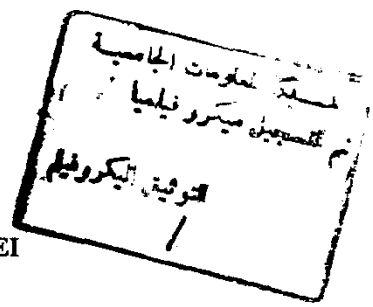
ISOTOPIC AND HYDROCHEMICAL STUDIES ON THE GROUNDWATER OF SINAI PENINSULA

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN SCIENCE

(Chemistry)



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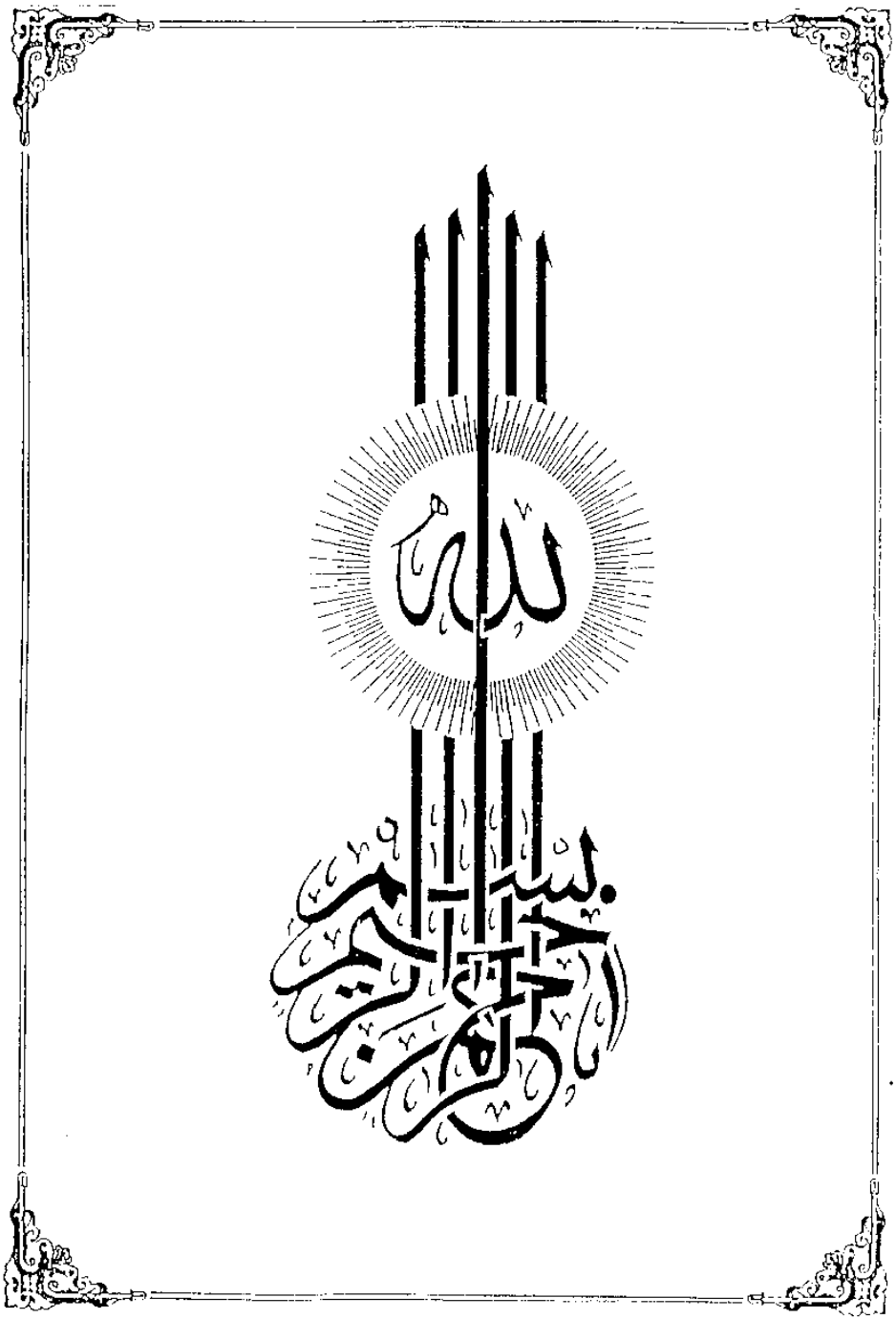

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Chapter (1)

Introduction

Chapter (1)

