Neogene submarine relief and Troodos uplift in southeastern Cyprus

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Abstract

In the Choirokoitia (engl.: Khirokitia) area of southeastern Cyprus there occurs within the hemipelagic Miocene Pachna Formation a local coarse-detritic channel facies of terrigenous source. These channels together with their surrounding pelitic beds were formerly interpreted to be deeply incised into the Pachna beds and to be of Late Pliocene age. From this a rapid Late Pliocene uplift of the Troodos hinterland was postulated. This paper will explain how the so-called deeply incised channel consists of numerous flat channels all lying in superposition with each corresponding to the lateral pelitic shallow basin facies. Therefore, a rapid Troodos uplift is not necessary. From the study of the Choirokoitia area and the southern adjoining Amala Mountains it follows that all sedimentary units of the Choirokoitia Site occur within a tight stratigraphical connection with lateral facies transitions within the higher Pachna Formation. The whole rock complex is covered by the gypsum of the Messinian Kalavasos Formation. Consequently, the age of the channel system has to be Miocene.

Introduction

The Neogene development of Cyprus is determined by the uplift of the central island Troodos ophiolite complex. All stratigraphical units of its sedimentary cover reflect the movements of this ophiolite complex. The uplift is due to a generally northerly subduction of the African Plate below the Turkish Plate along the Cyprean Arc together with Cyprus at its southern rim (Kempler and Ben-Avraham 1987). The current subduction activity was initiated (Eaton and Robertson, 1993) in the early Miocene. Since that time the development of Cyprus and its adjacent marine border is controlled by sedimentary transport off the uplifting ophiolite area. The following text deals with the question of uplift rate during the later Miocene to later Pliocene at the southeastern border of the Troodos ophiolite complex (Fig. 1).

The problem

Bagnall (1960) has mapped and carefully described the Miocene beds of the Amala Mountain area of southeastern Cyprus. He presents the following strata subdivision:

Pliocene

unconformity

Miocene: Dhali Group

- Koronia Limestone + Gypsum Deposits
- Pachna Formation:
- Limestone-Shale Member with *Discospirina* band
- Fragmental Limestone Member
- Wavy-bedded Limestone Member

Xenophontos *et al.* (1987) describe within the Fragmental Limestone Member of the Pachna Formation near Choirokoitia a 20 m thick channel fill with coarse material from Lefkara beds and Troodos igneous rocks. Such a submarine relief suggests strong uplift movements of the Choirokoitia area during that time.

Houghton *et al.* (1990) assign the same channel to "uppermost Pliocene age" due to a coccolith flora. Moreover, this channel is much wider and deeper in dimensions than that described by Xenophontos *et al.*, (1987), for the flora dated has been sampled from silt within, as well as below, the cobble-filled channel. Thus they infer a steep-sided submarine gully of Late Pliocene age cut into the Middle/Upper Miocene Pachna beds. This gully formation implies an unusual rapid Late Pliocene Troodos uplift.

The results of field work carried out between 1992 and 1994 and given in this paper show that first there does not exist a 20 m deep or even deeper channel system. Second the cobble and silt beds, assigned as being of Late Pliocene age, are not younger than the *Discospirina* Beds of Middle/Upper Miocene age. Thus the consequences for a rapid Troodos uplift in the Late Pliocene cannot be based on the Choirokoitia channel occurences.

The Choirokoitia Site

Near Choirokoitia the Maroni River (or Potamos tou Agiou Mina) offers along its course a few high and steep-cut slopes with similar exposures (Fig. 2). Bagnall (1960) describes one at the "north bank of the Maroni River 200 yards northeast of Chirokitia village", with its top ending in the "Katselia area" ("Katsella" after the topographical map 1:5000 of 1977). This is undoubtedly the eastern slope of the Maroni valley 350 m northeast of the church of Choirokoitia. Bagnall records inter alia seven conglomerate layers each with a thickness ranging from 0.6 up to 3 m. The polymictic conglomerates contain

