

Lezione 11 | 25 giugno 2013

I macroforaminiferi del Paleogene:
classificazione, biostratigrafia e paleoecologia

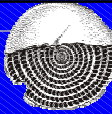
ISPRA
SAPIENZA
DIPARTIMENTO DI SCIENZE DELLA TERRA

Agglutinanti e porcellanacei

Johannes Pignatti

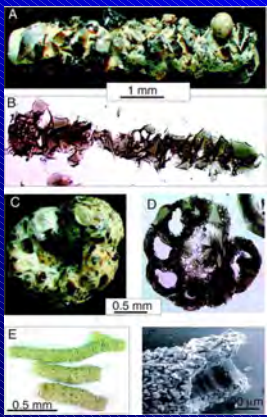
Università di Roma "La Sapienza"
Dipartimento di Scienze della Terra
johannes.pignatti@uniroma1.it

A matter of shell



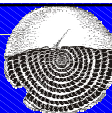
1. In LF, there is a finite number of shell forms, chamber arrangements and chamber compartments (endo- and exoskeleton, supplementary skeleton, chamberlets): several shell architectures are iterative
2. Shell architecture depends largely on shell texture and composition
3. Although phylogenetically unrelated, porcelaneous and agglutinated shells share an important feature: their test is opaque (imperforate); this ecologically relevant property is achieved in fundamentally different modes

Agglutinated shells

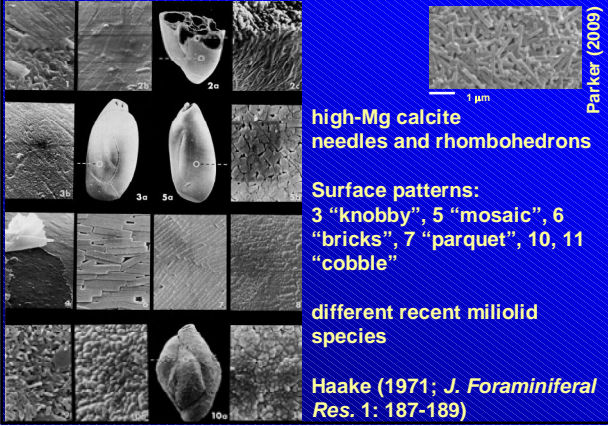


different organic and calcareous cements
different grain selectivity

Davis & Clague (2003; *Geology* 31: 103-106)



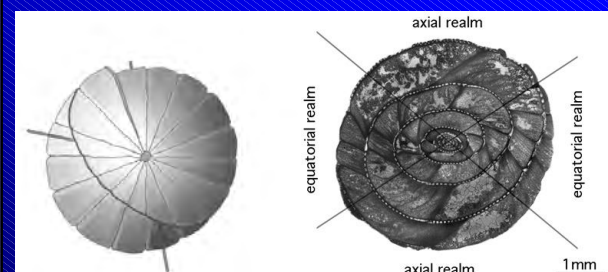
Porcelaneous shells (Miliolina)



Complex vs. simple architecture

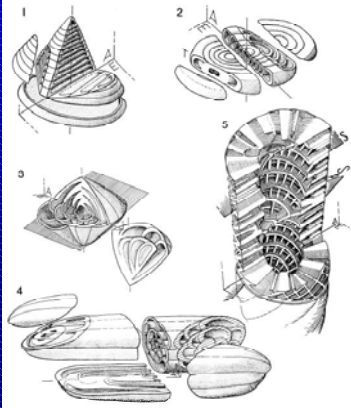


A matter of sections

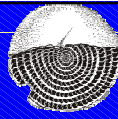


Flosculinized *Alveolina*, obliquely sectioned. From Hottinger (2005)

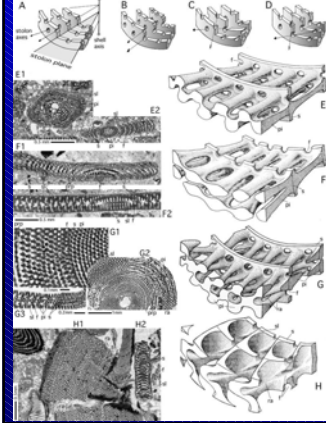
and of interpreting architecture



1. Conical-uniserial
 2. Discoidal-evolute
 3. Planispiral-involute-biconvex
 4. Planispiral-involute-fusiform
 5. Trochospiral-elongate
- Hottinger (1981)



Endoskeleton: basics



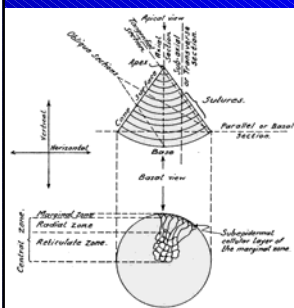
Endoskeletal patterns in discoidal shells

- E. *Pseudotaberina*
- F. aff. *Pastrikella* n. gen.
- G. *Amphisorus*
- H. *Orbitolites*

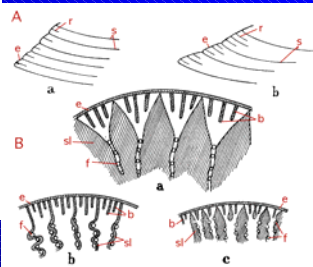
- b: beam
- f: foramen
- pi: pillar
- prp: preseptal space
- ra: ramp
- s: septum
- sl: septulum

Hottinger (2005)

Exoskeleton: basics



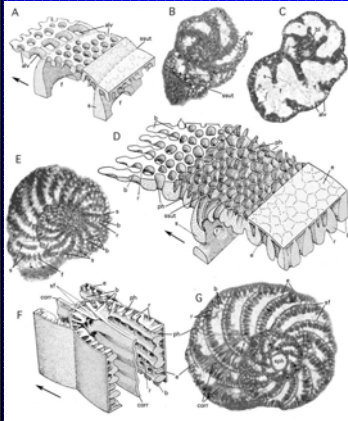
Exoskeletal patterns in conical agglutinated shells (Orbitolinidae)



Henson (1948)

Henson (1948) from Hottinger (2005) b: beam; e: epiderm; f: foramina; r: rafter; s: septum; sl: septulum

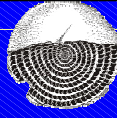
Exoskeleton: basics



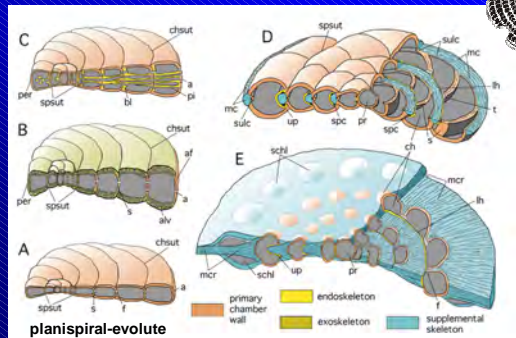
Exoskeletal patterns in discoidal shells: alveolar exoskeleton and polygonal network

various Mesozoic genera

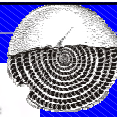
Hottinger (2005)



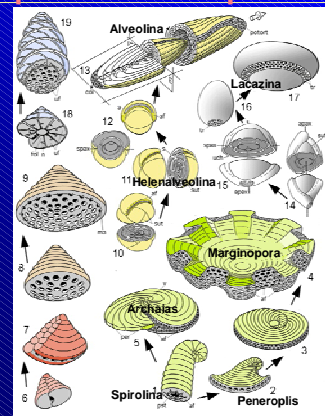
Planispiral LF shells



Hottinger (2005)

