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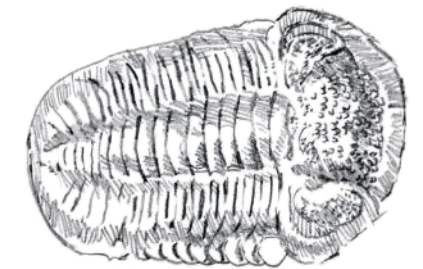
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Rocks & Fossils of Brixham

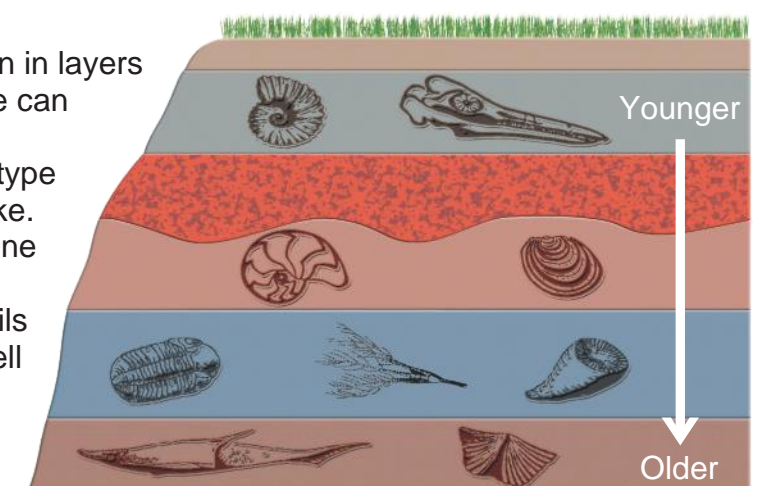


Geology is the study of the Earth and the rocks which are the building blocks of our world. Geologists can read the rocks around Brixham to find evidence of dramatic natural events that have formed and reformed our landscape over 400 million years.



Sedimentary Rocks

Most of the rocks around Brixham were laid down in layers by the sea, or on land by rivers and the wind. We can read the order in which they were deposited with younger layers laid down over older layers. The type of sediment tells us what the environment was like. Around Torbay, Devonian limestone and mudstone were deposited in the sea, and Permian breccia and dune sand were deposited in a desert. Fossils within the rocks show us what life was like and tell us more about the environment at the time.



Igneous Rocks

Formed locally by the cooling of molten rock, including lava and ash which were erupted onto the surface by volcanoes. Other igneous rocks in Devon such as the Dartmoor granite, solidified deep underground.

