International Association of Volcanology and Chemistry of the Earth's Interior

Commission on the Chemistry of Volcanic Gases

Report on the 15th workshop of the Commission on the Chemistry of Volcanic Gases

Silvana Hidalgo, Tobias Fischer
Toshiya Mori, Masaaki Morita, Hiroshi Shinohara
Santiago Arellano, Carlo Cardellini, Peter Kelly, Fátima Viveiros, Nicole Bobrowski, Takeshi Obha

The 15th workshop of the Commission on the Chemistry of Volcanic Gases (CCVG) was held from 1st to 7th September 2025, in Hokkaido-Japan. The meeting was attended by 83 participants from 18 countries and supported by the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI), Earthquake Research Institute, the University of Tokyo, VDAP, IGCP705-UNESCO and the Tokyo Geographical Society (Figure 1).

Figure 1.- Participants of the 15th CCVG Workshop at Toyako.

The meeting consisted of a main conference session held in Sapporo (1-2 September) with 30 oral and 64 poster presentations, that included also a flash talk for each poster presenter. The following days, field expeditions for remote sensing, direct sampling and diffuse degassing, took place at three Hokkaido volcanoes: Kuttara, Usu and Tarumae. An optional field trip to Tokachidake volcano (28-30 August; 16 participants) was also carried out, as well as half-day group discussions to organize the treatment of the collected data for future reports or potential publications.

The program also included social activities such as a welcome reception, and a karaoke farewell party.

The scientific committee was composed of **Fátima Viveiros, Clara Lamberti, Tjarda Roberts** Marie Boichu, **Jonas Kuhn, Andrea Ricci**, Christoph Kern, Brendan McCormick (bold names were present at the workshop). The committe organized the contributions in four main topics:

- Geochemistry of Magmatic Gases (*5 oral, 17 poster*)
- Innovations and Recent Advances in Observational Techniques and Methods (*10 oral, 14 poster*)
- Quantification, composition, and chemistry of volcanic plumes (*9 oral, 8 poster*)
- Deciphering Volcanic Processes Using Gas Emission Observations (*8 oral, 15 poster*)

Financial support by the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI), Earthquake Research Institute, the University of Tokyo, Volcano Disaster Assistance Program (VDAP), IGCP-705 UNESCO and the Tokyo Geographical Society, allowed to provide 14 grants for ECR and low-income countries participants to attend the meeting. These grants were assigned by the Scientific Committee and the CCVG current board, aiming to guarantee the fairest distribution.

The conference was opened by a welcome speech by Takeshi Ohba and a brief report of the current CCVG board by Silvana Hidalgo. Scientific program started with the presentation on the Fumarolic and Hydrothermal Activity in Kuttara, Tarumae and Usu Volcanoes volcanoes given by Ryo Takahashi from the Hokkaido Research Organization. This talk was followed by the presentation of the CCVG decadal plan by Nicole Bobrowski.

The oral presentations classified under four main scientific sessions started after the first tea break. At the end of the oral presentations a set of flash talks was presented previous the poster session.

The full program with presentation titles, abstracts and main authors is appended to this report.

Figure 2.- Oral and poster presentations (Pictures by Silvana Hidalgo and Shogo Numata)

The participants came from 18 different countries. As usual, the organizing country had the higher participation with 25 researchers attending the meeting. The list of countries and the corresponding number of participants is below, together with a word cloud representing the distribution (Figure 3).

Japan:28
Italy: 14
United States: 8
Chile: 5
Spain: 4
Ecuador, Germany: 3
Argentina, Canada, France, Iceland, Portugal, Indonesia, Philippines: 2
Mexico, Singapore, Sweden, Taiwan: 1

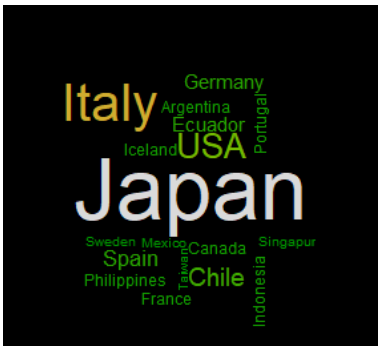

Figure 3. Distribution of participants by country.

This workshop showed almost the same number in female participation compared to the previous one in Perú three years ago with 54 male and 29 female participants (Figure 4).

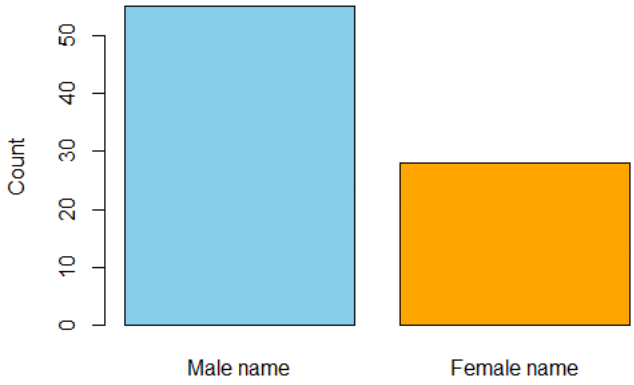

Figure 4. Distribution of participants according to female and male names.