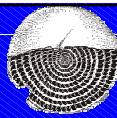


Apertures and apertural face

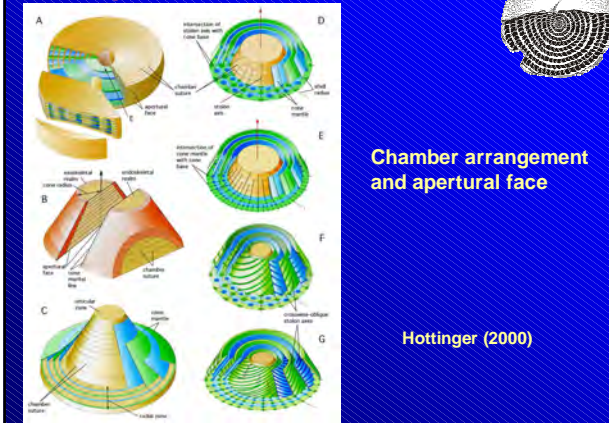


Chamber arrangement and apertural face

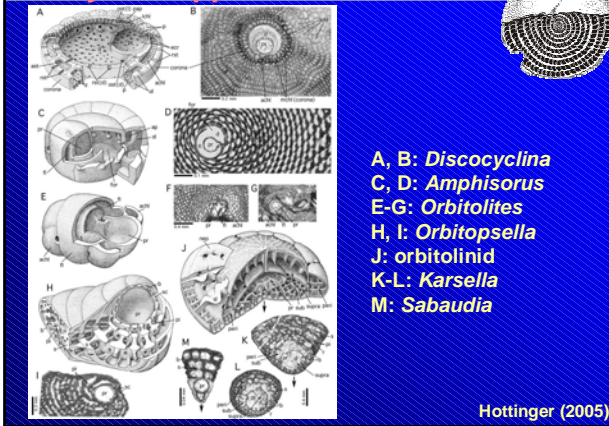
Hottinger (2000)



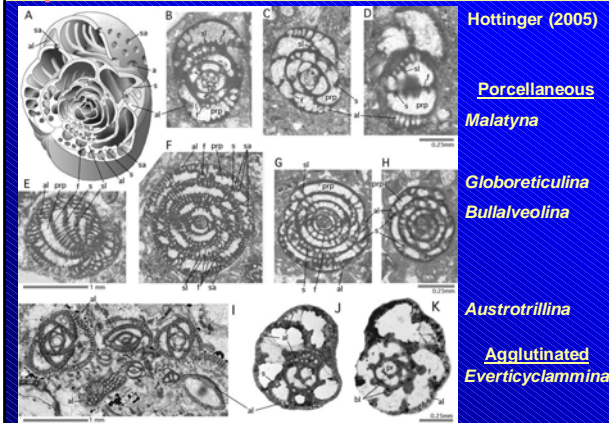
Stolon planes, foraminal axes



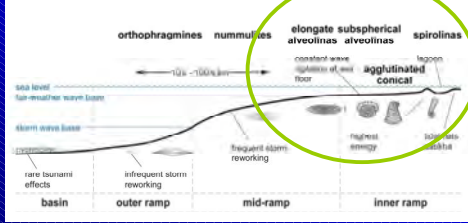
Embryonic apparatus



Imperforate shells: alveoles

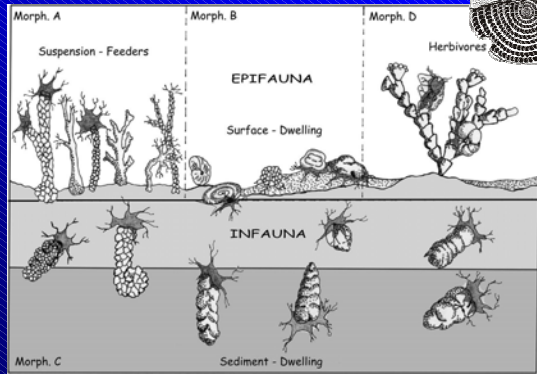


Environment



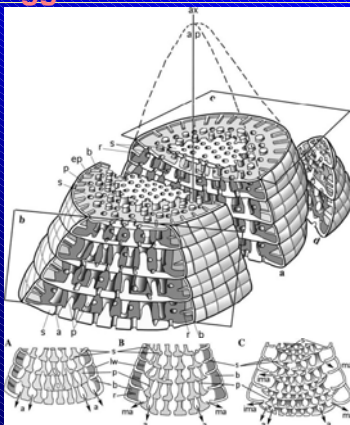
Carbonate ramp model after Burchette & Wright (1992)

Agglutinated morphotypes



Adapted from Jones & Charnock (1985) by Mancin (2001)

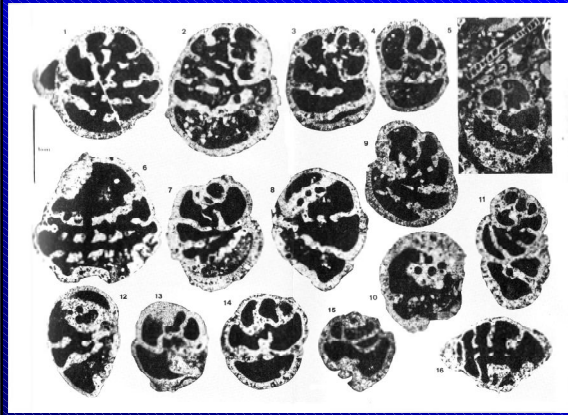
Agglutinated conicals



a aperture, ap apex, ax shell axis, b beam (exoskeleton), ep epiderm, ima interiomarginal aperture, lw lateral chamber wall, ma marginal aperture (located in marginal trough), p pillar (endoskeleton), r rafter (exoskeleton), s septum

Vecchio & Hottinger (2007)

Cribrbulimina



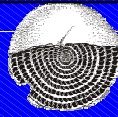
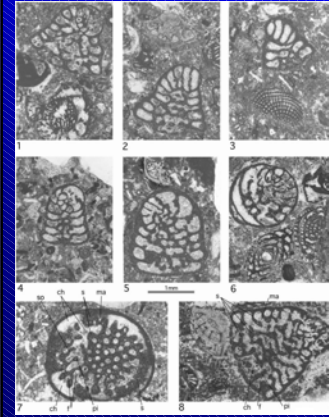
C. carnolica Hottinger & Drobne, 1980 (SBZ 3)

Coskinon



C. rajkai Hottinger & Drobne, 1980 (SBZ 3)

Coskinolina

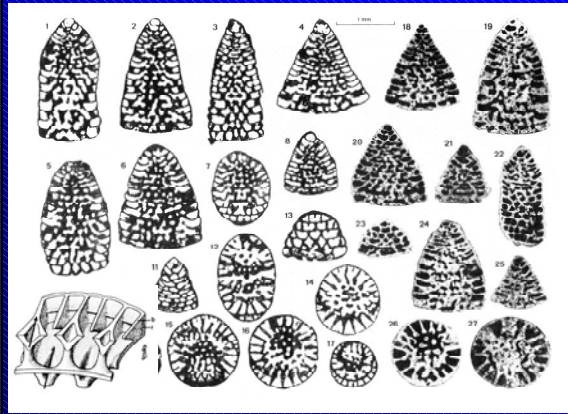


Coskinolina perpera
Hottinger & Drobne, 1980

Bartonian
Jahrum Fm., Iran

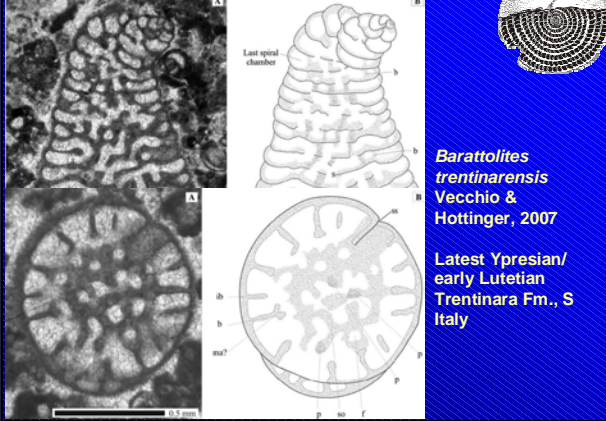
Hottinger (2007)

