

WATER QUALITY UNDER SINAI PENINSULA "EGYPT"

M.SH. DIAB and I.H. HIMIDA

Menoufia University and Desert Institute, Cairo, Egypt

ABSTRACT

The regional hydrochemical studies for the groundwater occurrences under Sinai Peninsula indicate the following:

1. The majority of water occurring at different localities are of saline to highly saline nature. At some places fresh to brackish water is present.
2. The best quality of water has been encountered in wadi sillings where the wadies run over the basement or metamorphic rocks.
3. The hydrochemical aspects of the wadi deposits show some regularities e.g. wadi El Arish.
4. In the oil fields the groundwater of Miocene, Eocene, Cretaceous is characterized by very high salinity, the only exception for this is the deep lying water of Jurassic and Nubian aquifers at Ayun Mousa.

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INTRODUCTION

The Sinai Peninsula occupies a strategic position from the Egyptian territories. It acts as natural connection between Africa and Asia. The tremendous potentialities of Sinai in mining, oil exploration and exploitation, recreation and touristic projects, and land reclamation projects make it necessary to develop water resources plans to meet requirements. The arid conditions prevailing this area indicate the insufficiency in surface water resources, hence, the exploration for groundwater resources is of importance. The quality of the groundwater is of utmost roll for the mentioned important activities. In geological and hydrogeological informatinos indicate that Sinai Peninsula contains the following groundwater bearing formations:

1. Dune water accumulation
2. Quaternary water bearing formation
3. Miocene water bearing formation
4. Eocene water bearing formation
5. Cretaceous water bearing formation (Nubian?)
6. Jurassic water bearing formations
7. Weathered basement rocks bearing formations

In addition a discussion in brief for the quality of groundwater of the mentioned water bearing formation will be attempted.

### 1. Quality of groundwater accumulations in the sand dunes of northern Sinai

The groundwater accumulated within the sand dunes are of limited quantities, since the dunes recharge on behalf of rain falls on northern Sinai amounts an average of about 100 mm/year. The water of these dunes are of fresh to brackish nature, salinity ranges between 400 - 800 ppm. The hydrochemical type is mainly  $\text{HCO}_3$  - ca with dominant bicarbonate salt.

### 2. Quality of groundwater of quaternary aquifers

The quaternary aquifer is mainly composed of sands, sandstones, gravels and wadi fillings. The quaternary aquifer have been encountered at variable depths in wadi sudr, wadi El Qaa, Sahl Al Tina, Wadi El Tayiba.

Groundwater of under these localities is mainly brackish; total dissolved solids range between 2000 and 5300 ppm. The main chemical type of these groundwater occurrences is chloride, sulphate - sodium, calcium. The  $\text{Na}/\text{Cl}$  ionic ratio ranges between 0.24 to 0.49, whileas the ionic ratio  $\text{So}_4/\text{Cl}$  ranges between 0.19 to 0.79. Under the surface of Wadi El Arish the area is dominated by a thick layer composed of sands, gravels, our local name 'Fagra'. The Fagra formation under the Delta of Wadi El Arish contains a very big aquifer recharge its water on behalf of the infiltrated run off water from the southern high lands (El Tih plateau) and from the local rainfall. The chemical analysis of this water indicates that it is of brackish salinity, the total dissolved salts range between 1000 to 2500 ppm. The groundwater salinity increase is in SW-NE direction. The water quality of this water is mainly bicarbonate, however sulphate water also is present in the vicinity of Nakhl the groundwater at a depth of 16 m has brackish nature (T.D. 5.3.8. gm/l) and is of chloride, sulphate - sodium type. However, at El Gedayrat area the groundwater of the Wadi fillings belongs to quaternary is of more fresh nature (T.D.S. 1.5. gm/l) and the water is of chloride-sodium type. It follows from the above mentioned that the groundwater of Wadi El Arish and tributaries may be utilized for water supply and irrigation though the quantity of water does not cover completely the requirements.

