Distribution of Fault Controlled, Wave-Tide Dominated, Prograding Oolitic Shoals of the Miocene Carbonate-Evaporite Successions of the Ar-Rajmah Group, Al-Jabal Al-Khdar Uplift and Soluq Trough, Cyrenaica, NE Libya

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ABSTRACT

This work focuses on the tectonics, depositional processes, and their relationship with the distribution of the oolitic facies along the basin strike in the Cyrenaican Miocene carbonate-evaporite ramp of NE Libya. Detailed regional facies relationships were determined from 29 field measured stratigraphic sections and 14 spectral gamma-ray profiles constructed using a hand-held gamma-ray scintillometer at 0.5 m intervals, as well as 101 readings of paleocurrent data measured from large scale planar and trough cross-bedding, herringbone cross-bedding, and the progradation direction of unidirectional oolitic clinoforms. The oolitic facies of the Cyrenaican Miocene Platform are mapped. Also, the directional paleocurrent data are plotted on the maps of the Early Miocene, Middle Miocene, and Upper Miocene rock intervals.

The Ar-Rajmah Group Miocene carbonate rocks record two second-order supersequences that comprise six third-order sequences. The lower Miocene Benghazi Formation is 46 m maximum thickness, is dominated by red algal reefs and bioclastic packstones, and contains some oolitic grainstone. The Middle and Upper Miocene Wadi Al-Qattarah Formation is 26 m and 25 m maximum thicknesses, respectively, and dominated by continuous oolitic grainstones, microbialites that associated with evaporites and siliciclastics.

The oolitic grainstone facies are contained within two curved faults that have roughly north-south orientation and run parallel two each other. The spacing between these two faults is 40 km in the south narrowing down to 20 km towards the north. The maps

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show progradation of the oolitic grainstone facies throughout the Miocene from the fault lines toward the basin center.

Azimuths of the large scale planar and trough cross-bedding, herringbone cross-bedding, and the unidirectional clinoforms of the oolitic grainstone facies that are between the two faults are parallel to the curved fault lines. However, the azimuths of the same sedimentary structures of the oolitic grainstone facies that are at or close to the western fault line (Lower Escarpment) are roughly perpendicular to the curved fault line. The geometrical distribution of the wave-tide dominated prograding oolitic shoals of the Cyrenaican Miocene is fault controlled. These continuous oolitic outcrops that extend along the basin strike for more than 135 km are good analogues to study for subsurface reservoirs of similar setting.

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GCAGS-Talk-2016-Corpus Christi, Texas, USA

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Session Title: CONVENTIONAL CLASTICS AND CARBONATES, **Session Style:** Technical-Talk

Bill Ambrose and Mike Bergsma, Session Chairs

Session Date: Tuesday-Sept 19, 2016- 2:20 PM

Session Location:

Measurements & Analysis:

(A) 29 detailed measured stratigraphic sections

(B) 14 gamma ray scintillometer profiles,

(C) 11 Depositional Facies, and

(D) 2 Structural elements (faults), and

(E) 101 Paleocurrent azimuths,

- **Through time analysis, integration, and mapping of the sedimentological, stratigraphic, directional paleocurrent, and structural elements data sets to define the relationship between the distribution of the oolitic grainstone facies and the controlling tectonics and depositional processes in the Cyrenaican Miocene carbonate-evaporite ramp of NE Libya**

