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Seleucia Pieria: an ancient harbour submitted to two successive uplifts

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Historical sources ascribe the foundation of Seleucia (Seleukeia) Pieria to Seleucos I Nikator, shortly before the foundation of Antioch in the late 4th century BC. The Seleucia Pieria site seems however to have been inhabited earlier, perhaps from around 700 BC, possibly by a Greek population under an Assyrian ruler. The city became of considerable military importance during the wars between the Ptolemies and the Seleucids; it was occupied by the Romans in the 1st century BC, but had practically disappeared in the 6th century AD.

Geomorphological surveys in the area have revealed the existence of elevated marine notches and rims bioconstructed by vermetids, oysters and calcareous algae, which occasionally erode or intersect the archaeological sites, showing that two rapid land uplift movements, probably of seismic origin, took place during the late Holocene. The first movement, which occurred about 2500 ± 100 years BP, was the strongest one and caused a local vertical displacement of about 1·7 m, which may have severely affected the earlier Greek settlement. Though several earthquakes are reported to have occurred in the area during the following ten centuries, none of them seem to have been strong enough to cause significant vertical displacements. The second movement occurred around 1400 years BP, probably in May 526 AD, when a great earthquake followed by tsunami waves is known to have caused devastating damage in Antioch and Seleucia. According to geomorphological data supported by several radiocarbon dates, the earthquake was accompanied by a 0·7 to 0·8 m upheaval. This seismotectonic event also caused a rapid silting of the Seleucia Pieria closed harbour basin and entrances, thus preventing its further use.

Introduction

The occurrence of submerged archaeological remains is quite usual along Mediterranean coasts (e.g. Flemming, 1969, 1978; Schmiedt, 1972; Blackman, 1973; Flemming *et al.*, 1973; Pirazzoli, 1976; Groupe Nivmer, 1979–80; Raban, 1988). Much less frequent is evidence of uplift movements having affected archaeological sites, because an uplifted site on dry land is generally hard to distinguish from a site which was constructed at a higher elevation or further inland. In certain cases, however, the occurrence of elevated marine marks on the remains or elevation inconsistencies in artefacts which had clearly been intended for use close to sea-level may reveal that a change in the relative sea-level did happen. In other cases an uplift movement may be suggested by nearby geomorphological or bioconstructed features (elevated notches, benches, beachrocks, beach deposits, marine incrustations, *Lithophaga* holes, etc.), which may sometimes provide a way to obtain radiometric estimations of the emersion date. In this paper, after some notes on the Quaternary evolution of the Orontes Delta region and a brief summary of historical information on the Seleucia Pieria harbour, new recently published geomorphological, sea-level and radiometric data (Pirazzoli *et al.*, 1991) are used to explain the tectonic and environmental changes which had an influence on the harbour history and contributed to its rapid wane and disappearance in the 6th century AD, which was faster and more complete than the decline of Antioch.

Quarternary evolution

On the backslope of the present Orontes Delta plain, several outcrops of marine sediments (sands and pebbles) are found up to 150 m in elevation (Fig. 1). There are abundant fossils in these sediments, some of which were collected by Erol (1963) and determined by Nuttall (1961). In

