http://www.biltek.tubitak.gov.tr/bilgipaket/jeolojik/index.htm

PALEONTOLOGY

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Department of Geology

Lecture 2

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http://members.cox.net/jdmount/paleont.html

Topics

- Taxonomy, taxonomic hiarerchy
- Rules for fossil writings

- Utilities of fossils (Significance of fossils)
- Dating of rocks by using fossil data
- Interpreting of paleoenvironments by fossil data
- Interpreting of Structural Geology of an area by using fossils
- Examples of other utilities of fossils

- Sampling
- Research and Presentations

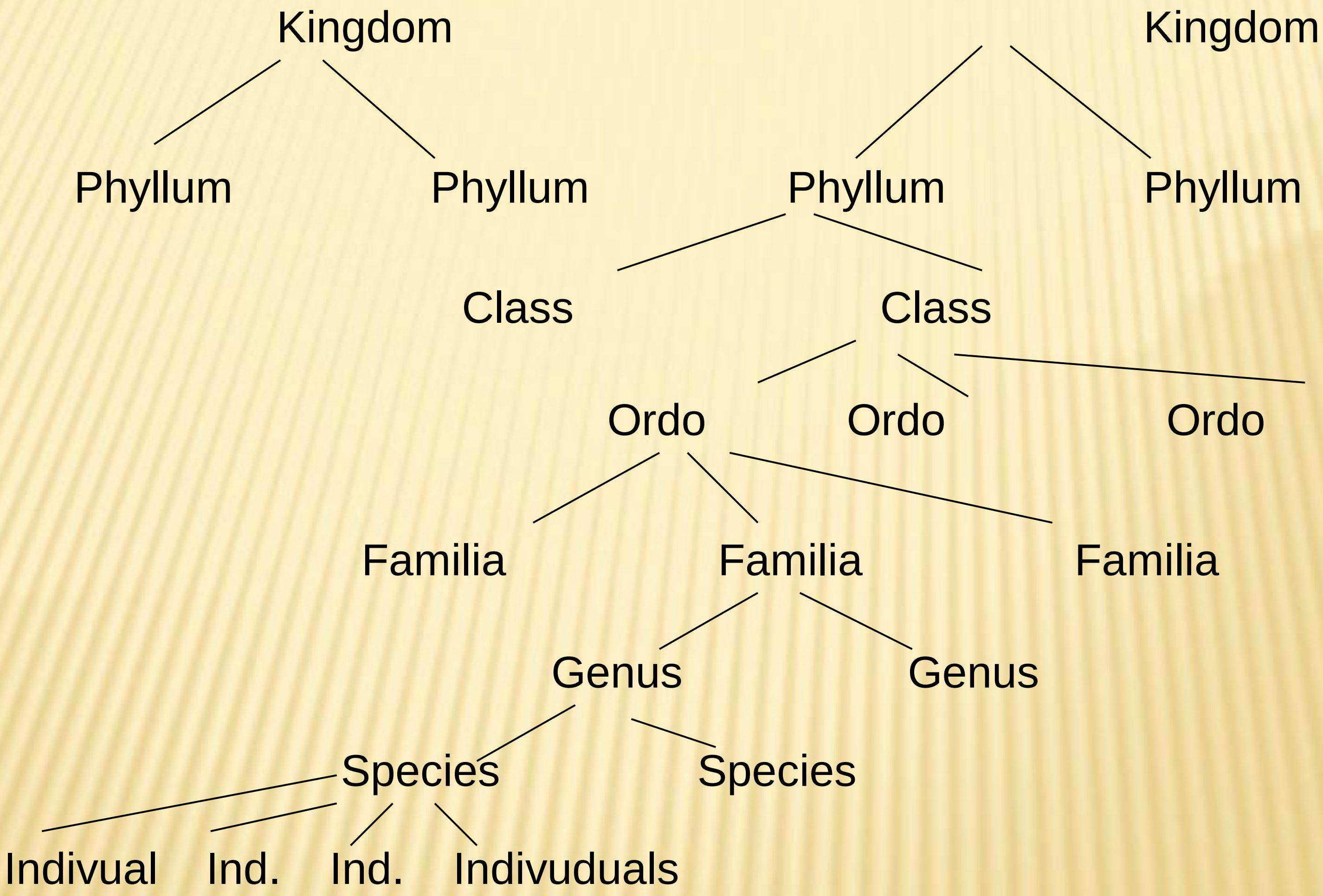
- Classification of organisms
- Microfossil groups

Taxonomic hiarerchy

SPECIES: It is a similar organism assemblage that include similar individuals by reproduction. Three main points should be taken into consideration for species concept. These are;

- Reproduction
- Geographic distribution
- Morphologic similarities

Taxsonomic hierarcy



Fossil writing rules

1. We use Linne’ proposal. Two words we use to identfy the fossil. The first name is genus, second name is species, such as:

   Felis domesticus

   Felis leo

   Felis tigris

2. The first letter of genus is capital, the first letter of species starts by small letter.

   F*elis* ***d****omesticus*

3. The genus and species names should be written in italics, such as:

   Felis domesticus

4. ***Felis*** sp. sp. means unidentified species and it is written in normal character.

5. *Felis* cf. *domesticus*

   Felis aff. *domesticus*

   where cf and aff. show similarities.

6. *Pseudomia hekimhanensis* Görmüş, 1999

Genus species author date

in italics in italics normal characters

7. Species name can not be changedi but genus may be changed. When the species is included into another genus, the first author should be written in brackets such as:

Edomia hekimhanensis (Görmüş, 1999), Canberk, 2050

8. ------cea subfix for superfamily Exmp: Loftusicea

------dae subfix for family Exmp: Loftusidae

------nae subfix for subfamily Exmp: Loftusinae

belirtilen ekleri içeren kelimeler normal karakterlerde yazılır.

9. In animals Phyllum, in plants Division we use

10. Holotype, paratype, neotype are important words for fossils.

Homework 2

Find an article page from a web site or an article or somewhere, and study and write the fossil names the same as seen in the article page, indicating if they are true or false.

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Herein,
Cibicides lobatus
Bolivina paula
Buliminella elagantissima
Genus –italics, species-italics

Reference
It must be written.

1973). The dominant modern species found in the bed 16 assemblages include *Cibicides lobatulus, Bolivina paula,* and *Buliminella elegantissima.* In bed 18, the dominant species are *Bolivina paula* and *Buliminella elegantissima* with a considerably smaller percentage of *Cibicides lobatulus.* These assemblages indicate inner neritic environments with an abundance of organic carbon. The highly bioturbated sediment at both levels suggests that abundant organic carbon and moderate oxygen levels were present.

The paleoclimatic setting for these beds is postulated by Gibson (1962:72) and Gernant (1970:47), on the basis of foraminiferal and ostracode assemblages, as being of temperate nature, probably similar to that presently found off the Maryland coast.

Statistical Analyses of Bed 16

UNISPECIES ANALYSES.—The number of individuals, x_{ij}, for the stations $i = 1, 2, \ldots, 9$ and replicates $j = 1, 2, \ldots, 5$ for each of 36 species were enumerated. In all there are N = 45 observational samples of p = 36 species from h = 9 stations. Table 1 lists the 36 observed species and assigns each a number. To normalize the data and equalize the variance, the original variables were transformed to $\ln(x_{ij} + 1)$. The original data are given in Appendix 1 (9 rarely occurring species were not used in the analysis). To gain some familiarity with the data being analyzed, the mean of $\ln(x_{ij} + 1)$ for each of the 9 stations and 36 species is listed in Table 2. To give the reader an idea of the number of individuals involved, ln 2 = 8, ln 3 = 20, ln 4 = 55, and ln 5 = 150.

In the present study, homogeneity within a bedding surface is defined as a lack of significant difference between the mean number of individuals at each station. A one-way analysis of variance (ANOVA) was carried out to test for the homogeneity of each species. The results of these 36 analyses are shown in Table 3. At the p<.05 level, for $F_{(8,36)}$ a value greater than 2.2 is considered significant. Species 1, 5, 7, and 8 have significant values. Species 1 occurs in only 2 of our observations (both at the same station) and little importance can be attached to its large F value.

Table 2 indicates that species 5, 7, and 8 are all relatively abundant species. With the exception of species 1, which can be regarded as an anomaly, none of the rarer species is inhomogeneous. At the same time, a number of the more abundant species, 2, 3, 6, and 12, for example, are homogeneous. In general, on a species by species basis, we conclude that bed 16 is highly homogeneous.

MULTISPECIES ANALYSES.—In the unispecies analyses we defined homogeneity as being the lack of a significant difference between the mean number of individuals at each station. Similarly, homogeneity for the multispecies case is defined as a lack of significant difference between the mean vectors of species abundances at the 9 stations. In the unispecies case we tested for homogeneity by ANOVA; a suitable extension to test for differences between the mean vectors is the multivariate analysis of variance (MANOVA). If differences do exist (multispecies population is heterogeneous), then a canonical variate analysis (CVA) can be utilized to discover which stations are similar and which are different (Seal, 1964; Buzas, 1966, 1967; Reyment et al., 1984). We have compressed the procedure somewhat and gone directly to a CVA because the test for the significance of the eigenvalues computes a U variate, which is also an approximate test of the significance of a MANOVA (Seal, 1964). In other words, in evaluating the significance of the first eigenvalue in a CVA, we obtain the same U variate as would be computed from the ratio of determinants in a MANOVA. Consequently, if the first eigenvalue of a CVA proves significant, we can be confident that there is a significant difference between the mean vector of species abundances.

TABLE 1.—List of species from bed 16 used in statistical analysis.

Species no.	Species
1	*Ammonia beccarii*
2	*Textularia* sp.
3	*Elphidium marylandicum*
4	*Nonionella* sp.
5	*Epistominella pontoni*
6	*Valvulinaria floridana*
7	*Rosalina* cf. *R. globularis*
8	*Cibicides lobatulus*
9	*Massilina glutinosa*
10	*Spiroplectammina exilis*
11	*Buliminella* cf. *B. brevior*
12	*Florilus pizarrense*
13	*Cassidulina* sp.
14	*Bolivina plicatella*
15	*Fursenkoina* sp.
16	*Uvigerina* sp.
17	*Florilus chesapeakensis*
18	*Anomalinoides* ? sp.
19	*Nonion* cf. *N. cassidulinoides*
20	*Bolivina paula*
21	*Buliminella elegantissima*
22	*Caucasina* sp.
23	*Lagena substriata*
24	*Quinqueloculina* sp.
25	*Fissurina lucida*
26	*Lenticulina* sp. and *Marginulinopsis* sp.
27	*Trifarina* sp.
28	*Fissurina bidens*
29	*Florilus* cf. *F. grateloupi*
30	*Discorbis* sp.
31	*Bolivina* cf. *B. marginata*
32	*Lagena* cf. *L. laevis*
33	*Asterigerinata* sp.
34	*Bolivina* sp.
35	*Fissurina* cf. *F. marginata*
36	*Pseudopolymorphina* sp.

Herein,
1. *Ammonia beccarii*
3. *Elphidium marylandicum*
5. *Epistominella pontoni*
6. *Valvulinaria floridana*
8. *Cibicides lobatulus*
9. *Massilina glutinosa*
10. *Spiroplectammina exilis*
12. *Floridus pizarrense*
14. *Bolivina plicatella*
17. *Florilus chasepeakensis*
20. *Bolivina poula*
21. *Buliminella elegantissima*
23. *Lagena substriata*
28. *Fissurina bidens*
Genus –*italics*, species- *italics*
2. *Textularia* sp.
4. *Nonionella* sp.
13. *Cassidulina* sp.
15. *Fursenkoina* sp.
16. *Uvagerina* sp.
18. *Anomalinoides* sp.
22. *Caucasina* sp.
24. *Quinqueloculina* sp.
27. *Trifarina* sp.
30. *Discorbis* sp.
34. *Bolivina* sp.
Genus- *italics*, sp. means unidentified species, normal in character.

7. *Rosalina* cf. *R. globularis*
11. *Buliminella* cf. *B. brevior*
19. *Nonion* cf. *N. cassidulinoides*
29. *Floridus* cf. *F. grateloupi*
31. *Bolivina* cf. *B. marginata*
32. *Lagena* cf. *L. laevis*
35. *Fissurina* cf. *F. marginata*
Genus- *italics*, cf. looks like *marginata*
marginata* species name, *R. B. F. B. L.* and *F.* the first letter of genus name, *italics

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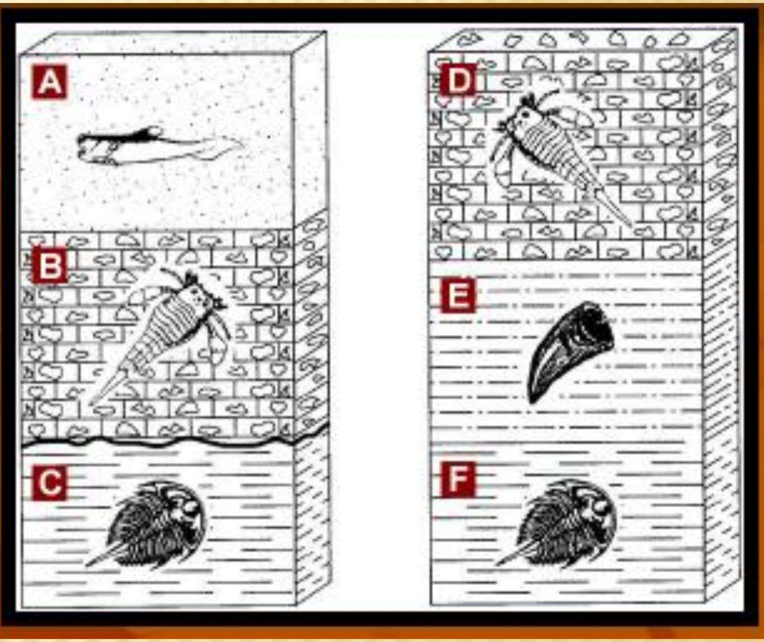
SIGNIFICANCE OF FOSSILS



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Utilities of fossils

1. **Relative dating of rocks**
2. **Paleoenvironmental interpretations, important clues to ancient environmental conditions**
3. **Interpretations on structural events**
4. **Correlation**
5. **Biostratigraphy (definations of biozones)**
6. **Paleobiogeography**
7. **Paleoecology**
8. **Extinction – disappearances of species and appearences, history of life**
9. **Framework for other events in Earth's History**
10. **Guide in exploring for fossil fuels**
11. **History of the Earth**

FOSSIL & MINERALS ARE THE IDENTY CARDS OF ROCKS SEEN TODAY, CLUES FOR FUTURE.

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1 Relative dating of rocks

The followings;

- index fossil defination

- ***which fossils may be index fossils?***

- ***fossilization history and rock types***

should be taken into the consideration

http://www.canandaiguaschools.org/webpages/dedrickr/index.cfm?subpage=1681

Index fosil

organism remains having the following features:

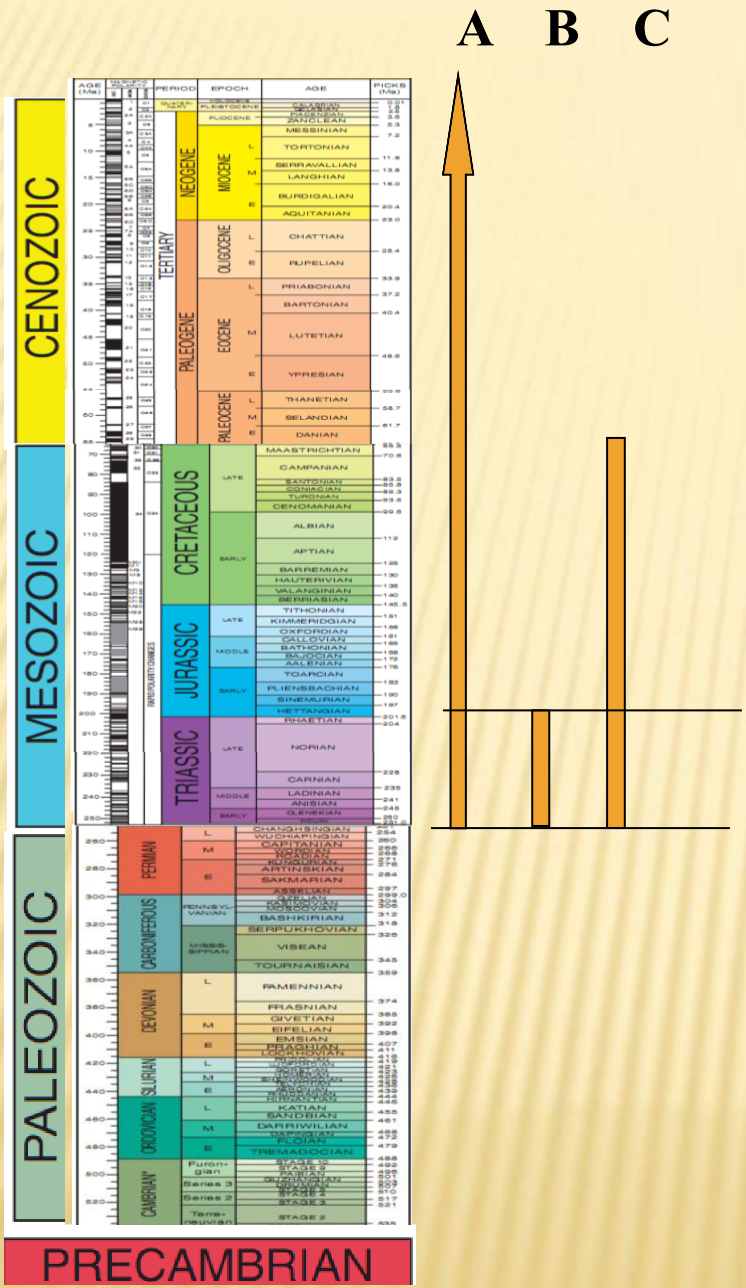
- representitive specific period in time, relatively short-lived (1),

- ***indicative a specific paleoenvironment (2),***

- ***showing a wide paleobiogeographic distribution (3),***

- ***abundant, prolofic reproducers (4), and***

- ***easy recognizable view characters (5)***



Lets say, if a rock include the following A, B, C fossils, and the ages of A, B, C fossils in the literature is as follows:

where, A is a fossil from Triassic to Recent,

B is Triassic in age

C is from Triassic to Crteaceous,

Question: What age could be attributed to the rock?

