APPENDIX: microfauna and microflora from samples of the Tetouan-Martil and Oued Laou-Tirinesse basins

Absolute ages of calcareous nannofloral events after Raffi et al. (2006); LO – lowest occurrence; LCO – lowest common occurrence; HO - highest occurrence.

**TETOUAN-MARTIL**

**RIF 1**

***Planktonic foraminifers***: *Orbulina universa, Turborotalia quinqueloba, Sphaeroidinellopsis seminulina, Globigerina* *bulloides, Globigerinoides obliquus, Globoturborotalia decoraperta, G.* *woodi, G. apertura,* ***Globoturborotalia nepenthes [***LAD = 4.37 Ma]*, Globigerinoides* *conglobatus, Globigerinoides ruber, Neogloboquadrina acostaensis, Neogloboquadrina* *humerosa, Dentoglobigerina altispira, Globoquadrina venezuelana, Globorotalia* *scitula.*

***Benthic foraminifers***: *Cibicidoides kullenbergi (18%), C. lobatulus (13%), Melonis pompilioides, Pullenia bulloides, Bolivina* gr. (*B. spathulata, B. dilatata) (26%), Uvigerina peregrina, Cas. carinata*

***Calcareous nannofossils***: ***Ceratolithus acutus***(FO at 5.32 Ma and HO at 5.04 Ma), *Coccolithus pelagicus, Reticulofenestra pseudoumbilicus* (HO 3.8 Ma, Late Zanclean), *R. minuta, R. minutula, R. haqii, Calcidiscus leptoporus, C. macintyrei* (HO 1.6 Ma), *Sphenolithus abies* (HO at 3.65 Ma), *Pontosphaera multipora, P. japonica, Umbilicosphaera jafari, Thoracosphaera spp., Helicosphaera carteri, H. sellii, Discoaster variabilis, Discoaster brouweri, D. surculus* (LCO – 7.88 Ma)*, D. intercalaris, D. pentaradiatus, D. asymmetricus Thoracosphaera sp.*

**RIF 5**

***Calcareous nannofossils:*** *Coccolithus pelagicus,* ***Reticulofenestra pseudoumbilicus*** (HO 3.8 Ma, Late Zanclean), *R. minuta, R. minutula, R. haqii, Calcidiscus leptoporus, C. macintyrei* (HO 1.6 Ma), ***Sphenolithus abies*** (HO at 3.65 Ma), *Discoaster brouweri, Pontosphaera multipora, P. japonica, Umbilicosphaera jafari, Thoracosphaera spp., Helicosphaera carteri, H. sellii, Discoaster variabilis, D. brouweri.* Many reworked Cretaceous-Paleogene-

**RIF 6**

***Calcareous nannofossils:*** *Coccolithus pelagicus,* ***Reticulofenestra pseudoumbilicus*** (HO 3.8 Ma, Late Zanclean), *R. minuta, R. minutula, R. haqii, Calcidiscus leptoporus, C. macintyrei* (HO 1.6 Ma), ***Sphenolithus abies*** (HO at 3.65 Ma), *Pontosphaera multipora, P. japonica, Umbilicosphaera jafari, Thoracosphaera spp., Helicosphaera carteri, H. sellii, Discoaster brouweri, Discoaster variabilis.* Many reworked Cretaceous-Paleogene-Miocene in age.

**TIRINESSE SOUTH**

**RIF 7-8**

***Calcareous nannofossils****:* ***Ceratolithus acutus***(LO at 5.32 Ma and HO at 5.04 Ma), *Coccolithus pelagicus,* ***Reticulofenestra pseudoumbilicus*** (HO 3.8 Ma, Late Zanclean), *R. minuta, R. minutula, R. haqii, Calcidiscus leptoporus, C. macintyrei* (HO 1.6 Ma), ***Sphenolithus abies*** (HO at 3.65 Ma), *Pontosphaera multipora, P. japonica, Umbilicosphaera jafari, Thoracosphaera spp., Helicosphaera carteri, H. sellii, Discoaster variabilis, D. brouweri,* many reworked Cretaceous-Paleogene-Miocene in age