Fallotella



F. alayensis Mangin, 1954 (SBZ 3)

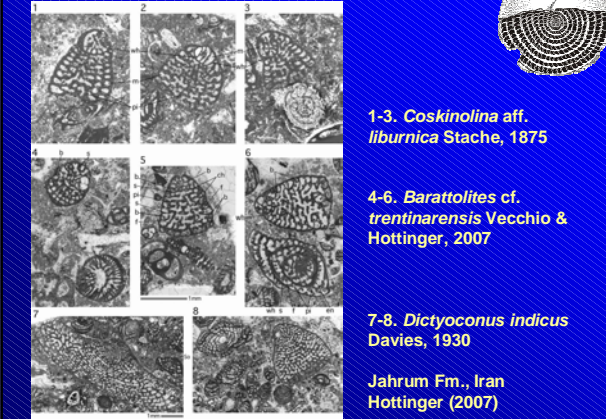
Barattolites



*Barattolites
trentinensis*
Vecchio &
Hottinger, 2007

Latest Ypresian/
early Lutetian
Trentinara Fm., S
Italy

Dictyoconus, Barattolites



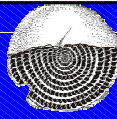
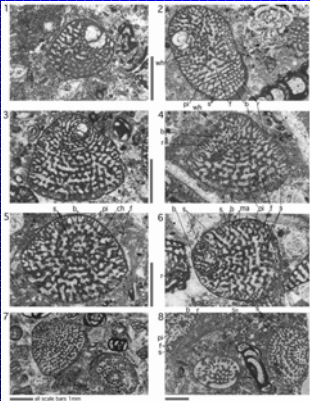
1-3. *Coskinolina* aff.
liburnica Stache, 1875

4-6. *Barattolites* cf.
trentinensis Vecchio &
Hottinger, 2007

7-8. *Dictyoconus indicus*
Davies, 1930

Jahrum Fm., Iran
Hottinger (2007)

Dictyoconus, Coskinolina



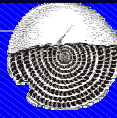
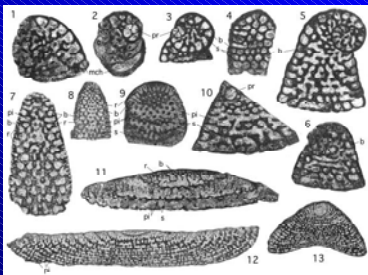
1-3. *Coskinolina* aff. *liburnica* Stache, 1875

4-6. *Barattolites* cf. *trentinarenensis* Vecchio & Hottinger, 2007

7-8. *Dictyoconus indicus* Davies, 1930

Jahrum Fm., Iran
Hottinger (2007)

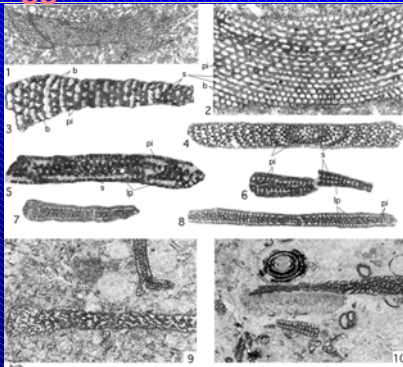
other conical taxa (N Somalia)



Pignatti (unpublished)

1, 2 – *Coskinolina* sp. Cuisian. 3-5 – *Daviesiconus* cf. *balsillei* (Davies). Cuisian. 6 – *Daviesiconus* sp. Lower-Middle Lutetian. 7, 8 – *Dictyoconus turriculus* Hottinger & Drobne. SBZ 4. 9 – *Dictyoconus* cf. *aegyptiensis* (Chapman). Lutetian. 10 – *Dictyoconus* sp. Lower-Middle Eocene. 11-13 – Unnamed, low-conical dictyoconid, microspheric (11, 12) and macrospheric (13), possibly related to *Cushmania*. SBZ 4.

Agglutinated discoidal

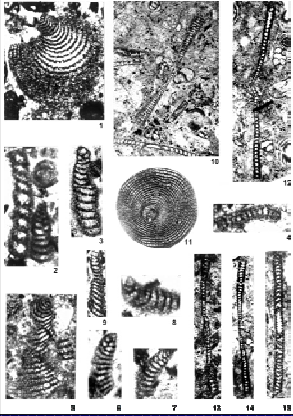


Several Paleocene genera, mostly monotypic (*Vania*, *Thomasella*); co-occur with porcelainous discoidal forms ("Taberina" *daviesi* in the Arabian province)

b: beam
(exoskeleton), bch:
brood chamber, lp:
lateral passage, pi:
pillar (endoskeleton),
s: septum.

1 – *Taberina* *daviesi* Hansen, oblique, subequatorial section, SBZ 4. 2 – Detail of fig. 1. Note subepidermal, axial exoskeleton (beams) and endoskeleton with pillars following an oblique-overcrossing pattern with ramps similar to *Orbicolites*. 5-8 – *Thomasella* (= *Vania* Auct.) *labyrinthica* (Grimsdale). SBZ 4-5. All from N Somalia unpublished.

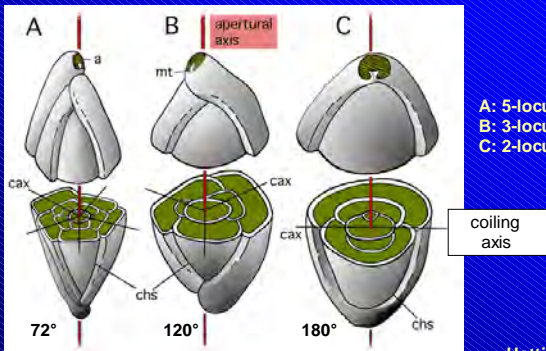
Agglutinated discoidal



1-9: *Postbroeckinella fiabelliformis* Sirel, 2013
SBZ 3, Turkey

10-15: *Vania anatolica* Sirel & Gündüz
SBZ 3, Turkey

Porcelaneous shells: milioline coiling

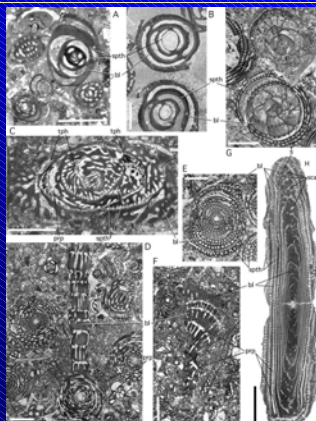


A: 5-loculine
B: 3-loculine
C: 2-loculine

Milioline coiling: two chambers per whorl

Hottinger (2005)

