of eruption magnitude and intensity and their associated limits. A twofold approach will be used to delve into the physical processes controlling volcanic eruptions. First, examples will be provided of multiparametric studies of well-documented eruptions. Such studies, integrating eruption signals routinely monitored at active volcanoes - from optical and thermal imaging to seismic and acoustic recordings - provide real 'broadband' coverage of the eruption dynamics outside of the volcanic vent. Second, selected case studies will illustrate how eruption parameters can be derived from laboratory simulations of otherwise inaccessible processes, such as magma fragmentation within the volcanic conduit and ash particles aggregation in volcanic clouds. All examples, natural and experimental, will be framed in a hazard mitigation perspective.

3. Finally, the last part will be dedicated to field excursions in the Roman Magmatic Province. Petrologically, rocks from the Roman Magmatic Province are mostly ultrapotassic and undersaturated in silica, although saturated to oversaturated potassic rocks also occur in some places (e.g. the Vulsini district and Vico volcano). The

Roman Volcanic Province is formed by the large volcanic complexes of Monti Vulsini, Vico, Monti Sabatini and Colli Albani, which together erupted about 900 km^3 of volcanic products over a time span of ca. 800-20 ka. In the north, these volcanoes are superimposed on the magmatic rocks from the Tuscan Magmatic Province with evidence of interaction between these two provinces. Volcanism has been mostly explosive, with numerous plinian eruptions associated with caldera and volcano-tectonic collapses. Participants will be guided through large-volume pyroclastic deposits and lava flows units. Thick ignimbrite sheets are particularly abundant and worth visiting, as they tend to form small plateau surrounded by steep cliffs.

Topics of Lectures

0. Introduction 1. History of glass tools from stone age to present 2. Glass-forming systems 3. Structure of silicate melts 4. Glass transition, viscosity and melt relaxation 5. Volatiles in melts and magma 6. Transport in melts 7. Crystallization and degassing 8. Analytical tools	F. Vetere H. Behrens M. Petrelli
9. Pre-eruptive conditions, magma mixing processes and eruptive style. 10. Volcanic eruption styles: lights and shadows 11. Seamounts 12. Eruption forces and dynamics 13. Integrated approaches to an eruption	J. Taddeucci G. Ventura D. Perugini D. Morgavi
14. The Roman Volcanic Province 15. Ignimbrite 16. Lava flow emplacement	J. Taddeucci D. Morgavi F.Vetere

Detailed Program

1. Tuesday morning from 9:00 to 13:00 Lectures 0-8.
Tuesday afternoon from 14:30 to 17:30: Lab experiments: participants will be divided into two groups (a) glass melting and viscosity, (b) trace element analysis using laser ablation ICP-MS, and exercises.

2. Wednesday morning from 9:00 to 13:00: Lectures 9-13.
Wednesday afternoon from 14:30 to 17:00: Eruption experiments and exercises.

3. Thursday from 7:30 to 18:00: Field trip in the Roman Magmatic Province.
Vico Lake, Latera Caldera Complex, Valentano scoria cone.

Contacts

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