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Note on the Vegetation Landscapes of Sidon and Tyre during Antiquity

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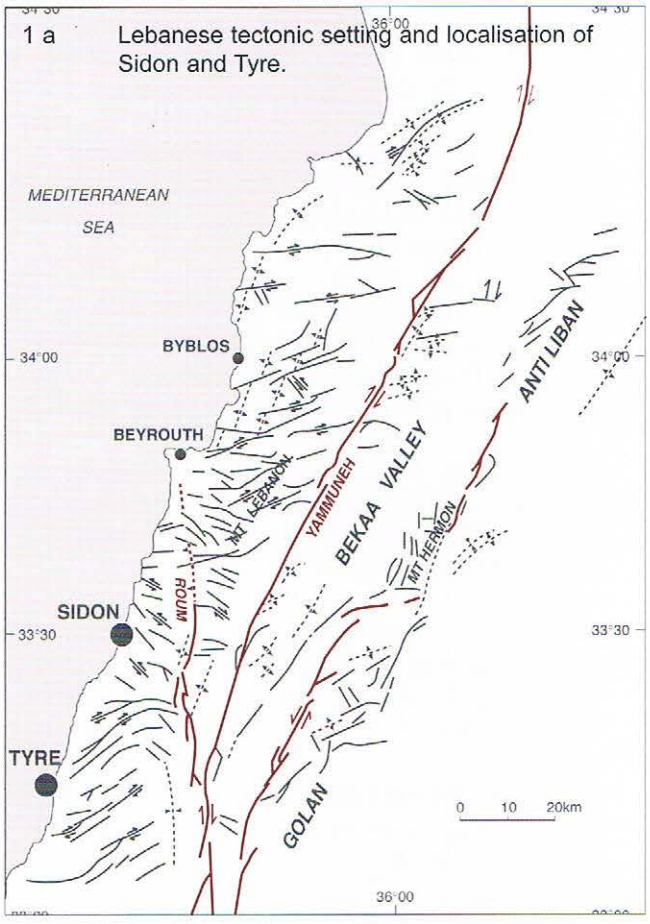
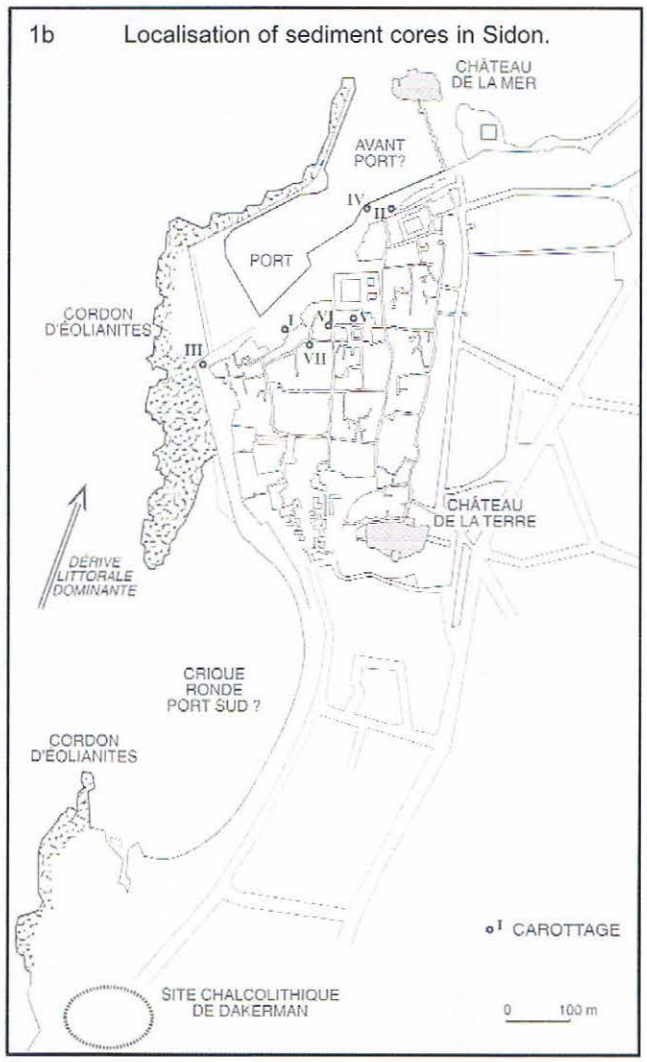
Compared to other areas of Eurasia, land-based vegetation history from the eastern Mediterranean is relatively poor. Dry climate and the frequency of limestone bedrock are not favourable to bog development and hence the preservation of pollen grains in the sedimentary record. This relative absence of anoxic basins is a clear limiting factor in many areas of the Levant and the Near East, and there have been very few serious land-based studies of Holocene vegetation change and anthropogenic impacts (Bottema and Woldring, 1990; Bottema, 1991; Yasuda *et al.*, 2000). The best regional syntheses for the vegetation history of the eastern Mediterranean over the late glacial to Holocene, are provided by Rossignol (1995, 1999) and Mudie *et al.* (2002), with data deriving from marine cores. On a longer timescale, deep lake sequences from Greece have yielded some of the most comprehensive pollen records in the world, archiving data for a series of Quaternary glacial-interglacial cycles (Tzedakis and Bennett, 1995).

