environmental sciences proceedings

MDPI

Proceedings Paper

The Hydrochemical Characteristics of Drinking Water in Central Settlements of Sukhbaatar Province, Eastern Mongolia †

Odsuren Batdelger *, Enkhjargal Togtokh, Oyun-Erdene Boldsaikhan, Renchinbud Badrakh and Gan-Erdene Enkhbold

Institute of Geography and Geo-Ecology, Mongolian Academy of Sciences, Mongolia;
email1@email.com (E.T.); email2@email.com (O.-E.B.); email3@email.com (R.B.); email4@email.com (G.-E.E.)
* Correspondence: odsurenb@mas.ac.mn
† Presented at the 7th International Electronic Conference on Water Sciences, 15–30 March 2023; Available online: https://ecws-7.sciforum.net.

Abstract: A focus of this study was to investigate water quality in the central settlement area of Sukhbaatar province, which is considered and characterized by semi-arid climate. A total of 47 water samples were collected from 13 soums in 2021, and major ions and trace elements were analyzed to evaluate the suitability of groundwater for drinking purposes. The dominant hydrochemical facies of groundwater were the Na-HCO_3 type, which represents 46.8% of the total analyzed samples. The water supply wells of Baruun-Urt soum, Asgat, Khalzan, and Erdenetsagaan soums does not meet the requirements of drinking water standards due to the content of magnesium, fluoride, and uranium ions. Also, the fluoride ion content in most wells exceeds the drinking water standard, while the fluoride content of Dariganga soum water was less than the drinking water standard, and Munkhkhaan soum was suitable.

Keywords: groundwater; hydrochemistry; semi-arid; sukhbaatar province

Citation: Batdelger, O.; Togtokh, E.; Boldsaikhan, O.-E.; Badrakh, R.; Enkhbold, G.-E. The Hydrochemical Characteristics of Drinking Water in Central Settlements of Sukhbaatar Province, Eastern Mongolia. *Environ. Sci. Proc.* **2023**, *5*, x. https://doi.org/10.3390/xxxxx

Academic Editor(s):

Published: 15 March 2023

1. Introduction

One of the main factors affecting the development of any country is clean and fresh water. Groundwater quality issues are crucial for sustainable water resources management in many countries worldwide, especially in arid and semi-arid regions. In the region, drinking water supply is mainly depending on the groundwater, and no surface water resources due to natural moisture supply conditions. There is a natural pattern of poor water quality due to poor groundwater recharge in the region. Chemical elements in drinking water could possibly affect human health [1].

The main objective of this work was to study drinking water quality of the soum centers in the Sukhbaatar province.

2. Materials and Methods

The Sukhbaatar province has a total area of 82.3 thousand km^2 and is included in the steppe zone. In terms of climate, dry, cool summer and cold winters, the average temperature in July is +21.3 °C, and the average temperature in January is −19.9 °C [2].

We collected 43 groundwater (GW) and 4 spring water samples from soum centers in June (summer), 2021 (Figure 1). All sampling sites were used for drinking water supply. Electrical conductivity (EC), Total Dissolved Solid (TDS), pH, ORP, water temperature were measured by Multiparameter Hanna HI98195 on-site. The sampling site locations were verified using a portable GPS meter (GPSMAP 76S; Garmin Ltd.). All water samples were sealed in 1000 mL (anion & cation) and 100 mL (heavy metal) polyethylene bottles

for chemical analysis. We measured Ca^{2+}, Mg^{2+}, Na^{+}, K^{+} and HCO_3^{-}, Cl^{-} were measured via titration. NH_4^{+}, NO_2^{-}, NO_3^{-}, SO_4^{2-}, F, Fe were analyzed by T-60 U spectrophotometer. The heavy metals were analyzed with ICP.

As a quality check on the analysis, the charge balance error (CBE ± 10%) was calculated using the following equation, and the calculated error did not exceed ±10%. The data were compared to the Mongolian standard (MNS0900:2018) [3].

$$CBE = \frac{\sum cations(eq) - |\sum anions|}{\sum cations(eq) + |\sum anions|} \times 100\% \quad (1)$$

