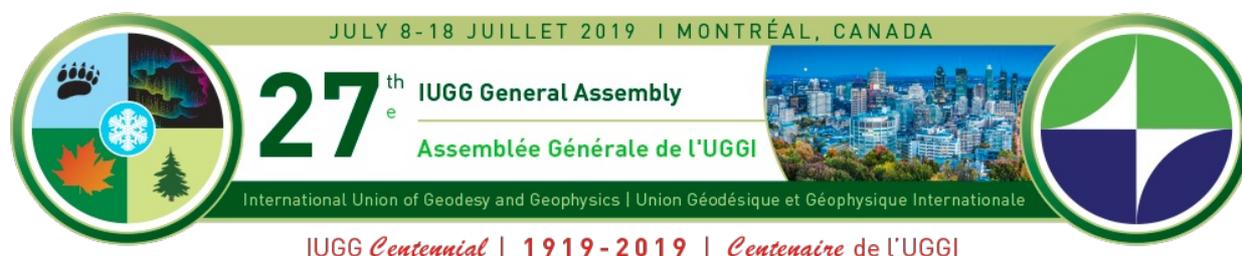


# 27th IUGG General Assembly | International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) > V | 2019

[iugg2019montreal.com/v.html](http://iugg2019montreal.com/v.html)



## ASSOCIATION SYMPOSIA [ IAVCEI ]

### V01 – Celebrating 100 Year of Volcanic Activity: 1919-2019

Convener: Patrick Allard (France)

Co-Conveners: Jan Llindsay (New Zealand), Donald Dingwell (Germany), Raymond Cas (Australia), Lizzette Rodriguez (Puerto Rico), Michael Ort (USA), Eliza Calder (UK), Shan de Silva (USA), Roberto Sulpizio (Italy)

#### Description

Celebration of 100 year of IAVCEI. Only invited speakers.

### V02 – When Magma Meets Water: Understanding the Trigger, the Dynamics and the Deposits of Phreatomagmatic Eruptions to Better Quantify the Associated Hazard

Conveners: Daniele Andronico (Italy), M. de' Michieli Vitturi (Italy)

#### Description

The interaction of magmatic gas and magma (fuel) with water (coolant) may generate phreatomagmatic explosions, among the most hazardous volcanic phenomena. They can precede magmatic activity or evolve into long-lasting eruptions, producing abundant tephra ranging in size from ash to bombs/blocks, which sometimes generate volcanic “structures” like maars, tuff cones, and tephra rings. The intensity of this interaction is thought due to external water availability together with efficiency and rate of the heat/energy transfer, which may occur both within the

volcanic conduit and outside the eruption vent. However, short-lived, impulsive explosive events related to phreatomagmatic activity may pose higher hazards than prolonged eruptions, directly threatening people close to the vent areas and potentially causing large injuries and casualties.

In this symposium, we explore phreatomagmatic events which result in short-sequences of closely-space explosions and produce an unexpected ejection of fine- to coarse-grained products. Furthermore, in view of recent events which have taken places in extreme environments (such as Iceland and Kamchatka) or in the upper slopes of volcanoes such as Etna, we encourage contributes describing the behavior of lava in presence of ice/snow cover. In particular, we look at the ambient conditions promoting the explosive lava-snow/ice interaction, like lava thickness, effusion rate, thickness of the snow/ice layer and its type (dry/wet/porous) and temperature (close to or much lower than 0 °C).

Understanding the mechanisms and physical parameters leading to the generation of steam that expand explosively under an active lava flow or within a volcanic conduit, is a crucial step for reducing the risks to volcanologists in charge of the monitoring, but especially tourists that visit the summit of volcanoes, keeping them at proper safety distances.

## V03 – Phreatic and Hydrothermal Eruptions: What We Really Know About Triggers, Magnitude, Styles and Hazards

Convener: Cristian Montanaro (New Zealand)

Co-Conveners: Bettina Scheu (Germany), Corentin Caudron (Singapore), Shaul Hurwitz (USA)

### Description

Hydrothermal or phreatic eruptions, alias steam-driven (non-magmatic) explosive events, are frequent phenomena occurring at active volcanoes, within geothermal areas and in rather pristine environments, e.g. heralding magmatic/phreatomagmatic eruptions. Circulating hydrothermal fluids may promote both pore pressure augmentation and alteration of the host-rock, with the latter process affecting the rock petrophysical properties (e.g. porosity, permeability strength). Pressure and temperature perturbations (e.g. magmatic fluids injection or landslides) may result in the near-instantaneous vaporization of pressurised hot fluids (especially water) trapped in pores and cracks within the upper parts of shallow hydrothermal system. The flashing/expansion of fluids blasts rock apart and ejects it upward and outward developing gas and mixed gas-liquid jets, pyroclastic density currents and lateral blasts, often accompanied by intense ballistic showers. These phenomena, whose violence depends on the explosivity of the fluids driving them, and on the petrophysical properties of the host-rocks, pose serious threats in areas increasingly exploited for tourism and geothermal power, or within populated areas. Due to the complex and still largely unknown interaction of the magmatic and hydrothermal systems, steam-driven eruptions are among the most sudden and unpredictable volcanic phenomena. Incomplete or missing stratigraphic records, limited understanding of explosive failure processes, absent or unclear precursors in geophysical and geochemical signals, all result in the lack of reliable scientific models to forecast locations, triggering, and magnitude of phreatic and hydrothermal eruptions.

This symposium invites contributions from a broad range of disciplines (from field geological observations to geophysical and geochemical monitoring, from physical modelling to laboratory experiments and numerical simulation) on phreatic and hydrothermal eruptions, including reports and lessons learned from recent events, to summarize our current state of knowledge on steam-driven eruptions and discuss future research directions.

## V04 – Modeling Volcanic Hazards and Their Impacts

Convener: Sylvain Charbonnier (USA)

Co-Conveners: Leah Courtland (USA), Eliza Calder (UK), Chuck Connor (USA), Sébastien Biass (USA), Susanna Jenkins (Singapore), Annie Winson (Singapore), Thomas Wilson (New Zealand), Jenni Barclay (UK)

### Description

Volcanic hazards include lava flows, debris flows and avalanches, pyroclastic density currents and ash/tephra fall, all of which have devastating consequences and impacts for the economy, transport and the environment. A key component to understanding the behavior and correctly evaluating the potential impacts of these physical processes is the development and implementation of accurate and usable forecast models and the study of hazard predictions and the subsequent geological event and the agreement/deviation of the two. Recent progress with analogue, statistical and numerical models has offered noteworthy insights into the behavior and resulting impacts of these hazardous events. We invite contributions from all those involved in experimental, statistical and numerical studies of volcanic hazards. This symposium aims to draw together modeling contributions in order to highlight new approaches, methodologies and results.

## V05 – Multiphase Flow Processes in Volcanic Eruptions: Experimental and Numerical Investigations

Convener: Eric Breard (USA)

Co-Conveners: Mattia De' Michieli Vitturi (Italy), Matteo Cerminara (Italy), Tomaso Esposti Ongaro (Italy), Joe Dufek (USA), Daniele Andronico (Italy)

### Description

Our ability to forecast volcanic hazards and mitigate risks relies on understanding volcanic processes and their interactions with the substrate and atmosphere. However, volcanic processes comprise complex multiphase behaviors that involve, for instance, turbulence, from one-way up to four-way coupling, frictional stresses, compressibility, thermal non-equilibrium, making the thermo-fluid dynamic models required to simulate these processes extremely challenging to develop and validate. Aided by the development of a wide range of experiments across disciplines, significant progress in non-linear multiphase flow physics has been achieved in the past decade, while subsequent increase in computing power has allowed small-to medium size simulations to be carried out at natural scales. This symposium aims at gathering experimental investigations and multiphase numerical simulations (at all scales) that further our understanding

of the physics of volcanic processes from the sub surface to aerial environments. This includes (but is not restricted to), plumes, pyroclastic currents, debris flows, lava flows.