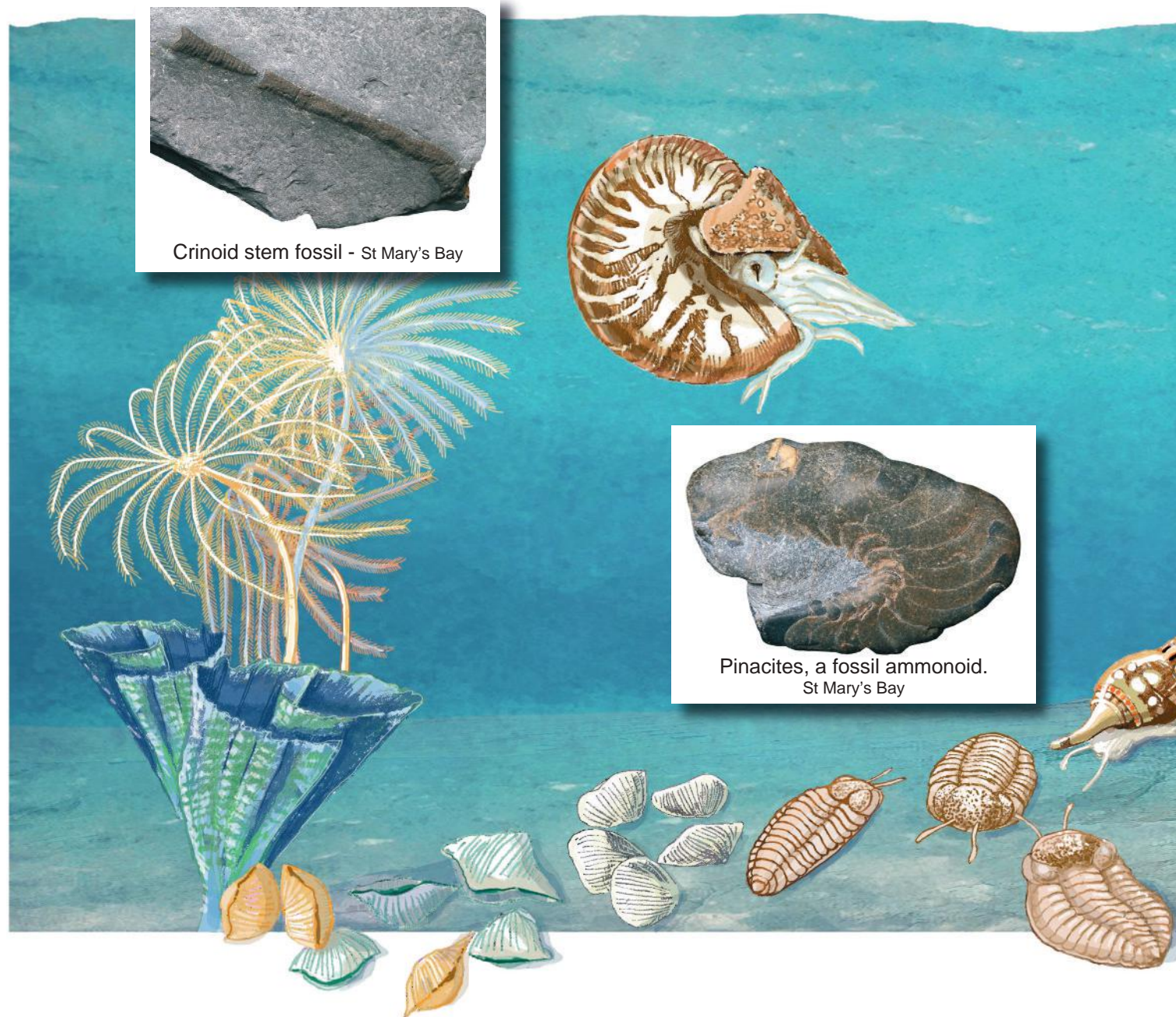
Metamorphic Rocks

300 million years ago during a period of mountain building, the older rocks in Devon were altered by heat and pressure to become new metamorphic rocks. Locally, Devonian mudstone was squashed to become slate. Although limestone and sandstone are less affected, the fossils in them are often pushed out of shape showing how much the rocks have been deformed.

Devonian Slates & Limestones

Most of the rocks around Brixham date from the **Devonian Period**. They are sedimentary rocks laid down in the sea at a time when Devon lay on the coast of Euramerica, an ancient continent which lay in the tropics just south of the equator. At this time life in the seas included corals, brachiopods (lamp shells), trilobites, nautiloids and crinoids (sea lilies), most of which are now extinct. Plants and animals were just starting to colonise the land.

Around Brixham the oldest rocks are **Early Devonian** slates and sandstones laid down in rivers and coasts about 400 million years ago, forming the hills south of Brixham.



By the Middle Devonian, about 390 million years ago, the area became a shallow tropical sea. Mud was deposited on the sea floor, eventually becoming the slates exposed at St Mary's Bay. Volcanic ash and lava on the south side of Sharkham Point date from this time.

Sharkham Point Iron Mine - 1790 to 1930s

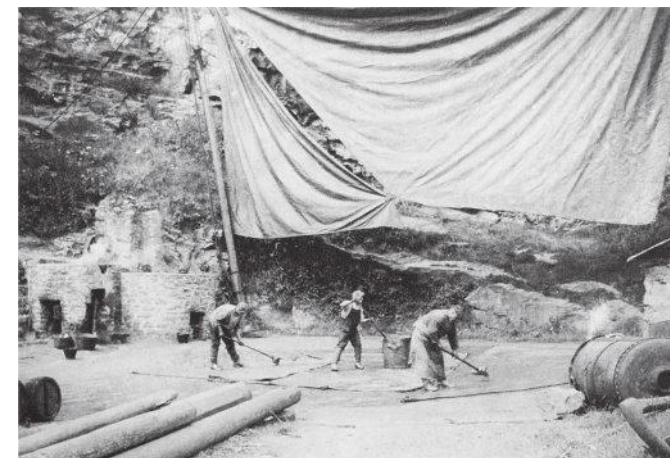
Iron mining began at Sharkham Point Iron Mine in 1790, when "considerable quantities" of haematite "kidney ore" deposits (iron oxide), were discovered at the site. This ore was shipped to London and the "Great provincial markets". During a 10-year period at the height of its operations (the 1890s) the mine employed 100 men and shipped over 1,000 tons of ore to Wales and West Hartlepool for smelting. By the 1930s the mine was abandoned as the remaining ore reserves were below sea level and therefore unworkable.



