POSITIONS 2016

The consortium laboratories

The Earth Science Laboratory (Laboratoire Magmas et Volcans; LMV) has an international reputation based on its expertise in the study of volcanic and magmatic processes. The laboratory is equipped with a range of state of the art analytical, experimental and modelling capabilities. The presence of IRD (overseas research and development agency) personnel in the laboratory reinforces the international development aspect of the laboratory, with especially close links to Latin America.

Website: http://wwwobs.univ-bpclermont.fr/lmv

The Particle Physics Laboratory (LPC) carries out research in the fields of experimental particle physics, astroparticle physics and hadronic physics. The laboratory has several multidisciplinary research groups ensuring knowledge and technology transfer to other scientific fields.

Website: http://clrwww.in2p3.fr

The Laboratory of Social and Cognitive Psychology (LAPSCO) is the only CNRS laboratory in France specialising in social psychology.

Website: http://wwwpsy.univ-bpclermont.fr/lapsco/

The Laboratory of Computing, Modelling and Optimization (LIMOS) specialises in the application of computer sciences to the design and the management of complex organisational systems (e.g., telecommunication, transportation, production, environmental systems).

Website: http://limos.isima.fr/

The Laboratory of Physical Meteorology (LaMP) specialises in the study of clouds, precipitation and atmospheric aerosol particles.

Website: http://wwwobs.univ-bpclermont.fr/atmos/fr

The Mathematics Laboratory (LM) specialises in operator algebra, partial differential equations, numerical analysis and scientific calculus, topology and geometry, mathematical modeling and simulation, statistics and probabilities, and number theory.

Website: http://recherche.math.univ-bpclermont.fr/

The Observatoire de Physique du Globe de Clermont-Ferrand (OPGC) has a 140-year history of long-term observation of natural phenomena, and offers a research environment closely linked to observational facilities. It is part of a national network of Earth and Space Science Observatories.

Website: http://wwwobs.univ-bpclermont.fr

The French Geological Survey (BRGM) is a research organization embracing most fields of applied earth sciences, such as geology, hydrology and hydrogeology, geophysics, environment, civil engineering, etc. Research of the Natural Risks Division of the BRGM focuses on the prediction, prevention and mitigation of risks associated with earthquakes, volcanic eruptions, tsunamis, landslides, climate change, coastal erosion and risks of human origin.

Website: http://www.brgm.fr

Laboratoire d'Excellence ClerVolc
Laboratoire Magmas et Volcans
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Definitions of jobs and salaries

PhD projects (PhD) will be for three years. The stipend (net, after payment of social charges but prior to income tax) will be about 1538 euros per month.

Postdoctoral research fellowships (PDocRes) will be awarded for one year, extendable to two years upon submission and favourable evaluation of a first-year report. The stipend will depend on the candidate's experience in research, ranging from 2115 to 2450 euros per month (net, after payment of social charges but prior to income tax).

Application procedure

Descriptions of the projects are provided below, along with the addresses of people they may contact for more details. Enquiries of a general nature can also be made to the ClerVolc administration manager, Socheata Sean (Socheata.SEAN@univ-bpclermont.fr).

Applicants are requested to send a CV, a letter of motivation, the names of two referees, and the pdfs up to five publications to the ClerVolc administration manager, Socheata Sean (Socheata.SEAN@univ-bpclermont.fr). Applications will be accepted until the **29 April 2016**.

Applicants do not need to speak French.

Positions

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Project title: Nucleation of nanoparticles in volcanic plumes and in the marine atmosphere

Post description: PhD project

Supervising scientist: Karine Sellegri (LaMP), Céline Planche (LaMP)

Project objectives: The aim of the thesis is to apprehend, how important is for the formation of ultrafine particles from natural sources under diverse atmospheric conditions, and its impact on climate relevant parameters.