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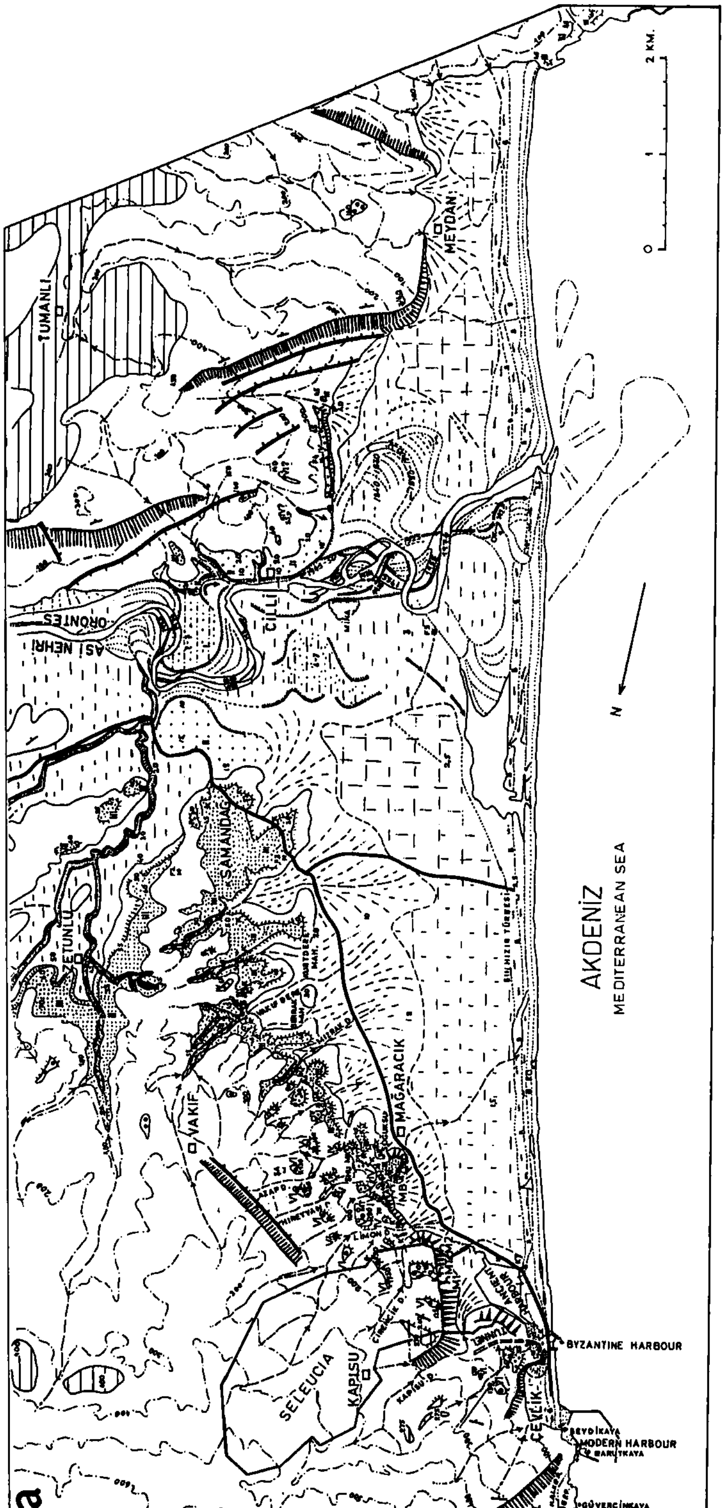
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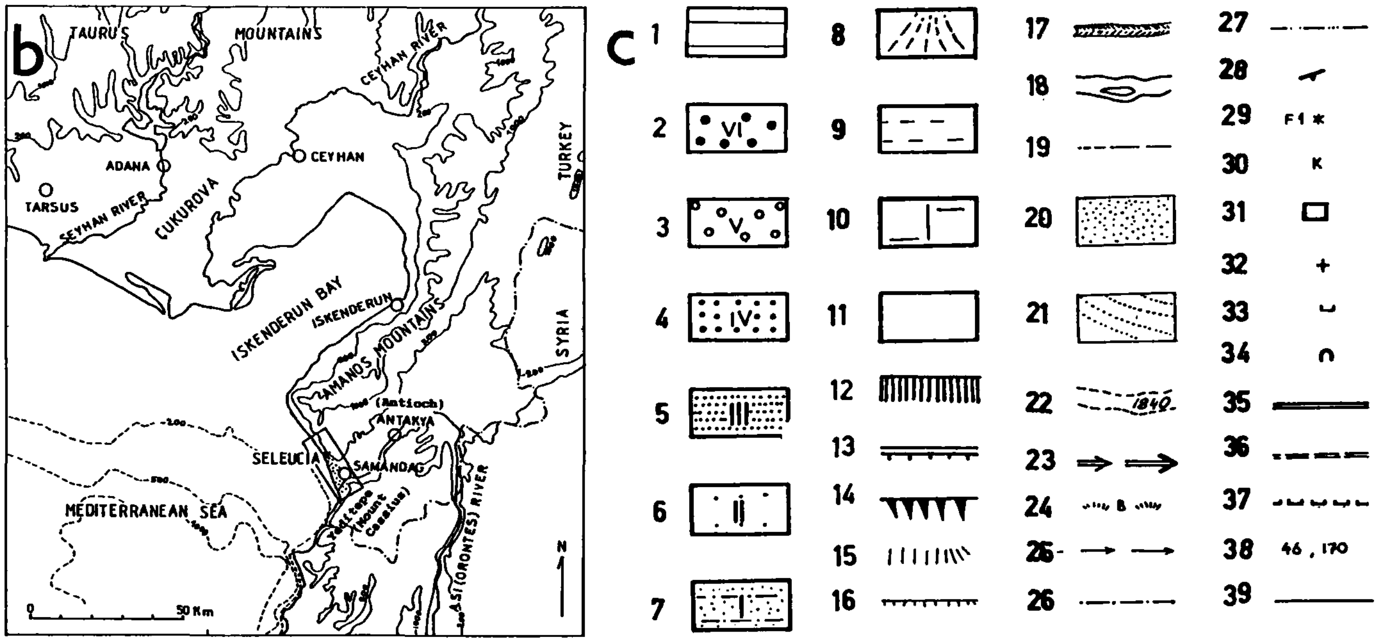

