**Functional ecology of Palaeozoic coral ecosystems - recent as a key to the past**

Coral reefs are the most complex marine ecosystems on the Earth. They occur in diverse environments, from tropical to cold waters, and from sun-lit shallow to the deep sea. Conquering such diverse environments necessitated a diverse range adaptations in scleractinian corals, the group of corals that build modern reefs). These adaptations are reflected, among others, in the shapes of coral skeleton (referred often to as growth forms), and other small anatomical features.

Reefs have been hotspots for biodiversity for hundreds of millions years, but the organisms that build reefs have changed through time. Scleractinian corals first started to build reefs in the Triassic period around 240 million years ago). However, coral reefs built by other organisms existed far earlier - the largest reefs in the Earth's history in the Silurian and Devonian periods (some 440-372 million years ago). These Palaeozoic reefs were built by extinct groups of corals: tabulate and rugose. Due to their antiquity we know very little about their physiology and systematic relationships; however, there is great interest in understanding how these ancient groups constructed such massive reef systems. Palaeontologists have generally thought that Palaeozoic reefs functioned quite ecologically different than those of their modern counterparts. However, recent evidence suggests that these distantly related reef-building coral groups show striking concordance in their ecology because they have independently evolved similar ecological solutions to the same evolutionary pressures.

Coral growth form is an interplay between genetics and environment. The range of shapes a colony can take is defined by genes, but the shape a colony actually takes is a result of environment – insolation, depth, sediment influx, water dynamics, and other factors. In modern corals, transplanted fragments from the same parent colony (clones) can take shapes from platy to branching under different light conditions, demonstrating that morphology is strongly environment-dependent. On the other hand, corals representing different species can in similar environmental conditions form very similar growth forms - a process called convergence). Many skeletal features, such as shape, or polyp size are related to particular ecological functions that allow corals to occur in a particular environment. For example, compact morphologies tend to occur in areas of high water movement, whereas corals in deeper or lower light habitats are more delicate and have a greater surface area to maximise light capture. Examining the composition of an ecological community based on the abundance of different functional traits, rather than simply the numbers of different species, can provide great insight into how a community functions and even the type of environment it occurs in.

Our recent preliminary study has shown that a modern scleractinian coral community on the Great Barrier Reef and an ancient Devonian (about 385 million years) community of rugose and tabulate corals show remarkable similarity in their functional composition, despite being built by distantly related groups. Therefore direct comparisons between fossil and recent coral communities are possible. **We can therefore formulate a hypothesis that similar environment will result in functionally (morphologically) similar coral communities**.

**The proposed project aims to broadly test this hypothesis** and examine whether modern scleractinian and ancient tabulate and rugose coral communities showed functional convergence. Essentially, the question we want to know is: if you want build reefs, is there only one ecological path that you have to follow? **We will quantify the functional diversity of Palaeozoic reefs** from the Devonian and Carboniferous of Anti-Atlas (Morocco) and Ardennes (Belgium)**, and compare them to modern scleractinian reefs in Australia, Japan and Singapore**. This kind of research is (apart from our pilot study) entirely new in the research on Palaeozoic coral ecosystems. The use of methodologically similar analyses of fossil and recent coral communities and their statistical comparison will provide reliable hypothesis testing.

This project comprises an international, interdisciplinary team of palaeontologists and reef ecologists that will provide important results for both palaeontologists and modern reef ecologists. We will show that Palaeozoic reefs were much more ecologically similar to modern reefs than has been previously thought, and that the processes governing reef growth in the past and today are very similar. From previous research we know that the great collapse of reefs that took place about 372 million years ago may have been caused by the rise of temperatures, a similar threat that puts coral reefs in danger. As a consequence, learning from the past may be a good lesson for today, especially regarding shallow water tropical reefs, which are among the most threatened of all marine ecosystems.