Hydrogeological and Environmental Studies of Water Resources in Wadi El-Natrun, Western Desert, Egypt

ノハ, モハメド, マシャール

（様式３）

氏 名：ノハ　モハメド　マシャール

論 文 名：Hydrogeological and Environmental Studies of
Water Resources in Wadi El-Natrun, Western Desert, Egypt
(エジプトウェスタンデザート、ワディ エル - ナトゥルンの水資源についての
水文学的環境学的研究)

区　　分　：　甲

論　文　内　容　の　要　旨

Providing sustainable sources of water in arid area for a growing population is a great challenge. This thesis outlines the climatic changes in Wadi El-Natrun area using hydrochemistry and isotope hydrology to address water resources and to quantify the sources and processes that govern the storage and movement of water on the area of study. The objectives of the current study can be summarized as follows:

1. Assemble ground-water quality data along successive four years.
2. Hydrochemical characterizations of the groundwater, identifying major anions and cations.
3. Identify origin of the groundwater using ^{18}O and ^{2}H isotopes to determine recharging sources.
4. Mechanism controlling variation among wells.
5. Evaluation of the groundwater suitability for different purposes.

Field and laboratory experiments were used to achieve the objectives of the study. The field work was conducted to gather information about the status and seasonal changes on groundwater geochemistry. Laboratory experiments were conducted on samples collected from five surveys from December 2014 until March 2018. The first survey aimed to explore the investigation area and collect water samples. The first survey was followed by another four trips aimed at collecting seasonal water samples from the same studied wells in the 1st expedition.

This thesis is composed of five chapters which investigate the hydrogeology of Wadi El-Natrun. (1) Chapter one introduces an overview, objectives of the research and previous work. (2) Chapter two describes the geomorphology, stratigraphy and, structure. (3) Chapter three handles occurrence of the groundwater in Sahara and an overview of the Holocene climatic changes in Egypt and its surroundings. (4) Chapter four deals with geochemistry of groundwater, in addition to, stable O and H isotopic data that characterize sources of

groundwater in the aquifer. (5) Chapter five asses the current situation of groundwater for agricultural and domestic purposes.

The majority of the collected samples was found to belong to the Na-Cl-SO_4 water type; some samples to Na-SO_4-HCO_3 water type. Results of the environmental stable isotopes ($\delta^{18}O$ and $\delta^{2}H$) showed that groundwater is mainly recharged from fresh Nile and recent recharge of local precipitation and/or aquifer water supplied in the past time.

The isotopic content is more enriched compared to paleo-water and close to Nile Water. Peripheral wells show greater variation in total dissolved salt concentration and are likely to undergo more intense water loss. On the contrary, the aquifer in the centre is under stable condition. This is compatible with water chemistry difference among wells. Water loss is estimated by applying Rayleigh Equation to the variation ranges from zero (stable wells) into ~ 60% (unstable wells). The water of wells in the centre is recoverable as continuous feeding from the surface irrigation canals near the Wadi, in addition to local precipitation.

The process of evaporation has been conventionally considered as direct cause of water quality change. The current study shows that effect of evaporation is not important and the direct cause of salinization of aquifer is water consumption by agro-activity. This should intensify the water pressure gradient and induce water suction from the aquifers, leaving salt.