ROCKWATCH

ABOUT TIME

ROCKWATCH DIG DEEPER SERIES

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SOME QUESTIONS WE WILL ANSWER

How old is the Earth?

What is the difference between a mineral and a rock?

How can we measure time?

Why are certain types of fossil useful for time measurement?

Who was responsible for the work on time and fossils?

HOW OLD IS THE EARTH?

It is impossible to imagine what a million years is like.

Even more difficult to think about 65 million years when the dinosaurs died out.

This example is just to give you a very rough idea of the sort of durations geologists talk about.

Count the dots on this piece of wallpaper, then look at the next slide.

How many dots are on this piece of paper?

Did you count 72 dots?

How about if you had to count the dots on this entire roll of wall paper?

THE NUMBER

If we had a pile of wallpaper rolls as high as the tallest building in London, all the dots would still not be as many as the number of years since dinosaurs died out.

THE PRESENT VALUE FOR THE AGE OF THE EARTH IS 4600 MILLION YEARS

(4.6 Billion Years)

But future measurements may change this.

4600000000 years (give or take a week)

Lots of zeros and more wallpaper than has ever been made

How did geologists find this out?

Time can be measured using rocks.

WE THEREFORE NEED TO KNOW WHAT A ROCK IS

The next few slides answer some important questions.

Rocks are made from minerals, so what are minerals?

A MINERAL HAS A FIXED CHEMICAL COMPOSITION

Minerals are made from chemical elements. Sometimes only one, often many elements combined together. Minerals therefore have a chemical formula.

Look up the chemical formula of a diamond and of table salt. Which is made of one element and which has two? Can you identify the elements in each?

WHAT ARE ROCKS?

Because rocks are made of mineral particles the amounts can vary. In most cases we can say what is in a rock but not precisely how much of each mineral.

Can you discover any rocks made of one mineral?

Rocks are naturally occurring associations of particles made of minerals.

Rocks (in most cases) do not have a fixed composition.

ROCKS CAN BE CLASSIFIED BY A NUMBER OF METHODS

By origin (how they are formed), composition (what minerals they contain), age, use terminology etc.

The most common is by mode of formation:

- Igneous: solidify from a melted (molten) state.
- Metamorphic: altered by heat and pressure or both.
- Sedimentary: From the erosion and weathering of any other rock, by chemical deposition or biological agents.

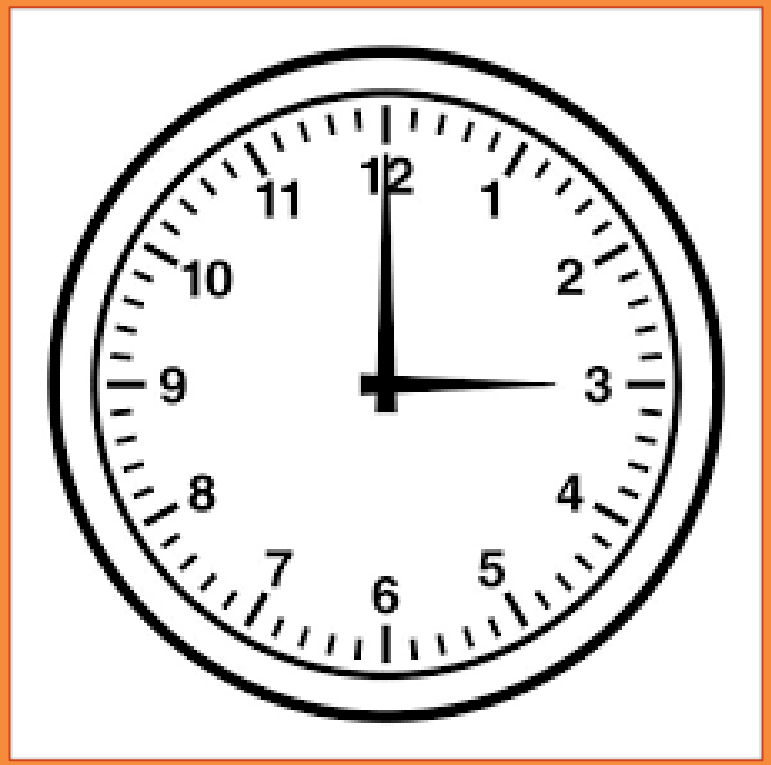
Obviously seaside rock is not a geological rock and a Rock Band has different meaning to a geologist and a musician.