Ochre Used To Make Rust-Proofing Paint - 1849 to 1961



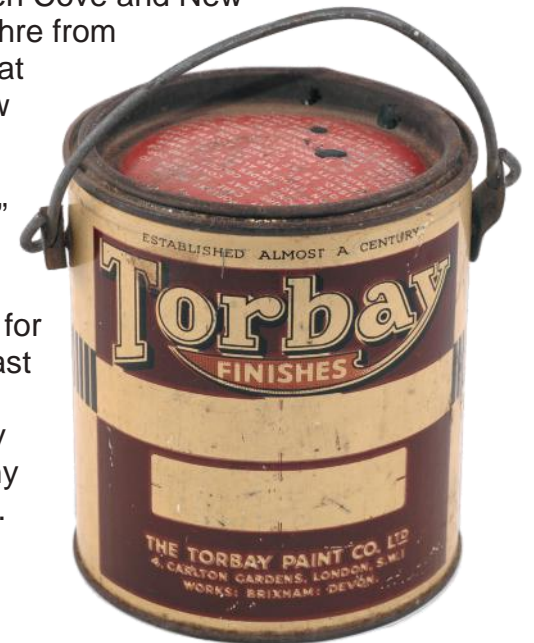
The old paint works at Oxen Cove



The Barking Yard at Overgang

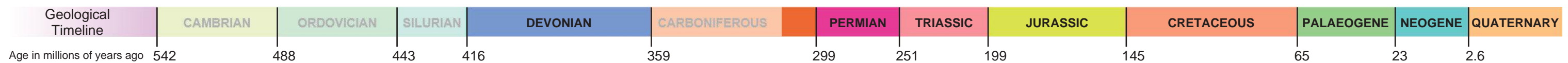
A specialist paint was invented in 1849 by John Rendall, a Torbay chemist. Ochre (red and yellow earthy iron oxide and hydroxides) was mixed with linseed oil and turpentine to make rust-proofing paint. It was manufactured from 1858 to 1961 at factories in Oxen Cove and New Road, using ochre from mine workings at Furzeham, New Road and Rea Barn Hill.

This "Iron paint" made in Brixham was highly effective for rust-proofing cast iron used for bridges, railway tracks and many other purposes. Not only was it widely used in Britain but also worldwide in places as distant as the bridge over the Zambezi River at Victoria Falls in southern Africa.



"Red Sails In The Sunset"

Ochre was also used to preserve sails from the effects of salt water. The characteristic colour of the "red sails" used on Brixham trawlers was the result of a preservation treatment known as "barking". This involved brushing onto the sails, a mixture, created by boiling oak bark, beef tallow, wood tar and red or yellow ochre in large water filled cauldrons. There were two barking yards at Overgang.

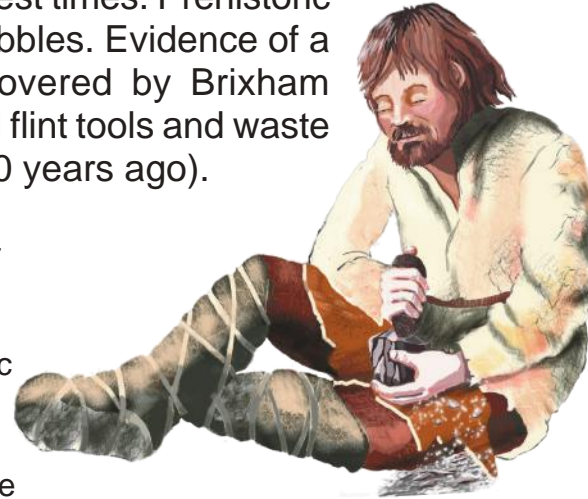


Making Use of Rocks

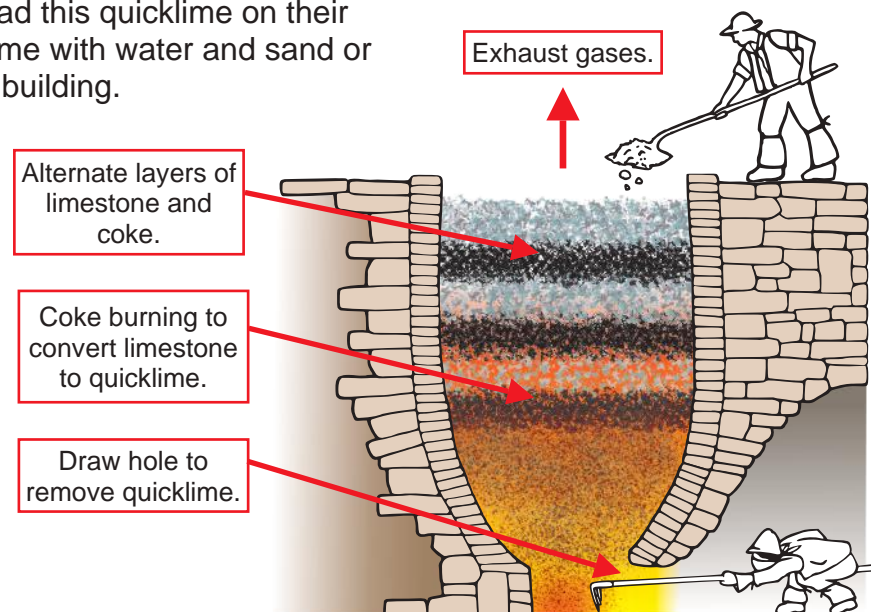
Humans have used rocks and minerals since the earliest times. Prehistoric flint tools were made from locally collected beach pebbles. Evidence of a flint knapping site on Berry Head has been discovered by Brixham Heritage Museum. The archaeology team have found flint tools and waste material from the Mesolithic period (about 9000-6000 years ago).

Limestone has been quarried locally since Medieval times for building stone. Local quarries supplied the stone for building many houses and other buildings in Brixham, including the Berry Head forts, during the French Revolutionary/Napoleonic Wars, and the Brixham Breakwater.

Limestone has also been used to make quicklime. To produce quicklime, limestone was heated to over 900 degrees centigrade in specially built limekilns. Farmers spread this quicklime on their fields as fertiliser. Builders mixed quicklime with water and sand or coal ash, creating lime mortar for use in building.



