

Groundwater quality assessment in the Khan- and Swakop-River catchment with respect to geogenic background concentrations of dissolved uranium



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Summary

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In 2009, 78 locations were sampled in the catchment areas of the ephemeral Swakop River and the tributary Khan River within the framework of a strategic environmental assessment (SEA) prior to new uranium mining activities. Samples were analysed for main components, dissolved uranium, and trace elements.

Alluvial groundwater in the upper Khan and Swakop River catchments is freshwater of drinking water quality, whereas groundwater in the lower river catchment is saline. Nitrate concentrations are elevated yet below the WHO guideline value apart from a few exceptions.

Potentially toxic trace element concentrations are without critical implications for drinking water quality. Drinking water samples from the municipalities of Swakopmund and Walvis Bay meet the requirements of the Namibian and the WHO drinking water standards. Process and seepage water samples from uranium mines have elevated concentrations of uranium, arsenic and fluoride, manganese and a number of other trace elements like lithium, nickel and cobalt.

Uranium is a common trace element in the groundwater of the catchment and mostly present at elevated concentrations. Only 21 % of analysed groundwater samples have uranium concentrations below the provisional WHO guideline value of 15 µg/L. Six groundwater samples in the vicinity of the Rössing and Langer Heinrich Uranium Mines and the lower Swakop River Valley have uranium concentrations above the regional background level. The chemical composition of water samples alone is insufficient and inconclusive to identify the source for the high uranium level in the respective groundwater samples.

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Abbreviations

| | |
|-------|---|
| BGR | Bundesanstalt für Geowissenschaften und Rohstoffe (Federal Institute for Geosciences and Natural Resources) |
| GSN | Geological Survey of Namibia |
| IHF | Institute of Hydrology, Freiburg |
| LHM | Langer Heinrich Uranium Mine Ltd. |
| RM | Rössing Uranium Mine Ltd. |
| SEA | Strategic environmental assessment |
| TDS | Total dissolved solids |
| UFZ | Helmholtz Zentrum für Umweltforschung (Helmholtz Centre for Environmental Research), Leipzig |
| WHO | World Health Organization |
| meq/L | Concentration in milliequivalents per liter solution |
| mg/L | Concentration in milligramm per liter solution |
| µg/L | Concentration in microgramm per liter solution |

1 Background

The current and planned mining activities in the Swakop River Basin and other areas in the Erongo Region will have large impacts on the availability and quality of water resources. In order to minimize negative impacts and to develop environmentally sound strategies for social and economic development, it is of paramount importance to understand the distribution of water resources and the processes affecting them. A Strategic Environmental Assessment (SEA) has been initiated assessing all the sector development scenarios in the Namib Uranium Province. One part of this SEA is a water quality study conducted under the auspices of the GSN (aiming at establishing baseline water quality values).

The institutions involved in the water quality study were:

- Federal Institute for Geosciences and Natural Resources (Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)), Hannover: Major, minor and trace elements (including uranium)
- Institute of Hydrology (IHF), Freiburg: Hydrofluorocarbon analyses
- Helmholtz Centre for Environmental Research (Helmholtz Zentrum für Umweltforschung (UFZ)), Leipzig: Stable isotopes, radionuclides, radon

This report is the hydrogeochemical contribution based on a dataset of 78 water samples collected in June/July 2009. It can be considered as a baseline study before the onset of new, additional mining operations. The report complements other specialized reports within the framework of the “Strategic Environmental Assessment” (SEA), in particular the “Water Balance Study” (BIWAC 2009b).

2 Objectives

The **main** objective of this report is to evaluate the groundwater samples from the Swakop River- and the Khan River catchment taken during the sampling campaign 2009 with respect to:

- main chemical components
- classification into different water types
- patterns of dissolved trace elements with special emphasis on uranium.

The discussion of the spatial distribution of the respective parameters is largely based on distribution curves. The distribution curve is also used to define the local geogenic background for dissolved uranium. Other trace elements (As, V, Mo, Th, Ni, Pb and Zn) are briefly discussed. Linear correlations are plotted to identify relationships between trace elements and main compo-

nents.

All alluvial groundwater samples¹ are screened for concentrations above the WHO Groundwater Guidelines values (WHO Groundwater Guidelines 2004) to identify potential health risks. Radiological aspects are not covered in this report.

As a **second** objective, six samples of surface water, process water, and groundwater from the Rössing Mine Uranium Ltd. (RM) and five respective samples from the Langer Heinrich Uranium Mine Ltd. (LHM) are analysed for the same range of parameters to characterize their chemical composition with respect to potential groundwater contamination.

As a **third** objective, two drinking water samples from the distribution systems of Walvis Bay and Swakopmund are analysed for the same spectra of parameters like their composition of main constituents and the concentrations of potentially harmful trace elements.

¹ A certain number of wells are screened in basement rocks. Groundwater samples are therefore no “alluvial samples” in a strict sense. Alluvial samples therefore stands for samples from boreholes in the Swakop and Khan River valley.

3 Methods

3.1 Sampling campaign

The field campaign in the Swakop-and Khan River alluvial beds was conducted between June/July 2009 consisting of 2 vehicle teams with local specialists and experts from the involved German institutions BGR, IHF and UFZ. The water samples were extracted by means of sampling pumps (Grundfos MP1) and a low yielding submersible pump mounted on a trailer with generator. For boreholes equipped with pumps, connectors were used to establish take-off points from the well head assembly.

Altogether 78 water samples were extracted, chemically stabilized and subsequently sent to BGR / Hannover for analysis. Physicochemical parameters (T, EC, pH, Eh) and alkalinity were measured during the sampling procedure. For further details please refer to Wagner et al. (2009) and BIWAC (2009b). The location of the sampling points is shown in Fig. 1.

3.2 Analysis

The samples were analysed for their inorganic chemical components and trace elements in the BGR-laboratories. For selected trace elements such as uranium, arsenic and rare earth elements the quadrupole ICP-MS was applied. The analytical methods applied are described in the appendix of this report.

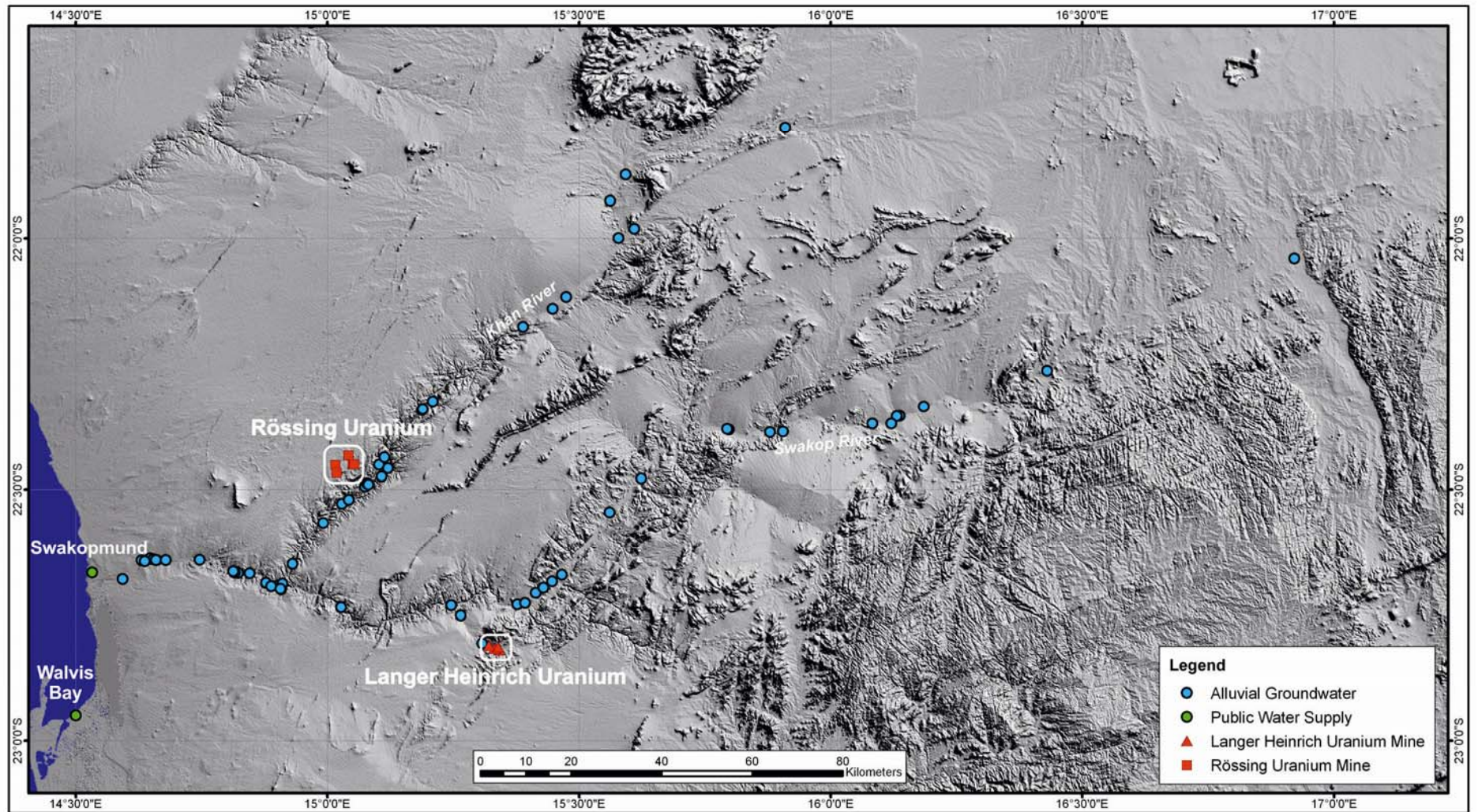


Fig. 1: Location of sampling points

4 Results

4.1 Main components and parameters

4.1.1 Water temperature

The median (p50) temperature of groundwater samples is 27.8°C (min. 18.1°C, max. 31.5°C). As the mean annual temperature is between 16°C and 22°C in the river catchments, the groundwater temperatures are higher than expected. This is most probably due to the fact that measured temperatures from the flow-through cell may include artefacts from warming of the sample by heat dissipation of the pump and heat exchange in the tubing.

4.1.2 Electrical Conductivity (EC)

The mean electrical conductivity (EC) as a measure of salinity of all groundwater samples is 6700 $\mu\text{S}/\text{cm}$ (min. 503 $\mu\text{S}/\text{cm}$, max. 34700 $\mu\text{S}/\text{cm}$). The distribution plot of all analysed samples (Fig.

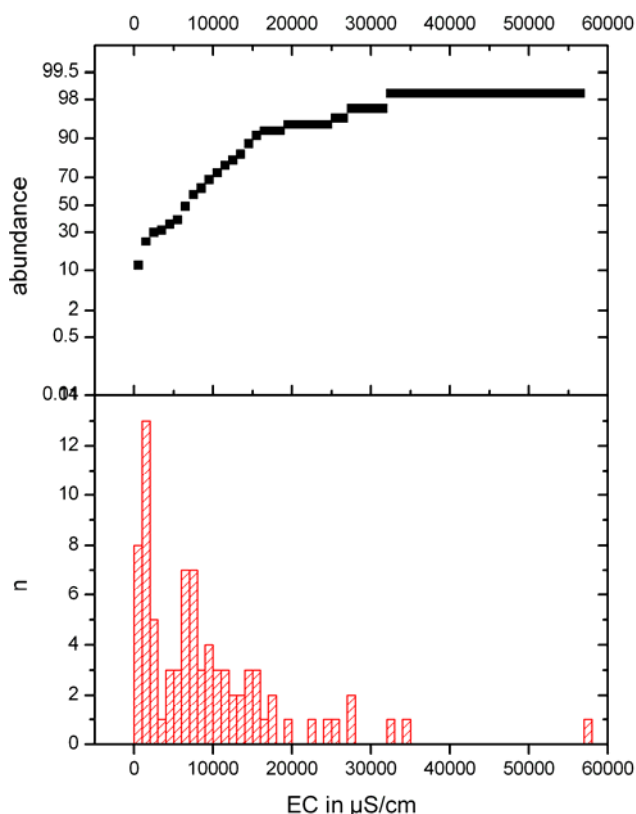


Fig. 2: Distribution of electrical conductivity in all samples including mine process waters

2) depicts two maxima, one at 1000 $\mu\text{S}/\text{cm}$ and a second one at 7000 $\mu\text{S}/\text{cm}$. Process waters plot above 20000 $\mu\text{S}/\text{cm}$. According to the classification of the Water Act (1956) only 23 groundwater samples (34 %) have an EC making them “acceptable” (B) or “excellent” (A) as a potential drinking water source. The majority of samples (44) are unsuitable for human consumption (group D) because of their elevated salinities.

The spatial distribution of EC from groundwater samples is shown in Fig. 3. In general, the occurrence of low salinity groundwater is restricted to the headwater region of the two rivers. In the downstream region groundwater is saline.

For the Khan River catchment samples with high EC also occur upstream of any discharge point from the Rössing Uranium Mine Ltd. (RM). Elevated EC is also found upstream of the Langer Heinrich Uranium Mine Ltd (LHM). Apart from a few exceptions, samples east of 15.35° latitude are in group “excellent” (A) and “acceptable” (B) while to the west of this latitude the groundwater is in group C or lower, making it unsuitable for human consumption.

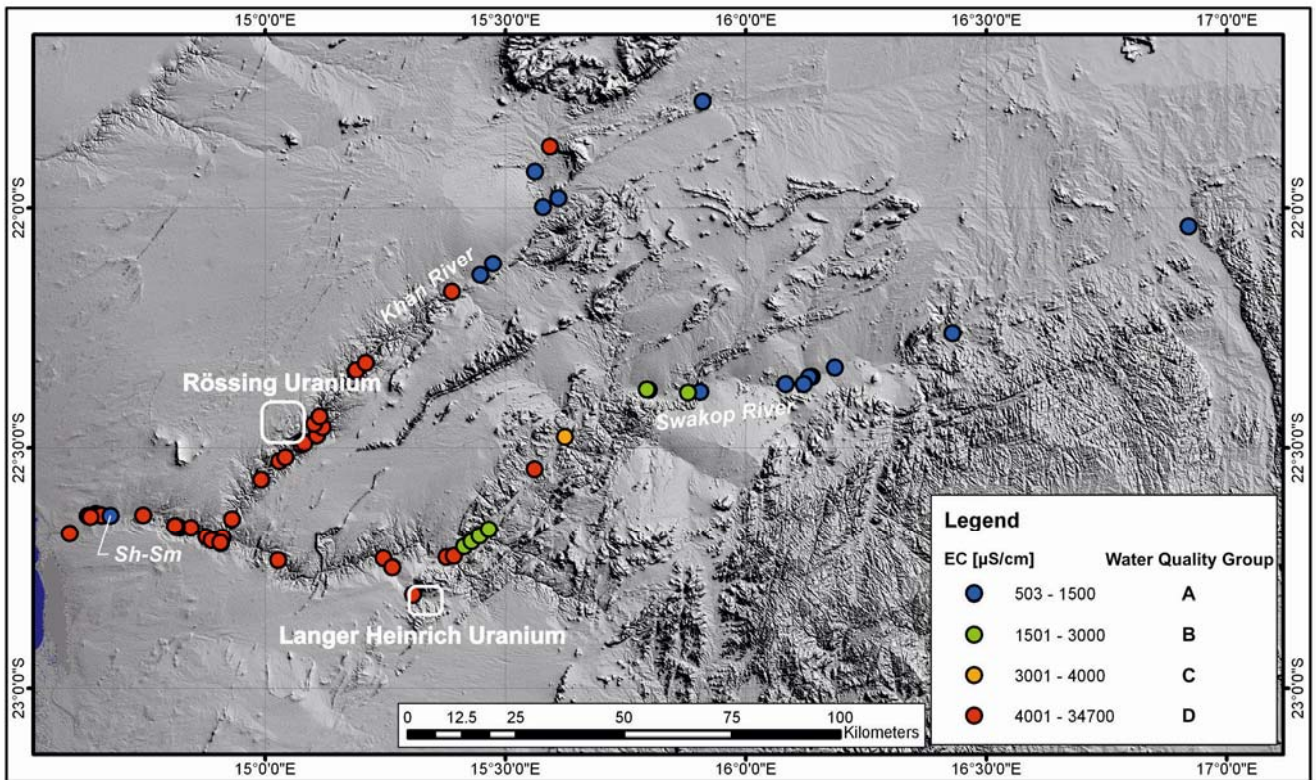


Fig. 3: Spatial distribution of electrical conductivity (EC)

The correlation plot (Fig. 4) shows the expected linear relationship between TDS and EC. Sample S13 is an outlier due to an extraordinary high sulphate concentration. Sulphate generally does not contribute to the electrical conductivity of aquatic solutions. The correlation factor between TDS and EC is 0.6232 (Sample S13 not included).

As an exception from the general trend, one sample (SH-SM) in the lower course of the Khan River has a low salinity of 1001 $\mu\text{S}/\text{cm}$ (649 mg/L TDS). The sample obviously represents water from a locally occurring freshwater lense on top of the saline water in a generally saline environment (Fig.5).

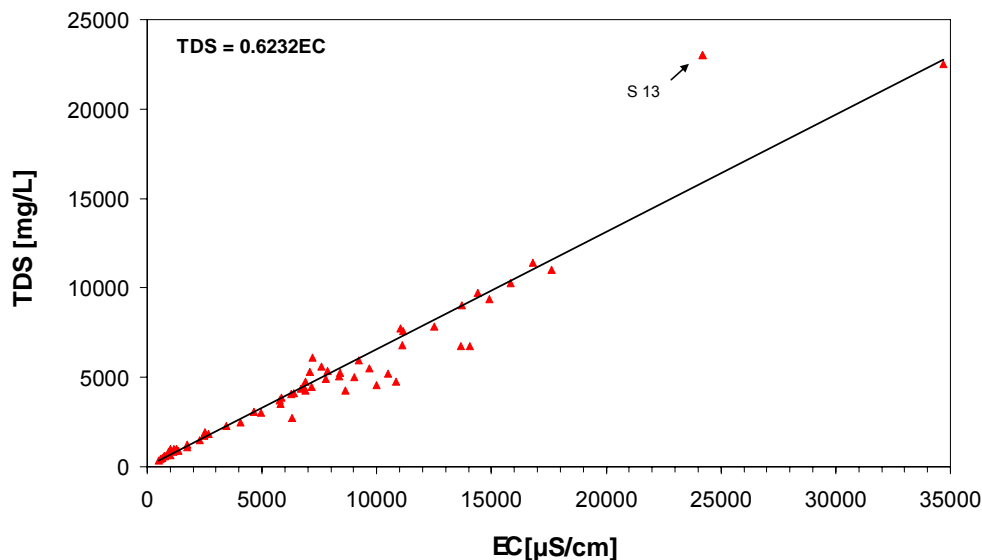


Fig. 4: Correlation between TDS and EC for alluvial groundwater samples (S 13 not included)

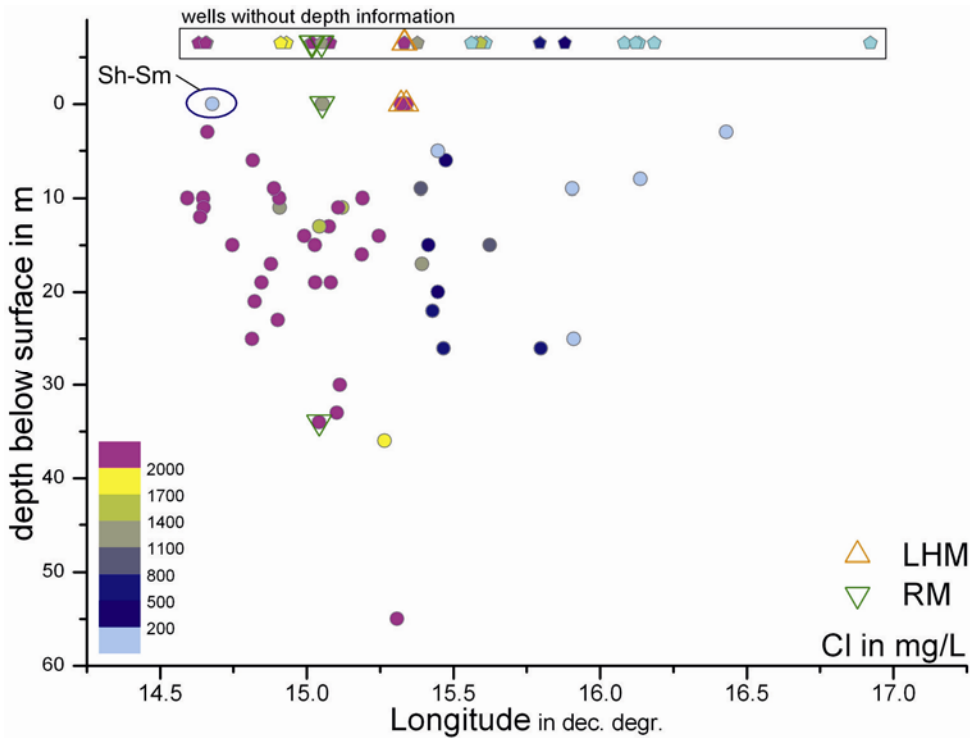


Fig. 5: E-W-projection of sampling depth for chloride as a measure of salinity (samples from Rössing and Langer Heinrich mine included)

4.1.3 Sodium adsorption ratio (SAR)

A classification of the alluvial groundwater with respect to its suitability for irrigation on the basis of the **sodium adsorption ratio** (SAR) in relation to the **salinity hazard** (electrical conductivity) according to Lloyd and Heathcote (1985) is depicted in Fig. 6. The plot includes all groundwater samples with an EC <5000 $\mu\text{S}/\text{cm}$ and the samples from the Swakopmund and Walvis Bay public

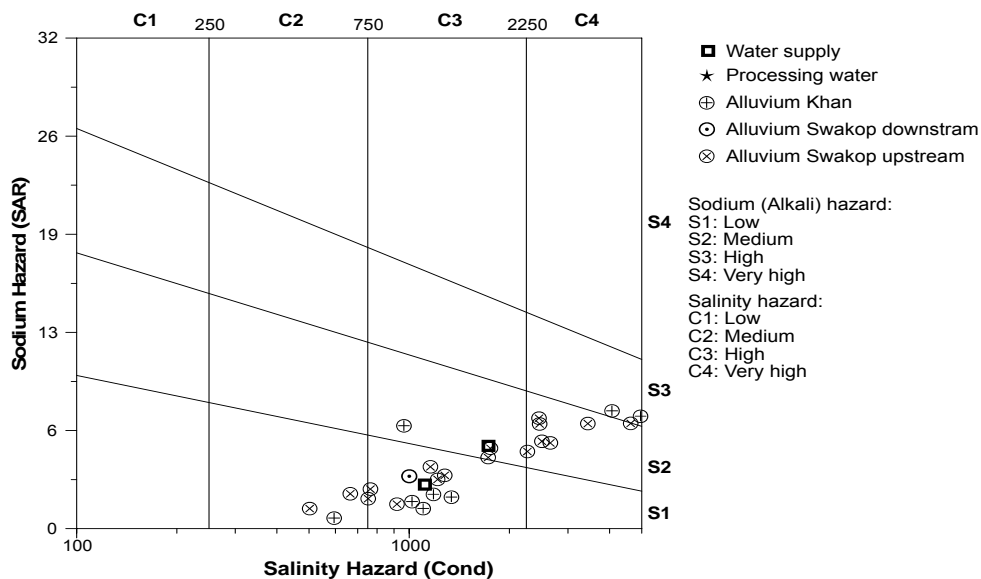


Fig. 6: Sodium hazard versus salinity hazard of alluvial groundwater in sampled water <5000 $\mu\text{S}/\text{cm}$

water supply.

The freshwater samples with an EC <1500 $\mu\text{S}/\text{cm}$ plot in the S1 field, saline water samples predominantly have a medium sodium hazard (S 2).

4.1.4 Cations and anions

The Piper-diagram is a useful representation to visualize clusters and chemical trends in water quality for a group of related water samples. All major cations and anions are plotted in their molar concentrations in two ternary and one quaternary diagram (Fig. 7). In order to indicate salinity-dependent chemical trends, the symbols are classified into percentiles with colours assigned according to their EC. As a general rule, samples with low EC are Ca-HCO₃-dominated waters, while samples with EC above 3000 $\mu\text{S}/\text{cm}$ have more than 60 % chloride and sodium. NaCl is therefore the dominant constituent in all alluvial groundwater samples with elevated EC.

In general, the occurrence of saline groundwater, as well as increasing salinity of groundwater downstream of river channel alluvia, is a common phenomenon in arid environments. It is commonly attributed to evapotranspiration and groundwater evaporation, especially in areas with shallow groundwater tables. In coastal regions, sea water intrusions may be an additional source of salinity. Furthermore, in case of the Swakop und Khan River catchments, the elevated salinities could be linked to Tertiary sediments with terrestrial evaporite layers (Proto-Swakop Karpfenkliff Formation) (CSIR 1997).

Different sources of salinity may be identified on the basis of bromide concentrations, more specifically their bromide/chloride ratio. During the evaporation process of a sodium chloride-dominated water, bromide is progressively accumulated in the residual brine during the different stadiums of salt precipitation. The bromide/chloride ratio of rock salt (halite) is therefore depleted by a factor of 7 to 13 compared to sea water (HERRMANN et al. 1973). Hence, saline waters formed by dilution of rock salt exhibit a substantially lower bromide/chloride ratio than sea water or saline waters formed by mixing of sea water and freshwater. Because sea salt is the main salt source in rain water, the bromide/chloride ratio of rain water is more or less similar to that of sea water. Saline groundwater, which is formed by evaporation of freshwater, is therefore expected to have a bromide/chloride ratio like that of sea water.

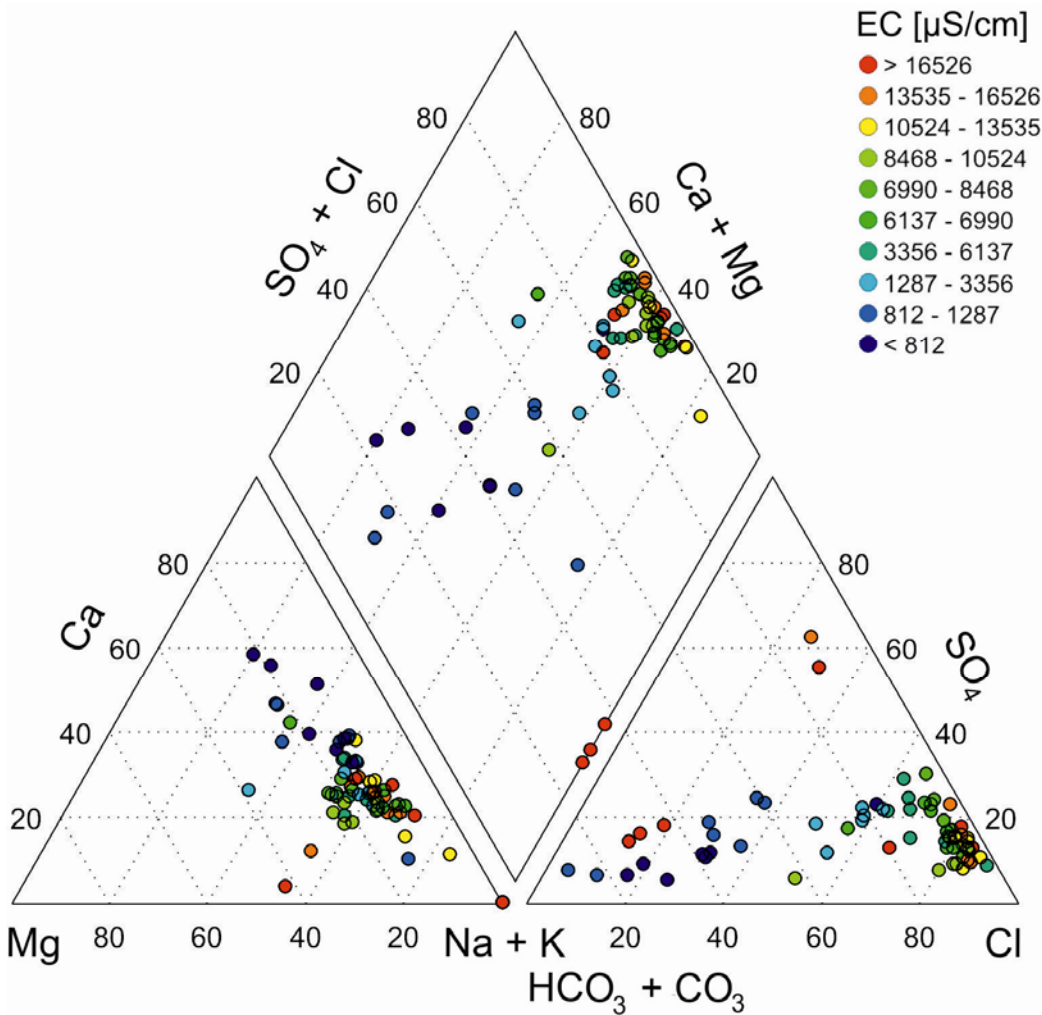


Fig 7: Piper-diagram of all water samples, colour-table depending on percentiles of EC.

In Fig. 8 the respective bromide/chloride molar ratios of the groundwater samples are plotted against EC. The plot exhibits two different groups of samples with respect to their Br/Cl ratios:

1. Saline water of $>10000 \mu\text{S}/\text{cm}$ plot in or slightly above the halite field.
2. Water samples with an EC $<10000 \mu\text{S}/\text{cm}$ exhibit a wide range of values, which are generally substantially higher than the respective sea water ratio.

Fig. 8 therefore supports the hypothesis, that dilution of rock salt is a major source of salinity in alluvial groundwater in the lower Swakop und Khan River valley.

Chloride is the dominating anion in saline water. The spatial distribution of **chloride** (Fig. 9) is therefore more or less identical with the EC pattern (Fig. 3).

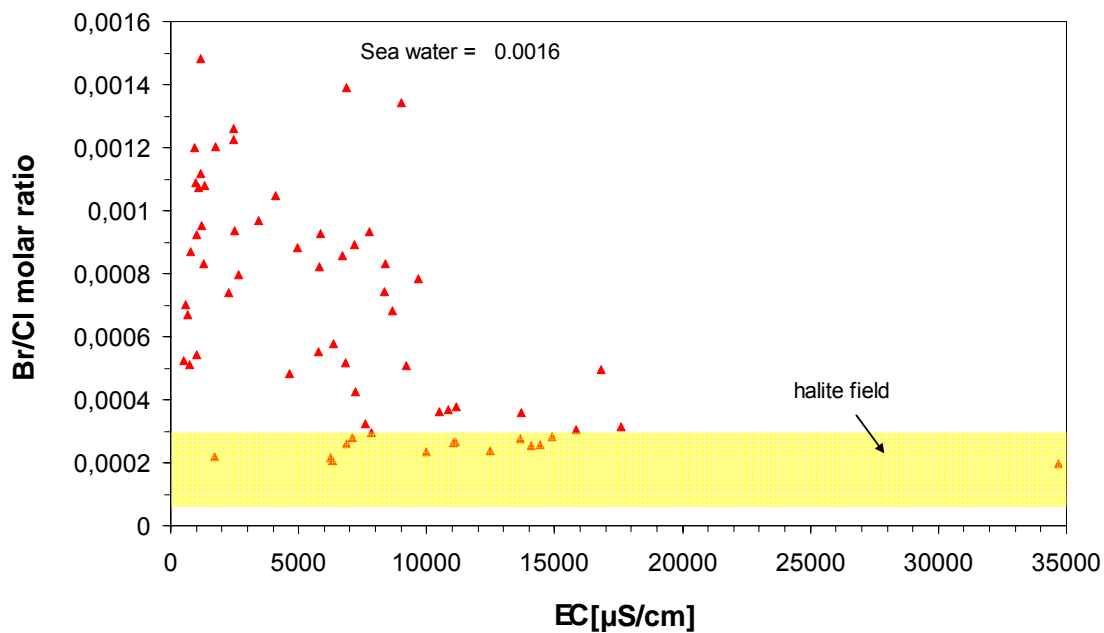


Fig. 8: Br/Cl molar ratios of alluvial groundwater samples

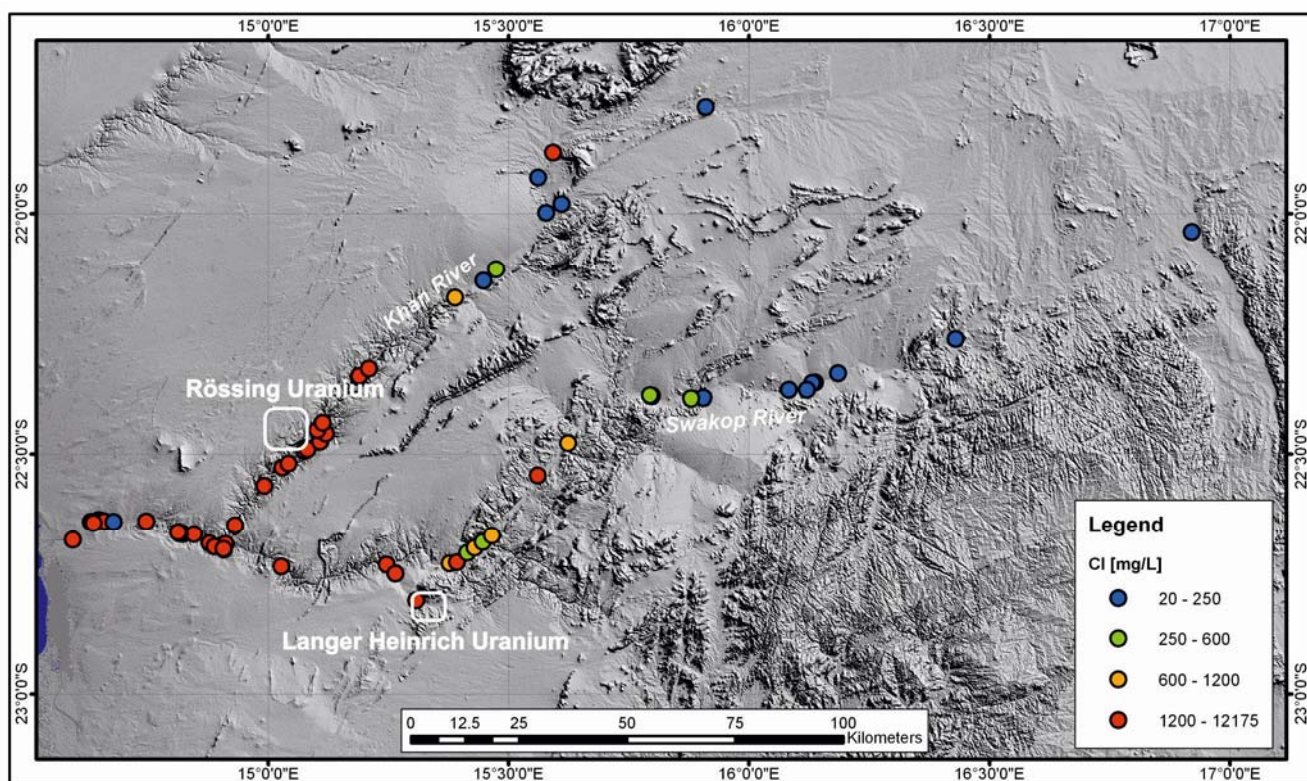


Fig. 9: Spatial distribution of chloride

In Fig. 10, the chloride/sodium molar ratio is plotted against the longitude of the sampling points. As a general trend, the plot exhibits increasing Cl/Na ratios with increasing water salinity. Freshwater samples have a sodium surplus (Cl/Na ratio <1) whereas saline waters exhibit a sodium deficit relative to chloride. The median (p50) value of all analysed salt water samples is 1.32. The observed

trend is a result of water-rock interaction in fresh and saline water environments. There are two main resources for sodium and chloride in fresh water: a) sea salt in rain water with a Cl/Na ratio of 1.17 and b) the hydrolytic decomposition of silicates, which leads to the release of additional sodium (but not chloride). Freshwater therefore commonly has Cl/Na ratios of <1.

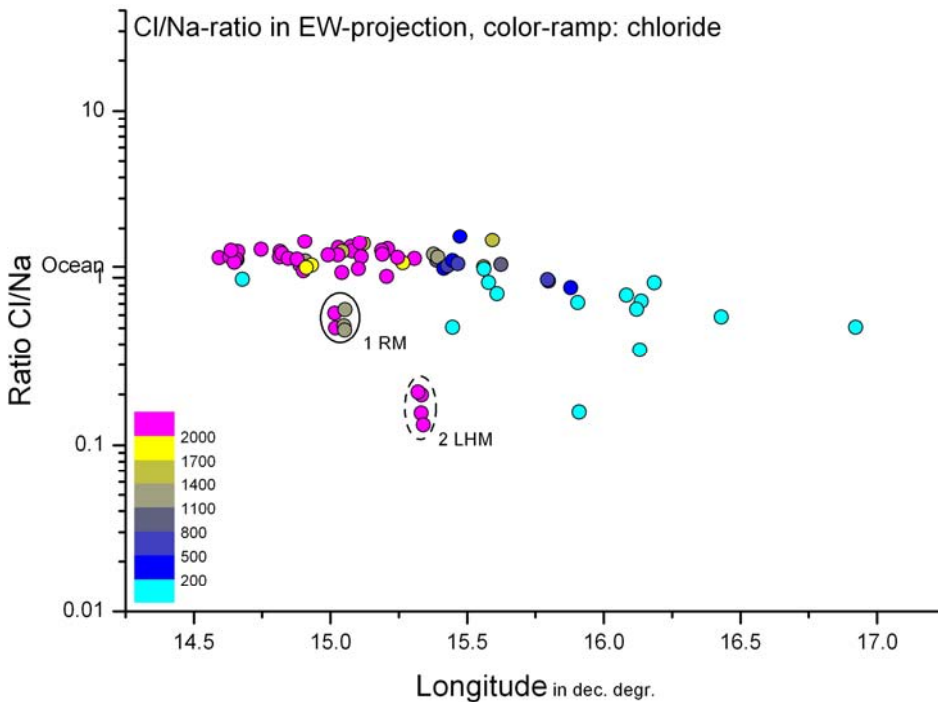


Fig 10: E-W-projection of the molar ratio of chloride to sodium (log10 scale)

In saltwater-bearing sediments, the chemical interactions between water and rock take place in a reverse direction: the contact of saltwater with alkali-earth bearing minerals leads to enrichment in calcium and magnesium and a corresponding depletion in sodium in the water. In addition, feldspars and clay minerals become unstable in contact with saline solutions. Weathering reactions give rise to sodium-rich clay minerals and the release of alkali-earth elements calcium, magnesium and strontium. Saline waters therefore do not contain stoichiometric compositions of sodium and chloride as would be expected in saline waters resulting from dilution of rock salt. Instead, they have a sodium deficit with respect to chloride and associated excess alkali-earth elements (KLINGE et al. 2007).

The clusters 1 (RM) and 2 (LHM) of mine water samples in Fig. 10 show the strong influence of mining and processing technology on the Cl/Na ratio. The alkaline sodium bicarbonate extraction method employed at Langer Heinrich Mine (LHM) is clearly visible in cluster 2.

The median (p50) **sulphate** concentration of all water samples is 494 mg/L (min. 18 mg/L, max. 11890 mg/L). The plot of sulphate versus EC (Fig. 11) shows a clear positive relation between sulphate und salinity. The borehole (S13) is located in vicinity to the Rössing Uranium Mine and exhibits an outstanding high sulphate concentration of 11890 mg/L. The chemical composition of this respective sample will be discussed in detail in connection with the spatial distribution of uranium.

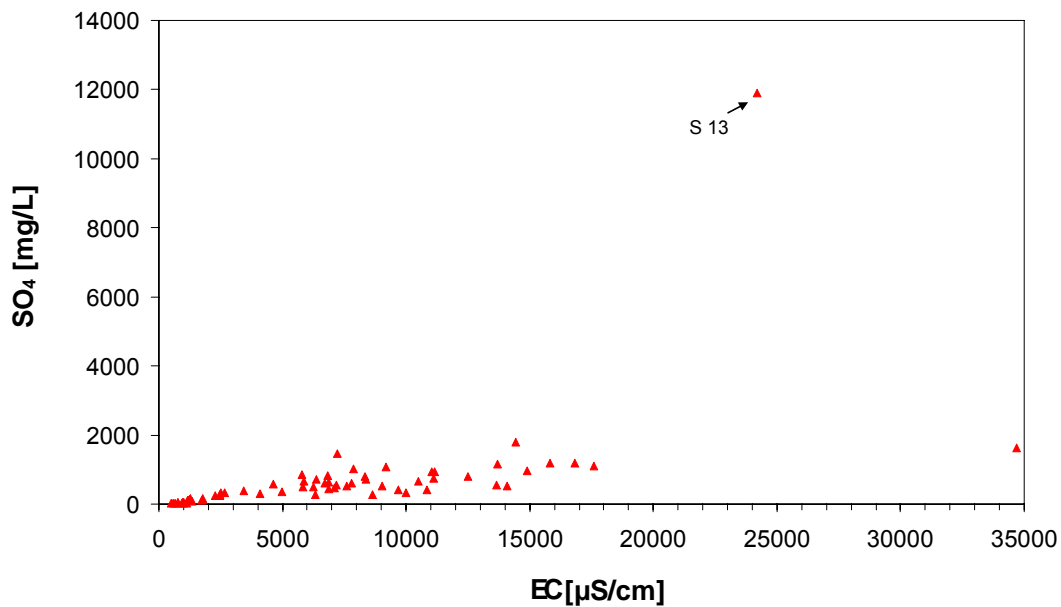


Fig. 11: Correlation between sulphate and electrical conductivity (EC) in alluvial groundwater

Water Samples also show a positive correlation between boron and EC (Fig. 12). Two groups of samples can be distinguished: a) samples with a linear correlation between boron and EC (hatched line in Fig. 12), b) samples with a higher boron concentration compared to group a) (yellow field)

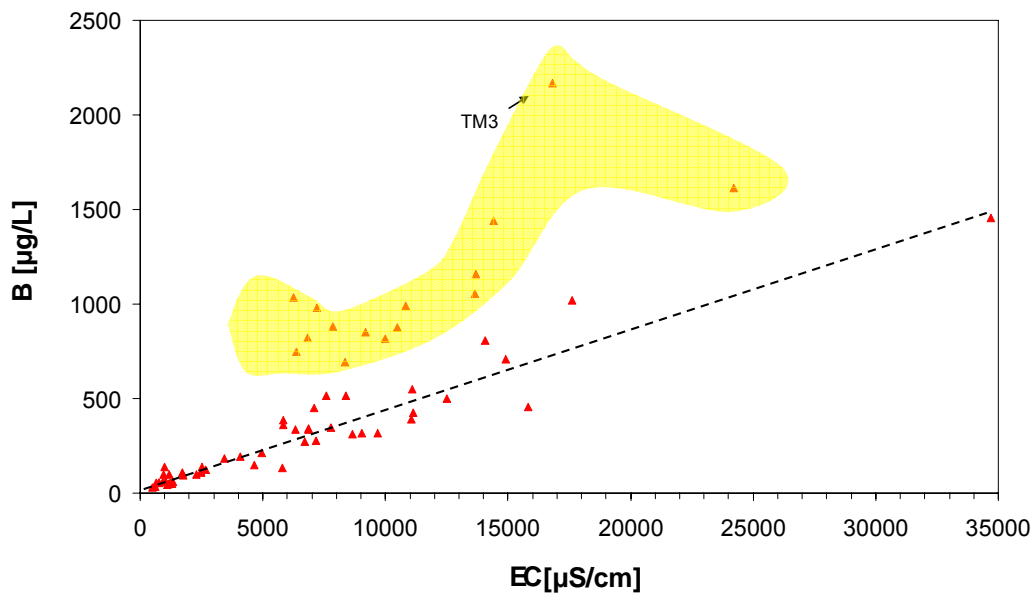


Fig. 12: Correlation between boron and electrical conductivity (EC) in alluvial groundwater

Boron minerals are typically associated with terrestrial evaporites. Group a) therefore represents samples with evaporation and evapotranspiration as the main source of salinity; group b) includes samples with dissolution of rock salt as an additional salinity source. Again there is one outlier (TM3 in vicinity of the Langer Heinrich Mine) with a considerably higher boron concentration.