Try to find out what Chalk is made from and how it was formed?

To measure time we need a clock.

Now find out what the oldest clock made by people is!

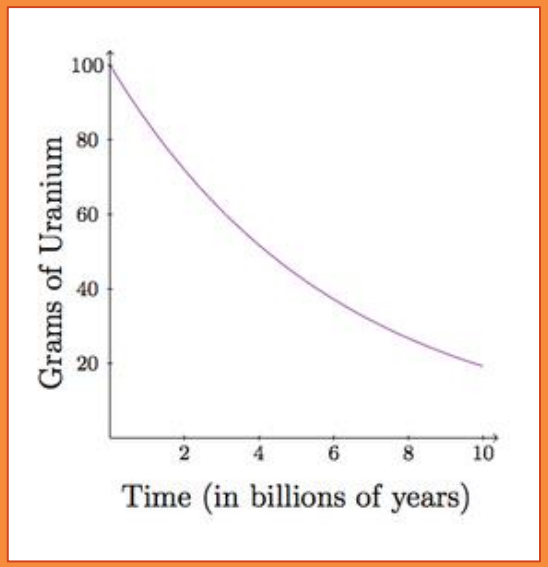
So, there were no clocks like the one below when the dinosaurs were alive!



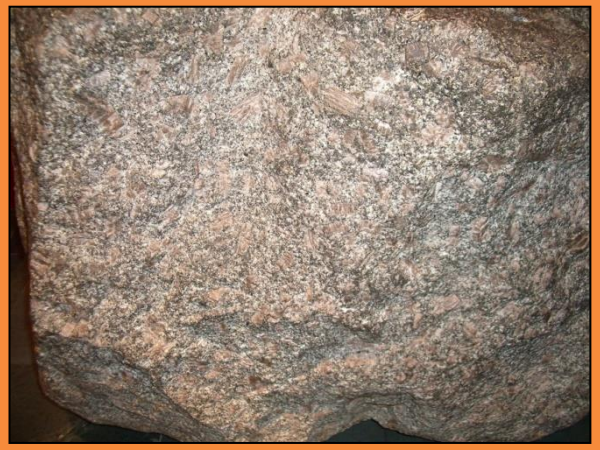
But, we can use rocks to act as a clock for time measurement before people existed.

SOME ROCKS (MOSTLY IGNEOUS ROCKS) ARE RADIOACTIVE

Warning! Danger, radioactivity and thinking required!



Some rocks contain radioactive elements that break down at a fixed rate - this is called decay. Some elements take millions of years to decay. If we know how much radioactive element is gone and how much remains or what it makes as a product after decay, we can use a graph to estimate the rocks age.



We can get an answer in YEARS. This is called an ABSOLUTE date.

EARLY GEOLOGISTS

AND HOW THEY HELPED SHAPE HOW WE LOOK AT THE EARTH AND TIME

NIELS STENSEN (STENO) 1638-1686

- Steno reasoned that rock layers are arranged in a time sequence, with the oldest on the bottom and the youngest on the top. This is known as Steno's law of superposition.
- THIS IS A RELATIVE DATE. The bed at the botton is older than the beds above but we don't know by how much!
- NOTICE – NO MENTION OF YEARS


Sedimentary rocks have layers
This is a beach in Dorset near
Burton Bradstock. Which rock beds are oldest?
If you wish, you can print this off and number
the levels by relative age.

WILLIAM SMITH (1769-1839)

Produced the first geological map of England and Wales

He observed that the fossils in a bed of rock could be assigned to an age. Age of monsters, men etc.

- William Smith was an engineer. He noticed during his work that particular beds of rock contained particular types of fossil.
- This **is biostratigraphy -** the division of sedimentary rocks based on the fossils they contain.
- Using his map it was possible to predict where particular types of rocks and fossils might be found.
- Almost anything living can become fossilised after death, however anything with a skeleton or shell is likely to preserve better.
- BODY FOSSILS are the remains of the actual organism. Things like bones, shells, trees.
- TRACE FOSSILS indicate that something was there - a burrow, footprint, fossil excrement (Coprolite) or track in the sediment.

The next two slides show Body and Trace fossils.
Can you identify what any of them are?