## V06 – Linking Volcano-Sedimentary Features with Eruptive Processes

Convener: Gabor Kereszturi (New Zealand)

Co-Conveners: Guilhem Amin Douillet (Germany), Gro Birkefeldt Møller Pedersen (Iceland)

### Description

Volcaniclastic sediments encompass all primary pyroclastic rocks and deposits that formed in relation with volcanic eruptions, and successions remobilized during a volcanic eruption before their secondary transport (e.g. erosion). Volcaniclastic sediments have witnessed magma fragmentation and subsequent transport as flow, turbulent current or tephra fall. Hence, volcaniclastic sediments hold important clues of both an eruption's dynamics and/or the transport and depositional processes after ejection. These processes are also responsible for determining geotechnical properties of the volcaniclastic materials, contributing to the construction of composite volcanic edifices. Traditionally, textural, chemical, depositional, physical and geotechnical properties of the rocks and sediments is often described and mapped in the field, imaged remotely, or studied through experiments. This session covers, but is not limited to: (1) field- and laboratory-based description and interpretation of volcaniclastic sediments, (2) reconstruction of eruptive and sediment transport histories, (3) technological advances to describe and interpret pyroclastic successions and associated transport processes, and (4) outcrop and volcano-scale remote sensing approaches.

## V07 – Fostering the Integration of Deposit and Modeling Studies to Investigate the Sub-Aerial Processes of Explosive Eruptions

Convener: S. Barsotti (Iceland)

Co-Conveners: M. Pistolesi (Italy), A. Van Eaton (USA), D. Andronico (Italy), M. de' Michieli Vitturi (Italy)

### Description

Understanding the dynamics of explosive eruptions is of paramount importance for the assessment of volcanic hazard and a major key to improve our knowledge is the study of resulting pyroclastic deposits. On one side, we know that differences in properties such as grain size,

vesicularity, clast morphology and deposit geometry clearly reflect different transport and depositional processes. For example, Prof. Walker showed how grain-size characteristics and dispersal area of a pyroclastic deposit can be used to infer eruption discharge rate and intensity. On the other side, we have to face the problem that preservation of deposit is typically incomplete and, for the interpretation of such partial information about past eruptions, modeling of subaerial explosive eruptions can be extremely helpful. For example, application of inversion techniques to

numerical models of ash dispersal is showing promising results. In this symposium, we encourage contributions from both field volcanologists and modelers to investigate how deposit studies can support the understanding and the modeling of volcanic processes and how modeling studies can help in the interpretation of deposit properties.

## V08 – Multidisciplinary Studies on Volcanic and Igneous Plumbing Systems

Conveners: Stephanie Burchardt (Sweden), Janine Kavanagh (UK)

### Description

Since the processes that occur within the volcanic plumbing system prior to, during, and after volcanic eruptions are dynamic and complex, our attempts to understanding these processes must be multi-disciplinary. Recent years have seen successful attempts to study magma storage and transport using combinations of geological, volcanological, geophysical, geodetic, structural, petrological and geochemical methods. This symposium welcomes contributions on such multi-disciplinary studies, including e.g.

- studies of solidified, eroded volcanic plumbing systems
- combined petrological and geophysical reconstructions of pre-eruptive magma storage conditions
- simulations of magma storage and/or transport using analogue and/or numerical modelling

## V09 – The Role of LIPs in Environmental Change and Biotic Extinctions on Earth over Geologic Time

Convener: Richard Ernst (Canada)

Co-Conveners: Mike Widdowson (UK), Simon Jowitt (USA), Ingrid-Ukstins Peate (USA)

### Description

This symposium, sponsored by the Large Igneous Provinces Commission ([www.largeigneousprovinces.org](http://www.largeigneousprovinces.org)), focuses attention on the growing recognition that large Igneous Provinces (LIPs) and silicic LIPs (SLIPs) (Bryan & Ferrari 2013, *GSAB*, v. 125, p. 1053–1078; Ernst, 2014 Cambridge U. Press) can be major drivers of rapid climate change (e.g., Ernst & Youbi, 2017, *PPP*, v. 478, p. 30-52; Bond & Grasby, 2017 *PPP*, v. 478, p. 3-29), including global warming (hothouse events), global cooling (icehouse events), anoxia, stepwise oxygenation of the atmosphere, sustained chemical attack on atmospheric chemistry and ozone destruction, acid rain and ocean acidification, enhanced hydrothermal and terrestrial nutrient fluxes, and mercury poisoning. Most dramatically, Phanerozoic mass extinction events can be temporally linked to LIP emplacement. We welcome research that investigates the role of LIPs in Phanerozoic and Precambrian climate change, particularly those that utilize the sedimentary record to monitor global environmental impact, and also research that assesses selected major LIP events (and their global environmental impact) as natural timescale boundaries in the Proterozoic.

# V10 – Present State of Calderas

Convener: Craig Miller (New Zealand)

Co-Conveners: Helene Le Mevel (USA), Shan de Silva (USA), Jon Stix (Canada), Nobuo Geshi (Japan), Darren Gravely (New Zealand)

## Description

This symposium focuses on understanding what is the present day state of active calderas, or large magmatic systems, around the world. Studies from mafic or silicic systems are welcome. We seek to answer fundamental questions such as where is the magma? how much magma is there?, what state (i.e. temperature, melt, crystal, volatile content) is it in? These questions may be answered by geophysical or geochemical studies on caldera unrest, or from studies aimed at imaging present day magma reservoirs. We seek submissions from the geophysicists, analytic and numerical modelers, together with petrologists and geochemists, to constrain and interpret geophysical observations. The goal is to determine the hazard a caldera system poses in its present state. A larger goal would be to create a catalogue of active systems around the world to quantify the global hazard such systems represent.

# V11 – Intra- and Extra-Caldera Large Volume Ignimbrites

Convener: Domenico Doronzo (Spain)

Co-Conveners: Silvina Guzmán (Argentina), Claudio Scarpati (Italy)

## Description

Large volume ignimbrites are a fundamental issue in geology, and particularly in volcano stratigraphy, physical volcanology, and petrology. In this symposium, contributions from integrated investigation approaches like field observations, petrology, laboratory sedimentology, theoretical modelling, and experiments on intra- versus extra-caldera lithofacies are welcome. Besides presenting the last studies in this branch of volcanology, the main goal is to update the state of the art on large volume ignimbrites in light of recent field, experimental, and modelling advances particularly relevant in caldera settings worldwide.

# V12 – Geochemistry and Geophysics of Active Crater Lakes

Convener: Joop Varekamp (USA)

Co-Conveners: Corentin Caudron (Singapore), Dmitri Rouwet (Italy)

## Description

Active crater lakes provide the opportunity to watch inside magmatic-hydrothermal systems.

The proto-type setting of "wet volcanoes" makes crater lakes prone to phreatic eruptions. Multidisciplinary approaches, by combining geophysical and geochemical measurements, and numerical and probabilistic modelling, have recently proven to be promising means to possibly reveal precursory signals of phreatic and phreatomagmatic eruptions. Hence, this section seeks contributions on how to measure and monitor crater lakes in relation with the activity of the underlying volcanoes.