Introduction

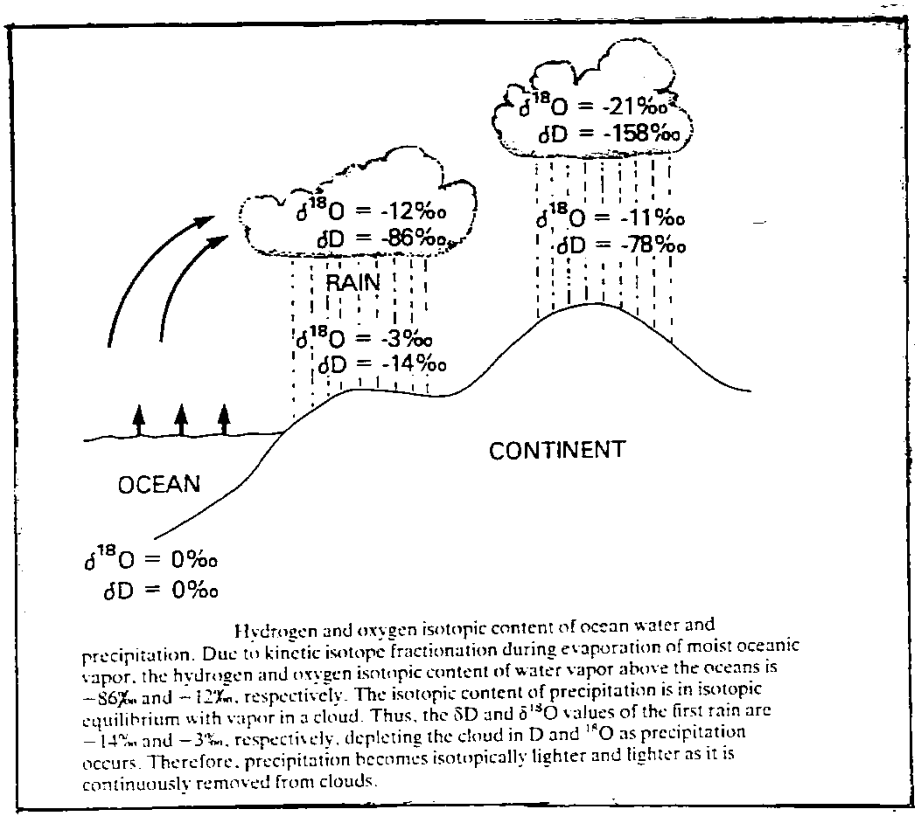
1.1 General outline

Water is located in all the regions of the earth, the problem is that the distribution, quality, quantity and mode of occurrence are highly variable from one location to another.

The most voluminous water source is the ocean, it's account for 90% of the total amount of water in the hydrosphere, three quarters of the total amount of precipitation falls down over the ocean and one-quarter over the land, the latter value consider as one-thirds of the precipitation, while the continental moisture formed two-third of the total precipitation over the land. The most valuable water supply in terms of quality or freshness contained within the atmosphere and on the earth's surface or underground, its distribution is dependent upon topographic and meteorological conditions as they influence precipitation and evapotranspiration.

Quantities of water stored are dependent to a large extent on the physical features of the earth and on the earth's geological structure as soil (type, moisture, permeability), ground cover, drainage conditions, depth of water table, intensity and volume of precipitation.

The processes that occur through the water cycle stages can be represented by both the stable isotopic changes ($\delta^{18}O$, δD) from the evaporated ocean water and precipitation due to kinetic isotope fractionation and the hydrochemical changes of water content as its reaches the ground through its passes and flow, these processes are shown in Fig(a,b).



Hydrogen and oxygen isotopic content of ocean water and precipitation. Due to kinetic isotope fractionation during evaporation of moist oceanic vapor, the hydrogen and oxygen isotopic content of water vapor above the oceans is −86‰ and −12‰, respectively. The isotopic content of precipitation is in isotopic equilibrium with vapor in a cloud. Thus, the δD and $\delta^{18}O$ values of the first rain are −14‰ and −3‰, respectively, depleting the cloud in D and ^{18}O as precipitation occurs. Therefore, precipitation becomes isotopically lighter and lighter as it is continuously removed from clouds.

Fig (a) Isotopic variation in water cycle.