The median (p50) concentration of **fluoride** is 0.48 mg/L (min. <0.02 mg/L, max. 4.88 mg/L). Unlike boron and sulphate, there is no positive correlation between fluoride and salinity (Fig. 13). Except for one sample, all samples with freshwater quality fall into quality group A (< 1 mg/L F), or group B (< 2 mg/L). One outlier (Tsawasis) has a considerably higher fluoride concentration of 4.9 mg/L which is harmful for human consumption.

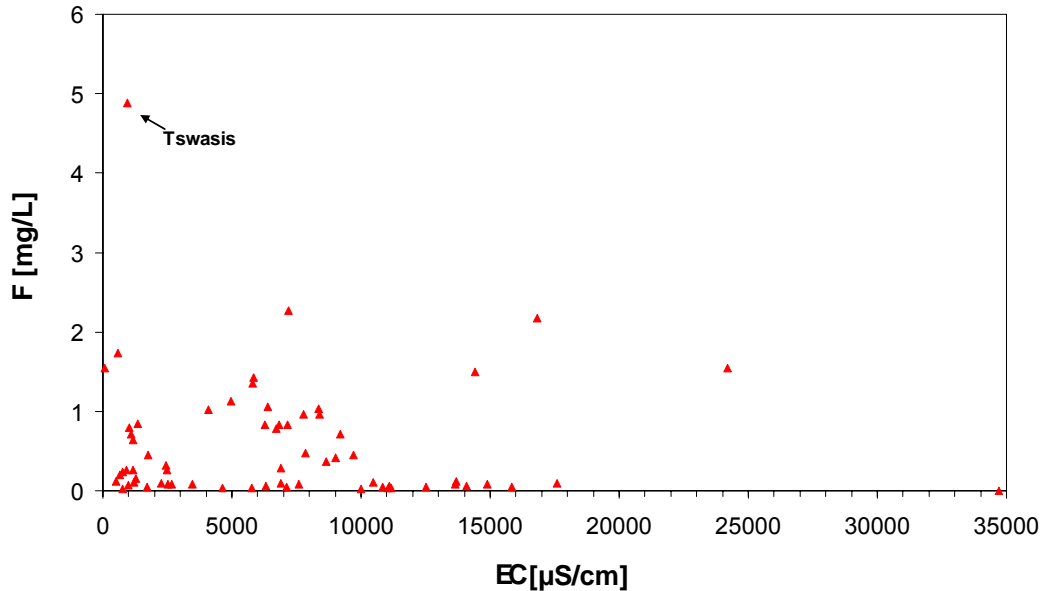


Fig. 13: Correlation between fluoride and electrical conductivity (EC) in alluvial groundwater

The **pH** of the alluvial groundwater is controlled by the $\text{HCO}_3^- - \text{H}_2\text{CO}_3^*$ -buffer system, where H_2CO_3^* stands for the sum of carbonic acid and CO_2 . For alluvial samples, median (p50) is pH 7.01 (min. pH 4.3, max. pH 8.23) and thus clearly not in the alkaline range which would go along with higher concentrations of CO_3^{2-} . In Fig. 14 the bicarbonate (HCO_3^-) concentration is plotted against EC. The majority of samples exhibit bicarbonate concentrations of between approx. 150 and 350 mg/l. A group of freshwater samples from the upper Kahn River catchment and a small number of saline water samples have considerably higher concentrations of up to 666 mg/L. Bicarbonate concentrations at this level are typically found in a carbonate environment. The previously mentioned sample S13 in the vicinity to the Rössing mine is free of bicarbonate due to a pH of 4.3.

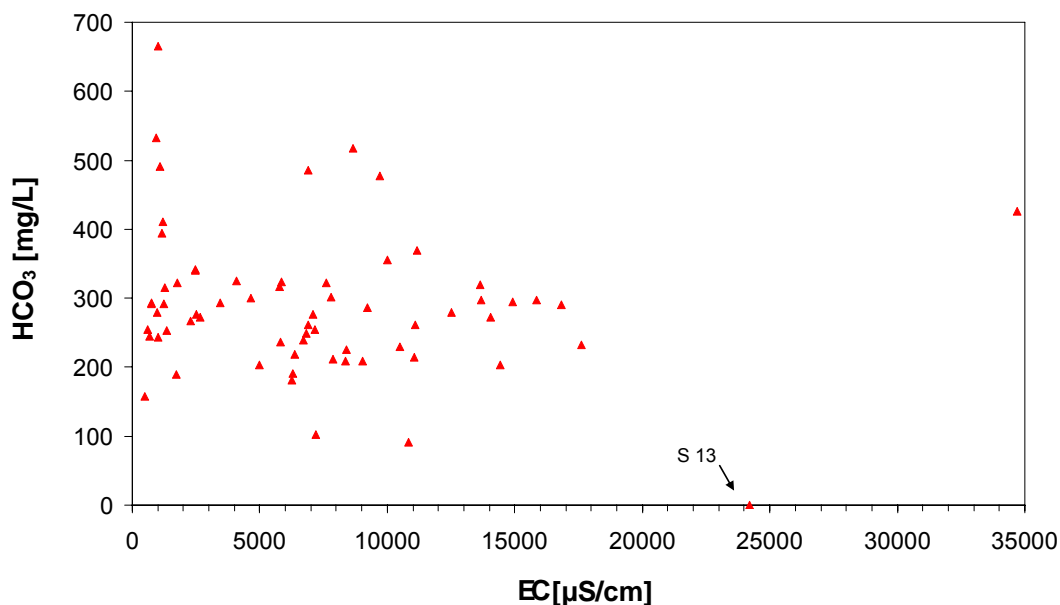


Fig. 14: Correlation between bicarbonate and electrical conductivity (EC) in alluvial groundwater

4.1.5 Redox conditions

The oxidation-reduction (**redox**) condition of groundwater is of vital importance because it controls the aqueous speciation of trace elements, in particular of uranium. Uranium is soluble under oxic conditions. **Dissolved iron** in a carbonate buffered groundwater is a robust indicator of reducing conditions. It is present as Fe(II) within the pH-range discussed above. Exposing the water to oxygen would lead to rapid oxidation and subsequent precipitation as Fe(OH)₃. Median (p50) dissolved iron in alluvial groundwater is 0.173 mg/L (min. <0.003 mg/L, max. 95.2 mg/L). The median value together with the maximum clearly shows, that reducing conditions do exist in the alluvial aquifers of the Khan and the Swakop River at a number of sites. Taking 0.05 mg/L dissolved Fe as an arbitrary value for the onset of iron-reducing conditions, 30 out of 60 alluvial samples could thus be classified as reduced, anoxic groundwater. The spatial distribution of dissolved Fe is given in Fig. 15.

A number of saline water samples from the Swakop River valley downstream of the confluence with the Khan River have elevated iron concentrations of up to 95 mg/L indicating reducing conditions.

Anoxic groundwater is rarer in subtropical and arid regions than in temperate regions, because of higher rates of organic carbon mineralisation due to increased temperature and much slower and infrequent transport of **TOC** through the unsaturated zone (median (p50) 1.3 mg/L; min. 0.3 mg/L, max. 7.1 mg/L) with high groundwater temperatures.

Other redox-sensitive parameters are the nitrogen compounds: **nitrate** (median (p50) 24.6 mg/L, min. <0.1 mg/L, max. 704 mg/L) for oxic and suboxic conditions, and **ammonia** (median (p50) 0.05 mg/L, min <0.01 mg/L, max. 1.58 mg/L) as well as **manganese** (median (p50) 0.12 mg/L, min. 0.001 mg/L, max. 10.7 mg/L) for anoxic conditions.

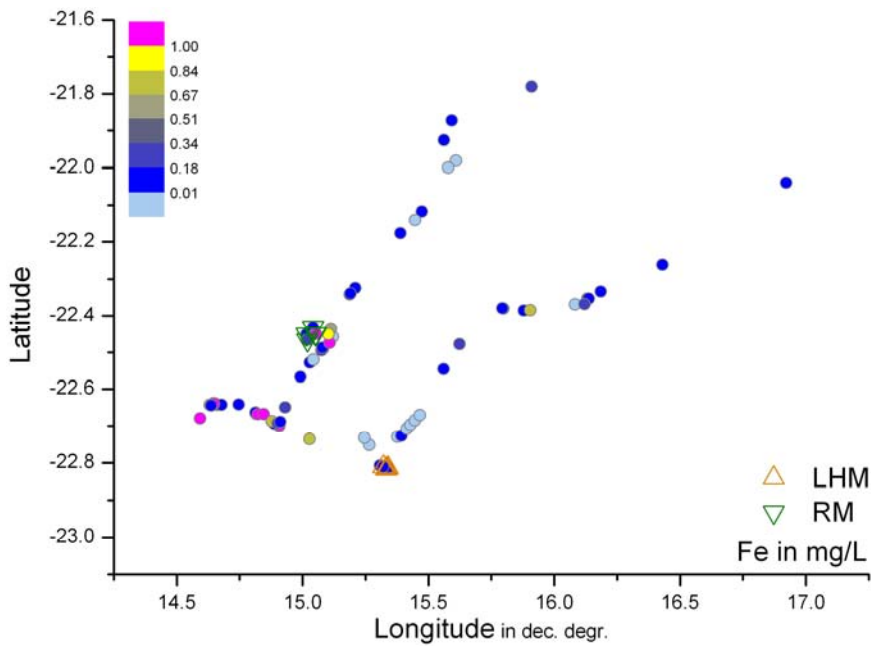


Fig. 15: Spatial distribution of iron (samples from Rössing and Langer Heinrich mine included)

The spatial distribution of nitrate is shown in Fig. 16. 90 % of the fresh water samples (EC <3000 $\mu\text{m}/\text{cm}$) have concentration below 40 mg/L (group A). As a general trend, saline groundwater from the lower Swakop River valley has a higher nitrate level than the fresh water from the headwater region. This may reflect nitrate enrichment due to agricultural activities in this area.

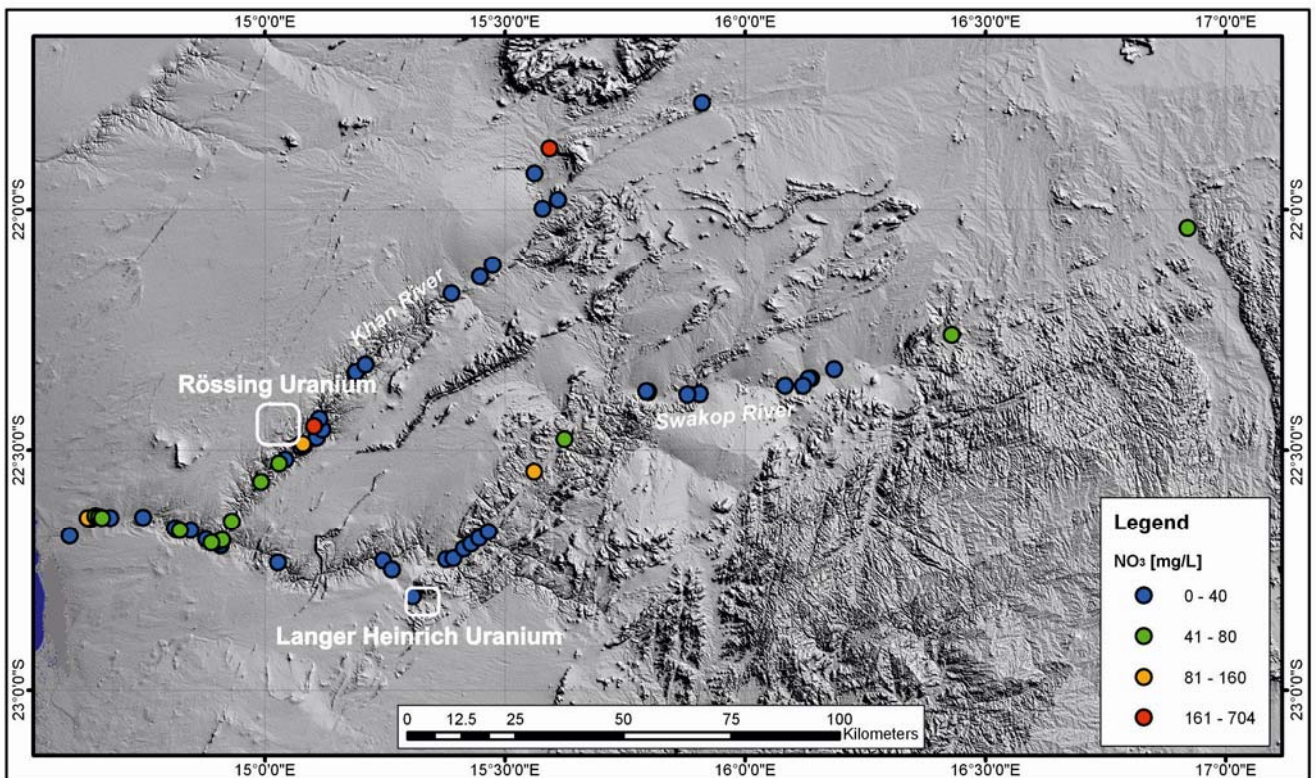


Fig. 16: Spatial distribution of nitrate in alluvial groundwater

There are two samples with an outstanding high nitrate concentration of 222 mg/L (S13 in vicinity of the Rossing Uranium Mine) and 704 mg/l (borehole Pos1 in the upper Khan River valley). The reason for such extremely high nitrate levels remains unclear.

4.2 Trace elements

4.2.1 Uranium

Uranium is widespread in nature occurring in crystalline rocks as well as in sediments. It is present in groundwater as a result of water rock interactions (leaching processes). Due to its toxicity WHO has established a provisional guideline value of 15 µg/L. The guideline value has been designated as provisional because of uncertainties regarding the toxicology and epidemiology of uranium as well as difficulties concerning its technical achievability for smaller suppliers (WHO 2004). The Namibian standard of 1000 µg/L uranium needs to be adjusted to this international standard.

The median (p50) concentration of dissolved uranium (U) in analysed alluvial groundwater samples is 39 µg/L ranging between min. 2 µg/L and max. 528 µg/L (Fig 17). No values below the detection limit were found. U is therefore a common trace metal in the groundwater of the catchment and

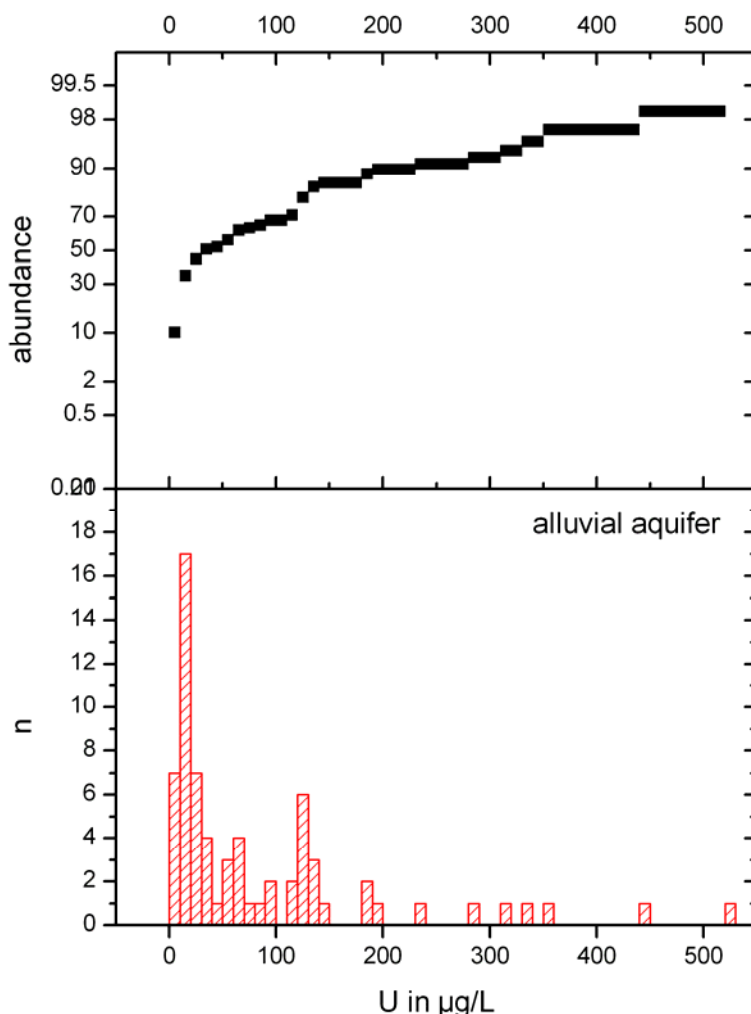


Fig. 17: Distribution of dissolved uranium in alluvial groundwater. Process water samples from mines are not included

mostly present at elevated concentrations. Only 14 out of 66 of the analysed alluvial water samples (21 %) have uranium concentrations below the provisional WHO guideline value. The spatial distribution of dissolved uranium in the two alluvial valleys is shown in Fig. 18.

The main conclusions which can be derived from the distribution pattern are:

- Fresh groundwater in the headwater region of the Swakop River valley and in the valley upstream of the Langer Heinrich Uranium Mine shows low concentrations below the WHO guideline value.

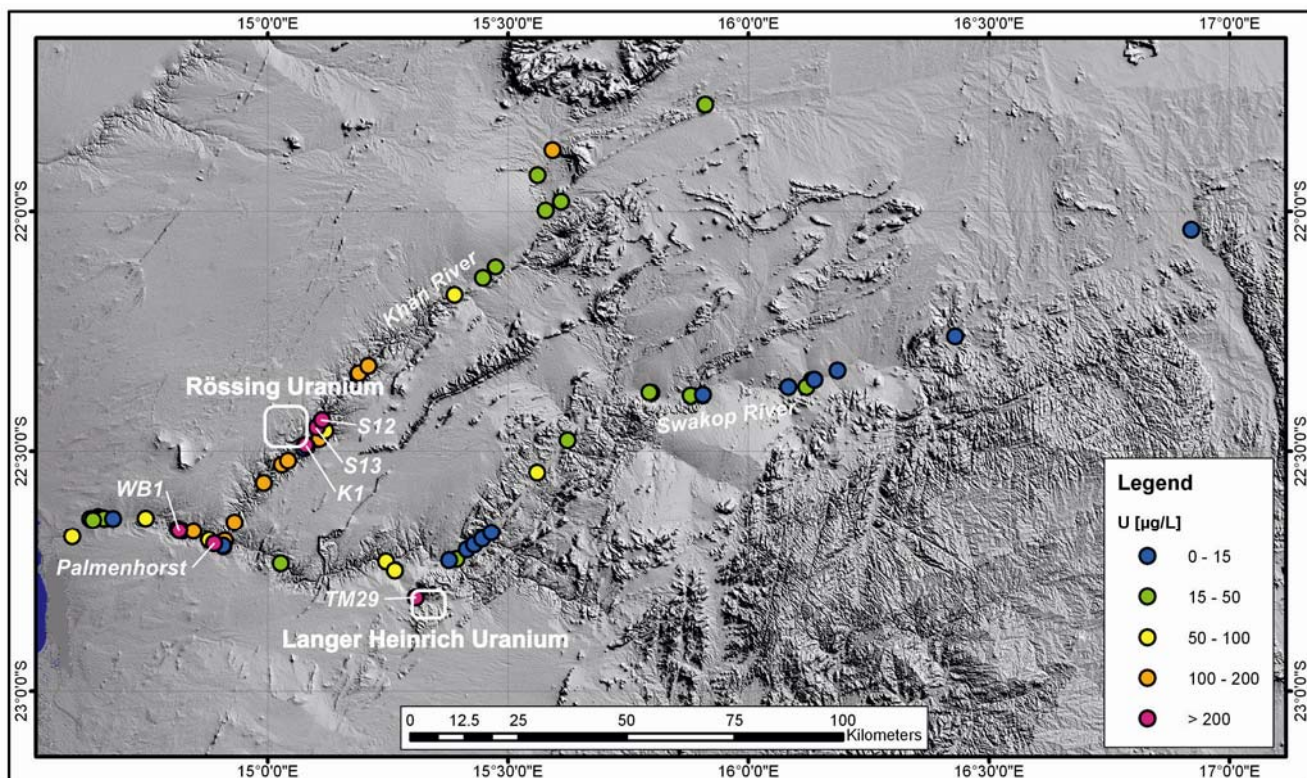


Fig. 18: Spatial distribution of uranium in alluvial groundwater

- Uranium concentrations in the Khan River valley are generally higher than in the Swakop River alluvial valley. The concentrations in freshwater samples from the upper Khan River valley are generally above the WHO guideline value.
- Saline water in the lower part of the Khan River valley and the Swakop River valley downstream from the confluence has considerably higher concentrations of 50 up to 230 µg/L.
- If the 90 % percentile of the alluvial groundwater uranium (U) distribution is chosen to define geogenic background levels, background concentrations would be 230 µg/L. Altogether six groundwater samples have uranium concentrations exceeding 230 µg/L (Tab 1).

Tab. 1: Groundwater samples with dissolved uranium concentrations above the 90 % percentile

| Sampling Point | Uranium [µg/L] | Location |
|-----------------------|-----------------------|---|
| S12 | 332 | vicinity of Rössing Uranium Mine |
| S13 | 354 | |
| K1 | 449 | |
| TM29 | 281 | vicinity of Langer Heinrich Uranium Mine |
| WB1 | 528 | Swakop River Valley downstream of the confluence of Swakop and Khan River |
| Palmenhorst | 239 | |

Tab. 2: Linear correlation matrix of dissolved Uranium and other anion-forming elements (red (>0.75) for “strong correlation”, bold black (>0.35) for “positive correlation” and bold blue (≤0.35) “disputed correlation, but higher than background”).

| Korrelationen | TDS | AL_40 | ALK | AS_69 | CA_40 | F_36 | FE_40 | HCO3_37 | K_40 | LF_35 | LI_40 | MN_40 | MO_69 | NH4_39 | NI_69 | NO3_36 | PB_69 | PH_35 | PO4_39 | SiO2_40 | SO4_36 | SR_40 | TH_69 | TOC_81 | U_40 | V_69 | ZN_40 | |
|---------------|-------|-------|-------|-------|-------|-------|-------|---------|-------|-------|-------|-------|-------|--------|-------|--------|-------|-------|--------|---------|--------|-------|-------|--------|-------|------|-------|---|
| TDS | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AL_40 | 0.54 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALK | -0.04 | -0.10 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| AS_69 | -0.13 | -0.03 | 0.06 | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| CA_40 | 0.84 | 0.07 | -0.05 | -0.18 | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| F_36 | 0.02 | 0.16 | -0.11 | 0.65 | -0.04 | 1 | | | | | | | | | | | | | | | | | | | | | | |
| FE_40 | 0.11 | 0.02 | -0.11 | -0.06 | 0.28 | -0.09 | 1 | | | | | | | | | | | | | | | | | | | | | |
| HCO3_37 | -0.04 | -0.10 | 1.00 | 0.06 | -0.05 | -0.11 | -0.11 | 1 | | | | | | | | | | | | | | | | | | | | |
| K_40 | 0.78 | -0.01 | -0.16 | -0.12 | 0.90 | -0.01 | 0.08 | -0.16 | 1 | | | | | | | | | | | | | | | | | | | |
| LF_35 | 0.96 | 0.35 | -0.05 | -0.13 | 0.88 | -0.06 | 0.10 | -0.05 | 0.87 | 1 | | | | | | | | | | | | | | | | | | |
| LI_40 | 0.57 | 0.99 | -0.14 | -0.03 | 0.12 | 0.22 | -0.02 | -0.14 | 0.07 | 0.39 | 1 | | | | | | | | | | | | | | | | | |
| MN_40 | 0.66 | 0.95 | 0.04 | -0.02 | 0.24 | 0.08 | 0.17 | 0.04 | 0.14 | 0.50 | 0.93 | 1 | | | | | | | | | | | | | | | | |
| MO_69 | 0.12 | -0.12 | -0.39 | 0.15 | 0.25 | 0.55 | -0.12 | -0.39 | 0.36 | 0.14 | -0.02 | -0.14 | 1 | | | | | | | | | | | | | | | |
| NH4_39 | 0.16 | 0.20 | -0.15 | 0.17 | 0.05 | -0.14 | 0.21 | -0.15 | 0.13 | 0.20 | 0.17 | 0.33 | 0.02 | 1 | | | | | | | | | | | | | | |
| NI_69 | 0.54 | 1.00 | -0.13 | -0.03 | 0.07 | 0.16 | 0.00 | -0.13 | -0.02 | 0.35 | 0.99 | 0.95 | -0.12 | 0.19 | 1 | | | | | | | | | | | | | |
| NO3_36 | 0.18 | 0.25 | 0.14 | -0.10 | 0.15 | 0.04 | -0.05 | 0.14 | -0.04 | 0.12 | 0.26 | 0.19 | -0.04 | -0.01 | 0.25 | 1 | | | | | | | | | | | | |
| PB_69 | 0.62 | 0.92 | 0.12 | -0.03 | 0.22 | 0.17 | 0.00 | 0.12 | 0.17 | 0.45 | 0.93 | 0.88 | -0.03 | 0.14 | 0.92 | 0.28 | 1 | | | | | | | | | | | |
| PH_35 | -0.40 | -0.47 | -0.13 | 0.22 | -0.19 | 0.04 | -0.01 | -0.13 | -0.10 | -0.30 | -0.47 | -0.45 | 0.14 | 0.02 | -0.47 | -0.21 | -0.45 | 1 | | | | | | | | | | |
| PO4_39 | -0.25 | -0.13 | 0.09 | 0.17 | -0.24 | -0.26 | -0.10 | 0.09 | -0.22 | -0.23 | -0.18 | -0.07 | -0.22 | 0.18 | -0.13 | -0.19 | -0.15 | 0.09 | 1 | | | | | | | | | |
| SiO2_40 | 0.45 | 0.53 | 0.05 | 0.01 | 0.25 | 0.46 | -0.14 | 0.05 | 0.35 | 0.34 | 0.62 | 0.44 | 0.27 | -0.08 | 0.53 | 0.18 | 0.64 | -0.35 | -0.35 | 1 | | | | | | | | |
| SO4_36 | 0.72 | 0.96 | -0.23 | -0.09 | 0.31 | 0.17 | 0.03 | -0.23 | 0.22 | 0.54 | 0.97 | 0.94 | 0.02 | 0.17 | 0.96 | 0.28 | 0.92 | -0.48 | -0.21 | 0.59 | 1 | | | | | | | |
| SR_40 | 0.73 | -0.13 | -0.03 | -0.11 | 0.87 | -0.08 | 0.05 | -0.03 | 0.93 | 0.86 | -0.06 | 0.03 | 0.25 | 0.10 | -0.13 | 0.04 | 0.03 | -0.03 | -0.21 | 0.21 | 0.09 | 1 | | | | | | |
| TH_69 | 0.42 | 0.62 | -0.15 | -0.05 | 0.11 | 0.03 | 0.05 | -0.15 | 0.13 | 0.36 | 0.61 | 0.59 | -0.07 | 0.13 | 0.61 | 0.16 | 0.60 | -0.29 | -0.11 | 0.40 | 0.61 | 0.05 | 1 | | | | | |
| TOC_81 | 0.20 | 0.14 | 0.23 | 0.06 | 0.18 | -0.06 | 0.03 | 0.23 | 0.04 | 0.17 | 0.14 | 0.21 | -0.17 | 0.20 | 0.15 | 0.61 | 0.17 | 0.01 | 0.28 | -0.04 | 0.15 | 0.12 | -0.01 | 1 | | | | |
| U_40 | 0.41 | 0.07 | -0.10 | -0.04 | 0.52 | 0.11 | 0.25 | -0.10 | 0.48 | 0.44 | 0.11 | 0.18 | 0.42 | 0.34 | 0.06 | 0.11 | 0.07 | -0.18 | 0.01 | 0.19 | 0.21 | 0.45 | 0.13 | 0.02 | 1 | | | |
| V_69 | 0.02 | -0.06 | 0.01 | 0.47 | 0.09 | 0.55 | -0.08 | 0.01 | 0.27 | 0.01 | 0.04 | -0.12 | 0.28 | -0.15 | -0.06 | -0.06 | 0.10 | 0.04 | -0.08 | 0.59 | -0.05 | 0.15 | -0.03 | 0.01 | -0.01 | 0.12 | 1 | |
| ZN_40 | 0.06 | 0.07 | 0.34 | -0.05 | 0.10 | -0.02 | -0.02 | 0.34 | -0.09 | 0.03 | 0.08 | 0.06 | -0.15 | 0.00 | 0.07 | 0.84 | 0.14 | -0.11 | -0.12 | 0.03 | 0.07 | 0.02 | -0.01 | 0.61 | 0.05 | 0.07 | -0.04 | 1 |

Additionally a linear correlation matrix has been calculated for uranium from:

- a. water constituents known to interact with U in aqueous solution
- b. other trace elements forming anion complexes.

The results are shown in Tab. 2 (ref. appendix for a large copy). To highlight the results, boundaries have been drawn for the mark-up colours: red (>0.75) for “strong correlation”, bold black (>0.35) for “positive correlation” and bold blue (≤0.35) “disputed correlation, but higher than background”.

Positive correlations with uranium (U) are found in the order of decreasing strength for BO₂, Mo, TDS, SiO₂, (SO₄, K), Li, NH₄, Sr. For the anion forming trace elements the strongest correlation is found with molybdenum (Mo), while no correlation is found for either vanadium (V) or arsenic (As).

A negative correlation exists with iron (Fe), alkalinity (ALK) and phosphate. A high iron concentration as an indicator of reducing conditions in the aquifer (s.a.) means a low uranium concentration and vice versa. Phosphate anions are part of the structure of a number of secondary uranium minerals, as is the case with hydrogen carbonate. A list of secondary uranium minerals with the carbonate anion in the structure has been compiled by PERROUD (2010) and is included in Tab. 8 in the appendix. The negative correlation with alkalinity might be tentatively interpreted in connection with the strength of calcrete forming processes in the aquifer, but must remain unresolved here.

4.2.2 Other trace elements of concern

Other trace elements of concern including arsenic (As), vanadium (V), nickel (Ni), thorium (Th), molybdenum (Mo) and zinc (Zn) are briefly summarized below. As, V and Mo are chosen for their

anionic properties in aqueous solution. Ni and Zn are chosen as elements which are common and readily solubilize under acidic conditions. The correlation factors are found in Tab. 1 above.

As Like uranium arsenic is highly toxic. The WHO guideline value is 10 µg/L. Again the Namibian standard of 100 to 600 µg/L needs to be adjusted to the international standard. The median (p50) concentration of As is 0.1 µg/L (min. 0.12 µg/L, max. 21.4 µg/L) for all alluvial groundwater samples. Only one sample from Tsawisis exceeds the WHO guideline value. Arsenic positively correlates with fluoride and vanadium.

V The median (p50) concentration of vanadium is 6.1 µg/L (min. 0.1 µg/L, max. 136 µg/L) for all alluvial groundwater samples. 12 samples have concentrations ≥10 µg/L, which are Arueis, Horebis, Nord, K1, Kranzberg, Naob, Safier, TM29, Tsawisis, Ukuib 1, Ukuib 2, WW25025, and WW41180. Vanadium has a positive correlation with SiO₂ and arsenic. All water samples from LHM have high or extreme concentrations of vanadium, high concentrations of tungsten and other trace elements. Vanadium is not included in the WHO guidelines.

Mo The median (p50) concentration of Molybdenum is 4.9 µg/L (min. 0.7 µg/L, max. 33.3 µg/L) for all alluvial groundwater samples. 11 samples have concentrations ≥10 µg/L, which are Borehole 1.6A, Horebis Nord, K1, KEM3, NN1, S12, SH-SM, TM29, TR5A, Tsawisis, WW41180. All values are below the WHO guideline value of 70 µg/L. Mo positively correlates with uranium, fluoride and potassium.

Th The median (p50) concentration of thorium is 0.006 µg/L (max. 0.23 µg/L) close to the detection limit for all alluvial groundwater samples. Only 4 samples have concentrations ≥0.1 µg/L.

Ni The median (p50) concentration of nickel is 0.5 µg/L (min. <0.3 µg/L, max. 1508 µg/L) for all alluvial groundwater samples. Five samples have concentrations of 2 to max. 9 µg/L, which are well below the WHO guideline value of 20 µg/L. Sample S13 is an outlier with an extremely high concentration of 1508 µg/L. The sample has a low pH of 4.3 and contains elevated concentrations of Al and other trace elements. Nickel positively correlates in the order of decreasing strength with Al, Li, (SO₄, Mn), Pb, TDS, SiO₂. It should be noted, that **lead** (Pb) displays a similar pattern.

Pb The median (p50) concentration of lead is 0.12 µg/L (min. <0.04 µg/L, max. 3.8 µg/L in sample S13) for all alluvial groundwater samples. The measured concentrations are well below the WHO guideline value of 10 µg/L.

Zn The median (p50) concentration of zinc is 0.03 mg/L (min. <0.003 mg/L, max. 2.6 mg/L) for all alluvial groundwater samples. 7 samples have concentrations ≥0.05 mg/L, which are: BH 1.6A, BH1.4, Pos 1, Pos 3, R1, S12, S13. Zinc correlates in the order of decreasing strength with NO₃, TOC, and bicarbonate. Zinc is not included in the WHO guidelines.

4.3 Classification of water types

A classification of all samples analysed is included in the appendix in Tab. 9.

4.3.1 Process water

In the course of the sampling campaign water samples were taken on the premises of the Rössing and Langer Heinrich Uranium Mines with the support of both mining corporations. The purpose of this sampling was to chemically characterise process waters and seepage water from the tailings as potential contamination sources.

Five samples were taken on the premises of the **Langer Heinrich Uranium Ltd. Mine**. They include one sample from an observation borehole, two samples from production boreholes for process water and two surface water samples from the tailing storage facilities (Tab. 3).

All samples are saline waters with ECs between 12000 and 58000 $\mu\text{S}/\text{cm}$ (TDS: 5.2 – 25.9 g/L). Sample LHU 2278 from the observation borehole on one hand, and the process and seepage waters on the other hand have strongly different water chemistries. LHU 2278 is a Na-Cl-type water with a salinity typically found in this region. The water has a slightly elevated uranium concentration of 317 $\mu\text{g}/\text{L}$ (background value 230 $\mu\text{g}/\text{L}$, p90), and a low arsenic concentration of 6.5 $\mu\text{g}/\text{L}$. Other trace elements are in a typical range of alluvial groundwater. In contrast to this sample, the process and seepage water samples are extremely alkaline waters with a pH of around 10, high sodium and bicarbonate/carbonate as main constituents as well as high sulphate concentrations. Their chemistry reflects the alkaline extraction methods of the calcrete based mineralization at the LHM. The concentration range of uranium and arsenic are approx. three orders of magnitude and that of fluoride two orders of magnitude above the regional background level. Vanadium is well above 6 mg/L and tungsten is elevated together with a number of rare earth elements (Tab. 4).

Tab. 3: List of water samples from the Langer Heinrich and Rössing uranium mines

| Mine | Sample No. | Sample type | Field Remarks |
|-----------------------------------|-------------------|--------------------|--|
| Langer Heinrich Mine Uranium Ltd. | LHU 2278 | Observation well | upstream of TSF, bailer (3.), casing 10 cm diameter |
| | LHU-DW11 | Production well | production borehole in use |
| | LHU-TM6 | Production well | production borehole in use |
| | LHU-TSF | Pond | Tailings storage facility, surface water sample |
| | W.-trench | Pond | protocol is missing |
| Rössing Mine Uranium Ltd. | RU-D1 | Production well | from production borehole around tailings |
| | RU-DW3 | Production well | from production borehole around tailings |
| | U-N13 | Observation well | upstream of tailings, own pump used, casing 20 cm diameter |
| | RU-SRK1 | Borehole | tailings water, seepage from production borehole |
| | RU-TP | Pond | tailing pond water (surface) |
| | RU-TP2 | Shaft | seepage from tailings dam |

Six samples were taken on the premises of the **Rössing Mine** (Tab 3). These include one sample from an observation borehole located upstream from the tailings storage facilities, three samples

from production boreholes and two samples of seepage water from tailing dams. The observation borehole sample RU-N13 is a saline Na-Cl-type water (EC: 25800 $\mu\text{S}/\text{cm}$; TDS: 18.2 g/L) with high calcium and sulphate concentrations and an elevated nitrate concentration of 314 mg/L. The water has a neutral pH around 7 and a low uranium concentration of 118 $\mu\text{g}/\text{L}$. Apart from the elevated nitrate concentration, there is no indication of a contamination through mining activities.

The samples from the production boreholes and from the tailing facilities are Na-SO₄-Cl- types waters. Compared to sample RU-N 13 the samples have a slightly lower pH. Due to sulphuric acid leaching of the ore bearing felsic uranium host rock the tailing pond samples RU-TP and RU-TP 2 are strongly acidic solutions with zero bicarbonate and elevated iron concentrations. Manganese concentrations are very high in all samples. Uranium concentrations are between 1600 and 3100 $\mu\text{g}/\text{L}$ in the groundwater samples and sample RU-TP 2, while the concentration range in RU-TP is one order of magnitude higher (33000 $\mu\text{g}/\text{L}$). In addition, the latter sample has a high arsenic concentration of 500 $\mu\text{g}/\text{L}$ whereas the former samples have very low arsenic concentrations. All Rössing Mine samples show elevated concentrations for Li, Ni, and Co, while Pb, Cu, V, Mo, and Cr concentrations are only elevated in the tailings pond sample (Tab 4).

Tab. 4: Chemical composition of water samples from the Langer Heinrich and Rössing uranium mines

| sample No. | Langer Heinrich Mine Uranium Ltd. | | | | | Rössing Mine Uranium Ltd. | | | | | |
|--------------------------------|-----------------------------------|----------|---------|---------|-----------|---------------------------|-------|--------|---------|---------|--------|
| | LHU-2278 | LHU-DW11 | LHU-TM6 | LHU-TSF | W.-trench | RU-N13 | RU-D1 | RU-DW3 | RU-SRK1 | RU-TP | RU-TP2 |
| EC [$\mu\text{S}/\text{cm}$] | 12100 | 27700 | 32000 | 57800 | 22500 | 25800 | 19180 | 15500 | 15990 | 27500 | 17000 |
| TDS [mg/L] | 5186 | 26857 | 29713 | 40425 | 25893 | 18232 | 14130 | 14924 | 10134 | 29525 | 11859 |
| pH | 7.04 | 9.5 | 9.7 | 10.7 | 10 | 7.15 | 6.72 | 6.8 | 6.4 | 2.1 | 4.2 |
| Na [mg/L] | 1617 | 9078 | 10570 | 16325 | 9299 | 5084 | 2607 | 2763 | 1653 | 1655 | 1372 |
| K [mg/L] | 71.5 | 150 | 130 | 372 | 139 | 123 | 129 | 226 | 72 | 207 | 47.9 |
| Ca [mg/L] | 209 | 2.75 | 1.92 | 1.7 | 3.4 | 1298 | 183 | 579 | 193 | 355 | 147 |
| Mg [mg/L] | 54.6 | 1.59 | 0.562 | 4.37 | 4.16 | 292 | 1161 | 950 | 815 | 1936 | 1004 |
| Cl [mg/L] | 2536 | 2779 | 2523 | 3317 | 2960 | 8430 | 2472 | 2133 | 1317 | 1243 | 1366 |
| NO ₃ [mg/L] | 1.55 | 66.5 | 66.4 | 0.16 | 59.4 | 314 | 214 | 75.4 | 24.1 | 133 | 16.5 |
| SO ₄ [mg/L] | 320 | 3611 | 3738 | 4867 | 3415 | 2578 | 5883 | 6837 | 5083 | 21615 | 7390 |
| HCO ₃ [mg/L] | 355 | 6622 | 5557 | 1056 | 3918 | 111 | 1472 | 1349 | 961 | 0 | 0 |
| CO ₃ [mg/L] | 0 | 4538 | 7072 | 14396 | 6050 | 0 | 0 | 0 | 0 | 0 | 0 |
| U [$\mu\text{g}/\text{L}$] | 317 | 229906 | 176892 | 141804 | 65434 | 118 | 2540 | 3136 | 1612 | 33350 | 2244 |
| As [$\mu\text{g}/\text{L}$] | 6.45 | 554 | 772 | 2251 | 1040 | 0.36 | 2.05 | 0.76 | 0.73 | 508 | 11.1 |
| F [mg/L] | 1.19 | 8.52 | 53.7 | 85.5 | 45.2 | 2.12 | 8.96 | 11.7 | 9.54 | - | 28.6 |
| Fe [mg/L] | 19.9 | 0.079 | 0.078 | 0.049 | 0.019 | 0.014 | 0.025 | 0.253 | 6.49 | 2381 | 487 |
| Mn [$\mu\text{g}/\text{L}$] | 1235 | 2.4 | 6 | 4.4 | 134 | 1.1 | 26592 | 19838 | 79647 | 1309296 | 523718 |

4.3.2 Drinking water samples

Two samples were taken from taps of the Swakopmund and Walvis Bay water supply to get a first indication on trace metal concentration in the public drinking water system. Consequently, metals

contained in alloys used in the tubing and distribution system may be elevated in concentration with regard to groundwater. Drinking water sources are the Omdel dam (Swakopmund) and the Kuiseb River (Walvis Bay).

Both samples have an EC below 2000 $\mu\text{S}/\text{cm}$ and a pH in the circum-neutral range.

The **Swakopmund** sample is a hard, slightly brackish water of $\text{Na}^{\text{*}}\text{-Ca-Cl}^{\text{*}}\text{-HCO}_3$ -type. With respect to uranium (14.4 $\mu\text{g}/\text{L}$) it is well below the median concentration from alluvial groundwater samples and below, but close to, the provisional WHO Guideline value of 15 $\mu\text{g}/\text{L}$.

The **Walvis Bay** sample is a hard, non-saline water of $\text{Na-Ca-Mg-HCO}_3\text{-Cl-SO}_4$ -type. It has a low uranium concentration of 4.1 $\mu\text{g}/\text{L}$.

Nitrate is below the WHO Guideline value for both samples. All relevant potentially harmful or toxic trace elements, among them fluoride, arsenic, lead and cadmium are well below the WHO guideline value (see appendix).

5 Conclusions

The main findings of the water quality study can be summarized as:

- Alluvial groundwater in the upper Khan and Swakop River catchments is Ca-Mg-HCO₃ dominated **freshwater** of “acceptable” (B) or “excellent” (A) quality as a potential drinking water source according to the classification of the Water Act (1956).
- Downstream of the E15.3° longitude the Ca-HCO₃ dominated freshwater of the upper catchment changes into Na-Cl-dominated **saline groundwater** with electrical conductivities of up to 17000 µS/cm (11000 mg/L TDS). The saline water is unsuitable for domestic use. Locally, freshwater lenses exist on top of saline groundwater.
- Apart from evapotranspiration and groundwater evaporation, characteristic bromide/chloride molar ratios as well as high boron concentrations indicate that dissolution of rock salt from evaporitic sediments is most likely a major source of the NaCl in saline water.
- The **pH** of the alluvial groundwater is controlled by the HCO₃⁻ - H₂CO₃* -buffer system and has a median (p50) of pH 7.01. One sample (S 13) in the vicinity to the Rössing mine has an acidic pH of 4.3.
- Nitrate concentrations are largely elevated, but 90 % of the freshwater samples (<3000 µS/cm) have **nitrate** concentrations below the Namibian Drinking Water Standard of 10 mg/L N (40 mg/L nitrate).
- Concentrations of potentially harmful or toxic elements such as **fluoride, arsenic, lead or cadmium** are – with the exception of one or two outliers – below the standard of the Namibian Water Act.
- **Drinking water samples** from the municipalities of Swakopmund and Walvis Bay meet the requirements of the Namibian and the WHO drinking water standards with respect to salinity, main constituents and potentially toxic trace elements.
- **Process and seepage water** samples from the Langer Heinrich Uranium Mine are alkaline sodium-carbonate waters with extraordinary high concentrations of uranium, arsenic and fluoride. The respective samples from the Rössing Uranium Mine premises are acidic solutions with elevated concentrations of uranium, manganese and a number of trace elements like Li, Ni, and Co. At both sites, samples from observation wells show no clear indication of contamination by process waters.
- **Uranium** is a common trace metal in the groundwater of the catchment and mostly present at elevated concentrations. To define the geogenic background concentration the 90 % percentile of the alluvial groundwater uranium (U) distribution of 230 µg/L is chosen. Only 21 % of analysed groundwater samples have uranium concentration below the provisional WHO guideline value of 15 µg/L. The natural concentrations are generally higher in the upper Khan

River catchment compared to the upper Swakop River catchment. Saline water samples from lower Swakop River catchment generally exhibit higher uranium concentrations than the respective samples from in the headwater regions.

