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SEDIMENTOLOGICAL DEVELOPMENT OF THE UPPER PLIOCENE- PLEISTOCENE SEDIMENTS IN THE AREAS OF EL SALAMONY AND EL SAWAMHA SHARQ, NORTH EAST SOHAG , EGYPT

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التطور الترسيبي لرواسب البلايوسين العلوي والبلايستوسين في مناطق السلاموني والصوامعة شرق - شمال شرق سوهاج - مصر

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تكون رواسب البلايوسين العلوي والبلايستوسين في مناطق السلاموني - الصوامعة شرق شرفتين نهريتين أمكن تقسيمها إلى خمس سحنات صخرية هي : سحن سهول فيضانية ، ركام وبحيرات في الشرفة العليا وكذلك سحن قنوات وسهول فيضانية في الشرفة السفلى .

من دراسة التغيرات في السحن امكن التوصل إلى ثلاثة مراحل ترسيبية هي :

١ - المرحلة الأولى (البلايوسين المتأخر) كانت المناطق على شكل خليج ترسبت فيها فتاتيات سيليسية دقيقة .

٢ - المرحلة الثانية : (فجر البلايستوسين) لعبت الوديان ذات الأصل التكتوني القادمة من الشرق دوراً هاماً في تصنيف سحنة البحيرات إلى نموذجين ترسيبين :

٣ - المرحلة الثالثة (البلايستوسين المتوسط) حدث اتصال بالمجرى الرئيسي للنهر وترسبت سحنة قنوات .

٤ - المرحلة الرابعة (نهاية البلايستوسين) ترسبت فتاتيات دقيقة كسهول فيضانية في المناطق المنخفضة (السلاموني) .

Key Words: Nile valley, Terraces, Lacustrine, Terrigenous, Carbonates, Travertine.

ABSTRACT

The Upper Pliocene- pleistocene Nile sediments cropping out in the areas around El Salamony and El Sawamha Sharq constitute two terraces including five facies ; flood plain , talus and lacustrine facies in the upper terrace skirting the Eocene scrap and fluviatile (channels and flood plain) facies in the lower terrace near the cultivated land.

Distribution and facies changes exhibited by these sediments, in this particular area , proved that the early stage of sedimentation started with the accumulation of flood plain fine siliciclastics in the local bays during the Late Pliocene .

In the second stage (Early Pleistocene), the easterly trending structurally- controlled wadis were active , thus leading to deposition of great coarse terrigenous sediments in area facing these wadis (El Salamony model) . On the peripheries , these discharged coarse clastics interfingered with talus facies . In areas between these wadis the coarse terrigenous material intermixed with lacustrine carbonates (El Sawamha Sharq model) .

In this third stage (Middle Pleistocene) the local bays opened to the south and were invaded by a new river which drained from the south . This led to the accumulation of channel sandstone facies .

Later on, in the fourth stage (Late Pleistocene) a new river caused the deposition of fine siliciclastics of the flood plain facies into the submerged areas.

INTRODUCTION

The Nile sediments of the Nile Valley in Egypt extend laterally to occupy bays created in Post Eocene times. These bays were filled by sediments derived from various sources during the different stages of the Nile development [1].

The Upper Pliocene- Pleistocene sediments in the study area were partly dealt with by Abd El kireem [2] and Moustafa [3]. These authors pointed out that the Nile sediments are separated into terraces composed of sands, clays and conglomerates . Southwards east of Akhmin Said [1] classified the Nile sediments into two stratigraphic units ; a lower Armant Formation and an upper Issawia Formation. However the mode of deposition and the facies relationships of these sediments recieved little attention .

The present Study aims to throw more light on the stages of formation, the lateral facies variations and the enviroment of deposition of the Upper Pliocene- Pleistocene Nile sediments in the area between El Salamony and El Sawamha Sharq (Fig. 1) .

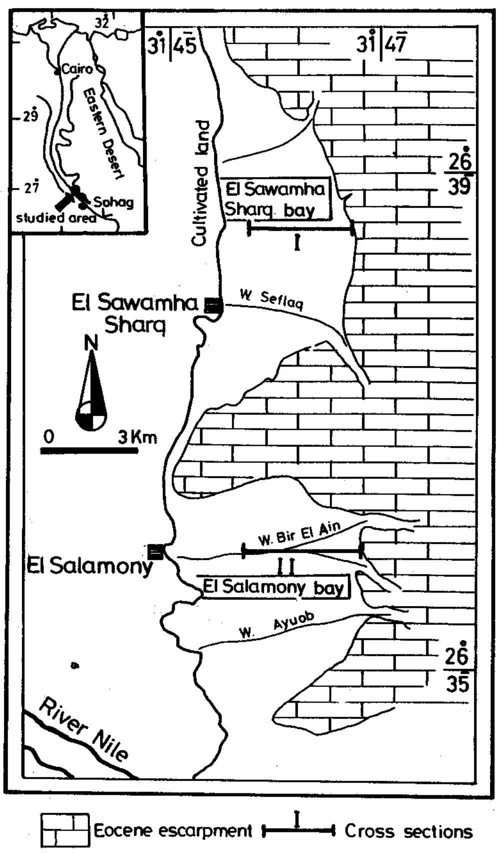

Fig. 1: Location map

UPPER PLIOCENE- PLEISTOCENE TERRACES

The Upper Pliocene- Pleistocene sediments cropping out in the area between El Salamony and El Sawamha Sharq constitute two terraces; an upper terrace nearer to the bounding Eocene scrap and the Lower terrace nearer to the cultivated land. Each terrace attains a certain elevation related to the different stages of evolution of the River Nile (Fig. 2)

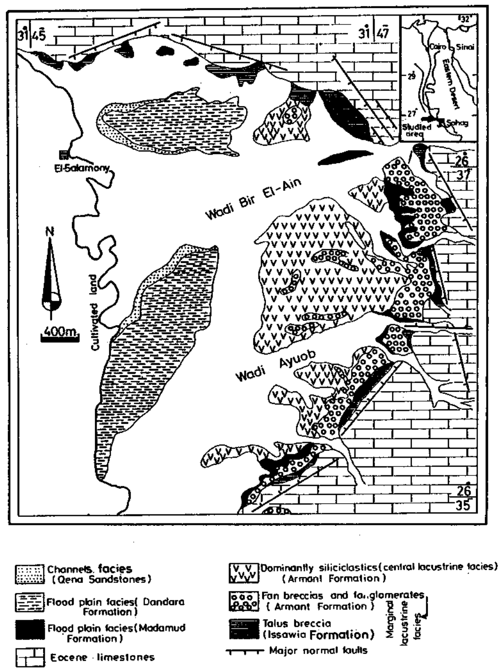

Fig. 2: Upper Pliocene-Pleistocene facies map of the area around El Salamony, NE of Sohag.