The importance of palynology as a tool in Mediterranean geoarchaeology has long been recognized. Traditionally two sorts of sites have been exploited:
Firstly, to obtain a regional picture of Holocene human impacts, the use of lakes and lagoons on coastal plains (Hassan, 1986; Yasuda *et al.*, 2000; Riéra-Mora and Esteban-Amat, 1994) has been most favourable.
Secondly, the use of archaeological sites and caves is more fervently debated (Vernet, 1997; Weinstein-Evron and Chaim, 1989). Pollen grains brought to the site by humans and animals will essentially reflect the local vegetation, and preservation of grains at such sites is variable. Anthropogenically modified substrates and local perturbation are often not conducive to providing good records.
Ancient harbour sediments overcome many of these problems (Goiran and Morhange, 2003; Weinstein-Evron and Chaim, 1989):
1 they serve as excellent anoxic sediment traps, harbourworks and installations creating low energy depositional environments;
2 the quasi-continuous nature of sedimentation allows a high resolution reading of the deposits through time;
Thirdly, the fine-grained nature of the harbour sediments is favourable to the preservation of biostratigraphical tracers, including pollen, diatoms, ostracods, *foraminifera* and marine macrofauna.



1 a Lebanese tectonic setting and localisation of Sidon and Tyre.

In this short note, we present early pollen results from current ongoing geoarchaeological investigations in Sidon and Tyre, in the Levant (Morhange *et al.*, 2003; Marriner *et al.*, in press). A number of samples from fine-grained ancient harbour units



1b Localisation of sediment cores in Sidon.

have yielded pollen grains in variable states of preservation (figures 1a, 1b and 1c). Slides were prepared using standard protocols including flotation on heavy liquor. Pollen concentration was rather low, some samples being sterile, but most of the preparations provided an acceptable number of pollen grains. The abundance of charcoal and other organic residues made pollen counting difficult. Apart from some extremely corroded sporomorphs, probably reworked from older sediments (mostly at Sidon), the majority of the pollen grains appeared well preserved. Only those grains in good taphonomic condition and deemed contemporaneous with the time of deposition have been counted.

South Lebanon lies in a transition zone between steppe conditions to the east, and temperate mixed forest/Eu-Mediterranean forest to the north-west (Roberts and Wright, 1993). Detailed descriptions of its vegetation and climate are available in Chouchani (1972) and Abi-Saleh (1978). The Emberger classification (1954) qualifies the climate of the coastal zones of southern Lebanon as sub-humid Mediterranean, with warm winters. At El Qasmiyé (between Sidon and Tyre) average annual precipitation is 660mm and average annual temperature 20°C. According to the Bagnouls and Gaussen (1957) classification, this region experiences six months of drought, from May to mid-October. These parameters are perfectly compatible with the development of Mediterranean forests, but much of the coastal zone between Sidon and Tyre has been transformed into farmland. Beside littoral associations in which *Tamarix,* growing on sand dunes is the only characteristic tree, the scattered residues of natural vegetation belts are, from the lowlands to the mountains:

A. The *Ceratonia siliqua-Pistacia lentiscus* series on the costal plain, this series includes sub-associations with *Pinus halepensis* and *Pinus brutia*, and an association with *Pinus pinea* on sandstones;

B. The *Quercus calliprinos* series (lower temperatures and higher precipitation) on the lowlands to the west of mount Lebanon (*Quercus Calliprinos* is an evergreen oak);

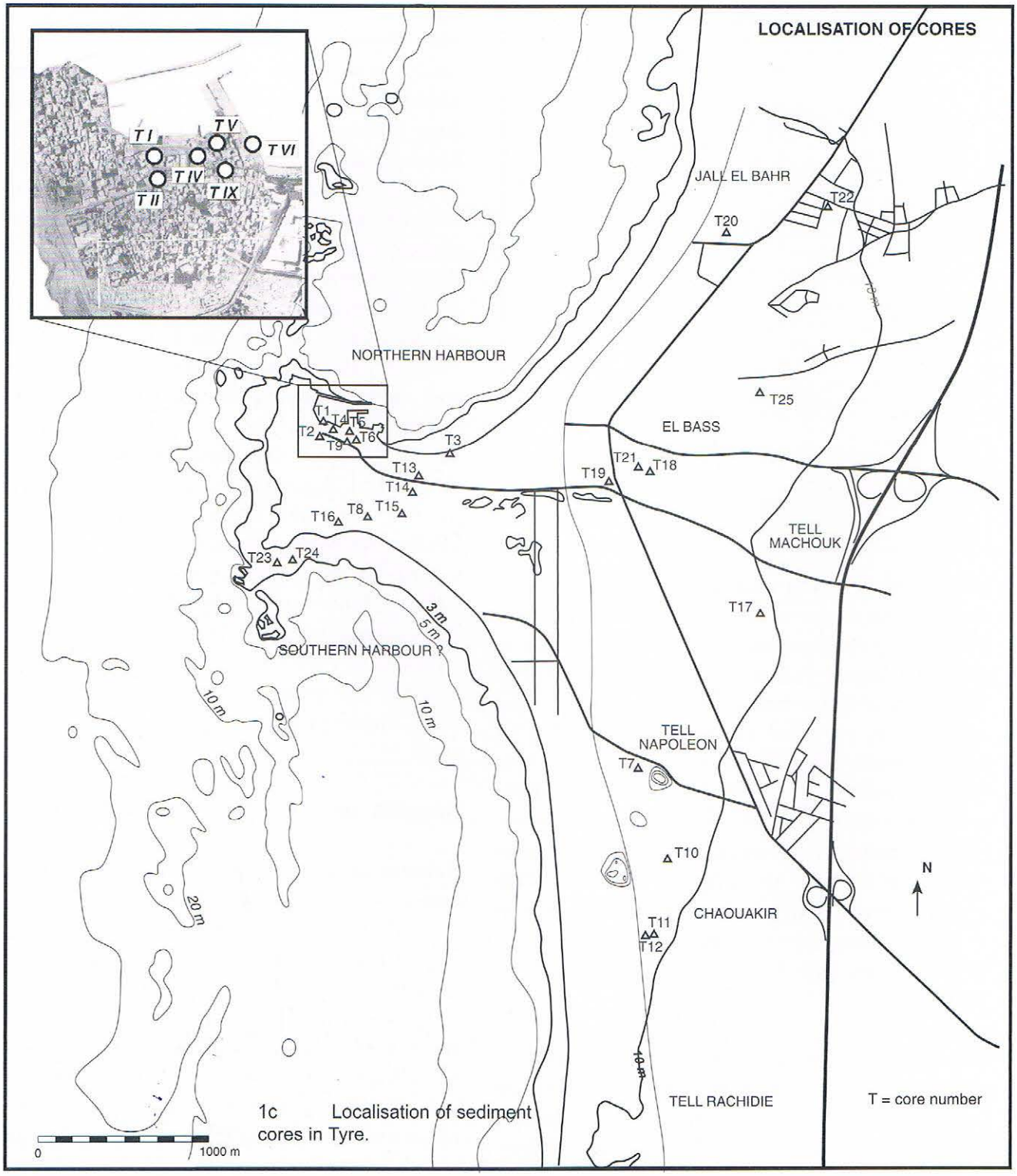
C. The *Quercus infectoria* series, between 800 and 1200 m above sea level; the degraded garrigues of this deciduous oak are frequently invaded by the widespread *Pinus brutia*. It is also important to mention the *Quercus cerris* and *Cedrus libani* belts, higher in altitude and far from our studied sites.

