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CEPHALOPODA

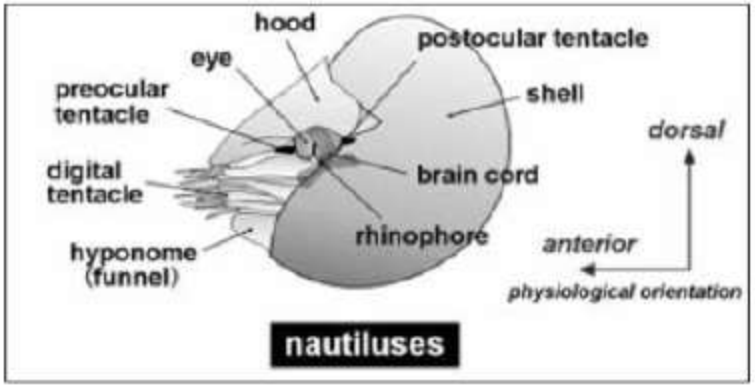
General Characteristics

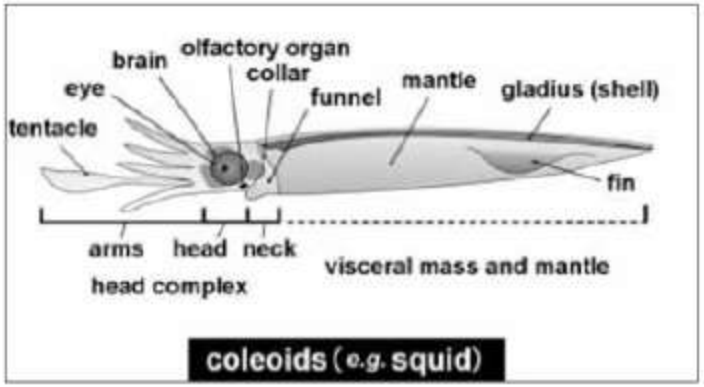
- Entirely marine
- Most highly organized of all molluscs, with the greatest complexity of any of the spiralian groups
- The close association of a well defined head with the foot modified into tentacles gives them their name: cephalopoda
- All modern cephalopods are distinguished by having a properly developed head with a good brain and elaborate sensory organs
- High metabolic and mobility rates, a well developed nervous system, and sharp eyesight are ideal adaptations for a **carnivorous predatory** life mode
- The funnel or **hyponome** is modified from foot and squirts out water from the mantle cavity providing the animal with a form of jet propulsion.

Modern Cephalopods

Nautilus
- *has an external coiled shell*
- *thin internal mantle*
- *nearly 100 tentacles*
- *only five species of this genus are extant*

Coleoids
- *Have internal shell*
- *thick external mantle*
- *include 10 tentacled extinct belemnites, squids and cuttlefish*
- *Octopus has eight tentacles but has lost its skeleton*





Tripartite Division

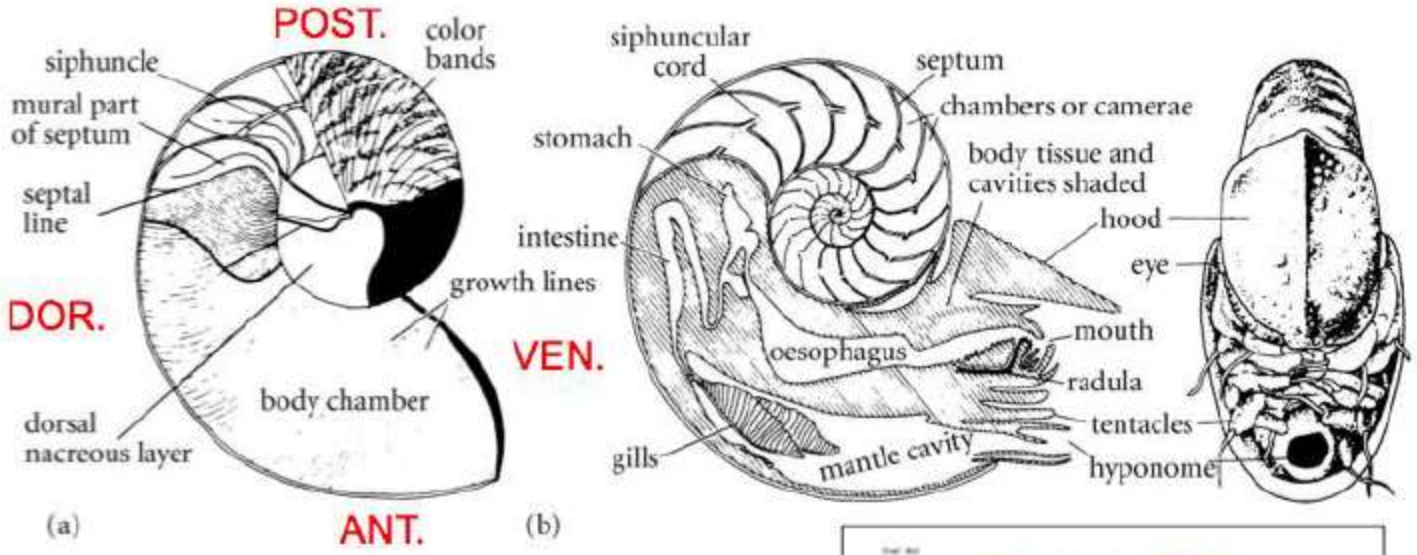
Nautiloidea
straight or coiled external shells with simple sutures
Late Cambrian to Recent