By comparing the lithological chracteristics of the Upper Pliocene and Pleistocene Nile sediments of Said [1] in general, with that sediments described in the study area in particular, a similarity in the lithological chracteristics was noticed . . So in the present paper the author follows classification proposed by Said [1].

A- The Upper Terrace (nearer to the Eocene scrap)

The Upper terrace is widely distributed in the mapped area and is represented by the oldest terraces which reach a maximum hight of about 200m above the present sea level . It skirts the lower slopes of the Eocene limestone escarpment surrounding the area.

The sediments of the upper terraces are distinguished into three rock units; a lower unit of the Madmoud Formation and the upper two intertonguing Armant and Issawia Formations. The Madmoud Formation belongs to the Late Pliocene, and the other two formation are Early Pleistocene [1].

1- Madmoud Formation

The Madmoud Formation constitutes the oldest unit in the studied area. It is composed of fine siliciclastics (siltstones, mudstones and shales). The thickest outcrops of these sediments are located in El Salamoy area (up to 10m thick). Northward, in El Sawamha Sharq, it decreases in thickness reaching 4m . In El Salamoy area boreholes dug for underground water proved that the Madmoud Formation extends downwards and may reach 150m in thickness .

2- Armant Formation

The Armant Formation conistitutes the upper part of the upper terrace . In El Salamoy area it is dominantly composed of breccias and conglomerates in the east, and sandstones and shales including conglomerates lenses to the west (total thickness : 30-40m). At El Sawamha Sharq, these sediments are dominated by mixed breccia and conglomerates to the east, and carbonates and mixed siliciclastics- carbonates (50m thick) to the west .

3- Issawia Formation

The sediment of the Issawia Formation from an elongate ridge plastered on the bounding escarpment. It is composed of accumulations of friable to poorly cemented cobbly to boulderly breccias and conglomerates together with big blocks of Eocene limestones (with a total thickness reaching 15m).

Both Armant and Issawia formations are laterally intertonguing, and unconformably cut through the Madmoud Formation .

B- The lower terrace (nearer to the cultivated land)

The lower terrace attains elevations reaching some 80 meters above present sea level . It represents a very narrow belt extending to the west of the upper terrace. The sediments of the lower terrace can be separated into two units ; the lower Qena Sandstone and an upper Dandra Formation (Fig. 3). Said [1] considered the Qena Sandstones as Middle Pleistocene and Dandra Formation as belonging to the Late Pleistocene .

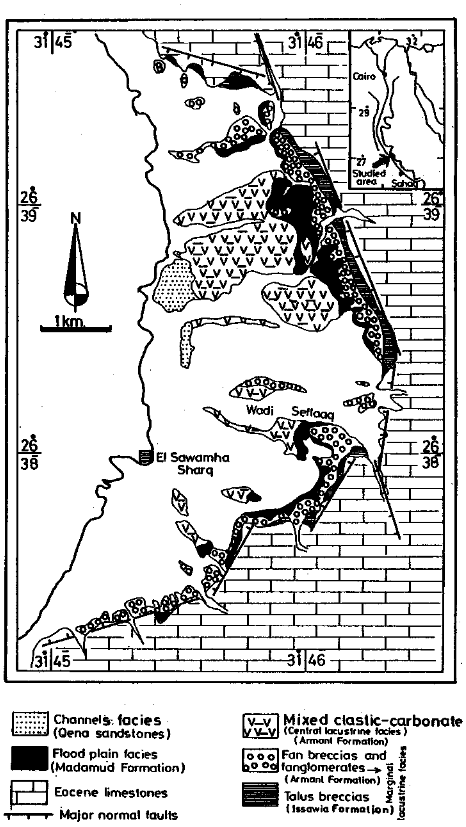

Fig. 3: Upper Pliocene-Pleistocene facies map of the area around El Sawamha Sharq, NE of Sohag.

1- Qena Sandstones

The sediments of the Qena Sandstones cut through the low lying parts of the Armant Formation to the east. It is composed of cross bedded sandstones and gravel lenses. The thickest outcrops of these sediments reaches 20m in thickness. Near the El Salamony area, three boreholes dug for ground water proved that the Qena Sandstones extends downwards and may reach 100 m in thickness .

2- Dandra Formation

The sediments of the Dandra Formation are located in the area around El Salamony, covering the Qena Sandstones. It is dominantely composed of siltstones, shales and sandstones (a total thickness of 20 m). In the El Sawamha Sharq, area the Dandra Formation is completely missing .

FACIES TYPES

Five major sedimentary facies types could be recognized in the studied area .

A- Facies Associations of the Upper Terrace

Field and petrographic studies have demonstrated that the sediments of the upper terrace start at the base with the flood plain facies of the Madmoud Formation. This is followed upward by two interfingering facies; the lacustrine facies of the western part (the Armant Formation), and the talus facies of the eastern part (the Issawia Formation), respectively.

1- The flood plain facies

This facies forms the basal part of the upper terrace. It begins at the base with evenly laminated calcareous claystone and siltstones. Lenticular cross laminated sandstones are found enclosed within the clay beds. The upper part is dominated by massive claystones and shales riched in black organic remains, clusters of Eocene Pabbles and reworked algal debris derived from the surrounding lower Eocone algal Drunka Formation. The cross laminated measurements indicate a northerly trending paleocurrent pattern.