Results and discussion

Relative abundances of arboreal pollen (AP) and non-arboreal pollen (NAP) are depicted in diagrams 2 and 3, and give a general picture of the vegetation landscapes of this area of the Phoenician coast during antiquity.

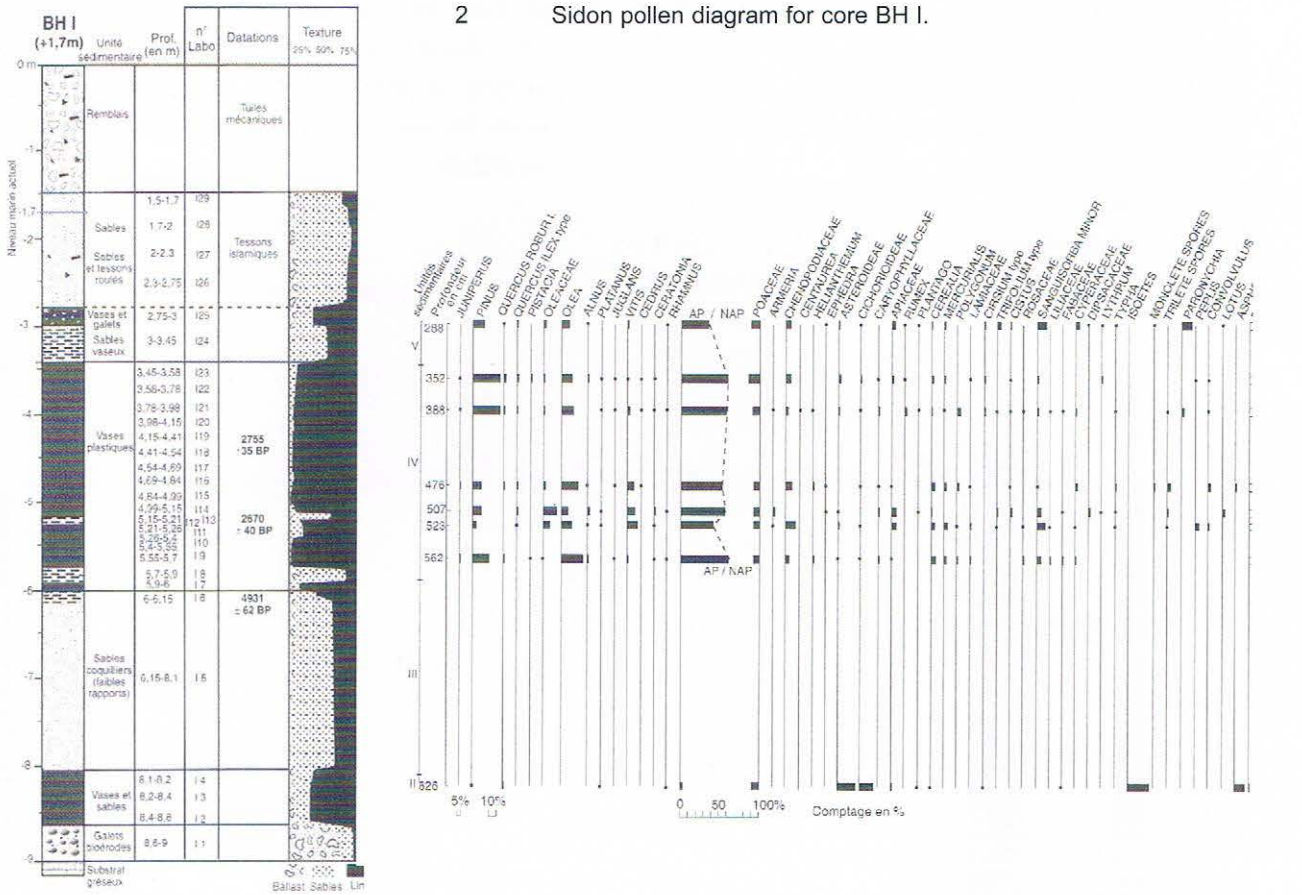
Both the diagrams for Sidon and Tyre show only moderate variations in the percentages of arboreal pollen (AP) and non-arboreal pollen (NAP). Moreover, among the dominant arboreal species