Project context and description: Atmospheric particles are important components for climate and air quality issues. Their atmospheric concentration is largely determined by their sources, which are dominated, in term of number concentrations, by the process of new particle formation from the gaz phase (i.e. nucleation). Volcanic and marine emissions are two major natural sources of particles in the atmosphere. Both types of particles have been shown to have a significant impact on cloud properties, through their abilities to form cloud droplets.

The first part of the thesis will aim at deriving parameterization of the new particle number flux and properties as a function of identified volcanic and marine precursors. It will rely on field experiments performed in passive plumes of the ETNA volcano (Sicily) using ground-based, airborne and UAV platforms, and from ship-borne measurements in the Mediterranean Sea.

The second part of the thesis will use a 3D meso-scale model in which the new parameterizations will be implemented in order to assess the impact of such emissions on cloud formation and properties.

Deliverables: new particle formation parameterizations from field experiments, 3D-meso-scale model upgraded with new sources

Candidate profile: the applicant should have a background in atmospheric sciences (physics and/or chemistry), a strong motivation for participating in field campaigns and modelling exercises

Contact person: Karine Sellegri K.Sellegri@opgc.cnrs.fr

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Project title: Density imaging of volcanoes through joint inversion of gravity and muography data

Position description: Postdoctoral researcher

Supervising scientist: C. Cârloganu (LPC) and V. Cayol (LMV)

Project objectives: Investigate the capabilities of muon tomography to image the density and density changes of volcanic edifices. Investigate the improvements of density images when jointly inverting muography and gravity data.

Project context and description: Muon tomography is a new method for imaging the interior of volcanoes and monitoring their activity [*Tanaka*, 2014]. The method is based on the measurement of the absorption of fluxes of atmospheric muons flux by dense media. Acquisitions over several days to several months, depending on the target volume, lead to maps of integrated densities [*Nishiyama*, JGR, 2013]. The precision of a density measurement is the result of a compromise between the duration of recording and the angular resolution [*Ambrosino et al.*, JGR, 2015]. In order to obtain a given precision in a limited acquisition time, the angular resolution, hence the edifice discretization, can be made coarser. Moreover, the 3D tomographic reconstruction is limited by the number of radiographic images that can be acquired. This makes the physical problem of density reconstruction ill-posed and under-determined. Similarly the interpretation of gravity data in order to infer density strustures is an ill-posed problem. However, as both the muon flux and the gravity field are sensitive to densities, their integration permits to increase the inversion sensitivity and resolution. The proposed project concerns the integration of gravity and muography measurements within a robust inversion procedure, in order to assess the model and provide the data resolutions. In a first step, the formalism for the joint inversion will be implemented and the potential resolution of the joint inversions will be assessed through synthetic tests. The joint inversion will be tested on muon and gravity data already acquired on Puy de Dome volcano. He/she is also expected to work on defining measurement strategies for a campaign on Stromboli volcano planned in 2017 and to participate to detector operation and data acquisition.

Deliverables: A robust method for jointly inverting muography and gravity data. An assessment of the capabilities and the tuning of the method for different applications of muons tomography for volcanoes imaging and monitoring.

Candidate profile: A physicist or geophysicist with an expertise in inversion. A background in data analysis and Monte Carlo simulations would be preferable.

Contact Persons: C. Cârloganu Cristina.Carloganu@in2p2.fr, V. Cayol V.Cayol@opgc.fr

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Project title: Inverse modeling of fracture surface displacement in volcanic context

Position description: Postdoctoral researcher

Supervising scientist: J. Koko (LIMOS), O. Bodart (LM), V. Cayol (LMV)

Project objectives: Combine a fictitious domain method and an inversion algorithm to invert surface displacement associated to magma intrusions or fault displacements. Inversions will be implemented in order to simultaneously solve for fracture geometry, location and stress distributions. Faults will be able to resist to displacement by friction.