2- The talus facies

This facies occurs as scree deposits interfingering with the bedded fan breccia and conglomerates. They are represented by accumulations of big blocks (5m in diameter) at the base, which grade upward to crudely bedded cobbly to boulderly breccias (2-1.0m in diameter), characterised by poorly sorted and angular rock fragments of Eocene algal carbonates and cherts (Fig. 4A).

It was noticed that the breccias at the base are friable to poorly cemented. Upwards these clasts form the so called "

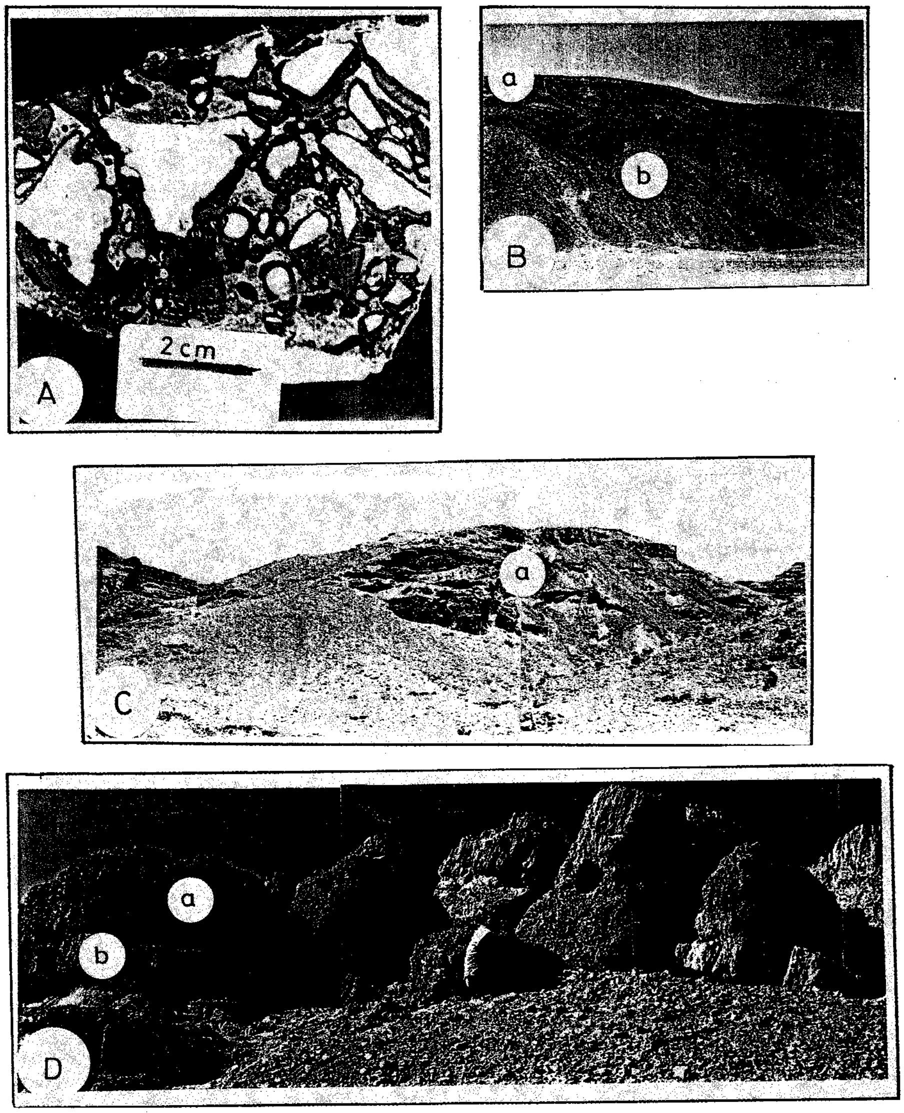

Fig. (4) - A - Polished slab showing the angular breccia claasts embedded in ferro - calcitic cement, talus faies, El Salamony area, B- Talus deposits (b) on Eocene limrstones escarpments (a). El Salamony area. C- Thick fan breccias and conglomerates (a) facing to the major wadies, marginal lacustrine subfacies, El Salamony area. D-A Panorama showing tongues of carbonates (b) intercalated coarse breccia and conglomerates (b), marginal lacustrine subfacies.

Red Breccias" the product of later cementation by ferro-calcitic minerals.

It is believed that the sediments of this facies accumulated as talus breccia deposits .

3- The lacustrine facies

The sediments of this facies encroach over a great part of the Nile sediments in the mapped areas. Comparing of their regional setting, the absence of marine fauna and their facies distribution with models for lacustrine sedimentation earlier interpreted by selly [4], and Philobbos and Abd El Rahman [5], suggests that these sediments accumulated in a lacustrine setting. Distribution and facies changes exhibited by these sediments enabled the author to recognize two depositional models of lacustrine sedimentation; a model for the dominantly terrigenous lacustrine facies (localized in El Salamony area), and another model for the mixed carbonates and terrigenous lacustrine facies (localized in El Sawamha Sharq area).

a- A model for the dominently terrigenous lacustrine facies

The aerial distribution of the the dominently terrigenous lacustrine facies shows a central core of fine siliciclastics to the west (the central subfacies) that interfingers with coarser deposits (the marginal subfacies) to the east (Fig. 5).

i- The marginal subfacies

The sediments of this subfacies are composed of coarsening upward cycles of interbedded breccias and conglomerates (30m thick,Fig. 6B). Each cycle begins at the base with thinly bedded polygenic pebbly breccias and lenticular sandstone bodies, followed upward by interfingering cobbly to boulderly coglomerates and breccias. The lithoclasts are composed mainly of mixed Eocene micrites and numulitic algal grainstones and packsones as well as cherts, derived mainly from the surrounding Drunka Formation. In areas facing the major wadis (e.g. W. Bir El Ain) these coarse clastics are thicker and reach 50 m in thickness (Fig. 4C).

ii- The central subfacies

This subfacies occupies the central portion of the ancient lake where it reached its maximum thickness, (Fig. 5). Near its peripheries its thickness is very thin. It is dominated mainly by a fine to medium grained siliciclastic sequence. The basal part is composed of uniformly cross bedded coarse to medium grained sandstones(3m thick). The direction of cross beddings indicates a northeasterly trending pa-

