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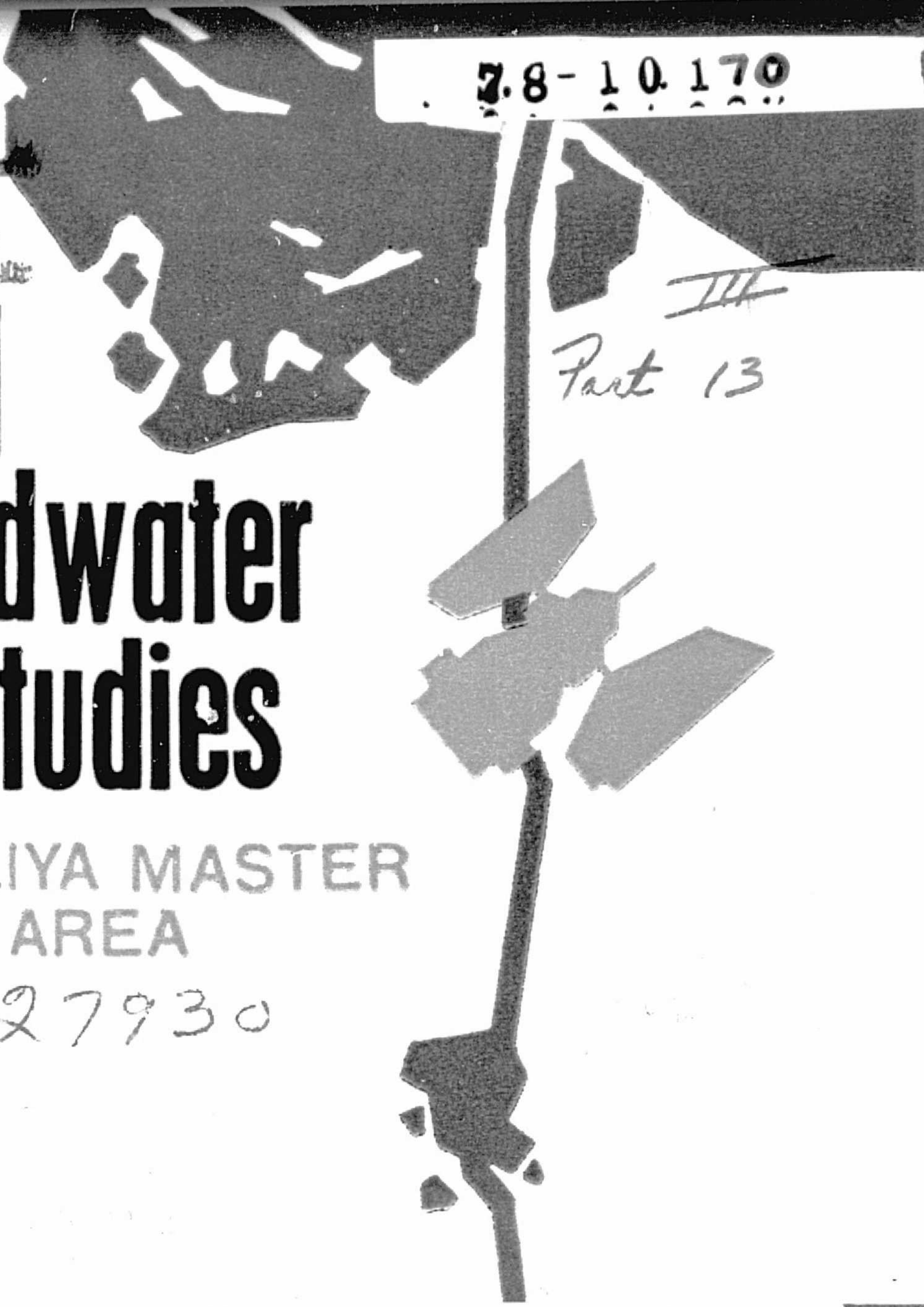

geological and groundwater potential studies

OF EL ISMAILIYA MASTER PLAN STUDY AREA

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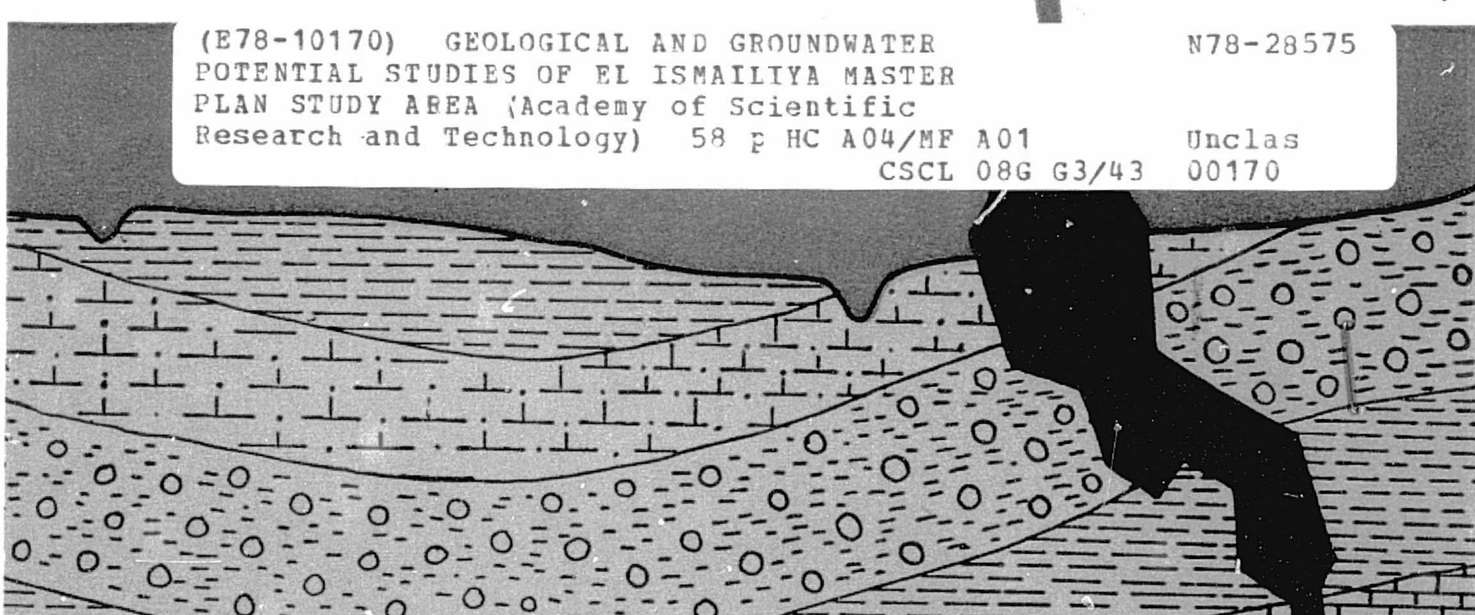

Geological and Groundwater Potential Studies of El Ismailiya Master Plan Study Area

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abstract

New geological, structural and drainage maps have been made and studied from ERTS-1 satellite images for El Ismailiya Master Plan Study area. The groundwater, hydrogeological characteristics and potentials of the same area have been compiled and evaluated to serve the purpose of the reclamation projects to be carried out.

part 1

geological, structural and drainage mapping from ERTS-1 satellite images

Introduction

El Ismailiya Master Plan Study area covers a surface of about 10.000 km^2, approximately limited by latitude 20°57' North to the Mediter ranean Sea, and longitudes 31°40'—32°40' East, Fig. 1.

The surface features of the Project area are shared unequally between the different geographical elements including cultivated lands, desert lands and lakes.

Cultivated Lands

These are represented mainly by the west central side of the Project area, including the easternmost part of El Sharquia Governorate, as well as the central strip around the encountered part of El Ismailiya-Cairo Agricultural road. These areas are covered by Nile silt which has been deposited from the flood waters of the eastern branch of Nile Delta (Damietta Branch) and from the El Ismailiya Canal respectively. Different plant crops are cultivated in the flat alluvial lands of these areas all the year round. Bordering these cultivated lands are some plains and terraces of concealed silts, sands and gravels. Moreover, between El Ismailiya and Suez, along the western side of the southern part of Suez Canal, there are some detached small areas of cultivation getting their irrigating water mainly from El Suez Sweet Water Canal.

Desert Lands

To the south of El Ismailiya-Cairo Agricultural road, the Project area is mainly formed of desert lands bordering the previously mentioned cultivated lands. They are built mostly of sandstone and limestone plateaux, representing the geographical continuation of the north Eastern Desert. Although uniformity and monotony of these sandstone-limestone plateaux are characteristic features of this part of the Project area, yet it is broken up by a number of interesting surface contrasts and marked changes in relief, topography and drainage.

The desert lands of the area under consideration have a generally moderate to low relief with an average height of about 200 m above the sea level. Six triangulation points are located in the south central part of the area. There is a triangulation point at Gebel Umm Raqm (275 m) forming a conspicuous topographic feature in the western side of the area just to the west of the ruined palace of Dar. The other triangulation points are located at Gebel Shubrawit (226m), Gebel El Girba (238m), Gebel Umm Raqm (243m), and Gebel Iweibid (520m).

Lakes

Apart from the lakes of the Suez Canal zone, the Project area encounters also a great portion of Lake Manzala. It occupies the lowermost part of the area under investigation at its northern side along the Mediterranean Sea coast between Port Said and Damietta, and extends southwards to the sandy plain. It is surrounded by some other small shallow lakes and marshes, as well as wet lands and sabkhas. These parts represent, all-together, the relics of the ancient sea areas which the River Nile acquired to build its delta.

These lakes give also the evidence of the oscillations of the sea and land during Pleistocene and Miocene times, which culminated in slow land subsidence since the beginning of the Neolithic.

On comparison of the recent ERTS-1 satellite images, Fig 9, and the previously published maps, some features are found to have been changed such as the disappearance of some islets in the Lake Manzala and the submergence of some structures in it. These are indications that the slow subsidence of land which persisted throughout the Neolithic is still continuing on a small local scale.

Drainage

The southern part of the Project area is a moderate to low hilly country followed northwards by a wide plain which is drained generally into a north to northwest direction by many water courses which start generally from the south, southwest and southeast. Some of these small tributaries unite together and form some main drainage lines in the area. Among the most important and the largest drainage lines in the area under consideration and its surroundings are Wadi El Gafra, Wadi El Bahhara, Wadi Abu El Awasig and Wadi El Ashara, Fig. 2.

To the north of the southern plain which is mainly covered by Wadi deposits, the ground is dissected into isolated Oligocene gravel mound and some ridges of generally darker tone. Further northeast, the marine Miocene sediments form some conspicuous ridges of lighter tone, and exhibit dip-slope topography, sloping northwards to a wide plain.

The northern slopes of Gebel Ataqa, which are encountered along the southern side of the investigated area, are draining northwards and northeastwards by a coarse dendritic system through Wadi El Himeira and other tributaries to a wide drain called Wadi El Bahhara which is trending generally in the NW-SE direction, where it starts from the southeastern slopes of Gebel Iweibid and ends at the Gulf of Suez near the town of Suez.

Wadi Kahaliya and Wadi Umm Gifran drain from the northwestern slopes of Gebel Abu Tireifiya, while Wadi Iseili and Wadi El Gindali drain from the northern slopes of Gebel El Kutamiya. These wadis are mostly of the coarse dendritic type, but they constitute in general nearly parallel to subparallel system. They extend northwards to join the intersection of Wadi El Gafra and Wadi Barasha in a plain area between Gebel El Gafra and Gebel Umm Raqm. Wadi El Gafra is one of the main wadis in the studied area, and it receives some parallel small tributaries both from the south and from the north that extend mostly in the N-S direction, such as Wadi Muftah. Along the southwestern corner of the area under investigation, Wadi El Furn drains from the northern slopes of Gebel Yahmum El Asfar northwestwards to meet Wadi Abu Durma at Sawanet El Dabba.

The south central hilly country of the area, including Gebel Umm Raqm and Gebel El Girba, is drained northwestwards by Wadi Abu El Awasig which is a a long wadi extending for more than 25 km from the SE to the NW, where it joins Wadi Sakran in the wide plain area between Ilwet Abu Ashqar and Khabira Umm Gidam.

Generally speaking, there is an obvious relationship between the drainage pattern of the Project area and both its lithology and structures, especially exhibited in the desert lands due south of El Ismailiya-Cairo agricultural road. However, there is a remarkable contrast in the pattern and density of drainage and in the order of the main drainage lines, especially in the main rock units of the terrestrial Oligocene and the marine Miocene and Eocene sediments.

Generally, the drainage pattern of the Oligocene is essentially dendritic, mostly due to its sandy and gravelly poorly bedded nature. On the other hand, the pattern of drainage of Miocene and Eocene is almost parallel to subparallel due mainly to the dip-slope topography of the Miocene and the Eocene beds underneath. Also, the gently dipping strata of these geological units and their landscapes of long ledges have some influence on their characteristic drainage pattern. Concerning the density of drainage pattern, it is found that in the Oligocene the drainage is very dense relative to the Miocene and Eocene which have poor and moderate densities respectively.

The plain strip along the western coast of Suez Canal is traversed by some wadi lines extending almost in the E-W direction such as Wadi Yasara and Wadi El Ashara.

The central part of the investigated area is crossed by El Ismailiya Canal which is an important irrigation and navigation canal starting from the River Nile North of Cairo to the Lake Timsah. At El Ismailiya, two other irrigation canals are branched from El Ismailiya Canal, the northern branch is called El Abbasiya Canal extending to El Qantara, while the southern branch is that known as El Suez Sweet Water Canal reaching Suez.

The northern sector of the Project area is mostly covered by the Lake Manzala and some small lakes (e.g., Lake El Sibeita), water ponds, swamps and salt marshes occupying the surrounding low lands. This area includes two artificial canals; Bahr El Baqar used as the main drain of irrigation waters from El Sharqia cultivated lands, and El Manzala Canal as a navigation canal passing from Port Said to Damietta through Lake Manzala.

Plenty of small islands and land bars and arches found in Lake Manzala are usually effected by the tidal waves of the Mediterranean Sea water and its common oscillations during different climatic conditions.

Structures

El Ismailiya Master Plan Study area is located at the cross roads of major geographical regions namely the Eastern Desert, Sinai Peninsula, the Nile Delta and the Mediterranean Littoral with its Lakes. It is enclosed between the Suez Canal to the east and the eastern boundary of the Nile Delta to the west, the line extending from Gebel Ataqa to Gebel Mokattam to the south, and Lake Manzala to the north. The area in question is dissected by many structural lineaments, as interpreted from ERTS-1 satellite images, Fig. 3. These lineaments are of three different densities according to the topographic expression and rock or soil cover.

The mountainous part of El Ismailiya Master Plan Study area is located to the south of Cairo-Suez asphalt road and dissected by lineaments running mostly either NNW-SSE or NW-SE. The first set is constituted of short lineaments mostly not exseeding 20 km in length, while the NW-SE lineaments are long and some of them extend to the Gulf of Suez region representing major faulting disrupting in the Gulf itself. A third minor set of lineaments present is running nearly E-W with small deviations to WNW or ENE directions. The age relation of these lineaments is most probably: a) the nearly E-W lineaments are the oldest ones as they are dissected and dislocated by the other trends, and b) the NW-SE lineaments are more prominent than the NNW-SSE ones, thus indicating that the latter are most probably younger or they are of different fracturing type. An interesting anticlinal structure is recorded in the area to the southwest of the Bitter Lakes which is comparable to the Syrian arcs of north and central Sinai.

The second part of El Ismailiya Master Plan Study area which is located between the Cairo-Suez and Cairo-Ismailiya agricultural asphalt roads is mostly covered by Quaternary clayey and sandy surfacial deposits in addition to some limestone outcrops to the west of the Bitter Lakes. The lineaments traversing the limestone exposures are of two main trends; NNW-SSE and E-W directions.

However, the lineaments are rarely observed in locations showing Quaternary sandy or clayey cover except for some short lineaments striking N-S, NE-SW, E-W and WNW-ESE.

Concerning the part of El Ismailiya Master Plan Study area located to the north of Cairo-El Ismailiya agricultural asphalt road, lineaments could not be directly observed, from ERTS-1 satellite images, while the distribution of the sandy or shelly bars and islands inside Lake Manzala and the marshes to the south may give the impression of controlling structural linear elements including folding and faulting.

Geology

The geology of El Ismailiya Master Plan Study area is dominated by a sedimentary succession ranging from Eocene to Quaternary, with Mid-Tertiary basalts. A new geological map (Fig. 4) is presented here which has been constructed from ERTS-1 satellite images. The geological units are shown as groups, formations and smaller lithologic units according to the standard international and local stratigraphic terminology. Geologic mapping in various scales and studies have been carried out previously in the investigated area by Thiebaud (1943), Shukri and Ayouti (1956), Farag and Sadek (1966), Barakat and Aboul Ela (1970), El Shazly, **et al.** (1974), ... etc.

Eocene

Three formations are distinguished of which Darat Formation and Khaboba Formation belong to the Middle Eocene while Tanka Formation is mainly of Late Eocene age. These formations correspond in a general manner to those given by Viotti and El Demerdash (1968) to the Eocene exposures at Wadi Nukhul on the eastern side of the Gulf of Suez.

Darat Formation

It is mostly of white colour and smooth texture, and it is exposed in three localities; a) east of Gebel Ataqa with coarse texture, b) forming repeated rims in the circular feature exposed to the west of the Great Bitter Lake, and c) the southern narrow strip of Gebel Iweibid, with light colour and smooth texture at the latter two localities. This difference in texture may be due to the low relief hills covered by this formation while at Gebel Ataqa the Darat Formation forms a thick horizon exposed on the slopes which is covered by younger formations. Darat Formation is mostly composed of marl with fossiliferous chalky limestones.

Khaboba Formation

It is of brown colour, coarse texture, and forming the peripheral ridges of Gebel Ataqa and the southern limit of Gebel Iweibid. This formation is made up of marl and fossiliferous limestones with flint bands.

Tanka Formation

It has a lighter brown colour with characteristic fine to medium texture. It forms the topmost horizon in Gebel Ataqa and Gebel Iweibid, and it is exposed in the south and west of the Khaboba at Gebel Ataqa. This formation is constitued of fossiliferous limestones with shales.

Oligocene

Gebel Ahmar Formation

On the ERTS-1 satellite images, this formation could be differentiated into three lithologic units according to the tone, grade and the texture differences as follows :

Unit 1 : On ERTS-1 colour composite images, it shows with light green to yellowish green colour, with fine to smooth texture. This unit is exemplified by the rock exposure at Wadi Kahaliya which is mostly constituted of sands and flint gravels.

Unit 2 : It is exhibited by the darkest tone of the greyish colour with coarse texture. This unit is mostly composed of ferruginated red sandstones, exemplified by the rocks exposed at Gebel Umm Raqm and Wadi Yasara.

Unit 3 : It is characterized by medium texture and greenish grey colour of lighter tone grade than unit 2. This unit is exposed on both sides of Wadi El Gindali, and is composed mostly of quartzitic and less ferruginated sandstone, and flint gravels.

Mid-Tertiary Volcanics

These volcanics are mostly basalt sheets which are found on the colour composite images as small spots or patches characterized by dark to medium grey colour. Stratigraphically the basalt is Late Oligocene to Early Miocene.

Miocene

Two formations of Middle Miocene age are distinguished, namely El Shatt Formation and Hommath Formation.

El Shatt Formation (new formation name, * type locality El Shatt on the Suez Canal)

This formation is of Middle Miocene age as in the case of Ras Malaab Group, the latter is well developed in the Gulf of Suez region (El Gezeery and Marzouk, 1974). In the Suez Canal zone, the lithology has been found to be different from the Gulf of Suez region, due to the difference in the conditions of the deposition of the Middle Miocene sediments in both cases. El Shatt Formation which is the characteristic Middle Miocene Formation in the Suez Canal zone is constituted of sandstones, clays and limestones arranged in the order of their abundance with variable amounts of gypsum-anhydrite. It may be stated that El Shatt Formation is mainly constituted of detrital material with subsidiary evaporites while in Ras Malaab Group evaporites play an important role in the constitution of the sediments. The Middle Miocene in the area extending to the west of the Gulf of Suez and the Suez Canal Zone is characterized in the mapped area by the occurrence of shallow marine limestones with clays and sands/sandstones (Hommath Formation).

El Shatt Formation has been divided on the new geological map prepared from ERTS-1 satellite images into the two following units :

Unit 1 : This is characterized by a lighter tone of greyish green colour ; fine texture and smooth surface with some scattered isolated rocky outcrops and exposures.

The unit is exposed mainly on the eastern side of the Suez Canal to the south of the Bitter Lakes. It is constituted of sandstones, clays and limestones, with more gypsum-anhydrite than the northern unit 2. Accordingly, unit 1 is more akin and is geographically closer to Ras Malaab Group in comparison to unit 2.

Unit 2 : Exposed towards the east and northeast of the Bitter Lakes, and it is constituted of sandstones, clays and limestones, with small and sometimes insignificant propor-

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* This formation was discovered during the field checking of the interpreted satellite images for this area.

tions of gypsum-anhydrite. It is characterized by dark greenish grey colour, which changes to bluish grey near the shores of the lakes. The texture is coarse in general while near the shore it becomes finer.

Hommath Formation

The name has been previously given by Abdalla and Abdel Hady (1966) for the Middle Miocene succession at Sodat area on the western side of the Gulf of Suez. In the present work, the same formation has been extended to cover the Middle Miocene rocks to the westwards and northwards of this area. Hommath Formation is constituted mainly of limestones with variable intercalations of clays and sands/sandstones. The limestones are greatly impure and sandy. The formation under consideration has been distinguished into two units varying in their characteristics, and their distribution is shown on the geological map, Fig 4.

Unit 1 : Characterized in the images by its light tone of the grey colour and medium to fine texture. The unit is constituted of limestones with prominent intercalated exposed sands/sandstones.

Unit 2 : This is made up of limestones with prominent intercalated outcropping clays. It seems from the pattern of distribution of the two units that pass into each other laterally and most likely also in depth. Unit 2 exhibits lighter tone, characterized by greyish yellow colour with a smooth surface.

Pliocene

The pliocene unit is isolated due to its light greyish yellow colour with its fine texture. It is made up of gravels and sands with less abundant clays and it is mostly covered by small dispersed desert vegetation. The age of this unit is not certain and it is exposed between the Cairo-El Ismailiya desert and agricultural roads.

Quaternary

Gravel plains

This unit, which is located to the north of El Ismailiya Canal, has been isolated on ERTS-1 satellite images due to its dark grey colour and coarse texture which is nearly similar to the surface features of Ras Malaab Group. It is formed of gravels of various sandy, limy and clayey rocks. Many artificial hillocks and some natural vegetation are superimposed on this unit.

The main advantage of using ERTS-1 satellite images in mapping has been the distinction of various Quaternary units of great practical value to reclamation projects.

These include in El Ismailiya Master Plan Study area the following : deluvium of Eocene rocks : wadi alluvium of limy, marly and gypsiferous clays ; wadi alluvium of clayey and sandy gravels ; sand dunes with remarkable lineaments ; eolian sands and sand dunes ; marshes and sabkhas ; shallow water bodies with seasonal variations ; lakes and ponds ; as well as the cultivated lands peripheral to the Nile Delta.

part 2

groundwater studies

Introduction

The study of the geomorphology and geology of groundwater in the desert area east of the Nile Delta must be considered as the key-stone in any future reclamation projects. So, the elucidation of the physiographic provinces and the main geomorphic units are of great help in understanding the main groundwater reservoirs in this area. Moreover, the geological and hydrogeological investigation of the different potentialities of these groundwater resources will be useful.

As the subsurface data in the Ismailiya-Manzala strip is scarce, the up-to-date data of El Qantara area compiled with the few previously drilled holes help in suggestion of the subsurface Neogene-Quaternary aquifer and aquiclude horizons.

Due south of the latitude of Ismailiya, the groundwater resources are locally controlled by the geological setting of the outcropping sediments.

Physiographic synopsis

Most of the studied area occupies a semi-flat terrain with the exception of the area to the south of latitude 30°15' where the land rises up towards the southern hills.

From a regional point of view, the physiographic features of the area east of the Nile Delta flood plains could be differentiated into the following provinces :

1. Gebel Mokattam-Gebel Ataqa tableland.
2. Cairo-Shubrawit ridges.
3. Umm Gidam slopes.
4. El Tell El Kabir-El Salhiya plain.
5. Lake Manzala and sabkhas.
6. Isthmus stretch.

Gebel Mokattam-Gebel Ataqa Tableland

The area is bounded at its southern periphery by a series of highly elevated plateaux at latitude 30°. From west to east they are : Gebel Mokattam, Gebel Kutamiya, Gebel Abu Tireifiya and Gebel Ataqa. Their altitudes range from 150 m (Gebel Mokattam) to 870 m (Gebel Ataqa). The surface elevation of this tableland increases due east and exhibits irregular short valleys and gullies, **e.g.,** Wadi Gindel, Wadi El Khayat and Wadi Umm Zeita.

Cairo-Gebel Shubrawit Ridges

This stretch of land is located between latitudes 30° and 30° 15', and it is represented by a series of elongated ridges mostly oriented in WNW-ESE and E-W directions.

The ridges are represented by Gebel El Hamza, Sawanet El Dabba, Gebel Iweibid, Gebel Umm Raqm, Gebel Gharra and Gebel Shubrawit. The average altitudes of these ridges range from 150 m to 200 m, and their lengths range from 20 to 50 km.

A series of immense depressions are alternating with the above mentioned ridges. Two main depressions could be differentiated namely, Heliopolis depression bounded by Gebel El Hamza to the north and Sawanet El Dabba at the south, and El Dakruri depression bounded northwards by Sawanet El Dabba and southwards by Gebel Mokattam-Gebel Ataqa tableland. These depressions are striated by a crowded drainage system (centripetal trellis, braided and dendritic types).

Umm Gidam Slopes

The terrain here slopes from south to north and occupies the landscape extending from Cairo-Gebel Shubrawit ridges in the south to Wadi El Tumilat in the north. The altitudes decrease gradually from 180 m to 40 m within a distance of 15 to 20 km, **e.g.,** the general slope is roughly 7 m/km.

Wadi El Tumilat represents the northern limit of Umm Gidam slopes. The former is an elongated depression oriented in an E-W direction and extending from El Ismailiya to El Abbasa in which El Ismailiya Canal was dug.

El Tell El Kabir-El Salhiya Plain

A semi-flat area extends to the north of Ismailiya latitude till the southern extremities of Lake Manzala and sabkhas with altitudes ranging from 0 to 20 m.

Lake Manzala and Sabkhas

Manzala is the largest lake of the Egyptian coastal belt. Wide sabkhas and salty ponds are widespread around the main lake.