Answer:

Overlap age is Triassic. So, the age of Triassic is attributed to the rock.

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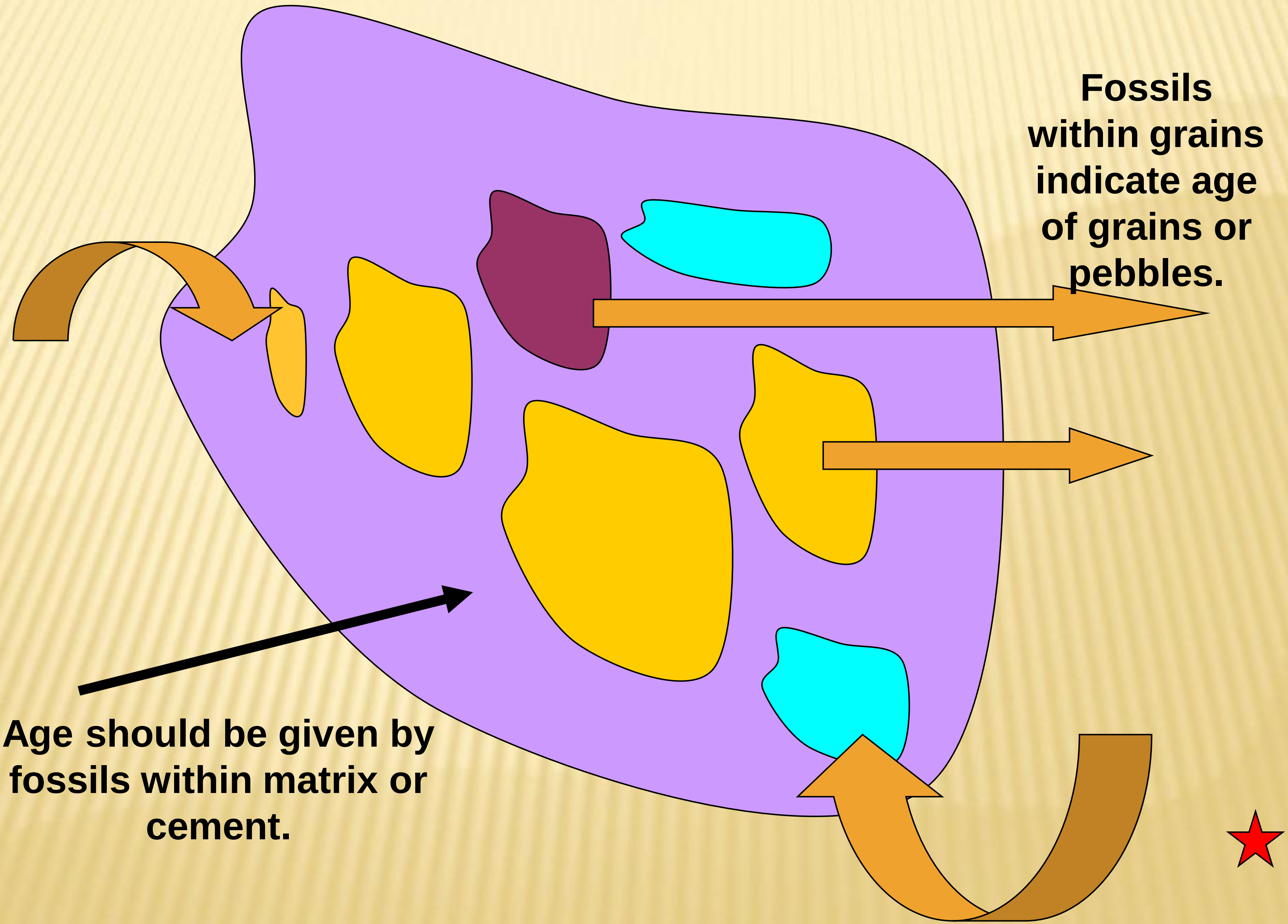
A sandstone or a conglomerate example



Fossils within grains indicate age of grains or pebbles.

Age should be given by fossils within matrix or cement.

Examples of Index fossils:

Example of Subphyllum:	**Graptoliths**	**Upper Cambrian to Silurian**
Example of Class:	**Trilobita**	**Paleozoic**
Example of Class:	**Rudists (Bivalvia)**	**Late Cretaceous**
Example of Family:	**Loftusidae**	**Late Cretaceous**
Example of species:	***Orbitoides apiculatus***	**Maastrichtian**

Relative dating by fossils mainly comes from index species of organisms. Thus, we have to be ceruful on the followings:

1. Overlaping time (concorrunce time) of included fossil contents within a rock,

2. Species identifications are more important than other hyerarcy positions.

3. Reworking, transportations are also important.

4. Index fossils within matrix or cement of a rock should be taken into consideration

2 Paleoenvironmental interpretations, important clues to ancient environmental conditions

Factors:

1.Substrate (rocky, sandy, mudy and mixed substrates), important points: grain Size – firm/soft, composition, mobility/stability

2. Salinity (Kinne (1964) classifies waters as follows: fresh water, brackish water, normal salted marine water 30-40 %o, extreme salted marine water 40-80 %o, very extreme salted marine water >80%o), euryhalin organisms: stenohaline organisms

3. Temperature (eurythermal, stenothermal)

4. Depth (tidal, shelf, bathyal, abissal etc.)

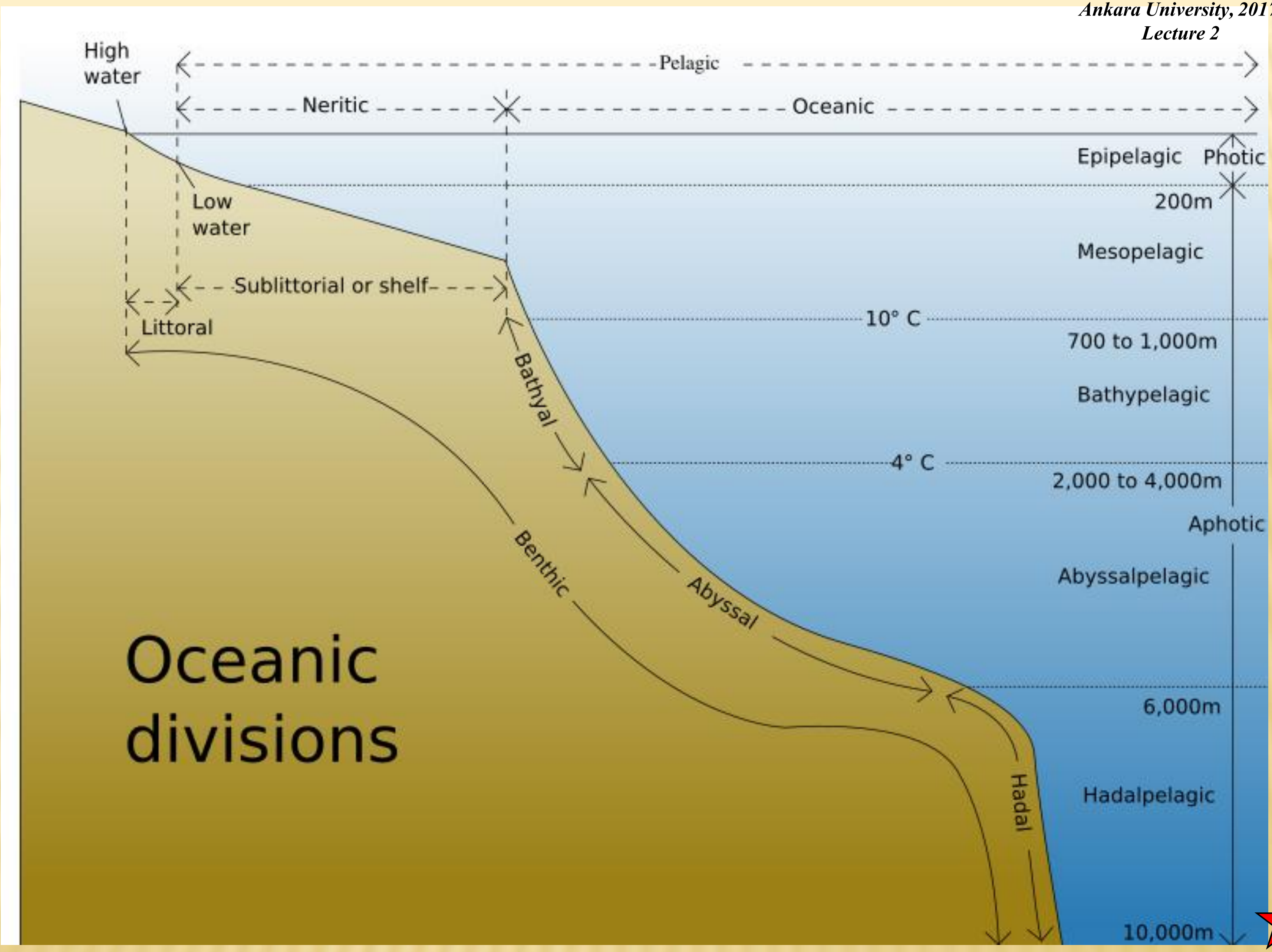
5. Light (photic-euphotic: the depth of water in lake or ocean having sufficant sunlight for photosynthesis to occur; aphotic zone)

6. Oxygenation, Eh, pH

7. Agitation / Currents, Clarity/Cloudiness of Water

8. Biological factors (life modes) & Nutrients: type, abundance, distribution

9. Reworking, transportation

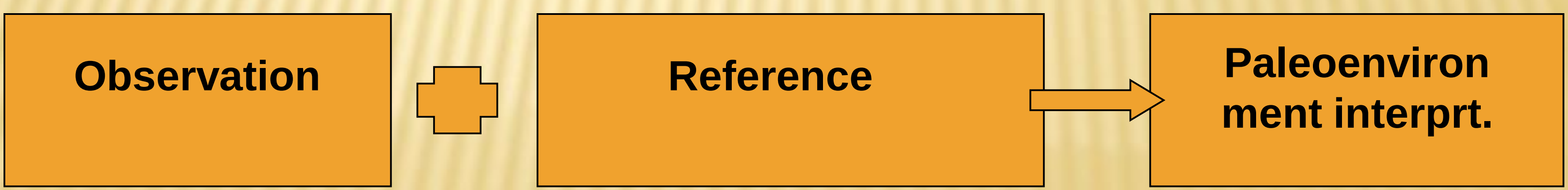


http://en.wikipedia.org

Fauna properties for sedimentalogic history may be include the observations on the followings;

1. **Their positions and lineations**
2. **Crystallization within test; geopetal structure**
3. **Cyrstallization of shell and filling materials**
4. **Fossil preservations, break up,**
5. **Reworking, transportations,**
6. **Stylolithic structures and others**

etc…



3 Interpretations on structural events

- **Faults**
- **Foldings**
- **Unconformities**

EXAMPLES FOR FAULTS

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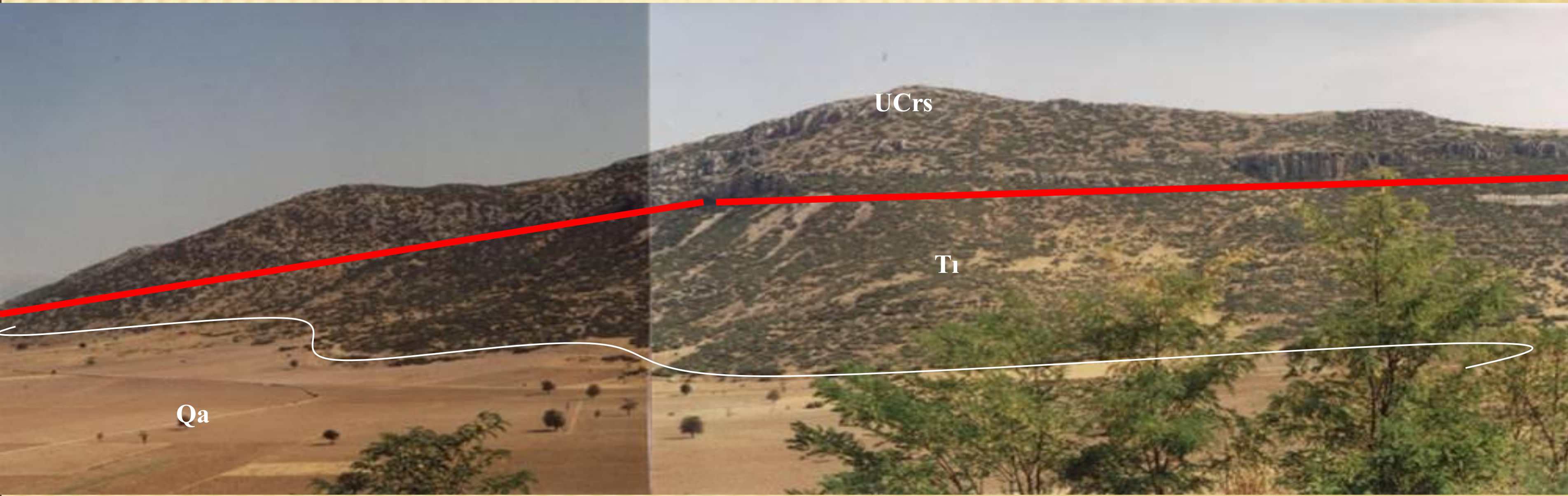
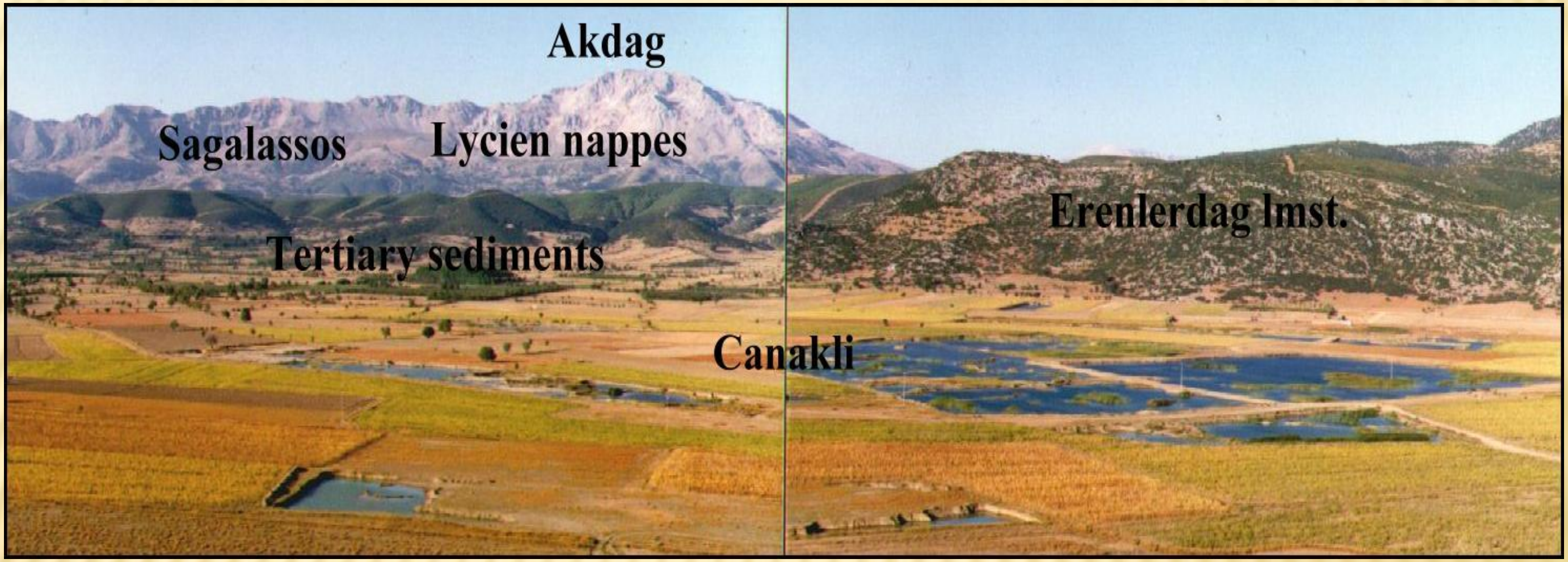


Views from Cretaceous aged carbonates (UKrs. Söbüdağ lmst. UKrç. Çiğdemtepe lmst.) and Lower Tertiary aged clastics (Isparta Fm.), red lines show normal faults.