Lime Kiln in Churston Grove



Berry Head Quarry

Limestone on the northern flank of the Berry Head promontory was quarried for building stone and for converting to quicklime from at least the mid-18th century. With the quarry conveniently located on the coastline, stone could be readily transport by sea. This quarry remained in operation until 1969.

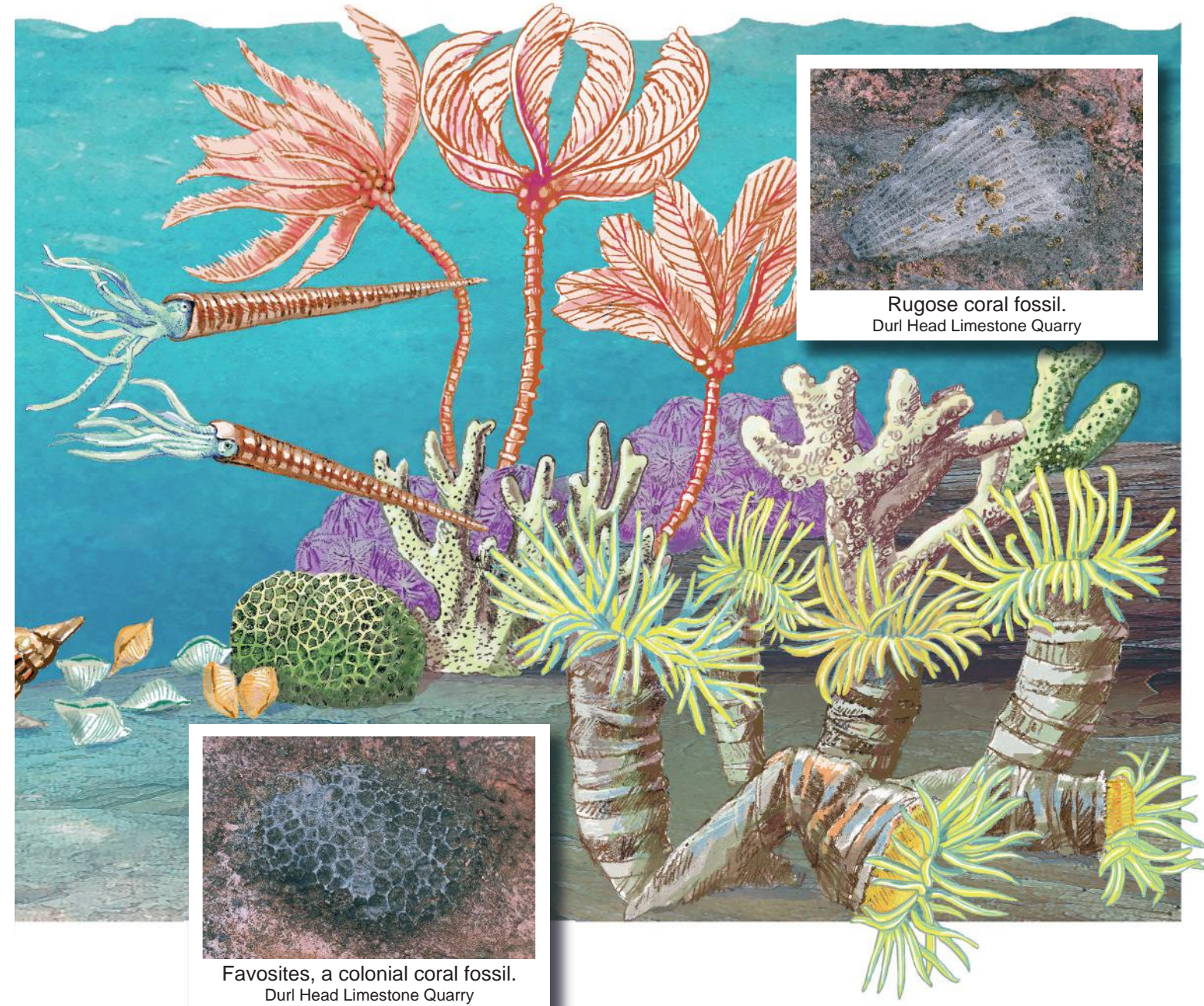


Berry Head Quarry c1960

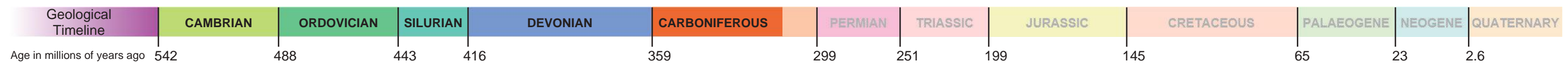


The quarry removed almost half of Berry Head

During the Middle Devonian Period, a shallow bank of limestone built up in the warm clear seawater. Marine animals filled these seas. Over millions of years the shelly remains of this marine life mixed with lime muds and settled on the ocean floor layer upon layer. Fossils include stromatoporoids (lime depositing sponges), the extinct rugose and tabulate corals, snails, brachiopods and crinoids. Crinoids were important in the early buildup of the bank. As the water became shallower, corals and stromatoporoids became more abundant, sometimes forming coral thickets on the shallow seafloor.



