



**Benha University
Faculty of Science
Geology Department
4th year Botany
and Chemistry**

**Fossilization and plant fossils (219G)
Final Ex. (48 marks)
Time Two Hours
Date 4-6-2017.**

Model Answer

I- Fossilization

I- Write on four only from the following: (8 marks)

a – Common mineral components of the skeleton of marine organisms.

Calcium carbonate CaCO_3 Principal mineral components of most sea shells. Two common calcareous minerals in sea shells:

Aragonite – unstable over geological time.

Aragonitic shells commonly are dissolved (preserved as moulds) or transform to calcite (poor preservation of primary textures).

Calcite – stable over geological time. Consequently, calcitic (e.g. brachiopod) shells tends to be well-preserved.

Silica SiO_2 – Usually amorphous hydrated silica (Opal A) which commonly transforms to quartz and other silica minerals following death.

Opal may be well preserved in pelagic sediments, if deeply buried.

This is the principal “mineral” component of the skeletons of some sponges, and micro-organisms such as diatoms and radiolarians.

Skeletons may be lost or degraded through opal dissolution and obliteration of the original amorphous structure through quartz crystallization.

Calcium phosphate (apatite)

$\text{Ca}_3(\text{F,Cl,OH})(\text{PO}_4)_3$ – stable over geological time (tends to be well-preserved). Principal mineral component of bones, teeth and some shells.

b - Types of fossil remains.

Unaltered soft parts: Rare fossil cases in which both soft and hard parts are preserved without alteration as Mammoth and Insects in Amber.

Unaltered hard parts: Shells of Invertebrates or bones of Vertebrates are preserved without alteration. (Skeletal remains that are composed of stable minerals (e.g. calcite, calcium phosphate) can be preserved without significant change in chemical make up or internal structure).

Altered hard parts: Shells of Invertebrates or bones of Vertebrates are showing various degrees of alteration.

c- Binomial Nomenclature of fossils.

The fundamental unit of biological classification is the species. Members of a species are able to interbreed and give rise to fertile offspring. Palaeontologists, lacking evidence of reproductive isolation of ancient “species”, focus on morphological definitions of species. Above the species level are increasingly more inclusive groups which are defined by certain characteristics possessed by all their members.

Binomial Nomenclature Linnaeus (1758)

Types: (Holotype & Paratypes), Type species,

Open Nomenclature: affinis = aff. e.g. *Lophoaff. dichotoma* confer = cf. e.g. *Lophacf. dichotoma* sp. e.g. *Lopha* sp. Synonyms: Homonyms: Law of priority:

d- Encounter Hypothesis:

A passing star contributed greatly to the tidal and eruptive forces of the Sun, causing great clouds of gas to be thrown out of the Sun's interior into large spirals. This material was quickly cooled into solids and liquids, which accumulated into planets by collisions.

e- The main physical events through the Cenozoic Era

- 1- The Americas were separated from Europe and Africa except for a connection across the North Atlantic where Greenland formed a passable land bridge.
- 2- In the Southern Hemisphere Australia and Antarctica had lost contact with all other southern lands but remained joined to each other until the Eocene.
- 3- Antarctica soon drifted southward into a polar position and Australia

commenced a northward trip that is still continuing today.

- 4- The formation of the great Alpine and Himalayan ranges, were basically due to northward movement of Africa and other southern blocks towards Eurasian lands.
- 5- The Arabian peninsula, which was originally part of Africa split apart from the parent continent to create the Red Sea in the Oligocene and Miocene and at the same time pushed up the Zagros ranges and became part of the Eurasian continent.
- 6- The most spectacular of all was the collision of India in the Eocene and Oligocene giving rise to the Himalayan ranges and Tibetan Plateau.
- 7- All these dramatic movements reached a culmination in the middle Tertiary to create one of the earth's greatest disturbance the Alpine Revolution (cf. Alpine Orogeny).

II- Choose the correct answer:

(5 marks)

- a- One of the following is not belong to the geochronological units (Age, **Stage**, Era).
- b- One of the following is belonging to the Paleogene epochs (**Paleocene**, Cenomanian, Miocene).
- c- The inoceramids are firstly appeared nearly at the Middle of the (Paleozoic Era, **Mesozoic Era**, Cenozoic Era).
- d- The fusulines are considered among the diagnostic foraminifera for (**Carboniferous**, Eocene, Miocene).

e- The radiolaria are belonging to (Kingdom Animalia, Kingdom Fungi, **Kingdom Protista**).