Isthmus Stretch

The topography of this land strech is mainly affected by the artificial processes caused by the digging of the Suez Canal. It extends from the Gulf of Suez in the south to El Ballah lagoons in the north.

Geomorphology

As the geomorphic features in this area have a direct bearing on the groundwater resources and reservoirs, a brief explanation of the land features in relation to geology has to be made.

The main geomorphic units (Fig. 5) could be distinguished, as follows :

Gebel Mokattam-Gebel Ataqa Structural Tableland.

This persistent limestone tableland is mainly striking out due to the late Eocene and younger upheavals. The tableland was affected by epirogenic forces which led to the creation of the faulted escarpment edges on its northern peripheries. The nature of the hard Middle and Late Eocene limestones which are the predominant facies exhibits three features :

a) Joints and fissures, b) short and shallow wadis and gullies, and c) naked rocks with regard to soil and gravel mantles.

As the porosity of these massive rocks is generally low, they represent a watershed area mainly due north, **e.g.,** to El Dakruri depression, On the other hand, where joints and fissures are remarkable features «karst conditions» are dominant.

Cairo-Gebel Shubrawit Structural Ridges and Depressions

Here four main structural ridges are striking out. Gebel El Hamza ridge and Gebel Umm Raqm-Gebel Shubrawit ridge constitute the northern landmass, whereas Sawanet El Dabba ridge and Gebel Iweibid ridge constitute the southern positive landmass.

As these ridges are built up of Miocene sandy limestone facies and Oligocene gravels and basalts, their capability for groundwater storage is much higher than the southern Eocene tableland. In particular, watershed areas are represented where slopes are sharply reversed on both sides of the ridge. However, in most cases where the clysmic faults cut across these ridges, deep wadis debouch due north (the general slope), **e.g.** Wadi Anqabiya and Wadi El Nasuri.

Alternating with the above mentioned positive structural ridges, two consequent negative structural depressions exist. An extensive depression extends east of Cairo till Gebel Umm Raqm along a distance of about 50 km (Heliopolis depression). The southern one, El Dakruri depression, of about 60 km length extends in an E-W direction from Gebel Anqabiya in the west to the northern extremity of the Gulf of Suez in the east. This structural depression is wide in the west (about 20 km), where it is defined by Sawanet El Dabba due north and Gebel Kutamiya due south. It wedges out east reaching a width of 5 km where the structural tableland extends northwards. The main hydrographic drainage and basins in this landscape have three patterns :

Main central drainage pattern

Two drainage systems mainly dendritic are present. The western one ends at Wadi El Gafra whose tributaries extend due south to the structural tableland along smaller wadis.

e.g. Wadi El Gindali, Wadi El Ful, Wadi Shanab El Basha, ... etc., and cut across the structural ridges along the clysmic faulting which originally led to the topographic separation of the above mentioned ridges (between Gebel El Hamza and Gebel Umm Raqm ridges).

The eastern system ends by Wadi El Watan which mainly drains its resources from the structural ridges,e.g. Gebel Girba, Gebel Umm Katib, Gebel Gharra, ... etc.

The above two drainage systems occupy the central portion of El Dakruri depression and the eastern rim of Heliopolis depression, and debouch due north in Umm Gidam slopes.

Noteworthy, the above mentioned structural depressions are mantled by the coalescent debris of the destroyed surrounding ridges and tableland. It is mostly mantled by gravel and coarse sands which originated from the carbonate Eocene-Miocene rocks, and the siliceous and basaltic Oligocene rocks. Moreover, the thickness of this gravelly mantle is expected to attain its maximum depth at the central portion of these structural depressions (about 50 to 60 m thick).

Western Drainage Pattern

This pattern mainly occupies Heliopolis depression and is related to the centripetal trellis and barbed drainage types. Two main valleys; Wadi El Hamza and Wadi El Hag, exist in this depression. Due to the west, the nature of the gravelly facies has been affected by the Nile flood plains and changed to finer texture. Moreover, an abrupt increase in thickness of the Quaternary sediments is expected.

Eastern Drainage Pattern

This system has derived its resources from the eastern rims of the structural tableland and the eastern sides of the structural ridges, e.g. Gebel Shubrawit and Gebel Gineifa, and debouches the Isthmus stretch. This pattern is related mainly to the dendritic drainage system.

Finer Quaternary deposits have been contributed by this system to the Agrud depression due to the exposure of low strength Cretaceous sediments on the highland areas.

Umm Gidam Gravelly Slopes

The southern belt of these slopes represents the typical piedmont slopes of the structural ridges, where the altitudes range between 80 to 180 m, e.g. Ilwet Abu Ashqar, Khabret Umm Gidam and Ridan El Hamal. Due north the landscape downgrades gently to Wadi El Tumilat.

In this stretch of land, terraces are found in the environs of Wadi Tumilat at absolute levels of 30 to 40 m, the role of the late Pliocene-early Pleistocene eastern foreset of the Nile Delta could be remarkable. It is assumed that the rock debris derived from the east and south landmasses in the late Pliocene-early Pleistocene times were debouching in this old downthrown faulted basin.

It has been observed that the gravels and sands which cover most of this landscape are coarser in the south than in the north. Nowadays, under the prevailing semi-arid conditions this land stretch has been transformed to a typical «desert pavement».

El Tell El Kabir-El Salhiya Plain

Several agents have led to the creation of this plain :

1. The late Pleistocene pluviations.

2. The late Pleistocene-Holocene Nile floods.

3. The remnant salty lakes resulting under the influence of the Mediterranean Sea.

4. The old tributaries of the Nile branches passing through this area.

5. Artificial canals and drains.

According to the previously mentioned factors, the following morphopedological sectors could be differentiated in this plain :

1. Wadi El Tumilat represents a conspicuous unit of depressional features (7 to 10 m in altitude) surrounded by old terraces of early Pleistocene gravels and filled with younger sands and clayey sand facies. It extends in an E-W direction, about 50 km in length and about 5 km wide. It is presumed that this wadi reflects a deep subsurface structural lineament which has now been much affected by the Ismailiya canal which has been dug through it.

2. About 10 to 15 km to the north of Wadi El Tumilat (El Tell El Kabir strips), the area is still affected by the southern gravelly slopes. The land cover is dominated by coarse sands and fine gravels, whereas at its western margin at El Abbasa, the Nile floods build clayey soils.

3. Due north, i.e. El Salhiya-Bir El Abd strip, the plain is predominated by the silty and

clayey flats which resulted from the old Nile branches at that time including Ferma Nile branch. Moreover, the retreating of El Manzala lagoons (late Pleistocene-Holocene) left their salty mud flats on the surface of this area. A silty clay coquinal bed of about 1 m thick exists in different localities of this landstrip, e.g. El Qantara El Gharbiya. The old beaches of these lakes are exhibited as irregular lenses (1 to 2 m thick) of shelly sands and faintly cemented sandstone bands.

4. Sabkhas are widespread with their saline soils along the southern peripheries of the present Lake Manzala.

Isthmus Sandy Stretch

This sandy stretch extends from the Gulf of Suez in the south to near El Ballah lagoons in the north. Such stretch was occupied, before the construction of the Suez Canal, by a series of salty lakes related to its negative altitudes. The relics of these old lakes are well represented at El Ballah area.

However, this strip of land has been much disturbed by the artificial Suez Canal and its digging products. Wind-blown sand sheets have accumulated along both banks of the Suez Canal.

Subsurface geological synopsis

The sediments older than the Eocene are not of interest to the purpose of this study, therefore a compiled stratigraphic section and two provisional geological cross sections (Fig. 6) are briefly presented :

Eocene

Eocene carbonate facies of 400 to 500 m thick mostly occupied the structural tableland. Faulting predominate folding and karst conditions prevailed.

Oligocene

Mainly constituted of sands and gravels (maximum thickness 80 m) and capped by Mid-Tertiary were active. Indications of old «geysers» are common.

It is mostly exposed along the foot-hill slopes of the Cairo-Gebel Shubrawit structural depressions.

The Oligocene exposures represent the intake areas for the seasonal rains on the southern belt of the concerned area. In the subsurface, the Oligocene sediments extend and slope generally northwards.

Miocene

It is represented mainly by the marine sandy limestones. Most of the faulted structural ridges are built up of this facies. Due north it is found under the post-Miocene sediments due to the step, mostly, clysmic fault series.

A remarkable buried normal fault is deduced under Wadi El Tumilat. Near the south of this wadi, the subsurface Miocene sediments have been recorded at depth of 140 m, whereas on its northern side the shallow wells (200 m depth) did not reach the Miocene.

It may be expected that the groundwater which percolates through these sediments (if spudded in the subsurface) is probably saline. Moreover, the Miocene sediments of the Gulf of Suez enclose abundant evaporites.

Pliocene

There have been many controversies about the Pliocene gulfs in this area. However, it is expected that the early Pliocene sediments particularly below the Isthmus stretch and the area north of Umm Gidam slopes are of fluviomarine clays and sandy clays. They represent an aquiclude horizon for the upper layers. Their thickness varied and was consequently affected by the pre-Pliocene configurated surface.

Early Pleistocene

Contemporaneous with the termination of the Pliocene and the early Pleistocene times. pluviations took place. Consequently irregular thick gravelly sand and sandy gravel beds were deposited on the late Pliocene negative areas, mainly the early Pleistocene basin north of the structural ridges. The eastern foreset of the Nile Delta invaded the western side of this basin and helped the accumulation of these sediments. Due north of Wadi El Tumilat, clayey beds intercalate these sediments. The latter wedge out on the northern rim of the structural tableland due south, and increase in thickness due north. At El Qantara area, the thickness of these sediments reaches 70 to 80 m, however, no detailed studies are available for them at present.

Late Pleistocene-Holocene

These sediments cover the area due north of Khabret Umm Gidam and the Isthmus stretch.

They are characterized by the alternations of gravelly sands, sands, slightly calcareous sandstones and clays. They attain a thickness ranging from 10 to 70 m, overlying the early Pleistocene, with thickness increasing due north. These sediments are mainly replenished by groundwater from the surface water of the Nile Delta, Ismailiya Canal, Suez Canal, Lake Manzala and various drains. Along the limbs of the old Lake Manzala, coquinal clay beds are present.

Holocene sediments are represented by sand sheets particularly along the eastern side of the Isthmus stretch, and sand sheets and hammocks west of El Tell El Kabir-El Salhiya plain. Sabkhas and salt marshes dominate the northern strip of El Tell El Kabir-El Salhiya plain.

So the groundwater in these sediments is mostly of leaky nature and its salinization reflects the nature of the neighbouring sources.

Groundwater potentialities

The area under investigation comprises the desert area of the region east of the Nile Delta fringing the cultivated land. The water potentialities of such desert area are not fully understood due to the lack of detailed exploratory hydrogeological work, especially in its southern portion which is typically of arid climatic conditions. In the northern portion where sub-arid climatic conditions prevail, some efforts to reclaim some tracts of this desert area, **e.g.** El Salhiya Project and El Shabab Project, have been made, and consequently some data about the hydrogelogical conditions are available. In connection with the geomorphological and the geological features displayed within the area in question, the hydrogeological conditions will be discussed.

Tableland

The bulk of the tableland surface is dominated by Eocene limestones which are mostly jointed and fissured. Within this area, which constitutes the main watershed, characteristics of such limestones in the surrounding regions point to the possibility that these limestones act as an aquifer of limited potentialities. Such characteristics permit whatever rain-water there is to infiltrate through fissures and joints, and to collect and form very small water bodies.

The surface of this tableland is consequently dissected by a number of drainage lines which act during the rainy seasons as important drainage arteries. These drainage lines (wadis) are principally directed northward, **i.e.** towards the structural depressions, and form suitable sites for the accumulation of the surface runoff in the wadi fillings dominating the channels of such wadis. The water which may be obtained from the tableland area is expected to be relatively saline owing to the washing and leaching processes. On these bases, and on the basis of the scarcity of the present rainfall for the purpose of surface water conservation, the tableland area is considered to have very poor potentialities with regard to land reclamation.

Structuarl Depressions

Within the structural ridges area extending from the lower slopes of the tableland escarpments in the south to the northern foot-slopes of Gebel El Hamza-Gebel Shubrawit ridge in the north, over a distance of 50 km, two very prominent structural depressions are confined. These are represented by El Dakruri depression to the south and Heliopolis depression to the north, and are considered as typical water collecting areas. The surface of El Dakruri depression slopes in the northward direction, and is dissected by a braided drainage system. It is occupied by sands and gravels of fluviatile origin. Heliopolis depression, on the other hand, constitutes a portion of the Pliocene gulf near the eastern edge of the Delta, in which detrital materials composed of sands and gravels up to 100 m thick, were deposited wedging eastwards (El Fayoumy, 1968). These materials are washed into that depression by the River Nile and the lateral wadis.

The groundwater conditions within these depressions can be deduced from the few data obtained from a deep water well drilled in the year 1960 in the western reaches of El Dakruri depression, immediately north of the Cairo-Suez road at a distance of 45 km from Cairo. The geological succession encountered in this well (E7) is as follows :

TABLE 1

Geological Succession in Well E7

Depth in m		Geological Units
From	To	
0	21	Coarse sands and gravels, of Quaternary age.
21	270	Alternation of sand and clay beds with shaly and sandy limestone horizons, of Miocene age.
270	503	Coarse sand with occasional gravels, of Oligocene age.

The recorded water level in this well was at 170 m from the land surface (the water level exists at about 100 m above sea level). The salinity of the water in the well has been calculated on the basis of the true resistivity and self potential method. The measured salinity was in the order of 5,500 ppm at different depths through the length of the water column in both the Miocene and the Oligocene aquifers.

The existence of the groundwater at this high level in the depressional areas may indicate completely different water conditions from those in the surrounding areas where groundwater occurs at about sea level. It may also indicate the probable recharge of the different aquifers from the desert wadis draining the depressions or directly from rain water in old pluvial times when these aquifers were exposed.

Outside the area under investigation due west, the hydrogeological conditions in Heliopolis depression differ greatly, where water depends on lateral seepage from the Nile as well as from the desert Wadis. Due to the inherited depositional characteristics of the sediments, the groundwater is relatively saline. In this depression (near Heliopolis) the water is produced from the Quaternary sands and gravels, and exists at a level of about 28 m from the surface near sea level (Well E6). The calculated salinity by the true resistivity and self potential methods is 2,000 ppm at a depth of 50 m, and 4,000 ppm at a depth of 81 m from the surface.

From the structural configuration and the geomorphological setting, the depressions to the north of the tableland area acting as collecting areas where a limited contribution of the surface runoff from the watershed area takes place. As the surface of these depressions, especially their central portions is dominated by Quaternary sands and gravels the vertical movement of the surface runoff water is possible. These sands and gravels overlie either the Pliocene clays (aquiclude) in the western extremities or the Miocene sands, clays and sandy limestone. The sandy facies of the Miocene act as an aquifer and produce water of saline nature. Below the Miocene the geological succession passes conformably into the Oligocene sediments which are developed into sands and garvels with occasional clays. These proved to be water-bearing, producing relatively less saline water. The Oligocene sands and gravels are encountered at a depth of about 300 m below surface and in some cases are separated from the overlying Miocene by a basaltic aquifer. Such condition may prevent whatever saline water is existing in the Miocene aquifer to infiltrate downward into the Oligocene aquifer which is probably recharged by the upward leakage from the underlying Eocene and Cretaceous aquifers or from the water precipitation from the past successive wet periods.

The probable dryness of the Quaternary sand and gravel mantle, and the high salinity of the water in the Miocene aquifer may not eliminate the importance of such structural depressions, especially in their central portions. for fresh water findings as deeper drilling is suspected to pass through the sands and gravels of the Oligocene which may represent an important aquifer.

Umm Gidam Slopes

The structural ridges area is followed in the northward direction by sandy gravelly slopes which are occupied by Umm Gidam slopes to the south and El Tell El Kabir slopes to the north. The southern slopes are separated from the northern ones by a low lying depression occupied by Wadi El Tumilat across which Ismailiya Sweet Water Canal runs to El Ismailiya.

Umm Gidam slopes are occupied by sands and gravels belonging to the early Pleistocene, and overlying unconformably the Miocene sediments. These deposits attain a thickness of about 200 m reported in well E5. The surface of Umm Gidam slopes regionally in a northward direction towards Wadi El Tumilat and in the eastward direction towards the Isthmus stretch, both of which act as natural drainage areas. The sand and gravel succession with intercalated clays encountered in a few wells put down in the slope area, can be explained as a mass of fluviatile or deltaic deposits extending northward from a shoreline which is marked by the edge of the outcrop of Miocene or older rocks existing to the south (Shotton, 1946).

The groundwater conditions in Umm Gidam slopes can be deduced mainly from two deep wells (E2 and E5) drilled on these slopes in 1961. The analysis of the data obtained from these two wells revealed that the geological succession encountered is composed of:

1. An upper unit composed of loose quartz sand with pebbles and granules with intercalated thin clayey beds, having a thickness varying

between 200 and 250 m, and is assigned to the early Pleistocene.

2. A lower unit constituted of alternating dark grey sandy limestone and clay with lenses of loose quartz sand and marl (these sediments show wide lateral change of facies) and belong to the Miocene.

The water confined in the upper sandy geological units (early Pleistocene aquifer) shows markedly lower salinity (less than 1,000 ppm) but this salinity shows gradual increase with depth reaching its maximum calculated value (5,000 ppm) in the Miocene aquifer as shown from the figures in Table 2.

TABLE 2

Salinity in aquifers encountered in wells E2 and E5

Aquifer	Well E2		Well E5	
	Depth m	Salinity ppm	Depth m	Salinity ppm
Early Pleistocene	104	980	95	86
	114	1,100	115	1,000
	122	1,700	135	2,200
	144	2,500	220	4,500
	157	3,800	—	—
Miocene	225	5,000	255	6,000
	250	5,000	252	9,000

The water exists at a level varying between 103 m (E2) and 78.5 m (E5) from the ground surface, a few meters above sea level. The depth to water in Umm Gidam slopes from the ground surface is controlled by the ground elevation.

Outside these slopes in the area under investigation, and due west where there is a direct connection with sub-Nile Delta, the fresh groundwater column is considerable and the salinity of water (as calculated in well E3 to the south of Abu Hammad) is in the average of 300 ppm along the water column 175 m from the surface. Below this depth, the salinity shows gradual increase till it reaches 10,500 ppm at the depth of 315 m.

From the above mentioned available limited data, the following points concerning the hydrogeological situation in Umm Gidam slopes, are considered :

1. Deep drilling indicated that the main aquifer exists in the Pliocene-early Pleistocene sands and gravels. The top portion of the water column is characterized by a relatively less saline nature (salinity less than 1,000 ppm), which increases with depth.

2. The early Pleistocene aquifer is underlain by another aquifer restricted to the Miocene. The salinity of water in the latter aquifer is high varying between 500 and 10,000 ppm.

3. The fresh nature of water in the early Pleistocene sands and gravels is in the first place due to the replenishment from desert wadis and from the surface runoff falling on the shed area to the south.

4. The increase of salinity with depth may be due to the upward leakage of the saline water confined in the underlying Miocene aquifer. There is a possibility of the lateral seepage of saline water existing in the Miocene aquifer which is near the surface further to the south where the early Pleistocene aquifer comes opposite to that of the Miocene as a result of faulting.

5. The water table in the southern portion of Umm Gidam slopes occurs at a deep level relative to the ground elevation. This water table becomes shallower in the northward direction towards Wadi El Tumilat as well as in the westward direction towards the Nile Delta Basin.

6. The flow of groundwater is essentially from south to north, i.e. towards Wadi El Tumilat, and partly in a northeastern direction towards El Manayif Oasis (to the south west of El Ismailiya), both of which act as natural drainage areas.

7. The salinity of water decreases northward and westward where the effect of Ismailiya Sweet Water Canal and sub-Delta reservoir have their effect respectively.

The groundwater obtained from the wells drilled in Wadi El Tumilat depression is obviously «not due to the negligible rain fall which occurs in the area, but can be ascribed to any alleged leakage from the Sweet Water Canal, not too much of its water is used locally for irrigation». The main source of this groundwater is the water in the sub-Delta gravels and this must seep laterally, either from the west or the northwest, i.e. the water originates essentially by lateral impregation from the gravels under the Nile Delta. The salinity of the water in this depression is rather low, especially in the areas surrounding Ismailiya Canal (although in the low lying areas which are affected by the artificial irrigation and drainage system, the water is subjected to evaporation and the ground has been encrusted with salts). In the reaches of the Suez Canal to the east, the salinity of water becomes higher. Concerning the low salinity of the water in Wadi El Tumilat and its more or less consistent value with depth or as a result of water discharge, the constant recharge from Ismailiya Canal as well as the possibility of the direct connection with the Nile aquifer under-neath the Delta, must not be overlooked.

The effect of these two factors is reflected northward in the southern portion of El Tell El Kabir-El Salhyia plain. In this area, the early Pleistocene sands and gravels constitute the main aquifer. The water table exists at a depth varying between 10 and 5 m from the surface. The salinity of groundwater rarely exceeds 1000 ppm.

Towards the northern portion, the area under investigation passes into different plains existing on the edge of the Mediterranean geosyncline, and constitutes El Manzala-El Bardawil coastal plain. The water becomes highly saline and shows ionic ratios and coefficients typical of sea water. This drastic change in the quality of water from south to north is due both to the continuous leaching of the water bearing strata which has inherited high salinity due to the depositional environment under fluviomarine conditions, and to the direct salt water intrusion. The salinity increases near the reaches of Lake Manzala, i.e. in the northward direction. The groundwater is normally obtained from the late Pleistocene sands (upper aquifer) and from the early Pleistoncene sands and gravels (lower aquifer). The recent drilling in El Qantara area conducted as a part of the overall effort by the Remote Sensing Project to investigate the geology and hydrogeology of the Suez Canal zone, revealed the existence of at least three aquifers, all of them producing saline water, as follows :

1. An upper leaky aquifer under free water conditions either in the Holocene fluviomarine sands dominating to the west of Suez Canal or in the Holocene sand dune belt dominating to the east. The water existing in this aquifer is of low salinity (in the order of 4,000 to 7,000 ppm) where a permanent recharge of less saline water from the irrigation and drainage system in the west, or from local precipitation in the east takes place. At the approach to the Suez Canal, the salinity increases rapidly (reaching over 40,000 ppm) due to the salt water intrusion from the canal. This aquifer is not in direct connection with the lower aquifers as it is separated from the underlying aquifers by thick clay beds.

2. A middle aquifer existing under subconfined conditions in the old fluviomarine sands (late Pleistocene). The water in this aquifer is highly saline (reaching 82,000 ppm).

3. A lower main aquifer existing under semi-artesian conditions in early Pleistocene sands and gravels. In this area, such aquifer exists at 70 m from the surface and attains a thickness of about 70 m. The water attains also high salinity in the average of 80,000 ppm.

The hydraulic parameters of the early Pleistocene aquifer have been determined in some localities near the western boundary of the area under investigation (near Abu Hammad and at El Mullak area to the south of El Ismailiya Canal). The results obtained show marked variations even in the same area. This can be shown from the following figures in El Mullak area obtained from three pumping tests conducted in three localities, Table 3.

TABLE 3
Hydraulic parameters of early Pleistocene aquifer
(Staff of Energoprojekt, 1966)

Location	K	S	T
a	7.5 × 10 cm	0.0145	3,450m/day
b	9.1 × 10 cm	0.0208	4,850m/day
c	5.7 × 10 cm	0.0097	2,160m/day

Such variations are expected all over the area where different boundary conditions of the aquifer exist.

Isthmus Stretch

In the Isthmus stretch, the geological conditions are not favourable for exploiting the obtainable groundwater. The geological succession is composed of alternating sandstone and clay beds with occasional sandy limestone, conglomerate and marly layers belonging to the Miocene. The sandstone and the conglomerate constitute the main water bearing geological units within this Miocene section in which water exists under almost partially confined conditions. This aquifer looses some of its hydrological characteristics due to the conspicuous change of the rock facies both laterally and vertically, with regard to the free nature of the groundwater occurrences and the salt water intrusion from the Suez Canal. Due to this, the aquifers are hydrologically connected and different values of hydrological parameters are expected due to the lateral change in facies and to the non-continuity of the layers acting as aquicludes. The water in the Miocene aquifer is likely to be of connate type with some contributions from the annual precipitation falling on the upland shed areas existing to the west and the south. In addition to this, the nature of the Miocene succession and the abundance of anhydrite-gypsum within this succession and the continuous leaching processes, minimize the potentialities of this aquifer.

The main Miocene aquifer is overlain by a subsidiary leaky aquifer in the top soil layer (3 m thick) which is composed of clayey sand. The water in this layer is contributed by leakage from the irrigation and drainage system (on the western side of the Suez Canal) and from local precipitation (on the eastern side). within this Isthmus stretch, the Suez Canal acts as a natural drain for this water.

Underlying this Miocene aquifer, relatively less saline water horizons were recorded in the Oligocene sandy geological units at depths from 583 m to 600 m in Habashi well on the eastern side of the Great Bitter Lake. The groundwater in these Oligocene horizons has a hydraulic pressure lifting it to nearly 16 m above the present sea level. The water in this aquifer has lower salinity (less than 3,000 ppm) than that existing in the overlying Miocene aquifer. This Oligocene aquifer seems to be reacharged from the heavy precipitation during the past wet periods on the intake areas of such rocks as well as from the upward leakage from the underlying Eocene and Cretaceous aquifers (possibly through fault lines).

Conditions of the Aquifers

Based upon the afore mentioned hydrogeological investigations, the following deductions of the conditions of the water bearing formations are concluded :

1. Unconfined early Pleistocene aquifer dominating Umm Gidam slopes.

2. Free water Holocene aquifer dominating the coastal Mediterranean belt.

3. Leaky late Pleistocene aquifer dominating the southern portion of El Tell El Kabir-El Salhiya plain and the top soil in the Isthmus stretch.

4. Sub-artesian early Pleistocene aquifer dominating the northern portion of El Salhiya Plain. This condition characterizes also the Oligocene aquifer in the eastern side of the Isthmus stretch.

5. Semi-confined Miocene aquifer dominating in the Isthmus stretch.

Groundwater Use with Regard to Salinity

1. Unsuitable water, salinity more than 3.000 ppm (Fig. 7)

a) The Miocene and Oligocene aquifers (to the depth of 500 m from the surface) in the structural depressions.

b) The Miocene aquifer in Umm Gidam slopes.

c) The early Pleistocene aquifer in north El Tell El Kabir-El Salhiya plain.

d) The late Pleistocene fluviomarine aquifer in El Salhiya-Bir El Abd strip.

e) The Miocene aquifer in the Isthmus stretch.