Clay material area around Canaklı for Sagalassos settlement place showing autochthonous Cretaceous aged Erenlerdag limestone and Tertiary sediments (C/T boundary) and allochthonous carbonates in Akdağ, namely Lycien nappes, looking towards the north.

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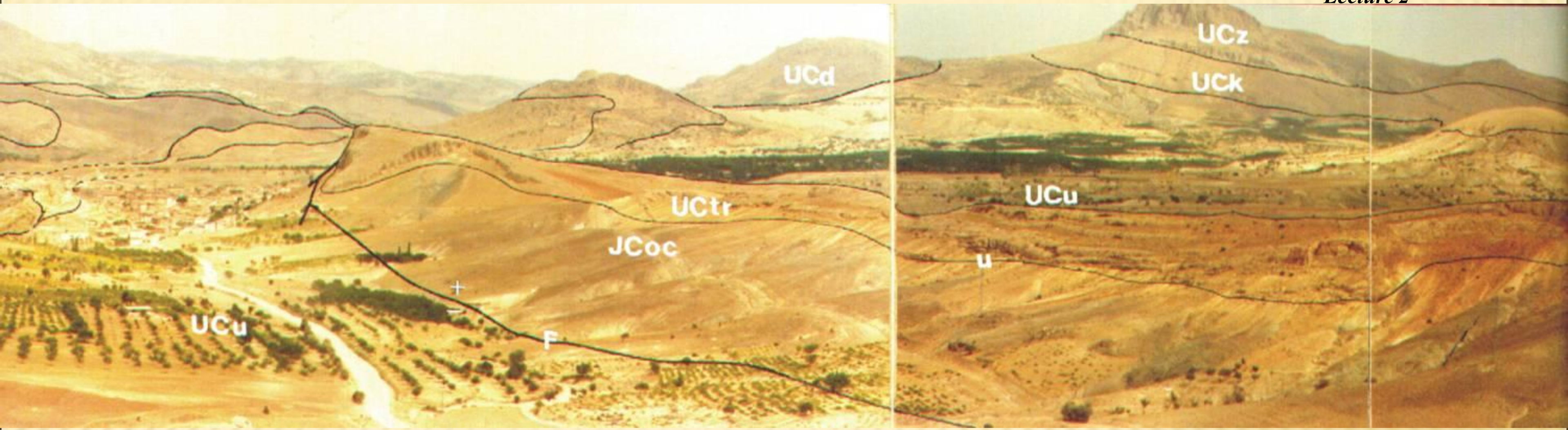
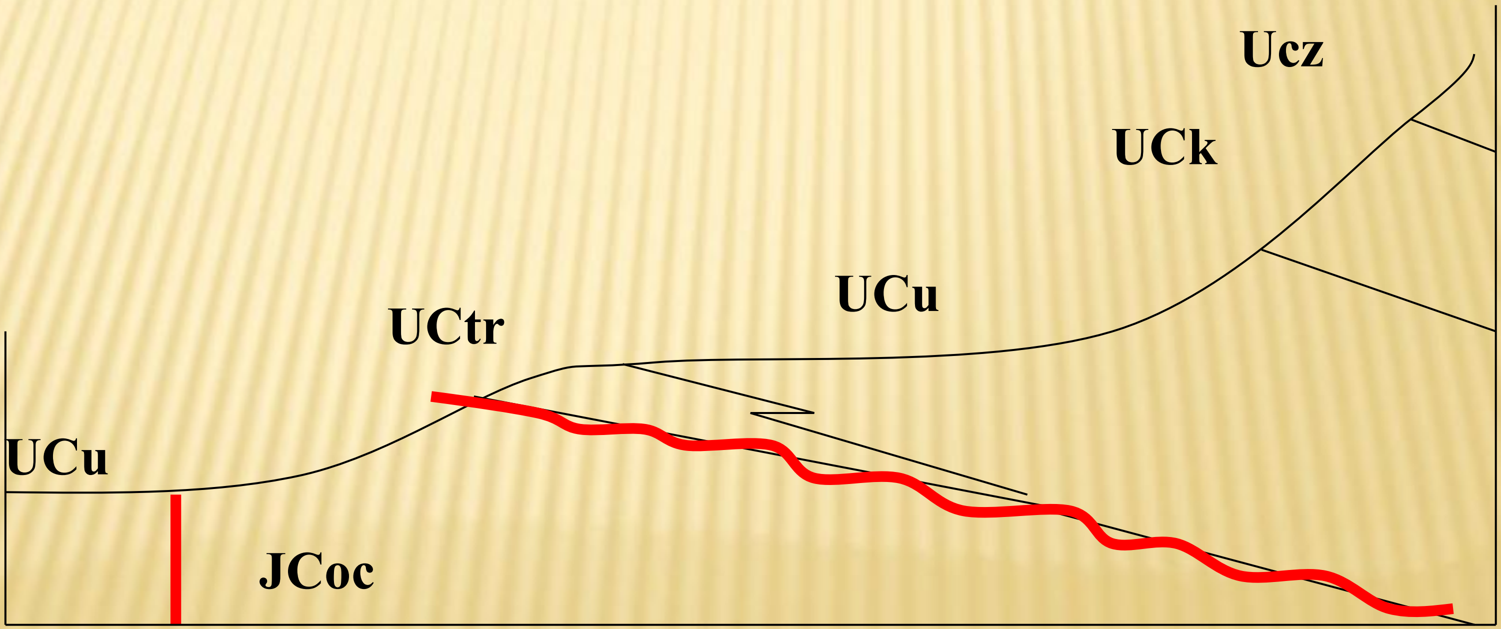
EXAMPLES FOR FOLDINGS





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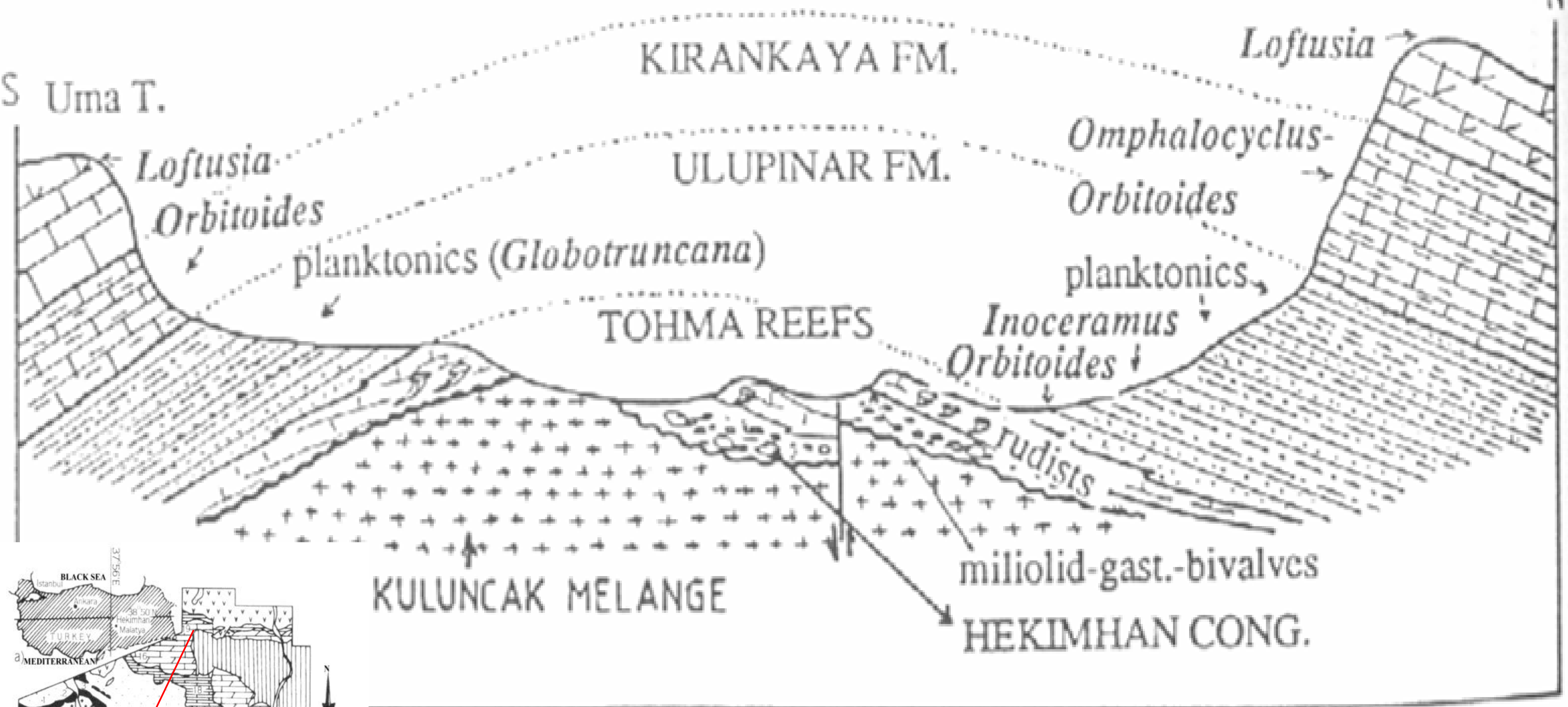

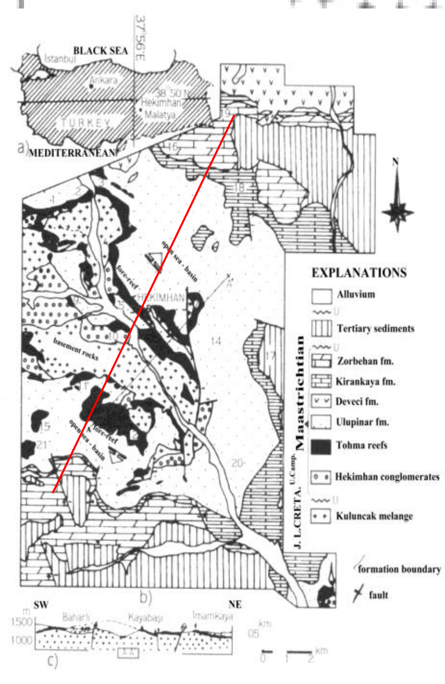

A schematic geological cross-section, S-N in direction showing a large anticline and transgressive to regressive succession in the area during the Campanian to Maastrichtian times.

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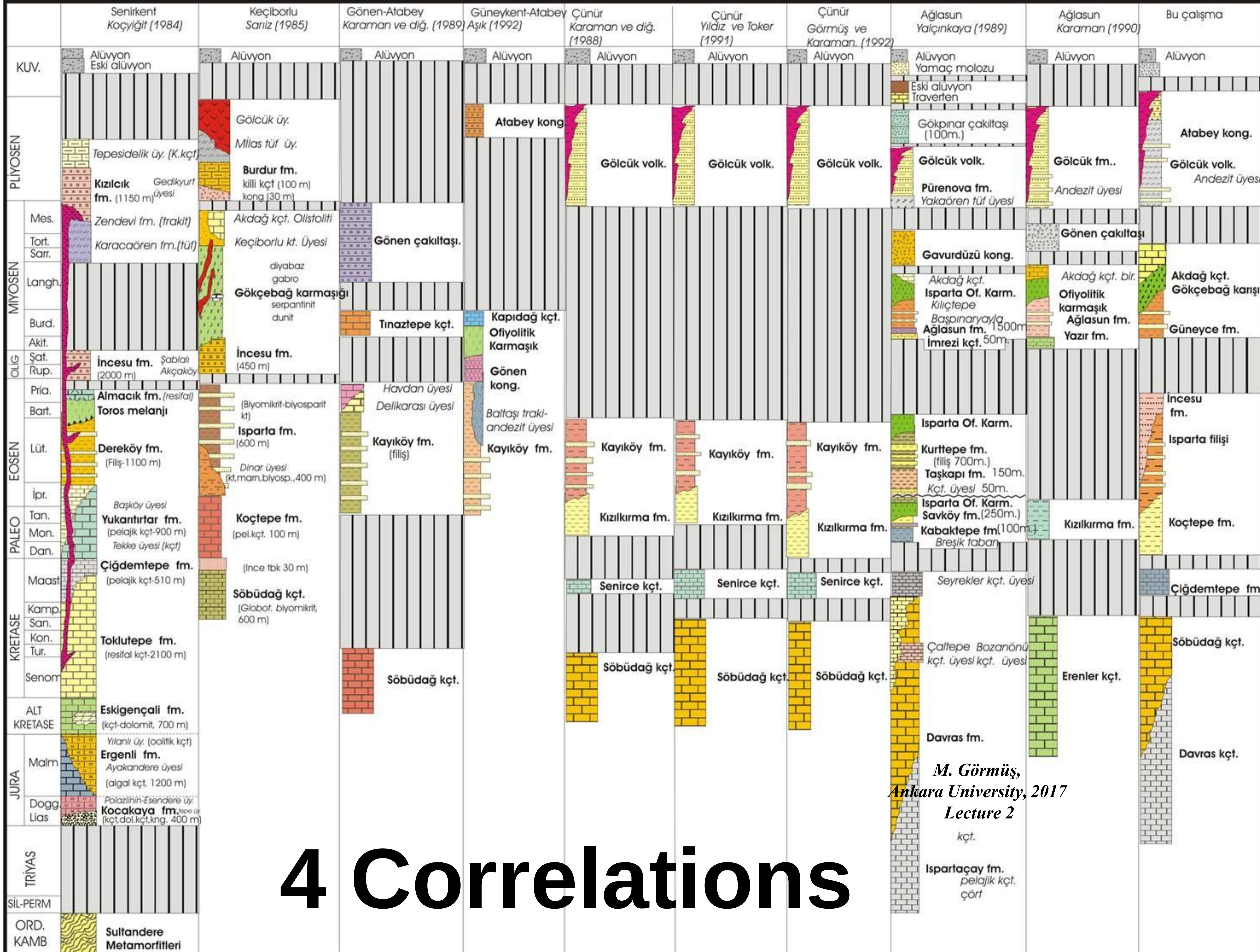
EXAMPLES FOR UNCONFORMITIES

Unconformity between Ispartaçay (TrJı) and Karabayır (Mk) formations, Mk1. conglomerates, Mk2-3. algal, miliolid bearing carbonates (Görmüş & Hançer, 1997), İmrezi Village around.

