



High resolution sequence stratigraphic analysis of the Late Miocene Abu Madi Formation, Northern Nile Delta Basin



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Abstract Abu Madi Formation represents the Upper Miocene Messinian age in the Nile Delta basin. It consists mainly of sandstones and shale intercalations and because of its richness in hydrocarbon, it has been subdivided by the petroleum companies into Level-I, Level-II and Level-III, respectively according to the increase in the sandstone to the shale ratio.

The Miocene cycle in the northern subsurface section of the Nile Delta encompasses three main formations namely from the base; Sidi Salim formation, Qawasim Formation and Abu Madi Formation at the top. The high resolution sequence stratigraphic analysis, using gamma ray responses, has been done for the Late Miocene formation in the northern part of the Nile delta subsurface section. For this purpose, the gamma-ray logs of ten deep wells, arranged in four cross-sections trending in almost north–south direction throughout the northern region of the Nile Delta, were analyzed.

The analysis has revealed that the interpreted 4th order depositional cycles within Abu Madi Formation display great variations in both number and gamma ray responses in each investigated well, and cannot be traced laterally, even in the nearest well. These variations in the interpreted 4th order depositional sequences could be attributed to the presence of normal faults buried in the inter-area laying between the investigated wells.

This finding matches with the conclusion of that Abu Madi Formation represents a part of the Upper Miocene Nile Delta syn-rift megasequence, developed during the Upper Miocene rift phase of the Red Sea – Gulf of Suez province in Egypt. Accordingly, in the sequence stratigraphic approach, the depositional history of Abu Madi Formation was strongly overprinted by the

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tectonic controls rather than the relative sea-level changes which are assumed to be of a secondary influence.

Regarding the hydrocarbon aspects of the Abu Madi Formation, the present work recommends to direct the drilling efforts into the stratigraphic traps in the sandy intervals of the LST, TST and HST within the 4th order interpreted depositional sequences in both level-II and/or level-III.

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1. Introduction

The Nile Delta basin represents one of the largest deltaic basins in the world, covering a fan-shaped area of $\sim 250,000 \text{ Km}^2$ (Sestini, 1989). It consists of about 6.0 km thick Oligocene-Quaternary sedimentary subsurface succession, essentially of fine-grained siliciclastic facies (Hussein and Abd-Allah, 2001; Kellner et al., 2009). The Nile Delta basin is a passive margin basin resulted by the thermal subsidence subsequent to the tectonic extension separated the Afro-Arabian plate away from the Eurasian plate initiated in the Late Triassic up to the Early Cretaceous times (May, 1991; Dolson et al., 2001, 2005).

The Miocene – Pliocene sediments of the Nile Delta basin have a long history of oil and gas exploration, however the explored Late Miocene (Messinian) Abu Madi Formation

natural gas was the main target for many working companies since 1963 in both the onshore and the offshore parts (Abu El-Ella, 1990).

Rizzini et al. (1976) were the first who applied the term Abu Madi Formation for a lower Pliocene rock unit in the subsurface section in the northern part of the Nile Delta. The type section lies within Abu Madi Well-1, between the subsurface interval 3002 and 3229 m. It is mainly composed of medium to coarse grained sandstone and shale interbeds. The lower Pliocene age stated by Rizzini et al. (1976) was later re-adjusted by many workers (e.g. El-Heiny and Morsi, 1992; EGPC, 1994) to be Messinian (uppermost Miocene).

The present work adopted this re-adjusted Messinian age for the present Abu Madi Formation. Tectonically, this formation represents the final event during the evolution of the Upper Miocene syn-rift megasequence beneath the Nile Delta

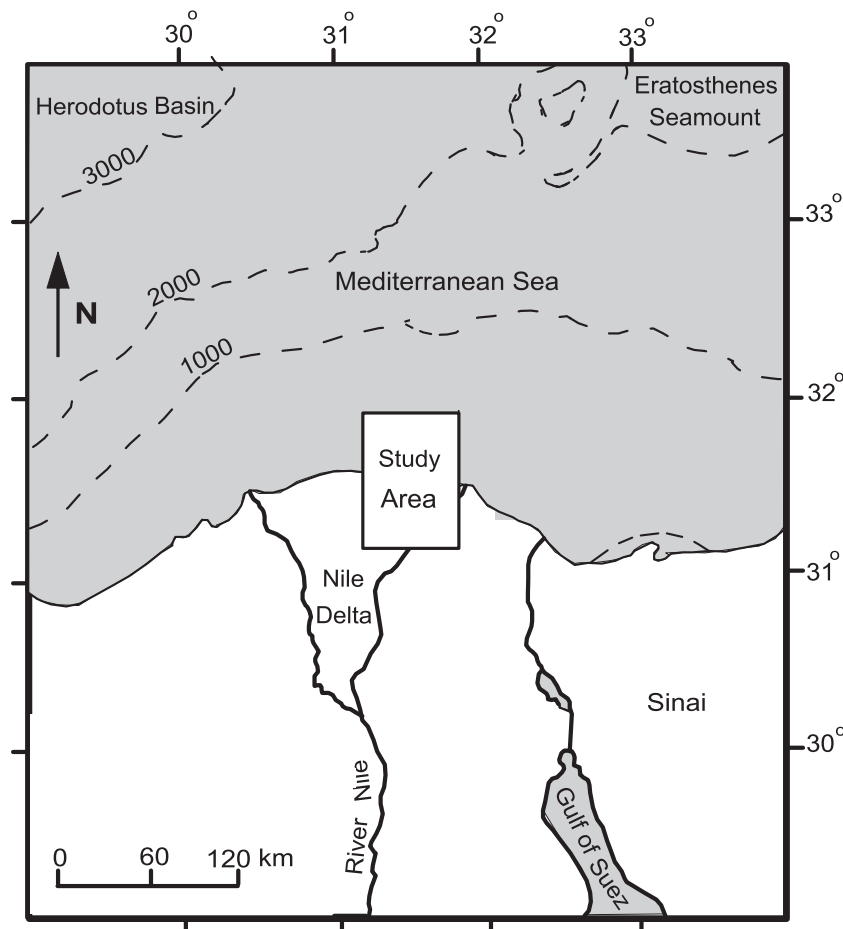


Figure 1 Study area.

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