

## Geothermal Volcanology Workshop 2024

Institute of Volcanology and Seismology  
Far Eastern Branch of the Russian Academy of Sciences  
Petropavlovsk-Kamchatsky, September 02 – September 08, 2024



Kamchatka, Russia  
02 - 08 September, 2024

**Geothermal Volcanology Workshop 2024** will be held from **September 02 to September 08, 2024** in Petropavlovsk-Kamchatsky, Russia. Kamchatka is an active volcanic, seismic and hydrothermal region. Active volcanism is accompanied by magma injections into host structures, magmatic fracturing, and the formation of hydrothermal systems adjacent to volcanoes. Geo-scientific and engineering studies of hydrothermal systems and geothermal reservoirs are a necessary condition for their effective use for heat and power supply, and for balneological/recreational use. Active volcanic areas studies are extremely important for predicting volcanic, magma-hydrothermal activity, and strong earthquakes forecasts, and for understanding conditions of formations and exploitations of geothermal fields, ore deposits and hard-to-recover hydrocarbon reservoirs. The interdisciplinary focus and unique place of this workshop and field trips are stimulating breakthrough ideas, international scientific-technical cooperation, and multiple applications in Earth Science.

### Topics of scientific sessions:

- Magma-hydrothermal, magmatogenic and epithermal deposits;
- Hydrothermal systems, geothermal and hydromineral resources;
- Active faults and seismicity in geofluid systems;
- Magmatic systems of active volcanoes;
- Modeling of the heat & mass transfer, geomechanical processes and chemical interactions in geofluid systems;
- Conditions of formation and exploitation of the geothermal and hard-to-recover hydrocarbon reservoirs;
- Mechanism of geyser functioning and catastrophic processes in hydrothermal systems.

## Program Organizing Committee:

**Dr. A.V. Kiryukhin (IVS FEB RAS) (Chair)**, Dr. S.N. Rychagov (Co-Chair), Dr. E.G. Kalacheva (Co-Chair), Dr. Prof. A. G. Vakhromeev (Institute of the Earth Crust SB RAS, Irkutsk), Dr. S. B. Korotkov (Gazprom Invest JSC) (Co-Chair), Prof. J. Eichelberger (Alaska University, USA), Dr. G.A. Karpov (IVS FEB RAS), Prof. N. Tsuchiya (Tohoku University, Japan), Prof. Tianfu Xu, Jilin University (China), Dr. G. A. Karpov (IVS FEB RAS), Dr. G. N. Kopylova (KB FRC UGS RAS).

## Technical Organizing Committee:

**Dr. A.V. Kiryukhin (Chair)**, Dr. A.Yu. Polyakov (Dep. Chair), E.V. Chernykh (Secretary), O.O. Usacheva (Secretary), O.A. Yevdokimova, O.E. Bograd, V.P. Fedulova, G.N. Zadvernyak, Yu. A. Zhigadlo, V.A. Danilov, L.A. Ptashinsky, I.M. Romanova, Dr. A.V. Sergeeva, Dr. A.V. Solomatin, Dr. O.V. Bergal-Kuvikas, P.O. Voronin, N.B. Zhuravlev, O.A. Gololobova.

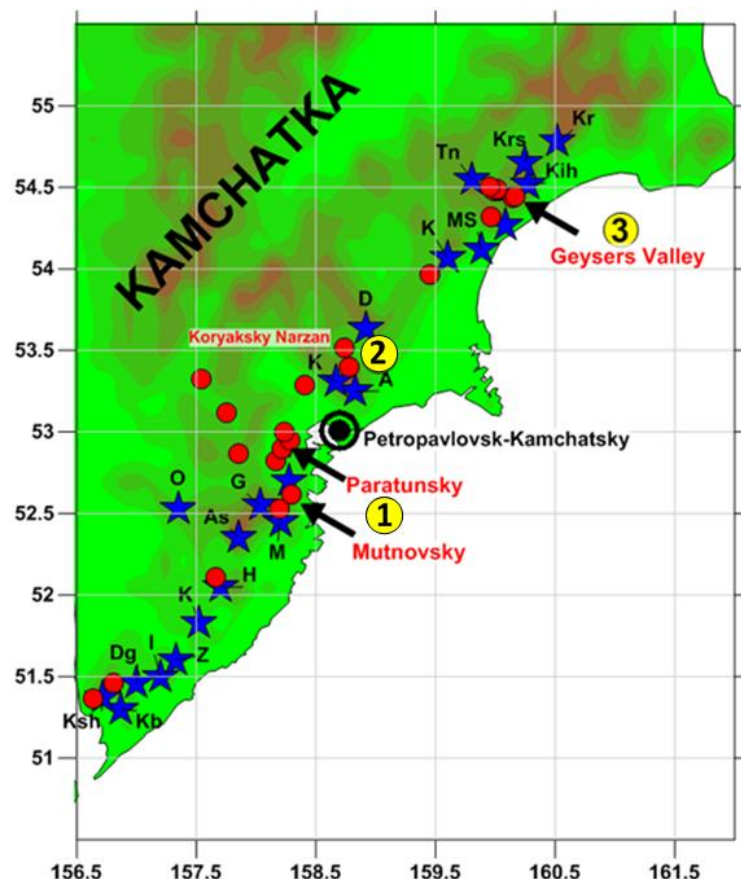
**Meeting format:** Oral and on-line, Russian \ English.