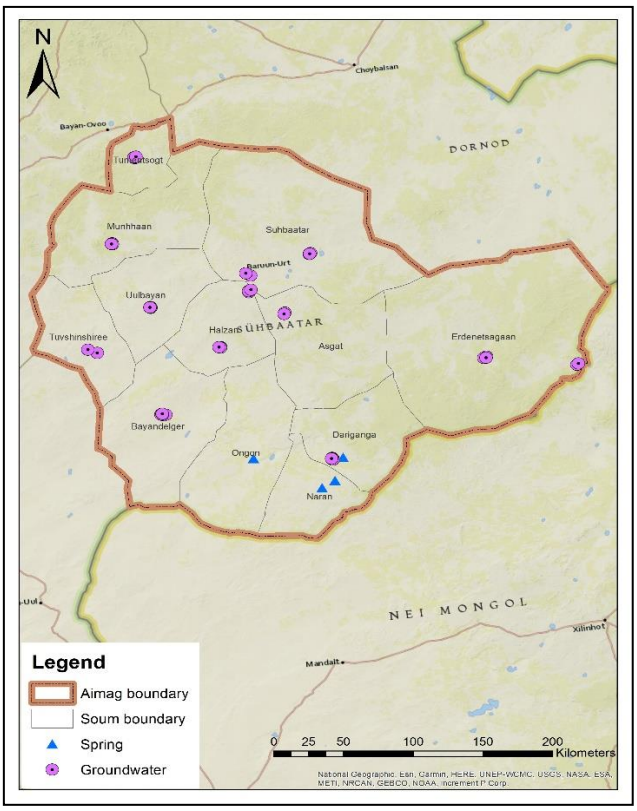

Figure 1. Study area.

3. Results and Discussion

Figure 2 shows classification of the hydro-chemical characteristics of water samples based on the main ion concentrations. The dominant hydro-chemical facies of groundwater were the Na-HCO_3 type, which represents 46.8% of the total analyzed samples, while Ca-HCO_3, HCO_3-mixed type each represents 17%, HCO_3-Na-Mg, HCO_3-Mg-Na type each represent 8.5%, and mixed-Na-Mg type represent 2.1% of the total samples (Figure 2). The water supply wells of Baruun-Urt soum and Asgat, Khalzan, and Erdenetsagaan soums does not meet the requirements of drinking water standards due to the content of magnesium, fluorine, and uranium ions. Also, the fluoride ion content in most wells exceeds the drinking water standard, while the fluoride content of Dariganga soum water was less than the drinking water standard, and Munkhkhaan Sum was suitable. Almost 60% of the water samples exceeds the standard by magnesium.

21 or 44.7% of all samples do not meet drinking water standards due to uranium content, and 11 or 23.4% of all samples have nitrate pollution. These findings suggests that appropriate groundwater management and the protection of public health in the Sukhbaatar province.

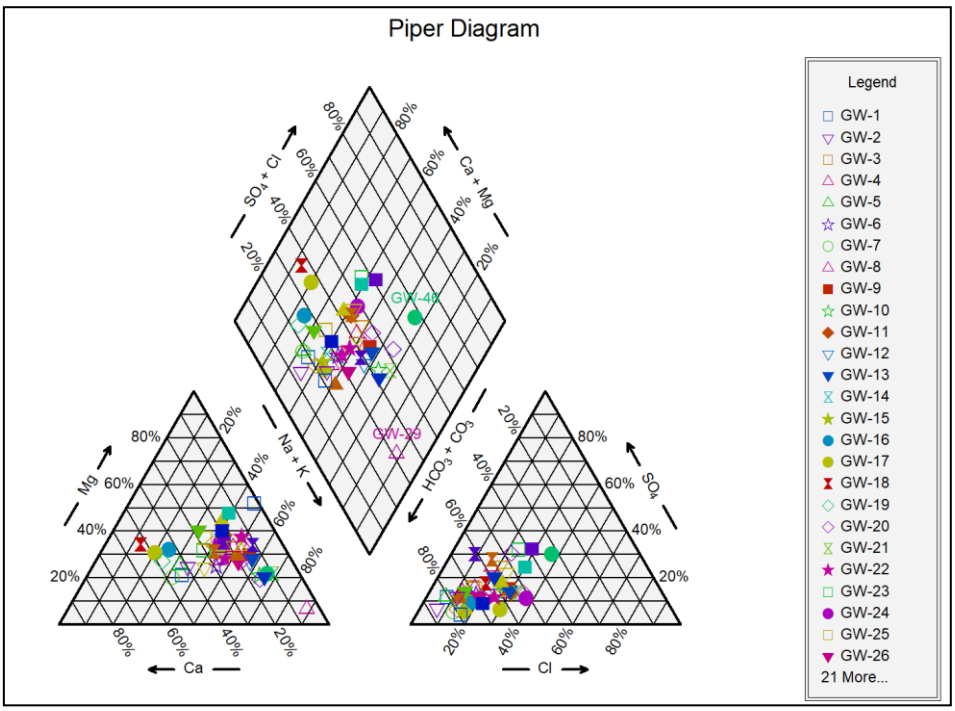

Figure 2. Piper diagram of the collected water samples in the study area.

