

How diverse were reef corals of South East Asia during the Miocene?

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The maximum centre of marine biodiversity (MCMB) is located in the South East Asia region. Corals play an important role in the concentration of this extraordinary diversity, not only due to their high diversity within this region (approx. 500 species), but also because they are the main constructors of the carbonate framework that supports high diversity of other taxa characteristic of reef habitats (HOEKSEMA 2007). The origins of this high diversity remain obscure. By studying fossil corals, this study aims to start to fill gaps in our knowledge of the long-term biological and environmental history of the region to better understand the timing, environmental conditions, and ecological processes involved in the development of the MCMB. Some palaeontological and molecular evidence (WILLIAMS 2007; RENEMA et al. 2008) suggest that the formation of the ancestral centre of diversity could be related to the constriction of the Indonesian Throughflow current (ITF) during the Cenozoic (HALL 2002; KUHNT et al. 2004; WILSON 2008), resulting in increased speciation and/or immigration during the Miocene age.

Our methods include building extensive new collections of thousands of specimens from hundreds of well-localized samples to overcome the lack of specimens in museum collections and the consequent taxonomic limitations. The study area is East Kalimantan, with local influence of the Mahakan River Delta in the Kutai Basin (WILSON 2005; 2008). In our first expedition (Nov-Dec 2010), we found that corals were a common component in almost all the outcrops visited. Twenty-five sections were stratigraphically logged and coral specimens were systematically collected. Based on preliminary observations of larger benthic foraminifera and nannofossils, our samples are of Burdigalian to Tortonian age (Miocene, 7-20 Ma).

Two main coral assemblages were observed:

Platy coral assemblages, mainly common of Burdigalian to Serravallian age (11-20 Ma). Our observations suggest that the coral succession starts with very thin platy coral forms (1-10 mm) able to settle directly on soft sediments (Fig. 1A), or using fine sand grains, mollusks, or forams, as substrate to initiate growth. These initial stages are characterized by a high diversity, which is slowly replaced by a community dominated by few coral species that develop thicker and larger tabular colonies (Fig. 1B). Some of the most representative genera were *Porites*, *Cyphastrea*, *Hydnophora*, *Pachyseris*, *Echinopora* (Fig. 1C), *Echinophyllia*, and *Leptoseris*. Although scattered, some colonies of branching *Porites* and *Acropora* were also observed within the platy coral matrix. Platy coral communities could be interpreted as an adaptive response to extreme environmental conditions around the Kutai Basin: poor light levels in waters with high sedimentation rates (ROSEN et al. 2001; WILSON 2005).

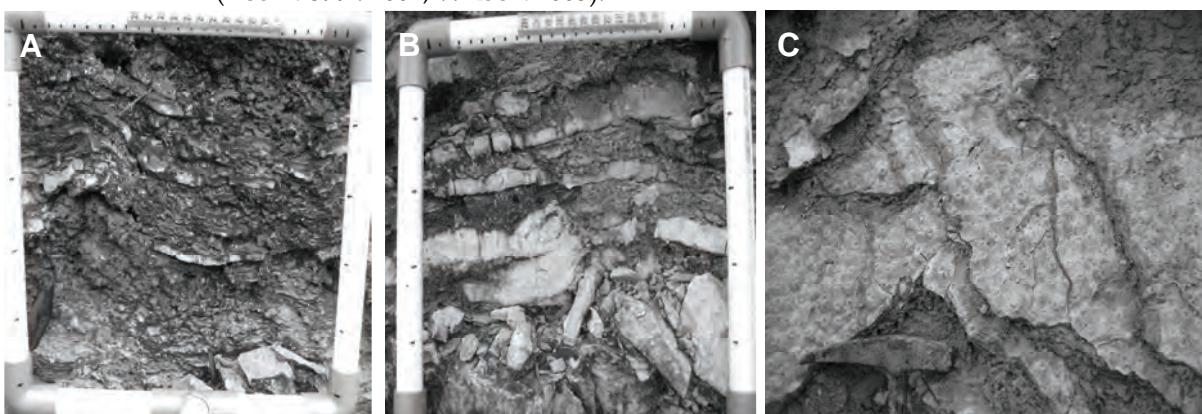


Fig. 1: Platy coral assemblages during the Miocene in East Kalimantan: (A,B) Section TF126 Serravallian (11.6-13.8 Ma), predominance of thin platy coral colonies at lower units (A) followed by the accumulation of thicker tabular coral colonies at upper units (B). **(C)** Section TF153, Burdigalian (16-20.4 Ma), showing a large platy colony of *Echinopora* sp.

B. Branching coral assemblages of Tortonian age (7 Ma). Mainly composed by *Seriatopora*, *Stylophora*, *Dyctyarea*, and *Goniopora* species. These communities might have developed in shallower bottoms with more light and less sediments, and higher water currents. These settings were located at the northernmost part of the study area.

A detailed morphological examination of the specimens will allow an inventory of the Miocene coral species. The resulting taxa and their occurrences will be analyzed at various geographical and temporal scales.

Further research and the integration of our results with parallel studies of palaeoenvironments, chronostratigraphy, and high-resolution environmental proxies will allow a test whether the observed differences in coral composition (platy vs. branching forms) have been controlled by differences of sediment flux depending on the proximity to the Mahakan Delta, or there are additional controls related to regional changes at the temporal scale (Early to Late Miocene).



Fig. 2: Branching coral assemblages of Tortonian Age (7-11 Ma). TF154, Bontang, East Kalimantan.

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