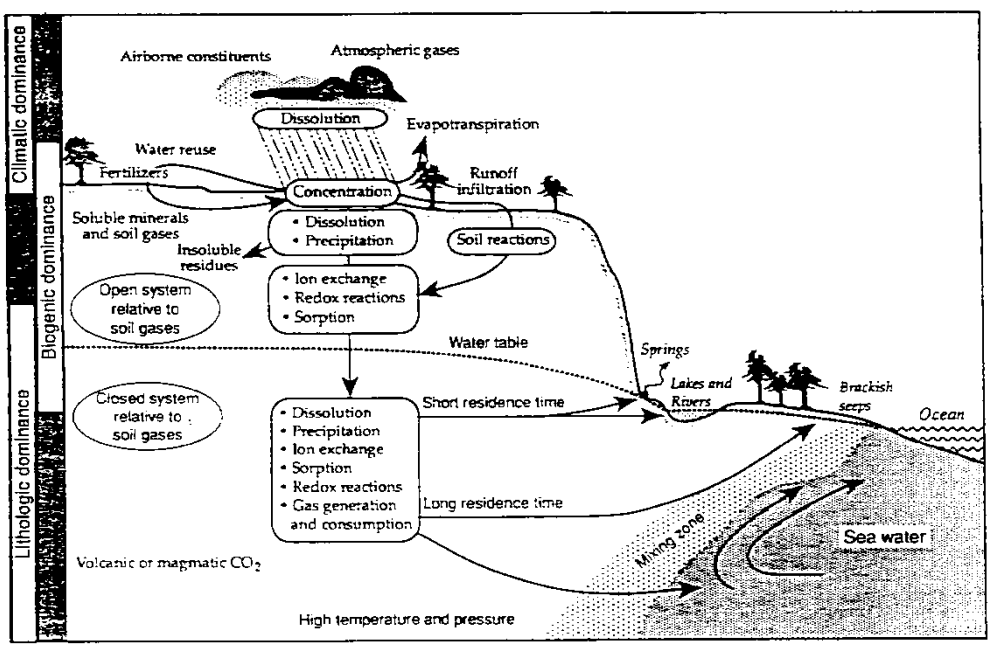


Fig (b) Hydrochemical variation in water cycle.

1.2 Scope of the present work :

This work presents a review of the groundwater in the Quaternary aquifer along the coastal belt of the northern part of Sinai Peninsula, which need periodical monitoring in time and space according with rapid growth of population and their needs.

This study includes :

- The geological aspects and the climatic conditions in the area.

- The hydrochemical characteristic of different groundwater samples and the evaluation of it's as :

  i- Assortment of water samples according to it's genesis.

  ii- The assessment of different sources of salinity affecting the groundwater in the aquifers.

  iii- The ion exchange process through water-rock interaction as salinization or refreshnening process.

  iiii- Evaluation of water quality for different uses.

-Determination of the stable isotopic content (Delta-^{18}O, Delta-D) of water samples in order to evidently emphasize the mechanism of recharging the aquifer starting from the rain drops till its reach the water table.

-Estimation of the evaporating water percentage in El-Arish area by stable isotopes in two different water sources by using the evaporation pan method.

1.3Problem formulation :

Sea water intrusion in coastal aquifer is a problem of water conservation and water management in quantity and quality, which particularly appear in arid and semi arid conditions with the absence of surface water, the scarcity of rainfall and highly evaporation rate.

The highly increasing population rate and the growing water demand for reclamation and different purpose may lead to over pumping and excessive abstraction of groundwater from coastal aquifers with little replenishment has ended by mining and encroachment of sea water in these aquifers. This problem will be increase day by day with continuous uses of this water especially if the rate of discharge are not balanced with the recharge rate.

So increasing the salinization problem point up the need for additional attention to the quality of water sources.

1.4 Area of study :

The area under investigation are located in the northern part of Sinai Peninsula along the Mediterranean sea shore located between latitude 30^{o} 45\ to 31^{o} 10\ north and longitude 33^{o}.oo\. to 34^{o} 15\ as shown in Fig(1) This area are specified into three Locations from west to east: Bir El-Abd, El-Arish and Sheihk Zuwayid- Rafah areas.

