THE ROLE OF PRIMARY PRODUCTION AND THE RESPONSE OF TERRESTRIAL ENVIRONMENTS DURING THE LAST 18KYRS IN SE AEGEAN CORE NS-14: A MULTIPROXY APPROACH; PRELIMINARY RESULTS.

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ABSTRACT

A first approach on the reconstruction of the climate history of SE Aegean Sea during the last 18kyrs is recorded in the 400cm-long high sedimentation NS14 core collected in the vicinity of Nisyros Island. The results concerning the sea surface conditions during late Pleistocene-Holocene are acquainted through multi-proxy analyses of algal and organic biomarkers and comparison with pollen assemblages, defining eight paleoenvironmental units that imply their response to climatic changes.

Key Words: coccolithophorids, pollen, dinoflagellates, organic biomarkers, Aegean Sea
INTRODUCTION
The southeastern Mediterranean, a semi-enclosed basin, is ideal for reconstructions of past climatic changes due to its unique physical and geographic configuration. It is considered as one of the most oligotrophic regions in the world (Psarra et al., 2000). On the contrary, the late Pleistocene deposition of sapropels demonstrate that dramatically different conditions periodically occurred and coincided with changes in global and regional climate. In this work we present the results of an integrated study based on multi proxy approach, aiming to determine the paleoenvironmental changes during the last 18 kyrs in the SE Aegean Sea and provide further information about the mechanism of sapropel S1 deposition.

MATERIALS AND METHODS
The 400cm-long high sedimentation NS14 gravity core was collected (R/V Aegeo, HCMR) in the vicinity of Nisyros Island (long. 27° 0’ 28’’, lat. 36° 38’ 55’’) at 505m depth. Stratigraphic framework was based on radiocarbon dating. Additionally Z2 Santorini tephra layer, sapropel S1, and a turbiditic layer (225-250cm) are well represented. An interruption in S1 sapropelic sequence has been observed in-between 69-88cm of the core. The AMS $^{14}$C dating that has been performed at 78-82cm provided an age of 8280 yr BP$^{nc}$, and at 250-256 cm an age of 11770 yr BP$^{nc}$. The basal part of core NS14 represents mass gravity flow event with an AMS provided age of not more than 18240 yr BP$^{nc}$. The determination of marine biogeochemical conditions is performed with the quantitative and qualitative study of the organic biomarkers (sterols/ long chain alkenones/ alkandiols/ ketols/ isoprenoid derivatives/ $n$-alkanes/ $n$-alkanols). SST is derived from alkenone estimations. These results are combined with the determination of algal biomarkers, calcareous nannofossils and dinoflagellates as tools to investigate paleoproductivity trends. Finally, the direct correlation with pollen assemblages permits to evidence major responses of the terrestrial environment to climatic change.

RESULTS. PALEOENVIRONMENTAL INTERPRETATION
The NS-14 core shows wide variations of all the applied proxies, which imply their response to climatic changes and fluctuations of environmental parameters. According to these variations a paleoenvironmental interpretation of depositional conditions is attempted. Unit I (280-400 cm) represents the uppermost glacial turbiditic deposits in the area. Pollen and dinoflagellates are practically absent whereas calcareous nannofossils are rare. Unit II (280-250cm) is considered to represent indication of a warm period corresponding to Termination 1A event. A similar warming interval with increase in continental moisture and temperature has been detected also in Adriatic Sea by Giunta et al. (2003) between 14360 and 11670 yr BP$^{nc}$, and in western Aegean Sea by Geraga et al. (2000) at around 12800 yr BP$^{nc}$. The abundance peak of coccolithophorids (mainly Calciosolenia spp.) at 250 cm indicates a wetter period and coincides with the increase of ter-alkanes and ter-alkohols; their occurrence reveals the importance of terrestrial inputs in the study area during early deglaciation phases. Unit III (225-140 cm) is considered to indicate temperature decrease –in respect of the below and above determined Units- in a wetter period at the base of Holocene. Additionally alkenone derived SSTs reveal a decrease in surface temperature with a min at 160-170 cm, followed by a small abundance peak of calcareous nannofossil Braarudosphaera bigelowii (suggesting influx of less saline waters) and a peak of productivity, as it has been detected by the organic biomarkers brassicasterol and cholesterol. However the lowest determined temperatures are as high as 17° C, therefore they do not imply the presence of a cold event as the Younger Dryas. The Younger
Dryas is considered not to be detected during Unit III and pollen spectra are characterized by high Poaceae and Artemisia values and the presence of diverse taxa like Quercus, Cedrus, Acer and Alnus, indicating climatic conditions less severe than the YD.