Porcelaneous shells: basal layer

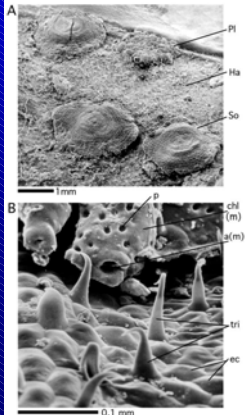


A. Large miliolid, *Fabularia roselli* Caus, *Dendritina* sp.
B. *Idalina antiqua*
C. *Fabularia verseyi* Cole
D-F. *Pseudochubbina globularis* (Smout), *P. kassabi* De Castro
G. *Alveolina daniensis* Drobne
H. *Alveolina tenuis* Hottinger

bl: basal layer
prp: preseptal space
sca: supplementary canals
spth: spirotheca
tph: trematophore

Hottinger (2005)

Porcelaneous shells: epiphytes

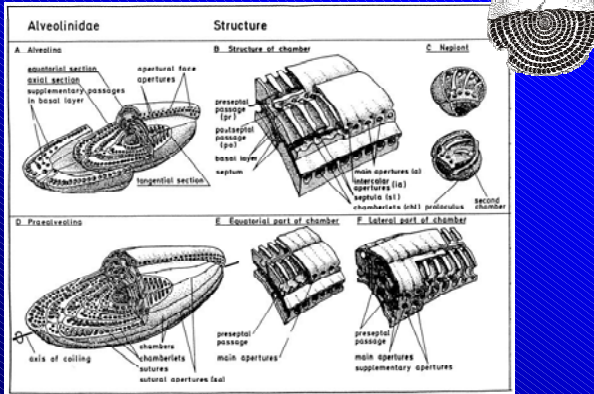


PI: *Planogypsina* (Rotaliina)
 So: *Sorites* (Miliolina)
 Ha: *Halophila* (seagrass)

trichomes: leaf hair of seagrass
 strengthening the adhesion of the
 epiphyte to its substrate

Hottinger (2005)

Alveolinid basics

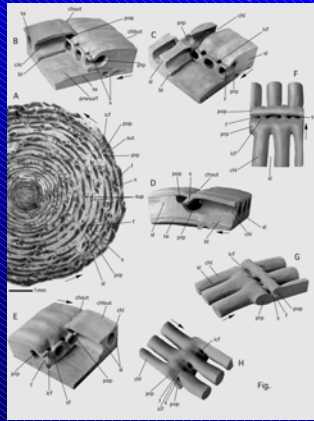


Hottinger (1974)

Alveolinid basics

1. porcelaneous [a sympleksiomorphy]
2. multichambered [a sympleksiomorphy]
3. broad, low apertural face (at least in early stages)
4. apertures slit-like or multiple, devoid of teeth
5. one or more rows of apertures
6. early coiling streptospiral (at least in microspheric or monomorphic forms) [probably, a sympleksiomorphy]
7. later coiling planispiral, involute producing spherical to fusiform tests
8. chambers subdivided by longitudinal septula into chamberlets
9. chamberlets connected by a low open space below the apertural face (praeseptal spaces/passages) and postseptal spaces/passages
10. chamberlets may be multiplied by one or more layers parallel to chamber floor
11. basal layer may be thickened (flosculinization)
12. basal layer may possess supplementary cavities (irregular, anastomosing canals)
13. septula alternating (e.g., in *Alveolina*) or continuous

Alveolinid basics: passages



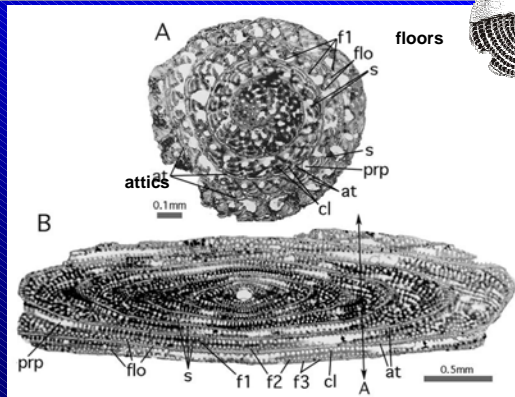
Alveolina munieri Hottinger – plasticine models (B-H) of the shell by M. Reichel

prp: praeseptal passages
pop: postseptal passages

F-H: shell cavities

Hottinger (2005)

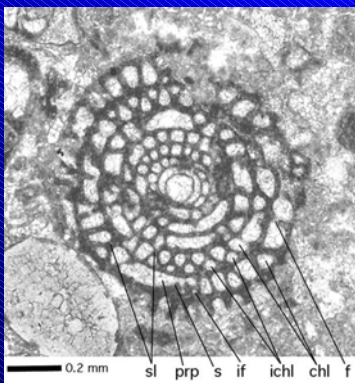
Alveolinid basics: attics and floors



Alveolinella borneensis Tan Sin Hok

Hottinger (2005)

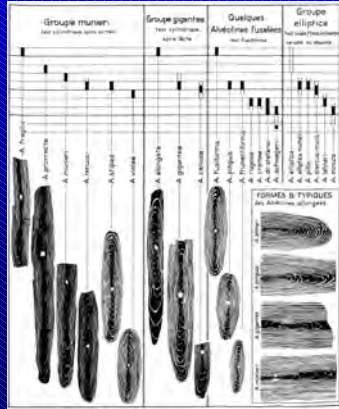
Alveolinid basics: intercalary chamberlets



Borelis curdica (Reichel), Qum Basin, Iran

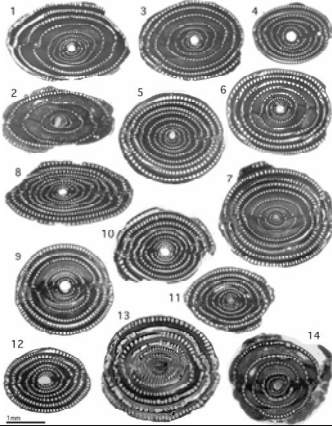
Hottinger (2005)

Alveolina: Main lineages 2



Hottinger (1960)

Alveolina: early Ypresian



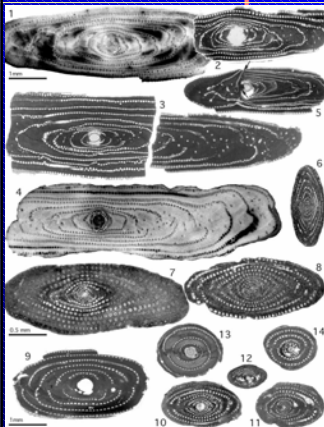
- 1-3: *Alveolina decipiens* Schwager, 1883
- 4: *A. cf. globula* Hottinger, 1960
- 5-7: *A. avellana* Hottinger, 1960
- 8: *A. moussoulensis* Hottinger, 1960
- 9: *A. pisiformis* Hottinger, 1960
- 10, 13: *A. gr. dolioformis* Schwager, 1883
- 11, 12: *A. regularis* Hottinger, 1960
- 14: *A. globosa* Leymerie, 1846

Northern Aquitaine, France
Sztrákócs et al. (2011)

SBZ 5-SBZ 6

SBZ 6-SBZ 7

Alveolina: late Ypresian-Lutetian



- 1-4: *Alveolina elongata* d'Orbigny, 1828
- 5: *A. cf. stipes* Hottinger, 1960
- 6-8: *A. boschii* (Defrance in Bronn, 1825)
- 9: *A. canavarii* Checchia-Rispoli, 1905
- 10: *A. fornasinii* Checchia-Rispoli, 1905
- 11, 12: *A. cf. schwageri* Checchia-Rispoli, 1905
- 13: *A. sp. indet.*
- 14: *A. cf. minuta* Checchia-Rispoli, 1905

