

Geothermal Volcanology Workshop 2023

Institute of Volcanology and Seismology, Far Eastern Branch, Russian Academy of Sciences,
Petropavlovsk-Kamchatsky, September 04 – September 10, 2023

However, depending of COVID-19 situation, it will have to be partially a virtual meeting



Kamchatka, Russia
04 - 10 September, 2023



Geothermal Volcanology Workshop 2023 will be held from **September 04 to September 10, 2023** 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 in volcanic and non-volcanic areas
- 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. Bo Cheng (Jilin U., China), Dr. Prof. N. Tsuchiya (Sendai U., Japan) (Co-Chair), Prof. J. Eichelberger (SMU, USA), Dr. G.A. Karpov (IVS FEB RAS), Dr. G.N Kopylova (KB FRC UGS RAS), Dr. T. Korovina (JSC «Coretest Services», Tyumen), Dr. I.F. Delemen (IVS FEB RAS).

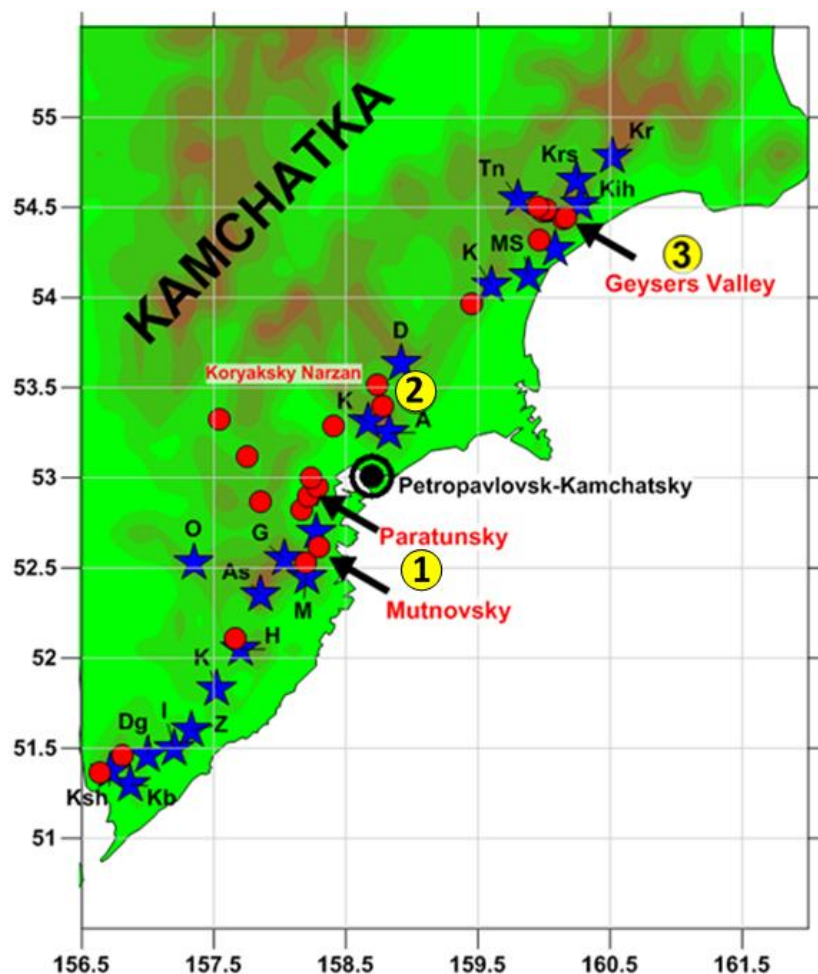
Technical Organizing Committee:

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

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 & Thermal Mineral Springs, (3) Valley of Geysers, (4) Dykes of the Lagernaya Bay & Pacific Ocean Beach (P-Kamchatsky). Field trip (1) with overnight stay at the "Rodnikovaya" base on September 07/08. Field Trips will be offered depending on demand. Please indicate your interest(s) in advance.



(1) Mutnovsky and Paratunsky Geothermal Areas

This field trip lasts 2 days (07-08 September 2023). Number of participants is up to 20. Transport (car+walk), map and route points (Figures 2 & 3): IVS FEB RAS – V-Paratunsky hot springs – IVS FEB RAS (track-car); V-Paratunsky hot springs – Vilyuchinsky Volcano – Gorely Volcano caldera – night stay at Rodnikovaya – waterfall “Ice Leopard» - Mutnovsky geothermal field – Blowing Well - Mutnovsky Volcano Crater (view from above) – “Little Geysers Valley” (Dachny thermal springs) - IVS FEB RAS. Everyday 2 meal stops (lunchbox + tea), breakfast & dinner. Price 15 000 rubles per one participant. Prepayment at registration desk.

