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Detection of High-Organic-Carbon Features in Sediments by Direct-Push Color Logging

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A biogeochemical site characterization aims at delineating zones of reducing and oxidizing conditions in the subsurface to infer their influence on solute and contaminant turnover processes along groundwater flow paths. Hereby, large values of the total organic carbon (TOC) content mark reducing conditions in soils and sediments. Dark sediment colors are good predictors for high-TOC zones and thus indicate hotspots of biogeochemical turnover and microbial activity. Traditionally, obtaining the sediment color requires costly sampling, resulting in poor horizontal resolution and related uncertainty caused by interpolation. We suggest using a direct-push soil color optical screening tool to acquire multiple high-resolution vertical color profiles and demonstrate its applicability in floodplain sediments down to 12 m depth. We use Gaussian mixture models for a cluster analysis of the color logs in the CIE L*a*b* color space to identify color-facies, determine facies-specific relationships between the L*a*b* color-values and the TOC content of the sediments, and to construct the 3-D distributions of three distinct facies and organic matter. Direct-push color-logging may also be used for in-situ mapping of redox-zonation, iron content, or sedimentary structures.