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Seismic stratigraphy, tectonics and depositional history in the Halk el Menzel region, NE Tunisia

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Abstract

In the Halk el Menzel area, the proximal- to pelagic platform transition and related tectonic events during the Upper Cretaceous–Lower Miocene have not been taken into adequate consideration. The integrated interpretation of outcrop and subsurface data help define a seismic stratigraphic model and clarify the geodynamic evolution of the Halk el Menzel block. The sedimentary column comprises marls and limestones of the Campanian to Upper Eocene, overlain by Oligocene to Lower Miocene aged siliciclastics and carbonates.

Well to well correlations show sedimentary sequences vary considerably in lithofacies and thicknesses over short distances with remarkable gaps. The comparison of sedimentary sequences cut by borehole and seismic stratigraphic modelling as well help define ten third order depositional sequences (S1–S10). Sequences S1 through S6 (Campanian–Paleocene) are mainly characterized by oblique to sigmoid configurations with prograding sedimentary structures, whereas, sequences S7–S10 (Ypresian to Middle Miocene) are organized in shallow water deposits with marked clinoform ramp geometry. Sedimentary discontinuities developed at sequence boundaries are thought to indicate widespread fall in relative sea level. Angular unconformities record a transpressive tectonic regime that operated from the Campanian to Upper Eocene.

The geometry of sequences with reduced thicknesses, differential dipping of internal seismic reflections and associated normal faulting located westerly in the area, draw attention to a depositional sedimentary system developed on a gentle slope evolving from a tectonically driven steepening towards the Northwest.

The seismic profiles help delimit normal faulting control environments of deposition. In contrast, reef build-ups in the Eastern parts occupy paleohighs NE–SW in strike with bordering Upper Maastrichtian-Ypresian seismic facies onlapping Upper Cretaceous counterparts.

During the Middle–Upper Eocene, transpressive stress caused reactivation of faults from normal to reverse play. This has culminated in propagation folds located to the west; whereas, the eastern part of the block has suffered progressive subsidence. Transgressive carbonate depositional sequences have predominated during the Middle Miocene and have sealed pre-existing tectonic structures.
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Keywords: Proximal; Pelagic platform; Seismic stratigraphy; Campanian-Middle Miocene; Geodynamic evolution; Distally steepened ramp; Tunisia

1. Introduction

Various studies have discussed the geometry and eustatic/tectonic controls on lithofacies distribution of basins (Vail et al., 1977, 1991; Sarg, 1988; Gardiner et al., 1995; Pepe et al., 2005). In northeastern Tunisia (Fig. 1), vertical and lateral variations in lithofacies and basin fill characteristics are discussed mainly in the western Kairouan and Cap-Bon provinces (Blondel, 1991; Saadi, 1997; Rabhi, 1999; Boussiga et al., 2003). These regions expose series of geodynamic events directly related to

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eustasy and tectonism (Haller, 1983; Bédir et al., 1996; Jorry, 2004). In the Gulf of Hammamet area (Fig. 1), depositional successions outline Meso-Cenozoic rhomb-shaped blocks where faulting has cut and deformed series of thick-bedded limestones, marl and siliciclastic deposits (Ben Ferjani et al., 1990).

Previous studies in the region have dealt with the determination of lithostratigraphic units, (Burollet, 1956; Fournié, 1978; Bonnefous and Bismuth, 1982), description of sedimentary associations and tectonic framework of the Upper Cretaceous to Miocene terrains. Few studies have also undertaken the subsidence (Ellouz, 1984; Patriat et al., 2003) and geothermal (Zenati-Chilli, 2000) aspects in the gulf of Hammamet area. Vertical and lateral variations of Upper Cretaceous-Oligocene lithofacies, particularly in terms of relative sea-level changes, transitional pelagic platform into platform environments and tectonism have not been taken into consideration.

The ultimate objective of this study is to integrate reflection seismic data, well logs and outcrop geological sections to develop a seismic stratigraphic model explaining the Campanian – Langhian geological period. This procedure will be applied to check and to clarify the evolution of the Halk el Menzel area and its surrounding zones (Fig. 1).

Furthermore, the tectonic evolution and sedimentary environment of deposition may also exert control on source and reservoir-rock formation and oil maturation; thus, our study discusses the reservoir rock and petroleum potential in the Halk el Menzel area.

