Geothermal field training

Summary report

June 12-July 6, 2024

With the financial support of the DAAD-SDG project of the German Academic Exchange Fund, field training in geothermy was held from June 12 to July 6, 2024. The training, conducted over a total of 6 days in three stages, was supervised by Professor George Melikadze of the Technical University of Georgia, President Georgian Geothermal Association and assisted by Nino Kapanadze, a scientist-researcher at the M. Nodia Institute of Geophysics, PhD student.

The training included a lecture course in geothermal energy and visits to the geothermal wells of Western Georgia, Samtskhe-Javakheti, and Tbilisi. Participants conducted on-site measurements and took samples for chemical and isotopic analysis. Seven students from the Technical University of Georgia participated: Master's student Elene Chikviladze and six bachelor's students: Luka Asanidze, Nini Kuprashvili, Eka Khetsuriani, Lasha Menabdishvili, Mate Beridze, and Lizi Elizbarashvili.

In addition to the lecture course and sampling, the training included visits to cultural monuments. This experience was invaluable for the students, as they developed both teamwork skills and general fieldwork habits.

Field surveys and sampling were preceded by the selection of geothermal wells to be sampled. After the selection, a map was created in GIS to obtain their locations and plan a favorable route. A total of 22 wells were selected. During the field trip, students were provided with information about commonly accepted modern methods and techniques for researching underground and surface water. These methods are integrated into the modern course of hydrogeophysics and allow the study of water genesis, movement direction, pollution, and thermal and hydrochemical regimes.

After a general introduction to the basics of geothermal energy, students were shown the water sampling procedure at the very first geothermal well. This included bottle preparation, labeling, direct sampling, and preparation for transportation. Additionally, the measurement of volatile physical parameters of the sampled water was demonstrated using the portable field laboratory WTW 197i, along with its calibration process.

The maps, the catalog and the table of physical parameters of the visited geothermal wells are presented as an appendixes.

Field Studies - Testing of Water Points

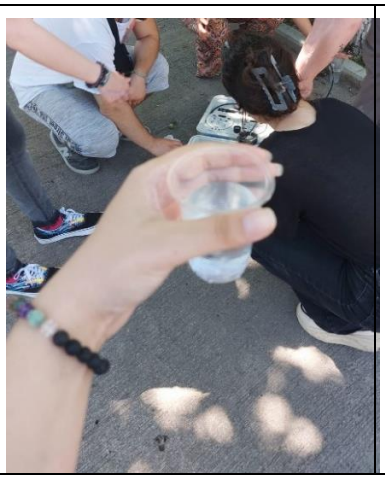
Field research began on June 12 with the departure from Tbilisi towards Samtskhe-Javakheti. To develop field skills for students, all available information about each well (including well name, depth, drilling years, and depth and capacity of the aquifer) was collected and recorded in a field log at each location. The GPS coordinates of each well

were marked, and photographs were taken. In the next stage, sampling was carried out according to the protocol. Unstable parameters of water, such as pH, temperature, electrical conductivity (EC), salinity, and oxygen content, were measured using a portable field laboratory. This process was conducted by all students to ensure hands-on learning.

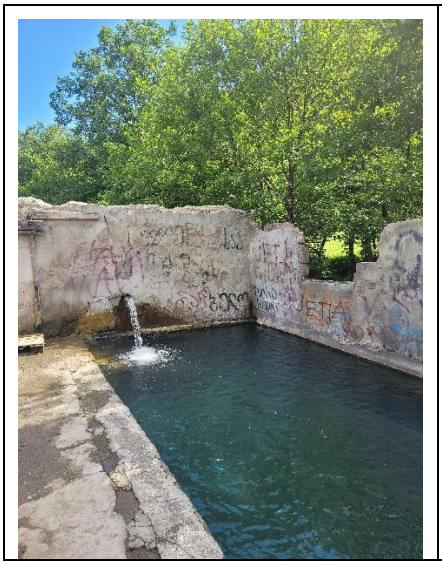
1. The first location was Borjomi (Kvibisi) well N25. After sampling, the physical parameters of the water, such as pH, temperature, electrical conductivity (EC), and salinity, were measured on-site using a WTW multimeter.

2. The second location visited was Borjomi well N41, where the students also tasted raw Borjomi water directly from the well. Coordinates were recorded, and a water sample was taken for chemical and isotopic analysis. Physical parameters were also measured.





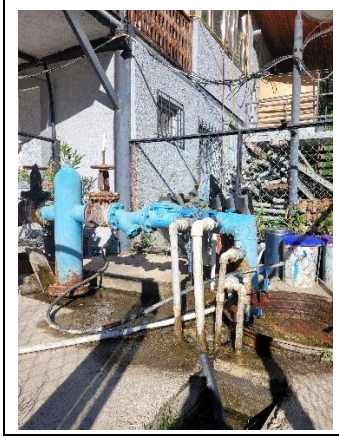

3. The third location visited was the village of Tsinubani to see the next thermal well, where only the ruins of the thermal bath remain. The water temperature was a pleasant 38.8 degrees Celsius. Coordinates were recorded, water was sampled, and physical parameters were measured here as well.