## V13 – Monogenetic Volcanism: Diversity, Processes, Tectonic Contexts, Risk and Geoheritage

Convener: Karoly Nemeth (New Zealand)

Co-Conveners: Marie-Noelle Guilbaud (Mexico), Alison Graettinger (USA), Pierre-Simon Ross (Canada), Benjamin van Wyk de Vries (France)

### Description

Monogenetic volcanoes are the most common manifestation of volcanism on land, and probably under the oceans. Monogenetic volcanoes range from seemingly very simple small, single magma batch eruption products, through to larger volume, compositionally diverse eruptions with complex edifices. Monogenetic volcanic fields also reflect this diversity, ranging from widely spaced, compositionally limited fields, to closely spaced fields with a wide spread of magma types.

## V14 – New Approaches in Geosite Evaluation and Usage of Volcanic Geoheritage in Geoeducation

Convener: Károly Németh (New Zealand)

Co-Conveners: Ben van Wyk de Vries (France), Jon Procter (New Zealand), Cecile Olive-Garcia (France)

### Description

Geoheritage studies is an emerging science developed especially over the last decade. Volcanic geoheritage research particularly evolved recently in order to provide a scientifically correct approach to describe, evaluate and promote geoheritage values of volcanic landscape, volcanic processes and volcanic hazards to various end-users and to the public. Volcanic geoheritage studies are gradually became an important element of volcanic risk education and in general part of the geoeducational works to understand Earth System science in various levels. The newly established IAVCEI Commission on Volcanic Geoheritage and Protected Volcanic Landscapes serves the global scientific community, linking volcano science to geoscience outreach programs. In addition, volcanic geoheritage science is developing methods and standards for objective comparison of geoheritage values for all types of volcanic sites (from active young features to ancient sites). These carry significant scientific values that can be utilized in geoeducation, geoconservation and geotourism, and resilience. Volcanic geoheritage forms

fundamental parts of many recent applications and promotion of UNESCO Worlds Heritage sites and UNESCO Global Geopark programs. Volcanic geoheritage is also a valuable element of local and regional projects driven by communities to establish their geoeducational, geoconservational and geotouristic programs fit to the local and regional conservation, education and touristic programs. On the basis of this recent boom of geoheritage research, the IAVCEI Commission on Volcanic Geoheritage and Promotion of Protected Volcanic Landscapes invites the full range of researchers to share their latest research in geoheritage science. We particularly interested in to see works that: 1) target understanding the place of volcanic geoheritage in Earth System Science and disaster reduction; 2) Research that targets new methods of objective geosite evaluation; 3) application of traditional pedagogical methods for geoeducational programs to promote volcanic sciences; 4) studies intending to determine the value of volcanic geoheritage in various geotouristic programs; 5) Geoheritage and risk/resilience/ hazards and 6) the linkage of traditional volcanic geoheritage knowledge to western science and defining effective methods to provide scientifically valid information to various geoconservation projects in various scales (from local to global) and multiple cultures around the world.

## V15 – Volatile Constraints on Magma Plumbing Systems and Eruption Dynamics at Open-Conduit Volcanoes

Convener: Patrick Allard (France)

Co-Conveners: Hiroshi Shinohara (Japan), John Stix (Canada)

### Description

Among the 1551 volcanoes recognized to be active on Earth, only about a hundred displays continuous eruptive activity or/and persistent degassing with sizeable plume emissions, implying that their conduit remains open. Illustrative examples include Nyiragongo, Kilauea, Etna, Stromboli, Colima, Masaya, Villarica, Merapi, Asama, Sakurajima, Ambrym, Yasur, etc. These continuously active volcanoes erupt various magma types, in different tectonic settings, and their eruptive styles cover a wide range from purely effusive (e.g. lava lakes) to violently explosive. They thus offer remarkable opportunities for real-time investigations of magmatic and volcanic processes, for deciphering the dynamics of magma plumbing systems, and for the testing of new technologies and new models. Moreover, many of these volcanoes are located in densely inhabited regions of the world, which fully justifies that they be closely surveyed.

Given the key role of magmatic volatiles in the dynamics of magma ascent and volcanic eruptions, studying the composition and flux of gas emissions from these volcanoes, as well as the pressure-related behavior of volatiles dissolved in their magmas, is one important approach to broadly understand how volcanoes work. Such studies have been widely developed in recent decades on the above volcanoes, allowing great achievements. In this symposium, we invite research contributions dealing with both field measurements, laboratory analyses, and theoretical modelling of magma degassing and volcanic gas release in relation to eruptive phenomena at open-conduit volcanoes. Cutting-edge studies involving ground-based and space-borne remote sensing tools, new unmanned platforms, and high-resolution geochemical/petrological tracers are particularly welcomed. The Symposium will be organized in order to give maximum allowance to both case studies and review talks, as well as discussions.

# V16 – From High to Low-Enthalpy: Geothermal Energy at Work

Convener: Daniele Pinti (Canada)

Co-Conveners: Clara Castro (USA), Paul Baudron (Canada), Jasmin Raymond (Canada)

## Description

Geothermal energy is considered a renewable form of energy that can partially fill the increasing human demand. Yet only a few countries, located in high heat flow regions of the Earth can benefit from high-enthalpy resources to produce electricity. However, low to very low enthalpy geothermal resources are increasingly in demand, especially in cold northern countries such as Canada, Norway etc. Here, heat extracted from groundwater can be sufficient for domestic heating/cooling uses, particularly in remote areas. This symposium will be devoted to all aspects of geothermal energy, from exploration to exploitation and tools (geophysics, geochemistry, geology etc.) needed to evaluate the extent of this resource.

# V17– Living with Volcanoes: Challenges and Benefits for Building Resilient and Healthy Societies

Convener: Graham Leonard (New Zealand)

## Description

Volcanic risk management requires the integration of a wide range of stakeholders such as government organisations, vulnerable communities and the public, different scientific groups (academic and non-academic), private companies such as insurance, and non-governmental agencies. Given the requirement of local contingencies and the need to also align with national, and sometime international policy and frameworks (such as the ISDNR Sendai framework), the ability to effectively integrate these perspectives is vital to the effectiveness of volcanic risk management. There is increasing evidence of the need to develop more holistic and robust processes such as hazard and risk assessment strategies to negotiate the many inherent complexities. This entails the bringing together of different academic disciplinary knowledge via multi-disciplinary approaches, but also the consideration of trans-disciplinary issues that sit between disciplinary stakeholders and those stakeholders affected by volcanic risk. This symposium aims to explore state of the art research and practice surrounding both successful and unsuccessful collaboration at both multi- and trans-disciplinary levels. We invite submissions and experiences from all disciplines (especially physical sciences in the case of IUGG), because by its nature multi-disciplinary research does not fit into any one area, along with contributions from a wide range of stakeholders and from different natural hazard experiences to share lessons identified and potential solutions.