2. Structural setting

The study area is located in the central part of the gulf of Hammamet (Fig. 1); it covers approximately 100,000 km^2 and it is bounded by the Sahel Province in the West, the Cap Bon Peninsula in the North and the Malta escarpment in the East.

The gulf of Hammamet occupies to the west, the present margin of the Pelagian Sea, transected to the East by the Pantelleria – Malta – Linosa rifting (Boccaletti et al., 1987; Gardiner et al., 1995; Torelli et al., 1995; Catalano et al., 1996; Tavarnelli et al., 2004). Tectonic pulses mainly during the Tertiary have also resulted in magmatism that took place along with the opening of rift basins.

The gulf of Hammamet has also been subjected to faulting and regional subsidence organised in three main periods (Ellouz, 1984; Burollet, 1991; Patriat et al., 2003) of the Cretaceous, the Oligocene–Miocene and the Middle to Late Miocene – Pliocene. Triassic halokinesis which may play a prominent role in tectonic settings was described in the western Sahel area (Haller, 1983; Touati, 1985), but not reported by previous workers in the study area.

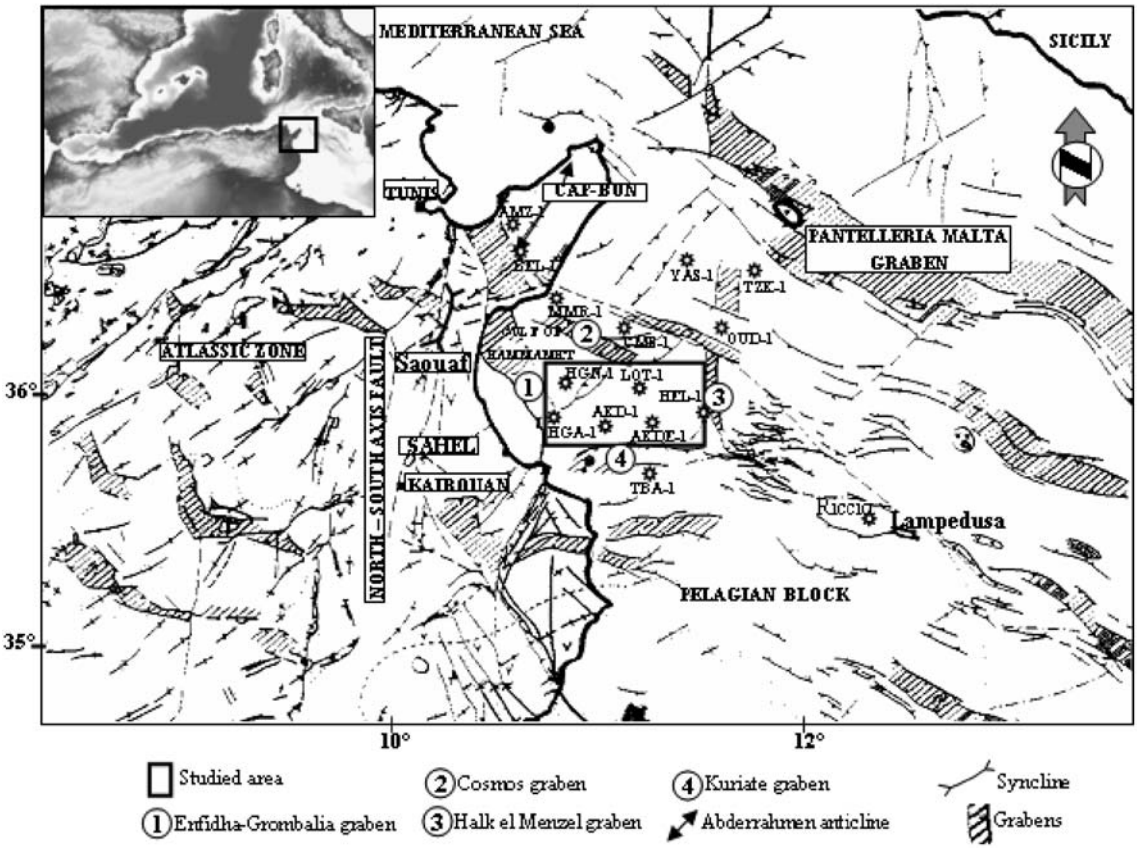

Fig. 1. Regional structural map of Gulf of Hammamet (After Burollet, 1991) modified.

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