EU4Environment in Eastern Partner Countries:
Water Resources and Environmental Data (ENI/2021/425-550)

GROUNDWATER SURVEY 2024
GEORGIA

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ABOUT THIS REPORT

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ABOUT EU4ENVIRONMENT – WATER RESOURCES AND ENVIRONMENTAL DATA

(ENI/2021/425-550)

This Programme aims at improving people's wellbeing in EU's Eastern Partner Countries and enabling their green transformation in line with the European Green Deal and the Sustainable Development Goals (SDGs). The programme's activities are clustered around two specific objectives: 1) support a more sustainable use of water resources and 2) improve the use of sound environmental data and their availability for policy-makers and citizens. It ensures continuity of the Shared Environmental Information System Phase II and the EU Water Initiative Plus for Eastern Partnership programmes.

The programme is implemented by five Partner organisations: Environment Agency Austria (UBA), Austrian Development Agency (ADA), International Office for Water (OiEau) (France), Organisation for Economic Co-operation and Development (OECD), United Nations Economic Commission for Europe (UNECE). The programme is principally funded by the European Union and co-funded by the Austrian Development Cooperation and the French Artois-Picardie Water Agency based on a budget of EUR 12,75 million (EUR 12 million EU contribution). The implementation period is 2021-2024.

https://eu4waterdata.eu

CONTENTS

List of abbreviations

ADA .... Austrian Development Agency
DG NEAR .... Directorate-General for Neighbourhood and Enlargement Negotiations of the European Commission
EC .... European Commission
EU .... European Union
EUWI+ .... European Union Water Initiative Plus
GW .... Groundwater
GWB .... Groundwater body
IOW/OIEau .... International Office for Water, France
OECD .... Organisation for Economic Cooperation and Development
SDGs .... Sustainable Development Goals
RBD .... River Basin District
UBA .... Umweltbundesamt GmbH, Environment Agency Austria
UNECE .... United Nations Economic Commission for Europe

Country Specific Abbreviations Georgia

MEPA .... Ministry of Environmental Protection and Agriculture of Georgia
NEA .... National Environmental Agency
NWP .... National Water Partnership

Key messages

This groundwater survey in Georgia in March 2024 followed comprehensive preparation and planning which started several months in advance. Originally planned as transboundary survey with Azerbaijan, it turned into a national survey due to Azerbaijan's cancellation of participation. The survey covered six monitoring sites (artesian wells) in the Alazani-Iori RBD along the Alazani. From each groundwater site two samples were taken by the two sampling teams of NEA (Georgia) and Umweltbundesamt Austria and they were analysed by the two laboratories of NEA and Umweltbundesamt Austria.

The parallel sampling and analysis allowed for valuable comparison of results.

Some lessons learned from the survey could be gathered in regard of sampling and laboratory analyses.

Executive Summary

In March 2024 a groundwater survey was performed in groundwater body GWB GPA0003 in the Alazani-Iori RBD of Georgia. In total 6 monitoring sites along the Alazani river were sampled by two different sampling teams, from NEA Georgia and Umweltbundesamt Austria. Each water sample was then analysed by the two laboratories of NEA Georgia and Umweltbundesamt Austria.

Initially, this survey was planned as transboundary with Azerbaijan in autumn 2023 and then postponed to spring 2024. The preparatory phase of this survey started in March 2023 with a physical meeting of representatives of AZ and GE in Tbilisi (GE). Thereby, transboundary groundwater bodies were identified and monitoring sites were selected. Unfortunately, in spring 2024 Azerbaijan cancelled the participation and the survey was then implemented as national survey.

According to the monitoring results, the chemistry of the groundwater in the northwestern part of the investigated area (sampling sites N50, N51, N52 and N53) belong to the “alkaline earth - bicarbonate type” or “alkaline earth – alkaline - bicarbonate type”. Whereas the groundwater from well N55 (middle) belong to the “alkaline – chloride - sulphate type”. The results from well N49 couldn’t be classified due to differences in the results from the two laboratories. Iron (Fe) concentrations from well N55, manganese (Mn) concentrations from wells N49 and N55 and the arsenic (As) and lead (Pb) concentration from well 50 exceed the quality standards of the European Drinking Water Directive.

The monitoring results of the two laboratories revealed significant variations for certain parameters.

1. Introduction

1.1. Objective of the survey

The objectives of the groundwater chemical survey were:

- receiving an impression about groundwater quality in the Alazani-Iori RBDs close to the Georgian-Azerbaijan border;
- validating and strengthening the uniformity of the sampling approaches by joint sampling;
- comparing the results of two different laboratories by double analyses of the water samples.

1.2. Scope of the survey

Overall Location	Groundwater body GWB GPA0003 in the Alazani-Iori RBD of Georgia
Survey location	Around Shroma, Davitiani, Tsiteli Sabatlo (Kakheti Region)
Number of monitoring sites	6 artesian wells
Field work	26–28 March 2024
Quality elements	Field parameters, major ions, (heavy) metals

1.3. Preparatory steps

The preparatory phase started in late 2022 with a first online meeting. At a bilateral coordination workshop (30th March 2023 in Tbilisi) with representatives of Azerbaijan and Georgia, the transboundary groundwater bodies in the Khrami-Debed RBD of Georgia and the Kura-Araz RBD of Azerbaijan were identified and agreed upon. Thereby, the experts from both countries agreed to perform a joint transboundary GW survey and decided to focus at GWB GPA0003 in the Eastern part of Khrami-Debed RBD of Georgia and GWB G101 in the Kura-Araz RBD of Azerbaijan.

The initial date of the survey in autumn 2023 had to be postponed to spring 2024. First preparatory steps were taken (e.g. selection of monitoring sites, parameters, logistics etc.) and survey manuals were drafted. Unfortunately, Azerbaijan cancelled its participation in 2024 after the survey in Georgia already took place. Hence, this survey turned into a national survey. Permissions from the related border control administrations were collected and the survey took place between 26th and 28th March 2024.

