Paleoecological variations in marine producers of the Andaman Sea during the late Miocene reconstructed by algal biomarkers in sediments from site U1447 (Exp. 353)

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Productivity of diatom was high in the Indian Ocean during the latest Miocene (6-5 Ma), which can be evidence for 'biogenic bloom' (Dickens and Owen, 1999). However, in the sediment inform the Andaman Sea, 'biogenic silica crash' was reported after 6 Ma (Cawthern et al., 2014). The shipboard microfossil data from U1447 sediments similarly indicate that diatoms decreased after 7 Ma and finally disappeared from ~6.5 Ma. Moreover, the C_4 plant might expand from the central Asia under arid climate before these events (~8 Ma; Pagani et al., 1999), and intensification of Indian summer monsoon associated with the Himalayan uplift (~7 Ma; Gupta et al., 2015). In the present study, we focus on algal biomarkers such as alkenones, alkyl diols and steroids to reconstruct variations in primary production and their producer community in the Andaman Sea during the late Miocene.

The sediments from site U1447 deposited during the late Miocene (Unit IV and the lower part of Unit III) are mainly composed of nannofossil-rich clay, clayey nannofossil ooze and biosilica-rich clay and percentage of biosilica increase from the lower part of Unit IV (Subunit IVb). In addition, the sedimentation rates of these deposits are constant (~6.5 cm/ky.). The extraction of freeze-dried sediments was fractionated using silica-gel column and analyzed by GC-MS.

Haptophyte species *Reticulofenestra minuta* are main component among the genus *Reticulofenestra* in the samples characterized by higher alkenone concentrations. We suggested *R. minuta* was main alkenone producer in the Andaman Sea during late Miocene. The C_{38} methyl alkenone ratios among alkenones increase with increase in *R. pseudoumbilicus* abundance and decrease in alkenone concentrations after 7 Ma. The alkenone composition in the Baltic Sea (lower SSS region) is characterized by lower relative abundance of C_{38} methyl alkenones (Schulz et al., 2000). The C_{38} methyl alkenone ratio consistently increase with the decreasing trend of C_{32} diols ratios (fresh water indicator; Lattaud et al., 2017), which indicates diminishment of freshwater input after 7 Ma. The diol Index-2 (DI-2) indicate productivity of diatom genus *Proboscia* (Rampen et al., 2014). The DI-2 values are higher from 7.5 to 6 Ma, although diatom tests rapidly decrease after 7 Ma. From our biomarker results, the diatom productivity was consistently higher after 7 Ma. We presume that such diatoms were degraded by dissolution during/after deposition after 7 Ma. Variations in dinosteroid ratios among steroids (dinoflagellate productivity indicator), concentrations of steroids and diols, stanol/sterol ratios (paleoredox indicator) and taraxerol ratios among triterpenoids (mangrove indicator) synchronously increase after 7Ma. Indian summer monsoon enhanced after 7 Ma due to the Himalayan uplift (Gupta et al., 2015). These evidences are inconsistent with result of fresh water diminishment after 7 Ma evaluated from C_{32} diols and C_{38} methyl alkenone ratio. In this region, the higher C_{38} alkenones and lower C_{32} diols ratios merely indicate higher contribution of marine coccolithophorid (*R. pseudoumbilicus*) and eustigmatophyta. Thus, we conclude that productivity of diatom, dinoflagellate and marine eustigmatophyta against *R. minuta* elevated in the Andaman Sea, and mangrove vegetation expanded in the hinterland due to enhancement of monsoonal activity after 7 Ma.

Keywords: Andaman Sea, Indian Ocean, IODP, biomarker, marin primary production