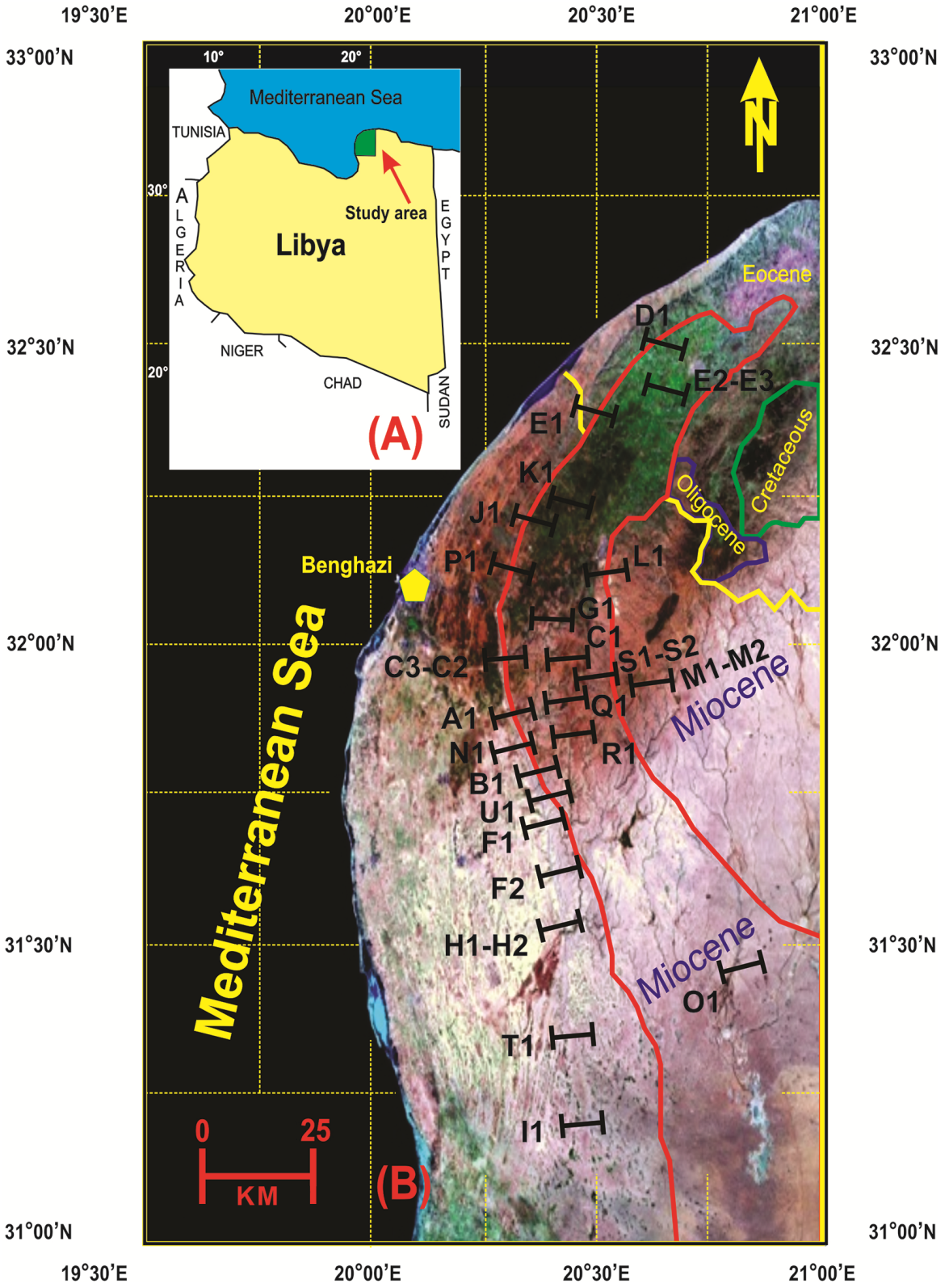
Location

Cyrenaican Miocene,

Al-Jabal Al-Khdar Uplift and Soluq Trough, NE Libya

Central Mediterranean

-Base map and location map with measured sections annotations



Sedimentology and Sequence Stratigraphy

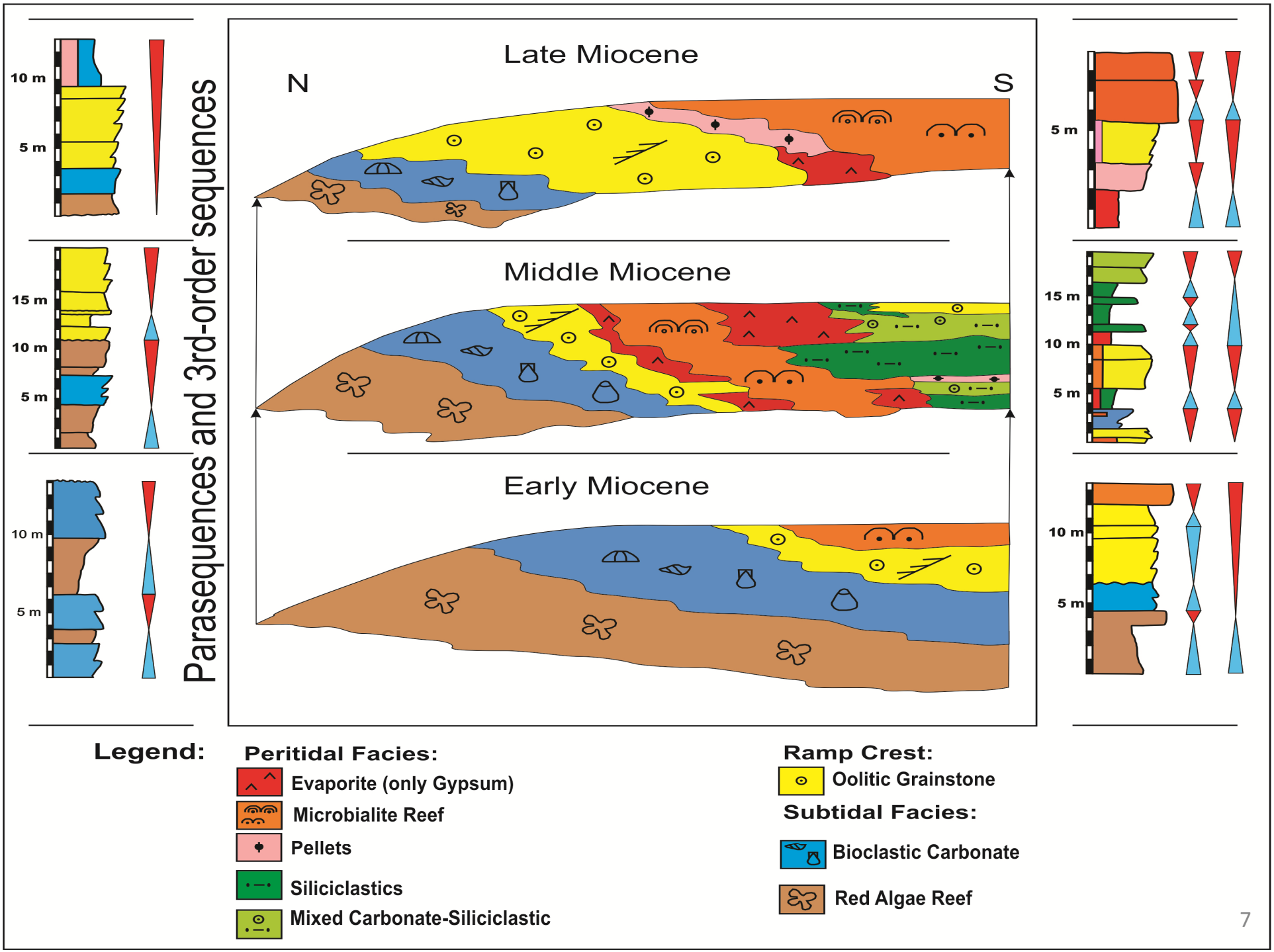
The Ar-Rajmah Group: nine **carbonate** facies and two **siliciclastic** facies, deposited in three environments on a gently sloping **ramp**.

