Investigating coral reefs to help understand past and future climate change

May 16 2007

Increasing Earth temperatures and rising sea levels. Both of these are effects of climate change. The current concern is that human activity is changing our climate at a rate well above the natural climate cycling. Understanding how the Earth's climate system works and responds to human impact is therefore of uttermost importance.

"To predict future climate change we must first go back in the archives to understand a bit more about the natural cycles. This will enable us to decipher between natural changes and what's out of the ordinary," explained Gilbert Camoin, Centre National de la Recherche Scientifique (CNRS), at the European Geosciences Union (EGU) General Assembly in Vienna in April 2007.

The last deglaciation (23,000 – 6,000 years ago) is generally seen as a potential recent analogue for today's environmental changes. This period was characterised by abrupt climatic change and rapid sea-level rise due to polar ice sheets melting, similar conditions to what we see the Earth facing now and which are predicted for the future. Reconstructing past environments may lead to a better estimate of the climate sensitivity and hence of future climate change.

Fossil coral reefs can be used to accurately reconstruct past sea level variations, climate change and environmental perturbations. According to Camoin, they provide the most precise records of sea-level changes. This is because corals always live within very strict ecological requirements. They need clear and oxygenated water, only live in the

first 50m of the sea column, at temperatures ranging from 18-35 C and within the very narrow salinity range of 35-36 per ml. Any ecological changes affecting the narrow requirements of the coral reef environment will lead to changes in coral reef growth and composition. Thus, a fossil coral reef drill sample gives accurate information about the sea level, salinity and temperature at different times in history. Interpreting this information provides a way to reconstruct past climate change.

Using coral reefs as climatic archives started about 20 years ago. Initially, due to technical constraints, it was only possible to capture the last 10,000 years through coral reef drilling. To get datasets covering the entire period of the last deglaciation, it was crucial to find another technique. This became possible during a project where the Integrated Ocean Drilling Program (IODP) provided Camoin with the technology to drill down to 1100m recovering more than 600m of reef cores from 37 holes at depths ranging from 40 – 117m from the area around the island of Tahiti. Based on this initial success, the CHECREEF project was developed. CHECREEF is part of the European Science Foundation EUROCORES Programme EuroMARC. CHECREEF will look at data from both the Tahiti drilling site and an additional site in the Great Barrier Reef.

"We think that we will be able to reconstruct the sea level change going back 16-17,000 years in Tahiti and even further back in time in the Great Barrier Reef. With this we will be able to reconstruct sea surface temperature and salinity which are good indicators of the climatic changes at that time to see what happened to the reefs. We are pretty sure that we will achieve this goal within three years based on the datasets we have already collected," said Camoin.

The two sites provide a good basis for creating a picture of past climate change. Firstly, they are away from the regions of the world covered by ice during the last ice age. Secondly, the core sites are located in the

tropical pacific, a crucial point of the globe where many climatic anomalies are born e.g. El Nino. In addition, the two sites are located in zones which are tectonically quiet unlike volcanic islands and continental margins. This is the rational behind the CHECREEF proposal. However, Camoin goes on to say that to get a clear picture and a very good dataset, it is necessary to investigate other sites in the Indian Ocean and the Caribbean. This is Camoin's plan for the future.

Camoin also highlighted that it is crucial to collaborate and compare the coral reef data with other techniques, from ice cores to ocean and lake sediments, to verify datasets.

"The project has just started and we are trying to get a good chronological frame to make sure where we are. The ice core records are well advanced and we will go back to compare our data to theirs in a year of two. We also have geophysical modellers waiting for our results to enter into their models," explained Camoin.

Source: European Science Foundation