Ammonoidea
coiled, commonly ribbed external shells with complex sutures
Early Devonian to latest Cretaceous

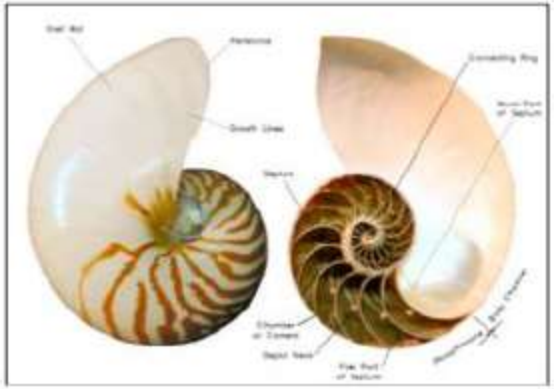
Coleoidea
internal skeletons
Carboniferous to Recent

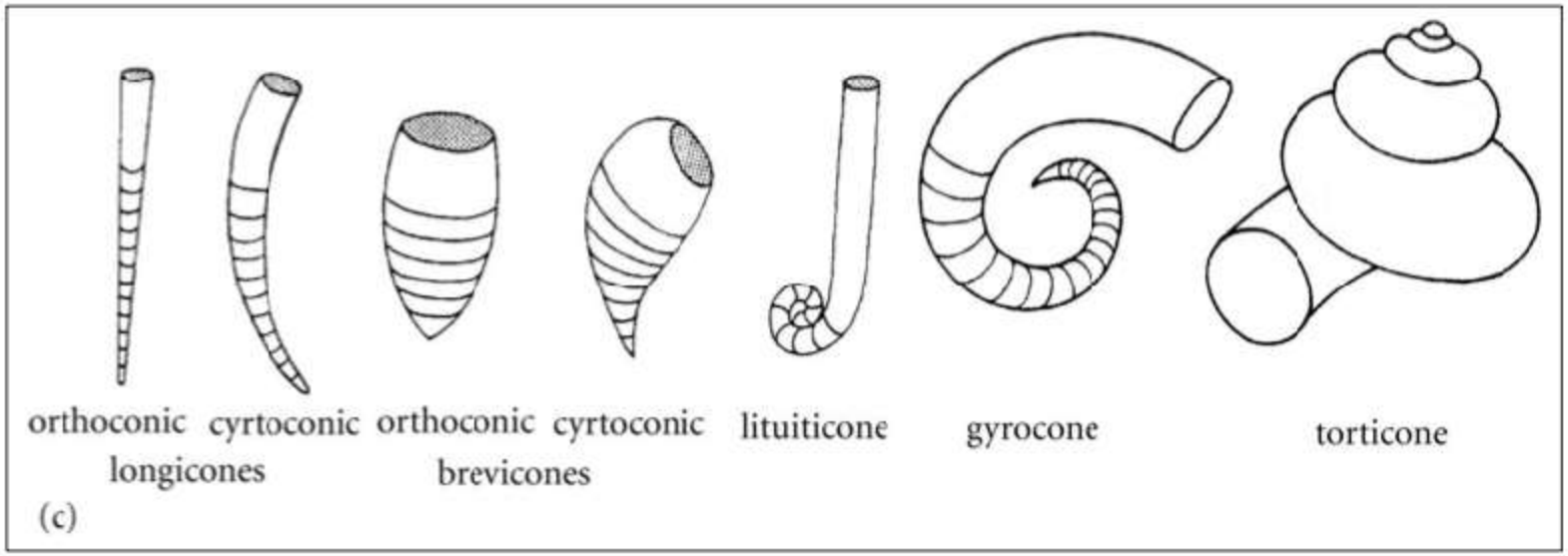
Nautiloidea

- Occurs mainly in southwest Pacific
- Shallow dweller, at depths of 5-550m
- Pursues a nocturnal, nektobenthonic life mode as both a carnivore and scavenger



Anterior at the aperture, posterior at the point furthest from the aperture, the venter on the side with the hyponome, and the dorsum opposite.