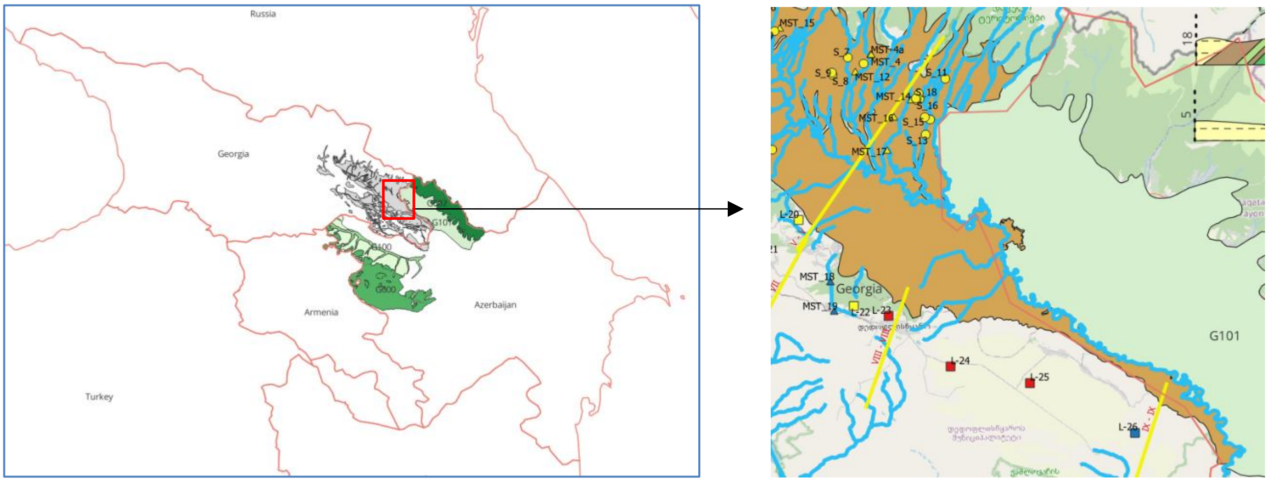
The selected 6 monitoring sites along the Alazani river were sampled by two different sampling teams, from NEA Georgia and Umweltbundesamt Austria. Both used their own sampling bottles but sample stabilisation (for metals) was done by the same acid from NEA.

2. General description of the survey

2.1. Selected River Basin District and groundwater bodies

The GW survey focused at GWB GPA0003 in the Alazani-Iori RBD of Georgia which is next to the Georgian-Azerbaijan border (see Figure 1). The overall flow direction of the GW at the survey area is NW to SE, from Georgia to Azerbaijan.

Figure 1: Location of the investigated GWB GPA0003 in the Alazani-Iori RBD of Georgia.



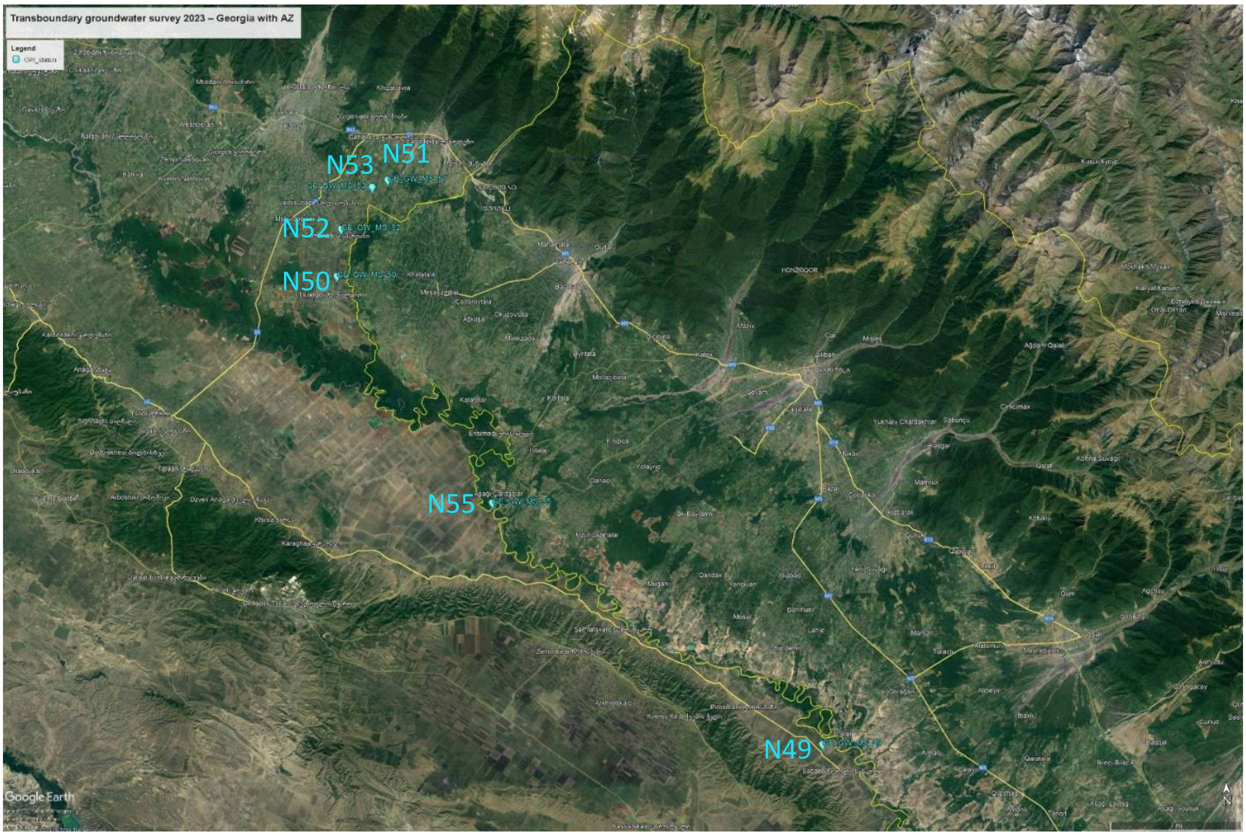
2.2. Selected monitoring sites

The sampling covered in total six already existing GW monitoring sites. All of them were artesian wells.

Table 1: Groundwater monitoring sites in GWB GPA0003 subject to the groundwater survey.

Site ID	Type of site	Location	X coordinate	Y coordinate	Altitude m a.s.l.	Coordinate system
GE_GW_MS_51	Artesian well	Shroma	601687	4626365		WGS 1984 UTM
GE_GW_MS_53	Artesian well	Davitiani	600335	4625800		WGS 1984 UTM
GE_GW_MS_52	Artesian well	Tamariani	597590	4622295		WGS 1984 UTM
GE_GW_MS_50	Artesian well	Tsitelgori	597146	4618288		WGS 1984 UTM
GE_GW_MS_55	Artesian well	Milari	610093	4598705		WGS 1984 UTM
GE_GW_MS_49	Artesian well	Tsiteli Sabatlo	638062	4577471		WGS 1984 UTM

Figure 2: Location of the six monitoring sites in Georgia.