**Location:** Institute of Volcanology and Seismology FEB RAS, Piip 9, Petropavlovsk-Kamchatsky, Russia.

### Field Trips:

- (1) Mutnovsky & Paratunsky Geothermal Areas;
- (2) Avachinsky Volcano and Koryaksky Volcano's Dyke Fields;
- (3) Valley of Geysers.

Field Trips will be offered depending on demand. Field trip (1) with overnight stay at the «Rodnikovaya» Base on September 05-06. Please indicate your interest(s) in advance.



## (1) Field Trip 1: Mutnovsky and Paratunsky Geothermal Areas

This field trip lasts 2 days (September 05-06, 2024). Number of participants is up to 20.

**Transport (car+walk), map and route points:** **Day 1:** IVS FEB RAS – V-Paratunsky hot springs – Vilyuchinsky Volcano – Gorely Volcano caldera – night stay at Rodnikovaya Base; **Day 2:** Rodnikovaya Base – «Ice Leopard» waterfall – Mutnovsky geothermal field – Blowing Well – «The Little Valley of Geysers» (Dachnye thermal springs) – Mutnovsky Geothermal Power Plant – IVS FEB RAS. Two meals a day (dry rations + tea), dinner and breakfast at the Rodnikovaya base. **The cost is 20 000 rubles per participant.**

*The Mutnovsky geothermal area is part of the Eastern Kamchatka active volcano belt. Mutnovsky, 80 ka old and an aging strato-volcano (a complex of 4 composite volcanic cones), acts as a magma- and water-injector into the 25-km-long North Mutnovsky extension zone (Figure 2). Magmatic injection events (dykes) are associated with plane-oriented MEQ (Micro Earth Quakes) clusters, most of them occurring in the NE sector of the volcano ( $2 \times 10 \text{ km}^2$ ) at elevations from -4 to -2 km, while some magmatic injections occur at elevations from -6 to -4 km below the Mutnovsky geothermal production field. Water recharge of production reservoirs is from the Mutnovsky volcano crater glacier (+1500 to +1800 masl), as confirmed by water isotopic data ( $\delta D$ ,  $\delta^{18}O$ ) of production wells at an earlier stage of development. The Mutnovsky (Dachnye) 260-310°C high-temperature production geothermal reservoir with a volume of  $16 \text{ km}^3$  is at the junction of NNE- and NE-striking normal faults, which coincides with the current dominant dyke injection orientation. According to the results of TOUGH2 modeling, the natural upflow of deep fluid with enthalpy of 1420 kJ/kg is estimated at 80 kg/s. Modeling also shows that the reservoir is capable of providing sustainable production up to 87-105 MWe, if additional wells are drilled in the SE sector of the field and binary technologies are applied.*

1. [Selyangin O. B. To Mutnovsky and Gorely volcanoes: volcanological and tourist guide "New Book", 2009. 108 p.](#)

2. [Kiryukhin A.V., Polyakov A.Y., Voronin P.O., Zhuravlev N.B., Usacheva O.O, Solomatin A.V. Magma Fracking and Production Reservoirs Beneath and Adjacent to Mutnovsky Volcano Based on Seismic Data and Hydrothermal Activity // Geothermics 105 \(2022\) 102474](#)





Figure 1. Mutnovsky GeoPP with installed capacity of 50 MW, with Mutnovsky-1 volcano at a distance of 6 km in the background. Photo by A.V. Kiryukhin, August 2005.