Figure 1. (a) Geomorphological map of the delta of the Orontes (Asi) River (from Erol, 1963, adapted). (b) Location map of Seleucia. (c) Legend to map (a). *Flat topographic surfaces:* 1, High level surfaces; 2, Highest terrace (VI); 3, Terrace V; 4, Terrace IV; 5, Terrace III; 6, Terrace II; 7, Terrace I; 8, Coalescent alluvial fans; 9, Valley floors; 10, Filled lagoon in the delta. *Slopes and escarpments:* 11, Various slopes; 12, Cliffs with very steep beds of limestone; 13, Slopes probably related to fault lines; 14, Limestone slopes shaped by sea waves during the Pleistocene; 15, Old slopes shaped on the surface of the 5–8 m terraces; 16, Embankment bordering alluvial beds and terraces; 17, Recent gullies, 3–5 m deep, cutting the valley floor. *Fluvial shapes:* 18, stream channel of the Orontes (Asi) River; 19, Small rivers and streams; 20, Accumulation of sand in the river bed; 21, Sandy strips showing evidence of older river channels; 22, Old channels abandoned by the Orontes River (year indicates the period when the River used to flow in that channel); 23, Evidence of a previous course of the Orontes River. *Other landscape features:* 24, Old bar of sand containing pumice (B), with seawards the barrier beach and the today's sandy beach ridges; 25, Overwash channel; 26, Sand bar; 27, Geomorphologically-significant boundaries of geologic outcrops; 28, Dips and orientation of beds; 29, locations of fossil finds; 30, Places where marine sand has been observed in association with Pleistocene marine terraces; 31, Village; 32, Minor sites; 33, Graveyard or holy sepulchre; 34, Cave; 35, Road; 36, Geriz, the northern canal of the ancient harbour of Seleucia; 37, Wall ruins; 38, altitude (m); 39, Today's coastline and other geomorphological boundaries.

this area there are also several elevated marine abrasional platforms and notches (Erol, 1963; Pirazzoli *et al.*, 1991). As it seems unlikely that the sea-level has been higher than at present by more than a few metres during the past 2·5 million years (Shackleton, 1987), these elevated features show that a long-term uplift trend is occurring.

The lower coastlines, between 35 and 8 m above the present sea-level, look like stepped, elevated, deltaic sedimentary surfaces, suggesting that the Orontes River has built here intermittent delta formations since at least the late mid-Pleistocene, and has been affected by contemporaneous tectonic movements in Turkey (Erol, in prep.), which occurred as intermittent uplifts in this area. The recent deltaic plain of the Orontes (Asi) River below +8 m developed from the end of the Holocene transgression. Erol (1963) deduced from the occurrence of bioerosional marine notches, reaching up to +2·5 m, that when the relative sea-level was about 2·5 m higher than at present, sea water reached as far as the foot of the rocky cliff behind the present plain and that later, the coastline prograded as the sedimentary deltaic plain grew and sea-level lowered.

Levalloiso-Mousterain artefacts, found by Senyürek and Bostanci (1956, 1958) in several raised sea caves cut into the steep rocky limestone cliff about 100 m high behind the city harbour, give evidence of prehistoric settlements in the area. In the lowest caves near the base of the cliff some pottery and other relics were found, suggesting that ancient Greeks, probably sailors, used the caves as shelters, behind the coastline of a deltaic lagoon which existed at that time at the mouth of a mountain torrent today called Kapisu.