- Six groundwater samples have uranium concentrations exceeding 230 µg/L (239 - 528 µg/L). Three of the sampling points are located in vicinity of Rössing Uranium Mine, one in vicinity of Langer Heinrich Uranium Mine, and two samples are from wells in the Swakop River Valley downstream the confluence of Swakop and Khan River.

The question to be discussed in this context is whether high concentrations of dissolved uranium in the respective six samples are an indicator for contamination by mine effluents or whether they represent the local natural elevated uranium background level in vicinity to the mines. As far as the samples in the Lower Swakop River valley are concerned a contamination by mine effluents is unlikely for 2 reasons: a) the boreholes are located far downstream from the two mines b) samples from adjacent boreholes have substantially lower uranium concentrations (Fig. 14).

Among the three samples in the vicinity of the Rössing Mine (K1, S12, S 13), sample S12 has a remarkable chemical composition with an acidic pH of 4.3, an extremely high sulphate concentration of 11.90 g/L (!), elevated concentrations of Al, Mn, and trace elements including U, Li, Cu Pb, Zn, Mo and Ce as well as an elevated nitrate concentration. The samples K1 and S13 have a neutral pH and – apart from elevated uranium concentrations – no elevated concentrations of trace elements. As sulphuric acid leaching is applied in the mine, the chemical composition of S12 could theoretically be seen as an indication for a groundwater contamination by process waters from the mine.

On the other hand, the borehole S12 is located in a small tributary, flowing parallel to the Khan outside the surface and groundwater catchment of the Rössing mine. Groundwater was struck in Khan/Rössing formation meta-sediments. The S12 and S13 boreholes are located in an Fe-anomaly area or sulphidic ore, which was delineated already in the 1970s. The acidic pH of groundwater therefore could be a result of oxidization of metal sulphids leading to the pH reduction and release of metals into the groundwater. A report about this issue is currently compiled (pers. communication Arnold Bittner).

The sample TM29 in the vicinity of the Langer Heinrich Mine is a saline groundwater of a regionally typical salinity. Besides an elevated uranium concentration the sample has the highest vanadium concentration of all alluvial groundwater samples. Process water from the mine exhibits very high vanadium concentrations as well. Other trace elements, like arsenic, which a found in high concentrations in mine process waters are at a normal level in sample TM29.

The above discussion shows that the chemical composition of water samples alone is insufficient and inconclusive to identify the source for the high uranium level in the respective groundwater

samples. Further information and data in particular on the local hydrogeological situation have to be considered to clearly identify or exclude a groundwater contamination by mine waters. This may include the installation of a network of quality monitoring wells up and downstream of the mines. The analysis of important daughter elements of the uranium decay series could be a helpful tool to identify different uranium sources.

6 Extended summary

A strategic environmental assessment (SEA) has been initiated to provide a scientific basis for environmental planning and water management prior to an extension of uranium mining activities in the catchment of the Swakop River and the tributary Kahn River. The scope of this study is firstly to assess the groundwater quality in the catchment with regards to a) main chemical components (solutes) and b) dissolved uranium and a limited number of trace elements. Secondly, samples from both currently operating mines are included for characterization of the potential contamination sources. Thirdly, two samples from the public water supply system of Swakopmund and Walvis Bay are analysed. For these objectives 78 samples, most of them groundwater from river alluvium, were sampled in a campaign designed and headed by BIWAC CC / Windhoek. Laboratory analysis was carried out at BGR / Hannover. All analytical results are documented in this report.

Alluvial groundwater in the upper Khan and Swakop River catchments is a Ca-Mg-HCO₃ dominated freshwater of drinking water quality. In the lower river catchments downstream of E15.3° longitude, Na-Cl-dominated saline groundwater, unsuitable for domestic use, is found. Apart from evapotranspiration and groundwater evaporation dissolution of rock salt from evaporitic sediments is most likely a major source of the NaCl in the saline water. Nitrate concentrations are elevated yet below the WHO guideline value (WHO 2004) apart from a few exceptions. Only a few samples are above the WHO guideline values with respect to their main chemical components apart from salinity.

Other trace elements screened in this study, including arsenic (As), vanadium (V), molybdenum (Mo), thorium (Th), nickel (Ni), lead (Pb) and zinc (Zn), showed no elevated concentrations resulting in no critical implications for groundwater quality. These low trace element concentrations, with the exception of uranium, are due to a strongly buffered circum-neutral pH and abundant calcrete in the aquifer.

Drinking water samples from the municipalities of Swakopmund and Walvis Bay meet the requirements of the Namibian and the WHO drinking water standards. Process and seepage water samples from the Langer Heinrich Uranium Mine are alkaline sodium-carbonate waters with extraordinary high concentrations of uranium, arsenic and fluoride. The respective samples from the Rössing Uranium Mine premises are acidic solutions with elevated concentrations of uranium, manganese and a number of trace elements like lithium, nickel and cobalt.

Uranium is a common trace element in the groundwater of the catchment and mostly present at elevated concentrations. If the 90 % percentile of the alluvial groundwater uranium (U) distribution is chosen to define geogenic background levels, background concentrations would be 230 µg/L. Only 21 % of the analysed groundwater samples have uranium concentrations below the provisional WHO guideline value of 15 µg/L. The natural concentrations are generally higher in the upper Khan

River catchment compared to the upper Swakop River catchment. Saline water samples from the lower Swakop River catchment generally exhibit higher uranium concentrations than the respective samples from in the headwater regions. Six groundwater samples have uranium concentrations exceeding 230 µg/L (239 – 528 µg/L). Three of the sampling points are located in the vicinity of the Rössing Uranium Mine, one in the vicinity of the Langer Heinrich Uranium Mine, and two samples are from wells in the Swakop River Valley downstream of the confluence of the Swakop and Khan River. The chemical composition of water samples alone is insufficient and inconclusive to identify the source for the high uranium levels in the respective groundwater samples. Further information and, in particular, data on the local hydrogeological situation have to be considered to clearly identify or exclude a groundwater contamination by mine waters. This may include the installation of a network of quality monitoring wells up and downstream of the mines. The analysis of important daughter elements of the uranium decay series could be a helpful tool to identify different uranium sources.

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BUNDESANSTALT FÜR GEOWISSENSCHAFTEN UND ROHSTOFFE

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Appendix

- Analytical methods
- Correlation matrices
- Secondary uranium minerals
- Classification of water types
- Water analysis sheets

Analytical methods

Main components

Concentrations of main components Na, K, Ca, Mg, B, Al, Si, Mn and Fe and other trace elements including Zn, Cu and others are analyzed from acidified solution with ICP-OES (inductively coupled plasma optical emission spectroscopy) based on standard DIN EN ISO 11885 (1998). The elemental concentrations of S, Cl, P, Br are determined in the oxygen-free chamber. S and P are recalculated to the appropriate oxides present in solution.

Trace elements

Concentrations of trace elements As, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Pt, Sb, Sn, Tl and Zn are analyzed from acidified solution with quadruple ICP-MS (inductively coupled plasma mass spectrometry).

Alkalinity

For the determination of alkalinity (acid neutralizing capacity) of a water sample a 10 mL aliquot of the unfiltered sample is titrated with 0.02 N HCl down to pH=4.3. (DIN 38409, 1979; Schuster, 2002). The Endpoint is determined potentiometrically using a 2-cell pH-glass electrode.

Anions

For the determination of the anions F^- , Cl^- , Br^- , NO_3^- , SO_4^{2-} , an IC method (ionic chromatography) based on DIN EN ISO 10304-1 (1995) is used. The anions-peaks are detected by electrical conductivity, following neutralization of the alkaline KOH-eluent with a membrane suppressor technique; H_2SO_4 is used for regenerating the system.

TOC/TIC

The concentration of DOC (dissolved organic carbon) is determined according to DIN EN 1484 (1997). Prior to analysis, TIC (total inorganic carbon) is removed by acidification and sparging with CO_2 -free air. TIC is detected IR-spectrometrically as CO_2 . The remaining non-volatile organic substances are oxidized under CO_2 -free O_2 in the oven and detected IR-spectrometrically as CO_2 . The result is given as NPOC (non purgeable organic carbon). NPOC is molar to DOC for most practical applications in the range of groundwaters.

Ammonium

Ammonium is determined photometrically as a complex based on standard DIN 38406 (1983).

Correlation matrices

Tab. 5: Linear correlation matrix of dissolved uranium and trace elements

| Korrelationen | TDS | AL_40 | ALK | AS_06 | CA_40 | FE_40 | HCO3_K_40 | LF_30 | LI_40 | MN_40 | MO_6 | NH4_3 | NI_69 | NO3 | PB_6 | PH_30 | PO4_3 | SI02 | SO4 | SR_4 | TH_6 | TOC | U_69 | V_69 | ZN_40 | | | |
|---------------|-------|-------|-------|-------|-------|-------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|------|-------|------|-------|---|
| TDS | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AL_40 | 0.54 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ALK | -0.04 | -0.10 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| AS_69 | -0.13 | -0.03 | 0.06 | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| CA_40 | 0.84 | 0.07 | -0.05 | -0.18 | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| F_36 | 0.02 | 0.16 | -0.11 | 0.65 | -0.04 | 1 | | | | | | | | | | | | | | | | | | | | | | |
| FE_40 | 0.11 | 0.02 | -0.11 | -0.06 | 0.28 | -0.09 | 1 | | | | | | | | | | | | | | | | | | | | | |
| HCO3_37 | -0.04 | -0.10 | 0.06 | 0.06 | -0.05 | -0.11 | -0.11 | 1 | | | | | | | | | | | | | | | | | | | | |
| K_40 | 0.78 | -0.01 | -0.16 | -0.12 | 0.90 | -0.01 | 0.08 | -0.16 | 1 | | | | | | | | | | | | | | | | | | | |
| LF_35 | 0.96 | 0.35 | -0.05 | -0.13 | 0.88 | -0.06 | 0.10 | -0.05 | 0.87 | 1 | | | | | | | | | | | | | | | | | | |
| LI_40 | 0.57 | 0.99 | -0.14 | -0.03 | 0.12 | 0.22 | -0.02 | -0.14 | 0.07 | 0.39 | 1 | | | | | | | | | | | | | | | | | |
| MN_40 | 0.66 | 0.95 | 0.04 | -0.02 | 0.24 | 0.08 | 0.17 | 0.04 | 0.14 | 0.50 | 0.93 | 1 | | | | | | | | | | | | | | | | |
| MO_69 | 0.12 | -0.12 | -0.39 | 0.15 | 0.25 | 0.55 | -0.12 | -0.39 | 0.36 | 0.14 | -0.02 | -0.14 | 1 | | | | | | | | | | | | | | | |
| NH4_39 | 0.16 | 0.20 | -0.15 | 0.17 | 0.05 | -0.14 | 0.21 | -0.15 | 0.13 | 0.20 | 0.17 | 0.33 | 0.02 | 1 | | | | | | | | | | | | | | |
| NI_69 | 0.54 | 1.00 | -0.13 | -0.03 | 0.07 | 0.16 | 0.00 | -0.13 | -0.02 | 0.35 | 0.99 | 0.95 | -0.12 | 0.19 | 1 | | | | | | | | | | | | | |
| NO3_36 | 0.18 | 0.25 | 0.14 | -0.10 | 0.15 | 0.04 | -0.05 | 0.14 | -0.04 | 0.12 | 0.26 | 0.19 | -0.04 | -0.01 | 0.25 | 1 | | | | | | | | | | | | |
| PB_69 | 0.62 | 0.92 | 0.12 | -0.03 | 0.22 | 0.17 | 0.00 | 0.12 | 0.17 | 0.45 | 0.93 | 0.88 | -0.03 | 0.14 | 0.92 | 0.28 | 1 | | | | | | | | | | | |
| PH_35 | -0.40 | -0.47 | -0.13 | 0.22 | -0.19 | 0.04 | -0.01 | -0.13 | -0.10 | -0.30 | -0.47 | -0.45 | 0.14 | 0.02 | -0.47 | -0.21 | -0.45 | 1 | | | | | | | | | | |
| PO4_39 | -0.25 | -0.13 | 0.09 | 0.17 | -0.24 | -0.26 | -0.10 | 0.09 | -0.22 | -0.23 | -0.18 | -0.07 | -0.22 | 0.18 | -0.13 | -0.19 | -0.15 | 0.09 | 1 | | | | | | | | | |
| SI02_40 | 0.45 | 0.53 | 0.05 | 0.01 | 0.25 | 0.46 | -0.14 | 0.05 | 0.35 | 0.34 | 0.62 | 0.44 | 0.27 | -0.08 | 0.53 | 0.18 | 0.64 | -0.35 | -0.35 | 1 | | | | | | | | |
| SO4_36 | 0.72 | 0.96 | -0.23 | -0.09 | 0.31 | 0.17 | 0.03 | -0.23 | 0.22 | 0.54 | 0.97 | 0.94 | 0.02 | 0.17 | 0.96 | 0.28 | 0.92 | -0.48 | -0.21 | 0.59 | 1 | | | | | | | |
| SR_40 | 0.73 | -0.13 | -0.03 | -0.11 | 0.87 | -0.08 | 0.05 | -0.03 | 0.93 | 0.86 | -0.06 | 0.03 | 0.25 | 0.10 | -0.13 | 0.04 | 0.03 | -0.03 | -0.21 | 0.21 | 0.09 | 1 | | | | | | |
| TH_69 | 0.42 | 0.62 | -0.15 | -0.05 | 0.11 | 0.03 | 0.05 | -0.15 | 0.13 | 0.36 | 0.61 | 0.59 | -0.07 | 0.13 | 0.61 | 0.16 | 0.60 | -0.29 | -0.11 | 0.40 | 0.61 | 0.05 | 1 | | | | | |
| TOC_81 | 0.20 | 0.14 | 0.23 | 0.06 | 0.18 | -0.06 | 0.03 | 0.23 | 0.04 | 0.17 | 0.14 | 0.21 | -0.17 | 0.20 | 0.15 | 0.61 | 0.17 | 0.01 | 0.28 | -0.04 | 0.15 | 0.12 | -0.01 | 1 | | | | |
| U_69 | 0.46 | 0.32 | -0.15 | 0.10 | 0.39 | 0.33 | -0.09 | -0.15 | 0.44 | 0.44 | 0.40 | 0.35 | 0.62 | 0.39 | 0.32 | 0.20 | 0.33 | -0.22 | -0.03 | 0.45 | 0.44 | 0.36 | 0.25 | 0.08 | 1 | | | |
| V_69 | 0.02 | -0.06 | 0.01 | 0.47 | 0.09 | 0.55 | -0.08 | 0.01 | 0.27 | 0.01 | 0.04 | -0.12 | 0.28 | -0.15 | -0.06 | -0.06 | 0.10 | 0.04 | -0.08 | 0.59 | -0.05 | 0.15 | -0.03 | 0.01 | -0.01 | 1 | | |
| ZN_40 | 0.06 | 0.07 | 0.34 | -0.05 | 0.10 | -0.02 | -0.02 | 0.34 | -0.09 | 0.03 | 0.08 | 0.06 | -0.15 | 0.00 | 0.07 | 0.84 | 0.14 | -0.11 | -0.12 | 0.03 | 0.07 | 0.02 | -0.01 | 0.61 | 0.05 | 0.07 | -0.04 | 1 |
| | >0.75 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | >0.35 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <0.35 | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Tab. 6: Linear correlation matrix of main components

| Korrelationen | NA_40 | K_40 | CA_40 | MG_40 | BA_40 | SR_40 | FE_40 | MN_40 | SO4_36 | HCO3_37 | NO3_36 | CL_36 | BR_36 | F_36 | PO4_39 | BO2_40 | SIO2_40 | U_69 | NH4_39 |
|---------------|-------|--------|-------|-------|-------|-------|-------|-------|--------|---------|--------|-------|-------|-------|--------|--------|---------|------|--------|
| NA_40 | 1 | | | | | | | | | | | | | | | | | | |
| K_40 | 0.90 | 1 | | | | | | | | | | | | | | | | | |
| CA_40 | 0.91 | 0.90 | 1 | | | | | | | | | | | | | | | | |
| MG_40 | 0.44 | 0.20 | 0.29 | 1 | | | | | | | | | | | | | | | |
| BA_40 | -0.10 | -0.05 | 0.07 | -0.11 | 1 | | | | | | | | | | | | | | |
| SR_40 | 0.89 | 0.93 | 0.87 | 0.11 | 0.05 | 1 | | | | | | | | | | | | | |
| FE_40 | 0.08 | 0.08 | 0.28 | 0.01 | 0.19 | 0.05 | 1 | | | | | | | | | | | | |
| MN_40 | 0.39 | 0.14 | 0.24 | 0.24 | 0.96 | -0.05 | 0.17 | 1 | | | | | | | | | | | |
| SO4_36 | 0.43 | 0.22 | 0.31 | 0.99 | -0.13 | 0.09 | 0.03 | 0.94 | 1 | | | | | | | | | | |
| HCO3_37 | -0.04 | -0.16 | -0.05 | 0.02 | 0.24 | -0.03 | -0.11 | 0.04 | -0.23 | 1 | | | | | | | | | |
| NO3_36 | 0.05 | -0.04 | 0.15 | 0.27 | 0.54 | 0.04 | -0.05 | 0.19 | 0.28 | 0.14 | 1 | | | | | | | | |
| CL_36 | 0.99 | 0.91 | 0.93 | 0.39 | -0.06 | 0.91 | 0.13 | 0.35 | 0.39 | -0.05 | 0.04 | 1 | | | | | | | |
| BR_36 | 0.62 | 0.67 | 0.64 | 0.79 | 0.18 | 0.77 | 0.02 | 0.20 | 0.62 | -0.04 | 0.23 | 0.65 | 1 | | | | | | |
| F_36 | -0.05 | -0.01 | -0.04 | 0.14 | -0.23 | -0.08 | -0.09 | 0.08 | 0.17 | -0.11 | 0.04 | -0.07 | 0.09 | 1 | | | | | |
| PO4_39 | -0.20 | -0.22 | -0.24 | -0.20 | 0.28 | -0.21 | -0.10 | -0.07 | -0.21 | 0.09 | -0.19 | -0.22 | -0.37 | -0.26 | 1 | | | | |
| BO2_40 | 0.77 | 0.85 | 0.71 | 0.39 | -0.11 | 0.73 | 0.00 | 0.32 | 0.44 | -0.25 | 0.12 | 0.74 | 0.52 | 0.18 | -0.28 | 1 | | | |
| SIO2_40 | 0.30 | 0.35 | 0.25 | 0.55 | -0.14 | 0.21 | -0.14 | 0.44 | 0.59 | 0.05 | 0.18 | 0.25 | 0.35 | 0.46 | -0.35 | 0.60 | 1 | | |
| U_69 | 0.36 | 0.44 | 0.39 | 0.41 | 0.03 | 0.36 | -0.09 | 0.35 | 0.44 | -0.15 | 0.20 | 0.36 | 0.41 | 0.33 | -0.03 | 0.66 | 0.45 | 1 | |
| NH4_39 | 0.12 | 0.13 | 0.05 | 0.19 | 0.22 | 0.10 | 0.21 | 0.33 | 0.17 | -0.15 | -0.01 | 0.13 | -0.01 | -0.14 | 0.18 | 0.21 | -0.08 | 0.39 | 1 |
| | | >0.75 | | | | | | | | | | | | | | | | | |
| | | >0.35 | | | | | | | | | | | | | | | | | |
| | | =<0.35 | | | | | | | | | | | | | | | | | |

Tab. 7: Linear correlation matrix of dissolved uranium and other anion-forming elements

| | TDS | AS_69 | AS_69 | BR_36 | BR_36 | CL_36 | CR_40 | F_36 | HCO3_37 | HCO3_37 | MO_69 | NO3_36 | PO4_39 | SiO2_40 | SO4_36 | TIC_81 | U_69 | V_69 | ZN_40 |
|---------|-------------|------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------|-------------|-------------|-------------|--------|-------|------|-------|
| TDS | 1 | | | | | | | | | | | | | | | | | | |
| AS_69 | -0.13 | 1 | | | | | | | | | | | | | | | | | |
| BR_36 | 0.75 | -0.06 | 1 | | | | | | | | | | | | | | | | |
| CL_36 | 0.67 | -0.16 | 0.52 | 1 | | | | | | | | | | | | | | | |
| CR_40 | 0.92 | -0.13 | 0.74 | 0.65 | 1 | | | | | | | | | | | | | | |
| F_36 | 0.21 | -0.18 | 0.21 | -0.06 | 0.05 | 1 | | | | | | | | | | | | | |
| HCO3_37 | 0.02 | 0.65 | 0.18 | 0.09 | -0.07 | -0.09 | 1 | | | | | | | | | | | | |
| MO_69 | -0.04 | 0.06 | -0.25 | -0.04 | -0.05 | -0.16 | -0.11 | 1 | | | | | | | | | | | |
| NO3_36 | 0.44 | 0.09 | 0.78 | 0.42 | 0.46 | -0.04 | 0.26 | -0.18 | 1 | | | | | | | | | | |
| PO4_39 | 0.12 | 0.15 | 0.46 | 0.30 | 0.16 | -0.03 | 0.55 | -0.39 | 0.55 | 1 | | | | | | | | | |
| SiO2_40 | 0.18 | -0.10 | 0.12 | 0.23 | 0.04 | 0.04 | 0.04 | 0.14 | 0.07 | -0.04 | 1 | | | | | | | | |
| SO4_36 | -0.25 | 0.17 | -0.28 | -0.37 | -0.22 | 0.04 | -0.26 | 0.09 | -0.18 | -0.22 | -0.19 | 1 | | | | | | | |
| TIC_81 | 0.45 | 0.01 | 0.60 | 0.35 | 0.25 | 0.20 | 0.46 | 0.05 | 0.51 | 0.27 | 0.18 | -0.35 | 1 | | | | | | |
| U_69 | 0.72 | -0.09 | 0.44 | 0.62 | 0.39 | 0.42 | 0.17 | -0.23 | 0.20 | 0.02 | 0.28 | -0.21 | 0.59 | 1 | | | | | |
| V_69 | -0.17 | 0.02 | -0.23 | -0.01 | -0.08 | -0.29 | -0.18 | 0.97 | -0.14 | -0.33 | 0.18 | 0.04 | -0.08 | -0.34 | 1 | | | | |
| ZN_40 | 0.46 | 0.10 | 0.66 | 0.41 | 0.36 | 0.18 | 0.33 | -0.15 | 0.54 | 0.62 | 0.20 | -0.03 | 0.45 | 0.44 | -0.29 | 1 | | | |
| | 0.02 | 0.47 | 0.36 | 0.13 | 0.05 | -0.11 | 0.55 | 0.01 | 0.57 | 0.28 | -0.06 | -0.08 | 0.59 | -0.05 | 0.05 | 0.12 | 1 | | |
| | 0.06 | -0.05 | -0.03 | 0.16 | -0.01 | -0.08 | -0.02 | 0.34 | -0.01 | -0.15 | 0.84 | -0.12 | 0.03 | 0.07 | 0.44 | 0.07 | -0.04 | 1 | |
| | | >0.75 | | | | | | | | | | | | | | | | | |
| | | >0.35 | | | | | | | | | | | | | | | | | |
| | | =<0.35 | | | | | | | | | | | | | | | | | |

Secondary uranium minerals

Tab. 8: Secondary uranium minerals containing carbonate as groups; citation:
<http://un2sg4.unige.ch/athena/mineral/mineral.html>

| Mineral | Formula | System | PP |
|--------------------|--|---------|----|
| ALBRECHTSCHRAUFITE | $\text{Ca}_4\text{Mg}(\text{UO}_2)_2(\text{CO}_3)_6\text{F}_2 \cdot 17\text{H}_2\text{O}$ | A | 0 |
| ANDERSONITE | $\text{Na}_2\text{Ca}(\text{UO}_2)(\text{CO}_3)_3 \cdot 6\text{H}_2\text{O}$ | R | 1 |
| ASTROCYANITE-(Ce) | $\text{Cu}+2(\text{Ce}, \text{Nd}, \text{La}, \text{Pr}, \text{Sm}, \text{Ca}, \text{Y})_2(\text{UO}_2)(\text{CO}_3)_5(\text{OH})_2 \cdot 3\text{H}_2\text{O}$ | H | 0 |
| BAYLEYITE | $\text{Mg}_2(\text{UO}_2)(\text{CO}_3)_3 \cdot 18\text{H}_2\text{O}$ | M | 1 |
| BIJVOETITE-(Y) | $[(\text{Y}, \text{REE})_8(\text{H}_2\text{O})_{25}(\text{UO}_2)_{16}\text{O}_8(\text{OH})_8(\text{CO}_3)_{16}](\text{H}_2\text{O})_{14}$ | M ps O | 0 |
| BLATONITE | $(\text{UO}_2)(\text{CO}_3) \cdot \text{H}_2\text{O}$ | H/R (?) | 0 |
| CEJKAITE | $\text{Na}_4(\text{UO}_2)(\text{CO}_3)_3$ | A | 0 |
| FONTANITE | $\text{Ca}(\text{UO}_2)_3(\text{CO}_3)_4 \cdot 3\text{H}_2\text{O}$ | O | 0 |
| GRIMSELITE | $\text{K}_3\text{Na}(\text{UO}_2)(\text{CO}_3)_3 \cdot \text{H}_2\text{O}$ | H | 1 |
| JOLIOTITE | $(\text{UO}_2)(\text{CO}_3) \cdot 2\text{H}_2\text{O}$ | O | 0 |
| KAMOTOITE-(Y) | $(\text{Y}, \text{Nd}, \text{Gd})_2\text{U}+++++4(\text{CO}_3)_3\text{O}_{12} \cdot 14, 5\text{H}_2\text{O}$ | M | 1 |
| LIEBIGITE | $\text{Ca}_2(\text{UO}_2)(\text{CO}_3)_3 \cdot 11\text{H}_2\text{O}$ | O | 1 |
| MCKELVEYITE-(Y) | $\text{Ba}_3\text{Na}(\text{Ca}, \text{U})\text{Y}(\text{CO}_3)_6 \cdot 3\text{H}_2\text{O}$ | A ps R | 0 |
| METAZELLERITE | $\text{Ca}(\text{UO}_2)(\text{CO}_3)_2 \cdot 3\text{H}_2\text{O}$ | O | 0 |
| OSWALDPEETERSITE | $(\text{UO}_2)_2\text{CO}_3(\text{OH})_2 \cdot 4\text{H}_2\text{O}$ | M | 0 |
| RABBITTITE | $\text{Ca}_3\text{Mg}_3(\text{UO}_2)_2(\text{CO}_3)_6(\text{OH})_4 \cdot 18\text{H}_2\text{O}$ | M | 0 |
| ROUBAULTITE | $\text{Cu}_2(\text{UO}_2)_3(\text{CO}_3)_2\text{O}_2(\text{OH})_2 \cdot 4\text{H}_2\text{O}$ | A | 0 |
| RUTHERFORDINE | $\text{UO}_2(\text{CO}_3)$ | O | 1 |
| SCHROCKINGERITE | $\text{NaCa}_3(\text{UO}_2)(\text{CO}_3)_3(\text{SO}_4)\text{F} \cdot 10\text{H}_2\text{O}$ | A | 1 |
| SHABAITE-(Nd) | $\text{Ca}(\text{Nd}, \text{Y})_2(\text{UO}_2)(\text{CO}_3)_4(\text{OH})_2 \cdot 6\text{H}_2\text{O}$ | M | 1 |
| SHARPITE | $\text{Ca}(\text{UO}_2)_6(\text{CO}_3)_5(\text{OH})_4 \cdot 6\text{H}_2\text{O}$ | O | 1 |
| SWARTZITE | $\text{CaMg}(\text{UO}_2)(\text{CO}_3)_3 \cdot 12\text{H}_2\text{O}$ | M | 0 |
| URANCALCARITE | $\text{Ca}(\text{UO}_2)_3(\text{CO}_3)(\text{OH})_6 \cdot 3\text{H}_2\text{O}$ | O | 0 |
| VOGLITE | $\text{Ca}_2\text{Cu}^{++}(\text{UO}_2)(\text{CO}_3)_4 \cdot 6\text{H}_2\text{O} (?)$ | M | 0 |
| WIDENMANNITE | $\text{Pb}_2(\text{UO}_2)(\text{CO}_3)_3$ | O | 0 |
| WYARTITE | $\text{CaU}++++(\text{UO}_2)_2(\text{CO}_3)_4(\text{OH}) \cdot 7\text{H}_2\text{O}$ | O | 1 |
| ZELLERITE | $\text{Ca}(\text{UO}_2)(\text{CO}_3)_2 \cdot 5\text{H}_2\text{O}$ | O | 0 |
| ZNUCALITE | $\text{CaZn}_{11}(\text{UO}_2)(\text{CO}_3)_3(\text{OH})_{20} \cdot 4\text{H}_2\text{O}$ | A | 1 |

Classification of water types

Tab. 9: Classification of water types with regard to German hardness, salinity and water type

| Sample Id | Sample name | Sample type | classification | Calculated EC [$\mu\text{S}/\text{cm}$] | German hardness class | Salinity class | water type |
|-----------|------------------------|---------------------|----------------|---|-----------------------|----------------|--|
| 0918578 | Arueis | groundwater | alluvial | 1262 | hard | water | Na-Ca-HCO ₃ -Cl-SO ₄ |
| 0918579 | BH 1.6A | groundwater | alluvial | 9238 | very hard | brackish water | Na*-Ca-Cl* |
| 0918580 | BH1.4 | groundwater | alluvial | 7872 | very hard | brackish water | Na*-Ca-Mg-Cl* |
| 0918581 | BH4 | groundwater | alluvial | 7698 | very hard | brackish water | Na*-Ca-Mg-Cl* |
| 0918582 | Birkenfels 1 | groundwater | alluvial | 17944 | very hard | salt water | Na*-Ca-Cl* |
| 0918583 | HH production borehole | groundwater | alluvial | 4647 | very hard | brackish water | Na*-Ca-Cl* |
| 0918584 | HH 2 | groundwater | alluvial | 13887 | very hard | brackish water | Na-Ca-Cl* |
| 0918585 | Hodygos | groundwater | alluvial | 757 | moderately hard | water | Ca-Na-HCO ₃ * |
| 0918586 | Horebis Nord | groundwater | alluvial | 6490 | very hard | brackish water | Na*-Ca-Cl*-SO ₄ |
| 0918587 | K1 | groundwater | alluvial | 10538 | very hard | brackish water | Na-Ca-Cl*-SO ₄ |
| 0918588 | KEM 3 | groundwater | alluvial | 5312 | very hard | brackish water | Na*-Ca-Mg-Cl* |
| 0918589 | Kranzberg | groundwater | alluvial | 1254 | hard | water | Ca-Na-Mg-HCO ₃ *-Cl |
| 0918590 | LHU 2278 | groundwater | LHM | 8737 | very hard | brackish water | Na*-Cl* |
| 0918591 | LHU-DW11 | groundwater/process | LHM | 36512 | very soft | salt water | Na*-CO ₃ -HCO ₃ |
| 0918592 | LHU-TM6 | groundwater/process | LHM | 42294 | very soft | salt water | Na*-CO ₃ |
| 0918593 | LHU-TSF | surface water, pond | LHM | 62472 | very soft | salt water | Na*-CO ₃ * |
| 0918594 | LIK 4B | groundwater | alluvial | 8664 | very hard | brackish water | Na-Ca-Mg-Cl* |
| 0918595 | Lilof | groundwater | alluvial | 16288 | very hard | brackish water | Na*-Ca-Cl* |
| 0918596 | Marmor | groundwater | alluvial | 3740 | very hard | brackish water | Na*-Ca-Cl*-SO ₄ |
| 0918597 | Naob | groundwater | alluvial | 1371 | hard | water | Mg-Na-Ca-Cl*-HCO ₃ |
| 0918598 | NN1 | groundwater | alluvial | 6065 | very hard | brackish water | Na*-Ca-Cl* |
| 0918599 | NN2 | groundwater | alluvial | 551 | moderately hard | water | Ca*-Mg-HCO ₃ * |
| 0918600 | Palmenhorst | groundwater | alluvial | 10193 | very hard | brackish water | Na*-Ca-Cl*-SO ₄ |
| 0918601 | Pos 1 | groundwater | alluvial | 7697 | very hard | brackish water | Ca-Na-Mg-Cl* |
| 0918602 | Pos 3 | groundwater | alluvial | 1082 | hard | water | Ca*-Na-HCO ₃ *-Cl |
| 0918603 | R1 | groundwater | alluvial | 37725 | very hard | salt water | Na*-Ca-Cl* |
| 0918604 | RU-D1 | groundwater/process | RM | 22071 | very hard | salt water | Na*-Mg-SO ₄ *-Cl |
| 0918605 | RU-DW3 | groundwater/process | RM | 23121 | very hard | salt water | Na*-Mg-SO ₄ *-Cl |
| 0918606 | RU-N13 | groundwater | RM | 30358 | very hard | salt water | Na*-Ca-Cl* |
| 0918607 | RU-SRK1 | groundwater | RM | 15932 | very hard | salt water | Na-Mg-SO ₄ *-Cl |
| 0918608 | RU-TP | surface water, pond | RM | | very hard | salt water | Mg-SO ₄ * |
| 0918609 | RU-TP2 | leachate, tailings | RM | | very hard | salt water | Mg-Na-SO ₄ * |
| 0918610 | S12 | groundwater | alluvial | 16915 | very hard | brackish water | Na*-Ca-Cl*-SO ₄ |
| 0918611 | S13 | groundwater | alluvial | | very hard | salt water | Mg*-Na-SO ₄ *-Cl |
| 0918612 | Safier | groundwater | alluvial | 4120 | very hard | brackish water | Na*-Mg-Ca-Cl* |
| 0918613 | SH-EH | groundwater | alluvial | 9166 | very hard | brackish water | Na*-Ca-Cl* |
| 0918614 | SH-Hoppe | groundwater | alluvial | 19008 | very hard | salt water | Na*-Ca-Cl* |
| 0918615 | SH-Moocity | groundwater | alluvial | 11877 | very hard | brackish water | Na*-Ca-Cl* |
| 0918616 | SH-Santa 1 | groundwater | alluvial | 9622 | very hard | brackish water | Na*-Ca-Cl* |
| 0918617 | SH-SM | groundwater | alluvial | 925 | moderately hard | water | Na*-Ca-Mg-Cl*-HCO ₃ |
| 0918618 | Spes Bona | groundwater | alluvial | 1052 | hard | water | Ca-Na-Mg-HCO ₃ * |
| 0918619 | SS10C | groundwater | alluvial | 11722 | very hard | brackish water | Na*-Ca-Cl* |

| | | | | | | | |
|---------|----------------------------|---------------------|----------|-------|--------------------|----------------|----------------------|
| 0918620 | Swakop River - IDA dome | groundwater | alluvial | 7344 | very hard | brackish water | Na*-Ca-Cl* |
| 0918621 | Swp small holdings | groundwater | alluvial | 13673 | very hard | brackish water | Na*-Ca-Cl* |
| 0918622 | TM29 | groundwater | alluvial | 19733 | very hard | salt water | Na*-Ca-Cl* |
| 0918623 | TR5A | groundwater | alluvial | 8804 | very hard | brackish water | Na*-Ca-Cl* |
| 0918624 | Tsawisis | groundwater | alluvial | 962 | soft | water | Na*-HCO3-Cl |
| 0918625 | Ukuib 1 | groundwater | alluvial | 2702 | hard | brackish water | Na*-Ca-Cl*-HCO3 |
| 0918626 | Ukuib 2 | groundwater | alluvial | 2794 | very hard | brackish water | Na*-Ca-Cl*-HCO3-SO4 |
| 0918627 | Valencia springs | groundwater | alluvial | 8954 | very hard | brackish water | Na*-Mg-Cl* |
| 0918628 | WB 1 | groundwater | alluvial | 7865 | very hard | brackish water | Na*-Ca-Cl* |
| 0918629 | WB 2 | groundwater | alluvial | 11734 | very hard | brackish water | Na*-Ca-Cl* |
| 0918630 | Western trench | process/groundwater | LHM | 38138 | very soft | salt water | Na*-CO3 |
| 0918631 | WH | groundwater | alluvial | 1316 | moderately hard | brackish water | Na*-Ca-HCO3-Cl |
| 0918632 | WW200393 | groundwater | alluvial | 9604 | very hard | brackish water | Na*-Mg-Ca-Cl* |
| 0918633 | WW200395 | groundwater | alluvial | 7276 | very hard | brackish water | Na*-Mg-Cl* |
| 0918634 | WW200411 | groundwater | alluvial | 7036 | very hard | brackish water | Na*-Ca-Cl*-SO4 |
| 0918635 | WW200413 | groundwater | alluvial | 15635 | very hard | brackish water | Na*-Ca-Cl* |
| 0918636 | WW200414 | groundwater | alluvial | 8357 | very hard | brackish water | Na*-Cl* |
| 0918637 | WW25025 | groundwater | alluvial | 1845 | hard | brackish water | Na*-Ca-Cl-HCO3 |
| 0918638 | WW25054 | groundwater | alluvial | 507 | mittelhard | water | Ca*-Na-HCO3*-Cl |
| 0918639 | WW25055 | groundwater | alluvial | 931 | hard | water | Ca-Na-Mg-HCO3* |
| 0918640 | WW25056 | groundwater | alluvial | 664 | mittelhard | water | Na-Ca-HCO3*-Cl |
| 0918641 | WW25575 | groundwater | alluvial | 1373 | hard | water | Na-Ca-HCO3-Cl-SO4 |
| 0918642 | WW27107 | groundwater | alluvial | 778 | moderately hard | water | Na-Ca-HCO3*-Cl |
| 0918643 | WW41073 | groundwater | alluvial | 9085 | very hard | brackish water | Na*-Ca-Cl* |
| 0918644 | WW41075 | groundwater | alluvial | 9204 | very hard | brackish water | Na*-Ca-Cl*-SO4 |
| 0918645 | WW41076 | groundwater | alluvial | 7571 | very hard | brackish water | Na*-Ca-Cl*-SO4 |
| 0918646 | WW41180 | groundwater | alluvial | 7018 | very hard | brackish water | Na*-Ca-Cl* |
| 0918647 | WW41182 | groundwater | alluvial | 13125 | very hard | brackish water | Na*-Ca-Cl* |
| 0918648 | WW41183 | groundwater | alluvial | 5192 | very hard | brackish water | Na-Ca-Cl*-SO4 |
| 0918649 | WW41184 | groundwater | alluvial | 6275 | very hard | brackish water | Na-Ca-Cl*-SO4 |
| 0918650 | WW41188 | groundwater | alluvial | 2356 | hard | brackish water | Na*-Ca-Cl*-SO4 |
| 0918651 | WW41189 | groundwater | alluvial | 2951 | very hard | brackish water | Na-Ca-Cl*-SO4 |
| 0918652 | WW41190 | groundwater | alluvial | 1738 | hard | brackish water | Na*-Ca-Cl* |
| 0918653 | WW41191 | groundwater | alluvial | 3135 | very hard | brackish water | Na*-Ca-Cl*-SO4 |
| 0918654 | Swakomund | drinking water | tap | 1696 | hard | brackish water | Na*-Ca-Cl*-HCO3 |
| 0918655 | Walfishbay | drinking water | tap | 1151 | hard | water | Na-Ca-Mg-HCO3-Cl-SO4 |

Water analysis sheets

Sample-ID

Arueis

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

1219 EC, calc. [$\mu\text{S}/\text{cm}$]

1262

Total dissolved solids, TDS, calc. [mg/l]

907

pH

7.3

Total hardness [mmol/l]

3.4

Sum-parameters [mg/l]

NPOC

3.4

TIC

62.3

Cations

| | [mg/l] | c_d [mmol/l] | % c_{eq} |
|------------------|--------------------------|----------------------------------|------------|
| K^+ | 13.8 | 0.353 | 2.7 |
| Na^+ | 136 | 5.916 | 45.2 |
| Mg^{2+} | 22.7 | 1.867 | 14.3 |
| Ca^{2+} | 98.8 | 4.930 | 37.7 |
| Sum | | 13.079 | Error 3.1% |

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|--------------------|--------------------------|-------------------------------------|------------|
| Cl^- | 165 | 4.654 | 36.7 |
| SO_4^{2-} | 144 | 2.998 | 23.6 |
| HCO_3^- | 292 | 4.785 | 37.7 |
| NO_3^- | 13.9 | 0.224 | 1.8 |
| Sum | | 12.685 | |

Uncharged species [mg/l]

SiO_2 18.6

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | <3.00 | Co^{2+} | 0.049 | Cu^{2+} | 13.9 | Fe^{2+} | 4.00 | Li^+ | 2.00 |
| Mn^{2+} | 36.0 | NH_4^+ | <10.00 | Ni^{2+} | 0.410 | Pb^{2+} | 0.110 | Sr^{2+} | 498 |
| Zn^{2+} | 13.4 | NO_2^- | <5.00 | BO_2^- | 250 | F^- | 106 | Br^- | 364 |
| PO_4^{3-} | 640 | As | 1.07 | Ba | 98.0 | Be | 0.005 | Bi | 0.001 |
| Ag | 0.002 | Ce | 0.009 | Cr | 0.100 | Cs | 0.007 | Dy | 0.001 |
| Cd | 0.021 | Eu | 0.000 | Ga | 0.003 | Gd | 0.001 | Ge | 0.020 |
| Er | 0.000 | Hg | 0.000 | Ho | 0.000 | La | 0.005 | Lu | 0.000 |
| Hf | 0.001 | Nb | 0.001 | Nd | 0.006 | Pr | 0.001 | Rb | 1.81 |
| Mo | 4.26 | Sc | <1.000 | Se | 1.82 | Sm | 0.002 | Sn | 0.014 |
| Sb | 0.053 | Tb | 0.000 | Te | 0.007 | Th | 0.001 | Ti | 0.030 |
| Ta | 0.001 | Tm | 0.000 | U | 10.00 | V | 14.3 | W | 0.105 |
| Tl | 0.005 | Yb | 0.001 | Zr | 0.010 | | | | |
| Y | 0.007 | | | | | | | | |

It is a hard Na^+ - Ca^{2+} - HCO_3^- - Cl^- - SO_4^{2-} -water.

