The Evolution of Whales

Geology 230
EVOLUTION OF WHALES

http://www.pbs.org/wgbh/evolution/library/03/4/l_034_05.html
The Mis-evolution of Whales

GO BACK AND TRY AGAIN.
Whales
Evolution of Whales
1990s
Evolution of Whales 2000s

Prothero, 2007
A family tree of Whales (CETACEA in Latin)

Mysticeti (or baleen whales)
- Basilosauridae
- Dorudontidae
- Protocetidae
- Remingtonocetidae
- Ambulocetidae
- Pakicetidae

Odontoceti (or toothed whales, which includes dolphins and porpoises)

These are the whales that lived in the Eocene Period (about 55 to 37 million years ago). Collectively they are often referred to as archaeocetes.
The two major groups of living whales: Mysticetes and Odontocetes
Blue Whale, Humpback Whale, Sperm Whale, and Killer Whale
Whale Evolution Video with Phil Gingerich:
http://www.pbs.org/wgbh/evolution/library/03/4/l_034_05.html
Tertiary Outcrops Yielding Fossil Whales in Asia
Closing of the Tethys Sea during the Cenozoic
Ambulocetus: 49 MY old

Pakicetus: 50 MY old

Indohyus: 47 MY old

Basilosaurus: 37 MY old

Figure 7-17
*Earth System History, Third Edition*
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Pakicetus: 50 MY old

Size comparison with a modern coyote skull
Ambulocetus: 49 MY old
Ambulocetus in action
Rodhocetus: 46 MY old
The ankle bones of *Rodhocetus* are more similar to artiodactyls (even-toed ungulates) than the traditional mesonychian ancestor.
Odocoileus virginianus Astragalus
Deer Right Ankle Bone
MODERN

Rodhocetus balochistanensis Astragalus
Fossil Whale Ankle Bone (cast)
EARLY EOCENE

Similar ankle bone assemblies in this deer and in early whales strongly indicate their ancestral relationship.
Basilosaurus: 37 MY old

Ankle, foot, and toes of *Basilosaurus* excavated in Wadi Hitan, Egypt. The foot as shown is approximately 12 cm long. Photograph ©1991 Philip Gingerich.
Dr. B. Holly Smith working at the base of the tail at a *Basilosaurus* excavation in Wadi Hitan, Egypt. We are particularly interested in this part of the skeleton because this is where the reduced hind limbs, feet, and toes are found. Photograph ©1991 Philip Gingerich.
Virtually complete skeleton of *Dorudon* excavated in Wadi Hitan, Egypt. Note the retention of hind limbs, feet, and toes like those found in *Basilosaurus*. The skeleton is approximately 5 m long. Photograph ©1998 Philip Gingerich.
Dorudon from the late Eocene of Egypt
vestigial whale hips
Dolphin with extra fins in position of rear legs, Japan 2006
Evolution of nasal opening in whales

The ancient, amphibious whale *Pakicetus* had a land mammal’s nostrils at the end of the snout.

*Rodhocetus* swam the seas; its nostrils were higher on the skull, intermediate to those of its ancestors and modern whales.

A modern gray whale’s blowhole allows it to break the surface, inhale, and resubmerge without having to stop or tilt the snout up.

Hearing in whales

Though more aquatic than *Pakicetus*, *Ambulocetus* still heard directly through its ears.

Sounds were transmitted to the middle ears of *Basilosaurus* as vibrations from the lower jaw.

Modern toothed whales echolocate: The melon directs sound at an object, and the lower jaw receives the echoing reply.
Genetic evidence suggests that hippos (artiodactyls) are the closest living relatives of whales.