4 Correlations



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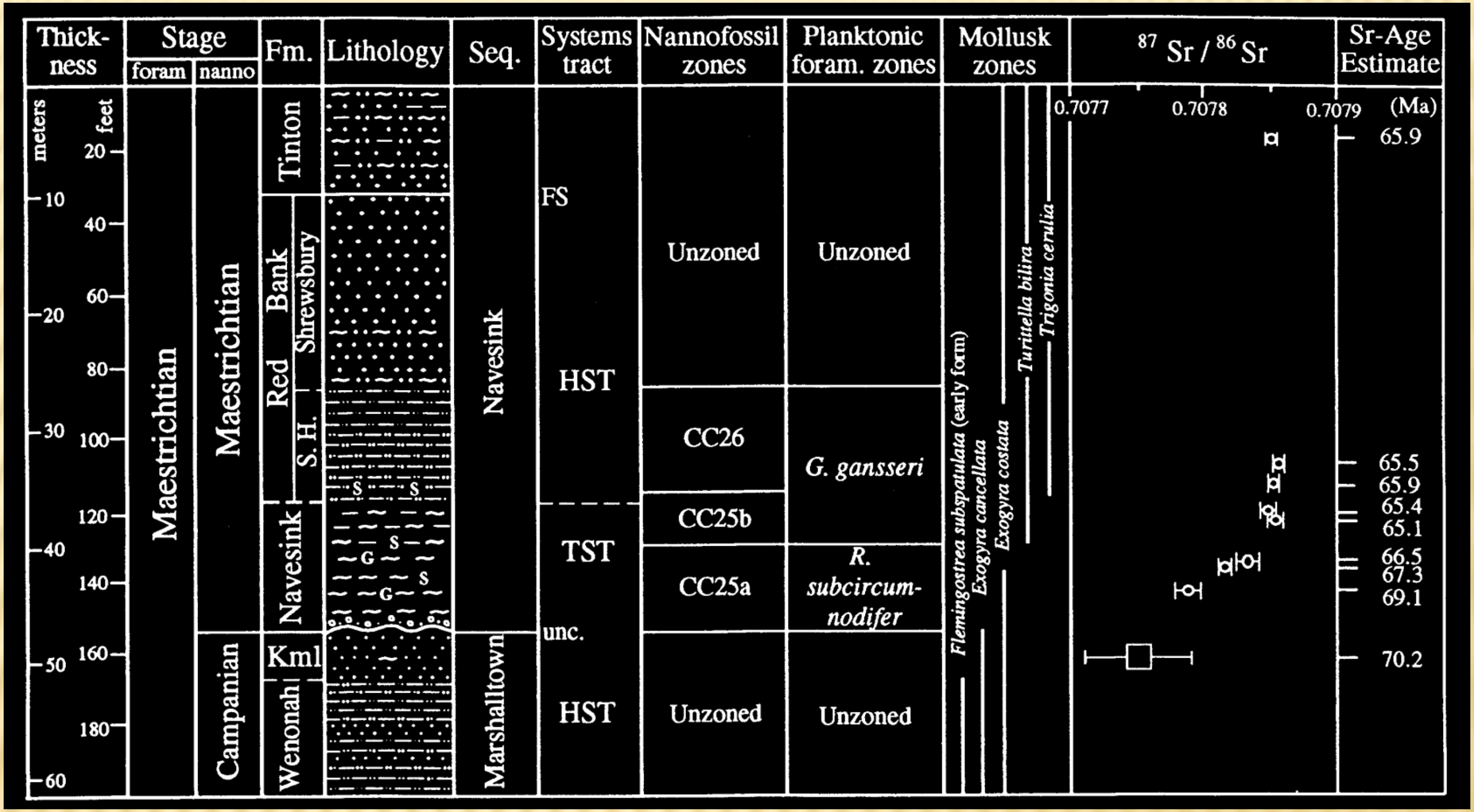
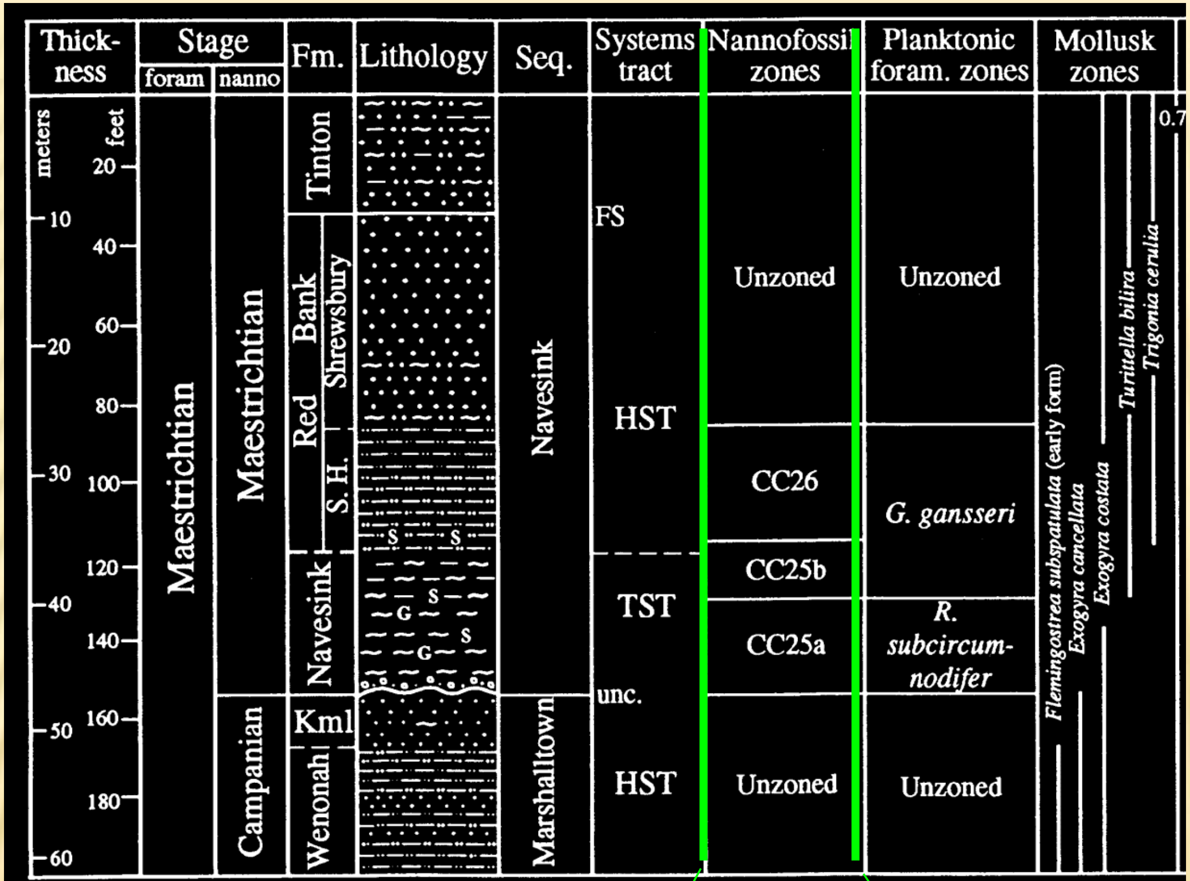
5. Biostratigraphy

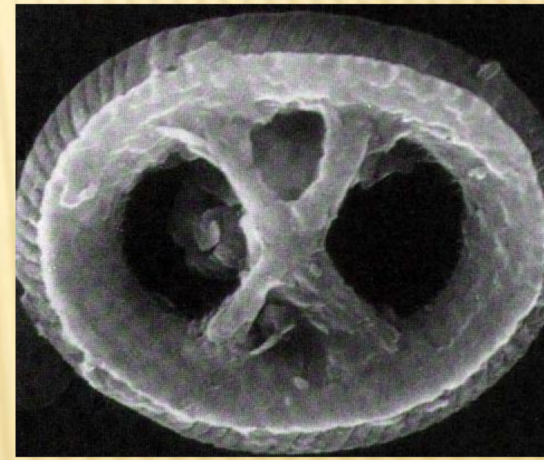


From Sugarman, et. al, 1995

Biostratigraphic zones - intervals of time defined by the presence of particular fossil species.

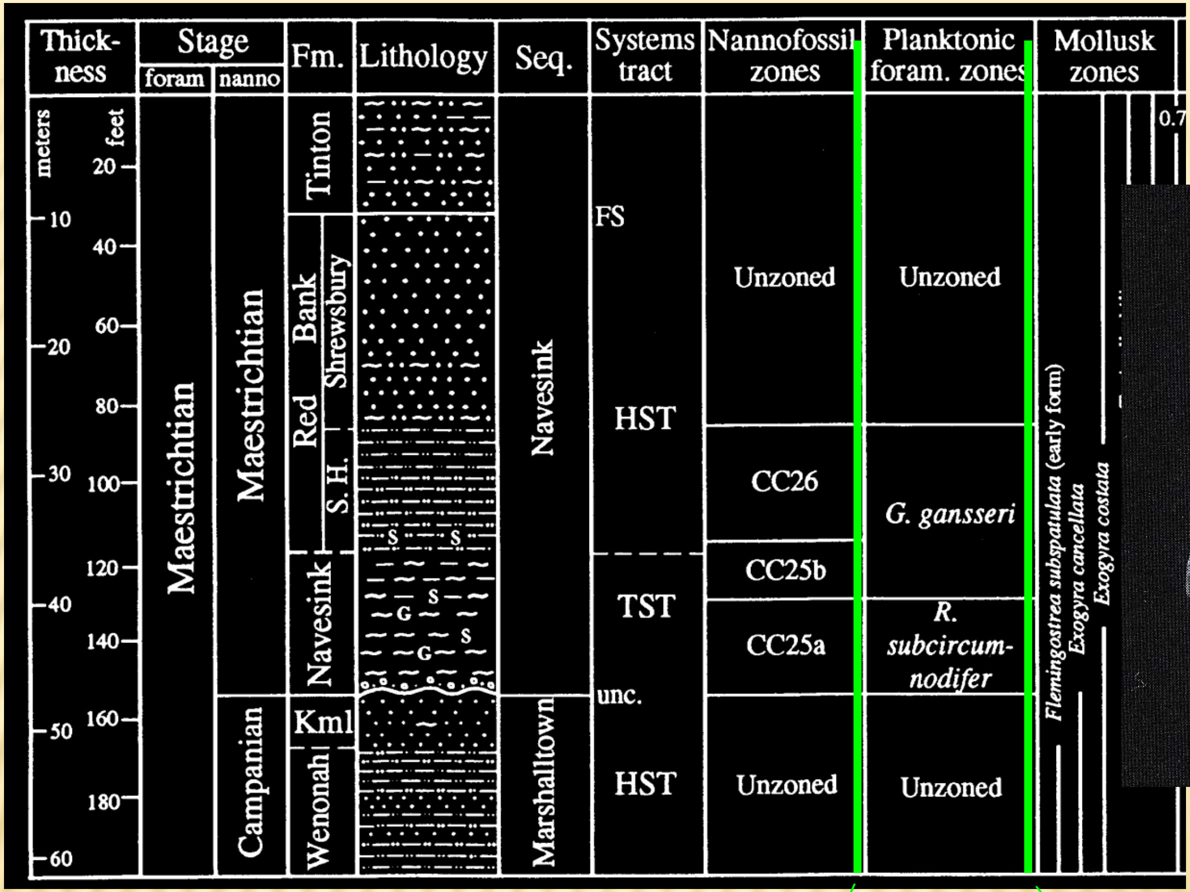
http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html

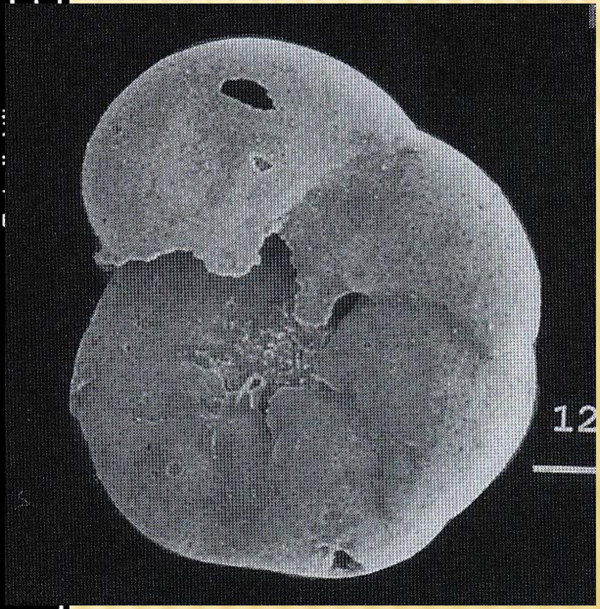




Coccoliths

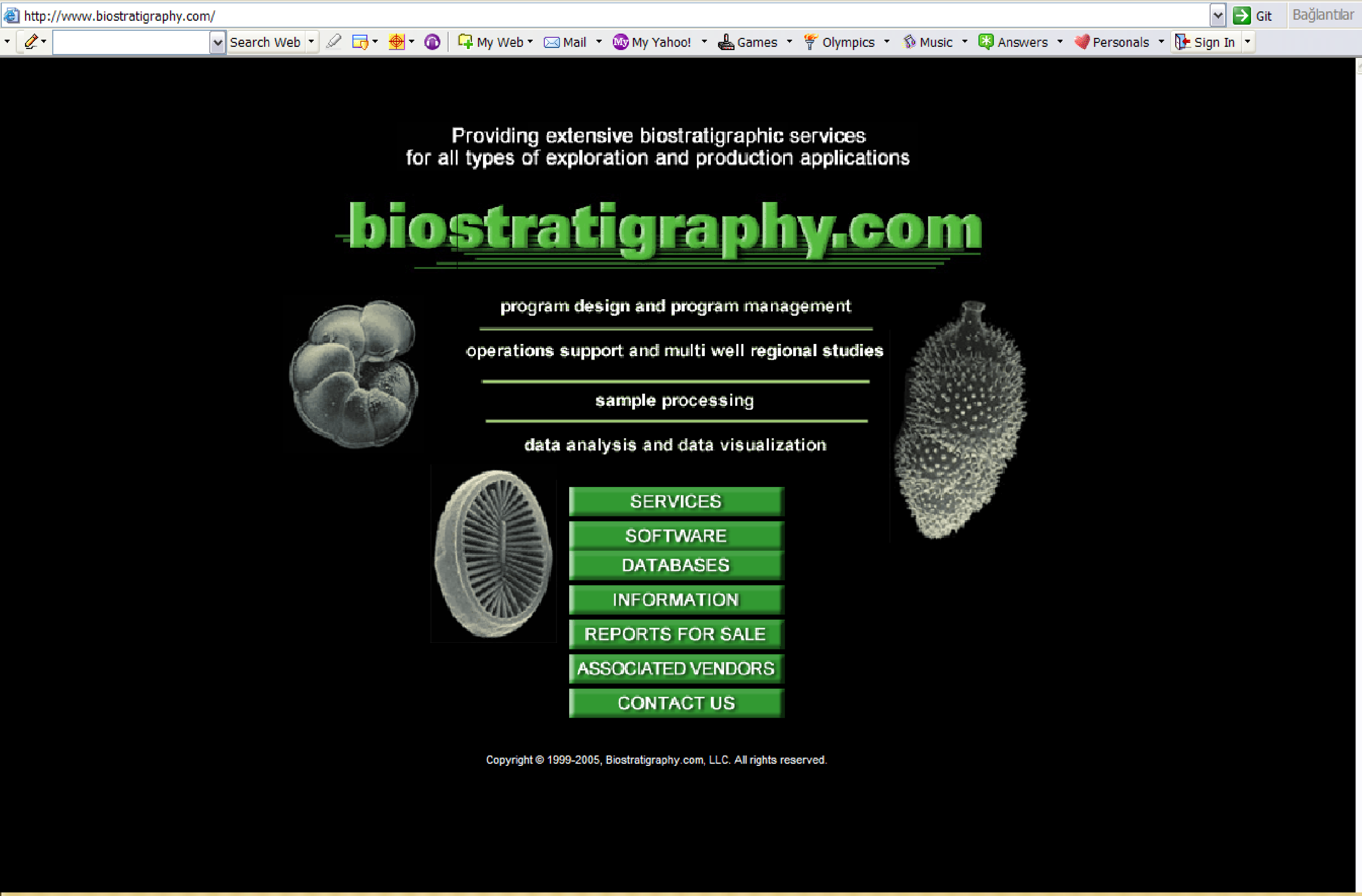
http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html





Foraminifera

http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html



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6-7. Paleobiogeography & Paleoecology

- www.d.umn.edu/gk12/

- Organisms adapt to their environments
- Fossils provide clues to organism lifestyle
- Analogy to living relatives
- Functional Morphology
- Association with other fossils – similar preferences
- Type of substrate

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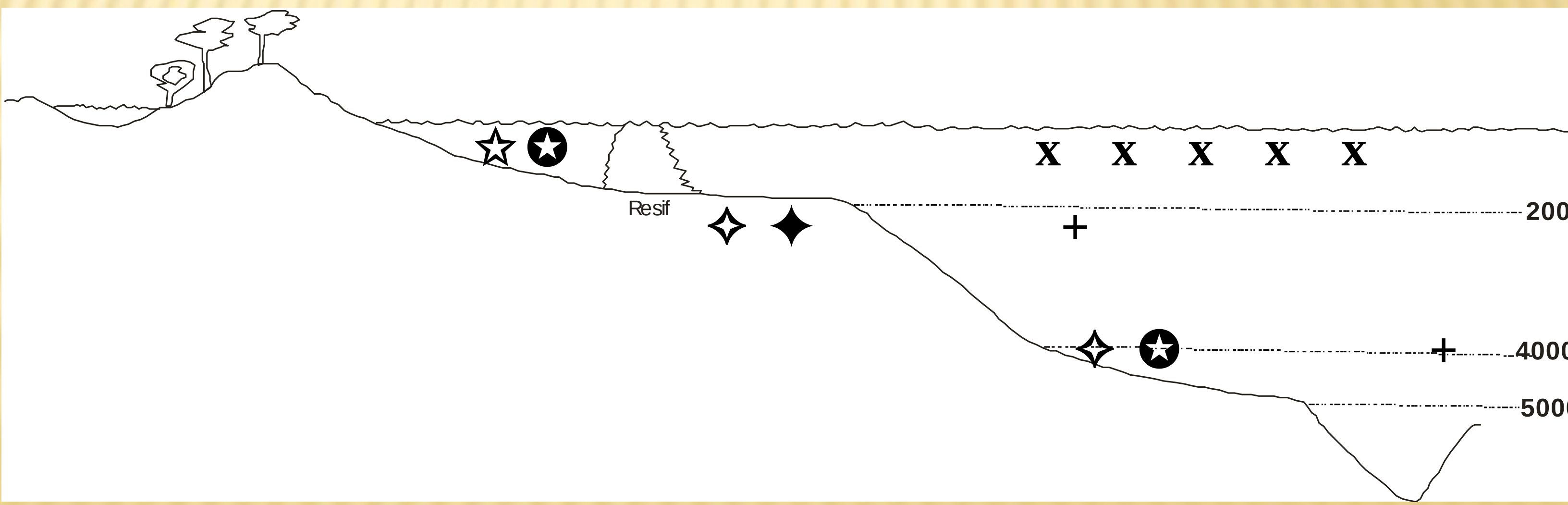
Life Modes

Benthic organisms (live in/on substrate)

	Sessile (unmobile)	Motile (mobile)
Infauna	✧	✦
Epifuna	☆	✪

Pelagic (live within water)

- **Nectic (live itself, mobile)** +
- **Planktic (live by water movements)** x (phytoplanktic, zooplanktic)



