Friday, 14 July 2006, 15:50 GMT 16:50 UK

Charcoal reveals wildfire history

UK scientists have traced the history of wildfires by studying lumps of ancient charcoal from around the world.

The fossils show the incidence of fires through time is closely related to the level of atmospheric oxygen.

Andrew Scott and Ian Glasspool say huge swathes of the planet were ablaze when concentrations of the gas peaked some 275 million years ago.

Their research is published in the US scientific journal Proceedings of the National Academy of Sciences.

"People might think the charcoal they pull out of a bonfire is just rubbish; but look at it under a microscope and you see that it has beautiful anatomical preservation," said geologist Professor Scott, from Royal Holloway, University of London.

"In other words, the charcoal retains information not just about the fire but about the type of plants that were being burned. This means we can tell whether the fires moved through surface plants or big trees," he told BBC News.

Oxygen feeder

Charcoal is almost pure carbon and is left virtually unchanged in the fossilisation process.

Scott and Glasspool, who is affiliated to Chicago's Field Museum, examined charcoal residues preserved from about 440 to roughly 250 million years ago.

It covers the period when scientists believe plants first got a strong foothold on land and spread rapidly across the surface.

The charcoal samples studied came from all around the world, including the US, Australia, Scotland, India, Norway, South Africa and Antarctica.

The researchers examined the material to ascertain the types of fires that produced the charcoal and their likely incidence. They then compared this with models other scientists have produced to describe how oxygen in Earth's atmosphere is thought to have changed over time.

There appears to be a strong link.

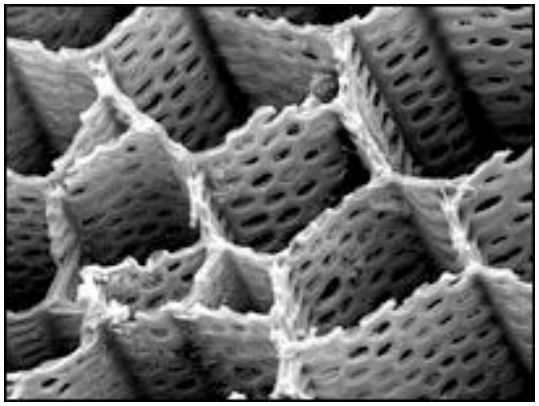
The team found that fires were rare and localised for the first 50 million years of plant evolution but then they increased in frequency as the levels of oxygen in the atmosphere rose.

From around 365 million years ago, severe fires became widespread across the planet. Oxygen levels peaked at 30% 275 million years ago, in comparison with only 21% today. In this period even damp vegetation would have ignited easily causing many more fires.

Whole Earth

"From the Late Devonian - from about 365 million years ago - there was a rapid increase in fire," Professor Scott explained.

"One might have expected that to occur earlier but it seems to have coincided with this rapid rise in atmospheric oxygen that people have modelled. So, this is the first time anyone has used the charcoal record to constrain the atmospheric oxygen models."



The Royal Holloway scientist has spent the best part of 30 years studying charcoal.

He says the material's importance has been overlooked by many geologists.

It is clear, he argues, that fires have been an integral part of the Earth system and that changing atmosphere and climate are both influenced by, as well as influencing, fire occurrence.

"Fire sustains certain systems. If more carbon is bound up and buried as charcoal, you are taking carbon dioxide out of the atmosphere, which changes the climate.

"In the time we looked at, we had the 'global ice house' (a period worldwide cooling) and a fall in sea levels; you have therefore more area to be colonized by plants which can burn. And as the oxygen levels rise, you can burn more and more of the wetter material. So, you get various feedbacks.

"From an Earth systems point of view, factoring in fire is quite important. Too many geologists in the field dismiss charcoal as detrital plant material and throw it away.

"As people recognise the information content of charcoal and its significance, hopefully more people will collect it."

PLANT DEVELOPMENT, OXYGEN LEVELS AND WILDFIRE FREQUENCY

- The scientists examined charcoal samples to ascertain the types of fires that produced the material and their likely frequency
- This was matched with models describing oxygen (O2) level changes in the atmosphere - a new model (A) and a popular,

older one (B)

- A "fire window" exists between 13% and 35%. Too little O2 and fires will not start; too much and they cannot be extinguished
- The present atmospheric level (PAL) of oxygen is 21%. Plant material needs to be relatively dry before it will catch fire
- The study shows fires were rare when O2 levels were low; but were extensive when levels were high, even in wetland areas (mires)