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BIO-LITHOSTRATIGRAPHY DEVELOPMENT, AT UPPER CRETACEOUS-LOWER PALEOGENE, IN THE AL HAMADAH AL HAMRA AREA, LIBYA

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ABSTRACT

The extensive Triassic to Upper Jurassic sedimentary complex represents a significant period of deposition following a prolonged continental phase from the Upper Permian to the Lower Triassic, spanning approximately (8 million years). This complex is characterised by three distinct hiatuses, including two short interruptions in the Upper Triassic sediments and a substantial hiatus during the Upper Jurassic to Barremian. In addition, the Upper Campanian/Maastrichtian (Al Gharbiyah Formation), is characterised by warm but humid conditions as evidenced by the presence of Fe oxides and glauconitic levels, the Maastrichtian-Danian boundary is marked by the last occurrence of Omphalocyclus macroporus Lamarck and the appearance of Postrugoglobigerina daubjergensis (Broennimann) and Eoglobigerina danica (Bang), while, The transition to the Shurfah Formation is marked by lagoonal sediments at the base, followed by pelagic calcareous limestones and neritic Ammur limestones at the top. Based on the study of the biosedimentary and facies characteristics of the sediments and the facies changes in the Gharbia and Tabaqah Formations, the distribution and proposed new name of the Shurfah Formation has been redefined as Tar Member (formerly Lower Tar Member), the upper part of the Gharbia Formation, and Umm El Kifan (formerly Upper Ta Member), the upper part of the Tabaqah Formation.

1.0 Introduction

The Al Hamadah Al Hamra located in northwest Libya, is a fascinating geological region. Its flat terrain and arid environment characterize the plateau. The geology of the Al Hamadah Al Hamra plateau is heavily influenced by tectonic activities. The Cenozoic faulting in the region is largely affected by the Paleozoic oil-bearing structures, which are hidden beneath the late Cretaceous-Paleocene. This has made the area a target for diverse geological studies.

Overall, the Al Hamadah Al Hamra plateau is a region of significant geological interest with its unique tectonic features and the potential for further oil exploration and study. This study aims to document the dividing line between the layers through field and laboratory studies in the Umm El Kifan area. (Al Hamadah Al Hamra)

1.1 Material and methods

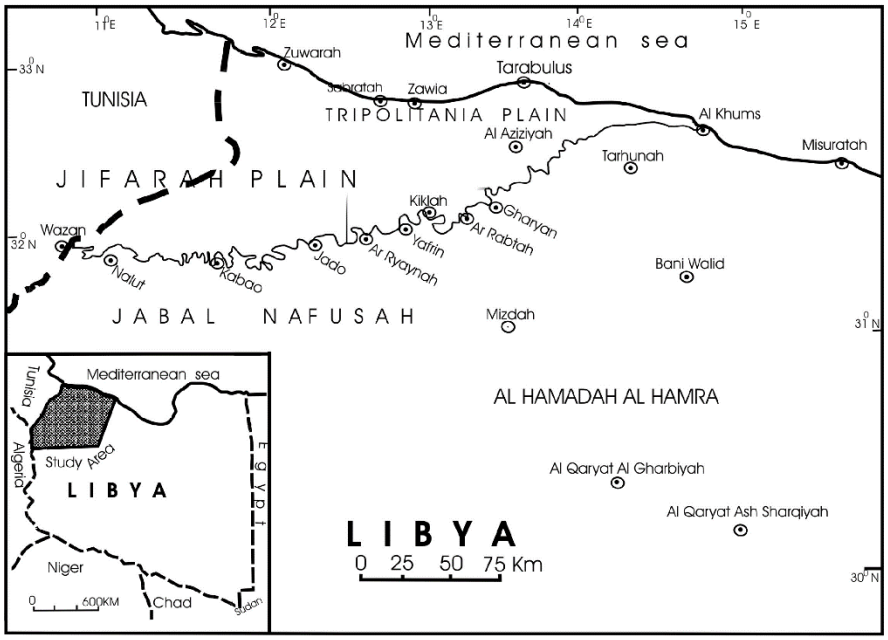

Fig. 1 Location map of study area in NW Libya

Samples for foraminiferal microstratigraphic evaluation were taken from the measured profiles mentioned in the explanatory booklets published by the Industrial Research Centre, Tripoli, and from individual Mesozoic-Paleogene samples taken from the area.

The samples were washed (with H_2O_2) on a 0.008 mm sieve. Some solid rocks (limestones, dolomitic limestones, calcareous sandstones) have been studied on thin sections (2 x 3.5 cm^2) for microbiofacial analysis, to determine the type of porosity of some Upper Cretaceous and Palaeogene horizons, and to prove and document some regression and transgression processes.

