Sediment properties influencing upwelling spectral reflectance signatures: The [biofilm gel effect[

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Limnol. Oceanogr., 48(1_part_2), 2003, 431-443 | DOI: 10.4319/lo.2003.48.1_part_2.0431

ABSTRACT: Microbial communities often produce copious films of extracellular polymeric secretions (EPS) that may interact with sediments to influence spectral reflectance signatures of shallow marine sediments. We examined EPS associated with microbial mats to determine their potential effects on sediment reflectance properties. Distinct changes in spectral reflectance signatures of carbonate sediments from the Bahamas were observed among several sediment sites, which were specifically chosen for their presence of microbial mats and adjacent nonmat sediments. The presence of mats greatly reduced sediment reflectance signatures by ~10%-20%, compared with adjacent nonmat areas having similar sediment characteristics. Decreases in reflectance near 444 and 678 nm could be attributed primarily to absorbance by photopigments. However, additional nonspecific decreases in reflectance occurred across a wide spectral range (400-750 nm). Experimental manipulations determined that nonspecific reflectance decreases were due to EPS that are produced by biofilm-associated microorganisms of the mats. Microbial EPS, isolated from natural mat sediments exhibited small but nonspecific absorbances across a broad spectral range. When EPS was in relatively high concentrations, as in microbial mats, there was a [[biofilm gel effect]] on sediment reflectance properties. The effect was twofold. First, it increased the relative spacing of sediment grains, a process that permitted light to penetrate deeper into sediments. Second, it resulted in a more efficient capture of photons because of the change in refractive index of EPS gel itself relative to seawater. The relatively translucent EPS of biofilms, therefore, influenced the magnitude of reflectance across a broad spectral range in marine sediments.