ENVIRONMENTAL ATLAS OF ABU DHABI EMIRATE

Is that really the time?

A teacher briefing on geological time

AGEDI

هيئة البيئة - أبوظبي
Environment Agency - ABU DHABI

This teacher briefing is for teachers and other educators to give young people an understanding of geological time.

Geologists have determined that the Earth is about 4.56 billion years old.

To really appreciate the geographic inheritance of Abu Dhabi, it is important to have a good understanding of geological time. This requires thinking in terms of tens and hundreds of millions of years, which, in comparison to our own momentary life-spans, can be quite difficult to get to grips with.

The geological timescale shown in this briefing is divided into distinct periods within which the physical geography of Abu Dhabi developed and continues to evolve. Each of the geological periods relate to events which have happened in the Earth's history.

600 million years ago

300 million years ago

100 million years ago

20 million years ago

Present Day

Abu Dhabi and the rest of the UAE is located on the Arabian Plate, once part of the ancient super continent known as Gondwana. Evidence of its geological history can be traced with some certainty to about 950 million years ago. Subsequently, the Arabian Plate underwent periods when it was partially submerged below the sea, acquiring marine sediments (creating rocks such as sandstones and limestones), or exposed above the surface and subjected to erosive forces that deposited fluvial (river origins), lacustrine (lake origins) or aeolian (wind-blown) sediments. These diverse episodes are recorded within the sub-surface rocks and geological formations of the Emirate.

Throughout the Palaeozoic era (542–251 million years ago), the Arabian Plate, and the whole of Gondwana, was located in the southern hemisphere. Furthermore, in the early Paleozoic the Arabian Plate was actually oriented 90° counter clockwise relative to today's poles. However, under the influence of plate tectonics, Gondwana moved across the South Pole, migrating to the other side of the planet. It eventually emerged the 'right way up', with the land mass that included the Arabian Plate oriented more or less as we see it today.

Neogene	0 - 23.03 ma
Paleogene	23.03 - 65.5 ma
Cretaceous	65.5 - 145.5 ma
Jurassic	145.5 - 199.6 ma
Triassic	199.6 - 251 ma
Permian	251 - 299 ma
Carboniferous	299 - 359.2 ma
Devonian	359.2 - 416 ma
Silurian	416 - 443.7 ma
Ordovian	443.7 - 488.3 ma
Cambrian	488.3 - 542 ma
Proterozoic	542 - 1600 ma
Archean	1600 - 4600 ma

ma - million years

AGEDI
هيئة البيئة - أبوظبي
Environment Agency - ABU DHABI

Neogene

The continents in the Neogene period were very close to their current positions[1]. Sea levels fell, exposing land bridges between Africa and Eurasia and between Eurasia and North America[2]. The global climate became seasonal and continued its overall drying and cooling trend which began in the beginning of the Paleogene period[3].

Paleogene

The global climate during the Paleogene changed from the hot and humid conditions of the late Mesozoic era and began a cooling and drying trend which, although having been periodically disrupted by warm periods such as the one that persists today[4]. The continents during the Paleogene continued to drift closer to their current positions[5].

Cretaceous

The Cretaceous was a period with a relatively warm climate and a high worldwide sea level[6]. The oceans and seas were populated with now extinct marine reptiles, ammonites and molluscs; and the land by dinosaurs[7]. At the same time, new groups of mammals and birds as well as flowering plants appeared[8].