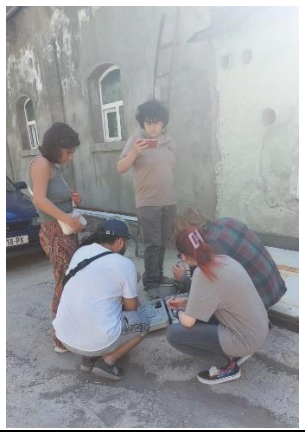


4. The next stop was in Akhaltsikhe at the thermal well, where there is a carbon dioxide factory and a small, modest spa center. Coordinates were recorded, water was sampled, and physical parameters were measured here as well.

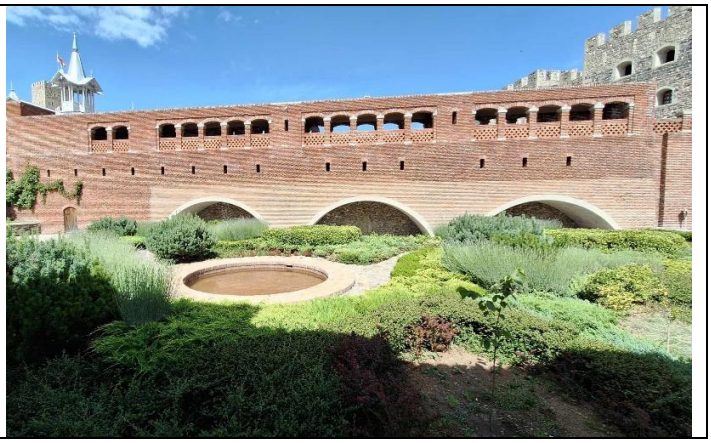


5. Next, we visited Abastumani and its famous royal bath. The bath is still functional, allowing us to take a water sample directly from the well. Coordinates were recorded, a water sample was collected, and physical parameters were measured.





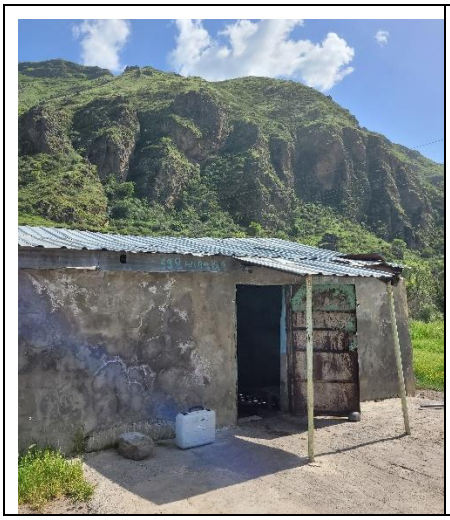

In the evening, we stayed at a hotel in Akhaltsikhe, and the students visited the night fortress of Rabat.

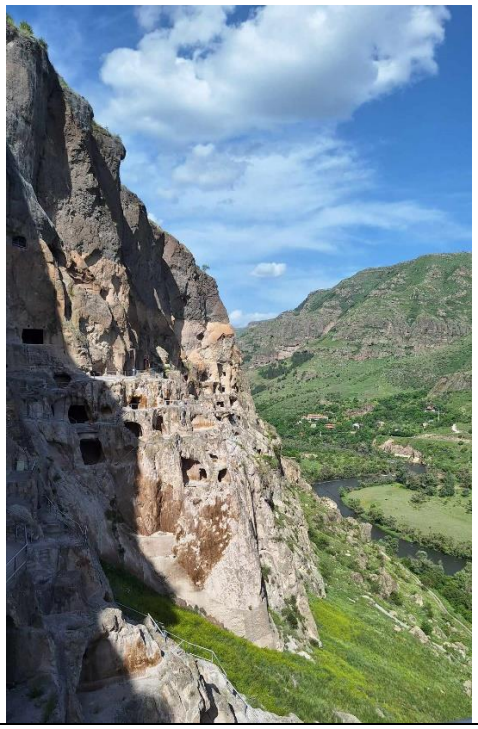

6. On June 13, we departed for Vardzia. The first well we visited is characterized by high carbon dioxide content and high salinity.

