

## Secular variation in composition of shallow-water carbonates on submerged seamounts in the northwestern Pacific Ocean

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Recent biogeochemical studies have shown that biomineralization are closely related to the thermodynamic driving force reflected by seawater chemistry (e.g. Mg/Ca ratio,  $\text{Ca}^{2+}$  and  $\text{HCO}_3^-$  concentrations, and  $p\text{CO}_2$ ). Shallow-water carbonates on seamounts in the northwestern Pacific Ocean would provide excellent information to consider the relationship between biomineralization and seawater chemistry, because we could collect continuous records of biotic (and abiotic) composition of reefs/carbonate platforms for the last 100 million years from those deposits.

We have conducted sedimentological, paleontological, chronological, and geochemical investigations on shallow-water carbonates on submerged seamounts recovered from 34 sites on 28 seamounts in 7 areas in the northwestern Pacific Ocean with the Deep-sea Boring Machine System (D-BMS). Based on the investigations, remarkable differences were detected in biotic and abiotic composition between Cretaceous and Cenozoic shallow-water carbonates. The Cretaceous shallow-water carbonates are characterized by abundance of molluscs (including rudists), non-skeletal grains (e.g. ooids, peloids, cortoids, and intraclasts), and microbial sediments, which were mainly formed by biotic extracellular calcification or chemical precipitation. It is also noteworthy that most components have been micritized to possess thick micrite envelopes. Yet, the Cenozoic shallow-water carbonates are delineated by dominance of hermatypic organisms, such as larger foraminifers, scleractinian corals, nongeniculate coralline algae, *Halimeda*, and dasycladacean algae, all of which precipitated carbonates within closed to semi-closed spaces within their bodies.

Abundance of abiotic components, such as peloids, cortoids, and intraclasts, indicates active bioerosion, which may have been caused by relatively higher nutrient availability. The major cause of the change (extracellular calcification vs. intracellular calcification) in calcification patterns is believed to be a shift in the Mg/Ca ratio,  $\text{Ca}^{2+}$  and  $\text{HCO}_3^-$  concentrations, and  $p\text{CO}_2$  of seawater and carbonate saturation state. Our results, therefore, may indicate that seawater chemistry in the Cretaceous shallow-water seas were characterized by relatively high  $\text{Ca}^{2+}$  and  $\text{HCO}_3^-$  concentrations, enhanced  $\text{CaCO}_3$  saturation state, and high nutrient level. On the other hand, seawater chemistry in the Cenozoic shallow-water seas was characterized by relatively low  $\text{Ca}^{2+}$  and  $\text{HCO}_3^-$  concentrations, reduced  $\text{CaCO}_3$  saturation state and low nutrient level. Hermatypic corals have been widespread since the Oligocene, when seawater chemistry changed; 1) mMg/Ca ratios rose above two into the aragonite stability field, 2) the atmospheric  $\text{Ca}^{2+}$  concentration progressively was declined, and 3) the  $\text{CaCO}_3$  saturation state of seawater increased. Therefore, changes in seawater chemistry, such as Mg/Ca ratio,  $\text{Ca}^{2+}$  and  $\text{HCO}_3^-$  concentrations,  $p\text{CO}_2$ , and  $\text{CaCO}_3$  saturation state, might be a critical factor controlling variations in composition of shallow-water carbonate factory on seamounts in the northwestern Pacific Ocean from the Cretaceous onwards.