論文の内容の要旨

Influence on deep-sea ferromanganese nodules and planktonic foraminifera by ocean acidification

（海洋酸性化における深海底鉄マンガンノジュールおよび浮遊性有孔虫への影響）

氏名：王 権 (Quan Wang)

Ocean acidification caused by increased atmospheric carbon dioxide (CO_2) will lead to enhanced acidity and lowered carbonate ion concentration in the marine environment. Most of the atmospheric CO_2 absorbed by the oceans resides in relatively shallow waters; however, surface seawaters are slowly mixing with the intermediate and deep seawaters of the oceans. Over time, this acidification effect will spread to the deep oceans. Due to the lack of carbonate as a natural buffer to pH decrease, the deep-sea environments are more vulnerable to pH changes. The response of metal-rich deep-sea ferromanganese (Fe–Mn) nodules to predicted pH values have been investigated in Chapter 2. On the other hand, marine organisms such as planktonic foraminifera build their shells by using the carbonate ion from the seawater, the influence of seawater chemistry changes on planktonic foraminifera, *Globigerinoides ruber* (white), have been discussed in Chapter 3.

The experiments by using phosphate buffer solutions revealed that the release of element from deep-sea Fe–Mn nodules is not simply increased in response to pH decrease. The element behavior is mainly regulated by sorption-desorption processes which are primarily determined by changes in the acidity of the solutions and ion species in the solutions. Based on this result, we improved the assessment by introducing artificial seawaters and a CO_2-induced pH regulation system. The pH changes caused by ocean acidification are simulated by adjusting

the pH of the artificial seawaters through altering the partial pressure of CO_2. The improved experiments revealed that the pH decrease caused by ocean acidification would promote the elements those exist as positively charged ions or complexes to release from the deep-sea sediments and restrain the elements those exist as negatively charged ions or complexes to be exchanged into the seawaters.

In order to investigate the response of the foraminiferal shells to ocean acidification, a piston core collected from above the lysocline in the East China Sea was used. The shells of planktonic foraminifera *Globigerinoides ruber* (white) were picked and performed weight/size measurements and X-ray microcomputed tomography (XMCT) measurements. The size-normalized weight of *Globigerinoides ruber* (white) covaries well with atmospheric pCO_2, which agrees with previous studies and manifest that the size-normalized weight of planktonic foraminiferal shells primarily reflects the changes of carbonate chemistry in surface seawaters. The high-resolution XMCT results helped to verify the post-depositional alteration and revealed that ocean acidification affects the shell volume (i.e., shell wall thickness) rather than shell density of planktonic foraminifera *G. ruber* (w).