2. Permissible water, salinity from 1,000 to 3,000 ppm

a) Quaternary gravel mantle in the central parts of the structural depressions (expected).

b) Early Pleistocene aquifer in Umm Gidam slopes.

c) Early Pleistocene-late Pleistocene aquifers in the southern portion of El Tell El Kabir-El Salhiya plain.

d) Holocene sand aquifer existing as a fresh water layer (1 to 5 m thick) in the environs east of the Suez Canal.

3. Suitable water, salinity less than 1,000 ppm

Pliocene-early Pleistocene aquifer in Wadi El Tumilat and its peripheries to the north and the estern frontier of El Tell El Kabir-El Salhiya plain.

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10.3.1975

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Remote Sensing Project
Academy of Scientific Research
and Technology
101 Kasr El Aini Street
Cairo

Ismailia Master Plan Study

Geological and Groundwater Potential Studies of El Ismailiya Master Plan Study Area

Dear Dr Abdel-Hady,

I wish to thank you for completing our recently commissioned study on the geology, structure and surface drainage of our Master Plan Study area as interpreted from ERTS.1 Images, including also groundwater potentialities in the area.

As you are aware the Master Plan Study we are carrying out for the Ministry of Housing and Reconstruction is a comprehensive planning study covering a range of physical, social and economic considerations and factors.

The Study Area offers considerable potential for soil reclamation and increased economic activity arising from an increase in population. In formulating our recommendations on the capacity of the Study Area, we must examine, in some detail, natural and physical constraints to alternative development options. These constraints could ultimately determine the optimum holding capacity of the Study Area.

Set in this context the study you have carried out for us is particularly significant as it adds to our knowledge and understanding of geology and groundwater potential. Information gained from your study will enable us to better evaluate the resource potential of the area and to identify areas and/or characteristics requiring further detailed study. We will also be able to establish priorities, study parameters and specify realistic work programmes for these future studies.

From the outset of our association we have been extremely impressed by the expertise and capability of your project team, the sophisticated level of technology and resources

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-2- 10.3.1975

at your disposal and finally in the high standard and technical quality of the work produced for us.

Once again I wish to thank you and your colleagues on an excellent study, for the time and cooperation you have extended to our team members, in particular Mr M Varela, and for your willingness to undertake the study at such short notice.

It has been a great pleasure working with you and your colleagues and I sincerely hope that we can continue our relationship on latter stages of our project or in future work.

Yours sincerely,

David B Allen
Project Manager

Manuel Varela
Hydrogeologist

مستخلص

قام مشروع الاستشعار من البعد باعداد خرائط جيولوجية وتركيبية وصرف سطحي جديدة لمنطقة شرق الدلتا (بين دلتا نهر النيل وقناة وخليج السويس) باستخدام الصور الفضائية المجمعة من القمر الصناعي ارتس ـ ١ .

وقد تم اعداد هذه الخرائط بهدف استخدامها في اعداد الدراسات الاقليمية لمشروعات تعمير منطقة الاسماعيلية .

كما تم ايضا اجراء دراسة مبدئية عن المياه الجوفية ومصادر المياه واحتمالاتها المختلفة للمنطقة تحت الدراسة بقصد استخدامها في الدراسات الخاصة بمشروعات استصلاح الأراضي في هذه المنطقة .

الدراسات الجيولوجية واحتمالات المياه الجوفية لتخطيط منطقة الإسماعيلية باستخدام القمر الصناعي ارتس ــ ١

استاذ دكتور الشاذلي محمد الشاذلي

نائب مدير هيئة الطاقة الذرية ورئيس قسم الجيولوجيا والخامات الذرية ومدير المجموعة الجيولوجية لمشروع الاستشعار من البعد ــ القاهرة .

استاذ دكتور محمد احمد عبد الهادى

استاذ الهندسة المدنية بجامعة ولاية أوكلاهوما بالولايات المتحدة ومدير مشروع الاستشعار من البعد ــ القاهرة .

دكتور محمد محمد الشاذلي

استاذ باحث مساعد بمعهد الصحراء ــ القاهرة .

دكتور محمد عبد الرازق الغوابى
والجيولوجي ابراهيم على القصاص

جيولوجيان بقسم الجيولوجيا والخامات الذرية وباحثان بمشروع الاستشعار من البعد ــ القاهرة .

جيولوجي عبد العاطى بدر سلمان
وجيولوجي مرسى احمد مرسى

قسم الجيولوجيا والخامات الذرية ، هيئة الطاقة الذرية ــ القاهرة .

الناشر

مشروع الاستشعار من البعد ،
اكاديمية البحث العلمي والتكنولوجيا ،
١٠١ شارع قصر العينى ، القاهرة ،
جمهورية مصر العربية
١٩٧٥

مطابع شركة الاعلانات الشرقية

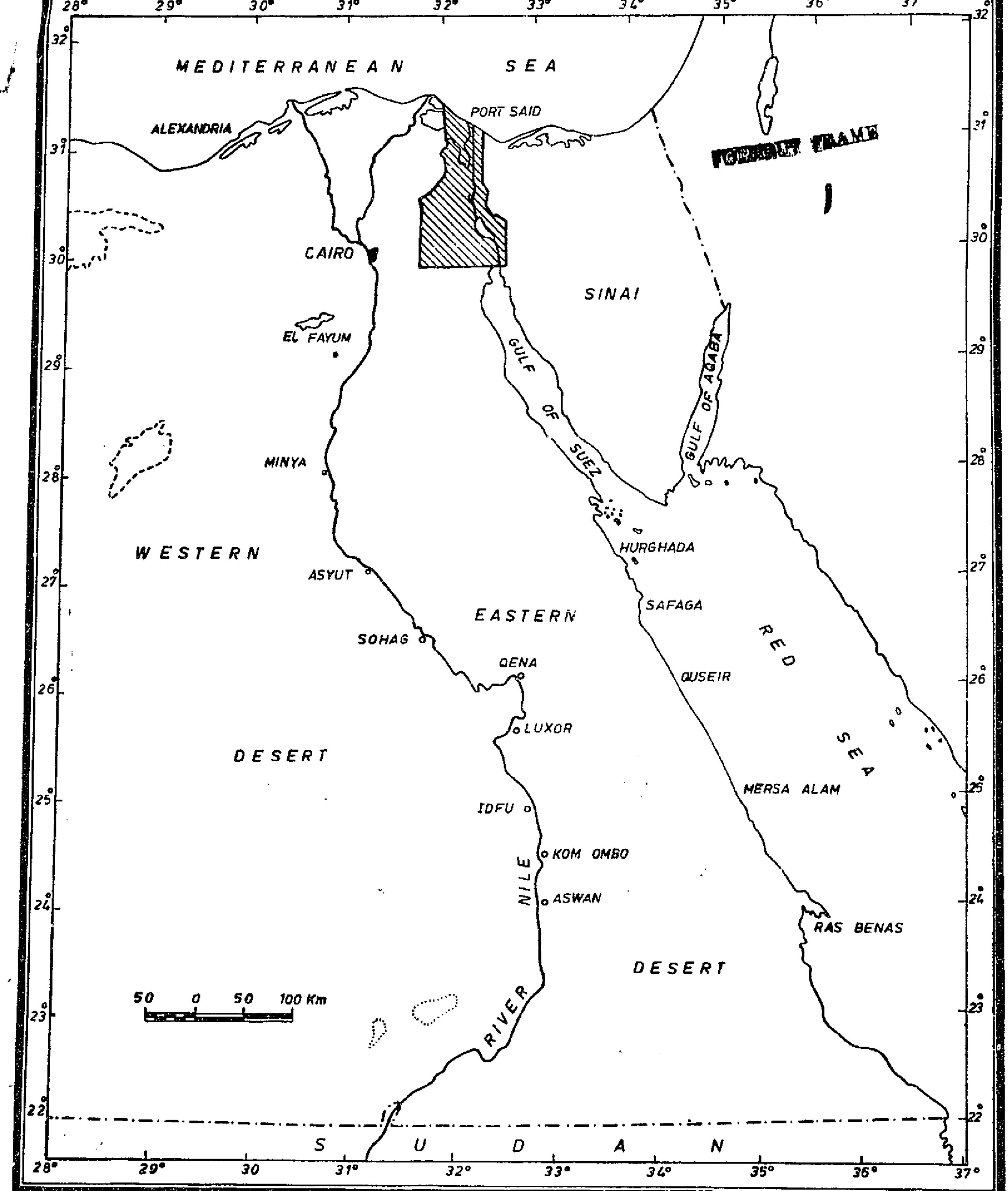
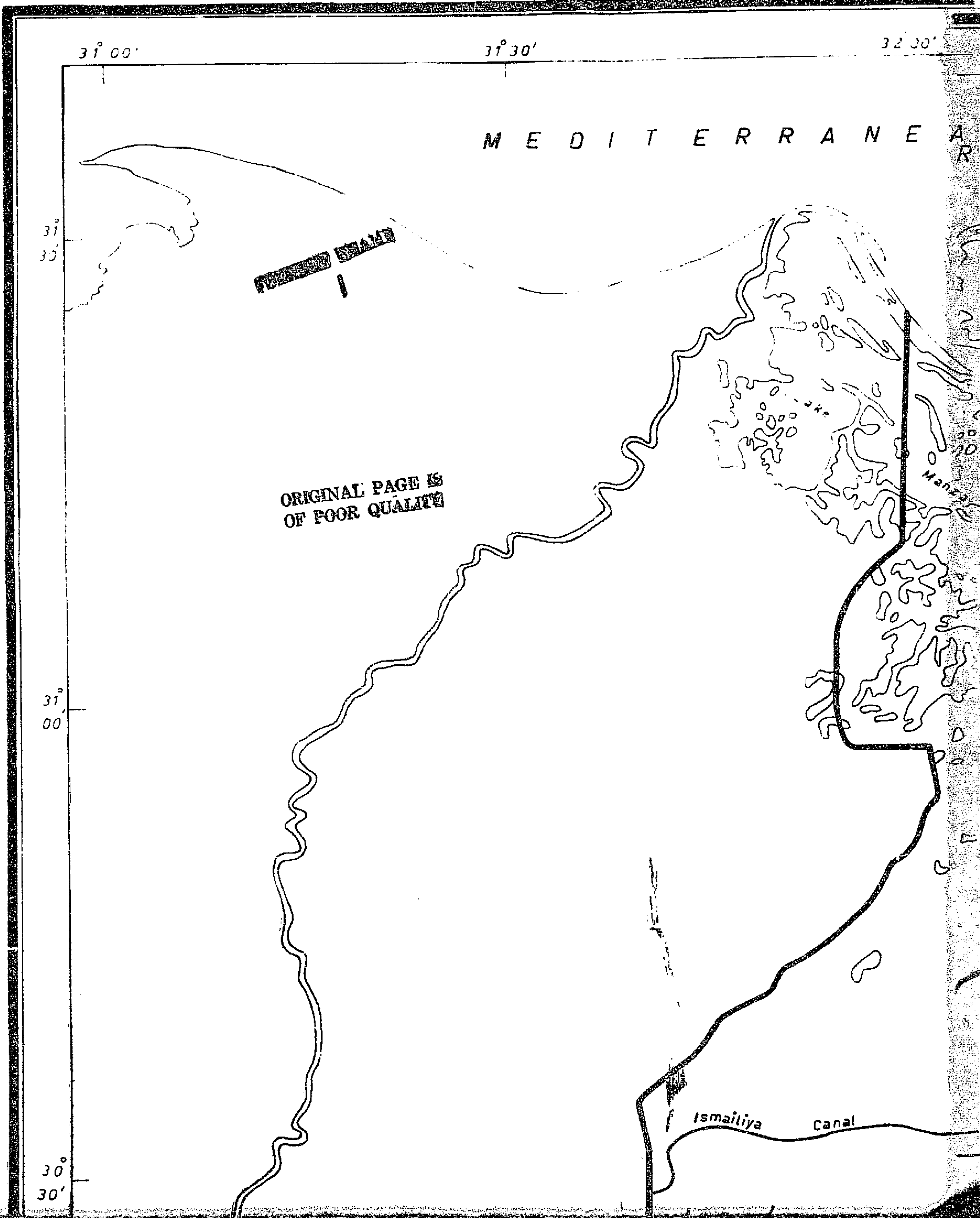
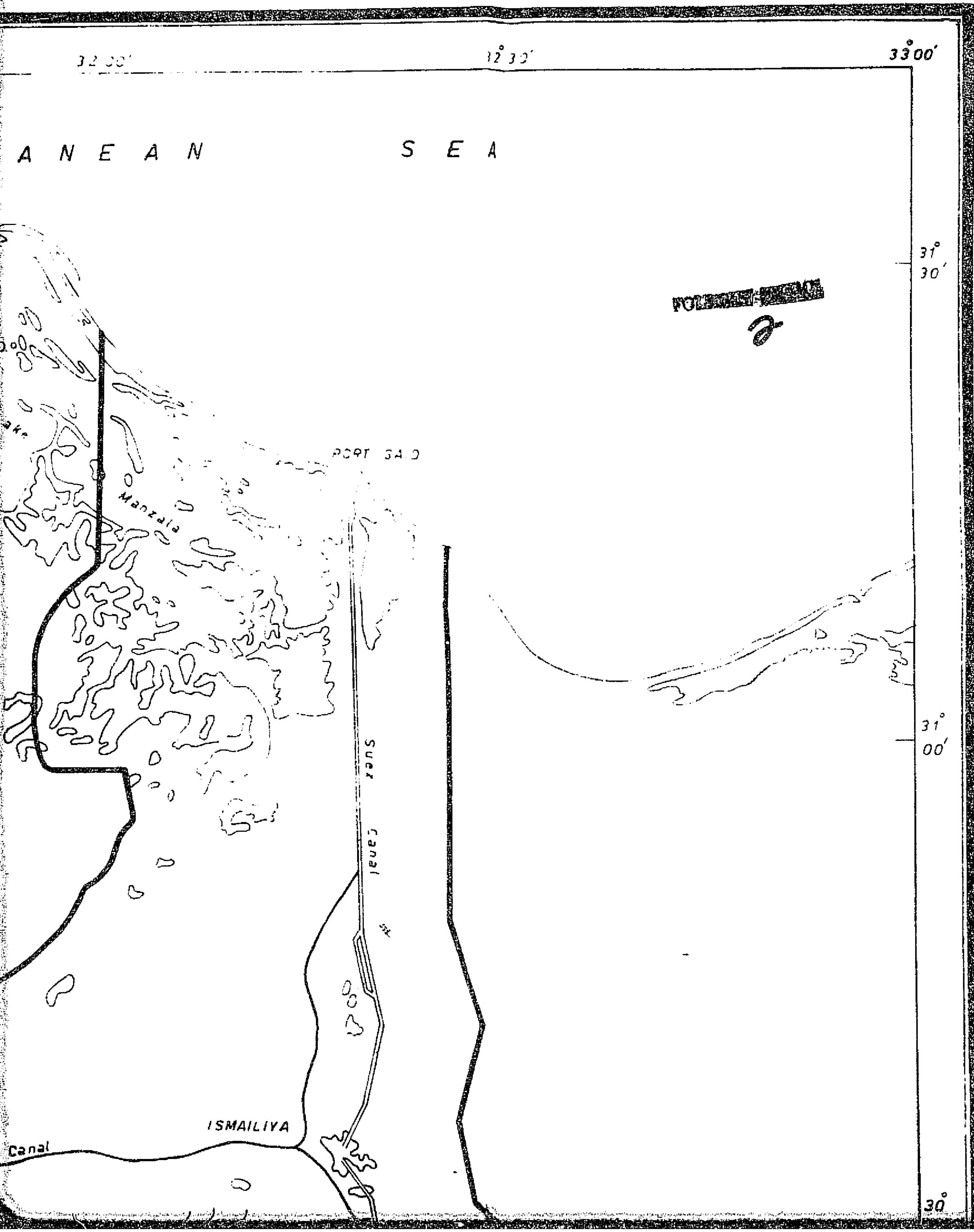


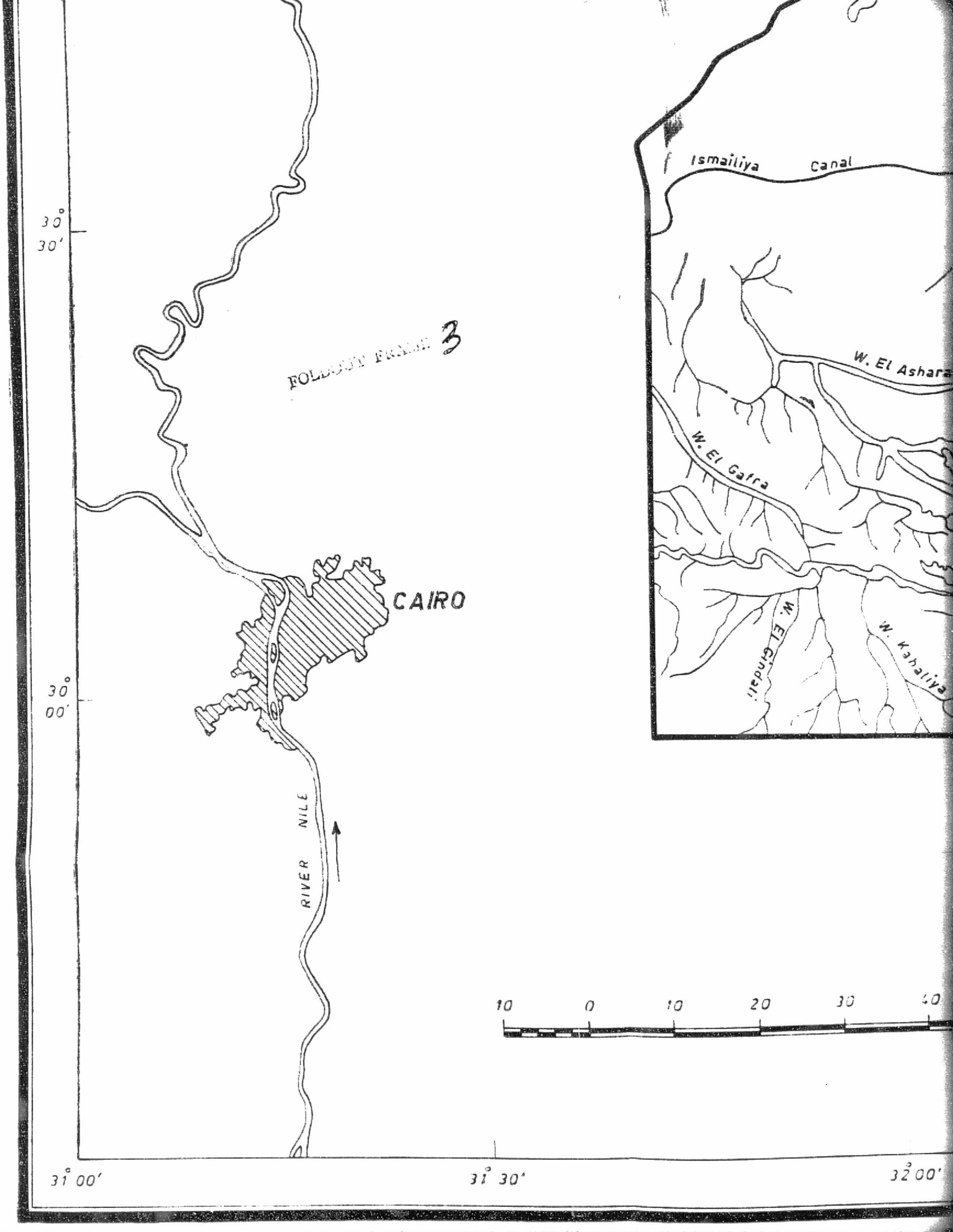
FIG. 1 KEY MAP

SHOWING THE LOCATION OF EL ISMAILIYA MASTER PLAN .STUDY AREA, EGYPT.

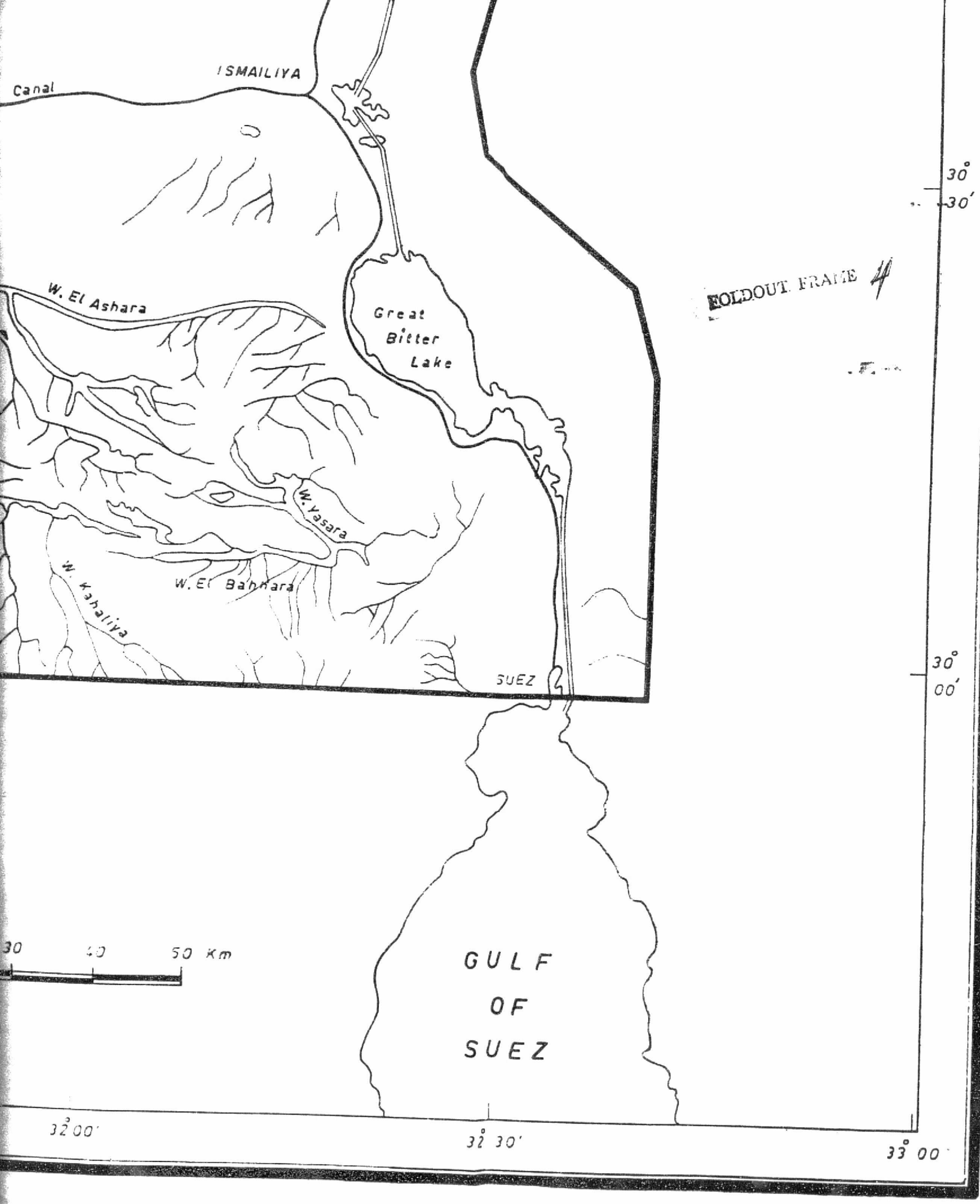

31°00'
31°30'
32°00'
M E D I T E R R A N E A
31° 30'
31° 00
30° 30'
Ismailiya Canal



32°30'
33°00'
A N E A N
S E A
31° 30'
PORT SAID
Manzala
Suez Canal
31° 00'
ISMAILIYA
Canal
30°



FOLDOUT FRAME 3
30° 30'
30° 00'
CAIRO
RIVER NILE
Ismailiya Canal
W. El Ashara
W. El Gafra
W. El Gindali
W. Kahaliya
10 0 10 20 30 40
31° 00'
31° 30'
32° 00'



Canal
ISMAILIYA
Great
Bitter
Lake
W. El Ashara
W. Yasara
W. El Bahhara
W. Kahaliya
SUEZ
GULF
OF
SUEZ
30
40
50 Km
30° 30′
30° 00′
32° 00′
32° 30′
33° 00