Historical data

According to the earliest historical records mentioned by Pauly-Wissova (1921), a Greek settlement seems to have been established on the Seleucia site under Assyrian rule at about 700 BC. A group of buildings existed on the hill slopes before the foundation of Seleucia according to Malalas[1], whereas an ancient town ('Paleopolis') is mentioned by Pausanias (Fragm. hist. graec., IV: 468).

Seleucia Pieria was founded in the last years of the 4th century BC by Seleucos I Nikator and

Figure 2. The tunnel exit about half-way between **n** and **m** (Fig. 5). The small arch in the foreground has been dated AD 149 by Chapot (1907) from a nearby Latin inscription.

became the port of Antioch. Captured by Ptolemy Euergetes and taken again by Antiochus III, the town of Seleucia appears to have been of considerable size, with a population of 30,000 in the year 219 BC. A strong breakwater was built at the seaside of the lagoon and the exit of the harbour opened directly to relatively deep waters.

Seleucia fell into Roman hands in 64 BC. At the beginning of the Christian era, the sands brought by offshore currents from the south had started to fill the harbour entrance, and the Kapisu torrent was bringing a lot of alluvium and pebbles from the mountain, causing sedimentation in the habour basin. To prevent this alluviation, a tunnel more than 1 km long was constructed in order to divert the Kapisu torrent and its sediments towards the north, outside the harbour, which was probably the naval basis of the Syrian fleet of the Romans (the *classis Syriaca*, which became in the 4th century, *classis Seleucena*) (Van Berchem, 1985). This work started during Vespasianic times (AD 69–79) and continued for many years (Fig. 2). Later, the

Figure 3. The present day conditions of the channel mouth (Ω in Fig. 5), looking southwards. Arrows indicate remnants of breakwaters.

southern entrance was closed by a wall and a new channel about 500 m long was cut towards the north during the first half of the 4th century AD, with the aim of using the mouth of this second entrance of the inner harbour as an outer harbour (Fig. 3). Chesney (1839) even thinks that there were canal locks in it, making it possible to dry up the water in the inner harbour and remove the mud from the bottom. Indeed, Erol (1963) observed outside the breakwater the occurrence of thick sediments containing many sherds and brackish-water *Cardium* shells, which in 1988 were being removed for road construction.

In spite of various efforts to keep the harbour active, Seleucia Pieria was gradually losing its importance. Lastly, in AD 526, the city was ruined by a great earthquake[2]; many people were killed and the harbour was invaded by tsunami waves. Another great earthquake followed in AD 528[3], destroying the buildings which had resisted the previous shocks, as well as those which had just been reconstructed (Guidoboni, 1989). After AD 596 there was no longer any record of the city and the harbour.

With the exception of limited preliminary excavations by an American team, rapidly interrupted by the war (Stillwell, 1941), the archaeology of the harbour site remains to be investigated and the only detailed description available is still that by Chapot (1907).

Late Holocene seismic vertical displacements

In a recent study, Pirazzoli *et al.* (1991) demonstrated, using geomorphological and marine biological evidence supported by 13 radiocarbon dates of marine samples (Table 1), that the Hatay coast was affected during the late Holocene by two rapid uplifts, probably of coseismic origin (i.e., accompanying great-magnitude earthquakes). The relative sea-level had already reached a position similar to the present one by 5200 years BP and seems to have remained almost stable until around 2500 ± 100 years BP, when a seismotectonic event took place uplifting the coast by about 1·2 m south of the Orontes Delta plain. North of the delta the uplift was about 1·7 m at Çevlik, and even increased 12 km northward to 2·2 m, probably owing to coastal tilting. After the uplift, the relative sea level again remained almost stable for around 1000 years. About 1400 years ago, a new seismotectonic event consistently uplifted the coastal area investigated by about 0·7 to 0·8 m. Since that time, the relative sea-level has remained similar to the present sea-level (Fig. 4). These two uplift jerks correspond with a recent tectonic contribution to the long-term uplift trend which, at least during the Middle and Late Quarternary period, affected this coastal area located near a zone where three crustal plates (Arabian, Anatolian, African) come into contact (McKenzie, 1972).