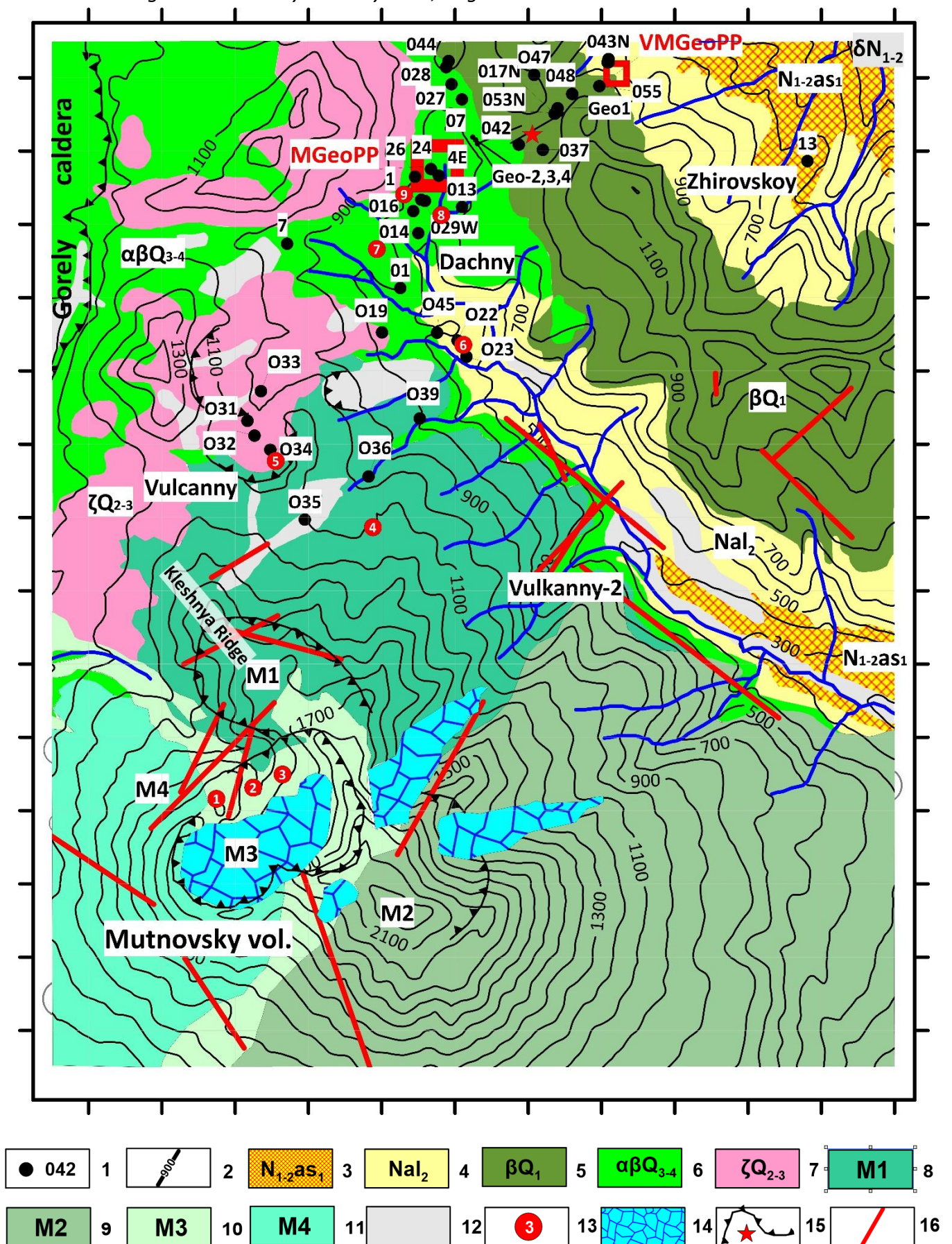




Figure 2. Map of the Mutnovsky geothermal area. Legend and explanations: see [2].

**The Paratunsky low temperature geothermal field** (Figure 3) has been operating since 1964. During the period of exploitation from 1966-2014, 321 Mt of thermal water (Cl-Na, Cl-SO<sub>4</sub>-Na composition, M up to 2600 ppm) with temperatures of 70-100°C were extracted and used for district heating, balneology and greenhouses. The structure of the 40 km<sup>3</sup> Paratunsky low temperature (80-110°C) geothermal volcanogenic reservoir includes three hot water upflow regions. Water isotope and gas (N<sub>2</sub>, 96-98%) data analysis indicated that the main recharge region of the Paratunsky geothermal reservoirs is the Viluychinsky Volcano (2173 masl) and adjacent elevated structures, located 10-25 km south from the geothermal field. TOUGH2 modeling of the thermo-hydrodynamic natural state and the history of exploitation (involving pressure, temperature and chemical response to utilization) between 1965 and 2014 yield estimates of hot water upflow rates (190 kg/s). Modeling confirmed areal discharge of the thermal water from the production reservoir in the top groundwater aquifer. Modeling of the chemical (Cl-) history of exploitation provides an explanation of gradual Cl- accumulation due to the inflow of chloride-containing water through the eastern (open) boundary of the geothermal reservoirs. Thermal hydrodynamic modeling forecast of operation in the Paratunsky geothermal field using submersible pumps shows possibility long term extraction of 1150 kg/s of heat carrier at an initial temperature of 80°C, that's equivalent of 1630 000 GCal per year (216 MW of heat) to completely supply the Petropavlovsk-Kamchatsky centralized heating systems.