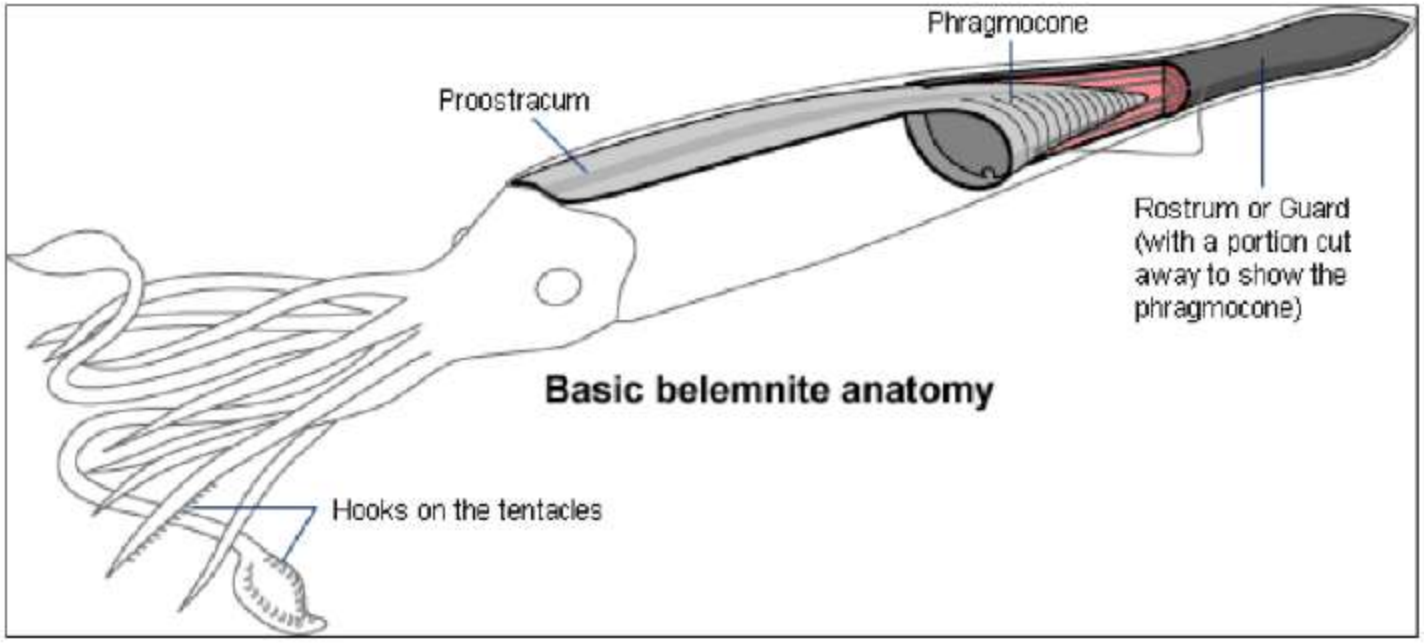




Shapes of the nautiloid shells

Belemnites

The fossil record of most cephalopods in the clade Coloidea (squid, cuttlefish, octopuses, and their relatives) is poor, especially when compared to their shelly relatives. Their hard parts, if any, are internal, can be greatly reduced in size, and often lack calcification. The extinct belemnites, however, are the exception. These squid-like animals swam with ammonoids and nautiloids in oceans of the Triassic, Jurassic, and Cretaceous Periods and are considered by paleontologists to be the ancestors of the Coleoidea. Like orthocones, belemnites had a straight shell, but it was internal, not external. It was made of three parts, **a proostracum and phragmocone** followed by a **rostrum**. Being highly resistant, the posterior bullet-shaped rostrum is most often preserved and can be found in great quantity and concentration in Mesozoic marine sediments.

