Fundamental changes in light scattering associated with infection of marine bacteria by bacteriophage

Balch, William M., James M. Vaughn, James F. Novotny, David T. Drapeau, Joaquim I. Goes, Emily Booth, Janeen M. Lapierre, Cathy L. Vining, Amanda Ashe, James M. Vaughn Jr.

Limnol. Oceanogr., 47(5), 2002, 1554-1561 | DOI: 10.4319/lo.2002.47.5.1554

ABSTRACT: Bacteria and phytoplankton are key determinants of the ocean's inherent optical properties. Despite their high abundance, marine viruses have generally been thought to play a minor role in ocean optics because of their small scattering cross-sections. Nevertheless, the role of specific viral infection on the optical properties of bacteria and phytoplankton has remained unknown (i.e., as viruses disrupt micron-sized host cells to produce submicron cell debris). Here, we used laboratory and mesocosm cultures of marine bacteria for virus infection experiments in which growth conditions and host-virus specificity were controlled. We report that the chief optical impact of viruses is associated with infection and lysis of their hosts. We quantitatively describe, for the first time, two optical changes associated with infection and lysis of marine bacteria by bacteriophage: (1) rapid, strong shifts in the magnitude and shape of the optical volume scattering function and (2) rapid production of colored dissolved organic material. Qualitatively, these changes result in nearly complete clearing of turbid host bacterial suspensions. Although some optical differences would be expected between infection of bacteria in laboratory cultures versus field populations (mainly because of differences in cell size), these results are applicable to the field, especially for dense host suspensions such as in blooms. Even in nonbloom situations, as long as the host bacteria contribute a significant amount of the total particle backscattering, we expect that virus-induced backscattering changes would be detectable by use of satellite or aircraft remote-sensing techniques.

Article Links

Download Full-text PDF

Return to Table of Contents