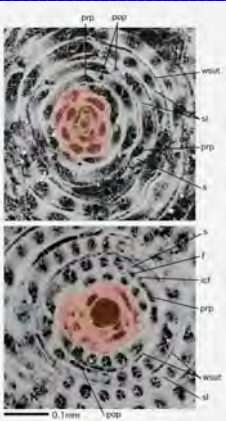
Sztrákócs et al. (2011; Géologie de la France, 2010/2: 3-52)

SBZ 16

SBZ 13

SBZ 10

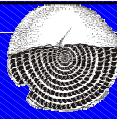
Alveolinidae: *Glomalveolina*



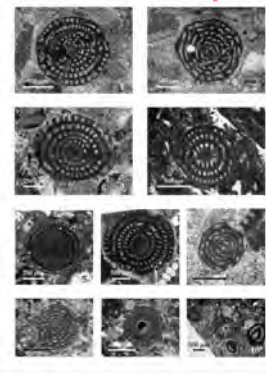
Glomerulus (pink): streptospirally coiled neplont prior to fixation of a coiling axis; often only in the microspheric generation

Glomalveolina lepidula (Schwager) from Tremp, Northern Spain, Early Ypresian

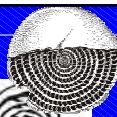
Hottinger (2005)



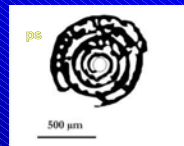
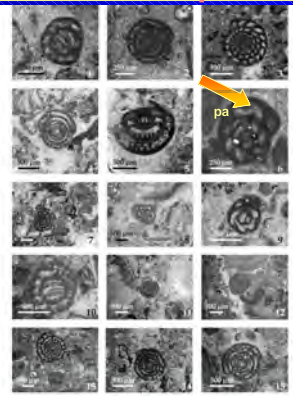
**Alveolinidae: *G. primaeva*
Glomalveolina primaeva - SBZ3**



courtesy M. Di Carlo



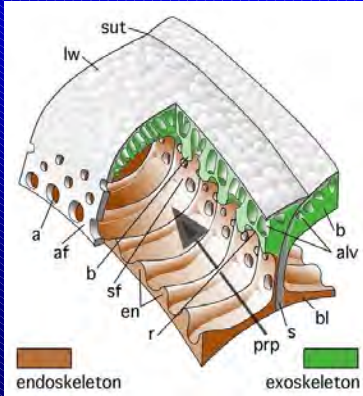
***Globoflarina sphaeroidea* - SBZ 2/3a**



ps= partizioni subepidermali
pa= peristomi anteroversi
courtesy M. Di Carlo

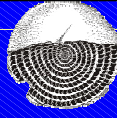


Globoreticulina

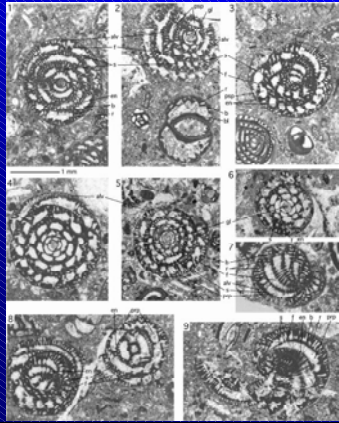


a: aperture; af: apertural face; alv: alveole; b: beam; bl: basal layer; en: endoskeletal ridges; lw: lateral, free chamber wall; prp: preseptal passage; r: rafter; s: septum; sf: septal face; sut: chamber suture

Hottinger (2007; Carnets de Géologie / Notebooks on Geology - Article 2007/06)



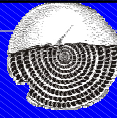
Globoreticulina



Globoreticulina iranica
Rahaghi, 1978

Bartonian (SBZ 17/18),
Jahrum Fm., Shiraz, Iran

Hottinger (2007)



Helenalveolina

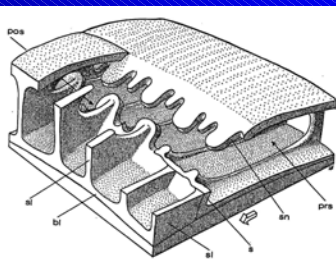
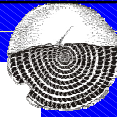


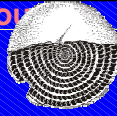
Fig. 3. *Helenalveolina sippaxar* n. gen. n. sp. Stereograph of apertural features in adult chambers of microspheric forms. Approximastly $\times 150$.
bl: basal layer; s: septum; sl: septulum; en: endoskeletal ridges; pos: notches in distal margin of aperture; prp: postseptal passage; prs: preseptal space; arrow: direction of growth.

1. foramen is an elongate slit
 2. early chambers unsubdivided
 3. septula alternating
- Cretaceous-Paleocene

Hottinger et al. (1989)



Discoïdal-lenticular porcellanaceo



Various distinct Paleogene-Recent groups
(classification probably artificial)

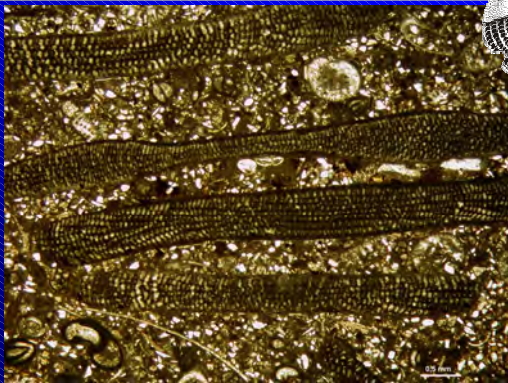
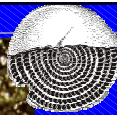
MEANDROPSINIDAE

Hottingerinae: *Hottingerina*

SORITIDAE

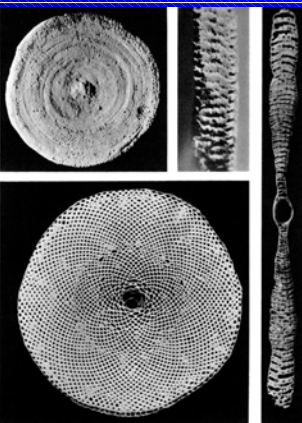
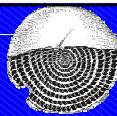
1. Soritinae: *Orbitolites*, *Sorites*, *Amphisorus*, *Marginopora*, *Yaberinella*
2. Opertorbitolitinae: *Opertorbitolites*, *Somalina*
3. Praerhapydioninae: *Praerhapydionina*
4. Archaiasinae: several genera
5. Fusarchaiasinae: *Fusarchaias*

Orbitolitids



Clasto (età: Ypresiano superiore) nella Fm. di Ussana (Sardegna)

Orbitolites

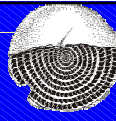
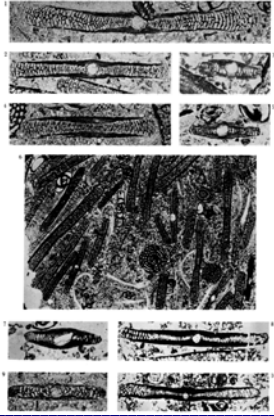