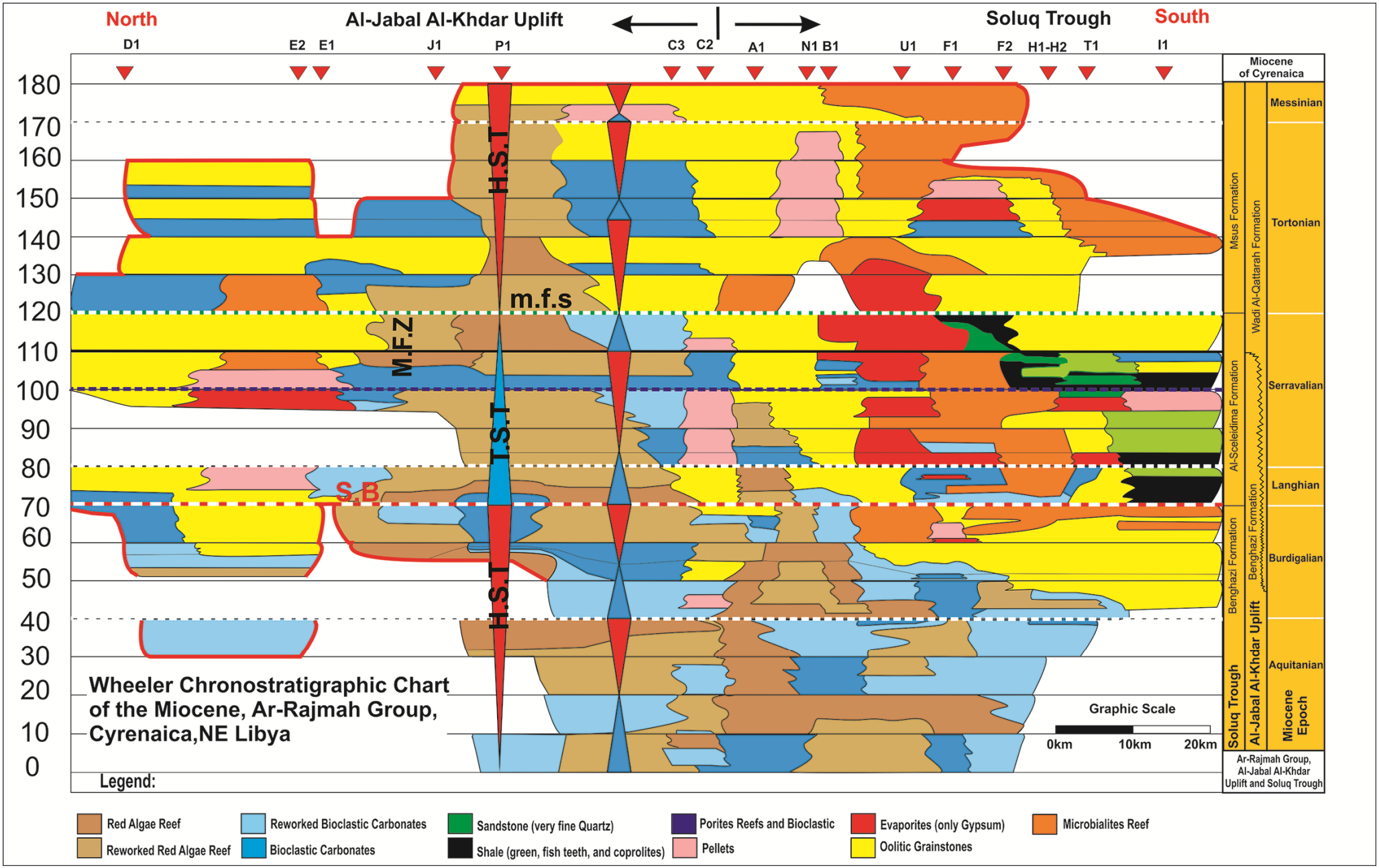
- **The peritidal facies** : 1) evaporite, 2) microbialite (stromatolites, thrombolites, and laminite), 3) pelletal wackestone/packstone, 4) porites reefs and bioclastic packstone, 5) very fine to fine quartz sandstone, 6) green shale.

- **The ramp crest facies**: 1) oolitic grainstone.