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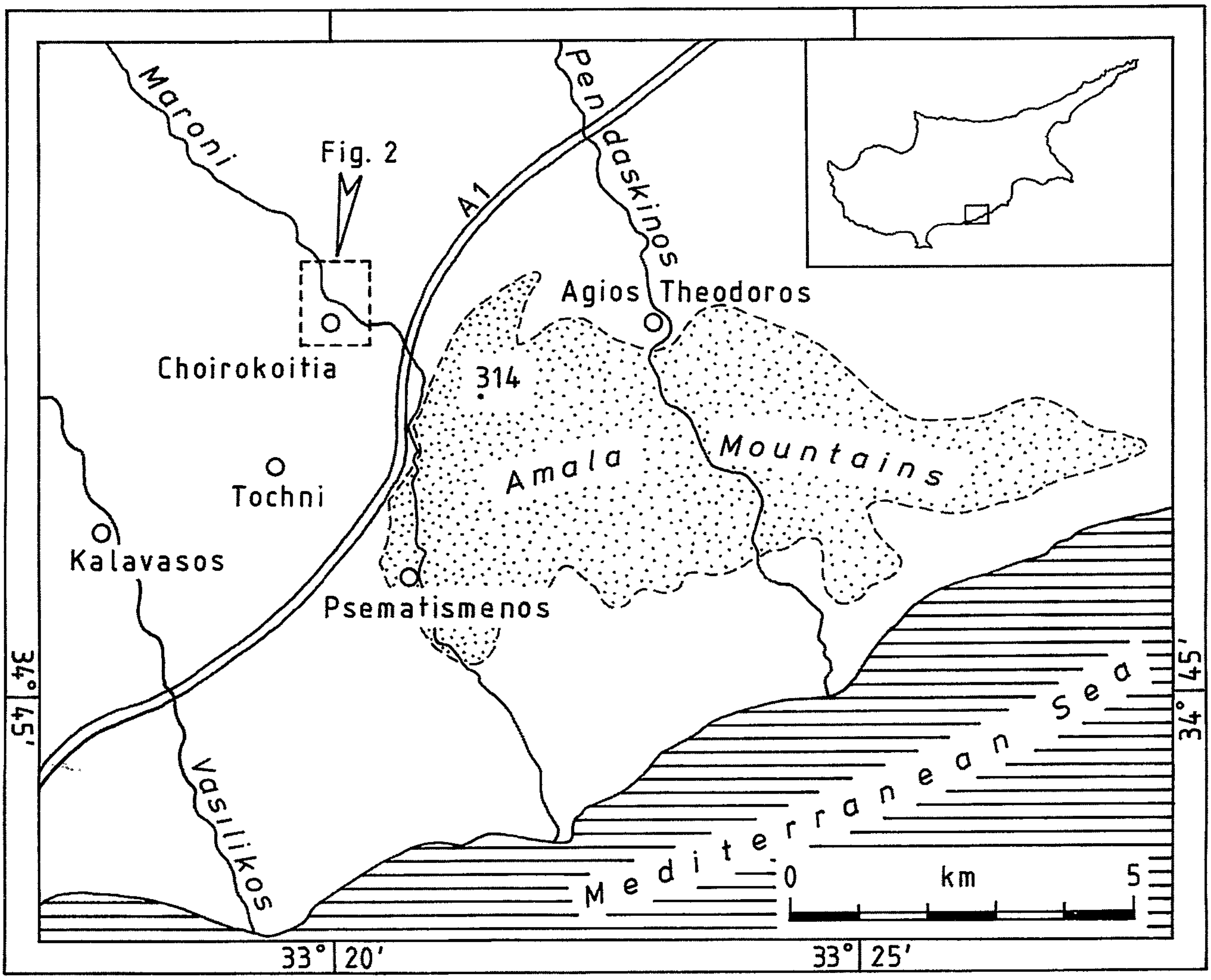

Figure 1. Location of the investigations: The Amala Mountains and Choirokoitia in the southeast of Cyprus

"diabase, basalt, andesite, chalk, chert and reef limestone fragments", some blocks "up to 6 feet in length". "Two of the thicker conglomerates are...almost entirely formed by large, well rounded boulders of algal and coral limestone associated with only small amounts of angular blocks of Lapithos chalk" [nowadays called Lefkara chalk].

Xenophontos *et al.* (1987) describe not the same section but one lying exactly on the opposite side to that of Bagnall within the Maroni valley. Though they put their "spectacular cliff" on the north bank of the river, their photo, plate D2 on p. 122, proves to be the section on the southwest bank of the Maroni River 250 m northeast of the church of Choirokoitia. They record the same facts as Bagnall but they place the group of conglomerate layers in a "some 20 m thick" channel deposit. Likewise in the paper of Houghton *et al.* (1990) the same channel deposit is recorded as "c. 20 metres thick and c. 30 metres wide".

This cliff is called the Choirokoitia Site in this text. It is situated 250 m northeast of the church (UTM grid 307.5/511) on the western wall of the Maroni valley immediately below the village (Fig. 2).

Indeed, at first glance the cliff presents the conglomerate layers as belonging to one fill and one deep channel (Fig. 3a). However, actually there are at least ten single channels well separated from each other and situated almost in superposition (Fig. 3b) and, what is essential there, their thicknesses range from only 0.7 m - 10 m.

It exhibits a succession of channels embedded into a monotonous, thin-bedded, grey, pelitic-arenitic sequence of silty marlstones that are alternating with small calcarenite beds. The channel fill displays from base to top the following sequence (Fig. 3a, b):