Later in the Middle Devonian, around 385 million years ago, a massive reef developed in the sea. Huge stromatoporoid masses up to 2 metres across, together with a few corals and crinoids, grew into each other to form an enormous solid structure, which could withstand the force of the waves in very shallow rough water. Berry Head is part of the remains of this reef. Lagoon limestones which were deposited behind the reef are exposed in the land west of Brixham.

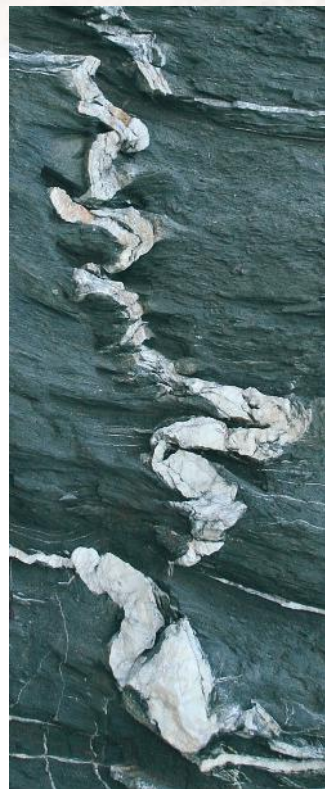
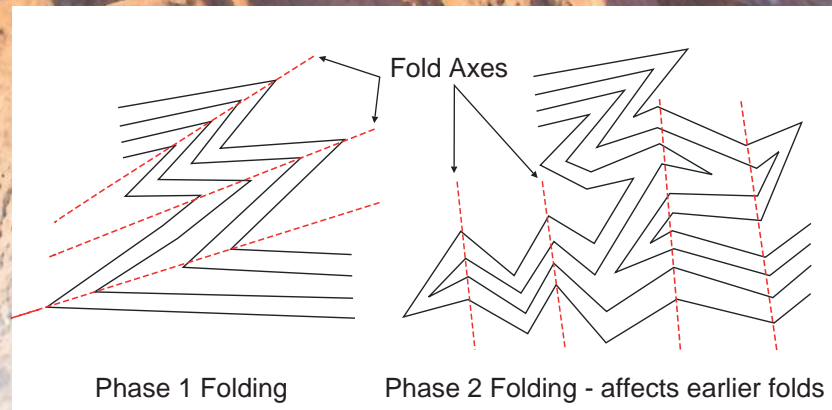


Building Mountains

The Devonian rocks around Brixham were uplifted into a chain of high mountains by a continental collision during the **Late Carboniferous and Early Permian Periods** around 310 to 280 million years ago. This event is known as the **Variscan Orogeny**.



Refolded folds - Oxley Head



Folded Quartz vein
St Mary's Bay

At this time Brixham lay at the southern edge of the continent of Euramerica, and the slow motion of the Earth's tectonic plates, made it collide with the southern continent of Gondwana. This process took a few tens of millions of years and closed the Devonian Sea, creating the supercontinent of Pangaea which made up most of the world's landmass.

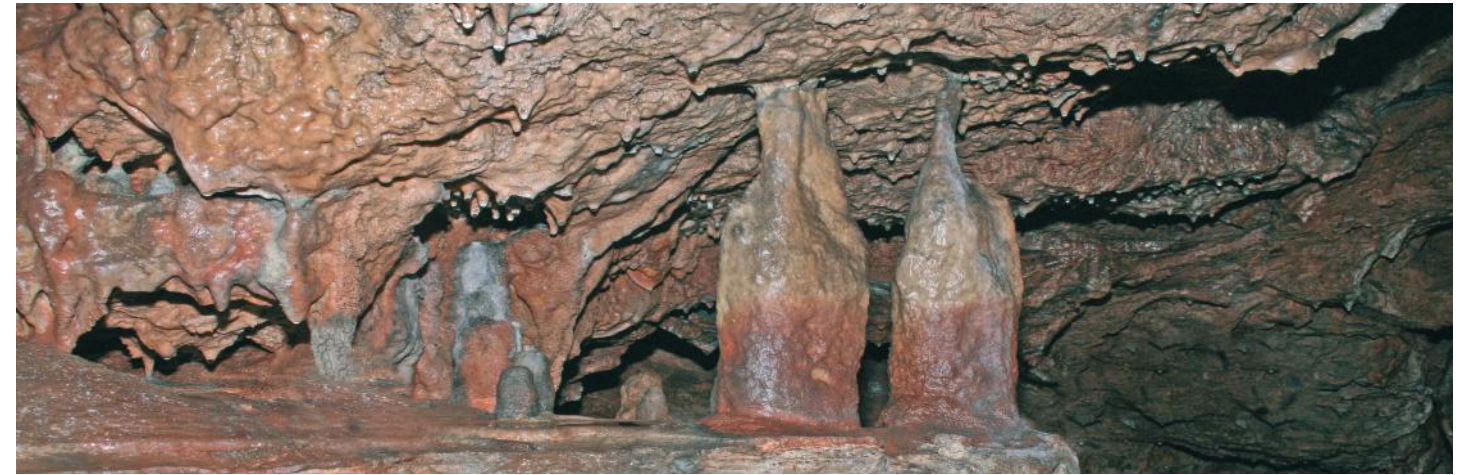
The powerful forces of the continental collision produced earth movements that folded, faulted, heated, and uplifted the Devonian rocks to form the new mountains. Early Devonian rocks were thrust over younger Middle Devonian rocks and now form the highest hills south of Brixham. Molten rock was intruded deep under the mountains, forming the Dartmoor granite.