# V18 – Mapping Volcanoes. Methodology and Applications

Convener: Gianluca Gropelli (Italy)

Co-Conveners: Joan Marti Molist (Spain), Natalia Pardo (Colombia), Federico Lucchi (Italy), Claudia Principe (Italy)

#### Description

Geological maps show the distribution at the Earth's surface of different kinds of Earth materials. But a geological map is much more than that, it is a synthesis of the knowledge on the geology of an area. It is, at the same moment, the first introduction to an area being visited, and the culmination of a geological investigation. Understanding a geological map make you able to predict what occurs at and beneath the surface, and for this reason it his of utmost importance in working on environmental, geography, archaeology, oil reservoirs, coal, aquifers, ore bodies, land subsidence, and much more. Although, geology is undergoing great changes, geological maps remain as fundamental as ever in depicting the geology of a territory. After all, they embody the very matters that set geology apart from other disciplines: dealing with real Earth materials in three dimensions and through time. Today, computer based methods are adding yet further to their power and versatility. Today, new technologies are being employed in the production of maps and in manipulating map information, and geological maps acquired new and utmost importance to promote better environmental understanding and to foster an integrated approach to the planning of future land use. This adds tremendous flexibility to the way we can use maps, but it also makes an understanding of the basic principles behind them more important than ever. This is particularly true for the geological mapping in volcanic areas. As a matter of fact, if a geological map is the basic tool for understanding the foundations of landscape, a well done geological map of a volcano has a tremendous impact on the provisional plans for the prevision and the mitigation of the effects of future eruptions. This section is focused on old and new methods of mapping volcanoes and their influence on the present-day-used holistic approach to the cartography of volcanoes. Contributions on the changing methods in producing volcanic maps (starting from old-stile maps, mainly based on lavas distribution or petrography, going up to the modern maps, based on data derived from chrono-stratigraphy and facies analysis) are welcome as well as the contribution to volcanic mapping given by historical sources, archaeological findings, structural analyses, boreholes data, and geomorphology. The utility of grouping mapped units as Eruptive units or Unconformity Bounded Stratigraphic Units, or others units typologies volcanologic maps will be an argument of interest as well as the use of Geographic Information System."

## V19 – Experimental Volcanology Approach to Investigate Magma Generation, Ascent and Eruption

Convener: Claudia Romano (Italy)

Co-Conveners: Kelly Russell, (Canada), Satoshi Okumura, (Japan), Diego Perugini (Italy), Alessandro Vona (Italy)

#### Description

Volcanic eruptions vary tremendously in style, scale, duration and frequency. What are the parameters controlling the occurrence and the nature of a certain eruption at a specific time and place? What are the physical and chemical processes leading to volcanic eruption from magma generation and rise, to transport along the conduit, to fragmentation and flow? Laboratory studies can help single out important aspects of very complex processes. In this symposium, we invite the experimental volcanology community to contribute to and discuss the critical issues that we face today. In this view, we welcome innovative and multidisciplinary contributions from experimental volcanologists and petrologists who use novel and advanced techniques to unravel magma chamber and eruptive processes and their timescales.

## V20 – Recent Advances in Volcanology

Conveners: Michael Ort (USA), Lizzette Rodriguez (Puerto Rico)

### Description

Volcanoes produce many different types of eruptions that result in varied deposits. In the 100 years since the foundation of IAVCEI, volcanology has grown as a science and the understanding of magmatic and eruptive processes has improved through time. This symposium will discuss and compare these processes and products.

## V21 – Generation, Storage and Transport of Magma in Plutonic and Volcanic Environments

Convener: Stephan Kolzenburg (Canada)

Co-Conveners: Shane Rooyackers (Canada), Mattia Pistone (Switzerland), Danilo Di Genova (UK), Kim Berlo (Canada), John Stix (Canada), Olivier Bachman (Switzerland)

### Description

Understanding the processes that govern the generation, differentiation, emplacement, storage, ascent, and eruption of magma, the timescales over which these processes operate, and the architecture of magmatic systems are important challenges in geosciences. In recent years, major advances have been made through experimentation on natural and analogue materials, computational modelling, and field, geochemical and geophysical studies of volcanic and plutonic systems. However, because magmatic systems are highly dynamic, and involve a complex plethora of chemical and physical processes that often operate far from compositional chemical and textural equilibrium, many core questions remain open or only partially answered. Ultimately, a holistic understanding of the dynamics of such complex systems can only be obtained with multi-disciplinary approaches.

This process-oriented symposium is aimed at stimulating trans-disciplinary discussion in order to generate a holistic view of the dynamic natural processes in magmatic and volcanic environments.

- Topics include but are not restricted to:
- Physical properties of magmas and lavas.
- The detection and configuration of magma storage and plumbing systems.

- Thermal, chemical and petrological evolution of magma during storage and transport.
- Timescales of magma assembly, storage and ascent.
- Deformation mechanisms in magmas and host rocks during emplacement and eruption.
- The plutonic-volcanic connection.
- We especially solicit interdisciplinary studies investigating the chemical and physical development of magmatic and volcanic phenomena by cross-correlation of experimental- and/or modelling results with field- and/or analytical data.

## V22 - Arctic & Antarctic volcanism in space & time – magmatic, tectonic and palaeoenvironmental aspects & linkages

Convener: John Smellie (UK), Adelina Geyer (Spain)

### Description

The Polar Regions contain an unusually broad diversity of volcanism, including subduction-related continental-margin volcanism & ridge subduction, oceanic volcanic arcs, mid-ocean ridges and ocean ridge—plume interaction. They also contain two of the world's largest alkaline volcanic provinces; voluminous products of Jurassic & Cenozoic plume-driven continental breakup magmatism; and unrivalled & largely untapped terrestrial records of Neogene ice sheet interactions and climate during the Palaeogene 'Hothouse'. Bipolar volcanism is thus widespread and situated at tectonically and environmentally strategic locations. The products are outstanding probes of the Earth's inaccessible lithospheric interior, they accurately record Earth's past climatic changes and the volcanic heat produced by subglacial and MOR eruptions has the potential to modulate cryosphere behaviour and influence future global change. Polar volcanic studies are thus crucial for a holistic understanding of the palaeoenvironmental, palaeoclimatic and geological evolution of our planet, in space and in time.

We invite contributions discussing recent advances in all aspects of Polar volcanism, particularly wide-ranging reviews of entire Polar-focussed volcanic topics or those discussing important regional or thematic issues. The goal is to host a broad-spectrum discussion at any scale. Of particular interest are possible linkages between Polar volcanism and crustal, lithospheric or mantle processes occurring at all scales up to planetary; and volcanism and environmental development, including the growth and stability of ice sheets and documenting the Polar hothouse world.

This session is sponsored by AntVolc, the SCAR expert group for Antarctic volcanism.

## JOINT SYMPOSIA WITH OTHER ASSOCIATIONS LED BY IAVCEI

- JV01 - Advances in Volcano Seismology and Acoustics in a Multi-Disciplinary Context (IAVCEI, IASPEI)

Convener: Jürgen Neuberg (UK, IAVCEI/IASPEI)

Co-Conveners: Jeff Johnson (USA, IAVCEI), David Fee (USA, IASPEI), Láslo Evers (Netherlands, IASPEI)

#### Description

Volcano seismology requires often special consideration due to the fact that the source mechanisms as well as wave propagation effects are significantly different from conventional tectonic earthquakes. Particularly for open volcanic systems, acoustic monitoring provides additional information and constraints regarding magmatic processes. Hence, seismic and acoustic monitoring of active and dormant volcanoes remains the key element of any monitoring program undertaken by volcano observatories or research institutions.

Major advances have been made in the last years allowing us to identify several categories of seismic and acoustic events, and interpret them in terms of different magmatic or tectonic processes encountered on a volcano. Attempts based on multi-disciplinary methodologies turned out to be particularly successful.

This symposium is dedicated to latest developments in volcano seismic and acoustic monitoring techniques, as well as the interpretation and modelling methodology in a wider volcanological context.

We invite contributions for both oral and poster presentations that deal with any aspects relevant to seismic or acoustic monitoring, new methodologies as well as case studies from a variety of volcanic settings. This includes advances in instrumentation, as well as theoretical approaches. Particularly welcome are studies that combine seismic and acoustic monitoring and modelling techniques with other disciplines such as ground deformation, gas monitoring, petrology and fluid dynamics of magmatic systems.

