Mesozoic Mammalia (MES-MAM)
Tertiary Mammalia (TER-MAM)
Pleistocene Vertebrata (PCN-VTB)

Block Description

This block description provides a general introduction to all of the fossil mammals GCR blocks, which includes the Mesozoic Mammalia, Tertiary Mammalia and Pleistocene Vertebrata blocks.

Visit https://jncc.gov.uk/gcr-site-list, for more information on GCR blocks and sites
For Palaeontology GCR block descriptions and GCR site lists,
visit https://jncc.gov.uk/gcr-blocks-palaeontology

Introduction

In contrast to the manner in which most invertebrate fossils are represented in the GCR, fossils of vertebrates, arthropods (except trilobites) and terrestrial plants do have their own dedicated GCR Blocks, because of the relative rarity of the fossil material. The GCR sites selected for the Mesozoic Mammalia GCR Block represent the British fossil record of mammals from the emergence of the group in the Triassic Period (which ranged from about 200 to 130 million years ago (Ma)), through the remainder of Mesozoic Era (ending 65 Ma); the fossil record for Cainozoic times (i.e. from the end of the Cretaceous Period to the present) is encompassed by the Tertiary Mammalia (65–2 Ma) and Pleistocene Vertebrata (2 Ma to 10 000 years ago) GCR Blocks.

Palaeontological/palaeobiological characteristics

The mammals arose during the Late Triassic Epoch (227–205 Ma) from a reptile group commonly termed the ‘mammal-like reptiles’. Mammals and mammal-like reptiles together form the clade Synapsida, one of the major divisions of terrestrial vertebrates. During the Carboniferous Period (354–292 Ma) there arose a new group of tetrapods, the amniotes, which had broken the link with dependence on water. Amniotes lay eggs that act as small ‘private ponds’, so they no longer have to lay their eggs in water. The amniotic egg has a semi-permeable outer membrane and shell that allow gases, but not water, to pass through, a supply of food (yolk) and a waste-disposal system. Amniotes today include reptiles, birds and mammals.

The basal Amniota divided during the Carboniferous Period into three main branches, the Anapsida, which led to modern turtles, the Diapsida, which led to modern crocodiles, birds and lizards, and the Synapsida. British sites that are important in documenting these early phases of amniote, and synapsid, evolution are encompassed by the Permian - Triassic (PER-TRI) GCR Block.

Mammals arose from cynodonts, a group of largely carnivorous synapsids that arose in late Permian times (the Permian Period ranges from 292–251 Ma). During the Middle (242-227 Ma) and Late (227–205 Ma) Triassic epochs, certain smaller cynodonts showed the key transitions to mammals in the nature of the lower jaw.

Mammals are distinguished by a number of features, notably their expanded brain, which fills the whole posterior portion of the skull, and with the braincase bony elements fused to the outer skull bones, double-rooted cheek teeth (premolars, molars), and a jaw articulation between the dentary (lower jaw) and squamosal (skull). These features contrast with tritylodonts (a type of cynodont) and other reptiles, which have a much smaller brain, and the braincase elements generally remain separate from the outer skull bones, single-rooted cheek teeth, and a jaw articulation between the articular (lower jaw) and quadrate (skull). The expansion of the braincase and the shift of the jaw joint happened in several stages through the Triassic Period.

Some commentators have restricted the term ‘Mammalia’ to the immediate ancestors of modern mammals only, hence excluding many Mesozoic groups traditionally called mammals, but in the GCR the traditional definition is used, thereby the Mammalia are defined by the switch from an articular–quadrate jaw joint to a dentary–squamosal jaw joint.

The early Mesozoic mammals include 10 or so groups, known best from the Jurassic (205–142 Ma) System of Europe and North America, with some of the earliest known sites occurring in Britain. Modern mammal groups probably appeared during the Late Jurassic Epoch, although the oldest fossils are Early Cretaceous (192–99 Ma) in age. Modern mammals fall into three subclasses: the Monotremata – the platypus and echidna from Australasia – which lay eggs; the Marsupialia – the pouched mammals of Australasia and the Americas – which produce tiny young that complete their development in the pouch; and the Eutheria – placental mammals – which produce relatively developed young. All these

modern mammal groups exhibit hair, warm-bloodedness (endothermy), large brains and extended parental care, and they suckle their young from milk-producing glands, or mammae, hence the name ‘mammal’.