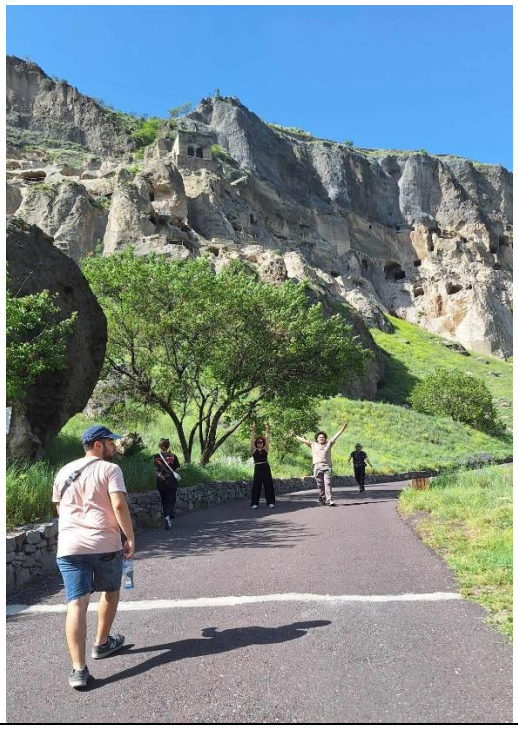


7. Nearby, we also visited a second existing well where an improvised pool is set up on the remains of the bath. Coordinates were taken, water samples were collected from both locations, and physical parameters were measured.

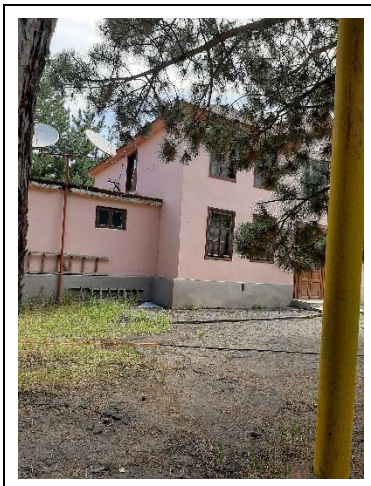


The students visited Vardzia's cave-city and were highly satisfied.





8. On the way to Akhaltsikhe, we visited the Aspindza thermal well, took a water sample, recorded coordinates, and measured the physical parameters of the water."



9. On June 14, we visited the sulfur bath of Tmogvi, which, like everywhere else, is in a deplorable condition. Coordinates were recorded, water samples were taken, and physical parameters were measured

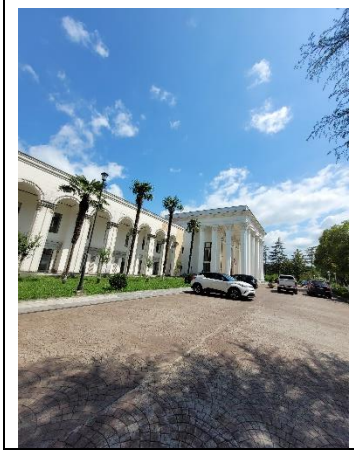
10. The next stop was the Nakalakevi carbon dioxide plant, where we followed the same procedure: coordinates were recorded, water was sampled, and physical parameters were measured.

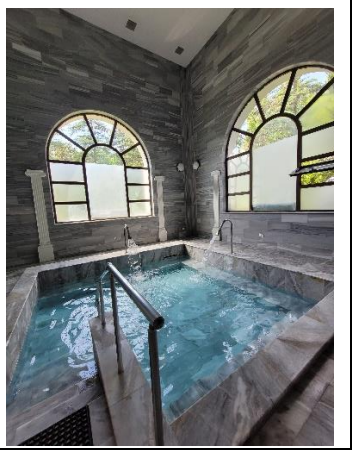


On both evenings, Giorgi Melikadze gave a presentation-lecture to the students on the research and evaluation of geothermal deposits using current and implemented projects as examples. This concluded the first stage of the training, after which we returned to Tbilisi.

In the second stage, on June 19-20, we traveled to Western Georgia with the objective of demonstrating the transformation conditions of low-temperature thermal waters from Tskaltubo into high-temperature thermal waters in Zugdidi-Tsaish and Samtredia-Vani. The field testing procedure remained consistent.

11. The first location was Tskaltubo, where we visited the historical building of the famous treatment-rehabilitation center - the legendary "No. 6 Spring". Here, we were introduced to the proposed procedures and explored the park and its wells. Samples were taken, coordinates were recorded, and measurements were made at the source. Due to Tskaltubo's thermal waters containing radon, an additional sample was taken to determine radon concentration. In the evening, Elene Chikviladze organized a demonstration of radon concentration measurement using Alphaguard for the students. This was particularly relevant as radon waters in Tskaltubo are the focus of her master's thesis. Elene also provided general information about radon, its distribution, and associated risks