## • JV02 - Petrological Reactions Forced by Transport and Deformation (IAVCEI, IASPEI)

Convener: Yan Lavallee (UK, IAVCEI)

Co-Conveners: Michael Manga (USA, IAVCEI/IASPEI), Jihua Chen (USA, IASPEI)

#### Description

An increasing body of work is demonstrating that geochemical exchanges and petrological reactions may be strongly influenced by differential stresses and the resultant strain. In these systems a range of controlling processes and factors have been invoked or constrained, ranging from pressure solution, anisotropic diffusion, advection, shear heating, strain of the material micro- and macro- structure, and cage jumps (in colloids). Sharing these observations and interpretations between the different sub-disciplines of geoscience will help advance the next-generation petrological, mechanical and rheological models. In this symposium, we invite observational, experimental and modelling contributions in petrology, rheology, and rock physics that explore the nature of these anisotropic physico-

chemical processes in relation to rocks, magmas, glasses and single-phase crystals. The discussions should aim to shed light on the implications for geological processes such as volcanic eruptions, diagenesis, metamorphic reactions, and engineering applications

## • JV03 - Strain Localisation and Seismic Hazards (IAVCEI, IASPEI, IAG)

Convener: Lori Kennedy (Canada, IAVCEI/IASPEI)

Co-Conveners: Boris Krauss (Germany IAVCEI/IASPEI), , Jeff Freymueller (USA, IAG/IAVCEI)

### Description

Tectonic deformation is often distributed across very broad plate boundary zones, especially in continental crust. However, within these broad zones there are almost always regions of significant strain localization, such that major fault systems accommodate the majority of the total plate motion. Strain localization can be controlled by pre-existing lithospheric weaknesses, plate boundary geometry and applied forces, thermal weakening through volcanism, or a combination of factors. The extent to which strain is localised or distributed has important impacts on long-term tectonics, and on the spatial distribution of earthquake hazards. At depth, the extent of strain localization within the mantle may have important impacts on the earthquake cycle. This session will combine observational, experimental, and theoretical studies using a variety of techniques to address the mechanical properties of the lithosphere and asthenosphere within plate boundary zones, and the processes that relate to localization of strain within the crust and mantle.

## • JV04 - Advances in Terrestrial Heat Flow Measurement and Interpretation (IAVCEI, IASPEI)

Convener: Shaopeng Huang (China/USA, IAVCEI/IASPEI)

Co-Conveners: Massimo Verdoya (Italy, IASPEI), Jacek Majorowicz (Canada, IASPEI), Guangzheng Jiang (China, IASPEI)

### Description

Terrestrial heat flow is a measure of the thermal energy flux from the interior of the Earth. This parameter provides fundamental information on the Earth's energy budget, subsurface thermal structure, lithosphere thermo-tectonic history and bulk chemical composition (especially concerning the radiogenic heat-producing elements of the crust). Moreover, analyses of heat flow data are essential to evaluate the potential of geothermal energy and to reconstruct paleoclimate change on regional and global scales. Heat flow data are conventionally determined from the combination of geothermal gradient, obtained from underground temperature logs, and rock thermal conductivity measurements, often derived from laboratory experiments. High-quality heat flow measurements require appropriate raw data reduction, because both geothermal gradient and thermal conductivity are subject to site-specific perturbations associated with geological, geographical, hydrological, and even

climatic settings. The major objective of this symposium is to provide a forum for discussions on all aspects related to the terrestrial heat-flow measurements and interpretation. We welcome contributions that describe results in theoretical and/or experimental works, as well as on the use of heat flow and underground thermal data for the exploration of geothermal energy.

## • JV05 - Recent Advances in Subaqueous Volcanism Derived from Ancient and Modern Volcanic Successions, Laboratory and Numerical Approaches (IAVCEI, IAPSO)

Convener: James White (New Zealand, IAVCEI)

Co-Conveners: Karin Orth (Australia, IAVCEI), Adam Soule (USA, IAVCEI), Evi Nomikou (Greece, IAVCEI), Steffen Kutterolf (Germany, IAVCEI), Rebecca Carey (Australia, IAVCEI), Chris German (USA, IAPSO)

### Description

Seventy percent of Earth's volcanoes are hidden beneath the surface of the oceans. Although largely 'invisible', submarine volcanoes are responsible for >75% of Earth's magma output, and the eruptions put gas, heat, and volcanic material into the hydrosphere and atmosphere as well as greatly influence biogeochemical processes.

This symposium will include presentations of both terrestrial ancient marine volcanic environments modern-day submarine volcanic systems, with the aim of enabling cross-fertilization of ideas. We call for abstracts for field, laboratory and numerical studies of submarine volcanism. We also call for abstracts that combine innovative and emerging technologies that enable breakthrough developments for advancement of knowledge in submarine volcanism.

## • JV06 - Tephra Hazard Modelling for Operational Use: Challenges, Successes and New Frontiers (IAVCEI, IAMAS)

Convener: Sara Barsotti (Iceland, IAVCEI)

Co-Conveners: Antonio Costa (Italy, IAVCEI), Andrew Tupper (Australia, IAMAS)

### Description

During volcanic eruptions tephra affect the surrounding environment by impacting the ground by pyroclasts fallout and the atmosphere by advected volcanic ash clouds. Our society, economy, environment is always exposed to discomforts and disruptions when similar events occur and assessing hazards associated to explosive eruptions is a crucial goal for the volcanological community. Simulating the dynamics of volcanic processes (from

the magma migration to the explosion in the atmosphere) is now a well-established approach to investigate the phenomena and anticipate their possible evolution in time and space. Tephra hazard modelling is nowadays a viable tool to forecast in real-time those areas affected by contamination of ash in the atmosphere and on the ground. The aviation sector benefits significantly from these numerical tools as well as all that part of the population living nearby erupting volcanoes. However in time of crises is challenging to produce reliable forecast of an event for which estimates of the eruptive source parameters (like mass flow rate, total grain size distribution, plume height) are still unavailable or possibly affected by large uncertainty. The data assimilation process is an essential part of the operational response to constrain the ongoing scenario and adding credibility to the model results. At the same time assessing and communicating uncertainties associated with the measurements, observations and model results is fundamental when numerical products are provided to decision-makers and other stakeholders.

Operational tools need to be robust, fast, accurate and flexible. Large part of the research in the recent years have been investigating on how to improve the operational response by implementing new tool developed in more academic environments. In this symposium we welcome all contributions addressing those steps moved toward bridging science and operations within the tephra numerical modelling sector. Examples from experiences are kindly invited. Goals achieved and open questions will be essential for a fruitful discussion.

## • JV07 - Glaciovolcanism as a Paleoclimate Proxy (IAVCEI, IACS)

Convener: Ben Edwards (USA, IAVCEI)

Co-Conveners: Kelly Russell (Canada, IAVCEI)

### Description

This symposium invites contributions that focus on methods for and examples of extracting paleoclimate records from volcanic sequences formed by interactions with ice on planets. Increasingly scientists who model past climates on Earth and on Mars need data to test their models for the timing, extent and thickness of now-extinct bodies of ice. Deposits formed during interactions between volcanoes and glaciers are one of the few records that can document the exact location of past glaciers, are generally amenable to geochronologic studies, and are relatively resist to erosion by subsequent processes. While the study of glaciovolcanic deposits has been ongoing for several decades, new studies are increasingly extracting more detail information about past ice extents and even paleohydrology. We invite contributions from field and laboratory studies whose foci are extraction of paleoenvironmental data from glaciovolcanic deposits.