Gibbs diagram used for the geochemical evolution of groundwater as evaluating evaporation, weathering and precipitation in arid and semi-arid regions [4]. We can see in Figure 3, most of the samples plotted in the field of rock dominance area, indicating that the main geochemical process is rock-water interaction in the study area.

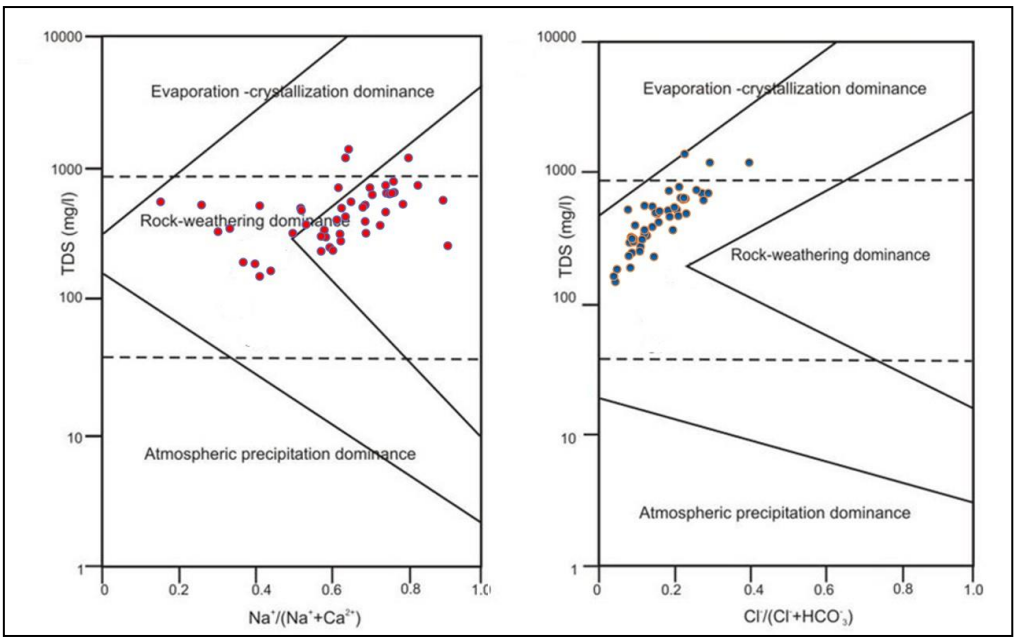

Figure 3. Gibbs diagram of water samples in the study area.

4. Conclusions

A total of 47 water samples were collected from 13 soums to study the suitability of groundwater for drinking purposes. The major conclusions are:

1. The Na-HCO_3 type represents 46.8% of the total samples.

2. 11 soum center's drinking water do not meet drinking water standard by fluoride ion out of 13 soums, Dariganga soum water was less than the standard, and Munkhkhaan soum was suitable
3. Magnesium, fluoride, uranium and nitrate were among the elements found higher than the standard, and the worst water soum was Baruun-Urt.

Author Contributions: O.B. wrote the paper and E.T. carried out data preparation. Field study performed by all. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Governor of Sukhbaatar province.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The authors acknowledge the financial support received by Governor of Sukhbaatar province.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Messeret, B. *Assessment of Drinking Water Quality and Determinants of Household Potable Water Consumption in Simada District, Ethiopia*; Cornell University: Ithaca, NY, USA, 2012.
2. Sukhbaatar, C.; Batdelger, B.; Togtokh, E.; Enkhbold, E.; Boldsaikhan, O.; Badrakh, R. *Drinking Water Quality Survey, Conclusions and Recommendations in the Soum Centers of Sukhbaatar Province*; Ulaanbaatar, Mongolia, 2021.
3. Drinking water. Hygienic requirements MNS 900:2018.
4. Gibbs, R.J. Mechanisms Controlling World Water Chemistry. *Science* **1970**, *170*, 1088–1090. https://doi.org/10.1126/science.170.3962.1088.