3. [Kiryukhin A.V., Vorozheikina L.A., Voronin P.O., Kiryukhin P.A. THERMAL-PERMEABILITY STRUCTURE AND RECHARGE CONDITIONS OF THE LOW TEMPERATURE PARATUNSKY GEOTHERMAL RESERVOIRS, KAMCHATKA, RUSSIA // Geothermics 70 \(2017\) 47–61.](#)



Overnight stop at the Vilyuchinsky thermal springs (Alney base) on Sept. 05/06 during Field Trip 1.

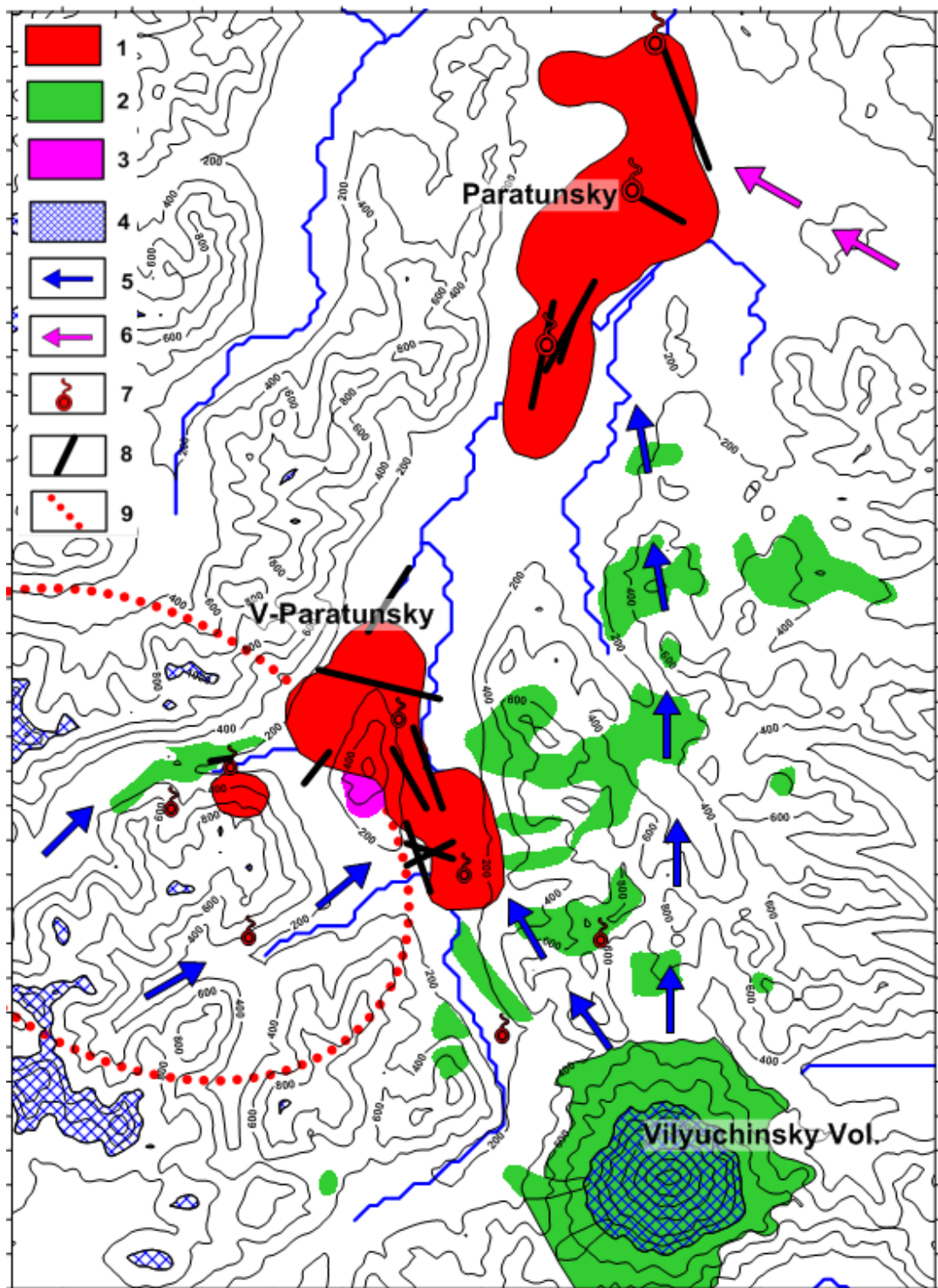


Figure 3. Paratunsky geothermal fields thermo-geo-filtration structure and recharge conditions, with topographical elevations shown, grid scale 1 km. Legend: 1 – counters of production geothermal reservoirs at -750 masl based on geoisotherm 75°C (Paratunsky) and 60°C (Verkhne-Paratunsky); 2 – Holocene lava flows and cinder cones; 3 – Rhyolite extrusions 0.5-0.8 MY; 4 – water recharge regions for the Paratunsky geothermal reservoirs (with an elevation of more than 1000 masl); 5- Horizontal projections of fluid flows from water recharge regions to the production geothermal reservoirs; 6 – Chloride water attracted into the production reservoir due to its exploitation; 7 – Hot springs; 8 – Production zone traces at -750 masl; 9 – Leonov caldera rim 1.2-1.5 MY (Leonov et al., 2007).

## (2) Field Trip 2: Avachinsky Volcano (2A) & Koryaksky Volcano Dyke Fields (2B – by land, 2C – by sea)

The Avachinsky-Koryaksky volcanogenic basin (Figure 4), which has an area of 2530 km<sup>2</sup>, is located 25 km from Petropavlovsk-Kamchatsky City and includes five Quaternary volcanoes (two of which, Avachinsky (2750 masl) and Koryaksky (3456 masl), are active), and is located within a depression that has formed in Cretaceous basement rocks. The dyke field on the southern slope of the Koryaksky volcano is accessible to be visited (Fig. 4, photo). Surface outcrops of dykes and sills can also be seen on the Pacific coast on a marine tour. **Three variants (2A, 2B, 2C) of excursion 2 are listed below. Only one option will be chosen, depending on the participants' requests at the registration.**