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 (δD , $\delta^{18}\text{O}$) of production wells at an earlier stage of development. The Mutnovsky (Dachny) 260-310°C high-temperature production geothermal reservoir with a volume of 16 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 MW, 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](#)



Mutnovskaya 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.

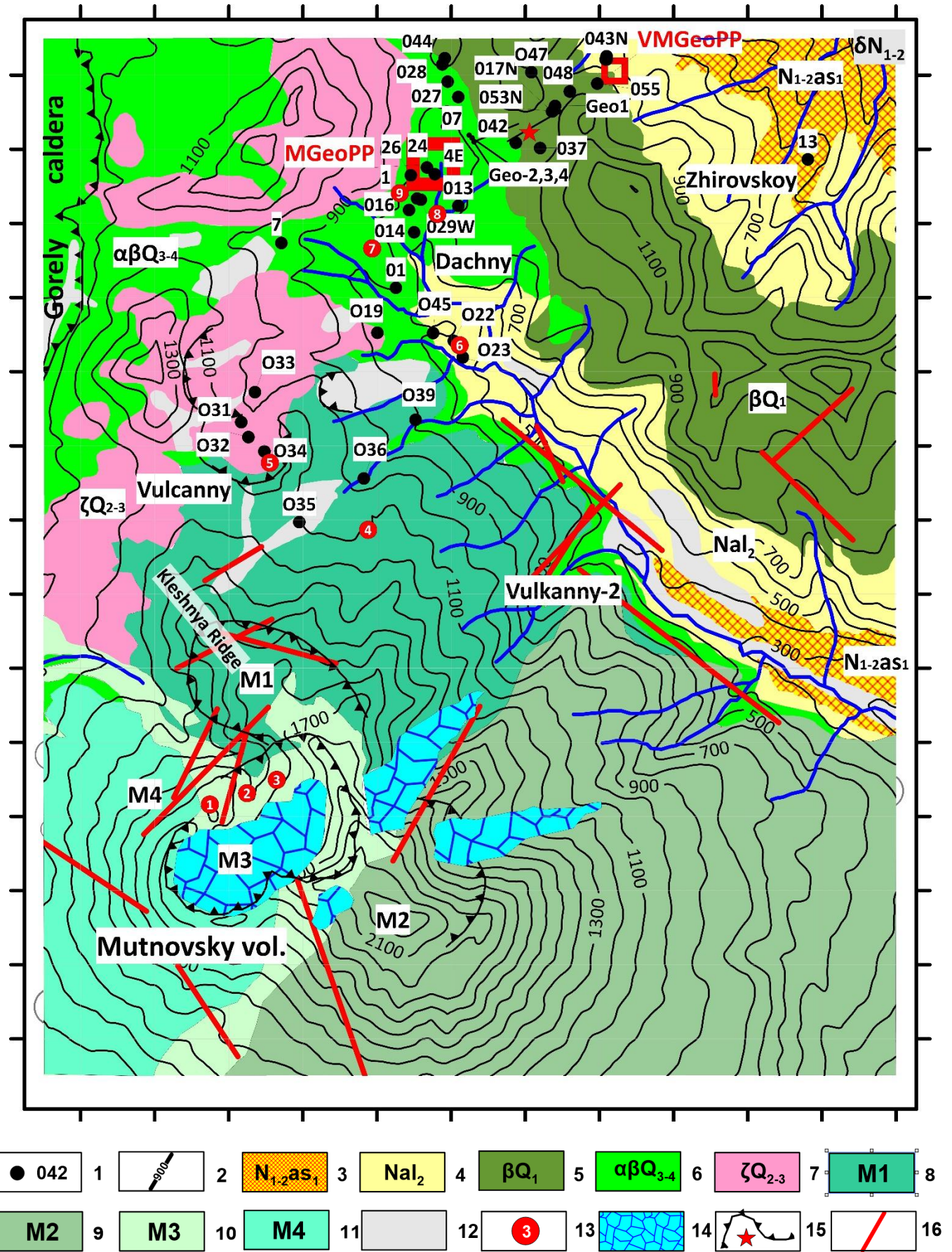


Fig. 2. Map of the Mutnovsky geothermal area. Legend and explanations: see. [2].

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-SO₄-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 km³ Paratunsky low temperature (80-110°C) geothermal volcanogenic reservoir includes three hot water upflow regions. Water isotope and gas (N₂, 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. 07/08 during Field Trip 1.