El-Arish : It's consider the firstly population area, which occupies an area about 19.500 sq. km, small portion of this basin extends eastward in El Naqub desert. The southern part is formed of calcareous plateau generally sloping towards the north at a rate of about 0.8%, the northern part is characterized by Delta Wadi El- Arish with extended alluvial plain beside the coastal strended ridges. More than half of the entire region is drained by a single watershed Wadi Arish, which discharge into the

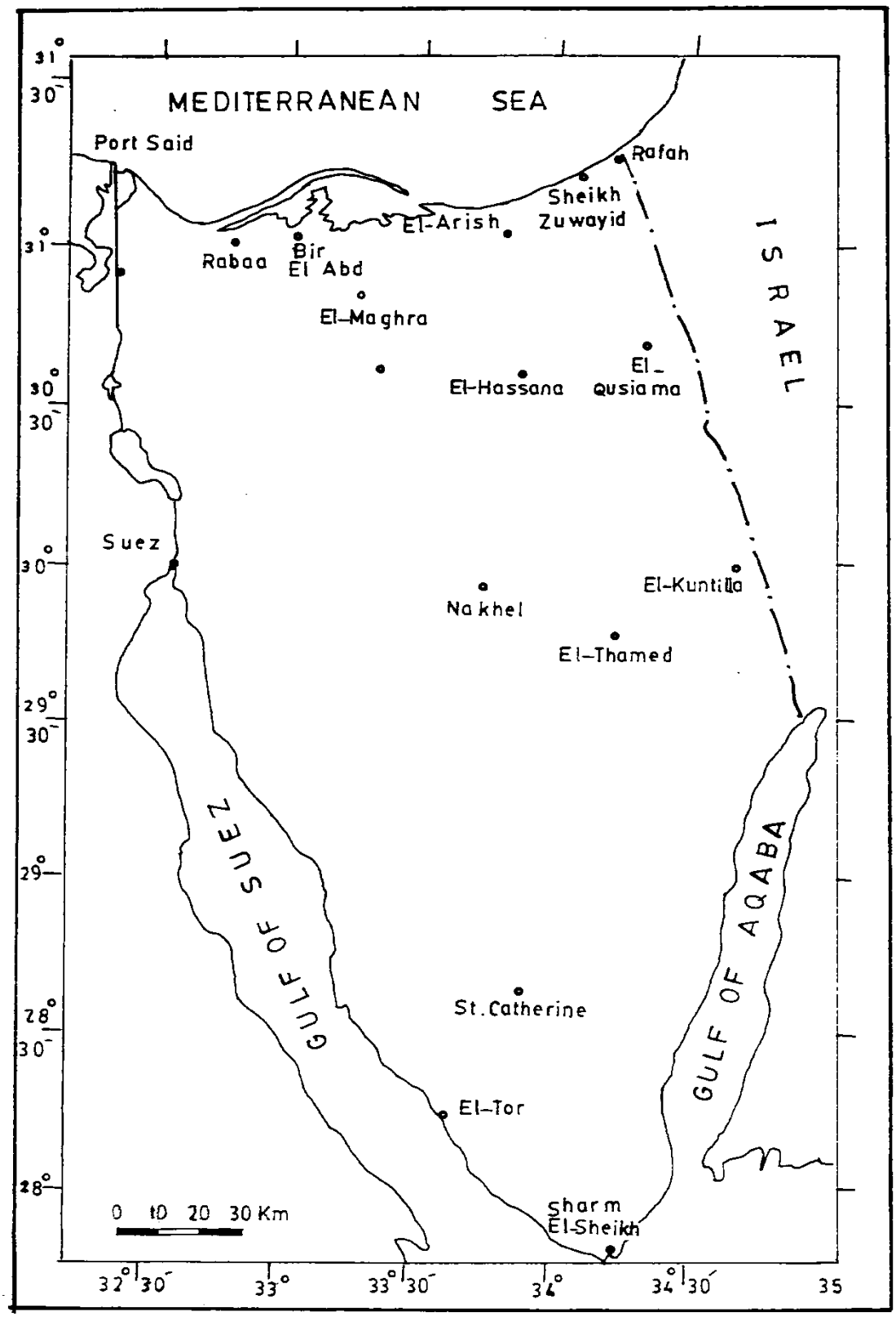


Fig (1) Sinai Peninsula

Mediterranean at El-Arish, this drainage is completely dry much of the time, discharge occurs infrequently at El-Arish (RIWR,1990).

Twenty three of groundwater samples were collected from Wadi El-Arish are shown in Fig(2).

Rafah-Sheikh Zuwayid :The secondly populated area in the northern coastal belt, it's located in the eastern part of Egyptian-Israelian border. It's receive the highest rain intensity in the whole area which reach approximately 300mm/y in the northern part at Rafah decreasing toward the south direction and the west toward Sheikh-Zuwayid area which contain low land forming some sabkhats.

Eighteen of groundwater samples were collected, fourteen from Rafah area and four from Sheikh-Zuwayid area which shown in Fig(3).