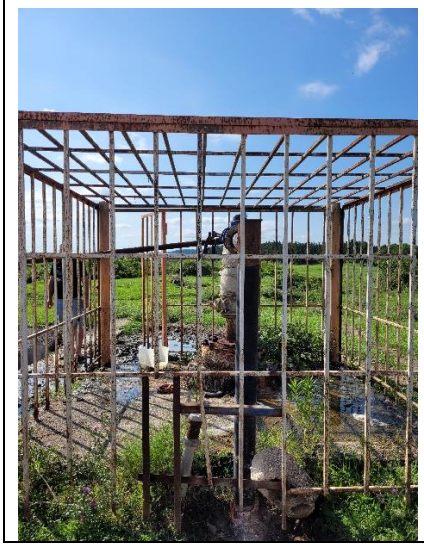




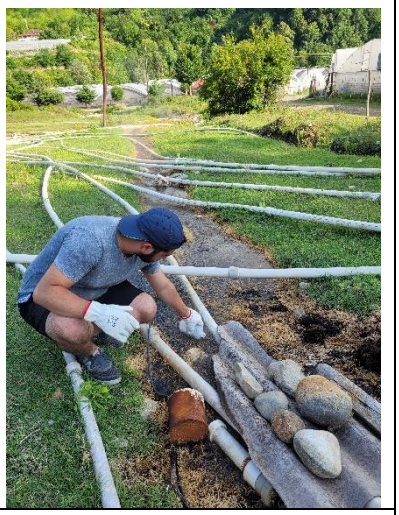


The next stop was the Samtredia well, but we were unable to access it due to the owner of the well being unreachable.

12. We continued to Khobi, where high-temperature thermal water is utilized in greenhouses. We recorded coordinates, sampled water, and were graciously treated to delicious cucumbers grown in the greenhouse by the owner.

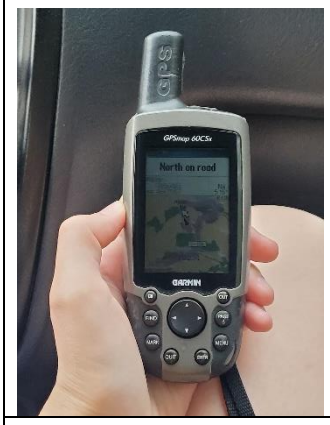


13. 14. 15. After that, we moved towards Zugdidi. On the way, we stopped in Tsaishi, where we visited three wells. Unfortunately, like in Khobi, we couldn't measure the physical parameters of the water on-site due to device temperature limitations. However, we collected samples and recorded coordinates.
    During our visit, we visited Tsaishi's public school, which uses water from well 10 through a geothermal circulation system for its heating and hot water supply. This project was funded by USAID and is still operational today.



After a tiring day, we stayed at the hotel. The next day, on June 20, after breakfast, Giorgi Melikadze gave a lecture to the students on the use of geothermometers and natural isotopes in the research of geothermal reservoirs.


16. After the lecture, we set off, and our first stop was the thermal well of Chagan-Chvish. We recorded coordinates, collected water samples, and measured physical parameters.

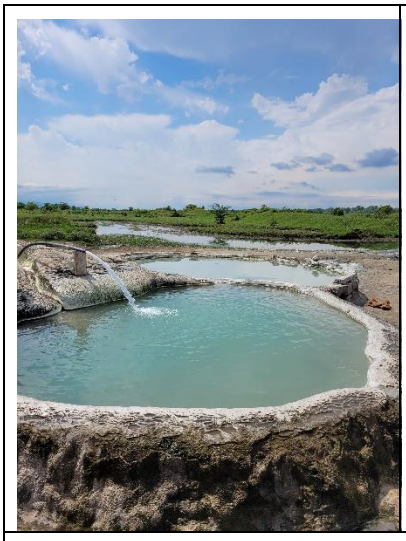




17. The next stop was at the tsikhe-Sulori thermal well. Again, coordinates were recorded, water samples were taken, and physical parameters were measured.



18. We approached the Dikhashkho thermal geyser, recorded coordinates, sampled water, and measured physical parameters.




Unfortunately, we could not visit the well in Vani due to our inability to contact the owner.

19. We visited the well of the former baths in the village of Amagleba. The area and the building are in a deplorable condition. Coordinates were recorded, water samples were taken, and physical parameters were measured.

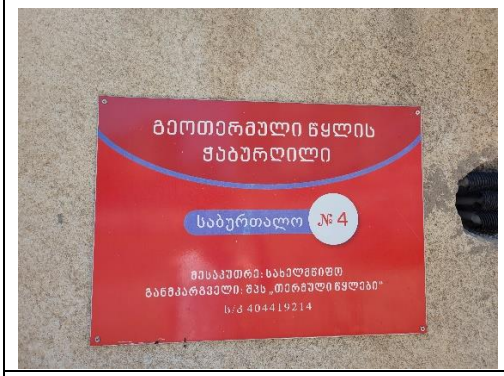
After concluding the second stage of field training in Western Georgia, we departed for Tbilisi.

Tbilisi

20. Lisi Well N5

On July 6, during the final stage of the training, we visited Well N5 in the Lisi geothermal area. Following a brief informational lecture, coordinates were recorded, water samples were taken, and physical parameters were measured."

21. After Lisi, we visited Well N4 in the Saburtalo geothermal area, where we recorded coordinates, took water samples, and measured physical parameters.