**(2A) Excursion to Avachinsky volcano** is possible if there are favorable weather conditions on September 07, 2024. Excursion duration is 14 hours (7-00 to 21-00). The number of participants is up to 15 people. Transport (car+walk), map and route points (Figure 4): IVS FEB RAS – Avachinsky Base – trekking (4 hr) to Avachinsky Volcano somma ridge (2100 masl) – ascending (3 hr) to Avachinsky Volcano Cone (2750 masl) – descending (4 hr) to Avachinsky Base – IVS FEB RAS. 2 meal stops (lunchbox + tea) included. The price is **10 000 rubles** per one participant. Prepayment at registration desk.

**(2B) Route to the dyke field on the southern slope of Koryaksky volcano.** Excursion duration is 14 hours (7-00 to 21-00). The number of participants is up to 15 people. Transportation (car+walking), the route plan: IVS FEB RAS - Avachinsky pass/IVS base camp - trekking (4 hours) to the dike field (1600 m abs)- dikes sightseeing (1 hour) - return (3 hours) to Avachinsky pass/IVS base camp - IVS FEB RAS. 2 meals a day (dry ration + tea). The price is **10 000 rubles** per one participant. Prepayment at registration desk.

**(2C) Marine tour along the coastal cliffs of the Coastal Volcanic Complex of Southern Kamchatka**, with outcrops of dyke and sill intrusions, volcanogenic-sedimentary rocks of Vilyuchinskaya, Spaseniya and Vilyui bays. The price is **15 000 rubles** per one participant. Hot meals (snacks, fresh crabs, soups, drinks) and fishing gear included.

4. [Kiryukhin A., Lavrushin V., Kiryukhin P., Voronin P. "Geofluid Systems of Koryaksky-Avachinsky Volcanoes \(Kamchatka, Russia\)," Geofluids, vol. 2017, Article ID 4279652, 2017.](#)

5. [A.V. Kiryukhin, I.N. Nazhalova, N.B. Zhuravlev, Hot water-methane reservoirs at northwest foothills of Koryaksky volcano, Kamchatka, Geothermics, Volume 106, 2022, 102552](#)

6. [O.V. Bergal-Kuvikas, A.V. Latyshev, M.B. Anosova, E.A. Latanova. EXPEDITION TO STUDY MIOCENE IGNEOUS ROCKS OF SOUTHERN KAMCHATKA / VESTNIK KRAUNTS. Ser. Earth Sciences. 2022. № 4. No. 56. p. 123-128](#)