Using the calibration method for radiocarbon-dated marine samples proposed by Stuiver *et al.* (1986) and the difference in reservoir age, $\Delta R = -80 \pm 25$ suggested for the Mediterranean area by Stiros *et al.* (1991), the first Late Holocene uplift event[4] occurred with probability 0·95 (2 sigma) in the time span 1010–520 BC; it is not impossible, therefore, that it occurred after the first Greek settlement in this

Table 1. *List of dated sea-level indicators collected from* in situ *bioconstructed rims in the Hatay coastal area*

Location (Lat. N)	(Long. E)	Sample no.	Material*	Elevation† (m)	Estimated palaeo-MSL elevation (m)	Age (years BP)	Lab. no.
36°13′	35°50′	8CV8	V	+3·0	+3·0±0·2	2595±100	Pa-775
36°11′	35°52′	8CV2	V	+2·5	+2·5±0·1	4800±80	Pa-779
36°11′	35°52′	8CV3	V,O	+0·8	+0·8±0·1	2050±60	Pa-823
36°11′	35°52′	8CV4	V	+0·8	+0·8±0·1	2040±80	Pa-782
36°11′	35°52′	8CV11	V,A,O,C	+0·4	+0·8±0·1	1710±100	Pa-781
36°11′	35°52′	JL3A	V	+0·8	+0·8±0·3	2410±60	Pa-776
36°11′	35°52′	JL3B	O	+0·4	+0·8±0·3	2830±60	Pa-774
36°10′	35°52′	8CV1	V	+1·2	+0·8±0·1	2315±80	Pa-822
36°09′	35°53′	8CV10	O	+0·75	+0·8±0·1	1345±70	Pa-771
36°03′	35°56′	8KE4	V	+0·72	+0·75±0·1	2290±95	Pa-769
36°03′	35°56′	8KE5	O	+0·55	+0·75±0·1	2685±100	Pa-778
36°02′	35°55′	8KE1	A,V	+2·0	+2·0±0·1	5170±190	Pa-773
36°01′	35°54′	8KE2	A,V,O	+2·0	+2·0±0·1	2910±95	Pa-780

*V, vermetids (*Dendropoma*); O, oysters; A, calcareous algae; C, coralline algae.
†Measured above present-day counterpart.

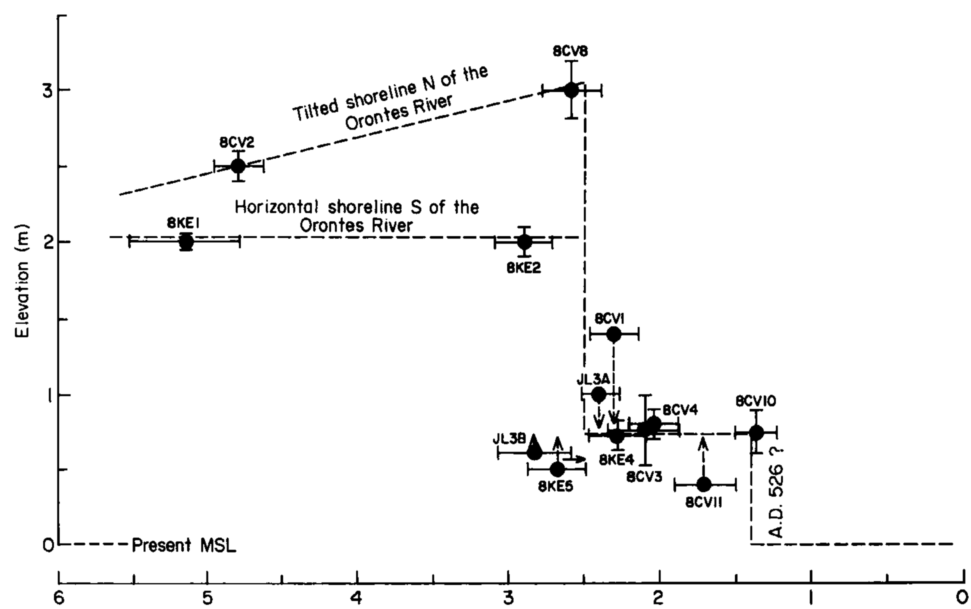

Figure 4. Relative sea-level changes (dashed lines) in the Seleucia Pieria area. Filled circles correspond to radiocarbon-dated samples of marine incrustations (vermetids, calcareous algae, oysters) closely related to sea-level and horizontal and vertical bars to uncertainty margins (after Pirazzoli *et al.*, 1991).

area and prior to the Seleucid foundation. At that time the coastline would have been at the foot of the mountain cliff and the first settlers may have used the lagoons as a landing site or even constructed the first small inland harbour (Fig. 5).