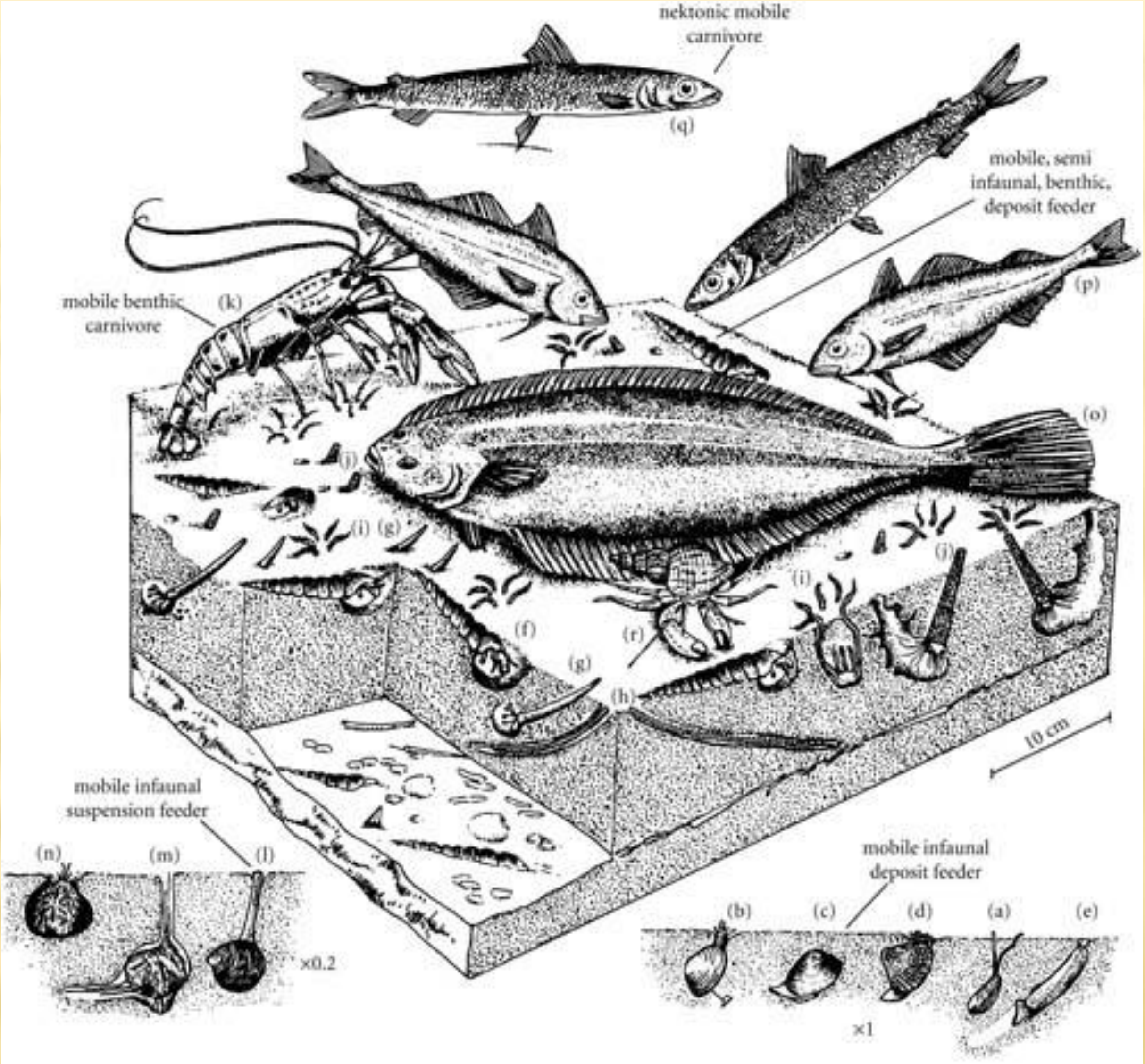
Lifestyles of organisms tell us about environmental conditions

- Sessile organisms rely on currents to bring food
- Motile organisms can search for food in water or in/on sediment
- Distribution of food related to agitation/currents

- *www.d.umn.edu/gk12/*

WAYS TO FEED

- Producer – Plants
- Primary Consumer – Herbivore
- Secondary Consumer – Carnivore
- Passive/semi-active
  - Filter feeding
- Active Feeding
  - Swimming, crawling, scavenging, preying
  - *www.d.umn.edu/gk12/*



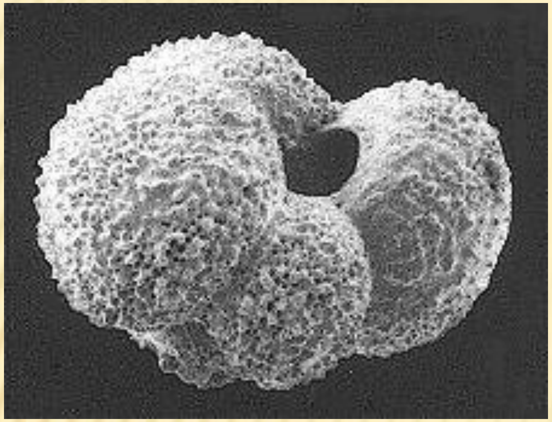
McKerrow, 1978

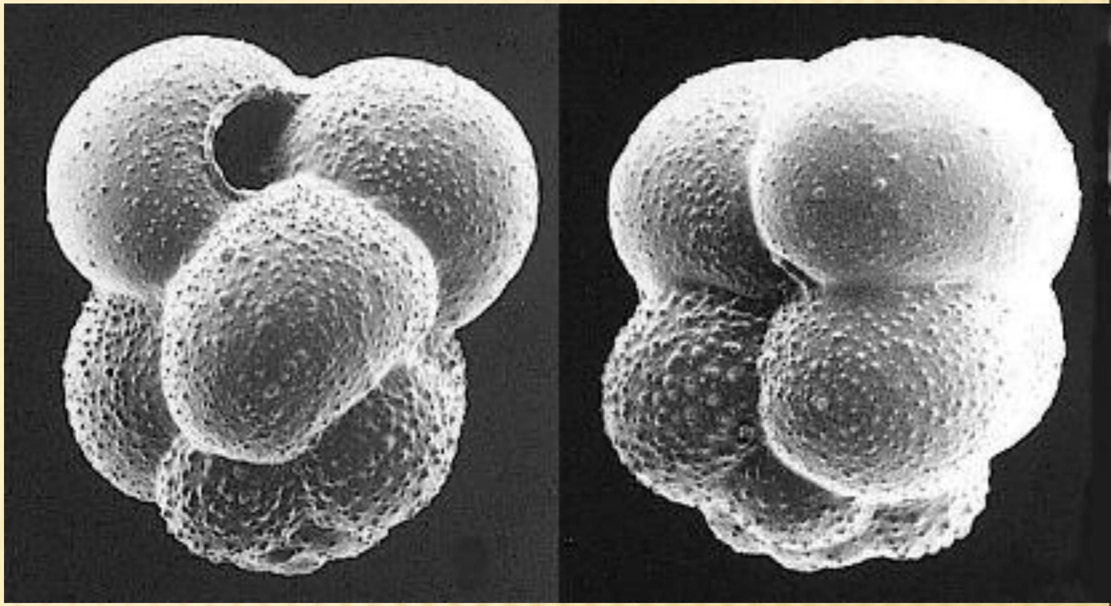
Why are we interested in marine fossils, and why are they useful?

If we simplify the answer, the following more reliable data come from them.

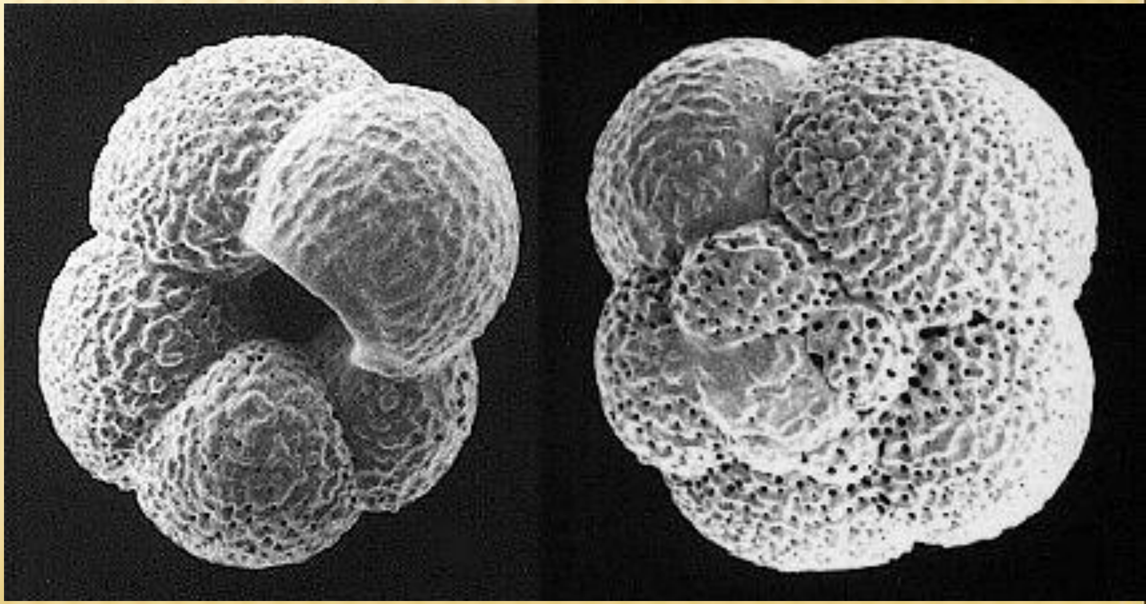
- Biostratigraphy - dating rock layers using fossils.
- Environmental reconstruction - identifying different marine environments in the past.
- Paleothermometry - determining ocean water temperature in the past.
- Paleoclimatology - reconstructing climate change through Earth's history.

Foraminifera





- **Fossil foram species can be used to date age of seafloor and sediment layers.**



http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html

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Stable Isotopes
Oxygen

O^{16} — 99.76%

O^{18} — .2%

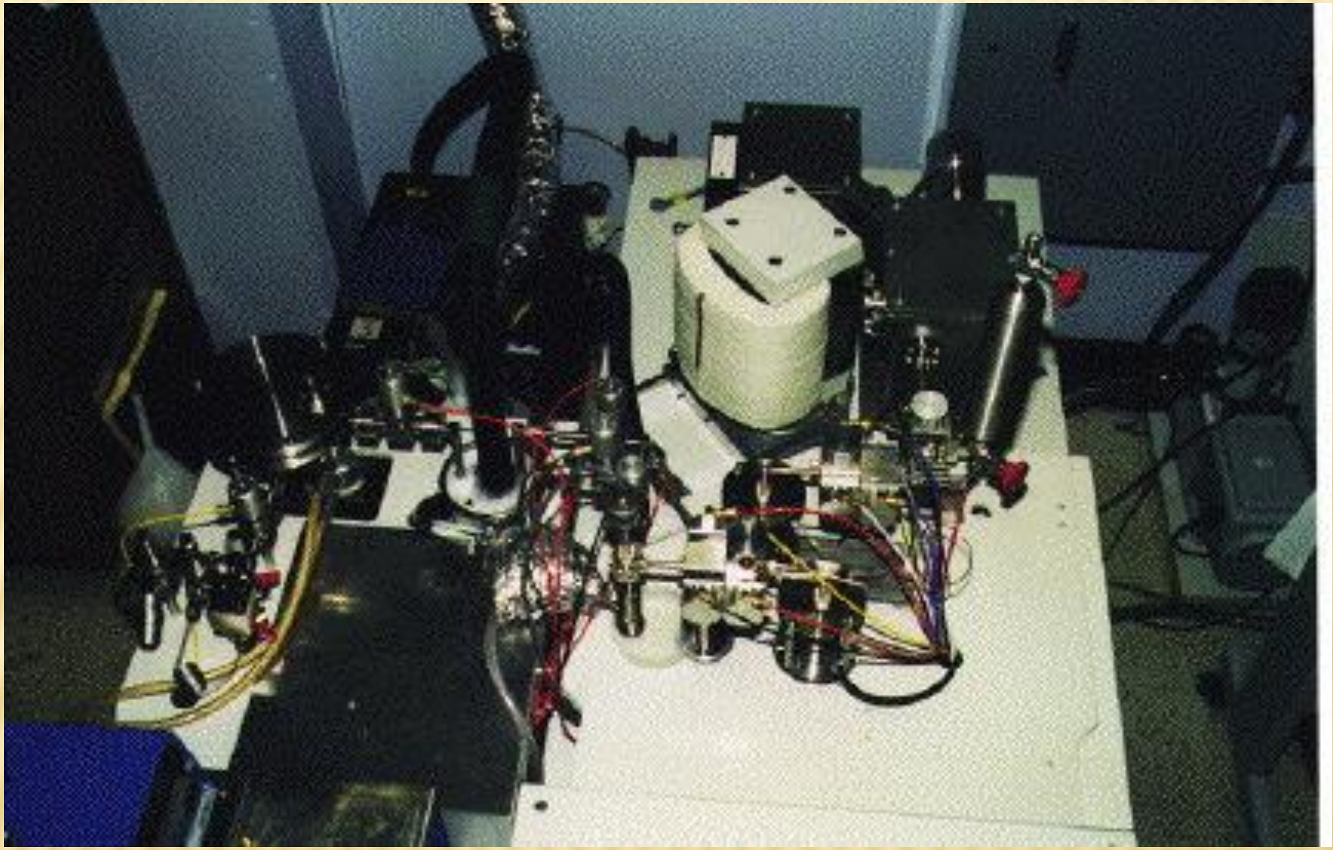
$$CO_2 + H_2O = HCO_3^{-1} + H^+$$

$$2\ HCO_3^{-1} + Ca^{++} = CaCO_3 + H_2CO_3$$

- O^{18} is preferentially removed from seawater during calcite formation.
- This effect is sensitive to temperature.
- Ratio of O^{18} / O^{16} in shell is temperature dependent.
- Can be measured using a mass spectrometer.

http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html

Mass Spectrometer



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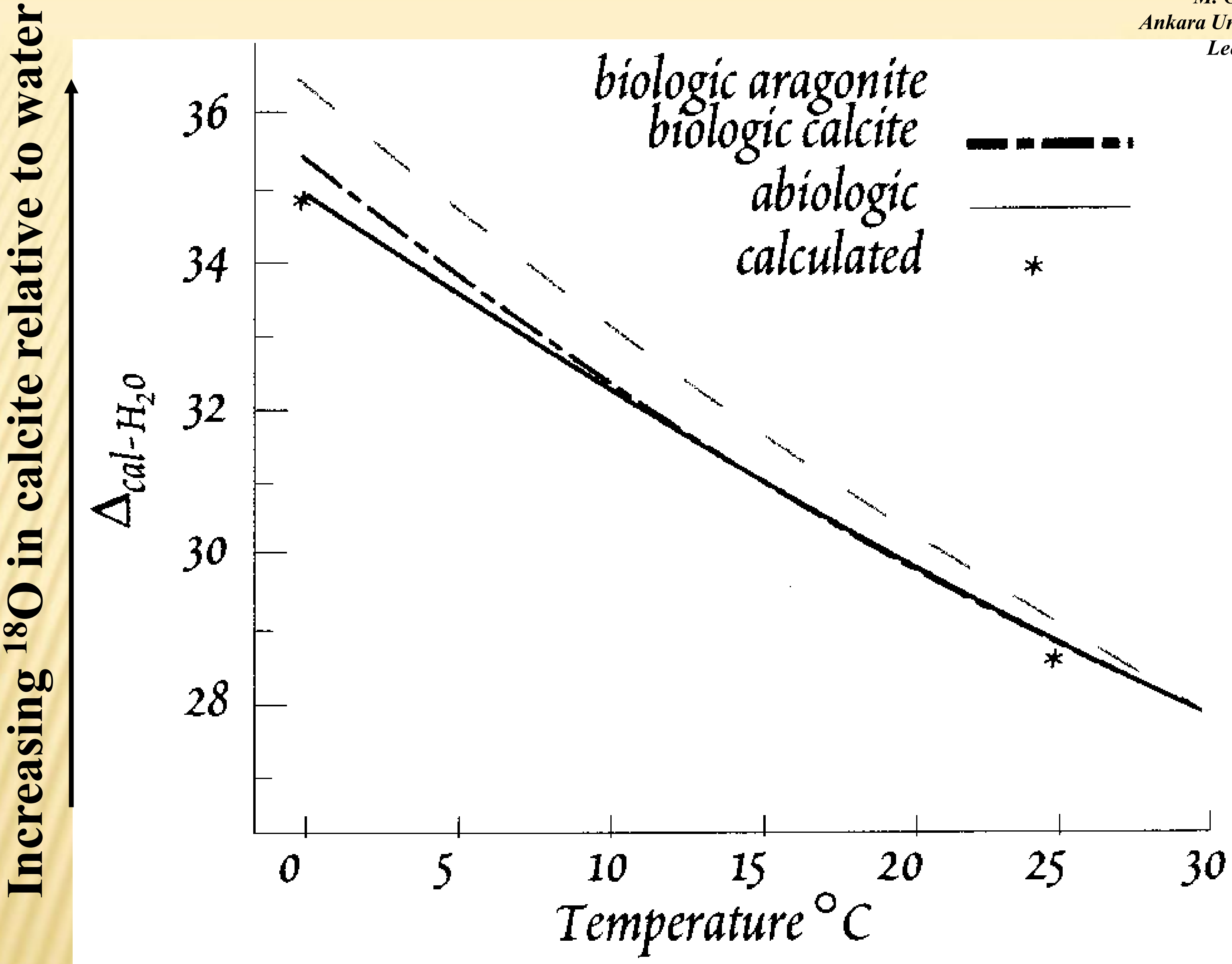