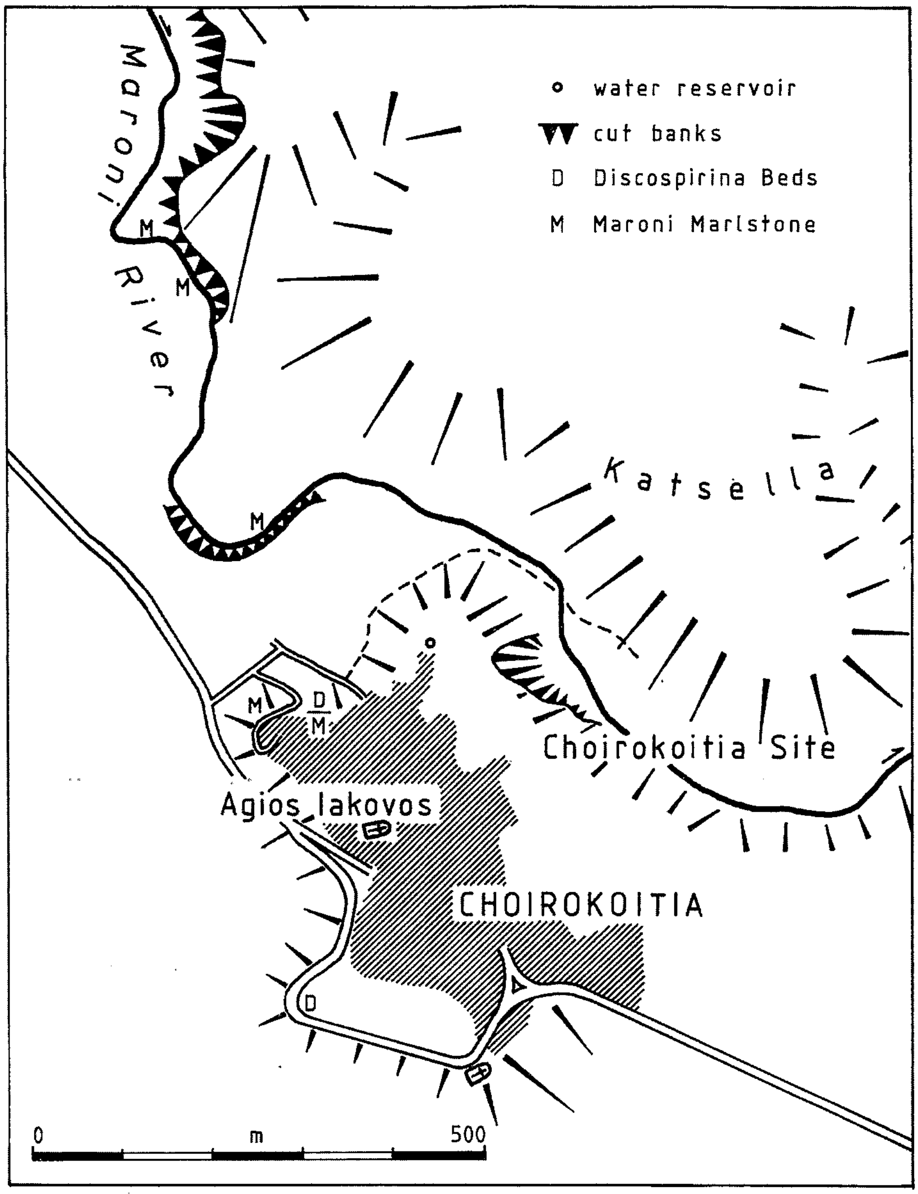

Figure 2. The local situation of the surroundings of Choirokoitia (Engl.: Khirokitia). For location see inset in Figure 1.

Channel 1

It is the lowest channel visible at the exposed wall (Fig. 4). Perhaps there are older channels below covered by the debris at the foot of the steep wall. This channel is situated below the lowest easily visible boulder-filled channel. The material of its fill resembles more the pelitic-arenitic outside-channel facies. Therefore, channel 1 is more easily recognizable by standing immediately before the wall.

Its maximum thickness above the talus debris is 1.7 m, 0.7 m of which have been preserved below channel 2. The fill consists of small calcarenite beds and marlstones with distinct trough-bedding. Gravel of reworked marlstone, Troodos ophiolite rocks, chert and Lefkara limestone, the latter up to 0.6 m in diameter occur occasionally. The channel top is formed by calcarenitic to marly beds up to 20 cm thick.

Channel 2

It is the channel below the big Lefkara chalk boulder within the cliff. Its thickness ranges up to 2.0 m. The fine-clastic outside-channel facies that corresponds to the channel facies has a thickness of 1.35 m. The main channel fill is coarse clasts up to 40 cm in dia., consisting of Troodos ophiolite rocks, Lefkara chalk and corals in a coarse-sandy, pebbly matrix. The roundness varies from excellent to bad. The channel fill is covered by a grey-green marlstone layer of max. 25 cm thickness containing a slight amount of gravel above the channel axis. Beyond the channel it forms a 12 cm thick prominent band within the grey-green marlstone facies. This layer dips down from beyond the channel into it (Fig. 4). The dipping is not only an effect of stronger compaction within the big channel complex but it also marks the primary channel form.

Figure 3a. General view of the Choirokoitia Site.

Channel 3

It is the channel with the big Lefkara chalk boulder. This boulder is 2.0 m vertical and 2.3 m horizontal in size, somewhat more than the thickness of the whole channel fill which reaches up to 1.5 m. The correponding sandy marl facies beyond the channel comes up to 0.8 m. On the stoss side of the boulder (right side at the cliff) a lag facies has been deposited with rudites up to 50 cm in dia. mainly consisting of coral and algal chunks. On the lee side (left side) a sand bar has been left by the current.

A fine-clastic layer up to 0.6 m tops this third channel fill forming a conspicuous groove in the cliff. Again, this fine layer has been deposited outside as well as inside the channel, dipping towards the channel and wedging out towards the channel axis due to later erosion during the formation of the base of channel 4.

Channel 4

This channel, up to 3.1 m thick, is very rich in rudites. They consist of large coral and algal heads in addition to white Lefkara chalk and dark Troodos ophiolite boulders. As in the lower channels a marlstone layer from outside the channel extends from the left side some meters over the channel fill.

Channel 5

It is the channel with the hole of *Corvus monedula* (Cypr.: Koliós, Engl.: Jackdaw). The coarse-clastic channel fill rises up to 5.5 m. The channel axis lies above the left rim of channel 4. The channel fill is conspicuously cemented thus forming the hardest bastion within the cliff with a vegetated roof. Its bluff contains the crevise with the jackdow hole.

The fill consists of thick-bedded conglomerate; the clasts are on average 20 cm across and at maximum 1 m. Troodos ophiolite rudites come up to 30 cm in diameter. Coral cobbles are frequent. The matrix is fine- to medium-sandy. Carbonateous cementation is conspicuous. The fine-clastic top separating channels 5 and 6 may be 2m in thickness.

Channel 6

This channel, lighter in colour than those below and above, and up to 4 m in thickness has again a coarse-gravelly fill with a gradation coarsening upwards. Lefkara chalk boulders flat-ellipsoidally shaped and well imbricated range up to good 2 m. The channel is topped by a grey-green pelitic layer up to 10 cm thick exposed to a lateral extent of 5 m.