Project context and description: Satellite observations permit the imaging of surface displacements over large surfaces, with unprecedented precision and frequency. These data call for physically sound three-dimensional models. Inverting displacements associated to fractures in heterogeneous media is numerically challenging, specifically when the geometry and stress distribution are simultaneously inverted. The Post-doctorate objective is to develop such a method. The research will rely on an approach initiated during a previous Clervolc post-doctoral fellowship, which was dedicated to the development of a fictitious domain method for linear elastic heterogeneous media, deformed by fractures. The method allows to use a single mesh whatever the fracture configuration, leading to a significant saving in computation time and resources. To combine fictitious domain methods and inversions, two approaches will be compared: one in which a fine mesh is used whatever the fracture; another one in which meshes are locally refined around the fracture for each new configuration. The joint determination of the fracture geometry, location and the distribution of stress on the fractures will be enforced in the framework of Bayesian inversions. Non-linear fracture behavior induced by fault friction will be implemented using augmented Lagrangian methods. The different developments will be tested by conducting synthetic tests. They will further be applied to Piton de la Fournaise volcano.

Deliverables: a freely accessible code for volcanologists and seismologists dedicated to the inversion of surface displacements induced by fractures located in 3D linear elastic heterogeneous media

Candidate profile: The candidate should have a strong mathematical and computational background. In-depth knowledge of Partial Differential Equations and Optimization is an asset. Further requirements include excellent skills in programming (C/C++, Matlab, ...).

Contact person: J. Koko Koko@isima.fr, O. Bodart O.Bodart@math.univ-bpclermont.fr, V. Cayol V.Cayol@opgc.fr

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Project title: Effect of oxygen fugacity on water storage in the deep mantle

Post description: PhD project

Supervising scientists: N. Bolfan-Casanova (LMV)

Project objectives: This study aims at determining the effect of oxygen fugacity on the storage of volatiles in the upper mantle and transition zone. Indeed, the oxygen fugacity in the mantle is not constant and the observations from xenoliths transported by kimberlitic magmas, show that the oxygen fugacity, fO_2, of the mantle decreases (at least of 4 log units) with increasing depth. The fO_2 is important because it controls the speciation of fluids, which plays an important role on the mantle solidus. With regard to the incorporation of water in Nominally Anhydrous Minerals (NAMS), most studies have been conducted under oxidizing conditions, with H_2O+/-CO_2 fluids. What happens under reducing conditions and in the presence of carbon? Even low carbon content in the fluid have the ability to greatly reduce the water activity. This study will provide new realistic constraints on the water cycle but also on the carbon cycle. It will also provide valuable information on the evolution of the nature of aqueous fluids with increasing depth.

Project context and description: This study includes an experimental part consisting in synthesizing the samples in the multi-anvil press, from 3 to 20 GPa. Secondly, analysis will be performed using infrared or Raman spectroscopies in order to determine the water content in the samples. Electrical conductivity measurements can also be envisioned, since this property is very sensitive to the water presence in the mantle. The laboratory Magmas and Volcanoes hosts all the tools necessary to accomplish this investigation.

Deliverables: The first year will be dedicated to synthesize and analyse the samples, the second year will be dedicated to measuring physical properties. At least one publication is demanded before submission of the PhD manuscript. PhD must be performed in 3 years.

Candidate profile: The candidate should be familiar with experimental petrology techniques and also analyses of geological material with common techniques such as electron microprobe and scanning electron microscopy.

Contact person: N. Bolfan-Casanova N.Bolfan@opgc.univ-bpclermont.fr

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Project title: Role of the mantle in driving caldera-forming silicic eruptions at an arc volcano.

Post description: PhD project

Supervising scientists: T.H. Druitt (LMV), O. Sigmarsson (LMV), P. Schiano (LMV)

Project objectives: The project will combine melt inclusion analysis and U-series disequilibrium studies on basaltic magmas from Santorini Volcano in order to throw light on the nature of different basaltic batches feeding the caldera system, the residence times of those batches in the crust, and the influence of time variations in basaltic supply on eruptive processes, and particularly on the generation and discharge of large silicic magma chambers.