Bir El-Abd :This area is consider the third area after El-Arish and Rafah areas. It's cover about 300sq.km, comprising part of low land to the west and south west of El Bardawil lagoon, the original slopeis toward the north to the Mediterranean sea, this area is covered with sand dunes. The depression part are mostly covered with sabkha deposits due to seepage from sea water and in the area close to the Mediterranean sea tidal marches cover large parts which form salt lakes mostly connected to the Bardawil lake.

Forty of groundwater samples and one sample from El-Bardawil lake were collected are representing in Fig(4).

1.5 Sampling Technique :

Water samples for physical, chemical and isotopic analysis should be truly representative for the supply and site of sampling. It should characterized the water composition in order to determine water quality or eventually water pollution, so collection, storage, transport, and handling of water samples must be performed in

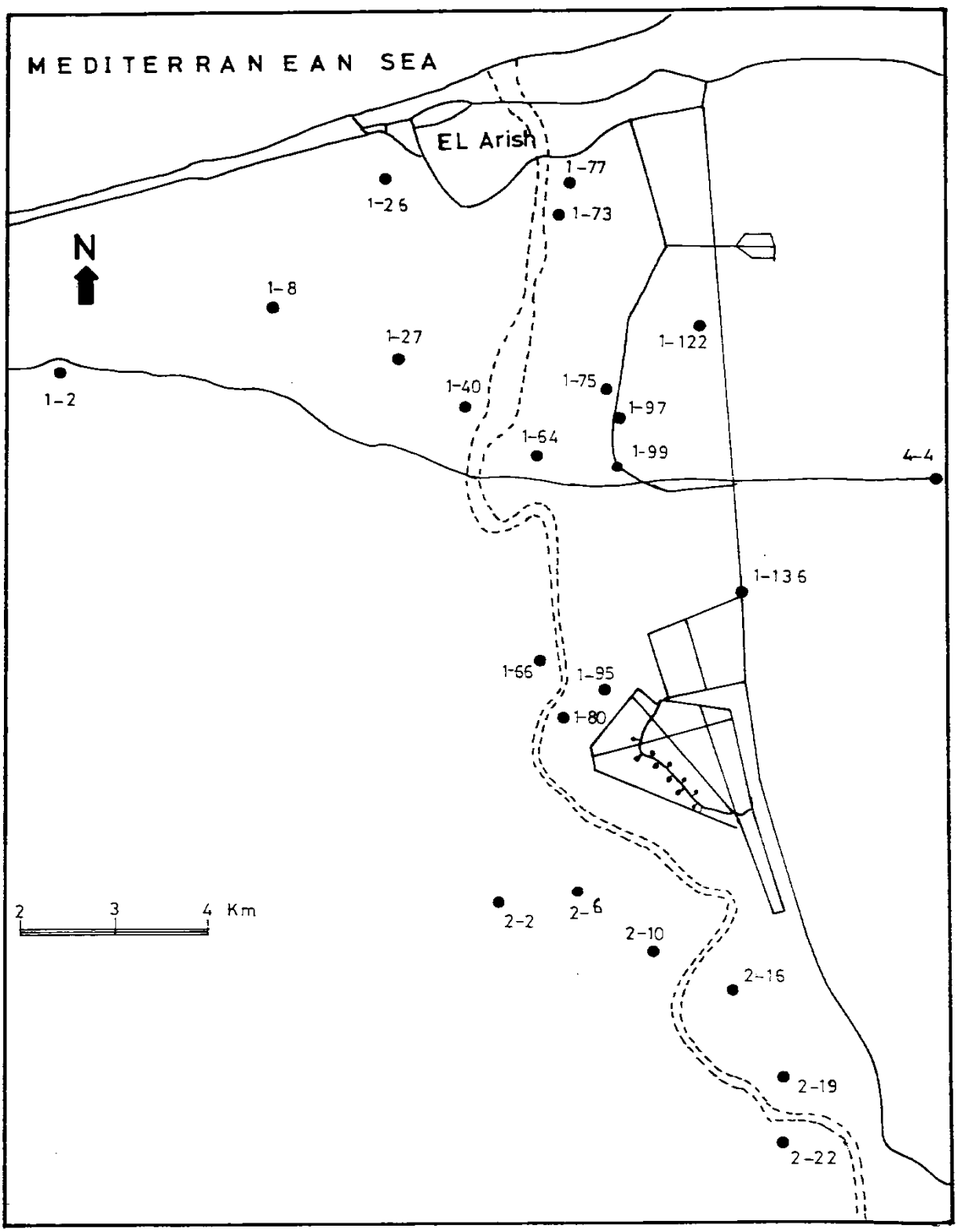


Fig.(2): Location map for EL Arish area.