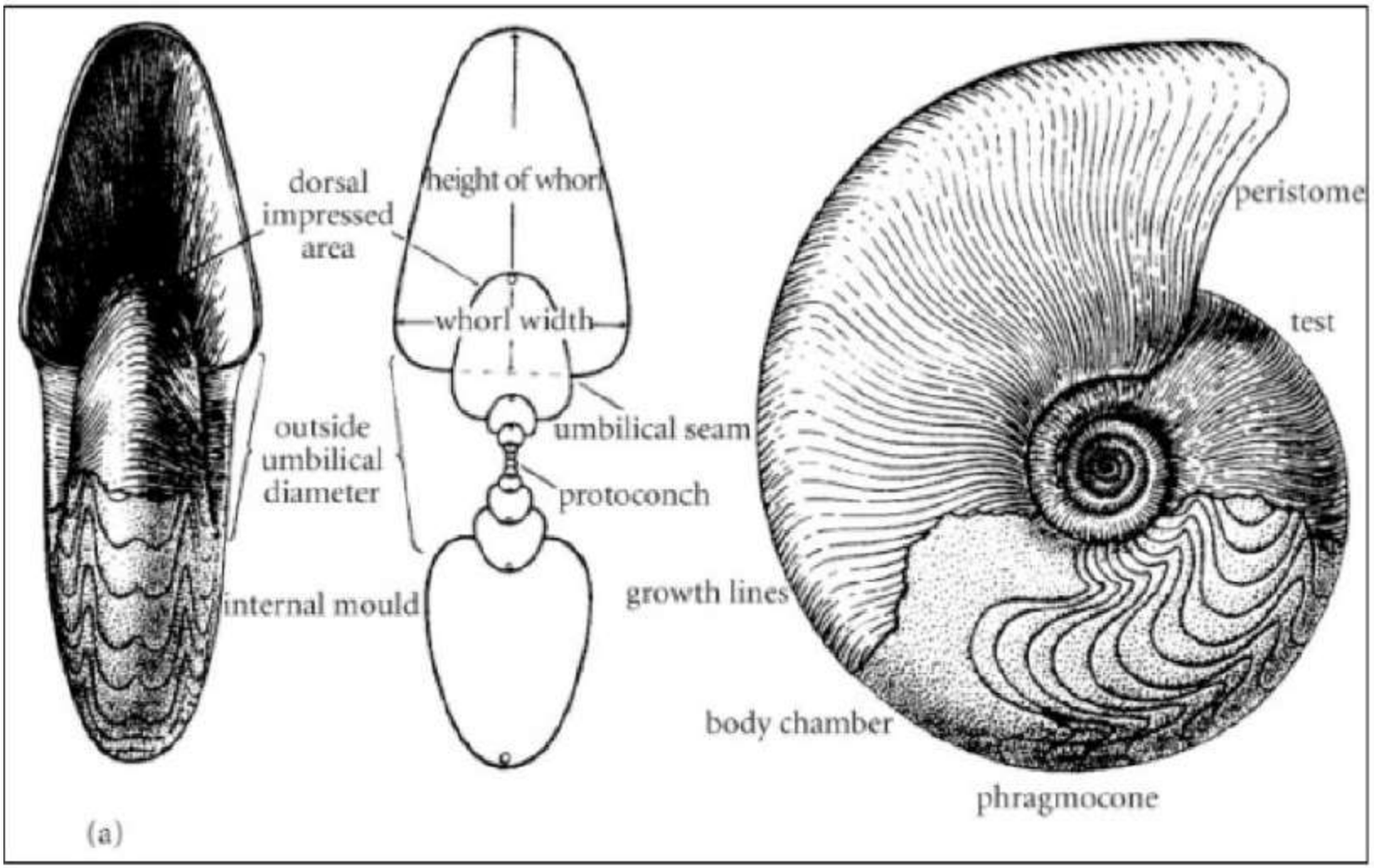


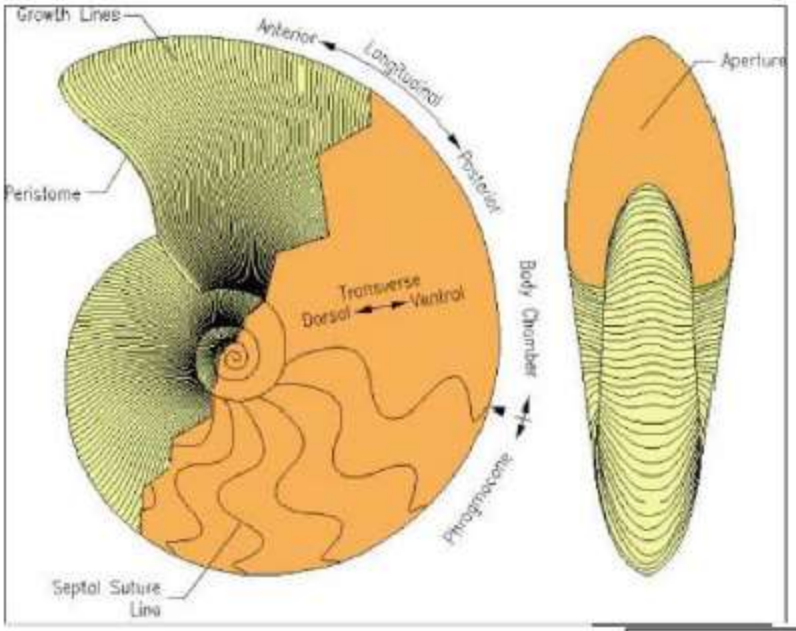
Ammonoidea

- Usually planispirally coiled shell comprising the protoconch, phragmocone and body chamber
- Protoconch records the earliest ontogeny of the animal
- Phragmocone is chambered, with each chamber marking successive occupation by

the animal, and sealed off from previous chambers by a septum, complex in structure and its margins, like a sheet of corrugated iron