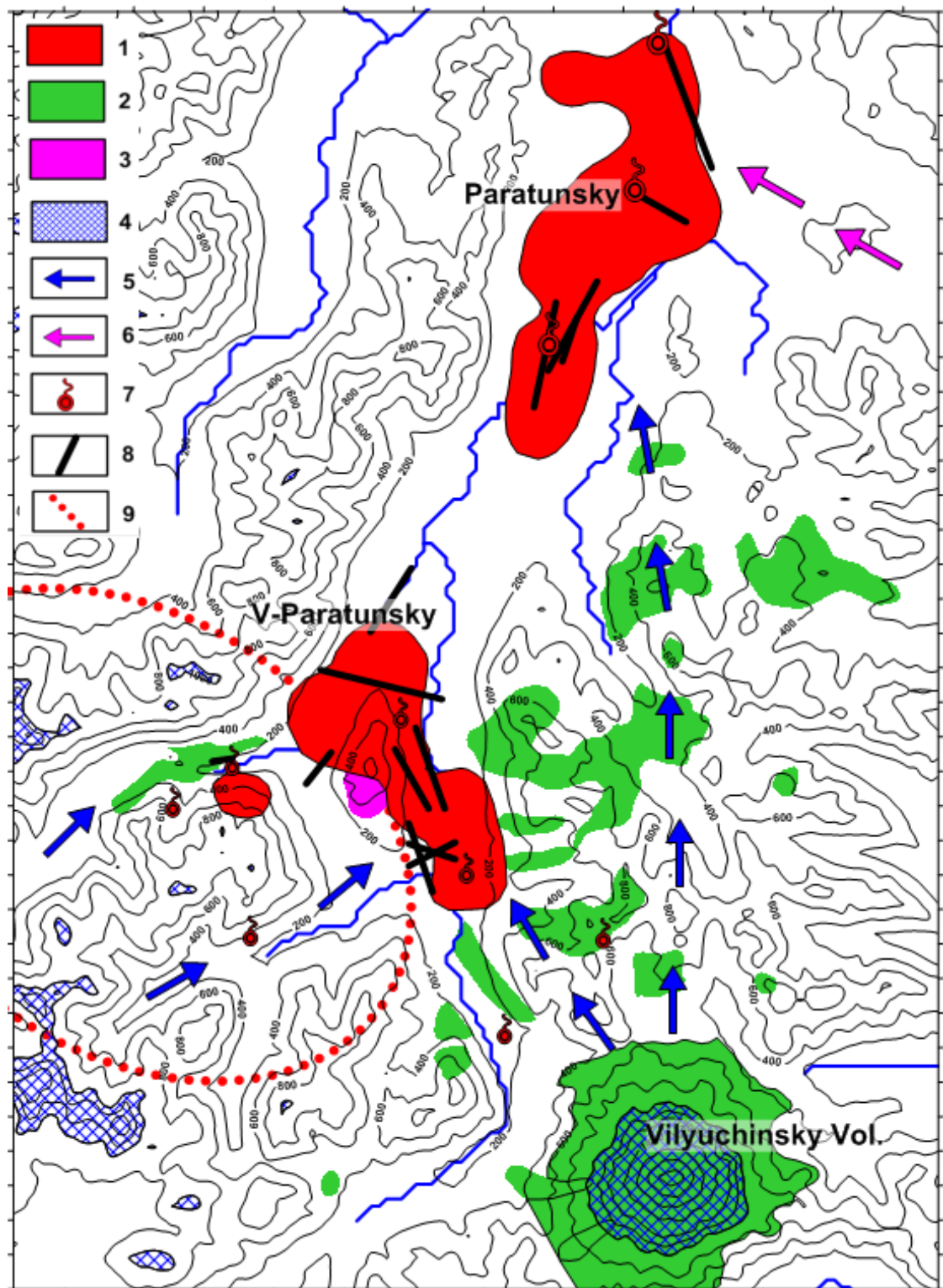


Figure 3 Paratunsky geothermal fields thermo-geo-filtration structure and recharge conditions, with topographical elevations shown, grid scale 1 km. Legend: 1 – counters of production geothermal reservoirs at -750 masl based on geoisotherm 75°C (Paratunsky) and 60°C (Verkhne-Paratunsky); 2 – Holocene 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).

(4) Avachinsky Volcano & Koryaksky Volcano's Dyke Fields & Thermal Mineral Springs

The Avachinsky-Koryaksky volcanogenic basin (Figure 1), which has an area of 2530 km², 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.

Excursion to Avachinsky volcano is possible if there are favorable weather conditions on September 09, 2022. 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 1): IVS FEB RAS – Avachinsky Base /IVS Base (AVH) – 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 (AVH) – IVS FEB RAS. 2 meal stops (lunchbox + tea). Price 7500 rubles per one participant. Prepayment at registration desk.