Orbitolites complanatus
Lamarck, 1801

Lutetian, Grignon, France

Lehmann (1961)

Opertorbitolites



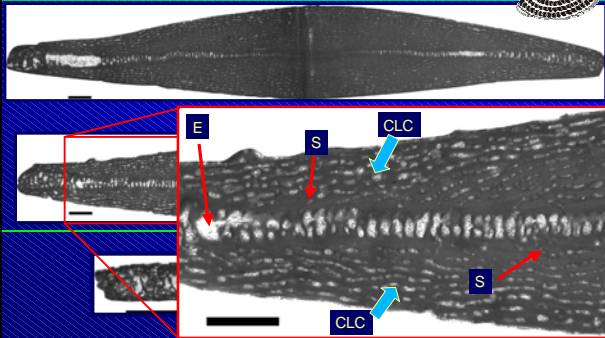
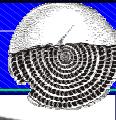
Opertorbitolites spp.
Ypresian, Spain and S France

Lehmann (1961)

Somalina

Late Ypresian-Lutetian

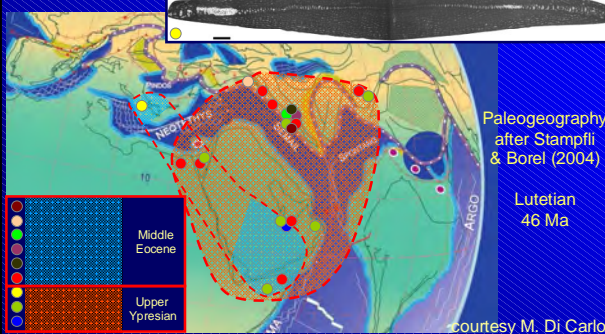
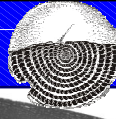
Scale bar = 0.5 mm



Abbreviations - CLC: chamberlet-like cavity; E: equatorial chamberlet(s); S: stolon.

Somalina: paleobiogeography

Scale bar = 0.5 mm



Paleogeography after Stampfli & Borel (2004)

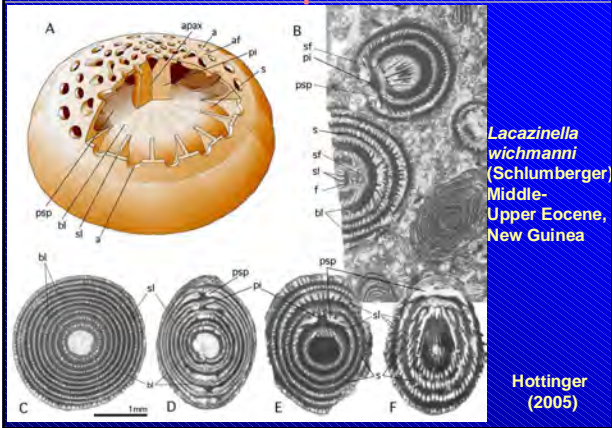
Lutetian
46 Ma

courtesy M. Di Carlo

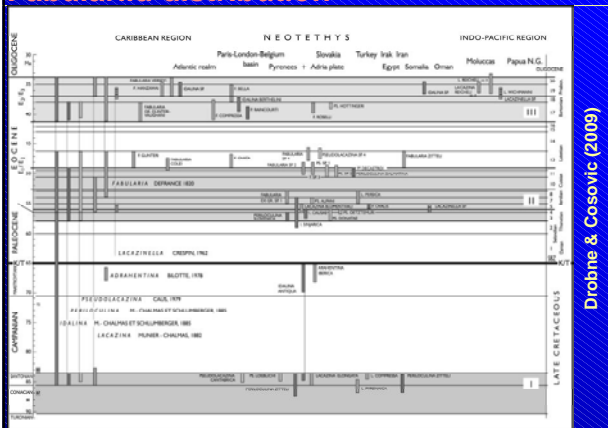
Fabulariids

1. porcelaneous [a symplesiomorphy]
2. early growth stages milioline [a symplesiomorphy]
3. fixed apertural axis [a symplesiomorphy]
4. trematophorate (in adult stages)
5. thickened basal layer
6. basal layer forming one or more layers of tubular chamber compartments (chamberlets)
7. Coniacian-Oligocene

Fabulariids: trematophores



Fabulariid distribution



Paleogene fabulariids

Drobne & Cosovic (2009;
Bull. Soc. géol. Fr. 180: 317-331)

Haymanella Sirel, 1998

agglutinated milioline wall

Haymanella paleocaenica Sirel, 1998
Danian
SBZ 1

Haymanella elongata Sirel, 2009
(Danian?)-Selandian
SBZ (1?) - 2

agglutinated milioline wall

Sirel (2009)

Haymanella huberi

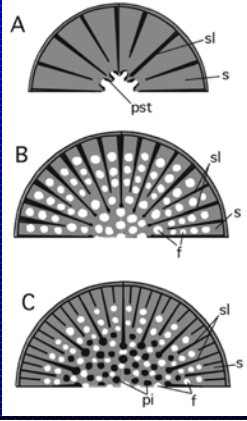
crozier-shaped
single stellate aperture
peristome
short proximal radial partitions

agglutinated milioline wall

Haymanella huberi (Henson, 1950)
[= *Praerhapydionina huberi* Henson, 1950]
Bartonian
Jahrum Fm., Iran
f: foramen; rp: radial partition

Hottinger (2007)

Elongated porcellaneous genera



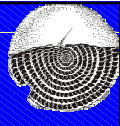
Praerhapydionina van Wessem, 1943

Rhabdorites Fleury, 1996

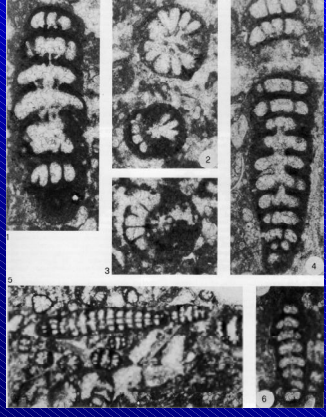
Neotaberina Hottinger, 2007

f: foramen; pi: pillar; pst: peristomal rims or folds; s: septum; sl: septulum

Hottinger (2007)

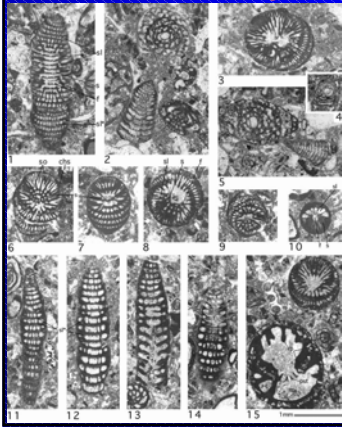


Praerhapydionina delicata



Praerhapydionina delicata Henson, Chattian, S Apulia
 Esu et al. (1995; *Boll. Soc. Paleontol. Ital.* 33: 183-195)

***Rhabdorites* Fleury, 1996**

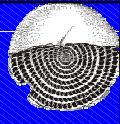


Rhapydionina malatyaensis Sirel, 1976

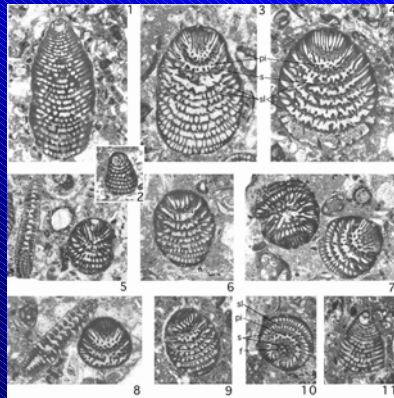
Jahrum Formation, Iran, Bartonian

Additional species:
Rhabdorites minimus (Henson, 1948) Luterian

Hottinger (2007)