Source: Survey manual, 2024, Google Maps, 31.07.2024

2.3. Logistics and responsibilities

2.3.1. Schedule and approach

The following activities happened during the mission:

- Day 1 (Mon 25 March 2024): Arrival of UBA experts in Tbilisi.
- Day 2 (Tue 26 March 2024): Meeting of EU Member State experts with GE experts in Tbilisi. Travel to the Kakheti Region and joint sampling of well GE_GW_MS_50 – Tsitelgori, GE_GW_MS_52 – Tamariani, GE_GW_MS_53 – Davitiani and GE_GW_MS_51 – Shroma.
- Day 3 (Wed 27 March 2024): Joint sampling of well GE_GW_MS_49 - Tsiteli Sabatlo and GE_GW_MS_55 – Milari.
- Day 4 (Thu 28 March 2024): Travel of GE and UBA experts to Tbilisi. Handing over of samples to the respective GE laboratory. UBA experts return to Austria;
- Day 5 (Fr 29 March 2024): UBA experts handover samples to their laboratory.

At each monitoring site, each team (GE and UBA) took samples according to the survey manual and by their own sampling approach, in line with ISO standards, which was observed by each other.

2.3.2. Sampling team

The international team of the GW survey consisted of 2 national and 2 international experts plus one driver.

Table 2: International sampling team

Name	Organisation
Georgia	
Mr Zaur Makharashvili	NEA, Department of Geology
Mr Onise Beridze	NEA, Department of Geology
EU4Environment Water and Data	
Mr Andreas Scheidleder	UBA Environment Agency Austria
Mr Markus Reischer	UBA Environment Agency Austria

2.3.3. Responsibilities in Georgia

Responsibilities	Institution, contact person, email-address
Monitoring/Sampling	**NEA, Department of Geology**
Overall responsible for groundwater chemical monitoring	Contact persons: Ms. Nana Kitiashvili
Responsible for the organisation of groundwater sampling	Contact persons: Ms. Nana Kitiashvili
Groundwater sampling team	Team leader: Mr. Onise Beridze Supporting persons: Mr. Zaur Makharashvili
Responsible for functional check of sampling equipment	Contact person: Mr. Onise Beridze
Responsible for calibration of field measuring equipment	Contact person: Mr. Zaur Makharashvili
Laboratory	**NEA, The Atmospheric Air, Water and Soil Analyses Laboratory**
Overall contact person at the laboratory for the sampling crew	Contact person: Ms Lia Aptsiauri
Before sampling Pick-up bottles, chemicals and equipment for field measurements.	Contact person: Ms Gulchina Kuchava
After sampling Handover of filled bottles, remaining chemicals and equipment.	Contact person: Ms Gulchina Kuchava

2.4. Monitored quality elements

2.4.1. Parameters for field measurement

Field measurements	Unit	Measurement device UBA	Measurement device GE
Water discharge	l/s	10L bucket	10L bucket
Water temperature	°C	Myron L Ultrapen PT1	WTW Multi 3630 IDS Hanna Combo pH/EC/TDS/G/PPM Tester HI98129
Electrical conductivity	µS/cm	Myron L Ultrapen PT1	WTW Multi 3630 IDS Hanna Combo pH/EC/TDS/G/PPM Tester HI98129
Dissolved oxygen	mg/l		WTW Multi 3630 IDS
pH value			WTW Multi 3630 IDS Hanna Combo pH/EC/TDS/G/PPM Tester HI98129
Odour			
Colour			
Turbidity			
Total hardness, NO3, NO2, NH4		Test strips	

2.4.2. Parameters for laboratory analyses

Parameter/Indicator	Unit	Sample treatment / Conservation
Major ions		
Calcium Ca	mg/l	No sample treatment and no conservation
Magnesium Mg	mg/l	
Sodium Na	mg/l	
Potassium K	mg/l	
Chloride Cl	mg/l	
Nitrate NO3	mg/l	
Sulphate SO4	mg/l	
Hydrogen carbonate HCO3	mg/l	
Nitrite NO2	mg/l	
Ammonia NH4	mg/l	
Total mineralisation	mg/l	
Total hardness	mg/l	
Metals		
Iron Fe	mg/l	unfiltered, acidification with HNO_3
Manganese Mn	mg/l	
Aluminium Al	mg/l	
Arsenic As	mg/l	
Lead Pb	mg/l	
Cadmium Cd	mg/l	
Chromium Cr	mg/l	
Copper Cu	mg/l	
Nickel Ni	mg/l	
Zinc Zn	mg/l	

3. Sampling

3.1. Sampling and field measurements

The water sampling for physico-chemical analyses was conducted following the requirements of ISO 5667-3:2018 and the General Manual for Chemical Freshwater Sampling (EUWI+, ENI/2016/372-403).

The sampling teams of Georgia and UBA performed their procedures of field measurements, sample treatment and sampling individually and in parallel.

Field measurements were done directly at the source or in a bucket in the flowing water. After that, the bottles were filled according to the requirements defined in the survey manual.

Nationally used sampling protocols were completed.

The samples were treated as follows:

- GE and UBA: no stabilization of samples for major ion analyses.
- GE and UBA: no filtration of samples for metal analyses. Stabilization with HNO_3. UBA team used the acid from Georgia.
- UBA: A blank sample was taken with the stabilization acid only.

Table 3: Used bottles for the samples

Item	Size (ml, litre)	Labelling of bottle
Georgia		
Plastic bottles – PET	1 L	Ions
Plastic bottles	250 ml	Metals
UBA		
Plastic bottles – PET	1 L	Ions
centrifuge tube – PP	2 x 50 ml	Ions
centrifuge tube – PP	2 x 50 ml	Metals unfiltered

The GE bottles were put into cooling boxes immediately after the sampling, the UBA samples were put into a refrigerator after the end of the sampling day. The preservation, handling, transport and storage of all water samples followed the procedure outlined in ISO 5667-3:2018 laboratory standard operating procedure.

On March 28, all samples taken by the GE experts were transported to the NEA laboratory. The samples of UBA were transported to the UBA laboratory at the end of the mission on 29 March 2024.

3.2. Problems observed

All six monitoring sites were successfully sampled. Road conditions were partially challenging.

4. Survey results

At the GW survey in March 2024 six GW samples were taken and field parameters measured by GE and UBA experts. All samples were analysed by the two corresponding laboratories of NEA (GE) and UBA (AT).

The recorded electrical conductivity varies between 107 µS/cm at well N51 and 930 µS/cm at well N55 (Annex 1). The pH-values are between 7.3 at well N53 and 8.5 at well N49. The lowest GW temperature of 13.9 °C has been recorded at well N53 and the highest GW temperature of 20.3 °C at well N49. The oxygen concentration was only recorded at the wells N49 and N55 and ranges between 1.64 mg/l and 3.09 mg/l.

The laboratory analyses has revealed that the water samples from the wells in the northwest (N50, N51, N52 and N53) belong to the "alkaline earth - bicarbonate type" or "alkaline earth – alkaline - bicarbonate type" on the basis of the Piper-Furtak diagram (Figure 3). Especially the results for NO3, HCO3, Cl and SO4 from well N50 are different to the wells N51, N52 and N53. The sample from well N55 from the middle of the investigated area belongs to the "alkaline – chloride - sulphate type". The results from well N49 couldn't be classified due to differences in the results from the two laboratories.