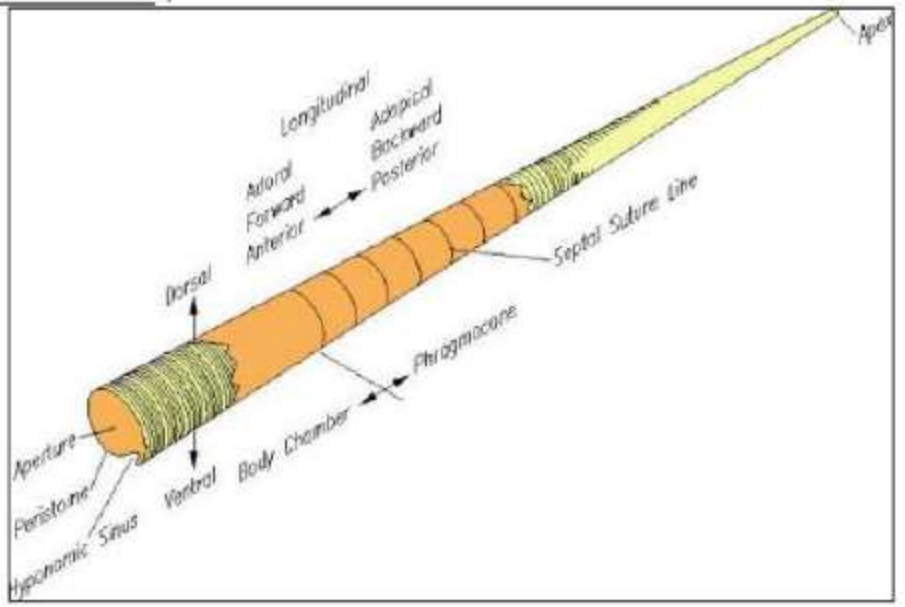
- Where the septum is welded to the shell, a suture is developed, commonly with a complex pattern of lobes and saddles


dorsal impressed area
height of whorl
whorl width
outside umbilical diameter
umbilical seam
protoconch
internal mould
growth lines
peristome
test
body chamber
phragmocone
(a)