**RIF 8**

***Calcareous nannofossils: Ceratolithus acutus***(LO at 5.32 Ma and HO at 5.04 Ma),***Amaurolithus primus***(LO at 7.362 and HO at 4.5 Ma)*, Coccolithus pelagicus,* ***Reticulofenestra pseudoumbilicus*** (HO 3.8 Ma, Late Zanclean), *R. minuta, R. minutula, R. haqii, Calcidiscus leptoporus, C. macintyrei* (HO 1.6 Ma), ***Sphenolithus abies*** (HO at 3.65 Ma), *Pontosphaera multipora, Thoracosphaera spp., Helicosphaera carteri, H. sellii, Discoaster variabilis, D. brouweri, Thoracosphaera sp.* Many reworked Cretaceous-Paleogene-Miocene in age

**RIF 9**

***Calcareous nannofossils: Reticulofenestra pseudoumbilica****, R. minuta, R. minutula, R. haqii, Coccolithus pelagicus, Pontosphaera multipora, Helicosphaera carteri*),***Sphenolithus abies****, Thoracosphaera spp.* Many reworked taxa Cretaceous -Oligocene-Lower and Middle Miocene

**RIF 10**

***Benthic foraminifers*:** Oligospecific *Eponides repandus* assemblage (together with *Nonion scaphum*). Eponinids are reported to be abundant on circalittoral detritic bottoms.

***Calcareous nannofossils: Reticulofenestra pseudoumbilica****, R. minuta, R. minutula, R. haqii, Coccolithus pelagicus, Pontosphaera multipora, Helicosphaera carteri*),***Sphenolithus abies****, Thoracosphaera spp.* Many reworked taxa Cretaceous -Oligocene-Lower and Middle Miocene

**RIF 11**

***Calcareous nannofossils: Amaurolithus primus***(LO at 7.362 and HO at 4.5 Ma)*, Calcidiscus leptoporus, Calcidiscus macintyrei,* ***Reticulofenestra pseudoumbilica****, R. minuta, R. minutula, R. haqii, Coccolithus pelagicus, Pontosphaera multipora, Helicosphaera carteri, H. sellii* (LO at 9.6 Ma),***Sphenolithus abies****.* Many reworked taxa Cretaceous -Oligocene-Lower and Middle Miocene

**RIF 12**

***Calcareous nannofossils:*** *Calcidiscus leptoporus, Calcidiscus macintyrei,* ***Reticulofenestra pseudoumbilica****, R. minuta, R. minutula, R. haqii, Coccolithus pelagicus, Pontosphaera multipora, Helicosphaera carteri, H. sellii* (LO at 9.6 Ma),***Sphenolithus abies****.* Many reworked taxa Cretaceous -Oligocene-Lower and Middle Miocene

**RIF 13**

***Benthic foraminifers*:** Oligospecific *Eponides repandus* assemblage (together with *Nonion scaphum*). Eponinids are reported to be abundant on circalittoral detritic bottoms.

***Calcareous nannofossils:*** *Calcidiscus leptoporus, Calcidiscus macintyrei,* ***Reticulofenestra pseudoumbilica****, R. minuta, R. minutula, R. haqii, Coccolithus pelagicus, Pontosphaera multipora, Helicosphaera carteri, H. sellii* (LO at 9.6 Ma),***Sphenolithus abies****.* Many reworked taxa Cretaceous -Oligocene-Lower and Middle Miocene.

**RIF 14**

***Calcareous nannofossils:*** *Calcidiscus leptoporus, Calcidiscus macintyrei,* ***Reticulofenestra pseudoumbilica****, R. minuta, R. minutula, R. haqii, Coccolithus pelagicus, Pontosphaera multipora, Helicosphaera carteri, H. sellii* (LO at 9.6 Ma),***Sphenolithus abies****.* Many reworked taxa Cretaceous -Oligocene-Lower and Middle Miocene.