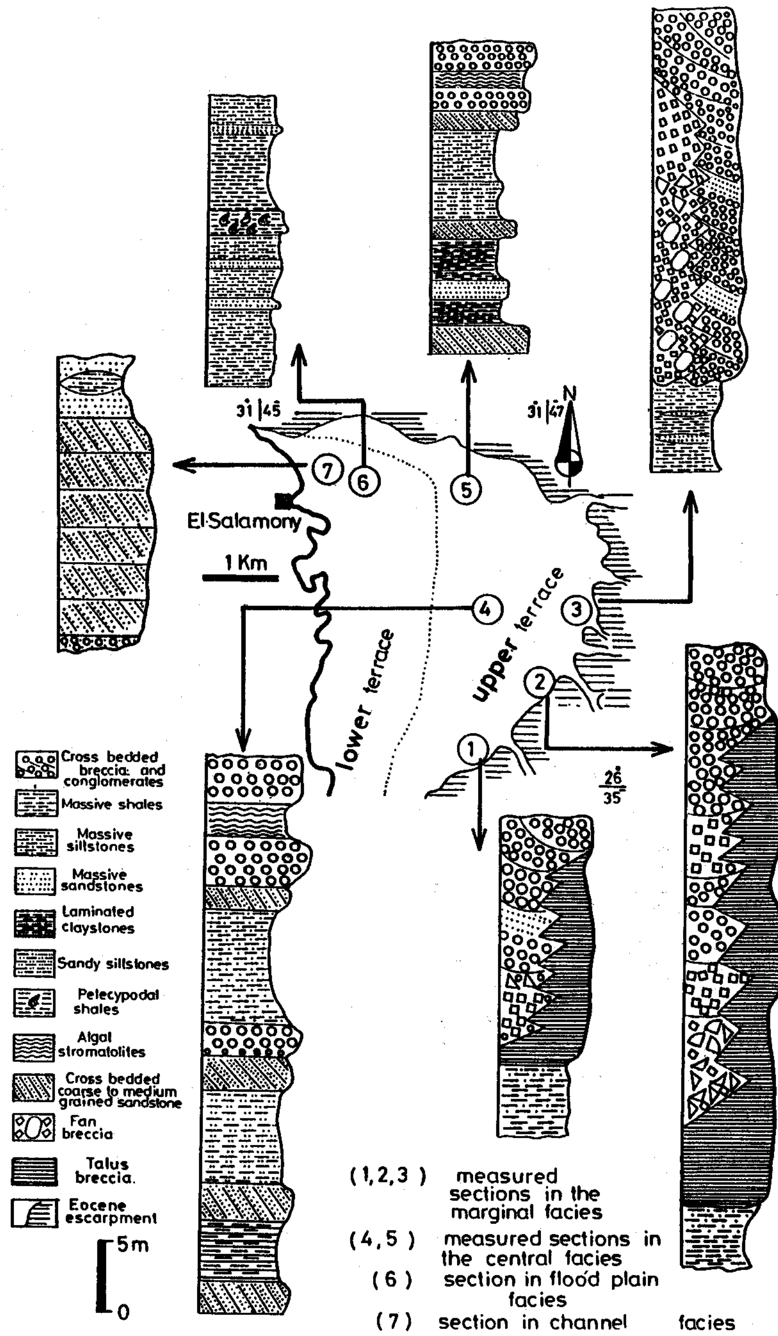

Fig. 5. Measured columnar sections in the upper terrace (1,2,3,4,5) and the lower terrace (6,7), El Salamony area.

leocurrent pattern. This grades upwards into massive to horizontally laminated gray to grayish blue mudstones, shales and siltstones (10m thick). The sandstones contain moderately sorted to well sorted with subrounded grains. They are mainly feldspathic to quartz arenites. The upper portion is capped by polygenetic cobbly to pebbly conglomerates (3m thick) intercalated with thin beds of algal stromatolites. The presence of algal stromatolites as well as the paucity of marine fossils may point to intermittent hypersaline conditions during sedimentation.

It is worth mentioning that this model fits the one proposal by selly [4] for lacustrine sedimentary settings that with high relief hinterland and semi arid climatic conditions. Such areas were influenced by a permanent supply of terringenous coarse clastics eroded from the surrounding regions (Fig. 8A).