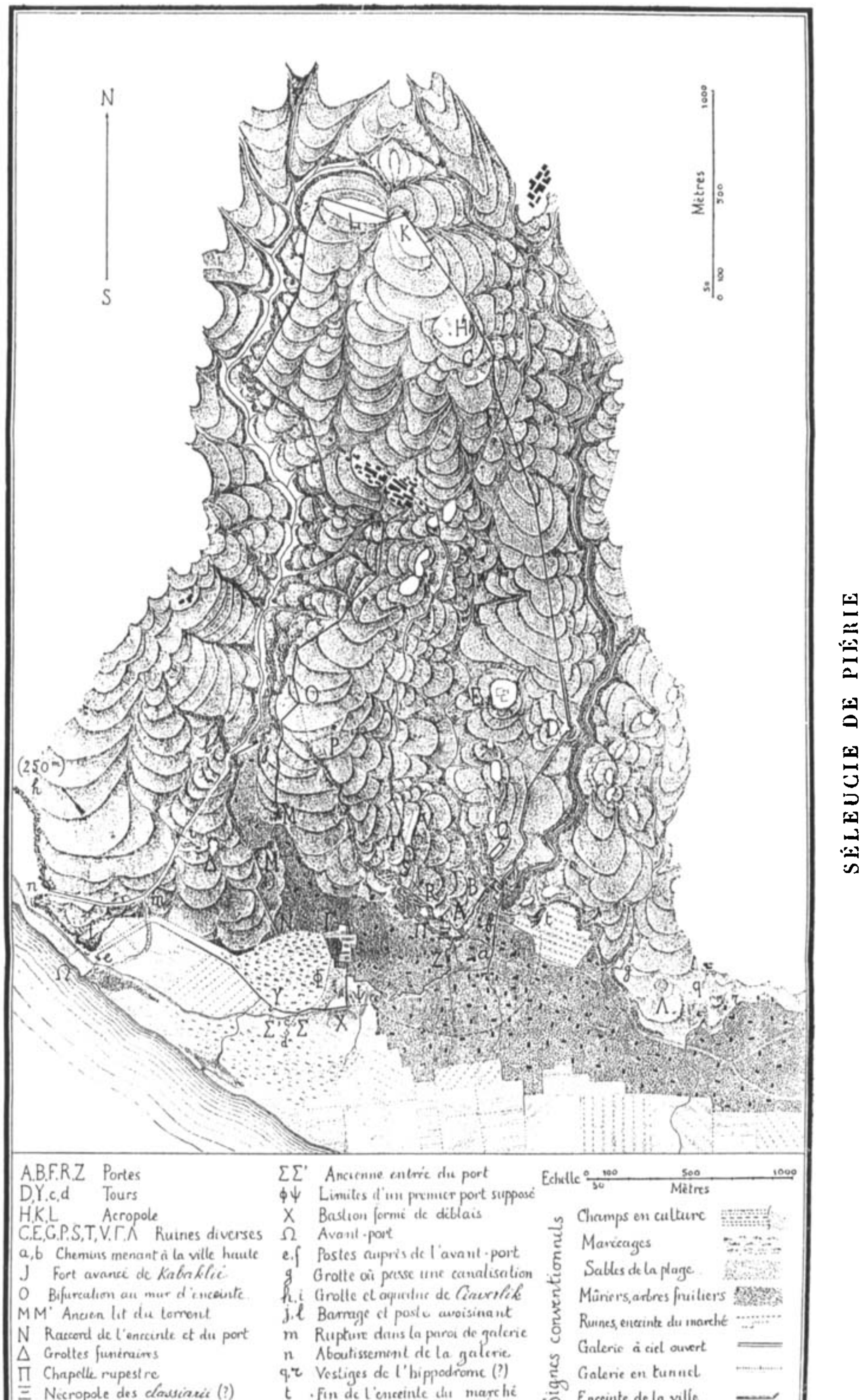

Figure 5. Map of Seleucia Pieria by Toselli, reproduced from Chapot (1907).