### 3. Quality of the Miocene formation water

Formation groundwater belongs to Miocene have been encountered at different places along the Gulf of Suez e.g. Asal, Neburi, Sudr, Matarma, Ayn Mousa and Ras Misalla. These deep groundwater occurrences under this area have been tapped by deep bores drilled for oil, coal and other mineral deposits. Although the wells are located very close, they hit water bearing formations at different depths. The chemical studies on these water occurrences indicate that they are of very high salinity; as the salinity ranges between 45600 to 60400 ppm at Asal, 41500 to 85000 ppm at Neburi, 27000 to 67000 ppm at Sudr, 36500 to 64000 ppm at Matarma, 5000 to 8000 ppm at Ayun Mousa and

2500 to 2700 ppm at Ras Misalla. The groundwater chemical type is mainly chloride-sodium and the water is of nonsatisfactory quality for irrigation. The value of  $\frac{Na}{Cl}$  ionic ratio ranges between 0.86 and 0.95 and that of  $\frac{SO_4}{Cl}$  ionic ratio amounts to 0.001 whereas the value of  $\frac{Ca}{Mg}$  ionic ratio amounts to 6.9. This indicates that this water is of sea origin and been contaminated with oil and gas accumulation within the aquifer.

#### 4. Quality of the Eocene formation water

Formation groundwater belongs to Eocene have been also encountered at different places along the Eastern side of the Gulf of Suez e.g. at Asal, Neburi, Ras Sudr and Matarma. The chemical studies on Eocene formation water indicate that the water is of very high salinity. The salinity values range between 8600 to 25000 ppm at Asal, 10 000 - 30 000 ppm at Nebwi, 7000 to 9300 ppm at Sudr and 8500 to 201 200 ppm at Matarma. These high salinity values are the result of the contamination of the old sedimentation water of Eocene with gas and oil in addition to other factors (solubility, ionic exchange ...). The groundwater of Eocene is of chloride - sodium type and is of bad quality for human use. The values of the ionic ratios range between 0.77 to 0.92 for  $\frac{Na}{Cl}$ , 0.61 to 0.213 for  $\frac{SO_4}{Cl}$  and 2.66 - 3.5 for  $\frac{Ca}{Mg}$  at the different places of occurrence of the Eocene formational water.

#### 5. Quality of Lower Cretaceous groundwater (Nubian water)

Lower Cretaceous groundwater have been encountered at Ayun Mousa and Lagia localities on the eastern shore of the Gulf of Suez. The water bearing formations have been encountered at a depth varying between 62 to 250 m at Ayun Mousa and 1000 m at Lagia. Nubian groundwater at Ayun Mousa is mainly brackish ( T.D. 5 range from 5.2 to 5.8 gm/l). The water chemical type is mainly chloride, sulphate - sodium calcium with ionic ratios ranging between 0.77 to 0.92 for  $\frac{Na}{Cl}$ , 0.061 to 0.213 for  $\frac{SO_4}{Cl}$  and 2.68 to 3.5 for  $\frac{Ca}{Mg}$  at Lagia Nubian groundwater is abnormal high salinity (T.D. 5 range between 17 000 to 153 100 ppm). The water chemical type is of chloride - sodium type.

#### 6. Quality of Jurassic groundwater

The Jurassic groundwater is mainly developed at Ayun Mousa area. It has been encountered at different depths ranging between 528 to 650 m with a thickness of about 200 - 400 m and hydrostatic pressure of 40 - 50 m above sea level. The water chemical type is chloride, sulphate - sodium, calcium. It could be mentioned that groundwater quality of Jurassic is of better salinity and type than that of the Miocene.

### 7. Quality of groundwater of the weathered igneous rocks

The groundwater associated with the igneous rocks of the mountainous country of southern and central Sinai. A vast network of Wadies in the area of weathered igneous rocks drains the fractured zone at Wadi Ferran, Wadi Sidri, Wadi El Hamma. The groundwater salinity ranges between 1.07 gm/l and 2.3 gm/l at Wadi Feiran, Wadi Sidri and Wadi El Hamma, i.e. the water is of fresh to slightly brackish salinity, unfortunately the water quantities are very limited and their utilization for water supply of local population or industry or for irrigation is very difficult.

### 8. Hot springs of Sinai

Sinai Peninsula has a great number of springs, the most famous of which are Ayun Mousa springs, Hamman Fara'aun springs, Elu Tor and Sydra Mousa Springs. Most of these springs issues along fault planes (still active) affecting Tertiary rocks lying unconformable on the Lower Cretaceous (Nubian Sandstone). The salinity of the groundwater of these springs are tabulated on table 1. The water of these springs could be used according to their physical properties in recreation and touristic purposes as they are of historical and medical values.

#### REFERENCES

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