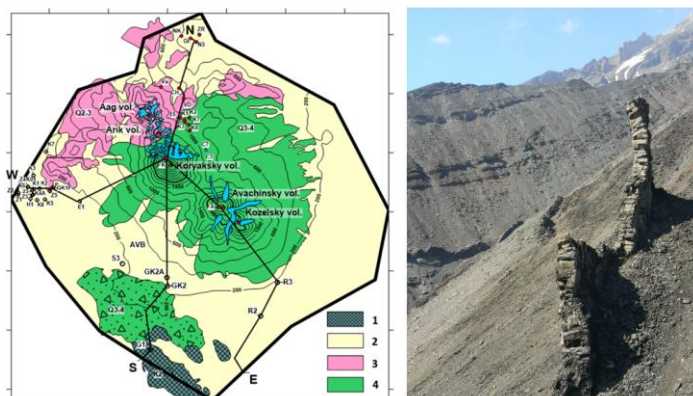


Figure 4. Geological map of the Koryaksky–Avachinsky volcanogenic basin (left) and dyke field in the south slope of Koryaksky volcano (right). Legend and explanations in [4], [5].



### Field Trip 3: Valley of Geysers

The field trip lasts 10 hours (from 9-00 to 21-00). Number of participants is up to 20. Helicopter MI-8 flights are supported by «Vityaz-Travel» <http://vityaz.travel/valley> **Route points:** IVS FEB RAS – Nikolayevka Heliport – Valley of Geysers – Uzon Caldera – Nalychevsky Hot Springs – Nikolayevka Heliport – IVS FEB RAS. Each group is accompanied by a qualified guide. Hot meals are supplied during this field trip. Swimming in a Nalychevsky hot springs is available. IVS FEB RAS will support transfer to the Nikolayevka heliport. **The trip costs 70 000 rubles per one participant (the price is for the year 2023).**

*Since discovering by Tatiana Ustinova in 1941 to 2021 the Valley of Geysers monitoring (Kamchatka, Kronotsky Reserve) reveals a very dynamic geyser behavior under natural state conditions: significant changes of IBE (interval between eruptions) and power of eruptions, chloride and other chemical components, and pre-eruption bottom temperature. These changes are caused by redistribution of the thermal discharge due to Giant Landslide of June 3, 2007, Mudflow of Jan. 3, 2014 and other events of geothermal caprock erosion and water injection into the geothermal reservoir. Temperature logging in geysers Velikan (1994, 2007, 2015-2019) and Bolshoy (2015, 2016-2019) conduits shows pre-eruption temperatures below boiling at corresponding hydrostatic pressure, meaning that CO<sub>2</sub> and non-condensable gases creates gas-lift conditions for geysers eruptions. Over the observation period from 1941 to 2013. IBE of the Giant geyser is characterized by a gradual increase from 3 to 6.5 hours. Mudflow of Jan. 3, 2014 reshaped the Velikan geyser's conduit and diminished its fountain height.*

*A new geyser (named Shaman) formed in the Uzon caldera (Kronotsky Federal Nature Biosphere Reserve, Russia) in autumn 2008 from a cycling hot Na-Cl spring. The geyser is a pool-type CO<sub>2</sub>-gas lift driven. From 2012 to 2018, the geyser has shown a rather stable interval between eruptions (IBE) from 129 to 144 min with a fountain height up to 4 m, and the geyser conduit has gradually enlarged.*

[7. Kiryukhin A.V., Polyakov A.Y., Zhuravlev N.B., Tsuchiya N., Rychkova T.V., Usacheva O.O., Dubrovskaya I.K. Dynamics of Natural Discharge of the Hydrothermal System and Geyser Eruption Regime in the Valley of Geysers, Kamchatka // Applied Geochemistry 136\(2022\) 105166 https://doi.org/10.1016/j.apgeochem.2021.105166](https://doi.org/10.1016/j.apgeochem.2021.105166)

[8 A.V. Kiryukhin, A.V. Sergeeva, O.O. Usacheva. Modeling of the thermal-hydrodynamic and chemical regime of Geyser reservoir \(Valley of Geyser, Kamchatka\). Geothermics, 2023, article 102808.](#)