The different regions (northwest, middle and southeast) can be distinguished based on the HCO_3^- and SO_4^{2-} concentration (Figure 4). The wells in the northwest show overall a lower SO_4^{2-} concentration in comparison to wells N55 and N49.

Regarding the analysed metals following observations can be highlighted:

- The highest Fe concentrations of 230 µg/l (AT-lab) / 217.4 µg/l (GE-lab) have been measured in the samples from well N55. These values exceed the EU-drinking water standard of 200 µg/l.
- The Mn concentrations from well N49 and N55 exceed the EU-drinking water standard of 50 µg/l.
- The observed As concentration is high (93 µg/l, AT-lab) at well N50 and exceeds the EU-drinking water standard of 10 µg/l.
- The sample from well N50 contains 5.3 µg/l of Pb (GE-lab). Hence, the sample exceeds the EU-drinking water standard of 5 µg/l.

A comparison of the individual results from each laboratory revealed that the results especially for the parameters Na, K, partially Mg and NO3 differ between the different laboratories (Annex 1). The variations of the laboratory results for selected parameters can be seen in Schöller diagrams (Figure 6-11). Please be aware of the logarithmic scale. Figure 4: HCO_3^- vs. SO_4^{2-} diagram

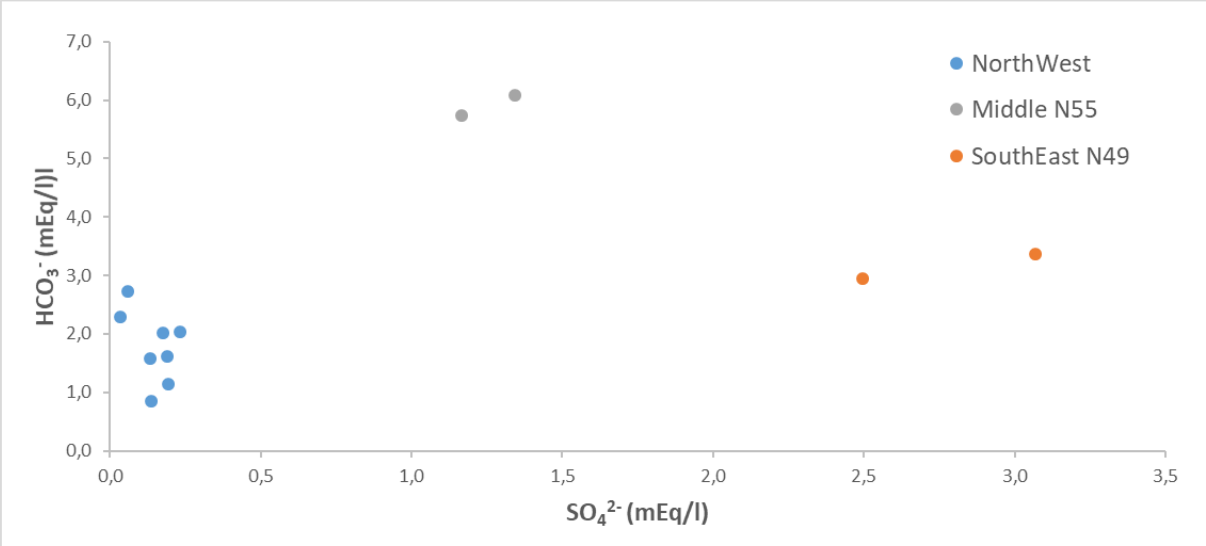
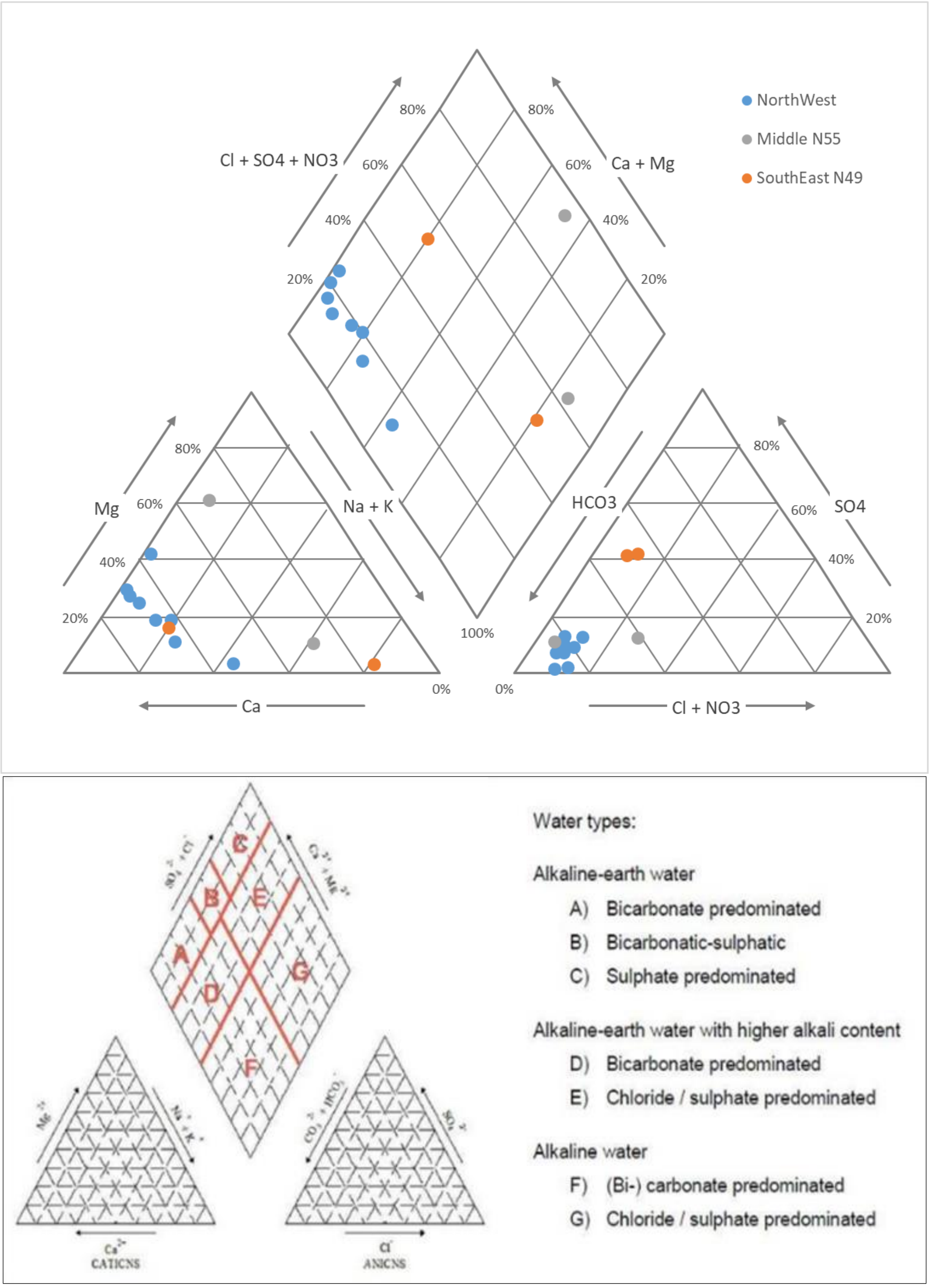


Figure 55 compares the mean laboratory results of the three monitoring sites. The calculation of the charge balance for all samples reveals that the charge balance for samples analysed by GE is negative. This indicates that either a relevant cation/anion has not be analysed or the results of either one or more cations/anions are either too high or too low.