III- Correct the following sentences: (4 marks)

- a- The Trilobites are firstly appeared in the **Cambrian and extinct at the end of the Paleozoic Era.**
- b- The Cenozoic Era is subdivided into the following periods **Paleogene, Neogene, and Quaternary.**
- c- The BIF are formed during the Precambrian
- d. **The ammonoids** are firstly appeared in the Devonian and extinct at the end of the Mesozoic Era.

IV - Compare between the following: (7 marks)

a- Paleozoic and Cenozoic marine invertebrates

Paleozoic

Trilobites, Graptolites, Brachiopodes, Corals, The extinct Archaeocyaths (Sponge-like animals which are limited to the cambrian). Molluscs (Nautiloids, Gastropods, Bivalves), Crinoids, Fusulines, Ostracods, Conodonts

Cenozoic

Marine Invertebrates:

1-Protistans (unicellular organisms with nuclei)

A-Protozoa (predominantly autotrophic unicellular organisms) The pelagic golden algae particularly the coccolithophores, silicoflagellates, the siliceous diatoms, dinoflagellates, and the red algae.

B-Protozoa (predominantly heterotrophic unicellular organisms) The foraminifera both benthic and planktonic

Animals:

Marine Invertebrates: Hexacorals, Bryozoa, Mollusca; Bivalves (Pelecypods), Gastropods and Cephalopods, Annelids, Crustacean (ostracods), and Echinoids.

b- Solnhofen and Edicara fossils.

Solnhofen Fossils are those rare fossil occurrences of soft-bodied animals which are rarely preserved in the geologic record. Near Solnhofen-Eichstatt area (Southern Germany) There are deposits of very fine-grained limestone (Solnhofen limestone) was deposited in quiet broad lagoon in the Late Jurassic.

This limestone contains fishes, jellyfish, insects, pterosaurs, birds, and many other forms.

The body outlines showing jellyfish tentacles, insect wings, pterosaur wing membranes, and the feather of the oldest birds are preserved as impressions.

Edicara fossils: Fossils of many called animals appear near to the close of the Proterozoic (Edicaran or the last Period of Neoproterozoic Era). They represent fossils of three phyla (Coelenterates, Annelids, and Arthropods)
 Ediacara-type fossils represent a group of soft-bodied organisms, mainly known from imprints.

c- Paleozoic and Mesozoic Mass Extinctions.

Paleozoic mass extinction

When (End of...)	Species Loss**	Major Loses to
Ordovician	85 ± 3%	Brachiopods & bryozoans
Devonian	83 ± 4%	Rugose & tabulate corals, armored* & jawless fish
Permian	95 ± 2%	All life! - Trilobites*, corals*, blastoids*

Mesozoic Mass extinction

Triassic	80 ± 4%	Most synapsids
Cretaceous	76 ± 5%	Dinosaurs, marine reptiles, ammonites

Dr. Gamal El Qot

II- Plant Fossils

Answer the following questions **(16 marks)**

1- (a)- Define the following terms (Fossils – Coccoliths - Biozone). (3 marks)

Fossils: are the remains or traces of animals or plants which have been preserved by natural causes in the earth's crust.

Coccoliths: are the minute calcite plates produced by unicellular marine algae, the coccolithophorides.

Biozone: it is the biostratigraphic unit which is an interval of geological strata that are defined on the basis of their characteristic fossil taxa. **or** Biozones are bodies of strata that are defined or characterized on the basis of their contained fossils.

(b)- Write on the (Restricted environment) as a type of calcareous nannofossils

Paleoenvironments. (3 marks)

Restricted environment

a- Monospecific assemblages

Monospecific or monogeneric assemblages are rare in Cenozoic sediments. In the South Atlantic Braarudosphaera chalk, there are usually a few other calcareous nannofossils present, but the assemblage is dominated completely by Braarudosphaera. Monogeneric or monospecific assemblages can also be derived by dissolution of all but the most solution-resistant coccoliths and nannoliths are present. Monospecific assemblages may be found in bays with a restricted environment.

b- Blooms

Blooms of certain species have been noted in many sections just above the Cretaceous/Tertiary boundary, where they include species of Thoracosphaera and

Braarudosphaera. They are considered to be due to unstable ecologic conditions after the Cretaceous/Tertiary boundary events that caused the mass mortality of calcareous plankton at the end of the Cretaceous.

2- Write short notes on Jurassic/Cretaceous boundary - Oligocene/Miocene boundaries with their zones (zonal boundaries). (5 marks)

Jurassic/Cretaceous boundary

The first occurrence of the genus *Nannoconus* is almost synchronous with the Tithonian/Berriasian boundary and thus the Jurassic/Cretaceous boundary. Where *Nannoconus* is found consistently in the Lower Cretaceous, several species will also be found in the uppermost Jurassic: *N. quadratus*, *N. colomii*, *N. steinmannii*, *N. dolomiticus*, *N. globulus* and *N. broennimannii* according to Deres & Acheriteguy (1980).