On the final day of the workshop topical round table discussions were divided into four groups covering various aspects of direct sampling, diffuse degassing, remote sensing and multi-gas techniques (Figure 5). These discussions were led by experts on the different methodologies and were directed to expert colleagues as well as newcomers to the techniques. Leading experts for the organization of the collected data were nominated: Takeshi Ohba, Carlo Cardellini, Nicole Bobrowski and Peter Kelly, respectively.

Figure 5. Group discussions: Direct Sampling, Diffused CO_2, Remote Sensing, Multigas.

Discussion of the decadal plan was led by Tobias Fischer, co-leader of the CCVG (Figure 6). Through this discussion we created four task forces with already several volunteers to guide and participate in these initiatives which hopefully will be integrated by some more volunteers in the upcoming weeks.

Research/Innovation: Nicole Bobrowski, Sara Peek, Charlotte Barrington
Community resources: Carlo Cardellini, Peter Kelly
Peer training:
Broadening community: Fátima Viveiros, Simon Carn

The task forces will report out to the Board at regular intervals, and we expect a report of the accomplishments of the task forces by the next CCVG workshop.

Figure 6. Decadal plan discussion led by Tobias Fischer (photo by Syegi Kunrat).

The structure of the Board has been confirmed, including two co-leaders and a secretary. The members of the new board will be elected by an online voting in the incoming weeks with the support of IAVCEI. We have five candidates for co-leader and one for secretary. This will be the first time that the board will be elected online. We hope that this option will allow a major participation of the whole CCVG community.

Field work

Pre-Conference field trip – Tokachidake

The field trip at Tokachidake was carried on August 29. The participants performed Mobile DOAS measurements, multigas measurements, and direct sampling (Figure 7).
On August 30 the group participated in T, pH and conductivity measurements of thermal waters around Tokachidake as well as sampling.

Figure 7. Images of the field work at Tokachidake volcano. Pictures from Hiroshi Shinohara, Shogo Numata and Silvana Hidalgo.

Field work during the conference

Kuttara Volcano

The field trip to Kuttara volcano took place on September 3. The group realized direct sampling of thermal waters and fumaroles, multiGAS measurements at the fumaroles and thermal images (Figure 8).

Figure 7. Images of the field work at Kuttara volcano. Pictures from Allan Lerner, Syegi Kunrat and Silvana Hidalgo.

Tarumae Volcano

The field trip to Tarumae volcano took place on September 4 and 5. The group was split in two in order to realize direct sampling of thermal waters and fumaroles, multigas measurements at the fumaroles and thermal images (Figure 8). On this volcano mobile DOAS and UV camera was also performed.

Figure 8. Images of the field work at Tarumae volcano. Pictures from Allan Lerner, Syegi Kunrat and Silvana Hidalgo.

Usu Volcano

The field trip to Usu volcano took place on September 4 and 5. The group was split in two in order to realize direct sampling of thermal waters and fumaroles, multigas measurements at the fumaroles and thermal images (Figure 9).

Figure 9. Images of the field work at Usu volcano. Pictures from Allan Lerner, Syegi Kunrat and Silvana Hidalgo.

Summary of multi-GAS activities

A sizeable and enthusiastic group of scientists convened in Hokkaido to make sensor-based in situ measurements of volcanic plume compositions. In total, thirteen multi-GAS instruments and one portable FTIR system from eight groups were used during the workshop. A broad spectrum of volcanic gas compositions was measured at the three field areas: from steam-dominated hydrothermal features at Usu Volcano, to more CO_2-and-H_2S rich hydrothermal gases at Kuttara Volcano, to CO_2-SO_2-H_2S rich magmatic-hydrothermal gases at Tarumae. The acquired dataset will facilitate detailed intercomparisons of multi-GAS instruments across a range of volcanic degassing settings and provide valuable reference data for the FTIR system. Following the fieldwork, the multi-GAS group discussed future activities. In addition to completing analysis of the workshop data, the group strongly supported the idea of generating best-practices guidelines for multi-GAS operations and data analysis. The group will explore possible avenues toward achieving these goals in the time between now and the next CCVG meeting.

Summary of the Diffused CO_2 activities

Diffuse degassing measurements and soil gas sampling were carried out during two days at Usu volcano summit area with the collaboration of six teams using different instruments based on the accumulation chamber method (Figure 10). The instrumentations were provided by Perugia University, Hokkaido University, Icelandic Met Office, Instituto Volcanológico de Canarias - INVOLCAN, GFZ Helmholtz Centre for Geosciences and Istituto Nazionale di Geofisica e Vulcanologia - INGV-Bologna. The field work included comparative test and intercalibration of the different instruments at several measuring points, and a collaborative survey of the CO_2 flux from the soil covering an area of about 0.5 km^2 with 274 measurements. IVAR-University of the Azores, University of Perugia and INVOLCAN teams performed also sampling from the accumulation chamber of released gas for the determination of $\delta^{13}C$ of CO_2 that will be measured at INVOLCAN and INGV-Naples laboratories. INVOLCAN collected also soil gases at for a multicomponent chemical and isotopic determination.