Mudstones and sandstones deposited during the Carboniferous Period were eroded away as the mountains were uplifted, so they do not survive around Brixham.

Undistorted *Xystostrophia* fossil



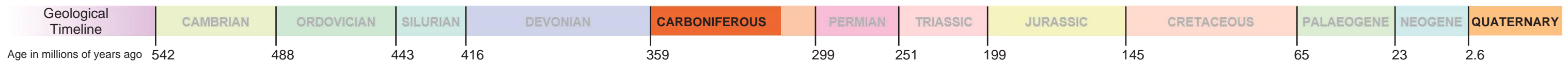
Distorted *Xystostrophia* fossils show how the rock has been distorted and squeezed.



Brixham Bone Cavern was the site of pioneering excavations by William Pengelly. In 1858 he found flint tools alongside the bones of extinct animals in the cave, providing undeniable evidence of the antiquity of prehistoric man. The scientific excavation and recording system he invented here was later developed into the methods used by archaeologists today.

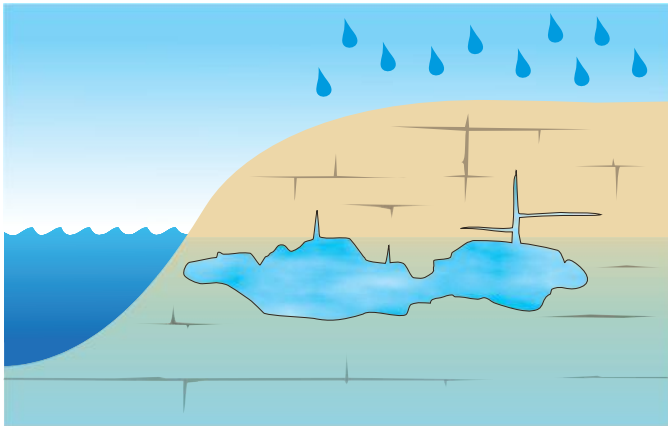


Spotted Hyaena Jaw Bone
and Upper Palaeolithic Leaf Point
Bench Fissure c.42,000 yrs BP
Copyright Torquay Museum



Brixham Bone Caves

During the interglacial periods of **the Middle and Late Quaternary**, acidic rainwater trickling through the limestone dissolved some of the rock to form caves. They were drained during the glacial periods as sea level dropped, and they became suitable shelters for animals and early man. Over time sediments laid down in the caves formed cave earths. Animal bones and flint tools were buried in Brixham Bone Cavern, Bench Fissure and Ash Hole Cavern.



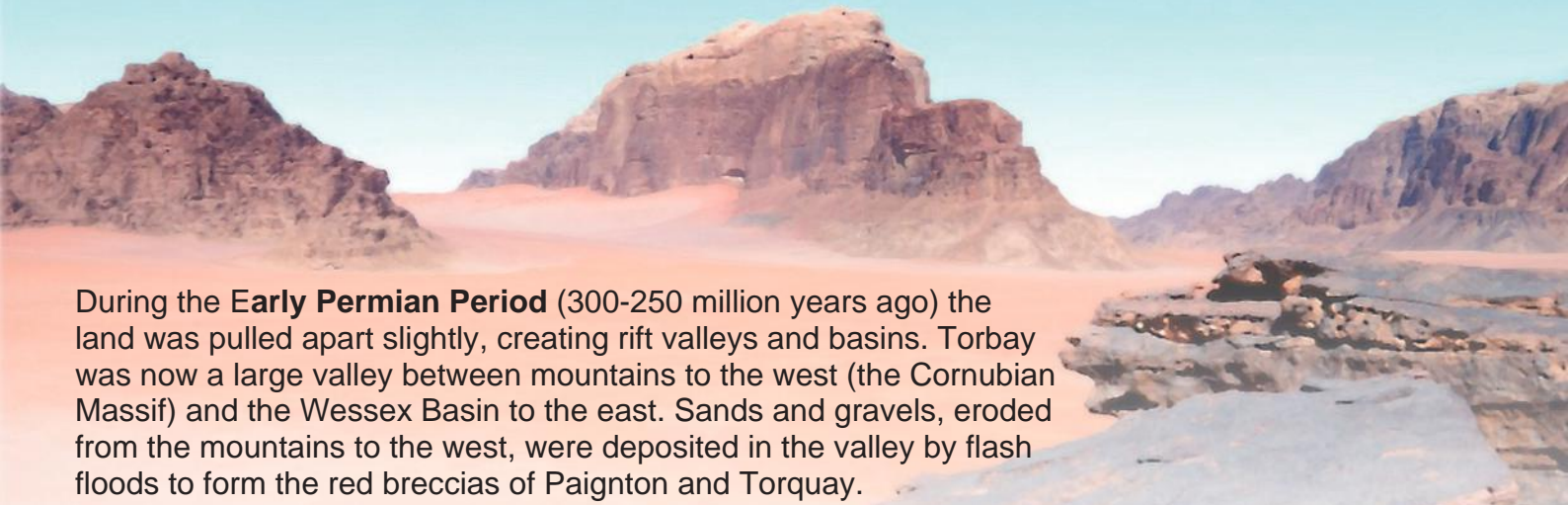
Animals living locally during the last glacial period, from about 59 to 25,000 years ago included: spotted hyaenas, bears, wolves, lions, mammoths, woolly rhinos, horses, red deer, reindeer and bison. The most important were spotted hyaenas, which used the caves as dens. They were formidable predators and could bring down animals as large as a woolly rhinoceros. They brought their prey back to the cave, producing thick accumulations of animal bones that show us which other animals were around at the time. Other carnivores that denned in caves included lions, wolves and foxes. Bears used the caves as hibernation sites and to give birth.