Jurassic

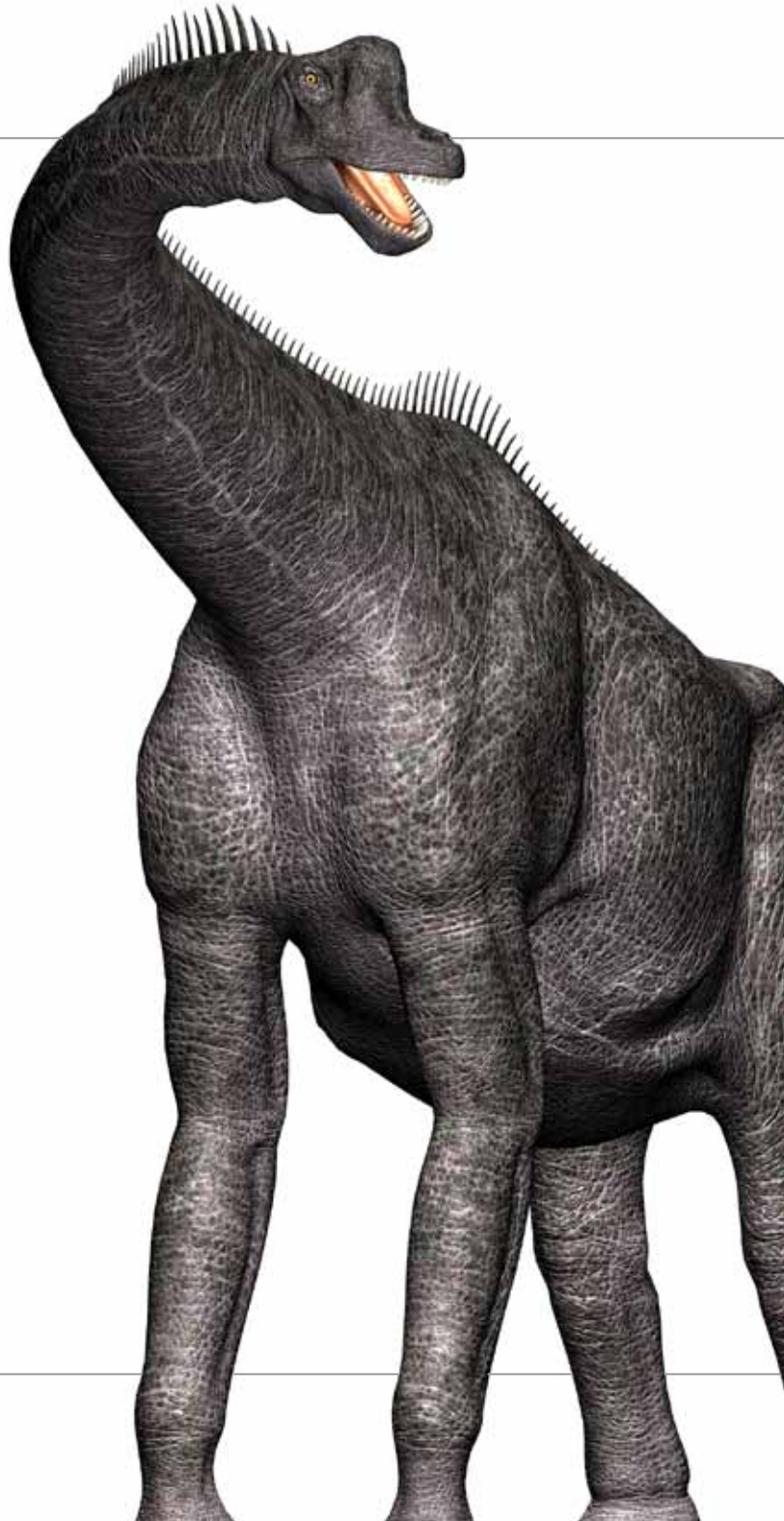
By the beginning of the Jurassic period, the supercontinent Pangaea had split into two landmasses, Laurasia to the north and Gondwana to the south[9]. This created more coastlines and caused a change in global climate from hot and dry to warm and humid, and many of the arid deserts of the Triassic were replaced by lush rainforests[10]. The dinosaurs continued to dominate the land, and reached their peak in this period as they diversified into a wide variety of groups[11].

Triassic

The Triassic climate was generally hot and dry[12]. There is no evidence of glaciation at or near either pole; in fact, the polar regions were apparently moist and temperate, a climate suitable for reptile-like creatures[13]. Pangaea's large size limited the stabilising effect of the global ocean; its continental climate was highly seasonal, with very hot summers and cold winters[14].