# OTHER IAVCEI JOINT SYMPOSIA WITH OTHER ASSOCIATIONS LEADING

## • JA02 - Geophysical Data Assimilation (IAGA, IACS, IAG, IAHS, IAMAS, IAPSO, IASPEI, IAVCEI)

Convener: Sabrina Sanchez (Germany, IAGA)

Co-Conveners: Marie Bocher (Switzerland, IASPEI), Matthias Morzfeld (USA, IAGA/IAMAS), Takemasa Miyoshi (Japan, IAMAS), Entcho Demirov (Canada, IAPSO), Julien Brajard (France, IAPSO/IACS), Salvatore Grimaldi (Italy, IAHS), Pavel Novak (Czech Republic, IAG)

### Description

Data assimilation has become a valuable tool for improving our understanding of the Earth and its different dynamical layers, such as the core, mantle, oceans, atmosphere and magnetosphere. By merging sparse observations, complex physical models and their respective errors, data assimilation attempts to unveil hidden features of a given system as well as predicting its evolution. Although its long-term development in the field of meteorology has led to a well-established framework, data assimilation methodologies still bear considerable challenges. Amongst those we can cite the numerical stability of ensemble-based methods such as the Ensemble Kalman Filter, the identification and handling of model errors and biases, the hybridization of variational and sequential approaches, and the usage of multi-model ensembles for parameter estimation. Moreover, in many fields of application, such as core and mantle dynamics, as well as volcanism and space weather, data assimilation remains fairly exploratory. However, these novel applications can provide a platform for further analysis of the aforementioned challenges. This symposium aims at promoting a constructive dialogue between the different geophysical communities with a shared interest in the development of innovative strategies in data assimilation. We therefore particularly encourage the participation of contributions connected to emerging research fields of geophysical data assimilation, as well as the development of libraries, testbeds and computationally efficient data assimilation schemes.

> U03

## • JA03 - Geophysical Records of Tectonic and Geodynamic Processes (IAGA, IASPEI, IAG, IAVCEI)

Convener: Fernando Poblete (Chile, IAGA)

Co-Conveners: Leonardo Sagnotti (Italy, IAGA), Matthias Morzfeld (USA, IAGA/IAMAS), Marie Bocher (Switzerland, IASPEI), Haluk Ozener (Turkey, IAG), Heather Handley (Australia, IAVCEI)

### Description

This symposium aims to bring together a wide range of investigations related to paleomagnetism, magnetic anisotropy, gravimetry, seismic, volcanologic and other

geophysical studies intended to unveil tectonic and geodynamic processes at different scales and their links to Earth Dynamics. Thus, presentations may include:

- Characterization of subsurface structures and implications in tectonic evolution
- Tectonic evolution of subduction related orogens
- Geodynamic processes in a collisional setting
- Geodynamic processes at convergent/divergent plate margins
- Plate kinematics

## . JA07 - Geoscience Data Licensing, Production, Publication, and Citation (IAGA, IACS, IAG, IAHS, IAMAS, IAPSO, IASPEI, IAVCEI)

Convener: Masahito Nosé (Japan, IAGA)

Co-Conveners: Simon Flower (UK, IAGA), Yasuhiro Murayama (Japan, IAMAS), Helle Pedersen (France, IASPEI), Attilio Castellarin (Italy, IAHS), Gabriel Guimarães (Brazil, IAG), Toru Suzuki (Japan, IAPSO), Aude Chambodut (France, UCDI), Giuseppe Puglisi (Italy, IAVCEI)

### Description

A number of national and international geoscience research infrastructures have been created in recent years, for example, EPOS (the European Plate Observing System), Copernicus (European Union's Earth Observation Programme), IUGONET (the Inter-university upper atmosphere global observation network), EarthCube (the 'system of systems' infrastructure for geosciences) and AuScope (the Australian geoscience and geospatial infrastructure). At the same time the World Data System is evolving and certification of data repositories (ICSU-WDS, CoreTrustSeal) is becoming an important concern. Together these initiatives make it possible for users to easily access huge archives of disparate geoscience data and metadata in a secure and reliable manner, a task that was complex and time consuming before these initiatives were available.

Clear licensing of geoscience data gives users clarity over how they can use and share the data, protects the rights of data providers and promotes integrated research. Data publication and citation will benefit data suppliers by giving them proper credit, professional recognition and rewards for their works, in a similar manner to the way that publication of scientific results benefits scientific researchers. Licensing, publication and citation of data are becoming a requirement for contribution to geoscience infrastructures. The system of licensing, producing, publishing, and citing of geoscience data is a structure for persistent intellectual content identification and management as well as for connection of users with content suppliers.

This symposium solicits contributions presenting actual practices and future plans of data licensing, producing, publication, and citation of scientific data, and possible related topics.

## • JA08 - Probing the Earth's Lithosphere and Its Dynamics Using Geophysical Modeling (IAGA, IASPEI, IAVCEI, IAG)

Convener: Foteini Vervelidou (Germany, IAGA)

Co-Conveners: Stavros Kotsiaros (USA, IAGA), Robert Tenzer (Hong Kong, IAG), Jörg Ebbing (Germany, IAG/IAGA), Rob Govers (Netherlands, IASPEI/IAG), Javier Fulla (Ireland, IASPEI), Magdalena Scheck-Wenderoth (Germany, ILP), Silvia Massaro (Italia, IAVCEI)

### Description

This symposium focuses on the structure and dynamics of the Earth's lithosphere. Multiple geophysical observations help us probe the Earth's lithospheric structure and understand its dynamic behavior. These include the magnetic and gravity field, electromagnetic induction, heat flow and seismological data.

The lithospheric magnetic field reflects properties like composition and temperature and carries information about tectonic, chemical, and thermal alterations that magnetized rocks have undergone throughout their history. Gravity field, apart from information on composition, reveals information about mass exchange mechanisms related to dynamic processes like sea level rise, glacial retreat, and lithospheric flexure. Magnetotelluric studies image Earth's electrical conductivity from the near-surface to deep within the mantle. Seismological methods including receiver functions map the location of major interfaces like the Moho and the Lithosphere-Asthenosphere Boundary. Seismic velocities can be inverted for density and temperature, and seismic attenuation and seismic anisotropy are correlated with temperature and strain, respectively. Global heat flow measurements help constrain the lithospheric geotherm and Earth's energy budget. These geophysical data sets provide us with a highly valuable data pool for the study of the Earth's lithosphere and its mechanical strength.

We solicit contributions focused on any related geophysical data set or combinations of them with the ultimate goal of enhancing our knowledge about the structure, composition and dynamics of the Earth's crust and uppermost mantle. In this respect, we welcome contributions from studies focusing on data collection and processing, global or regional modeling and interpretation of data and models in terms of tectonic, geological or geophysical implications.

> U04

## • JA10 - Electromagnetic Signals Generated by Volcanic Eruptions/Activity, Fluid Pressure, Earthquakes and Aseismic Fault Slip (IAGA, IAVCEI, IASPEI)

Convener: Jacques Zlotnicki (France, IAGA)

Co-Conveners: Malcolm Johnston (USA, IAGA/IASPEI), Takeshi Hashimoto (Japan, IASPEI/IAVCEI), Xuhui Shen (China, IASPEI), Yoichi Sasai (Japan, IAVCEI)

#### Description

Changes in inter-related crustal stress, deformation, pressure/temperature of electrically conducting fluids and pore pressure in crustal rocks all occur in both volcanic regions and regions of seismic and aseismic fault failure. All these processes generate electric and magnetic (EM) fields. Furthermore, global EM effects are observed in the atmosphere and ionosphere with explosive ash eruptions. While co-eruptive effects and co-seismic fault failure effects in EM fields, deformation, seismicity and geochemistry are readily observed and modeled, the inter-relation between various parameters during periods of volcanic unrest and aseismic activity that are driven by perhaps the same underlying physics is much less clear. This symposium focuses on bringing together examples of multi-parameter land and satellite observations during volcanic activity and earthquake rupture (Part 1), non-eruptive volcanic activity (Part 2) and aseismic fault activity (Part 3) in order to identify the dominant but perhaps changing physical processes involved. Knowledge of the non-uniform EM tomography of volcanoes and fault systems is a necessary prerequisite for modeling these different processes.