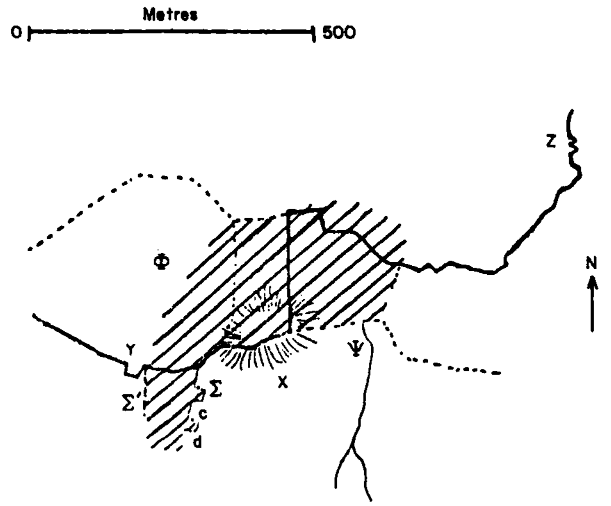

Figure 6. Variant of Fig. 5 proposed by Chapot (1907) with possible location of an early harbour. Symbols and orientation are the same as in Fig. 5.

A date of about 1400 years BP may correspond with 0·95 probability to any date of the critical period from the middle of the 4th century to the end of the 6th century AD, during which time several great earthquakes had been recorded in the eastern Mediterranean, some of them accompanied by exceptional tectonic displacements (Pirazzoli, 1986). In particular, the Levant coast was affected by most dramatic events on 20–29 May 526 and 29 November 528 AD (especially near Antioch and Seleucia Pieria) and on 9 July 551 AD (especially on the Lebanon coasts)[5].

Discussion and conclusions

Erol (1963) distinguished in the Holocene deltaic plain two geomorphological parts: (1) an older part, developed at the foot of the hills, between +3 and +8 m; this more fertile part is now occupied by vegetable gardens, fruit trees and houses (the Roman harbour of Seleucia was situated at the northern end of this plain); (2) a younger part, extending along the coastline and consisting mainly of an uplifted and dried lagoonal plain, between +1·5 and +2·5 m, covered only by swampy ground and scattered fields.

Between 5000–2500 years BP, when the relative sea level was about 2·5 m above the present situation, the older shoreline was probably at the foot of the rocky cliffs, as suggested by the map by Toselli (an Italian civil engineer living in Antioch at the beginning of this century) published by Chapot (1907) (Fig. 5), and by a variant proposed by Chapot (Fig. 6), who assumed that an ancient harbour had already been located in this area. This early port may have been used by the first Greek settlers in the area. The map of Fig. 5 shows the location of the ancient city of Seleucia, erected on a sequence of terraces built on the slopes of the mountain, and that of the harbour(s). The ancient city was defended by walls 12·5 km long and its altitude varied between slightly above sea-level and 322 m. Three torrents are well visible, two of them running out of the walls. The middle one, less important and intermittent (it springs up in the middle of the town), reaches the easternmost torrent outside the walls. The westernmost torrent (Kapisu) was deviated by a tunnel from **j** to **n**, though its present path goes from an opening **m**, made in the beginning of Moslem times, to **e**.

The location of the most ancient harbour is thought to be near Φ (see also Fig. 6). An earlier harbour channel (Σ—Σ'), unfavourably oriented in relation to prevailing winds and longshore currents, must have silted up quite rapidly, although it is not possible to say when. Later, after the construction of the 130–140 m wide

Figure 7. The southern breakwater. In the foreground, emerged oyster incrustations still in their growth position are visible (indicated by an arrow).

'Vespasian channel', a boat arriving at Ω would have found two breakwaters (Fig. 2), each about 10 m wide. The south one was formed of huge rock blocks (Fig. 7) some of which were as much as 8 m long, connected with cramps, whose traces are still marked by iron stains in some places. Possible mooring stones are also visible (Fig. 8). From **e**, an elbow channel 800 m long led into the later inner harbour (Y—Φ). Houses and other buildings existing at the beginning of this century are represented as small black rectangles on the map. Most of them are concentrated on the more fertile land area (which may have been of smaller size here in ancient times).

The uplift of 2500 ± 100 years BP must have caused a rapid progradation of the coastline, which seems also to have continued during the subsequent millenium of tectonic quiescence. During Roman times, the city of Seleucia and its harbour still developed only to the north of the older part of the deltaic plain. To protect the harbour from the negative influences of environmental changes, mainly from the northward extension of beach sedimentation, a tunnel was first excavated, as mentioned above, then a second channel was cut. Later the inner harbour was abandoned and a new smaller harbour was built on the open coastline. After the most recent 0·7 to 0·8 m uplift had occurred, attempts were made for some decades to keep the harbour partly active. However, as a consequence of the recent lowering in the relative sea-level and of accelerated silting processes, it must have become rapidly and definitely unfit for navigation.