The authors in the Palaeogene do not use the Selandian (Middle) for the reason that this is not applied in the Nordafucan limnology more the Mcntian (Middle Palaeocene stage) has the facies and faunae that are not present in the Selaudian. More the vase of the Selaudian.

Samples for foraminiferal microstratigraphic evaluation were taken from the measured profiles mentioned in the explanatory booklets published by the Industrial Research Centre, Tripoli (Fig. 3), as well as from individual Mesozoic-Paleogene samples taken from the area.

2- **Stratigraphy**

A composite stratigraphic column of Mesozoic-Paleogene rocks (Fig. 2) is based on exposures along the study area (Figs. 3), which includes ten sheets of the 1:250,000 scale Geological Map of Libya: Tarabulus Sheet (NI 33-13) [7], Mizdah Sheet (NH 33-1) [1], Nalut Sheet (NH 32-4) [15], Bani Walid Sheet (NH 33-2) [29], Al Qaryat Al Gharbiyah Sheet (NH 33-5) [18], Al Qaryat Ash Sharqiyah Sheet (NH 33-6) [3], Hun Sheet (NH 33-11) [25], Ghadames Sheet (NH 32-7) [16], Al Khums Sheet (NI 33-14) [12] and Ra's Jdeir (NI 32-16) [27].

In terms of lithostratigraphy, a stratigraphic column was constructed based on field measurements in the type section of the Al Gharbiyah Fm (Al Qaryat Al Gharbiyah area). The geological map with laboratory studies (on Bu Ra's Member) coupled with thin section studies (PLATE 2). The results have helped to define the palaeoenvironments of the area between NW Libya and SE Tunisia.

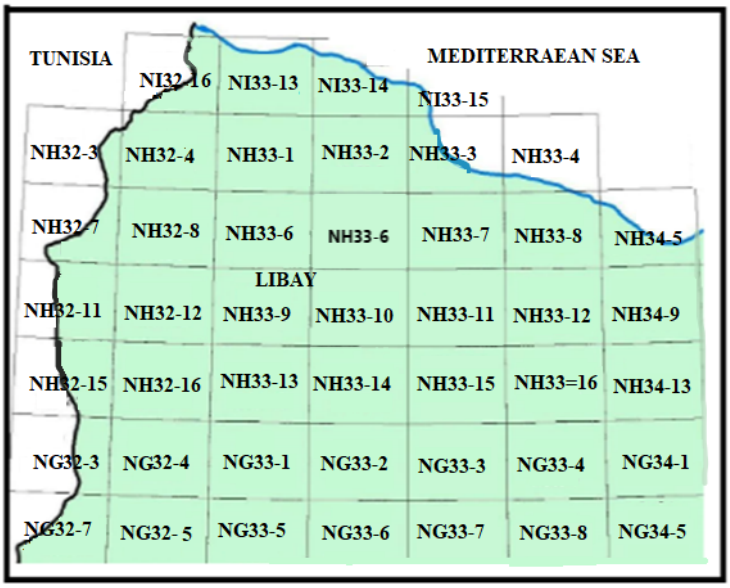

Fig. 3 Location of the sheet maps of study area in NW

The stratigraphic assignment of these units to the Upper Senonian and Paleocene is based on detailed micro- and micropaleontological studies (PLATE 1).

In the following, the general sedimentological description of the strata forming the sedimentary cycles and their main faunas are discussed and the lithological descriptions of the features discussed below are given.

3.0 Result and Discussion

3-1 Upper Campanian – Maastrichtian Age

Zimam Formation

The Zimam Formation was originally defined by [11] (1963) after Wadi Zimam. And [14] (1992) proved a revision of the Upper Cretaceous stratigraphy of Northwest Libya, between the Thala and the "Upper Tar" members, they identified three members,

1- Lower Tar at base; [19] (1987) showed that the section of the formation is composed of beds belonging to three sedimentary cycles. The cycles are separated by the presence of phosphate horizons indicating regressive phases.

2- Thala member "Upper Tar Member". They studied the Qarayat al Gharbiyah area south-east of Mizdah and provided a general sedimentological description of the 'Lower Tar Member' in measured type sections; and they proposed a new formation name for the Al Gharbiyah Formation with a type section. They identified the formation with three sedimentary cycles characterised by Upper Campanian to Maastrichtian microfauna.

3- The Bi'r Bu al Ghurab, the Bi'r bu Zamilah Member with pelagic facies and the Tar Member represent three shallower neritic sequences.