Coiled Cephalopod

Uncoiled Cephalopod (Orthoconic)

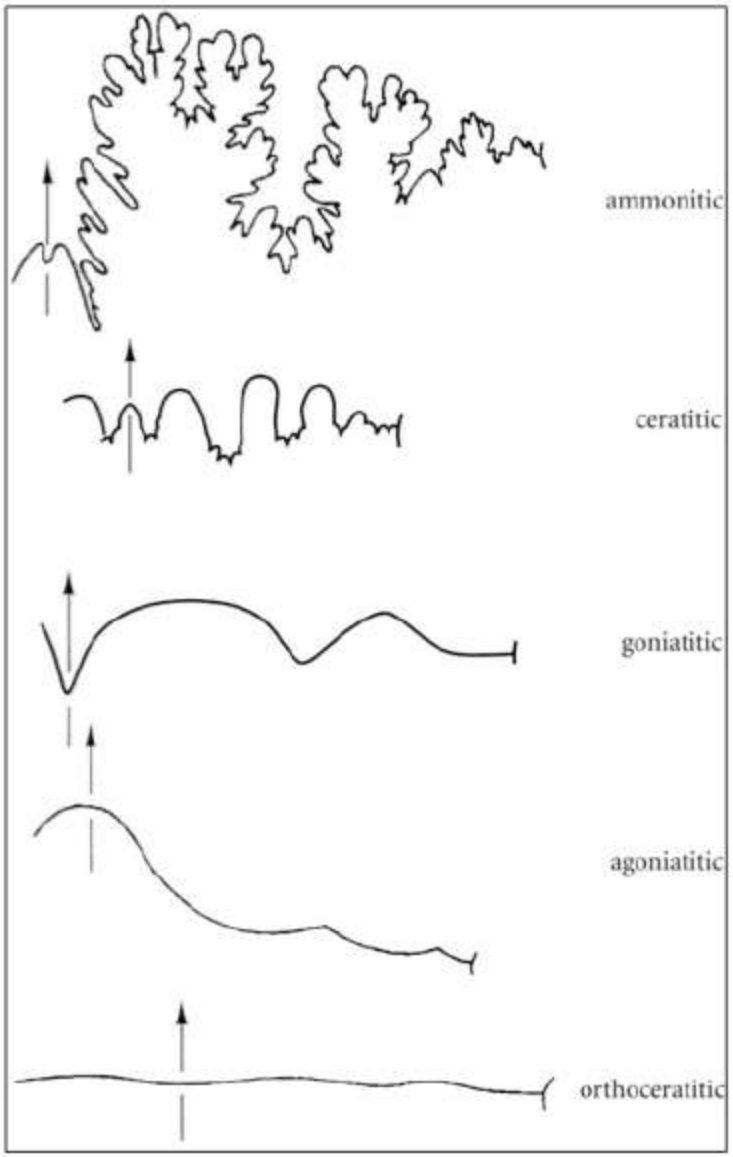


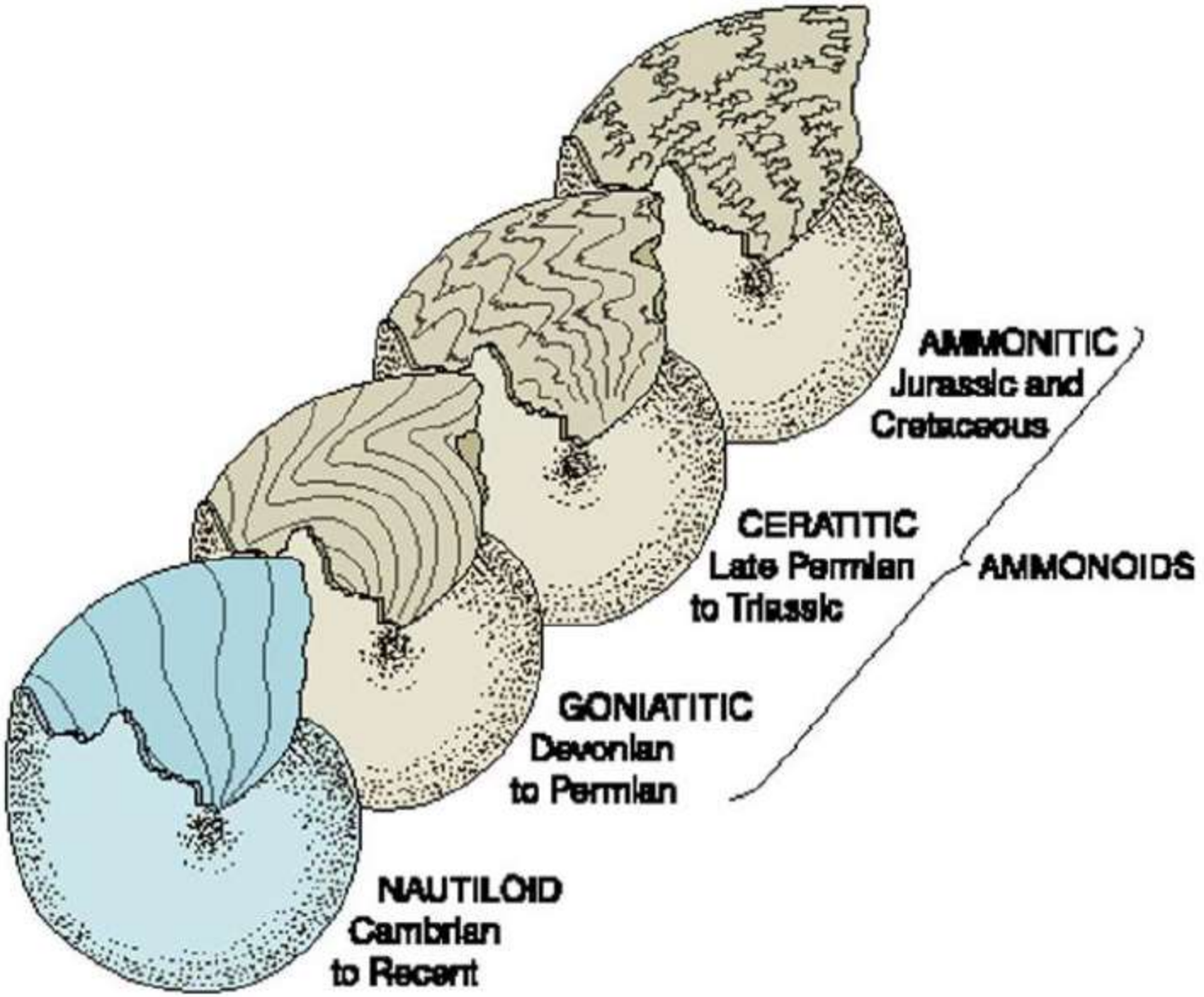
Involute coiling

Evolute coiling

Simple sutures, like those in nautiloids and early ammonoids, can withstand great pressure but have poor buoyancy control. They interpret that these animals lived at depth and were not fast moving.
In contrast, complex sutures like those in ammonites of the Cretaceous did not withstand pressure well, but allowed for very effective buoyancy control. They infer that this reflects a lifestyle at shallower depths. Based on this evidence, it appears that many ammonoid lineages evolved over millions of years, beginning in deep water habitats and evolving to inhabit relatively shallow ones.

Evolution of suture patterns: the five main types; arrows point towards the frontal aperture.




AMMONITIC
Jurassic and
Cretaceous
CERATITIC
Late Permian
to Triassic
AMMONOIDS
GONIATITIC
Devonian
to Permian
NAUTILOID
Cambrian
to Recent

Orthoceratitic: broad undulations or rounded lobes and saddles; Late Cambrian to Late Triassic.