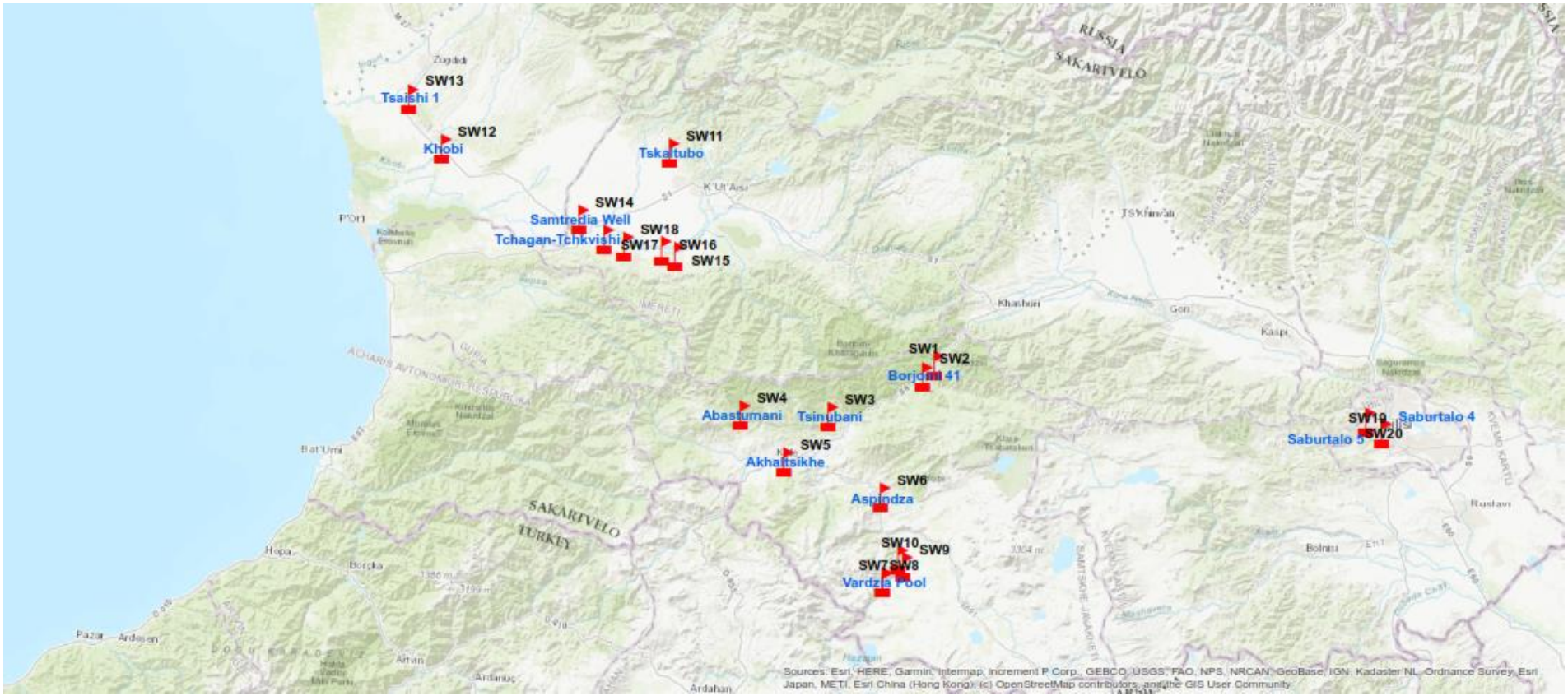


After completing all three stages of field training, a catalog of sampled thermal wells and a table of measured physical parameters were measured.