The oldest monotreme fossils are isolated jaw fragments from the Early Cretaceous Epoch (192–99 Ma) of Australia. The oldest marsupial and placental fossils are again isolated teeth and jaws, from the mid-Cretaceous Period of North America and Asia.

By the end of the Cretaceous Period (65 Ma) the marsupials and placentals were relatively diverse. Most of the more primitive mammal groups had long disappeared, and only two families of marsupials died out during the Cretaceous–Tertiary mass extinction, 65 million years ago, which saw the end of the dinosaurs and other large reptiles.

During the Tertiary Sub-Era (65–1.8 Ma), the marsupials at first existed mainly in the Americas. They spread to Europe, where they occur commonly in Eocene and Oligocene faunas, and they also dispersed to Asia and north Africa. In the Americas, the marsupials diversified during Tertiary time, especially in South America, where they became important components of the faunas, especially as small to large carnivores. By the early Eocene Epoch (55–34 Ma), marsupials had spread across Antarctica to Australia, where they evolved into a diverse array of familiar animals, from wombats to kangaroos. Marsupials became extinct everywhere by the end of Miocene times (5 Ma), except in South America and Australia, and they subsequently re-invaded parts of North America more recently. Both Australia and South America were largely isolated from the rest of the world during the Tertiary Period, so their mammals evolved independently, marsupials in Australia and marsupials and other unusual mammals, including sloths and armadillos, in South America.

Only about half of the modern orders of mammals had appeared by the Palaeocene Epoch (65–54 Ma), but almost all of the 20 or so modern groups had appeared by the early Eocene Epoch, around 50 million years ago. The various primitive Palaeocene groups largely survived into the Eocene Epoch and some continued for a little longer than that, but they all eventually disappeared. Most of the modern orders are known in the fossil record of the Eocene Series onwards in Europe, including the excellent Eocene sequences of the south of England:

Modern mammalian orders

The Edentata restricted mainly to South America, where sloths, anteaters and armadillos evolved. Close relatives are the Pholidota – the pangolins – known today from Africa and south-east Asia.

The Insectivora, represented today by shrews, hedgehogs, moles and their relatives, are all small insect-eating forms, and they are known from most good Tertiary localities.

The Carnivora, represented by modern cats, dogs, bears, seals and sealions, came to the fore between the Eocene and Miocene epochs. The feliforms, or cats, civets, mongooses and hyaenas, include many extinct forms that were similar to living representatives, but also many sabre-toothed cats. The caniforms – dogs, bears, racoons and weasels – and the marine forms also included some unusual extinct forms – the amphicyonids, something like giant bear-dogs. The marine carnivores – the pinnipeds, including the seals, sealions and walruses evolved in the Oligocene Epoch from terrestrial caniforms.

The Scandentia, or tree shrews, are a small group of squirrel-like animals from Asia. The Dermoptera, or flying lemurs, include two species from south-east Asia and a single Eocene fossil from Thailand. Close relatives are the extinct Plesiadapiformes from the early Tertiary Period: tree-dwelling plant-eaters that were once erroneously classified as primates. The primates themselves include an array of forms: the lemurs, lorises and bushbabies, the tarsiers, the Old World and New World monkeys and the apes. The apes evolved from Old World monkeys, and they have a rich fossil record, especially in Miocene deposits in Africa. Humans of course belong here, and the oldest humans are from rocks dated as over 4

million years old, in East Africa. The Chiroptera – the bats – have a long history dating back to the early Eocene Epoch, when the oldest bats looked very like modern forms.

The largest modern order of mammals, the Rodentia, consists of 1800 species today – about 40% of all mammal species. Most of these are myomorphs – mice, rats and their relatives – a group that radiated explosively in the past 20 million years. Other rodent groups include the sciuromorphs (squirrels and beavers) and the hystricognaths (guinea pigs, capybaras and chinchillas), a group restricted to South America. The Lagomorphs – rabbits and hares – are close relatives of the rodents, as probably are the Macroscelidea, the elephant shrews of Africa.