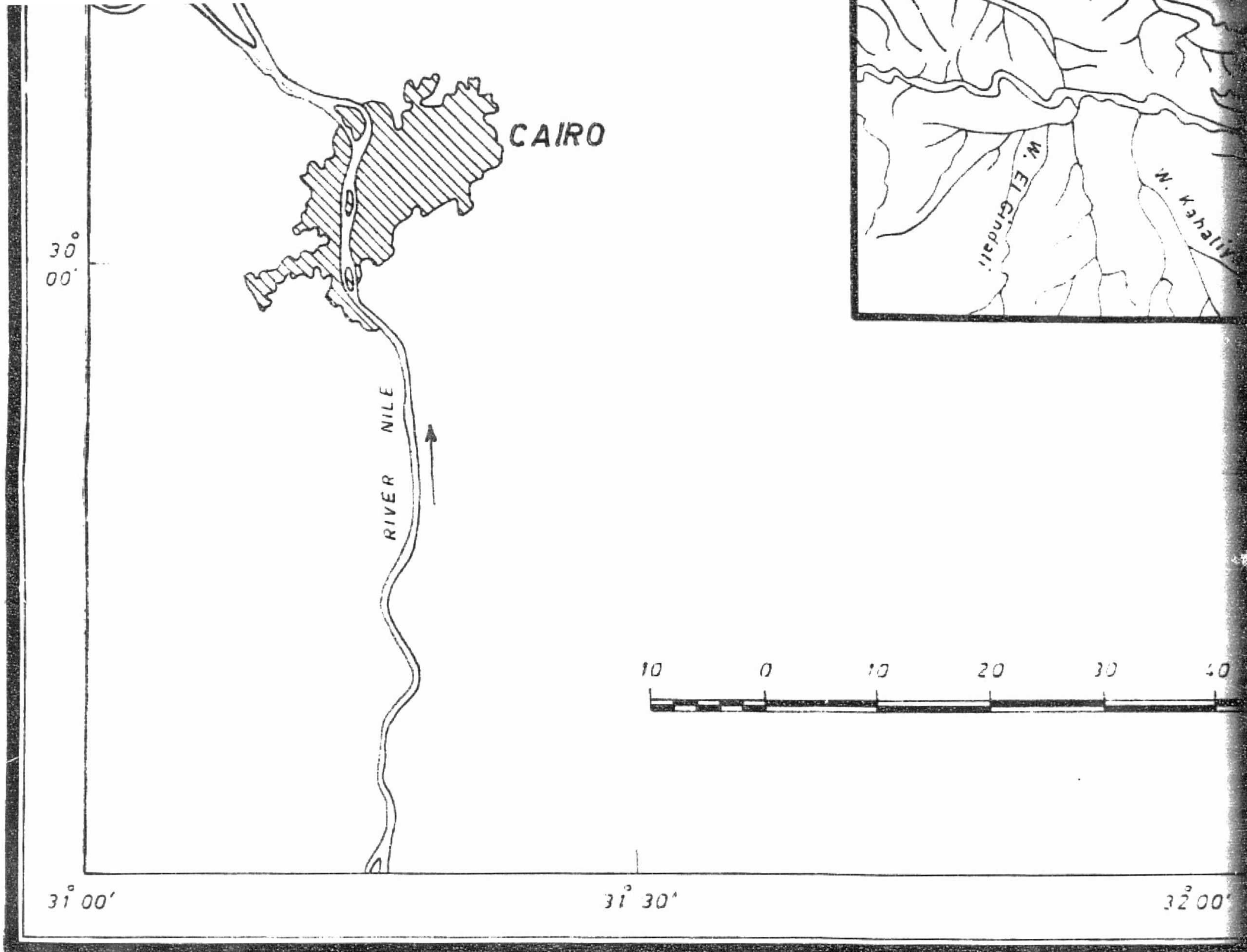
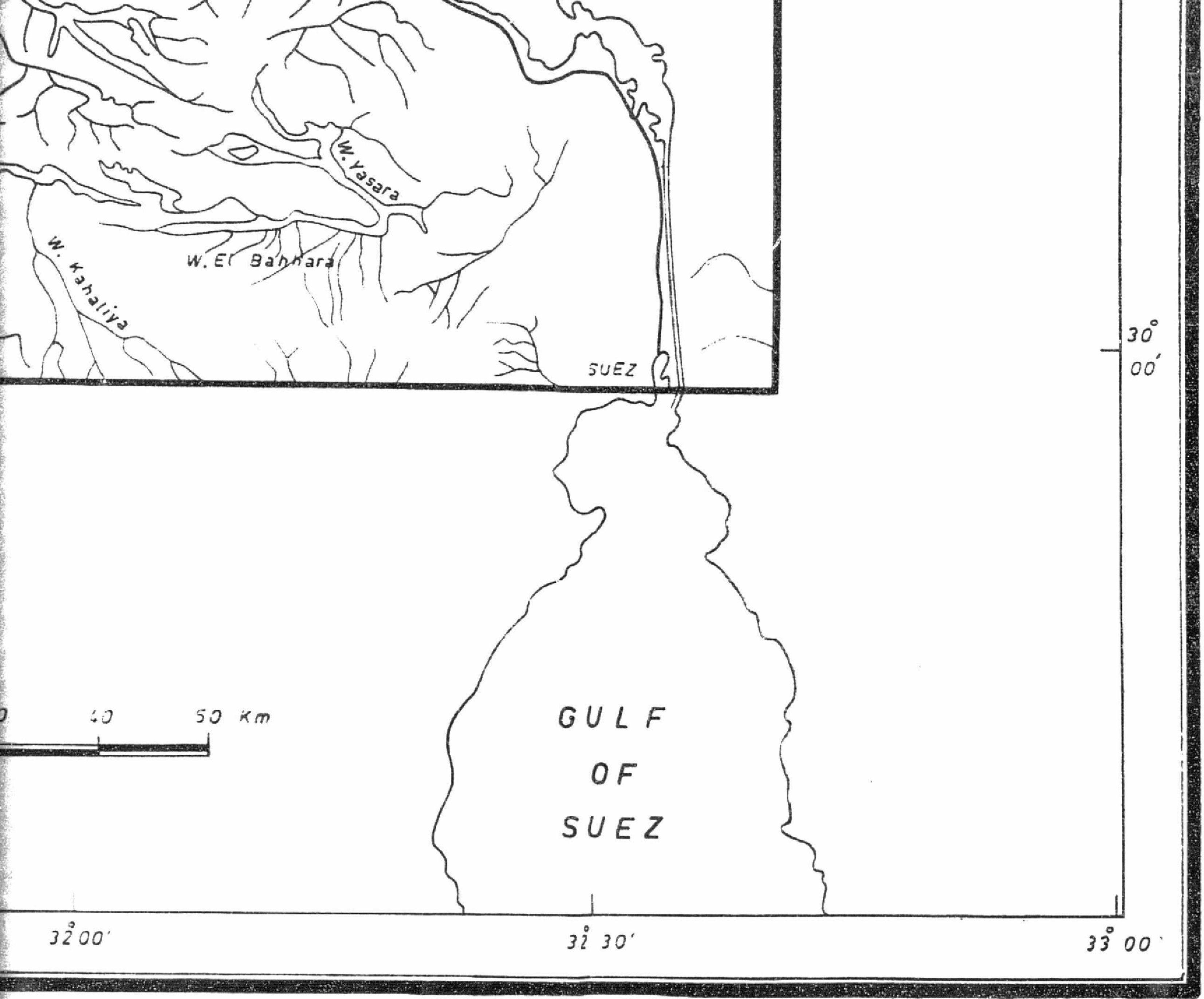


FIG. 2

GENERAL DRAINAGE MAP OF EL ISMAILI

(FROM ERTS-1 SATELLITE

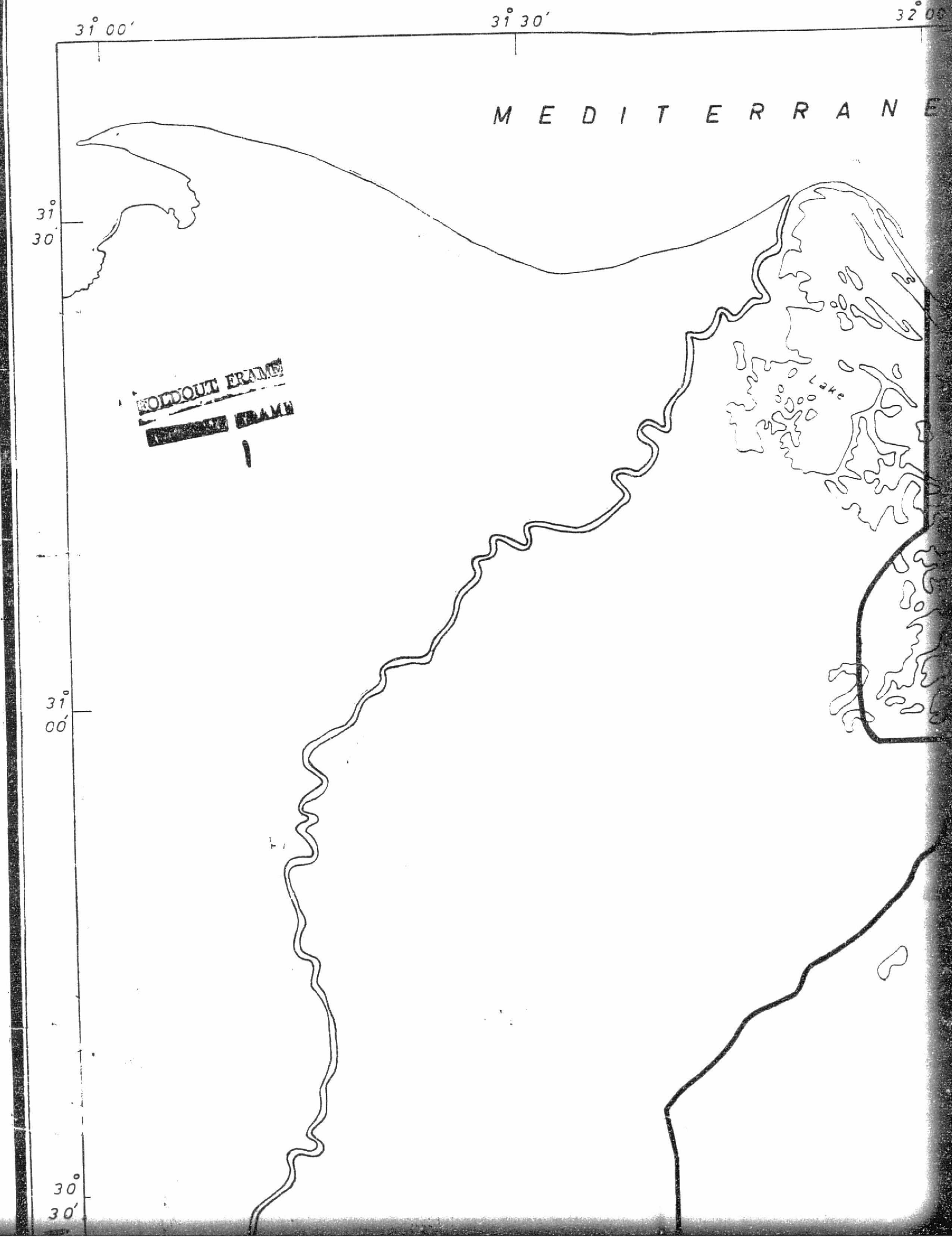
5



MAILIYA MASTER PLAN STUDY AREA, EGYPT.

LITE IMAGES, MARCH 1973)

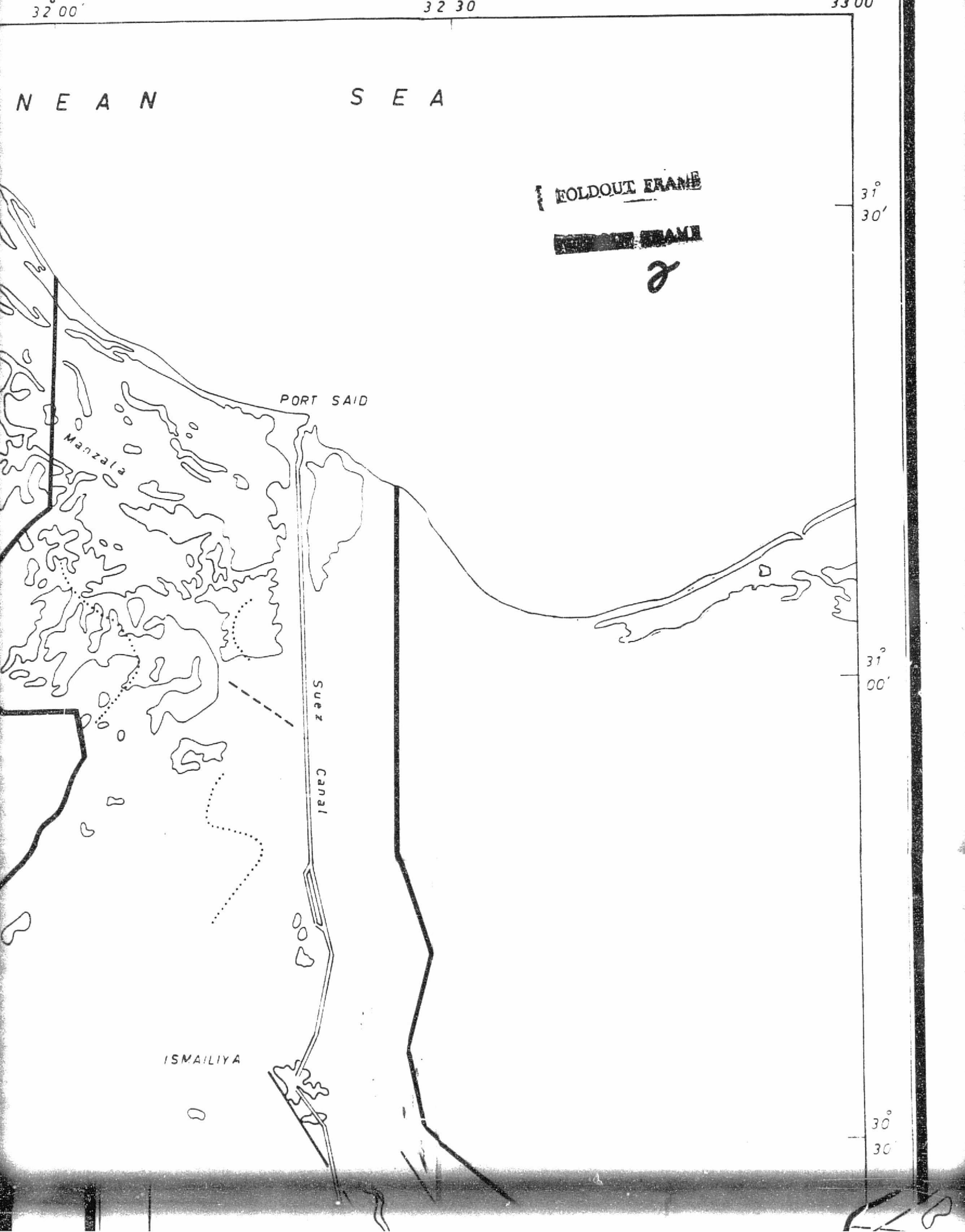
6

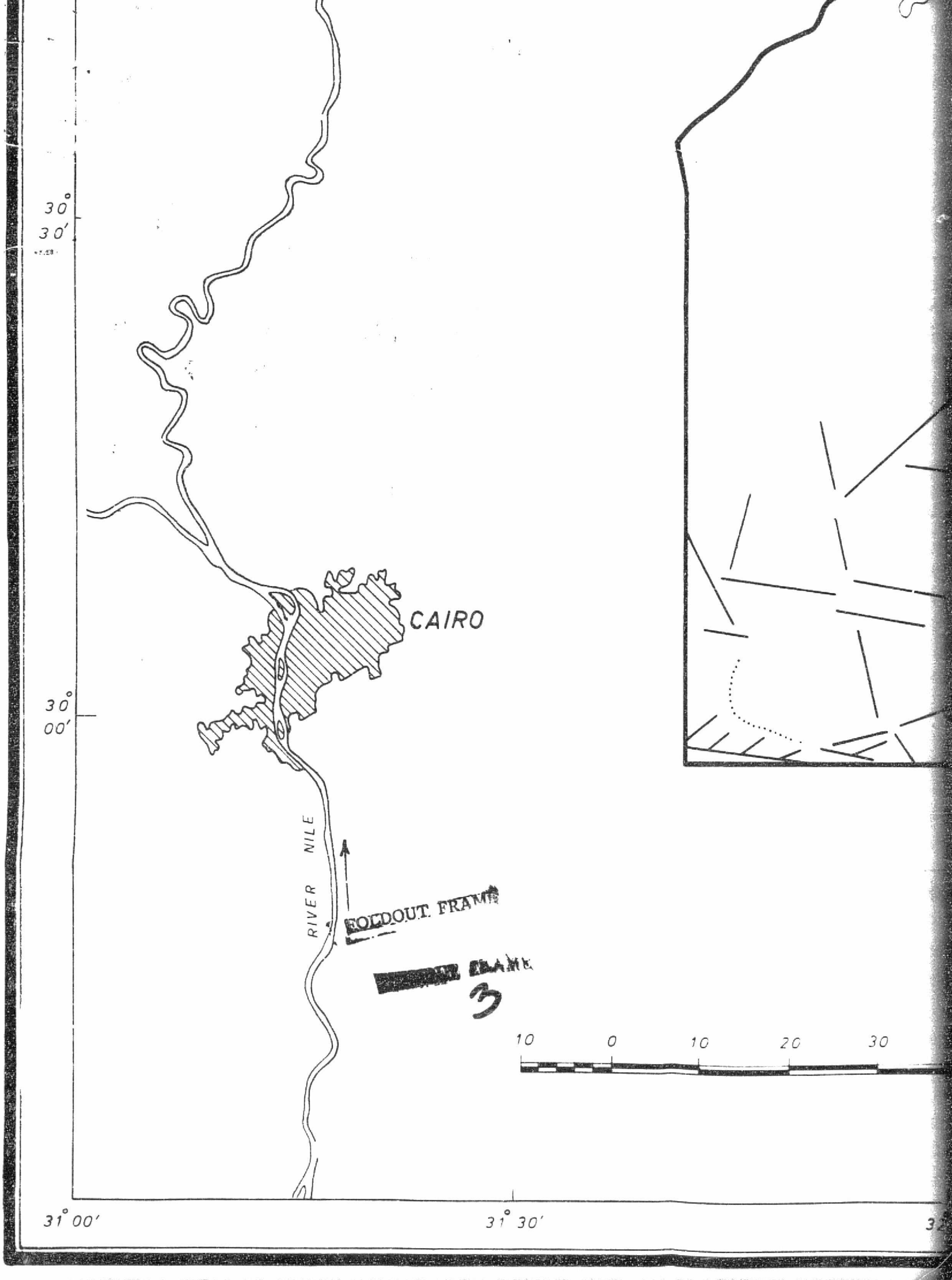

31° 00'
31° 30'
32° 00
M E D I T E R R A N E
31° 30'
Lake
31° 00'
30° 30'

FOLDOUT FRAME

[redacted] FRAME

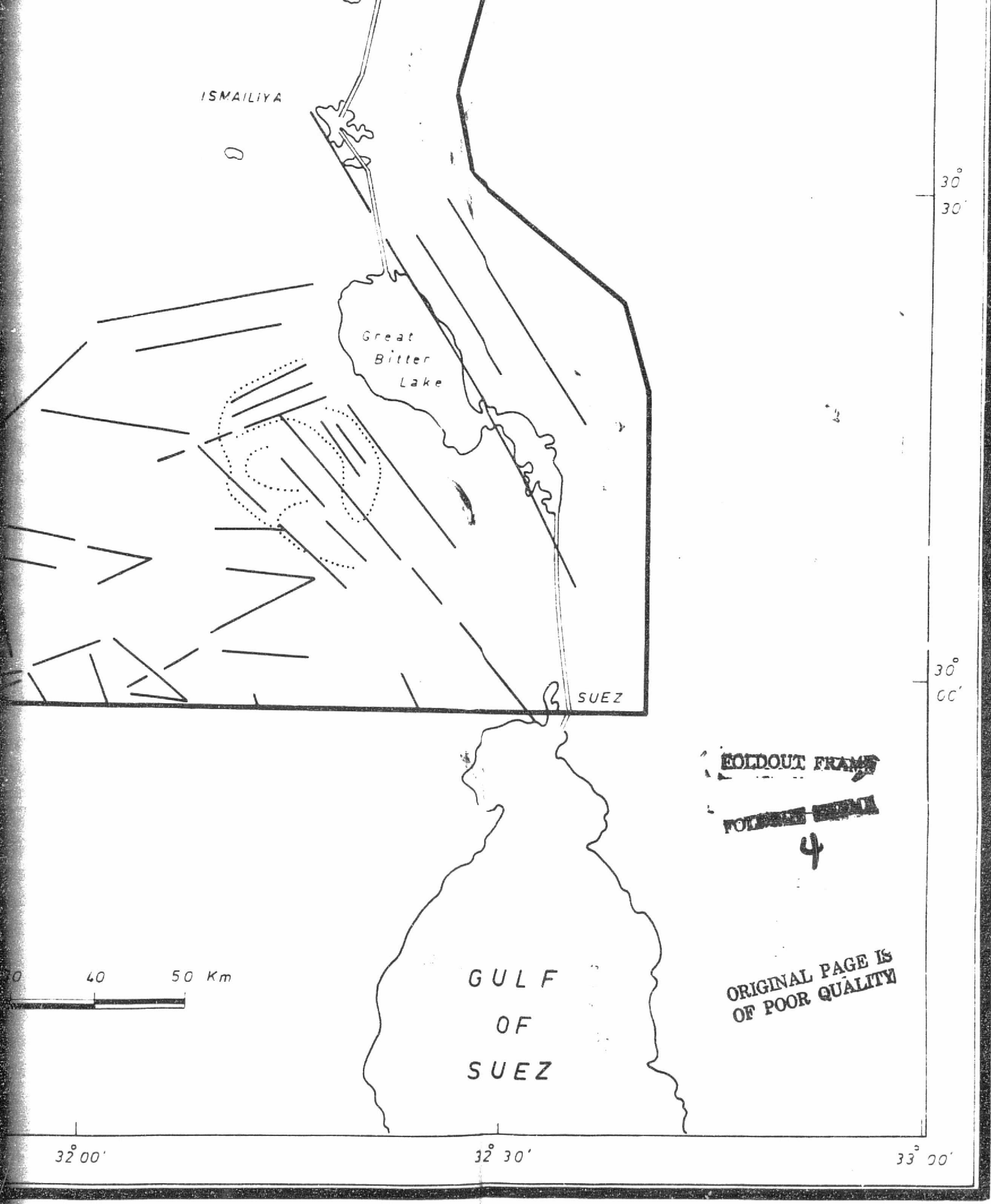
2

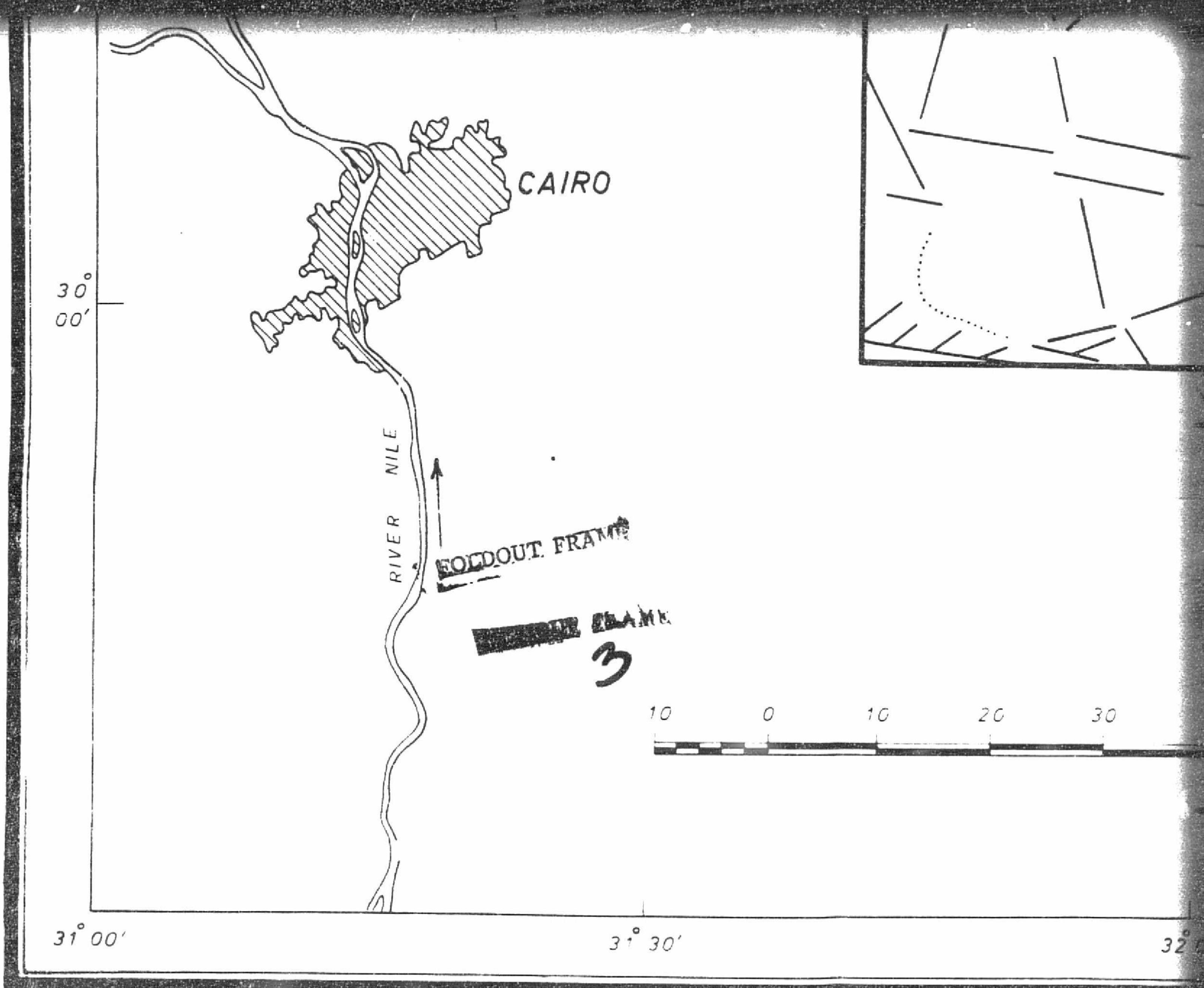




FOLDOUT FRAME

FRAME
3


ISMAILIYA
Great Bitter Lake
SUEZ
GULF OF SUEZ
30° 30'
30° 00'
40
50 Km
32° 00'
32° 30'
33° 00'



FOLDOUT FRAME

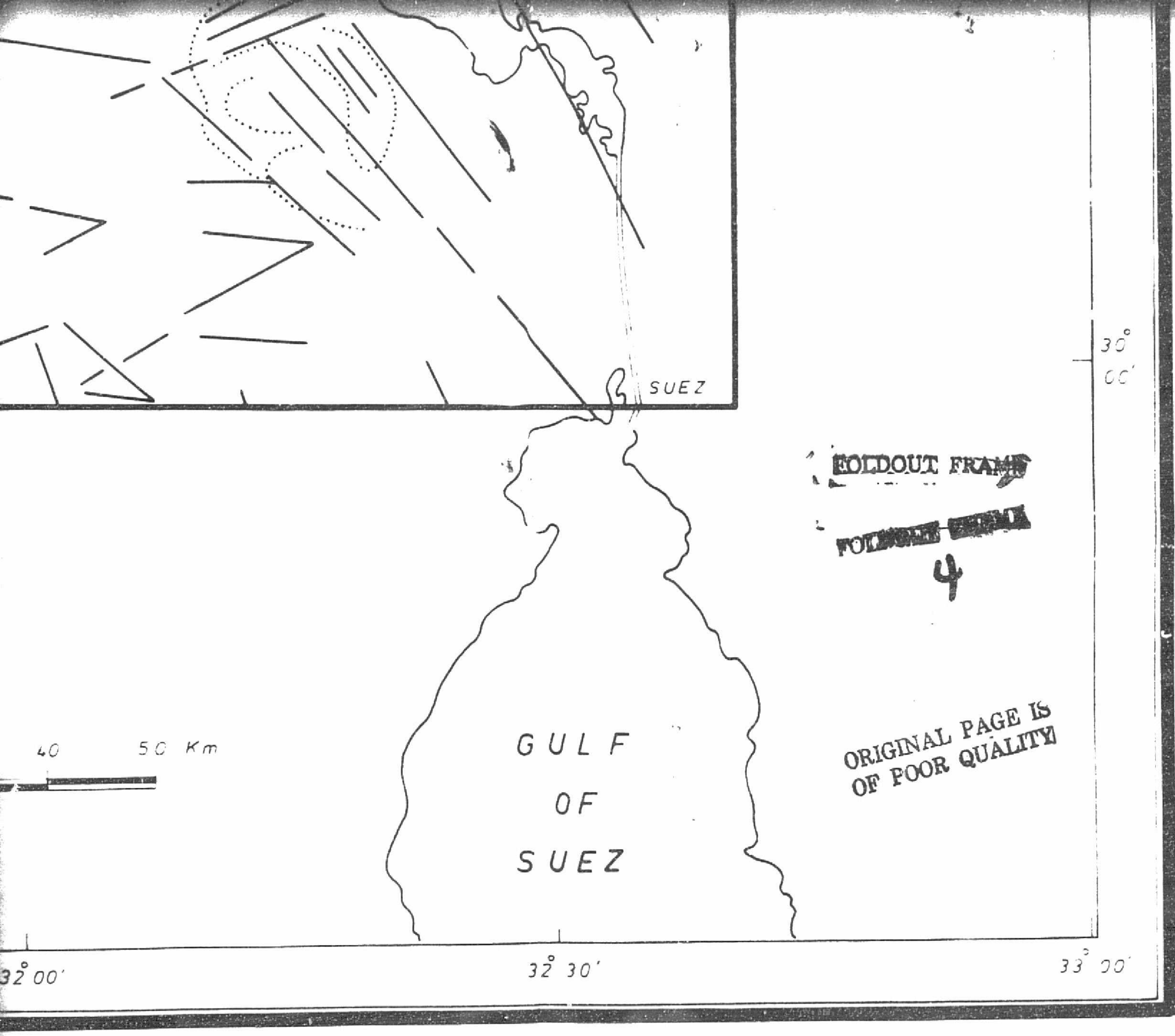
FIG. 5

STRUCTURAL LINEATION MAP OF EL ISMA

(FROM ERTS-1 SATELLITE

Fault or fracture lineament

Inferred lineam



AILIYA MASTER PLAN STUDY AREA, EGYPT.

