TELLING TIME WITH DIATOMS: CORROBORATING PHYLOGENETIC RELATIONSHIPS AND OCCURRENCE IN THE FOSSIL RECORD WITH MOLECULAR DATA

Matthew L. Julius[1] & Patrick Kociolek[2]

[1]St. Cloud State University, Department of Biological Sciences

[2]University of Colorado Museum of Natural History, Department of Ecology and Evolutionary Biology, University of Colorado

Diatom taxa are frequently used as biostratigraphic indicators in marine and freshwater sediments. Prior to the development of molecular clock techniques, stratigraphic distribution of species was the only data set providing temporal information. Corroboration of first occurrence observations for lineages in the paleontological record could not then be independently verified other than observationally. Despite this, robust hypotheses for the stratigraphic ranges of numerous species and genera were developed. These distributions were refined and supported via stratigraphic observations of species lineages from disparate biogeographic localities. Among these are distributions for Thalassiosirales genera and species in marine and freshwater habitats. Oceanic cores have yielded data allowing the construction of a detailed species chronology for Thalassiosira species from the Oligocene to present. Freshwater diatomites containing Thalassiosirales species in Asia and the western North America have facilitated the development of a chronological sequence for the divergence of freshwater genera beginning in the late Miocene. The order of generic diversification in marine and freshwater Thalassiosirales lineages has largely been corroborated by phylogenetic investigations utilizing both morphological and molecular data sets. The timing of these divergences suggested by the fossil record have not, however, been the subject of scrutiny by molecular clock techniques. Recently, freshwater Thalassiosiroid genera with Miocene and Pliocene origins were reported from Eocene sediments. This observation potentially disrupts preexisting hypotheses concerning Thalassiosirales distributions in both marine and freshwater sediments. Sequence data (SSU, psbC, LSU, rbcL) is used to calculate molecular clock estimates of Thalassiosirales divergence events using calibration points from multiple stratigraphic horizons. This temporal hypothesis refutes the Eocene observations and identifies divergences events supporting the phylogenetic hypotheses for generic occurrence and proposed stratigraphies for oceanic and freshwater diatomites from Asia and western North America.