The results of the laboratory analyses are displayed in Annex 1. In addition to the results also the drinking water standards of the EU Drinking Water Directive (2020/2184) are given in column “EU DW”. Yellow colour means that the measured value exceeds the respective drinking water standard.

Figure 3: Piper-Furtak diagram



Source: https://www.researchgate.net/figure/Classification-of-hydrochemical-water-types-according-to-Furtak-and-Langguth-1967_fig1_325261043

Figure 4: HCO_3^- vs. SO_4^{2-} diagram

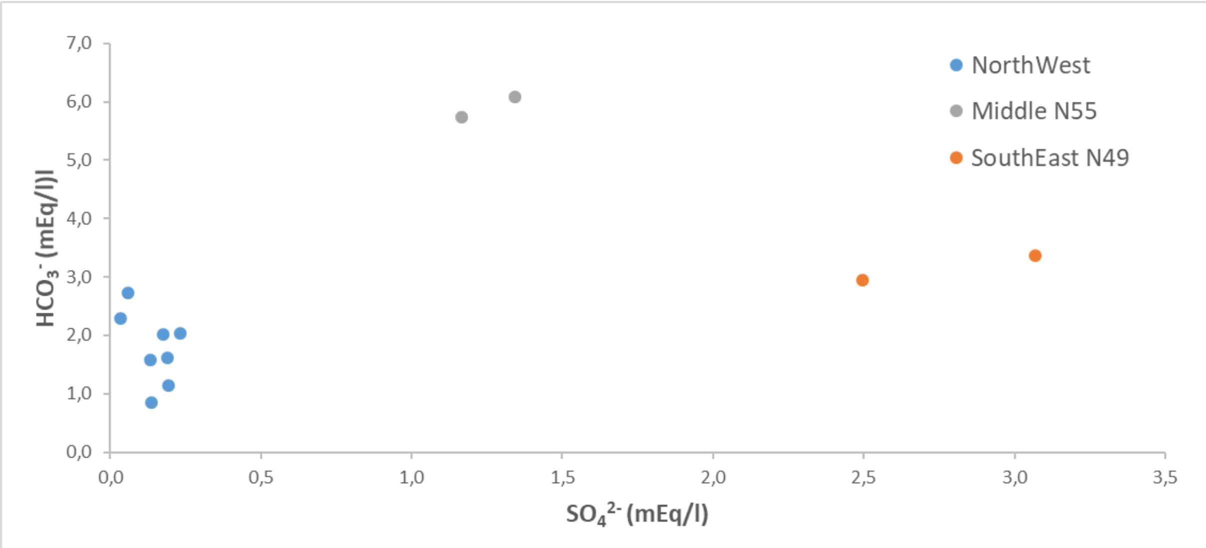


Figure 5: Schöller diagram of laboratory mean values

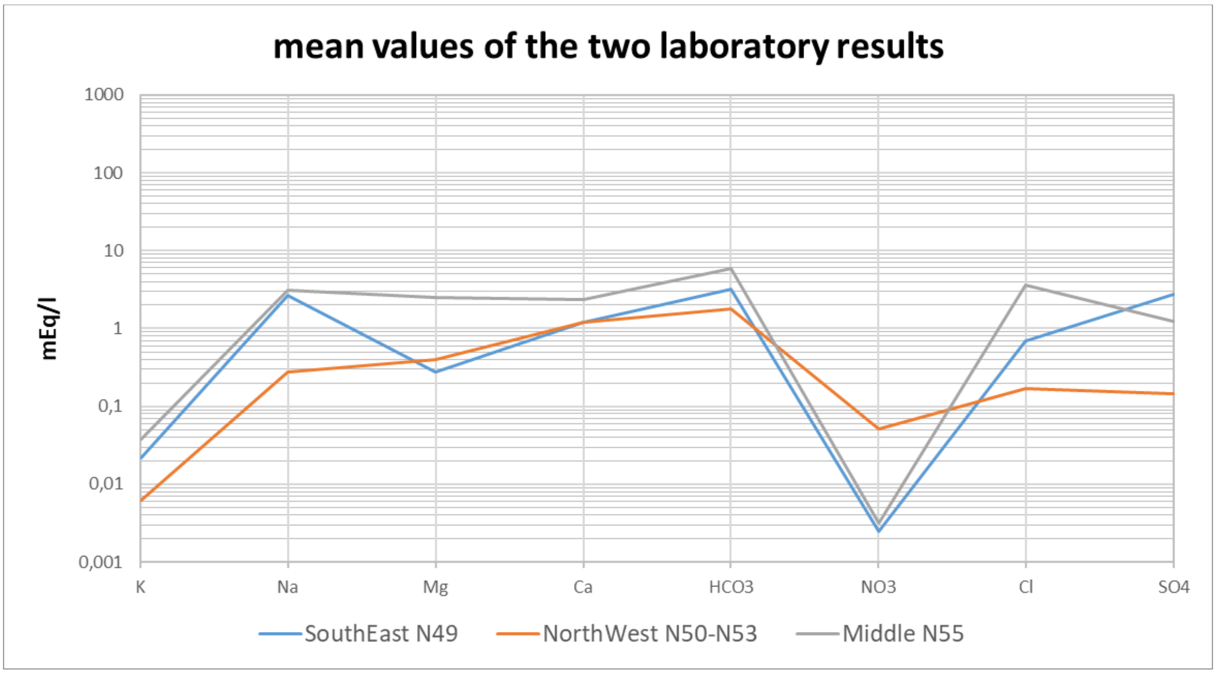


Figure 6: Schöller diagram of results from GE_GW_MS_50

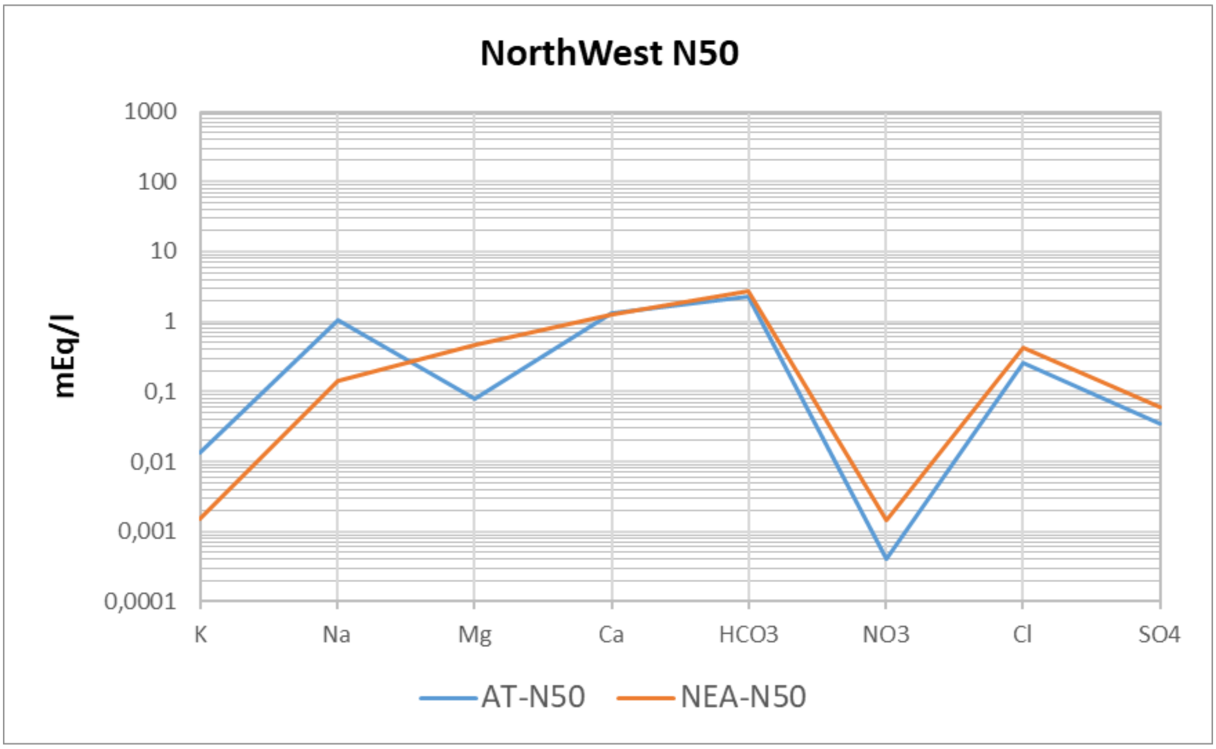


Figure 7: Schöller diagram of results from GE_GW_MS_51

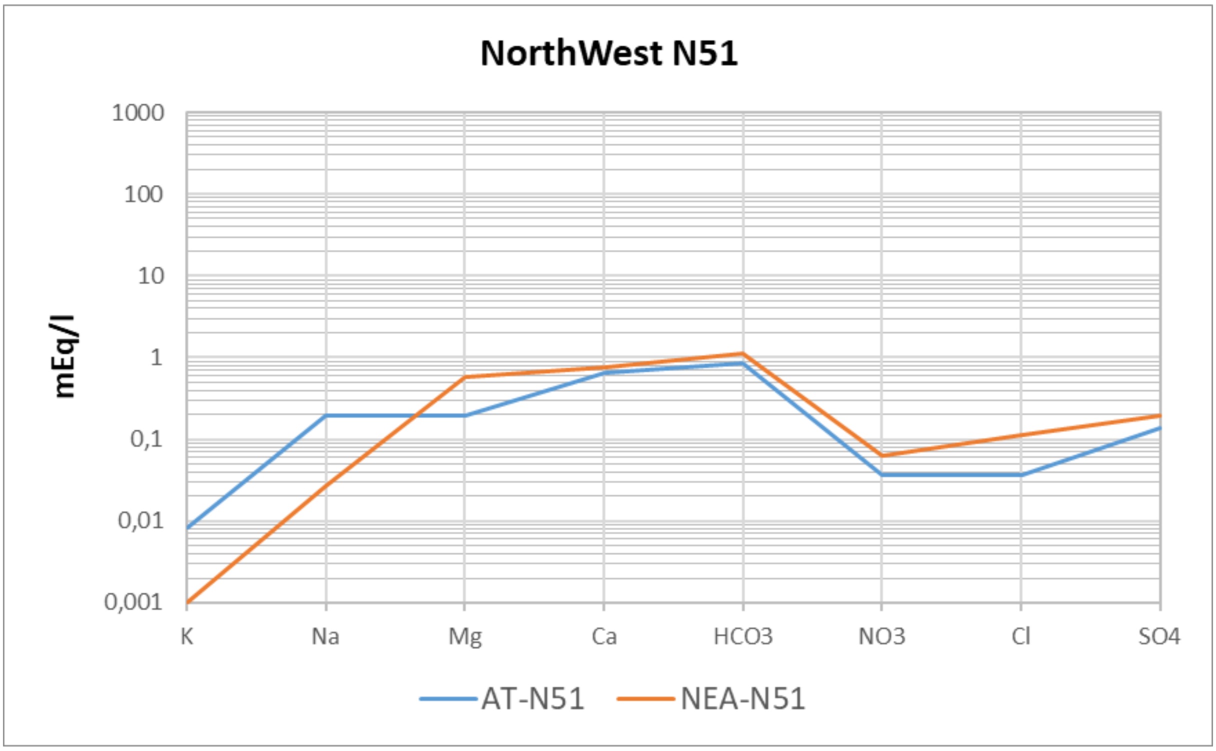


Figure 8: Schöller diagram of results from GE_GW_MS_52

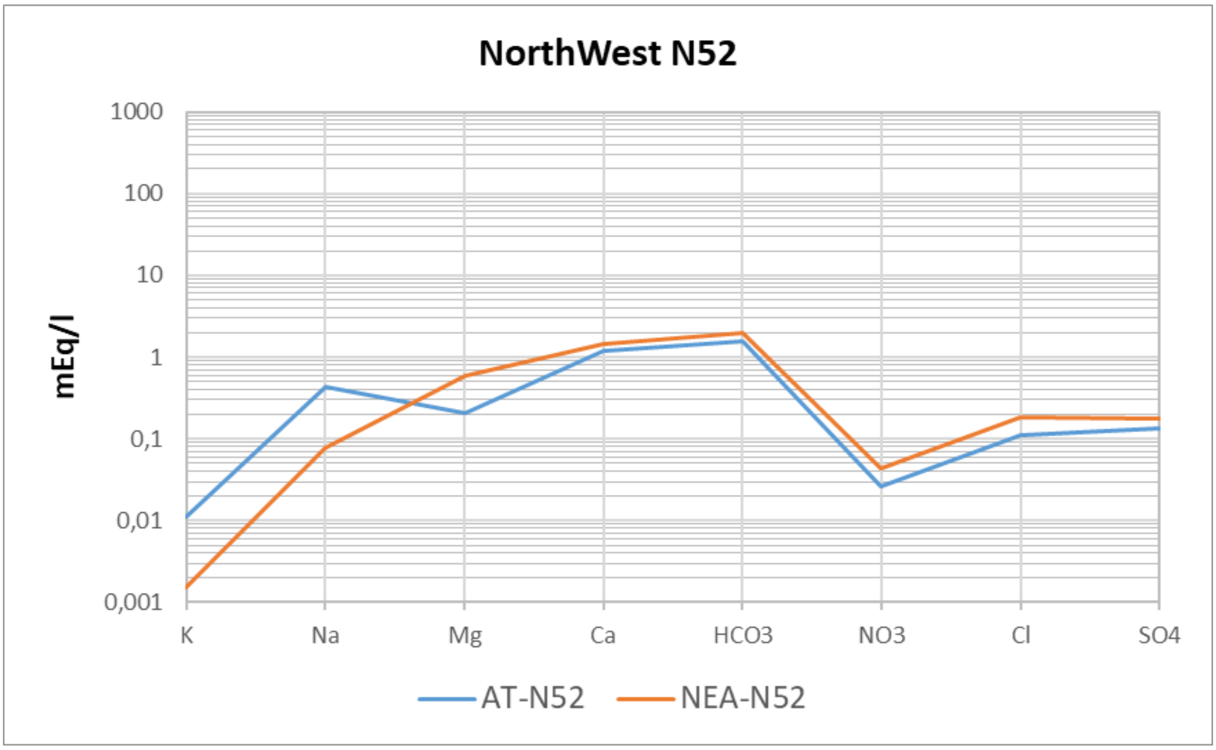


Figure 9: Schöller diagram of results from GE_GW_MS_53

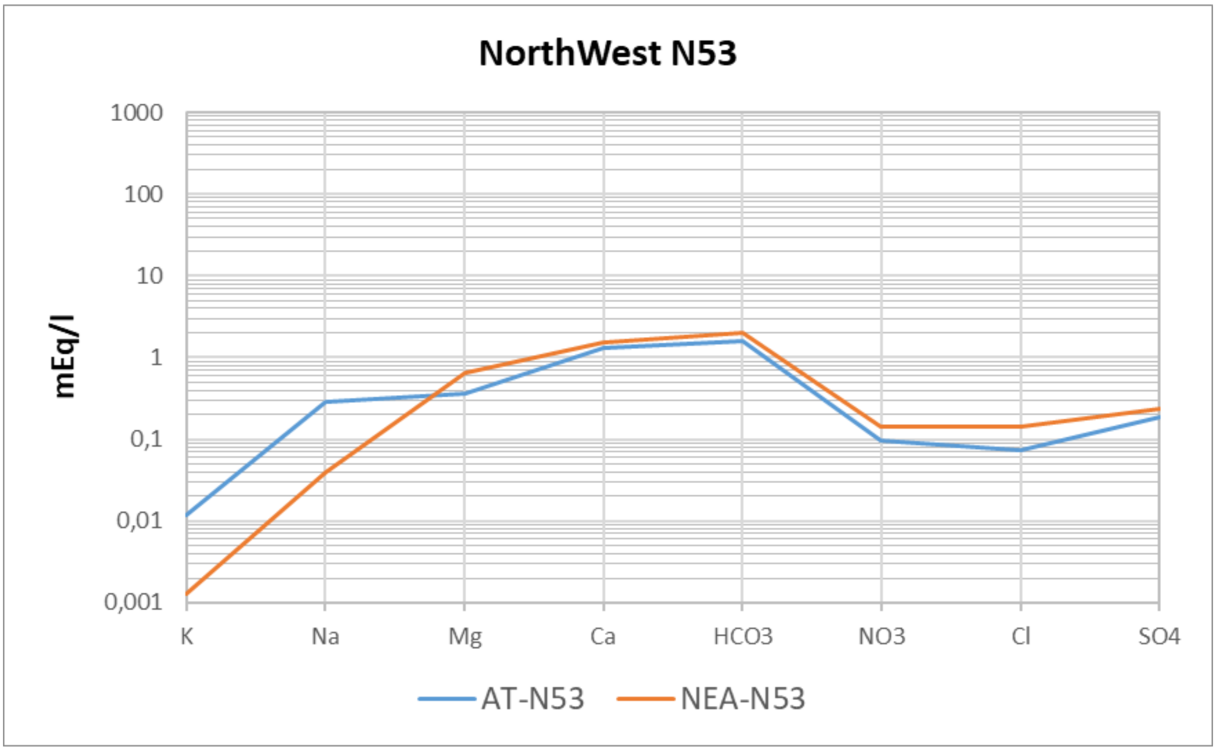