TE IMAGES, MARCH 1973)

6

eament

Inferred folding trace

LEGEND TO THE GEOLOGICAL MAP
OF EL ISMAILIYA MASTER PLAN STUDY AREA

FORELAND SEDIMENTS

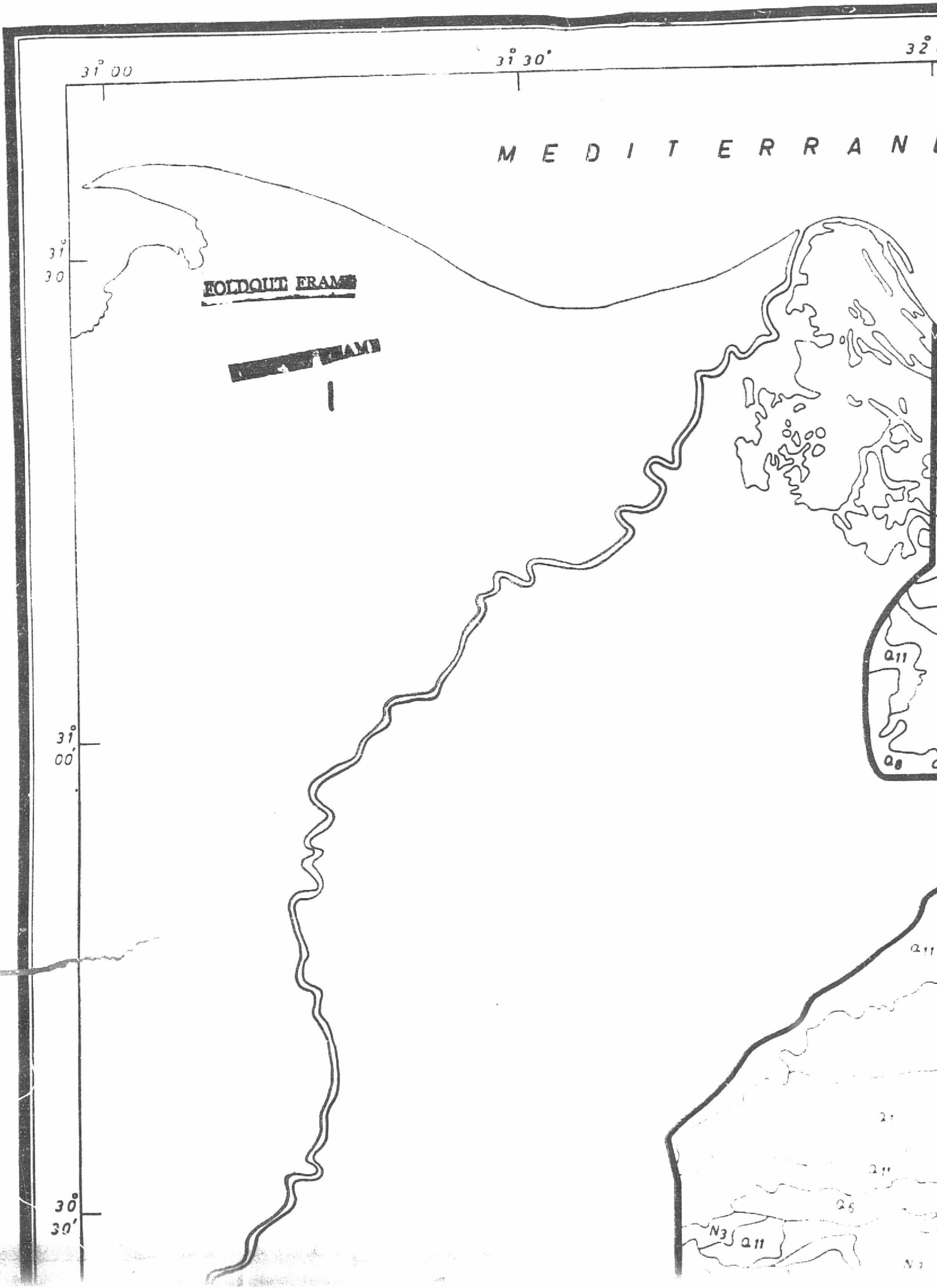
FIFTH DETRITAL SEDIMENTS

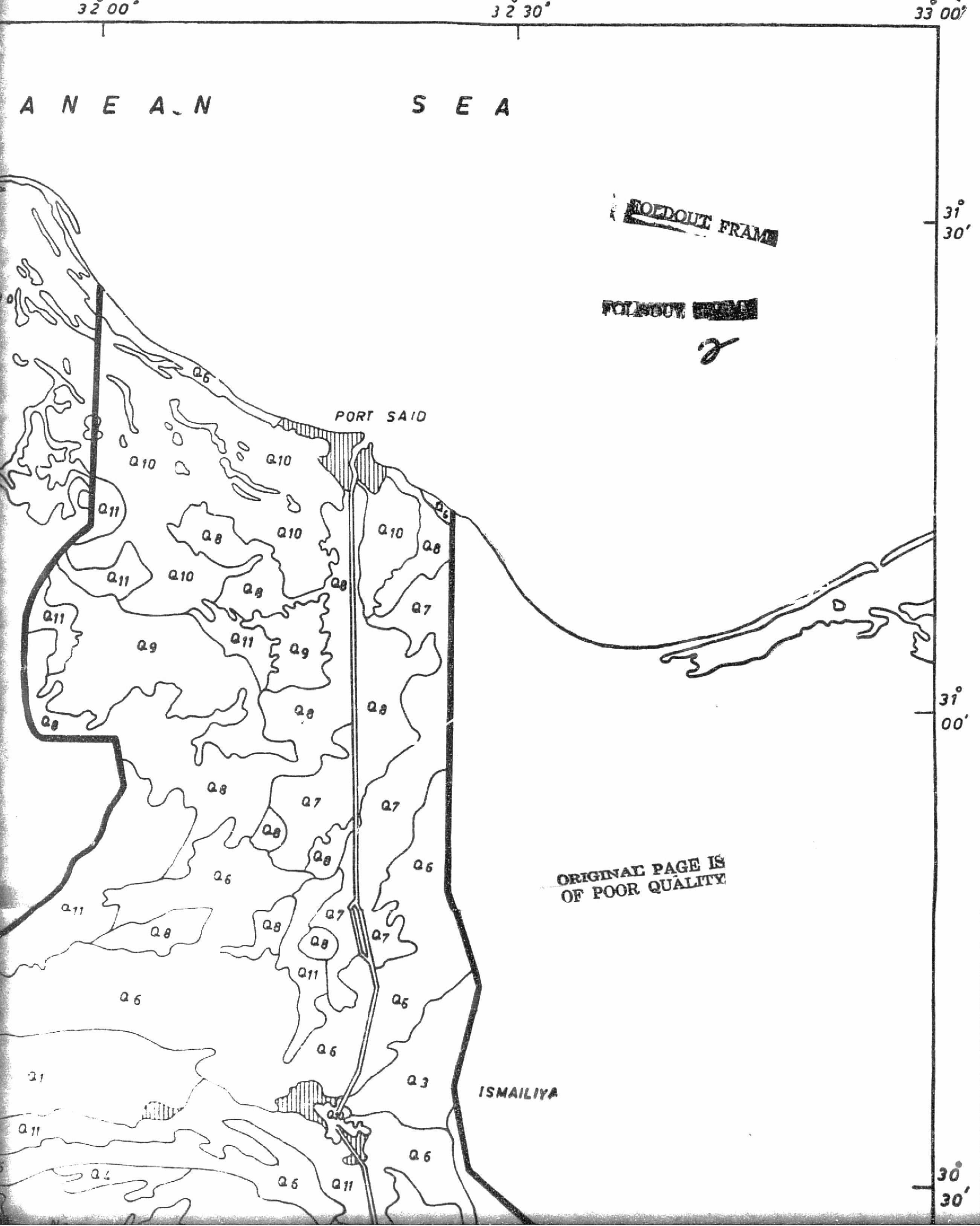
Q11	Peripheral cultivation	HOLOCENE-PLEISTOCENE	QUATERNARY
Q10	Lakes and ponds		
Q9	Shallow water bodies, with seasonal variations		
Q8	Marshes and sabkhas		
Q7	Salt crusts and salty surficial sediments		
Q6	Eolian sands and sand dunes		
Q5	Sand dunes with remarkable lineaments		
Q4	Wadi alluvium : clayey and sandy gravels		
Q3	Wadi alluvium : limy, marly and clayey		
Q2	Deluvium of Eocene rocks		
Q1	Gravel plains, with artificial hillocks		
N3	Gravels, sands and clays	PLIOCENE ?	NEOGINE
N2	Hommath Formation: $N2^2$ Limestones with prominent sandstones; $N2^1$ Limestones with promenent clays	MIOCENE	
N1	El Shatt Formation ≈ Ras Malaab Group: $N1^2$ Sandstones, clays and limestones, gypsum least abundant; $N1^1$ Sandstones, clay and limestones, gypsum more abundant		
	Mid-Tertiary Basalts ≈Gebel Qatrani volcanics		

THIRD DETRITAL AND FOURTH CALCAREOUS SEDIMENTS

PG4	Gebel Ahmar Formation: $PG4^3$ Quartzitic sandstones; $PG4^2$ Red sandstones; $PG4^1$ Sands and gravels	OLIGOCENE	PALEOGINE
PG3	≈ Tanka Formation — Mainly Late Eocene	EOCENE	
PG2	≈ Khaboba Formation — Middle Eocene		
PG1	≈ Darat Formation — Middle Eocene		

Towns and settlements


31° 00
31° 30'
32°
M E D I T E R R A N
31°
30
31°
00'
30°
30'
FOLDOUT FRAME
Q11
Q8
Q11
Q11
Q5
N3
Q11


32°00'
32°30'
33°00'
A N E A N
S E A
31° 30'
31° 00'
30° 30'
PORT SAID
ISMAILIYA
Q6
Q10
Q10
Q11
Q8
Q10
Q10
Q8
Q11
Q10
Q8
Q8
Q7
Q11
Q9
Q11
Q9
Q8
Q8
Q8
Q8
Q7
Q7
Q8
Q8
Q6
Q6
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Q11
Q6
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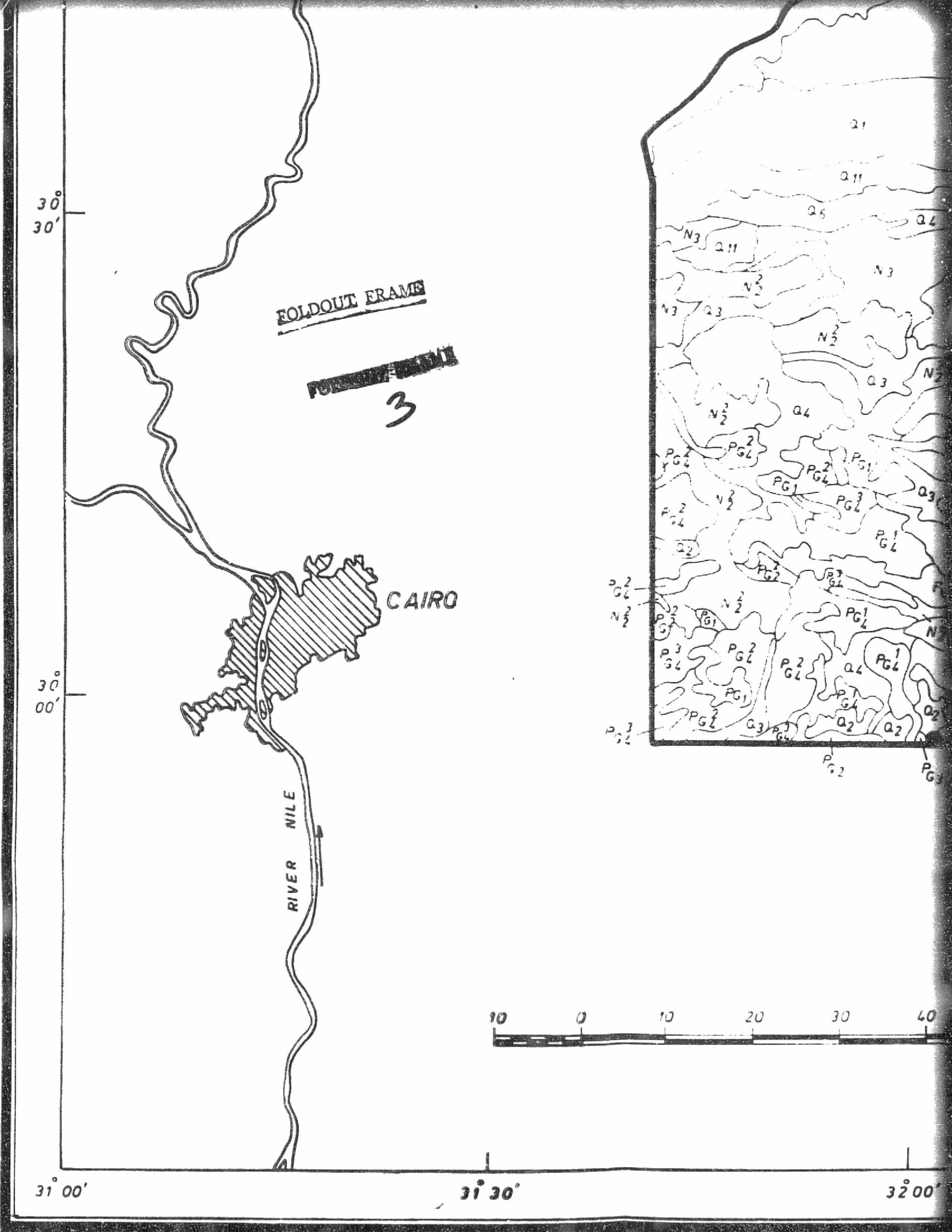
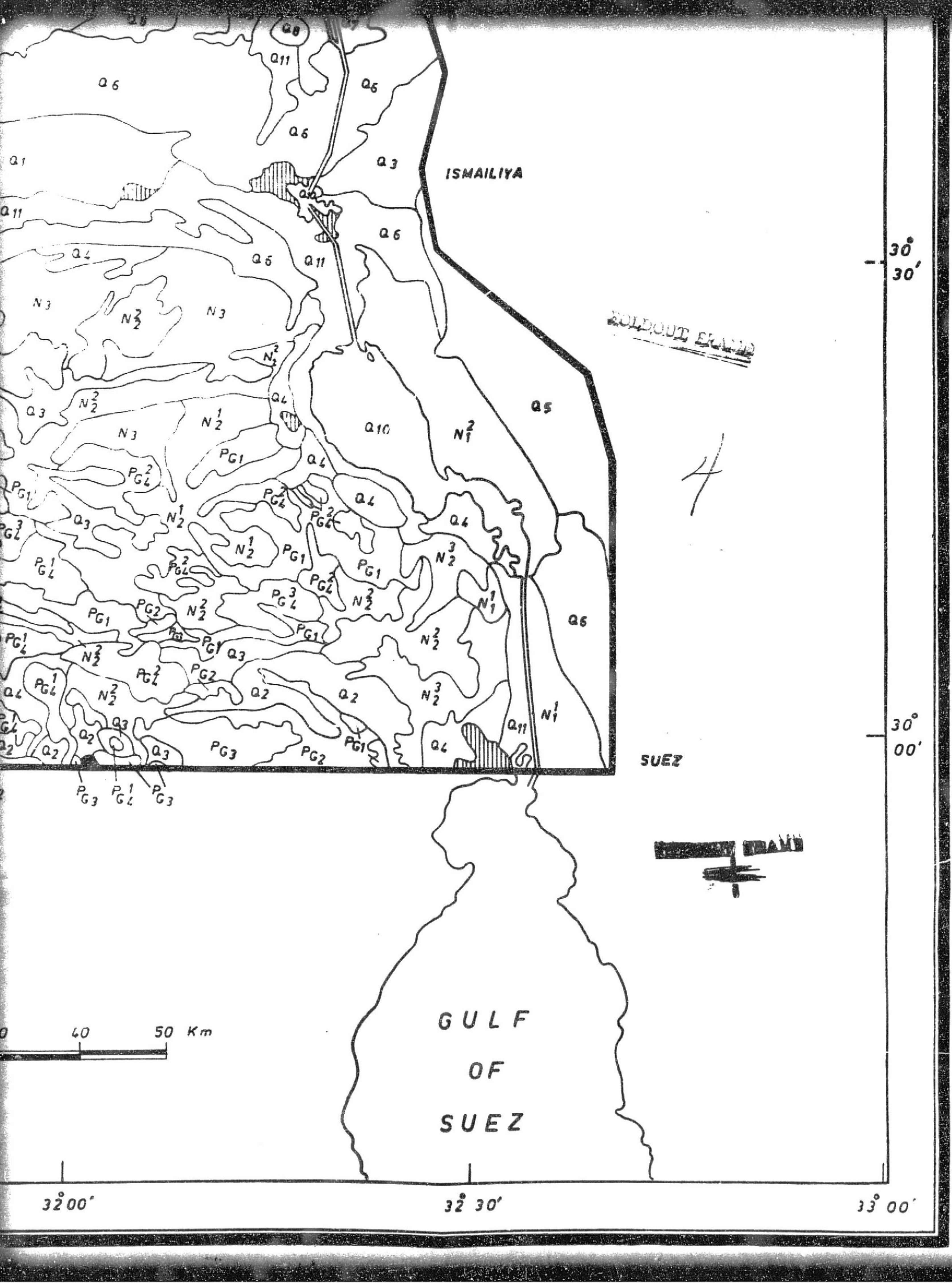
Q6
Q3
Q11
Q6
Q5
Q11



FOLDOUT FRAME

3


ISMAILIYA
SUEZ
GULF
OF
SUEZ
30°
30′
30°
00′
32°00′
32° 30′
33° 00′
40
50 Km
4

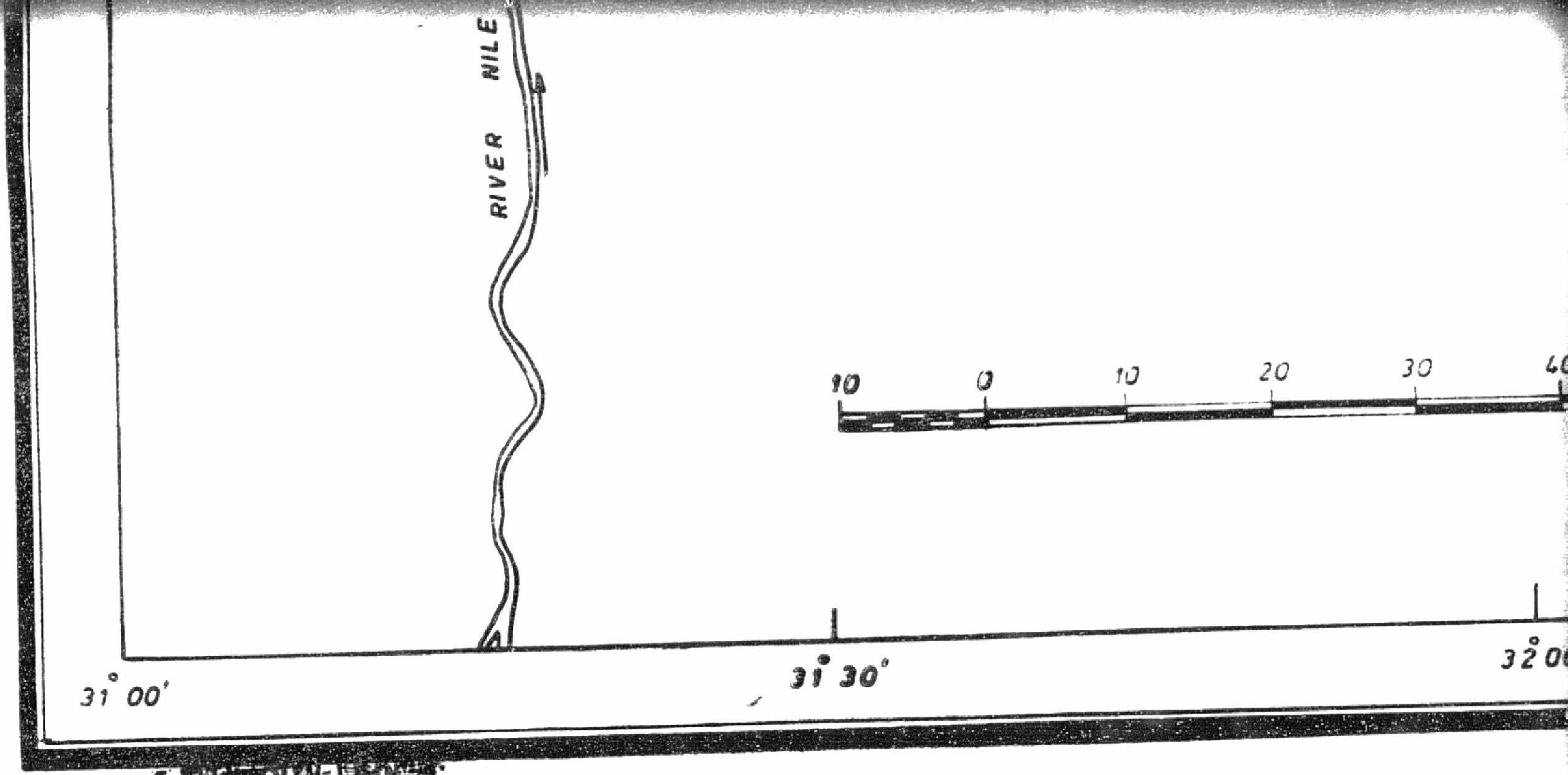
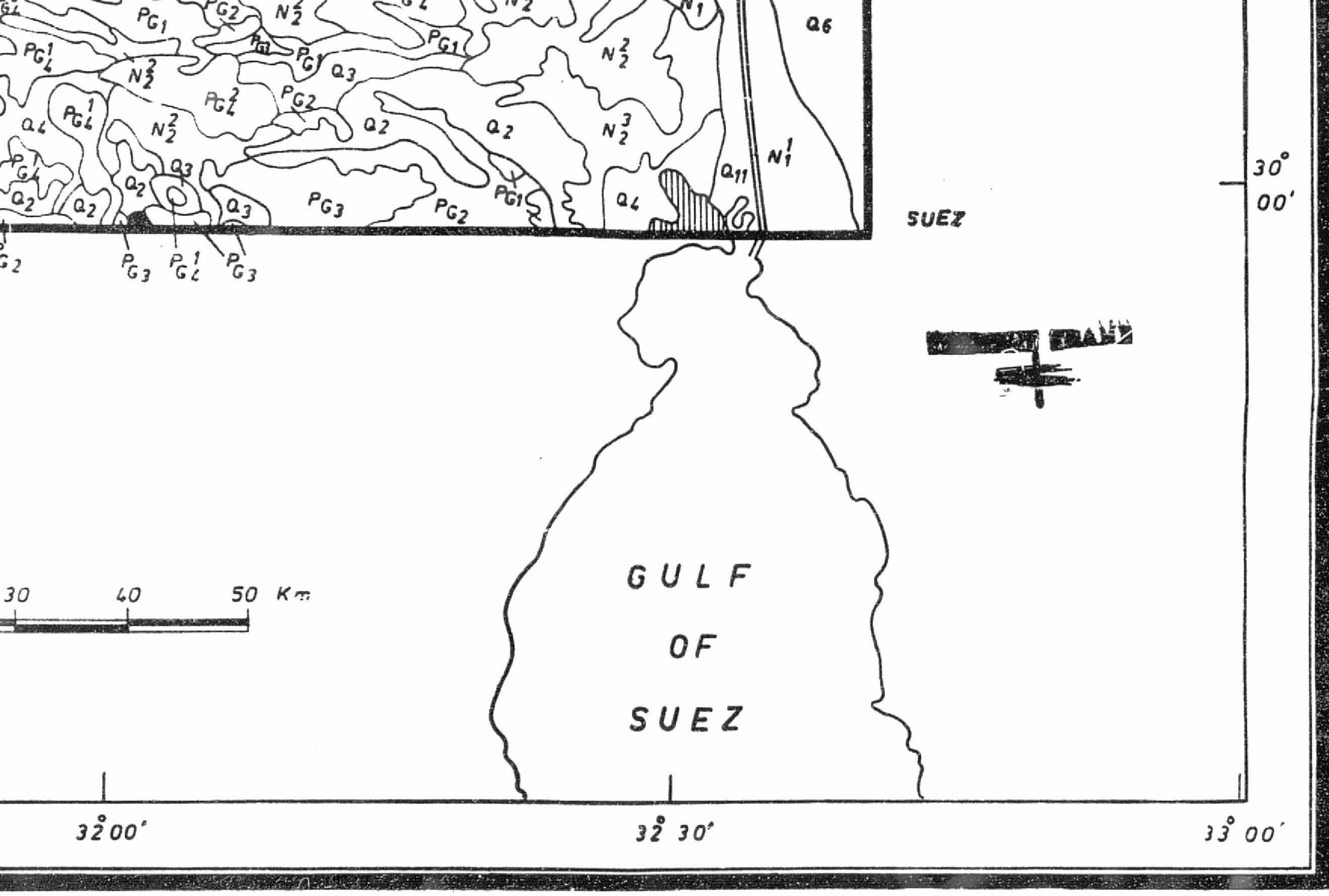