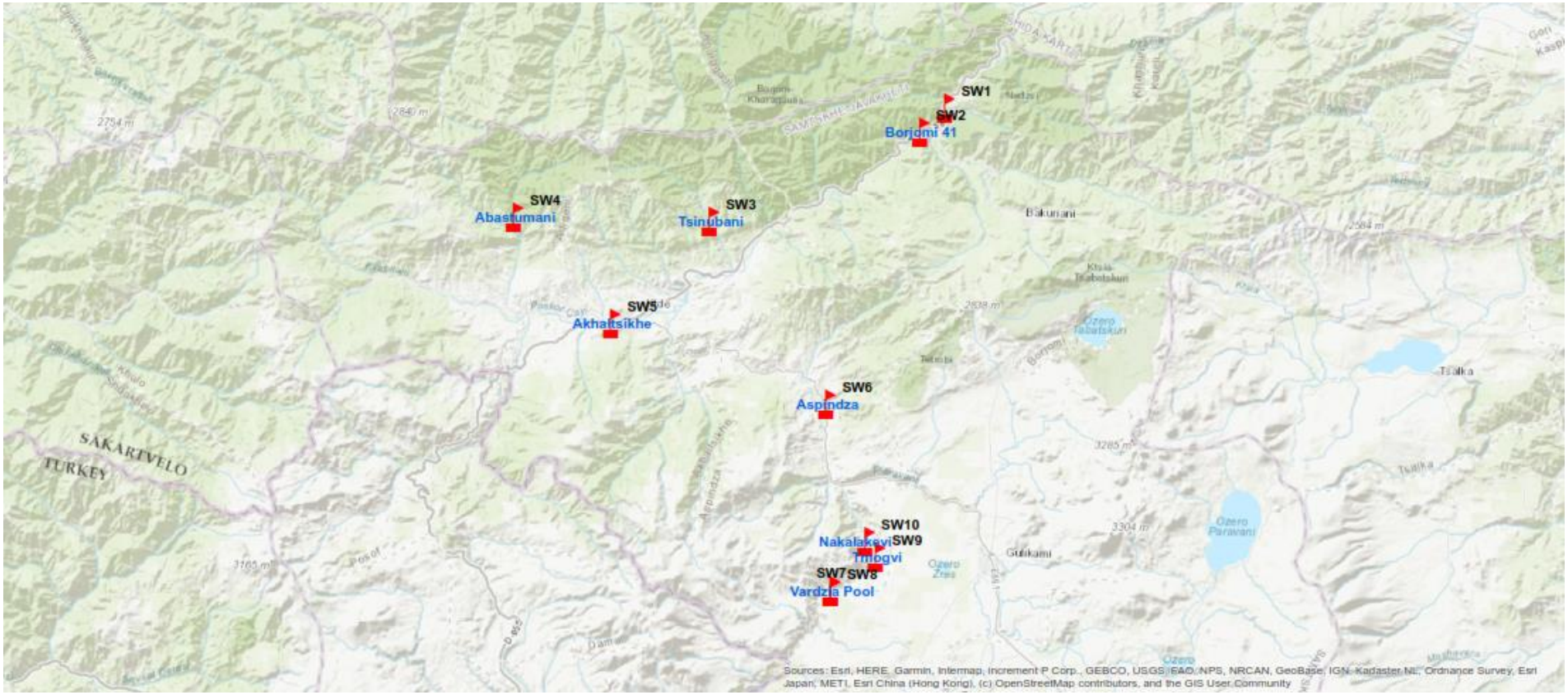
In conclusion, the training was evaluated by the students as interesting, useful, and informative.

Appendix 1

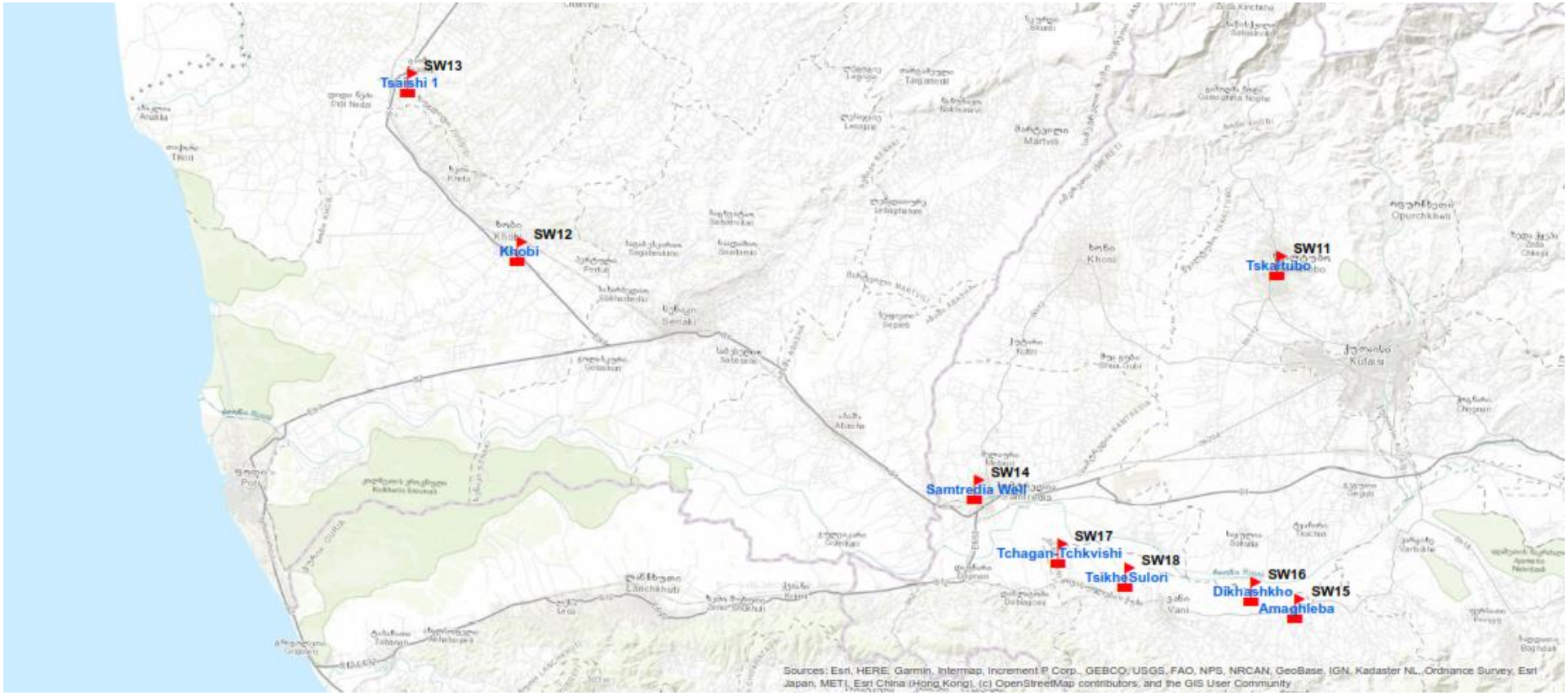
Maps with the location of the visited Thermal wells