Black (1971 a) noted a substantial break between Upper Jurassic and Lower Cretaceous assemblages with very few species crossing the boundary.

Cretaceous

The calcareous nannofossil zonation of the Cretaceous (especially the Upper Cretaceous) is well advanced compared to the zonation of the Jurassic. Perch-Nielsen (1979a) and Doeven (1983) gave overviews of several previous zonations and the former suggested evolutionary lineages for some of the stratigraphically important genera and families.

Nannoconus steinmannii Zone (CC I)

Definition: First Occurrence (FO) = Lowest Occurrence (LO) of *Nannoconus steinmannii* to FO of *Stradneria crenulata*.

Age: Latest Tithonian to Early Berriasian (Jurassic/Cretaceous boundary).

Oligocene/Miocene boundary

The Oligocene/Miocene boundary in terms of calcareous nannofossils is placed at the top of NP 25 by some and within NN 1 by other authors. The sequence of disappearance of *H. recta*, *S. ciproensis*, *D. bisectus* and *Z. bijugatus* varies somewhat from section to section and the boundary is thus set differently by different authors, depending on their choice of marker species.

Miocene

The subdivision of the Miocene is based mainly on species of *Discoaster* and thus is usually easily accomplished in low latitudes, where discoasters are common in open ocean assemblages. It is difficult in high latitudes, where discoasters are absent or very rare, and in assemblages from marginal seas, where discoasters and most other markers tend to be rare or missing. Also, the other marker species belong to genera that are more common or even restricted to low latitudes and thus, even more than in the Oligocene, the zonation is most reliable and correlatable over wide distances in low latitudes only.

Sphenolithus ciproensis Zone (NP 25)

Definition: LO of *Sphenolithus distentus* to the LO of *Helicosphaera recta* and/or the LO of *Sphenolithus ciproensis*.

Age: Late Oligocene.

Triquetrorhabdulus carinatus Zone (NN I)

Definition: LO of *Helicosphaera recta* and/or *Sphenolithus ciproensis* to FO of *Discoaster druggii*

Age: Early Miocene and/or latest Oligocene.

3- Write in detail about (Coccolithaceae) family with drawing. (5 marks)

Coccolithaceae

This family includes some very well known and well illustrated genera and species, but also a large number of dubious genera and species. The coccolithaceae include elliptical and round coccoliths with a distal shield of radiating petaloid elements. In the optical orientation of most genera of this family, the distal shield does not show birefringence when viewed between crossed nicols. Thus most coccoliths of the coccolithaceae appear smaller between crossed nicols than in normal light, since the proximal shield is usually smaller and shows strong birefringence in many species. In other species the proximal shield only shows slight or no birefringence.

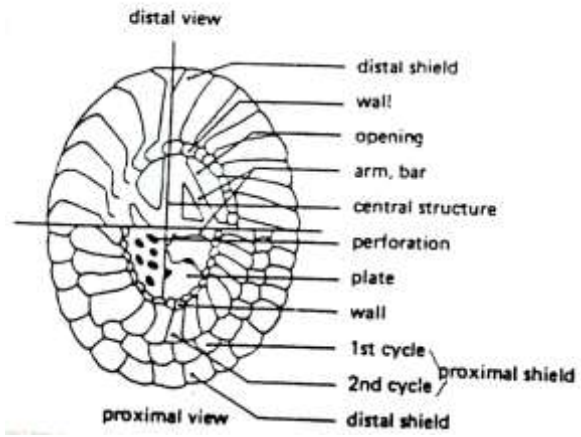
The proximal shield consists of two cycles of elements in some genera as (*Chiasmolithus-Coccolithus-Cruciplacolithus-Ericsonia*) and of a single cycle of elements in others as (*Calcidiscus-Cyclagelosphaera-Markalius*).

The genera *Chiasmolithus* and *Cruciplacolithus* play an important role in the subdivision of the paleogene and several species of other genera of the coccolithaceae have been used as zonal or subzonal markers.

The family coccolithaceae has been grouped into the following three groups:

- 1- Elliptical or rounded coccolithaceae with a distinct central structure, as *Chiasmolithus* and *Cruciplacolithus*.
- 2- Elliptical coccolithaceae with an open or closed central area, as: *Coccolithus* and *Ericsonia*.
- 3- Round coccolithaceae with an open or closed central area, as: *Calcidiscus* and *Cyclococcolithus*.

Coccolithaceae



Best Wishes

Dr/ Fatma Shaker