3-2 Danian age

We have divided the Tabaqah into two members: the Umm al Kifan member, (new proposed name), and the Had member, corresponding to the former middle and upper parts of the Zimam formation. ***Umm al Kifan Member*****,** new proposed name (= former Upper Tar Marl Member), The type locality: Wádí Umm Kifan see [20, p. 31];

The Umm al Kifan Member, (new proposed name), is restricted to the central and eastern part of the Al Hamadeh al Hamra Basin and extends south to the northern Dor el Gussa area; it represents the first transgressive-regressive sedimentary cycle of the Tabaqah Formation for the central part of the former (Zimam Formation). The Umm al Kifan Member was most likely deposited in the pre-barrier to open sea zone, as suggested by the nature of the rocks and the presence of brackish species. It is composed of yellowish green marl and calcareous mudstone with shaly intercalations, particularly thick and numerous in the middle part of the sequence.

The interbedded limestone consists of microcrystalline calcite. Thickness: 6-10 m. In the area of Al Qaryat al Gharbiyah, the lithology of this member consists of light to white, in places dolomitic calcilutites, poorly laminated and slightly silicified. Intracalcilutites to chalky calcilutites and calcarenites are subordinate. Locally, greenish gypsiferous clays are present at the base of this sequence in the northeastern area.

The Danian age of the Umm al Kifan Member is determined by the planktonic foraminifers [18, p. 33], the (Tar)/Umm al Kifan Member boundary and thus also the Maastrichtian/Danian boundary is determined by the disappearance of the Upper Maastrichtian orbitoids, represented by Omphalocyclus macroporus Lamarck, which do not pass to the Danian and to the Umm al Kifan Member either (see plate 1 &2)

3-3 Montian age

Had Limestone Member

This member is a highly resistant bed of carbonate rocks that forms the second sedimentary cycle of the Tabaqah Formation and the extensive Al Hamadeh al Hamra plateau [2]. The most widespread sequence of all sedimentary units in the study area contributes to the geological composition of the very extensive Hamadeh al Hamra plateau. [1, 29, 3, 16, 18 and 26].

3-4 Thanetian age

Shurfah Formation

Established by [11] for a Paleocene sequence of shales, marls and limestones exposed near Wadi Tar (Hun area). It is divided into three members (Orbilite or Operculina or Operculinoides Limestone, Galta Chalk and Bu Ra's Marl) [2], the last of which is exposed in the Mizdah, Nalut and most of the Al Qaryat al Gharbiyah area [26].

(Bu Ra's Member, Qaltah (Galta) Member, and Ammur Member (Upper Paleocene).

4.0 Conclusion

Our results on the Upper Cretaceous to Lower Paleogene lithostratigraphy contribute to the regional geology of northwest Libya, with applications for geological mapping and the petroleum exploration industry.In particular, we have studied the sedimentology and facies

characteristics of the Al Gharbiyah, the Tabaqah. We propose a new name for the Umm al Kifan , redefining the Tar Mb (formerly the Lower Tar Mb), the upper part of the Al Gharbiyah Fm, and the Umm al Kifan (formerly the Upper Tar Mb), the upper part of the Tabaqah Fm.

However, the high porosity of these formations in the deeper zone or below the Shurfah Fm in the western part of the Hamadah al Hamra is important from an oil accumulation point of view.

Also, our results are good for stratigraphic interpretations and applications, especially throughout the Campanian to Lower Eocene sedimentary formations, for finding criteria of sedimentary conditions incorrect application of the knowledge of the Archipelago Zone facies in the Campanian to Lower Eocene, represented by the Al Gharbiyah and Shurfah Fms. In the Upper Senonian, this Archipelago Zone was associated with other Upper Senonian to Lower Eocene formations in the Libyan offshore zone and with the Cyrenaica platform in eastern Libya.

This Archipelago Zone is very similar in its stratigraphic development and sedimentary breaks to the Gosau facies in the Western Carpathians and Eastern Alpine Belts. In both areas the Inoceramus Marlis and Orbitoides Limestones are present and in places the pelagic Red Marl with planktonic foraminifers. These facies correspond to the shallow neritic facies, with a slight influence of pelagic sedimentation, with many stratigraphic gaps. The tectonic evolution of the two areas was completely different, alpine in the northern areas of the Alps and Western Carpathians, and epeirogenic in the south on the Saharan platform, in the Hamadah Al Hamra areas.

The application of our knowledge of humid paleoclimatic events during the Campanian and Early Paleogene successions, based on the presence of red marls and ferruginous concretions in many stratigraphic levels, especially studied in the Cyrenaica Platform [21], is also possible in the lithofacies development of the Al Gharbiyah Fm and all Paleogene rock units of western Libya.

References are cited in the text just by square brackets [1]. (If square brackets are not available, slashes may be used instead, e.g. /2/.) Two or more references at a time may be put in one set of brackets [3,4]. The references are to be numbered in the order in which they are cited in the text and are to be listed at the end of the contribution under a heading References, see our example below.

