UNIVERSITÀ DEGLI STUDI DI PERUGIA

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

Short Course on Magmas, Eruptions and Hazard

Third Edition

Perugia (Italy), 28-31 March 2017

Contact and information:

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Lecturer/researcher:

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Program

- 3 days of lectures in the morning (9-13 a.m.) and exercises in the afternoon (2:30- 5:30 p.m.) + 1 day on the field (Roman Magmatic province).
- Beers and some snacks on Thursday 30, afternoon after 5:30 p.m.

Qualifications

A certificate of "successful participation in 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 to provide an up to date and modern knowledge about magmatic-volcanic processes on Earth interior and their eruption on the surface.

1. The first part will deal on 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 parameters such as composition, temperature, and pressure. Participant will have the opportunity to visit the PVRG-lab and use experimental apparatus in order to measure magma viscosity.

2. The second part will focus on detailed descriptions of volcanic rocks. Classical petrography will guide students in detailed analyses using petrographic microscopes to get insights how rocks are usually classified by the mineral content and the textural relationships within the rock. The classification of rocks is the fundamental part in petrographic analysis and is the a-priori study needed for any further experimental approach.

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. Additionally, submarine eruptions will be discussed using Marsili seamount as an example.

4. Finally, the fourth and last part will cover aspects related to volcanic hazard and the effective risk-reduction strategies, which requires a multidisciplinary knowledge and an effort of the whole civil protection system and the scientific community. The

part will provide an overview of Italian Civil Protection, whose core structure the Department of Civil Protection (DPC) plays a guiding role in the emergency field, in coordination with local authorities. DPC is leading projects and activities devoted to prevention and forecasting of risks as well as supervising the civil protection procedures. The emergency cycle (forecasting, preparation, emergency management and emergency overcoming) will be illustrated. We will get into focus of the volcanic risk management in Italy, analyzing the best practices for the prevention and the mitigation, for the volcano monitoring systems and the prevention and preparation actions. Experiences related to the basic level management of the volcanic hazard and of the volcano crisis at Etna and Stromboli will be shown. Furthermore examples of scenario definition and planning emergency activities developed for Vesuvius and Campi Flegrei areas will be illustrated in detail.

Topics of Lectures

0. Introduction 1. Glass-forming systems 2. Structure of silicate melts 3. Glass transition 4. Viscosity and melt relaxation 5. Volatiles in melts and magma 6. Transport in melt 7. Crystallization and degassing 8. Analytical tools	F. Vetere H. Behrens M. Petrelli
9. Volcanic eruption styles: lights and shadows 10. Eruption forces and dynamics 11. Integrated approaches to an eruption 12. Phase diagrams in volcanic studies 13. Petrographic studies on volcanic rocks.	J. Taddeucci F. Holtz J. Koepke D.Perugini
14. Overview of the Italian Service of Civil Protection 15. Stakeholders identification and roles 16. Volcanic risk management 17. Hazard and risk assessment and mapping 18. Prevention, preparation and mitigation measures	C. Cardaci

Detailed Program

1. Tuesday morning from 9:00 to 13:00 Lectures 0-8.
Tuesday afternoon from 14:30 to 17:30: Lab experiments in three groups on three topics (a) Glass melting and viscosity. (b) Trace element analysis using laser ablation ICP-MS. (c) Eruption experiments.

2. Wednesday morning from 9:00 to 13:00: Lectures 9-14.
Wednesday afternoon from 14:30 to 17:00: Classical studies on thin sections of volcanic rocks using microscopy.

3. Thursday: Excursion

4: Friday morning from 9:00 to 13:00: lectures 15-19.
Friday afternoon from 14:30 to 17:00: Final volcano crisis simulation.

This exercise will provide the participants with the unique opportunity to be part of an Emergency Operation Centre (EOC) during the management of a volcano crisis simulating the unrest of a volcano. Students will be required to assume the duties of specific professionals involved in emergencies, including scientists, emergency managers, public officials, press, and more. Roles will be assigned based on student expertise, and actual scientists and decision-makers will provide guidance through the managing of the crisis. The simulation will end with a short debriefing to review critically actions and decisions carried out.
Participants will be forced to make decisions and take action based on limited information, with emphasis on problem identification and solving, critical decision-making, coordination, communication, and teamwork. Inter-relations between scientific community and decision makers will also be highlighted.

Contacts

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