Alternative options are: (1) Field trip to dyke field on south foothills of Koryaksky vol. (8 hr walk); (2) Optional trip on helicopter Robinson 44 (2 passengers + 1 guide). Flight route Nikolaevka airport - Dyke field on the south slope of Koryaksky volcano –Koryaksky Narzan (K2) – Koryaksky Narzan (K1) – Isotovskiy Hot Spring (IS) - Nikolaevka. The helicopter trip costs 60 000 rubles/per one helicopter hr (2022), approximate duration is 1.5 hr.

[4] [Kiryukhin A., Lavrushin V., Kiryukhin P., Voronin P. "Geofluid Systems of Koryaksky-Avachinsky Volcanoes \(Kamchatka, Russia\)," Geofluids, vol. 2017, Article ID 4279652, 21 pages, 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](#)

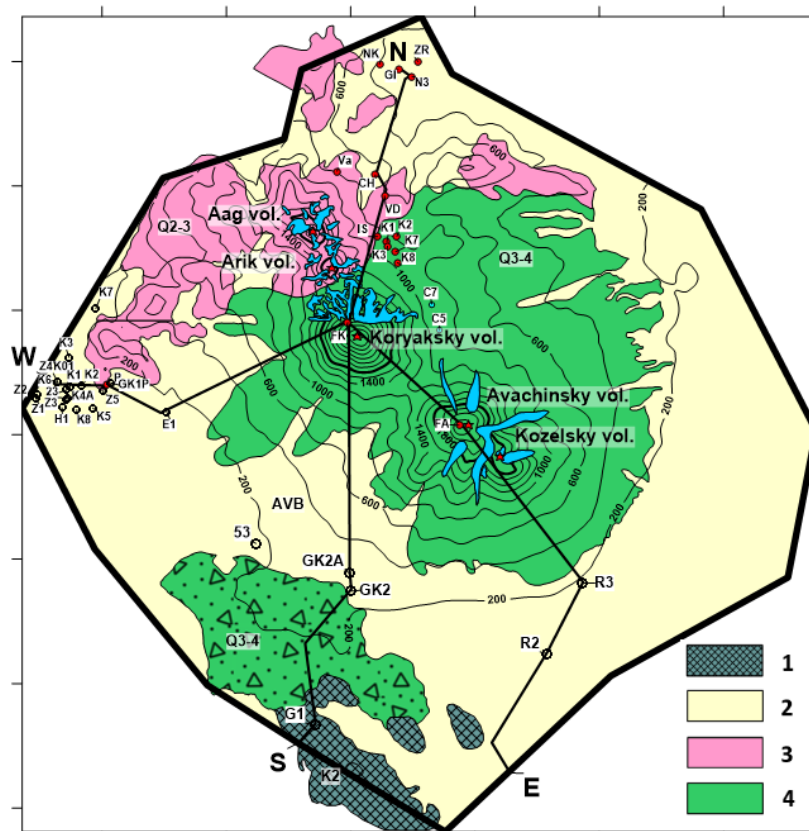


Figure 4 Geological map of the Koryaksky–Avachinsky volcanogenic basin. Legend and explanations in [4], [5].

(3) Valley of Geysers

The field trip lasts 10 hours (from 9-00 to 21-00). Number of participants is up to 40. Helicopter MI-8 flights are supported by «Vityaz-Travel» <http://vityaz.travel/valley> Nikolayevka Airport – Valley of Geysers – Uzon Caldera – Nalychevsky Hot Springs - Nikolayevka Airport. 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 supported transfer to Nikolayevka airport. The trip costs 55 000 rubles per one participant (in 2022 year).

Since discovering by T. 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 CO₂ 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 CO₂-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

[6] [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)