Project context and description: Volcanoes in volcanic arcs are a source of large caldera-forming eruptions. Such caldera systems have long and complex histories, with multiple constructional-destructional cycles, plinian eruptions, caldera collapses, interplinian volcanism and repose periods. They pose hazards on both local and global scales. There is a societal need to better understand the conditions that lead to the generation and eruption of large bodies of silicic melt in arc crust. Recent advances in our understanding of caldera volcanism include (1) that large, shallow crustal magma chambers are assembled on geologically short timescales, (2) that this involves events of high-flux transfer of silicic melt from deeper levels in the crust, and (3) that late stage replenishment by silicic melt can occur only decades to years prior to eruption. What are the mechanistic origins of these melt transfer events? One possibility is that such events are controlled purely by processes in the crust; another is that they are driven in part by the mantle through time-variations of flux of basaltic supply, and hence in time-variations of flux of silicic melts derived from the basalt.

How does the basaltic input change with time beneath a caldera, and particularly how does it vary relative to large silicic eruptions? Can different basaltic batches be distinguished? What is the nature of the lower crustal basaltic reservoir(s)? Is the basaltic supply to the crust approximately constant, or does it vary widely? Do episodes of high magma eruption rate (e.g., plinian events) result from transient high basaltic input fluxes or purely from crustal processes under approximately constant basaltic flux? The study will be carried out at Santorini caldera in Greece as part of a long-term project on this magmatic system. The volcanic history and products of Santorini have been characterized in detail through field-stratigraphic, chronological, petrological, phase-equilibria, geochemical and multi-isotopic studies, forming a base for addressing fundamental questions. The project will involve (1) detailed geochemical studies of basaltic phenocryst-hosted melt inclusions from throughout the history of the volcano in order to identify different populations of mantle-derived basaltic melts, (2) detailed U-series studies of basaltic samples in order to determine the time-residence history of those melt batches, and (3) integration of those data within the existing conceptual framework at Santorini.

Deliverables. (1) Improved understanding of the interaction between mantle and crustal processes in arc volcanism. (2) Training of a student in modern geochemical techniques in the context of modern concepts on arc volcanism. (3) Use of ClerVolc ICPMS instruments to address fundamental questions related to volcanism.

Candidate profile. The candidate must have a background in Earth Sciences with, if possible, training in geochemistry and volcanology.

Contact person. T.H. Druitt T.Druitt@opgc.univ-bpclermont.fr

Project title: Metal volatility at high temperature – application to planetary accretion and volcanic degassing

Post description: PhD project

Supervising scientist: T. Hammouda (LMV)

Project objective: Obtaining experimental data on vapor / metal / silicate equilibria, in order to interpret the record of natural samples that were once in contact with a vapor phase at high temperature, whether in the solar nebula or in present day magmatic systems.

Project context and description: Vapor transport of metals is evidenced in the context of planet formation as well as in the present day context of volcanic degassing. The first steps of the formation of the solar system consisted of condensation / precipitation reactions followed by equilibrium between condensed phases and the surrounding gas. Some primitive meteorites (i.e., little modified since their formation) carry evidence of this early stage. In the present time, similar reactions occur during volcanic degassing, in particular when hot gases are trapped in gas vesicles, yielding to the formation of base metals deposits.

A significant part of this project will be devoted to experimental developments. In particular, low oxygen fugacity vapor will be generated, so that silicon, sulfur and iron will be evaporated. Experiments will be performed under vacuum conditions. Thermodynamic modeling of the vapor phase will be necessary. This project is at the interface of the Petrology and the Geochemistry groups of the Laboratoire Magmas et Volcans.

Deliverables: (i) Experimental determination of metal volatility at high temperature; (ii) Experimental determination of melt – vapor element partitioning; (iii) Construction of a model enabling the interpretation of vapor / metal / silicate equilibria in a wide variety of contexts (from solar nebula to volcanic gas emissions).

Candidate profile: The applicants should have a strong training in earth sciences, and particularly in petrology. Experience in experimental techniques and/or thermodynamic modeling would be appreciated.

Contact person: T. Hammouda T.Hammouda@opgc.univ-bpclermont.fr

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