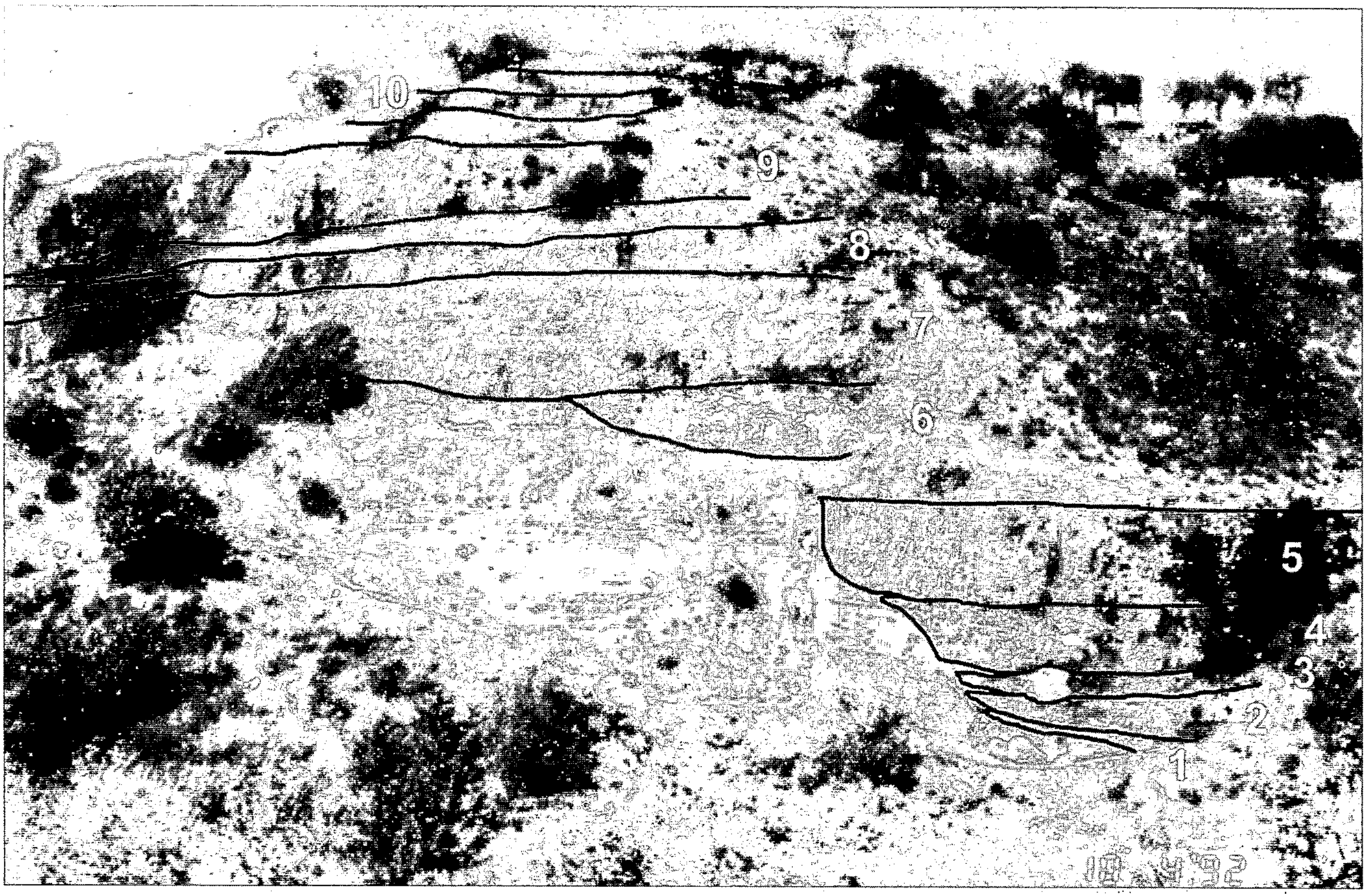

Figure 3b. The Choirokoitia Site with channel fills 1-10 (Amala Facies). On top the capping rock (Choirokoitia Limestone).

Channel 7

On the steep wall this channel is a brown colour. Its thickness is up to 6 m. Its maximum incision lies just outside the edge of channel 6. Its fill exhibits predominantly well stratified calcarenite layers. Subordinate gravel concentrations show well rounded pebbles. Lefkara chalk blocks run up to 1 m across. The channel is topped by a 10 cm thick fine-grained layer forming a conspicuous groove in the cliff. On its right edge there are two little shrubs marking the groove.

Channel 8

The channel differs from channel 7 because of the grey-green colour of its gravel-rich base. The channel thickness is up to 6.9 m on the left side of the cliff. The deepest channel incision lies above a large shrub of *Pistacia lentiscus* (Cypr.: sinià, Engl.: Mastic tree). The channel fill is very rich in boulders (up to 70 cm in diameter).

It is topped by a much finer grey-green layer up to 1.2 m thick, pelitic and calcarenitic, forming a ledge in the cliff overgrown with grass and shrub. Over a small area within this fine layer a light limestone bed (c. 20 cm thick) of *Discospirina* Bed type is visible from below.

Channel 9

This, the thickest one of all these superimposed channels, runs up to 10 m. Its fill forms the roof of the ridge at the left (southern) side of the cliff. There, the cliff wall exhibits a dark colour. Towards the north even higher strata are preserved above channel 9. The deepest incision of channel 9 lies on the left side of the outcrop. Additionally, there the basal conglomerate of this channel displays its maximum thickness of 1.8 m and is thinning out towards the right side. This basal layer exhibits a carbonate-supported conglomerate composed chiefly of Troodos igneous rocks, Lefkara chalk and chert (up to 20cm in diameter). It is followed by a vivid alternation of calcarenites and carbonate-supported conglomerates with boulders up to 1m in diameter.

The channel fill is topped by soft beds, 3.40 m thick at maximum, forming a 3 m wide ledge on the cliff. As far as the rocks of the soft beds are exposed they consist of thick ophiolite-sandy calcarenite beds and fine-clastic beds ending on top with 20 cm yellow-green silt that forms a groove. They contain fine plant detritus and represent in facies and colour the type of the *Discospirina* marlstone of the adjoining area.