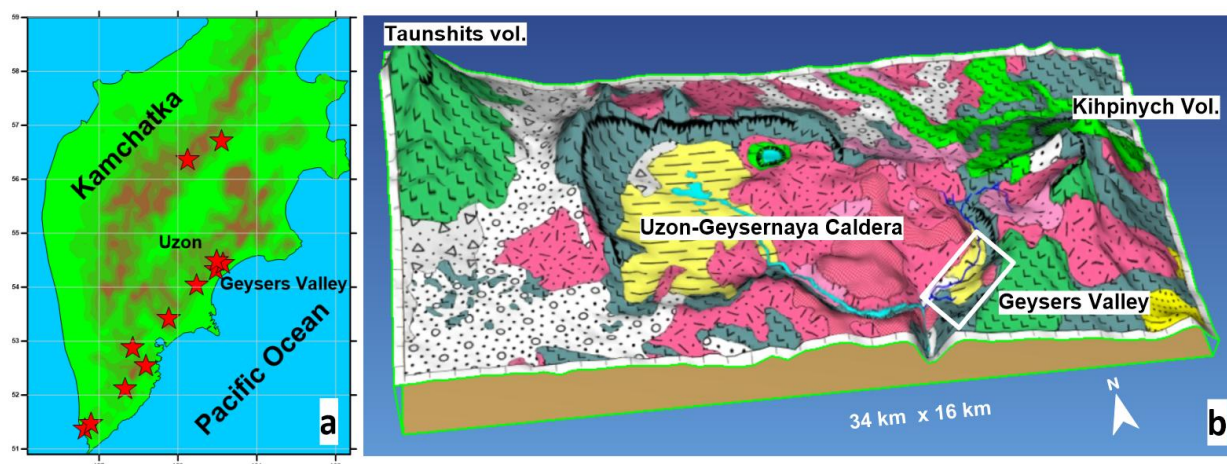


Fig. 5. High-temperature hydrothermal systems of Kamchatka (fig. left) and schematic 3D image of the Uzon-Geyser Caldera (fig. right). Legend and explanations: see. [6]

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

One hour during technical session days (time TBD).



Transport: Daily flights between Moscow and Petropavlovsk-Kamchatsky, frequent flights from, Khabarovsk and Vladivostok. Participants from Japan and China can take flights through Vladivostok or Khabarovsk.

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.

Cost: Workshop registration fee: **7000 rub.** (includes the expenses for organization and conducting of the workshop and general events).

Accommodation: Hotels "Arseniev", "Petropavlovsk", "Avacha" and "Oktyabrskaya". The most inexpensive rooms (about \$ 100) .

Support: The organizers anticipate support from the Russian Science Foundation (RSF), Russian Foundation for Basic Research (RFBR), JSC Teplo Zemli, JSC KamchatskEnergO, International Geothermal Association (IGA).

For all questions concerning the organization of the meeting, contact Evgenia Chernykh and Olga Usacheva GeothermalVolcanology@mail.ru

Look also on the website of IVS FEB RAS:

<http://www.kscnet.ru/ivs/conferences/GeothermVolc2023/en/index>

Short Abstracts

Abstract submission is until **June 1, 2023.**

Abstract submissions should be 0.5 page or less, and include title, author(s), author(s) affiliation, author(s) email, and abstract text. Please do not include any graphics.

Abstracts should be uploaded to the conference website

<http://www.kscnet.ru/ivs/conferences/GeothermVolc2023/en/abstracts>

upon registration and also sent by e-mail to GeothermalVolcanology@mail.ru

Short abstracts will be reviewed with regard to scientific quality and suitability for the conference. Accepted abstracts will be designated for either oral or on-line presentation at the

discretion of the organizing committee. Each presenting author is generally allowed one paper as a first author at the conference.

The notification of acceptance of abstracts will be sent by **July 1, 2023**.

Extended Abstracts

FORMAT and LENGTH: Extended Abstracts should be **4 pages**, 12 point Times New Roman, 1-inch margins. This length includes all figures, tables and references. Basic requirements for the design of extended abstracts on the conference website in the tab Submissions (template for the design of abstracts).

The due date for submitting extended abstracts will be **August 1, 2023**.

Presentations in video recording format (mp4) lasting 15 minutes must be e-mailed to GeothermalVolcanology@mail.ru no later than August 25, 2023.

Recommended name for your mp4-file upload: **Name_Title of presentation_v#.mp4**

TIME ALLOTTED for Oral Presentations: 20 minutes total (15 minutes talk + 5 minutes for discussion)

Schedule of the GVW-2023 and Field Trips

Date	Event	Time & Place
September 04, 2023	Registration	IVS FEBRAS, room 215, 9:00 -18:00
September 05-06, 2023	Registration (continues) Technical Sessions	IVS FEBRAS, Large Conference Hall,9:00 -18:00
September 07-08, 2023	Field trip 1	Mutnovsky & Paratunsky Geothermal Areas, 07.09.2023 07:00 – 08.09.2023 21:00
September, 09 2023 if weather conditions are favorable	Field trip 2	Avachinsky Volcano & Koryaksky Volcano’s Dyke Fields and Thermal Mineral Springs , 7:00 – 21:00
September, 09, 2023	Field trip 3	Valley of Geysers, 9:00 – 19:00
September, 10, 2023	Reserve Day: Field Trip 2, Field Trip 3	