FIG. 5

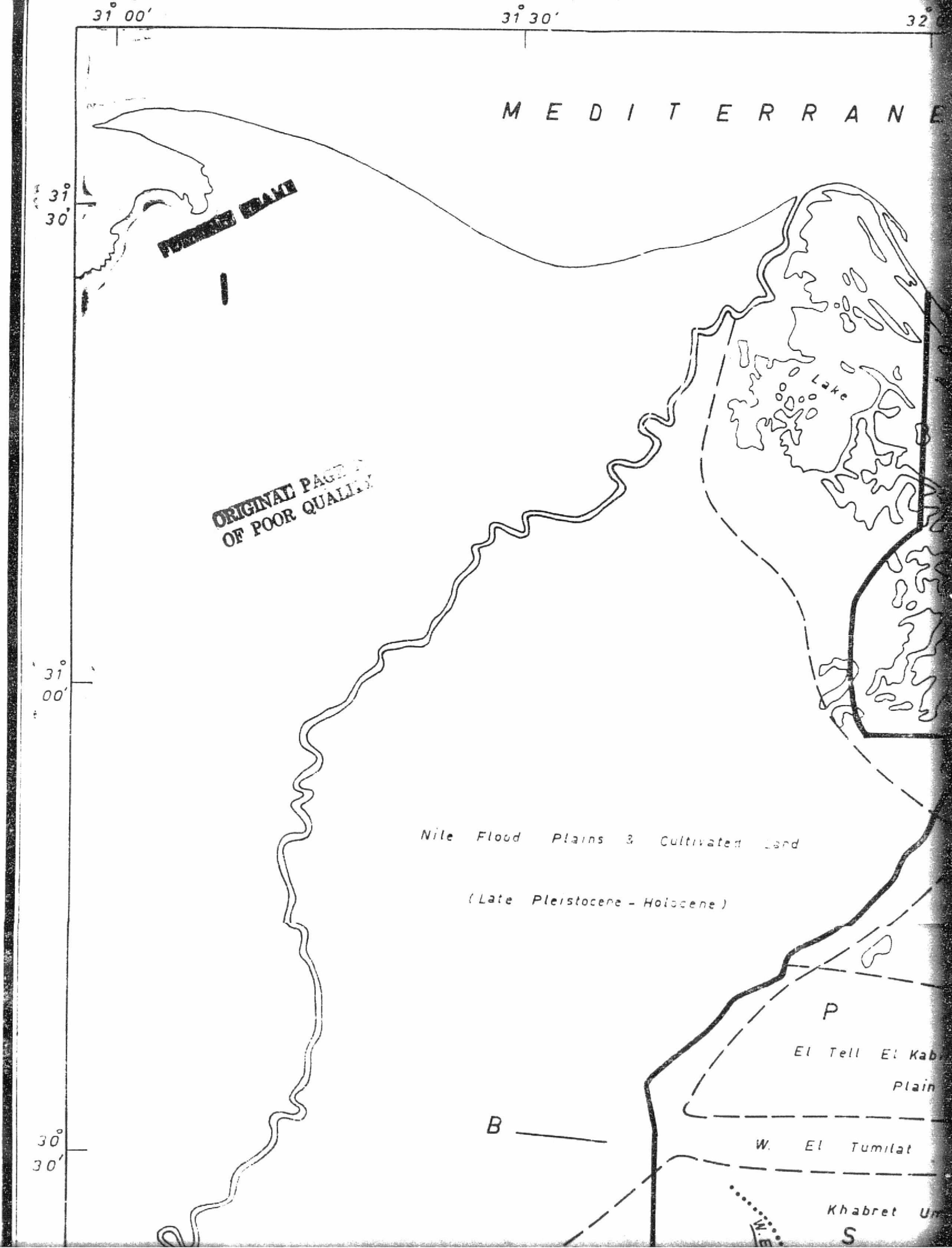
GEOLOGICAL MAP OF EL ISMAILIYA

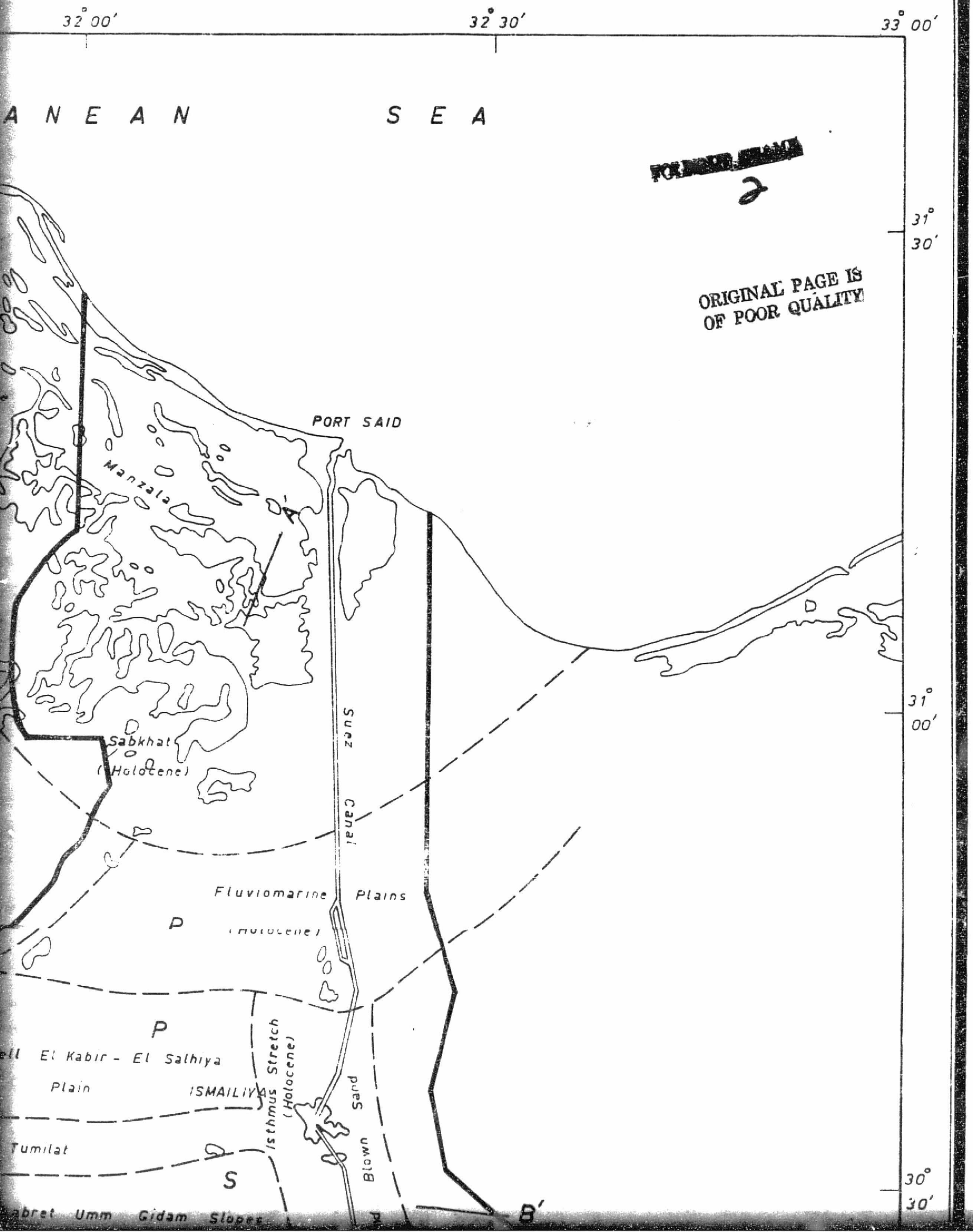
(FROM ERTS-1 SATELLITE



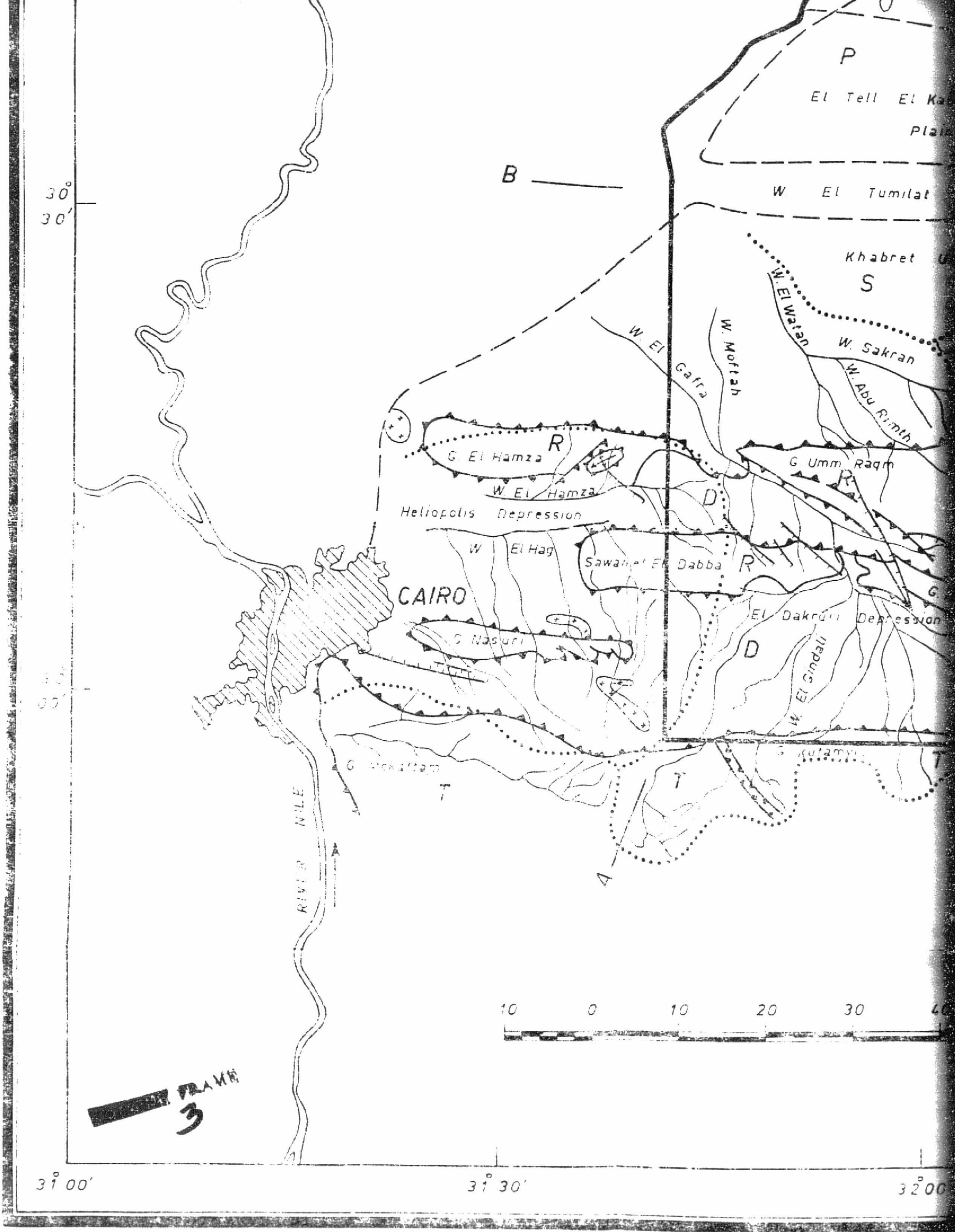
...IYA MASTER PLAN STUDY AREA, EGYPT.

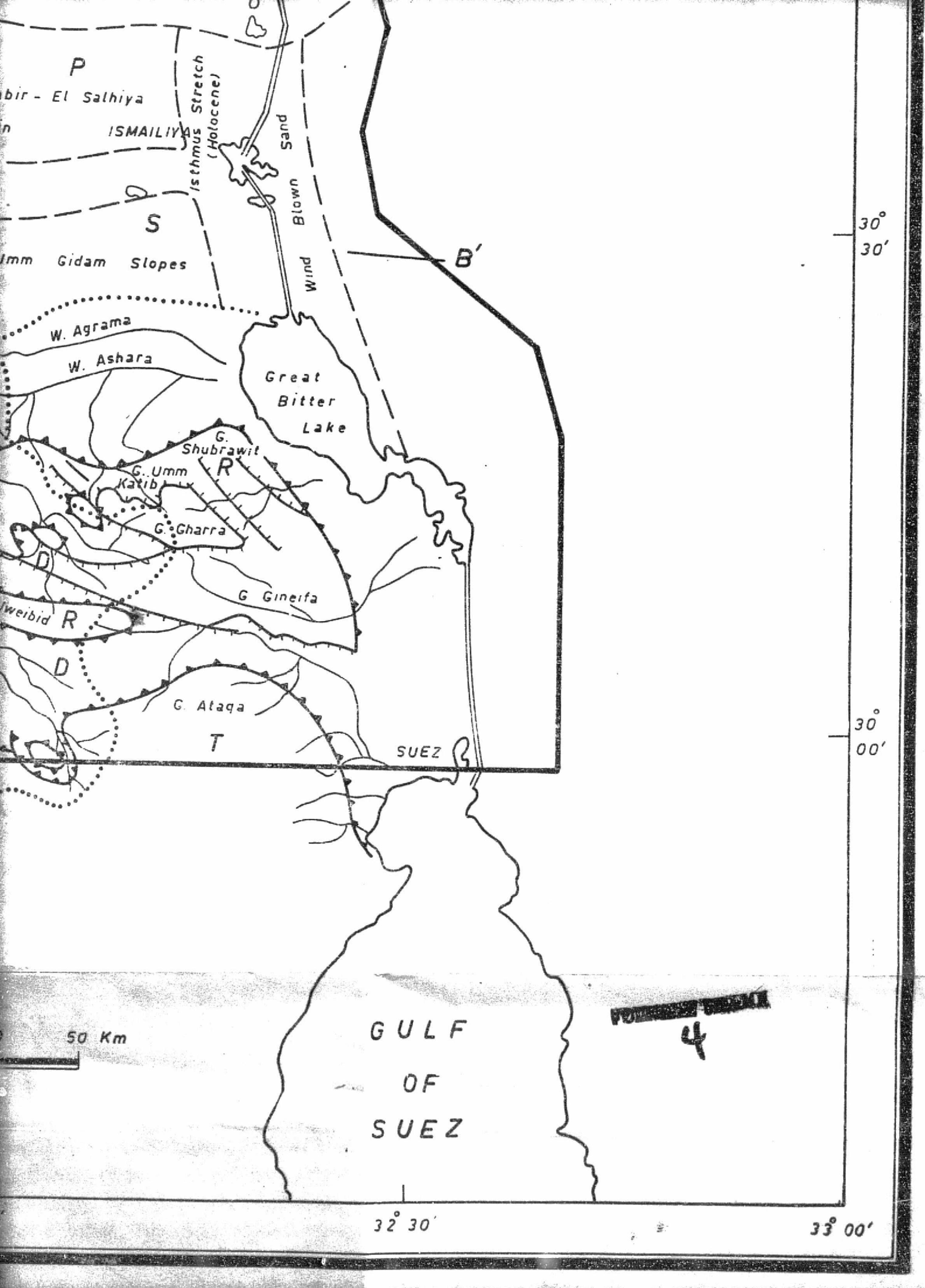
...ELLITE IMAGES, MARCH 1973)


31° 00'
31° 30'
32°
M E D I T E R R A N E
31° 30'
I
Lake
31° 00'
Nile Flood Plains & Cultivated Land
(Late Pleistocene - Holocene)
P
El Tell El Kab
Plain
B
W. El Tumilat
30° 30'
Khabret Um
S



32° 00'
32° 30'
33° 00'
ANEAN SEA
31° 30'
PORT SAID
Manzala
A'
31° 00'
Sabkhat
(Holocene)
Suez Canal
Fluviomarine Plains
(Holocene)
P
P
ell El Kabir - El Salhiya
Plain
ISMAILIYA
Isthmus Stretch
(Holocene)
Blown Sand
Tumilat
S
30° 30'
abret Umm Gidam Slopes
B'


P
El Tell
W. El Tumilat
B
30° 30′
Khabret
S
W. El Watan
W. Sakran
W. Abu Rimth
W. Moftah
W. El Gafra
G. El Hamza
R
W. El Hamza
Heliopolis Depression
D
G. Umm Raqm
W El Hag
Sawanet El Dabba
CAIRO
G. Nasuri
El Dakruri Depression
W. El Gindali
T
RIVER NILE
A
10 0 10 20 30
31° 00′
31° 30′
[redacted] FRAME 3



P
bir - El Salhiya
ISMAILIYA
Isthmus Stretch (Holocene)
Blown Sand
Wind
S
Imm Gidam Slopes
B′
30° 30′
W. Agrama
W. Ashara
Great Bitter Lake
G. Shubrawit
R
G. Umm Katib
G. Gharra
D
G Gineifa
weibid
R
D
G. Ataqa
T
SUEZ
30° 00′
50 Km
GULF OF SUEZ
32° 30′
33° 00′

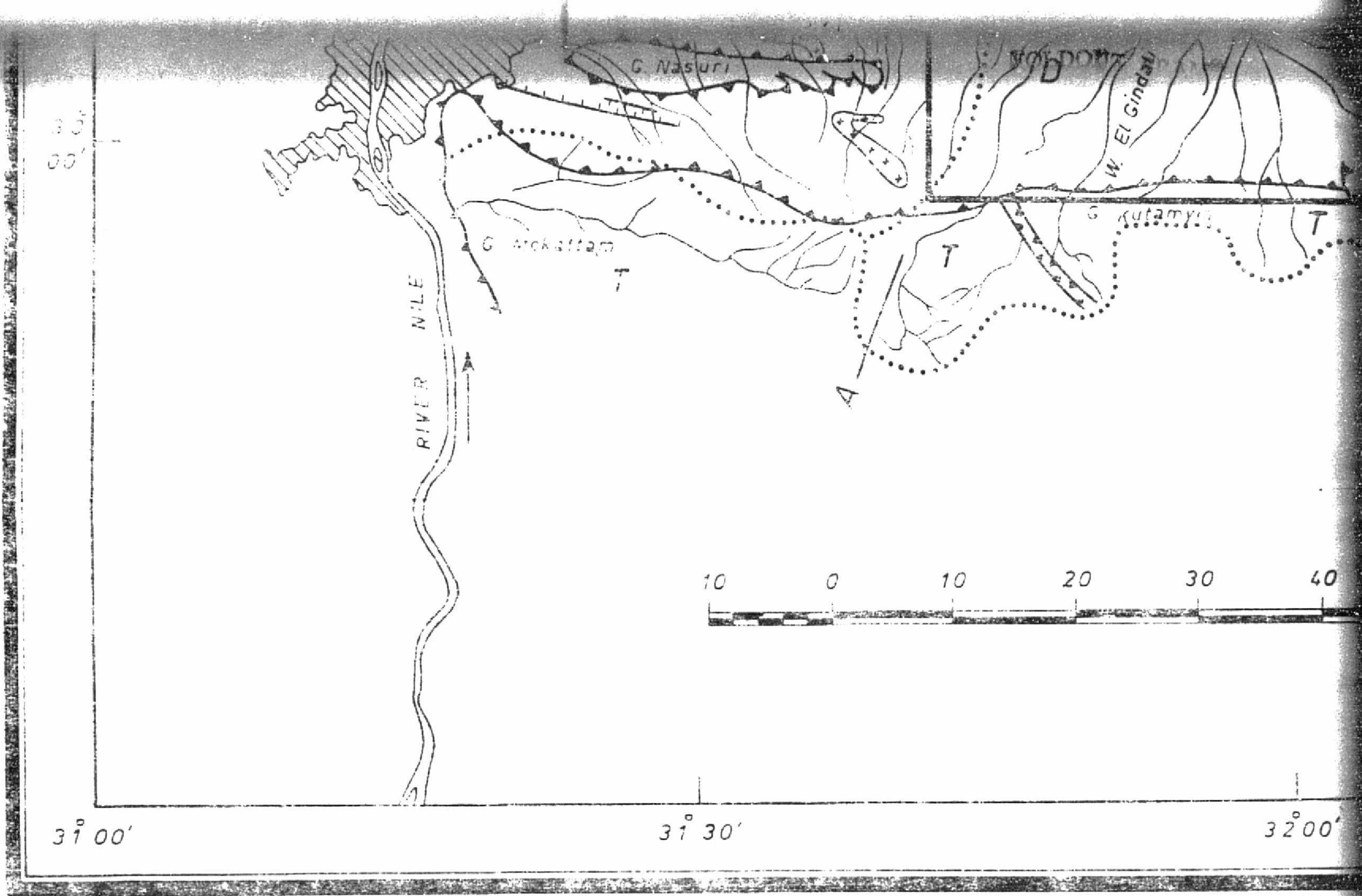


FIG. 5

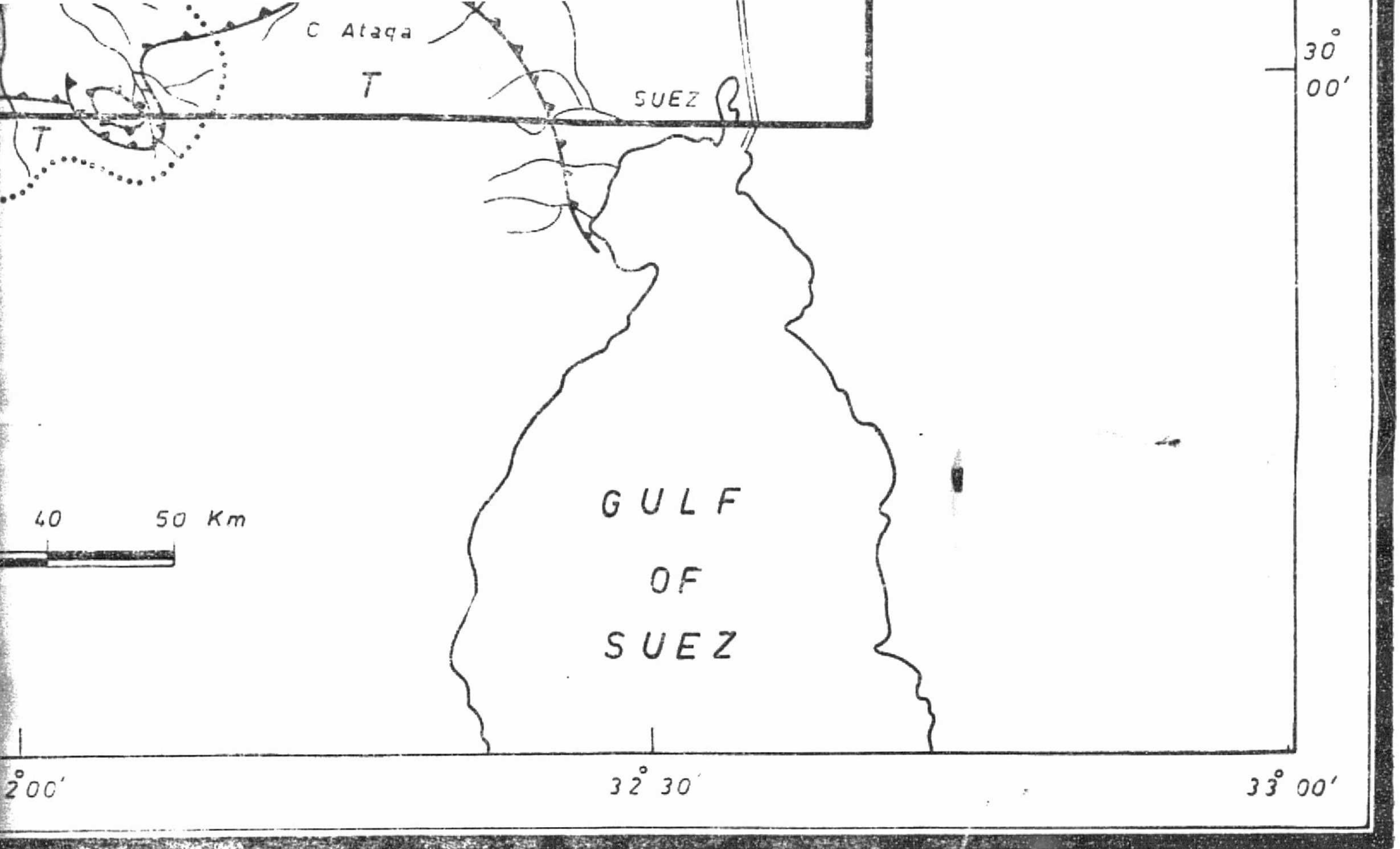
LANDSCAPE MAP OF THE DESERT A

5

LEGEN

T	Structural tableland (Eocene)
R	Structural ridges (Oligocene - Miocene)
D	Structural depressions (Quaternary)
S	Umm Gidam gravelly slopes (Early + Late Pleistocene)
P	El Tell El Kabir - El Salhiya Plain