Man also occupied the same caves, using them as camp sites and leaving flint flakes and tools as evidence of their presence. Neanderthal man used Shoalstone and Brixham Bone Cavern before the last interglacial period, and provide the earliest evidence of humans around Brixham, perhaps around 200,000 years ago. Neanderthals revisited the area during the last glacial period, leaving tools in Brixham Bone Cavern and Bench Fissure caves around 42-43,000 years ago. Evidence of early modern humans has been found in Brixham Bone Cavern, dating from around 36-37,000 years ago.



Permian Desert

After the continental collision, Devon lay a little north of the equator, within a gigantic landmass in the tropics. The environment was a harsh, arid, mountainous desert far from the sea.



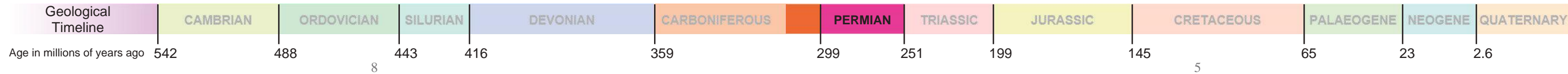
During the **Early Permian Period** (300-250 million years ago) the land was pulled apart slightly, creating rift valleys and basins. Torbay was now a large valley between mountains to the west (the Cornubian Massif) and the Wessex Basin to the east. Sands and gravels, eroded from the mountains to the west, were deposited in the valley by flash floods to form the red breccias of Paignton and Torquay.



Neptunian Dykes

The rifting also opened up fissures in the high limestone ground of Brixham and Berry Head. They were filled by red sandstone and calcite deposits to form sandstone dykes which can be easily seen at Shoalstone Beach. Some of these neptunian dykes were opened more than once and have been filled several times, with alternating calcite linings and sandstone fills.

At Sharkham Point irregular fissures in the limestone were filled with deposits of haematite iron ore and barite. They are thought to be Permian or Triassic in age, deposited by warm fluids circulating deep below the desert surface.



Mesozoic and Cenozoic

There are no rocks left in the landscape around Brixham from the time between the end of **the Permian** and **the Quaternary Periods**. To work out what happened during this time geologists have to look at places nearby, where rocks from these ages are preserved. Desert conditions continued into **the Triassic Period** (252 - 201 million years ago), and the mountains in the area were gradually worn down. Rocks of this age can be seen nearby between Budleigh Salterton and Sidmouth.

During **the Early Jurassic Period** (201 - 185 million years ago) the sea returned, flooding the Wessex Basin to the east. The ancient mountains to the west became a large island (Cornubia), with its coast close to Brixham. Marine sediments from this time occur on the sea floor 11 kilometres off Berry Head and can be seen on land at the Lias cliffs of Lyme Regis and Charmouth. These Dorset cliffs contain fossils of ichthyosaurs, plesiosaurs and ammonites that swam in the Jurassic seas, and dinosaurs, pterosaurs and plants probably from the Cornubian island.



Ichthyosaurus communis
Copyright Nobu Tamura
(www.spinops.blogspot.co.uk)

Sea levels peaked during **the Late Cretaceous** (100 – 66 million years ago), and the whole area was submerged except perhaps the top of Dartmoor. Thick layers of chalk were deposited in this sea and covered the whole area.

During **the Palaeogene and Neogene** (66 – 2.6 million years ago) the area became land again. Erosion continued in subtropical conditions and the chalk was stripped from the landscape. Flints derived from the chalk can still be found on Brixham beaches. The modern landscape began to emerge during this time.



Palaeogene fossil plants are preserved in Bovey Basin clays found between Newton Abbot and Bovey Tracey. These include exotic species like redwoods, palms and magnolias. Other plants from this time, including willows and royal ferns, still grow in Devon today.