Figure 10: Schöller diagram of results from GE_GW_MS_55

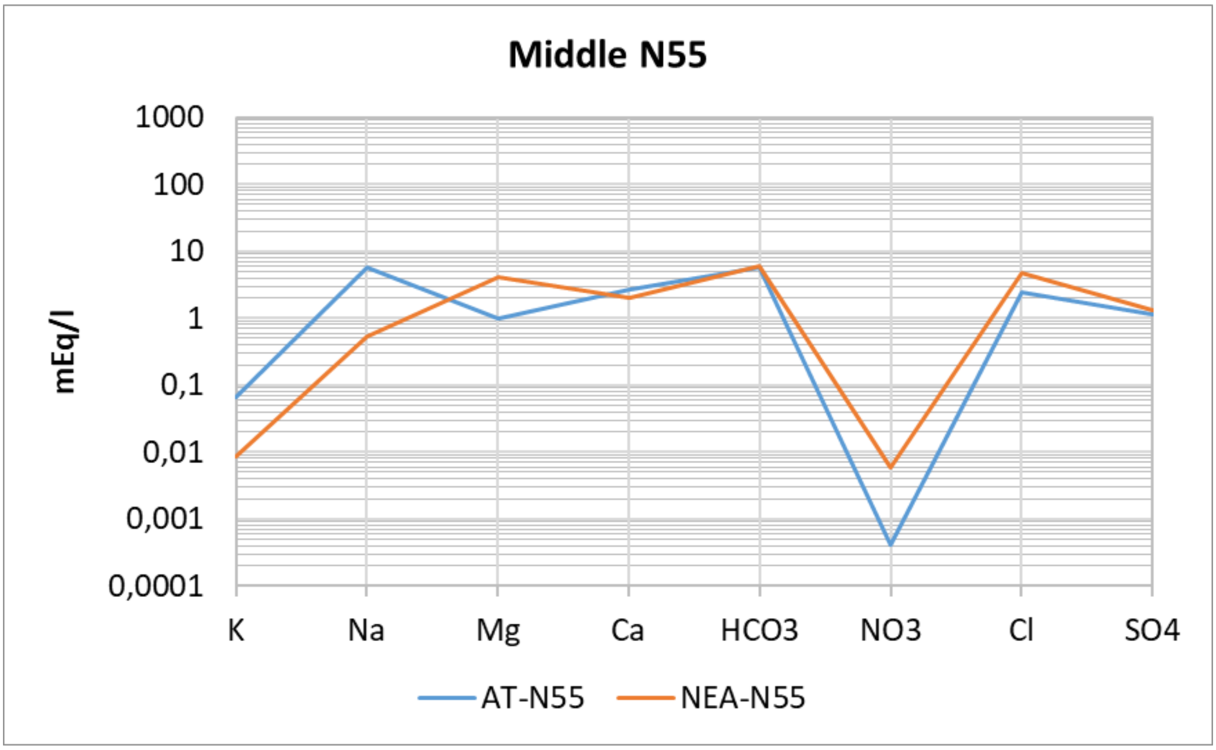
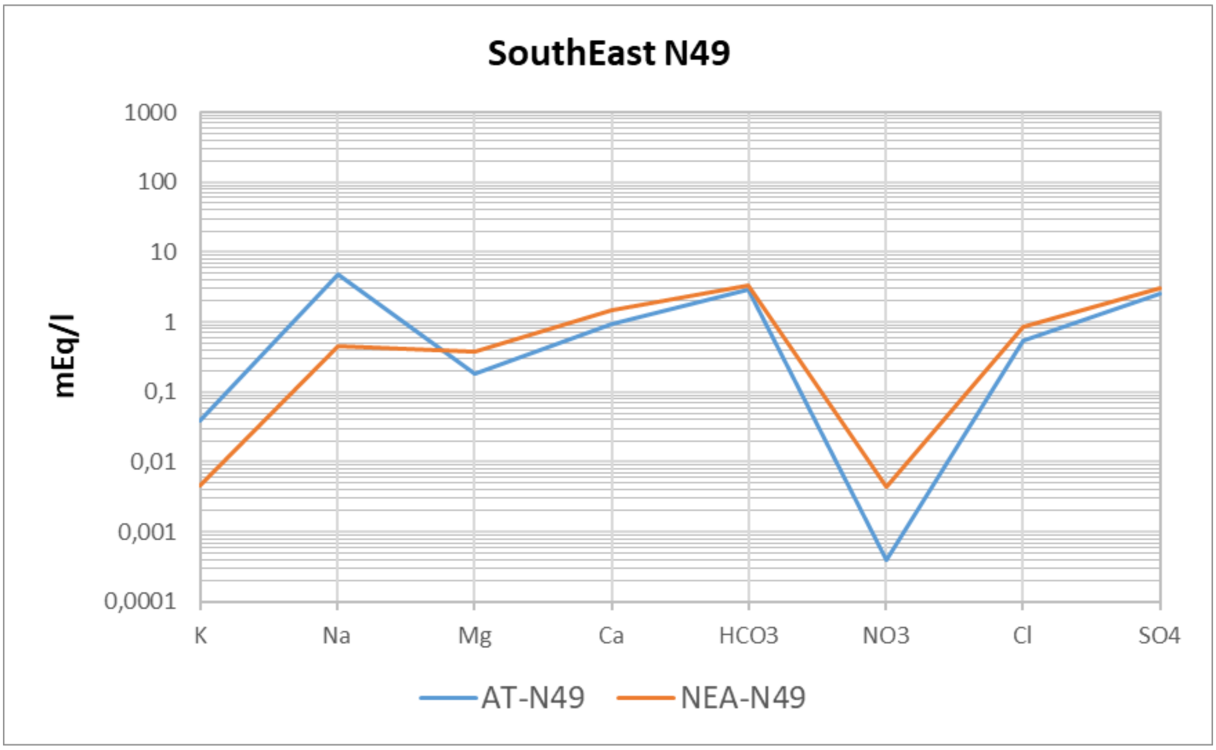


Figure 11: Schöller diagram of results from GE_GW_MS_49



5. Lessons learned

5.1. Survey preparation

Generally, the survey was prepared well. Nonetheless, few points should be considered in future.

Recommendations

- The check lists (Tables 5-7) in the survey manual include elements which were not on board (e.g. pump etc.). Better prepare the check list for each survey individually. The check lists should be used before the survey to check whether all items on the list are finally in the car.
- Put labels on the bottles which indicate the parameter groups as indicated in Table 8 of the survey manual. Otherwise the laboratory might mix up the bottles and analyses the ions in the stabilized sample and the metals in the non-stabilized samples. Better be sure to avoid this.
- If possible, measure the field parameters in the bucket in flowing water and not move the bucket with water to the car and measure then.