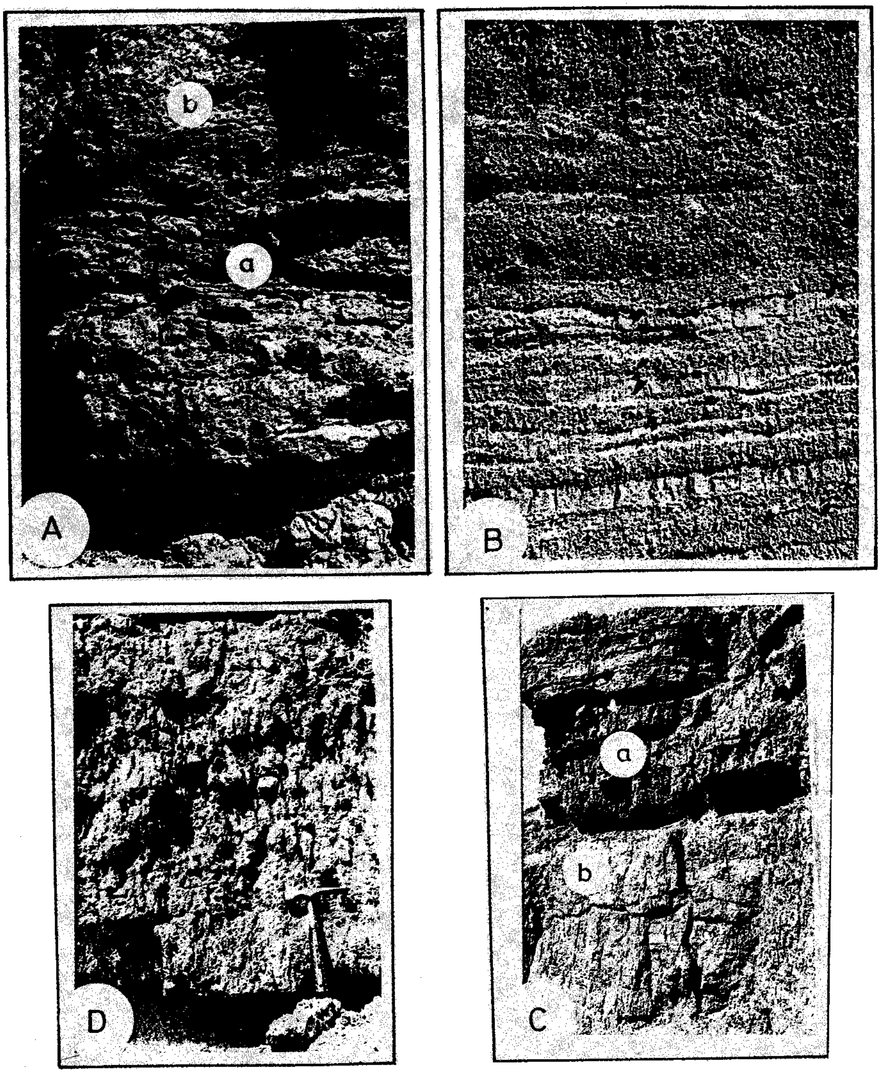

Fig. 6. A- Algal laminites and stromatolites (a) intercalated with travertines (b), central lacustrine subfacies, El Sawamha Sharq. B- Coarsenning upward sequences of breccia and conglomerates, marginal lacustrine subfacies, El Salamony area. C- Field view showing tufaceous breccias (a) and tracertines (b), central lacustrine subfacies, El Sawamha Sharq. D- Close-up view showing tufa limestones, central lacustrine subfacies, El Sawamha Sharq.

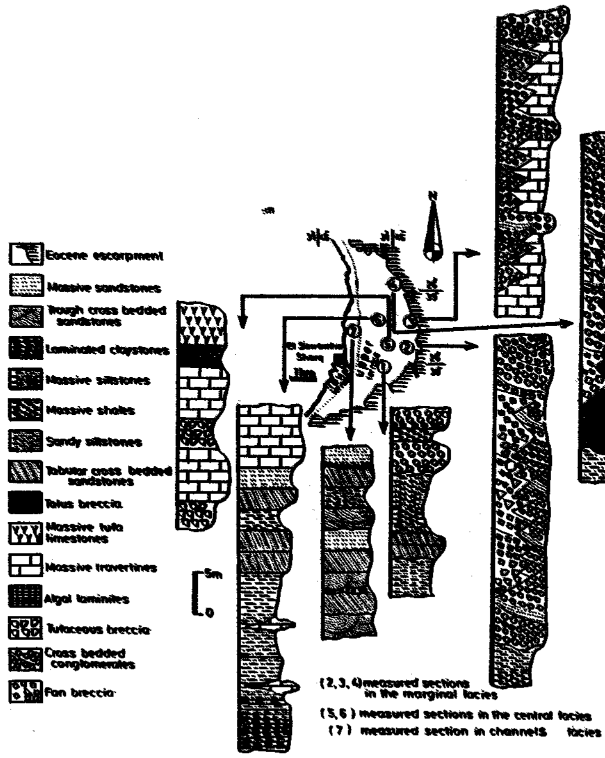

Fig. 7. Measured columnar sections in the upper terrace (1,2,3,4,5,6) and the lower terrace (7), El Sawamha Sharq area.

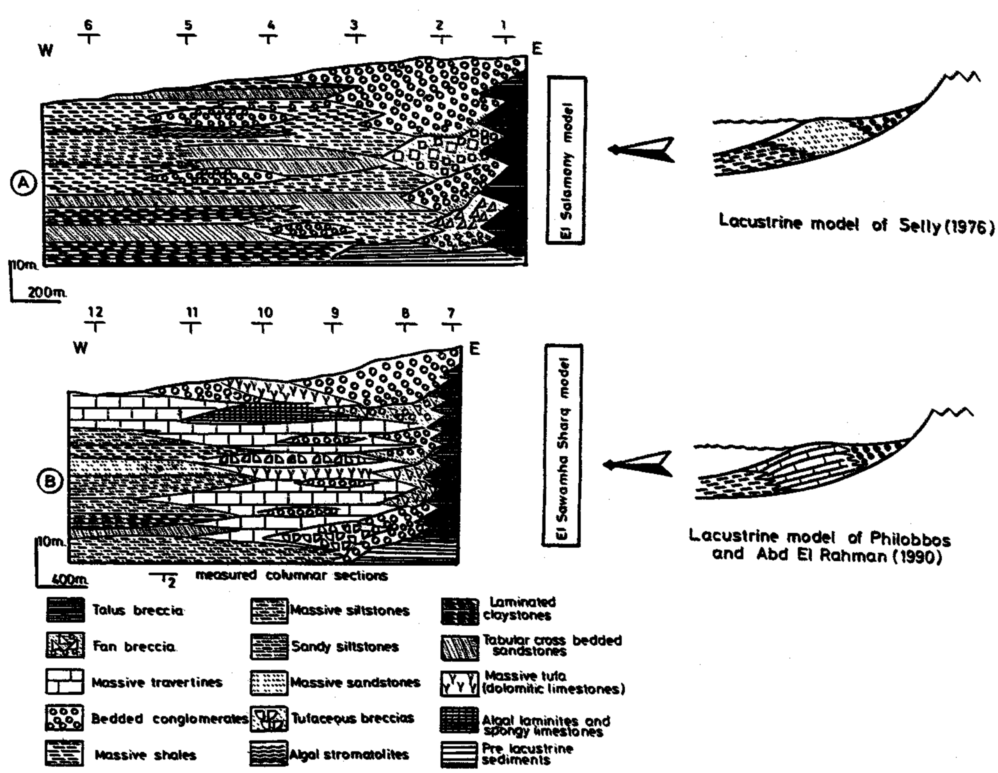

Fig. 8. East west cross sections in the lacustrine facies:
A- section in dominantly terrigenous lacustrine facies (El Salamony mode), B- section in mixed carbonates-terrigenous lacustrine facies (El Sawamha Sharq model).

b- A model for the mixed carbonates-terrigenous lacustrine facies

The sediments of this model are composed of fime grained siliciclastics near the center of the ancient lake interfingering laterally, and upwards with carbonates (the central subfacies). Towards the peripheries the lacustrine carbonates interfingered with conglomerate and breccias (the marginal subsurfaces, Fig. 4D).

i- The marginal subfacies

The sediments of this subfacies reach their maximum thickness in areas facing the major wadis , where it reaches 40 m in thickness (e.g.W. Saflaq). Between these wadis this facies is thin, (Fig. 7) .