**TIRINESSE CENTRE**

**RIF15**

***Planktonic foraminifers***: *Orbulina universa, Globigerina bulloides, Globigerina apertura, Globigerinoides extremus, G. obliquus, Neogloboquadrina humerosa.*

***Calcareous nannofossils****:* ***Ceratolithus acutus***(LO at 5.32 Ma and HO at 5.04 Ma), ***Amaurolithus primus*** (FO at 7.362 and HO at 4.5 Ma)*, , A. delicatus,* *Coccolithus pelagicus, Reticulofenestra pseudoumbilicus* (HO 3.8 Ma, Late Zanclean), *R. minuta, R. minutula, R. haqii, Helicosphaera carteri, H. sellii, Calcidiscus leptoporus, C. macintyrei* (HO 1.6 Ma), *Sphenolithus abies* (HO at 3.65 Ma), *Pontosphaera multipora, Discoaster variabilis,, Thoracosphaera sp.* Few reworked mainly Eocene-Oligocene in age

**RIF 16**

***Planktonic foraminifers***: *Orbulina universa, Turborotalia quinqueloba, Dentoglobigerina altispira, Globigerina*

*bulloides, Globoturborotalia decoraperta, G. apertura, Candeina nitida, Globigerinita glutinata, Globorotalia**scitula.*

***Benthic foraminifers***: High dominance of *B. spathulata* gr. (almost 90%), *Pullenia bulloides, Nonion, Melonis pompilioides, Oridorsalis umbonatus, Lenticulina.* *B. spathulata* adapt to different water depths, depending on prevailing environmental conditions. Dysoxic conditions, meso- to eutrophic environment.

***Calcareous nannofossils****:* ***Ceratolithus acutus***(LO at 5.32 Ma and HO at 5.04 Ma), ***Amaurolithus primus*** (LO at 7.362 and HO at 4.5 Ma)*, Coccolithus pelagicus,* ***Reticulofenestra pseudoumbilicus*** (HO 3.8 Ma, Late Zanclean), *R. minuta, R. minutula, R. haqii, Helicosphaera carteri, H. sellii, Calcidiscus leptoporus, C. macintyrei* (HO 1.6 Ma), ***Sphenolithus abies*** (HO at 3.65 Ma), *Discoaster brouweri, Pontosphaera multipora, P. japonica, Thoracosphaera sp.* Few reworked mainly Eocene-Oligocene in age

**RIF 18**

***Planktonic foraminifers***: *Globigerina bulloides, Orbulina universa, Globigerinoides sp.*

***Calcareous nannofossils: Reticulofenestra pseudoumbilica****, R. minuta, R. minutula, R. haqii, Coccolithus pelagicus, Pontosphaera multipora, Helicosphaera carteri***, *Sphenolithus abies****, Thoracosphaera spp.* Many reworked taxa Cretaceous -Oligocene-Lower and Middle Miocene

**RIF 21**

***Planktonic foraminifers***: *Globigerinoides extremus, G. obliquus, Globigerina bulloides, Orbulina universa, Globigerinita glutinata, Globoturborotalia woodi,* ***G. nepenthes****, G. apertura, Globorotalia scitula,* *Neogloboquadrina acostaensis*

***Benthic foraminifers***: some broken *Bolivina. Bolivina dilatata (*stress marker), *Bolivina alata, Cibicides dutemplei (*upper bathyal zone), *Pullenia bulloides* (it occurs in middle to lower bathyal water depths)*, Bulimina elegans*

***Calcareous nannofossils:*** *Calcidiscus leptoporus, Calcidiscus macintyrei,* ***Reticulofenestra pseudoumbilica****, R. minuta, R. minutula, R. haqii, Coccolithus pelagicus, Pontosphaera multipora, Helicosphaera carteri, H. sellii* (LO at 9.6 Ma),***Sphenolithus abies****, Thoracosphaera spp.* Many reworked taxa Cretaceous -Oligocene-Lower and Middle Miocene.

**TIRINESSE NORTH**

**Rif 30**

***Calcareous nannofossils:*** *Calcidiscus leptoporus, Calcidiscus macintyrei,* ***Reticulofenestra pseudoumbilica****, R. minuta, R. minutula, R. haqii, Coccolithus pelagicus, Pontosphaera multipora, Helicosphaera carteri, H. sellii* (LO at 9.6 Ma),***Sphenolithus abies***Many reworked taxa Cretaceous -Oligocene-Lower and Middle Miocene.