- Check the smell of the water. Put some water in a bottle, close and shake it and then smell.
- Bring enough and appropriate spare batteries for the devices you have on board. Be aware, that the WTW field instrument shall not be charged as long as normal batteries are in the device and not the rechargeable ones.
- The manuals (or copies) of the measuring devices should be in the device box or in the car.
- Bring the survey manual in printed form and not only on the laptop.
- Bring the values from the last measurement(s) so that a quick plausibility check could be made.
- Discharge measurements should be repeated (3 times in total), when the time for filling the bucket is less than 20 seconds. You could also use a bucket with a larger volume.

5.2. Comparability of results

The comparison of monitoring results showed partly significant differences between the two involved laboratories (see Figure 6 - 11).

All GW experts sampled in the same quality assured way and all laboratories follow quality control.

Recommendations

- Perform plausibility checks by calculating the ion/charge balance and by calculating a synthetic electrical conductivity for comparison with field measurements.
- It is recommended to review and strengthen the communication and cooperation processes between the laboratories and the sampling teams. The laboratory teams need to describe exactly the sampling, treatment and preservation methods of the samples (according to ISO standards), that have to be followed by the sampling team.
- The joint (sampling team and laboratory) preparation of a survey manual for each survey campaign would be an excellent basis in clarifying and documenting all these aspects from the preparatory phase to the hand-over at the end of a survey.

Overall, this groundwater survey was very valuable and provides significant lessons learned.

6. Annexes

Annex 1: Chemical data (in Excel format);

Annex 2: Laboratory results of NEA (GE);

Annex 3: Laboratory results of UBA (AT);

Annexes are available as separate documents

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