

Biology of a picoeukaryotic phytoplankton, Parmales, a sister group of diatoms

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Parmales is a group of pico-sized eukaryotic marine phytoplankton with cells surrounded by several silica plates. Parmales has been found widely in the world's oceans, from polar to subtropical regions, and is frequently abundant in polar and subarctic regions. Based on similarities in cell wall structure, Parmales has been proposed as a close relative to diatoms, which are the most successful phytoplankton group in modern oceans. However, there was very little biological information on Parmales, because no cultures were available for laboratory study. Recently, we successfully established the first ever culture of Parmales isolated using a fluorescent silicon tracer PDMPO from the Oyashio water in the Western Subarctic Pacific. SEM and TEM observations, molecular phylogenetics and photosynthetic pigments analyses of this culture indicated that Parmales belongs to Heterokonta and is positioned within a sister group of diatoms, Bolidophyceae, which are pico-sized autotrophic naked flagellates mainly living in subtropical waters. It can be hypothesized that parmalean and bolidophycean algae (or their common ancestor) have a life cycle that switches between silicified non-flagellated and naked flagellate stages. This hypothetical life cycle has similarities to centric diatoms, which are an ancient lineage that has a vegetative stage that switches to production of naked flagellated male gametes (spermatozoa) for sexual reproduction. Because the origin of the silica cell wall and the early evolution of diatoms are not yet fully understood, Parmales may play a key role in answering these questions. We present an overview of our current study of the biology of Parmales to explore the evolutionary link between Parmales, Bolidophyceae and diatoms using ecological, physiological, genomic, metagenomic and biogeochemical approaches.

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