## • JC03 – Mountain Cryosphere Hazards (IACS, IAVCEI)

Convener: Marten Geertsema (Canada, IACS)

Co-Conveners: John J. Clague, (Canada, IACS), Michael Krautblatter (Germany, IACS), Lucia Capra (Mexico, IAVCEI),

#### Description

High mountains are currently experiencing some of the largest changes in climate on the planet. Climate warming is driving changes in geomorphic processes operating in mountains, with attendant large impacts on landscapes and ecosystems. This symposium features presentations on the hazards faced by people living and recreating in high mountains, notably avalanches, landslides, debris flows, earthquakes, outburst floods from glacier- and moraine-dammed lakes, volcano-ice interactions, permafrost thaw, and cascading processes. We welcome case studies and contributions featuring state-of-the art tools useful for assessing mountain hazards, including satellite and ground-based InSAR, LiDAR, unmanned aerial vehicles, and modelling using state-of-the art numerical codes.

## • JC07 – Gravity-Driven Flows in the Earth System (IACS, IAPSO, IAVCEI)

Convener: Jim N. McElwaine (UK, IACS)

Co-Conveners: Dieter Issler (Norway, IACS), Federico Falcini (Italy, IAPSO), Roberto Sulpizio (Italy, IAVCEI)

#### Description

Gravity-driven flows — subaqueous and subaerial, terrestrial and extra-terrestrial — occur in a variety of types that nevertheless share many features. There is large potential for improving our understanding of these fascinating and practically important phenomena by comparing experimental data and mathematical modelling approaches across traditional subdiscipline boundaries.

This interdisciplinary symposium therefore aims to summarize our current understanding of, and identify future research challenges in, gravity-driven flows.

Contributions are welcomed on the following topics, among others:

- Novel field observations and measurements
- New experimental techniques
- General modelling frameworks for gravity-driven flows at different scales and level of detail
- Mathematical models of specific processes (e.g., flow-regime changes, erosion, entrainment and deposition, particle–fluid interaction, turbulence)
- Hazard assessment and mitigation methods

## • JG05 - Remote Sensing and Modelling of the Atmosphere (IAG, IAGA, IAMAS, IAVCEI)

Convener: Michael Schmidt (Germany, IAG)

Co-Conveners: Lung-Chih Tsa (Taiwan, IAG), Robert Heinkelmann (Germany, IAG), Claudia Stubenrauch (France, IAMAS), Veronika Barta (Hungary, IAGA), Arnau Folch (Spain, IAVCEI)

### Description

Satellite observations provide a continuous survey of our planet's surrounding atmosphere, which is structured into distinct layers, according to e.g. temperature or charge state.

Ionosphere, plasmasphere and thermosphere are manifestations of space weather; its impacts and risks are gaining more and more importance in politics and sciences, since our modern society is highly depending on space-borne techniques, e.g. for communication and positioning.

Stratosphere and troposphere and their constituents are essential for life on our planet, and tropospheric water vapour is source of clouds and of precipitation, which in turn affect the large-scale circulation through heat transfer. The synergistic use of different instruments and modelling is leading to major advances in the understanding of our climate.

This symposium invites contributions on advances in observing and understanding our atmosphere – from troposphere to magnetosphere. Specific topics are:

- (near) real-time approaches to monitor and forecast the ionospheric state
- combination of various observation techniques and improvement of the representation of atmospheric key parameters
- interaction between atmospheric layers and Global Navigation Satellite System

reflectometry

- studies on space weather research and coupling processes in the upper atmosphere
- studies on empirical atmosphere models, e.g. for the upper atmosphere, and numerical weather models
- aerosol, cloud and radiation processes and interactions in the climate system
- use of synergetic satellite observations and modelling for a better understanding of cloud processes and feedbacks

## • JG07 - Monitoring, Imaging and Mapping of Volcanic Belts (IAG, IAGA, IASPEI, IAVCEI)

Convener: José Fernandez (Spain, IAG)

Co-Conveners: Patrick Whelley (USA, IAVCEI), Mark Bebbington (New Zealand, IAVCEI), Jacob Richardson (USA, IAVCEI), Martyn Unsworth (Canada, IAGA), Philippe Jousset (Germany, IASPEI), Simone Cesca (Germany, IASPEI)

Description

A range of important geological processes occur beneath volcanic belts. Subsurface fluxes of magma and hydrothermal fluids have generated both the continental and oceanic crust and formed many mineral deposits. However, the crustal structure of volcanic belts is not fully understood. This symposium seeks to advance this research area by gathering researchers studying the subsurface structure of active volcanic systems. We welcome all contributions that present (a) geophysical studies of volcanic belts and (b) geological studies that seek to interpret geophysical models in terms of laboratory experiments, (c) Geodetic measurements, imaging and topography of volcanic belts, and (d) multidisciplinary studies on volcanic belts.

## • JG08 - Earth Systems Literacy: Geophysics in K-16 Class Rooms, Outreach Projects, and Citizen Science Research Projects (IAG, IASPEI, IAVCEI)

Convener: Katherine Boggs (Canada, IASPEI)

Co-Conveners: Maite Agopian (USA, IASPEI), Beth Bartal (USA, IAVCEI), Josef Zens (Germany, IAG), Chris King (UK, IUGS-COGE)

Description

Earth systems are complex and public awareness is critical for balancing societal demands for minerals and water with sound environmental practices, as well as building resilience to natural hazards and a changing climate. Increasingly over the past decade large geophysical programs such as EarthScope, SINOPROBE, IPOC, AlpArray and AusLAMP have produced “Big Data” which is becoming more and more openly available for teaching in K-16 classrooms and citizen science research programs. Strong partnerships between

scientists, data scientists, teachers and non-academic communities are critical for successfully guiding such citizen scientist and educator use of these data products. Such approaches are important for both recruiting the geophysicists of the future and for developing critical skills for our future generations. Key among these skills is the ability to assess and recheck claims made about environmental issues by interested parties, thus enabling evidence-based decision-making processes. This symposium invites contributions from scientists, educators, communicators and those who design, facilitate, fund or deliver such programs.

## • JM02 - Anthropogenic changes in Chemistry and Physics of the Atmosphere: Evidence and Attribution Studies (IAMAS, IAVCEI, IAG)

Convener: John P. Burrows (Germany, IAMAS)

Co-Conveners: Maria Kanakidou (Greece, IAMAS), Franco Tassi (Italy, IAVCEI), Isabelle Panet (France, IAG)

### Description

This symposium focuses on the impact of natural emissions, such as those from volcanoes, and anthropogenic fluxes on atmospheric composition, chemical transformation, dynamics and climate. In this context we welcome contributions from

- i) laboratory and chamber studies
- ii) field measurements;
- iii) satellite observations;
- iv) numerical modelling;
- v) scientific and socio-economic assessments.