Neotaberina Hottinger, 2007

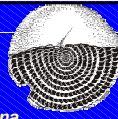


*Neotaberina
neaniconica* Hottinger
2007

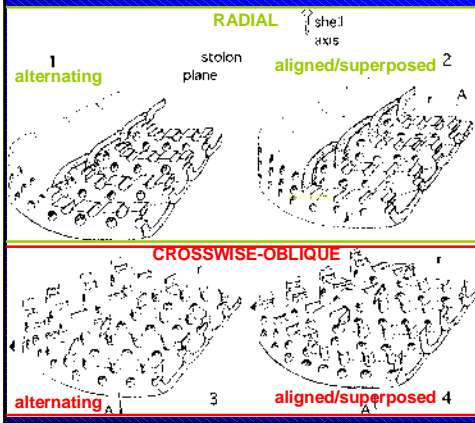
Bartonian (SBZ 17/18),
Jahrum Fm., Shiraz,
Iran

f: foramen; pl: pillar;
pst: peristomal rims or
folds; s: septum; sl:
septulum

Hottinger (2007)



Porcelaneous shells: stolons



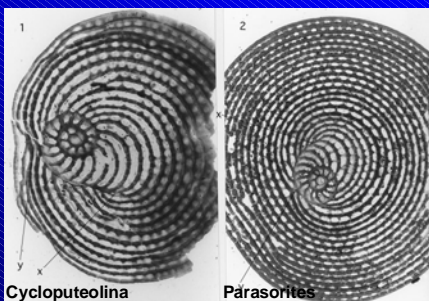
ARCHAIASIDS
(often: pillared
endoskeleton)

SORITIDS
(often: lateral,
subepidermal
partitions)

Hottinger
(2001; *J. Paleontol.* 75:
475-512)



Soritids



Cycloputeolina

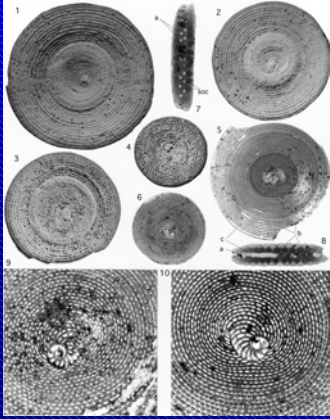
Parasorites

- successive growth stages: peneropliform-planispiral (up to x),
flabelliform (up to y) and annular (first complete annulus)
- crosswise-oblique stolon axes

Hottinger (2001)



Soritids

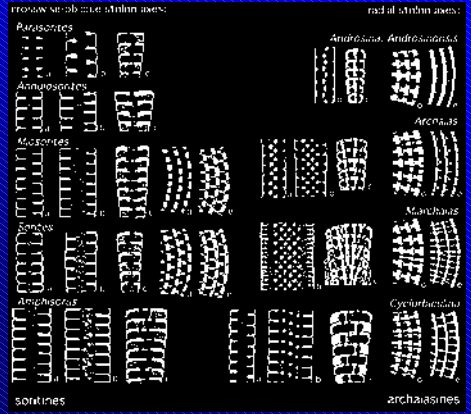


Parasorites cf. orbitolitoides,
late Miocene, Dominican
Republic

Hottinger (2001)



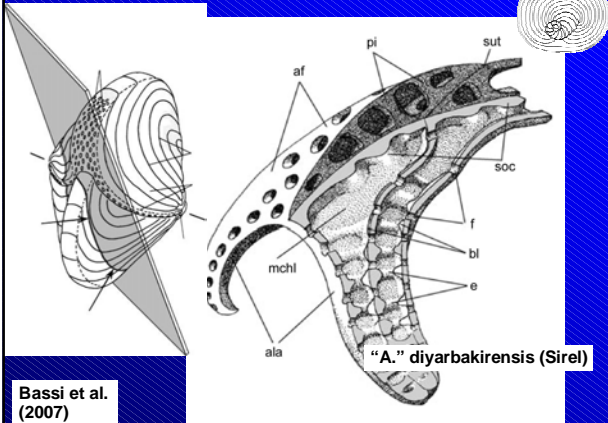
Soritids - Archaiasids



Hottinger
(2001; J.
Paleontol.)



Archaiasids

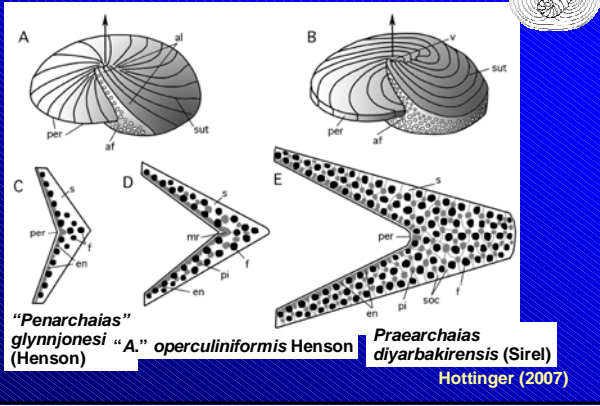


"A." diyarbakirensis (Sirel)

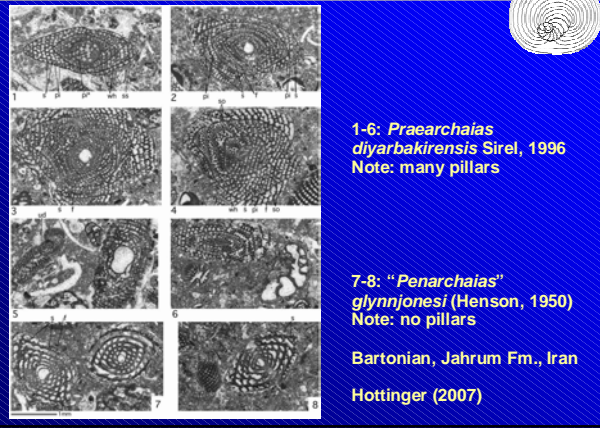
Bassi et al.
(2007)



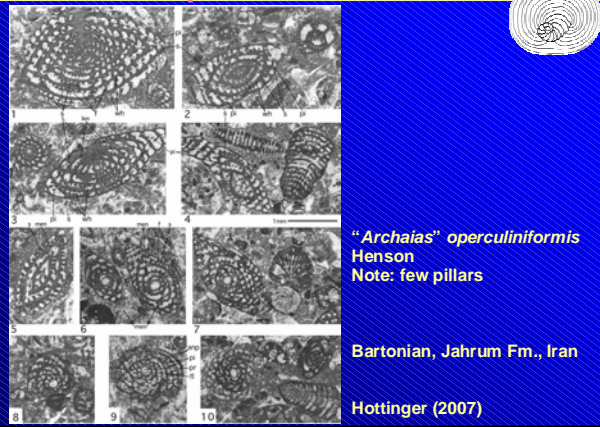
Archaiasids



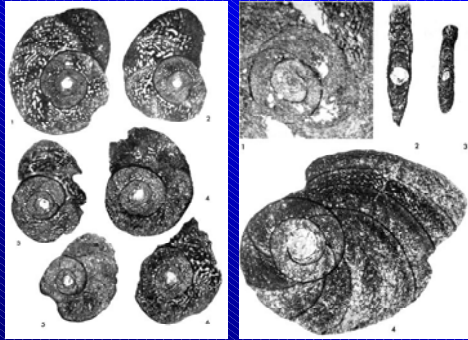
Praearchaias, Penarchaias



"Archaias" operculiniformis



Yaberinella Vaughan, 1928



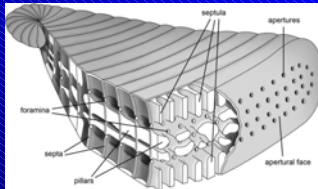
Yaberinella trelawniensis
Vaughan, 1929
Jamaica, Eocene