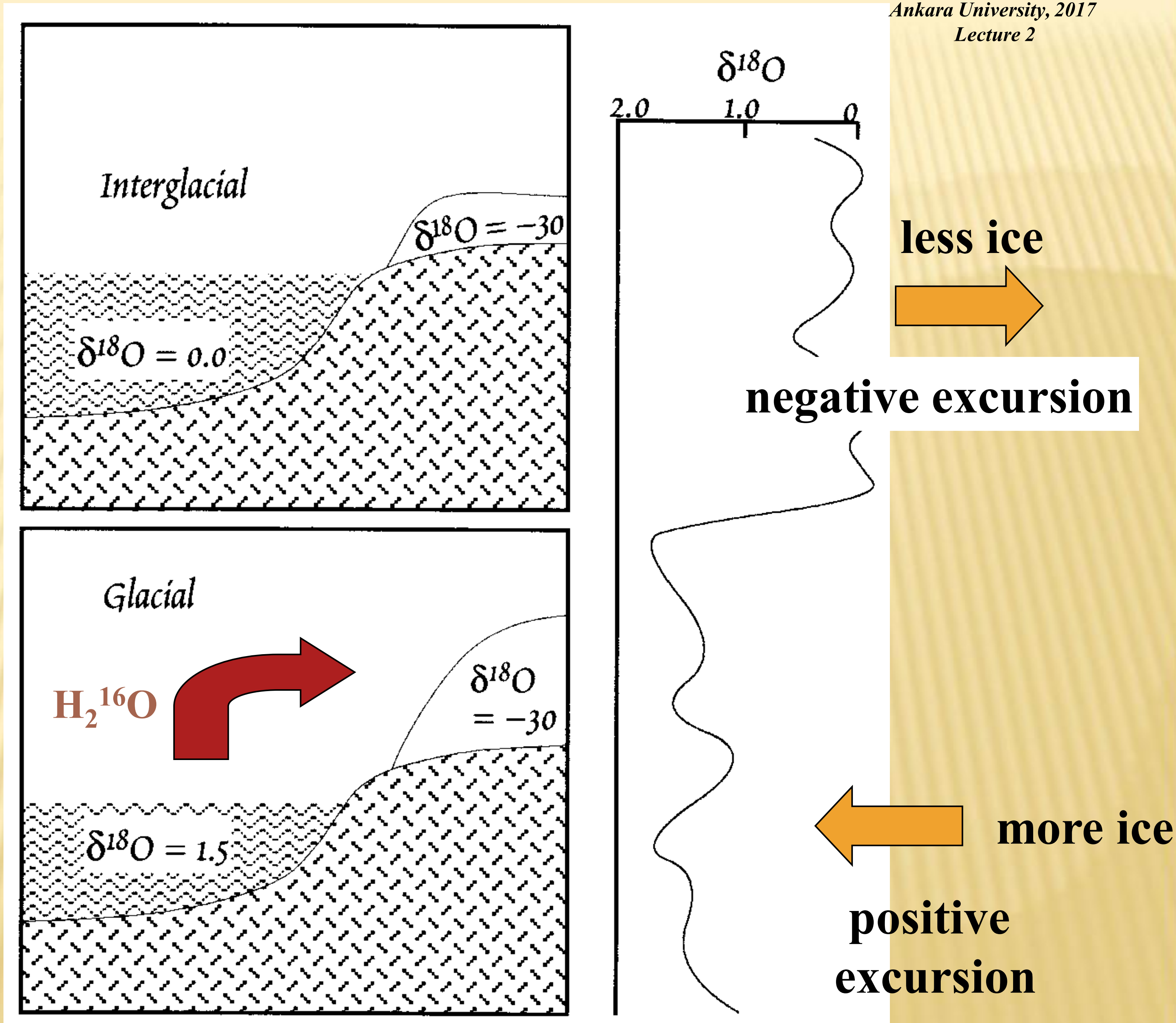
Change in isotopic ratio in carbonate shell with change in water temperature.

http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html

$\delta^{18}O$ due to ice buildup

Glaciations cause more $\delta^{18}O$ to accumulate in seawater.

This happens because ^{16}O evaporates preferentially and becomes trapped on land as glacial ice.



http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html

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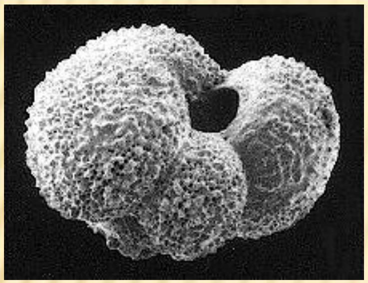
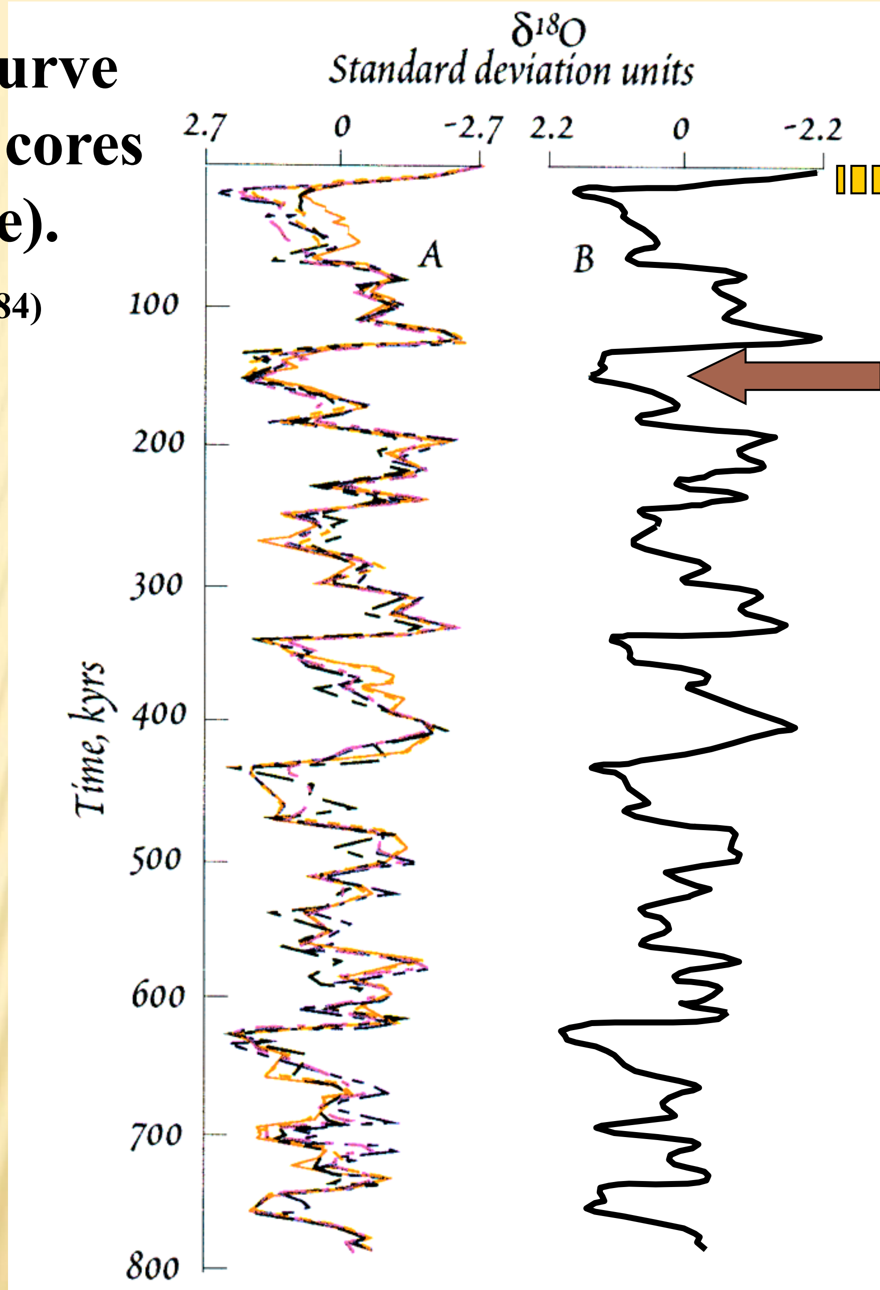
Average δ18O curve from 5 deep sea cores (foram calcite).

After Imbrie et al. (1984)

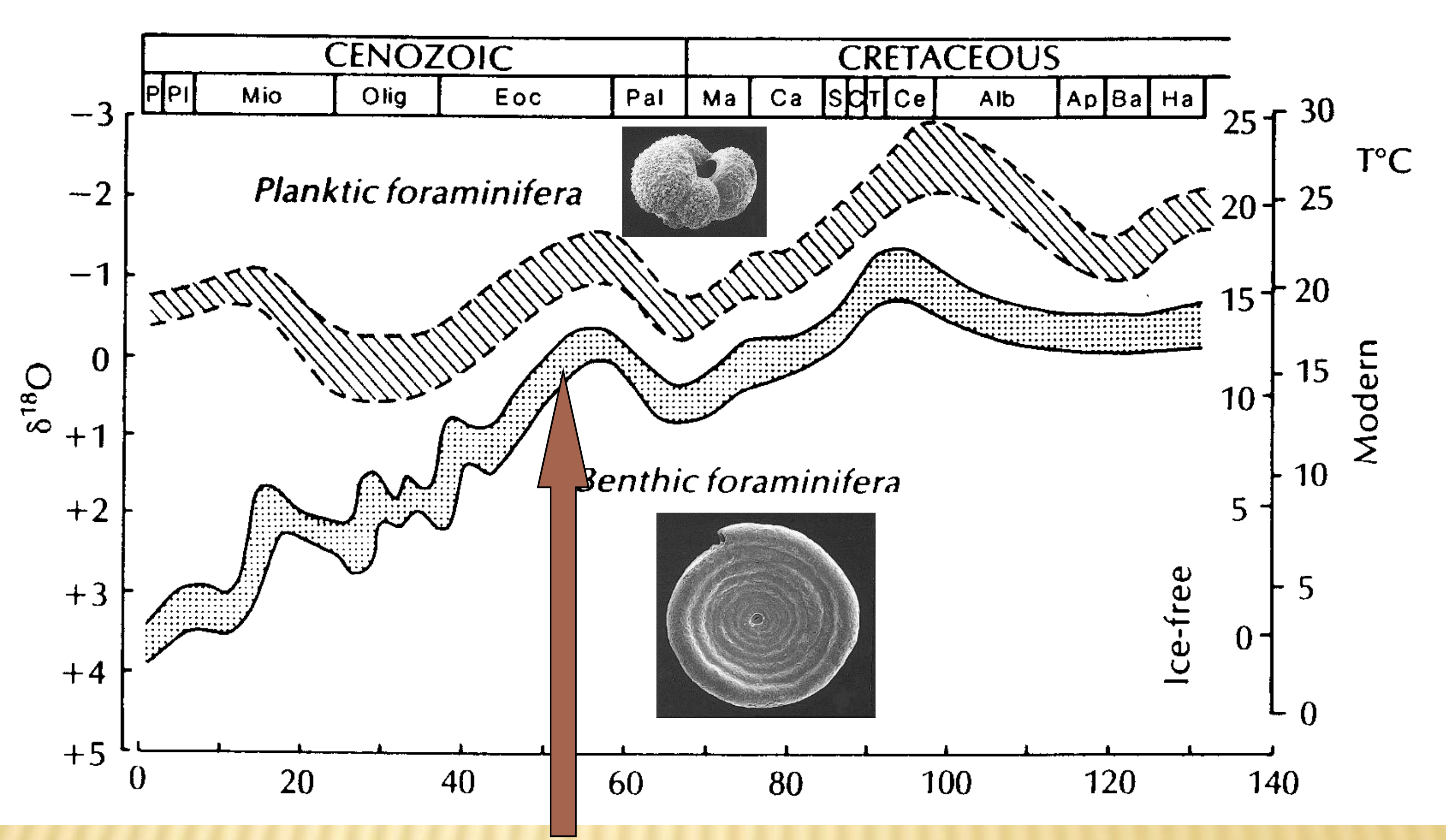




warming

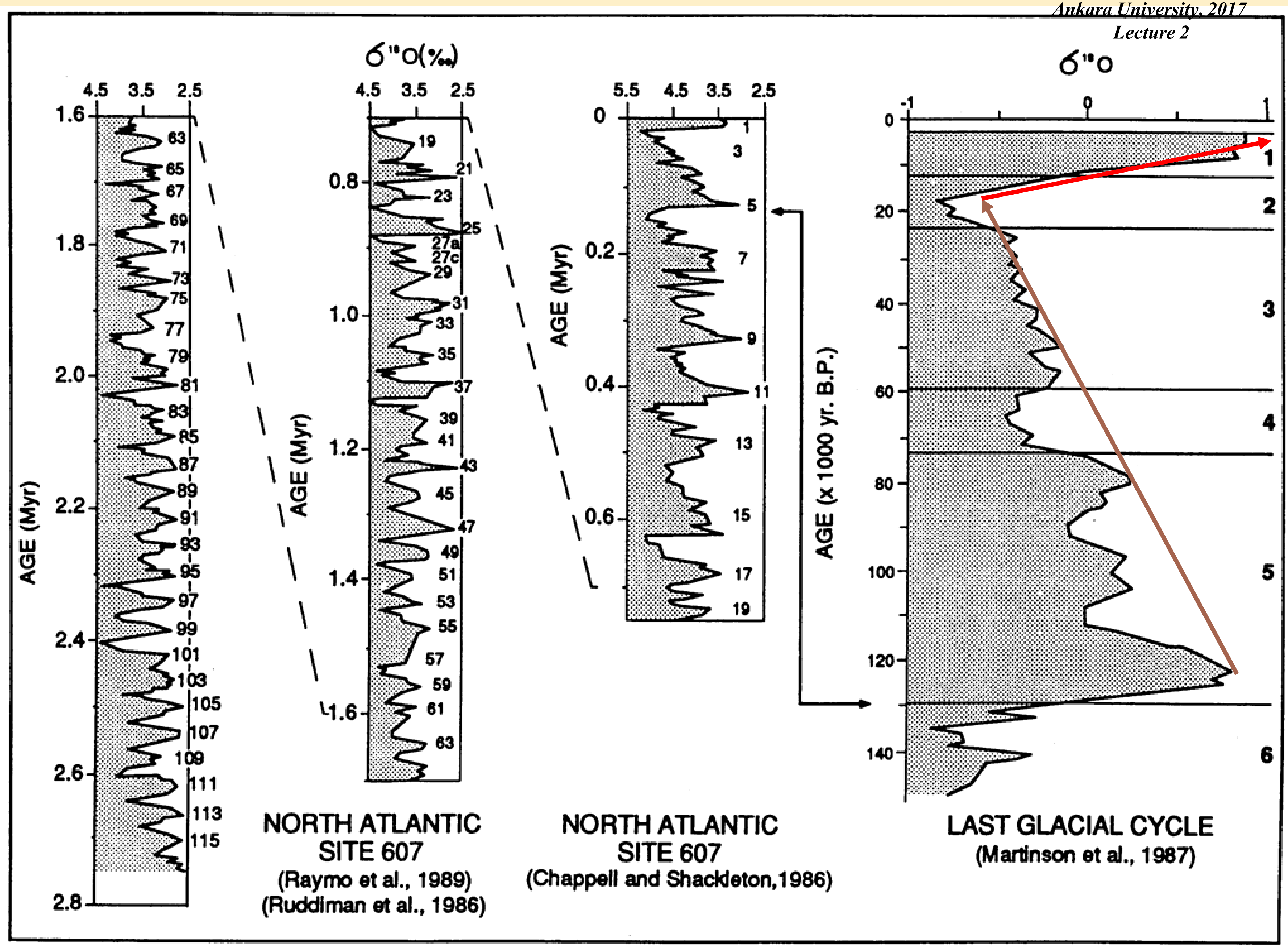
cooling

http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html



Onset of Cenozoic cooling trend - development of cold deep ocean circulation.

http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html



http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html

Sampling

The samples may be;

1) *Ordinary* (if you want to know just age etc. and interested in applied geology, mineralogy-petrograph, but not paleontology)

2) *Sistematic* (if you want the details, and interested in paleontology)

From the consilated hard rocks such as limestone, you can get the *thin section* samples,

From the consilated soft rocks such as mudstone, you can get the *washing* samples

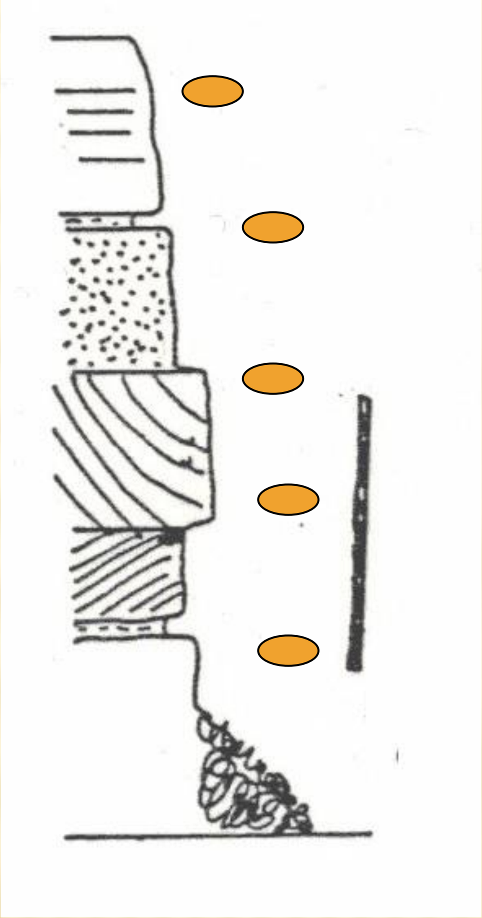
Chalk Cliffs, England

http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html

Navesink Formation, central New Jersey

http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html

Sistematic samples may be get meters, santimeters, even milimeters in thickness



Get the samples of about half kilogram for thin-sections from hard-rocks

Get the samples of about half kilogram from soft rocks,

You can also collect the larger forams or other fossils indivudallly alterated.