Field and petrographic evidances proved that he sediments of this subfacies are composed of superimposed coarsening upward cycles . Each cycles begins at the base with polymictic pebble and granule breccias intercalated with lenticular bodies of tufa and travertine carbonates which extend westwards forming the main body of the lacustrine carbonates of the central subfacies. These lithoclasts are embedded in sparry calcite, dolosparite (Fig. 9A) and fine grained limestone clasts as well as ferrugenous materials.

According to the geometry and lateral distribution this facies of coarse breccias and conglomerates is considered as coallescing fans that poured into the lake through the major wadis.

ii- The central subfacies

This subfacies extend as interfingering bodies of lacustrine carbonates and fine siliciclastics reaching their maximum thickness in the central portion of the ancient lake. In the eastern side this facies is dominated by carbonates and tongues of conglomerates . These carbonates show rabid east-west facies variations (Fig.8B) . In the east

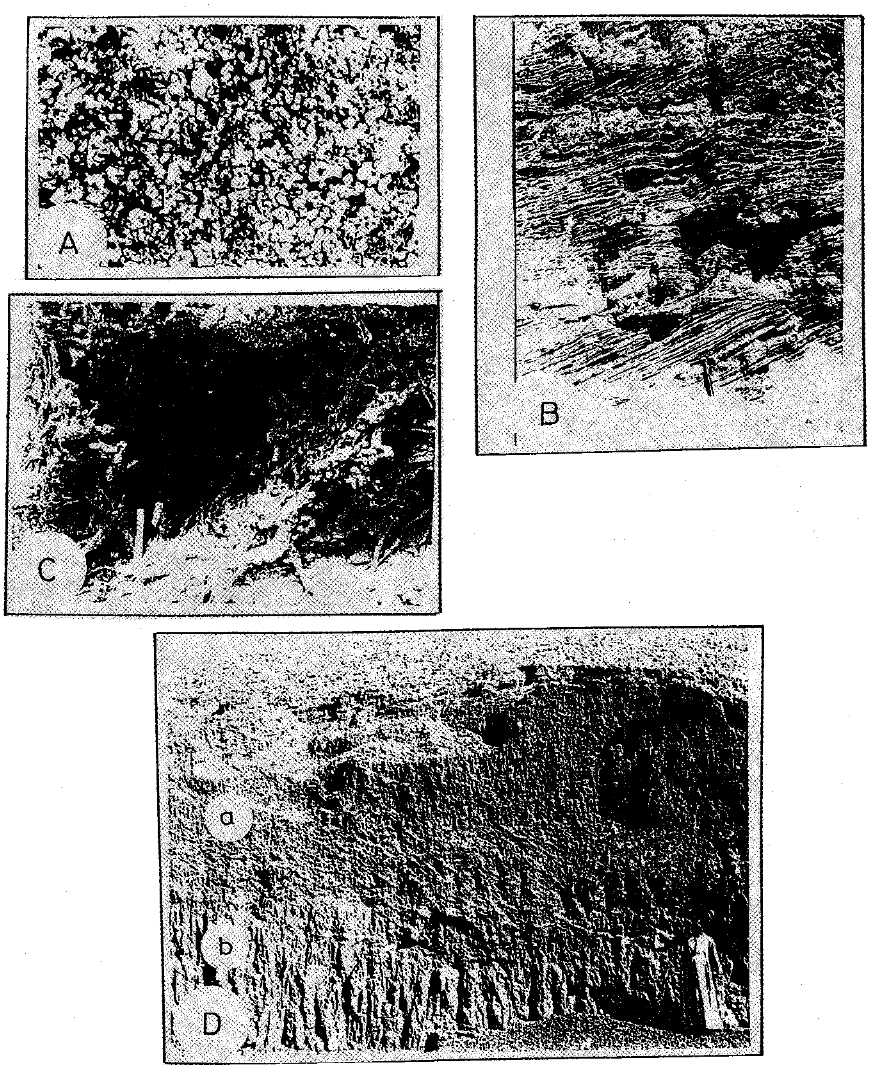

Fig. 9. - A - A photmicrograph showing dolosparite cemented pebbly conglomerates, marginal lacustrine subfacies, El Sawamha Sharq. B- Cross bedded sandstones, channels facies, El Sawamha Sharq. C- verticasl and branched rootlets channels facies, El Sawamha Sharq, D- Massive gypsiferous shales (a) and fine grained sandstones (b), flood plain facies, lower terrace, El Salamony area.

the lacustrine carbonates are composed of tufa breccia (Fig. 6D&C) and massive bedded tufa and thin beds of dolomitic travertine. Towards to the west carbonates change into thick bedded fractured dolomitic travertine interfingering with fine sandstones and siltstones. Algal laminites and stromatolites are encountered in the top part of the carbonates facies ,(Fig. 6A).

In the westernmost side the central subfacies starts at the base with laminated fine grained sandstones, siltstones and silty claystones (20 m thick) .It is followed upward with cross bedded fine grained sandstones , claystones, massive shales and marls (16 m thick). The top part is capped by highly fractured friable limestones enriched with algal traces.

This mixed terrigenous-carbonate lacustrine model fits with that suggested by Philobbos and Abd El Rahman [5]. In such areas coarse clastics were laid down by intermittent torrents and the carbonates were precipitated near the peripheries of the lake and its central parts.