Channel 10

The channel deposits form a small but very solid cliff above the

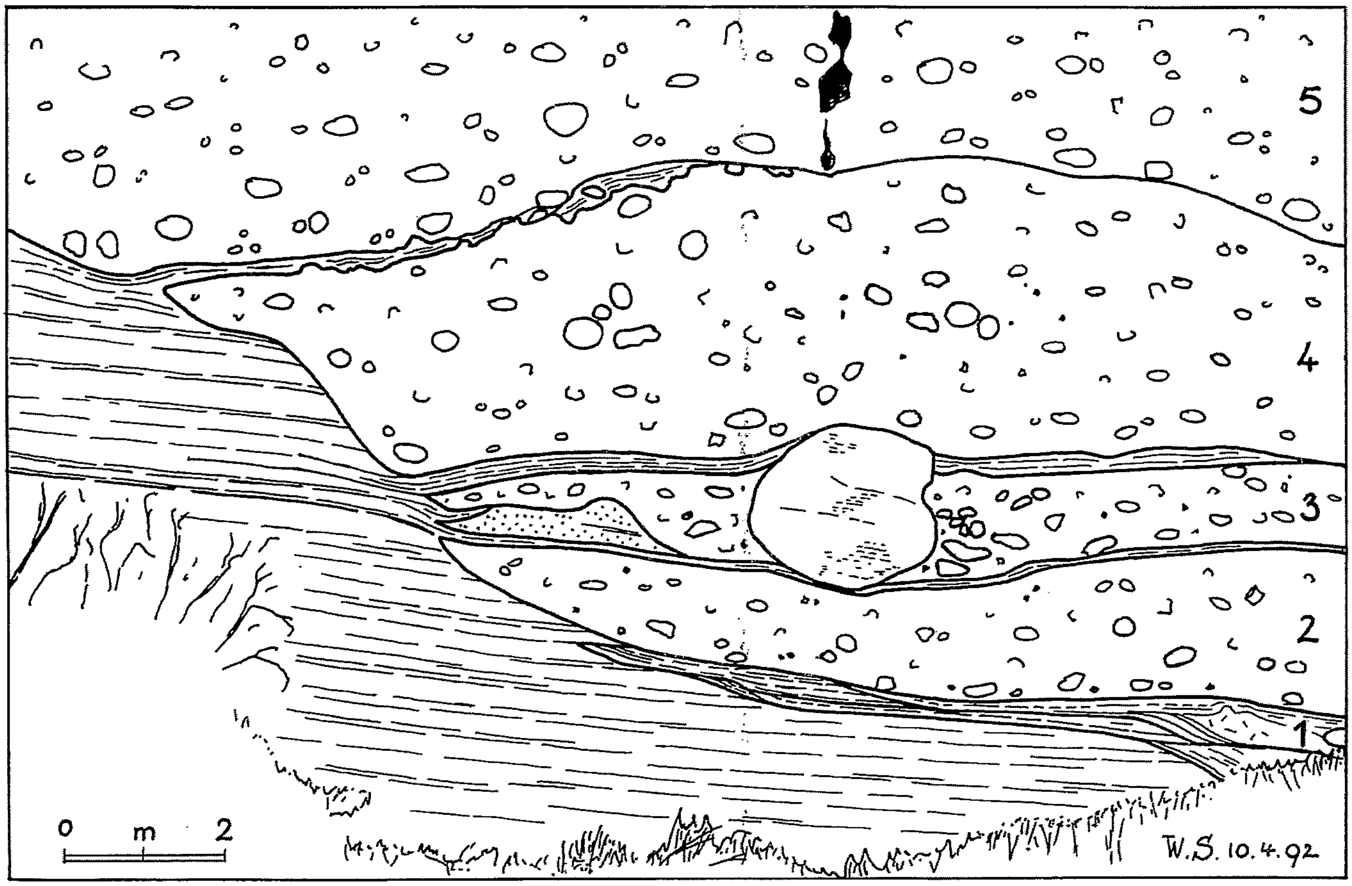

Figure 4 Choirokoitia Site. Detail of channels 1-5

ledge of the upper part of channel 9. Upon this cliff a few *Ceratonia siliqua* (Cypr.: teratsia, Engl.: carob tree) are growing, easily visible from the bottom of the valley. The channel fill is at least 1.7m thick. Its base cuts the fine-clastic top of the fill of channel 9. A deepening of 1 m along a lateral stretch of 5 m is recognizable. The fill consists of crystalline limestone, rich in fossils, containing ophiolite and Lefkara pebbles ranging from a few centimeters up to 20 cm in diameter, microgabbro pebbles strongly weathered, up to 15 cm, as well as black, bluish coated Perapedhi radiolarite.

This hard channel fill is covered above with soft rocks up to 65 cm thick forming a groove behind a 2 m wide ledge. It consists of grey-green limestone marl and pink ophiolite-conglomeratic calcarenite. In places, these soft beds are eroded by the rock capping the ridge.

Capping rock

The top of the ridge is formed by a 3 m thick recrystallized limestone, coarse-bedded, rich in cavities, with plenty of fossil moulds. It is embedded with gravel bands of Lefkara chalk up to 15cm in diameter and Troodos igneous pebbles up to 10 cm. At the southern edge there occur 10-20 cm thick smooth limestone beds rich in fossils.

Interpretation of the Choirokoitia Site section

Palaeogeographical setting

The Choirokoitia Site displays a well-stratified, marly-calcarenitic facies interfingering with a conglomeratic channel facies. The first is a marine deposit of a shallow basin. The channel facies is a linear debris supply onto the basin margin by scooping out flat channels and filling them with material supplied by erosion from a steep hinterland that could be marine, litoral as well as terrestrial.