A - A' Provisional geological profile



T AREA EAST OF THE NILE DELTA

END

Mid-Tertiary Basalts

Fault showing direction of downthrow

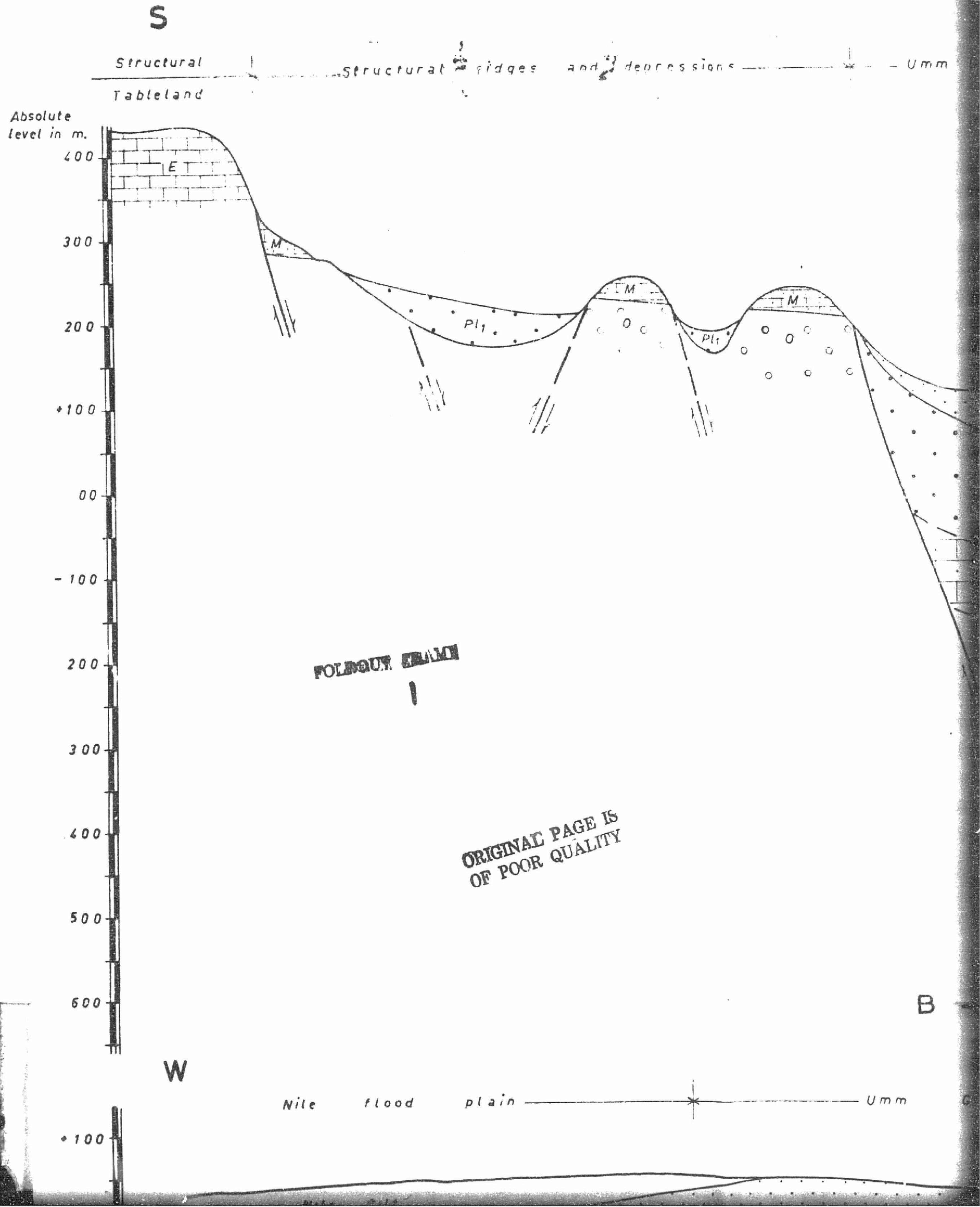
Faulted escarpment

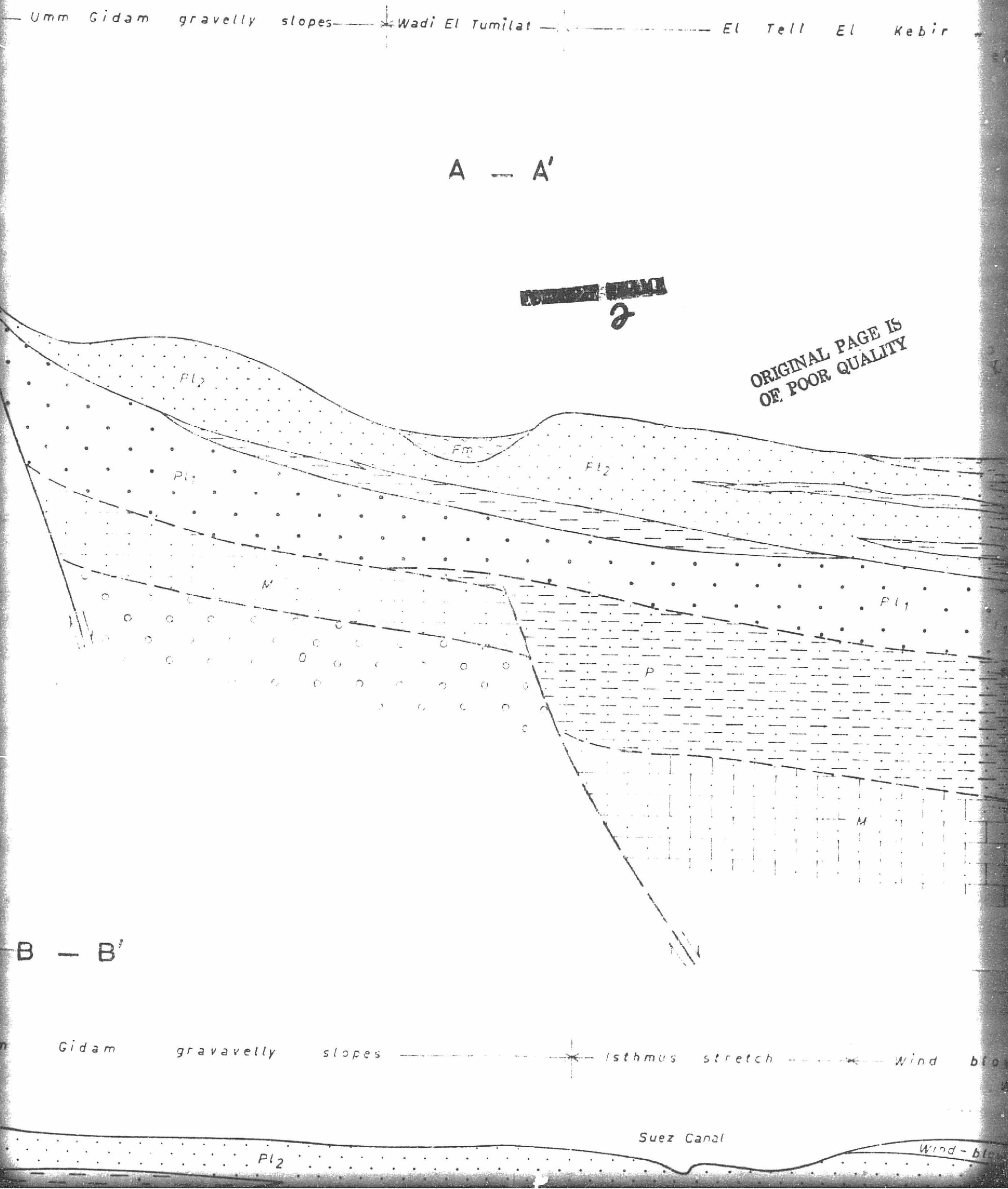
enel

Wadi and drainage line

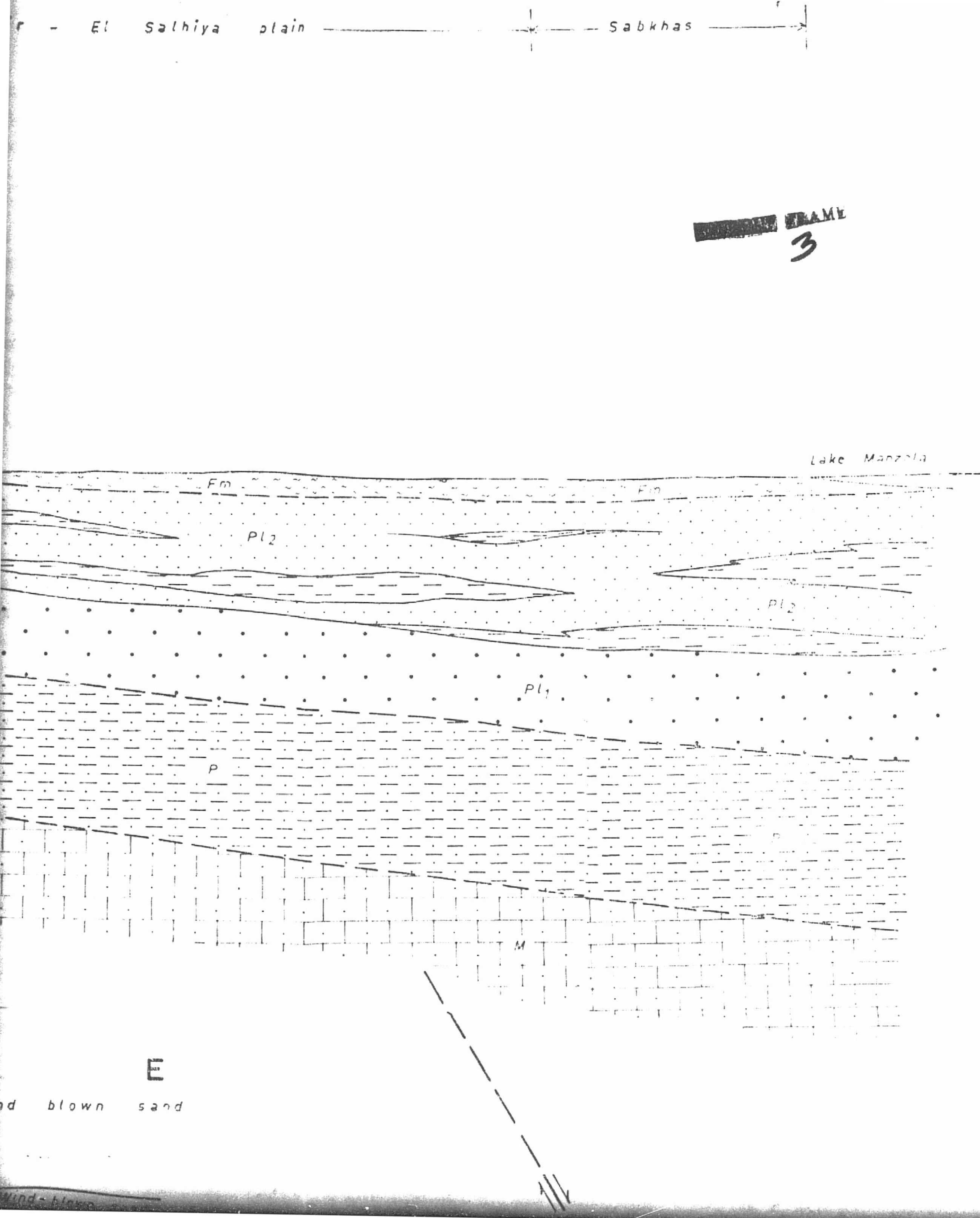
Boundary of hydrographic pattern

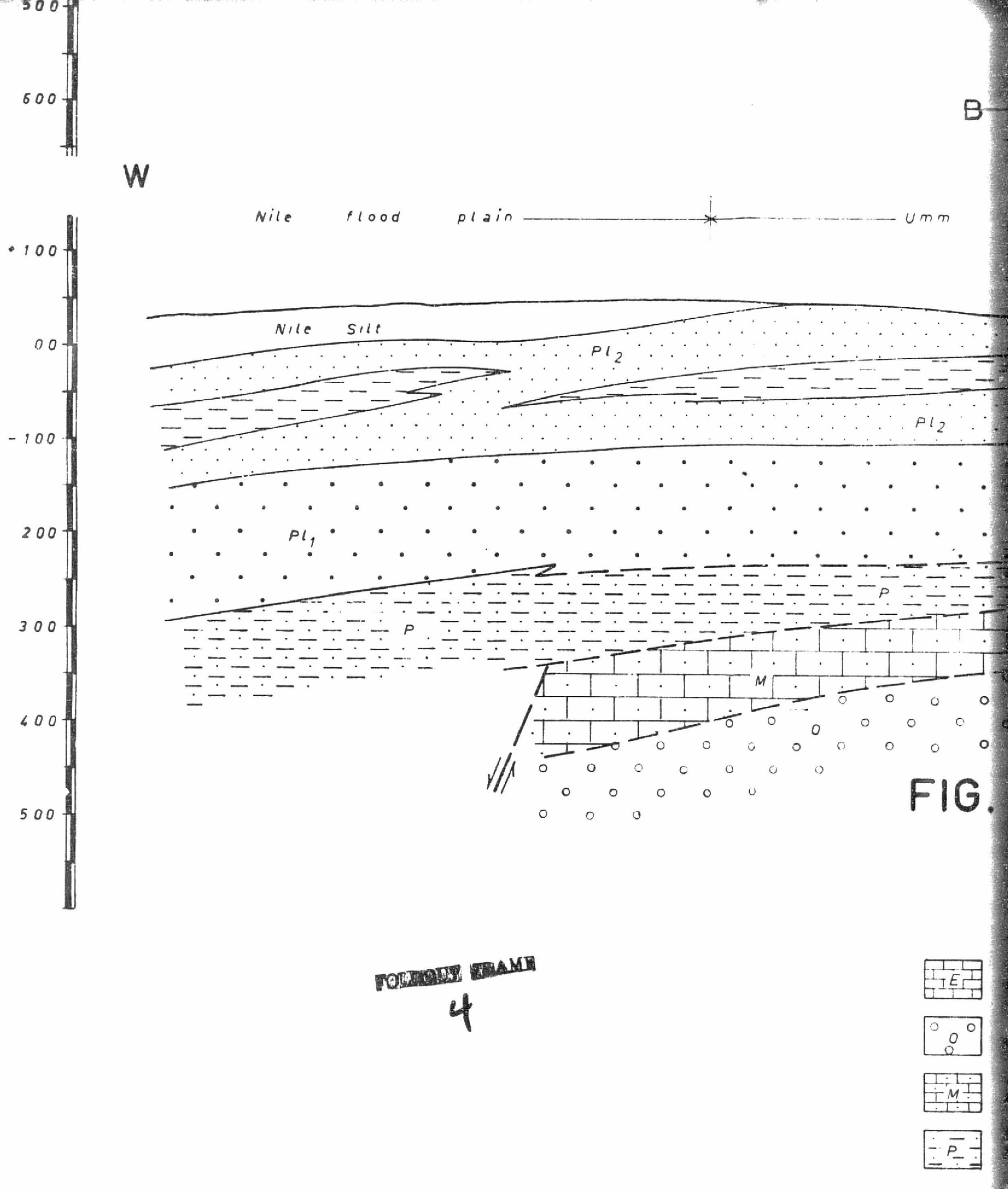
Boundary of area under invistegation


S
Structural
Tableland
Structural ridges and depressions
Umm
Absolute level in m.
400
300
200
+100
00
- 100
200
300
400
500
600
E
M
M
M
Pl_1
Pl_1
B
W
Nile flood plain
Umm
+100



Umm Gidam gravelly slopes
Wadi El Tumilat
El Tell El Kebir
A — A'
Pl2
Fm
Pl2
Pl1
M
Pl1
P
M
B — B'
Gidam gravavelly slopes
Isthmus stretch
Wind
Suez Canal
Wind-
Pl2


r - El Salhiya plain
Sabkhas
Lake Manzala
Fm
Fm
Pl_2
Pl_2
Pl_1
P
M
E
nd blown sand



500
600
B
W
Nile flood plain
Umm
100
00
-100
200
300
400
500
Nile Silt
Pl_2
Pl_2
Pl_1
P
P
M
O
E
O
M
P

FIG.

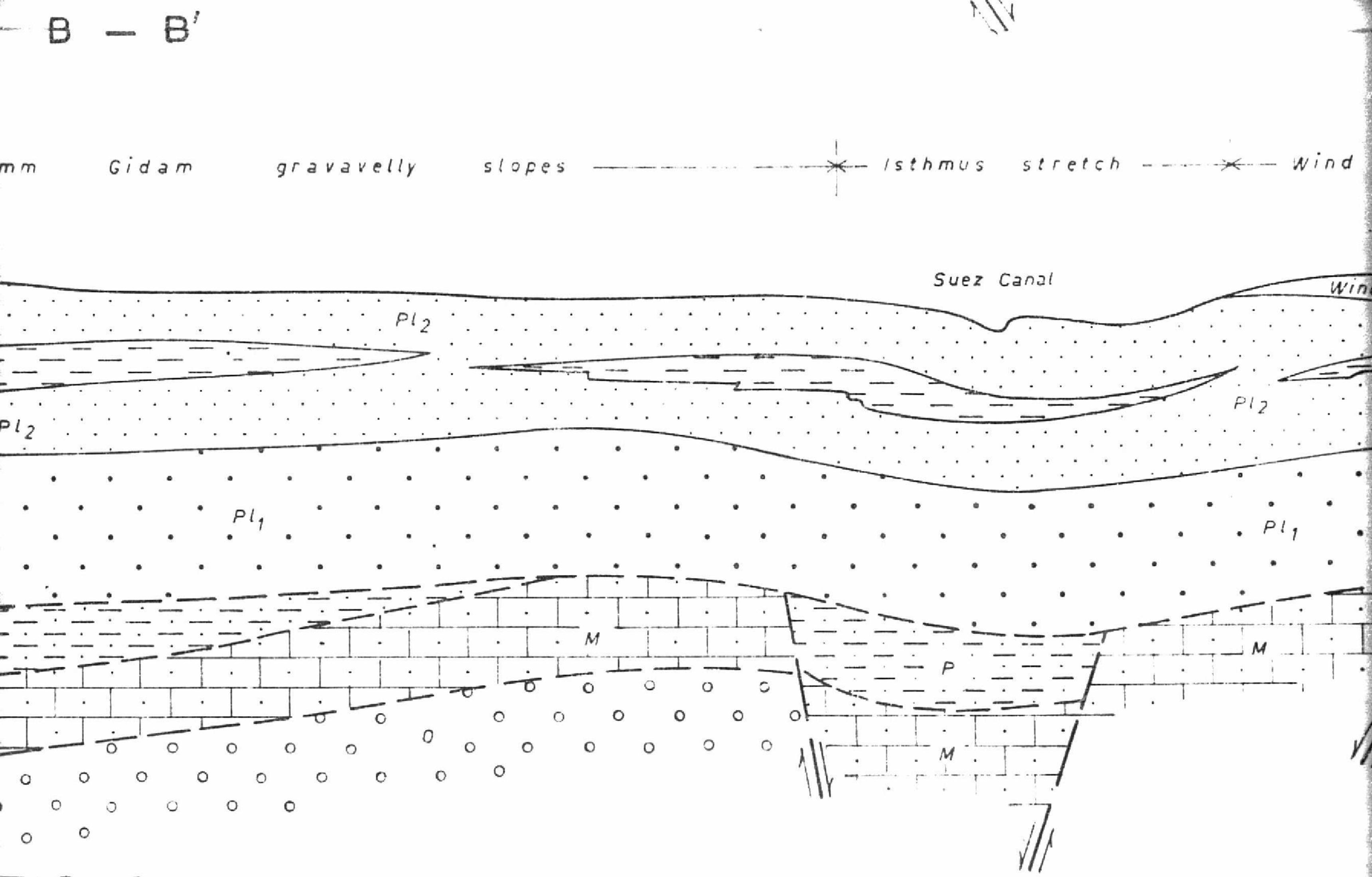
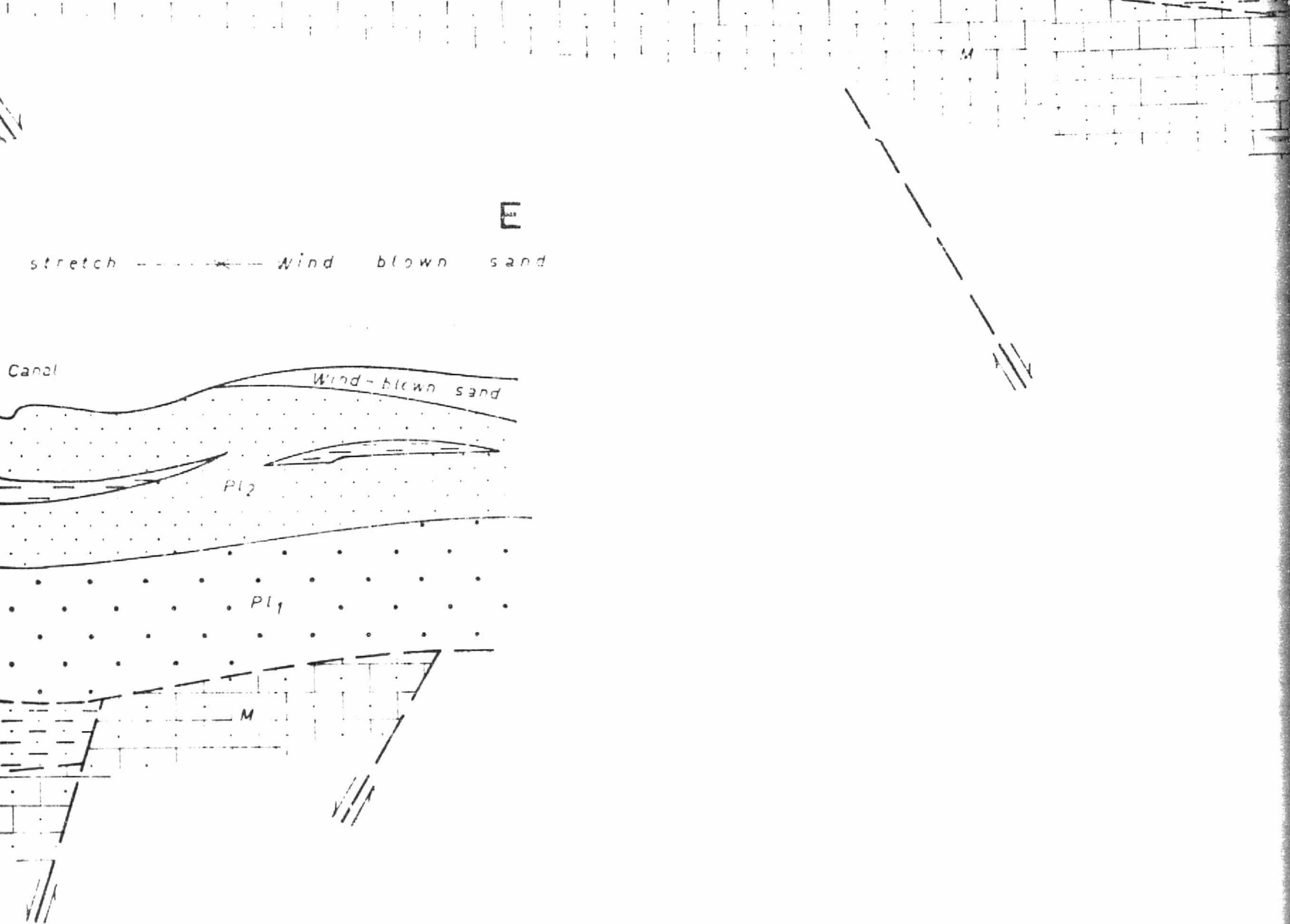


FIG.

PROVISIONAL GEOLOGICAL PROFILES

- E — Middle and Late Eocene
- O — Oligocene
- M — Miocene
- P — Pliocene
- Pl1 — Early Pleistocene
- Pl2 — Late Pleistocene
- Fm — Fluviomarine (Late Pleistocene - Holocen
- Fault
- Inferred Fa

5



. PROFILES

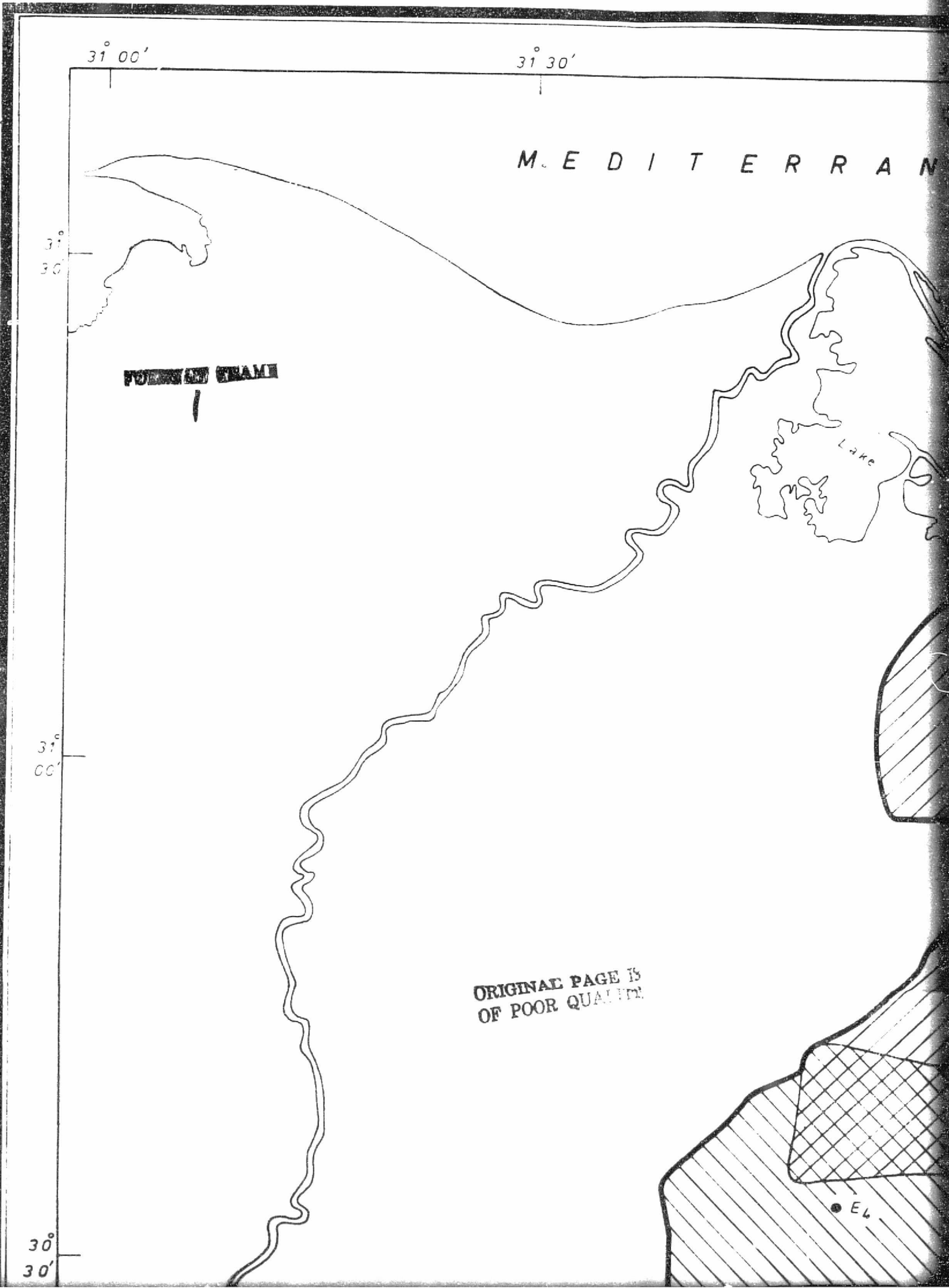
'ocene

ocene

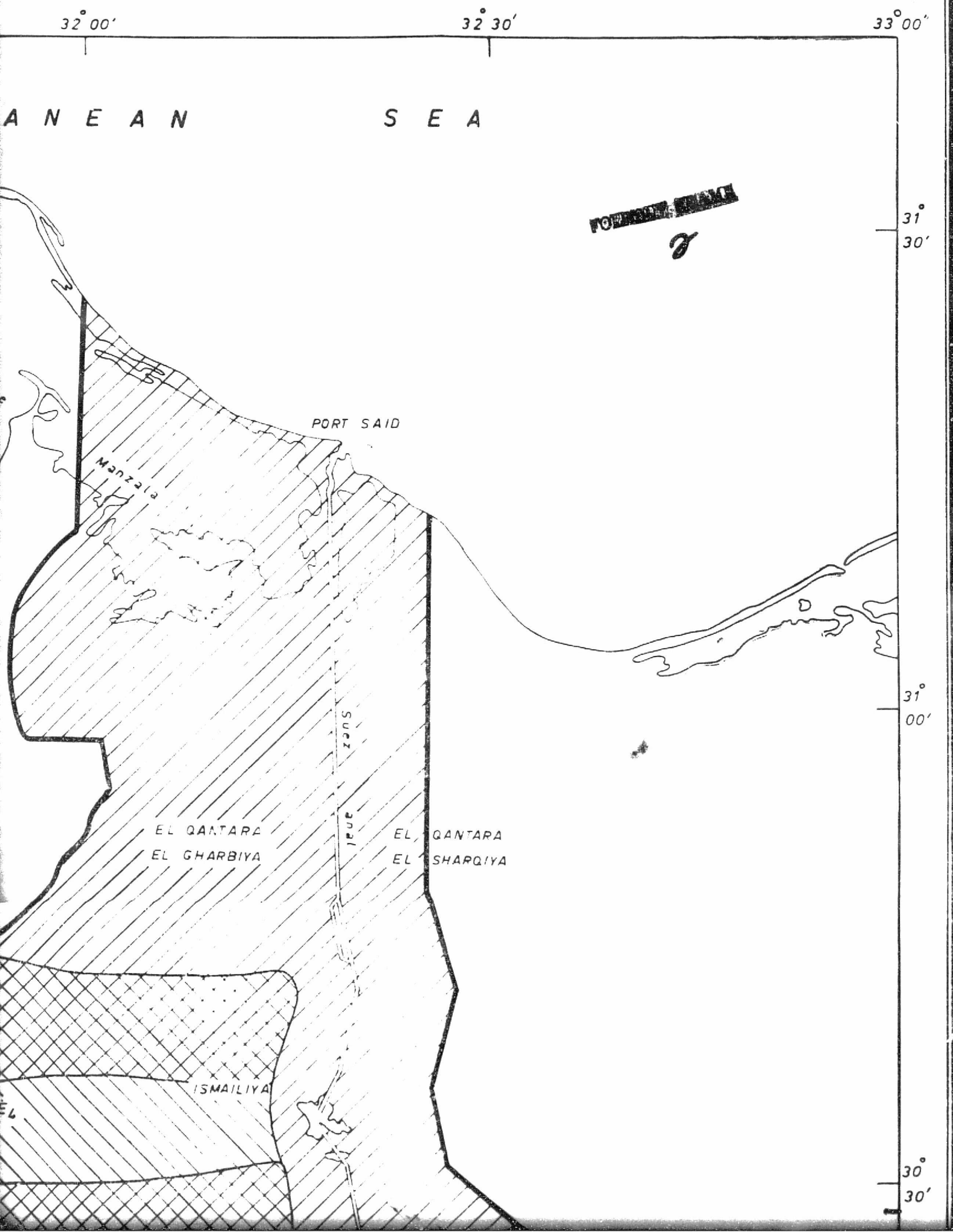
(Late Pleistocene - Holocene)