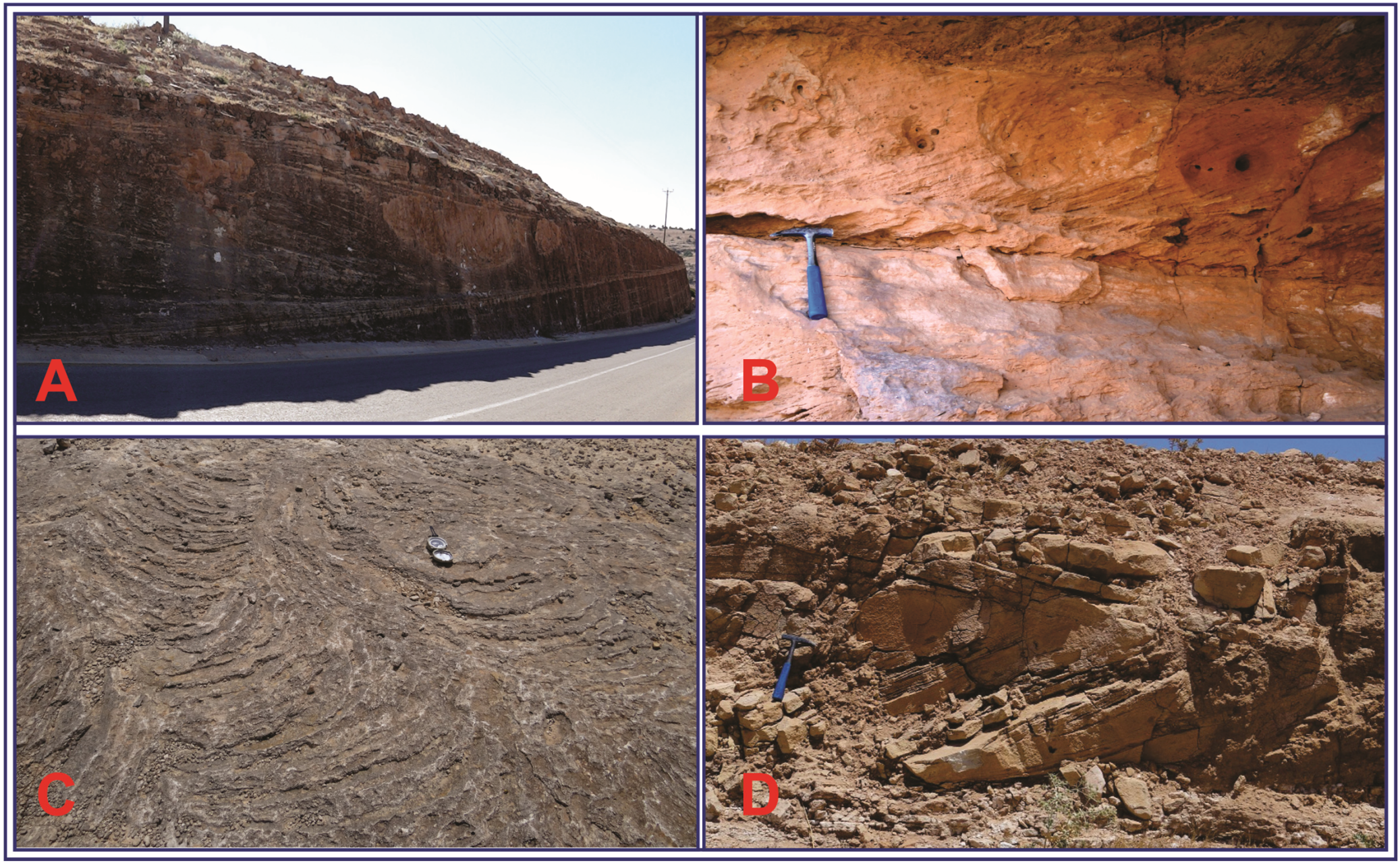
- **The subtidal facies** : 1) bioclastic carbonate, 2) reworked bioclastic carbonate, 3) red algae reefs, 4) reworked red algae.

