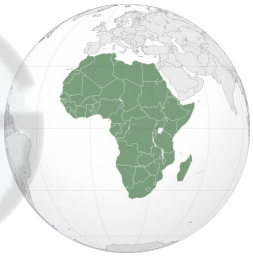
Exploring the African past (Part I)

Unveiling Earth's secret past from the remote cradle of humanity



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intro - tension/story

WHY IS AFRICA A GREAT PLACE TO LOOK TO THE PAST ?

The African continent is a fantastic place to look for answers in the past. It is the continent from which our species emerged approximately 200 000 years ago; a place where the environment has been subjected to intense transformations over time; containing a great biodiversity for a large population living with a close connection to nature.

The lifestyles of industrialized countries are at conflict with nature preservation at a global scale. At a local scale, rural livelihoods in Africa have also been accused of clashing with conservation objectives.

That is why it is good to look back in time, so we can recreate how the landscape has changed and reacted to different human impacts.

In the remoteness of the Ethiopian highlands (see Fig 1), people have been traditionally burning the landscape to produce new grass for their cows and sheep to eat. However, they are told that if they burn very frequently, they may destroy the heathland [glossary]. These people live inside a National Park and the managers are worried about the future of the heathland as well as the future of the people.

Let's time-travel to explore whether the heathlands have ever been burnt before and if heather recovered afterwards.

To time-travel to the past, instead of using history books, we look at the hidden pages of the Earth. On those there is a code written that we have "to hack" if we want to recreate what happened [see "Hacking the code" box]. To visualize what happen to the heathland, we recovered the pollen grains from the heather (the species is called *Erica arborea*) that fossilized at the bottom of a lake in the Bale Mountains of Ethiopia.

methods- not too much (box above)

Figure 1: Lake Garba Guracha (Bale Mountains, Ethiopia). There are several local communities whose animals graze in this area.

The scientific method always works with a similar workflow. Can you identify in the text the steps of the scientific method?

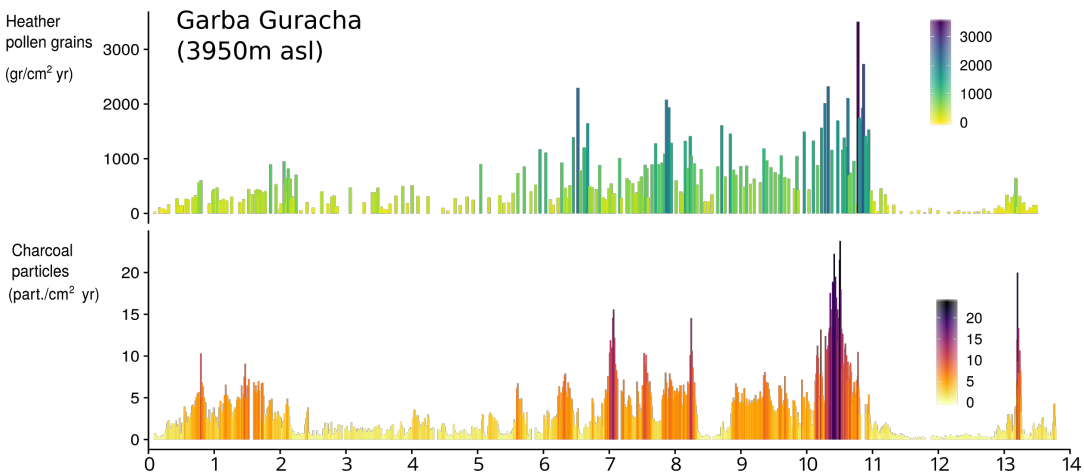
The Garba Guracha lake lies at 3950 m above sea level - that's pretty high! Besides how heather has changed, we can also visualize how fire history happened by looking at charcoal particles sedimented (caught) at the same time at the lacustrine bottom mud. Looking at Figure 2 you can discover some interesting patterns.

Check in the glossary:
radiocarbon dating, Before Present, palynology

some insights, but also challenge the reader to think

IMAGINE, CREATE...RECREATE!

In this plot we see that we could recover an archive, like a book, as old as 14 000 years old. In there, we see a variation in the existing amount of heather (upper panel) and a variation on the number of charcoal particles (lower panel). Just by looking at this plot we can draw some ideas:



*Before present refers to the time palaeoscientists have defined as present, that corresponds to the year 1950.

Figure 2: Evolution of heather and fire since 14 000 years BP until now. On the y axis we have the heather pollen grains (upper panel) and the charcoal particles (lower panel) and on the x axis we have time expressed per thousand years.

note that time runs from right to left

1

It seems that this area has had an active fire history since many years ago. And indeed it seems like the fire is very active (many charcoal particles) since 10 500 years ago, the beginning of a period we call the Holocene.

Just by looking at what the heather pollen has done during the same period of time, one would think that there is some sort of parallel evolution between fire and heather…
Could there there be some kind of relationship?

2

Sometimes we may draw a quick hypothesis just looking at our data and later we can compare it with some more analyses…

Do you dare to make some hypotheses on how fire affects Erica by looking at these data?

Figure 3: On the left you can see a floating raft where the researchers are using a Livingstone corer to perforate the lake's bed and recover a mud cylinder (also called core). On the right you cans e a longitudinal section of one core. Note how the different layers containing information can be seen.

HACKING THE CODE

To be able to recreate what happened in the past, we need to be able to peek into any of the environmental indicators that may get trapped in the Earth archives. As in a book written in a secret code, each indicator (we also call them proxies) tells us something about the past environment: how was the climate, which plants and animals were there, how did they interact between each other. The proxies might be many different things, from fossils to organic molecules, that's why we need a large group of "code experts" hacking the code so we can read it. The archive for many of us is often a lake (but there are many others, such as ice, corals, tree rings…).

Lakes keep at their bottoms sediments that have trapped and preserve some of these indicators. To get them out we use different devices ready to take cylinders (aka cores) of that mud from the bottom. These devices, or corers, are on a floating platform. Sometimes that mud is kind of layered - just like the pages of a book! (Fig 3).
We take these cores to the lab and, with different physical and chemical procedures, each researcher isolates their proxies. And then they are ready to read their code! In the case I present here, the proxies were pollen grains and charcoal particles, so we could reconstruct vegetation and fire histories.

If you want to know more, these resources might be useful:
- Drilling deep looking for climate in the past: https://youtu.be/B1iU0fBTfUw
- Why it's important to look to the past (using bodypaint!): https://youtu.be/bUMa61WPgu0
- What is paleoclimate? https://youtu.be/ytGgFXqJOI8

In the next article we will tell you more about how the questions we posed in this lake example were solved. If you can't wait until then, check out the original publication here.