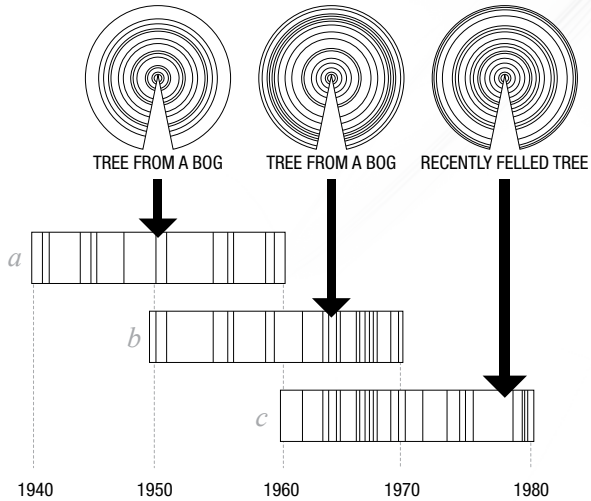
Briefing Sheet Session 2: The age of the Earth

Scientists have used many different methods to calculate the age of the earth and its geological features. Here are just four of them[1]:

Tree Rings

You can determine the age of a tree that has been cut down by counting the number of rings in the trunk. One ring is formed each year, so it is easy to get an exact date. The characteristics of the tree rings (such as thickness) change depending on the local climate conditions each year, so if two trees are growing in the same area the ring patterns in their trunks will be very similar.

By comparing the overlap in ring patterns between many fallen trees in a forest, including trees preserved in bogs, scientists can count tree rings further back than the age of any individual tree. For example, researchers using these methods have built up a unique tree-ring chronology for trees in central Germany that dates back over ten thousand years.



OVERLAPPING TIMBERS ENABLE THE BUILDING OF A TREE-RING CHRONOLOGY

Ice Cores

The ice in the Arctic and Antarctic ice caps also builds up annual layers. Ice core samples taken from holes drilled into the Arctic ice cap in Greenland penetrate as far as ice dating from about 200,000 years ago, while one ice core in the Antarctic reaches ice formed over 700,000 years ago. The layers near the bottom are compressed together by the weight of the layers on top, so there may be uncertainty of up to 10 percent in counting the oldest layers.

Magnetic Polarity

Due to its inner structure, the earth has a magnetic field. The north and south poles switch direction irregularly, typically every 1–3 million years. Rocks which contain magnetic minerals record the direction of the earth's field when they were formed, and this can be used to date them.

Radiometric Dating

The 'half-life' of the radioactive isotope Carbon-14 is 5,730 years, which is the time it takes for half the Carbon-14 isotopes to decay to the 'daughter' chemical Nitrogen-14. After about 10 half-lives there is too little Carbon-14 left to measure, so this method only works back to about 40,000 years.

Radiometric dating works by measuring the amounts of radioactive isotopes in rocks. Radioactive isotopes decay over a specific period of time into other isotopes. The time it takes for half of any sample of a radioactive isotope to decay from a 'parent' to a 'daughter' isotope is always the same, and this is called the 'half-life'. When scientists know the half-life of a radioactive isotope and its present parent to daughter ratio, they can date the time from the formation of the rock containing the isotope with precision.

There are around 40 different radioactive isotopes which can be used for dating the materials which form the earth. Some of these have half-lives of tens of millions, or even billions, of years. The longer the half-life, the older the rock that can be dated.

Potassium-40 decays to Argon-40. Argon-40 is a non-reactive gas and is not trapped by rocks when they are formed from molten lavas. When scientists find a rock which has Argon-40 in it, they know that it came from the decay of Potassium-40. The half-life of Potassium-40 is about 1.248 billion years – this makes it useful for dating the age of the materials which make up the earth.

Using these methods, scientists have been able to date the age of the material which forms the earth with some certainty to 4,564–4,568 million years. The universe is about three times older – about 13.7 billion years.

Some Christians have disagreed with this conclusion because they believe that the Bible states that the earth is only a few thousand years old. They would call themselves 'Young Earth Creationists'. However, Christians all agree on the fact that God created the earth.

1. Adapted with permission from Robert S. White, '*The Age of the Earth*', **www.st-edmunds.cam.ac.uk/faraday/Papers.php**.