at both sites, *Olea* and *Vitis* correspond to cultivated plants. According to experiments on the modern dispersal of *Olea* pollen (Beaulieu, 1977), percentages of *Olea* exceeding 10% correspond to its cultivation in the area surrounding the ancient harbour. If these two taxa are excluded, low levels of AP suggest a garrigue-steppe vegetation dominated during the time period under consideration. Nevertheless pine pollen are more abundant at Sidon. This is in a good agreement with the distribution maps of the present day pine forests (Abi-Saleh, 1978) which show that the three local pines (*P. Halepensis, P.*



1c Localisation of sediment cores in Tyre.

Pinea and *P. Brutia)* do not grow to the south of Sidon. Their contribution to the pollen spectra corresponds to transportation from woodstands some kilometres away. The very few *Cedrus* pollen grains are concomitant with long distant transport from the mountainous areas, the closest population being about 25 km to the north-east of Sidon. Among the oak pollen, the *Quercus robur* type corresponds to *Quercus infectorria*. The *Quercus suber* type (two grains in Tyre) corresponds to *Quercus cerris*, which is very distant from the harbour and the *Quercus ilex* type to the evergreen. *Quercus calliprinos*, the latter being more abundant in proximity to Tyre. The other trees, mostly *Ceratonia* and *Pistacia*, belong to the warmest ecosystems which grow close to the coast. The *Ceratonia* pollen is a large grain which is poorly dispersed by the wind, meaning that even low percentages may reflect the occurrences of woodstands not very far from the harbours. Given this, it is still too early to attempt a detailed reconstruction of the regional landscape. Large areas occupied by degraded "garrigues" and steppes are supported by the high amount, in both cores, of *Sanguisorba minor* type which locally corresponds to the bushy *Sarcopoterium spinosum*, a characteristic of this open landscape. This pollen is also abundant in surface samples along the Carmel coast (Galili and Weinstein-Evron, 1985). Degradation of the natural vegetation is also indicated by *Cerealia*-type pollen, *Centaurea jacea*, *Artemisia* and relatively high levels of *Brassicaceae,* and *Mercurialis*. Rare pollen grains such as *Cucumis melo* and *Croton tinctoria* are also indicative of diverse cultivations. The presence of *Plantago-lanceolata* pollen could be consistent with livestock farming (Yasuda *et al.*, 2000). The landscape would have been typically garrigue in nature.



2 Sidon pollen diagram for core BH I.

The NAP herbaceous layer is diverse in its composition, with aquatic (*Nasturtium*, *Cardamine*) and littoral taxa (*Alyssum*, *Cakile*). Generally speaking, the herbaceous plants can be separated into three groups:

1. Plants linked to anthropogenic activities (*Cerealia*-type and nitrophile taxa: *Sanguisorba*, *Mercurialis, Brassicaceae*).