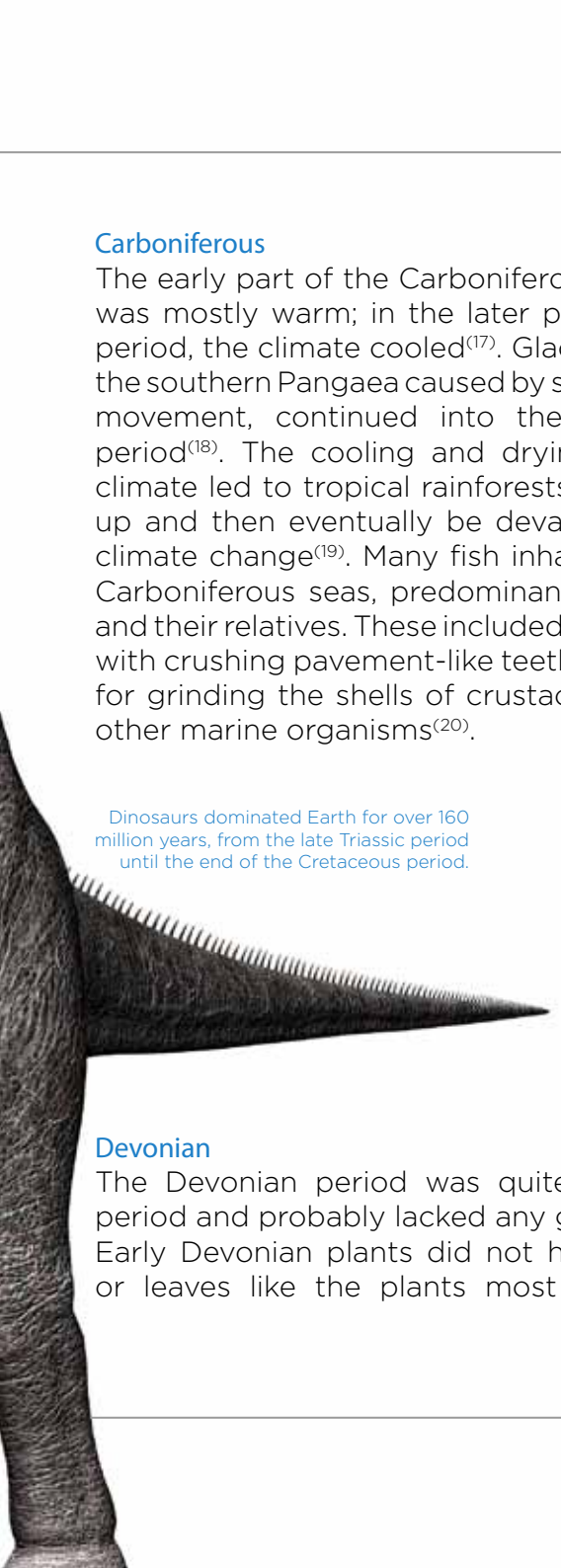
Permian

The climate in the Permian period was quite mixed. At the beginning of the Permian, the Earth was still at the grip of an Ice Age from the Carboniferous period[15]. The world at the time was dominated by a single supercontinent known as Pangaea[16].



Carboniferous

The early part of the Carboniferous period was mostly warm; in the later part of the period, the climate cooled[17]. Glaciations in the southern Pangaea caused by southward movement, continued into the Permian period[18]. The cooling and drying of the climate led to tropical rainforests to break up and then eventually be devastated by climate change[19]. Many fish inhabited the Carboniferous seas, predominantly sharks and their relatives. These included some fish with crushing pavement-like teeth adapted for grinding the shells of crustaceans and other marine organisms[20].



Dinosaurs dominated Earth for over 160 million years, from the late Triassic period until the end of the Cretaceous period.

Devonian

The Devonian period was quite a warm period and probably lacked any glaciers[21]. Early Devonian plants did not have roots or leaves like the plants most common today and did not grow much more than a few centimeters tall. The first seed-bearing plants spread across dry land[22].

Silurian

The Silurian period enjoyed quite stable and warm temperatures, unlike the extreme glaciations of the Ordovician before it, and the extreme heat of the ensuing Devonian[23]. During this period, the Earth entered a long warm greenhouse phase and warm shallo seas covered much of the equatorial land masses[24]. Early in the Silurian, glaciers retreated back into the South Pole until they almost disappeared in the middle of Silurian[25].

