

Silver Gelatin Photo Paper as a Tool for Characterizing Microbially-Mediated Redox Dynamics in Saturated Sediments

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At temperate latitudes, *Spartina*-dominated salt marshes exist as a dynamic balance between the rate of sea level rise; the availability of sediment for vertical marsh accretion; and the growth and predominance of botanical species with varying tolerances for salt exposure and rootzone saturation. For these coastal marshes, a limiting condition for healthy growth and sustained function may lie in the frequency, depth and duration of tidal inundation. Specifically, prolonged soil saturation following inundation results in water logging of the soil; biogeochemically, water logging in the presence of sulfate (SO_4^{2-}) results in shallowing (shoaling) of the depth of microbial sulfate reduction and resultant accumulation of sulfide with potential impacts on seed germination, plant root development and rhizome propagation. Ultimately, prolonged inundation of low topographic areas on a marsh platform results in the localized die-back of marsh vegetation and the elevated potential for overall marsh fragmentation.

Monitoring sulfide within the root zone of marsh soils is challenging for reasons including analytical costs, specificity of sample stabilization requirements and temporal limitations on the duration of field deployments. To address these limitations and based on the high affinity of silver (Ag) for free sulfide (S) ($K_{sp} \approx 10^{-50}$), strips of field-deployed photographic paper (“silver gelatin prints”) have been tested as a sulfide monitoring medium over a sulfide concentration range (~ 5-50 mg/L) relevant for assessing botanical toxicity. Utilizing this approach and applying free ImageJ software to quantify and chemically characterize the results of stabilized (fixed) and subsequently digitally scanned test strips, short (< ½ hr) field deployments have been effected for fine-scale determination of ecologically relevant concentrations of porewater sulfide in coastal Maine salt pools. Results are presented here for deployment series in a range of coastal Maine salt marsh pools (5 min. deployment period) as well as in comparison to a porewater sulfide profile generated with a 30-day dialysis sampler deployment. The dialysis sampler deployment applied the standard method of sulfide determination following field stabilization of porewater aliquots with Zn-acetate and spectrophotometric analysis via the Cline method.