Sample-ID

BH 1.6A

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

8390 EC, calc. [$\mu\text{S}/\text{cm}$]

9238

Total dissolved solids, TDS, calc. [mg/l]

5292

pH

6.8

Total hardness [mmol/l]

21.0

Sum-parameters [mg/l]

NPOC 1.4 TIC 46.0

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 53.5 | 1.368 | 1.5 | Cl ⁻ | 2437 | 68.745 | 77.8 |
| Na ⁺ | 1043 | 45.368 | 51.0 | SO ₄ ²⁻ | 721 | 15.011 | 17.0 |
| Mg ²⁺ | 198 | 16.283 | 18.3 | HCO ₃ ⁻ | 225 | 3.687 | 4.2 |
| Ca ²⁺ | 518 | 25.848 | 29.0 | NO ₃ ⁻ | 43.3 | 0.698 | 0.8 |
| Sr ²⁺ | 4.86 | 0.111 | 0.1 | BO ₂ ⁻ | 2.45 | 0.057 | 0.1 |
| | | | | Br ⁻ | 4.69 | 0.059 | 0.1 |
| Sum | | 89.008 | Error 0.8% | Sum | | 88.309 | |

Uncharged species [mg/l]

SiO₂ 39.6

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|-----------------|-------|
| Al ³⁺ | <3.00 | Co ²⁺ | 0.056 | Cu ²⁺ | 0.640 | Fe 2+ | 12.0 | Li ⁺ | 183 |
| Mn ²⁺ | 4.00 | NH ₄ ⁺ | 10.00 | Ni ²⁺ | 0.540 | Pb ²⁺ | 0.120 | Zn 2+ | 85.0 |
| PO ₄ ³⁻ | 40.0 | NO ₂ ⁻ | <30.0 | F ⁻ | 960 | | | | |
| Ag | 0.081 | As | 0.870 | Ba | 36.0 | Be | 0.013 | Bi | 0.002 |
| Cd | 0.018 | Ce | 0.016 | Cr | 0.840 | Cs | 0.032 | Dy | 0.004 |
| Er | 0.003 | Eu | 0.001 | Ga | 0.006 | Gd | 0.005 | Ge | 0.050 |
| Hf | 0.005 | Hg | 0.010 | Ho | 0.001 | La | 0.015 | Lu | 0.001 |
| Mo | 11.7 | Nb | 0.008 | Nd | 0.011 | Pr | 0.002 | Rb | 9.97 |
| Sb | 0.020 | Sc | <1.000 | Se | 4.26 | Sm | 0.006 | Sn | 0.024 |
| Ta | 0.008 | Tb | 0.000 | Te | 0.020 | Th | 0.006 | Ti | 0.050 |
| Tl | 0.009 | Tm | 0.001 | U | 186 | V | 5.70 | W | 0.182 |
| Y | 0.032 | Yb | 0.004 | Zr | 0.021 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-brackish water.

Sample-ID

BH1.4

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

7160 EC, calc. [$\mu\text{S}/\text{cm}$]

7872

Total dissolved solids, TDS, calc. [mg/l]

4518

pH

6.9

Total hardness [mmol/l]

17.5

Sum-parameters [mg/l]

NPOC

1.6

TIC

58.9

Cations

Anions

| | [mg/l] | c_d [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|----------------------------------|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 44.7 | 1.143 | 1.5 | Cl^- | 2104 | 59.351 | 78.2 |
| Na^+ | 901 | 39.191 | 51.9 | SO_4^{2-} | 563 | 11.722 | 15.5 |
| Mg^{2+} | 197 | 16.201 | 21.4 | HCO_3^- | 255 | 4.179 | 5.5 |
| Ca^{2+} | 378 | 18.862 | 25.0 | NO_3^- | 28.7 | 0.463 | 0.6 |
| Fe^{2+} | 1.10 | 0.039 | 0.1 | BO^{2-} | 1.22 | 0.028 | 0.0 |
| Sr^{2+} | 4.03 | 0.092 | 0.1 | Br^- | 4.35 | 0.054 | 0.1 |
| Sum | | 75.584 | Error 0.4% | Sum | | 75.853 | |

Uncharged species [mg/l]

SiO_2 33.8

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 14.0 | Co^{2+} | 0.523 | Cu^{2+} | 0.400 | Li^+ | 130 | Mn^{2+} | 325 |
| NH_4^+ | 380 | Ni^{2+} | 0.750 | Pb^{2+} | 0.090 | Zn^{2+} | 85.0 | | |
| PO_4^{3-} | 70.0 | NO_2^- | 489 | F^- | 836 | | | | |
| Ag | 0.006 | As | 0.830 | Ba | 67.0 | Be | 0.010 | Bi | 0.003 |
| Cd | 0.020 | Ce | 0.134 | Cr | 0.120 | Cs | 0.046 | Dy | 0.009 |
| Er | 0.005 | Eu | 0.005 | Ga | 0.018 | Gd | 0.008 | Ge | 0.090 |
| Hf | 0.002 | Hg | 0.010 | Ho | 0.002 | La | 0.040 | Lu | 0.001 |
| Mo | 6.63 | Nb | 0.013 | Nd | 0.029 | Pr | 0.008 | Rb | 6.24 |
| Sb | 0.014 | Sc | <1.000 | Se | 2.16 | Sm | 0.009 | Sn | 0.009 |
| Ta | 0.003 | Tb | 0.001 | Te | 0.018 | Th | 0.008 | Ti | 1.20 |
| Tl | 0.010 | Tm | 0.001 | U | 92.2 | V | 3.50 | W | 0.160 |
| Y | 0.055 | Yb | 0.003 | Zr | 0.017 | | | | |

It is a very hard Na^+ - Ca^{2+} - Mg^{2+} - Cl^- -brackish water.

Sample-ID

BH4

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

6700 EC, calc. [$\mu\text{S}/\text{cm}$]

7698

Total dissolved solids, TDS, calc. [mg/l]

4418

pH

7.5

Total hardness [mmol/l]

17.0

Sum-parameters [mg/l]

NPOC 1.5 TIC 52.6

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 44.5 | 1.138 | 1.6 | Cl ⁻ | 2047 | 57.743 | 77.2 |
| Na ⁺ | 860 | 37.408 | 51.4 | SO ₄ ²⁻ | 600 | 12.492 | 16.7 |
| Mg ²⁺ | 185 | 15.214 | 20.9 | HCO ₃ ⁻ | 240 | 3.933 | 5.3 |
| Ca ²⁺ | 377 | 18.812 | 25.9 | NO ₃ ⁻ | 28.7 | 0.463 | 0.6 |
| Sr ²⁺ | 3.87 | 0.088 | 0.1 | BO ₂ ⁻ | 1.14 | 0.027 | 0.0 |
| | | | | Br ⁻ | 4.06 | 0.051 | 0.1 |
| Sum | | 72.719 | Error 2.8% | Sum | | 74.755 | |

Uncharged species [mg/l]

SiO₂ 24.8

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|-----------------|-------|
| Al ³⁺ | 6.00 | Co 2+ | 0.082 | Cu ²⁺ | 0.410 | Fe 2+ | 215 | Li ⁺ | 119 |
| Mn ²⁺ | 594 | NH ₄ ⁺ | 220 | Ni ²⁺ | 0.360 | Pb ²⁺ | 0.060 | Zn 2+ | 2.20 |
| PO ₄ ³⁻ | 20.0 | NO ₂ ⁻ | 210 | F ⁻ | 781 | | | | |
| Ag | 0.006 | As | 0.330 | Ba | 213 | Be | 0.006 | Bi | 0.002 |
| Cd | 0.009 | Ce | 0.054 | Cr | 0.040 | Cs | 0.018 | Dy | 0.004 |
| Er | 0.003 | Eu | 0.010 | Ga | 0.027 | Gd | 0.006 | Ge | 0.070 |
| Hf | 0.008 | Hg | 0.010 | Ho | 0.001 | La | 0.015 | Lu | 0.001 |
| Mo | 5.95 | Nb | 0.009 | Nd | 0.018 | Pr | 0.004 | Rb | 8.95 |
| Sb | 0.017 | Sc | <1.000 | Se | 2.04 | Sm | 0.007 | Sn | 0.017 |
| Ta | 0.004 | Tb | 0.001 | Te | 0.045 | Th | 0.005 | Ti | 0.420 |
| Tl | 0.001 | Tm | 0.001 | U | 12.0 | V | 0.400 | W | 0.083 |
| Y | 0.036 | Yb | 0.007 | Zr | 0.019 | | | | |

It is a very hard Na⁺-Ca²⁺-Mg²⁺-Cl⁻-brackish water.

Sample-ID

Birkenfels 1

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

15840 EC, calc. [$\mu\text{S}/\text{cm}$]

17944

Total dissolved solids, TDS, calc. [mg/l]

10292

pH

6.9

Total hardness [mmol/l]

38.8

Sum-parameters [mg/l]

NPOC 1.6 TIC 61.3

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 75.0 | 1.918 | 1.1 | Cl ⁻ | 5087 | 143.498 | 82.7 |
| Na ⁺ | 2226 | 96.825 | 54.8 | SO ₄ ²⁻ | 1199 | 24.964 | 14.4 |
| Mg ²⁺ | 315 | 25.905 | 14.7 | HCO ₃ ⁻ | 297 | 4.867 | 2.8 |
| Ca ²⁺ | 1040 | 51.896 | 29.4 | NO ₃ ⁻ | 11.9 | 0.192 | 0.1 |
| Sr ²⁺ | 6.95 | 0.159 | 0.1 | BO ₂ ⁻ | 1.72 | 0.040 | 0.0 |
| | | | | Br ⁻ | 3.58 | 0.045 | 0.0 |
| Sum | | 176.710 | Error 1.8% | Sum | | 173.609 | |

Uncharged species [mg/l]

SiO₂ 28.3

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 4.00 | Co ²⁺ | 0.091 | Cu ²⁺ | 1.48 | Fe ²⁺ | 12.0 | Li ⁺ | 29.0 |
| Mn ²⁺ | 23.0 | NH ₄ ⁺ | 10.00 | Ni ²⁺ | 1.03 | Pb ²⁺ | 0.170 | Zn ²⁺ | 19.7 |
| PO ₄ ³⁻ | 100.0 | NO ₂ ⁻ | <50.0 | F ⁻ | 51.0 | | | | |
| Ag | 0.370 | As | 0.960 | Ba | 50.0 | Be | 0.023 | Bi | 0.004 |
| Cd | 0.121 | Ce | 0.015 | Cr | 2.02 | Cs | 0.025 | Dy | 0.005 |
| Er | 0.007 | Eu | 0.007 | Ga | 0.021 | Gd | 0.013 | Ge | 0.050 |
| Hf | 0.006 | Hg | 0.040 | Ho | 0.002 | La | 0.020 | Lu | 0.002 |
| Mo | 4.21 | Nb | 0.025 | Nd | 0.011 | Pr | 0.004 | Rb | 8.85 |
| Sb | 0.035 | Sc | <1.000 | Se | 8.14 | Sm | 0.005 | Sn | 0.016 |
| Ta | 0.008 | Tb | 0.002 | Te | 0.092 | Th | 0.004 | Ti | 0.160 |
| Tl | 0.037 | Tm | 0.002 | U | 51.0 | V | 7.10 | W | 0.125 |
| Y | 0.250 | Yb | 0.003 | Zr | 0.011 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-salt water.

| | | | |
|--|---|--|------|
| Sample-ID | HH production borehole | | |
| Location | alluvial aquifer, Swakop/Khan | | |
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 6310 EC, calc. [$\mu\text{S}/\text{cm}$] | | 4647 |
| | Total dissolved solids, TDS, calc. [mg/l] | | 2751 |
| pH | 7.2 | | |
| Total hardness [mmol/l] | 7.2 | | |

| Cations | | | | Anions | | | |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
| K ⁺ | 33.3 | 0.852 | 1.9 | Cl ⁻ | 1276 | 35.994 | 79.3 |
| Na ⁺ | 656 | 28.534 | 65.1 | SO ₄ ²⁻ | 280 | 5.830 | 12.8 |
| Mg ²⁺ | 50.8 | 4.178 | 9.5 | HCO ₃ ⁻ | 191 | 3.130 | 6.9 |
| Ca ²⁺ | 204 | 10.180 | 23.2 | NO ₃ ⁻ | 25.2 | 0.406 | 0.9 |
| Sr ²⁺ | 2.48 | 0.057 | 0.1 | BO ²⁻ | 1.51 | 0.035 | 0.1 |
| Sum | | 43.803 | Error 3.6% | Sum | | 45.409 | |

Uncharged species [mg/l]

SiO₂ 29.7

| Trace elements [$\mu\text{g}/\text{l}$] | | | | | | | | | |
|---|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | <3.00 | Co ²⁺ | 0.060 | Cu ²⁺ | 1.13 | Fe ²⁺ | 6.00 | Li ⁺ | 17.0 |
| Mn ²⁺ | 1.000 | NH ₄ ⁺ | <10.00 | Ni ²⁺ | 0.190 | Pb ²⁺ | 0.440 | Zn ²⁺ | 16.7 |
| PO ₄ ³⁻ | 180 | NO ₂ ⁻ | <30.0 | F ⁻ | 64.0 | Br ⁻ | 609 | | |
| Ag | 0.015 | As | 0.620 | Ba | 40.0 | Be | 0.008 | Bi | 0.002 |
| Cd | 0.010 | Ce | 0.008 | Cr | 0.730 | Cs | 0.022 | Dy | 0.001 |
| Er | 0.001 | Eu | 0.002 | Ga | 0.012 | Gd | 0.003 | Ge | 0.040 |
| Hf | 0.002 | Hg | 0.000 | Ho | 0.000 | La | 0.006 | Lu | 0.001 |
| Mo | 4.31 | Nb | 0.009 | Nd | 0.011 | Pr | 0.001 | Rb | 4.49 |
| Sb | 0.018 | Sc | <1.000 | Se | 4.08 | Sm | 0.004 | Sn | 0.007 |
| Ta | 0.002 | Tb | 0.000 | Te | 0.013 | Th | 0.001 | Ti | 0.140 |
| Tl | 0.007 | Tm | 0.000 | U | 27.7 | V | 6.40 | W | 0.076 |
| Y | 0.011 | Yb | 0.002 | Zr | 0.006 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-brackish water.

Sample-ID

HH 2

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

11050

EC, calc. [$\mu\text{S}/\text{cm}$]

13887

Total dissolved solids, TDS, calc. [mg/l]

7875

pH

6.9

Total hardness [mmol/l]

33.6

Sum-parameters [mg/l]

NPOC

1.7

TIC

48.3

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 56.3 | 1.440 | 1.1 | Cl^- | 3807 | 107.391 | 82.0 |
| Na^+ | 1487 | 64.680 | 47.2 | SO_4^{2-} | 952 | 19.821 | 15.1 |
| Mg^{2+} | 182 | 14.967 | 10.9 | HCO_3^- | 214 | 3.507 | 2.7 |
| Ca^{2+} | 1048 | 52.295 | 38.2 | NO_3^- | 5.23 | 0.084 | 0.1 |
| Fe^{2+} | 95.2 | 3.410 | 2.5 | BO_2^- | 1.60 | 0.037 | 0.0 |
| Mn^{2+} | 2.11 | 0.077 | 0.1 | Br^- | 2.33 | 0.029 | 0.0 |
| Sr^{2+} | 4.02 | 0.092 | 0.1 | | | | |
| Sum | | 137.018 | Error 4.6% | Sum | | 130.886 | |

Uncharged species [mg/l]

SiO_2

16.9

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|---------------|-------|-----------------|-------|
| Al^{3+} | 207 | Co^{2+} | 4.89 | Cu^{2+} | 1.11 | Li^+ | 19.0 | NH_4^+ | 540 |
| Ni^{2+} | 9.91 | Pb^{2+} | 0.180 | Zn^{2+} | 30.3 | | | | |
| PO_4^{3-} | 10.00 | NO_2^- | 682 | F ⁻ | 35.0 | | | | |
| Ag | 0.013 | As | 0.190 | Ba | 165 | Be | 0.007 | Bi | 0.005 |
| Cd | 0.011 | Ce | 0.319 | Cr | 0.150 | Cs | 0.045 | Dy | 0.023 |
| Er | 0.012 | Eu | 0.007 | Ga | 0.108 | Gd | 0.029 | Ge | 2.14 |
| Hf | 0.006 | Hg | 0.020 | Ho | 0.004 | La | 0.121 | Lu | 0.002 |
| Mo | 0.763 | Nb | 0.032 | Nd | 0.078 | Pr | 0.019 | Rb | 10.5 |
| Sb | 0.015 | Sc | <1.000 | Se | 4.68 | Sm | 0.017 | Sn | 0.043 |
| Ta | 0.009 | Tb | 0.003 | Te | 0.050 | Th | 0.036 | Ti | 3.19 |
| Tl | 0.010 | Tm | 0.002 | U | 3.81 | V | 0.200 | W | 0.044 |
| Y | 0.131 | Yb | 0.018 | Zr | 0.039 | | | | |

It is a very hard Na^+ - Ca^{2+} - Cl^- -brackish water.

Sample-ID

Hodygos

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

754 EC, calc. [$\mu\text{S}/\text{cm}$]

757

Total dissolved solids, TDS, calc. [mg/l]

634

pH

7.2

Total hardness [mmol/l]

2.4

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 10.7 | 0.274 | 3.4 | Cl ⁻ | 54.2 | 1.529 | 18.9 |
| Na ⁺ | 69.3 | 3.014 | 37.3 | SO ₄ ²⁻ | 35.8 | 0.745 | 9.2 |
| Mg ²⁺ | 19.1 | 1.571 | 19.4 | HCO ₃ ⁻ | 293 | 4.802 | 59.5 |
| Ca 2+ | 64.3 | 3.209 | 39.7 | NO ₃ ⁻ | 60.9 | 0.982 | 12.2 |
| Sr ²⁺ | 0.438 | 0.010 | 0.1 | | | | |
| Sum | | 8.092 | Error 0.3% | Sum | | 8.068 | |

Uncharged species [mg/l]

SiO₂ 25.8

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 3.00 | Co 2+ | 0.041 | Cu ²⁺ | 2.47 | Fe 2+ | 142 | Li ⁺ | 11.0 |
| Mn ²⁺ | 3.00 | NH ₄ ⁺ | 120 | Ni ²⁺ | 0.700 | Pb ²⁺ | 0.310 | Zn ²⁺ | 20.3 |
| PO ₄ ³⁻ | 310 | NO ₂ ⁻ | <30.0 | BO ₂ ⁻ | 210 | F ⁻ | 26.0 | Br ⁻ | 64.0 |
| Ag | 0.004 | As | 0.600 | Ba | 204 | Be | 0.002 | Bi | 0.001 |
| Cd | 0.043 | Ce | 0.014 | Cr | 0.660 | Cs | 0.004 | Dy | 0.001 |
| Er | 0.001 | Eu | 0.002 | Ga | 0.008 | Gd | 0.003 | Ge | 0.010 |
| Hf | 0.001 | Hg | 0.000 | Ho | 0.000 | La | 0.010 | Lu | 0.000 |
| Mo | 1.03 | Nb | 0.001 | Nd | 0.009 | Pr | 0.002 | Rb | 0.620 |
| Sb | 0.012 | Sc | <1.000 | Se | 0.430 | Sm | 0.002 | Sn | 0.005 |
| Ta | 0.000 | Tb | 0.000 | Te | 0.003 | Th | 0.002 | Ti | 0.150 |
| Tl | 0.002 | Tm | 0.000 | U | 1.97 | V | 8.10 | W | 0.103 |
| Y | 0.009 | Yb | 0.001 | Zr | 0.014 | | | | |

It is a moderately hard Ca²⁺-Na⁺-HCO₃⁻-water.

| | | | |
|--|---|------|--|
| Sample-ID | Horebis Nord | | |
| Location | alluvial aquifer, Swakop/Khan | | |
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 5850 EC, calc. [$\mu\text{S}/\text{cm}$] | 6490 | |
| | Total dissolved solids, TDS, calc. [mg/l] | 3940 | |
| pH | 7.0 | | |
| Total hardness [mmol/l] | 12.4 | | |

Sum-parameters [mg/l]

| | | | |
|------|-----|-----|------|
| NPOC | 0.9 | TIC | 74.4 |
|------|-----|-----|------|

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 46.0 | 1.176 | 1.9 | Cl ⁻ | 1493 | 42.116 | 67.0 |
| Na ⁺ | 835 | 36.320 | 58.2 | SO ₄ ²⁻ | 664 | 13.825 | 22.0 |
| Mg ²⁺ | 117 | 9.622 | 15.4 | HCO ₃ ⁻ | 324 | 5.310 | 8.4 |
| Ca ²⁺ | 305 | 15.220 | 24.4 | NO ₃ ⁻ | 92.1 | 1.485 | 2.4 |
| Sr ²⁺ | 3.18 | 0.073 | 0.1 | BO ₂ ⁻ | 1.65 | 0.039 | 0.1 |
| | | | | F ⁻ | 1.42 | 0.075 | 0.1 |
| | | | | Br ⁻ | 3.20 | 0.040 | 0.1 |
| Sum | 62.434 | | Error 0.7% | Sum | 62.891 | | |

Uncharged species [mg/l]

| | |
|------------------|------|
| SiO ₂ | 53.8 |
|------------------|------|

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 14.0 | Co ²⁺ | 0.126 | Cu ²⁺ | 1.07 | Fe ²⁺ | 108 | Li ⁺ | 113 |
| Mn ²⁺ | 11.0 | NH ₄ ⁺ | 10.00 | Ni ²⁺ | 1.11 | Pb ²⁺ | 0.740 | Zn ²⁺ | 12.2 |
| PO ₄ ³⁻ | 180 | NO ₂ ⁻ | <30.0 | | | | | | |
| Ag | 0.053 | As | 1.47 | Ba | 44.0 | Be | 0.003 | Bi | 0.007 |
| Cd | 0.019 | Ce | 0.082 | Cr | 1.39 | Cs | 0.013 | Dy | 0.008 |
| Er | 0.005 | Eu | 0.001 | Ga | 0.006 | Gd | 0.013 | Ge | 0.050 |
| Hf | 0.011 | Hg | 0.020 | Ho | 0.002 | La | 0.035 | Lu | 0.001 |
| Mo | 16.0 | Nb | 0.014 | Nd | 0.035 | Pr | 0.008 | Rb | 3.71 |
| Sb | 0.049 | Sc | <1.000 | Se | 6.78 | Sm | 0.006 | Sn | 0.030 |
| Ta | 0.004 | Tb | 0.002 | Te | 0.030 | Th | 0.011 | Ti | 1.25 |
| Tl | 0.007 | Tm | 0.001 | U | 68.0 | V | 14.2 | W | 0.150 |
| Y | 0.046 | Yb | 0.006 | Zr | 0.097 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl-SO₄²⁻-brackish water.

Sample-ID

K1

Location alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] 7200 EC, calc. [$\mu\text{S}/\text{cm}$] 10538
Total dissolved solids, TDS, calc. [mg/l] 6136

pH 7.1
Total hardness [mmol/l] 24.5

Sum-parameters [mg/l]

NPOC 0.6 TIC 22.0

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 47.9 | 1.225 | 1.3 | Cl ⁻ | 2390 | 67.419 | 66.3 |
| Na ⁺ | 1074 | 46.716 | 48.0 | SO ₄ ²⁻ | 1474 | 30.689 | 30.2 |
| Mg ²⁺ | 144 | 11.842 | 12.2 | HCO ₃ ⁻ | 103 | 1.688 | 1.7 |
| Ca ²⁺ | 748 | 37.325 | 38.4 | NO ₃ ⁻ | 102 | 1.645 | 1.6 |
| Sr ²⁺ | 4.34 | 0.099 | 0.1 | BO ₂ ⁻ | 3.92 | 0.092 | 0.1 |
| | | | | F ⁻ | 2.27 | 0.119 | 0.1 |
| | | | | Br ⁻ | 2.35 | 0.029 | 0.0 |
| Sum | | 97.249 | Error 4.5% | Sum | | 101.681 | |

Uncharged species [mg/l]

SiO₂ 39.5

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | <3.00 | Co ²⁺ | 0.072 | Cu ²⁺ | 0.480 | Fe ²⁺ | 24.0 | Li ⁺ | 266 |
| Mn ²⁺ | 2.00 | NH ₄ ⁺ | 20.0 | Ni ²⁺ | 0.300 | Pb ²⁺ | 0.070 | Zn ²⁺ | 22.7 |
| PO ₄ ³⁻ | 10.00 | NO ₂ ⁻ | <50.0 | | | | | | |
| Ag | 0.106 | As | 1.18 | Ba | 22.0 | Be | 0.042 | Bi | 0.000 |
| Cd | 0.036 | Ce | 0.011 | Cr | 0.620 | Cs | 0.811 | Dy | 0.002 |
| Er | 0.002 | Eu | 0.000 | Ga | 0.005 | Gd | 0.002 | Ge | 0.100 |
| Hf | 0.005 | Hg | 0.010 | Ho | 0.001 | La | 0.008 | Lu | 0.001 |
| Mo | 33.3 | Nb | 0.010 | Nd | 0.013 | Pr | 0.001 | Rb | 29.3 |
| Sb | 0.025 | Sc | <1.000 | Se | 9.74 | Sm | 0.006 | Sn | 0.011 |
| Ta | 0.007 | Tb | 0.000 | Te | 0.058 | Th | 0.006 | Ti | 0.240 |
| Tl | 0.033 | Tm | 0.001 | U | 449 | V | 10.3 | W | 3.90 |
| Y | 0.019 | Yb | 0.004 | Zr | 0.015 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl-SO₄²⁻-brackish water.

Sample-ID

KEM 3

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

4970 EC, calc. [$\mu\text{S}/\text{cm}$]

5312

Total dissolved solids, TDS, calc. [mg/l]

3062

pH

7.1

Total hardness [mmol/l]

11.8

Sum-parameters [mg/l]

NPOC 1.1 TIC 44.6

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 32.8 | 0.839 | 1.7 | Cl ⁻ | 1433 | 40.423 | 77.9 |
| Na ⁺ | 578 | 25.141 | 50.7 | SO ₄ ²⁻ | 362 | 7.537 | 14.5 |
| Mg ²⁺ | 133 | 10.938 | 22.0 | HCO ₃ ⁻ | 203 | 3.327 | 6.4 |
| Ca ²⁺ | 253 | 12.625 | 25.4 | NO ₃ ⁻ | 28.8 | 0.464 | 0.9 |
| Sr ²⁺ | 2.77 | 0.063 | 0.1 | F ⁻ | 1.13 | 0.059 | 0.1 |
| | | | | Br ⁻ | 2.93 | 0.037 | 0.1 |
| Sum | | 49.622 | Error 4.4% | Sum | | 51.868 | |

Uncharged species [mg/l]

SiO₂ 30.2

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | <3.00 | Co ²⁺ | 0.082 | Cu ²⁺ | 0.570 | Fe ²⁺ | 7.00 | Li ⁺ | 103 |
| Mn ²⁺ | 1.000 | NH ₄ ⁺ | 10.00 | Ni ²⁺ | 0.350 | Pb ²⁺ | 0.040 | Zn ²⁺ | 16.4 |
| PO ₄ ³⁻ | 30.0 | NO ₂ ⁻ | <30.0 | BO ₂ ⁻ | 880 | | | | |
| Ag | 0.028 | As | 0.930 | Ba | 26.0 | Be | 0.005 | Bi | 0.001 |
| Cd | 0.021 | Ce | 0.007 | Cr | 0.810 | Cs | 0.017 | Dy | 0.001 |
| Er | 0.002 | Eu | 0.001 | Ga | 0.008 | Gd | 0.002 | Ge | 0.020 |
| Hf | 0.006 | Hg | 0.000 | Ho | 0.001 | La | 0.006 | Lu | 0.000 |
| Mo | 15.3 | Nb | 0.006 | Nd | 0.005 | Pr | 0.001 | Rb | 4.47 |
| Sb | 0.015 | Sc | <1.000 | Se | 1.71 | Sm | 0.002 | Sn | 0.020 |
| Ta | 0.002 | Tb | 0.001 | Te | 0.018 | Th | 0.000 | Ti | 0.050 |
| Tl | 0.005 | Tm | 0.000 | U | 65.7 | V | 5.80 | W | 0.204 |
| Y | 0.009 | Yb | 0.001 | Zr | 0.010 | | | | |

It is a very hard Na⁺-Ca²⁺-Mg²⁺-Cl-brackish water.

Sample-ID

Kranzberg

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

1185 EC, calc. [$\mu\text{S}/\text{cm}$]

1254

Total dissolved solids, TDS, calc. [mg/l]

980

pH

7.3

Total hardness [mmol/l]

4.2

Sum-parameters [mg/l]

NPOC 03 TIC 87.3

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 6.80 | 0.174 | 1.3 | Cl ⁻ | 130 | 3.667 | 27.4 |
| Na ⁺ | 105 | 4.567 | 34.7 | SO ₄ ²⁻ | 122 | 2.540 | 19.0 |
| Mg ²⁺ | 41.5 | 3.413 | 26.0 | HCO ₃ ⁻ | 411 | 6.735 | 50.4 |
| Ca ²⁺ | 99.4 | 4.960 | 37.7 | NO ₃ ⁻ | 23.7 | 0.382 | 2.9 |
| Sr ²⁺ | 1.16 | 0.026 | 0.2 | F ⁻ | 0.639 | 0.034 | 0.3 |
| Sum | | 13.151 | Error 1.7% | Sum | | 13.374 | |

Uncharged species [mg/l]

SiO₂ 38.2

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | <3.00 | Co ²⁺ | 0.008 | Cu ²⁺ | 0.720 | Fe 2+ | 9.00 | Li ⁺ | 68.0 |
| Mn ²⁺ | 1.000 | NH ₄ ⁺ | <10.00 | Ni ²⁺ | 0.080 | Pb ²⁺ | 0.130 | Zn ²⁺ | 3.50 |
| PO ₄ ³⁻ | 40.0 | NO ₂ ⁻ | <5.00 | BO ₂ ⁻ | 420 | Br ⁻ | 446 | | |
| Ag | 0.001 | As | 2.20 | Ba | 72.0 | Be | 0.022 | Bi | 0.001 |
| Cd | 0.006 | Ce | 0.005 | Cr | 0.110 | Cs | 0.028 | Dy | 0.002 |
| Er | 0.002 | Eu | 0.001 | Ga | 0.004 | Gd | 0.002 | Ge | 0.110 |
| Hf | 0.001 | Hg | 0.000 | Ho | 0.001 | La | 0.006 | Lu | 0.000 |
| Mo | 2.17 | Nb | 0.001 | Nd | 0.004 | Pr | 0.001 | Rb | 1.29 |
| Sb | 0.013 | Sc | <1.000 | Se | 1.41 | Sm | 0.002 | Sn | 0.003 |
| Ta | 0.001 | Tb | 0.000 | Te | 0.009 | Th | 0.001 | Ti | 0.170 |
| Tl | 0.002 | Tm | 0.000 | U | 22.2 | V | 26.0 | W | 0.102 |
| Y | 0.016 | Yb | 0.002 | Zr | 0.005 | | | | |

It is a hard Ca²⁺-Na⁺-Mg²⁺-HCO₃⁻-Cl-water.

Sample-ID

LHU 2278

Location

Mine Langer Heinrich Uranium Ltd.

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

12100

EC, calc. [$\mu\text{S}/\text{cm}$]

8737

Total dissolved solids, TDS, calc. [mg/l]

5359

pH

7.0

Total hardness [mmol/l]

7.4

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|--------------------|--------|--------------------------|-------------------|
| K^+ | 71.5 | 1.829 | 2.0 | Cl^- | 2536 | 71.537 | 84.8 |
| Na^+ | 1617 | 70.335 | 78.5 | SO_4^{2-} | 320 | 6.663 | 7.9 |
| Mg^{2+} | 54.6 | 4.490 | 5.0 | HCO_3^- | 355 | 5.818 | 6.9 |
| Ca^{2+} | 209 | 10.429 | 11.6 | NO_3^- | 1.55 | 0.025 | 0.0 |
| Al^{3+} | 13.9 | 1.546 | 1.7 | PO_4^{3-} | 2.30 | 0.024 | 0.0 |
| Fe^{2+} | 199 | 0.713 | 0.8 | BO_2^- | 7.75 | 0.181 | 0.2 |
| Li^+ | 0.758 | 0.109 | 0.1 | F^- | 1.19 | 0.063 | 0.1 |
| Mn^{2+} | 1.20 | 0.044 | 0.0 | Br^- | 2.89 | 0.036 | 0.0 |
| Si^{2+} | 6.44 | 0.147 | 0.2 | | | | |
| Sum | | 89.651 | Error 6.1% | Sum | | 84.346 | |

Uncharged species [mg/l]

SiO_2 138

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|------------------|-------|------------------|-------|-----------------|-------|------------------|-------|------------------|-------|
| Co^{2+} | 309 | Cu^{2+} | 33.3 | NH_4^+ | 70.0 | Ni^{2+} | 46.2 | Pb^{2+} | 19.2 |
| Zn^{2+} | 66.7 | | | | | | | | |
| NO_2^- | <50.0 | | | | | | | | |
| Ag | 0.087 | As | 6.45 | Ba | 282 | Be | 0.637 | Bi | 0.223 |
| Cd | 0.062 | Ce | 106 | Cr | 66.6 | Cs | 11.2 | Dy | 3.14 |
| Er | 1.15 | Eu | 0.818 | Ga | 7.92 | Gd | 5.67 | Ge | 2.39 |
| Hf | 0.038 | Hg | 0.000 | Ho | 0.487 | La | 32.4 | Lu | 0.100 |
| Mo | 22.0 | Nb | 1.43 | Nd | 35.2 | Pr | 9.37 | Rb | 86.1 |
| Sb | 0.023 | Sc | 4.00 | Se | 4.02 | Sm | 6.95 | Sn | 0.134 |
| Ta | 0.121 | Tb | 0.675 | Te | 0.079 | Th | 12.9 | Ti | 1006 |
| Tl | 0.448 | Tm | 0.126 | U | 317 | V | 247 | W | 2.75 |
| Y | 107 | Yb | 0.721 | Zr | 1.16 | | | | |

It is a very hard Na^+ - Cl^- -brackish water.

Sample-ID

LHU-DW 1 1

Location

Mine Langer Heinrich Uranium Ltd.

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

27700 EC, calc. [$\mu\text{S}/\text{cm}$]

36512

Total dissolved solids, TDS, calc. [mg/l]

26893

pH

9.5

Total hardness [mmol/l]

0.1

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|---------|--------------------------|-------------------|
| K ⁺ | 150 | 3.836 | 1.0 | Cl ⁻ | 2779 | 78.392 | 18.9 |
| Na ⁺ | 9078 | 394.867 | 99.0 | SO ₄ ²⁻ | 3611 | 75.182 | 18.1 |
| Mg ²⁺ | 1.59 | 0.131 | 0.0 | HCO ₃ ⁻ | 6622 | 108.522 | 26.1 |
| Ca ²⁺ | 2.75 | 0.137 | 0.0 | NO ₃ ⁻ | 66.5 | 1.072 | 0.3 |
| | | | | CO ₃ ²⁻ | 4538 | 151.216 | 36.4 |
| | | | | PO ₄ ³⁻ | 8.67 | 0.089 | 0.0 |
| | | | | BO ₂ ⁻ | 9.30 | 0.217 | 0.1 |
| | | | | F ⁻ | 8.52 | 0.448 | 0.1 |
| | | | | Br ⁻ | 1.38 | 0.017 | 0.0 |
| | Sum | 399.015 | Error 4.0% | Sum | 415.157 | | |

Uncharged species [mg/l]

SiO₂ 15.3

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|------------------------------|--------|------------------------------|--------|------------------|--------|------------------|-------|------------------|--------|
| Al ³⁺ | 38.0 | Co ²⁺ | 4.72 | Cu ²⁺ | 20.3 | Fe ²⁺ | 79.0 | Li ⁺ | 206 |
| Mn ²⁺ | 53.0 | NH ₄ ⁺ | <10.00 | Ni ²⁺ | 3.90 | Pb ²⁺ | 0.520 | Sr ²⁺ | 167 |
| Zn ²⁺ | 5.30 | | | | | | | | |
| NO ₂ ⁻ | <100.0 | | | | | | | | |
| Ag | 0.381 | As | 554 | Ba | 12.0 | Be | 21.8 | Bi | 0.017 |
| Cd | 0.230 | Ce | 32.4 | Cr | 17.4 | Cs | 0.095 | Dy | 0.417 |
| Er | 0.510 | Eu | 0.017 | Ga | 0.116 | Gd | 0.381 | Ge | 0.450 |
| Hf | 0.053 | Hg | 0.150 | Ho | 0.132 | La | 0.232 | Lu | 0.138 |
| Mo | 304 | Nb | 0.047 | Nd | 0.547 | Pr | 0.106 | Rb | 9.21 |
| Sb | 0.113 | Sc | <39.0 | Se | 15.3 | Sm | 0.204 | Sn | <0.003 |
| Ta | 0.014 | Tb | 0.061 | Te | 0.405 | Th | 5.61 | Ti | 1.15 |
| Tl | 0.010 | Tm | 0.106 | U | 229906 | V | 6470 | W | 564 |
| Y | 3.50 | Yb | 0.745 | Zr | 9.58 | | | | |

It is a soft Na⁺-CO₃²⁻-HCO₃⁻-salt water.

Sample-ID

LHU-TM6

Location

Mine Langer Heinrich Uranium Ltd.

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

32000 EC, calc. [$\mu\text{S}/\text{cm}$]

42294

Total dissolved solids, TDS, calc. [mg/l]

29833

pH

9.7

Total hardness [mmol/l]

0.1

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|---------|--------------------------|-------------------|
| K ⁺ | 130 | 3.325 | 07 | Cl ⁻ | 2523 | 71.171 | 14.8 |
| Na ⁺ | 10570 | 459.765 | 99.2 | SO ₄ ²⁻ | 3738 | 77.826 | 16.2 |
| Mg ²⁺ | 0.562 | 0.046 | 00 | HCO ₃ ⁻ | 5557 | 91.069 | 19.0 |
| Ca 2+ | 1.92 | 0.096 | 00 | NO ₃ ⁻ | 66.4 | 1.071 | 0.2 |
| | | | | CO ₃ ²⁻ | 7072 | 235.655 | 49.1 |
| | | | | PO ₄ ³⁻ | 11.4 | 0.118 | 0.0 |
| | | | | BO 2- | 7.64 | 0.178 | 0.0 |
| | | | | F ⁻ | 53.7 | 2.826 | 0.6 |
| | | | | Br ⁻ | 1.91 | 0.024 | 0.0 |
| | Sum | 463.255 | Error 3.5% | Sum | 479.944 | | |

Uncharged species [mg/l]

SiO₂ 98.2

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|------------------------------|-------|------------------------------|-------|------------------|--------|------------------|-------|------------------|-------|
| Al ³⁺ | 16.0 | Co ²⁺ | 2.93 | Cu ²⁺ | 16.2 | Fe ²⁺ | 78.0 | Li ⁺ | 68.0 |
| Mn ²⁺ | 44.0 | NH ₄ ⁺ | 50.0 | Ni ²⁺ | 5.25 | Pb ²⁺ | 0.790 | Sr ²⁺ | 162 |
| Zn 2+ | 10.00 | | | | | | | | |
| NO ₂ ⁻ | 316 | | | | | | | | |
| Ag | 0.150 | As | 772 | Ba | 19.0 | Be | 13.7 | Bi | 0.012 |
| Cd | 0.153 | Ce | 6.30 | Cr | 2.85 | Cs | 0.040 | Dy | 0.053 |
| Er | 0.067 | Eu | 0.013 | Ga | 0.250 | Gd | 0.046 | Ge | 0.450 |
| Hf | 0.060 | Hg | 0.140 | Ho | 0.015 | La | 0.054 | Lu | 0.013 |
| Mo | 158 | Nb | 0.081 | Nd | 0.111 | Pr | 0.021 | Rb | 10.8 |
| Sb | 0.096 | Sc | <29.0 | Se | 17.7 | Sm | 0.033 | Sn | 0.009 |
| Ta | 0.049 | Tb | 0.013 | Te | 0.590 | Th | 4.16 | Ti | 0.000 |
| Tl | 0.015 | Tm | 0.012 | U | 176892 | V | 2083 | W | 907 |
| Y | 0.316 | Yb | 0.070 | Zr | 0.449 | | | | |

It is a soft Na⁺-CO₃²⁻-salt water.

Sample-ID

LHU-TSF

Location

Mine Langer Heinrich Uranium Ltd.

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

57800 EC, calc. [$\mu\text{S}/\text{cm}$]

62472

Total dissolved solids, TDS, calc. [mg/l]

40594

pH

10.7

Total hardness [mmol/l]

0.2

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 372 | 9.514 | 1.3 | Cl ⁻ | 3317 | 93.568 | 13.4 |
| Na ⁺ | 16325 | 710.091 | 98.6 | SO ₄ ²⁻ | 4867 | 101.333 | 14.5 |
| Mg ²⁺ | 4.37 | 0.359 | 0.0 | HCO ₃ ⁻ | 1056 | 17.306 | 2.5 |
| Ca ²⁺ | 1.70 | 0.085 | 0.0 | NO ₃ ⁻ | 0.160 | 0.003 | 0.0 |
| NH ₄ ⁺ | 2.98 | 0.162 | 0.0 | CO ₃ ²⁻ | 14396 | 479.707 | 68.8 |
| | | | | PO ₄ ³⁻ | 12.4 | 0.128 | 0.0 |
| | | | | NO ₂ ⁻ | 8.67 | 0.188 | 0.0 |
| | | | | BO ₂ ⁻ | 11.5 | 0.269 | 0.0 |
| | | | | F ⁻ | 85.5 | 4.500 | 0.6 |
| | | | | Br ⁻ | 1.67 | 0.021 | 0.0 |
| Sum | | 720.250 | Error 3.3% | Sum | | 697.022 | |

Uncharged species [mg/l]

SiO₂ 131

Trace elements [μg/l]

| | | | | | | | | | |
|------------------|-------|------------------|-------|------------------|--------|------------------|--------|------------------|-------|
| Al ³⁺ | 28.0 | Co ²⁺ | 1.96 | Cu ²⁺ | 9.33 | Fe ²⁺ | 49.0 | Li ⁺ | 179 |
| Mn ²⁺ | 30.0 | Ni ²⁺ | 2.44 | Pb ²⁺ | 1.02 | Sr ²⁺ | 252 | Zn ²⁺ | 9.10 |
| Ag | 0.090 | As | 2251 | Ba | 104 | Be | 163 | Bi | 0.017 |
| Cd | 0.202 | Ce | 2.42 | Cr | 30.8 | Cs | 0.580 | Dy | 0.099 |
| Er | 0.125 | Eu | 0.009 | Ga | 1.07 | Gd | 0.052 | Ge | 0.810 |
| Hf | 0.111 | Hg | 0.170 | Ho | 0.035 | La | 0.034 | Lu | 0.037 |
| Mo | 216 | Nb | 0.110 | Nd | 0.051 | Pr | 0.009 | Rb | 52.9 |
| Sb | 0.928 | Sc | <22.0 | Se | 10.7 | Sm | 0.030 | Sn | 0.037 |
| Ta | 0.091 | Tb | 0.009 | Te | 0.455 | Th | 3.07 | Ti | 0.770 |
| Tl | 0.042 | Tm | 0.022 | U | 141804 | V | 141056 | W | 958 |
| Y | 0.618 | Yb | 0.167 | Zr | 1.96 | | | | |

It is a soft Na⁺-CO₃²⁻-salt water.

Sample-ID

LIK 4B

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

7780 EC, calc. [$\mu\text{S}/\text{cm}$]

8664

Total dissolved solids, TDS, calc. [mg/l]

4974

pH

6.9

Total hardness [mmol/l]

19.8

Sum-parameters [mg/l]

NPOC

1.4

TIC

53.2

Cations

Anions

| | [mg/l] | c_q [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|----------------|------------|-------------------------------|--------|-------------------|------------|
| K ⁺ | 45.3 | 1.159 | 1.4 | Cl ⁻ | 2358 | 66.516 | 78.5 |
| Na ⁺ | 940 | 40.887 | 50.0 | SO ₄ ²⁻ | 612 | 12.742 | 15.0 |
| Mg ²⁺ | 225 | 18.503 | 22.6 | HCO ₃ ⁻ | 302 | 4.949 | 5.8 |
| Ca ²⁺ | 422 | 21.058 | 25.7 | NO ₃ ⁻ | 23.0 | 0.371 | 0.4 |
| Fe ²⁺ | 1.03 | 0.037 | 0.0 | BO ²⁻ | 1.42 | 0.033 | 0.0 |
| Sr ²⁺ | 4.82 | 0.110 | 0.1 | Br ⁻ | 5.09 | 0.064 | 0.1 |
| Sum | | 81.779 | Error 3.5% | Sum | | 84.728 | |

Uncharged species [mg/l]

SiO₂ 32.9

Trace elements [μg/l]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 19.0 | Co ²⁺ | 0.223 | Cu ²⁺ | 0.480 | Li ⁺ | 133 | Mn ²⁺ | 73.0 |
| NH ₄ ⁺ | 10.00 | Ni ²⁺ | 0.800 | Pb ²⁺ | 0.050 | Zn ²⁺ | 9.60 | | |
| PO ₄ ³⁻ | 230 | NO ₂ ⁻ | 80.0 | F ⁻ | 959 | | | | |
| Ag | 0.009 | As | 0.470 | Ba | 48.0 | Be | 0.006 | Bi | 0.000 |
| Cd | 0.022 | Ce | 0.060 | Cr | 0.160 | Cs | 0.027 | Dy | 0.006 |
| Er | 0.002 | Eu | 0.001 | Ga | 0.019 | Gd | 0.006 | Ge | 0.030 |
| Hf | 0.003 | Hg | 0.000 | Ho | 0.001 | La | 0.017 | Lu | 0.000 |
| Mo | 7.77 | Nb | 0.009 | Nd | 0.013 | Pr | 0.002 | Rb | 6.86 |
| Sb | 0.025 | Sc | <1.000 | Se | 2.52 | Sm | 0.002 | Sn | 0.012 |
| Ta | 0.004 | Tb | 0.001 | Te | 0.017 | Th | 0.024 | Ti | 0.410 |
| Tl | 0.011 | Tm | 0.001 | U | 128 | V | 4.00 | W | 0.178 |
| Y | 0.033 | Yb | 0.003 | Zr | 0.008 | | | | |

It is a very hard Na⁺-Ca²⁺-Mg²⁺-Cl⁻-brackish water.