Evaluating the material of the channel fills the occurrence of reworked coral individuals points to a shallow-marine source. The occurrence of weathered microgabbro seems to point to a terrestrial hinterland. But possibly the microgabbro weathered later, after being uplifted together with its surrounding

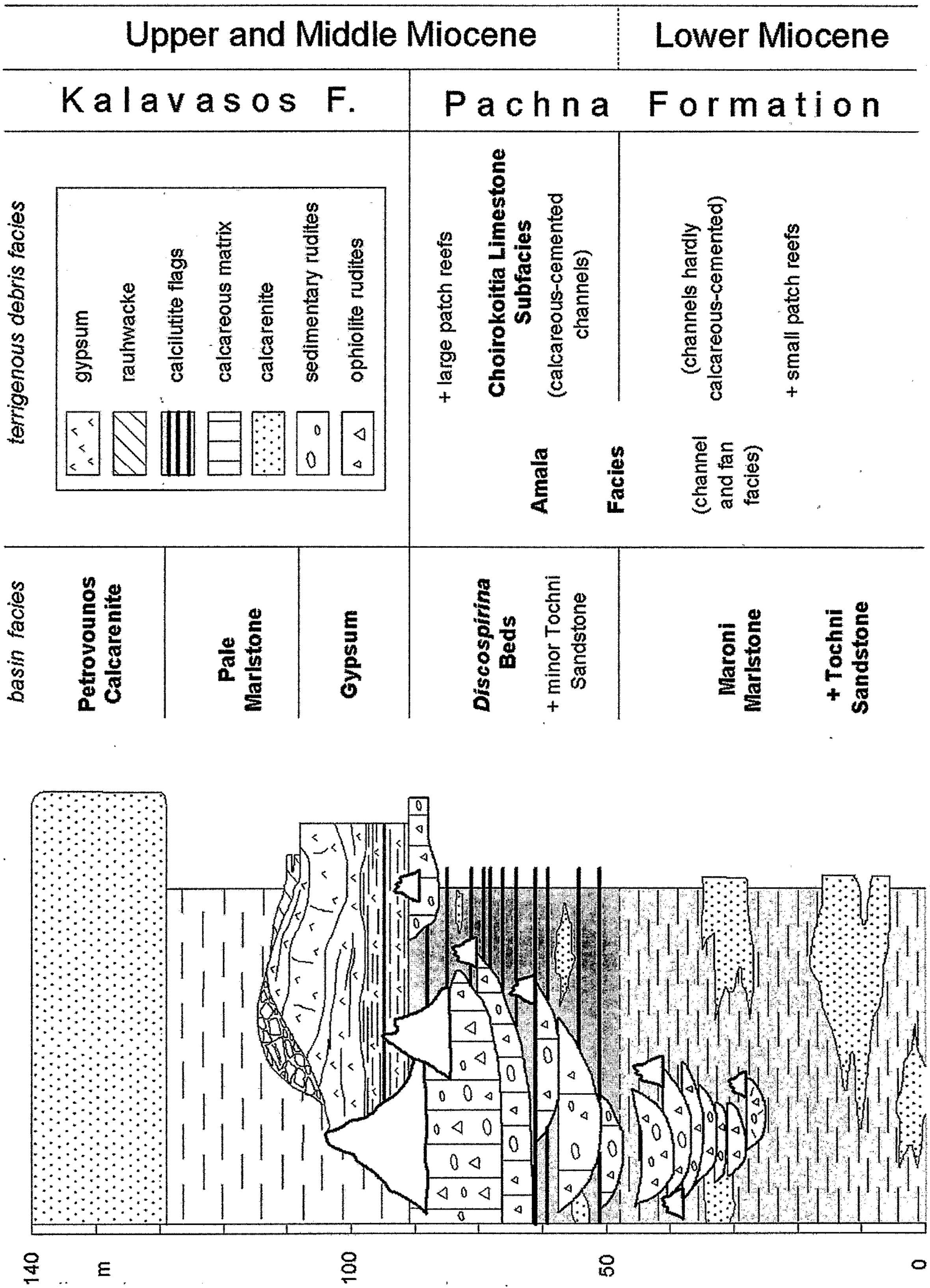

Figure 5. Schematical sketch of the configuration of the upper Pachna and Kalavasos deposits in the western Amala Mountains

limestone. A better clue for a terrestrial hinterland is given by the large and numerous boulders and cobbles. It seems difficult to explain their origin only as being underwater, especially because of the fact that they occur within channels that run preferably radially off the hinterland and cross the basin margin linearly. Proof for a terrestrial hinterland in Pachna time in general is given by vegetational remnants preserved within the neighbouring Pachna beds. Robertson (1977) records plant detritus of Lower Miocene age. Bagnall (1960) was the first to note fossilized wood from the Tochni Sandstone as well as from (presumable) Maroni Marlstone of Lower to Middle Miocene age. Recently sparse diminutive plant detritus was found by the author within the basal marlstone at the Choirokoitia site as well as in the *Discospirina* Beds of Middle to Upper Miocene age.

It is not likely that the linear debris supply is of underwater origin. In this case only earthquakes or big storms could have produced the enormous amount of coarse debris. A mere littoral environment is also unlikely. It should produce sparse debris in space and time more widely scattered over the basin margin. The concentration of the debris into distinct channels points to rivers in the hinterland supplying debris linearly to the marine basin.

Synchronety of the channel facies and the basin facies

Most channels exhibit a depositional fill grading upwards from coarse boulders at the base to finely stratified sandy-pelitic mud at the top. In case of channels 1-6, where there is enough preservation of the mud layers topping each channel, these mud layers can be correlated accurately to corresponding layers of the basin deposits outside the channels (e. g. Figs. 3, 4).

From this follows the synchron age of both the channel fills and the pelitic-arenitic deposits outside the channels.

Rate of channel erosion and uplift of the hinterland

The Choirokoitia site displays a stak of at least 10 channel fills. The maximum amount of erosion of the ten channels varies from 0.7 - 10 m, that is 3.7 m on average. From this small amount of erosion follows a very smooth uplift activity of the hinterland. In no case can a rapid and big uplift of the hinterland nor of the Choirokoitia area be deduced, as postulated by Xenophontos *et al.* (1987) and Houghton *et al.* (1990). In contrast, instead of a rapid uplift, there is a tendency for periodical, repeated debris supply from the hinterland continuing over a long period.