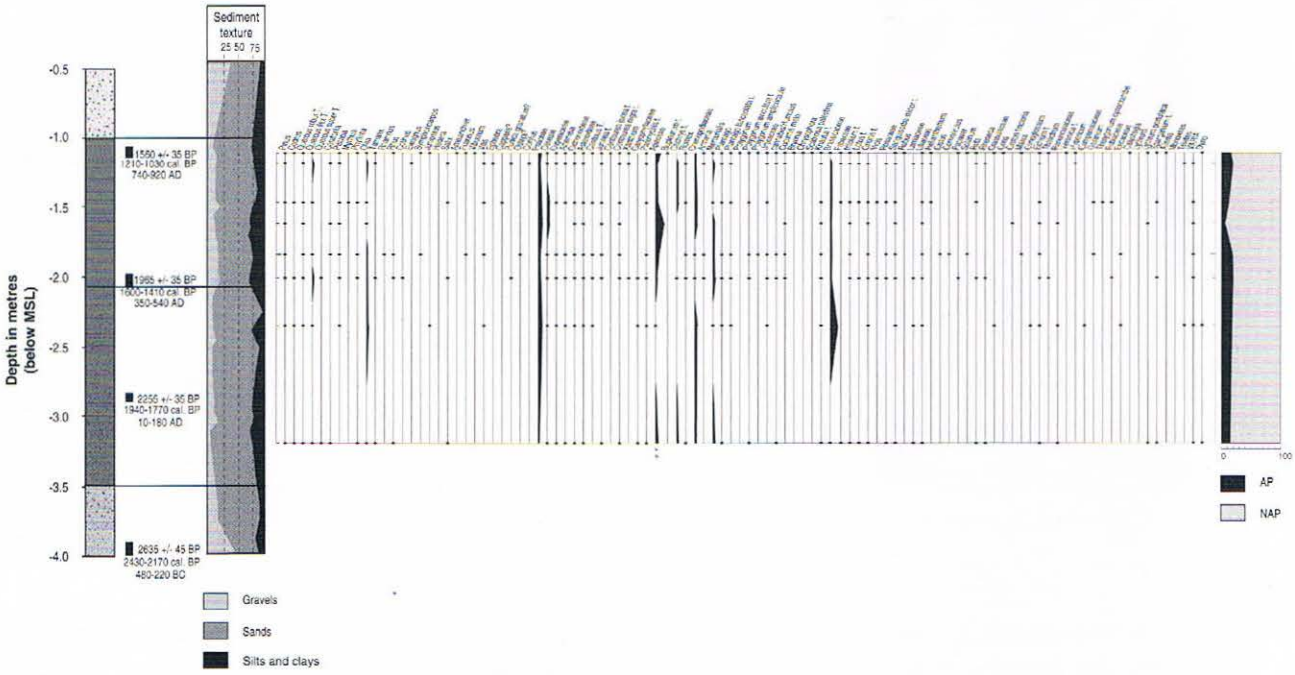
2. Steppic taxa corroborating open vegetation conditions (*Poaceae*, *Xanthium*, *Artemisia*, *Herniaria*, *Cistus*, *Helianthemum*, *Asphodelus*).

3. Taxa adapted to humid conditions (*Isoetes*, *Typha*, *Polygonum*, *Peplis*). These indicate marshy conditions in proximity to the ancient harbours of Sidon and Tyre. In Tyre, organo-lacustrine sediments cored between Tyre and Rachidieh attest to the existence of ancient marshlands in this area, during the mid to late Holocene (Marriner and Morhange, 2002). Today this area continues to support a humid vegetation type, although the marshlands (*sensu stricto)* have disappeared due to natural sediment filling and land drainage for agricultural ends.

Conclusion

The pollen data suggests that the vegetation of coastal areas in proximity to Sidon and Tyre were already heavily modified in antiquity. Unfortunately, the time period covered by our data does not enable us to constrain the beginnings of this anthropogenic modification. Broadly speaking the vegetation in antiquity would have been Mediterranean scrubland with isolated tree patches of pine and oak. In Tyre, evidence also exists for areas of marshland between Tyre and Rachidieh.

3 Tyre pollen diagram for core T I.



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