Figure 10. Measurements of CO_2 diffuse degassing from the soil at Usu volcano summit area. Top left, site of comparative measurements.

Summary of the Direct sampling activities

The direct gas sampling group consisted of up to 8 separate teams and collected samples at all three official locations of the workshop: 1) Kuttara Volcano at Oyunuma bubbling pool; 2) Mt Uzu at I-Crater fumarole area and 3) Traumae Volcano at Fumarole site A and site B. The members of the group collected a large variety of samples including in caustic solution filled bottles, dry gas in evacuated flasks, gas condensates, and in copper tubes and Pb-glass. Samples also included more unconventional approaches such as absorbing plume gas on desiccant material and collecting plume gas into larger evacuated glass flasks. Following field work, the group decided on compiling and sharing the analytical results and making the data available in a databases with an assigned DOI.

Summary of the Remote sensing activities

During the 15th CCVG Field Workshop, remote sensing measurements were done at Tokachi-dake, Kuttara, Usu, and Tarumae. The pre-workshop field trip to Tokachi-dake on the 28 August 2025 offered possibilities for DOAS walking traverses around the rims of the "Taisho" and "62-2" craters. Winds drove emissions from the first of these two craters in a direction favorable for estimating the bulk of the emission from the main fumarole used for direct sampling. Besides traverses, a thermal infrared camera was deployed at the crater rim and aimed at the sampled fumarole of Taisho. A prototype spectro-polarimeter was deployed at the volcano's flank (next to a climbers' hut) for remote sensing of particles. Measurements were conducted by groups from Japan, Ecuador, Iceland, and Sweden and lasted for a couple of hours, until the onset of rain. At Kuttara, only thermal infrared camera measurements by the Ecuadorian team were performed on the fumarole around the Oyunum geothermal pond on 3 September. At Usu, thermal camera, spectropolarimeter, and DOAS walking traverses were attempted on 4 September, but no clear signals of SO_2 were detected. At Tarumae, the same techniques were used by the same groups, joined by DOAS walking traverses from Italy and the United States, and UV SO_2 camera measurements from Chile and Italy. The UV camera measurements were made from the base of the caldera and aimed at crater "A" of Tarumae on 4 and 5 September. Weather conditions were better on the first of these days, when only UV camera measurements were made. All measurements of 5 October were conducted under light rain and focused on crater "A". Heavy rain prevented good measurements on crater "B", although at least one such attempt was made by the US group. Thermal infrared camera measurements were attempted from the same position as the UV cameras, and the spectro-polarimeter was running next to crater A of Tarumae. A handheld anemometer was used in tandem with the DOAS traverses. Calibration with SO_2 cells was done by all groups with DOAS spectrometers at the Toyako Manseikaku Hotel on 6 September.

Discussions on remote sensing activities of CCVG were held on the last day of the workshop. The goal is to summarize measurement results from this workshop before the end of 2025. As a contribution to the Decadal Plan of CCVG, this community wants to set up working groups on the standardization of data formats and the estimation of uncertainty for different remote sensing techniques. Ideally, such groups should involve experts on measurement techniques and statistical methods. Regarding inter-comparison of techniques, experiences such as the "CINDI" campaigns of the atmospheric DOAS community were mentioned as a good example. In preparation for the next field workshop, it would be good if a few members of the remote sensing community work under the lead of a member of the local organizing committee to design community experiments for the workshop. Satellite measurements should also be included in such experiments, and enough time should be allocated for the calibration of the different techniques during the workshop. Selection of a suitable data repository and publication channel for field workshop data and results was also discussed by this group.

Figure 11 Upper: A walk around the 62-2 crater of Tokachi. A lunch break at Usu. Lower: A "remote sensor" in crater A and sampling under the rain on crater B of Tarumae

Final remarks

The CCVG community would like to extend a heartfelt thanks to the organizers of the 15th workshop, in particular Toshiya Mori, Masaaki Morita and Hiroshi Shinohara involved in the organization for extraordinary preparations and support during the workshop.

Board elections will be held online through IAVCEI platform, following IAVCEI requirements and recommendations.

The site of the next workshop will be decided by January 2026, after the members will be able to vote among two current proposals: Chile and Indonesia.

Finally, we acknowledge the members of the scientific committee for preparation of the program.

This 15th Gas Workshop benefited from the financial support of the IAVCEI, Earthquake Research Institute, the University of Tokyo, the USGS VDAP, IGCP705-UNESCO and the Tokyo Geographical Society.