Republic of Yemen

Sana'a University
Faculty of Petroleum and Natural Resources

الجمهورية اليمنية

جـامعة صنعـاء
كليـــة البترول والموارد الطبيعية

Scientific report on the Master of Science degree obtained by Ibrahim Mahmood Al-Saghiry on a topic related to groundwater investigation of Al-Hodeidah city well fields, dated 5th November 2022.

Thesis title:

Hydrogeochemistry and Quality Assessment of Groundwater wells in Al-Baydda and Wadi Al-Qutay Regions, Al-Hodeidah Governorate, Yemen

This study was conducted on the groundwater wells owned by the Hodeidah Water and Sanitation Local Corporation (HWSLC), which is the provider of Al-Hodeidah City with household water. This work aims to assess the suitability of the groundwater of Al-Hodeidah City to be used for different purposes. Al-Hodeidah is the largest city in the Yemeni Tihama Coastal Plain with more than 1,000000 inhabitants. The targeted locations for this investigation are the Al-Baydda and Al-Qutay well fields. This study has utilized data obtained from HWSLC as well as data generated by this study of groundwater major ions for summer and winter seasons.

Results of the chemical investigations show that the salinization process is ubiquitous throughout the Al-Baydda aquifers indicating recent seawater intrusions, whereas the freshening process is widespread among samples collected from Al-Qutay well fields. Currently, Al-Qutay wells are the main supplier of potable water to the harbor city of Al-Hodeidah.

Chemical analyses of major ions of samples from Al-Bayda wells are in the following order $Na^{+} > Ca^{+2} > Mg^{+2} > K^{+}$ and $Cl^{-} > SO_4^{-2} > HCO_3^{-} > NO_3^{-}$ to indicate salinization processes. On the other hand, samples of Wadi Al-Qutay show different trends in major ions arrangement, suggesting different sources for the solute ions controlling the chemistry of groundwater in the region. Generally, the ion composition tends to be arranged in the following order: $Na^{+} > Mg^{+2} > Ca^{+2} > K^{+}$ and $Cl^{-} > HCO_3^{-} > SO_4^{-2} > NO_3^{-}$.

Saturation indices (SI) point to the tendency of water to dissolve evaporite minerals, and precipitate calcite and dolomite. The results of ionic relationships and ionic ratios of the Al-Baydda region's samples provide some indications for seawater intrusion into groundwater. This intrusion was more noticeable in the summer (rainy season) samples than in the winter (dry season).

This increase may be justified by the increase in the groundwater abstraction from the wells to meet the water demands in the summer season. The low concentrations of calcium and magnesium ions in both seasons are due to calcite and dolomite precipitation. Nitrate (NO_3^{-}) concentrations are high in both collections to reflect anthropogenic activities in the region represented by extensive use of fertilizers in the agricultural areas, and/or the possible infiltration of sewage water into the groundwater aquifers.

The spatial distribution map for the nitrate ion concentrations of Al-Baydda water samples in the winter (dry season) analyses shows a southwest gradual increase towards the direction of the sewage

ص.ب. : 13295 صنعاء تلفون 464733-

Tel: 464733 – P.O.Box 13295 Sana'a

Email: fpnr.info@su.edu.ye

treatment plant in Al-Hodeidah city to suggest possible existence of reverse flow for the groundwater movement from west to east during winter (dry season).

This study shows that the groundwater of Al-Baydda wells is unsuitable for drinking and domestic uses, because of the concentration of some ions that exceed the maximum permissible limits outlined by the Yemeni standard specifications for public drinking water (YSSPDW), 1999, and WHO standards. However, samples from Wadi Al-Qutay are of better quality and can be used for crop irrigation depending on the irrigation water quality indices used (EC, SAR, RSC, PI, Na%, KR, MH). High levels of salinity may negatively affect the crop types and their productivity.

Republic of Yemen

Sana'a University
Faculty of Petroleum and Natural Resources

الجمهورية اليمنية

جـامعة صنعـاء
كليـــة البترول والموارد الطبيعية

تلفون 464733- ص.ب. : 13295 صنعاء

Tel: 464733 – P.O.Box 13295 Sana'a

Email: fpnr.info@su.edu.ye