BODY FOSSIL

1

2

3

4

5

TRACE FOSSIL

1

2

3

4

5

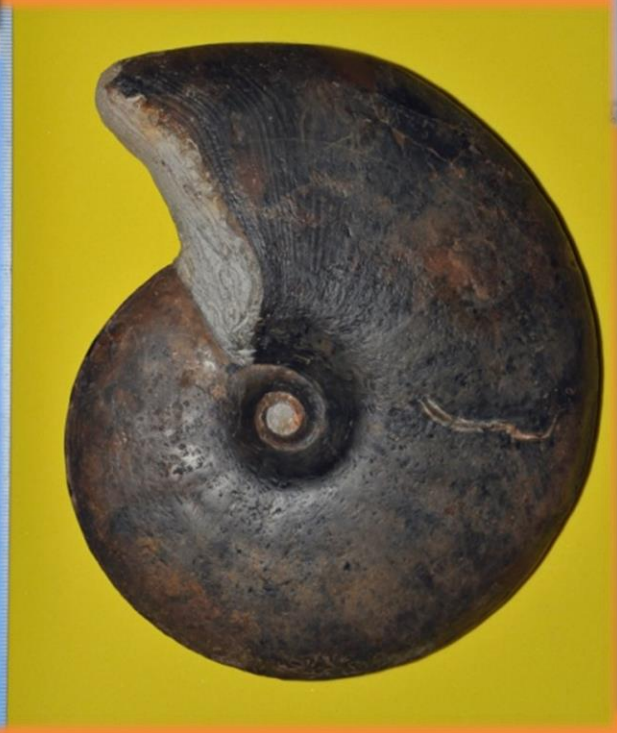
6

WHY ARE AMMONITES SUCH GOOD CLOCKS?

One group of animals with shells are particularly good for measuring relative Time. AMMONITES existed in the Jurassic and Cretaceous Periods.

- They are big enough to see
- They are common as fossils
- They evolve (change quickly through time) quickly
- They have hard parts (shells) that fossilise well
- They exist in most marine environments
- They swim so are not dependent on water depth
- They existed for over 150 million years

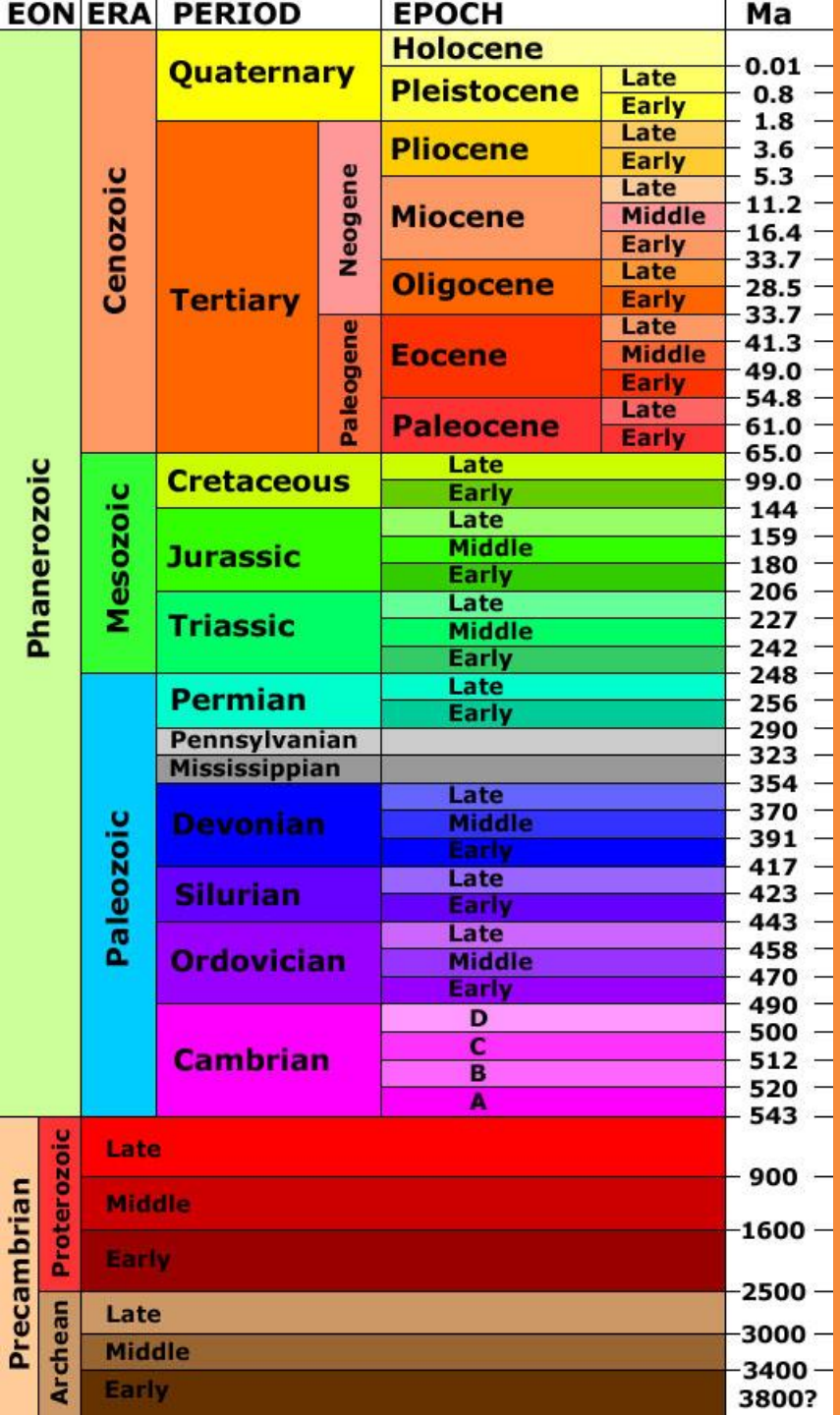
AMMONITES EXIST IN MANY SHAPES AND SIZES