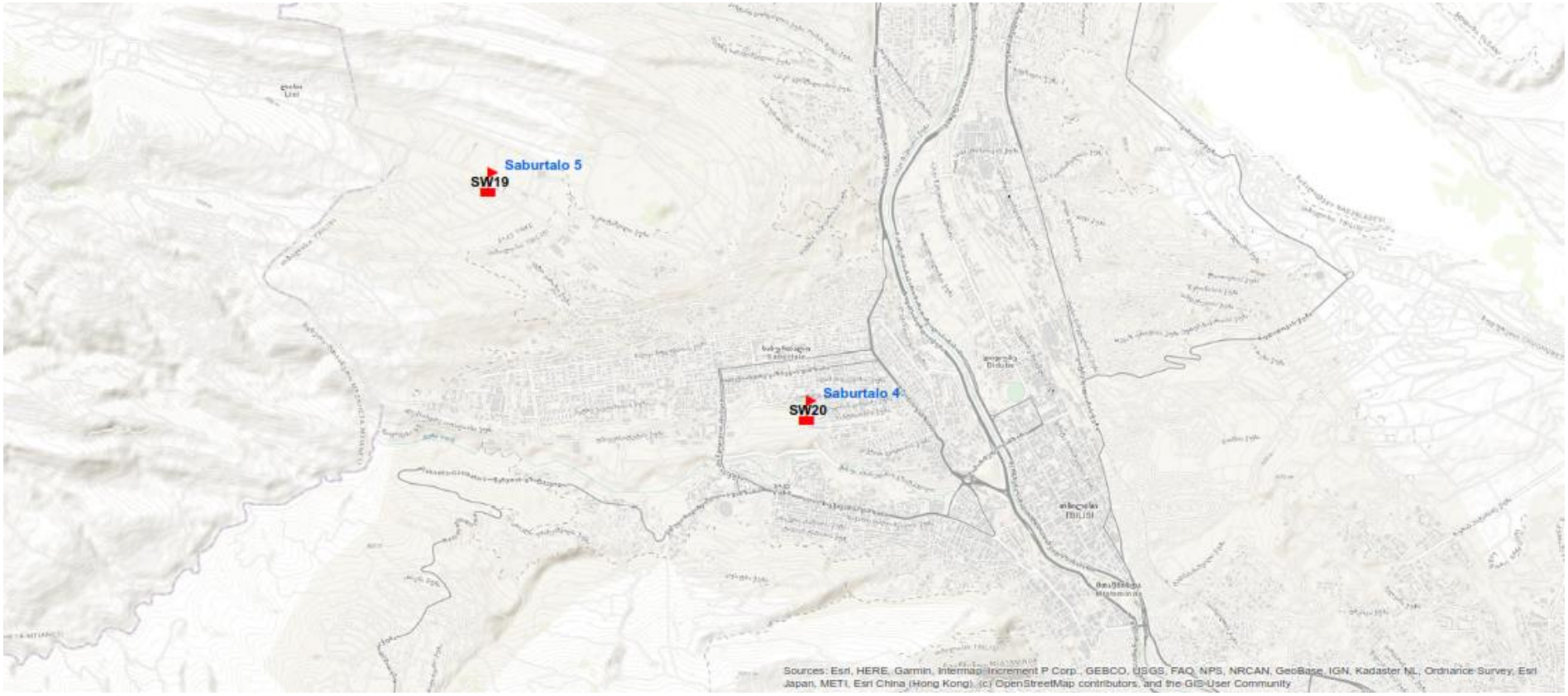
1. Summary map



2. Samtskhe-Javakheti region



3. West Georgia


Saburtalo 5
SW19
Saburtalo 4
SW20
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

