Journal of African Earth Sciences 124 (2016) 126–138

Contents lists available at ScienceDirect

Journal of African Earth Sciences

journal homepage: www.elsevier.com/locate/jafrearsci

Carbonate platform facies development of the Turonian Wata Formation in central and eastern Sinai, Egypt

M.A. Khalifa [a, *], S. Farouk [b], A.M. Hassan [c]

[a] Geology Determent, Menoufia University, Shiben El Kom, Egypt
[b] Exploration Determent, Egyptian Petroleum Research Institute, Nasr City, 11727, Egypt
[c] Geology Determent, Sohag University, Sohag, Egypt

ARTICLE INFO

Article history:
Received 21 February 2016
Received in revised form
11 September 2016
Accepted 15 September 2016
Available online 16 September 2016

Keywords:
Carbonate platform
Wata formation
Turonian
Sinai
Egypt

ABSTRACT

The Wata carbonate platform in central and eastern Sinai show a clear pattern of evolutionary development during sedimentation. Three facies are recognized in the carbonate platform. Inner-platform in the south, inter-platform basin in the middle, and outer-platform in the northwest. Such classification was probably performed by the effect of Syrian Arc System that culminated during Turonian in Sinai. Inner-platform includes fining-upward cycles, each begins with packstone, followed by wackestone and capped by lime-mudstone or claystone or molluscan bioclastic wackestone at the base capped by sandy oolitic packstone or dolostone. The dominant faunal associations are molluscs, and echinoids. Inter-platform basin occurs north of inner-platform and extends northwest-southeast direction and comprises fining-upward cycles, each of which begins with bioclastic ostracodal packstone, calcisphere packstone, bioclastic packstone, capped by wackestone and lime-mudstone The faunal association includes, sponge spines, ostracodes, molluscan debris and calcispheres. They were deposited in shoal marine and barrier. The outer-platform occurs at Gebel Giddi and extended northwestwards. The lithofacies are entirely represented by calcisphere wackestone/packstone, with a reduced thickness of 20 m.

1. Introduction

Passive margin basins are generally considered to be the major site of carbonate platform formation (e.g. Wright and Burchette, 1999; Einsele, 1992; Bachmann and Kuss, 1998). The largest and most extensively studied Cenozoic platforms come from the Florida–Bahamas region (e.g., Schlager, 1981 & 1999; Schlager and Ginsburg, 1981; Ginsburg, 2001), the Great Barrier Reef (e.g., Davies et al., 1989) and the NW shelf of Australia (Butcher, 1990). Sedimentology and stratigraphy of these platforms are dominantly controlled by the low rate of sedimentation, the localization of siliciclastic supply from the adjacent mature continental landscape or isolation from clastic supply in offshore banks, and subsidence at relatively slow rates in the Cenozoic (~0.03–0.04 m/ky, from Schlager and Ginsburg, 1981) as well as regional or eustatic sea-level changes. During the Cenomanian-Turonian a carbonate platform which extended over large parts of northern parts of Sinai was established (Bauer et al., 2002). As a result of eustasy and local subsidence, the sea level fluctuated over the predominantly shallow water platform during the Cenomanian and Turonian leading to cyclic sedimentation of a variety of sedimentary rocks.

Ghorab (1961) assigned the name Wata Formation for the carbonate succession at Wadi Wata in western Sinai. In central and eastern Sinai, little sedimentological work has been done on the Turonian Wata Formation (e.g., Said, 1971; Barakat et al., 1986; El Azabi and Al Araby, 1996; Bachmann and Kuss, 1998; Luning et al., 1998a; 1998b; Kuss et al., 2000; Khalifa et al., 2003; El-Hariri et al., 2012). However, geological discussion on the Wata Formation was done by (Issawi et al., 1981; Cherif et al., 1989; Kora and Hamama, 1987; and Ziko et al., 1993). All the above studies were focused on local Turonian sections without focusing on the lateral and vertical facies changes during the Turonian time. The studied localities in the present work are situated at Gebel Giddi, El Mineidra El Kebira, Gebel Shiti, Gebel Gunna, Gebel Hazim and Wadi Watir in central eastern Sinai (Fig. 1). Aims of this paper are 1) to describe the facies associations of the Wata Formation, 2) to interpret the possible depositional environments of the studied facies, 3) to document the broad stratigraphical and depositional

* Corresponding author.
E-mail addresses: kh_cycle@yahoo.co.uk (M.A. Khalifa), geo.sherif@hotmail.com (S. Farouk), geoabdallah@gmail.com (A.M. Hassan).