Activity and quiescence phases in debris supply

The channels display the picture of one sitting tightly upon the other forming a vertical channel stack. Though basal erosional features are described above in detail, they are weak enough to preserve very little of the fine clastic top of the respective underlying channel. Consequently, each channel has been preserved with its essential units: the coarse bottom lag fill, the finer top fill, but also a topping veneer of basin deposits denoting the end of the channel activity.

This and the fact that the mud layers topping each channel correlate with the basin deposits outside the channels, indicate that there is a distinct break between the single channel activities. Consequently, during the higher Pachna Formation the southeastern Cyprus shallow water basin is characterized by an alternation of phases of activity and quiescence in debris supply from the island.

Duration of the channel activity periods and the interchannel periods

The repeated occurrence of channel fills needs a constantly existing hinterland, a high-rising relief which provides the basin periodically with sedimentary supply.

On the supposition that the hinterland had nearly the same elevation all the time and the shallow basin would have been without notable marine sedimentation, the linear debris currents would have spread their load laterally depositing channel fill beside channel fill. Actually, as the channel fills are stacked in the course between the single channel activities, there had to be considerable basin sedimentation ranging up to a thickness comparable to the rate of the channel erosion. Such a basin sedimentation process requires appreciable time, time enough to supply the basin with depositional mud high enough that the erosion of the next channel could not remove essential parts of the previous one. Thus, from the fact of the stacking of the channel fills it follows that the channel-cut-and-fill activity together with the periods of quiescence in between extended over a very long period from Lower to Upper Miocene (about 10 million years from Burdigalian through Tortonian L; Eaton and Robertson, 1993).

Moreover, it follows that periods of quiescence between channel activities lasted much longer than periods of channel activity.

Constancy of the channel position

It is extremely significant that the ten channels show a constancy of their positions. Fig. 3 displays together with the description of the site a certain shifting of the right bank of each channel to the west. (The right bank in flow direction is that on the left side in the figure.) It cannot be determined from the Choirokoitia Site whether the whole river bed is shifting somewhat towards the west or the channel is widening on both banks. In any case the movements of the stream are minimal and insignificant in relation to the position of the channels which is virtually constant during a very long geological time.

The consequence of this phenomenon is a constantly existing topography of the basin margin and the coastal configuration as well as in the hinterland that is producing the debris rhythmically. Such a relief would likely be an early river valley of Cyprus. The axis of the channel system can be traced from Choirokoitia to the western Amala Mountains. By tracing back to the hinterland it points to a catchment area in the eastern Troodos Mountains around or east of Mount Kionia.

The reason for the occasional debris supply may be phases of local uplift and/or phases of earthquakes triggering mud flows and landslides. In no case can the channel periods be regarded as repeated emersion of land from the sea. In such a case the river system would not have been able to maintain the constant position which it has done.

The Choirokoitia Site in the view of the previous studies

The stratigraphical assignment by Houghton *et al.* (1990) is based on microfossils. The sampling of the material was carried out by C. Xenophontos (oral communication April 1992) on the left side of the channel system in a vertical line from the green-grey marl facies (normal facies) outside the channel system (samples KH 1-2A) upwards through the channel fill (sample KH 3), which is channel 7 after the channel listing of this paper. Thus, the grey-green marl facies together with the channel system are considered by the authors to belong to a Late Pliocene gully fill deeply cut into the Miocene Pachna beds.

These Pachna beds together with the *Discospirina* band are exposed along the street around Choirokoitia, 450 m southwest of the Choirokoitia Site cliff (cf. Xenophontos *et al.* 1987), resp. 200 m SSW of Agios Iakovos church.

In addition to these statements, Bagnall (1960) records that in his section the *Discospirina* beds occur as reworked in the uppermost pebble conglomerate below his "Koronia reef limestone".

All in all, the authors cited envisage three sedimentary systems: the Middle/Upper Miocene Pachna beds with the *Discospirina* band, therein incised a Late Pliocene channel with a grey-green marlstone fill, therein again incised a channel with conglomeratic fill of Late Pliocene age.

The Choirokoitia Site seen from its geological frame

What is lacking in the Choirokoitia area are the visible links between the three sedimentary systems of the authors cited above, especially the visible field-stratigraphical configuration connecting these three sedimentary systems. The stratigraphical configuration, however, is easily visible somewhat to the south in the western Amala Mountains and in the Maroni valley downstream from the Choirokoitia Site. A schematic sketch of the stratigraphy of this area is given in Fig. 5. The figure shows that all three sedimentary systems, depicted by the authors cited, are embraced in one single stratigraphical system without larger channel incisions. Furthermore the existing flat channels are well connected to lateral basin deposits. All three sedimentary systems belong to the Pachna Formation which exhibits both a normal facies, i. e. the marly-calcareous basin facies (Maroni Marlstone and *Discospirina* Beds), and a terrigenously influenced debris facies with strings of coarse-clastic debris (Amala Facies with Choirokoitia Limestone Subfacies). The *Discospirina* Beds are proof for to the Middle to Upper Miocene age.

Eaton and Robertson (1993) display a model of facies associations for the Pachna sedimentary basin. Concerning the larger Choirokoitia area there occurs a proximal gullied-slope association with coarse-grained channel fills passing laterally into hemipelagic fine-grained chalks and silty marlstones. Basinwards is a more distal basin-margin association consisting mainly of calcarenites interbedded with chalks and marls. The model given in Fig. 5 differs in so far as the calcarenite (Tochni Sandstone) covers the proximal as well as the distal milieu of a shallow basin. The Amala Facies forms proximally channels and spreads distally as aprons over the basin environment.