Inferred Fault

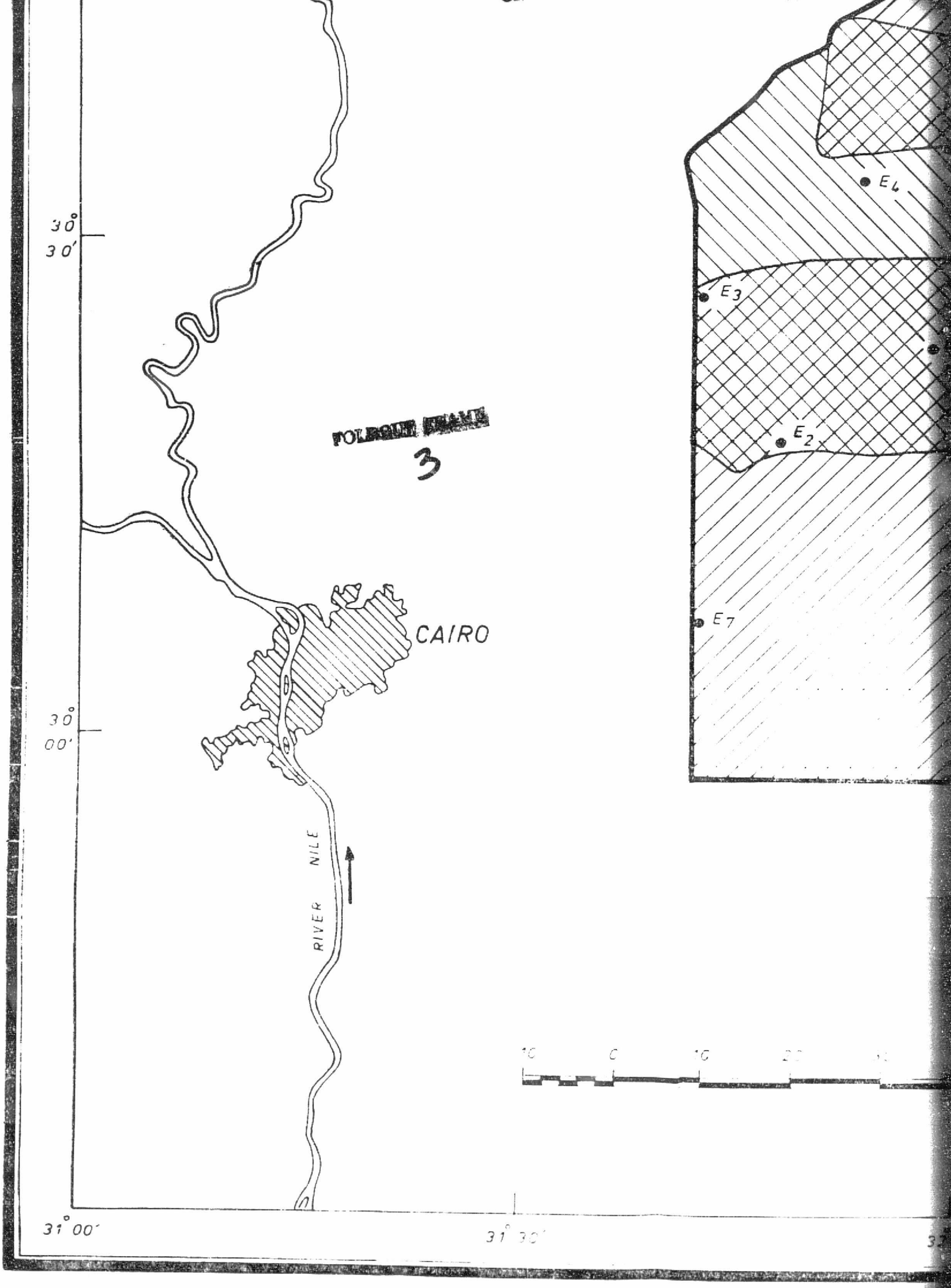
6

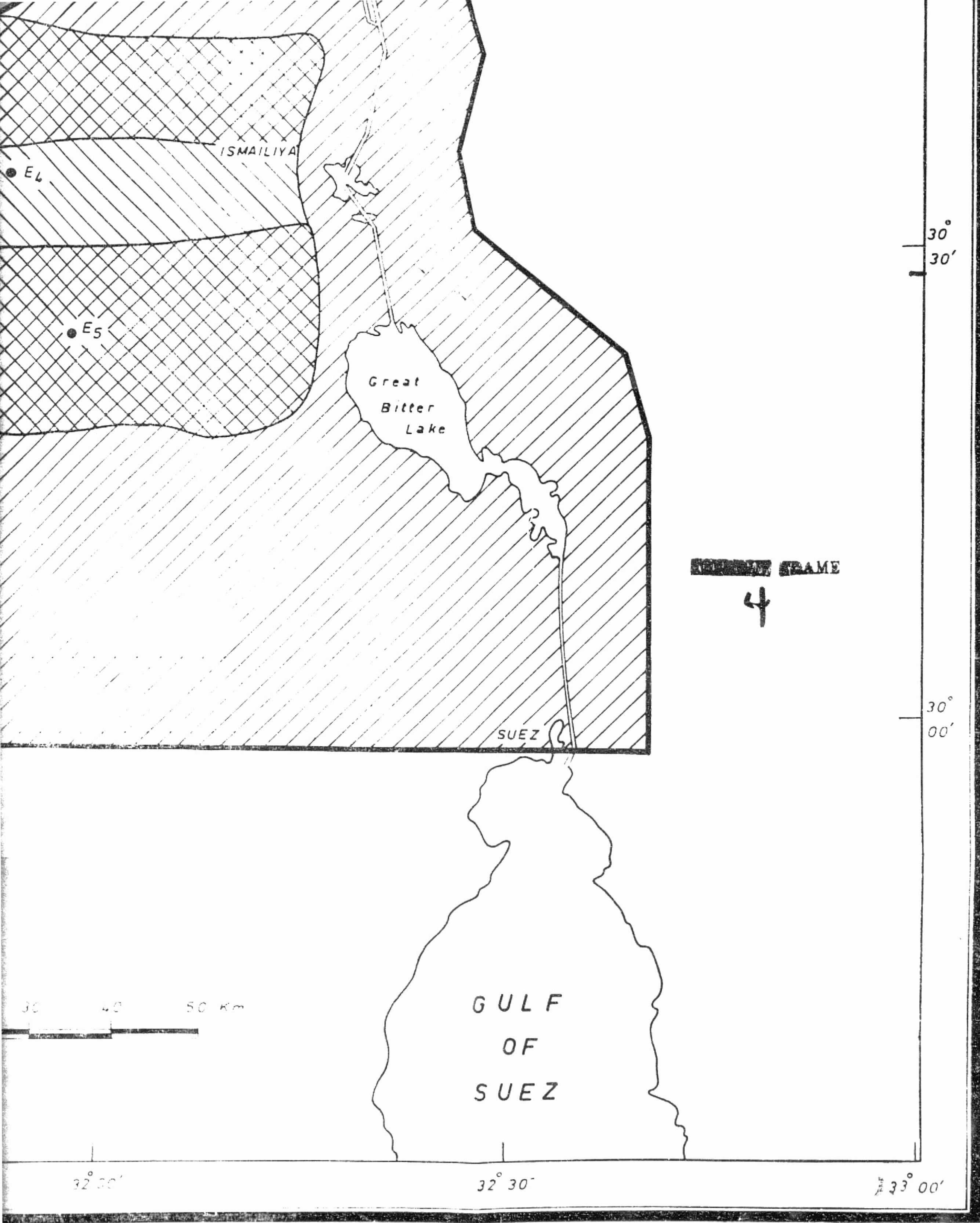


31° 00′
31° 30′
MEDITERRAN
31° 30′
Lake
31° 00′
30° 30′
EL



32°00'
32°30'
33°00'
ANEAN
SEA
31° 30'
PORT SAID
Manzala
Suez
Canal
EL QANTARA
EL GHARBIYA
EL QANTARA
EL SHARQIYA
31° 00'
ISMAILIYA
30° 30'


30° 30'
30° 00'
31° 00'
31° 30'
CAIRO
RIVER NILE
E4
E3
E2
E7
10
0
10
FOLDOUT FRAME
3



[redacted] FRAME
4

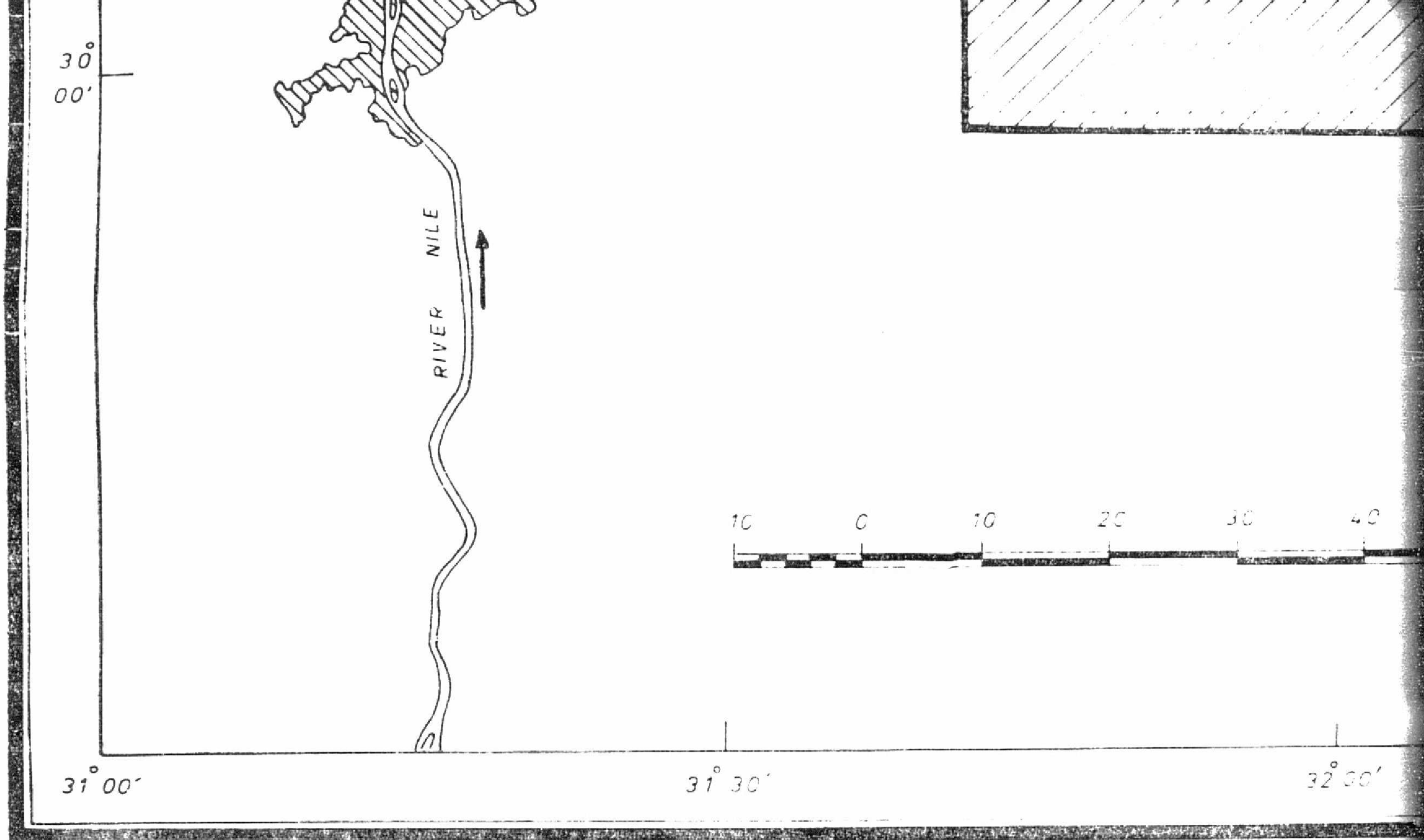


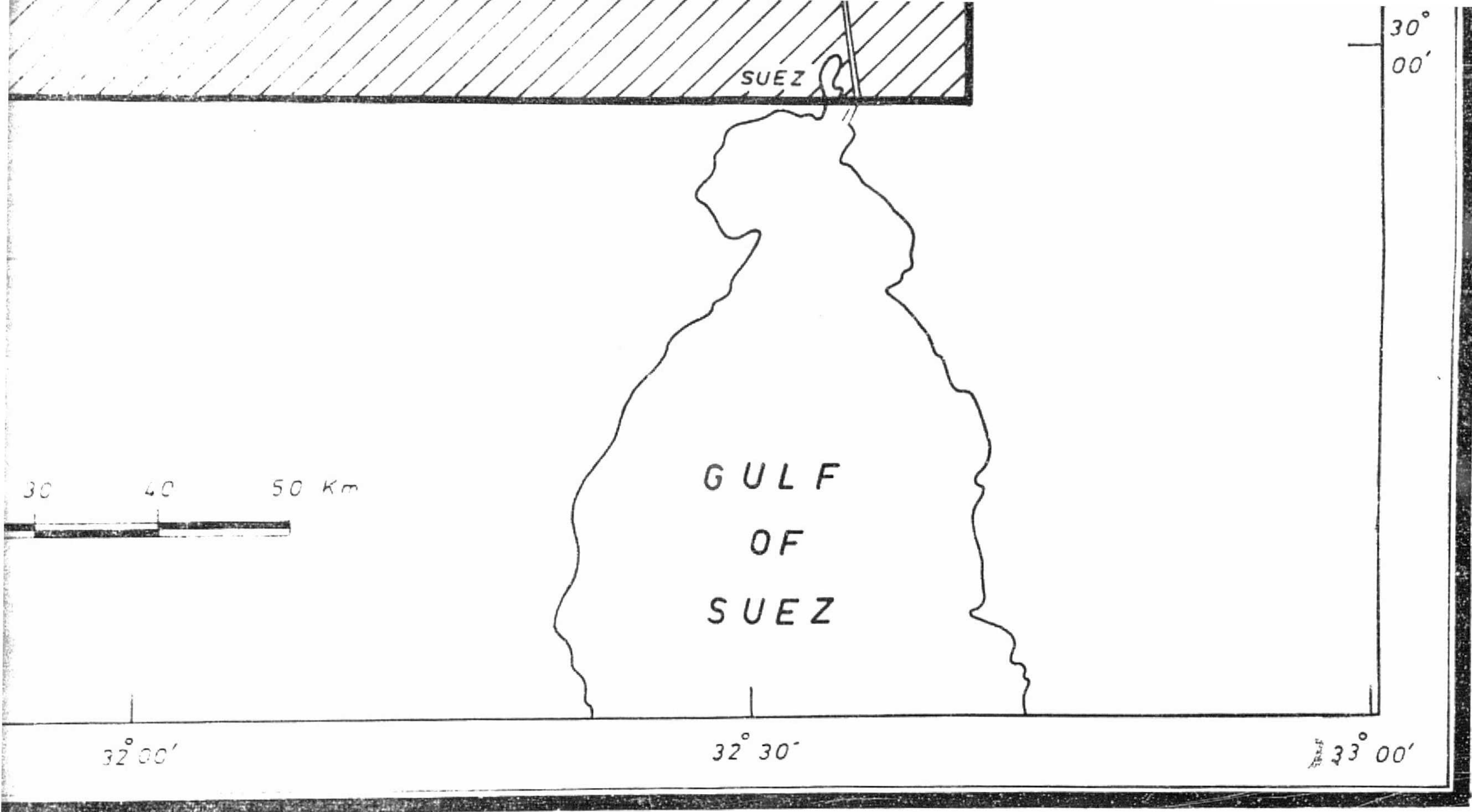
FIG. 5

PROVISIONAL GENERALIZED G

(Based on scanty data from various aquifers especially in t

Unsuitable (Salinity 3000 ppm)

Permissible (Salinity 1000 - 3000 ppm)



6

ZED GROUNDWATER QUALITY MAP

especially in the southern part of the investigated area)

m) | Suitable Salinity 1000 ppm

ppm) | Test Wells

FOLDOUT FRAME

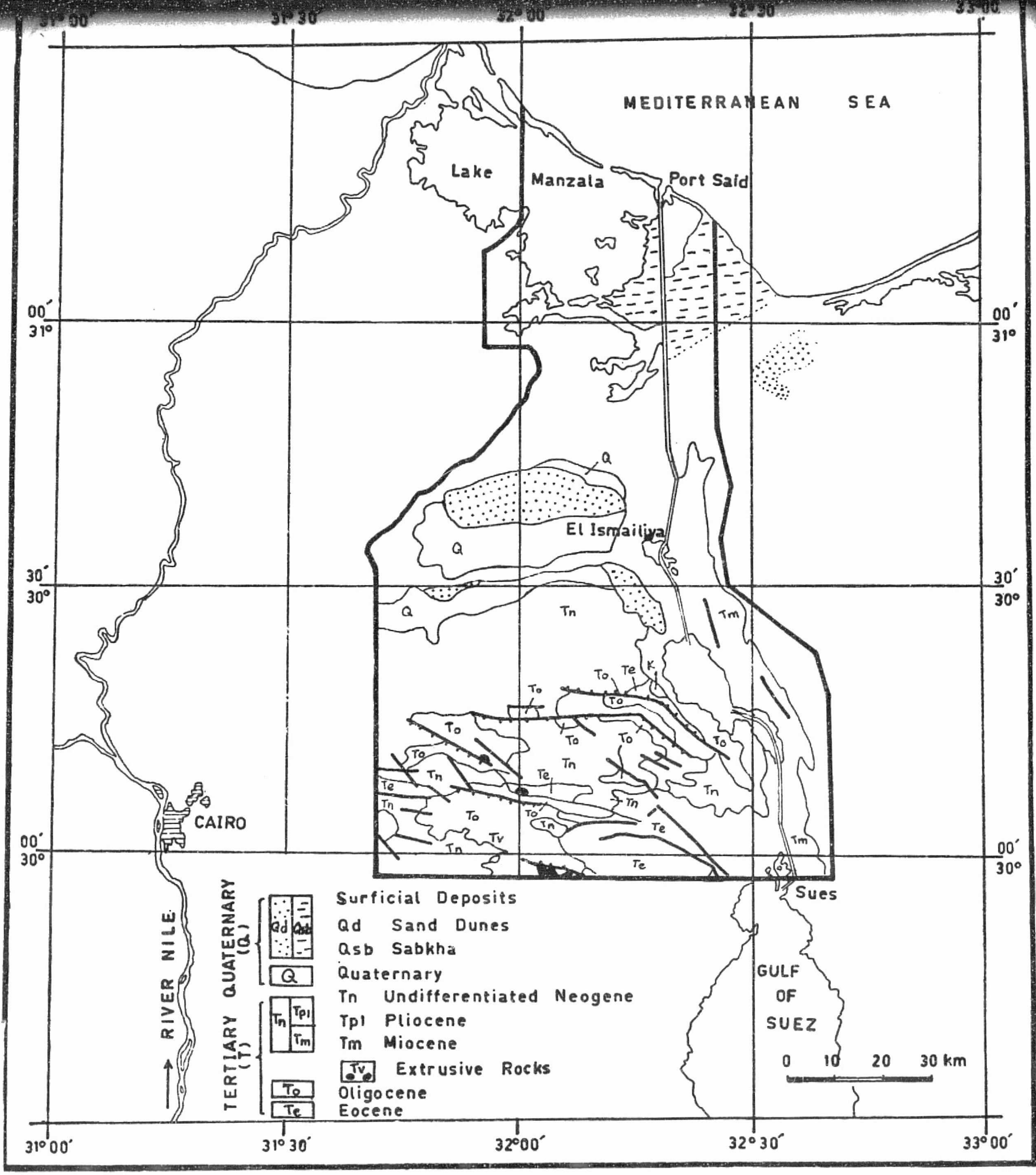


FIG.8 COMPILED GEOLOGICAL MAP OF EL ISMAILIYA MASTER PLAN STUDY AREA

(AFTER GEOLOGICAL MAP OF EGYPT, 1: 2,000,000, 1972)

ORIGINAL PAGE IS
OF POOR QUALITY

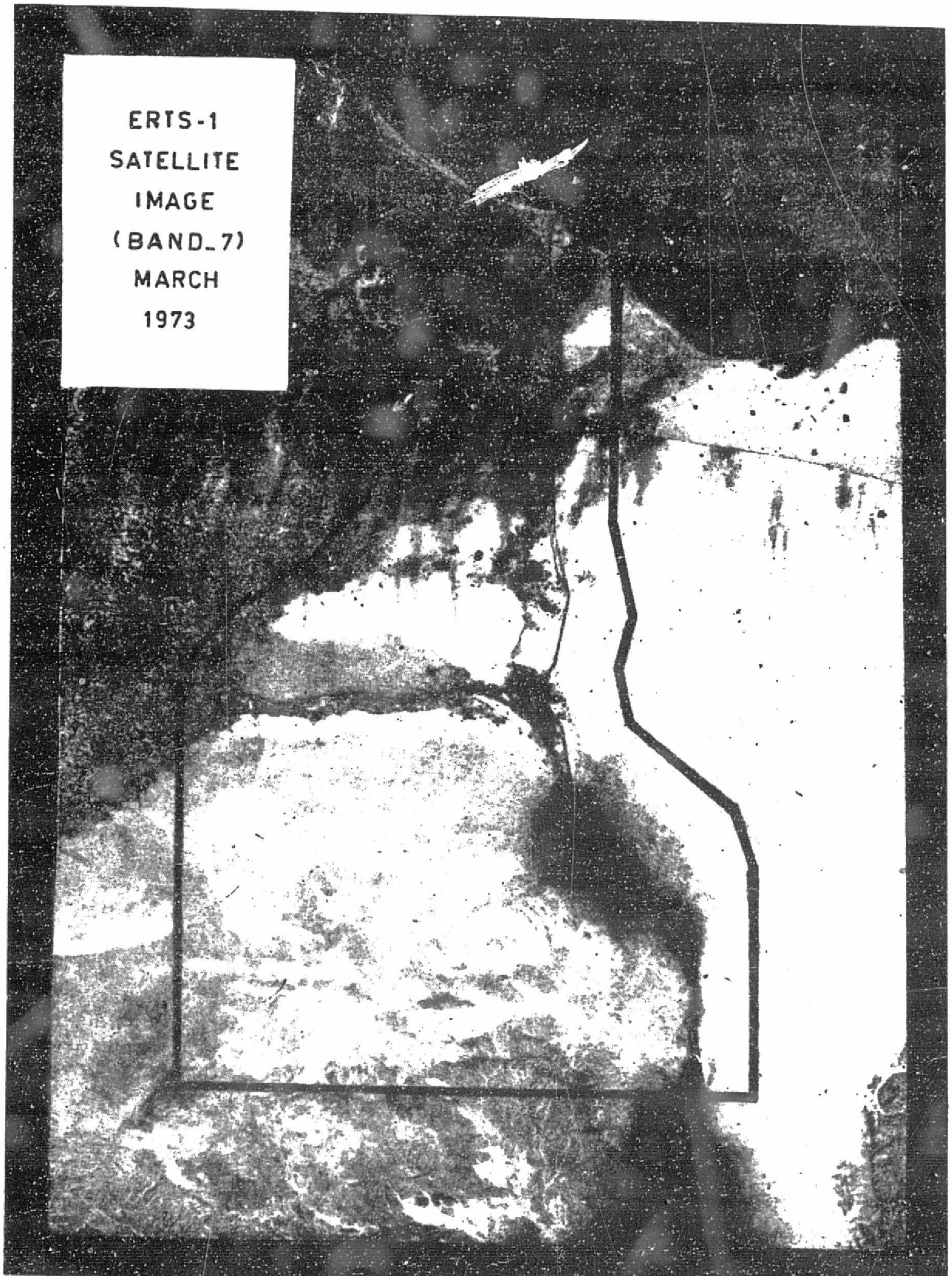


FIG. 9 INFRARED IMAGE OF EL ISMAILIYA MASTER PLAN STUDY AREA, EGYPT