http://dx.doi.org/10.1016/j.jafrearsci.2016.09.011
1464-343X/

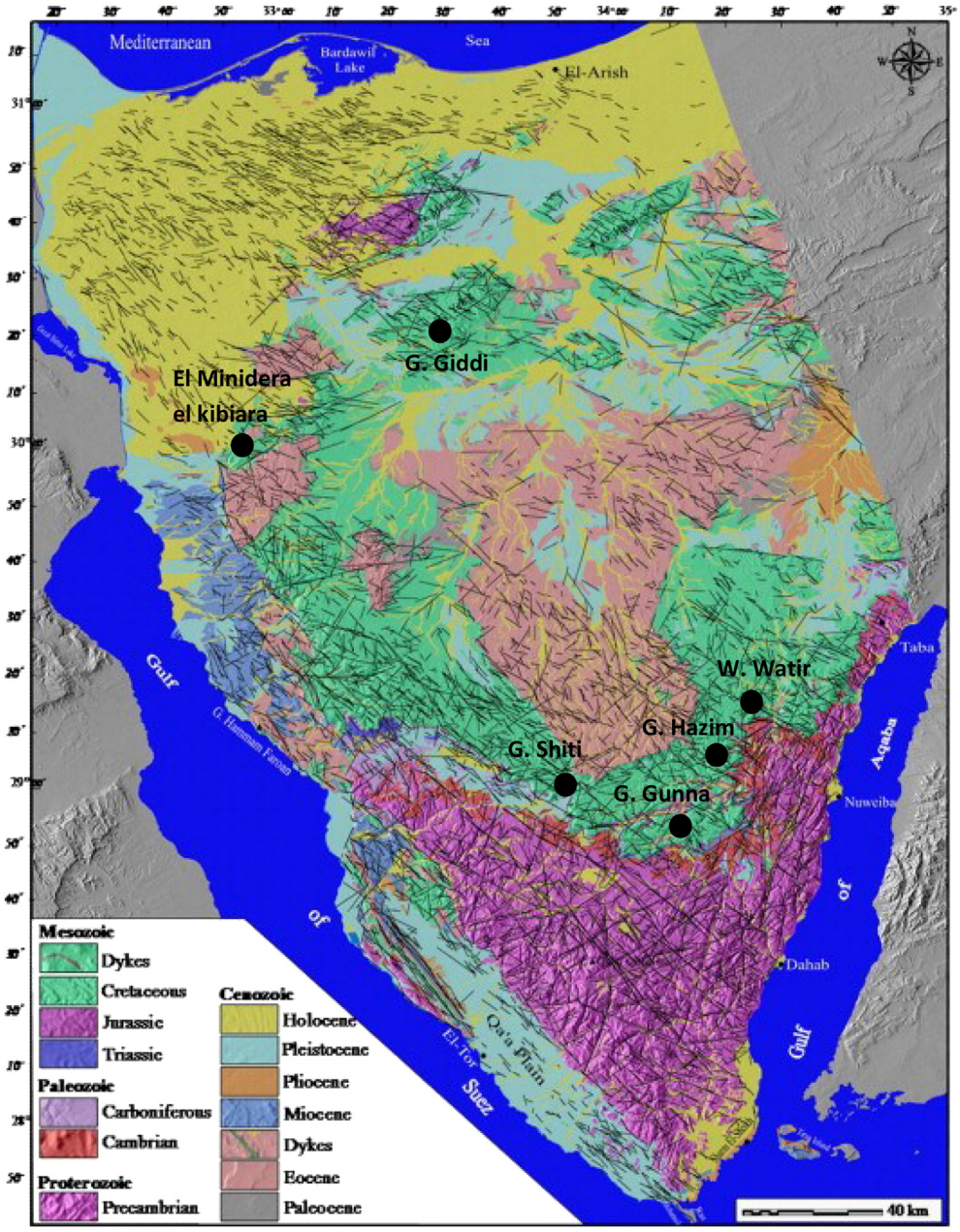

Fig. 1. Simplified geological map with the location of studied sections in Sinai.

history of the Wata carbonate platform, and 4) to interpret the reasons for the development of pure carbonate platform in this particular area. This approach will help in understanding the dominant control on development of carbonate platform.

2. Geological setting

The Sinai Peninsula lies at the junction between Africa and Asia continents and represents the Asian part of Egypt. Egypt lies in the northeast of the African Plate, where it forms a part of the Sahara Craton (El Emam et al., 1990) that is considered as a part of a passive continental margin of Gondwana. During its passive margin phase, the North African margin was also influenced by pulses of compression, strike-slip and extension in specific areas (Guiraud et al., 2001). Most notably in the Arabian-Egyptian region, the margin was affected by tectonic inversion along the Syrian Arc (Garfunkl, 1999). Geologically, Egypt includes three structural units; the Arabian-Nubian Massif in the south, southern facies belt in the central region; and the northern facies belt in the extreme north. The Arabian-Nubian Shield (New-Proterozoic) in the southern Western Desert, the eastern parts of the Eastern Desert (Red-Sea hills) and the southern Sinai consist of gneisses, granitoids, and meta-sedimentary rocks. It was formed by early evolution from the accretion of island arcs (during New-Proterozoic) and of oceanic terrains (Stern, 1985; Guiraud et al., 2001). The Upper Cretaceous southern facies belt (equivalent to stable shelf of Said, 1962) onlapped on the Arabian-Nubian Massif extending in a northeast-southwest direction. It represents a platform consisting mostly of the Maghrabi/Bahariya formations (Early Cenomanian); El Heiz (Late Cenomanian), El Hefhuf Formation (Turonian-Santonian) and Ain Giffara Formation (Campanian). The above sequence is capped by the Khoman Chalk (Maastrichtian). The northern facies belt of