Unit IV (140-120 cm SSTs derived from alkenones show a temperature increase at 130 cm. Pollen analysis reveals the expansion of Chenopodiaceae which may reflect a turn to dryer conditions or the presence of salt marshes in the source area (Rossignol-Strick, 1999).

Unit V (120-90 cm, deposition of S1a): SSTs derived from alkenone concentrations show a significant increase (up to 24°C) towards the upper part of S1a. This is also reflected in the calcareous nannofossil assemblages. The organic biomarkers loliolide and isololiolide are also increased possibly suggesting bottom water anoxia/dysoxia. Pollen assemblages include frost sensitive taxa like Pistacia and Sanguisorba, indicative of high moisture, warm summers, and according to altitude, mild to cool frost free winters.

Unit VI (90-70 cm, S1 interruption): SST falls dramatically at the base of S1 interruption. Additionally all organic PP biomarkers decrease at the same interval. Moreover ter-alkohols (terrigenus input) are increased followed by a slight increase in B. bigelowii – suggesting lower salinities. This evidence, supported by the shift towards lower SSTs, can be related to increased runoff and a change towards colder conditions.

Unit VII (70-48 cm, deposition of S1b): At the base of S1b there is a clear peak of Florisphaera profunda and reworked nannofossil taxa accompanied by peak of organic biomarkers (peak in loliolide may indicate bottom water dysoxia/anoxia) and peak in SST. B. bigelowii shows small but clear peak suggesting influx of less saline water. Towards the upper part of S1b (at 60 cm) F. profunda displays a distinct reduction whereas an abrupt increase of B. bigelowii and Gephyrocapsa oceanica is recorded, which imply severe reduction of stratification caused by great

Fig. Core NS-14: Lithology, age assessment, paleoenvironmental Units and down-core records of different proxies (total coccolithophores (n/mm2), total pollen (grains/gr), SST 0°C (Uk37), total alkenones, total primary productivity biomarkers, loliolide+isololiolide).
influx of less saline waters most probably from the Black Sea. This is accompanied by decrease in temperature and presence of relatively colder dinoflagellate species associations. Pollen analysis suggests that from 73 to 37 cm an expansion of mountainous conifer forest is observed together with a coinciding fall in Mediterranean evergreen forest. 

Unit VIII (48-0 cm): The reestablishment of the normal marine conditions is taking place during this unit. Two distinct intervals can be observed. The first corresponds to 40-30 cm; approximately 4700–5700 yr BPnc (extrapolated age), whereas a clear increase of coccolithophorid *Helicosphaera carteri* is documented associated with increase in productivity. SST is also increased followed by an increase of terrestrial input, and organic biomarkers mainly dinosterol (representing dinoflagellates). In particular peaks of *Gephyrocapsa muellerae* associated with high abundance of *Calciosolenia* spp. and minor peaks of *B. bigelowii* indicate lower salinity of surface waters. A second interval is observed just above the Santorini tephra layer (17-12 cm). During this interval SST is decreasing. However brassicasterol mainly associated with prymnesiophyceae/coccolithophorids is increased, showing higher productivity which is now due to the increase of Emiliania huxleyi as it is confirmed by the nanofossil assemblages.

CONCLUSIONS

Eight paleoenvironmmental units have been defined in core NS-14 during the last 18kyrs in SE Aegean Sea. Warm and stratified conditions during S1a are characterized by abundance of calcareous nanofossil F.profunda, suggesting the presence of DCM. The organic biomarkers loliolide and isololiolide possibly suggest bottom water dysoxia/anoxia. Pollen assemblages indicate high moisture and warm summers. SST falls dramatically at the base of S1 interruption. Towards the upper part of S1b calcareous nanofossils imply severe reduction of stratification caused by great influx of less saline waters most probably from the Black Sea. This is accompanied by decrease in temperature and presence of relatively colder dinoflagellate species associations. Pollen analysis suggests an expansion of mountainous conifer forest. At approximately 4700-5700 yr BPnc, (extrapolated age), calcareous nanofossils suggest increase in productivity. SST is also increased followed by an increase of terrestrial input, and organic biomarkers mainly produced by dinoflagellates.

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REFERENCES