Sample-ID

Lilof

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

14900 EC, calc. [$\mu\text{S}/\text{cm}$]

16288

Total dissolved solids, TDS, calc. [mg/l]

9445

pH

6.8

Total hardness [mmol/l]

29.7

Sum-parameters [mg/l]

NPOC 1.7 TIC 67.4

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 70.9 | 1.813 | 1.1 | Cl ⁻ | 4607 | 129.958 | 83.1 |
| Na ⁺ | 2332 | 101.435 | 62.3 | SO ₄ ²⁻ | 976 | 20.321 | 13.0 |
| Mg ²⁺ | 225 | 18.503 | 11.4 | HCO ₃ ⁻ | 294 | 4.818 | 3.1 |
| Ca ²⁺ | 820 | 40.918 | 25.1 | NO ₃ ⁻ | 72.3 | 1.166 | 0.7 |
| Sr ²⁺ | 7.06 | 0.161 | 0.1 | BO ₂ ⁻ | 3.18 | 0.074 | 0.0 |
| | | | | Br ⁻ | 3.01 | 0.038 | 0.0 |
| Sum | | 162.842 | Error 4.0% | Sum | | 156.380 | |

Uncharged species [mg/l]

SiO₂ 34.0

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 8.00 | Co ²⁺ | 0.076 | Cu ²⁺ | 1.31 | Fe 2+ | 48.0 | Li ⁺ | 46.0 |
| Mn ²⁺ | 10.00 | NH ₄ ⁺ | 10.00 | Ni ²⁺ | 0.450 | Pb ²⁺ | 0.060 | Zn ²⁺ | 10.1 |
| PO ₄ ³⁻ | 110 | NO ₂ ⁻ | <50.0 | F ⁻ | 81.0 | | | | |
| Ag | 0.240 | As | 0.630 | Ba | 44.0 | Be | 0.010 | Bi | 0.004 |
| Cd | 0.047 | Ce | 0.030 | Cr | 0.520 | Cs | 0.044 | Dy | 0.005 |
| Er | 0.004 | Eu | 0.001 | Ga | 0.005 | Gd | 0.004 | Ge | 0.000 |
| Hf | 0.004 | Hg | 0.010 | Ho | 0.001 | La | 0.011 | Lu | 0.001 |
| Mo | 4.54 | Nb | 0.007 | Nd | 0.015 | Pr | 0.003 | Rb | 7.29 |
| Sb | 0.016 | Sc | <1.000 | Se | 9.95 | Sm | 0.007 | Sn | 0.002 |
| Ta | 0.002 | Tb | 0.001 | Te | 0.025 | Th | 0.011 | Ti | 0.410 |
| Tl | 0.017 | Tm | 0.001 | U | 75.3 | V | 5.80 | W | 0.121 |
| Y | 0.041 | Yb | 0.006 | Zr | 0.002 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-brackish water.

Sample-ID

Marmor

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

3450 EC, calc. [$\mu\text{S}/\text{cm}$]

3740

Total dissolved solids, TDS, calc. [mg/l]

2316

pH

7.1

Total hardness [mmol/l]

7.8

Sum-parameters [mg/l]

NPOC 10 TIC 65.1

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | $\%c_{\text{eq}}$ | | [mg/l] | c_{eq} [mmol/l] | $\%c_{\text{eq}}$ |
|------------------|--------------------------|--|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 33.1 | 0.847 | 2.4 | Cl^- | 816 | 23.018 | 62.6 |
| Na^+ | 440 | 19.139 | 53.7 | SO_4^{2-} | 379 | 7.891 | 21.5 |
| Mg^{2+} | 81.6 | 6.711 | 18.8 | HCO_3^- | 293 | 4.802 | 13.1 |
| Ca^{2+} | 178 | 8.882 | 24.9 | NO_3^- | 61.4 | 0.990 | 2.7 |
| Sr^{2+} | 1.86 | 0.042 | 0.1 | Br^- | 1.83 | 0.023 | 0.1 |
| Sum | | 35.657 | Error 3.1% | Sum | | 36.770 | |

Uncharged species [mg/l]

SiO_2 28.0

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 3.00 | Co^{2+} | 0.066 | Cu^{2+} | 0.300 | Fe^{2+} | 215 | Li^+ | 49.0 |
| Mn^{2+} | 26.0 | NH_4^+ | 370 | Ni^{2+} | 0.340 | Pb^{2+} | 0.110 | Zn^{2+} | 7.80 |
| PO_4^{3-} | 120 | NO_2^- | 1000 | BO_2^- | 800 | F^- | 81.0 | | |
| Ag | 0.009 | As | 1.22 | Ba | 45.0 | Be | 0.003 | Bi | 0.001 |
| Cd | 0.009 | Ce | 0.012 | Cr | 0.570 | Cs | 0.089 | Dy | 0.002 |
| Er | 0.001 | Eu | 0.002 | Ga | 0.010 | Gd | 0.002 | Ge | 0.030 |
| Hf | 0.001 | Hg | 0.000 | Ho | 0.000 | La | 0.007 | Lu | 0.000 |
| Mo | 4.71 | Nb | 0.003 | Nd | 0.007 | Pr | 0.001 | Rb | 2.80 |
| Sb | 0.021 | Sc | <1.000 | Se | 4.75 | Sm | 0.003 | Sn | 0.003 |
| Ta | 0.001 | Tb | 0.000 | Te | 0.010 | Th | 0.002 | Ti | 0.270 |
| Tl | 0.003 | Tm | 0.000 | U | 29.8 | V | 8.30 | W | 0.165 |
| Y | 0.009 | Yb | 0.000 | Zr | 0.004 | | | | |

It is a very hard Na^+ - Ca^{2+} - Cl^- - SO_4^{2-} -brackish water.

Sample-ID

Naob

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

1342 EC, calc. [$\mu\text{S}/\text{cm}$]

1371

Total dissolved solids, TDS, calc. [mg/l]

913

pH

7.7

Total hardness [mmol/l]

4.5

Sum-parameters [mg/l]

NPOC 24 TIC 51.8

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 17.2 | 0.440 | 3.2 | Cl^- | 271 | 7.645 | 55.2 |
| Na^+ | 99.3 | 4.319 | 31.5 | SO_4^{2-} | 77.9 | 1.622 | 11.7 |
| Mg^{2+} | 64.1 | 5.271 | 38.4 | HCO_3^- | 253 | 4.146 | 29.9 |
| Ca^{2+} | 73.0 | 3.643 | 26.6 | NO_3^- | 22.8 | 0.368 | 2.7 |
| Sr^{2+} | 0.992 | 0.023 | 0.2 | F^- | 0.840 | 0.044 | 0.3 |
| Sum | | 13.710 | Error 1.0% | Sum | | 13.848 | |

Uncharged species [mg/l]

SiO_2 31.6

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 17.0 | Co^{2+} | 0.056 | Cu^{2+} | 1.38 | Fe^{2+} | 28.0 | Li^+ | 77.0 |
| Mn^{2+} | 2.00 | NH_4^+ | <10.00 | Ni^{2+} | 0.520 | Pb^{2+} | 0.130 | Zn^{2+} | 4.30 |
| PO_4^{3-} | 140 | NO_2^- | 340 | BO_2^- | 260 | Br^- | 677 | | |
| Ag | 0.002 | As | 6.44 | Ba | 8.00 | Be | 0.003 | Bi | 0.002 |
| Cd | 0.014 | Ce | 0.040 | Cr | 0.100 | Cs | 0.025 | Dy | 0.004 |
| Er | 0.003 | Eu | 0.001 | Ga | 0.007 | Gd | 0.006 | Ge | 0.010 |
| Hf | 0.002 | Hg | 0.000 | Ho | 0.001 | La | 0.025 | Lu | 0.000 |
| Mo | 4.33 | Nb | 0.002 | Nd | 0.021 | Pr | 0.006 | Rb | 1.87 |
| Sb | 0.034 | Sc | <1.000 | Se | 1.82 | Sm | 0.005 | Sn | 0.016 |
| Ta | 0.001 | Tb | 0.001 | Te | 0.006 | Th | 0.002 | Ti | 0.250 |
| Tl | 0.006 | Tm | 0.000 | U | 26.9 | V | 29.2 | W | 0.665 |
| Y | 0.022 | Yb | 0.001 | Zr | 0.004 | | | | |

It is a hard Mg^{2+} - Na^+ - Ca^{2+} - Cl^- - HCO_3^- -water.

Sample-ID

NN1

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

5820 EC, calc. [$\mu\text{S}/\text{cm}$]

6065

Total dissolved solids, TDS, calc. [mg/l]

3557

pH

7.0

Total hardness [mmol/l]

12.4

Sum-parameters [mg/l]

NPOC

1.2

TIC

51.1

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 39.3 | 1.005 | 1.8 | Cl^- | 1573 | 44.372 | 74.9 |
| Na^+ | 710 | 30.883 | 54.4 | SO_4^{2-} | 494 | 10.285 | 17.4 |
| Mg^{2+} | 113 | 9.293 | 16.4 | HCO_3^- | 237 | 3.884 | 6.6 |
| Ca^{2+} | 310 | 15.469 | 27.3 | NO_3^- | 35.4 | 0.571 | 1.0 |
| Sr^{2+} | 2.63 | 0.060 | 0.1 | BO^{2-} | 1.65 | 0.039 | 0.1 |
| | | | | F^- | 1.35 | 0.071 | 0.1 |
| | | | | Br^- | 3.00 | 0.038 | 0.1 |
| Sum | 56.730 | | Error 4.4% | Sum | 59.260 | | |

Uncharged species [mg/l]

SiO_2

36.6

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 3.00 | Co^{2+} | 0.070 | Cu^{2+} | 0.830 | Fe^{2+} | 8.00 | Li^+ | 127 |
| Mn^{2+} | 8.00 | NH_4^+ | <10.00 | Ni^{2+} | 1.41 | Pb^{2+} | 0.050 | Zn^{2+} | 11.2 |
| PO_4^{3-} | 40.0 | NO_2^- | <5.00 | | | | | | |
| Ag | 0.022 | As | 0.800 | Ba | 27.0 | Be | 0.004 | Bi | 0.000 |
| Cd | 0.016 | Ce | 0.027 | Cr | 1.11 | Cs | 0.014 | Dy | 0.003 |
| Er | 0.003 | Eu | 0.001 | Ga | 0.003 | Gd | 0.005 | Ge | 0.030 |
| Hf | 0.004 | Hg | 0.000 | Ho | 0.001 | La | 0.011 | Lu | 0.001 |
| Mo | 10.00 | Nb | 0.006 | Nd | 0.008 | Pr | 0.003 | Rb | 6.54 |
| Sb | 0.023 | Sc | <1.000 | Se | 2.42 | Sm | 0.006 | Sn | 0.008 |
| Ta | 0.002 | Tb | 0.000 | Te | 0.020 | Th | 0.005 | Ti | 0.400 |
| Tl | 0.009 | Tm | 0.000 | U | 190 | V | 7.20 | W | 0.227 |
| Y | 0.024 | Yb | 0.003 | Zr | 0.007 | | | | |

It is a very hard Na^+ - Ca^{2+} - Cl^- -brackish water.

Sample-ID

NN2

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

596 EC, calc. [$\mu\text{S}/\text{cm}$]

551

Total dissolved solids, TDS, calc. [mg/l]

458

pH

7.2

Total hardness [mmol/l]

2.4

Sum-parameters [mg/l]

NPOC 10 TIC 47.2

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 4.80 | 0.123 | 2.1 | Cl^- | 35.1 | 0.990 | 17.3 |
| Na^+ | 24.2 | 1.053 | 17.6 | SO_4^{2-} | 17.6 | 0.366 | 6.4 |
| Mg^{2+} | 15.6 | 1.283 | 21.5 | HCO_3^- | 254 | 4.163 | 72.6 |
| Ca^{2+} | 70.1 | 3.498 | 58.6 | NO_3^- | 7.27 | 0.117 | 2.0 |
| Sr^{2+} | 0.375 | 0.009 | 0.1 | F^- | 1.73 | 0.091 | 1.6 |
| Sum | 5.968 | | Error 4.0% | Sum | 5.732 | | |

Uncharged species [mg/l]

SiO_2 27.1

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | <3.00 | Co^{2+} | 0.022 | Cu^{2+} | 0.380 | Fe^{2+} | 3.00 | Li^+ | 17.0 |
| Mn^{2+} | 1.000 | NH_4^+ | <10.00 | Ni^{2+} | 0.050 | Pb^{2+} | 0.020 | Zn^{2+} | 0.400 |
| PO_4^{3-} | 90.0 | NO_2^- | 6.00 | BO_2^- | 140 | Br^- | 57.0 | | |
| Ag | 0.000 | As | 2.14 | Ba | 15.0 | Be | 0.006 | Bi | 0.002 |
| Cd | 0.005 | Ce | 0.004 | Cr | 0.070 | Cs | 0.006 | Dy | 0.000 |
| Er | 0.000 | Eu | 0.000 | Ga | 0.005 | Gd | 0.001 | Ge | 0.030 |
| Hf | 0.003 | Hg | 0.000 | Ho | 0.000 | La | 0.003 | Lu | 0.000 |
| Mo | 4.94 | Nb | 0.001 | Nd | 0.002 | Pr | 0.001 | Rb | 0.410 |
| Sb | 0.017 | Sc | <1.000 | Se | 0.210 | Sm | 0.001 | Sn | 0.014 |
| Ta | 0.002 | Tb | 0.000 | Te | 0.004 | Th | 0.002 | Ti | 0.130 |
| Tl | 0.004 | Tm | 0.000 | U | 17.1 | V | 7.60 | W | 0.268 |
| Y | 0.006 | Yb | 0.000 | Zr | 0.007 | | | | |

It is a moderately hard Ca^{2+} - Mg^{2+} - HCO_3^- -water.

| | | | |
|--|--|--|-------|
| Sample-ID | Palmenhorst | | |
| Location | alluvial aquifer, Swakop/Khan | | |
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 9200 EC, calc. [$\mu\text{S}/\text{cm}$] | | 10193 |
| | Total dissolved solids, TDS, calc. [mg/l] | | 6010 |
| pH | 7.1 | | |
| Total hardness [mmol/l] | 19.8 | | |

| Cations | | | | Anions | | | |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
| K ⁺ | 54.2 | 1.386 | 1.4 | Cl ⁻ | 2454 | 69.224 | 70.8 |
| Na ⁺ | 1328 | 57.764 | 58.4 | SO ₄ ²⁻ | 1082 | 22.528 | 23.0 |
| Mg ²⁺ | 170 | 13.980 | 14.1 | HCO ₃ ⁻ | 287 | 4.703 | 4.8 |
| Ca ²⁺ | 514 | 25.649 | 25.9 | NO ₃ ⁻ | 72.1 | 1.163 | 1.2 |
| Sr ²⁺ | 4.12 | 0.094 | 0.1 | BO ₂ ⁻ | 3.81 | 0.089 | 0.1 |
| | | | | Br ⁻ | 2.88 | 0.036 | 0.0 |
| | Sum | 98.917 | Error 1.1% | Sum | 97.790 | | |

Uncharged species [mg/l]

SiO₂ 35.8

| Trace elements [$\mu\text{g}/\text{l}$] | | | | | | | | | |
|---|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | <3.00 | Co ²⁺ | 0.893 | Cu ²⁺ | 0.580 | Fe ²⁺ | 54.0 | Li ⁺ | 136 |
| Mn ²⁺ | 548 | NH ₄ ⁺ | 30.0 | Ni ²⁺ | 0.490 | Pb ²⁺ | 0.030 | Zn ²⁺ | 2.90 |
| PO ₄ ³⁻ | 100.0 | NO ₂ ⁻ | 397 | F ⁻ | 713 | | | | |
| Ag | 0.042 | As | 0.840 | Ba | 27.0 | Be | 0.007 | Bi | 0.001 |
| Cd | 0.051 | Ce | 0.030 | Cr | 0.290 | Cs | 0.014 | Dy | 0.005 |
| Er | 0.004 | Eu | <0.001 | Ga | 0.025 | Gd | 0.001 | Ge | 0.050 |
| Hf | 0.001 | Hg | 0.000 | Ho | 0.001 | La | 0.010 | Lu | 0.001 |
| Mo | 8.16 | Nb | 0.007 | Nd | 0.005 | Pr | 0.003 | Rb | 6.82 |
| Sb | 0.013 | Sc | <1.000 | Se | 8.23 | Sm | 0.001 | Sn | 0.015 |
| Ta | 0.004 | Tb | 0.000 | Te | 0.058 | Th | 0.013 | Ti | 0.080 |
| Tl | 0.012 | Tm | 0.000 | U | 239 | V | 8.50 | W | 0.261 |
| Y | 0.024 | Yb | 0.004 | Zr | 0.005 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl-SO₄²⁻-brackish water.

Sample-ID

Pos 1

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

6880 EC, calc. [$\mu\text{S}/\text{cm}$]

7697

Total dissolved solids, TDS, calc. [mg/l]

4819

pH

6.6

Total hardness [mmol/l]

23.6

Sum-parameters [mg/l]

NPOC

7.1

TIC

131

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 23.4 | 0.598 | 0.8 | Cl ⁻ | 1513 | 42.680 | 56.4 |
| Na ⁺ | 581 | 25.272 | 34.4 | SO ₄ ²⁻ | 640 | 13.325 | 17.6 |
| Mg ²⁺ | 197 | 16.201 | 22.1 | HCO ₃ ⁻ | 486 | 7.965 | 10.5 |
| Ca ²⁺ | 623 | 31.088 | 42.4 | NO ₃ ⁻ | 704 | 11.353 | 15.0 |
| Sr ²⁺ | 4.22 | 0.096 | 0.1 | NO ₂ ⁻ | 8.58 | 0.186 | 0.2 |
| Zn ²⁺ | 2.60 | 0.080 | 0.1 | BO ₂ ⁻ | 1.40 | 0.033 | 0.0 |
| | | | | Br ⁻ | 4.87 | 0.061 | 0.1 |
| Sum | | 73.366 | Error 3.0% | Sum | | 75.618 | |

Uncharged species [mg/l]

SiO₂

28.9

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|-----------------|-------|
| Al ³⁺ | <3.00 | Co ²⁺ | 0.197 | Cu ²⁺ | 2.15 | Fe ²⁺ | 64.0 | Li ⁺ | 157 |
| Mn ²⁺ | 35.0 | NH ₄ ⁺ | 90.0 | Ni ²⁺ | 0.390 | Pb ²⁺ | 0.340 | | |
| PO ₄ ³⁻ | 30.0 | F ⁻ | 289 | | | | | | |
| Ag | 0.008 | As | 0.570 | Ba | 406 | Be | 0.032 | Bi | 0.001 |
| Cd | 0.053 | Ce | 0.073 | Cr | 0.130 | Cs | 0.134 | Dy | 0.014 |
| Er | 0.009 | Eu | 0.014 | Ga | 0.010 | Gd | 0.020 | Ge | 0.050 |
| Hf | 0.002 | Hg | 0.010 | Ho | 0.003 | La | 0.078 | Lu | 0.001 |
| Mo | 1.72 | Nb | 0.008 | Nd | 0.059 | Pr | 0.014 | Rb | 2.65 |
| Sb | 0.013 | Sc | <1.000 | Se | 7.46 | Sm | 0.017 | Sn | 0.011 |
| Ta | 0.003 | Tb | 0.002 | Te | 0.013 | Th | 0.006 | Ti | 0.070 |
| Tl | 0.018 | Tm | 0.001 | U | 141 | V | 6.60 | W | 0.085 |
| Y | 0.149 | Yb | 0.008 | Zr | 0.009 | | | | |

It is a very hard Ca²⁺-Na⁺-Mg²⁺-Cl-brackish water.

Sample-ID

Pos 3

Location alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] 1104 EC, calc. [$\mu\text{S}/\text{cm}$] 1082
Total dissolved solids, TDS, calc. [mg/l] 902

pH 6.9
Total hardness [mmol/l] 4.5

Sum-parameters [mg/l]

NPOC

0.7

TIC

116

Cations

Anions

| | [mg/l] | c_{α} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|---|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 6.60 | 0.169 | 1.4 | Cl^- | 110 | 3.103 | 26.0 |
| Na^+ | 63.3 | 2.753 | 23.1 | SO_4^{2-} | 30.9 | 0.643 | 5.4 |
| Mg^{2+} | 28.1 | 2.311 | 19.4 | HCO_3^- | 491 | 8.047 | 67.5 |
| Ca^{2+} | 133 | 6.637 | 55.6 | NO_3^- | 4.96 | 0.080 | 0.7 |
| Sr^{2+} | 0.679 | 0.015 | 0.1 | F^- | 0.713 | 0.038 | 0.3 |
| Zn^{2+} | 1.21 | 0.037 | 0.3 | | | | |
| Sum | | 11.931 | Error 0.1% | Sum | | 11.920 | |

Uncharged species [mg/l]

SiO_2 30.5

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|---------------|-------|
| Al^{3+} | <3.00 | Co^{2+} | 0.064 | Cu^{2+} | 1.45 | Fe^{2+} | 110 | Li^+ | 33.0 |
| Mn^{2+} | 6.00 | NH_4^+ | <10.00 | Ni^{2+} | 0.290 | Pb^{2+} | 0.310 | | |
| PO_4^{3-} | 60.0 | NO_2^- | 36.0 | BO_2^- | 190 | Br^- | 273 | | |
| Ag | 0.001 | As | 1.17 | Ba | 42.0 | Be | 0.019 | Bi | 0.000 |
| Cd | 0.020 | Ce | 0.006 | Cr | 0.020 | Cs | 0.081 | Dy | 0.001 |
| Er | 0.001 | Eu | 0.002 | Ga | 0.007 | Gd | 0.002 | Ge | 0.040 |
| Hf | 0.001 | Hg | 0.000 | Ho | 0.000 | La | 0.004 | Lu | 0.000 |
| Mo | 0.850 | Nb | 0.001 | Nd | 0.005 | Pr | 0.001 | Rb | 0.770 |
| Sb | 0.019 | Sc | <1.000 | Se | 0.240 | Sm | 0.002 | Sn | 0.011 |
| Ta | 0.001 | Tb | 0.000 | Te | 0.003 | Th | 0.001 | Ti | 0.190 |
| Tl | 0.003 | Tm | 0.000 | U | 22.4 | V | 4.60 | W | 0.076 |
| Y | 0.011 | Yb | 0.001 | Zr | 0.007 | | | | |

It is a hard Ca^{2+} - Na^+ - HCO_3^- -Cl-water.

Sample-ID

R1

Location alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] 34700 EC, calc. [$\mu\text{S}/\text{cm}$] 37725
Total dissolved solids, TDS, calc. [mg/l] 22569

pH 7.1
Total hardness [mmol/l] 62.4

Sum-parameters [mg/l]

NPOC 3.4 TIC 99.0

Anions

| Cations | | | | Anions | | | |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
| K ⁺ | 149 | 3.811 | 1.0 | Cl ⁻ | 12175 | 343.441 | 89.3 |
| Na ⁺ | 5991 | 260.592 | 66.8 | SO ₄ ²⁻ | 1628 | 33.895 | 8.8 |
| Mg ²⁺ | 550 | 45.230 | 11.6 | HCO ₃ ⁻ | 426 | 6.981 | 1.8 |
| Ca ²⁺ | 1597 | 79.691 | 20.4 | NO ₃ ⁻ | <0.100 | | |
| Fe ²⁺ | 1.54 | 0.055 | 0.0 | BO ²⁻ | 5.27 | 0.123 | 0.0 |
| Mn ²⁺ | 2.38 | 0.087 | 0.0 | Br ⁻ | 5.54 | 0.069 | 0.0 |
| Sr ²⁺ | 15.2 | 0.347 | 0.1 | | | | |
| Sum | | 389.840 | Error 1.4% | Sum | | 384.514 | |

Uncharged species [mg/l]

SiO₂ 22.2

Trace elements [μg/l]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|-----------------|-------|------------------------------|-------|
| Al ³⁺ | 6.00 | Co ²⁺ | 2.24 | Cu ²⁺ | 1.65 | Li ⁺ | 47.0 | NH ₄ ⁺ | 260 |
| Ni ²⁺ | 1.33 | Pb ²⁺ | 0.500 | Zn ²⁺ | 219 | | | | |
| PO ₄ ³⁻ | 330 | NO ₂ ⁻ | <30.0 | F ⁻ | <20.0 | | | | |
| Ag | 0.046 | As | 2.55 | Ba | 59.0 | Be | 0.026 | Bi | 0.010 |
| Cd | 0.029 | Ce | 0.039 | Cr | 0.170 | Cs | 0.141 | Dy | 0.018 |
| Er | 0.004 | Eu | 0.010 | Ga | 0.101 | Gd | 0.003 | Ge | 0.050 |
| Hf | 0.009 | Hg | 0.060 | Ho | 0.002 | La | 0.023 | Lu | 0.003 |
| Mo | 3.36 | Nb | 0.016 | Nd | 0.020 | Pr | 0.006 | Rb | 12.6 |
| Sb | 0.021 | Sc | <1.000 | Se | 2.45 | Sm | 0.024 | Sn | 0.015 |
| Ta | 0.009 | Tb | 0.004 | Te | 0.116 | Th | 0.003 | Ti | 0.340 |
| Tl | 0.010 | Tm | 0.002 | U | 88.1 | V | 1.000 | W | 0.273 |
| Y | 0.040 | Yb | 0.002 | Zr | 0.056 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-salt water.

Sample-ID

RU-D 1

Location

Mine Rössing Uranium Ltd.

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

19180 EC, calc. [$\mu\text{S}/\text{cm}$]

22071

Total dissolved solids, TDS, calc. [mg/l]

14286

pH

6.7

Total hardness [mmol/l]

52.2

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 129 | 3.299 | 1.5 | Cl ⁻ | 2472 | 69.732 | 31.6 |
| Na ⁺ | 2607 | 113.397 | 50.2 | SO ₄ ²⁻ | 5883 | 122.486 | 55.5 |
| Mg ²⁺ | 1161 | 95.477 | 42.3 | HCO ₃ ⁻ | 1472 | 24.123 | 10.9 |
| Ca ²⁺ | 183 | 9.132 | 4.0 | NO ₃ ⁻ | 214 | 3.451 | 1.6 |
| Li ⁺ | 1.98 | 0.285 | 0.1 | BO ₂ ⁻ | 15.3 | 0.357 | 0.2 |
| Mn ²⁺ | 25.6 | 0.932 | 0.4 | F ⁻ | 8.96 | 0.472 | 0.2 |
| NH ₄ ⁺ | 55.6 | 3.022 | 1.3 | Br ⁻ | 1.84 | 0.023 | 0.0 |
| Sr ²⁺ | 6.97 | 0.159 | 0.1 | | | | |
| Sum | | 225.713 | Error 2.3% | Sum | | 220.645 | |

Uncharged species [mg/l]

SiO₂ 48.4

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 26.0 | Co ²⁺ | 17.0 | Cu ²⁺ | 10.00 | Fe ²⁺ | 25.0 | Ni ²⁺ | 74.0 |
| Pb ²⁺ | 0.130 | Zn ²⁺ | 91.0 | | | | | | |
| PO ₄ ³⁻ | 80.0 | NO ₂ ⁻ | <50.0 | | | | | | |
| Ag | 0.133 | As | 2.05 | Ba | 4.00 | Be | 6.30 | Bi | 0.006 |
| Cd | 0.206 | Ce | 0.423 | Cr | 0.310 | Cs | 0.129 | Dy | 0.080 |
| Er | 0.049 | Eu | 0.008 | Ga | 0.466 | Gd | 0.063 | Ge | 0.680 |
| Hf | 0.060 | Hg | 0.010 | Ho | 0.017 | La | 0.291 | Lu | 0.008 |
| Mo | 20.5 | Nb | 0.031 | Nd | 0.182 | Pr | 0.049 | Rb | 45.8 |
| Sb | 0.023 | Sc | <1.000 | Se | 3.69 | Sm | 0.053 | Sn | 0.122 |
| Ta | 0.022 | Tb | 0.012 | Te | 0.092 | Th | 0.029 | Ti | 0.380 |
| Tl | 0.089 | Tm | 0.008 | U | 2540 | V | 97.3 | W | 2.03 |
| Y | 0.675 | Yb | 0.059 | Zr | 0.259 | | | | |

It is a very hard Na⁺-Mg²⁺-SO₄²⁻-Cl⁻-salt water.

Sample-ID

RU-DW3

Location

Mine Rössing Uranium Ltd.

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

15500 EC, calc. [$\mu\text{S}/\text{cm}$]

23121

Total dissolved solids, TDS, calc. [mg/l]

15087

pH

6.8

Total hardness [mmol/l]

53.4

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 226 | 5.780 | 2.4 | Cl ⁻ | 2133 | 60.169 | 26.5 |
| Na ⁺ | 2763 | 120.183 | 50.8 | SO ₄ ²⁻ | 6837 | 142.349 | 62.7 |
| Mg ²⁺ | 950 | 78.125 | 33.0 | HCO ₃ ⁻ | 1349 | 22.108 | 9.7 |
| Ca ²⁺ | 579 | 28.892 | 12.2 | NO ₃ ⁻ | 75.4 | 1.216 | 0.5 |
| Li ⁺ | 1.19 | 0.171 | 0.1 | BO ₂ ⁻ | 18.4 | 0.430 | 0.2 |
| Mn ²⁺ | 19.4 | 0.706 | 0.3 | F ⁻ | 11.7 | 0.616 | 0.3 |
| NH ₄ ⁺ | 46.8 | 2.543 | 1.1 | Br ⁻ | 2.28 | 0.029 | 0.0 |
| Sr ²⁺ | 7.52 | 0.172 | 0.1 | | | | |
| Sum | | 236.597 | Error 4.2% | Sum | | 226.916 | |

Uncharged species [mg/l]

SiO₂ 66.4

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 93.0 | Co ²⁺ | 29.0 | Cu ²⁺ | 7.18 | Fe ²⁺ | 253 | Ni ²⁺ | 62.9 |
| Pb ²⁺ | 0.350 | Zn ²⁺ | 37.3 | | | | | | |
| PO ₄ ³⁻ | 60.0 | NO ₂ ⁻ | <50.0 | | | | | | |
| Ag | 0.069 | As | 0.760 | Ba | 11.0 | Be | 5.38 | Bi | 0.006 |
| Cd | 0.185 | Ce | 0.708 | Cr | 10.7 | Cs | 0.509 | Dy | 0.283 |
| Er | 0.274 | Eu | 0.012 | Ga | 0.399 | Gd | 0.172 | Ge | 0.630 |
| Hf | 0.017 | Hg | <0.010 | Ho | 0.084 | La | 0.342 | Lu | 0.034 |
| Mo | 68.6 | Nb | 0.110 | Nd | 0.267 | Pr | 0.060 | Rb | 65.1 |
| Sb | 0.022 | Sc | <1.000 | Se | 2.58 | Sm | 0.102 | Sn | 0.181 |
| Ta | 0.016 | Tb | 0.041 | Te | 0.118 | Th | 0.186 | Ti | 11.1 |
| Tl | 0.239 | Tm | 0.039 | U | 3136 | V | 13.6 | W | 0.154 |
| Y | 2.55 | Yb | 0.252 | Zr | 0.166 | | | | |

It is a very hard Na⁺-Mg²⁺-SO₄²⁻-Cl⁻-salt water.

Sample-ID

RU-N13

Location

Mine Rössing Uranium Ltd.

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

25800 EC, calc. [$\mu\text{S}/\text{cm}$]

30358

Total dissolved solids, TDS, calc. [mg/l]

18314

pH

7.2

Total hardness [mmol/l]

44.3

| | | | | | | |
|------------------------------|--|--|--|--|--|--|
| Sum-parameters [mg/l] | | | | | | |
|------------------------------|--|--|--|--|--|--|

| | | | |
|------|-----|-----|------|
| NPOC | 1.2 | TIC | 21.9 |
|------|-----|-----|------|

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 123 | 3.146 | 1.0 | Cl ⁻ | 8430 | 237.800 | 79.5 |
| Na ⁺ | 5084 | 221.140 | 70.5 | SO ₄ ²⁻ | 2578 | 53.675 | 18.0 |
| Mg ²⁺ | 292 | 24.013 | 7.7 | HCO ₃ ⁻ | 111 | 1.819 | 0.6 |
| Ca ²⁺ | 1298 | 64.770 | 20.7 | NO ₃ ⁻ | 314 | 5.064 | 1.7 |
| Sr ²⁺ | 14.8 | 0.338 | 0.1 | BO ₂ ⁻ | 17.2 | 0.402 | 0.1 |
| | | | | F ⁻ | 2.12 | 0.112 | 0.0 |
| | | | | Br ⁻ | 9.80 | 0.123 | 0.0 |
| Sum | | 313.454 | Error 4.7% | Sum | | 298.993 | |

Uncharged species [mg/l]

SiO₂ 39.3

Trace elements [μg/l]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 7.00 | Co ²⁺ | 0.101 | Cu ²⁺ | 1.48 | Fe 2+ | 14.0 | Li ⁺ | 300 |
| Mn ²⁺ | 9.00 | NH ₄ ⁺ | 20.0 | Ni ²⁺ | 0.810 | Pb ²⁺ | 0.250 | Zn ²⁺ | 22.4 |
| PO ₄ ³⁻ | 20.0 | NO ₂ ⁻ | <100.0 | | | | | | |
| Ag | 0.159 | As | 0.360 | Ba | 3.00 | Be | 0.059 | Bi | 0.006 |
| Cd | 0.129 | Ce | 0.027 | Cr | 0.660 | Cs | 2.34 | Dy | 0.012 |
| Er | 0.008 | Eu | 0.000 | Ga | 0.036 | Gd | 0.009 | Ge | 0.050 |
| Hf | 0.010 | Hg | 0.070 | Ho | 0.003 | La | 0.026 | Lu | 0.001 |
| Mo | 33.4 | Nb | 0.021 | Nd | 0.020 | Pr | 0.004 | Rb | 20.5 |
| Sb | 0.056 | Sc | <1.000 | Se | 22.9 | Sm | 0.027 | Sn | 0.027 |
| Ta | 0.008 | Tb | 0.002 | Te | 0.149 | Th | 0.008 | Ti | 0.680 |
| Tl | 0.011 | Tm | 0.001 | U | 118 | V | 2.30 | W | 0.704 |
| Y | 0.065 | Yb | 0.009 | Zr | 0.043 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-salt water.

Sample-ID

RU-SRK1

Location

Mine Rössing Uranium Ltd.

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

15990 EC, calc. [$\mu\text{S}/\text{cm}$]

15932

Total dissolved solids, TDS, calc. [mg/l]

10423

pH

6.4

Total hardness [mmol/l]

38.3

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 72.0 | 1.841 | 1.1 | Cl ⁻ | 1317 | 37.151 | 23.2 |
| Na ⁺ | 1653 | 71.901 | 44.4 | SO ₄ ²⁻ | 5083 | 105.830 | 66.2 |
| Mg ²⁺ | 815 | 67.023 | 41.3 | HCO ₃ ⁻ | 961 | 15.749 | 9.8 |
| Ca ²⁺ | 193 | 9.631 | 5.9 | NO ₃ ⁻ | 24.1 | 0.389 | 0.2 |
| Fe ²⁺ | 6.49 | 0.232 | 0.1 | NO ₂ ⁻ | 1.43 | 0.031 | 0.0 |
| Li ⁺ | 2.00 | 0.288 | 0.2 | BO ²⁻ | 11.4 | 0.266 | 0.2 |
| Mn ²⁺ | 83.3 | 3.032 | 1.9 | F ⁻ | 9.54 | 0.502 | 0.3 |
| NH ₄ ⁺ | 147 | 7.989 | 4.9 | Br ⁻ | 1.27 | 0.016 | 0.0 |
| Sr ²⁺ | 3.49 | 0.080 | 0.0 | | | | |
| Sum | | 162.111 | Error 1.4% | Sum | | 159.934 | |

Uncharged species [mg/l]

SiO₂ 37.3

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 396 | Co ²⁺ | 698 | Cu ²⁺ | 52.6 | Ni ²⁺ | 380 | Pb ²⁺ | 0.100 |
| Zn ²⁺ | 353 | | | | | | | | |
| PO ₄ ³⁻ | <340 | | | | | | | | |
| Ag | 0.095 | As | 0.730 | Ba | 26.0 | Be | 21.1 | Bi | 0.006 |
| Cd | 0.327 | Ce | 0.320 | Cr | 0.050 | Cs | 1.41 | Dy | 0.079 |
| Er | 0.062 | Eu | 0.007 | Ga | 1.69 | Gd | 0.027 | Ge | 1.16 |
| Hf | 0.162 | Hg | 0.010 | Ho | 0.021 | La | 0.194 | Lu | 0.013 |
| Mo | 12.6 | Nb | 0.075 | Nd | 0.050 | Pr | 0.011 | Rb | 153 |
| Sb | 0.026 | Sc | <1.000 | Se | 2.81 | Sm | 0.003 | Sn | 0.275 |
| Ta | 0.035 | Tb | 0.006 | Te | 0.076 | Th | 0.055 | Ti | 0.380 |
| Tl | 0.644 | Tm | 0.015 | U | 1612 | V | 5.80 | W | 0.208 |
| Y | 1.27 | Yb | 0.057 | Zr | 0.388 | | | | |

It is a very hard Na⁺-Mg²⁺-SO₄²⁻-Cl-salt water.

Sample-ID

RU-TP

Location

Mine Rössing Uranium Ltd.

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] 27500

Total dissolved solids, TDS, calc. [mg/l] 32856

pH 2.1

Total hardness [mmol/l] 88.3

Cations

Anions

| | [mg/l] | ceq[mmol/l] | %ceq | | [mg/l] | ceq[mmol/l] | %ceq |
|------------------|--------|-------------|------------|-------------------------------|--------|-------------|------|
| K ⁺ | 207 | 5.294 | 1.1 | Cl | 1243 | 35.063 | 7.1 |
| Na ⁺ | 1655 | 71.988 | 15.0 | SO ₄ ²⁻ | 21615 | 450.031 | 91.7 |
| Mg ²⁺ | 1936 | 159.211 | 33.1 | NO ₃ ⁻ | 133 | 2.145 | 0.4 |
| Ca ²⁺ | 355 | 17.715 | 3.7 | PO ₄ ³⁻ | 341 | 3.516 | 0.7 |
| Al ³⁺ | 632 | 70.300 | 14.6 | BO ₂ ⁻ | 4.57 | 0.107 | 0.0 |
| Cu ²⁺ | 7.13 | 0.225 | 0.0 | Br ⁻ | 1.26 | 0.016 | 0.0 |
| Fe ²⁺ | 2381 | 85.279 | 17.7 | | | | |
| Li ⁺ | 2.98 | 0.429 | 0.1 | | | | |
| Mn ²⁺ | 1690 | 61.522 | 12.8 | | | | |
| Ni ²⁺ | 1.04 | 0.035 | 0.0 | | | | |
| Pb ²⁺ | 3.42 | 0.033 | 0.0 | | | | |
| Sr ²⁺ | 4.25 | 0.097 | 0.0 | | | | |
| Zn ²⁺ | 16.9 | 0.517 | 0.1 | | | | |
| H ⁺ | | 7.943 | 1.7 | | | | |
| Sum | | 480.612 | Error 2.1% | Sum | | 490.878 | |

Uncharged species [mg/l]

SiO₂ 626

Trace elements [μg/l]

| | | | | | | | | | |
|------------------------------|--------|----|-------|----|-------|----|-------|----|------|
| Co ²⁺ | 709 | | | | | | | | |
| NO ₂ ⁻ | <100.0 | | | | | | | | |
| Ag | 0.348 | As | 508 | Ba | 60.0 | Be | 665 | Bi | 1.82 |
| Cd | 29.4 | Ce | 5599 | Cr | 1982 | Cs | 24.2 | Dy | 6298 |
| Er | 4910 | Eu | 135 | Ga | 89.5 | Gd | 2436 | Ge | 107 |
| Hf | 10.8 | Hg | 0.260 | Ho | 1480 | La | 1782 | Lu | 657 |
| Mo | 225 | Nb | 20.0 | Nd | 3211 | Pr | 666 | Rb | 936 |
| Sb | 2.44 | Sc | 245 | Se | 477 | Sm | 1591 | Sn | 35.5 |
| Ta | 9.32 | Tb | 754 | Te | 2.95 | Th | 51892 | Ti | 692 |
| Tl | 25.7 | Tm | 832 | U | 33350 | V | 2127 | W | 59.5 |
| Y | 27165 | Yb | 5375 | Zr | 20.4 | | | | |

It is a very hard Mg²⁺-SO₄²⁻-salt water.

| | |
|--|---|
| Sample-ID | RU-TP2 |
| Location | Mine Rössing Uranium Ltd. |
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 17000 |
| | Total dissolved solids, TDS, calc. [mg/l] 12444 |
| pH | 4.2 |
| Total hardness [mmol/l] | 44.9 |

| Cations | | | | Anions | | | |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
| K ⁺ | 47.9 | 1.225 | 0.6 | Cl ⁻ | 1366 | 38.533 | 19.8 |
| Na ⁺ | 1372 | 59.678 | 31.1 | SO ₄ ²⁻ | 7390 | 153.862 | 79.2 |
| Mg ²⁺ | 1004 | 82.566 | 43.1 | NO ₃ ⁻ | 16.5 | 0.266 | 0.1 |
| Ca ²⁺ | 147 | 7.335 | 3.8 | BO ₂ ⁻ | 8.21 | 0.192 | 0.1 |
| Al ³⁺ | 58.5 | 6.507 | 3.4 | F ⁻ | 28.6 | 1.505 | 0.8 |
| Fe ²⁺ | 487 | 17.443 | 9.1 | Br ⁻ | 1.46 | 0.018 | 0.0 |
| Li ⁺ | 1.67 | 0.241 | 0.1 | | | | |
| Mn ²⁺ | 450 | 16.382 | 8.5 | | | | |
| Sr ²⁺ | 1.83 | 0.042 | 0.0 | | | | |
| Zn ²⁺ | 7.18 | 0.220 | 0.1 | | | | |
| Sum | | 191.751 | Error 1.4% | Sum | | 194.385 | |

Uncharged species [mg/l]

SiO₂ 54.5

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|------------------------------|-------|------------------|-------|------------------|-------|------------------|------|----|-------|
| Co ²⁺ | 726 | Cu ²⁺ | 29.5 | Ni ²⁺ | 723 | Pb ²⁺ | 1.08 | | |
| NO ₂ ⁻ | 364 | | | | | | | | |
| Ag | 0.015 | As | 11.1 | Ba | 6.00 | Be | 110 | Bi | 0.001 |
| Cd | 4.58 | Ce | 605 | Cr | 0.250 | Cs | 4.19 | Dy | 834 |
| Er | 629 | Eu | 22.2 | Ga | 11.1 | Gd | 368 | Ge | 23.4 |
| Hf | 1.39 | Hg | 0.010 | Ho | 193 | La | 121 | Lu | 78.6 |
| Mo | 1.45 | Nb | 0.045 | Nd | 551 | Pr | 98.8 | Rb | 310 |
| Sb | 0.024 | Sc | 0.000 | Se | 83.2 | Sm | 244 | Sn | 0.244 |
| Ta | 0.388 | Tb | 102 | Te | 0.152 | Th | 2.22 | Ti | 2.87 |
| Tl | 0.161 | Tm | 102 | U | 2244 | V | 5.30 | W | 1.84 |
| Y | 4011 | Yb | 624 | Zr | 0.195 | | | | |

It is a very hard Mg²⁺-Na⁺-SO₄²⁻-salt water.