Among modern mammals, the 'ungulates', or hoofed mammals, include all the large plant-eaters. The Perissodactyla usually have an odd number of hooves on each foot (one in horses, three in rhinoceroses), and the axis of the foot passes through the middle toe. Horses had a mainly Northern Hemisphere distribution. The earliest dog-sized Pliolophus (formerly known as Hyracotherium), from the beginning of the Eocene Epoch, evolved through larger Oligocene to Pliocene forms to the modern Equus. Fossil rhinoceroses were once much more widespread and diverse than they are today. Extinct perissodactyls include the large brontotheres, with forked nose horns, and the strange gorilla-like chalicotheres. Feet of the Artiodactyla have even numbers of hooves: two in modern camels, deer and cattle, but four in ancestral Eocene forms and in modern pigs and hippos. Extinct relatives of the pigs include some unusual forms, especially the huge, rather terrifying entelodonts from the mid-Tertiary Period. Camels, cattle and deer came to the fore especially after the Miocene Epoch. These groups are characterized by a complex digestive system that allows them to ruminate their food ('chew the cud') so as to extract maximum nutritive value from it.

Other 'ungulate' groups include the Order Cetacea – the whales. Whales arose in Eocene times, evolving from land-living carnivorous mammals. There were some primitive long, serpent-like whales in the Eocene Epoch, the archaeocetes (such as Basilosaurus). After the Eocene Epoch, whales evolved into their two modern groups, the odontocetes or toothed whales (flesh-eating dolphins, porpoises, killer whales) and the mysticetes, or whalebone whales, the giants that feed on plankton. A small, possibly ungulate, group, is the Order Tubulidentata, represented today by the African aardvark, an ant-eating form. The Proboscidea – elephants and their relatives – evolved largely in Africa and expanded worldwide as a diverse and successful group in the Miocene Epoch. Extinct forms include the deinotheres, with curved tusks on the lower jaws, the gomphotheres, with four tusks, the mastodonts and the mammoths. These groups disappeared as the world became colder, although the mastodonts and mammoths adapted to the cold of the Pleistocene ice ages and then mostly disappeared 10 000 years ago as the ice receded. Some mammoths survived on Arctic islands until around 3700 years ago. Close relatives of the proboscideans are the Sirenia (the sea cows) and the Hyracoidea, the small rabbit-like hyraxes of Africa and the Middle East.

Palaeogeography

The palaeogeography of each relevant geological period since the appearance of the earliest British fossil mammals of the Mesozoic Era can be found elsewhere on the pages of this website. **See Aalenian - Bajocian (AAL-BAJ), Aalenian - Bajocian (AAL-BAJ)Aptian-Albian (APT-ALB), Bathonian (BAT), Berriasian, Valanginian, Hauterivian, Barremian (BER-BAR), Cenomanian, Turonian, Senonian, Maastrichtian (CEN-MAA) , Callovian (CLV), Hettangian, Sinemurian and Pliensbachian (HET-PBN), Kimmeridgian (KIM), Oxfordian (OXF) Portlandian - Berriasian (PTL-BER) Permian - Triassic (PER-TRI) Rhaetian (RTN).**

GCR site selection

This Block contains full coverage of Geological Conservation Review (GCR) sites for fossil mammals in the Mesozoic Era.

Tertiary sub-Era mammal sites are covered by the Tertiary Mammalia GCR Block (TER-MAM).

Pleistocene GCR sites important for mammals were in fact selected for all aspects of their vertebrate palaeontology: for finds of mammals, but also for their content of (usually rarer) birds, fishes, amphibians and reptiles (**see Pleistocene Vertebrata (PCN-VTB)**)

British fossil mammal sites range through virtually the entire known record of the group, from the Late Triassic Epoch (c. 215 million years ago) to the present day. Representation is especially good in the Jurassic Period and Early Cretaceous Epoch, the Eocene and Oligocene epochs, and the Pleistocene Epoch.

The fossil mammal GCR sites selected are widely distributed across Great Britain, with an inevitable clustering of Mesozoic and Tertiary sites in southern England, associated with the main belts of outcrop. One exception is the important Middle Jurassic site on Skye in the Scottish Inner Hebrides. The Pleistocene localities are more widely distributed, including cave locations in Carboniferous limestone regions of central England, Wales and south-west England, and bedded terrestrial, fluvial and marine sediments of Scotland and northern, eastern and southern England.