Ramp Depositional models, Ar-Rajmah Group



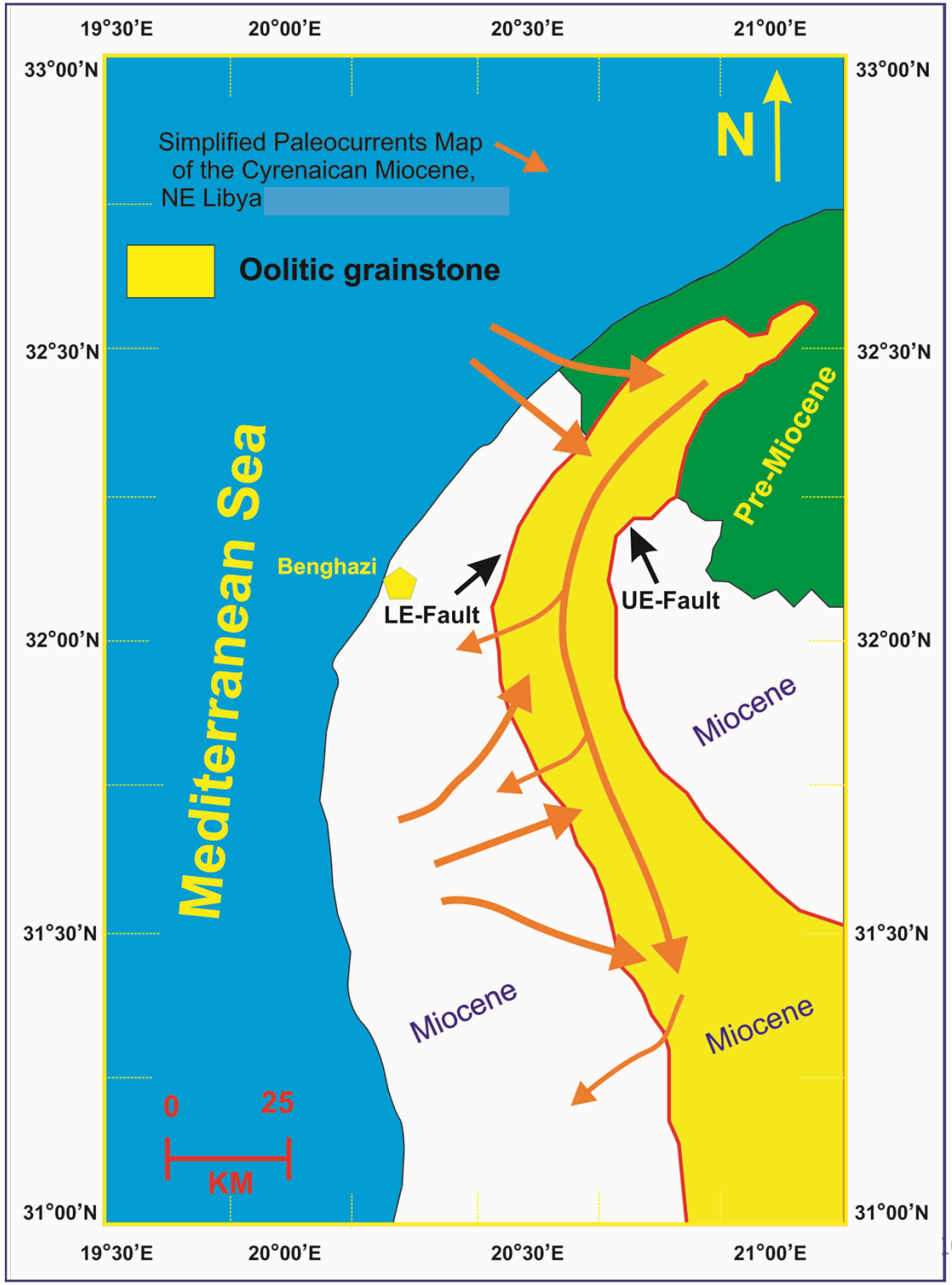

North
Al-Jabal Al-Khdar Uplift
Soluq Trough
South
D1
E2
E1
J1
P1
C3
C2
A1
N1
B1
U1
F1
F2
H1-H2
T1
I1
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
H.S.T
m.f.s
M.F.Z
T.S.T
S.B
H.S.T
Wheeler Chronostratigraphic Chart of the Miocene, Ar-Rajmah Group, Cyrenaica,NE Libya
Graphic Scale
0km
10km
20km
Legend:
Red Algae Reef
Reworked Red Algae Reef
Reworked Bioclastic Carbonates
Bioclastic Carbonates
Sandstone (very fine Quartz)
Shale (green, fish teeth, and coprolites)
Porites Reefs and Bioclastic
Pellets
Evaporites (only Gypsum)
Oolitic Grainstones
Microbialites Reef
Miocene of Cyrenaica
Msus Formation
Al-Sceleidima Formation
Benghazi Formation
Wadi Al-Qattarah Formation
Benghazi Formation
Soluq Trough
Al-Jabal Al-Khdar Uplift
Messinian
Tortonian
Serravalian
Langhian
Burdigalian
Aquitanian
Miocene Epoch
Ar-Rajmah Group, Al-Jabal Al-Khdar Uplift and Soluq Trough

The mesoforms sedimentary structures



(A) the unidirectional clinoforms of the oolitic grainstone facies, (B) large scale planar cross bedding, (C)large trough cross bedding, and (D)large herringbone cross bedding.

A simplified map diagram of the **palaeocurrents azimuths** of the **Cyrenaica Miocene**, Ar-Rajmah Group, NE Libya.



Through time Analysis and Integration (Maps Analysis).