Ordovian

From the Early to Middle Ordovian, the Earth experienced a milder climate in which the weather was warm and the atmosphere contained a lot of moisture[26]. However, when Gondwana finally settled on the South Pole during the Late Ordovian, big glaciers formed causing shallow seas to drain and sea levels to drop[27]. The Ordovian is best known for the presence of its diverse marine invertebrates. A typical marine community also consisted of red and green algae, primitive fish and corals[28].

Cambrian

The Cambrian Period marks an important point in the history of life on Earth[29]. It is the time when most of the major groups of animals first appear in the fossil record[30]. This event is sometimes called the "Cambrian Explosion"[31], because of the relatively short time over which this diversity of forms appears.

Proterozoic

The period of Earth's history that began 2.5 billion years ago and ended 543 million years ago is known as the Proterozoic[33]. Many exciting events in the history of the Earth and of life occurred during this period - stable continents first appeared and began to grow together, a long process taking about a billion years[34].

Archean

The Archean is one of the four important eons of Earth history. The atmosphere was very different from what we breathe today; at that time, it was probably an atmosphere of gases that would be poisonous to most life on our planet today[35]. Also during this time, the Earth's crust cooled enough that rocks and continental plates began to form[36].

The following definitions are provided for the educator's reference. Young people should have the opportunity to explore definitions through individual activities. Some definitions may have been deliberately simplified for a young audience.

Ammonites
Ammonites were free-swimming molluscs of the ancient oceans.

Atmosphere
The layers of gases surrounding the earth.

Crustaceans
An animal of the large, mainly aquatic group Crustacea, such as a crab, lobster, shrimp, or barnacle.

Eons
An indefinite and very long period of time.

Equatorial
Of, at, or near the equator: equatorial regions.

Eurasia
The term used to describe the total continental land mass of Europe and Asia combined.

Geological
A scientific description which deals with the physical structure and substance of the earth, their history, and the processes which act on them.

Glaciation
The process or state of being covered by glaciers or ice sheets.

Gondwana
A vast continental area believed to have existed in the southern hemisphere and to have resulted from the break-up of Pangaea in Mesozoic times . It comprised present-day Arabia, Africa, South America, Antarctica, Australia, and the peninsula of India.

Greenhouse gases
Gases that contributes to the greenhouse effect by absorbing infrared radiation. Carbon dioxide and chlorofluorocarbons are examples of greenhouse gases.

Laurasia
A vast continental area believed to have existed in the northern hemisphere and to have resulted from the break-up of Pangaea in Mesozoic times. It comprised the present North America, Greenland, Europe, and most of Asia north of the Himalayas.

Molluscs
Animals which include snails, slugs, mussels and octopuses. They have a soft body and live in aquatic or damp habitats and most kinds have a hard shell.

Pangaea
A vast continental area or supercontinent comprising all the continental crust of the earth, which is thought to have existed in late Palaeozoic and Mesozoic times before breaking up into Gondwana and Laurasia.

For more teacher resources including Teacher Briefings, Lesson Plans, Activity Worksheets, and Fact Sheets, go to **www.environmentalatlas.ae**

References: 1) L. M. Surhone (2010) Quaternary: Quaternary, Geologic Time Scale, Cenozoic, Neogene, Pleistocene, Holocene. 2,3) W. A Berggren (1974) Late Neogene: Biostratigraphy, Geochronology and Paleoclimatology of the Last 15 Million Years in Marine and Continental Sequences (Developments in palaeontology and stratigraphy. 4,5) J. F. Kirkaldy (1971) Geological Time. 6) P. W. Skelton (2003) The Cretaceous World. 7) V. A. Vakhrameev (2010) Jurassic and Cretaceous Floras and Climates of the Earth. 8) F. P. Miller (2010) Cretaceous. 9) B. Vrielynck (2004) The Changing Face of the Earth, the Break-up of Pangaea and Continental Drift Over the Past 250 Million Years. For full references, go to www.environmentalatlas.ae.