Yaberinella jamaicensis
Vaughan, 1928

Hottinger (1969)

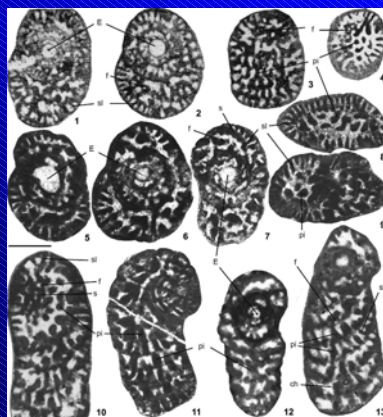
Praerhapydioninae

- first growth stages planispiral-involute, later uniserial,
- adult growth stages planispiral-discoid to flabelliform, flaring in the megalospheric form
- chambers low, with subcircular to subelliptical outline in tranverse
- sections of megalospheric specimens
- adult chambers subdivided by
 - (peripheral) regularly disposed, radial partitions or septula, continuous from one chamber to the other
 - (median) pillars
- apertures multiple



Vicedo et al. (2013)

Taberina

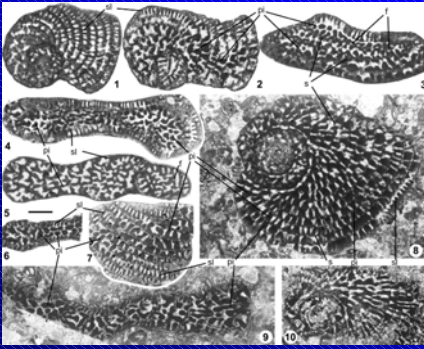


1-4: *Taberina cubana*
Keijzer, 1945
megalospheric
Cuba, ?Paleocene

5-13: *Taberina* sp.
megalospheric
SBZ3-4, Paleocene,
Chiapas, Mexico

Vicedo et al. (2013)

Taberina



Taberina sp.
microspheric

SBZ3-4,
Paleocene,
Chiapas, Mexico

Vicedo et al.
(2013)



Peneroplids

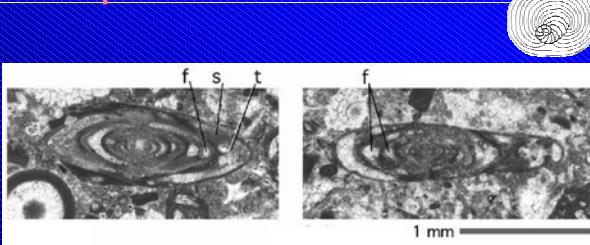


Peneroplis planatus
(Fichtel & Moll, 1798)
Recent, Persian Gulf

Hottinger (2007)



Peneropliidae



"Peneroplis" dusenburyi HENSON, 1950.
[May eventually be referred to *Penarchaias*]
f: foramen; s: septum; t: tooth

Bartonian, Jahrum Fm., Iran

Hottinger (2007)



Rhapydioninidae



Rhapydioninidae Keijzer, 1945

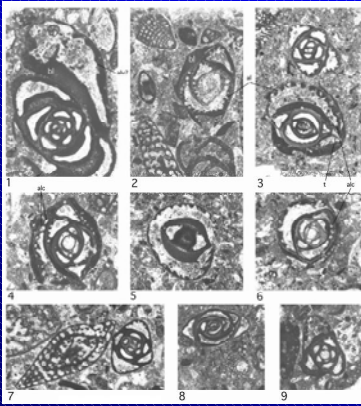
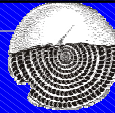
Possess either

1) a "central thickening" pierced by tubular passages (i.e., perforations, not true chamberlets)

or

2) chambers subdivided by septula and floors into numerous chamberlets (Hamaoui & Fourcade, 1973; De Castro, 1990; Fleury & Fourcade, 1990)

Austrorillinae



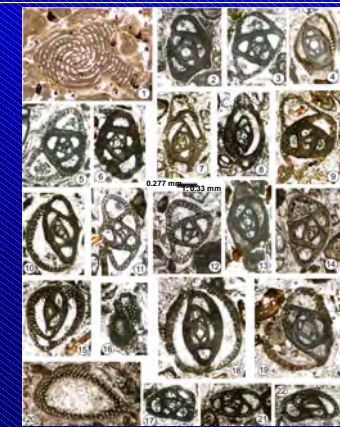
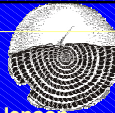
"True" miliolids, possessing an alveolar exoskeleton:
Austrorillina Parr, 1942
[Middle Eocene-Early Miocene]

Austrorillina eocaenica
Hottinger, 2007

Bartonian, Iran

Hottinger (2007)

Austrorillinae



1: *Archaias kirkukensis* Henson

2-17: *Austrorillina brunni* Marie

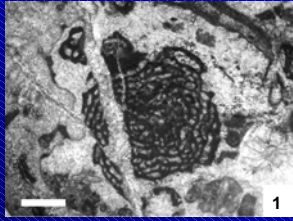
early Rupelian,
Turkey

Sirel et al. (2013;
Geol. Croatica 66: 83-109)

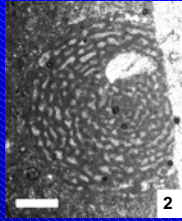
Keramospheridae

An artificial grouping; includes several undescribed species from the Danian (SBZ1) to early Thanetian (SBZ 3) of Europe and Asia

Keramosphaerinopsis gr. *iranicus* (Rahaghi, 1983)



1



2

SBZ 2, Costa Arrenti (Avezzano)

SBZ 3, Gargano (M. Saraceno)

Scale bar = 0.5 mm

Pignatti et al. (2006)

undescribed taxa

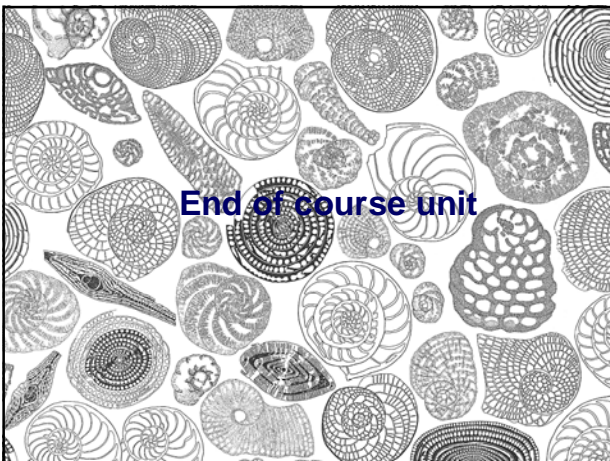
Subaxial sections of an undescribed ?miliolid or ?nubeculariid with alveolate wall from SBZ 6-7 of western Cephalonia (Accordi et al., 1999; Pignatti et al. 2006)



1

2

Scale bar = 0.5 mm



End of course unit