Data sets of

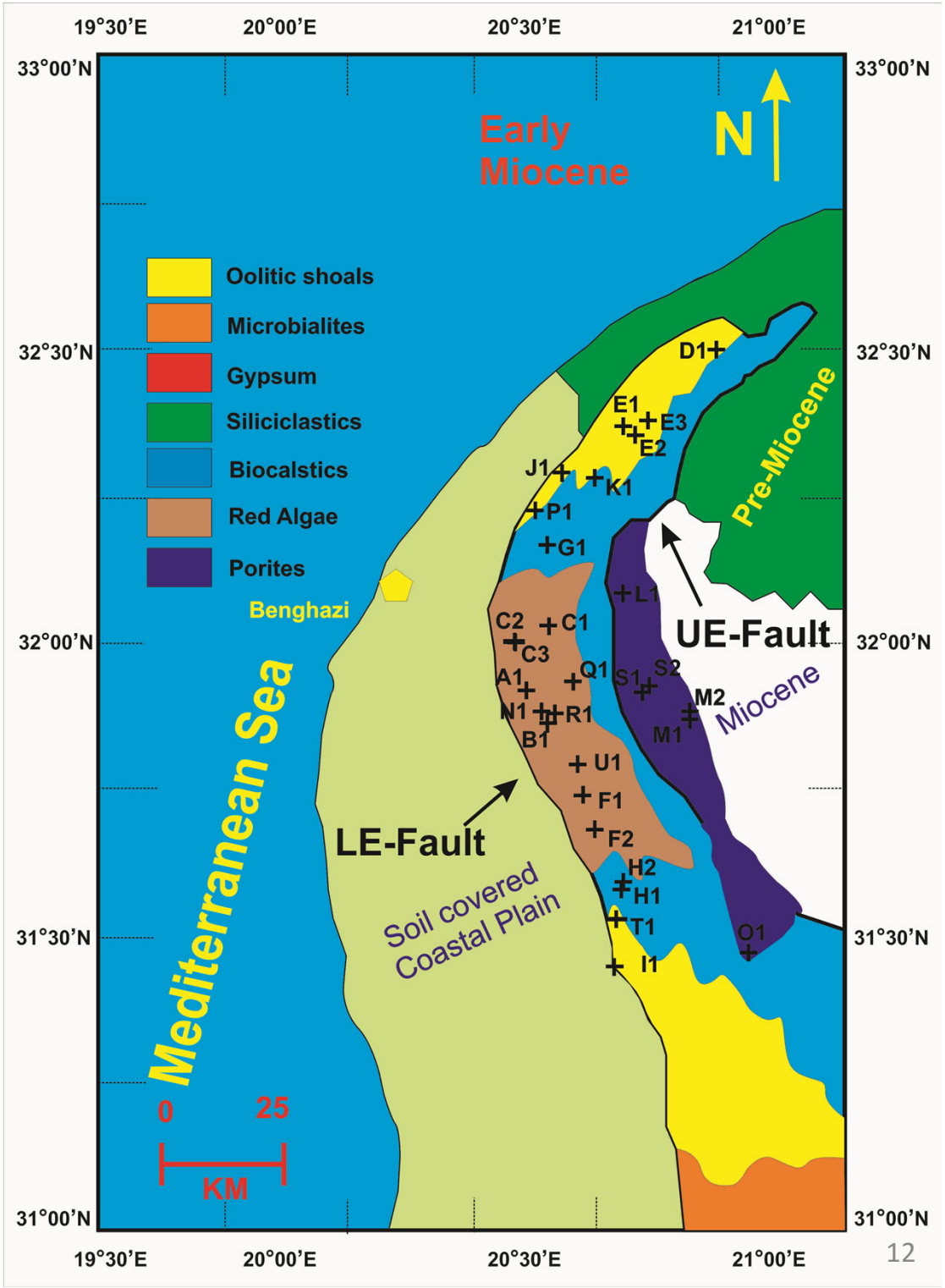
sedimentological, stratigraphic,

directional paleocurrent, and

structural elements

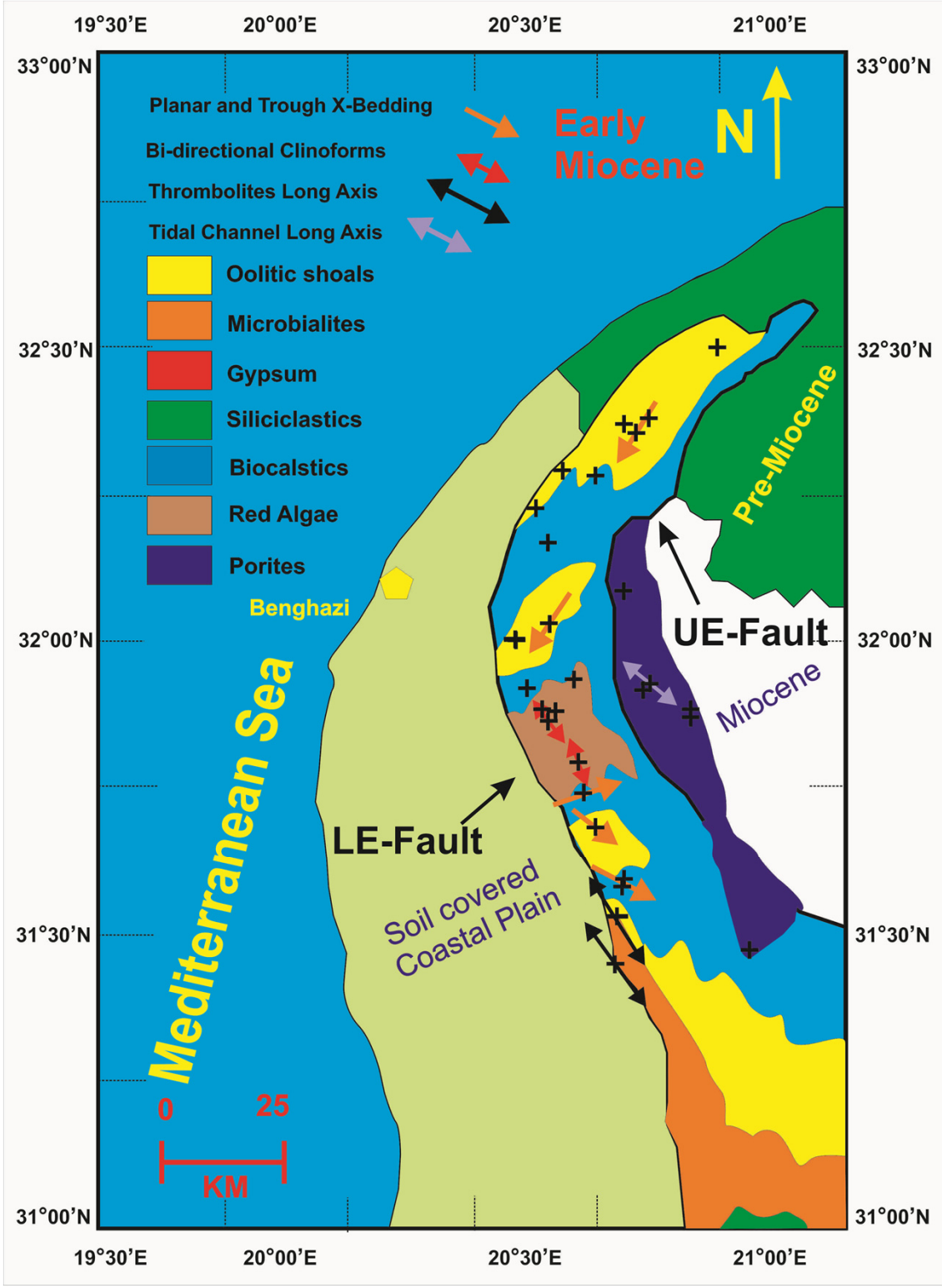
Early Miocene
of the Cyrenaica

The paleogeographic map of the Early Miocene of Cyrenaica, Ar-Rajmah Group, NE Libya includes: depositional facies distribution, the lower escarpment fault and the upper escarpment fault, locations of the visited outcrops.



