Development of new proxies using macromolecular structures of marine palynomorphs

*Takuto Ando[1], Kazumi Matsuoka[2], Karin Zonneveld[3], Gerard Versteegh[3,4]

1. Estuary Research Center, Shimane University, 2. Institute for East China Sea Research, Nagasaki University, 3. Center for Marine Environmental Sciences (marum), Bremen University, 4. Department of Earth and Environmental Science, Jacobs University Bremen

Palynomorphs are the microscopic organic remains of organisms. These microfossils are composed of resistant macromolecules and preserved in the sedimentary rocks even after thermal maturation. They are important sources of information for (paleo)environment, stratigraphy, fisheries, forensic science, honey origin, pollen allergy etc. Marine palynomorphs are characterized by organic-walled shells and membranes originated from marine organism. Dinocyst, ciliate cyst/lorica, foraminiferal lining, prasinophycean phycoma and acritarch are major components of marine palynomorphs. This information is extracted from differences in morphology. However, it is not always easy to link the palynomorph to a single source organism. First, different species may produce morphologically identical palynomorphs. One aspect here of is that we cannot always separate toxic from non-toxic taxa. Second, for several recent and fossil palynomorphs we do not know their biological origin.

Like morphology, chemical composition is the result of adaptation of the source organism to its environment, both over the course of evolution (genotypic) and in reaction to its living conditions. Exploring palynomorph chemistry may not only help to resolve the problems of attributing palynomorphs to their source organisms, but may also provide new information on the evolution and adaptation of the source organisms to their environment. Recently, we have suggested that the macromolecular analyses of marine palynomorphs using by micro-FTIR and pyrolysis GC-MS are useful methods for differentiating these palynomorphs chemotaxonomically. For example, Bogus et al. (2014, *Journal of Phycology*) reported that difference of macromolecular structures between autotroph and heterotroph dinocysts. Moreover, palynomorph chemistry may differ due to factors independent of the source organism such as diagenesis. Analysis of palynomorph chemistry therefore may prove to provide important insight in the diagenetic history and preservation of sedimentary organic matter, and through this, the functioning of the global carbon cycle.

Blooming (red-tide) of dinoflagellate, especially toxic/harmful species, in coastal waters adversely impact on both marine ecosystem and human life. Formation and preservation of dinocysts in the sediments are important for understanding the mechanism of red-tide. *Alexandrium catenella/pacificum* are toxic and form the elliptical transparent cysts. On the other hand, palynomorphs with unknown origin, called as acritarch, are also frequently observed in sediment. The plankton cells of some spherical dinocysts and ciliate cysts are still unknown and these palynomorphs are conventionally belong to sphaeromorph acritarchs. It is also possible that these spherical palynomorphs are the fragments of foraminiferal linings. The records of these processes are possibly remained as difference in macromolecular structure of same species of palynomorphs.

Here, we present the results of micro-FTIR analyses by means of attenuated total reflection (ATR) of individual cyst-walls of toxic and non-toxic, morphologically similar to identical *Alexandrium* species including *A. catenella* and *A. pacificum* from the surface sediments of Osaka Bay, Japan. In addition, we show the results and discuss the potential of new proxies using macromolecular structures of marine palynomorphs.

Keywords: palynomorph, Palynochemistry, macromolecule, Organic Geochemistry, Micropaleontology