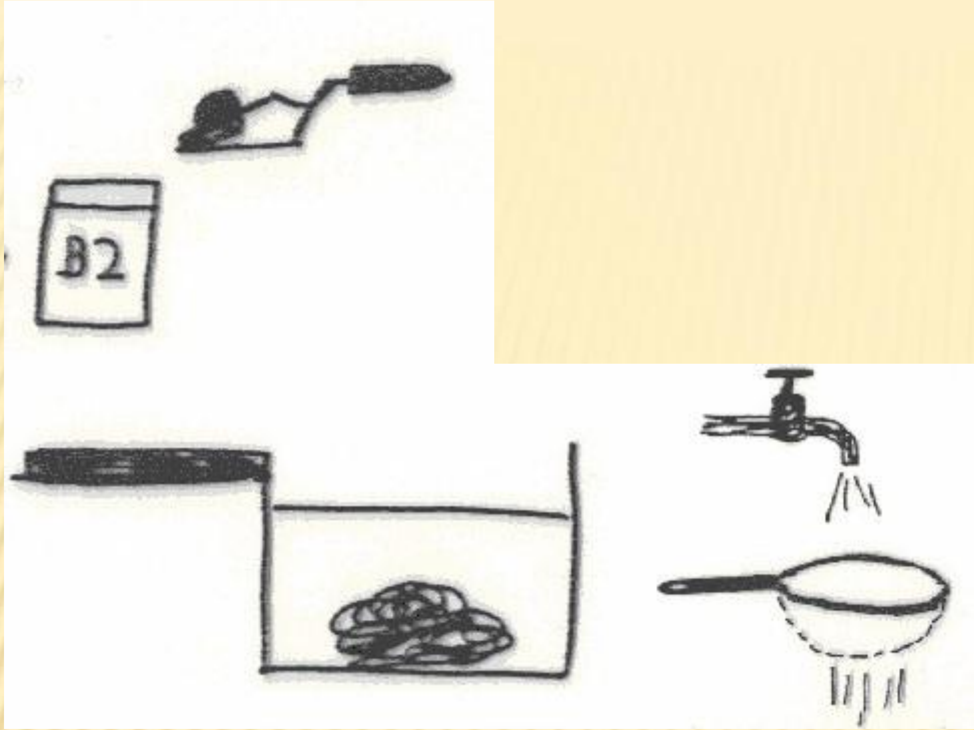
http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html

Deep Sea Drilling Project ship - Glomar Challenger

http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html

Recovering sediment cores from the deep ocean.

http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html



Washing samples may be evaluated for different micro-organisms by using different dissolutions. Then, they are seived bu using various mesh-sized seives, and picked up under a microscope.

Limestone and radiolarite samples are broken up at first, then they are put into a specific solution.

http://people.hofstra.edu/faculty/
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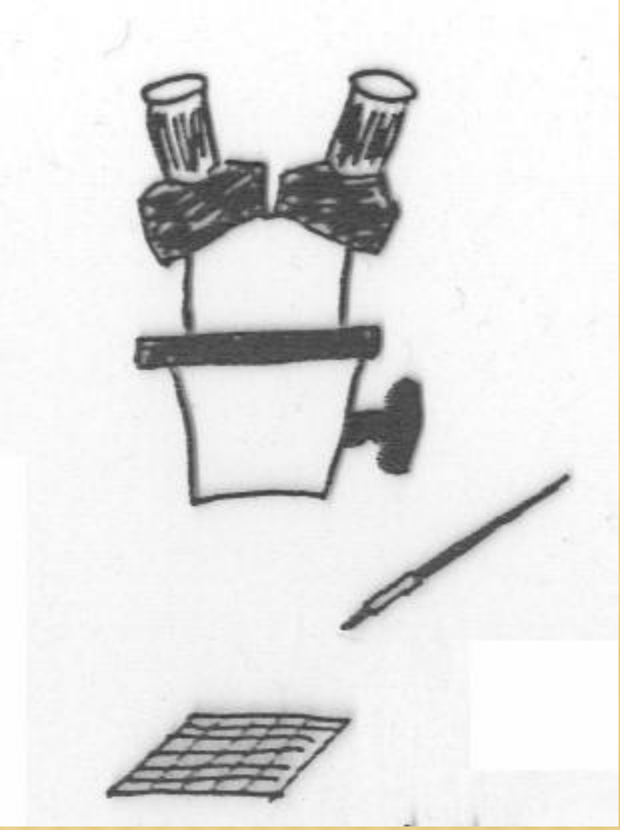
microfossils.html

Obtained microfossils are seperated under a microscope, by using a suitable needle.



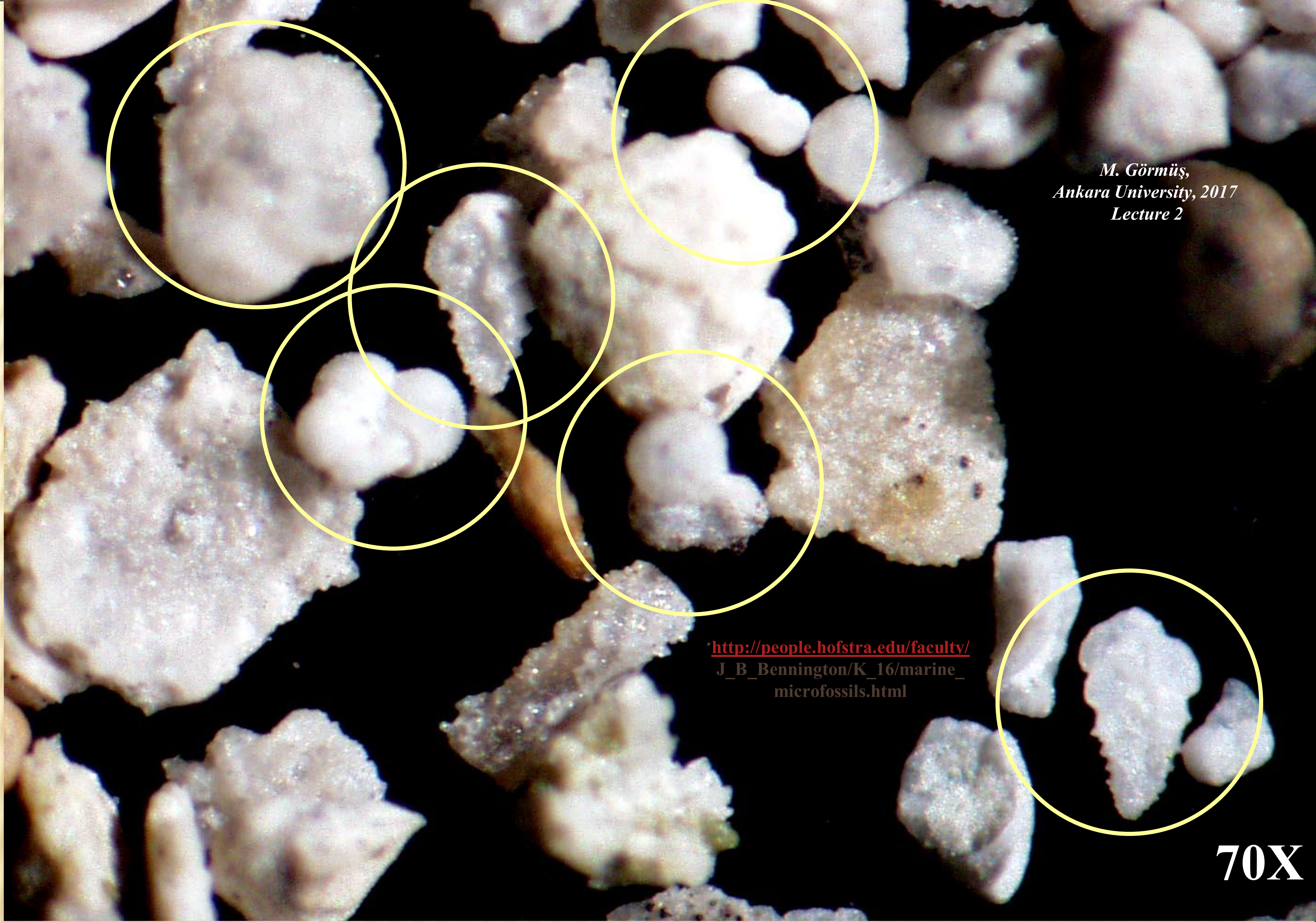
http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html

Benthic foraminifera individuals

http://people.hofstra.edu/faculty/
J_B_Bennington/K_16/marine_
microfossils.html

Benthic foraminifera individuals

http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html



Benthic and planktic foraminifera individuals

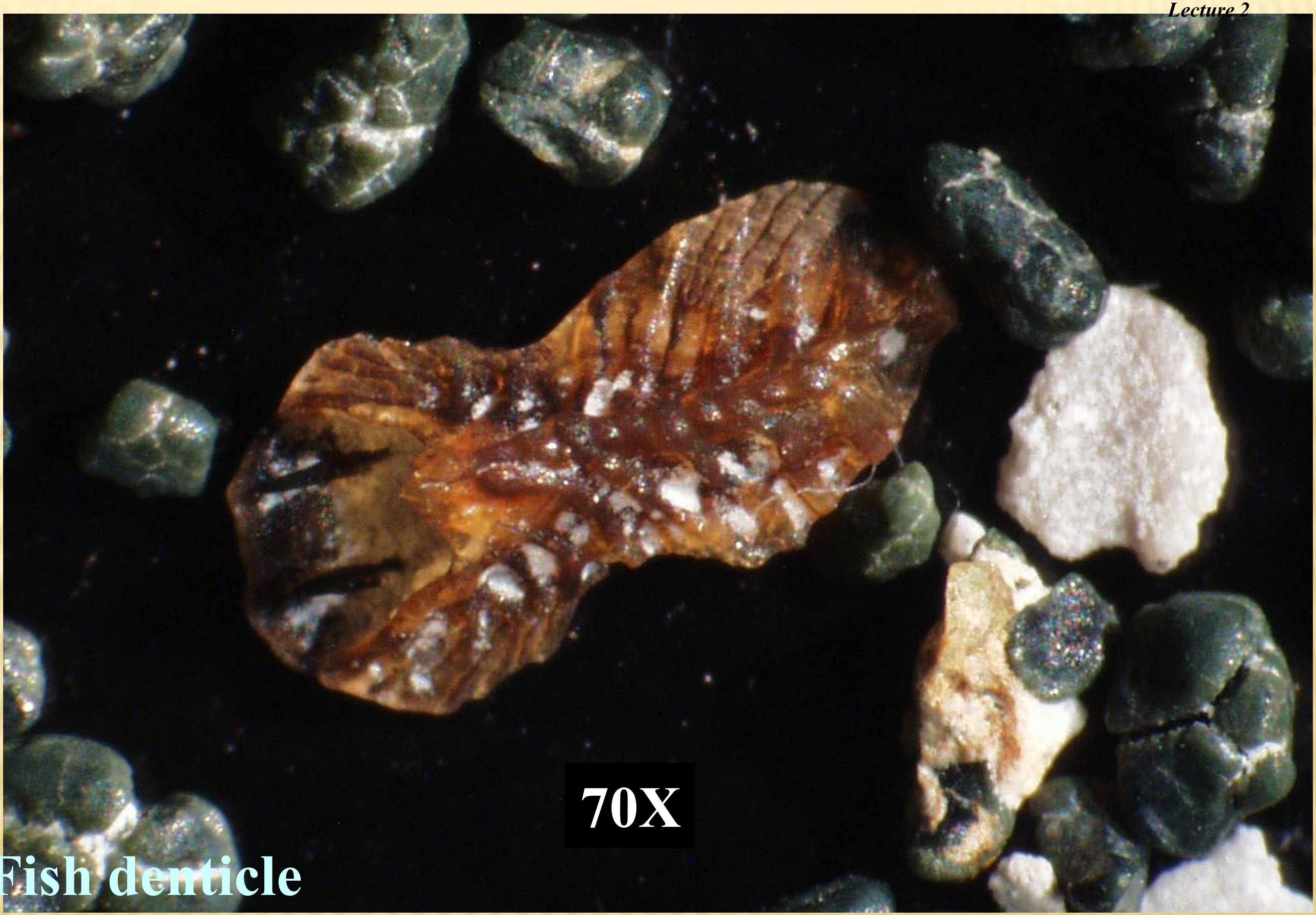
http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html

Ostracod valve

http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html

Burrowing echinoid spine

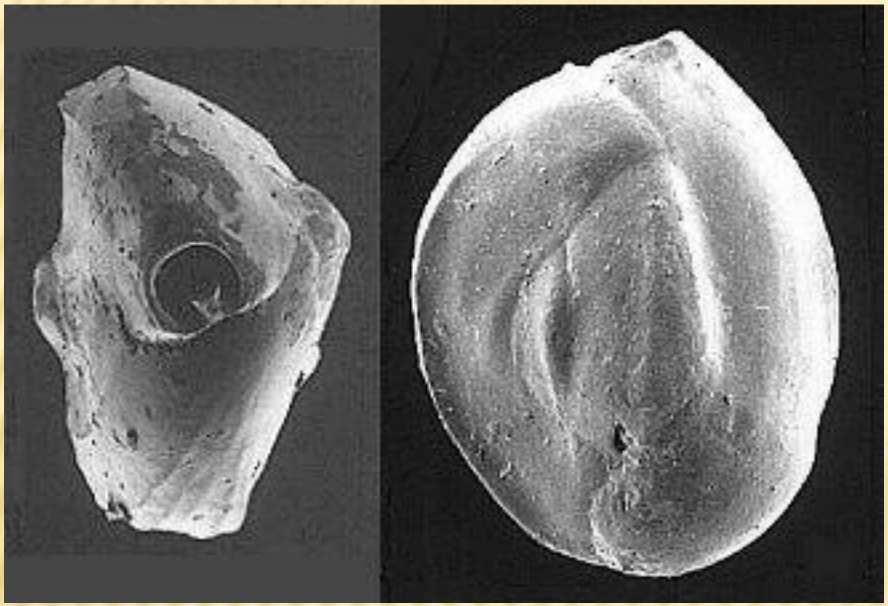
http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html



http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html

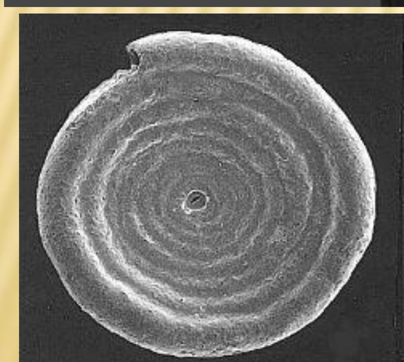
http://www.fortunecity.com/greenfield/ecolodge/60/micstart.htm

A slide including tiny foraminifers

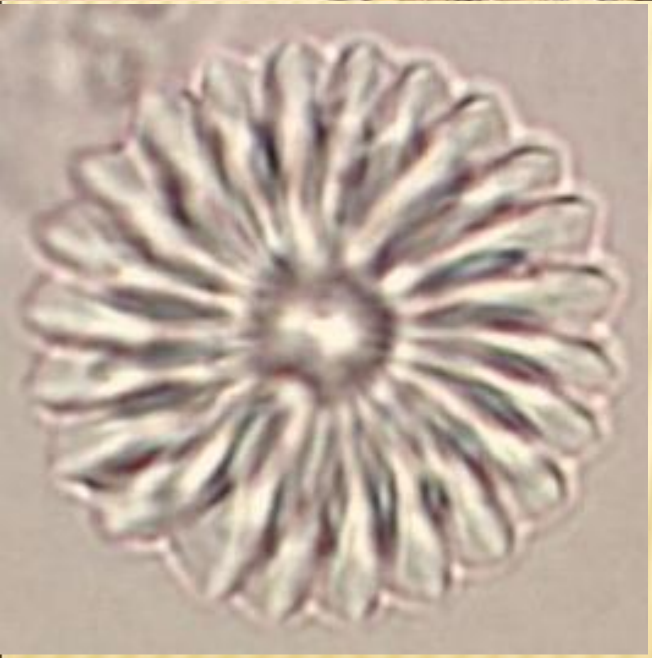


SEM views of a foraminifera

These kinds of fossils must be examined and recognised by using stereomicroscop or SEM or a research microscope.



http://people.hofstra.edu/faculty/J_B_Bennington/K_16/marine_microfossils.html



Examples for thin section views

Lineer scale must be shown.