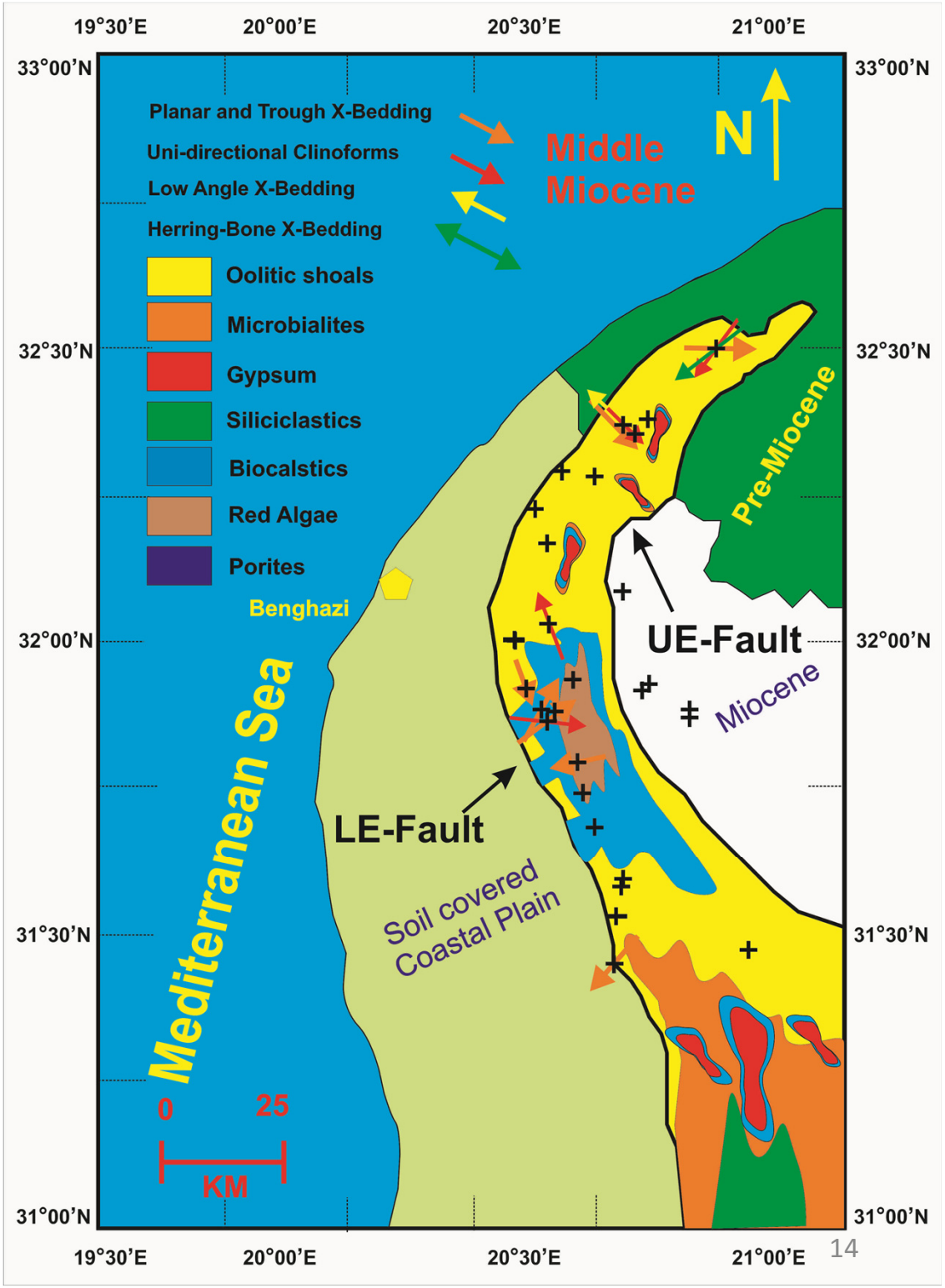
Early Miocene
of the Cyrenaica

The paleogeographic map of the Early Miocene of Cyrenaica, Ar-Rajmah Group, NE Libya includes: depositional facies distribution, the lower escarpment fault and the upper escarpment fault, locations of the visited outcrops, and the palaeocurrents azimuths of the directional sedimentary structures.