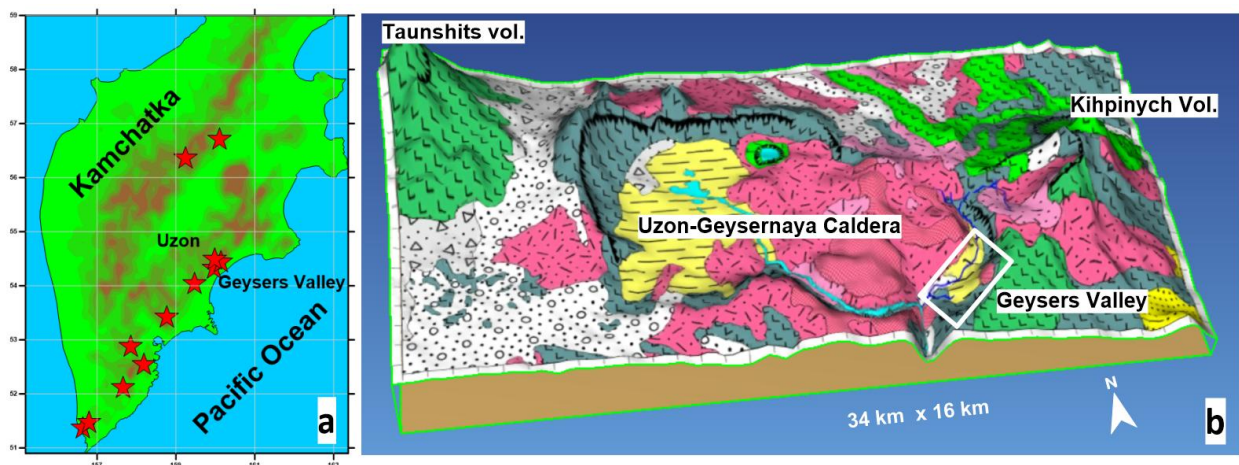




Figure 5. High-temperature hydrothermal systems of Kamchatka (Left) and schematic 3D image of the Uzon-Geyser Caldera (Right). Legend and explanations: see. [6]

#### (4) Volcanological Museum of the Institute of Volcanology & Seismology FEB RAS

One hour during technical session days (time TBD).



#### (5) TOUGH Modeling Training Seminar\* - September 02, 2024, 09:00 to 17:00

**Cost:** 15000 rubles (non-refundable, meals included). Cost includes a sandwich/salad lunch, hot and cold beverages throughout the day, and two snack breaks.

**Where:** Institute of Volcanology and Seismology FEB RAS, large conference hall

**Leader:** A.V. Kiryukhin, **Instructors:** N.B. Zhuravlev, O.O. Usacheva, A.V. Sergeeva

**\*This is a practical seminar in the classroom. It is NOT available online.**

*The seminar will cover the basics of TOUGH2 and TOUGHREACT modeling using PetraSim software.*

*Lecture/exercise topics include:*

- Conceptual models
- Mesh generation
- Materials properties
- Initial and boundary conditions
- Results visualization
- Examples: basic model of a hydrothermal system, hydrothermal circulation in an isolated fault, single well operation.

#### THE REGISTRATION AND SUBMISSION PROCEDURE FOR THE PROCEEDINGS

To participate in the conference it is required to **register** on the conference website, after that the participant's personal cabinet will be opened. After logging in you need to fill the participant **registration form** (full name, organization, academic degree, student/postgraduate status), after that you will be able to **add a paper**, selecting the section, entering the title of the paper and authors.

**The GVV-2024 organizing committee notes that the paper should be submitted by the co-author who plans to present it at the conference.** Only papers presented at the conference by one of the co-authors will be published in the conference proceedings.

**There is no possibility to participate on-line.**

After registering the paper title, the participant can edit the data, specify the title and the list of co-authors, and upload a file with the text of the paper.

**The rules for the paper layout are available at the link.**

The conference proceedings will be indexed in the Russian Science Citation Index, a national scientific information and analytics system.

The GVW2024 Organizing Committee reserves the right to reject papers that do not comply with the conference theme and/or layout rules.

## **REGISTRATION FEES**

**The amount of the organizational fee is 7000 rubles.** The fee includes participant's kit, coffee breaks, publication of conference materials in digital format.

**For full-time undergraduate and postgraduate students the organizational fee is 2 000 rubles.** Student/postgraduate status must be stated when filling in the registration form on the conference website.

**Payment of the organizational fee for participation in the conference is carried out under the contract.** To conclude the contract the participant should download **the contract** template, fill it out and send it to the Organizing Committee e-mail [geothermalvolcanology@mail.ru](mailto:geothermalvolcanology@mail.ru).

After the registration of the contract, the participant will receive an e-mail with information on how to pay the organizational fee. Upon arrival at the conference, the participant will be given the originals of all the documents, as well as the acceptance certificate of services provided.

**Payment of the Registration Fee directly at the conference in cash is not provided.** The organizational fee will not be refunded in case of impossibility to participate in the conference. The participant's kit will be sent by mail.