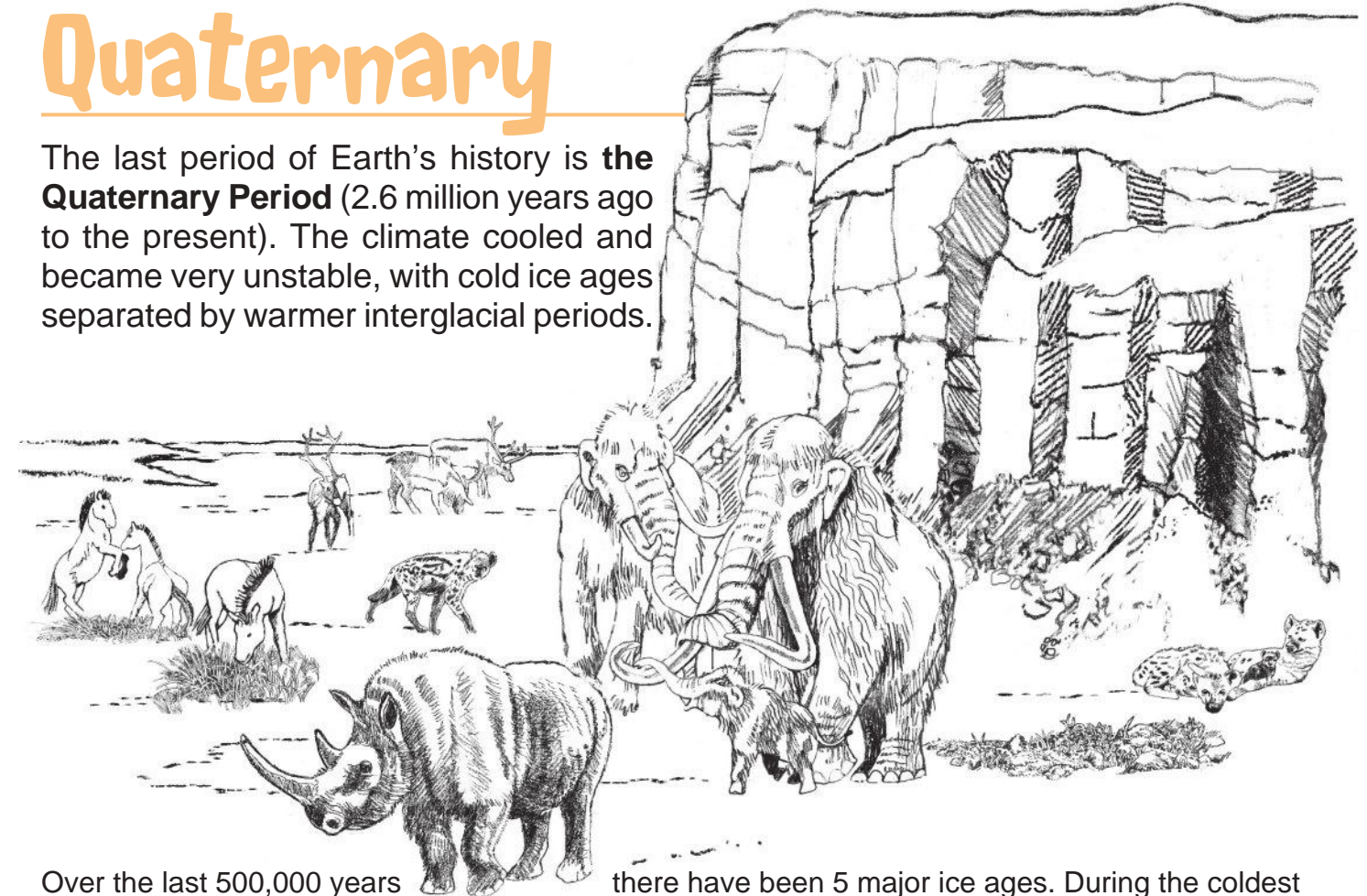
During the Palaeogene, mammals evolved to become the dominant large animals on land following the disappearance of the dinosaurs in the end-Cretaceous mass extinction.



Local beach flint was later used by early man.

Quaternary

The last period of Earth's history is **the Quaternary Period** (2.6 million years ago to the present). The climate cooled and became very unstable, with cold ice ages separated by warmer interglacial periods.



Over the last 500,000 years there have been 5 major ice ages. During the coldest glacial periods, northern Britain was buried beneath ice sheets hundreds of metres thick. As the ice sheets grew, water was locked into the ice and sea levels fell up to 100 meters. South Devon was just south of the glacial limit but the climate was very cold and the ground frozen by permafrost. The hilly landscape of Brixham would have been many miles from the coast with a wide plain of dry land where the sea of the English Channel is now. Caves along the edge of the hills were used by wild animals.



Interglacial raised beach at Berry Head

Interglacial periods occurred about every 100,000 years, and lasted around 10-20,000 years. The climate was as warm as today (or sometimes warmer), the ice melted and sea levels were higher than today. Berry Head became a coastal headland by around 400,000 years ago. There are interglacial raised beaches about 125,000 years old on Berry Head and Sharkham Point.



We are living in an interglacial period, which began about 10,000 years ago. Sea levels are high and in the warm climate temperate forests have grown, though most have been cleared by people.