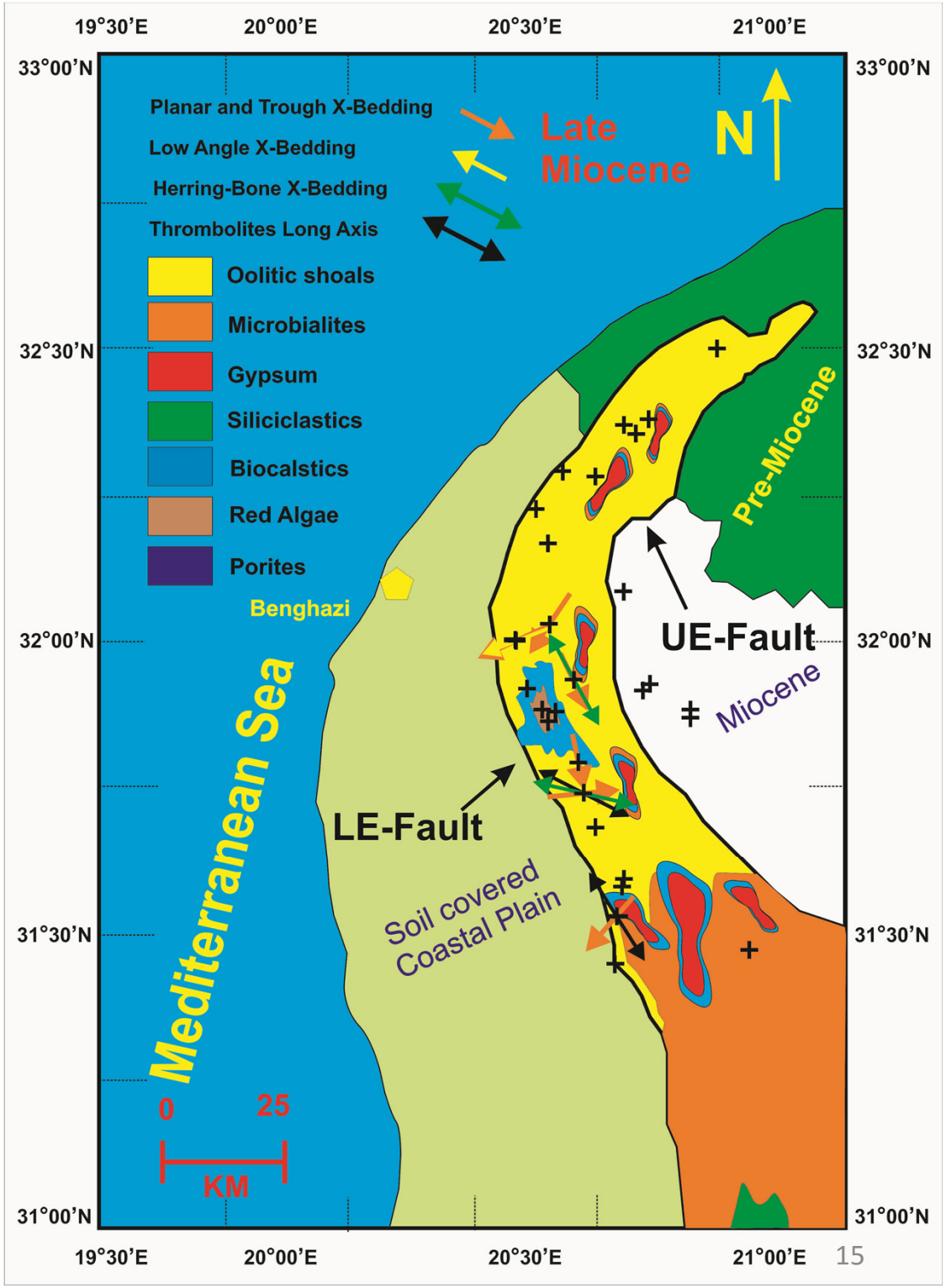
Middle Miocene
of the Cyrenaica

The paleogeographic map of the Middle Miocene of Cyrenaica, Ar-Rajmah Group, NE Libya includes: depositional facies distribution, the lower escarpment fault and the upper escarpment fault, locations of the visited outcrops, and the palaeocurrents azimuths of the directional sedimentary structures.



Late Miocene
of the Cyrenaica

The paleogeographic map of the Late Miocene of Cyrenaica, Ar-Rajmah Group, NE Libya includes: depositional facies distribution, the lower escarpment fault and the upper escarpment fault, locations of the visited outcrops, and the palaeocurrents azimuths of the directional sedimentary structures.



Results

- **1-** These maps show an elongated basin bounded by two curved faults running north-south.
- **2-** Two 2nd-order supersequences in the Ar-Rajmah Group Miocene carbonate rocks record comprise six 3rd-order sequences and eleven shallow marine depositional facies.
- **3-** The sedimentary structures in the prograding oolitic grainstone facies are produced by both tidal and wave processes.
- **4-** The azimuths of the directional sedimentary structures vary with proximity to the western LE-fault line.

Conclusions

➢**1-** The Cyrenaican Miocene depositional ramp includes eleven facies arranged into six 3rd order sequences that form two 2nd order supersequences.

➢**2-** The shallower facies prograded throughout the Miocene from the north and south directions to fill the basin on the expenses of the deeper facies.

➢**3-** The Cyrenaican Miocene ramp facies deposited within a faulted basin; facies distribution and the palaeocurrents passages were fault controlled**.**

➢**4-** The mesoforms sedimentary structures that are proximal to the western LE-fault line their azimuths are roughly perpendicular, whereas the azimuths of the distal ones are parallel to the western LE-Fault**.**

➢**5-** The Cyrenaican tectonic faults controlled the basin geometry, the depositional environments, the depositional facies distribution and palaeocurrents pathways during the Miocene**.**

Thanks
Any Questions?!

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