Agoniatitic or Anarcestid: narrow mid ventral lobe and a broad lateral lobe with additional lobes and saddles; Early to Mid Devonian

Goniatitic: sharp lobes and rounded saddles; Late Devonian to Permian

Ceratitic: frilled lobes and undivided saddles; Late Permian to Triassic

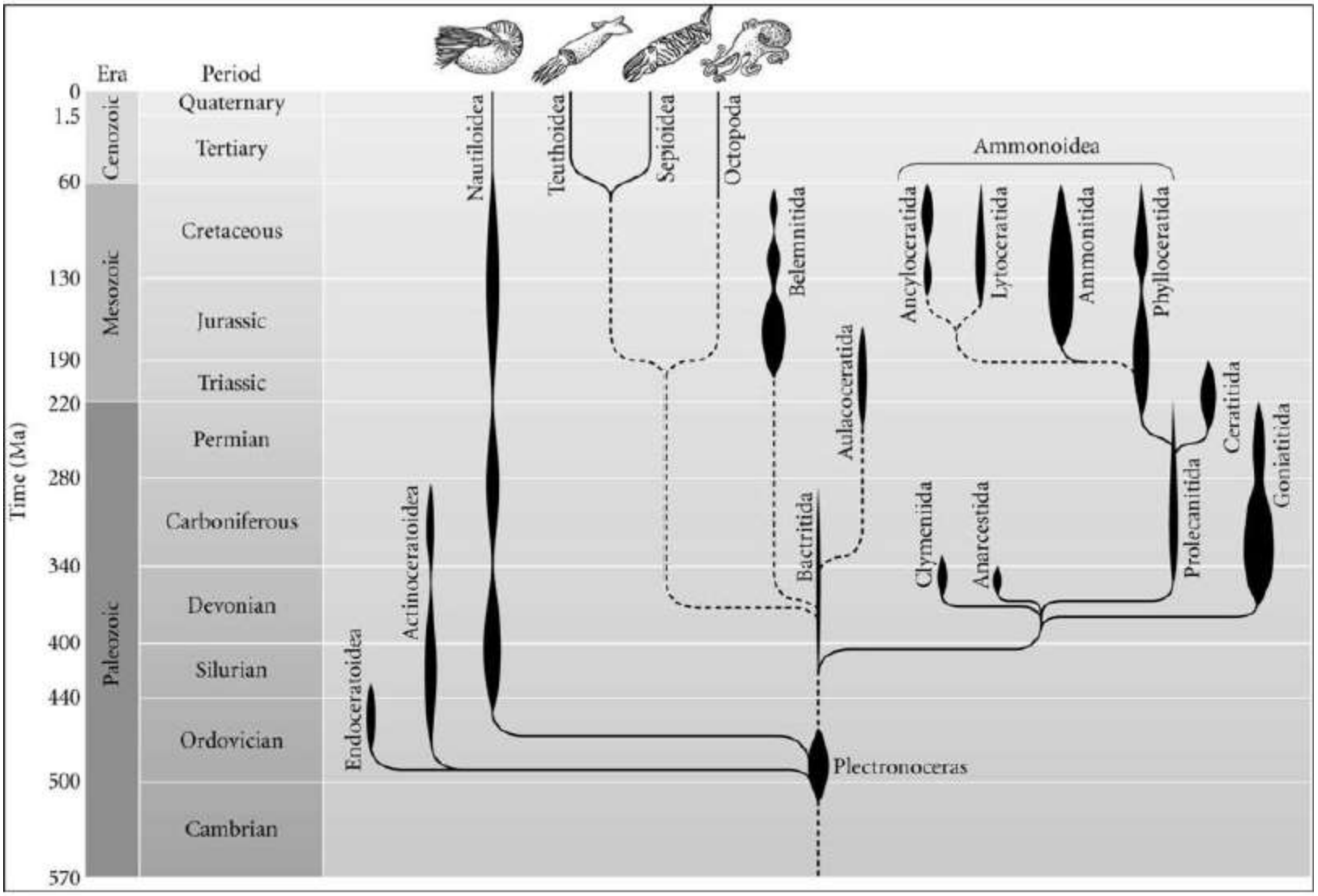
Ammonitic: both the lobes and saddles fluted and frilled; Jurassic and Cretaceous

Based on these patterns three groups ammonoids can be recognized in a general way:

The goniatites are typical of Devonian-Permian

The ceratites are typical of Triassic

The ammonites dominated Jurassic and Cretaceous



Stratigraphic ranges of the main ammonite taxa together with the other main cephalopod groups.