B- Facies Associations of the Lower Terrace

The sediments of the lower terrace exhibit vertical facies variations. They start at the base with channels sandstones facies followed upwards with flood plain fine siliciclastics (e.g. El Salamony area) At El Sawamha Sharq, however the sequence is represented only by a channel facies, and the upper facies is completely missing.

i- The channel facies

This facies is dominated by yellow, moderately to well sorted, medium to coarse grained quartz sandstones. It starts at the base with channel lag deposites formed by a 1 m thick layer of pebbley igneous clasts composed of granites, diorities , and metabasalts. It is followed upward by uniformally cross bedded medium grained quartzose sandstones (Fig. 9B). The thickness of foresets ranges between 7 and 15 cm, exhibiting fining upward grain size. The cross bed dip measurements indicate northerly and northwesterly trending paleocurrent directions. The upper portion is dominated by evenly laminated fine to medium grained feldespathic sandstones with lenses of black siltstones . It was noticed that vertical and branched rootlets are common in these sandstones (Fig. 9C).

ii- The Flood Plain Facies

The sediments of this facies are located in the area around El Salamony where they conformably overlie the channel facies . It is dominated at the base by massive claystones and siltstones and cross laminated fine grained sandstones ,(Fig. 9D). This grades upwards into gypsferous gray shales rich in fresh water bivalves (e.g. Unio sp.). The clay beds include clusters of Eocene limestone clasts , as well as black organic remains and sand balls. Occasionally, bands and nodules of fresh water carbonate are encountered the upper parts of the section .

UPPER PLIOCENE-PLEISTOCENE SEDIMENTATION HISTORY

The valley of the Nile started to form at the end of Miocene [1,6,7]. Numerous local bays in the bounding Eocene escrapment were formed on both sides of the valley, [1] .

Field studies have demonstrated that these bays in the area between El Salamony and El Sawamha Sharq were created by the intersection of N, NE and SW fault trends , which have affected the area since Late Miocene time .This is indicated by the presence of accumulations of big blocks of Eocene limestones as the fault breccias along the fault lines surrounding the local bays , as well as an abudance of drag faults which are observed close to the bounding cliffs .

At the start of the Late Pliocene thick siliciclastic sediments, representing a flood plain facies (the basal part of the inner terrace, Fig. 10 A&B), accumulated under high rainfall climatic conditions. The thickness of these sediments in the El Salamony bay is much greater than in the El Sawamha Sharq bay . This is evidenced by boreholes drilled in these areas. The local bays acted as sediment traps for the streams that drained the Eastern Desert.

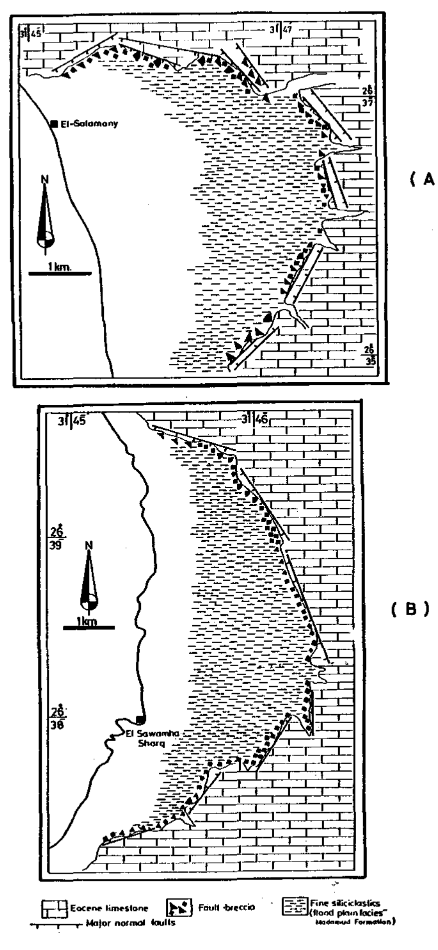

Fig. (10 A,B): Paleogeography of the area during the deposition of flood plain facies (Early stage).

Both the faults bounding these bays, as well as the easterly trending faults and old features were rejuvinated at the start of the Pleistocene . This coincided with the movements that affected the Red Sea -Gulf of Aqaba rift. This event led to the accumulation of thick breccias in the foot-slopes of the bounding cliffs, forming the talus facies of the Issawia Formation .

Major wadis follow the preceding easterly trending faults and the older fractures, and funneled their loads of coarse clastics to form piedmont fan breccias and conglomerates on the peripheries of an ancient lake. In areas facing these wadis (e.g. El Salamony bay) the continuous influx of coarse clastics has led to the accumulation of great amounts of terrigenous clastic sediment which occupied the peripheral m (Fig. 4C) and the central parts of an ancient lake (the model of terrigenous lacustrine facies ,Fig. 11A). Hay et. al. [8] mentioned that rapid sedimentation from a great terrigenous supply may have caused the elimination of carbonate production .

In the other bay (El Sawamha Sharq) the discharge of clastics was intermittent, resulting in the interonguing of coarse clastics with carbonates at the peripheries of the lake as well as in areas facing the drainage wadis .In areas between these tectonically- controlled wadis and in the central part of the lake the carbonate production prevailed, (Fig. 11B). As suggested by Murry et al. [9] and Friedman [10] carbonate production was relatively high during quiescent periods of clastics supply. Rainy periods interrupted these arid conditions causing the deposition of the fine siliciclastics interfingering the lacustrine carbonates (model of mixed terrigenous-carbonates lacustrine facies).

By the beginning of Middle Pleistocene these local bays opened to the south and were connected with a new river that came from a lacustrine facies to a fluviatile (channels) facies covering the south. This event led to the change of lithologic chracteristics and the environment of deposition changed from the valley areas (Fig. 12 A&B) , and forming a new terrace (e.g. the lower terrace).

In the Late Pleistocene , rainy climatic conditions in the Nile Valley prevailed. This led to the flooding of new River over the low lying areas of these old bays, causing the accumulations of flood plain fine siliciclastics over the channels facies in El Salamony area (Fig. 13) . In the north, in the El Sawamha Sharq area, the old bay was still emerging during the periodes of flood.