These kinds of fossils are examined and recognised by using polarizan, light microscope, Sem and orher research microscopes.

http://people.hofstra.edu/faculty/ J_B_Bennington/K_16/marine_ microfossils.html

Presentations

It must be prepared according to fossil presentation rules. The aim is important.

Suggestion: If you are interested in fossil researches, please find a recent article, and look at its presentation.

For example,

Order *FORAMINIFERIDA* Eichwald, 1830
Suborder *TEXTULARIINA* Delage and Herouard, 1896
Superfamily *LITUOLACEA* de Blainville, 1827
Family *LITUOLIDAE* de Blainville, 1827
Subfamily AMMOMARGINULININAE Podobina, 1978
Genus *Ammobaculites* Cushman, 1910
Ammobaculites alexanderi Cushman, 1933
Pl. 1, fig. 1

1933 ***Ammobaculites alexanderi*** Cushman; p. 51, pl. 5, fig. 5
1968 ***Ammobaculites alexanderi*** Cushman; Sliter, p.45, pl. 2,

Description: Compressed test, planispiral coil at the initial part, later becoming rectilinear, uniform width, long uniserial part twice as high as initial coil, sutures indistinct, wall agglutinated, aperture at the final chamber.

Remarks: The form is easily distinguished by its initial planispiral coil, relatively high uniserial chambers and coarse agglutination of walls. It has been described from California by Sliter (1968) in Upper Campanian age and from Carpathian in Campanian by Hanzlikova (1972).

Presentations

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Filum
Class
Order
Family
Genus
Species name
Pl. .., figs.

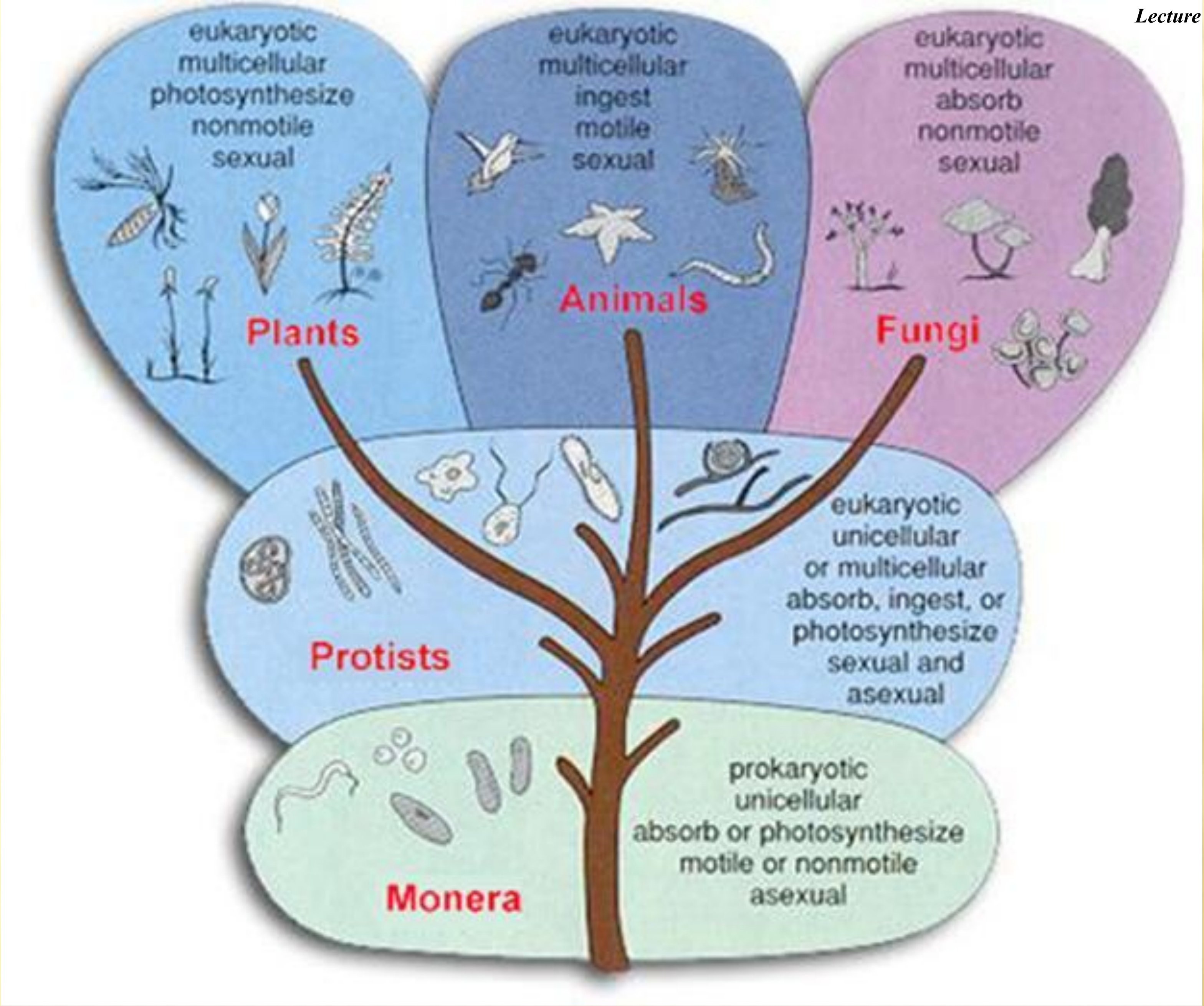
List of literature (Synonim)
Origin of name (in the new species)
Holotype (in the new species)
Paratype (in the new species)
Depository (in the new species)
Type locality (in the new species)

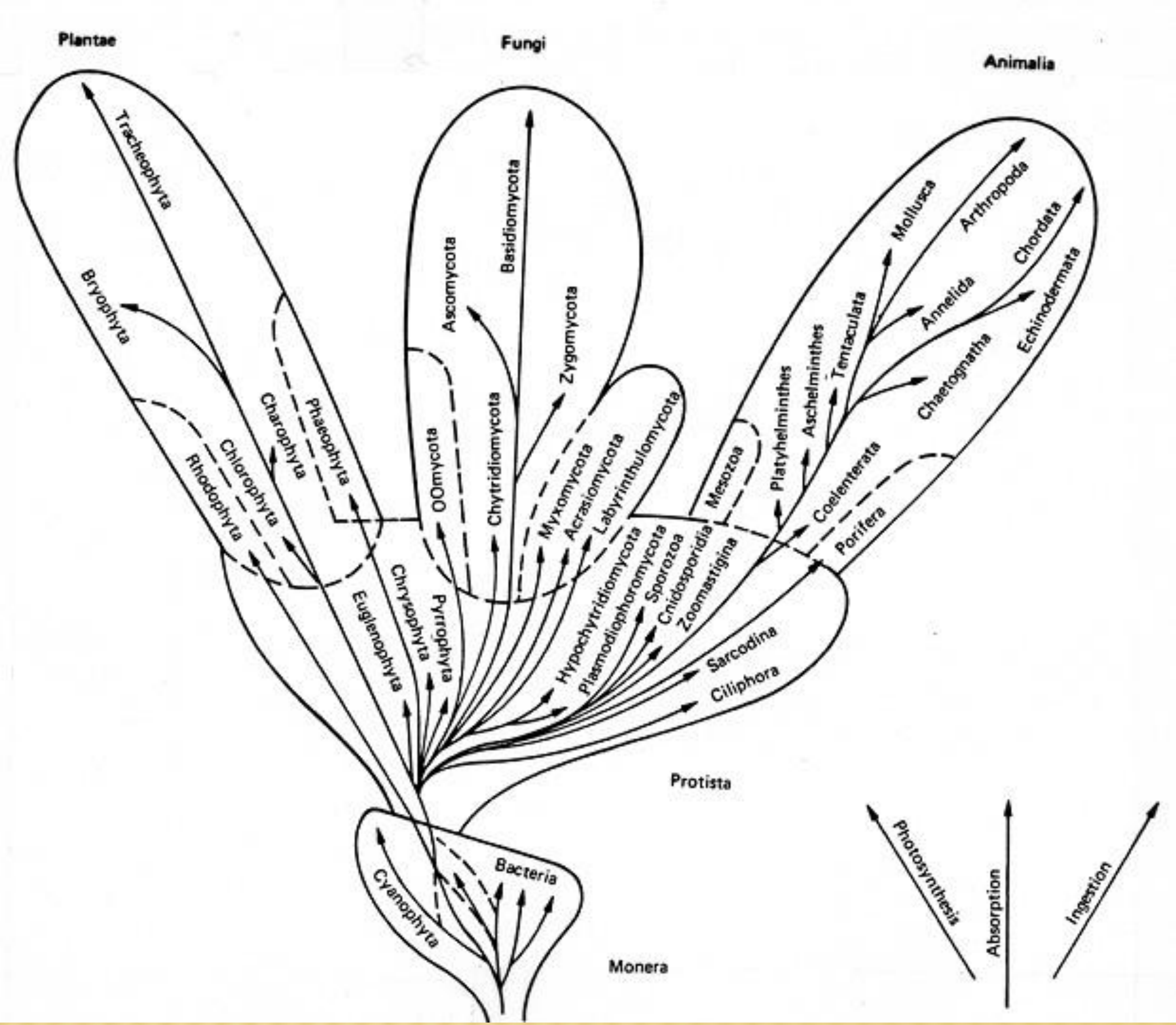
Description
  External view
    Test shape, length, diameter, ratio of length to diameter, thickness etc…
    Symetrical or asymetrical, polar view
    Ornement types and their features
    Main and auxiliary apertures
  Internal view
    Dimorphic character (if exist)
    Wall structure (wall view, colour, thickness etc.)
    Equatorial section features (proloculus, its size, chamberlets, their growth view, septa, septula, embryo chamberlets, their shapes, sizes, peri-embryonic chamberlets (if exists), their measurements, stolons etc…)
    Axial section features (pillars, their thickness, frquency etc…)
    Whorling (numbers, growth etc…)
Remarks, similarities and differences
Stratigraphical ranges
Occurrences

Classification of organisms

Empire	Superkingdom	Kingdom	Subkingdom(s)
BACTERIA		EUBACTERIA	NEGIBACTERIA
			POSIBACTERIA
		ARCHAEBACTERIA	
EUKARYOTA	ARCHEZOA		
	METAKARYOTA	PROTOZOA	GYMNOMYXA
			CORTICATA
		PLANTAE	VIRIPLANTAE (green plants)
			BILIPHYTA (red algae and glaucophytes)
		ANIMALIA	RADIATA
			BILATERATIA
		FUNGI	
		CHROMISTA	CHLORARACHINA
			EUCHROMISTA (cryptomonads, *Goniomonas*, heterokonts, haptophytes)

Fig. 1.2 The empires of life. (Modified from Cavalier-Smith 1993.)


eukaryotic
multicellular
photosynthesize
nonmotile
sexual
Plants
eukaryotic
multicellular
ingest
motile
sexual
Animals
eukaryotic
multicellular
absorb
nonmotile
sexual
Fungi
eukaryotic
unicellular
or multicellular
absorb, ingest, or
photosynthesize
sexual and
asexual
Protists
prokaryotic
unicellular
absorb or photosynthesize
motile or nonmotile
asexual
Monera


Plantae
Fungi
Animalia
Tracheophyta
Bryophyta
Basidiomycota
Ascomycota
Zygomycota
Mollusca
Arthropoda
Chordata
Annelida
Echinodermata
Tentaculata
Aschelminthes
Platyhelminthes
Chaetognatha
Mesozoa
Coelenterata
Porifera
Charophyta
Phaeophyta
Chlorophyta
Rhodophyta
OOmycota
Chytridiomycota
Myxomycota
Acrasiomycota
Labyrinthulomycota
Hypochytridiomycota
Plasmodiophoromycota
Sporozoa
Cnidosporidia
Zoomastigina
Euglenophyta
Chrysophyta
Pyrrophyta
Sarcodina
Ciliphora
Protista
Bacteria
Cyanophyta
Monera
Photosynthesis
Absorption
Ingestion

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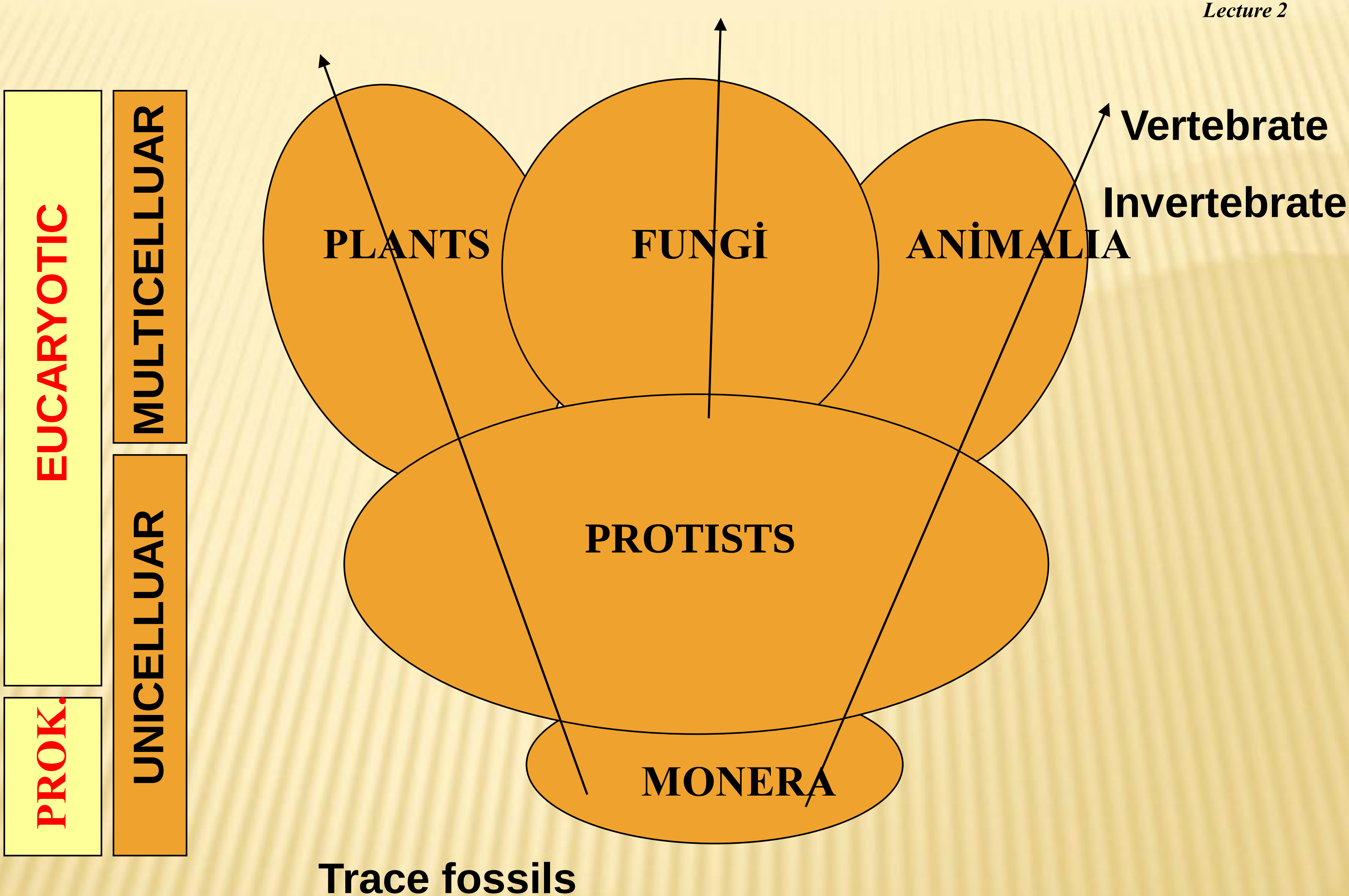

Vertebrate	Invertebrate
Skeleton	Shell
Mainly phosphatic	Mainly carbonate
Mainly terrestrial	Mainly marine
Mainly carnivor	Different life modes

INVERTEBRATA (Phyllums)

Resim http://www.rolandjuvyns.com/

Archaeocyatha

Stramatoporoid

Annelid

Porifera

Cnidaria

Bryozoa

Brachiopoda

Mollusca – Pelecypoda, Gastropoda, Sefelopoda

Arthropoda - Trilobita

Echinodermata – Echinid, Crinoid

Hemicordata (Graptoliths)

VERTEBRATES

Pisces
Amphibia
Reptilia
Aves

Mammalia: **Carnivora (Yırtıcı memeliler),**
Proboscidea (Hortumlu Memeliler),
Equidae (Atlar),
Rhinocerotidae (Gergedanlar),
Giraffidae(Zürafalar),
Suoidea (Domuzlar),
Bovidae (Boşboynuzlular),
Cervidae (Geyikler),
Primata (Bey hayvanlar)

Maraş Mastadon

http://www.mta.gov.tr/muze/paleo/muze_ornekleri.asp

Mastadont

http://www.mta.gov.tr/muze/paleo/muze_ornekleri.asp