Sample-ID

S12

Location alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] 14420 EC, calc. [$\mu\text{S}/\text{cm}$] 16915
Total dissolved solids, TDS, calc. [mg/l] 9760

pH 7.0
Total hardness [mmol/l] 36.9

Sum-parameters [mg/l]

| NPOC | | TIC | | Anions | | | |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| 1.1 | | 43.5 | | | | | |
| Cations | | | | Anions | | | |
| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
| K ⁺ | 99.1 | 2.535 | 1.5 | Cl ⁻ | 4270 | 120.451 | 74.5 |
| Na ⁺ | 2072 | 90.126 | 54.0 | SO ₄ ²⁻ | 1800 | 37.477 | 23.2 |
| Mg ²⁺ | 348 | 28.618 | 17.2 | HCO ₃ ⁻ | 203 | 3.327 | 2.1 |
| Ca ²⁺ | 908 | 45.309 | 27.2 | NO ₃ ⁻ | 14.0 | 0.226 | 0.1 |
| Sr ²⁺ | 4.93 | 0.113 | 0.1 | BO ²⁻ | 5.34 | 0.125 | 0.1 |
| | | | | F ⁻ | 1.50 | 0.079 | 0.0 |
| | | | | Br ⁻ | 2.55 | 0.032 | 0.0 |
| Sum | | 166.827 | Error 3.1% | Sum | | 161.717 | |

Uncharged species [mg/l]

SiO₂ 30.0

Trace elements [μg/l]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 72.0 | Co ²⁺ | 0.127 | Cu ²⁺ | 0.650 | Fe ²⁺ | 653 | Li ⁺ | 497 |
| Mn ²⁺ | 523 | NH ₄ ⁺ | 30.0 | Ni ²⁺ | 1.21 | Pb ²⁺ | 0.470 | Zn ²⁺ | 57.0 |
| PO ₄ ³⁻ | 90.0 | NO ₂ ⁻ | <50.0 | | | | | | |
| Ag | 0.012 | As | 0.120 | Ba | 29.0 | Be | 0.021 | Bi | 0.006 |
| Cd | 0.036 | Ce | 0.072 | Cr | 0.200 | Cs | 6.35 | Dy | 0.006 |
| Er | 0.008 | Eu | 0.005 | Ga | 0.036 | Gd | 0.006 | Ge | 0.130 |
| Hf | 0.006 | Hg | 0.020 | Ho | 0.002 | La | 0.027 | Lu | 0.001 |
| Mo | 27.8 | Nb | 0.018 | Nd | 0.010 | Pr | 0.005 | Rb | 48.4 |
| Sb | 0.044 | Sc | <1.000 | Se | 8.97 | Sm | 0.005 | Sn | 0.029 |
| Ta | 0.002 | Tb | 0.001 | Te | 0.074 | Th | 0.005 | Ti | 0.340 |
| Tl | 0.005 | Tm | 0.001 | U | 332 | V | 2.80 | W | 1.31 |
| Y | 0.043 | Yb | 0.006 | Zr | 0.026 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl-SO₄²⁻-brackish water.

Sample-ID

S13

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

24200

Total dissolved solids, TDS, calc. [mg/l]

23158

pH

4.3

Total hardness [mmol/l]

138.5

Sum-parameters [mg/l]

NPOC

2.7

TIC

9.8

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 36.8 | 0.941 | 0.2 | Cl ⁻ | 4647 | 131.086 | 34.3 |
| Na ⁺ | 2660 | 115.702 | 29.2 | SO ₄ ²⁻ | 11890 | 247.554 | 64.7 |
| Mg ²⁺ | 3048 | 250.658 | 63.2 | NO ₃ ⁻ | 222 | 3.580 | 0.9 |
| Ca ²⁺ | 535 | 26.697 | 6.7 | BO ₂ ⁻ | 5.29 | 0.124 | 0.0 |
| Al ³⁺ | 7.62 | 0.848 | 0.2 | F ⁻ | 1.54 | 0.081 | 0.0 |
| Li ⁺ | 6.29 | 0.906 | 0.2 | | | | |
| Mn ²⁺ | 10.7 | 0.390 | 0.1 | | | | |
| Ni ²⁺ | 1.51 | 0.051 | 0.0 | | | | |
| Sum | | 396.340 | Error 3.6% | Sum | | 382.424 | |

Uncharged species [mg/l]

SiO₂ 83.8

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------------------|-------|------------------|--------|
| Co ²⁺ | 509 | Cu ²⁺ | 40.6 | Fe ²⁺ | 853 | NH ₄ ⁺ | 550 | Pb ²⁺ | 3.80 |
| Sr ²⁺ | 404 | Zn ²⁺ | 277 | | | | | | |
| PO ₄ ³⁻ | <30.0 | NO ₂ ⁻ | <50.0 | | | | | | |
| Ag | 0.447 | As | 0.950 | Ba | 7.00 | Be | 206 | Bi | 0.010 |
| Cd | 0.567 | Ce | 49.6 | Cr | 0.590 | Cs | 105 | Dy | 15.2 |
| Er | 8.68 | Eu | 8.43 | Ga | 0.585 | Gd | 148 | Ge | 1.44 |
| Hf | 0.046 | Hg | 0.060 | Ho | 3.14 | La | 198 | Lu | 1.14 |
| Mo | 0.660 | Nb | 0.021 | Nd | 45.9 | Pr | 948 | Rb | 629 |
| Sb | 0.040 | Sc | <1.000 | Se | 20.3 | Sm | 127 | Sn | <0.009 |
| Ta | 0.019 | Tb | 2.47 | Te | 0.198 | Th | 0.226 | Ti | 0.340 |
| Tl | 1.98 | Tm | 1.20 | U | 354 | V | 140 | W | 0.507 |
| Y | 99.1 | Yb | 7.21 | Zr | 0.030 | | | | |

It is a very hard Mg²⁺-Na⁺-SO₄²⁻-Cl⁻-salt water.

Sample-ID

Safier

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

4080 EC, calc. [$\mu\text{S}/\text{cm}$]

4120

Total dissolved solids, TDS, calc. [mg/l]

2497

pH

6.9

Total hardness [mmol/l]

8.5

Sum-parameters [mg/l]

NPOC

2.1

TIC

76.6

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 22.5 | 0.575 | 1.4 | Cl ⁻ | 1009 | 28.463 | 70.3 |
| Na ⁺ | 514 | 22.358 | 56.0 | SO ₄ ²⁻ | 294 | 6.121 | 15.1 |
| Mg ²⁺ | 106 | 8.717 | 21.8 | HCO ₃ ⁻ | 325 | 5.326 | 13.2 |
| Ca ²⁺ | 165 | 8.234 | 20.6 | NO ₃ ⁻ | 27.6 | 0.445 | 1.1 |
| Sr ²⁺ | 2.01 | 0.046 | 0.1 | F ⁻ | 1.02 | 0.054 | 0.1 |
| | | | | Br ⁻ | 2.45 | 0.031 | 0.1 |
| Sum | | 39.955 | Error 1.3% | Sum | | 40.466 | |

Uncharged species [mg/l]

SiO₂

26.7

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 18.0 | Co ²⁺ | 0.083 | Cu ²⁺ | 0.610 | Fe ²⁺ | 74.0 | Li ⁺ | 119 |
| Mn ²⁺ | 88.0 | NH ₄ ⁺ | 10.00 | Ni ²⁺ | 0.200 | Pb ²⁺ | 0.010 | Zn ²⁺ | 0.800 |
| PO ₄ ³⁻ | 110 | NO ₂ ⁻ | 227 | BO ₂ ⁻ | 900 | | | | |
| Ag | 0.020 | As | 2.99 | Ba | 57.0 | Be | 0.019 | Bi | 0.001 |
| Cd | 0.022 | Ce | 0.018 | Cr | 0.040 | Cs | 0.104 | Dy | 0.003 |
| Er | 0.002 | Eu | 0.001 | Ga | 0.009 | Gd | 0.004 | Ge | 0.020 |
| Hf | 0.002 | Hg | 0.000 | Ho | 0.001 | La | 0.015 | Lu | 0.000 |
| Mo | 5.58 | Nb | 0.002 | Nd | 0.013 | Pr | 0.003 | Rb | 2.65 |
| Sb | 0.021 | Sc | <1.000 | Se | 1.19 | Sm | 0.004 | Sn | 0.008 |
| Ta | 0.001 | Tb | 0.001 | Te | 0.005 | Th | 0.009 | Ti | 0.240 |
| Tl | 0.011 | Tm | 0.001 | U | 63.4 | V | 10.6 | W | 0.222 |
| Y | 0.023 | Yb | 0.001 | Zr | 0.006 | | | | |

It is a very hard Na⁺-Mg²⁺-Ca²⁺-Cl⁻-brackish water.

Sample-ID

SH-EH

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

7100 EC, calc. [$\mu\text{S}/\text{cm}$]

9166

Total dissolved solids, TDS, calc. [mg/l]

5335

pH

7.2

Total hardness [mmol/l]

14.7

Sum-parameters [mg/l]

NPOC 10 TIC 55.2

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 45.7 | 1.169 | 1.3 | Cl ⁻ | 2632 | 74.245 | 83.4 |
| Na ⁺ | 1329 | 57.808 | 65.4 | SO ₄ ²⁻ | 463 | 9.640 | 10.8 |
| Mg ²⁺ | 111 | 9.128 | 10.3 | HCO ₃ ⁻ | 276 | 4.523 | 5.1 |
| Ca ²⁺ | 406 | 20.259 | 22.9 | NO ₃ ⁻ | 35.9 | 0.579 | 0.7 |
| Sr ²⁺ | 3.84 | 0.088 | 0.1 | BO ₂ ⁻ | 2.01 | 0.047 | 0.1 |
| | | | | Br ⁻ | 1.70 | 0.021 | 0.0 |
| Sum | | 88.458 | Error 0.7% | Sum | | 89.059 | |

Uncharged species [mg/l]

SiO₂ 28.8

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | <3.00 | Co ²⁺ | 0.078 | Cu ²⁺ | 4.70 | Fe ²⁺ | 36.0 | Li ⁺ | 24.0 |
| Mn ²⁺ | 15.0 | NH ₄ ⁺ | 10.00 | Ni ²⁺ | 0.440 | Pb ²⁺ | 0.110 | Zn ²⁺ | 6.40 |
| PO ₄ ³⁻ | 70.0 | NO ₂ ⁻ | <30.0 | F ⁻ | 45.0 | | | | |
| Ag | 0.357 | As | 0.420 | Ba | 47.0 | Be | 0.004 | Bi | 0.001 |
| Cd | 0.029 | Ce | 0.016 | Cr | 1.23 | Cs | 0.006 | Dy | 0.006 |
| Er | 0.002 | Eu | 0.001 | Ga | 0.009 | Gd | 0.005 | Ge | 0.000 |
| Hf | 0.002 | Hg | 0.000 | Ho | 0.001 | La | 0.008 | Lu | 0.001 |
| Mo | 2.60 | Nb | 0.004 | Nd | 0.010 | Pr | 0.001 | Rb | 4.89 |
| Sb | 0.015 | Sc | <1.000 | Se | 5.85 | Sm | 0.003 | Sn | 0.032 |
| Ta | 0.002 | Tb | 0.000 | Te | 0.025 | Th | 0.005 | Ti | 0.090 |
| Tl | 0.014 | Tm | 0.000 | U | 24.4 | V | 5.70 | W | 0.068 |
| Y | 0.028 | Yb | 0.004 | Zr | 0.005 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-brackish water.

Sample-ID

SH-Hoppe

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

17600 EC, calc. [$\mu\text{S}/\text{cm}$]

19008

Total dissolved solids, TDS, calc. [mg/l]

11039

pH

7.1

Total hardness [mmol/l]

32.7

Sum-parameters [mg/l]

NPOC 0.8 TIC 48.8

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 85.8 | 2.194 | 1.2 | Cl ⁻ | 158.138 | 84.8 | 84.8 |
| Na ⁺ | 2718 | 118.225 | 63.5 | SO ₄ ²⁻ | 5606 | 22.861 | 12.3 |
| Mg ²⁺ | 244 | 20.066 | 10.8 | HCO ₃ ⁻ | 1098 | 3.818 | 2.0 |
| Ca ²⁺ | 909 | 45.359 | 24.4 | NO ₃ ⁻ | 233 | 1.606 | 0.9 |
| Sr ²⁺ | 8.94 | 0.204 | 0.1 | | 99.6 | 0.107 | 0.1 |
| | | 186.092 | | BO ₂ | 4.57 | | 0.0 |
| Sum | | | Error 0.3% | Br ⁻ | 4.09 | 0.051 | |
| | | | | Sum | 186.587 | | |

Uncharged species [mg/l]

SiO₂ 26.6

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 8.00 | Co ²⁺ | 0.744 | Cu ²⁺ | 3.05 | Fe ²⁺ | 677 | Li ⁺ | 87.0 |
| Mn ²⁺ | 130 | NH ₄ ⁺ | 10.00 | Ni ²⁺ | 1.14 | Pb ²⁺ | 0.050 | Zn ²⁺ | 12.0 |
| PO ₄ ³⁻ | 20.0 | NO ₂ ⁻ | <50.0 | F ⁻ | 99.0 | | | | |
| Ag | 1.70 | As | 0.200 | Ba | 40.0 | Be | 0.011 | Bi | 0.002 |
| Cd | 0.082 | Ce | 0.033 | Cr | 0.080 | Cs | 0.043 | Dy | 0.010 |
| Er | 0.005 | Eu | 0.000 | Ga | 0.018 | Gd | 0.007 | Ge | 0.130 |
| Hf | 0.000 | Hg | 0.030 | Ho | 0.002 | La | 0.014 | Lu | 0.001 |
| Mo | 4.86 | Nb | 0.003 | Nd | 0.018 | Pr | 0.004 | Rb | 8.56 |
| Sb | 0.012 | Sc | <1.000 | Se | 12.9 | Sm | 0.005 | Sn | 0.003 |
| Ta | 0.002 | Tb | 0.002 | Te | 0.041 | Th | 0.007 | Ti | 0.000 |
| Tl | 0.019 | Tm | 0.002 | U | 53.9 | V | 2.30 | W | 0.088 |
| Y | 0.052 | Yb | 0.002 | Zr | 0.004 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-salt water.

| | | | |
|--|-------------------------------|---|-------|
| Sample-ID | SH-Mooccity | | |
| Location | alluvial aquifer, Swakop/Khan | | |
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 1110 | EC, calc. [$\mu\text{S}/\text{cm}$] | 11877 |
| | | Total dissolved solids, TDS, calc. [mg/l] | 6837 |
| pH | 7.0 | | |
| Total hardness [mmol/l] | 23.4 | | |

Sum-parameters [mg/l]

| | | | |
|------|-----|-----|------|
| NPOC | 1.0 | TIC | 51.8 |
|------|-----|-----|------|

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 59.0 | 1.509 | 1.3 | Cl ⁻ | 3346 | 94.386 | 81.9 |
| Na ⁺ | 1508 | 65.594 | 57.5 | SO ₄ ²⁻ | 752 | 15.657 | 13.6 |
| Mg ²⁺ | 175 | 14.391 | 12.6 | HCO ₃ ⁻ | 261 | 4.277 | 3.7 |
| Ca ²⁺ | 649 | 32.385 | 28.4 | NO ₃ ⁻ | 49.7 | 0.801 | 0.7 |
| Sr ²⁺ | 4.71 | 0.108 | 0.1 | BO ₂ ⁻ | 2.24 | 0.052 | 0.0 |
| | | | | Br ⁻ | 2.06 | 0.026 | 0.0 |
| Sum | | 113.995 | Error 1.1% | Sum | | 115.204 | |

Uncharged species [mg/l]

| | |
|------------------|------|
| SiO ₂ | 27.9 |
|------------------|------|

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|-----------------|-------|
| Al ³⁺ | <3.00 | Co 2+ | 0.168 | Cu ²⁺ | 0.580 | Fe 2+ | 20.0 | Li ⁺ | 31.0 |
| Mn ²⁺ | 39.0 | NH ₄ ⁺ | 10.00 | Ni ²⁺ | 0.310 | Pb ²⁺ | 0.120 | Zn 2+ | 17.5 |
| PO ₄ ³⁻ | 70.0 | NO ₂ ⁻ | <50.0 | F ⁻ | 54.0 | | | | |
| Ag | 0.223 | As | 0.450 | Ba | 55.0 | Be | 0.003 | Bi | 0.006 |
| Cd | 0.039 | Ce | 0.024 | Cr | 0.460 | Cs | 0.009 | Dy | 0.005 |
| Er | 0.006 | Eu | 0.002 | Ga | 0.006 | Gd | 0.006 | Ge | 0.010 |
| Hf | 0.003 | Hg | 0.000 | Ho | 0.002 | La | 0.015 | Lu | 0.001 |
| Mo | 4.35 | Nb | 0.006 | Nd | 0.014 | Pr | 0.003 | Rb | 5.42 |
| Sb | 0.022 | Sc | <1.000 | Se | 5.61 | Sm | 0.003 | Sn | 0.022 |
| Ta | 0.002 | Tb | 0.001 | Te | 0.029 | Th | 0.009 | Ti | 0.090 |
| Tl | 0.019 | Tm | 0.001 | U | 31.8 | V | 5.40 | W | 0.070 |
| Y | 0.045 | Yb | 0.009 | Zr | 0.004 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-brackish water.

Sample-ID

SH-Santa 1

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

7600 EC, calc. [$\mu\text{S}/\text{cm}$]

9622

Total dissolved solids, TDS, calc. [mg/l]

5635

pH

7.5

Total hardness [mmol/l]

15.5

Sum-parameters [mg/l]

NPOC 1.0 TIC 56.6

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 52.6 | 1.345 | 1.5 | Cl ⁻ | 2739 | 77.264 | 82.2 |
| Na ⁺ | 1377 | 59.896 | 64.8 | SO ₄ ²⁻ | 514 | 10.702 | 11.4 |
| Mg ²⁺ | 118 | 9.704 | 10.5 | HCO ₃ ⁻ | 323 | 5.293 | 5.6 |
| Ca ²⁺ | 429 | 21.407 | 23.2 | NO ₃ ⁻ | 44.2 | 0.713 | 0.8 |
| Sr ²⁺ | 4.04 | 0.092 | 0.1 | BO ₂ ⁻ | 2.07 | 0.048 | 0.1 |
| | | | | Br ⁻ | 2.06 | 0.026 | 0.0 |
| Sum | | 92.451 | Error 1.7% | Sum | | 94.050 | |

Uncharged species [mg/l]

SiO₂ 29.4

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | <3.00 | Co ²⁺ | 0.149 | Cu ²⁺ | 1.73 | Fe ²⁺ | 8.00 | Li ⁺ | 33.0 |
| Mn ²⁺ | 14.0 | NH ₄ ⁺ | 10.00 | Ni ²⁺ | 0.510 | Pb ²⁺ | 0.450 | Zn ²⁺ | 24.7 |
| PO ₄ ³⁻ | 70.0 | NO ₂ ⁻ | <50.0 | F ⁻ | 78.0 | | | | |
| Ag | 0.307 | As | 0.670 | Ba | 34.0 | Be | 0.005 | Bi | 0.001 |
| Cd | 0.232 | Ce | 0.023 | Cr | 2.24 | Cs | 0.010 | Dy | 0.004 |
| Er | 0.004 | Eu | 0.000 | Ga | 0.004 | Gd | 0.008 | Ge | 0.040 |
| Hf | 0.002 | Hg | 0.000 | Ho | 0.002 | La | 0.013 | Lu | 0.001 |
| Mo | 3.57 | Nb | 0.003 | Nd | 0.014 | Pr | 0.003 | Rb | 5.63 |
| Sb | 0.033 | Sc | <1.000 | Se | 5.79 | Sm | 0.008 | Sn | 0.025 |
| Ta | 0.001 | Tb | 0.002 | Te | 0.029 | Th | 0.006 | Ti | 0.270 |
| Tl | 0.012 | Tm | 0.001 | U | 32.1 | V | 6.10 | W | 0.090 |
| Y | 0.049 | Yb | 0.008 | Zr | 0.015 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-brackish water.

Sample-ID

SH-SM

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

1001 EC, calc. [$\mu\text{S}/\text{cm}$]

925

Total dissolved solids, TDS, calc. [mg/l]

657

pH

8.2

Total hardness [mmol/l]

2.2

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|--------------------|--------|--------------------------|-------------------|
| K^+ | 18.5 | 0.473 | 4.8 | Cl^- | 174 | 4.908 | 51.8 |
| Na^+ | 115 | 5.002 | 50.6 | SO_4^{2-} | 27.1 | 0.564 | 6.0 |
| Mg^{2+} | 24.7 | 2.031 | 20.6 | HCO_3^- | 243 | 3.982 | 42.0 |
| Ca^{2+} | 46.2 | 2.305 | 23.3 | NO_3^- | 0.020 | 0.000 | 0.0 |
| NH_4^+ | 0.830 | 0.045 | 0.5 | BO^{2-} | 0.580 | 0.014 | 0.1 |
| | Sum | 9.878 | Error 4.1% | | Sum | 9.479 | |

Uncharged species [mg/l]

SiO_2 5.50

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 32.0 | Co^{2+} | 2.27 | Cu^{2+} | 1.33 | Fe^{2+} | 43.0 | Li^+ | 1.000 |
| Mn^{2+} | 194 | Ni^{2+} | 2.62 | Pb^{2+} | 0.120 | Sr^{2+} | 361 | Zn^{2+} | 1.10 |
| PO_4^{3-} | 180 | NO_2^- | 107 | F^- | 66.0 | Br^- | 219 | | |
| Ag | 0.001 | As | 4.73 | Ba | 38.0 | Be | 0.008 | Bi | 0.006 |
| Cd | 0.009 | Ce | 0.291 | Cr | 0.130 | Cs | 0.013 | Dy | 0.018 |
| Er | 0.009 | Eu | 0.004 | Ga | 0.037 | Gd | 0.021 | Ge | 0.070 |
| Hf | 0.002 | Hg | 0.000 | Ho | 0.003 | La | 0.112 | Lu | 0.001 |
| Mo | 10.6 | Nb | 0.016 | Nd | 0.100 | Pr | 0.027 | Rb | 2.00 |
| Sb | 0.124 | Sc | <1.000 | Se | 0.510 | Sm | 0.022 | Sn | 0.013 |
| Ta | 0.001 | Tb | 0.003 | Te | 0.039 | Th | 0.014 | Ti | 2.31 |
| Tl | 0.003 | Tm | 0.001 | U | 15.0 | V | 4.60 | W | 1.06 |
| Y | 0.091 | Yb | 0.008 | Zr | 0.074 | | | | |

It is a moderately hard Na^+ - Ca^{2+} - Mg^{2+} - Cl^- - HCO_3^- -water.

Sample-ID

Spes Bona

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

1022 EC, calc. [$\mu\text{S}/\text{cm}$]

1052

Total dissolved solids, TDS, calc. [mg/l]

1006

pH

6.8

Total hardness [mmol/l]

4.2

Sum-parameters [mg/l]

NPOC 05 TIC 158

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 6.40 | 0.164 | 1.3 | Cl ⁻ | 20.1 | 0.567 | 4.5 |
| Na ⁺ | 82.9 | 3.606 | 29.5 | SO ₄ ²⁻ | 45.4 | 0.945 | 7.6 |
| Mg ²⁺ | 33.4 | 2.747 | 22.4 | HCO ₃ ⁻ | 666 | 10.914 | 87.4 |
| Ca ²⁺ | 114 | 5.689 | 46.5 | NO ₃ ⁻ | 0.380 | 0.006 | 0.0 |
| Sr ²⁺ | 0.568 | 0.013 | 0.1 | F ⁻ | 0.794 | 0.042 | 0.3 |
| Sum | | 12.243 | Error 1.9% | Sum | | 12.482 | |

Uncharged species [mg/l]

SiO₂ 35.3

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 3.00 | Co ²⁺ | 0.184 | Cu ²⁺ | 0.270 | Fe ²⁺ | 298 | Li ⁺ | 67.0 |
| Mn ²⁺ | 120 | NH ₄ ⁺ | <10.00 | Ni ²⁺ | 0.260 | Pb ²⁺ | 0.090 | Zn ²⁺ | 10.2 |
| PO ₄ ³⁻ | 50.0 | NO ₂ ⁻ | <5.00 | BO ₂ ⁻ | 250 | Br ⁻ | 43.0 | | |
| Ag | 0.000 | As | 2.21 | Ba | 74.0 | Be | 0.017 | Bi | 0.000 |
| Cd | 0.010 | Ce | 0.024 | Cr | 0.060 | Cs | 0.056 | Dy | 0.004 |
| Er | 0.003 | Eu | 0.002 | Ga | 0.010 | Gd | 0.004 | Ge | 0.070 |
| Hf | 0.000 | Hg | 0.000 | Ho | 0.001 | La | 0.012 | Lu | 0.000 |
| Mo | 2.31 | Nb | 0.002 | Nd | 0.011 | Pr | 0.003 | Rb | 0.530 |
| Sb | 0.030 | Sc | <1.000 | Se | 0.260 | Sm | 0.004 | Sn | 0.011 |
| Ta | 0.001 | Tb | 0.001 | Te | 0.006 | Th | 0.002 | Ti | 0.150 |
| Tl | 0.004 | Tm | 0.001 | U | 17.0 | V | 9.50 | W | 0.467 |
| Y | 0.042 | Yb | 0.002 | Zr | 0.013 | | | | |

It is a hard Ca²⁺-Na⁺-Mg²⁺-HCO₃⁻-water.

Sample-ID

SS 10C

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

14070 EC, calc. [$\mu\text{S}/\text{cm}$]

11722

Total dissolved solids, TDS, calc. [mg/l]

6795

pH

7.1

Total hardness [mmol/l]

18.2

Sum-parameters [mg/l]

NPOC 0.9 TIC 54.3

Cations

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|
| K^+ | 60.8 | 1.555 | 13 |
| Na^+ | 1791 | 77.903 | 67.1 |
| Mg^{2+} | 44 | 11.842 | 102 |
| Ca^{2+} | 494 | 24.651 | 212 |
| Fe^{2+} | 1.20 | 0.043 | 00 |
| Sr^{2+} | 6.49 | 0.148 | 01 |
| Sum | | 116.175 | Error 3.1% |

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|--------------------|--------------------------|--|-------------------|
| Cl^- | 3415 | 96.333 | 85.5 |
| SO_4^{2-} | 520 | 10.827 | 9.6 |
| HCO_3^- | 273 | 4.474 | 4.0 |
| NO_3^- | 54.9 | 0.885 | 0.8 |
| BO^{2-} | 3.20 | 0.075 | 0.1 |
| Br^- | 2.01 | 0.025 | 0.0 |
| Sum | | 112.623 | |

Uncharged species [mg/l]

SiO_2 28.8

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 187 | Co^{2+} | 0.783 | Cu^{2+} | 1.70 | Li^+ | 52.0 | Mn^{2+} | 94.0 |
| NH_4^+ | 10.00 | Ni^{2+} | 1.67 | Pb^{2+} | 0.540 | Zn^{2+} | 10.4 | | |
| PO_4^{3-} | 120 | NO_2^- | <50.0 | F^- | 63.0 | | | | |
| Ag | 0.237 | As | 0.650 | Ba | 42.0 | Be | 0.061 | Bi | 0.015 |
| Cd | 0.050 | Ce | 1.86 | Cr | 2.78 | Cs | 0.300 | Dy | 0.120 |
| Er | 0.060 | Eu | 0.033 | Ga | 0.394 | Gd | 0.174 | Ge | 0.080 |
| Hf | 0.014 | Hg | 0.020 | Ho | 0.019 | La | 1.02 | Lu | 0.005 |
| Mo | 4.79 | Nb | 0.200 | Nd | 0.902 | Pr | 0.262 | Rb | 11.0 |
| Sb | 0.020 | Sc | <1.000 | Se | 8.70 | Sm | 0.209 | Sn | 0.079 |
| Ta | 0.009 | Tb | 0.022 | Te | 0.033 | Th | 0.194 | Ti | 81.0 |
| Tl | 0.047 | Tm | 0.007 | U | 46.7 | V | 7.00 | W | 0.128 |
| Y | 0.451 | Yb | 0.036 | Zr | 0.201 | | | | |

It is a very hard Na^+ - Ca^{2+} - Cl^- -brackish water.

Sample-ID Swakop River - IDA dome

Location alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] 6880 EC, calc. [$\mu\text{S}/\text{cm}$] 7344
Total dissolved solids, TDS, calc. [mg/l] 4287

pH 7.1
Total hardness [mmol/l] 12.9

Sum-parameters [mg/l]

NPOC 0.7 TIC 54.9

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 42.1 | 1.077 | 1.6 | Cl ⁻ | 2049 | 57.800 | 80.4 |
| Na ⁺ | 970 | 42.192 | 61.0 | SO ₄ ²⁻ | 452 | 9.411 | 13.1 |
| Mg ²⁺ | 91.0 | 7.484 | 10.8 | HCO ₃ ⁻ | 261 | 4.277 | 5.9 |
| Ca ²⁺ | 367 | 18.313 | 26.5 | NO ₃ ⁻ | 22.4 | 0.361 | 0.5 |
| Sr ²⁺ | 2.46 | 0.056 | 0.1 | BO ₂ ⁻ | 1.60 | 0.037 | 0.1 |
| | | | | Br ⁻ | 1.24 | 0.016 | 0.0 |
| Sum | | 69.167 | Error 3.9% | Sum | | 71.907 | |

Uncharged species [mg/l]

SiO₂ 26.4

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 6.00 | Co ²⁺ | 0.325 | Cu ²⁺ | 0.310 | Fe ²⁺ | 683 | Li ⁺ | 36.0 |
| Mn ²⁺ | 391 | NH ₄ ⁺ | <10.00 | Ni ²⁺ | 0.280 | Pb ²⁺ | 0.080 | Zn ²⁺ | 5.80 |
| PO ₄ ³⁻ | 50.0 | NO ₂ ⁻ | <30.0 | F ⁻ | 92.0 | | | | |
| Ag | 0.007 | As | 0.310 | Ba | 41.0 | Be | 0.004 | Bi | 0.002 |
| Cd | 0.025 | Ce | 0.016 | Cr | 0.050 | Cs | 0.012 | Dy | 0.002 |
| Er | 0.002 | Eu | 0.000 | Ga | 0.019 | Gd | 0.003 | Ge | 0.050 |
| Hf | 0.004 | Hg | 0.000 | Ho | 0.001 | La | 0.008 | Lu | 0.000 |
| Mo | 5.29 | Nb | 0.012 | Nd | 0.007 | Pr | 0.002 | Rb | 6.27 |
| Sb | 0.015 | Sc | <1.000 | Se | 4.10 | Sm | 0.004 | Sn | 0.004 |
| Ta | 0.004 | Tb | 0.001 | Te | 0.022 | Th | 0.004 | Ti | 0.720 |
| Tl | 0.008 | Tm | 0.000 | U | 33.2 | V | 2.70 | W | 0.110 |
| Y | 0.012 | Yb | 0.001 | Zr | 0.010 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-brackish water.

| | | | |
|--|---|---|-------|
| Sample-ID | Swp small holdings | | |
| Location | alluvial aquifer, Swakop/Khan | | |
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 12500 EC, calc. [$\mu\text{S}/\text{cm}$] | | 13673 |
| | | Total dissolved solids, TDS, calc. [mg/l] | 7880 |
| pH | 7.0 | | |
| Total hardness [mmol/l] | 25.3 | | |

Sum-parameters [mg/l]

| | | | |
|------|-----|-----|------|
| NPOC | 1.2 | TIC | 59.7 |
|------|-----|-----|------|

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 65.4 | 1.673 | 1.3 | Cl ⁻ | 4009 | 113.089 | 84.0 |
| Na ⁺ | 1780 | 77.425 | 59.6 | SO ₄ ²⁻ | 791 | 16.469 | 12.2 |
| Mg ²⁺ | 201 | 16.530 | 12.7 | HCO ₃ ⁻ | 279 | 4.572 | 3.4 |
| Ca ²⁺ | 685 | 34.182 | 26.3 | NO ₃ ⁻ | 24.8 | 0.400 | 0.3 |
| Sr ²⁺ | 5.53 | 0.126 | 0.1 | BO ₂ ⁻ | 1.93 | 0.045 | 0.0 |
| | | | | Br ⁻ | 2.20 | 0.028 | 0.0 |
| Sum | | 129.972 | Error 3.5% | Sum | | 134.607 | |

Uncharged species [mg/l]

| | |
|------------------|------|
| SiO ₂ | 33.9 |
|------------------|------|

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 4.00 | Co ²⁺ | 1.66 | Cu ²⁺ | 1.10 | Fe ²⁺ | 77.0 | Li ⁺ | 29.0 |
| Mn ²⁺ | 737 | NH ₄ ⁺ | 40.0 | Ni ²⁺ | 0.960 | Pb ²⁺ | 0.620 | Zn ²⁺ | 21.1 |
| PO ₄ ³⁻ | 150 | NO ₂ ⁻ | <50.0 | F ⁻ | 48.0 | | | | |
| Ag | 0.014 | As | 1.08 | Ba | 48.0 | Be | 0.012 | Bi | 0.005 |
| Cd | 0.042 | Ce | 0.084 | Cr | 0.110 | Cs | 0.021 | Dy | 0.014 |
| Er | 0.018 | Eu | 0.005 | Ga | 0.050 | Gd | 0.003 | Ge | 0.050 |
| Hf | 0.007 | Hg | 0.020 | Ho | 0.005 | La | 0.038 | Lu | 0.004 |
| Mo | 5.13 | Nb | 0.030 | Nd | 0.030 | Pr | 0.005 | Rb | 5.53 |
| Sb | 0.030 | Sc | <1.000 | Se | 8.53 | Sm | 0.012 | Sn | 0.009 |
| Ta | 0.011 | Tb | 0.003 | Te | 0.049 | Th | 0.065 | Ti | 0.370 |
| Tl | 0.020 | Tm | 0.002 | U | 39.2 | V | 4.50 | W | 0.512 |
| Y | 0.108 | Yb | 0.019 | Zr | 0.023 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-brackish water.

Sample-ID

TM29

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

16820 EC, calc. [$\mu\text{S}/\text{cm}$]

19733

Total dissolved solids, TDS, calc. [mg/l]

11549

pH

6.5

Total hardness [mmol/l]

35.8

Sum-parameters [mg/l]

NPOC

19

TIC

73.8

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 150 | 3.836 | 1.9 | Cl^- | 5668 | 159.887 | 84.2 |
| Na^+ | 2820 | 122.662 | 61.8 | SO_4^{2-} | 1184 | 24.651 | 13.0 |
| Mg^{2+} | 205 | 16.859 | 8.5 | HCO_3^- | 291 | 4.769 | 2.5 |
| Ca^{2+} | 1098 | 54.790 | 27.6 | NO_3^- | 10.4 | 0.168 | 0.1 |
| Sr^{2+} | 10.8 | 0.247 | 0.1 | BO^{2-} | 9.27 | 0.217 | 0.1 |
| | | | | F^- | 2.18 | 0.115 | 0.1 |
| | | | | Br^- | 6.51 | 0.081 | 0.0 |
| Sum | 198.510 | | Error 4.4% | Sum | 189.888 | | |

Uncharged species [mg/l]

SiO_2 93.2

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 5.00 | Co^{2+} | 0.110 | Cu^{2+} | 1.17 | Fe^{2+} | 11.0 | Li^+ | 787 |
| Mn^{2+} | 8.00 | NH_4^+ | <10.00 | Ni^{2+} | 1.71 | Pb^{2+} | 0.870 | Zn^{2+} | 38.0 |
| PO_4^{3-} | 60.0 | NO_2^- | <50.0 | | | | | | |
| Ag | 0.132 | As | 3.42 | Ba | 124 | Be | 0.088 | Bi | 0.003 |
| Cd | 0.053 | Ce | 0.135 | Cr | 0.560 | Cs | 0.096 | Dy | 0.013 |
| Er | 0.012 | Eu | 0.010 | Ga | 0.035 | Gd | 0.017 | Ge | 0.250 |
| Hf | 0.019 | Hg | 0.040 | Ho | 0.004 | La | 0.107 | Lu | 0.002 |
| Mo | 17.4 | Nb | 0.017 | Nd | 0.085 | Pr | 0.016 | Rb | 13.4 |
| Sb | 0.049 | Sc | <1.000 | Se | 17.1 | Sm | 0.010 | Sn | 0.002 |
| Ta | 0.010 | Tb | 0.002 | Te | 0.124 | Th | 0.015 | Ti | 0.370 |
| Tl | 0.013 | Tm | 0.001 | U | 281 | V | 136 | W | 4.51 |
| Y | 0.114 | Yb | 0.008 | Zr | 0.030 | | | | |

It is a very hard Na^+ - Ca^{2+} - Cl^- -salt water.

Sample-ID

TR5A

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

8350 EC, calc. [$\mu\text{S}/\text{cm}$]

8804

Total dissolved solids, TDS, calc. [mg/l]

5092

pH

7.2

Total hardness [mmol/l]

18.4

Sum-parameters [mg/l]

NPOC

0.9

TIC

44.6

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 50.2 | 1.284 | 1.5 | Cl^- | 2249 | 63.441 | 75.1 |
| Na^+ | 1062 | 46.194 | 54.7 | SO_4^{2-} | 792 | 16.490 | 19.5 |
| Mg^{2+} | 177 | 14.556 | 17.2 | HCO_3^- | 209 | 3.425 | 4.1 |
| Ca^{2+} | 446 | 22.255 | 26.4 | NO_3^- | 59.4 | 0.958 | 1.1 |
| Sr^{2+} | 4.47 | 0.102 | 0.1 | BO_2^- | 2.89 | 0.068 | 0.1 |
| | | | | F^- | 1.03 | 0.054 | 0.1 |
| | | | | Br^- | 3.87 | 0.048 | 0.1 |
| Sum | 84.419 | | Error 0.1% | Sum | 84.485 | | |

Uncharged species [mg/l]

SiO_2

34.7

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 13.0 | Co^{2+} | 0.247 | Cu^{2+} | 1.04 | Fe^{2+} | 18.0 | Li^+ | 169 |
| Mn^{2+} | 13.0 | NH_4^+ | 10.00 | Ni^{2+} | 2.44 | Pb^{2+} | 0.110 | Zn^{2+} | 9.60 |
| PO_4^{3-} | 40.0 | NO_2^- | <30.0 | | | | | | |
| Ag | 0.051 | As | 0.890 | Ba | 49.0 | Be | 0.010 | Bi | 0.001 |
| Cd | 0.026 | Ce | 0.133 | Cr | 0.530 | Cs | 0.057 | Dy | 0.005 |
| Er | 0.005 | Eu | 0.000 | Ga | 0.020 | Gd | 0.006 | Ge | 0.060 |
| Hf | 0.009 | Hg | 0.020 | Ho | 0.001 | La | 0.029 | Lu | 0.001 |
| Mo | 13.9 | Nb | 0.014 | Nd | 0.017 | Pr | 0.005 | Rb | 9.31 |
| Sb | 0.025 | Sc | <1.000 | Se | 5.91 | Sm | 0.007 | Sn | 0.017 |
| Ta | 0.007 | Tb | 0.001 | Te | 0.037 | Th | 0.011 | Ti | 1.21 |
| Tl | 0.012 | Tm | 0.001 | U | 184 | V | 5.50 | W | 1.42 |
| Y | 0.036 | Yb | 0.005 | Zr | 0.019 | | | | |

It is a very hard Na^+ - Ca^{2+} - Cl^- -brackish water.

Sample-ID

Tsawisis

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

966 EC, calc. [$\mu\text{S}/\text{cm}$]

962

Total dissolved solids, TDS, calc. [mg/l]

757

pH

7.9

Total hardness [mmol/l]

1.3

Sum-parameters [mg/l]

NPOC 16 TIC 56.2

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 9.80 | 0.251 | 2.4 | Cl^- | 135 | 3.808 | 37.0 |
| Na^+ | 173 | 7.525 | 73.0 | SO_4^{2-} | 65.4 | 1.362 | 13.2 |
| Mg^{2+} | 17.7 | 1.456 | 14.1 | HCO_3^- | 280 | 4.589 | 44.6 |
| Ca^{2+} | 21.3 | 1.063 | 10.3 | NO_3^- | 16.1 | 0.260 | 2.5 |
| | | | | F ⁻ | 4.88 | 0.257 | 2.5 |
| Sum | | 10.309 | Error 0.2% | Sum | | 10.291 | |

Uncharged species [mg/l]

SiO_2 32.3

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | <3.00 | Co^{2+} | 0.041 | Cu^{2+} | 1.23 | Fe^{2+} | 9.00 | Li^+ | 55.0 |
| Mn^{2+} | 3.00 | NH_4^+ | <10.00 | Ni^{2+} | 0.170 | Pb^{2+} | 0.040 | Sr^{2+} | 291 |
| Zn^{2+} | 0.900 | | | | | | | | |
| PO_4^{3-} | 150 | NO_2^- | <5.00 | BO^{2-} | 430 | Br^- | 340 | | |
| Ag | 0.001 | As | 21.4 | Ba | 5.00 | Be | 0.004 | Bi | 0.001 |
| Cd | 0.009 | Ce | 0.006 | Cr | 0.560 | Cs | 0.011 | Dy | 0.001 |
| Er | 0.001 | Eu | 0.000 | Ga | 0.008 | Gd | 0.001 | Ge | 0.020 |
| Hf | 0.006 | Hg | 0.010 | Ho | 0.000 | La | 0.003 | Lu | 0.000 |
| Mo | 11.6 | Nb | 0.004 | Nd | 0.004 | Pr | 0.001 | Rb | 1.03 |
| Sb | 0.051 | Sc | <1.000 | Se | 1.49 | Sm | 0.001 | Sn | 0.003 |
| Ta | 0.004 | Tb | 0.000 | Te | 0.008 | Th | 0.003 | Ti | 0.330 |
| Tl | 0.003 | Tm | 0.000 | U | 28.6 | V | 66.5 | W | 3.68 |
| Y | 0.005 | Yb | 0.000 | Zr | 0.013 | | | | |

It is a moderately soft Na^+ - HCO_3^- - Cl^- -water.