Today, remains of the historical city of Seleucia Pieria and its harbour can be seen at the northern end of the deltaic plain. Recently, the village of Çevlik spread in the same locality and a small artifical harbour was also built there 12 years ago. The houses and other constructions for this new harbour unfortunately ruined many marks of late Holocene emergence which had been described at Seydikaya (Seydi rock) by Erol (1963). Nevertheless it remains interesting, for this site is the most convenient point for a harbour on this relatively inhospitable coast devoid of bays and shelters, where several generations of harbours were established during historical times. Indeed, the Kapisu river lagoon which had formerly been used as a landing place by ancient Greek and other early sailors was converted first into an inner harbour before Roman

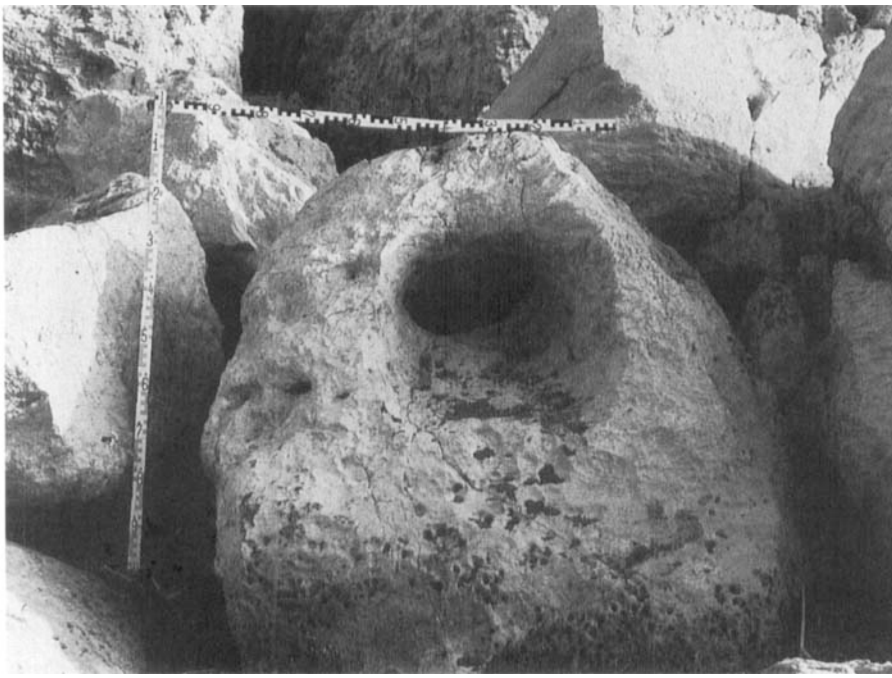

Figure 8. A mooring stone (or possibly an anchor) among fallen blocks, with many *Lithophaga* holes in its base. Though it is not certain whether this artefact is *in situ*, the upper limit of holes corresponds closely with the level of the +0·7/+0·8 m shoreline.

times, then as the natural conditions changed, into an outer harbour, which was demolished by an earthquake possibly in AD 526. Lastly, a modern harbour has been re-built on about the same site today.

Acknowledgements

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Notes

[1] 'Itaque per mare descendens, urbem conspexit exiguam, in monte sitam, a Syro, Agenoris F. olim conditam ...' (Corpus scriptorum historiae byzantinae, *Chronographia L. VIII, 0254*. Bonn, 1831, p. 199).

[2] Various historical sources mentioning this event have been quoted by Guidoboni (1989): Evagr. 4.5; Malalas 419–20; Marcell. Com. 102.19–24; Procop. bell, 2.15.6, anekd. 18.41; Theoph. 172.11–19, 172.30–173.1; Chr. Edess., Chronica Minora I.11–12; Cedren. 640–641; Glyk. 266.

[3] Malalas 442–43; Theoph. 177.22–178.7.

[4] The first Late Holocene uplift event is dated 2500 ± 100 years BP; for details on the samples used, their relation to sea-level, laboratory analyses and discussion of the results, see Pirazzoli *et al.* (1991).

[5] Anton. Plac. it. 1.39.159.7–17; Malalas 485; Theoph. 227.21. For a discussion of the historical sources of these earthquakes, see Brown, 1969; Guidoboni, 1989.

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