4. Tbilisi

Appendix 2

Catalogue of visited Thermal wells

#	well #	Location	Drilling year	Depth m	Aquifer interval m	Geol. Index	Temperature ℃	Debit m3/day	Thermal capacity $\Delta\tau=\tau-25°X$	Utilization
1	25	Qvibisi, Borjomi	1956	1072	949-1074	K_1	41	1685	1.3	Bottling
2	41	Borjomi, central area	1953	1300	506-1300	K_1	38	432	0.3	Bottling
3		Tsinubani	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No usage
4		Akhaltsikhe, CO2 factory	N/A	N/A	N/A	N/A	N/A	N/A	N/A	CO 2 factory
5		Abastumani, royal bath	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Spa-resort
6	1	Aspindza, vil. Vardzia	1988	1900	1300-1900	K_2	58	864	2	No usage
7	22	Aspindza, vil. Vardzia	N/A	766	570-776	K_2	45	346	0.3	Spa-resort
8	8	Aspindza, resort	1957	365	62-365	P_2^2	42	864	0.7	Spa-resort
9	75	aspindza, vil. Tmogvi	1972	1196	1050-1196	K_2	62	520	0.9	Spa-resort
10	157	Asindza, vill. Nakalakevi, CO2 factory	1100	1988	533-1100	K_1	38	260	0.16	CO2 factory
11	185	Tskaltubo, Beauty spring						292		Spring in the park
12	1	Khobi	1980	3600	2450-3200	K_1	82	450	1.1	Greenhouse
13	10	Zugdidi, vil. Tsaishi	1985	2803	2264-2410	K_1	98	3500	11.9	greenhouse, School heating
14	8	Zugdidi, vil. Tsaishi	1983	1675	763-1675	K_1	84	4900	13.4	Greenhouse
15	1	Zugdidi, vil. Tsaishi	1980	1272	854-1272	K_1	85	2700	7.5	Greenhouse
16	7	Vani, vil. Ckvishi	1978	1210	1114-1210	K_1	60	1200	1.9	Greenhouse
17	5	Vani, vil Tsikhesulori	1976	1305	1234-1305	K_1	52	432	0.6	No usage
18		Dikhashkho gayser	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Natural "spa"
19	45	Vani, vil. Amagleba	1970	1250	838-1250	K_2	41	346	0.3	No usage
20	4	Tbilisi, SaburTalo	1979	3695	2613-2650	P_2^2	68	780	1.6	Heating
21	5	Tbilisi, Lisi	1979	2255	1750-1880	P_2^2	60	1750	2.8	Heating

Appendix 3

In-situ measurement data, water parameters

#	well #	Location	T °C	cond. µS/cm	ϱ Ω*cm	TDS mg/L	sal.	pH	U mV	mbar	O_2 mg/L	O_2 %
1	25	Qvibisi, Borjomi	41	7000	-	-	-	5.13	-	-	0.18	2.9
2	41	Borjomi, central area	38	6030	-	-	3.3	4.82	-	-	0.22	-
3		Tsinubani	38.2	235	4270	234	0	9.68	-161.4	46.1	1.5	26.6
4		Akhaltsikhe, CO2 factory	39.5	4280	234	4270	2.3	6.9	1.2	77.3	2.53	44.4
5		Abastumani, royal bath	50	783	1284	778	0.3	9.32	-144.8	36.6	1.09	23
6	1	Aspindza, vil. Vardzia	49.5	15260	65.6	15230	9.1	7.52	-36.6	108.6	3.21	68.6
7	22	Aspindza, vil. Vardzia	41.3	14260	70.1	15250	8.4	7.03	-6.9	53.6	1.72	32.2
8	8	Aspindza, resort	37.5	1627	615	1625	0.8	9.24	-135.9	64.6	2.18	37.2
9	75	aspindza, vil. Tmogvi	55.2	9150	109.4	9150	5.3	6.68	2	error	error	error
10	157	Asindza, vill. Nakalakevi, CO2 factory	35.5	15630	63.9	15620		7.43	-29.7	32.4	1.12	18.9
11	185	Tskaltubo, Beauty spring	33	1066	937	1067	0.5	7	-3.5	11.8	0.45	6.1
12	1	Khobi	82	No data due to device temperature limitations.								
13	10	Zugdidi, vil. Tsaishi	98									
14	8	Zugdidi, vil. Tsaishi	84									
15	1	Zugdidi, vil. Tsaishi	84									
16	7	Vani, vil. Ckvishi	48.4	3.07	325	3.06	1.6	6.769	13.9	65.4	2.2	36.6
17	5	Vani, vil Tsikhesulori	54.4	3.2	312	3.2	1.7	6.64	22.9	error	error	error
18		Dikhashkho gayser	41.1	14.59	68.5	14.6	8.6	6.3	44.6	13.1	0.447	6.7
19	45	Vani, vil. Amagleba	35.7	15.66	63.9	15.66	9.3	6.5	21.3	52	1.9	26.9
20	4	Tbilisi, SaburTalo	68	602	1661	603	0.2	8.8	-121	13	0.41	7.6
21	5	Tbilisi, Lisi	60	365	2700	366	0.1	9.6	-170	17.2	0.5	11.5