Sample-ID

Ukuib 1

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

2460 EC, calc. [$\mu\text{S}/\text{cm}$]

2702

Total dissolved solids, TDS, calc. [mg/l]

1757

pH

7.3

Total hardness [mmol/l]

5.1

Sum-parameters [mg/l]

NPOC 23 TIC 72.5

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 25.2 | 0.645 | 2.4 | Cl ⁻ | 550 | 15.515 | 58.4 |
| Na ⁺ | 373 | 16.224 | 60.0 | SO ₄ ²⁻ | 248 | 5.163 | 19.4 |
| Mg ²⁺ | 48.7 | 4.005 | 14.8 | HCO ₃ ⁻ | 342 | 5.605 | 21.1 |
| Ca ²⁺ | 123 | 6.138 | 22.7 | NO ₃ ⁻ | 13.8 | 0.223 | 0.8 |
| Sr ²⁺ | 1.05 | 0.024 | 0.1 | Br ⁻ | 1.56 | 0.020 | 0.1 |
| Sum | | 27.041 | Error 1.8% | Sum | | 26.554 | |

Uncharged species [mg/l]

SiO₂ 29.7

Trace elements [μg/l]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | <3.00 | Co ²⁺ | 0.043 | Cu ²⁺ | 1.17 | Fe ²⁺ | 11.0 | Li ⁺ | 30.0 |
| Mn ²⁺ | 4.00 | NH ₄ ⁺ | <10.00 | Ni ²⁺ | 0.910 | Pb ²⁺ | 0.050 | Zn ²⁺ | 3.60 |
| PO ₄ ³⁻ | 190 | NO ₂ ⁻ | <5.00 | BO ₂ ⁻ | 460 | F ⁻ | 316 | | |
| Ag | 0.006 | As | 1.58 | Ba | 52.0 | Be | 0.002 | Bi | 0.006 |
| Cd | 0.009 | Ce | 0.012 | Cr | 0.380 | Cs | 0.009 | Dy | 0.002 |
| Er | 0.001 | Eu | 0.001 | Ga | 0.010 | Gd | 0.002 | Ge | 0.040 |
| Hf | 0.000 | Hg | 0.000 | Ho | 0.001 | La | 0.006 | Lu | 0.000 |
| Mo | 7.82 | Nb | 0.002 | Nd | 0.004 | Pr | 0.002 | Rb | 3.81 |
| Sb | 0.019 | Sc | <1.000 | Se | 1.92 | Sm | 0.003 | Sn | 0.015 |
| Ta | 0.000 | Tb | 0.000 | Te | 0.012 | Th | 0.003 | Ti | 0.100 |
| Tl | 0.005 | Tm | 0.000 | U | 16.4 | V | 14.2 | W | 0.235 |
| Y | 0.013 | Yb | 0.002 | Zr | 0.007 | | | | |

It is a hard Na⁺-Ca²⁺-Cl⁻-HCO₃⁻-brackish water.

Sample-ID

Ukuib 2

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

2470 EC, calc. [$\mu\text{S}/\text{cm}$]

2794

Total dissolved solids, TDS, calc. [mg/l]

1800

pH

7.2

Total hardness [mmol/l]

5.6

Sum-parameters [mg/l]

NPOC 11 TIC 70.6

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 23.5 | 0.601 | 2.1 | Cl^- | 562 | 15.853 | 58.3 |
| Na^+ | 373 | 16.224 | 57.6 | SO_4^{2-} | 265 | 5.517 | 20.3 |
| Mg^{2+} | 49.3 | 4.054 | 14.4 | HCO_3^- | 341 | 5.588 | 20.6 |
| Ca^{2+} | 145 | 7.236 | 25.7 | NO_3^- | 10.2 | 0.164 | 0.6 |
| Sr^{2+} | 1.14 | 0.026 | 0.1 | Br^- | 1.64 | 0.021 | 0.1 |
| Sum | | 28.151 | Error 3.5% | Sum | | 27.170 | |

Uncharged species [mg/l]

SiO_2 27.4

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 19.0 | Co^{2+} | 0.032 | Cu^{2+} | 0.500 | Fe^{2+} | 101 | Li^+ | 24.0 |
| Mn^{2+} | 4.00 | NH_4^+ | <10.00 | Ni^{2+} | 0.560 | Pb^{2+} | 0.360 | Zn^{2+} | 2.00 |
| PO_4^{3-} | 170 | NO_2^- | <5.00 | BO_2^- | 440 | F^- | 262 | | |
| Ag | 0.019 | As | 1.26 | Ba | 45.0 | Be | 0.005 | Bi | 0.001 |
| Cd | 0.009 | Ce | 0.063 | Cr | 0.710 | Cs | 0.022 | Dy | 0.005 |
| Er | 0.002 | Eu | 0.002 | Ga | 0.019 | Gd | 0.005 | Ge | 0.050 |
| Hf | 0.001 | Hg | 0.000 | Ho | 0.001 | La | 0.032 | Lu | 0.001 |
| Mo | 3.56 | Nb | 0.010 | Nd | 0.026 | Pr | 0.008 | Rb | 2.98 |
| Sb | 0.015 | Sc | <1.000 | Se | 1.54 | Sm | 0.006 | Sn | 0.056 |
| Ta | 0.002 | Tb | 0.001 | Te | 0.010 | Th | 0.005 | Ti | 2.64 |
| Tl | 0.006 | Tm | 0.000 | U | 16.3 | V | 13.5 | W | 0.198 |
| Y | 0.021 | Yb | 0.003 | Zr | 0.008 | | | | |

It is a very hard Na^+ - Ca^{2+} - Cl^- - HCO_3^- - SO_4^{2-} -brackish water.

| | | | |
|--|---|--|------|
| Sample-ID | Valencia springs | | |
| Location | alluvial aquifer, Swakop/Khan | | |
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 9030 EC, calc. [$\mu\text{S}/\text{cm}$] | | 8954 |
| | Total dissolved solids, TDS, calc. [mg/l] | | 5068 |
| pH | 7.7 | | |
| Total hardness [mmol/l] | 17.7 | | |

| Cations | | | | Anions | | | |
|------------------|--------------------------|--|-------------------|--------------------|--------------------------|--|-------------------|
| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{aq} |
| K^+ | 43.3 | 1.107 | 13 | Cl^- | 2579 | 72.750 | 83.4 |
| Na^+ | 1117 | 48.586 | 57.0 | SO_4^{2-} | 526 | 10951 | 12.5 |
| Mg^{2+} | 238 | 19.572 | 229 | HCO_3^- | 209 | 3.425 | 3.9 |
| Ca^{2+} | 318 | 15.868 | 186 | NO_3^- | <0.100 | | |
| Sr^{2+} | 5.71 | 0.130 | 02 | BO_2^- | 1.29 | 0.030 | 0.0 |
| | | | | Br^- | 8.02 | 0.100 | 0.1 |
| | Sum | 85.299 | Error 2.3% | Sum | | 87.279 | |

Uncharged species [mg/l]

SiO_2 22.1

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | <3.00 | Co^{2+} | 0.272 | Cu^{2+} | 0.760 | Fe^{2+} | 27.0 | Li^+ | 221 |
| Mn^{2+} | 12.0 | NH_4^+ | 10.00 | Ni^{2+} | 0.730 | Pb^{2+} | 0.120 | Zn^{2+} | 4.30 |
| PO_4^{3-} | 30.0 | NO_2^- | <50.0 | F^- | 410 | | | | |
| Ag | 0.009 | As | 1.41 | Ba | 134 | Be | 0.002 | Bi | 0.002 |
| Cd | 0.019 | Ce | 0.020 | Cr | 0.060 | Cs | 0.020 | Dy | 0.007 |
| Er | 0.004 | Eu | 0.004 | Ga | 0.004 | Gd | 0.006 | Ge | 0.030 |
| Hf | 0.006 | Hg | 0.000 | Ho | 0.001 | La | 0.015 | Lu | 0.000 |
| Mo | 7.88 | Nb | 0.010 | Nd | 0.014 | Pr | 0.005 | Rb | 6.64 |
| Sb | 0.042 | Sc | <1.000 | Se | 0.630 | Sm | 0.007 | Sn | 0.026 |
| Ta | 0.006 | Tb | 0.001 | Te | 0.029 | Th | 0.011 | Ti | 0.280 |
| Tl | 0.012 | Tm | 0.001 | U | 132 | V | 2.00 | W | 0.215 |
| Y | 0.030 | Yb | 0.004 | Zr | 0.013 | | | | |

It is a very hard Na^+ - Mg^{2+} - Cl^- -brackish water.

Sample-ID

WB 1

Location alluvial aquifer, Swakop/Khan

| | | | |
|--|-------|---|------|
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 10000 | EC, calc. [$\mu\text{S}/\text{cm}$] | 7865 |
| | | Total dissolved solids, TDS, calc. [mg/l] | 4588 |
| pH | 6.9 | | |
| Total hardness [mmol/l] | 14.4 | | |

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 57.5 | 1.471 | 20 | Cl ⁻ | 2274 | 64.147 | 83.0 |
| Na ⁺ | 1023 | 44.498 | 59.3 | SO ₄ ²⁻ | 345 | 7.183 | 9.3 |
| Mg ²⁺ | 125 | 10.280 | 13.7 | HCO ₃ ⁻ | 356 | 5.834 | 7.5 |
| Ca ²⁺ | 371 | 18.513 | 24.7 | NO ₃ ⁻ | 0.100 | 0.002 | 0.0 |
| Fe ²⁺ | 1.05 | 0.038 | 0.1 | BO ₂ ⁻ | 3.59 | 0.084 | 0.1 |
| Mn ²⁺ | 1.27 | 0.046 | 0.1 | Br ⁻ | 1.24 | 0.016 | 0.0 |
| NH ₄ ⁺ | 1.58 | 0.086 | 0.1 | | | | |
| Sr ²⁺ | 4.98 | 0.114 | 0.2 | | | | |
| Sum | | 75.059 | Error 2.9% | Sum | | 77.276 | |

Uncharged species [mg/l]

SiO₂ 21.9

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|-------|------------------|-------|-----------------|-------|------------------|-------|
| Al ³⁺ | 75.0 | Co 2+ | 0.522 | Cr ²⁺ | 0.350 | Li ⁺ | 39.0 | Ni ²⁺ | 2.91 |
| Pb ²⁺ | 0.090 | Zn 2+ | 5.10 | | | | | | |
| PO ₄ ³⁻ | 900 | NO ₂ ⁻ | <50.0 | F ⁻ | 28.0 | | | | |
| Ag | 0.007 | As | 8.85 | Ba | 205 | Be | 0.014 | Bi | 0.005 |
| Cd | 0.016 | Ce | 0.346 | Cr | 0.810 | Cs | 0.075 | Dy | 0.023 |
| Er | 0.016 | Eu | 0.011 | Ga | 0.092 | Gd | 0.025 | Ge | 0.030 |
| Hf | 0.008 | Hg | 0.010 | Ho | 0.003 | La | 0.147 | Lu | 0.003 |
| Mo | 9.31 | Nb | 0.074 | Nd | 0.131 | Pr | 0.035 | Rb | 8.36 |
| Sb | 0.148 | Sc | 0.000 | Se | 0.850 | Sm | 0.037 | Sn | 0.034 |
| Ta | 0.005 | Tb | 0.005 | Te | 0.058 | Th | 0.045 | Ti | 17.3 |
| Tl | 0.005 | Tm | 0.003 | U | 528 | V | 2.40 | W | 0.611 |
| Y | 0.140 | Yb | 0.012 | Zr | 0.247 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-brackish water.

Sample-ID

WB 2

Location alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] 13650 EC, calc. [$\mu\text{S}/\text{cm}$] 11734
Total dissolved solids, TDS, calc. [mg/l] 6802

pH 6.9
Total hardness [mmol/l] 19.3

| | | | |
|------------------------------|--|--|--|
| Sum-parameters [mg/l] | | | |
|------------------------------|--|--|--|

| | | | |
|------|-----|-----|------|
| NPOC | 1.3 | TIC | 69.7 |
|------|-----|-----|------|

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 65.5 | 1.675 | 1.5 | Cl ⁻ | 3451 | 97.348 | 84.9 |
| Na ⁺ | 1682 | 73.162 | 64.4 | SO ₄ ²⁻ | 552 | 11.493 | 10.0 |
| Mg ²⁺ | 177 | 14.556 | 12.8 | HCO ₃ ⁻ | 320 | 5.244 | 4.6 |
| Ca ²⁺ | 482 | 24.052 | 21.2 | NO ₃ ⁻ | 29.9 | 0.482 | 0.4 |
| Sr ²⁺ | 6.43 | 0.147 | 0.1 | BO ₂ ⁻ | 3.99 | 0.093 | 0.1 |
| | | | | Br ⁻ | 2.21 | 0.028 | 0.0 |
| Sum | | 113.621 | Error 0.9% | Sum | | 114.694 | |

Uncharged species [mg/l]

SiO₂ 29.7

Trace elements [μg/l]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 5.00 | Co ²⁺ | 0.760 | Cu ²⁺ | 0.490 | Fe ²⁺ | 16.0 | Li ⁺ | 88.0 |
| Mn ²⁺ | 381 | NH ₄ ⁺ | 10.00 | Ni ²⁺ | 0.720 | Pb ²⁺ | 0.040 | Zn ²⁺ | 6.10 |
| PO ₄ ³⁻ | 80.0 | NO ₂ ⁻ | <50.0 | F ⁻ | 89.0 | | | | |
| Ag | 0.020 | As | 0.910 | Ba | 34.0 | Be | 0.016 | Bi | 0.004 |
| Cd | 0.046 | Ce | 0.060 | Cr | 0.140 | Cs | 0.020 | Dy | 0.006 |
| Er | 0.005 | Eu | 0.004 | Ga | 0.023 | Gd | 0.010 | Ge | 0.000 |
| Hf | 0.004 | Hg | 0.030 | Ho | 0.001 | La | 0.032 | Lu | 0.001 |
| Mo | 6.92 | Nb | 0.010 | Nd | 0.033 | Pr | 0.009 | Rb | 8.89 |
| Sb | 0.012 | Sc | <1.000 | Se | 4.57 | Sm | 0.008 | Sn | 0.010 |
| Ta | 0.011 | Tb | 0.002 | Te | 0.025 | Th | 0.012 | Ti | 0.190 |
| Tl | 0.024 | Tm | 0.002 | U | 139 | V | 5.90 | W | 0.182 |
| Y | 0.043 | Yb | 0.004 | Zr | 0.009 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-brackish water.

| | | | |
|--|---|-------|--|
| Sample-ID | Western trench | | |
| Location | Mine Langer Heinrich Uranium Ltd. | | |
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 22500 EC, calc. [$\mu\text{S}/\text{cm}$] | 38138 | |
| | Total dissolved solids, TDS, calc. [mg/l] | 26046 | |
| pH | 10.0 | | |
| Total hardness [mmol/l] | 0.3 | | |

Sum-parameters [mg/l]

NPOC 95 TIC 2500

Cations

Anions

| | [mg/l] | ceq[mmol/l] | % ceq | | [mg/l] | ceq[mmol/l] | % ceq |
|------------------|--------|-------------|------------|-------------------------------|--------|-------------|-------|
| K ⁺ | 139 | 3.555 | 0.9 | Cl ⁻ | 2960 | 83.498 | 19.7 |
| Na ⁺ | 9299 | 404.480 | 99.0 | SO ₄ ²⁻ | 3415 | 71.101 | 16.8 |
| Mg ²⁺ | 4.16 | 0.342 | 0.1 | HCO ₃ ⁻ | 3918 | 64.208 | 15.1 |
| Ca ²⁺ | 3.40 | 0.170 | 0.0 | NO ₃ ⁻ | 59.4 | 0.958 | 0.2 |
| | | | | CO ₃ ²⁻ | 6050 | 201.599 | 47.5 |
| | | | | PO ₄ ³⁻ | 6.12 | 0.063 | 0.0 |
| | | | | BO ₂ ⁻ | 8.48 | 0.198 | 0.0 |
| | | | | F ⁻ | 45.2 | 2.379 | 0.6 |
| | | | | Br ⁻ | 2.92 | 0.037 | 0.0 |
| Sum | | 408.580 | Error 3.7% | Sum | | 424.043 | |

Uncharged species [mg/l]

SiO₂ 135

Trace elements [μg/l]

| | | | | | | | | | |
|------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 15.0 | Co ²⁺ | 1.52 | Cu ²⁺ | 9.18 | Fe ²⁺ | 19.0 | Li ⁺ | 119 |
| Mn ²⁺ | 20.0 | NH ₄ ⁺ | 30.0 | Ni ²⁺ | 1.76 | Pb ²⁺ | 0.700 | Sr ²⁺ | 437 |
| Zn ²⁺ | 28.6 | | | | | | | | |
| NO ₂ | 55.0 | | | | | | | | |
| Ag | 0.012 | As | 1040 | Ba | 8.00 | Be | 13.9 | Bi | 0.006 |
| Cd | 0.146 | Ce | 1.03 | Cr | 7.39 | Cs | 0.062 | Dy | 0.860 |
| Er | 0.715 | Eu | 0.022 | Ga | 0.489 | Gd | 0.332 | Ge | 0.200 |
| Hf | 0.049 | Hg | 0.120 | Ho | 0.213 | La | 0.244 | Lu | 0.087 |
| Mo | 186 | Nb | 0.145 | Nd | 0.442 | Pr | 0.094 | Rb | 10.7 |
| Sb | 0.149 | Sc | <10.00 | Se | 9.93 | Sm | 0.227 | Sn | 0.067 |
| Ta | 0.041 | Tb | 0.104 | Te | 0.202 | Th | 8.03 | Ti | 10.3 |
| Tl | 0.012 | Tm | 0.122 | U | 65434 | V | 6457 | W | 736 |
| Y | 3.67 | Yb | 0.690 | Zr | 0.220 | | | | |

It is a soft Na⁺-CO₃²⁻-salt water.

Sample-ID

WH

Location alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] 1160 EC, calc. [$\mu\text{S}/\text{cm}$] 1316
Total dissolved solids, TDS, calc. [mg/l] 1029
pH 6.9
Total hardness [mmol/l] 3.2

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 11.0 | 0.281 | 2.0 | Cl ⁻ | 148 | 4.175 | 30.0 |
| Na ⁺ | 165 | 7.177 | 51.9 | SO ₄ ²⁻ | 108 | 2.249 | 16.1 |
| Mg ²⁺ | 22.0 | 1.809 | 13.1 | HCO ₃ ⁻ | 394 | 6.457 | 46.4 |
| Ca ²⁺ | 91.0 | 4.541 | 32.8 | NO ₃ ⁻ | 62.7 | 1.011 | 7.3 |
| Sum | | 13.831 | Error 0.7% | Sum | | 13.925 | |

Uncharged species [mg/l]

SiO₂ 25.3

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 14.0 | Co ²⁺ | 0.066 | Cu ²⁺ | 0.740 | Fe ²⁺ | 36.0 | Li ⁺ | 27.0 |
| Mn ²⁺ | 63.0 | NH ₄ ⁺ | 20.0 | Ni ²⁺ | 0.530 | Pb ²⁺ | 0.130 | Sr ²⁺ | 524 |
| Zn ²⁺ | 8.70 | | | | | | | | |
| PO ₄ ³⁻ | 530 | NO ₂ ⁻ | 148 | BO ₂ ⁻ | 270 | F ⁻ | 259 | Br ⁻ | 383 |
| Ag | 0.010 | As | 0.500 | Ba | 102 | Be | 0.008 | Bi | 0.001 |
| Cd | 0.024 | Ce | 0.019 | Cr | 0.420 | Cs | 0.006 | Dy | 0.002 |
| Er | 0.001 | Eu | 0.000 | Ga | 0.008 | Gd | 0.002 | Ge | 0.020 |
| Hf | 0.000 | Hg | 0.000 | Ho | 0.000 | La | 0.011 | Lu | 0.000 |
| Mo | 1.70 | Nb | 0.000 | Nd | 0.011 | Pr | 0.002 | Rb | 0.770 |
| Sb | 0.020 | Sc | <1.000 | Se | 0.480 | Sm | 0.003 | Sn | 0.007 |
| Ta | 0.000 | Tb | 0.000 | Te | 0.005 | Th | 0.002 | Ti | 0.370 |
| Tl | 0.002 | Tm | 0.000 | U | 13.6 | V | 6.40 | W | 0.059 |
| Y | 0.006 | Yb | 0.000 | Zr | 0.007 | | | | |

It is a moderately hard Na⁺-Ca²⁺-HCO₃⁻-Cl⁻-brackish water.

| | |
|--|---|
| Sample-ID | WW200393 |
| Location | alluvial aquifer, Swakop/Khan |
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 9690 EC, calc. [$\mu\text{S}/\text{cm}$] Total dissolved solids, TDS, calc. [mg/l] |
| | 9604 5532 |
| pH | 6.8 |
| Total hardness [mmol/l] | 21.7 |

| Cations | | | | Anions | | | |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
| K ⁺ | 42.0 | 1.074 | 1.1 | Cl ⁻ | 2679 | 75.571 | 82.1 |
| Na ⁺ | 1190 | 51.762 | 53.7 | SO ₄ ²⁻ | 405 | 8.432 | 9.2 |
| Mg ²⁺ | 281 | 23.109 | 24.0 | HCO ₃ ⁻ | 477 | 7.817 | 8.5 |
| Ca ²⁺ | 407 | 20.309 | 21.1 | NO ₃ ⁻ | 5.69 | 0.092 | 0.1 |
| Sr ²⁺ | 5.96 | 0.136 | 0.1 | BO ₂ ⁻ | 1.31 | 0.031 | 0.0 |
| | | | | Br ⁻ | 4.87 | 0.061 | 0.1 |
| | Sum | 96.429 | Error 4.7% | Sum | 92.029 | | |

Uncharged species [mg/l]

SiO₂ 32.3

| Trace elements [$\mu\text{g}/\text{l}$] | | | | | | | | | |
|---|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 6.00 | Co ²⁺ | 0.589 | Cu ²⁺ | 0.430 | Fe ²⁺ | 73.0 | Li ⁺ | 195 |
| Mn ²⁺ | 213 | NH ₄ ⁺ | <10.00 | Ni ²⁺ | 0.920 | Pb ²⁺ | 0.040 | Zn ²⁺ | 10.7 |
| PO ₄ ³⁻ | 90.0 | NO ₂ ⁻ | <50.0 | F ⁻ | 456 | | | | |
| Ag | 0.011 | As | 1.22 | Ba | 62.0 | Be | 0.017 | Bi | 0.003 |
| Cd | 0.012 | Ce | 0.059 | Cr | 0.110 | Cs | 0.043 | Dy | 0.007 |
| Er | 0.004 | Eu | 0.005 | Ga | 0.007 | Gd | 0.006 | Ge | 0.000 |
| Hf | 0.004 | Hg | 0.010 | Ho | 0.001 | La | 0.020 | Lu | 0.001 |
| Mo | 6.09 | Nb | 0.010 | Nd | 0.015 | Pr | 0.004 | Rb | 5.62 |
| Sb | 0.022 | Sc | <1.000 | Se | 1.44 | Sm | 0.005 | Sn | 0.011 |
| Ta | 0.005 | Tb | 0.001 | Te | 0.021 | Th | 0.005 | Ti | 0.280 |
| Tl | 0.012 | Tm | 0.001 | U | 127 | V | 5.50 | W | 0.190 |
| Y | 0.050 | Yb | 0.005 | Zr | 0.010 | | | | |

It is a very hard Na⁺-Mg²⁺-Ca²⁺-Cl⁻-brackish water.

| | | |
|--|--|------|
| Sample-ID | WW200395 | |
| Location | alluvial aquifer, Swakop/Khan | |
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 8650 EC, calc. [$\mu\text{S}/\text{cm}$] | 7276 |
| | Total dissolved solids, TDS, calc. [mg/l] | 4319 |
| pH | 6.9 | |
| Total hardness [mmol/l] | 14.3 | |

| |
|------------------------------|
| Sum-parameters [mg/l] |
|------------------------------|

NPOC 1.5 TIC 101

| Cations | | | | Anions | | | |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
| K ⁺ | 37.7 | 0.964 | 1.4 | Cl ⁻ | 2035 | 57.405 | 80.0 |
| Na ⁺ | 955 | 41.540 | 58.3 | SO ₄ ²⁻ | 271 | 5.642 | 7.9 |
| Mg ²⁺ | 182 | 14.967 | 21.0 | HCO ₃ ⁻ | 517 | 8.473 | 11.8 |
| Ca ²⁺ | 273 | 13.623 | 19.1 | NO ₃ ⁻ | 8.04 | 0.130 | 0.2 |
| Sr ²⁺ | 4.81 | 0.110 | 0.2 | BO ₂ ⁻ | 1.21 | 0.028 | 0.0 |
| | | | | Br ⁻ | 3.21 | 0.040 | 0.1 |
| Sum | | 71.237 | Error 0.7% | Sum | | 71.738 | |

Uncharged species [mg/l]

SiO₂ 30.3

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 6.00 | Co 2+ | 0.510 | Cu ²⁺ | 0.870 | Fe 2+ | 12.0 | Li ⁺ | 174 |
| Mn ²⁺ | 170 | NH ₄ ⁺ | 10.00 | Ni ²⁺ | 0.720 | Pb ²⁺ | 0.070 | Zn ²⁺ | 11.0 |
| PO ₄ ³⁻ | 70.0 | NO ₂ ⁻ | <50.0 | F ⁻ | 371 | | | | |
| Ag | 0.015 | As | 1.55 | Ba | 50.0 | Be | 0.020 | Bi | 0.001 |
| Cd | 0.012 | Ce | 0.030 | Cr | 0.100 | Cs | 0.034 | Dy | 0.002 |
| Er | 0.002 | Eu | 0.001 | Ga | 0.016 | Gd | 0.007 | Ge | 0.050 |
| Hf | 0.004 | Hg | 0.010 | Ho | 0.001 | La | 0.009 | Lu | 0.001 |
| Mo | 5.74 | Nb | 0.008 | Nd | 0.005 | Pr | 0.002 | Rb | 5.06 |
| Sb | 0.026 | Sc | <1.000 | Se | 1.80 | Sm | 0.007 | Sn | 0.005 |
| Ta | 0.005 | Tb | 0.001 | Te | 0.062 | Th | 0.005 | Ti | 0.190 |
| Tl | 0.013 | Tm | 0.000 | U | 110 | V | 6.20 | W | 0.183 |
| Y | 0.020 | Yb | 0.003 | Zr | 0.012 | | | | |

It is a very hard Na⁺-Mg²⁺-Cl⁻-brackish water.

| | | |
|--|---|------|
| Sample-ID | WW200411 | |
| Location | alluvial aquifer, Swakop/Khan | |
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 6370 EC, calc. [$\mu\text{S}/\text{cm}$] | 7036 |
| | Total dissolved solids, TDS, calc. [mg/l] | 4170 |
| pH | 7.0 | |
| Total hardness [mmol/l] | 12.1 | |

Sum-parameters [mg/l]

| | | | |
|------|-----|-----|------|
| NPOC | 1.7 | TIC | 45.2 |
|------|-----|-----|------|

Cations

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|
| K ⁺ | 42.8 | 1.095 | 1.6 |
| Na ⁺ | 944 | 41.061 | 61.8 |
| Mg ²⁺ | 115 | 9.457 | 14.2 |
| Ca ²⁺ | 295 | 14.721 | 22.2 |
| Sr ²⁺ | 2.97 | 0.068 | 0.1 |
| Sum | | 66.438 | Error 3.1% |

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|-------------------------------|--------------------------|--|-------------------|
| Cl ⁻ | 1732 | 48.858 | 71.3 |
| SO ₄ ²⁻ | 714 | 14.866 | 21.7 |
| HCO ₃ ⁻ | 218 | 3.573 | 5.2 |
| NO ₃ ⁻ | 65.3 | 1.053 | 1.5 |
| BO ₂ ⁻ | 3.07 | 0.072 | 0.1 |
| F ⁻ | 1.06 | 0.056 | 0.1 |
| Br ⁻ | 2.32 | 0.029 | 0.0 |
| Sum | | 68.506 | |

Uncharged species [mg/l]

| | |
|------------------|------|
| SiO ₂ | 33.6 |
|------------------|------|

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 7.00 | Co 2+ | 0.158 | Cu ²⁺ | 0.810 | Fe 2+ | 244 | Li ⁺ | 135 |
| Mn ²⁺ | 18.0 | NH ₄ ⁺ | 120 | Ni ²⁺ | 0.660 | Pb ²⁺ | 0.110 | Zn ²⁺ | 15.8 |
| PO ₄ ³⁻ | 10.00 | NO ₂ ⁻ | <5.00 | | | | | | |
| Ag | 0.007 | As | 0.480 | Ba | 34.0 | Be | 0.007 | Bi | 0.000 |
| Cd | 0.017 | Ce | 0.049 | Cr | 0.570 | Cs | 0.017 | Dy | 0.004 |
| Er | 0.003 | Eu | 0.002 | Ga | 0.015 | Gd | 0.008 | Ge | 0.100 |
| Hf | 0.005 | Hg | 0.010 | Ho | 0.001 | La | 0.017 | Lu | 0.001 |
| Mo | 9.95 | Nb | 0.009 | Nd | 0.013 | Pr | 0.002 | Rb | 6.44 |
| Sb | 0.024 | Sc | <1.000 | Se | 4.69 | Sm | 0.003 | Sn | 0.041 |
| Ta | 0.003 | Tb | 0.000 | Te | 0.029 | Th | 0.001 | Ti | 0.090 |
| Tl | 0.004 | Tm | 0.000 | U | 124 | V | 5.80 | W | 0.210 |
| Y | 0.022 | Yb | 0.002 | Zr | 0.012 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl-SO₄²⁻-brackish water.

Sample-ID

WW200413

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

13690 EC, calc. [$\mu\text{S}/\text{cm}$]

15635

Total dissolved solids, TDS, calc. [mg/l]

9081

pH

6.8

Total hardness [mmol/l]

29.2

Sum-parameters [mg/l]

NPOC 1.5 TIC 63.3

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 79.2 | 2.026 | 1.4 | Cl ⁻ | 4394 | 123.949 | 80.5 |
| Na ⁺ | 2040 | 88.734 | 59.3 | SO ₄ ²⁻ | 1167 | 24.297 | 15.8 |
| Mg ²⁺ | 245 | 20.148 | 13.5 | HCO ₃ ⁻ | 298 | 4.884 | 3.2 |
| Ca ²⁺ | 770 | 38.423 | 25.7 | NO ₃ ⁻ | 42.1 | 0.679 | 0.4 |
| Fe ²⁺ | 1.64 | 0.059 | 0.0 | BO ²⁻ | 4.05 | 0.095 | 0.1 |
| Sr ²⁺ | 6.16 | 0.141 | 0.1 | Br ⁻ | 3.66 | 0.046 | 0.0 |
| Sum | | 149.567 | Error 2.9% | Sum | | 153.956 | |

Uncharged species [mg/l]

SiO₂ 29.5

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 10.00 | Co ²⁺ | 0.697 | Cu ²⁺ | 1.20 | Li ⁺ | 107 | Mn ²⁺ | 310 |
| NH ₄ ⁺ | 150 | Ni ²⁺ | 0.660 | Pb ²⁺ | 0.080 | Zn ²⁺ | 23.5 | | |
| PO ₄ ³⁻ | 50.0 | NO ₂ ⁻ | <50.0 | F ⁻ | 116 | | | | |
| Ag | 0.019 | As | 0.350 | Ba | 38.0 | Be | 0.014 | Bi | 0.003 |
| Cd | 0.045 | Ce | 0.027 | Cr | 0.030 | Cs | 0.036 | Dy | 0.004 |
| Er | 0.006 | Eu | 0.000 | Ga | 0.012 | Gd | 0.014 | Ge | 0.080 |
| Hf | 0.003 | Hg | 0.000 | Ho | 0.002 | La | 0.013 | Lu | 0.001 |
| Mo | 6.98 | Nb | 0.009 | Nd | 0.007 | Pr | 0.003 | Rb | 8.91 |
| Sb | 0.015 | Sc | <1.000 | Se | 5.32 | Sm | 0.008 | Sn | 0.014 |
| Ta | 0.004 | Tb | 0.001 | Te | 0.033 | Th | 0.007 | Ti | 0.940 |
| Tl | 0.012 | Tm | 0.002 | U | 127 | V | 3.80 | W | 0.071 |
| Y | 0.032 | Yb | 0.003 | Zr | 0.002 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-brackish water.

| | | | |
|--|-------------------------------|---|------|
| Sample-ID | WW200414 | | |
| Location | alluvial aquifer, Swakop/Khan | | |
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 10830 | EC, calc. [$\mu\text{S}/\text{cm}$] | 8357 |
| | | Total dissolved solids, TDS, calc. [mg/l] | 4786 |
| pH | 7.4 | | |
| Total hardness [mmol/l] | 10.9 | | |

| Cations | | | | Anions | | | |
|------------------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
| K ⁺ | 60.6 | 1.550 | 2.0 | Cl ⁻ | 2534 | 71.481 | 87.2 |
| Na ⁺ | 1261 | 54.850 | 69.9 | SO ₄ ²⁻ | 415 | 8.640 | 10.5 |
| Mg ²⁺ | 114 | 9.375 | 11.9 | HCO ₃ ⁻ | 91.6 | 1.501 | 1.8 |
| Ca ²⁺ | 248 | 12.375 | 15.8 | NO ₃ ⁻ | 14.5 | 0.234 | 0.3 |
| Fe ²⁺ | 2.52 | 0.090 | 0.1 | BO ₂ ⁻ | 3.88 | 0.091 | 0.1 |
| NH ₄ ⁺ | 1.52 | 0.083 | 0.1 | Br ⁻ | 2.16 | 0.027 | 0.0 |
| Sr ²⁺ | 4.96 | 0.113 | 0.1 | | | | |
| Sum | | 78.491 | Error 4.4% | Sum | | 81.990 | |

Uncharged species [mg/l]

SiO₂ 30.9

Trace elements [μg/l]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|-----------------|-------|------------------|-------|
| Al ³⁺ | 11.0 | Co ²⁺ | 1.02 | Cu ²⁺ | 0.320 | Li ⁺ | 18 | Mn ²⁺ | 869 |
| Ni ²⁺ | 1.23 | Pb ²⁺ | 0.030 | Zn ²⁺ | 13.2 | | | | |
| PO ₄ ³⁻ | 10.00 | NO ₂ ⁻ | 621 | F ⁻ | 43.0 | | | | |
| Ag | 0.005 | As | 0.140 | Ba | 67.0 | Be | 0.001 | Bi | 0.004 |
| Cd | 0.010 | Ce | 0.068 | Cr | 0.030 | Cs | 0.019 | Dy | 0.004 |
| Er | 0.003 | Eu | 0.003 | Ga | 0.036 | Gd | 0.008 | Ge | 0.150 |
| Hf | 0.003 | Hg | 0.000 | Ho | 0.001 | La | 0.019 | Lu | 0.000 |
| Mo | 6.88 | Nb | 0.005 | Nd | 0.015 | Pr | 0.005 | Rb | 7.37 |
| Sb | 0.017 | Sc | <1.000 | Se | 5.28 | Sm | 0.007 | Sn | 0.018 |
| Ta | 0.003 | Tb | 0.001 | Te | 0.025 | Th | 0.006 | Ti | 0.280 |
| Tl | 0.000 | Tm | 0.001 | U | 125 | V | 0.000 | W | 0.068 |
| Y | 0.028 | Yb | 0.005 | Zr | 0.023 | | | | |

It is a very hard Na⁺-Cl-brackish water.

Sample-ID

WW25025

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

1757 EC, calc. [$\mu\text{S}/\text{cm}$]

1845

Total dissolved solids, TDS, calc. [mg/l]

1265

pH

7.4

Total hardness [mmol/l]

4.0

Sum-parameters [mg/l]

NPOC 18 TIC 67.3

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 19.5 | 0.499 | 2.6 | Cl^- | 323 | 9.111 | 49.7 |
| Na^+ | 240 | 10.439 | 55.3 | SO_4^{2-} | 164 | 3.415 | 18.6 |
| Mg^{2+} | 38.5 | 3.166 | 16.8 | HCO_3^- | 322 | 5.277 | 28.8 |
| Ca^{2+} | 95.4 | 4.760 | 25.2 | NO_3^- | 30.6 | 0.493 | 2.7 |
| | | | | F ⁻ | 0.449 | 0.024 | 0.1 |
| Sum | | 18.892 | Error 2.9% | Sum | | 18.345 | |

Uncharged species [mg/l]

SiO_2 28.8

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 4.00 | Co^{2+} | 0.042 | Cu^{2+} | 1.07 | Fe 2+ | 34.0 | Li^+ | 58.0 |
| Mn^{2+} | 7.00 | NH_4^+ | <10.00 | Ni^{2+} | 0.300 | Pb^{2+} | 0.050 | Sr^{2+} | 712 |
| Zn^{2+} | 10.5 | | | | | | | | |
| PO_4^{3-} | 320 | NO_2^- | <5.00 | BO^{2-} | 430 | Br^- | 900 | | |
| Ag | 0.004 | As | 1.10 | Ba | 33.0 | Be | 0.004 | Bi | 0.000 |
| Cd | 0.007 | Ce | 0.014 | Cr | 0.350 | Cs | 0.094 | Dy | 0.014 |
| Er | 0.011 | Eu | 0.001 | Ga | 0.006 | Gd | 0.005 | Ge | 0.120 |
| Hf | 0.000 | Hg | 0.000 | Ho | 0.003 | La | 0.007 | Lu | 0.002 |
| Mo | 4.35 | Nb | 0.002 | Nd | 0.012 | Pr | 0.002 | Rb | 3.24 |
| Sb | 0.025 | Sc | <1.000 | Se | 1.94 | Sm | 0.003 | Sn | 0.010 |
| Ta | 0.001 | Tb | 0.002 | Te | 0.006 | Th | 0.074 | Ti | 0.240 |
| Tl | 0.003 | Tm | 0.002 | U | 16.1 | V | 11.8 | W | 0.274 |
| Y | 0.065 | Yb | 0.014 | Zr | 0.005 | | | | |

It is a hard Na^+ - Ca^{2+} - Cl^- - HCO_3^- -brackish water.

Sample-ID

WW25054

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

503 EC, calc. [$\mu\text{S}/\text{cm}$]

507

Total dissolved solids, TDS, calc. [mg/l]

379

pH

7.2

Total hardness [mmol/l]

1.6

Sum-parameters [mg/l]

NPOC

0.9

TIC

34.3

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 8.10 | 0.207 | 4.0 | Cl ⁻ | 55.2 | 1.557 | 31.4 |
| Na ⁺ | 38.3 | 1.666 | 32.3 | SO ₄ ²⁻ | 28.5 | 0.593 | 12.0 |
| Mg ²⁺ | 7.66 | 0.630 | 12.2 | HCO ₃ ⁻ | 158 | 2.589 | 52.2 |
| Ca ²⁺ | 52.9 | 2.640 | 51.2 | NO ₃ ⁻ | 12.4 | 0.200 | 4.0 |
| Sr ²⁺ | 0.286 | 0.007 | 0.1 | PO ₄ ³⁻ | 0.640 | 0.007 | 0.1 |
| | | | | F ⁻ | 0.118 | 0.006 | 0.1 |
| Sum | 5.154 | | Error 3.9% | Sum | 4.956 | | |

Uncharged species [mg/l]

SiO₂ 16.8

Trace elements [μg/l]

| | | | | | | | | | |
|------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 4.00 | Co ²⁺ | 0.022 | Cu ²⁺ | 0.510 | Fe ²⁺ | 14.0 | Li ⁺ | 25.0 |
| Mn ²⁺ | 4.00 | NH ₄ ⁺ | <10.00 | Ni ²⁺ | 0.180 | Pb ²⁺ | 0.020 | Zn ²⁺ | 7.20 |
| NO ₂ ⁻ | <5.00 | BO ₂ ⁻ | 120 | Br ⁻ | 67.0 | | | | |
| Ag | 0.006 | As | 1.13 | Ba | 35.0 | Be | 0.002 | Bi | 0.000 |
| Cd | 0.008 | Ce | 0.004 | Cr | 0.290 | Cs | 0.004 | Dy | 0.000 |
| Er | 0.001 | Eu | 0.000 | Ga | 0.008 | Gd | 0.001 | Ge | 0.030 |
| Hf | 0.000 | Hg | 0.000 | Ho | 0.000 | La | 0.002 | Lu | 0.000 |
| Mo | 1.49 | Nb | 0.001 | Nd | 0.003 | Pr | 0.000 | Rb | 0.670 |
| Sb | 0.020 | Sc | <1.000 | Se | 0.230 | Sm | 0.001 | Sn | 0.032 |
| Ta | 0.000 | Tb | 0.000 | Te | 0.003 | Th | 0.001 | Ti | 0.210 |
| Tl | 0.002 | Tm | 0.000 | U | 2.31 | V | 6.80 | W | 0.072 |
| Y | 0.002 | Yb | 0.001 | Zr | 0.005 | | | | |

It is a slightly hard Ca²⁺-Na⁺-HCO₃⁻-Cl⁻-water.

Sample-ID

WW25055

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

920 EC, calc. [$\mu\text{S}/\text{cm}$]

931

Total dissolved solids, TDS, calc. [mg/l]

857

pH

6.9

Total hardness [mmol/l]

3.8

Sum-parameters [mg/l]

NPOC

0.7

TIC

117

Cations

Anions

| | [mg/l] | c_{α} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|---|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 7.60 | 0.194 | 1.8 | Cl^- | 40.7 | 1.148 | 10.8 |
| Na^+ | 71.3 | 3.101 | 28.6 | SO_4^{2-} | 34.2 | 0.712 | 6.7 |
| Mg^{2+} | 29.9 | 2.459 | 22.6 | HCO_3^- | 533 | 8.735 | 82.3 |
| Ca^{2+} | 102 | 5.090 | 46.9 | NO_3^- | 0.010 | 0.000 | 0.0 |
| | | | | F | 0.257 | 0.014 | 0.1 |
| Sum | 10.861 | | Error 2.3% | Sum | 10.617 | | |

Uncharged species [mg/l]

SiO_2 37.4

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 3.00 | Co^{2+} | 0.026 | Cu^{2+} | 0.400 | Fe 2+ | 10.00 | Li^+ | 29.0 |
| Mn^{2+} | 23.0 | NH_4^+ | <10.00 | Ni^{2+} | 0.230 | Pb^{2+} | 0.030 | Sr^{2+} | 474 |
| Zn^{2+} | 2.70 | | | | | | | | |
| PO_4^{3-} | 120 | NO_2^- | <5.00 | BO_2^- | 240 | Br^- | 113 | | |
| Ag | 0.001 | As | 0.480 | Ba | 49.0 | Be | 0.002 | Bi | 0.000 |
| Cd | 0.009 | Ce | 0.023 | Cr | 0.140 | Cs | 0.006 | Dy | 0.003 |
| Er | 0.002 | Eu | 0.000 | Ga | 0.006 | Gd | 0.005 | Ge | 0.020 |
| Hf | 0.000 | Hg | 0.000 | Ho | 0.001 | La | 0.010 | Lu | 0.000 |
| Mo | 0.830 | Nb | 0.001 | Nd | 0.015 | Pr | 0.003 | Rb | 0.680 |
| Sb | 0.016 | Sc | <1.000 | Se | 0.100 | Sm | 0.004 | Sn | 0.011 |
| Ta | 0.000 | Tb | 0.001 | Te | 0.008 | Th | 0.001 | Ti | 0.210 |
| Tl | 0.004 | Tm | 0.000 | U | 18.9 | V | 8.60 | W | 0.068 |
| Y | 0.027 | Yb | 0.001 | Zr | 0.011 | | | | |

It is a hard Ca^{2+} - Na^+ - Mg^{2+} - HCO_3^- -water.