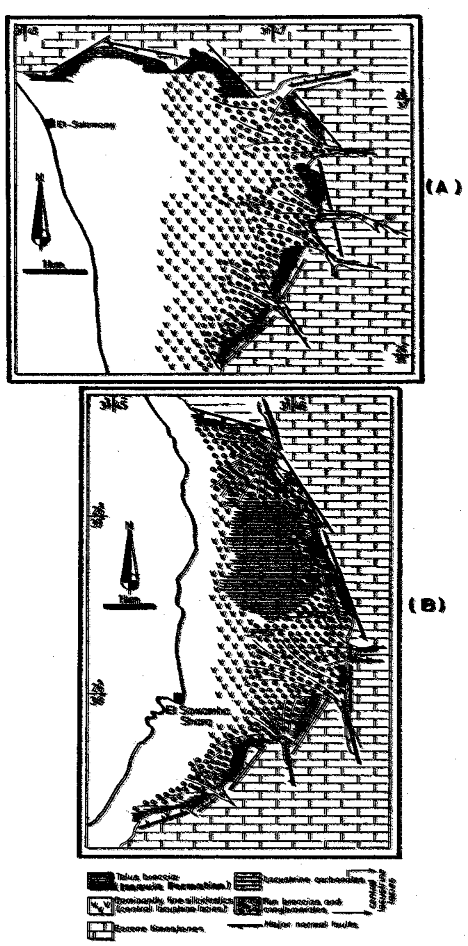

Fig (11 A,B) Paleogeography of the area during the deposition of the lacustrine facies (Second stage).

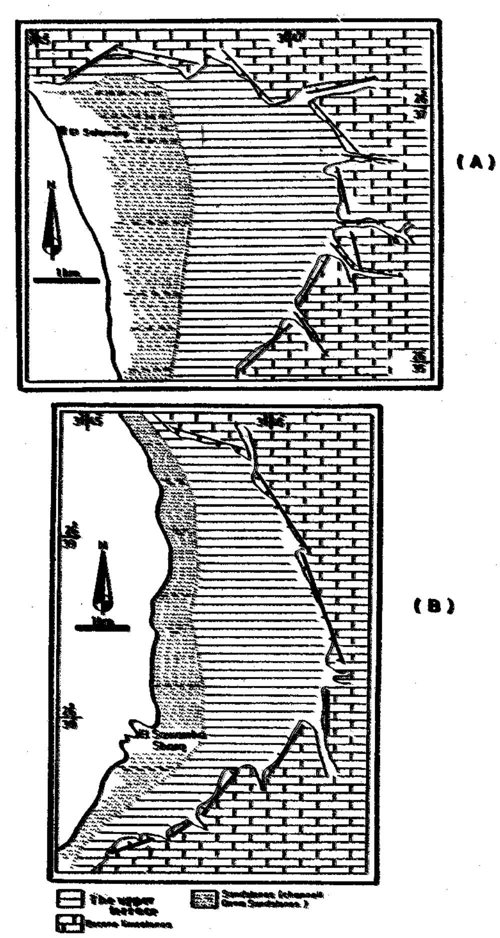

Fig. (12 A,B) Paleogeography of the area during the deposition of the channels facies (Third stage).

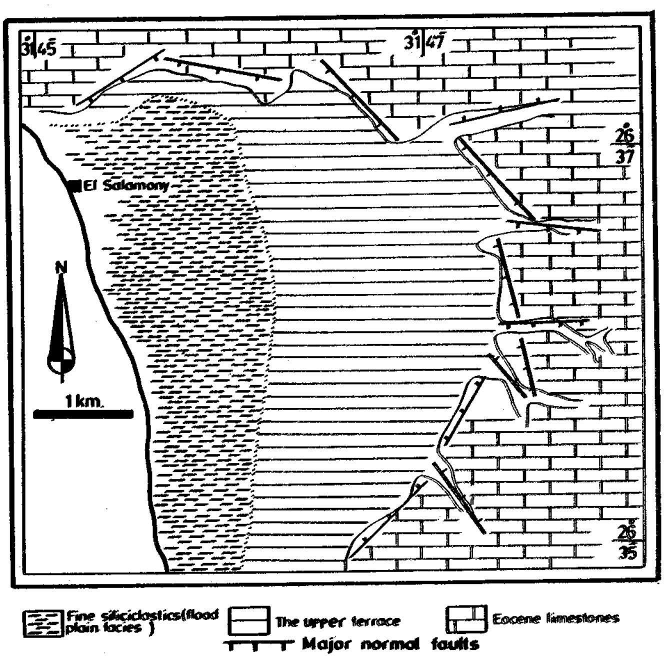

Fig. 13: Paleography of the area around El Salamony during the deposition of flood plain facies (Fourth stage).

SUMMARY AND CONCLUSIONS

The Upper Pliocene-Pleistocene Nile terraces cropping out in the area between El Salamony and El Sawamha Sharq constitute two terraces. The upper terrace with a maximum elevation of 200 m above the present sea level is composed of the Madmoud Formation at the base, followed upward by the two interfingering Issawia and Armant formations. The lower terrace (with maximum elevation of 80 m above the present sea level) is composed of the Qena Sandstones and Dandara Formation at the El Salamony area whereas in the area around El Sawamha Sharq the Dandara Formation is missing.

The detailed field study and the facies maps constructed for these sediments have revealed four stages to their depositional history in the study area:

1 - In the first stage (Late Pliocene) the earliest sedimentation started with the accumlation of a thick sequence of fine silicilastics as flood plain deposits trapped in these local bays.

2 - In the second stage (Early Pleistocene) the easterly trending structurally-controlled wadis funnelled their loads of coarse clastics in the areas facing these wadis (terrigenous lacustrine model in El Salamony area). On the peripheries these coarse clastics laterally interfinger with a talus facies. In areas between these wadis the discharged coarse clastics intermixed with carbonates (mixed terrigenous - carbonates model in El Sawamha Sharq area).

3 - In the third stage (Middle Pleistocene) the local bays opened to south and connected with a new river. Thus led to accumulation of a channel sandstones facies covering the whole Nile Valley area.

4 - In the last fourth stage (Late Pleistocene) rainy climatic conditions dominated. This led to the flooding of a new River over low land areas causing the accumulation of flood plain deposits in the El Salamony bay. On the other hand the El Sawamha Sharq bay was still emerging during the flood periods.

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