



### Abstract

Palynological analysis was carried out on five outcrop samples from the Bartonian (middle Eocene) Sannor Formation exposed at Gebel El-Goza El-Hamra in the Shabrawet area, Egypt. These samples cover about 40 m of section representing floodplain-dominated alluvial deposits comprised mainly of mottled mudstone with alternations of sandstones and conglomerates. Such sedimentary facies, especially in arid areas like Egypt, are not known for good preservation and production of fossil palynomorphs. Therefore, the present record, which is first of its kind, provides invaluable information about the depositional environment of the studied section as well as the Bartonian climate in the southeast Mediterranean. Opaque phytoclasts dominated the recorded particulate organic matter (POM) components, which contain minor amounts of degraded phytoclasts and palynomorphs. This POM association reflects (1) oxidizing depositional paleoenvironmental controls that selectively destroyed the majority of less resistant organic particles, leaving only few types of POM, and/or (2) organicpoor facies in an area characterized by patchy vegetation, similar to the present day arid/desert conditions.

Identified palynomorphs include Momipites coryloides, Triatriopollenites triangulus, Pinuspollenites, and pollen similar to those of the family Amaranthaceae. M. coryloides is derived from wind-pollinated angiosperm trees of the Engelhardia-Oromunnea-Alfaroa complex (Juglandaceae). Pinuspollenites are produced by the well-known evergreen, conifer trees of the gymnosperm family Pinaceae. In contrast, angiospermous pollen grains of T. triangulus (Myricaceae) and those of the family Amaranthaceae are usually produced by small trees, herbs, and shrubs. This pollen association represents a woodland-savanna ecosystem subject to dry subtropicaltemperate climatic conditions. The prevailing low moisture habitat probably prevented the woodland from fully developing and diversifying, providing a good opportunity for the herb/shrub community to grow and spread. This scenario, combined with the oxidizing conditions, explains the absence of embryophytic spores in all the analyzed samples.

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# Palynological Evidence for Epicontinental Dry Subtropical to Temperate **Climatic Conditions During the Eocene in the Southeast Mediterranean**

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Stratigraphic profile of the Sannor Formation showing the approximate locations of the studied samples (red arrows). Sequence stratigraphic interpretations are after Wanas et al. (2015) — Sn-1, Sn-2 and Sn-3 refer to the lower, middle, and upper units of the Sannor Formation, respectively; SB: sequence boundary; TST: transgressive systems tract; LAST: low accommodation systems tract; HAST: high accommodation systems tract.





Laminated siltstone facies

Field photographs of the different sedimentary facies observed within the Sannor Formation.



Plant roots facies



Sandstone facies



Bright field transmitted light photomicrographs showing: (a) general view of the opaque phytoclasts in the studied samples, sample no. EGH-7, 5X; (b) degraded phytoclast particle, sample no. EGH-7, 10X; (c) well preserved phytoclast particle, sample no. EGH-9, 20X; (d) dendritic-shaped phytoclast?, sample no. EGH-11, 40X; (e) dark brown phytoclast particle which has almost become opaque, sample no. EGH-8, 20X; (f) Momipites coryloides Wodehouse, 1933, sample no. EGH-7, 40X; (g) probable grain of *Momipites coryloides*, sample no. EGH-8, 40X; (h) *Triatriopollenites triangulus* Frederiksen, 1979, sample no. EGH-8, 4oX; (i) *Pinuspollenites* sp., sample EHG-8, 4oX; (j) fungal spore, sample no. EGH-7, 4oX.



Percentage distribution of the recovered sedimentary particulate organic matter (POM) from the studied samples.







#### Bedrock

Hypothetical depositional model for the studied middle unit of the Sannor Formation (Sn-2) showing the patchy distribution of the major vegetational elements (woodland-savanna) in the Shabrawet area during the middle Eocene time. The prevailing low moisture habitat probably prevented the woodland from fully developing and diversifying, providing a good opportunity for the herb/shrub community to grow and spread.

#### References

Wanas, H. A., Sallam, E., Zobaa, M. K. and Li, X. (2015): Mid-Eocene alluvial-lacustrine succession at Gebel El-Goza El-Hamra (Shabrawet area, NE Eastern Desert, Egypt): Facies analysis, sequence stratigraphy and paleoclimatic implications. Sedimentary Geology. V. 329, p. 115–129. DOI: 10.1016/j.sedge0.2015.09.006

Paper No. 44-14 Session No. 44--Booth# 364 T146. Palynology (Posters) Sunday, 1 November 2015: 9:00 AM-5:30 PM Exhibit Hall (Baltimore Convention Center) Geological Society of America Abstracts with Programs. Vol. 47, No. 7, p.142