## • JP05 - Tsunamis (IAPSO, IASPEI, IAVCEI)

Convener: Vasily V. Titov (USA, IAPSO)

Co-Conveners: Fumuhiko Imamura (Japan, IAPSO), Maria Ana Baptista (Portugal, IAPSO), Alexander Rabinovich (Russia, IASPEI), Joan Marti (Spain, IAVCEI)

### Description

Tsunamis present persistent hazard for growing coastal population around the world. Tsunami events of this century vividly illustrated increasing risk of such disasters for coastal population and infrastructure. As the response to these deadly tsunamis of the XXI century, many new tsunamis forecast and warning capabilities have been developed and

implemented. Tsunami warning systems have expanded from the Pacific to all world oceans, and now provide tsunami warning capabilities based on expanded set of real-time observations for virtually all vulnerable coastlines.

The global warning system presents new challenges for tsunami science. Newly available real-time data provide large volume of high-quality observations that require new methods and data-assimilation tools for use in data-based forecast products. New modelling and analysis methods are required to take advantage of the new computational and observational capabilities, to convert scientific and modelling results into actionable and effective forecast and warning. The tsunami science now has the opportunity to make all coastal communities resilient to tsunami threat. The symposium will discuss progress and challenges of all aspects of tsunami research and practical warning applications.

> U02

## • JS03 - Subduction Zone Deformation and Structure (IASPEI, IAG, IAVCEI)

Convener: Yajing Liu (Canada, IASPEI)

Co-Conveners: Michael Bostock (Canada, IASPEI), Kelin Wang (Canada, IASPEI), Lucinda Leonard (Canada, IAG), Simon Peacock (Canada, IAVCEI)

### Description

Subduction zones encompass a range of significant processes contributing to the long-term evolution of the Earth. Megathrust earthquakes along subduction margins define a major geohazard capable of catastrophic damages, as evidenced by the 2011 Japan and 2004 Indian Ocean earthquakes, that are stark reminders of what is likely in store for Cascadia. However, our understanding of subduction zone processes and ultimately characterization of geohazards is hampered by a lack of observations, in particular offshore. For Cascadia, this data gap lies directly above the seismogenic zone and its downdip transition to slow earthquake phenomena, where material properties evolve due to hydro-mechanical variations and metamorphic reactions. In recent years, improvements to permanent monitoring networks and dense temporary deployments have focused on a 4D characterization of stress, strength and fluid pressure evolution in subduction zones. In this session we invite contributions from a broad range of disciplines that address first-order questions about how megathrusts work, based on onshore/offshore surveys and integration of observation and modeling approaches for global subduction zones.

## • JS05 - Probabilistic & Statistical Approaches in Geosciences (IASPEI, IAG, IAVCEI)

Convener: Kerry Gallagher (France, IASPEI)

Co-Conveners: Nico Sneeuw (Germany, IAG), Andrew Bell (UK, IAVCEI)

### Description

Probabilistic and statistical approaches to modeling different types of Geoscience data have become more popular in the last 15--20 years, partly due to advances in methodological approaches and algorithms, and also due to increasing computing power. Different applications include analysis of large and/or complex data sets, inverse modeling, model choice, assessment of multiple forward modeling scenarios and forecasting, all potentially allowing for uncertainties in observations, model formulations and estimation of model parameters. In this symposium, we solicit submissions addressing new methods, comparisons of methods and application/ case studies of probabilistic/statistical techniques aimed at improving how we can identify and extract information from data and models in the general context of the Geosciences.

> U03

## • JS06 - Old Data for New Knowledge: Preservation and Utilization of Historical Data in the Geosciences (IASPEI, IAG, IAHS, IAGA, IAMAS, IACS, IAPSO, IAVCEI)

Convener: Josep Batlló Ortiz (Spain, IASPEI)

Co-Conveners: Alberto Viglione (Austria, IAHS), József Ádám (Hungary, IAG), Edward Cliver (USA, IAGA), Kris Harper (USA, IAMAS), Bruce Raup (USA, IACS), Florence Fetterer (USA, IACS), E. Pattabhi Rama Rao (India, IAPSO), Roberto Carniel (Italy, IAVCEI)

### Description

Studying a changing world needs long series of data. Moreover, reanalysis of old geophysical/geodetic data in the light of our present knowledge has become an important tool for understanding topics such as solar variability, climatic change, tectonics, earth rotation, and extreme natural events (e.g., magnetic storms, hurricanes, rainfall, floods, earthquakes etc.). Those old data are in analogue form and, many times, are contained in unique documents. Historical information may also be retrieved from documentary evidence such as narrative sources and legal-administrative institutional documentation (e.g. chronicles, newspapers, private and official protocols and correspondence, account books, etc.). Techniques and methodologies for preservation, dissemination, interpretation, homogenisation and use of such data, as well as for their present scientific use are important topics for advancing of our understanding of the changing Earth and of past extreme events. Different approaches have been devised to deal with different data and problems. Sharing the already large accumulated experience in the different fields covered by the IUGG shall contribute to improve our preservation and dissemination tools, our analysis methods and, ultimately, to further research results. This symposium welcomes contributions on:

(a) Locating, assessing, preserving, and disseminating historical data about sunspots, polar motion, time and temperature measurements, magnetograms, seismograms, eruptions, glacier extent, tide gauge records, aurorae, flood/drought events and many others and

(b) Methodologies and study cases using these historical data to advance our understanding of the Earth.

> U04

> U07

## • JS09 - Tectonophysics of the Continental Lithosphere: Integrating the Thermal Field with Thermo-Barometric, Seismological, Electromagnetic and Seismicity Data (IASPEI, IAVCEI, IAGA)

Convener: Andrea Förster (Germany, IASPEI)

Co-Conveners: Rainer Kind (Germany, IASPEI), Alan Jones (Canada, IAGA), Gianluca Gola (Italy, IAVCEI)

### Description

Geotherms are fundamental for the quantification of the Earth's thermal structure and the understanding of tectonophysical processes. They are numerical models that require a sound understanding of surface heat flow, and sensu stricto terrestrial heat flow, rock thermal conductivity (which is pressure and temperature dependent) and radiogenic heat production. For stabilized crust, known values of mantle heat flow can help to constrain those thermal properties of the crust. The ambiguity of the lithospheric thermal regime is large owing to uncertainties in the quantification of the governing parameters, for example the lithosphere structure and composition and the lithosphere-asthenosphere depth.

Uncertainties also arise from the different laboratory measurements deployed in constraining the heat flow and rock thermal properties. Other problems are linked with transient thermal processes not depicted yet by surface heat flow. It is therefore desirable to seek for independent evidence to verify the thermal field, which is e.g. by xenolith-derived thermo-barometry data, data on the cut-off depth of earthquakes, by seismology and electromagnetic surveys. We therefore welcome papers that address an integration of the thermal field with geophysical imaging techniques to answer fundamental questions in rheology and geomechanics, and young geodynamic processes.

## • JS10 - Physics and chemistry of earth materials with implications for earth structure and dynamics (IASPEI, IAVCEI)

Convener: Jihua Chen (USA, IASPEI/IAVCEI))

Co-Conveners: Tomo Katsura (Germany, IAVCEI), Sergio Speziale (Germany, IASPEI)

### Description

Research progress in field-based observations, laboratory experiments, and theoretical modeling advance our understanding of the structure and dynamics of the Earth's interior. This interdisciplinary symposium will bring together new results from seismological and electrical sounding directed towards elucidating the structure of the mantle and core (including discontinuities, anisotropy and attenuation), observations of the Earth's magnetic field and its relationship to planetary heat flow, relevant research on earth materials (including phase equilibria, element partitioning, deformation and the development of texture, the influence of volatiles on partial melting, seismic and electrical properties, and rheology), and numerical modeling of properties and processes on distance scales ranging from atomic to global, and on timescales ranging from accretion and core formation to the present.

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