For more detailed information on how to pay the organizational fees, please visit the conference website in the **Registration Fee**.

**Transport:** There are direct flights to Petropavlovsk-Kamchatsky from Moscow, Novosibirsk, Irkutsk, Vladivostok, Khabarovsk and Yuzhno-Sakhalinsk (Aeroflot, Rossiya, Aurora and S7 airlines). Some flights do not operate daily, check the schedule on the [Yelizovo International Airport website](http://pkc.aero) (pkc.aero), as well as on the airlines' websites.

Air ticket from Moscow to Petropavlovsk-Kamchatsky and back at the end of August costs approximately 40000 rubles (round trip). Please note that due to the time zone gap, flights from Moscow (and not only) arrive in Kamchatka the day after the day of departure. Be careful when buying air tickets!

From Yelizovo airport to Petropavlovsk-Kamchatsky there are shuttle buses № 102 and № 104. You can also order a taxi cab via Yandex.Go, the cost of the trip is 800-900 rubles.

For navigation in the city you can use 2GIS [https://2gis.ru/p\\_kamchatskiy](https://2gis.ru/p_kamchatskiy) and Yandex Maps <https://maps.yandex.ru/>

**Weather:** The beginning of September in Petropavlovsk-Kamchatsky is usually sunny with a temperature of +16 °C, but the possibility of a rain is not ruled out.

**Accommodation:** Reservations and payment for accommodation are made by the conference participants themselves.

Hotels located closest to the conference venue:

Hotel «Petropavlovsk», Karl Marx Ave. 31A, <https://www.petropavlovsk-hotel.ru>

Hotel «Geyser», Toporkova St. 10, <https://www.geyser-hotel.ru>

Mini-hotel «Peninsula», Abelya St., 41, <https://poluostrov-hotel.ru>



Hotel «Arsenyev», Arsenyeva St., 1 <https://hotelkam.ru/>  
 Other possible booking options can be found on the websites:  
<https://www.sutochno.ru/> <https://www.avito.ru/> , <https://www.ostrovok.ru>

If you have any questions about the registration procedure, submission of materials and payment of organizational fees, please contact the Organizing Committee at [geothermalvolcanology@mail.ru](mailto:geothermalvolcanology@mail.ru).

**Support:** The organizers expect support from the Russian Science Foundation, Teplo Zemli JSC, Kamchatskenergo PJSC, Gazprom Invest JSC.

For all questions concerning the organization of the meeting, contact Evgenia Chernykh and Olga Usacheva [geothermalvolcanology@mail.ru](mailto:geothermalvolcanology@mail.ru)

Look also on the website of IVS FEB RAS:

<http://www.kscnet.ru/ivs/conferences/GeothermVolc2024/en/index>

### IMPORTANT DATES

**Registration and submission of paper title:** January 15, 2024 - June 01, 2024.

**Submission of extended abstracts:** January 15, 2024 - August 01, 2024.

**Contract conclusion, fee payment:** January 15 - August 01, 2024.

**Conference:** September 02 - September 08, 2024.

### EXTENDED ABSTRACTS

Extended abstracts are indexed in RSCI.

The text volume of extended abstracts should be no more than four A4 pages (including tables, figures and references). The basic layout requirements in [the form of a template for abstracts](#) can be found on the conference website in the "Materials Submission" section.

**Presentations in \*.pptx format** should be sent to [geothermalvolcanology@mail.ru](mailto:geothermalvolcanology@mail.ru), **not later than September 01, 2024**. The recommended filename to send is: **Name\_Title of presentation\_v#.pptx**. Time for oral presentations: 20 minutes total (15 minutes presentation + 5 minutes for discussion)

### GVW-2024 and Field Trips schedule

Date	Event Location and time	Location and time
September 02, 2024	TOUGH Modeling Training Seminar	IVS FEB RAS, Conference hall, 9:00 -17:00
September 02, 2024	Participant registration	IVS FEB RAS, office 215, 9:00 - 18:00
September 03-04, 2024	Participant registration Presentation of papers	IVS FEB RAS, Conference hall, 09:00 -18:00
September 05-06, 2024	Field Trip 1	Mutnovsky and Paratunsky geothermal areas, 05.09.2024 07:00 – 06.09.2024 21:00
September 07, 2024	Field Trip 2 (2A or 2B or 2C depending on weather conditions)	2A – Avachinsky volcano, 2B – Dike fields (by land), 2C - Dike fields (by sea) 07:00 – 21:00
September 08, 2024	Field Trip 3	Valley of Geysers, 08:00 – 19:00