**Rif 31**

***Benthic foraminifers***: *Cibicidoides kullenbergi, C. ungerianus, C. dutemplei, P. bulloides, Melonis barleanus, Bulimina elegans, B. aculeate, B. costata, Cassidulinoides bradyi .* Deep shelf and Bathyal zone.

***Calcareous nannofossils:*** *Calcidiscus leptoporus, Calcidiscus macintyrei,* ***Reticulofenestra pseudoumbilica****, R. minuta, R. minutula, R. haqii, Coccolithus pelagicus, Pontosphaera multipora, P. japonica, Helicosphaera carteri, H. sellii* (LO at 9.6 Ma),***Sphenolithus abies****, Thoracosphaera spp.* Many reworked taxa Cretaceous -Oligocene-Lower and Middle Miocene

**Rif 32**

***Benthic foraminifers***: hemipelagic deep-water benthic foraminifera, *Osangularia plummerae.*  Oxidized plant-wood fragments. Epicontinental, outer shelf – outer slope, outer neritic – upper bathyal zone.

***Calcareous nannofossils:*** *Calcidiscus leptoporus, Calcidiscus macintyrei,* ***Reticulofenestra pseudoumbilica****, R. minuta, R. minutula, R. haqii, Coccolithus pelagicus, Pontosphaera multipora, Helicosphaera carteri, H. sellii* (LO at 9.6 Ma),***Sphenolithus abies****.* Many reworked taxa Cretaceous –Oligocene-Lower and Middle Miocene.

**OUED LAOU**

**RIF 22**

***Planktonic foraminifers****: Orbulina universa, Globigerinita glutinata, Globigerina bulloides, Globigerinoides*

*quadrilobatus, G. obliquus, G. extremus, Neogloboquadrina humerosa.*

***Calcareous nannofossils:******Ceratolithus acutus***(LO at 5.32 Ma and HO at 5.04 Ma), ***Amaurolithus primus****, A. delicatus,* *Coccolithus pelagicus, Reticulofenestra pseudoumbilicus* (HO 3.8 Ma, Late Zanclean), *R. minuta, R. minutula, R. haqii, Helicosphaera carteri, H. sellii, Calcidiscus leptoporus, C. macintyrei* (HO 1.6 Ma), ***Sphenolithus abies*** (HO at 3.65 Ma), *Discoaster brouweri, Pontosphaera multipora, Discoaster variabilis, Thoracosphaera sp.* Few reworked mainly Eocene-Oligocene in age.

**RIF 23**

***Planktonic foraminifers***: *Orbulina universa, Globigerina bulloides, Globoturborotalia woodi, Globigerinoides obliquus, G. extremus.*

***Benthic foraminifers***: a few brown *Nonion*, very oxidized wood fragments.

***Calcareous nannofossils:*** *Calcidiscus leptoporus, Calcidiscus macintyrei,* ***Reticulofenestra pseudoumbilica****, R. minuta, R. minutula, R. haqii, Coccolithus pelagicus, Pontosphaera multipora, Helicosphaera carteri, H. sellii* (LO at 9.6 Ma),***Sphenolithus abies****, Braarudosphaera bigelowii, Pontosphaera multipora, Rhabdosphaera claviger.* Many reworked taxa Cretaceous -Oligocene-Lower and Middle Miocene

**RIF 24**

***Planktonic foraminifers***: *Globigerina bulloides, Globigerinoides obliquus, Globoturborotalia woodi.*

***Benthic foraminifers***: *Oridorsalis umbonatus, Bulimina elegans, Bulimina aculeata, Bulimina costata, Pullenia bulloides, Bolivina dilatata, Cibicides dutemplei, Nonion fabum,* a few transported *Ammonia beccarii* and *Valvulineria bradyana.* Lower epibathyal to upper mesobathyal zone.

***Calcareous nannofossils:*** *Calcidiscus leptoporus, Calcidiscus macintyrei,* ***Reticulofenestra pseudoumbilica****, R. minuta, R. minutula, R. haqii, Coccolithus pelagicus, Pontosphaera multipora, Helicosphaera carteri, H. sellii* (LO at 9.6 Ma),***Sphenolithus abies****, Thoracosphaera spp.* Many reworked taxa Cretaceous-Oligocene-Lower and Middle Miocene.