S. S. BUCKMAN 1860-1929

Fossil ammonites can be used to place rocks in relative age order. Buckman noticed that he could make further subdivisions.

James Buckman moved to Dorset when his son Sydney was a boy. Sydney grew up in an area with some of the most ammonite fossil-rich rocks known. Sydney soon realised that he could subdivide rocks into **horizons** containing ammonites that he could use to compare with other areas.



ROCKWATCH

HOW OLD?

The earth is about 4600 million years old.

The first rocks with life (fossils) are about 3800 million years old.

This slide shows the geological column. Buckman worked mostly on the Jurassic Period.

He understood that time goes on, but sedimentary rocks are not continuously deposited.

JUST TO CLARIFY..

The Jurassic System is a pile of rocks.

The Jurassic Period is a period of time.

ANSWERS TO QUESTIONS

- The number of dots is 72
- The formula of a diamond is C. It is just made of Carbon
- The formula of table salt is NaCl. It is made of Sodium and Chlorine
- A rock made of one mineral is LIMESTONE. The formula is CaCO3. It is made from Calcium, Carbon and Oxygen
- The earliest clock is from about 1386 but sundials go back much further

CREDITS

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The portrait of S. S. Buckman was kindly supplied by Professor H. Torrens.

Other pictures are supplied by the author.

ABOUT THE AUTHOR ROBERT CHANDLER

Robert's interest in fossils started when at 6 years old, he listened to a BBC broadcast called '*How things began.*

From then, he began to collect ammonites and sharks' teeth with his parents in Folkestone and the Isle of Sheppey in Kent, and in Robert's own words,

> *"spent many days at the Natural History Museum in the holidays, irritating the palaeontology staff who identified fossils for me!"*

Robert says his serious involvement in geology was a matter of luck. It was at the age of 12, that a passionate teacher by the name of John Hanson helped Robert to develop his lifelong interest in geology and to start a school geology club.

In 1967 Mr Hanson organised a club visit to Bridport in Dorset, and after that Robert's interest was firmly set on the Jurassic of that area.

Robert Chandler

J. Hanson, geologist, Spencer Park School, Wandsworth

Chandler & Callomon 2003

Robert still works with the same school friends today.

Another key moment for Robert was he attended a talk in the 1970s given by a chemist named John Callomon, who was an expert on Jurassic ammonites.

Robert and John met and formed a great friendship, which continued until John died in 2010. Although neither of them ever worked as a professional geologist, they were both science teachers. John – a Professor of Chemistry and Robert - Head of Science in a Croydon school. They formed a geology club named the Wessex Cephalopod Club which still lives on today.

Together with others, John and Robert have produced a number of papers on Jurassic ammonites and the rocks of Dorset. Robert is also a fantastic Rockwatch Ambassador and enjoys passing on his passion for geology to young people, as Mr Hanson once did to him.

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