Sample-ID

WW25056

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

666 EC, calc. [$\mu\text{S}/\text{cm}$]

664

Total dissolved solids, TDS, calc. [mg/l]

525

pH

7.3

Total hardness [mmol/l]

1.8

Sum-parameters [mg/l]

NPOC

2.7

TIC

51.5

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 10.00 | 0.256 | 3.7 | Cl ⁻ | 76.7 | 2.164 | 31.1 |
| Na ⁺ | 70.0 | 3.045 | 43.8 | SO ₄ ²⁻ | 35.2 | 0.733 | 10.6 |
| Mg ²⁺ | 13.4 | 1.102 | 15.9 | HCO ₃ ⁻ | 245 | 4.015 | 57.8 |
| Ca ²⁺ | 50.0 | 2.495 | 35.9 | NO ₃ ⁻ | 0.830 | 0.013 | 0.2 |
| Fe ²⁺ | 0.817 | 0.029 | 0.4 | F ⁻ | 0.197 | 0.010 | 0.1 |
| Mn ²⁺ | 0.326 | 0.012 | 0.2 | | | | |
| Sum | | 6.949 | Error 0.0% | Sum | | 6.946 | |

Uncharged species [mg/l]

SiO₂

21.4

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------------------|-------|------------------|-------|------------------------------|--------|
| Al ³⁺ | 6.00 | Co ²⁺ | 0.522 | Cu ²⁺ | 0.440 | Li ⁺ | 18.0 | NH ₄ ⁺ | <10.00 |
| Ni ²⁺ | 0.940 | Pb ²⁺ | 0.020 | Sr ²⁺ | 296 | Zn ²⁺ | 3.50 | | |
| PO ₄ ³⁻ | 380 | NO ₂ ⁻ | 11.0 | BO ₂ ⁻ | 230 | Br ⁻ | 119 | | |
| Ag | 0.001 | As | 1.26 | Ba | 53.0 | Be | 0.001 | Bi | 0.001 |
| Cd | 0.006 | Ce | 0.016 | Cr | 0.100 | Cs | 0.004 | Dy | 0.002 |
| Er | 0.001 | Eu | 0.001 | Ga | 0.012 | Gd | 0.001 | Ge | 0.040 |
| Hf | 0.000 | Hg | 0.010 | Ho | 0.000 | La | 0.009 | Lu | 0.000 |
| Mo | 1.86 | Nb | 0.003 | Nd | 0.008 | Pr | 0.002 | Rb | 1.18 |
| Sb | 0.031 | Sc | <1.000 | Se | 0.150 | Sm | 0.002 | Sn | 0.012 |
| Ta | 0.000 | Tb | 0.000 | Te | 0.005 | Th | 0.002 | Ti | 0.460 |
| Tl | 0.003 | Tm | 0.000 | U | 1.97 | V | 1.10 | W | 0.825 |
| Y | 0.008 | Yb | 0.001 | Zr | 0.004 | | | | |

It is a slightly hard Na⁺-Ca²⁺-HCO₃⁻-Cl-water.

Sample-ID

WW25575

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

1281 EC, calc. [$\mu\text{S}/\text{cm}$]

1373

Total dissolved solids, TDS, calc. [mg/l]

1002

pH

7.0

Total hardness [mmol/l]

3.6

Sum-parameters [mg/l]

NPOC

2.3

TIC

75.0

Anions

Cations

c_{eq} [mmol/l]

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 12.2 | 0.312 | 2.2 | Cl ⁻ | 170 | 4.795 | 34.6 |
| Na ⁺ | 152 | 6.612 | 46.6 | SO ₄ ²⁻ | 163 | 3.394 | 24.5 |
| Mg ²⁺ | 20.0 | 1.645 | 11.6 | HCO ₃ ⁻ | 316 | 5.179 | 37.4 |
| Ca ²⁺ | 112 | 5.589 | 39.4 | NO ₃ ⁻ | 27.9 | 0.450 | 3.2 |
| Sr ²⁺ | 0.857 | 0.020 | 0.1 | | | | |
| Sum | | 14.184 | Error 2.4% | Sum | | 13.844 | |

Uncharged species [mg/l]

SiO₂

26.1

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 3.00 | Co ²⁺ | 0.057 | Cu ²⁺ | 0.610 | Fe ²⁺ | 19.0 | Li ⁺ | 28.0 |
| Mn ²⁺ | 50.0 | NH ₄ ⁺ | <10.00 | Ni ²⁺ | 0.330 | Pb ²⁺ | 0.050 | Zn ²⁺ | 1.70 |
| PO ₄ ³⁻ | 760 | NO ₂ ⁻ | 34.0 | BO ₂ ⁻ | 220 | F ⁻ | 159 | Br ⁻ | 327 |
| Ag | 0.063 | As | 0.940 | Ba | 217 | Be | 0.002 | Bi | 0.001 |
| Cd | 0.012 | Ce | 0.006 | Cr | 0.140 | Cs | 0.004 | Dy | 0.001 |
| Er | 0.000 | Eu | 0.005 | Ga | 0.005 | Gd | 0.003 | Ge | 0.040 |
| Hf | 0.000 | Hg | 0.000 | Ho | 0.000 | La | 0.004 | Lu | 0.000 |
| Mo | 1.50 | Nb | 0.001 | Nd | 0.003 | Pr | 0.001 | Rb | 1.35 |
| Sb | 0.022 | Sc | <1.000 | Se | 0.830 | Sm | 0.002 | Sn | 0.013 |
| Ta | 0.000 | Tb | 0.000 | Te | 0.005 | Th | 0.001 | Ti | 0.110 |
| Tl | 0.004 | Tm | 0.000 | U | 10.2 | V | 7.20 | W | 0.064 |
| Y | 0.005 | Yb | 0.001 | Zr | 0.003 | | | | |

It is a hard Na⁺-Ca²⁺-HCO₃⁻-Cl⁻-SO₄²⁻-water.

Sample-ID

WW27107

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

766 EC, calc. [$\mu\text{S}/\text{cm}$]

778

Total dissolved solids, TDS, calc. [mg/l]

619

pH

7.3

Total hardness [mmol/l]

2.1

Sum-parameters [mg/l]

NPOC

4.1

TIC

62.7

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 9.50 | 0.243 | 2.9 | Cl ⁻ | 87.0 | 2.454 | 29.9 |
| Na ⁺ | 87.0 | 3.784 | 45.3 | SO ₄ ²⁻ | 45.1 | 0.939 | 11.4 |
| Mg ²⁺ | 13.3 | 1.094 | 13.1 | HCO ₃ ⁻ | 292 | 4.785 | 58.3 |
| Ca ²⁺ | 64.3 | 3.209 | 38.4 | NO ₃ ⁻ | <0.010 | | |
| Fe ²⁺ | 0.310 | 0.011 | 0.1 | F ⁻ | 0.233 | 0.012 | 0.1 |
| Sum | | 8.358 | Error 1.9% | Sum | | 8.202 | |

Uncharged species [mg/l]

SiO₂ 18.8

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 3.00 | Co ²⁺ | 0.437 | Cu ²⁺ | 1.10 | Li ⁺ | 18.0 | Mn ²⁺ | 209 |
| NH ₄ ⁺ | 10.00 | Ni ²⁺ | 0.890 | Pb ²⁺ | 0.080 | Sr ²⁺ | 277 | Zn ²⁺ | 4.10 |
| PO ₄ ³⁻ | 420 | NO ₂ ⁻ | <5.00 | BO ₂ ⁻ | 210 | Br ⁻ | 175 | | |
| Ag | 0.001 | As | 1.61 | Ba | 85.0 | Be | 0.003 | Bi | 0.001 |
| Cd | 0.007 | Ce | 0.013 | Cr | 0.040 | Cs | 0.002 | Dy | 0.001 |
| Er | 0.001 | Eu | 0.002 | Ga | 0.009 | Gd | 0.002 | Ge | 0.040 |
| Hf | 0.000 | Hg | 0.000 | Ho | 0.000 | La | 0.006 | Lu | 0.000 |
| Mo | 4.78 | Nb | 0.002 | Nd | 0.008 | Pr | 0.001 | Rb | 1.08 |
| Sb | 0.029 | Sc | <1.000 | Se | 0.080 | Sm | 0.003 | Sn | 0.025 |
| Ta | 0.000 | Tb | 0.000 | Te | 0.004 | Th | 0.002 | Ti | 0.140 |
| Tl | 0.002 | Tm | 0.000 | U | 15.6 | V | 2.80 | W | 0.175 |
| Y | 0.009 | Yb | 0.002 | Zr | 0.011 | | | | |

It is a moderately hard Na⁺-Ca²⁺-HCO₃⁻-Cl-water.

Sample-ID

WW41073

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

10490

EC, calc. [$\mu\text{S}/\text{cm}$]

9085

Total dissolved solids, TDS, calc. [mg/l]

5273

pH

7.0

Total hardness [mmol/l]

16.2

Sum-parameters [mg/l]

NPOC

1.5

TIC

60.0

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 55.1 | 1.409 | 1.6 | Cl ⁻ | 2466 | 69.563 | 79.4 |
| Na ⁺ | 1234 | 53.676 | 61.3 | SO ₄ ²⁻ | 651 | 13.554 | 15.5 |
| Mg ²⁺ | 144 | 11.842 | 13.5 | HCO ₃ ⁻ | 230 | 3.769 | 4.3 |
| Ca ²⁺ | 411 | 20.509 | 23.4 | NO ₃ ⁻ | 37.4 | 0.603 | 0.7 |
| Sr ²⁺ | 4.46 | 0.102 | 0.1 | BO ₂ ⁻ | 3.50 | 0.082 | 0.1 |
| | | | | Br ⁻ | 2.06 | 0.026 | 0.0 |
| Sum | | 87.595 | Error 0.0% | Sum | | 87.607 | |

Uncharged species [mg/l]

SiO₂ 33.0

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 7.00 | Co ²⁺ | 0.386 | Cu ²⁺ | 0.520 | Fe ²⁺ | 715 | Li ⁺ | 110 |
| Mn ²⁺ | 367 | NH ₄ ⁺ | 20.0 | Ni ²⁺ | 0.590 | Pb ²⁺ | 0.020 | Zn ²⁺ | 10.00 |
| PO ₄ ³⁻ | 130 | NO ₂ ⁻ | 151 | F ⁻ | 112 | | | | |
| Ag | 0.006 | As | 0.590 | Ba | 41.0 | Be | 0.009 | Bi | 0.002 |
| Cd | 0.049 | Ce | 0.029 | Cr | 0.090 | Cs | 0.012 | Dy | 0.020 |
| Er | 0.014 | Eu | 0.002 | Ga | 0.013 | Gd | 0.005 | Ge | 0.090 |
| Hf | 0.004 | Hg | 0.000 | Ho | 0.004 | La | 0.012 | Lu | 0.002 |
| Mo | 6.60 | Nb | 0.004 | Nd | 0.011 | Pr | 0.003 | Rb | 7.66 |
| Sb | 0.018 | Sc | <1.000 | Se | 4.88 | Sm | 0.006 | Sn | 0.019 |
| Ta | 0.004 | Tb | 0.002 | Te | 0.033 | Th | 0.099 | Ti | 0.380 |
| Tl | 0.006 | Tm | 0.003 | U | 91.9 | V | 3.50 | W | 0.097 |
| Y | 0.111 | Yb | 0.016 | Zr | 0.007 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-brackish water.

| | | |
|--|--|------|
| Sample-ID | WW41075 | |
| Location | alluvial aquifer, Swakop/Khan | |
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 7860 EC, calc. [$\mu\text{S}/\text{cm}$] | 9204 |
| | Total dissolved solids, TDS, calc. [mg/l] | 5404 |
| pH | 7.0 | |
| Total hardness [mmol/l] | 16.5 | |

| Cations | | | | Anions | | | |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
| K ⁺ | 50.7 | 1.297 | 1.4 | Cl ⁻ | 2187 | 61.693 | 70.8 |
| Na ⁺ | 1290 | 56.111 | 61.9 | SO ₄ ²⁻ | 1010 | 21.029 | 24.1 |
| Mg ²⁺ | 163 | 13.405 | 14.8 | HCO ₃ ⁻ | 212 | 3.474 | 4.0 |
| Ca ²⁺ | 394 | 19.661 | 21.7 | NO ₃ ⁻ | 49.4 | 0.797 | 0.9 |
| Sr ²⁺ | 3.38 | 0.077 | 0.1 | BO ₂ ⁻ | 3.56 | 0.083 | 0.1 |
| | | | | Br ⁻ | 1.49 | 0.019 | 0.0 |
| | Sum | 90.583 | Error 3.9% | Sum | 87.120 | | |

Uncharged species [mg/l]

SiO₂ 38.4

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 8.00 | Co ²⁺ | 0.091 | Cu ²⁺ | 0.390 | Fe ²⁺ | 263 | Li ⁺ | 142 |
| Mn ²⁺ | 13.0 | NH ₄ ⁺ | 10.00 | Ni ²⁺ | 0.370 | Pb ²⁺ | 0.030 | Zn ²⁺ | 15.5 |
| PO ₄ ³⁻ | 160 | NO ₂ ⁻ | <5.00 | F ⁻ | 472 | | | | |
| Ag | 0.008 | As | 0.490 | Ba | 38.0 | Be | 0.007 | Bi | 0.000 |
| Cd | 0.010 | Ce | 0.073 | Cr | 0.770 | Cs | 0.011 | Dy | 0.024 |
| Er | 0.018 | Eu | 0.003 | Ga | 0.009 | Gd | 0.010 | Ge | 0.040 |
| Hf | 0.003 | Hg | 0.000 | Ho | 0.005 | La | 0.024 | Lu | 0.003 |
| Mo | 3.39 | Nb | 0.010 | Nd | 0.021 | Pr | 0.006 | Rb | 5.51 |
| Sb | 0.020 | Sc | <1.000 | Se | 7.81 | Sm | 0.012 | Sn | 0.015 |
| Ta | 0.004 | Tb | 0.002 | Te | 0.021 | Th | 0.103 | Ti | 0.090 |
| Tl | 0.004 | Tm | 0.003 | U | 127 | V | 5.30 | W | 0.079 |
| Y | 0.131 | Yb | 0.023 | Zr | 0.003 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl-SO₄²⁻-brackish water.

Sample-ID

WW41076

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

6820 EC, calc. [$\mu\text{S}/\text{cm}$]

7571

Total dissolved solids, TDS, calc. [mg/l]

4527

pH

7.0

Total hardness [mmol/l]

12.6

Sum-parameters [mg/l]

NPOC

06

TIC

52.2

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 41.9 | 1.072 | 1.5 | Cl ⁻ | 1822 | 51.396 | 69.3 |
| Na ⁺ | 1026 | 44.628 | 62.8 | SO ₄ ²⁻ | 835 | 17.385 | 23.4 |
| Mg ²⁺ | 114 | 9.375 | 13.2 | HCO ₃ ⁻ | 249 | 4.081 | 5.5 |
| Ca ²⁺ | 318 | 15.868 | 22.3 | NO ₃ ⁻ | 74.7 | 1.205 | 1.6 |
| Sr ²⁺ | 3.13 | 0.071 | 0.1 | BO ₂ ⁻ | 3.34 | 0.078 | 0.1 |
| | | | | Br ⁻ | 2.18 | 0.027 | 0.0 |
| Sum | | 71.037 | Error 4.4% | Sum | | 74.216 | |

Uncharged species [mg/l]

SiO₂ 36.7

Trace elements [μg/l]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 6.00 | Co ²⁺ | 0.031 | Cu ²⁺ | 0.730 | Fe ²⁺ | 10.00 | Li ⁺ | 142 |
| Mn ²⁺ | 4.00 | NH ₄ ⁺ | <10.00 | Ni ²⁺ | 0.250 | Pb ²⁺ | 0.050 | Zn ²⁺ | 12.4 |
| PO ₄ ³⁻ | 50.0 | NO ₂ ⁻ | <5.00 | F ⁻ | 832 | | | | |
| Ag | 0.035 | As | 0.700 | Ba | 27.0 | Be | 0.008 | Bi | 0.001 |
| Cd | 0.010 | Ce | 0.025 | Cr | 3.08 | Cs | 0.011 | Dy | 0.022 |
| Er | 0.016 | Eu | 0.002 | Ga | 0.007 | Gd | 0.006 | Ge | 0.080 |
| Hf | 0.004 | Hg | 0.000 | Ho | 0.004 | La | 0.012 | Lu | 0.003 |
| Mo | 6.87 | Nb | 0.001 | Nd | 0.019 | Pr | 0.003 | Rb | 6.43 |
| Sb | 0.016 | Sc | <1.000 | Se | 5.68 | Sm | 0.009 | Sn | 0.011 |
| Ta | 0.002 | Tb | 0.002 | Te | 0.013 | Th | 0.100 | Ti | 0.280 |
| Tl | 0.011 | Tm | 0.004 | U | 131 | V | 6.40 | W | 0.172 |
| Y | 0.112 | Yb | 0.014 | Zr | 0.006 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-SO₄²⁻-brackish water.

Sample-ID

WW41180

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

6260 EC, calc. [$\mu\text{S}/\text{cm}$]

7018

Total dissolved solids, TDS, calc. [mg/l]

4125

pH

7.0

Total hardness [mmol/l]

10.4

Sum-parameters [mg/l]

NPOC

03

TIC

38.3

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|-------------------------------|--------|--------------------------|-------------------|
| K ⁺ | 50.4 | 1.289 | 1.9 | Cl ⁻ | 1923 | 54.245 | 79.4 |
| Na ⁺ | 1014 | 44.106 | 66.5 | SO ₄ ²⁻ | 502 | 10.452 | 15.3 |
| Mg ²⁺ | 68.3 | 5.617 | 8.5 | HCO ₃ ⁻ | 181 | 2.966 | 4.3 |
| Ca ²⁺ | 304 | 15.170 | 22.9 | NO ₃ ⁻ | 31.6 | 0.510 | 0.7 |
| Sr ²⁺ | 3.39 | 0.077 | 0.1 | BO ₂ ⁻ | 4.34 | 0.101 | 0.1 |
| Sum | | 66.298 | Error 3.0% | Sum | | 68.330 | |

Uncharged species [mg/l]

SiO₂ 41.0

Trace elements [μg/l]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 5.00 | Co ²⁺ | 0.019 | Cu ²⁺ | 0.350 | Fe ²⁺ | 5.00 | Li ⁺ | 261 |
| Mn ²⁺ | 3.00 | NH ₄ ⁺ | <10.00 | Ni ²⁺ | 0.170 | Pb ²⁺ | 0.090 | Zn ²⁺ | 16.2 |
| PO ₄ ³⁻ | 20.0 | NO ₂ ⁻ | <5.00 | F ⁻ | 829 | Br ⁻ | 962 | | |
| Ag | 0.019 | As | 2.46 | Ba | 37.0 | Be | 0.061 | Bi | 0.003 |
| Cd | 0.021 | Ce | 0.039 | Cr | 0.350 | Cs | 0.064 | Dy | 0.022 |
| Er | 0.018 | Eu | 0.003 | Ga | 0.012 | Gd | 0.009 | Ge | 0.060 |
| Hf | 0.004 | Hg | 0.010 | Ho | 0.004 | La | 0.021 | Lu | 0.002 |
| Mo | 12.6 | Nb | 0.004 | Nd | 0.023 | Pr | 0.005 | Rb | 4.68 |
| Sb | 0.003 | Sc | <1.000 | Se | 4.57 | Sm | 0.007 | Sn | 0.011 |
| Ta | 0.002 | Tb | 0.002 | Te | 0.021 | Th | 0.098 | Ti | 0.090 |
| Tl | 0.002 | Tm | 0.003 | U | 54.4 | V | 38.2 | W | 0.581 |
| Y | 0.124 | Yb | 0.017 | Zr | 0.006 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-brackish water.

Sample-ID

WW41182

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

11150

EC, calc. [$\mu\text{S}/\text{cm}$]

13125

Total dissolved solids, TDS, calc. [mg/l]

7623

pH

6.9

Total hardness [mmol/l]

26.1

Sum-parameters [mg/l]

NPOC 2.9 TIC 72.8

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 61.1 | 1.563 | 1.2 | Cl ⁻ | 3543 | 99.944 | 79.5 |
| Na ⁺ | 1738 | 75.598 | 58.3 | SO ₄ ²⁻ | 943 | 19.634 | 15.6 |
| Mg ²⁺ | 185 | 15.214 | 11.7 | HCO ₃ ⁻ | 370 | 6.064 | 4.8 |
| Ca ²⁺ | 743 | 37.076 | 28.6 | NO ₃ ⁻ | 2.98 | 0.048 | 0.0 |
| Mn ²⁺ | 1.15 | 0.042 | 0.0 | BO ₂ ⁻ | 1.58 | 0.037 | 0.0 |
| Sr ²⁺ | 4.37 | 0.100 | 0.1 | Br ⁻ | 3.09 | 0.039 | 0.0 |
| Sum | | 129.601 | Error 3.0% | Sum | | 125.770 | |

Uncharged species [mg/l]

SiO₂ 26.2

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|--------|------------------------------|--------|------------------|-------|------------------|-------|-----------------|-------|
| Al ³⁺ | 5.00 | Co ²⁺ | 0.967 | Cu ²⁺ | 0.600 | Fe ²⁺ | 8.00 | Li ⁺ | 50.0 |
| NH ₄ ⁺ | <10.00 | Ni ²⁺ | 1.24 | Pb ²⁺ | 0.060 | Zn ²⁺ | 14.4 | | |
| PO ₄ ³⁻ | 330 | NO ₂ ⁻ | <50.0 | F ⁻ | 36.0 | | | | |
| Ag | 0.005 | As | 0.890 | Ba | 68.0 | Be | 0.002 | Bi | 0.000 |
| Cd | 0.194 | Ce | 0.678 | Cr | 0.150 | Cs | 0.013 | Dy | 0.025 |
| Er | 0.011 | Eu | 0.010 | Ga | 0.016 | Gd | 0.043 | Ge | 0.000 |
| Hf | 0.001 | Hg | 0.000 | Ho | 0.004 | La | 0.285 | Lu | 0.002 |
| Mo | 3.46 | Nb | 0.004 | Nd | 0.307 | Pr | 0.079 | Rb | 6.07 |
| Sb | 0.027 | Sc | <1.000 | Se | 1.49 | Sm | 0.048 | Sn | 0.008 |
| Ta | 0.002 | Tb | 0.003 | Te | 0.029 | Th | 0.020 | Ti | 0.380 |
| Tl | 0.019 | Tm | 0.002 | U | 69.3 | V | 8.90 | W | 0.112 |
| Y | 0.113 | Yb | 0.009 | Zr | 0.014 | | | | |

It is a very hard Na⁺-Ca²⁺-Cl⁻-brackish water.

Sample-ID

WW41183

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

4640 EC, calc. [$\mu\text{S}/\text{cm}$]

5192

Total dissolved solids, TDS, calc. [mg/l]

3106

pH

7.3

Total hardness [mmol/l]

12.0

Sum-parameters [mg/l]

NPOC 09 TIC 64.8

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|--------------------|--------|--------------------------|-------------------|
| K^+ | 35.4 | 0.905 | 1.9 | Cl^- | 1167 | 32.920 | 65.4 |
| Na^+ | 548 | 23.836 | 48.7 | SO_4^{2-} | 593 | 12.346 | 24.5 |
| Mg^{2+} | 90.2 | 7.418 | 15.2 | HCO_3^- | 300 | 4.916 | 9.8 |
| Ca^{2+} | 335 | 16.717 | 34.2 | NO_3^- | 6.61 | 0.107 | 0.2 |
| Sr^{2+} | 2.12 | 0.048 | 0.1 | Br^- | 1.30 | 0.016 | 0.0 |
| Sum | | 48.937 | Error 2.8% | Sum | | 50.323 | |

Uncharged species [mg/l]

SiO_2 26.0

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 5.00 | Co^{2+} | 0.031 | Cu^{2+} | 4.23 | Fe^{2+} | 2.00 | Li^+ | 38.0 |
| Mn^{2+} | 105 | NH_4^+ | 30.0 | Ni^{2+} | 0.120 | Pb^{2+} | 0.240 | Zn^{2+} | 14.5 |
| PO_4^{3-} | 250 | NO_2^- | <5.00 | BO_2^- | 570 | F^- | 31.0 | | |
| Ag | 0.031 | As | 0.890 | Ba | 111 | Be | 0.002 | Bi | 0.001 |
| Cd | 0.019 | Ce | 0.011 | Cr | 0.320 | Cs | 0.008 | Dy | 0.003 |
| Er | 0.001 | Eu | 0.001 | Ga | 0.007 | Gd | 0.002 | Ge | 0.030 |
| Hf | 0.001 | Hg | <0.010 | Ho | 0.000 | La | 0.007 | Lu | 0.001 |
| Mo | 3.86 | Nb | 0.003 | Nd | 0.006 | Pr | 0.001 | Rb | 3.61 |
| Sb | 0.015 | Sc | <1.000 | Se | 0.800 | Sm | 0.002 | Sn | 0.006 |
| Ta | 0.001 | Tb | 0.000 | Te | 0.005 | Th | 0.005 | Ti | 0.340 |
| Tl | 0.005 | Tm | 0.000 | U | 10.7 | V | 5.20 | W | 0.069 |
| Y | 0.016 | Yb | 0.002 | Zr | 0.010 | | | | |

It is a very hard Na^+ - Ca^{2+} - Cl^- - SO_4^{2-} -brackish water.

Sample-ID

WW41184

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

5780 EC, calc. [$\mu\text{S}/\text{cm}$]

6275

Total dissolved solids, TDS, calc. [mg/l]

3755

pH

7.1

Total hardness [mmol/l]

14.4

Sum-parameters [mg/l]

NPOC 12 TIC 68.3

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|--------------------|--------|--------------------------|-------------------|
| K^+ | 39.6 | 1.013 | 1.7 | Cl^- | 1351 | 38.110 | 62.4 |
| Na^+ | 657 | 28.578 | 48.9 | SO_4^{2-} | 851 | 17.718 | 29.0 |
| Mg^{2+} | 110 | 9.046 | 15.5 | HCO_3^- | 317 | 5.195 | 8.5 |
| Ca^{2+} | 396 | 19.760 | 33.8 | NO_3^- | 1.19 | 0.019 | 0.0 |
| Sr^{2+} | 2.58 | 0.059 | 0.1 | Br^- | 1.73 | 0.022 | 0.0 |
| Sum | | 58.473 | Error 4.4% | Sum | | 61.081 | |

Uncharged species [mg/l]

SiO_2 26.5

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 23.0 | Co^{2+} | 0.166 | Cu^{2+} | 0.530 | Fe^{2+} | 25.0 | Li^+ | 32.0 |
| Mn^{2+} | 216 | NH_4^+ | 10.00 | Ni^{2+} | 0.290 | Pb^{2+} | 0.110 | Zn^{2+} | 5.70 |
| PO_4^{3-} | 270 | NO_2^- | <5.00 | BO_2^- | 520 | F^- | 39.0 | | |
| Ag | 0.012 | As | 0.560 | Ba | 108 | Be | 0.007 | Bi | 0.000 |
| Cd | 0.018 | Ce | 0.055 | Cr | 0.280 | Cs | 0.015 | Dy | 0.008 |
| Er | 0.004 | Eu | 0.004 | Ga | 0.018 | Gd | 0.010 | Ge | 0.020 |
| Hf | 0.003 | Hg | 0.000 | Ho | 0.002 | La | 0.032 | Lu | 0.001 |
| Mo | 3.99 | Nb | 0.016 | Nd | 0.029 | Pr | 0.008 | Rb | 4.29 |
| Sb | 0.017 | Sc | <1.000 | Se | 0.380 | Sm | 0.009 | Sn | 0.022 |
| Ta | 0.002 | Tb | 0.001 | Te | 0.013 | Th | 0.008 | Ti | 5.06 |
| Tl | 0.017 | Tm | 0.001 | U | 15.6 | V | 4.30 | W | 0.240 |
| Y | 0.033 | Yb | 0.003 | Zr | 0.013 | | | | |

It is a very hard Na^+ - Ca^{2+} - Cl^- - SO_4^{2-} -brackish water.

Sample-ID

WW41188

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

2270 EC, calc. [$\mu\text{S}/\text{cm}$]

2356

Total dissolved solids, TDS, calc. [mg/l]

1514

pH

7.2

Total hardness [mmol/l]

5.3

Sum-parameters [mg/l]

NPOC 06 TIC 55.8

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 21.2 | 0.542 | 2.4 | Cl ⁻ | 468 | 13.202 | 56.9 |
| Na ⁺ | 266 | 11.570 | 50.9 | SO ₄ ²⁻ | 251 | 5.226 | 22.5 |
| Mg ²⁺ | 36.6 | 3.010 | 13.2 | HCO ₃ ⁻ | 267 | 4.376 | 18.9 |
| Ca ²⁺ | 152 | 7.585 | 33.4 | NO ₃ ⁻ | 22.5 | 0.363 | 1.6 |
| Sum | | 22.739 | Error 2.0% | Sum | | 23.193 | |

Uncharged species [mg/l]

SiO₂ 27.4

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 5.00 | Co ²⁺ | 0.092 | Cu ²⁺ | 0.380 | Fe ²⁺ | 3.00 | Li ⁺ | 35.0 |
| Mn ²⁺ | 143 | NH ₄ ⁺ | <10.00 | Ni ²⁺ | 0.180 | Pb ²⁺ | 0.050 | Sr ²⁺ | 915 |
| Zn ²⁺ | 3.80 | | | | | | | | |
| PO ₄ ³⁻ | 200 | NO ₂ ⁻ | <5.00 | BO ₂ ⁻ | 440 | F ⁻ | 95.0 | Br ⁻ | 801 |
| Ag | 0.001 | As | 0.690 | Ba | 49.0 | Be | 0.010 | Bi | 0.000 |
| Cd | 0.009 | Ce | 0.010 | Cr | 0.050 | Cs | 0.007 | Dy | 0.003 |
| Er | 0.003 | Eu | 0.001 | Ga | 0.006 | Gd | 0.002 | Ge | 0.020 |
| Hf | 0.001 | Hg | 0.000 | Ho | 0.001 | La | 0.005 | Lu | 0.000 |
| Mo | 2.97 | Nb | 0.001 | Nd | 0.006 | Pr | 0.001 | Rb | 2.01 |
| Sb | 0.010 | Sc | <1.000 | Se | 1.77 | Sm | 0.002 | Sn | 0.134 |
| Ta | 0.000 | Tb | 0.000 | Te | 0.009 | Th | 0.008 | Ti | 0.190 |
| Tl | 0.004 | Tm | 0.001 | U | 6.36 | V | 6.70 | W | 0.205 |
| Y | 0.021 | Yb | 0.003 | Zr | 0.002 | | | | |

It is a hard Na⁺-Ca²⁺-Cl-SO₄²⁻-brackish water.

Sample-ID

WW41189

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

2660 EC, calc. [$\mu\text{S}/\text{cm}$]

2951

Total dissolved solids, TDS, calc. [mg/l]

1843

pH

2.5

Total hardness [mmol/l]

6.7

Sum-parameters [mg/l]

NPOC

0.4

TIC

54.2

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 23.8 | 0.609 | 1.9 | Cl^- | 606 | 17.094 | 59.7 |
| Na^+ | 333 | 14.485 | 45.4 | SO_4^{2-} | 320 | 6.663 | 23.3 |
| Mg^{2+} | 48.7 | 4.005 | 12.6 | HCO_3^- | 272 | 4.458 | 15.6 |
| Ca^{2+} | 189 | 9.431 | 29.6 | NO_3^- | 23.4 | 0.377 | 1.3 |
| Sr^{2+} | 1.07 | 0.025 | 0.1 | Br^- | 1.12 | 0.014 | 0.0 |
| H^+ | | 3.311 | 10.4 | | | | |
| | Sum | 31.873 | Error 10.7% | Sum | 28.622 | | |

Uncharged species [mg/l]

SiO_2

23.9

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 4.00 | Co^{2+} | 0.043 | Cu^{2+} | 0.230 | Fe^{2+} | <3.00 | Li^+ | 35.0 |
| Mn^{2+} | 60.0 | NH_4^+ | <10.00 | Ni^{2+} | 0.140 | Pb^{2+} | 0.050 | Zn^{2+} | 4.60 |
| PO_4^{3-} | 180 | NO_2^- | <5.00 | BO_2^- | 430 | F^- | 82.0 | | |
| Ag | 0.009 | As | 0.640 | Ba | 61.0 | Be | 0.003 | Bi | 0.000 |
| Cd | 0.009 | Ce | 0.015 | Cr | 0.690 | Cs | 0.005 | Dy | 0.004 |
| Er | 0.001 | Eu | 0.000 | Ga | 0.010 | Gd | 0.002 | Ge | 0.030 |
| Hf | 0.002 | Hg | 0.000 | Ho | 0.001 | La | 0.008 | Lu | 0.000 |
| Mo | 2.82 | Nb | 0.002 | Nd | 0.008 | Pr | 0.002 | Rb | 2.19 |
| Sb | 0.015 | Sc | <1.000 | Se | 2.31 | Sm | 0.002 | Sn | 0.009 |
| Ta | 0.001 | Tb | 0.001 | Te | 0.012 | Th | 0.006 | Ti | 0.490 |
| Tl | 0.003 | Tm | 0.001 | U | 10.00 | V | 6.10 | W | 0.135 |
| Y | 0.014 | Yb | 0.001 | Zr | 0.006 | | | | |

It is a very hard Na^+ - Ca^{2+} - Cl^- - SO_4^{2-} -brackish water.

Sample-ID

WW41190

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

1730 EC, calc. [$\mu\text{S}/\text{cm}$]

1738

Total dissolved solids, TDS, calc. [mg/l]

1097

pH

7.2

Total hardness [mmol/l]

3.8

Sum-parameters [mg/l]

NPOC

0.4

TIC

40.1

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|--------------------|--------------------------|--|-------------------|
| K^+ | 18.4 | 0.471 | 2.8 | Cl^- | 404 | 11.396 | 67.1 |
| Na^+ | 207 | 9.004 | 52.8 | SO_4^{2-} | 107 | 2.228 | 13.1 |
| Mg^{2+} | 31.7 | 2.607 | 15.3 | HCO_3^- | 190 | 3.114 | 18.3 |
| Ca^{2+} | 99.0 | 4.940 | 29.0 | NO_3^- | 14.1 | 0.227 | 1.3 |
| Sum | 17.042 | | Error 0.4% | Sum | 16.983 | | |

Uncharged species [mg/l]

SiO_2 24.6

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 4.00 | Co^{2+} | 0.021 | Cu^{2+} | 0.240 | Fe^{2+} | <3.00 | Li^+ | 32.0 |
| Mn^{2+} | 3.00 | NH_4^+ | <10.00 | Ni^{2+} | 0.110 | Pb^{2+} | 0.030 | Sr^{2+} | 681 |
| Zn^{2+} | 4.50 | | | | | | | | |
| PO_4^{3-} | 160 | NO_2^- | <50.0 | BO_2^- | 470 | F^- | 43.0 | Br^- | 204 |
| Ag | 0.005 | As | 0.620 | Ba | 55.0 | Be | 0.007 | Bi | 0.001 |
| Cd | 0.007 | Ce | 0.006 | Cr | 0.940 | Cs | 0.005 | Dy | 0.001 |
| Er | 0.001 | Eu | 0.002 | Ga | 0.009 | Gd | 0.002 | Ge | 0.030 |
| Hf | 0.000 | Hg | 0.000 | Ho | 0.000 | La | 0.004 | Lu | 0.000 |
| Mo | 2.68 | Nb | 0.001 | Nd | 0.006 | Pr | 0.001 | Rb | 1.76 |
| Sb | 0.010 | Sc | <1.000 | Se | 0.680 | Sm | 0.001 | Sn | 0.009 |
| Ta | 0.000 | Tb | 0.000 | Te | 0.006 | Th | 0.001 | Ti | 0.170 |
| Tl | 0.003 | Tm | 0.000 | U | 2.98 | V | 7.10 | W | 0.206 |
| Y | 0.007 | Yb | 0.001 | Zr | 0.003 | | | | |

It is a hard Na^+ - Ca^{2+} - Cl^- -brackish water.

Sample-ID

WW41191

Location

alluvial aquifer, Swakop/Khan

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

2510 EC, calc. [$\mu\text{S}/\text{cm}$]

3135

Total dissolved solids, TDS, calc. [mg/l]

1944

pH

7.2

Total hardness [mmol/l]

7.2

Sum-parameters [mg/l]

NPOC

0.4

TIC

59.4

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------|--------------------------|-------------------|--------------------|--------|--------------------------|-------------------|
| K^+ | 27.8 | 0.711 | 2.3 | Cl^- | 659 | 18.590 | 61.4 |
| Na^+ | 352 | 15.311 | 50.2 | SO_4^{2-} | 322 | 6.704 | 22.1 |
| Mg^{2+} | 61.7 | 5.074 | 16.6 | HCO_3^- | 276 | 4.523 | 14.9 |
| Ca^{2+} | 188 | 9.381 | 30.7 | NO_3^- | 27.1 | 0.437 | 1.4 |
| Sr^{2+} | 1.34 | 0.031 | 0.1 | Br^- | 1.43 | 0.018 | 0.1 |
| Sum | | 30.514 | Error 0.7% | Sum | | 30.290 | |

Uncharged species [mg/l]

SiO_2 26.4

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|--------------------|-------|------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al^{3+} | 5.00 | Co^{2+} | 0.014 | Cu^{2+} | 0.190 | Fe^{2+} | <3.00 | Li^+ | 35.0 |
| Mn^{2+} | 3.00 | NH_4^+ | <10.00 | Ni^{2+} | 0.070 | Pb^{2+} | 0.090 | Zn^{2+} | 4.00 |
| PO_4^{3-} | 120 | NO_2^- | <5.00 | BO_2^- | 530 | F^- | 86.0 | | |
| Ag | 0.007 | As | 0.660 | Ba | 55.0 | Be | 0.001 | Bi | 0.000 |
| Cd | 0.007 | Ce | 0.023 | Cr | 0.480 | Cs | 0.006 | Dy | 0.002 |
| Er | 0.001 | Eu | 0.003 | Ga | 0.003 | Gd | 0.004 | Ge | 0.030 |
| Hf | 0.002 | Hg | 0.000 | Ho | 0.000 | La | 0.007 | Lu | 0.000 |
| Mo | 2.69 | Nb | 0.005 | Nd | 0.008 | Pr | 0.002 | Rb | 2.17 |
| Sb | 0.018 | Sc | <1.000 | Se | 4.97 | Sm | 0.002 | Sn | 0.008 |
| Ta | 0.001 | Tb | 0.000 | Te | 0.007 | Th | 0.004 | Ti | 1.06 |
| Tl | 0.004 | Tm | 0.000 | U | 10.9 | V | 6.30 | W | 0.411 |
| Y | 0.009 | Yb | 0.002 | Zr | 0.007 | | | | |

It is a very hard Na^+ - Ca^{2+} - Cl^- - SO_4^{2-} -brackish water.

| | | | |
|--|---|------|--|
| Sample-ID | Swakomund | | |
| Location | public water supply | | |
| Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)] | 1717 EC, calc. [$\mu\text{S}/\text{cm}$] | 1696 | |
| | Total dissolved solids, TDS, calc. [mg/l] | 1115 | |
| pH | 7.7 | | |
| Total hardness [mmol/l] | 3.4 | | |

Sum-parameters [mg/l]

NPOC 0.4 TIC 46.5

Cations

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|
| K ⁺ | 12.2 | 0.312 | 1.8 |
| Na ⁺ | 227 | 9.874 | 58.2 |
| Mg ²⁺ | 23.7 | 1.949 | 11.5 |
| Ca ²⁺ | 96.0 | 4.790 | 28.2 |
| Sr ²⁺ | 1.29 | 0.030 | 0.2 |
| Sum | | 16.974 | Error 0.8% |

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|-------------------------------|--------------------------|--|-------------------|
| Cl ⁻ | 375 | 10.578 | 62.8 |
| SO ₄ ²⁻ | 96.5 | 2.009 | 11.9 |
| HCO ₃ ⁻ | 238 | 3.900 | 23.2 |
| NO ₃ ⁻ | 17.9 | 0.289 | 1.7 |
| BO ²⁻ | 0.910 | 0.021 | 0.1 |
| F ⁻ | 0.535 | 0.028 | 0.2 |
| Sum | | 16.834 | |

Uncharged species [mg/l]

SiO₂ 25.5

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 43.0 | Co ²⁺ | 0.068 | Cu ²⁺ | 9.67 | Fe ²⁺ | 64.0 | Li ⁺ | 60.0 |
| Mn ²⁺ | 4.00 | NH ₄ ⁺ | <10.00 | Ni ²⁺ | 1.54 | Pb ²⁺ | 1.91 | Zn ²⁺ | 83.0 |
| PO ₄ ³⁻ | 110 | NO ₂ ⁻ | <5.00 | Br ⁻ | 558 | | | | |
| Ag | 0.027 | As | 4.45 | Ba | 222 | Be | 0.028 | Bi | 0.006 |
| Cd | 0.052 | Ce | 0.077 | Cr | 2.31 | Cs | 0.140 | Dy | 0.011 |
| Er | 0.005 | Eu | 0.006 | Ga | 0.026 | Gd | 0.013 | Ge | 0.040 |
| Hf | 0.000 | Hg | 0.000 | Ho | 0.002 | La | 0.039 | Lu | 0.001 |
| Mo | 2.32 | Nb | 0.007 | Nd | 0.043 | Pr | 0.009 | Rb | 2.75 |
| Sb | 0.027 | Sc | <1.000 | Se | 1.14 | Sm | 0.009 | Sn | 0.065 |
| Ta | 0.000 | Tb | 0.002 | Te | 0.009 | Th | 0.003 | Ti | 2.14 |
| Tl | 0.002 | Tm | 0.001 | U | 14.4 | V | 12.2 | W | 0.208 |
| Y | 0.046 | Yb | 0.004 | Zr | 0.007 | | | | |

It is a hard Na⁺-Ca²⁺-Cl⁻-HCO₃⁻-brackish water.

Sample-ID

Walvisbay

Location

public water supply

Elec. conductivity, EC [$\mu\text{S}/\text{cm}$ (25°C)]

1106 EC, calc. [$\mu\text{S}/\text{cm}$]

1151

Total dissolved solids, TDS, calc. [mg/l]

842

pH

7.9

Sum-parameters [mg/l]

NPOC 10 TIC 52.6

Cations

Anions

| | [mg/l] | c_{eq} [mmol/l] | % c_{eq} | | [mg/l] | c_{eq} [mmol/l] | % c_{eq} |
|------------------|--------------------------|--|-------------------|-------------------------------|--------------------------|--|-------------------|
| K ⁺ | 15.0 | 0.384 | 3.2 | Cl ⁻ | 145 | 4.090 | 35.4 |
| Na ⁺ | 118 | 5.133 | 42.7 | SO ₄ ²⁻ | 125 | 2.603 | 22.5 |
| Mg ²⁺ | 29.4 | 2.418 | 20.1 | HCO ₃ ⁻ | 270 | 4.425 | 38.3 |
| Ca ²⁺ | 81.4 | 4.062 | 33.8 | NO ₃ ⁻ | 25.9 | 0.418 | 3.6 |
| Sum | | 12.009 | Error 3.9% | Sum | | 11.554 | |

Uncharged species [mg/l]

SiO₂ 30.8

Trace elements [$\mu\text{g}/\text{l}$]

| | | | | | | | | | |
|-------------------------------|-------|------------------------------|--------|------------------------------|-------|------------------|-------|------------------|-------|
| Al ³⁺ | 2.00 | Co ²⁺ | 0.017 | Cu ²⁺ | 4.69 | Fe ²⁺ | <3.00 | Li ⁺ | 24.0 |
| Mn ²⁺ | 3.00 | NH ₄ ⁺ | <10.00 | Ni ²⁺ | 0.360 | Pb ²⁺ | 0.000 | Sr ²⁺ | 379 |
| Zn ²⁺ | 19.8 | | | | | | | | |
| PO ₄ ³⁻ | 210 | NO ₂ ⁻ | <5.00 | BO ₂ ⁻ | 480 | F ⁻ | 75.0 | Br ⁻ | 111 |
| Ag | 0.002 | As | 1.78 | Ba | 8.00 | Be | 0.000 | Bi | 0.000 |
| Cd | 0.020 | Ce | 0.000 | Cr | 5.19 | Cs | 0.021 | Dy | 0.000 |
| Er | 0.001 | Eu | 0.001 | Ga | 0.011 | Gd | 0.001 | Ge | 0.030 |
| Hf | 0.004 | Hg | 0.000 | Ho | 0.000 | La | 0.006 | Lu | 0.000 |
| Mo | 4.85 | Nb | 0.024 | Nd | 0.001 | Pr | 0.000 | Rb | 4.06 |
| Sb | 0.012 | Sc | <1.000 | Se | 2.07 | Sm | 0.001 | Sn | 0.001 |
| Ta | 0.010 | Tb | 0.000 | Te | 0.006 | Th | 0.001 | Ti | 0.030 |
| Tl | 0.012 | Tm | 0.000 | U | 4.13 | V | 17.6 | W | 0.197 |
| Y | 0.003 | Yb | 0.001 | Zr | 0.023 | | | | |

It is a hard Na⁺-Ca²⁺-Mg²⁺-HCO₃⁻-Cl⁻-SO₄²⁻-water.