The Choirokoitia Site belongs in any case to the proximal facies association. The Maroni Marlstone as a member of the normal facies is the lowermost stratigraphical unit in the Choirokoitia Site. It exhibits a well developed lateral transition to the coarse-detritical Amala Facies: channels 1 to 6. The incision of the six channels is not deeper than 5 m.

Generally, in the Amala Mountains area the Maroni marlstone is followed upwards by the *Discospirina* Beds. This link cannot be seen in the Choirokoitia Site but is exposed on the northwestern side of Choirokoitia along the concrete road leading to the northwestern bastion of the village plateau (UTM grid 304.75/ 510.4; see D/M in Fig. 2). Moreover this boundary is easily visible in several places down the valley, which will be published elsewhere. In contrast to the Maroni marlstone the *Discospirina* Beds are more calcareous. The visible proof of this is a few limestone seams within the marls. Moreover this fact becomes evident in the coarse-detritical channel facies where there is an increase in calcareous matrix: The Amala facies, normally less carbonaceously cemented, changes upwards into the increased carbonaceously cemented Choirokoitia limestone subfacies.

Again, this lateral transition between the *Discospirina* Beds and the Choirokoitia limestone is not visible in the Choirokoitia Site but is easily visible southwards in the Amala Mountains. There the Choirokoitia limestone occurs within, above and below the *Discospirina* limestone beds. In places the Choirokoitia limestone cuts channel-like and unconformably some of the *Discospirina* limestone seams. This explains the fact described by Bagnall that pebbles of *Discospirina* beds occur reworked within the channel facies. Maybe the above described limestone bed topping channel 8 forms an erosional relic of one of the numerous *Discospirina* limestone beds.

The last proof that all three sedimentary units mentioned by the foregoing authors are of Pachna age is given by the fact that in the whole Amala Mountain area all these units are overlain by the gypsum of the Messinian Kalavasos Formation. This gypsum covering the Pachna Formation is also capping the village plateau of Choirokoitia. It occurs in the southern as well as in the northern part of the village plateau and covers there the capping rock of the Choirokoitia site.

The Choirokoitia Limestone Subfacies

The Choirokoitia site together with its closer surroundings serves as the type locality for the Choirokoitia limestone subfacies. Thus this term needs some explanation.

As Fig. 5 shows in the Amala Mountain area the normal basin facies is represented by the Maroni marlstone and the *Discospirina* beds. Compared with the Maroni marlstone the *Discospirina* beds display an increase of carbonate precipitation. From the early Cyprus island in the north this shallow basin is supplied by periodical deposition of terrigenous coarse debris, the Amala facies. Its submarine debris strings can be followed along the recent Maroni valley north and south of Choirokoitia. From there they spread like an apron towards the south, there forming the main corpus of the Amala Mountains. In its lower part the Amala facies is less carbonaceously cemented, laterally corresponding to the Maroni marlstone. In its higher part, however, the Amala facies is highly cemented, laterally corresponding to the *Discospirina* beds. Yet, the base of the Choirokoitia limestone need not correspond sharply with the base of the *Discospirina* beds. The increase of carbonate within the channel facies culminates on top in pure recrystallized limestones and eventually on top in an increase of patch reef formation, although the phenomenon of patch reef formation is a character of the whole Amala facies. This carbonate augmentation within the Amala facies of the higher Pachna Formation is what I call Choirokoitia limestone subfacies.

In the Choirokoitia Site the lower eight channel fills of the channel stack are poor in carbonate cementation and range up to a maximum thickness of 6.9 m (channel 8). Amongst them only channel 5 has an augmented carbonate cementation. The upper two channel fills (channel 9 and 10) as well as the capping rock are richer in carbonaceous cementation, thus representing the Choirokoitia limestone subfacies. They exhibit a maximum channel thickness of 10 m (channel 9) and a total thickness of barely 19 m (together with the intercalated small soft beds). The upper contact of the Choirokoitia limestone subfacies is not exposed in the Choirokoitia site. But it is well preserved to the west in the area of the Choirokoitia village where the Choirokoitia limestone is covered by gypsum of the Messinian Kalavasos Formation. To the east, on the opposite side of the valley below the Katsella hill, the Choirokoitia limestone accompanied by patch reefs is covered by the Pale marlstone of Messinian age. The roof of the mesa-like Katsella hill is formed by Petrovounos calcarenite.

In the Choirokoitia site and its surroundings this Choirokoitia limestone subfacies is excellently exposed with its coarse conglomeratic base, its top formed by thick recrystallized limestone (the capping rock) and sporadicly sprinkled patch reefs as well as its upper contact to overlying gypsum and the Pale marlstone of Messinian age. Thus, this place reveals sufficient evidence about the facies and origin of the rocks as described above. Therefore, the outcrops along the Maroni valley bluffs around Choirokoitia are suitable to serve as the *locus typicus* for this carbonate cemented channel facies.

Conclusions

There are some arguments that the postulated Pliocene deep channel cannot exist: The most striking argument is the fact, that the lithological sequence of the Choirokoitia Site occurs likewise around Choirokoitia as well as in the Amala Mountains in all its finest details. These are the stacked channel fills with their tendency to increase in carbonate cementation towards the top, the distinct lithology of the individual channel fills and the manifold facies configuration between the channel fills and the lateral basin deposits. This sequence is proved to be of Miocene age in the Amala Mountains as well as in the Choirokoitia area close to the Choirokoitia site. A duplicity of such an immense cumulation of features in the Miocene as well as in the Pliocene can be excluded. Another argument against this postulated channel is that there is no space left for the course of such a channel within the area of undoubted lithologies of Miocene age. These are predominately the patch reefs as part of the Choirokoitia Limestone and the Kalavasos gypsum. Thus, the entire Choirokoitia site is no doubt part of the Pachna Formation.

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