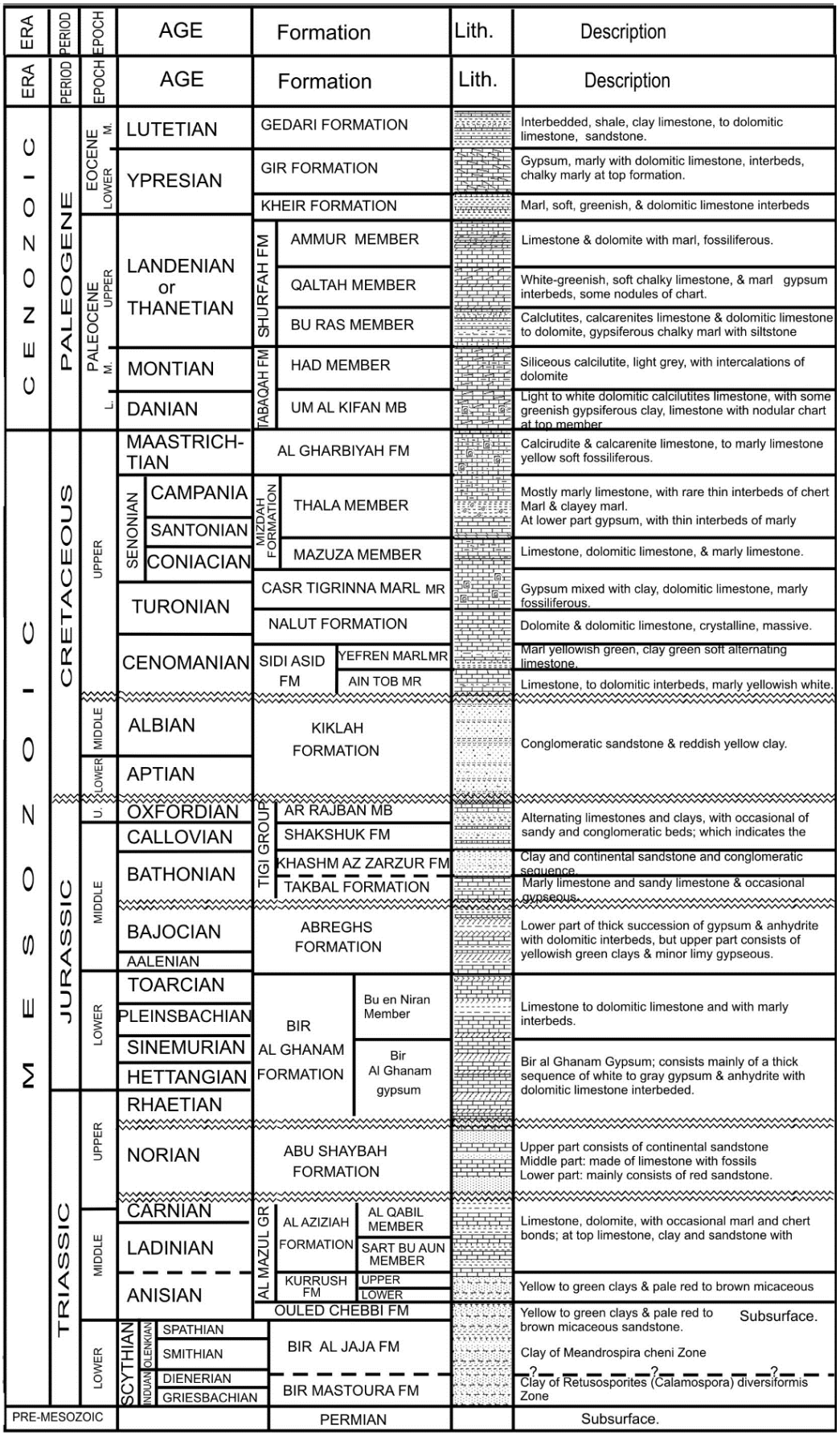

Fig. 2 Generalized chart of Mesozoic and Cenozoic Rocks in Northwest Libya

Plate 1

Figure 4

(1-1 & 1- 2)- *Lopha (Actinostreon) dichotoma* (Bayle), Al Gharbiyah Fm , s.s., Upper Campanian. (2-1 & 2-2)- *Amphidonte overwegi (*Buch), Al Gharbiyah Fm, Lower Maastrichtian., (3-1 to 3-2) *Agerostrea ungulata* (Schlotheim), Tar Mb, S. S., Upper Maastrichtian., (4-1 to 4-3) *Ceratostreon aff sp. +nosum* (Matheron) Tar Member. S.S., Upper Maastrichtian.

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