Effects of microalgal communities on reflectance spectra of carbonate sediments in subtidal optically shallow marine environments

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ABSTRACT: This study was conducted in subtidal areas around Lee Stocking Island, Bahamas, to investigate how microalgal biomass and community structure affect hyperspectral reflectance of sediments. Hyperspectral reflectance was measured on the surfaces of sediment cores collected from several types of carbonate sediments and habitats. Subsequently, photosynthetic and photoprotective pigments within the microalgae colonizing the top 5 mm of the sediment cores were quantified by high-performance liquid chromatography (HPLC). Results of pigment analyses indicate that both microalgal biomass and community structure varied within and among sampling sites. Examination of spectral reflectance revealed differences both in the magnitude of overall reflectance between 400 and 710 nm and in the magnitude of absorption features. Second derivative analysis of reflectance spectra was used to identify nine narrow wavebands that correspond to wavelengths most affected by in vivo absorption by specific pigments. Results of linear regression analyses of the ratio of second derivatives at 676 nm to reflectance at 676 nm versus chlorophyll a plus chlorophyllide a indicate that total (living plus senescent or dead) microalgal biomass can be estimated from measurements of hyperspectral reflectance. Estimates of microalgal biomass can also be made based on the ratios of second derivatives at 444 nm to reflectance at 444 nm. Concentrations of other pigment groups can be estimated from second derivatives at 492 and 540 nm. These relationships between hyperspectral reflectance of sediments and benthic microalgal pigments suggest that remote sensing reflectance might be useful for distinguishing major differences among benthic habitats in some optically shallow areas.